Basic Study about Bandwidth Requirement for Discrete Multi-tone Modulation

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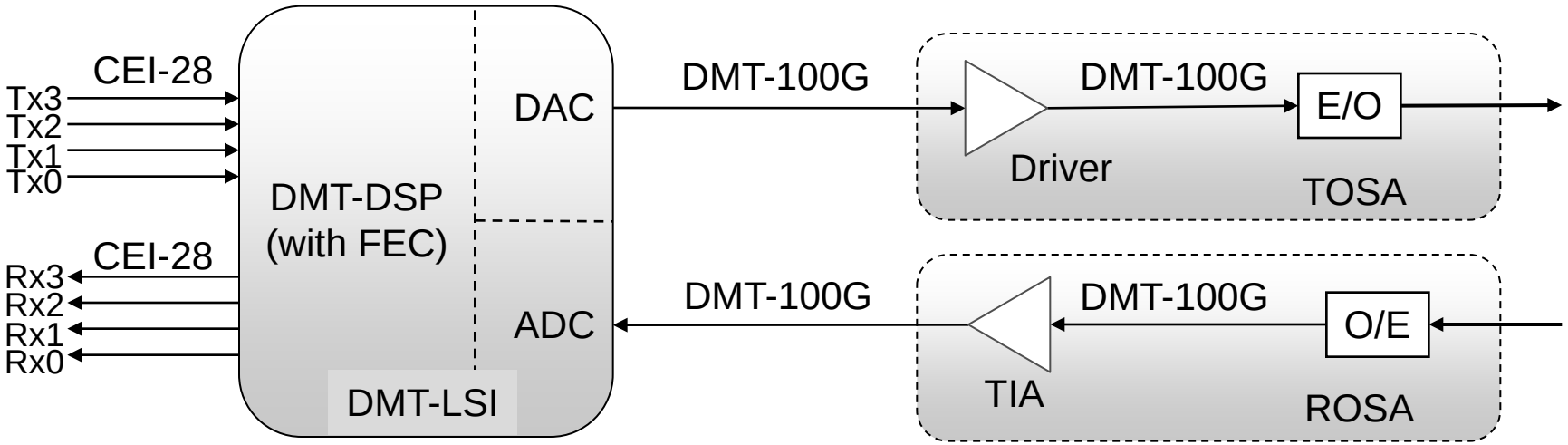
Background

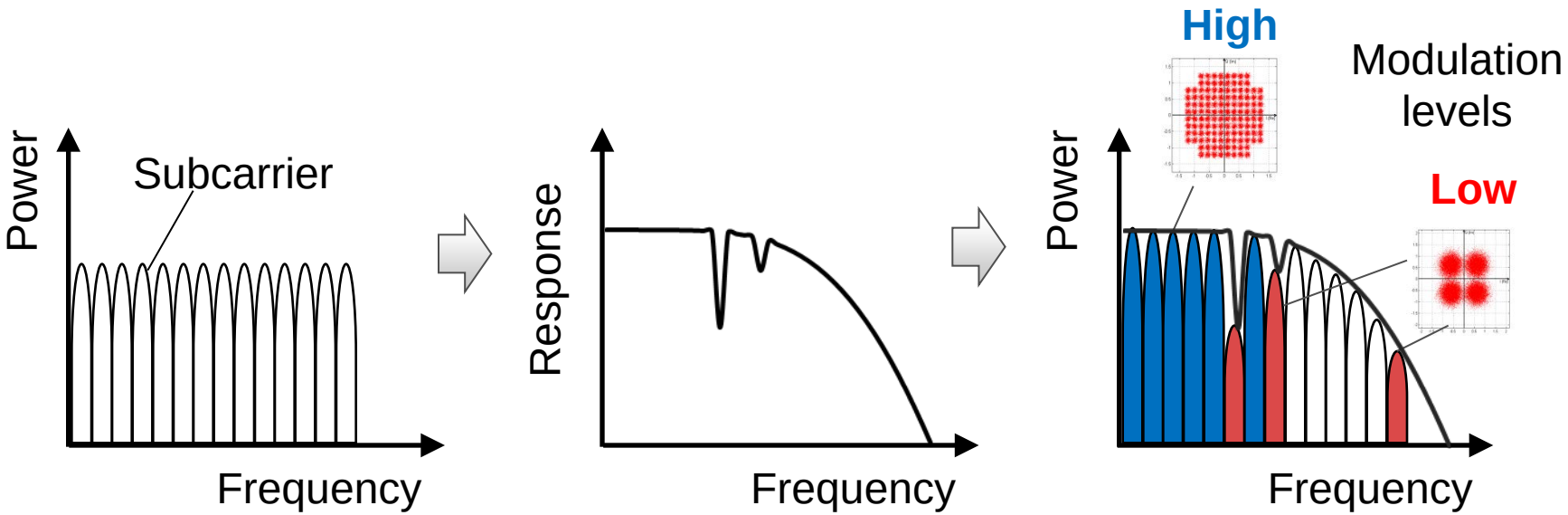
- Previous presentation
  - Basic explanation of Discrete Multi-Tone (DMT)
  - Experimental results for 100GbE DMT
- This presentation
  - Basic simulation for optical 100GbE DMT
    - Bandwidth requirement
  - Discussion for device candidate



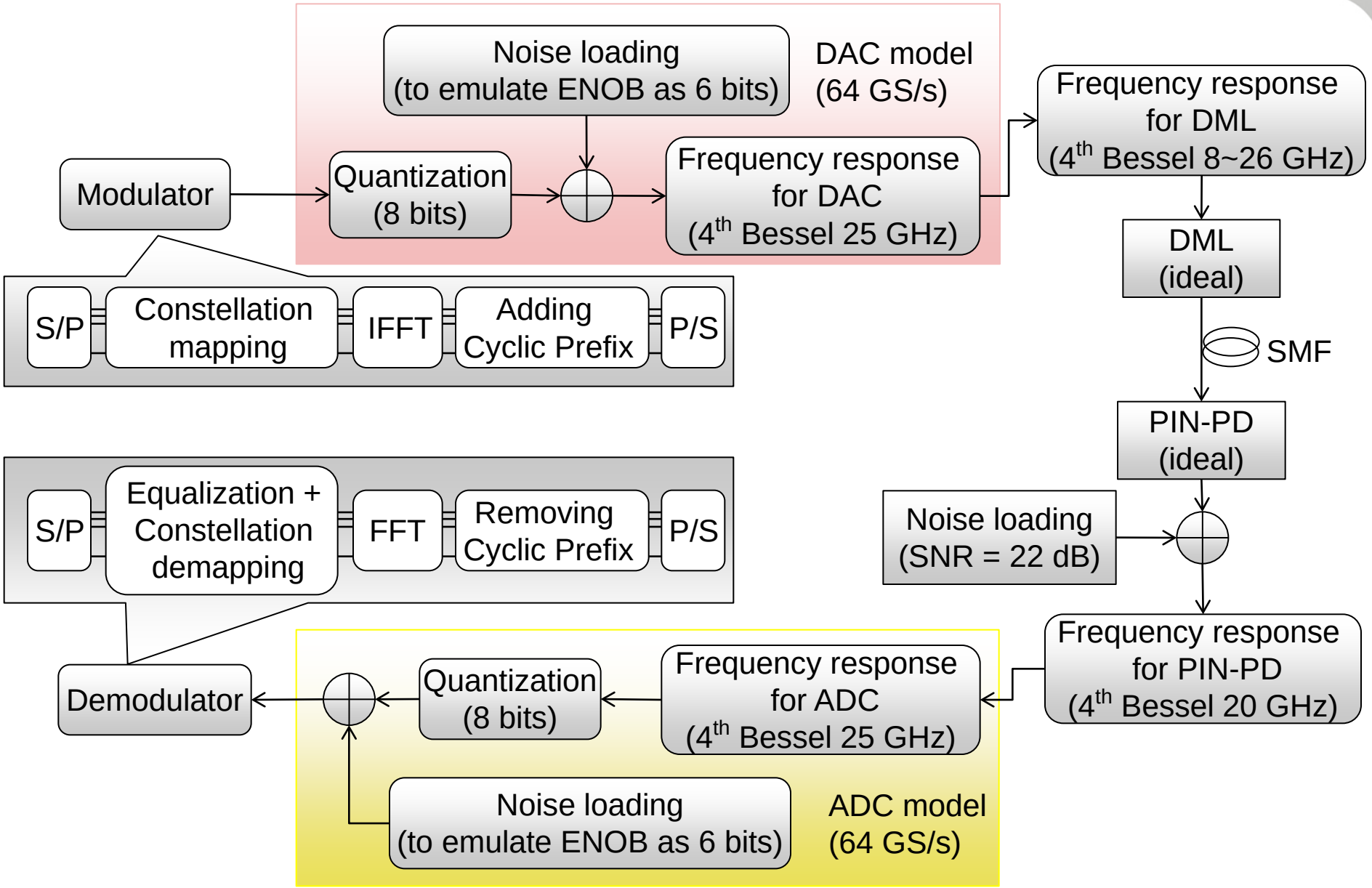
(TIA: Transimpedance amplifier, TOSA: Transmitter optical subassembly, ROSA: Receiver optical subassembly)

Discrete Multi-tone (DMT) Technology

- Widely used in xDSL systems (ADSL, HDSL….)
  - High spectral efficiency and cost effectiveness
- Adaptive bit and power allocation for each subcarrier depending on transmission characteristics
  - SNR measurement by using the probing signal
    - Modulation format of all subcarriers: QPSK
  - Waterfilling algorithm from the SNRs of the transmitted probing signal

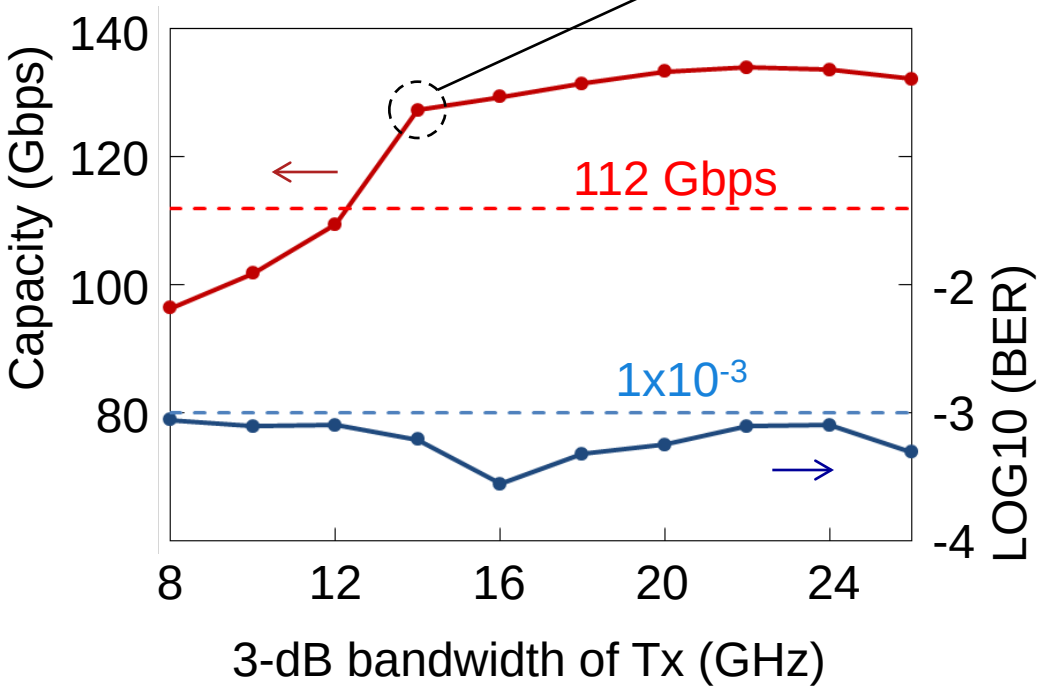


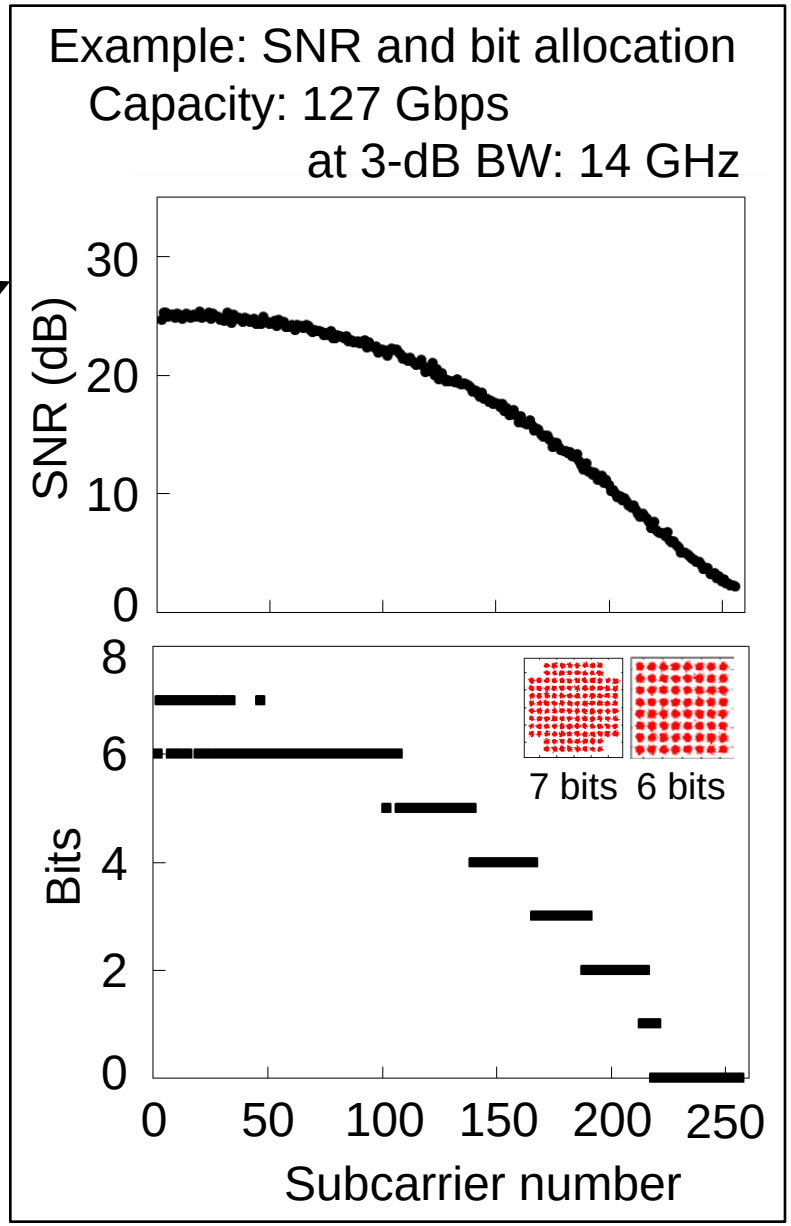
Simulation Platform



Bandwidth Requirement for Optical 100GbE DMT

- Simulation condition for DMT
  - ✓ Subcarrier(SC) number: 256
  - ✓ Baud rate per SC: about 125 MHz
  - ✓ Cyclic prefix: 16
  - ✓ Target BER: $1x10^{-3}$





Discussion for Device Candidates

From the basic simulation, Tx bandwidth requirement is less than 14 GHz.

- Transmitter (TOSA)
  - Any devices used in modules for 10GbE-LR and 100GbE-LR4
    - 10-Gbps class TOSA: 10-Gbps class DML, 10-Gbps class EML
    - 25-Gbps class TOSA: 25-Gbps class DML, 25-Gbps class EML

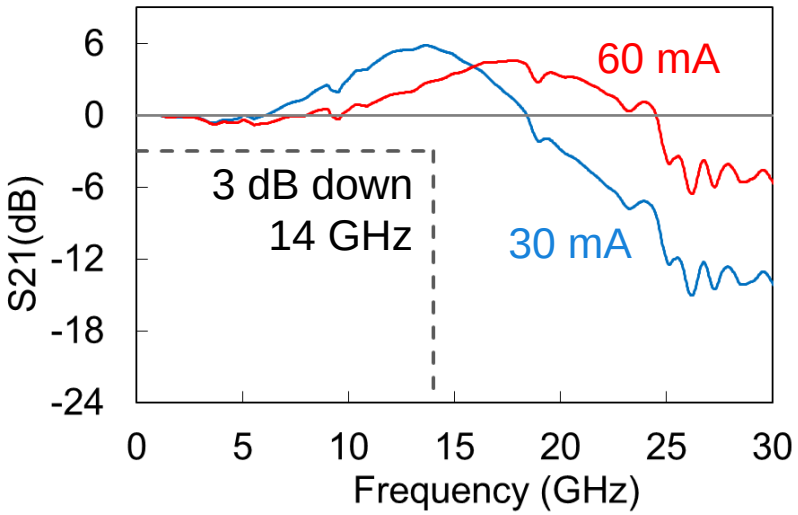
  Driver amplifier has to be changed to linear amplifier.

- Receiver (ROSA)
  - Devices used in modules for 100GbE-LR4
    - 25-Gbps class ROSA: 25-Gbps class PD
  - Receiver with narrower bandwidth than 20 GHz might be possible.
    - will check with simulation

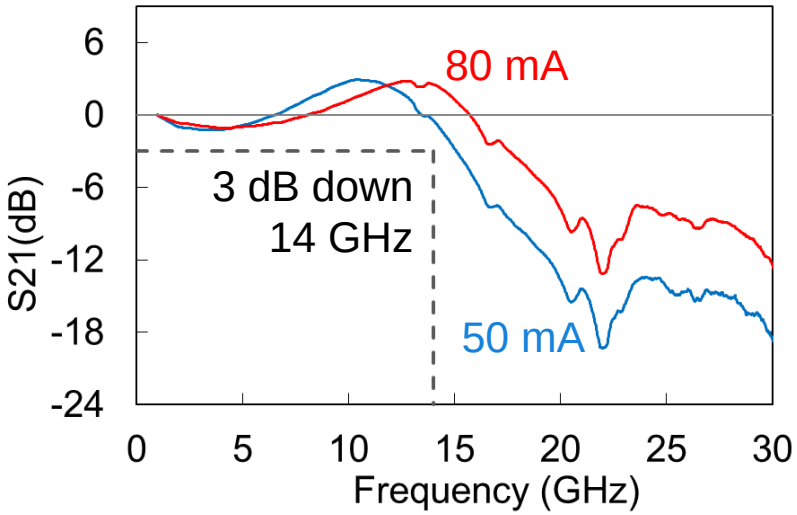
  Limiting amplifier has to be changed to linear amplifier.

Example of Frequency Response

- 10-Gbps class DML
  - Vendor1



  - Vendor2



DMT modulation is tolerant of a non-ideal frequency response due to bit allocation for each SC with low baud rate

Summary

- Basic simulation for optical 100GbE DMT
  - Tx bandwidth requirement: less than 14 GHz
- Discussion for device candidates
  - Transmitter: 10-Gbps class DML, 10-Gbps class EML,
    25-Gbps class DML, 25-Gbps class EML
  - Receiver: 25-Gbps class PD

    Narrow bandwidth receivers will be evaluated through simulation.

➢ Linear operation required for Tx and Rx amplifiers.

Thank you