IEEE 802.15.4 Refresher

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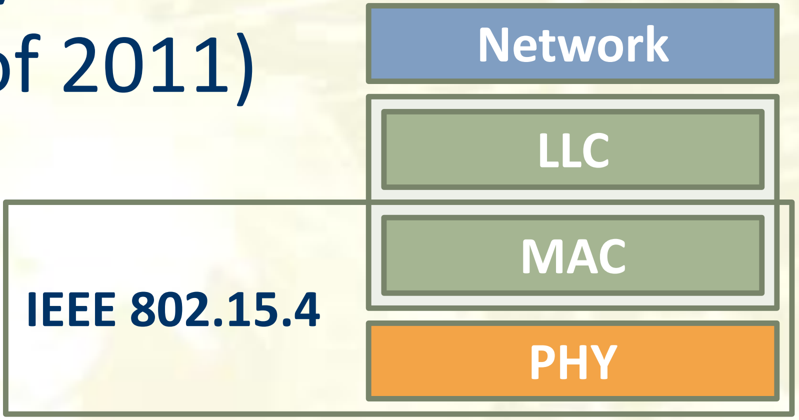
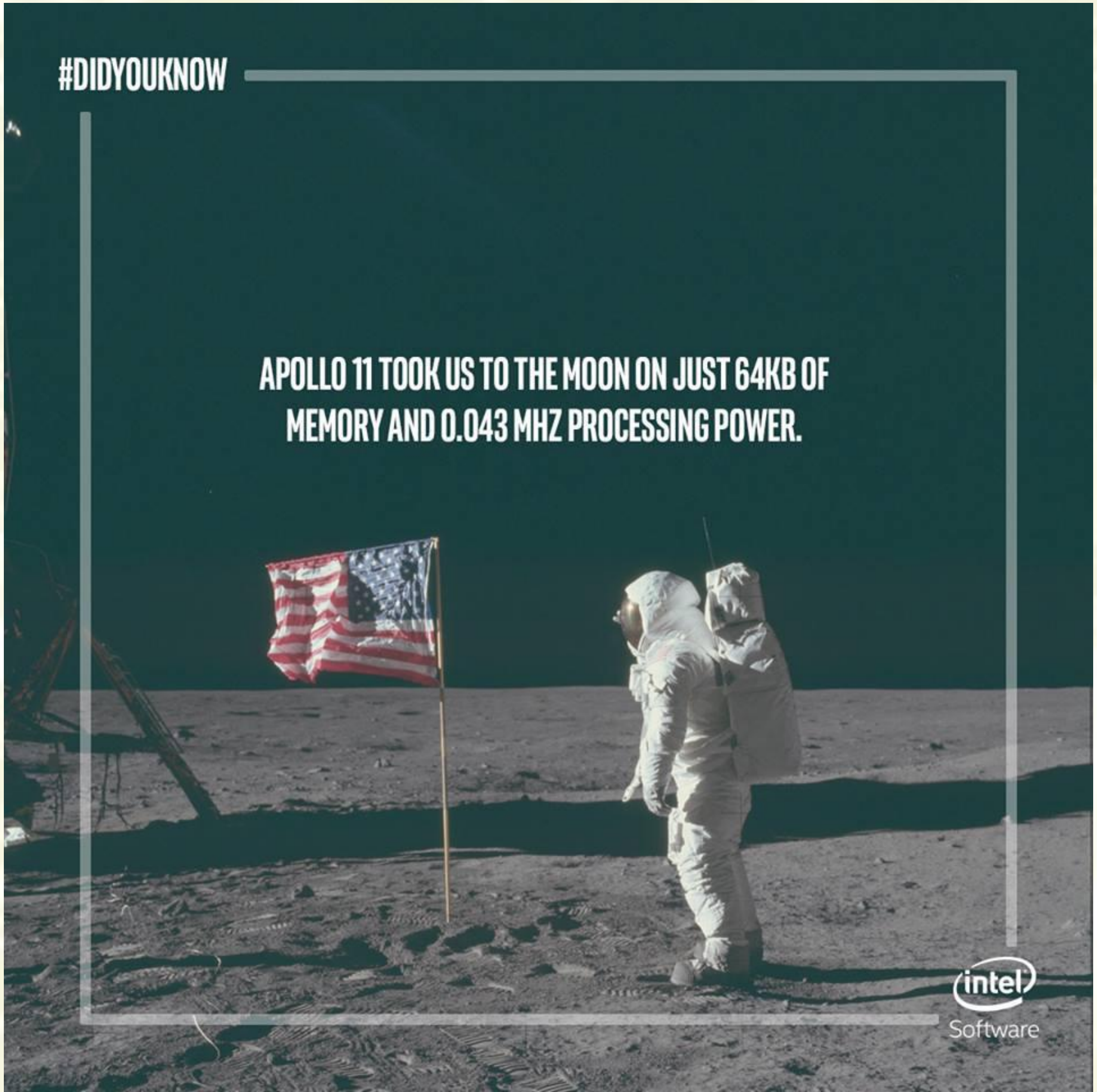
IEEE 802.15.4 standard

- Standard PHY and MAC layers for low-rate WPANs (latest release as of 2011)



- Goal
  - Defining a communication standard for constrained devices with limited computation, power (battery powered devices) and memory

Limited? how much?



IEEE 802.15.4 features

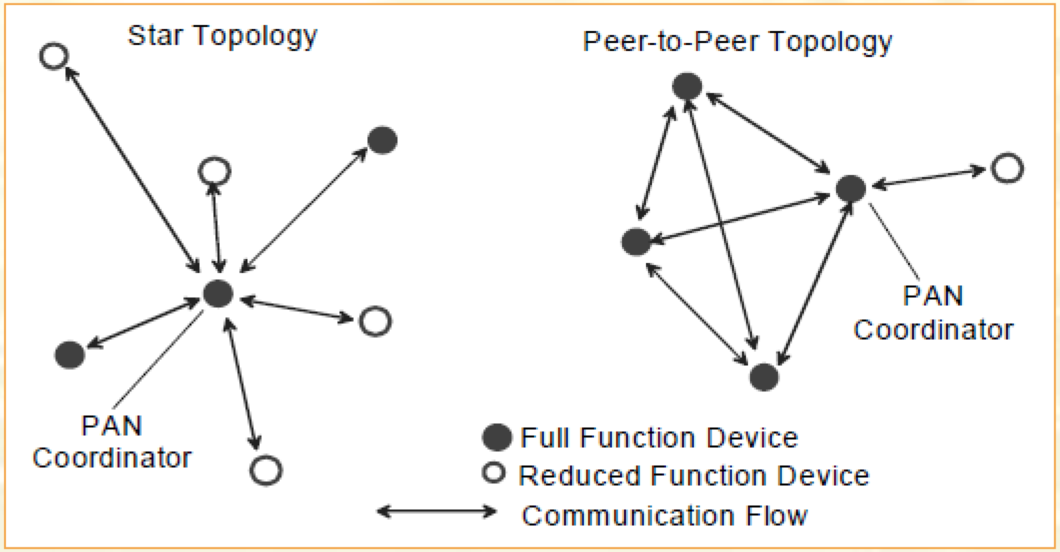
- Main features
  - Low data rate: 20-250 Kbit/s data rates
  - Pure CSMA or hybrid TDMA/CSMA MAC protocols
  - 127 bytes max frame size
  - Long (64-bit) and short (16-bit) addressing modes
  - Star and peer-to-peer network operation
  - Link layer security

IEEE 802.15.4 topologies

- Full vs. Reduced Function Devices
  - FFDs can talk to RFDs or other FFDs, while an RFD can talk only to an FFD
- An RFD is intended for applications that are extremely simple
- The RFD can be implemented using minimal resources and memory capacity
- A full-function device (FFD) has more resources and it is capable of **relaying** messages
- FFDs can operate in three modes: *regular device*, *coordinator* and *PAN coordinator*

IEEE 802.15.4 topologies

- Star vs. P2P topologies
  - **Star**: the communication is established between devices and the single *central controller*, the *PAN coordinator*
  - **P2P**: any device can communicate with any other device in range. *Mesh functionalities for multi-hop data delivery can added at the higher layer, <u>but are not part of this standard</u>*
- PAN unique id
- Coordinators provide synchronization services to other devices



IEEE 802.15.4 addressing

- 64-bit addresses based on IEEE EUI-64, a globally unique id assigned by the manufacturer

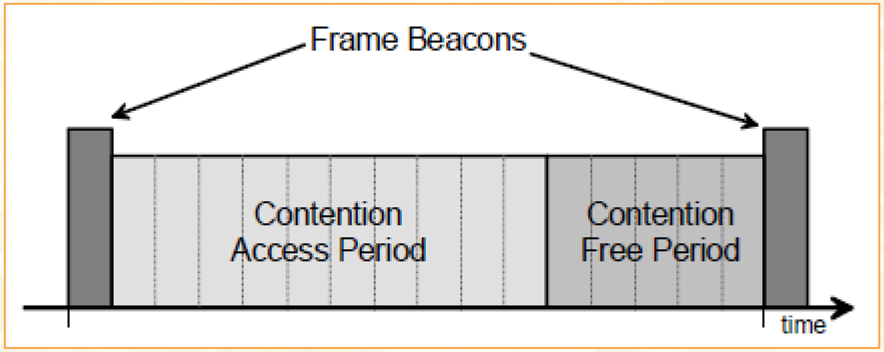
```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     OUI     |L|M|          OUI (cont.)          |               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+               +
|                   extension identifier                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

M = multicast
L = local

- Short 16-bit addresses dynamically assigned during network formation
- Source and destination addresses are augmented by the 16-bit *PAN id*

IEEE 802.15.4 operation modes

- Beaconless vs. beacon-enabled MAC operation
- Beaconless mode
  - uses a pure CSMA channel access and operates quite like basic IEEE 802.11
- Beacon-enabled mode
  - superframe structure and the possibility to reserve time-slots for critical data



IEEE 802.15.4 Frame format

- MAC frame format
  - 127 bytes max
  - 88 bytes payload in the worst case

Octets: 2	1	0/2	0/2/8	0/2	0/2/8	0/5/6/10/14	variable	2
Frame Control	Sequence Number	Destination PAN Identifier	Destination Address	Source PAN Identifier	Source Address	Auxiliary Security Header	Frame Payload	FCS
		Addressing fields						
MHR							MAC Payload	MFR

Sniffer

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Sniffer

- Sniffer, what's this thing?

Sniffer

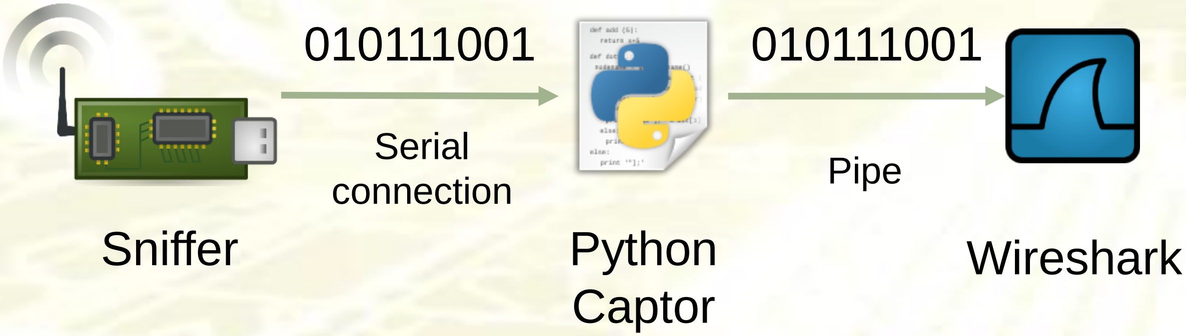
- Download sniffer program inside the example folder:
  - git clone https://github.com/lab-anaws/lab2-2017.git
- Load the sniffer into one sensor
  - make TARGET=sky MOTE=1 sniffer.upload

Sniffer

- Run the captor program:

python sensniff.py --non-interactive -d /dev/ttyUSB0

USB port of the mote acting as sniffer



Run Wireshark

- Run Wireshark
- Configure the program to collect packets from the mote:
  - Go to Capture -> options -> Manage Interfaces -> New (under Pipes) -> type /tmp/sensniff and save
  - The pipe will then appear as an interface. Start a capture on it

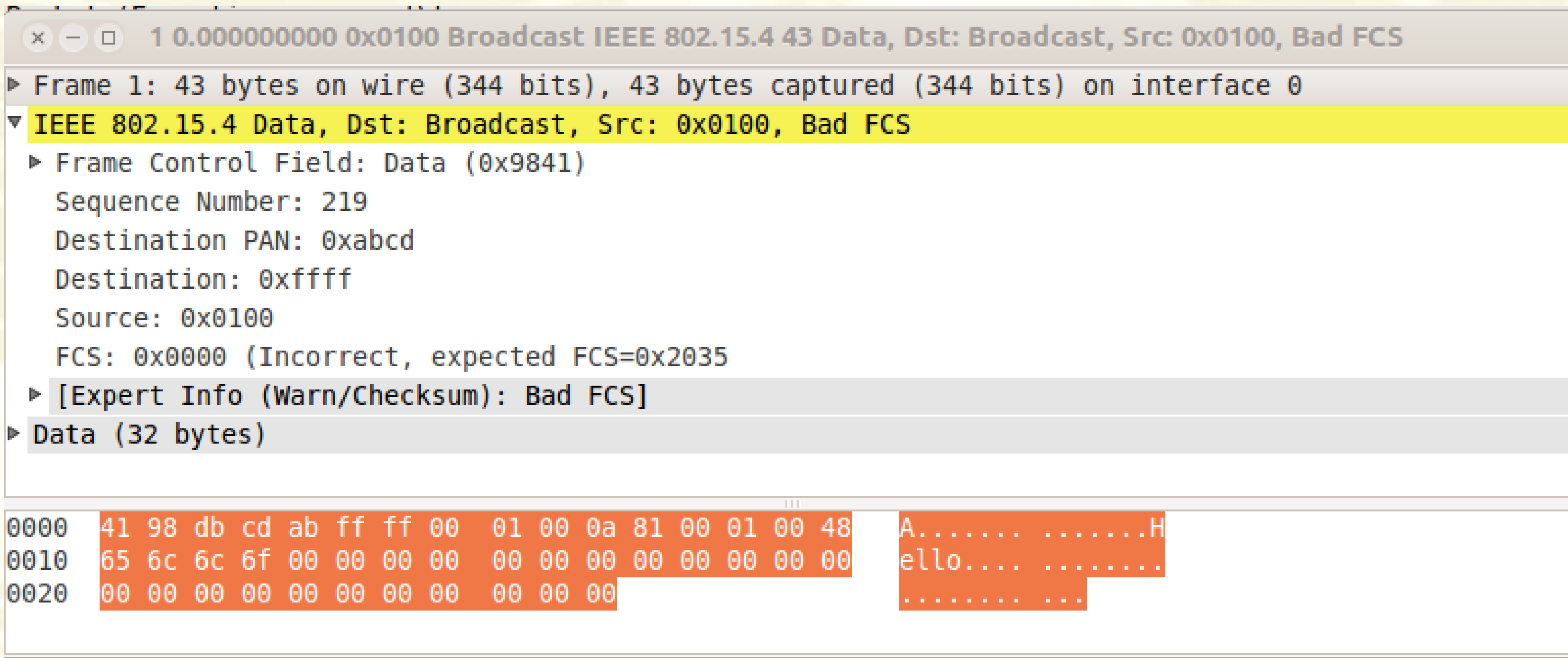
Generate some traffic

- Load on another mote a program to generate some traffic, e.g. “broadcast-example.c” in “examples/rime”

Set the same channel on all the motes!!

Captured data

- Captured data is shown in wireshark



Bad FCS Error

- Frame payload is not dissected (wireshark is supposed to analyze packets’ payload and show their content)
- An error, “Bad FCS”, is shown
- The frame check sequence (FCS) is a field included in IEEE802.15.4 frames to verify the integrity of the MAC frame
- *That field is processed in hardware*

Bad FCS Error

- Go to Edit -> Preferences
- Select Protocols -> IEEE 802.15.4
- Uncheck “Dissect only good FCS”