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Title	CMI/CSI consolidation and Inter-System Communications with IEEE 802.11Y Systems
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Re:	CMI and CSI consolidation and new input on IEEE 802.11Y Inter-System Signaling
Abstract	An attempt is made to consolidate the CSI and CMI concepts of the draft document and suggest a manner in which this would lead to the detection of and signaling to 802.11Y systems in order to attain inter-system coexistence in the 3.65-3.7 GHz Bands.
Purpose	To simplify & rationalize sensing , detection, and messaging in support of the Cognitive Radio features within IEEE 802.16h. Provide a concept for discussion with the IEEE 802.11Y Tg
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CMI/CSI consolidation and Inter-System Communications with IEEE 802.11Y Systems

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Introduction

This document proposes the consolidation of CMI and CSI signaling by taking attributes of both concepts and combining them to form a technique that can be used to provide inter and intra system signaling between WirelessMAN and non-WirelessMAN-CX systems. The consolidation will also support a technique to detect and signal IEEE 802.11y systems operating at 3.65 GHz. This function can be achieved if the IEEE 802.11y and IEEE 802.16h systems use a common method of encoding control messages and synchronize the transmission and reception of these to a universal timing standard. It is expected that with additional changes the consolidated proposal will support dynamic spectrum trading and other features important to the implementation of cognitive radio for coexistence.

The proposal is meant for discussion by the IEEE 802.16h.

1) Similarities between CSI and CMI

CSI and CMI are signaling techniques that have been proposed in the IEEE 802.16h discussions. There are a number of similarities between these as shown below.

CSI concept attribute	CMI concept attribute	Function
OCSI	BSD in the CX_CMI_D(n)	Broadcast IP address and other information about system on a regular basis. Received by SS
OCSI assignment	CX_CMI_D/U claiming	The process of securing a periodic slot in the messaging system where messaging can take place.
ICSI/IP (CXP)	BSD/SSURF/IP	Technique used by an IBS to determine the extent of its interference zone and support its creation of a coexistence community
ICSI	CX_CMI_U(n) CX_CMI_D(n)	A detected/assigned clear downlink channel to be used for IBS entry.
Signaling of IP bits done by RSSI envelopes that are 100's usec long	BSD messages are 100's of usec long	Similar physical RSSI envelope
Uses repetitive ICSI and OCSI intervals with known	Uses a CXCC which is synchronized to a	Synchronization of virtual control channel.

