



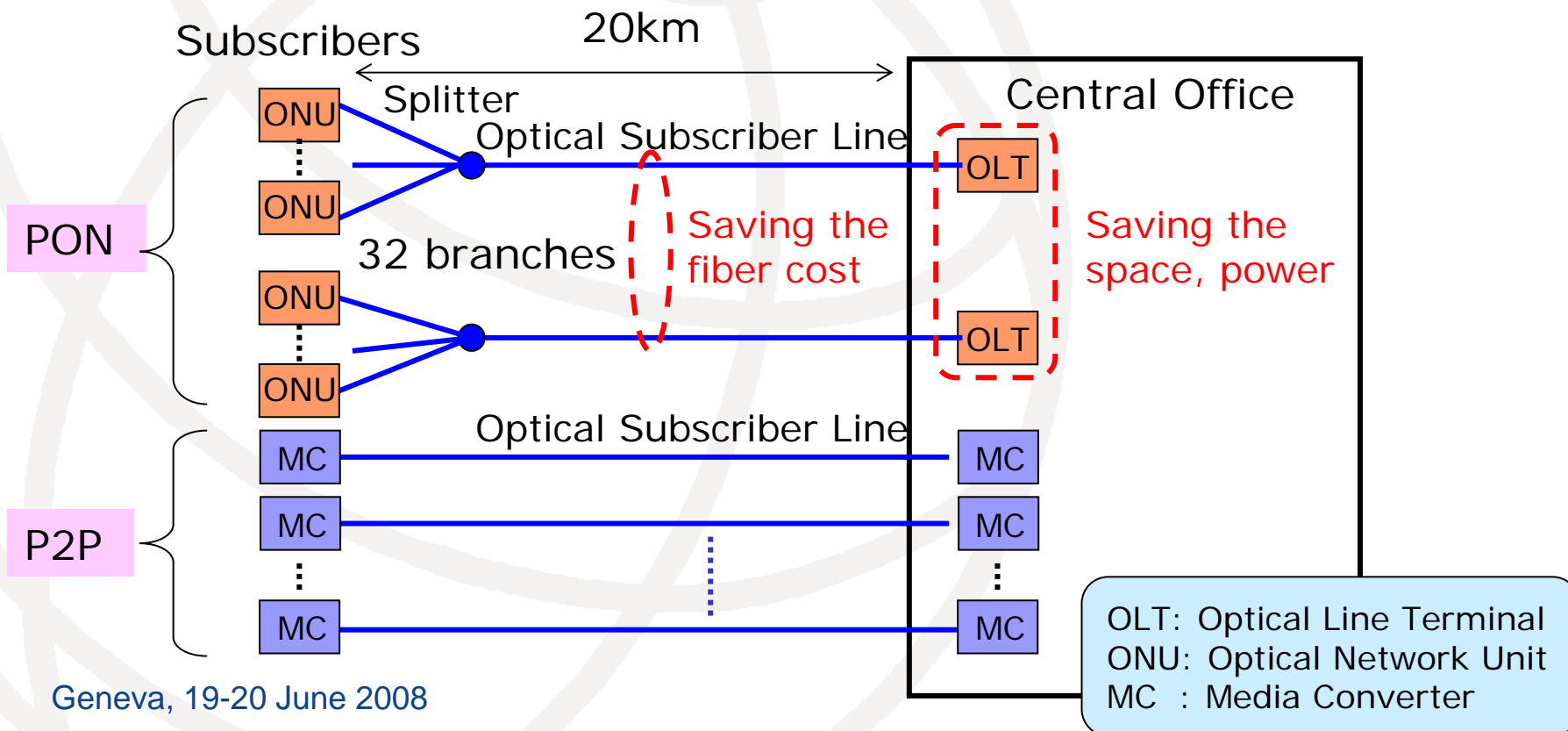
# **Joint ITU-T/IEEE Workshop on Next Generation Optical Access Systems**

