Simulating coexistence between 802.11y and 802.16h systems in the 3.65GHz band – Scenarios and assumptions

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Purpose:

Simulating coexistence between 802.11y and 802.16h systems in the 3.65GHz band – *scenarios and assumptions*

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Simulation model and starting assumptions

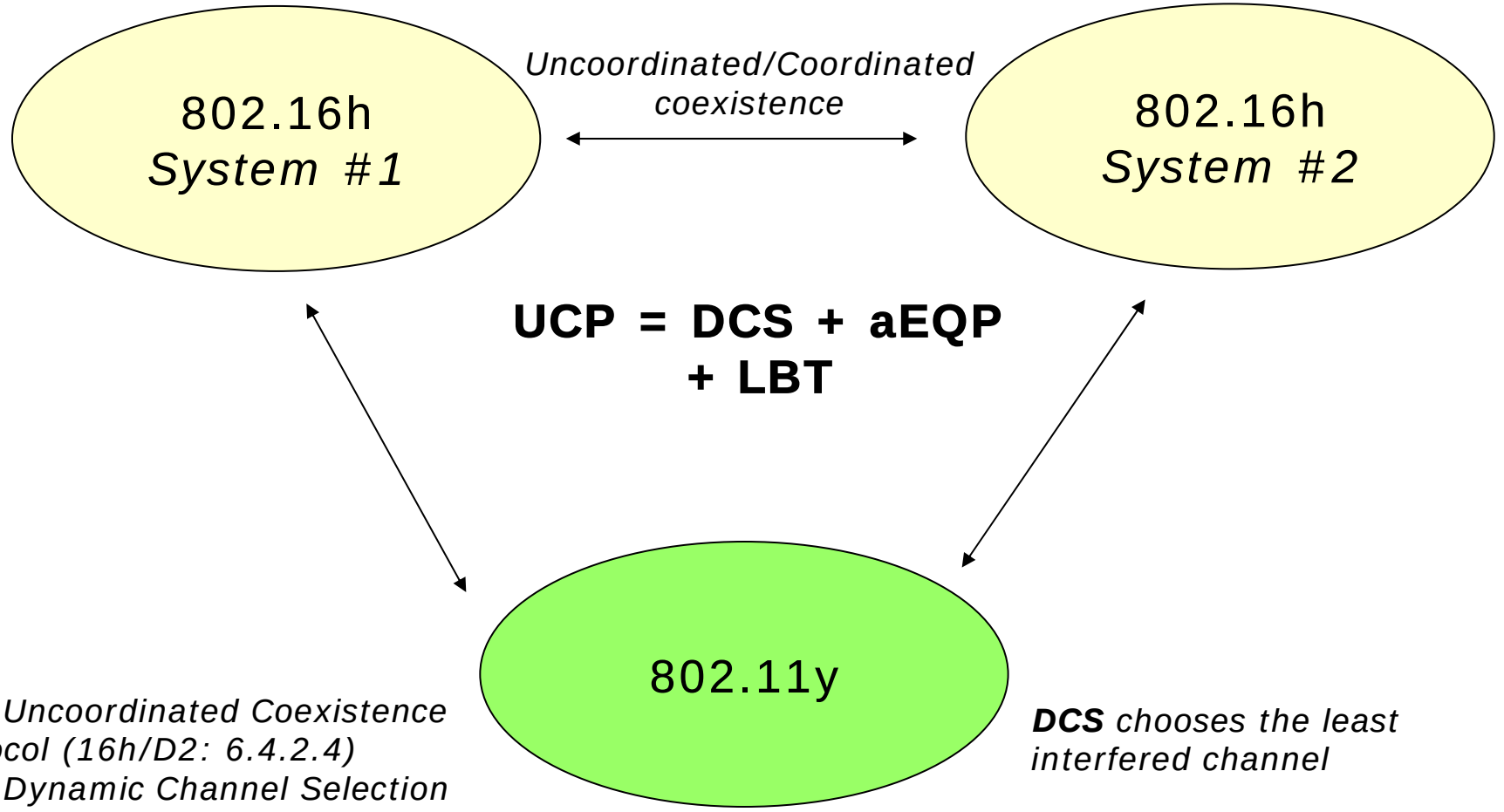
System level simulation based on:

- **Interference assessment (pathloss + link budget evaluation)**
- **Time domain analysis (1 µs resolution)**

- 802.16h assumptions are based on *WiMAX Forum Mobile System Profile (Release 1.0 – Revision 1.2.2)* parameters with features to meet CBP (Contention Based Protocol) as specified in 16h/D2

- 802.11y model is based on 802.11a 5GHz OFDM with modifications defined by 802.11 TGy:
  - Maximum packet duration of 4ms
  - CCA-ED thresholds (details on a later side)
  - Specific Contention Window values (15 -> 1023)
  - *Other parameters within the scope of this simulation effort?*

Simulating the coexistence environment



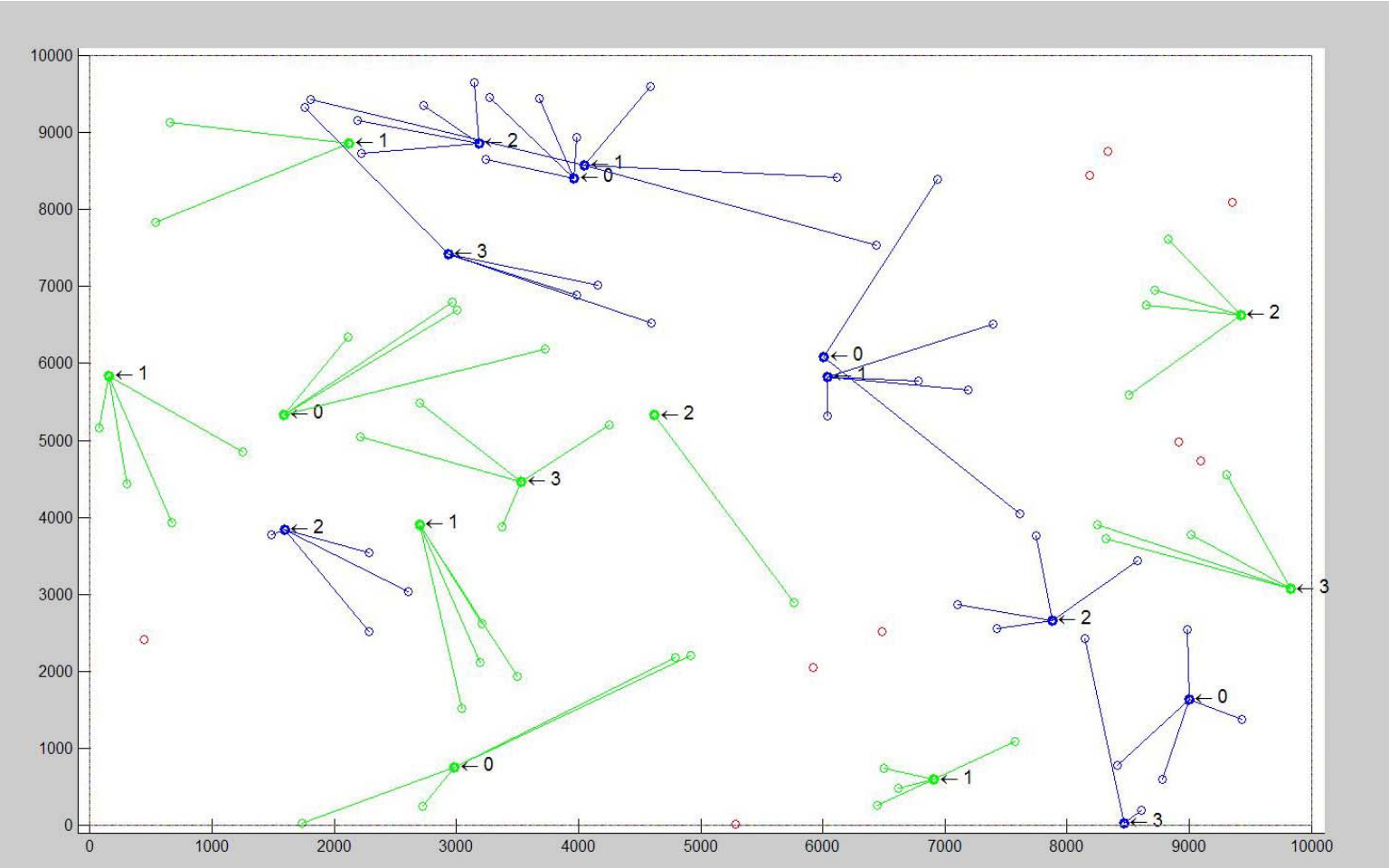
UCP *Uncoordinated Coexistence Protocol (16h/D2: 6.4.2.4)*
DCS *Dynamic Channel Selection (16h/D2: 6.4.2.3.2)*
aEQP *Adaptive Extended Quiet Period (16h/D2: 6.4.3.3)*
LBT *Listen Before Talk (16h/D2: 6.4.3.4)*

DCS *chooses the least interfered channel*

aEQP *is predominately for 802.16/802.16 coexistence*

LBT *is predominately for 802.16/802.11 coexistence*

Definition of the *Simulation Space*

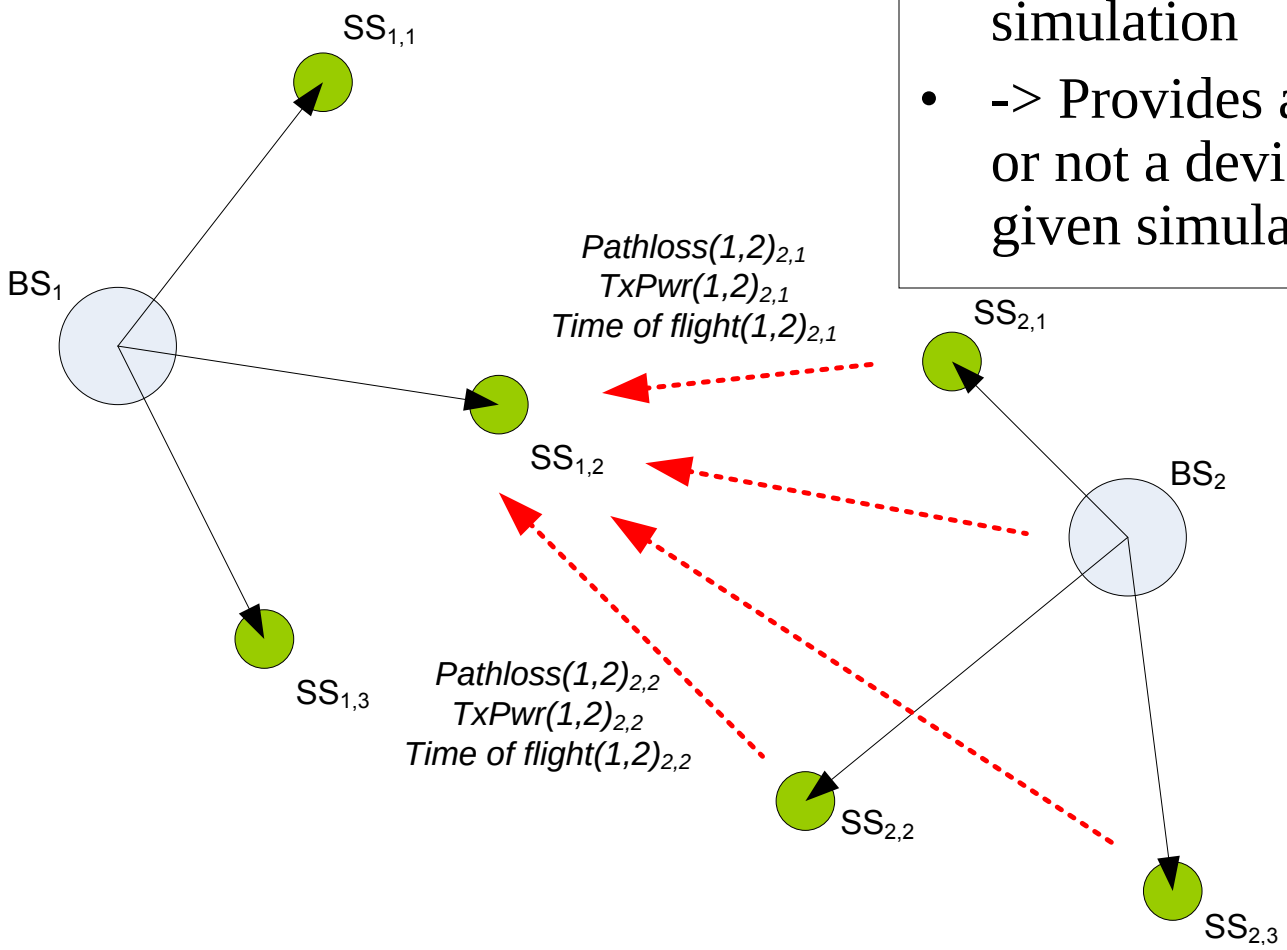


- *n* 802.11y APs (blue, 10)
- *m* 802.16 BSs (green, 10)
- Max *x* SS per AP/BS (4)
- This example uses 4 channels

- SS are associated to AP/BS on minimum pathloss
- Not all SS are associated in a given simulation run
- This example defines a 10kmx10km simulation area

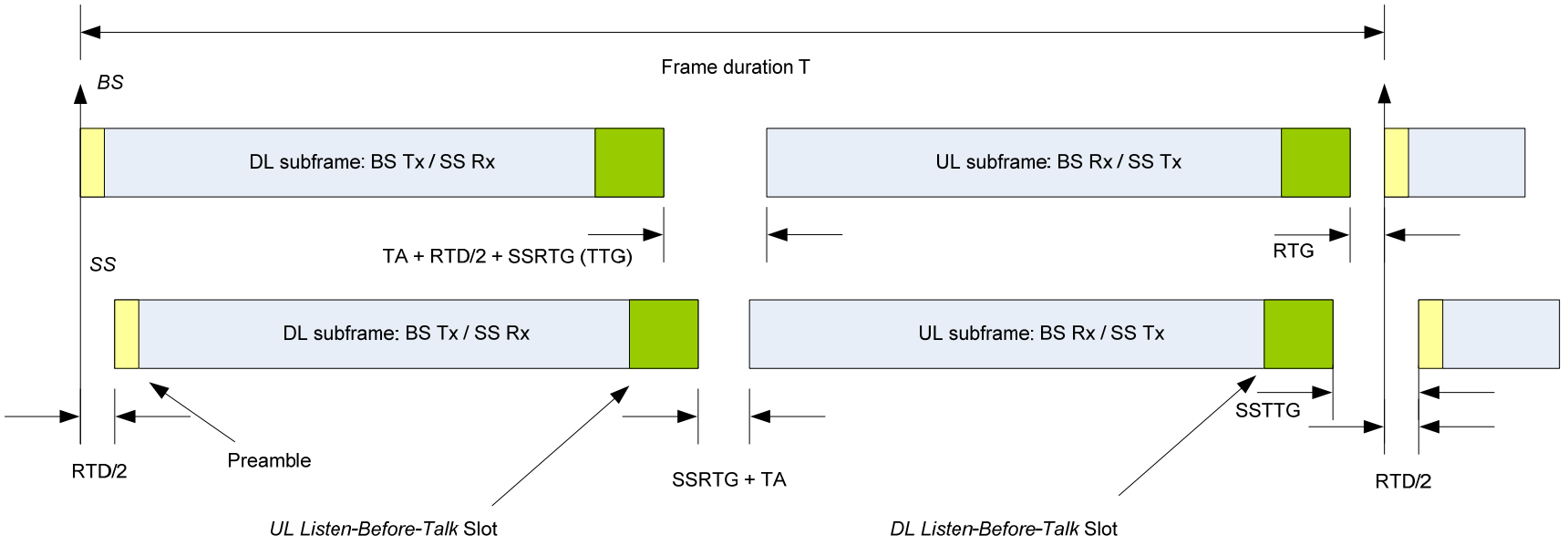
Interference geometry calculation

- Evaluation of link budget to calculate interference
- Compensation for *time of flight* given the 1µs resolution of the simulation
- -> Provides a decision on whether or not a device is transmitting at a given simulation interval

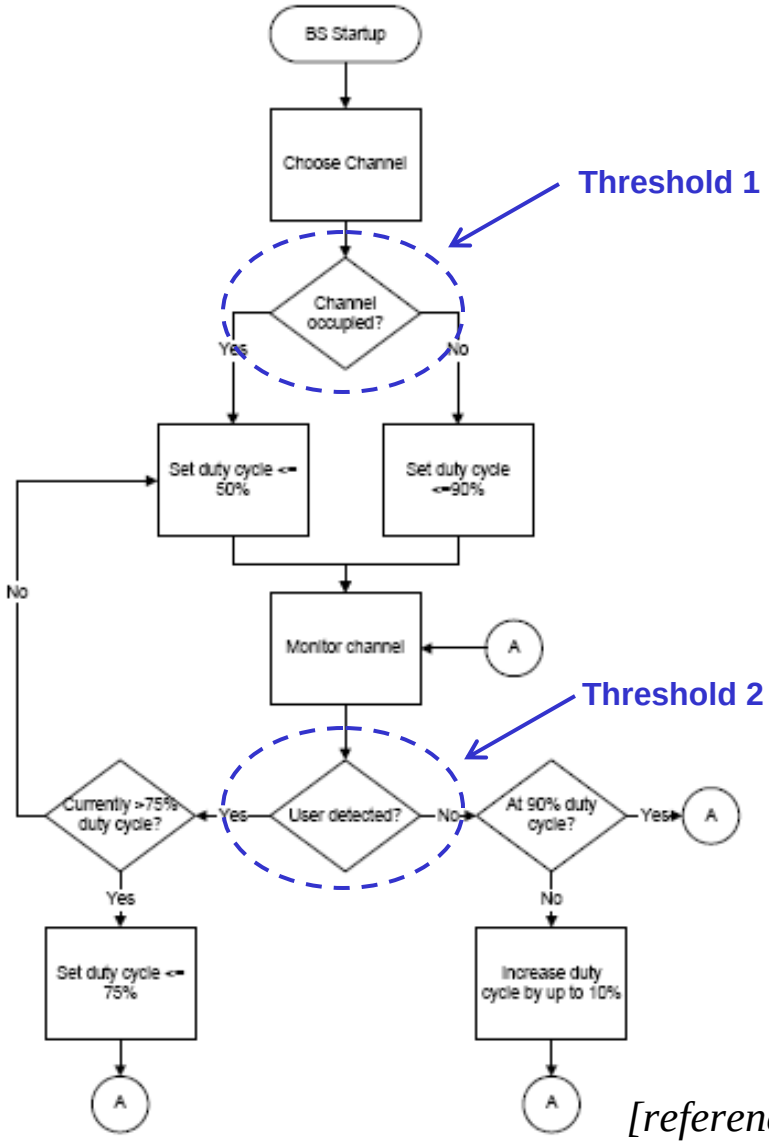


Listen Before Talk (LBT)

- As implemented in 802.16h/D2 sub clause 6.4.3.4
- Configuration:
  - DL LBT
  - UL LBT
  - DL&UL LBT
- Measurements are made in a dedicated OFDM slot (102µs) just prior to respective DL and UL subframe
- Controlled at BS with the associated SS acting independently



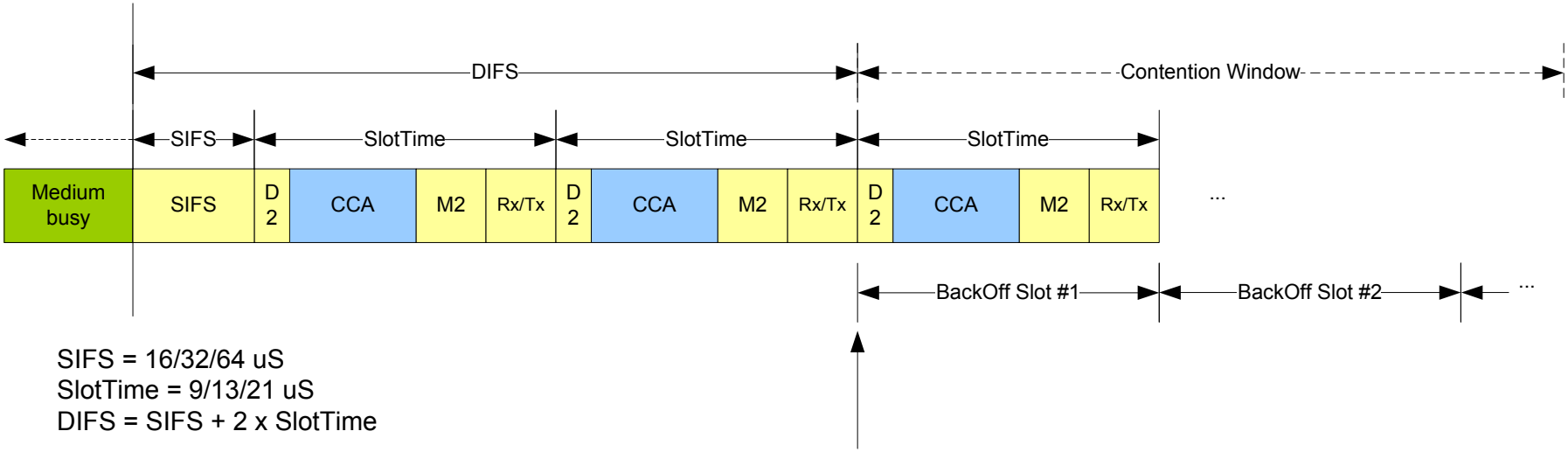
Adaptive Extended Quiet Period (EQP/aEQP)



- As implemented in 802.16h/D2
  - Sub clause 6.4.3.2 and 6.4.3.3
- Controlled at the BS
- Driven by interference calculations in the entire EQP UL sub-frame
- Measured at 50µs intervals
- Measurements provide a mechanism to allocate quiet frames based on prevailing conditions and therefore provide other systems an opportunity to transmit

[reference 802.16h/D2]

802.11y model representation (time domain)



SIFS = 16/32/64 uS
SlotTime = 9/13/21 uS
DIFS = SIFS + 2 x SlotTime

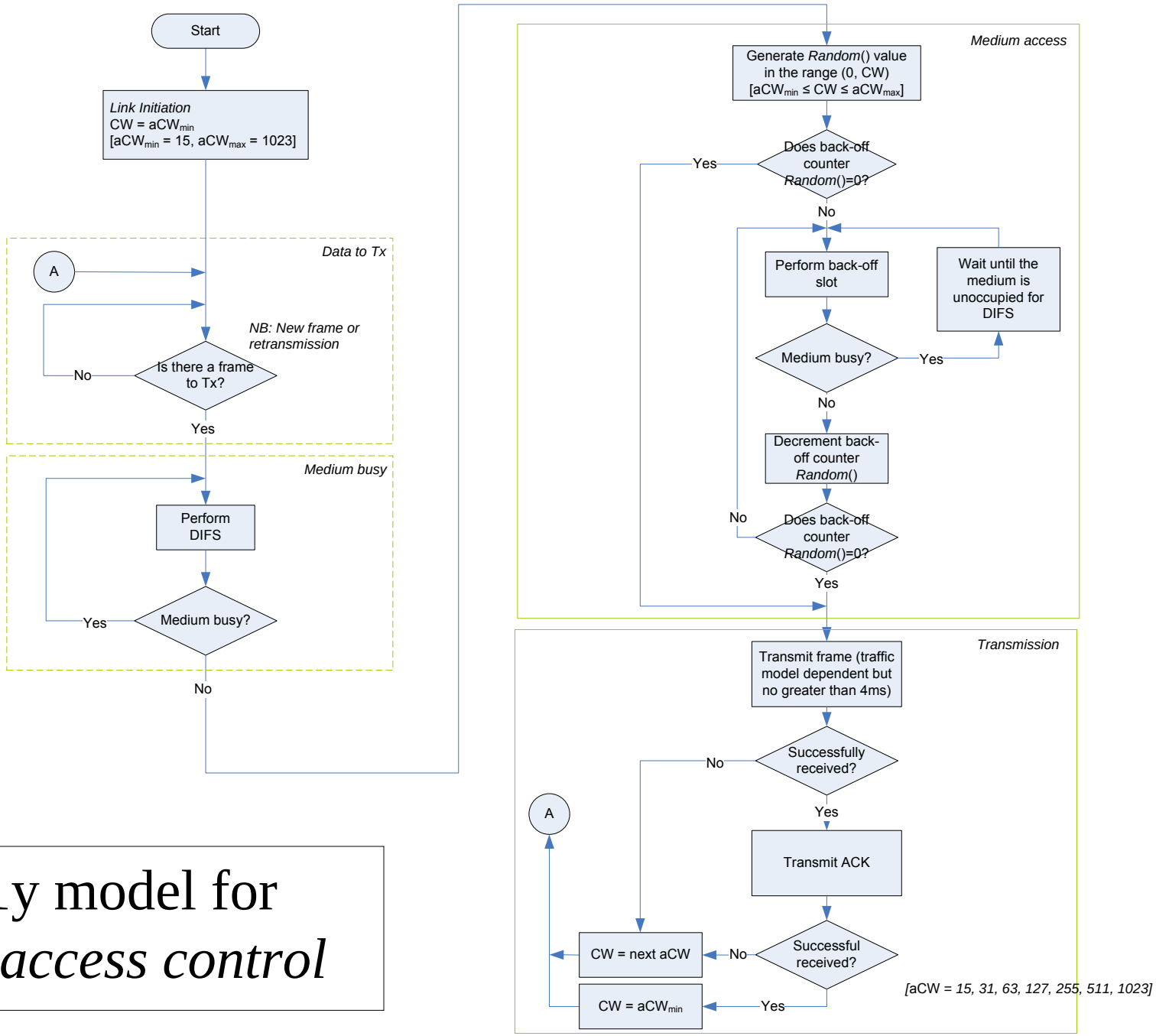
DIFS = 34/58/106 uS

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*

- 802.11y proposes the following thresholds:
  - CCA-CS: -82/-85/-88dBm
  - CCA-ED: -62/-65/-68dBm
- *Specifically for the 3.65GHz band only*:
  - **CCA-CS: -82/-85/-88dBm**
  - **CCA-ED: -72/-75/-78dBm**
- What is the motivation for choosing -72/-75/-78dBm?
- It's not clear what analysis has gone into the revised numbers for 3.65GHz
- Driven by a need to minimize the probability of false detection



802.11y model for *medium access control*

Conclusions and continuing work

- *Any comments on 802.11 simulation model?*
- *Any comments on simulation scenarios and the stated assumptions?*

- Simulation results are seeking to consider:
  - 802.11y impact on 802.16h *(e.g. given the CBP interpretations)*
  - 802.16h impact on 802.11y (*e.g. TTG/RTG values*)
  - 802.11y impact on 802.11y (*e.g. CCA-ED thresholds*)
  - 802.16h impact on 802.16h (*e.g. 16h features*)
  - Relative performance based on system loading
  - Performance of LBT and aEQP features
  - The validity of the current proposed CCA-ED thresholds
  - Optimization of 802.16h and 802.11y parameters for operation in 3.65GHz band