Project	**IEEE 802.16 Broadband Wireless Access Working Group <**http://ieee802.org/16**>**	
Title	**Proposed FDM structure between Unicast and E-MBS and E-MBS Channel Structure for 802.16m**	
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Abstract	Stage 2 proposes text to complement existing SDD text draft	
Purpose	Discussion and Approval	
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FDM structure between unicast and E-MBS

[Advantages of FDM]

- Improves flexibility of unicast resource scheduling.
- Realtime unicast packets such as re-transmission or UL ack/nck remain unaffected.

[Requirement to take full advantages of FDM]

- Localized unicast might be flexibly scheduled.
- Keep the sufficient frequency diversity gain for MBS and distributed unicast.

[MBS channel structure]

(Scheme 1) Common pilot and common data among cells

(Scheme 2) Common phase difference between pilot and data among cells with cluster-wise scrambling

The second alternative is particularly effective for FDM because the unicast pilot can commonly used as MBS pilot.

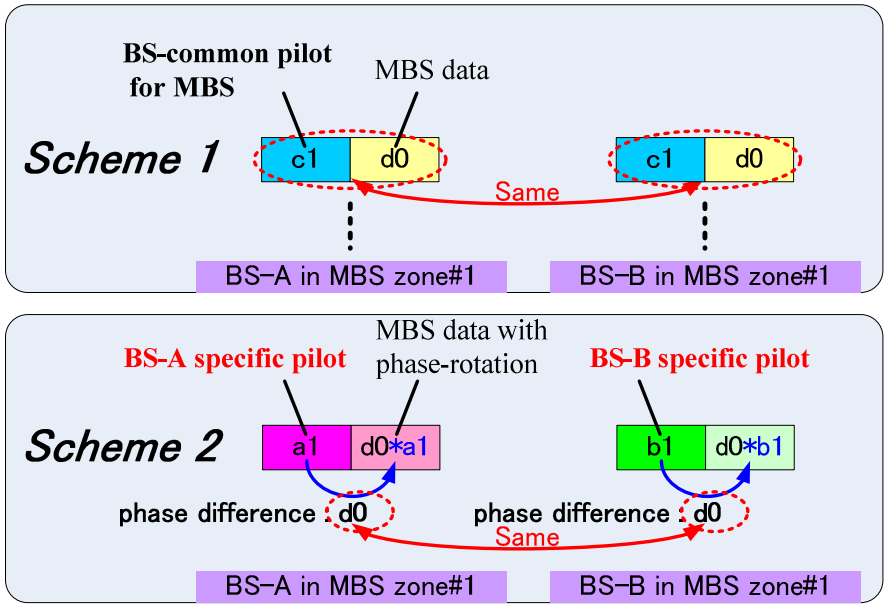
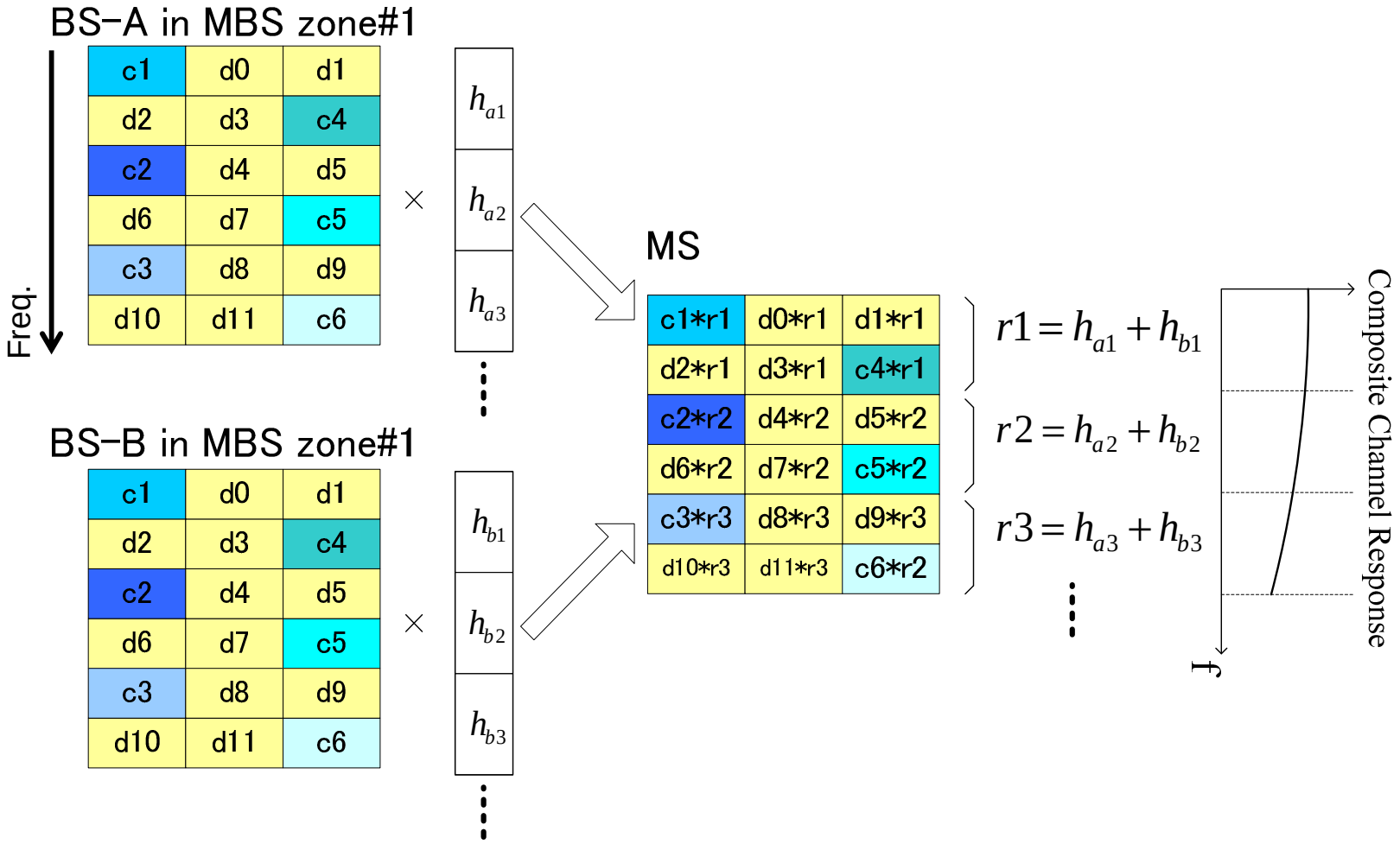