## **Physical layer requirements for smooth migration from the current FTTH**

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Mitsubishi Electric**

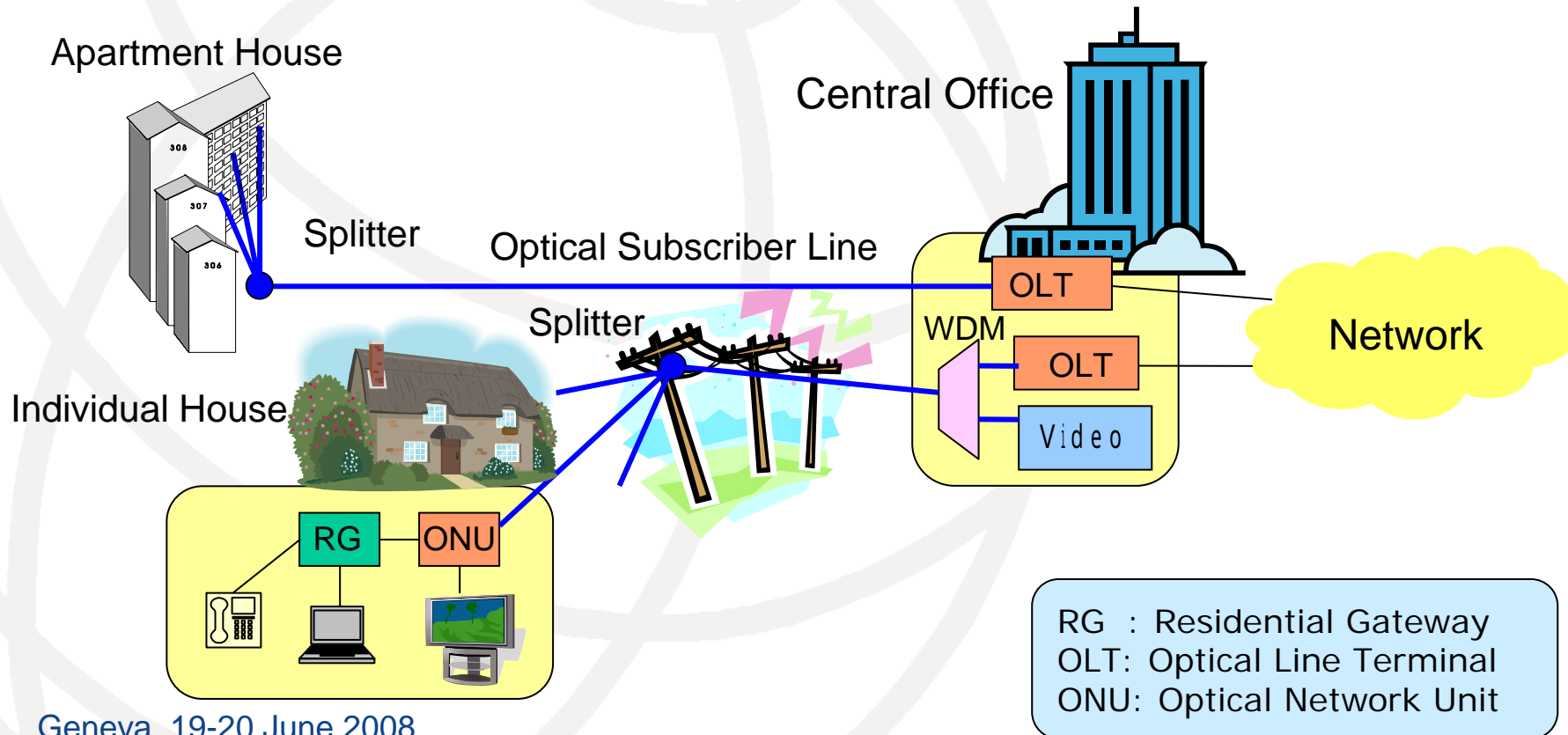
# PON provides FTTH economically

- PON is a mainstream of FTTH
- Saving the fiber cost, space and power in comparison with P2P.



