Firewall: iptables

CSC 154

Partial slides adapted from Breno de Medeiros, Blair Hicks, Trent Jaeger and iptables man page.

Firewall Options

- Commercial Firewall Devices (Cisco PIX)
- Routers (ACL Lists)
- Linux
- …

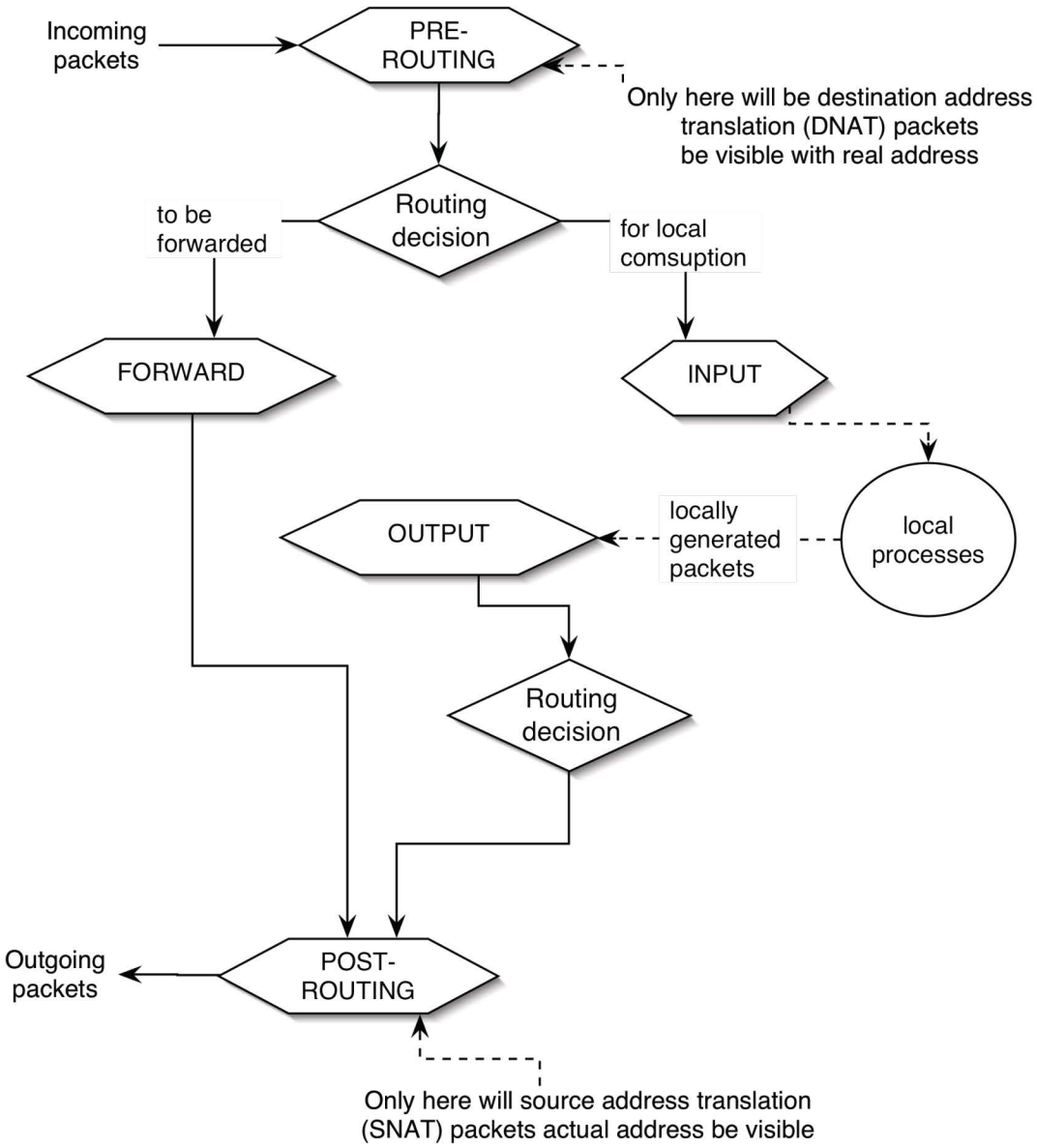
Commands to Configure Cisco Router

- cu -l /dev/ttyS0 -s 9600 //connect to cisco devices via serial port
- Router>enable //User mode->privilege mode
- Router#configure terminal //Privilege mode->global configuration mode
- Router(config)#hostname DMZ
- DMZ(config)#interface vlan 1 //Enter interface mode
- DMZ(config-if)# ip address 192.168.202.1 255.255.255.0
- DMZ(config-if)# no shutdown
- DMZ(config)#router rip //enter router configuration mode
- DMZ(config)#version 2
- DMZ(config)#network 192.168.101.0 //associate with the RIP routing process
- DMZ(config)#network 192.168.202.0
- DMZ(config)#ip route 0.0.0.0 0.0.0.0 192.168.101.14 //static routing
- DMZ(config)#access-list 101 permit tcp any host 192.168.101.5 eq 80
- DMZ(config)#inter ethernet 0
- DMZ(config-if)#ip access-group in 101 in //apply the access lists to Ethernet interfaces
- DMZ(config)#end
- DMZ# copy running-config startup-config // save the current running configuration to the //startup configuration file

Linux

- ipfwadm: Linux kernel 2.0.34
- ipchains: Linux kernel 2.2.*
- **iptables**: Linux kernel 2.4.* - later versions
  - Packet traversal in Linux

IPtables


Incoming packets
PRE-ROUTING
Only here will be destination address translation (DNAT) packets be visible with real address
Routing decision
to be forwarded
for local comsuption
FORWARD
INPUT
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locally generated packets
local processes
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Netfilter Hooks

- **hook**s in Linux network protocol stack
  - PREROUTING: before routing
  - INPUT: inbound, for local consumption
  - FORWARD: inbound, to be forwarded
  - OUTPUT: outbound
  - POSTROUTING: after routing

iptables Concepts

- The iptables firewall looks in the firewall ***table*** to seek if the ***chain*** associated with the current hook ***matches*** a packet, and executes the ***target*** if it does.
  - Table: all the filewall rules
  - Chain: list of rules associated with the chain identifer, e.g. the hook name
  - Match: when a packet match all a rule's fields
  - Target: operation to execute when a packet matched

Syntax of IPtables commands

- iptables -A/D (INPUT/ OUTPUT/ FORWARD/ PREROUTING/ POSTROUTING) -s (source address) -p (protocol) - d (destination) (DROP/REJECT/LOG/ACCEPT/ User-defined chain)

Chain manipulation rules

- Create a new chain (-N)
- Delete an empty chain (-X)
- Change the policy for a built-in chain. (-P)
- List the rules in a chain (-L)
- Flush the rules out of a chain (-F)
- Zero the packet and byte counters on all rules in a chain (-Z)

Example: `# iptables -L -Z FORWARD`

Rule manipulation within a chain

- Append a new rule to a chain (-A)
- Insert a new rule at some position in a chain (-I)
- Replace a rule at some position in a chain (-R)
- Delete a rule at some position in a chain, or the first that matches (-D)

Examples:

- `iptables -A INPUT -s 127.0.0.1 -p icmp -j DROP`
- `iptables -D INPUT -s 127.0.0.1 -p icmp -j DROP`

Targets

- Define what to do with the packet at this time
  - Built-in targets
    - ACCEPT/DROP: allow/disallow the packet through
  - Extension target (come back later after extension introduced)
    - LOG: log any packet that matches
    - REJECT: drops and returns error packet
    - RETURN: enables packet to return to previous chain
    - QUEUE: pass the packet to the userspace
      - modprobe iptable_filter
      - modprobe ip_queue
      - iptables -A OUTPUT -p icmp -j QUEUE
  - User-defined chains (come back later after extension introduced)

How to specify

- Specifying Source and Destination IP Addresses
  - -s/-d
- Specifying Inversion
  - -s **!** localhost
- Specifying a protocol
  - -p TCP/-p ! TCP
- Specifying an Interface
  - -i/--in-interface
  - -o/--out-interface
- Specifying fragments
  - -f/--fragment

iptables Examples (1)

- iptables -L -v -n

- iptables -A INPUT -s 200.200.200.2 -j ACCEPT
- iptables -A INPUT -s 200.200.200.1 -j DROP
- iptables -A INPUT -s 200.200.200.1 -p tcp -j DROP
- iptables -A INPUT -s 200.200.200.1 -p tcp --dport telnet -j DROP
- iptables -A INPUT -p tcp --dport telnet -i ppp0 -j DROP
- iptables -A OUTPUT -f -d 192.168.1.1 -j DROP

iptables Examples (2)

- iptables -I INPUT -i eth1 -p tcp -s 192.168.56.1 --sport 1024:65535 -d 192.168.56.2 --dport 22 -j ACCEPT

- iptables -I OUTPUT -o eth1 -p tcp ! --syn -s 192.168.56.2 --sport 22 -d 192.168.56.1 --dport 1024:65535 -j ACCEPT

Test out (1)

- PING on localhost
  - *ping -c 1 127.0.0.1*
- Add iptables rule to block
  - *iptables -A INPUT -s 127.0.0.1 -p icmp -j DROP*
- Try ping again
- Delete the rule
  - *iptables -D INPUT 1*
  - *iptables -D INPUT -s 127.0.0.1 -p icmp -j DROP*
  - *iptables -F INPUT*

Test out (2)

- TCP via localhost loopback
  - *nc –l –p 3456 (server: listening to port 3456)*
  - *nc –p 2345 localhost 3456 (client: sent messages from port 2345 to 3456)*
- Add iptables rule to block
  - *iptables –A INPUT –s 127.0.0.1 –p tcp –j DROP*
- Try above TCP communication again
- Delete the rule
  - *iptables -D INPUT 1*
  - *iptables -D INPUT -s 127.0.0.1 -p tcp -j DROP*
  - *iptables -F INPUT*

iptables Extension

- Kernel Extension through kernel modules
  - /lib/modules/2.4.0-test10/kernel/net/ipv4/netfilter
  - CONFIG_KMOD configured in kernel compilation (/boot)

- Extension to the iptables program - new matches
  - /usr/local/lib/iptables/, /lib/iptables, /usr/lib/iptables
  - TCP/UDP/ICMP *automatically* offer new tests
    - -p TCP/UDP/ICMP
  - Use -m to invoke extension
    - -m mac (MAC address)
    - -m limit (rate of matches, suppressing log messages)
    - -m state (State)

