On the Complexity of Multiple 192 MHz Channels

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Overview

- PHY complexity comparison with one and four 192 MHz OFDM channels is presented
- Purpose is to provide assessment on the additional complexity associated with using “PHY bonding” idea presented by Ed Boyd et al. to the Geneva meeting
  - *EPoC Downstream Bonding/ Ed Boyd et al. Geneva Sep 2012*
- Results show that complexity does NOT scale linearly with number of the downstream channels
  - Four channels are 60% more complex than a single channel

PHY Complexity CNU side Analysis

- PHY components affecting complexity
  - RF / Analog front End
  - Digital downstream OFDM demodulator
  - Digital upstream OFDM modulator
  - LDPC decoder
  - Interleavers

Complexity Comparison
One and Four 192 MHz OFDM channels (1)

- RF / Analog front End
  - Complexity is mainly determined by the bandwidth and not by the number of channels
  - Supported bandwidth is similar for the two compared cases
    - ***No significant complexity difference***
- Digital downstream receiver
  - Complexity is mainly determined by FFT buffer sizes, with four buffers per OFDM channel
    - ***Complexity scaled with number of channels***
- Digital upstream transmitter
  - Upstream transmitter is identical for the two cases
    - ***No complexity difference***

Complexity Comparison
One and Four 192 MHz OFDM channels (2)

- LDPC Decoder
  - LDPC complexity has three main components
    - Bit-node processing
    - Decoding memory
    - Check-node processing
      - Bit-node processing is scaled with the bit rate
      - Decoding memory and check-node processing complexity is a function of the number of check equations and not so much on the data throughput
    - ***50% more complexity with four channels***
- Interleavers
  - Assuming Interleaver at the transmitter and the receiver
    - ***Complexity is scaled with number of channels***

Complexity Comparison
One and Four 192 MHz OFDM channels (3)

- BRCM analyzed actual block sizes for the various PHY blocks
- Considered: 1,2,4 192-MHz OFDM channels with 4K and 16K sub-carriers in each channels
- Analysis done for the CNU side
- Results summarized the in table below

	1-chan	2-chan	4-chan
4096	100%	120%	160%
16384	100%	130%	180%

Implications on MAC Complexity

- To maintain EPoC performance at least at GPON speed it will need to support 2.5Gbps
- 10GEPON would be used to reach that speed
- Maximal 10GE rate is 8.7Gbps
  - No additional complexity to support 5 Gbps
  - Complies with maximal throughput from four 192 MHz OFDM channels, roughly 8 Gbps with 12 bits/Hz

Summary

- A comparison of the EPoC PHY complexity in the CNU side is presented
- *Four channels increase PHY complexity by 60% with 4K sub-carriers and by 80% with 16K sub-carriers per channel*
- complexity does NOT scale linearly with number of the downstream channels
- No additional MAC complexity is required