Iptables Tutorial 1.1.9

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Introduction

Why this document was written

Well, I found a big empty space in the HOWTO's out there lacking in information about the iptables and netfilter functions in the new Linux 2.4.x kernels. Among other things, I'm going to try to answer questions that some might have about the new possibilities like state matching. Is it possible to allow passive FTP to your server, but not allow outgoing DCC from IRC as an example? I will build this all up from an example rc.firewall.txt file that you can use in your `/etc/rc.d/` scripts. Yes, this file was originally based upon the masquerading HOWTO for those of you who recognize it.

Also, there's a small script that I wrote just in case you screw up as much as I did during the configuration available as rc.flush-iptables.txt.

How it was written

I've placed questions to Marc Boucher and others from the core netfilter team. A big thanks going out to them for their work and for their help on this tutorial that I wrote and maintain for boingworld.com. This document will guide you through the setup process step by step, hopefully make you understand some more about the iptables package. I will base most of the stuff here on the example rc.firewall file since I find that example to be a good way to learn how to use iptables. I have decided to just follow the basic chains and from there go down into each and one of the chains traversed in each due order. This tutorial has turned a little bit harder to follow this way but at the same time it is more logical. Whenever you find something that's hard to understand, just consult this tutorial.

About the author

I'm someone with too many old computers on my hands, sitting with my own LAN and wanting them all to be connected to the Internet, at the same time having it fairly secure. The new iptables is a good upgrade from the old ipchains in this regard. Before, you could make a fairly secure network by dropping all incoming packages not destined to certain ports, but this would be a problem with things like passive FTP or outgoing DCC in IRC, which assigns ports on the server, tells the client about it, and then lets the client connect. There was some child diseases in the iptables code that I ran into in the beginning, and in some respects I found the code not quite ready for release in full production. Today, I'd recommend everyone who uses ipchains or even older ipfwadm etc to upgrade unless they're happy with what their current code is capable of and if it does what they need it to.

Dedications

First of all I would like to dedicate this document to my wonderful girlfriend Ninel. She has supported me more than I ever can support her to any degree. I wish I could make you just as happy as you make me.

Second of all, I would like to dedicate this work to all of the incredibly hard working Linux developers and maintainers. It is people like those who makes this wonderful operating system possible.

Preparations

This chapter is aimed at getting you started and to help you understand the role netfilter and **iptables** play in Linux today. This chapter should hopefully get you set up and finished to go with your experimentation and installation of a firewall which should hopefully run smoothly in the future.

Where to get iptables

The **iptables** userspace package can be downloaded from the netfilter homepage. The **iptables** package also makes use of kernel space facilities which can be configured into the kernel during **make configure**. The necessary pieces will be discussed a bit further down in this document.

Kernel setup

To run the pure basics of **iptables** you need to configure the following options into the kernel while doing **make config** or one of it's related commands:

`CONFIG_PACKET` - This option allows applications and programs that needs to work directly to certain network devices. An example would be tcpdump or snort.

`CONFIG_NETFILTER` - This option is required if you're going to use your computer as a firewall or gateway to the internet. In other words, this is most definitely required if for anything in this tutorial to work at all. I assume you'll want this since you're reading this at all.

And of course you need to add the proper drivers for your interfaces to work properly, ie. Ethernet adapter, PPP and SLIP interfaces. The above will only add some of the pure basics in iptables. You won't be able to do anything to be pretty honest, it just adds the framework to the kernel. If you want to use the more advanced options in IPTables, you need to set up the proper configuration options in your kernel. Here we will show you the options available in a basic 2.4.9 kernel and a brief explanation :

`CONFIG_IP_NF_CONNTRACK` - This module is needed to make connection tracking. Connection tracking is used by, among other things, NAT and Masquerading. If you need to firewall machines on a LAN you most definitely should mark this option. For example, this module is required by the *rc.firewall.txt* to work.

`CONFIG_IP_NF_FTP` - This module is required if you want to do connection tracking on FTP connections. Since FTP connections are quite hard to do connection tracking on in normal cases conntrack needs a so called helper, this option compiles the helper. If you don't add this module you won't be able to FTP through a firewall or gateway properly.

`CONFIG_IP_NF_IPTABLES` - This option is required if you want do any kind of filtering, masquerading or NAT. It adds the whole iptables identification framework to kernel. Without this you won't be able to do anything at all with iptables.

`CONFIG_IP_NF_MATCH_LIMIT` - This module isn't exactly required but it's used in the example *rc.firewall.txt*. This option provides the LIMIT match, that adds the possibility to control how many packets per minute that's supposed to be matched with a certain rule. For example, **-m limit --limit 3/minute** would match a maximum of 3 packets per minute. This module can also be used to avoid certain Denial of Service attacks.

`CONFIG_IP_NF_MATCH_MAC` - This allows us to match packets based on MAC addresses. Every Ethernet adapter has it's own MAC address. We could for instance block packets based on what MAC address used and block a certain computer pretty well since the MAC address don't change. We don't use this option in the *rc.firewall.txt* example or anywhere else.

`CONFIG_IP_NF_MATCH_MARK` - This allows us to use a **MARK** match. For example, if we use the target **MARK** we could mark a packet and then depending on if this packet is marked further on in the table, we can match based on this mark. This option is the actual match **MARK**, and further down we will describe the actual target **MARK**.

`CONFIG_IP_NF_MATCH_MULTIPORT` - This module allows us to match packets with a whole range of destination ports or source ports. Normally this wouldn't be possible, but with this match it is.

`CONFIG_IP_NF_MATCH_TOS` - With this match we can match packets based on their TOS field. TOS stands for *Type Of Service*. TOS can also be set by certain rules in the mangle table and via the ip/tc commands.

`CONFIG_IP_NF_MATCH_TCPMSS` - This option adds the possibility for us to match TCP packets based on their MSS field.

`CONFIG_IP_NF_MATCH_STATE` - This is one of the biggest news in comparison to **ipchains**. With this module we can do stateful matching on packets. For example, if we've already seen trafic in two directions in a TCP connection, this packet will be counted as **ESTABLISHED**. This module is used extensively in the *rc.firewall.txt* example.

`CONFIG_IP_NF_MATCH_UNCLEAN` - This module will add the possibility for us to match IP, TCP, UDP and ICMP packets that looks strange or are invalid. We could for example drop these packets, but we never know if they are legitimate or not. Note that this match is still experimental and might not work perfectly in all cases.

`CONFIG_IP_NF_MATCH_OWNER` - This option will add the possibility for us to do matching based on the owner of a socket. For example, we can allow only the user root to have Internet access. This module was originally just written as an example on what could be done with the new **iptables**. Note that this match is still experimental and might not work for everyone.

`CONFIG_IP_NF_FILTER` - This module will add the basic filter table which will enable you to do basic filtering. In the filter table you'll find the INPUT, FORWARD and OUTPUT chains. This module is required if you plan to do any kind of filtering on packets that you receive and send.

`CONFIG_IP_NF_TARGET_REJECT` - This target allows us to specify that an ICMP error message should be sent in reply to incoming packets instead of plainly dropping them dead to the floor. Mind you that TCP connections are always reset or refused with a TCP RST packet.

`CONFIG_IP_NF_TARGET_MIRROR` - This allows packets to be bounced back to the sender of the packet. For example, if we set up a MIRROR target on destination port HTTP on our INPUT chain and someone tries to access this port we would plainly bounce his packets back to himself and finally he would see his own homepage.

`CONFIG_IP_NF_NAT` - This module allows network address translation, or NAT, in it's different forms. With this option we can do port forwarding, masquerading etc. Note that this option is is not required for firewalling and masquerading of a LAN, but mostly is, unless you are able to provide unique IP addresses for all hosts. Hence, this option is required for the example *rc.firewall.txt* to work properly, and most definitely on your network if you do not have the ability to add unique IP addresses as specified above.

`CONFIG_IP_NF_TARGET_MASQUERADE` - This module adds the **MASQUERADE** target. For instance if we don't know what IP we have to the Internet this would be the preferred way of getting the IP instead of using DNAT or SNAT. In other words, if we use DHCP, PPP, SLIP or some other connection that dynamically assigns us an IP, we need to use this target instead of SNAT. Masquerading gives a slightly higher load on the computer than NAT does, but will work without us knowing the IP in advance.

`CONFIG_IP_NF_TARGET_REDIRECT` - This target is useful together with proxies for example. Instead of letting a packet pass right through, we remap them to go to our local box instead. In other words, we have the possibility to make a transparent proxy this way.

`CONFIG_IP_NF_TARGET_LOG` - This adds the **LOG** target to **iptables** and the functionality of it. We can use this module to log certain packets to syslogd and hense see the packet further on. This could be useful for forensics or debugging a script you're writing.

`CONFIG_IP_NF_TARGET_TCPMSS` - This option can be used to overcome Internet Service Providers and servers who block ICMP Fragmentation Needed packets. This can result in webpages not getting through, small mails getting through while larger mails don't get through, ssh works but scp dies after handshake, etcetera. We can then use the TCPMSS target to overcome this by clamping our MSS (Maximum Segment Size) to the PMTU (Path Maximum Transmit Unit). This way, we'll be able to handle what the authors of netfilter themself call "criminally braindead ISPs or servers" in the kernel configuration help.

`CONFIG_IP_NF_COMPAT_IPCHAINS` - Adds a compatibility mode with the old **ipchains**. Do not look at this as any real long term solution for solving migration from Linux 2.2 kernels to 2.4 kernels since it may well be gone with kernel 2.6.

`CONFIG_IP_NF_COMPAT_IPFWADM` - Compatibility mode with old **ipfwadm**. Do absolutely not look at this as a real long term solution.

As you can see, there is a heap of options. I have briefly explained what kind of extra behaviours you can expect from each module here. These are only the options available in a vanilla Linux 2.4.9 kernel. If you would like to get a look at more options, I suggest you look at the patch-o-matic functions in netfilter userland which will add heaps of other options in the kernel. POM fixes are additions that are supposed to be added in the kernel in the future but has not quite reached the kernel yet. These functions should be added in the future, but has not quite made it in yet. This may be for various reasons such as the patch not being stable yet, to Linus Torvalds being unable to keep up or not wanting to let the patch in to the mainstream kernel yet since it is still experimental.

You will need the following options compiled into your kernel, or as modules, for the *rc.firewall.txt* script to work. If you need help with the options that the other scripts needs, look at the example firewall scripts section.

- CONFIG_PACKET
- CONFIG_NETFILTER
- CONFIG_CONNTRACK
- CONFIG_IP_NF_FTP
- CONFIG_IP_NF_IRC
- CONFIG_IP_NF_IPTABLES
- CONFIG_IP_NF_FILTER
- CONFIG_IP_NF_NAT
- CONFIG_IP_NF_MATCH_STATE
- CONFIG_IP_NF_TARGET_LOG
- CONFIG_IP_NF_MATCH_LIMIT
- CONFIG_IP_NF_TARGET_MASQUERADE

The above will be required at the very least for the *rc.firewall.txt* script. In the other example scripts I will explain what requirements they have in their respective section. For now, lets try to stay focused on the main script which you should be studying now.

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userland setup

First of all, let's look at how we compile the **iptables** package. This compilation goes quite a lot hand in hand with the kernel configuration and compilation so you are aware of this. Certain distributions comes with the **iptables** package preinstalled, one of these are Red Hat 7.1. However, in Red Hat 7.1 it is disabled per default. We will check closer on how to enable it on this, and other distributions further on in this chapter

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Compiling the userland applications

First of all unpack the **iptables** package. Here, we have used the *iptables 1.2.3* package and a vanilla 2.4.9 kernel. Unpack as usual, using **bzip2 -cd iptables-1.2.3.tar.bz2 | tar -xvf -** (this can also be accomplished with the **tar -xjvf iptables-1.2.3.tar.bz2**, which should do pretty much the same as the first command. However, this may not work with older versions of **tar**). Hopefully the package should now be unpacked properly into a directory named `iptables-1.2.3`. For more information read the `iptables-1.2.3/INSTALL` file which contains pretty good information on compiling and getting the program to run.

After this, there is the option to install extra modules and options etcetera to the kernel.The step described here will only check patches that are pending for inclusion to the kernel, there are some even more experimental patches further along, which may only be available when you do some other steps.

Note: Some of these are highly experimental and may not be a very good idea to install. However, there are heaps of extremely interesting matches and targets in this installation step so don't be afraid of at least looking at them. To do this step we do something like this from the root of the iptables package:

make pending-patches KERNEL_DIR=/usr/src/linux/

The variable `KERNEL_DIR` should point to the actual place that your kernel source is located at. Normally this should be `/usr/src/linux/` but this may vary, and most probably you will know yourself where the kernel source is available.

Note: This only asks about certain patches that are just about to enter the kernel anyways. There might be more patches and additions that the developers of netfilter are about to add to the kernel, but is a bit further away from actually getting there. One way to install these are by doing the following:

make most-of-pom KERNEL_DIR=/usr/src/linux/

The above command would ask about installing parts of what in netfilter world is called **patch-o-matic**, but still skip the most extreme patches that might cause havoc in your kernel. Note that we say ask, because that's what these commands actually do. They ask you before anything is changed in the kernel source. To be able to install *all* of the patch-o-matic stuff you will need to run the following command:

make patch-o-matic KERNEL_DIR=/usr/src/linux/

Don't forget to read the help for each patch thoroughly before doing anything. Some patches will destroy other patches while others may destroy your kernel if used together with some patches from patch-o-matic etc.

Note: You may totally ignore the above steps if you don't want to patch your kernel, it is in other words not necessary to do the above. However, there are some really interesting things in the patch-o-matic that you may want to look at so there's nothing bad in just running the commands and see what they contain.

After this you are finished doing the patch-o-matic parts of installation, you may either compile a new kernel making use of the new patches that you have added to the source. Don't forget to configure the kernel again since the new patches probably are not added to the configured options and so on. You may wait with the kernel compilation until after the compilation of the userland program **iptables** if you feel like it, though.

Continue by compiling the **iptables** userland application. To compile **iptables** you issue a simple command that looks like this:

make KERNEL_DIR=/usr/src/linux/

The userland application should now compile properly, if not, you're on your own, or possibly try the netfilter mailing list who might help you with your problems. There is a few things that might go wrong with the installation of **iptables** so don't panic if it won't work, try to think logically about it and find out what's wrong or get someone to help you.

If everything has worked smoothly, you're ready to install the binaries by now. To do this, you would issue the following command to install them:

make install KERNEL_DIR=/usr/src/linux/

Hopefully everything should work in the program now. To use any of the changes in the **iptables** userland applications you should definitely recompile and reinstall your kernel by now if you haven't done so before. For more information about installing the userland applications from source, check the `INSTALL` file in the source which contains excellent information on the subject of installation.

Installation on Red Hat 7.1

Red Hat 7.1 comes preinstalled with a 2.4.x kernel that has netfilter and **iptables** compiled in. It also contains all the basic userland programs and configuration files that is needed to run it, however, they have disabled the whole thing by using the backwards compatible **ipchains** module. Annoying to say the least, and a lot of people are asking different mailing lists why **iptables** don't work. So, let's take a brief look at how to turn the module off and how to install **iptables** instead.

Note: The default Red Hat 7.1 installation today comes with an utterly old version of the userspace applications so you might want to compile a new version of the applications as well as install a new and homecompiled kernel before fully exploiting **iptables**.

First of all you will need to turn off the **ipchains** modules so it won't start in the future. To do this, you will need to change some filenames in the `/etc/rc.d/` directory-structure. The following command should do it:

chkconfig --level 0123456 ipchains off

By doing this we move all the soft links that points to the real script to K92ipchains. The first letter which per default would be S tells the initscripts to start the script. By changing this to K we tell it to Kill the service instead, or to not run it if it was not previously started. Now the service won't be started in the future.

However, to stop the service from actually running right now we need to run another command. This is the **service** command which can be used to work on currently running services. We would then issue the following command to stop the **ipchains** service:

service ipchains stop

Finally, to start the **iptables** service. First of all, we need to know which runlevels we want it to run in. Normally this would be in runlevel 2, 3 and 5. These runlevels are used for the following things:

- 2. Multiuser without NFS or the same as 3 if there is no networking.
- 3. Full multiuser mode, ie. the normal runlevel to run in.
- 5. X11. This is used if you automatically boot into Xwindows.

To make **iptables** run in these runlevels we would do the following commands:

chkconfig --level 235 iptables on

The above commands would in other words make the **iptables** service run in runlevel 2, 3 and 5. If you'd like the **iptables** service to run in some other runlevel you would have to issue the same command in those. However, none of the other runlevels should be used, so you should not really need to activate it for those runlevels. Level 1 is for single user mode, ie, when you need to fix a screwed up box. Level 4 should be unused, and level 6 is for shutting the computer down.

To activate the **iptables** service, we just run the following command:

service iptables start

Of course, there is no rules in the **iptables** script. To add rules to an Red Hat 7.1 box, there is two common ways. First of all, you chould edit the `/etc/rc.d/init.d/iptables` script. This would have the bad effect that the rules would be deleted if you updated the iptables package by RPM. The other way would be to load the ruleset and then save them with the **iptables-save** command and then have it loaded automatically by the rc.d scripts.

First we will describe the possibility of doing the set up by cut and paste to the **iptables** init.d script. To add rules that should be run when the computer starts the service, you add them under the start) section, or in the start() function. Note, if you add the rules under the start) section don't forget to stop the start() function from running in the start) section. Also, don't forget to edit a the stop) section either which tells the script what to do when the computer is going down for example, or when we are entering a runlevel that don't require iptables to run. Also, don't forget to check out the restart section and condrestart. Note that this set up may be automatically erased if you have, for example, Red Hat Network automatically updating your packages. It may also be erased by updating from the **iptables** RPM package.

The second way of doing the set up would require the following steps to be taken. First of all, make and write a ruleset in a file, or directly with **iptables**, that will meet your requirements, and don't forget to experiment a bit. When you find a set up that works without problems or bugs as you can see, use the **iptables-save** command. You could either use it normally, such as **iptables-save > /etc/sysconfig/iptables** which would save the ruleset to the file `/etc/sysconfig/iptables`. This file is automatically used by the **iptables** rc.d script to restore the ruleset in the future. The other way to save the script would be to use **service iptables save** which would save the script automatically to this file. When you reboot the computer in the future, the **iptables** rc.d script will use the command **iptables-restore** to restore the ruleset from the save-file `/etc/sysconfig/iptables`. Do not intermix this and the previous set up instruction since they may heavily damage eachother and render each and one useless.

When all of these steps are finished we can deinstall the currently installed **ipchains** and **iptables** packages. We do this since we don't want the system to mix up the new **iptables** userland application with the old preinstalled **iptables** applications. This step is only necessary if you will install **iptables** from the source package. It's not unusual that the new and the old package get's mixed up since the rpm based installation installs the package in non-standard places and won't get overwritten by the installation for the new **iptables** package. To do the deinstallation, do as follows:

rpm -e iptables

And of course, why keep **ipchains** lying around when it is of no use? That is done the same way as with the old **iptables** binaries, etc:

rpm -e ipchains

After all this is done you are finished to update the **iptables** package from source according to the source installation instructions. None of the old binaries, libraries or include files etc should be lying around any more.

How a rule is built

This chapter will discuss in legth how to build your rules. A rule could be described as the pure rules the firewall will follow when blocking different connections and packets in each chain. Each line you write that's inserted to a chain should be considered a rule. We will also discuss the basic matches that str available and how to use them as well as the different targets and how we can make new targets to use (ie, new subchains).

Basics

As we've already explained each rule is a line that the kernel looks at to find out what to do with a packet. If all the criterias, or matches, are met, we perform the target, or jump, instruction. Normally we would write a rule something like this:

iptables [-t *`table`*] command [match] [target/jump]

There is nothing that says that the target instruction must be last in the line, however, you would do this normally to get a better readability. Also, we have used this way of writing rules since it is the most usual way of writing them. Hence, if you read someone elses script you'll most likely recognise the way of writing a rule and understand it quickly.

If you want to use another table than the standard table, you could insert the table specification where [table] is specified. However, it is not necessary to specify it explicitly all the time since **iptables** per default uses the filter table to implement your commands on. It is not required to put the table specification at this location, either. It could be set pretty much anywhere in the rule, however, it is more or less standard to put the table specification at the beginning of the commandline.

One thing to think about though; the command should always be first, or directly after the table specification. This tells the **iptables** command what to do. We will enter this a bit further on. We use this first variable to tell the program what to do, for example to insert a rule or to add a rule to the end of the chain, or to delete a rule.

The match is the part which we send to the kernel that says what a packet must look like to be matched. We could specify what IP address the packet must come from, or which network interface the packet must come from etc. There is a heap of different matches that we can use that we will look closer at further on in this chapter.

Finally we have the target of the packet. If all the matches are met for a packet we tell the kernel to perform this action on the packet. We could tell the kernel to send the packet to another chain that we create ourself, which must be part of this table. We could tell the kernel to drop this packet dead and do no further processing, or we could tell kernel to send a specified reply to be sent back. As with the rest of the content in this section, we'll look closer at them further on in the chapter.

Tables

The **-t** option specifies which table to use. Per default, the filter table is used. The following options are available to the **-t** command:

Table 1. Tables

Table	Explanation
nat	The nat table is used mainly for Network Address Translation. Packets in a stream only traverse this table once. The first packet of a stream is allowed, we presume. The rest of the packets in the same stream are automatically NAT'ed or Masqueraded etc, in case they are supposed to have those actions taken on them. The rest of the packets in the stream will in other words not go through this table again, but instead they will automatically have the same actions taken to them as the first packet in the stream. This is one reason why you should not do any filtering in this table, as we will discuss more in length further on. The PREROUTING chain is used to alter packets as soon as they get in to the firewall. The OUTPUT chain is used for altering locally generated packets (ie, on the firewall) before they get to the routing decision. Note that OUTPUT is currently broken. Finally we have the POSTROUTING chain which is used to alter packets just as they are about to leave the firewall.

mangle	This table is used mainly for mangling packets. We could change different packets and how their headers look among other things. Examples of this would be to change the **TTL**, **TOS** or **MARK**. Note that the **MARK** is not really a change to the packet, but a mark for the packet is set in kernelspace which other rules or programs might use further on in the firewall to filter or do advanced routing on with tc as an example. The table consists of two built in chains, the PREROUTING and OUTPUT chains. PREROUTING is used for altering packets just as they enter the firewall and before they hit the routing decision. OUTPUT is used for changing and altering locally generated packets before they enter the routing decision. Note that mangle can not be used for any kind of Network Address Translation or Masquerading, the nat table was made for these kinds of operations.
filter	The filter table should be used for filtering packets generally. For example, we could **DROP**, **LOG**, **ACCEPT** or **REJECT** packets without problems as in the other tables. There are three chain built in to this table. The first one is named FORWARD and is used on all non-locally generated packets that are not destined for our localhost (the firewall, in other words). INPUT is used on all packets that are destined for our local host (the firewall) and OUTPUT is finally used for all locally generated packets.

The listing above has hopefully explained the basics about the three different tables that are available. They should be used for totally different things, and you should know what to use each chain for. If you do not understand their usage you may well fall into a pit once someone finds the hole you have unknowingly placed in the firewall yourself. We will discuss the tables and chains more in the *Traversing of tables and chains* chapter.

Commands

In this section we will bring up all the different commands and what can be done with them. The command tells **iptables** what to do with the rest of the commandline that we send to the program. Normally we want to either add or delete something to some table or another. The following commands are available to iptables:

Table 2. Commands

Command
Example
Explanation
-A, **--append**
iptables -A INPUT ...
This command appends the rule to the end of the chain. The rule will will in other words always be put last in the ruleset in comparison to previously added rules, and hence be checked last, unless you append or insert more rules later on.

-D, **--delete**
iptables -D INPUT --dport 80 -j DROP, **iptables -D INPUT 1**
This command deletes a rule in a chain. This could be done in two ways, either by specifying a rule to match with the **-D** option (as in the first example) or by specifying the rule number that we want to match. If you use the first way of deleting rules, they must match totally to the entry in the chain. If you use the second way, the rules are numbered from the top of each chain, and the top rule is number 1.
-R, **--replace**
iptables -R INPUT 1 -s 192.168.0.1 -j DROP
This command replaces the old entry at the specified line. It works in the same way as the **--delete** command, but instead of totally deleting the entry, it will replace it with a new entry. This might be good while experimenting with iptables mainly.
-I, **--insert**
iptables -I INPUT 1 --dport 80 -j ACCEPT
Insert a rule somewhere in a chain. The rule is inserted at the actual number that we give. In other words, the above example would be inserted at place 1 in the INPUT chain, and hence it would be the absolutely first rule in the chain from now on.
-L, **--list**
iptables -L INPUT
This command lists all the entries in the specified chain. In the above case, we would list all the entries in the INPUT chain. It's also legal to not specify any chain at all. In the last case, the command would list all the chains in the specified table (To specify a table, see the *Tables* section). The exact output is affected by other options sent to the program, for example the **-n** and **-v** options, etcetera.
-F, **--flush**
iptables -F INPUT
This command flushes the specified chain from all rules and is equivalent to deleting each rule one by one but is quite a bit faster. The command can be used without options, and will then delete all rules in all chains within the specified table.
-Z, **--zero**
iptables -Z INPUT
This command tells the program to zero all counters in a specific chain or in all chains. If you have used the **-v** option with the **-L** command, you have probably seen the packet counter in the beginning of each field. To zero this packet counter, use the **-Z** option. This option works the same as **-L** except that **-Z** won't list the rules. If **-L** and **-Z** is used together (which is legal), the chains will first be listed, and then the packet counters are zeroised.
-N, **--new-chain**
iptables -N allowed

This command tells the kernel to create a new chain by the specified name in the specified table. In the above example we create a chain called **allowed**. Note that there must be no target of the same name previously to creating it.
-X, **--delete-chain**
iptables -X allowed
This command deletes the specified chain from the table. For this command to work, there must be no rules that are referring to the chain that is to be deleted. In other words, you would have to replace or delete all rules referring to the chain before actually deleting the chain. If this command is used without any options, all chains that are not built in will be deleted from the specified table.
-P, **--policy**
iptables -P INPUT DROP
This command tells the kernel to set a specified default target, or policy, on a chain. All packets that don't match any rule will then be forced to use the policy of the chain. Legal targets are: **DROP**, **ACCEPT** and **REJECT** (There might be more, mail me if so)
-E, **--rename-chain**
iptables -E allowed disallowed
The **-E** command tells **iptables** to rename the first name of a chain, to the second name. In the example above we would, in other words, change the name of the chain from `allowed` to `disallowed`. Note that this will not affect the actual way the table will work. It is, in other words, just a cosmetic change to the table.

A command should always be specified, unless you just want to list the built-in help for **iptables** or get the version of the command. To get the version, use the **-v** option and to get the help message, use the **-h** option. As usual, in other words. Here comes a few options that can be used together with a few different commands. Note that we tell you with which commands the options can be used and what effect they will have. Also note that we do not tell you any options here that is only used to affect rules and matches. The matches and targets are instead looked upon in a later section of this chapter.

Table 3. Options

Option
Commands used with
Explanation
-v, **--verbose**
--list, **--append**, **--insert**, **--delete**, **--replace**
This command shows a verbose output and is mainly used together with the **--list** command. If used together with the **--list** command it makes the output from the command include the interface address, rule options and TOS masks. The **--list** command will also include a bytes and packet counter for each rule if the **--verbose** option is set. These counters uses the K (x1000), M (x1,000,000) and G (x1,000,000,000) multipliers. To overcome this and to get exact output, you

could use the -x option described later. If this option is used with the **--append**, **--insert**, **--delete** or **--replace** commands, the program will output detailed information on what happens to the rules and if it was inserted correctly etcetera.
-x, **--exact**
--list
This option expands the numerics. The output from **--list** will in other words not contain the K, M or G multipliers. Instead we will get an exact output of how many packets and bytes that has matched the rule in question from the packets and bytes counters. Note that this option is only usable in the **--list** command and isn't really relevant for any of the other commands.
-n, **--numeric**
--list
This option tells iptables to output numerical values. IP addresses and port numbers will be printed by using their numerical values and not hostnames, network names or application names. This option is only applicable to the **--list** command. This option overrides the default of resolving all numerics to hosts and names if possible.
--line-numbers
--list
The **--line-numbers** command is used to output line numbers together with the **--list** command. Each rule is numbered together with this option and it might be easier to know which rule has which number when you're going to insert rules. This option only works with the **--list** command.
-c, **--set-counters**
--insert, **--append**, **--replace**
This option is used when creating a rule in some way or modifying it. We can then use the option to initialize the packets and bytes counters of the rule. The syntax would be something like **--set-counters 20 4000**, which would tell the kernel to set the packet counter to 20 and byte counter to 4000.
--modprobe
All
The **--modprobe** option is used to tell iptables which command to use when probing for modules to the kernel. It could be used if your **modprobe** command is not somewhere in the searchpath etc. In such cases it might be necessary to specify this option so the program knows what to do in case a needed module is not loaded. This option can be used with all commands.

Matches

This section will talk a bit more about the matches. I've chosen to split down the matches into five different subcategories here. First of all we have the *generic matches* which are generic and can be used in all rules. Then we have the *TCP matches* which can only be applied to TCP packets. We have *UDP matches* which can only be applied to UDP packets and *ICMP matches* which can only be used on ICMP packets. Finally we have special matches such as the state, owner and limit matches and so on. These final matches has in turn been split down to even more subcategories even though they might not necessarily be different matches at all. I hope this is a reasonable breakdown and that all people out there can understand this breakdown.

Generic matches

This section will deal with *Generic matches*. A generic match is a kind of match that is always available whatever kind of protocol we are working on or whatever match extensions we have loaded. No special parameters are in other words needed to load these matches at all. I have also added the **--protocol** match here, even though it is needed to use some protocol specific matches. For example, if we want to use an *TCP match*, we need to use the **--protocol** match and send TCP as an option to the match. However, **--protocol** is in itself a match, too, since it can be used to match specific protocols. The following matches are always available.

Table 4. Generic matches

Command
Example
Explanation
-p, **--protocol**
iptables -A INPUT -p tcp
This match is used to check for certain protocols. Examples of protocols are TCP, UDP and ICMP. This list can vary a bit at the same time since it uses the `/etc/protocols` if it can not recognise the protocol itself. First of all the protocol match can take one of the three aforementioned protocols, as well as ALL, which means to match all of the previous protocols. The protocol may also take a numeric value, such as 255 which would mean the RAW IP protocol. Finally, the program knows about all the protocols in the `/etc/protocols` file as we already explained. The command may also take a comma delimited list of protocols, such as **udp,tcp** which would match all UDP and TCP packets. If this match is given the numeric value of zero (0), it means ALL protocols, which in turn is the default behaviour in case the **--protocol** match is not used. This match can also be inversed with the **!** sign, so **--protocol ! tcp** would mean to match the ICMP and UDP protocols.
-s, **--src**, **--source**
iptables -A INPUT -s 192.168.1.1
This is the source match which is used to match packets based on their source IP address. The main form can be used to match single IP addresses such as *192.168.1.1*. It could be used with a netmask in a bits form. One way is to do it with an regular netmask in the *255.255.255.255* form (ie, *192.168.0.0/255.255.255.0*), and the other way is to only specify the number of ones (1's) on the left side of the network mask. This means that we could for example add */24* to use a *255.255.255.0* netmask. We could then match whole IP ranges, such as our local networks or network segments behind the firewall. The line would then look something like, for example, *192.168.0.0/24*. This would match all packets in the *192.168.0.x* range. We could also inverse the match with an **!** just as before. If we would in other words use a match in the form of **--source !**

192.168.0.0/24 we would match all packets with a source address not coming from within the *192.168.0.x* range. The default is to match all IP addresses.
-d, **--dst**, **--destination**
iptables -A INPUT -d 192.168.1.1
The **--destination** match is used to match packets based on their destination address or addresses. It works pretty much the same as the **--source** match and has the same syntax, except that it matches based on where the packets are going. To match an IP range, we can add a netmask either in the exact netmask form, or in the number of ones (1's) counted from the left side of the netmask bits. It would then look like either *192.168.0.0/255.255.255.0* or like *192.168.0.0/24* and both would be equivalent to each other. We could also invert the whole match with an **!** sign, just as before. **--destination ! 192.168.0.1** would in other words match all packets except those not destined to the *192.168.0.1* IP address.
-i, **--in-interface**
iptables -A INPUT -i eth0
This match is used to match based on which interface the packet came in on. Note that this option is only legal in the INPUT, FORWARD and PREROUTING chains and will render an error message when used anywhere else. The default behaviour of this match, in case the match is not specified, is to assume a string value of **+**. The **+** value is used to match a string of letters and numbers. A single **+** would in other words tell the kernel to match all packets without considering which interface it came in on. The **+** string can also be used at the end of an interface, and **eth+** would in other words match all ethernet devices. We can also invert the meaning of this option with the help of the **!** sign. The line would then have a syntax looking something like **-i ! eth0**, which would mean to match all incoming interfaces, except eth0.
-o, **--out-interface**
iptables -A FORWARD -o eth0
The **--out-interface** match is used to match packets depending on which interface they are leaving on. Note that this match is only available in the OUTPUT, FORWARD and POSTROUTING chains, in opposite of the **--in-interface** match. Other than this, it works pretty much the same as the **--in-interface** match. The **+** extension is understood so you can match all eth devices with **eth+** and so on. To inverse the meaning of the match, you can use the **!** sign in exactly the same sense as in the **--in-interface** match. Of course, the default behaviour if this match is left out is to match all devices, regardless of where the packet is going.
-f, **--fragment**
iptables -A INPUT -f
This match is used to match the second and third part of a fragmented packet. The reason for this is that in the case of fragmented packets, there is no way to tell the source or destination ports of the fragments, nor ICMP types, among other things. Also, fragmented packets might in rather special cases be used to compile attacks against computers. Such fragments of packets will not be matched by other rules when they look like this, and hence this match was created. This option can also be used in conjunction with the **!** sign, however, in this case the **!** sign must precede the match, like this **! -f**. When this match is inversed, we match all head fragments and/or unfragmented packets. What this means is that we match all the first fragments of a fragmented packets, and not the second, third, and so on, fragments. We also match all packets that has not been fragmented during the transfer.

Also note that there are defragmentation options within the kernel that can be used which are really good. As a secondary note, in case you use connection tracking you will not see any defragmented packets since they are dealt with before hitting any chain or table in **iptables**.

Implicit matches

This section will describe the matches that are loaded implicitly. *Implicit matches* are loaded automatically when we tell **iptables** that this rule will match for example TCP packets with the **--protocol** match. There are currently three types of *implicit matches* that are loaded automatically for three different protocols. These are *TCP matches*, *UDP matches* and *ICMP matches*. The TCP based matches contain a set of different matches that are available for only TCP packets, and UDP based matches contain another set of matches that are available only for UDP packets, and the same thing for ICMP packets. There is also explicitly loaded matches that you must load explicitly with the **-m** or **--match** option which we will go through later on in the next section.

TCP matches

These matches are protocol specific and are only available when working with TCP packets and streams. To use these matches you need to specify **--protocol tcp** on the command line before trying to use these matches. Note that the **--protocol tcp** match must be to the left of the protocol specific matches. These matches are loaded implicitly in a sense, just as the *UDP* and *ICMP matches* are loaded implicitly. The other matches will be looked over in the continuation of this section, after the *TCP match* section.

Table 5. TCP matches

Match
Example
Explanation
--sport, **--source-port**
iptables -A INPUT -p tcp --sport 22
The **--source-port** match is used to match packets based on their source port. This match can either take a service name or a port number. If you specify a service name, the service name must be in the `/etc/services` file since **iptables** uses this file to look up the service name in. If you specify the port by port number, the entry of the rule will be slightly faster since **iptables** don't have to check up the service name, however, it could be a little bit harder to read in case you specify the numeric value. If you are writing a ruleset consisting of a 200 rules or more, you should definitely do this by port numbers since you will be able to notice the difference(On a slow box, this could make as much as 10 seconds if you are running a large ruleset consisting of 1000 rules or so). The **--source-port** match can also be used to match a whole range of ports in this fashion **--source-port 22:80** for example. This example would match all source ports between 22 and 80. If we omit the first port specification, the port 0 is assumed to be the one we mean. **--source-port :80** would then match port 0 through 80. And if the last port specification is omitted, port 65535 is assumed. If we would write **--source-port 22:** we would in turn get a port specification that tells us to match all ports from

port 22 through port 65535. If we inversed the port specification in the port range so the highest port would be first and the lowest would be last, **iptables** automatically reverses the inversion. If a source port definition looked like **--source-port 80:22**, it would be understood just the same as **--source-port 22:80**. We could also invert a match by adding a **!** sign like **--source-port ! 22** which would mean that we want to match all ports but port 22. The inversion could also be used together with a port range and would then look like **--source-port ! 22:80**, which in turn would mean that we want to match all ports but port 22 through 80. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--dport, **--destination-port**
iptables -A INPUT -p tcp --dport 22
This match is used to match TCP packets depending on its destination port. It uses exactly the same syntax as the **--source-port** match. It understands port and port range specifications, as well as inversions. It does also reverse high and low ports in a port range specification if the high port went into the first spot and the low port into the last spot. The match will also assume the values of 0 or 65535 if the high or low port is left out in a port range specification. In other words, exactly the same as **--source-port** in syntax. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--tcp-flags
iptables -p tcp --tcp-flags SYN,ACK,FIN SYN
This match is used to match depending on the TCP flags in a packet. First of all the match takes a list of flags to compare (a mask) and second it takes list of flags that should be set to 1, or turned on. Both lists should be comma-delimited. The match knows about the SYN, ACK, FIN, RST, URG, PSH flags but it also recognizes the words ALL and NONE. ALL and NONE is pretty much self describing, ALL means to use all flags and NONE means to use no flags for the option it is set. **--tcp-flags ALL NONE** would in other words mean to check all of the TCP flags and match if none of the flags are set. This option can also be inverted with the **!** sign. Also note that the comma delimitation should not include spaces. The correct syntax could be seen in the example above.
--syn
iptables -p tcp --syn
The **--syn** match is more or less an old relic from the ipchains days and is still there out of compatibility reasons, and for ease of traversing from one to the other. This match is used to match packets if they have the SYN bit set and the ACK and FIN bits unset. This command would in other words be exactly the same as the **--tcp-flags SYN,ACK,FIN SYN** match. Such packets are used to request new TCP connections from a server mainly. If you block these packets, you should have effectively blocked all incoming connection attempts, however, you will not have blocked the outgoing connections which a lot of exploits today uses (for example, hack a legit service and then make a program or such make the connect to you instead of setting up an open port on your host). This match can also be inverted with the **!** sign in this, **! --syn**, way. This would tell the match to match all packet with the FIN or the ACK bits set, in other words packets in an already established connection.
--tcp-option
iptables -p tcp --tcp-option 16
This match is used to match packets depending on their TCP options.

UDP matches

This section describes matches that will only work together with UDP packets. These matches are implicitly loaded when you specify the **--protocol UDP** match and will be available after this specification. Note that UDP packets are not connection oriented, and hence there is no such thing as different flags to set in the packet to give data on what the datagram is supposed to do, such as open or closing a connection, or if they are just simply supposed to send data. UDP packets do not require any kind of acknowledgement either. If they are lost, they are simply lost (Not taking ICMP error messaging etcetera into account). This means that there is quite a lot less matches to work with on a UDP packet than there is on TCP packets. Note that the state machine will work on all kinds of packets even though UDP or ICMP packets are counted as connectionless protocols. The state machine works pretty much the same on UDP packets as on TCP packets. There will be more about the state machine in a future chapter.

Table 6. UDP matches

Match
Example
Explanation
--sport, **--source-port**
iptables -A INPUT -p udp --sport 53
This match works exactly the same as its TCP counterpart. It is used to perform matches on packets based on their source UDP ports. It has support for port ranges, single ports and port inversions with the same syntax. To make a UDP port range you could do 22:80 which would match UDP ports 22 through 80. If the first value is omitted, port 0 is assumed. If the last port is omitted, port 65535 is assumed. If the high port comes before the low port, the ports switch place with eachother automatically. Single UDP port matches look as in the example above. To invert the port match, add a **!** sign in this, **--source-port ! 53** fashion. This would match all ports but port 80. Of course, the match can understand service names as long as they are available in the `/etc/services` file. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--dport, **--destination-port**
iptables -A INPUT -p udp --dport 53
The same goes for this match as for the UDP version of **--source-port**, it is exactly the same as the equivalent TCP match, but will work with UDP packets instead. The match is used to match packets based on their UDP destination port. The match handles port ranges, single ports and inversions. To match a single port we do **--destination-port 53**, to invert this we could do **--destination-port ! 53**. The first would match all UDP packets going to port 53 while the second would match packets but those going to the destination port 53. To specify a port range, we would do **--destination-port 22:80** for example. This example would match all packets destined for UDP port 22 through 80. If the first port is omitted, port 0 is assumed. If the second port is omitted, port 65535 is assumed. If the high port is placed before the low port, they automatically switch place so the low port winds up before the high port. Note that this match does not handle multiple ports and port ranges. For more

information about this, look at the multiport match extension.

ICMP matches

These are the *ICMP matches*. These packets are even worse than UDP packets in the sense that they are connectionless. The ICMP protocol is mainly used for error reporting and for connection controlling and such features. ICMP is not a protocol subordinated to the IP protocol, but more of a protocol beside the IP protocol that helps handling errors. The headers of a ICMP packet are very similar to those of the IP headers, but contains differences. The main feature of this protocol is the type header which tells us what the packet is to do. One example is if we try to access an unaccessible IP adress, we would get an `ICMP host unreachable` in return.For a complete listing of ICMP types, see the *ICMP types* appendix. There is only one ICMP specific match available for ICMP packets, and hopefully this should suffice. This match is implicitly loaded when we use the **--protocol ICMP** match and we get access to it automatically. Note that all the generic matches can also be used, so we can know source and destination adress too, among other things.

Table 7. ICMP matches

Match
Example
Explanation
--icmp-type
iptables -A INPUT -p icmp --icmp-type 8
This match is used to specify the ICMP type to match. ICMP types can be specified either by their numeric values or by their names. Numerical values are specified in RFC 792. To find a complete listing of the ICMP name values, do a **iptables --protocol icmp --help**, or check the *ICMP types* appendix. This match can also be inverted with the **!** sign in this, **--icmp-type ! 8**, fashion. Note that some ICMP types are obsolete, and others again may be "dangerous" for a simple host since they may, among other things, redirect packets to the wrong places.

