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How to Detect Mainframe Intrusion Attempts

Paul R. Robichaux
NewEra Software, Inc.

Wednesday, February 6, 2013 at 3:00 PM
Session Number 12257
Grand Ballroom B

Insert Custom Session QR If Desired.

SHARE in San Francisco 2013

Abstract and Speaker

- The Internet today is a complex entity comprised of diverse networks, users, and resources. Most of the users are oblivious to the design of the Internet and its components and only use the services provided by their operating system or applications. However, there is a small minority of advanced users who use their knowledge to exploit potential system vulnerabilities. With time and adequate system resources these Hackers or Crackers can compromise any information system including a zEnterprise Mainframe Complex.

- This presentation will provide insight into:

  First, the severity of the intrusion problem, the common attack points: Ports and Packets, how they are exploited by spies to reach and steal proprietary information or embed Remote Access Trojans (RATs) that can take remote control of a system and it's connected resources.

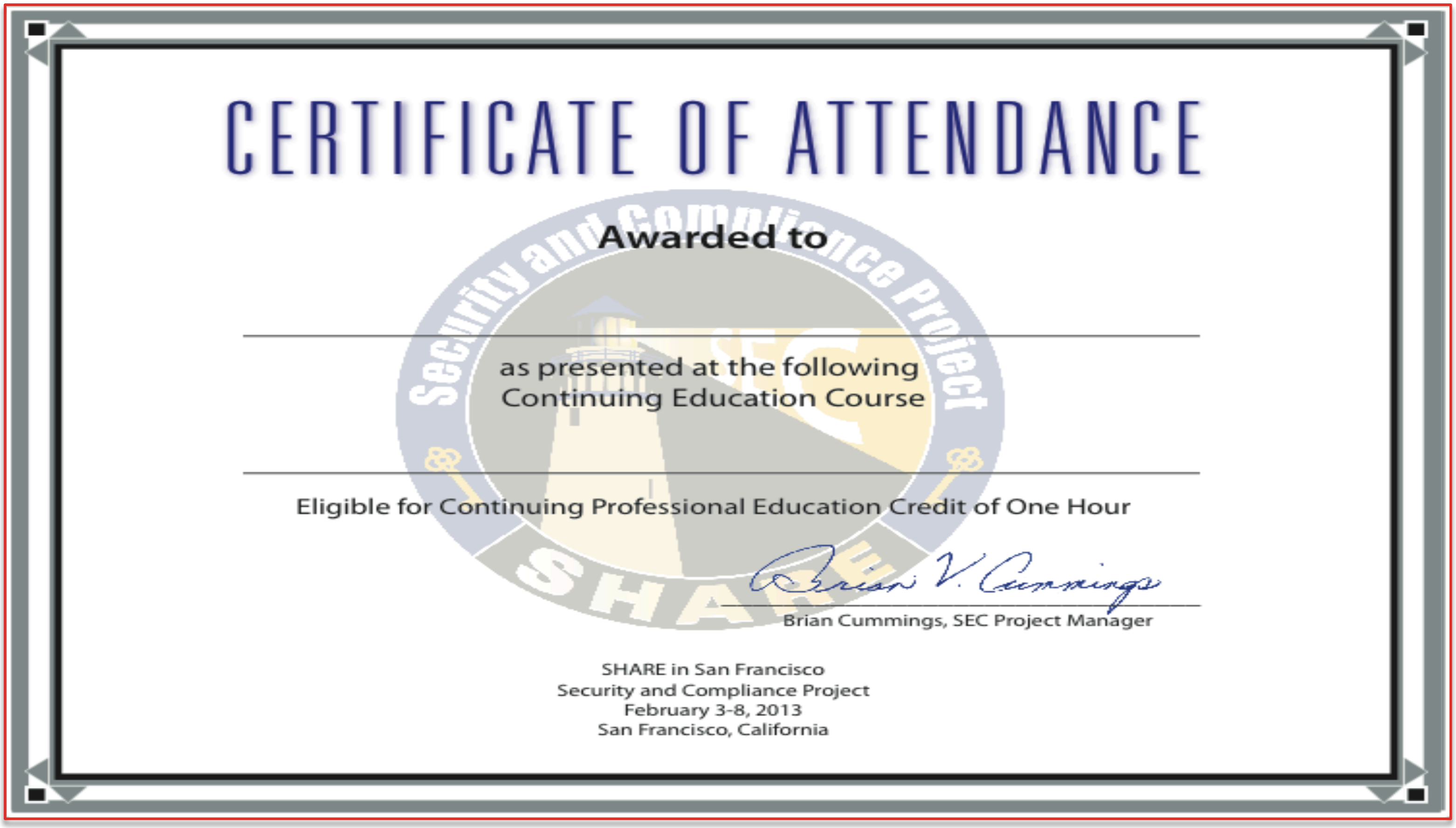
  Second, who the attackers are: Hackers, Crackers, Spies and how to detect their activities and fight back their attacks using a combination of common sense best practices and system tools.

  Third, the components of Network Policy Management and how the Policy Management Agent (PAGENT) can be used in a zEnterprise to detect and defend against a Mainframe Intrusion.

- Paul R. Robichaux is CEO of NewEra Software, Inc. He served as the Chief Financial Officer of Boole and Babbage for the ten years immediately preceding his co-founding of NewEra in 1990. He holds a BS in Accounting and a Masters in Business Administration from a Louisiana State University and is a Certified Public Accountant.

- The corporate mission of NewEra Software is to provide software solutions that help users avoid non-compliance, make corrections as needed and in doing so, continuously improve z/OS integrity.

Continuing Education Credit



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Mainframe Intrusion!

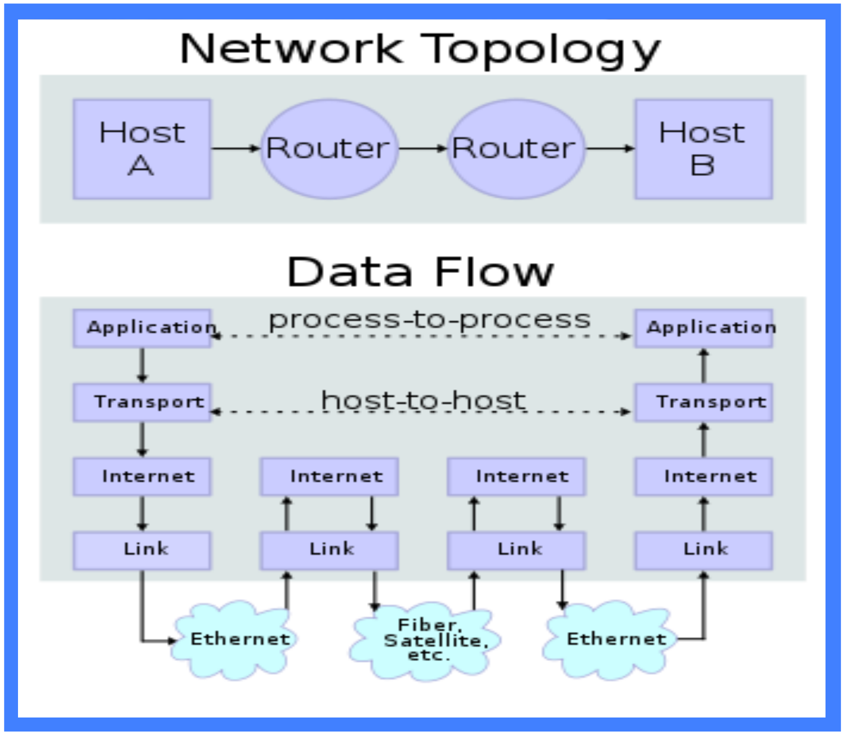
Is your Mainframe Safe? – What's there to Protect? Topology and Data Flow!

❑ Two Internet hosts connected via two routers and the corresponding layers used at each hop.

❑ The application on each host executes read and write operations as if the processes were directly connected to each other by some kind of data pipe.

❑ Every other detail of the communication is hidden from each process.

❑ The underlying mechanisms that transmit data between the host computers are located in the lower protocol layers.



Source:http://en.wikipedia.org/wiki/Internet_protocol_suite

Mainframe Intrusion!

We're all under Attack! > Is your Mainframe Safe? > How do you know?

❑ Inside the Castle, personnel that have authorized system access and necessary technical knowledge that are motivated by positive organizational goals are considered organizational assets; friendly, vetted, productive system users. On the other hand those negatively motivated to do harm are a threat to system integrity.

❑ Outside the Castle, all those negatively motivated and in possession of the required resources: time, technical knowledge and hardware and software tools, Hackers and Crackers, represent an equally dangerous threat to system integrity.

Source: Phil Hopley – h2index – a UK based IT Research Firm

Mainframe Intrusion!

We're all under Attack! > Is your Mainframe Safe? > What Should You Do?

❑ The old "medieval city" approach to IT Security just doesn't work anymore.

❑ Organizations believed to have adopted the best approaches have a robust security governance policy, backed up by good communications to assure ***awareness***, ***awareness*** and more ***awareness*** among everyone in their organizations.

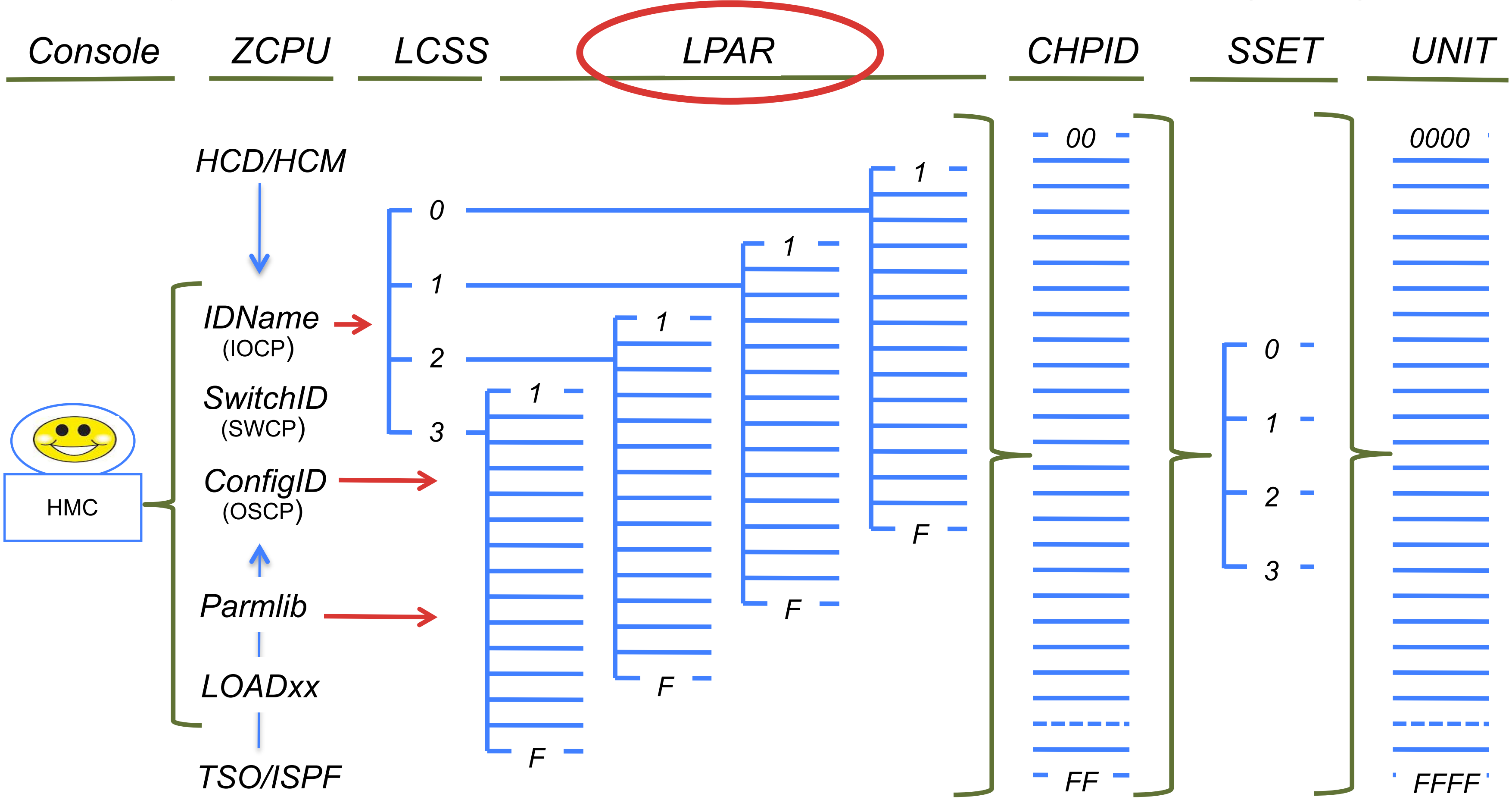
❑ 97% of all Security Breaches could be avoided if organizations adopted simple, straight forward, IT Security Measures.

❑ IT Security should be everyone's concern, it is for certain everyone's problem!

Source: Phil Hopley – h2index – a UK based IT Research Firm

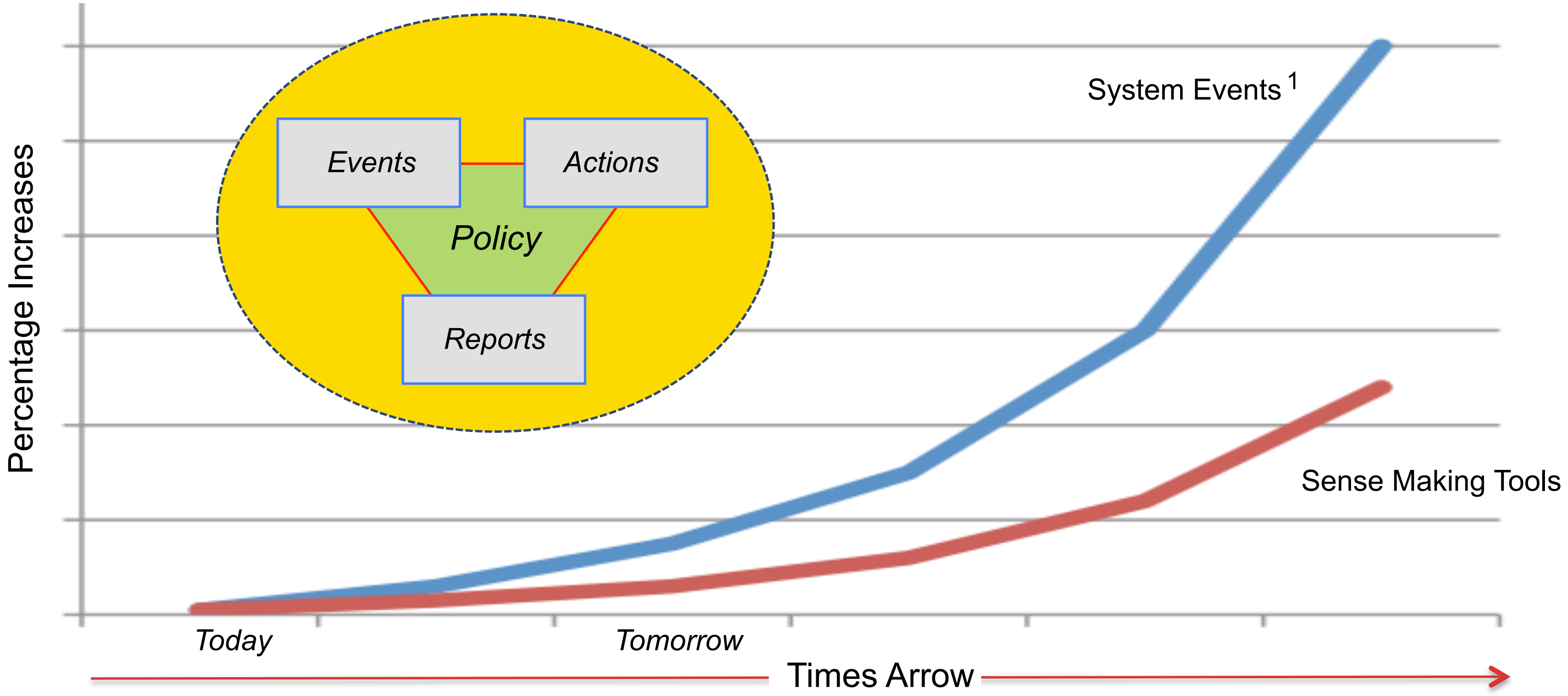
Mainframe Intrusion!

