Proxies | IDS

INGI2347: COMPUTER SYSTEM SECURITY (Spring 2014)

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Plan for today

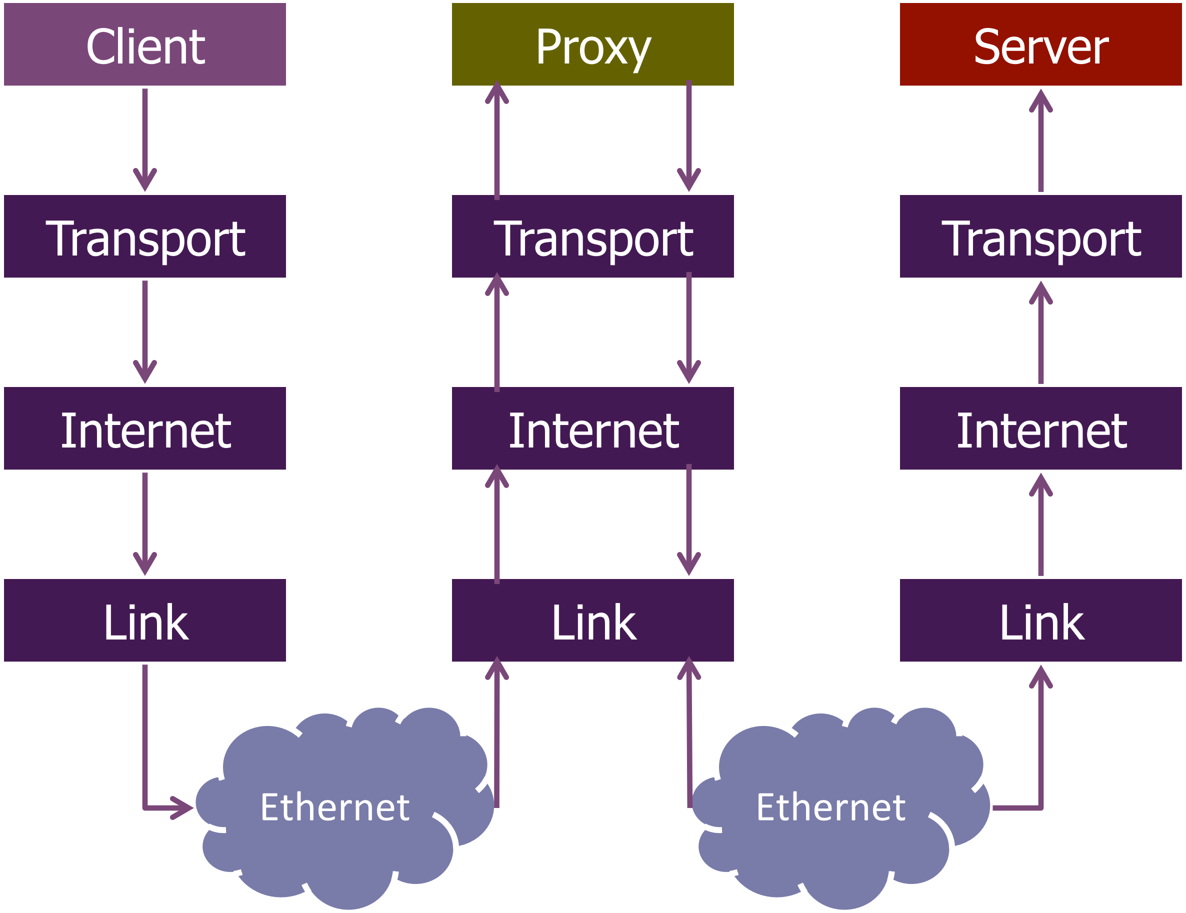
Lecture 5

- Proxies

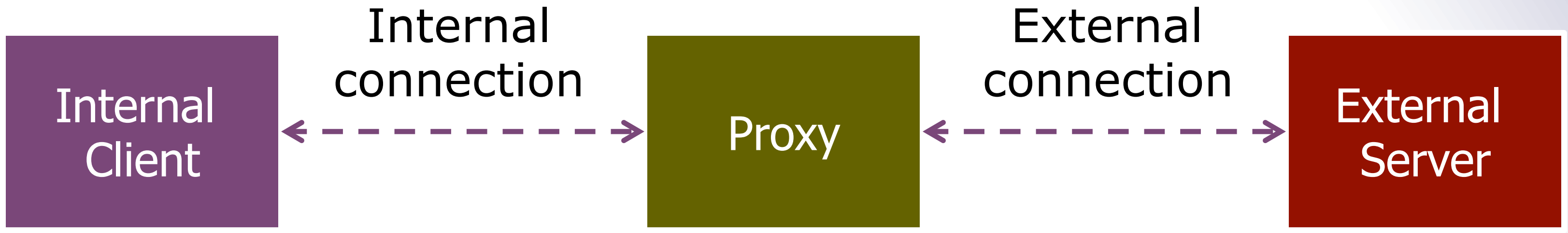
  NEXT

  - Proxies features and benefits
  - Types of proxies
  - Reverse proxies
- Intrusion Detection Systems

Proxies are application relays



Proxy



- Proxy acts like both a client and a server
- Can provide other services too
  - Examples: caching, load balancing, mobile page transformation, content transcoding/compression/translation
- A typical example of the defense in depth and choke point principles

Proxy Benefits

- Prevent direct connections from the internal network towards the Internet
  - Choke point
  - Possibly authentication
- Able to filter application-level info
  - URL or DNS blacklists, URL filtering
  - Content type (MIME) filtering, keyword filtering
  - Virus, exploit, …

Cache Feature

- The proxy can keep a copy of all the contents it has served in a cache
- When another client asks for the same content, it can provide the cached copy
  - Ensure content is up-to-date (Example: in HTTP, use header info)
- The transfer is much faster (increase in QoE)
- We can save on bandwidth (limit cost)

HTTP Without Proxy

```
$ telnet www.example.com 80
GET /index.html HTTP/1.0

HTTP/1.1 200 OK
Date: Mon, 10 Feb 2014 15:21:38 GMT
Server: Apache/2.2.3 (CentOS)
Expires: Mon, 10 Feb 2014 15:21:38 GMT
Cache-Control: no-cache
Pragma: no-cache
Connection: close
Content-Type: text/html;charset=UTF-8

<html>
<head><title>Example</title></head>
<body>…
```

HTTP With Proxy

```
$ telnet www.example.com 80
GET http://www.example.com/index.html HTTP/1.0

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<html>
<head><title>Example</title></head>
<body>…
```
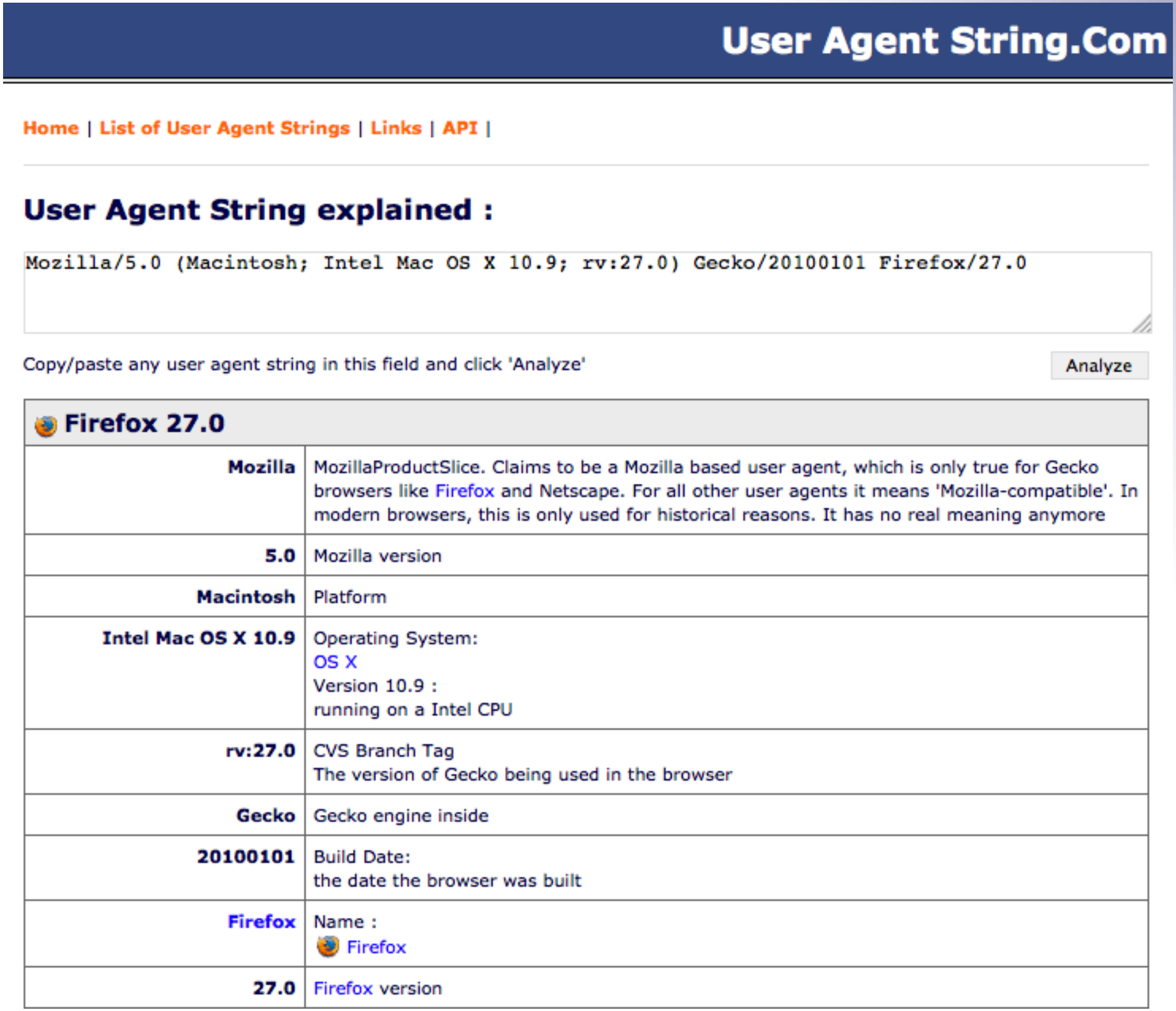

- Requires browser configuration!

Anonymity?

- Surf anonymously?

- IP address of proxy is visible
- HTTP request headers are visible
- Traffic can be analyzed by the proxy operator



User Agent String explained :

```
Mozilla/5.0 (Macintosh; Intel Mac OS X 10.9; rv:27.0) Gecko/20100101 Firefox/27.0
```

Copy/paste any user agent string in this field and click 'Analyze'

Firefox 27.0

Mozilla	MozillaProductSlice. Claims to be a Mozilla based user agent, which is only true for Gecko browsers like Firefox and Netscape. For all other user agents it means 'Mozilla-compatible'. In modern browsers, this is only used for historical reasons. It has no real meaning anymore
5.0	Mozilla version
Macintosh	Platform
Intel Mac OS X 10.9	Operating System: OS X Version 10.9 : running on a Intel CPU
rv:27.0	CVS Branch Tag The version of Gecko being used in the browser
Gecko	Gecko engine inside
20100101	Build Date: the date the browser was built
Firefox	Name : Firefox
27.0	Firefox version

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Types of Proxies

Transparent Proxy (intercepting proxy)

