802.11 MAC Analysis

Definitions & Suggestions as they relate to the WPAN

Access Point Definition

• An AP is a station that organizes all of the other stations in the wireless LAN around itself

• It acts as a conduit for all of these stations communications
  – In 802.11, if there is an AP present then there is no peer-to-peer communication
  • This is a requirement on how the protocol is used
Creation of a WPAN “AP”

• Add an IUT (WPAN “AP”) to the existing PICS
  – Can be used for a “deeper” power management function
    • This avoids the need for the ATIM function
• Operation of the WPAN “AP”
  – The WPAN “AP” would wake up and send a beacon then go
to sleep. It basically sets the NAV in this beacon to help
“shutdown” other devices in the WPAN
  – The other stations in the WPAN could go to sleep during the
same “sleep” period as the “AP”
  – Provision is for a non-continuously powered AP
• This function could be implemented with a new
  element in the existing 802.11 beacon

WPAN-AP Considerations

• Stations that are Uni-directional in their
communications model can “sleep” for as
long as they need
• For devices that are Bi-directional and
require longer sleep periods
  – Buffering of data packets is implied
    • This is a tradeoff that needs to be considered in the
architecture and classes of devices supported by the
WPAN
Suggestions for Moving Forward

• For present purposes, define the PICS for the WPAN with an AP and a station as its elements
  – To address the need for no single point of failure at least one and possibly more stations need to assume that function
  – The function of transitioning to another AP is undefined at present and may be placed at a higher level in the stack than the MAC layer
  – Using an AP may be the only way to meet the WPAN power requirements

Authentication (PC1.2)

• The process of identifying another station and deciding to allow/disallow communication with it
  – Transient devices can enter and leave the WPAN with authentication services
  – Open authentication allows for a positive ACK for any device that comes in range of the WPAN (PHY parameters & BSS ID must be set prior to this step)
  – Use of shared keys provide for a higher level of security
    • Creation & exchange of the shared key is not part of the 802.11 MAC
WEP (PC2)

- Wired Equivalent Privacy
  - Minimal encryption for operation
  - Without WEP present, you could have a manual authentication process

- ALTERNATIVE 1
  - Use WEP & a shared key authentication, or...

- ALTERNATIVE 2
  - Use open authentication with higher level functions (including manual) authentication
  - This is the minimal cost solution

NAV (PC3.1)

- Net Allocation Vector
  - This is a “virtual” busy signal from the network to handle the hidden node problem
  - For example, it prevents stations from accessing the medium before the ACK returns

- If you ASSUME:
  - That all nodes within a WPAN can hear each other at all times, then the NAV function is not required
PCF (PC4)

- Point Coordination Function
  - This controls access to the medium for contention free services
  - This function can be removed from the MAC if the concept of WPAN-AP power saving modes are included in the design of the WPAN
    - This approach allows the WPAN-AP to power down
  - Implication of this change:
    - Lengthens the joining process (by a few seconds)

Fragmentation/Defragmentation (PC6 & PC7)

- Function depends upon the error characteristics of the channel in use
- The function is needed to support efficient use of the radio spectrum
- Performance of the WPAN will be better if this function is implemented at the MAC level
  - This reduces the overall # of bytes transmitted per MSDU
- Recommend that we keep it!
- Cost of implementation is a wash - this is needed somewhere in the implementation
Multirate Support (PC9)

- If this option is removed it may limit the future extensions of WPANs
  - Lower power implementations
  - Gateway extensions to higher speed networks
- This option can add complexity to the implementation of the MAC...
  - So, the WPAN requirements need to place a relative value on its importance

Timing Synchronization (PC11.1)

- A Given...
  - The concept of timing needs to exist within the network infrastructure
- How does the network maintain its timing if the AP loses its power?
  - In this scenario, the network timing function can be transferred to another station either...
    - Automatically in the MAC (Distributed Beaconing)...
    - By a higher layer protocol or ...
    - Manually by the user
Timing Synchronization (PC11.1) [Cont.]

- ALTERNATIVE 1
  - Use a “Distributed Beacon” mechanism and tweak it so that one station will assume the role of sending the beacon (WPAN-AP)
  - This allows for the immediate recognition & recovery of the network when the beaconer is lost or goes away

- The Implication:
  - This would push the function of frame buffering onto the stations in the network capable of being an AP
  - Potentially, this could increase memory requirements, and likely the WPAN device cost

MIB (PC15)

- Management Information Base
  - Recommend that it be re-defined for WPAN applications
  - Existing MIB will affect power consumption and memory requirements for WPAN applications
  - Need to address authentication & encryption in our review of the new MIB implementation
MAC Frame Format

• Recommend that the WPAN MAC frame format remain identical to the existing 802.11 frame format:
  – WPAN may need to define at least one and maybe two new IUTs (Implementation Under Test)
  – These “new” devices would be compliant as new classes of 802.11 devices

WPAN MAC Summary

• Keep 95% of the existing 802.11 MAC
• Extend current 802.11 capabilities
  – The AP gains power management
  – AP functionality migrates between WPAN capable devices
• Remove some OH
  – Slim down the MIB
  – Eliminate RTS/CTS
  – Eliminate IBSS