Introduction of IEEE P802.11

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- The Physical Layer Group assembled at the Westgate Hotel, San Diego, California
- The FCC staff at the Federal Communications Building, Washington, D.C.
802.11 Functional requirements

- Requirements study showed two types of networking needs:
  - asynchronous, that is bursty traffic, but when something to send: need for very fast delivery
  - isochronous, that is regular traffic, in small amounts at a time, but at a constant pace
- Therefore 802.11 adopted the following requirements:
  - Asynchronous MSDU delivery on all stations
    - MSDU is the MAC Service Data Unit
    - Optionally "time-bound MSDU delivery service"
  - Pedestrian speed and vehicular speed
    - premises environment
  - Security: first review 802.10 provisions
  - Common MAC to support various PHYs
    - regulation dependency

Computer Architecture

Introduction of 802.11 to the FCC

Vic Hayes, Chair, AT&T
Multiple PHYs

<table>
<thead>
<tr>
<th>MAC</th>
<th>PHY</th>
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<tbody>
<tr>
<td>wired</td>
<td>802.3</td>
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<tr>
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<tr>
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</tr>
<tr>
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<td>IR</td>
</tr>
<tr>
<td>wireless</td>
<td>possibly all 802.11, but not interoperable on the medium</td>
</tr>
</tbody>
</table>

802.11, MAC: Basics

- "Distributed Medium Access Control Protocol" using an Ethernet like CSMA/CA + Ack scheme.
  - Collision "Avoidance" rather then a "Detection" scheme.
    - Effectiveness demonstrated in Wavelan product.
  - Allows MAC level recovery of "Lost Packet" using a retransmission algorithm.
  - Includes provisions to deal with "Hidden Nodes".

Slide 9

Slide 10
802.11, MAC: Performance

- Efficient and stable throughput.
  - Example: Based on 2 Mbps Wavelan speed.

802.11, MAC: Other Functions

- Roaming through the Wireless Infrastructure
  - Maintain Continuous connectivity
  - Station will “Re-Associate” with Access Points based on “Signal / Link Quality”.
  - Support multi channel roaming.
  - “Distribution System” will adapt to logical location changes of the station.
- Provisions to use minimum Battery Power
  - Strategy: Switch nodes off as much as possible, while maintaining network configuration.
  - Traffic buffering functions are included in the Access Point to support this.
- “Wired Equivalent Privacy” encryption algorithm is included.
**802.11, PHY, Radio**

- Concentrate radio work on the 2.4 GHz band (ISM)
  - Most promising globally Spread Spectrum required
- Also allowed to start work in 1.9, 5.2 and 5.8 GHz bands
  - no activity yet

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**Direct Sequence Spread Spectrum**

- Direct Sequence uses an 11 chip Barker Sequence to multiply the transmitted data
- Receiver divides received signal by same Sequence to recover the data
  - narrow band interference diminished
  - implementations can resolve multipath in the correlation
- modulation of 2 Mbit/s in DQPSK (Differential Quadrature Phase Shift Keying)
- fall back modulation of 1 Mbit/s in DBPSK (Differential Binary PSK)
Frequency Hopping Spread Spectrum

- Frequency Hopping uses one of out 79 channels at a time
- hops from one frequency channel to the next at a 2.5 hops/s
  - 3 sets of 22 hop sequences defined
- modulation for 1 Mbit/s in 2 level GFSK (Gaussian Frequency Shift Keying)
- modulation for 2 Mbit/s in 4 level GFSK, channel permitting

802.11, PHY, Infra-Red

- Modulation for 1 Mbit/s (basic rate) in 16-PPM (Pulse Position Modulation)
- Modulation for 2 Mbit/s (enhanced rate) in 4-PPM
- Transmitter illuminates the ceiling with diffused Infra-red light
- Receiver read from ceiling, so there is no requirements to line transmitter and receiver pairs
Status

• Second draft ballot conducted
• 47.5 % approval (75 % required, unanimous preferred)
  - 31 (17) approving
  - 33 (66) disapproving
  - 5 (11) abstaining
• Resolving negative votes at November/January meeting
• Second draft sent to ISO annexed to a Proposed New Work Item

 IEEE P802.11 schedule

• WG Confirmation ballot Jan/Feb 1995
• Resolve issues at March 1996 meeting
• Sponsor Ballot Mar/Apr 1996
• Resolve issues at May 1996 meeting
• Sponsor Confirmation ballot Jun 1996
• Resolve issues at July 1996 meeting
• Standards Board meeting September 17-18, 1996