Comparison of existing and proposed wireless standards

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Abstract: This document serves the purpose of providing a bird's eye view of the existing standards (some of which are under revision) to aid participants in making a choice for WirelessHUMAN™ PHY & MAC layers.

IEEE 802.11(a)

1. PHY layer

Salient Features

- 5 GHz U-NII bands (5.15 - 5.35, 5.725 - 5.825 GHz)
- Orthogonal Frequency Division Multiplexing (OFDM), with 52 sub-carriers
- BPSK, QPSK, 16 QAM, 64 QAM for OFDM
- Data Rates: 24 Mbps, 6-54 Mbps possible
- Convolutional Coding, K=7, R=1/2 (or 2/3 or 3/4 by puncturing)

Perspective

The 802.11 (a) is the high rate standard, based on OFDM; for operation in the 5 GHz unlicensed bands. The other counterpart is the 802.11 (b) which uses direct sequence spread spectrum, for operation in the ISM bands (2.4 GHz), and this provides a max. throughput of 11 Mbps. 802.11 (a) is a good candidate, being high-speed, with multiple rates and operating in the same frequency band.

2. MAC layer

Salient Features

- Uses CSMA/CA for broadcast frames; CSMA/CA + ACK for unicast frames
- Provision for *peer-to-peer* configuration (Ad-Hoc network) or *Infrastructure* configuration (for access to say, a wired LAN)
- Uses of RTS/CTS to provide a *Virtual Carrier Sense* to solve the hidden node problem (transmitters not hearing each other).
- Use of Association/Reassociation function (for base station joining/roaming a network).

Perspective

The CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) scheme may fail with the large distances involved in a MAN, and the correspondingly large delay spreads. The 802.11 (e) is the enhanced version of the 802.11 MAC; with improved provisions for QoS, security and authentication. This allows for multiple enhanced services like multimedia, VoIP etc. Since 802.11 (e) is a relatively new project, it would be interesting to see how it progresses.

HiperLAN/2

1. PHY layer

Salient features

- 5 GHz HiperLAN bands (5.15-5.35, 5.425 – 5.725 GHz)
- Orthogonal Frequency Division Multiplexing (OFDM), with 52 sub-carriers (48 for data, 4 pilots)
- BPSK, QPSK, 16 QAM supported, 64 QAM optional
- Data Rates: 27 Mbps, 6-54 Mbps possible
- Convolutional Coding, K=7, R=1/2 or 9/16 or 3/4

Perspective
The HiperLAN/2 PHY and 802.11 (a) PHY have many similarities; with few differences.

2. MAC layer

Salient features

- Based on TDD and dynamic TDMA
- Connection-oriented; provision for both point-to-point (bi-directional) and point-to-multipoint (towards base station)
- QoS support either absolute (defined for each user) or relative (depending on other users); permitting multiple services like voice, video & data
- Automatic Frequency Selection and Power Save mode

Perspective

Robust MAC with support for Unicast, Multicast and Broadcast traffic. At beginning of session (association), link capabilities are assessed, including supported PHY modes, convergence layers, security, authentication. The cell-based and packet-based convergence layers make the architecture generic and allow for radio access to different fixed technologies like ATM, IP & Ethernet.

802.16.1

1. PHY layer

Salient features

- Upstream: Uses combination of TDMA & DAMA (Demand Assignment Multiple Access)
  Downstream: TDM (continous transmission) or TDMA (burst transmission)
- 3 PHY layers: Continous downstream PHY (Mode A), Burst downstream PHY (Mode B) and Upstream PHY.
- Mode A:
  - Uses a RS code for outer code, convolutional interleaver, followed by convolutional code
  - QPSK, 16 QAM (Optional) or 64 QAM (Optional)

  Mode B:
  - RS code (mandatory) or turbo code (optional) for outer code; parity check, concatenated block-convolutional code, no code (mandatory) for inner code.
  - QPSK, 16 QAM, or 64 QAM (optional)
  - Scrambling

  Upstream:
  - FEC Coding scheme and modulation schemes same as Mode B
  - Randomization

Perspective

The PHY layer(s) have very specific functions, but since the PHY is designed for a MAN (wide area access), some of the features would be useful to look into.

2. MAC layer

Salient features

- Assumes point to multi-point network topology

- Protocol designed to be independent of type of traffic (voice, video, data etc.)
- Supports QoS for real-time traffic
- Supports multiple PHYs. PHY layer hidden from MAC layer by means of a *transmission convergence layer*
- Duplex schemes include FDD, TDD (TDMA downlink, TDM uplink)& FSDD (TDMA downlink & uplink)
- Connection Oriented, data transmitted in variable length PDUs

Perspective

The 802.16.1 MAC is designed for a long distance wireless link, typically for implementing low cost LMDS services. Being connection oriented, it needs a lesser overhead for headers, and thus the increased efficiency. It has convergence layers (under development) for IP, Ethernet and ATM, to allow for flexibility of network technology. Among the services provided are Constant Bit Rate (CBR) services, real-time Variable Bit Rate (VBR) services, and bursty traffic like VoIP.