Telematics Homework #4

Niklas Neumann

19 November 2009

What kind of switching fabrics are there and how do they work?

- Bus switching
  - Fabric connects ports by means of a bus that is shared among all ports
- Memory switching
  - Fabric connects ports by means of a common memory that is used by all ports
- Crossbar switching
  - Fabric can connect any input port to any output port directly

When and where does buffering occur? What are its effects?

- Input ports:
  - Fabric slower than incoming traffic
- Output ports:
  - Datarate from fabric is faster than outgoing data rate
- Buffering introduces queueing delays and ultimately leads to loss

When and where does head-of-line blocking occur?

- When a packet is queued at an input port, following packets must wait until that packet is processed

In an IP datagram: what is the header checksum for and where is it calculated?

- Used for error-checking of the header
  - By intermediate routers
  - By the destination
- Calculated
  - At the source
  - At every intermediate router after decrementing the time-to-live value

Where does IP fragmentation occur?

- IP fragmentation occurs in intermediate routers when a datagram is bigger than the maximum transmission unit (MTU) of the following network segment

Fragmentation

- Assume you have a 2,000 byte long datagram which needs to be fragmented for a 1,000 bytes MTU. Please fill the following table with the data of the resulting datagrams.

Datagram No.	Length	Frag. Flag	Offset
1	996 (976+20)	1	0
2	996 (976+20)	1	122
3	48 (28+20)	0	244
4			

Tip: IP Address Conversion (Decimal to Binary)

- Make yourself a table:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Rest								
Bit								

- For each octet:
  - Put octet number into first „rest“ cell
  - Bit = (value >= rest ? 1 : 0)
  - $Rest_{next} = Rest_{prev} – Bit_{prev} \times Value_{prev}$
  - Rinse and Repeat

Tip: IP Address Conversion (Example)

- First octet of 66.135.207.138:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Rest								
Bit								

- Result:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Rest	66	66	2	2	2	2	2	0
Bit	0	1	0	0	0	0	1	0

Convert the following IP addresses into their binary notion

- 66.135.207.138
  - 01000010.10000111.11001111.10001010
- 192.35.225.7
  - 11000000.00100011.11100001.00000111

Tip: IP Address Conversion (Binary to Decimal)

- Make yourself a table:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Bit								
Sum								

- For each octet:
  - Fill the „Bit“ row with the bits of the octet
  - Fill the sum row:
    $Sum_{next} = Sum_{prev} + Bit_{prev} \times Value_{prev}$

Tip: IP Address Conversion (Example)

- Octet 10000110:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Bit								
Sum								

- Result:

Power	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Value	128	64	32	16	8	4	2	1
Bit	1	0	0	0	0	1	1	0
Sum	128	128	128	128	128	132	134	**134**

Convert the following IP addresses into their decimal notion

- 10000110.01001100.01010001.00011001
  - 134.76.81.25
- 11011000.10011110.01010111.00010111
  - 216.158.87.23

Tip: Subnet calculations

- Subnet calculations are used to break a given network into smaller pieces
- A (sub-) network mask shows how many bits of an IP address denote the network
  - Decimal: /17
  - Binary: 11111111.11111111.10000000.00000000
  - Hexadecimal: 255.255.128.0

Tip: Subnet calculations

- Given address: 128.30.10.0
  - 10000000.00011110.00001010.00000000
- Given netmask: 17 (= 255.255.128.0)
  - 11111111.11111111.10000000.00000000
- => Network: 128.30.0.0/17
  - 10000000.00011110.00000000.00000000
- => Broadcast: 128.30.127.255
  - 10000000.00011110.01111111.11111111
- => First host: 128.30.0.1
  - 10000000.00011110.00000000.00000001
- => Last host: 128.30.127.254
  - 10000000.00011110.01111111.11111110
- Number of hosts: $2^{15} – 2 = 32,766$

Tip: Subnet calculations (Example)

- Given network: 128.30.0.0/17
- Wanted: Four sub networks
- First step: Find new subnet mask
  - To address four networks we need at least two bits ($2^2 = 4$).
  - The new subnet mask is 17+2 = 19
- Second step: Find new network addresses (see next slide)
- Third step: Calculate data for new networks (see previous slide)

Tip: Subnet calculations (Example)

- New netmask: 19 (= 255.255.224.0)
  - 11111111.11111111.11100000.00000000
- => New network 1: 128.30.0.0/19
  - 10000000.00011110.00000000.00000000
- => New network 2: 128.30.32.0/19
  - 10000000.00011110.00100000.00000000
- => New network 3: 128.30.64.0/19
  - 10000000.00011110.01000000.00000000
- => New network 4: 128.30.96.0/19
  - 10000000.00011110.01100000.00000000
- Number of hosts: $2^{13} – 2 = 8,190$

Subnet calculation

- A provider has been assigned the network 128.30.0.0/17 and wants to divide it into four subnets. Please fill the following table with the data of the resulting sub networks.

Subnet No.	Network Address	Netmask	Host Range	No. of Hosts
1	128.30.0.0/19	255.255.224.0	128.30.0.1 – 128.30.31.254	8,190
2	128.30.32.0/19	255.255.224.0	128.30.32.1 – 128.30.64.254	8,190
3	128.30.64.0/19	255.255.224.0	128.30.64.1 – 128.30.95.254	8,190
4	128.30.96.0/19	255.255.224.0	128.30.96.1 – 128.30.127.254	8,190

What is the “NAT traversal problem” and how can it be solved?

- NAT traversal problem:
  - A server behind a NAT cannot be reached directly because no mapping between external and internal address exists
- Solution 1: Statically configured mapping
- Solution 2: Dynamically configured mapping (e.g. by using UPnP)

What is the “NAT traversal problem” and how can it be solved? (cont’d)

- Solution 3: Relaying
  - Node behind NAT establishes connection to relay
  - External node connects to relay
  - Relay forwards packets between nodes

What are the main differences between IPv4 and IPv6?

- Bigger address space in IPv6 (128 bit vs. 32 bit)
- Fixed-length 40 byte header in IPv6
- No fragmentation allowed in IPv6
- No header checksum in IPv6
- Options outside of header in IPv6
- New version of ICMP in IPv6 (ICMPv6)

How can an IPv4 host communicate with an IPv6 host?

- Trick question:
  - An IPv4 host cannot directly communicate with an IPv6 host
- Tunneling:
  - Allows to connect IPv6 hosts with IPv4 hosts in the middle
- Dual stack:
  - Use IPv4 to communicate with IPv4 hosts and IPv6 to communicate with IPv6 hosts
- There will be no trick questions in the written examination!

Thank you

Any questions?