Requirements for G.RoF

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FSAN, Operator only

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Location: Kuala Lumpur, Malaysia

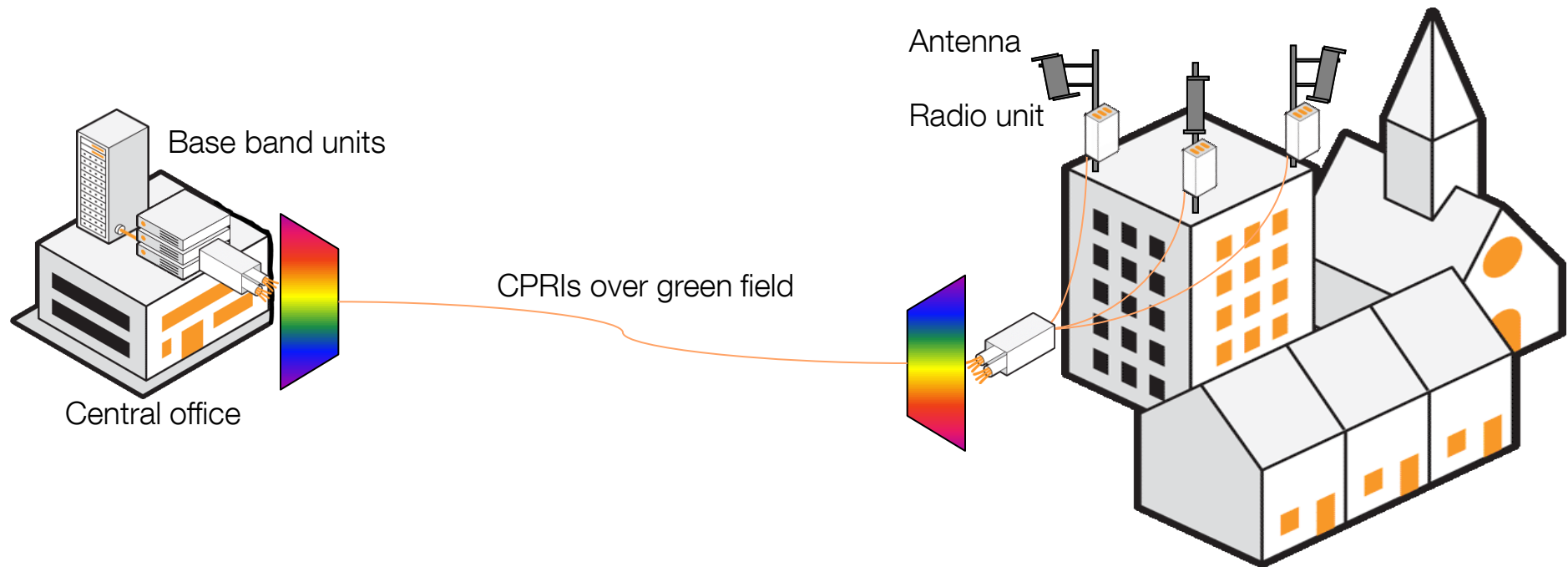# Answer to the CFC item

CFC for Operators

- Requirements for the G.RoF standard
- Requirements for XGS-PON
    - What are the minimum set of diagnostics for Optical Supervision
    - Any new requirements for XGS-PON beyond those captured in the joint Operator contribution made in Atlanta
- From a service perspective:
    - what are the use-cases of coexistence of XG-PON1 and XGS-PON?
    - what are the preferred coexistence methods?
    - what are the trade-offs for TDMA coexistence of XG-PON1 and XGS-PON?
- High-rate services
    - Requirements for services in excess of 10 Gbit/s per client
    - Operational perspectives of TWDM channel bonding, increased line rate per wavelength channel pair, and other possible support methods