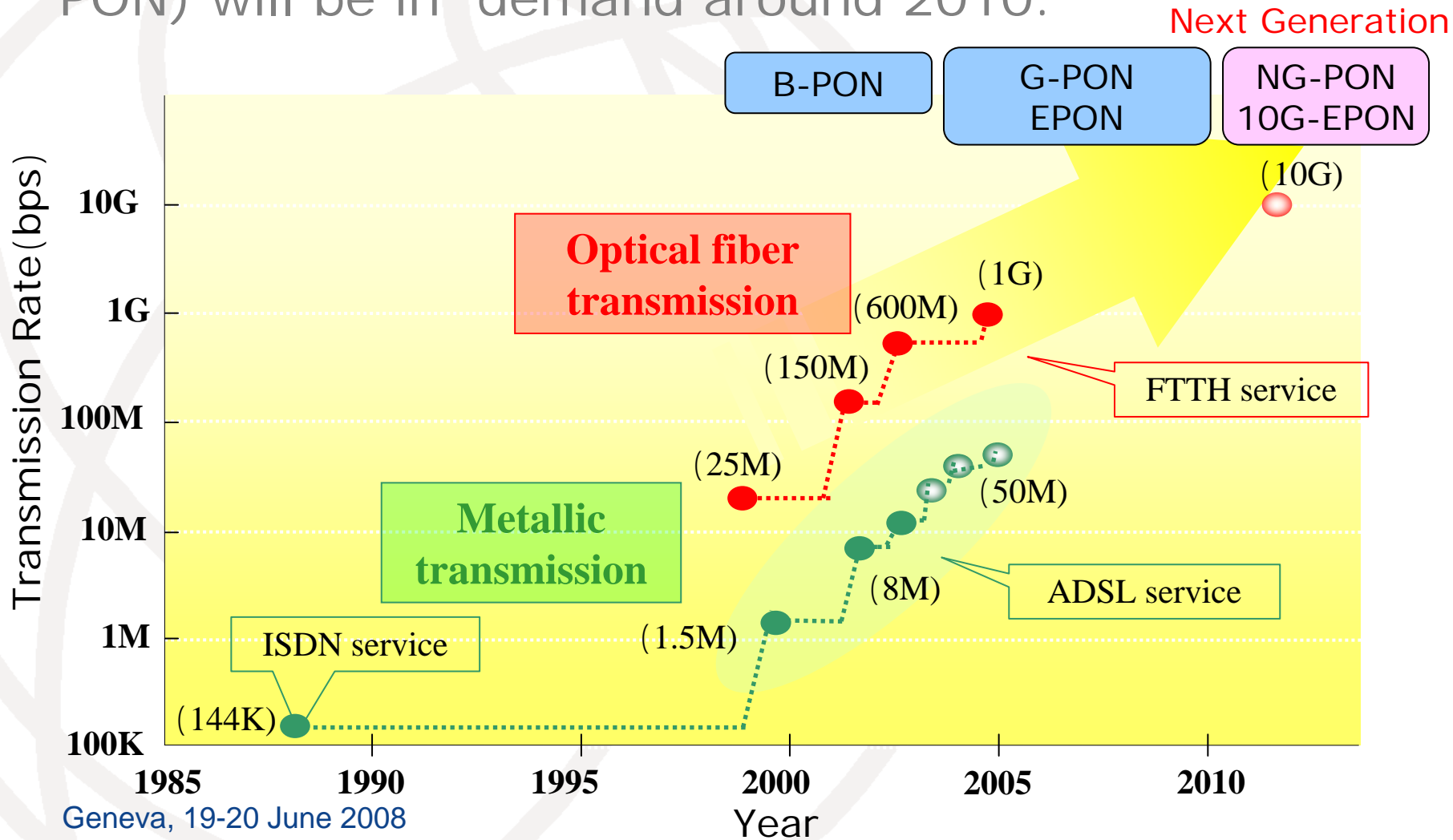
# Triple play over PON

- High speed internet access
- Voice over IP
- Video overlay



# Evolution of the transmission rate of access network

- Large capacity of PON (e.g. Next Generation PON) will be in demand around 2010.



# Next Generation PON

- Currently, Next Generation PON is under discussion.

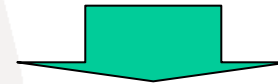
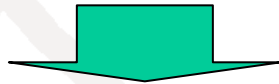
IEEE

ITU-T

Current PON

EPON (1.25G/1.25G)

G-PON (2.5G/1.25G)



Next Generation PON (NG-PON)

10G-EPON

Asymmetric 10G/1G

Symmetric 10G/10G

NG-PON1

Overlay G-PON (2.5G/1.25G) x m

XG-PON1 (10G/2.5G x n)

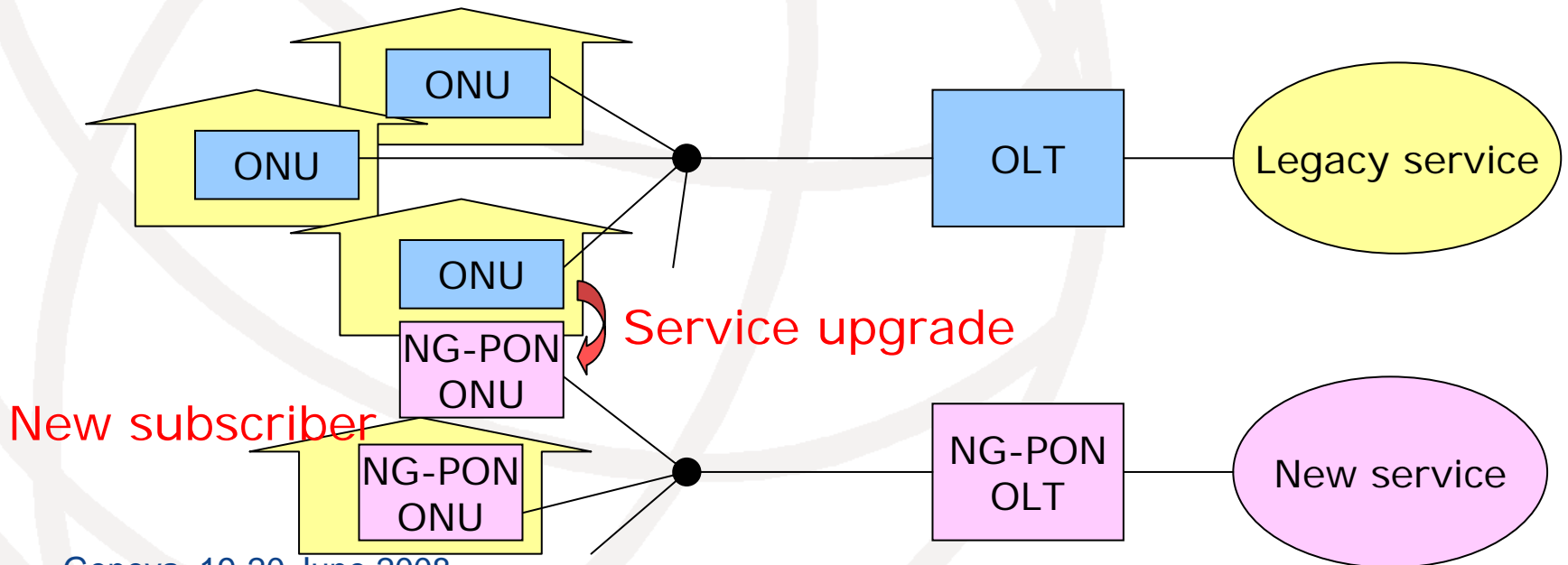
**XG-PON2 (10G/10G)**

NG-PON2

Higher rate TDM, DWDM, CDM etc.

# NG-PON Migration

- New service will drive the NG-PON migration.
- There will be both of new subscribers and service upgrade subscribers.



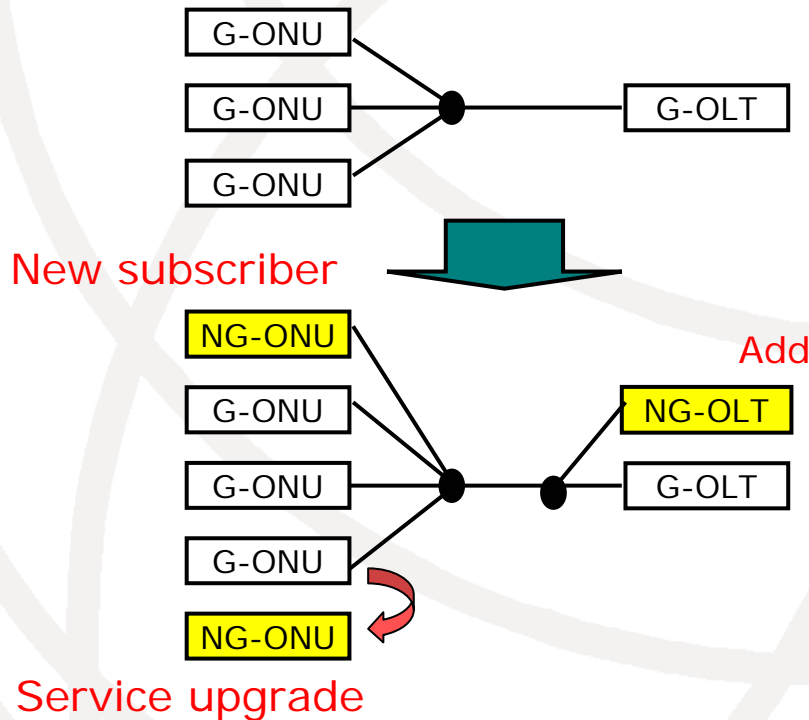
# Requirements for NG-PON

- PON is expected as a cost effective solution.
  1. Equipment cost is important.
  2. Installation cost is also concerned.
  
- Co-existence with G/E-PON in the same ODN.
  1. In the age of NG-PON, a large number of G/E-PON system will be already installed.
  2. Number of new service subscribers will increase gradually.

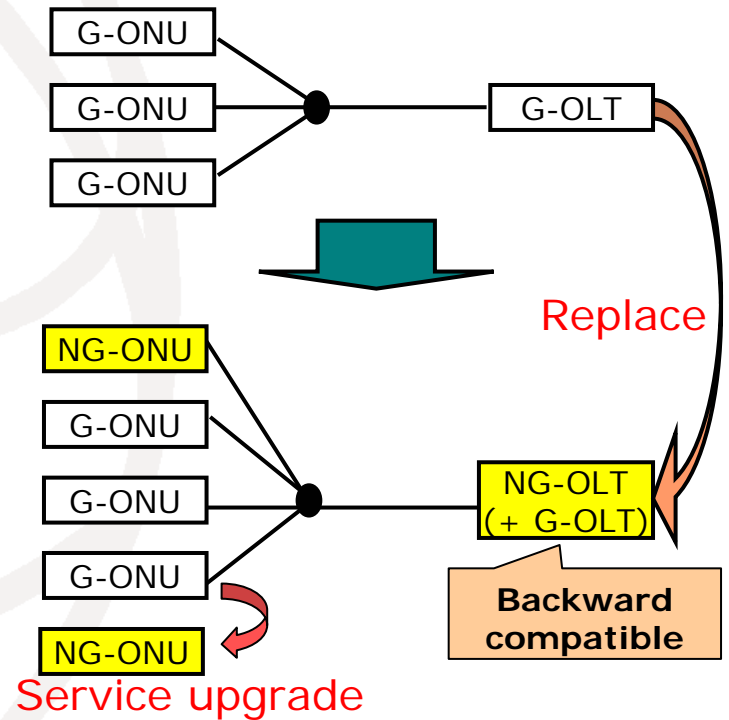
# Co-existence with current PON

- OLT ADD scenario  
Addition of NG-OLT to the same ODN as legacy PON.
- OLT REPLACE scenario  
Replace the OLT to backward compatible NG-OLT.

