3TCA

NET

Medium Access Control

membre de UNIVERSITÉ DE LYON

Département Télécommunications
Services & Usages

INSA LYON

Medium Access Control

- Intervenant
  - Razvan Stanica – razvan.stanica@insa-lyon.fr.
  - Ingénieur Télécom-Réseaux ENSEEIHT, promo 2008.
  - Thèse sur le *Contrôle de Congestion dans les Réseaux Véhiculaires*, INP Toulouse 2011.
  - Maitre de conférences INSA Lyon depuis Septembre 2012.
  - Cours: 3TC PRS (responsable), 3TC NET, 4TC ARP, 4TC ARM.

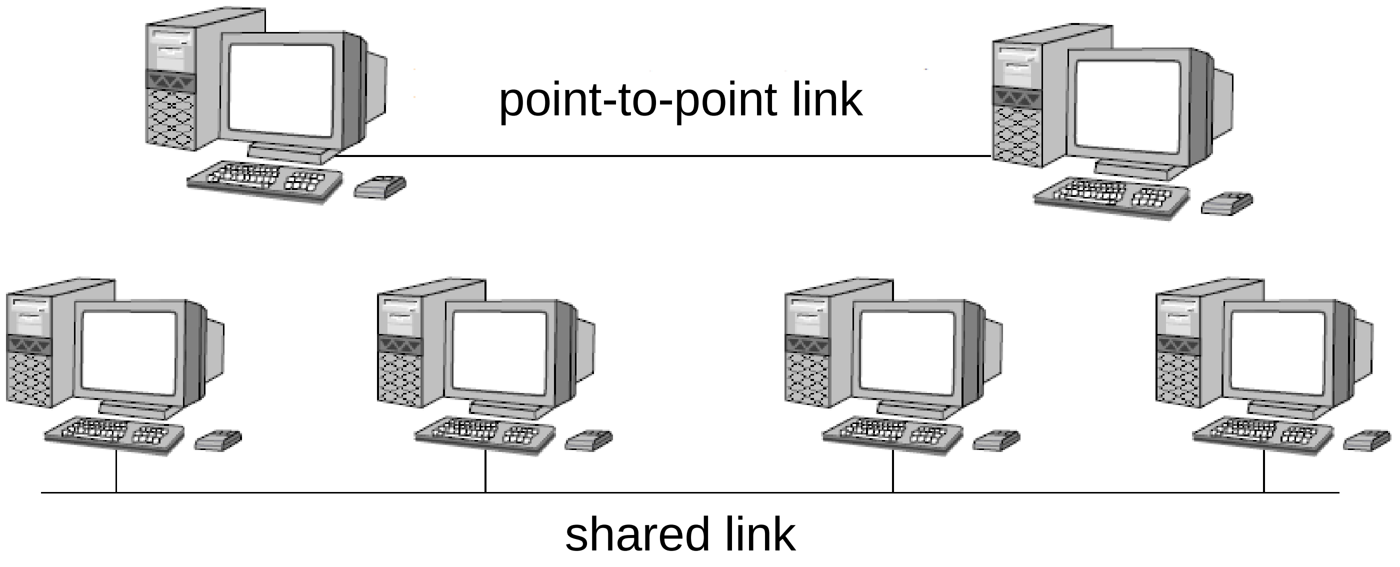
Medium Access Control

- MAC class
  - slides in English
  - 4h (today and Monday)

- Three main topics
  - general MAC strategies
  - CSMA/CD
  - CSMA/CA

Medium Access Control

- MAC role
  - a part of the data link layer, in charge of handling user access to the channel.