Fig. illustration of MBS channel structure

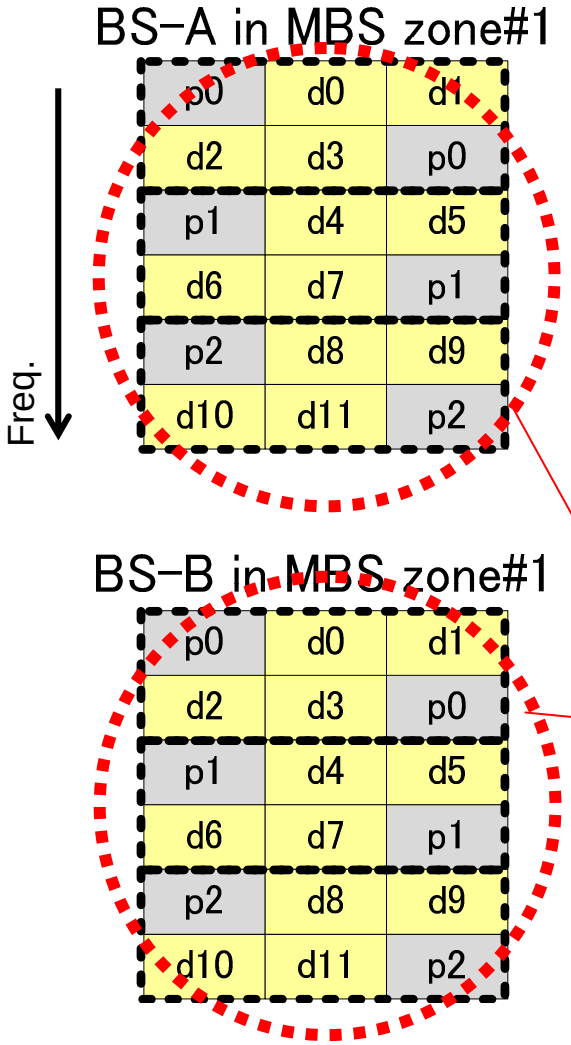
We propose preferred FDM structure with MBS channel structure.

MBS channel structure (Conventional method)



- BS common pilot is used for channel estimation for MBS
- Composite channel responses are continuously changing in frequency domain.

Cluster-wise scrambling method 1/4



Identical MBS data and pilot symbols are prepared at each BS.

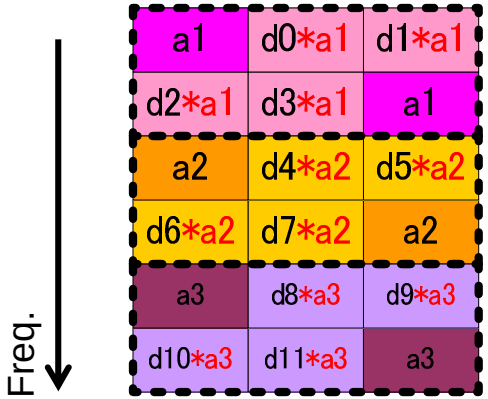
CS process 1)

MBS sub-carriers are split into several cluster, and each cluster contains at least one pilot symbol.

Identical

Cluster-wise scrambling method 2/4

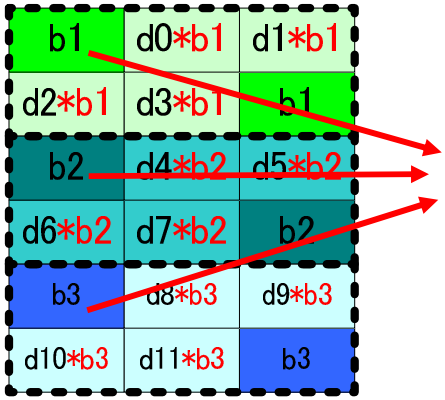
BS-A in MBS zone#1



CS process 2)

MBS data and pilot symbols in each cluster are rotated by the same amount as that of the BS-specific scrambling code.

