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# Scheduling of Quiet Periods and Extended Quiet Periods in 802.11

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## 1 Introduction

There are different possibilities to achieve coexistence with 802.11 such that the cell size of 802.16 will not be affected by interference in a harmful way:

- Reducing the “energy detect” threshold around the 802.16 Noise levels;
- Separating the two fundamentally different systems in time.

The first possibility is very problematic to be accepted in 802.11, so we tried to find a solution following the principle of the separation in time. According to this principle, the 802.11 system shall be silent during the Master sub-frames belonging to 802.16-based systems.

This means that:

- the 802.16 and 802.11 systems SHALL be synchronized with a common time source, like GPS;
- the 802.11 Base Station shall defer any transmission during the 802.16 Master times;
- the 802.11 STAs shall be silent during the 802.16 Master times.

The Coexistence Frame structure, for the case of one 802.11 sharing the channel with one 802.16h system is presented in the figure A1. It is assumed that the 802.11 or the 802.16 systems have not implemented the CXP (Coexistence Protocol) and the 802.16 systems do not use “listen before send”.

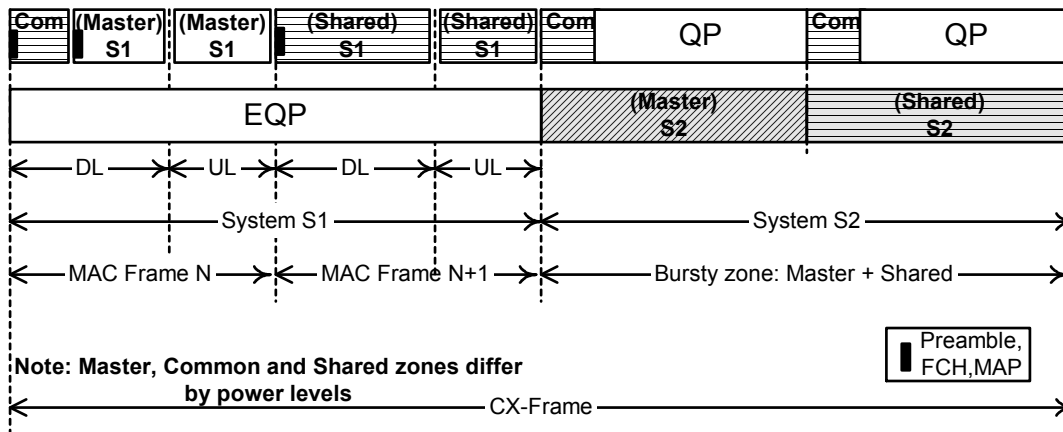


Fig. A1 – One 802.16h system and one 802.11 system

The 802.11 system needs to stay silent during its EQP interval.

The most complicated case is related to the situation of two 802.16h systems and one 802.11 system and is shown in the fig. A2. The 802.11 system needs to stay silent during its QP and EQP intervals.

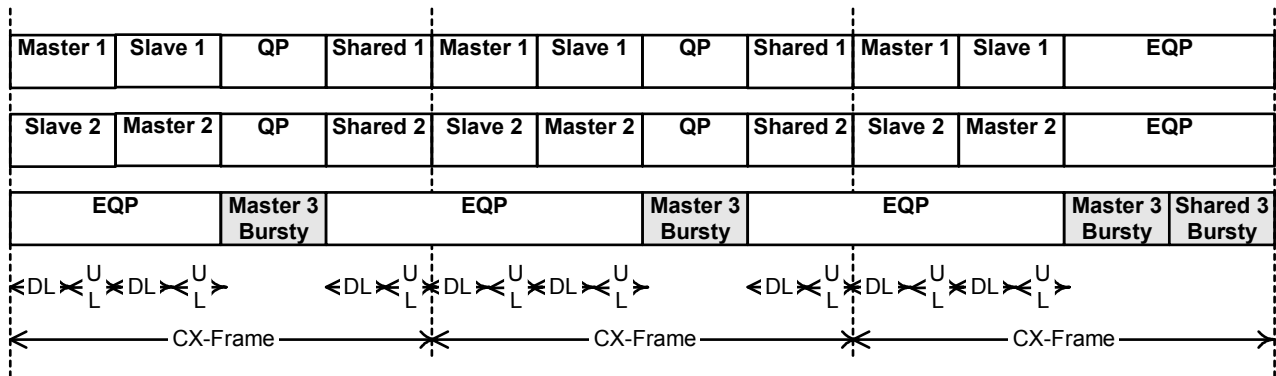


Fig. A2 Two 802.16h systems and one 802.11 system

## 2 Solution for scheduling the QP and EQP in 802.11

802.11 defines MAC frames using the “Beacons” for synchronization. Fig. A3 shows possible “Beacon” locations for the synchronization of the CX-Frames. The Beacon shall be transmitted synchronously with the start of the first Master sub-frame of a Bursty system within a CX-Frame.

