

25G and 50G EPON downstream wavelength plan

- Ed Harstead, Nokia
- John Johnson, Broadcom

Supporters

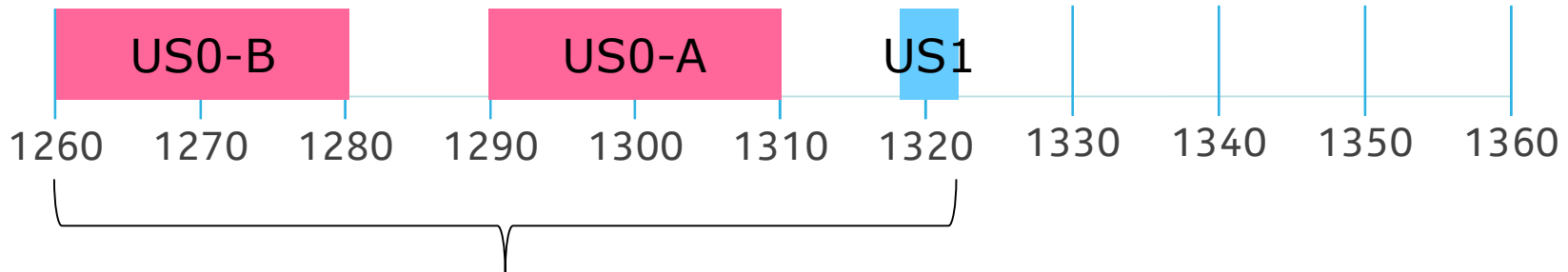
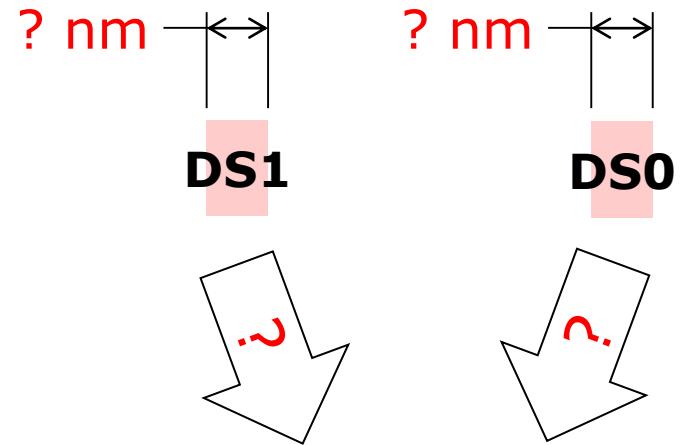
100G-EPON

- ❑ Wang Bo, China Telecom
- ❑ Dekun Liu, Huawei
- ❑ Phil Miguelez, Comcast
- ❑ Daisuke Umeda, Sumitomo Electric
- ❑ Ed Walter, AT&T
- ❑ Wey Jun Shan, ZTE

Specifying DS wavelengths

Need to specify:

- ❑ wavelength tolerance
- ❑ center wavelength



Upstream wavelength plan

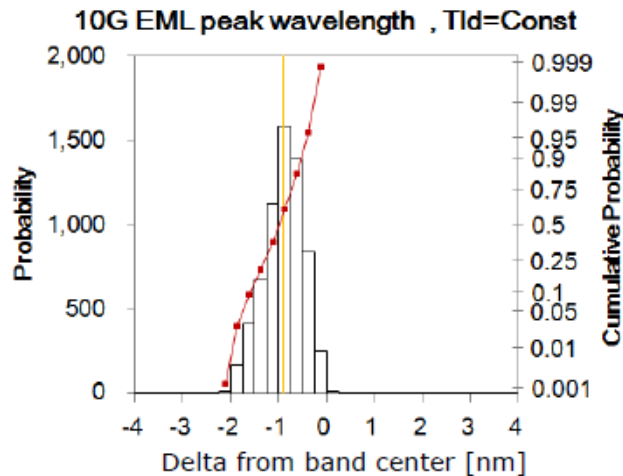
- US0-B: 1270 +/- 10 nm
- US0-A: 1300 +/- 10 nm
- US1: 1320 +/- 2 nm

