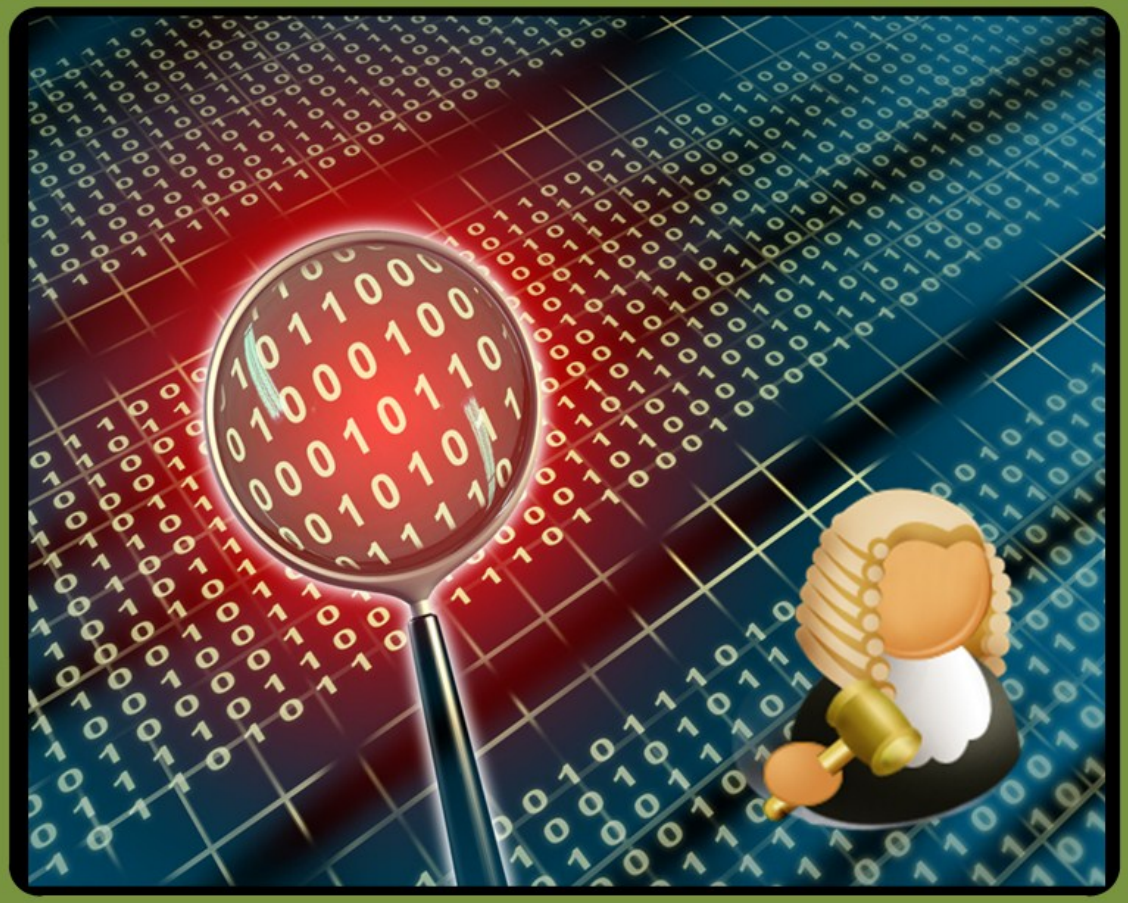
Network Forensics

- Understand some of the methodologies used in network forensics.
- Provide an in-depth understanding of the key network protocols, including IP, TCP, ARP, ICMP, DNS, Application Layer protocols, and so on.
- Define a range of audit sources for network activity.

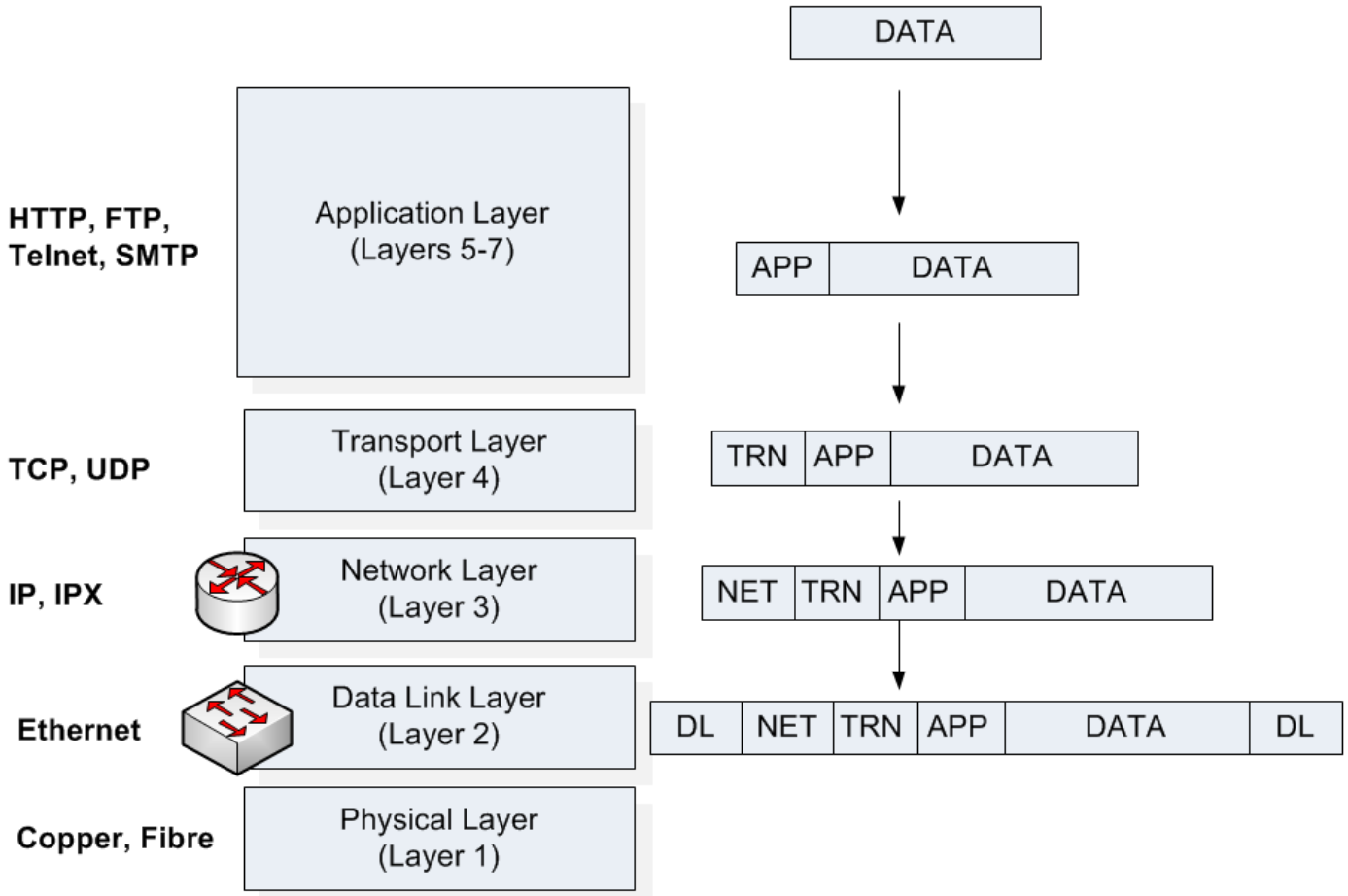
Author: Prof Bill Buchanan

Network Forensics



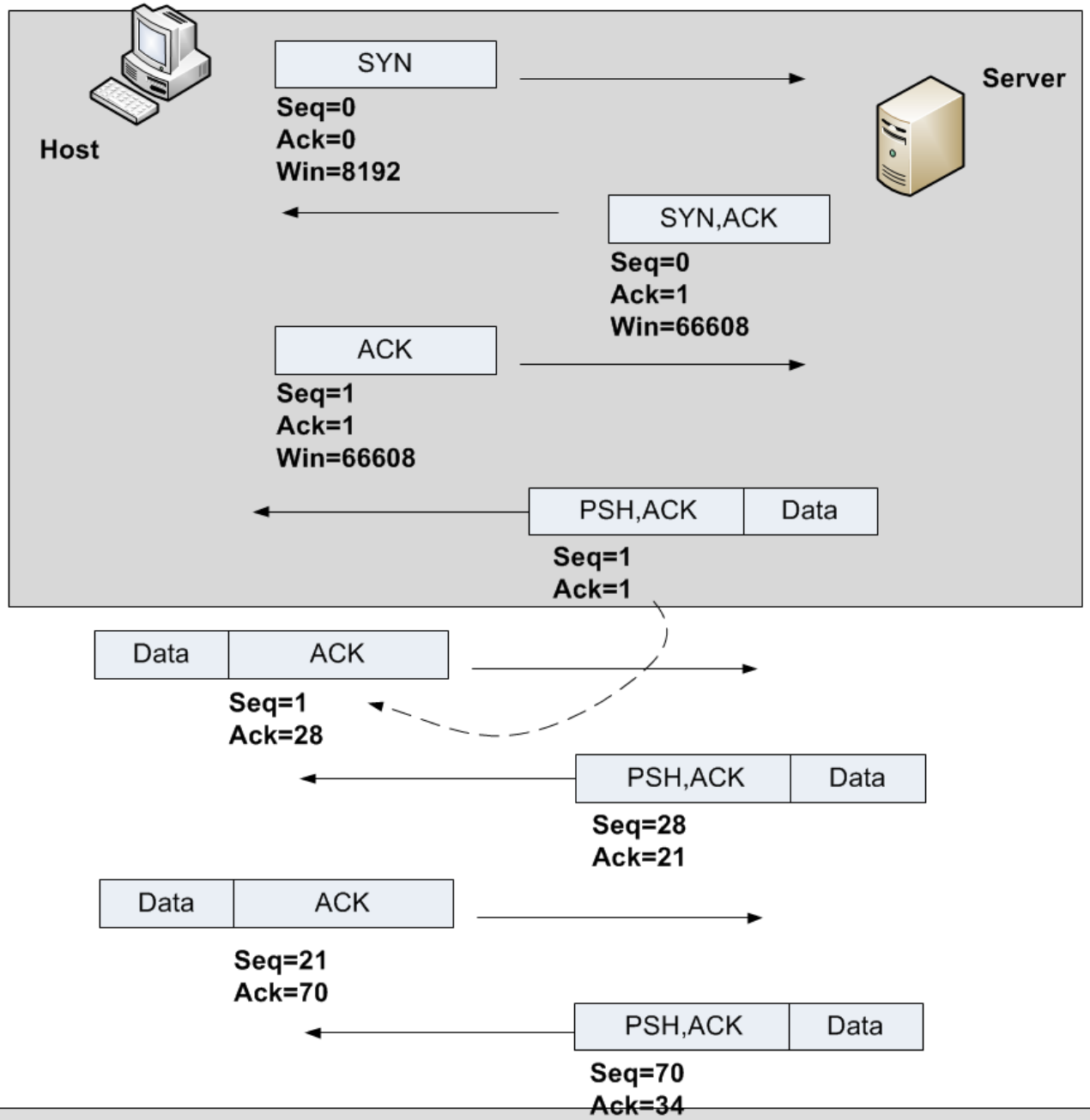
Ethernet, IP and TCP

Author: Prof Bill Buchanan



Author: Prof Bill Buchanan

Ethernet, IP, TCP and so on...



3-way handshake

Author: Prof Bill Buchanan

Client/server

Protocol:
1 – ICMP
6 – TCP
8 – EGP
17 - UDP

IP header

Version	Header len.	Type of service	
Total length			
Identification			
0	D	M	Fragment Offset
Time-to-live (TTL)		Protocol	
Header Checksum			
Source IP Address			
Destination IP Address			

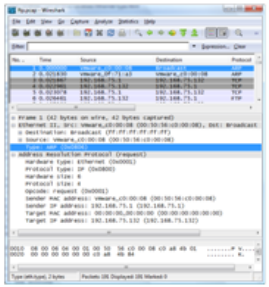
TCP header

TCP Source Port	
TCP Destination Port	
Sequence Number	
Acknowledgement Number	
Data Offset	Flags/Reserved
Window	
Checksum	
Urgent Pointer	

Preamble (7 bytes)	Start (1 B)	Dest. MAC (6 bytes)	Src. MAC (6 bytes)	Type (2 bytes)	data...	Checksum (4 bytes)

Ethernet frame

Type:
0x800 – IP
0x806 – ARP

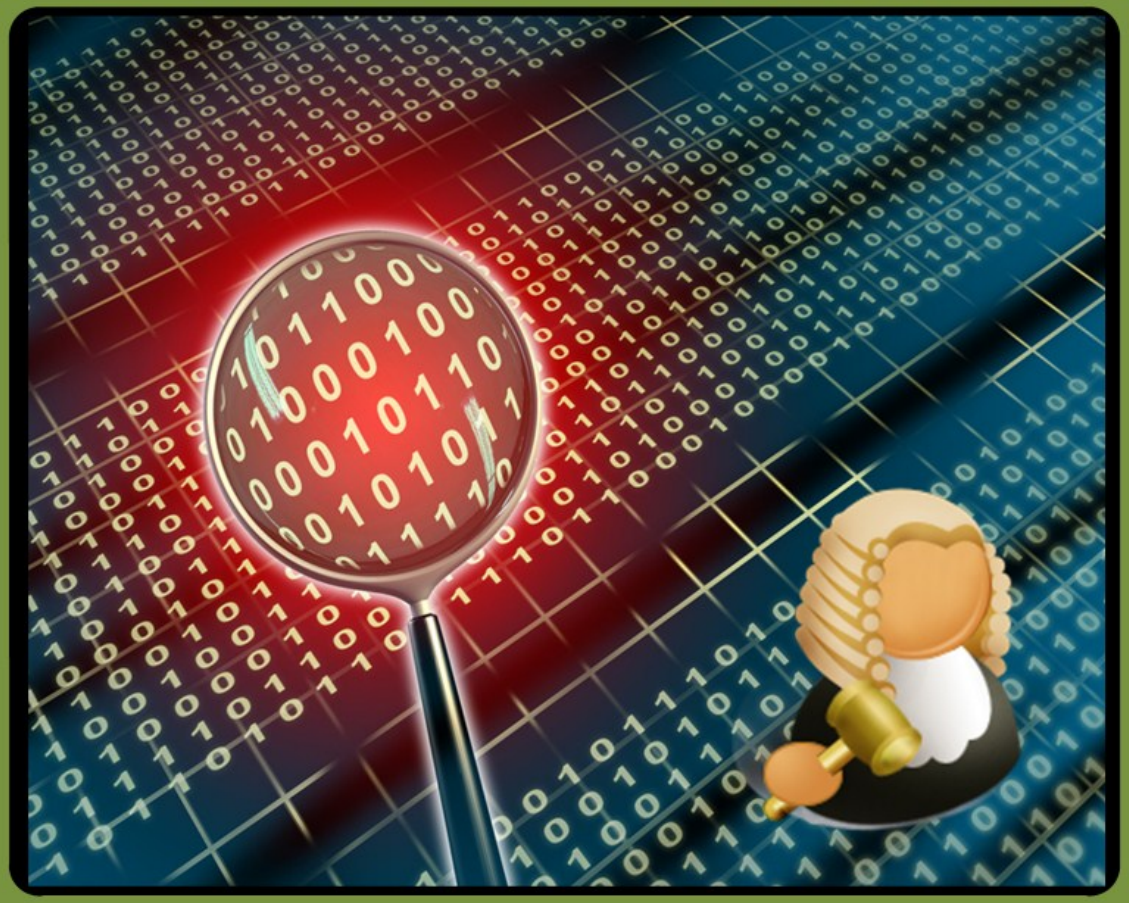


Ethernet ...

