

**SAMPLE  
3-DAY COURSE**

**Analyzing**

**TCP/IP**

**Networks with**

**Wireshark**



**CHAPPELLUNIVERSITY**

## **Chappell University™ Sample 3-Day Course: Analyzing TCP/IP Networks with Wireshark®**

Copyright © Protocol Analysis Institute, Inc. All rights reserved. No part of this Sample 5-Day Course Outline, or related materials, including interior design, cover design and trace files, may be reproduced or transmitted in any form, by any means (electronic, photocopying, recording or otherwise) without the prior written permission of the publisher.

ISBN13: N/A

Part No: Custom 3-Day Sample Outline

Distributed worldwide for Chappell University through Protocol Analysis Institute, Inc.

For general information on Chappell University or Protocol Analysis Institute, Inc, including information on corporate licenses, updates, future titles or courses, contact Protocol Analysis Institute, Inc. at 408/378-7841 or send email to [info@chappellU.com](mailto:info@chappellU.com).

For authorization to photocopy items for corporate, personal or educational use, contact Protocol Analysis Institute, Inc. at [info@chappellU.com](mailto:info@chappellU.com).

Trademarks: All brand names and product names used in this book or mentioned in this course are trade names, service marks, trademarks, or registered trademarks of their respective owners.

Limit of Liability/Disclaimer of Warranty. The author and publisher have used their best efforts in preparing this Student Manual and the related materials used in this training course. Protocol Analysis Institute, Inc., Chappell University and the author(s) make no representations or warranties or merchantability or fitness for a particular purpose. Protocol Analysis Institute, Inc. and Chappell University assume no liability for any damages caused by following instructions or using the techniques or tools listed in this Student Manual or related materials used in this training course. Protocol Analysis Institute, Inc., Chappell University and the author(s) make no representations or warranties that extend beyond the descriptions contained in this paragraph. No warranty may be created or extended by sales representatives or written sales materials. The accuracy or completeness of the information provided herein and the opinions stated herein are not guaranteed or warranted to produce any particular result and the advice and strategies contained herein may not be suitable for every individual. Protocol Analysis Institute, Inc., Chappell University and author(s) shall not be liable for any loss of profit or any other commercial damages, including, without limitation special, incidental, consequential, or other damages.

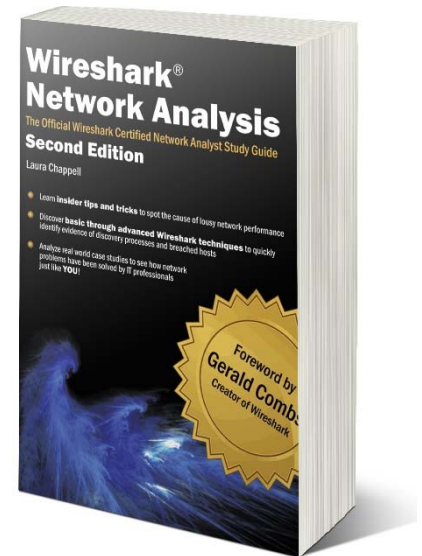
Copy Protection. In all cases, reselling or duplication of this Student Manual and related materials used in this training course without explicit written authorization is expressly forbidden.

Protocol Analysis Institute, Inc.  
dba Chappell University  
59 Damonte Ranch Parkway, B340  
Reno, NV 89521 USA  
[info@chappellU.com](mailto:info@chappellU.com)

## Wireshark Network Analysis: The Official Wireshark Certified Network Analyst Study Guide – Second Edition

This book focuses on practical use of the Wireshark Certified Network Analyst Exam objectives. For more information, visit [www.wiresharkbook.com](http://www.wiresharkbook.com).

Author: Laura Chappell, Founder of Wireshark University  
Foreword: Gerald Combs, Creator of Wireshark  
Contributors: Numerous  
Paperback: 986 pages  
Publisher: Protocol Analysis Institute  
Website: [www.wiresharkbook.com](http://www.wiresharkbook.com)  
Language: English  
ISBN-10: 1-893939-94-4  
ISBN-13: 978-1-893939-94-3  
Dimensions: 7.44 x 9.69 inches  
Weight: 4 pounds  
Contact: [info@wiresharkbook.com](mailto:info@wiresharkbook.com)  
Exam Info: [www.wiresharktraining.com/certification](http://www.wiresharktraining.com/certification)



### **Wireshark Certified Network Analyst Exam**

The Wireshark Certified Network Analyst program is designed to validate a professional's abilities to analyze, troubleshoot, secure and optimize networks using Wireshark.

For more information on the Wireshark Certified Network Analyst Exam, visit [www.wiresharktraining.com/certification](http://www.wiresharktraining.com/certification).

## ***About the Course Author***

### ***Wireshark University/Chappell University Founder***

Ms. Chappell is the Founder of Wireshark University and Chappell University, and the Senior Protocol/Security Analyst for the Protocol Analysis Institute, Inc., three US-based companies that research, document and present information on network and host forensics, security breaches and cutting-edge exploit tools.

Ms. Chappell is often called in to troubleshoot more complex network problems that require visibility into the communications system. Her clients include the U.S. Navy, IBM Corporation, Apple, Cisco Systems, U.S. Court of Appeals, United Bank of Switzerland, Dell Corporation, Australian High Tech Crime Centre, Capital One Financial Services, U.S. Armory, Hong Kong Police Department, Symantec Corporation, McAfee Corporation, Microsoft, Bank of San Francisco, Beth Israel Medical Center (Harvard), U.S. Joint Warfare Analysis Center and Pharmerica Corporation. With her skills as both a network analyst and Instructor, Ms. Chappell mixes onsite analysis services with live analysis training to develop self-sufficient IT teams within her client organizations.

As a member of the High Technology Crime Investigation Association (HTCIA) and the FBI's Infragard, Ms. Chappell has trained local, regional, national, and international law enforcement officers, as well as corporate security professionals on the methods and tools used to attack and defend networks. Ms. Chappell is also a voting member of Institute for Electrical and Electronics Engineers (IEEE) (member since 1990).

Ms. Chappell's enthusiasm for her topics, sense of humor and preference for working "live" during sessions has consistently ranked her as a top-presenter at numerous conferences including Microsoft TechEd North America, Microsoft TechEd Europe, HP Technical Forum, HTCIA International Conference, InterOp, Altiris ManageFusion and Novell BrainShare.

Ms. Chappell can be reached via email at [laura@chappellu.com](mailto:laura@chappellu.com).

[This page intentionally left blank.]

# Table of Contents

Wireshark Certified Network Analyst Exam .....	i
About the Course Author Wireshark University/Chappell University Founder .....	ii
Course Logistics .....	X
Course Supplements .....	xi
Simple Course Set Up .....	xi
The Creation of Ethereal... then Move to Wireshark .....	xii
The Wireshark License .....	xiii
Get the Latest Version of Wireshark .....	xiv
Stable Release Version/Subversion Numbering .....	xiv
Developer Release Version/Subversion Numbering .....	xiv
<b>Section 1: Troubleshooting Methodology .....</b>	<b>1</b>
Overview of a Four-Part Analysis Methodology .....	3
Task 1: Define the Problem .....	3
Task 2: Collect System, Application and Path Information .....	4
Task 3: Capture and Analyze Packet Flows .....	4
Task 4: Consider Other Tools .....	6
Use a Troubleshooting Checklist .....	7
Verify Trace File Integrity and Basic Communications .....	7
Focus on Complaining User's Traffic .....	7
Detect and Prioritize Delays .....	7
Look for Throughput Issues .....	8
Check Miscellaneous Traffic Characteristics .....	8
TCP-Based Application: Determine TCP Connection Issues/Capabilities .....	9
TCP-Based Application: Identify TCP Issues .....	9
UDP-Based Application: Identify Communication Issues .....	9
Spot Application Errors .....	9
<b>Section 2: Master Key Wireshark® Troubleshooting Tasks .....</b>	<b>11</b>
Top Causes of Performance Problems .....	13
Capturing Traffic: Link-Layer Interfaces .....	14
Opening Trace Files .....	15
Processing Packets .....	16
Core Engine .....	16
Dissectors, Plugins and Display Filters .....	16
The Qt Framework Provides the User Interface .....	16
The Qt Interface Overview .....	18
First Step: Create a Troubleshooting Profile .....	19
The Icon Toolbar .....	20

Master the Intelligent Scrollbar .....	21
The Changing Status Bar .....	22
Right-Click Functionality .....	23
Keyboard Shortcuts (Accelerators).....	24
General Analyst Resources .....	25
How to Use ask.wireshark.org .....	25
Your First Task When You Leave Class - Baseline.....	26
Use Annotations.....	26
Use Logical Naming Conventions for Trace Files.....	27
Customize the User Interface .....	28
Add Custom Columns for the Packet List Pane.....	29
Define Name Resolution Preferences .....	30
Mapping IP Addresses on the Earth (GeoIP Mapping).....	31
Build Permanent Coloring Rules.....	32
Identify a Coloring Source .....	33
Apply Temporary Coloring .....	34
Mark Packets of Interest.....	35
Capture File Properties.....	36
View Active Protocols .....	37
Filter On or Colorize Protocol Traffic.....	37
Locate the Most Active Conversations and Endpoints .....	38
Follow TCP Streams to Reassemble Data .....	39
Graph the Traffic Flows for a More Complete View.....	40
Quick Overview of VoIP Traffic Analysis .....	41
Watch for Error Codes and Packet Loss.....	42

**Section 3: Learn Capture Methods and Use Capture Filters ..... 44**

Capture Issues.....	46
Task Offload (Including Checksum Offload) .....	46
Dropped Packets During Capture .....	46
Analyzer Placement: Switches .....	47
Walk-Through a Sample SPAN Configuration.....	48
Analyze Full-Duplex Links with a Network TAP.....	49
Analyzing Wireless Networks .....	50
Initial Analyzing Placement.....	51
Identify Active Capture Interfaces Using Sparklines.....	52
Save Directly to Disk.....	53
Save to File Sets for Manageable File Sizes .....	53
Use a Ring Buffer to Avoid Filling a Drive .....	53

Capture Output and Options .....	54
Define the Criteria to Create a New File .....	54
Define Auto-Stop Criteria .....	54
Limit Your Capture with Capture Filters .....	55
Examine Key Capture Filters .....	56
<b>Section 4: Troubleshoot with Time .....</b>	<b>58</b>
Examine the Delta Time .....	60
Set a Time Reference .....	60
Reading Time Values .....	61
Compare Timestamp Values .....	62
Seconds Since Beginning of Capture (default; <code>frame.time_relative</code> ) .....	62
Seconds Since Previous Captured Packet ( <code>frame.time_delta</code> ) .....	62
Compare Timestamps of Filtered Traffic .....	63
Seconds Since Previous Displayed Packet ( <code>frame.time_delta_displayed</code> ) .....	63
Enable and Use TCP Conversation Timestamps .....	64
Compare TCP Conversation Timestamp Values .....	65
Determine the Initial Round Trip Time (iRTT) .....	66
Troubleshooting Example Using Time .....	67
Wire Latency .....	67
Processor Latency .....	67
Analyzing Delay Types .....	68
Detect DNS Delays .....	70
Detect HTTP Delays .....	71
<b>Section 5: Master Basic and Advanced IO Graph Functions .....</b>	<b>72</b>
Graph Throughput to Spot Performance Problems Quickly .....	74
Graph Specific Traffic with Filters .....	74
Distinguish Traffic with Various Styles .....	74
Advanced I/O Graphing .....	75
SUM(Y Field) Graphing .....	75
MAX(Y Field), MIN(Y Field), and AVG(Y Field) Graphing .....	76
COUNT FRAMES(*) or COUNT FIELDS(*) Calc .....	77
LOAD(Y Field) Graphing .....	79
Graph Round Trip Times .....	80
Graph TCP Throughput .....	81
Find Problems Using TCP Time Sequence Graphs .....	82
Identify TCP Window Size Problems .....	83
Identify Retransmissions .....	84



## **Section 6: Focus on Traffic Using Display Filters..... 86**

Overview of Display Filters .....	88
Filter on Conversations/Endpoints .....	89
Build Filters Based on Packets .....	90
Apply as Filter (Apply Now).....	90
Prepare a Filter (Manually Apply) .....	90
... Filter Options .....	90
Understand Display Filter Syntax .....	91
Use Comparison and Membership Operators .....	92
Filter on Text Strings.....	93
Regular Expressions 101.....	94
Build Filters Expression Buttons .....	95
Watch for Common Display Filter Mistakes.....	96
Filter Error Checking .....	96

## **Section 7: TCP/IP Communications and Resolutions Overview..... 98**

TCP/IP Functionality Overview .....	100
When Everything Goes Right .....	101
The Multi-Step Resolution Process .....	102
Port Number Resolution.....	103
Name Resolution .....	103
Location Resolution .....	104
Local – MAC Address Resolution .....	104
Remote – Route Resolution.....	105
Remote – MAC Address Resolution for a Gateway.....	105
Resolution Helped Build the Packet .....	106
Where Can Faults Occur? .....	107
Typical Causes of Slow Performance.....	108

## **Section 8: Analyze Transmission Control Protocol (TCP) Protocol..... 111**

TCP Overview.....	113
The TCP Connection Process .....	114
Watch Service Refusals.....	115
TCP Packet Structure .....	116
Source Port Field .....	116
Destination Port Field.....	116
Sequence Number Field .....	116
Acknowledgment Number Field .....	117

Data Offset Field (Header Length field) .....	117
Flags Field .....	117
Window Field .....	118
Checksum Field .....	118
Urgent Pointer Field .....	118
TCP Options Field(s) .....	118
The TCP Sequencing/Acknowledgment Process .....	120
TCP Segmentation Offload (TSO) .....	121
Packet Loss Detection .....	122
Retransmission Detection .....	123
Fast Recovery/Fast Retransmission Detection .....	124
Spurious Retransmission Detection .....	125
Out-of-Order Segment Detection .....	126
Selective Acknowledgement (SACK) Overview .....	127
TCP Sliding Window Overview .....	128
Window Scaling Overview .....	130
Window Size Issue: Receive Buffer Problem .....	131
Window Size Issue: Unequal Window Size Beliefs .....	132

## **Section 9: Identify Problems Using Wireshark's Expert ..... 133**

Troubleshoot TCP Quickly with Expert Information .....	135
TCP Expert Information Details Sample .....	136
Expert Information Classifications .....	136
What Triggers <i>TCP Retransmissions</i> ? .....	137
What Triggers <i>Fast Retransmission</i> ? .....	137
What Triggers <i>Spurious Retransmissions</i> ? .....	137
What Triggers <i>Previous Segment Not Captured</i> ? .....	137
What Triggers <i>ACKed Unseen Segment</i> ? .....	137
What Triggers <i>Keep Alive</i> ? .....	137
What Triggers <i>Duplicate ACK</i> ? .....	137
What Triggers <i>Zero Window</i> ? .....	138
What Triggers <i>Zero Window Probe</i> ? .....	138
What Triggers <i>Zero Window Probe ACK</i> ? .....	138
What Triggers <i>Keep Alive ACK</i> ? .....	138
What Triggers <i>Out-of-Order</i> ? .....	138
What Triggers <i>Window Update</i> ? .....	138
What Triggers <i>Window Full</i> ? .....	139
What Triggers <i>TCP Ports Reused</i> ? .....	139

<b>Part 10: Command-Line and 3rd Party Tools.....</b>	<b>141</b>
Tshark and Dumpcap Command-Line Tools .....	143
Capinfos Command-Line Tool .....	144
Editcap Command-Line Tool .....	145
Mergecap Command-Line Tool .....	146
Sanitize Trace Files .....	147
Other Tools .....	148

# Course Introductions

---

- About this online training process
- Course starting, ending and break times, and the timer
- Student Manual format
- Course trace files
- Submitting questions along the way
- Testing your systems

## **Course Logistics**

At this time, your instructor provides detail about the online training format, course times and course format. In addition, you will review the Student Manual format and items contained on the Chappell University Online Training Portal.



### **FYI**

This is the ideal time to test your system to ensure Wireshark is able to open up trace files and just scroll through the packets. Also examine the Interface List on the Wireshark Start Screen to be certain that Wireshark can see at least one interface on your system. Wireshark relies on packet capture drivers (such as WinPcap and libpcap to capture traffic).

## Course Estimator and Quote Request Form

Ready to train your team on Wireshark, TCP/IP analysis, troubleshooting and network forensics? Complete Part 1 of this Cost Estimator and Quote Request Form to determine the cost of training.

Training is available in three formats:

- **Onsite:** instructor-led, lab-based at your location - customize with your own traffic files
- **Online Live:** instructor-led, lab-based connected via the Internet - customize with your own traffic files
- **On-Demand:** online recorded, available 24x7, transcripts, one-year All Access Pass subscriptions

Please contact us at [info@chappellU.com](mailto:info@chappellU.com) if you have any questions.

Email completed forms to Brenda Cardinal ([brenda@chappellU.com](mailto:brenda@chappellU.com)).

### Part 1: Training Project Information (Required for Formal Quotes)

Use this form for group pricing for onsite, online or on-demand training.

Project Title	
Contact Name	
Company	
Phone Number	
Your Email Address	
Company Billing Address for Quote?	
Desired Course Format	Onsite Live Online Live On-Demand (All Access Pass Subscriptions) Other
Course Delivery Timeline	Within 3 months 3-6 months 6+ months I have specific dates in mind (see next item)
Desired Training Dates	
Course Location (if known)	
Number of Students	Up to 20 students 21-30 students 31-40 students 41-50 students Over 50 students (estimated student count:      )
Course Length	Less than 2 days (online training option only) 2 days 3 days 4 days 5 days 6 or more days (estimated course length in days:      )

# CHAPPELLUNIVERSITY

## Course Objectives

Objective #1

Objective #2

Objective #3

Additional Elements to  
include in your training quote  
(optional)

Pre- and post-course quizzes

Discounted All Access Pass Group Subscriptions (online 1-year training subscription)

*Wireshark Network Analysis* book (1 per student)

*Wireshark 101: Essential Skills for Network Analysts* book (1 per student)

*Troubleshooting with Wireshark* book (1 per student)

*Wireshark Certified Network Analyst Exam Prep Guide* (1 per student)

Follow-up Live Online Webinar

*Wireshark Certified Network Analyst Exam* Vouchers

Other

Will you provide trace files  
for further customization  
of the training material?

Yes

No

Unknown

Other Requests or Comments

## Part 2: Design Your Course Content

Please let us know what topics you would like covered in your custom course. Visit [www.chappellu.com/onsite.html](http://www.chappellu.com/onsite.html) for sample course outlines. You may choose to use a sample outline with modifications if desired.

<b>Section 1</b> <b>Network Analysis Overview</b>	All items in this section Troubleshooting Tasks for the Network Analyst Security Tasks for the Network Analyst Application Analysis Tasks for the Network Analyst Security Issues Related to Network Analysis Legal Issues Related to Listening to Network Traffic Overcome the "Needle in a Haystack" Issue Example of a Network Analysis Session from Symptoms to Resolution Other
<b>Section 2</b> <b>Wireshark Functionality Overview</b>	All items in this section Capturing Packets on Wired or Wireless Networks Working with Trace Files from Other Capture Devices - Wiretap Library How Wireshark Processes Packets – Drivers, Dissectors, Filters, Plugins Wireshark Installation Options, Executable Files and Configuration Files Accessing the Wireshark Code and Updates Other
<b>Section 3</b> <b>Capture Techniques: Wired/Wireless</b>	All items in this section Where to Tap into the Network–Wired/WLAN, Duplex Issues, Switches Infrastructure Effects – NAT/PAT, QoS Routing, VLANs, APs Options for Remote Capture Using File Sets and Optimizing for Large Capture Quantity Conserve Memory with Command-line Capture (tshark, dumpcap) Using Default and Custom Capture Filters Filter by a Protocol, Address or Host Name Advanced Capture Filters (Operators and Byte Offset Filtering) Work with Multi-Adapter Capture Other
<b>Section 4</b> <b>Customize Wireshark: Preferences and Profiles</b>	All items in this section Create a Custom Profile and Share Profile Elements Set Global and Personal Configurations Customize Your User Interface Settings Define Your Capture Preferences Define IP and MAC Name Resolution Options for Network Name Resolution Define ARP, TCP, HTTP/HTTPS and Other Protocol Settings Use Colors to Distinguish Traffic Mark Packets of Interest Annotations and Report Generation Working with Columns for Efficient Analysis Dealing with Applications Running Over Non-Standard Port Numbers Using Right-Click Functionality Other

# CHAPPELLUNIVERSITY

<b>Section 5</b> <b>Troubleshoot with Time Values and Summary Information</b>	All items in this section Alter the Default Time Column Measure Roundtrip Time and Path Latency Create Additional Time Columns Analyze Application Response Times Other
<b>Section 6</b> <b>Interpret Basic Trace File Statistics to Identify Trends</b>	All items in this section Identify Protocols and Applications in Use Identify the Most Active Conversations/Endpoints List Endpoints and Map Them on the Earth (GeoIP Mapping) List Conversations or Endpoints for Specific Traffic Types List All UDP and TCP Ports Used Graph the Flow of Traffic Analyze HTTP Statistics Analyze WLAN Statistics Other
<b>Section 7</b> <b>Create and Apply Display Filters for Efficient Analysis</b>	All items in this section Create Display Filters Using Auto Complete Create and Apply Saved Display Filters Filter on a Conversation, Endpoint or Protocol Use Expressions for Filters of Lesser-Known Applications Combine Display Filters with Comparison Operators Alter Display Filter Meaning with Parentheses Filter on Specific Bytes in a Packet Avoid Common Display Filter Mistakes Manually Edit the <i>dfilters</i> File Add Filter Expression Buttons Share Display Filters with Other Wireshark Systems Other
<b>Section 8</b> <b>Follow Streams and Reassemble Data</b>	All items in this section Follow and Reassemble UDP Conversations Follow and Reassemble TCP Conversations Use Reassembly to Identify Undissected Traffic Use Reassembly to Extract Files Transferred Across a Network Identify Common File Types Based on File Identifiers Follow and Reassemble SSL Conversations Other
<b>Section 9</b> <b>TCP/IP Traffic Analysis Overview - Resolutions</b>	All items in this section Define Basic TCP/IP Functionality Define the Multistep Resolution Process Define Port Number Resolution Define Network Name Resolution Define Route Resolution for a Local Target Define Local MAC Address Resolution for a Target Define Route Resolution for a Remote Target Define Local MAC Address Resolution for a Gateway Other



# CHAPPELLUNIVERSITY

**Section 10**  
**Analyze Domain Name System (DNS) Traffic**

All items in this section  
Analyze Normal DNS Queries/Responses  
Analyze Unusual DNS Queries/Responses  
Dissect the DNS Packet Structure  
Identifying DNS Faults with Filter Expression Buttons  
Use DNS Packets in the Trace File for Wireshark Name Resolution  
Other

---

**Section 11**  
**Analyze Address Resolution Protocol (ARP) Traffic**

All items in this section  
Analyze Normal ARP Requests/Responses  
Analyze Unusual ARP Requests/Responses  
Analyze Gratuitous ARP  
Dissect the ARP Packet Structure  
Other

---

**Section 12**  
**Analyze Internet Protocol (IPv4) Traffic**

All items in this section  
Analyze Normal IPv4 Traffic  
Analyze Unusual IPv4 Traffic  
Dissect the IPv4 Header Structure  
Set Your IP Protocol Preferences  
Identify Issues Related to Fragmentation and Reassembly  
Identify Black Hole Detection Blocking Issues  
Analyze the Use of Differentiated Services Code Point (DSCP)  
IPv6 Overview and Comparison with IPv4  
Other

---

**Section 13**  
**Analyze Internet Control Messaging Protocol (ICMP) Traffic**

All items in this section  
Analyze Normal ICMP Traffic  
Analyze Unusual ICMP Traffic  
Dissect the ICMP Packet Structure  
Service Refusal Detection – Destination Unreachable  
Black Hole Detection  
ICMP Types and Codes to Catch  
Other

---

**Section 14**  
**Analyze User Datagram Protocol (UDP) Traffic**

All items in this section  
Analyze Normal UDP Traffic  
Analyze Unusual UDP Traffic  
Dissect the UDP Header Structure  
Analyze UDP-based Multicast Video Streams  
Other

---

<b>Section 15</b> <b>Analyze Transmission Control Protocol (TCP) Traffic</b>	All items in this section Access Expert Info Analyze Normal TCP Communications Analyze Unusual TCP Communications (Packet Loss, Congestion, etc.) Define the Establishment of TCP Connections (3-Way and 2-Way Handshakes) Define How TCP-based Services Are Refused TCP Sequential Packet Tracking TCP Selective ACK (SACK) Analysis TCP Window Scaling Analysis TCP Timestamp Analysis (Including PAWS) Define TCP Flow Control (Receiver Congestion, Congestion Window) Analyze the Most Common TCP Problems (See Section 16) Set TCP Protocol Parameters Work with TCP Stream Index Values Graph TCP Streams (Stevens/tcptrace) Other
---	--

---

<b>Section 16</b> <b>Use Wireshark's Expert System to Identify Anomalies</b>	All items in this section Filter on TCP Expert Information Elements Expert Info: tcp_analysis_retransmission Expert Info: tcp_analysis_fast_retransmission Expert Info: tcp_analysis_spurious_retransmission Expert Info: tcp_analysis_out_of_order Expert Info: tcp_analysis_reused_ports Expert Info: tcp_analysis_lost_packet Expert Info: tcp_analysis_ack_lost_packet Expert Info: tcp_analysis_window_update Expert Info: tcp_analysis_window_full Expert Info: tcp_analysis_keep_alive Expert Info: tcp_analysis_keep_alive_ack Expert Info: tcp_analysis_duplicate_ack Expert Info: tcp_analysis_zero_window Expert Info: tcp_analysis_zero_window_probe Expert Info: tcp_analysis_zero_window_probe_ack Interpret Developer Comments in the Wireshark Code Other
---	---

---

<b>Section 17</b> <b>Analyze Dynamic Host Configuration Protocol (DHCP) Traffic</b>	All items in this section Analyze Normal DHCP Traffic Analyze Unusual DHCP Traffic Dissect the DHCP Packet Structure Analyze Relay Agent Use Other
--	---

---

<b>Section 18</b> <b>Analyze Common Hypertext Transfer Protocol (HTTP/HTTPS) Traffic</b>	All items in this section Analyze Normal HTTP Communications Analyze Unusual HTTP Communications Filter on HTTP and HTTPS Traffic Export and Display HTTP Objects (Reassembly) Graph HTTP Traffic Flows Set HTTP Preferences Decrypt HTTPS Traffic Analyze the SSL/TLS Handshake Other
---	---

---

# CHAPPELLUNIVERSITY

## Section 19 Analyze File Transfer Protocol (FTP) Traffic

All items in this section  
Analyze Normal FTP Communications  
Analyze Unusual FTP Communications  
Reassemble FTP Data Transfers  
Colorize FTP Commands  
Other

---

## Section 20 Analyze Email Traffic Patterns

All items in this section  
Analyze Normal Email Communications  
Analyze Unusual Email Communications  
Analyze POP Traffic  
Analyze SMTP Traffic  
Other

---

## Section 21 Graph I/O Rates and TCP Trends

All items in this section  
Generate Basic I/O Graphs (All Traffic/Expert-Flagged Traffic)  
Graph Host and Application Traffic  
Use Calc Functions to Graph Field Sums, Averages, Maximums, Minimums, etc.  
Graph Roundtrip Time and Throughput Rates  
Graph TCP Window Size Issues  
Interpret Packet Loss, Duplicate ACKs and Retransmissions in Graphs  
Other

---

## Section 22 802.11 (WLAN) Analysis Fundamentals

All items in this section  
Analyze Normal 802.11 Communications  
Filter on All WLAN Traffic  
Analyze Frame Control Types and Subtypes  
Analyze Signal Strength and Interference  
Capture WLAN Traffic - Compare Monitor Mode and Promiscuous Mode  
Set up WLAN Decryption  
Prepend a Radiotap or PPI Header  
Compare Signal Strength and Signal-to-Noise Ratios  
Describe 802.11 Traffic Basics  
Other

---

## Section 23 Voice over IP (VoIP) Analysis Fundamentals

All items in this section  
Define VoIP Traffic Flows  
Analyze SIP Call Setup Traffic  
Examine RTP Call Traffic  
Detect if DSCP is Affecting Directional Traffic Flows  
Analyze VoIP Problems and Error Response Codes  
Playback Unencrypted VoIP Calls  
Other

---

## Section 24 Network Forensics Fundamentals

All items in this section  
Methodology and Wireshark Use  
The "Good Traffic" Rule  
Anomaly and Signature Locations  
Capture Location and Methods  
Methods for Avoiding Capture Detection  
Essential Capture Filters  
Offset Capture Filters  
String-Matching Capture Filters  
Building a Network Forensics Profile  
Detect Active Applications and Hosts  
Right-Click Features Used for Network Forensics  
Using the Expert to Detect Anomalies

## Network Forensics Fundamentals (continued)

- Exporting Traffic Subsets from Large Trace Files
- GeoIP Mapping
- Data Carving and Object Reassembly
- Annotating for a Network Forensics Report
- Display Filter Essentials for Network Forensics
- Applying Conversation Filters
- Building and Applying Compound Filters
- Keyword Filtering
- Regular Expression (Regex) Filters for Network Forensics
- Turn Network Forensic Filters into Buttons
- Colorize Unusual Traffic Patterns
- Check out Complementary Forensic Tools
- Other

---

## Section 25 Detect Scanning and Discovery Processes

- All items in this section
- Detect ARP Scans (aka ARP Sweeps)
- Detect ICMP Ping Sweeps
- Detect Various Types of TCP Port Scans
- Detect UDP Port Scans
- Detect IP Protocol Scans
- Define Idle Scans
- Know Your ICMP Types and Codes
- Analyze Traceroute Path Discovery
- Detect Dynamic Router Discovery
- Define Application Mapping Processes
- Use Wireshark for Passive OS Fingerprinting
- Detect Active OS Fingerprinting
- Identify Spoofed Addresses and Scans
- Other

---

## Section 26 Analyze Suspect Traffic

- All items in this section
- Define Suspicious Traffic Types
- Identify Vulnerabilities in the TCP/IP Resolution Processes
- Identify Unacceptable Traffic
- Locate .exe, .zip, .jar Files in Trace Files using Regular Expressions
- Find Maliciously Malformed Packets
- Identify Invalid or Dark Destination Addresses
- Differentiate between Flooding or Standard Denial of Service Traffic
- Find Clear Text Passwords and Data
- Identify Phone-Home Behavior
- Catch Unusual Protocols and Applications
- Detect Applications Using Non-Standard Port Numbers
- Force Dissections on Non-Standard Port Number Traffic
- Locate Route Redirection that Uses ICMP
- Catch ARP Poisoning
- Catch IP Fragmentation and Overwriting
- Spot TCP Splicing
- Watch Other Unusual TCP Traffic
- Identify Password Cracking Attempts
- Other

---

# CHAPPELLUNIVERSITY

## Section 27

### Use Command-Line Tools

All items in this section  
Use Wireshark.exe (Command-Line Launch)  
Capture Traffic with tshark  
Capture Traffic with dumpcap  
List Trace File Details with Capinfos  
Edit Trace Files with Editcap  
Merge Trace Files with Mergecap  
Other

---

### Additional Course Requests

Click **Save** when you have completed this form. Email your form to Brenda Cardinal ([brenda@chappellU.com](mailto:brenda@chappellU.com)) to receive a formal quote after we review your request.

Thank you.

Brenda Cardinal ([brenda@chappellU.com](mailto:brenda@chappellU.com))

**CHAPPELLUNIVERSITY**  
+1 408.378-7841