MULTIPLE DOWNSTREAM OFDM CHANNELS

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OVERVIEW

- **A concept approach for multiple OFDM channels was used as part of an example in laubach_3bn_02_1113.pdf (page 3-8).**
- **This presentation formalizes and proposes multiple downstream channels in support of meeting/approaching our 10 Gbps objective**
  - The 802.3 1.4.233 *lane* definition does not really fit this approach, the 1.4.127 *channel* definition is more accurate.
- **Good news: OFDM is already using subcarriers. The downstream Symbol Mapper multiplexes over a space of 4096 subcarriers (max 3800 usable).**
  - 4096 is a nice binary number
  - Multiplexing over N * 4096 is a straightforward extension for both the Symbol Mapper as well as configuration management
  - Question is: what value is N?

HOW MANY CHANNELS?

- **Proposal development initially examined 4 downstream channels**
  - Can be amended to 5, 6, or 7 after discussion and Objective review
- **First: viewed from raw data capacity (all overheads on page 7):**
  - (N = 4) * 190 MHz * 12 bits/sec/Hz = 4 * 2.28 Gbps = 9.12 Gbps
    - (N = 5) = 11.4 Gbps
  - N = 4 is a more than a little short of 10 Gbps at MAC / PLS Objective
    - N = 5 gets closer, still more needed
- **Second: viewed from RF Spectrum availability:**
  - In the lifetime of EPoC, available RF Spectrum may move:
  - From: 54 MHz to 1 GHz => 940 MHz
    - 4.8 channels
  - To: 300 MHz to 1 GHz => 700 MHz (proposal focus)
    - 3.6 channels
  - Or to: 300 MHz 1.212 GHz = 912 MHz (haven't seen > 1.0 GHz hardware)
    - 4.75 channels
  - The above also assumes a Cable Operator will devote the majority of their downstream RF spectrum to EPoC – not very likely

PROPOSED DOWNSTREAM ARCHITECTURE

- **Refer to Figure: laubach_3bn_04_0914.fm (PDF)**
- **Symbol Mapper extends to (N = 4) * 4096 (4 * 3800) subcarriers for mapping**
  - Mapping simply starts at Channel 0, then 1, 2, 3.
  - FCP (NCP) is not effected
- **Each channel is separately placed in RF spectrum**
  - Encompassed spectrum may be immediately adjacent, but no overlap; i.e. no exclusion or guard band needed between a subcarrier of one channel with the adjacent subcarrier from another channel
- **Channels 1, 2, 3 are optionally enabled, 0 is always configured**
- **PHY Link is associated / processed as part of Channel 0**
  - One PHY Link for the downstream (reduced complexity over multiple)
- **Each OFDM Channel**
  - Same extended OFDM symbol time and windowing configuration
  - Same symbol rate clock, inter-channel transmit skew tolerance ≤ 156.25 ns
  - Same frame timing synchronization with PHY Discovery
  - Separate interleaver, pilot insertion, IFFT, cyclic prefix and windowing

DRAFT TEXT CHANGES

- **Draft text changes in laubach_3bn_05_0914.pdf (PDF)**

Objectives (2/4)

- **Provide a physical layer specification that is capable of:**
  - A baseline data rate of 1 Gb/s at the MAC/PLS service interface when transmitting in 120 MHz, or less, of assigned spectrum under defined baseline plant conditions;
  - A data rate lower than the baseline data rate when transmitting in less than 120 MHz of assigned spectrum or under poorer than defined plant conditions;
  - A data rate higher than the 1Gb/s baseline data rate and up to 10 Gb/s when transmitting in assigned spectrum and in channel conditions that permit.
- **PHY to support symmetric and asymmetric data rate operation.**

5 OR 6 CHANNELS AND CHANGE OBJECTIVE?

See laubach_3bn_15_0914.xlsx

Channels	DS RF MHz		DS FEC Rate	64B/66B/65B Rate	CLT_DS_DataRate	XGMII Rate (approx)
1	192.00		0.882716049	0.984615385	2,175,219,512.20	1,890,561,156.28
Static values						
0.62105	120.00				1,348,097,560.98	1,171,679,855.47
1	192.00				2,175,219,512.20	1,890,561,156.28
4	762.00				8,714,926,829.27	7,574,454,923.22
4.64	883.60				10,109,853,658.54	8,786,835,772.36
5	952.00				10,894,829,268.29	9,469,086,178.86
5.3	1,009.00				11,548,682,926.83	10,037,373,803.07
6	1,142.00				13,074,731,707.32	11,363,717,434.51

Note: Clause 51.2 PMA_UNITDATA.request rate is (16 bits * 644531250 Hz) = 10,312,500,000.00

			RS (255,223) Rate	64B/66B Rate	PMA rate	XGMII Rate (approx)
			0.874509804	0.96969697	10,312,500,000.00	8,745,098,039.22

Adopt N = 5 channels

Modify objective, change “10 Gb/s” to “10G-EPON equivalent rate”

PROPOSED MOTION

Move to:

Adopt into the draft the figure 100-2 update based on laubach_3bn_04_0914.pdf Page 1 and text updates as per laubach_3bn_05_9414.pdf. Editors will update to support 5 downstream OFDM channels.

PROPOSED MOTION

Move to:

Amend P802.3bn Task Force objective as follows:

- A data rate higher than the 1Gb/s baseline data rate and up to ~~10 Gb/s~~ 10G-EPON equivalent rate when transmitting in assigned spectrum and in channel conditions that permit.

Direct the P802.3bn Chair to bring forward at next IEEE 802 plenary meeting for Working Group approval.

Thank you