ipfw & IP Filter

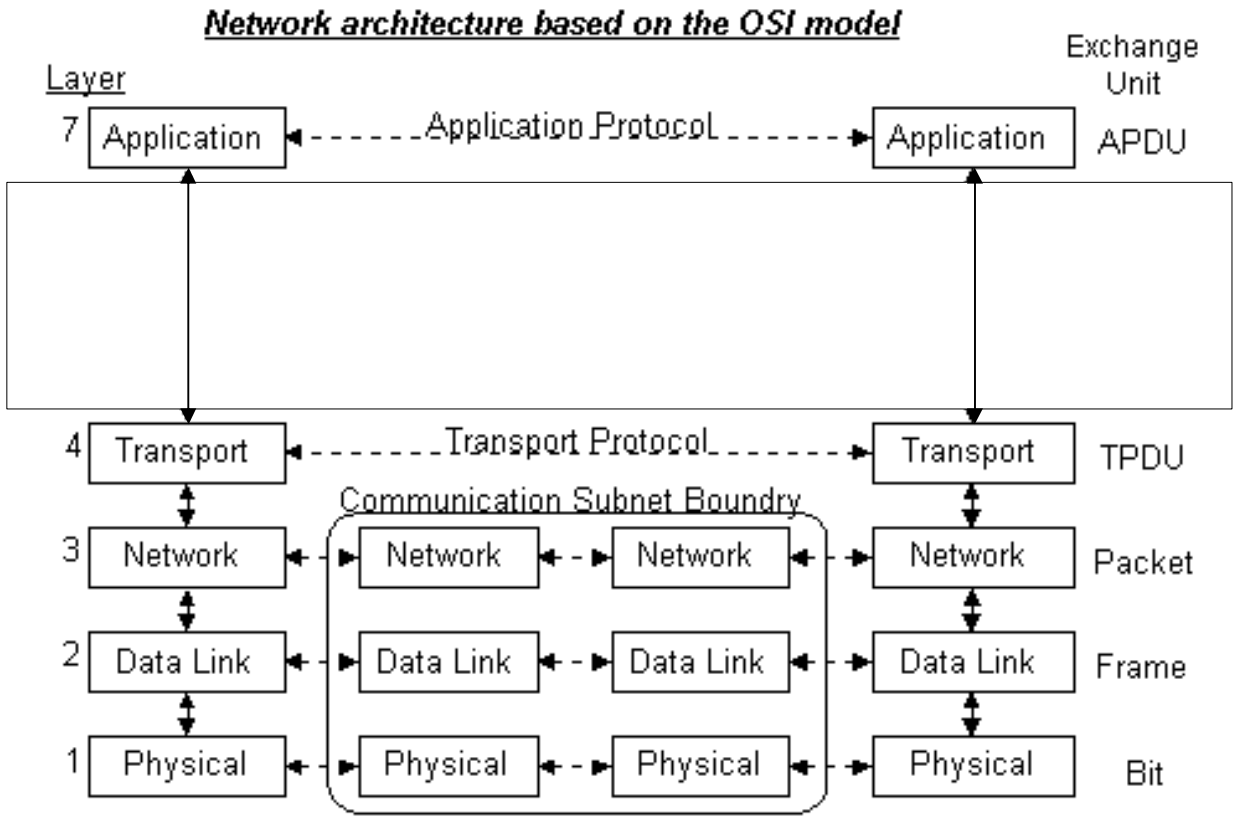
Yung-Zen Lai (yzlai@tp.edu.tw)

2004/10

Agenda

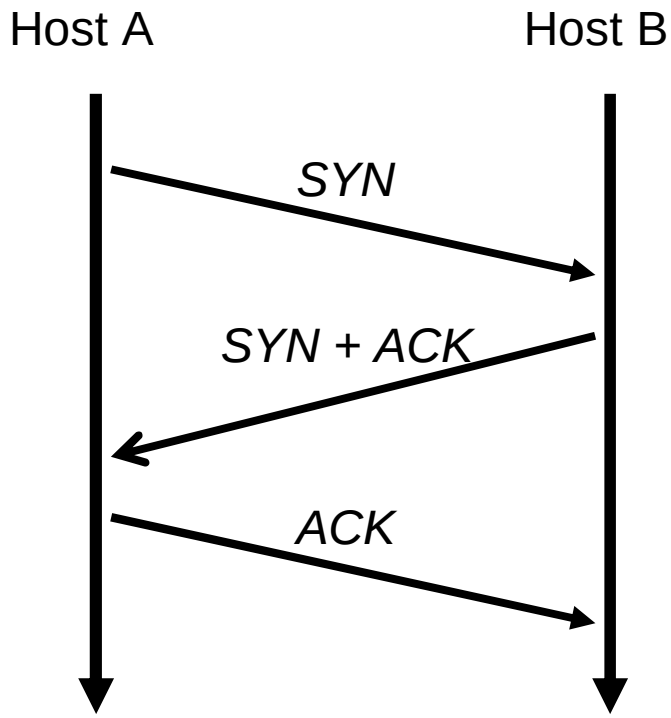
- Network and Firewall Basics
- ipfw – FreeBSD IP Firewall and Traffic Shaper
  - Firewall
  - Traffic Shaper
- IP Filter – TCP/IP Firewall/NAT Software
  - Firewall
  - Network Address Translation

Network Basics – OSI 7 Layer



Network Basics – TCP, UDP

- TCP
  - Transmission Control Protocol
  - Connection-Oriented
  - Three-Way handshake
- UDP
  - User Datagram Protocol
  - Connectionless



Firewall Basics

- filter packets based on their components
  - IP
  - TCP
  - UDP
  - ICMP
  - Other Protocol
- to perform an action on packets that match the filter.
  - Pass
  - Reject
  - Discard
  - Log

ipfw – Firewall

- ipfw
  - options IPFIREWALL in KERNCONF
  - first match
  - add/delete
  - list/show
  - flush
  - zero/resetlog
  - set disable/enable
  - set move/swap/show

ipfw Firewall rules

- ipfw add / delete [number]
  - < allow | reject | deny | reset | unreach >
  - < all | icmp | tcp | udp >
- from
  - < src-net/host > < src-port >
- to
  - < dst-net/host > < dst-port >
- [< via interface > / < options >]

ipfw Firewall rules (cont.)

- Allow packets that match rule
  - allow | accept | pass | permit
  - ipfw add allow all from me to any
  - ipfw add allow all from smtp.tp.edu.tw to me
- Discard packets that match this rule.
  - reject | deny | drop
  - ipfw add deny all from any to 224.0.0.0/8
- Send some notice back
  - reset(TCP), unreach <code>(ICMP)
  - ipfw add reset tcp from any to any 23

ipfw Firewall rules – Rule Actions

- < allow | accept | pass | permit >
- < check-state >
- < count >
- < divert > port
- < fwd | forward > ipaddr[, port]
- < reject >
- < reset >
- < skipto > number
- < tee > port
- < unreach > code

ipfw Firewall rules – Rule Body

- ip from { x or not y or z } to any
- [proto from src to dst] [options]
- src and dst: {addr | { addr or ... }} [[not] ports]
- addr: [not] {any | me | addr-list | addr-set}
  - any
    - matches any IP address.
  - me
    - matches any IP address configured on an interface in the system.

ipfw Firewall rules – Rule Body

- ip-addr:
  - numeric-ip | hostname
  - addr/masklen
  - addr:mask
- ports: {port | port-port}[,ports]

ipfw Firewall rules – Rule Options

- established
- frag
- icmptypes types
- in | out
- keep-state
- limit {src-addr | src-port | dst-addr | dst-port} N
- setup

ipfw Firewall rules example

- # Telnet/SSH access control (controlled by hosts.allow)
  - ipfw add pass tcp from any to me 22 setup
  - ipfw add pass tcp from any to me 23 setup
- # Allow setup of SMTP/POP3
  - ipfw add pass tcp from any to me 25 setup
  - ipfw add pass tcp from any to me 110 setup
- # Allow setup of DNS
  - ipfw add pass tcp from any to me 53 setup
  - ipfw add pass udp from any to me 53
- # Default to deny
  - ipfw add add 65500 reset log tcp from any to any

ipfw Firewall rules – Dynamic Rules

ipfw add check-state

ipfw add deny tcp from any to any established

ipfw add allow tcp from my-net to any setup keep-state

ipfw add allow tcp from my-net/24 to any setup limit src-addr 10

ipfw add allow tcp from any to me setup limit src-addr 4

ipfw Firewall sets of rules

- 32 different sets, numbered 0 to 31
- Set 31 is reserved for the default rule
- Rules are put in set 0 by default
- # Allow icmp (ping and traceroute only)

  ipfw add set 1 pass icmp from any to any icmptypes 0,3,8,11

  ipfw add set 1 pass udp from any to any 33434-34000

- ipfw set move {rule rule-number | old-set} to new-set
- ipfw set swap first-set second-set

ipfw – Traffic Shaper

- options DUMMYNET in KERNCONF
- ipfw
  - <pipe> number config pipe-configuration
  - <queue> number config queue-configuration
- parameters can be configured for a pipe
  - bw [bandwidth | device]
    - ipfw pipe 1 config bw 300Kbit/s
  - delay ms-delay
- parameters can be configured for a queue
  - pipe pipe_nr
  - weight weight

