Week	Date	Teaching	Attended
9	**Mar 2013**	Lab 9: Network Forensics	

Aim: The aim of this lab is to further investigate network-based forensic investigations, including network evidence capture and analysis using TShark, Wireshark and NetWitness tools.

Time to complete:
4 hours (Two supervised hours in the lab, and two additional hours, unsupervised).

Activities:

- **Complete Lab 9**: Network Forensics
  http://www.dcs.napier.ac.uk/~cs342/CSN10102/Lab9.pdf

Learning activities:
At the end of these activities, you should understand:

- How to capture network-based evidence.
- How to analyse network packet captures using various methods.
- How to analyse files for their endpoints, and protocols over time.
- How to investigate sessions and reconstruct data.

Reflective statements (end-of-exercise):
What might be the problems in collecting network-based evidence in a proactive manor?
Why might specifying a maximum size of capture files be important?
How would you go about analysing a very large network evidence trace file?
Which tools would be best for network-based digital evidence analysis on a Windows system?

Lab 9: Network Forensics

Rich Macfarlane 2013

9.1 Details

Aim: The aim of this lab is to investigate network-based digital investigation, including gathering and analysis of network-based evidence.

9.2 Activities – Network Forensics

Many different methodologies exist for forensic investigations in general, and network-based digital investigations have specific techniques. A very simplified process is shown below, and this lab will look at the basic steps of Collecting and then Analysing evidence in a network-based digital investigation.

Network Forensic Steps:

1. Gathering Network-based Evidence
2. Analysis of Network-based Evidence
3. Reporting

Gathering Network-based Evidence

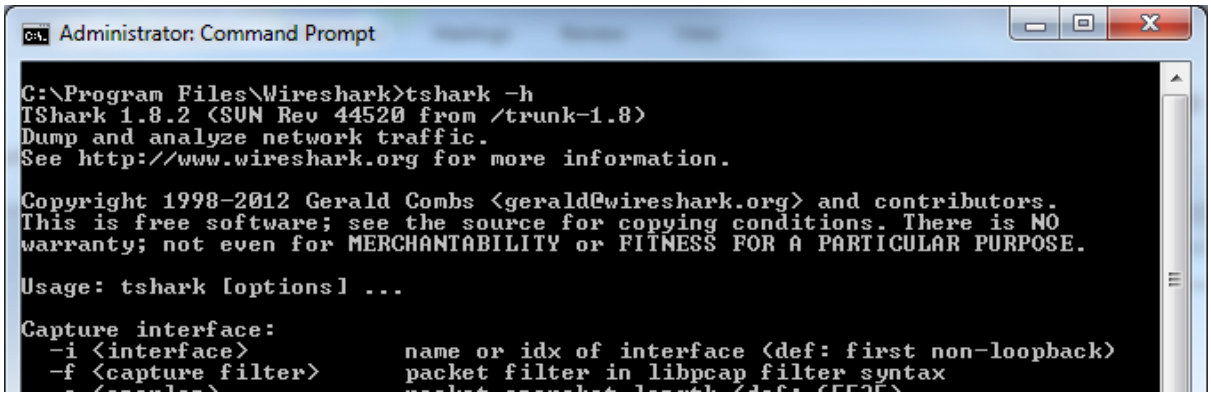
Many different types of network-based digital evidence can be gathered by organisations. There are many tools which can be used to help collect and collate this evidence. This section of the lab introduces some of the tools and techniques for network-based evidence gathering.

TShark

TShark is a command line packet capture and analysis tool. It can capture packets live from a network interface, or read packets from a saved pcap capture file.

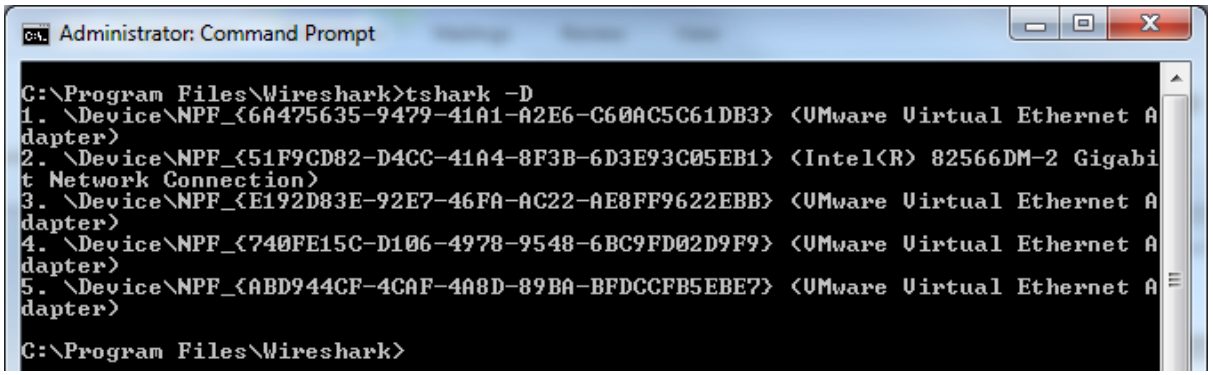
If you have Wireshark installed on your system, change to the Wireshark directory, and use the following to check the Dumpcap options:

```
tshark -h
```



Check the interfaces available via Dumpcap:

```
tshark -D
```

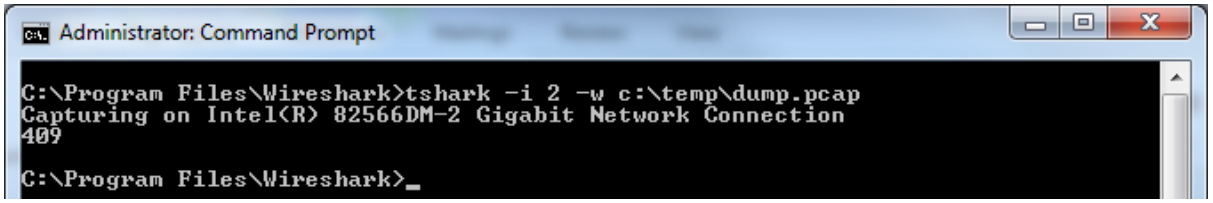


Capture some packets from your Ethernet interface, and dump to a file, with a command similar to the following:

```
tshark -i 2 -w c:\temp\dump.pcap
```

Create some traffic using a web browser.

Use CTRL+C to stop the capture.



View the details of the capture file in Wireshark using:

```
start wireshark c:\temp\dump.pcap
```

Questions

Q. Did you successfully save your capture to disc, and view in Wireshark?

YES/NO

TShark differs from TCPDump and Wireshark in that it allows advanced specification of when to stop collecting the traffic.

Try using the –c argument to only capture 1000 packets.

Questions

Q. What is the command?

Q. Did you successfully save your capture to disc?

YES/NO

Start Wireshark with the capture and scroll down to the bottom of the capture.

Questions

Q. What is the packet number of the last packet?

TShark can also be set up to stop collecting packets based on time and filesize using the –a argument.

Try using the –a command to capture packets for only 60 seconds:

```
tshark –i 2 –w c:\temp\dump.pcap –a duration:60
```

Create some web traffic before the trace stops.

Questions

Q. How many packets were captured?

List the details of the dump file:

```
dir c:\temp\dump.pcap
```

Questions

Q. What is the size of the file?

Q. What would the size of the file be if you captured this type of traffic for an entire day?

(*60=1hr, *24=1day … /1000,000,000=GB)

Sometimes capture files of a certain size would be sought after. Files which can be analysed without too much overhead can be more efficient to work with.

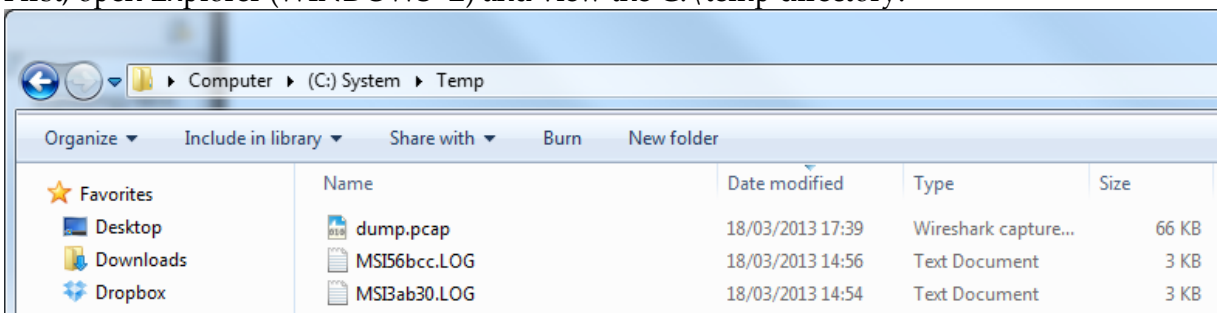
Try using the –a command to stop the capture after a file reaches a size of 64 kilobytes:

Questions

Q. What is the tshark command?

Multiple files of a certain size can be saved off using TShark, but care must be taken as captures can quickly fill up your disk!

First, open Explorer (WINDOWS+E) and view the C:\temp directory.



Multiples files can be generated using the –b argument – try creating multiple files of 64Kb.

```
tshark -i 2 -w c:\temp\dump.pcap -b filesize:64
```

Questions

Q. Can you see the files being created?

Use CTRL+C to stop the tshark capture (before it fills up your HDD). Delete the time stamped dump files.

Questions

Q. What is the problem with this method?

A Gigabyte of date per machine would not unusual per machine per day. Depending on the organisation and use for the network forensic captures, several days worth of data might need to be stored per machine.

Typically at least several days worth of data would need to be stored. To do this data would need to be overwritten after a period of time or when a number of files get to a certain size.

TShark has functionality to overwrite captures; using the –b arguments a ring buffer can be set up. This saves the capture in multiple files and starts overwriting the first file (in the ring buffer) once the last file is full.

This time create a ring buffer of dump files –b argument twice; once to create a new dump file every 3 seconds and secondly to use multiple files in the ring buffer.

```
tshark -i 2 -w c:\temp\dump.pcap -b duration:3 -b files:5
```

Questions

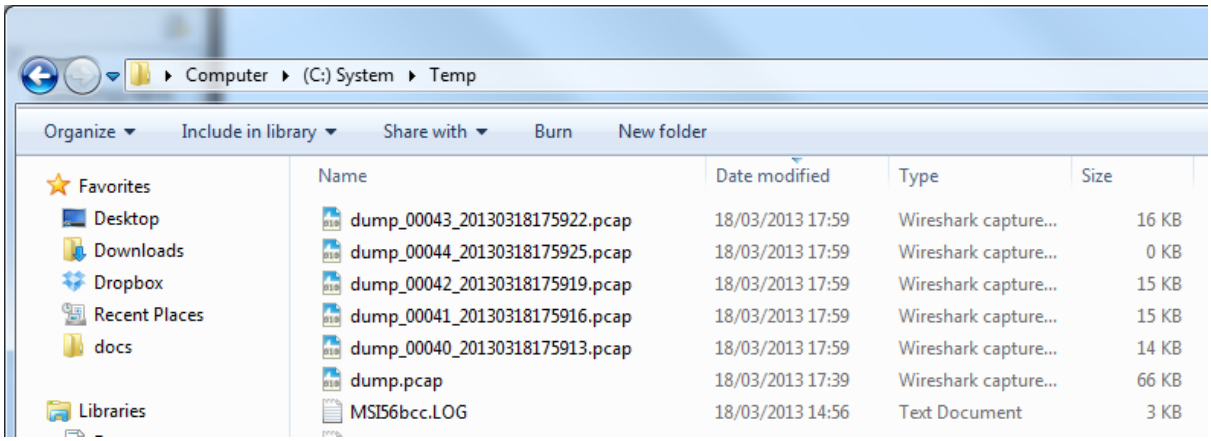
Q. Was the ring buffer capture successful?

YES/NO

Q. How many files are being used in the ring buffer?

Q. When is the capture complete?

```
C:\Program Files\Wireshark>tshark -i 2 -w c:\temp\dump.pcap -b duration:3 -b fil
es:5
Capturing on Intel(R) 82566DM-2 Gigabit Network Connection
4828
```



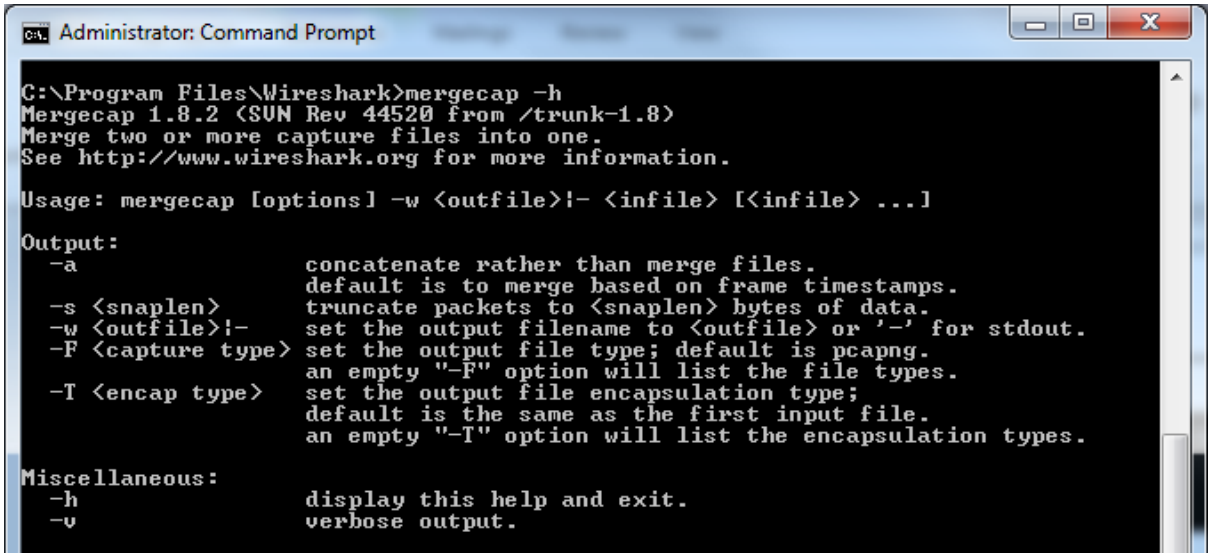
This type of capture can be used to continually collect possible evidence, for later analysis.

Mergecap

Mergecap is a packet capture merge tool. It can combine multiple captures into a new pcap capture file. It can manipulate libpcap format capture files, including files created using Wireshark, TShark and TCPDump.

Use the –h flag to check the options:

```
mergecap -h
```



We can try to merge our ring buffer files together into a single capture. Before we merge open one of the ringz buffer files in Wireshark.

Questions

Q. What is the total number of packets in the capture?

Q. What is the size of the file?

Use mergecap to create a single capture file from our ring buffer files:

```
mergecap -w c:\temp\mergedump.pcap c:\temp\dump_*.pcap -a
```

Open the new capture file in Wireshark.

Questions

Q. What is the total number of packets in the capture?

Q. What is the size of the new file?

Analysis of Network Forensic Evidence

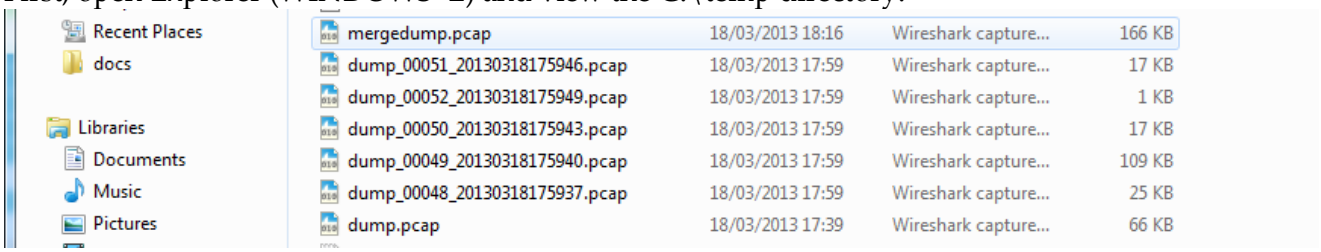
Many different methodologies exist for network-based evidence analysis, and many tools can be used. This section of the lab introduces some of the types of network-based evidence analysis and some of the well known tools.

Analysis of Entire Evidence (Full Content Data)
Full content data is the type of data we collected in the previous section. All packets, with full content of every packet. This gives the analyst access to all of the network-based evidence, which can be overwhelming. It can however allow the analysis of the entire traffic which can be used to derive statistics, and to drill right down to details of specific packets, and to follow an attacker via his actions through the entire network.

As we have seen in the previous section, the downside to this type of data is that it can take up a huge amount of storage, and as we will see it can also take large amounts of time to analyse.

Wireshark
Wireshark is one of the most popular network traffic analysis tools. It runs on many platforms, is free, and is used extensively in industry and for education.

First, open Explorer (WINDOWS+E) and view the C:\temp directory.



Open two of the ring buffer dump files which should contain contiguous chronological data. The 2nd number in the file name is the time stamp and so in the above example, the files ending in 785937 and 75940 should be contiguous.

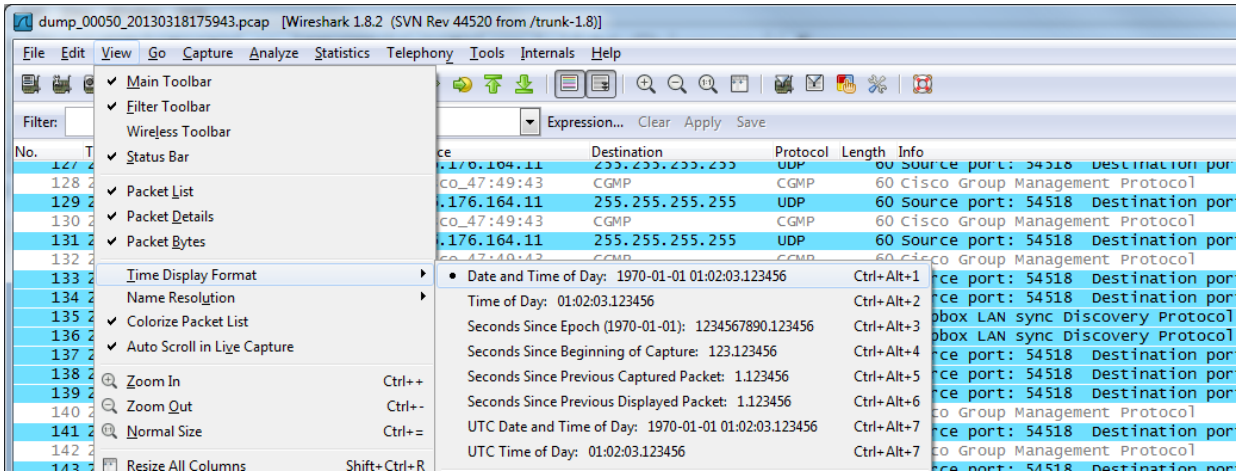
Date and Time

When analysing network evidence it is sometimes important to focus on the timings of incidents. The Time column in Wireshark is derived from the timestamp from libpcap at capture time, but can be displayed in various ways.

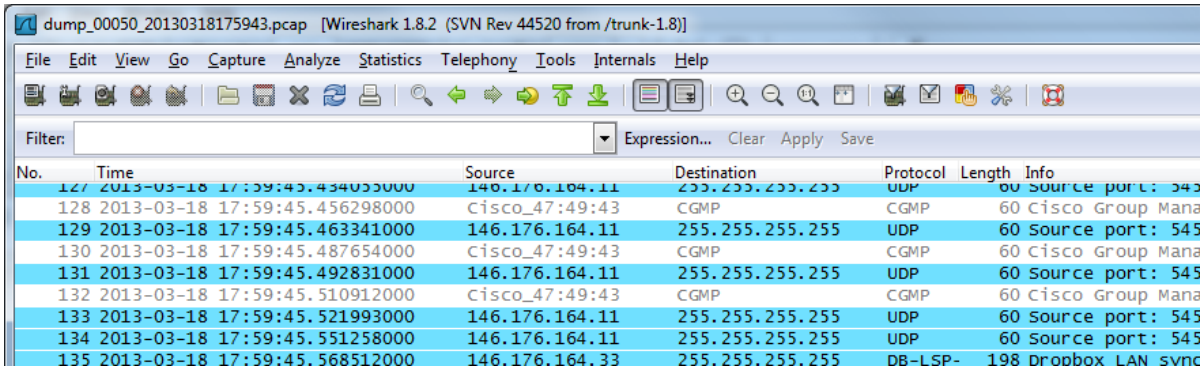
For the open captures, us select the **View>Time Display Format** menu and review the options.

Questions

Q. What is the Time format current being displayed in the Time column?



We cannot compare packets in the 2 different captures using this relative time format. Set the Time column to **Date and Time of Day** for your 2 open captures.



Scroll to the end of the earlier capture, and the beginning of the later capture file.

Questions

Q. Can you see the time and packets where the capture files meet?

Now open the mergedump.pcap capture file and change the time format to the same.

Questions

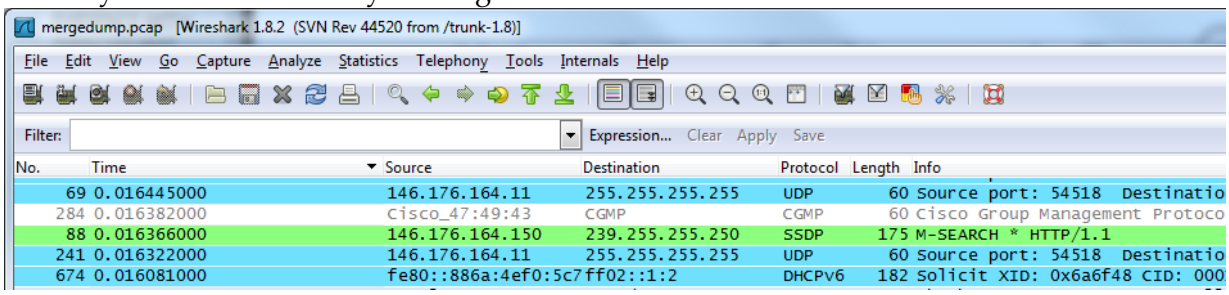
Q. From the Time column, can you identify the packet number of the last packet in the earlier trace file, and the first in the later trace file?

This time format is useful if you want to find day/time of specific incidents. Close the 2 ring buffer trace files.

Questions

Q. Can you tell easily if there are any large delays between packets in the mergedump trace?

Set the Time column to **Seconds Since Previous Displayed** for the mergedump capture, and order by the Time column by clicking the column header.



Questions

Q. Can you easily identify the 3 packets with the largest delays?

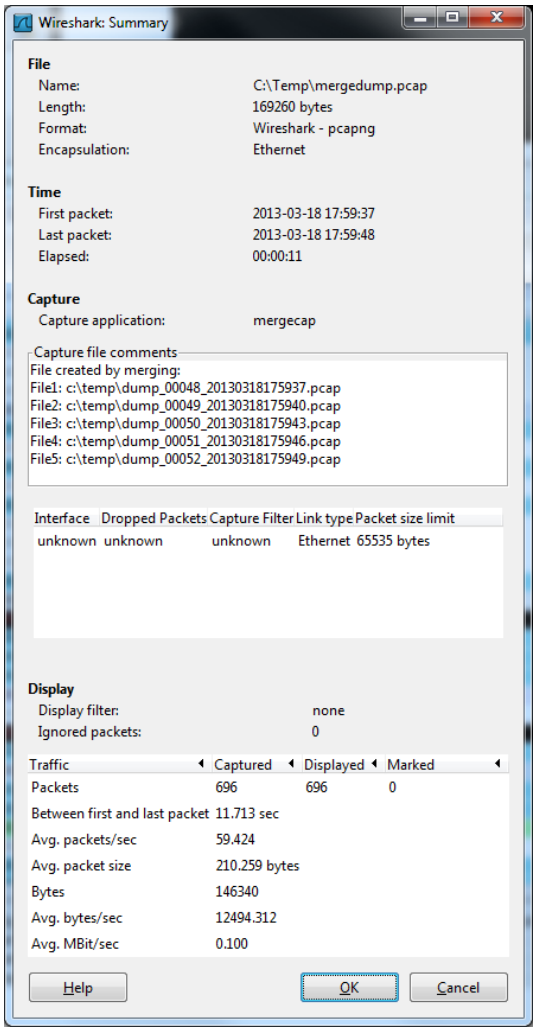
Order by the packet number column to return the trace into chronological order.

Techniques such as this can be useful when trying to identify time gaps leading up to an incident, or machines being particularly overloaded which may signify an attack.

Analysis of Statistics

Full content data can be used to generate network statistics, which can be useful in the early part of the analysis phase, to identify machines and network traffic types involved in any incident.

Select the **Statistics->Summary** menu option, and you should be shown a summary of basic information about the trace file.



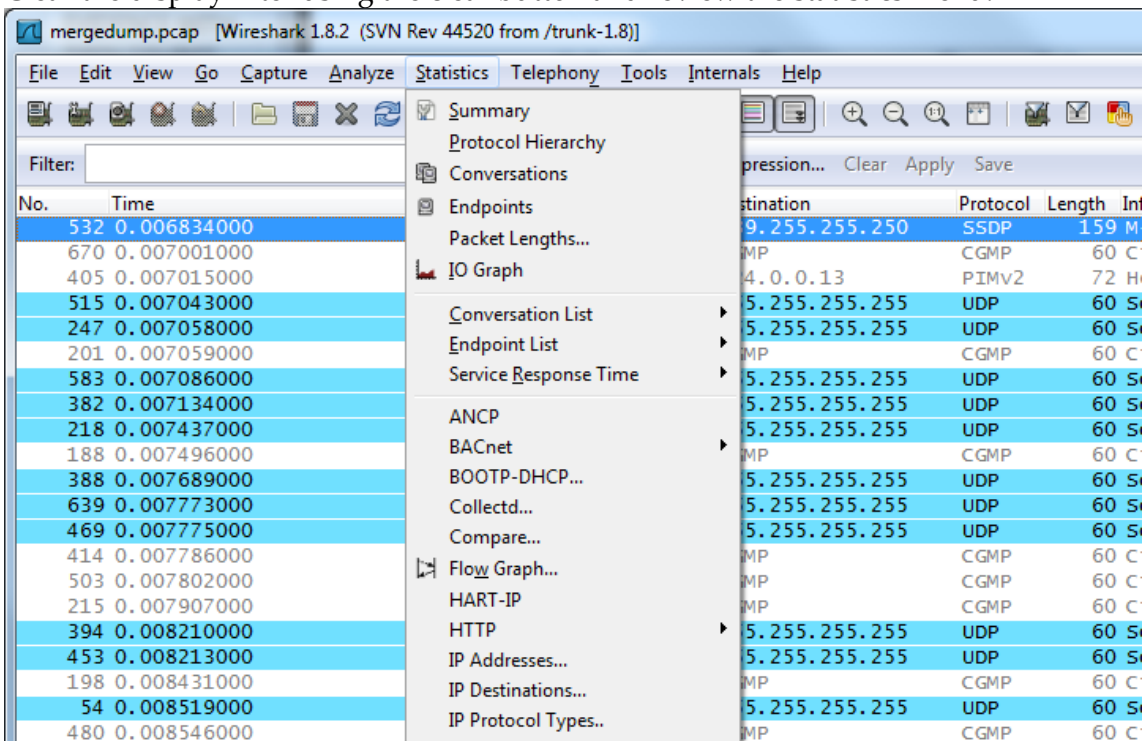
This can also be used to get summary information on sections of a trace. Add a display filter of **http** and generate the summary statistics again.

Questions

Q. How many seconds between the 1st and last packets?

This could be used to compare various dump files/protocols/sessions and spot unusually slow processes. It is not unusual for baseline traffic statistics to be stored for this type of comparison, which can identify unusual behaviour/incidents.

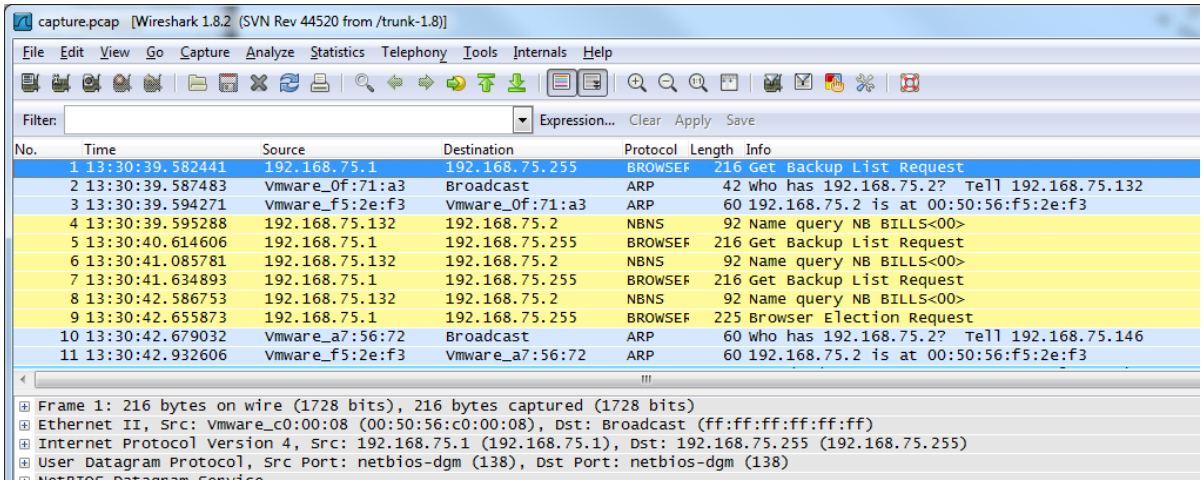
Wireshark can produce statistics for a number of different network behaviours and traffic types.
Clear the display filter using the clear button and review the statistics menu.



Close this trace and download the following large network-based evidence capture file, and unpack to the c:\temp directory.

Network Evidence Capture File:
http://www.dcs.napier.ac.uk/~cs342/CSN10102/netfor_capture.zip

Open the capture in Wireshark, and change the Time format to **Time of Day**.



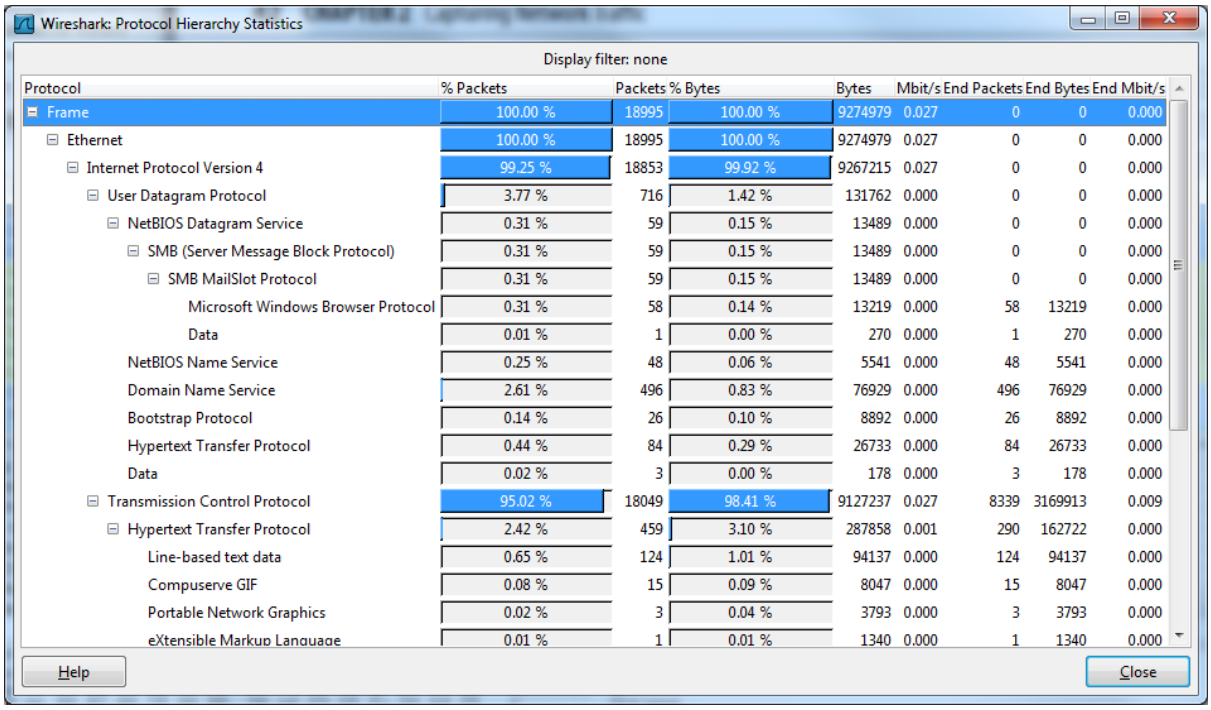
Questions

Q. What are the start and end times of the trace?

Q. Get summary statistics and check is this matches the start and end packet times?

Statistics on Protocols and Applications

Use the Statistics>Protocol Hierarchy menu option to examine the traffic type within the evidence trace file.



Questions

Q. What percentage of packets are web browsing packets?

Q. Which protocols can be seen which would encryption traffic?

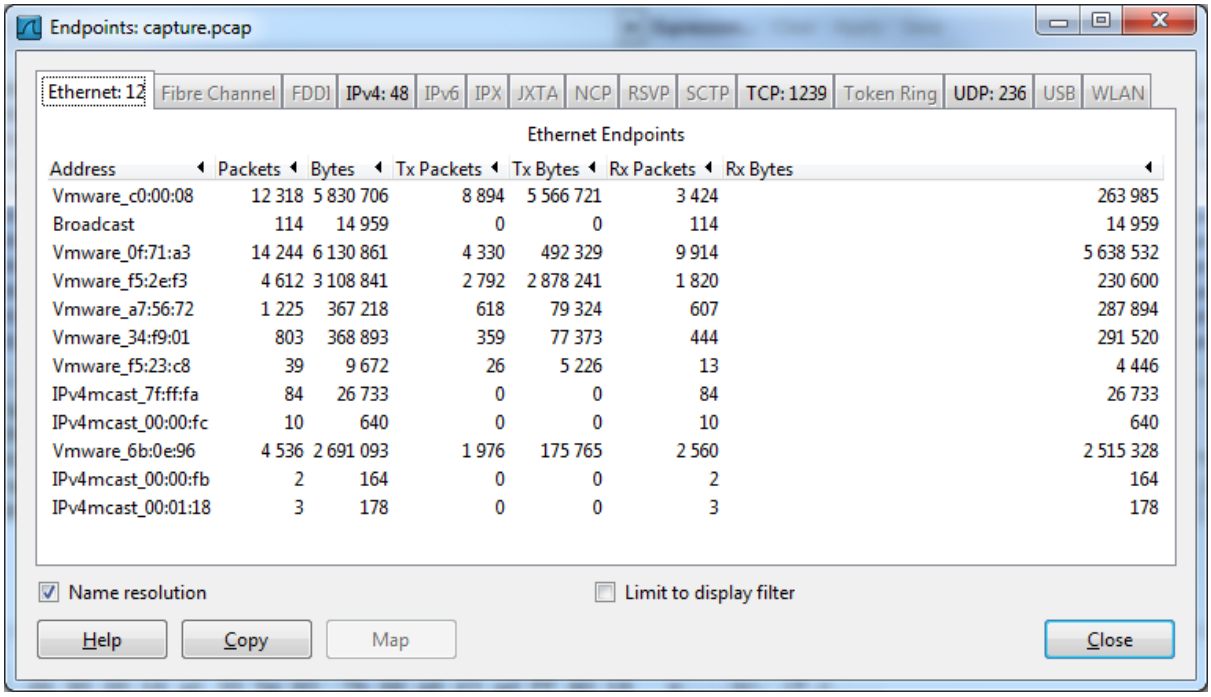
Q. Approx. what percentage of packets are encrypted?

Q. Which application protocol shows a higher than might be expected amount of traffic?

Display filters can be used to remove traffic we may not be interested in. Try the display filter !udp and generate the protocol statistics again.

Endpoints

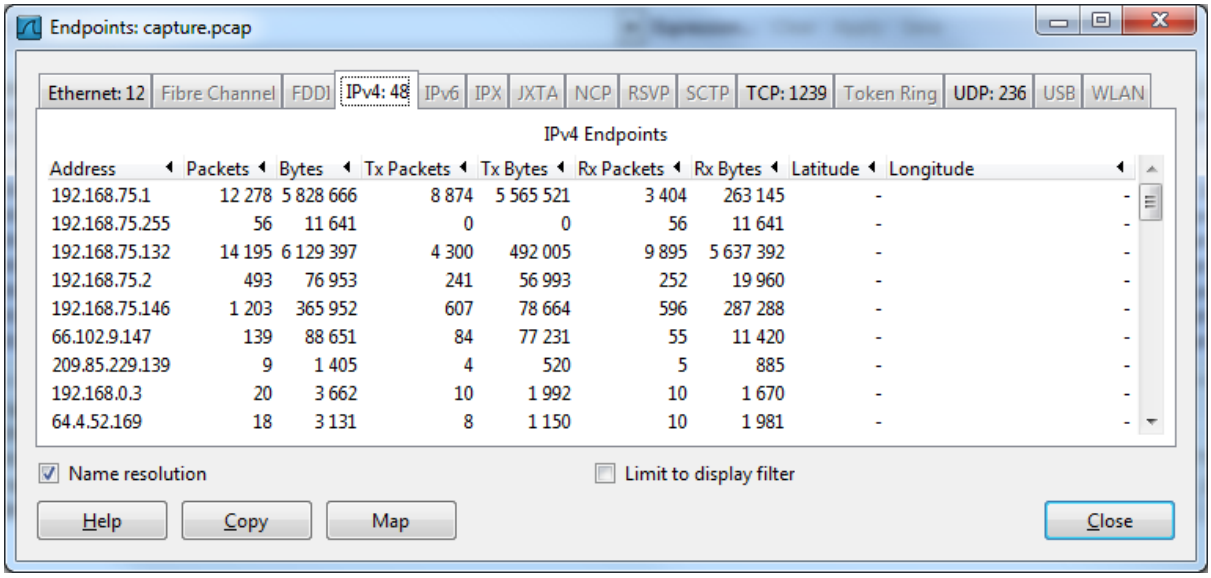
Use the Statistics>Endpoints menu option to examine the session endpoints within the evidence trace file.



Questions

Q. What type of addresses are shown by default?

Change to network addresses, by selecting the IPv4 tab.



This shows the IP Adresses of each end of a network session/conversation.
Order by total Packets, by clicking on the Packets column, then by Tx Packets and Tx Bytes to see which endpoint transmitted the most packets and data, and by Rx Packets and Rx Bytes to see which endpoint received the most packets and data.

Questions

Q. Which IP Address was involved with the most packets?

Q. Which IP Address transmitted the most packets?

Q. Which IP Address received the most data?

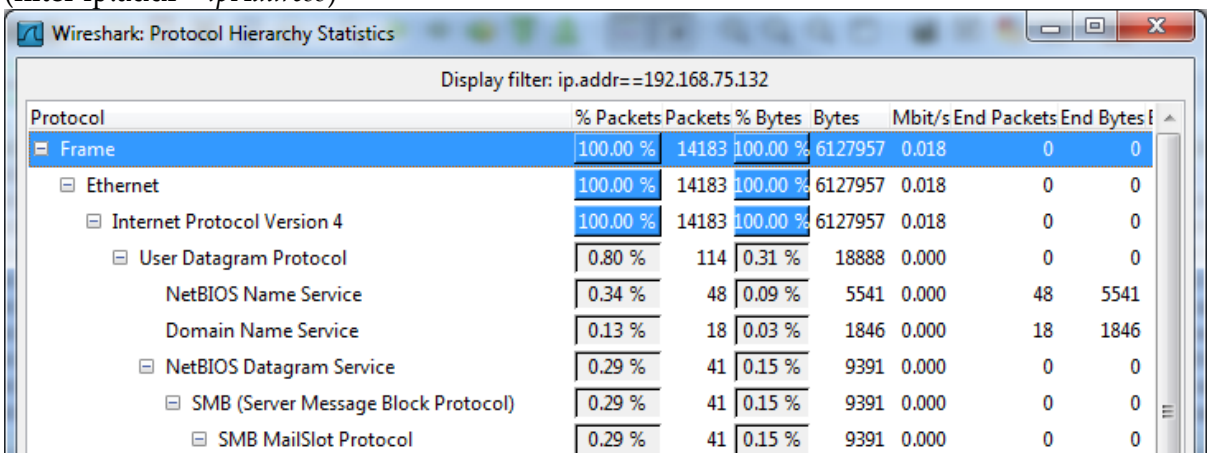
Q. Which IP subnet are these machines on?

This endpoint analysis can be used to produce a network map of the IP Addresses involved from the evidence trace.

Questions

Q. Can you list the IP Addresses of the machines on the local subnet?

Endpoint and Protocol analysis can be used together. Try adding a display filter for the IP Address which was involved with the most traffic and then generating protocol statistics (filter ip.addr==*ipAddress*)



Questions

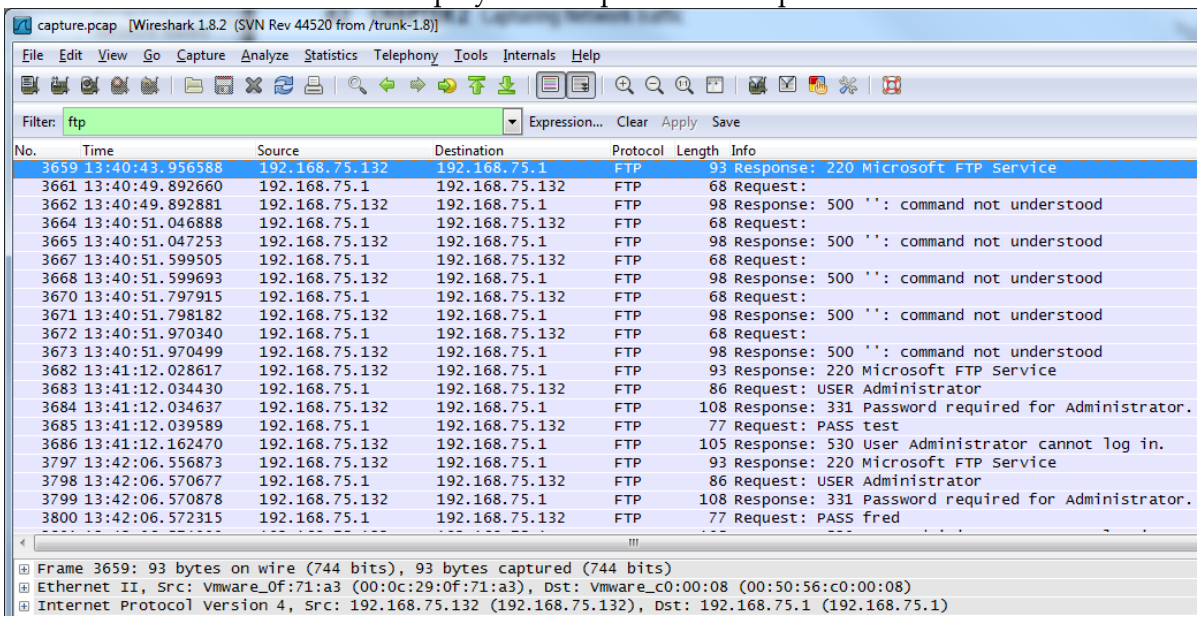
Q. What is the percentage of FTP traffic for this host?

Other menu items Statistics>IP Addresses/IP Destinations can also be useful for host identification/analysis.

Analysis of Protocol and Session Data

Once Protocols and hosts involved have been identified, protocol and specific session data can be analysed.

Having identified that the FTP protocol data is unusually large for the evidence trace, we can concentrate on this. Use a display filter to pull out the ftp data.



Display filters can then be used to pull out traffic relating to specific types of traffic. Try the display filter to highlight all traffic with an FTP command in:

```
ftp.request.command
```

Questions

Q. What is the IP Address of the server?

Q. Which hosts are using the FTP service?

To highlight the hosts attempting to login with the USER command, try the following filter:

```
ftp.request.command=="USER"
```

Questions

Q. What is the IP Address of the host trying to log in many times?

To highlight the hosts attempting to transfer files to the FTP server:

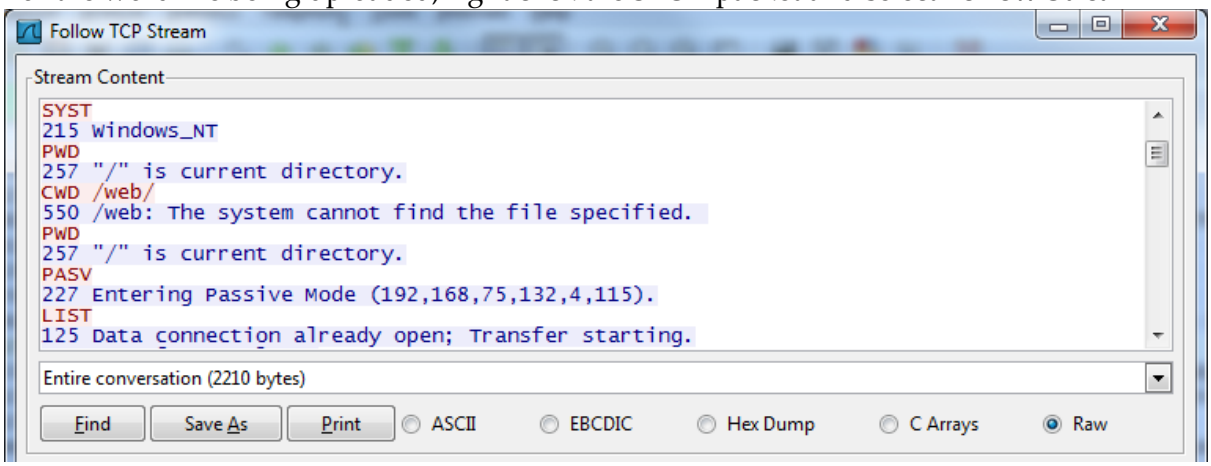
```
ftp.request.command=="STOR"
```

Questions

Q. What is the IP Address of the host uploading files?

Q. Can you list some of the files?

To focus in on a certain session/conversation, we can use Wiresharks conversation Stream rebuilding functionality.
For the word file being uploaded, right click the STOR packet and select **Follow Stream**



Questions

Q. Which directory is created in this session?

Q. Which text files are uploaded to the FTP server in this session?

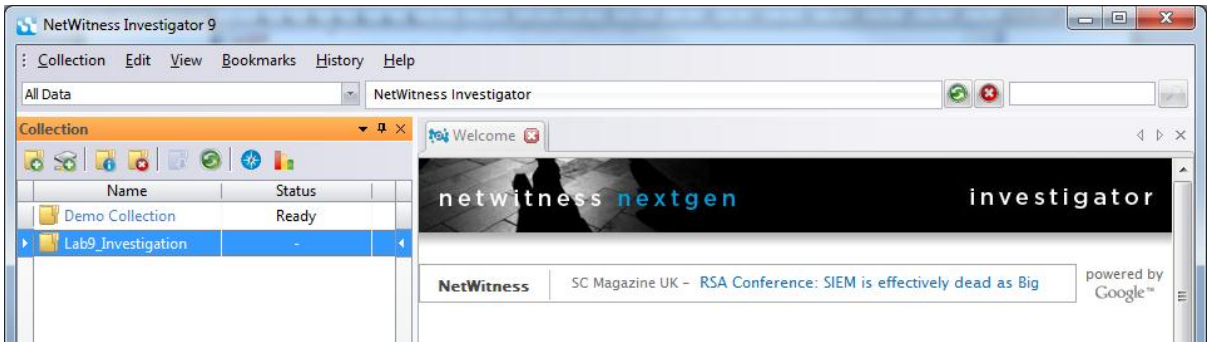
NetWitness Investigator

Netwitness Investigator is free to use. Download the file, install and sign up for a free account.

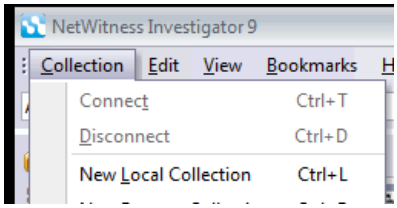
Netwitness free can be found at:
http://www.emc.com/security/rsa-netwitness.htm#!freeware

Netwitness is an analysis tool that allows for easy, rapid, investigation of voluminous amounts of network traffic. By importing a network capture file in a .pcap, or other recognised format, into a 'Collection', an investigator can view the main characteristics of the data in the capture file. The tools takes the packets in the capture and reassembles session streams for services and hosts, even for connectionless protocols.

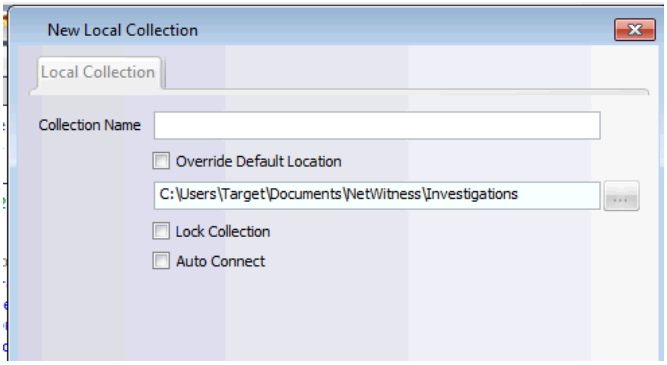
Run Netwitness:



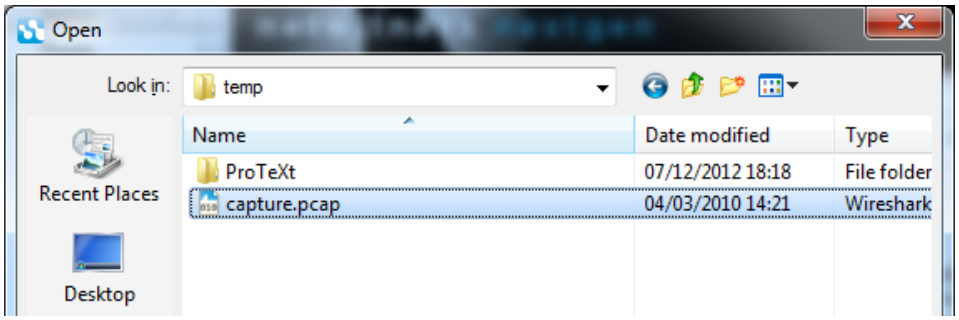
To create a new Collection, select **Collection>New Local Collection**



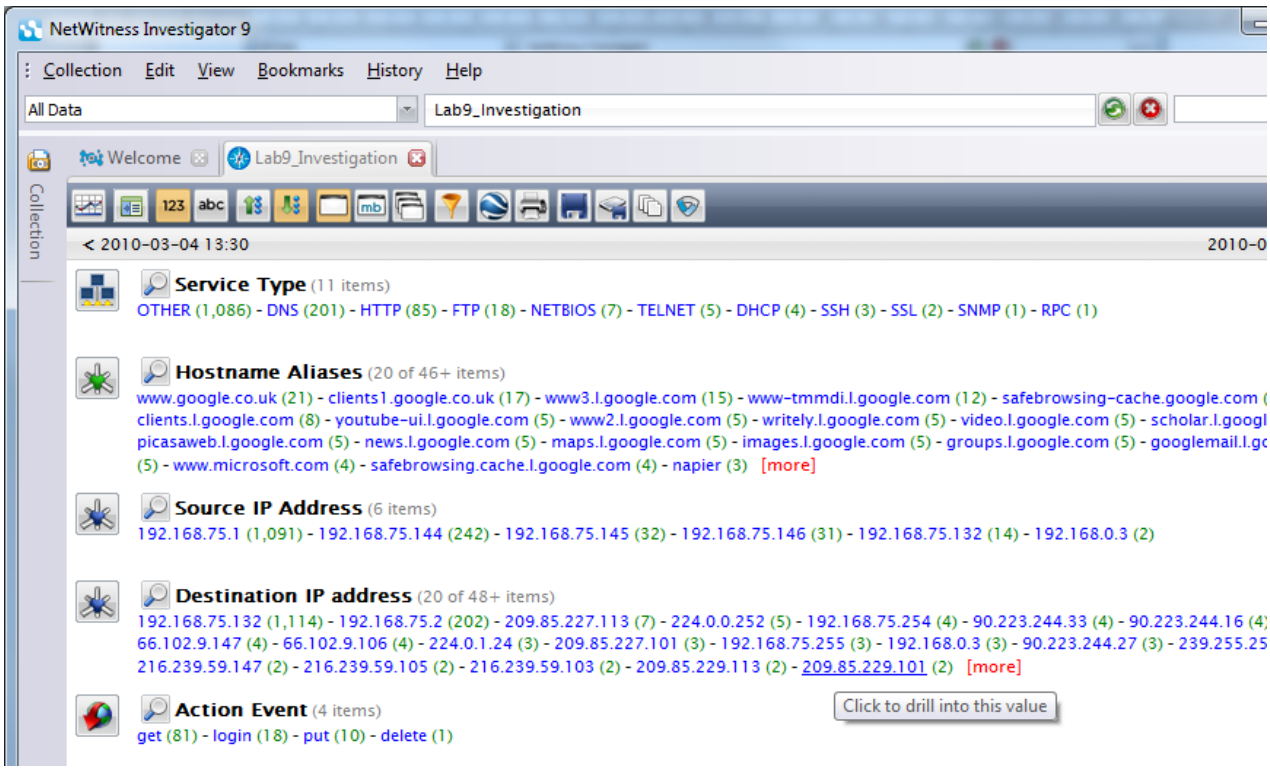
In the New Local Collection Dialog Box, type the name of the Collection, such as Lab9 Investigation and hit OK.



To analyse network data, it must be imported into a collection. To import your pcap file , double click on the new collection, until it states it is **Ready**. Then select **Collection>Import Packets** and add the capture file



Double click the collection and the details of the capture file are shown

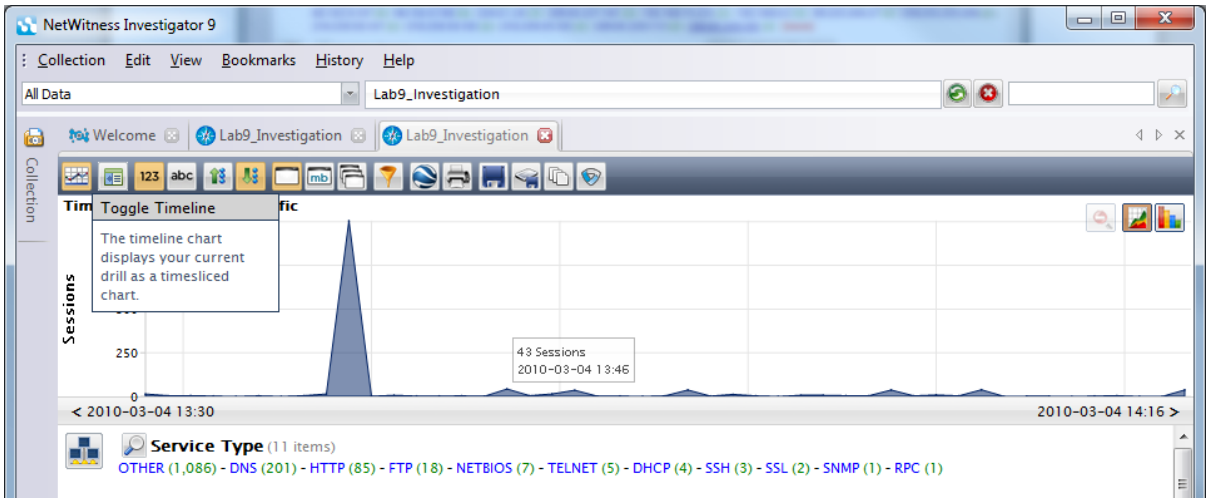


The navigation/breadcrumb bar is at the top. This allows you to understand the context of the data you are currently looking.

Note that each protocol name/data type is a hyperlink that can be clicked in order to further drill-down into the data.

Timeline

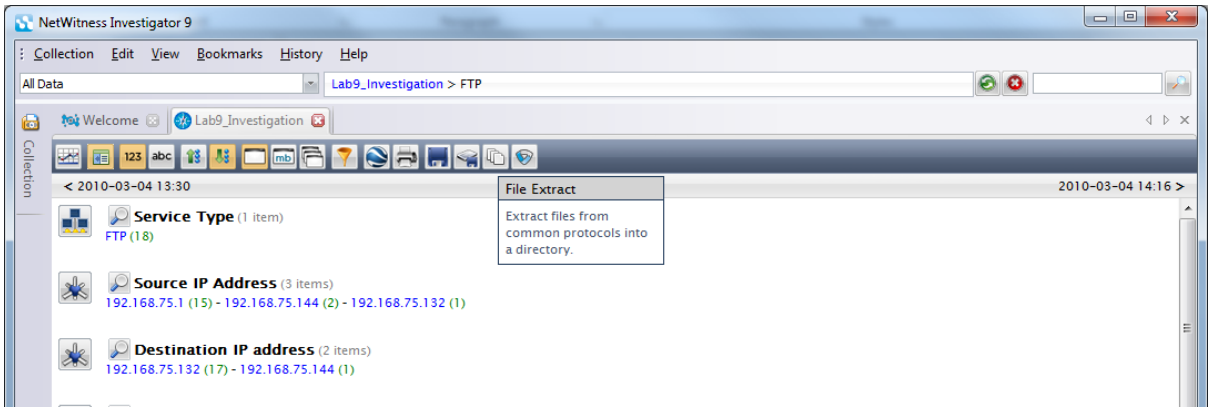
To create a timeline of activity for the entire trace, click the Toggle Timeline button, on the far left of the button toolbar.



Questions

Q. At what time do the sessions spike?

Protocols and sessions can be drilled into. Click on the FTP protocol and the details of all FTP sessions can be seen.



Questions

Q. Which FTP user has been used?

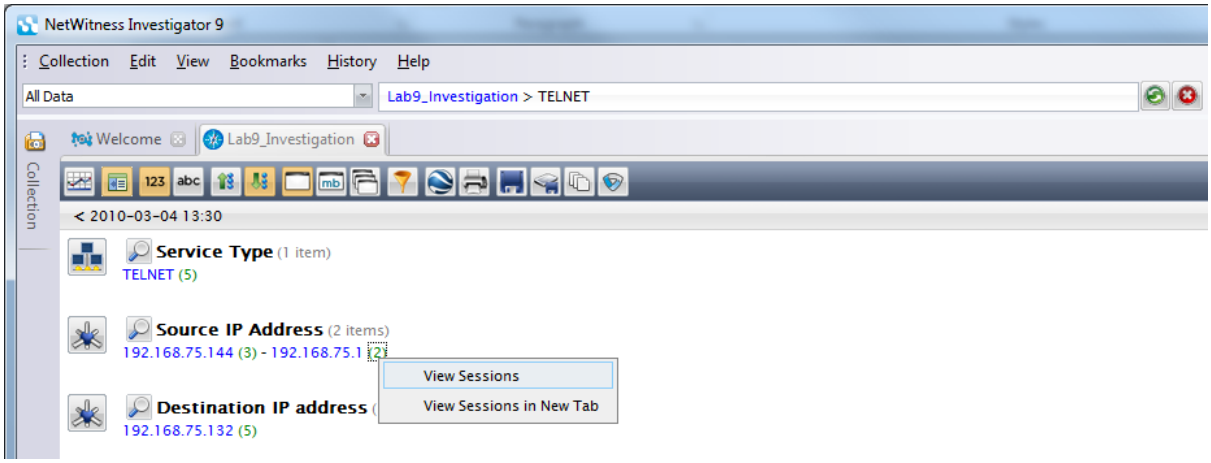
Go back to the main trace and select the Telnet sessions.

Questions

Q. From the details, which 3 IP Addresses are involved in Telnet?

Q. Which user accounts have been used?

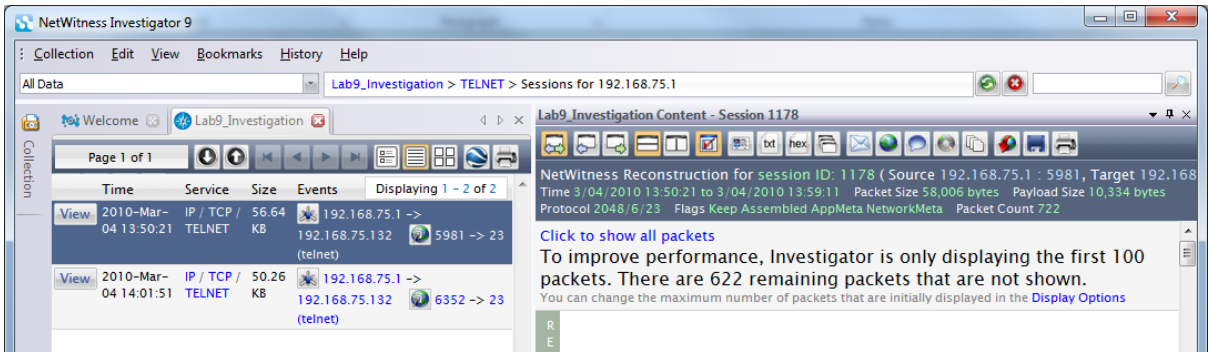
To drill down further, Right click the session number for the 192.168.75.1 host and selct View Sessions.



Questions

Q. What are the times of the FTP sessions?

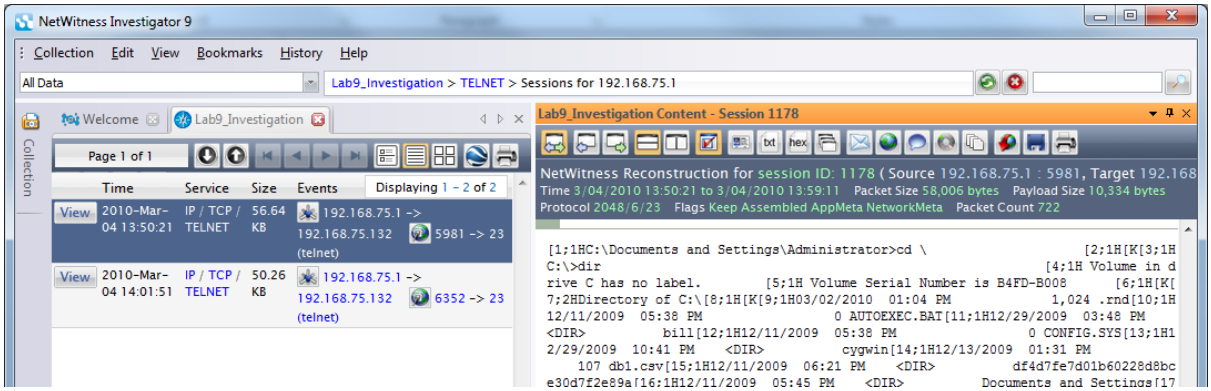
Click the 1st session and the details and content of the session should be shown:



Scroll down to see the content.

Questions

Q. Can you find the directory listing, and can you list some of the directories?



Netwitness can view details on sessions in various formats, reconstructing web pages, images and emails. The view buttons at the top of the session details pane can be used.

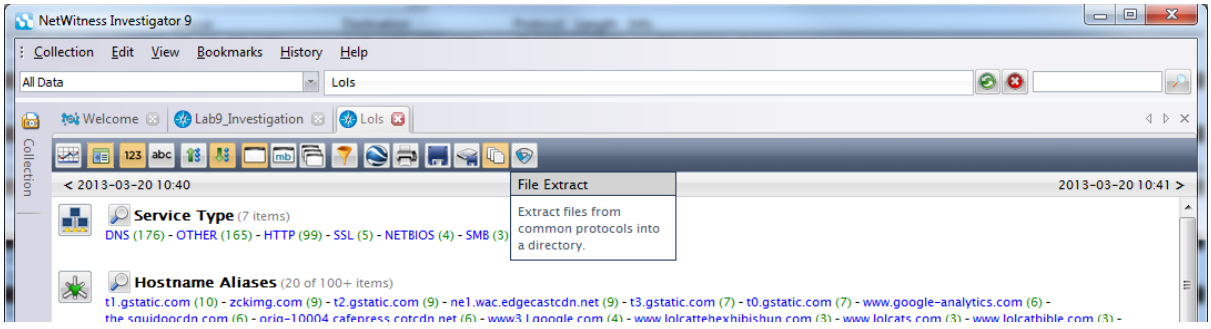
Extracting and Rebuilding File Content from Evidence Files

In NetWitness, create a new collection, and download and add the following evidence trace to the collection.

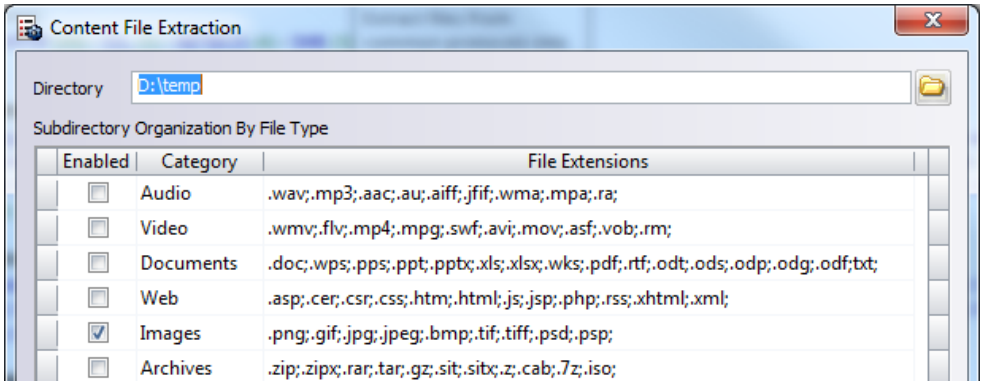
The Evidence Trace is at:
http://www.dcs.napier.ac.uk/~cs342/CSN10102/evidence_lol.pcap

Explore the trace briefly.

Now extract and rebuild image files from the trace using the File Extract button:



Click the images button and save to your c:\temp drive:

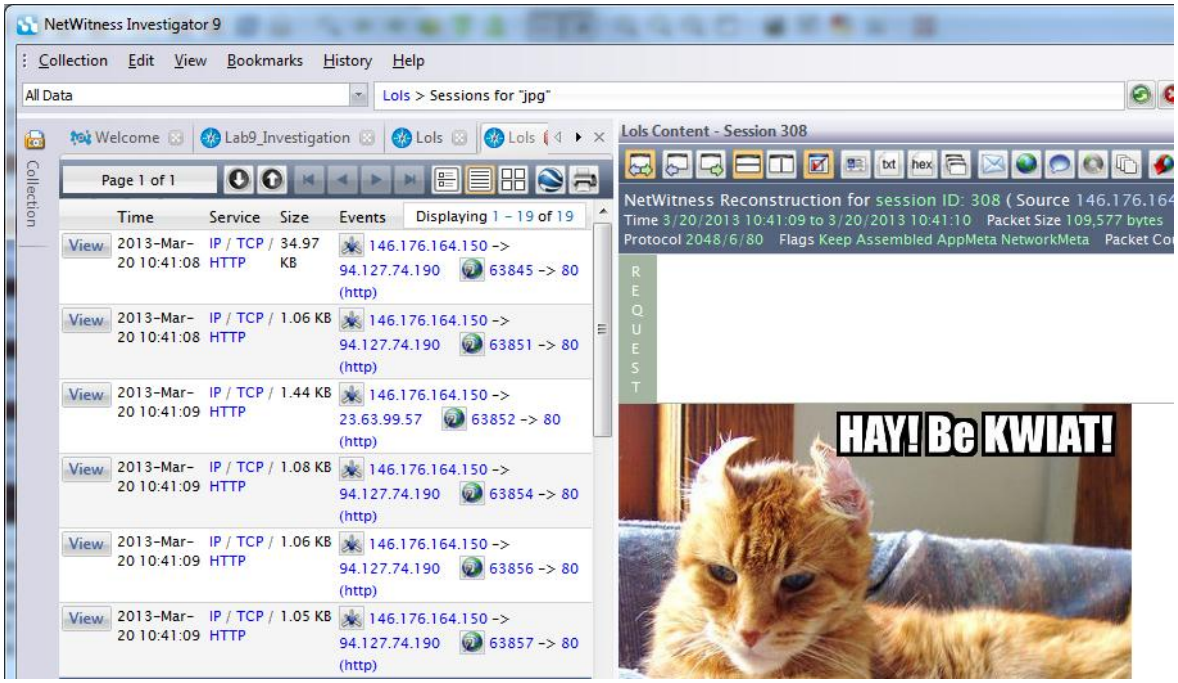


Open Explorer and investigate the evidence image files recovered.

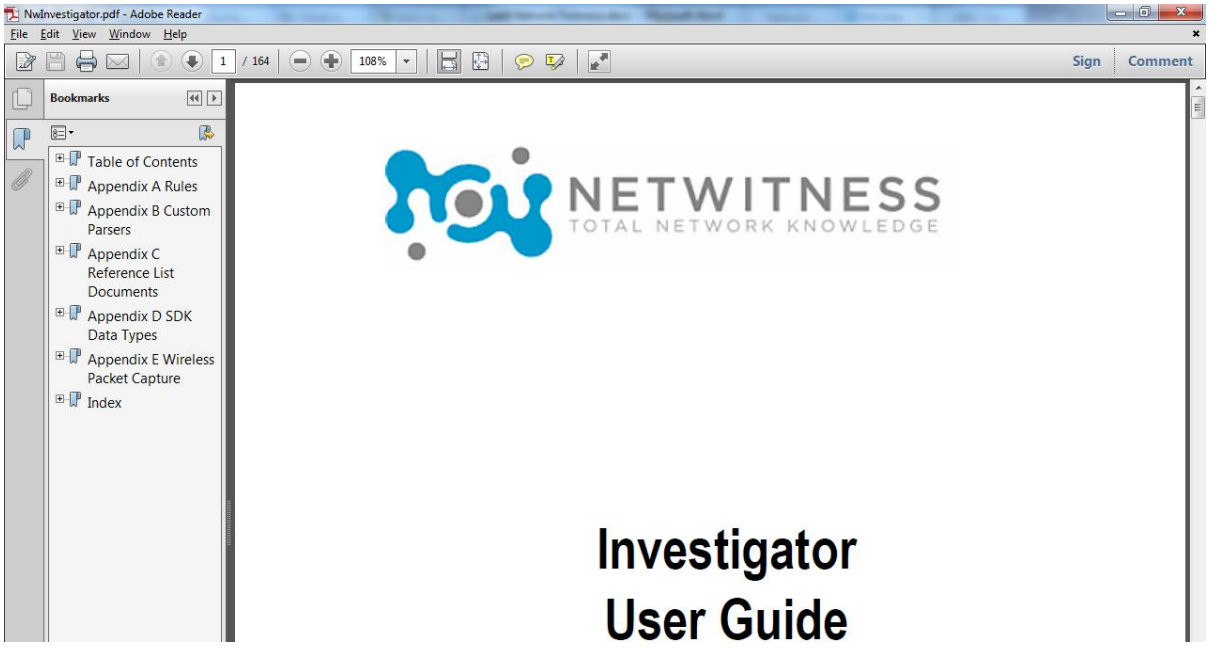
Questions

Q. What type of image files have been found?

Explore the HTTP sessions, and the image type sessions, of the trace and try to view each image file individually:

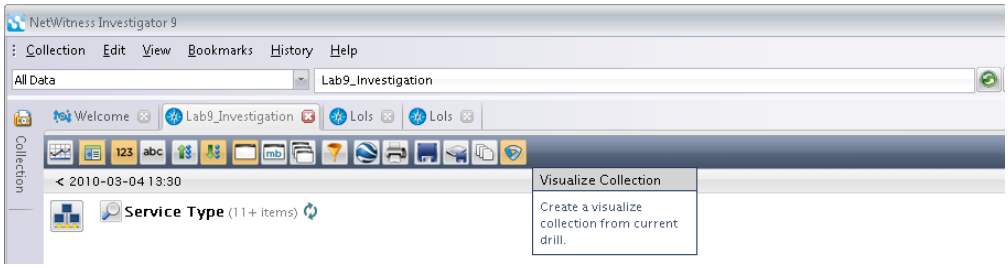


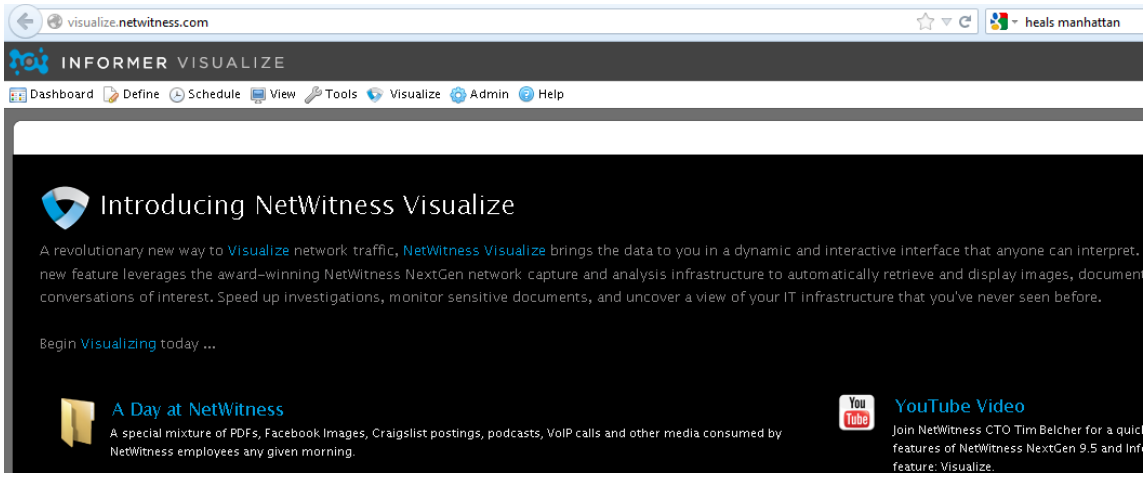
For more detailed information on Netwitness refer to the manual, which can be accessed from Help>Documentation menu option, as shown below:



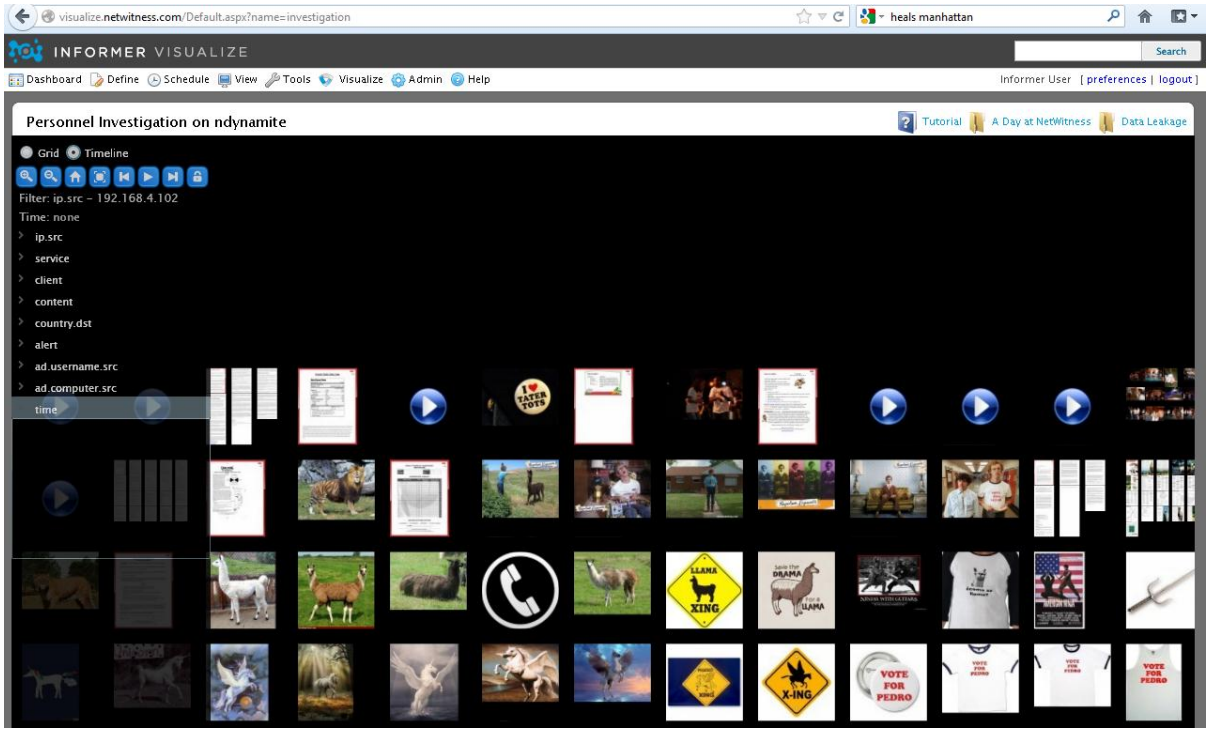
Netwitnes Visualize

Netwitness Visualize is a brand new web-based visualisation tool for network trace analysis. It allows the analysis of completely visualised network trace. If you click the **Visualise Collection** button, it will take you to the web site.





The YouTube video gives an overview of the visualisation tool, and the **A Day at Netwitness** and **Personnel Investigation** links let you try out the tool.


visualize.netwitness.com/Default.aspx?name=investigation
heals manhattan
INFORMER VISUALIZE
Search
Dashboard
Define
Schedule
View
Tools
Visualize
Admin
Help
Informer User [preferences | logout]
Personnel Investigation on ndynamite
Tutorial
A Day at NetWitness
Data Leakage
Grid
Timeline
Filter: ip.src = 192.168.4.102
Time: none
ip.src
service
client
content
country.dst
alert
ad.username.src
ad.computer.src
time
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