Wavelength Proposal for 50 Gb/s BIDI 40KM

Lemon Geng, Ming Qi, Ruoxu Wang

Huawei Technologies

Background information

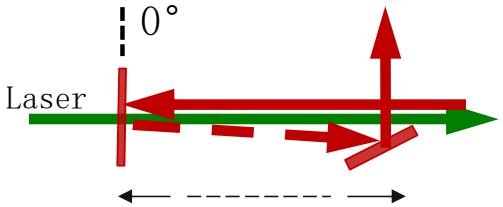
- At Sep meeting, the following wavelengths were agreed as a starting point,

Down / Up	10km	20km	40km
10Gb/s NRZ	1330 / 1270 ±10nm	1330 / 1270 ±10nm	1330 / 1270 ±10nm
25Gb/s NRZ	1330 / 1270 ±10nm	1310 / 1290 ±8nm	1310 / 1290 ±8nm
50Gb/s PAM4	1330 / 1270 ±10nm	1310 / 1290 ±8nm	1310 / 1290 ±8nm

- At the ad hoc Oct, the concern about the 4nm wavelength difference was raised.
- This presentation, we present our study for the 50Gb/s 40km application.

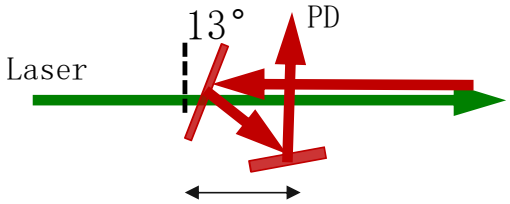
The achievable wavelength gap

Ideal condition:
0° incident angle

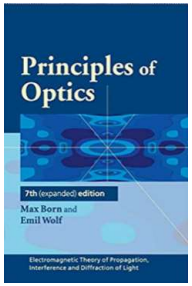


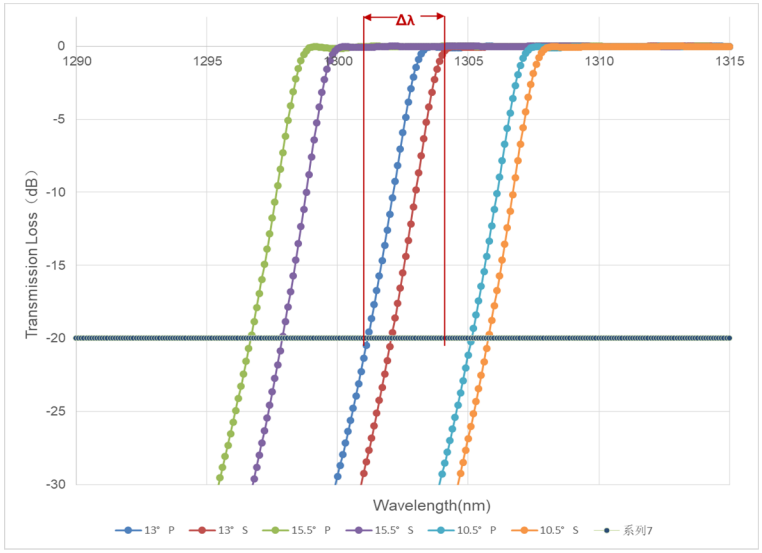
BOSA length: infinitely long

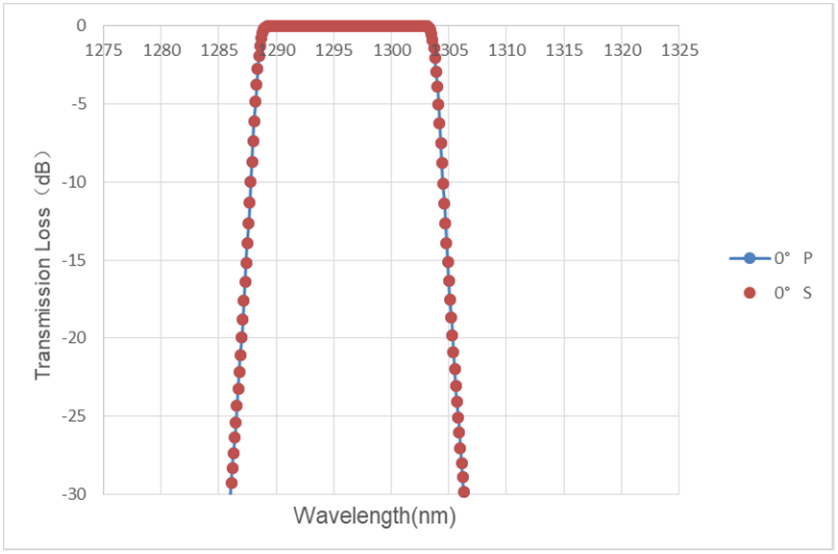
feasible condition:
13° incident



Feasible length of BOSA







- Considering the feasible length of BOSA, 13° is the minimal incident angle.
- From the classic Fresnel equation, Fabry–Pérot interference equation, and considering the optical film deposition vendor's capability, the wavelength gap need more than 9nm @13° incident angle.

Wavelength consideration I

Proposal from Shuai_3cp_01_1909

Description	Proposal	Unit
	40km	
Transmitter Wavelengths (range)	Up: 1292.21 to 1296.59 Down:1306.29 to 1310.19	nm
Receiver Wavelengths (range)	Up: 1306.29 to 1310.19 Down: 1292.21 to 1296.59	nm

Advantages:

- Guard band is 10 nm
- Reuses wavelengths from LWDM
- Could compensate dispersion penalty and fiber loss for 40km

Disadvantage:

- Will require Tx cooling.

Wavelength consideration II

Proposal from Effenberger_3cp_01_1910

- Upstream is 1288 ± 8nm, Downstream is 1312 ± 8nm

Advantages:

- Guard band is 8 nm
- Passband wide enough to allow uncooled Tx
- Upstream is entirely in negative dispersion region

- Disadvantage:
  - 8nm might not enough
  - Part of the region can not satisfy the 40km dispersion penalty and fiber loss.
  - Somewhat nonstandard wavelengths
- Suggestion for guard band:
  - Upstream is 1288 ± 8nm, Downstream is 1314 ± 8nm

Wavelength consideration II Revised

For further consideration of the second proposal, the smallest grid of the wavelength range is 100GHz.

Description	Proposal	Unit
	40km	
Transmitter Wavelengths (range)	Up: 1280.07 to 1296.59 Down:1306.29 to 1322.42	nm
Receiver Wavelengths (range)	Up: 1306.29 to 1322.42 Down: 1280.07 to 1296.59	nm

Table 122–6—200GBASE-LR4 wavelength-division-multiplexed lane assignments

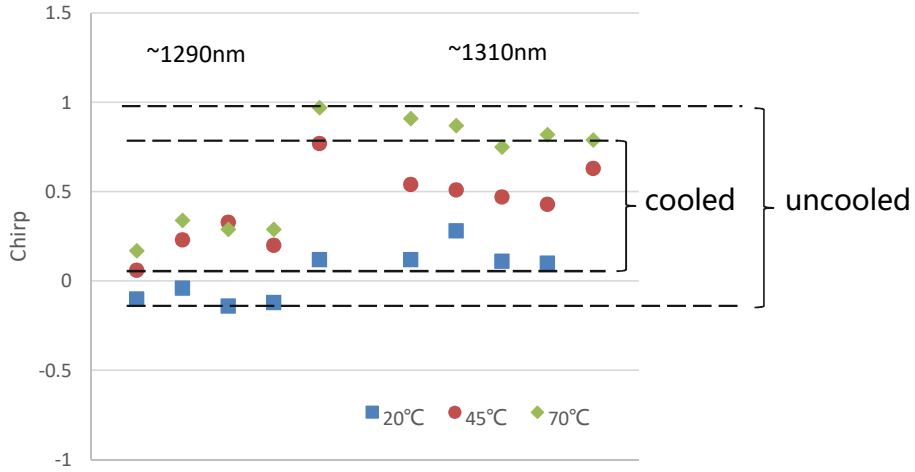
Lane	Center frequency	Center wavelength	Wavelength range
L_0	231.4 THz	1295.56 nm	1294.53 to 1296.59 nm
L_1	230.6 THz	1300.05 nm	1299.02 to 1301.09 nm
L_2	229.8 THz	1304.58 nm	1303.54 to 1305.63 nm
L_3	229 THz	1309.14 nm	1308.09 to 1310.19 nm

Advantages:

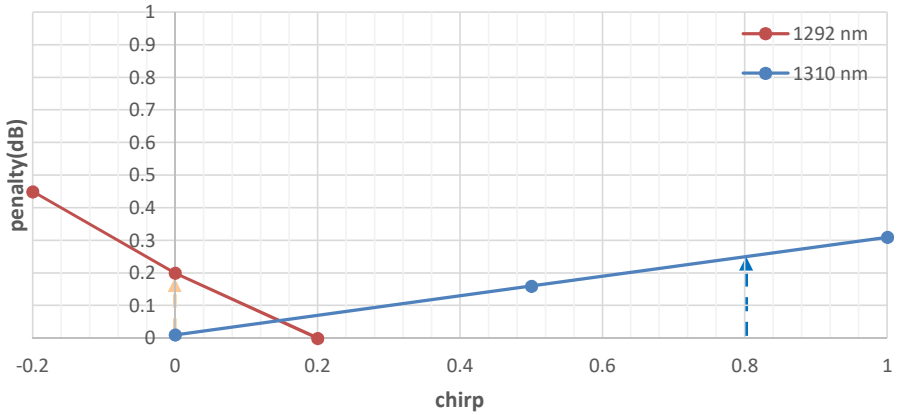
- Reusing wavelengths from LWDM

The dispersion penalty study

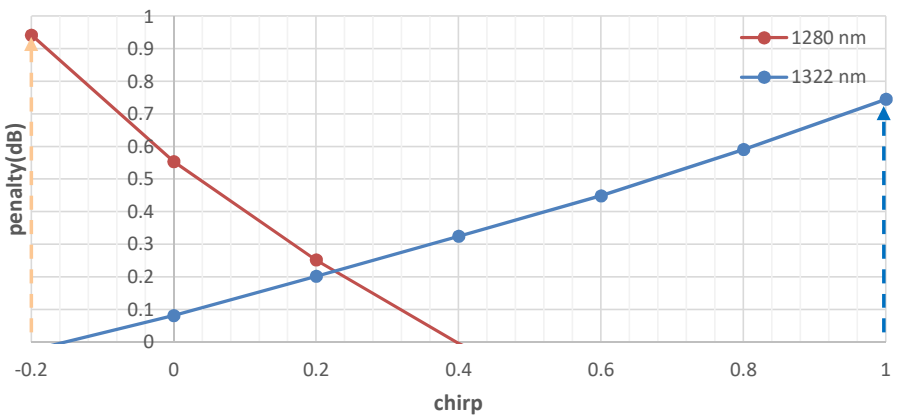
- The uncooled EML' bias voltage may track with the temperature to achieve stable extinction ratio, resulting in the wider range of chirp than the cooled EML.
- The worse case dispersion penalty for up stream 1280nm is 1.0dB at -0.2 chirp, when it is 0.2dB for 1292nm at 0 chirp.
- The worse case dispersion penalty for down stream 1322nm is 0.75dB at +1 chirp, when it is 0.25dB for 1310nm at +0.8 chirp.



