Frame Structure for IEEE 802.16m

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Re:
TGm Call for Contributions, IEEE 802.16m-07/047, specifically on "16m Frame Structure with special attention to legacy support"

Abstract:
Discussion on the 16m frame structure supporting coexistence between legacy and advanced mobiles. Four frame structures are proposed and brief calculations of latency are included.

Purpose:
To discuss the frame structure in the 802.16m SDD

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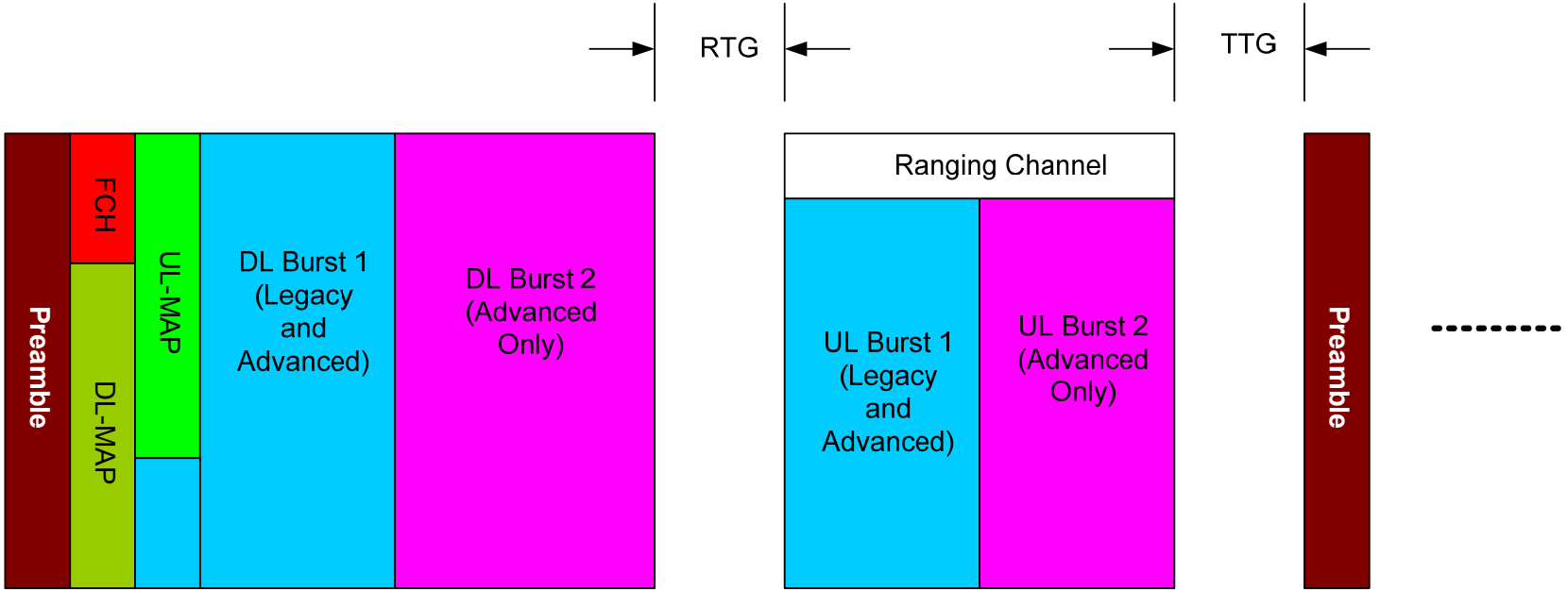
Frame Structures for IEEE 802.16m

LG Electronics Mobile Research (LGEMR)
Research and Standards Group

Objectives

- Design new Frame Structures to support legacy and new transmissions assuming
  - » Maintain the same number of switching points (1 RTG and 1 TTG of current IEEE 802.16e Frame Structure)
  - » Support the same or different numerologies for legacy and new transmissions
  - » Support a delay latency requirement defined in SRD for new mobiles

Structure 1 (1/4)



Structure 1 (2/4)

- Legacy and new systems may use the same numerologies
- New mobiles can be assigned to DL/UL Bursts 1 and 2
- Legacy mobile can be assigned to DL Burst 1 and UL Burst 1
  - » DL Burst 2 and UL Burst 2 are transparent to legacy mobiles
- Modified DL / UL MAP messages are needed to support DL/UL Burst 1 and 2
- Each UL Burst (1 or 2) may have its own ranging channel
- Starting times of DL Burst 2 and UL Burst 2 are adjustable depending the number of legacy and new mobiles, and the amount of traffic, etc

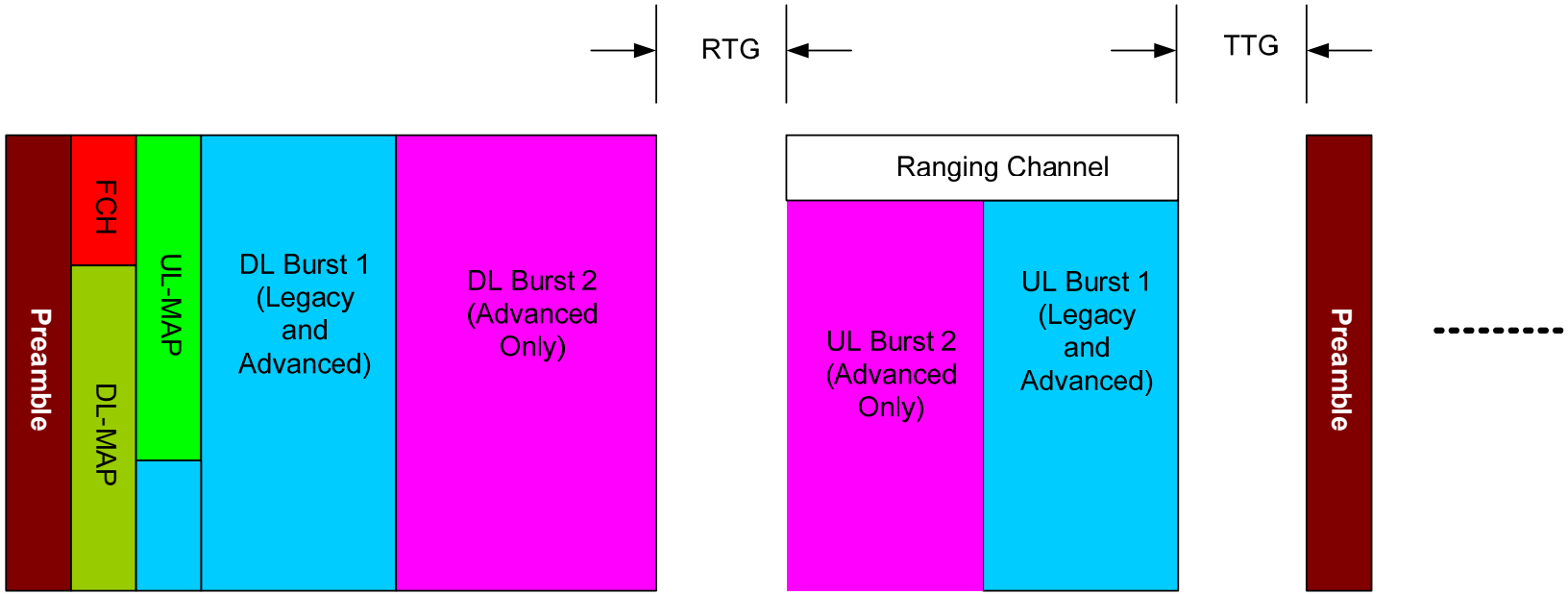
Structure 1 (3/4)

- Location of DL Burst 1 and 2 may be switchable , i.e. DL Burst for “Advanced only” transmission comes first and DL Burst for “Legacy and Advanced” transmission follows
- New mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 or UL Burst 2
  - » For example, delay sensitive transmission from new mobile on DL Burst 1 may be acknowledged in UL Burst 1
  - » Delay tolerant transmission from new mobile on DL Burst 1 may be acknowledged in UL Burst 2 or UL Burst 1 or 2 in the next super-frame
  - » Load balancing of acknowledge transmission
- New mobile transmission on DL Burst 2 may be acknowledged in UL Burst 2 or UL Burst 1 in the next super-frame
- Legacy mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 of current or following super-frames

Data Latency (4/4)

- Time between the start of first transmission and the end of 1 retransmission
- Assumption:
  - » 48 OFDM symbols / frame
  - » Same numerologies with IEEE 802.16e
    - 102.82 us symbol duration
    - 64.64 us idle time
  - » 1 switching point
  - » DL:UL = 8:8 (4 DL Burst 1: 4 DL Burst 2, 4 UL Burst 1: 4 UL Burst 2)
  - » 1 TTI = 3 OFDM symbols
- Worst case = 24 TTI + 1 RTG + 1TTG = 7.8 ms
  - » 1st transmission in 2nd TTI in DL and retransmission in 8th TTI in DL of next frame
- Best Case = 17 TTI + 1 RTG + 1TTG = 5.4 ms
  - » 1st transmission in 2nd TTI in DL and retransmission in 2nd TTI in DL of next frame

Structure 2 (1/3)



