Local area networks

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Lecture 1: Introduction to local area networks

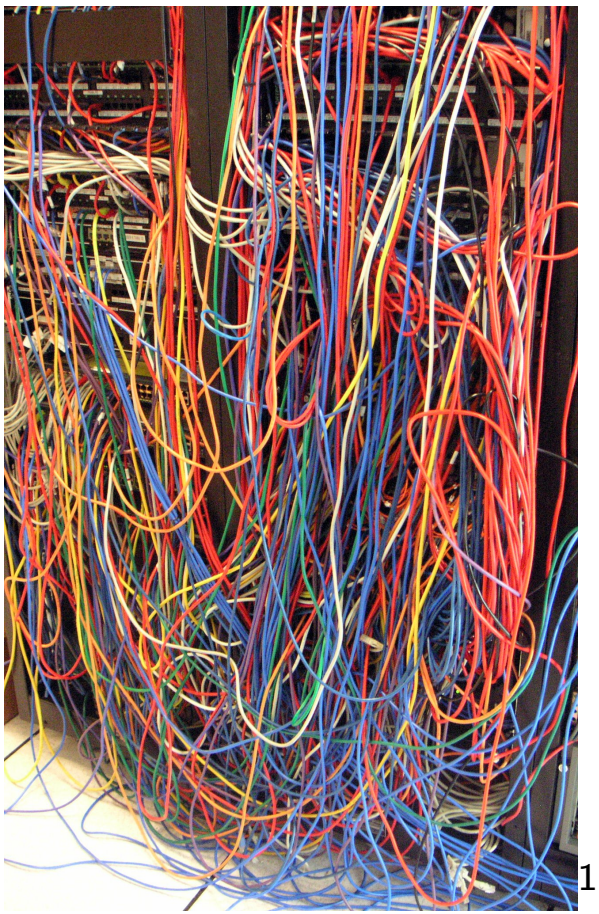
Central question for this class :

How to create *a network* for *devices* that are *relatively close* to each other – a *local network* ?

Local area networks

NOT a dedicated wire per communication

It doesn't scale: for N devices, we need $N(N-1)/2$ wires.

 [1]

[1] source: https://cedarandthistle.files.wordpress.com/2013/09/messy_cables.jpg

Local area networks

Share the wire !

All devices have to share the same wire.

- In this case, the communication is by nature ***in broadcast*** mode

Each transmitted bit is received by all other nodes on the channel

Shared access networks

What happens if a device sends its message whenever needed?

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Shared access networks

What happens if a device sends its message whenever needed?

Different situations may occur:

- No one else is transmitting data for the complete transmission duration.
  $\rightarrow$ The message is received properly by the destination ☺.
- Another device transmits a message during the transmission
  $\rightarrow$ The messages are superimposed (destructively) and can't be understood:

there is a collision ☹!

Shared access networks

Collisions

Have of course to be mitigated. But how?

Shared access networks

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Using a Medium Access Control protocol

a.k.a. MAC protocol.
These are rules enforced so as to:

- Avoid collisions or re-transmit data if a collision occurs,
- Offer each node a *fair* access to the channel.
  Each device on the network gets a fair share of channel bandwidth on average.

Shared access networks

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Bandwidth

The amount of data that can be passed along a communication channel in a given period of time.

MAC protocol and channel access method

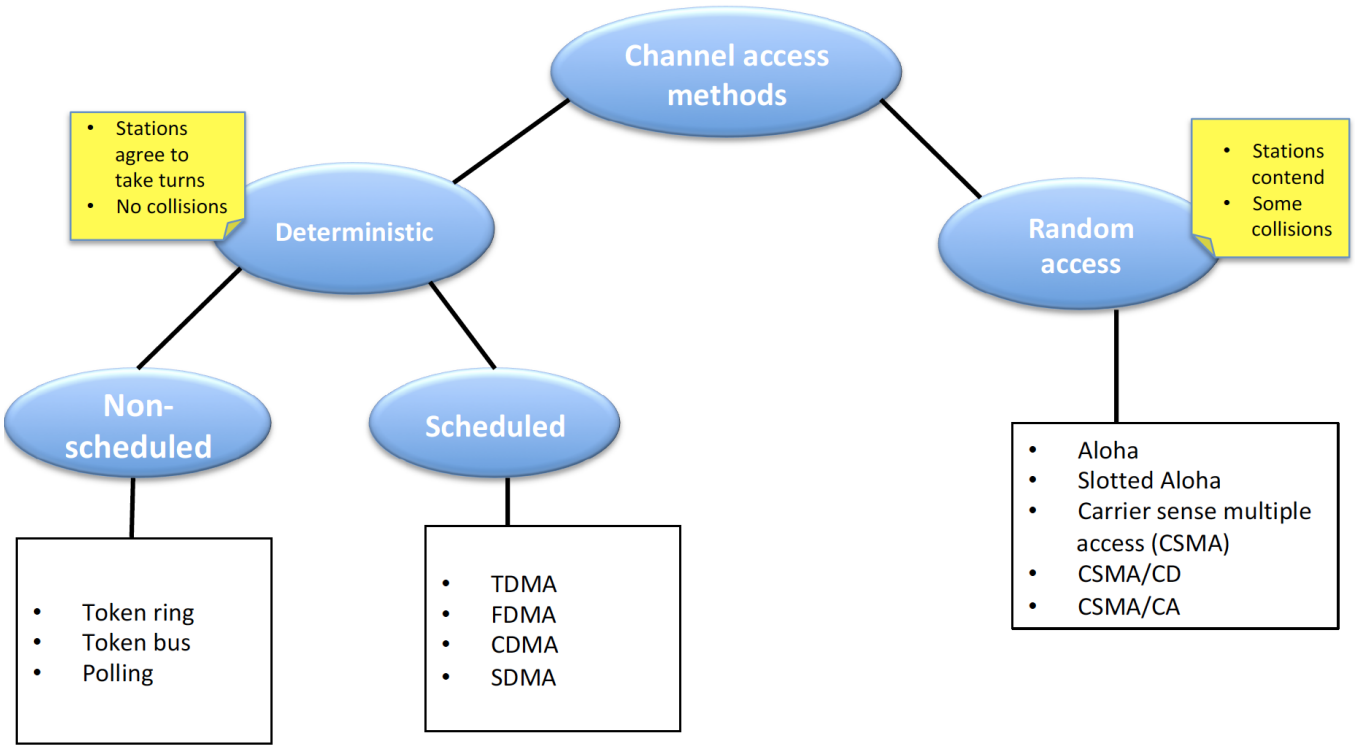
MAC protocol

Decides when each device can transmit its messages on the shared channel (or who speaks next).
There are numerous MAC protocols available:

- For wired networks:
  Ethernet, switched Ethernet, HDLC, Token Ring, Token Bus, CAN, AFDX, FDDI, etc...
- For wireless networks:
  WiFi, Bluetooth, ZigBee, WiMax, GSM, LTE, etc...

Channel access methods

MAC protocols follow different approaches for sharing the channel. Each type is called a *channel access method*.



Channel access methods

Random Access

- Stations contend with each other without any centralized coordination
  - Collisions are the norm
- A specific algorithm for resolving contention/reducing collisions once they happen
  - resolve collisions : detect a collision and do something to fix it
  - reduce collisions : reduce the odds for a collision to happen

Channel access methods

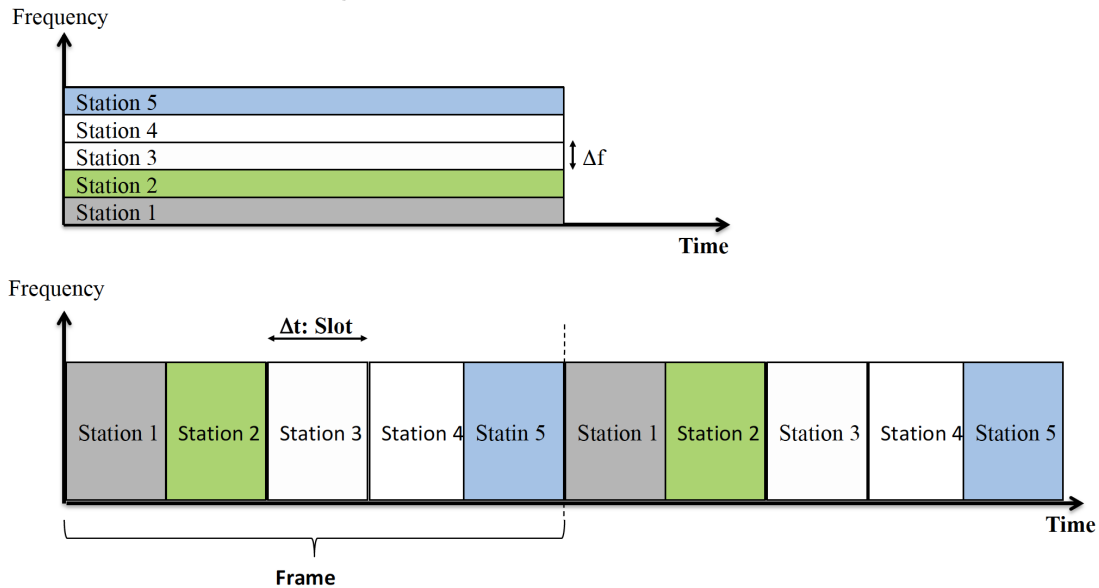
Deterministic Access

- There is no contention – stations agree in advance
  - There are no collisions
- Different ways to agreeing, resulting in different MAC protocols :
  - Centralized : a unique entity decides on resource allocation
  - Distributed : nodes agree by exchanging messages

Channel access methods

Deterministic Access

- Different ways to executing the agreement
  - Circuit-like: TDMA, FDMA, ...
  - Packet based: Polling, Token passing
- Remember from telephony:



Either we share *time* (TDMA), *frequencies* (FDMA), *time-frequency blocks* (FTDMA), orthogonal *codes* (CDMA), or *space* (SDMA).

This course

This course introduces

*** the main channel access methods ***

and illustrates them with

*** state-of-the-art MAC protocols.***

Outline for the rest of this class

Lecture 1: Introduction to local area networks

Part 1: Random channel access

Lecture 2: Random channel access
Lecture 3: Ethernet and switched Ethernet
Lecture 4: WiFi - Distributed Coordination Function (DCF)

Part 2: Deterministic channel access

Lecture 5: WiFi (PCF)
Lecture 6: Token Ring