Per Motions 12 and 15, minutes_unapproved_3ca_0118.pdf

DS wavelength tolerance

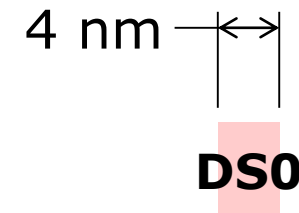
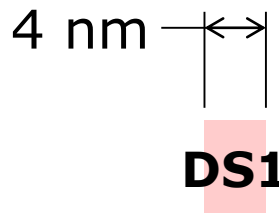
- ❑ Assume EML implementation
- ❑ 4 nm is adequate for high yield

Distribution of 10G-EPON EML
(>8,000 samples from >10 wafers, Pout=Constant)



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- ❑ Therefore choose 4nm for DS0 and DS1

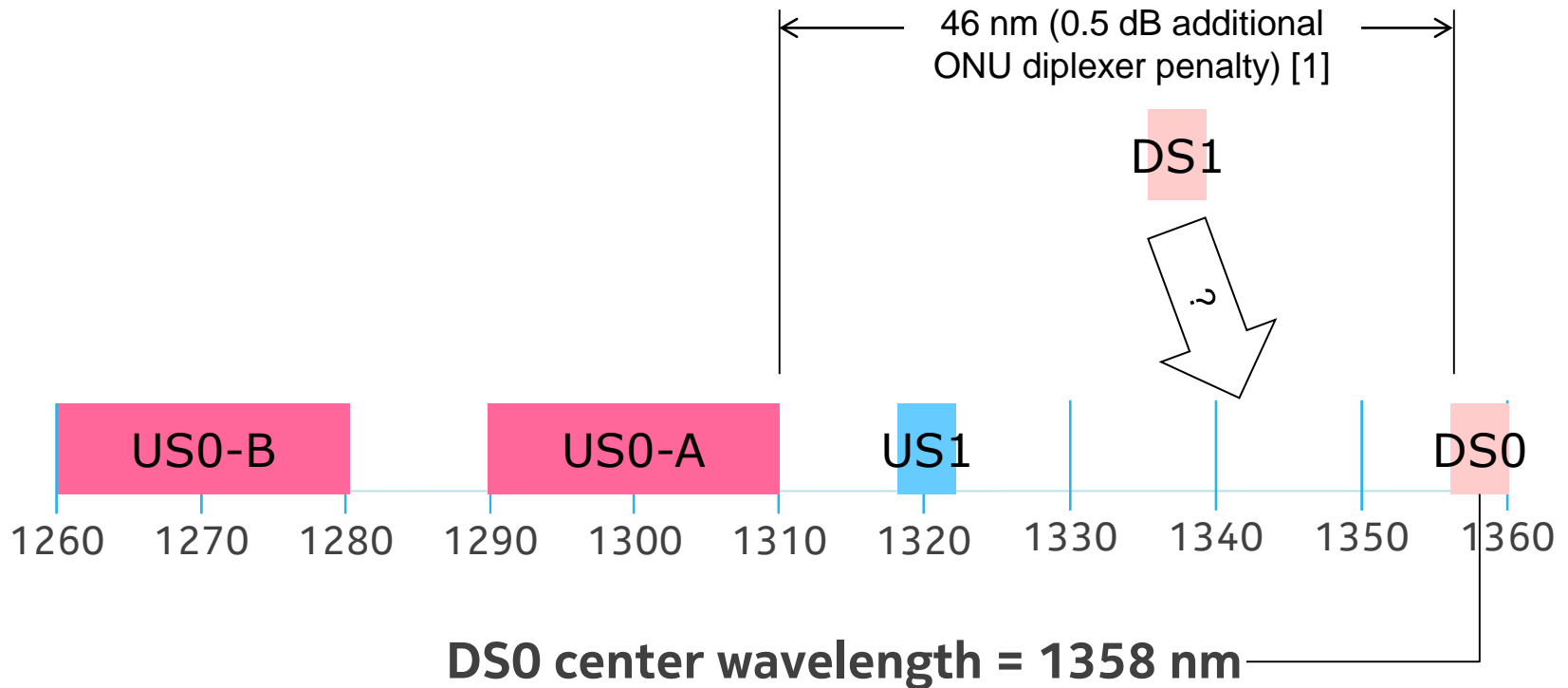


EML wavelength re-use?

- ❑ If EMLs already existed at wavelengths >1330 nm, there would be development cost savings if these wavelengths would be reused.
 - For example, CWDM at 1351 nm.
- ❑ However EMLs do not exist >1330 nm so this is not a consideration.

