The sensible guide to 802.11y

On September 26th, IEEE 802.11y-2008, an amendment to the IEEE 802.11-2007 standard, was approved for publication.

3650 Mhz

The 802.11y project was initiated in response to a novel licensing scheme introduced by the US Federal Communications Commission (FCC) for the 3650-3700 MHz band.

3650MHz Licensees pay a small fee for a nationwide, non-exclusive license to operate as many stations as they wish. They also pay an additional nominal fee for each high powered base station that they deploy. The location of each high powered station must be registered in an FCC database before operation. Low powered, unlicensed client devices (which may be fixed or mobile) are allowed in the band, but these devices must receive an enabling signal from a licensed base station before transmitting.

It is a requirement that multiple licensees' devices are given the opportunity to transmit in the same area using a "contention based protocol" when possible.

Devices may not operate near 30 “exclusion zones” that contain satellite earth stations without permission of the incumbent users, and all stations must be identifiable in the event they cause interference to incumbent operators. A further motive for station identification arises from the requirement that obligates licensees to resolve disputes between themselves when interference between licensed stations, or the devices that they have enabled, cannot be mediated by technical means.

Higher Power

The US 3650 MHz rules allow for registered stations to operate at much higher power than traditional Wi-Fi gear (Up to 20 watts EIRP). The combination of more power and enhancements made to the MAC timing in 802.11-2007 will allow for the development of standards based 802.11 devices that will operate at distances of 5 km or more.

IEEE 802.11y adds three new concepts to 802.11-2007:

Contention based protocol (CBP)- Enhancements have been made to the carrier sensing and energy detection mechanisms of 802.11 in order to meet the FCC's definition of a contention based protocol.

Extended channel switch announcement (ECSA) provides a mechanism for an access point to notify stations of its intention to change channel frequency or bandwidth. This mechanism will allow for the WLAN to continuously choose the channel that is the least noisy and the least likely to cause interference. ECSA is also used in 802.11n, making it possible to switch between the 3.65GHz, 2.4GHz and 5GHz bands.

Dependent station enablement (DSE)- is the mechanism by which an operator extends and retracts permission to license exempt devices (referred to as dependent STAs in .11y) to use licensed radio spectrum.

Benefits of DSE include:

-Satisfying the regulatory requirement for a dependent STA's operation to be contingent upon its ability to receive periodic messages from a licensee's base station.

-The enabling station (aka the licensee's base station) may or may not be the access point that the dependent STA connects to. In fact, an enabling station may enable both an access point and its clients. Also, in the US 3650 Mhz band, although the dependent STAs are required by regulation to receive information from the enabling station over the air, they are not required transmit over the air to complete the DSE process. A dependent STA may connect to a nearby Access Point for a short period of time and use the internet or some other means to complete the channel permissioning process with the enabling station. This flexibility reduces the likelihood of a dependent STA causing interference while attempting to connect to a far off enabling station.

-The personal privacy and security of end users are ensured while, at the same time, licensees will have the information necessary to resolve disputes. All .11y devices transmit a unique identifier for the purpose of resolving interference. The high powered fixed stations and enabling stations transmit the location that they are operating from as their unique identifier. This location is registered in a publicly accessible database that identifies the licensee. The dependent STAs broadcast the location of the station that enabled it plus a unique string supplied by the enabling station. This ensures that the responsible party, the licensee, is contacted to resolve disputes. This mechanism also alleviates the problems associated with having the dependent STA broadcasting its location. Requiring all devices to have GPS or some other means of verifying their location would increase the cost and complexity of devices, and this solution may be inadequate indoors. This method also resolves fears that a mobile device that constantly beacons its location could be used inappropriately by third parties to track a user's location.

Applications

- Back haul for Municipal Wi-Fi networks
- Industrial automation and controls
- QoS links for video delivery
- Campus and enterprise networking
- Last Mile Wireless Broadband Access
- Fixed Point to point links
- Fixed point to mobile links
- Public safety and security networks

Beyond the US 3650 band

While the project was initiated in order to address the rules for operating in the 3650 to 3700 MHz band in the United States, care was taken so that, if the light licensing concept was well received, it would not be necessary to start the 3+ year task group process in order for 802.11 devices to operate in other countries or in other frequency bands. As a result, licensed 802.11 devices will be able to operate in any 5, 10, or 20 MHz channel that regulators make available by adding entries to the existing country and regulatory information tables in 802.11.

Other potential bands for 802.11y include:

TV "Whitespace"- Wireless internet service providers in the US have been lobbying the FCC to allow 11y like operation on vacant TV channels. DSE was originally conceived of as a method for avoiding wireless microphones in the TV bands.

4.9 GHz - The regulatory classes and channel sizing needed to support the US public safety allocation at 4.9 GHz were added to 802.11-2007. DSE and ECSA will allow frequency coordinators to have dynamic control over channel access.

5 GHz - Regulators and equipment manufactures continue to debate the effectiveness of dynamic frequency selection (DFS) as a mechanism to avoid incumbent users in the 5 GHz bands. For example, Canada is not currently certifying 802.11 equipment for use in the 5600-5650 MHz band that is used by certain types of weather radars. 802.11y may provide a solution that will allow WLANs access to these bands. Firstly, DSE can be used to create exclusion zones around incumbent users; Secondly, when combined with DSE, the 802.11y device identification mechanism allows devices that cause interference to be denied further access to a channel within seconds.

IMT-Advanced candidate bands- (450-862, 2300-2400, 2700-2900, 3400-4200, and 4400-5000 MHz- Since 2003, The International Telecommunications Union (ITU) has been studying the potential for IMT-advanced services (aka systems beyond IMT-2000 or 4G) to use a number of frequencies between 450 and 5000 MHz for the next generation of cellular infrastructure. These systems will be capable of transmitting 100 Mb/s when mobile and 1000 Mb/s while stationary.

Unfortunately, with the exception of a small amount of UHF spectrum that will become available upon the completion of the transition from analog to digital television, these bands are occupied on a piecemeal basis by incumbent users that are not easily relocated. Extensive sharing studies have concluded that co-existence with legacy equipment over the same area is not feasible, so traditional mobile licensing approaches are not practical. Yet academic studies have shown that at any given time, even in dense urban environment, there is substantial unused spectrum across the candidate bands. The problem is that usage by the primary services in these bands may change over time (as is the case with some radar systems) or vary by channel based on location (as is the case in the TV bands "white spaces"). 802.11, may provide a solution to this problem that would allow for channel access to be granted based on a user's location.

It is of note that the US has not been able to adopt a single position on the suitability of the 3650-3700 band for IMT-advanced, and that neither of the positions proposed so far seem to recognize the FCC's rules, or the standardization work that has been done to date.

Looking Back

- Sept 26, 2008: A 74 page amendment to the 802.11 Base Standard, P802.11y, was approved by the IEEE-SA Standards Board. The final draft document has been forwarded to the IEEE's Standards Publications Department in preparation for printing.

- Jun 2008: Draft 11 is meets the requirements to be forwarded to RevCom and the IEEE SA's Standards Board for approval and publication.

- Dec. 2007: IEEE/ISO Sponsor Ballot process began using Draft 7 of the amendment.

- Nov 2007: FCC began accepting applications for non-exclusive nationwide licenses in the 3650 Band.

- 2007: After receiving almost 450 comments on documents 05-56 and 07-99, the FCC released details describing operations in the 3650 band.

- Jul 2007: Conditional approval was obtained to forward .11y to sponsor ballot.

- Jun 2007: Draft 3.0 is approved by 94% of 802.11 voters.

- Jun 2007: The FCC issues an MO&O (FCC-07-99) in which the many petitions for reconsideration and other filings that resulted from FCC's 05-56 are addressed.

- Jan 2007: Ballot on first .11y draft received greater than 75% approval from 802.11 voting members.

- Jun 2007: Draft 3.0 received 94% approval from 802.11 WG.
- Jun 2007: FCC issued an MO&O (FCC-07-99) in which the many petitions for reconsideration and other filings that resulted from FCC's 05-56 are addressed.
- Jan 2007: First letter ballot of .11y received greater than 75% approval from 802.11 WG
- Nov 2005: Based on the recommendations of the contention based protocol study group, the IEEE 802 Executive Committee approved creating the 802.11y Task Group.
- Mar 2005: 802.11 members requested that a study group be formed to examine the opportunities afforded by FCC's 3650 MHz Report and Order and Memorandum Opinion and Order (FCC 05-56).
- Mar 2005: FCC issued a Report and Order (05-56) titled "Wireless Operations in the 3650-3700 MHz Band; Rules for Wireless Broadband Services in the 3650-3700 MHz Band"
- Apr 2004: FCC issued Notice of Proposed Rule Making (04-100) titled "Unlicensed Operation in the Band 3650-3700 MHz et al".
- Jan 1999: The spectrum from 3650 to 3700 is given “mixed-use status” and becomes available for non-federal use
- Dec 1998: FCC issued a press release (98-337) announcing the transition of the 3650MHz band to "mixed use".
- 1995: NTIA suggested the transfer of the 3650 MHz to 3700 MHz frequency band to “mixed use" status.

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