IEEE 802.16m Uplink Design Considerations

Document Number:
IEEE C802.16m-08/012

Date Submitted:
2008-01-16

Source:
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RE:
TGm Call for comments on SDD, IEEE 802.16m-07/047, in the area of “Multiple access and multi antenna techniques”

Purpose:
To review and adopt

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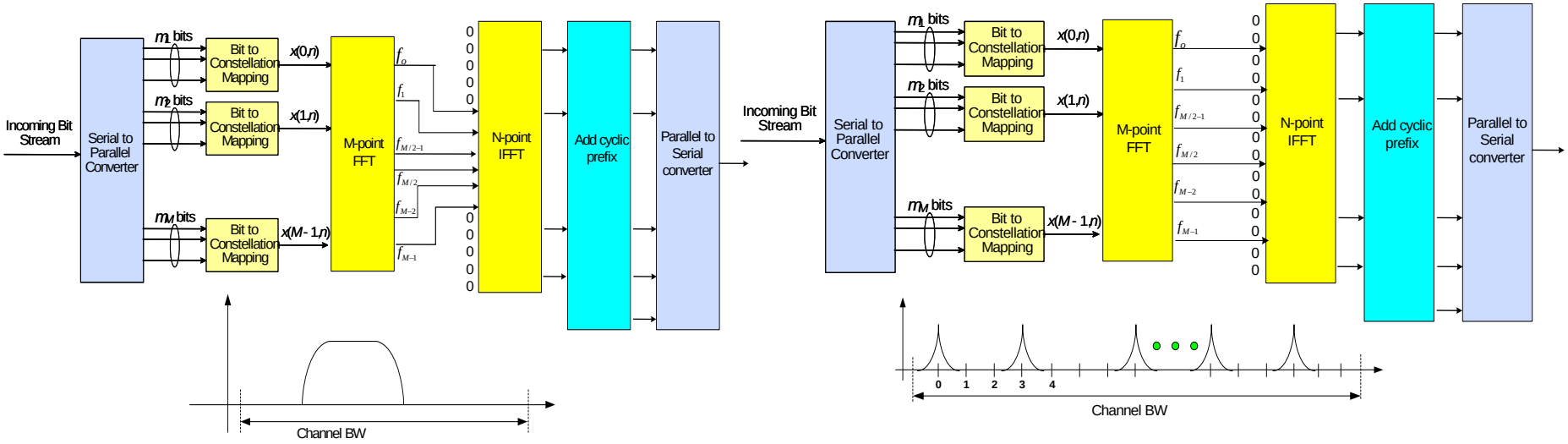
Uplink: DFT Spread-OFDM

•DFT-SOFDM is “functionally” equivalent to IFDMA but has differences in Numerology due to frequency-domain implementation



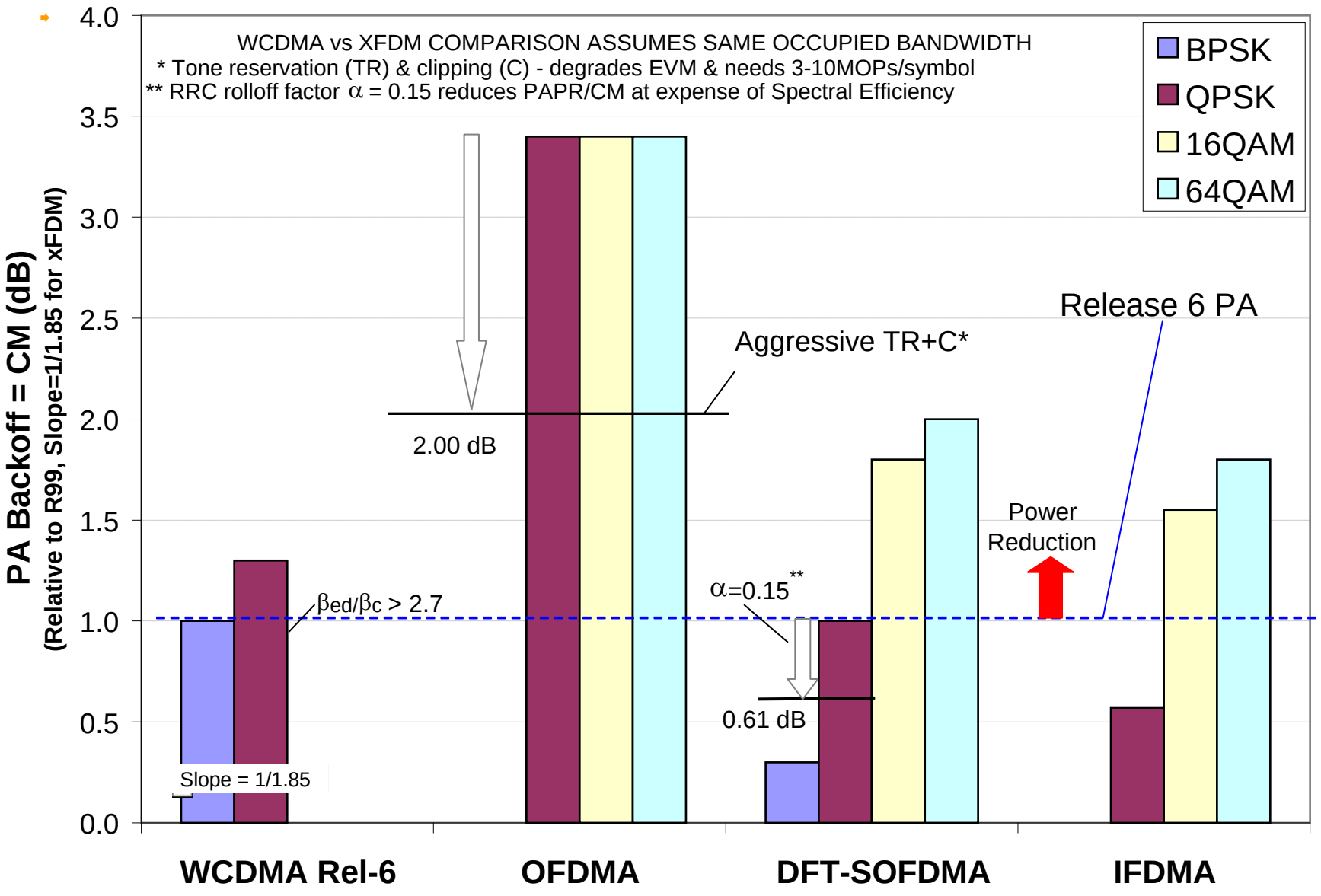
•Adjacent sub-carrier mapping

•Similar to narrowband single-carrier with cyclic-prefix (or IFDMA with repetition factor = 1)

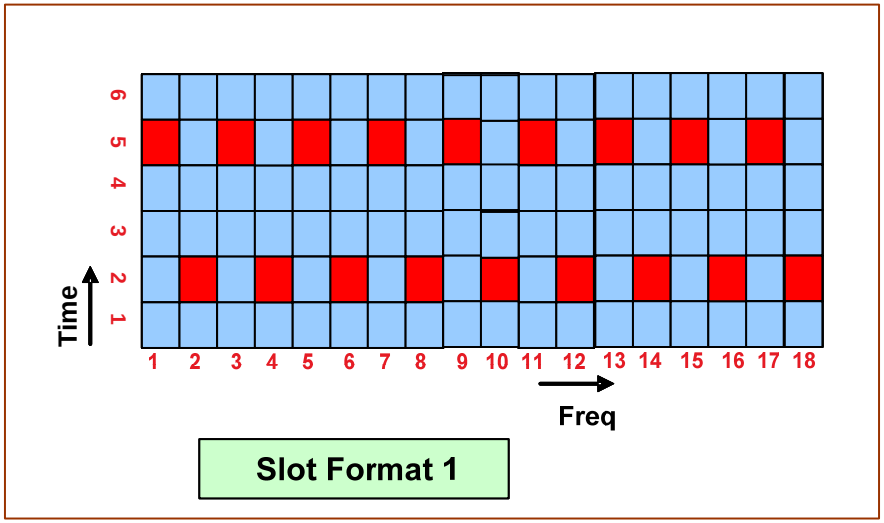
•Equally-spaced sub-carrier mapping

•Similar to IFDMA with repetition factor > 1

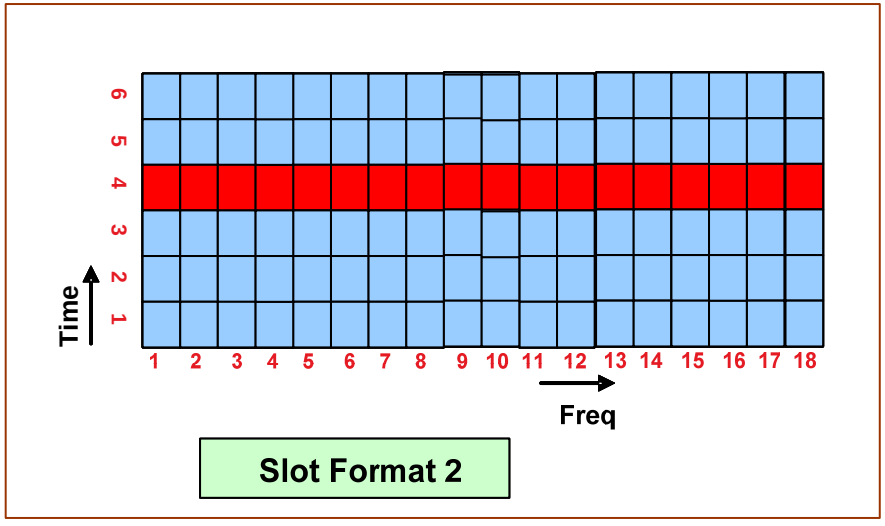
Uplink Multiple Access Options



Hybrid: UL OFDM & DFT-S-OFDM Slot Structure (Example)



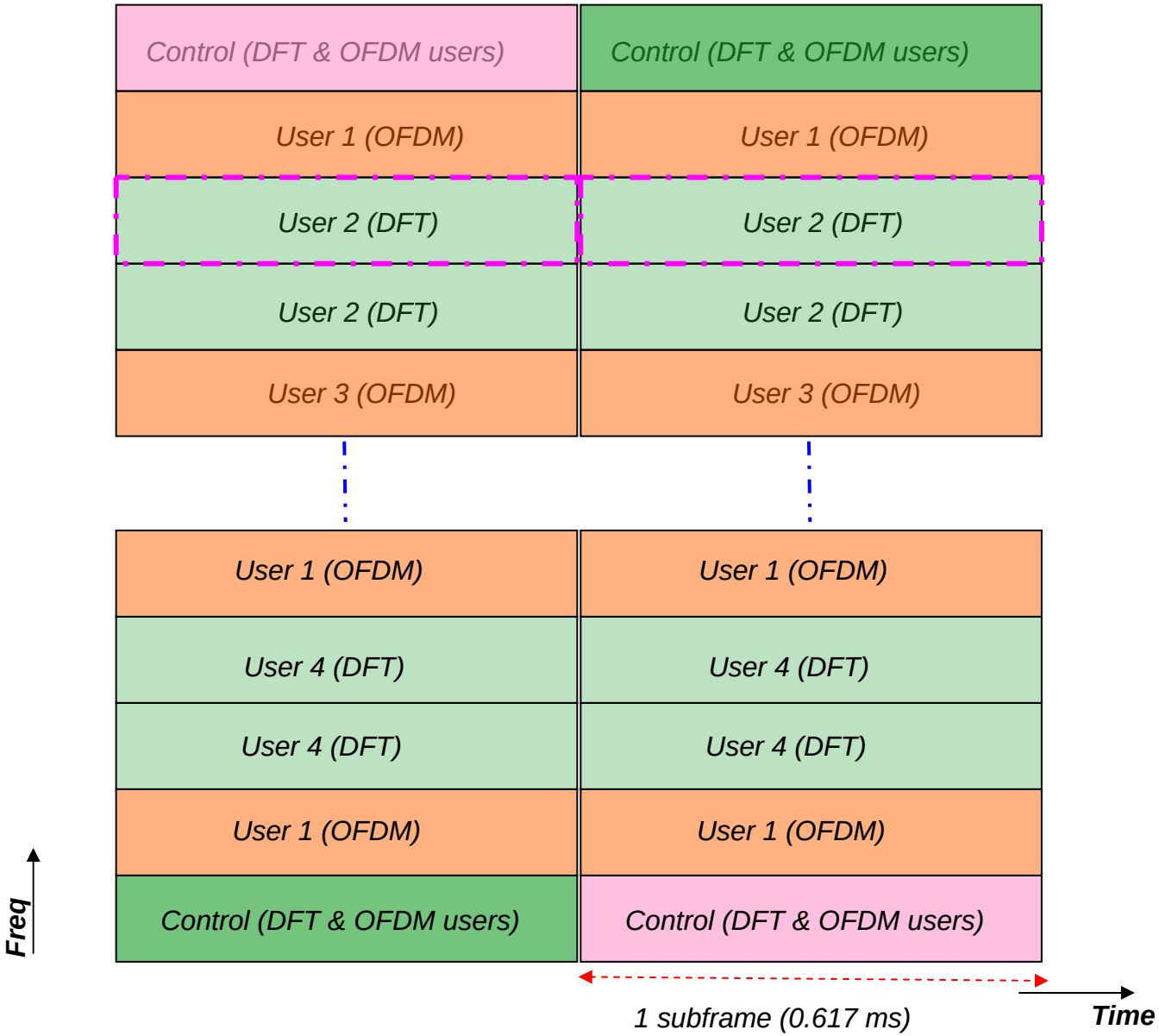
An example of UL pilot allocation for OFDM



