Network Computing courses

Maël Auzias

ENSIBS - UBS

October 2014

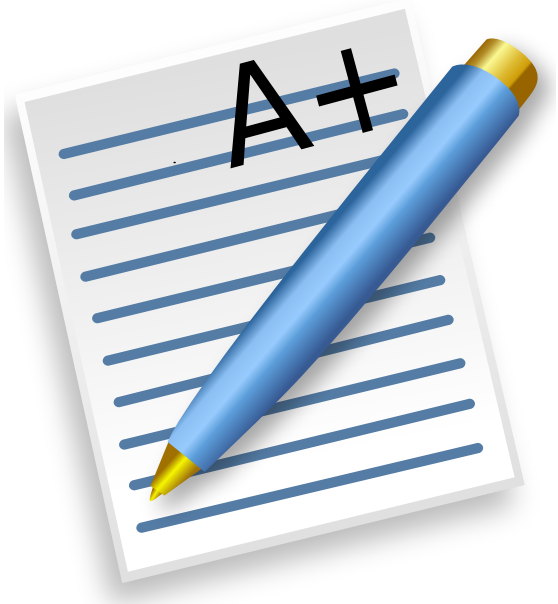
Figure: teaching.auzias.net

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

Definitions

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

Definitions

- **Network:** an **interconnected** group or system
- **Internet:** world wide **interconnected system of networks**
  RFC791 (September 1981)

Definitions

- **Network:** an **interconnected** group or system
- **Internet:** world wide **interconnected system of networks** RFC791 (September 1981)
- **IP:** Internet **Protocol** provides the functions necessary to deliver a package of bits from a source to a destination over a network

Definitions

- **Network:** an **interconnected** group or system
- **Internet:** world wide **interconnected system of networks** RFC791 (September 1981)
- **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

Definitions

- **HTTP:** Hypertext Transfer **Protocol**, application-level protocol for distributed, collaborative, hypermedia information systems draft HTTP2 (July 2014)

Definitions

- **HTTP:** Hypertext Transfer **Protocol**, application-level protocol for distributed, collaborative, hypermedia information systems draft HTTP2 (July 2014)
- **FTP:** File Transfer **Protocol** promotes sharing of files, encourages the use of remote computers RFC959 (October 1985)

Definitions

- **HTTP:** Hypertext Transfer **Protocol**, application-level protocol for distributed, collaborative, hypermedia information systems draft HTTP2 (July 2014)
- **FTP:** File Transfer **Protocol** promotes sharing of files, encourages the use of remote computers RFC959 (October 1985)
- **TCP:** Transmission Control **Protocol** is intended for use as a highly reliable host-to-host RFC761 (January 1980)

Definitions

- **HTTP:** Hypertext Transfer **Protocol**, application-level protocol for distributed, collaborative, hypermedia information systems draft HTTP2 (July 2014)
- **FTP:** File Transfer **Protocol** promotes sharing of files, encourages the use of remote computers RFC959 (October 1985)
- **TCP:** Transmission Control **Protocol** is intended for use as a highly reliable host-to-host RFC761 (January 1980)
- **UDP:** User Datagram **Protocol** provides a procedure for application programs to send messages to other programs with a minimum of protocol mechanism RFC768 (August 1980)

Definitions

- **HTTP:** Hypertext Transfer **Protocol**, application-level protocol for distributed, collaborative, hypermedia information systems draft HTTP2 (July 2014)
- **FTP:** File Transfer **Protocol** promotes sharing of files, encourages the use of remote computers RFC959 (October 1985)
- **TCP:** Transmission Control **Protocol** is intended for use as a highly reliable host-to-host RFC761 (January 1980)
- **UDP:** User Datagram **Protocol** provides a procedure for application programs to send messages to other programs with a minimum of protocol mechanism RFC768 (August 1980)
- **RFC:** Request For Comments (Internet Draft (ID), RFC, Internet Standard)

Definitions

- **Router:** network **hardware** providing routing services

Definitions

- **Router:** network **hardware** providing routing services
- **Routing: algorithm processed** to decide where to forward a packet