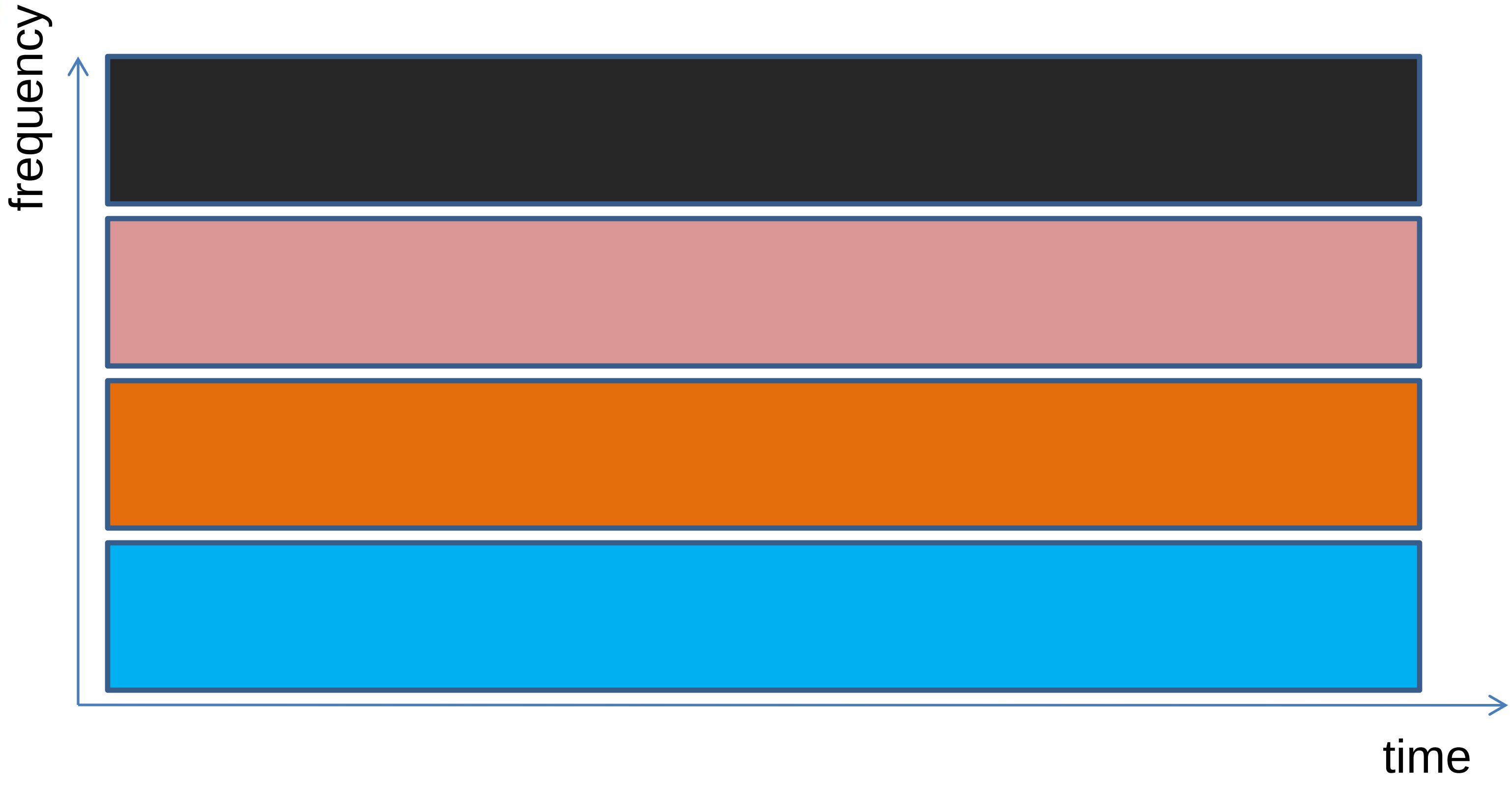


Medium Access Control

- Sharing the medium

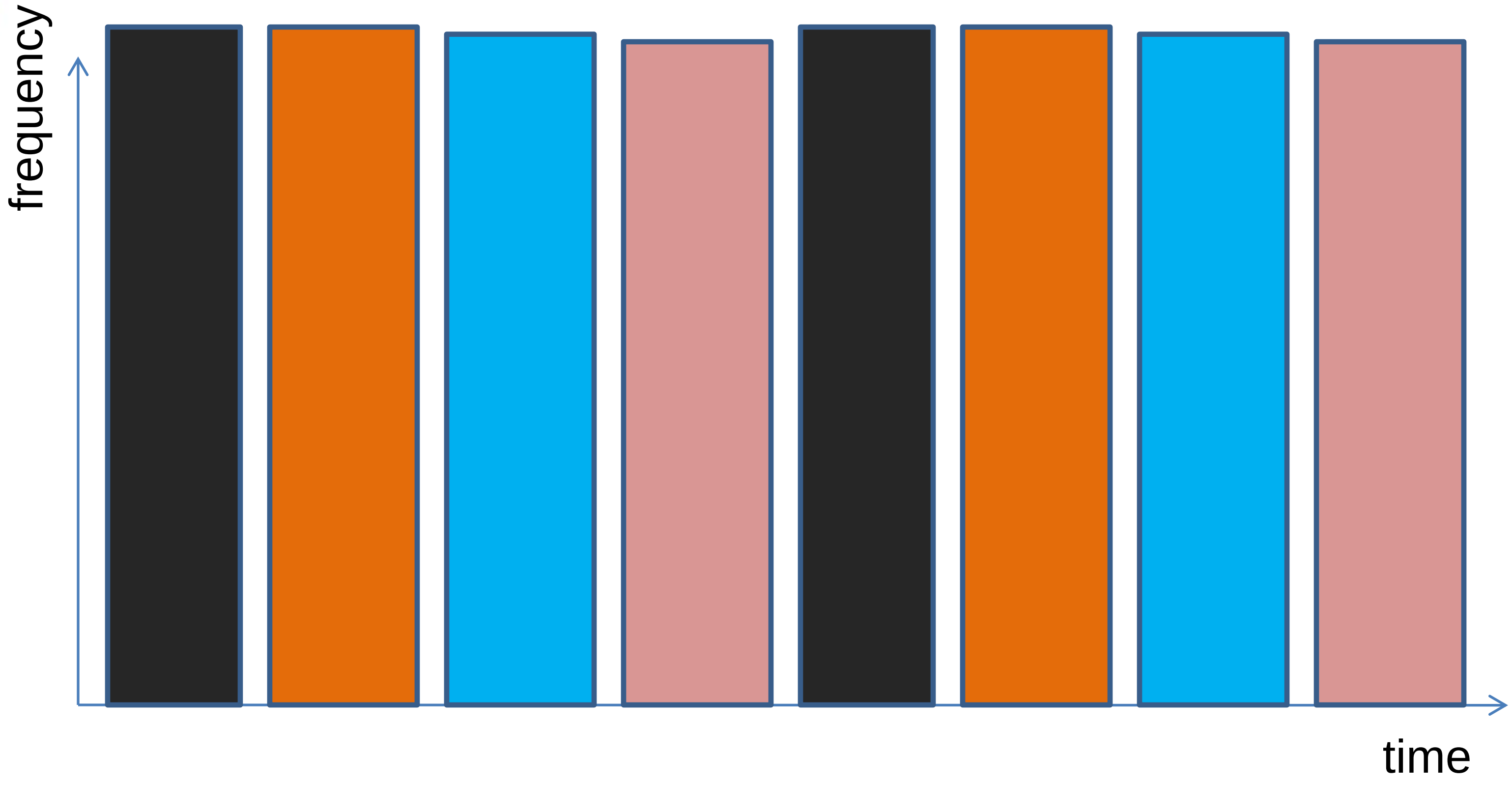
Medium Access Control

- Sharing the medium
  - Frequency Division Multiple Access - FDMA



