

Solutions Networking 1

R1,R19, R23, R24

R1

There is no difference. Throughout this text, the words “host” and “end system” are used interchangeably. End systems include PCs, workstations, Web servers, mail servers, PDAs, Internet-connected game consoles, etc

R19

- 19. a) 500 kbps
- b) 64 seconds
- c) 100kbps; 320 seconds

R23

The five layers in the Internet protocol stack are – from top to bottom – the application layer, the transport layer, the network layer, the link layer, and the physical layer. The principal responsibilities are outlined in Section 1.5.1.

R24

Encapsulation is the process of passing a packet from a higher layer to a lower layer. In the simplest case, it simply appends additional information (i.e., a *header*) to the source packet. In more complicated scenarios, the original packet can be split into multiple packets, each carrying its own header. Decapsulation is the opposite process of encapsulation. It extracts the header from a source packet from a lower layer and passes the payload to the higher layer. If lower layer packets are part of a sequence, the corresponding payloads are put together before they are passed to the higher layer. Each protocol in a layer of a protocol stack relies on the services of the lower layers but not on their information. Thus, the information a protocol needs to process a packet should entirely be contained in the header of that protocol. Encapsulation and decapsulation are flexible mechanisms to allow each protocol to operate independently from others while being able to interface with each other.

Øvelser

- 1) http://gaia.cs.umass.edu/kurose_ross/interactive/end-end-delay.php

(finds online på siden)

- 2) http://gaia.cs.umass.edu/kurose_ross/interactive/end-end-throughput.php

(finds online på siden)

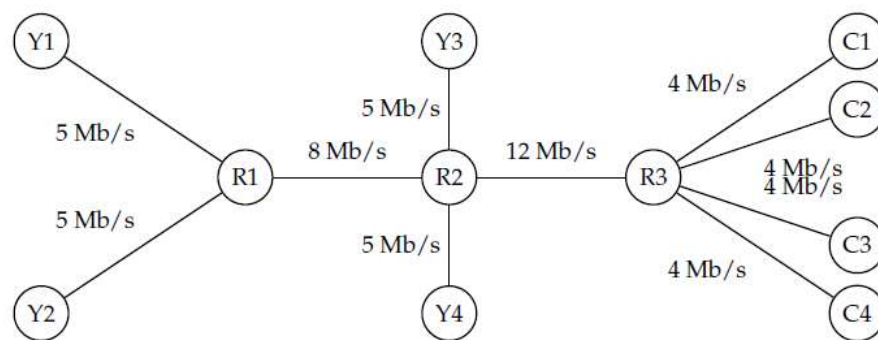
- 3)

Problem 6

- a) $d_{prop} = m / s$ seconds.
- b) $d_{trans} = L / R$ seconds.
- c) $d_{end-to-end} = (m / s + L / R)$ seconds.
- d) The bit is just leaving Host A.
- e) The first bit is in the link and has not reached Host B.
- f) The first bit has reached Host B.
- g) Want

$$m = \frac{L}{R} s = \frac{120}{56 \times 10^3} (2.5 \times 10^8) = 536 \text{ km.}$$

4)



The network shows four servers Y1 to Y4 which host video content and four clients C1 to C4 who are concurrently downloading the video content using FTP from each of these servers (C1 from Y1, C2 from Y2, C3 from Y3 and C4 from Y4). The network is connected using routers R1, R2 and R3 and the transmission rates of the individual links have been outlined in the figure. The end to end throughput experienced by the clients for their download is

- ☐ a) 2 Mb/s
- ☐ b) 3 Mb/s
- ☐ c) 4 Mb/s
- ☐ d) 5 Mb/s

Solution: B)

5)

Problem 25

- a) 160,000 bits
- b) 160,000 bits
- c) The bandwidth-delay product of a link is the maximum number of bits that can be in the link.
- d) the width of a bit = length of link / bandwidth-delay product, so 1 bit is 125 meters long, which is longer than a football field
- e) s/R

- 6) Et streaming firma skal have uploadet et ny datasæt på 40 terabytes til en server, der er placeret tæt hos forbrugerne, men et stykke væk fra firmaet. Deres Internet forbindelse til serveren tillader en gennemsnitlig upload hastighed på 100 Mbps. Hvor lang tid tager det? Sammenlig tid og pris med at sende en fysisk pakke med et speditiousfirma med næste-dags levering. Antag firmaet køber en dedikeret forbindelse til serveren, med 10 gange højere kapacitet. Hvor lang tid tager det så? Hvad bliver den gennemsnitlige udnyttelsesgrad af denne, under antagelse af at et nyt datasæt uploades en gang om måneden, og den daglige trafik (email, web-surfing, etc) udgør 20 Mbps i gennemsnit. Overvej de praktiske konsekvenser i scenariet.

40 terabytes = $40 * 10^{12} * 8$ bits. So, if using the dedicated link, it will take $40 * 10^{12} * 8 / (100 * 10^6)$ = 3200000 seconds = 37 days.

1GB forbindelse 3.7 dage.

Udnyttelsesgrad (ex måned): 3.7 dage med 100% + 30 dage med 20Mbps/1Gbps % / 30dage) = 4.3/30% = 14%

Med fysisk forsendelse med næste-dag-levering, kan du garantere at data er klar næste dag til en pris (for international forsendelse) på 500Kr. Send så store data-mængder i en kasse med harddiske vha. et shipping firma!

<https://what-if.xkcd.com/31/>

Praktiske

- P105 Wireshark Lab.
- Nedenfor har jeg opsnappet en kommunikation til <http://www.cs.aau.dk> (GET). Reponset på dette er en kode "301" (Redirect) som fortæller at dokumentet er flyttet til et andet URL, som angiver at HTTPS protokollen skal anvendes. Browserens reaktion er at genindlæse dokumentet ved brug af den nye URL.

I det midterste vindue er det muligt at udfolde og se headerne på alle niveauer i stakken; her: Ethernet, IP, TCP, http. Prøv at bemærke "enveloping"/"encapsulation" (I skal ikke forstå indholdet af headerne endnu).

Bemærk at der bliver sendt og modtaget ganske mange pakker selv i et kort scenarie, så det er normal nødvendigt at sætte filtre op, så man kun får vist de pakker der er interessante for det I kigger efter.

Ethernet II

No.	Time	Source	Destination	Protocol	Length Info
1628	3.282147	192.168.0.181	192.168.0.1	DNS	83 Standard query 0x3d10 A stats.g.doubleclick.net
1631	3.290007	192.168.0.1	192.168.0.181	DNS	169 Standard query response 0x3d10 A stats.g.doubleclick.net CNAME stats.l.doubleclick.net A 64.233.184.156..
+88	2.416431	192.168.0.181	130.225.63.3	HTTP	502 GET / HTTP/1.1
-91	2.435929	130.225.63.3	192.168.0.181	HTTP	592 HTTP/1.1 301 Moved Permanently (text/html)
77	2.150986	192.168.0.51	192.168.0.181	ICMP	120 Destination unreachable (Port unreachable)
1784	3.653378	192.168.0.51	192.168.0.181	ICMP	120 Destination unreachable (Port unreachable)
1830	5.151088	192.168.0.51	192.168.0.181	ICMP	120 Destination unreachable (Port unreachable)
1853	6.338124	192.168.0.27	192.168.0.181	ICMP	120 Destination unreachable (Port unreachable)
1876	6.653007	192.168.0.51	192.168.0.181	ICMP	120 Destination unreachable (Port unreachable)
73	2.137973	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
74	2.137990	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
75	2.138255	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
76	2.138270	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
112	2.547569	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
113	2.547578	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
114	2.547661	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
115	2.547667	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0x961d PTR 51.0.168.192.in-addr.arpa
1872	6.651698	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1873	6.651720	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1874	6.652000	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1875	6.652019	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1881	7.062132	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1882	7.062148	fe80::c472:c696:ed6f:f02::1:3	ff02::1:3	LLMNR	105 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1883	7.062237	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
1884	7.062244	192.168.0.181	224.0.0.252	LLMNR	85 Standard query 0xcdd9 PTR 51.0.168.192.in-addr.arpa
71	2.137164	192.168.0.181	192.168.0.51	NBNS	92 Name query NBSTAT *(<0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0>
72	2.137182	192.168.0.181	192.168.0.51	NBNS	92 Name query NBSTAT *(<0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0>
1782	3.636503	103.168.0.51	102.168.0.51	NBNS	92 Name query NBSTAT *(<0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0><0>

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Frame 91: 592 bytes on wire (4736 bits), 592 bytes captured (4736 bits) on interface \Device\NPF_{D5EB09A5-5960-4374-B1C3-5C4316773839}, id 0
Ethernet II, Src: Ictera_88:3a:53 (00:1e:80:88:3a:53), Dst: ASUSTek_X19:22:8a (54:00:a6:19:22:8a)
Internet Protocol Version 4, Src: 130.225.63.3, Dst: 192.168.0.181
Transmission Control Protocol, Src Port: 80, Dst Port: 52434, Seq: 1, Ack: 449, Len: 538
Hypertext Transfer Protocol
Line-based text data: text/html (7 lines)
<!DOCTYPE HTML PUBLIC "-//IETF//DTD HTML 2.0//EN">\n
<html><head>\n
<title>301 Moved Permanently</title>\n
</head><body>\n
<h1>Moved Permanently</h1>\n
<p>The document has moved <a href="https://www.cs.aau.dk/">here</a>.</p>\n
</body></html>\n
0000 54 04 a5 19 22 8a 00 1e 00 88 3a 53 00 00 45 00 T.....S...E...
0010 02 42 0d 06 40 00 33 b6 b5 6e 82 e1 3f 03 c0 a8 B...g...n?...?....
0020 00 b5 00 50 cc d2 e2 da ab 26 fc ce ea 9f 50 18 ...P.....&....P...
0030 00 ed 9a 09 00 00 48 54 54 50 2f 31 2e 31 20 33 00 ..ed EA 09 00 00 48 54 54 50 2f 31 2e 31 20 33 03
0040 30 31 20 4d 6f 76 65 64 20 50 65 72 60 61 6e 65 01 Moved Perma
0050 6e 74 cf 79 0d 0a 4d 61 74 65 3a 0a 4d 6f 6e 2c ntent-Len ght: 23
0060 20 31 36 20 
```