Video overlay options in 1 Gbit/s EPONs

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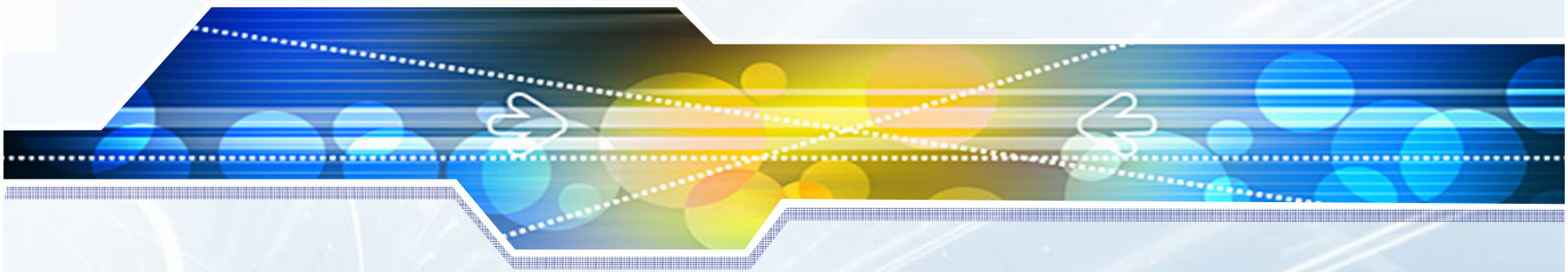

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Short into

- Video overlay delivery specs reused by three standards for PON in use today: ITU G.983.3 BPON, ITU G.984.2 GEPON and IEEE 802.3 ah EPON;
- Video signal delivered in the 1550 – 1560 nm window in analog or digital mode;

Analog video delivery [1]

- Cable TV-type video transmitted over the 50-550-MHz band using sub-carrier modulation in 1550 – 1560 nm transmission window;
- Signal needs to be amplified in EDFA optical amplifier stage prior to injection into PON network;
- Critical parameter in analog video overlay – *carrier-to-noise ratio* (CNR) of the signal received by the ONU;
- FCC-specified minimum CNR is 44 dB;
- Noise artifacts eliminated at CNR ≥ 47 dB;
- Carriers require typically CNR ≥ 48 dB;
- CNR = 48 dB is equal to ≈ -5 dBm at ONU;

Analog video delivery [2]

- Future ONU RXs may provide CNR = 48 dB at ≈ -7/8 dBm though still uncertain;
- On TX side, *stimulated Brillioun scattering* (SBS) limits the system reach with the analog video overlay;
- Very high optical power transmission into a relatively long length (>8 km) of fiber excites a sound wave along the length of the fiber, resulting in backscattering of a portion of the optical launch power;
- High SBS values increase RX noise, degrade CNR and analog picture quality;

Digital video delivery [1]

- Migration to all-digital broadcast video systems to:
  - reduce power, system cost and eliminate content theft;
  - increase effective bandwidth to add channels;
  - accommodate the 4X higher-bandwidth requirement for high-definition TV channels (HD and SHD TV);
- Digital video eliminates the CNR noise concerns of analog systems and produces clearer image;
- Digitial video delivery takes advantage of advanced compression formats (MPEG 4 and newer standards) to provide scalable video streams for multi-device applications (mobile devices, set-up boxes, TVs, HD TVs etc.);

Digital video delivery [2]

- Two delivery methods for digital video signals using:
  - An RF signal at 1550 - 1560 nm transmission window with the application of 64-QAM or 256-QAM encoding;
  - Video-Over-IP (VOIP) infrastructure embedded in the downstream data, typically in a broadcast and/or multicast mode;
- SBS is of no practical concern with digital video systems:
  - Require much less power at the RX and TX modules;
  - Less powerful amplifiers, if any;
  - In case of QAM encoding, the RX power level drops to ≤-12 dBm, with EDFA power levels down to ≤ 7 dBm;
  - In case of VOIP systems, standard RX power level concerns apply – just like the ones we consider for normal data stream transmission in e.g. EPON systems;

Digital video delivery [3]

- Impairments of digital video delivery systems:
  - Data channel in the 1490 nm window can suffer from noise caused by *stimulated Raman scattering* (SRS) in the 1550-nm video signal, if transmitted power level is high.
  - This noise reduces CNR by < ≈0.25 dB if 1490-nm launch power is limited to -1 (155-Mbit/sec), +1 (622-Mbit/sec), and +3 dBm (1.25-Gbit/sec).
  - Modern optical transceivers accommodate such launch power constraints cost-effectively – thus no real concerns here.