Network Security: From Firewalls to Internet Critters—Some Issues for Discussion

Presentation Contents

- Firewalls
- Viruses
- Worms and Trojan Horses
- Securing Information Servers

Section 1:

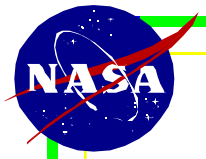
Firewalls—What they are and how to build them

What is a Firewall?

- A barrier between internal and external environments, designed to prevent outsiders from accessing your data.
- Offer the greatest security by giving multiple levels of protection while allowing necessary services.
- Not necessarily a single piece of hardware or software.
- Audit or log Internet usage, keep statistics
- Act as a central point of contact

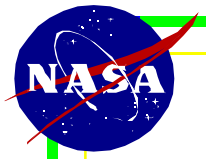
Firewalls

- What are the threats
- Curious crackers
- Vandals
  - ***System Downtime***
  - ***Network Outages***
  - ***Telephone line use***
- Accidental data disclosure
  - ***Privacy issues***



Firewalls

- Network Security Paradigms
- That which is not expressly permitted is prohibited
  - ***firewall blocks everything - services must be individually enabled on a case by case basis***
  - ***Administrator must take steps to support each service***
  - ***Users may see firewall as a hindrance***
- That which is not expressly prohibited is permitted
  - ***Firewall blocks services that are known security risks***
  - ***Users can potentially introduce security holes in system***



Some Questions to Ask

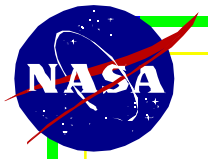
- If the firewall is breached, what kind of damage could be done to private net?
- How big is the zone of risk?
- How easy is it to detect that a break in or destruction has occurred?
- How much audit information will be kept for diagnosis?
- How inconvenient is the firewall to the users?

Firewall Precautions

- Do not run Network Information System (NIS) on the firewall (like having the Yellow Pages)
- Ensure strong passwords and filesystem protection on the firewall
- Eliminate all non-essential services
- Do not mount remote NFS filesystems on the firewall machine
- Enable extensive logging
- Don’t allow user accounts on firewall machines

Firewall Costs

- Obvious Costs
  - Hardware
  - Software
- Hidden Costs
  - Maintenance
  - Administration
  - Loss of Services Due to Security
  - Violation Potential
  - Training

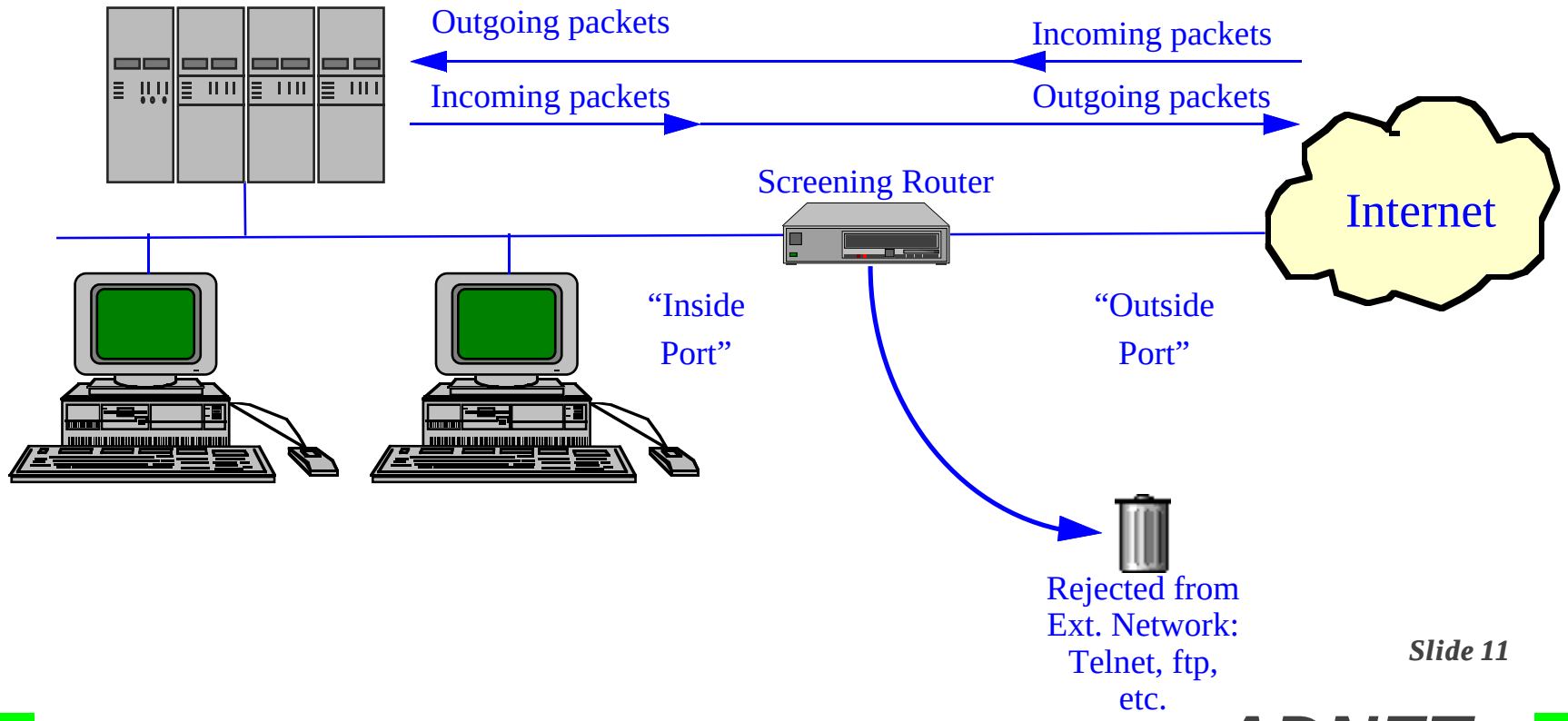


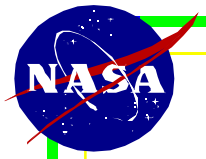
Firewall Categories

Screening Routers

- Least secure method
- Can be a commercial router or host that supports packet screening, eg Cisco, Proteon, 3Com
- Block traffic between networks, hosts, IP ports, protocols or packet types
- Some screening routers permit various levels and types of packet logging
- May be the only component in a firewall
- Design Philosophy - “That which is not expressly prohibited is permitted”

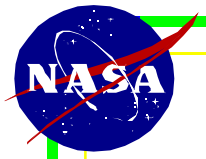
Screening Router Placement





Packet Filter Questions

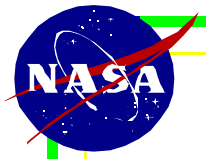
- *Where is the filtering to be done? On input, output, or both?*
- *What attributes (i.e. protocol, source, destination, etc) can be checked?*
- *How are protocols other than TCP, UDP handled?*
- *Can source routed packets be rejected?*
- *How comprehensible is the filter language? Can you control the order of application of the rules?*



Firewall Categories

Risks of Screening Routers

- Very minimal logging information
- Difficult to configure screening rules
- Entire network can be unprotected if firewall is breached
- Addition of new services may open holes
- Can be bypassed by tunnelling, eg DNS.
- Can be vulnerable to source routed traffic
- Some protocols not suited to packet filtering, eg rcp, rlogin, rsh, rdist, NFS, NIS

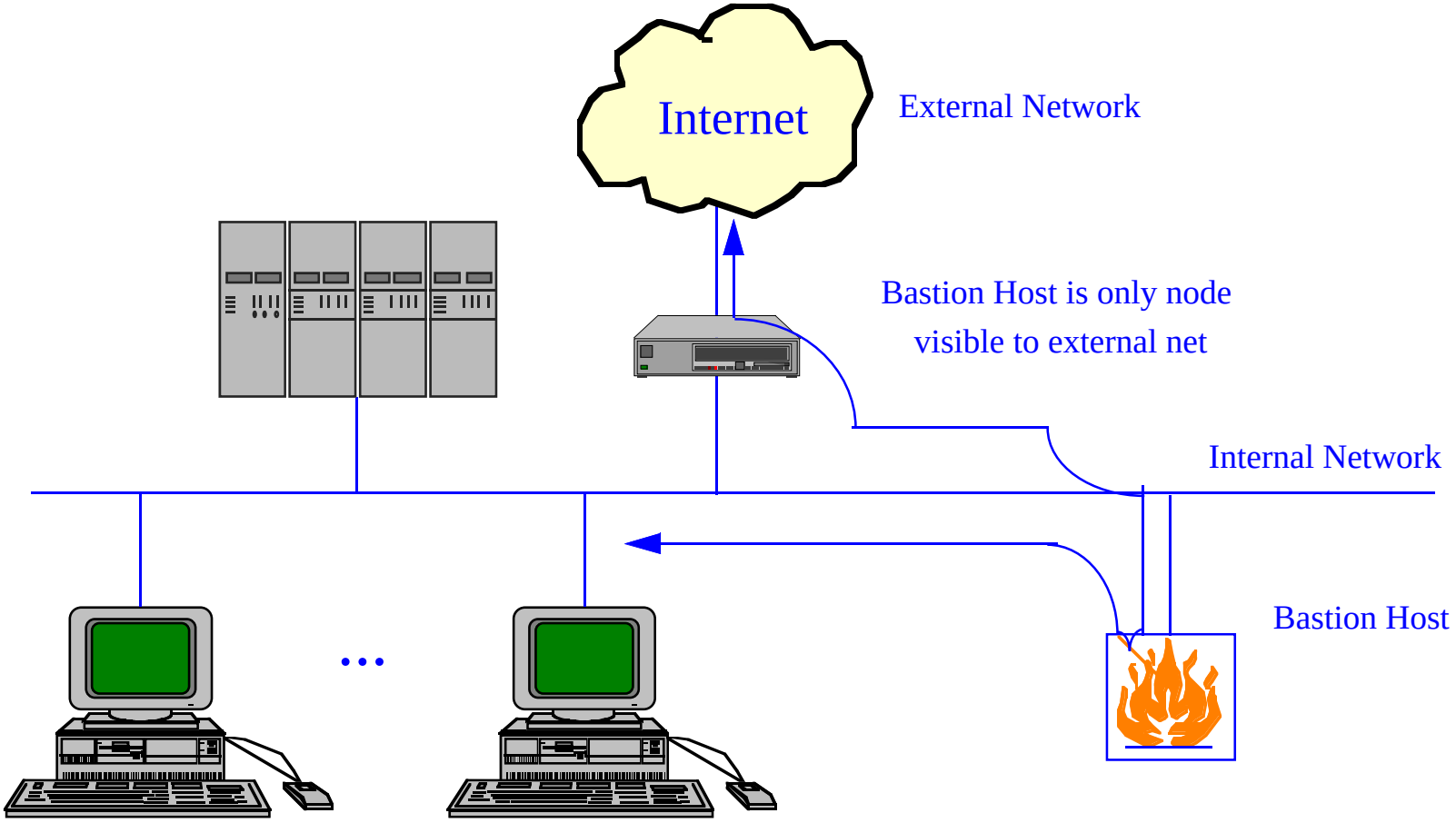


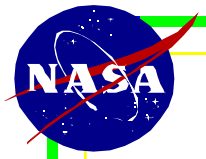
Firewall Categories

Bastion Hosts

- Only system visible to external network
- Special systems identified as network “strong points”
- Often act in capacity of E-mail relays, name servers, FTP servers, Usenet servers etc,.
- Generally, a Bastion Host is one that is recognized as a potential point of attack and will have extra attention paid to its security, audits, software etc.
- Should not be “trusted”