Minimizing 25G diplexer penalty for US0-A

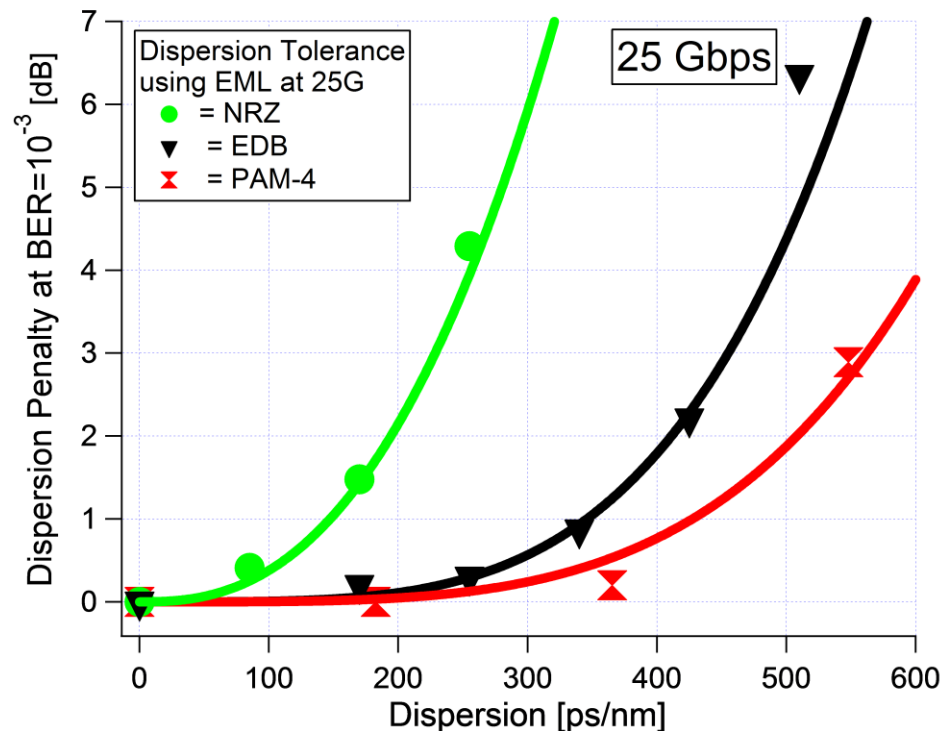
- ❑ DS0: move to the longest wavelength in the O-band to maximize the DS/US gap, thereby minimizing 25G diplexer penalty for US0-A
- ❑ Dispersion will be slightly higher there, but not a significant problem at 25G. It will be a bigger problem for future 50G.



[1] funada_3ca_1_0117

DS1: considering 1x50G PON

- ❑ 1x50G PON downstream: chromatic dispersion penalty (DP) becomes a concern, even in the O-band.
- ❑ Empirical dispersion tolerance values for NRZ, EDB and PAM4 modulations using EMLs, are available for 25G:

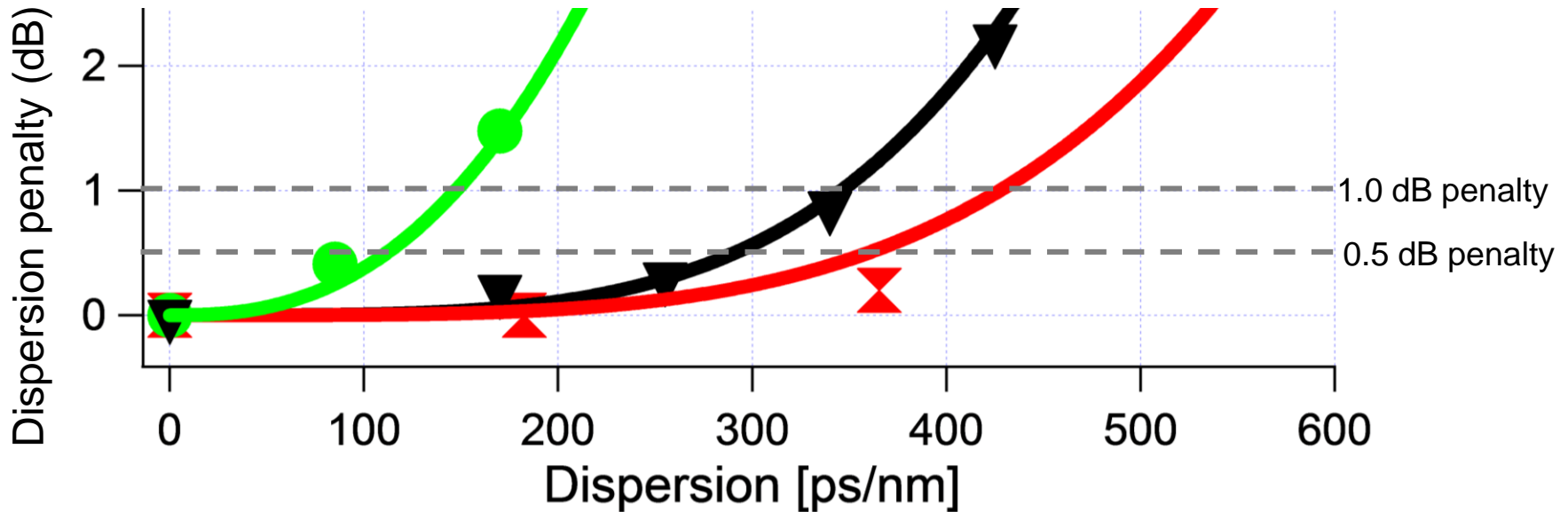


Notes:

1. No dispersion compensation
2. Penalties shown for 1e-3 BER. Should be very similar for 1e-2 BER

V. Houtsma, D. van Veen, "A Study of Options for High-Speed TDM-PON Beyond 10G", J. Lightwave Tech., Feb. 2015.

50G dispersion tolerance (DT)



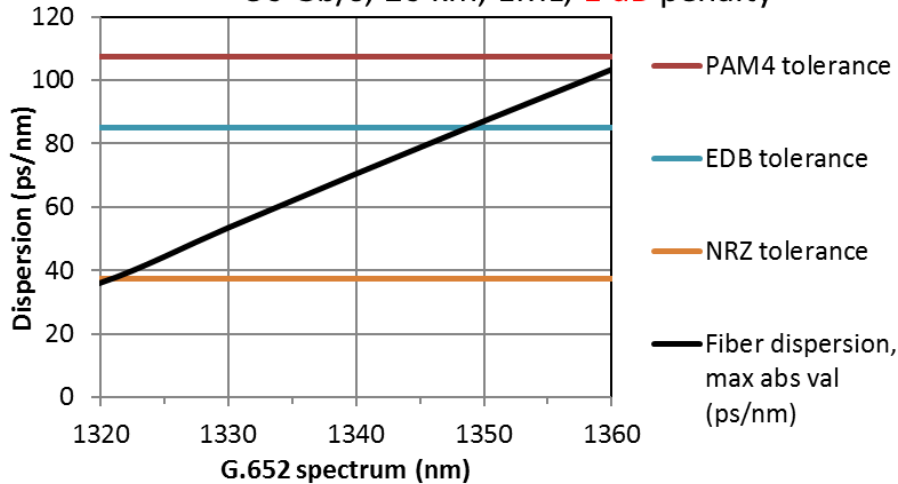
| DP | Bit rate | Dispersion tolerance (ps/nm) | | |
|---------------|----------------|------------------------------|-----------|------------|
| | | NRZ | EDB | PAM4 |
| 0.5 dB | 25 Gb/s | 115 | 290 | 360 |
| 1.0 dB | 25 Gb/s | 150 | 340 | 430 |
| 0.5 dB | 50 Gb/s | 28 | 73 | 90 |
| 1.0 dB | 50 Gb/s | 38 | 85 | 108 |

From the chart

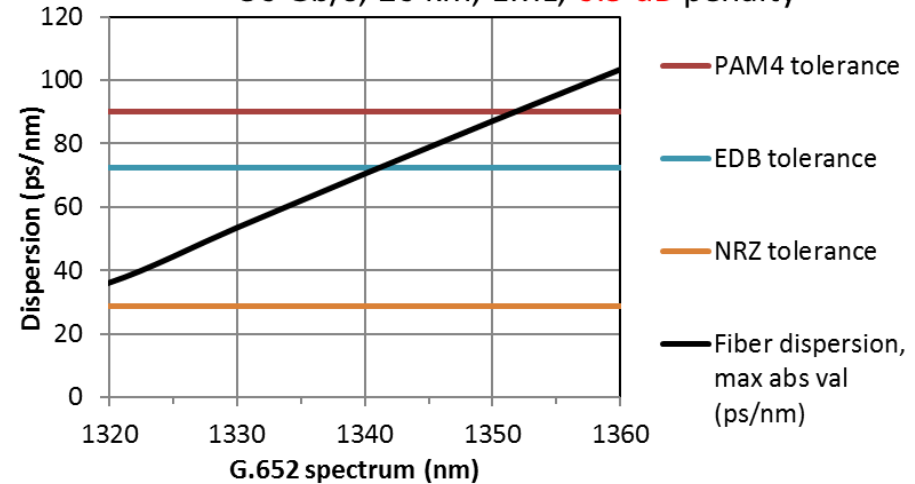
As a first approximation,
50G DT=25G DT/4

Optimizing DS1 for 50G dispersion (1/2)

Fiber dispersion and dispersion tolerance
50 Gb/s, 20 km, EML, 1 dB penalty



Fiber dispersion and dispersion tolerance
50 Gb/s, 20 km, EML, 0.5 dB penalty



For 1 dB DP:

- ❑ EDB requires DS1 <1348 nm.
- ❑ PAM4 OK to 1360 nm

For 0.5 dB DP:

- ❑ EDB requires DS1 <1341 nm.
- ❑ PAM4 requires DS1 <1352 nm.

Note: electronic dispersion compensation could provide some limited benefit:

- Enable NRZ for >1320 nm
- Further minimize dispersion penalty for EDB and PAM4

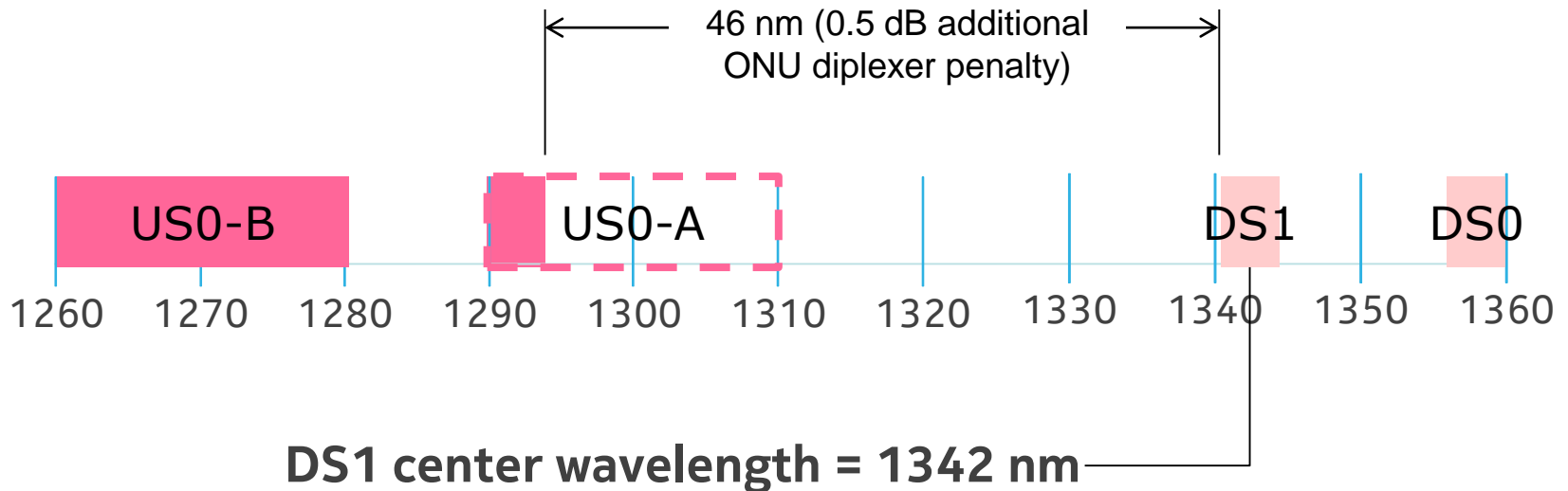
Optimizing DS1 for 50G dispersion (2/2)

Keeping in mind that these are first approximations, we can still draw these conclusions

- ❑ NRZ >1320 nm will only work if accept >1 dB dispersion penalty
- ❑ Minimizing the DS1 wavelength will reduce the dispersion penalty for 50G regardless of whether NRZ, EDB or PAM4 modulation is chosen.

