Övning 3
EITF25 & EITF45 - 2017
IP, TCP och 802.11

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Uppgift 1.
Bestäm klassen på följande IPv4-adresser:

1.1 208.34.54.12

1.2 238.34.2.1

1.3 114.34.2.8

1.4 129.14.6.8

1.5 241.34.2.8

Solution 1.
The class is determined by the range of the first octet.

Class	First octet range
A	1-126
B	128-191
C	192-223
D	224-239
E	240-255

1.1 As according to the table above.

Answer: C

1.2 As according to the table above.

Answer: D

1.3 As according to the table above.

Answer: A

1.4 As according to the table above.

Answer: B

1.5 As according to the table above.

Answer: E

Uppgift 2.
Bestäm nät-id och värd-id för följande klassfulla IP-adresser:

2.1 114.34.2.8

2.2 171.34.14.8

2.3 192.8.56.2

Solution 2.

2.1 The address is of class A, as such the first 8 bits remark the net ID, leaving the remaining 24 bit to the represent the host ID.

Answer:
Net ID : 114.0.0.0
Host ID : 0.34.2.8

2.2 The address is of class B, as such the first 16 bits remark the net ID, leaving the remaining 16 bit to the represent the host ID.

Answer:
Net ID : 171.34.0.0
Host ID : 0.0.14.8

2.3 The address is of class C, as such the first 24 bits remark the net ID, leaving the remaining 8 bit to the represent the host ID.

Answer:
Net ID : 192.8.56.0
Host ID : 0.0.0.2

Uppgift 3.
Bestäm nät-id och värd-id för följande klasslösa IP-adresser:

3.1 IP-adress 130.235.185.49, mask 255.255.0.0.

3.2 IP-adress 130.235.188.247, mask 255.255.192.0.

3.3 IP-adress 120.14.22.16, mask 255.255.128.0

3.4 IP-adress 141.181.14.16, mask 255.255.224.0

Solution 3.

3.1 The mask splits the class-less IP address into two identifiers.

Answer:
Net ID : 130.235.0.0
Host ID : 0.0.185.49

3.2 Converting the decimal address to binary yields:

Address	|10000010.11101011.10111100.11110111|
net ID mask	|11111111.11111111.11000000.00000000|
net ID	|10000010.11101011.10000000.00000000|

The above sum yields a net ID of 130.235.128.0 Conversely, we retrieve the host ID by inverting the mask, as seen below:

Address	|10000010.11101011.10111100.11110111|
host ID mask	|00000000.00000000.00111111.11111111|
host ID	|00000000.00000000.00111100.11110111|

Which yields a host ID of 0.0.60.247. As you may have noticed you only need to tend to the 2-byte address + mask segments where the mask is greater than one and less that 255.

Answer:
Net ID : 130.235.128.0
Host ID : 0.0.60.247

3.3 Similarly. Here the mask is only interesting at the 3rd 2-byte segment.

Answer:
Net ID : 120.14.0.0
Host ID : 0.0.22.16

3.4 Similarly. Here the mask is only interesting at the 3rd 2-byte segment.

Answer:
Net ID : 141.181.0.0
Host ID : 0.0.14.16

Uppgift 4.
Skriv följande IPv4 masker i /n formatet:

4.1 255.255.255.0

4.2 255.0.0.0

4.3 255.255.224.0

4.4 255.255.240.0

Solution 4.
In the /n notation, n is the length of the mask in bits. For example, the mask, 255.128.0.0 → 11111111.1000000.00000000.00000000 has 9 bits, and can thus be expressed as /9.

4.1 The mask i represented by $8 \cdot 3 = 24$ bits.

Answer: /24

4.2 8 bits represent the mask.

Answer: /8

4.3 Following the reasoning in the sample above, 19 bits.

Answer: /19

4.4 Following the reasoning in the sample above, 20 bits.

Answer: /20

Uppgift 5.
Beräkna antalet IPv4-addresser i följande adressblock:

5.1 200.17.21.128/27

5.2 17.34.16.0/23

5.3 180.34.64.64/30

5.4 123.56.77.55/29

Solution 5.
Stateless IP address mask specifications.

5.1 27 net ID bits leaves 5 bits to represent $2^5 = 30$ host addresses - 2 for broadcast addresses.

Answer: 30

5.2 23 net ID bits leaves 9 bits to represent $2^9 = 510$ host addresses - 2 for broadcast addresses.

Answer: 510

5.3 30 net ID bits leaves 2 bits to represent $2^2 = 2$ host addresses - 2 for broadcast addresses.

Answer: 2

5.4 29 net ID bits leaves 3 bits to represent $2^3 = 6$ host addresses - 2 for broadcast addresses.

Answer: 6

Uppgift 6.
Visa kortaste form av följande IPv6-adresser:

6.1 2340:1ABC:119A:A000:0000:0000:0000:0001

6.2 0000:00AA:0000:0000:0000:0000:119A:A231

6.3 2340:0000:0000:0000:0000:119A:A001:0000

6.4 0000:0000:8000:2340:0000:0000:0000:0000

Solution 6.

6.1 Leading consecutive zeros can be concatenated.

2340:1ABC:119A:A000:<u>0000:0000:0000</u>:0001

Answer: 3440:1ABC:119A:A000::1

6.2 Following the same reasoning as above yields.

<u>000</u>0:<u>00</u>AA:<u>0000:0000:0000:0000</u>:119A:A231

Answer: 0:AA::119A:A231

6.3 Following the same reasoning as above yields.

2340:<u>0000:0000:0000:0000</u>:119A:A001:<u>000</u>0

Answer:
2340::119A:A001:0

6.4 Following the same reasoning as above yields.

<u>000</u>0:<u>000</u>0:8000:2340:<u>0000:0000:0000:0000</u>

Answer: 0:0:8000:2340:

Uppgift 7.
Visa den ursprungliga, oavkortade formen av följande IPv6-adresser:

7.1 0::0

7.2 0:AA::0

7.3 0:1234::3

7.4 123::1:2

Solution 7.
7.1 Follow the reverse reasoning in Problem 6.

Answer: 0000:0000:0000:0000:0000:0000:0000:0000

7.2 Follow the reverse reasoning in Problem 6.

Answer: 0000:00AA:0000:0000:0000:0000:0000:0000

7.3 Follow the reverse reasoning in Problem 6.

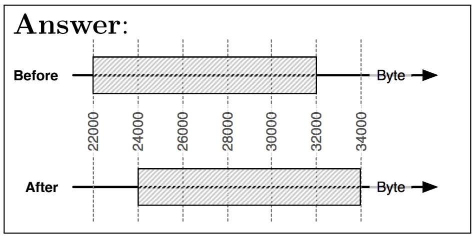
Answer: 0000:1234:0000:0000:0000:0000:0000:0003

7.4 Follow the reverse reasoning in Problem 6.

Answer: 0123:0000:0000:0000:0000:0000:0001:0002

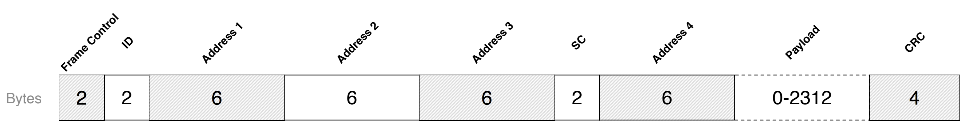
Uppgift 8.
Antag en TCP-session har ett sändfönster med storleken 10 000 byte. Det senast mottagna ACK-numret är 22 001. Sändaren tar nu emot ett segment där ACK-numret är 24 001. Som svar skickar sändaren två segment om vardera 1 500 byte. Rita ett diagram som visar sändarfönstret före och efter mottagandet av det senaste ACK:et samt efter sändningen.

Solution 8.
In general, TCP deploys cumulative acknowledgements to achieve a reliable transmission. As such, an ACK message from the receiver will tell the sender which sequence byte it i expecting next.



IEEE 802.11b frame structure and RTS/CTS specifications

The 802.11b frame structure in Figure 1 is not present needed to solve Problems 9, 10, and 11.



Figur 1: 802.11 frame structure

Additionally, Table 1 details the parameters in the 802.11b collision avoidance system.

Segment	Size	T_x time
DIFS	-	50 μs
SIFS	-	10 μs
RTS	160 bits	14.45 μs
CTS	112 bits	10.18 μs
ACK	112 bits	10.18 μs

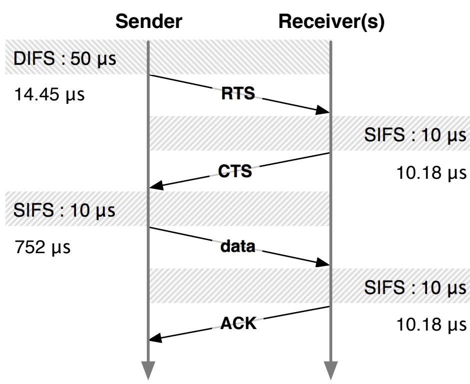
Tabell 1: Transmission events

Uppgift 9.
Antag att en dator med 802.11b är konfigurerad så att den alltid reserverar kanalen med RTS/CTS innan den sänder. Antag att datorn vill sända 1000

bytes data och att ingen annan sänder. Beräkna hur lång tid det tar att sända dessa 1000 bytes och få ett ACK tillbaka. I uttrycket får längden av SIFS och DIFS ingå. Vi antar att sändare och mottagare är så nära varandra att vi kan sätta utbredningstiden = 0.

Solution 9.

In 802.11b, the DIFS is $50\mu s$ and SIFS is $10\mu s$. The size of an RTS frame is 20 bytes, the CTS and ACK frames are made up of 14 bytes each. Furthermore, an arbitrary sequence of 1000 bytes, fits into one 802.11b frame of a total of 1034 bytes. The theoretical maximum transmission rate of 802.11b is 11 Mbps. The transmission will adhere to the sequence in the Figure below.



Aggregating the information in Table 1 and the figure above yields a total transmission time of 867 μs.

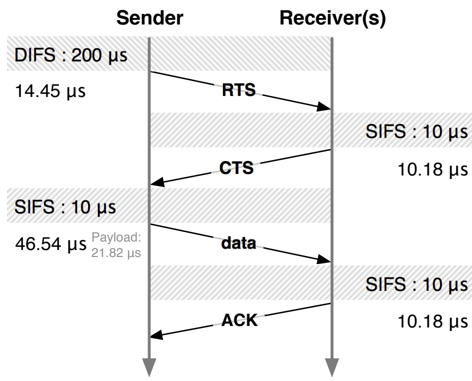
Answer: 867 μs

Uppgift 10.

Antag att ramar av storleken 64 bytes skickas i ett 802.11b-nät. Antag vidare att sändaren alltid har buffrade paket att skicka, att DIFS=200 μ s och att värdet på SIFS är 10 μ s. Dessutom antar vi att det inte blir några bitfel och att vi kan försumma utbredningstiden. Hur många bitar nyttolast per sekund kan sändaren maximalt skicka? Nyttolast = det som finns i payload-fältet (eller frame body-fältet) i WiFi-ramen.

Solution 10.

This problem builds on the findings and rationale in problem 5. However, in this instance the the packet is smaller, only 64 bytes, or 512 bits. Additionally, instead of a random time between frames we use a standard DIFS delay.



Following the sequence in the figure below yields a total transmission time of $311.35\mu s$ per frame. Referring to Figure 1, if a frame is 64 bytes long it holds 30 bytes of payload. The time spent sending the payload is thus $\frac{30 \cdot 8 \text{ bits}}{11\text{Mbps}} = 21.82\mu s$. As a result, $\frac{21.82\mu s}{311.35\mu s} = 7\%$ of the total transmission time is spent on the payload. Nevertheless, for every 311.35 μs we spend transmitting we purvey $30 \cdot 8 = 240$ bits of data, consequent our payload or effective transmission rate is $\frac{240 \text{ bits}}{311.35\mu s} = 0.77$ Mbps.

Answer: 0.77 Mbps

Uppgift 11.

Antag att bitfelssannolikheten är 0,001 i nätet i Uppgift 10.

11.1 Vad är sannolikheten att ett paket är skadat?

11.2 Hur många gånger måste man i medeltal sända ett paket innan det tas emot korrekt?

11.3 Vad blir nu bithastigheten jämfört med Uppgift 10 där vi antog att bitfelssannolikheten var noll?

Solution 11.

This problem builds on the findings in Problems 9 and 10. For simplicity sake, we assume that the bit error is limited to the data frame.

11.1 With a bit error probability of 0.1% a fame has a $1-(1-0.001)^{512} =$ 40.1% chance of being corrupt.

Answer: 40.1 %

11.2 A frame will arrive successfully after $\frac{1}{1-0.401} = 1.67$ attemps.

Answer: 1.67 times

11.3 The resulting bitrate is thus $\frac{0.77\text{Mbps}}{1.67} = 0.46$ Mbps.

Answer: 0.46 Mbps