Project	IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>
Title	Time Stamp for Wireless MAN-CX Applications
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Re:	Recirculation of Working Group Review of Working Document 80216h-06_015r1

Abstract	D1 [1] has currently different absolute time formats. Harmonization is required. This contribution proposes a time stamp for WirelessMAN-CX Applications.

Purpose	Harmonize the absolute time format in [1]

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Time Stamp for Wireless MAN-CX Applications

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Overview

There is a need for IEEE 802.16h systems to have distributable time stamp that is referenced to a universal timing standard. This is needed because Wireless MAN-CX systems will need to communicate with non-Wireless MAN-CX systems in scheduling temporal coexistence zones or identifying interference events by their start and end times. As another example sophisticated (cognitive radio) coexistence protocol algorithms may be required to search data bases (such as accumulated lists of SS and BS interference tables) with the purpose of identifying time-dependent interference phenomena. Such searches would be facilitated by the use of precise event-timing information.

Universal Timing

Wireless MAN-CX base stations must be synchronized to a UTC time standard. Typically the UTC timing is distributed by signals from geo-positioning satellite systems such as GPS, Galileo, or Glonass; all of which support low cost receivers which provide a UTC time stamp consisting of year, day, minute, hour, second, and fractional second data outputs. Such receivers also provide a 1 pps signal, the rising edge typically having a +/-50 nsec repetition accuracy. A specific 1 pps pulse can be provided with a UTC time stamp by such receivers. (See Annex h_B). The 1pps interval for Wireless MAN-CX application is called a Network Time Interval (NTI). See Section 15.2.1.

Universal Time Stamp

The Coexistence Control Channel provides a facility for distributing absolute timing for Wireless MAN-CX systems. The tracking of the timing is undertaken by Base Stations and Subscriber Stations counting the CX_MAC_NO. The control channel also has a method for distribution of absolute timing information that is TBD. In addition to these timing facilities, it is proposed that a 4 Byte word representing a Universal Time Stamp be used by Wireless MAN-CX systems. This word would be created by either the Base Station or the Subscriber Station whenever an event needs stamping with a time signature. It is proposed that the UTC Time Stamp (UTC_TS) consist of 4 byte word specifying the day, hour, minute, second, and millisecond of record.

It is proposed that the day, hour, minutes, and second portion of the word be derived from the geo-positioning satellite UTC data. This information will be available to all Base Stations, being generated by their on-board UTC receivers, or to all Subscriber Stations, in which case it will be derived from the Coexistence Control Channel.

It is proposed that the millisecond portion of the word be generated by timing sources within the BS or SS; sources which themselves will be slaved to the 1 pps pulse. It may be possible to derive millisecond accuracy from the geo-positioning satellite systems, however this will be system dependent. Allowing the millisecond

portion to be generated by the BS or SS (which will subdivide the 1pps pulse duration by a thousand) should not substantially compromise the accuracy of time stamp. Currently the 1 millisecond interval is defined in Section 15.2.1 and is called the NTI_S. There are 1000 NTI_S units per NTI.

Specific editorial changes

This section provides a list of changes to the draft document.

Blue text represents specific editorial additions.

~~Red strikethrough~~ text is to be deleted.

Black text is text already in the draft.

Bold italic text is editorial instructions to the editor.

Text proposal for section 15.2.1

These changes are to Section 15.2.1 of the current draft document [1]

 15.2.1.1 Network Time Interval and CX_MAC_NO Frame start

All synchronized WirelessMAN-CX base stations will ~~either synthesize or~~ derive a 1 pps clock broadcast by a global navigational system or other means. The 1 sec duration is called the Network Time Interval (NTI). The rising edge of the 1 pps synchronization pulse will be considered as the start of the NTI and of the WirelessMAN-CX MAC Frame. The 1pps pulse will have a stability of +/- ~~1 microsecond~~ 50 nanoseconds, as measured from rising edge to rising edge. The beginning of every Coexistence Control cycle (see Table 345d) CX_MAC_NO 1 will always start at every tenth NTI.

15.2.1.2 Granularity of the NTI

The NTI will be comprised of 1000 1 Millisecond slots called NTI_S units that will be used by both TDD and FDD systems. NTI_S units can determined internally by the BS or SS, being derived from the NTI. NTI_S units can be also supplied directly to the BS or SS by the global navigational system receivers used to determine the NTI. ~~to negotiate times and durations of co-channel occupancy. Negotiation for access time to common spectrum will be specified in terms of the NTI_S unit 1 millisecond units. Occupancy times will be specifiedin terms of time from the beginning of the NTI and in terms of negotiated number of NTI_S unit1 millisecond intervals~~.

15.2.1.3 UTC Standard Time

The common clock specified in section *15.2.1* will provide a Universal Coordinated Time (UTC) signal to all WirelessMAN-CX systems, making all systems synchronized to this referenced time stamp. WirelessMANCX base stations will use the UTC time standard for coordinating and identifying specific NTI intervals. One millisecond granularity of the UTC Standard Time will be provided by specifying the NTI_S units ~~See further explanations in *15.9.*~~
[Note: detail description of the GPS deployment could be written in 15.7 Recommended practice for WirelessMANCX.]

Insert the new paragraph below immediately after the paragraph above

15.2.1.4 UTC Time Stamp Word

The Wireless MAN-CX will time stamp coexistence protocol events using a 4 byte Universal Time Stamp (UTC_TS). The composition of this word and the derivation of its contents will be as specified in Table XXX.

Bit Numbers	Value (decimal)	Origin of Value
0-4 (MSB)	1-31 (days)	Derived from universal timing standard system
5-9	1-24 (hours)	"
10-15	1-60 (minutes)	"
16-21	1-60 (seconds) NTI	"
22- 31 (LSB)	1-1000 (milliseconds) NTI_S	Derived internally at BS or SS or taken from universal timing standard system if available

Table XXX Composition of UTC_TS

References

[1] IEEE 802.16h/D1: Part 16: Air Interface for Fixed Broadband Wireless Access Systems Amendment for Improved Coexistence Mechanisms for License-Exempt Operation; 2006-10-10