

# Meeting the Need for Speed - OIF work on 100G Long Haul DWDM



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# Topics

- ◆ Carriers Requirements
- ◆ Status of 100G Standards
- ◆ OIF Roles in 100G
- ◆ Key Elements of 100G ULH DWDM OIF Program
- ◆ Optical Modulation Formats
- ◆ Integrated photonic modulator/demodulator
- ◆ FEC
- ◆ 100G Transceiver Module Architecture
- ◆ Summary : OIF 100G Project Structure

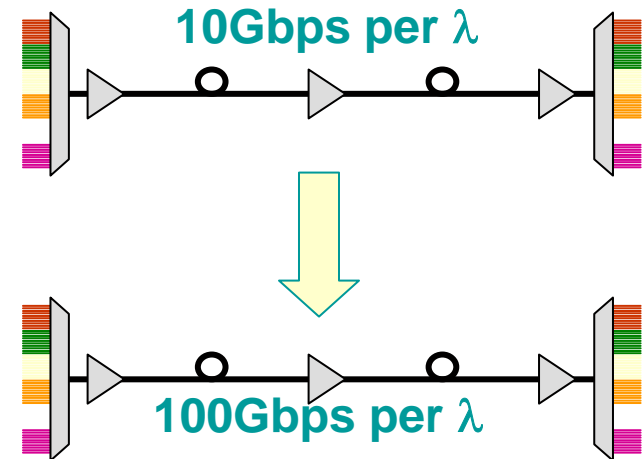
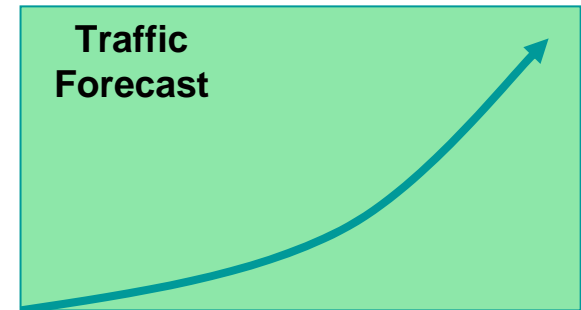
# What Tier-1 Carriers are Telling Us

## ◆ Needs:

- More transport capacity
- Support native 100G signals
  - Big pipes for their routers/switches
  - 100G services

## ◆ Requirements:

- Capacity efficiency
  - More than 10G, 40G systems
  - On existing infrastructure
    - Typically 80 ch & 1500 KM
- CAPEX benefits
  - lower cost per bit than 10G and 40G
- OPEX benefits
  - Number of systems constant
  - Reduced space and power per bit



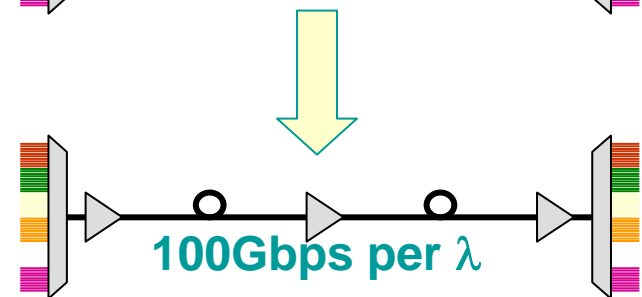
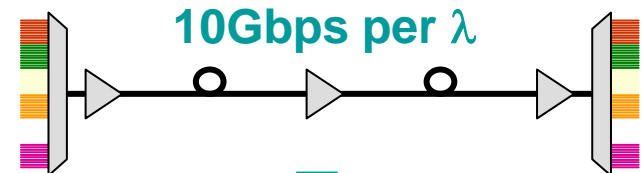
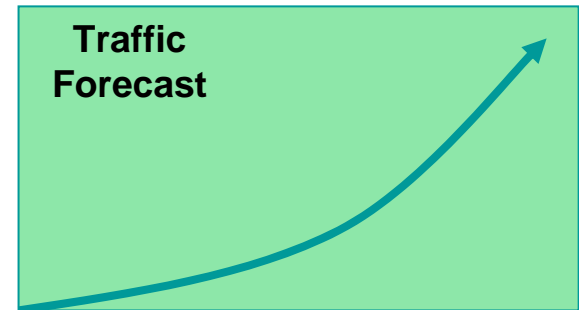
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# Industry Challenges - 100Gb/s

