

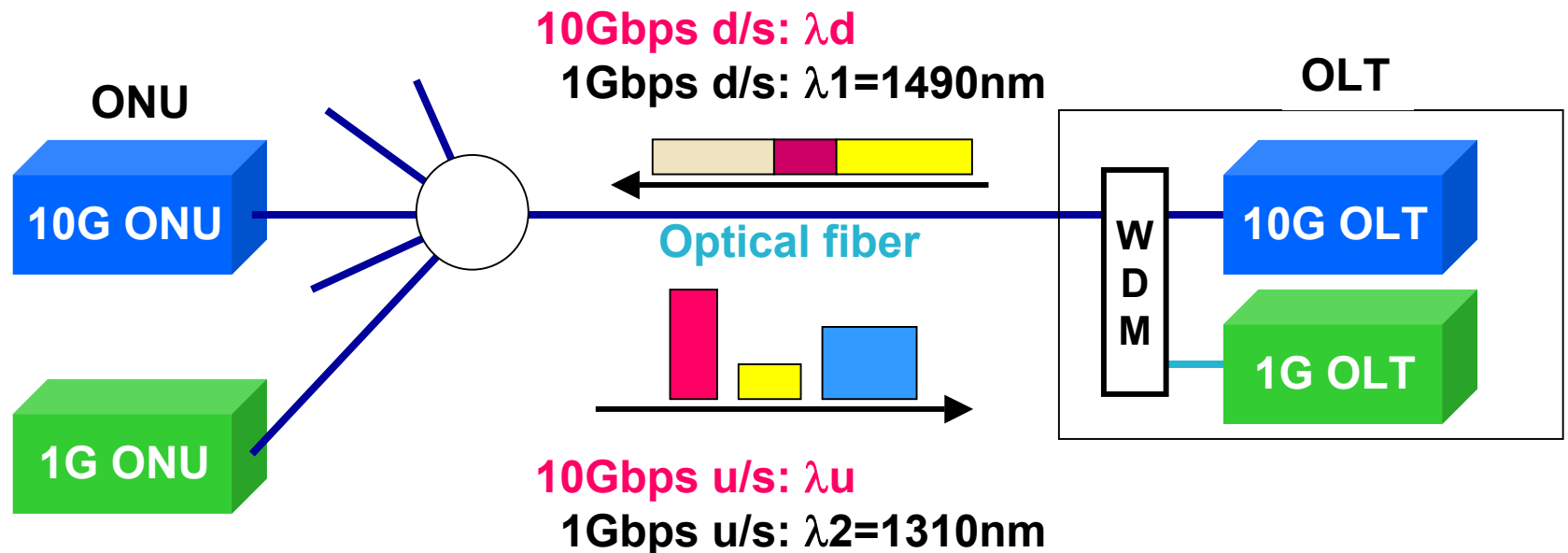
[Technical Feasibility] Optical Budget for 10G-EPON

July 18-20, 2006

Motoyuki Takizawa, Fujitsu Access
Tetsuya Yokomoto, Fujitsu Access

Prerequisite for 10Gb/s EPON PHY

- Reuse of the existing fiber plant supports economical feasibility and future growth of 10G-EPON.
 - Necessity of 29dB + 1dB(penalty) power budget(w/o FEC)
 - Coexistence of 1G-EPON and 10G-EPON in the same fiber
- Take into account not only existing technologies but upcoming ones in the near future.



Case1: Green Field

Same wavelength allocation as that of 1G-EPON.

Advantages

- Directly modulated DFB-LD can be applied to upstream.

Disadvantages

- 10G-EPON cannot coexist with 1G-EPON in the same fiber.
- Installation of another fiber plant infrastructure will be required.
- The market might be limited and smaller than the other migration cases from 1G-EPON.

