

# Multiplexing Downlink Resource Unit for 802.16m

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None

Purpose:

To be discussed and adopted by TGM for the 802.16m SDD

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# **Multiplexing Downlink Resource Unit for IEEE 802.16m**

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# About This Contribution

## ▪ Goal and scope of this presentation

- Propose a multiplexing between diversity(PUSC) and band selection(band AMC) resource unit in a sub-frame for 16m.

## ▪ Issue to be resolved in this contribution

- Multiplexing: FDM vs TDM
- Two options in FDM mode
  - Opt 1: Distribution of diversity resource excluding subbands used for band selection
  - Opt 2: Distribution of diversity resource over the entire bandwidth, while unused resources in a subband are used for band selection.

## ▪ Proposed working assumption

⇒ **FDM**

**(with distribution of diversity resources excluding subbands used for band selection)**

# DL Resource Unit

- **DL resource unit can be composed of**
  - Band selection(band AMC-like) resource unit to achieve frequency selective multi-user diversity where users are coordinated to a portion of bandwidth in favorable characteristics.
  - Diversity(PUSC-like) resource unit offers the advantage of frequency diversity when scheduling can not track the instantaneous fading variation.
  
- **Considerations of multiplexing between band selection and diversity resource unit (FDM vs TDM)**
  - Scheduler flexibility
  - Reliable transmission
  - Performance

