# Wireshark Lab: Ethernet and ARP<sup>1</sup>

## 1. Capturing and analyzing Ethernet frames

Let's begin by capturing a set of Ethernet frames to study. Do the following:

- First, make sure your browser's cache is empty. (To do this under Netscape 7.0, select Edit -> Preferences -> Advanced -> Cache and clear the memory and disk cache. For Internet Explorer, select Tools -> Internet Options -> Delete Files. For Firefox select Tools -> Clear Private Data.
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser: <u>http://www.unab.edu.co</u>
- Stop Wireshark packet capture. First, find the packet numbers (the leftmost column in the upper Wireshark window) of the HTTP GET message that was sent from your computer to www.unab.edu.co, as well as the beginning of the HTTP response message sent to your computer by www.unab.edu.co. You should see a screen that looks something like this (where packet 49 in the screen shot below contains the HTTP GET message)

Microsoft - Wireshark							
Elie Edit View Go Capture Analyze Statistics Telephony Icols Help							
I I I I I I I I I I I I I I I I I I I							
Filter	•	Expression Clear Apply					
No. Time Source	Destination	Protocol Info					
34 1.180918 200.69.124.61	192.168.0.10	ICP NTTP > 498/4	[SYN, ACK] Seq=U ACK=1 W1N=4904U LEN=U MSS=140U WS=U SAG	K_PERM=1			
35 1.180968 192.168.0.10	200.69.124.61	TCP 49874 > http	[ACK] Seq=1 Ack=1 Win=17520 Len=0				
36 1.181336 200.69.124.61	192.168.0.10	TCP NTTP > 498/5	[SYN, ACK] Seq=0 ACK=1 Win=49640 Len=0 MSS=1460 WS=0 SAG	K_PERM=1			
37 1.181383 192.108.0.10	200.69.124.61	TCP 49875 > Http	[ACK] SEQ=1 ACK=1 W1N=1/320 LEN=0 MSS-1460 SACK DEDA	-1 wc-9			
39 1 182071 192 168 0 10	216 137 47 210	TCP 49876 > http	[ACK] Seg=1 Ack=1 Win=17520 Len=0	1-1 W3-0			
40 1.182439 216.137.47.210	192.168.0.10	TCP http > 49877	[SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM	1=1 WS=8			
41 1.182487 192.168.0.10	216.137.47.210	TCP 49877 > http	[ACK] Seg=1 Ack=1 Win=17520 Len=0				
42 1.192299 200.69.124.29	192.168.0.10	HTTP HTTP/1.1 200	OK (text/html)				
43 1.238039 4.27.24.253	192.168.0.10	TCP http > 49872	[SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM	1=1 WS=7			
44 1.238152 192.168.0.10	4.27.24.253	TCP 49872 > http	[ACK] Seq=1 Ack=1 Win=17520 Len=0				
45 1.275372 199.59.148.30	192.168.0.10	TCP http > 49869	[SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM	1=1 W5=8			
46 1.275478 192.168.0.10	199.59.148.30	TCP 49869 > http	[ACK] Seq=1 Ack=1 Win=17520 Len=0				
47 1.275906 199.59.148.30	192.168.0.10	TCP http > 49870	[SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM	1=1 WS=8			
48 1.2/3960 192.168.0.10	200 60 124 20	HTTP CFT (portal/	[ACK] Seq=1 ACK=1 W1N=1/520 Len=0				
50 1 354013 4 27 24 253	192 168 0 10	TCP http > $49871$	[SVN_ACK] Seg=0 Ack=1 win=5840 Len=0 MSS=1460 SACK PERM	(=1 WS=7			
51 1.354108 192.168.0.10	4, 27, 24, 253	TCP $49871 > http$	[ACK] Seg=1 Ack=1 Win=17520 Len=0	1-1 W3-7			
52 1.415340 200.69.124.29	192,168,0,10	TCP http > 49868	[ACK] Seg=1088 Ack=1082 Win=65535 Len=0				
53 1.946700 200.69.124.29	192.168.0.10	TCP [TCP segment	of a reassembled PDU]				
54 1.947379 200.69.124.29	192.168.0.10	TCP [TCP segment	of a reassembled PDU				
55 1.947411 192.168.0.10	200.69.124.29	TCP 49868 > http	[ACK] Seq=1082 Ack=4008 Win=17520 Len=0				
56 1.948147 200.69.124.29	192.168.0.10	TCP [TCP segment	of a reassembled PDU]				
57 1.949138 200.69.124.29	192.168.0.10	TCP [TCP segment	of a reassembled PDU]				
58 1 949181 197 168 0 10	24 hits) 622 hitos ca	ntuned (4084 bits)	Tack1 Sen=1087 ack=6978 win=17570 Ten=0				
Ethernet TT_Src: D-Link 7d:67:	64 DTLS), 625 Dytes ta	Dst: Thomson 7e:4e	23 (00.24.d1.7e.4e.23)				
Thternet Protocol Src: 192 168	0 10 (192 168 0 10)	pst: 200 69 124 29 (	200 69 124 29)				
Transmission Control Protocol.	Src Port: 49868 (49868	), Dst Port: http (8	), Seg: 513, Ack: 1088, Len: 569				
Hypertext Transfer Protocol		, ,	,,,·, ·····, -···				
GET /portal/page/portal/UNAB	HTTP/1.1\r\n						
Host: www.unab.edu.co/r/n							
Connection: keep-alive\r\n							
Referer: http://www.unab.edu.	co/\r\n						
User-Agent: Mozilla/5.0 (Windows; U; Windows NT 6.1; en-US) ApplewebKit/534.16 (KHTML, like Gecko) Chrome/10.0.648.151 Safari/534.16\r\n							
Accept: application/xml,appli	cation/xntmi+xmi,text/	ntmi;q=0.9,text/plai	1; q=0.8, 1mage/png, */*; q=0.5\r\n				
Accept-Encouring: g21p, der race							
ACCept-Language: en-US,en;q=U.8,es;q=0.6(r\n							
Cookie: utmz=174858726.1297	095727.1.1.utmcsr=(dir	ect) utmccn=(direct)	utmcmd=(none)\r\n				
<pre>\r\n</pre>							
0010 02 61 05 06 40 00 80 06 ee	70 67 67 68 00 45 00 7b c0 a8 00 0a c8 45	. 3. ~N#. :		<u>^</u>			
0020 7c 1d c2 cc 00 50 89 00 c0	e2 Of a9 8f 5b 50 18	P[P.					
0030 40 31 d9 8c 00 00 47 45 54	20 2f 70 6f 72 74 61	@1GE T /porta					
<ul> <li>Frame (frame), 623 bytes</li> </ul>	Packets: 806 Displayed: 806 Mar	ked: 0 Dropped: 0		Profile: Default			

<sup>&</sup>lt;sup>1</sup> Lab modified version from Computer Networking: A Top down Approach, 4th edition by J.F. Kurose and K.W. Ross.

