

Multiplexing Downlink Resource Unit for 802.16m

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Junsung Lim, Chiwoo Lim, Jaeweon Cho, Hokyu Choi,
Heewon Kang, DS Park

Samsung Electronics Co., Ltd.

416 Maetan-3, Suwon, 443-770, Korea

Voice: +82-31-279-7467

E-mail: junsung.lim@samsung.com

Venue:

IEEE 802.16m-08/005, “Call for Contributions on Project 802.16m System Description Document (SDD)”.

Target topic: “Downlink Physical Resource Allocation Unit”.

Base Contribution:

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

*Junsung Lim, Chiwoo Lim, Jaeweon Cho, Hokyu Choi,
Heewon Kang, DS Park*

Samsung Electronics Co., Ltd.

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
 - Distribution of diversity resource excluding subbands used for band selection
 - 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

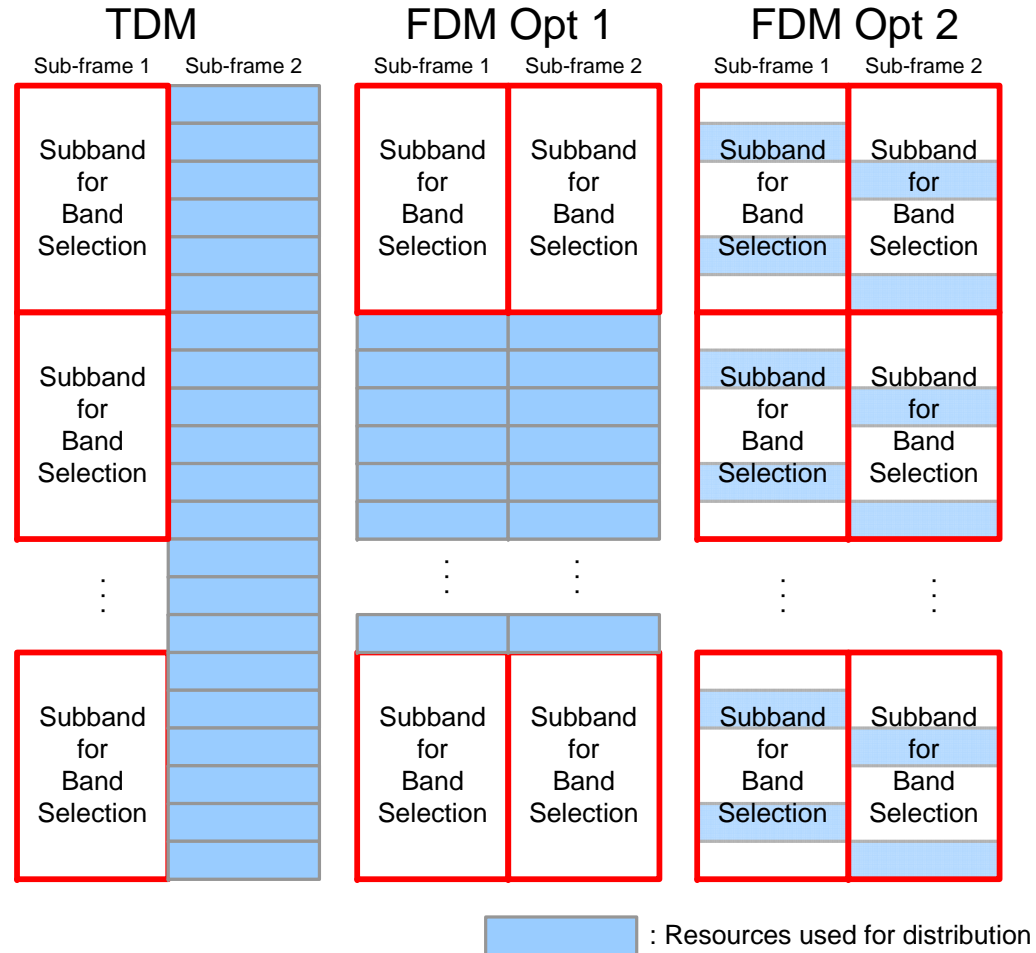
Data Multiplexing

■ 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.



