Synchronous Non-adaptive HARQ in IEEE 802.16m Uplink

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Re: IEEE 80216m-08/016r1 - Call for Contributions on Hybrid ARQ

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Purpose:
To be discussed and adopted by TGm for use in the IEEE 802.16m SDD

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Outline

- HARQ Classification
- HARQ Operation for Uplink
- Considerations on MCS
- Simulation Results
- Conclusions
- Text Proposal for the 802.16m SDD

Synchronous/Asynchronous

- Synchronous HARQ
  - All the HARQ retransmission processes are restricted to occur at pre-determined time
    - does not require HARQ process number (ACID)
  - Low signaling overhead
- Asynchronous HARQ
  - No restriction of retransmission timing
    - Flexible scheduling in time domain
    - Explicit signaling is required at every transmissions
  - High signaling overhead

Adaptive/Non-adaptive

- Adaptive HARQ
  - Transmission format may be changed during retransmissions
    - Modulation order, Code rate, Resource allocation
    - Scheduling can be more flexible
  - High signaling overhead
- Non-adaptive HARQ
  - Transmission format is not changed or is known to MS & BS
    - Difficult to get scheduling gain
  - Low signaling overhead

HARQ Operation in UL

- Uplink
  - It is difficult for BS to accurately estimate the uplink signal due to interferences from MSs in other cells.
  - Adaptive scheduling may not give significant system gain even with much signaling overhead in uplink
- Support synchronous non-adaptive HARQ operation in uplink
  - Reduce system overhead for control signaling

Considerations on MCS

- Why not getting advantages of adaptive HARQ characteristics without additional signaling overhead to achieve better performance

- MCS (Modulation and Coding Set) can be changed during retransmissions in a pre-determined manner

	initial transmission	1st retransmission
Modulation	**4**	**2**
Code rate	**1/2**	**1/1**
eff. code rate	**1/2**	**1/3**
Nsch	**50**	**50**

Considerations on MCS

- Normalized Resource Size
  - $$\frac{\text{Symbols per Unit Resource} \times \text{Allocated \# of Unit Resources}}{\text{Encoding packet size}}$$
  - Regarded as the inverse of MPR
- Effective code rate
  - $$\frac{1}{\sum_{i=1}^{T}\left(\text{Normalized Resource Size} \times \text{Modulation Order}_i\right)}, \quad \textit{where } T = \textit{Number of Transmissions}$$
  - Same resource size during retransmissions

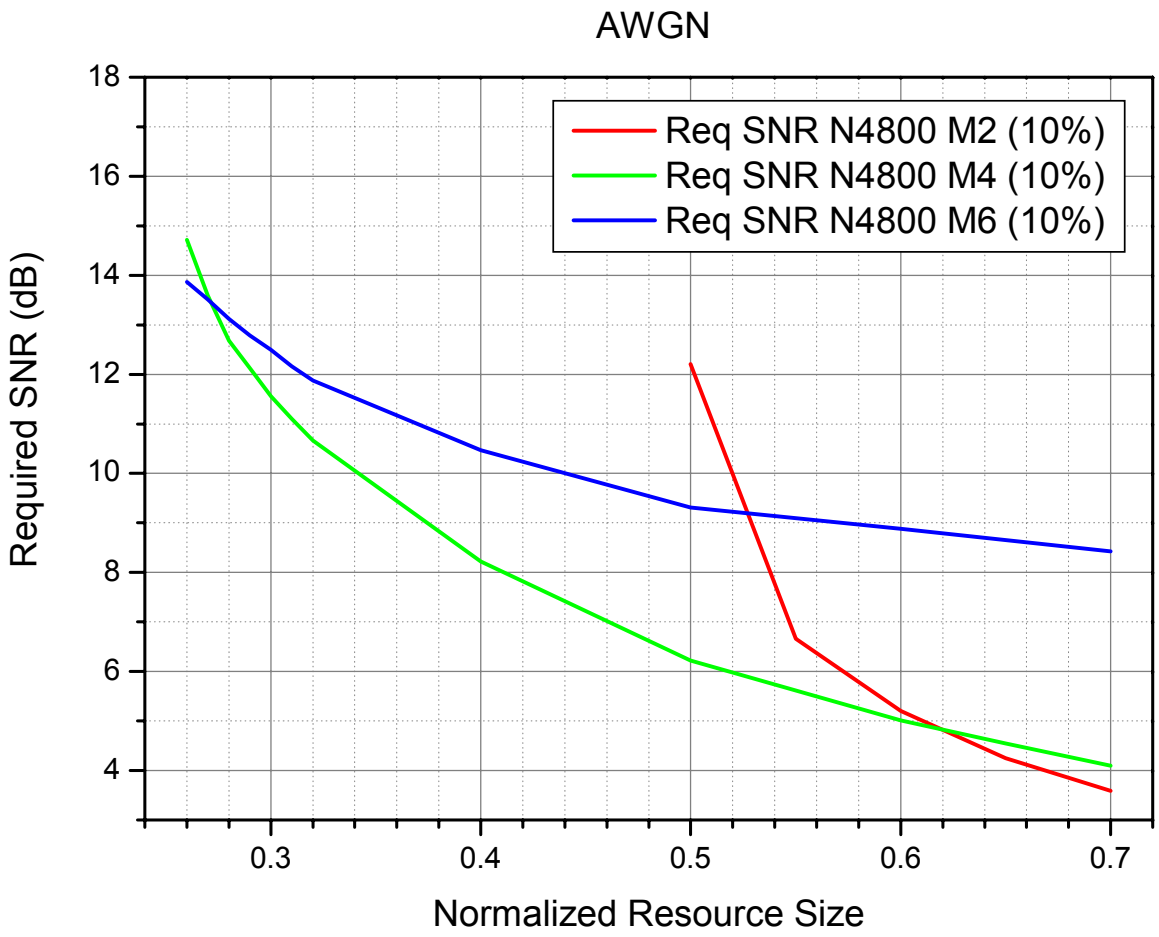
Simulation Results

- IEEE 802.16e CTC IR HARQ system
- Simulation Parameters

Parameters	***Assumption***
Bandwidth	10 MHz
Number of subcarriers	1024
Frame length	5ms
N_{EP}	4800 bits
Channel estimation	Perfect
Channel code	CTC (Mother code rate : 1/3)
Modulation	QPSK / 16 QAM / 64QAM
MIMO configuration	None (SISO)
Resource allocation	PUSC
Channel model	AWGN / PedB / Veh A
MS mobility	- / 3km/h / 30km/h
Receiver type	Linear MMSE

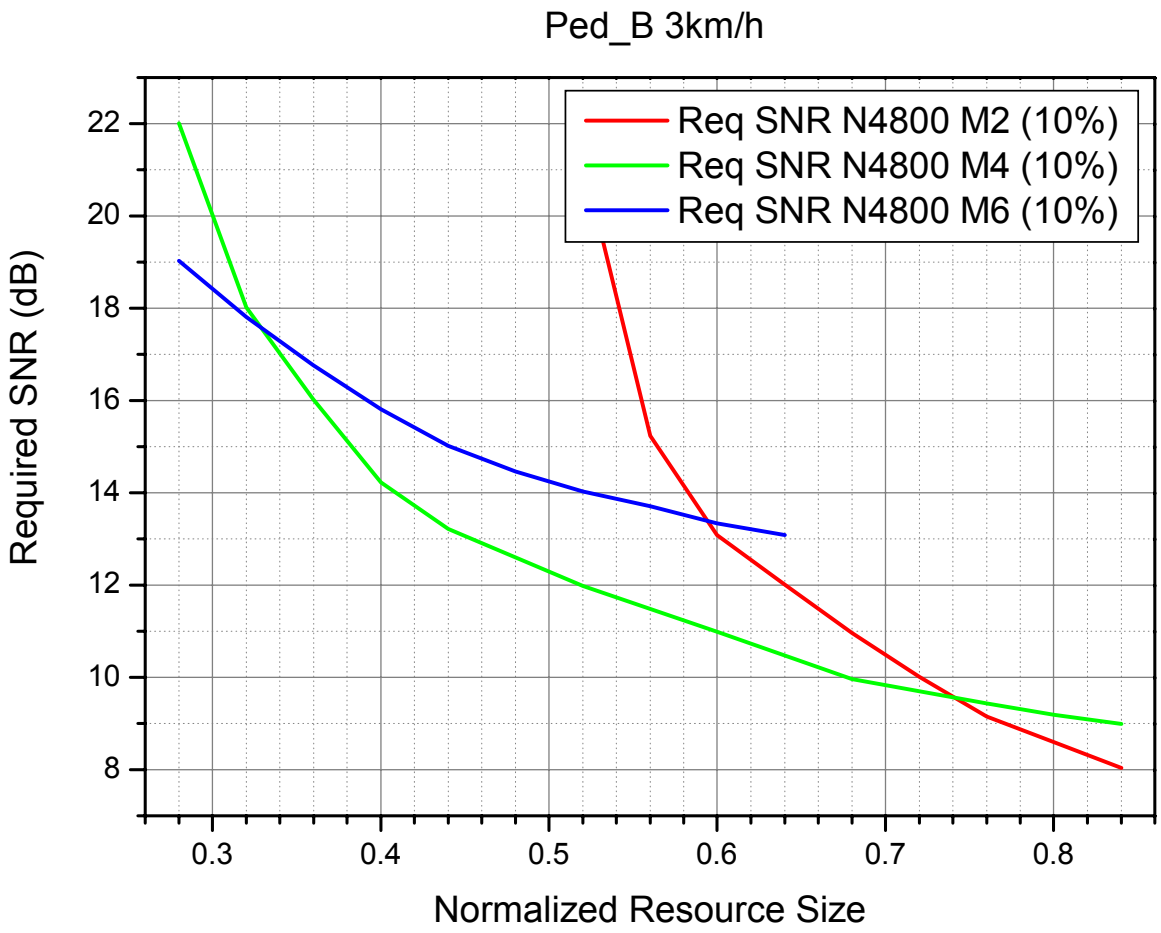
Simulation Results

- Required SNR (at 10% FER) vs. the modulation order and the Normalized Resource Size (AWGN)



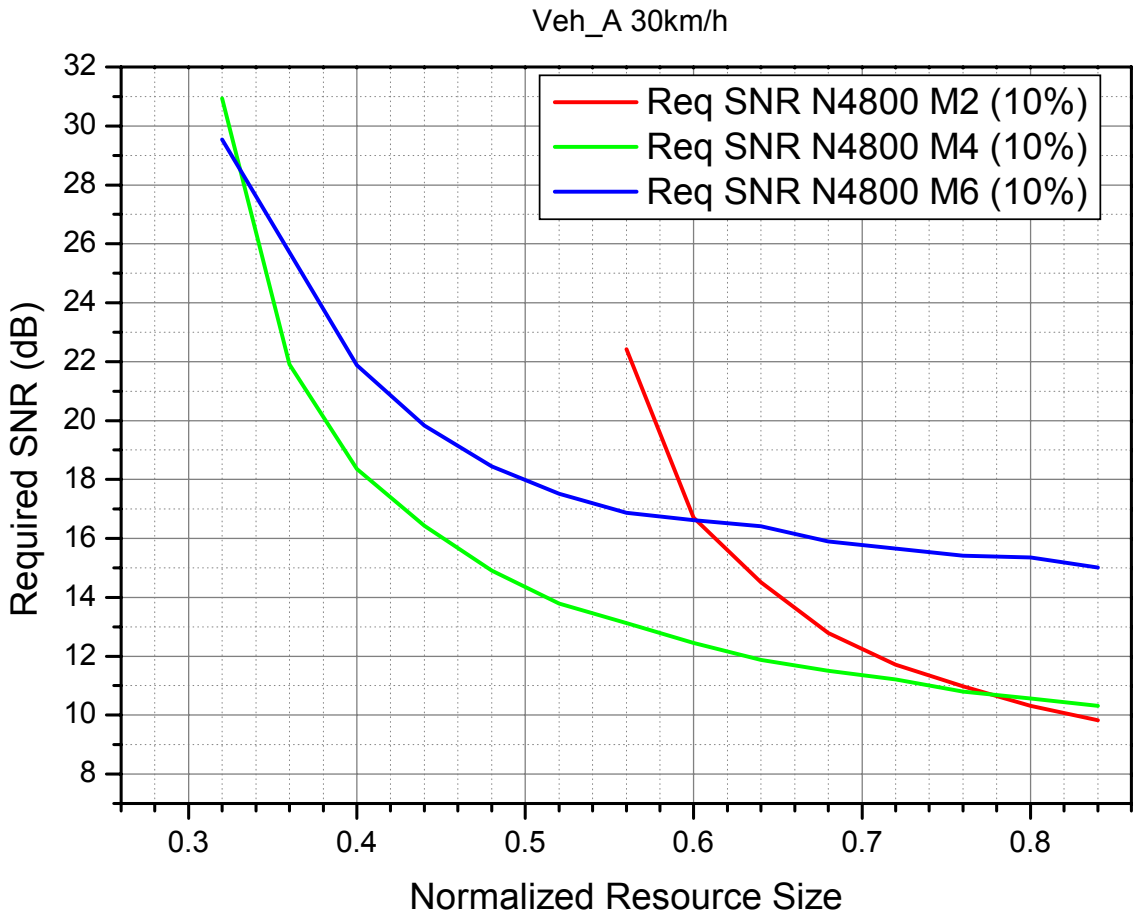
Simulation Results

- Required SNR (at 10% FER) vs. the modulation order and the Normalized Resource Size (PedB 3km/h)



Simulation Results

- Required SNR (at 10% FER) vs. the modulation order and the Normalized Resource Size (VehA 30km/h)



Conclusions

- We support synchronous non-adaptive HARQ operation as IEEE 802.16m uplink HARQ operation.

- By adopting the aforementioned scheme, synchronous non-adaptive HARQ may obtain better performance without additional control signaling overhead.

Text Proposal for the 802.16m SDD

- Section 11 – PHY Layer
  - The UL HARQ shall support synchronous non-adaptive operation.
  - In UL HARQ operation, the allocated resource size shall be fixed during retransmissions and the MCS shall be able to be changed during retransmissions.