Media Independent MAC Enhancements for RF Management of Wireless 802 Networks

An Introduction
Overview

• Into to 802 Wireless Networks
• What is “RF Management”
• Why a standard is needed
• Why a common interface is needed
• What would such an interface look like in the IEEE 802 architecture
Brief Intro to IEEE 802 Wireless Networks

• Various MACs exist or are under development
  – E.g. 802.11, 802.15, 802.16, 802.20, 802.22

• I will talk about 802.11 as an example

• Infrastructure vs. Ad Hoc
  – I will talk about Infrastructure as an example
APs and STAs

○ = Access Point

× = Station (STA)

An “Association”

“Distribution Service” (DS) – often a wired LAN
Overview (continued)

• APs can operate on one of several channels
  – E.g. 802.11 b/g supports 3 non-overlapping channels
  – E.g. 802.11 a supports 8 or more non-overlapping channels
  – Channel selection is not part of the standard
  – The vast majority of products come pre-configured to a channel (mostly the same one)

• STAs make associations with APs
  – How a STA chooses an AP is not part of the standard

• Transmit power of APs and STAs
  – Usually set at factory to a regulatory max (or less).
  – Sometimes manually adjustable
  – How a radio selects a transmit power level is not part of the standard.
What is RF Management?

- Sometimes it’s useful to:
  - cause the APs to select different channels
    - To avoid “co-channel interference”
    - To distribute energy across the spectrum within a given geographical area
  - adjust the transmit power
    - See above
    - Enhanced privacy
  - direct STAs to associate to certain APs
    - For load balancing purposes
    - To manage interference issues
    - For other considerations of QoS
    - To enforce other sorts of policies
  - enquire of APs and STAs their sense of the RF environment
    - E.g. what other STAs and APs can you hear and at what signal strength?
    - Detection of “Rogue APs”
    - Detection of attempted intrusions
    - To gather locality information about APs or STAs
  - stuff we may not yet have considered
Why Standardization

• Different chip sets report signal strength in different ways
  – Sometimes just a relative signal strength (RSSI) in dB
  – Sometimes an absolute power measurement in dBm

• There is no standard interface to set transmit power
  – Management applications must muck about in the chip driver
  – Management applications must be ported individually to every bit of hardware
  – Optional OIDs for NDIS exist but doesn’t address non-Windows devices

• There is no interoperability between different management applications
  – MIBs are not up to date

• Even if more attention were paid to MIBs, each is crafted individually by the different “dots”
  – Would be like having spanning tree for 802.3 and Source Routing for 802.5!
  – Boxes will be built that will interconnect different wireless technologies e.g. 802.16 to connect to the ISP, and 802.11 to connect to the home LAN.

• The lack of a standard RF management interface for different implementations of a given MAC as well as different wireless MACs discourages multi vendor, interoperable Wireless Network management
Why interoperability is so important for Wireless Networks

• All the usual reasons plus:
  – Radio waves do not respect administrative boundaries
    • Neighbors cannot cooperate on channel selection even if they wanted to
    • Increasingly dense deployments, and all the APs don’t belong to the same owner!
  • You can control access but you can’t control the laws of physics
Why 802.1

• This issue spans all wireless MACs
  – Requires input from all Wireless MACs
• This is architecture
  – 802.1 has the most protocol expertise
  – 802.1 has the most management expertise
• 802.1 is the logical place to develop standards which may make use of the interface
Examples of what the interface might look like

\textit{MA-UNITDATA.indication}

Example modifications to the semantics of the 802.11 \textit{MA-UNITDATA.indication} service primitive are underlined.

\texttt{MA-UNITDATA.indication (}
\begin{itemize}
  \item source address,
  \item destination address,
  \item routing information,
  \item data,
  \item reception status,
  \item priority,
  \item service class,
  \item received power
\end{itemize}
\texttt{)}

The received power parameter specifies the signal strength, expressed in dBm, at which the MSDU was received.
MLME Example

MLME-SCAN.request ( Channel List
Scan Time
Quiet Channel
CTS Duration )
MLME Example

MLME-SCAN.indication (Channel List BSS List)
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