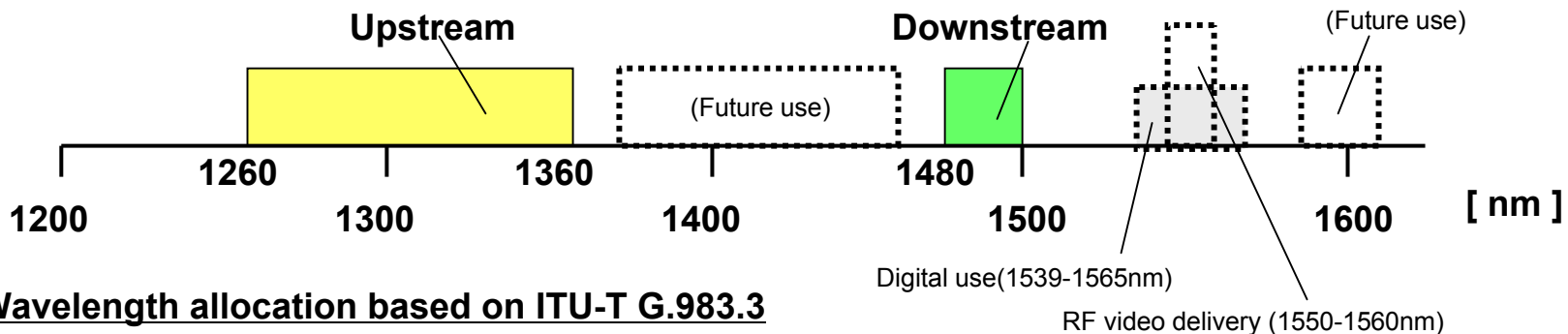
Methodology

Example

- * Assumed penalty less than 1 dB
- * OA means optical amplifier like EDFA or SOA

| Upstream ($\lambda = 1310\text{nm}$) | | | |
|--|---------|----------|--------------|
| ONU Tx | | OLT Rx | |
| DFB | + 2 dBm | - 28 dBm | OA-pre + APD |
| Optical Power Budget : 30 dB | | | |

| Downstream ($\lambda = 1490\text{nm}$) | | | |
|--|----------|---------|-------------|
| ONU Rx | | OLT Tx | |
| APD | - 24 dBm | + 6 dBm | EAM-LD + OA |
| Optical Power Budget : 30 dB | | | |



Wavelength allocation based on ITU-T G.983.3

Case2: New Wavelengths (1)

Use future-use wavelength between 1360 and 1480nm for both upstream and downstream.

Advantages

- 10G-EPON can coexist with 1G-EPON in the same fiber.

Disadvantages

- Blocking WDM filters are required for 1G-EPON system .

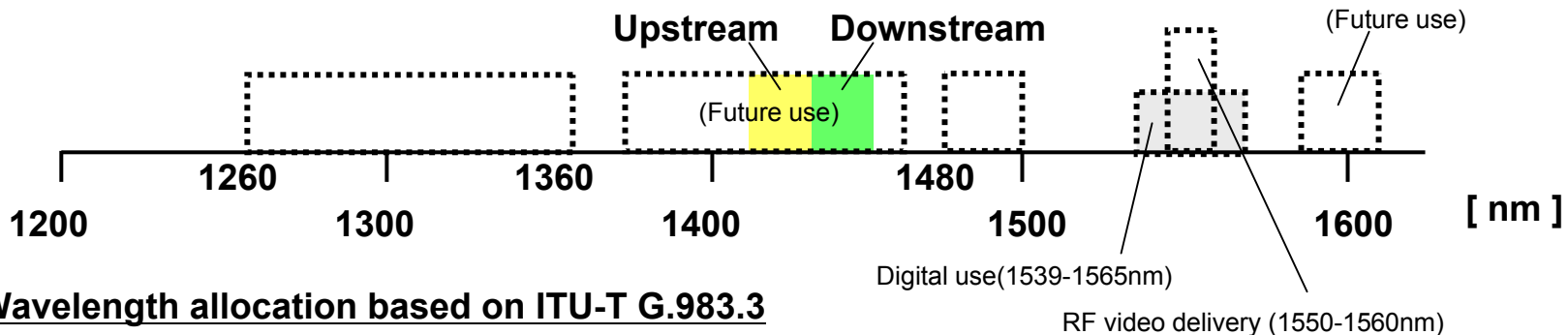
Methodology

Example

- * Assumed penalty less than 1 dB
- * OA means optical amplifier like EDFA or SOA

| Upstream ($\lambda = 1430\text{nm}$ -band) | | | |
|---|---------|----------|--------------|
| ONU Tx | | OLT Rx | |
| QDLD | + 2 dBm | - 28 dBm | OA-pre + APD |
| Optical Power Budget : 30 dB | | | |

| Downstream ($\lambda = 1450\text{nm}$ -band) | | | |
|---|----------|---------|-----------|
| ONU Rx | | OLT Tx | |
| APD | - 24 dBm | + 6 dBm | QDLD + OA |
| Optical Power Budget : 30 dB | | | |



Wavelength allocation based on ITU-T G.983.3

Future useful technologies such as directly modulated Quantum Dot LD (QDLD), which has potentially less temperature dependency of output power and can reduce system cost, will be applicable in the future.

Case3: New Wavelengths (2)

Wavelength-band of C- and/or L-band are used for both upstream and downstream.

Advantages

- 10G-EPON can coexist with 1G-EPON in the same fiber.
- C-band LDs and OAs are well-matured optical components.

Disadvantages

- Blocking WDM filters are required for 1G-EPON system .
- Cost-reduction of C-band devices with temperature control should be promoted, and is also same for L-band devices.

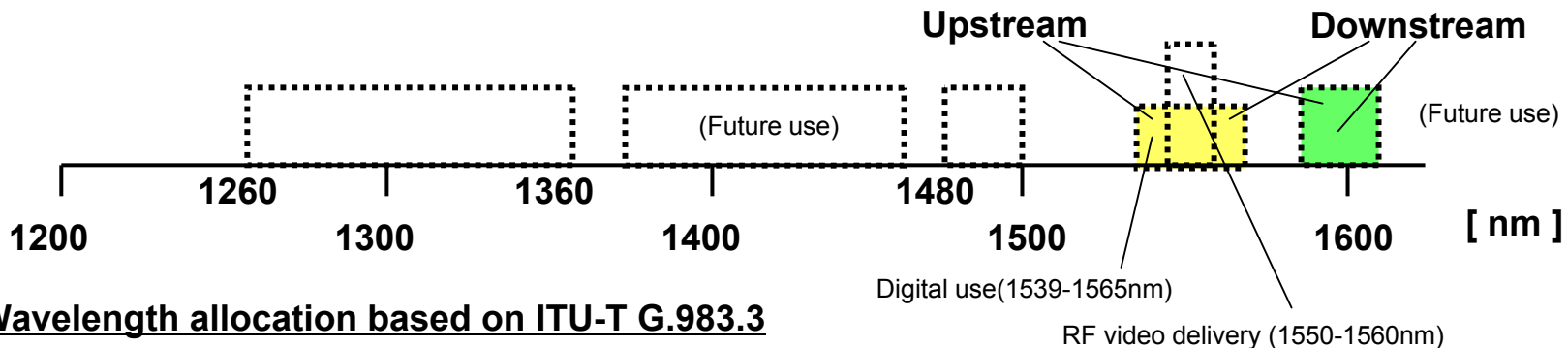
Methodology

Example

* Assumed penalty less than 1 dB
 *OA means optical amplifier like EDFA or SOA

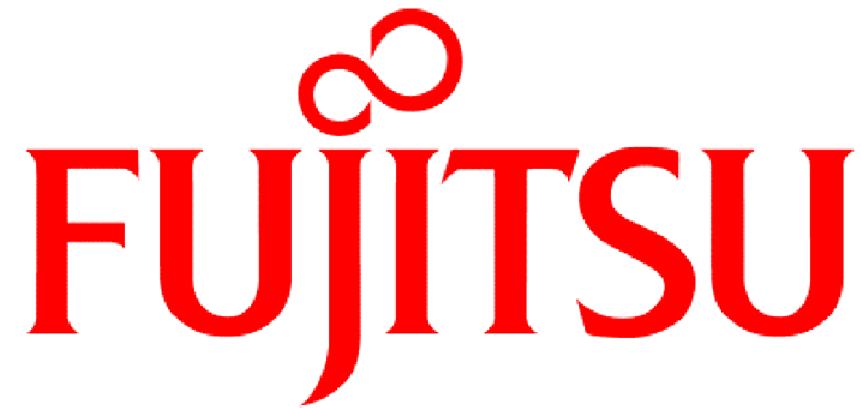
| Upstream ($\lambda =$ C- or L-band) | | | |
|--------------------------------------|---------|----------|--------------|
| ONU Tx | | OLT Rx | |
| EAM-LD + OA or LN | + 2 dBm | - 28 dBm | OA-pre + APD |
| Optical power budget : 30 dB | | | |

| Downstream ($\lambda =$ C- or L-band) | | | |
|--|----------|---------|-------------------|
| ONU Rx | | OLT Tx | |
| APD | - 24 dBm | + 6 dBm | EAM-LD or LN + OA |
| Optical power budget : 30 dB | | | |



Wavelength allocation based on ITU-T G.983.3

- **Technical feasibility for 29 dB optical budget(w/o FEC and penalty) has been studied, and it is feasible from the viewpoint of optical budget by using new technologies which will be mature in the near future.**
- **OBJECTIVES in this 10G-EPON PHY SG should include description of target optical budgets, which will accelerate cost-reduction of optical devices and promote development of new applicable technologies in the near future.**
- **FEC will be optionally applicable to mitigate optical power budget and to reduce optical components cost, even though traffic efficiency will decrease to some extent. Therefore, it is worth considering FEC application.**



FUJITSU

THE POSSIBILITIES ARE INFINITE