position wrt to MAC frames	CX_MAC_NO frame count	

2) Signaling Capabilities of CSI and CMI

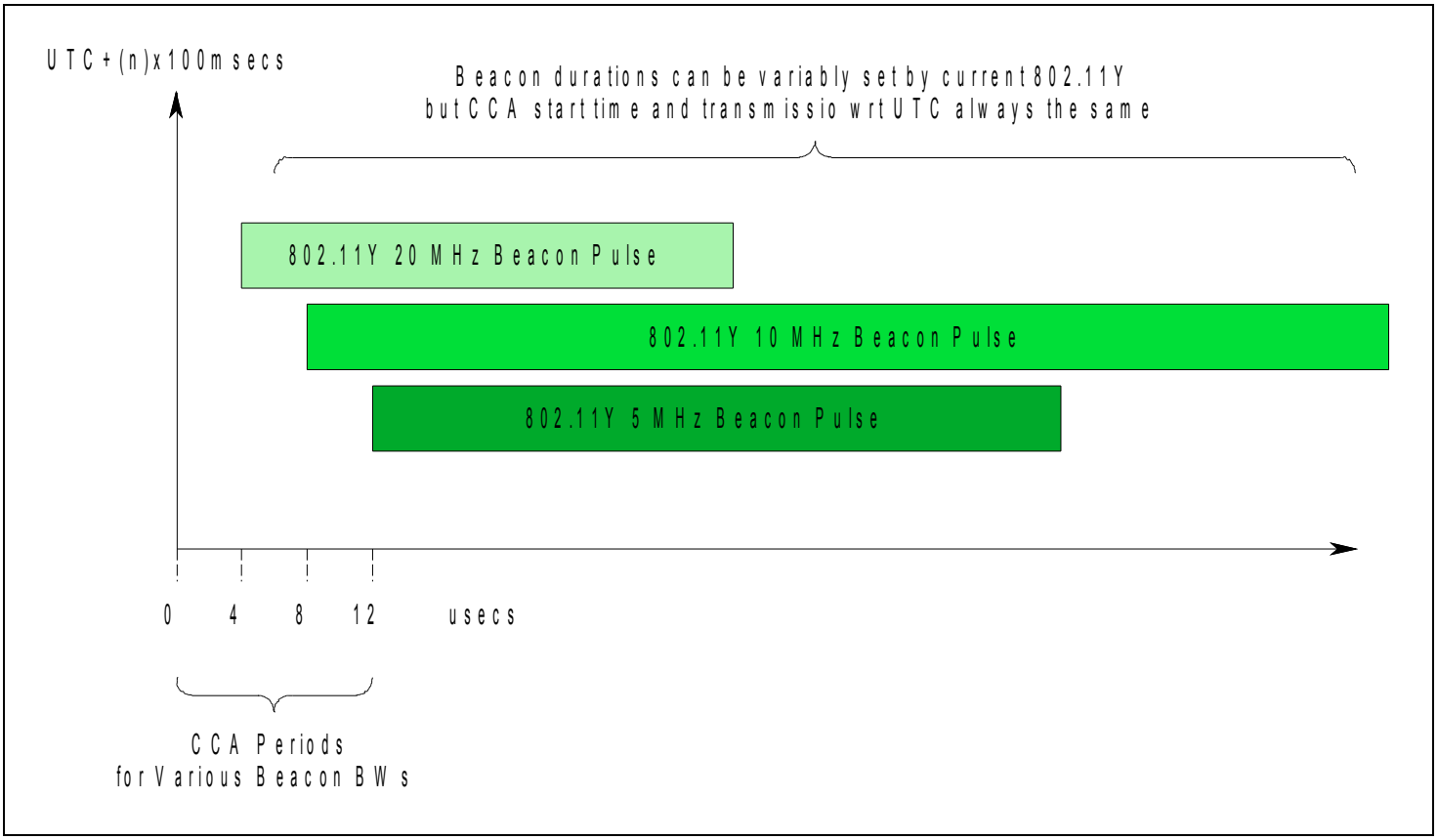
CSI and CMI have different signaling capabilities and support different types and speed of inter and intra-system coexistence.

Attribute	CSI concept	CMI concept
Demarcation of interference zone caused by IBS to other-systems SS	Can do	Can do
Identification of interfering SS	Cannot do	Can do
Detection of co-channel CSI or CMI signaling	Cannot do	Can do
Determine interfering system radiation parameters	Can do by IP, very slowly by RF messaging	Can do by IP, quickly by RF signaling.
Detection of sporadic interference	Cannot do or done with difficulty	Can do quickly by RF detection.
GPS synchronization of messaging and detection zones	Implied, and likely used	Explicitly used
Control Channel	Implied, and likely used but with added demand on link capacity	Explicitly used, link capacity requirement determined @ 1%.
Quantification & Threshold control of measurement of interference events	Cannot do	Intrinsic to the concept

1) 802.11y Beacon Signaling

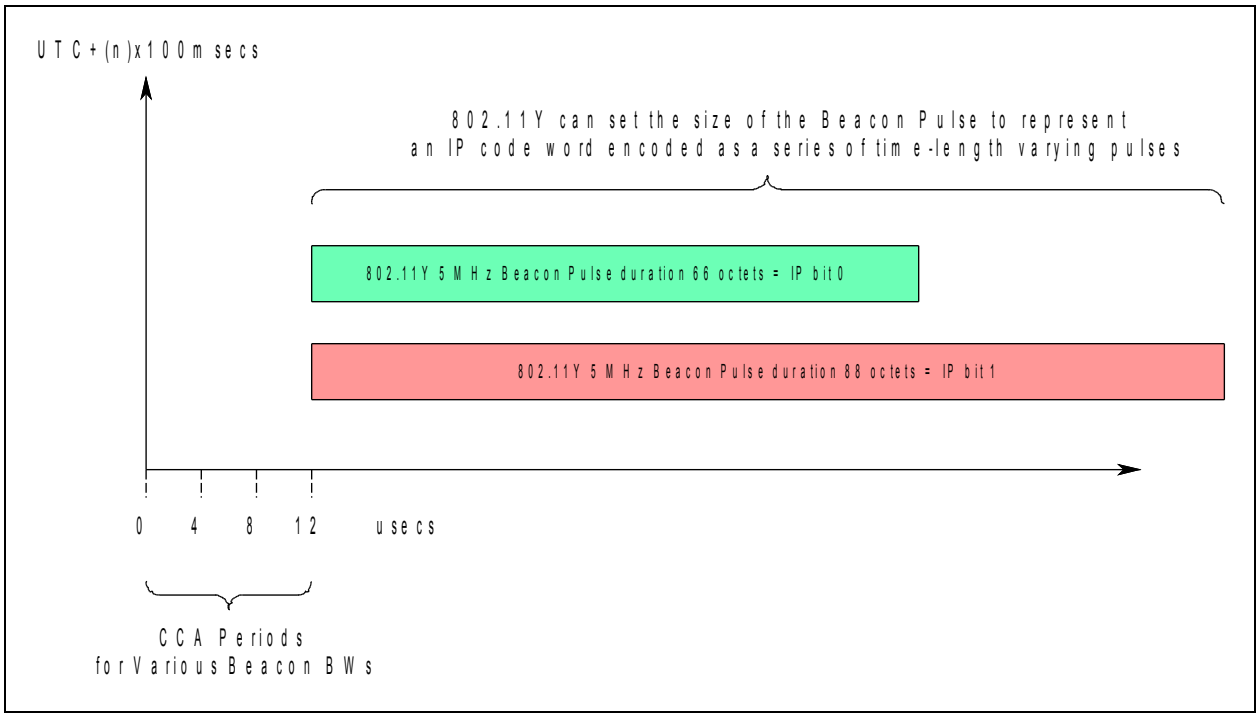
IEEE 802.11Y uses a beacon for a number of synchronization and system control tasks inherent to the standard. The characteristics of the beacon are:

- Beacon pulses will be synchronized to a GPS-like timing standard.
- Duration of beason pulse length is variable, but can be fixed by the standard.
- Periodicity of Beacon pulses is variable, but can be fixed by the standard.
- Beacon pulses are always sent unless pre-empted by ongoing traffic. Beacon transmission obeys the CSMA/CA protocol at all levels other than the transmission start (which is universally synchronized).



The CCA period duration depends on the bandwidth being transmitted by the IEEE 802.11Y device. Enablling stations in the IEEE 802.11Y standard emit Beacons.

It may be possible to modify the IEEE 802.11Y standard so that only two different duration beacons are Transmitted. If this were done it would be possible to create a repeated pulse-duration code representing the IP address or other information about the IEEEn 802.11Y transmiter.



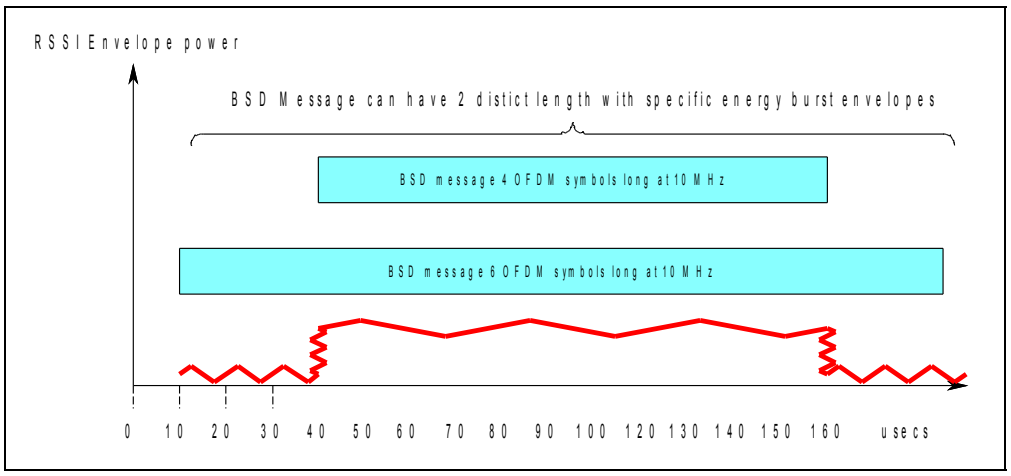
802.11Y Beacon signals encoded as durations

2) BSD Messages in CMI and CSI

It may be also possible to use the durations of specific signaling messages in the IEEE 802.16h concept to encode information that could then be transported between different PHYs, as proposed by the CSI concept but with off-on energy keying.

- Duration of a BSD message comprised of REF1/2 /FCH/BSD data is 4 OFDM sysmbols: Duration of this message at 10 MHz is ~ 100 usec…..similar to the length of the 802.11Y durations.
- It is possible to have 2 types of BSD with varying length.
- BSD messages can have, for example, RSSI envelopes that can be 100-150 usec in width and used to encode RSSI into IP "energy duration" bits.
- Currently proposed CSI messages also have a duration an integral number of symbols long, similar to the proposed BSD.
- IP "energy bit" data should be encoded to allow Viterbi decoding for better error performance.
- An RSSI demodulator based on duration detection needs to be devised.

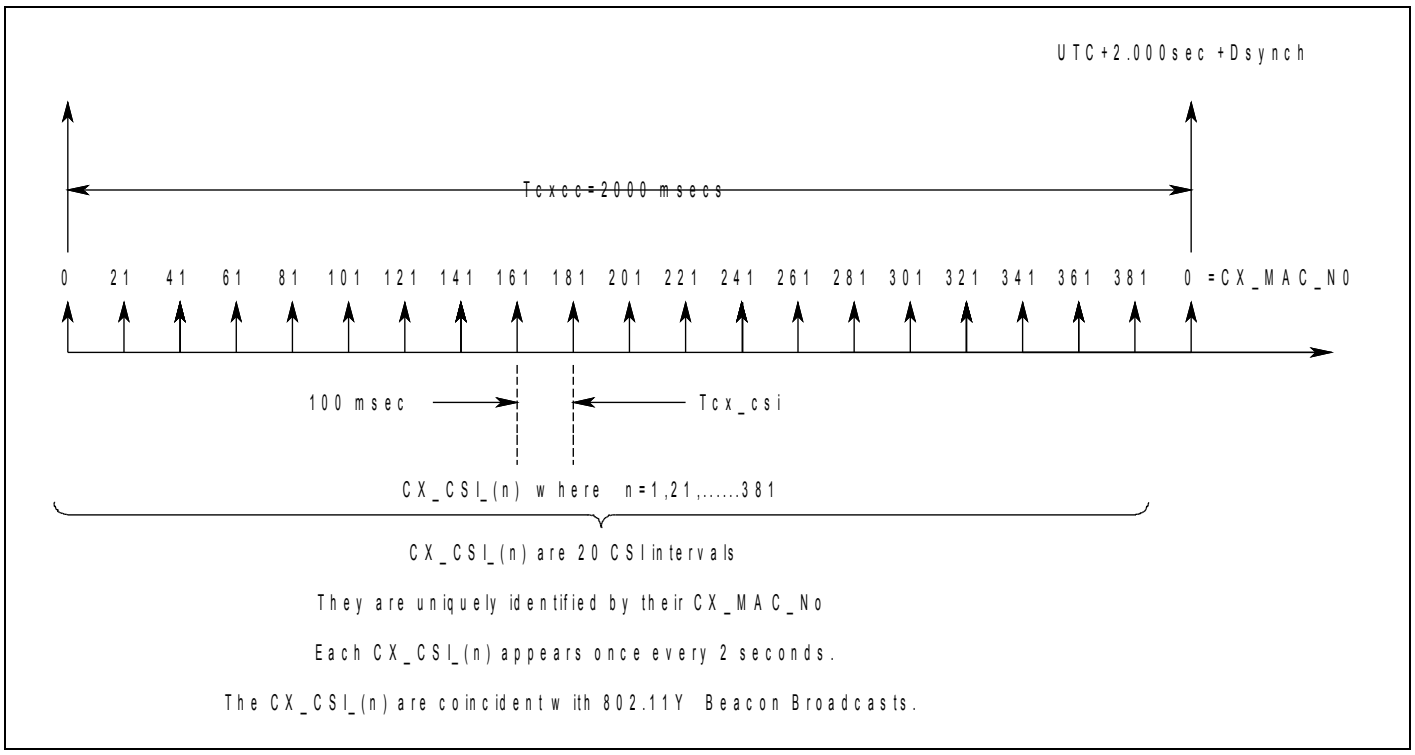
An example of what the encoded RSSI "energy duration" bits would look like:



5) Consolidation Proposal

- Encode BSD energy duration bursts on downlink. These messages can be demodulated and used as by same PHY systems in the manner of CMI and their envelopes can be detected by differing-PHY systems as IP encoded RSSI, in the manner of CSI.
- The messages would be sent out in the same manner as CSI, using ICSI/OCSI concept
- The CSI frames would be synchronized and repeat periodically as in the CXCC
- The RSSI IP bits would be Viterbi-decoded for better detection.
- (No+Io) slots would be provided.
- 802.11Y detection would form part of this proposal.
- Other traffic, such as spectrum trading, token exchange, etc. may be more quickly supported.

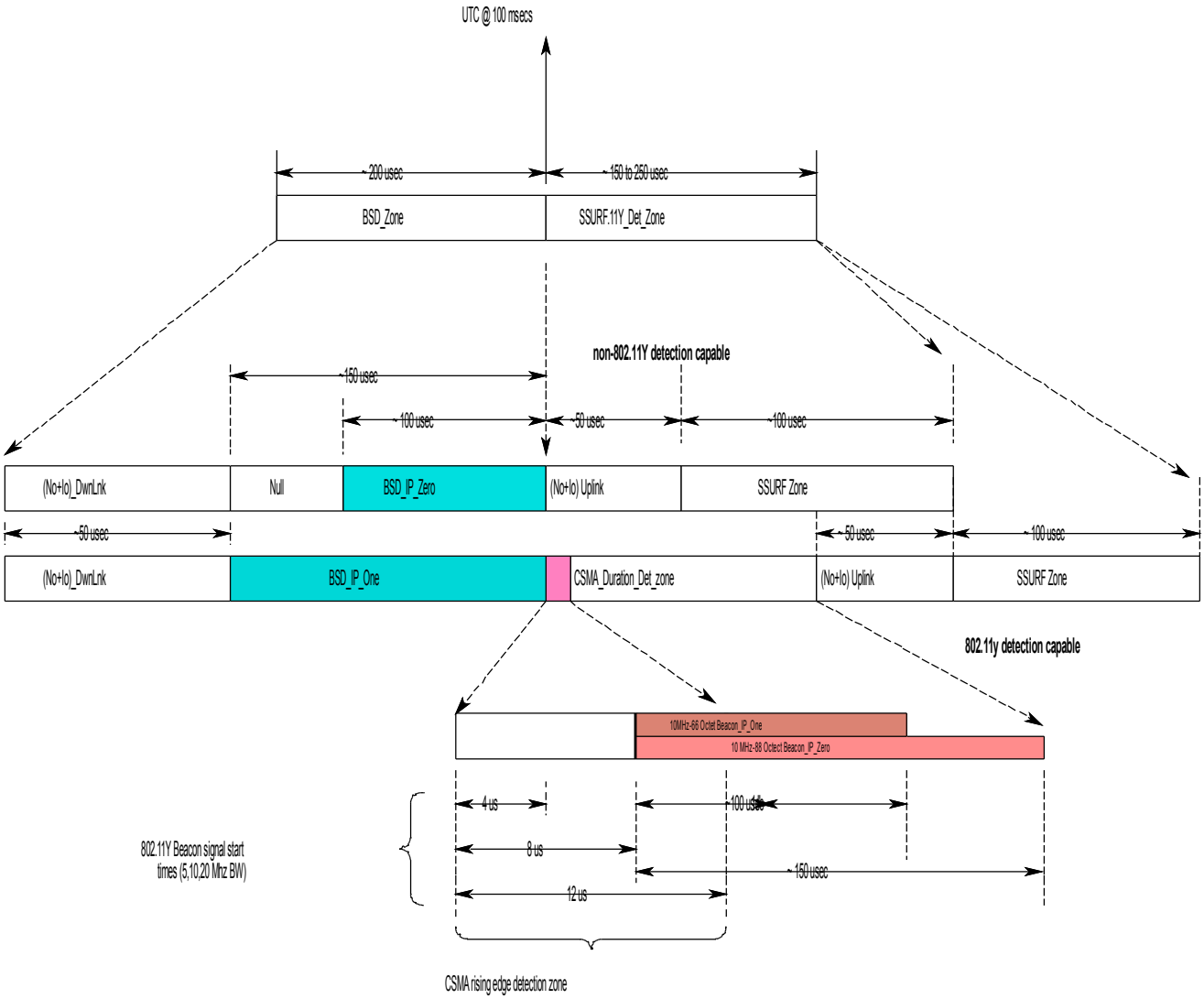
6) Consolidated CXCC and ISCI/OCSI structure



- The equivalent of ICSI/OCSI occur every 100 msec to coincide with 802.11Y beacon events…..this facilitates their detection
- They occur at the TTG as in the CSI concept.
- The CX_CSI_(n) repeat every 2 seconds. A specific CX_CSI(n) is claimed or assigned to a specific system

The intervals can be used as control channels, monitoring channels (when unoccupied) or in special instances, as fast CXP control channels to facilitate Token/Spectrum Trading events.

7) Details of the Combined Proposal: a look at a specific CX_CSI



8) Benefits

- Allows for more (No+Io) opportunities for detection of non-Wireless MAN-CX systems,etc.
- Supports both CSI and CMI functionality, including SS detection by SSURF
- Can transport a Energy pulsed-duration IP address from a BS in 2-3 minutes…not a problem for fixed applications.
- Uses less bandwidth than either the CMI and CMI concepts as presently proposed.
- Causes less impairment to QOS because it only uses a fraction of a IEEE 802.16 Frame (10% for 5 ms Frames for example)
- Can support fast IP for spectrum trading.
- Has a much more simplified and easily coded cyclic structure
- Does not affect spectrum mask.
- Can be used to for DFS in a much faster manner than CMI.
- Can be more robust against co-channel occupancy of signaling slots than either the current CMI or CSI approach.

9) Conclusion

Cognitive Radio system operation relies on sensing and identification at many levels. One of the most difficult problems we face in the implementation of CR is coexistence with systems other than our own. We are faced with this problem in the 3.65-3.7 GHz band with coexistence between 802.11Y and 802.16h systems. This proposal shows how this problem can be approached.

This proposal also combines two signaling concepts that were for the longest time perceived as divergent or different. In fact, little difference actually exists and we see, through this work, that a common ground can be attained.

If this new direction is judged as useful, more details can be provided which will economize and improve on what has been described in a general manner above.