## 1. OLT ADD scenario



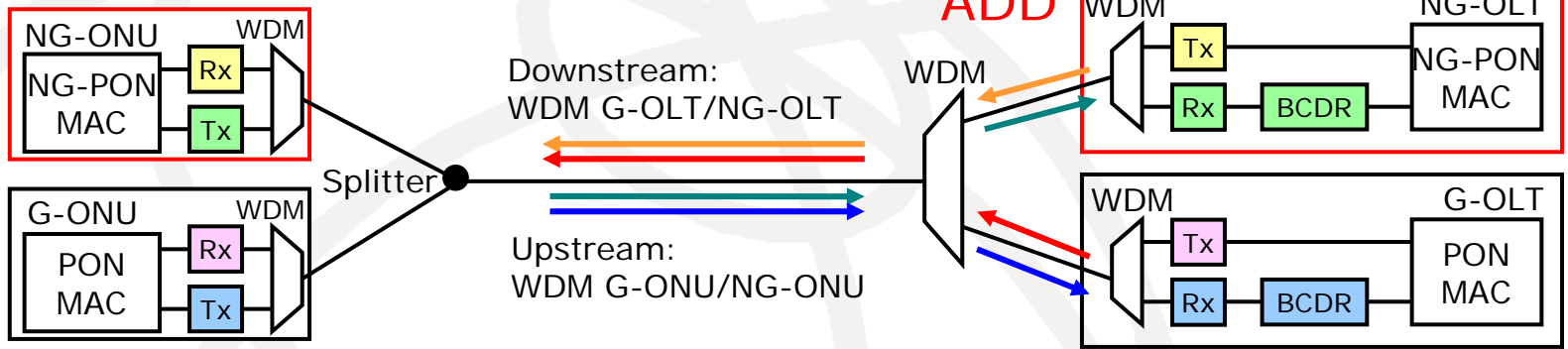
## 2. OLT REPLACE scenario



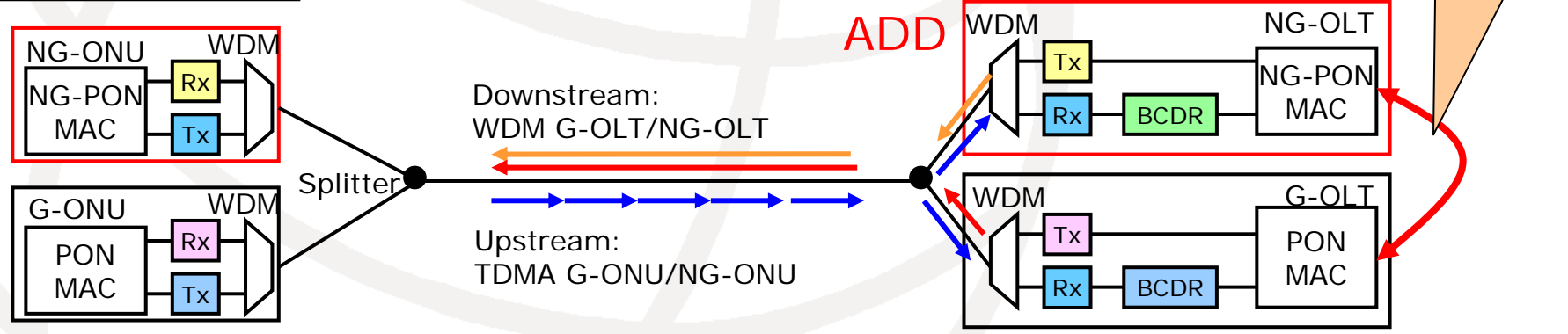


# OLT ADD scenario

## WDM approach



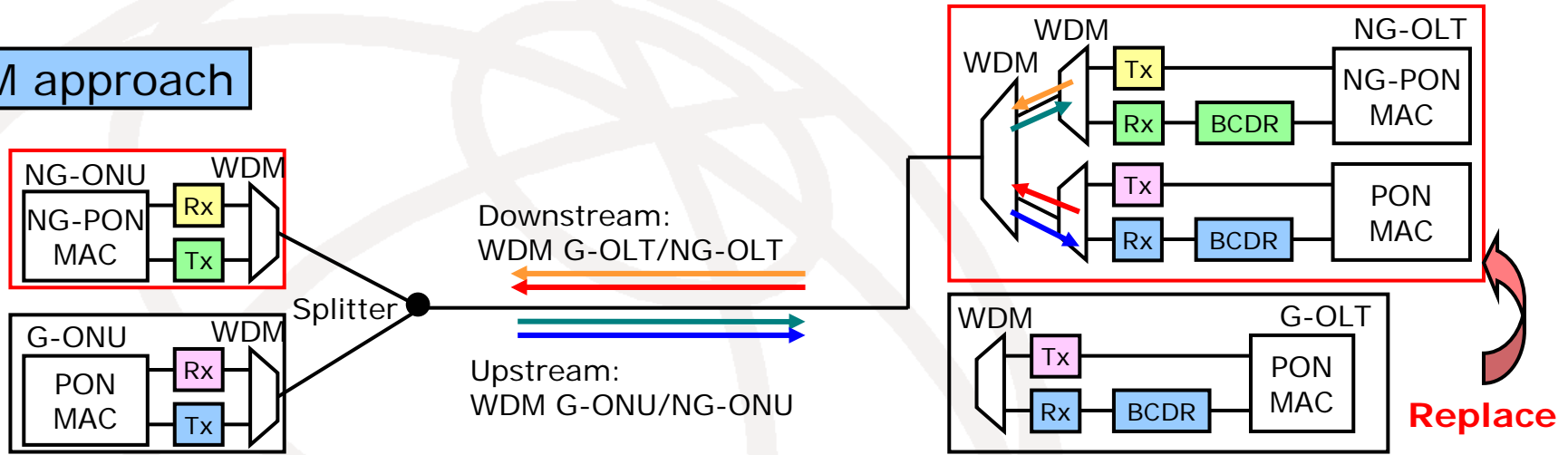
## TDMA approach



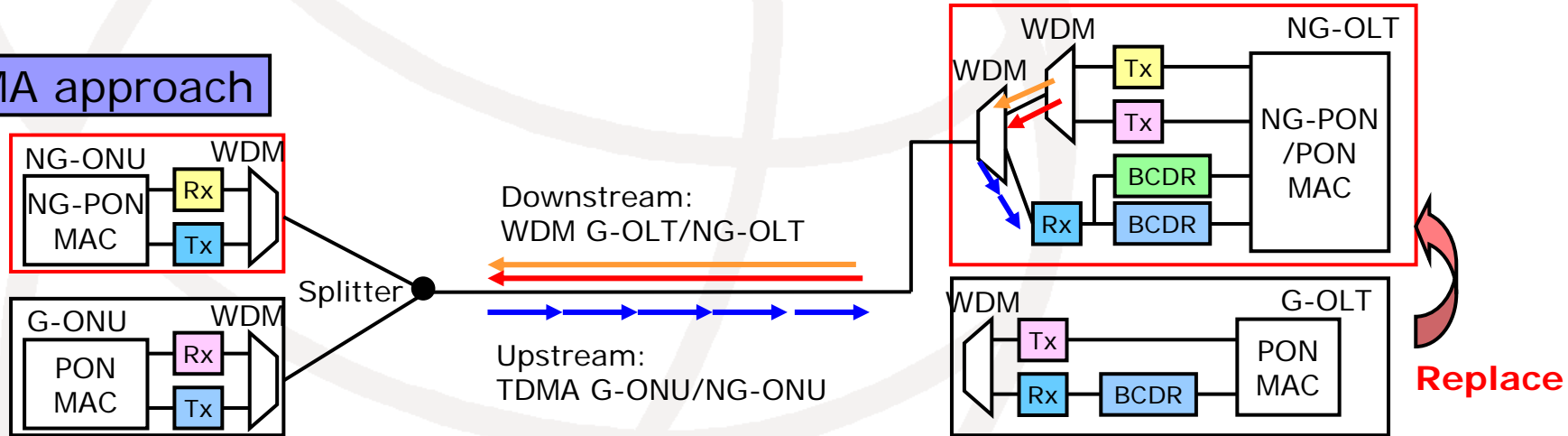
G-OLT/ONU : Legacy OLT/ONU  
 NG-OLT/ONU: NG-PON OLT/ONU  
 BCDR : Burst CDR

# OLT REPLACE scenario

## WDM approach



## TDMA approach



G-OLT/ONU : Legacy OLT/ONU  
 NG-OLT/ONU: NG-PON OLT/ONU  
 BCDR : Burst CDR

# Migration scenario comparison

Migration	Co-existence	Comments	Evaluation
OLT ADD	WDM	WDM which combines and splits NG-PON and legacy PON needs to be equipped at day one.	OK!
	TDMA	Individual G-OLT and NG-OLT need to be synchronized each other. <b>Technically difficult.</b>	NG!
OLT REPLACE	WDM	NG-OLT requires also Tx and Rx for legacy PON. <b>More expensive than "OLT REPLACE and TDMA approach".</b>	NG!
	TDMA	No technical problem.	OK!

# Requirements for physical layer

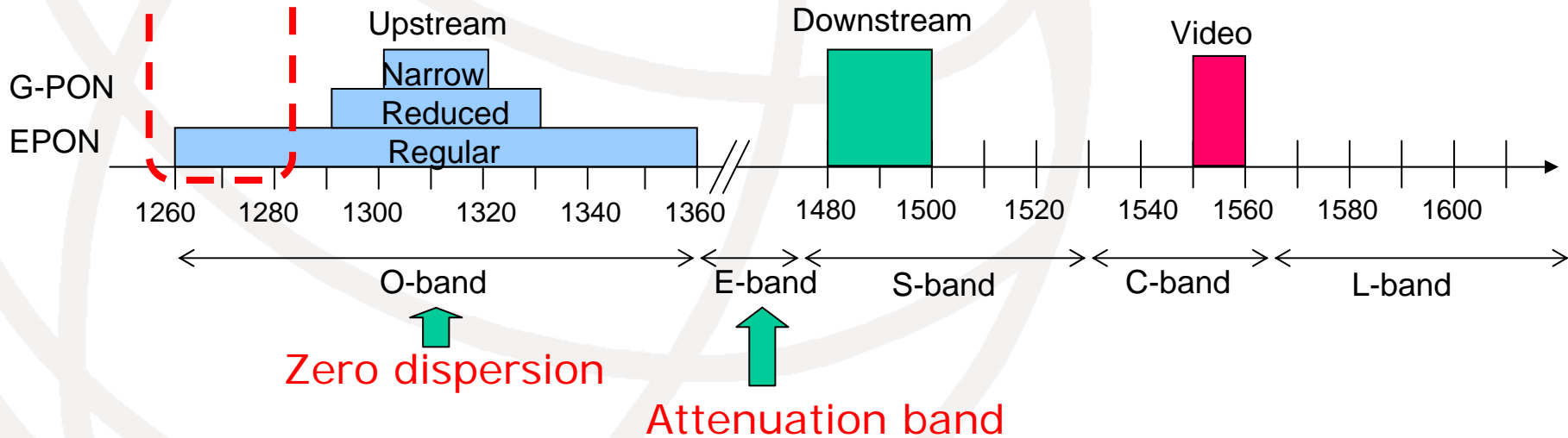
- Wavelength allocation will be different depending on the NG-PON migration scenario.
- With “OLT ADD & WDM approach”, only C/L band are available for NG-PON wavelength allocation.
- With “OLT REPLACE & TDMA approach”, O-band is also available for NG-PON wavelength allocation. **It helps the cost reduction of optics.**

# Wavelength allocation

OLT ADD and WDM approach

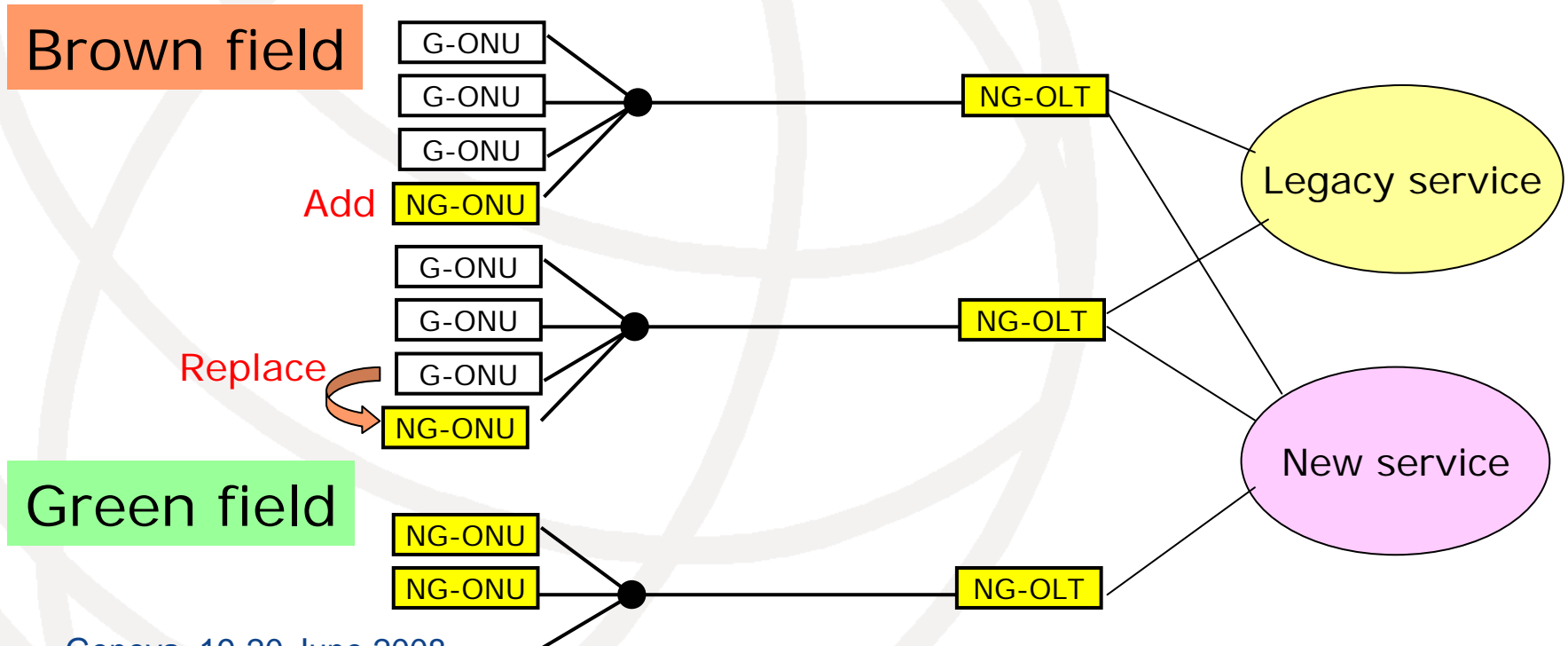


OLT REPLACE and TDMA approach



# Cost of optics is important

- In the age of NG-PON, there still remains the green field.
- For green field, co-existence is not a matter, reduction of the equipment cost is important.



# Conclusion

- NG-PON should be a cost efficient solution.
- The cost related to physical layer is dominant in PON system.
- For cost reduction, “OLT REPLACE & TDMA” approach has advantage. It enables the use of O-band for upstream.
- Common specification between ITU-T and IEEE will encourage the cost reduction of optics.