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Pre-coded NRZ and Electrical Duo-Binary Transmission in C and O-band at Data Bit Rates Up To 25 Gbit/s

Justine Konopacki¹⁻², Bertrand Le Guyader¹, Naveena Genay¹, Luiz Anet Neto¹, Philippe Chanclou¹, Didier Erasme²

(1) Orange Labs, 2 avenue Pierre-Marzin, 22307 Lannion, France
(2) LTCI, Télécom ParisTech, Université Paris-Saclay, 75013 Paris, France

Abstract
We present real-time transmission performance up to 25 Gbit/s for optical access networks.
• Based on pre-coded NRZ and electrical duo-binary modulations
• Using limited electrical bandwidth DML in C and O-band at transceiver
• And an electrical duo-binary receiver with an 8 GHz APD photodiode and a duo-binary to binary converter

Data bit rates evolution in the optical access network
• Presently PON solutions are based on NRZ modulation formats. [1-4]
• Standardization groups are working on 25 Gbit/s PON.
• Solutions proposed:
  o NRZ coupled with electrical equalization [5, 6]
  o Efficient modulation formats such as PAM-4 [7, 8] & duo-binary [9, 10]

EDB modulation format
• What is EDB?
  NRZ
  EDB
  0
  0
  1
  +1 or -1
• Where?
  At Tx → coder
  At Rx → 8 GHz APD
• FIR
• How?
• Pre-coder
• Low-pass filter

EDB electrical spectrum is compressed by a factor 2 compared to a NRZ signal at the same data bit rate [9]. Opportunity to re-use optical components already developed for 10 Gbit/s transmission.

EDB and pre-coded NRZ (p-NRZ) transmission experimental setup
• Tx: 14/16 GHz C/O band DML
• Rx: 8 GHz APD/TIA → EDB detection
• Duo-binary to NRZ decoder: APD out and oút + limiting amplifiers + XOR gate

O band performance

Bb & Rx: NRZ
Tx: p-NRZ 20 Gbit/s
| BER 10⁻³ |
| Optical Budget - OB (dB) |

Bb & Rx: EDB
Tx: p-NRZ 20 Gbit/s

N1 class: maximum OB 29 dB

C band performance

Bb & Rx: NRZ
Tx: p-NRZ 25 Gbit/s
40 km & Rx: EDB
| BER 10⁻³ |
| Optical Budget - OB (dB) |

C band performance

Conclusion
O-band transmission
At 25 Gbit/s, up to 40 km propagation with 26.5 dB OB using pre-coded NRZ emission.
At 20 Gbit/s, up to 40 km propagation with 28 dB OB using EDB & pre-coded NRZ emission.

C-band transmission
Performance is worse due to chromatic dispersion.
At 20 Gbit/s, up to 10 km propagation with 28 dB OB with pre-coded NRZ emission. Use pre-equalization and mitigation techniques to increase performance.

References: