Wavelength plan proposal

ver. 1.1

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Summary at March meeting

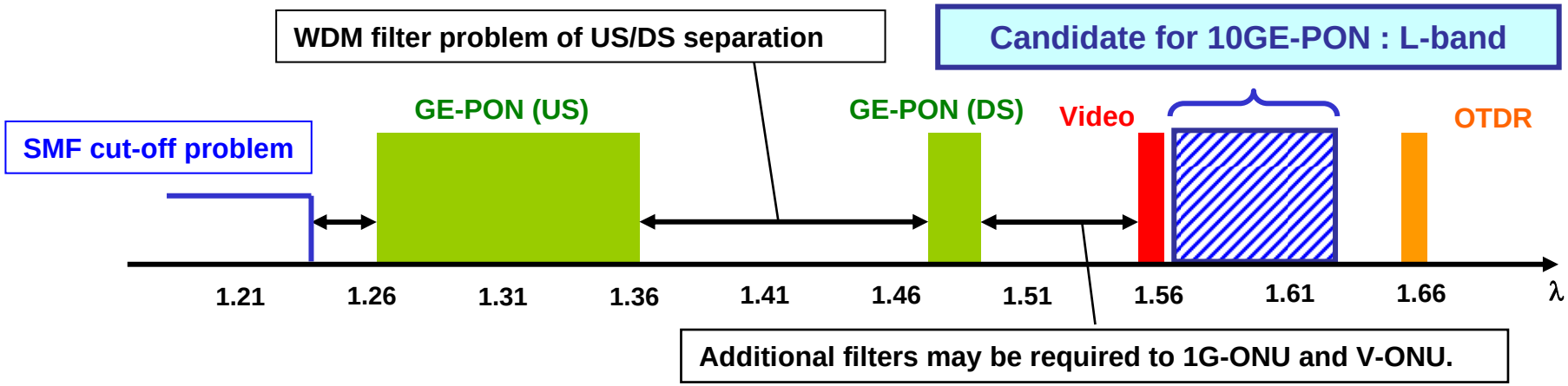
Conclusion in March meeting presentation

By reviewing the proposals in IEEE meetings and systematically narrowing the 10GE-PON system configuration achieving coexistence with current systems, we found that

- US : TDM-based overlay is preferable

- DS : WDM-based overly using L-band is the only solution.

Wavelength allocation



Action Item for May meeting

- ✓ **Wavelength plan proposal**

Studied items

(1) Restrictions from already deployed systems and standards

- OTDR wavelength
- ITU-T standardized wavelength plan

These are associated with operator's perspectives.

(2) Required specifications of ONU optical filter

- Insertion loss
- Wavelength pass-band

These are linked to power budget ad hoc, and we determined preconditions for the feasibility study of ONU optical filter.

(3) Feasibility of the ONU optical filter to meet the above conditions

We would like to propose the downstream wavelength band.

Studied Item (1) :

Restrictions from already deployed systems and standards

Studied Item (2) :

Required specifications of ONU optical filter for DS direction: precondition for the feasibility study of the ONU optical filter

Studies on LD type of OLT transmitter

Modulation scheme: DML or EML

- Only EML is considered for all the PMD classes in power budget ad-hoc.

Discussion on the necessity of cooled-typed LD

- To achieve a high loss budget of 29 dB, cooled-typed LD is necessary.
- Uncooled-typed EML is still at the research stage and not commercially available.
- When using an uncooled-typed EML, we must consider the penalties associated with the extinction ratio degradation caused by the temperature fluctuation.
- Uncooled-typed EML requires a wavelength pass-band of around 15nm, equivalent to the CWDM laser pass-band.

(Question)

How should we specify the signal pass-band for PX10, 20 and PX20+?

(Solutions)

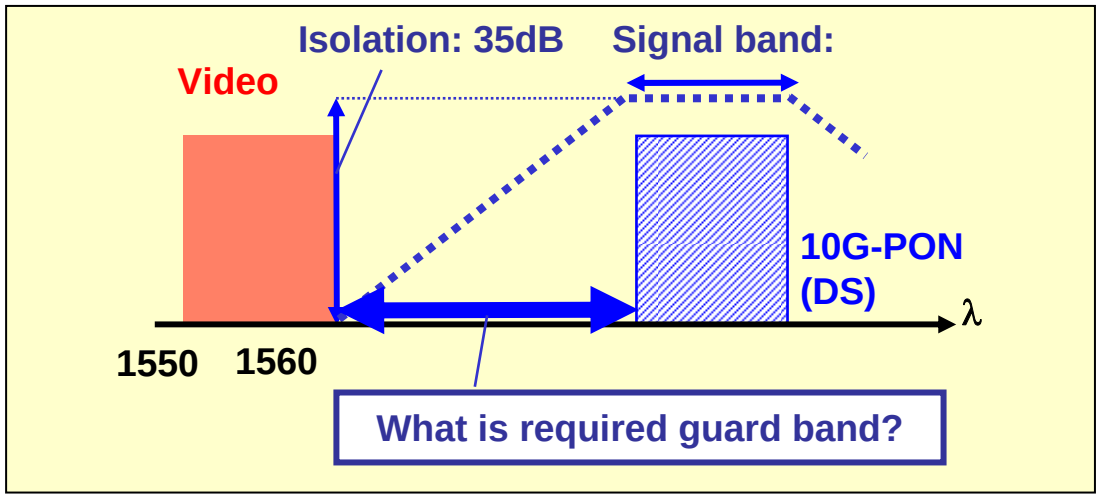
(1) To specify one common signal pass-band for all the PMD classes assuming to adopt cooled-typed LD

(2) To specify different pass-band for each PMD classes: somewhat large pass-band for PX10 and 20 and a small pass-band for PX20+

Preconditions for feasibility study of ONU filters

In studying the feasibility of the ONU blocking filters, we assumed the following conditions:

- **(a) No additional filter to already deployed 1G-ONU and V-ONU,**
- **(b) Insertion loss : < 1dB,**
- **(c) Isolation@1560nm : > 35 dB,**
- **(d) No restriction on the module type,**
- **(e) ONU embedded filter (preferable).**



System vendors investigated the required guard band (GB) for blocking video signal.

Studied Item (3) :

Feasibility of ONU blocking filter to achieve co-existence with current systems.

Feasibility study results from Japanese system vendors

Vendor	Active alignment (ex. BIDI) (*)	Passive alignment (ex. PLC)
A	• 15~20nm-GB is technically feasible. (A GB of less than 10nm would be difficult.)	• 30~40nm-GB is necessary for embedded typed filter.
	• A smaller pass-band is preferable to achieve a smaller GB. We should specify a reasonable pass-band in considering the practical characteristics of EMLs. • We should consider options to adopt an external or detachable blocking filter, by which 5nm-GB is achievable.	
B	• Theoretical limit of the shortest wavelength of the signal pass-band :1571nm • A signal pass-band between 1574 and 1580nm is technically possible.	
C	• The GB of currently specified TO-CAN is 20nm. • 5nm-GB is achievable by using an external filter whose relative cost would be x30.	
D	• The cost of 20nm- and 10nm-GB filter would be 20x and 30x of that of 40nm-GB one, respectively.	
E	• 5nm-GB filter is technically feasible.	

(*) In the feasibility studies of active alignments, all the vendors considered the case-2 configuration in the following pages.

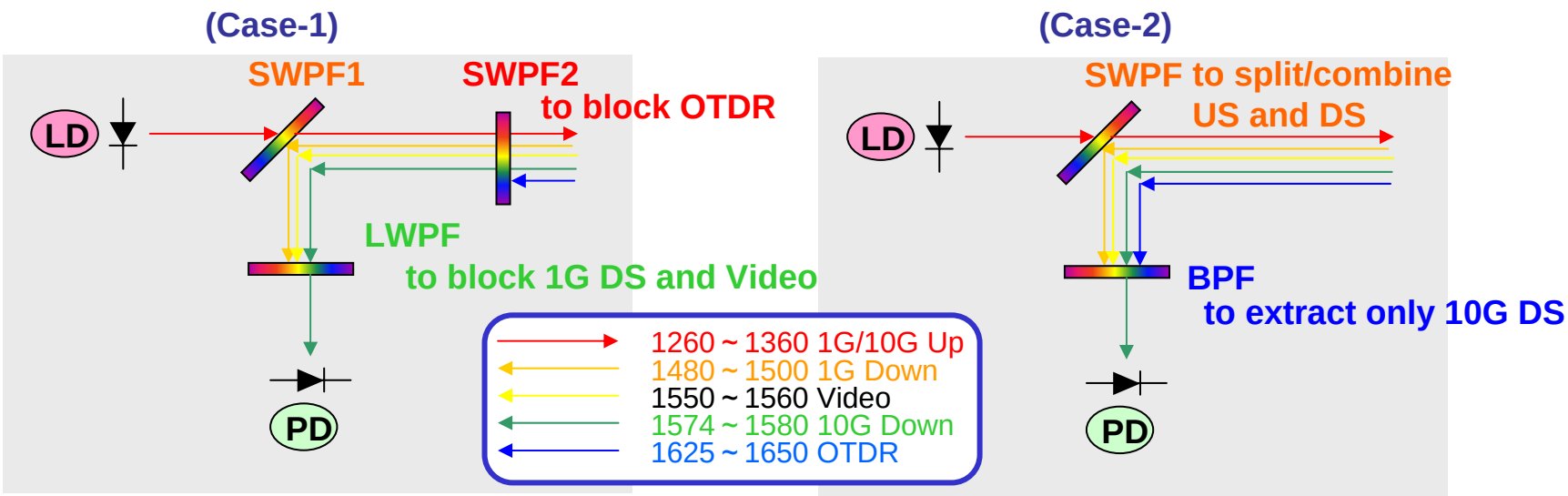
It is considered that 14nm-GB, the shortest λ of 1574nm, would be possible.

Configuration of optical filters in ONUs (1)

Several types of optical filter configuration in ONUs are considered for coexistence. In general, they are commonly categorized into:

(Case-1) combination of several WDM filters, as shown in 3av_0703_hajduczenia_2.pdf,

(Case-2) combination of WDM filters and optical band-pass filter.

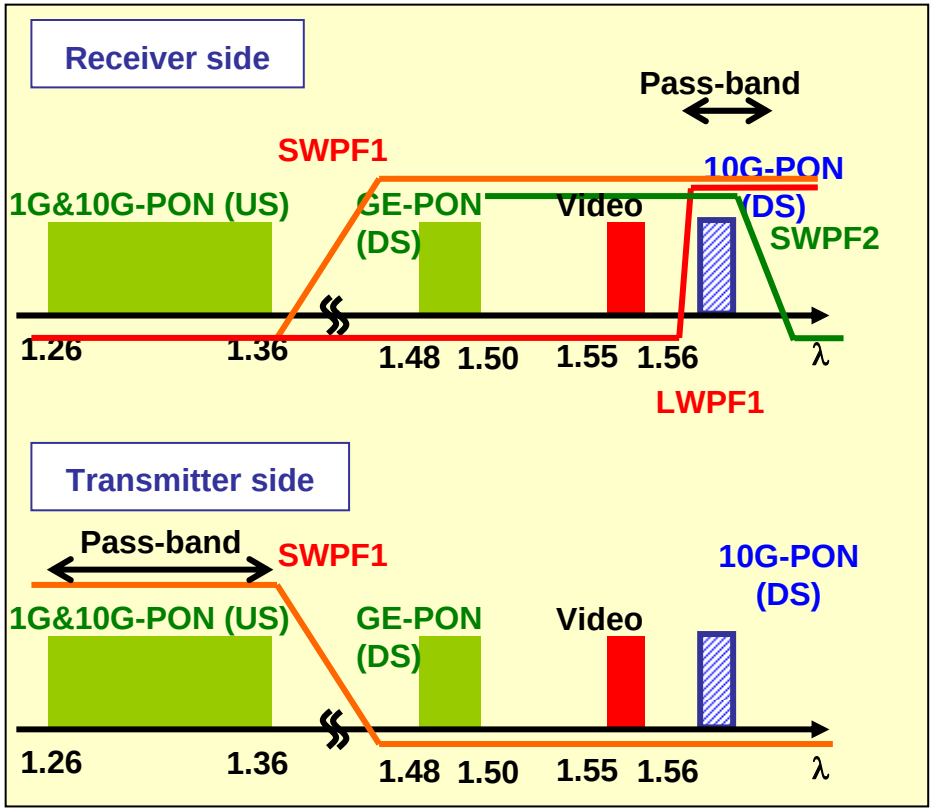


Filter name	Pass λ band [nm]	Min. guard band [nm]	Filter angle [deg]
SWPF1	-1360	120	45
SWPF2	-1580	45	0
LWPF	1574-	14	0

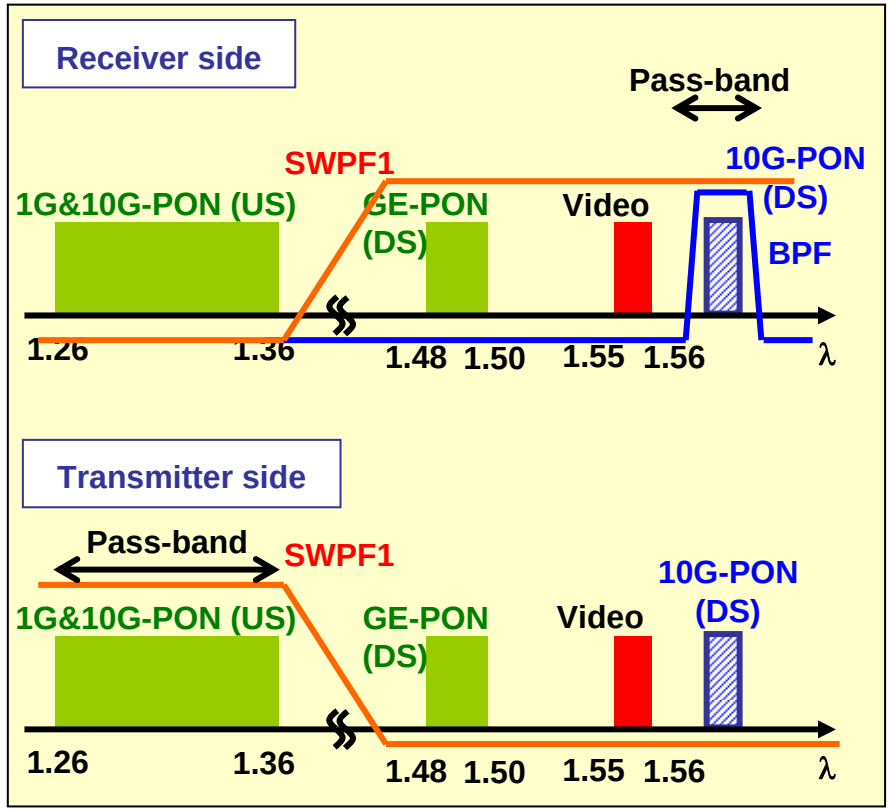
Filter name	Pass λ band [nm]	Min. guard band [nm]	Filter angle [deg]
SWPF	-1360	120	45
BPF	1574-1580	14	0

Configuration of optical filters in ONUs (2)

(Case-1)



(Case-2)

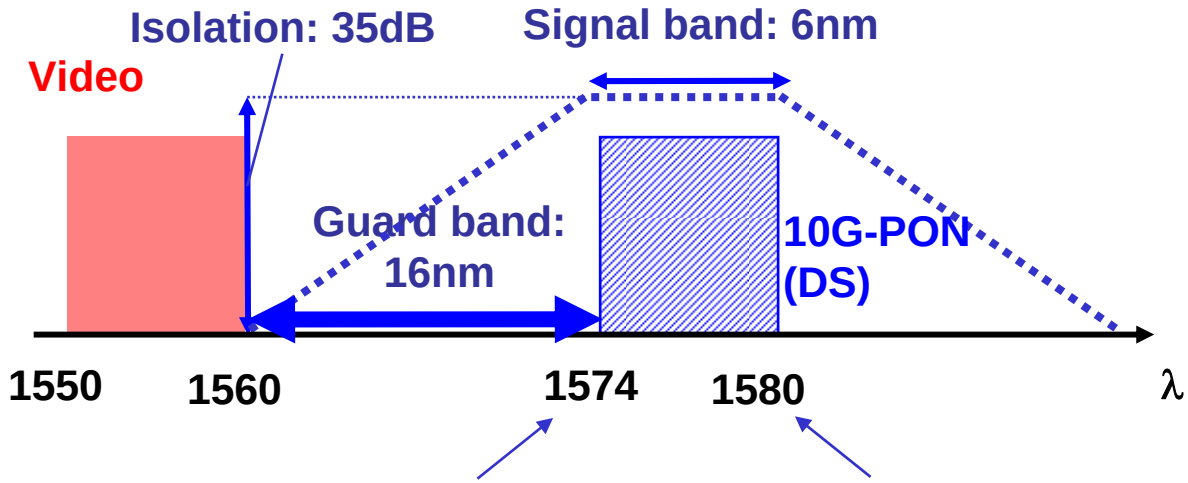


The cost of the ONU is mainly dominated by the optical transceiver components. The insertion loss should be decisive factor when designing optical filters to relax the optical transceiver specifications.

From this perspective, the feasibility of the case-2 filter was considered; a smaller number of filters is preferable in terms of lower insertion loss.

Summary of 10GE-PON DS wavelength proposal

Wavelength allocation and BPF specification



- The shortest wavelength is bound by the characteristics of the optical BFP.
- The longest wavelength is bound by conventional ITU-T recommendations such as G.982 and 983, in which the signal wavelength range shall be less than 1580nm.

(Conclusion)

DS wavelength proposal :1574 ~ 1580nm

Consideration on 10GE-PON US wavelength band

In the last Orlando meeting, it is conditionally approved as a baseline that TDM-based overlay using 1.3um wavelength should be applied to the upstream.

Situation in power budget ad-hoc

- **FP-laser would not be applicable to ONU laser source at a speed of 10Gbps due to its high dispersion penalty.**
- **If all the laser type is DFB, there is no reason to allocate a 100nm wavelength band between 1260 and 1360nm for upstream. A signal band of 6nm and 20nm might be enough for cooled- and uncooled-typed laser, respectively.**

➡ **A narrow wavelength band is preferable for upstream**

Wavelength plan proposal for upstream

As a next step, we should consider the following issues:

(1) Wavelength band for upstream,

(2) Center wavelength of the band.

(example)