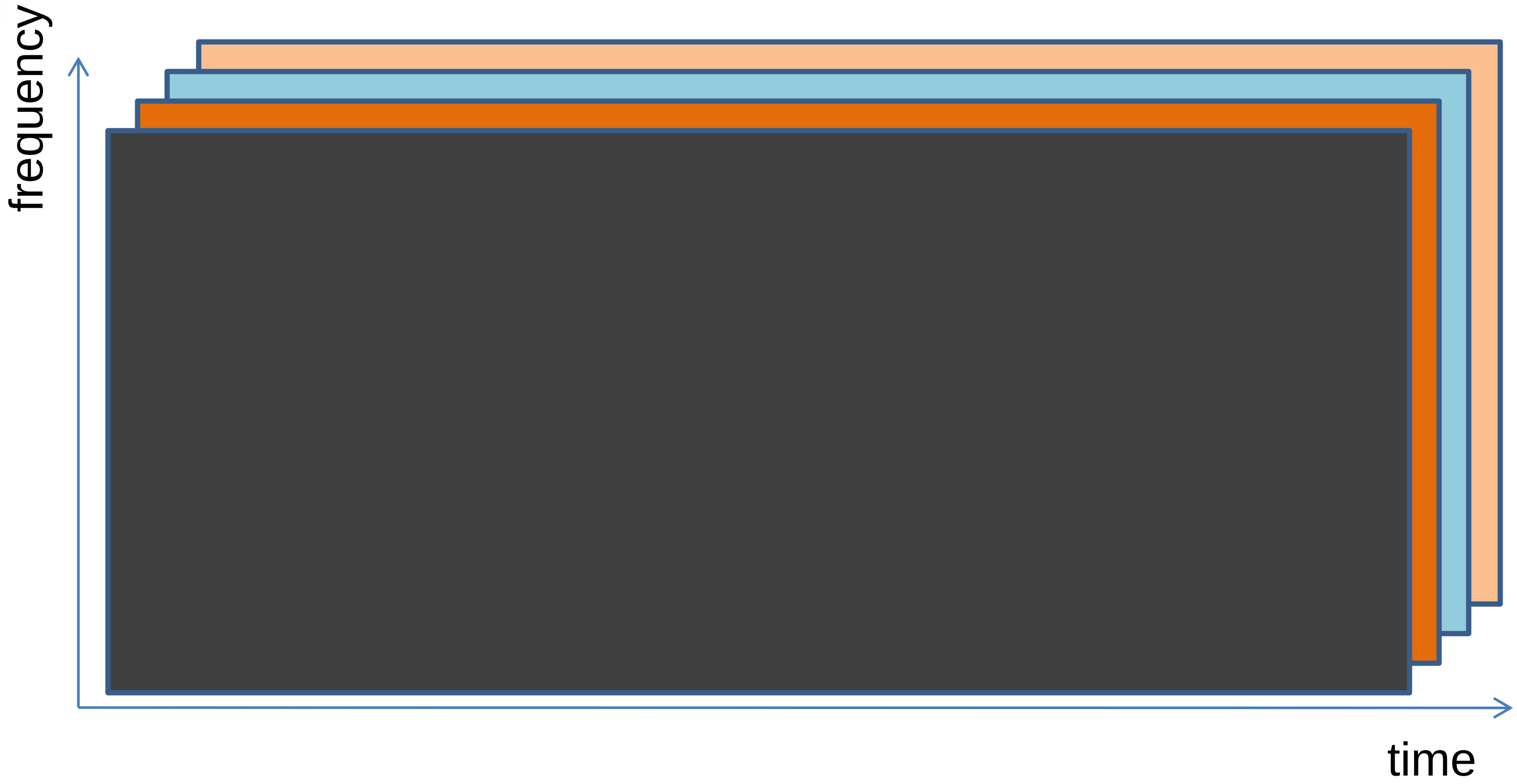
Medium Access Control

- Sharing the medium
  - Time Division Multiple Access - TDMA



Medium Access Control

- Sharing the medium
  - Code Division Multiple Access - CDMA



Medium Access Control

- Role of the MAC layer
  - Share the different resources (frequency blocks, time slots, codes).
  - Easiest solution: static assignment. Every node has its own, unique resource – not scalable.