Explicit matches

Explicit matches are matches that must be specifically loaded with the **-m** or **--match** option. If we would like to use the state matches for example, we would have to write **-m state** to the left of the actual match using the state matches. Some of these matches may be specific to some protocols, or was created for testing/experimental use or plainly to show examples of what could be accomplished with **iptables**. This in turn means that all these matches may not always be useful, however, they should mostly be useful since it all depends on your imagination and your needs. The difference between implicitly loaded matches and explicitly loaded ones is that the implicitly loaded matches will automatically be loaded when you, for example, match TCP packets, while explicitly loaded matches will not be loaded automatically in any case and it is up to you to activate them before using them.

MAC match

Table 8. MAC match options

Match
Example
Explanation
--mac-source
iptables -A INPUT --mac-source 00:00:00:00:00:01
This match is used to match packets based on their MAC source address. The MAC address specified must be in the form *XX:XX:XX:XX:XX:XX*, else it will not be legal. The match may be reversed with an **!** sign and would look like **--mac-source ! 00:00:00:00:00:01**. This would in other words reverse the meaning of the match so all packets except packets from this MAC address would be matched. Note that since MAC addresses are only used on ethernet type networks, this match will only be possible to use on ethernet based networks. This match is also only valid in the PREROUTING, FORWARD and INPUT chains and nowhere else.

Limit match

The **limit** match extension must be loaded explicitly with the **-m limit** option. This match is excellent to use to do limited logging of specific rules etcetera. For example, you could use this to match all packets that goes over the edge of a certain chain, and get limited logging of this. What this means, is that when we add this match we **limit** how many times a certain rule may be matched in a certain timeframe. This is its main usage, but there are more usages, of course. The **limit** match may also be inversed by adding a **!** flag in front of the **limit** match explicit loading, it would then look like **-m ! limit**. This means that all packets will be matched after they have broken the limit.

Table 9. Limit match options

Match
Example
Explanation
--limit
iptables -A INPUT -m limit --limit 3/hour
This sets the maximum average matching rate of the **limit** match. This match is specified with a number and an optional time specifier. The following time specifiers are currently recognised: **/second /minute /hour /day**. The default value here is 3 per hour, or 3/hour. This tells the **limit** match how many times to let this match run per timeunit (ie /minute).
--limit-burst

iptables -A INPUT -m limit --limit-burst 5
This is the setting for the *burst limit* of the **limit** match. It tells **iptables** the maximum initial number of packets to match. This number gets recharged by one every time the limit specified is not reached, up to this number. The default value is 5. (If anyone got a good/better and simpler explanation than this, send me a mail and I'll try to make this more understandable).

Multiport match

The **multiport** match extension can be used to specify more destination ports and port ranges than one, which would sometimes mean you would have to make several rules looking exactly the same just to match different ports.

Table 10. Multiport match options

Match
Example
Explanation
--source-port
iptables -A INPUT -p tcp -m multiport --source-port 22,53,80,110
This match matches multiple source ports. A maximum of 15 separate ports may be specified. The ports must be comma delimited, as you can see in the example. This match may only be used in conjunction with the **-p tcp** or **-p udp** matches. It is mainly an enhanced version of the normal **--source-port** match.
--destination-port
iptables -A INPUT -p tcp -m multiport --destination-port 22,53,80,110
This match is used to match multiple destination ports. It works exactly the same way as the source port match mentioned just above, except that it matches destination ports. It has a maximum specification of 15 ports and may only be used in conjunction with **-p tcp** and **-p udp**.
--port
iptables -A INPUT -p tcp -m multiport --port 22,53,80,110
This match extension can be used to match packets based both on their destination port and their source port. It works the same way as the **--source-port** and **--destination-port** matches above. It can take a maximum of 15 ports specified to it in one argument. It can only be used in conjunction with **-p tcp** and **-p udp**. Note that this means that it will only match packets that comes from, for example, port 80 to port 80 and if you have specified port 80 to the **--port** match.

Mark match

The **mark** match extension is used to match packets based on the marks they have set. A **mark** is a special field only maintained within the kernel that is associated with the packets as they travel through the computer. They may be used by different kernel routines for such tasks as traffic shaping and filtering. As of today, there is only one way of setting a mark in Linux, namely the **MARK** target in **iptables**. This was previously done with the **FWMARK** target in **ipchains**, this is why people still refer to **FWMARK** in advanced routing areas. The mark field is currently set to an unsigned integer, hence the limit of 65535 possible marks to use within your ruleset. In other words, you are probably not going to run into this limit in quite some time.

Table 11. Mark match options

Match
Example
Explanation
--mark
iptables -t mangle -A INPUT -m mark --mark 1
This match is used to match packets that have previously been marked. Marks can be set with the **MARK** target which we will discuss a bit more later on in the next section. All packets traveling through netfilter gets a special mark field associated with them. Note that this mark field does not in any way travel outside, with or without the packet, the actual computer itself. If this mark field matches the **mark** match it is a match. The mark field is an unsigned integer, hence there can be a maximum of 65535 different marks. You may also use a mask with the mark. The mark specification would then look like, for example, **--mark 1/1**. If a mask is specified, it is logically ANDed with the mark specified before the actual comparison.

Owner match

The **owner** match extension is used to match packets based on who created them. This extension was originally written as an example on what **iptables** might be used for. This match only works within the OUTPUT chain as it looks today, for obvious reasons. It is pretty much impossible to find out any information about who sent a packet on the other end, or if we where an intermediate hop to the real destination. Even within the OUTPUT chain it is not very reliable since certain packets may not have an owner. Notorious packets of that sort is different ICMP responses among other things. ICMP responses will, hence, never match.

Table 12. Owner match options

Match
Example
Explanation
--uid-owner
iptables -A OUTPUT -m owner --uid-owner 500

This packet match will match if the packet was created by the given `User ID` (UID). This could be used to match outgoing packets based on who created them. One possible use would be to block any other user than root to open new connections outside your firewall, or another possible use could be to block everyone but the httpuser from creating packets from HTTP.
--gid-owner
iptables -A OUTPUT -m owner --gid-owner 0
This match is used to match all packets based on their `Group ID` (GID). This means that we match all packets based on what group the user creating the packets are in. This could be used to block all but the users part of the "network" group from getting out onto the internet, or as described above to only allow "httpgroup" to be able to create packets going out on the HTTP port.
--pid-owner
iptables -A OUTPUT -m owner --pid-owner 78
This match is used to match packets based on their `Process ID` (PID) and which PID created the packets. This match is a bit harder to use, but one example would be to only allow PID 94 to send packets on the HTTP port, or we could write a small script that grabs the PID from a ps output for a specific daemon and then adds a rule for it. (If anyone has actually used this match for a production server, I would love to hear what they used it for and how they did it).
--sid-owner
iptables -A OUTPUT -m owner --sid-owner 100
This match is used to match packets based on their `Session ID` and the `Session ID` used by the program in question. If anyone have an idea for the usage of this match, please give me a note of it and of other possible uses.

State match

The **state** match extension is used in conjunction with the connection tracking code in the kernel and allows access to the connection tracking state of the packets. This allows us to know in what state the connection is, and works for pretty much all protocols, including stateless protocols such as ICMP and UDP. In all cases, there will be a default timeout for the connection and it will then be dropped from the connection tracking database. This match needs to be loaded explicitly by adding a **-m state** statement to the rule. You will then have access to one new match. This concept will be more deeply introduced in a future chapter since it is such a large area.

Table 13. State matches

Match
Example
Explanation
--state
iptables -A INPUT -m state --state RELATED,ESTABLISHED

This match option tells the **state** match what states the packets must be in to be matched. There is currently 4 states that can be used. **INVALID**, **ESTABLISHED**, **NEW** and **RELATED**. **INVALID** means that the packet is associated with no known stream or connection and that it may contain faulty data or headers. **ESTABLISHED** means that the packet is part of an already established connection that has seen packets in both directions and is fully valid. **NEW** means that the packet has or will start a new connection, or that it is associated with a connection that has not seen packets in both directions. Finally, **RELATED** means that the packet is starting a new connection and is associated with an already established connection. This could for example mean an FTP data transfer, or an ICMP error associated with an TCP or UDP connection for example. Note that the **NEW** state does not look for SYN bits in TCP packets trying to start a new connection and should, hence, not be considered very good in cases where we have only one firewall and no load balancing between different firewalls. However, there may be times where this could be useful. For more information on how this could be used, read in the future chapter on the state machine.

Unclean match

The **unclean** match takes no options and requires no more than explicit loading when you want to use it. Note that this option is regarded as experimental and may not work at all times, nor will it take care of all unclean packages or problems. This match tries to match packets which seems malformed or unusual, such as packets with bad headers or checksums and so on. This could be used to **DROP** connections and to check for bad streams etcetera, however you should be aware that this may break legal connections too.

TOS match

The **TOS** match can be used to match packets based on their TOS field. TOS stands for Type Of Service, consists of 8 bits, and is located in the IP header. This match is loaded explicitly by adding **-m tos** to the rule. TOS is normally used to tell intermediate hosts the preceeding of the stream, and what kind of content it has(not really, but it tells us if there is any specific requirements for this stream such as that it needs to be sent as fast as possible, or it needs to be able to send as much payload as possible). How different routers and people deal with these values depends. Most do not care at all, while others try their best to do something good with the packets in question and the data they provide.

Table 14. TOS matches

Match
Example
Explanation
--tos
iptables -A INPUT -p tcp -m tos --tos 0x16
This match is used as described above, it can match packets based on their TOS field and their value. This could be used for, among other things, to **mark** packets for later usage together with the **iproute2** and advanced routing functions in linux. The match takes an hex or numeric value as an

option, or possibly one of the names given if you do an **iptables -m tos -h**. At the time of writing it contained the following named values: `Minimize-Delay 16 (0x10)`, `Maximize-Throughput 8 (0x08)`, `Maximize-Reliability 4 (0x04)`, `Minimize-Cost 2 (0x02)`, and `Normal-Service 0 (0x00)`. `Minimize-Delay` means to minimize the delay for the packets, example of standard protocols that this includes are telnet, SSH and FTP-control. `Maximize-Throughput` means to find a path that allows as big throughput as possible, a standard protocol would be FTP-data. `Maximize-Reliability` means to maximize the reliability of the connection and to use lines that are as reliable as possible, some good protocols that would fit with this TOS values would be BOOTP and TFTP. `Minimize-Delay` means to minimize the delay until the packets gets through all the way to the client/server, ie find the fastest route. Some good protocols that would use this would be RTSP (Real Time Stream Control Protocol) and other streaming video/radio protocols. `Normal-Service` would finally mean any normal protocol that has no special needs for their transfers.

TTL match

The **TTL** match is used to match packets based on their TTL (Time To Live) field residing in the IP header. The TTL field contains 2 bits and is decremented once every time it is processed by an intermediate host between the client and host. If the TTL reaches 0, an ICMP type 11 code 0 (TTL equals 0 during transit) or code 1 (TTL equals 0 during reassembly) is transmitted to the party sending the packet and telling about the problem. This match is only used to match packets based on their TTL, and not to change anything. This is true here, as well as in all kinds of matches. To load this match, you need to add an **-m ttl** to the rule.

Table 15. TTL matches

Command
Example
Explanation
--ttl
iptables -A OUTPUT -m ttl --ttl 60
This match option is used to specify which TTL value to match. It takes an numeric value and matches based on this value. There is no inversion and there is no other specifics to this match. This target could be used for debugging your local network, for example hosts which seems to have problems connecting to hosts on the internet, or to find possible infestations of trojans etcetera. The usage is pretty much limited, however, it is only your imagination which stops you. One example, as described above, would be to find hosts with bad TTL values set as default (may be due to badly implemented TCP/IP stack, or due to a malconfiguration).

Targets/Jumps

The target/jumps tells the rule what to do with a packet that is a perfect match with the match section of the rule. There is a few basic targets, the **ACCEPT** and **DROP** targets which we will deal with first of all targets. However, before we do that, let us have a brief look at how a jump is done.

The jump specification is done exactly the same as the target definition except that it requires a chain within the same table to jump to. To jump to a specific chain, it is required that the chain has already been created. As we have already explained before, a chain is created with the **-N** command. For example, let's say we create a chain in the filter table called **tcp_packets** like this: **iptables -N tcp_packets**. We could then add a jump target to it like this: **iptables -A INPUT -p tcp -j tcp_packets**. We would then jump from the **INPUT** chain to the **tcp_packets** chain and start traversing that chain. When/If we reach the end of that chain, we get dropped back to the **INPUT** chain and the packet starts traversing from the rule one step below where it jumped to the other chain (tcp_packets in this case). If a packet is **ACCEPT**'ed within one of the subchains, it will automatically be **ACCEPT**'ed in the superset chain also and it will not traverse any of the superset chains any further. However, do note that the packet will traverse all other chains in the other tables in a normal fashion. For more information on table and chain traversing, see the *Traversing of tables and chains* chapter.

Targets on the other hand specify an action to take on the packet in question. We could for example, **DROP** or **ACCEPT** the packet depending on what we want to do. There is also a number of other actions we may want to take which we will describe further on in this section. Targets may also end with different results one could say, some targets will make the packet stop traversing the specific chain and superset chains as described above. Good examples of such rules are **DROP** and **ACCEPT**. Rules that are stopped, will not pass through any of the rules further on in the chain or superset chains. Other targets, may take an action on the packet and then the packet will continue passing through the rest of the rules anyway, a good example of this would be the **LOG**, **DNAT** and **SNAT** targets. These packets may be logged, Network Address Translationed and then be passed on to the other rules in the same chains. This may be good in cases where we want to take two actions on the same packet, such as both mangling the TTL and the TOS value of a specific packet/stream. Some targets will also take options that may be necessary (What address to do NAT to, what TOS value to use etcetera) while others have options not necessary, but available in any case (log prefixes, masquerade to ports and so on). We will try to answer all these questions as we go in the descriptions. Let us have a look at what kinds of targets there are.

ACCEPT target

This target takes no special options first of all. When a packet is perfectly matched and this target is set, it is accepted and will not continue traversing the chain where it was accepted in, nor any of the calling chains. Do note, that packets that was accepted in one chain will still travel through any subsequent chains within the other tables and may be dropped there. There is nothing special about this target whatsoever, and it does not require, or have the possibility, to add options to the target. To use this target, we specify it like **-j ACCEPT**.

DROP target

The **DROP** target does just what it says, it drops packets dead to the ground and refuses to process them anymore. A packet that matches a rule perfectly and then has this action taken on it will be blocked and no further processing will be done. Note that this action may be a bit bad in certain cases since it may leave dead sockets around on the server and client. A better solution would be to use the **REJECT** target in those cases, especially when you want to block certain portscanners from getting to much information, such as filtered ports and so on. Also note that if a packet has the **DROP** action taken on them in a subchain, the packet will not be processed in any of the above chains in the structure either. The target will not send any kind of information in either direction, either to tell the client or the server as told previously.

QUEUE target

Table 16. QUEUE target

Option
Example
Explanation
Option
Example
Explanation

RETURN target

The **RETURN** target will make the current packet stop travelling through the chain where it hit the rule. If it is a subchain to another chain, the packet will continue to travel through the above chains in the structure as if nothing had happened. If the chain is the main chain, for example the INPUT chain, the packet will have the default policy taken on it. The default policy is normally set to **ACCEPT** or **DROP** or something the like.

For example, lets say a packet enters the INPUT chain and then hits a rule that it matches and that gives it **--jump EXAMPLE_CHAIN**. The packet will then start traversing the **EXAMPLE_CHAIN**, and all of a sudden it matches a specific rule which has the **--jump RETURN** target set. It will then jump back to the previous chain, which in this case would be the INPUT chain. Another example would be if the packet hit a **--jump RETURN** rule in the INPUT chain. It would then be dropped to the default policy as previously described, and no more actions would be taken in this chain.

LOG target

The **LOG** target is specially made to make it possible to log snippets of information about packets that may be illegal, or for pure bughunting and errorfinding. The **LOG** target will log specific information such as most of the IP headers and other interesting information via the kernel logging facility. This information may then be read with **dmesg** or **syslogd** and likely programs and applications. This is an excellent target to use while you are debugging your rulesets to see what packets go where and what rules are applied on what packets. Also note that it may be a really great idea to use the **LOG** target instead of the **DROP** target while you are testing a rule you are not 100% sure about on a production firewall since this may otherwise cause severe connectivity problems for your users. Also note that the

ULOG target may be interesting in case you are getting heavy logs, since the **ULOG** target has support for logging directly to MySQL databases and such.

Note that it is not a **iptables** or netfilter problem in case you get your logs to the consoles or likely, but instead a problem of your syslogd configuration which you may find in `/etc/syslog.conf`. Read more in **man syslog.conf** for information about these kind of problems.

The **LOG** target currently takes five options that may be interesting to use in case you have specific needs for more information, or want to set different options to specific values. They are all listed below.

Table 17. LOG target options

Option	Example	Explanation
--log-level	**iptables -A FORWARD -p tcp -j LOG --log-level debug**	This is the option that we can use to tell **iptables** and **syslog** which log level to use. For a complete list of loglevels read the `syslog.conf` manual. Normally there are the following log levels, or priorities as they are normally referred to: debug, info, notice, warning, warn, err, error, crit, alert, emerg and panic. The keyword error is the same as err, warn is the same as warning and panic is the same as emerg. Note that all three of these are deprecated, in other words do not use error, warn and panic. The priority defines the severity of the message being logged. All messages are logged through the kernel facility. In other words, setting kern.=info `/var/log/iptables` in your syslog.conf file and then letting all your **LOG** messages in iptables use log level info, would make all messages appear in the `/var/log/iptables` file. Note that there may be other messages here as well from other parts of the kernel that uses the info priority. For more information on logging I recommend you to read the **syslog** and `syslog.conf` manpages as well as other HOWTO's etcetera.
--log-prefix	**iptables -A INPUT -p tcp -j LOG --log-prefix "INPUT packets"**	This option tells **iptables** to prefix all log messages with a specific prefix which may then be very good to use together with, for example, **grep** and other tools to distinguish specific problems and outputs from specific rules. The prefix may be up to 29 letters long, including whitespace and those kind of symbols.
--log-tcp-sequence	**iptables -A INPUT -p tcp -j LOG --log-tcp-sequence**	This option will log the TCP Sequence numbers together with the log message. The TCP Sequence number are special numbers that identify each packet and where it fits into a TCP sequence and how the stream should be reassembled. Note that this option is a security risk if the log is readable by any users, or by the world for that matter. Any log that is, which may contain logging messages from **iptables**.

--log-tcp-options
iptables -A FORWARD -p tcp -j LOG --log-tcp-options
The **--log-tcp-options** option will log the different options from the TCP packets header. These may be valuable when trying to debug what may go wrong and what has gone wrong. This option takes no variable fields or anything like that, just as most of the **LOG** options.
--log-ip-options
iptables -A FORWARD -p tcp -j LOG --log-ip-options
The **--log-ip-options** option will log most of the IP packet header options. This works exactly thesame as the **--log-tcp-options** option, but instead works on the IP options. These logging messages may be valuable when trying to debug or finding out specific culprits and what goes wrong, just the same as the previous option.

MARK target

The **MARK** target is used to set **netfilter** mark values that are associated with specific packets. This target is only valid in the mangle table, and will not work outside there. The **MARK** values may be used in conjunction with the advanced routing capabilities in Linux to send different packets through different routes and to tell them to use different queue disciplines (qdisc), etcetera. For more information on advanced routing, check out the LARTC HOWTO. Note that the mark value is not set within the actual package, but is an value that is associated within the kernel with the packet. In other words, you may not set a **MARK** for a package and then expect the **MARK** to still be there on another computer. If this is what you want, you will be better off with the **TOS** target which will mangle the TOS value in the IP header.

Table 18. MARK target options

Option
Example
Explanation
--set-mark
iptables -t mangle -A PREROUTING -p tcp --dport 22 -j MARK --set-mark 2
The **--set-mark** option is required to set a mark. The **--set-mark** match takes an integer value. For example, we may set mark 2 to a specific stream of packets, or on all packets from a specific host and then do advanced routing on that host, limiting or unlimiting their network speed etcetera.

REJECT target

The **REJECT** target works basically the same as the **DROP** target, but it also sends back an error message to the host sending the packet that was blocked. The **REJECT** target is as of today only valid in the INPUT, FORWARD and OUTPUT chain or subchains of those chains, which would also be the only chains where it would make any sense to put this target in. Note that the chains that uses the **REJECT** target may only be called upon by the INPUT, FORWARD, and OUTPUT chains, else they won't work. There currently is only one option which controls the nature of how this target works, which in turn may take a huge set of variables. Most of them are fairly easy to understand if you have a basic knowledge of TCP/IP.

Table 19. REJECT target

Option
Example
Explanation
--reject-with
iptables -A FORWARD -p TCP --dport 22 -j REJECT --reject-with tcp-reset
This option tells the **REJECT** target what response to send to the host that sent the packet that we found to be a match. Once we get a packet that matches a specific rule and we specify this target, the target will first of all send the specified reply, and then the packet is dropped dead to the ground, just the same as with the **DROP** target. There are currently the following reject types that can be used: `icmp-net-unreachable`, `icmp-host-unreachable`, `icmp-port-unreachable`, `icmp-proto-unreachable`, `icmp-net-prohibited` and `icmp-host-prohibited`. The default error message is to send an **port-unreachable** to the host. All of the above are ICMP error messages and may be set as you wish, and you may get some more information by looking in the appendix *ICMP types*. There is also an option called **echo-reply**, but this option may only be used in conjunction with rules which would match ICMP ping packets. Finally, there is one more option called **tcp-reset** which may only be used together with the TCP protocol. the tcp-reset option will tell **REJECT** to send an TCP RST packet in reply to the sending host. TCP RST are used to close open connections gracefully. For more information about the TCP RST read RFC 793 - Transmission Control Protocol. As stated in the **iptables** man page, this is mainly useful for blocking ident probes which frequently occur when sending mail to broken mail hosts, which won't accept your mail otherwise.

TOS target

The **TOS** target is used to set the Type of Service field within the IP header. The TOS field consists of 8 bits which are used to route packets. This is one of the few fields that can be used within **iproute2** and its subsystem to route packets. Also note that if you handle several separate firewalls and routers, this is the only way to propagate routing information between these routers and firewalls within the actual packet. As noted before, the **MARK** target which sets a **MARK** associated with a specific packet is only available within the kernel, and can not be propagated with the packet. If you feel a need to propagate routing information on how to do routing for a specific packet or stream, you should hence set the TOS field which was developed for this. There are currently a lot of routers on the internet which does a pretty bad job at this so it may be a bit useless as of now to do any TOS mangling before sending the packets on to the internet. At best the routers will do nothing with the TOS field, and they will not even look at them. At worst, they will look at the TOS field and do the wrong thing based on the information. As stated previously, however, there is most definitely a good use if you have a large WAN or LAN with several routers and actually have the possibility to give packets different routes and preference depending on their TOS value, at least within your own network.

Note that this target is only valid within the mangle table and can not be used outside it. Also note that some old versions (1.2.2 or below) of iptables provided a broken implementation of this target which would not fix the packet checksum upon mangling, and hence rendered the packets bad and in need of retransmission, which in turn most probably would be mangled and the connection would never work.

The **TOS** target only takes one option as described below.

Table 20. TOS target

Option
Example
Explanation
--set-tos
iptables -t mangle -A PREROUTING -p TCP --dport 22 -j TOS --set-tos 0x10
The **--set-tos** option tells the **TOS** mangler what TOS value to set on packets that are matched. The option takes a numeric value, either in hex or in decimal value. As the TOS value consists of 8 bits, the value may be 0-255, or in hex 0x00-0xFF. Note that most of these values will never be used by anyone on the internet so you may be better of by using the named values available (which should be more or less standardized). These values are `Minimize-Delay` (decimal value 16, hex value 0x10), `Maximize-Throughput` (decimal value 8, hex value 0x08), `Maximize-Reliability` (decimal value 4, hex value 0x04), `Minimize-Cost` (decimal value 2, hex 0x02) or `Normal-Service` (decimal value 0, hex value 0x00). The default value on most packets are `Normal-Service`, or 0. Note that you can, of course, use the actual names instead of the actual hex values to set up the TOS value, and it should generally be recommended since the values behind the names may be changed if you are unlucky. For a complete listing of the "descriptive values", do an **iptables -j TOS -h**. This listing is complete as of iptables 1.2.5 and should hopefully be so for another period of time.

MIRROR target

The **MIRROR** target is an experimental demonstration target only, and you should be warned of using this since it may result in really bad loops, hence resulting in a bad kind of Denial of Service, among other things. The **MIRROR** target is used to invert the source and destination fields in the IP header, and then to retransmit the packet. This results in some really funny things, and I would be quite sure that someone has had a good laugh at some cracker or another that has cracked his own box via this target by now. The result of this target is really simple. Lets say we set up a **MIRROR** target for port 80 at computer A. If computer B would be coming from yahoo.com, and tried to access the HTTP server at computer A, the MIRROR target would make so computer B got the webpage at yahoo.com back (since this is where he came from).

Note that the **MIRROR** target is only valid within the **INPUT**, **FORWARD** and **PREROUTING** chains, and any user-defined chains which are only called from those chains. Also note that the outgoing packets created by the **MIRROR** target is not seen by any of the normal chains in the filter, **NAT** or mangle tables to avoid loops and other problems. However, this does not make the target free of any likely problems. One thing would for example be to send a spoofed packet to a host that uses the **MIRROR**command with a **TTL** of 255, and see to it that the packet is spoofed so it looks as if it comes from another host that uses the **MIRROR** command. The packet will then bounce back and forth a huge set of times, depending on how many hops there is between them. If there is only 1 hop, the packet will jump back and forth 240-255 times. Not bad for a cracker in other words to send 1500 bytes of data, and eat up 380 kbyte of your connection. Note that this is a best case scenario for the cracker or scriptkiddie, whichever we want to call them.

SNAT target

The **SNAT** target is used to do Source Network Address Translation, which means that this target will rewrite the Source IP address in the IP header of the packet. For example, this is good when we want several computers to share an internet connection. We could then turn on ip forwarding in the kernel, and then set an **SNAT** rule which would translate all packets from our local network to the **source IP** of our own internet connection. Without doing this, the outside world would not know where to send reply packets, since our local networks should use the IANA specified IP addresses which are allocated for **LAN** networks. If we forwarded these packets as is, noone on the internet would know that they where actually from us. The **SNAT** target does all the translation needed to do this kind of work, letting all packets leaving our **LAN** look as if they came from a single host, which would be our firewall.

The **SNAT** target is only valid within the nat table, within the **POSTROUTING** chain. This is in other words the only place that you may do **SNAT** in. If the first packet in a connection is mangled in this fashion, then all future packets in the same connection will also be **SNAT**'ed and, also, no further processing of rules in the **POSTROUTING** chain will be commenced on the packets in the same stream.

Table 21. SNAT target

Option
Example
Explanation
--to-source
iptables -t nat -A POSTROUTING -o eth0 -j SNAT --to-source 194.236.50.155-194.236.50.160:1024-32000
The **--to-source** option is used to specify which source the packets should use. This option, at it simplest, takes one IP address to which we should transform all the **source IP** addresses in the **IP header**. If we want to balance between several IP addresses we could use an range of IP addresses separated by a hyphen, it would then look like, for example, 194.236.50.155-194.236.50.160 as

described in the example above. The source IP would then be set randomly for each stream that we open, and a single stream would always use the same IP address for packets within that stream. There may also be an range of ports specified that should only be used by **SNAT**. All the source ports would then be mapped to the ports specified. This would hence look as within the example above, :1024-32000 or something alike. iptables will always try to not make any port alterations if it is possible, but if two hosts tries to use the same ports, iptables will map one of them to another port. If no port range is specified, then all source ports below 512 will be mapped to other ports below 512 if needed. Those between source ports 512 and 1023 will be mapped to ports below 1024. All other ports will be mapped to 1024 or above. As previously stated, iptables will always try to maintain the source ports used by the actual workstation making the connection. Note that this has nothing to do with destination ports, so if a client tries to make contact with an **HTTP** server outside the firewall, it will not be mapped to the **FTP control** port.

DNAT target

The **DNAT** target is used to do Destination Network Address Translation, which means that it is used to rewrite the `Destination IP` address of a packet. If a packet is matched, and this is the target of the rule, the packet, and all subsequent packets in the same stream will be translated, and then routed on to the correct device, host or network. This target can be extremely useful, for example, when you have an host running your webserver inside a *LAN*, but no real IP to give it that will work on the internet. You could then tell the firewall to forward all packets going to its own HTTP port, on to the real webserver within the *LAN*. We may also specify a whole range of destination IP addresses, and the **DNAT** mechanism will choose the destination IP address at random for each stream. Hence, we will be able to deal with a kind of load balancing by doing this.

Note that the **DNAT** target is only available within the PREROUTING and OUTPUT chains in the nat table, and any of the chains called upon from any of those listed chains. Note that chains containing **DNAT** targets may not be used from any other chains, such as the POSTROUTING chain.

Table 22. DNAT target

Option
Example
Explanation
--to-destination
iptables -t nat -A PREROUTING -p tcp -d 15.45.23.67 --dport 80 -j DNAT --to-destination 192.168.1.1-192.168.1.10
The **--to-destination** option tells the DNAT mechanism which Destination IP to set in the IP header, and where to send packets that are matched. The above example would send on all packets destined for IP address 15.45.23.67 to a range of *LAN* IP's, namely 192.168.1.1 through 10. Note, as described previously, that a single stream will always use the same host, and that each stream will randomly be given an IP address that it will always be Destinated for, within that stream. We could also have specified only one IP address, in which case we would always be connected to the same host. Also note that we may add an port or port range to which the traffic would be redirected to. This is done by adding, for example, an :80 statement to the IP addresses to which we want to

DNAT the packets. A rule could then look like **--to-destination 192.168.1.1:80** for example, or like **--to-destination 192.168.1.1:80-100** if we wanted to specify a port range. As you can see, the syntax is pretty much the same for the **DNAT** target, as for the **SNAT** target even though they do two totally different things. Do note that port specifications are only valid for rules that specify the TCP or UDP protocols with the **--protocol** option.

MASQUERADE target

The **MASQUERADE** target is used basically the same as the **SNAT** target, but it does not require any **--to-source** option. The reason for this is that the **MASQUERADE** target was made to work with, for example, dialup connections, or DHCP connections, which gets dynamic IP addresses when connecting to the network in question. This means that you should only use the **MASQUERADE** target with dynamically assigned IP connections, which we don't know the actual address of at all times. If you have a static IP connection, you should instead use the **SNAT** target.

When you masquerade a connection, it means that we set the IP address used on a specific network interface instead of the **--to-source** option, and the IP address is automatically grabbed from the information about the specific interface. The **MASQUERADE** target also has the effect that connections are forgotten when an interface goes down, which is extremely good if we, for example, kill a specific interface. If we would have used the **SNAT** target, we may have been left with a lot of old connection tracking data, which would be lying around for days, swallowing up worthful connection tracking memory. This is in general the correct behaviour when dealing with dialup lines that are probable to be assigned a different IP every time it is up'ed. In case we are assigned a different IP, the connection is lost anyways, and it is more or less idiotic to keep the entry around.

It is still possible to use the **MASQUERADE** target instead of **SNAT** even though you do have an static IP, however, it is not favorable since it will add extra overhead, and there may be inconsistencies in the future which will thwart your existing scripts and render them "unusable".

Note that the **MASQUERADE** target is only valid within the POSTROUTING chain in the nat table, just as the **SNAT** target. The **MASQUERADE** target takes on option specified below, which is optional.

Table 23. MASQUERADE target

Option
Example
Explanation
--to-ports
iptables -t nat -A POSTROUTING -p TCP -j MASQUERADE --to-ports 1024-31000
The **--to-ports** option is used to set the source port or ports to use on outgoing packets. Either you can specify a single port like **--to-ports 1025** or you may specify a port range as **--to-ports 1024-3000**. In other words, the lower port range delimiter and the upper port range delimiter separated with a hyphen. This alters the default SNAT port-selection as described in the *SNAT target* section. The **--to-ports** option is only valid if the rule match section specifies the TCP or UDP protocols with

the **--protocol** match.

REDIRECT target

The **REDIRECT** target is used to redirect packets and streams to the machine itself. This means that we could for example **REDIRECT** all packets destined for the HTTP ports to an HTTP proxy like squid, on our own host. Locally generated packets are mapped to the 127.0.0.1 address. In other words, this rewrites the destination address to our own host for packets that are forwarded, or something alike. The **REDIRECT** target is extremely good to use when we want, for example, transparent proxying, where the *LAN* hosts do not know about the proxy at all.

Note that the **REDIRECT** target is only valid within the PREROUTING and OUTPUT chains of the nat table. It is also valid within user-defined chains that are only called from those chains, and nowhere else. The **REDIRECT** target takes only one option, as described below.

Table 24. REDIRECT target

Option
Example
Explanation
--to-ports
iptables -t nat -A PREROUTING -p tcp --dport 80 -j REDIRECT --to-ports 8080
The **--to-ports** option specifies the destination port, or port range, to use. Without the **--to-ports** option, the destination port is never altered. This is specified, as above, **--to-ports 8080** in case we only want to specify one port. If we would want to specify an port range, we would do it like **--to-ports 8080-8090**, which tells the **REDIRECT** target to redirect the packets to the ports 8080 through 8090. Note that this option is only available in rules specifying the TCP or UDP protocol with the **--protocol** matcher, since it wouldn't make any sense anywhere else.

TTL target

The **TTL** target is used to modify the Time To Live field in the IP header. One useful application of this is to change all Time To Live values to the same value on all outgoing packets. One reason for doing this is if you have a bully *ISP* which don't allow you to have more than one machine connected to the same internet connection, and who actively pursue this. Setting all **TTL** values to the same value, will effectively make it a little bit harder for them to notify that you are doing this. We may then reset the **TTL** value for all outgoing packets to a standardized value, such as 64 as specified in Linux kernel.

For more information on how to set the default value used in Linux, read the *ip-sysctl.txt*, which you may find within the *Other resources and links* appendix.

The **TTL** target is only valid within the mangle table, and nowhere else. It takes 3 options as of writing this, all of them described below in the table.

Table 25. TTL target

Option
Example
Explanation
--ttl-set
iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-set 64
The **--ttl-set** option tells the **TTL** target which TTL value to set on the packet in question. A good value would be around 64 somewhere. It's not too long, and it is not too short. Do not set this value too high, since it may affect your network and it is a bit immoral to set this value to high, since the packet may start bouncing back and forth between two misconfigured routers, and the higher the TTL, the more bandwidth will be eaten unnecessary in such a case.
--ttl-dec
iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-dec 1
The **--ttl-dec** option tells the **TTL** target to decrement the Time To Live value by the amount specified after the **--ttl-dec**option. In other words, if the TTL for an incoming packet was 53 and we had set **--ttl-dec 3**, the packet would leave our host with a TTL value of 49. The reason for this is that the networking code will automatically decrement the TTL value by 1, hence the packet will be decremented by 4 steps, from 53 to 49 in other words. IF ANYONE HAS A GOOD USAGE FOR THIS OPTION, NOTIFY ME
--ttl-inc
iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-inc 1
The **--ttl-inc** option tells the **TTL** target to increment the Time To Live value with the value specified to the **--ttl-inc** option. This means that we should raise the TTL value with the value specified in the **--ttl-inc** option, and if we specified **--ttl-inc 4**, a packet entering with a TTL of 53 would leave the host with TTL 56. Note that the same thing goes here, as for the previous example of the **--ttl-dec** option, where the network code will automatically decrement the TTL value by 1, which it always does. This may be used to make our firewall a bit more stealthy to traceroutes among other things. By setting the TTL one value higher for all incoming packets, we effectively make the firewall hidden from traceroutes. Traceroutes are a loved and hated thing, since they provide excellent information on problems with connections and where it happens, but at the same time, it gives the hacker/cracker some good information about your upstreams if they have targeted you. For a good example on how this could be used, see the ttl-inc.txt script.

ULOG target

The **ULOG** target is used to provide userspace logging of matching packets. If a packet is matched and the **ULOG** target is set, the packet information is multicasted together with the whole packet through a netlink socket. One or more userspace processes may then subscribe to various multicast groups and receive the packet. This is in other words a more complete and more sophisticated logging facility that is only used by iptables and netfilter so far, and it contains much better facilities for logging packets. This target enables us to log information to MySQL databases, and other databases, making it much simpler to search for specific packets, and to group log entries etcetera.

Table 26. ULOG target

Option
Example
Explanation
--ulog-nlgroup
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-nlgroup 2
The **--ulog-nlgroup** option tells the **ULOG** target which netlink group to send the packet to. There are 32 netlink groups, which are simply specified as 1-32. If we would like to reach netlink group 5, we would simply write **--ulog-nlgroup 5**. The default netlink groupd used is 1.
--ulog-prefix
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-prefix "SSH connection attempt: "
The **--ulog-prefix** option works just the same as the prefix value for the standard **LOG** target. This option prefixes all log entries with a userspecified log prefix. It can be 32 characters long, and is definitely most useful to distinguish different logmessages and where they came from.
--ulog-cprange
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-cprange 100
The **--ulog-cprange** option tells the **ULOG** target how many bytes of the packet to send to the userspace daemon of **ULOG**. If we specify 100 as above, we would copy 100 bytes of the whole packet to userspace, which would include the whole header hopefully, plus some leading data within the actual packet. If we specify 0, the whole packet will be copied to userspace, regardless of the packets size. The default value is 0, so the whole packet will be copied to userspace.
--ulog-qthreshold
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-qthreshold 10
The **--ulog-qthreshold** option tells the **ULOG** target how many packets to queue inside the kernel before actually sending the data to userspace. For example, if we set the threshold to 10 as above, the kernel would first accumulate 10 packets inside the kernel, and then transmit it outside to the userspace as one single netlink multipart message. The default value here is 1 because of backwards compatibility, the userspace daemon did not know how to handle multipart messages previously.

Traversing of tables and chains

This chapter will talk about how packets traverse the the different chains and in which order. Also we will speak about in which order the tables are traversed. This is extremely valuable information later on when you write your own specific rules. We will also look at which points certain other parts that also are kernel dependant gets in the picture. With this we mainly mean the different routing decisions and so on. This is especially needed if you want to write rules with **iptables** that chould change how different packets get routed, good examples of this is **DNAT** and **SNAT** and of course the TOS bits.

General

When a packet first enters the firewall, it hits the hardware and then get's passed on to the proper device driver in the kernel. Then the packet starts to go through a series of steps in the kernel before it is either sent to the correct application (locally), or forwarded to another host or whatever happens to it. In this example, we're assuming that the packet is destined for another host on another network. The packet goes through the different steps in the following fashion:

Table 1. Forwarded packets

Step	Table	Chain	Comment
1			On the wire(ie, internet)
2			Comes in on the interface(ie, eth0)
3	mangle	PREROUTING	This chain is normally used for mangling packets, ie, changing TOS and so on.
4	nat	PREROUTING	This chain is used for Destination Network Address Translation mainly. Source Network Address Translation is done further on. Avoid filtering in this chain since it will be passed through in certain cases.
5			Routing decision, ie, is the packet destined for our localhost or to be forwarded and where.
6	filter	FORWARD	The packet got routed onto the FORWARD chain, only forwarded packets go through here, we do all the filtering here. Note that all traffic that's forwarded goes through here (not only in one direction), so you need to think about it when writing your ruleset.
7	nat	POSTROUTING	This chain should first and foremost be used for Source Network Address Translation, avoid doing filtering here since certain packets might pass this chain without ever hitting it. This is also where Masquerading is done.
8			Goes out on the outgoing interface (ie, eth1).
9			Out on the wire again (ie, LAN).

As you can see, there's quite a lot of steps to pass through. The packet can be stopped at any of the **iptables** chains, or anywhere else in case it is malformed, however, we are mainly interested in the **iptables** aspect of this lot. Do note that there is no specific chains or tables for different interfaces or anything like that. FORWARD is always passed by all packets that are forwarded over this firewall/ router. Now, let us have a look at a packet that is destined for our own localhost. It would pass through the following steps before actually being delivered to our application to receive it:

Table 2. Destination localhost

Step	Table	Chain	Comment
1			On the wire (ie, Internet)
2			Comes in on the interface(ie, eth0)
3	mangle	PREROUTING	This chain is normally used for mangling packets, ie, changing TOS and so on.
4	nat	PREROUTING	This chain is used for Destination Network Address Translation mainly. Avoid filtering in this chain since it will be passed through in certain cases.
5			Routing decision, ie, is the packet destined for our localhost or to be forwarded and where.
6	filter	INPUT	This is where we do filtering for all incoming traffic destined for our localhost. Note that all incoming packets destined for this host passes through this chain, no matter what interface and so on it came from.
7			Local process/application (ie, server/client program)

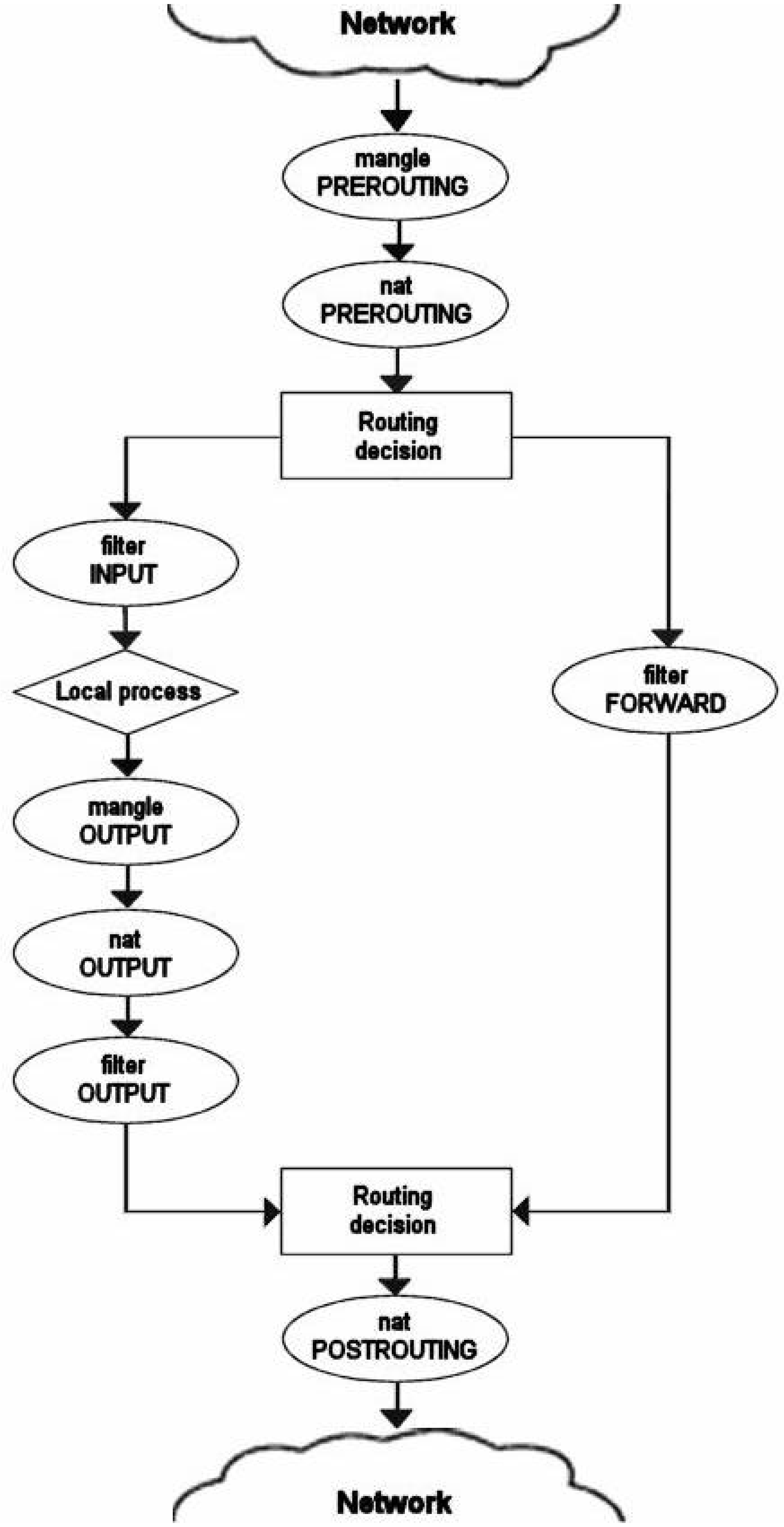
Note that this time the packet was passed through the INPUT chain instead of the FORWARD chain. Quite logical. Most probably the only thing that's really logical about the traversing of tables and chains in your eyes in the beginning, but if you continue to dig in it, I think it gets clearer with time. I think. Finally we look at the outgoing packets from our own localhost and what steps they go through.