Is your Mainframe Safe? – What About each Logical Partition (LPAR)?



Mainframe Intrusion!

Is your Mainframe Safe? – How do you Know? How are you Fighting Back?



[1] *More than 40,000 unique message IDs are defined for z/OS and the IBM software that runs on z/OS systems.*

Mainframe Intrusion!

Is your Mainframe Safe? – Fighting Back > Management Policy

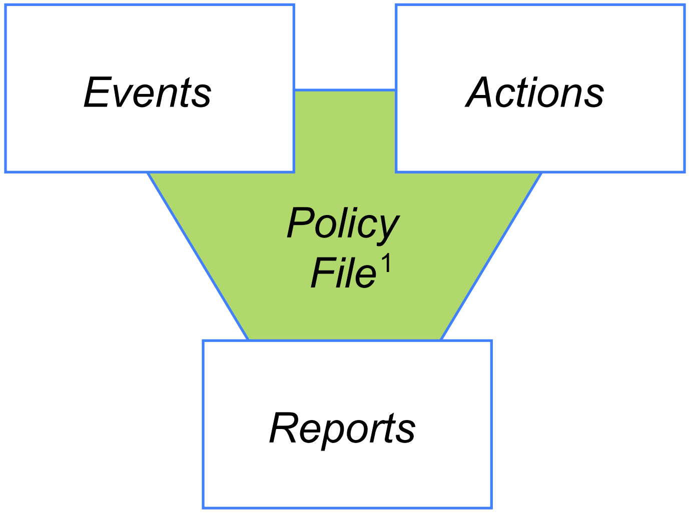
❑ Management Policies are a pre-defined set of network Events, corresponding reply Actions, related Notifications and Reports.

❑ Policy files are created and maintained using the z/OSMF Configuration Assistant, or the PC-based Configuration Assistant for the z/OS Communication Server.

❑ The same Policy Configuration can be applied across many multiple IP Stacks in the same underlying LPAR.

❑ Unique Policy Configurations can be deployed for each IP Stack in an LPAR.

Policy Infrastructure Elements



[1] /etc/cfgasst/v1r13/imagename/stackname/idsPol

Source: V1R13 IBM Configuration Assistant for z/OS Communications Server tool

Mainframe Intrusion!

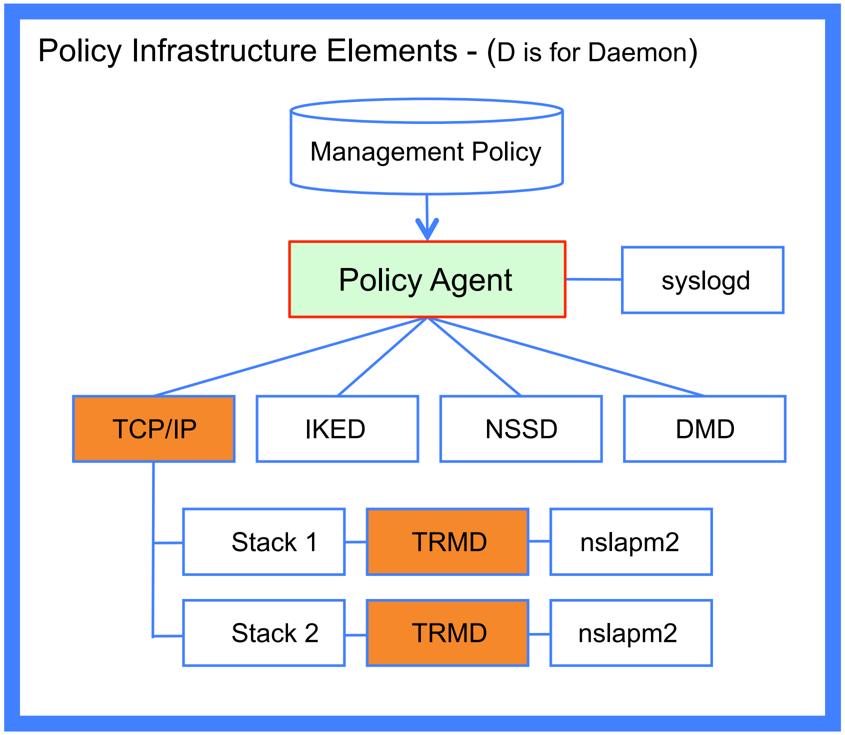
Is your Mainframe Safe? – Fighting Back > Policy Enforcement

❑ PAGENT, a z/OS address space, builds the Policy Infrastructure needed by the z/OS Communication Server to support Intrusion Detection Services (IDS). PAGENT acts as a:

- ✓ Policy Server: executes on a single system and installs policies for others
- ✓ Policy Client: retrieves remote policies from the Policy Server.

❑ The Policy Infrastructure Includes:

- ✓ Internet Key Exchange (IKED)
- ✓ Network Security Services (NSSD)
- ✓ Defense Manager (DMD)
- ✓ Traffic Regulation Management (TRMD)
- ✓ The Reporting Subagent (nslapm2)



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012 - Volume 4
Note – TCP/IP Profile DECK, IPSECURITY Keyword on the IPCONFIG Statement

Mainframe Intrusion!

Is your Mainframe Safe? – Fighting Back > Report > Cyber Crimes

❑ Management has the obligation to put in place and enforce *Best Practices* that:

✓ With Respect to Employees

1. Educate
2. Equip
3. Empower

✓ With Respect to Stakeholders

1. Disclose Material Attacks
2. Potential Damages
3. Damage Mitigation
4. Corrective Actions

✓ With Respect to Law Enforcement

1. Report, Cooperate
2. Prosecute Offenders

Source:http://www.thenewstribune.com/2012/06/29/2198831/cybercrime-disclosures-scarce.html

Mainframe Intrusion!

Is your Mainframe Safe? – Presentation Descriptive Matrix

	Message	*Delivery*	*Packets*	*Destination*	*Security*	*Attacks*	*Defenses*
Message	Public, Private Hackers						
Delivery		Network Layers					
Packets			Header, Payload Trailer				
Destination				IPAddress, Port Socket			
Security					IPSec SSL, TSL, SSH		
Attacks						Players, Tools, Training	
Defenses							Fighting Back PAGENT

Source: How to Detect Mainframe Intrusion Attempts - SHARE SF 02/2013 - Session 12257

Mainframe Intrusion!

Is your Mainframe Safe? - Message > We're all under Attack!

"…In Q4/2012 more than 8 million new kinds of malware were discovered up 25% from the prior years. There are now more than 90 million unique strands of malware in the wild."

Source: "Threats Report" by McAfee an Intel (INTC, Fortune 500) subsidiary

"…Government, businesses and consumers are under attack. Hardly a week goes by without a report of a cyber security breach and warnings from IT security experts about the vulnerability of corporate assets ranging from intellectual property to critical nation state infrastructure assets."

Source: CYBERSECURITY – A Financial Times Special Report – June 1, 2012

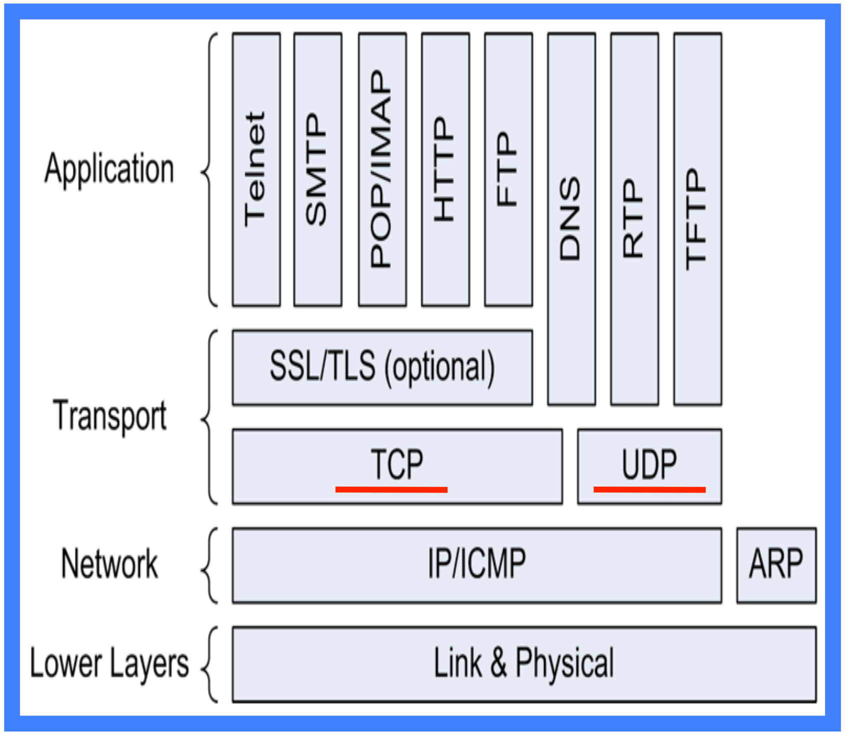
"…In 2011 Security Breaches Cost US Companies an Estimated $US125 Billion."

Source: The Ponemon Institute – www.ponemon.org – Annual Survey 2011

Mainframe Intrusion!

Is your Mainframe Safe? - Delivery > Layers in the Typical Network

- ❑ *Application:*
  User data created, communicate to other processes on another or the same host - Peers. This is where the "higher level" protocols such as SMTP, FTP, SSH, HTTP, etc. operate.
- ❑ *Transport:*
  Opens and maintains the connections between host systems separated by routers.
- ❑ *Network:*
  Establishes networking, exchanges datagrams across network boundaries routing them to the next IP router with connectivity to destination.
- ❑ *Lower Layers or Link Layer:*
  Defines methods used by local network to effect transmission of Network layer datagrams to the next-neighbor router and/or hosts.



Application

Telnet

SMTP

POP/IMAP

HTTP

FTP

DNS

RTP

TFTP

Transport

SSL/TLS (optional)

TCP

UDP

Network

IP/ICMP

ARP

Lower Layers

Link & Physical

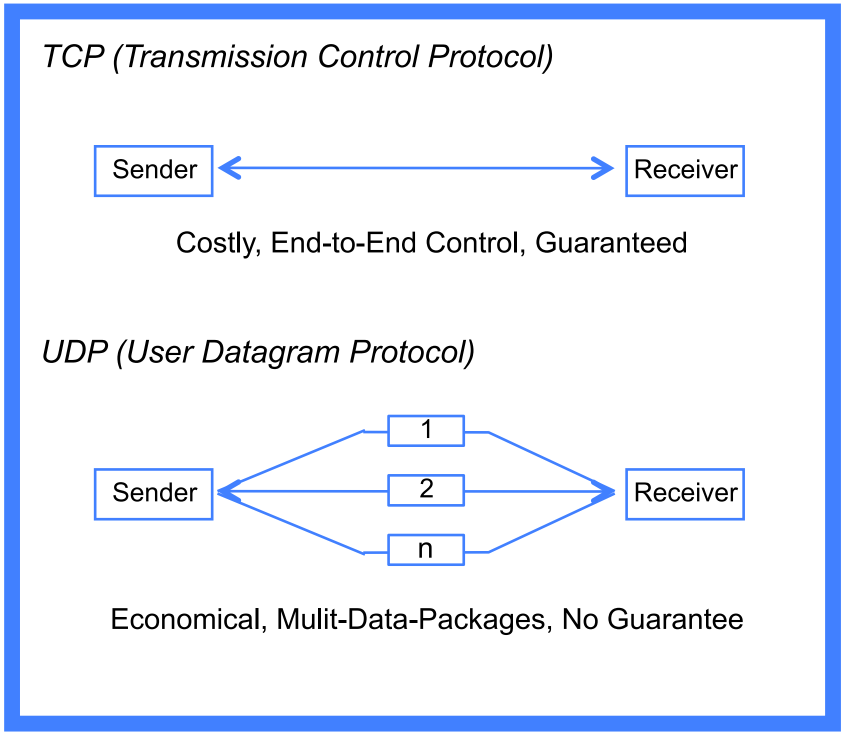
Source: GOOGLE “the internet layer of the internet architecture model”

Mainframe Intrusion!

Is your Mainframe Safe? - Delivery > TCP Vs. UDP

- ❑ TCP (Transmission Control Protocol) Port transmissions connect directly to the computer it’s sending data to, and stay connected for the duration of the transfer. With this method, the two computers can guarantee that the data has arrived safely and correctly.

- ❑ UDP (User Datagram Protocol) Ports release data packages into the network with the hopes that they will get to the right place. This means that UDP relies on the devices in between the sending and receiving computer to get the data where it is supposed to go, no guarantee it will.



TCP (Transmission Control Protocol)

Sender

Receiver

Costly, End-to-End Control, Guaranteed

UDP (User Datagram Protocol)

Sender

1

2

n

Receiver

Economical, Mulit-Data-Packages, No Guarantee

Source: http://www.bleepingcomputer.com/tutorials/tcp-and-udp-ports-explained/
Note: OSPF Open Shortest Path First, ICMP Internet Control Message Protocol

Mainframe Intrusion!

Is your Mainframe Safe? - Delivery > Display Your System Values

❑ Network Ports, under the control of the z/OS Communication Server, are defined to the TCP/IP Stack via a unique configuration profile.

❑ Identifying and documenting the types and uses of each port is an essential step towards increasing security awareness.

❑ A Port Scanner is often used to identify ports. Freely available Scanners Advertise:

> *"Use this tool to inspect your own computer's TCP/IP ports and see what open network ports hackers might discover on your machine."*

z/OS Communication Server for z/OS

<> Operator Command to Display Ports:

```
/Display TCPIP,,NETSTAT,PORTList
```

<> Port List Report returned to System Log:

```
RESPONSE=S0W1
EZZ2500I NETSTAT CS V1R11 TCPIP 404
PORT# PROT USER     FLAGS    RANGE  MORE>
7     TCP  MISCSERV DA
9     TCP  MISCSERV DA
19    TCP  MISCSERV DA
20    TCP  OMVS     DA
21    TCP  FTPSERVE DA
19    UDP  MISCSERV DA
53    UDP  NAMESRV  DA
111   UDP  PORTMAP  DA
135   UDP  LLBD     DA
161   UDP  OSNMPD   DA
```

Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012 and GOOGLE: "TCP/IP Port Scanner"

Mainframe Intrusion!

Is your Mainframe Safe? - Packets > Elements of a Packet

❑ A packet consists of two kinds of data: Control Information and the User Payload.

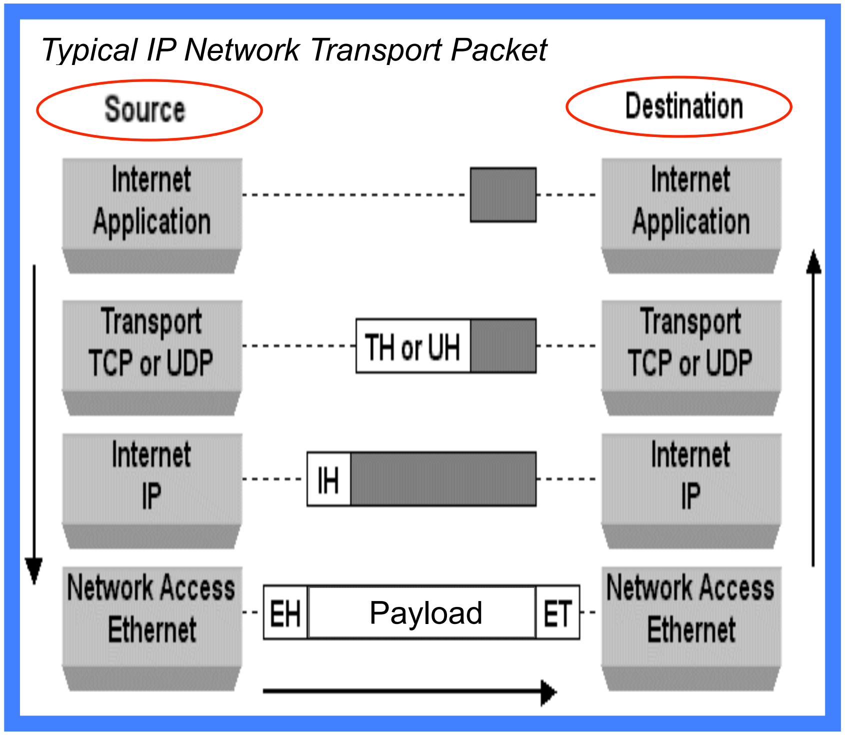
❑ Control information provides data the network needs to deliver data, for example:

- ✓ source and destination addresses,
- ✓ error detection codes, checksums, and
- ✓ sequencing information

❑ Typically, Control Information is found in packet headers and trailers, with payload data in between.