ipfw – Traffic Shaper examples

- limit traffic from local clients on 192.168.2.0/24
  - ipfw add pipe 1 ip from 192.168.2.0/24 to any out
  - ipfw pipe 1 config bw 300Kbit/s queue 50KBytes
- simulate a bidirectional link with bandwidth limitations
  - ipfw add pipe 1 ip from any to any out
  - ipfw add pipe 2 ip from any to any in
  - ipfw pipe 1 config bw 64Kbit/s queue 10Kbytes
  - ipfw pipe 2 config bw 64Kbit/s queue 10Kbytes

ipfw – Traffic Shaper examples

- introduce some delay in the communication
  - ipfw add pipe 1 ip from any to any out
  - ipfw add pipe 2 ip from any to any in
  - ipfw pipe 1 config delay 250ms bw 1Mbit/s
  - ipfw pipe 2 config delay 250ms bw 1Mbit/s

IP Filter – Firewall

- ipfilter
  - options IPFILTER in KERNCONF
  - Last/first match
  - ipf -F <a|i|o|s|S> -f <filename>
  - ipfstat -i/-o
  - ipnat –C/-F/-l/-s

- The official IPF homepage
  - http://coombs.anu.edu.au/~avalon/ip-filter.html

ipfilter Firewall rules

- pass | block | nomatch
  - in | out
- [log]
- [quick]
- [proto < tcp | udp | icmp >]
- from
  - < src-net / host / all > [port = XX | icmp-type X]
- to
  - < dst-net / host / all > [port = XX | icmp-type X]

ipfilter Firewall rules (cont.)

- [on < interface >]
- [options]
  - [flags < flag >]
  - keep state
  - keep frags

ipfilter Firewall rules (cont.)

- Responding To a Blocked Packet
  - block return-rst in …
    - Return RST packet in TCP
  - block return-icmp(port-unr) in …
    - Return port-unreachable in ICMP using firewall's IP address
  - block return-icmp-as-dest(port-unr) in …
    - Return port-unreachable in ICMP using destination's IP address
- Fancy Logging Techniques
  - block in log level auth.info quick …
  - block in log level auth.alert quick …

ipfilter Firewall rules (cont.)

- Allow packets that match rule
  - pass out from 163.21.249.172 to any
  - pass in from smtp.tp.edu.tw to any
- Discard packets that match this rule.
  - block in proto udp from any to any port = 137
  - block in proto udp from any to any port = 138
- Send some notice back
  - block return-rst in proto tcp all flags S
  - block return-icmp[return-code]

ipfilter Firewall rules example

- # Telnet/SSH access control (controlled by hosts.allow)
  - pass in proto tcp from any to any port = ssh flags S keep state
  - pass in proto tcp from any to any port = telnet flags S keep state
- # Default to deny
  - block in log all
  - block return-rst in proto tcp all flags S

Rule Groups

- [head X] & [group X]

```
block out quick on bge0 all head 1
block out quick on bge1 all head 2
block in quick from 192.168.0.0/16 to any group 1
block in quick from 172.16.0.0/12 to any group 1
pass out quick proto tcp from any to
    163.21.249.128/25 port = 80 flags S keep state
    group 1
```

ipnat – ipfilter NAT

- /etc/rc.conf
  - gateway_enable=“YES”
  - ipnat_enable=“YES”
  - ipnat_rules="/etc/ipnat.rules“
- ipnat.rules
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32 portmap tcp/udp 40000:60000
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32 proxy port ftp ftp/tcp

ipnat (cont.)

- Mapping Many Addresses Into One Address
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32
  - map bge0 192.168.100.0/24 -> 0/32
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32 portmap tcp/udp 40000:60000
    - transport tcp/udp into the port range of 40000 to 60000
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32 portmap tcp/udp auto
  - map bge0 192.168.100.0/24 -> 163.21.249.172/32 proxy port ftp ftp/tcp
    - Application Proxies

ipnat (cont.)

- Mapping Many Addresses Into a Pool of Addresses
  - map bge0 192.168.100.0/24 -> 163.21.249.192/26
- Policy NAT
  - map bge0 from 192.168.100.0/24 ! to 140.122.0.0/16 -> 163.21.249.191/32
- One to One Mappings
  - bimap bge0 192.168.100.1/32 -> 163.21.249.190/32

ipnat (cont.)

- Spoofing Services
  - rdr bge0 163.21.249.172/32 port 80 -> 192.168.0.5 port 80
- Transparent Proxy Support
  - rdr bge0 0.0.0.0/0 port 80 -> 127.0.0.1 port 3128
- Using NAT As a Load Balancer
  - rdr bge0 163.21.249.172/32 port 80 -> 192.168.0.5 port 80 tcp round-robin
  - rdr bge0 163.21.249.172/32 port 80 -> 192.168.0.6 port 80 tcp round-robin

The End

Thank you!