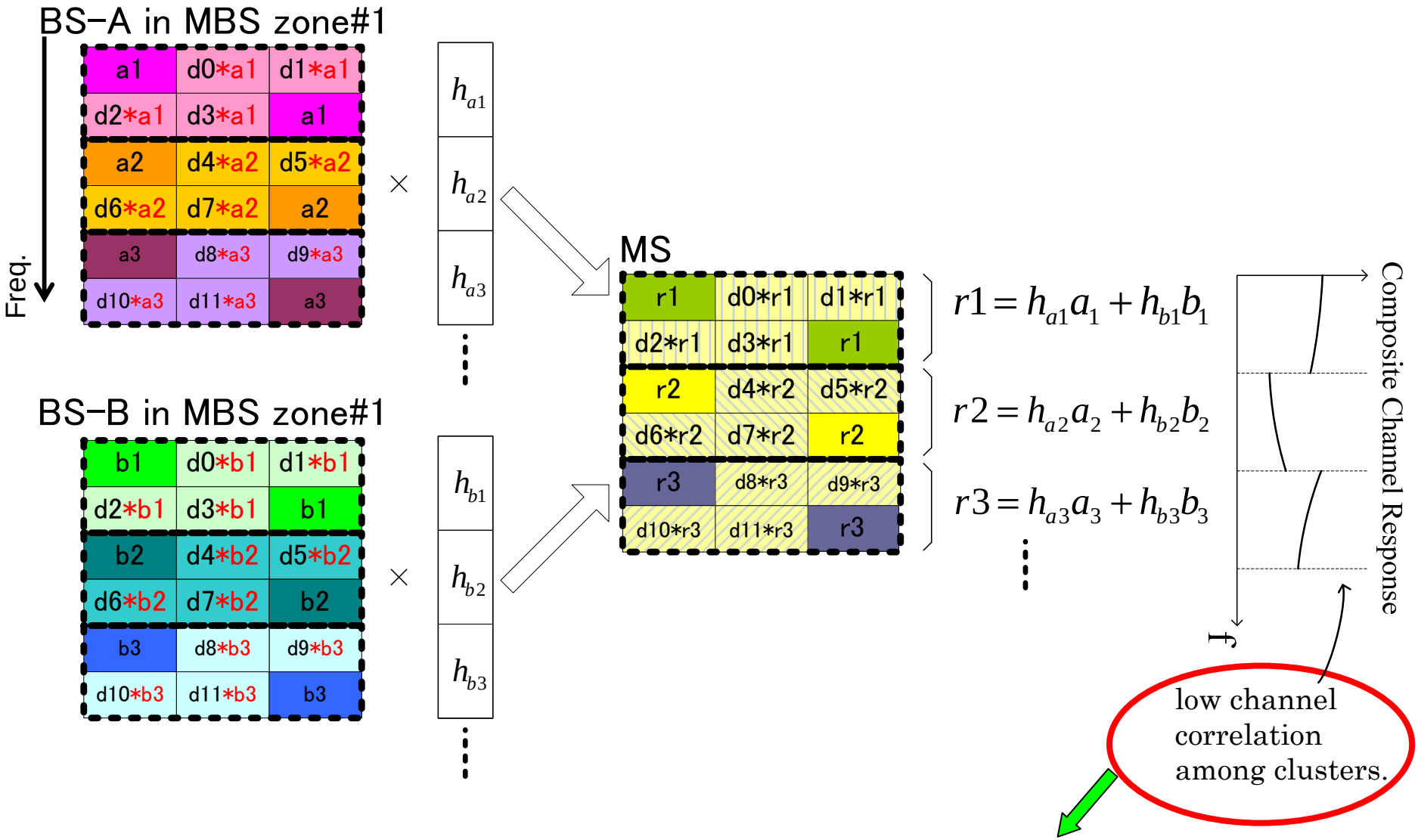
BS-B in MBS zone#1



MBS pilot symbols are BS-specific
And same as unicast pilot.

Adv.1) Common use as unicast pilot.

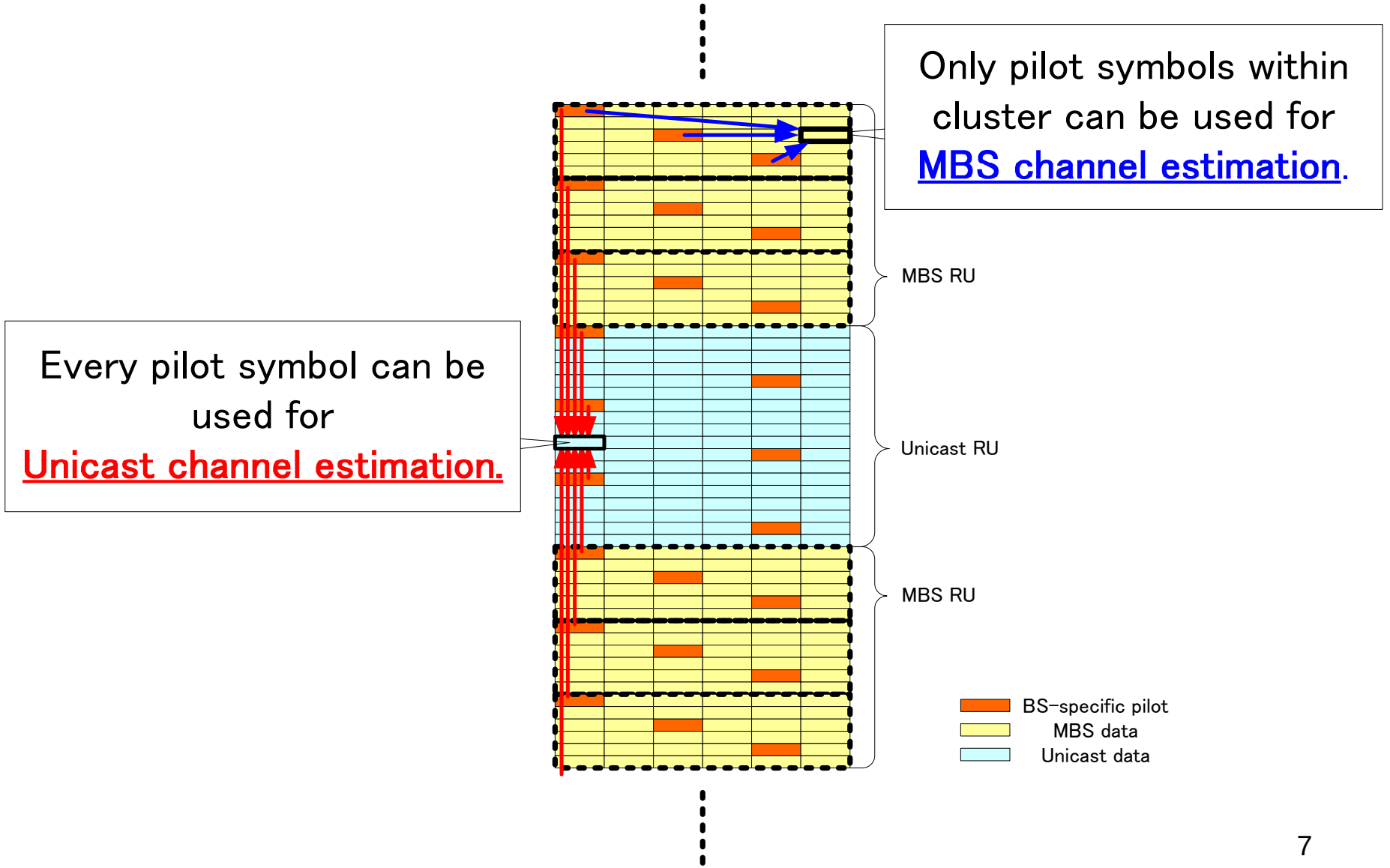
Cluster-wise scrambling method 3/4



Adv.2) Additional diversity gain is obtained.

