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 losses 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