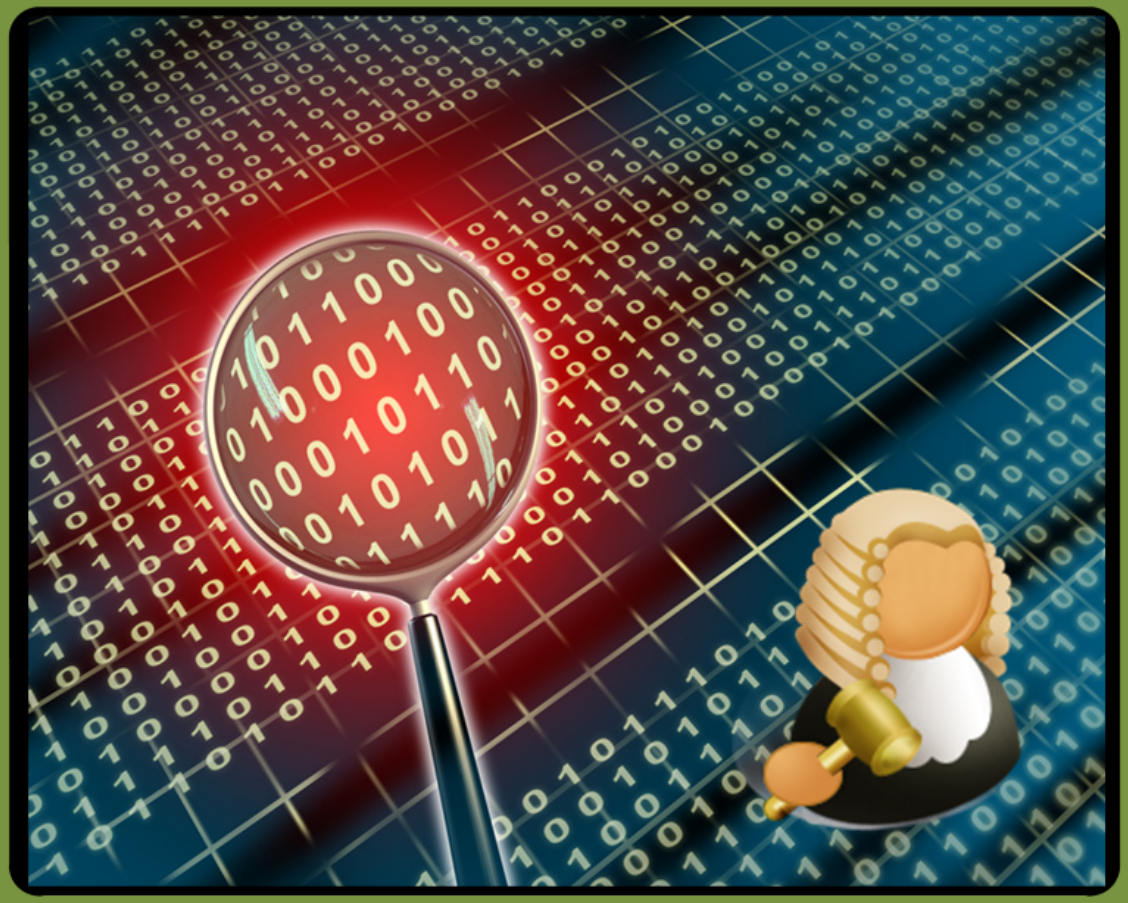
Network Forensics

- 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.

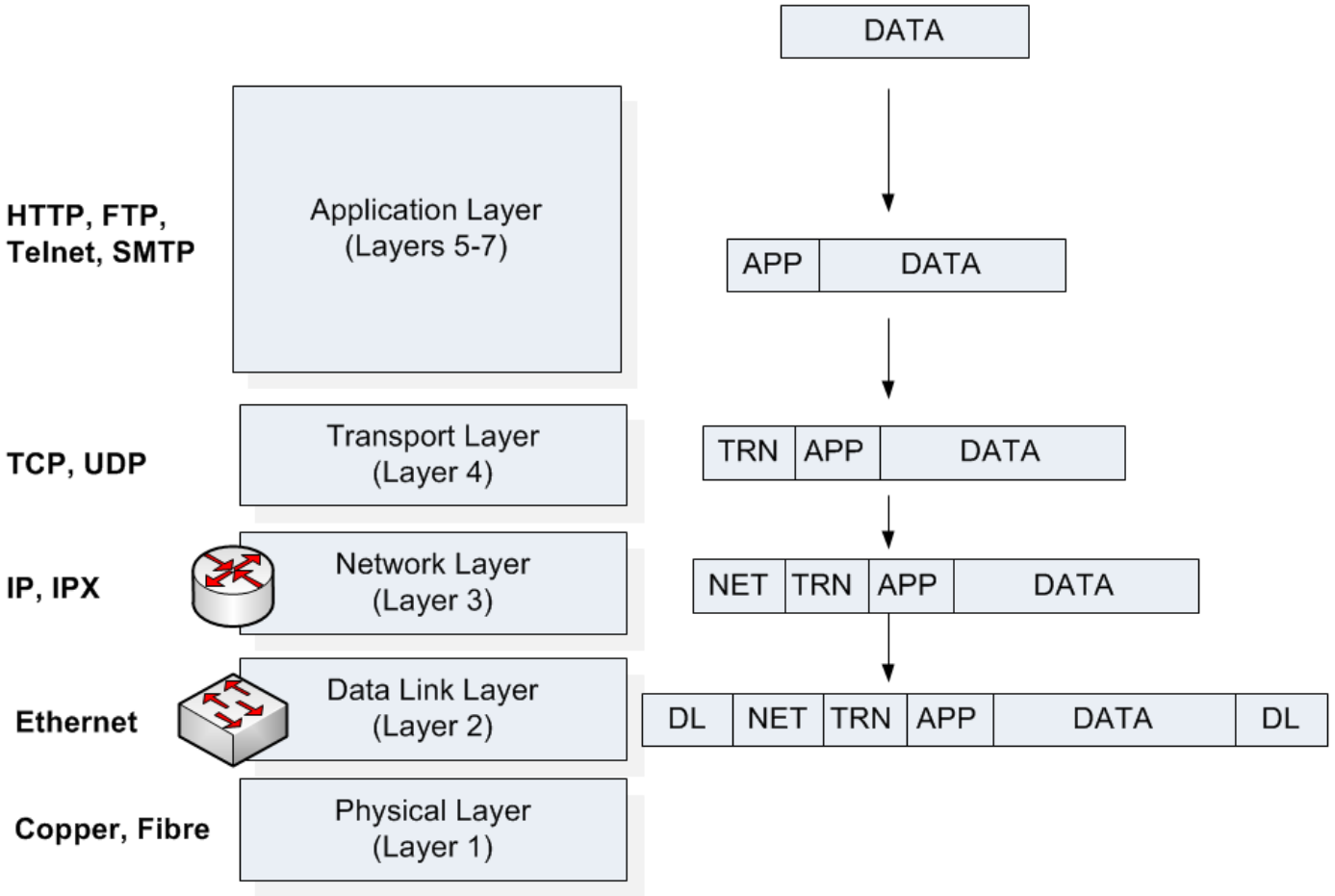
Author: Prof Bill Buchanan

Network Forensics

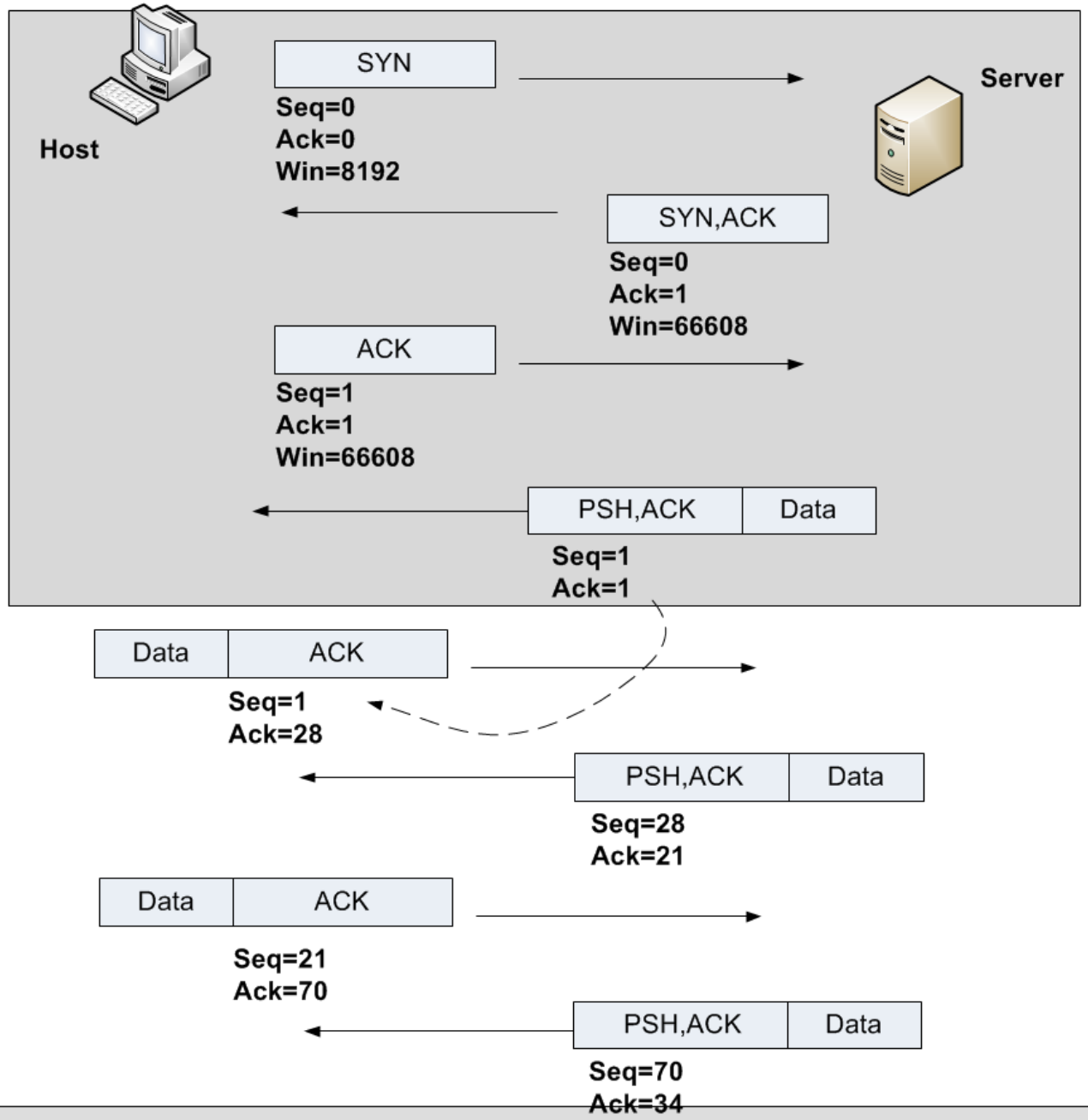


Ethernet, IP and TCP

Author: Prof Bill Buchanan



Author: Prof Bill Buchanan



Author: Prof Bill Buchanan

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		

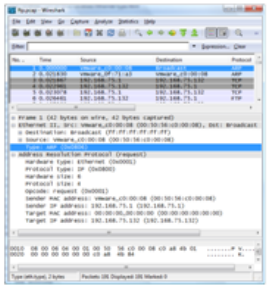
TCP header

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)

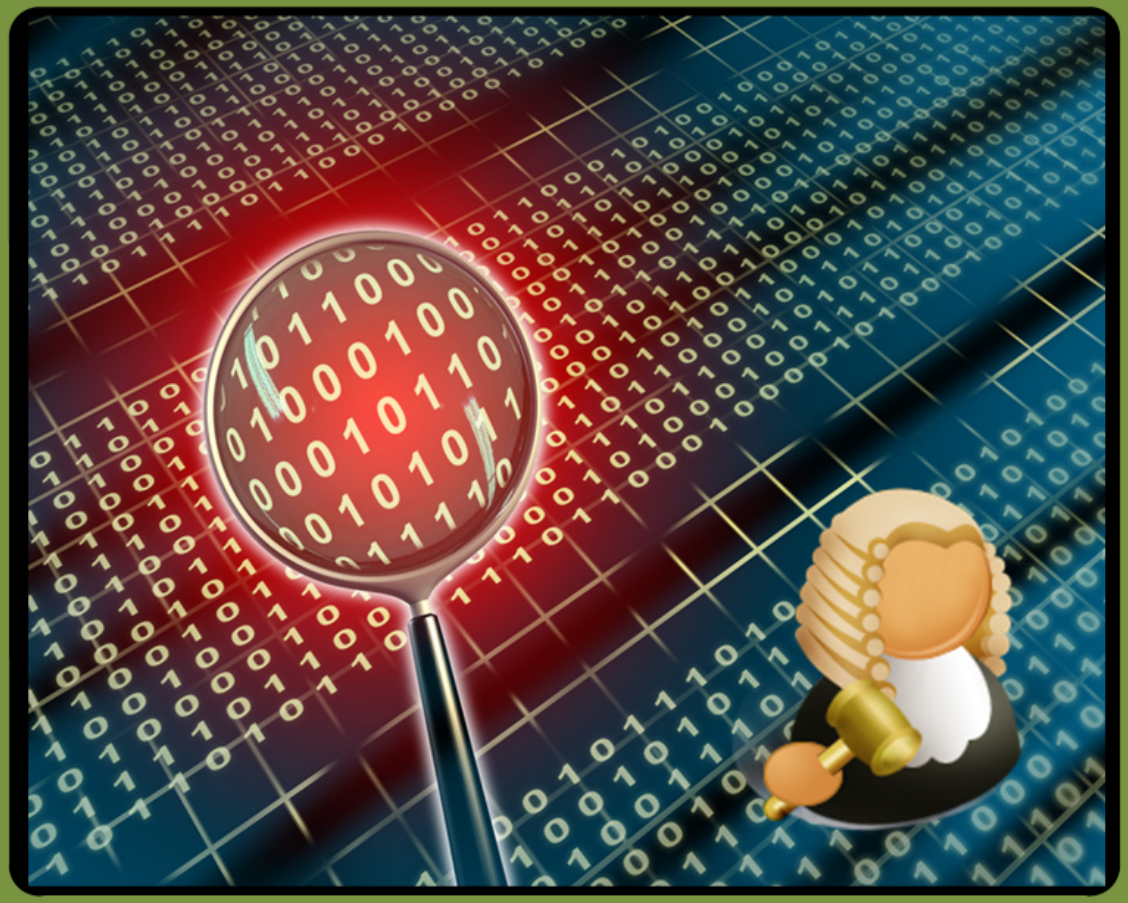
Type:
0x800 – IP
0x806 – ARP

Ethernet frame



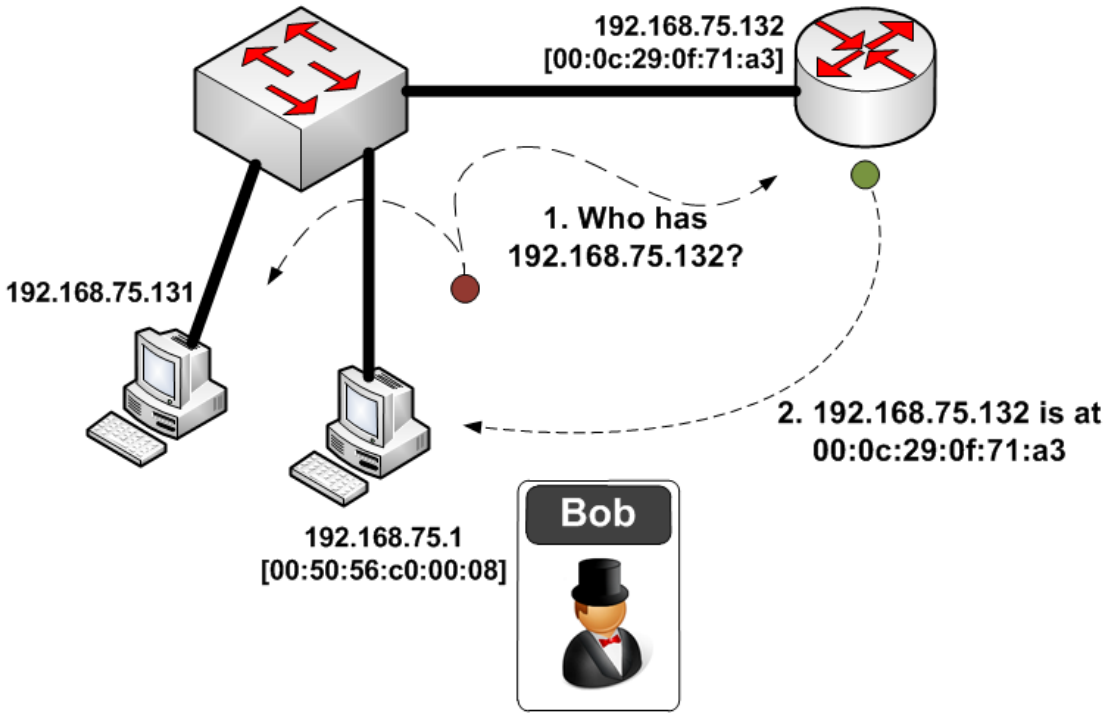
Author: Prof Bill Buchanan

Network Forensics



ARP

Author: Prof Bill Buchanan

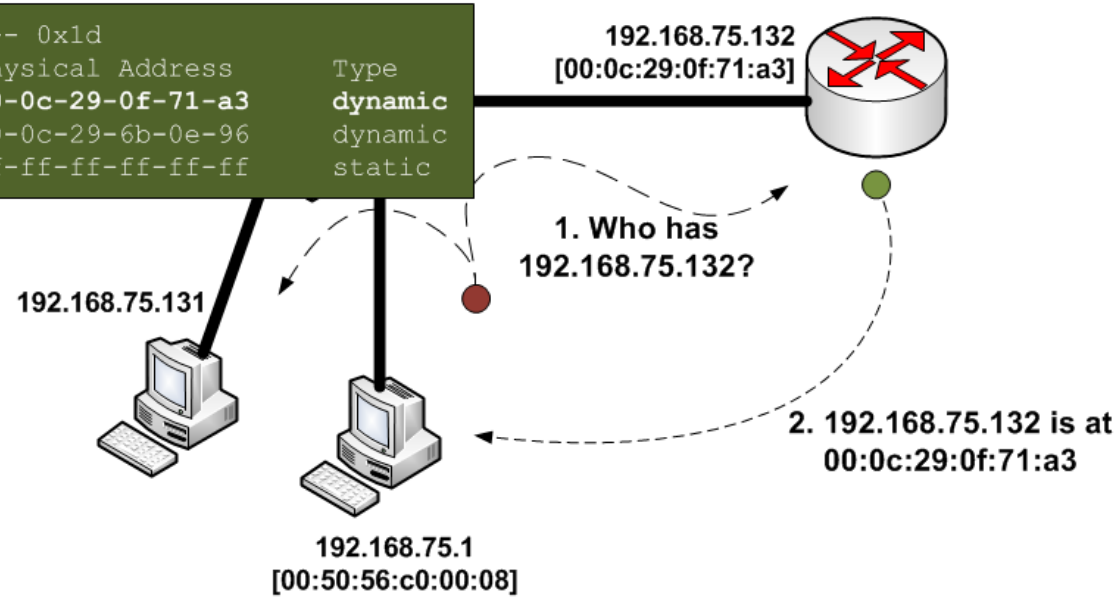


Author: Prof Bill Buchanan

```
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
```



ARP

```
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)
```

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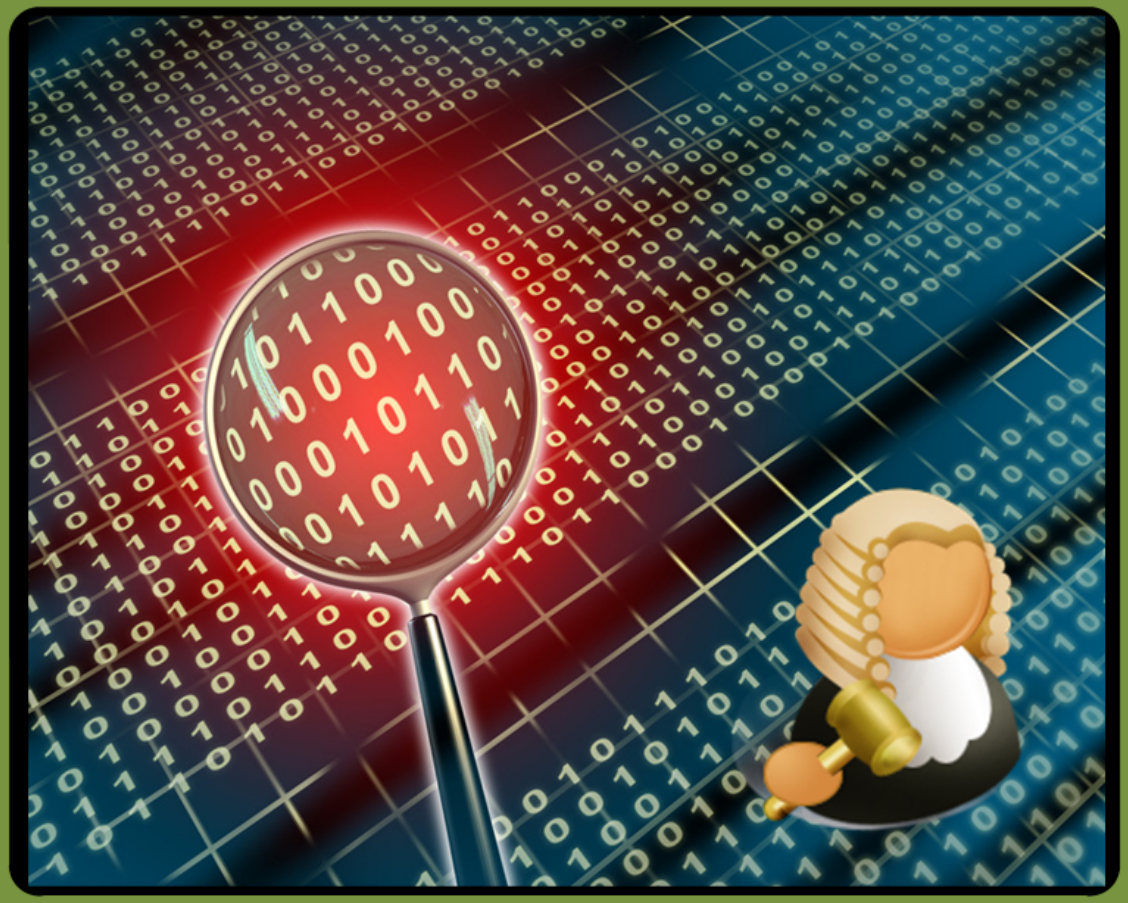
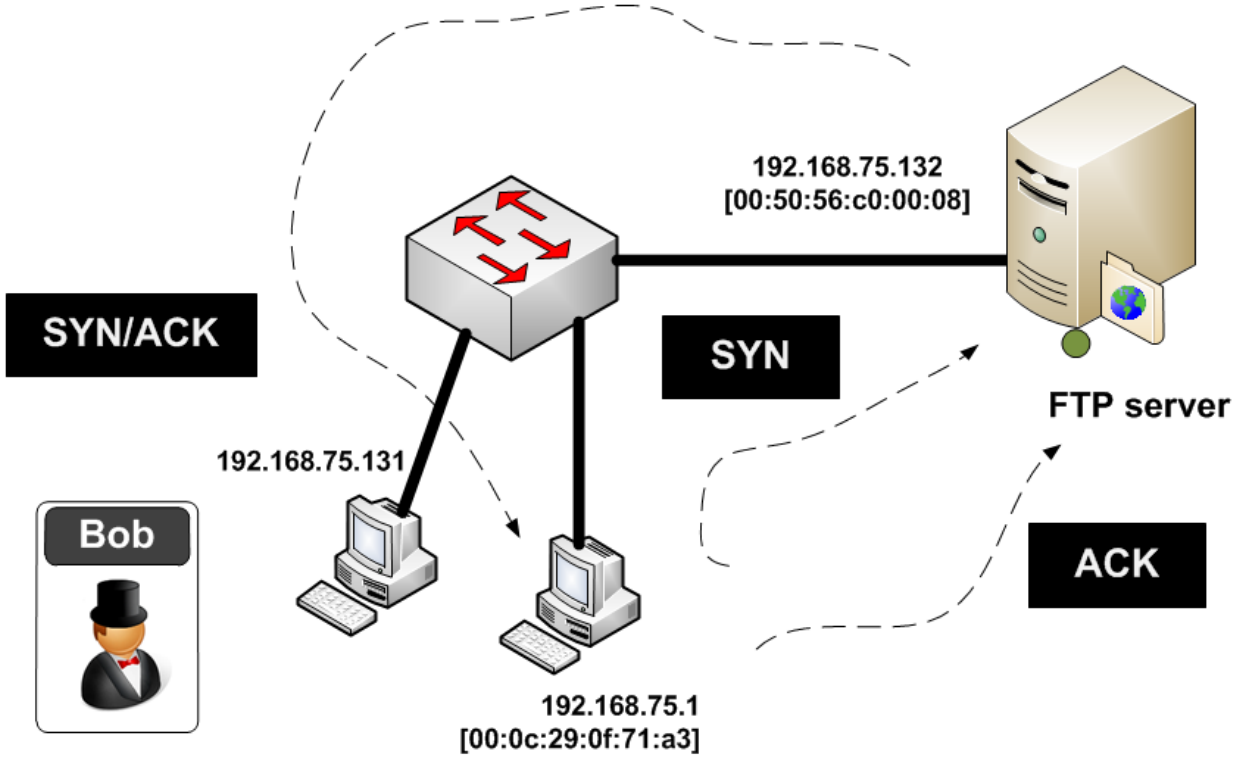
Network Forensics



SYN

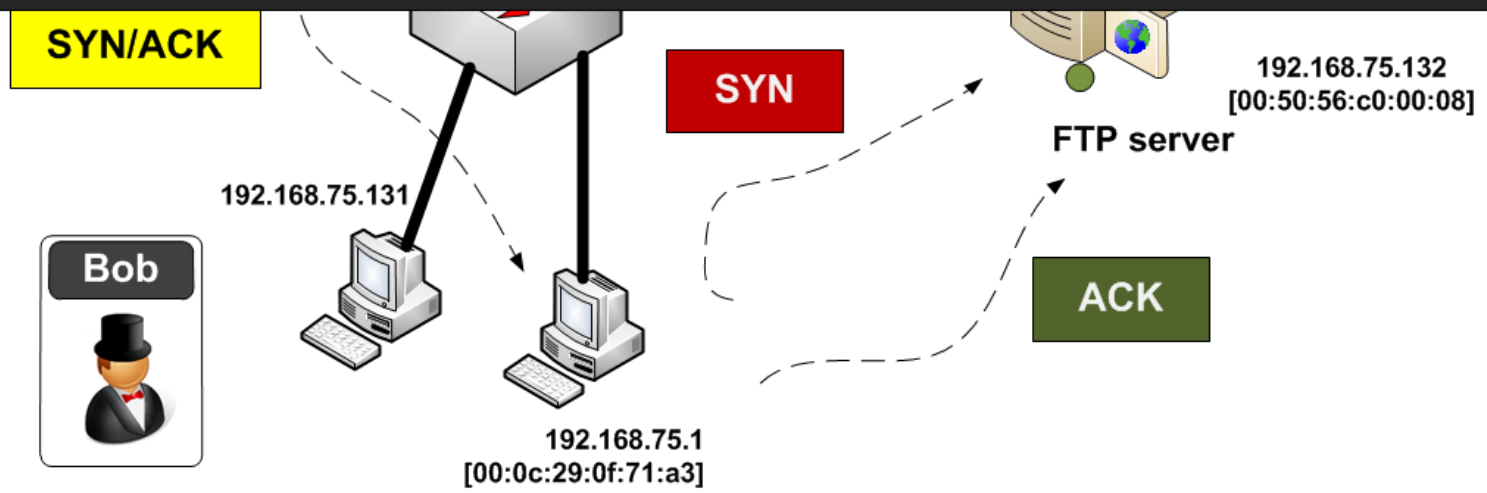
Author: Prof Bill Buchanan

SYN



Author: Prof Bill Buchanan

```
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
```

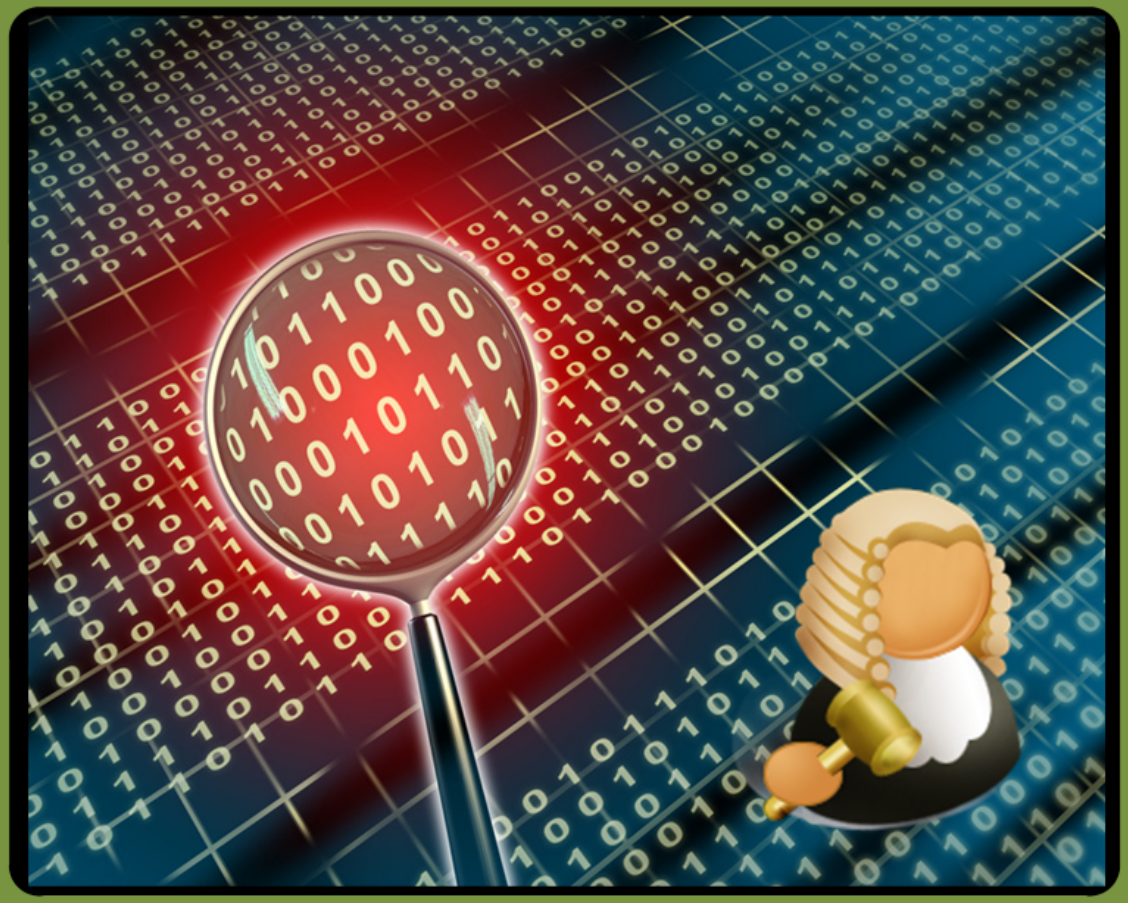


SYN

Net Forensics

Author: Prof Bill Buchanan

Net Forensics



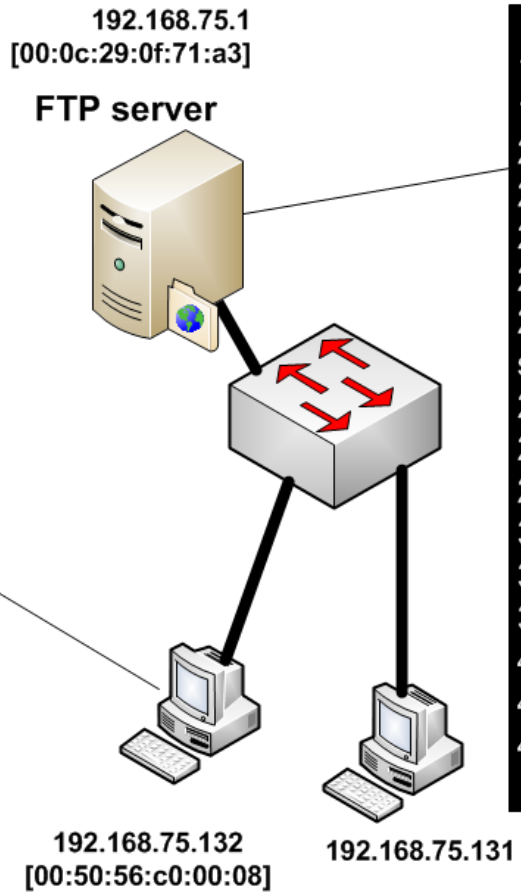
Application Protocol (FTP)

Author: Prof Bill Buchanan

FTP

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.

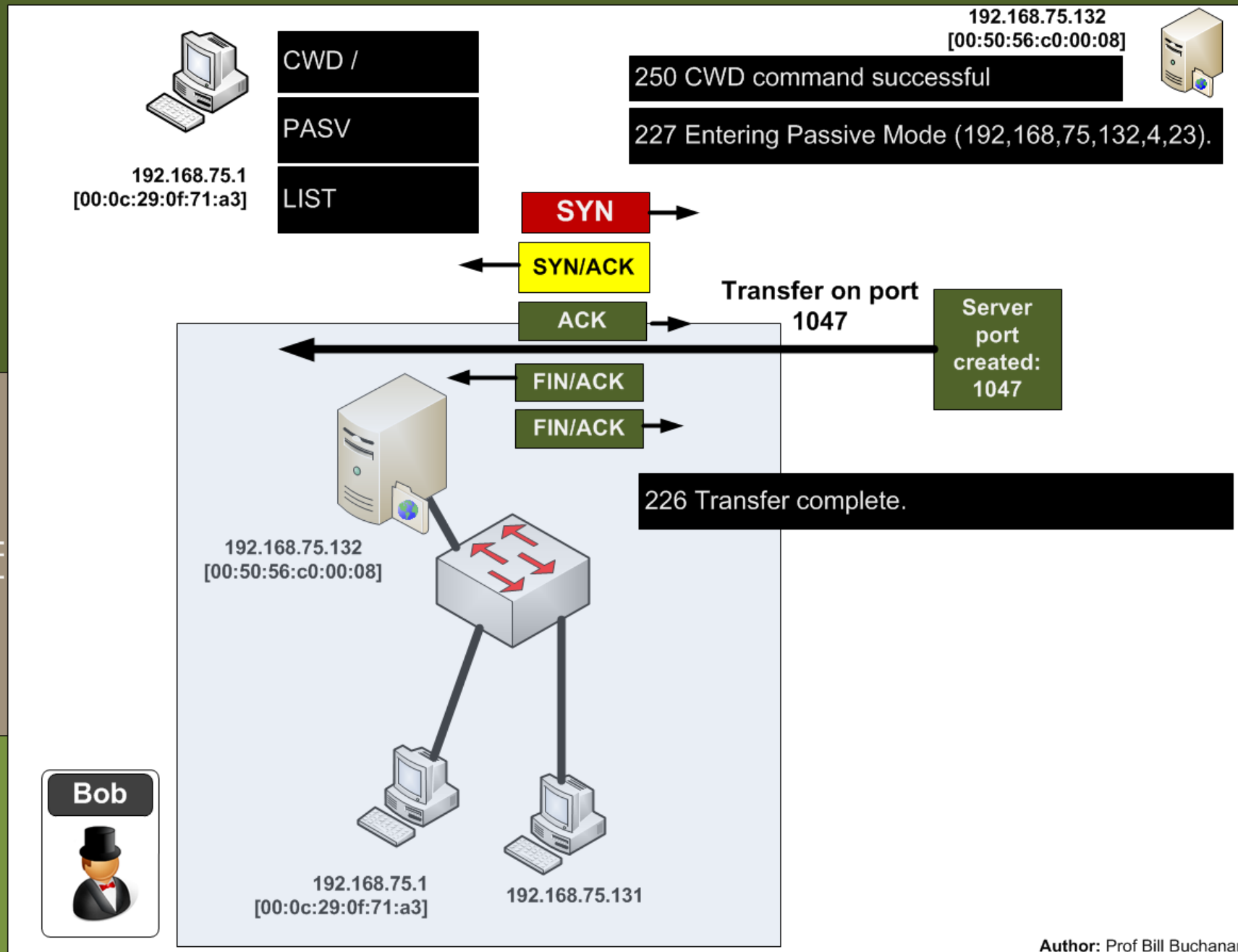
Author: Prof Bill Buchanan

	220 Microsoft FTP Service
USER Administrator	331 Password required for Administrator.
PASS napier	230 User Administrator logged in.
SYST	215 Windows_NT
PWD	257 "/" is current directory.
PASV	227 Entering Passive Mode (192,168,75,132,4,22).
LIST	125 Data connection already open; Transfer starting. 226 Transfer complete.
CWD /	250 CWD command successful.
PASV	227 Entering Passive Mode (192,168,75,132,4,23).
TYPE A	125 Data connection already open; Transfer starting. 226 Transfer complete.
PASV	257 "/" is current directory.
STOR db1.csv	200 Type set to A.
	227 Entering Passive Mode (192,168,75,132,4,24).
	125 Data connection already open; Transfer starting. 226 Transfer complete.

FTP

Net Forensics

FTP commands and responses


192.168.75.132
[00:50:56:c0:00:08]
CWD /
PASV
LIST
250 CWD command successful
227 Entering Passive Mode (192,168,75,132,4,23).
192.168.75.1
[00:0c:29:0f:71:a3]
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
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Author: Prof Bill Buchanan

Passive FTP

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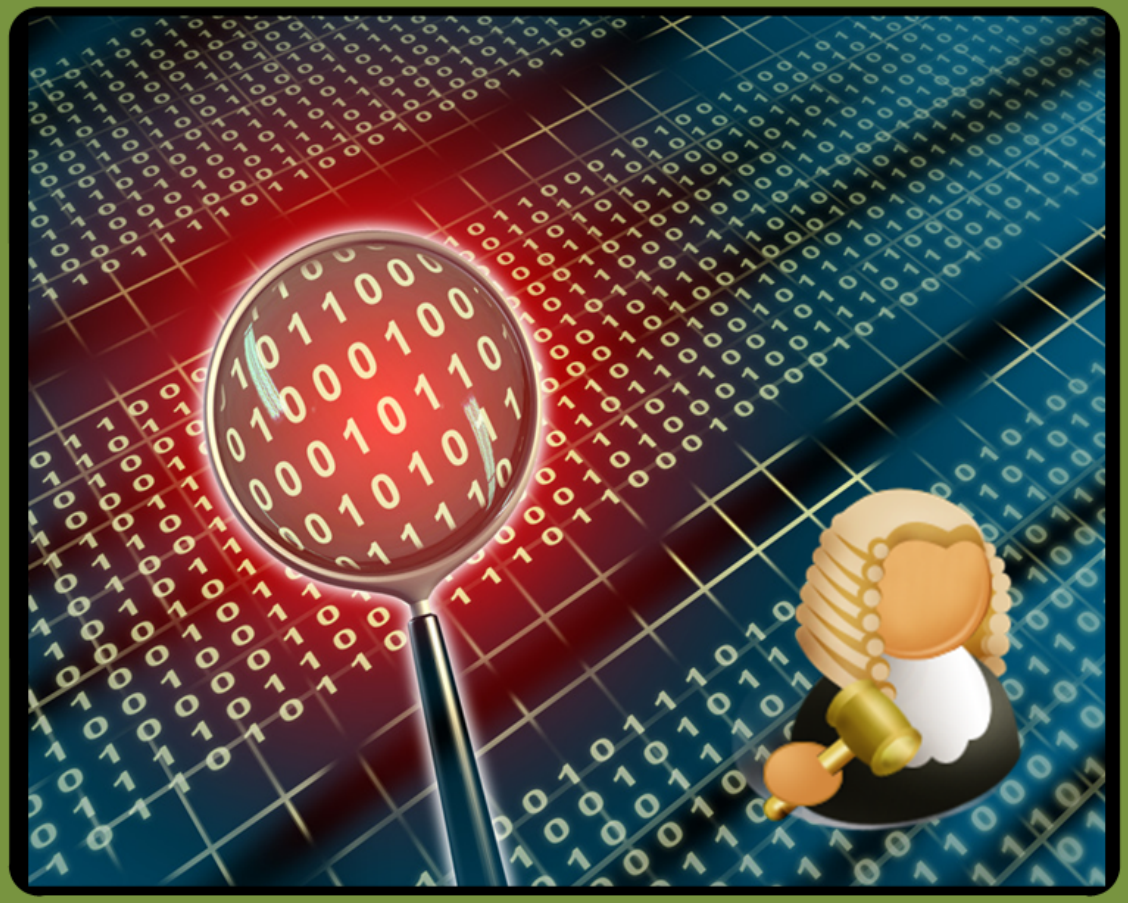
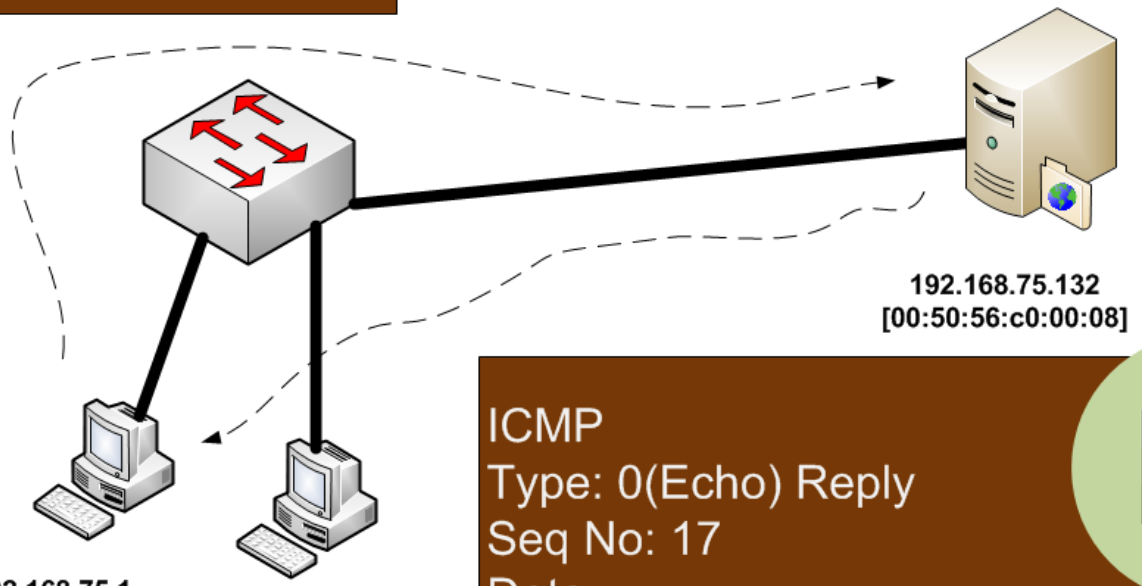


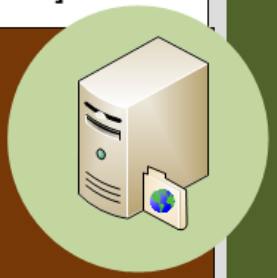
ICMP

Author: Prof Bill Buchanan

ICMP

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





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

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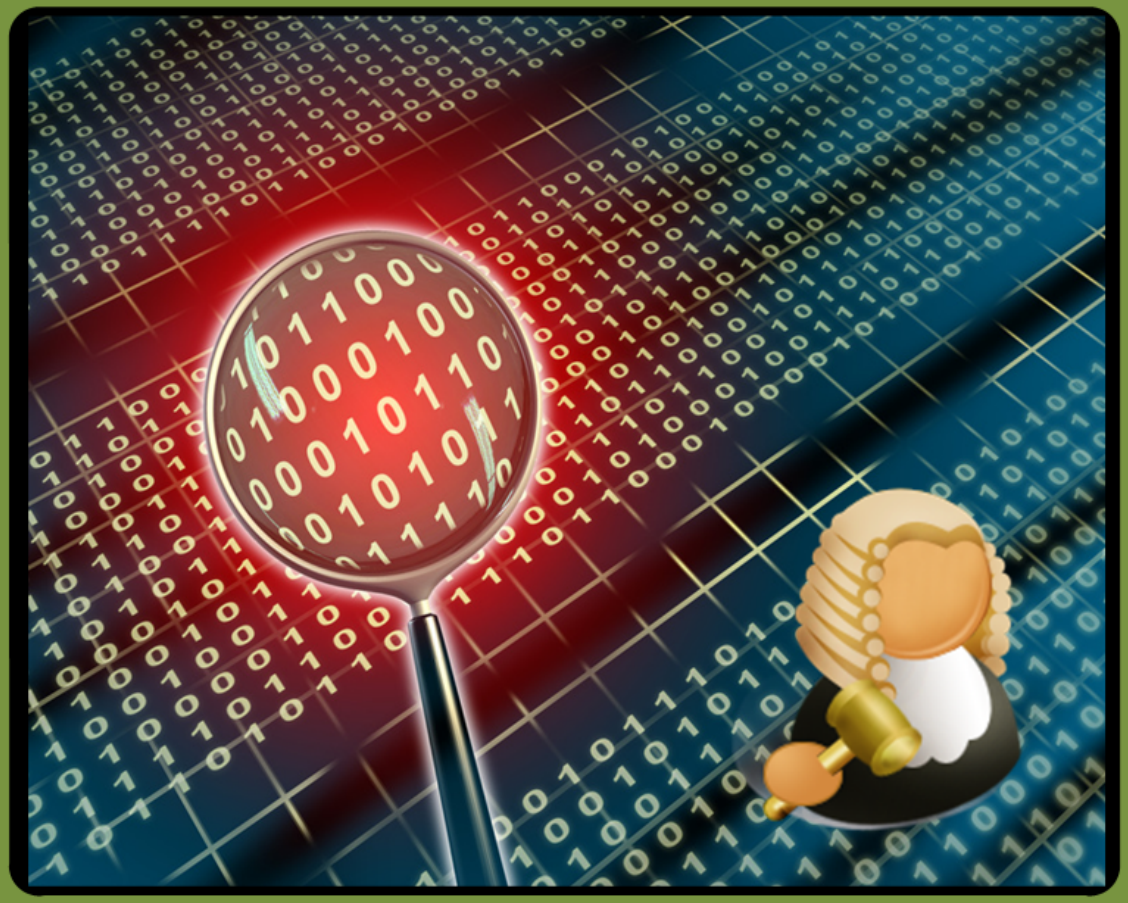
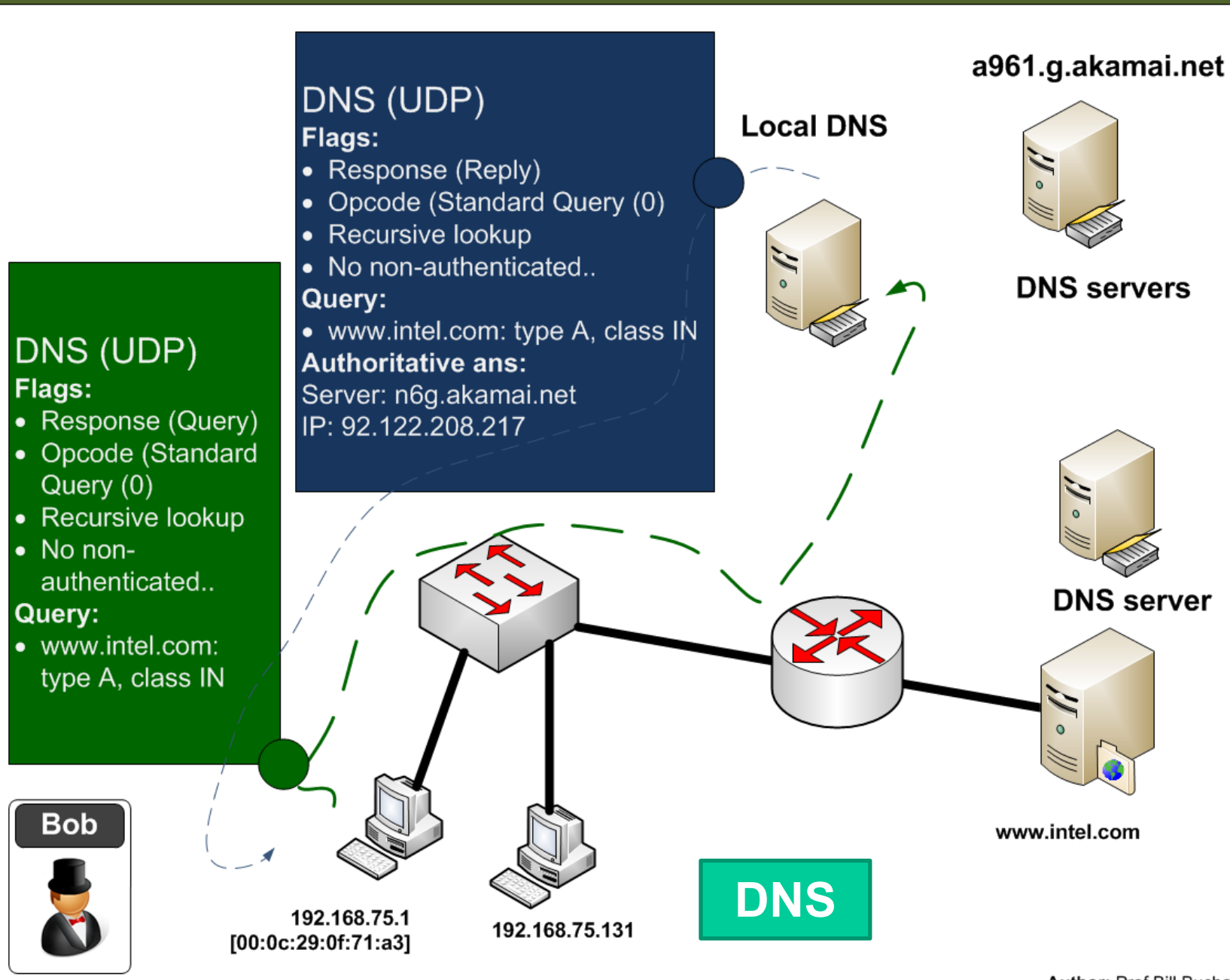
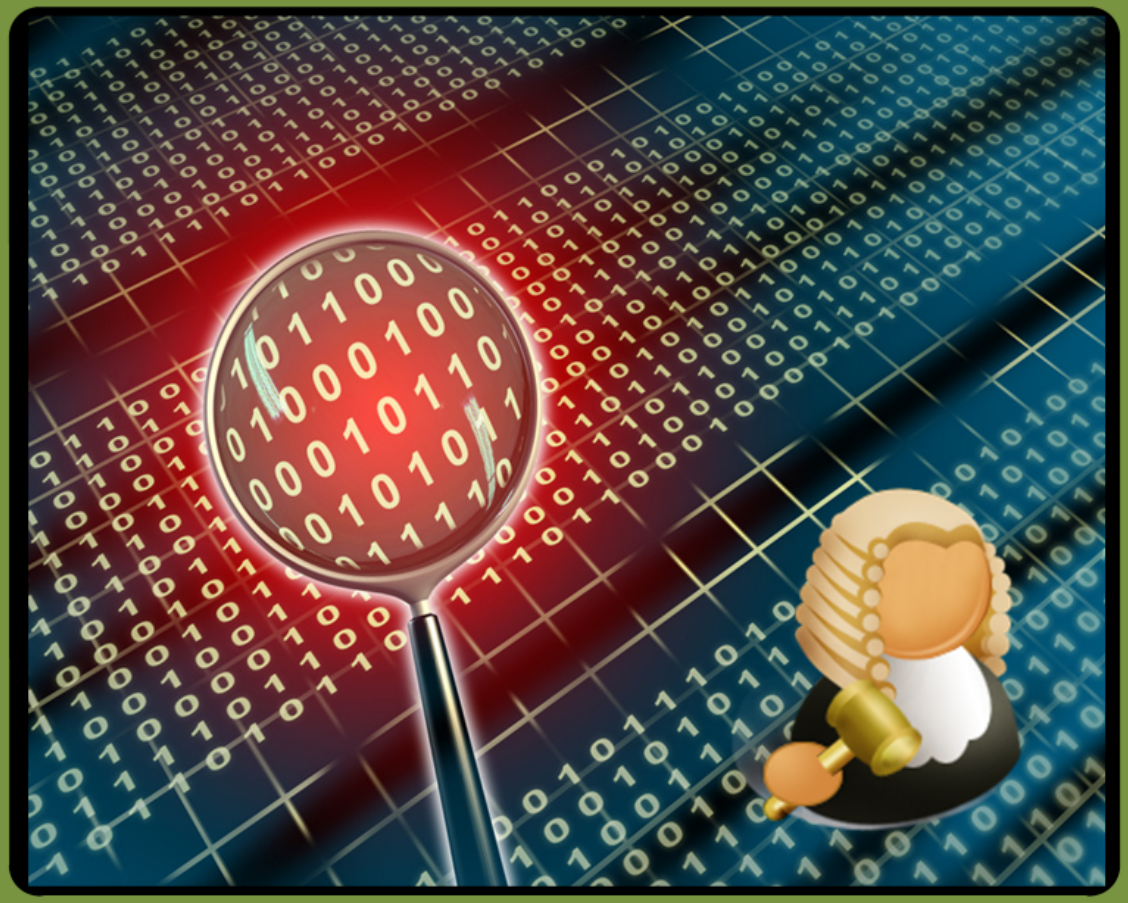


DNS

Author: Prof Bill Buchanan


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
DNS (UDP)
Flags:
• Response (Query)
• Opcode (Standard Query (0)
• Recursive lookup
• No non-authenticated..
Query:
• www.intel.com: type A, class IN
Local DNS
a961.g.akamai.net
DNS servers
DNS server
www.intel.com
Bob
192.168.75.1
[00:0c:29:0f:71:a3]
192.168.75.131
DNS
Author: Prof Bill Buchanan

Net Forensics



Port Scan

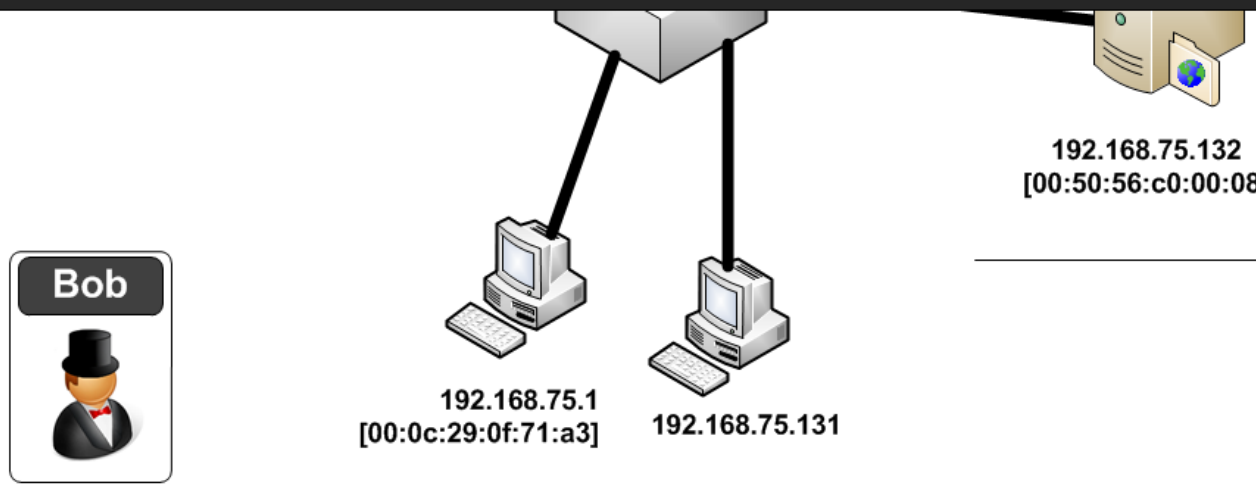
Author: Prof Bill Buchanan

```
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

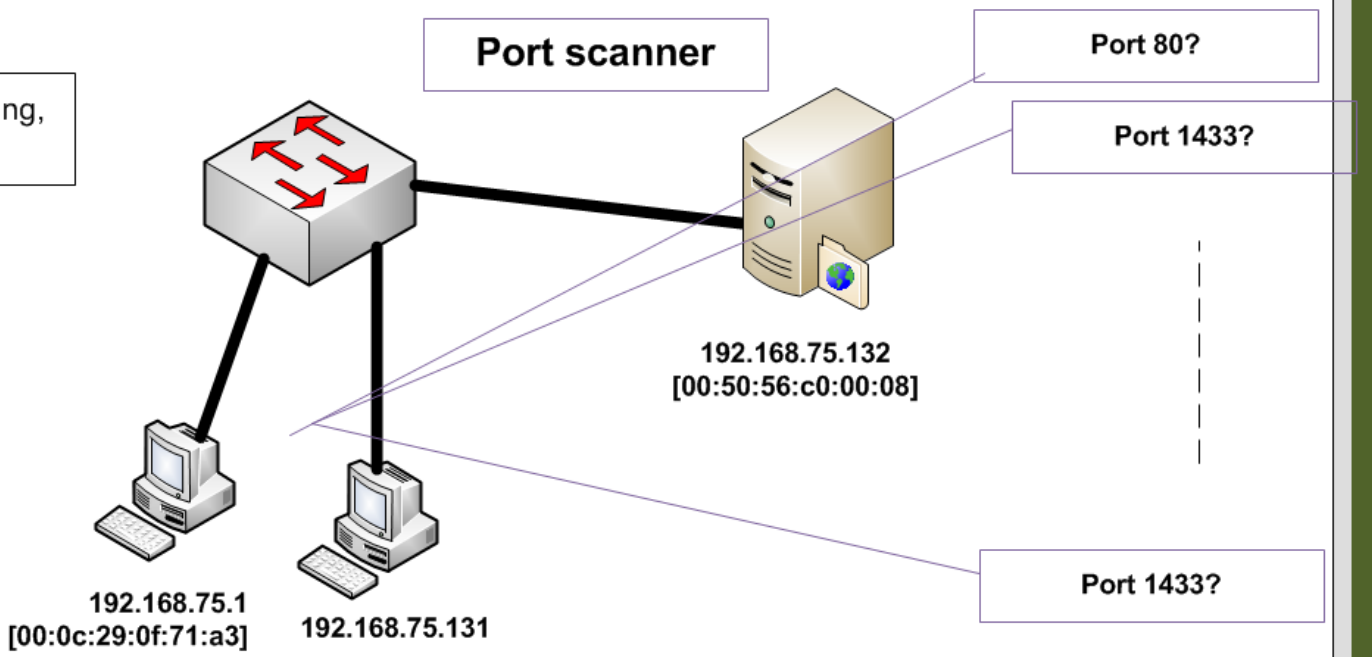
Net Forensics

Author: Prof Bill Buchanan

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

NMAP

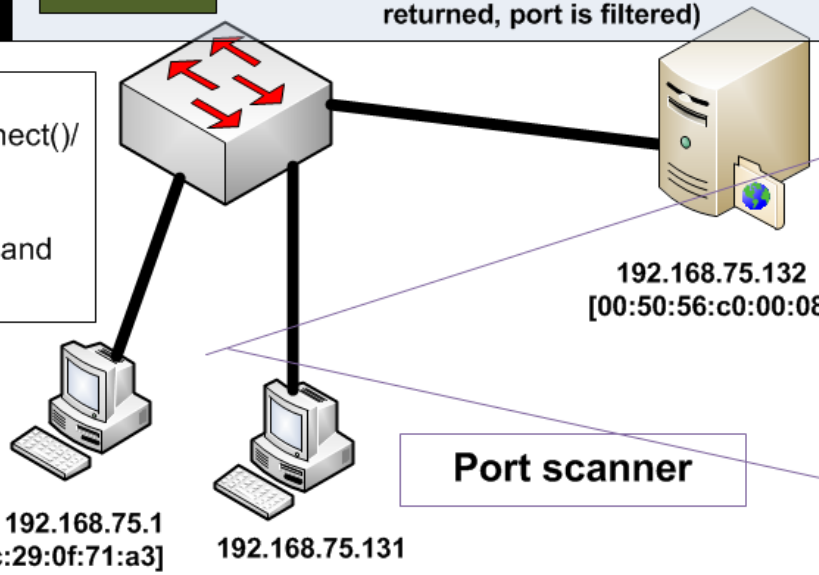


Author: Prof Bill Buchanan

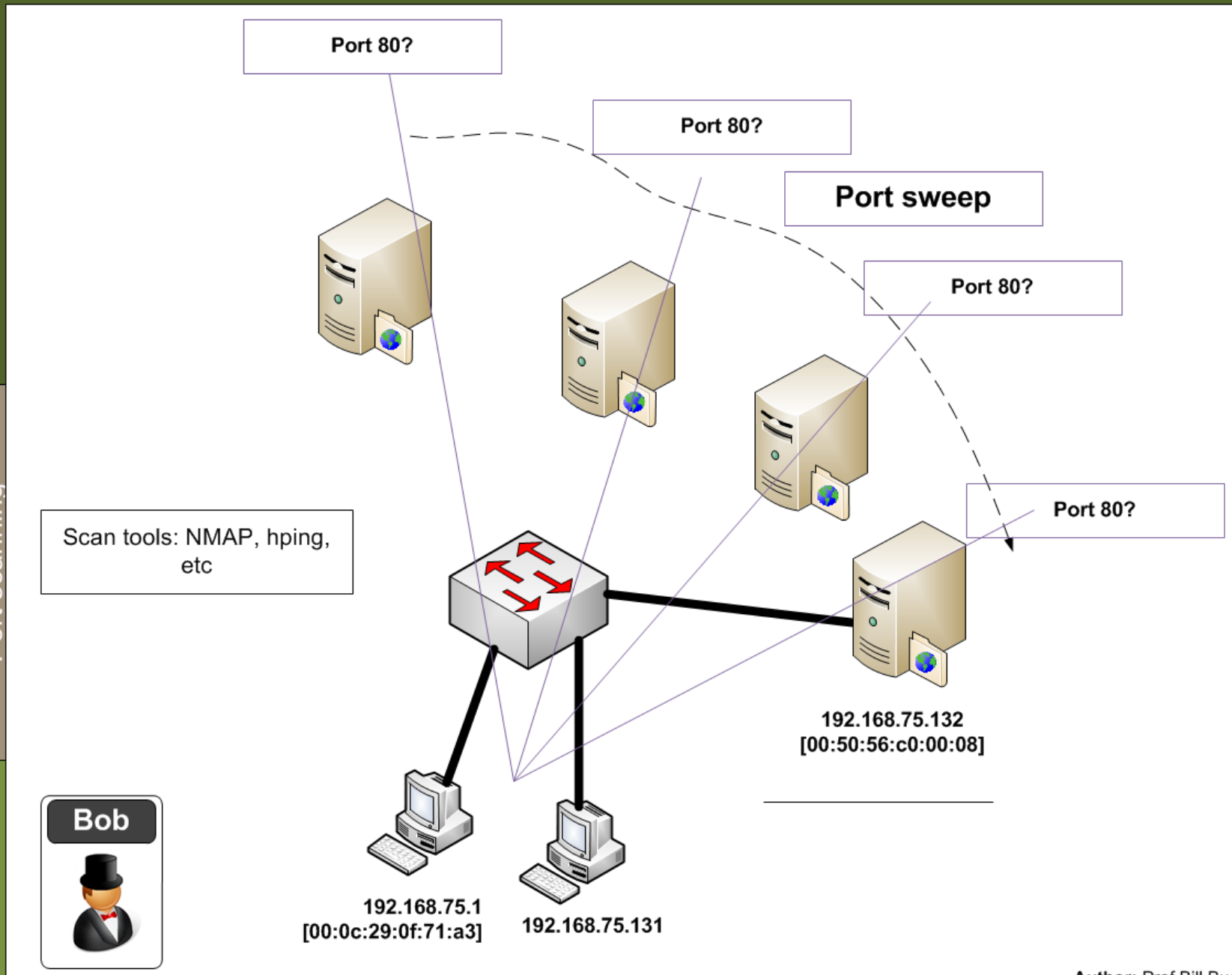
Connect Scan	SYN	ACK	FIN/ACK	Open ports: SYN/ACK; Closed ports: RST/ACK
SYN Scan	SYN			Creates half-open connections
FIN Scan	FIN			Closed ports respond with a RST, but open ports ignore.
NULL scan				Open ports / Closed ports: RST
XMAS scan	FIN	URG	PSH	
ACK scan	ACK			Determines ACLs on firewall or if stateless inspection (if ICMP Destination Unreachable returned, port is filtered)

Scan tools: NMAP, hping, etc

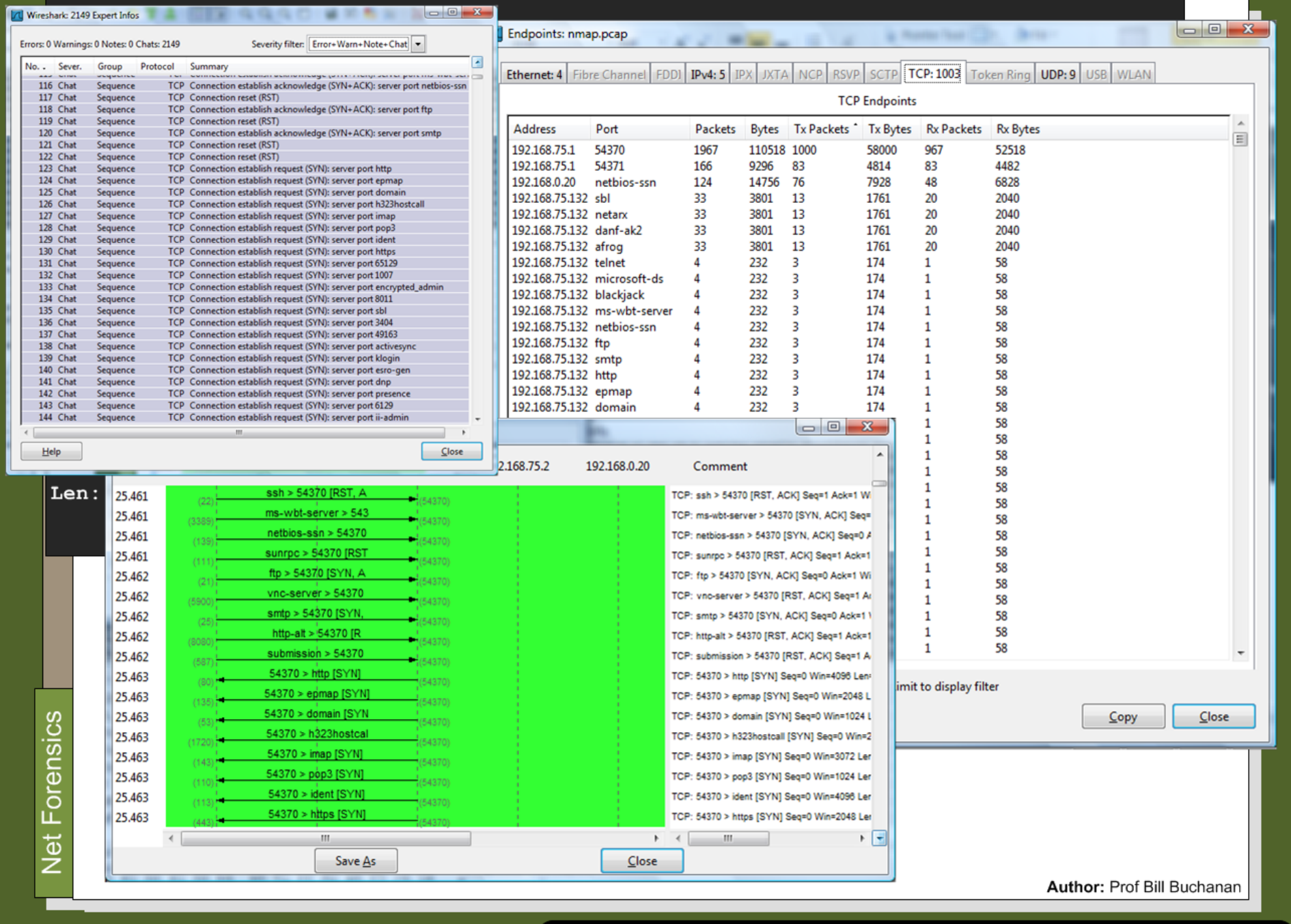
- -sS/sT/sA: TCP SYN/Connect()/ ACK
- -sU: UDP Scan
- -sN/sF/sX: TCP Null, FIN, and Xmas scans



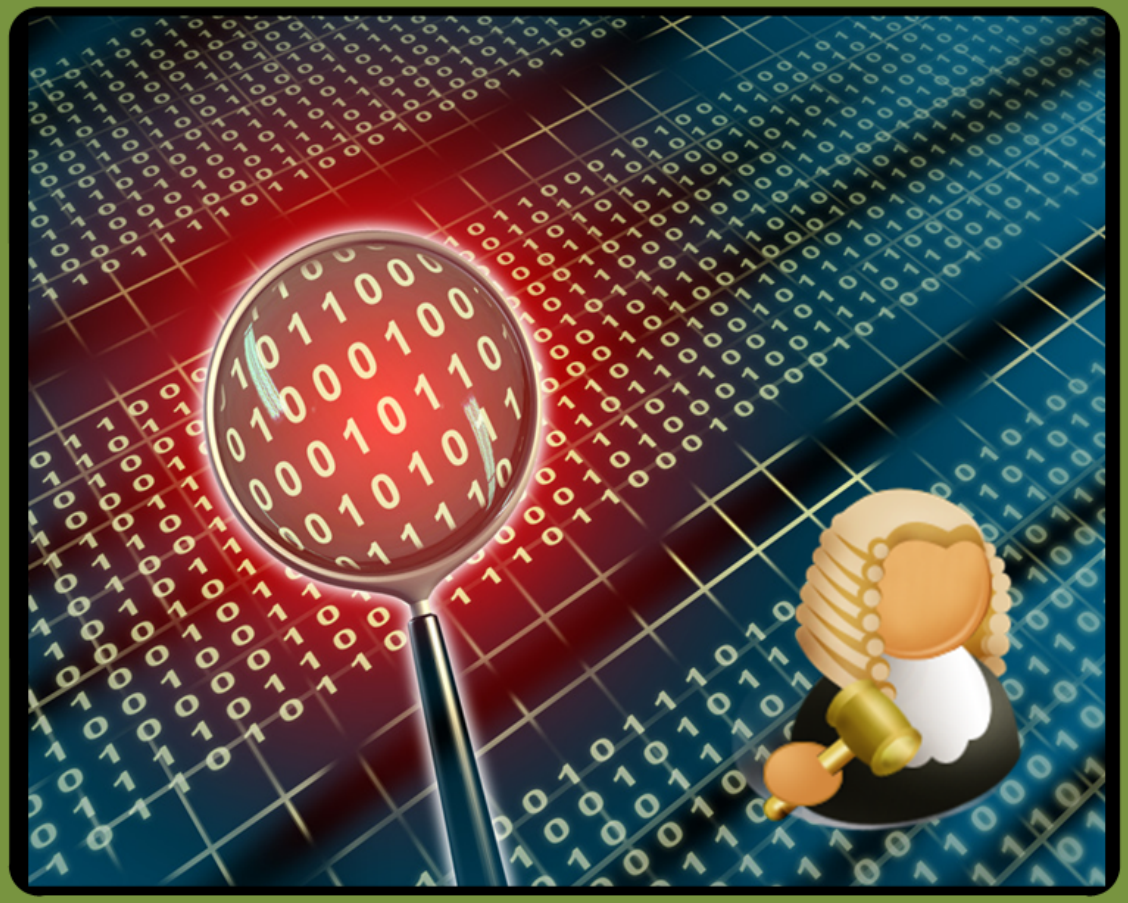
Author: Prof Bill Buchanan



Author: Prof Bill Buchanan


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
imit to display filter
Copy
Close
Len :
2.168.75.2
192.168.0.20
Comment
25.461 ssh > 54370 [RST, A
25.461 ms-wbt-server > 543
25.461 netbios-ssn > 54370
25.461 sunrpc > 54370 [RST
25.462 ftp > 54370 [SYN, A
25.462 vnc-server > 54370
25.462 smtp > 54370 [SYN,
25.462 http-alt > 54370 [R
25.462 submission > 54370
25.463 54370 > http [SYN]
25.463 54370 > epmap [SYN]
25.463 54370 > domain [SYN
25.463 54370 > h323hostcal
25.463 54370 > imap [SYN]
25.463 54370 > pop3 [SYN]
25.463 54370 > ident [SYN]
25.463 54370 > https [SYN]
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
TCP: 54370 > h323hostcall [SYN] Seq=0 Win=2
TCP: 54370 > imap [SYN] Seq=0 Win=3072 Len
TCP: 54370 > pop3 [SYN] Seq=0 Win=1024 Len
TCP: 54370 > ident [SYN] Seq=0 Win=4096 Len
TCP: 54370 > https [SYN] Seq=0 Win=2048 Len
Save As
Close
Net Forensics
Author: Prof Bill Buchanan
Port Scan

Net Forensics



SYN FLOOD

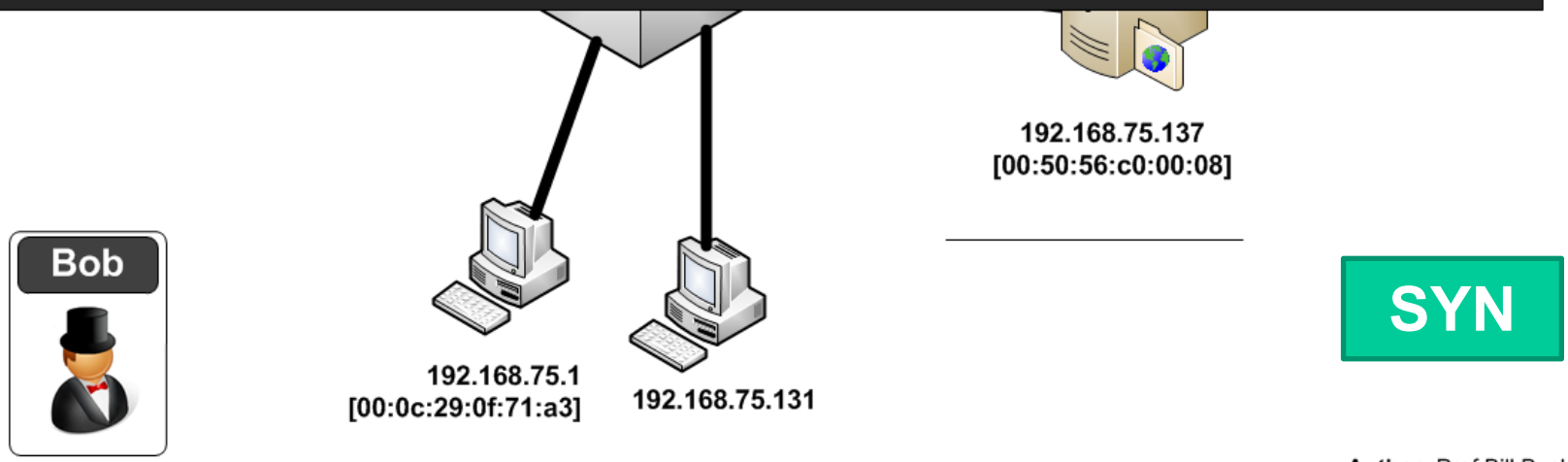
Author: Prof Bill Buchanan

```
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
```



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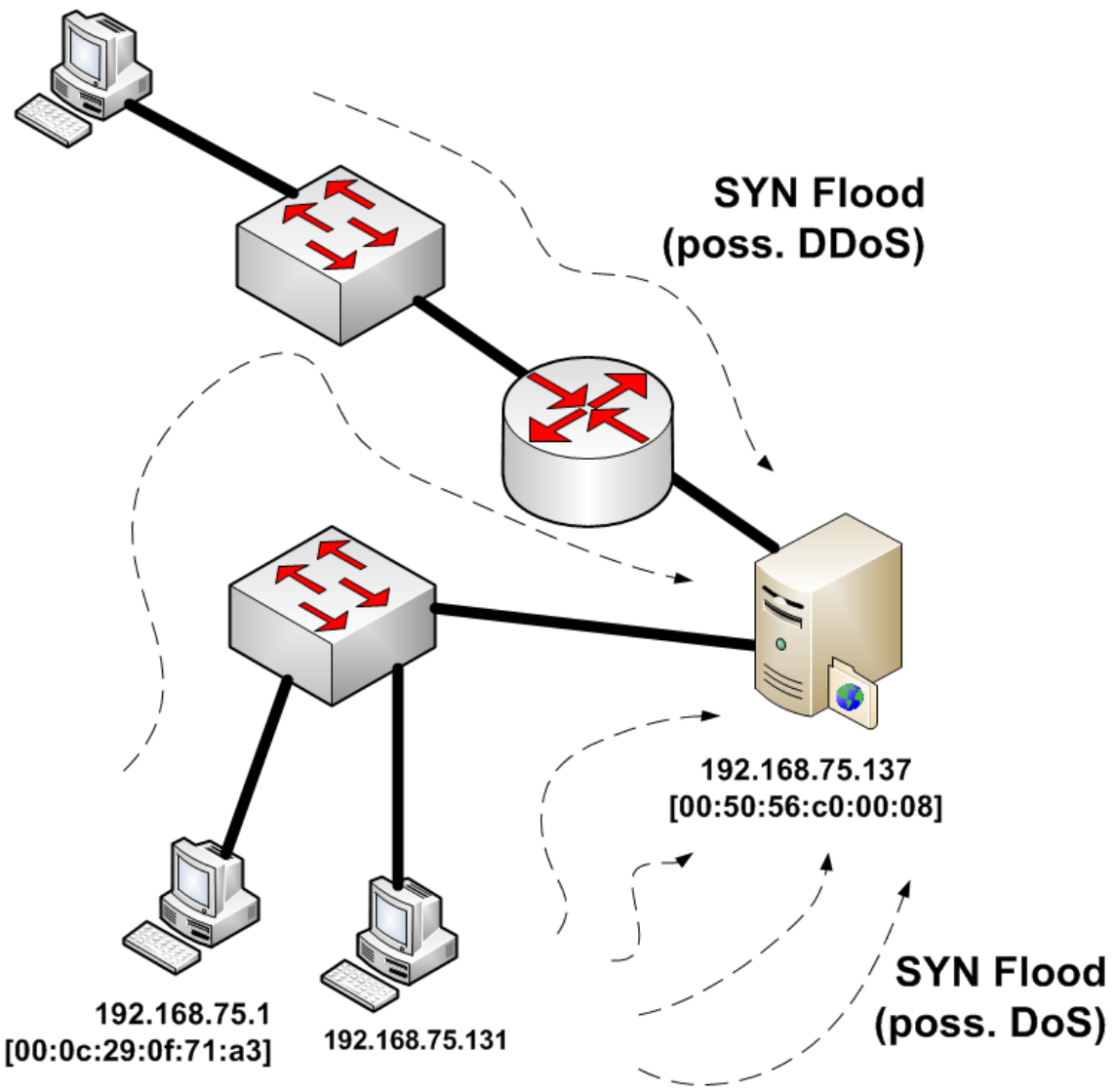

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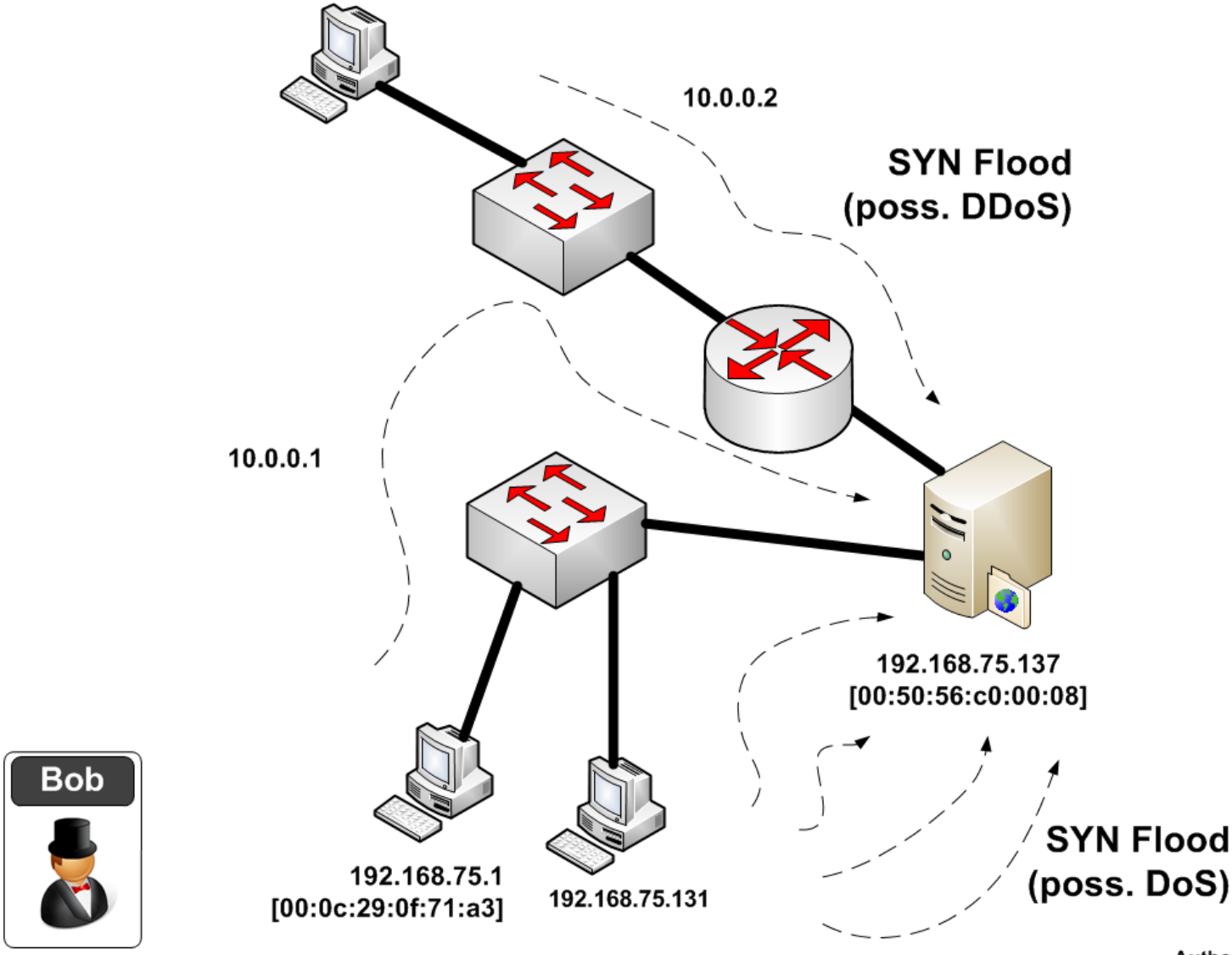

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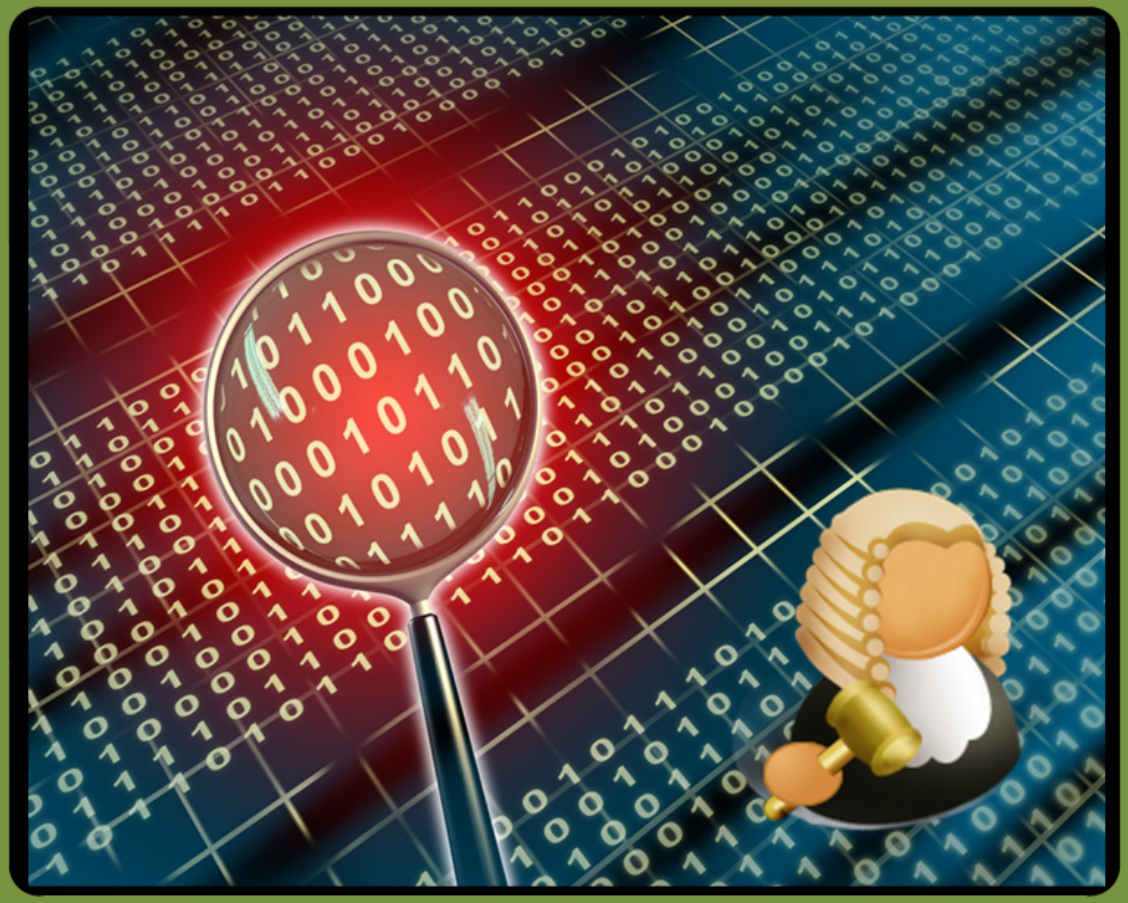
Net Forensics



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

```
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

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