❑ A Packet is considered Malformed when it is of a non-standard size, fragmented or contains overlaid Control Information.

Typical IP Network Transport Packet

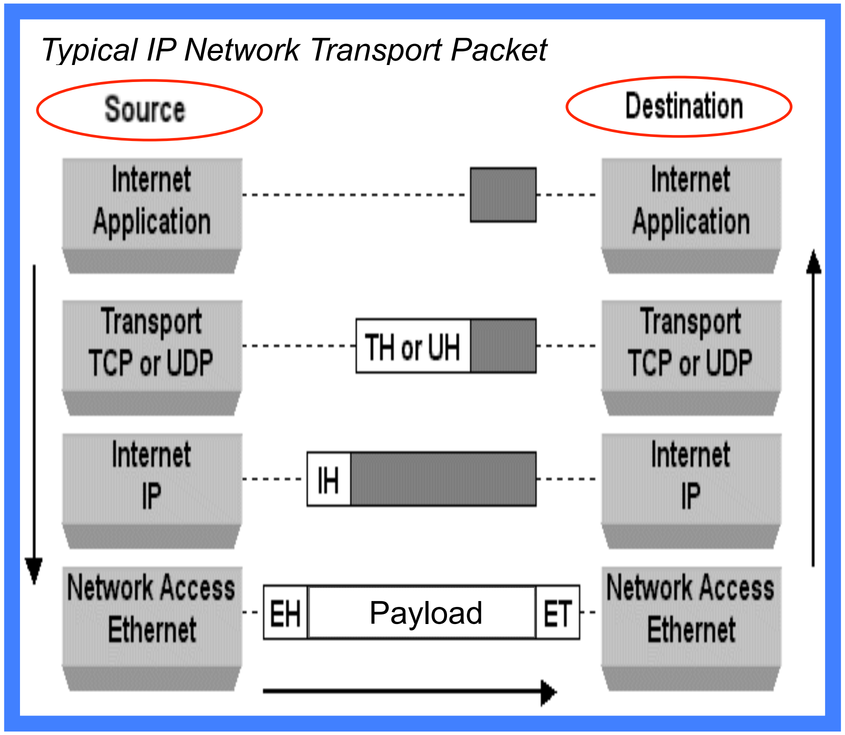


Source: Wikipedia – From the Query "Network Packet"

Mainframe Intrusion!

Is your Mainframe Safe? - Packets > Payload Types and Payload Security

- ❑ "Payload" can mean the actual user data contents of a packet. A better term would be "Data Payload" as it will help to distinguish between user data contents and header information i.e. TCP or UDP.
- ❑ IPsec offers two modes of security:
  - A) *Tunnel Mode* protects - packet IP Header, TCP or Application/Transport Header, Data payload - not just the "Data Payload" - VPN.
  - B) *Transport Mode* protects the TCP or Application/Transport Header and the Data Payload.
- ❑ SSL/TLS, secures only the "Data Payload" and not the IP or the Transport Header.



Source: Linda Harrison and Gwen Dente, *zEnterprise Network Team, IBM ATS*

Mainframe Intrusion!

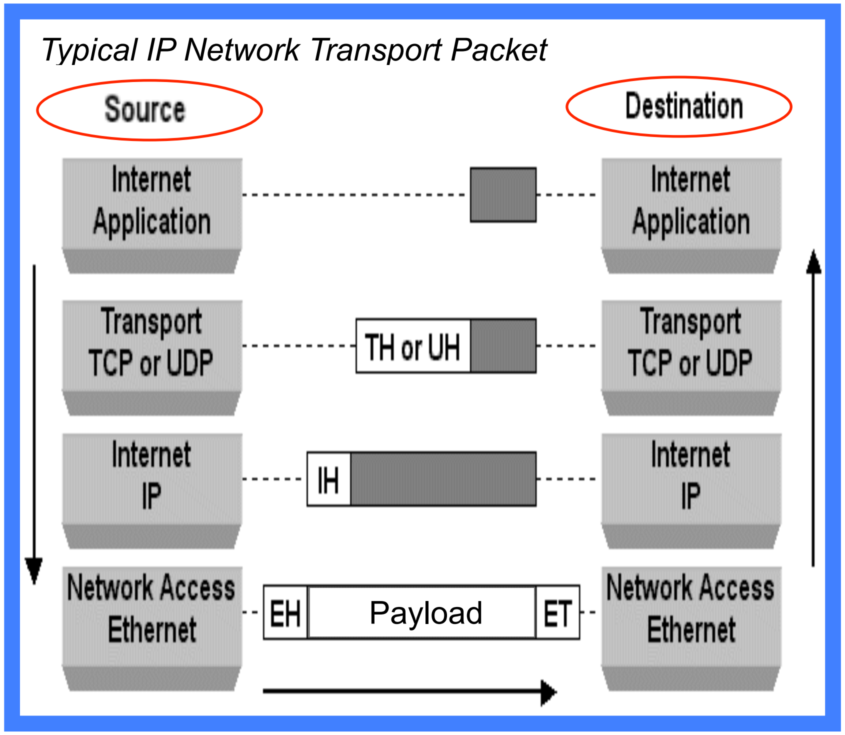
Is your Mainframe Safe? - Packets > Hiding in Plain Sight!

❑ Intrusion Detection (IDS) Attack Policies help protect z/OS Mainframes from both known and unknown attacks and provide timely notification when attacks do occur.

❑ The philosophy behind IDS Attack Policies is to disallow anything that is not known and/or specifically allowed.

❑ Malformed Packet Policies cover many known attacks designed to cause system crashes and/or denials of IT service.

❑ Many malformed packet attacks use fragmentation to overlay header fields.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012 Vol 4 - Security and Policy-Based Networking

Mainframe Intrusion!

Is your Mainframe Safe? - Destination > Ports

- ❑ One popular Spying Method used to identify host targets is to look for open Network Ports.
- ❑ Think of a Network Port as an entry point into the Castle. Once inside friends and enemy spies have access to your treasure!
- ❑ In a typical computer network the Port Address and an IP address are joined together to create a unique access point.
- ❑ Spies will Exploit Networks by:
  - ✓ Scanning for exposed Port defenses
  - ✓ Sending fraudulent Data Packages
  - ✓ Hiding Remote Attack Trojans (RATS)

Source: http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers
Note - Denial-of-Service (DoS) Attacks, Man-in-the-middle attacks

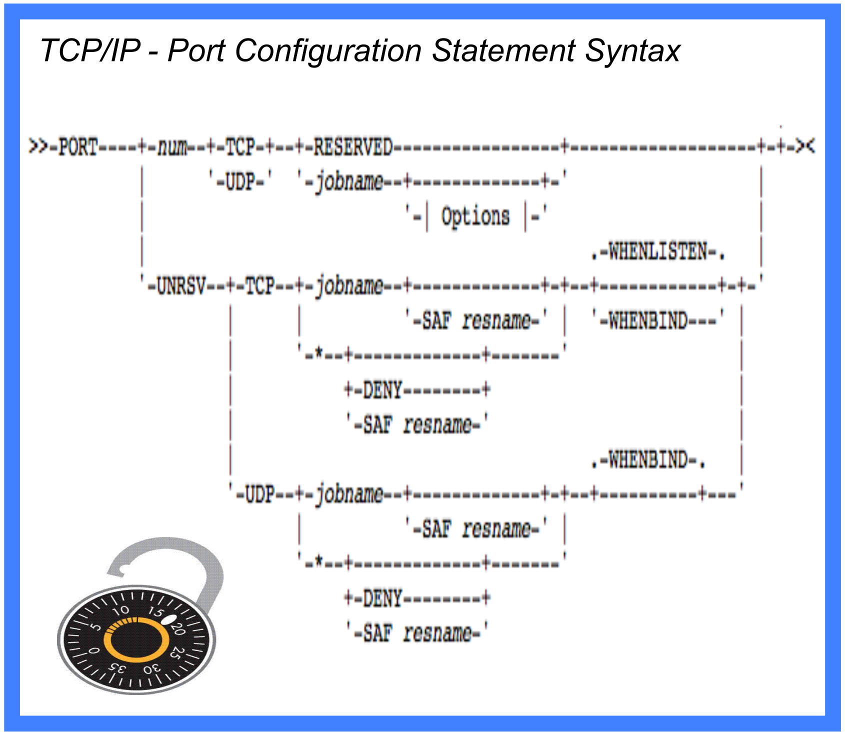
Mainframe Intrusion!

Is your Mainframe Safe? - Destination > Port Statement - TCP/IP Profile

❑ The PORT statement is used to reserve a port for one/more job names or to control application access to unreserved ports.

❑ For example, use the PORT statement to control the port that will be used by the SMTP server for receiving mail. If PORT is not coded, SMTP defaults to the value 25, the well known port for mail service.

❑ Note that port 25 is typically reserved in hlq.PROFILE.TCPIP for the SMTP server to accept incoming mail. If another port number is selected for the SMTP server, then update the hlq.PROFILE.TCPIP file accordingly.



TCP/IP - Port Configuration Statement Syntax

```
>>-PORT----+-num--+-TCP-+--+-RESERVED-----------------+-------------------+-+-><
           |      '-UDP-'  '-jobname--+-------------+-'                   |
           |                          '-| Options |-'                     |
           |                                             .-WHENLISTEN-.   |
           '-UNRSV--+-TCP--+-jobname--+-------------+-+--+------------+-+-'
                    |      |          '-SAF resname-' |  '-WHENBIND---' |
                    |      '-*--+-------------+-------'                 |
                    |           +-DENY--------+                         |
                    |           '-SAF resname-'                         |
                    |                                    .-WHENBIND-.   |
                    '-UDP--+-jobname--+-------------+-+--+----------+---'
                           |          '-SAF resname-' |
                           '-*--+-------------+-------'
                                +-DENY--------+
                                '-SAF resname-'
```

Source: http://publib.boulder.ibm.com/infocenter/zos/v1r11/index.jsp?topic=/com.ibm.zos.r11.istimp0/startpr.htm

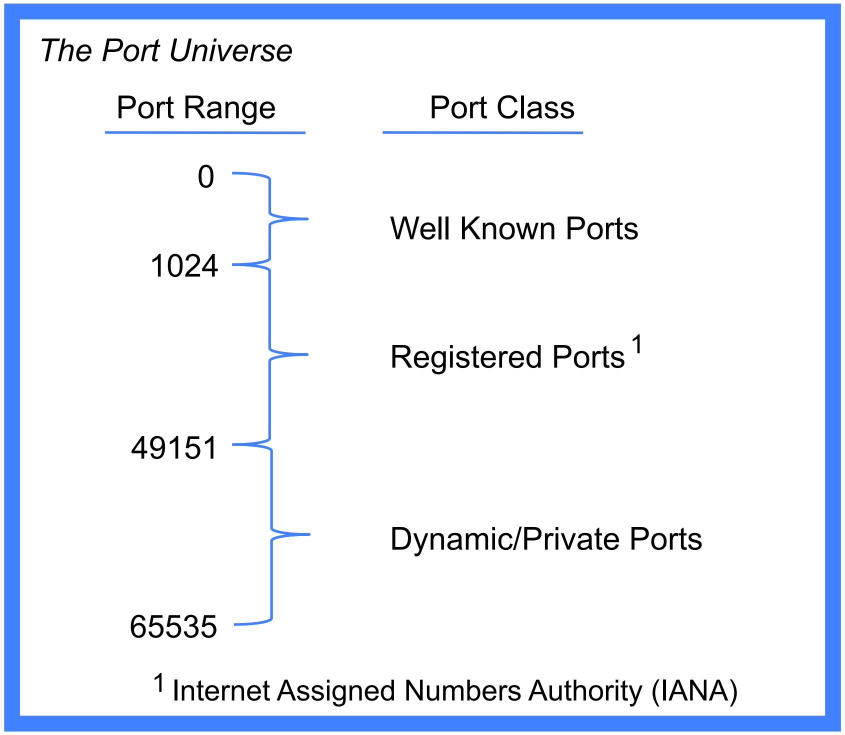
Mainframe Intrusion!

Is your Mainframe Safe? - Destination > Port Ranges

❑ Well Known Ports, port numbers in the range from 0 to 1023 are used by system processes that provide widely-used types of network services.

❑ Registered Ports, port numbers in the range from 1024 to 49151 are assigned by IANA[1] for specific service upon application by a requesting entity. Can be used by ordinary users and processes.

❑ Dynamic or Private Ports, port numbers in the range 49152–65535 cannot be registered and are used for automatic allocation of temporary ports.



The Port Universe

Port Range	Port Class
0 – 1024	Well Known Ports
1024 – 49151	Registered Ports [1]
49151 – 65535	Dynamic/Private Ports

[1] Internet Assigned Numbers Authority (IANA)

Note – Raw Ports: Partly formed and generally bypass Network Filters.

Source: http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers

Mainframe Intrusion!

Is your Mainframe Safe? - Destination > IPAddress + Port = Sockets

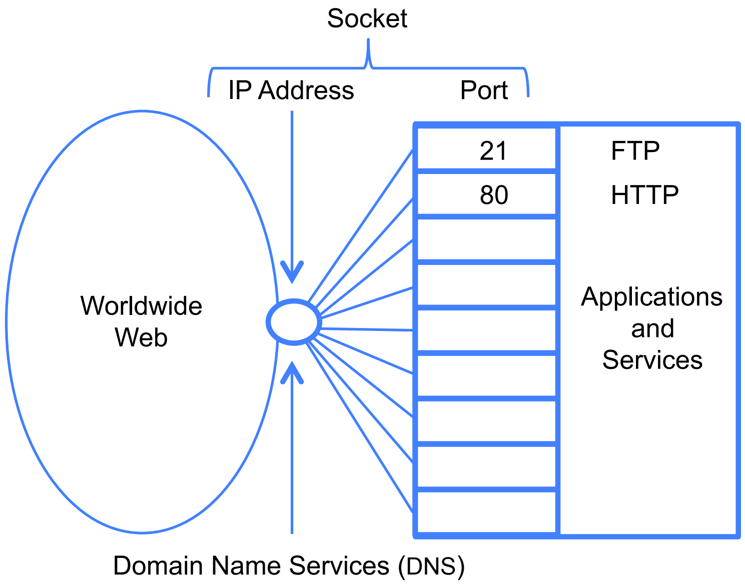
❑ A socket address combines an IP and port number, much like a telephone connection combines a phone number and a particular office interchange extension.

❑ Based on this address, internet sockets deliver incoming data packets to the appropriate application process or thread.

❑ Some Ports are designed specifically to "Listen" for requests such as the return of a web page to a display browser or to receive file transfers from remote users and sites.

❑ The open nature of such Listening Ports makes them vulnerable to network spies.

Socket is an IP Address and Port Combination



Source: http://en.wikipedia.org/wiki/List_of_TCP_and_UDP_port_numbers

Mainframe Intrusion!