- Traffic targeted at a certain port is automatically redirected towards the proxy by the firewall
- Pros
  - Avoid having to configure browsers
  - Enforce usage of the proxy
  - Enable load balancing
- Cons
  - Doesn’t work for servers that are not on the configured port

Transparent Proxy (intercepting proxy)

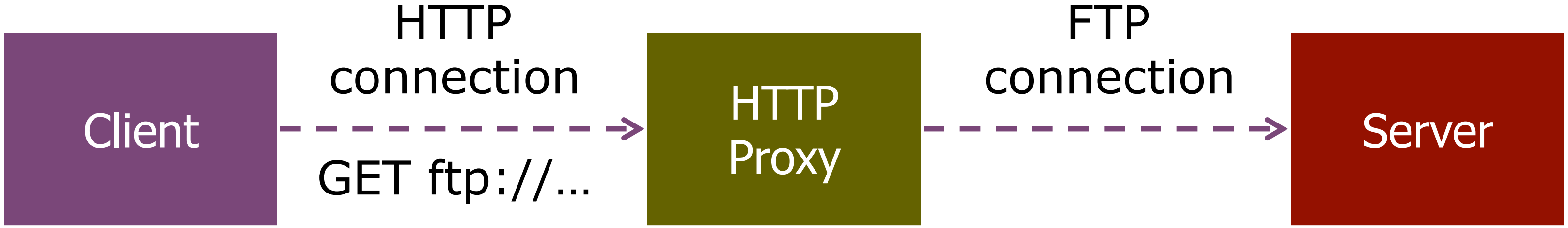
- “A 'transparent proxy' is a proxy that does not modify the request or response beyond what is required for proxy authentication and identification.” [RFC2616]
- Detection of the use of a proxy:
  - Compare IP address of client with that observed by the server
    - (if client is not NATed)
  - Examine HTTP request headers at the server
  - Make a connection to an IP address at which there is no server

FTP Proxy

- FTP summary
  - FTP uses a command connection and a data connection
  - The data connection can be directed towards the client (active mode, default setting) or towards the server (passive mode)
- The FTP protocol has not been designed to be used through a proxy

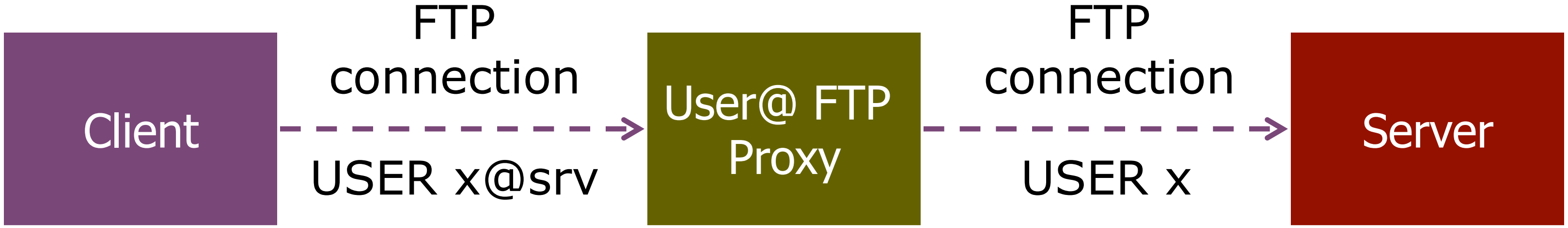
FTP Proxy using HTTP

- Browsers allow specifying URLs in the form ftp://example.com/filename
- If the browser is configured to use an HTTP proxy, it will ask the proxy for that URL
- The HTTP proxy carries out the FTP transfer and provides the document as part of the HTTP reply



User@ FTP Proxy

- User@ proxy behaves like a standard FTP server
- Access server through the proxy by connecting with USER user@server as username to the proxy
- The latter connects to the server and relays the password, commands and the data
- The two connections can use active or passive mode independently



SMTP Proxy

- SMTP was conceived for relaying mail hop by hop
- Hence, any SMTP server can work as a proxy
- Outbound (forward path):
  - Use specified as SMTP server for outgoing mail in the mail client
- Inbound (reverse path):
  - Proxy registered in the DNS as the official server for that domain
  - Proxy has to be configured to forward all mail to the internal server

DNS Proxy

- DNS protocol is designed to retransmit requests from one server to another
- DNS servers can work as proxies
- DNS servers have a cache to limit traffic and reduce response times
- It is a good idea to configure a DNS proxy to direct all its request towards a bigger server (e.g., that of an ISP) to take advantage of a bigger cache

SOCKS Proxy

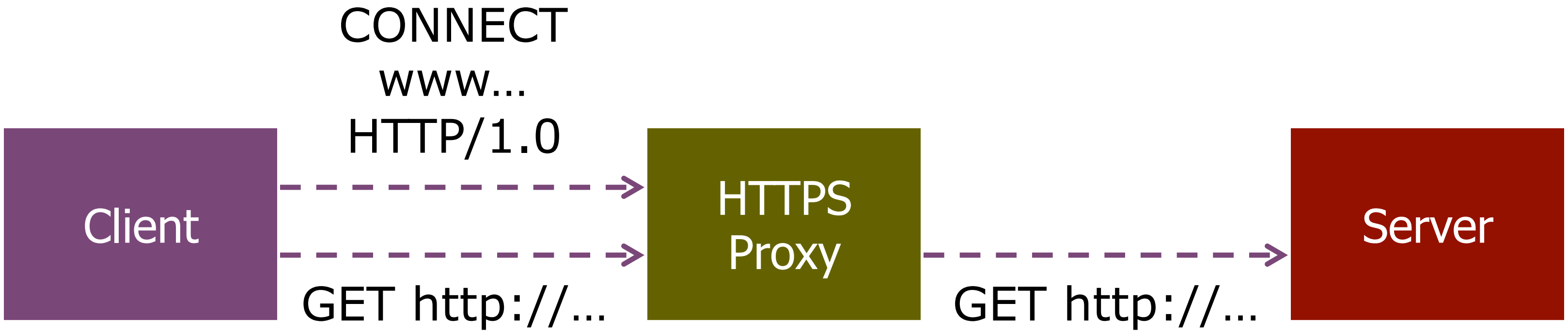
- SOCKS (Socket Server) proxy is a general proxy for TCP (and UDP) connections
- Accept a client connection, then open another one towards the server
- Then relay data between the two connections
- SOCKS allows any protocol to pass via a proxy
  - **Both an advantage and limitation**

HTTPS Proxy

- HTTPS is the secure version of HTTP
  - (encryption, authentication)
- HTTPS proxies are **NOT** a secure version of HTTP proxies!
- HTTPS encrypts and authenticates end-to-end
- HTTPS proxy just transparently relays data between client and server
  - Much like SOCKS

HTTPS Proxy: Implementation

- HTTPS proxy uses the HTTP command CONNECT that indicates the server address
- Replies with a status and becomes transparent



HTTPS Proxy: Security Issues

- The HTTPS proxy allows relaying any type of protocol (it is transparent, just like SOCKS)
- To limit abuses, the available ports are often limited to 443 (HTTPS) and 563 (SNEWS)
- To allow any protocol to cross a firewall, it is sufficient to run the server on port 443 and pass through an HTTPS proxy

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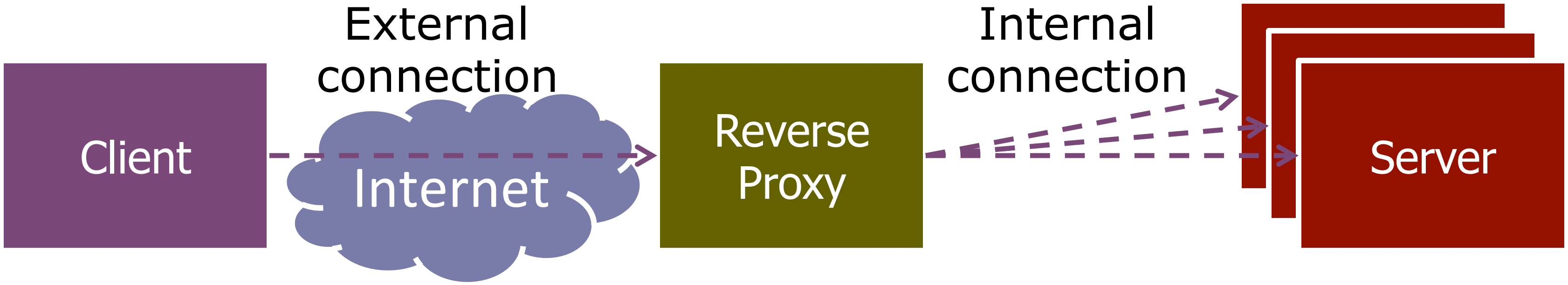
Reverse Proxies

Reverse Proxy

- Appears to clients to be an ordinary server
- Requests are forwarded to one or more origin servers which handle the requests
- Client has no knowledge of the origin servers



Reverse HTTP Proxy

- Filter requests (blocking exploits)
- Authenticate clients even before they communicate with the server
  - Cannot attack the server unless authenticated
- Accelerate servers
  - Encryption acceleration
  - Caching static content
  - Load balancing
- Accelerate clients via content compression

HA
PROXY

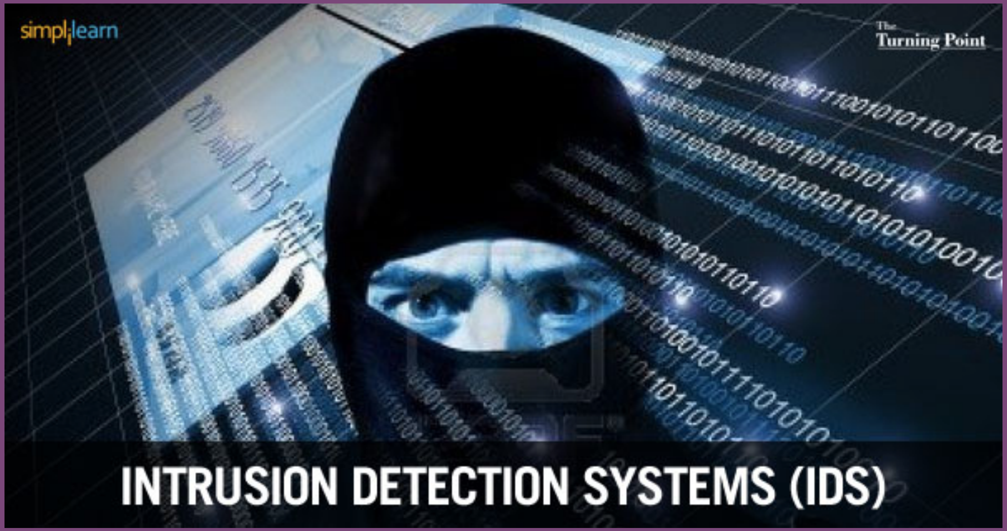
NGINX™

Reverse HTTPS Proxy

- HTTPS proxies are used as encryption accelerators
  - Can reduce the server load by taking care of encryption
  - Can have a hardware accelerator for encrypting data
- The connection between the proxy and the server is HTTP and not HTTPS

Protocol Translation Proxy

- A proxy can use different protocols each side
  - Examples:
  - A Web mail proxy can accept HTTPS requests from the Internet and generate IMAP requests towards the mail server
  - An MPTCP proxy can enable MPTCP-compatible hosts to connect to TCP-only hosts
- Protocol diversity strongly limits the chances of exploiting a vulnerability across a proxy



