Contention-based protocols

The contention based protocol PAMAS

- In contention-based protocols, a given transmit opportunity toward a receiver node can in principle be taken by any of its neighbors.
- If only one neighbor tries its luck, the packet goes through the channel.
- If two or more neighbors try their luck, these have to compete with each other and in unlucky cases due to hidden-terminal situations, a collision might occur, wasting energy for both transmitter and receiver.

PAMAS

- The PAMAS protocol (Power Aware Multiaccess with Signaling) originally designed for ad hoc networks.
- It provides a detailed overhearing avoidance mechanism while it does not consider the idle listening problem.
- The protocol combines the busy-tone solution and RTS/CTS handshake similar to the MACA protocol

Features of PAMAS:

- It uses two channels: a **data channel** and a **control channel**.
- All the signaling packets (RTS, CTS, busy tones) are transmitted on the control channel, while the data channel is reserved for data packets.

Protocol operation of PAMAS:

- Let us consider an idle node *x* to which a new packet destined to a neighboring node *y* arrives.
- First, *x* sends an RTS packet on the control channel without doing any carrier sensing. This packet carries both *x*'s and *y*'s MAC addresses.
- If *y* receives this packet, it answers with a CTS packet if *y* does not know of any ongoing transmission in its vicinity.
- Upon receiving the CTS, *x* starts to transmit the packet to *y* on the data channel. When *y* starts to receive the data, it sends out a **busy-tone** packet on the control channel.
- If *x* fails to receive a CTS packet within some time window, it enters the backoff mode,

where a binary exponential backoff scheme is used.

- The backoff time is uniformly chosen from a time interval that is doubled after each failure to receive a CTS.
- Now, let us look at the nodes receiving *x*'s RTS packet on the control channel. There is the intended receiver *y* and there are other nodes; let *z* be one of them.
- If *z* is currently receiving a packet, it reacts by sending a busy-tone packet, which overlaps with *y*'s CTS at node *x* and effectively destroys the CTS.
- Therefore, *x* cannot start transmission and *z*'s packet reception is not disturbed. Since the busy-tone packet is longer than the CTS, we can be sure that the CTS is really destroyed.
- Next, we consider the intended receiver *y*. If *y* knows about an ongoing transmission in its vicinity, it suppresses its CTS, causing *x* to back off.
- Node *y* can obtain this knowledge by either sensing the data channel or by checking whether there was some noise on the control channel immediately after receiving the RTS.
- This noise can be an RTS or CTS of another node colliding at *y*.
- In the other case, *y* answers with a CTS packet and starts to send out a busy-tone packet as soon as *x*'s transmission has started.
- Furthermore, *y* sends out busy-tone packets each time it receives some noise or a valid packet on the control channel, to prevent its neighborhood from any activities.

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Schedule-based protocols

Advantages and disadvantages of scheduled based protocols.

Advantages:

- Schedule-based protocols that do not explicitly address idle listening avoidance but do so implicitly, for example, by employing TDMA schemes, which explicitly assign transmission and reception opportunities to nodes and let them sleep at all other times.
- In schedule-based protocols is that transmission schedules can be computed such that no collisions occur at receivers and hence no special mechanisms are needed to avoid hidden-terminal situations.

Disadvantages:

- First, the setup and maintenance of schedules involves signaling traffic, especially when faced to variable topologies.

- Second, if a TDMA variant is employed, time is divided into comparably small slots, and both transmitter and receiver have to agree to slot boundaries to actually meet each other and to avoid overlaps with other slots, which would lead to collisions.
- However, maintaining time synchronization involves some extra signaling traffic.
- Third drawback is that such schedules are not easily adapted to different load situations on small timescales. Specifically, in TDMA, it is difficult for a node to give up unused time slots to its neighbors.
- Fourth drawback is that the schedule of a node may require a significant amount of memory, which is a scarce resource in several sensor node designs.
- Finally, distributed assignment of conflict-free TDMA schedules is a difficult problem in itself.