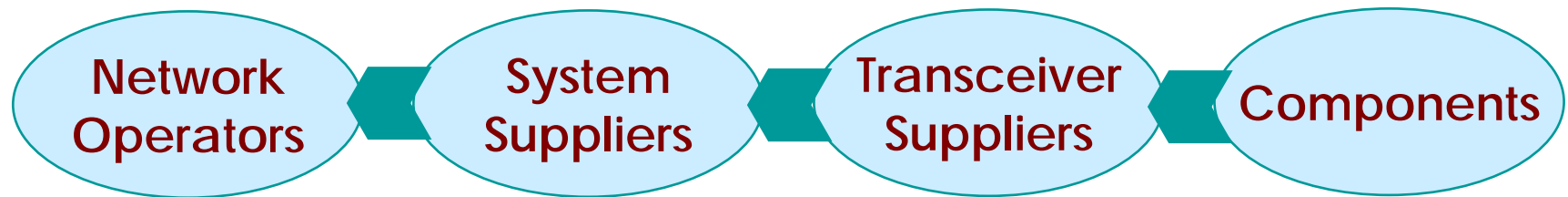
- ◆ Market need exists for 100G
- ◆ Market demands are driving carriers and NE vendors to 100G field trials in advance of standards
- ◆ Some NE vendors are developing first generation 100G product – may not be as compact as carriers need
- ◆ Component/chip suppliers must make significant investments to support 100G in the face of emerging standards
- ◆ A fragmented customer base and a modest market in the initial years of 100G

# Status of 100G Standards: IEEE 802.3ba and ITU-T

- ◆ IEEE 802.3ba TF
  - 100GE/40GE specification progressing well (Draft D2.1 is available, approval standards July 2010)
  - one of the agreed objectives for 40GE/100GE is the appropriate support of OTN
- ◆ For 100Gb, OTN transport (ODU4) is currently being defined by ITU-T SG15 in recommendation G.709 (Scheduled for approval Oct 09)
- ◆ Close cooperation between IEEE and ITU-T to meet the requirements of both groups is maintained

# OIF Role in 100G

Foster an ecosystem to accelerate the availability of economically attractive 100G transmission solutions for ULH DWDM networks



## Approach

- ◆ Choose application target – core backbone networks
- ◆ Build upon IEEE and ITU-T standards
- ◆ Agree on modulation format
- ◆ Identify key technology building blocks and interfaces
- ◆ Develop interoperability agreements among building blocks
- ◆ Develop Implementation Agreements for MSA transceiver module and integrated photonics module
- ◆ “Line side” DWDM system interoperability is not a current objective

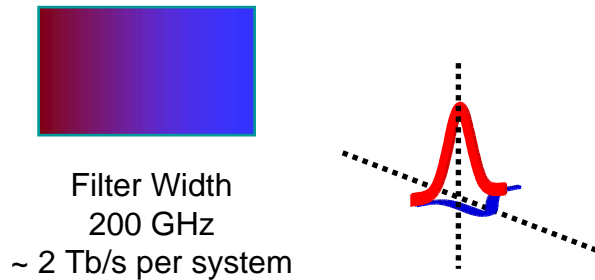
# 100G ULH DWDM

## Key elements of the OIF 100G program

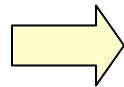
- ◆ Dual polarization with quadrature phase shift keying modulation
  - Spectrally efficient, improved signal/noise, CMOS electronics
- ◆ Coherent receiver technology
  - Improved signal/noise ratio, mitigate optical impairments in CMOS
- ◆ Dense photonic module integration
  - Hybrid or monolithic integration to reduce cost, space and power
- ◆ High Performance Forward Error Correction (FEC)
  - Improved coding gain over current 10G systems
- ◆ Industry standard MSA transceiver module
  - Specifying physical outline, pin-out, control, max power dissipation
  - Compatible with but not limited to DP-QPSK modulation
  - No specification for line side DWDM interoperability

# 100 G Modulation Format

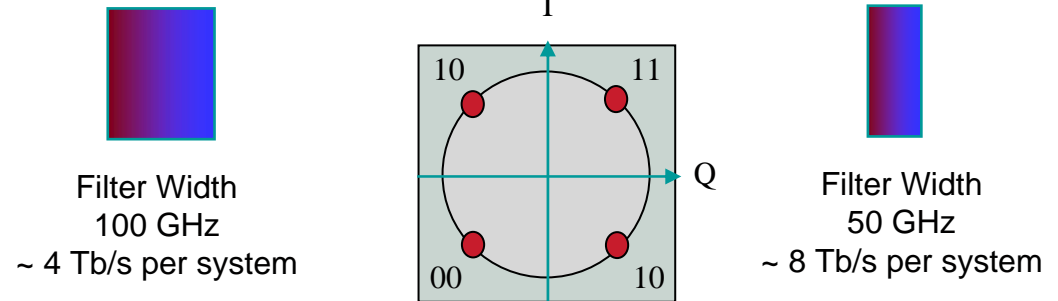
## Dual Polarization



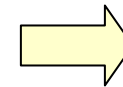
1 X 100 G



## Quadrature Phase Shift Keying



2 X 50 G

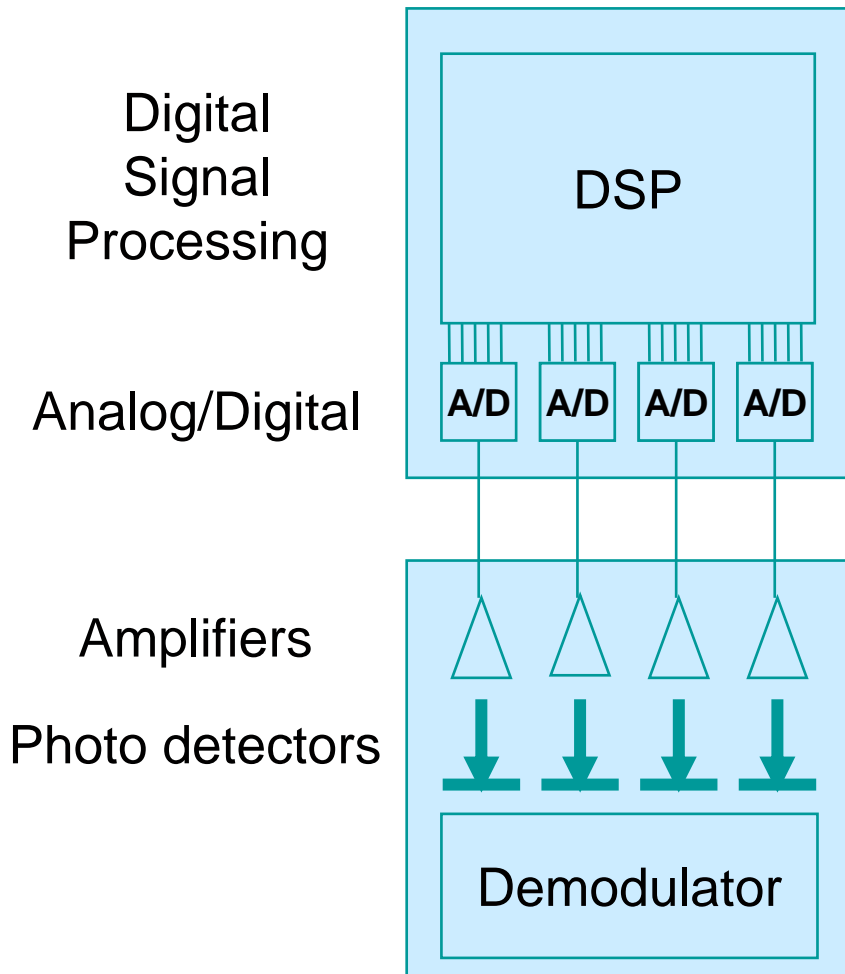


4 X 25 G

Trade speed for parallelism, then attack parallel complexity with photonic integration