Intrusion Detection System

Intrusion Detection System (IDS)

Idea: don't wait for the symptoms of an attack before reacting

- An Intrusion Detection System (IDS) monitors
  - Network traffic (Network IDS, NIDS), typically in front of the firewall
  - Events on servers (Host IDS, HIDS)
- When malicious activities are detected, launch an alarm (SMS, mail, etc.)
- Can attempt prevent attacks from succeeding
  - Example: reconfigure firewalls or servers
- Analysis can be done in real-time or by analyzing logs

IDS: Approaches

	Off-line Analysis	Real-time Analysis
Network IDS (NIDS)	Analysis of logs and configuration of firewall, routers	Network sniffer
Host IDS (HIDS)	Examination of system logs	Log/Registry/ Sys-call watcher

IDS with Traffic Characterization

- IDS performs statistical analysis on traffic
  - If a value goes beyond its usual limits then assume there is an attack
- Can recognize new attacks
- May also not recognize them… (false negatives)
- Or see attacks where there aren't (false positives)
- High false positives makes this IDS type unpopular
  - Example: Port Scanning (slow mode to avoid detection)

Signature-based IDS

- Use a database of known attacks
  - Example: Web request with URL of 2000 characters == buffer overflow
- Doesn’t recognize new attacks
  - Must be constantly updated
  - Honeypots: traps to detect attack
- False negatives
  - Manual attacks can have variations that are not detected
  - Signatures are not always precise
- False positives
  - Doesn’t know if an attempted attack was successful
  - Doesn’t know if the target is vulnerable (e.g. Linux attack on Windows server)

Snort: Signature-based

- Lightweight IDS for Linux and Windows
- "Signature, protocol and anomaly based inspection methods"
- Analyze traffic, for example in front of the firewall, to detect possible attacks
- Send mails and/or update filtering rules
- Huge signature database updated by users

Snort: Example of Signatures

```
log tcp any 80 -> any any
```

- Means “Log TCP packets coming from any host, port 80, going to any host, any port”

