25G upstream wavelength

Dekun Liu

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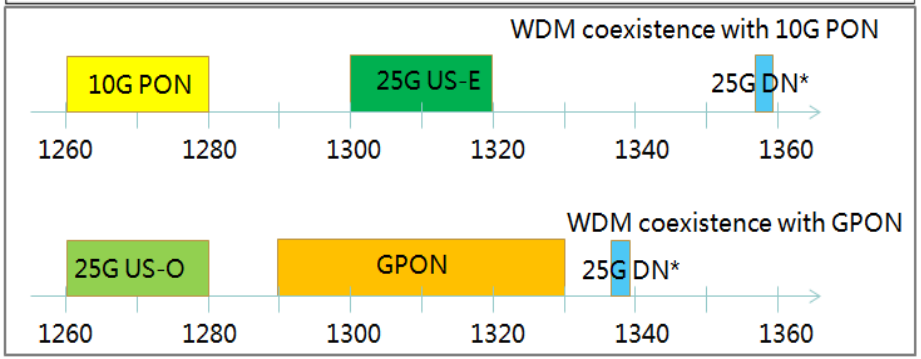
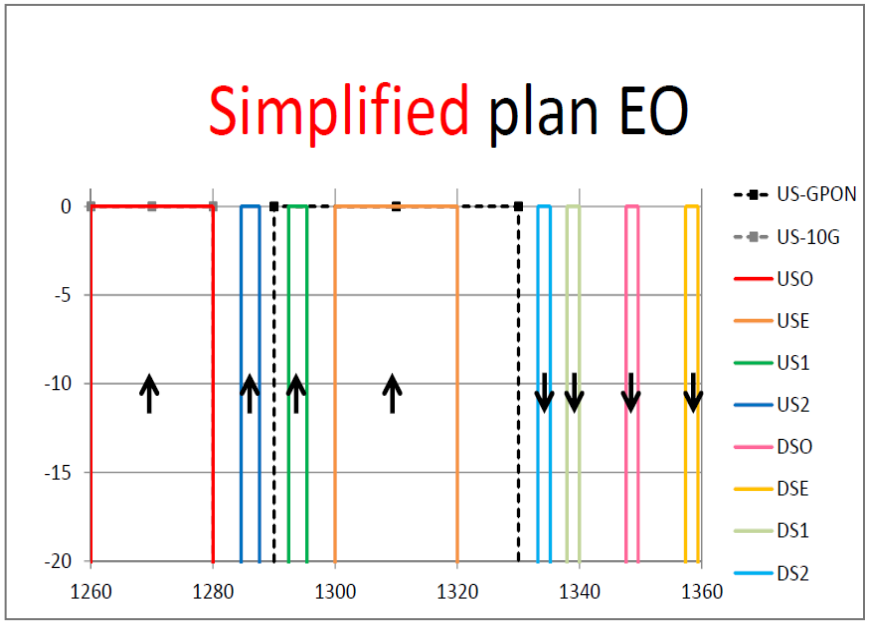
Two 25G upstream window

Motion #5

802.3ca shall adopt an upstream wavelength plan for the first 25G and new 10G (EQ based) channel with two options,
Option 1: at 1310nm width 20nm; WDM coexistent with 10G-EPON
Option 2: at 1270nm width 20nm; WDM coexistent with G-PON reduced wavelength set.
TDM coexistence with legacy PONs is not required.
Moved: Frank Effenberger Second: John Johnson
For: 21 Against: 1 Abstain: 4
Technical (≥ 75%) Motion Passed



Note: 25G DN is only for example



- Two 20nm upstream windows has been defined for 25G upstream mainly due to the following reasons:
  - Coexistence requirement with GPON and 10G EPON→two options
  - Low cost on ONU transmitter, enable uncool DML → 20nm pass band
  - Have four upstream wavelength, avoid FWM → 1310+/-10nm for USE
- The third requirement has gone as we have agreed to remove the 100G

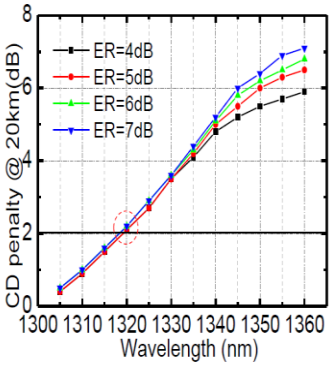
High CD penalty and small DS/US gap in option 1

CD penalty in O band+ after 20km SSMF

liu_3ca_3_0516

	ER (dB)			
	4	5	6	7
ROF @ (B2B) BER = E-3 / dBm	-23.7	-24.8	-25.6	-26.4
wavelength where CD penalty = 2dB after 20 km SMF	~1320 nm			

