CODIAC Protocol
Centralized or Distributed Integrated Access Control

Slides for document IEEE P802.11-93/54

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Goals

• Take advantage of the contention avoidance, power efficiency and time-bounded support characteristics of a point coordination function;

• Operate efficiently and with fairness in the absence of a point coordination function;

• Provide maximum flexibility, allowing the protocol to be tailored to varying implementations without losing compatibility across those implementations.

Concept

Combination of two protocols:
Xircom's Wireless Hybrid Asynchronous Time-bounded (WHAT) Protocol
Spectrix' Reservation/Polling Protocol (RPP)
Theory of Operation

- Two modes of operation: centralized and distributed.
- Centralized: point coordination function managed by a controller.
- Distributed: enhanced listen-before-talk.
- Data transfer performed point-to-point by exchange of four frames: RTS, CTS, DATA and ACK.
- Station startup procedure: listen.

Distributed Mode

- WHAT
Centralized Mode

Superframe

RSYNC frame describes layout of this request period
DBSYNC frame describes layout of this data period

RSYNC specifies 18 total slots, 5 registration slots.

13 stations have already registered and been assigned ID's 1 to 13, which are specifies the request time slot they own.

Registering stations generate random numbers from 1 to 5 and contend for the five registration slots.
Centralized Mode

Registration

- Stations must be registered to use the medium (for anything but registration).
- Controller allocates any number of registration slots.
- Registration slots can overlap owned slots if the implementation choose to do so.
- Controller assigns registering station an owned slot number, which becomes the station's ID, used when in frames sent to/from that station for the duration of its registration.

Centralized Mode

Upward Data Period

![Diagram of Centralized Mode Upward Data Period]

Coordinator

- Request Period
- Upward Data Period
- Downward Data Period

Station 1

- Rsyn
- Rts
- Dsyn
- Cts
- Data
- Ack
- Rayne

Time slot offset according to station 1's ID
Centralized Mode

Downward Data Period

Controller to Station

Changing Modes

- Stations change modes according to whether or not they hear the controller.
- Two types of controllers, dedicated and potential.
- Dedicated controllers always operate in centralized mode.
- Potential controllers can operate as regular stations in distributed mode or as controllers in centralized mode at their discretion.
- Criteria for potential controller changing modes is choice of the implementation.
ACK & Duplicate Detection

Goals

• minimize retransmission of data frames
• filter out most duplicates
• NOT to guarantee no duplicates

Mechanism

• Retry Bit
• Sequence Bit
• Out-of-sequence Bit

Example 1
flags ⇒ (retry, out-of-sequence, sequence)
ACK & Duplicate Detection

Example 2
flags ⇒ (retry, out-of-sequence, sequence)

Station A  Station B
\[
\begin{array}{l}
\text{rst}(0,0,1) \\
\text{csta}(0,0,1) \\
\text{data}(0,0,1) \\
\text{ack}(0,0,1) \\
\text{rst}(0,0,0) \\
\text{csta}(0,0,0) \\
\text{data}(0,0,0) \\
\text{ack}(0,0,0) \\
\text{rst}(1,0,0) \\
\text{ack}(1,0,0)
\end{array}
\]

Following this successful transmission:
Station B last data nr_sequence = 1
Station A last data br_sequence = 1

Station B receive data, last nr_sequence = 0.
Station A does not receive ACK.

Station A retries with retry bit set, same sequence number.
Station B sees retry bit with nr_sequence = 0, so it knows the last ACK was lost.

ACK & Duplicate Detection

Example 3  flags ⇒ (retry, out-of-sequence, sequence)

Station A  Station B
\[
\begin{array}{l}
\text{rst}(0,0,1) \\
\text{csta}(0,0,1) \\
\text{data}(0,0,1) \\
\text{ack}(0,0,1) \\
\text{rst}(0,0,0) \\
\text{csta}(0,0,0) \\
\text{data}(0,0,0) \\
\text{ack}(0,0,0) \\
\text{rst}(1,0,0) \\
\text{ack}(1,0,0) \\
\text{rst}(0,1,1) \\
\text{csta}(0,1,1) \\
\text{data}(0,1,1) \\
\text{ack}(0,1,1) \\
\text{rst}(1,1,0) \\
\text{data}(1,1,0) \\
\text{ack}(1,1,0)
\end{array}
\]

Following the successful transmission:
Station B left data nr_sequence = 1
Station A last data br_sequence = 1

Station B receives data, but nr_sequence = 0.
Station A does not receive ACK for next transmission.

Station A retries N times, then discard data.

Station A has new data to send, and sets the out-of-sequence bit because the previous transmission failed.

Station A retries N times, then discard data.

Station A has more new data to send.

Station A does not receive an ACK in first try, so tries again with retry bit set.
Station B receives data with retry bit and nr_sequence = 0, when last nr_sequence = 0. Because of the out-of-sequence bit, station A does not trust the as a duplicate.
Overlapping Modes
Distributed/Distributed

- null case

The AP and Station A are centralized, station B is distributed.

Performance of both centralized and distributed stations in the overlap is degraded.
Overlapping Modes
Centralized/Centralized
AP1, AP2 and station A all centralized.

Station A powers up this way - it cannot communicate, but could try to register to inform an AP of the problem.

Station A moves into this position, ?

Frame Format

<table>
<thead>
<tr>
<th>Minimum Frame Length (10 + n) octets</th>
<th>FCS Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preamble</td>
<td>SD</td>
</tr>
<tr>
<td>8n</td>
<td>8</td>
</tr>
</tbody>
</table>

Field names:
- Preamble
- Start Delimiter
- Destination Identifier
- Frame Type
- Control Flags: AP, sequence, out-of-sequence, retry, hierarchical
- Information (0 <= m <= to be determined)
- Frame Check Sequence, CRC-32
- End Delimiter

Destination identifier values:
- FFFFh = broadcast
Possible Enhancements
Pages 21 & 22 of document 93/54.

802.11 Issues
Pages 29 to 36 of document 93/54