Options for relaxing the 800GBASE-ER1 optical frequency accuracy specification

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Supporting comment 389

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Overview

Currently 800GBASE-ER1 specifies a tighter than required carrier frequency accuracy, inherited from DWDM applications

This contribution discusses the pros/cons of relaxing the carrier frequency specification to allow the use of unlocked lasers

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Comment Type **T**   *Comment Status* **D**   Optical) Coherent parameters

The ± 1.8GHz accuracy specification in Table 187-5 is required for DWDM applications, however is note required for single-wavelength applications such as 800GBASE-ER1. This accuracy can be loosened, and depending on other requirements can still be compatible with DWDM lasers. Loosening the optical frequency accuracy spec allows additional technologies to be used for 800GBASE-ER1

SuggestedRemedy

Relax the accuracy spec in 800GBASE-ER1 to ± 20GHz. A supporting contribution will be provided, showing the tradeoffs with different laser implementations.

Proposed Response   *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
Pending review of the following presentation and CRG discussion.
<URL>/maniloff_3dj_xx_2507.pdf.

More details of carrier frequency accuracy are presented in
https://www.ieee802.org/3/dj/public/24_05/maniloff_3dj_01_2405.pdf

Frequency accuracy Specs: 800GBASE-LR1 and 800GBASE-ER1

800GBASE-ER1 has been designed to leverage the volume of 800ZR

Typical coherent receivers can digitally acquire with up to a ± 2GHz offset between Rx and LO

DWDM requirements are met with a ± 1.8GHz laser accuracy

For single wavelength applications, the laser accuracy specs for DWDM applications aren't required, allowing migration to unlocked lasers

Table 185–5—800GBASE-LR1 transmit characteristics

Description	Value	Unit
Signaling rate (range)	123.6364 ± 50 ppm	GBd
Modulation format	DP-16QAM	—
Average launch power (max)	−6	dBm
Average launch power (min) for ETCC ≤ 1 dB for 1 < ETCC ≤ 3.4 dB	−11.2 −12.2 + ETCC	dBm
Carrier frequency (range)	228.675 ± 20 GHz	THz

Table 187–5—800GBASE-ER1-20 and 800GBASE-ER1 transmit characteristics

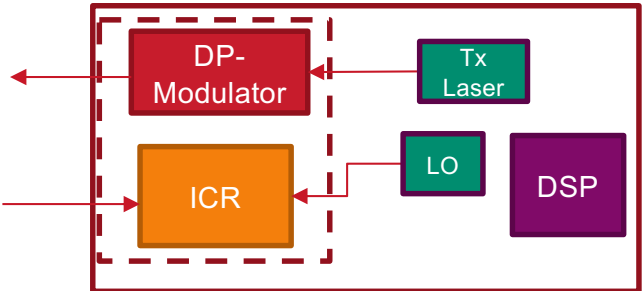| Description	800GBASE-ER1-20	800GBASE-ER1	Unit
Signaling rate (range)	118.203351 ± 20 ppm		GBd
Modulation format	DP-16QAM		—
Average launch power (max)	−7	−1	dBm
Average launch power (min)	−11	−5	dBm
Carrier frequency (range)	193.7 ± 1.8 GHz		THz

Coherent lasers / control overview
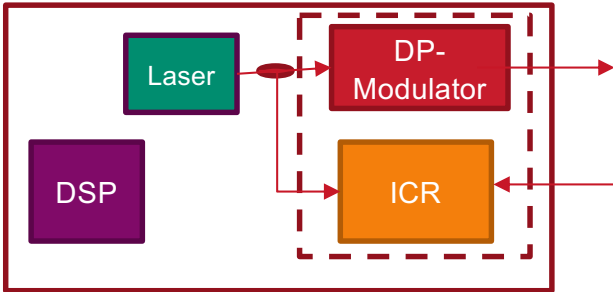
shared laser
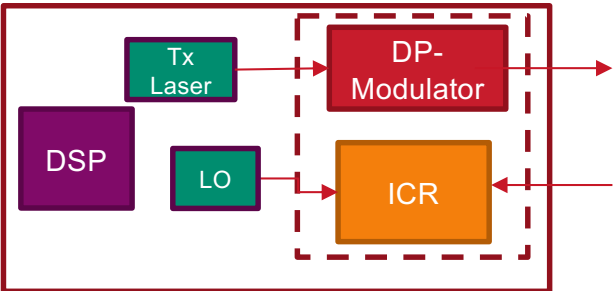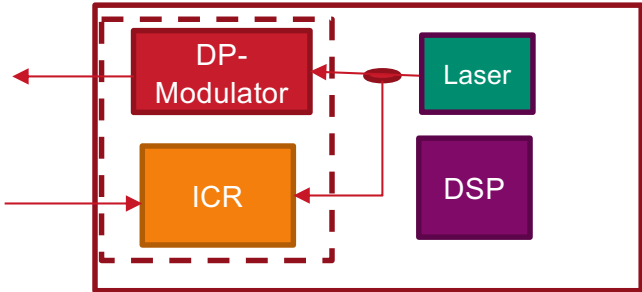
Two laser

Typical coherent implementation uses a shared laser for both Tx & Rx (LO)

The optics design & specifications ensure that the frequency difference between the two lasers (IF) is small enough to be removed at the DSP Rx
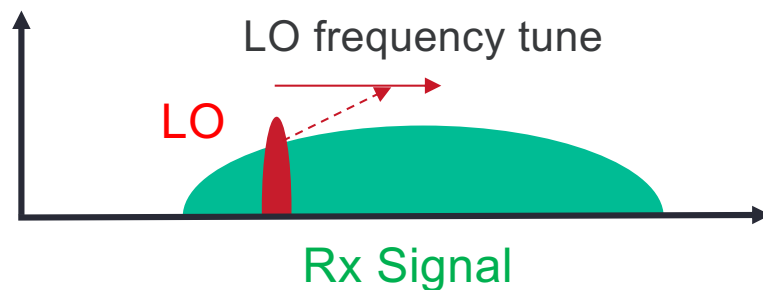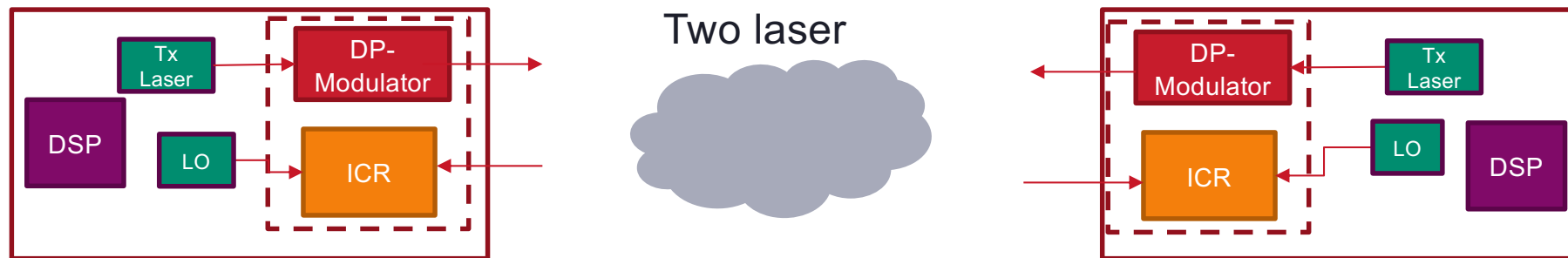
Moving to unlocked lasers, the MAX frequency error will exceed the DSP ability to digitally lock

Two laser solutions

With separate Rx and LO lasers, only the LO will tune

- Tx has no means of determining offset
- LO will tune to align with Received signal

LO tuning range (MAX) must accommodate the worst-case Tx frequency inaccuracy

Two laser

A locked LO laser with ~± 4 GHz tuning range will not guarantee interop with less accurate lasers

LO frequency tune

LO

Rx Signal

Shared Laser Solutions

With a shared laser, both lasers will tune

The requirement for this to function is for each laser to have tuning range ≥ 2x its accuracy spec

Shared laser

Module A, ± 1.8GHz accuracy

Module B, ± 20 GHz accuracy
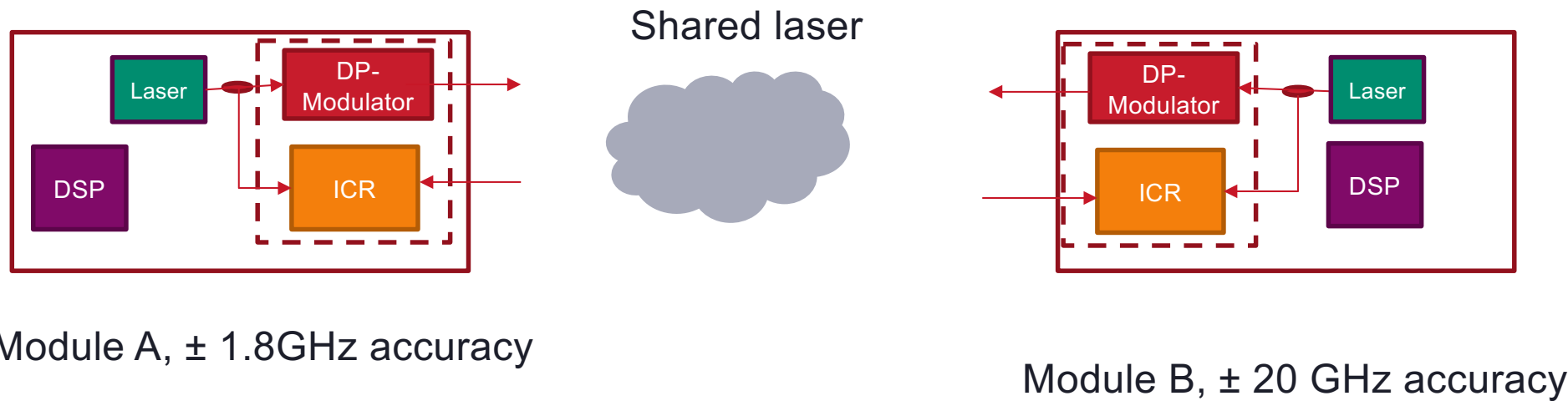
Module B's tuning range allows interop, as B will tune to align the two ends' lasers

Mixed Solutions

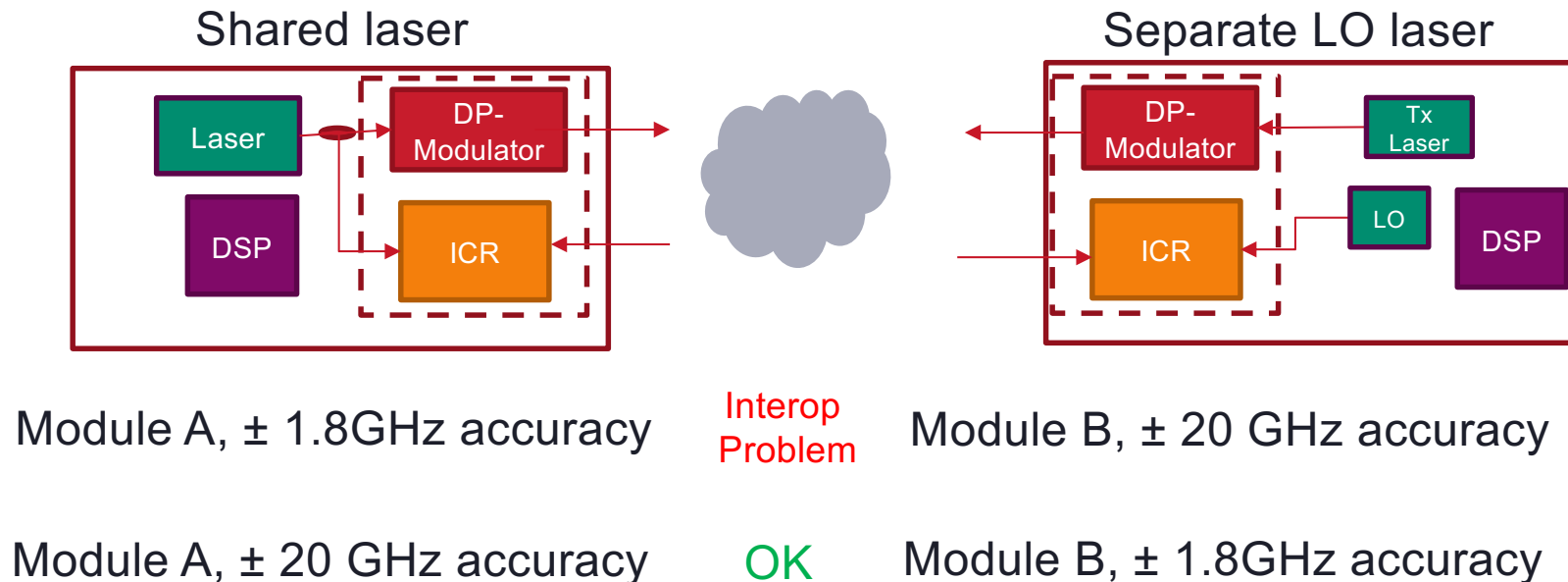**The LO tuning range must accommodate the worst-case Tx frequency inaccuracy**

Since module B Tx does not tune, Module A Laser must have sufficient range to accommodate worst case frequency offset

- Support for single-laser solutions with a limited tuning range would be incompatible with dual-unlocked lasers.
- 800GBASE-ER1 can accommodate a looser accuracy spec, provided a shared laser is required

Shared laser   Separate LO laser

Laser	DP-Modulator		DP-Modulator	Tx Laser
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DSP	ICR		ICR LO	DSP

Module A, ± 1.8GHz accuracy   **Interop Problem**   Module B, ± 20 GHz accuracy

Module A, ± 20 GHz accuracy   **OK**   Module B, ± 1.8GHz accuracy

800GBASE-ER1 optical carrier frequency accuracy specification

Currently 800GBASE-ER1 & ER1-20 adopt a carrier frequency based on ZR applications

This tight accuracy is not required for single channel applications

However, reuse of DWDM modules has been a key objective for 800GBASE-ER1

Allowing use of lower complexity unlocked lasers for this application would be a useful addition

Changing the carrier frequency spec to ± 20GHz broadens the available components for 800GBASE-ER1

- To relax this specification, it is necessary to include a requirement for a shared Tx/Rx laser

Summary

The carrier frequency accuracy of 800GBASE-ER1 can be loosened to ± 20GHz to allow a wider range of technical solutions

To ensure interoperability with DWDM lasers, devices with ≥ ± 1.8GHz accuracy require shared lasers between Tx/LO to ensure alignment between the two ends' carrier frequencies.

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