- Two approaches
  - Centralized: a master node that decides the scheduling of the other nodes (e.g. cellular networks).
  - Distributed: resource allocation is decided by the nodes themselves (e.g. local area networks).

Medium Access Control

- Centralized solutions
  - Low scalability.
  - High overhead.
- Distributed solutions
  - Deterministic: gives precise bounds on the channel access delay.
  - Random: nothing certain, based on probabilities, works *most of the time*.

Medium Access Control

- Some examples – Token Ring
  - The nodes share one token.
  - A virtual ring structure is created: every node has a right neighbor and a left neighbor.
  - Only the node who owns the token has the right to transmit.
  - After a transmission, the token moves to the right neighbor.

Medium Access Control

- Some examples – Aloha
  - Transmit whenever data is available.
  - The receiver acknowledges the data (ACK).
  - Transmitter starts a timer.
  - Collision detected on timeout, followed by retransmission after a random delay.

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Carrier Sense Multiple Access with Collision Detection

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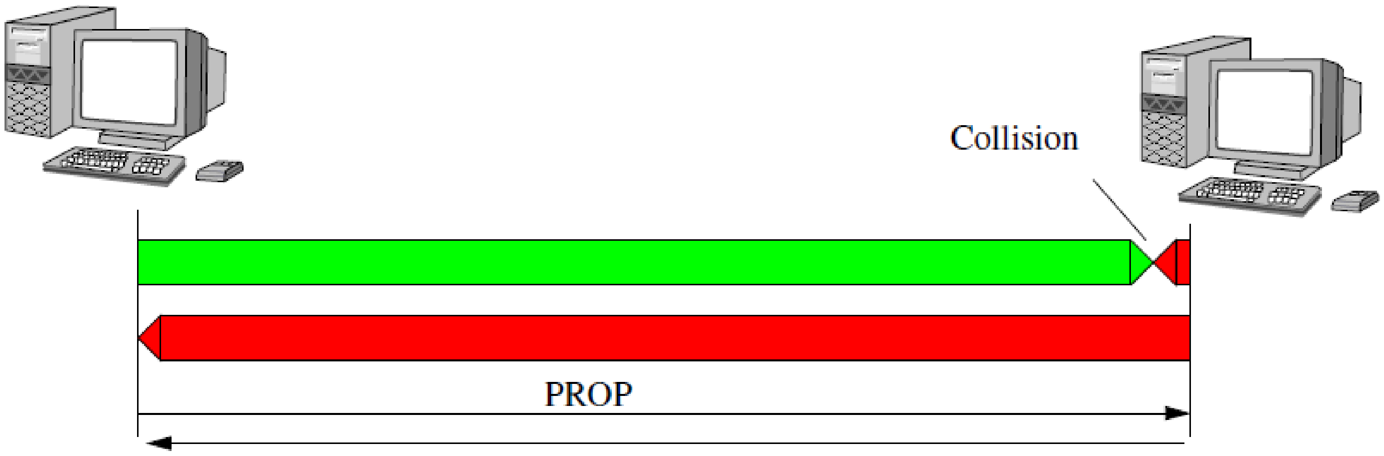
CSMA/CD

- Basic principles
  - Carrier Sense – listen the medium to detect ongoing transmissions.
  - Collision Detection – notice a collision as soon as possible and enter a back-up mode.
  - Listen and transmit at the same time.
  - Compare transmitted and received signals to detect collisions.