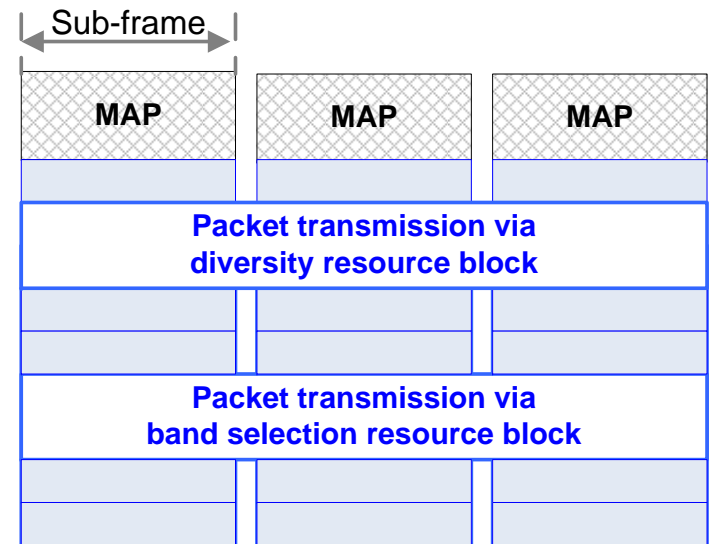
FDM vs TDM Multiplexing

▪ 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 | Flexible Granularity: Subband | Less flexible Granularity: sub-frame |
| | Support long TTI | Favorable | Unfavorable |
| Reliability on transmitting MAP/Small packet | | Good (achieve diversity gain via diversity resource unit) | 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.

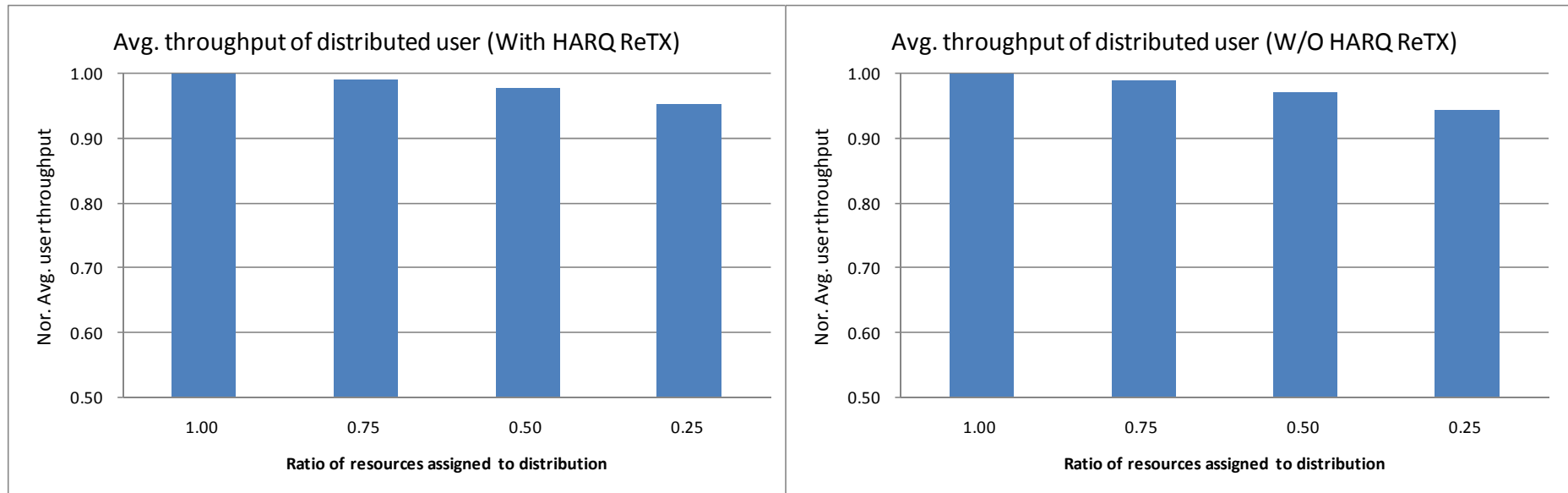
System Level Evaluation for FDM Opt 1

- **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 2
- 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