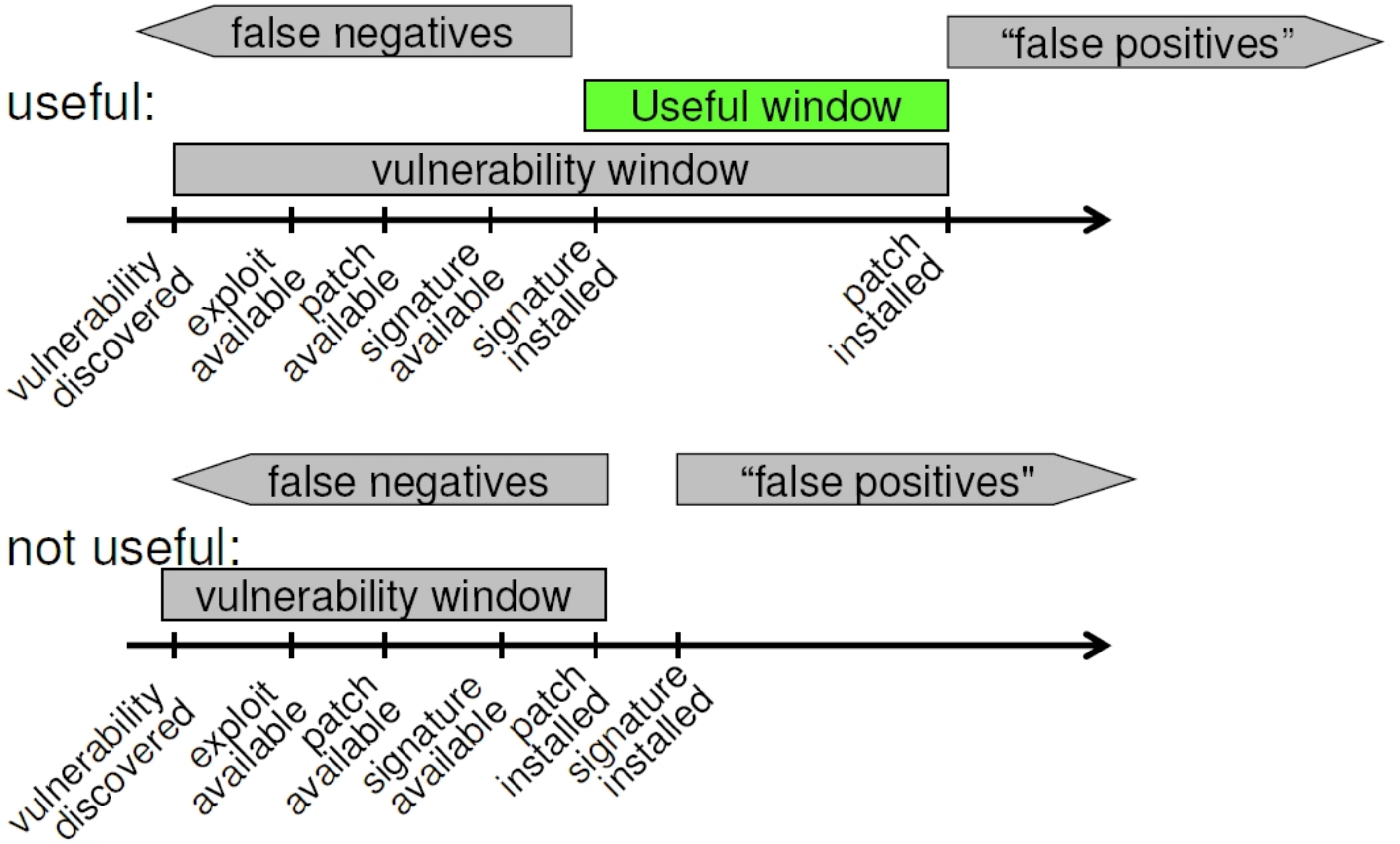
```
alert tcp any any -> 192.168.1.0/24 143
(content: "|90C8 C0FF FFFF|/bin/sh"; msg:
"IMAP buffer overflow!";)
```

- Means “Alert when receiving a packet from any host, any port to port 143 of a computer with IP address in 192.168.1.0/24, when the packet contains the string “|90C8 C0FF FFFF|/bin/sh”

Integrity-based Host IDS: Tripwire

- Typical example of a HIDS with a differed analysis
- Create a digital signature of all files and directories that should not be modified
- Signatures cannot be modified by an attacker
- Regularly compare files and signatures to detect any modification
- Generate an alarm when a modification is detected and can automatically restore the original version of the file

IDS: Efficiency



Intrusion Prevention Systems: IPS

- An IDS that reacts to an attack
  - IP level: Filters the source IP address in the firewall (for a while)
  - TCP level: Sends a spoofed TCP reset packet to the destination to kill the connection
  - Application level: “Corrects” a Web request by removing special characters
- Beware of denial of service through false positives!

IDS: Discussion

- Traffic-characterization IDSes are not yet very efficient
- IDS with signatures work well but:
  - Majority of the attacks for which we have the signature can be blocked by a FW or proxies
  - We should first prevent before trying to detect
- Not sufficient to install an IDS: must also know how to react to attacks and deal with many false positives
- Automatic reactions are usually not advisable (DoS)

IDS: Discussion

- If both traffic characterization and signature-based are possible, it provides a good defense in depth
- IDS deployed in internal networks create less frequent and more critical alarms

Summary

- Proxies
  - Prevent direct connections
  - Application-level filtering
  - Defense in depth and choke point principles
  - Other useful features (e.g., load balancing, caching)
- IDS
  - Monitor network and system activities
  - Raise alarms
  - IPS: react to alarms automatically
  - Challenge: deal with false positives (self DoS)

Any questions?

Stay tuned

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Next time you will learn about

Cryptography