Composite channel responses are continuously changing only within cluster.

Cluster-wise scrambling method 4/4



Possible candidate for FDM structure

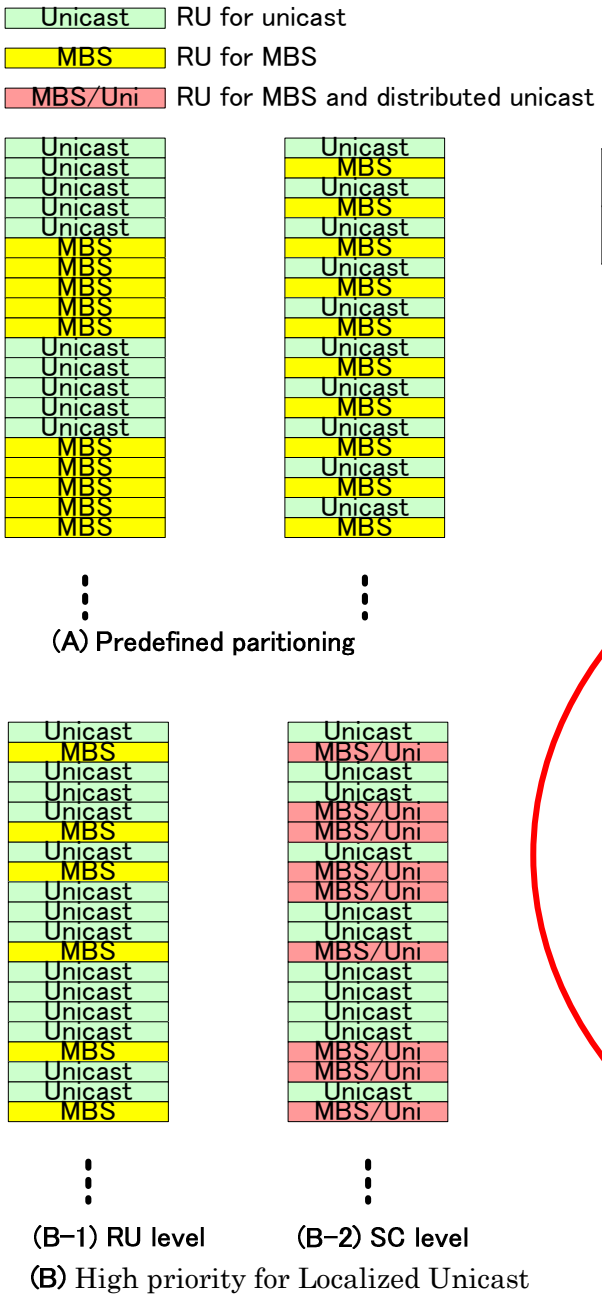


Table 1. Comparison between A) and B)

	A	B
Unicast throughput	Worse	Fair

Removed!

Table 2) comparison between B-1 and B-2

[Conventional method]

	B-1
Freq Diversity for Dist. Uni.	Fair
Freq Diversity for MBS	Fair
CE performance for Dist. Uni.	Worse
CE performance for MBS	Fair

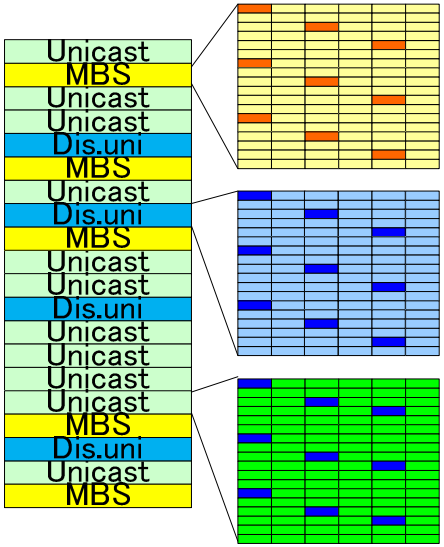
B-2 with conventional is removed due to pilot overhead.

[Cluster-wise Scrambling method]

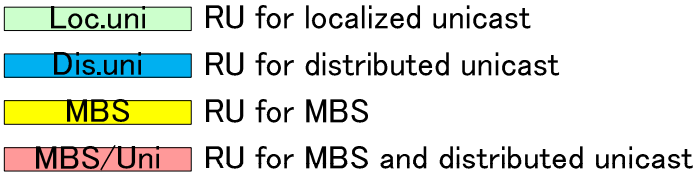
	B-1	B-2
Freq Diversity for Dist. Uni.	Better	Even better
Freq Diversity for MBS	Better	Even better
CE performance for Dist. Uni.	Fair	Fair
CE performance for MBS	Even worse	Even worse

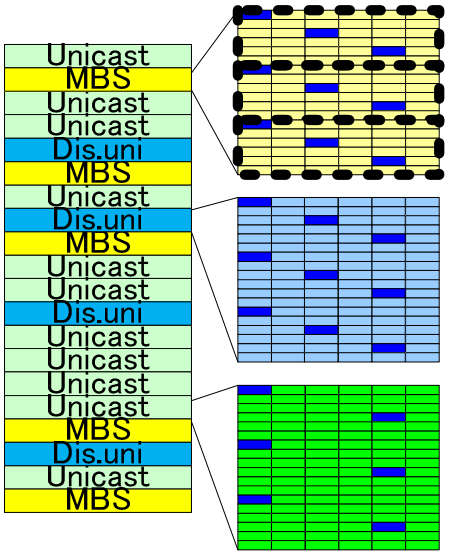
Candidates!