Net Forensics

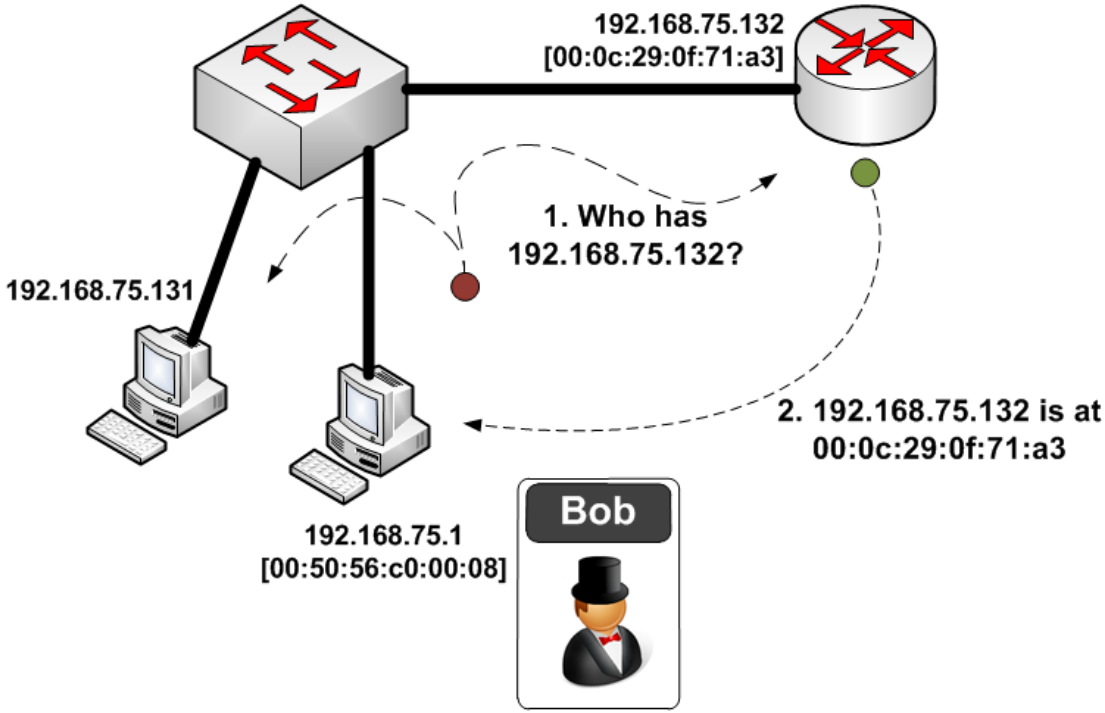
Author: Prof Bill Buchanan

Network Forensics



ARP

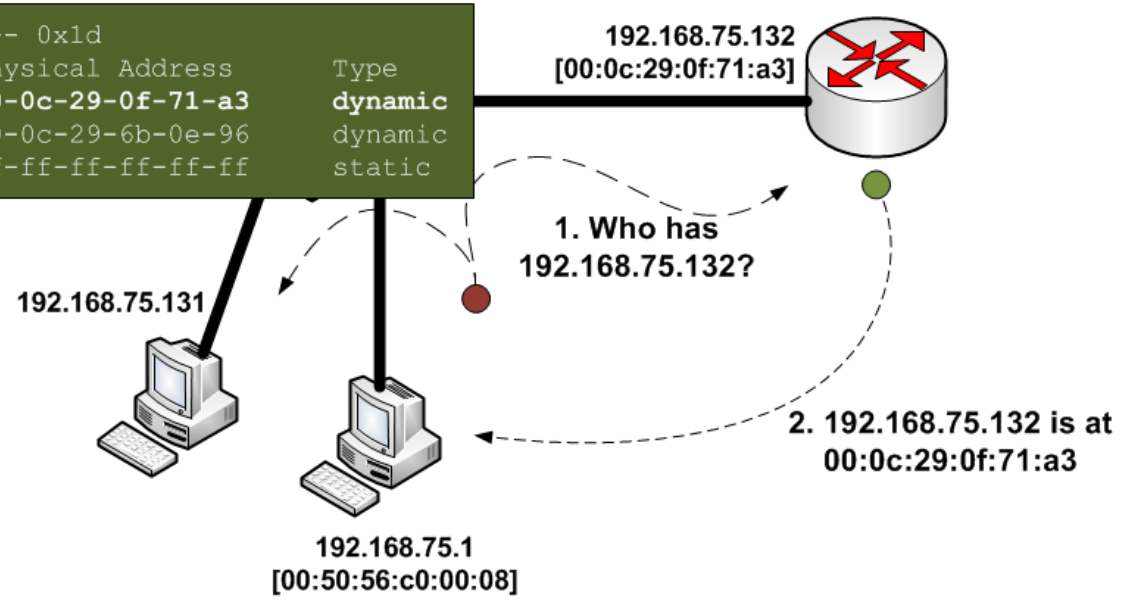
Author: Prof Bill Buchanan



Author: Prof Bill Buchanan

```
No.     Time        Source                Destination           Protocol Info
      1 0.000000    Vmware_c0:00:08       Broadcast             ARP      Who has
192.168.75.132?  Tell 192.168.75.1

Frame 1 (42 bytes on wire, 42 bytes captured)
Ethernet II, Src: Vmware_c0:00:08 (00:50:56:c0:00:08), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
Address Resolution Protocol (request)
```

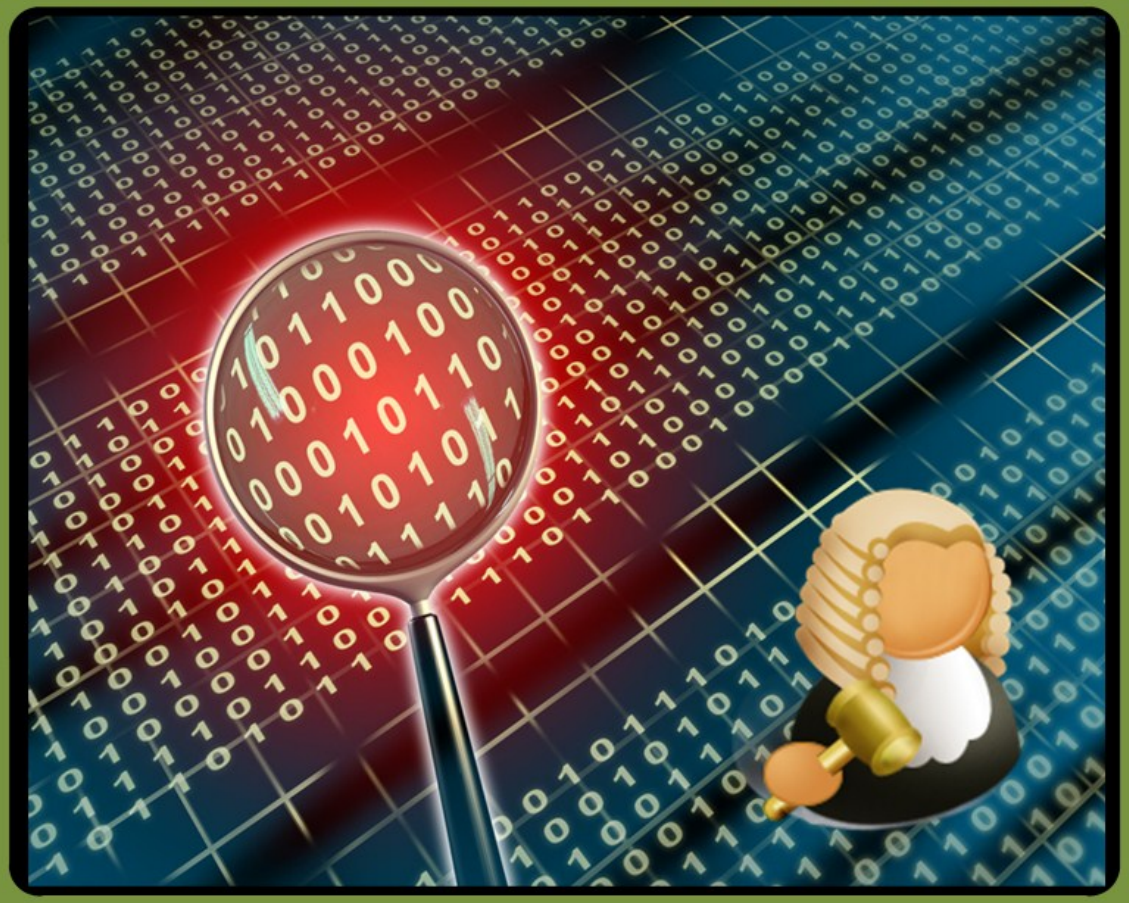
```
Interface: 192.168.75.1 --- 0x1d
  Internet Address      Physical Address      Type
  192.168.75.132        00-0c-29-0f-71-a3     dynamic
  192.168.75.138        00-0c-29-6b-0e-96     dynamic
  192.168.75.255        ff-ff-ff-ff-ff-ff     static
```




```
No.     Time        Source                Destination           Protocol Info
      2 0.021830    Vmware_0f:71:a3       Vmware_c0:00:08       ARP      192.168.75.132 is at
00:0c:29:0f:71:a3

Frame 2 (42 bytes on wire, 42 bytes captured)
Ethernet II, Src: Vmware_0f:71:a3 (00:0c:29:0f:71:a3), Dst: Vmware_c0:00:08 (00:50:56:c0:00:08)
Address Resolution Protocol (reply)
```

