

ECOC 2025, WORKSHOP 15:

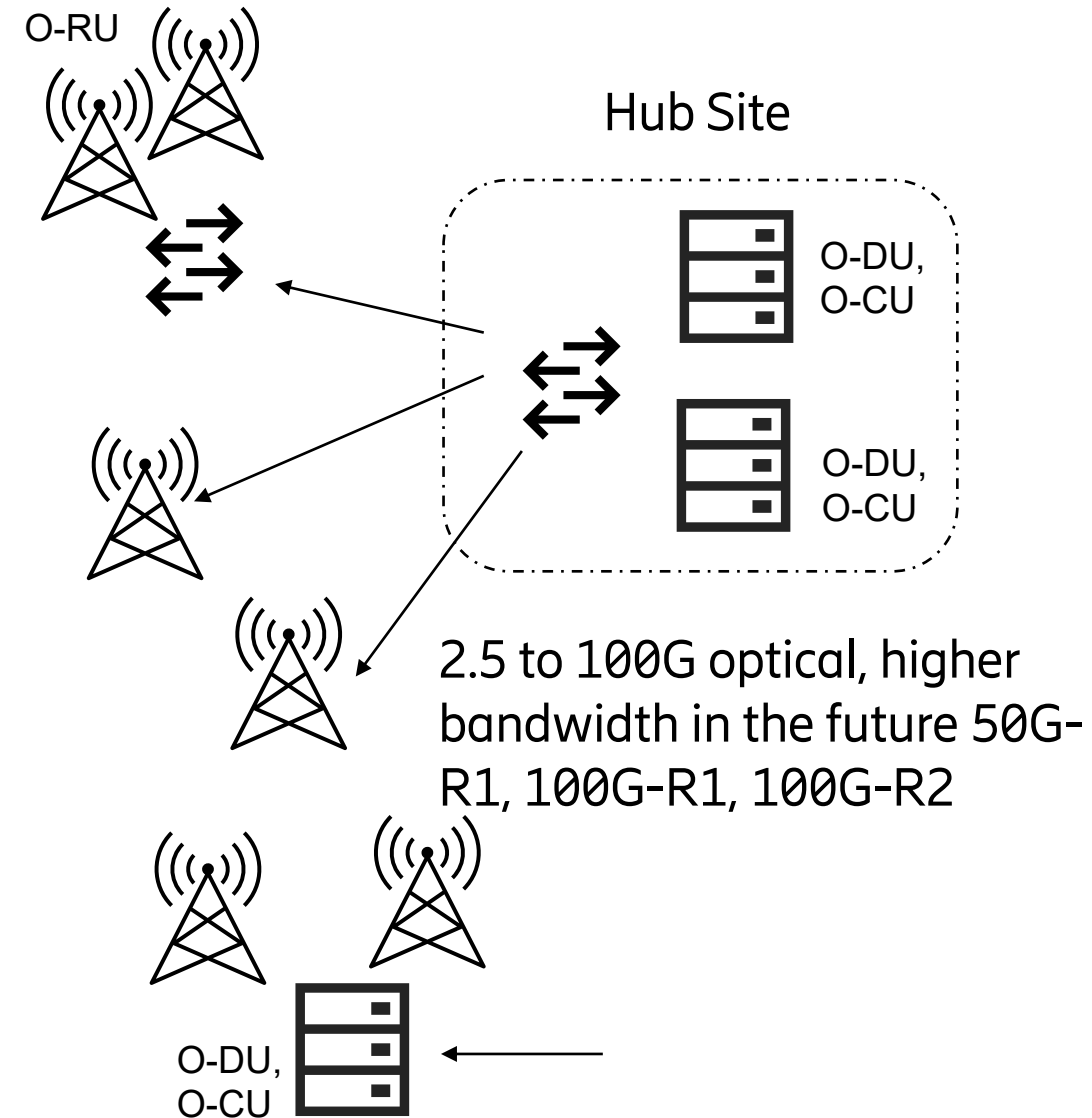
**Optical auto-negotiation
for mobile fronthaul links
Sunday, September 28**



Ulf Parkholm, Ericsson, Sweden

Background & Problem formulation

- Need to support a complex and heterogenous RAN transport environment; CRAN & DRAN
- Advances in silicon and optical technology loosely aligns with generation of BaseBand, Transport and Radio equipment
- Brownfield installation is the norm, maintaining interoperability and backwards compatibility is key
- Automation and zero touch installation & upgrade is highly advantageous
- Trial and Error link up, CPRI Auto Detect, low visibility & troubleshooting capability

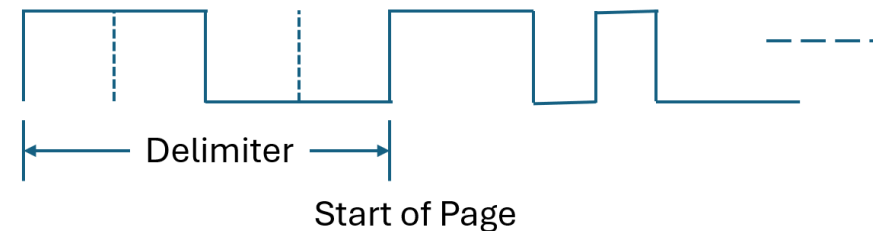
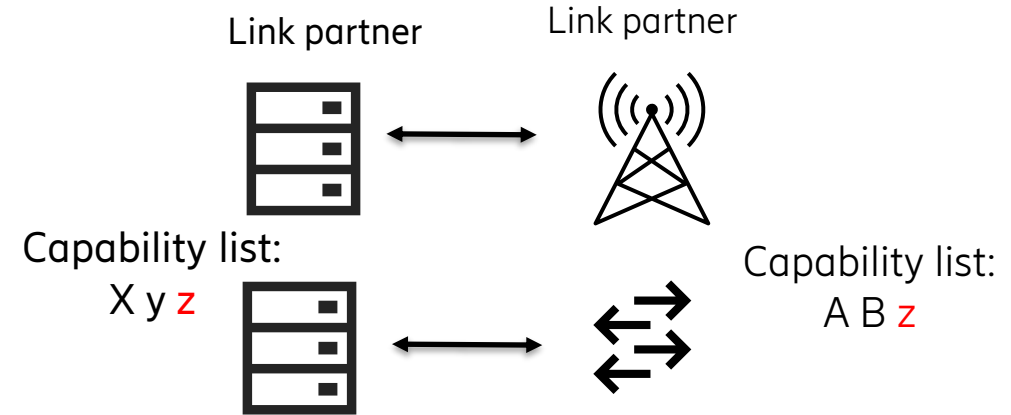


Ethernet Auto-Negotiation (AN) IEEE 802.3 Clause 73

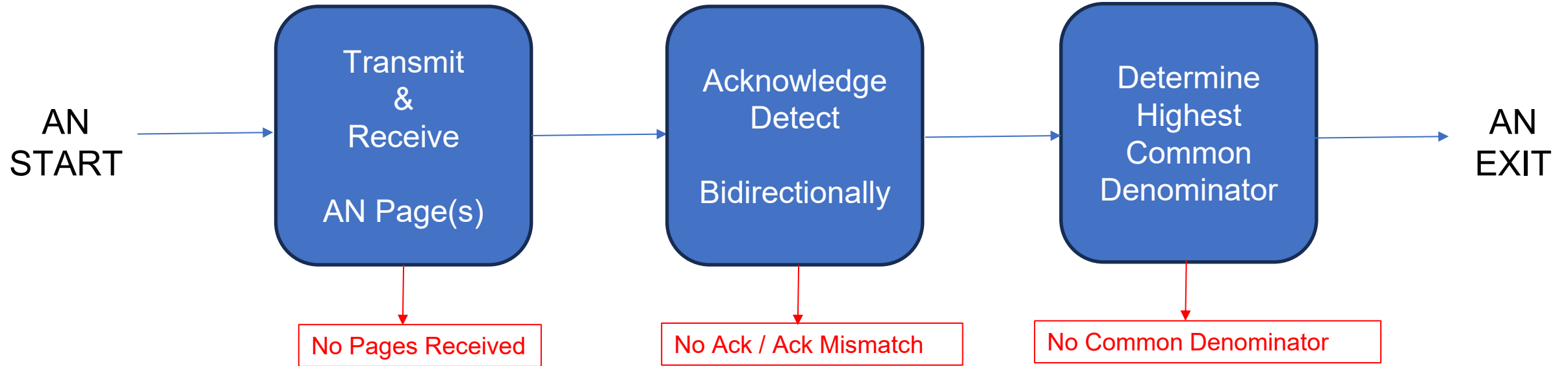
Purpose: Advertise capabilities -> Establish a common mode of operation with the link partners

Features:

- Low-speed out-of-band signal
 - About 312.5Mbaud
- Differential Manchester Encoding (DME)
 - Odd position - Clock
 - Even position - Data
 - Delimiter - beginning of a page
- Base Link codeword (Base Page)
 - 48 bits
 - Technology Ability Field
 - Transmitted Nonce Field: the host device
 - Echoed Nonce Field: from the link partner
- Next Page
 - Additional information exchange



Ethernet Auto-Negotiation (AN) IEEE 802.3 Clause 73

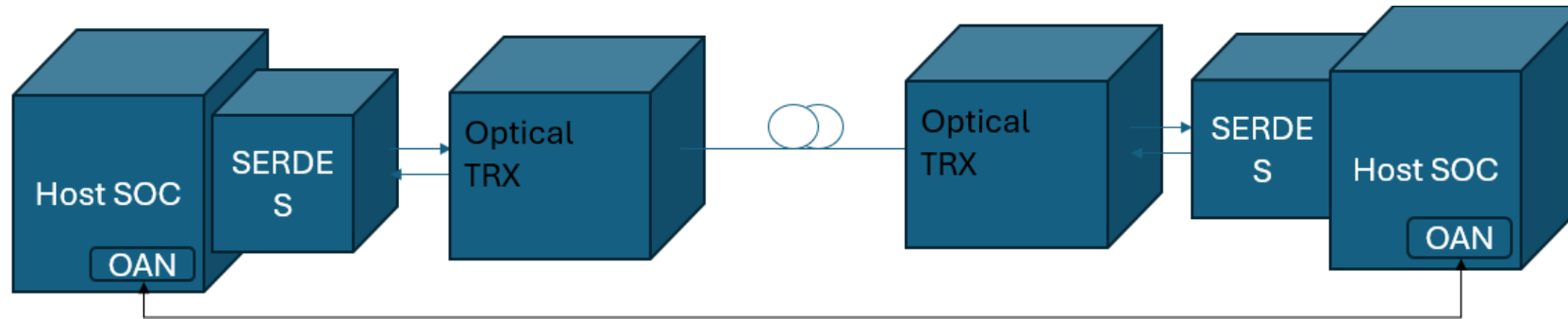


- AN Transmit, Receive, Arbitration Functions
- Priority Resolution Function
 - Determine the Highest Common Denominator
 - Line rate, data per lane, reach distance...

Advantages: Efficient, Flexible, Robust

Priority	Technology	Capability
1, Highest	200GBASE-KR4	200Gbps 4 lanes, backplane
2	100GBASE-KR2	100Gbps 2 lanes, backplane
3	100GBASE-CR4	100Gbps 4 lanes, copper cable
4	100GBASE-KR4	100Gbps 4 lanes, backplane
...
Lowest	1000BASE-KX	1Gbps 1 lane, backplane

Proposed Optical Auto Negotiation (OAN)



Standard Clause 73

- IEEE 802.3 Clause 73 AN (312.5Mbaud) to optical links
- Bypass Clock and Data Recovery(CDR) in optical plug

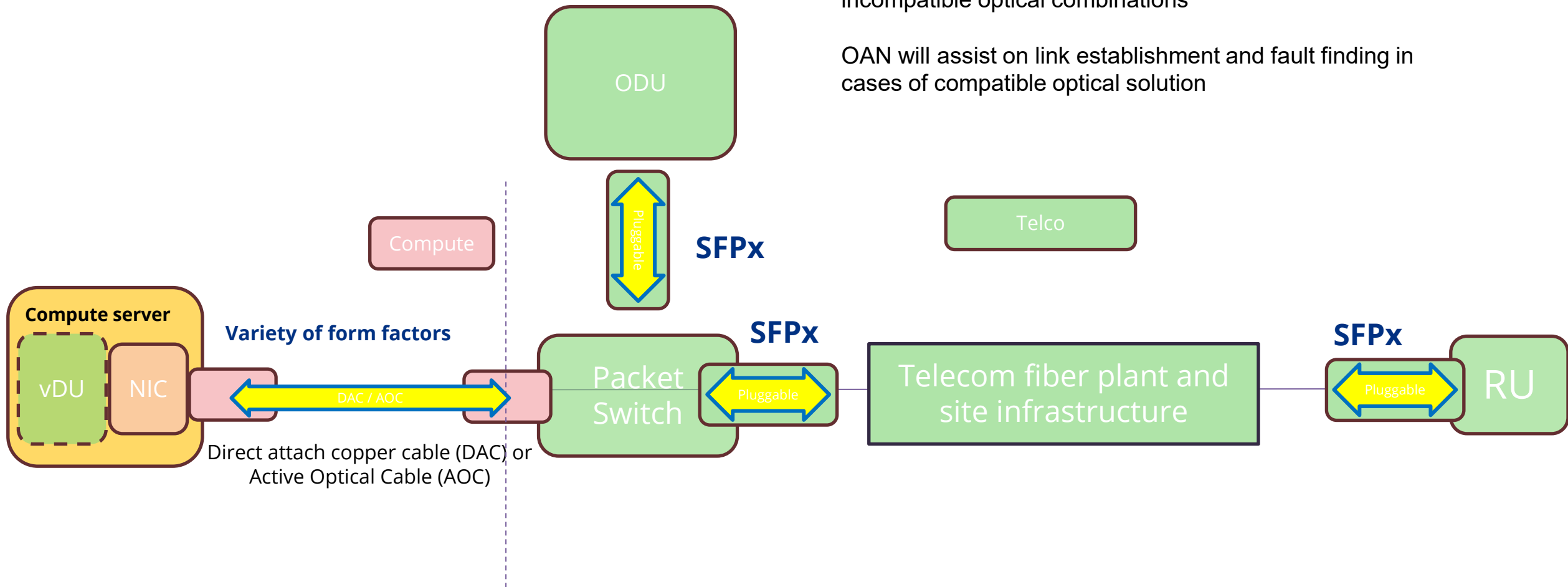
Direct Laser on/off Control (OOK)

- Laser on/off control -> Optical pulses with modulated data
- CDR bypass function not required

OR

Recommendation ITU-T G.698.4
(05/2025)

Not all optics are created equal



This OAN proposal doesn't solve all cases— there are many incompatible optical combinations

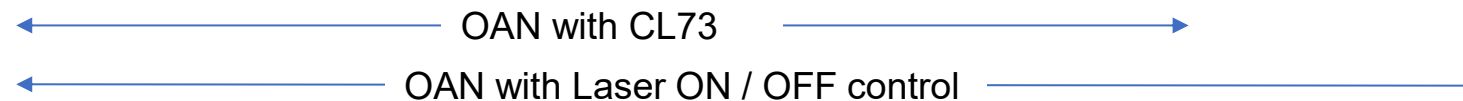
OAN will assist on link establishment and fault finding in cases of compatible optical solution

Proposed Optical Auto Negotiation used with SFPxy

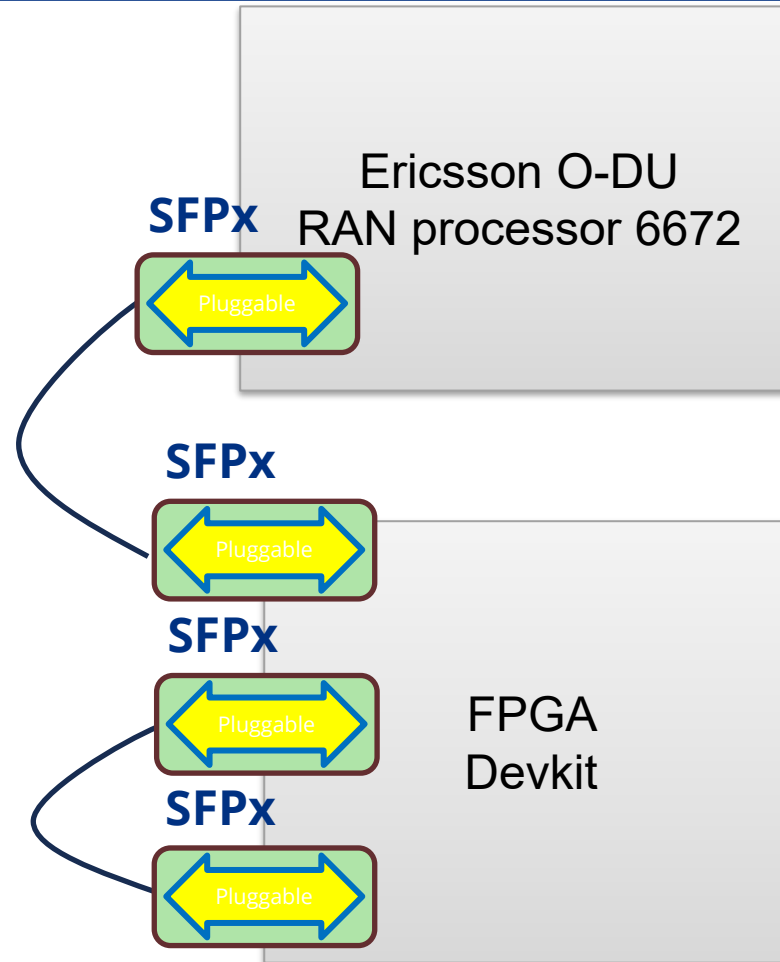
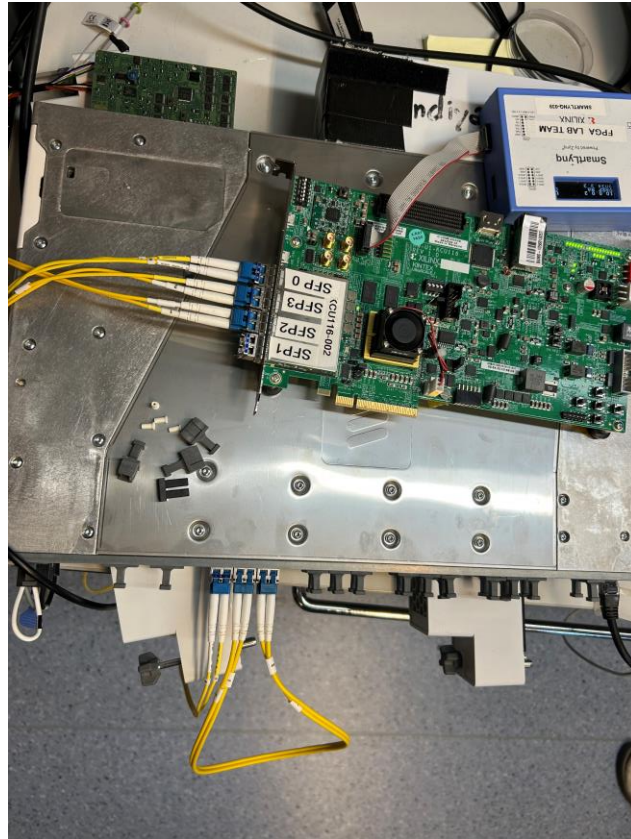
- **Small Form-Factor (SFF) Standards**
 - Low speed and enhanced interfaces
 - Memory maps: status and control registers
- **Electrical Control and Monitoring**
 - TX_Disable: turn on/off transmitter laser
 - RX_LOS: indicate loss of receiving signal
- **Module Selection**
 - Low-speed signal supported: corner frequency of capacitors (20kHz)
 - Line rates: range from low to high speed
 - Signal modulations: NRZ, PAM4...



Module Name	SFP+		SFP56			
	Ethernet Type	Line Rate (Gbps)	Internal Retimer/CDR	Ethernet Type	Line Rate (Gbps)	Internal Retimer/CDR
Ethernet Type	GbE	10GbE	Bypass	10GbE	25GbE	50GbE
Line Rate (Gbps)	1.25	10.3125	Bypass	10.3125	25.78125	53.125
Internal Retimer/CDR	Not implemented		Bypass	Bypass/ Enabled	Enabled	



Come visit ECOC 2025 OAN DEMO



AN Test completed at 12:49:02
Port0: 0x00000200, Port1: 0x00020200
Auto-negotiation succeed! Time consumption: 196 milliseconds

Laser ON Laser OFF Read AN Status

AN Ability Configuration:

Device/Port 0 Abilities	Device/Port 1 Abilities
<input type="checkbox"/> 1000base_kx	<input type="checkbox"/> 1000base_kx
<input type="checkbox"/> 2_5gbase_kx	<input type="checkbox"/> 2_5gbase_kx
<input type="checkbox"/> 5gbase_kr	<input type="checkbox"/> 5gbase_kr
<input type="checkbox"/> 10gbase_kx4	<input type="checkbox"/> 10gbase_kx4
<input type="checkbox"/> 10gbase_kr	<input type="checkbox"/> 10gbase_kr
<input checked="" type="checkbox"/> 25gbase_kr1	<input type="checkbox"/> 25gbase_kr1
<input checked="" type="checkbox"/> 25gbase_cr1	<input checked="" type="checkbox"/> 25gbase_cr1
<input checked="" type="checkbox"/> 25gbase_krcr_s	<input checked="" type="checkbox"/> 25gbase_krcr_s
<input type="checkbox"/> 25gbase_krcr	<input type="checkbox"/> 25gbase_krcr

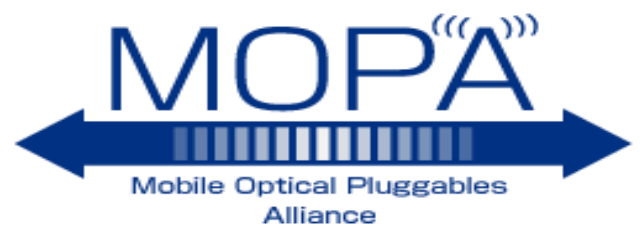
Start AN Test with Selected Abilities

Current AN Status:

Device/Port 0 Status	Device/Port 1 Status
STAT_AN_LINK_CTL (0x0460): Raw Value: 0x000C0000	STAT_AN_LINK_CTL (0x0460): Raw Value: 0x000C0000
<input checked="" type="checkbox"/> 1000base_kx	<input checked="" type="checkbox"/> 1000base_kx
<input checked="" type="checkbox"/> 10gbase_kx4	<input checked="" type="checkbox"/> 10gbase_kx4
<input checked="" type="checkbox"/> 10gbase_kr	<input checked="" type="checkbox"/> 10gbase_kr
<input checked="" type="checkbox"/> 25gbase_krcr_s	<input checked="" type="checkbox"/> 25gbase_krcr_s
<input checked="" type="checkbox"/> 25gbase_krcr	<input checked="" type="checkbox"/> 25gbase_krcr
<input checked="" type="checkbox"/> 2_5gbase_kx	<input checked="" type="checkbox"/> 2_5gbase_kx
<input checked="" type="checkbox"/> 5gbase_kr	<input checked="" type="checkbox"/> 5gbase_kr
STAT_AN_LINK_CTL2 (0x09F0): Raw Value: 0x00000000	STAT_AN_LINK_CTL2 (0x09F0): Raw Value: 0x00000000
<input checked="" type="checkbox"/> 25gbase_kr1	<input checked="" type="checkbox"/> 25gbase_kr1
<input checked="" type="checkbox"/> 25gbase_cr1	<input checked="" type="checkbox"/> 25gbase_cr1

ENABLE = PCS connected for mission mode
SCAN_FOR_CARRIER = RX connected to PCS
DISABLE = PCS disconnected
NOT_USED = Reserved state
Time: 2025-09-05 12:49:04

The demo's will be held on Tuesday 30th September in Hall C from **11.00am to 12.30pm.**



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