Table 3. Source localhost

Step	Table	Chain	Comment
1			Local process/application (ie, server/client program)
2	Mangle	OUTPUT	This is where we mangle packets, it is suggested that you do not filter in this chain since it can have sideeffects.
3	Nat	OUTPUT	This is currently broken, could someone tell me when this will be fixed? Please?
4	Filter	OUTPUT	This is where we filter packets going out from localhost.

5			Routing decision. This is where we decide where the packet should go.
6	Nat	POSTROUTING	This is where we do Source Network Address Translation as described earlier. It is suggested that you don't do filtering here since it can have sideeffects, and certain packets might slip through even though you set a default policy of **DROP**.
7			Goes out on some interface (ie, eth0)
8			On the wire (ie, Internet)

We have now seen how the different chains are traversed in three separate scenarios. If we would figure out a good map of all this, it would look something like this:



Hopefully you got a clearer picture of how the packets traverses the built in chains now. All comments welcome, this might still be wrong or it might change in the future. If you feel that you want more information, you could use the *rc.test-iptables.txt* script. This test script should give you the necessary rules to test how the tables and chains are traversed.

Mangle table

This table should as we've already noted mainly be used for mangling packets. In other words, you may freely use the mangle matches etc that could be used to change TOS (Type Of Service) fields and so on.

It is strongly adviced that you don't use this table to do any filtering in, nor will any DNAT, SNAT or Masquerading work in this table.

Target's that only valid in the mangle table:

- TOS
- TTL
- MARK

The **TOS** target is used to set and/or change the Type of Service field in the packet. This could be used for setting up policies on the network regarding how a packet should be routed and so on. Note that this has not been perfected and is not really implemented on the internet and most of the routers don't care about the value in this field, and sometimes, they act faulty on what they get. Don't set this in other words for packets going to the internet unless you want to do routing decisions on it with iproute2.

The **TTL** target is used to change the TTL (Time To Live) field of the packet. We could tell packets to only have a specific TTL and so on. One good reason for this could be that we don't want to give ourself away to nosy Internet Service Providers. Some Internet Service Providers does not like users running multiple computers on one single connection, and there are some Internet Service Providers known to look for a single host generating many different TTL values, and takes this as one of many signs of multiple computers connected to a single connection.

The **MARK** target is used to set special mark values to the packet. These marks could then be recognised by the **iproute2** programs to do different routing on the packet depending on what mark they have, or if they don't have any. We could also do bandwidth limiting and Class Based Queuing based on these marks.

Nat table

This table should only be used for NAT (Network Address Translation) on different packets. In other words, it should only be used to translate packets source field or destination field. Note that, as we have said before, only the first packet in a stream will hit this chain. After this, the rest of the packets will automatically have the same action taken on them as the first packet. The actual targets that does these kind of things are:

- DNAT
- SNAT
- MASQUERADE

The **DNAT** (Destination Network Address Translation) target is mainly used in cases such as when you have one IP and want to redirect accesses to the firewall to some other host on a DMZ for example. In other words, we change the destination address of the packet and reroute it to some other host.

SNAT (Source Network Address Translation) is mainly used for changing the source address of packets. This is mainly done to hide our local networks or DMZ, etcetera. A good example when this is very good is when we have a firewall that we know the outside IP address of, but need to change our local networks IP numbers to the same of the IP of our firewall. The firewall will with this target automatically **SNAT** and **De-SNAT** the packets, hence making it possible to make connections from the LAN to the Internet. If you're network uses 192.168.x.x netmask for example, the packets would never get back from the Internet because these networks are regulated to be used in LAN's by IANA.

The **MASQUERADE** target is used in exactly the same way as **SNAT**, but the **MASQUERADE** target takes a little bit more overhead to compute. The reason for this is that each time that the **MASQUERADE** target gets hit by a packet, it automatically checks for the IP address to use, instead of doing as the **SNAT** target does and just use an IP address submitted while the rule was parsed. The **MASQUERADE** target will on the other hand work properly with Dynamic IP addresses that you may be provided when you connect to the Internet with, for example PPP, SLIP or DHCP.

Filter table

The filter table is, of course, mainly used for filtering packets. We can match packets and filter them however we want, and there is nothing special to this chain or special packets that might slip through because they are malformed, etc. This is the place that we actually take action against packets and look at what they contain and **DROP**/**ACCEPT** depending on their payload. Of course we may do filtering earlier too, however, this is the place that was designed for it. Almost all targets are usable in this chain, however, the targets discussed previously in this chapter are only usable in their respective tables. We will not go into deeper discussion about this table though, as you already know, this is where we (should) do the main filtering.

---

rc.firewall file

This chapter will deal with an example firewall setup and how the script file could look. We have used one of the basic setups and dug deeper into how it works and what we do in it. This should be used to get a basic idea on how to solve different problems and what you may need to think about before actually putting your scripts into work. It could be used as is with some changes to the variables, but is not suggested since it may not work perfectly together with your network setup. As long as you have a very basic setup however, it will very likely run quite smooth with just a few fixes to it.

Note: note that there might be more efficient ways of making the ruleset, however, the script has been written for readability so that everyone can understand it without having to know too much BASH scripting before reading this

---

example rc.firewall

Ok, so you have everything set up and are ready to check out an example configuration script. You should at least be if you have come this far. This example rc.firewall.txt (also included in the *Example scripts codebase*appendix) is fairly large but not a lot of comments in it. Instead of looking for comments, I suggest you read through the script file to get a basic hum about how it looks, and then you return here to get the nitty gritty about the whole script.

---

explanation of rc.firewall

Configuration options

The first section you should note within the example rc.firewall.txt is the configuration section. This should always be changed since it contains the information that is vital to your actual configuration. For example, your IP address will always change, hence it is available here. The **$INET_IP** should always be a fully valid IP address, if you got one (if not, then you should probably look closer at the *rc.DHCP.firewall.txt*, however, read on since this script will introduce a lot of interesting stuff anyways). Also, the **$INET_IFACE** variable should point to the actual device used for your internet connection. This could be eth0, eth1, ppp0, tr0, etcetera just to name a few possible device names.

This script does not contain any special configuration options for DHCP or PPPoE, hence these sections are empty. The same goes for all sections that are empty, they are however left there so you can spot the differences between the scripts in a more efficient way. If you need these parts, then you could always create a mix of the different scripts, or (hold yourself) create your own from scratch.

The Local Area Network section contains most of the configuration options for your LAN, which are necessary. For example, you need to specify the IP address of the physical interface connected to the LAN as well as the IP range which the LAN uses and the interface that the box is connected to the LAN through.

Also, as you may see there is a Localhost configuration section. We do provide it, however you will with 99% certainty not change any of the values within this section since you will almost always use the 127.0.0.1 IP address and the interface will amost certainly be named lo. Also, just below the Localhost configuration, you will find a brief section that pertains to the iptables. Mainly, this section only consists of the **$IPTABLES** variable, which will point the script to the exact location of the

iptables application. This may vary a bit, and the default location when compiling the iptables package by hand is `/usr/local/sbin/iptables`. However, many distributions put the actual application in another location such as `/usr/sbin/iptables` and so on.

Initial loading of extra modules

First, we see to it that the module dependencies files are up to date by issuing an **/sbin/depmod -a** command. After this we load the modules that we will require for this script. Always avoid loading modules that you do not need, and if possible try to avoid having modules lying around at all unless you will be using them. This is for security reasons, since it will take some extra effort to make additional rules this way. Now, for example, if you want to have support for the `LOG`, **REJECT** and **MASQUERADE** targets and don't have this compiled statically into your kernel, we load these modules as follows:

/sbin/insmod ipt_LOG
/sbin/insmod ipt_REJECT
/sbin/insmod ipt_MASQUERADE

Next is the option to load `ipt_owner` module, which could for example be used to only allow certain users to make certain connections, etcetera. I will not use that module in this example but basically, you could allow only root to do FTP and HTTP connections to redhat and **DROP** all the others. You could also disallow all users but your own user and root to connect from your box to the Internet, might be boring for others, but you will be a bit more secure to bouncing hacker attacks and attacks where the hacker will only use your host as an intermediate host. For more information about the ipt_owner match, look at the *Owner match* section within the *How a rule is built* chapter.

We may also load extra modules for the state matching code here. All modules that extend the state matching code and connection tracking code are called ip_conntrack_* and ip_nat_*. Connection tracking helpers are special modules that tells the kernel how to properly track the specific connections. Without these so called helpers, the kernel would not know what to look for when it tries to track specific connections. The NAT helpers on the other hand, are extensions of the connection tracking helpers that tells the kernel what to look for in specific packets and how to translate these so the connections will actually work. For example, FTP is a complex protocol by definition, and it sends connection information within the actual payload of the packet. So, if one of your hosts NAT'ed boxes connect to a FTP server on the internet, it will send its own local network IP address within the payload of the packet, and tells the FTP server to connect to that IP address. Since this local network address is not valid outside your own network, the FTP server will not know what to do with it and hence the connection will break down. The FTP NAT helpers do all of the translations within these connections so the FTP server will actually know where to connect. The same thing applies for DCC file transfers (sends) and chats. Creating these kind of connections requires the IP address and ports to be sent within the IRC protocol, which in turn requires some translation to be done. Without these helpers, some FTP and IRC stuff will work no doubt, however, some other things will not work. For example, you may be able to receive files over DCC, but not be able to send files. This is due to how the DCC starts a connection. First off, you tell the receiver that you want to send a file and where he should connect to. Without the helpers, the DCC connection will look as if it wants the receiver to connect to some host on the receivers own local network. In other words, the whole connection will be broken. However, the other way around, it will work flawlessly since the sender will (most probably) give you the correct address to connect to.

As of this writing, there is only the option to load modules which add support for the FTP and IRC protocols. For a long explanation of these conntrack and nat modules, read the *Common problems and questionmarks* appendix. There are also H.323 conntrack helpers within the patch-o-matic, as well as some other conntrack helpers. To be able to use these helpers, you need to use the patch-o-matic and compile your own kernel. For a better explanation on how this is done, read the *Preparations* chapter.

Note that you need to load the ip_nat_irc and ip_nat_ftp if you want Network Adress Translation to work properly on any of the FTP and IRC protocols. You will also need to load the ip_conntrack_irc and ip_conntrack_ftp modules before actually loading the NAT modules. They are used the same way as the conntrack modules, but it will make it possible for the computer to do NAT on these two protocols.

---

proc set up

At this point we start the IP forwarding by echoing a 1 to `/proc/sys/net/ipv4/ip_forward` in this fashion:

echo "1" > /proc/sys/net/ipv4/ip_forward

It may be worth a thought where and when we turn on the IP forwarding. In this script and all others within the tutorial, we turn it on before actually creating any kind of IP filters (ie, **iptables** rulesets). This will lead to a brief period of time where the firewall will accept forwarding any kind of traffic for everything between a millisecond to a minute depending on what script we are running and on what box. This may give malicious people a small timeframe to actually get through our firewall. In other words, this option should really be turned on *after* creating all firewall rules, however, I have chosen to turn it on here to maintain consistency with the script breakdown currently user.

In case you need dynamic IP support, for example if you use SLIP, PPP or DHCP you may enable the next option, `ip_dynaddr` by doing the following :

echo "1" > /proc/sys/net/ipv4/ip_dynaddr

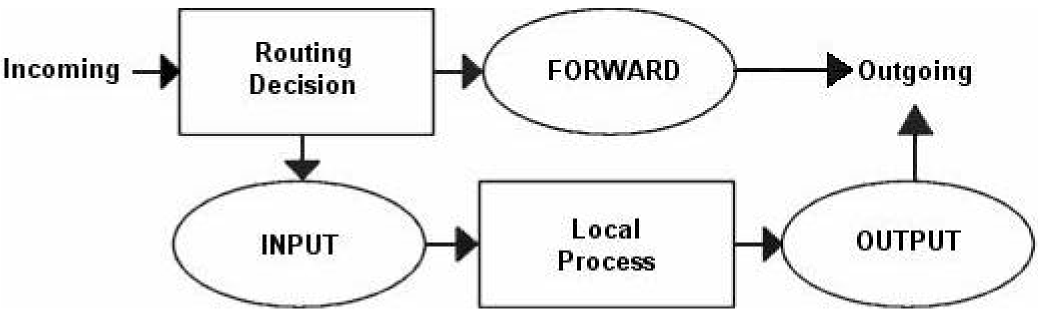
If there is any other options you might need to turn on you should follow that style, there's other documentations on how to do these things and this is out of the scope of this documentation. There is a good but rather brief document about the proc system available within the kernel, which is also available within the *Other resources and links* appendix. Also, it may be worth looking at that appendix in the future, in case there are possible additional links added to other and better resources of information.

Note: The `rc.firewall.txt` script, and all others contained within this tutorial, do contain a small section of non-required proc settings. These may be a good starters to look at, however, do not turn these on before actually knowing what they mean.

Displacement of rules to different chains

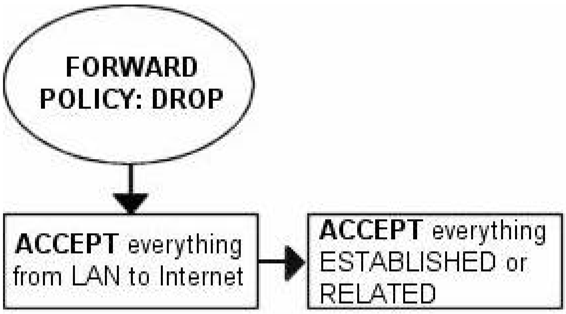
This section will briefly describe my choices within the tutorial regarding user specified chains and some choices specific to the `rc.firewall.txt` script. Some of the paths I have chosen to go here may be wrong from one or another of aspect. I hope to point these aspects and possible problems out to you when and where they occur. Also, this section contains a brief look back to the *Traversing of tables and chains* chapter. Hopefully, this will remind you a little bit of how the specific tables and chains are traversed in a real live example.

I have displaced all the different user-chains in the fashion I have to save as much CPU as possible but at the same time put the main weight on security and readability. Instead of letting a TCP packet traverse ICMP, UDP and TCP rules, I simply match all TCP packets and then let the TCP packets traverse an user specified chain. This way we do not get too much overhead out of it all. The following picture will try to explain the basics of how an incoming packet traverses netfilter. With these pictures and explanations, I wish to explain and clarify the goals of this script. We will not discuss any specific details yet, but instead further on in the chapter. This is a really trivial picture in comparison to the one in the *Traversing of tables and chains* chapter where we discussed the whole traversal of chains and tables in depth.

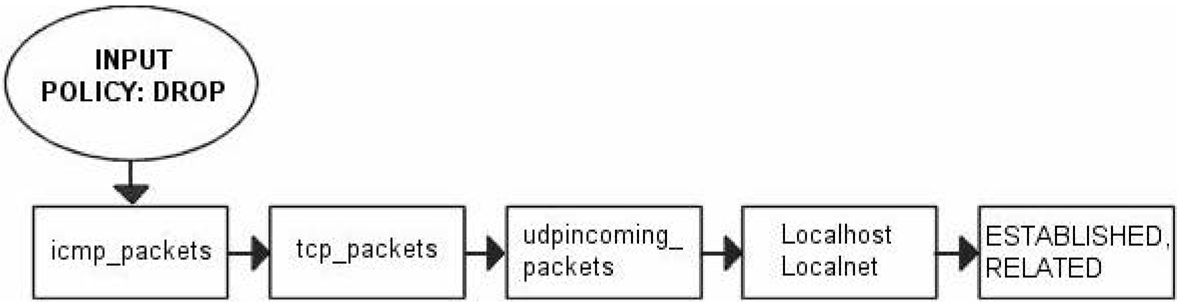


Based upon this picture, let's make clear what our goals are. This whole example script is based upon the assumption that we are looking at a scenario containing one local network, one firewall and an Internet connection connected to the firewall. This example is also based upon the assumption that we have a static IP to the internet (as opposed to DHCP, PPP and SLIP and others). In this case, we also want to allow the firewall to act as a server for certain services on the internet, and we trust our local network fully and hence we will not block any of the traffic from the local network. Also, this script has as a main priority to only allow traffic that we explicitly want to allow. To do this, we want to set default policies within the chains to DROP. This will effectively kill all connections and all packets that we do not explicitly allow inside our network or our firewall.

In the case of this scenario, we would also like to let our local network do connections to the internet. Since the local network is fully trusted, we want to allow all kind of traffic from the local network to the internet. However, the Internet is most definitely not a trusted network and hence we want to block them from getting to our local network. Based upon these general assumptions, let's look at what we need to do and what we do not need to do.



First of all, we want the local network to be able to connect to the internet, of course. To do this, we will need to NAT all packets since none of the local computers have real IP addresses. All of this is done within the PREROUTING chain, which is created last in this script. This means that we will also have to do some filtering within the FORWARD chain since we will otherwise allow outsiders full access to our local network. We trust our local network to the fullest, and because of that we specifically allow all traffic from our local network to the internet. Since noone on the Internet should be allowed to contact our local network computers, we will want to block all traffic from the Internet to our local network except already established and related connections, which in turn will allow all return traffic from the Internet to our local network.

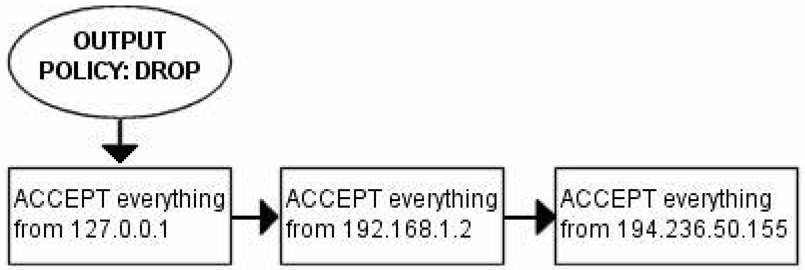


As for our firewall, we may be a bit low on funds perhaps, or we just want to offer a few services to people on the internet. Therefore, we have decided to allow HTTP, FTP, SSH and IDENTD access to the actual firewall. All of these protocols are available on the actual firewall, and hence it should be allowed through the INPUT chain, and we need to allow the return traffic through the OUTPUT chain. However, we also trust the local network fully, and the loopback device and IP address are also trusted. Because of this, we want to add special rules to allow all traffic from the local network as well as the loopback network interface. Also, we do not want to allow specific packets or packet headers in specific conjunctions, nor do we want to allow some IP ranges to reach the firewall from the Internet. For instance, the 10.0.0.0/8 address range is reserved for local networks and hence we would normally not want to allow packets from such a address range since they would with 90% certainty be spoofed. However, before we implement this, we must note that certain Internet Service Providers actually use these address ranges within their own networks. For a closer discussion of this, read the *Common problems and questionmarks* chapter.

Since we have an FTP server running on the server, as well as the fact we want to traverse as few rules as possible, we add a rule which lets all established and related traffic through at the top of the INPUT chain. For the same reason, we want to split the rules down into subchains. By doing this, our packets will hopefully only need to traverse as few rules as possible. By traversing less rules, we make the ruleset less timeconsuming for each packet, and reduce redundancy within the network.

In this script, we choose to split the different packets down by their protocol family, for example TCP, UDP or ICMP. All TCP packets traverse a specific chain named tcp_packets, which will contain rules for all TCP ports and protocols that we want to allow. Also, we want to do some extra checking on the TCP packets, so we would like to create one more subchain for all packets that are accepted for using valid port numbers to the firewall. This chain we choose to call the "allowed" chain, and should contain a few extra checks before finally accepting the packet. As for ICMP packets, these will traverse the icmp_packets chain. When we decided on how to create this chain, we could not see any specific needs for extra checks before allowing the ICMP packets through if we agree with the type and code of the ICMP packet, and hence we accept the directly. Finally, we have the UDP packets which needs to be dealt with. These packets, we send to the udp_packets chain which handles all incoming UDP packets. All incoming UDP packets should be sent to this chain, and if they are of an allowed type we should accept them immediately without any further checking.

Since we are running on a relatively small network, this box is also used as a secondary workstation and to give some extra levy for this, we want to allow certain specific protocols to make contact with the firewall itself, such as speak freely and ICQ.



Finally, we have the firewalls OUTPUT chain. Since we actually trust the firewall quite a lot, we allow pretty much all traffic leaving the firewall. We do not do any specific user blocking, nor do we do any blocking of specific protocols. However, we do not want people to use this box to spoof packets leaving the firewall itself, and hence we only want to allow traffic from the IP addresses assigned to the firewall itself. We would most likely implement this by adding rules that ACCEPT all packets leaving the firewall in case they come from one of the IP addresses assigned to the firewall, and if not they will be dropped by the default policy in the OUTPUT chain.

Setting up the different chains used

So, now you got a small picture on how the packet traverses the different chains and how they belong together. You should also have a clear picture of the goals of this script. It is now about time that we take care of setting up all the rules and chains that we wish to create and to use, as well as all of the rulesets within the chains.

First of all, we set all the default policies on the different chains with a quite simple command.

iptables -P <chain name> <policy>

The default policy is used every time the packets don't match a rule in the chain. After this, we create the different special chains that we want to use with the **-N** command. The new chains are created and set up with no rules inside of them. The chains we will use are icmp_packets, tcp_packets, udpincoming_packets and the allowed chain for tcp_packets. Incoming packets on eth0, of ICMP type, will be redirected to the chain icmp_packets, of TCP type, will be redirected to tcp_packets and incoming packets of UDP type from eth0 go to udpincoming_packets chain.

INPUT chain

The INPUT chain as I've written it uses mostly other chains to do the hard work. This way we don't get too much load from the iptables, and it will work much better on slow machines which might otherwise drop packets at high loads.

We do certain checks for bad packets here. If you want to fully understand this, you need to look at the Appendices regarding state NEW and non-SYN packets getting through other rules. These packets could be allowed under certain circumstances but in 99% of the cases we wouldn't want these packets to get through. Hence, we log them to our logs and then we DROP them.

First of all we match all ICMP packets in the INPUT chain that come on the incoming interface **$INET_IFACE**, which in my case is eth0, and send those to the `icmp_packets`, which was previously described. After this, we do the same match for TCP packets on the **$INET_IFACE** and send those to the tcp_packets chain, and after this all UDP packets get sent to udpincoming_packets chain.

Finally, we check for everything that comes from our **$LOCALHOST_IP**, which would normally be 127.0.0.1 and **ACCEPT** all incoming traffic from there, do the same for everything to **$LAN_IP**, which in my case would be 192.168.0.0/24, and after this, something that some might consider a security problem, I allow everything that comes from my own Internet IP that is either **ESTABLISHED** or **RELATED** to some connection. Also, we allow broadcast traffic from our LAN. some applications depend on it such as Samba etc. These applications will not work properly without it.

Before we hit the default policy of the INPUT chain, we log it so we might be able to find out about possible problems and or bugs. Either it might be a packet that we just dont want to allow or it might be someone who's doing something bad to us, or finally it might be a problem in our firewall not allowing traffic that should be allowed. In either case we want to know about it so it can be dealt with. Though, we don't log more than 3 packets per minute as to not getting flooded with crap all over the log files, also we set a prefix to all log entries so we know where it came from.

Everything that hasn't yet been caught will be **DROP**'ed by the default policy on the INPUT chain. The default policy was set quite some time back, as you might remember.

The TCP allowed chain

If a packet comes in on eth0 and is of TCP type, it travels through the tcp_packets chain, if the connection is against an allowed port, we want to do some final checks on it to see if we actually do want to allow it or not.

First of all, we create the chain the same way as all the others. After that, we check if the packet is a SYN packet. If it is a SYN packet, it is most likely to be the first packet in a new connection so, of course, we allow this. Then we check if the packet comes from an **ESTABLISHED** or **RELATED** connection, if it does, then we, again of course, allow it. An **ESTABLISHED** connection is a connection that has seen traffic in both directions, and since we've got a SYN packet, and a reply to this SYN packet, the connection then must be in state **ESTABLISHED**. The last rule in this chain will **DROP** everything else. In this case this pretty much means everything that hasn't seen traffic in both directions, ie, we didn't reply to the SYN packet, or they are trying to start the connection with a non SYN packet. There is *no* practical use of not starting a connection with a SYN packet, except to portscan people pretty much. There is no currently available TCP/IP implementation that supports opening a TCP connection with something else than a SYN packet to my knowledge, hence, **DROP** the crap since it's 99% sure to be a portscan.

The ICMP chain

This is where we decide what ICMP types to allow. If a packet of ICMP type comes in on eth0 on the INPUT chain, we then redirect it to the `icmp_packets` chain as explained before. Here we check what kind of ICMP types to allow. As it is now, I only allow incoming ICMP Echo Replies, Destination unreachable, Redirect and Time Exceeded.

The reason that I allow these ICMP packets are as follows, Echo Replies is what you get for example when you ping another host, if we don't allow this, we will be unable to ping other hosts.

Destination Unreachable is used if a certain host is unreachable, so for example if we send a HTTP request, and the host is unreachable, the last gateway that was unable to find the route to the host replies with a Destination Unreachable telling us that it was unable to find it. This way we won't have to wait until the browser's timeouts kicks in after some 60 seconds or more.

Time Exceeded, is allowed in the case where we might want to traceroute some host or if a packet gets its Time To Live set to 0, we will get a reply about this. For example, when you traceroute someone, you start out with TTL = 1, and it gets down to 0 at the first hop on the way out, and a Time Exceeded is sent back from the first gateway en route to the host we're trying to traceroute, then TTL = 2 and the second gateway sends Time Exceeded, and so on until we get an actual reply from the host we finally want to get to.

For a complete listing of all ICMP types, see the appendix ICMP types. For more information on ICMP types and their usage, i suggest reading the following documents and reports :

- The Internet Control Message Protocol ICMP
- RFC 792 - Internet Control Message Protocol by J. Postel.

As a side-note, I might be wrong in blocking some of these ICMP types for you, but in my case, everything works perfectly while blocking all the other ICMP types that I don't allow.

The TCP chain

So now we reach TCP connections. This specifies what ports that are allowed to use on the firewall from the Internet. Though, there is still more checks to do, hence we send each and one of them on to allowed chain, which we described previously.

-A tcp_packets tells **iptables** in which chain to add the new rule, the rule will be added to the end of the chain. **-p TCP** tells it to match TCP packets and **-s 0/0** matches all source addresses from 0.0.0.0 with netmask 0.0.0.0, in other words *all* sources addresses, this is actually the default behaviour but I'm using it for brevity in here. **--dport 21** means destination port 21, in other words if the packet is destined for port 21 they also match. If all the criteria are matched, then the packet will be targeted for the allowed chain. If it doesn't match any of the rules, they will be passed back to the original chain that sent the packet to the tcp_packets chain.

As it is now, I allow TCP port 21, or FTP control port, which is used to control FTP connections and later on I also allow all **RELATED** connections, and that way we allow PASSIVE and PORT connections since the ip_conntrack_ftp module is, hopefully, loaded. If we don't want to allow FTP at all, we can unload the ip_conntrack_ftp module and delete the **$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed** line from the `rc.firewall.txt` file.

Port 22 is SSH, much better than allowing telnet on port 23, if you want to allow anyone from the outside to use a shell on your box at all. Note that you are dealing with a firewall. It is always a bad idea to give others than yourself any kind of access to these kind of boxes. Firewalls should always be kept to a bare minimum and not more.

Port 80 is HTTP, in other words your web server, delete it if you don't want to run a web server on your site.

And finally we allow port 113, which is IDENTD and might be necessary for some protocols like IRC, etc to work properly.

If you feel like adding more open ports with this script, well, its quite self explanatory how to do that by now=).

The UDP chain

If we do get a UDP packet on the INPUT chain, we send them on to udpincoming_packets where we once again do a match for the UDP protocol with **-p UDP** and then match everything with a source address of 0.0.0.0 and netmask 0.0.0.0, in other words everything again. If they have a source port of 53 also, we **ACCEPT** them directly.

As it is now, I **ACCEPT** incoming UDP packets from port 53, which is what we use to do DNS lookups, without this we wouldn't be able to do domain name lookups and we would be reversed to only use IP's. We don't want this behaviour, hence we allow DNS, of course.

I personally also allow port 123, which is NTP or network time protocol. This protocol is used to set your computer clock to the same time as certain other time servers which have *very* accurate clocks.

Though, most of you probably don't use this protocol, I'm allowing it per default since I know there are some who actually do.

We currently also allow port 2074, which is used for certain real-time `multimedia' applications like speak freely which you can use to talk to other people in real-time by using speakers and a microphone, or even better, a headset.

Port 4000 is the ICQ protocol. This should be an extremely well known protocol that is used by the Mirabilis application named ICQ. There is at least 5 different ICQ clones for Linux and it's one of the most widely used chat programs in the world. I doubt there is any further need to explain what it is.

OUTPUT chain

Since i know that there's pretty much no one but me using this box which is partially used as a Firewall and a workstation currently, I allow pretty much everything that goes out from it that has a source address **$LOCALHOST_IP**, **$LAN_IP** or **$STATIC_IP**. Everything else might be spoofed in some fashion, even though I doubt anyone that I know would do it on my box. Last of all we log everything that gets dropped. If it does get dropped, we'll sure as hell want to know about it for some reason or another. Either it's a nasty error, or it's a weird packet that's spoofed. Finally we **DROP** the packet in the default policy.

FORWARD chain

Even though I haven't actually set up a certain section in the `rc.firewall.txt` example file, I would like to comment on the few lines in there anyways. As it is now, we first of all **ACCEPT** all packets coming from our LAN with the following line:

/usr/local/sbin/iptables -A FORWARD -i $LAN_IFACE -j ACCEPT

So everything from our Localnet's interface gets **ACCEPT**'ed whatever the circumstances. After this we allow everything in a state **ESTABLISHED** or **RELATED** from everywhere, in other words, if we open a connection from our LAN to something on the Internet, we allow the packets coming back from that site that's either **ESTABLISHED** or **RELATED** but nothing else. And after this we log everything and drop it. We log maximally 3 log entries per minute as to not flood our own logs, and prefix them with a short line that is possible to grep for in the logfiles. Also we log them with debug level. We finally hit the default policy of the FORWARD chain that says to **DROP** everything.

PREROUTING chain of the nat table

The PREROUTING chain is pretty much what it says, it does network adress translation on packets before they actually hit the routing tables that sends them onwards to the INPUT or FORWARD chains in the filter table. Note that this chain should not be used for any filtering or such, it should be used for network adress translation, among other things since this chain is only traversed by the first packet in a stream.

First of all we check for obviously spoofed IP addresses, such as in case we get packets from the Internet interface that claim to have a source IP of 192.168.x.x, 10.x.x.x or 172.16.x.x, in such case, we drop them quicker than hell since these IP's are reserved especially for local intranets and definitely shouldn't be used on the Internet. This might be used in the opposite direction, too, if we get an packet from `$LAN_IFACE` that claims to *not* come from an IP address in the range which we know that our LAN is on, we might drop that too. As it looks now, we don't do that though.

Starting the Network Address Translation

So, our final mission would be to get the **MASQUERADE**ing up, correct? At least to me. First of all we add a rule to the nat table, in the POSTROUTING chain that will masquerade all packets going out on our interface connected to the Internet. For me this would be eth0. However, there are specific variables added to these example scripts that may be used to automatically configure these settings. These settings are widely used within the example scripts, mainly to make them easier to configure, but also to improve the readability a bit. The **-t** option tells us which table to use, in this case nat while the **-A** command tells us that we want to Add a new rule to an existing chain named POSTROUTING and **-o $INET_IFACE** tells us to match all outgoing packets on **INET_IFACE** (or eth0, per default settings in this script) and finally we target the packet for **MASQUERADE**'ing. So all packets that match this rule will be masqueraded to look as it came from your Internet interface. Simple, isn't it?

The next step we take is to **ACCEPT** all packets traversing the FORWARD chain in the default table filter that come from the input interface eth1 which is my interface connecting to the internal network. All packets that are being forwarded on our box traverse the FORWARD chain in the filter table.

The next thing we do is to **ACCEPT** all packets from anywhere that are **ESTABLISHED** and/or **RELATED** to some connection. In other words, we first send a packet from our local box behind eth1, and since it comes from eth1 we **ACCEPT** it, then when the Internet box replies, it gets caught by this rule since the connection has seen packets in both directions.

The last thing we do is to log all traffic that gets dropped over the border, and hits the default policy. In some cases these might be packets that should have gotten through but didn't, in other cases it might be packets that definitely shouldn't get through and you want to be notified about this. We allow this rule to be matched a maximum of 3 times per minute with a burst limit of 3. This means we get maximally 3 log entries per minute from this specific line, and the burst is also set to 3 so if we get 3 log entries in 2 seconds, it'll have to wait for another 1 minute for the next log entry. This is good if someone starts to flood you with crap stuff that otherwise would generate many megabytes of logs. We also set a prefix to the log with the **--log-prefix** and set the log level with the **--log-level**. Log level tells the **syslogd**, or logging facility what kind of importance this log entry has.

Example scripts

The objective of this chapter is to give a fairly brief and short explanation of each script available with this tutorial, and to provide an overlook of the scripts and what services they provide. These scripts are not in any way perfect, and they may not fit your exact intentions perfectly. It is in other words up to you to make these scripts suitable for your needs. The rest of this tutorial should most probably be helpful in making this feat. The first section of this tutorial deals with the actual structure that I have established in each script so we may find our way within the script a bit easier.

---

rc.firewall.txt script structure

All scripts written for this tutorial has been written after a specific structure. The reason for this is that they should be fairly conformative to each other and to make it easier to find the differences between the scripts. This structure should be fairly well documented in this brief chapter. This chapter should hopefully give a short understanding to why all the scripts has been written as they have, and why I have chosen to maintain this structure.

Note: Even though this is the structure I have chosen, do note that this may not be the best structure for your scripts. It is only a structure that I have chosen to use since it fits the need of being easy to read and follow the best according to my logic.

The structure

This is the structure that all scripts in this tutorial should follow. If they differ in some way it is probably an error on my part, unless it is specifically explained why I have broken this structure.

1. *Configuration* - First of all we have the configuration options which the rest of the script should use. Configuration options should pretty much always be the first thing in any shell-script.

    1. *Internet* - This is the configuration section which pertains to the Internet connection. This could be skipped if we do not have any Internet connection. Note that there may be more subsections than those listed here, but only such that pertains to our Internet connection.

        1. *DHCP* - If there are possibly any special DHCP requirements with this specific script, we will add the DHCP specific configuration options here.

        2. *PPPoE* - If there are a possibility that the user that wants to use this specific script, and if there are any special circumstances that raises the chances that he is using a PPPoE connection, we will add specific options for those here.

    2. *LAN* - If there is any LAN available behind the firewall, we will add options pertaining to that in this section. This is most likely, hence this section will almost always be available.

    3. *DMZ* - If there is any reason to it, we will add a DMZ zone configuration at this point. Most scripts lacks this section, mainly because any normal home network, or small corporate network, will not have one.

    4. *Localhost* - These options pertain to our localhost. These variables are highly unlikely to change, but we have put most of it into variables anyway. Hopefully, there should be no reason to change these variables.

   5. *iptables* - This section contains iptables specific configuration. In most scripts and situations this should only require one variable which tells us where the iptables binary is located.

   6. *Other* - If there are any other specific options and variables, they should first of all be fitted into the correct subsection (If it pertains to the Internet connection, it should be subsectioned there, etcetera). If it does not fit in anywhere, it should be subsectioned directly to the configuration options somewhere.

3. *Module loading* - This section of the scripts should maintain a list of modules. The first part should contain the required modules, while the second part should contain the non-required modules.

   > Note that some modules that may raise security, or add certain services or possibilities, may have been added even though they are not required. This should normally be noted in such cases within the example scripts.

   1. *Required modules* - This section should contain the required modules, and possibly special modules that adds to the security or adds special services to the administrator or clients.

   2. *Non-required modules* - This section contains modules that are not required for normal operations. All of these modules should be commented out per default, and if you want to add the service it provides, it is up to you.

4. *proc configuration* - This section should take care of any special configuration needed in the proc filesystem. If some of these options are required, they will be listed as such, if not, they should be commented out per default, and listed under the non-required proc configurations. Most of the useful proc configurations will be listed here, but far from all of them.

   1. *Required proc configuration* - This section should contain all of the required proc configurations for the script in question to work. It could possibly also contain configurations that raises security, and possibly which adds special services or possibilities for the administrator or clients.

   2. *Non-required proc configuration* - This section should contain non-required proc configurations that may prove useful. All of them should be commented out, since they are not actually necessary to get the script to work. This list will contain far from all of the proc configurations or nodes.

5. *rules set up* - By now the scripts should most probably be ready to insert the ruleset. I have chosen to split all the rules down after table and then chain names. All user specified chains are created before we do anything to the system builtin chains. I have also chosen to set the chains and their rulespecifications in the same order as they are output by the **iptables -L** command.

1. *Filter table* - First of all we go through the filter table and its content. First of all we should set up all the policies in the table.

    1. *Set policies* - Set up all the default policies for the systemchains. Normally I will set DROP policies on the chains in the filter table, and specifically ACCEPT services and streams that I want to allow inside. This way we will get rid of all ports that we do not want to let people use.

    2. *Create user specified chains* - At this point we create all the user specified chains that we want to use later on within this table. We will not be able to use these chains in the systemchains anyways if they are not already created so we could as well get to it as soon as possible.

    3. *Create content in user specified chains* - After creating the user specified chains we may as well enter all the rules within these chains. The only reason I have to enter this data at this point already is that may as well put it close to the creation of the user specified chains. You may as well put this later on in your script, it is totally up to you.

    4. *INPUT chain* - When we have come this far, we do not have a lot of things left to do within the filter table so we get onto the INPUT chain. At this point we should add all rules within the INPUT chain.

        Note: At this point we start following the output from the **iptables -L** command as you may see. There is no reason for you to stay with this structure, however, do try to avoid mixing up data from different tables and chains since it will become much harder to read such rulesets and to fix possible problems.

    5. *FORWARD chain* - At this point we go on to add the rules within the FORWARD chain. Nothing special about this decision.

    6. *OUTPUT chain* - Last of all in the filter table, we add the rules dealing with the OUTPUT chain. There should hopefully not be too much to do at this point.

2. *nat table* - After the filter table we take care of the nat table. This is done after the filter table because of a number of reasons within these scripts. First of all we do not want to turn the whole forwarding mechanism and NAT function on at a too early stage, which could possibly lead to packets getting through the firewall at just the wrong timepoint (ie, when the NAT has been turned on, but none of the filter rules has been run). Also, I look upon the nat table as a sort of layer that lies just outside the filter table and kind of surrounds it. The filter table would hence be the core, while the nat table acts as a layer lying around the filter table, and finally the mangle table lies around the nat table as a second layer. This may be wrong in some perspectives, but not too far from reality.

    1. *Set policies* - First of all we set up all the default policies within the nat table. Normally, I will be satisfied with the default policy set from the beginning, namely the ACCEPT policy. This table should not be used for filtering anyways, and we

should not let packets be dropped here since there are some really nasty things that may happen in such cases due to our own presumptions. I let these chains be set to ACCEPT since there is no reason not to do so.

3. *Create user specified chains* - At this point we create any user specified chains that we want within the nat table. Normally I do not have any of these, but I have added this section anyways, just in case. Note that the user specified chains must be created before they can actually be used within the systemchains.

4. *Create content in user specified chains* - By now it should be time to add all the rules to the user specified chains in the nat table. The same thing goes here as for the user specified chains in the filter table. We add this material here since I do not see any reason not to.

5. *PREROUTING chain* - The PREROUTING chain is used to do DNAT on packets in case we have any need for it. In most scripts this feature is not used, or at the very least commented out, reason being that we do not want to open up big holes to our local network without knowing about it. Within some scripts we have this turned on by default since the sole purpose of those scripts are to provide such services.

6. *POSTROUTING chain* - The POSTROUTING chain should be fairly well used by the scripts I have written since most of them depend upon the fact that you have one or more local networks that we want to firewall against the Internet. Mainly we will try to use the SNAT target, but in certain cases we are forced to use the MASQUERADE target instead.

7. *OUTPUT chain* - The OUTPUT chain is barely used at all in any of the scripts. As it looks now, it is not broken, but I have been unable to find any good reasons to use this chain so far. If anyone has a reason to use this chain, send me a line and I will add it to the tutorial.

4. *mangle table* - The last table to do anything about is the mangle table. Normally I will not use this table at all, since it should normally not be used for anyone, unless they have specific needs, such as masking all boxes to use the exact same TTL or to change TOS fields etcetera. I have in other words chosen to leave these parts of the scripts more or less blank, with a few exceptions where I have added a few examples of what it may be used for.

   1. *Set policies* - Set the default policies within the chain. The same thing goes here as for the nat table pretty much. The table was not made for filtering, and hence you should avoid it all together. I have not set any policies in any of the scripts in the mangle table one way or the other, and you are encouraged not to do so either.

   2. *Create user specified chains* - Create all the user specified chains. Since I have barely used the mangle table at all in the scripts, I have neither created any chains here since it is fairly unusable without any data to use within it. However, this section was added just in case someone, or I, would have the need for it in the future.

3. *Create content in userspecified chains* - If you have any user specified chains within this table, you may att this point add the rules that you want within them here.

4. *PREROUTING* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

5. *INPUT chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

6. *FORWARD chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

7. *OUTPUT chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

8. *POSTROUTING chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

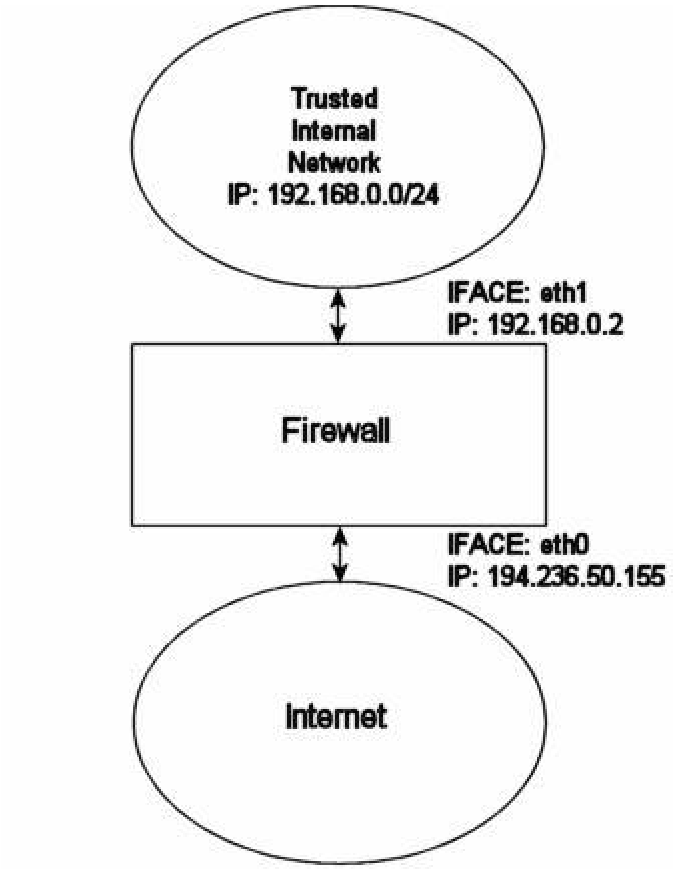
Hopefully this should explain more in detail how each script is structured and why they are structured in such a way.

Caution

Do note that these descriptions are extremely brief, and should mainly just be seen as a brief explanation to what and why the scripts has been split down as they have. There is nothing that says that this is the only and best way to go.

---

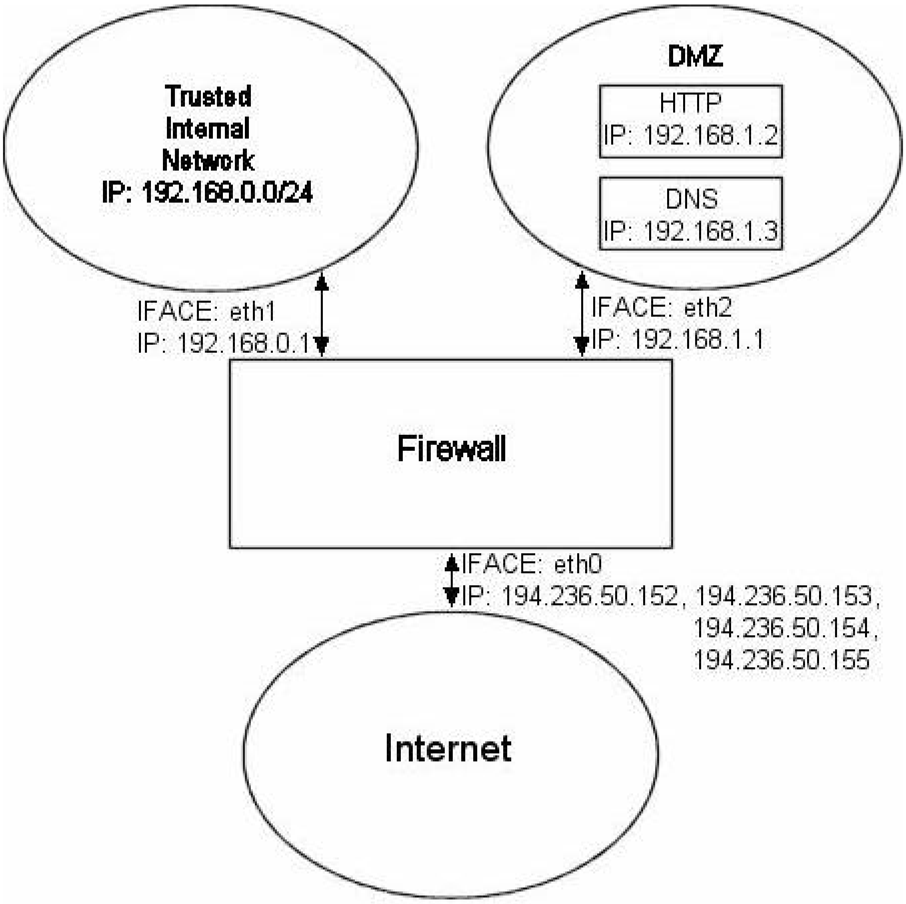
rc.firewall.txt



The rc.firewall.txt script is the main core on which the rest of the scripts are based upon. The *rc.firewall file* chapter should explain every detail in the script most thoroughly. Mainly it was written for a dual homed network. For example, where you have one LAN and one Internet Connection. This script also makes the assumption that you have a static IP to the Internet, and hence don't use DHCP, PPP, SLIPor some other protocol that assigns you an IP automatically. If you are looking for a script that will work with those setups, please take a closer look at the *rc.DHCP.firewall.txt* script.

---

rc.DMZ.firewall.txt



The rc.DMZ.firewall.txt script was written for those people out there that has one Trusted Internal Network, one De-Militarized Zone and one Internet Connection. The De-Militarized Zone is in this case 1-to-1 NAT'ed and requires you to do some IP aliasing on your firewall, ie, you must make the box recognise packets for more than one IP. There are several ways to get this to work, one is to set 1-to-1 NAT, another one if you have a whole subnet is to create a subnetwork, giving the firewall one IP both internally and externally. You could then set the IP's to the DMZ'ed boxes as you wish. Do note that this will "steal" two IP's for you, one for the broadcast address and one for the network address. This is pretty much up to you to decide and to implement, this tutorial will give you the tools to actually accomplish the firewalling and NAT'ing part, but it will not tell you exactly what you need to do since it is out of the scope of the tutorial.

You need to have two internal networks with this script as you can see from the picture. One uses IP range 192.168.0.0/24 and consists of a Trusted Internal Network. The other one uses IP range 192.168.1.0/24 and consists of the De-Militarized Zone which we will do 1-to-1 NAT to. For example, if someone from the internet sends a packet to our `DNS_IP`, then we use DNAT, which stands for Destination Network Adress Translation, to send the packet on to our DNS on the DMZ network. When the DNS sees our packet, the packet will be destined for the actual DNS internal network IP, and not to our external DNS IP. If the packet would not have been translated, the DNS wouldn't have answered the packet. We will show a short example of how the DNAT code looks:

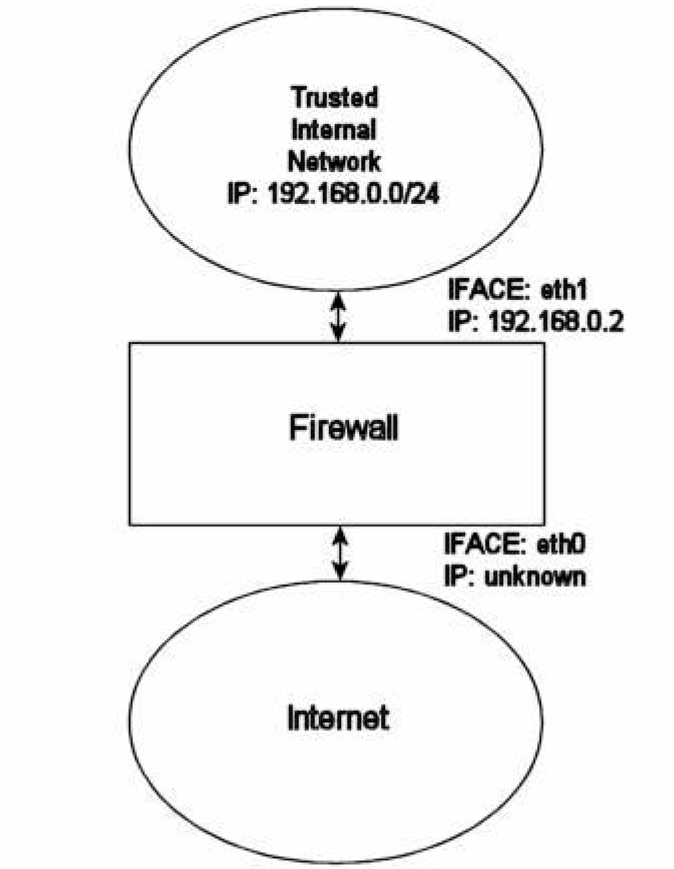
$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $DNS_IP --dport 53 -j DNAT --to-destination $DMZ_DNS_IP

First of all, DNAT can only be performed in the PREROUTING chain of the nat table. Then we look for TCP protocol on our `$INET_IFACE` with destination IP that matches our `$DNS_IP`, and is directed to port 53, which is the TCP port for zone transfers between DNS's. If we actually get such a packet we give a target of DNAT, in other words Destination NAT. After that we specify where we want the packet to go with the **--to-destination** option and give it the value of `$DMZ_DNS_IP`, in other words the IP of the DNS on our DMZ network. This is how basic DNAT works. When the reply to the DNAT'ed packet is sent through the firewall, it automatically gets un-DNAT'ed.

By now you should have enough understanding of how everything works to be able to understand this script pretty well without any huge complications. If there is something you don't understand, that hasn't been gone through in the rest of the tutorial, mail me since it is probably a fault on my side.

---

rc.DHCP.firewall.txt



The rc.DHCP.firewall.txt script is pretty much identical to the original *rc.firewall.txt*. However, this script no longer uses the **STATIC_IP** variable, which is the main change to the original rc.firewall.txt script. The reason is that this won't work together with a dynamic IP connection. The actual changes needed to be done to the original script is minimal, however, I've had some people mail me and ask about the problem so this script will be a good solution for you. This script will allow people who uses DHCP, PPP and SLIP connections to connect to the internet.

The main changes done to the script consists of erasing the `STATIC_IP` variable as I already said and deleting all referenses to this variable. Instead of using this variable the script now does it's main filtering on the variable `INET_IFACE`. In other words **-d $STATIC_IP** has been changed to **-i $INET_IFACE**. This is pretty much the only changes made and that's all that's needed really.

There is some more things to think about though. We can no longer filter in the INPUT chain depending on, for example, **--in-interface $LAN_IFACE --dst $INET_IP**. This in turn forces us to filter only based on interfaces in such cases where the internal machines must access the internet adressable IP. One great example is if we are running an HTTP on our firewall. If we go to the main page, which contains static links back to the same host, which could be some dyndns solution, we would get a real hard trouble. The NAT'ed box would ask the DNS for the IP of the HTTP server, then try to access that IP. In case we filter based on interface and IP, the NAT'ed box would be unable to get to the HTTP because the INPUT chain would **DROP** the packets flat to the ground. This also applies in a sense to the case where we got a static IP, but in such cases it could be gotten around by adding rules which checks the LAN interface packets for our `INET_IP`, and if so **ACCEPT** them.

As you may read from above, it may be a good idea to grab a script, or write one, that handles dynamic IP in a better sense. We could for example make a script that grabs the IP from **ifconfig** and adds it to a variable, upon bootup of the internet connection. A good way to do this, would e to use for example the `ip-up` scripts provided with **pppd** and some other programs. For a good site, check out the linuxguruz.org iptables site which has a huge collection of scripts available to download. You will find a link to the linuxguruz.org site from the *Other resources and links* appendix.

Note

This script might be a bit less secure than the `rc.firewall.txt` script. I would definitely advise you to use that script if at all possible since this script is more open to attacks from the outside.

Also, there is the possibility to add something like this to your scripts:

INET_IP=`ifconfig $INET_IFACE | grep inet | cut -d : -f 2 | cut -d \ -f 1`

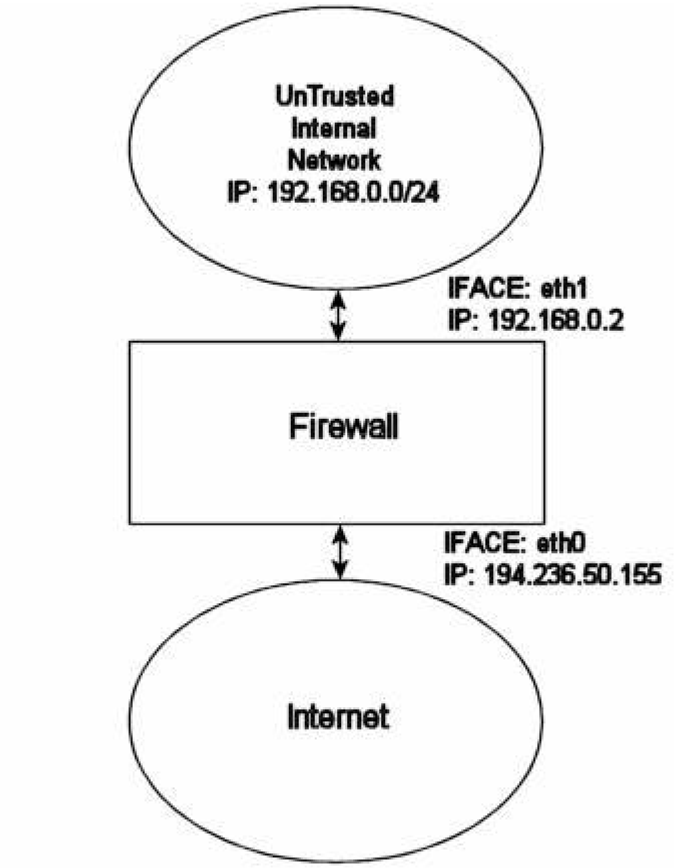
The above would automatically grab the IP address of the **$INET_IFACE** variable, grep the correct line which contains the IP address and then cuts it down to a manageable IP address. However, there are serious drawbacks with this approach, as described in the following list.

1. If the script is run from within a script which in turn is executed by, for example, the PPP daemon, it will hang all currently active connections due to the NEW not SYN rules (see the *State NEW packets but no SYN bit set* section). It is possible to get by, if you get rid of the NEW not SYN rules for example, but it is questionable.

2. If you got rules that are static and always want to be around, it is rather harsh to add and erase rules all the time, without hurting the already existing ones. For example, if you want to block hosts on your LAN to connect to the firewall, but at the same time operate a script from the PPP daemon, how would you do it without erasing your already active rules blocking the LAN?

3. It may get unnecessarily complicated, as seen above which in turn could lead to security compromises. If the script is kept simple, it is easier to spot problems, and to keep order in it.

rc.UTIN.firewall.txt



The rc.UTIN.firewall.txt script will in contrast to the other scripts block the LAN that is sitting behind us. In other words, we don't trust anyone on any networks we are connected to. We also disallow people on our LAN to do anything but specific tasks on the Internet. The only things we actually allow is POP3, HTTP and FTP access to the internet. We also don't trust the internal users to access the firewall more than we trust users on the Internet.

This script follows the golden rule to not trust anyone, not even our own employees. This is a sad fact, but a large part of the hacks and cracks that a company gets hit by is a matter of people from their own staff perpetrating the hit. This script will hopefully give you some clues as to what you can do with your firewall to strengthen it up. It's not very different from the original `rc.firewall.txt` script, but it does give a few hints at what we would normally let through etc.

rc.test-iptables.txt

The rc.test-iptables.txt script can be used to test all the different chains, but it might need some tweaking depending on your configuration, such as turning on **ip_forwarding**, and setting up masquerading etcetera. It will work for mostly everyone though who has all the basic set up and all the basic tables loaded into kernel. All it really does is set some **LOG** targets which will log ping reply's and ping requests. This way, you will get information on which chain was traversed and in which order. For example, run this script and then do:

ping -c 1 host.on.the.internet

And **tail -n 0 -f /var/log/messages** while doing the first command. This should show you all the different chains used and in which order, unless the log entries are swapped around for some reason.

Note: This script was written for testing purposes only. In other words, it's not a good idea to have rules like this that logs everything of one sort since your log partitions might get filled up quickly and it would be an effective Denial of Service attack against you and might lead to real attacks on you that would be unlogged after the initial Denial of Service attack.

---

rc.flush-iptables.txt

The rc.flush-iptables.txt script should not really be called a script in itself. The rc.flush-iptables.txt script will reset and flush all your tables and chains. The script starts by setting the default policies to **ACCEPT** on the INPUT, OUTPUT and FORWARD chains of the filter table. After this we reset the default policies of the PREROUTING, POSTROUTING and OUTPUT chains of the nat table. We do this first so we won't have to bother about closed connections and packets not getting through. This script is intended for actually setting up and troubleshooting your firewall, and hence we only care about opening the whole thing up and reset it to default values.

After this we flush all chains first in the filter table and then in the NAT table. This way we know there is no redundant rules lying around anywhere. When all of this is done, we jump down to the next section where we erase all the user specified chains in the NAT and filter tables. When this step is done, we consider the script done. You may consider adding rules to flush your MANGLE table if you use it.

Note: One final word on this issue. Certain people has mailed me asking from me to put this script into the original rc.firewall script using redhat Linux syntax where you type something like rc.firewall start and the script starts. However, I will not do that since this is a tutorial and should be used as a place to fetch ideas mainly and it shouldn't be filled up with shell scripts and strange syntax. Adding shell script syntax and other things makes the script harder to read as far as I am concerned and the tutorial was written with readability in mind and will continue being so.

Detailed explanations of special commands

Listing your active ruleset

To list your currently active ruleset you run a special option to the **iptables** command, which we have discussed briefly previously in the *How a rule is built* chapter. This would look like the following:

iptables -L

This command should list your currently active ruleset, and translate everything possible to a more readable form. For example, it will translate all the different ports according to the `/etc/services` file as well as DNS all the IP addresses to get DNS records instead. The later can be a bit of a problem though. For example, it will try to resolve LAN IP addresses, ie `192.168.1.1`, to something useful. `192.168.0.0/16` is a private range though and should not resolve to anything and the command will seem to hang while resolving the IP. To get around this problem we would do something like the following:

iptables -L -n

Another thing that might be interesting is to see a few statistics about each policy, rule and chain. We could get this by adding the verbose flag. It would then look something like this:

iptables -L -n -v

There is also a few files that might be interesting to look at in the `/proc` filesystem. For example, it might be interesting to know what connections are currently in the conntrack table. This table contains all the different connections currently tracked and serves as a basic table so we always know what state a connection currently is in. This table can not be edited and even if it was possible, it would be a bad idea. To see the table you can run the following command:

cat /proc/net/conntrack | less

The above command will show all currently tracked connections even though it might be a bit hard to understand everything.

Updating and flushing your tables

If at some point you screw up your **iptables**, there are actually commands to flush them, so you don't have to reboot. I've actually gotten this question a couple times by now so I thought I'd answer it right here. If you added a rule in error, you might just change the **-A** parameter to **-D** in the line you added in error. **iptables** will find the erroneous line and erase it for you, in case you've got multiple lines looking exactly the same in the chain, it erases the first instance it finds matching your rule. If this is not the wanted behaviour you might try to use the **-D** option as **iptables -D INPUT 10** which will erase the 10th rule in the INPUT chain.

There is also instances where you want to flush a whole chain, in this case you might want to run the **-F** option. For example, **iptables -F INPUT** will erase the whole INPUT chain, though, this will not change the default policy, so if this is set to DROP you'll block the whole INPUT chain if used as above. To reset the chain policy, do as how you set it to DROP, for example **iptables -P INPUT ACCEPT**.

I have made a small script (available as an appendix as well) that will flush and reset your **iptables** that you might consider using while setting up your `rc.firewall.txt` file properly. One thing though, if you start mucking around in the mangle table, this script will not erase those, it is rather simple to add the few lines needed to erase those but I have not added those here since the mangle table is not used in my `rc.firewall.txt` script so far.

Common problems and questionmarks

Passive FTP but no DCC

This is one of the really nice parts about the new **iptables** support in the 2.4.x kernels, you can for example allow Passive FTP connections, but not allow DCC send functions with the new state matching code. You may ask yourself how, well, its quite simple once you get to think of it. Just compile the `ip_conntrack_irc`, `ip_nat_irc`, `ip_conntrack_ftp` and `ip_nat_ftp` code as modules and not statically into the kernel. What these modules do is that they add support to the connection tracking machine and the NAT machine so they can distinguish and modify a Passive FTP connection or a DCC send connection. Without these modules they can't recognize these kinds of connections.

If you for example want to allow Passive FTP, but not DCC send, you would load the `ip_conntrack_ftp` and `ip_nat_ftp` modules, but not the `ip_conntrack_irc` and `ip_nat_irc modules` and then do:

/usr/local/sbin/iptables -A INPUT -p TCP -m state --state RELATED -j ACCEPT

To allow Passive FTP but not DCC. If you would want to do the reverse, you'd just load the `ip_conntrack_irc` and `ip_nat_irc` modules, but not the `ip_conntrack_ftp` and `ip_nat_ftp` modules. Do note that the `ip_nat_*` modules are only needed in case you need and want to do Network Adress Translation on the connections, ie, if you want to let people run IRC from your local network which is using a NAT'ed or masqueraded connection to the internet.

For more information about Active and Passive FTP, read RFC 959 - File Transfer Protocol by J. Postel and J. Reynolds. This RFC contains information regarding the FTP protocol and Active and Passive FTP and how they work. As you can understand from this document, during Active FTP the client sends the server an IP address and random port to use and then the server connects to this port on the client. In case your client sits behind a Network Address Translationing system (**iptables**), then the packets data section needs to be NAT'ed too, that is what the `ip_nat_ftp` module does. In Passive FTP, the proceeding is reversed. The client tells the server that it wants to send or receive data and the server replies, telling the client what address to connect to and what port to use.

State NEW packets but no SYN bit set

There is a certain *feature* in **iptables** that is not so well documented and may therefore be overlooked by a lot of people(yes, including me). If you use state **NEW**, packets with the SYN bit unset will get through your firewall. This feature is there because in certain cases we want to consider that a packet may be part of an already **ESTABLISHED** connection on, for instance, another firewall. This feature makes it possible to have two or more firewalls, and for one of the firewalls to go down without any loss of data. The firewalling of the subnet could then be taken over by our secondary firewall.This does however lead to the fact that state **NEW** will allow pretty much any kind of TCP connection, regardless if this is the initial 3-way handshake or not. To take care of this problem we add the following rules to our firewalls INPUT, OUTPUT and FORWARD chain:

```
  $IPTABLES -A INPUT -p tcp ! --syn -m state --state NEW -j LOG --log-prefix "New not
syn:"
  $IPTABLES -A INPUT -p tcp ! --syn -m state --state NEW -j DROP
```

Caution: The above rules will take care of this problem. This is a badly documented behaviour of the **netfilter/iptables** project and should definitely be more highlighted. In other words, a huge warning is in it's place for this kind of behaviour on your firewall.

Note that there is some troubles with the above rules and bad Microsoft TCP/IP implementations. The above rules will lead to certain conditions where packets generated by microsoft products gets labeled as a state **NEW** and hence get logged and dropped. It will however not lead to broken connections to my knowledge. The matter is that when a connection gets closed and the final FIN/ACK has been sent and the state machine of **netfilter** has closed this connection and it is no longer in the conntrack table. At this point the faulty Microsoft implementation sends another packet which is considered as state **NEW** but lacks the SYN bit and hence gets matched by the above rules. In other words, don't worry to much about this rule, or if you are worried anyways, set the **--log-headers** option to the rule and log the headers too and you'll get a better look at what the packet looks like.

There is one more known problem with these rules. If someone is currently connected to the firewall, lets say from the LAN, and you have the script set to be activated when running a PPP connection. In this case, when you start the PPP connection, the person previously connected through the LAN will be more or less killed. This only applies when you are running with the conntrack and nat codebases as modules, and the modules are loaded and unloaded each time you run the script. Another way to get this problem is to run the `rc.firewall.txt` script from a telnet connection from a host not on the actual firewall. To put it simple, you connect with **telnet** or some other stream connection. Start the connection tracking modules, then load the **NEW** not SYN packet rules. Finally, the **telnet client** or **daemon** tries to send something. the connection tracking code will not recognise this connection as a legal connection since it has not seen packets in any direction on this connection before, also there will be no SYN bits set since it is not actually the first packet in the connection. Hence, the packet will match to the rules and be logged and afterwards dropped to the ground.

Internet Service Providers who use assigned IP addresses

I have added this since a friend of mine told me something I have totally forgotten. Certain stupid Internet Service Providers use IP addresses assigned by *IANA* for their local networks on which you connect to. For example, the swedish Internet Service Provider and phone monopoly Telia uses this approach for example on their DNS servers, which uses the 10.x.x.x IP address range. The problem you will most probably run into is that we, in this script, do not allow connections from any IP addresses in the 10.x.x.x range to us, because of spoofing possibilities. Well, here is unfortunately an example where you actually might have to lift a bit on those rules. You might just insert an **ACCEPT** rule above the spoof section to allow traffic from those DNS servers, or you could just comment out that part of the script. This is how it might look:

/usr/local/sbin/iptables -t nat -I PREROUTING -i eth1 -s 10.0.0.1/32 -j ACCEPT

I would like to take my moment to bitch at these Internet Service Providers. These IP address ranges are not assigned for you to use for dumb stuff like this, at least not to my knowledge. For large corporate sites it is more than ok, or your own home network, but you are not supposed to force us to open up ourself just because of some whince of yours.

ICMP types

This is a complete listing of all ICMP types:

Table 1. ICMP types

TYPE	CODE	Description	Query	Error
0	0	Echo Reply	x	
3	0	Network Unreachable		x
3	1	Host Unreachable		x
3	2	Protocol Unreachable		x
3	3	Port Unreachable		x
3	4	Fragmentation needed but no frag. bit set		x
3	5	Source routing failed		x
3	6	Destination network unknown		x
3	7	Destination host unknown		x
3	8	Source host isolated (obsolete)		x
3	9	Destination network administratively prohibited		x
3	10	Destination host administratively prohibited		x
3	11	Network unreachable for TOS		x
3	12	Host unreachable for TOS		x
3	13	Communication administratively prohibited by filtering		x
3	14	Host precedence violation		x

3	15	Precedence cutoff in effect		x
4	0	Source quench		
5	0	Redirect for network		
5	1	Redirect for host		
5	2	Redirect for TOS and network		
5	3	Redirect for TOS and host		
8	0	Echo request	x	
9	0	Router advertisement		
10	0	Route sollicitation		
11	0	TTL equals 0 during transit		x
11	1	TTL equals 0 during reassembly		x
12	0	IP header bad (catchall error)		x
12	1	Required options missing		x
13	0	Timestamp request (obsolete)	x	
14		Timestamp reply (obsolete)	x	
15	0	Information request (obsolete)	x	
16	0	Information reply (obsolete)	x	
17	0	Address mask request	x	
18	0	Address mask reply	x	

Other resources and links

Here is a list of links to resources and where I have gotten information from, etc :

- ip-sysctl.txt - from the 2.4.14 kernel. A little bit short but a good reference for the IP networking controls and what they do to the kernel.
- ip_dynaddr.txt - from the 2.4.14 kernel. A really short reference to the ip_dynaddr settings available via sysctl and the proc filesystem.
- iptables.8 - The iptables 1.2.4 man page. This is an HTML'ized version of the man page which is an excellent reference when reading/writing iptables rulesets. Always have it at hand.
- http://netfilter.filewatcher.org/ - The official **netfilter** and **iptables** site. It is a must for everyone wanting to set up **iptables** and **netfilter** in linux.

- http://netfilter.filewatcher.org/netfilter-faq.html - The official **netfilter** *Frequently Asked Questions*. Also a good place to stat at when wondering what **iptables** and **netfilter** is about.

- http://netfilter.filewatcher.org/unreliable-guides/packet-filtering-HOWTO/index.html - Rusty Russells Unreliable Guide to packet filtering. Excellent documentation about basic packet filtering with **iptables** written by one of the core developers of **iptables** and **netfilter**.

- http://netfilter.filewatcher.org/unreliable-guides/NAT-HOWTO/index.html - Rusty Russells Unreliable Guide to Network Address Translation. Excellent documentation about Network Address Translation in **iptables** and **netfilter** written by one of the core developers, Rusty Russell.

- http://netfilter.filewatcher.org/unreliable-guides/netfilter-hacking-HOWTO/index.html - Rusty Russells Unreliable Netfilter Hacking HOWTO. One of the few documentations on how to write code in the **netfilter** and **iptables** userspace and kernel space codebase. This was also written by Rusty Russell.

- http://www.linuxguruz.org/iptables/ - Excellent linkpage with links to most of the pages on the internet about **iptables** and **netfilter**. Also maintains a list of different iptables scripts for different purposes.

- http://www.islandsoft.net/veerapen.html - Excellent discussion on automatic hardening of **iptables** and how to make small changes that will make your computer automatically add hostile sites to a special banlist in **iptables**.

- http://www.docum.org - Excellent information about the CBQ, **tc** and the **ip** commands in Linux. One of the few sites that has any information at all about these programs. Maintained by Stef Coene.

- http://lists.samba.org/mailman/listinfo/netfilter - The official netfilter mailing-list. Extremely useful in case you have questions about something not covered in this document or any of the other links here.

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Example scripts codebase

Example rc.firewall script

```
#!/bin/sh
#
# rc.firewall - Initial SIMPLE IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
```

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###########################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.155"
INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
```

```
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
```

```
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

###########################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets
```

```
#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed

#
# UDP ports
```

```
#

# nondocumented commenting out of these rules
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from the internet.
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets
$IPTABLES -A INPUT -p TCP -i $INET_IFACE -j tcp_packets
$IPTABLES -A INPUT -p UDP -i $INET_IFACE -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#

$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_BCAST_ADRESS -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -s $LAN_IP_RANGE -j ACCEPT
$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#
```

```
#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $INET_IP -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#
```

```
#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#
```

```
#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.DMZ.firewall script

```
#!/bin/sh
#
# rc.DMZ.firewall - DMZ IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#

#
```

```
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.152"
HTTP_IP="194.236.50.153"
DNS_IP="194.236.50.154"
INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

DMZ_HTTP_IP="192.168.1.2"
DMZ_DNS_IP="192.168.1.3"
DMZ_IP="192.168.1.1"
DMZ_IFACE="eth2"

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"
```

```
#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#
/sbin/depmod -a



#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

###########################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#
```

```
echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#
```

```
#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Packets from the Internet to this box
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets

#
# Packets from LAN, DMZ or LOCALHOST
#

#
# From DMZ Interface to DMZ firewall IP
#
```

```
$IPTABLES -A INPUT -p ALL -i $DMZ_IFACE -d $DMZ_IP -j ACCEPT

#
# From LAN Interface to LAN firewall IP
#

$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_BCAST_ADRESS -j ACCEPT

#
# From Localhost interface to Localhost IP
#
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT

#
# All established and related packets incoming from the internet to the
# firewall
#

$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Logging rule
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets


#
# DMZ section
#
# General rules
#

$IPTABLES -A FORWARD -i $DMZ_IFACE -o $INET_IFACE -j ACCEPT
```

```
$IPTABLES -A FORWARD -i $INET_IFACE -o $DMZ_IFACE -m state \
--state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A FORWARD -i $LAN_IFACE -o $DMZ_IFACE -j ACCEPT
$IPTABLES -A FORWARD -i $DMZ_IFACE -o $LAN_IFACE -j ACCEPT

#
# HTTP server
#

$IPTABLES -A FORWARD -p TCP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_HTTP_IP \
--dport 80 -j allowed
$IPTABLES -A FORWARD -p ICMP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_HTTP_IP \
-j icmp_packets

#
# DNS server
#

$IPTABLES -A FORWARD -p TCP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
--dport 53 -j allowed
$IPTABLES -A FORWARD -p UDP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
--dport 53 -j ACCEPT
$IPTABLES -A FORWARD -p ICMP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
-j icmp_packets

#
# LAN section
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# LOG all packets reaching here
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets
```

```
#
# Allow ourself to send packets not spoofed everywhere
#

$IPTABLES -A OUTPUT -p ALL -o $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $LAN_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $INET_IFACE -s $INET_IP -j ACCEPT

#
# Logging rule
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# Enable IP Destination NAT for DMZ zone
#

$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $HTTP_IP --dport 80 \
-j DNAT --to-destination $DMZ_HTTP_IP
$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $DNS_IP --dport 53 \
-j DNAT --to-destination $DMZ_DNS_IP
$IPTABLES -t nat -A PREROUTING -p UDP -i $INET_IFACE -d $DNS_IP --dport 53 \
-j DNAT --to-destination $DMZ_DNS_IP

#
# 4.2.5 POSTROUTING chain
#
```

```
#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP


#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.UTIN.firewall script

```
    #!/bin/sh
#
# rc.firewall - UTIN Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

############################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.155"
INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
```

```
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
```

```
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

###########################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr


###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
```

```
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT
```

```
#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed

#
# UDP ports
#

$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from anywhere
#

$IPTABLES -A INPUT -p ICMP -j icmp_packets
$IPTABLES -A INPUT -p TCP -j tcp_packets
$IPTABLES -A INPUT -p UDP -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#

$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Log weird packets that don't match the above.
#
```

```
$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward between interfaces.
#

$IPTABLES -A FORWARD -p tcp --dport 21 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -p tcp --dport 80 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -p tcp --dport 110 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $INET_IP -j ACCEPT

#
```

```
# Log weird packets that don't match the above.
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
```

```
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.DHCP.firewall script

```
#!/bin/sh
#
# rc.firewall - DHCP IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
```

```
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# Information pertaining to DHCP over the Internet, if needed.
#
# Set DHCP variable to no if you don't get IP from DHCP. If you get DHCP
# over the Internet set this variable to yes, and set up the proper IP
# adress for the DHCP server in the DHCP_SERVER variable.
#

DHCP="no"
DHCP_SERVER="195.22.90.65"

#
# 1.1.2 PPPoE
#

# Configuration options pertaining to PPPoE.
#
# If you have problem with your PPPoE connection, such as large mails not
# getting through while small mail get through properly etc, you may set
# this option to "yes" which may fix the problem. This option will set a
# rule in the PREROUTING chain of the mangle table which will clamp
# (resize) all routed packets to PMTU (Path Maximum Transmit Unit).
#
# Note that it is better to set this up in the PPPoE package itself, since
# the PPPoE configuration option will give less overhead.
#

PPPOE_PMTU="no"

#
```

```
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#


###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_conntrack
```

```
/sbin/modprobe ip_tables
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_MASQUERADE

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc


#############################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

#############################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#
```

```
$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
```

```
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed

#
# UDP ports
#

$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
if [ $DHCP == "yes" ] ; then
 $IPTABLES -A udpincoming_packets -p UDP -s $DHCP_SERVER --sport 67 \
 --dport 68 -j ACCEPT
fi

# nondocumented commenting out of these rules
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from the internet.
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets
$IPTABLES -A INPUT -p TCP -i $INET_IFACE -j tcp_packets
$IPTABLES -A INPUT -p UDP -i $INET_IFACE -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#
```

```
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -s $LAN_IP_RANGE -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $INET_IFACE -m state \
--state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
```

```
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $LAN_IFACE -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $INET_IFACE -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

if [ $PPPOE_PMTU == "yes" ] ; then
 $IPTABLES -t nat -A POSTROUTING -p tcp --tcp-flags SYN,RST SYN \
 -j TCPMSS --clamp-mss-to-pmtu
fi
$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j MASQUERADE

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
```

```
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.flush-iptables script

```
#!/bin/sh
#
```

```
# rc.flush-iptables - Resets iptables to default values.
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
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# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA

#
# Configurations
#
IPTABLES="/usr/sbin/iptables"

#
# reset the default policies in the filter table.
#
$IPTABLES -P INPUT ACCEPT
$IPTABLES -P FORWARD ACCEPT
$IPTABLES -P OUTPUT ACCEPT

#
# reset the default policies in the nat table.
#
$IPTABLES -t nat -P PREROUTING ACCEPT
$IPTABLES -t nat -P POSTROUTING ACCEPT
$IPTABLES -t nat -P OUTPUT ACCEPT

#
# reset the default policies in the mangle table.
#
$IPTABLES -t mangle -P PREROUTING ACCEPT
$IPTABLES -t mangle -P OUTPUT ACCEPT

#
# flush all the rules in the filter and nat tables.
#
$IPTABLES -F
$IPTABLES -t nat -F
$IPTABLES -t mangle -F
```

```
#
# erase all chains that's not default in filter and nat table.
#
$IPTABLES -X
$IPTABLES -t nat -X
$IPTABLES -t mangle -X
```

Example rc.test-iptables script

```
#!/bin/bash
#
# rc.test-iptables - test script for iptables chains and tables.
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
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# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

#
# Filter table, all chains
#
iptables -t filter -A INPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter INPUT:"
iptables -t filter -A INPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter INPUT:"
iptables -t filter -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter OUTPUT:"
iptables -t filter -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter OUTPUT:"
iptables -t filter -A FORWARD -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter FORWARD:"
```

```
iptables -t filter -A FORWARD -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter FORWARD:"

#
# NAT table, all chains except OUTPUT which don't work.
#
iptables -t nat -A PREROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat PREROUTING:"
iptables -t nat -A PREROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat PREROUTING:"
iptables -t nat -A POSTROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat POSTROUTING:"
iptables -t nat -A POSTROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat POSTROUTING:"
iptables -t nat -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat OUTPUT:"
iptables -t nat -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat OUTPUT:"

#
# Mangle table, all chains
#
iptables -t mangle -A PREROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="mangle PREROUTING:"
iptables -t mangle -A PREROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="mangle PREROUTING:"
iptables -t mangle -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="mangle OUTPUT:"
iptables -t mangle -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="mangle OUTPUT:"
```

Done.

Iptables Tutorial 1.1.9

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Table of Contents

Introduction

Why this document was written

Well, I found a big empty space in the HOWTO's out there lacking in information about the iptables and netfilter functions in the new Linux 2.4.x kernels. Among other things, I'm going to try to answer questions that some might have about the new possibilities like state matching. Is it possible to allow passive FTP to your server, but not allow outgoing DCC from IRC as an example? I will build this all up from an example rc.firewall.txt file that you can use in your `/etc/rc.d/` scripts. Yes, this file was originally based upon the masquerading HOWTO for those of you who recognize it.

Also, there's a small script that I wrote just in case you screw up as much as I did during the configuration available as rc.flush-iptables.txt.

How it was written

I've placed questions to Marc Boucher and others from the core netfilter team. A big thanks going out to them for their work and for their help on this tutorial that I wrote and maintain for boingworld.com. This document will guide you through the setup process step by step, hopefully make you understand some more about the iptables package. I will base most of the stuff here on the example rc.firewall file since I find that example to be a good way to learn how to use iptables. I have decided to just follow the basic chains and from there go down into each and one of the chains traversed in each due order. This tutorial has turned a little bit harder to follow this way but at the same time it is more logical. Whenever you find something that's hard to understand, just consult this tutorial.

About the author

I'm someone with too many old computers on my hands, sitting with my own LAN and wanting them all to be connected to the Internet, at the same time having it fairly secure. The new iptables is a good upgrade from the old ipchains in this regard. Before, you could make a fairly secure network by dropping all incoming packages not destined to certain ports, but this would be a problem with things like passive FTP or outgoing DCC in IRC, which assigns ports on the server, tells the client about it, and then lets the client connect. There was some child diseases in the iptables code that I ran into in the beginning, and in some respects I found the code not quite ready for release in full production. Today, I'd recommend everyone who uses ipchains or even older ipfwadm etc to upgrade unless they're happy with what their current code is capable of and if it does what they need it to.

Dedications

First of all I would like to dedicate this document to my wonderful girlfriend Ninel. She has supported me more than I ever can support her to any degree. I wish I could make you just as happy as you make me.

Second of all, I would like to dedicate this work to all of the incredibly hard working Linux developers and maintainers. It is people like those who makes this wonderful operating system possible.

Preparations

This chapter is aimed at getting you started and to help you understand the role netfilter and **iptables** play in Linux today. This chapter should hopefully get you set up and finished to go with your experimentation and installation of a firewall which should hopefully run smoothly in the future.

Where to get iptables

The **iptables** userspace package can be downloaded from the netfilter homepage. The **iptables** package also makes use of kernel space facilities which can be configured into the kernel during **make configure**. The necessary pieces will be discussed a bit further down in this document.

Kernel setup

To run the pure basics of **iptables** you need to configure the following options into the kernel while doing **make config** or one of it's related commands:

`CONFIG_PACKET` - This option allows applications and programs that needs to work directly to certain network devices. An example would be tcpdump or snort.

`CONFIG_NETFILTER` - This option is required if you're going to use your computer as a firewall or gateway to the internet. In other words, this is most definitely required if for anything in this tutorial to work at all. I assume you'll want this since you're reading this at all.

And of course you need to add the proper drivers for your interfaces to work properly, ie. Ethernet adapter, PPP and SLIP interfaces. The above will only add some of the pure basics in iptables. You won't be able to do anything to be pretty honest, it just adds the framework to the kernel. If you want to use the more advanced options in IPTables, you need to set up the proper configuration options in your kernel. Here we will show you the options available in a basic 2.4.9 kernel and a brief explanation :

`CONFIG_IP_NF_CONNTRACK` - This module is needed to make connection tracking. Connection tracking is used by, among other things, NAT and Masquerading. If you need to firewall machines on a LAN you most definitely should mark this option. For example, this module is required by the *rc.firewall.txt* to work.

`CONFIG_IP_NF_FTP` - This module is required if you want to do connection tracking on FTP connections. Since FTP connections are quite hard to do connection tracking on in normal cases conntrack needs a so called helper, this option compiles the helper. If you don't add this module you won't be able to FTP through a firewall or gateway properly.

`CONFIG_IP_NF_IPTABLES` - This option is required if you want do any kind of filtering, masquerading or NAT. It adds the whole iptables identification framework to kernel. Without this you won't be able to do anything at all with iptables.

`CONFIG_IP_NF_MATCH_LIMIT` - This module isn't exactly required but it's used in the example *rc.firewall.txt*. This option provides the LIMIT match, that adds the possibility to control how many packets per minute that's supposed to be matched with a certain rule. For example, **-m limit --limit 3/minute** would match a maximum of 3 packets per minute. This module can also be used to avoid certain Denial of Service attacks.

`CONFIG_IP_NF_MATCH_MAC` - This allows us to match packets based on MAC addresses. Every Ethernet adapter has it's own MAC address. We could for instance block packets based on what MAC address used and block a certain computer pretty well since the MAC address don't change. We don't use this option in the *rc.firewall.txt* example or anywhere else.

`CONFIG_IP_NF_MATCH_MARK` - This allows us to use a **MARK** match. For example, if we use the target **MARK** we could mark a packet and then depending on if this packet is marked further on in the table, we can match based on this mark. This option is the actual match **MARK**, and further down we will describe the actual target **MARK**.

`CONFIG_IP_NF_MATCH_MULTIPORT` - This module allows us to match packets with a whole range of destination ports or source ports. Normally this wouldn't be possible, but with this match it is.

`CONFIG_IP_NF_MATCH_TOS` - With this match we can match packets based on their TOS field. TOS stands for *Type Of Service*. TOS can also be set by certain rules in the mangle table and via the ip/tc commands.

`CONFIG_IP_NF_MATCH_TCPMSS` - This option adds the possibility for us to match TCP packets based on their MSS field.

`CONFIG_IP_NF_MATCH_STATE` - This is one of the biggest news in comparison to **ipchains**. With this module we can do stateful matching on packets. For example, if we've already seen trafic in two directions in a TCP connection, this packet will be counted as **ESTABLISHED**. This module is used extensively in the *rc.firewall.txt* example.

`CONFIG_IP_NF_MATCH_UNCLEAN` - This module will add the possibility for us to match IP, TCP, UDP and ICMP packets that looks strange or are invalid. We could for example drop these packets, but we never know if they are legitimate or not. Note that this match is still experimental and might not work perfectly in all cases.

`CONFIG_IP_NF_MATCH_OWNER` - This option will add the possibility for us to do matching based on the owner of a socket. For example, we can allow only the user root to have Internet access. This module was originally just written as an example on what could be done with the new **iptables**. Note that this match is still experimental and might not work for everyone.

`CONFIG_IP_NF_FILTER` - This module will add the basic filter table which will enable you to do basic filtering. In the filter table you'll find the INPUT, FORWARD and OUTPUT chains. This module is required if you plan to do any kind of filtering on packets that you receive and send.

`CONFIG_IP_NF_TARGET_REJECT` - This target allows us to specify that an ICMP error message should be sent in reply to incoming packets instead of plainly dropping them dead to the floor. Mind you that TCP connections are always reset or refused with a TCP RST packet.

`CONFIG_IP_NF_TARGET_MIRROR` - This allows packets to be bounced back to the sender of the packet. For example, if we set up a MIRROR target on destination port HTTP on our INPUT chain and someone tries to access this port we would plainly bounce his packets back to himself and finally he would see his own homepage.

`CONFIG_IP_NF_NAT` - This module allows network address translation, or NAT, in it's different forms. With this option we can do port forwarding, masquerading etc. Note that this option is is not required for firewalling and masquerading of a LAN, but mostly is, unless you are able to provide unique IP addresses for all hosts. Hence, this option is required for the example *rc.firewall.txt* to work properly, and most definitely on your network if you do not have the ability to add unique IP addresses as specified above.

`CONFIG_IP_NF_TARGET_MASQUERADE` - This module adds the **MASQUERADE** target. For instance if we don't know what IP we have to the Internet this would be the preferred way of getting the IP instead of using DNAT or SNAT. In other words, if we use DHCP, PPP, SLIP or some other connection that dynamically assigns us an IP, we need to use this target instead of SNAT. Masquerading gives a slightly higher load on the computer than NAT does, but will work without us knowing the IP in advance.

`CONFIG_IP_NF_TARGET_REDIRECT` - This target is useful together with proxies for example. Instead of letting a packet pass right through, we remap them to go to our local box instead. In other words, we have the possibility to make a transparent proxy this way.

`CONFIG_IP_NF_TARGET_LOG` - This adds the **LOG** target to **iptables** and the functionality of it. We can use this module to log certain packets to syslogd and hense see the packet further on. This could be useful for forensics or debugging a script you're writing.

`CONFIG_IP_NF_TARGET_TCPMSS` - This option can be used to overcome Internet Service Providers and servers who block ICMP Fragmentation Needed packets. This can result in webpages not getting through, small mails getting through while larger mails don't get through, ssh works but scp dies after handshake, etcetera. We can then use the TCPMSS target to overcome this by clamping our MSS (Maximum Segment Size) to the PMTU (Path Maximum Transmit Unit). This way, we'll be able to handle what the authors of netfilter themself call "criminally braindead ISPs or servers" in the kernel configuration help.

`CONFIG_IP_NF_COMPAT_IPCHAINS` - Adds a compatibility mode with the old **ipchains**. Do not look at this as any real long term solution for solving migration from Linux 2.2 kernels to 2.4 kernels since it may well be gone with kernel 2.6.

`CONFIG_IP_NF_COMPAT_IPFWADM` - Compatibility mode with old **ipfwadm**. Do absolutely not look at this as a real long term solution.

As you can see, there is a heap of options. I have briefly explained what kind of extra behaviours you can expect from each module here. These are only the options available in a vanilla Linux 2.4.9 kernel. If you would like to get a look at more options, I suggest you look at the patch-o-matic functions in netfilter userland which will add heaps of other options in the kernel. POM fixes are additions that are supposed to be added in the kernel in the future but has not quite reached the kernel yet. These functions should be added in the future, but has not quite made it in yet. This may be for various reasons such as the patch not being stable yet, to Linus Torvalds being unable to keep up or not wanting to let the patch in to the mainstream kernel yet since it is still experimental.

You will need the following options compiled into your kernel, or as modules, for the *rc.firewall.txt* script to work. If you need help with the options that the other scripts needs, look at the example firewall scripts section.

- CONFIG_PACKET
- CONFIG_NETFILTER
- CONFIG_CONNTRACK
- CONFIG_IP_NF_FTP
- CONFIG_IP_NF_IRC
- CONFIG_IP_NF_IPTABLES
- CONFIG_IP_NF_FILTER
- CONFIG_IP_NF_NAT

- CONFIG_IP_NF_MATCH_STATE
- CONFIG_IP_NF_TARGET_LOG
- CONFIG_IP_NF_MATCH_LIMIT
- CONFIG_IP_NF_TARGET_MASQUERADE

The above will be required at the very least for the *rc.firewall.txt* script. In the other example scripts I will explain what requirements they have in their respective section. For now, lets try to stay focused on the main script which you should be studying now.

---

userland setup

First of all, let's look at how we compile the **iptables** package. This compilation goes quite a lot hand in hand with the kernel configuration and compilation so you are aware of this. Certain distributions comes with the **iptables** package preinstalled, one of these are Red Hat 7.1. However, in Red Hat 7.1 it is disabled per default. We will check closer on how to enable it on this, and other distributions further on in this chapter

---

Compiling the userland applications

First of all unpack the **iptables** package. Here, we have used the *iptables 1.2.3* package and a vanilla 2.4.9 kernel. Unpack as usual, using **bzip2 -cd iptables-1.2.3.tar.bz2 | tar -xvf -** (this can also be accomplished with the **tar -xjvf iptables-1.2.3.tar.bz2**, which should do pretty much the same as the first command. However, this may not work with older versions of **tar**). Hopefully the package should now be unpacked properly into a directory named `iptables-1.2.3`. For more information read the `iptables-1.2.3/INSTALL` file which contains pretty good information on compiling and getting the program to run.

After this, there is the option to install extra modules and options etcetera to the kernel.The step described here will only check patches that are pending for inclusion to the kernel, there are some even more experimental patches further along, which may only be available when you do some other steps.

Note: Some of these are highly experimental and may not be a very good idea to install. However, there are heaps of extremely interesting matches and targets in this installation step so don't be afraid of at least looking at them. To do this step we do something like this from the root of the iptables package:

make pending-patches KERNEL_DIR=/usr/src/linux/

The variable `KERNEL_DIR` should point to the actual place that your kernel source is located at. Normally this should be `/usr/src/linux/` but this may vary, and most probably you will know yourself where the kernel source is available.

This only asks about certain patches that are just about to enter the kernel anyways. There might be more patches and additions that the developers of netfilter are about to add to the kernel, but is a bit further away from actually getting there. One way to install these are by doing the following:

make most-of-pom KERNEL_DIR=/usr/src/linux/

The above command would ask about installing parts of what in netfilter world is called **patch-o-matic**, but still skip the most extreme patches that might cause havoc in your kernel. Note that we say ask, because that's what these commands actually do. They ask you before anything is changed in the kernel source. To be able to install *all* of the patch-o-matic stuff you will need to run the following command:

make patch-o-matic KERNEL_DIR=/usr/src/linux/

Don't forget to read the help for each patch thoroughly before doing anything. Some patches will destroy other patches while others may destroy your kernel if used together with some patches from patch-o-matic etc.

You may totally ignore the above steps if you don't want to patch your kernel, it is in other words not necessary to do the above. However, there are some really interesting things in the patch-o-matic that you may want to look at so there's nothing bad in just running the commands and see what they contain.

After this you are finished doing the patch-o-matic parts of installation, you may either compile a new kernel making use of the new patches that you have added to the source. Don't forget to configure the kernel again since the new patches probably are not added to the configured options and so on. You may wait with the kernel compilation until after the compilation of the userland program **iptables** if you feel like it, though.

Continue by compiling the **iptables** userland application. To compile **iptables** you issue a simple command that looks like this:

make KERNEL_DIR=/usr/src/linux/

The userland application should now compile properly, if not, you're on your own, or possibly try the netfilter mailing list who might help you with your problems. There is a few things that might go wrong with the installation of **iptables** so don't panic if it won't work, try to think logically about it and find out what's wrong or get someone to help you.

If everything has worked smoothly, you're ready to install the binaries by now. To do this, you would issue the following command to install them:

make install KERNEL_DIR=/usr/src/linux/

Hopefully everything should work in the program now. To use any of the changes in the **iptables** userland applications you should definitely recompile and reinstall your kernel by now if you haven't done so before. For more information about installing the userland applications from source, check the `INSTALL` file in the source which contains excellent information on the subject of installation.

Installation on Red Hat 7.1

Red Hat 7.1 comes preinstalled with a 2.4.x kernel that has netfilter and **iptables** compiled in. It also contains all the basic userland programs and configuration files that is needed to run it, however, they have disabled the whole thing by using the backwards compatible **ipchains** module. Annoying to say the least, and a lot of people are asking different mailing lists why **iptables** don't work. So, let's take a brief look at how to turn the module off and how to install **iptables** instead.

The default Red Hat 7.1 installation today comes with an utterly old version of the userspace applications so you might want to compile a new version of the applications as well as install a new and homecompiled kernel before fully exploiting **iptables**.

First of all you will need to turn off the **ipchains** modules so it won't start in the future. To do this, you will need to change some filenames in the `/etc/rc.d/` directory-structure. The following command should do it:

chkconfig --level 0123456 ipchains off

By doing this we move all the soft links that points to the real script to K92ipchains. The first letter which per default would be S tells the initscripts to start the script. By changing this to K we tell it to Kill the service instead, or to not run it if it was not previously started. Now the service won't be started in the future.

However, to stop the service from actually running right now we need to run another command. This is the **service** command which can be used to work on currently running services. We would then issue the following command to stop the **ipchains** service:

service ipchains stop

Finally, to start the **iptables** service. First of all, we need to know which runlevels we want it to run in. Normally this would be in runlevel 2, 3 and 5. These runlevels are used for the following things:

- 2. Multiuser without NFS or the same as 3 if there is no networking.
- 3. Full multiuser mode, ie. the normal runlevel to run in.
- 5. X11. This is used if you automatically boot into Xwindows.

To make **iptables** run in these runlevels we would do the following commands:

chkconfig --level 235 iptables on

The above commands would in other words make the **iptables** service run in runlevel 2, 3 and 5. If you'd like the **iptables** service to run in some other runlevel you would have to issue the same command in those. However, none of the other runlevels should be used, so you should not really need to activate it for those runlevels. Level 1 is for single user mode, ie, when you need to fix a screwed up box. Level 4 should be unused, and level 6 is for shutting the computer down.

To activate the **iptables** service, we just run the following command:

service iptables start

Of course, there is no rules in the **iptables** script. To add rules to an Red Hat 7.1 box, there is two common ways. First of all, you chould edit the `/etc/rc.d/init.d/iptables` script. This would have the bad effect that the rules would be deleted if you updated the iptables package by RPM. The other way would be to load the ruleset and then save them with the **iptables-save** command and then have it loaded automatically by the rc.d scripts.

First we will describe the possibility of doing the set up by cut and paste to the **iptables** init.d script. To add rules that should be run when the computer starts the service, you add them under the start) section, or in the start() function. Note, if you add the rules under the start) section don't forget to stop the start() function from running in the start) section. Also, don't forget to edit a the stop) section either which tells the script what to do when the computer is going down for example, or when we are entering a runlevel that don't require iptables to run. Also, don't forget to check out the restart section and condrestart. Note that this set up may be automatically erased if you have, for example, Red Hat Network automatically updating your packages. It may also be erased by updating from the **iptables** RPM package.

The second way of doing the set up would require the following steps to be taken. First of all, make and write a ruleset in a file, or directly with **iptables**, that will meet your requirements, and don't forget to experiment a bit. When you find a set up that works without problems or bugs as you can see, use the **iptables-save** command. You could either use it normally, such as **iptables-save > /etc/sysconfig/iptables** which would save the ruleset to the file `/etc/sysconfig/iptables`. This file is automatically used by the **iptables** rc.d script to restore the ruleset in the future. The other way to save the script would be to use **service iptables save** which would save the script automatically to this file. When you reboot the computer in the future, the **iptables** rc.d script will use the command **iptables-restore** to restore the ruleset from the save-file `/etc/sysconfig/iptables`. Do not intermix this and the previous set up instruction since they may heavily damage eachother and render each and one useless.

When all of these steps are finished we can deinstall the currently installed **ipchains** and **iptables** packages. We do this since we don't want the system to mix up the new **iptables** userland application with the old preinstalled **iptables** applications. This step is only necessary if you will install **iptables** from the source package. It's not unusual that the new and the old package get's mixed up since the rpm based installation installs the package in non-standard places and won't get overwritten by the installation for the new **iptables** package. To do the deinstallation, do as follows:

rpm -e iptables

And of course, why keep **ipchains** lying around when it is of no use? That is done the same way as with the old **iptables** binaries, etc:

rpm -e ipchains

After all this is done you are finished to update the **iptables** package from source according to the source installation instructions. None of the old binaries, libraries or include files etc should be lying around any more.

How a rule is built

This chapter will discuss in legth how to build your rules. A rule could be described as the pure rules the firewall will follow when blocking different connections and packets in each chain. Each line you write that's inserted to a chain should be considered a rule. We will also discuss the basic matches that str available and how to use them as well as the different targets and how we can make new targets to use (ie, new subchains).

Basics

As we've already explained each rule is a line that the kernel looks at to find out what to do with a packet. If all the criterias, or matches, are met, we perform the target, or jump, instruction. Normally we would write a rule something like this:

iptables [-t *`table`*] command [match] [target/jump]

There is nothing that says that the target instruction must be last in the line, however, you would do this normally to get a better readability. Also, we have used this way of writing rules since it is the most usual way of writing them. Hence, if you read someone elses script you'll most likely recognise the way of writing a rule and understand it quickly.

If you want to use another table than the standard table, you could insert the table specification where [table] is specified. However, it is not necessary to specify it explicitly all the time since **iptables** per default uses the filter table to implement your commands on. It is not required to put the table specification at this location, either. It could be set pretty much anywhere in the rule, however, it is more or less standard to put the table specification at the beginning of the commandline.

One thing to think about though; the command should always be first, or directly after the table specification. This tells the **iptables** command what to do. We will enter this a bit further on. We use this first variable to tell the program what to do, for example to insert a rule or to add a rule to the end of the chain, or to delete a rule.

The match is the part which we send to the kernel that says what a packet must look like to be matched. We could specify what IP address the packet must come from, or which network interface the packet must come from etc. There is a heap of different matches that we can use that we will look closer at further on in this chapter.

Finally we have the target of the packet. If all the matches are met for a packet we tell the kernel to perform this action on the packet. We could tell the kernel to send the packet to another chain that we create ourself, which must be part of this table. We could tell the kernel to drop this packet dead and do no further processing, or we could tell kernel to send a specified reply to be sent back. As with the rest of the content in this section, we'll look closer at them further on in the chapter.

Tables

The **-t** option specifies which table to use. Per default, the filter table is used. The following options are available to the **-t** command:

Table 1. Tables

Table	Explanation
nat	The nat table is used mainly for Network Address Translation. Packets in a stream only traverse this table once. The first packet of a stream is allowed, we presume. The rest of the packets in the same stream are automatically NAT'ed or Masqueraded etc, in case they are supposed to have those actions taken on them. The rest of the packets in the stream will in other words not go through this table again, but instead they will automatically have the same actions taken to them as the first packet in the stream. This is one reason why you should not do any filtering in this table, as we will discuss more in length further on. The PREROUTING chain is used to alter packets as soon as they get in to the firewall. The OUTPUT chain is used for altering locally generated packets (ie, on the firewall) before they get to the routing decision. Note that OUTPUT is currently broken. Finally we have the POSTROUTING chain which is used to alter packets just as they are about to leave the firewall.
mangle	This table is used mainly for mangling packets. We could change different packets and how their headers look among other things. Examples of this would be to change the **TTL**, **TOS** or **MARK**. Note that the **MARK** is not really a change to the packet, but a mark for the packet is set in kernelspace which other rules or programs might use further on in the firewall to filter or do advanced routing on with tc as an example. The table consists of two built in chains, the PREROUTING and OUTPUT chains. PREROUTING is used for altering packets just as they enter the firewall and before they hit the routing decision. OUTPUT is used for changing and altering locally generated packets before they enter the routing decision. Note that mangle can not be used for any kind of Network Address Translation or Masquerading, the nat table was made for these kinds of operations.
filter	The filter table should be used for filtering packets generally. For example, we could **DROP**, **LOG**, **ACCEPT** or **REJECT** packets without problems as in the other tables. There are three chain built in to this table. The first one is named FORWARD and is used on all non-locally generated packets that are not destined for our localhost (the firewall, in other words). INPUT is used on all packets that are destined for our local host (the firewall) and OUTPUT is finally used for all locally generated packets.

The listing above has hopefully explained the basics about the three different tables that are available. They should be used for totally different things, and you should know what to use each chain for. If you do not understand their usage you may well fall into a pit once someone finds the hole you have unknowingly placed in the firewall yourself. We will discuss the tables and chains more in the *Traversing of tables and chains* chapter.

Commands

In this section we will bring up all the different commands and what can be done with them. The command tells **iptables** what to do with the rest of the commandline that we send to the program. Normally we want to either add or delete something to some table or another. The following commands are available to iptables:

Table 2. Commands

Command
Example
Explanation
-A, **--append**
iptables -A INPUT ...
This command appends the rule to the end of the chain. The rule will will in other words always be put last in the ruleset in comparison to previously added rules, and hence be checked last, unless you append or insert more rules later on.
-D, **--delete**
iptables -D INPUT --dport 80 -j DROP, **iptables -D INPUT 1**
This command deletes a rule in a chain. This could be done in two ways, either by specifying a rule to match with the **-D** option (as in the first example) or by specifying the rule number that we want to match. If you use the first way of deleting rules, they must match totally to the entry in the chain. If you use the second way, the rules are numbered from the top of each chain, and the top rule is number 1.
-R, **--replace**
iptables -R INPUT 1 -s 192.168.0.1 -j DROP
This command replaces the old entry at the specified line. It works in the same way as the **--delete** command, but instead of totally deleting the entry, it will replace it with a new entry. This might be good while experimenting with iptables mainly.
-I, **--insert**
iptables -I INPUT 1 --dport 80 -j ACCEPT
Insert a rule somewhere in a chain. The rule is inserted at the actual number that we give. In other words, the above example would be inserted at place 1 in the INPUT chain, and hence it would be the

absolutely first rule in the chain from now on.
-L, **--list**
iptables -L INPUT
This command lists all the entries in the specified chain. In the above case, we would list all the entries in the INPUT chain. It's also legal to not specify any chain at all. In the last case, the command would list all the chains in the specified table (To specify a table, see the *Tables* section). The exact output is affected by other options sent to the program, for example the **-n** and **-v** options, etcetera.
-F, **--flush**
iptables -F INPUT
This command flushes the specified chain from all rules and is equivalent to deleting each rule one by one but is quite a bit faster. The command can be used without options, and will then delete all rules in all chains within the specified table.
-Z, **--zero**
iptables -Z INPUT
This command tells the program to zero all counters in a specific chain or in all chains. If you have used the **-v** option with the **-L** command, you have probably seen the packet counter in the beginning of each field. To zero this packet counter, use the **-Z** option. This option works the same as **-L** except that **-Z** won't list the rules. If **-L** and **-Z** is used together (which is legal), the chains will first be listed, and then the packet counters are zeroised.
-N, **--new-chain**
iptables -N allowed
This command tells the kernel to create a new chain by the specified name in the specified table. In the above example we create a chain called **allowed**. Note that there must be no target of the same name previously to creating it.
-X, **--delete-chain**
iptables -X allowed
This command deletes the specified chain from the table. For this command to work, there must be no rules that are referring to the chain that is to be deleted. In other words, you would have to replace or delete all rules referring to the chain before actually deleting the chain. If this command is used without any options, all chains that are not built in will be deleted from the specified table.
-P, **--policy**
iptables -P INPUT DROP
This command tells the kernel to set a specified default target, or policy, on a chain. All packets that don't match any rule will then be forced to use the policy of the chain. Legal targets are: **DROP**, **ACCEPT** and **REJECT** (There might be more, mail me if so)
-E, **--rename-chain**
iptables -E allowed disallowed

The **-E** command tells **iptables** to rename the first name of a chain, to the second name. In the example above we would, in other words, change the name of the chain from `allowed` to `disallowed`. Note that this will not affect the actual way the table will work. It is, in other words, just a cosmetic change to the table.

A command should always be specified, unless you just want to list the built-in help for **iptables** or get the version of the command. To get the version, use the **-v** option and to get the help message, use the **-h** option. As usual, in other words. Here comes a few options that can be used together with a few different commands. Note that we tell you with which commands the options can be used and what effect they will have. Also note that we do not tell you any options here that is only used to affect rules and matches. The matches and targets are instead looked upon in a later section of this chapter.

Table 3. Options

Option
Commands used with
Explanation
-v, **--verbose**
--list, **--append**, **--insert**, **--delete**, **--replace**
This command shows a verbose output and is mainly used together with the **--list** command. If used together with the **--list** command it makes the output from the command include the interface address, rule options and TOS masks. The **--list** command will also include a bytes and packet counter for each rule if the **--verbose** option is set. These counters uses the K (x1000), M (x1,000,000) and G (x1,000,000,000) multipliers. To overcome this and to get exact output, you could use the -x option described later. If this option is used with the **--append**, **--insert**, **--delete** or **--replace** commands, the program will output detailed information on what happens to the rules and if it was inserted correctly etcetera.
-x, **--exact**
--list
This option expands the numerics. The output from **--list** will in other words not contain the K, M or G multipliers. Instead we will get an exact output of how many packets and bytes that has matched the rule in question from the packets and bytes counters. Note that this option is only usable in the **--list** command and isn't really relevant for any of the other commands.
-n, **--numeric**
--list
This option tells iptables to output numerical values. IP addresses and port numbers will be printed by using their numerical values and not hostnames, network names or application names. This option is only applicable to the **--list** command. This option overrides the default of resolving all numerics to hosts and names if possible.
--line-numbers
--list

The **--line-numbers** command is used to output line numbers together with the **--list** command. Each rule is numbered together with this option and it might be easier to know which rule has which number when you're going to insert rules. This option only works with the **--list** command.
-c, **--set-counters**
--insert, **--append**, **--replace**
This option is used when creating a rule in some way or modifying it. We can then use the option to initialize the packets and bytes counters of the rule. The syntax would be something like **--set-counters 20 4000**, which would tell the kernel to set the packet counter to 20 and byte counter to 4000.
--modprobe
All
The **--modprobe** option is used to tell iptables which command to use when probing for modules to the kernel. It could be used if your **modprobe** command is not somewhere in the searchpath etc. In such cases it might be necessary to specify this option so the program knows what to do in case a needed module is not loaded. This option can be used with all commands.

Matches

This section will talk a bit more about the matches. I've chosen to split down the matches into five different subcategories here. First of all we have the *generic matches* which are generic and can be used in all rules. Then we have the *TCP matches* which can only be applied to TCP packets. We have *UDP matches* which can only be applied to UDP packets and *ICMP matches* which can only be used on ICMP packets. Finally we have special matches such as the state, owner and limit matches and so on. These final matches has in turn been split down to even more subcategories even though they might not necessarily be different matches at all. I hope this is a reasonable breakdown and that all people out there can understand this breakdown.

Generic matches

This section will deal with *Generic matches*. A generic match is a kind of match that is always available whatever kind of protocol we are working on or whatever match extensions we have loaded. No special parameters are in other words needed to load these matches at all. I have also added the **--protocol** match here, even though it is needed to use some protocol specific matches. For example, if we want to use an *TCP match*, we need to use the **--protocol** match and send TCP as an option to the match. However, **--protocol** is in itself a match, too, since it can be used to match specific protocols. The following matches are always available.

Table 4. Generic matches

Command
Example

-p, --protocol

Explanation

iptables -A INPUT -p tcp

This match is used to check for certain protocols. Examples of protocols are TCP, UDP and ICMP. This list can vary a bit at the same time since it uses the `/etc/protocols` if it can not recognise the protocol itself. First of all the protocol match can take one of the three aforementioned protocols, as well as ALL, which means to match all of the previous protocols. The protocol may also take a numeric value, such as 255 which would mean the RAW IP protocol. Finally, the program knows about all the protocols in the `/etc/protocols` file as we already explained. The command may also take a comma delimited list of protocols, such as **udp,tcp** which would match all UDP and TCP packets. If this match is given the numeric value of zero (0), it means ALL protocols, which in turn is the default behaviour in case the **--protocol** match is not used. This match can also be inversed with the **!** sign, so **--protocol ! tcp** would mean to match the ICMP and UDP protocols.

-s, **--src**, **--source**

iptables -A INPUT -s 192.168.1.1

This is the source match which is used to match packets based on their source IP address. The main form can be used to match single IP addresses such as *192.168.1.1*. It could be used with a netmask in a bits form. One way is to do it with an regular netmask in the *255.255.255.255* form (ie, *192.168.0.0/255.255.255.0*), and the other way is to only specify the number of ones (1's) on the left side of the network mask. This means that we could for example add */24* to use a *255.255.255.0* netmask. We could then match whole IP ranges, such as our local networks or network segments behind the firewall. The line would then look something like, for example, *192.168.0.0/24*. This would match all packets in the *192.168.0.x* range. We could also inverse the match with an **!** just as before. If we would in other words use a match in the form of **--source ! 192.168.0.0/24** we would match all packets with a source address not coming from within the *192.168.0.x* range. The default is to match all IP addresses.

-d, **--dst**, **--destination**

iptables -A INPUT -d 192.168.1.1

The **--destination** match is used to match packets based on their destination address or addresses. It works pretty much the same as the **--source** match and has the same syntax, except that it matches based on where the packets are going. To match an IP range, we can add a netmask either in the exact netmask form, or in the number of ones (1's) counted from the left side of the netmask bits. It would then look like either *192.168.0.0/255.255.255.0* or like *192.168.0.0/24* and both would be equivalent to each other. We could also invert the whole match with an **!** sign, just as before. **--destination ! 192.168.0.1** would in other words match all packets except those not destined to the *192.168.0.1* IP address.

-i, **--in-interface**

iptables -A INPUT -i eth0

This match is used to match based on which interface the packet came in on. Note that this option is only legal in the INPUT, FORWARD and PREROUTING chains and will render an error message when used anywhere else. The default behaviour of this match, in case the match is not specified, is to assume a string value of +. The + value is used to match a string of letters and numbers. A single + would in other words tell the kernel to match all packets without considering which interface it came in on. The + string can also be used at the end of an interface, and **eth+** would in other words match all ethernet devices. We can also invert the meaning of this option with the help of the **!** sign. The line

would then have a syntax looking something like **-i ! eth0**, which would mean to match all incoming interfaces, except eth0.
-o, **--out-interface**
iptables -A FORWARD -o eth0
The **--out-interface** match is used to match packets depending on which interface they are leaving on. Note that this match is only available in the OUTPUT, FORWARD and POSTROUTING chains, in opposite of the **--in-interface** match. Other than this, it works pretty much the same as the **--in-interface** match. The **+** extension is understood so you can match all eth devices with **eth+** and so on. To inverse the meaning of the match, you can use the **!** sign in exactly the same sense as in the **--in-interface** match. Of course, the default behaviour if this match is left out is to match all devices, regardless of where the packet is going.
-f, **--fragment**
iptables -A INPUT -f
This match is used to match the second and third part of a fragmented packet. The reason for this is that in the case of fragmented packets, there is no way to tell the source or destination ports of the fragments, nor ICMP types, among other things. Also, fragmented packets might in rather special cases be used to compile attacks against computers. Such fragments of packets will not be matched by other rules when they look like this, and hence this match was created. This option can also be used in conjunction with the **!** sign, however, in this case the **!** sign must precede the match, like this **! -f**. When this match is inversed, we match all head fragments and/or unfragmented packets. What this means is that we match all the first fragments of a fragmented packets, and not the second, third, and so on, fragments. We also match all packets that has not been fragmented during the transfer. Also note that there are defragmentation options within the kernel that can be used which are really good. As a secondary note, in case you use connection tracking you will not see any defragmented packets since they are dealt with before hitting any chain or table in **iptables**.

Implicit matches

This section will describe the matches that are loaded implicitly. *Implicit matches* are loaded automatically when we tell **iptables** that this rule will match for example TCP packets with the **--protocol** match. There are currently three types of *implicit matches* that are loaded automatically for three different protocols. These are *TCP matches*, *UDP matches* and *ICMP matches*. The TCP based matches contain a set of different matches that are available for only TCP packets, and UDP based matches contain another set of matches that are available only for UDP packets, and the same thing for ICMP packets. There is also explicitly loaded matches that you must load explicitly with the **-m** or **--match** option which we will go through later on in the next section.

TCP matches

These matches are protocol specific and are only available when working with TCP packets and streams. To use these matches you need to specify **--protocol tcp** on the command line before trying to use these matches. Note that the **--protocol tcp** match must be to the left of the protocol specific matches. These matches are loaded implicitly in a sense, just as the *UDP* and *ICMP matches* are loaded implicitly. The other matches will be looked over in the continuation of this section, after the *TCP match* section.

Table 5. TCP matches

Match
Example
Explanation
--sport, **--source-port**
iptables -A INPUT -p tcp --sport 22
The **--source-port** match is used to match packets based on their source port. This match can either take a service name or a port number. If you specify a service name, the service name must be in the `/etc/services` file since **iptables** uses this file to look up the service name in. If you specify the port by port number, the entry of the rule will be slightly faster since **iptables** don't have to check up the service name, however, it could be a little bit harder to read in case you specify the numeric value. If you are writing a ruleset consisting of a 200 rules or more, you should definitely do this by port numbers since you will be able to notice the difference(On a slow box, this could make as much as 10 seconds if you are running a large ruleset consisting of 1000 rules or so). The **--source-port** match can also be used to match a whole range of ports in this fashion **--source-port 22:80** for example. This example would match all source ports between 22 and 80. If we omit the first port specification, the port 0 is assumed to be the one we mean. **--source-port :80** would then match port 0 through 80. And if the last port specification is omitted, port 65535 is assumed. If we would write **--source-port 22:** we would in turn get a port specification that tells us to match all ports from port 22 through port 65535. If we inversed the port specification in the port range so the highest port would be first and the lowest would be last, **iptables** automatically reverses the inversion. If a source port definition looked like **--source-port 80:22**, it would be understood just the same as **--source-port 22:80**. We could also invert a match by adding a **!** sign like **--source-port ! 22** which would mean that we want to match all ports but port 22. The inversion could also be used together with a port range and would then look like **--source-port ! 22:80**, which in turn would mean that we want to match all ports but port 22 through 80. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--dport, **--destination-port**
iptables -A INPUT -p tcp --dport 22
This match is used to match TCP packets depending on its destination port. It uses exactly the same syntax as the **--source-port** match. It understands port and port range specifications, as well as inversions. It does also reverse high and low ports in a port range specification if the high port went into the first spot and the low port into the last spot. The match will also assume the values of 0 or 65535 if the high or low port is left out in a port range specification. In other words, exactly the same as **--source-port** in syntax. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--tcp-flags
iptables -p tcp --tcp-flags SYN,ACK,FIN SYN
This match is used to match depending on the TCP flags in a packet. First of all the match takes a list of flags to compare (a mask) and second it takes list of flags that should be set to 1, or turned on. Both lists should be comma-delimited. The match knows about the SYN, ACK, FIN, RST, URG, PSH

flags but it also recognizes the words ALL and NONE. ALL and NONE is pretty much self describing, ALL means to use all flags and NONE means to use no flags for the option it is set. **--tcp-flags ALL NONE** would in other words mean to check all of the TCP flags and match if none of the flags are set. This option can also be inverted with the **!** sign. Also note that the comma delimitation should not include spaces. The correct syntax could be seen in the example above.
--syn
iptables -p tcp --syn
The **--syn** match is more or less an old relic from the ipchains days and is still there out of compatibility reasons, and for ease of traversing from one to the other. This match is used to match packets if they have the SYN bit set and the ACK and FIN bits unset. This command would in other words be exactly the same as the **--tcp-flags SYN,ACK,FIN SYN** match. Such packets are used to request new TCP connections from a server mainly. If you block these packets, you should have effectively blocked all incoming connection attempts, however, you will not have blocked the outgoing connections which a lot of exploits today uses (for example, hack a legit service and then make a program or such make the connect to you instead of setting up an open port on your host). This match can also be inverted with the **!** sign in this, **! --syn**, way. This would tell the match to match all packet with the FIN or the ACK bits set, in other words packets in an already established connection.
--tcp-option
iptables -p tcp --tcp-option 16
This match is used to match packets depending on their TCP options.

UDP matches

This section describes matches that will only work together with UDP packets. These matches are implicitly loaded when you specify the **--protocol UDP** match and will be available after this specification. Note that UDP packets are not connection oriented, and hence there is no such thing as different flags to set in the packet to give data on what the datagram is supposed to do, such as open or closing a connection, or if they are just simply supposed to send data. UDP packets do not require any kind of acknowledgement either. If they are lost, they are simply lost (Not taking ICMP error messaging etcetera into account). This means that there is quite a lot less matches to work with on a UDP packet than there is on TCP packets. Note that the state machine will work on all kinds of packets even though UDP or ICMP packets are counted as connectionless protocols. The state machine works pretty much the same on UDP packets as on TCP packets. There will be more about the state machine in a future chapter.

Table 6. UDP matches

Match
Example
Explanation
--sport, **--source-port**
iptables -A INPUT -p udp --sport 53

This match works exactly the same as its TCP counterpart. It is used to perform matches on packets based on their source UDP ports. It has support for port ranges, single ports and port inversions with the same syntax. To make a UDP port range you could do 22:80 which would match UDP ports 22 through 80. If the first value is omitted, port 0 is assumed. If the last port is omitted, port 65535 is assumed. If the high port comes before the low port, the ports switch place with eachother automatically. Single UDP port matches look as in the example above. To invert the port match, add a **!** sign in this, **--source-port ! 53** fashion. This would match all ports but port 80. Of course, the match can understand service names as long as they are available in the `/etc/services` file. Note that this match does not handle multiple separated ports and port ranges. For more information about this, look at the multiport match extension.
--dport, **--destination-port**
iptables -A INPUT -p udp --dport 53
The same goes for this match as for the UDP version of **--source-port**, it is exactly the same as the equivalent TCP match, but will work with UDP packets instead. The match is used to match packets based on their UDP destination port. The match handles port ranges, single ports and inversions. To match a single port we do **--destination-port 53**, to invert this we could do **--destination-port ! 53**. The first would match all UDP packets going to port 53 while the second would match packets but those going to the destination port 53. To specify a port range, we would do **--destination-port 22:80** for example. This example would match all packets destined for UDP port 22 through 80. If the first port is omitted, port 0 is assumed. If the second port is omitted, port 65535 is assumed. If the high port is placed before the low port, they automatically switch place so the low port winds up before the high port. Note that this match does not handle multiple ports and port ranges. For more information about this, look at the multiport match extension.

ICMP matches

These are the *ICMP matches*. These packets are even worse than UDP packets in the sense that they are connectionless. The ICMP protocol is mainly used for error reporting and for connection controlling and such features. ICMP is not a protocol subordinated to the IP protocol, but more of a protocol beside the IP protocol that helps handling errors. The headers of a ICMP packet are very similar to those of the IP headers, but contains differences. The main feature of this protocol is the type header which tells us what the packet is to do. One example is if we try to access an unaccessible IP adress, we would get an `ICMP host unreachable` in return.For a complete listing of ICMP types, see the *ICMP types* appendix. There is only one ICMP specific match available for ICMP packets, and hopefully this should suffice. This match is implicitly loaded when we use the **--protocol ICMP** match and we get access to it automatically. Note that all the generic matches can also be used, so we can know source and destination adress too, among other things.

Table 7. ICMP matches

Match
Example
Explanation
--icmp-type

iptables -A INPUT -p icmp --icmp-type 8
This match is used to specify the ICMP type to match. ICMP types can be specified either by their numeric values or by their names. Numerical values are specified in RFC 792. To find a complete listing of the ICMP name values, do a **iptables --protocol icmp --help**, or check the *ICMP types* appendix. This match can also be inverted with the **!** sign in this, **--icmp-type ! 8**, fashion. Note that some ICMP types are obsolete, and others again may be "dangerous" for a simple host since they may, among other things, redirect packets to the wrong places.

Explicit matches

Explicit matches are matches that must be specifically loaded with the **-m** or **--match** option. If we would like to use the state matches for example, we would have to write **-m state** to the left of the actual match using the state matches. Some of these matches may be specific to some protocols, or was created for testing/experimental use or plainly to show examples of what could be accomplished with **iptables**. This in turn means that all these matches may not always be useful, however, they should mostly be useful since it all depends on your imagination and your needs. The difference between implicitly loaded matches and explicitly loaded ones is that the implicitly loaded matches will automatically be loaded when you, for example, match TCP packets, while explicitly loaded matches will not be loaded automatically in any case and it is up to you to activate them before using them.

MAC match

Table 8. MAC match options

Match
Example
Explanation
--mac-source
iptables -A INPUT --mac-source 00:00:00:00:00:01
This match is used to match packets based on their MAC source address. The MAC address specified must be in the form *XX:XX:XX:XX:XX:XX*, else it will not be legal. The match may be reversed with an **!** sign and would look like **--mac-source ! 00:00:00:00:00:01**. This would in other words reverse the meaning of the match so all packets except packets from this MAC address would be matched. Note that since MAC addresses are only used on ethernet type networks, this match will only be possible to use on ethernet based networks. This match is also only valid in the PREROUTING, FORWARD and INPUT chains and nowhere else.

Limit match

The **limit** match extension must be loaded explicitly with the **-m limit** option. This match is excellent to use to do limited logging of specific rules etcetera. For example, you could use this to match all packets that goes over the edge of a certain chain, and get limited logging of this. What this means, is that when we add this match we **limit** how many times a certain rule may be matched in a certain timeframe. This is its main usage, but there are more usages, of course. The **limit** match may also be inversed by adding a **!** flag in front of the **limit** match explicit loading, it would then look like **-m ! limit**. This means that all packets will be matched after they have broken the limit.

Table 9. Limit match options

Match
Example
Explanation
--limit
iptables -A INPUT -m limit --limit 3/hour
This sets the maximum average matching rate of the **limit** match. This match is specified with a number and an optional time specifier. The following time specifiers are currently recognised: **/second /minute / hour /day**. The default value here is 3 per hour, or 3/hour. This tells the **limit** match how many times to let this match run per timeunit (ie /minute).
--limit-burst
iptables -A INPUT -m limit --limit-burst 5
This is the setting for the *burst limit* of the **limit** match. It tells **iptables** the maximum initial number of packets to match. This number gets recharged by one every time the limit specified is not reached, up to this number. The default value is 5. (If anyone got a good/better and simpler explanation than this, send me a mail and I'll try to make this more understandable).

Multiport match

The **multiport** match extension can be used to specify more destination ports and port ranges than one, which would sometimes mean you would have to make several rules looking exactly the same just to match different ports.

Table 10. Multiport match options

Match
Example
Explanation
--source-port
iptables -A INPUT -p tcp -m multiport --source-port 22,53,80,110
This match matches multiple source ports. A maximum of 15 separate ports may be specified. The ports must be comma delimited, as you can see in the example. This match may only be used in

conjunction with the **-p tcp** or **-p udp** matches. It is mainly an enhanced version of the normal **--source-port** match.
--destination-port
iptables -A INPUT -p tcp -m multiport --destination-port 22,53,80,110
This match is used to match multiple destination ports. It works exactly the same way as the source port match mentioned just above, except that it matches destination ports. It has a maximum specification of 15 ports and may only be used in conjunction with **-p tcp** and **-p udp**.
--port
iptables -A INPUT -p tcp -m multiport --port 22,53,80,110
This match extension can be used to match packets based both on their destination port and their source port. It works the same way as the **--source-port** and **--destination-port** matches above. It can take a maximum of 15 ports specified to it in one argument. It can only be used in conjunction with **-p tcp** and **-p udp**. Note that this means that it will only match packets that comes from, for example, port 80 to port 80 and if you have specified port 80 to the **--port** match.

Mark match

The **mark** match extension is used to match packets based on the marks they have set. A **mark** is a special field only maintained within the kernel that is associated with the packets as they travel through the computer. They may be used by different kernel routines for such tasks as traffic shaping and filtering. As of today, there is only one way of setting a mark in Linux, namely the **MARK** target in **iptables**. This was previously done with the **FWMARK** target in **ipchains**, this is why people still refer to **FWMARK** in advanced routing areas. The mark field is currently set to an unsigned integer, hence the limit of 65535 possible marks to use within your ruleset. In other words, you are probably not going to run into this limit in quite some time.

Table 11. Mark match options

Match
Example
Explanation
--mark
iptables -t mangle -A INPUT -m mark --mark 1
This match is used to match packets that have previously been marked. Marks can be set with the **MARK** target which we will discuss a bit more later on in the next section. All packets traveling through netfilter gets a special mark field associated with them. Note that this mark field does not in any way travel outside, with or without the packet, the actual computer itself. If this mark field matches the **mark** match it is a match. The mark field is an unsigned integer, hence there can be a maximum of 65535 different marks. You may also use a mask with the mark. The mark specification would then look like, for example, **--mark 1/1**. If a mask is specified, it is logically ANDed with the mark specified before the actual comparison.

Owner match

The **owner** match extension is used to match packets based on who created them. This extension was originally written as an example on what **iptables** might be used for. This match only works within the OUTPUT chain as it looks today, for obvious reasons. It is pretty much impossible to find out any information about who sent a packet on the other end, or if we where an intermediate hop to the real destination. Even within the OUTPUT chain it is not very reliable since certain packets may not have an owner. Notorious packets of that sort is different ICMP responses among other things. ICMP responses will, hence, never match.

Table 12. Owner match options

Match
Example
Explanation
--uid-owner
iptables -A OUTPUT -m owner --uid-owner 500
This packet match will match if the packet was created by the given `User ID` (UID). This could be used to match outgoing packets based on who created them. One possible use would be to block any other user than root to open new connections outside your firewall, or another possible use could be to block everyone but the httpuser from creating packets from HTTP.
--gid-owner
iptables -A OUTPUT -m owner --gid-owner 0
This match is used to match all packets based on their `Group ID` (GID). This means that we match all packets based on what group the user creating the packets are in. This could be used to block all but the users part of the "network" group from getting out onto the internet, or as described above to only allow "httpgroup" to be able to create packets going out on the HTTP port.
--pid-owner
iptables -A OUTPUT -m owner --pid-owner 78
This match is used to match packets based on their `Process ID` (PID) and which PID created the packets. This match is a bit harder to use, but one example would be to only allow PID 94 to send packets on the HTTP port, or we could write a small script that grabs the PID from a ps output for a specific daemon and then adds a rule for it. (If anyone has actually used this match for a production server, I would love to hear what they used it for and how they did it).
--sid-owner
iptables -A OUTPUT -m owner --sid-owner 100
This match is used to match packets based on their `Session ID` and the `Session ID` used by the program in question. If anyone have an idea for the usage of this match, please give me a note of it and of other possible uses.

State match

The **state** match extension is used in conjunction with the connection tracking code in the kernel and allows access to the connection tracking state of the packets. This allows us to know in what state the connection is, and works for pretty much all protocols, including stateless protocols such as ICMP and UDP. In all cases, there will be a default timeout for the connection and it will then be dropped from the connection tracking database. This match needs to be loaded explicitly by adding a **-m state** statement to the rule. You will then have access to one new match. This concept will be more deeply introduced in a future chapter since it is such a large area.

Table 13. State matches

Match
Example
Explanation
--state
iptables -A INPUT -m state --state RELATED,ESTABLISHED
This match option tells the **state** match what states the packets must be in to be matched. There is currently 4 states that can be used. **INVALID**, **ESTABLISHED**, **NEW** and **RELATED**. **INVALID** means that the packet is associated with no known stream or connection and that it may contain faulty data or headers. **ESTABLISHED** means that the packet is part of an already established connection that has seen packets in both directions and is fully valid. **NEW** means that the packet has or will start a new connection, or that it is associated with a connection that has not seen packets in both directions. Finally, **RELATED** means that the packet is starting a new connection and is associated with an already established connection. This could for example mean an FTP data transfer, or an ICMP error associated with an TCP or UDP connection for example. Note that the **NEW** state does not look for SYN bits in TCP packets trying to start a new connection and should, hence, not be considered very good in cases where we have only one firewall and no load balancing between different firewalls. However, there may be times where this could be useful. For more information on how this could be used, read in the future chapter on the state machine.

Unclean match

The **unclean** match takes no options and requires no more than explicit loading when you want to use it. Note that this option is regarded as experimental and may not work at all times, nor will it take care of all unclean packages or problems. This match tries to match packets which seems malformed or unusual, such as packets with bad headers or checksums and so on. This could be used to **DROP** connections and to check for bad streams etcetera, however you should be aware that this may break legal connections too.

TOS match

The **TOS** match can be used to match packets based on their TOS field. TOS stands for Type Of Service, consists of 8 bits, and is located in the IP header. This match is loaded explicitly by adding **-m tos** to the rule. TOS is normally used to tell intermediate hosts the preceeding of the stream, and what kind of content it has(not really, but it tells us if there is any specific requirements for this stream such as that it needs to be sent as fast as possible, or it needs to be able to send as much payload as possible). How different routers and people deal with these values depends. Most do not care at all, while others try their best to do something good with the packets in question and the data they provide.

Table 14. TOS matches

Match
Example
Explanation
--tos
iptables -A INPUT -p tcp -m tos --tos 0x16
This match is used as described above, it can match packets based on their TOS field and their value. This could be used for, among other things, to **mark** packets for later usage together with the **iproute2** and advanced routing functions in linux. The match takes an hex or numeric value as an option, or possibly one of the names given if you do an **iptables -m tos -h**. At the time of writing it contained the following named values: `Minimize-Delay 16 (0x10)`, `Maximize-Throughput 8 (0x08)`, `Maximize-Reliability 4 (0x04)`, `Minimize-Cost 2 (0x02)`, and `Normal-Service 0 (0x00)`. `Minimize-Delay` means to minimize the delay for the packets, example of standard protocols that this includes are telnet, SSH and FTP-control. `Maximize-Throughput` means to find a path that allows as big throughput as possible, a standard protocol would be FTP-data. `Maximize-Reliability` means to maximize the reliability of the connection and to use lines that are as reliable as possible, some good protocols that would fit with this TOS values would be BOOTP and TFTP. `Minimize-Delay` means to minimize the delay until the packets gets through all the way to the client/server, ie find the fastest route. Some good protocols that would use this would be RTSP (Real Time Stream Control Protocol) and other streaming video/radio protocols. `Normal-Service` would finally mean any normal protocol that has no special needs for their transfers.

TTL match

The **TTL** match is used to match packets based on their TTL (Time To Live) field residing in the IP header. The TTL field contains 2 bits and is decremented once every time it is processed by an intermediate host between the client and host. If the TTL reaches 0, an ICMP type 11 code 0 (TTL equals 0 during transit) or code 1 (TTL equals 0 during reassembly) is transmitted to the party sending the packet and telling about the problem. This match is only used to match packets based on their TTL, and not to change anything. This is true here, as well as in all kinds of matches. To load this match, you need to add an **-m ttl** to the rule.

Table 15. TTL matches

Command
Example
Explanation
--ttl
iptables -A OUTPUT -m ttl --ttl 60
This match option is used to specify which TTL value to match. It takes an numeric value and matches based on this value. There is no inversion and there is no other specifics to this match. This target could be used for debugging your local network, for example hosts which seems to have problems connecting to hosts on the internet, or to find possible infestations of trojans etcetera. The usage is pretty much limited, however, it is only your imagination which stops you. One example, as described above, would be to find hosts with bad TTL values set as default (may be due to badly implemented TCP/IP stack, or due to a malconfiguration).

Targets/Jumps

The target/jumps tells the rule what to do with a packet that is a perfect match with the match section of the rule. There is a few basic targets, the **ACCEPT** and **DROP** targets which we will deal with first of all targets. However, before we do that, let us have a brief look at how a jump is done.

The jump specification is done exactly the same as the target definition except that it requires a chain within the same table to jump to. To jump to a specific chain, it is required that the chain has already been created. As we have already explained before, a chain is created with the **-N** command. For example, let's say we create a chain in the filter table called **tcp_packets** like this: **iptables -N tcp_packets**. We could then add a jump target to it like this: **iptables -A INPUT -p tcp -j tcp_packets**. We would then jump from the **INPUT** chain to the **tcp_packets** chain and start traversing that chain. When/If we reach the end of that chain, we get dropped back to the **INPUT** chain and the packet starts traversing from the rule one step below where it jumped to the other chain (tcp_packets in this case). If a packet is **ACCEPT**'ed within one of the subchains, it will automatically be **ACCEPT**'ed in the superset chain also and it will not traverse any of the superset chains any further. However, do note that the packet will traverse all other chains in the other tables in a normal fashion. For more information on table and chain traversing, see the *Traversing of tables and chains* chapter.

Targets on the other hand specify an action to take on the packet in question. We could for example, **DROP** or **ACCEPT** the packet depending on what we want to do. There is also a number of other actions we may want to take which we will describe further on in this section. Targets may also end with different results one could say, some targets will make the packet stop traversing the specific chain and superset chains as described above. Good examples of such rules are **DROP** and **ACCEPT**. Rules that are stopped, will not pass through any of the rules further on in the chain or superset chains. Other targets, may take an action on the packet and then the packet will continue passing through the rest of the rules anyway, a good example of this would be the **LOG**, **DNAT** and **SNAT** targets. These packets may be logged, Network Address Translationed and then be passed on to the other rules in the same chains. This may be good in cases where we want to take two actions on the same packet, such as both mangling the TTL and the TOS value of a specific packet/stream. Some targets will also take options that may be necessary (What address to do NAT to, what TOS value to use etcetera) while others have options not necessary, but available in any case (log prefixes, masquerade to ports and so on). We will try to answer all these questions as we go in the descriptions. Let us have a look at what kinds of targets there are.

ACCEPT target

This target takes no special options first of all. When a packet is perfectly matched and this target is set, it is accepted and will not continue traversing the chain where it was accepted in, nor any of the calling chains. Do note, that packets that was accepted in one chain will still travel through any subsequent chains within the other tables and may be dropped there. There is nothing special about this target whatsoever, and it does not require, or have the possibility, to add options to the target. To use this target, we specify it like **-j ACCEPT**.

DROP target

The **DROP** target does just what it says, it drops packets dead to the ground and refuses to process them anymore. A packet that matches a rule perfectly and then has this action taken on it will be blocked and no further processing will be done. Note that this action may be a bit bad in certain cases since it may leave dead sockets around on the server and client. A better solution would be to use the **REJECT** target in those cases, especially when you want to block certain portscanners from getting to much information, such as filtered ports and so on. Also note that if a packet has the **DROP** action taken on them in a subchain, the packet will not be processed in any of the above chains in the structure either. The target will not send any kind of information in either direction, either to tell the client or the server as told previously.

QUEUE target

Table 16. QUEUE target

Option
Example
Explanation
Option
Example
Explanation

RETURN target

The **RETURN** target will make the current packet stop travelling through the chain where it hit the rule. If it is a subchain to another chain, the packet will continue to travel through the above chains in the structure as if nothing had happened. If the chain is the main chain, for example the INPUT chain, the packet will have the default policy taken on it. The default policy is normally set to **ACCEPT** or **DROP** or something the like.

For example, lets say a packet enters the INPUT chain and then hits a rule that it matches and that gives it **--jump EXAMPLE_CHAIN**. The packet will then start traversing the **EXAMPLE_CHAIN**, and all of a sudden it matches a specific rule which has the **--jump RETURN** target set. It will then jump back to the previous chain, which in this case would be the INPUT chain. Another example would be if the packet hit a **--jump RETURN** rule in the INPUT chain. It would then be dropped to the default policy as previously described, and no more actions would be taken in this chain.

LOG target

The **LOG** target is specially made to make it possible to log snippets of information about packets that may be illegal, or for pure bughunting and errorfinding. The **LOG** target will log specific information such as most of the IP headers and other interesting information via the kernel logging facility. This information may then be read with **dmesg** or **syslogd** and likely programs and applications. This is an excellent target to use while you are debugging your rulesets to see what packets go where and what rules are applied on what packets. Also note that it may be a really great idea to use the **LOG** target instead of the **DROP** target while you are testing a rule you are not 100% sure about on a production firewall since this may otherwise cause severe connectivity problems for your users. Also note that the **ULOG** target may be interesting in case you are getting heavy logs, since the **ULOG** target has support for logging directly to MySQL databases and such.

Note that it is not a **iptables** or netfilter problem in case you get your logs to the consoles or likely, but instead a problem of your syslogd configuration which you may find in `/etc/syslog.conf`. Read more in **man syslog.conf** for information about these kind of problems.

The **LOG** target currently takes five options that may be interesting to use in case you have specific needs for more information, or want to set different options to specific values. They are all listed below.

Table 17. LOG target options

Option
Example
Explanation
--log-level
iptables -A FORWARD -p tcp -j LOG --log-level debug
This is the option that we can use to tell **iptables** and **syslog** which log level to use. For a complete list of loglevels read the `syslog.conf` manual. Normally there are the following log levels, or priorities as they are normally referred to: debug, info, notice, warning, warn, err, error, crit, alert, emerg and panic. The keyword error is the same as err, warn is the same as warning and panic is the same as emerg. Note that all three of these are deprecated, in other words do not use error, warn and panic. The priority defines the severity of the message being logged. All messages are logged through the kernel facility. In other words, setting kern.=info `/var/log/iptables` in your syslog.conf file

and then letting all your **LOG** messages in iptables use log level info, would make all messages appear in the `/var/log/iptables` file. Note that there may be other messages here as well from other parts of the kernel that uses the info priority. For more information on logging I recommend you to read the **syslog** and `syslog.conf` manpages as well as other HOWTO's etcetera.
--log-prefix
iptables -A INPUT -p tcp -j LOG --log-prefix "INPUT packets"
This option tells **iptables** to prefix all log messages with a specific prefix which may then be very good to use together with, for example, **grep** and other tools to distinguish specific problems and outputs from specific rules. The prefix may be up to 29 letters long, including whitespace and those kind of symbols.
--log-tcp-sequence
iptables -A INPUT -p tcp -j LOG --log-tcp-sequence
This option will log the TCP Sequence numbers together with the log message. The TCP Sequence number are special numbers that identify each packet and where it fits into a TCP sequence and how the stream should be reassembled. Note that this option is a security risk if the log is readable by any users, or by the world for that matter. Any log that is, which may contain logging messages from **iptables**.
--log-tcp-options
iptables -A FORWARD -p tcp -j LOG --log-tcp-options
The **--log-tcp-options** option will log the different options from the TCP packets header. These may be valuable when trying to debug what may go wrong and what has gone wrong. This option takes no variable fields or anything like that, just as most of the **LOG** options.
--log-ip-options
iptables -A FORWARD -p tcp -j LOG --log-ip-options
The **--log-ip-options** option will log most of the IP packet header options. This works exactly thesame as the **--log-tcp-options** option, but instead works on the IP options. These logging messages may be valuable when trying to debug or finding out specific culprits and what goes wrong, just the same as the previous option.

MARK target

The **MARK** target is used to set **netfilter** mark values that are associated with specific packets. This target is only valid in the mangle table, and will not work outside there. The **MARK** values may be used in conjunction with the advanced routing capabilities in Linux to send different packets through different routes and to tell them to use different queue disciplines (qdisc), etcetera. For more information on advanced routing, check out the LARTC HOWTO. Note that the mark value is not set within the actual package, but is an value that is associated within the kernel with the packet. In other words, you may not set a **MARK** for a package and then expect the **MARK** to still be there on another computer. If this is what you want, you will be better off with the **TOS** target which will mangle the TOS value in the IP header.

Table 18. MARK target options

Option
Example
Explanation
--set-mark
iptables -t mangle -A PREROUTING -p tcp --dport 22 -j MARK --set-mark 2
The **--set-mark** option is required to set a mark. The **--set-mark** match takes an integer value. For example, we may set mark 2 to a specific stream of packets, or on all packets from a specific host and then do advanced routing on that host, limiting or unlimiting their network speed etcetera.

REJECT target

The **REJECT** target works basically the same as the **DROP** target, but it also sends back an error message to the host sending the packet that was blocked. The **REJECT** target is as of today only valid in the INPUT, FORWARD and OUTPUT chain or subchains of those chains, which would also be the only chains where it would make any sense to put this target in. Note that the chains that uses the **REJECT** target may only be called upon by the INPUT, FORWARD, and OUTPUT chains, else they won't work. There currently is only one option which controls the nature of how this target works, which in turn may take a huge set of variables. Most of them are fairly easy to understand if you have a basic knowledge of TCP/IP.

Table 19. REJECT target

Option
Example
Explanation
--reject-with
iptables -A FORWARD -p TCP --dport 22 -j REJECT --reject-with tcp-reset
This option tells the **REJECT** target what response to send to the host that sent the packet that we found to be a match. Once we get a packet that matches a specific rule and we specify this target, the target will first of all send the specified reply, and then the packet is dropped dead to the ground, just the same as with the **DROP** target. There are currently the following reject types that can be used: `icmp-net-unreachable`, `icmp-host-unreachable`, `icmp-port-unreachable`, `icmp-proto-unreachable`, `icmp-net-prohibited` and `icmp-host-prohibited`. The default error message is to send an **port-unreachable** to the host. All of the above are ICMP error messages and may be set as you wish, and you may get some more information by looking in the appendix *ICMP types*. There is also an option called **echo-reply**, but this option may only be used in conjunction with rules which would match ICMP ping packets. Finally, there is one more option called **tcp-reset** which may only be used together with the TCP protocol. the

tcp-reset option will tell **REJECT** to send an TCP RST packet in reply to the sending host. TCP RST are used to close open connections gracefully. For more information about the TCP RST read RFC 793 - Transmission Control Protocol. As stated in the **iptables** man page, this is mainly useful for blocking ident probes which frequently occur when sending mail to broken mail hosts, which won't accept your mail otherwise.

TOS target

The **TOS** target is used to set the Type of Service field within the IP header. The TOS field consists of 8 bits which are used to route packets. This is one of the few fields that can be used within **iproute2** and its subsystem to route packets. Also note that if you handle several separate firewalls and routers, this is the only way to propagate routing information between these routers and firewalls within the actual packet. As noted before, the **MARK** target which sets a **MARK** associated with a specific packet is only available within the kernel, and can not be propagated with the packet. If you feel a need to propagate routing information on how to do routing for a specific packet or stream, you should hence set the TOS field which was developed for this. There are currently a lot of routers on the internet which does a pretty bad job at this so it may be a bit useless as of now to do any TOS mangling before sending the packets on to the internet. At best the routers will do nothing with the TOS field, and they will not even look at them. At worst, they will look at the TOS field and do the wrong thing based on the information. As stated previously, however, there is most definitely a good use if you have a large WAN or LAN with several routers and actually have the possibility to give packets different routes and preference depending on their TOS value, at least within your own network.

Note that this target is only valid within the mangle table and can not be used outside it. Also note that some old versions (1.2.2 or below) of iptables provided a broken implementation of this target which would not fix the packet checksum upon mangling, and hence rendered the packets bad and in need of retransmission, which in turn most probably would be mangled and the connection would never work.

The **TOS** target only takes one option as described below.

Table 20. TOS target

Option
Example
Explanation
--set-tos
iptables -t mangle -A PREROUTING -p TCP --dport 22 -j TOS --set-tos 0x10
The **--set-tos** option tells the **TOS** mangler what TOS value to set on packets that are matched. The option takes a numeric value, either in hex or in decimal value. As the TOS value consists of 8 bits, the value may be 0-255, or in hex 0x00-0xFF. Note that most of these values will never be used by anyone on the internet so you may be better of by using the named values available (which should be more or less standardized). These values are `Minimize-Delay` (decimal value 16, hex value 0x10), `Maximize-Throughput` (decimal value 8, hex value 0x08), `Maximize-Reliability` (decimal value 4, hex value 0x04), `Minimize-Cost` (decimal value 2, hex 0x02) or `Normal-Service` (decimal value 0, hex value 0x00). The default value on most packets

are `Normal-Service`, or 0. Note that you can, of course, use the actual names instead of the actual hex values to set up the TOS value, and it should generally be recommended since the values behind the names may be changed if you are unlucky. For a complete listing of the "descriptive values", do an **iptables -j TOS -h**. This listing is complete as of iptables 1.2.5 and should hopefully be so for another period of time.

MIRROR target

The **MIRROR** target is an experimental demonstration target only, and you should be warned of using this since it may result in really bad loops, hence resulting in a bad kind of Denial of Service, among other things. The **MIRROR** target is used to invert the source and destination fields in the IP header, and then to retransmit the packet. This results in some really funny things, and I would be quite sure that someone has had a good laugh at some cracker or another that has cracked his own box via this target by now. The result of this target is really simple. Lets say we set up a **MIRROR** target for port 80 at computer A. If computer B would be coming from yahoo.com, and tried to access the HTTP server at computer A, the MIRROR target would make so computer B got the webpage at yahoo.com back (since this is where he came from).

Note that the **MIRROR** target is only valid within the **INPUT**, **FORWARD** and **PREROUTING** chains, and any user-defined chains which are only called from those chains. Also note that the outgoing packets created by the **MIRROR** target is not seen by any of the normal chains in the filter, **NAT** or mangle tables to avoid loops and other problems. However, this does not make the target free of any likely problems. One thing would for example be to send a spoofed packet to a host that uses the **MIRROR**command with a **TTL** of 255, and see to it that the packet is spoofed so it looks as if it comes from another host that uses the **MIRROR** command. The packet will then bounce back and forth a huge set of times, depending on how many hops there is between them. If there is only 1 hop, the packet will jump back and forth 240-255 times. Not bad for a cracker in other words to send 1500 bytes of data, and eat up 380 kbyte of your connection. Note that this is a best case scenario for the cracker or scriptkiddie, whichever we want to call them.