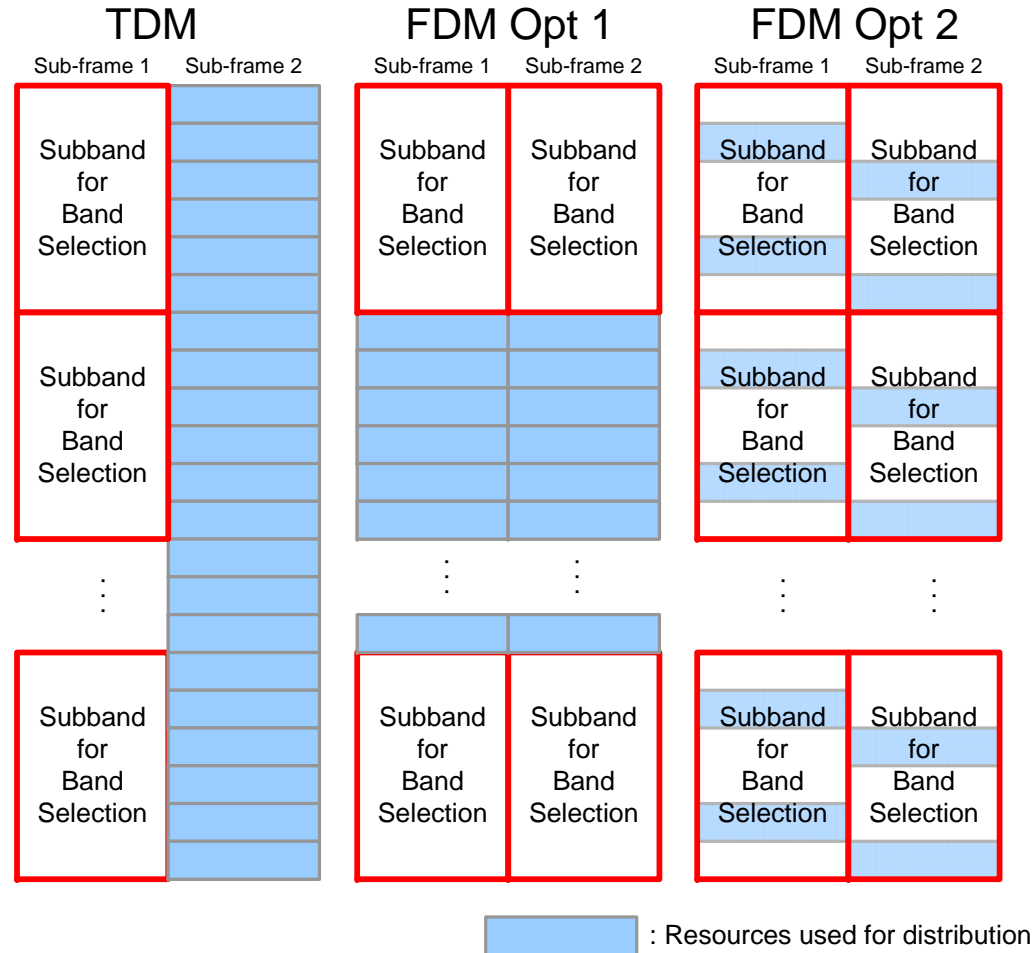
# Data Multiplexing

## ■ TDM

- Only band selection or diversity within a sub-frame

## ■ FDM

- Opt 1  
→ Distribution of diversity resource excluding subbands used for band selection.
- Opt2  
→ Distribution of diversity resource over the entire bandwidth, while unused resources in a subband are used for band selection.



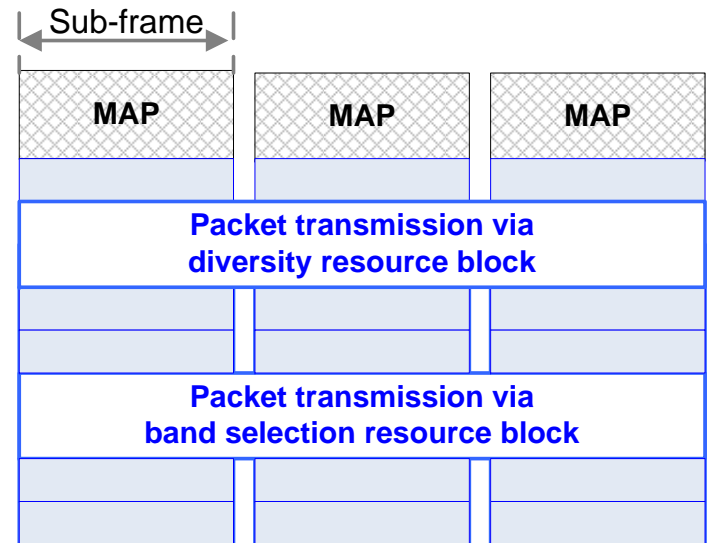
# FDM vs TDM Multiplexing

## ▪ Scheduling flexibility

- FDM provides various MUX ratios of diversity and band selection
  - Granularity on multiplex ratio: sub-frame for TDM, subband for FDM
- FDM is ease of supporting a long TTI
  - Assignment of a favorable subband for band selection (or logical subchannel for diversity) can be hold over multiple sub-frames.

## ▪ Reliable transmission

- Diversity mechanism is required for MAP/small packet transmission.
- Band selection in TDM mode can't employ diversity resource unit.



# FDM vs TDM Multiplexing (Cont'd)

- **Diversity/Scheduling gain**

- FDM may moderate the benefit of diversity or frequency selective scheduling.

Consideration		FDM	TDM
Scheduling flexibility	Multiplex ratio	<b>Flexible</b> <b>Granularity: Subband</b>	Less flexible Granularity: sub-frame
	Support long TTI	<b>Favorable</b>	Unfavorable
Reliability on transmitting MAP/Small packet		<b>Good</b> <b>(achieve diversity gain via diversity resource unit)</b>	Bad (No diversity gain for sub-frame with band selection resource unit)
Diversity/Scheduling gain		Moderate	Fully achievable



❖ **Preference : FDM**

# FDM Multiplexing

## ■ Two options

- Opt 1: Distribution of diversity resource excluding subbands used for band selection
- Opt 2: Distribution of diversity resource over the entire bandwidth, while unused resources in a subband are used for band selection.

Type	Impact on diversity	Impact on band selection
FDM opt 1	Mildly bad : Limited set of resource is used for diversity → Moderate diversity gain : HARQ ReTX compensates this deficit.	Good : Full benefit from frequency scheduling
FDM opt 2	Good : Full benefit from distribution over entire bandwidth	Bad : Less frequency selective scheduling gain

- Preference : FDM opt 1 if the moderation is not severe.



