

Correlated Scrambling Diversity Scheme for 802.16m E-MBS in SFN

Document Number:

IEEE S802.16m-08/893

Date Submitted:

2008-09-05

Source:

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Venue:

80216m-08/033

Base Contribution:

IEEE C802.16m-08/893

Purpose:

Discussion and adoption for 802.16m SDD

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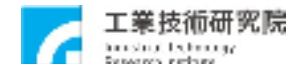
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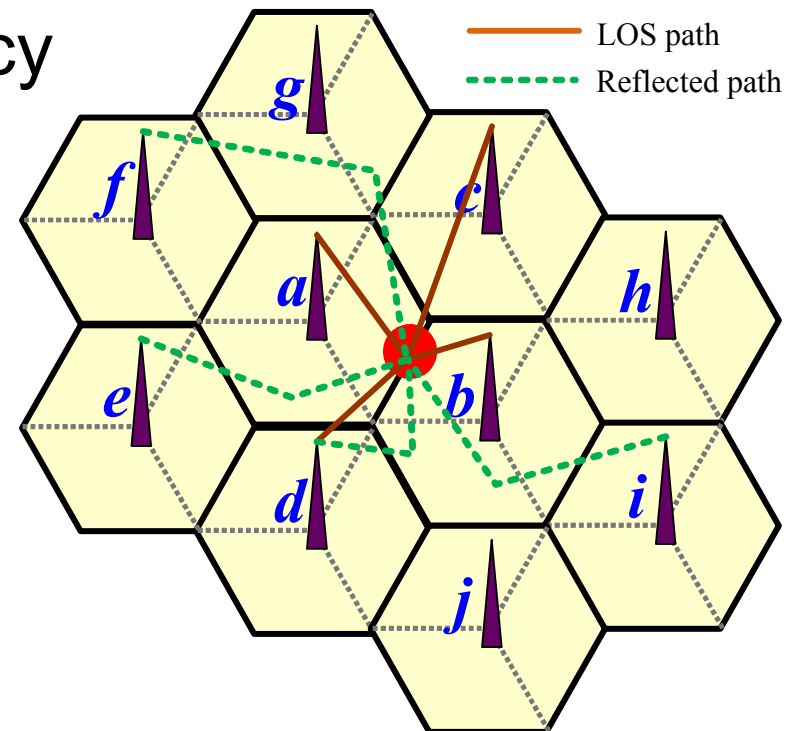
Outline

- Background
- Proposed correlated scrambling diversity scheme
- Simulation results
- Conclusion

BACKGROUND

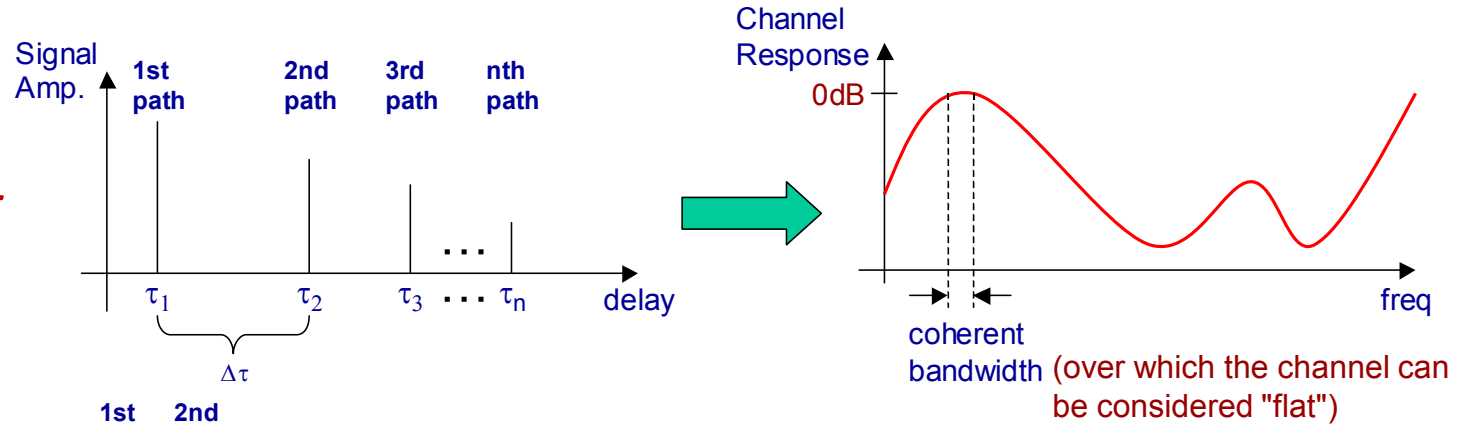
SFN and cell edge problem

- 802.16m can be used as a digital broadcast mechanism through a Single Frequency Network (SFN).
- At the cell edge between transmitters in an SFN, a receiver may receive the same signal from two transmitters almost simultaneously.

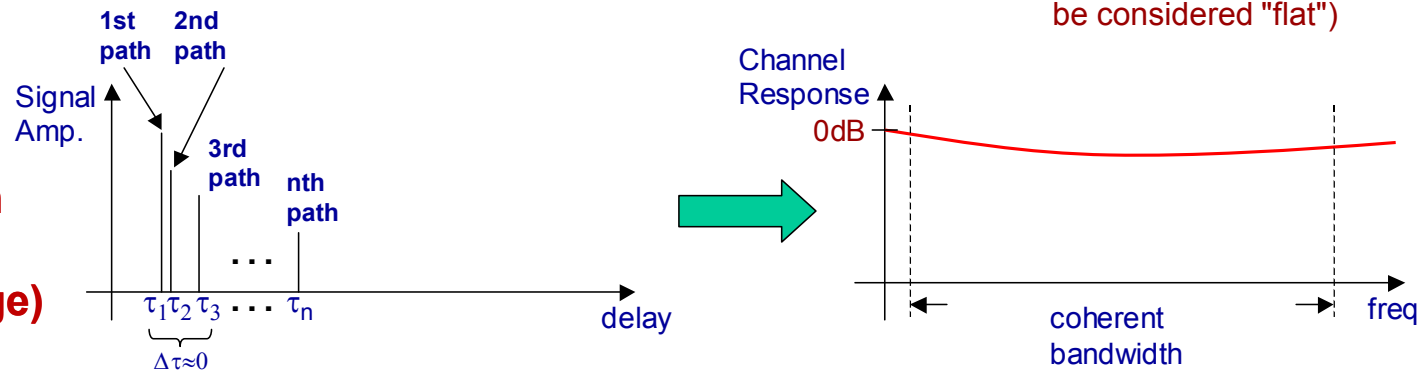


Delay spread and channel response

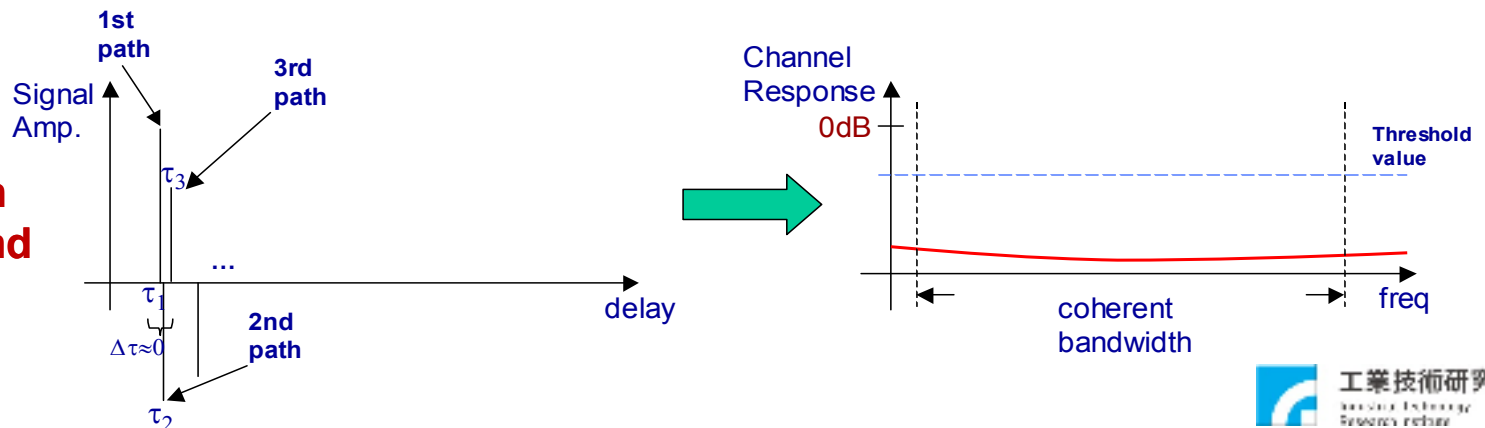
1. large multipath delay spread $\Delta\tau$



2. small multipath delay spread (transmitter edge)

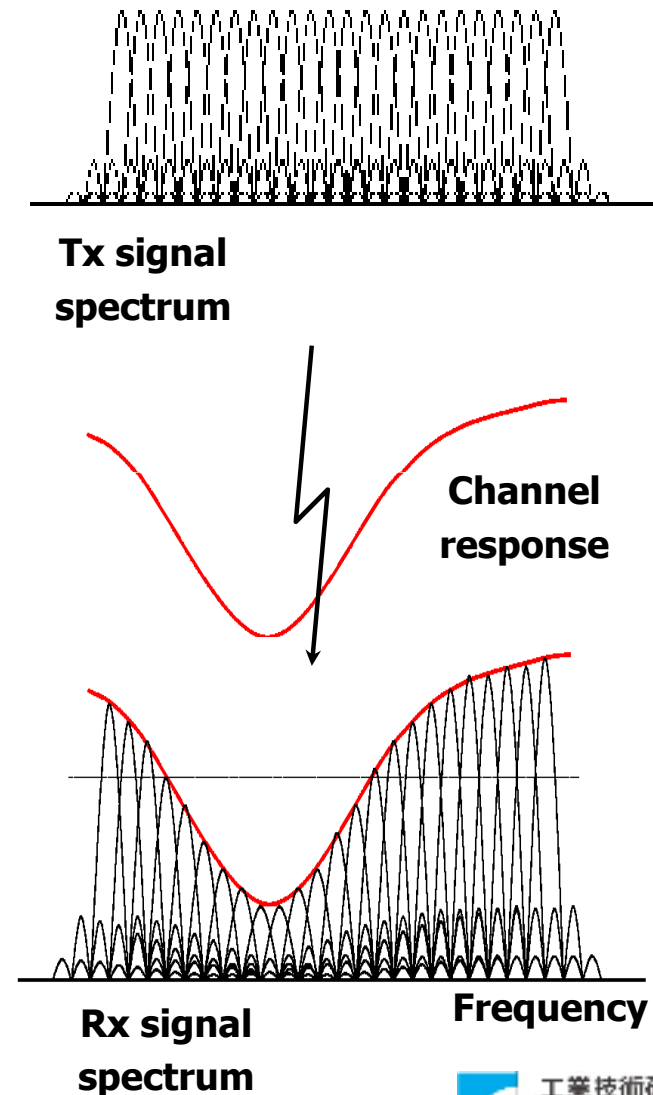


3. small multipath delay spread and inversed phase rotation



OFDM and channel diversity

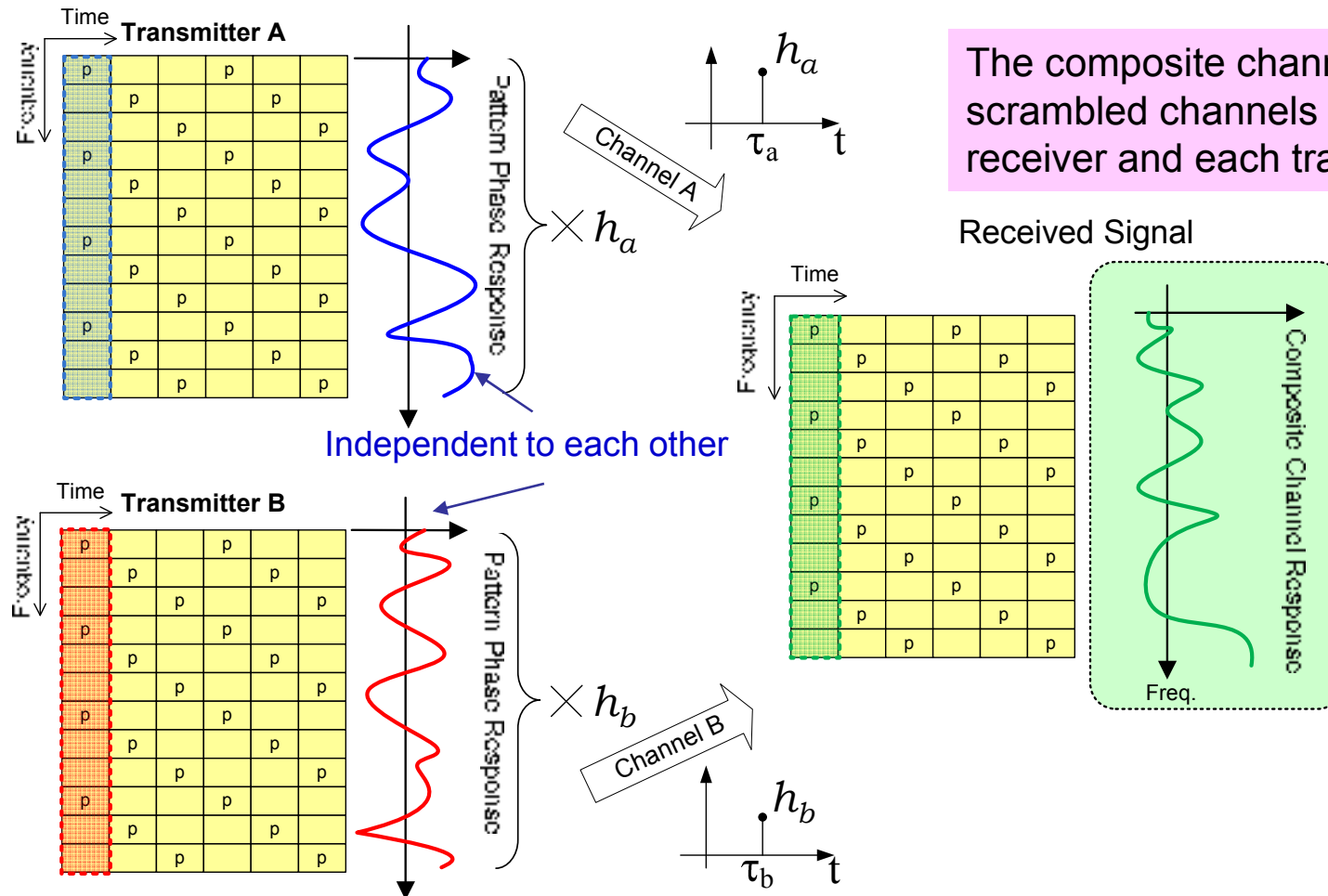
- Multi-carrier transmission technique
- Channel coding together with time interleaving technique can correct the faded signal parts by non-faded parts.
- It's important to “*create*” diversity for solving the problem at cell edge.



PROPOSED CORRELATED SCRAMBLING DIVERSITY SCHEME

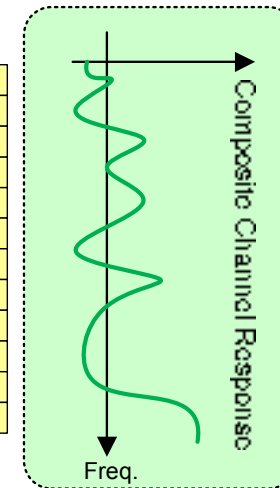
Correlated scrambling diversity (CSD)

Phase of each sub-carrier is rotated by multiplying a scrambling symbol which has **unity gain** (to keep signal power) and **correlated phase** for contiguous sub-carriers.

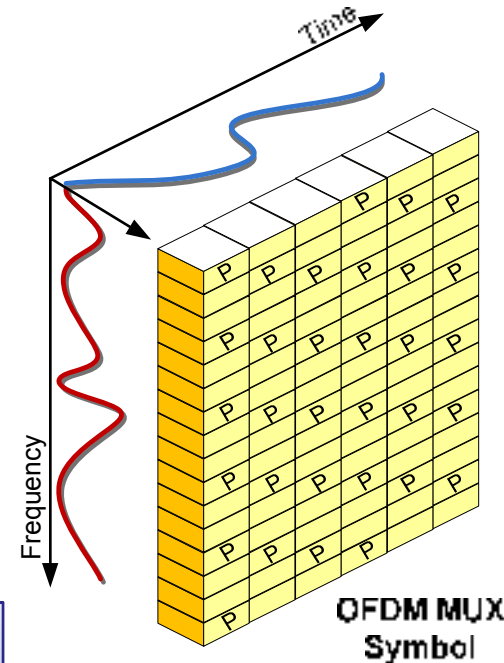
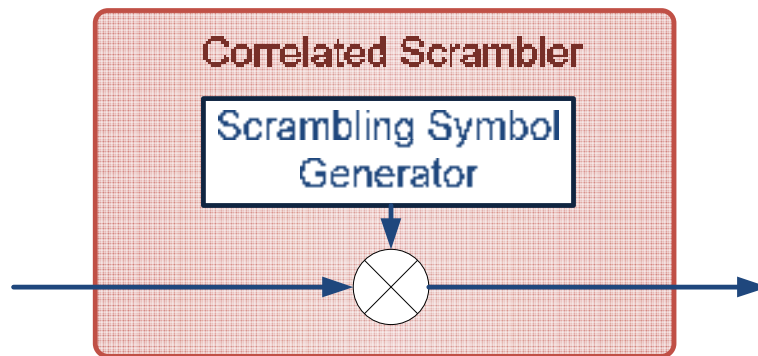
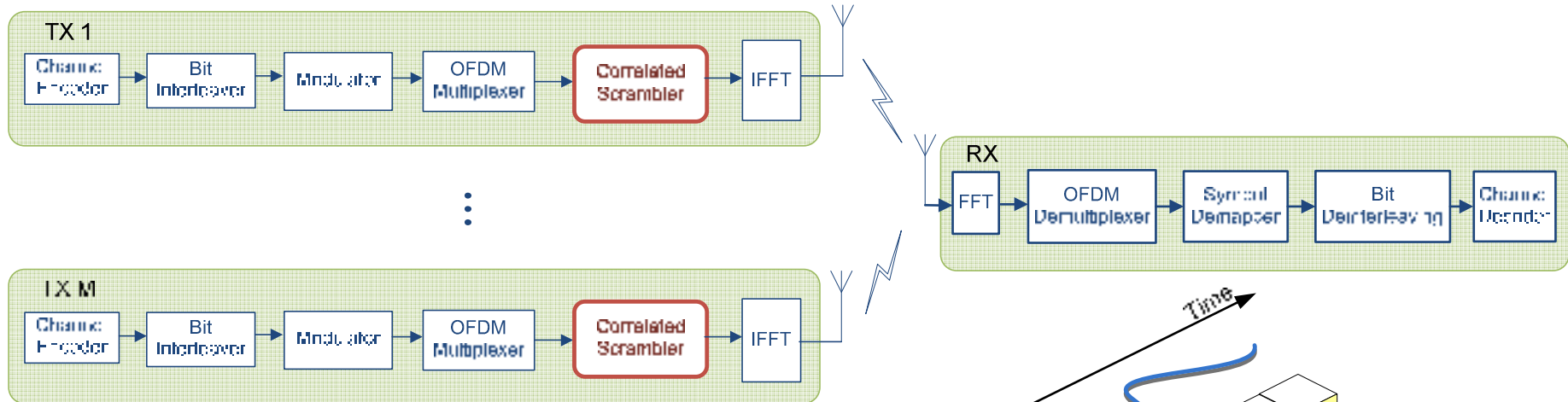


The composite channel is sum of the scrambled channels between the receiver and each transmitter

Received Signal

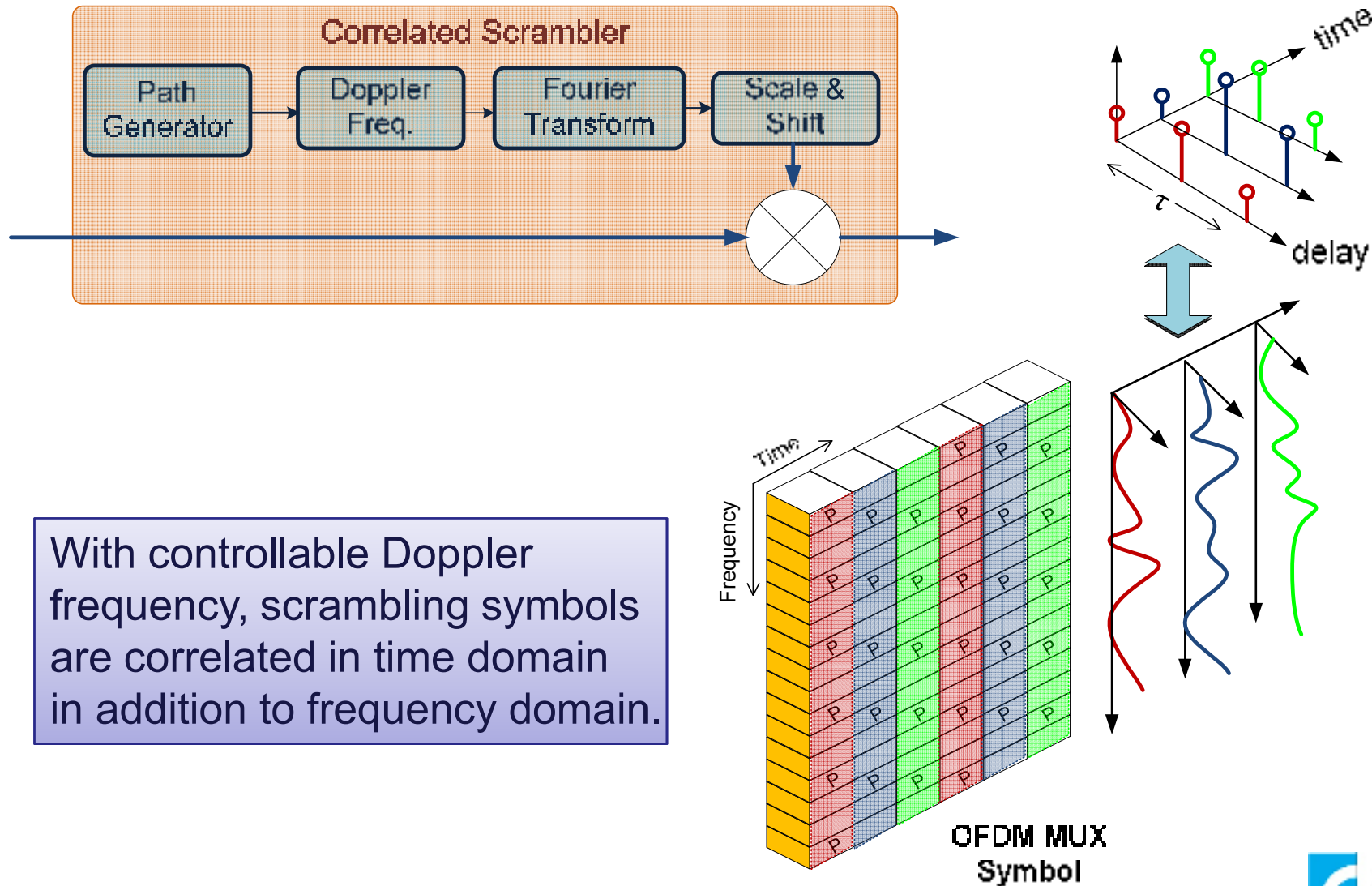


Apply CSD to the system



The scrambling symbols can be correlated in frequency or time domain, or both.

CSD pattern generation example

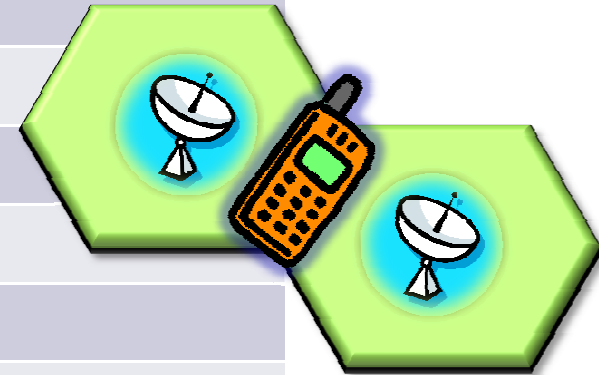


With controllable Doppler frequency, scrambling symbols are correlated in time domain in addition to frequency domain.

SIMULATION RESULTS

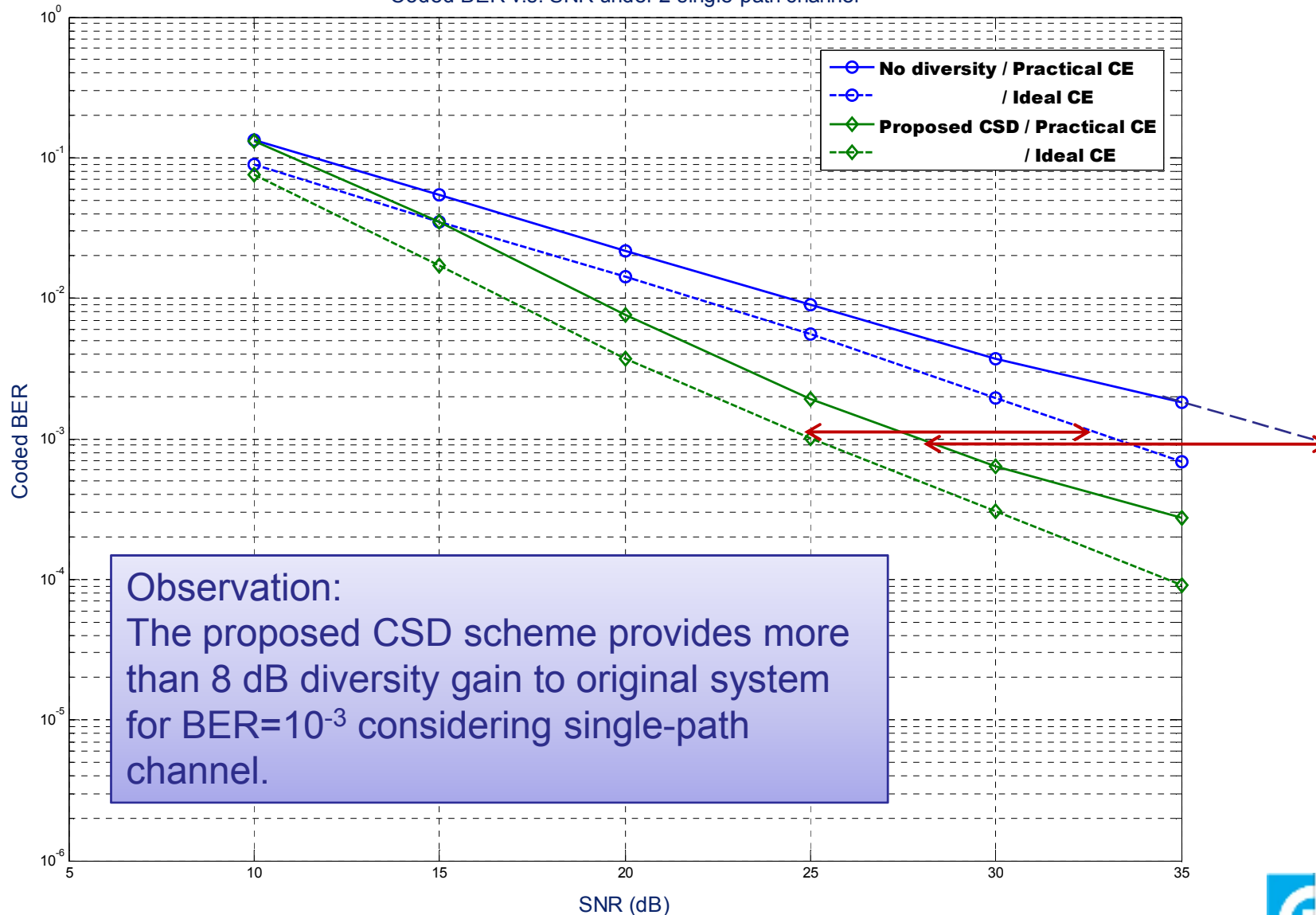
Simulation parameters

Parameter	Value
Channel bandwidth	10 MHz
Number of subcarriers	1,024
Subcarrier permutation	PUSC
Cyclic prefix	1/8
Modulation and Code rate	16-QAM 1/2
Channel coding	Convolutional turbo code (CTC)
FEC data block size	480 bits
Carrier frequency	2.5 GHz
Simulation time	3 sec
Number of cells	2
Channel model	ITU Vehicular A (VA) or single-path
Mobile station speed	30 km/hr
Channel estimation	Cluster based linear interpolation



Simulation results: single-path

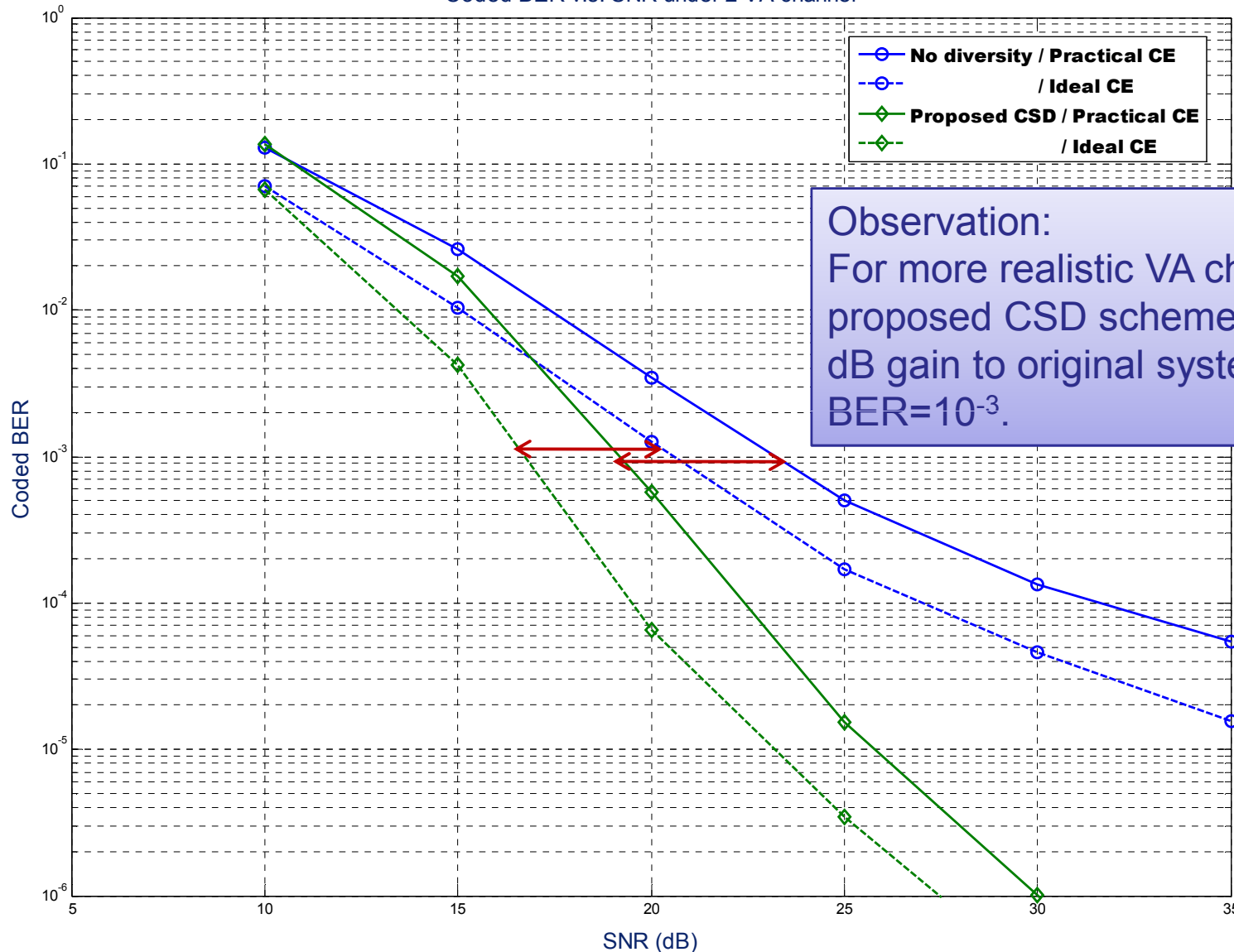
Coded BER v.s. SNR under 2 single-path channel



Observation:
The proposed CSD scheme provides more than 8 dB diversity gain to original system for BER= 10^{-3} considering single-path channel.

Simulation results: VA channel

Coded BER v.s. SNR under 2 VA channel



Observation:
For more realistic VA channel model, proposed CSD scheme still exhibit 4 dB gain to original system for $BER = 10^{-3}$.

CONCLUSION

- In SFN, UE at cell edges experiencing flat and/or slow fading cannot operate well.
- A novel correlated scrambling diversity scheme is proposed to overcome this problem.
- Through simulations the proposed scheme has provided significant diversity gain compared to the original system.

THANK YOU