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*Fiber Optic Solutions
for High-Speed Networks*

100G/400G SMF O/E Roadmap



Innovative Optical Module Solutions for 400Gb/s Ethernet Workshop

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Bait and Switch

= Toss out a Brick to Attract Jade

#17 from Thirty Six Strategies of Ancient China

Prepare a trap by creating the illusion of easy gain.



Place the Cart Before the Horse

= Ben Mo Dao Zhi



Introduction

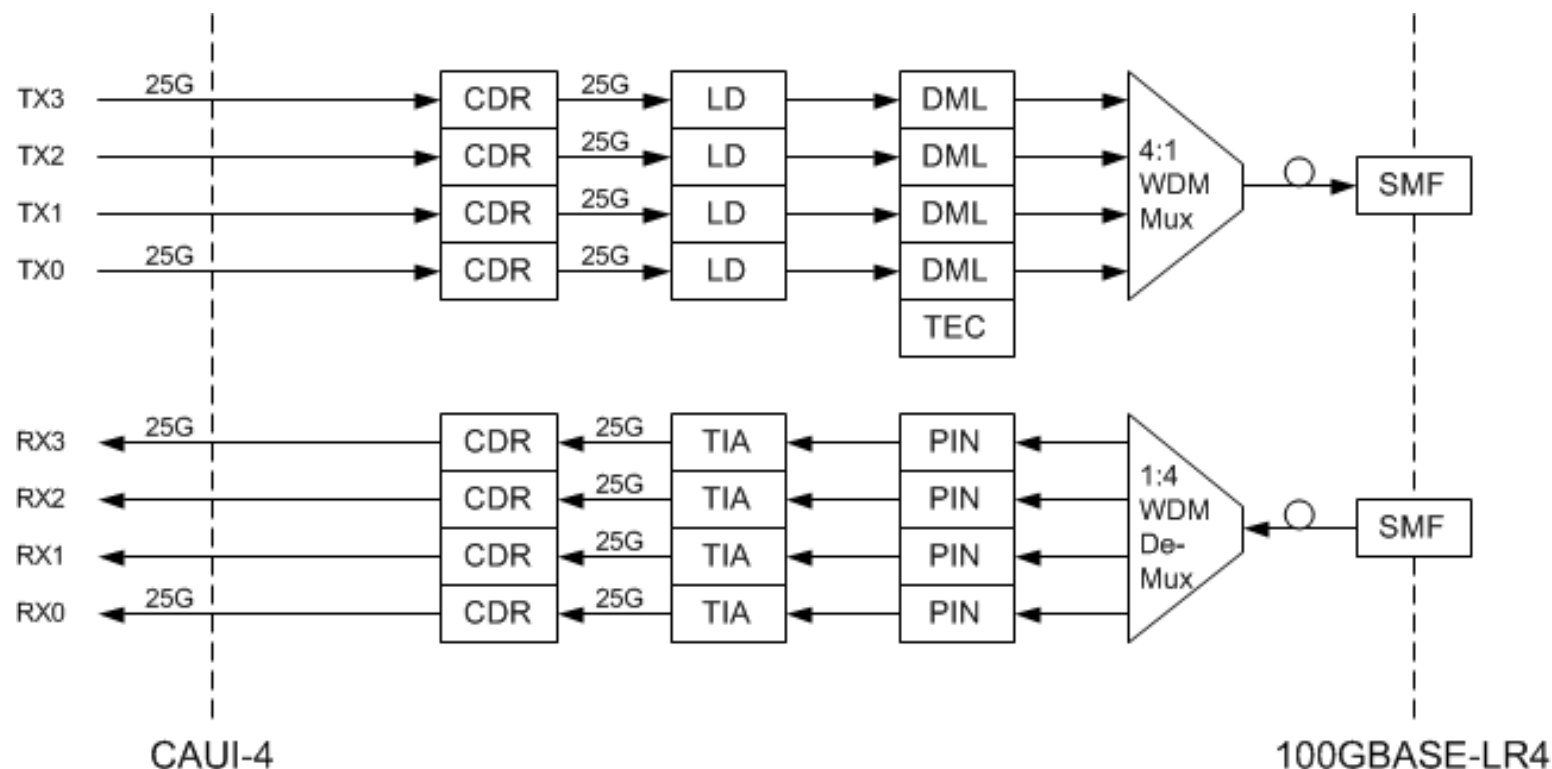
Why consider both 100G and 400G?

- ◆ Because next generation 100G and 400G should use common technology to leverage R&D investment

Do we have the answers to what 400G should be?

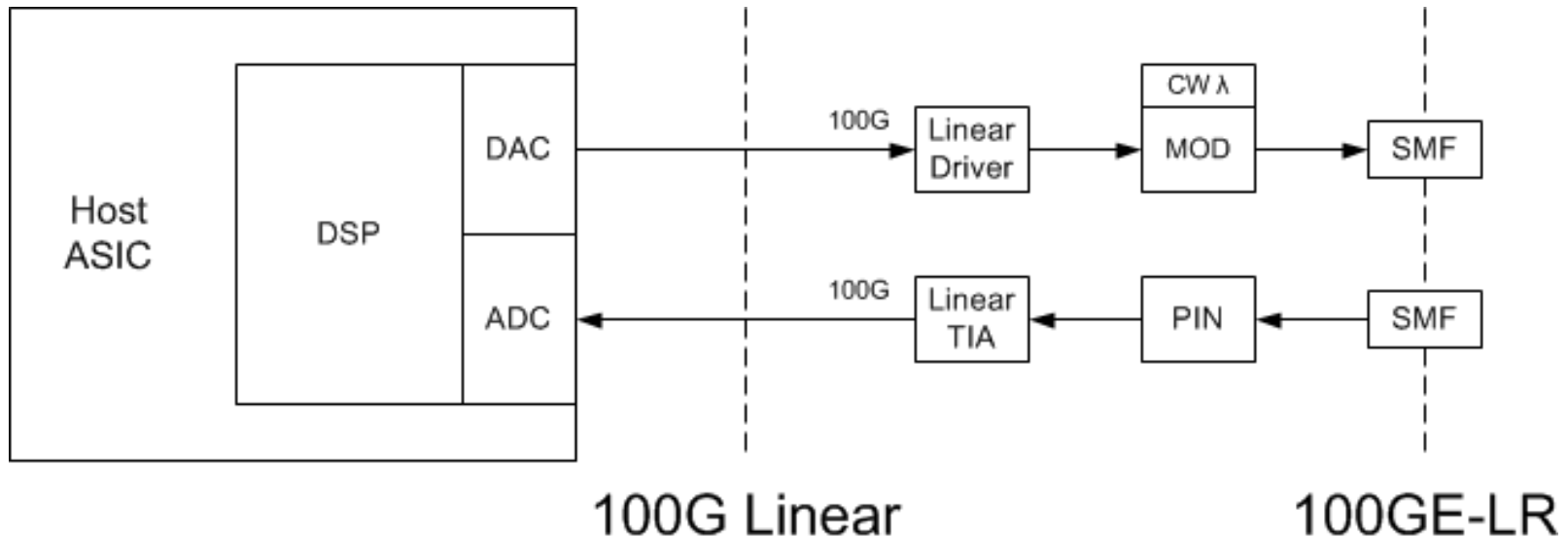
- ◆ No, because the real work is still to be done. We need to have the discipline not to jump to architectural decisions before we complete analysis. Huawei is showing technical leadership in doing the solid work required to find the right solution as demonstrated the IEEE 802.3 400G Study Group meeting in Indian Wells.

100G Today: 4x25G λ NRZ



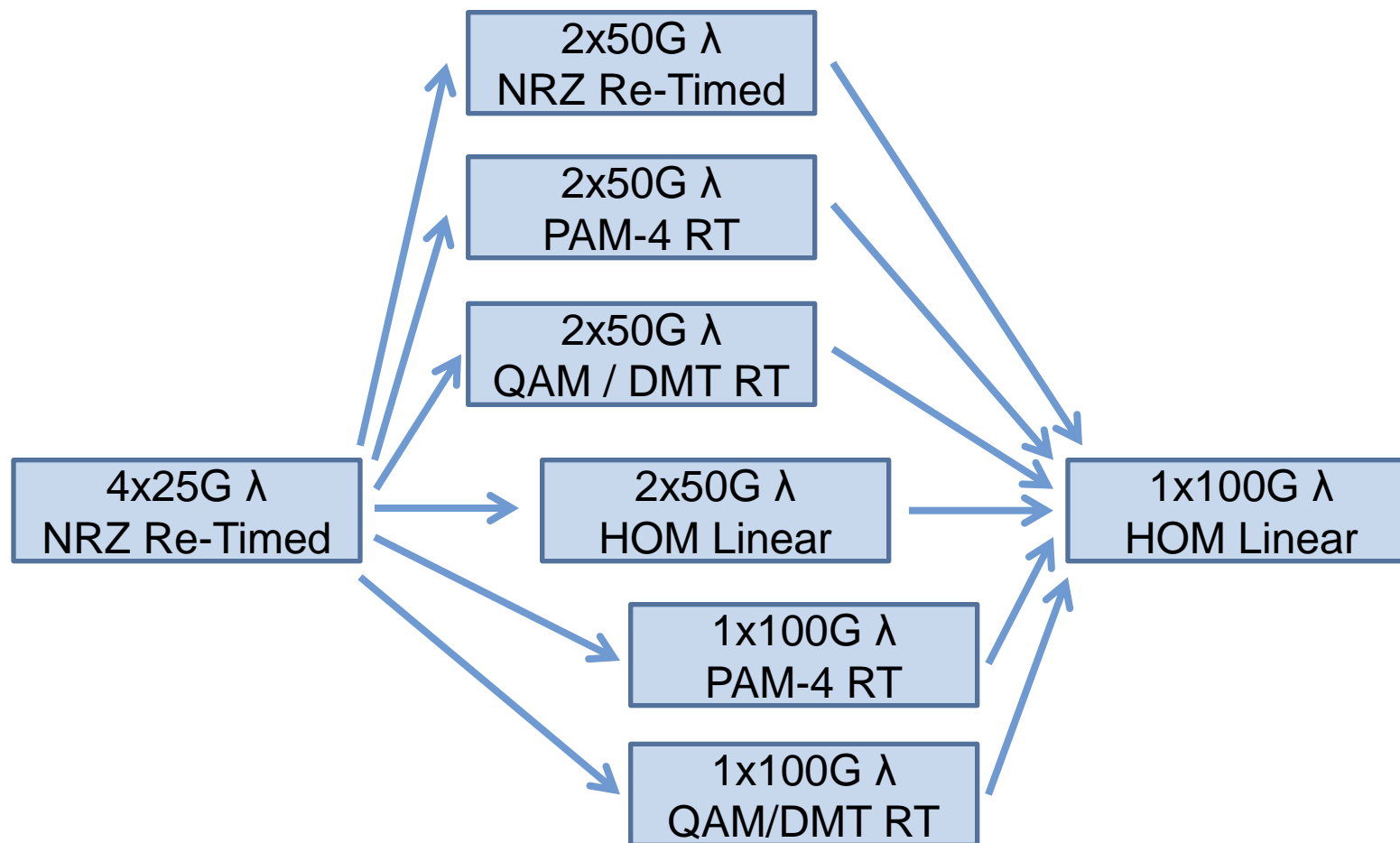
- ◆ SiP or InP Mod w/ Driver (MD) are alternatives
- ◆ CWDM alternative does not require a TEC
- ◆ LR4 is 4W typical in a CFP4 module (3W in a QSFP28)

Ultimate 100G: 1x100G λ HOM Linear



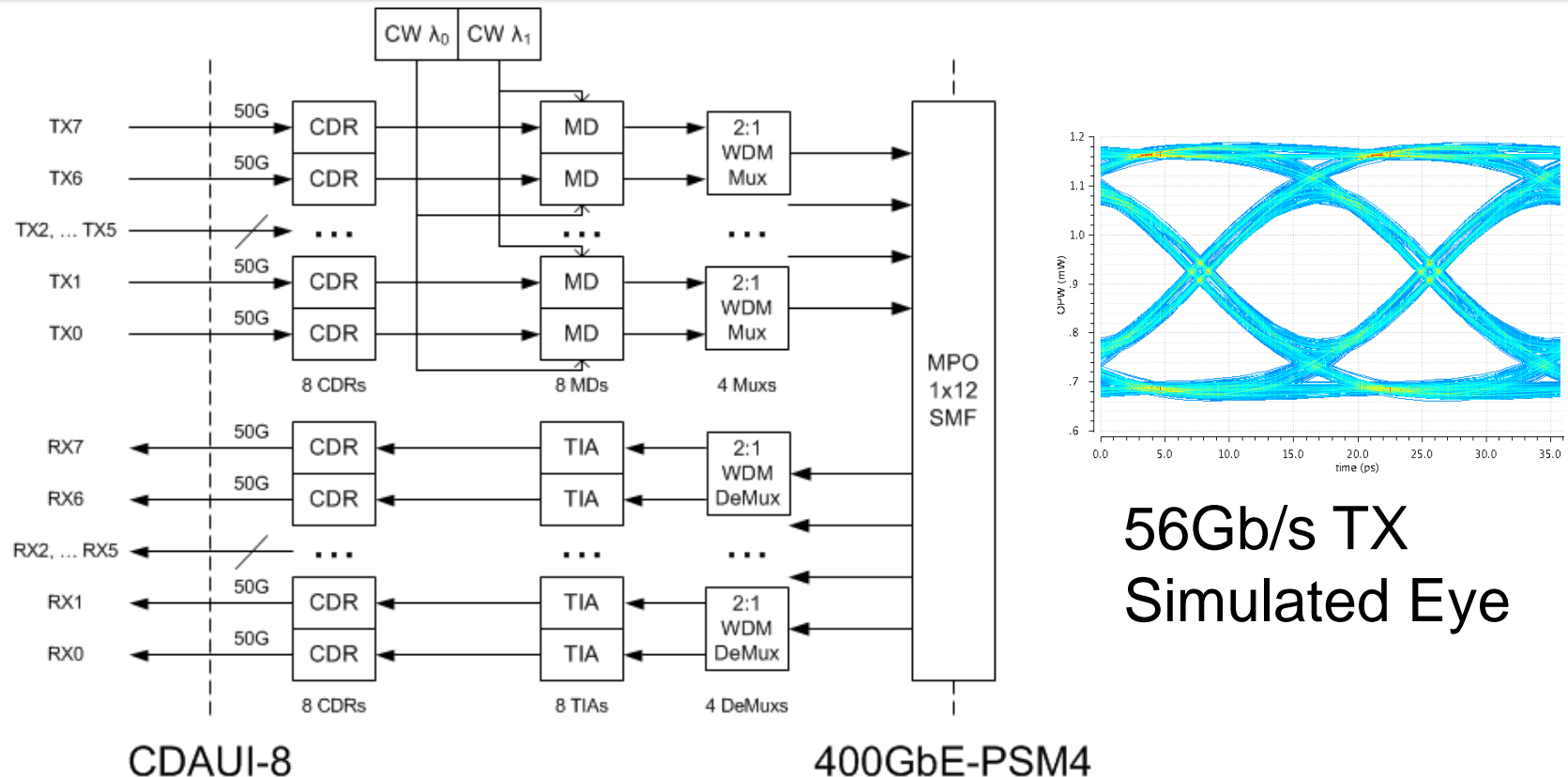
- ◆ Similar architecture to 10GbE-LRM SFP+
- ◆ Will leverage CFP2 AOC development
- ◆ Supports 4x density increase over 4x25G
- ◆ Requires future CMOS technology

100G Next Step Alternatives Roadmap



Each next step has advantages and disadvantages

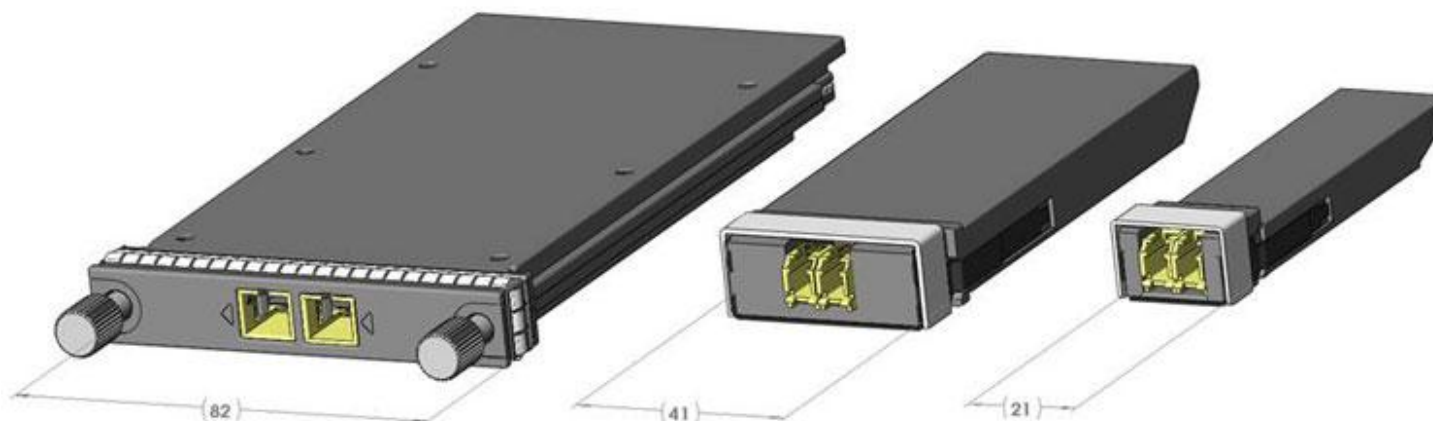
Baseline Next Step 100G: 2x50G λ NRZ (Quad)



56Gb/s TX
Simulated Eye

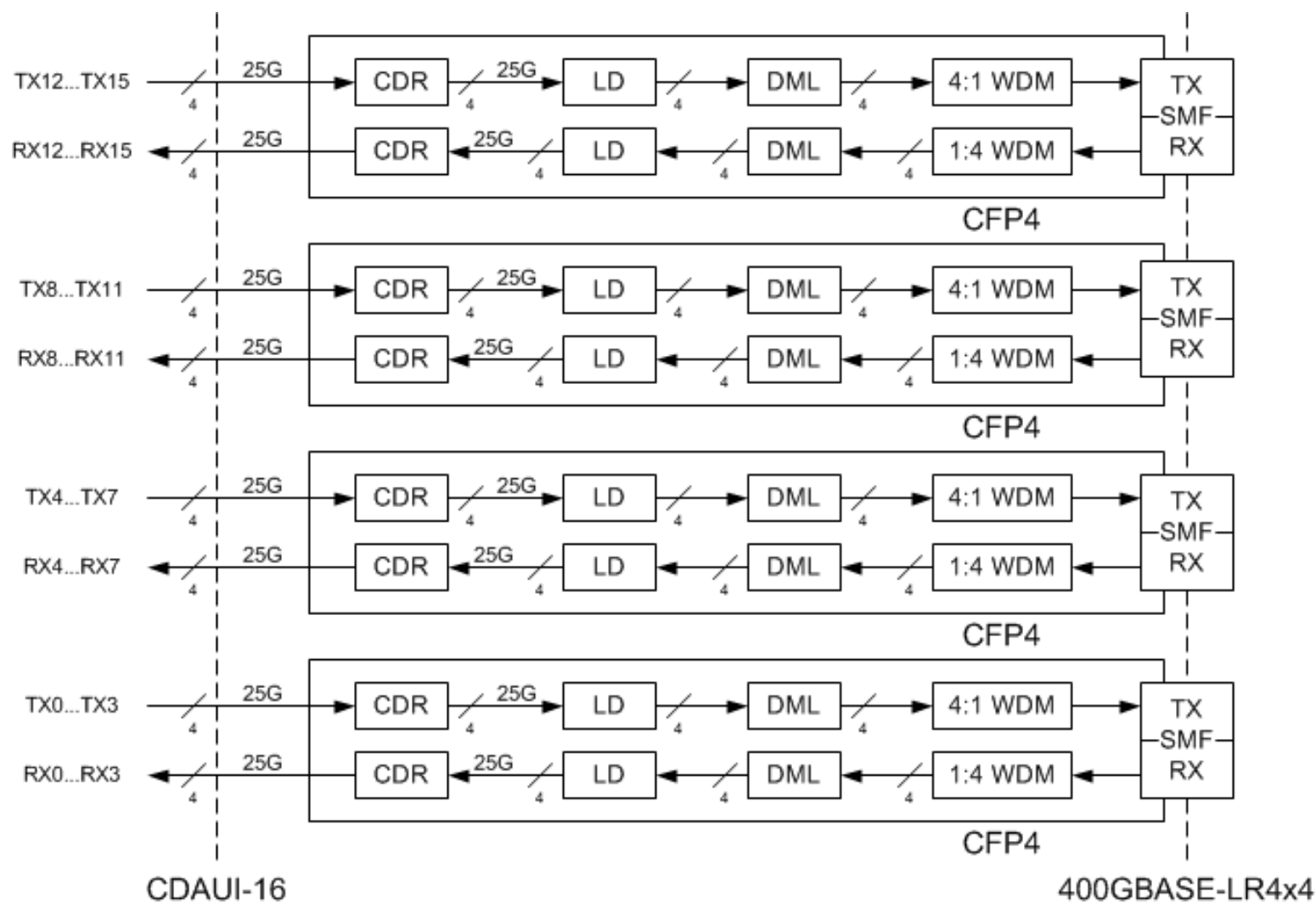
- ◆ ½ CW Laser and ~2.5W per 100GbE channel
- ◆ Conventional, demonstrated NRZ Electronics & Optics
- ◆ Benchmark against which to compare more complex steps

100G SMF Module Road Map

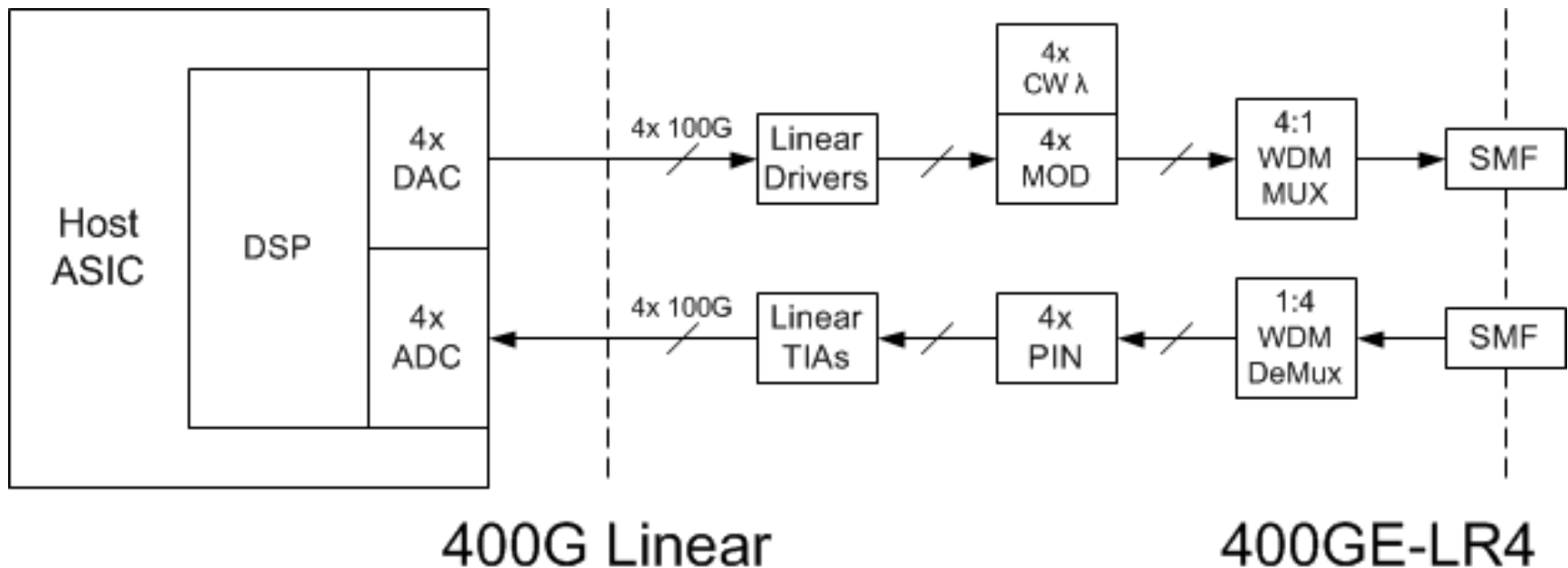


Module Type	CFP	CFP2	CFP4	QSFP28
LC port electrical I/O	10x10G	10x10G 4x25G	4x25G	4x25G
1 RU slot 100G ports	4 (single row)	8 (single row)	32 (belly-to-belly)	36 (double row)
MPO ports electrical I/O		8x50G	4x50G	
1 RU slot 100G ports		32 (single row)	64 (belly-to-belly)	

400G Possible Today: 4x 4x25G λ NRZ (PSM)

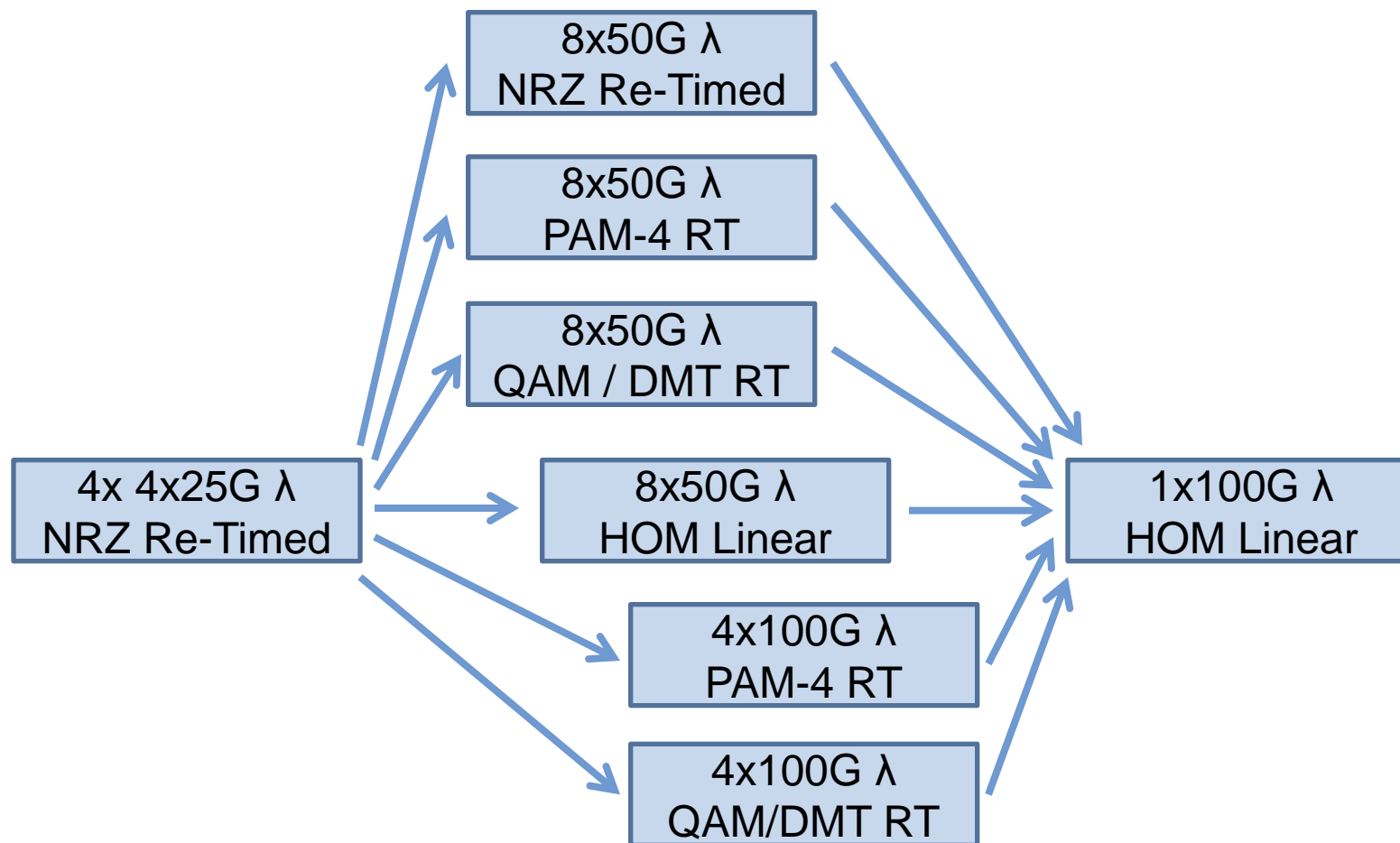


Ultimate 400G: 4x100G λ HOM Linear



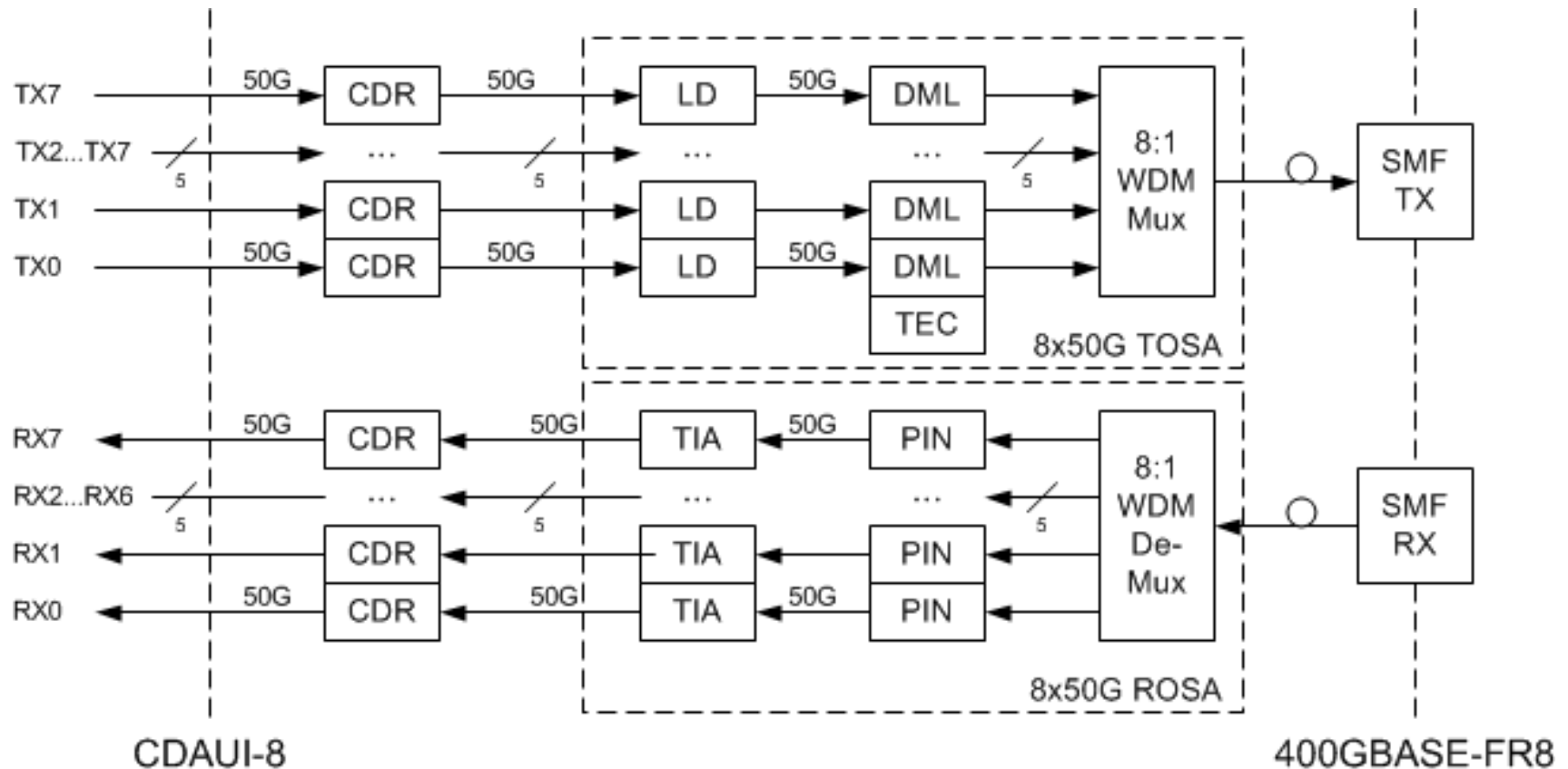
- ◆ Will leverage CFP2 AOC development
- ◆ Requires future CMOS technology

400G Alternatives Roadmap



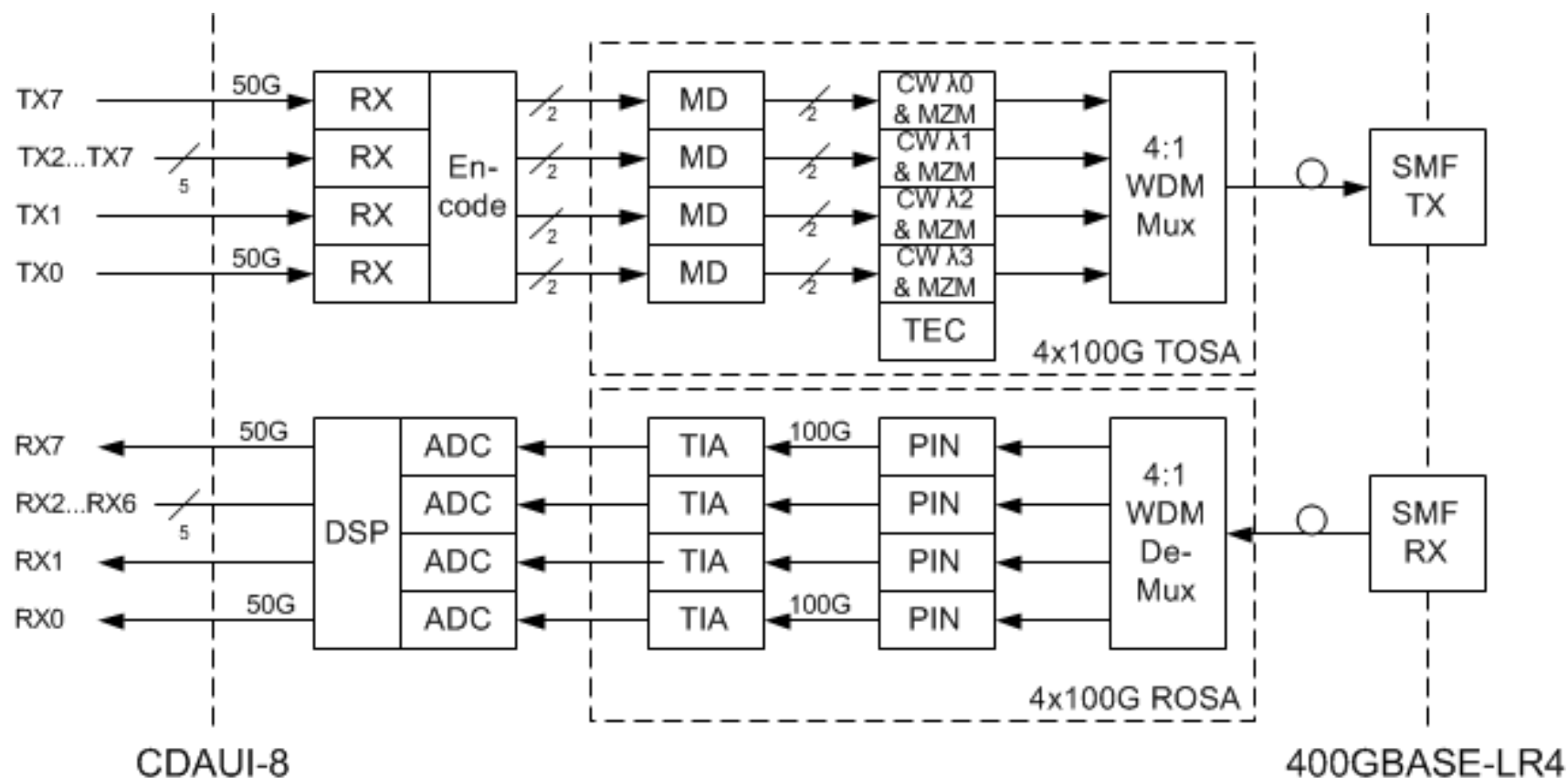
Each intermediate step has advantages and disadvantages

Baseline 400G: 8x50G λ NRZ



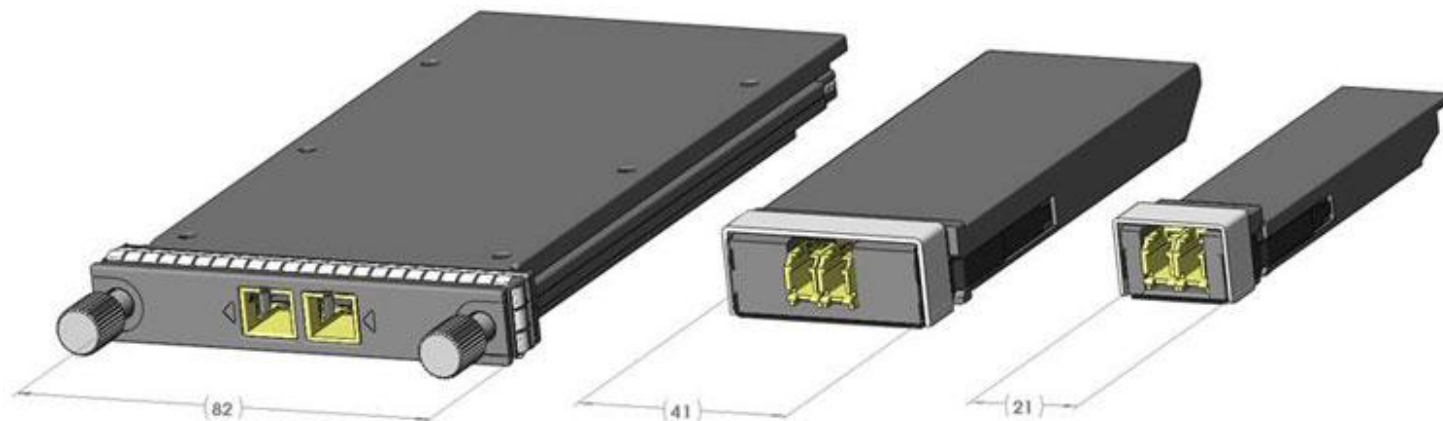
- ◆ 8 DFB DMLs; 16W typical (CW λ + Mod is an alternative)
- ◆ Benchmark against which to compare more complex steps

Alternative 400G: 4x100G λ PAM-4



- ◆ 4 CW λ ; 20W typical
- ◆ Requires 50G technology; same as on page 6 & 11

400G SMF Module Road Map



Module Type	4x CFP4	CDP* (TBD)	CDP2 (= CFP2)	CDP4 (= CFP4)
electrical I/O	16x25G	16x25G	8x50G	4x100G
1 RU slot 400G ports*	4	4	8	16

* To Be Defined by CFP MSA with System OEMs

100G & 400G Modules

I/O	10x10	10x10 4x25	4x25	16x25	8x50	4x100
CFP MSA	CFP	CFP2	CFP4	CDP	CDP2 (= CFP2)	CDP4 (= CFP4)
Other MSA	CXP			CDFP		
SFF			QSFP28			QSFP56
Cisco		CPAK				

Future 40G, 100G & 400G Interfaces

Thank you!