Is your Mainframe Safe? - Sockets > Display Your System Values

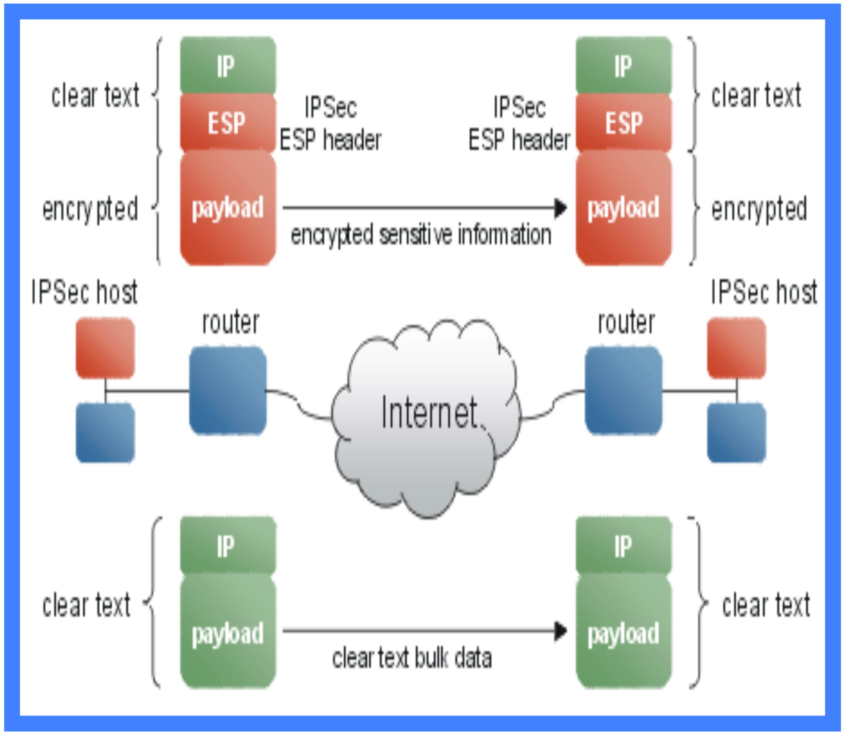
Socket is an IP Address and Port Combination - OMVS Command - `netstat -a`

```
MVS TCP/IP NETSTAT CS V1R13       TCPIP Name: TCPIP           18:43:55
User Id   Conn      Local Socket             Foreign Socket            State
-------   ----      ------------             --------------            -----
AXR04     00008716 192.86.33.152..1267      173.1.13.243..25          Establsh
BPXOINIT 0000000F 0.0.0.0..10007           0.0.0.0..0                Listen
FTPSERVE 0000000E 0.0.0.0..21              0.0.0.0..0                Listen
INETD1    00000012 0.0.0.0..23              0.0.0.0..0                Listen
TN3270    00008713 192.86.33.152..623       98.254.29.53..34346       Establsh
TN3270    000086CA 192.86.33.152..623       64.81.66.48..4076         Establsh
TN3270    0000000D 0.0.0.0..623             0.0.0.0..0                Listen
TN3270    000086DE 192.86.33.152..623       64.81.66.48..4089         Establsh
TN3270    000086BE 192.86.33.152..623       64.81.66.48..52802        Establsh
TN3270    000086C0 192.86.33.152..623       66.254.206.55..50373      Establsh
TN3270    000086B0 192.86.33.152..623       99.22.54.177..1045        Establsh
```

Mainframe Intrusion!

Is your Mainframe Safe? - Security > There are Different Types - IPsec

- ❑ Since the Internet has no built-in data-security, both application and user data is sent in clear text. This enables a third party to inspect or even modify data as it traverses the Internet. For example, passwords are sent in the open and can be seen and used to compromise a system.
- ❑ Internet Protocol Security (IPsec) is a protocol suite use to secure communications by authenticating and encrypting the packets used in a communication session. It solves the security problem which arises when embedded systems are connected to the Internet.



Source: http://en.wikipedia.org/wiki/IPsec

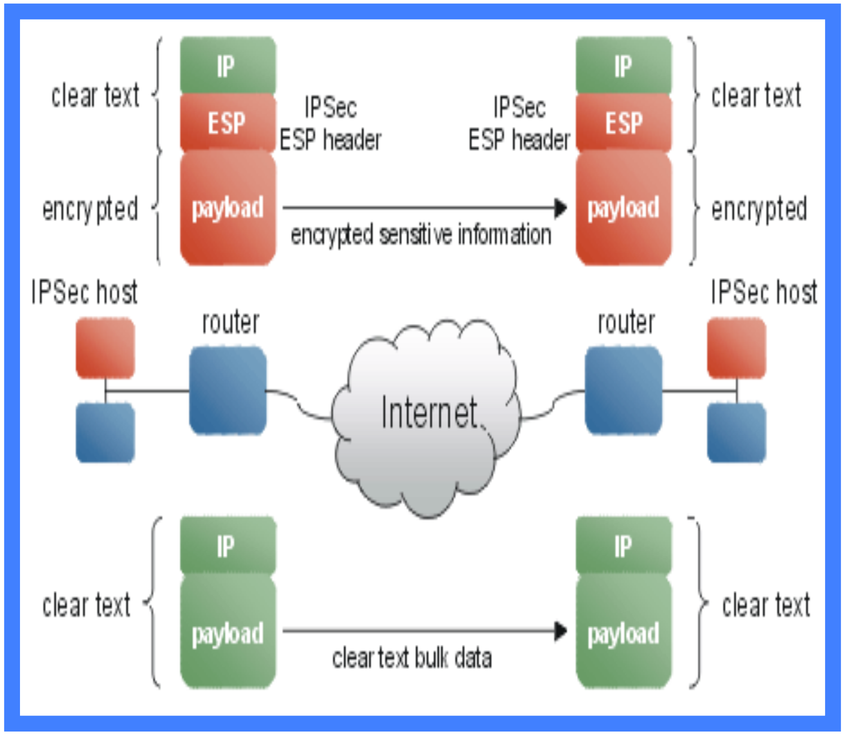
Mainframe Intrusion!

Is your Mainframe Safe? - Security > There are Different Types - IPsec

❑ IPSec Datagrams use one of following protocols to perform various functions:

- *Authentication Headers (AH)*
  Used to authenticate (but not encrypt) payloads, detect alterations and prevent replay attack.
- *Encapsulating Security Payloads (ESP)*
  Encryption is added for confidentiality via encapsulation of the payload. A specific (SA) encryption algorithm is generally specified.
- *Security Associations (SA)*
  The bundle of algorithms/data that provide the parameters necessary to operate the AH and/or ESP operations.

❑ Applications *NEED NOT* be designed to use IPsec - it protects any application traffic.



Source: http://www.unixwiz.net/techtips/iguide-ipsec.html

Mainframe Intrusion!

Is your Mainframe Safe? - Security > There are Different Types - Others

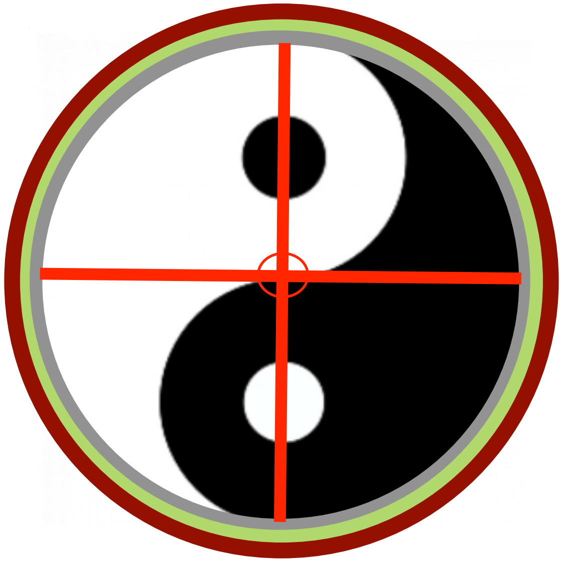
❑ Other Internet security systems in widespread use operate in the upper layers of the TCP/IP model. They include:

- Secure Sockets Layer (SSL)
- Transport Layer Security (TLS)
- Secure Shell (SSH)

❑ As a general statement TLS/SSL provide “Data Payload” security by being designed directly into an application.

❑ SSL is a more time-consuming process for servers but is favored over IPsec for use by financial institutions and other systems that require exceptional security measures.

We have you, your data and host in our sights!



Source: http://www.ehow.com/facts 7388002 difference-between-ipsec-ssl.html

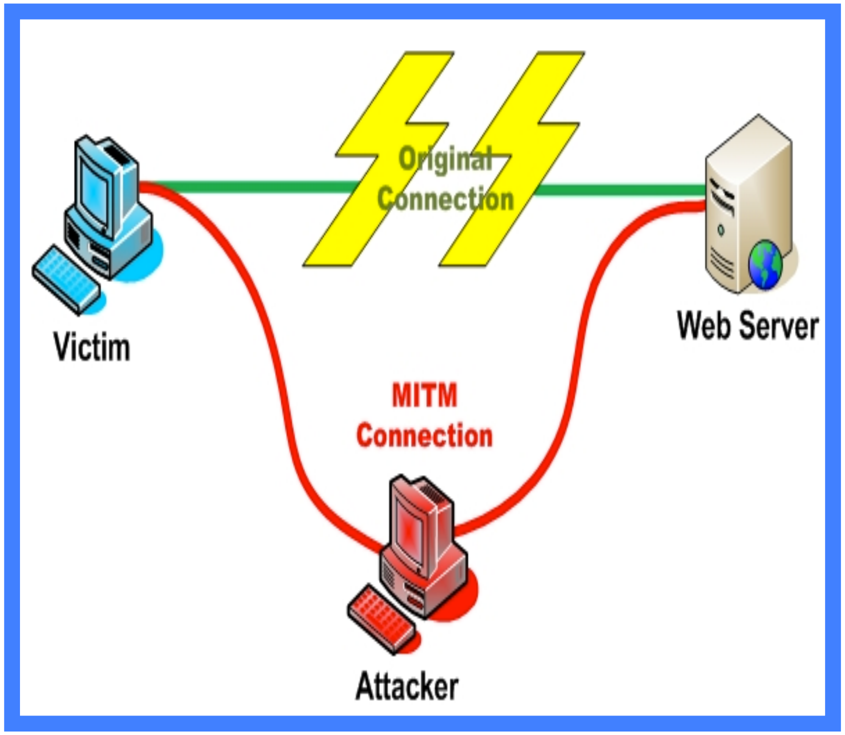
Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Man-in-the Middle (MitM)

❑ The goal of network security is to provide confidentiality, integrity and authenticity:

- Confidentiality
  Keeping the data secret from the unintended listeners on the network.
- Integrity
  Ensuring that the received data is the data was actually sent.
- Authenticity
  Proving the identity of the end point to ensure that the end point is the intended entity to communicate with.

❑ Man-in-the Middle attacks attempt to defeat and/or compromise these goals.



Source: A Technical Comparison of IPSec and SSL - Alshamsi and Saito - Tokyo University of Technology
https://www.owasp.org/index.php/Man-in-the-middle attack

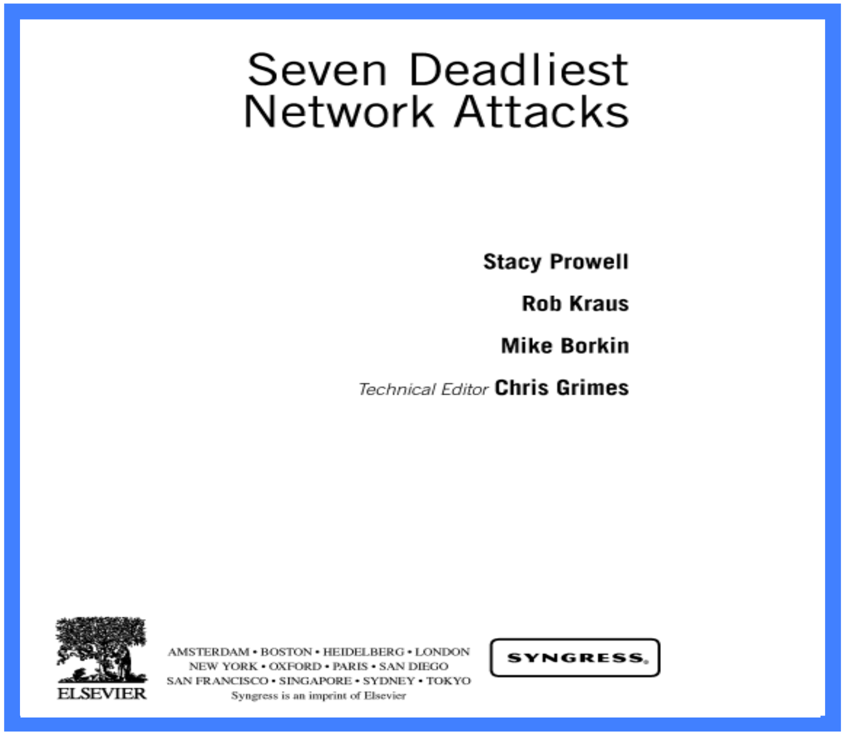
Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > New Attacks arrive Every Day!

❑ During a *Replay Attack* valid datagram transmissions are intercepted and then fraudulently repeated or delayed possibly as part of a *Masquerade Attack* by IP packet substitution, a *Stream Cipher Attack*.

❑ *Access Control Attacks* are used to infiltrate wireless network by bypassing access control measures. Once inside *War Driving Attack* processes are initiated that listen for wireless network traffic using either a PDA or a computer.

❑ The chief purpose of a *War Driving Attack* is to find a launch point from which the adversary can initiate her *MAIN ATTACK*.



Seven Deadliest
Network Attacks

Stacy Prowell

Rob Kraus

Mike Borkin

Technical Editor Chris Grimes

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Source: http://www.amazon.com/Seven-Deadliest-Network-Attacks/dp/1597495492 - © 2010

Mainframe Intrusion!

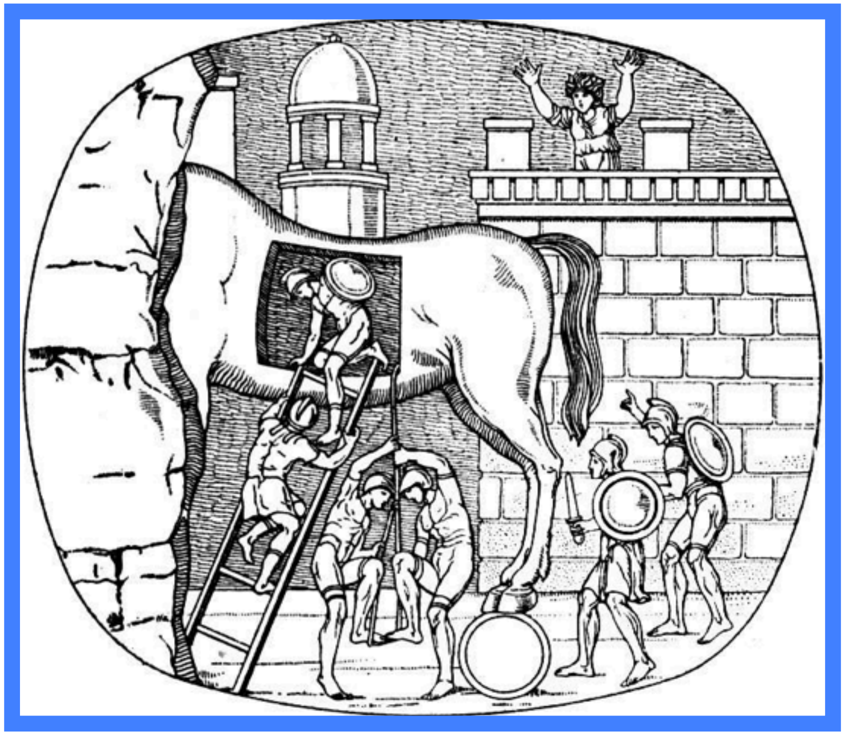
Is your Mainframe Safe? - Attacks > Trojans

❑ During the Trojan War Greeks presented Troy with a wooden horse containing hidden warriors. At night, they overran the city.

❑ Network Trojans contain malicious code inside apparently harmless programming or data that can take control to do damage.

❑ Trojans are classed by how they breach and damage systems. The main types are:

- ✓ Remote Access Trojans (RATS)
- ✓ Data Sending Trojans
- ✓ Destructive Trojans
- ✓ Proxy Trojans
- ✓ FTP Trojans



Source: http://www.webopedia.com/TERM/T/Trojan_horse.html

Mainframe Intrusion!

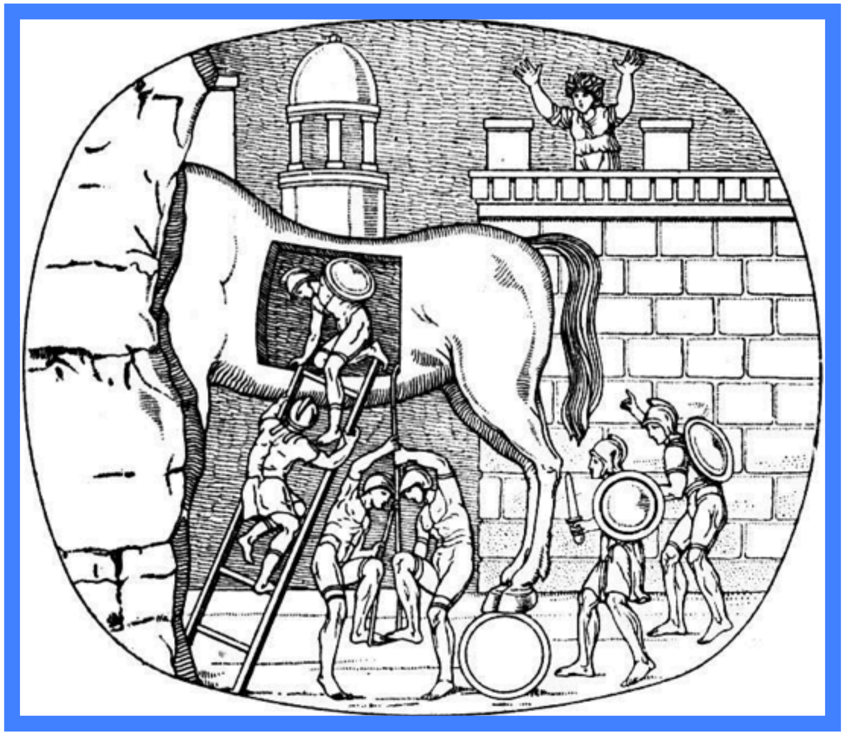
Is your Mainframe Safe? - Attacks > Remote Access Trojans (RATS)

❑ RATs can be key stroke loggers and remote controllers, they can configure the IP port the RAT listens on, and how the RATs execute and contact their originator.

❑ RATs are usually downloaded invisibly with a user-requested program -- such as a game -- or sent as an email attachment.

❑ Once the host system is compromised, the spy may use it to distribute RATs to other vulnerable computers and establish a botnet.

❑ RATs are difficult to detect because they don't show up as running programs or tasks.



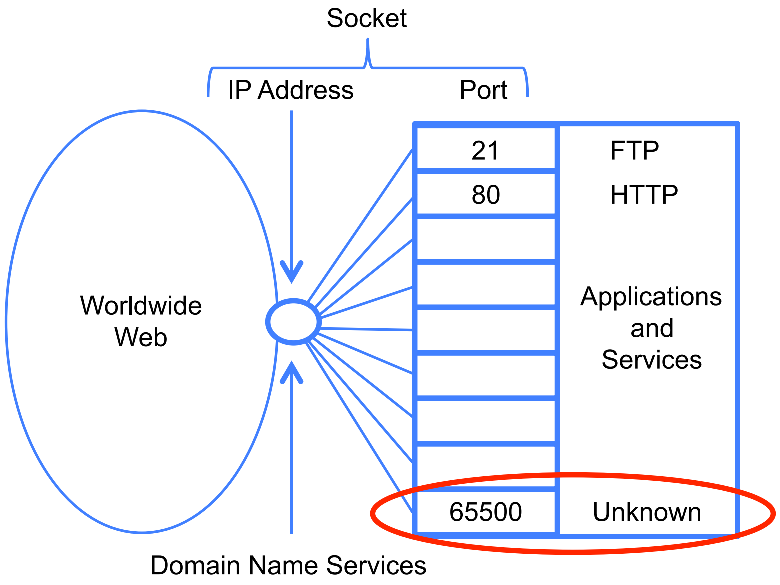
Source: http://searchsecurity.techtarget.com/definition/RAT-remote-access-Trojan

Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Remote Access Tools (RATS)

- ❑ A brute force attack is one where spies use automation to guess a valid password as quickly as possible.
- ❑ Whether or not a spy enters a system hiding in a Package Fragment or disguised behind a Valid Password the goal will be the same, take control of the system by creating an “Unknown” remotely controllable service.
- ❑ To avoid detection Hackers attempt to cover their tracks, for example, if they open an unauthorized network port they will replace system services (netstat) with their own, modified version of the service.

Socket is an IP Address and Port Combination



Socket

IP Address

Port

Worldwide Web

21	FTP
80	HTTP
	Applications and Services
65500	Unknown

Domain Name Services

Source: http://searchsecurity.techtarget.com/definition/RAT-remote-access-Trojan

Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > "Who Are These Guys?"

- ❑ Penetration tests (Pen-Tests) are a critical component to the over-arching information security (IPSec) plan protecting any organization from attack.
- ❑ Pen-tests provide valuable data on how well network and related information assets are reached and protected for intrusion.
- ❑ Pen-Testers are those that conduct Penetration Tests for the purpose of discovering and reporting weaknesses.
- ❑ Hackers, on the other hand, are those that use Penetration Tests to exploit network weaknesses for nefarious reasons.

Source: Detection and Characterization of Port Scan Attacks – 2002 - By Cynthia Bailey Lee, Chris Roedel, Elena Silenok - Computer Science & Engineering UC-San Diego

Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Their Tools

- ❑ Google the keywords *“Remote Access Trojan”* into your browser and the reply will be a set of links to hundreds of free RATs – the most popular being Back Orifice from Dead Cow and SubSeven.
- ❑ Google in *“Port Scanners”* and the results are similar – the most popular being nmap from nmap.org.
- ❑ Now Google in *“Free Hacker Tools”* in order to get a general idea of overall availability. The results will be on the order of 20 million hits with insecure.org topping the list of sources.

Source: GOOGLE “Remote Access Trojan”

Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Their Training

❑ Find what you need on YouTube! Here is your Starter Set:

✓ *Hackers*
A National Geographic Documentary - (46:39)

✓ *Introduction to Hacking*
Eli the Computer Guy - (68:00)

✓ *How to Hack a Web Site*
Dr. Susan Loneland - (43:53)

✓ *Anonymous, A Hackers World*
16X9 - (20:10)

✓ *SubSeven Trojan Backdoor*
Unknown - (6:57)

✓ *Nmap Basics and a Lot More*
nmap.org – (9:31)

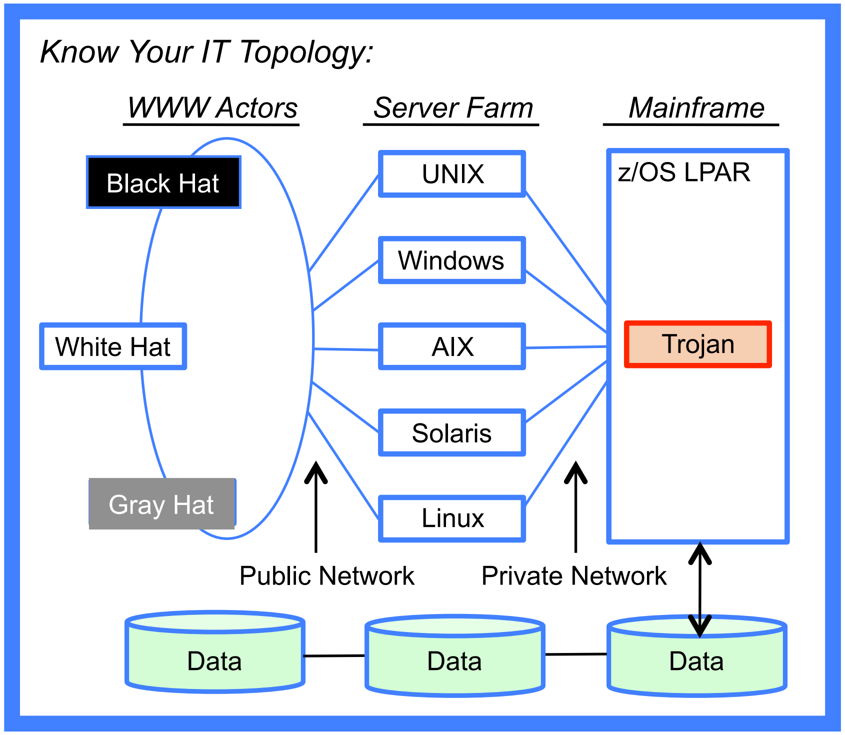
Source: http://youtube.com

Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Their Plan

❑ An attack against a z/OS Mainframe that is networked to a heterogeneous Server Farm could unfold as follows:

1. Scan the Server Farm for open ports
2. Send a malformed Packet to all
3. Open the packet and activate a port
4. Send a Trojan to the open server(s)
5. Begin scan for open mainframe port
6. Send malformed Packet to one
7. Open the packet and Logon
8. Begin scanning for Relevant Data
9. FTP Data to Internet Drop Box
10. Terminate and Erase Self



Source: All that have been cited up to this point!
Note - Denial-of-Service (DoS) Attacks, Man-in-the-middle attacks

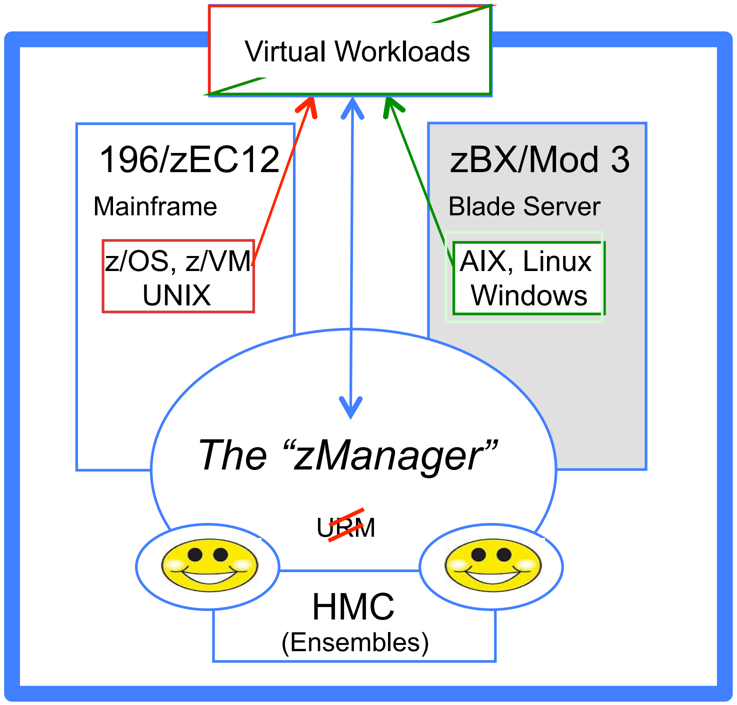
Mainframe Intrusion!

Is your Mainframe Safe? - Attacks > Mainframe of the Future?

❑ Hyper-scale servers are designed for large scale datacenter environments where parallelized workloads are prevalent. The form-factor serves the unique needs of these datacenters with streamlined system designs that focus on:

- Performance
- Energy efficiency
- Platform Density

❑ Hyper-scale servers forego the full management features and redundant hardware components found in traditional enterprise servers as these capabilities are accomplished primarily through software.

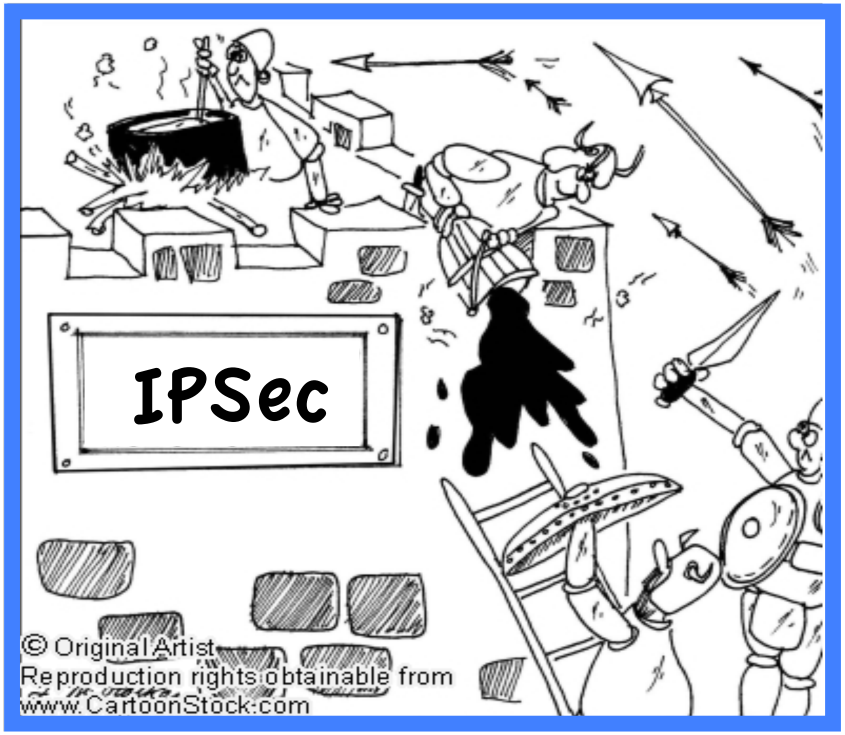


Source: Starting Q3 2011, IDC began to track the new form-factor called hyper-scale servers

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Ports

- ❑ Identifying that scanning missions are underway can alert a security analyst as to what services or types of computers are being targeted for possible attack.
- ❑ Knowing what services are targeted allows an administrator to take preventative IPSec measures e.g. installing patches, fire walling services from the outside, or removing services on machines which do not need to be running on them.
- ❑ Port Scan detection counts distinct destination IPs attempting to connect to a given Port within a certain time window.



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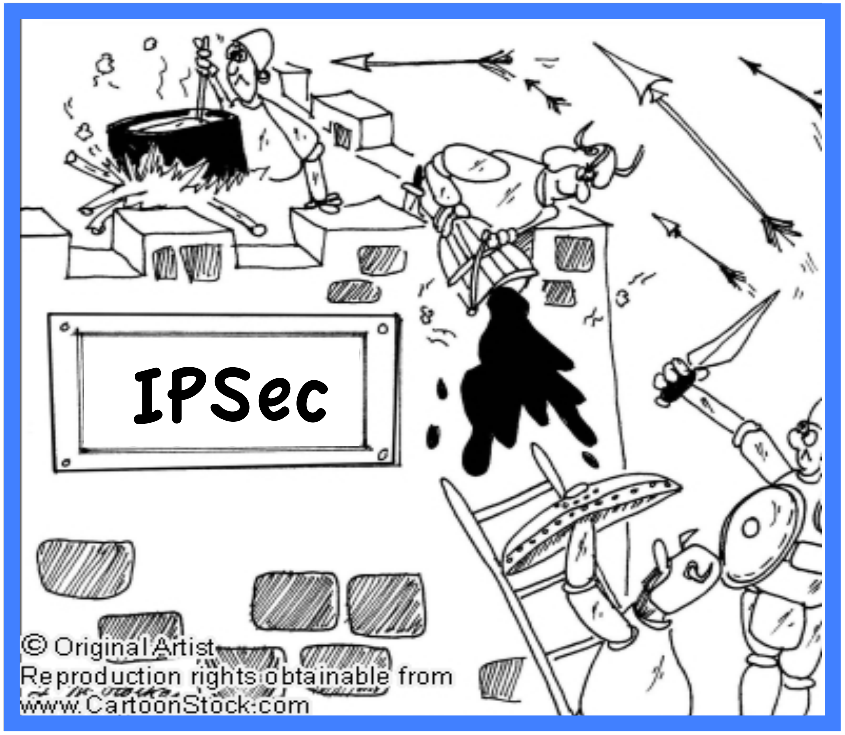
Source: Scan Detection: A Data Mining Approach – 2006 - By György J. Simon , Hui Xiong
University of Minnesota, Rutgers University

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Ports

- ❑ A number of Intrusion Detection System (IDS) methodologies have been developed to detect reconnaissance Port Scans. Most have three common weaknesses.
- ❑ Sufficiently low Scan Rate Policies lead to unacceptable false alarms as high scan activity will render the Policy useless.
- ❑ Setting a Higher threshold can leave slow and stealthy scanners undetected.
- ❑ Hiding the true identity of the attacking IP address by using IP decoys, or “zombie” computers that are under an attacker’s control mask the attack’s origin.



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Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012 - Volume 4
Note – The use of “Reputation Services” helps to reduce “False Positives”.

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Packets

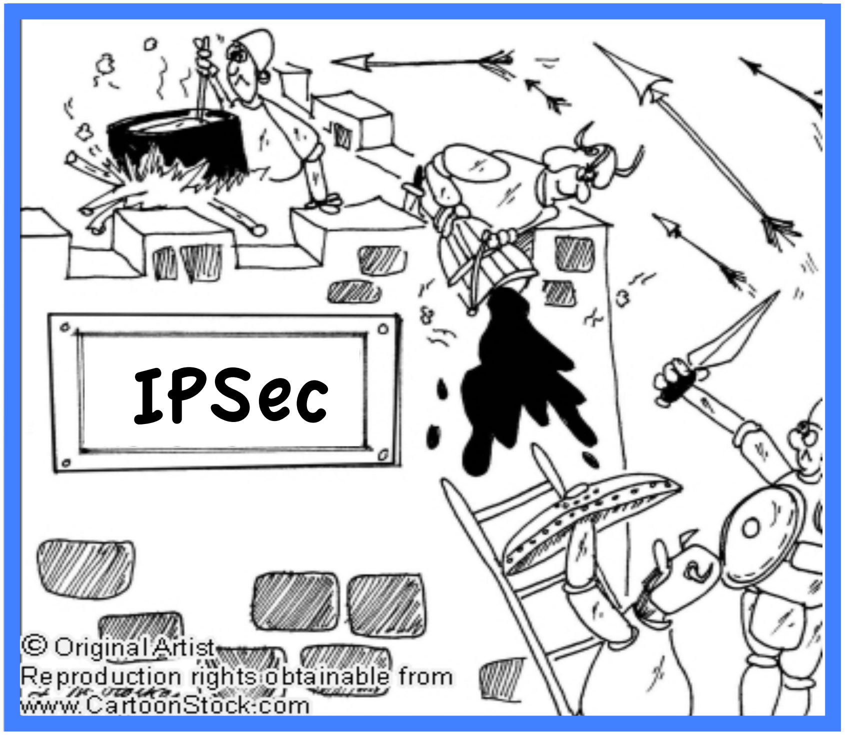
❑ Malformed Packet attacks can cause IT System crashes and/or denials of IT Service.

❑ As packets are sent or received, they are matched to policies of the appropriate type.

❑ When a matching policy is found, it is implemented against the packet.

❑ Depending on the policy type and packet contents, this results in a variety of actions. For example a packet might be:

- ✓ Totally discarded,
- ✓ Processed according to its priority,
- ✓ Have its routing changed.



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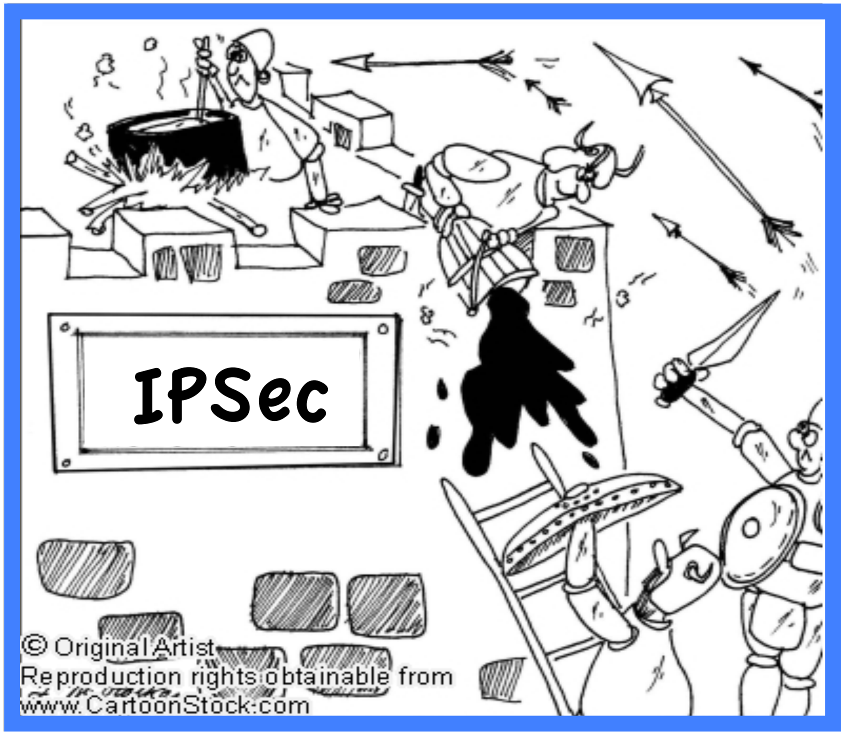
Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
Volume 4 - Security and Policy-Based Networking

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Packets

- ❑ Malformed Packets cover many known attacks designed to cause system crashes.
- ❑ Packets that fit these descriptions should always be discarded as they rarely have legitimate source address information.
- ❑ Many malformed packet attacks use fragmentation to overlay header fields.
- ❑ The IDS fragment restriction policy will protect the network from unknown attacks by disallowing fragmentation in the first 88 bytes of any datagram.
- ❑ Fragments must be disallowed by policy.



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Source: z/OS V1R13.0 Communications Server IP Configuration Guide

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Trojans

❑ The only way to defend yourself from a Cyber Spy is to understand the attacker and her intrusion methods in-depth.

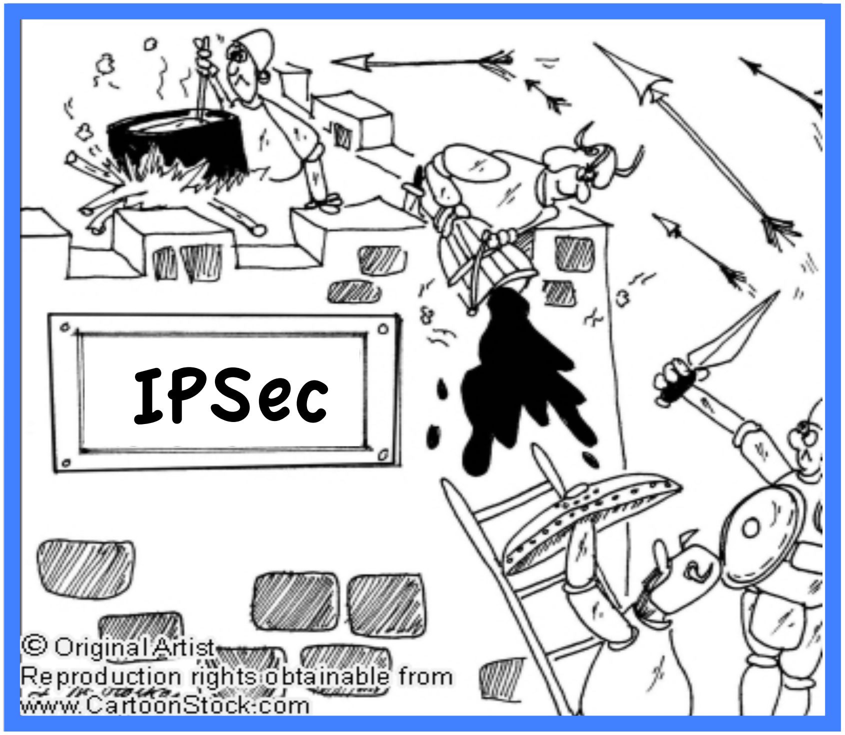
❑ Turn off any network service that is not needed so that it will not become an avenue of attack.

❑ Keep the operating system of all servers updated to the latest release.

❑ Understand and use logical and physical firewalls.

❑ Only talk to systems you know and trust.

❑ Things change quickly, stay up to date.



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Source: http://www.techrepublic.com/blog/security/10-security-tips-for-all-general-purpose-oses
http://infosec.ufl.edu/events/dlm-Cyber-Self-Defense-handout.pdf

Mainframe Intrusion!

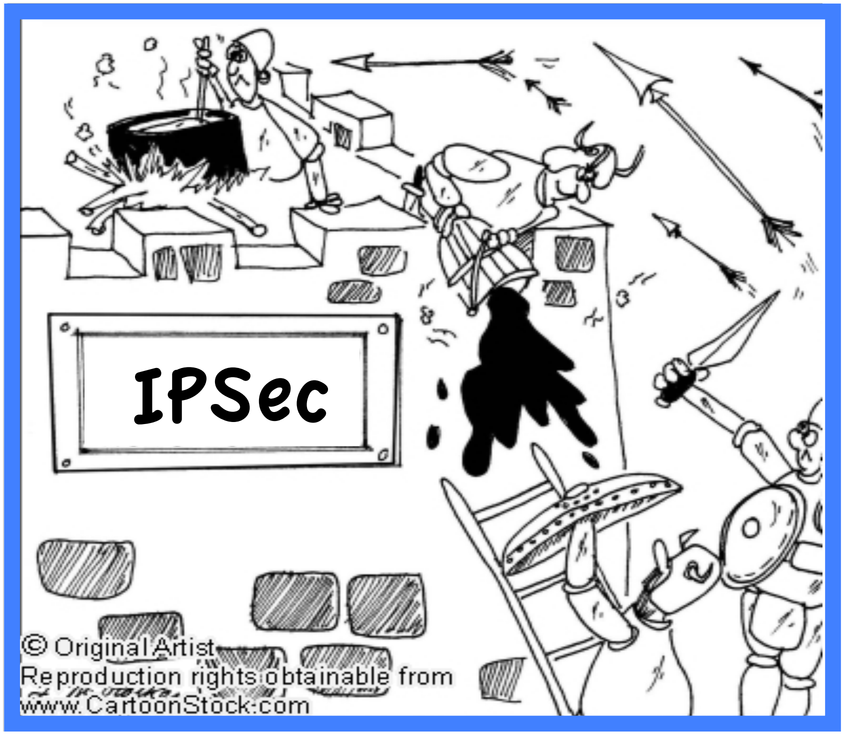
Is your Mainframe Safe? - Fight Back > Trojans

❑ Caution Security and Systems Staff on the use of Social Networking that might reveal personal information, password selection and/or personal planning, vacations and/or sick leave.

❑ Limit or deny access to System Administration Functions, root authority.

❑ Develop unique policies for controlling the selection and enforce of Admin Passwords, "Just say *NO* to IBMUSER".

❑ Scan for, Restrict and/or Deny access from "BYOD" or other unapproved Smart Phones, and other personal devices.



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Source: All cited up to this point
Note – Wireless "Hot Spots" and Routers plugged into otherwise secure networks.

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Management Policy

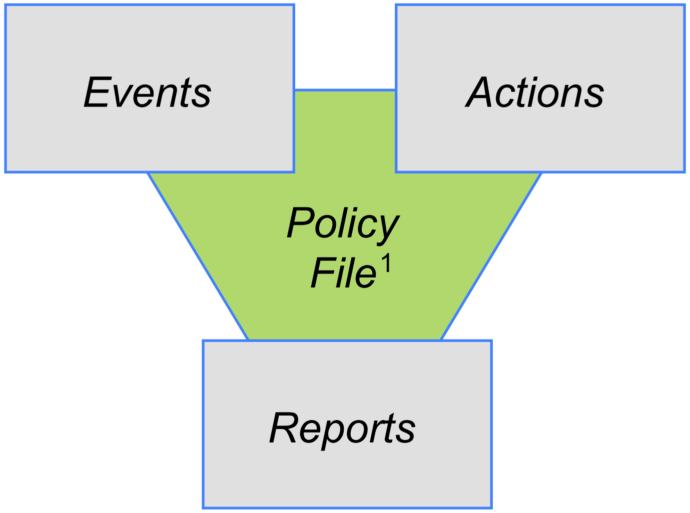
❑ Management Policies are a pre-defined set of network Events, corresponding reply Actions, related Notifications and Reports.

❑ Policy files are created and maintained using the z/OSMF Configuration Assistant, or the PC-based Configuration Assistant for the z/OS Communication Server.

❑ The same Policy Configuration can be applied across many multiple IP Stacks in the same underlying LPAR.

❑ Unique Policy Configurations can be deployed for each IP Stack in an LPAR.

Policy Infrastructure Elements



[1] /etc/cfgasst/v1r13/imagename/stackname/idsPol

Source: V1R13 IBM Configuration Assistant for z/OS Communications Server tool

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Enforcement

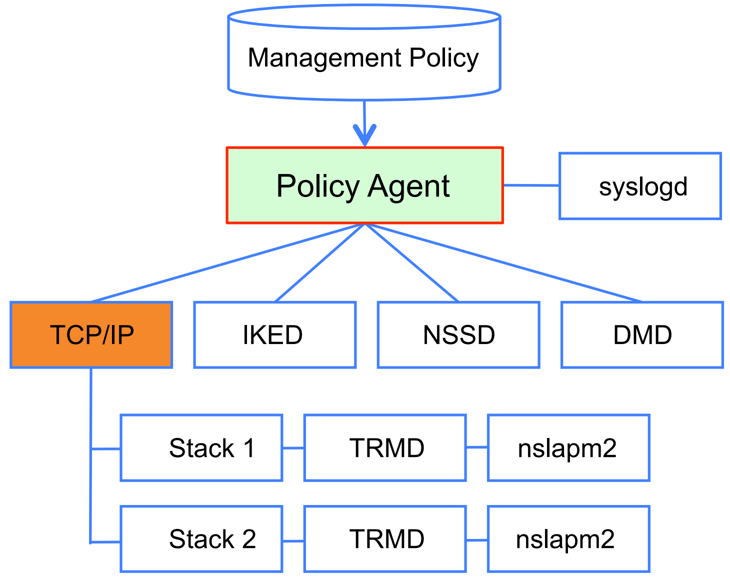
❑ PAGENT, a z/OS address space, builds the Policy Infrastructure needed by the z/OS Communication Server to support Intrusion Detection Services (IDS). PAGENT acts as a:

- ✓ Policy Server executes on a single system and installs policies for others
- ✓ Policy Client retrieves remote policies from the Policy Server.

❑ The Policy Infrastructure Includes:

- ✓ Internet Key Exchange (IKED)
- ✓ Network Security Services (NSSD)
- ✓ Defense Manager (DMD)
- ✓ Traffic Regulation Management (TRMD)
- ✓ The Reporting Subagent (nslapm2)

Policy Infrastructure Elements - (D is for Daemon)

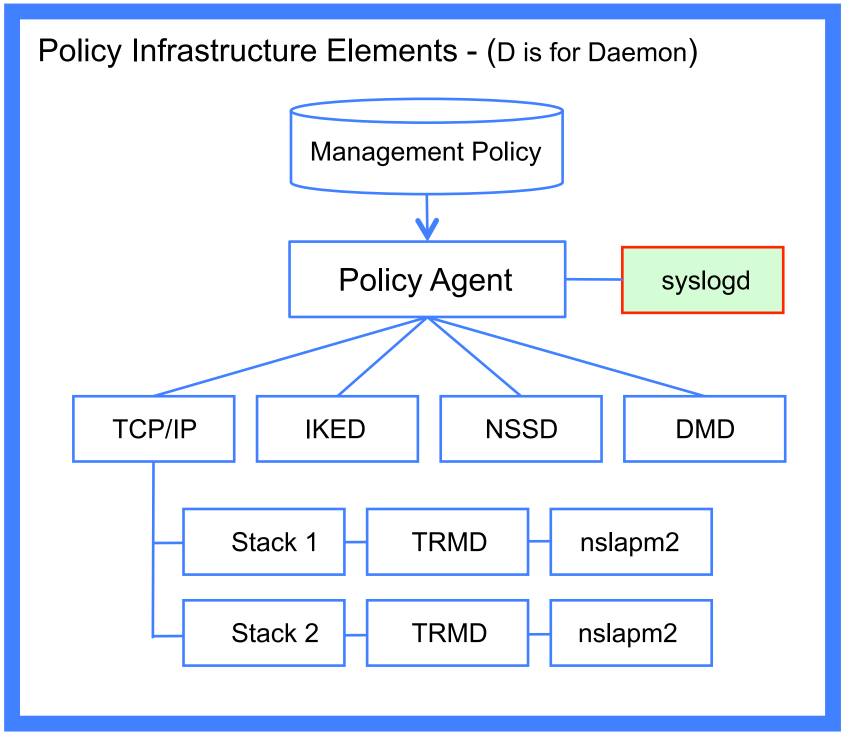


Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012 - Volume 4
Note – TCP/IP Profile DECK, IPSECURITY Keyword on the IPCONFIG Statement

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy daemons > Syslogd

- ❑ The central message logging facility for all z/OS UNIX® applications is the syslog daemon, syslogd.
- ❑ This daemon is not specific to the policy infrastructure, but the policy infrastructure does depend on the availability of syslogd to provide the central logging facility needed for maintaining an audit trail of policy events.
- ❑ If the syslog daemon is not available all policy event messages will be lost.
- ❑ One syslog daemon is needed for each Policy Managed LPAR in a Sysplex.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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Mainframe Intrusion!

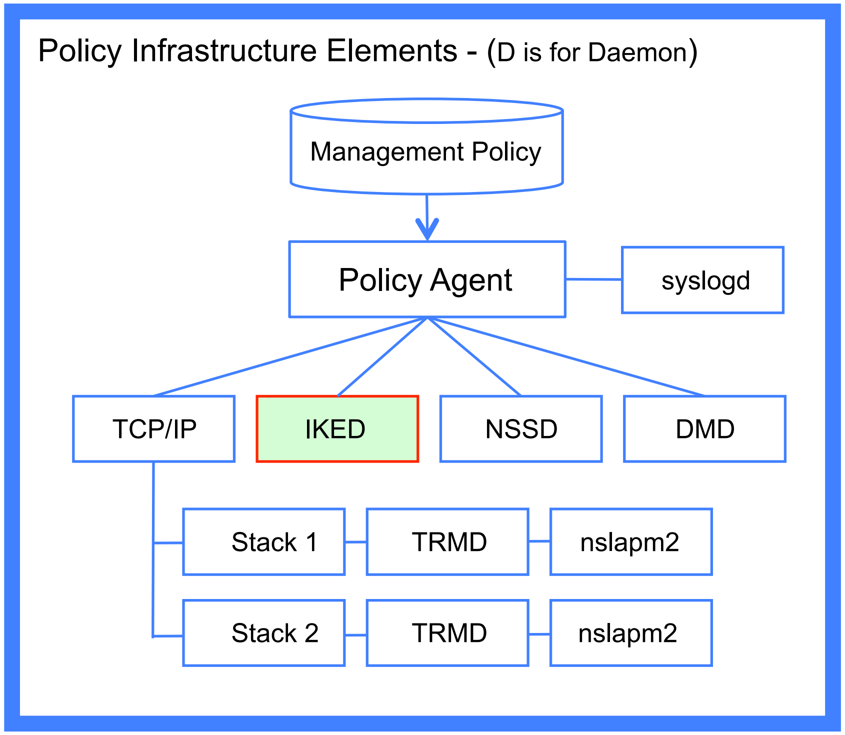
Is your Mainframe Safe? - Fight Back > Policy daemons > IKED

- ❑ The Internet Key Exchange daemon (IKED) employs the IPSec standard used to ensure the security for a Virtual Private Network (VPN). It does this by automatically negotiating and authenticating Security Associations (SA).

- ❑ Security Associations (SA) are security policies defined for communication between two or more entities where the relationship between the entities is represented by a key.

- ❑ IKED ensures secure communication without the need for pre-configuration.

- ❑ If IKED is required start one per LPAR.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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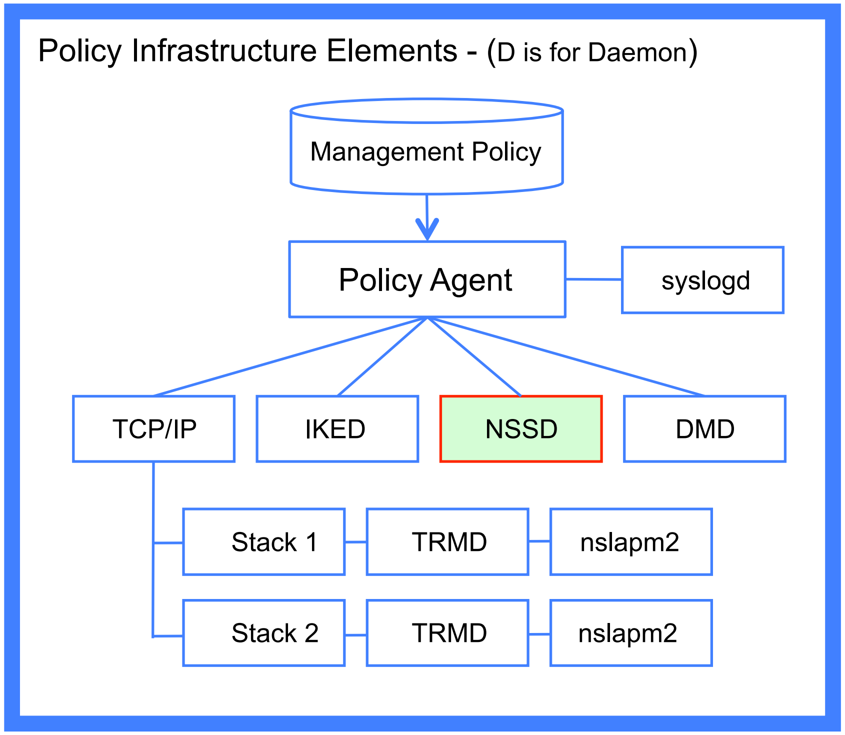
Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy daemons > NSSD

- ❑ The Network Security Services daemon (NSSD), an element of the overall z/OS networking policy infrastructure, provides IPSec Certificate and Remote Management Services and XML Appliance SAF access, certificate, and private key service.
- ❑ NSSD is the Central Certificate and Key Server for z/OS and the Network Security Server for non-z/OS platforms.
- ❑ NSSD can be used independently from any z/OS policies.
- ❑ One NSSD is required within a Sysplex.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy daemons > DMD

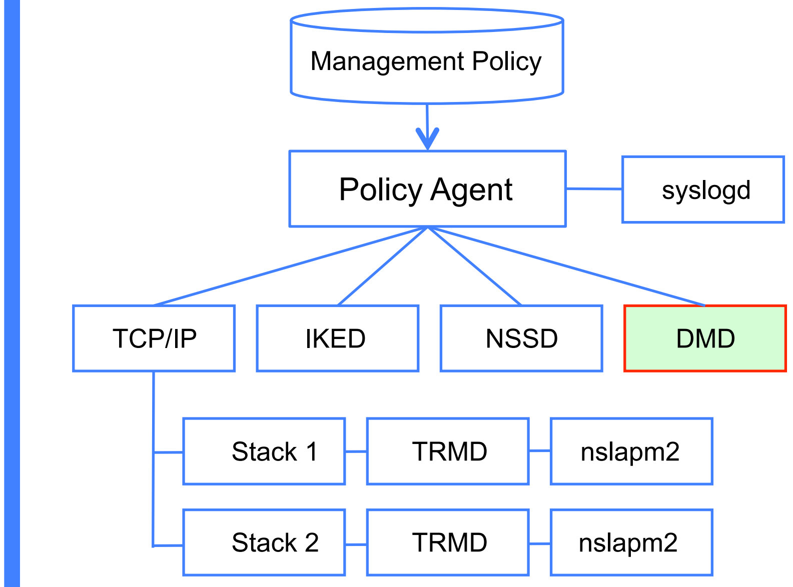
❑ The Defense Manager daemon (DMD) provides short-term defensive filtering.

❑ DMD filters are typically installed by a network specialist for a limited duration (for example, 30 minutes) to block specific attacks and/or a pattern of attacks that are not otherwise defined to network defenses.

❑ DMD filters can be used without defining the more permanent, IPSec defensive IDS policies but typically both DMD and IPSec filter policies are required and used.

❑ One DMD is needed per LPAR.

Policy Infrastructure Elements - (D is for Daemon)



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy daemons > TRMD

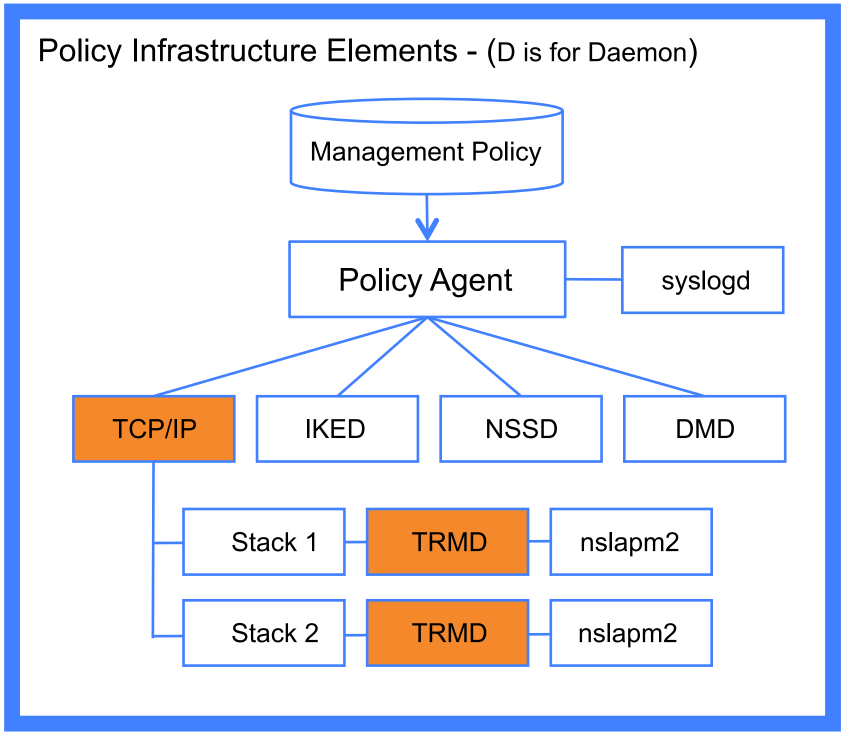
❑ The Traffic Regulation Management daemon (TRMD) formats and sends policy-related messages to syslogd.

❑ TRMD is used with:

- ✓ Traffic Regulation (TR),
- ✓ Intrusion Detection Services (IDS) and
- ✓ IP Security (IPSec)

❑ The Traffic Regulation Management (TRM) is incorporated into the Intrusion Detection Services (IDS).

❑ One TRMD is needed for each TCP/IP stack in an LPAR.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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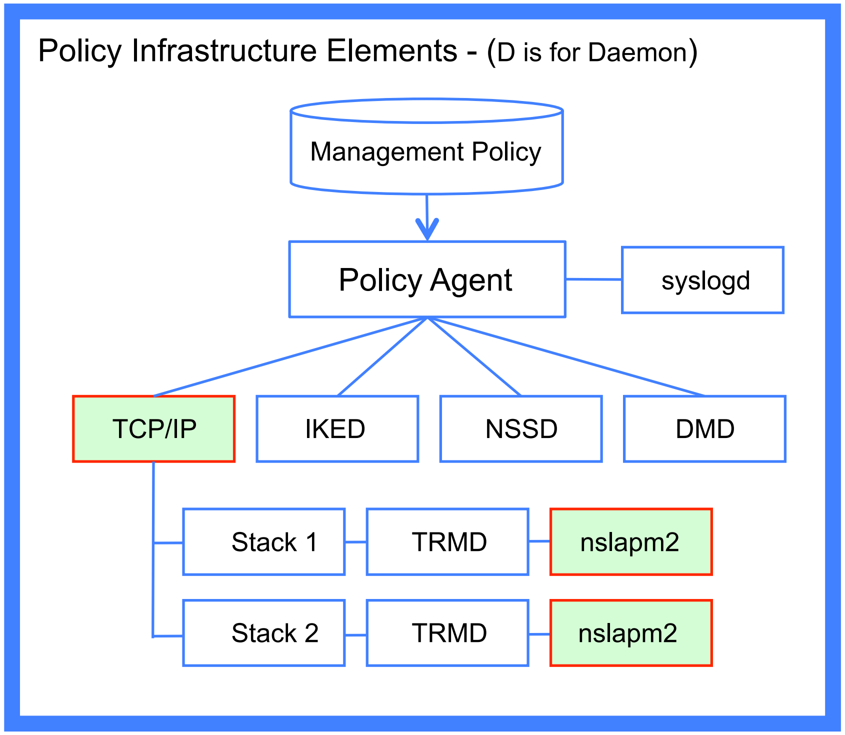
Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy daemons > nslapm2

❑ nslapm2 is an Simple Network Management Protocol (SNMP) subagent that provides information about defined network service policies and performance data used by network applications through Management Information Base (MIB) variables.

❑ These Quality of Service (QoS) metrics are retrieved by the nslapm2 subagent and monitored for any possible deviation from defined Network Policies.

❑ One nslapm2 subagent is needed for each TCP/IP stack in an LPAR.



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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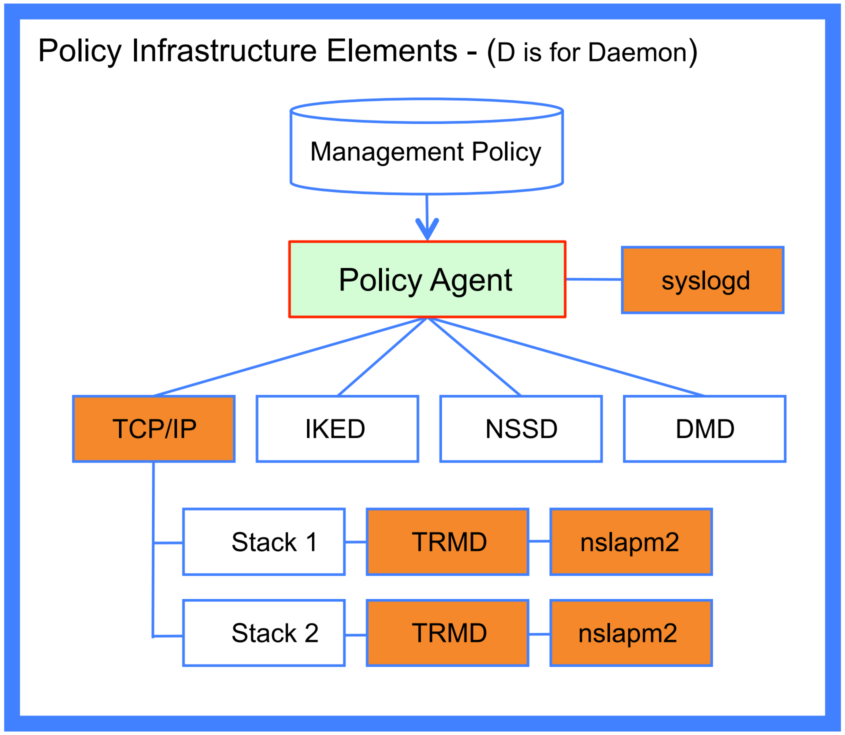
Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > Activating IDS

❑ IDS detects/reports network intrusion events. IDS policy regulates the types of events detected and reported. IDS policy may be defined for scans, attacks and traffic regulation for both TCP and UDP ports.

❑ To deploy Intrusion Detection Services (IDS) in a z/OS Environment the following components of the Policy Infrastructure must be present:

- ✓ PAGENT (for each LPAR)
- ✓ Syslogd (for each LPAR)
- ✓ TRMD (for each TCP/IP Stack)



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > Start-Up

□ PAGENT has its own configuration file. Typically the file name contains both the name of the Image Name and the name of the TCP/IP Stack. For Example:

/etc/cfgasst/v1r13/*imagename*/*stackname*/idsPol

□ When the Policy Agent is started it reads this configuration file and starts all defined Policy Applications (AppName) for each TCP/IP Stack named (TcpImageName).

□ Either z/OSMF Configuration Assistant, or the PC-based V1R13 IBM Configuration Assistant for z/OS Communications Server tool can be used to create the file.

The PAGENT Configuration File

```
AutoMonitorParms
{
 MonitorInterval 10
 RetryLimitCount 5
 RetryLimitPeriod 600
}
AutoMonitorApps
{
 AppName TRMD
 {
  TcpImageName TCPIP
  {
   Procname POLPROC
   Jobname TRMD
  }
 }
}
```

Source: A NewEra White Paper – The IDS Policy Management Project

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > daemon Status

- ❑ The Intrusion Detection Services policy is installed into the stack automatically by the Policy Agent (PAGENT).
- ❑ After the policy is installed, IDS detects, processes, and reports on events as requested by the policy.
- ❑ TRMD, part of IDS, handles reporting IDS statistics and events to syslogd.
- ❑ Problems might occur in:
  - ✓ Policy installation
  - ✓ Output to syslogd or the console,
  - ✓ TRMD initialization

Are the PAGENT daemons Running?

<> Operator Command to Display Ports:

```
/F PAGENT,MON,DISPLAY
```

<> PAGENT daemon Operational Status:

```
APPLICATION  MONITORED  JOBNAME  STATUS
DMD          NO         N/A      N/A
IKED         NO         N/A      N/A
NSSD         NO         N/A      N/A
SYSLOGD      NO         N/A      N/A
TRMD         YES        TRMD     ACTIVE
```

<> TRMD might fail because:

1. OMVS segment was not defined for the TRMD ID.
2. The TCP/IP stack is not up.

Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
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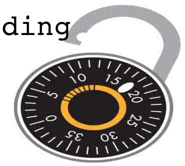
Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > Defensive Rules

- ❑ Attack rules are a set of conditions that predefine what constitutes an attack.
- ❑ The Policy Agent defends against:
  - ✓ *Malformed Packet*
  - ✓ *Flood*
  - ✓ *ICMP Redirect*
  - ✓ *IP Fragmentation*
  - ✓ *IP Protocol*
  - ✓ *Outbound Raw Restrictions*

Intrusion Detection Rules - DataHiding

```
#-------------------------------------
# Attack - IDSRule
#-------------------------------------
IDSRule                    DataHiding
{
  ConditionType            Attack
  IDSAttackCondition
  {
    AttackType             DATA_HIDING
    OptionPadChk           Enable
    IcmpEmbedPktChk        Enable
  }
  IDSActionRef             DataHiding
}
```



Source: z/OS V1R13.0 Communications Server IP Configuration Guide

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > Defensive Actions

- ❑ Actions associated with an Attack Rule define reporting and logging options for a detected attack.
- ❑ The Policy Agents will disallow:
  - ✓ ICMP redirect receipts
  - ✓ Fragmentation within first 88 bytes
  - ✓ IP protocols except ICMP, TCP and UDP
  - ✓ Outbound packets using RAW sockets
- ❑ A single reusable attack action is defined and shared among all the attack rules.

Intrusion Detection Actions – DataHiding

```
#-------------------------------------
# Attack - IDSAction
#-------------------------------------
IDSAction                     DataHiding
{
  ActionType                  Attack nodiscard
  IDSReportSet
  {
    TypeActions               LOG
    LoggingLevel              4
    TypeActions               STATISTICS
    StatType                  Normal
    StatInterval              60
  }
}
```

Source: z/OS V1R13.0 Communications Server IP Configuration Guide

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > Reporting

❑ A Report Set can be associated with defined actions. Report can include:

- ✓ Type of Action
- ✓ Statistics Interval
- ✓ Logging Level
- ✓ Trace Data
- ✓ Record Size

❑ If a packet meets a policy rule's condition during its validity period, the report specified in the policy is produced.

Intrusion Detection Actions – DataHiding

```
#------------------------------------
# IDSReportSet
#------------------------------------
IDSReportSet                ExceptStatReport
{
  TypeActions               Log
  TypeActions               Statistics
  LoggingLevel              1
  StatType                  Exception
  TraceData                 RecordSize
  TraceRecordSize           200
}
```

Source: z/OS V1R13.0 Communications Server IP Configuration Guide

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > pasearch

❑ The pasearch command can be used to obtain details of the management policies on your system. This is a sensitive command and needs to be protected.

❑ The profile to protect pasearch, defined in the SERVAUTH class is:

EZB.PAGENT.sysname.tcpprocname.*

Where:

- EZB is constant
- PAGENT is constant for this resource type
- sysname is the system name
- tcpprocname is the TCP/IP proc name
- * meaning for all policy type options

Securing Access to Policy Files:

```
TCP/IP pasearch CS V1R13 Image Name:
TCPIPD
Date: 08/03/2011 Time: 08:26:39
TTLS Instance Id: 1312374380
policyRule: Default_FTP-Server~1
  Rule Type: TTLS
  Version: 3 Status: Active
  Weight: 255 ForLoadDist: False
  Priority: 255 Sequence Actions: Don't Care
  No. Policy Action: 3
policyAction: gAct1~FTP-Server
   ActionType: TTLS Group
   Action Sequence: 0
policyAction: eAct1~FTP-Server
   ActionType: TTLS Environment
   Action Sequence: 0
```

Source: z/OS V1R13.0 Communications Server IP Configuration Guide
Volume 4 Security and Policy-Based Networking

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > IDS Testing

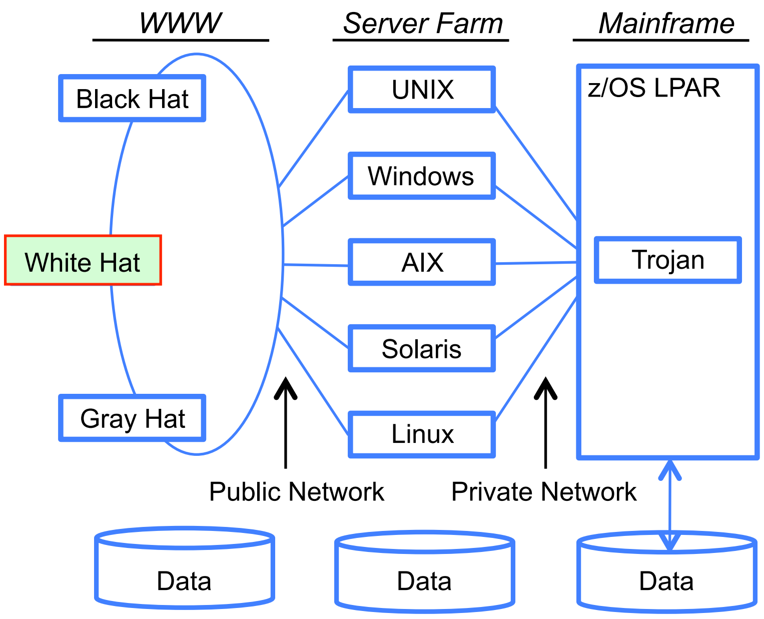
❑ You can test IDS Policy efficacy using a PC-based network penetration testing tool (Advanced Port Scanner V1.3) against the z/OS ports.

❑ Such a test will likely trigger system messages similar to the following:

```
EZZ8761I IDS EVENT DETECTED 638
EZZ8730I STACK TCPIP
EZZ8762I EVENT TYPE: FAST SCAN DETECTED
EZZ8766I IDS RULE ScanGlobal
EZZ8767I IDS ACTION ScanGlobalAction
```

❑ These messages can be detected and spawn notification to security staff.

Know Your IT Topology:



Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
Volume 4 - Security and Policy-Based Networking

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > IDS Summary

❑ There are 16 specific areas of network vulnerability that can be monitored using PAGENT and reported on using NETSTAT Operator Commands:

- SCAN Detection
- Malformed Packets
- Restrict Outbound
- Restrict Protocol
- Restrict IP Option
- Restrict Redirect
- Restrict Fragment
- UDP Perpetual Echo
- Floods
- Data Hiding
- TCP Queue Size
- Global TCP Stall
- EE LDLC Check
- EE Malformed Packet
- EE Port Check
- EE XID Flood

Checking Intrusion Detection Status:

<> Operator Command to Display Ports:

```
/Display TCPIP,,NETSTAT,IDS
```

<> Intrusion Detection Services Summary:

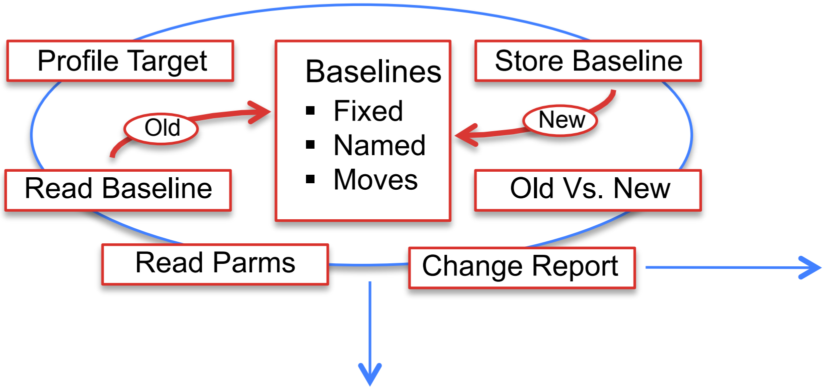
```
SCAN DETECTION:
  GLOBRULENAME: SCANGLOBAL
  ICMPRULENAME: ICMP~1
  TOTDETECTED:  0        DETCURRPLC: 0
  DETCURRINT:   0        INTERVAL:   30
  SRCIPSTRKD:   4        STRGLEV:    00000M
ATTACK DETECTION:
  MALFORMED PACKETS
    PLCRULENAME: MALFORMEDPACKET
    TOTDETECTED: 0        DETCURRPLC: 0
    DETCURRINT:  0        INTERVAL:   60
  OUTBOUND RAW RESTRICTIONS
    PLCRULENAME: OUTBOUNDRAW
```

Source: IBM z/OS V1R13 CS TCP/IP Implementation – March 2012
Volume 4 - Security and Policy-Based Networking

Mainframe Intrusion!

Is your Mainframe Safe? - Fight Back > Policy Agent > IDS Baseline

Building an Intrusion Detection Services Baseline and Change Report



```
+----------------------------------------------------------------+
|         Recent Trends in Intrusion Detection Reporting         |
+----------------------+-----------------------------------------+
|      SMFID:S0W1      | INTRUSION DETECTION HISTORY AND TRENDS  |
+----------------------+-----+-----+-----+-----+-----+-----+-----+
|       DATES          |07/01|06/29|--/--|--/--|--/--|--/--|--/--|
|       TIMES          |18:39|18:38|--:--|--:--|--:--|--:--|--:--|
+----------------------+-----+-----+-----+-----+-----+-----+-----+
|       TOTAL          | 002 | 003 | 000 | 000 | 000 | 000 | 000 |
+---policy_elements----+-----+-----+-----+-----+-----+-----+-----+
|   SCAN Detection     | --C | --C | --- | --- | --- | --- | --- |
|   Malformed Packets  | --- | --- | --- | --- | --- | --- | --- |
|   Restrict Outbound  | --- | --- | --- | --- | --- | --- | --- |
|   Restrict Protocol  | --- | --- | --- | --- | --- | --- | --- |
|   Restrict IP Option | --- | --- | --- | --- | --- | --- | --- |
|   Restrict Redirect  | --- | --- | --- | --- | --- | --- | --- |
|   Restrict Fragment  | --- | --- | --- | --- | --- | --- | --- |
|   UDP Perpetual Echo | --- | --- | --- | --- | --- | --- | --- |
|   Floods             | --C | --- | --- | --- | --- | --- | --- |
|   Data Hiding        | --- | --C | --- | --- | --- | --- | --- |
|   TCP Queue Size     | --- | --- | --- | --- | --- | --- | --- |
|   Global TCP Stall   | --- | --- | --- | --- | --- | --- | --- |
|   EE LDLC Check      | --- | --- | --- | --- | --- | --- | --- |
|   EE Malformed Packet| --- | --- | --- | --- | --- | --- | --- |
|   EE Port Check      | --- | --- | --- | --- | --- | --- | --- |
|   EE XID Flood       | --- | --- | --- | --- | --- | --- | --- |
+----------------------+-----+-----+-----+-----+-----+-----+-----+
```

Issue Operator Command

```
/Display TCPIP,,NETSTAT,IDS
```

Mainframe Intrusion!

Is your Mainframe Safe? – Presentation Descriptive Matrix

	Message	*Delivery*	*Packets*	*Destination*	*Security*	*Attacks*	*Defenses*
Message	Public, Private Hackers						
Delivery		Network Layers					
Packets			Header, Payload Trailer				
Destination				IPAddress, Port Socket			
Security					IPSec SSL, TSL, SSH		
Attacks						Players, Tools, Training	
Defenses							Fighting Back PAGENT

Source: How to Detect Mainframe Intrusion Attempts - SHARE SF 02/2013 - Session 12257

Mainframe Intrusion!

Is your Mainframe Safe? – Fighting Back > Report > Cyber Crimes

□ Management has the obligation to put in place and enforce *Best Practices* that:

✓ With Respect to Employees

1. Educate
2. Equip
3. Empower

✓ With Respect to Stakeholders

1. Disclose Material Attacks
2. Potential Damages
3. Damage Mitigation
4. Corrective Actions

✓ With Respect to Law Enforcement

1. Report, Cooperate
2. Prosecute Offenders

Source:http://www.thenewstribune.com/2012/06/29/2198831/cybercrime-disclosures-scarce.

Mainframe Intrusion!

Is your Mainframe Safe? – Fighting Back > Policy Agent > White Paper

❑ This “White Paper” describes in detail the mechanism for defining policy metrics which in turn are used to monitor and defend network operation from spies and intruders.

The Intrusion Detection Service (IDS) Policy Management Project

A NewEra Software, Inc. White Paper
July-August, 2012

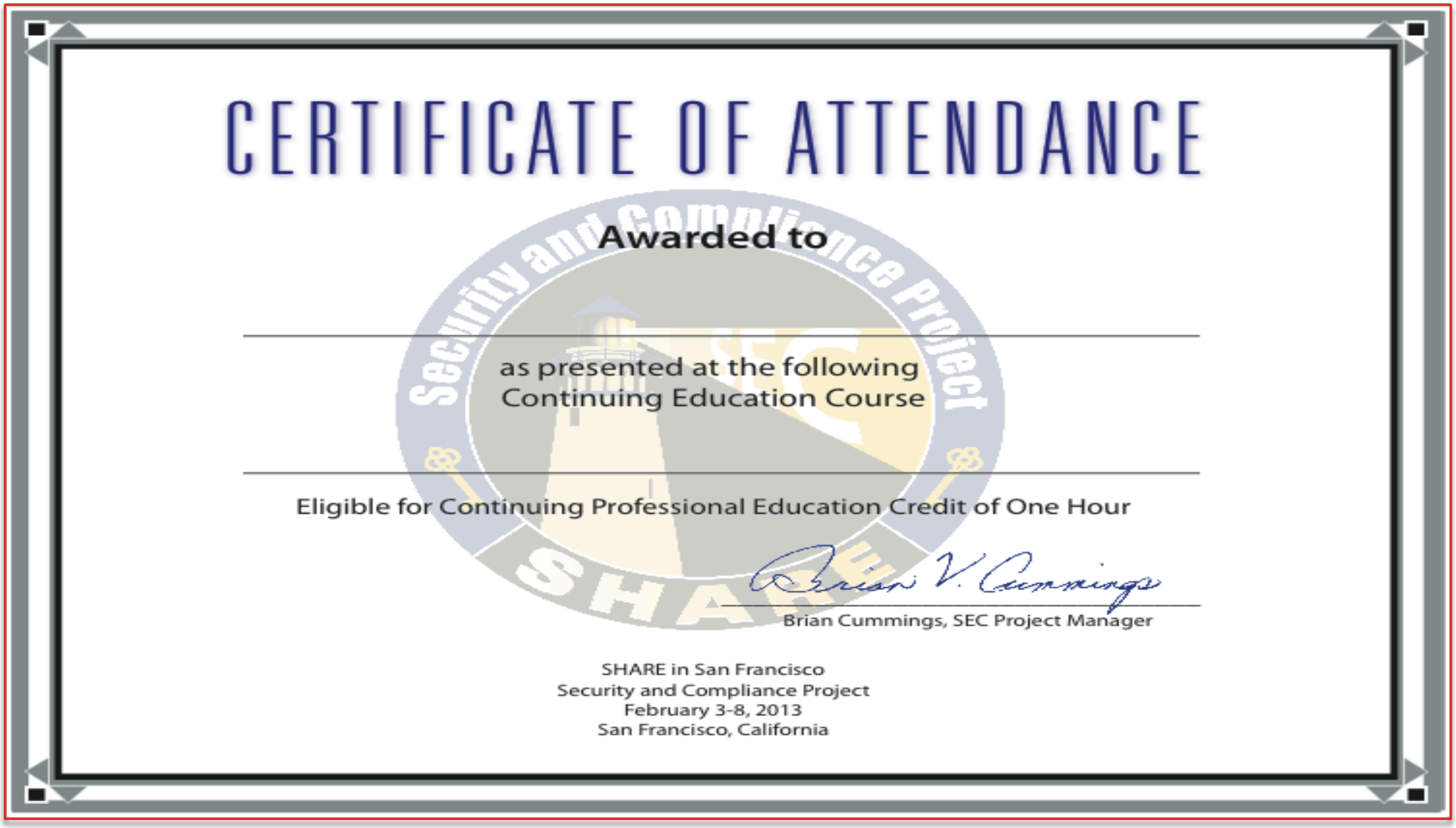
Table of Contents:

- Project Introduction
- IDS Configuration
- Penetration Testing
- Extended Analytics

Appendices:

- PAGENT configuration file contents
- Policy configuration file contents
- Extended Analytics Reports

Continuing Education Credit



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SHARE in San Francisco
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Mainframe Intrusion!

Session Evaluation - Session Number - 12257

How to Detect Mainframe Intrusion Attempts

Paul R. Robichaux
NewEra Software, Inc.
prr@newera.com

SHARE.org/SanFrancisoEval

Insert Custom Session QR If Desired.

Visit www.SHARE-SEC.com for more information on the SHARE Security & Compliance Project