SNAT target

The **SNAT** target is used to do Source Network Address Translation, which means that this target will rewrite the Source IP address in the IP header of the packet. For example, this is good when we want several computers to share an internet connection. We could then turn on ip forwarding in the kernel, and then set an **SNAT** rule which would translate all packets from our local network to the **source IP** of our own internet connection. Without doing this, the outside world would not know where to send reply packets, since our local networks should use the IANA specified IP addresses which are allocated for **LAN** networks. If we forwarded these packets as is, noone on the internet would know that they where actually from us. The **SNAT** target does all the translation needed to do this kind of work, letting all packets leaving our **LAN** look as if they came from a single host, which would be our firewall.

The **SNAT** target is only valid within the nat table, within the **POSTROUTING** chain. This is in other words the only place that you may do **SNAT** in. If the first packet in a connection is mangled in this fashion, then all future packets in the same connection will also be **SNAT**'ed and, also, no further processing of rules in the **POSTROUTING** chain will be commenced on the packets in the same stream.

Table 21. SNAT target

Option
Example
Explanation
--to-source
iptables -t nat -A POSTROUTING -o eth0 -j SNAT --to-source 194.236.50.155-194.236.50.160:1024-32000
The **--to-source** option is used to specify which source the packets should use. This option, at it simplest, takes one IP address to which we should transform all the **source IP** addresses in the **IP header**. If we want to balance between several IP addresses we could use an range of IP addresses separated by a hyphen, it would then look like, for example, 194.236.50.155-194.236.50.160 as described in the example above. The source IP would then be set randomly for each stream that we open, and a single stream would always use the same IP address for packets within that stream. There may also be an range of ports specified that should only be used by **SNAT**. All the source ports would then be mapped to the ports specified. This would hence look as within the example above, :1024-32000 or something alike. iptables will always try to not make any port alterations if it is possible, but if two hosts tries to use the same ports, iptables will map one of them to another port. If no port range is specified, then all source ports below 512 will be mapped to other ports below 512 if needed. Those between source ports 512 and 1023 will be mapped to ports below 1024. All other ports will be mapped to 1024 or above. As previously stated, iptables will always try to maintain the source ports used by the actual workstation making the connection. Note that this has nothing to do with destination ports, so if a client tries to make contact with an **HTTP** server outside the firewall, it will not be mapped to the **FTP control** port.

DNAT target

The **DNAT** target is used to do Destination Network Address Translation, which means that it is used to rewrite the `Destination IP` address of a packet. If a packet is matched, and this is the target of the rule, the packet, and all subsequent packets in the same stream will be translated, and then routed on to the correct device, host or network. This target can be extremely useful, for example, when you have an host running your webserver inside a *LAN*, but no real IP to give it that will work on the internet. You could then tell the firewall to forward all packets going to its own HTTP port, on to the real webserver within the *LAN*. We may also specify a whole range of destination IP addresses, and the **DNAT** mechanism will choose the destination IP address at random for each stream. Hence, we will be able to deal with a kind of load balancing by doing this.

Note that the **DNAT** target is only available within the PREROUTING and OUTPUT chains in the nat table, and any of the chains called upon from any of those listed chains. Note that chains containing **DNAT** targets may not be used from any other chains, such as the POSTROUTING chain.

Table 22. DNAT target

Option	**--to-destination**
Example	**iptables -t nat -A PREROUTING -p tcp -d 15.45.23.67 --dport 80 -j DNAT --to-destination 192.168.1.1-192.168.1.10**
Explanation	The **--to-destination** option tells the DNAT mechanism which Destination IP to set in the IP header, and where to send packets that are matched. The above example would send on all packets destined for IP address 15.45.23.67 to a range of *LAN* IP's, namely 192.168.1.1 through 10. Note, as described previously, that a single stream will always use the same host, and that each stream will randomly be given an IP address that it will always be Destinated for, within that stream. We could also have specified only one IP address, in which case we would always be connected to the same host. Also note that we may add an port or port range to which the traffic would be redirected to. This is done by adding, for example, an :80 statement to the IP addresses to which we want to DNAT the packets. A rule could then look like **--to-destination 192.168.1.1:80** for example, or like **--to-destination 192.168.1.1:80-100** if we wanted to specify a port range. As you can see, the syntax is pretty much the same for the **DNAT** target, as for the **SNAT** target even though they do two totally different things. Do note that port specifications are only valid for rules that specify the TCP or UDP protocols with the **--protocol** option.

MASQUERADE target

The **MASQUERADE** target is used basically the same as the **SNAT** target, but it does not require any **--to-source** option. The reason for this is that the **MASQUERADE** target was made to work with, for example, dialup connections, or DHCP connections, which gets dynamic IP addresses when connecting to the network in question. This means that you should only use the **MASQUERADE** target with dynamically assigned IP connections, which we don't know the actual address of at all times. If you have a static IP connection, you should instead use the **SNAT** target.

When you masquerade a connection, it means that we set the IP address used on a specific network interface instead of the **--to-source** option, and the IP address is automatically grabbed from the information about the specific interface. The **MASQUERADE** target also has the effect that connections are forgotten when an interface goes down, which is extremely good if we, for example, kill a specific interface. If we would have used the **SNAT** target, we may have been left with a lot of old connection tracking data, which would be lying around for days, swallowing up worthful connection tracking memory. This is in general the correct behaviour when dealing with dialup lines that are probable to be assigned a different IP every time it is up'ed. In case we are assigned a different IP, the connection is lost anyways, and it is more or less idiotic to keep the entry around.

It is still possible to use the **MASQUERADE** target instead of **SNAT** even though you do have an static IP, however, it is not favorable since it will add extra overhead, and there may be inconsistencies in the future which will thwart your existing scripts and render them "unusable".

Note that the **MASQUERADE** target is only valid within the POSTROUTING chain in the nat table, just as the **SNAT** target. The **MASQUERADE** target takes on option specified below, which is optional.

Table 23. MASQUERADE target

Option
Example
Explanation
--to-ports
iptables -t nat -A POSTROUTING -p TCP -j MASQUERADE --to-ports 1024-31000
The **--to-ports** option is used to set the source port or ports to use on outgoing packets. Either you can specify a single port like **--to-ports 1025** or you may specify a port range as **--to-ports 1024-3000**. In other words, the lower port range delimiter and the upper port range delimiter separated with a hyphen. This alters the default SNAT port-selection as described in the *SNAT target* section. The **--to-ports** option is only valid if the rule match section specifies the TCP or UDP protocols with the **--protocol** match.

REDIRECT target

The **REDIRECT** target is used to redirect packets and streams to the machine itself. This means that we could for example **REDIRECT** all packets destined for the HTTP ports to an HTTP proxy like squid, on our own host. Locally generated packets are mapped to the 127.0.0.1 address. In other words, this rewrites the destination address to our own host for packets that are forwarded, or something alike. The **REDIRECT** target is extremely good to use when we want, for example, transparent proxying, where the *LAN* hosts do not know about the proxy at all.

Note that the **REDIRECT** target is only valid within the PREROUTING and OUTPUT chains of the nat table. It is also valid within user-defined chains that are only called from those chains, and nowhere else. The **REDIRECT** target takes only one option, as described below.

Table 24. REDIRECT target

Option
Example
Explanation
--to-ports
iptables -t nat -A PREROUTING -p tcp --dport 80 -j REDIRECT --to-ports 8080
The **--to-ports** option specifies the destination port, or port range, to use. Without the **--to-ports** option, the destination port is never altered. This is specified, as above, **--to-ports 8080** in case we only want to specify one port. If we would want to specify an port range, we would do it like **--to-ports 8080-8090**, which tells the **REDIRECT** target to redirect the packets to the ports 8080 through 8090. Note that this option is only available in rules specifying the TCP or UDP protocol with the **--protocol** matcher, since it wouldn't make any sense anywhere else.

TTL target

The **TTL** target is used to modify the Time To Live field in the IP header. One useful application of this is to change all Time To Live values to the same value on all outgoing packets. One reason for doing this is if you have a bully *ISP* which don't allow you to have more than one machine connected to the same internet connection, and who actively pursue this. Setting all **TTL** values to the same value, will effectively make it a little bit harder for them to notify that you are doing this. We may then reset the **TTL** value for all outgoing packets to a standardized value, such as 64 as specified in Linux kernel.

For more information on how to set the default value used in Linux, read the *ip-sysctl.txt*, which you may find within the *Other resources and links* appendix.

The **TTL** target is only valid within the mangle table, and nowhere else. It takes 3 options as of writing this, all of them described below in the table.

Table 25. TTL target

Option	**Example**	**Explanation**
--ttl-set	**iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-set 64**	The **--ttl-set** option tells the **TTL** target which TTL value to set on the packet in question. A good value would be around 64 somewhere. It's not too long, and it is not too short. Do not set this value too high, since it may affect your network and it is a bit immoral to set this value to high, since the packet may start bouncing back and forth between two misconfigured routers, and the higher the TTL, the more bandwidth will be eaten unnecessary in such a case.
--ttl-dec	**iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-dec 1**	The **--ttl-dec** option tells the **TTL** target to decrement the Time To Live value by the amount specified after the **--ttl-dec**option. In other words, if the TTL for an incoming packet was 53 and we had set **--ttl-dec 3**, the packet would leave our host with a TTL value of 49. The reason for this is that the networking code will automatically decrement the TTL value by 1, hence the packet will be decremented by 4 steps, from 53 to 49 in other words. IF ANYONE HAS A GOOD USAGE FOR THIS OPTION, NOTIFY ME
--ttl-inc	**iptables -t mangle -A PREROUTING -o eth0 -j TTL --ttl-inc 1**	The **--ttl-inc** option tells the **TTL** target to increment the Time To Live value with the value specified to the **--ttl-inc** option. This means that we should raise the TTL value with the value specified in the **--ttl-inc** option, and if we specified **--ttl-inc 4**, a packet entering with a TTL of 53 would leave the host with TTL 56. Note that the same thing goes here, as for the previous example of the **--ttl-dec** option, where the network code will automatically decrement the TTL value by 1, which it always does. This may be used to make our firewall a bit more stealthy to traceroutes among other things. By setting the TTL one value higher for all incoming packets, we effectively make the firewall hidden from traceroutes. Traceroutes are a loved and hated thing, since they provide excellent information on problems with connections and where it happens, but at the same time, it gives the hacker/cracker some good information about your upstreams if they have targeted you. For a good example on how this could be used, see the ttl-inc.txt script.

ULOG target

The **ULOG** target is used to provide userspace logging of matching packets. If a packet is matched and the **ULOG** target is set, the packet information is multicasted together with the whole packet through a netlink socket. One or more userspace processes may then subscribe to various multicast groups and receive the packet. This is in other words a more complete and more sophisticated logging facility that is only used by iptables and netfilter so far, and it contains much better facilities for logging packets. This target enables us to log information to MySQL databases, and other databases, making it much simpler to search for specific packets, and to group log entries etcetera.

Table 26. ULOG target

Option
Example
Explanation
--ulog-nlgroup
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-nlgroup 2
The **--ulog-nlgroup** option tells the **ULOG** target which netlink group to send the packet to. There are 32 netlink groups, which are simply specified as 1-32. If we would like to reach netlink group 5, we would simply write **--ulog-nlgroup 5**. The default netlink groupd used is 1.
--ulog-prefix
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-prefix "SSH connection attempt: "
The **--ulog-prefix** option works just the same as the prefix value for the standard **LOG** target. This option prefixes all log entries with a userspecified log prefix. It can be 32 characters long, and is definitely most useful to distinguish different logmessages and where they came from.
--ulog-cprange
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-cprange 100
The **--ulog-cprange** option tells the **ULOG** target how many bytes of the packet to send to the userspace daemon of **ULOG**. If we specify 100 as above, we would copy 100 bytes of the whole packet to userspace, which would include the whole header hopefully, plus some leading data within the actual packet. If we specify 0, the whole packet will be copied to userspace, regardless of the packets size. The default value is 0, so the whole packet will be copied to userspace.
--ulog-qthreshold
iptables -A INPUT -p TCP --dport 22 -j ULOG --ulog-qthreshold 10
The **--ulog-qthreshold** option tells the **ULOG** target how many packets to queue inside the kernel before actually sending the data to userspace. For example, if we set the threshold to 10 as above, the kernel would first accumulate 10 packets inside the kernel, and then transmit it outside to the userspace as one single netlink multipart message. The default value here is 1 because of backwards compatibility, the userspace daemon did not know how to handle multipart messages previously.

Traversing of tables and chains

This chapter will talk about how packets traverse the the different chains and in which order. Also we will speak about in which order the tables are traversed. This is extremely valuable information later on when you write your own specific rules. We will also look at which points certain other parts that also are kernel dependant gets in the picture. With this we mainly mean the different routing decisions and so on. This is especially needed if you want to write rules with **iptables** that chould change how different packets get routed, good examples of this is **DNAT** and **SNAT** and of course the TOS bits.

General

When a packet first enters the firewall, it hits the hardware and then get's passed on to the proper device driver in the kernel. Then the packet starts to go through a series of steps in the kernel before it is either sent to the correct application (locally), or forwarded to another host or whatever happens to it. In this example, we're assuming that the packet is destined for another host on another network. The packet goes through the different steps in the following fashion:

Table 1. Forwarded packets

Step	Table	Chain	Comment
1			On the wire(ie, internet)
2			Comes in on the interface(ie, eth0)
3	mangle	PREROUTING	This chain is normally used for mangling packets, ie, changing TOS and so on.
4	nat	PREROUTING	This chain is used for Destination Network Address Translation mainly. Source Network Address Translation is done further on. Avoid filtering in this chain since it will be passed through in certain cases.
5			Routing decision, ie, is the packet destined for our localhost or to be forwarded and where.
6	filter	FORWARD	The packet got routed onto the FORWARD chain, only forwarded packets go through here, we do all the filtering here. Note that all traffic that's forwarded goes through here (not only in one direction), so you need to think about it when writing your ruleset.
7	nat	POSTROUTING	This chain should first and foremost be used for Source Network Address Translation, avoid doing filtering here since certain packets might pass this chain without ever hitting it. This is also where Masquerading is done.

8			Goes out on the outgoing interface (ie, eth1).
9			Out on the wire again (ie, LAN).

As you can see, there's quite a lot of steps to pass through. The packet can be stopped at any of the **iptables** chains, or anywhere else in case it is malformed, however, we are mainly interested in the **iptables** aspect of this lot. Do note that there is no specific chains or tables for different interfaces or anything like that. FORWARD is always passed by all packets that are forwarded over this firewall/ router. Now, let us have a look at a packet that is destined for our own localhost. It would pass through the following steps before actually being delivered to our application to receive it:

Table 2. Destination localhost

Step	**Table**	**Chain**	**Comment**
1			On the wire (ie, Internet)
2			Comes in on the interface(ie, eth0)
3	mangle	PREROUTING	This chain is normally used for mangling packets, ie, changing TOS and so on.
4	nat	PREROUTING	This chain is used for Destination Network Address Translation mainly. Avoid filtering in this chain since it will be passed through in certain cases.
5			Routing decision, ie, is the packet destined for our localhost or to be forwarded and where.
6	filter	INPUT	This is where we do filtering for all incoming traffic destined for our localhost. Note that all incoming packets destined for this host passes through this chain, no matter what interface and so on it came from.
7			Local process/application (ie, server/client program)

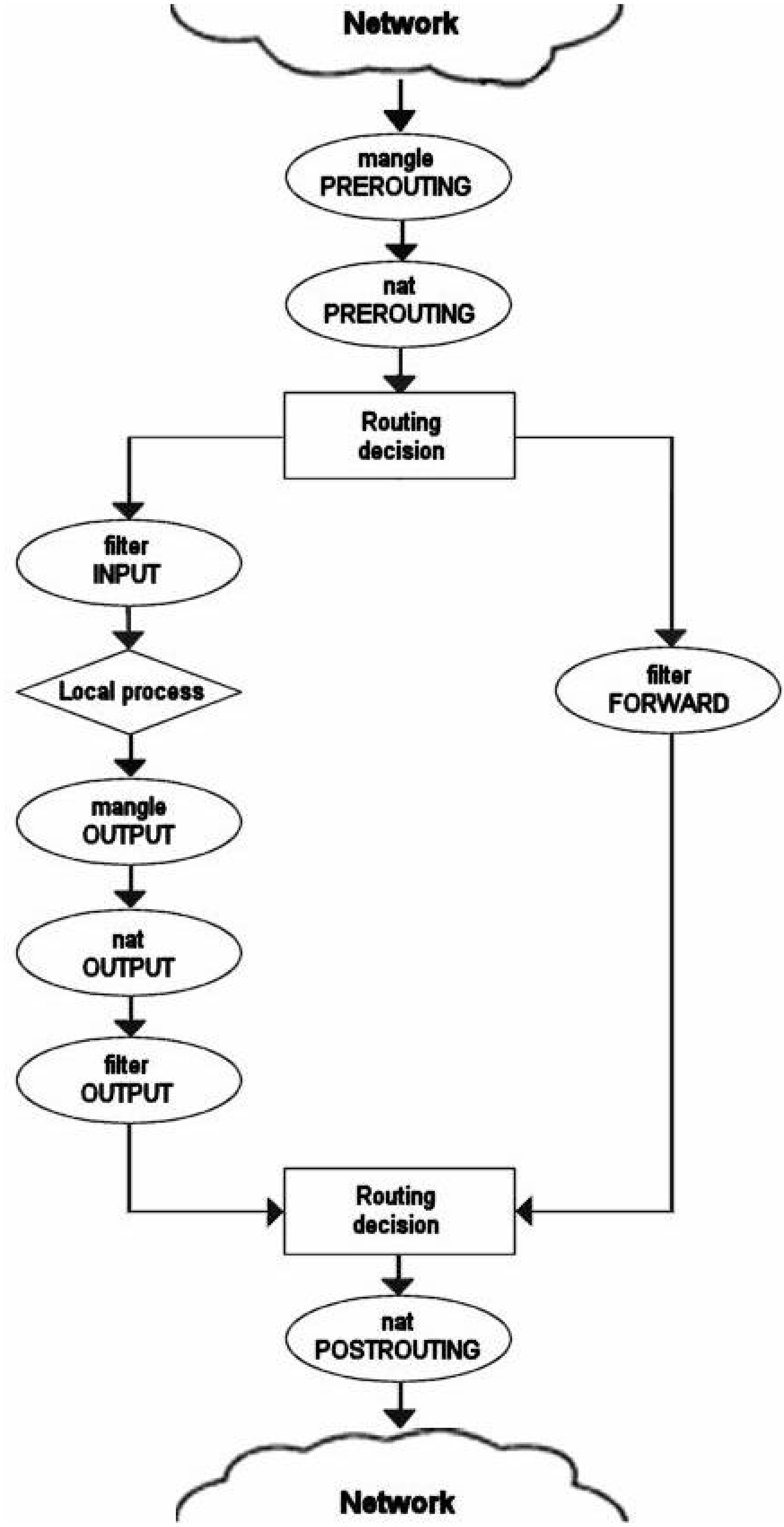
Note that this time the packet was passed through the INPUT chain instead of the FORWARD chain. Quite logical. Most probably the only thing that's really logical about the traversing of tables and chains in your eyes in the beginning, but if you continue to dig in it, I think it gets clearer with time. I think. Finally we look at the outgoing packets from our own localhost and what steps they go through.

Table 3. Source localhost

Step	**Table**	**Chain**	**Comment**
1			Local process/application (ie, server/client program)
2	Mangle	OUTPUT	This is where we mangle packets, it is suggested that you do not filter in this chain since it can have sideeffects.

3	Nat	OUTPUT	This is currently broken, could someone tell me when this will be fixed? Please?
4	Filter	OUTPUT	This is where we filter packets going out from localhost.
5			Routing decision. This is where we decide where the packet should go.
6	Nat	POSTROUTING	This is where we do Source Network Address Translation as described earlier. It is suggested that you don't do filtering here since it can have sideeffects, and certain packets might slip through even though you set a default policy of **DROP**.
7			Goes out on some interface (ie, eth0)
8			On the wire (ie, Internet)

We have now seen how the different chains are traversed in three separate scenarios. If we would figure out a good map of all this, it would look something like this:



Hopefully you got a clearer picture of how the packets traverses the built in chains now. All comments welcome, this might still be wrong or it might change in the future. If you feel that you want more information, you could use the *rc.test-iptables.txt* script. This test script should give you the necessary rules to test how the tables and chains are traversed.

Mangle table

This table should as we've already noted mainly be used for mangling packets. In other words, you may freely use the mangle matches etc that could be used to change TOS (Type Of Service) fields and so on.

Caution

It is strongly adviced that you don't use this table to do any filtering in, nor will any DNAT, SNAT or Masquerading work in this table.

Target's that only valid in the mangle table:

- TOS
- TTL
- MARK

The **TOS** target is used to set and/or change the Type of Service field in the packet. This could be used for setting up policies on the network regarding how a packet should be routed and so on. Note that this has not been perfected and is not really implemented on the internet and most of the routers don't care about the value in this field, and sometimes, they act faulty on what they get. Don't set this in other words for packets going to the internet unless you want to do routing decisions on it with iproute2.

The **TTL** target is used to change the TTL (Time To Live) field of the packet. We could tell packets to only have a specific TTL and so on. One good reason for this could be that we don't want to give ourself away to nosy Internet Service Providers. Some Internet Service Providers does not like users running multiple computers on one single connection, and there are some Internet Service Providers known to look for a single host generating many different TTL values, and takes this as one of many signs of multiple computers connected to a single connection.

The **MARK** target is used to set special mark values to the packet. These marks could then be recognised by the **iproute2** programs to do different routing on the packet depending on what mark they have, or if they don't have any. We could also do bandwidth limiting and Class Based Queuing based on these marks.

Nat table

This table should only be used for NAT (Network Address Translation) on different packets. In other words, it should only be used to translate packets source field or destination field. Note that, as we have said before, only the first packet in a stream will hit this chain. After this, the rest of the packets will automatically have the same action taken on them as the first packet. The actual targets that does these kind of things are:

- DNAT
- SNAT
- MASQUERADE

The **DNAT** (Destination Network Address Translation) target is mainly used in cases such as when you have one IP and want to redirect accesses to the firewall to some other host on a DMZ for example. In other words, we change the destination address of the packet and reroute it to some other host.

SNAT (Source Network Address Translation) is mainly used for changing the source address of packets. This is mainly done to hide our local networks or DMZ, etcetera. A good example when this is very good is when we have a firewall that we know the outside IP address of, but need to change our local networks IP numbers to the same of the IP of our firewall. The firewall will with this target automatically **SNAT** and **De-SNAT** the packets, hence making it possible to make connections from the LAN to the Internet. If you're network uses 192.168.x.x netmask for example, the packets would never get back from the Internet because these networks are regulated to be used in LAN's by IANA.

The **MASQUERADE** target is used in exactly the same way as **SNAT**, but the **MASQUERADE** target takes a little bit more overhead to compute. The reason for this is that each time that the **MASQUERADE** target gets hit by a packet, it automatically checks for the IP address to use, instead of doing as the **SNAT** target does and just use an IP address submitted while the rule was parsed. The **MASQUERADE** target will on the other hand work properly with Dynamic IP addresses that you may be provided when you connect to the Internet with, for example PPP, SLIP or DHCP.

Filter table

The filter table is, of course, mainly used for filtering packets. We can match packets and filter them however we want, and there is nothing special to this chain or special packets that might slip through because they are malformed, etc. This is the place that we actually take action against packets and look at what they contain and **DROP**/**ACCEPT** depending on their payload. Of course we may do filtering earlier too, however, this is the place that was designed for it. Almost all targets are usable in this chain, however, the targets discussed previously in this chapter are only usable in their respective tables. We will not go into deeper discussion about this table though, as you already know, this is where we (should) do the main filtering.

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rc.firewall file

This chapter will deal with an example firewall setup and how the script file could look. We have used one of the basic setups and dug deeper into how it works and what we do in it. This should be used to get a basic idea on how to solve different problems and what you may need to think about before actually putting your scripts into work. It could be used as is with some changes to the variables, but is not suggested since it may not work perfectly together with your network setup. As long as you have a very basic setup however, it will very likely run quite smooth with just a few fixes to it.

note that there might be more efficient ways of making the ruleset, however, the script has been written for readability so that everyone can understand it without having to know too much BASH scripting before reading this

example rc.firewall

Ok, so you have everything set up and are ready to check out an example configuration script. You should at least be if you have come this far. This example rc.firewall.txt (also included in the *Example scripts codebase*appendix) is fairly large but not a lot of comments in it. Instead of looking for comments, I suggest you read through the script file to get a basic hum about how it looks, and then you return here to get the nitty gritty about the whole script.

explanation of rc.firewall

Configuration options

The first section you should note within the example rc.firewall.txt is the configuration section. This should always be changed since it contains the information that is vital to your actual configuration. For example, your IP address will always change, hence it is available here. The **$INET_IP** should always be a fully valid IP address, if you got one (if not, then you should probably look closer at the *rc.DHCP.firewall.txt*, however, read on since this script will introduce a lot of interesting stuff anyways). Also, the **$INET_IFACE** variable should point to the actual device used for your internet connection. This could be eth0, eth1, ppp0, tr0, etcetera just to name a few possible device names.

This script does not contain any special configuration options for DHCP or PPPoE, hence these sections are empty. The same goes for all sections that are empty, they are however left there so you can spot the differences between the scripts in a more efficient way. If you need these parts, then you could always create a mix of the different scripts, or (hold yourself) create your own from scratch.

The Local Area Network section contains most of the configuration options for your LAN, which are necessary. For example, you need to specify the IP address of the physical interface connected to the LAN as well as the IP range which the LAN uses and the interface that the box is connected to the LAN through.

Also, as you may see there is a Localhost configuration section. We do provide it, however you will with 99% certainty not change any of the values within this section since you will almost always use the 127.0.0.1 IP address and the interface will amost certainly be named lo. Also, just below the Localhost configuration, you will find a brief section that pertains to the iptables. Mainly, this section only consists of the **$IPTABLES** variable, which will point the script to the exact location of the **iptables** application. This may vary a bit, and the default location when compiling the iptables package by hand is `/usr/local/sbin/iptables`. However, many distributions put the actual application in another location such as `/usr/sbin/iptables` and so on.

Initial loading of extra modules

First, we see to it that the module dependencies files are up to date by issuing an **/sbin/depmod -a** command. After this we load the modules that we will require for this script. Always avoid loading modules that you do not need, and if possible try to avoid having modules lying around at all unless you will be using them. This is for security reasons, since it will take some extra effort to make additional rules this way. Now, for example, if you want to have support for the `LOG`, **REJECT** and **MASQUERADE** targets and don't have this compiled statically into your kernel, we load these modules as follows:

/sbin/insmod ipt_LOG
/sbin/insmod ipt_REJECT
/sbin/insmod ipt_MASQUERADE

Next is the option to load `ipt_owner` module, which could for example be used to only allow certain users to make certain connections, etcetera. I will not use that module in this example but basically, you could allow only root to do FTP and HTTP connections to redhat and **DROP** all the others. You could also disallow all users but your own user and root to connect from your box to the Internet, might be boring for others, but you will be a bit more secure to bouncing hacker attacks and attacks where the hacker will only use your host as an intermediate host. For more information about the ipt_owner match, look at the *Owner match* section within the *How a rule is built* chapter.

We may also load extra modules for the state matching code here. All modules that extend the state matching code and connection tracking code are called ip_conntrack_* and ip_nat_*. Connection tracking helpers are special modules that tells the kernel how to properly track the specific connections. Without these so called helpers, the kernel would not know what to look for when it tries to track specific connections. The NAT helpers on the other hand, are extensions of the connection tracking helpers that tells the kernel what to look for in specific packets and how to translate these so the connections will actually work. For example, FTP is a complex protocol by definition, and it sends connection information within the actual payload of the packet. So, if one of your hosts NAT'ed boxes connect to a FTP server on the internet, it will send its own local network IP address within the payload of the packet, and tells the FTP server to connect to that IP address. Since this local network address is not valid outside your own network, the FTP server will not know what to do with it and hence the connection will break down. The FTP NAT helpers do all of the translations within these connections so the FTP server will actually know where to connect. The same thing applies for DCC file transfers (sends) and chats. Creating these kind of connections requires the IP address and ports to be sent within the IRC protocol, which in turn requires some translation to be done. Without these helpers, some FTP and IRC stuff will work no doubt, however, some other things will not work. For example, you may be able to receive files over DCC, but not be able to send files. This is due to how the DCC starts a connection. First off, you tell the receiver that you want to send a file and where he should connect to. Without the helpers, the DCC connection will look as if it wants the receiver to connect to some host on the receivers own local network. In other words, the whole connection will be broken. However, the other way around, it will work flawlessly since the sender will (most probably) give you the correct address to connect to.

As of this writing, there is only the option to load modules which add support for the FTP and IRC protocols. For a long explanation of these conntrack and nat modules, read the *Common problems and questionmarks* appendix. There are also H.323 conntrack helpers within the patch-o-matic, as well as some other conntrack helpers. To be able to use these helpers, you need to use the patch-o-matic and compile your own kernel. For a better explanation on how this is done, read the *Preparations* chapter.

Note that you need to load the ip_nat_irc and ip_nat_ftp if you want Network Adress Translation to work properly on any of the FTP and IRC protocols. You will also need to load the ip_conntrack_irc and ip_conntrack_ftp modules before actually loading the NAT modules. They are used the same way as the conntrack modules, but it will make it possible for the computer to do NAT on these two protocols.

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proc set up

At this point we start the IP forwarding by echoing a 1 to `/proc/sys/net/ipv4/ip_forward` in this fashion:

echo "1" > /proc/sys/net/ipv4/ip_forward

It may be worth a thought where and when we turn on the IP forwarding. In this script and all others within the tutorial, we turn it on before actually creating any kind of IP filters (ie, **iptables** rulesets). This will lead to a brief period of time where the firewall will accept forwarding any kind of traffic for everything between a millisecond to a minute depending on what script we are running and on what box. This may give malicious people a small timeframe to actually get through our firewall. In other words, this option should really be turned on *after* creating all firewall rules, however, I have chosen to turn it on here to maintain consistency with the script breakdown currently user.

In case you need dynamic IP support, for example if you use SLIP, PPP or DHCP you may enable the next option, `ip_dynaddr` by doing the following :

echo "1" > /proc/sys/net/ipv4/ip_dynaddr

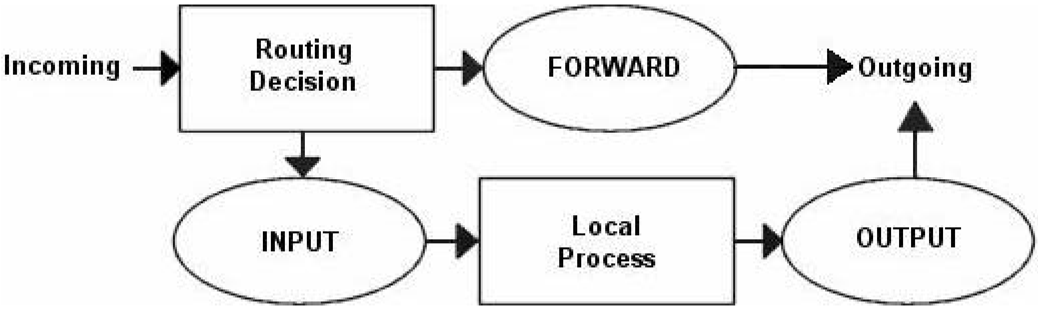
If there is any other options you might need to turn on you should follow that style, there's other documentations on how to do these things and this is out of the scope of this documentation. There is a good but rather brief document about the proc system available within the kernel, which is also available within the *Other resources and links* appendix. Also, it may be worth looking at that appendix in the future, in case there are possible additional links added to other and better resources of information.

The `rc.firewall.txt` script, and all others contained within this tutorial, do contain a small section of non-required proc settings. These may be a good starters to look at, however, do not turn these on before actually knowing what they mean.

Displacement of rules to different chains

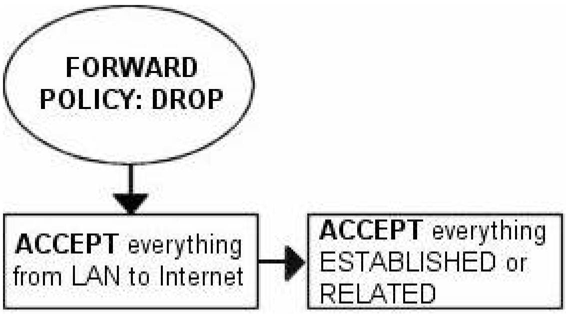
This section will briefly describe my choices within the tutorial regarding user specified chains and some choices specific to the `rc.firewall.txt` script. Some of the paths I have chosen to go here may be wrong from one or another of aspect. I hope to point these aspects and possible problems out to you when and where they occur. Also, this section contains a brief look back to the *Traversing of tables and chains* chapter. Hopefully, this will remind you a little bit of how the specific tables and chains are traversed in a real live example.

I have displaced all the different user-chains in the fashion I have to save as much CPU as possible but at the same time put the main weight on security and readability. Instead of letting a TCP packet traverse ICMP, UDP and TCP rules, I simply match all TCP packets and then let the TCP packets traverse an user specified chain. This way we do not get too much overhead out of it all. The following picture will try to explain the basics of how an incoming packet traverses netfilter. With these pictures and explanations, I wish to explain and clarify the goals of this script. We will not discuss any specific details yet, but instead further on in the chapter. This is a really trivial picture in comparison to the one in the *Traversing of tables and chains* chapter where we discussed the whole traversal of chains and tables in depth.

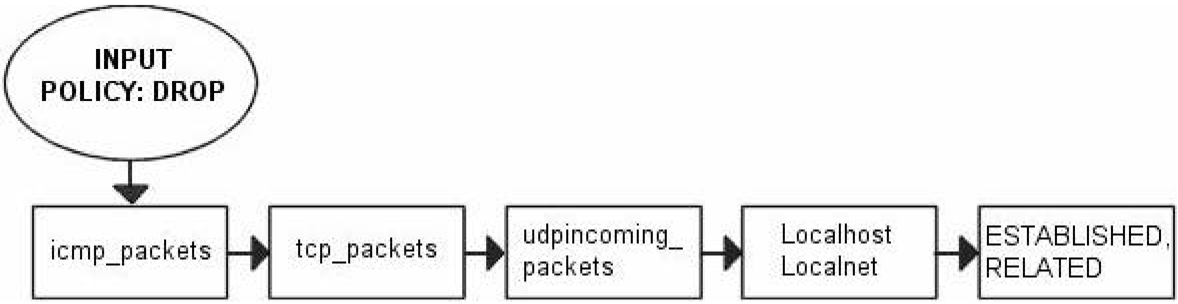


Based upon this picture, let's make clear what our goals are. This whole example script is based upon the assumption that we are looking at a scenario containing one local network, one firewall and an Internet connection connected to the firewall. This example is also based upon the assumption that we have a static IP to the internet (as opposed to DHCP, PPP and SLIP and others). In this case, we also want to allow the firewall to act as a server for certain services on the internet, and we trust our local network fully and hence we will not block any of the traffic from the local network. Also, this script has as a main priority to only allow traffic that we explicitly want to allow. To do this, we want to set default policies within the chains to DROP. This will effectively kill all connections and all packets that we do not explicitly allow inside our network or our firewall.

In the case of this scenario, we would also like to let our local network do connections to the internet. Since the local network is fully trusted, we want to allow all kind of traffic from the local network to the internet. However, the Internet is most definitely not a trusted network and hence we want to block them from getting to our local network. Based upon these general assumptions, let's look at what we need to do and what we do not need to do.



First of all, we want the local network to be able to connect to the internet, of course. To do this, we will need to NAT all packets since none of the local computers have real IP addresses. All of this is done within the PREROUTING chain, which is created last in this script. This means that we will also have to do some filtering within the FORWARD chain since we will otherwise allow outsiders full access to our local network. We trust our local network to the fullest, and because of that we specifically allow all traffic from our local network to the internet. Since noone on the Internet should be allowed to contact our local network computers, we will want to block all traffic from the Internet to our local network except already established and related connections, which in turn will allow all return traffic from the Internet to our local network.



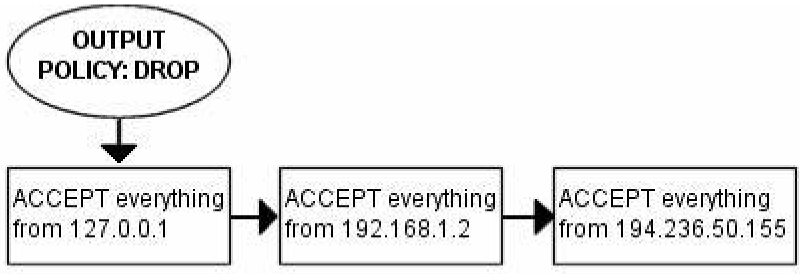
As for our firewall, we may be a bit low on funds perhaps, or we just want to offer a few services to people on the internet. Therefore, we have decided to allow HTTP, FTP, SSH and IDENTD access to the actual firewall. All of these protocols are available on the actual firewall, and hence it should be allowed through the INPUT chain, and we need to allow the return traffic through the OUTPUT chain. However, we also trust the local network fully, and the loopback device and IP address are also trusted. Because of this, we want to add special rules to allow all traffic from the local network as well as the loopback network interface. Also, we do not want to allow specific packets or packet headers in specific conjunctions, nor do we want to allow some IP ranges to reach the firewall from the Internet. For instance, the 10.0.0.0/8 address range is reserved for local networks and hence we would normally not want to allow packets from such a address range since they would with 90% certainty be spoofed. However, before we implement this, we must note that certain Internet Service Providers actually use these address ranges within their own networks. For a closer discussion of this, read the *Common problems and questionmarks* chapter.

Since we have an FTP server running on the server, as well as the fact we want to traverse as few rules as possible, we add a rule which lets all established and related traffic through at the top of the INPUT chain. For the same reason, we want to split the rules down into subchains. By doing this, our packets will hopefully only need to traverse as few rules as possible. By traversing less rules, we make the ruleset less timeconsuming for each packet, and reduce redundancy within the network.

In this script, we choose to split the different packets down by their protocol family, for example TCP, UDP or ICMP. All TCP packets traverse a specific chain named tcp_packets, which will contain rules for all TCP ports and protocols that we want to allow. Also, we want to do some extra checking on the TCP packets, so we would like to create one more subchain for all packets that are accepted for using valid port numbers to the firewall. This chain we choose to call the "allowed" chain, and should contain a few extra checks before finally accepting the packet. As for ICMP packets, these will traverse the icmp_packets chain. When we decided on how to create this chain, we could not see any specific needs for extra checks before allowing the ICMP packets through if we agree with the type and code of the ICMP packet, and hence we accept the directly. Finally, we have the UDP packets which needs to be dealt with. These packets, we send to the udp_packets chain which handles all incoming UDP packets.

All incoming UDP packets should be sent to this chain, and if they are of an allowed type we should accept them immediately without any further checking.

Since we are running on a relatively small network, this box is also used as a secondary workstation and to give some extra levy for this, we want to allow certain specific protocols to make contact with the firewall itself, such as speak freely and ICQ.



Finally, we have the firewalls OUTPUT chain. Since we actually trust the firewall quite a lot, we allow pretty much all traffic leaving the firewall. We do not do any specific user blocking, nor do we do any blocking of specific protocols. However, we do not want people to use this box to spoof packets leaving the firewall itself, and hence we only want to allow traffic from the IP addresses assigned to the firewall itself. We would most likely implement this by adding rules that ACCEPT all packets leaving the firewall in case they come from one of the IP addresses assigned to the firewall, and if not they will be dropped by the default policy in the OUTPUT chain.

Setting up the different chains used

So, now you got a small picture on how the packet traverses the different chains and how they belong together. You should also have a clear picture of the goals of this script. It is now about time that we take care of setting up all the rules and chains that we wish to create and to use, as well as all of the rulesets within the chains.

First of all, we set all the default policies on the different chains with a quite simple command.

iptables -P <chain name> <policy>

The default policy is used every time the packets don't match a rule in the chain. After this, we create the different special chains that we want to use with the **-N** command. The new chains are created and set up with no rules inside of them. The chains we will use are icmp_packets, tcp_packets, udpincoming_packets and the allowed chain for tcp_packets. Incoming packets on eth0, of ICMP type, will be redirected to the chain icmp_packets, of TCP type, will be redirected to tcp_packets and incoming packets of UDP type from eth0 go to udpincoming_packets chain.

INPUT chain

The INPUT chain as I've written it uses mostly other chains to do the hard work. This way we don't get too much load from the iptables, and it will work much better on slow machines which might otherwise drop packets at high loads.

We do certain checks for bad packets here. If you want to fully understand this, you need to look at the Appendices regarding state NEW and non-SYN packets getting through other rules. These packets could be allowed under certain circumstances but in 99% of the cases we wouldn't want these packets to get through. Hence, we log them to our logs and then we DROP them.

First of all we match all ICMP packets in the INPUT chain that come on the incoming interface **$INET_IFACE**, which in my case is eth0, and send those to the `icmp_packets`, which was previously described. After this, we do the same match for TCP packets on the **$INET_IFACE** and send those to the tcp_packets chain, and after this all UDP packets get sent to udpincoming_packets chain.

Finally, we check for everything that comes from our **$LOCALHOST_IP**, which would normally be 127.0.0.1 and **ACCEPT** all incoming traffic from there, do the same for everything to **$LAN_IP**, which in my case would be 192.168.0.0/24, and after this, something that some might consider a security problem, I allow everything that comes from my own Internet IP that is either **ESTABLISHED** or **RELATED** to some connection. Also, we allow broadcast traffic from our LAN. some applications depend on it such as Samba etc. These applications will not work properly without it.

Before we hit the default policy of the INPUT chain, we log it so we might be able to find out about possible problems and or bugs. Either it might be a packet that we just dont want to allow or it might be someone who's doing something bad to us, or finally it might be a problem in our firewall not allowing traffic that should be allowed. In either case we want to know about it so it can be dealt with. Though, we don't log more than 3 packets per minute as to not getting flooded with crap all over the log files, also we set a prefix to all log entries so we know where it came from.

Everything that hasn't yet been caught will be **DROP**'ed by the default policy on the INPUT chain. The default policy was set quite some time back, as you might remember.

The TCP allowed chain

If a packet comes in on eth0 and is of TCP type, it travels through the tcp_packets chain, if the connection is against an allowed port, we want to do some final checks on it to see if we actually do want to allow it or not.

First of all, we create the chain the same way as all the others. After that, we check if the packet is a SYN packet. If it is a SYN packet, it is most likely to be the first packet in a new connection so, of course, we allow this. Then we check if the packet comes from an **ESTABLISHED** or **RELATED** connection, if it does, then we, again of course, allow it. An **ESTABLISHED** connection is a connection that has seen traffic in both directions, and since we've got a SYN packet, and a reply to this SYN packet, the connection then must be in state **ESTABLISHED**. The last rule in this chain will **DROP** everything else. In this case this pretty much means everything that hasn't seen traffic in both directions, ie, we didn't reply to the SYN packet, or they are trying to start the connection with a non SYN packet. There is *no* practical use of not starting a connection with a SYN packet, except to portscan people pretty much. There is no currently available TCP/IP implementation that supports opening a TCP connection with something else than a SYN packet to my knowledge, hence, **DROP** the crap since it's 99% sure to be a portscan.

The ICMP chain

This is where we decide what ICMP types to allow. If a packet of ICMP type comes in on eth0 on the INPUT chain, we then redirect it to the `icmp_packets` chain as explained before. Here we check what kind of ICMP types to allow. As it is now, I only allow incoming ICMP Echo Replies, Destination unreachable, Redirect and Time Exceeded.

The reason that I allow these ICMP packets are as follows, Echo Replies is what you get for example when you ping another host, if we don't allow this, we will be unable to ping other hosts.

Destination Unreachable is used if a certain host is unreachable, so for example if we send a HTTP request, and the host is unreachable, the last gateway that was unable to find the route to the host replies with a Destination Unreachable telling us that it was unable to find it. This way we won't have to wait until the browser's timeouts kicks in after some 60 seconds or more.

Time Exceeded, is allowed in the case where we might want to traceroute some host or if a packet gets its Time To Live set to 0, we will get a reply about this. For example, when you traceroute someone, you start out with TTL = 1, and it gets down to 0 at the first hop on the way out, and a Time Exceeded is sent back from the first gateway en route to the host we're trying to traceroute, then TTL = 2 and the second gateway sends Time Exceeded, and so on until we get an actual reply from the host we finally want to get to.

For a complete listing of all ICMP types, see the appendix ICMP types. For more information on ICMP types and their usage, i suggest reading the following documents and reports :

- The Internet Control Message Protocol ICMP
- RFC 792 - Internet Control Message Protocol by J. Postel.

As a side-note, I might be wrong in blocking some of these ICMP types for you, but in my case, everything works perfectly while blocking all the other ICMP types that I don't allow.

The TCP chain

So now we reach TCP connections. This specifies what ports that are allowed to use on the firewall from the Internet. Though, there is still more checks to do, hence we send each and one of them on to allowed chain, which we described previously.

-A tcp_packets tells **iptables** in which chain to add the new rule, the rule will be added to the end of the chain. **-p TCP** tells it to match TCP packets and **-s 0/0** matches all source addresses from 0.0.0.0 with netmask 0.0.0.0, in other words *all* sources addresses, this is actually the default behaviour but I'm using it for brevity in here. **--dport 21** means destination port 21, in other words if the packet is destined for port 21 they also match. If all the criteria are matched, then the packet will be targeted for the allowed chain. If it doesn't match any of the rules, they will be passed back to the original chain that sent the packet to the tcp_packets chain.

As it is now, I allow TCP port 21, or FTP control port, which is used to control FTP connections and later on I also allow all **RELATED** connections, and that way we allow PASSIVE and PORT connections since the ip_conntrack_ftp module is, hopefully, loaded. If we don't want to allow FTP at all, we can unload the ip_conntrack_ftp module and delete the **$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed** line from the `rc.firewall.txt` file.

Port 22 is SSH, much better than allowing telnet on port 23, if you want to allow anyone from the outside to use a shell on your box at all. Note that you are dealing with a firewall. It is always a bad idea to give others than yourself any kind of access to these kind of boxes. Firewalls should always be kept to a bare minimum and not more.

Port 80 is HTTP, in other words your web server, delete it if you don't want to run a web server on your site.

And finally we allow port 113, which is IDENTD and might be necessary for some protocols like IRC, etc to work properly.

If you feel like adding more open ports with this script, well, its quite self explanatory how to do that by now=).

The UDP chain

If we do get a UDP packet on the INPUT chain, we send them on to udpincoming_packets where we once again do a match for the UDP protocol with **-p UDP** and then match everything with a source address of 0.0.0.0 and netmask 0.0.0.0, in other words everything again. If they have a source port of 53 also, we **ACCEPT** them directly.

As it is now, I **ACCEPT** incoming UDP packets from port 53, which is what we use to do DNS lookups, without this we wouldn't be able to do domain name lookups and we would be reversed to only use IP's. We don't want this behaviour, hence we allow DNS, of course.

I personally also allow port 123, which is NTP or network time protocol. This protocol is used to set your computer clock to the same time as certain other time servers which have *very* accurate clocks. Though, most of you probably don't use this protocol, I'm allowing it per default since I know there are some who actually do.

We currently also allow port 2074, which is used for certain real-time `multimedia' applications like speak freely which you can use to talk to other people in real-time by using speakers and a microphone, or even better, a headset.

Port 4000 is the ICQ protocol. This should be an extremely well known protocol that is used by the Mirabilis application named ICQ. There is at least 5 different ICQ clones for Linux and it's one of the most widely used chat programs in the world. I doubt there is any further need to explain what it is.

OUTPUT chain

Since i know that there's pretty much no one but me using this box which is partially used as a Firewall and a workstation currently, I allow pretty much everything that goes out from it that has a source address **$LOCALHOST_IP**, **$LAN_IP** or **$STATIC_IP**. Everything else might be spoofed in some fashion, even though I doubt anyone that I know would do it on my box. Last of all we log everything that gets dropped. If it does get dropped, we'll sure as hell want to know about it for some reason or another. Either it's a nasty error, or it's a weird packet that's spoofed. Finally we **DROP** the packet in the default policy.

FORWARD chain

Even though I haven't actually set up a certain section in the `rc.firewall.txt` example file, I would like to comment on the few lines in there anyways. As it is now, we first of all **ACCEPT** all packets coming from our LAN with the following line:

/usr/local/sbin/iptables -A FORWARD -i $LAN_IFACE -j ACCEPT

So everything from our Localnet's interface gets **ACCEPT**'ed whatever the circumstances. After this we allow everything in a state **ESTABLISHED** or **RELATED** from everywhere, in other words, if we open a connection from our LAN to something on the Internet, we allow the packets coming back from that site that's either **ESTABLISHED** or **RELATED** but nothing else. And after this we log everything and drop it. We log maximally 3 log entries per minute as to not flood our own logs, and prefix them with a short line that is possible to grep for in the logfiles. Also we log them with debug level. We finally hit the default policy of the FORWARD chain that says to **DROP** everything.

PREROUTING chain of the nat table

The PREROUTING chain is pretty much what it says, it does network adress translation on packets before they actually hit the routing tables that sends them onwards to the INPUT or FORWARD chains in the filter table. Note that this chain should not be used for any filtering or such, it should be used for network adress translation, among other things since this chain is only traversed by the first packet in a stream.

First of all we check for obviously spoofed IP addresses, such as in case we get packets from the Internet interface that claim to have a source IP of 192.168.x.x, 10.x.x.x or 172.16.x.x, in such case, we drop them quicker than hell since these IP's are reserved especially for local intranets and definitely shouldn't be used on the Internet. This might be used in the opposite direction, too, if we get an packet from `$LAN_IFACE` that claims to *not* come from an IP address in the range which we know that our LAN is on, we might drop that too. As it looks now, we don't do that though.

Starting the Network Address Translation

So, our final mission would be to get the **MASQUERADE**ing up, correct? At least to me. First of all we add a rule to the nat table, in the POSTROUTING chain that will masquerade all packets going out on our interface connected to the Internet. For me this would be eth0. However, there are specific variables added to these example scripts that may be used to automatically configure these settings. These settings are widely used within the example scripts, mainly to make them easier to configure, but also to improve the readability a bit. The **-t** option tells us which table to use, in this case nat while the **-A** command tells us that we want to Add a new rule to an existing chain named POSTROUTING and **-o $INET_IFACE** tells us to match all outgoing packets on **INET_IFACE** (or eth0, per default settings in this script) and finally we target the packet for **MASQUERADE**'ing. So all packets that match this rule will be masqueraded to look as it came from your Internet interface. Simple, isn't it?

The next step we take is to **ACCEPT** all packets traversing the FORWARD chain in the default table filter that come from the input interface eth1 which is my interface connecting to the internal network. All packets that are being forwarded on our box traverse the FORWARD chain in the filter table.

The next thing we do is to **ACCEPT** all packets from anywhere that are **ESTABLISHED** and/or **RELATED** to some connection. In other words, we first send a packet from our local box behind eth1, and since it comes from eth1 we **ACCEPT** it, then when the Internet box replies, it gets caught by this rule since the connection has seen packets in both directions.

The last thing we do is to log all traffic that gets dropped over the border, and hits the default policy. In some cases these might be packets that should have gotten through but didn't, in other cases it might be packets that definitely shouldn't get through and you want to be notified about this. We allow this rule to be matched a maximum of 3 times per minute with a burst limit of 3. This means we get maximally 3 log entries per minute from this specific line, and the burst is also set to 3 so if we get 3 log entries in 2 seconds, it'll have to wait for another 1 minute for the next log entry. This is good if someone starts to flood you with crap stuff that otherwise would generate many megabytes of logs. We also set a prefix to the log with the **--log-prefix** and set the log level with the **--log-level**. Log level tells the **syslogd**, or logging facility what kind of importance this log entry has.

Example scripts

The objective of this chapter is to give a fairly brief and short explanation of each script available with this tutorial, and to provide an overlook of the scripts and what services they provide. These scripts are not in any way perfect, and they may not fit your exact intentions perfectly. It is in other words up to you to make these scripts suitable for your needs. The rest of this tutorial should most probably be helpful in making this feat. The first section of this tutorial deals with the actual structure that I have established in each script so we may find our way within the script a bit easier.

---

rc.firewall.txt script structure

All scripts written for this tutorial has been written after a specific structure. The reason for this is that they should be fairly conformative to each other and to make it easier to find the differences between the scripts. This structure should be fairly well documented in this brief chapter. This chapter should hopefully give a short understanding to why all the scripts has been written as they have, and why I have chosen to maintain this structure.

> **Note**
>
> Even though this is the structure I have chosen, do note that this may not be the best structure for your scripts. It is only a structure that I have chosen to use since it fits the need of being easy to read and follow the best according to my logic.

The structure

This is the structure that all scripts in this tutorial should follow. If they differ in some way it is probably an error on my part, unless it is specifically explained why I have broken this structure.

1. *Configuration* - First of all we have the configuration options which the rest of the script should use. Configuration options should pretty much always be the first thing in any shell-script.

    1. *Internet* - This is the configuration section which pertains to the Internet connection. This could be skipped if we do not have any Internet connection. Note that there may be more subsections than those listed here, but only such that pertains to our Internet connection.

        1. *DHCP* - If there are possibly any special DHCP requirements with this specific script, we will add the DHCP specific configuration options here.

        2. *PPPoE* - If there are a possibility that the user that wants to use this specific script, and if there are any special circumstances that raises the chances that he is using a PPPoE connection, we will add specific options for those here.

    2. *LAN* - If there is any LAN available behind the firewall, we will add options pertaining to that in this section. This is most likely, hence this section will almost always be available.

    3. *DMZ* - If there is any reason to it, we will add a DMZ zone configuration at this point. Most scripts lacks this section, mainly because any normal home network, or small corporate network, will not have one.

    4. *Localhost* - These options pertain to our localhost. These variables are highly unlikely to change, but we have put most of it into variables anyway. Hopefully, there should be no reason to change these variables.

    5. *iptables* - This section contains iptables specific configuration. In most scripts and situations this should only require one variable which tells us where the iptables binary is located.

    6. *Other* - If there are any other specific options and variables, they should first of all be fitted into the correct subsection (If it pertains to the Internet connection, it should be subsectioned there, etcetera). If it does not fit in anywhere, it should be subsectioned directly to the configuration options somewhere.

2. *Module loading* - This section of the scripts should maintain a list of modules. The first part should contain the required modules, while the second part should contain the non-required modules.

   Note that some modules that may raise security, or add certain services or possibilities, may have been added even though they are not required. This should normally be noted in such cases within the example scripts.

   1. *Required modules* - This section should contain the required modules, and possibly special modules that adds to the security or adds special services to the administrator or clients.

   2. *Non-required modules* - This section contains modules that are not required for normal operations. All of these modules should be commented out per default, and if you want to add the service it provides, it is up to you.

3. *proc configuration* - This section should take care of any special configuration needed in the proc filesystem. If some of these options are required, they will be listed as such, if not, they should be commented out per default, and listed under the non-required proc configurations. Most of the useful proc configurations will be listed here, but far from all of them.

   1. *Required proc configuration* - This section should contain all of the required proc configurations for the script in question to work. It could possibly also contain configurations that raises security, and possibly which adds special services or possibilities for the administrator or clients.

   2. *Non-required proc configuration* - This section should contain non-required proc configurations that may prove useful. All of them should be commented out, since they are not actually necessary to get the script to work. This list will contain far from all of the proc configurations or nodes.

4. *rules set up* - By now the scripts should most probably be ready to insert the ruleset. I have chosen to split all the rules down after table and then chain names. All user specified chains are created before we do anything to the system builtin chains. I have also chosen to set the chains and their rulespecifications in the same order as they are output by the **iptables -L** command.

   1. *Filter table* - First of all we go through the filter table and its content. First of all we should set up all the policies in the table.

      1. *Set policies* - Set up all the default policies for the systemchains. Normally I will set DROP policies on the chains in the filter table, and specifically ACCEPT services and streams that I want to allow inside. This way we will get rid of all ports that we do not want to let people use.

      2. *Create user specified chains* - At this point we create all the user specified chains that we want to use later on within this table. We will not be able to use these chains in the systemchains anyways if they are not already created so we could as well get to it as soon as possible.

   3. *Create content in user specified chains* - After creating the user specified chains we may as well enter all the rules within these chains. The only reason I have to enter this data at this point already is that may as well put it close to the creation of the user specified chains. You may as well put this later on in your script, it is totally up to you.

   4. *INPUT chain* - When we have come this far, we do not have a lot of things left to do within the filter table so we get onto the INPUT chain. At this point we should add all rules within the INPUT chain.

      Note: At this point we start following the output from the **iptables -L** command as you may see. There is no reason for you to stay with this structure, however, do try to avoid mixing up data from different tables and chains since it will become much harder to read such rulesets and to fix possible problems.

   5. *FORWARD chain* - At this point we go on to add the rules within the FORWARD chain. Nothing special about this decision.

   6. *OUTPUT chain* - Last of all in the filter table, we add the rules dealing with the OUTPUT chain. There should hopefully not be too much to do at this point.

3. *nat table* - After the filter table we take care of the nat table. This is done after the filter table because of a number of reasons within these scripts. First of all we do not want to turn the whole forwarding mechanism and NAT function on at a too early stage, which could possibly lead to packets getting through the firewall at just the wrong timepoint (ie, when the NAT has been turned on, but none of the filter rules has been run). Also, I look upon the nat table as a sort of layer that lies just outside the filter table and kind of surrounds it. The filter table would hence be the core, while the nat table acts as a layer lying around the filter table, and finally the mangle table lies around the nat table as a second layer. This may be wrong in some perspectives, but not too far from reality.

   1. *Set policies* - First of all we set up all the default policies within the nat table. Normally, I will be satisfied with the default policy set from the beginning, namely the ACCEPT policy. This table should not be used for filtering anyways, and we should not let packets be dropped here since there are some really nasty things that may happen in such cases due to our own presumptions. I let these chains be set to ACCEPT since there is no reason not to do so.

   2. *Create user specified chains* - At this point we create any user specified chains that we want within the nat table. Normally I do not have any of these, but I have added this section anyways, just in case. Note that the user specified chains must be created before they can actually be used within the systemchains.

   3. *Create content in user specified chains* - By now it should be time to add all the rules to the user specified chains in the nat table. The same thing goes here as for the user specified chains in the filter table. We add this material here since I do not see any reason not to.

4. *PREROUTING chain* - The PREROUTING chain is used to do DNAT on packets in case we have any need for it. In most scripts this feature is not used, or at the very least commented out, reason being that we do not want to open up big holes to our local network without knowing about it. Within some scripts we have this turned on by default since the sole purpose of those scripts are to provide such services.

5. *POSTROUTING chain* - The POSTROUTING chain should be fairly well used by the scripts I have written since most of them depend upon the fact that you have one or more local networks that we want to firewall against the Internet. Mainly we will try to use the SNAT target, but in certain cases we are forced to use the MASQUERADE target instead.

6. *OUTPUT chain* - The OUTPUT chain is barely used at all in any of the scripts. As it looks now, it is not broken, but I have been unable to find any good reasons to use this chain so far. If anyone has a reason to use this chain, send me a line and I will add it to the tutorial.

5. *mangle table* - The last table to do anything about is the mangle table. Normally I will not use this table at all, since it should normally not be used for anyone, unless they have specific needs, such as masking all boxes to use the exact same TTL or to change TOS fields etcetera. I have in other words chosen to leave these parts of the scripts more or less blank, with a few exceptions where I have added a few examples of what it may be used for.

    1. *Set policies* - Set the default policies within the chain. The same thing goes here as for the nat table pretty much. The table was not made for filtering, and hence you should avoid it all together. I have not set any policies in any of the scripts in the mangle table one way or the other, and you are encouraged not to do so either.

    2. *Create user specified chains* - Create all the user specified chains. Since I have barely used the mangle table at all in the scripts, I have neither created any chains here since it is fairly unusable without any data to use within it. However, this section was added just in case someone, or I, would have the need for it in the future.

    3. *Create content in userspecified chains* - If you have any user specified chains within this table, you may att this point add the rules that you want within them here.

    4. *PREROUTING* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

    5. *INPUT chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

    6. *FORWARD chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

    7. *OUTPUT chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

8. *POSTROUTING chain* - At this point there is barely any information in any of the scripts in this tutorial that contains any rules here.

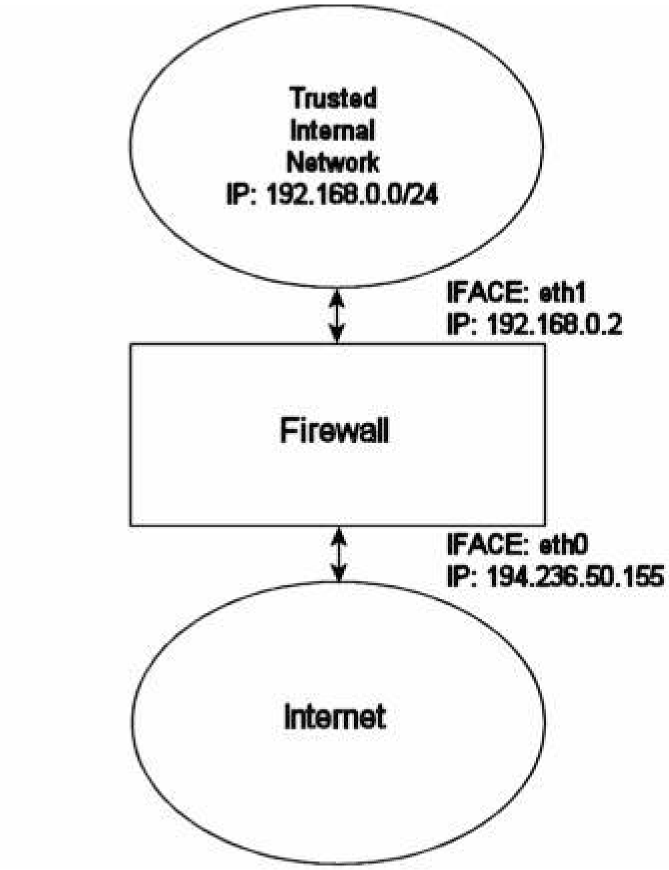
Hopefully this should explain more in detail how each script is structured and why they are structured in such a way.

Caution

Do note that these descriptions are extremely brief, and should mainly just be seen as a brief explanation to what and why the scripts has been split down as they have. There is nothing that says that this is the only and best way to go.

---

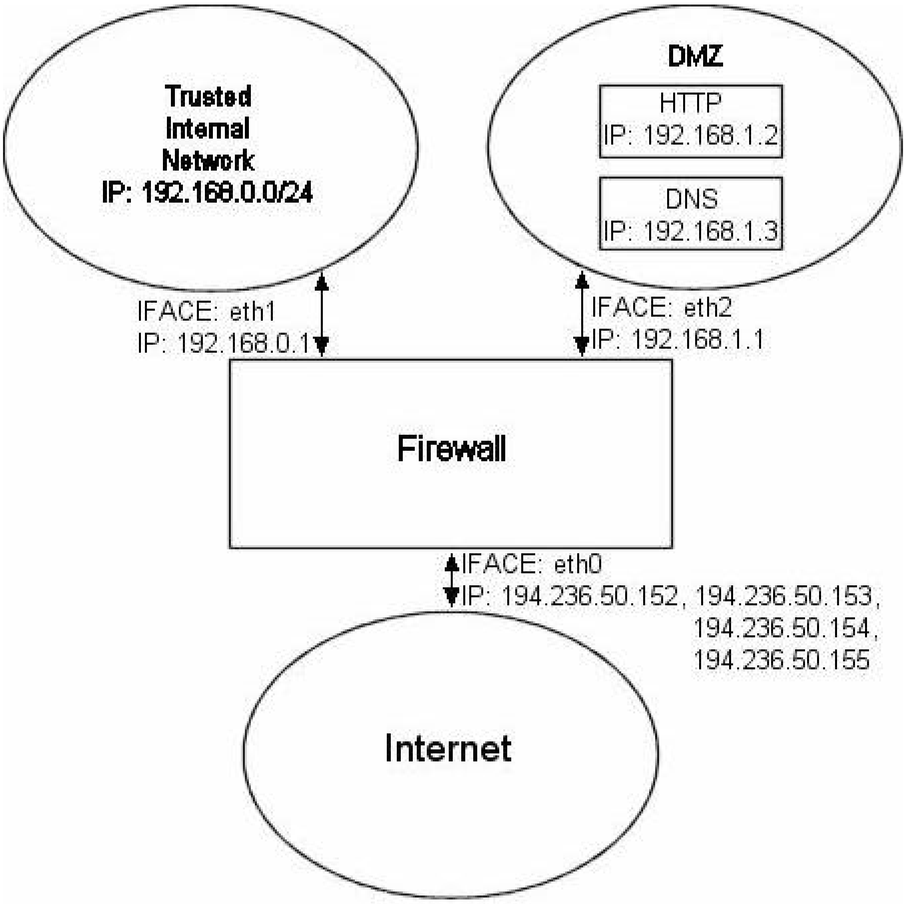
rc.firewall.txt



The rc.firewall.txt script is the main core on which the rest of the scripts are based upon. The *rc.firewall file* chapter should explain every detail in the script most thoroughly. Mainly it was written for a dual homed network. For example, where you have one LAN and one Internet Connection. This script also makes the assumption that you have a static IP to the Internet, and hence don't use DHCP, PPP, SLIPor some other protocol that assigns you an IP automatically. If you are looking for a script that will work with those setups, please take a closer look at the *rc.DHCP.firewall.txt* script.

---

rc.DMZ.firewall.txt



The rc.DMZ.firewall.txt script was written for those people out there that has one Trusted Internal Network, one De-Militarized Zone and one Internet Connection. The De-Militarized Zone is in this case 1-to-1 NAT'ed and requires you to do some IP aliasing on your firewall, ie, you must make the box recognise packets for more than one IP. There are several ways to get this to work, one is to set 1-to-1 NAT, another one if you have a whole subnet is to create a subnetwork, giving the firewall one IP both internally and externally. You could then set the IP's to the DMZ'ed boxes as you wish. Do note that this will "steal" two IP's for you, one for the broadcast address and one for the network address. This is pretty much up to you to decide and to implement, this tutorial will give you the tools to actually accomplish the firewalling and NAT'ing part, but it will not tell you exactly what you need to do since it is out of the scope of the tutorial.

You need to have two internal networks with this script as you can see from the picture. One uses IP range 192.168.0.0/24 and consists of a Trusted Internal Network. The other one uses IP range 192.168.1.0/24 and consists of the De-Militarized Zone which we will do 1-to-1 NAT to. For example, if someone from the internet sends a packet to our `DNS_IP`, then we use DNAT, which stands for Destination Network Adress Translation, to send the packet on to our DNS on the DMZ network. When the DNS sees our packet, the packet will be destined for the actual DNS internal network IP, and not to our external DNS IP. If the packet would not have been translated, the DNS wouldn't have answered the packet. We will show a short example of how the DNAT code looks:

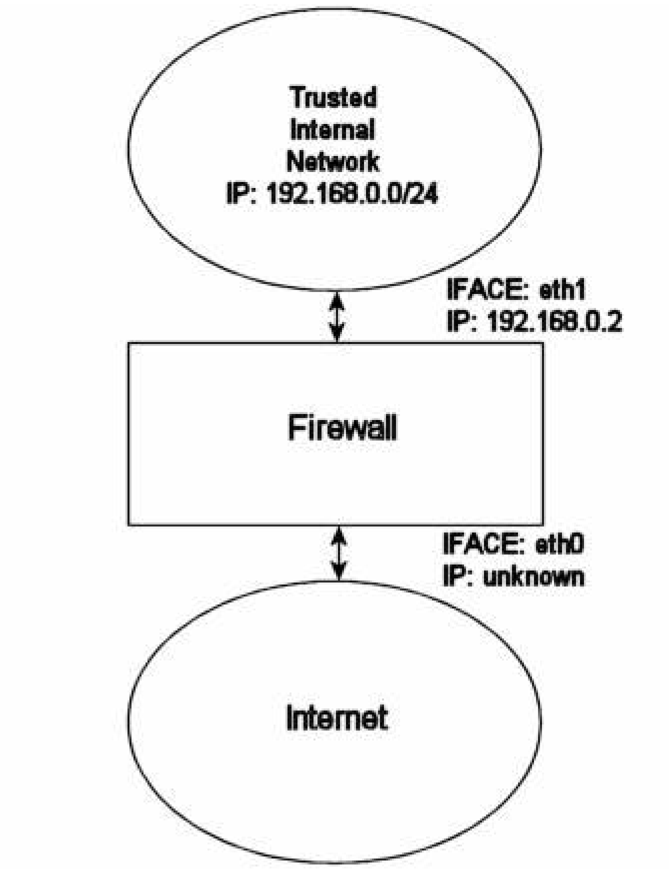
$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $DNS_IP --dport 53 -j DNAT --to-destination $DMZ_DNS_IP

First of all, DNAT can only be performed in the PREROUTING chain of the nat table. Then we look for TCP protocol on our `$INET_IFACE` with destination IP that matches our `$DNS_IP`, and is directed to port 53, which is the TCP port for zone transfers between DNS's. If we actually get such a packet we give a target of DNAT, in other words Destination NAT. After that we specify where we want the packet to go with the **--to-destination** option and give it the value of `$DMZ_DNS_IP`, in other words the IP of the DNS on our DMZ network. This is how basic DNAT works. When the reply to the DNAT'ed packet is sent through the firewall, it automatically gets un-DNAT'ed.

By now you should have enough understanding of how everything works to be able to understand this script pretty well without any huge complications. If there is something you don't understand, that hasn't been gone through in the rest of the tutorial, mail me since it is probably a fault on my side.

---

rc.DHCP.firewall.txt



The rc.DHCP.firewall.txt script is pretty much identical to the original *rc.firewall.txt*. However, this script no longer uses the **STATIC_IP** variable, which is the main change to the original rc.firewall.txt script. The reason is that this won't work together with a dynamic IP connection. The actual changes needed to be done to the original script is minimal, however, I've had some people mail me and ask about the problem so this script will be a good solution for you. This script will allow people who uses DHCP, PPP and SLIP connections to connect to the internet.

The main changes done to the script consists of erasing the `STATIC_IP` variable as I already said and deleting all referenses to this variable. Instead of using this variable the script now does it's main filtering on the variable `INET_IFACE`. In other words **-d $STATIC_IP** has been changed to **-i $INET_IFACE**. This is pretty much the only changes made and that's all that's needed really.

There is some more things to think about though. We can no longer filter in the INPUT chain depending on, for example, **--in-interface $LAN_IFACE --dst $INET_IP**. This in turn forces us to filter only based on interfaces in such cases where the internal machines must access the internet adressable IP. One great example is if we are running an HTTP on our firewall. If we go to the main page, which contains static links back to the same host, which could be some dyndns solution, we would get a real hard trouble. The NAT'ed box would ask the DNS for the IP of the HTTP server, then try to access that IP. In case we filter based on interface and IP, the NAT'ed box would be unable to get to the HTTP because the INPUT chain would **DROP** the packets flat to the ground. This also applies in a sense to the case where we got a static IP, but in such cases it could be gotten around by adding rules which checks the LAN interface packets for our `INET_IP`, and if so **ACCEPT** them.

As you may read from above, it may be a good idea to grab a script, or write one, that handles dynamic IP in a better sense. We could for example make a script that grabs the IP from **ifconfig** and adds it to a variable, upon bootup of the internet connection. A good way to do this, would e to use for example the `ip-up` scripts provided with **pppd** and some other programs. For a good site, check out the linuxguruz.org iptables site which has a huge collection of scripts available to download. You will find a link to the linuxguruz.org site from the *Other resources and links* appendix.

Note: This script might be a bit less secure than the `rc.firewall.txt` script. I would definitely advise you to use that script if at all possible since this script is more open to attacks from the outside.

Also, there is the possibility to add something like this to your scripts:

INET_IP=`ifconfig $INET_IFACE | grep inet | cut -d : -f 2 | cut -d \  -f 1`

The above would automatically grab the IP address of the **$INET_IFACE** variable, grep the correct line which contains the IP address and then cuts it down to a manageable IP address. However, there are serious drawbacks with this approach, as described in the following list.

1. If the script is run from within a script which in turn is executed by, for example, the PPP daemon, it will hang all currently active connections due to the NEW not SYN rules (see the *State NEW packets but no SYN bit set* section). It is possible to get by, if you get rid of the NEW not SYN rules for example, but it is questionable.

2. If you got rules that are static and always want to be around, it is rather harsh to add and erase rules all the time, without hurting the already existing ones. For example, if you want to block hosts on your LAN to connect to the firewall, but at the same time operate a script from the PPP daemon, how would you do it without erasing your already active rules blocking the LAN?

3. It may get unnecessarily complicated, as seen above which in turn could lead to security compromises. If the script is kept simple, it is easier to spot problems, and to keep order in it.

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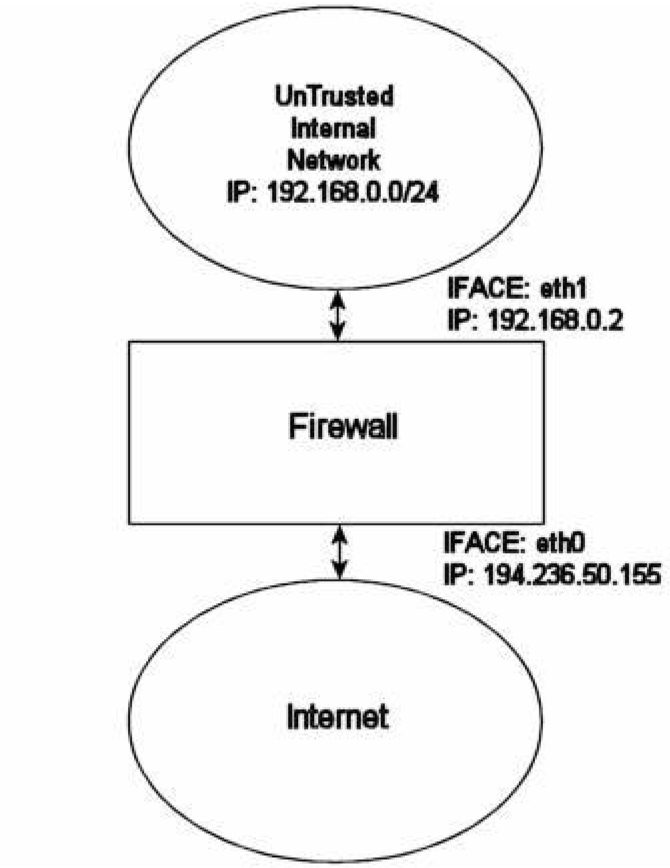
rc.UTIN.firewall.txt



The rc.UTIN.firewall.txt script will in contrast to the other scripts block the LAN that is sitting behind us. In other words, we don't trust anyone on any networks we are connected to. We also disallow people on our LAN to do anything but specific tasks on the Internet. The only things we actually allow is POP3, HTTP and FTP access to the internet. We also don't trust the internal users to access the firewall more than we trust users on the Internet.

This script follows the golden rule to not trust anyone, not even our own employees. This is a sad fact, but a large part of the hacks and cracks that a company gets hit by is a matter of people from their own staff perpetrating the hit. This script will hopefully give you some clues as to what you can do with your firewall to strengthen it up. It's not very different from the original `rc.firewall.txt` script, but it does give a few hints at what we would normally let through etc.

---

rc.test-iptables.txt

The rc.test-iptables.txt script can be used to test all the different chains, but it might need some tweaking depending on your configuration, such as turning on **ip_forwarding**, and setting up masquerading etcetera. It will work for mostly everyone though who has all the basic set up and all the basic tables loaded into kernel. All it really does is set some **LOG** targets which will log ping reply's and ping requests. This way, you will get information on which chain was traversed and in which order. For example, run this script and then do:

ping -c 1 host.on.the.internet

And **tail -n 0 -f /var/log/messages** while doing the first command. This should show you all the different chains used and in which order, unless the log entries are swapped around for some reason.

This script was written for testing purposes only. In other words, it's not a good idea to have rules like this that logs everything of one sort since your log partitions might get filled up quickly and it would be an effective Denial of Service attack against you and might lead to real attacks on you that would be unlogged after the initial Denial of Service attack.

---

rc.flush-iptables.txt

The rc.flush-iptables.txt script should not really be called a script in itself. The rc.flush-iptables.txt script will reset and flush all your tables and chains. The script starts by setting the default policies to **ACCEPT** on the INPUT, OUTPUT and FORWARD chains of the filter table. After this we reset the default policies of the PREROUTING, POSTROUTING and OUTPUT chains of the nat table. We do this first so we won't have to bother about closed connections and packets not getting through. This script is intended for actually setting up and troubleshooting your firewall, and hence we only care about opening the whole thing up and reset it to default values.

After this we flush all chains first in the filter table and then in the NAT table. This way we know there is no redundant rules lying around anywhere. When all of this is done, we jump down to the next section where we erase all the user specified chains in the NAT and filter tables. When this step is done, we consider the script done. You may consider adding rules to flush your MANGLE table if you use it.

One final word on this issue. Certain people has mailed me asking from me to put this script into the original rc.firewall script using redhat Linux syntax where you type something like rc.firewall start and the script starts. However, I will not do that since this is a tutorial and should be used as a place to fetch ideas mainly and it shouldn't be filled up with shell scripts and strange syntax. Adding shell script syntax and other things makes the script harder to read as far as I am concerned and the tutorial was written with readability in mind and will continue being so.

Detailed explanations of special commands

Listing your active ruleset

To list your currently active ruleset you run a special option to the **iptables** command, which we have discussed briefly previously in the *How a rule is built* chapter. This would look like the following:

iptables -L

This command should list your currently active ruleset, and translate everything possible to a more readable form. For example, it will translate all the different ports according to the `/etc/services` file as well as DNS all the IP addresses to get DNS records instead. The later can be a bit of a problem though. For example, it will try to resolve LAN IP addresses, ie `192.168.1.1`, to something useful. `192.168.0.0/16` is a private range though and should not resolve to anything and the command will seem to hang while resolving the IP. To get around this problem we would do something like the following:

iptables -L -n

Another thing that might be interesting is to see a few statistics about each policy, rule and chain. We could get this by adding the verbose flag. It would then look something like this:

iptables -L -n -v

There is also a few files that might be interesting to look at in the `/proc` filesystem. For example, it might be interesting to know what connections are currently in the conntrack table. This table contains all the different connections currently tracked and serves as a basic table so we always know what state a connection currently is in. This table can not be edited and even if it was possible, it would be a bad idea. To see the table you can run the following command:

cat /proc/net/conntrack | less

The above command will show all currently tracked connections even though it might be a bit hard to understand everything.

Updating and flushing your tables

If at some point you screw up your **iptables**, there are actually commands to flush them, so you don't have to reboot. I've actually gotten this question a couple times by now so I thought I'd answer it right here. If you added a rule in error, you might just change the **-A** parameter to **-D** in the line you added in error. **iptables** will find the erroneous line and erase it for you, in case you've got multiple lines looking exactly the same in the chain, it erases the first instance it finds matching your rule. If this is not the wanted behaviour you might try to use the **-D** option as **iptables -D INPUT 10** which will erase the 10th rule in the INPUT chain.

There is also instances where you want to flush a whole chain, in this case you might want to run the **-F** option. For example, **iptables -F INPUT** will erase the whole INPUT chain, though, this will not change the default policy, so if this is set to DROP you'll block the whole INPUT chain if used as above. To reset the chain policy, do as how you set it to DROP, for example **iptables -P INPUT ACCEPT**.

I have made a small script (available as an appendix as well) that will flush and reset your **iptables** that you might consider using while setting up your `rc.firewall.txt` file properly. One thing though, if you start mucking around in the mangle table, this script will not erase those, it is rather simple to add the few lines needed to erase those but I have not added those here since the mangle table is not used in my `rc.firewall.txt` script so far.

Common problems and questionmarks

Passive FTP but no DCC

This is one of the really nice parts about the new **iptables** support in the 2.4.x kernels, you can for example allow Passive FTP connections, but not allow DCC send functions with the new state matching code. You may ask yourself how, well, its quite simple once you get to think of it. Just compile the `ip_conntrack_irc`, `ip_nat_irc`, `ip_conntrack_ftp` and `ip_nat_ftp` code as modules and not statically into the kernel. What these modules do is that they add support to the connection tracking machine and the NAT machine so they can distinguish and modify a Passive FTP connection or a DCC send connection. Without these modules they can't recognize these kinds of connections.

If you for example want to allow Passive FTP, but not DCC send, you would load the `ip_conntrack_ftp` and `ip_nat_ftp` modules, but not the `ip_conntrack_irc` and `ip_nat_irc modules` and then do:

/usr/local/sbin/iptables -A INPUT -p TCP -m state --state RELATED -j ACCEPT

To allow Passive FTP but not DCC. If you would want to do the reverse, you'd just load the `ip_conntrack_irc` and `ip_nat_irc` modules, but not the `ip_conntrack_ftp` and `ip_nat_ftp` modules. Do note that the `ip_nat_*` modules are only needed in case you need and want to do Network Adress Translation on the connections, ie, if you want to let people run IRC from your local network which is using a NAT'ed or masqueraded connection to the internet.

For more information about Active and Passive FTP, read RFC 959 - File Transfer Protocol by J. Postel and J. Reynolds. This RFC contains information regarding the FTP protocol and Active and Passive FTP and how they work. As you can understand from this document, during Active FTP the client sends the server an IP address and random port to use and then the server connects to this port on the client. In case your client sits behind a Network Address Translationing system (**iptables**), then the packets data section needs to be NAT'ed too, that is what the `ip_nat_ftp` module does. In Passive FTP, the proceeding is reversed. The client tells the server that it wants to send or receive data and the server replies, telling the client what address to connect to and what port to use.

State NEW packets but no SYN bit set

There is a certain *feature* in **iptables** that is not so well documented and may therefore be overlooked by a lot of people(yes, including me). If you use state **NEW**, packets with the SYN bit unset will get through your firewall. This feature is there because in certain cases we want to consider that a packet may be part of an already **ESTABLISHED** connection on, for instance, another firewall. This feature makes it possible to have two or more firewalls, and for one of the firewalls to go down without any loss of data. The firewalling of the subnet could then be taken over by our secondary firewall.This does however lead to the fact that state **NEW** will allow pretty much any kind of TCP connection, regardless if this is the initial 3-way handshake or not. To take care of this problem we add the following rules to our firewalls INPUT, OUTPUT and FORWARD chain:

```
  $IPTABLES -A INPUT -p tcp ! --syn -m state --state NEW -j LOG --log-prefix "New not
syn:"
  $IPTABLES -A INPUT -p tcp ! --syn -m state --state NEW -j DROP
```

Caution: The above rules will take care of this problem. This is a badly documented behaviour of the **netfilter/iptables** project and should definitely be more highlighted. In other words, a huge warning is in it's place for this kind of behaviour on your firewall.

Note that there is some troubles with the above rules and bad Microsoft TCP/IP implementations. The above rules will lead to certain conditions where packets generated by microsoft products gets labeled as a state **NEW** and hence get logged and dropped. It will however not lead to broken connections to my knowledge. The matter is that when a connection gets closed and the final FIN/ACK has been sent and the state machine of **netfilter** has closed this connection and it is no longer in the conntrack table. At this point the faulty Microsoft implementation sends another packet which is considered as state **NEW** but lacks the SYN bit and hence gets matched by the above rules. In other words, don't worry to much about this rule, or if you are worried anyways, set the **--log-headers** option to the rule and log the headers too and you'll get a better look at what the packet looks like.

There is one more known problem with these rules. If someone is currently connected to the firewall, lets say from the LAN, and you have the script set to be activated when running a PPP connection. In this case, when you start the PPP connection, the person previously connected through the LAN will be more or less killed. This only applies when you are running with the conntrack and nat codebases as modules, and the modules are loaded and unloaded each time you run the script. Another way to get this problem is to run the `rc.firewall.txt` script from a telnet connection from a host not on the actual firewall. To put it simple, you connect with **telnet** or some other stream connection. Start the connection tracking modules, then load the **NEW** not SYN packet rules. Finally, the **telnet client** or **daemon** tries to send something. the connection tracking code will not recognise this connection as a legal connection since it has not seen packets in any direction on this connection before, also there will be no SYN bits set since it is not actually the first packet in the connection. Hence, the packet will match to the rules and be logged and afterwards dropped to the ground.

Internet Service Providers who use assigned

IP addresses

I have added this since a friend of mine told me something I have totally forgotten. Certain stupid Internet Service Providers use IP addresses assigned by *IANA* for their local networks on which you connect to. For example, the swedish Internet Service Provider and phone monopoly Telia uses this approach for example on their DNS servers, which uses the 10.x.x.x IP address range. The problem you will most probably run into is that we, in this script, do not allow connections from any IP addresses in the 10.x.x.x range to us, because of spoofing possibilities. Well, here is unfortunately an example where you actually might have to lift a bit on those rules. You might just insert an **ACCEPT** rule above the spoof section to allow traffic from those DNS servers, or you could just comment out that part of the script. This is how it might look:

/usr/local/sbin/iptables -t nat -I PREROUTING -i eth1 -s 10.0.0.1/32 -j ACCEPT

I would like to take my moment to bitch at these Internet Service Providers. These IP address ranges are not assigned for you to use for dumb stuff like this, at least not to my knowledge. For large corporate sites it is more than ok, or your own home network, but you are not supposed to force us to open up ourself just because of some whince of yours.

ICMP types

This is a complete listing of all ICMP types:

Table 1. ICMP types

TYPE	CODE	Description	Query	Error
0	0	Echo Reply	x	
3	0	Network Unreachable		x
3	1	Host Unreachable		x
3	2	Protocol Unreachable		x
3	3	Port Unreachable		x
3	4	Fragmentation needed but no frag. bit set		x
3	5	Source routing failed		x
3	6	Destination network unknown		x
3	7	Destination host unknown		x
3	8	Source host isolated (obsolete)		x
3	9	Destination network administratively prohibited		x
3	10	Destination host administratively prohibited		x

3	11	Network unreachable for TOS		x
3	12	Host unreachable for TOS		x
3	13	Communication administratively prohibited by filtering		x
3	14	Host precedence violation		x
3	15	Precedence cutoff in effect		x
4	0	Source quench		
5	0	Redirect for network		
5	1	Redirect for host		
5	2	Redirect for TOS and network		
5	3	Redirect for TOS and host		
8	0	Echo request	x	
9	0	Router advertisement		
10	0	Route sollicitation		
11	0	TTL equals 0 during transit		x
11	1	TTL equals 0 during reassembly		x
12	0	IP header bad (catchall error)		x
12	1	Required options missing		x
13	0	Timestamp request (obsolete)	x	
14		Timestamp reply (obsolete)	x	
15	0	Information request (obsolete)	x	
16	0	Information reply (obsolete)	x	
17	0	Address mask request	x	
18	0	Address mask reply	x	

Other resources and links

Here is a list of links to resources and where I have gotten information from, etc :

- ip-sysctl.txt - from the 2.4.14 kernel. A little bit short but a good reference for the IP networking controls and what they do to the kernel.

- ip_dynaddr.txt - from the 2.4.14 kernel. A really short reference to the ip_dynaddr settings available via sysctl and the proc filesystem.

- iptables.8 - The iptables 1.2.4 man page. This is an HTML'ized version of the man page which is an excellent reference when reading/writing iptables rulesets. Always have it at hand.

- http://netfilter.filewatcher.org/ - The official **netfilter** and **iptables** site. It is a must for everyone wanting to set up **iptables** and **netfilter** in linux.

- http://netfilter.filewatcher.org/netfilter-faq.html - The official **netfilter** *Frequently Asked Questions*. Also a good place to stat at when wondering what **iptables** and **netfilter** is about.

- http://netfilter.filewatcher.org/unreliable-guides/packet-filtering-HOWTO/index.html - Rusty Russells Unreliable Guide to packet filtering. Excellent documentation about basic packet filtering with **iptables** written by one of the core developers of **iptables** and **netfilter**.

- http://netfilter.filewatcher.org/unreliable-guides/NAT-HOWTO/index.html - Rusty Russells Unreliable Guide to Network Address Translation. Excellent documentation about Network Address Translation in **iptables** and **netfilter** written by one of the core developers, Rusty Russell.

- http://netfilter.filewatcher.org/unreliable-guides/netfilter-hacking-HOWTO/index.html - Rusty Russells Unreliable Netfilter Hacking HOWTO. One of the few documentations on how to write code in the **netfilter** and **iptables** userspace and kernel space codebase. This was also written by Rusty Russell.

- http://www.linuxguruz.org/iptables/ - Excellent linkpage with links to most of the pages on the internet about **iptables** and **netfilter**. Also maintains a list of different iptables scripts for different purposes.

- http://www.islandsoft.net/veerapen.html - Excellent discussion on automatic hardening of **iptables** and how to make small changes that will make your computer automatically add hostile sites to a special banlist in **iptables**.

- http://www.docum.org - Excellent information about the CBQ, **tc** and the **ip** commands in Linux. One of the few sites that has any information at all about these programs. Maintained by Stef Coene.

- http://lists.samba.org/mailman/listinfo/netfilter - The official netfilter mailing-list. Extremely useful in case you have questions about something not covered in this document or any of the other links here.

And of course the **iptables** source, documentation and individuals who helped me.

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---

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Example scripts codebase

Example rc.firewall script