CSMA/CD

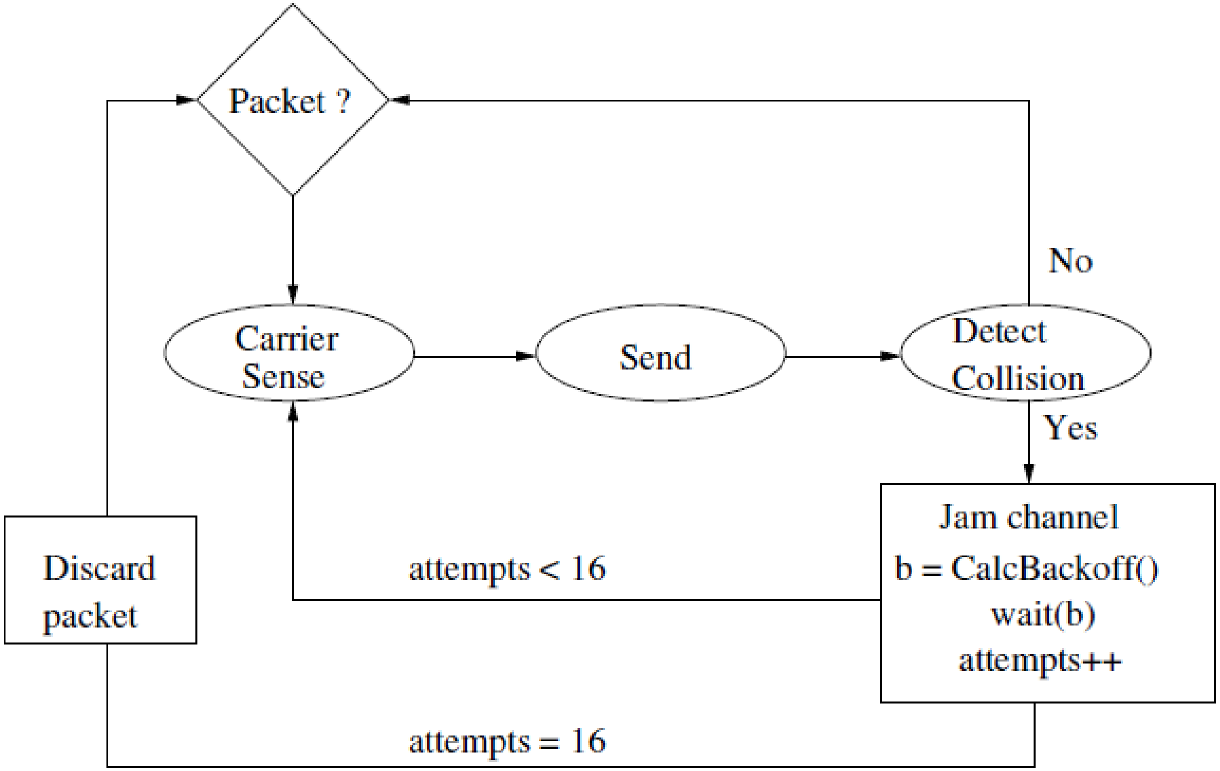
- Basic principles



- To properly handle collisions, a station needs to detect an incoming frame before the end of its own transmission.
- Minimum frame length: a transmission needs to last for at least 2xPROP.

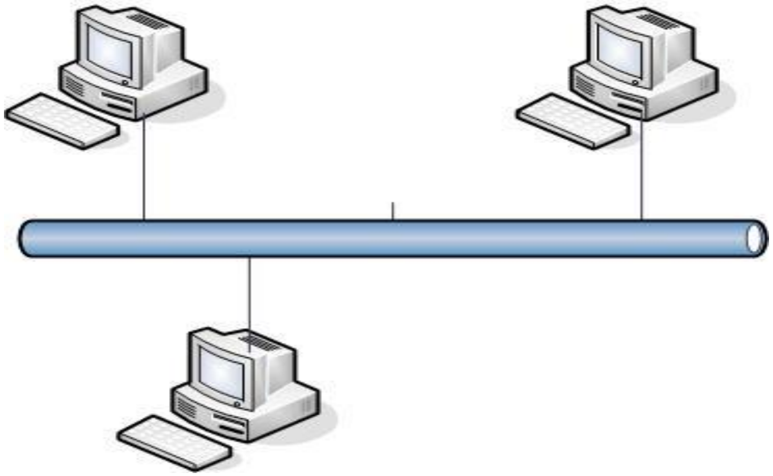
CSMA/CD

- Flow chart



CSMA/CD

- Mechanisms
  - Jam signal – when a collision is detected, do not stop.
  - All other stations need to start receiving a frame before the transmission ends.

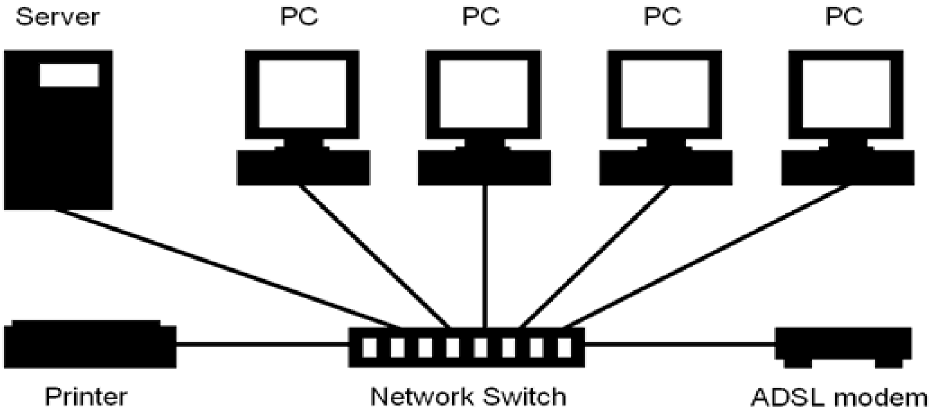


CSMA/CD

- Mechanisms
  - Back-off: when a collision is detected, the stations need to be de-synchronized.
  - All the contending and transmitting stations detecting a collision choose a random timer.
  - For the i^{th} consecutive collision: uniform choice in the interval $[0, 2^i-1]$ – back-off *b*.
  - Stations wait for *b* time slots before attempting retransmissions.
  - Time slot= time needed to transmit 512 bits (depends on the data rate)

CSMA/CD

- Implementations
  - Ethernet – developed in the early ‘70s at Xerox Palo Alto Research Center.
  - The dominant technology today.
  - Evolution in terms of data rate, physical support and topology.



CSMA/CD

- Implementations
  - In 1983, a slightly modified version of Ethernet has been standardized as IEEE 802.3.
  - The latest published version is IEEE 802.3bk.
  - Current work, mostly on optical networks, where IEEE 802.3 is becoming dominant.

CSMA/CD

- Implementations
  - Ethernet frame

Preamble	Destination	Source	Type	Data	CRC
8 bytes	6 bytes	6 bytes	2 bytes	46-1500 bytes	4 bytes

  - IEEE 802.3 frame

Preamble	Destination	Source	Length	802.2 header	Data	CRC
8 bytes	6 bytes	6 bytes	2 bytes	8 bytes	38-1492 bytes	4 bytes

CSMA/CD

- Ethernet frame

Preamble 8 bytes	Destination 6 bytes	Source 6 bytes	Type 2 bytes	Data 46-1500 bytes	CRC 4 bytes

- Preamble – synchronize the clock of the transmitter and receiver.
- Destination and Source – 48 bits addresses, assigned by network card manufacturers (need to be unique, at least in the local network).
- Type – unique code for the encapsulated protocol (e.g. 0x0800 for IP).
- Data – possibly with padding to reach the minimum size.
- CRC – error control.

CSMA/CD

- Ethernet address
  - Encoded on 6 bytes (48 bits).
  - Theoretically unique address, assigned by the manufacturer.
  - 3 bytes to identify the constructor, 3 bytes to identify the network card.
  - All frames are received by all the stations sharing the medium.
  - Dropped by stations that do not match with destination address.
  - Special broadcast (FF:FF:FF:FF:FF:FF) and multicast addresses.