NG-EPON:
PMD analysis

ZTE
Tomorrow never waits

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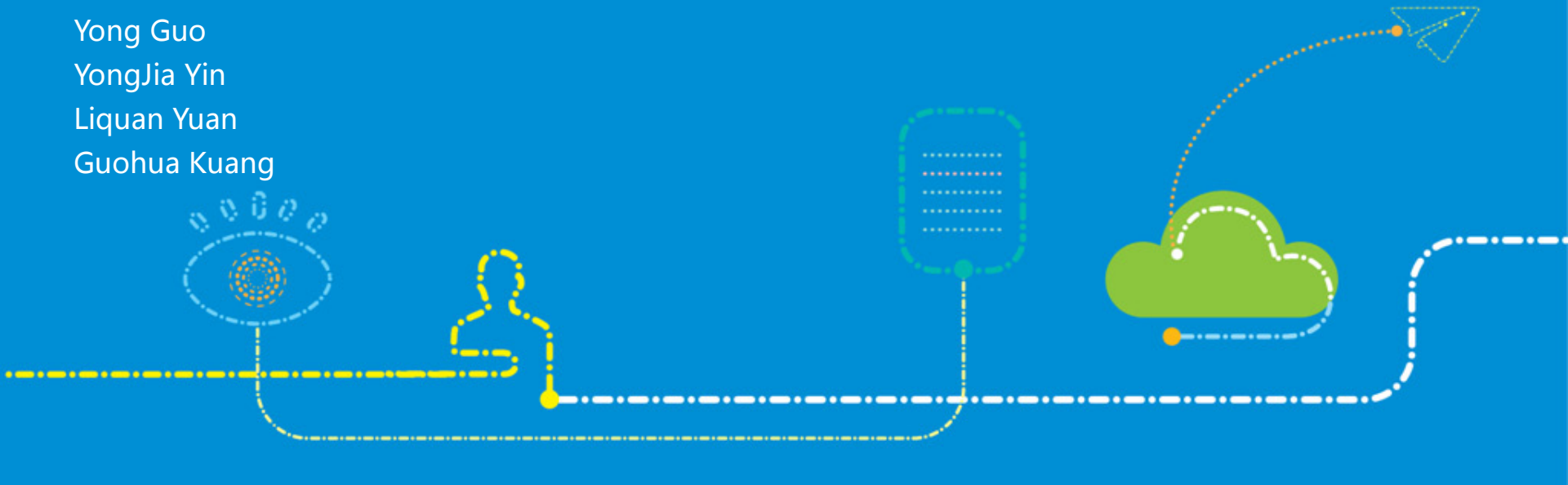

Supporters

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Introduction

There have been several modulation options proposed for 25G PHY in NG-EPON

- NRZ, DB or PAM4 are primary candidates
- However, many papers and reports reveal that they are of different implementations and bandwidth of components.

This presentation proposes to use 25Gb NRZ as the base modulation option and an enhanced PHY scheme to accommodate low bandwidth components (e.g., 10G).

NRZ as the base modulation option for 25G NG-EPON

So far, NRZ still works pretty good in fiber networks.

- NRZ outperforms multi-level modulation under same data rate.
  - NRZ shows better eye opening and timing accuracy.
  - Easily understandable and less new knowledge required.
- NRZ could greatly simplify and accelerate the standards and component design
  - Most 802.3 25Gb specs adopt NRZ, such as ba, bj, bm, by…
  - 25Gb supply chain is quite mature, great deal of 25Gb components for NRZ can be easily obtained, such as EML/DMLs, PIN/APD/TIAs, SERDES/CDRs…
  - 25Gb optics, such as SFP28 and QSFP28, have been commercialized available.
  - Equalization techniques for NRZ, such as Tx pre-emphasis, Rx CTLE, DFE/FFE and MLSE, have been built in 25Gb components

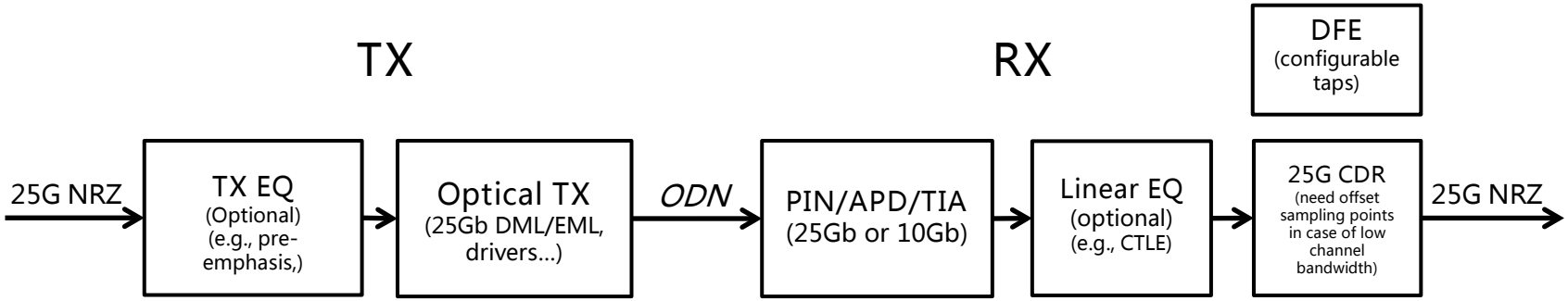
Concerns when using NRZ in 25G NG-EPON

NRZ has many advantages, however, several concerns have to be addressed and mitigated in 25G NG-EPON

- 25Gb requires stronger fiber dispersion mitigation
  - Several methods can be considered, such as using low-chirp DFB laser, external modulation, using O-band, DCF, EDC…

- Low bandwidth O/E components
  - There is a requirement that 10Gb optics shall still be used for 25G because 10Gb components are still cost-effective at this stage, especially for ONU.
  - Using low bandwidth O/E components introduces larger high-frequency signal loss and severe ISI in time domain, some enhancement techniques have to be considered, such as channel estimation and equalization.

Example architecture of enhanced PHY



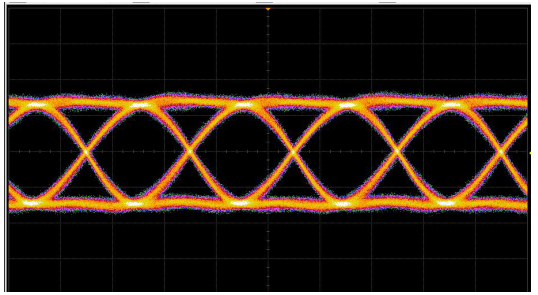
Enhanced PHY is technically feasible and cost-effective

- All functional blocks have been widely used in existing systems and 25Gb chipsets.
  - 25Gb NRZ can be straight supported in case 25Gb components are in use
  - If low bandwidth components (e.g., 10G optics) are used, 25Gb NRZ can also be achieved using advanced signal processing functions.
  - Functional settings, such as filter taps and CDR offsets, can be adjustable.

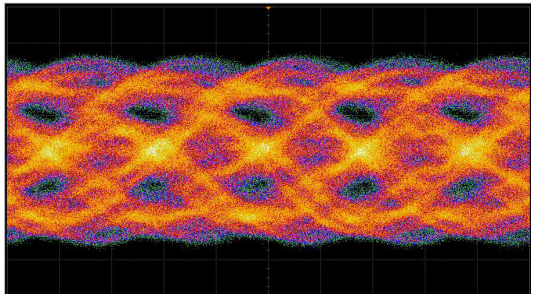
Experimental results

Experiment setup using 10G O/E components

- Wavelength: 1550nm
- 25km fiber transmission
- 25G NRZ signal generated using Keysight AWG 8195A
- Optical Tx uses 10G EML with 3dB bandwidth more than 15G
- Optical Rx uses OKI 10G PIN/TIA and Sumitomo 10G APD ROSA
- Received data are offline processed using 25GHz oscilloscope DSOX92504A with proposed PHY scheme
- Evaluated BER at 10^{-3}
- Measured sensitivity after 25km transmission
  - 10G PIN/TIA: -16dBm
  - 10G APD ROSA: -24dBm



25Gb NRZ AWG output



10G PIN/TIA output after 25Km

Summary

Proposes NRZ as the base modulation option

Enhanced PHY scheme to cope with low bandwidth components

Experimental results show technical feasibility

Thank you

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