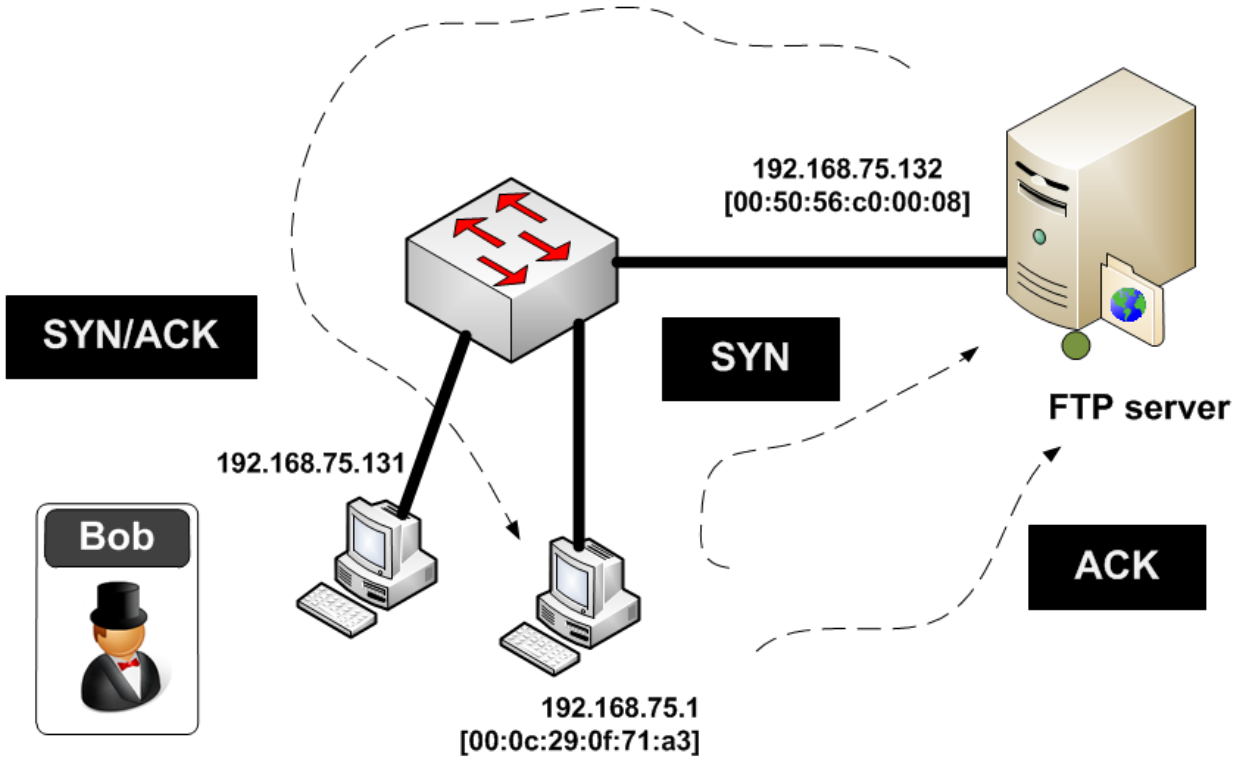
Author: Prof Bill Buchanan

Network Forensics



SYN

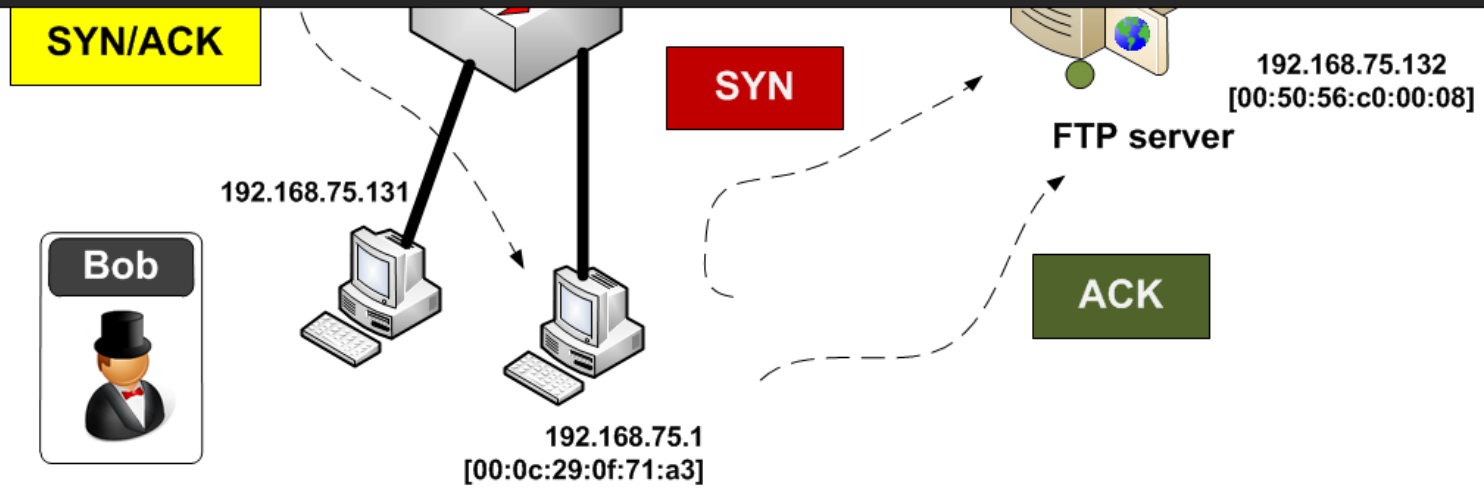
Author: Prof Bill Buchanan



Author: Prof Bill Buchanan

3-way handshake

```
No.     Time        Source                Destination           Protocol Info
      3 0.021867    192.168.75.1          192.168.75.132        TCP      abatemgr > ftp [SYN] Seq=0
Win=8192 Len=0 MSS=1460 WS=2 TSV=683746 TSER=0

Frame 3 (74 bytes on wire, 74 bytes captured)
Internet Protocol, Src: 192.168.75.1 (192.168.75.1), Dst: 192.168.75.132 (192.168.75.132)
Transmission Control Protocol, Src Port: abatemgr (3655), Dst Port: ftp (21), Seq: 0, Len: 0

No.     Time        Source                Destination           Protocol Info
      4 0.022961    192.168.75.132        192.168.75.1          TCP      ftp > abatemgr [SYN, ACK]
Seq=0 Ack=1 Win=64240 Len=0 MSS=1460 WS=0 TSV=0 TSER=0

Frame 4 (78 bytes on wire, 78 bytes captured)
Internet Protocol, Src: 192.168.75.132 (192.168.75.132), Dst: 192.168.75.1 (192.168.75.1)
Transmission Control Protocol, Src Port: ftp (21), Dst Port: abatemgr (3655), Seq: 0, Ack: 1, Len: 0

No.     Time        Source                Destination           Protocol Info
      5 0.023078    192.168.75.1          192.168.75.132        TCP      abatemgr > ftp [ACK] Seq=1
Ack=1 Win=66608 Len=0 TSV=683748 TSER=0

Frame 5 (66 bytes on wire, 66 bytes captured)
Internet Protocol, Src: 192.168.75.1 (192.168.75.1), Dst: 192.168.75.132 (192.168.75.132)
Transmission Control Protocol, Src Port: abatemgr (3655), Dst Port: ftp (21), Seq: 1, Ack: 1, Len: 0
```



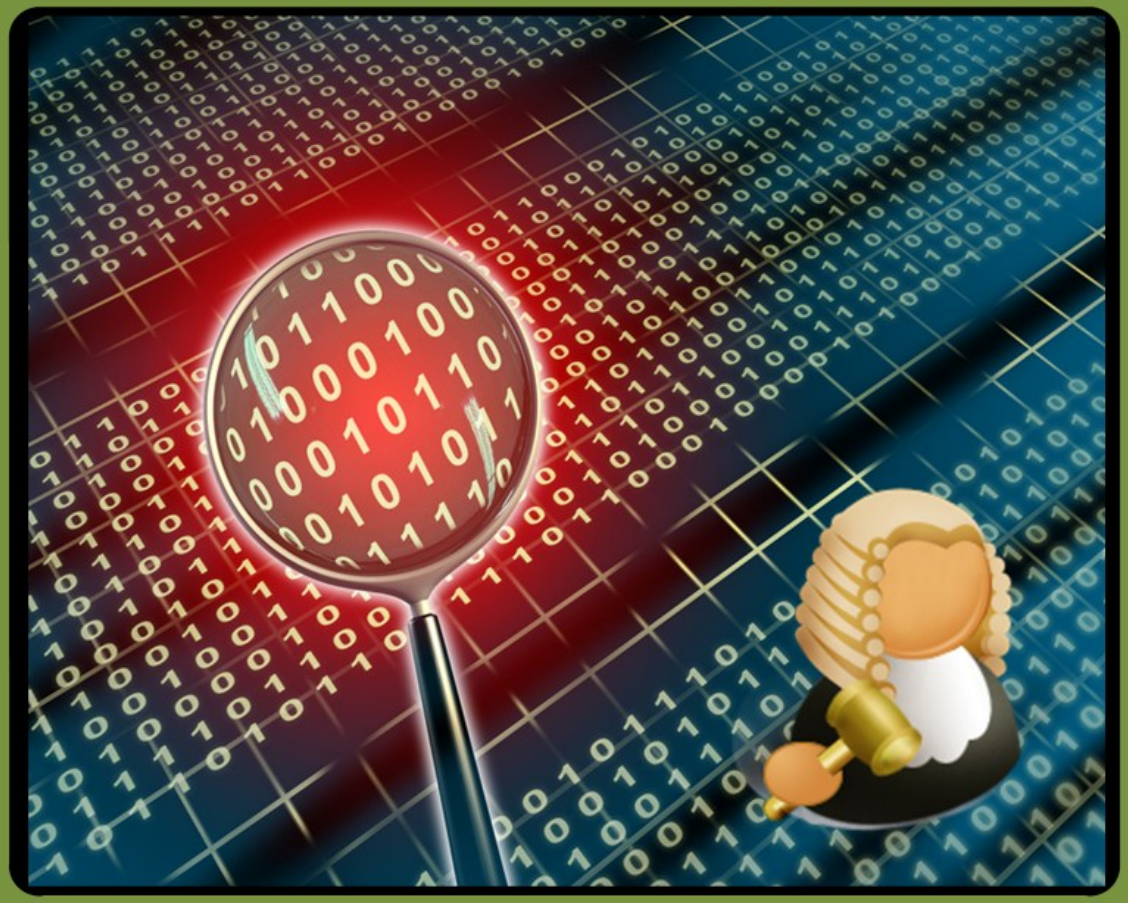
SYN

Net Forensics

Author: Prof Bill Buchanan

3-way handshake

Net Forensics

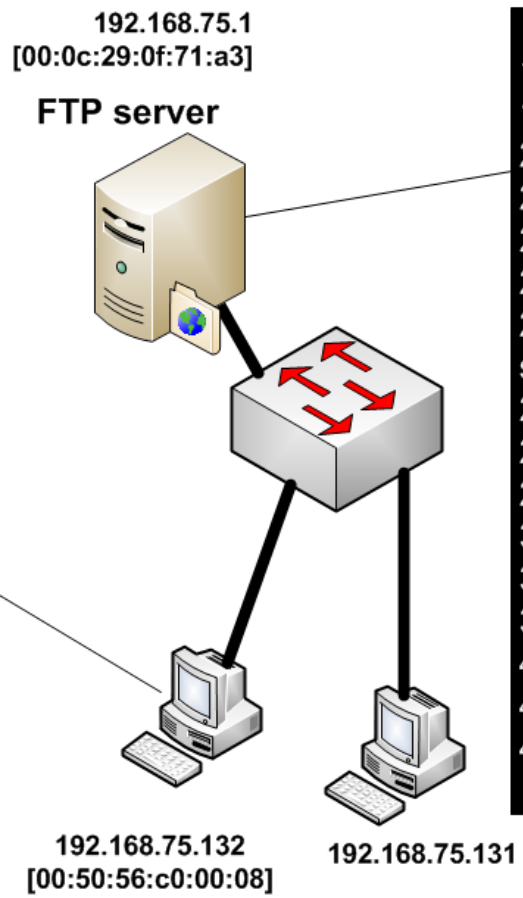


Application Protocol (FTP)

Author: Prof Bill Buchanan

100 Codes The requested action is being taken.
200 Codes The requested action has been successfully completed.
300 Codes The command has been accepted, but the requested action is being held pending receipt of further information.
400 Codes The command was not accepted and the requested action did not take place.
500 Codes The command was not accepted and the requested action did not take place.

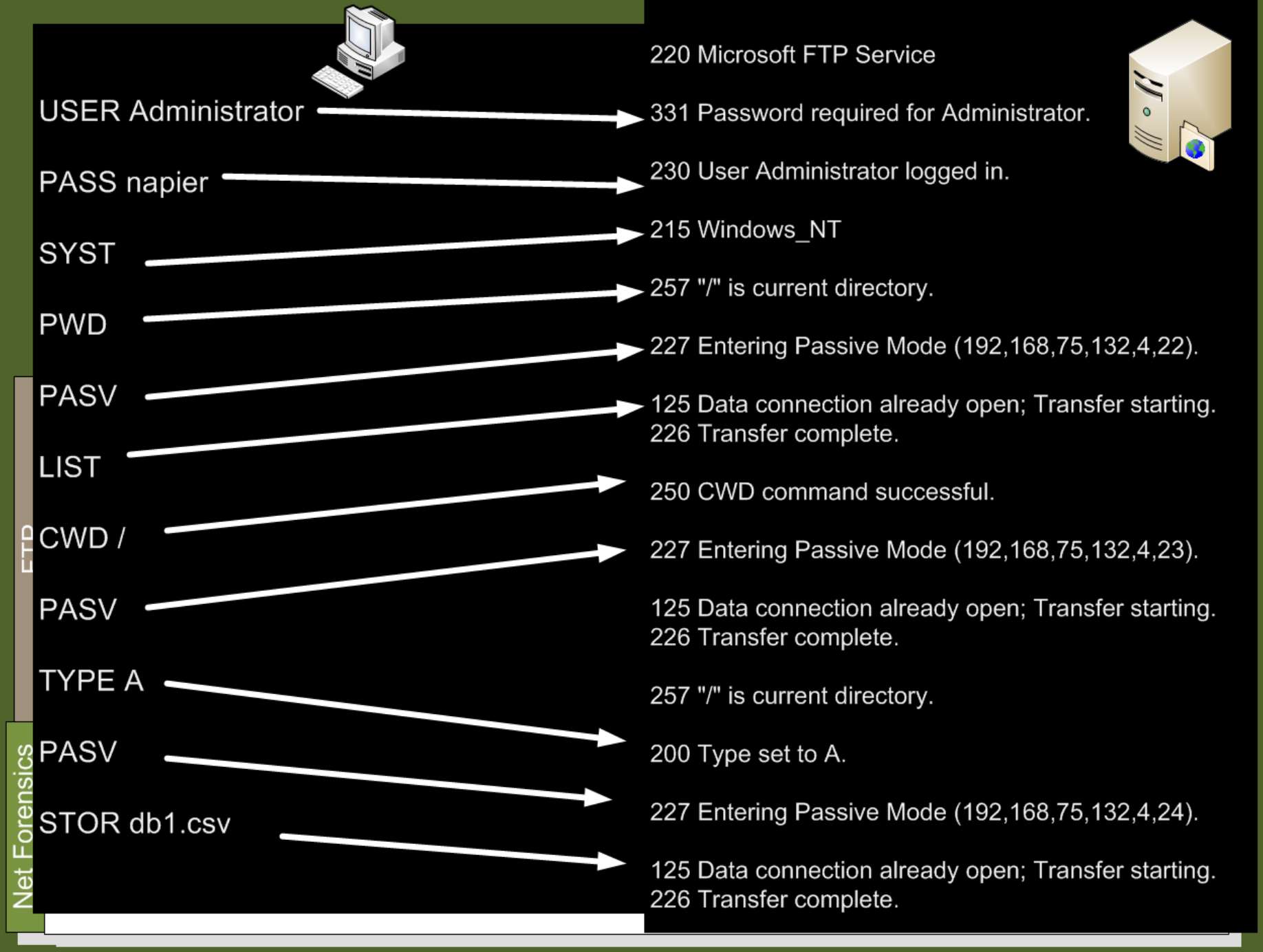
ascii
binary
bye
cd
close
delete
get
help
lcd
ls
mkdir
mget
mput
open
put
pwd
quit
rmdir



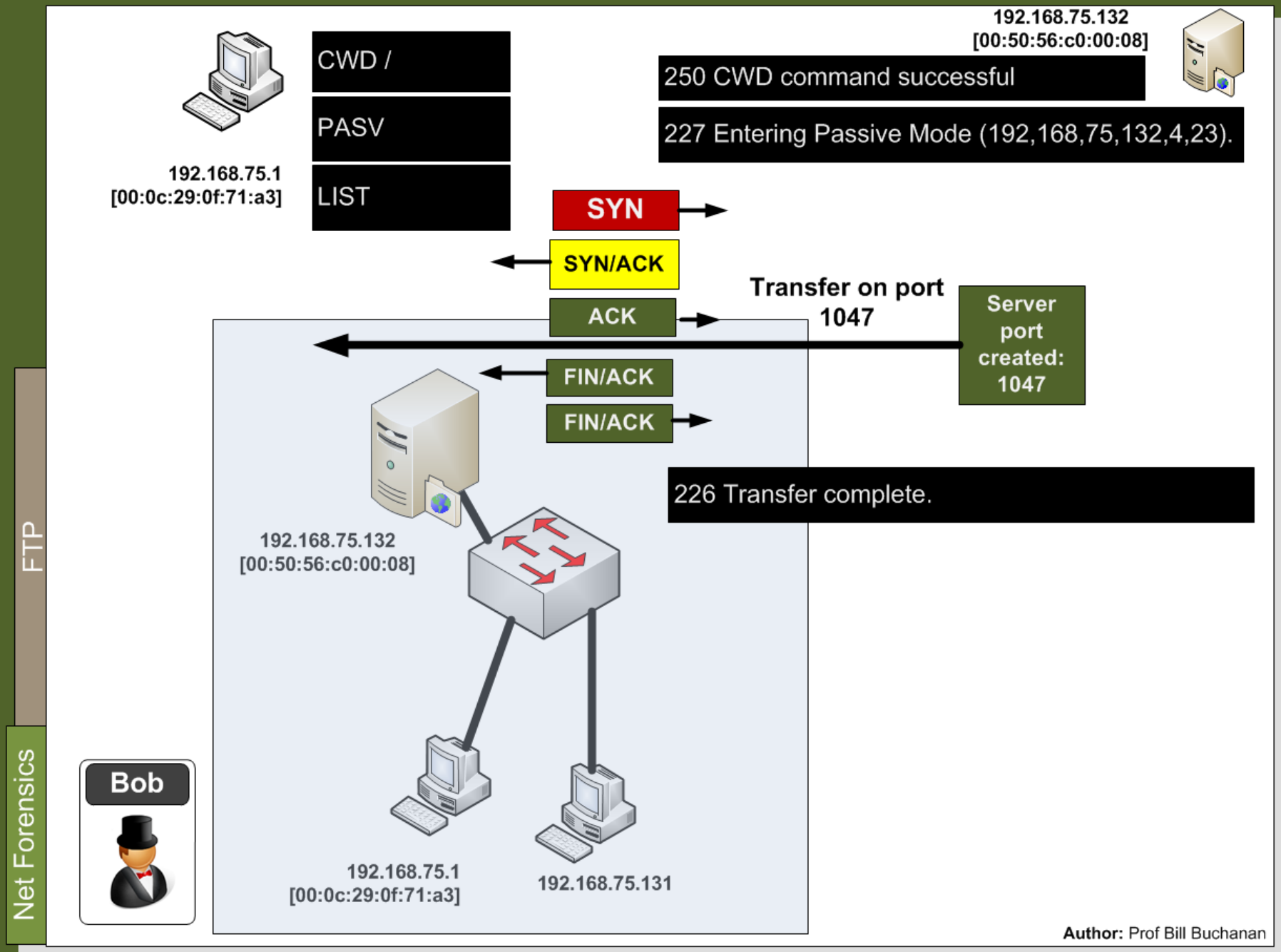
125 Data connection already open, transfer starting.
150 File status okay, about to open data connection.
200 Command okay.
202 Command not implemented
211 System status, or system help reply.
212 Directory status.
226 Closing data connection. Requested file action successful (file transfer, abort, etc.).
227 Entering Passive Mode
230 User logged in, proceed.
250 Requested file action okay, completed.
331 User name okay, need password.
332 Need account for login.
350 Requested file action pending further information.
421 Service not available, closing control connection.
425 Can't open data connection.
426 Connection closed, transfer aborted.

Author: Prof Bill Buchanan

FTP commands and responses

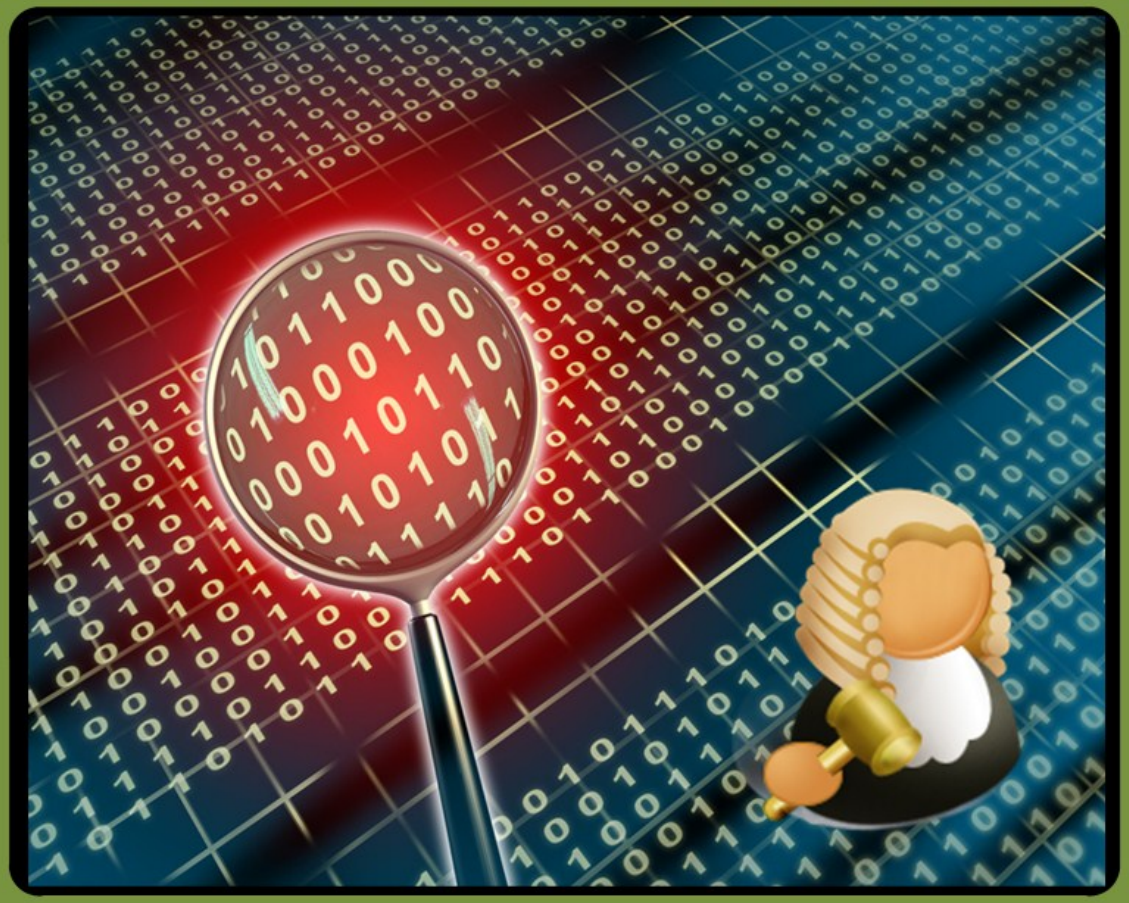


FTP commands and responses


192.168.75.132
[00:50:56:c0:00:08]
CWD /
250 CWD command successful
PASV
227 Entering Passive Mode (192,168,75,132,4,23).
192.168.75.1
[00:0c:29:0f:71:a3]
LIST
SYN
SYN/ACK
ACK
Transfer on port 1047
Server port created: 1047
FIN/ACK
FIN/ACK
226 Transfer complete.
192.168.75.132
[00:50:56:c0:00:08]
Bob
192.168.75.1
[00:0c:29:0f:71:a3]
192.168.75.131
FTP
Net Forensics
Author: Prof Bill Buchanan

Passive FTP

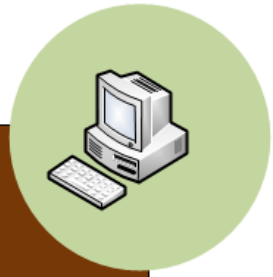
Net Forensics

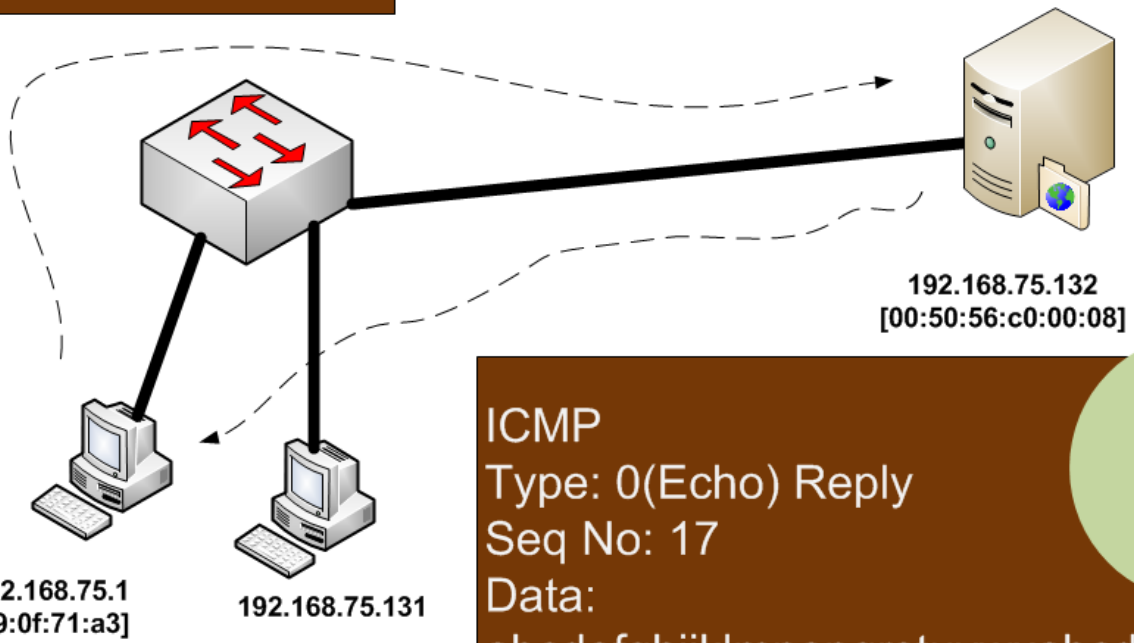


ICMP

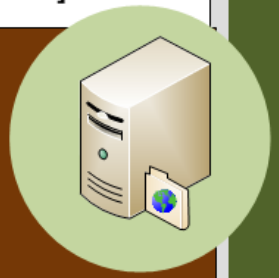
Author: Prof Bill Buchanan

ICMP
Type: 8 (Echo) Request
Seq No: 17
Data:
abcdefghijklmnopqrstuvwxabcdefghi

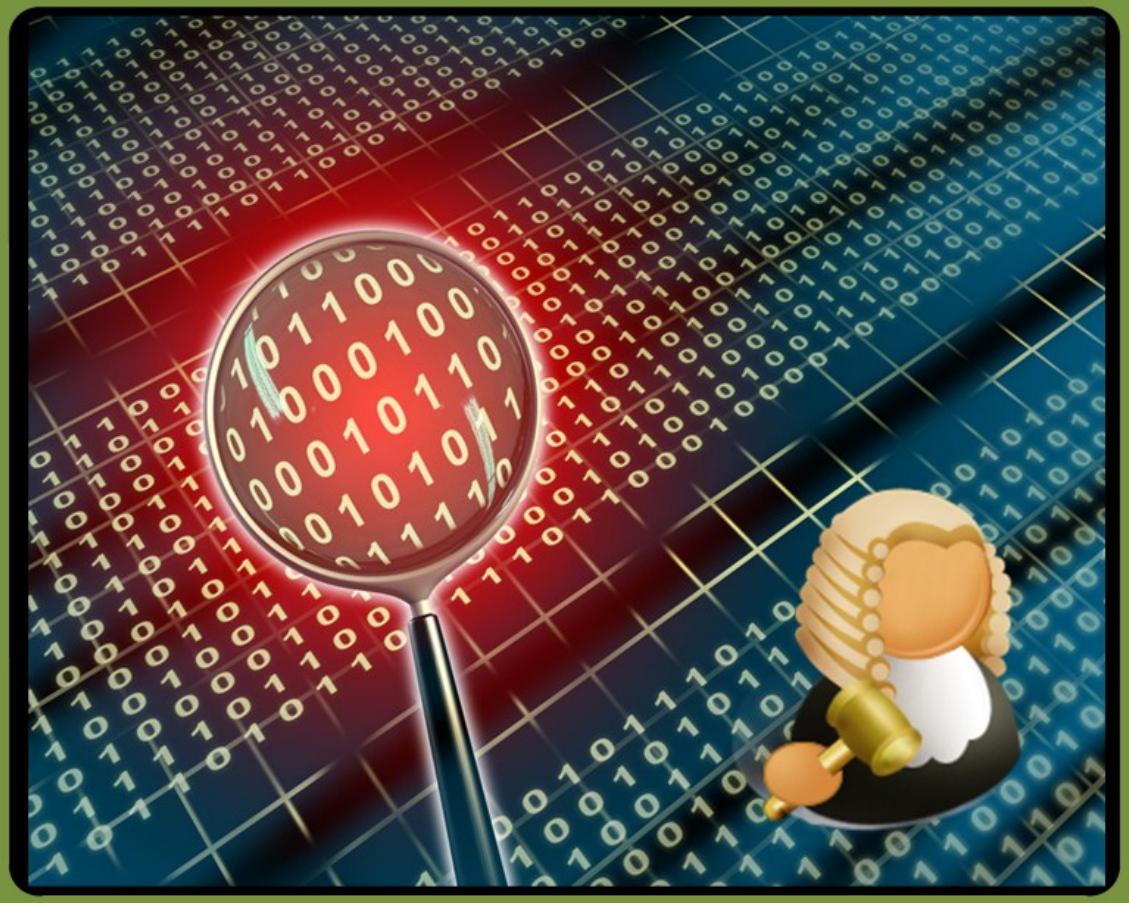




ICMP
Type: 0(Echo) Reply
Seq No: 17
Data:
abcdefghijklmnopqrstuvwxabcdefghi



Net Forensics



DNS

Author: Prof Bill Buchanan

DNS (UDP)

Flags:
- Response (Query)
- Opcode (Standard Query (0)
- Recursive lookup
- No non-authenticated..

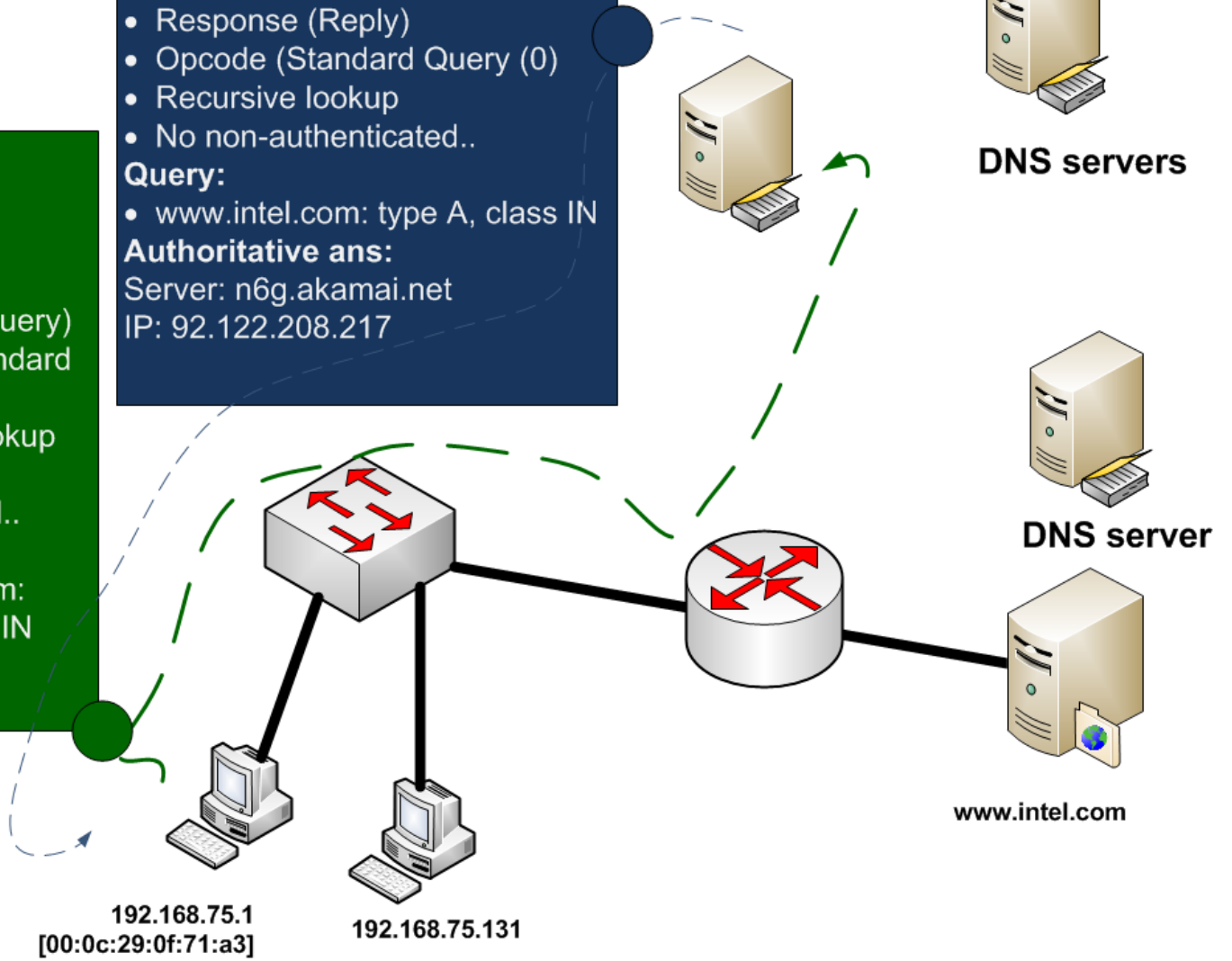
Query:
- www.intel.com: type A, class IN

DNS (UDP)

Flags:
- Response (Reply)
- Opcode (Standard Query (0)
- Recursive lookup
- No non-authenticated..

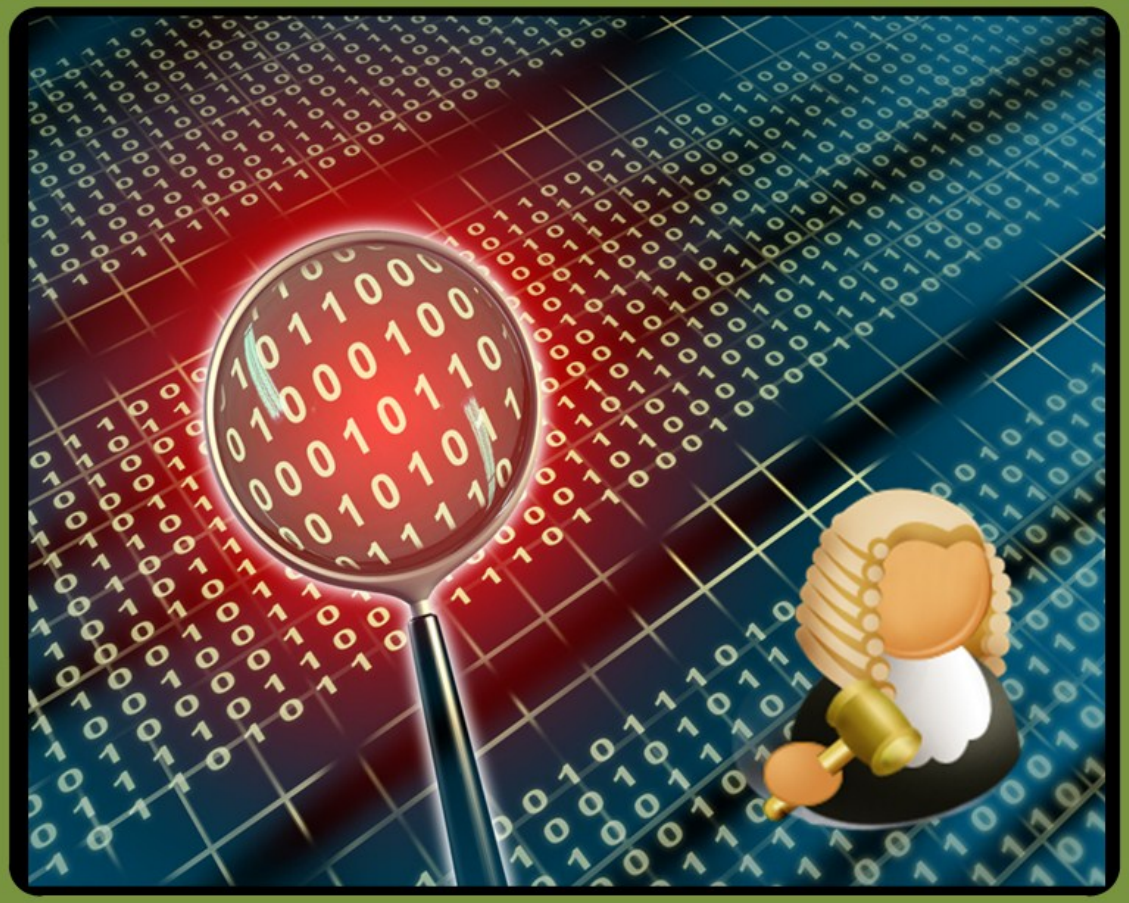
Query:
- www.intel.com: type A, class IN

Authoritative ans:
Server: n6g.akamai.net
IP: 92.122.208.217



Author: Prof Bill Buchanan

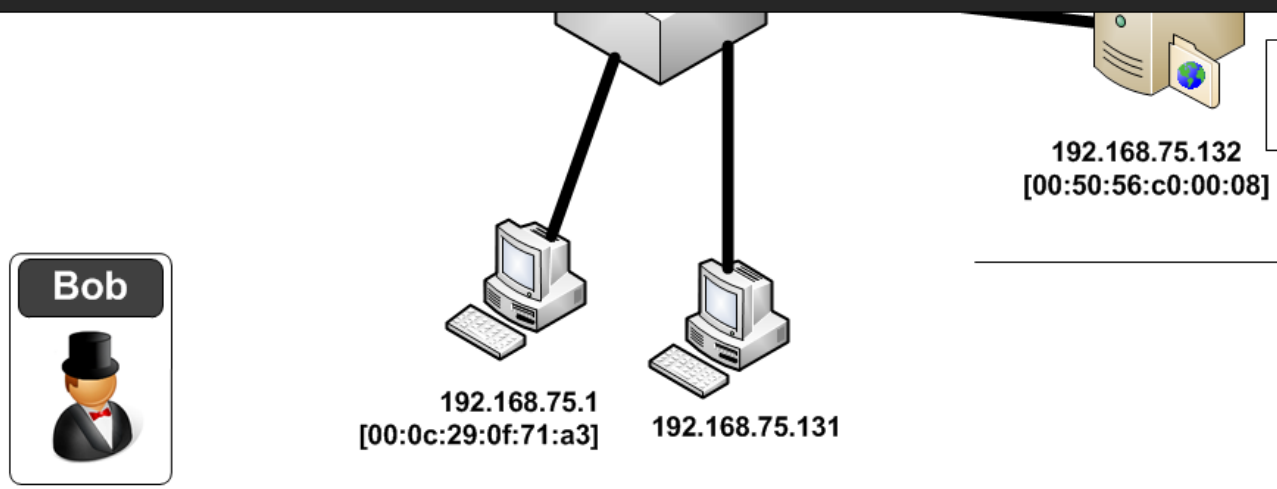
Net Forensics



Port Scan

Author: Prof Bill Buchanan

```
No.     Time        Source                Destination           Protocol Info
     85 25.420710   192.168.75.1          192.168.75.132        TCP      54370 > telnet
[SYN] Seq=0 Win=1024 Len=0 MSS=1460

Frame 85 (58 bytes on wire, 58 bytes captured)
Internet Protocol, Src: 192.168.75.1 (192.168.75.1), Dst: 192.168.75.132
(192.168.75.132)
Transmission Control Protocol, Src Port: 54370 (54370), Dst Port: telnet (23), Seq: 0,
Len: 0

No.     Time        Source                Destination           Protocol Info
     86 25.420836   192.168.75.1          192.168.75.132        TCP      54370 > rap
[SYN] Seq=0 Win=2048 Len=0 MSS=1460

Frame 86 (58 bytes on wire, 58 bytes captured)
Internet Protocol, Src: 192.168.75.1 (192.168.75.1), Dst: 192.168.75.132
(192.168.75.132)
Transmission Control Protocol, Src Port: 54370 (54370), Dst Port: rap (256), Seq: 0,
Len: 0
```



Scan tools: NMAP, hping, etc

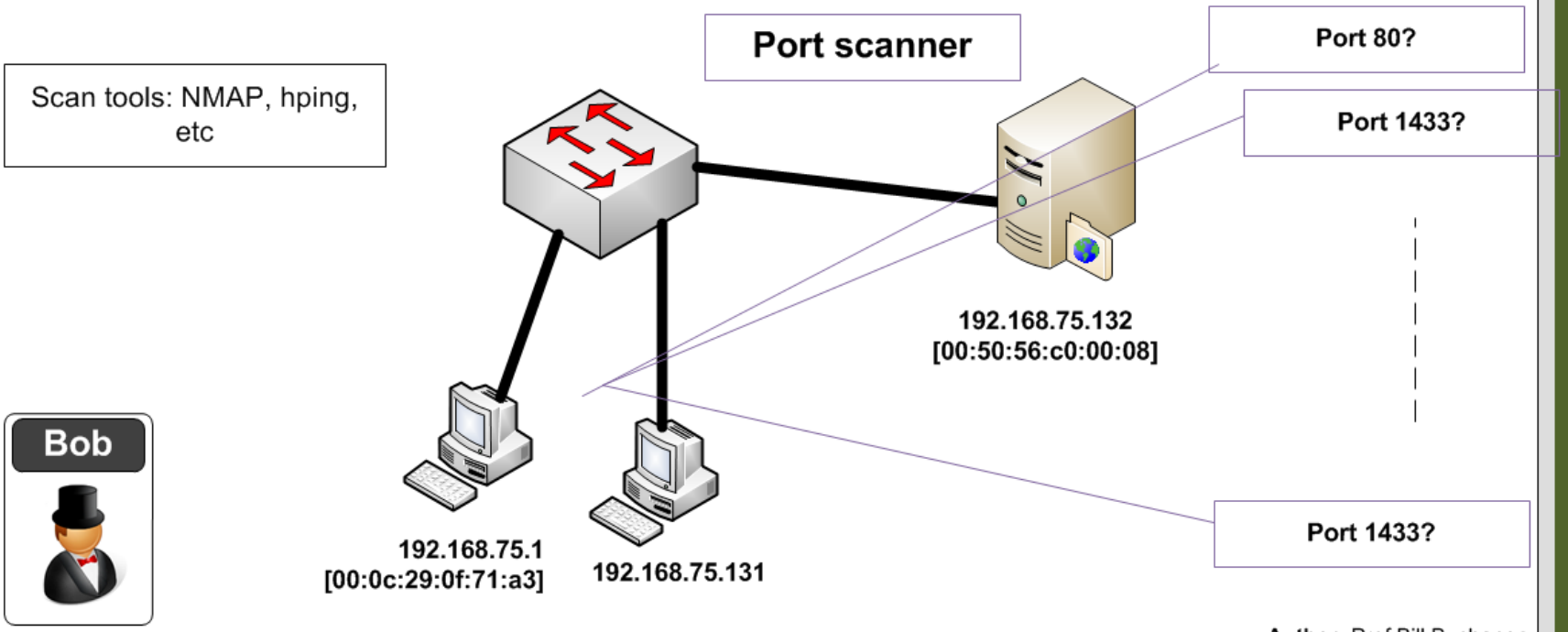
Net Forensics

Author: Prof Bill Buchanan

Port Scan

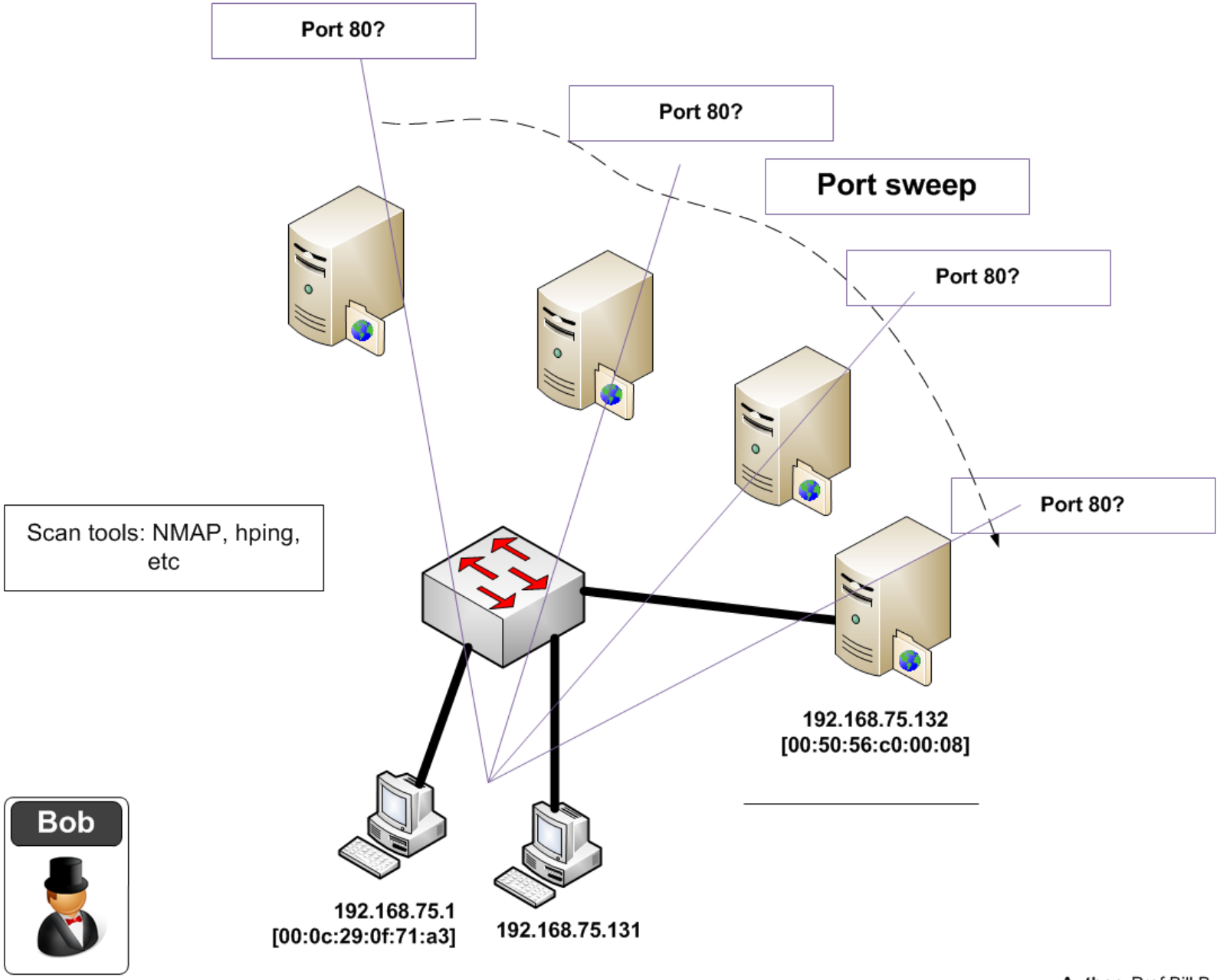
TCP Scan	SYN	SYN/ACK	ACK	FIN/ACK
SYN Scan	SYN	Creates half-open connections		
FIN Scan	FIN	Closed ports respond with a RST, but open ports ignore.		

Scan tools: NMAP, hping, etc



Author: Prof Bill Buchanan

Port scan



Author: Prof Bill Buchanan

Port sweep

Wireshark: 2149 Expert Infos

Errors: 0 Warnings: 0 Notes: 0 Chats: 2149 Severity filter: Error+Warn+Note+Chat

No.	Sever.	Group	Protocol	Summary
116	Chat	Sequence	TCP	Connection establish acknowledge (SYN+ACK): server port netbios-ssn
117	Chat	Sequence	TCP	Connection reset (RST)
118	Chat	Sequence	TCP	Connection establish acknowledge (SYN+ACK): server port ftp
119	Chat	Sequence	TCP	Connection reset (RST)
120	Chat	Sequence	TCP	Connection establish acknowledge (SYN+ACK): server port smtp
121	Chat	Sequence	TCP	Connection reset (RST)
122	Chat	Sequence	TCP	Connection reset (RST)
123	Chat	Sequence	TCP	Connection establish request (SYN): server port http
124	Chat	Sequence	TCP	Connection establish request (SYN): server port epmap
125	Chat	Sequence	TCP	Connection establish request (SYN): server port domain
126	Chat	Sequence	TCP	Connection establish request (SYN): server port h323hostcall
127	Chat	Sequence	TCP	Connection establish request (SYN): server port imap
128	Chat	Sequence	TCP	Connection establish request (SYN): server port pop3
129	Chat	Sequence	TCP	Connection establish request (SYN): server port ident
130	Chat	Sequence	TCP	Connection establish request (SYN): server port https
131	Chat	Sequence	TCP	Connection establish request (SYN): server port 65129
132	Chat	Sequence	TCP	Connection establish request (SYN): server port 1007
133	Chat	Sequence	TCP	Connection establish request (SYN): server port encrypted_admin
134	Chat	Sequence	TCP	Connection establish request (SYN): server port 8011
135	Chat	Sequence	TCP	Connection establish request (SYN): server port sbl
136	Chat	Sequence	TCP	Connection establish request (SYN): server port 3404
137	Chat	Sequence	TCP	Connection establish request (SYN): server port 49163
138	Chat	Sequence	TCP	Connection establish request (SYN): server port activesync
139	Chat	Sequence	TCP	Connection establish request (SYN): server port klogin
140	Chat	Sequence	TCP	Connection establish request (SYN): server port esro-gen
141	Chat	Sequence	TCP	Connection establish request (SYN): server port dnp
142	Chat	Sequence	TCP	Connection establish request (SYN): server port presence
143	Chat	Sequence	TCP	Connection establish request (SYN): server port 6129
144	Chat	Sequence	TCP	Connection establish request (SYN): server port ii-admin

Help Close

Endpoints: nmap.pcap

Ethernet: 4 | Fibre Channel | FDDI | IPv4: 5 | IPX | JXTA | NCP | RSVP | SCTP | TCP: 1003 | Token Ring | UDP: 9 | USB | WLAN

TCP Endpoints

Address	Port	Packets	Bytes	Tx Packets	Tx Bytes	Rx Packets	Rx Bytes
192.168.75.1	54370	1967	110518	1000	58000	967	52518
192.168.75.1	54371	166	9296	83	4814	83	4482
192.168.0.20	netbios-ssn	124	14756	76	7928	48	6828
192.168.75.132	sbl	33	3801	13	1761	20	2040
192.168.75.132	netarx	33	3801	13	1761	20	2040
192.168.75.132	danf-ak2	33	3801	13	1761	20	2040
192.168.75.132	afrog	33	3801	13	1761	20	2040
192.168.75.132	telnet	4	232	3	174	1	58
192.168.75.132	microsoft-ds	4	232	3	174	1	58
192.168.75.132	blackjack	4	232	3	174	1	58
192.168.75.132	ms-wbt-server	4	232	3	174	1	58
192.168.75.132	netbios-ssn	4	232	3	174	1	58
192.168.75.132	ftp	4	232	3	174	1	58
192.168.75.132	smtp	4	232	3	174	1	58
192.168.75.132	http	4	232	3	174	1	58
192.168.75.132	epmap	4	232	3	174	1	58
192.168.75.132	domain	4	232	3	174	1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58
						1	58

imit to display filter

Copy Close

Len :

2.168.75.2 192.168.0.20 Comment

25.461	(22)	ssh > 54370 [RST, A	(54370)
25.461	(3389)	ms-wbt-server > 543	(54370)
25.461	(139)	netbios-ssn > 54370	(54370)
25.461	(111)	sunrpc > 54370 [RST	(54370)
25.462	(21)	ftp > 54370 [SYN, A	(54370)
25.462	(5900)	vnc-server > 54370	(54370)
25.462	(25)	smtp > 54370 [SYN,	(54370)
25.462	(8080)	http-alt > 54370 [R	(54370)
25.462	(587)	submission > 54370	(54370)
25.463	(80)	54370 > http [SYN]	(54370)
25.463	(135)	54370 > epmap [SYN]	(54370)
25.463	(53)	54370 > domain [SYN	(54370)
25.463	(1720)	54370 > h323hostcal	(54370)
25.463	(143)	54370 > imap [SYN]	(54370)
25.463	(110)	54370 > pop3 [SYN]	(54370)
25.463	(113)	54370 > ident [SYN]	(54370)
25.463	(443)	54370 > https [SYN]	(54370)

TCP: ssh > 54370 [RST, ACK] Seq=1 Ack=1 W
TCP: ms-wbt-server > 54370 [SYN, ACK] Seq=
TCP: netbios-ssn > 54370 [SYN, ACK] Seq=0 A
TCP: sunrpc > 54370 [RST, ACK] Seq=1 Ack=1
TCP: ftp > 54370 [SYN, ACK] Seq=0 Ack=1 Wi
TCP: vnc-server > 54370 [RST, ACK] Seq=1 A
TCP: smtp > 54370 [SYN, ACK] Seq=0 Ack=1
TCP: http-alt > 54370 [RST, ACK] Seq=1 Ack=1
TCP: submission > 54370 [RST, ACK] Seq=1 A
TCP: 54370 > http [SYN] Seq=0 Win=4096 Len
TCP: 54370 > epmap [SYN] Seq=0 Win=2048 L
TCP: 54370 > domain [SYN] Seq=0 Win=1024 L
TCP: 54370 > h323hostcall [SYN] Seq=0 Win=2
TCP: 54370 > imap [SYN] Seq=0 Win=3072 Le
TCP: 54370 > pop3 [SYN] Seq=0 Win=1024 Le
TCP: 54370 > ident [SYN] Seq=0 Win=4096 Le
TCP: 54370 > https [SYN] Seq=0 Win=2048 Le

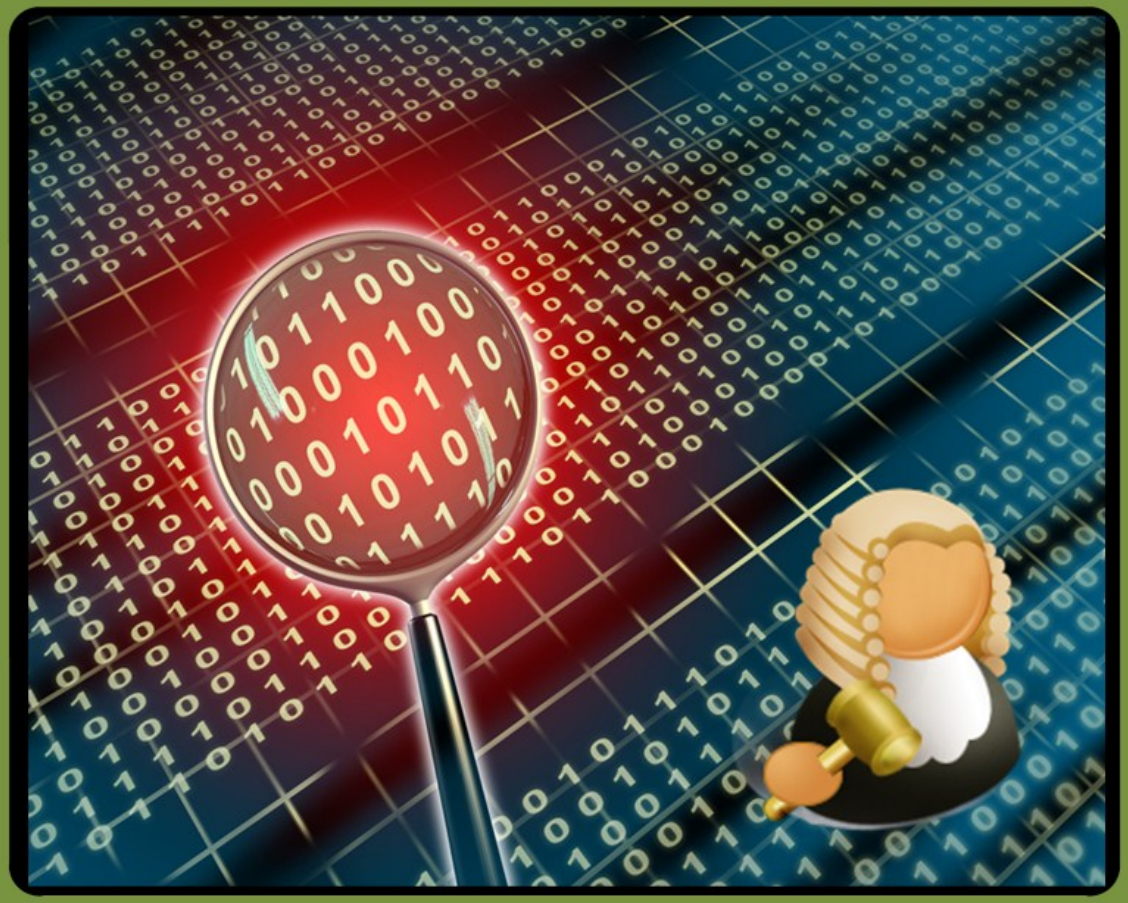
Save As Close

Net Forensics

Author: Prof Bill Buchanan

Port Scan

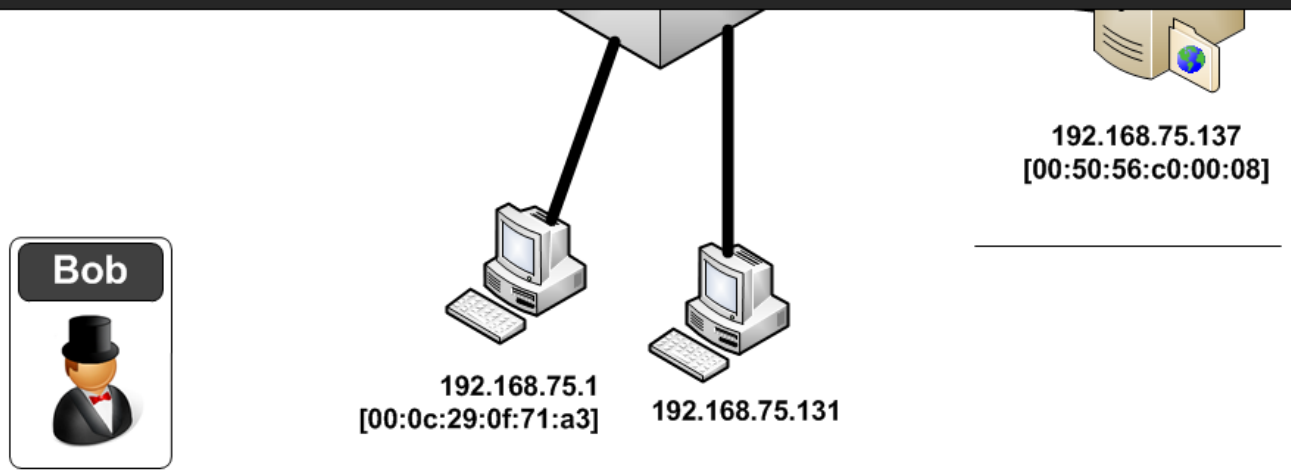
Net Forensics



SYN FLOOD

Author: Prof Bill Buchanan

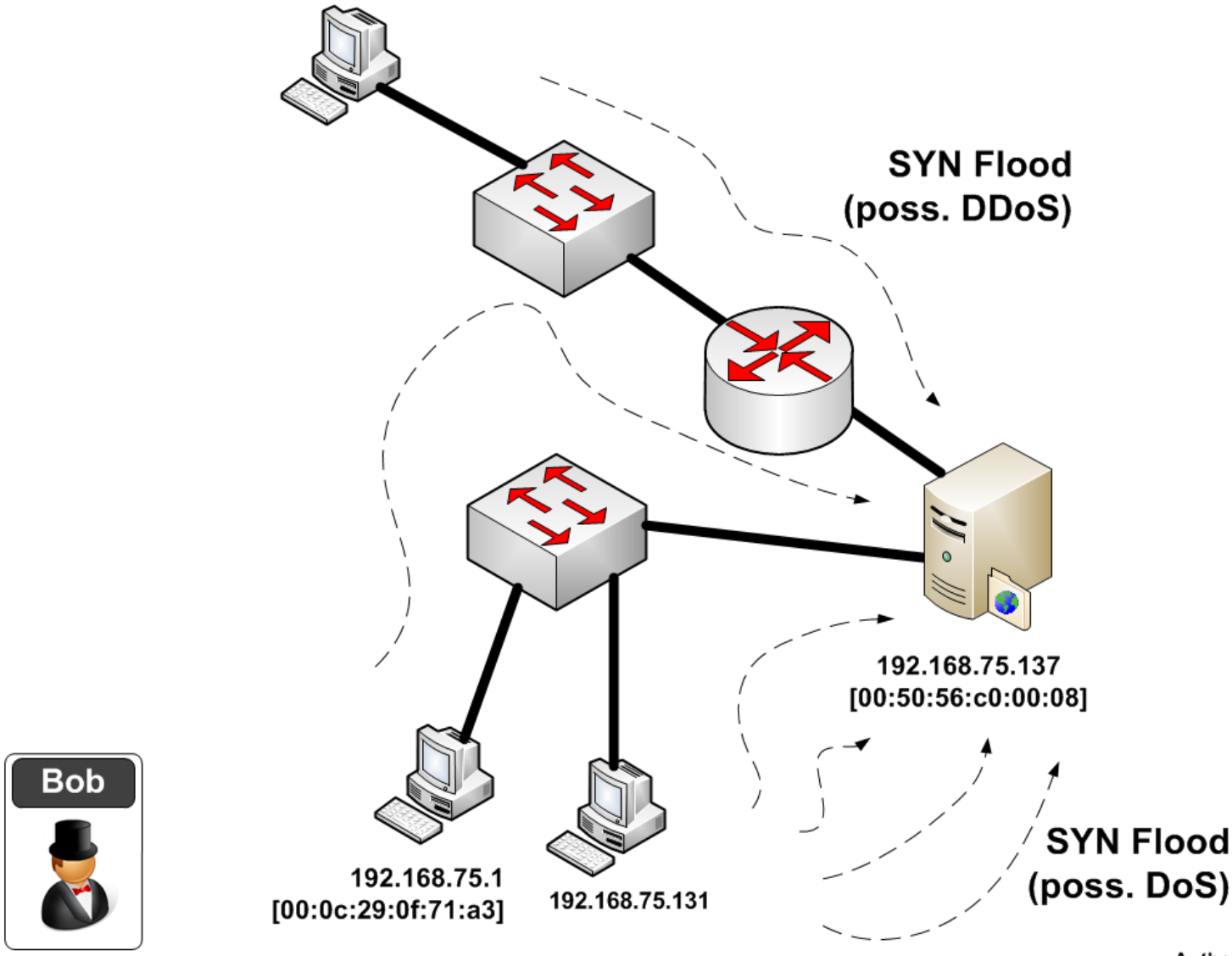
```
No.     Time        Source                Destination           Protocol Info
      2 4.510329    192.168.75.137        192.168.75.1          HTTP     Continuation
or non-HTTP traffic

Frame 2 (58 bytes on wire, 58 bytes captured)
Internet Protocol, Src: 192.168.75.137 (192.168.75.137), Dst: 192.168.75.1
(192.168.75.1)
Transmission Control Protocol, Src Port: smart-lm (1608), Dst Port: http (80), Seq: 0,
Len: 4
Hypertext Transfer Protocol

No.     Time        Source                Destination           Protocol Info
      3 5.514164    192.168.75.137        192.168.75.1          HTTP     Continuation
or non-HTTP traffic

Frame 3 (58 bytes on wire, 58 bytes captured)
Internet Protocol, Src: 192.168.75.137 (192.168.75.137), Dst: 192.168.75.1
(192.168.75.1)
Transmission Control Protocol, Src Port: isysg-lm (1609), Dst Port: http (80), Seq: 0,
Len: 4
Hypertext Transfer Protocol
```



Net Forensics

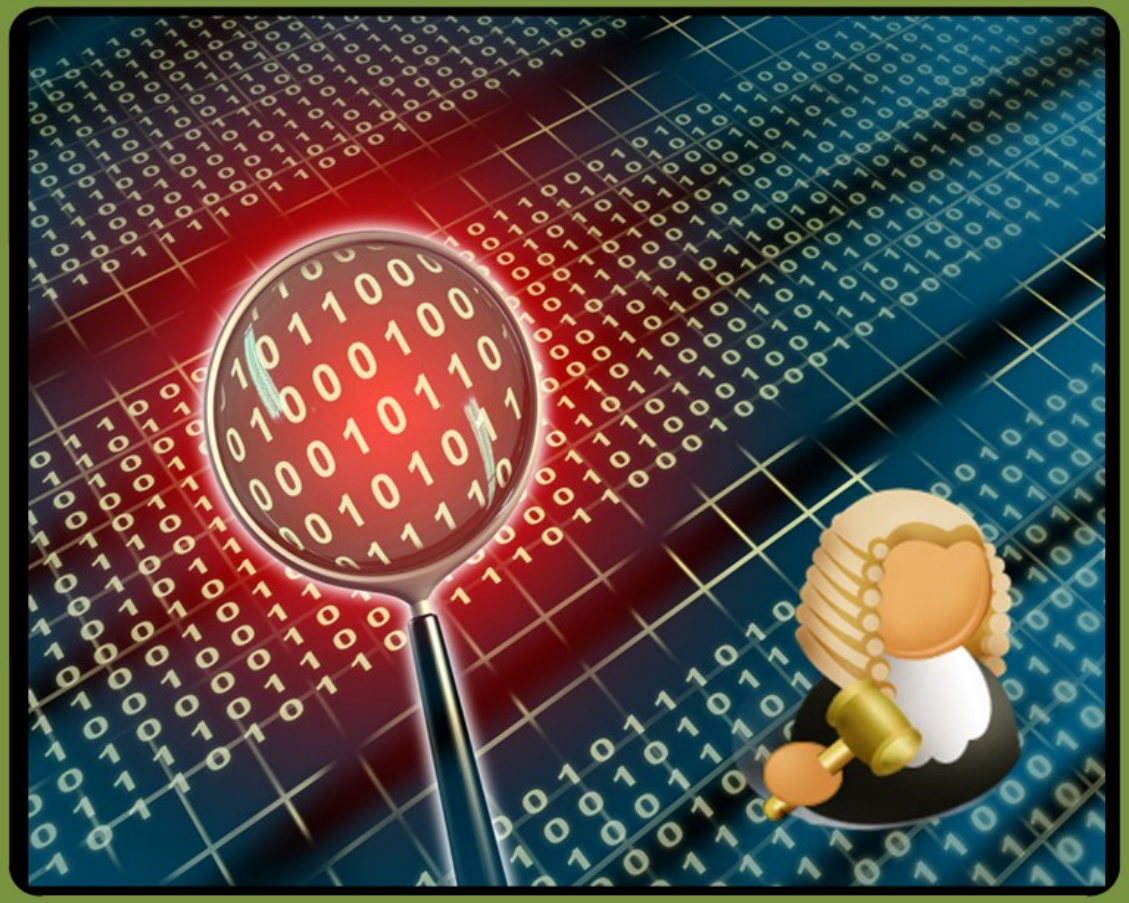
Author: Prof Bill Buchanan

SYN Flood



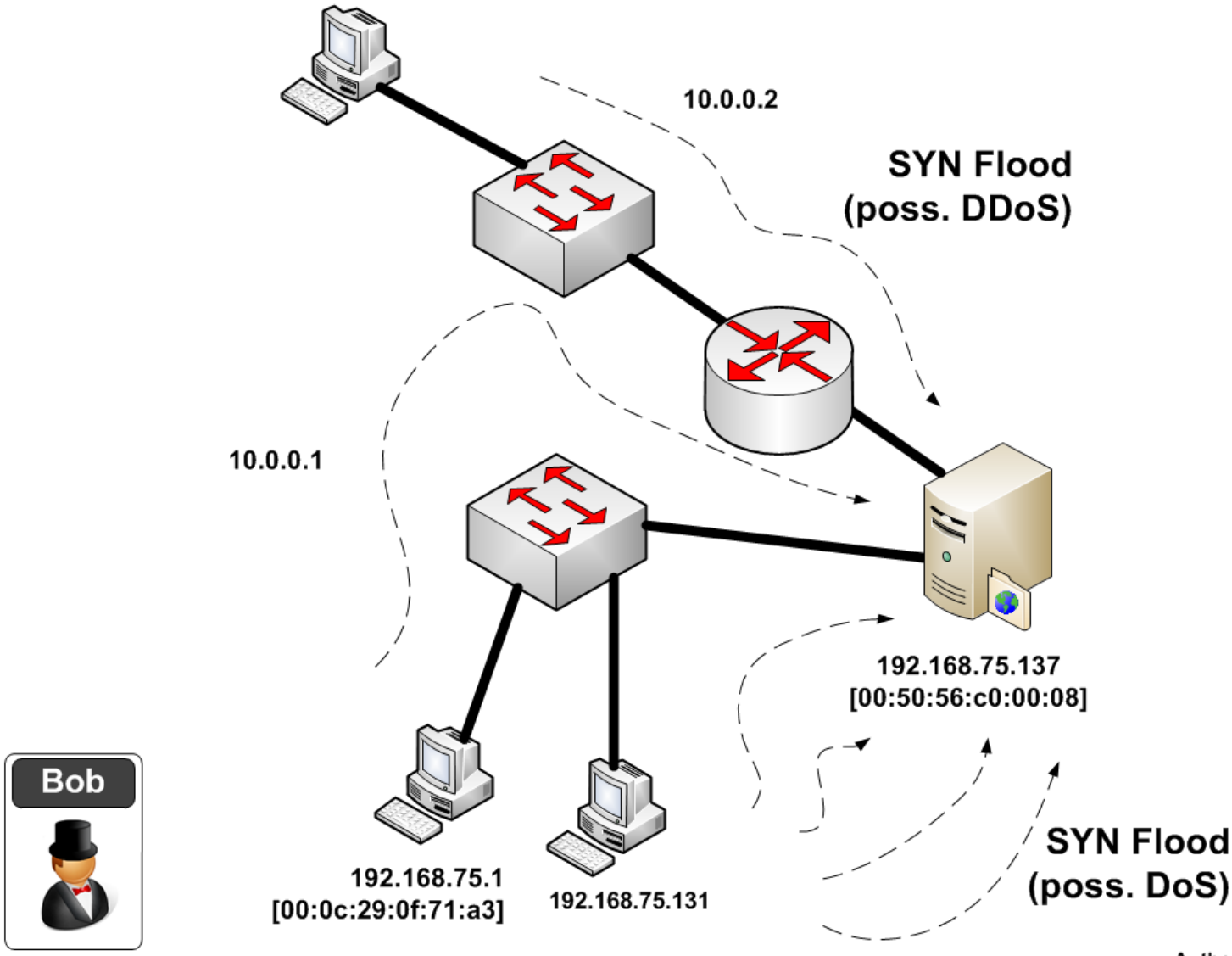
Author: Prof Bill Buchanan

Net Forensics



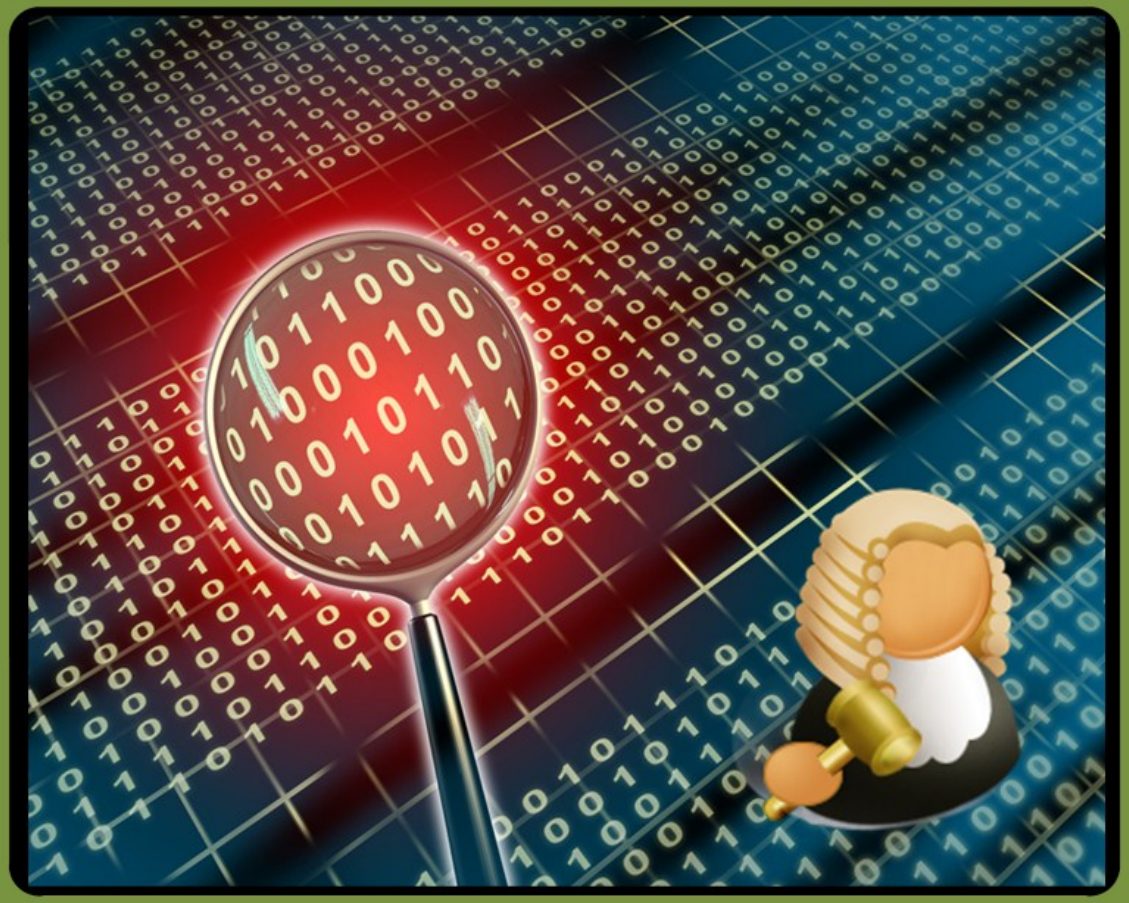
SPOOFED ADDRESSES

Author: Prof Bill Buchanan



Author: Prof Bill Buchanan

Net Forensics



Application Protocol

Author: Prof Bill Buchanan

```
GET / HTTP/1.1
User-Agent: Opera/9.80 (Windows NT 6.0; U; en) Presto/
2.2.15 Version/10.01
Host: 192.168.75.132
Accept: text/html, application/xml;q=0.9, application/
xhtml+xml, image/png, image/jpeg, image/gif, image/x-
xbitmap, */*;q=0.1 Accept-Language: en-GB,en;q=0.9
Accept-Charset: iso-8859-1, utf-8, utf-16, *;q=0.1
Accept-Encoding: deflate, gzip, x-gzip, identity, *;q=0
Connection: Keep-Alive…
```

```
HTTP/1.1 200 OK
Content-Length: 2606
Content-Type: text/html
Content-Location: http://192.168.75.132/iisstart.htm
Last-Modified: Sun, 13 Dec 2009 15:16:14 GMT
Accept-Ranges: bytes ETag: "fc31243677cca1:745" Server: Microsoft-IIS/
6.0 X-Powered-By: ASP.NET
Date: Sat, 02 Jan 2010 22:33:01 GMT
<HTML> <HEAD> <TITLE>SFC  (Final Test)</TITLE> <META http-equiv=Content-
Type content="text/html; charset=iso-8859-1"> <LINK href="2.css"
type=text/css rel=stylesheet> <style type="text/css"> …
```

192.168.75.1
[00:0c:29:0f:71:a3]

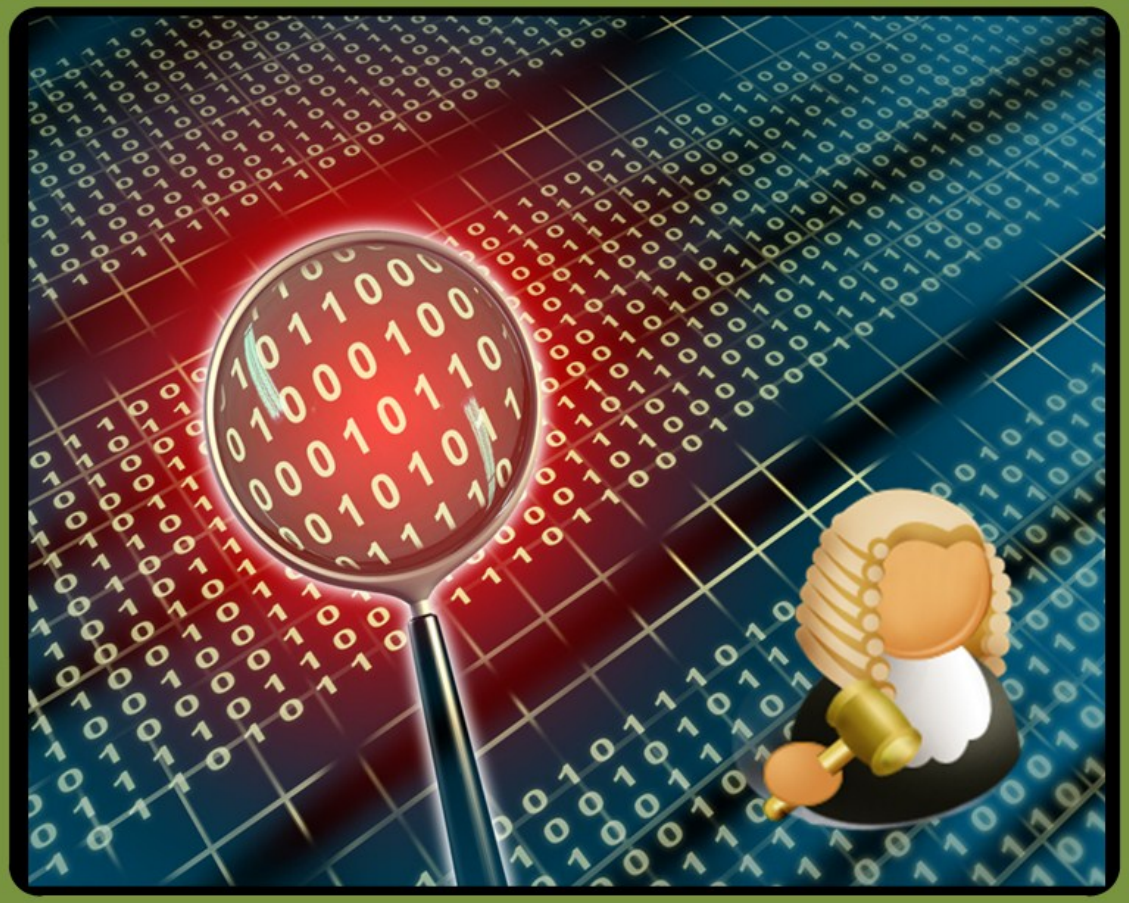
192.168.75.131

HTTP

Net Forensics

Author: Prof Bill Buchanan

Net Forensics



Tripwire

Author: Prof Bill Buchanan

+ Windows

+ System32

wmp.dll
ieframe.dll
shell32.dll
NlsLexicons0001.dll
NlsLexicons0007.dll
imageres.dll

Audit log

Author: Prof Bill Buchanan

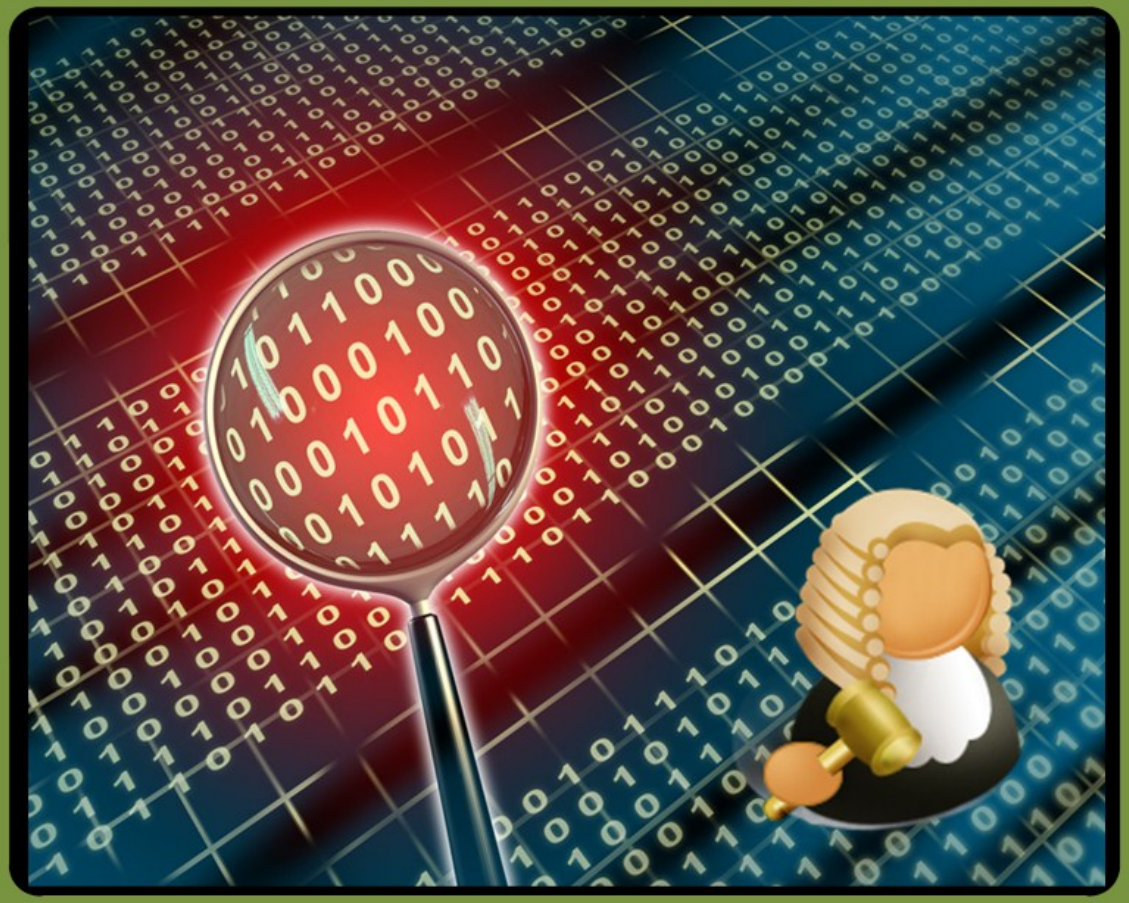
Start of demo

Author: Prof Bill Buchanan

End of demo

Author: Prof Bill Buchanan

Net Forensics



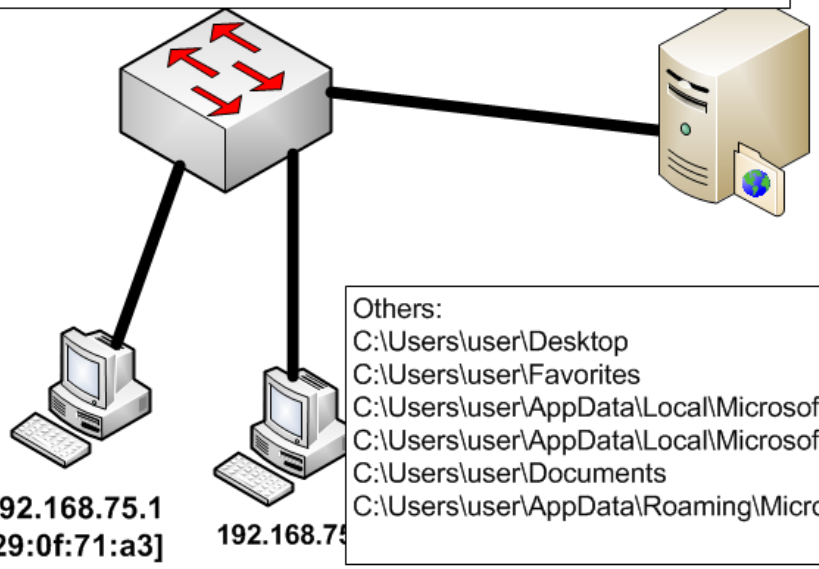
Host trace

Author: Prof Bill Buchanan

Recent Files
C:\Users\user\AppData\Roaming\Microsoft\Windows\Recent

Cookies
C:\Users\user\AppData\Roaming\Microsoft\Windows\Cookies

Explorer History
C:\Users\user\AppData\Local\Microsoft\Windows\History
C:\Users\user\AppData\Local\Microsoft\Windows\Temporary Internet Files



Others:
C:\Users\user\Desktop
C:\Users\user\Favorites
C:\Users\user\AppData\Local\Microsoft\Windows\History
C:\Users\user\AppData\Local\Microsoft\Windows\Temporary Internet Files
C:\Users\user\Documents
C:\Users\user\AppData\Roaming\Microsoft\Windows\Start Menu

Author: Prof Bill Buchanan

Network Forensics

- Understand some of the methodologies used in network forensics.
- Provide an in-depth understanding of the key network protocols, including IP, TCP, ARP, ICMP, DNS, Application Layer protocols, and so on.
- Define a range of audit sources for network activity.

Author: Prof Bill Buchanan