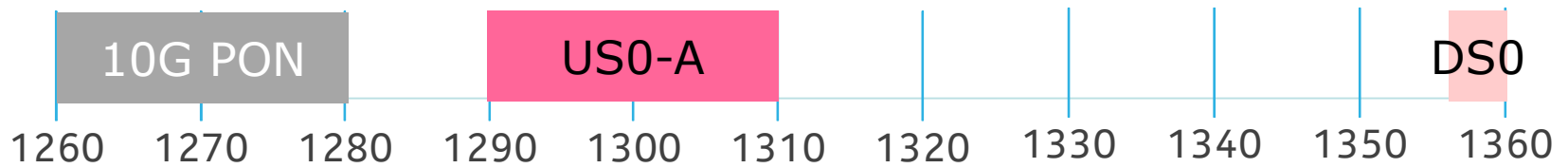
DS1 wavelength selection for 1x50G EPON

- ❑ 50G DS1 should be $> \sim 45\text{nm}$ away from 50G US0-A to allow 45deg ONU diplexers and minimizing diplexer penalty
- ❑ Not possible for DS1 if US0-A is 1290-1310 nm. But if 50G US0-A is restricted to 1290-1294nm (cooled laser), then DS1 > 1340 nm can work.

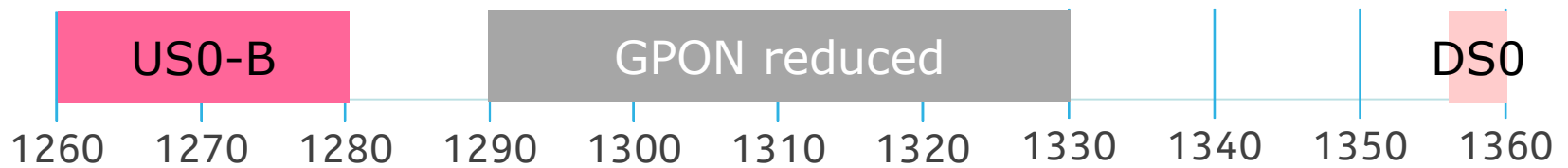


- ❑ DS1 at 1342 ± 2 nm corresponds to < 1 dB DP for EDB and ~ 0.5 dB DP for PAM4. These are manageable penalties.

Option 1



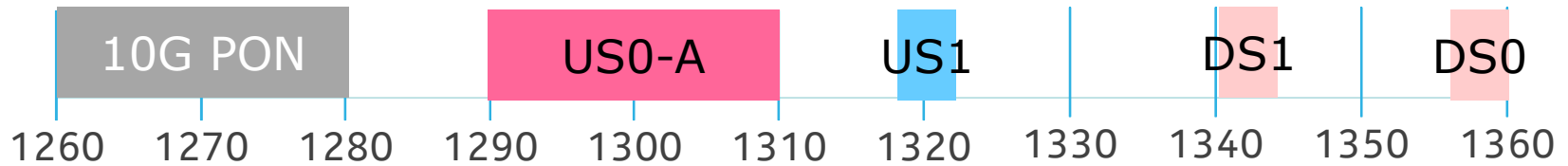
Option 2



2x25G EPON

100G-EPON

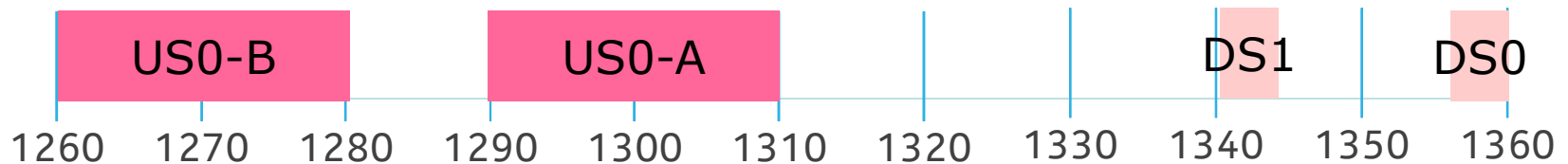
Option 1



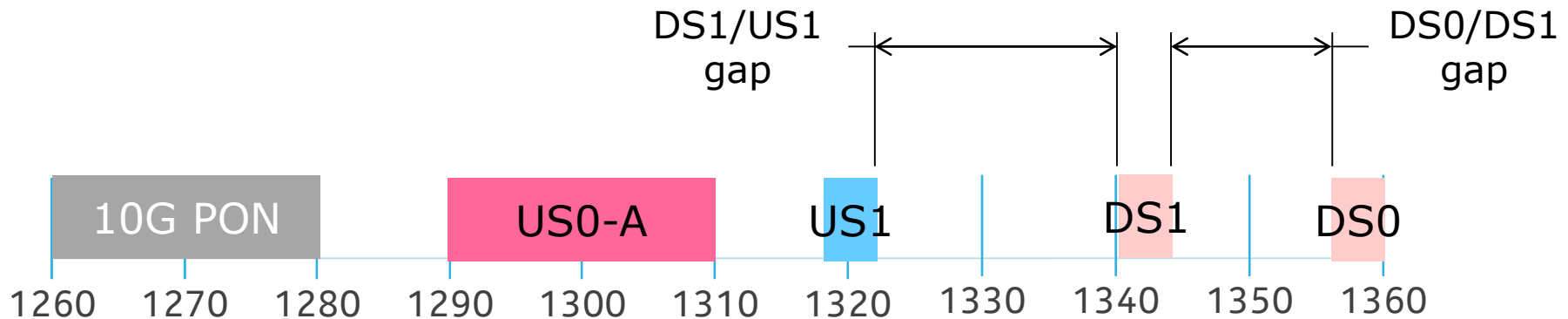
Option 2a



Option 2b (per liu_3ca_1_0118)



Check 2x25G filtering

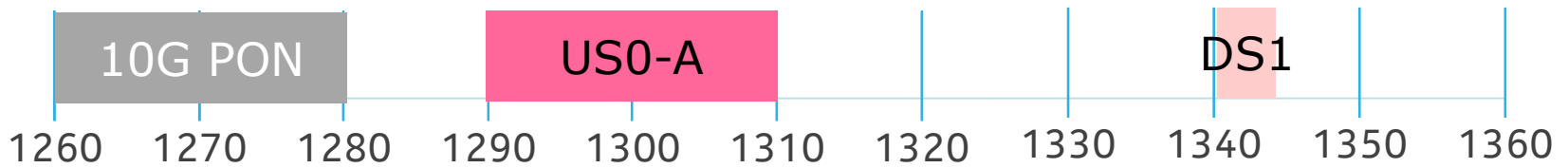


- ❑ DS1/US1 gap = 18 nm
- ❑ DS0/DS1 gap = 12 nm
- ❑ D. Umeda: For a 2x25G transceiver, 45 deg filters are not required and these gaps are enough for a narrower angle filter.

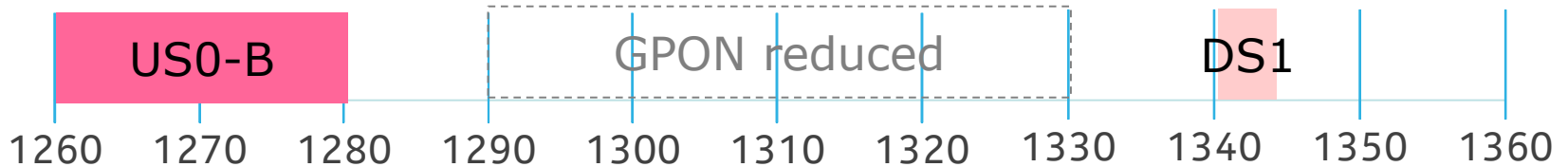
1x50G EPON

100G-EPON

Option 1



Option 2



Summary: DS wavelength plan

- ❑ The two downstream wavelengths, DS0 and DS1, should have 4 nm wavelength tolerance, for high EML yield
- ❑ One DS wavelength, DS0, should be optimized for 25G EPON: minimize diplexer penalty in a low cost BOSA package
- ❑ The other DS wavelength, DS1, should be optimized for 1x50G EPON: minimize dispersion penalty. But still allow for possible low cost BOSA package.
- ❑ Proposed DS wavelength plan
 - DS0: 1358 +/- 2 nm
 - DS1: 1342 +/- 2 nm
- ❑ 25G EPON will use DS0. 2x25G EPON will use DS0 and DS1. 1x50G EPON will use DS1.

Adopt the following downstream wavelength plan:

DS0: 1358 +/- 2 nm

DS1: 1342 +/- 2 nm

25G EPON will use DS0.

Moved: Ed Harstead

Seconded:

For:

Against:

Abstain: