

PMD Downstream Electrical Input/Output

Saif Rahman – Comcast

Tom Kolze – Broadcom

Joe Solomon - Comcast

Supporters

- Jorge Salinger – Comcast
- Matt Schmitt – CableLabs
- Curtis Knittle – CableLabs

PMD Electrical Transmit and Receive Requirements Proposal

- These slides provide definitions and an overview of the basic concepts needed to understand the performance metrics in the proposal
- Based on work completed for DOCSIS 3.1 OFDM transmit and receive.
- Incorporates previous technical motions where appropriate
- Proposal text provided in a separate document

Key Tx Concepts (1)

- Transmit requirements are based on equivalent 6 MHz channels
 - Frequency ranges from Spectrum Ad Hoc
 - Full OFDM channel block defined in terms of N_{eq} , which is number of 6 MHz channels that fit within a 192 MHz OFDM block (32)
 - N_{eq}' is the number of equivalent 6 MHz channels in an OFDM, based on occupied bandwidth. For example, for an OFDM block with the minimum contiguous spectrum (24 MHz), N_{eq}' is equal to 4.

Key Tx Concepts (2)

- **Encompassed Spectrum** – The range of frequency from the center frequency of the OFDM channel's lowest active subcarrier minus half the subcarrier spacing, to the center frequency of the OFDM channel's highest active subcarrier plus half the subcarrier spacing.
- **Modulated Spectrum** – Encompassed Spectrum minus the range of \pm half the subcarrier spacing around any excluded subcarriers inside the Encompassed Spectrum, where excluded subcarriers includes all the individually excluded subcarriers and all the subcarriers comprising excluded subbands.
- **Occupied Bandwidth** – The sum of the bandwidth in all standard channel frequency allocations (e.g., CEA channels) that are occupied by the OFDM channel. Even if one active subcarrier of an OFDM channel is placed in a certain standard channel frequency allocation, that standard channel frequency allocation in its entirety is said to be occupied by the OFDM channel.
- **dBc** – Relative measurement used to define power in relation to a referenced carrier
- **dBm** – Relative measurement used to define power in relation the average power of N_{eq} channels

Key Tx Concepts (3)

- Power and noise requirements are scaled proportional to actual RF spectrum used and normalized with a 6 MHz channel.
 - Noise is calculated relative to the signal power on a channel as if each subcarrier had equal power across the channel
- Modulation Error Ratio (MER) – Figure of merit for how closely the output symbol constellation matches the ideal constellation
- Transmit Power: If $N_{eq}' < N_{eq}/4$, then transmit power requirements are relaxed
 - DRW – Dynamic Range Window - Since subcarriers can vary in power, a window needs to be defined over which the receiver will operate.

Key Tx Concepts (4)

- Out of Band Noise: Requirements apply to frequency zones relative to the carrier frequency, with different requirements for different defined boundaries.
 - Adjacent channel
 - Next adjacent channel
 - Third adjacent channel
 - Far-out adjacent channel
- Diagnostic Modes of Operation: Introduces 3 diagnostic modes to allow measurements to be taken on muted subcarriers for field troubleshooting and specification verification

Key Rx Concepts

- Focuses on receiver packet error rate performance, given the transmitted signal and the receive channel characteristics
 - Assume that what the transmitter sends the receiver can receive and decode.
 - Receiver input level range per 24 MHz occupied spectrum
- Input return loss: Indicative of impedance mismatch