Revisions for Wavelength Plan A

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Introduction

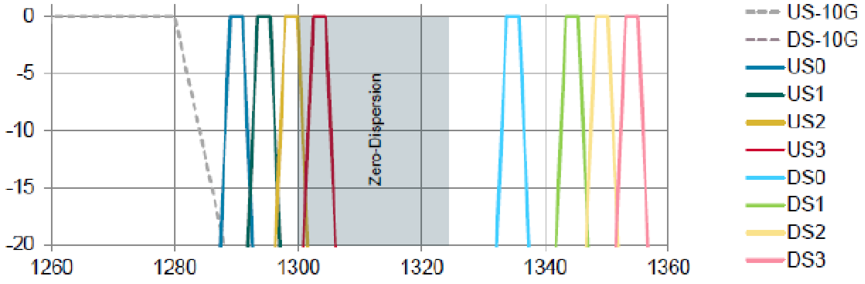
In San Antonio meeting

- 1+3 architecture was consented
- Wavelength plan has not been decided yet
  - Options A&B are in all O-band
  - Options C&D are in separated O & S or C or L band
- Concerns about wavelength plan A were raised

This presentation proposes revisions to the wavelength plan A to mitigate those concerns.

Some concerns for plan A in San Antonio

Plan A
johnson_3ca_1_0916.pdf



- Pass band width for upstream (+/-1nm) is suggested to be relaxed
- Worst case FWM penalty due to the close proximity of the upper edge of US2 to the ZD zone (1300nm)
- Gap between US0 & DS0 diplexer is a bit narrow, which could cause additional penalty
- Guard band between 10G US (1260nm-1280nm) and US0 is 9nm, which might not be safe.

Wide pass band or narrow pass band?

In the last meeting, costs of optical laser chips with ±1nm pass band for upstream wavelengths were estimated to be 50% higher than those with ±1.5nm pass band. So, it was suggested to relax the ±1nm pass band.

Central Wavelength Tolerance	**±3nm**	**± 2nm**	**± 1.5nm**	**± 1nm**	**± 0.5nm**
1st vendor's view	X	1.2X	1.6X	2.3X	3.5X
2nd vendor's view	Y	1.4Y	--	2.1Y	--

Wider pass band (e.g., ±1.5nm) needs wider channel spacing (e.g., 1200GHz). As a result, two upstream channels (US2&US3) could possibly enter the zero dispersion zone and cause FWM penalty (zhang_3ca_1_1116). To mitigate this issue, one can either move the channels out of the ZD zone or limit max ONU Tx power per channel to 5dBm. However, moving out of the ZD zone requires more wavelength resources, and limiting ONU max Tx power results in a more challenging OLT receiver sensitivity even using SOA (see guo_3ca_2_0117).

Update information related to pass band

The cost of laser chip is about 30-40% of the total optical module cost based on vendors' survey. So, the cost increase of a complete optical module would be ~15-20% if the pass band is narrowed from ±1.5nm to ±1nm.

	Laser/driver/CDR	Receiver To-Can	Other (Packaging, Lens, PCB, MCU…)
Vendor 1	40%/5%/10%	23%	22%
Vendor 2	30%/8%/15%	20%	27%

In general, it's true that using wider pass band can get higher yields. If NG-EPON and datacenter standards share similar specifications, then the high power version can be selected for PON application and the low power for datacenter application. This can significantly reduce the cost of optical modules for both applications.

Proposal:

- Maintain the ±1nm pass band for upstream wavelengths and 800G Hz channel spacing.

Revision to mitigate the worst case FWM penalty

In zhang_3ca_1_1116, the upper edge of US2 is shown to be ~12GHz (0.07nm) from the lower edge of the ZD zone (i.e., 1300nm). In the worst case, where all four upstream wavelengths are drifted towards longer wavelength, a 1.4dB FWM penalty could be observed for US2 channel.

Proposal:

- Shift all the upstream wavelengths to the shorter wavelength direction by at least one 50GHz wavelength grid.

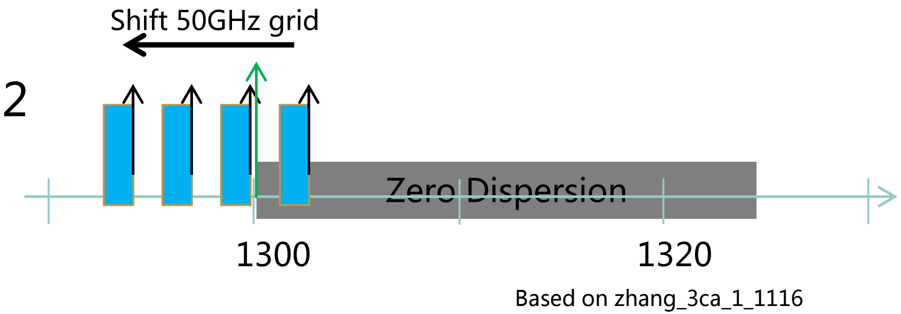


Table 1. Upstream wavelength shifted by 50GHz

	Center freq	Center WL
US0	232.450	1289.707
US1	231.650	1294.161
US2	230.850	1298.646
US3	230.050	1303.162

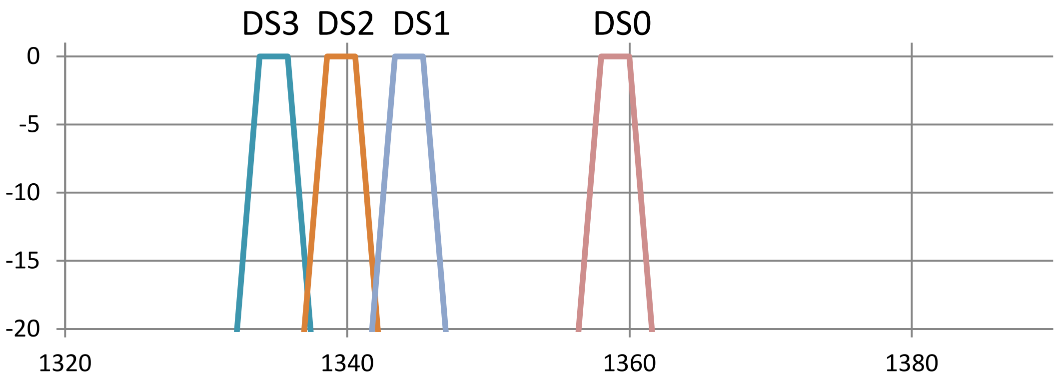
Revision to mitigate DS/US gap for 25G

The US/DS gap issue for 25G was analyzed in johnson_3ca_1a_1116.

- Up to 1dB penalty is possible with a 40nm US/DS gap if focusing beam optics are used.

Proposal:

- Change the order of downstream channels to DS3, DS2, DS1, DS0. The first 25G channel (DS0) is moved to the longest wavelength side so that the US/DS gap can be extended to 65nm. The gap between DS0 and DS1 is kept 2.4THz.

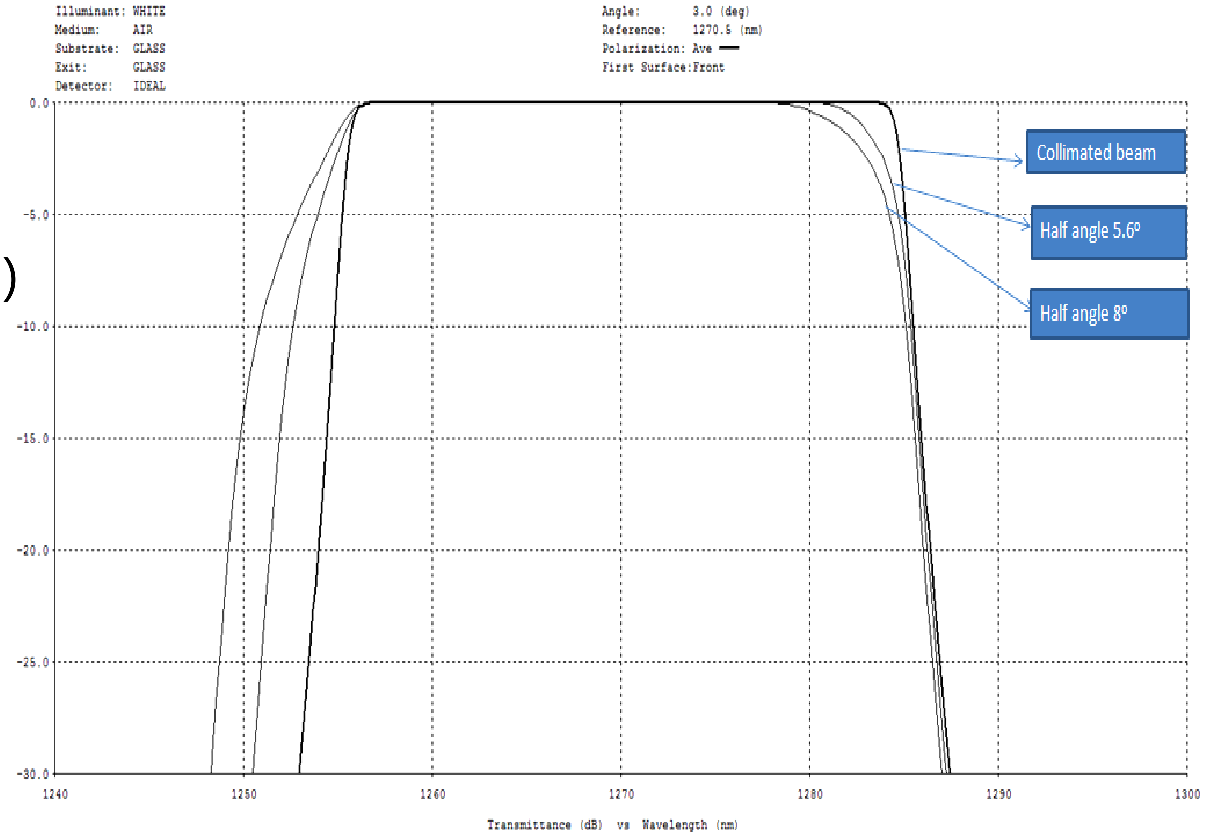


	Center freq	Center WL
DS3	224.600	1334.784
DS2	223.800	1339.555
DS1	223.000	1344.361
DS0	220.600	1358.987

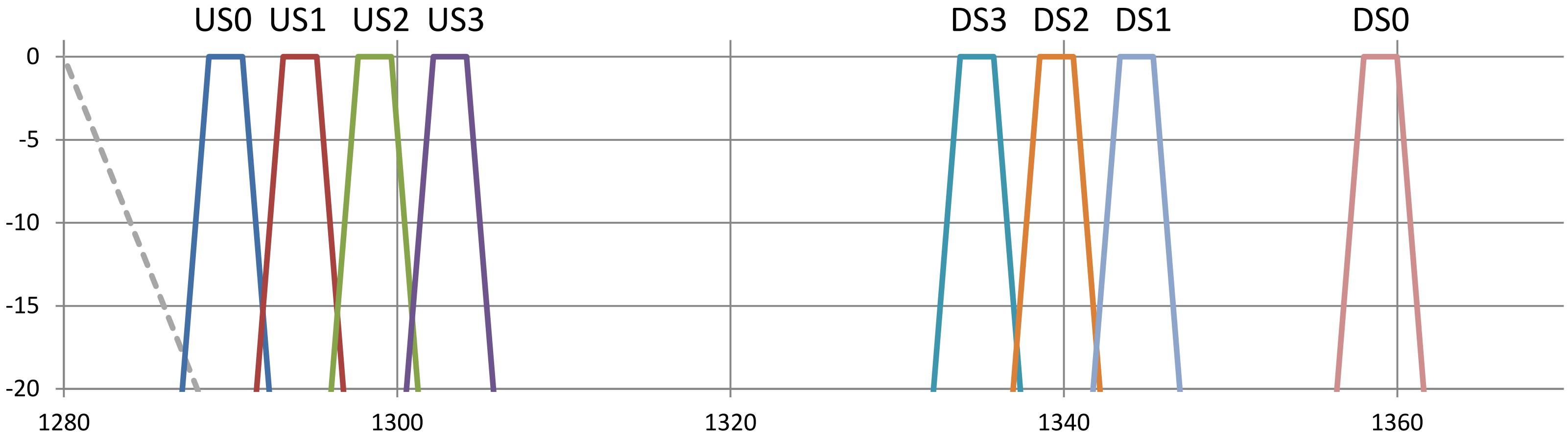
Guard band between 10G-EPON and NG-EPON US

Based on simulations from filter vendors (only shows data from 1280nm-1290nm)

- Even 10nm is not enough for 45 degree TFF filter
- By using filters with small angles, guard band can be reduced to less than 10nm



Proposed revision of wavelength plan A



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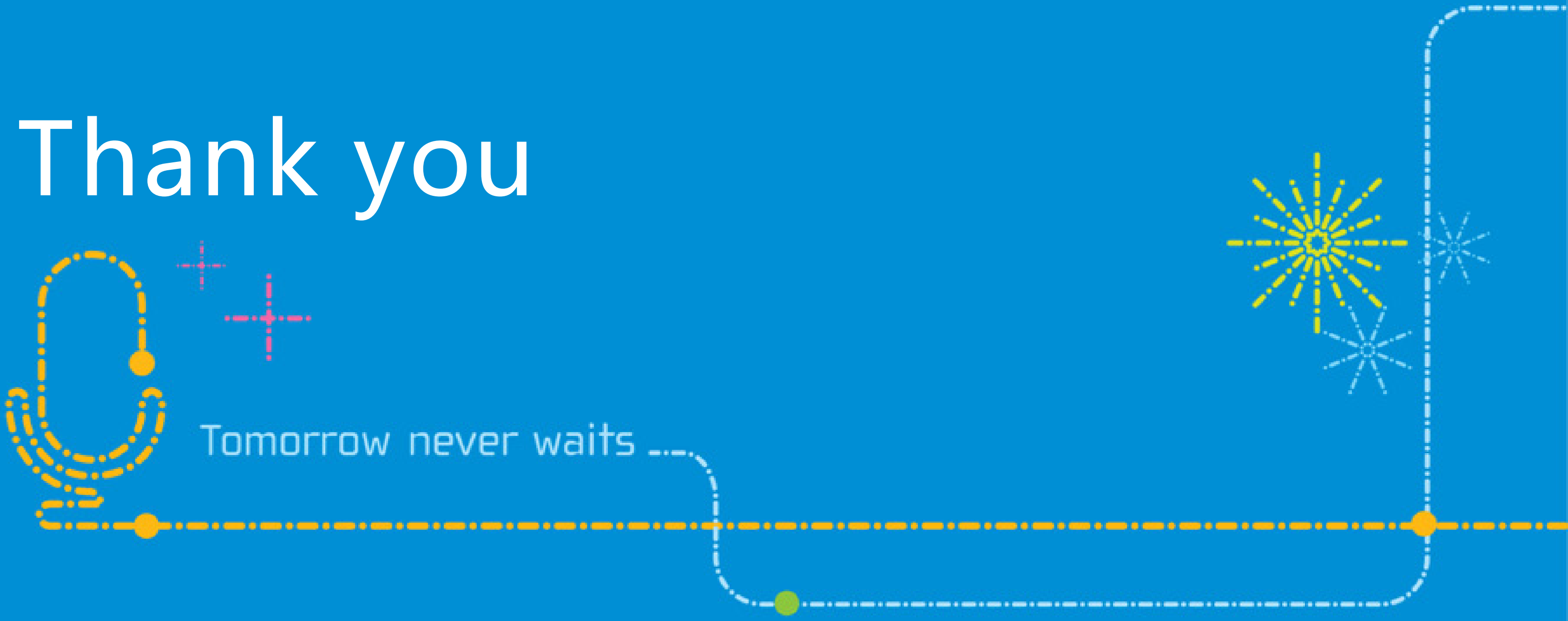
Summary

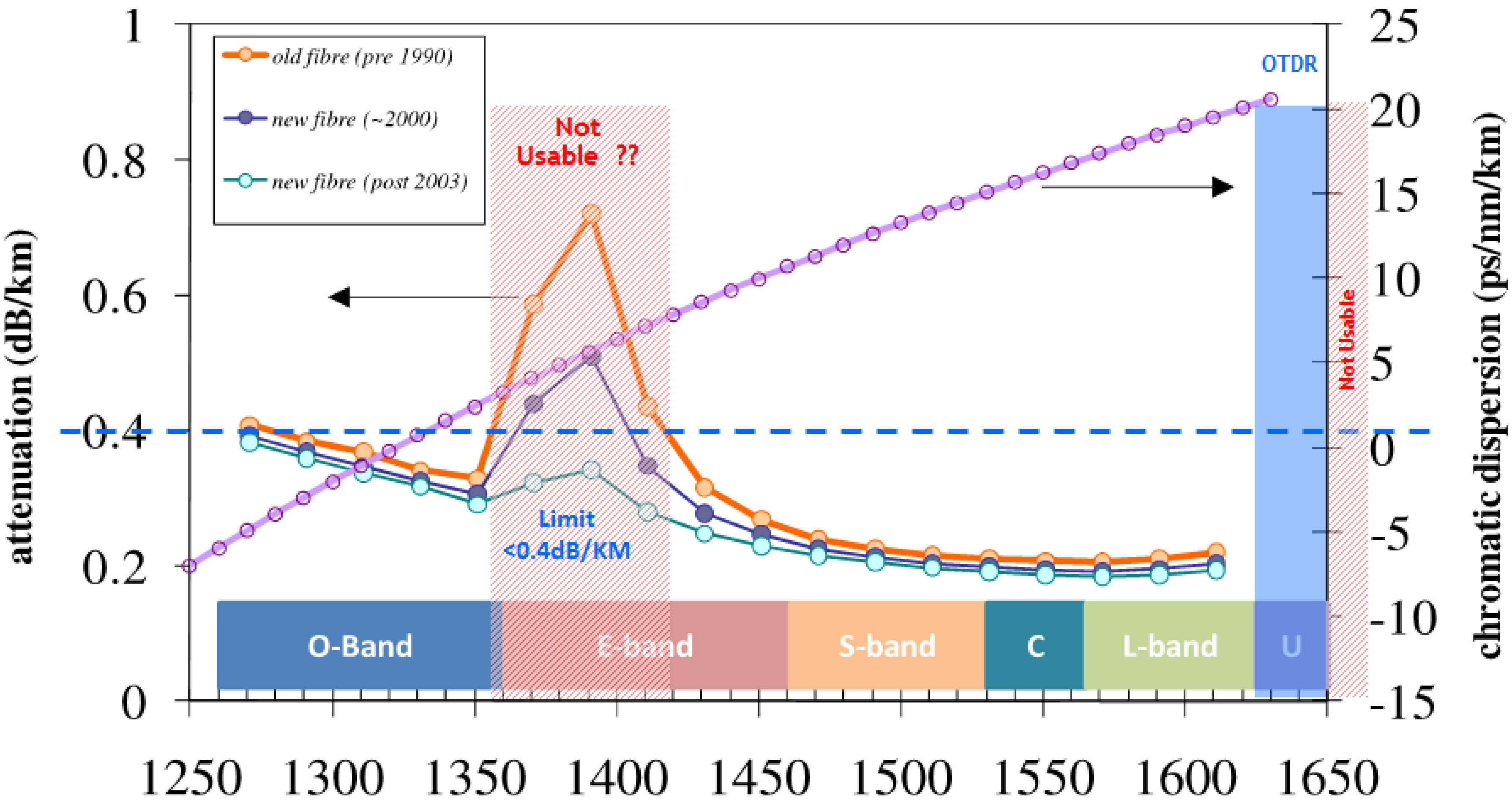
Proposed revisions of Plan A to address concerns from the last meeting:

- ±1nm pass band and 800GHz channel spacing for upstream wavelength are kept
- All upstream wavelengths are shifted to the shorter wavelength direction by 50GHz
- The order of downstream channels are changed to DS3, DS2, DS1, DS0, where DS0 is moved to the longest wavelength side
- Guard band between 10G-EPON US and 25G US0 can be less than 10nm if filters with smaller angles are used

Thank you



Backups


old fibre (pre 1990)
new fibre (~2000)
new fibre (post 2003)
Not Usable ??
Limit <0.4dB/KM
OTDR
Not Usable
O-Band
E-band
S-band
C
L-band
U
attenuation (dB/km)
chromatic dispersion (ps/nm/km)
1
0.8
0.6
0.4
0.2
0
25
20
15
10
5
0
-5
-10
-15
1250
1300
1350
1400
1450
1500
1550
1600
1650