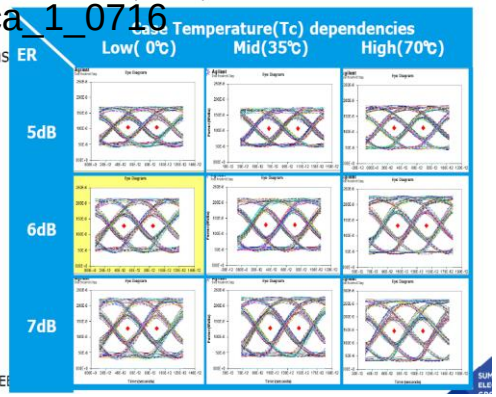
Note: The zero dispersion wavelength, λ0, corresponds to λmin = 1300 nm, with a CD penalty = 0 dB.

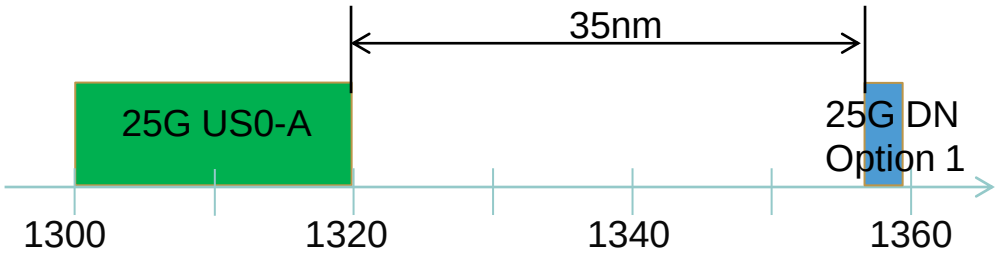


tanaka_3ca_1_0716

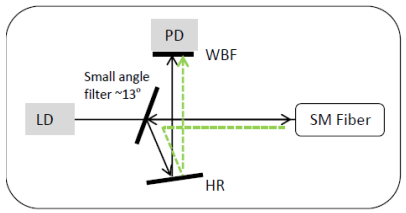
Transmitted waveforms
$\lambda_{0\ dispersion}$:**1300**nm
λ_{center} : ->**1320**nm
Fiber length:**20**km

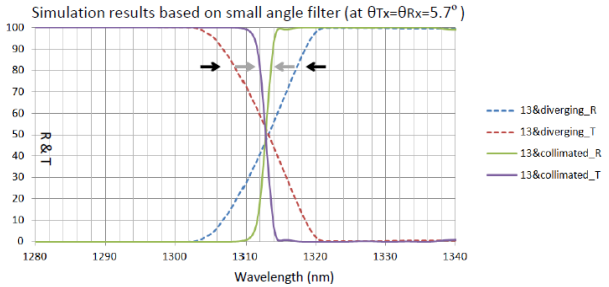
Worst penalty
TDP :2.29dB
DP :2.01dB





liu_3ca_2_0117

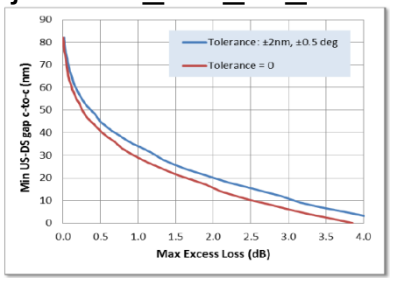




funada_3ca_1_0117

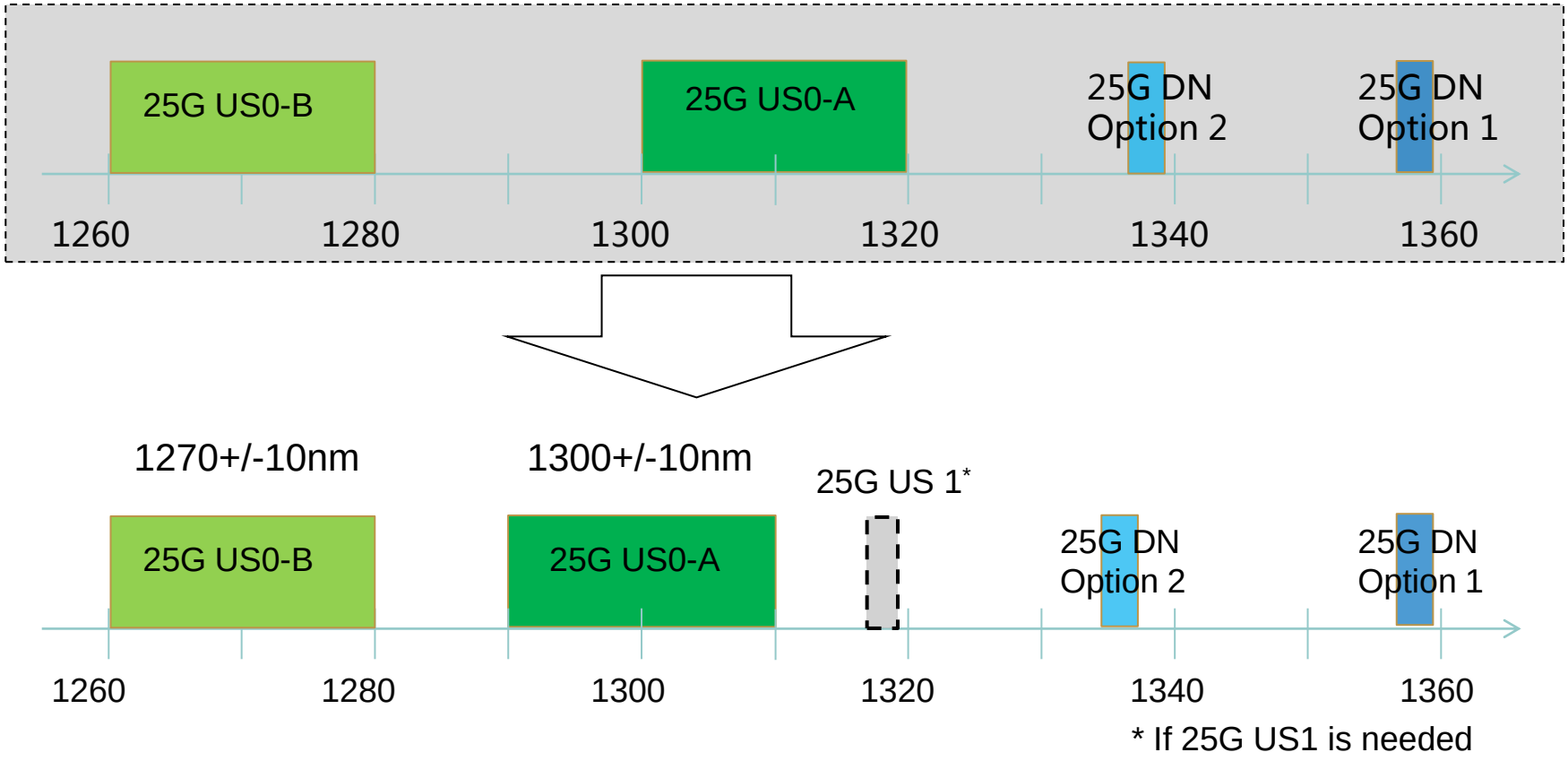
	US/DS Gap		
	40nm	50nm	60nm
Transmittance [dB]	<-10	<-16	<-26
Rx excess loss [dB]	<0.5	<0.1	0.0

johnson_3ca_1a_1116



- The dispersion penalty for 25G DML is +2dB in worst case ($\lambda_{0\ dispersion}$ = 1300nm), which may need EDC to overcome
- Small DS/US will result in complex package and extra insertion loss in 45 degree BiDi.

New recommendation

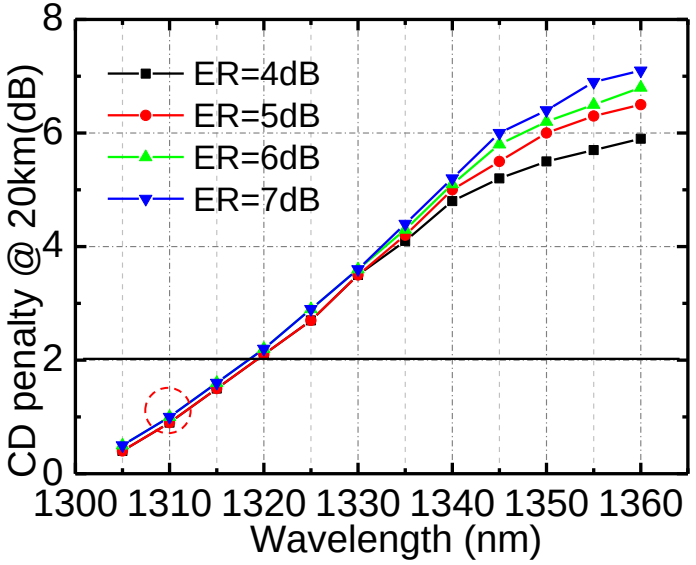


- Shift 25G US0-A to the left by 10nm to decrease the dispersion penalty
- DS/US gap for option 1 can be increased to 45nm
- 25G US1 can be placed in the right of US0-A if it is really needed.

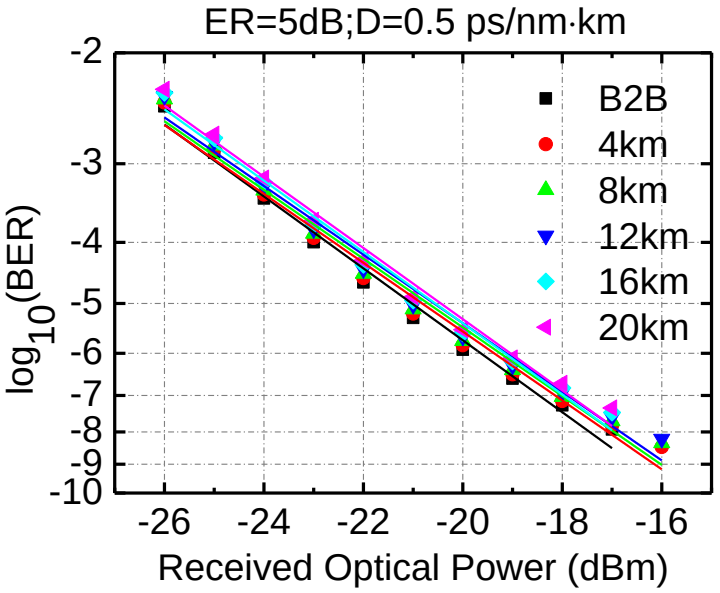
DP penalty analysis for new US0-A

Worst case DP= 1dB

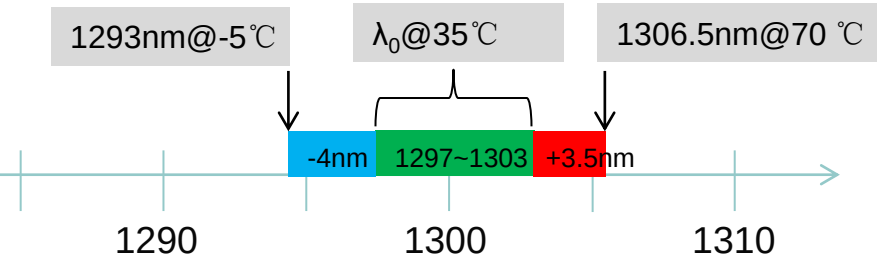
($\lambda D0_{min}$ = 1300 nm, D=0.91ps/nm/km@1310nm)



Typical case DP<0.5dB



Optical laser wavelength distribution in commercial temperature class



- The dispersion penalty in the worst case is 1dB, but the DP will be <0.5dB at the majority case
- At least1dB OPP(TDP-TP) margin is still needed even the DP is negative
- Such small DP difference between US0-A and US0-B can be neglected if we consider ~1.5dB OPP margin
- Two 25G options can have a same PMD spec

How to specify Tx power and TDP

- Traditional way: spec the min Tx power, and specify the TDP based on the worst worst case
  - Pros: most straight forward, easy for operators and factories to test and verifiy
  - Cons: needs a big enough TDP margin to guarantee all the worst case (3dB for 10G EPON), no space for different vendors to optimize Tx based on their own technology
- Specify “Tx – TDP” only
  - Pros: different vendors can optimize the Tx based on their own technology, eliminate excess TDP margin
  - Cons: give up the advantage to verify the link by power meters, more difficult to measure TDP

How to minimize the excess margin

- Define a reference transmitter based on real transmitter rather than ideal transmitter
  - Optimize the TP (sensitivity difference between reference tx and real Tx) to a small value
- Define the TDP based on major typical case, leave the vendors to guarantee the extreme worst case

Parameter	US0-B	US0-A	Unit
Wavelength range	1260 to 1280	1290 to 1310	nm
OLT RX sensitivity@1E-2 (max)	-25.5		dBm
Tx min	5		dBm
TDP(Note)	1.5		dB
Note: If a transmitter exhibits a higher penalty that specified, it can still comply if it equally increases the minimum launch power to compensate for extra TDP, while remaining under the maximum launch power			

- 1.5dB TDP are assumed based on :
  - 0.5dB TP by define a reference transmitter which is quite close to real DML Tx
  - 0.5dB DP if Tx wavelength can be limited <1306nm for uncooled Tx in commercial temperature class, or EDC can be used in OLT Rx by vendors
  - 0.5dB extra margin for unexpected reasons, such as reflection, Raman crosstalk

Summary

- As 100G has been removed in the objective and more wavelength is available now, in order to minimize the dispersion penalty, it is proposed to move 25G US0-A to 1300+/-10nm
- The dispersion penalty for new US0-A has been analyzed, the DP is less than 0.5dB at the majority case. Such a small dispersion penalty can be absorbed to the total OPP
- It’ s suggested that the two options of 25G can have a same PMD spec in upstream.

Thank you

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