Definitions

- **Router:** network **hardware** providing routing services
- **Routing: algorithm processed** to decide where to forward a packet
- **Forwarding: action** of moving a packet from one NIC to another

Definitions

- **Router:** network **hardware** providing routing services
- **Routing: algorithm processed** to decide where to forward a packet
- **Forwarding: action** of moving a packet from one NIC to another
- **NIC:** Network Interface Card
- **Switch (hub):** network **hardware** connecting systems using packet switching

Definitions

- **Router:** network **hardware** providing routing services
- **Routing: algorithm processed** to decide where to forward a packet
- **Forwarding: action** of moving a packet from one NIC to another
- **NIC:** Network Interface Card
- **Switch (hub):** network **hardware** connecting systems using packet switching
- **Packet switching:** forward-like method regardless of the content (destination-based)

Definitions

- **Router:** network **hardware** providing routing services
- **Routing: algorithm processed** to decide where to forward a packet
- **Forwarding: action** of moving a packet from one NIC to another
- **NIC:** Network Interface Card
- **Switch (hub):** network **hardware** connecting systems using packet switching
- **Packet switching:** forward-like method regardless of the content (destination-based)
- **NAT:** Network Address Translation, router modifying IP address into another IP address.

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server
- **Request: application message** destined for a server (*order*)

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server
- **Request: application message** destined for a server (*order*)
- **Server: computer** able to respond a client's requests

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server
- **Request: application message** destined for a server (*order*)
- **Server: computer** able to respond a client's requests
- **Request: application message** destined for a client (*result*)

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server
- **Request: application message** destined for a server (*order*)
- **Server: computer** able to respond a client's requests
- **Request: application message** destined for a client (*result*)
- **Fat client: application** where most functions are processed by the client itself

Definitions

- **Node (network):** any entity that can send packets to/receive packets from a network through a NIC
- **Client: computer** able to send requests to a server
- **Request: application message** destined for a server (*order*)
- **Server: computer** able to respond a client's requests
- **Request: application message** destined for a client (*result*)
- **Fat client: application** where most functions are processed by the client itself
- **Thin client: application** where most functions are carried out on a central server

What kind of network is it?

- **BAN:** Body Area Network

What kind of network is it?

- **BAN:** Body Area Network
- **PAN:** Personal Area Networks

What kind of network is it?

- **BAN:** Body Area Network
- **PAN:** Personal Area Networks
- **(W)LAN:** (Wireless) Local Area Networks (home, office, school or airport)

What kind of network is it?

- **BAN:** Body Area Network
- **PAN:** Personal Area Networks
- **(W)LAN:** (Wireless) Local Area Networks (home, office, school or airport)
- **MAN:** Metropolitan Area Networks, can cover a whole city

What kind of network is it?

- **BAN:** Body Area Network
- **PAN:** Personal Area Networks
- **(W)LAN:** (Wireless) Local Area Networks (home, office, school or airport)
- **MAN:** Metropolitan Area Networks, can cover a whole city
- **WAN:** Wide Area Networks cover a broad area (Internet)

Topologies

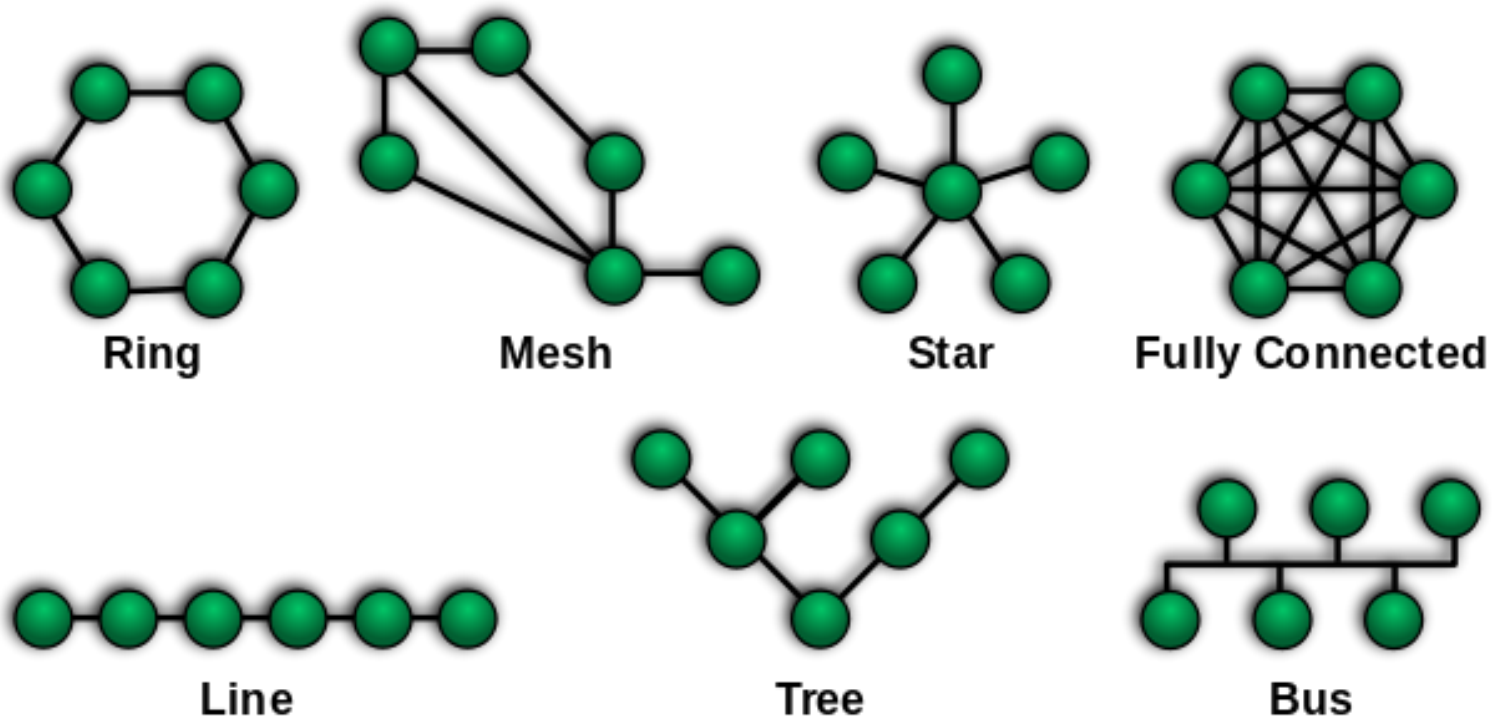


Figure: upload.wikimedia.org

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].
- **Star:** all messages go through the same central node, reducing network failure.

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].
- **Star:** all messages go through the same central node, reducing network failure.
- **Fully connected:** all nodes are connected to all other nodes.

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].
- **Star:** all messages go through the same central node, reducing network failure.
- **Fully connected:** all nodes are connected to all other nodes.
- **Line:** bidirectional link between two nodes. Node can only send packet going through its neighbors.

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].
- **Star:** all messages go through the same central node, reducing network failure.
- **Fully connected:** all nodes are connected to all other nodes.
- **Line:** bidirectional link between two nodes. Node can only send packet going through its neighbors.
- **Bus:** all nodes are connected to the same media. Only one can send a packet at a time, which all others then receive.

Topologies

- **Point-to-point:** two entities directly connected to each other (tunnel).
- **Ring:** data go around the ring, unidirectional way network.
- **Mesh:** all nodes cooperate in the distribution of data in the network[1].
- **Star:** all messages go through the same central node, reducing network failure.
- **Fully connected:** all nodes are connected to all other nodes.
- **Line:** bidirectional link between two nodes. Node can only send packet going through its neighbors.
- **Bus:** all nodes are connected to the same media. Only one can send a packet at a time, which all others then receive.
- **Tree:** hierarchical topology, such as a binary tree.

Bonus

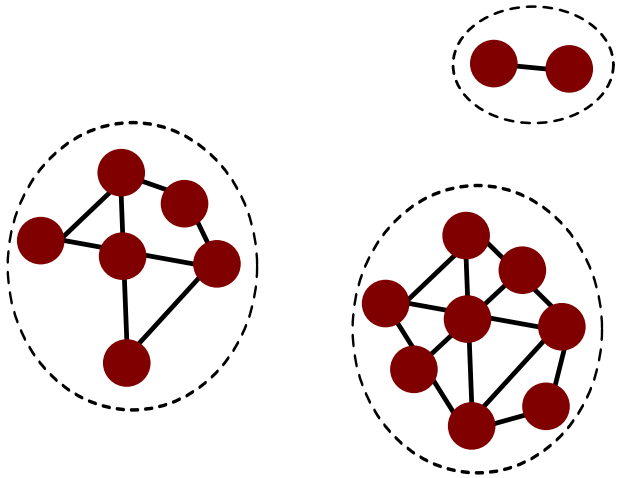


Figure: Disconnected MANET illustration [1]

Bonus

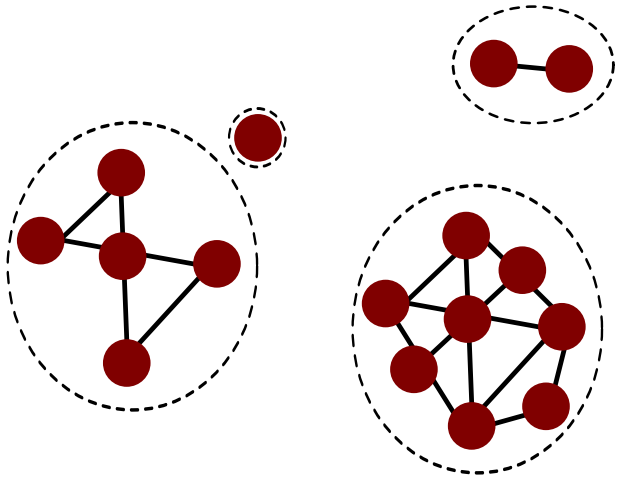


Figure: Store-carry-and-forward [1]

Bonus

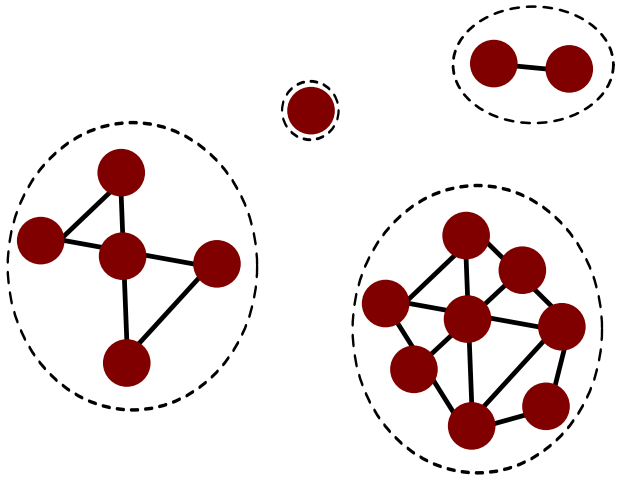


Figure: Store-carry-and-forward [1]

Bonus

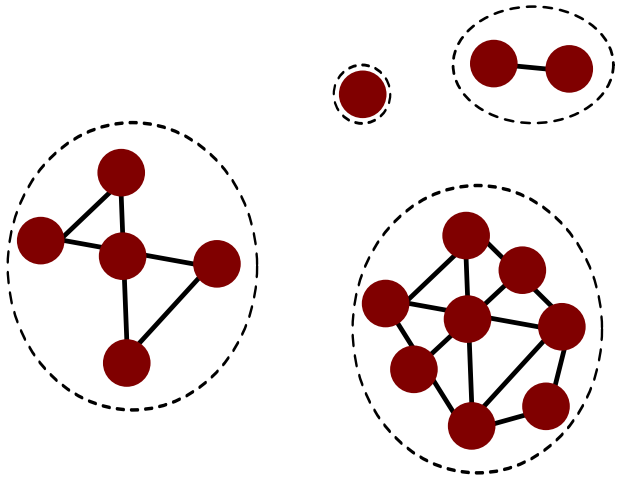


Figure: Store-carry-and-forward [1]

Bonus

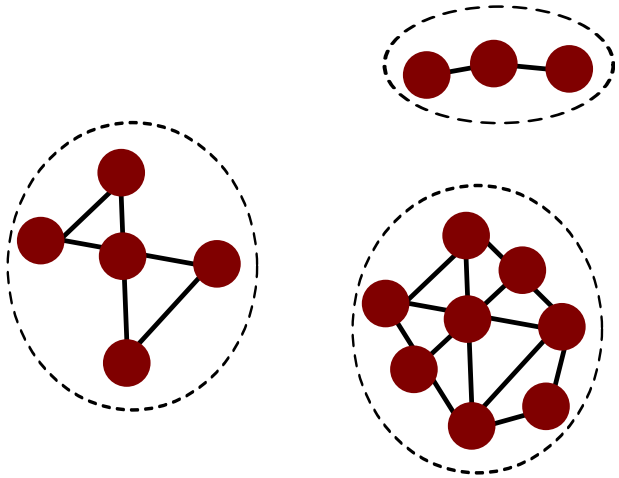


Figure: Store-carry-and-forward [1]

HTTP request/response example

Enter getbootstrap.com in your browser

HTTP request/response example

Enter getbootstrap.com in your browser

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

Figure: DNS request/response

HTTP request/response example

Enter getbootstrap.com in your browser

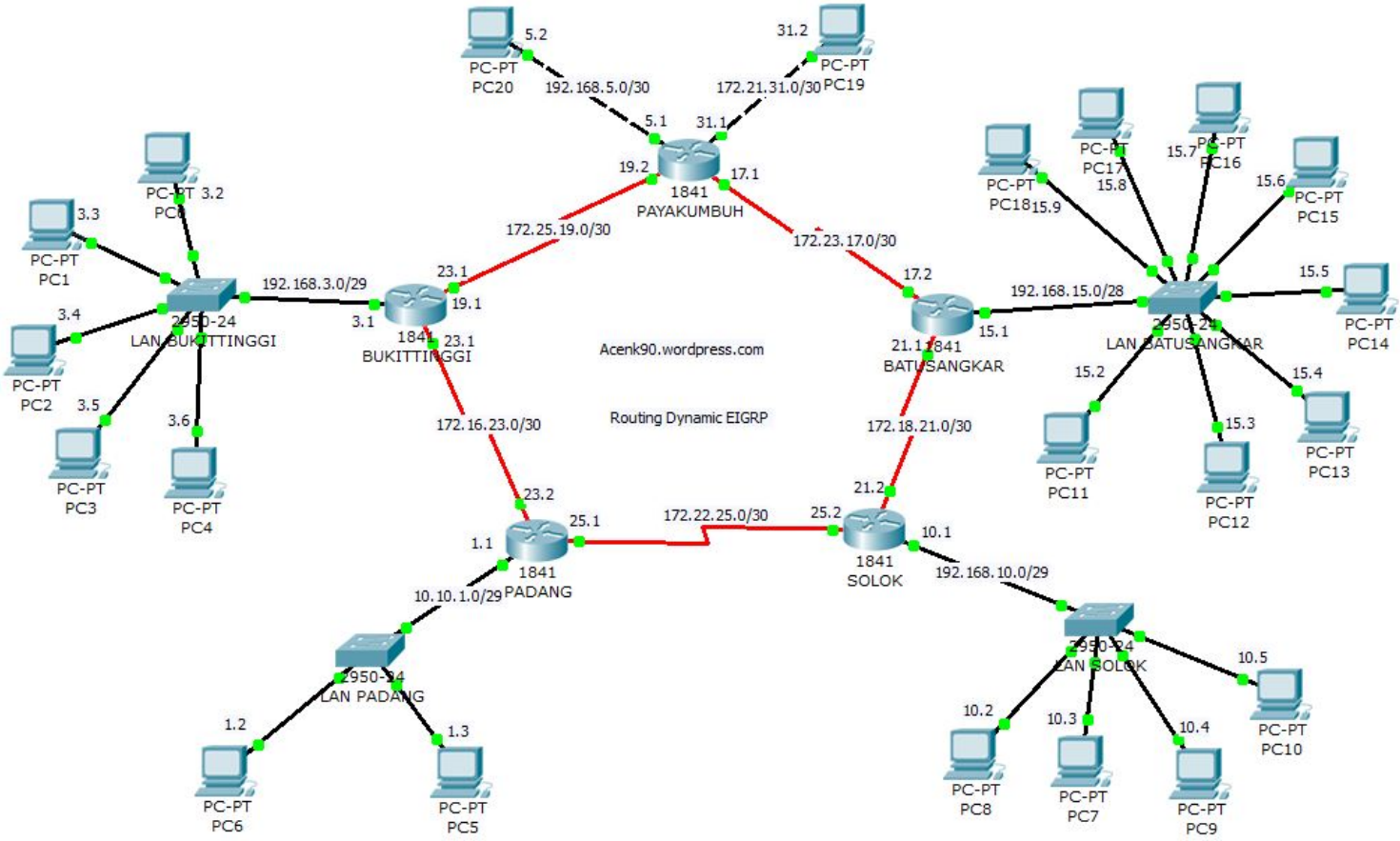
Source	Destination	Protocol	Length	Info
192.168.0.48	208.67.222.222	DNS	76	Standard query 0x4797 A getbootstrap.com
208.67.222.222	192.168.0.48	DNS	108	Standard query response 0x4797 A 192.30.252.154 A 192.30.252.153

Figure: DNS request/response

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

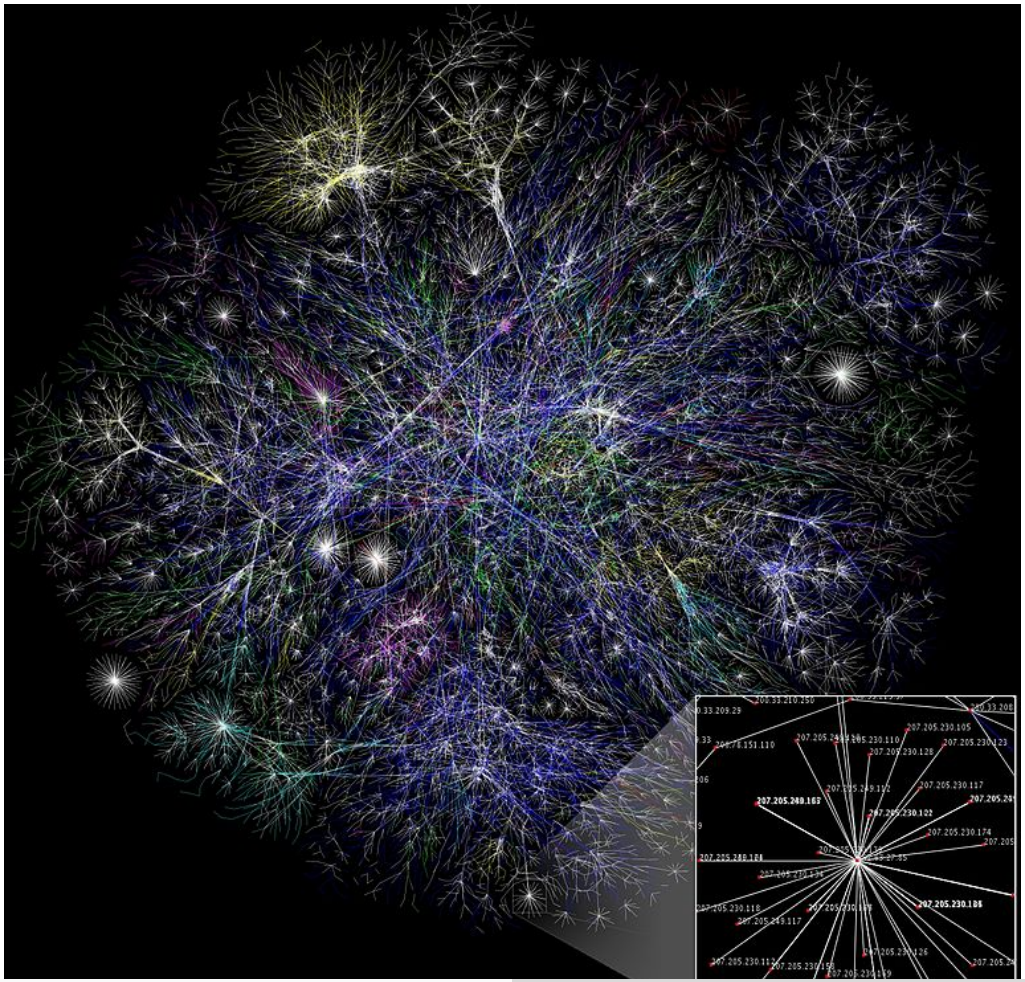
Figure: HTTP request/response

How do messages reach their destination?

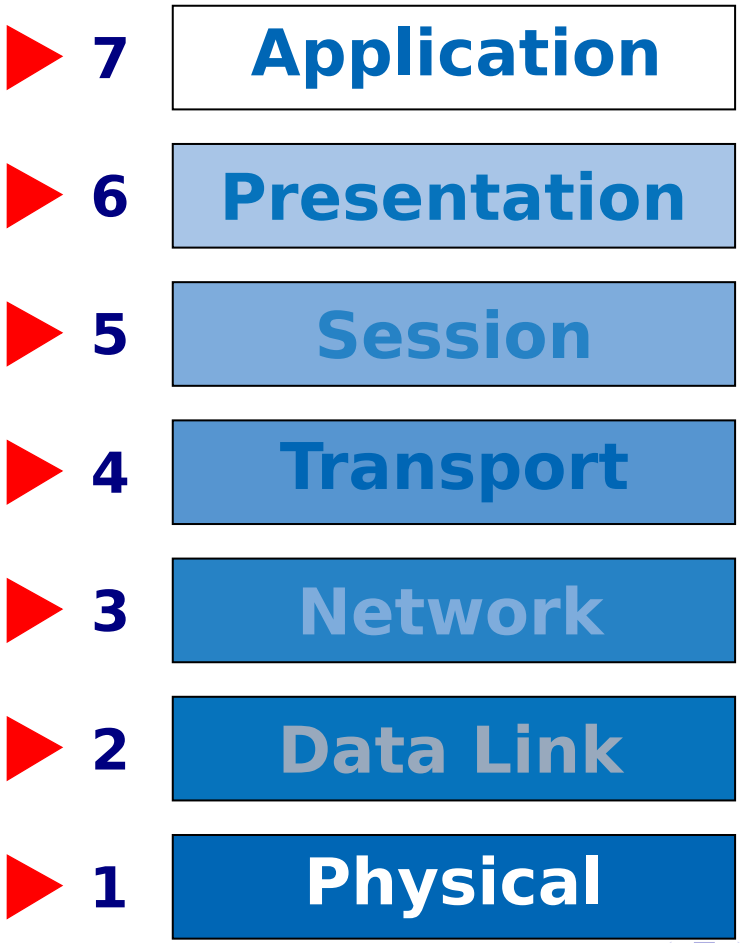


Topology Jaringan Menggunakan Routing Dynamic EIGRP Pada Cisco Router

More like this...



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



Presentation Outline

From analog/logical signals up to messages

Course details

Course details

Course details

Course details

Course details

Course details

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.