dispersion penalty for up 1292nm and down 1310nm

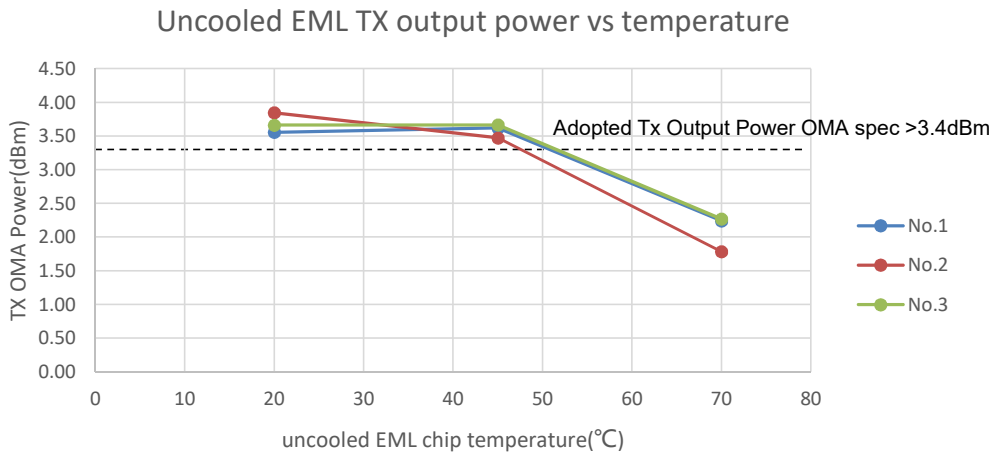


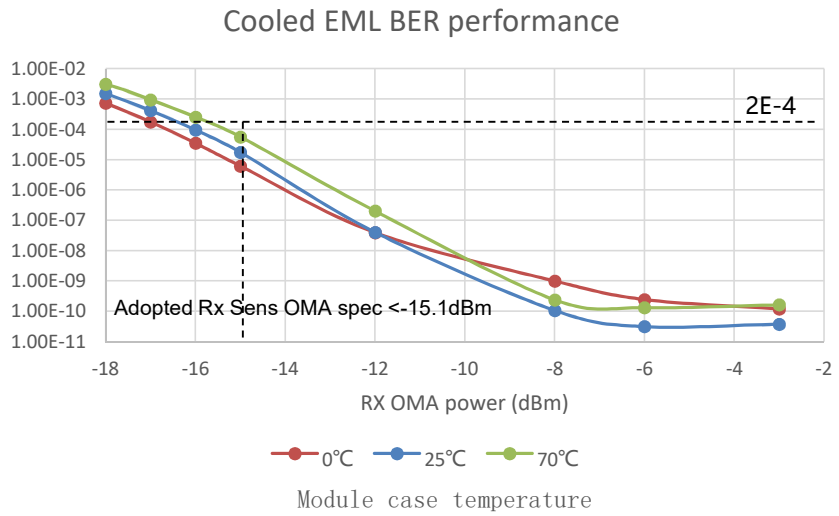
dispersion penalty for up 1280 nm and down 1322nm



The transmission performance study

- With uncooled Tx, the output power changes rapidly with the temperature even in auto power control. So the Tx output power can't meet the 40km spec 3.4dBm min within the whole temperature. And also the Rx performance of APD receiver which is sensitive to the noise degrades a lot due to the Tx noise increases with temperature.
- With cooled Tx, 50G 40km BIDI transmission performance stays stable, and meets 50G 40km BIDI Rx sensitivity spec within the whole temperature range.





Summary

- Based on our study, to balance the performance of 40km transmission and cost, the following wavelength was suggested:

Description	Proposal	Unit
	40km	
Transmitter Wavelengths (range)	Up: 1292.21 to 1296.59 Down:1306.29 to 1310.19	nm
Receiver Wavelengths (range)	Up: 1306.29 to 1310.19 Down: 1292.21 to 1296.59	nm


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
спасибо
Баярлалаа
рахмат
bedankt
dziękuję
hvala
obrigado
sukriya
kop khun krap
go raibh maith agat
mochchakkeram
merci
grazie
arigatō
takk
dakujem
terima kasih
ευχαριστώ
мерси
ありがとう
감사합니다
dank je
tapadh leat
sagolun
mauruuru
blagodaram
chnorakaloutioun
xвала
tanemirt
diolch
shukriya
xiexie
trugarez