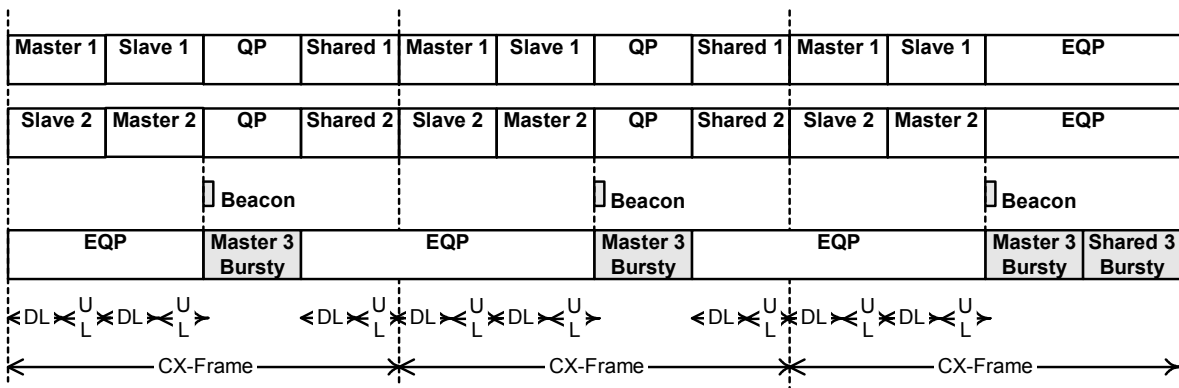


Fig. A3 – Beacon utilization

### 2.1 Frame synchronization

The Beacon Interval field is described in [1] as:

### 7.3.1.3 Beacon Interval field

The Beacon Interval field represents the number of time units (TUs) between target beacon transmission times (TBTTs). The length of the Beacon Interval field is 2 octets. The Beacon Interval field is illustrated in Figure 26.

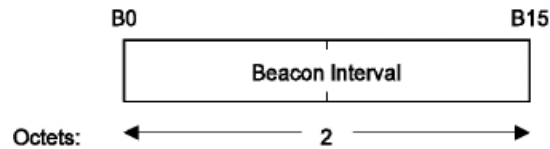


Figure 26—Beacon Interval fixed field

The time unit (TU) is defined as:

**3.45 time unit (TU):** A measurement of time equal to 1024  $\mu$ s.

The definition of the time unit will not allow a good and reliable synchronization between 802.16 and 802.11, because 802.16 uses MAC Frames which are multiple of milliseconds and 802.16h uses the absolute time reference (GPS for example), which uses seconds as time units.

This unit should be redefined as:

**3.45 time unit (TU):** A measurement of time equal to ~~1024~~ 1000  $\mu$ s.

In this case:

- The Beacon Interval shall be set to 20
- The Beacon shall be retransmitted synchronously with the 20ms absolute time and using the defined period.

In the case that this unit will not be redefined, the Beacon period will have to be adjusted from time to time to compensate the difference and:

- The Beacon Interval shall be set to 20;
- The Beacon shall be retransmitted synchronously with the 20ms absolute time and the time indication included in the Beacon shall be up-dated according to the absolute time.

## 2.2 Scheduling the quiet intervals

The 802.11 Base Station will remain silent during the QP and EQP intervals. In order to keep silent also the STAs will be used the following Information element (similar with TLVs in 802.16), part of the 802.11 Beacon and Probe Response Management messages, defined in 802.11h as follows:

Start quote

### 7.3.2.23 Quiet element

The Quiet element defines an interval during which no transmission shall occur in the current channel. This interval may be used to assist in making channel measurements without interference from other STAs in the BSS or IBSS. The format of the Quiet element is shown in Figure 46r.

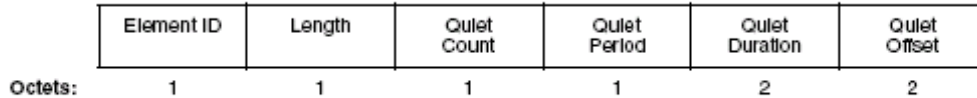


Figure 46r—Quiet element format

The Length field shall be set to 6.

The Quiet Count field shall be set to the number of TBTTs until the beacon interval during which the next quiet interval shall start. A value of 1 indicates the quiet interval will start during the beacon interval starting at the next TBTT. A value of 0 is reserved.

The Quiet Period field shall be set to the number of beacon intervals between the start of regularly scheduled quiet intervals defined by this Quiet element. A value of 0 indicates that no periodic quiet interval is defined.

The Quiet Duration field shall be set to the duration of the quiet interval, expressed in TUs.

The Quiet Offset field shall be set to the offset of the start of the quiet interval from the TBTT specified by the Quiet Count field, expressed in TUs. The value of the Quiet Offset field shall be less than one beacon interval.

The Quiet element may be included in Beacon frames, as described in 7.2.3.1, and Probe Response frames, as described in 7.2.3.9. The use of Quiet elements is described in 11.6.2.

end quote

The following parameters will be suitable for coexistence with 802.16h:

Quiet Count = 1  
 Quiet Period = 1  
 Quiet Duration = value  
 Quiet Offset = value.

### 3 Conclusion

The Master approach can be implemented using the existing 802.11 Management Elements. It highly desirable that the 802.11 timing will be consistent to the absolute time and the “time unit” in the definition 3.45 will be changed from 1024 to 1000.

## 4 References

[1] IEEE Wireless LAN Edition; Standards Information Network; IEEE Press A compilation based on IEEE Std 802.11TM-1999 (R2003) and its amendments

[2]IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 5: Spectrum and Transmit Power Management Extensions in the 5 GHz band in Europe

[3] IEEE P802.11-REVma™/D8.09.0 - (Revision of IEEE Std 802.11-1999) – Draft Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications