SUMITOMO ELECTRIC

Issues for wavelength allocation

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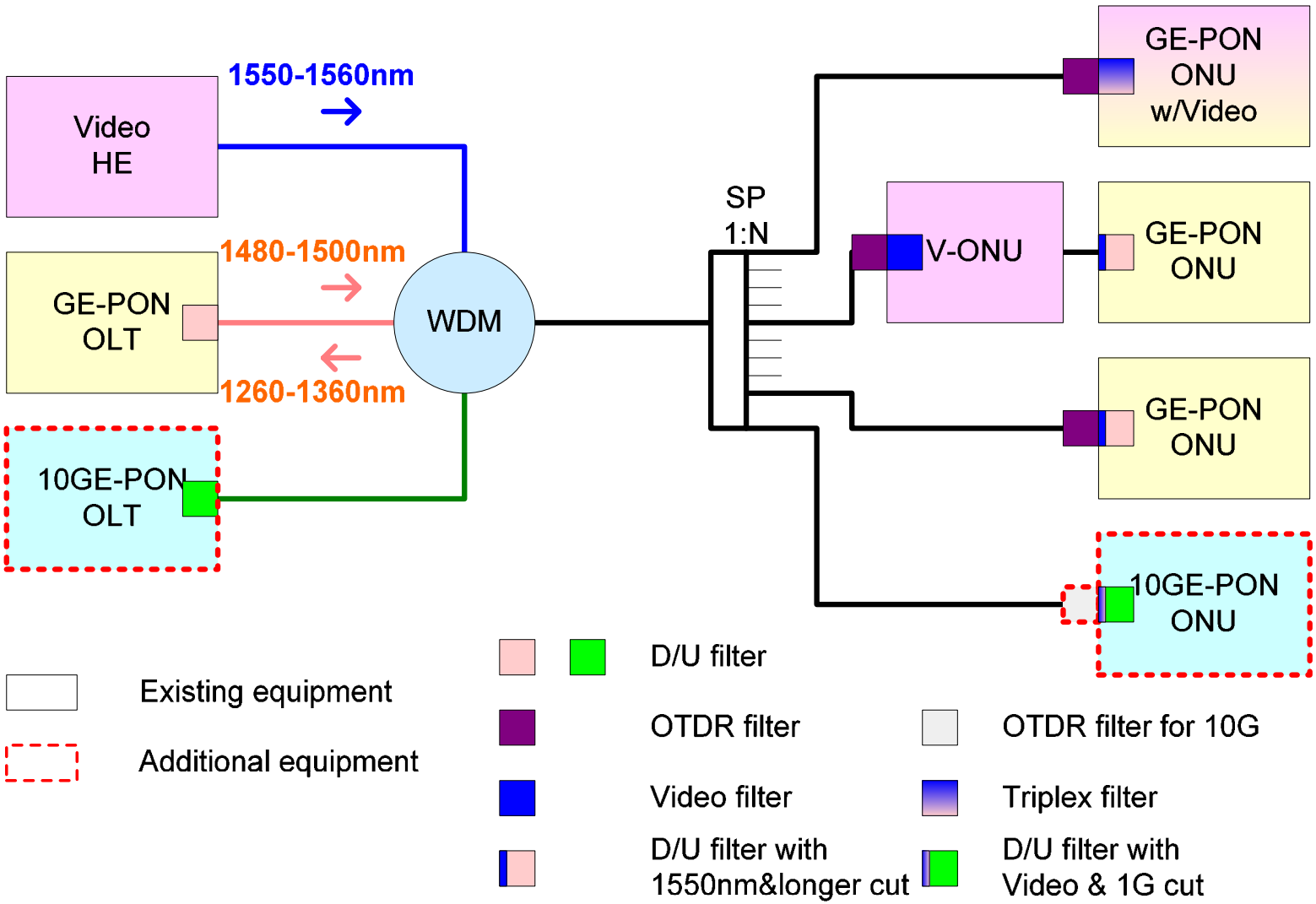
Scope

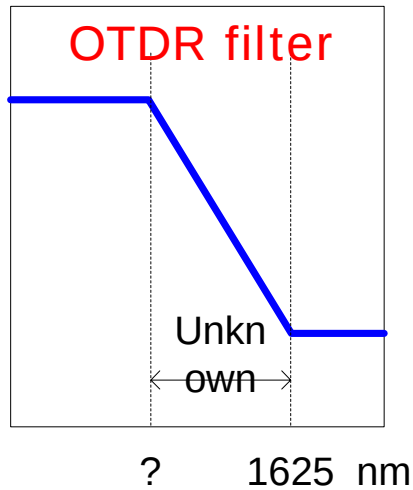
- Arranging wavelength allocation issue
  - Less impact to existing system
  - CO and ONU network device connection
  - Fiber non linear effect
- Focusing 5-lambda system
  - The biggest issue is the co-existence of
    - 2 lambda for 1GEPON
    - 1 lambda for video
    - 2 lambda for 10GEPON
  - For 3- 4-lambda system
    - More flexible if no more additional wavelength
    - Similar situation if keeping wavelength for future use

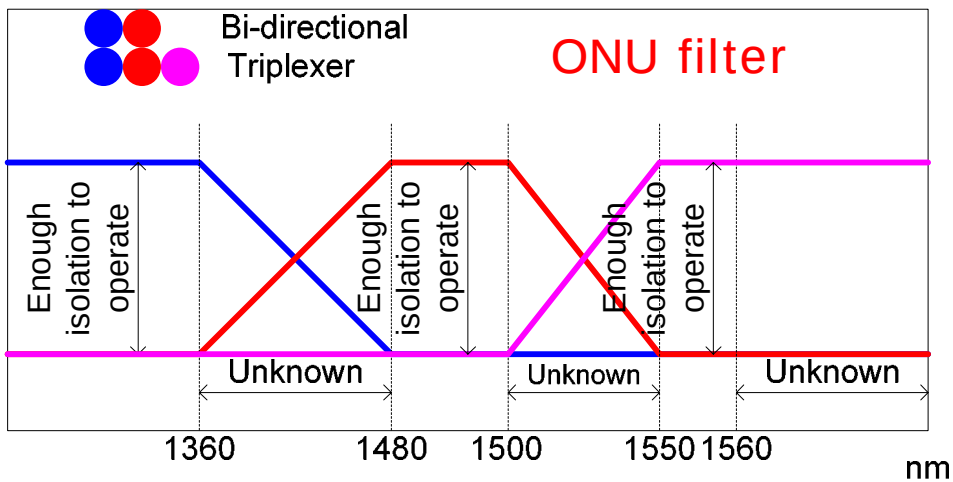
Wavelength limitation map

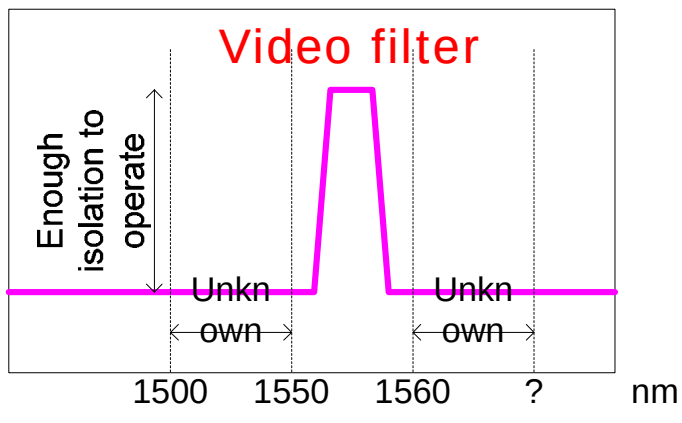


Filter characteristic

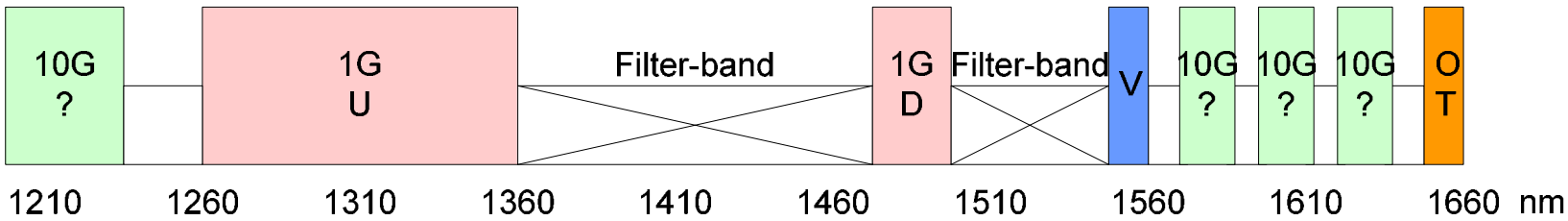
- ONU filter
  - Cut filter for video and longer wavelength
  - Triplexer type has longer pass filter
- V-ONU has video-band pass filter
  - Video signal has precise wavelength
- OTDR filter
  - Unknown wavelength(>1560nm) for pass band