Three alternatives of combination FDM structure with MBS structure

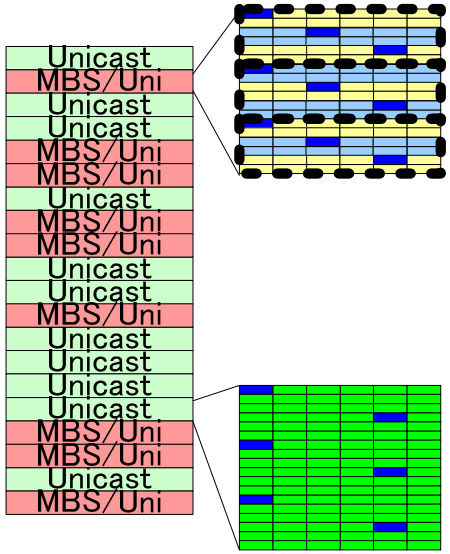


(B-1) with conventional method





(B-1) with cluster-wise scrambling method



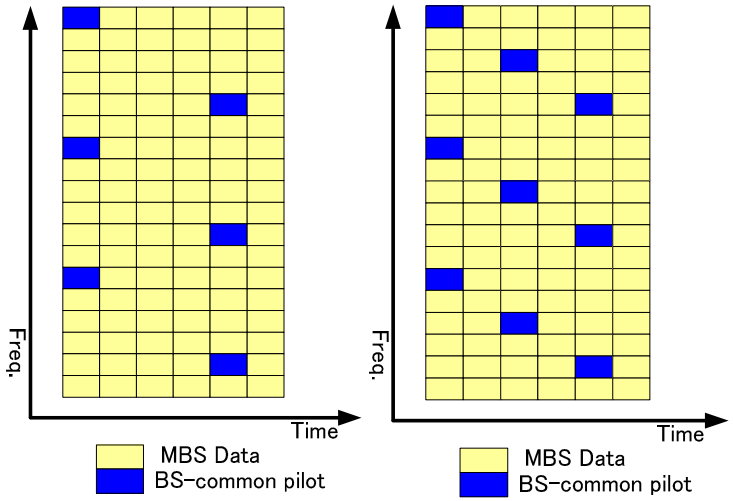
(B-2) with cluster-wuse scramblign method

Simulation condition (1/2)

Table. Simulation condition

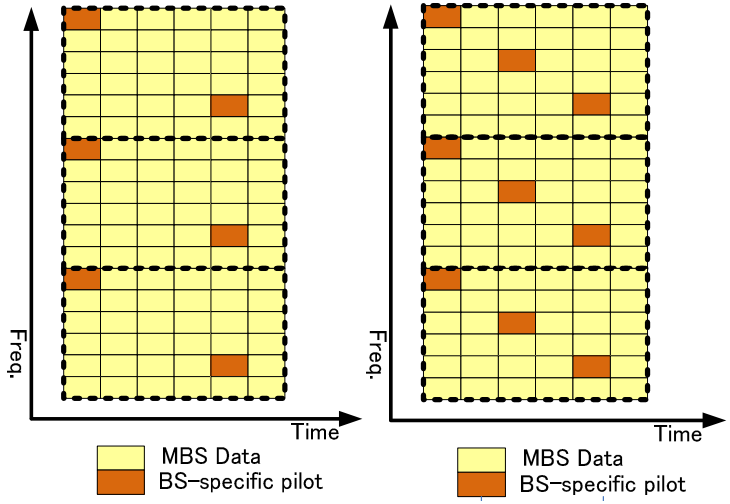
Inter-site distance	500m
System bandwidth	5MHz
Number of MBS symbols	6 OFDM symbol
Data modulation	16QAM
Channel coding	Turbo code (K=4, R=1/2) Max-Log-Map (8 iteration)
Channel estimation	Ideal MMSE
Path model	Pedestrian B
UE speed	3km/h(fD=5.55Hz)