FSAN
Full Service
Access Network

Internal document for FSAN members
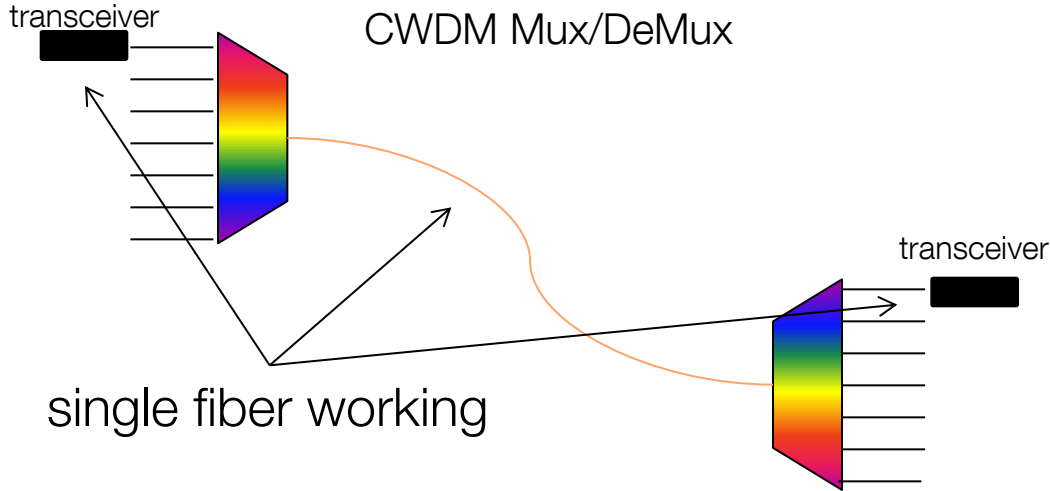
8

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Outline

- For existing fronthaul interface (eg. CPRI)

    – green field

    – existing ODN

- For new functional split (ex. NGFI)

    – existing ODN

- G.RoF understanding

The existing Fronthaul (eg. CPRI) for green field

- WR ODN is the prefered solution

Base band units

Central office

CPRIs over green field

Antenna

Radio unit

CWDM single fiber working (bidirectional)

transceiver

CWDM Mux/DeMux

single fiber working

transceiver

Requirements:
- outdoor compatible
- single fiber working
- optical budget
- OAM with AMCC or OMCI

Up   Down

CWDM

1260nm

1675nm

O–band	E–band	S–band	C–band	L–band	U–band

FSAN, December 2015
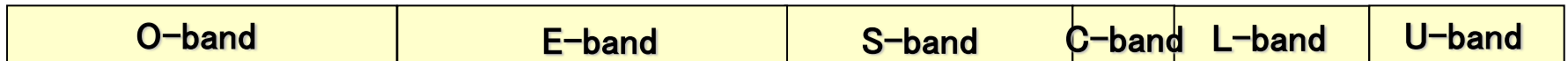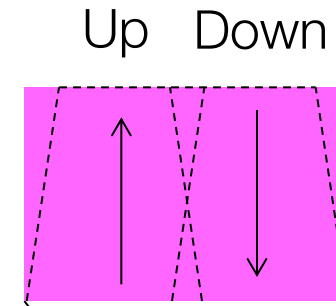
Uncooled DWDM single fiber working (bidirectional)

transceiver

CWDM Mux/DeMux

transceiver

single fiber working

Requirements:
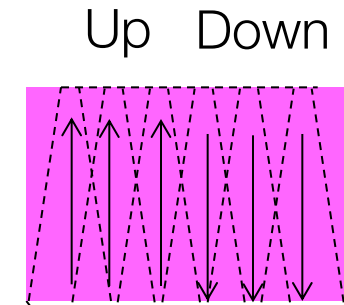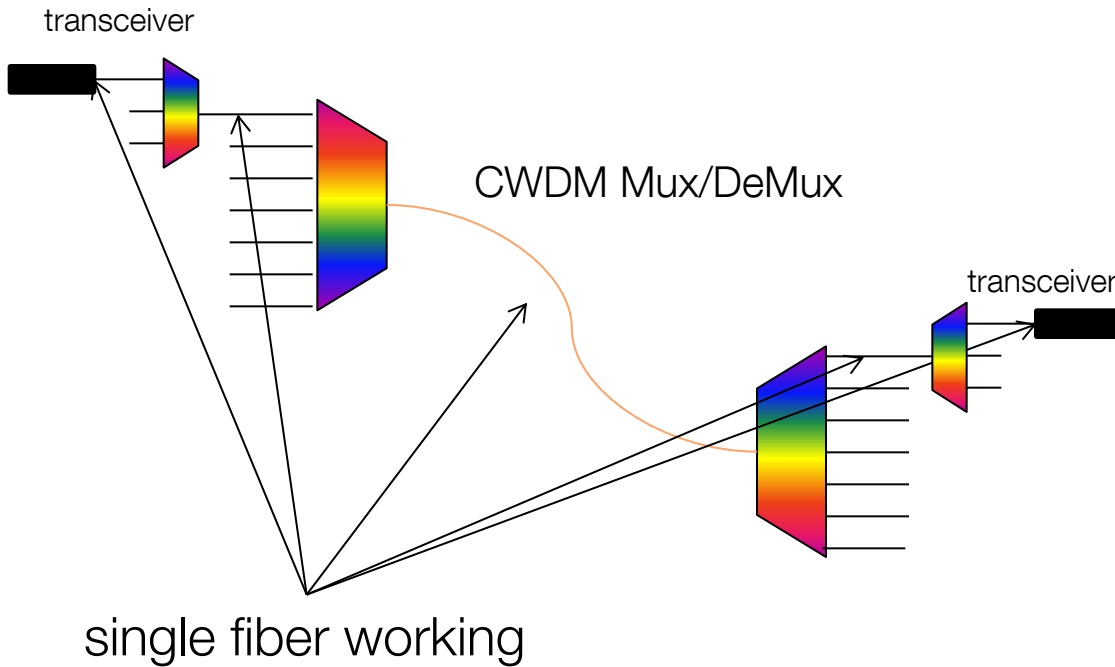- outdoor compatible
- single fiber working
- optical budget
- OAM with AMCC or OMCI