• Since this lab is about Ethernet and ARP, we're not interested in IP or higherlayer protocols. So let's change Wireshark's "listing of captured packets" window so that it shows information only about protocols below IP. To have Wireshark do this, select Analyze->Enabled Protocols. Then uncheck the IP box and select OK. You should now see an Wireshark window that looks like:

Explore       Go Cupture Analyze       Sentice Telephony Look Help         Explore       Senter       Periods       Senter         Process       Senter       Periods       Senter         Process       Senter       Periods       Senter         Process       Periods       Senter       Periods       Senter       Periods         Process       Periods       Periods       Senter       Periods	М	icrosoft - Wiresharl	k			
Image: And the analysis of a low of the analysis of the analysi	File	Edit View Go	Canture Analyze Statistic	cs Telephony Tools Help		
Bit Bit Control         Control         Designation         Designation         Designation         Designation           No.         The         Source         Designation         Protocol Med           44         1.273478         DetIntLo2455107         Thomson, 7e4423         Source         Designation           45         1.273420         DetIntLo2457107         Thomson, 7e4423         Source         DetIntLo2457107           45         1.273240         DetIntLo2457107         Thomson, 7e4423         Source         DetIntLo2457107           31         1.494707         Thomson, 7e4423         DetIntLo24567107         Source         DetIntLo2457107           31         1.494707         Thomson, 7e4423         DetIntLo24567107         Source         DetIntLo24567107           31         1.494707         Thomson, 7e4423         DetIntLo24567107         Source         DetIntLo24567107           31         1.994708         Thomson, 7e4423         DetIntLo24567107         Source         DetIntLo24567107           31         1.994708         Thomson, 7e4423         DetIntLo24567107         Douboot DP         DetIntLo24567107           31         1.994708         Thomson, 7e4423         DetIntLo24567107         Doubot DP         DetIntLo24567107	Enc :					
Fittee         Source         Dependent         Petersion         Clear Apply           No.         Source         Delinking         Petersion				S = = = = 1 Z		
No.         Time         Surve         Deltavitien         Petecel info           45         12.27506         http://dis/107         Thesson_7e14e23         0x0800 IP           45         12.27506         http://dis/107         Thesson_7e14e23         0x0800 IP           45         12.27526         D-tith//dis/107         Thesson_7e14e23         0x0800 IP           45         12.27526         D-tith//dis/107         Thesson_7e14e23         0x0800 IP           35         1.34103         Thesson_7e14e23         0x0800 IP         0x0800 IP           31         1.34103         Thesson_7e14e23         0x0800 IP         0x0800 IP           31         1.34138         D-tith//dis/17         Thesson_7e14e23         0x0800 IP           31         1.94737         Thesson_7e14e23         0x0800 IP         0x0800 IP           31         1.94738         Thesson_7e14e23         0x0800 IP         0x0800 IP           31         1.94738         Thesson_7e14e23         0x0800 IP         0x0800 IP           32         1.94338         D-tith//dis/17         Thesson_7e14e23         0x0800 IP           32         0.0187         Thesson_7e14e23         0x0800 IP         0x0800 IP           32         0.0187	Filter:			-	Expression Clear Apply	
461.27547       0-11mL_70167187       Thomson_7e:4e:23       000800 TP         471.27586       0-11mL_70167187       Thomson_7e:4e:23       000800 TP         481.275860       0-11mL_70167187       Thomson_7e:4e:23       000800 TP         301.134031       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.134031       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.134031       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.134031       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.194779       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.194731       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.194731       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         31.994381       0-11mL_70167187       Thomson_7e:4e:23       0-11mL_70167187         361.200287       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         061.200267       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         061.200267       Thomson_7e:4e:23       0-11mL_70167187       Thomson_7e:4e:23         061.200267       Thomson_7e:4e:23       0-11mL_70167187       <	No.	Time	Source	Destination	Protocol Info	
47 12:2500       Thomson_7:4:4:23       0-Link_7d:67:167         48 12:29260       0-Link_7d:67:167       Thomson_7:4:4:23       0x0800 IP         49 12:29260       0-Link_7d:67:167       Thomson_7:4:4:23       0x0800 IP         51 13:4130       0-Link_7d:67:167       Thomson_7:4:4:23       0x0800 IP         53 13:44700       Thomson_7:4:4:23       0x0800 IP         53 13:4470       Thomson_7:4:4:23       0x0800 IP         53 13:4471       0-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IP         53 13:4471       0-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IP         54 13:4413       10-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IP         55 19:44147       10-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IP         66 2:0:0:152       Thomson_7:4:4:23       0x1800 IP       0x0800 IP         67 2:0:0:250       Thomson_7:4:4:23       0x1800 IP       0x0800 IP         67 2:0:0:250       Thomson_7:4:4:23       0x1800 IF       0x0800 IP         67 2:0:0:250       D-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IF         67 2:0:0:250       D-Link_7d:67:167       Thomson_7:4:4:23       0x1800 IF         67 2:0:0:250       D-Link_7d:67:167       Thomson_7:4:4:23       0x184:4		46 1.275478	D-Link 7d:67:b7	Thomson 7e:4e:23	0x0800 TP	
481.27590       0-timk_7di67:b7       Thomson_7e:4e:23       0x0800 IP         501.35403       Thomson_7e:4e:23       0x0800 IP         511.35403       Thomson_7e:4e:23       0-timk_7di67:b7         511.35403       Thomson_7e:4e:23       0-timk_7di67:b7         511.35403       Thomson_7e:4e:23       0-timk_7di67:b7         511.35403       Thomson_7e:4e:23       0-timk_7di67:b7         511.97711       Thomson_7e:4e:23       0-timk_7di67:b7         511.98414       Thomson_7e:4e:23       0-timk_7di67:b7         511.98414       Thomson_7e:4e:23       0-timk_7di67:b7         511.98415       Thomson_7e:4e:23       0-timk_7di67:b7         511.98412       Thomson_7e:4e:23       0-timk_7di67:		47 1.275906	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
49.1279260       0-tikk_72(67:b7)       Thomson_7e:4e:23       0x8000 IP         59.135401       Thomson_7e:4e:23       0x8000 IP         53.1454700       Thomson_7e:4e:23       0x8000 IP         53.1454700       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.145470       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.1454737       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.1454737       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.145473       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.145473       Thomson_7e:4e:23       0x11k, 74(67:b7)         53.1454741       0x11k, 74(67:b7)       0x8000 IP         64.200756       Thomson_7e:4e:23       0x11k, 74(67:b7)         70.60041       Thomson_7e:4e:23       0x11k, 74(67:b7)         70.620201796       Thomson_7e:4e:23       0x11k, 74(67:b7)         70.620201796       Thomson_7e:4e:23       0x11k, 74(67:b7)         62.002365       Du11k, 74(67:b7)       Thomson_7e:4e:23       0x11k, 74(67:b7)         63.201832       Du11k, 74(67:b7)       Thomson_7e:4e:23       0x11k, 74(67:b7)         64.202365       Du11k, 74(67:b7)       Thomson_7e:4e:23       0x11k, 74(67:b7)         65.202365       Du11k, 74(67:b7)       Thomson_7e		48 1.275960	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
<pre>3 1.34013 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 31.34013 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 33.1.441380 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 33.1.441380 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 33.1.441390 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 33.1.44134 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 35.1.4414 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 36.1.44153 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.1.40136 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.1.40136 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 36.2.00236 Thomson_re:4e:23 D-L1nk_76:7b7 Ox6800 IP 36.2.00236 Thomson_re:4e:23 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 Thomson_re:4e:24 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 Thomson_re:4e:24 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00236 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.0023 D-L1nk_76:7b7 Thomson_re:4e:23 Ox6800 IP 36.2.00</pre>		49 1.279260	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
31:1:3130       0.111kC_316:7:10       Theorem Tretter2:3       0.0000 1P         31:1:3130       0.111kC_316:7:10       0.0000 1P         31:1:3131       1.947379       Theorem.7e:14:233       0.111kC_316:7:10       0.0000 1P         35:1:34741       0.111kC_316:7:10       0.0000 1P       0.0000 1P         35:1:34741       0.111kC_316:7:10       0.0000 1P         36:1:34813       Theorem.7e:14:23       0.111kC_316:7:10       0.0000 1P         36:1:34813       Theorem.7e:14:23       0.111kC_316:7:10       0.0000 1P         36:1:34813       Theorem.7e:14:23       0.111kC_316:7:10       0.0000 1P         60:1:10740       Theorem.7e:14:23       0.011kC_316:7:10       0.0000 1P         61:1:10740       Theorem.7e:14:23       0.011kC_316:7:10       0.0000 1P         62:1:10740       Theorem.7e:14:23       0.011kC_316:7:10       0.0000 1P         63:1:132       Theorem.7e:14:23       0.011kC_316:7:10       0.0000 1P         64:1:10746:7:10       Theorem.7e:14:23       0.0000 1P         65:1:1022893       0.111kC_316:7:10       0.0000 1P         62:1:107473       De11kC_316:7:10       0.0000 1P         62:1:107473       Theorem.7e:14:23       0.0000 1P         61:1:1:1074716:7:10       0.00		50 1.354013	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
i 1: 44:70       Thesson_7:e:4::33       0-tink_7:6::0::70       0x800 IP         i 1: 44:70       Thesson_7:e:4::33       0-tink_7:6::0::70       0x800 IP         i 1: 44:71       Thesson_7:e:4::33       0-tink_7:6::0::70       0x800 IP         i 1: 44:14       Thesson_7:e:4::33       0-tink_7:6::16::17       0x800 IP         i 1: 44:13       Thesson_7:e:4::23       0-tink_7:6::16::17       0x800 IP         i 1: 44:13       I 1: 0: 10::76::16::17       0x800 IP         i 1: 44:13       I 1: 0::76::16::17       0x800 IP         i 1: 41:17       I 1: 0::76::17::17       0x800 IP         i 1: 0::76:0       Thesson_7:e:4e::23       0x1: 0x::76::16::17       0x800 IP         i 1: 0::76:0       Thesson_7:e:4e::23       0x::16x::76::17       0x800 IP         i 1: 0::76:0       D-tink_7:16::17       0x800 IP       0:000 IP         i 1: 0::76:0       D-tink_7:16::17       0x800 IP       0:0800 IP         i 2: 0::73:0       D-tink_7:16::17       0x800 IP       0:0800 IP         i 2: 0::73:0       D-tink_7:16::17:0       0x800 IP       0:0800 IP         i 2: 0::73:0       D-tink_7:16::17:0       0x800 IP       0:0800 IP         i 3: 0::03:13       Thesson_7:e:4e::23       0x:ink::0::17:0:17:0       0:0800 IP <td></td> <td>51 1.354108</td> <td>D-L1NK_/0:6/:D/</td> <td>Inomson_/e:4e:23</td> <td>0x0800 IP</td> <td></td>		51 1.354108	D-L1NK_/0:6/:D/	Inomson_/e:4e:23	0x0800 IP	
<pre>si 1.947379 thomson_74:42:22 ptink_7di67:b7 0x0800 TP si 1.947410 ptink_7di67:b7 thomson_74:42:3 0x0800 TP si 1.948147 thomson_74:42:3 ptink_7di67:b7 0x0800 TP si 1.948147 thomson_74:42:3 ptink_7di67:b7 0x0800 TP si 1.949118 thomson_74:42:3 ptink_7di67:b7 0x0800 TP do 2.016704 thomson_74:42:3 ptink_7di67:b7 0x0800 TP do 2.02783 ptink_7di67:b7 thomson_74:42:3 0x0800 TP do 2.02783 thomson_74:42:3 ptink_7di67:b7 0x0800 TP do 2.02783 thomson_74:42:3 thomson_74:42:3 thomson_74:42:3 0x0800 TP do 2.02783 thomson_74:42:3 thomson_74:4</pre>		53 1. 946700	Thomson 7e:4e:23	D-Link 7d:67:b7	0x0800 TP	
55 1.947411       De.tink_7di67:b7       Thomson_7e:4e:23       De.tink_7di67:b7         55 1.947411       De.tink_7di67:b7       Towson_7e:4e:23       De.tink_7di67:b7         58 2.023547       Towson_7e:4e:23       De.tink_7di67:b7       Ox8000 IP         65 2.022844       Towson_7e:4e:23       De.tink_7di67:b7       Ox8000 IP         66 2.022847       Towson_7e:4e:23       De.tink_7di67:b7       Ox8000 IP         68 2.023547       Towson_7e:4e:23       Ox8000 IP       De.tink_7di67:b7         69 2.04773       De.tink_7di67:b7       Ox8000 IP       De.tin		54 1.947379	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
56 1.948.47       Thomson_Per4e:23       0-Link.7d:67:b7       0x0800 IP         58 1.9491.81       Dhomson_Per4e:23       0x0800 IP         58 1.9491.81       D-Link.7d:67:b7       0x0800 IP         60 2.016704       Thomson_Per4e:23       0x0800 IP         61 2.013705       D-Link.7d:67:b7       0x0800 IP         62 2.013736       D-Link.7d:67:b7       0x0800 IP         62 2.013736       D-Link.7d:67:b7       0x0800 IP         62 2.013736       D-Link.7d:67:b7       0x0800 IP         63 2.013736       D-Link.7d:67:b7       0x0800 IP         64 2.013399       D-Link.7d:67:b7       0x0800 IP         67 2.02283       Dhomson_Per4e:23       0x0800 IP         68 2.0237       Thomson_Per4e:23       0x0800 IP         69 2.047763       D-Link.7d:67:b7       0x0800 IP         68 2.02387       Thomson_Per4e:2		55 1.947411	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
<pre>57 1.949138 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 58 1.949138 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 60 2.017366 D-Link_7d:67:b7 Thomson_Peter23 0x0800 IP 61 2.017366 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 62 2.017366 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 63 2.018132 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 64 2.018132 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 65 2.022087 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 66 2.02387 Thomson_Peter23 0-Link_7d:67:b7 0x0800 IP 67 2.02289 D-Link_7d:67:b7 Thomson_Peter23 0x0800 IP 67 2.02289 D-Link_7d:67:b7 Thomson_Peter23 0x0800 IP 68 2.02387 Thomson_Peter23 0x0800 IP 69 2.047763 D-Link_7d:67:b7 (D0:219:17:06:7:b7), bst: Thomson_Peter23 (D0:24:d1:7e:4e:23) 60 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 60 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 61 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 61 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 62 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 63 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 64 Destination: Thomson_Peter24 (D0:24:d1:7e:4e:23) 74 Desti</pre>		56 1.948147	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
38 1.949181       0-Link_7d:67:17       Thomson_7e:4e:23       0x0800 IP         60 2.016704       Thomson_7e:4e:23       0-Link_7d:67:17       0x0800 IP         61 2.01736       0-Link_7d:67:17       0x0800 IP         62 2.01736       0-Link_7d:67:17       0x0800 IP         63 2.01823       Thomson_7e:4e:23       0x0800 IP         63 2.01812       Thomson_7e:4e:23       0x0800 IP         64 2.02264       Thomson_7e:4e:23       0x0800 IP         65 2.02264       Thomson_7e:4e:23       0x0800 IP         66 2.022847       Thomson_7e:4e:23       0x0800 IP         67 2.022847       De-Link_7d:67:17       0x0800 IP         68 2.02397       Thomson_7e:4e:23       0x0800 IP         69 2.047763       D-Link_7d:67:17       0x0800 IP         69 2.047763       D-Link_7d:67:17       Thomson_7e:4e:23         0x0800 IP       Image: Comparison and the comparison and		57 1.949138	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
<pre>3 1.950093 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 60 2.017365 b-Link_/3:6:7:7 0x0800 1P 61 2.017365 b-Link_/3:6:7:7 0x0800 1P 63 2.01312 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 63 2.01312 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 65 2.022087 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 65 2.022087 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 66 2.023547 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 66 2.023547 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 67 2.02389 b-Link_/3:6:7:7 fromson_/2:4:2:3 0x0800 1P 68 2.023547 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 68 2.023547 fromson_/2:4:2:3 b-Link_/3:6:7:7 0x0800 1P 69 2.04773 b-Link_/3:6:7:87 0x0800 1P 69 2.04773 b-Link_/3:6:7:87 0x0800 1P 69 2.04773 b-Link_/3:6:7:87 0x0800 1P 60 2.041 x0 4x0 4x0 4x0 4x0 4x0 4x0 4x0 4x0 4x0</pre>		58 1.949181	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
0 2.016/04       Thumbol_fet223       0 - Link_Jd6/15/15/       0 - Vol800 1P         61 2.017366       D-Link_Jd6/15/15/       0 - Vol800 1P         62 2.017386       D-Link_Jd6/15/15/       0 - Vol800 1P         64 2.018393       D-Link_Jd6/15/15/       Thumson_Fet4e:23       0 0 000 1P         65 2.022687       Thumson_Fet4e:23       0 - Vol800 1P         66 2.022687       Thumson_Fet4e:23       0 - Link_Jdf6/15/7       0 0 000 01P         66 2.022687       Thumson_Fet4e:23       0 - Link_Jdf6/15/7       0 0 000 01P         66 2.022893       D-Link_Jdf6/15/7       0 0 000 01P         66 2.022893       D-Link_Jdf6/15/7       0 0 000 01P         66 2.022893       D-Link_Jdf6/15/7       0 0 000 01P         67 2.022893       D-Link_Jdf6/15/7       0 0 0000 01P         68 2.02347       Thumson_Fet4e23       0 0000 1P         69 2.047763       D-Link_Jdf6/15/7       0 00800 1P         9 Frame 49: 623       Dytes captured (4984 bits)         9 Ethernet 11, src: D-Link_Jdf6/15/7       0 00800 1P         10 Destination: Thumson_Fet4e23       0 00214 dit/16/26/15/7         10 Add (ress: Thumson_Fet4e23       0 00214 dit/16/26/15/7         10 Add (ress: D-Link_Jdf6/15/7)       0 00214 dit/1704 dit/26/15/7         11 Mad		59 1.950093	Thomson_/e:4e:23	D-L1nk_/d:6/:b/	000800 IP	
62 2.02736       0-tink_7d:67:b7       0x0800 IP         63 2.02812       Thomson_7e:4e:23       0-tink_7d:67:b7       0x0800 IP         64 2.02859       D-tink_7d:67:b7       0x0800 IP         65 2.022087       Thomson_7e:4e:23       0-tink_7d:67:b7       0x0800 IP         65 2.022864       Thomson_7e:4e:23       0-tink_7d:67:b7       0x0800 IP         66 2.022864       Thomson_7e:4e:23       0x0800 IP         67 2.022893       D-tink_7d:67:b7       Thomson_7e:4e:23       0x0800 IP         68 2.02347       Thomson_7e:4e:23       0x0800 IP         69 2.047763       D-tink_7d:67:b7       Thomson_7e:4e:23       0x0800 IP         69 2.047763       D-tink_7d:67:b7       Thomson_7e:4e:23       0x0800 IP         69 2.047763       D-tink_7d:67:b7       Thomson_7e:4e:23       0x0200 IP         69 2.047763       D-tink_7d:67:b7       0x0800 IP         61 extrainton: Thomson_7e:4e:23       0x0240 IP       100:24:d1:7e:4e:23         62 extrainton: Thomson_7e:4e:23       0x0241:7e:4e:23       0x0240 IP         63 extrainton: Thomson_7e:4e:23       0x0241:7e:4e:23       0x0240 IP         64 extrainton: Thomson_7e:4e:23       0x0241:7e:4e:23       0x0240 IP         65 extrainton: Thomson_7e:4e:23       0x0241:7e:4e:23		61 2 017366	D_Link 7d:67:b7	D-LINK_/0:0/:D/ Thomson 7e:4e:23	0x0800 IP	
6 3 2.018132       Thomson_2:4:2:3       D_1ik_72i67:b7       0x0800 TP         6 4 2.018599       D_1ik_72i67:b7       Thomson_2:4:2:3       D_1ik_72i67:b7       0x0800 TP         6 5 2.022684       Thomson_2:4:2:3       D_1ik_72i67:b7       0x0800 TP       0x0800 TP         6 5 2.022684       Thomson_2:4:2:3       D_1ik_72i67:b7       Thomson_2:4:4:2:3       0x0800 TP         6 5 2.022684       Thomson_2:4:4:2:3       D_1ik_72i67:b7       Thomson_2:4:4:2:3       0x0800 TP         6 5 2.022684       Thomson_2:4:4:2:3       D_1ik_72i67:b7       Thomson_2:4:4:2:3       0x0800 TP         6 5 2.022547       Thomson_7:4:4:2:3       (0x0800 TP       0x0800 TP         6 5 2.02264       Thomson_7:4:4:2:3       (0x0800 TP       0x0800 TP         6 5 2.022547       Thomson_7:6:4:2:3       (0x0800 TP       0x0800 TP         6 5 2.02264       Thomson_7:6:4:2:3       (0x0800 TP       0x0800 TP         6 5 2.02264       Thomson_7:6:4:2:3       (0x14:d1:7:4:4:23)       0x0800 TP         6 5 2.02264       Thomson_7:6:4:2:3       (00:24:d1:7:4:4:23)       0x01:4:4:1:7:6:1:4:1:4:1:4:4:2:3         Address: Thomson_7:6:4:2:3       (00:24:d1:7:6:4:23)       0x01:4:4:1:7:6:1:4:1:4:1:4:1:4:1:4:1:4:1:4:1:4:1:4:1		62 2.017396	Thomson 7e:4e:23	D-Link 7d:67:b7	0x0800 TP	
64 2.018599       0-Link_7d:67:h7       Thomson_7e:4e:23       0.00800 IP         65 2.022864       Thomson_7e:4e:23       0-Link_7d:67:h7       0.00800 IP         65 2.022864       Thomson_7e:4e:23       0.01ink_7d:67:h7       0.00800 IP         68 2.023847       Thomson_7e:4e:23       0.01ink_7d:67:h7       0.00800 IP         69 2.047763       D-Link_7d:67:h7       Thomson_7e:4e:23       0.0021:1:7e:4e:23         10 estinitation: Thomson_7e:4e:23       000:21:01:7e:4e:23       (uncast)        0		63 2.018132	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
65 2.022864       Thomson_7e:4e:23       0-Link_7d:67:b7       V0x0800 JP         66 2.022864       Thomson_7e:4e:23       0-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 JP         67 2.02283       0-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 JP         69 2.047763       0-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 JP         69 2.047763       0-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 JP         69 2.047763       0-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 JP         69 Ename 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits)       Element 11, src: 0-Link_7d:67:b7 (00:21:91:7d:67:b7)         address: Thomson_7e:4e:23 (00:24:d1:7e:4e:23)		64 2.018599	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
6 6 2.02284 Thomson_7e:4e:23 D-Link_7d:67:b7 Dxx800 IP 6 7 2.02284 Thomson_7e:4e:23 D-Link_7d:67:b7 Thomson_7e:4e:23 0xx800 IP 6 8 2.02354 Thomson_7e:4e:23 D-Link_7d:67:b7 Thomson_7e:4e:23 0xx800 IP 9 Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) 9 Extinement II, src: D-Link_7d:67:b7 (00:21:91:7d:67:b7), Dst: Thomson_7e:4e:23 (00:24:d1:7e:4e:23) 1 Address: Thomson_7e:4e:23 (00:24:d1:7e:4e:23) 1 Address: Thomson_7e:4e:23 (00:24:d1:7e:4e:23) 10		65 2.022087	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
67 2.02283       D-Link_7d:67:b7       Thomson_7e:4e:23       D-Link_7d:67:b7       No8000 IP         69 2.047763       D-Link_7d:67:b7       Thomson_7e:4e:23       0x0800 IP         ■ Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits)       Ethernet II, src: D-Link_7d:67:b7       (0x)21:91:7d:67:b7         ■ Destination: Thomson_7e:4e:23       (0x)24:d1:7e:4e:23)		66 2.022864	Thomson_7e:4e:23	D-Link_7d:67:b7	0x0800 IP	
68 2.023347       Thomson_/P:44:23       D-L1nk_/d:67:b7       Thomson_/P:44:23       0x0800 IP         69 2.047763       D-L1nk_/d:67:b7       Thomson_/P:44:23       0x0800 IP         69 Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits)       Ethernet II, Src: D-L1nk_/d:67:b7 (00:21:91:7d:67:b7), Dst: Thomson_/P:44:23 (00:24:d1:7e:4e:23)         Address: Thomson_/P:44:23 (00:24:d1:7e:4e:23)		67 2.022893	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800 IP	
<pre>b 9 2.147/05 b-LTHK_70167:b7 THOMSOF_PE4E:23 00000 1P iFrame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) i Ethernet II, Src: 0-LInK_70167:b7 (00:21:91:70167:b7), DST: Thomson_7e:4e:23 (00:24:d1:7e:4e:23)     Address: Thomson_7e:4e:23 (00:24:d1:7e:4e:23)     Address: Thomson_7e:4e:23 (00:24:d1:7e:4e:23)    0 = L6 bit: Individual address (unicast)    0 = L6 bit: Globally unique address (factory default)     Source: D-Link_70167:b7 (00:21:91:70167:b7)     Address: D-Link_70167:b7 (00:21:91:70167:b7)    0 = L6 bit: Globally unique address (factory default)     Type: IP (0x0800)     Data (609 bytes)     Data (609 bytes)     Data: 45000261030640008006ee7bc0a8000ac8457c1dc2cc0050     [Length: 609]  0000 00 24 d1 /e 4e 23 00 21 01 /d 67 b7 08 00 45 00     Source: IP -Link_701 67:b7 (00:21:91:70167:b7)     = L6 bit: Globally unique address (factory default)     Type: IP (0x0800)     Data (609 bytes)     Data: 45000261030640008006ee7bc0a8000ac8457c1dc2cc0050     [Length: 609]  0000 00 24 d1 /e 4e 23 00 21 01 /d 67 b7 08 00 45 00     Source: IP -Link_701 67:b7 (b7:77 27:65 c1 c2:c0050     [Length: 609]  0000 01 24 d1 /e 4e 23 00 21 01 /d 67 b7 08 00 45 00     Source: IP -Link_70 c1 c2:c00 c1 c2:c00 c2:c0 c2:c0</pre>		68 2.023547	Thomson_7e:4e:23	D-L1nk_7d:67:b7	0x0800 IP	
<pre> im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes on wire (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes captured (4984 bits), 623 bytes captured (4984 bits) im Frame 49: 623 bytes captured (4984 bits), 624 bytes captured (4984 bit</pre>		09 2.047705	D-LTHK_/0:07:07	Thomson_/e:4e:25	000800 1P	
<pre> □ thermet 11, src: 0-Link_/0:07/b7 (00:22:91:70:07/b7), bst: fnomsof_/e:4e:23 (00:24:01:7e:4e:23)</pre>	E Fr	ame 49: 623 b	bytes on wire (4984	bits), 623 bytes cap	otured (4984 bits)	
□ best (halloh: Homson_2+e+e:23 (00:24:d1:/e+4e:23)         ∴ IG bit: Individual address (unicast)	EE	nernet II, Sr	Thomson 70:40:32 ((	(00:21:91:/d:6/:D/)	DSt: Thomson_/e:4e:23 (00:24:d1:/e:4e:23)	
<pre></pre>		Address: Th	homson 7e:4e:23 (00:	·24·d1·7e·4e·23)		
<pre></pre>				= IG bit: Individua	address (unicast)	
□ Source: D-Link_7d:67:b7 (00:21:91:7d:67:b7)         Address: D-Link_7d:67:b7 (00:21:91:7d:67:b7)        0        0        0        0        0        0        0        0        0        0        0		0		= LG bit: Globally u	unique address (factory default)	
Address: D-Link_76:67:b7 (00:21:91:7d:67:b7) 0	-	Source: D-Lir	nk_7d:67:b7 (00:21:9	91:7d:67:b7)		
		Address: D	-Link_7d:67:b7 (00:2	21:91:7d:67:b7)		
		0 .		= IG bit: Individua	address (unicast)	
Image: Delta (600 bytes)         Data: 4 5000261050640008006ee7bc0a8000ac8457c1dc2cc0050         [Length: 609]         0000       02 24 d1 76 4e 23 00 21 01 7d 67 b7 08 00 45 00         a.e.       a.e.         0000       02 61 05 66 40 00 80 06 ee 7b c0 a8 00 0a c8 45         a.e.       a.e.         0000       02 61 05 66 40 00 80 06 ee 7b c0 a8 00 0a c8 45         a.e.       a.e.         a.e.       a.e.         b.f.       b.f.         0000       02 61 05 66 40 00 80 06 ee 7b c0 a8 00 0a c8 45         a.e.       a.e.         a.e.       b.f.         b.f.       b.f.         a.e.       b.f.         b.f.       b.f.         b.f.       b.f.         b.f.       b.f.         c.f.       b.f.         c.f.       b.f.         b.f.       b.f.         c.f.       b.f.				= LG bit: Globally (	inique address (factory default)	
Data: 4003 50/E57 Data: 4003 50/E57 Data: 45000261050640008006ee7bc0a8000ac8457c1dc2cc0050 [Length: 609] 0000 02 4 01 /e 4e 23 00 21 91 /d 67 b7 08 00 45 00 5 0010 02 61 05 06 40 00 80 06 ee 7b c0 a8 00 0a c8 45 0020 7c 1d c2 cc 00 50 89 00 c0 c2 0f a9 8f 5b 50 18 1E 0030 40 31 d9 8c 00 00 47 45 54 20 2f 70 6f 72 74 61 81E 0040 6c 2f 70 61 67 65 2f 70 06 f7 27 44 61 cc 2f 55 4c 1/page/p ortal/UN 0050 41 42 20 48 54 54 50 2f 31 2e 31 0d 0a 48 6f 73 A8 HTTP/ 11Hos 0060 74 a2 07 77 77 72 6a 75 6e 61 62 2e 65 64 75 2e 63 66 56 cc ers-Agen114 events 0060 66 65 65 70 2d 61 65 66 77 03 a2 f2 77 77 77 2e ref: hurfe 0050 75 6e 61 62 2e 65 64 75 2e 63 6f 27 77 04 77 2e ref: hurfe 0050 75 6e 61 62 2e 65 64 75 2e 63 6f 72 77 04 77 2e ref: hurfe 0050 75 6e 61 62 2e 65 64 75 2e 63 6f 72 77 07 77 2e ref: hurfe 0050 75 2e 21 2d 16 76 56 6f 73 a2 6f 74 77 06 77 2e ref: hurfe 0050 75 2e 21 2d 16 76 56 6f 73 a2 0f 2f 77 77 77 2e ref: hurfe 0050 75 2e 22 4d 16 75 56 77 3a 2f 74 7a 6f 72 56 ce er-Agen114 events 0050 75 2e 21 2d 16 75 56 77 3a 20 df df 7a 69 6c 56 ce er-Agen114 events 0050 75 2e 22 4d 16 75 56 77 3a 2f 74 7a 6f 7a 69 6c 56 ce er-Agen114 events 0050 75 2e 21 2d 16 75 56 77 3a 2f 74 7a 6f 7a 69 6c 56 ce er-Agen114 events 0050 75 2e 2d 2d 16 75 56 77 3a 2f 74 7a 6f 7a 69 6c 56 ce er-Agen114 events 0050 75 2e 2d 41 6f 75 56 76 7a 3a 2f 74 7a 6f 7a 69 6c 56 ce er-Agen114 events 0050 75 6e 51 65 76 56 76 7a 51 7a 6f 7a 69 6c 6f 7a 69 6c 66 6f 7a 69 6c 66 6f 7a 69 6c 66 7a		Type: IP (OXC	0800)			
[Length: 609] 0000 00 24 dl / 0 46 23 00 21 91 7d 67 b7 08 00 45 00 0010 02 61 05 06 40 00 80 06 ee 7b c0 a8 00 0a c8 45 0020 7c 1d c2 cc 00 50 89 00 c0 e2 0f a9 8f 5b 50 18 0030 40 31 d9 8c 00 00 47 45 54 20 2f 70 6f 72 74 6l 6c 2f 55 4e 1/page/p ortal/UM 0040 6c 2f 70 6l 67 65 2f 70 6f 72 74 6l 6c 2f 55 4e 1/page/p ortal/UM 0050 41 42 20 48 54 54 50 2f 31 2e 31 00 48 8f 75 2e 0070 63 6f 0d 0a 43 6f 66 6e 65 63 74 69 6f 6e 3a 20 coconn ection: 0080 6b 65 65 70 2d 6l 6c 69 76 65 0d 0a 52 65 66 65 keep-all ve. Refe 0080 75 6e 6l 62 2e 65 64 77 2e 63 6f 72 7d 0a 57 73 unab.edu. 0080 75 6e 61 62 2e 65 66 77 2e 63 6f 72 70 0a 57 73 unab.edu. 0080 75 6e 61 62 2e 65 66 77 2e 63 6f 72 7d 0a 55 73 unab.edu. 0080 75 2e 21 2d 10 65 66 77 3a 20 4d 6f 7a 69 6c 6e c er-Aqent: Mozill	🖻 Da	Data: 4500020	5) 61050640008006ee7bc0	)a8000ac8457c1dc2cc00	150	
0000       00       24       01       76       42       00       01       74       67       57       08       00       45       00       00       24       01       76       42       00       21       01       70       67       57       08       00       45       00       00       02       61       05       64       00       80       60       cc       84       3       a.e.       e.e.       1       a.e.       E       1       a.e.       E       1       b.e.       E		[Length: 609]	1	Jubboouco+J/CIUCZCCO		
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Ethernet (eth), 14 bytes Packets: 806 Displayed: 806 Marked: 0 Dropped: 0 Profile: Default	🔵 Eti	nernet (eth), 14 byte	es Pa	ackets: 806 Displayed: 806 Mark	red: 0 Dropped: 0 Profile: Def	fault

In order to answer the following questions, you'll need to look into the packet details and packet contents windows (the middle and lower display windows in Wireshark). Select the Ethernet frame containing the HTTP GET message. Expand the Ethernet II information in the packet details window. Note that the contents of the Ethernet frame (header as well as payload) are displayed in the packet contents window. Answer the following questions, based on the contents of the Ethernet frame containing the HTTP GET message. Whenever possible, when answering a question you should hand in a printout of the packet(s) within the trace that you used to answer the question asked. Annotate the printout to explain your answer. To print a packet, use File->Print, choose Selected packet only, choose Packet summary line, and select the minimum amount of packet detail that you need to answer the question.

1. What is the 48-bit Ethernet address of your computer?

- 2. What is the 48-bit destination address in the Ethernet frame? Is this the Ethernet address of www.unab.edu.co? (Hint: the answer is no). What device has this as its Ethernet address?
- 3. Give the hexadecimal value for the two-byte Frame type field. What do the bit(s) whose value is 1 mean within the flag field?
- 4. How many bytes from the very start of the Ethernet frame does the ASCII "G" in "GET" appear in the Ethernet frame?
- 5. What is the hexadecimal value of the CRC field in this Ethernet frame?

Next, answer the following questions, based on the contents of the Ethernet frame containing the first byte of the HTTP response message.

- 6. What is the value of the Ethernet source address? Is this the address of your computer, or of www.unab.edu.co (Hint: the answer is no). What device has this as its Ethernet address?
- 7. What is the destination address in the Ethernet frame? Is this the Ethernet address of your computer?
- 8. Give the hexadecimal value for the two-byte Frame type field. What do the bit(s) whose value is 1 mean within the flag field?
- 9. How many bytes from the very start of the Ethernet frame does the ASCII "O" in "OK" (i.e., the HTTP response code) appear in the Ethernet frame?
- 10. What is the hexadecimal value of the CRC field in this Ethernet frame?

# 2. The Address Resolution Protocol

In this section, we'll observe the ARP protocol in action.

#### **ARP Caching**

Recall that the ARP protocol typically maintains a cache of IP-to-Ethernet address translation pairs on your computer. The arp command (in both MSDOS and Linux/Unix) is used to view and manipulate the contents of this cache. Since the arp command and the ARP protocol have the same name, it's understandably easy to confuse them. But keep in mind that they are different - the arp command is used to view and manipulate the ARP cache contents, while the ARP protocol defines the format and meaning of the messages sent and received, and defines the actions taken on message transmission and receipt.

Let's take a look at the contents of the ARP cache on your computer:

- MS-DOS. The arp command is in c:\windows\system32, so type either "arp" or "c:\windows\system32\arp" in the MS-DOS command line (without quotation marks).
- Linux/Unix. The executable for the arp command can be in various places. Popular locations are /sbin/arp (for linux) and /usr/etc/arp (for some Unix variants).

The arp command with no arguments will display the contents of the ARP cache on your computer. Run the arp command.

11. Write down the contents of your computer's ARP cache. What is the meaning of each column value?

In order to observe your computer sending and receiving ARP messages, we'll need to clear the ARP cache, since otherwise your computer is likely to find a needed IP-Ethernet address translation pair in its cache and consequently not need to send out an ARP message.

- MS-DOS. The MS-DOS arp –d \* command will clear your ARP cache. The –d flag indicates a deletion operation, and the \* is the wildcard that says to delete all table entries. You will need to run it as administrator.
- Linux/Unix. The arp –d \* will clear your ARP cache. In order to run this command you'll need root privileges.

## **Observing ARP in action**

Do the following

- Clear your ARP cache, as described above.
- Next, make sure your browser's cache is empty.
- Start up the Wireshark packet sniffer
- Enter the following URL into your browser: www.unab.edu.co
- Stop Wireshark packet capture. Again, we're not interested in IP or higher-layer protocols, so change Wireshark's "listing of captured packets" window so that it shows information only about protocols below IP. To have Wireshark do this, select Analyze->Enabled Protocols. Then uncheck the IP box and select OK.

You should now see a Wireshark window that looks like:

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File Edit View Go Capture Analyze Statistics Telephony Tools Help							
<b>E</b> ( #			Q 🖕 龄 🖧 🐺 🛛				
Filter:			•	expression.	Clear Apply		
No.	Time	Source	Destination	Protocol	Info	A	
	1 0.000000	D-Link_7d:67:b7	IPv4mcast_7f:ff:fa	0x0800	IP		
	2 2.551142	fe80::f435:d1a5:29	5ff02::c	SSDP	M-SEARCH * HTTP/1.1		
	3 3.000132	D-L1nk_/d:6/:b/	IPv4mcast_/f:ff:fa	0x0800	IP		
	4 0.00109/	D Link 7d:67:b7	Broadcast	ADD	M-SEARCH ^ HITP/1.1		
	6 6 556244	D-LINK_/0:0/:D/	D_Link 7d:67:b7	ARP	102 168 0 1 is at 00:24:d1:70:40:22		
	7 6 556374	D-Link 7d:67:b7	Thomson 7e:4e:23	0x0800	TP		
	8 6, 557455	fe80::f435:d1a5:29	5ff02::1:3	LLMNR	Standard guery A lifbcibllhkdhoafpifnlhfpfgnpldfl		
	9 6.557913	D-Link_7d:67:b7	IPv4mcast_00:00:fc	0x0800	IP		
	10 6.559406	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	11 6.559959	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	12 6.560267	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	13 6.560464	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	14 6.561369	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	15 6.562241	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	16 6.562674	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	1/ 6.5630//	D-L1nk_/d:6/:b/	Thomson_/e:4e:23	0x0800	IP		
	18 6.563495	D-L1NK_/0:6/:D/	Thomson_/e:4e:23	0x0800	1P		
	19 0. 303963	Themson 70140133	n Link 7d:67:67	0x0800	10		
	21 6 614905	Thomson 7e:4e:23	D-Link 7d:67:b7	0x0800	TP TD		
	22 6 615260	Thomson 7e:4e:23	D-Link 7d:67:b7	0x0800	TP		
	23 6. 61 5477	D-Link 7d:67:b7	Thomson 7e:4e:23	0x0800	TP		
	24 6.616342	D-Link_7d:67:b7	Thomson_7e:4e:23	0x0800	IP		
	DE 6 646745	work and the state of the		00000	T0		
⊕ Fr	ame 5: 42 byt	es on wire (336 bit	ts), 42 bytes capture	ed (336	bits)		
• Et	hernet II, Sr	C: D-Link_/d:6/:b/	(00:21:91:/d:6/:b/),	Dst: E	Broadcast (ff:ff:ff:ff:ff:ff)		
	uress Resolut	Ton Prococol (reque	25()				
	Brotocol type	: ELHEFHEL (0X0001)	)				
	Hardware size	- 6					
	Protocol size	4					
	Opcode: reque	est (0x0001)					
	[Is gratuitou	is: False]					
	Sender MAC ad	dress: D-Link_7d:67	7:b7 (00:21:91:7d:67:	b7)			
	Sender IP add	iress: 192.168.0.10	(192.168.0.10)				
	Target MAC ad	ldress: 00:00:00_00:	:00:00 (00:00:00:00:0	0:00)			
1	Target IP add	ress: 192.168.0.1 (	(192.168.0.1)				
0000	ff ff ff ff	ff ff 00 21 01 74	67 b7 08 06 00 01		1 30	1	
0010	08 00 06 04	00 01 00 21 91 7d	67 b7 c0 a8 00 0a		.!		
0020	00 00 00 00	00 00 c0 a8 00 01					
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	and a sec (all which	For For	seneral abor proprayed, abor Mark	care prop	hear a		

In the example above, frames 5 and 6 in the trace contain ARP messages.

Answer the following questions:

- 12. Locate the ARP request message.
  - a. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP request message?
  - b. Give the hexadecimal value for the two-byte Ethernet Frame type field. What do the bit(s) whose value is 1 mean within the flag field?
  - c. How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?
  - d. What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP request is made?
  - e. Does the ARP message contain the IP address of the sender?
  - f. Where in the ARP request does the "question" appear the Ethernet address of the machine whose corresponding IP address is being queried?
- 13. Now find the ARP reply that was sent in response to the ARP request.

- a. How many bytes from the very beginning of the Ethernet frame does the ARP opcode field begin?
- b. What is the value of the opcode field within the ARP-payload part of the Ethernet frame in which an ARP response is made?
- c. Where in the ARP message does the "answer" to the earlier ARP request appear the IP address of the machine having the Ethernet address whose corresponding IP address is being queried?
- d. What are the hexadecimal values for the source and destination addresses in the Ethernet frame containing the ARP reply message?