Filters and Firewalls

Goal: More secure system.
Action: Block or filter network packets.

Goal: Private subnet.
Action: rewrite network packet headers.

Tool: iptables

Chains:
`INPUT`: actions taken on inbound packets
`OUTPUT`: actions taken on outbound packets
`FORWARD`: actions taken on packets that are forwarded
Rules in a chain are applied sequentially

Samples:

Block all inbound ssh connections.

```
iptables -A INPUT -p tcp --dport ssh -j REJECT
```

Allow ssh from campus, reject all other ssh.

```
iptables -A INPUT -p tcp --dport ssh \
       -s 134.139.0.0/16 -j ACCEPT
iptables -A INPUT -p tcp --dport ssh -j REJECT
```

No web browsing.

```
iptables -A OUTPUT -p tcp --dport www -j REJECT
```


Iptables Basic Editing Options

`-A`, `--append`: appends the rule to the end of the chain

`-L`, `--list`: list all rules in a chain
`iptables -L OUTPUT` list the rules in the output chain

`-D`, `--delete`: delete a rule

```
iptables -D INPUT 2
```

delete rule 2 from the input chain

`-I`, `--insert`: specify the rule at which to insert

```
iptables -I INPUT 2 -p tcp --dport ftp -j REJECT
```

insert this rule at postition 2
Other rules are moved down.

`-R`, `--replace`: replace a rule, delete then insert

`-F`, `--flush`: delete all rules from a chain

Tables

4 tables: `raw`, `nat`, `mangle`, `filter`.

Each table has separate chains; for example, the output chain for `filter` is distinct from the output chain for `nat`.

The default table is `filter`.
You can specify a chain in a command:
`iptables -t filter -A OUTPUT --dport www -j REJECT`

What the Tables Do

`nat` Network Address Translation: allows the firewall to hide a server, yet forward packets to it

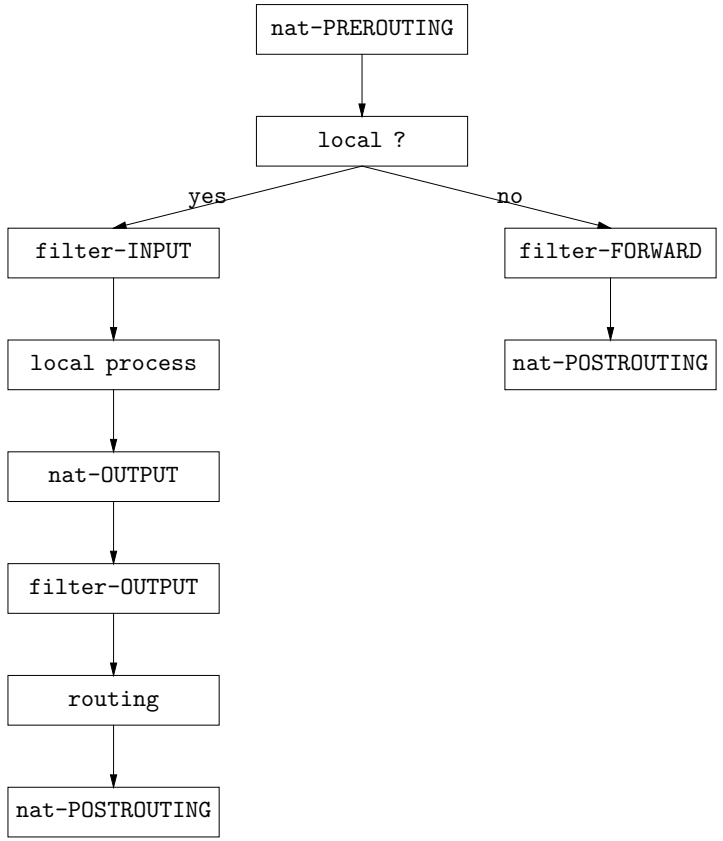
`filter` allows packets to be rejected, dropped or accepted

`mangle` modifies the packet header fields, such as the quality of service field

The `nat` table turns your gateway in to a firewall.

The `filter` table can be used to limit access to certain outside services (no web browsing).
Like tcp wrappers (`hosts.allow`/`hosts.deny`) it can limit in bound access to certain machines on the net.
`iptables` advantages: at the kernel level (blocks always), more robust against denial of service attacks.

Flow of Processing



Some Targets

`ACCEPT`: the packet is good

`DROP`: discard the packet

`REJECT`: discard the packet, inform the sender

`LOG`: send info to syslog

`DNAT`: rewrite the destination address

`SNAT`: rewrite the source address

`MASQUERADE`: rewrite source address (nat table only)

A Service Behind a Firewall

Suppose your web server is behind a firewall.
Detail:
firewall outside address `134.139.248.2`
firewall outside interface `eth0`
firewall inside interface `eth1`
web server address `134.139.248.18`

Tactic: block all inbound traffic except web requests.

```
iptables -A FORWARD -i eth0 -d 134.139.248.18 -p tcp \
      --dports 80,443 -j ACCEPT
iptables -A FORWARD -i eth0 -d 134.139.248.18 -j REJECT
```

Notice inside traffic is not blocked.
So if you have a database on the web server you may access it from any machine behind the firewall.

A Service Behind a Firewall

Suppose your web server is on a private subnet.
Detail:
firewall outside address `134.139.248.2`
firewall outside interface `eth0`
firewall inside interface `eth1`
web server address `192.168.1.18`

On the outside,
all web traffic appears to be to or from the firewall.
Inbound web packets forwarded to the web server.
Outbound web packets appear to be from the firewall.

```
iptables -t nat -A PREROUTING -d 134.139.248.2 \
  -i eth0 -p tcp --dport 80 -j DNAT --to 192.168.1.18:80
iptables -t nat -A PREROUTING -s 192.168.1.18 \
  -i eth1 -p tcp --sport 80 \
  -j SNAT --from 134.139.248.2:80
```


Outbound Packets Through a Firewall

Want to allow connections originating in the private subnet to go out.

```
iptables -t nat -A POSTROUTING -s 192.168.1.0/24 \
      -o eth0 -d 0/0 -j MASQUERADE
iptables -A FORWARD -o eth0 -m state \
      --state NEW,ESTABLISHED,RELATED -j ACCEPT
iptables -A FORWARD -i eth0 -m state \
      --state ESTABLISHED,RELATED -j ACCEPT
```

Masquerade always rewrites the source to the firewall IP address.

There is a state machine to track connection states.
Outbound stuff is allowed.
Inbound allowed only on established connections or connections getting established (related).