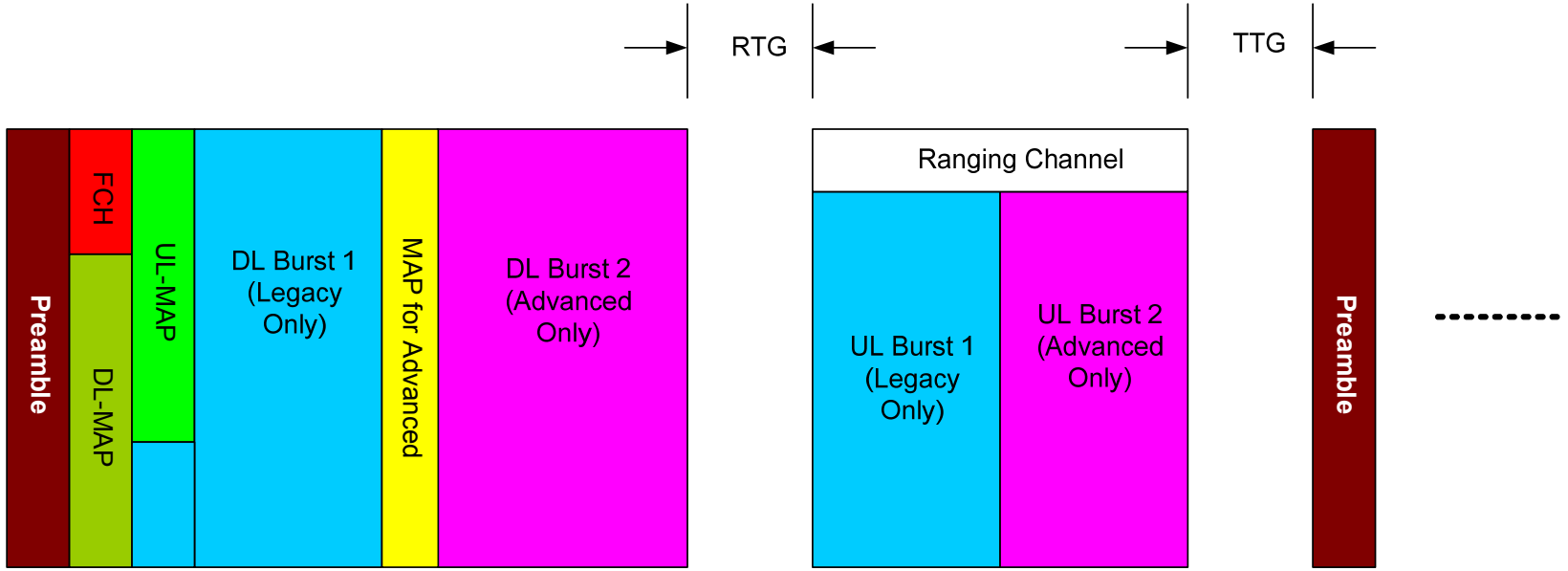
Structure 2 (2/3)

- Legacy and new systems may use the same numerologies
- New mobiles can be assigned to DL/UL Bursts 1 and 2
- Legacy mobile can be assigned to DL Burst 1 and UL Burst 1
  - » DL Burst 2 and UL Burst 2 are transparent to legacy mobiles
- Modified DL / UL MAP messages are needed to support DL/UL Burst 1 and 2
- Each UL Burst (1 or 2) may have its own ranging channel
- Starting time of DL Burst 2 and ending time of UL Burst 2 are adjustable depending the number of legacy and new mobiles, and the amount of traffic, etc

Structure 2 (3/3)

- Locations of DL Burst 1 and 2 are switchable
- New mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 or UL Burst 2
- New mobile transmission on DL Burst 2 may be acknowledged in UL Burst 1 or UL Burst 1 in the next super-frame
- Legacy mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 of current or following super-frames

Structure 3 (1/4)



Structure 3 (2/4)

- Legacy and new systems may use the different numerologies
- New mobiles can be assigned to DL/UL Bursts 2
- Legacy mobile can be assigned to DL/UL Burst 1
  - » DL Burst 2 and UL Burst 2 are transparent to legacy mobiles
- Legacy DL/UL MAP messages are used to support legacy transmission on DL/UL Burst 1
- New DL/UL MAP messages are needed to support new transmission on DL/UL Burst 2
- Each UL Burst (1 or 2) may have its own ranging channel
- Starting times of new DL/UL MAP messages and UL Burst 2 are adjustable depending the number of legacy and new mobiles, and the amount of traffic, etc

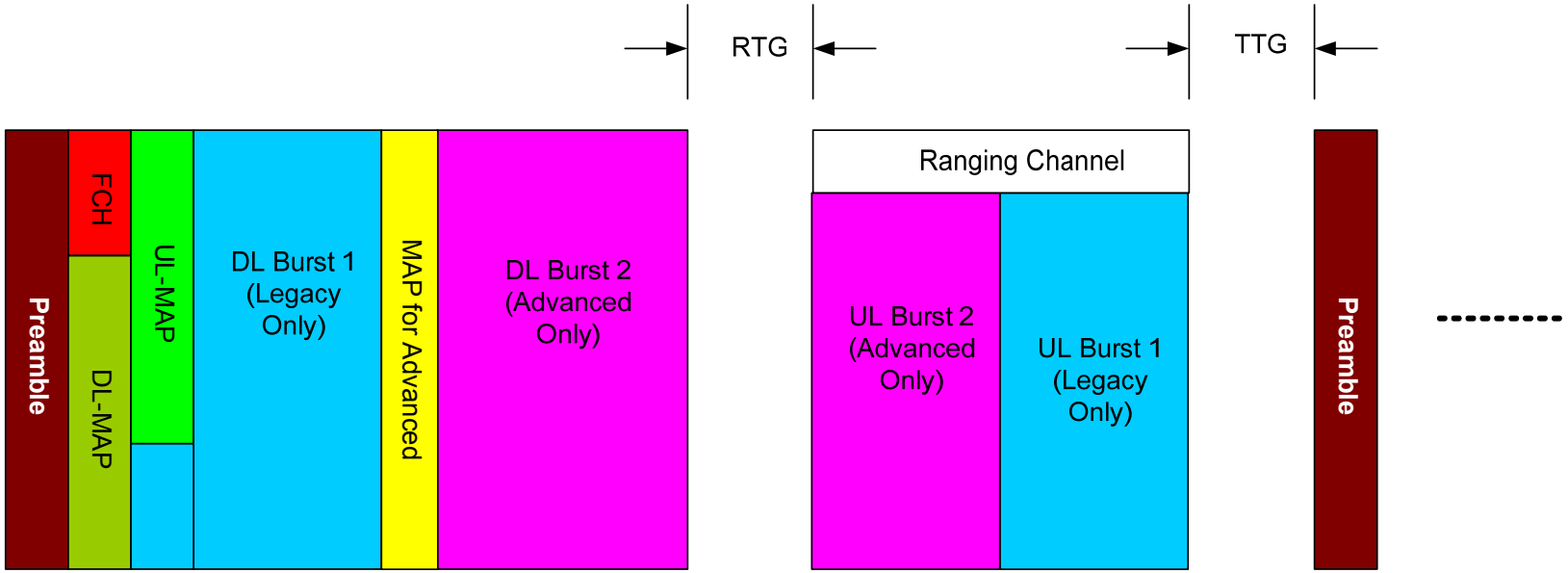
Structure 3 (3/4)

- New mobile transmission on DL Burst 2 may be acknowledged in UL Burst 2 in the current
- Legacy mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 of current or following super-frames

Data Latency (4/4)

- Time between the start of first transmission and the end of 1 retransmission
- Assumption:
  - 48 OFDM symbols / frame
  - Same numerologies with IEEE 802.16e
    - 102.82 us symbol duration
    - 64.64 us idle time
  - 1 switching point
  - DL:UL = 8:8 (4 DL Burst 1: 4 DL Burst 2, 4 UL Burst 1: 4 UL Burst 2)
  - 1 TTI = 3 OFDM symbols
- Worst case = 19 TTI + 1 RTG + 1TTG = 6 ms
  - 1st transmission in 2nd TTI in DL Burst 2 and retransmission in 4th TTI in DL Burst 2 of next frame
- Best Case = 16 TTI + 1 RTG + 1TTG = 5.1 ms
  - 1st transmission in 2nd TTI in DL Burst 2 and retransmission in 2nd TTI in DL Burst 2 of next frame

Structure 4 (1/3)



Structure 4 (2/3)

- Legacy and new systems may use the different numerologies
- New mobiles can be assigned to DL/UL Bursts 2
  - » New mobiles in high speed
- Legacy mobile can be assigned to DL/UL Burst 1
  - » DL Burst 2 and UL Burst 2 are transparent to legacy mobiles
- Legacy DL/UL MAP messages are used to support legacy transmission on DL/UL Burst 1
- New DL/UL MAP messages are needed to support new transmission on DL/UL Burst 2
- Each UL Burst (1 or 2) may have its own ranging channel
- Starting time of new DL/UL MAP messages and ending time of UL Burst 2 are adjustable depending the number of legacy and new mobiles, and the amount of traffic, etc

Structure 4 (3/3)

- New mobile transmission on DL Burst 2 may be acknowledged in UL Burst 2 in the current or following super-frame
- Legacy mobile transmission on DL Burst 1 may be acknowledged in UL Burst 1 of current or following super-frames

Conclusions

- Proposed possible frame structures for IEEE 802.16 system:
  - Maintain the same number of switching points as in IEEE 802.16e
  - Accommodate legacy and new mobiles with different numerologies
  - Satisfy a delay latency constraint for new mobiles defined in SRD