Simulating coexistence between 802.11y and 802.16h systems in the 3.65GHz band – An amendment for 802.11e

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Joint meeting with 802.11/802.16/802.19 concerning 3.65GHz coexistence

Base Document:

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Purpose:

Simulating coexistence between 802.11y and 802.16h systems in the 3.65GHz band – *An amendment for 802.11e*

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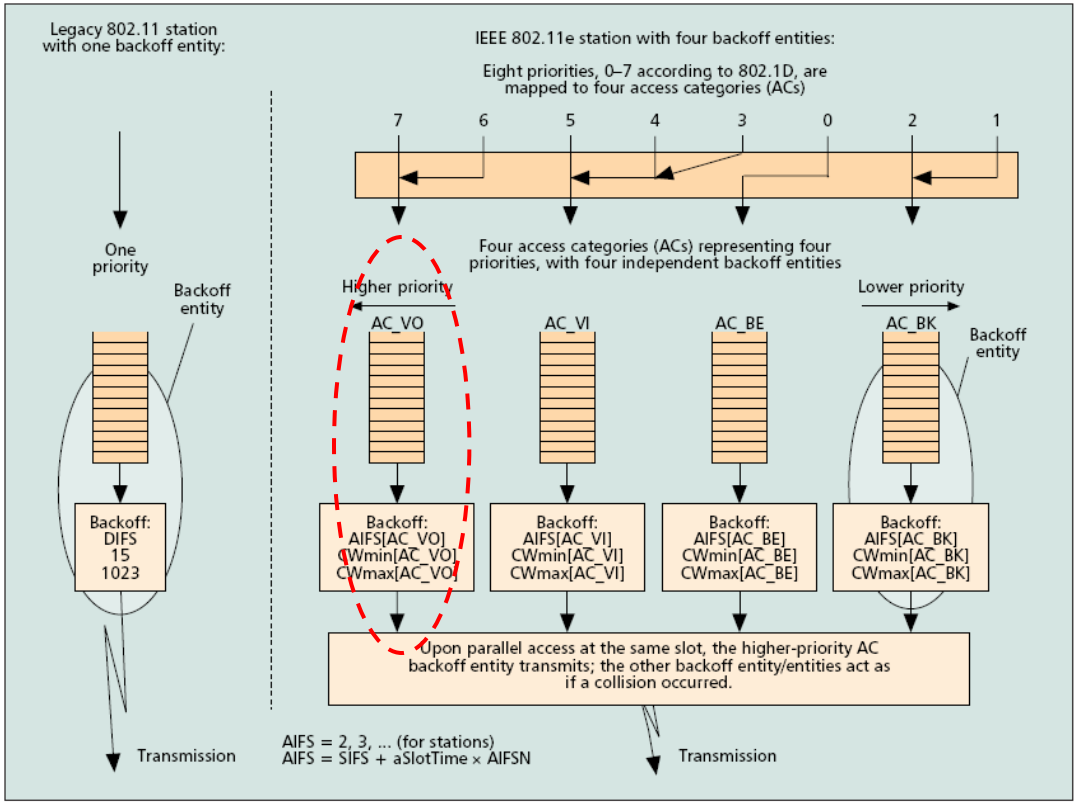
Simulation model and starting assumptions

- 802.11y specifies a maximum frame duration of 4ms
- CCA-ED threshold: -72/-75/-78dBm.
- RTS/CTS is implemented (helps with the hidden node problem)
- HCF (Hybrid Coordination Function) is specified in the 802.11e amendment
  - HCF consists of EDCA (Enhanced Distributed Channel Access, distribution function) and HCCA (HCF Controlled Channel Access, centralized function)
  - WMM (Wi-Fi Multimedia) certifies the EDCA and TXOP (Transmit Opportunity) features
  - EDCA and TXOP features enhance the QoS support in 802.11
  - EDCA introduces 4 AC (Access Categories) that prioritizes traffic class access to the air interface
  - TXOPs are used to provide a station with a time period in which to transmit in a non-contended manner

- Changes to the simulation that have been implemented:
  - Comment: *With DCF one does not need to wait DIFS for the first packet of a stream when the medium has been free for a while*
  - DIFS (= SIFS + 2.*SlotTime*) is replaced by *AIFS*[*AC*] (= SIFS + *AIFSN*[*AC*].SlotTime, *AIFSN*[*AC*]≥2)
  - *CWmin* is replaced by *CWmin*[*AC*]
  - *CWmax* is replaced by *CWmax*[*AC*]
  - TXOPs managed via the traffic model
  - A single AC is used in the simulation => AC_VO. This represents the AC that will be most aggressive at obtaining the medium and good baseline comparison for 802.16 – traffic model needs to match this

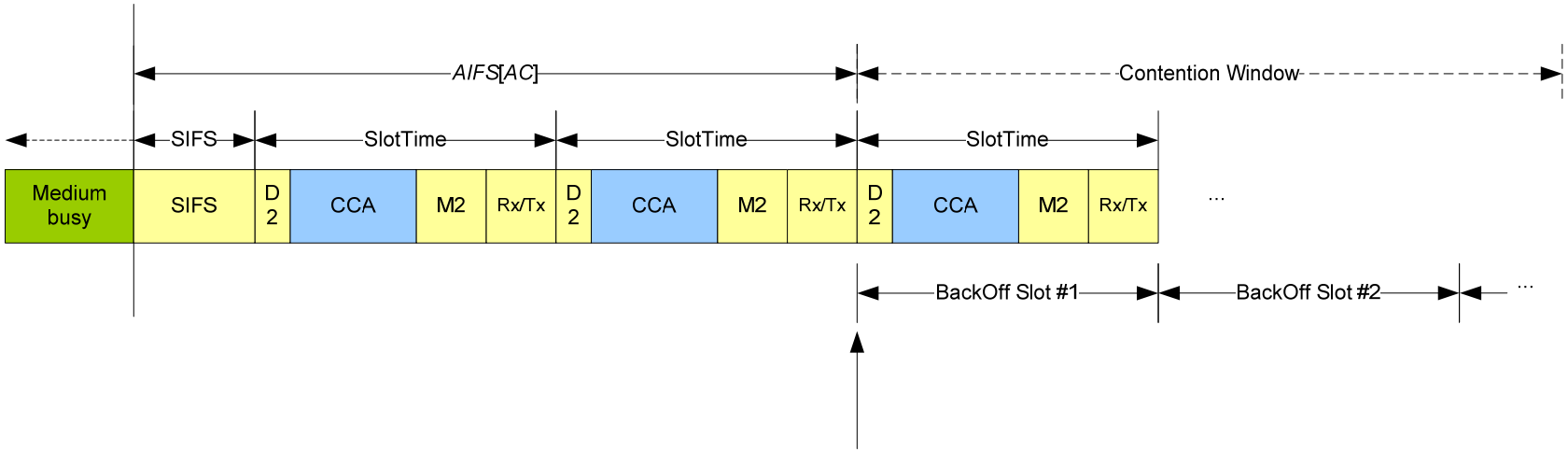
802.11y model representation (time domain analysis)

	AC_VO	AC_VI	AC_BE	AC_BK	High (AC H)	Medium (AC M)	Low (AC L)
AIFSN:	2	2	3	7	2	4	7
CWmin:	3	7	15	15	7	10	15
CWmax:	7	15	1023	1023	7	31	255



[Source: Analysis of IEEE 802.11e for QoS Support in Wireless LANs, Mangold, Choi, Hiertz, Klein, Walke, IEEE Wireless Communications, December 2003.]

802.11y model representation (time domain)



SIFS = 16/32/64 uS
SlotTime = 9/13/21 uS
AIFS[*AC*] = SIFS + *AIFSN*[*AC*] x SlotTime

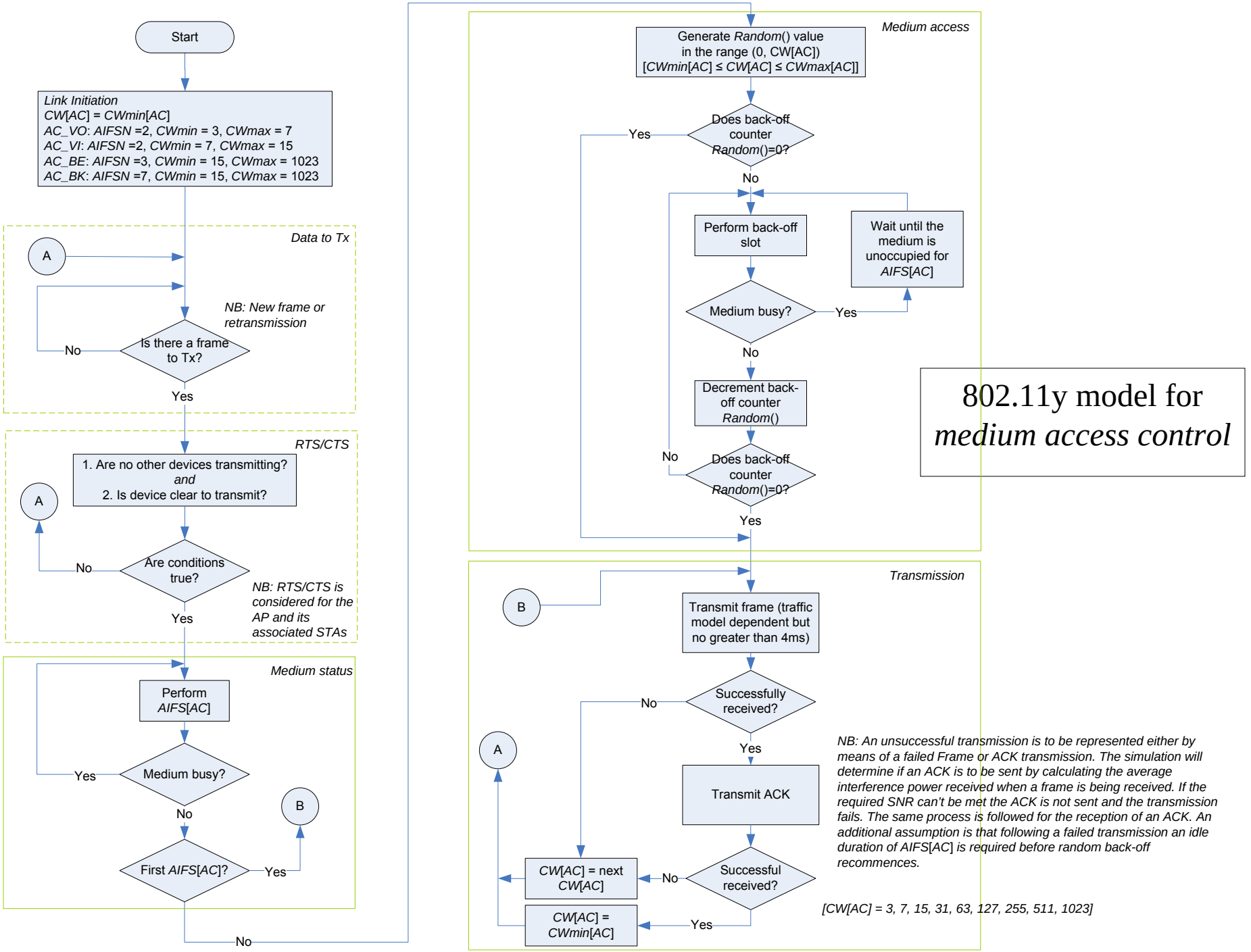
AIFSN[*AC*] = 2

AIFS[AC] = 34/58/106 uS

SlotTime = D2 + CCA + M2 + Rx/Tx

D2 (aRxRFDelay + aRxPLCPDelay) = 1/1/1 uS
CCA (Clear Channel Assessment) = 4/8/16 uS
M2 (aMACProcessingDelay) = 2/2/2 uS
Rx/Tx (aRXTXTurnaroundTime) = 2/2/2 uS

Legend: 20MHz/10MHz/5MHz Channel Bandwidth
Reference: *Table 147 OFDM PHY characteristics P802.11-REVma*


Start
Link Initiation
CW[AC] = CWmin[AC]
AC_VO: AIFSN =2, CWmin = 3, CWmax = 7
AC_VI: AIFSN =2, CWmin = 7, CWmax = 15
AC_BE: AIFSN =3, CWmin = 15, CWmax = 1023
AC_BK: AIFSN =7, CWmin = 15, CWmax = 1023
Data to Tx
A
NB: New frame or retransmission
Is there a frame to Tx?
No
Yes
RTS/CTS
1. Are no other devices transmitting?
and
2. Is device clear to transmit?
A
Are conditions true?
No
Yes
NB: RTS/CTS is considered for the AP and its associated STAs
Medium status
Perform AIFS[AC]
Medium busy?
Yes
No
First AIFS[AC]?
Yes
B
No
Medium access
Generate Random() value in the range (0, CW[AC])
[CWmin[AC] ≤ CW[AC] ≤ CWmax[AC]]
Does back-off counter Random()=0?
Yes
No
Perform back-off slot
Wait until the medium is unoccupied for AIFS[AC]
Medium busy?
Yes
No
Decrement back-off counter Random()
No
Does back-off counter Random()=0?
Yes
Transmission
B
Transmit frame (traffic model dependent but no greater than 4ms)
Successfully received?
No
Yes
A
Transmit ACK
CW[AC] = next CW[AC]
No
Successful received?
CW[AC] = CWmin[AC]
Yes
NB: An unsuccessful transmission is to be represented either by means of a failed Frame or ACK transmission. The simulation will determine if an ACK is to be sent by calculating the average interference power received when a frame is being received. If the required SNR can't be met the ACK is not sent and the transmission fails. The same process is followed for the reception of an ACK. An additional assumption is that following a failed transmission an idle duration of AIFS[AC] is required before random back-off recommences.
[CW[AC] = 3, 7, 15, 31, 63, 127, 255, 511, 1023]
802.11y model for medium access control