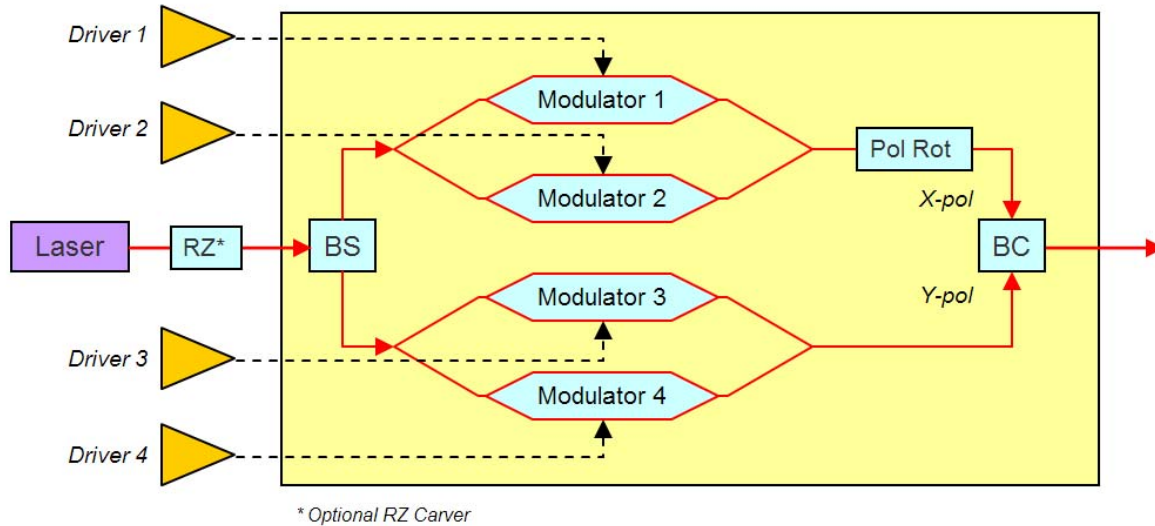
- ◆ **Two independent polarizations**
  - Same optical frequency
  - Halves the data rate
  - Halves the spectral width
  - Doubles components
- ◆ **Data encoded into 4 phase states**
  - Phase symbol – 2 bits of data
  - Halves the symbol rate
  - Halves the spectral width
  - Doubles components

# Coherent Receiver



- ◆ Improved signal/noise ratio
- ◆ Preserves optical phase info
- ◆ Electronic solution for
  - polarization separation
  - phase resolution
  - chromatic dispersion
  - polarization mode dispersion (PMD)
- ◆ Silicon economics

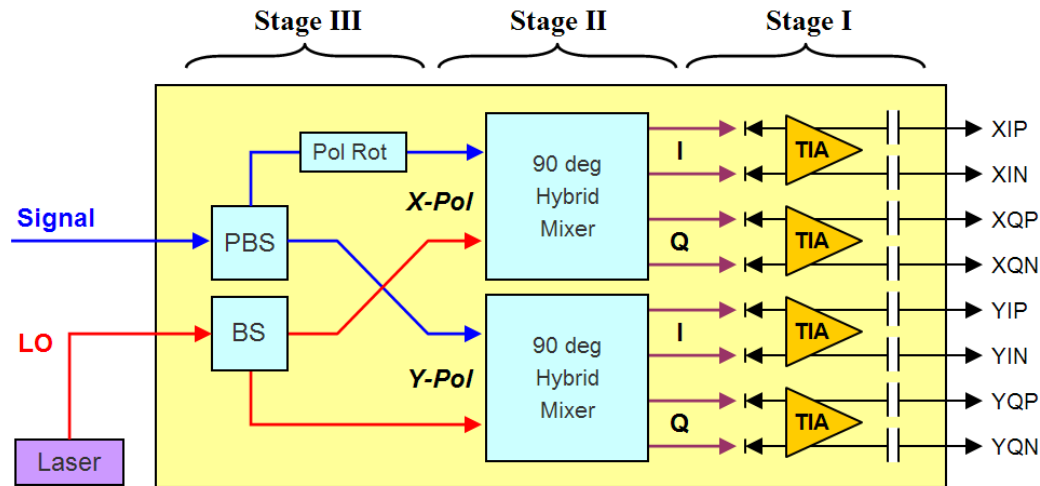
# Integrated Photonic Modulator



- ◆ **Current photonic transmitter module composition**
  - **Modulators and other optical components integrated**
  - **Integrated drivers on separate module(s)**
  - **Transmit laser using OIF ITLA\***
- ◆ **Future possibility of further integration**

\*Integratable Tunable Laser Assembly Implementation Agreement

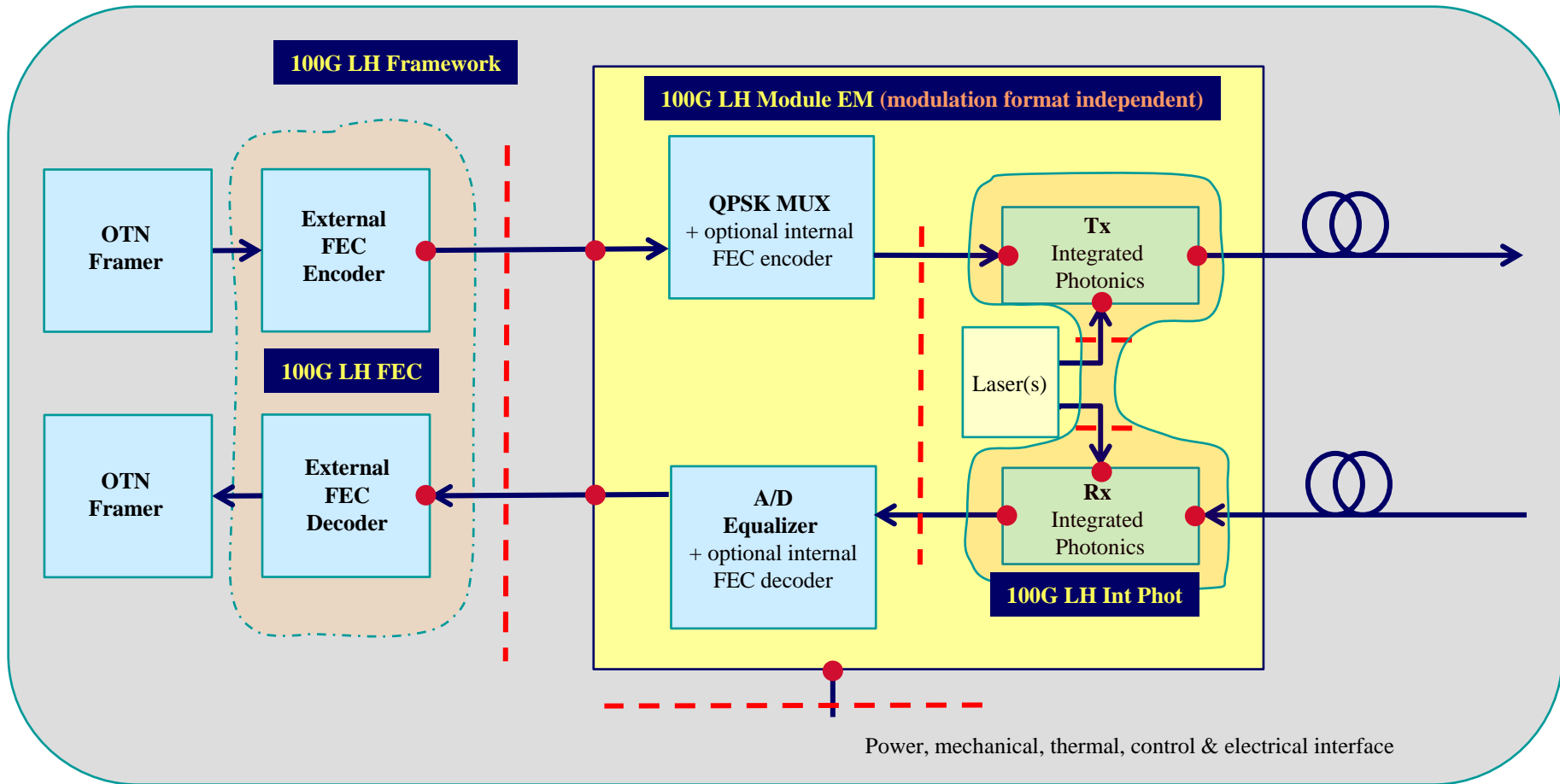
# Integrated Photonic Demodulator/Receiver



- ◆ **Current photonic receiver module composition**
  - **Beam splitters, hybrids, photodetectors and TIAs**
  - **Separate local oscillator based on OIF ITLA**

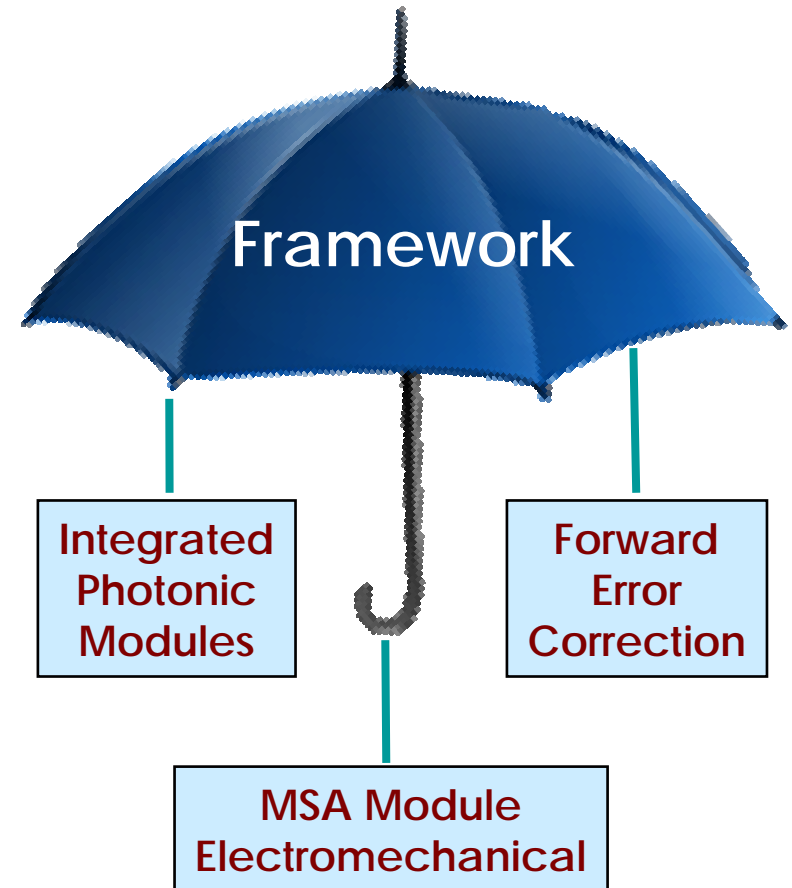


# 100G Transceiver Module Architecture



# Summary : OIF 100G Project Structure

- ◆ **Framework**
  - Application description
  - High level transceiver architecture
  - Transceiver modular decomposition
- ◆ **Integrated Photonic Modules**
  - Transmitter Module IA
  - Receiver module IA
  - Foundation for MSA Module IAs
- ◆ **Forward Error Correction**
  - Channel model
  - Studies of coding approaches
  - Performance estimates
- ◆ **Module - Electromechanical**
  - Mechanical dimensions
  - Electrical connector
  - Max power consumption
  - Communications interface



# Thank You for Attending!

## Collaboration and Innovation. At Light Speed.

For more information on the OIF please visit  
[www.oiforum.com](http://www.oiforum.com)