Bastion Host



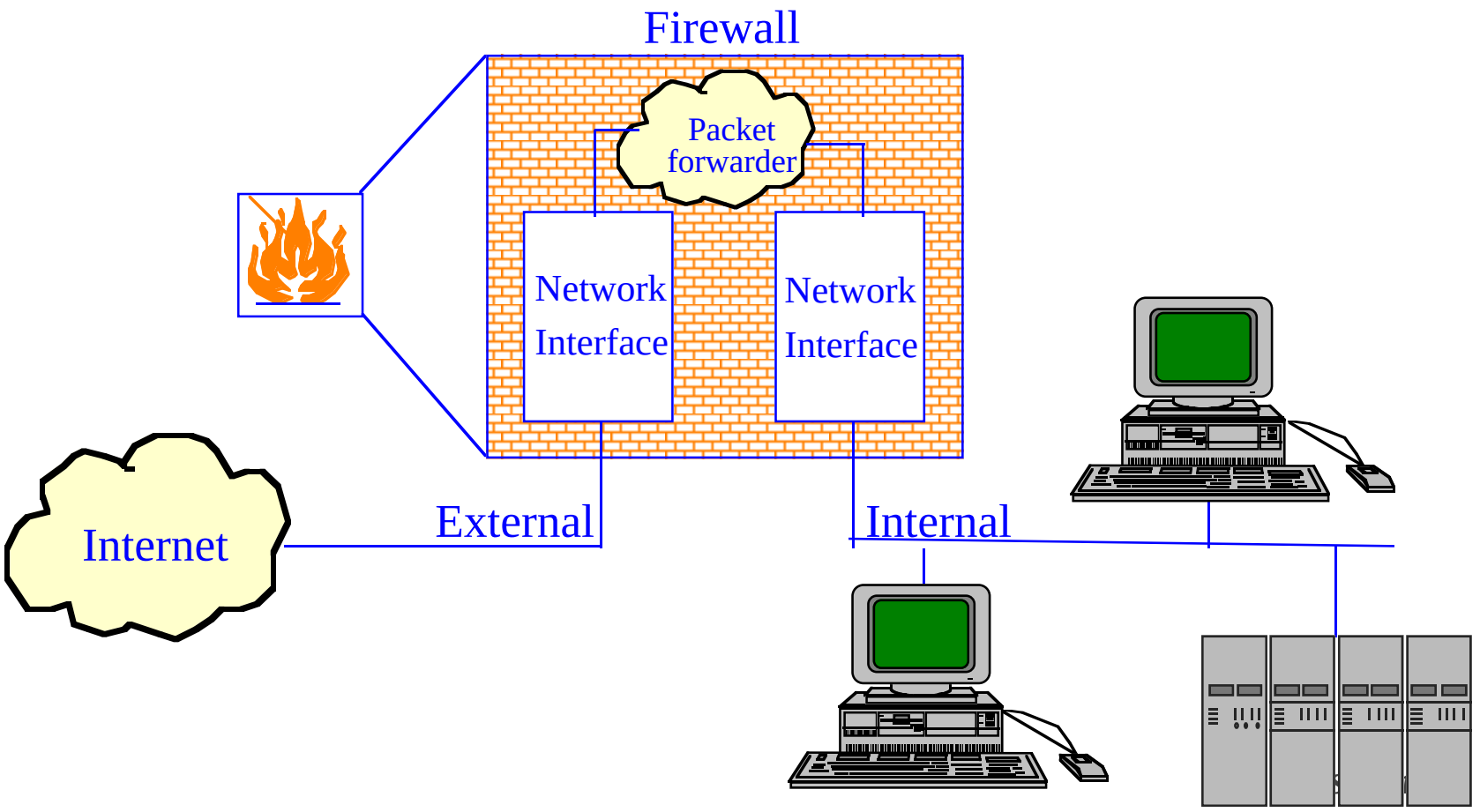


Firewall Categories

Dual Homed Gateway

- Special case of Bastion Host
- Reachable from both Internet and private network, with IP forwarding turned off (direct traffic between the networks is blocked)
- All traffic relayed through application level filters, must pass security checks before being passed on
- No user login accounts allowed on the system
- All connections are logged so that a complete audit trail is available

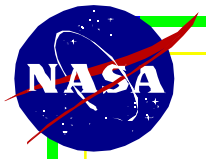
Dual Homed Gateway



Dual Homed Gateway

Disadvantages:

- difficult to set up properly
  - turning off IP source routing
- difficult to manage
  - large number of users
  - usually require a number of services
- inconvenient to use
  - users first have to access the dual homed host and then access services (services can't be accessed directly from the desktop)

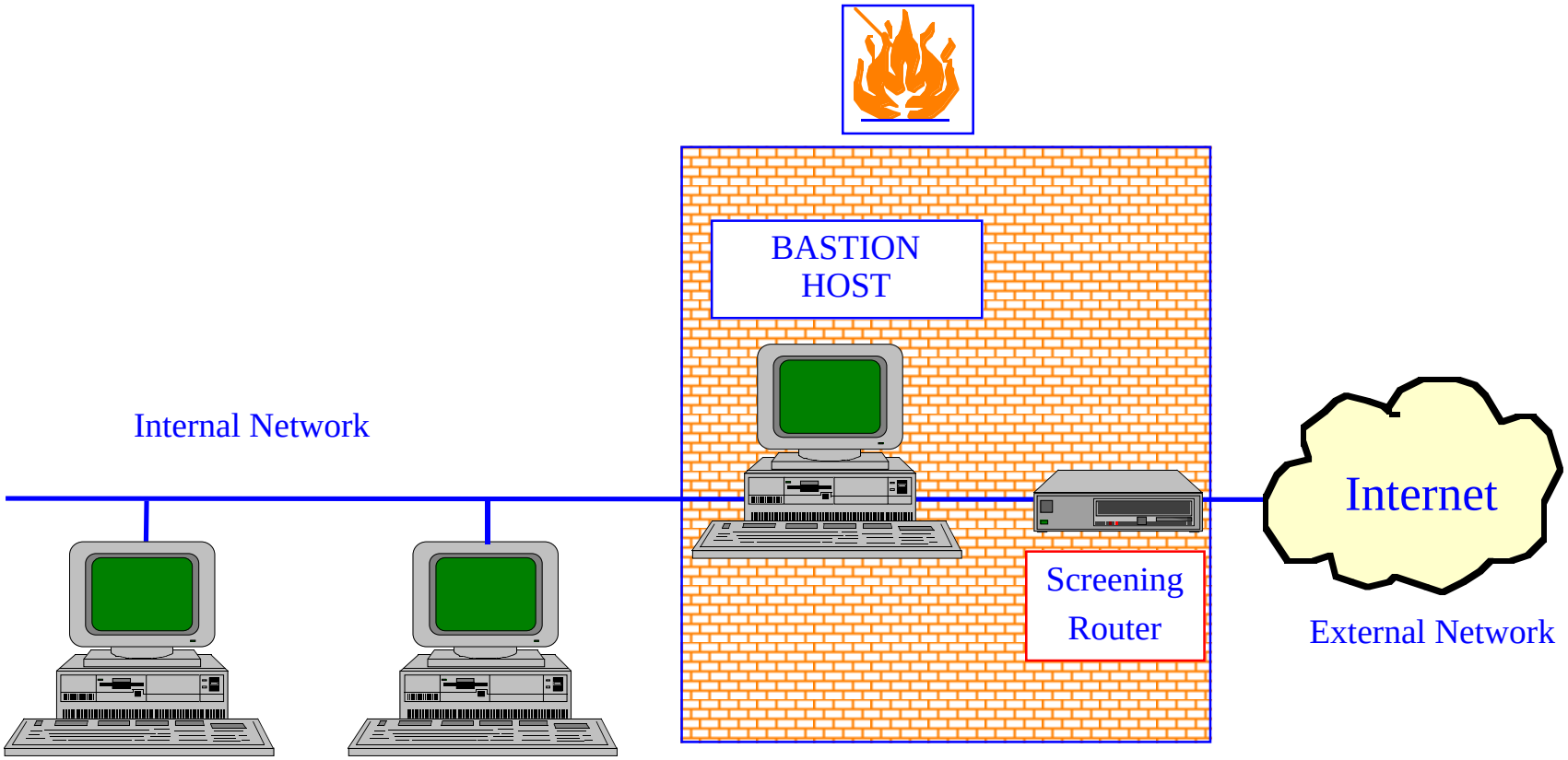


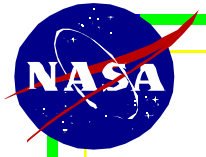
Firewall Categories

Screened Host Gateway

- Most common and flexible form of Firewall
- Screening Router blocks traffic between Internet and all hosts on private network except for a single Bastion Host
- Screening Router can be configured to permit nodes on private network to directly access Internet via Telnet or FTP.
- Screening router is usually configured to block traffic to the Bastion host on specific ports

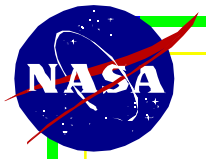
Screened Host Gateway





Screened Host Gateway

- Advantages:
  - added security over a single bastion host
  - fairly easy to implement
- Disadvantages:
  - requires a router and a bastion host
  - intruder detection depends on logging procedures



Firewall Categories

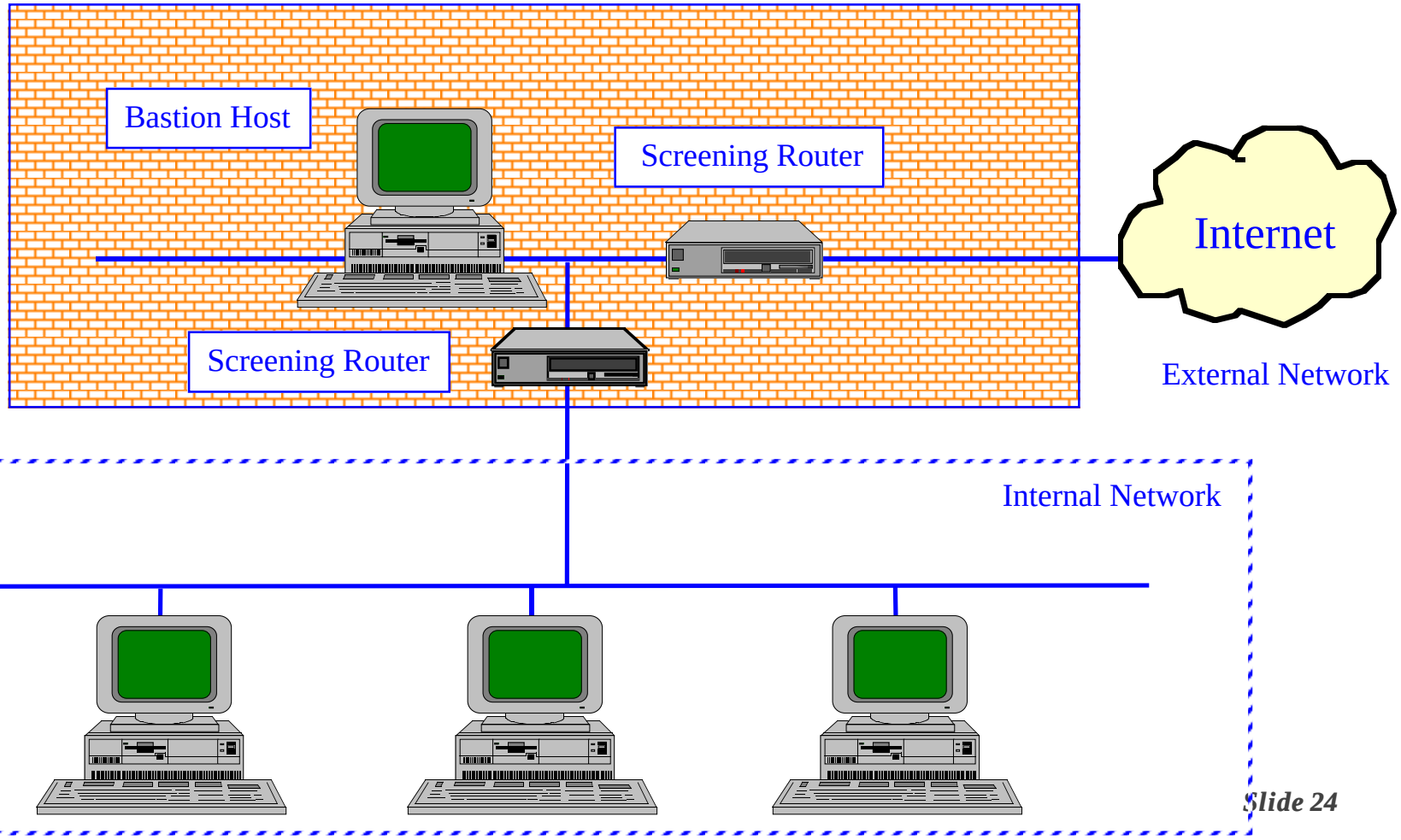
Screened Subnet

- Creates isolated subnet between Internet and private network
- Internet can only communicate with nodes on the Screened Subnet
- Private network nodes can only communicate with nodes on the Screened Subnet
- The private network becomes effectively invisible to the Internet

Screened Subnet

- Advantages:
  - sandbox or demilitarized zone between the protected network and the Internet
  - direct traffic across the screened subnet is blocked
  - Only the Bastion host is at risk
  - good for high volume and high speed traffic
- Disadvantages:
  - complexity of configuring screening routers
  - entire network is reachable from the outside if screening routers fail

Screened Subnet

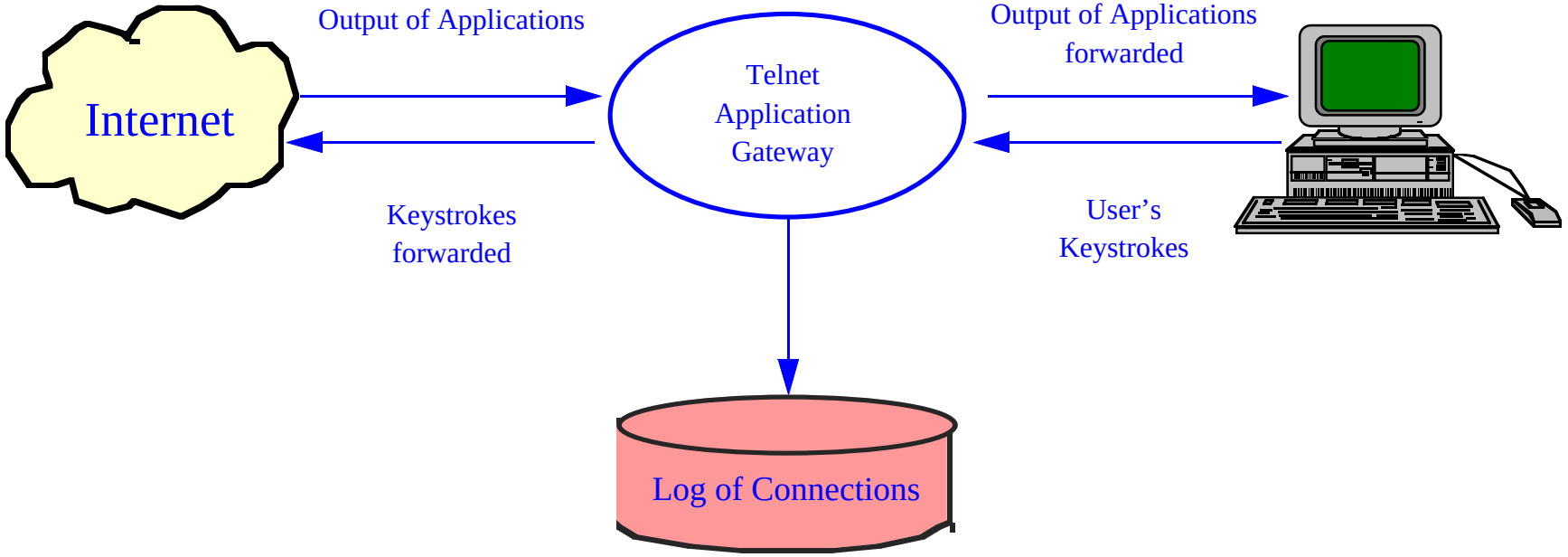


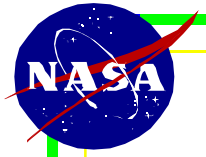
Firewall Categories

Proxy or Application Gateway

- Handle store and forward traffic and some types of interactive traffic
- Handle traffic at an application level
- Can easily log/audit traffic
- Can have extra security built in as needed
- Examples:
  - ***Sendmail***
  - ***Telnet***
  - ***FTP***
  - ***Web Server***

Telnet Application Gateway





Evaluating Application Gateways

- What applications are supported? (mail, gopher, X11)
- Are specialized client programs needed?
- How are the difficult services, such as FTP and X11, handled?
- Are the logging, access control, and filtering routines adequately documented?
- What sorts of logs and authentication mechanisms are provided?
- Are any traps or lures provided? Can you add your own?

Application Gateways

- ***Advantages:***
  - allow users to access internet services directly
  - good logging procedures
  - provide some form of authentication
- ***Disadvantages:***
  - new services need to be provided
  - burden the firewall administrator
  - proxy services are not workable for some services
  - require two steps to connect inbound and outbound traffic

Firewall Summary

- Use Common Sense
- Keep It Simple
- Trial and Error
- Use Help Resources
- Rely on the tools you know and understand

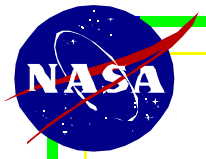
Section 2:
Viruses and how to combat them

Viruses

- “Infect” computer executable programs by attaching themselves to these programs
- May contain a “trigger” to perform some specific act when certain conditions are met
- Once infected, a program will infect other programs when it executes, thus spreading the virus
- Can be downloaded with programs off the Internet
- Most are benign, but may cause erratic behavior
- Cannot infect a computer via e-mail, or infect data
- Various virus tools are available to counteract them

Virus Examples

- The WDEF Virus causes computer to beep, frequently crash or display fonts incorrectly
- nVIR Virus causes computer to beep every 8 to 16 times it is started
- A newly discovered Mac Virus called “HC 9507” infects the HyperCard application.
- HC 9507 does not infect system files or other applications
- May cause screen to fade in and out, type “pickle” automatically or a system shutdown or lockup.

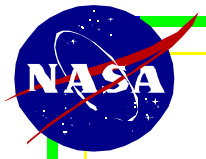


Virus Tools

- Detect the presence of a virus on a system
- Static Analysis—can inspect diskettes before installation, or test system on a regular basis
- Interception—halt the execution of an infected program as the virus attempts to replicate
- Modification—search for the unexpected modification of programs
- Identification—identify which particular virus has infected a system
- Removal—attempt to remove all viruses

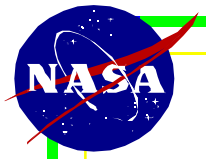
Virus Tools Selection Factors

- Accuracy
  - Detection Tools—false positives, false negatives
  - Identification—fails to correctly identify virus
  - Removal—hard failure and soft failure
- Ease of use—difficulty in using system, presentation of results
- Administrative Overhead—load on technical support team
- System Overhead—load on system



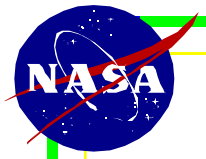
Section 3:

Internet Worms and Trojan Horses—descriptions and some examples



Internet Worms

- Use Network services to propagate
  - Network mail utility
  - Remote execution capability
  - Remote login capability
- Do not require a “host” program to spread
- Originally designed for useful purpose
- Can spread to many systems very quickly



Trojan Horse

Trojan Horse:

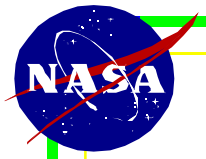
- A program that disguises itself by purporting to accomplish some useful function.
- For example, a Trojan horse program could be advertised as a calculator, but it may actually perform some other function when executed, such as modifying files.
- Cannot infect other machines unless it is run on them

Trojan Horse Example

PKZ300B:

- Version 3.00G of PKWARE's shareware DOS data compression utility
- Distributed as a self extracting archive, PKZ300B.EXE, which contains a Trojan Horse
- If run, will destroy all data on a PC's hard drive
- Will only affect the machine on which it is run
- Latest actual release of PKZip is v2.04G

Section 4:
Securing Internet Information Servers

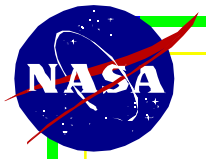


General Guidelines

- Information server should be a dedicated system
- Server process should run with as little privilege as possible
- Server software should be executed in a restricted file space
- Administrators should closely monitor the integrity of the system and information

Anonymous FTP Servers

- No files or directories should be owned by user “ftp”
- No encrypted passwords should be in the file ‘~ftp/etc/password’
- If possible, no files or directories should be writable by anonymous users



Web Server Security

- Run the server daemon as a nonprivileged user (“nobody”), rather than as root
- Turn off “Server Includes” or “Server Parsed” options
- Write CGI scripts (for user input) carefully
- Run the server in a restricted portion of the file space (use chroot for Unix)