Pilot structure for conventional method



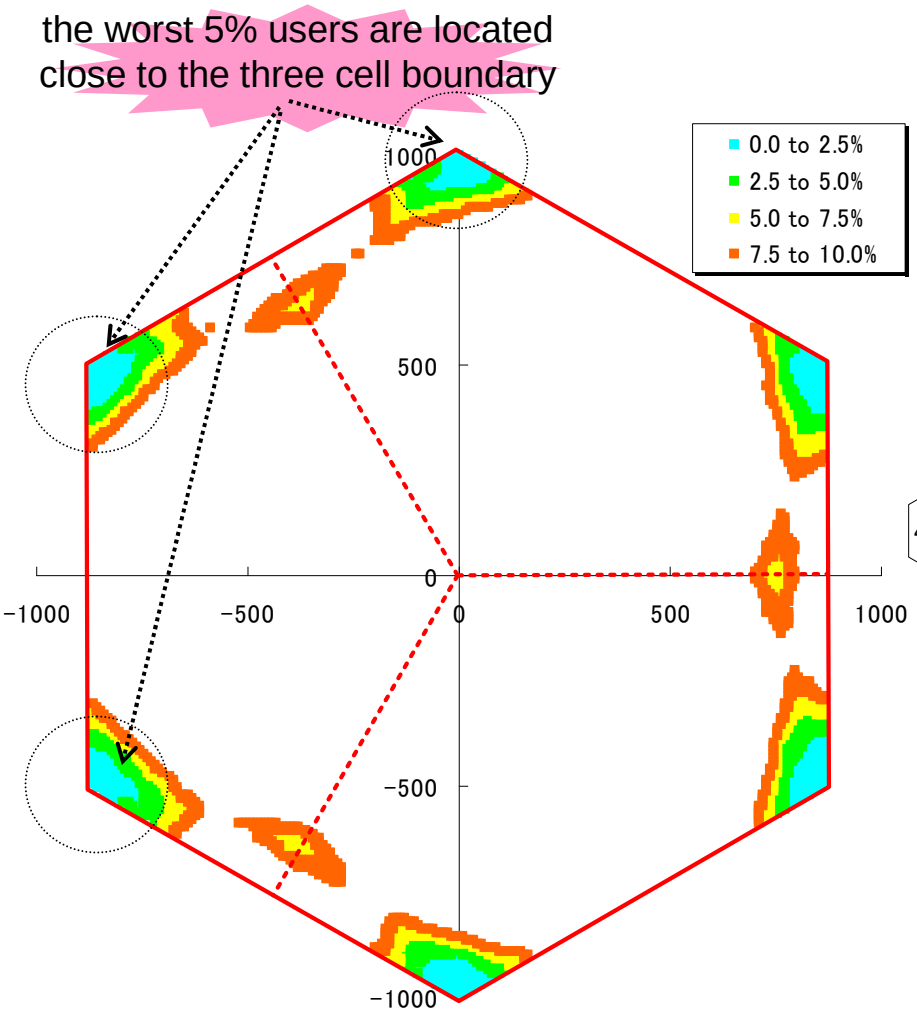
5.5% pilot OH　　8.3% pilot OH

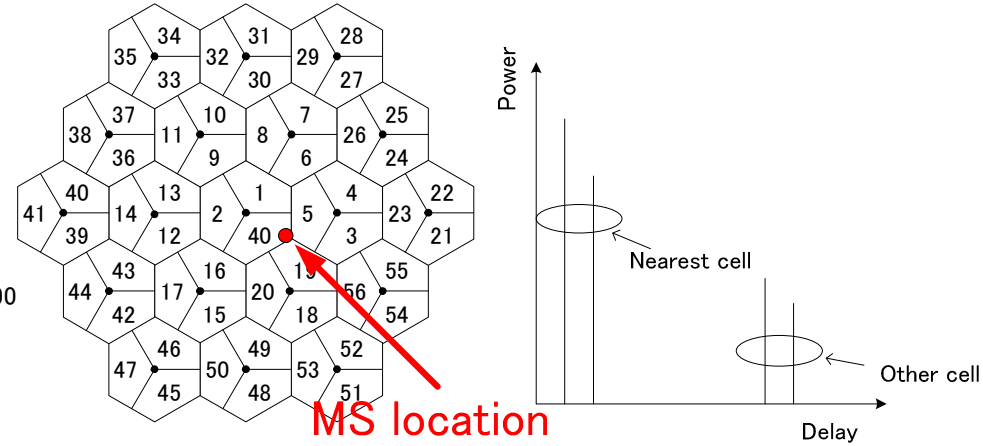
Pilot structure for cluster-wise scrambling method



5.5% pilot OH　　8.3% pilot OH

Simulation condition (2/2)



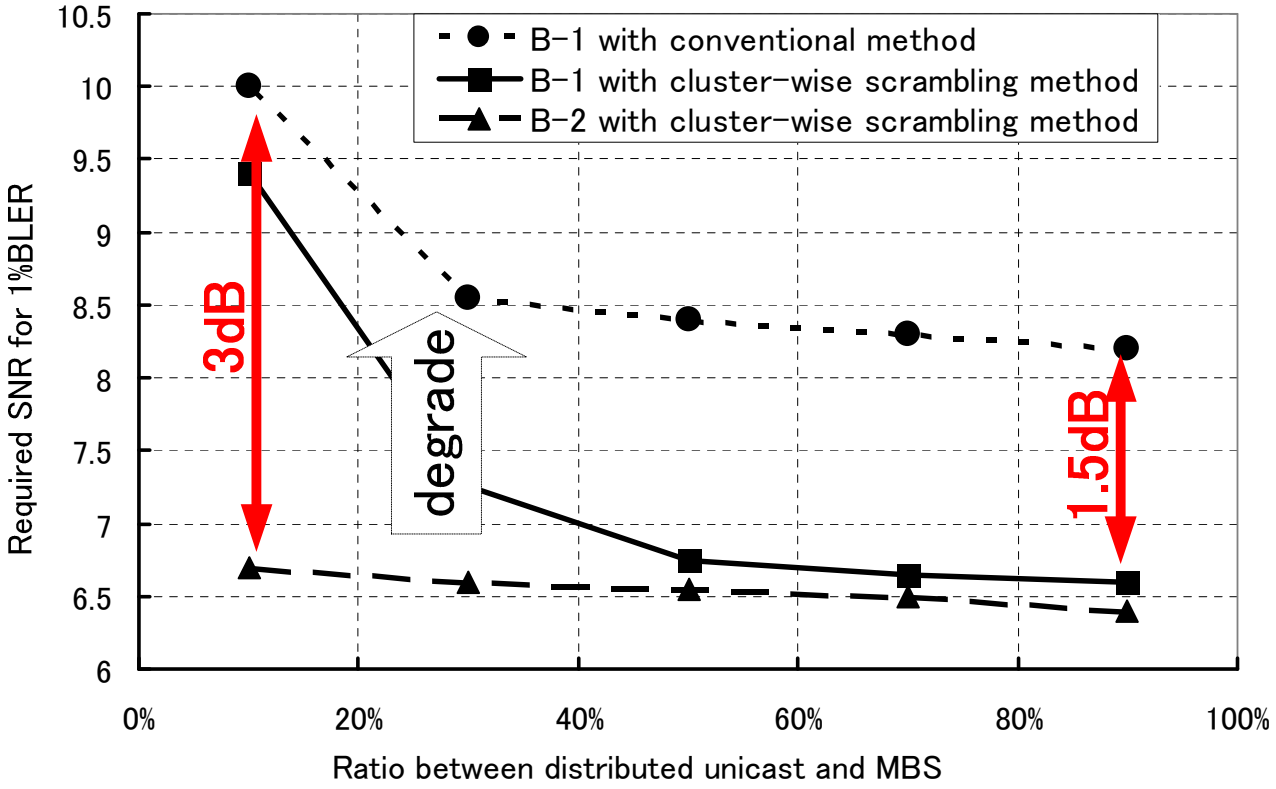


We assumed that MS is located at the BS-boundary with a geometry value of 95%. At that location, the r.m.s delay spread becomes almost the widest.

