Wireless Sensor Networks

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Credits: 6

Syllabus: Laboratory Activities

1. **PAN Formation**
2. **Data Transfer (point-to-point)**
3. **MAC Protocol (point-to-point)**
4. **NET Protocol (small network)**

PAN Formation

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Outline

1. IEEE 802.15.4 / Zigbee Protocol Stack
2. PAN Formation
3. Scan Primitives

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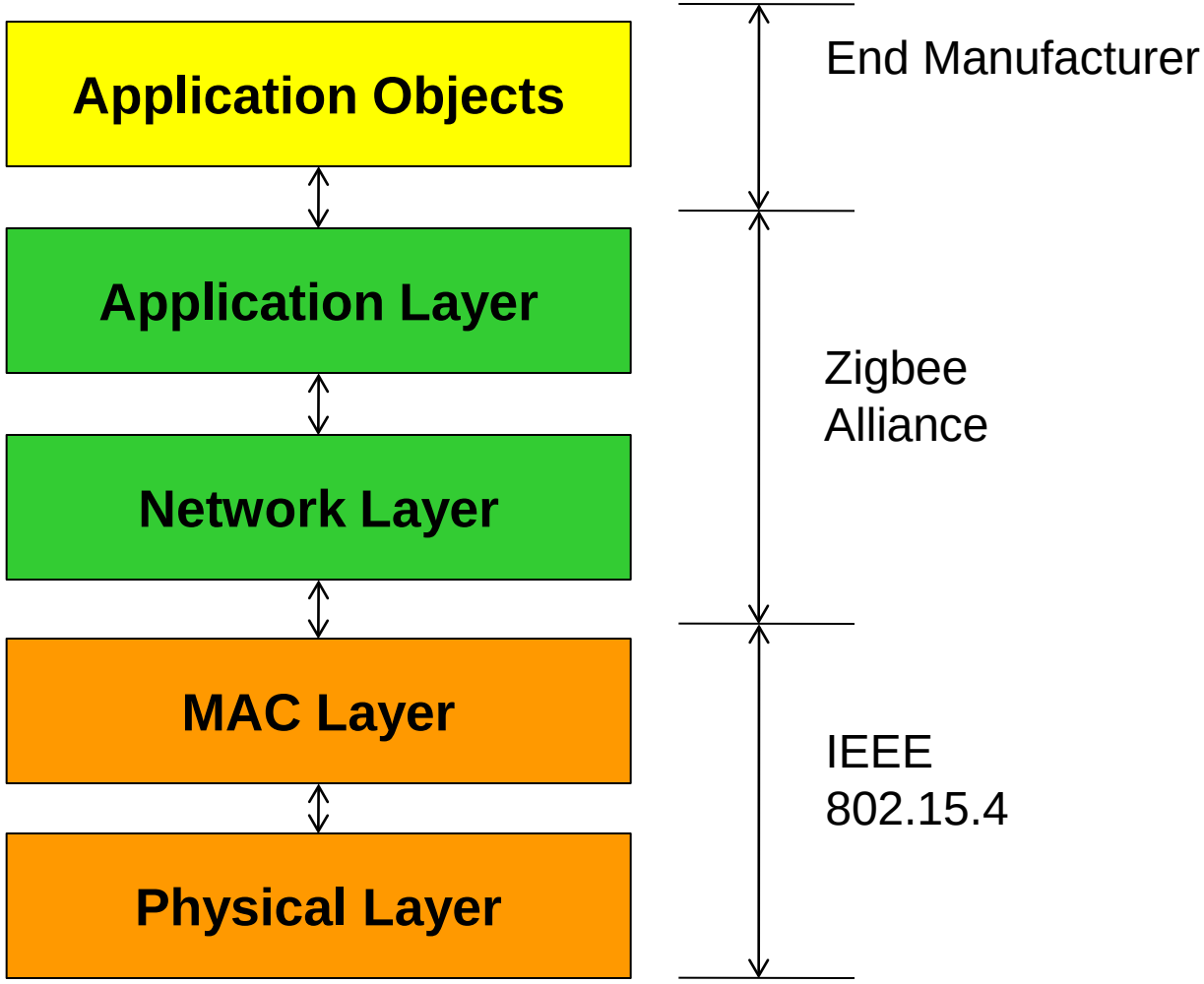
IEEE 802.15.4/Zigbee Protocol



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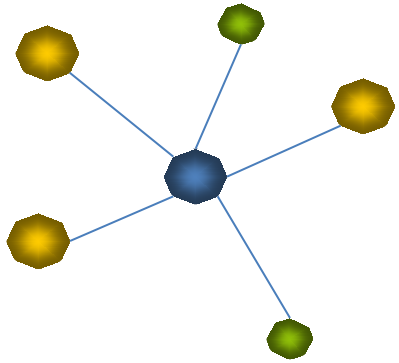
Network Devices

A Network (PAN) is managed by a PAN Coordinator.

RFD (Reduced Function Device)

- Reduced functionalities
- Battery powered
- No forwarding



FFD (Full Function Device)

- All functionalities are implemented
- Forwarding
- Can play the role of Coordinator

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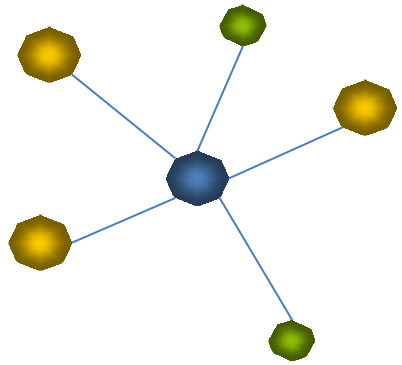
PAN Formation

- Each PAN works in a given channel, selected by the Coordinator.

- The Coordinator selects the less interfered channel.

- Interference between different PANs and other networks (e.g., Wi-Fi, Bluetooth), are minimised.



Channel Scanning

- Energy Detection Scan → allows a FFD to obtain a measure of the peak energy in each requested channel.

- Active Scan → allows a device to locate any coordinator transmitting beacon frames. A *beacon request command* is transmitted in each of the scan channels.

- Passive Scan → allows a device to locate any coordinator transmitting beacon frames. No *beacon request command* issued.

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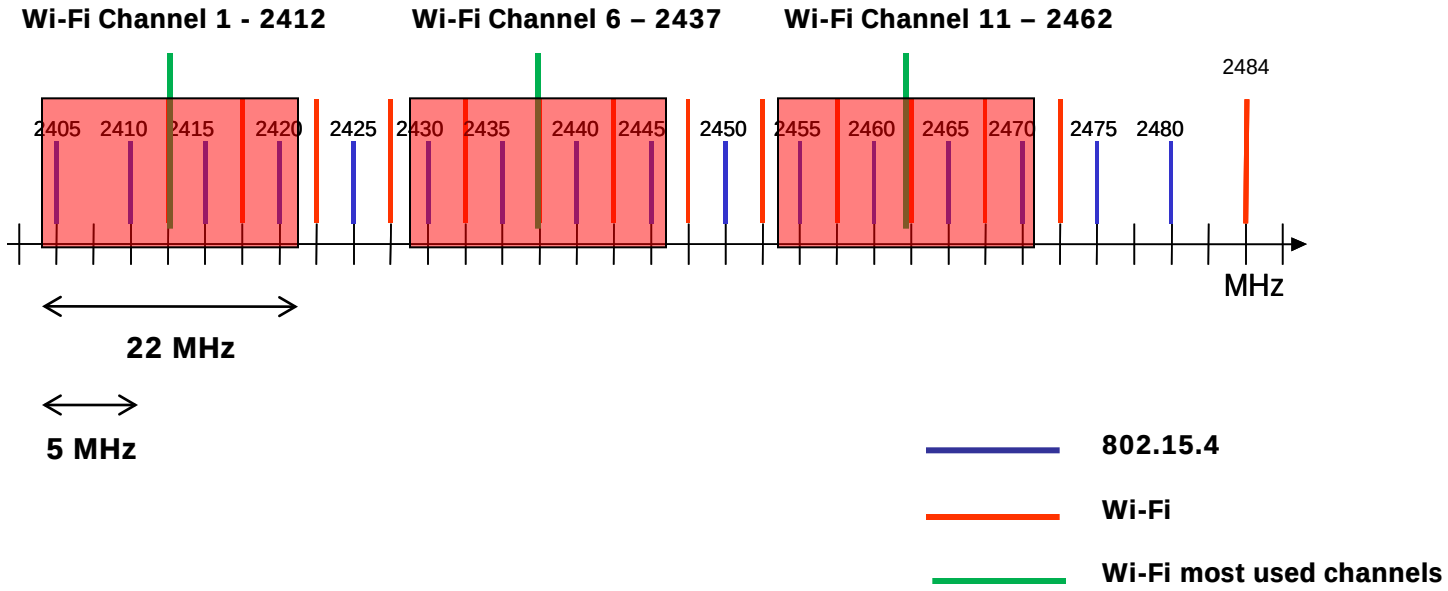
Why ED Scan is important?

Wi-Fi – 802.15.4 Channels



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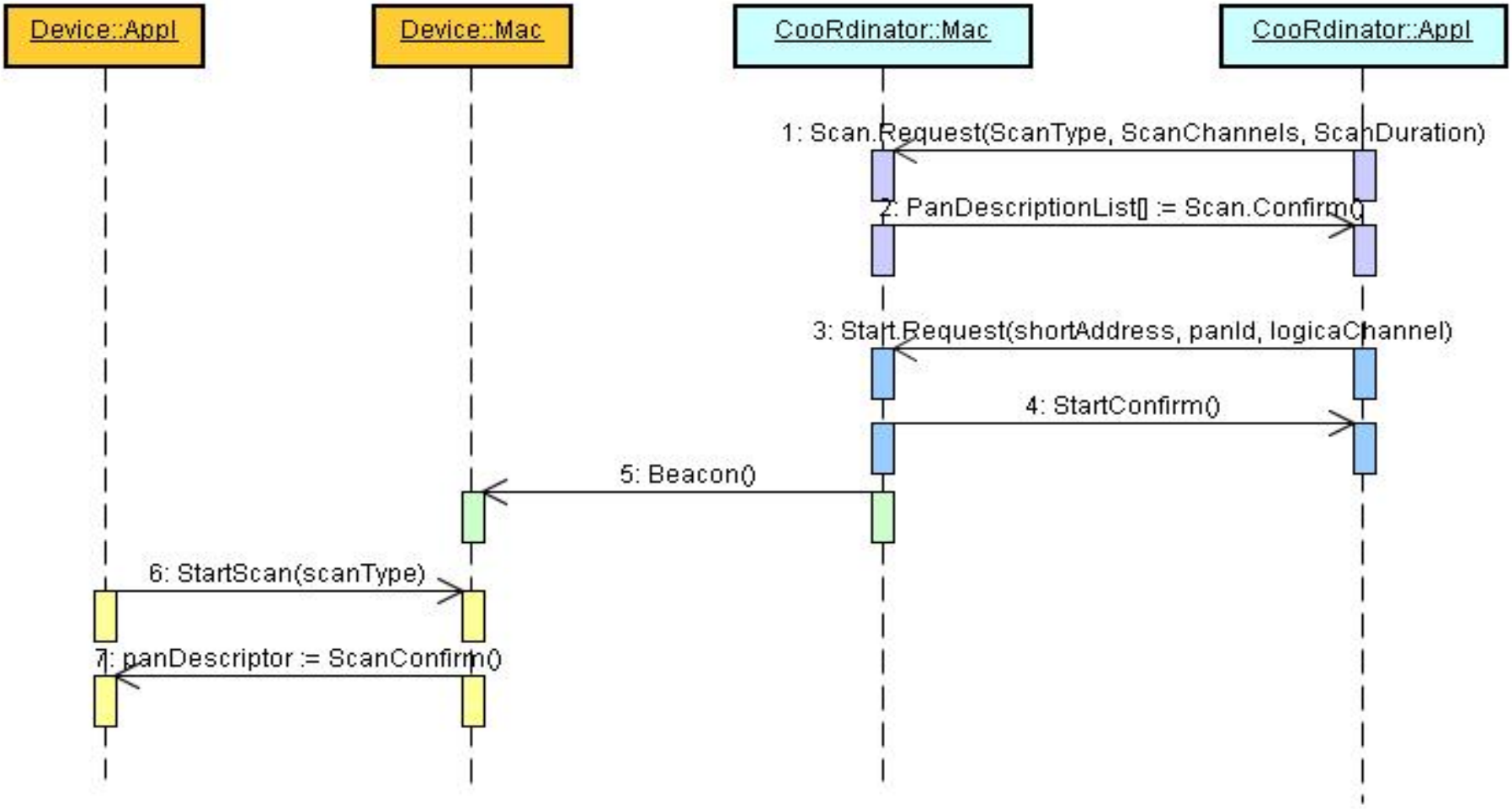
PAN Formation