```
#!/bin/sh
#
# rc.firewall - Initial SIMPLE IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
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```

```
#
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# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.155"
INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"
```

```
#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

###########################################################################
#
# 3. /proc set up.
#
```

```
#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
```

```
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed

#
# UDP ports
#

# nondocumented commenting out of these rules
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT
```

```
#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from the internet.
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets
$IPTABLES -A INPUT -p TCP -i $INET_IFACE -j tcp_packets
$IPTABLES -A INPUT -p UDP -i $INET_IFACE -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#

$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_BCAST_ADRESS -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -s $LAN_IP_RANGE -j ACCEPT
$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward
```

```
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $INET_IP -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#
```

```
#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#
```

```
#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.DMZ.firewall script

```
#!/bin/sh
#
# rc.DMZ.firewall - DMZ IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
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# it under the terms of the GNU General Public License as published by
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# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.152"
HTTP_IP="194.236.50.153"
DNS_IP="194.236.50.154"
INET_IFACE="eth0"
```

```
#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

DMZ_HTTP_IP="192.168.1.2"
DMZ_DNS_IP="192.168.1.3"
DMZ_IP="192.168.1.1"
DMZ_IFACE="eth2"

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
```

```
#

#
# Needed to initially load modules
#
/sbin/depmod -a



#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

############################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
```

```
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP
```

```
#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Packets from the Internet to this box
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets

#
# Packets from LAN, DMZ or LOCALHOST
#

#
# From DMZ Interface to DMZ firewall IP
#

$IPTABLES -A INPUT -p ALL -i $DMZ_IFACE -d $DMZ_IP -j ACCEPT

#
# From LAN Interface to LAN firewall IP
#

$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -d $LAN_BCAST_ADRESS -j ACCEPT
```

```
#
# From Localhost interface to Localhost IP
#
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT

#
# All established and related packets incoming from the internet to the
# firewall
#

$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Logging rule
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets


#
# DMZ section
#
# General rules
#

$IPTABLES -A FORWARD -i $DMZ_IFACE -o $INET_IFACE -j ACCEPT
$IPTABLES -A FORWARD -i $INET_IFACE -o $DMZ_IFACE -m state \
--state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A FORWARD -i $LAN_IFACE -o $DMZ_IFACE -j ACCEPT
$IPTABLES -A FORWARD -i $DMZ_IFACE -o $LAN_IFACE -j ACCEPT

#
# HTTP server
#
```

```
$IPTABLES -A FORWARD -p TCP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_HTTP_IP \
--dport 80 -j allowed
$IPTABLES -A FORWARD -p ICMP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_HTTP_IP \
-j icmp_packets

#
# DNS server
#

$IPTABLES -A FORWARD -p TCP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
--dport 53 -j allowed
$IPTABLES -A FORWARD -p UDP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
--dport 53 -j ACCEPT
$IPTABLES -A FORWARD -p ICMP -i $INET_IFACE -o $DMZ_IFACE -d $DMZ_DNS_IP \
-j icmp_packets

#
# LAN section
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# LOG all packets reaching here
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Allow ourself to send packets not spoofed everywhere
#

$IPTABLES -A OUTPUT -p ALL -o $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $LAN_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $INET_IFACE -s $INET_IP -j ACCEPT
```

```
#
# Logging rule
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# Enable IP Destination NAT for DMZ zone
#

$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $HTTP_IP --dport 80 \
-j DNAT --to-destination $DMZ_HTTP_IP
$IPTABLES -t nat -A PREROUTING -p TCP -i $INET_IFACE -d $DNS_IP --dport 53 \
-j DNAT --to-destination $DMZ_DNS_IP
$IPTABLES -t nat -A PREROUTING -p UDP -i $INET_IFACE -d $DNS_IP --dport 53 \
-j DNAT --to-destination $DMZ_DNS_IP

#
# 4.2.5 POSTROUTING chain
#

#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP
```

```
#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.UTIN.firewall script

```
    #!/bin/sh
#
# rc.firewall - UTIN Firewall script for Linux 2.4.x and iptables
#
```

```
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#

#
# 1.1 Internet Configuration.
#

INET_IP="194.236.50.155"
INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# 1.1.2 PPPoE
#

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"
```

```
#
# 1.3 DMZ Configuration.
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#

###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_tables
/sbin/modprobe ip_conntrack
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_state

#
# 2.2 Non-Required modules
#
```

```
#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ipt_MASQUERADE
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc

###########################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr


###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#

#
# Create chain for bad tcp packets
```

```
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed
```

```
#
# UDP ports
#

$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from anywhere
#

$IPTABLES -A INPUT -p ICMP -j icmp_packets
$IPTABLES -A INPUT -p TCP -j tcp_packets
$IPTABLES -A INPUT -p UDP -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#

$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LO_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $LAN_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LO_IFACE -s $INET_IP -j ACCEPT
$IPTABLES -A INPUT -p ALL -d $INET_IP -m state --state ESTABLISHED,RELATED \
-j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#
```

```
#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward between interfaces.
#

$IPTABLES -A FORWARD -p tcp --dport 21 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -p tcp --dport 80 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -p tcp --dport 110 -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 -j LOG \
--log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $LAN_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -s $INET_IP -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
```

```
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

#
# Enable simple IP Forwarding and Network Address Translation
#

$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j SNAT --to-source $INET_IP

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
#

#
# 4.3.3 Create content in user specified chains
#

#
```

```
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.DHCP.firewall script

```
#!/bin/sh
#
# rc.firewall - DHCP IP Firewall script for Linux 2.4.x and iptables
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

###########################################################################
#
# 1. Configuration options.
#
```

```
#
# 1.1 Internet Configuration.
#

INET_IFACE="eth0"

#
# 1.1.1 DHCP
#

#
# Information pertaining to DHCP over the Internet, if needed.
#
# Set DHCP variable to no if you don't get IP from DHCP. If you get DHCP
# over the Internet set this variable to yes, and set up the proper IP
# adress for the DHCP server in the DHCP_SERVER variable.
#

DHCP="no"
DHCP_SERVER="195.22.90.65"

#
# 1.1.2 PPPoE
#

# Configuration options pertaining to PPPoE.
#
# If you have problem with your PPPoE connection, such as large mails not
# getting through while small mail get through properly etc, you may set
# this option to "yes" which may fix the problem. This option will set a
# rule in the PREROUTING chain of the mangle table which will clamp
# (resize) all routed packets to PMTU (Path Maximum Transmit Unit).
#
# Note that it is better to set this up in the PPPoE package itself, since
# the PPPoE configuration option will give less overhead.
#

PPPOE_PMTU="no"

#
# 1.2 Local Area Network configuration.
#
# your LAN's IP range and localhost IP. /24 means to only use the first 24
# bits of the 32 bit IP adress. the same as netmask 255.255.255.0
#

LAN_IP="192.168.0.2"
LAN_IP_RANGE="192.168.0.0/16"
```

```
LAN_BCAST_ADRESS="192.168.255.255"
LAN_IFACE="eth1"

#
# 1.3 DMZ Configuration.
#

#
# 1.4 Localhost Configuration.
#

LO_IFACE="lo"
LO_IP="127.0.0.1"

#
# 1.5 IPTables Configuration.
#

IPTABLES="/usr/sbin/iptables"

#
# 1.6 Other Configuration.
#


###########################################################################
#
# 2. Module loading.
#

#
# Needed to initially load modules
#

/sbin/depmod -a

#
# 2.1 Required modules
#

/sbin/modprobe ip_conntrack
/sbin/modprobe ip_tables
/sbin/modprobe iptable_filter
/sbin/modprobe iptable_mangle
/sbin/modprobe iptable_nat
/sbin/modprobe ipt_LOG
/sbin/modprobe ipt_limit
/sbin/modprobe ipt_MASQUERADE
```

```
#
# 2.2 Non-Required modules
#

#/sbin/modprobe ipt_owner
#/sbin/modprobe ipt_REJECT
#/sbin/modprobe ip_conntrack_ftp
#/sbin/modprobe ip_conntrack_irc


###########################################################################
#
# 3. /proc set up.
#

#
# 3.1 Required proc configuration
#

echo "1" > /proc/sys/net/ipv4/ip_forward

#
# 3.2 Non-Required proc configuration
#

#echo "1" > /proc/sys/net/ipv4/conf/all/rp_filter
#echo "1" > /proc/sys/net/ipv4/conf/all/proxy_arp
#echo "1" > /proc/sys/net/ipv4/ip_dynaddr

###########################################################################
#
# 4. rules set up.
#

######
# 4.1 Filter table
#

#
# 4.1.1 Set policies
#

$IPTABLES -P INPUT DROP
$IPTABLES -P OUTPUT DROP
$IPTABLES -P FORWARD DROP

#
# 4.1.2 Create userspecified chains
#
```

```
#
# Create chain for bad tcp packets
#

$IPTABLES -N bad_tcp_packets

#
# Create separate chains for ICMP, TCP and UDP to traverse
#

$IPTABLES -N allowed
$IPTABLES -N icmp_packets
$IPTABLES -N tcp_packets
$IPTABLES -N udpincoming_packets

#
# 4.1.3 Create content in userspecified chains
#

#
# bad_tcp_packets chain
#

$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j LOG \
--log-prefix "New not syn:"
$IPTABLES -A bad_tcp_packets -p tcp ! --syn -m state --state NEW -j DROP

#
# allowed chain
#

$IPTABLES -A allowed -p TCP --syn -j ACCEPT
$IPTABLES -A allowed -p TCP -m state --state ESTABLISHED,RELATED -j ACCEPT
$IPTABLES -A allowed -p TCP -j DROP

#
# ICMP rules
#

# Changed rules totally
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 8 -j ACCEPT
$IPTABLES -A icmp_packets -p ICMP -s 0/0 --icmp-type 11 -j ACCEPT

#
# TCP rules
#

$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 21 -j allowed
```

```
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 22 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 80 -j allowed
$IPTABLES -A tcp_packets -p TCP -s 0/0 --dport 113 -j allowed

#
# UDP ports
#

$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
if [ $DHCP == "yes" ] ; then
 $IPTABLES -A udpincoming_packets -p UDP -s $DHCP_SERVER --sport 67 \
 --dport 68 -j ACCEPT
fi

# nondocumented commenting out of these rules
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 53 -j ACCEPT
#$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 123 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 2074 -j ACCEPT
$IPTABLES -A udpincoming_packets -p UDP -s 0/0 --source-port 4000 -j ACCEPT

#
# 4.1.4 INPUT chain
#

#
# Bad TCP packets we don't want.
#

$IPTABLES -A INPUT -p tcp -j bad_tcp_packets

#
# Rules for incoming packets from the internet.
#

$IPTABLES -A INPUT -p ICMP -i $INET_IFACE -j icmp_packets
$IPTABLES -A INPUT -p TCP -i $INET_IFACE -j tcp_packets
$IPTABLES -A INPUT -p UDP -i $INET_IFACE -j udpincoming_packets

#
# Rules for special networks not part of the Internet
#

$IPTABLES -A INPUT -p ALL -i $LO_IFACE -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $LAN_IFACE -s $LAN_IP_RANGE -j ACCEPT
$IPTABLES -A INPUT -p ALL -i $INET_IFACE -m state \
--state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
```

```
#

$IPTABLES -A INPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT INPUT packet died: "

#
# 4.1.5 FORWARD chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A FORWARD -p tcp -j bad_tcp_packets

#
# Accept the packets we actually want to forward
#

$IPTABLES -A FORWARD -i $LAN_IFACE -j ACCEPT
$IPTABLES -A FORWARD -m state --state ESTABLISHED,RELATED -j ACCEPT

#
# Log weird packets that don't match the above.
#

$IPTABLES -A FORWARD -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT FORWARD packet died: "

#
# 4.1.6 OUTPUT chain
#

#
# Bad TCP packets we don't want
#

$IPTABLES -A OUTPUT -p tcp -j bad_tcp_packets

#
# Special OUTPUT rules to decide which IP's to allow.
#

$IPTABLES -A OUTPUT -p ALL -s $LO_IP -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $LAN_IFACE -j ACCEPT
$IPTABLES -A OUTPUT -p ALL -o $INET_IFACE -j ACCEPT

#
# Log weird packets that don't match the above.
```

```
#

$IPTABLES -A OUTPUT -m limit --limit 3/minute --limit-burst 3 \
-j LOG --log-level DEBUG --log-prefix "IPT OUTPUT packet died: "

######
# 4.2 nat table
#

#
# 4.2.1 Set policies
#

#
# 4.2.2 Create user specified chains
#

#
# 4.2.3 Create content in user specified chains
#

#
# 4.2.4 PREROUTING chain
#

#
# 4.2.5 POSTROUTING chain
#

if [ $PPPOE_PMTU == "yes" ] ; then
 $IPTABLES -t nat -A POSTROUTING -p tcp --tcp-flags SYN,RST SYN \
 -j TCPMSS --clamp-mss-to-pmtu
fi
$IPTABLES -t nat -A POSTROUTING -o $INET_IFACE -j MASQUERADE

#
# 4.2.6 OUTPUT chain
#

######
# 4.3 mangle table
#

#
# 4.3.1 Set policies
#

#
# 4.3.2 Create user specified chains
```

```
#

#
# 4.3.3 Create content in user specified chains
#

#
# 4.3.4 PREROUTING chain
#

#
# 4.3.5 INPUT chain
#

#
# 4.3.6 FORWARD chain
#

#
# 4.3.7 OUTPUT chain
#

#
# 4.3.8 POSTROUTING chain
#
```

Example rc.flush-iptables script

```
#!/bin/sh
#
# rc.flush-iptables - Resets iptables to default values.
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
```

```
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA

#
# Configurations
#
IPTABLES="/usr/sbin/iptables"

#
# reset the default policies in the filter table.
#
$IPTABLES -P INPUT ACCEPT
$IPTABLES -P FORWARD ACCEPT
$IPTABLES -P OUTPUT ACCEPT

#
# reset the default policies in the nat table.
#
$IPTABLES -t nat -P PREROUTING ACCEPT
$IPTABLES -t nat -P POSTROUTING ACCEPT
$IPTABLES -t nat -P OUTPUT ACCEPT

#
# reset the default policies in the mangle table.
#
$IPTABLES -t mangle -P PREROUTING ACCEPT
$IPTABLES -t mangle -P OUTPUT ACCEPT

#
# flush all the rules in the filter and nat tables.
#
$IPTABLES -F
$IPTABLES -t nat -F
$IPTABLES -t mangle -F
#
# erase all chains that's not default in filter and nat table.
#
$IPTABLES -X
$IPTABLES -t nat -X
$IPTABLES -t mangle -X
```

Example rc.test-iptables script

```
#!/bin/bash
#
# rc.test-iptables - test script for iptables chains and tables.
#
# Copyright (C) 2001  Oskar Andreasson <blueflux@koffein.net>
#
# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; version 2 of the License.
#
# This program is distributed in the hope that it will be useful,
# but WITHOUT ANY WARRANTY; without even the implied warranty of
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
# GNU General Public License for more details.
#
# You should have received a copy of the GNU General Public License
# along with this program or from the site that you downloaded it
# from; if not, write to the Free Software Foundation, Inc., 59 Temple
# Place, Suite 330, Boston, MA  02111-1307   USA
#

#
# Filter table, all chains
#
iptables -t filter -A INPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter INPUT:"
iptables -t filter -A INPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter INPUT:"
iptables -t filter -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter OUTPUT:"
iptables -t filter -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter OUTPUT:"
iptables -t filter -A FORWARD -p icmp --icmp-type echo-request \
-j LOG --log-prefix="filter FORWARD:"
iptables -t filter -A FORWARD -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="filter FORWARD:"

#
# NAT table, all chains except OUTPUT which don't work.
#
iptables -t nat -A PREROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat PREROUTING:"
```

```
iptables -t nat -A PREROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat PREROUTING:"
iptables -t nat -A POSTROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat POSTROUTING:"
iptables -t nat -A POSTROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat POSTROUTING:"
iptables -t nat -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="nat OUTPUT:"
iptables -t nat -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="nat OUTPUT:"

#
# Mangle table, all chains
#
iptables -t mangle -A PREROUTING -p icmp --icmp-type echo-request \
-j LOG --log-prefix="mangle PREROUTING:"
iptables -t mangle -A PREROUTING -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="mangle PREROUTING:"
iptables -t mangle -A OUTPUT -p icmp --icmp-type echo-request \
-j LOG --log-prefix="mangle OUTPUT:"
iptables -t mangle -A OUTPUT -p icmp --icmp-type echo-reply \
-j LOG --log-prefix="mangle OUTPUT:"
```

Done.