Fig) Geographical distribution of Effective SNR worst 10% users.

Simulation result(1/3)

Frequency diversity gain for MBS



When the MBS ratio is small (e.g. at 10%):

- **Two methods of B-1 structure lose f-diversity gain significantly.**
- **B-2 with cluster-wise scrambling still remain f-diversity gain and is better than others in approximately 3dB.**

When the MBS ratio becomes larger (e.g., >50%):

- **Both B-1 and B-2 with cluster-wise scrambling method overperforms conventional method in approximately 1.5dB.**

Simulation result(2/3)

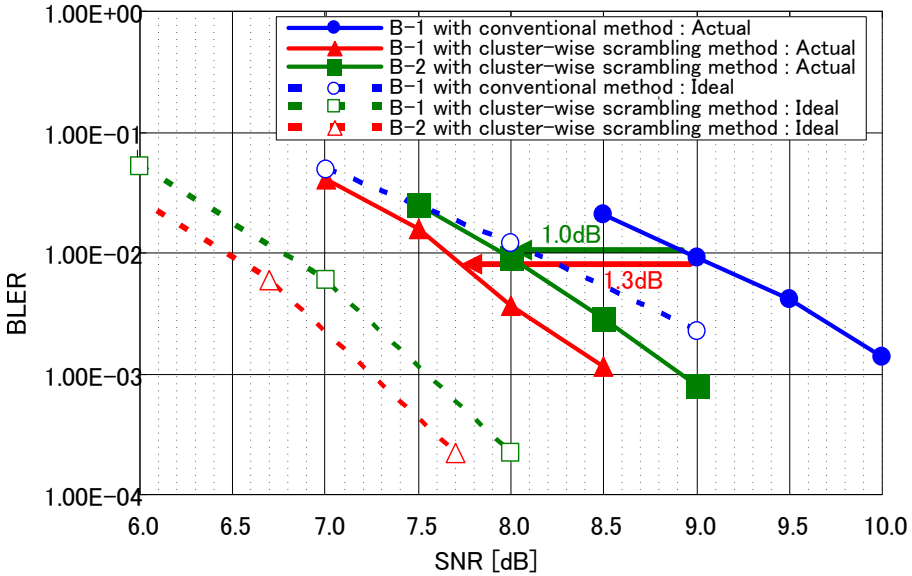
Channel estimation performance for MBS

Condition;

Ratio of MBS to dedicated unicast is 50%.

Two pilot overhead cases, 8.3% and 5.5%, are evaluated.

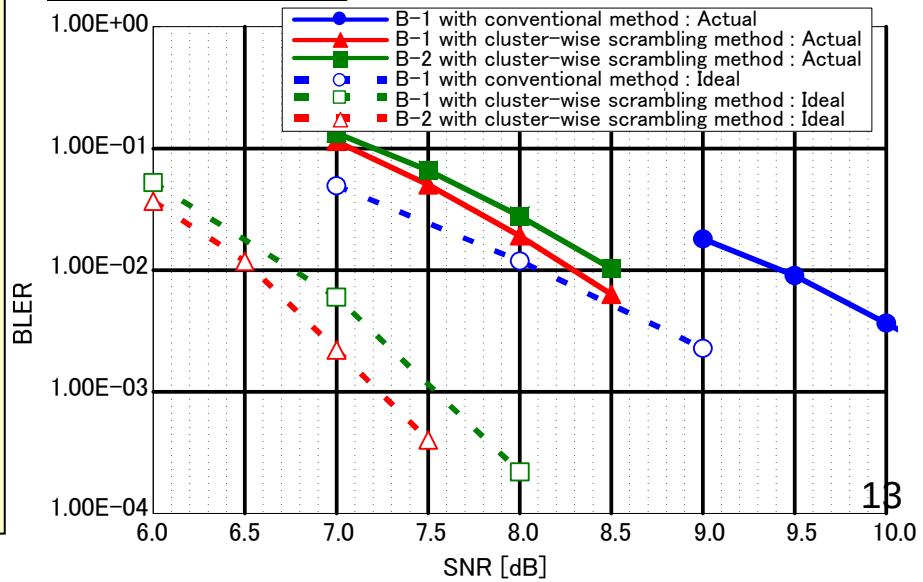
Pilot overhead = 8.3%



In both case, the performance loss of cluster-wise scrambling method is larger than conventinal method in 0.4dB.

However, with the channel estimation degradation considered, the cluster-wise scrambling method is preferable to conventional method.

Pilot overhead = 5.5%



Simulation result(3/3)

Channel estimation performance for unicast

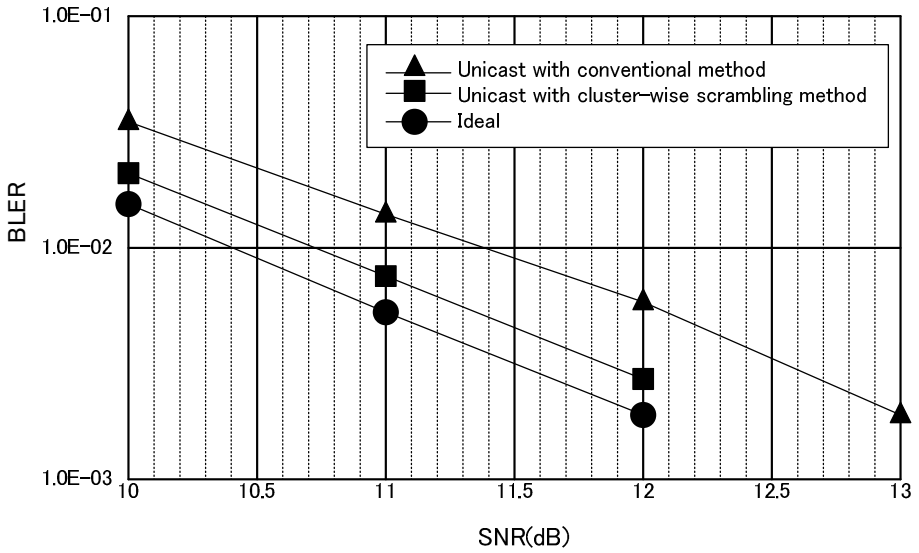
Condition;

Pilot overhead is 5.5.

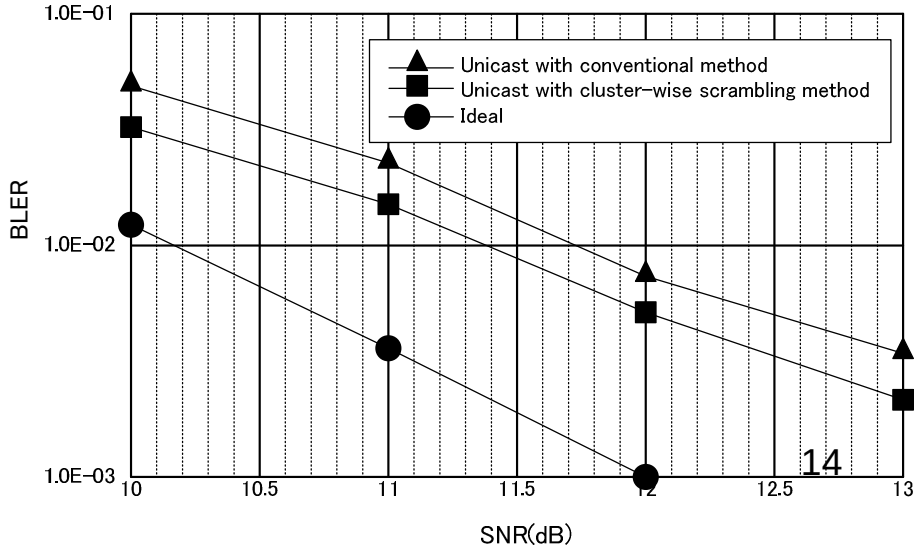
Two doppler frequency cases , 5.5Hz and 222Hz, are considered.

The channel estimation performance using pilot in single RU (conventional method) and that in all RUs (cluster-wise scrambling method) are evaluated.
Simulation results show that there is approximately 0.7dB and 0.3dB gain from cluster-wise scrambling method to conventional method.

fD=5.5Hz



fD=222Hz



Conclusion

- From the view point of performance for localized unicast, it is desired that the localized unicast is scheduled first and the rest of physical resources is shared by distributed unicast and MBS.
- From the view point of performance for both distributed unicast and MBS, it is desired that the distributed unicast and MBS is FDMed at sub-carrier level and the cluster-wise scrambling is applied as MBS structure.

Proposed text (1/3)

11.5.1.1 Distributed resource unit

The distributed resource unit (DRU) can be used to achieve frequency diversity gain. The DRU contains a group of subcarriers which are spread across the distributed group within a frequency partition by the subcarrier permutation. The size of the DRU equals the size of PRU, i.e., P_{sc} subcarriers by N_{sym} OFDMA symbols. The minimum unit for forming the DRU is equal to one subcarrier. The DRU can be allocated in E-MBS subframe.

11.5.1.2 Localized/Contiguous resource unit

The localized resource unit, a.k.a. contiguous resource unit (CRU) can be used to achieve frequency-selective scheduling gain. The CRU contains a group of subcarriers which are contiguous across the localized group within a frequency partition. The size of the CRU equals the size of the PRU, i.e., P_{sc} subcarriers by N_{sym} OFDMA symbols. The CRU can be allocated in E-MBS subframe.

Proposed text (2/3)

11.5.3.1 E-MBS ~~zone specific~~ pilot ~~for MBSFN~~

~~E-MBS zone specific pilot shall only be transmitted for MBSFN transmissions.~~

BS specific pilot which is the same pilot as unicast transmission shall be used as E-MBS pilot and the phase difference between BS specific pilot and E-MBS data is set to be common among E-MBS zone.

An E-MBS zone is a group of ABSs involved in an SFN transmission. ~~The E-MBS zone specific pilot, that's, common inside one E-MBS zone but different between neighboring E-MBS zones, is configured. Synchronous transmissions of the same contents with common pilot from multiple ABS in one MBS zone would result in correct MBSFN channel estimation.~~

The E-MBS zone specific pilot streams depends on the maximum number of streams within the E-MBS zone. Pilot structures/patterns should be supported up to two streams.

The definitions of the E-MBS ~~zone specific~~ pilots are FFS.

Proposed text (3/3)

14.4.1.1 Multiplexing of Unicast Data and E-MBS Data

E-MBS service can be time domain multiplexed (TDM) with unicast service by sub-frames. ~~The MBS sub-frames are put contiguously at the end of DL sub-frames.~~

Both TDM and FDM are supported for the mixed unicast and E-MBS. E-MBS service is time domain multiplexed (TDM) with unicast service at the sub-frame level. E-MBS service is frequency domain multiplexed at the LRU level.

The distributed unicast and E-MBS can be frequency domain multiplexed at subcarrier level.