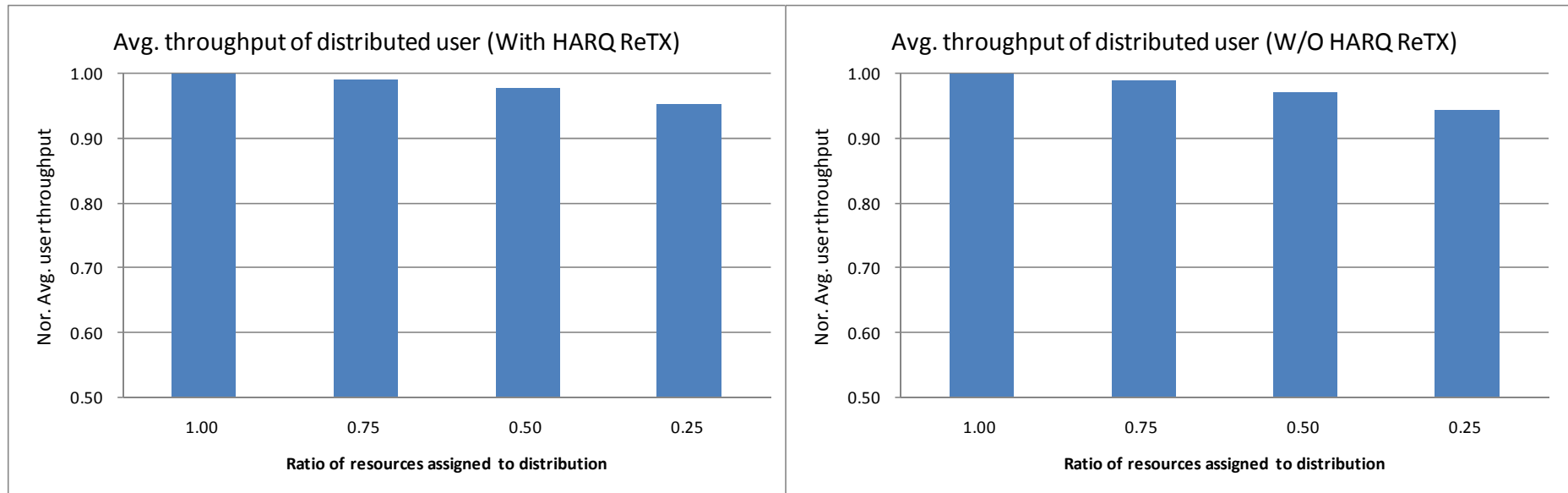
# System Level Evaluation for FDM Opt 1

- **Objective**

- To examine performance of diversity user when a limited set is used for diversity.

- **Performance metric**

- Average user throughput of distributed user normalized by throughput of a case that all subcarriers are used for diversity.



**Diversity loss due to FDM MUX is about 2~3% when half of resources are used for diversity.**

# Conclusions/Proposal

## ▪ Conclusions

- FDM benefits from
  - Better granularity on multiplexing
  - Support of long TTI
  - Reliable transmission for MAP and small packet

## ▪ We propose

- FDM data multiplexing between band selection and diversity resource unit.
- Type of FDM : Distribution of diversity resource excluding subbands used for band selection (FDM opt 1).

# Text Proposal to 802.16m SDD

*Insert the following text into Physical Layer clause (Chapter 11 in [IEEE 802.16m-08/003])*

## **11.x Data multiplexing**

The multiplexing between band selection and diversity resource unit is done in FDM manner within one sub-frame. Whole frequency band is divided into multiple subbands. A number of subbands can be devoted to band selection, while others are used for diversity.

# Appendix. System-level Simulation

## ▪ Considerations

- Total number of users: 12
- Mobile speed : Ped-B 30Km

## ▪ Resource allocation

- # of partition: 12 (1 partition = 72 subcarriers)
- Scheduler: RR
- Multiplexing type: FDM option 1
- Distribution for diversity user
  - Equidistant distribution among resources left over after band selection scheduling.

## ▪ HARQ type

- Synchronous HARQ/CC
- 5ms latency for HARQ retransmission

## ▪ Antenna configuration

- SIMO

