Network Computing courses

Maël Auzias
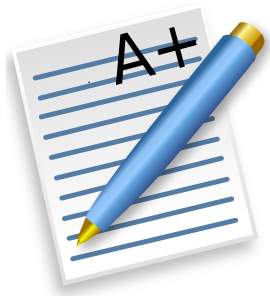
ENSIBS - UBS

October 2014

Figure: teaching.auzias.net

Course details

Objectives

- How do *computers* communicate?
- What are the mechanisms **under** an HTTP request or a telegram message?
- Networks are all around us, better study them!

Course details

Evaluation

- Short test at the beginning of every lesson (5 min) ?
- Project
- Final exam (1 hour)
- All same weighting

Material

- Slides available at teaching.auzias.net (github too)

Presentation Outline

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- **Network:** an **interconnected** group or system

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- **IP:** Internet **Protocol** provides the functions necessary to deliver a package of bits from a source to a destination over a network
- **(world wide) Web: network** consisting of a collection of Internet websites using HTTP

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- **RFC:** Request For Comments (Internet Draft (ID), RFC, Internet Standard)

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- **NAT:** Network Address Translation, router modifying IP address into another IP address.

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- **Thin client: application** where most functions are carried out on a central server

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- **WAN:** Wide Area Networks cover a broad area (Internet)

Topologies
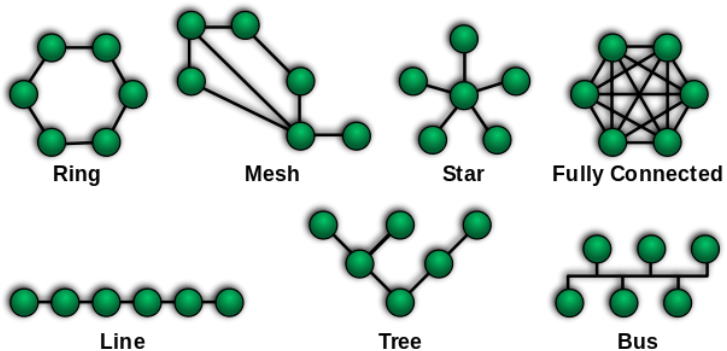
Figure: upload.wikimedia.org

Topologies

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- **Bus:** all nodes are connected to the same media. Only one can send a packet at a time, which all others then receive.

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- **Tree:** hierarchical topology, such as a binary tree.

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Bonus
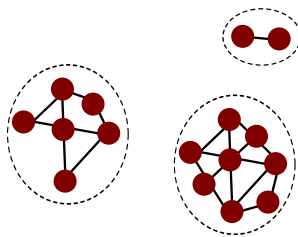
Figure: Disconnected MANET illustration [1]
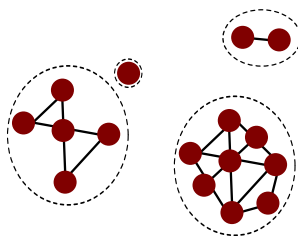
Bonus

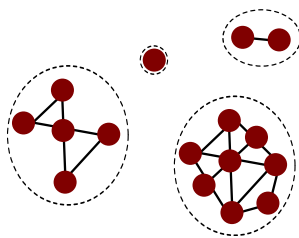

Figure: Store-carry-and-forward [1]

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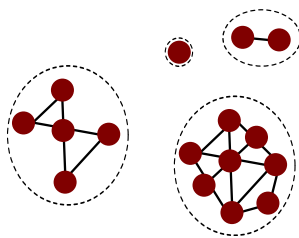# Bonus

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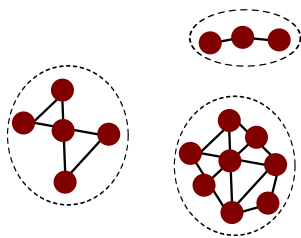

Figure: Store-carry-and-forward [1]

HTTP request/response example

Enter getbootstrap.com in your browser

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Source	Destination	Protocol	Length	Info
192.168.0.48	208.67.222.222	DNS	76	Standard query 0x4797 A getbootstrap.com
208.67.222.222	192.168.0.48	DNS	108	Standard query response 0x4797 A 192.30.252.154 A 192.30.252.153

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Source	Destination	Protocol	Length	Info
127.0.0.1	127.0.0.13	TCP	74	36159 > http [SYN] Seq=0 Win=43690 Len=0 MSS=65495 SACK_PERM=1 TSval=12
127.0.0.13	127.0.0.1	TCP	74	http > 36159 [SYN, ACK] Seq=0 Ack=1 Win=43690 Len=0 MSS=65495 SACK_PERM
127.0.0.1	127.0.0.13	TCP	66	36159 > http [ACK] Seq=1 Ack=1 Win=43776 Len=0 TSval=122257 TSecr=12225
127.0.0.1	127.0.0.13	HTTP	356	GET /index.html HTTP/1.1
127.0.0.13	127.0.0.1	TCP	66	http > 36159 [ACK] Seq=1 Ack=291 Win=44800 Len=0 TSval=122259 TSecr=122
127.0.0.13	127.0.0.1	HTTP	354	HTTP/1.1 200 OK (text/html)
127.0.0.1	127.0.0.13	TCP	66	36159 > http [ACK] Seq=291 Ack=289 Win=44800 Len=0 TSval=122259 TSecr=1
127.0.0.1	127.0.0.13	HTTP	357	GET /favicon.ico HTTP/1.1
127.0.0.13	127.0.0.1	HTTP	565	HTTP/1.1 404 Not Found (text/html)
127.0.0.1	127.0.0.13	TCP	66	36159 > http [ACK] Seq=582 Ack=788 Win=45952 Len=0 TSval=122269 TSecr=1

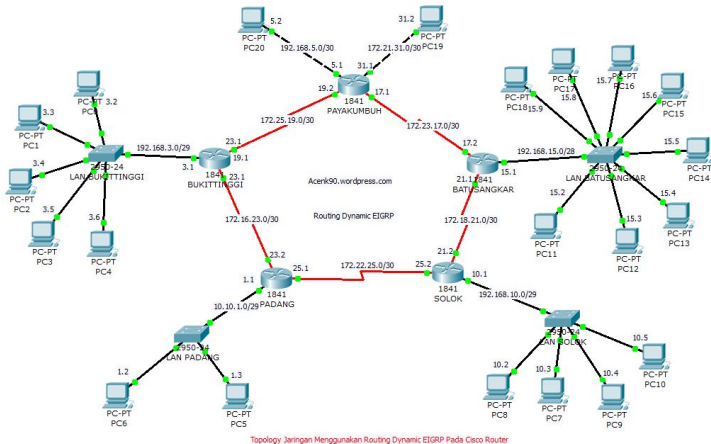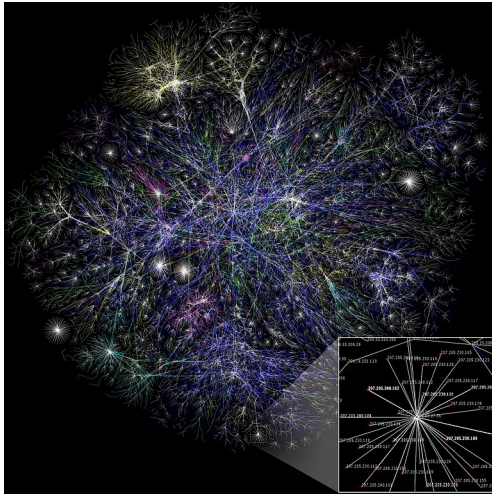Figure: HTTP request/response

How do messages reach their destination?

Figure: acenk90.files.wordpress.com

More like this...

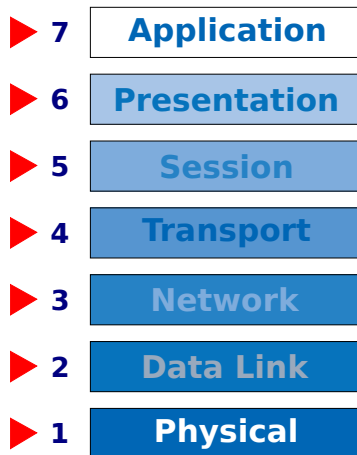Figure: wikimedia.org

How does it work? From signal to application...

Figure: OSI model
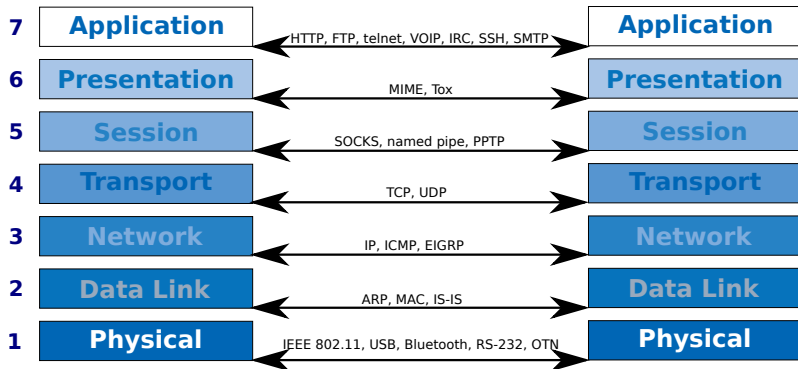
N^{th} layer communicate with N^{th} layer..

.. thanks to 3-th layers

7	**Application**		**Application**
6	**Presentation**		**Presentation**
5	**Session**		**Session**
4	**Transport**		**Transport**
3	**Network**		**Network**
2	**Data Link**		**Data Link**
1	**Physical**		**Physical**
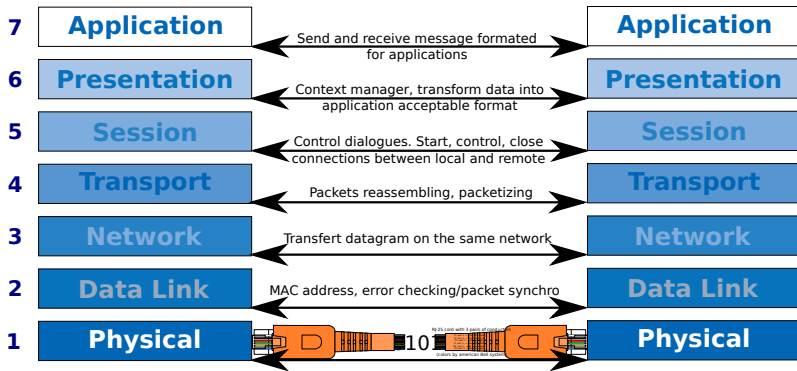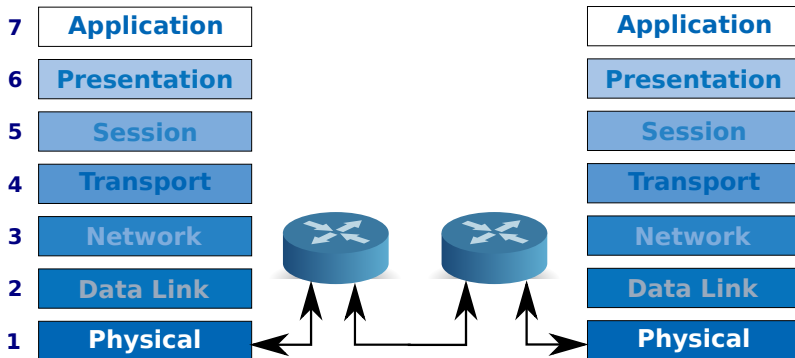
One single protocol, one single layer

7	**Application**	HTTP, FTP, telnet, VOIP, IRC, SSH, SMTP	**Application**
6	**Presentation**	MIME, Tox	**Presentation**
5	**Session**	SOCKS, named pipe, PPTP	**Session**
4	**Transport**	TCP, UDP	**Transport**
3	**Network**	IP, ICMP, EIGRP	**Network**
2	**Data Link**	ARP, MAC, IS-IS	**Data Link**
1	**Physical**	IEEE 802.11, USB, Bluetooth, RS-232, OTN	**Physical**
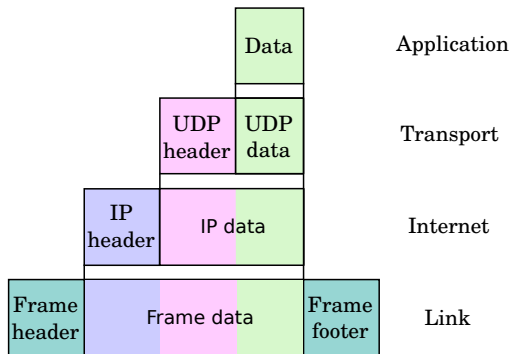
Encapsulation

Figure: Encapsulation

Presentation Outline

Aims

- Interface data link layer,

Aims

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- (De)Encode,

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- Transmit: 1 after 0 (after 0 or 1, after 0... or 1)

Hardware medium

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- USB, serial port such as RS-232...

Hardware medium: IEEE 802.3 (Ethernet)

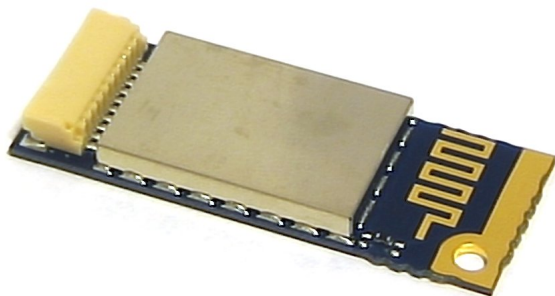Figure: RJ45 connector

Hardware medium: IEEE 802.15.1 (Bluetooth)

Figure: Bluetooth card
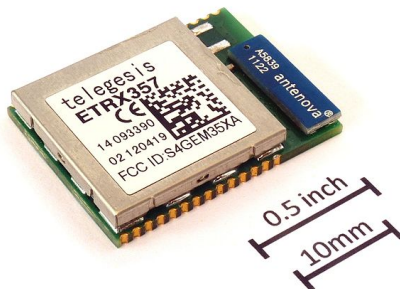
Hardware medium: IEEE 802.15.4 (ZigBee)

Figure: ZigBee card

Hardware medium: IEEE 802.16 (Wi-Max)

Figure: Wi-Max antenna

Hardware medium: IEEE 1394 (Firewire)

Figure: Firewire connector

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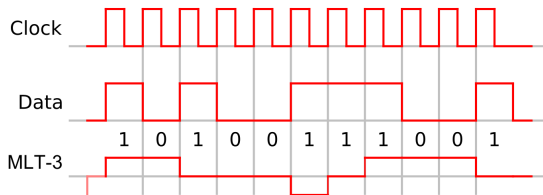- and so on...

Encoding: Multi-Level Transmit

Figure: Multi-Level Transmit

Encoding: Alternate Mark Inversion
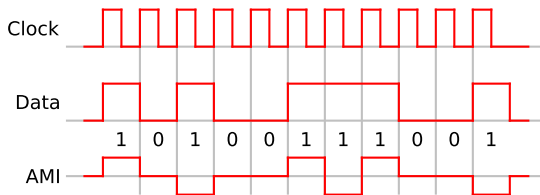

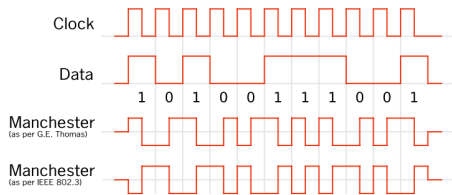Figure: Alternate Mark Inversion

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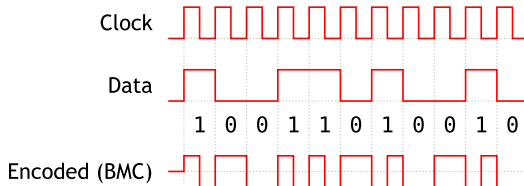
Encoding: Biphase Mark Code
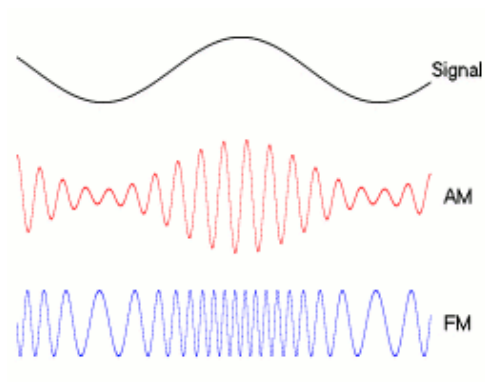

Figure: Biphase Mark Code

Transmitting

Figure: Amplitude and phase modulation

Error detection

- Repetition (hum...)

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- Parity (XOR)

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- Checksum

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Error correcting

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- Hamming

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- MDPC (Multidimensional parity-check code)

Correction: MDPC

Raw data to send: 0x01 02 03 04

0x01	0x02	0x03
0x03	0x04	0x07
0x04	0x06	

Figure: Data received with MDPC

Data sent (with MDPC): 0x01 02 03 03 04 07 04 06

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References

📄 Maurice J. Khabbaz, Assi Chadi M., and Fawaz Wissam F.
Disruption-Tolerant Networking: A Comprehensive Survey on
Recent Developments and Persisting Challenges.
IEEE communications surveys and tutorials, 2012.