    - iptables -A FORWARD -i ppp0 -m state ! --state NEW -j DROP

iptables – new targets

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      - modprobe iptable_filter
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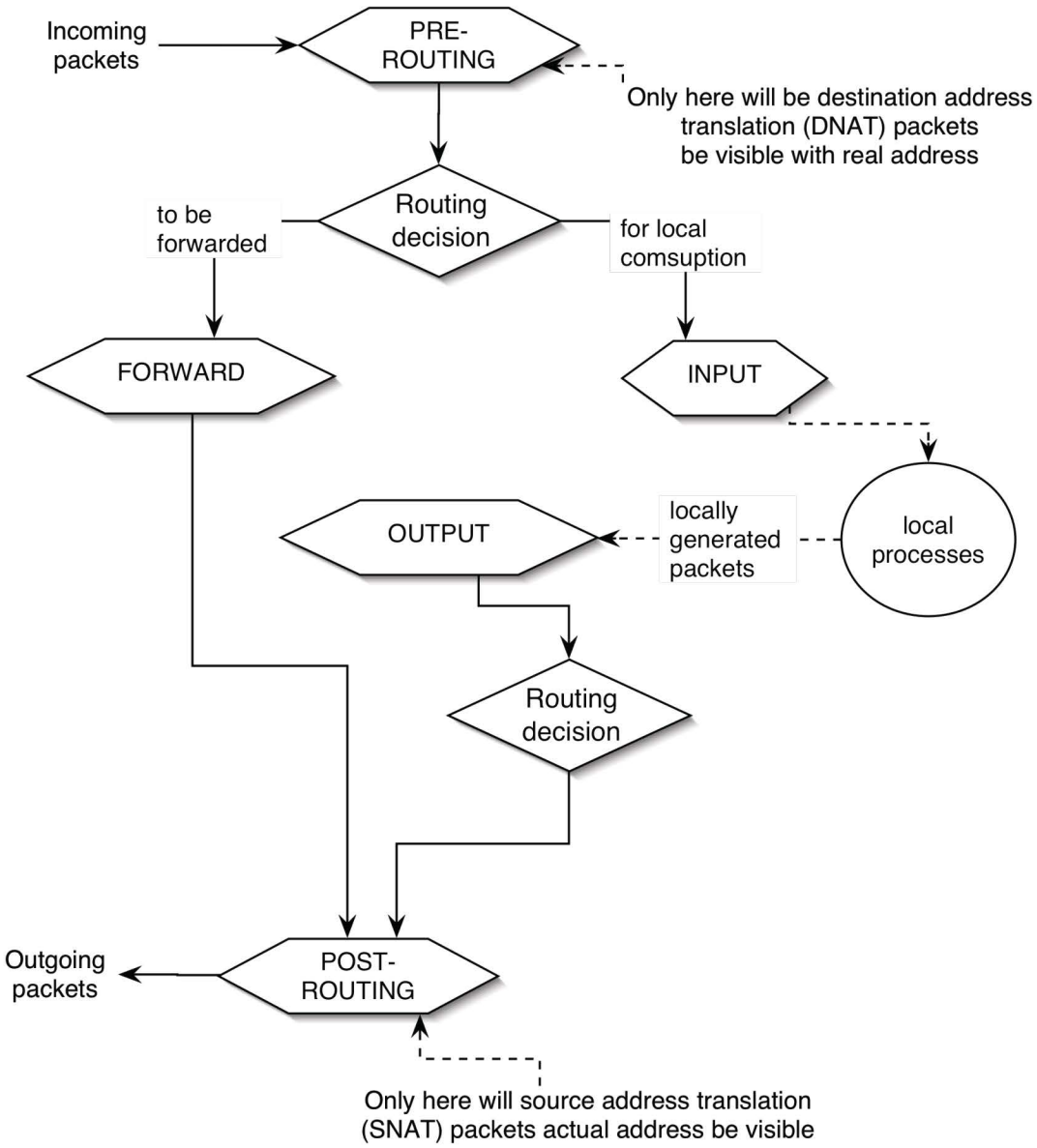
      - iptables -A OUTPUT -p icmp -j QUEUE
  - User-defined chains

Address Translation

- Source address translation (SNAT)
  - Used to multiplex a single IP address to provide internet connectivity to multiple boxes (clients); called “masquerading”
- Destination address translation (DNAT)
  - Allows to use several servers with a single IP address (for load balancing) or because of having a single IP for multiple servers on different ports “port forwarding”

IPtables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NAT Overview

- Source NAT
  - The source address of the initial packet is modified.
  - Performed on the POSTROUTING Chain.
  - Includes MASQUERADE functionality.

- Destination NAT
  - The destination address of the initial packet is modified.
  - Performed on the PREROUTING or OUTPUT chain.

NAT and filtering

- The way the NAT rules are arranged with respect to regular filtering rules allows you to ignore routing when performing filtering
  - The addresses visible to the rules will be the native addresses, not the translated addresses for public consumption