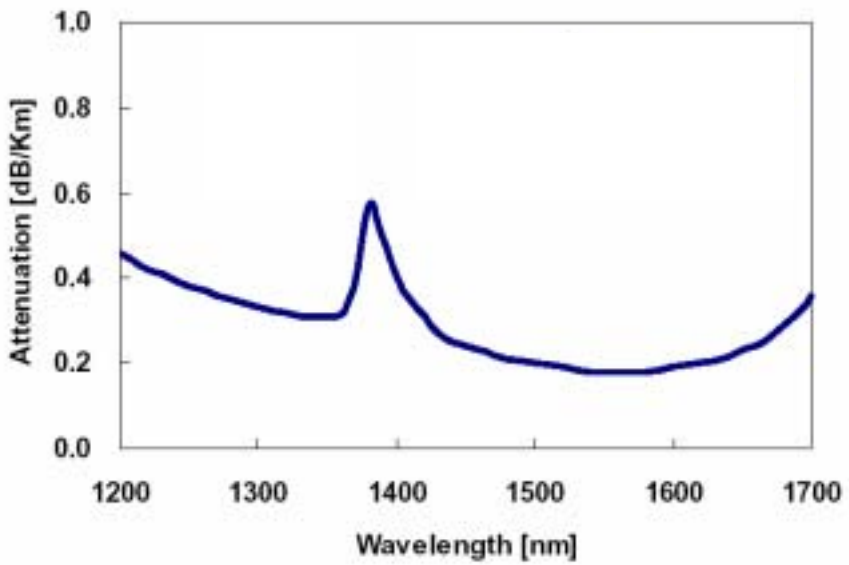
Wavelength characteristics

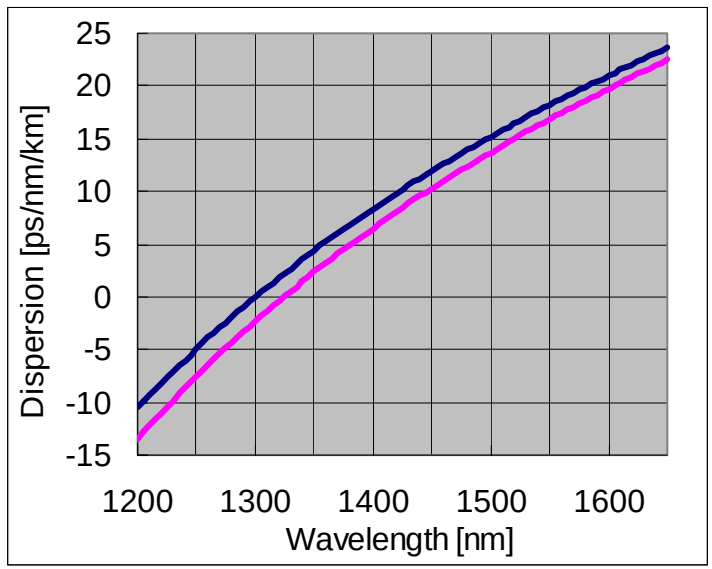


– <1260nm — Challenge to new use comparable with fiber cable cutoff
  Less dispersion than 1500nm band
– Filter band — EML & EDFA available at 1535-1550nm
  Additional filter preferred due to adjacent channel interference
– >1560nm — Used for 2.5G CWDM
  Optical amplifier exists
  Dispersion

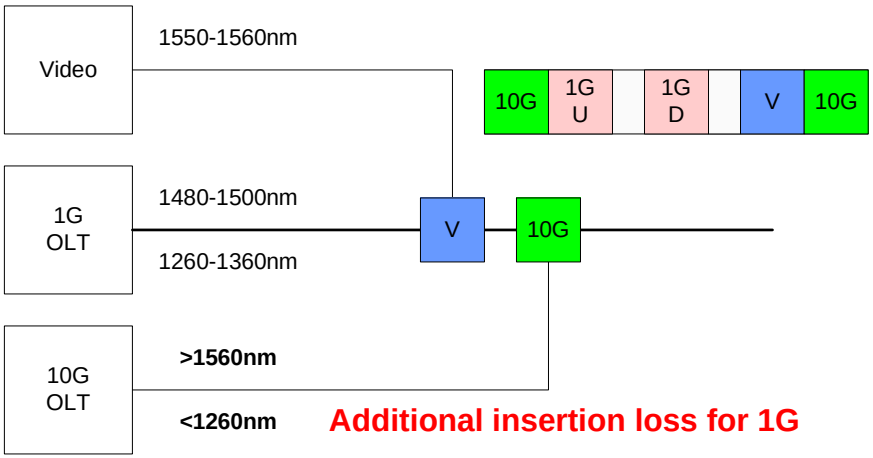
Transmission characteristic

- <1260nm; loss 0.1dB add to 1310nm
  dispersion -13ps/nm/km
- >1560nm; loss comparable to 1550nm
  dispersion 21ps/nm/km

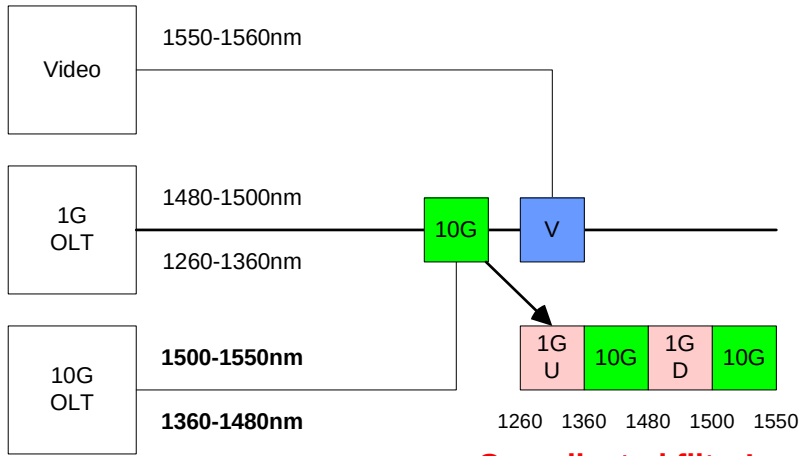




OLT side device connection

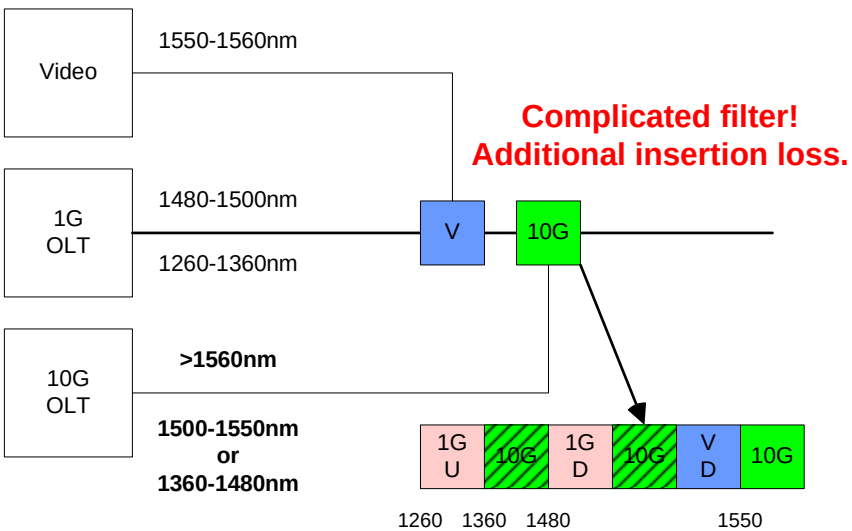


A) Shorter band

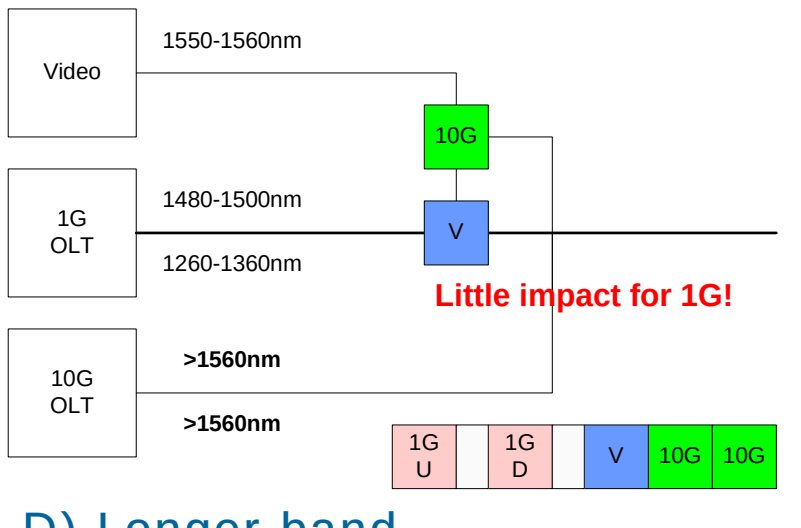


Complicated filter!
Additional insertion loss.

B) Filter-band 1



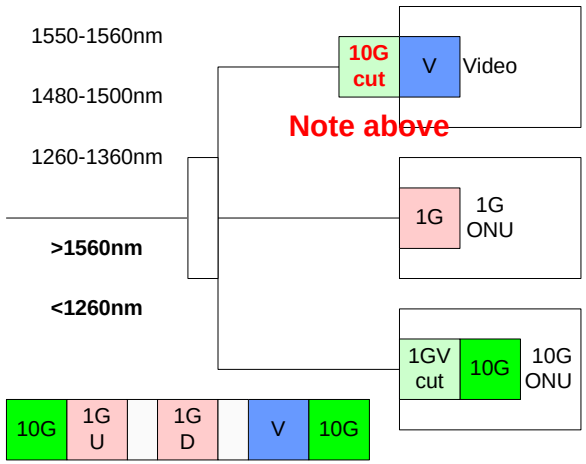
C) Filter-band 2



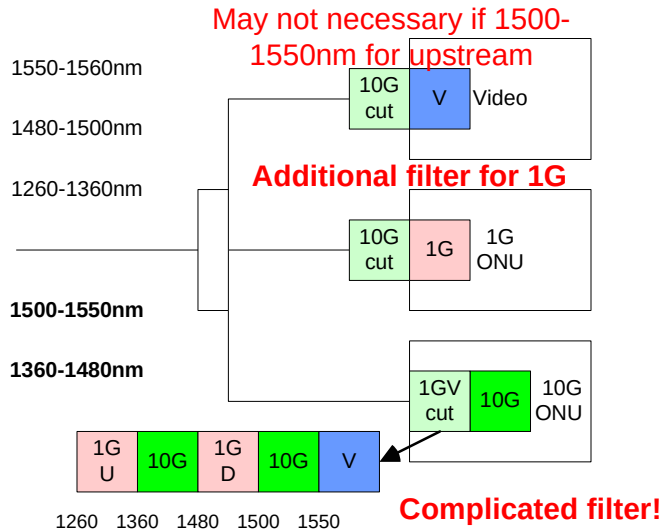
D) Longer band

ONU side device connection

10G cut filer is necessary if longer wavelength pass filter is used as a video filter.



A) Shorter band



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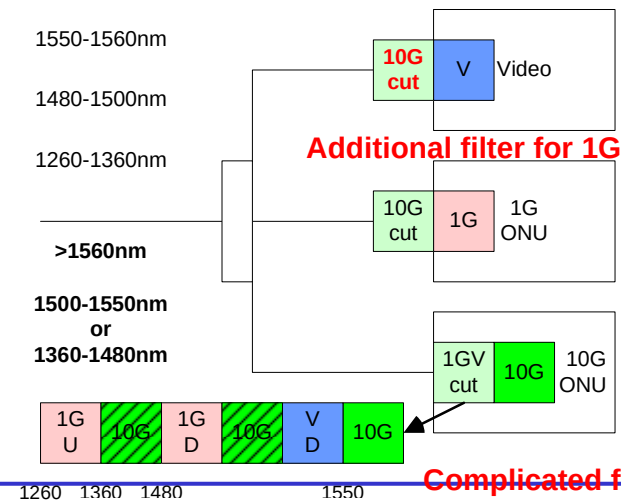
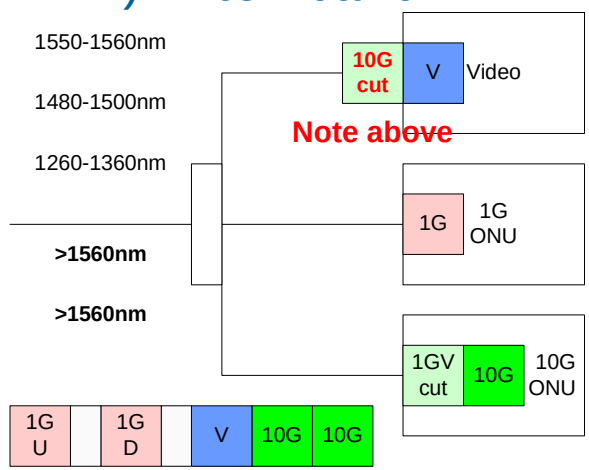


C) Filter-band 2

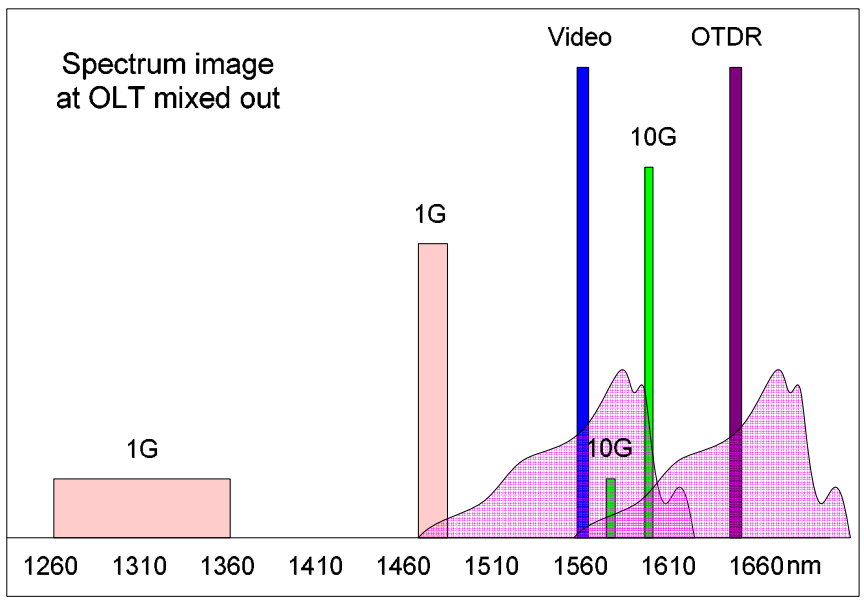


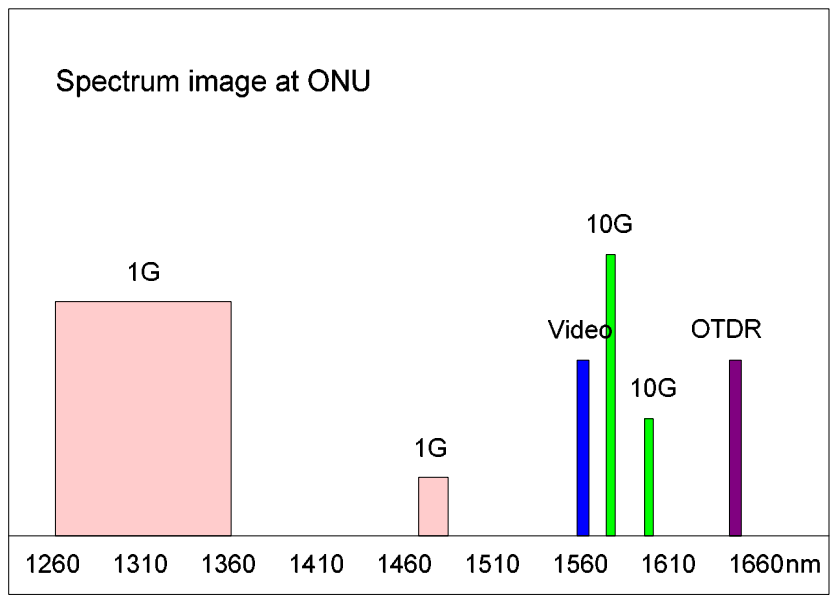
D) Longer band

Non-linear effect

- Fiber non-linear effect calculation
  - Crosstalk generated stimulated Raman scattering and cross phase modulation between 1G/Video and 10G downstream
  - Calculation assumption

    1G down 7dBm; 1480nm
    Video 18dBm; 1550nm
    10G down 14dBm; 1560-1580, 1580-1600 or 1600-1620 nm

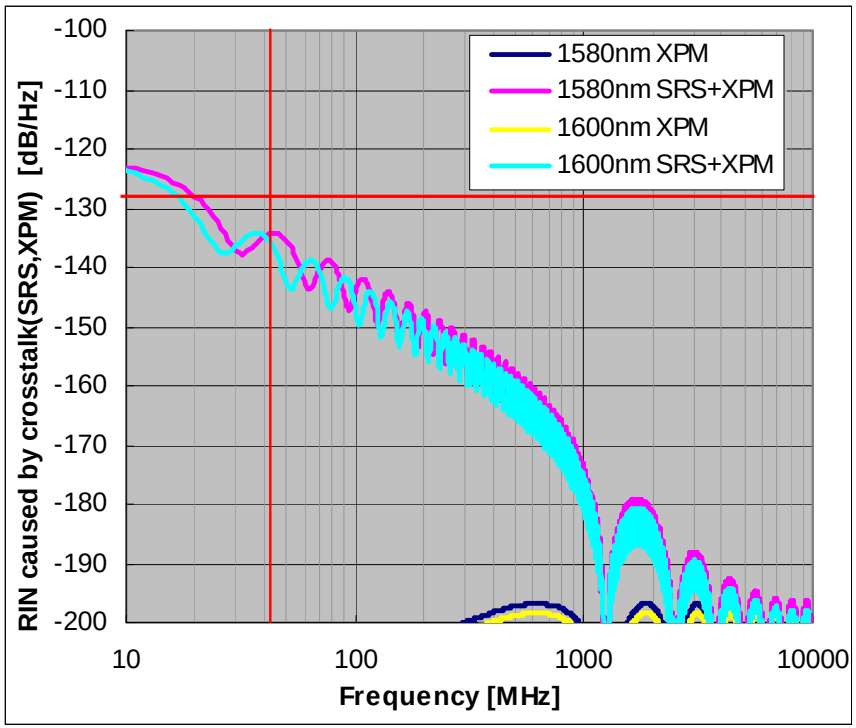




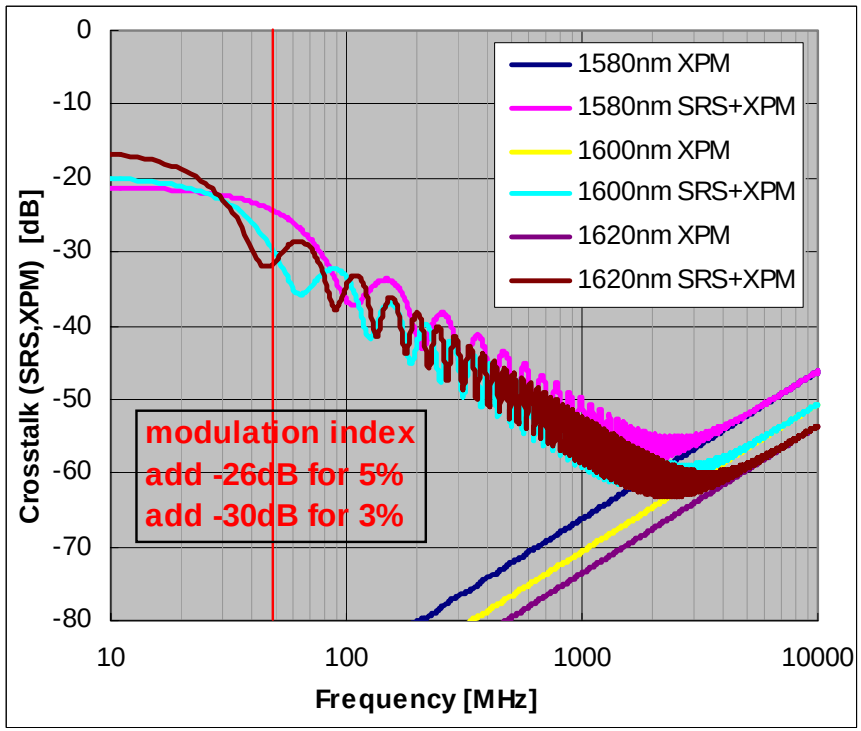
Non-linear effect calculation

- Signal type
  - GE-PON random sequence NRZ signal affects RIN like
  - Video sub-carrier multiplexed signal affects as an interference

Crosstalk from 1G to 10G



Crosstalk from Video to 10G



$RIN_{21}OMA$=-128dB/Hz for 10GBASE-E

~~Power depletion 0.6dB for 1480nm, 0.3dB for 1550nm.~~

Summary

- Thinking of network device connection, using over 1560nm for 10G both downstream and upstream seems less impact to existing system.
- Under 1260nm is Big challenge to transmit at the fiber cable cutoff region.
- Filter band will need additional filter at ONU. This is great impact.
- From non-linear calculation, the Raman crosstalk depletes 1G downstream less than 1dB under the calculation assumption.
- Further investigation is necessary. How about beginning to investigate for the use of over 1560nm?