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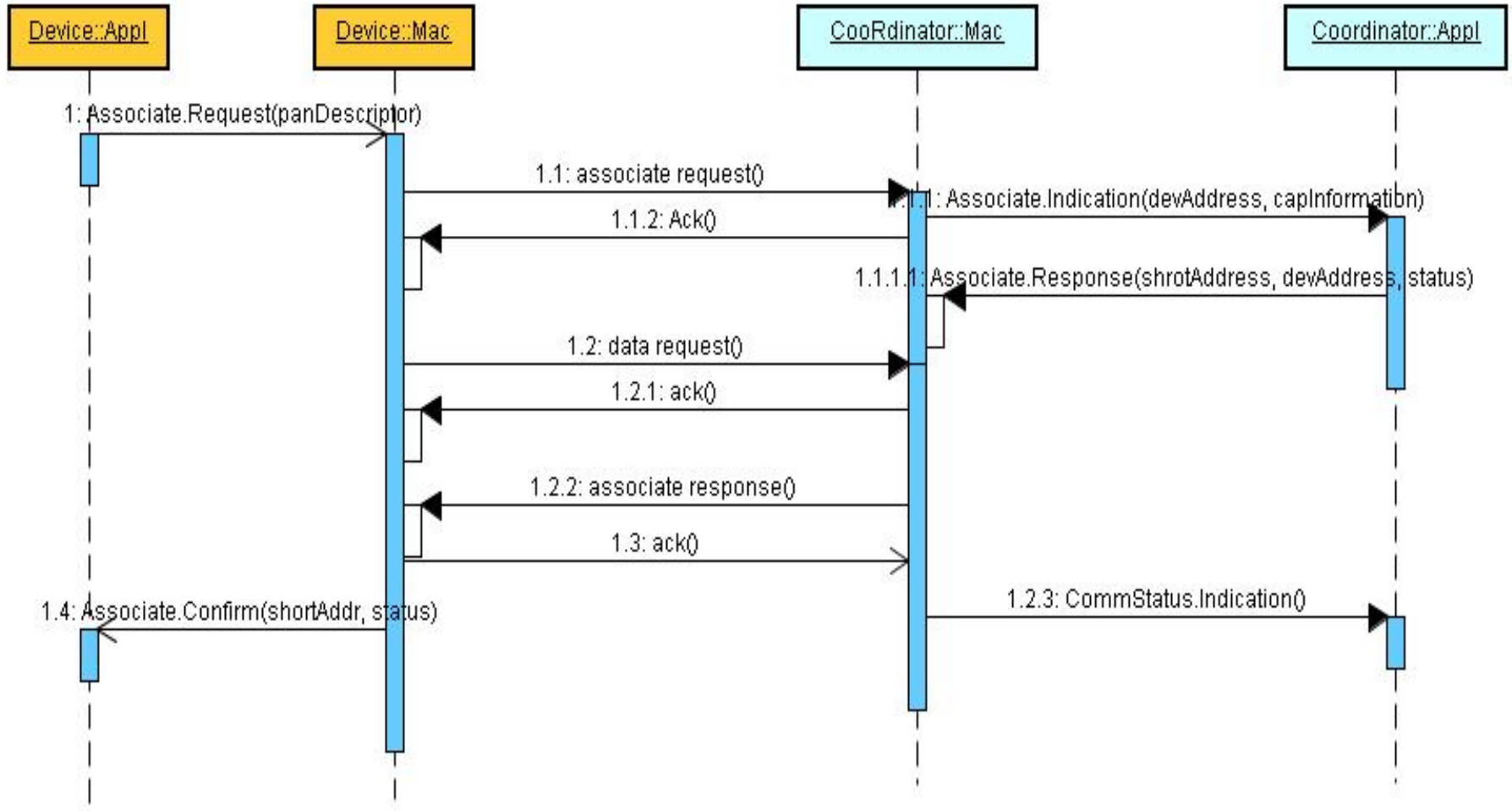
Nodes Association



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Scan Primitives

MLME-SCAN.request (
ScanType,
ScanChannels,
ScanDuration
)

ScanType → 0 (ED), 1 (active scan), 2 (passive scan)

ScanChannels → 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0

ch = 26 ch = 11

ScanDuration = *n* → Duration = 15.36 * (2^n +1) ms

Ex. n=0 → Duration ≈ 30 ms
n=3 → Duration ≈ 138 ms
n=4 → Duration ≈ 260 ms

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Scan Primitives

MLME-SCAN.confirm (
status
ScanType,
UnscannedChannels,
ResultListSize,
EnergyDetectList,
PANDescriptionList
)

EnergyDetectList → [LQI_{11} LQI_{12} LQI_{13} …… LQI_{26}]

PANDescriptionList → ID of the Coordinator
Channel used
LQI → RSSI [dBm]=(85 * LQI) / 255 - 100
……

Scan Primitives: Freescale SW

```
uint8_t App_StartEdScan_Example(void)
{
  mlmeMessage_t *pMsg;

  /* Allocate a message for the MLME. */
  pMsg = MSG_AllocType(mlmeMessage_t);
  if(pMsg != NULL)
  {
    /* Allocation succeeded. Fill out the message */
    pMsg->msgType = gMlmeScanReq_c;
    pScanReq->msgData.scanReq.scanType = gScanModeED_c;
    pScanReq->msgData.scanReq.scanChannels[0] = 0x00;
    pScanReq->msgData.scanReq.scanChannels[1] = 0xF8;
    pScanReq->msgData.scanReq.scanChannels[2] = 0xFF;
    pScanReq->msgData.scanReq.scanChannels[3] = 0x07;
    pScanReq->msgData.scanReq.scanDuration = 5;

    /* Send the Scan request to the MLME. */
    if(MSG_Send(NWK_MLME, pMsg) == gSuccess_c)
      return errorNoError;
    else
      return errorInvalidParameter;
  }
  else
  {
    /* Allocation of a message buffer failed. */
    return errorAllocFailed;
  }
}
```

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