An example of UL pilot allocation for DFT-S-OFDM

- *108 sub-carriers per slot:*
  - *6 OFDM symbols x 18 consecutive tones*
  - *0.617 msec duration*
  - *Primary pilot overhead = 1/6 ~ 16.7%*
  - *Auxillary pilots for MIMO/SDMA using cyclic shift*
- *Multiple UL subframes can be concatenated*
  - *See contribution [Motorola, C80216m-08_008.pdf]*

UL Hybrid Sub-Frame Illustration



UL Control Signaling

- No data associated control signaling (Synchronous Non-Adaptive HARQ)
- Control Transmission:
  - **Control without Data:**
    - Mapped to UL slots at carrier band edges (for both OFDM and DFT-S-OFDM SSs)
    - Switch location across subframes to gain frequency diversity
  - **Control with Data:**
    - For DFT-S-OFDM SSs: Multiplex Data and Control prior to DFT
    - Not an issue for OFDM SSs (can design to either multiplex with data or use band edge control region)

Summary

- **DFT-SOFDMA have lower PAPR compared to OFDMA**
  - Beneficial for power limited users
  - For non power limited users OFDMA has link performance advantage
- **Performance of a pure DFT-S-OFDM system can be enhanced significantly with Turbo equalizer**
  - Closes performance gap with OFDM
  - Cost is higher complexity BS receiver
- **Hybrid of OFDMA and DFT-SOFDMA can also be considered for 802.16m**
  - Provides enhanced cell-edge user throughput when compared to OFDMA
    - Lower PA backoff constraint when employing DFT-S-OFDMA
  - Support legacy 802.16e which is OFDMA based

Proposed Text to 16m SDD (IEEE C802.16m-07/320r1)

Insert the following text in Chapter 11 (Physical layer)

11.x Uplink modulation

In uplink, the modulation can be either OFDM, or DFT-S-OFDM. A block diagram of DFT-S-OFDM is shown in Fig XX.

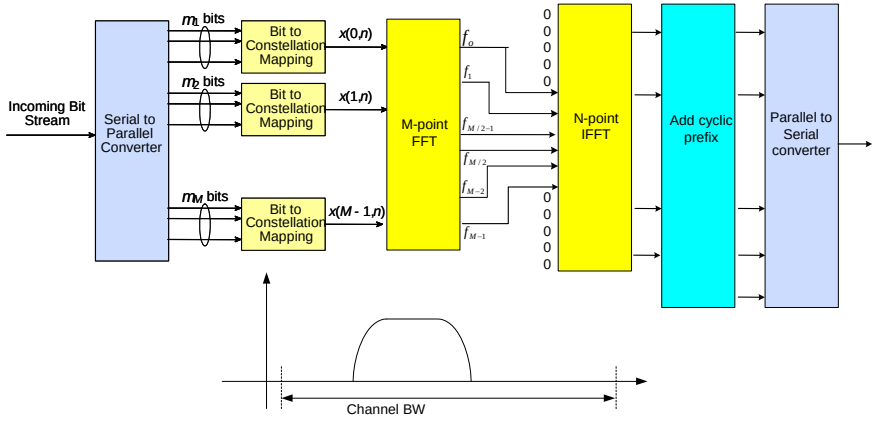


Fig XX: Block diagram of DFT-S-OFDM

Proposed Text to 16m SDD (IEEE C802.16m-07/320r1)

Insert the following text in Chapter 11 (Physical layer)

11.y Uplink control channel

Uplink control channel should be FDM with the data channels.

For mobiles using DFT-S-OFDM modulation, if there is no uplink data allocation for a mobile, the control message for this mobile can be transmitted using the uplink control channel allocated at the edge of the band. If there is data allocation for the mobile, the uplink control information for the mobile should be multiplexed with its uplink data. An example of uplink control channel allocation is shown in Fig. YY.

For mobiles using OFDM modulation, the control channel structure is TBD.

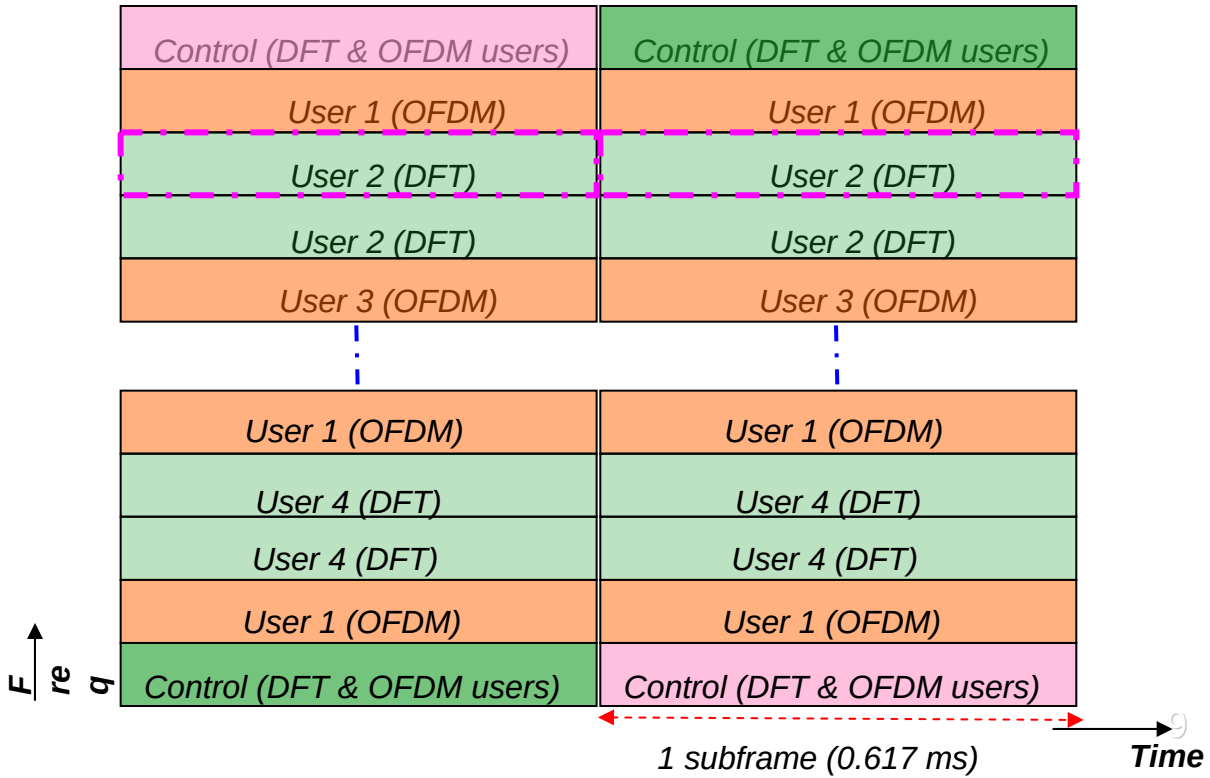


Fig YY: An example of UL control channel allocation

Proposed Text to 16m SDD (IEEE C802.16m-07/320r1)

Insert the following text in Chapter 11 (Physical layer)

11.z Uplink pilot allocation

An example of uplink pilot allocation for OFDM modulation is shown in Fig. ZZ. An example of uplink pilot allocation for DFT-S-OFDM is shown in Fig. AA. The pilot sequence should be TBD. A second pilot sequence from another mobile can be overlaid using cyclic shift to support uplink SDMA.

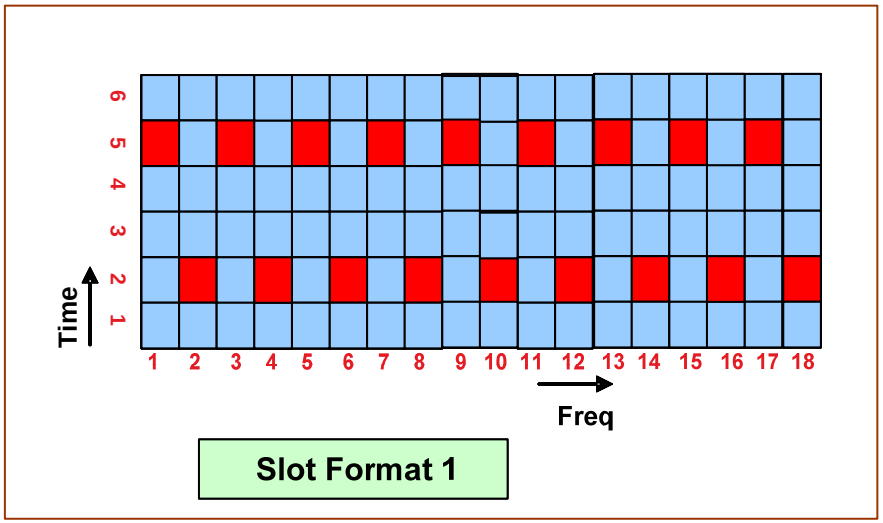


Fig ZZ: An example of UL pilot allocation for OFDM

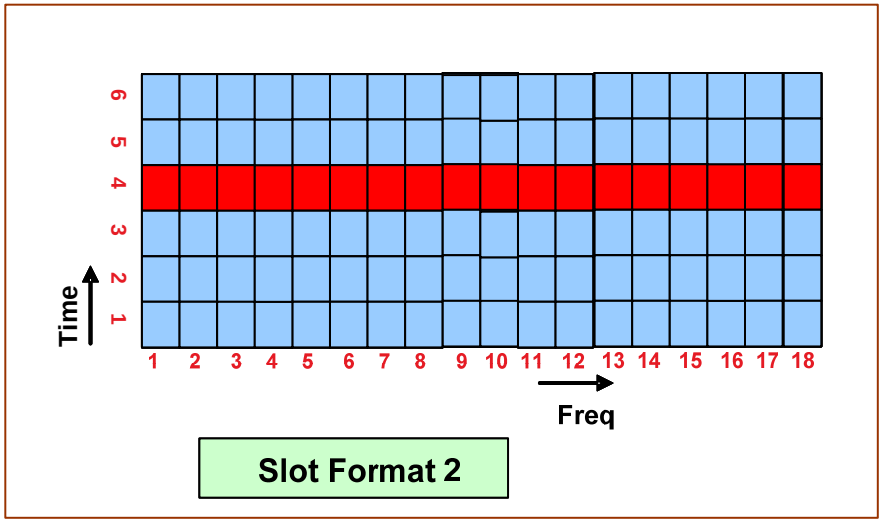


Fig AA: An example of UL pilot allocation for DFT-S-OFDM