

# Uplink Design Considerations for IEEE 802.16m

Document Number:

IEEE S802.16m-07/277r1

Date Submitted:

2007-11-07

Source:

Chandy Sankaran, Fan Wang, Amitava Ghosh  
Motorola

E-mail: {csankar1, fanw, amitava.ghosh}@motorola.com

Re:

TGm Call for comments on SDD, IEEE 802.16m-07/040

Abstract:

Discussed the functional of uplink design considerations and the relevant issues facing the working group

Purpose:

Discussion and adoption of functional area into SDD outline

Notice:

*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups.* It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.

Release:

The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.

Patent Policy:

The contributor is familiar with the IEEE-SA Patent Policy and Procedures:

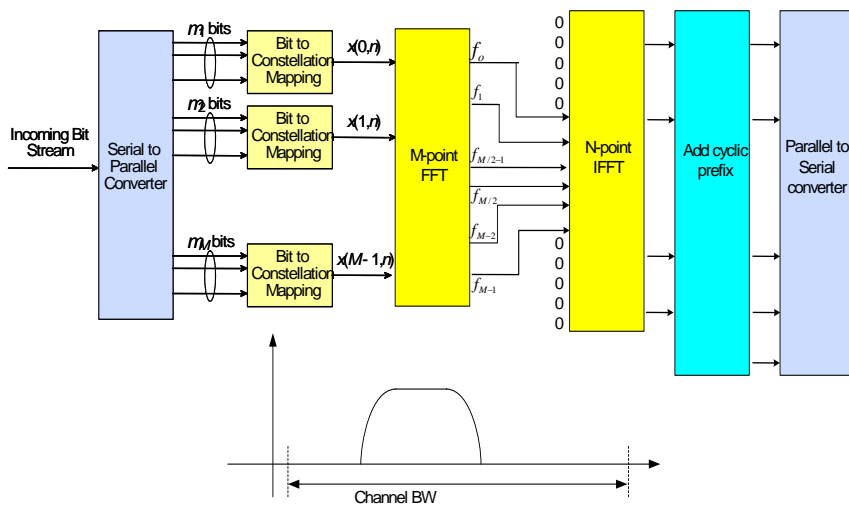
<<http://standards.ieee.org/guides/bylaws/sect6-7.html#6>> and <<http://standards.ieee.org/guides/opman/sect6.html#6.3>>.

Further information is located at <<http://standards.ieee.org/board/pat/pat-material.html>> and <<http://standards.ieee.org/board/pat>>.

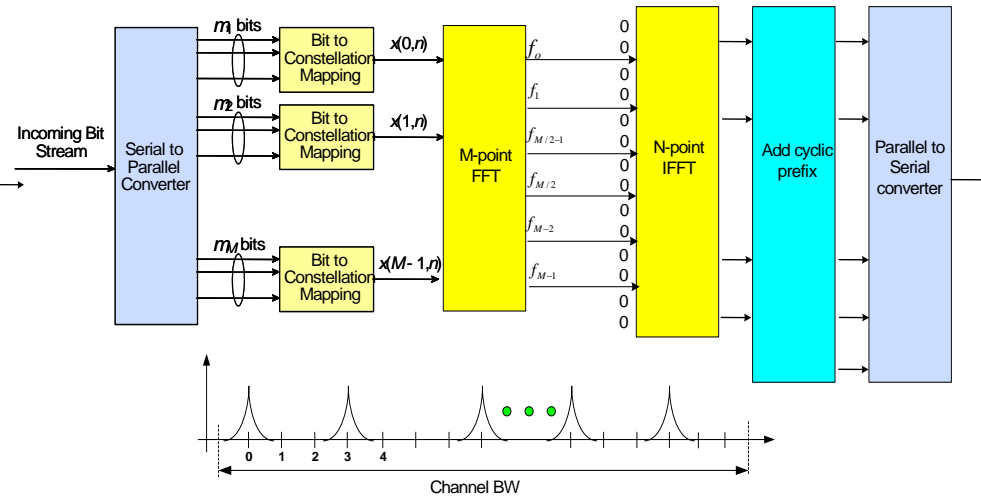
# Uplink: DFT Spread-OFDM

- UL single carrier modulation options include IFDMA, DFT-SOFDMA etc.
- DFT-SOFDMA is “functionally” equivalent to IFDMA but has differences in Numerology due to frequency-domain implementation

➔ Easier to coexist with OFDMA

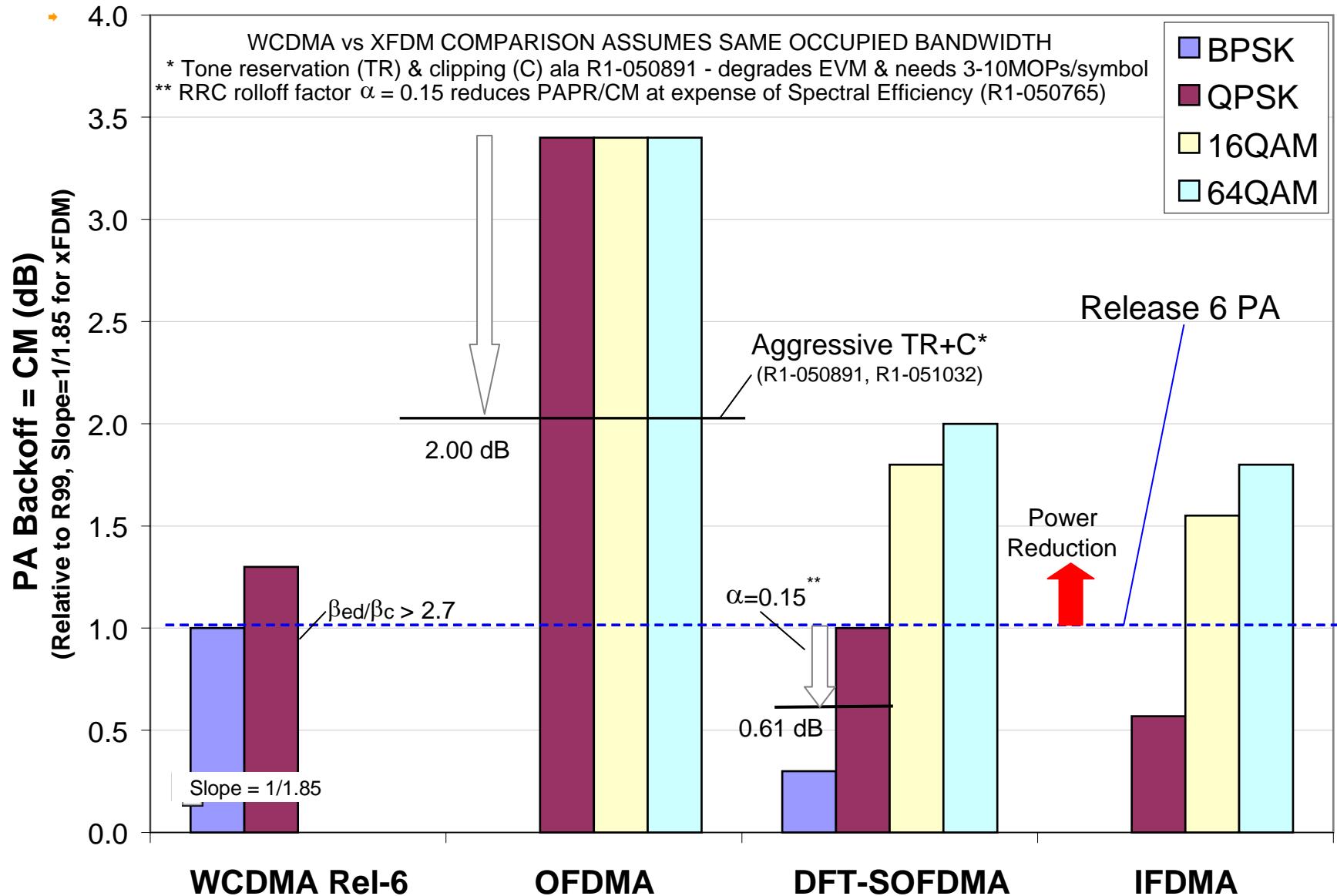


- Adjacent sub-carrier mapping
- Similar to narrowband single-carrier with cyclic-prefix (or IFDMA with repetition factor = 1)

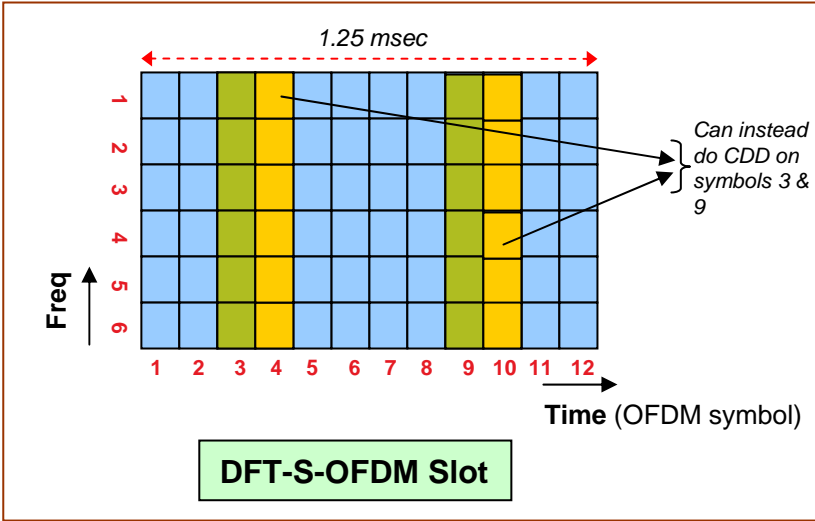
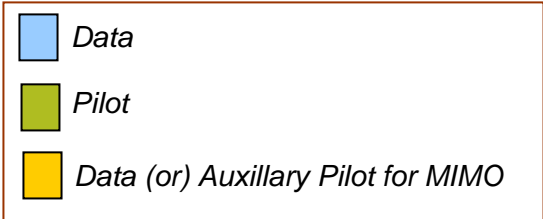
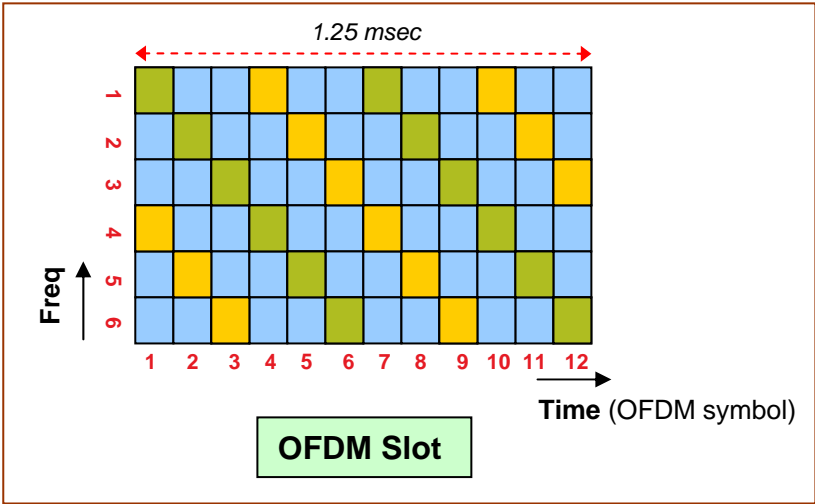


- Equally-spaced sub-carrier mapping
- Similar to IFDMA with repetition factor > 1

# Uplink Multiple Access Options

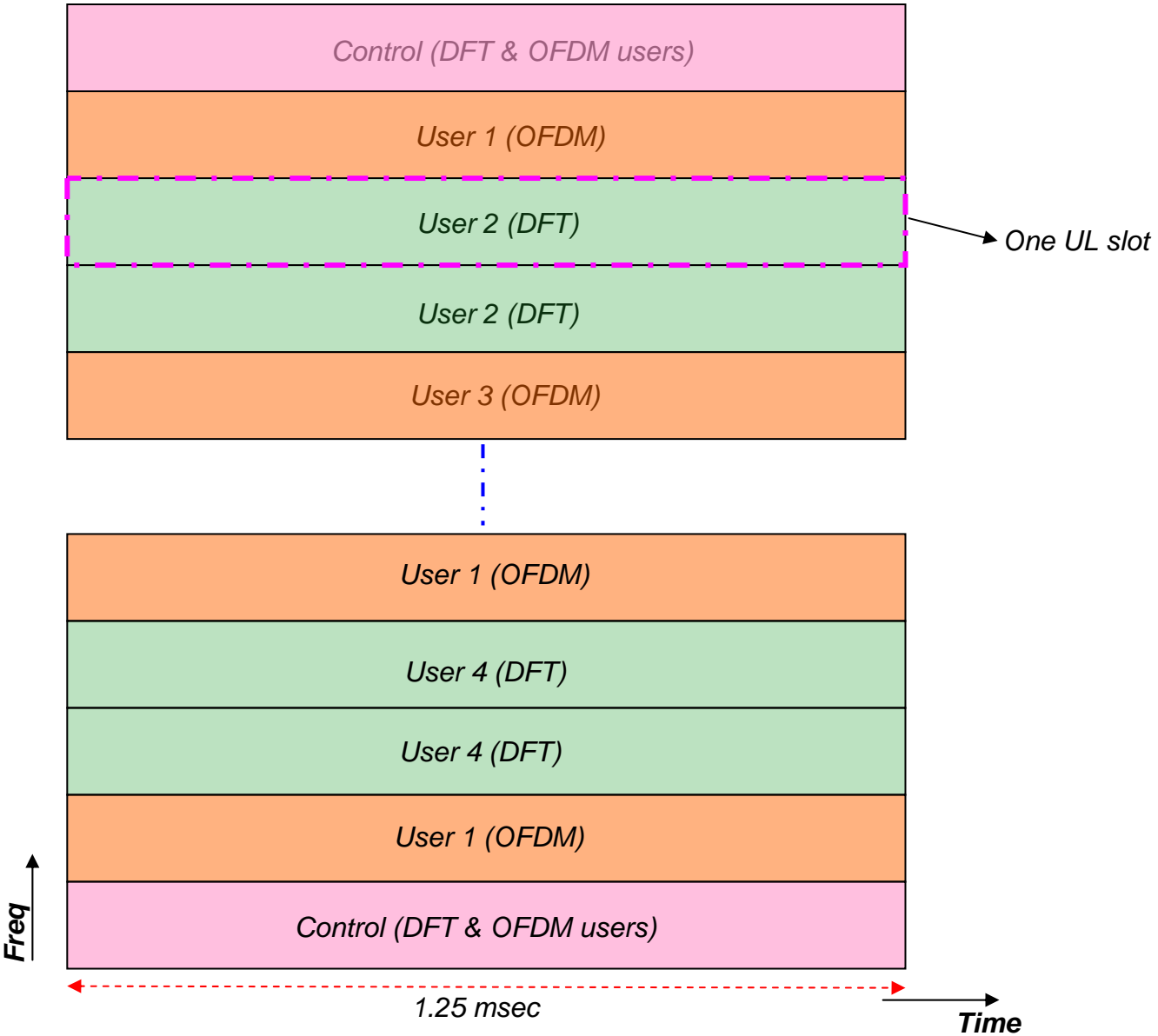


# Hybrid: UL OFDM & DFT-S-OFDM Slot Structure (Example)



- ❖ 72 sub-carriers per slot:
  - 12 OFDM symbols x 6 consecutive tones
  - 1.25 msec duration
  - Primary pilot overhead =  $12/72 \sim 17\%$
  - Auxillary pilots for MIMO/SDMA

# UL 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)
  - ❑ **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

- **Several key issues must be agreed regarding uplink multiple access**
  - ➔ DFT-S-OFDMA has lower PAPR compared to OFDMA and warrants consideration for 16m
    - ➔ 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 link performance gap with OFDM
    - ➔ Cost is higher complexity BS receiver
  - ➔ Hybrid of OFDMA and DFT-S-OFDMA 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
- **A major functional area of the SDD effort and outline should focus on uplink multiple access**
  - ➔ Select OFDMA, DFT-S-OFDMA, or other as multiple access scheme for 16m
  - ➔ Identify methods for interoperating with legacy OFDMA

# Proposal to 802.16m SDD

- **Include the following components in the SDD ToC**

- ➔ Uplink multiple access

***[ The following options should be studied, and one of them should be included in SDD ToC***

- ➔ **OFDMA**

- ➔ *Pilot allocation*

- ➔ *Resource block size and allocation*

- ➔ **Single carrier FDMA**

- ➔ *Pilot allocation*

- ➔ *Resource block size and allocation*

- ➔ **Hybrid single carrier and multicarrier FDMA**

- ➔ *Pilot allocation*

- ➔ *Resource block size and allocation*

***]***

- ➔ Uplink frame structure

- ➔ Uplink control channel