Multi-Rate support in the MAC

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IEE P802.11-94/247

Multi-Rate support levels:

- Definition of the Basic Rate Set and the rules that assure coexistence and interoperability in a mixed bitrate environment.
- Provisions to gather/distribute "Rate Capability" information.
- Rate negotiation per frame procedure.

- Level 1 is the minimum support level needed.
- Level 2 is desirable.
- Level 3 appears to be sufficient close to the patented subject matter that the mechanism has been deleted.

Level-1 Basic Definitions:

- ESS_BASIC_RATE_SET:
  - A set of rates that all the stations on the given ESS are capable of receiving.
  - According to the PHY definitions the default ESS_BASIC_RATE_SET for the different PHYs will be:
    - For DS: (1 Mbps, 2 Mbps)
    - For FH: (1 Mbps)
    - For IR: (1 Mbps, 2 Mbps)

- STATION_BASIC_RATE:
  - A value belonging to the ESS_BASIC_RATE_SET, that is used by the station for its transmissions.

Level-1 Basic rules:

- The Preamble and the PLCP Headers are always transmitted at the PLCP_RATE.
- The IFS specifications are station bitrate independent and specified per Phy type.
- All the Multicast and Broadcast Messages are sent at one of the STATION_BASIC_RATE set speeds.
- All Control frames (RTS/CTS/Ack etc.) are sent at one of the STATION_BASIC_RATE set speeds.
- "Duration" field is specified in time (usec). This is already in the 802.11 Draft.
- All unicast data frames can be sent on any available Tx-rate.
### Multi-Rate support in the MAC

**How is the rate selected?**

**Multiple approaches possible:**

- Transmitter to determine rate (Does not require interaction with the receiver).
  - Tx-only decision based on gathered information.
  - Decide on station characteristics (Power Save mode).
  - Or decide on link condition.

**What is needed:**

- To allow rate switching, the transmitter should know:
  - The Supported Rates of the local PHY.
  - The Supported Rates of the destination PHY.
  - Link quality, Power Saving, or other relevant condition if dynamic switching is used (implementation specific).

**How is the NAV updated:**

- RTS / CTS / Ack frames are send in BASIC RATE.
  - No NAV update problem.
- Situation for fragmented frames:
  - Ack (with CTS function) is transmitted at the BASIC RATE.
  - Not all Stations can understand the duration field in the data frame (indicating the NAV update for the next fragment), but Physical CS will assure defer.
  - The returning Ack can suffer from the "Hidden Station" problem.
  - This problem is unrelated to the mixed rate situation, and basic to the MAC (need type specific DIFS specification).
  - Has been detected also in the DTIBS proposal.
  - Is also present when RTS/CTS is not used.
  - Some effect occurs when RTS or Data frame has CRC errors.
  - Solution is provided in a separate submission.

**Example:**

- Unicast Data Frames are sent on any rate as selected by the transmitter.
  - The algorithm for selecting this rate is implementation specific.
    - Some trivial algorithms could be:
      - Try high, retransmit on lower (go back to high after T time).
      - Keep fixed tables for each peer.
      - Active query using management Supported_Rate Request/Response.
      - Keep dynamic tables for each peer using a signal quality (or any other parameter) dependent algorithm.
      - And, obviously, transmit always in BASIC RATE.

**Level-2 Hooks required:**

- Define a "Supported_Rate" MIB variable.
- Include "Supported_Rate" field in:
  - The "Association Request" indicates the rate capabilities of the requester.
  - The "Association Response" indicates the rate capabilities of the responder.
- In Management Type Request and response Frames to query the capabilities of the destination.
  - Indicate the rate capabilities of the requester, and requests a response indicating the remote rate capabilities.
  - The "Supported_Rate" indicates all speeds that the sender is able to receive.

**Effect on CCA for different speeds:**

- Assumptions about the CCA function:
  - Current PHY’s use "Length" to aid in "End Delimiter detection".
  - "Length" and "Rate" are encoded at the common PLCP rate.
  - Use "Length" and "Rate" to control CCA indication, independent of the modulation used in the Payload area.
  - Suggest to code the "Length" and "Rate" in a way that current stations can interpret future extended rate headers to determine the "CCA Duration".
  - Preferably this specification should be bitrate independent.
  - An example could be to specify "Length" in terms of the PLCP header symbol rate.
IPR situation:

- Applicability of the '236 patent:
  - Level 1 provisions are definitional and unrelated to the coverage of the cited patent.
  - Rate Negotiation has been deleted, because it was sufficiently close to the subject matter.
  - "Rate Capability" knowledge distribution is changed such that coverage is avoided.
  - Exchange of Rate Capability information between multiple peer MAC entities needs to be avoided.
  - In Infrastructure the "Rate Capability" exchange is between a station and the Distribution Service above the MAC.
  - In ad-Hoc the "Rate Capability" distribution is to be done above the MAC by mechanisms that can exceed the "Rate Capability" MIB variable.
- Conclusion is that described method does avoid the mechanism as described in the '236 patent.

Summary:

- To support Multiple Rate ESSs in a flexible way, we need to specify:
  - The level-1 definitions.
  - The level-1 basic rules.
- To allow distribution of the "Supported Rate" capabilities:
  - A "Supported_Rate" MIB variable.
  - "Supported_Rate" element / field in (Re-)Association request and responses.
  - "Supported_Rate" element / field in a Probe Request / Response Management frame.

Motion:

Move:

To adopt the recommendations in 94/247b as the basic mechanisms for the support of Multi rate Phy's in the MAC and change section 9.1.4.17, section 9.1.3.2, and section 9.1.2 to replace BSS by ESS.

passes 41/12/12