Up   Down

CWDM

1260nm   **1675nm**

O–band	E–band	S–band	C–band	L–band	U–band

FSAN, December 2015

transceiver

CWDM Mux/DeMux

transceiver

single fiber working

Requirements:
- outdoor compatible
- single fiber working
- optical budget
- OAM with AMCC or OMCI

1603

1524

shared spectrum PtP WDM
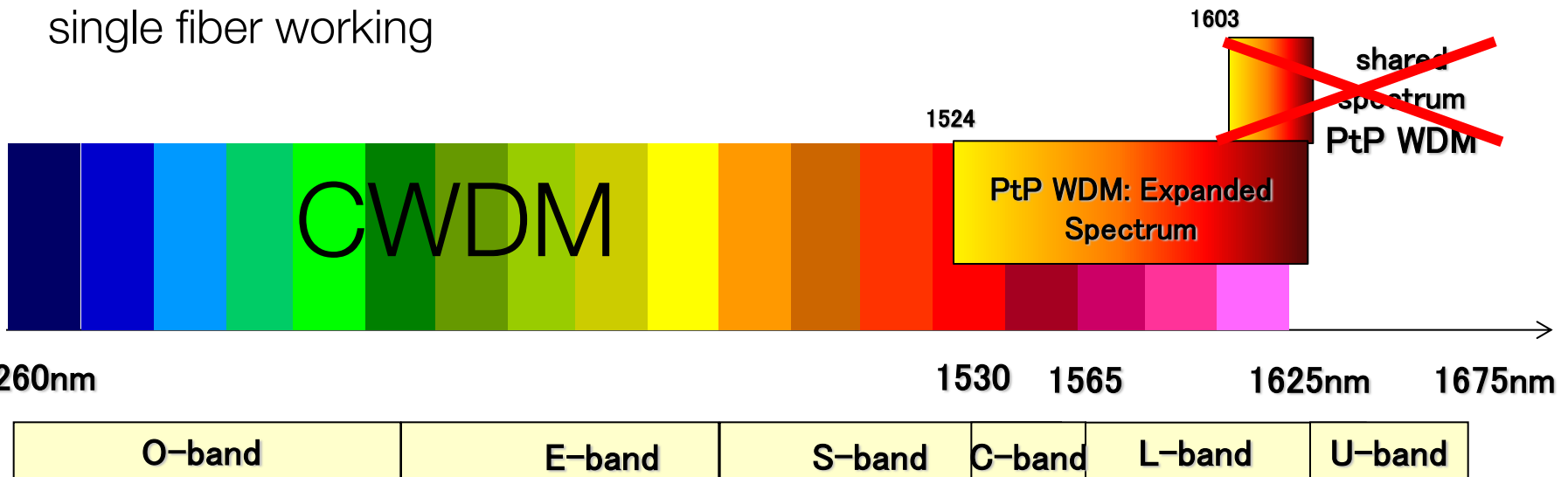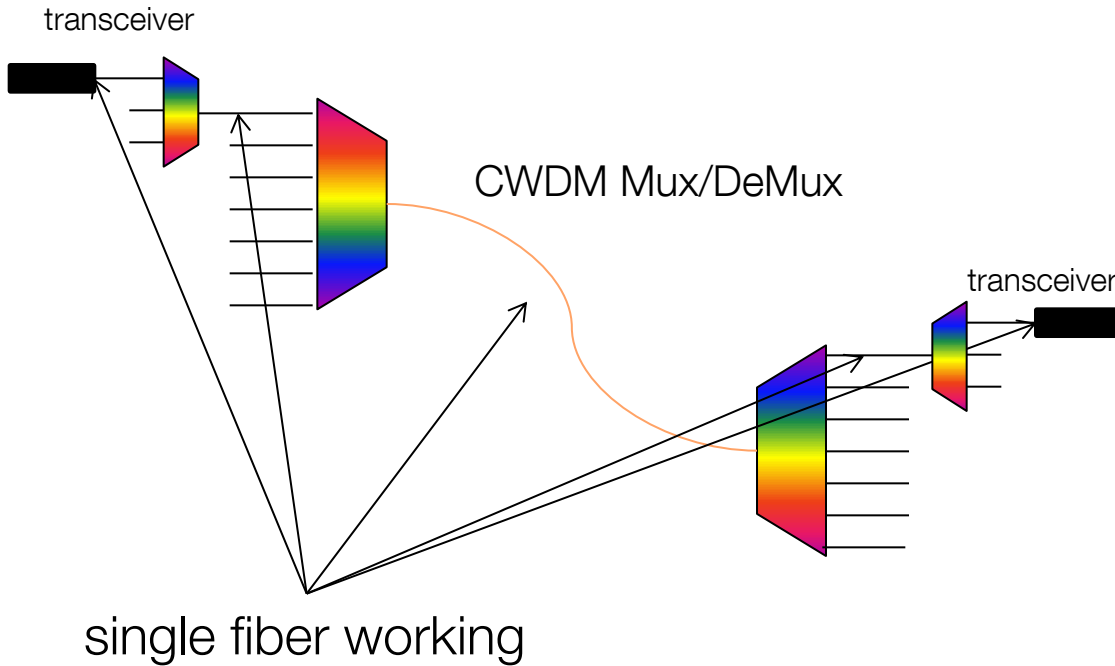
CWDM

PtP WDM: Expanded Spectrum

1260nm   1530 1565   1625nm   1675nm

O-band	E-band	S-band	C-band	L-band	U-band

PtP WDM (G.989.x) 2/3

transceiver

DWDM Mux/DeMux

transceiver

single fiber working
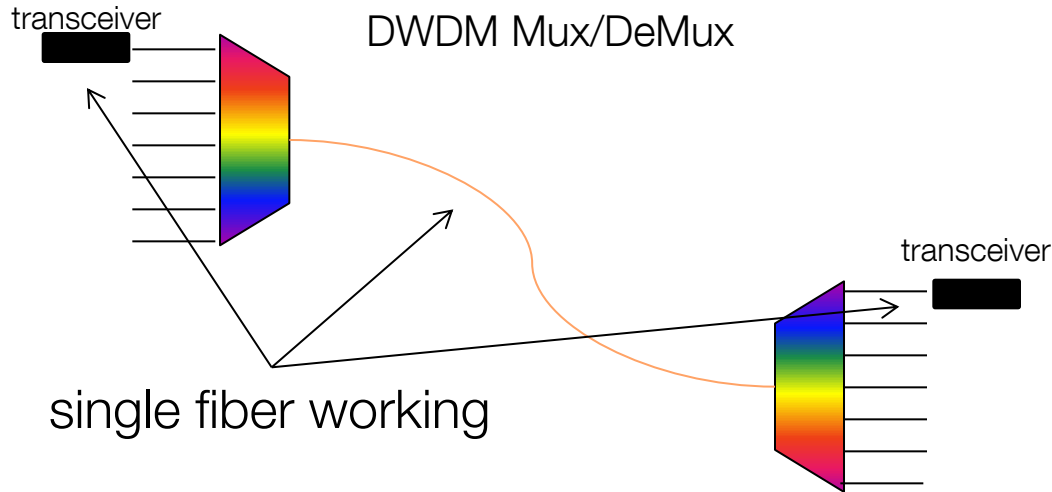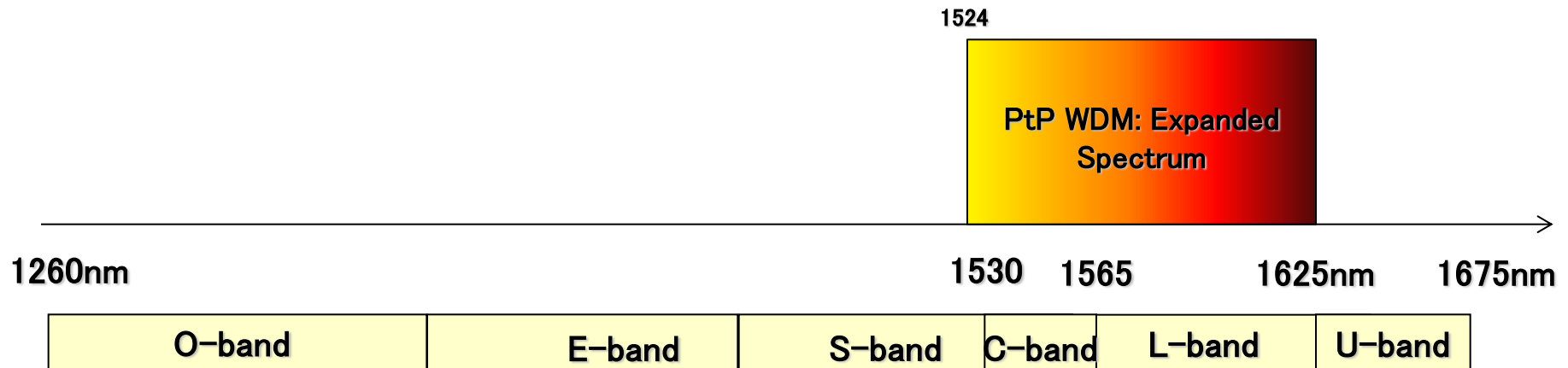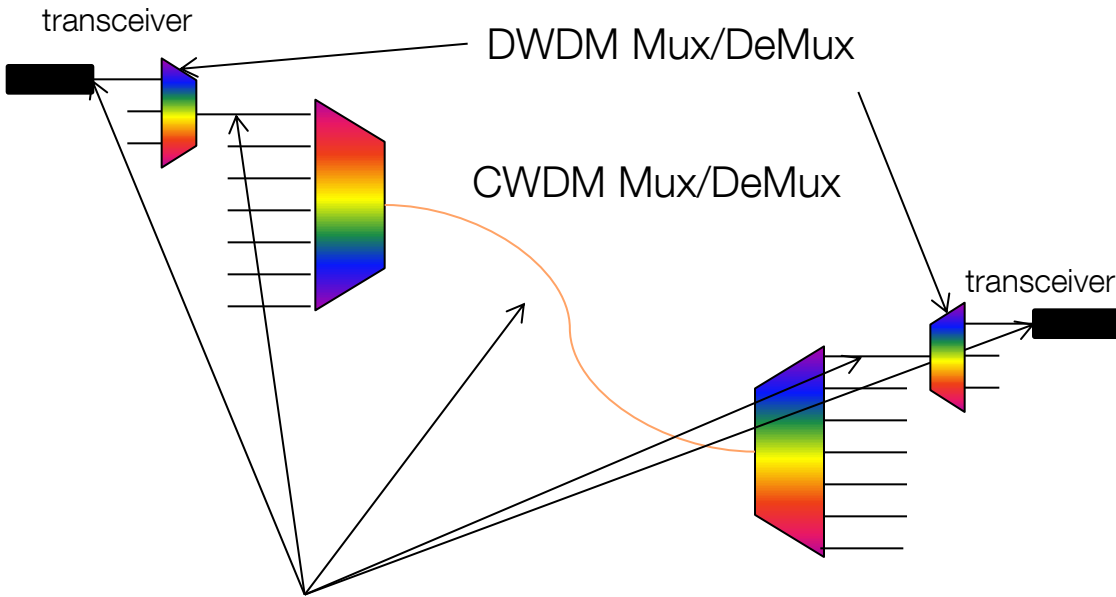
Requirements:
- outdoor compatible
- single fiber working
- optical budget
- OAM with AMCC or OMCI

Issue:
- No technology available to achieve colorless ONU for the full band 1524 to 1625 nm
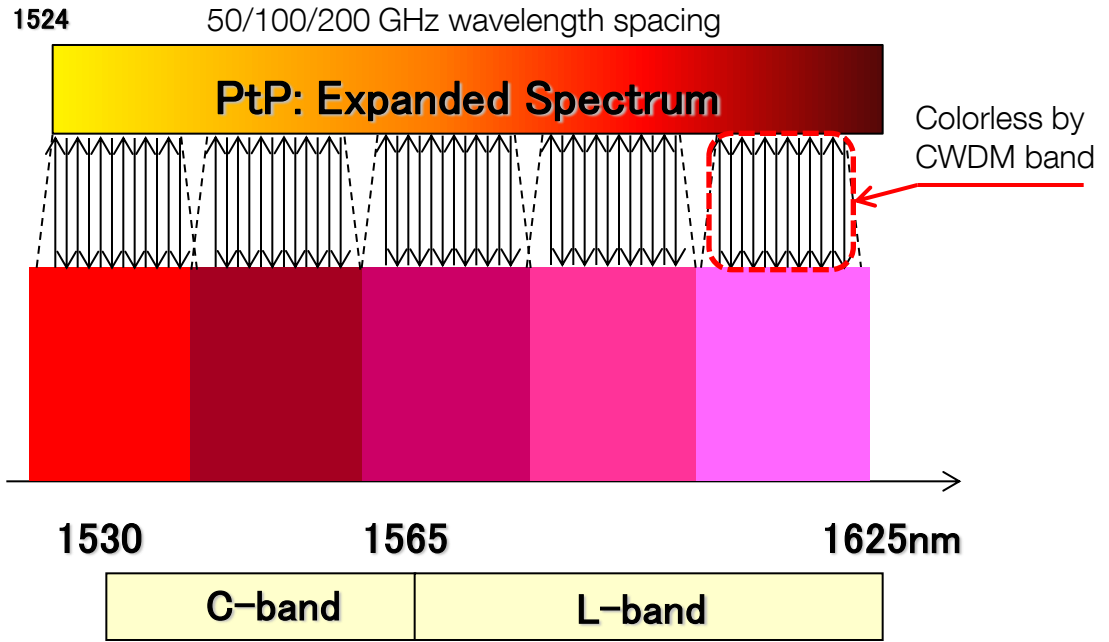
1524

PtP WDM: Expanded Spectrum

1260nm   1530   1565   1625nm   1675nm

O–band	E–band	S–band	C–band	L–band	U–band

FSAN, December 2015

PtP WDM (G.989.x) 3/3

transceiver

DWDM Mux/DeMux

CWDM Mux/DeMux

transceiver

single fiber working

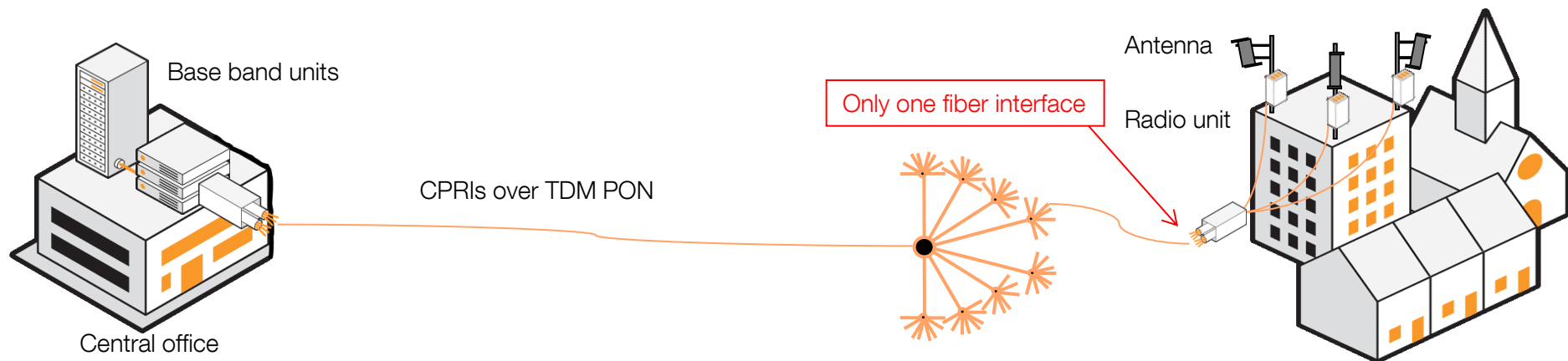**Requirements:**
- outdoor compatible
- single fiber working
- optical budget
- OAM with AMCC or OMCI
- Colorless by sub-band

1524   50/100/200 GHz wavelength spacing

PtP: Expanded Spectrum

Colorless by CWDM band

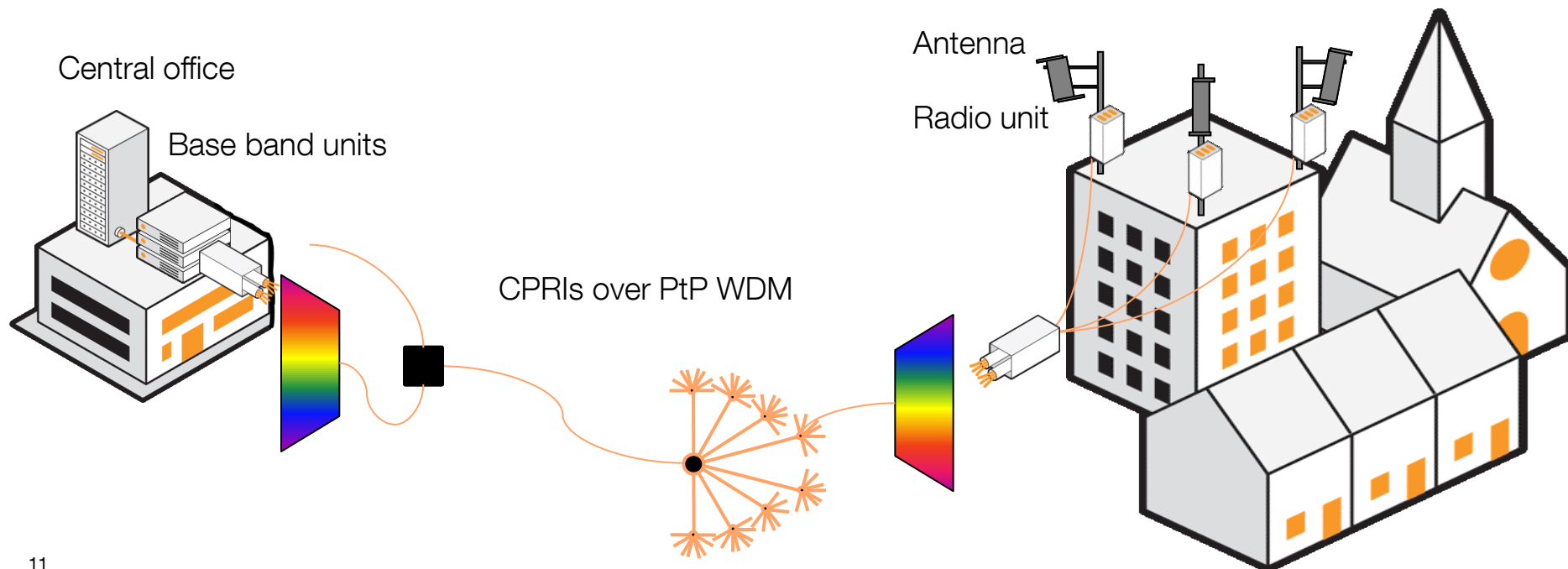1530   1565   1625nm

| C-band | L-band |

The existing Fronthaul (eg. CPRI) with deployed ODN

- Only WS ODN must be considered

- PON generations:

  - G-PON: limited in bit rate capacity

  - XG-PON1 : too much asymmetry between up and down-stream

  - XGS-PON :

    - one CPRI possible per ODN (with FBA or low latency DBA) in order to preserve bandwidth capacity for other customers

    - with compression, maybe up to "3" ORI-CPRIs per ODN

  - TWDM: possible with dedicated Channel Pair but only one fiber interface (one ONU)

    - One CP 10Gbps symmetrical = 4 x CPRI3 (more with CPRI compression)

    - Two CPs at one ODN end face = ONU capable bundle CPs (???)

Base band units

Antenna

Only one fiber interface

Radio unit
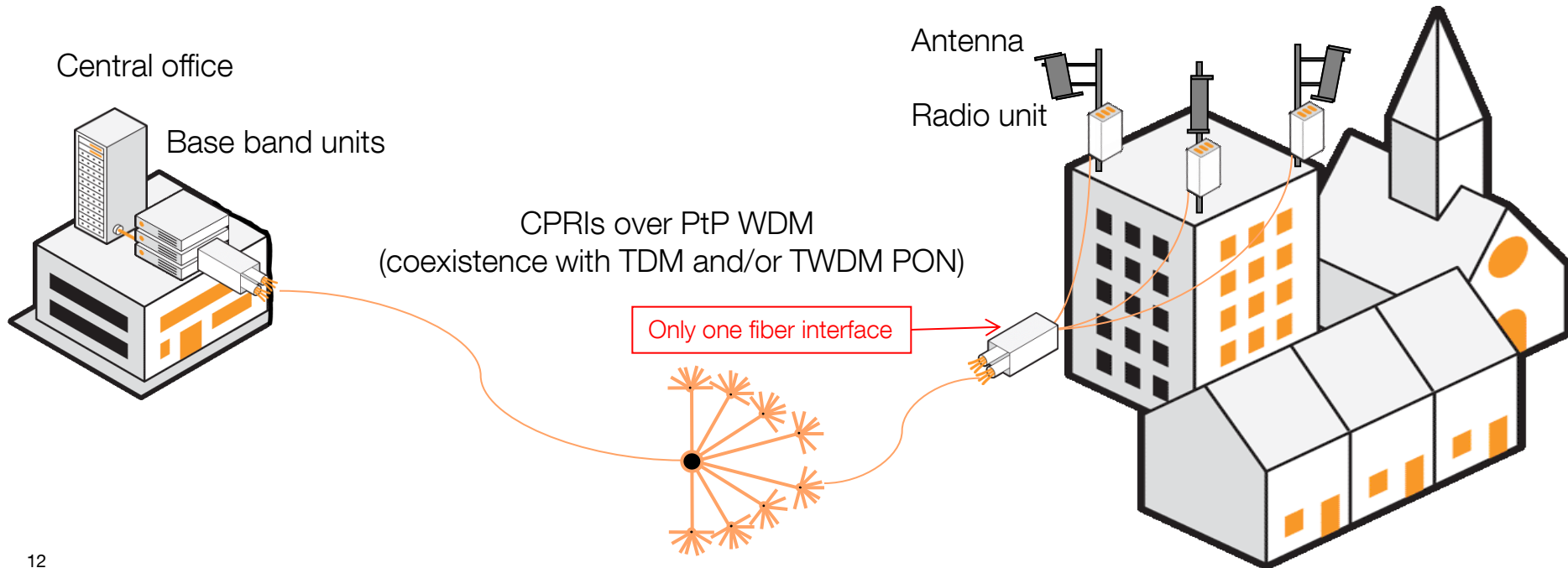
CPRIs over TDM PON

Central office

The existing Fronthaul (eg. CPRI) with deployed ODN

- WS ODN must be considered

- PON generation:

  - PtP WDM: too much optical budget when considering WS + WR ODN

Central office

Base band units

Antenna

Radio unit

CPRIs over PtP WDM

The existing Fronthaul (eg. CPRI) with deployed ODN

- WS ODN must be considered

- PON generation:

  - PtP WDM: One PtP WDM ONU need to supports all CPRI links (only one ODN end face)

    - 10Gbps : 4 x CPRI3 or more with compression
   - do we required 25Gbps or 40Gbps PtP WDM CP?

Central office

Base band units

Antenna

Radio unit

CPRIs over PtP WDM
(coexistence with TDM and/or TWDM PON)

Only one fiber interface

Outline

- For existing fronthaul interface (eg. CPRI)

    – green field

    – existing ODN

- **For new functional split (ex. NGFI)**

    – existing ODN

- G.RoF understanding

For new functional split (eg. NGFI) with deployed ODN

- Only WS ODN is considered

- Hypothesis : The Cell site aggregator network interface should need+20% of bit rate compare to traditional backhaul. So here we consider minimum 1Gbps (macro/micro cell use cases) and maximum 10Gbps (hot spot with Massive MiMo).

- PON generation:

    - G-PON and XG-PON1 : limited in bit rate capacity

    - XGS-PON : possible to collect 1 to 8 "1Gpps" (with or without coexistence with residential customers)

    - TWDM : possible with either shared or dedicated Channel Pair but only one fiber interface (one ONU)

        - with TDM shared 10Gbps symmetrical Channel Pair

        - possible with dedicated Channel Pair

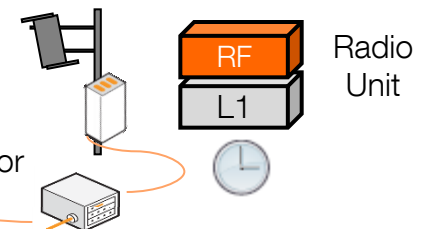   - One CP: 8 x "1Gbit/s" or one "10Gbps"
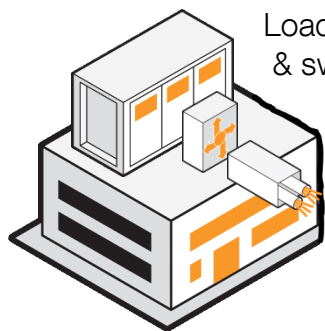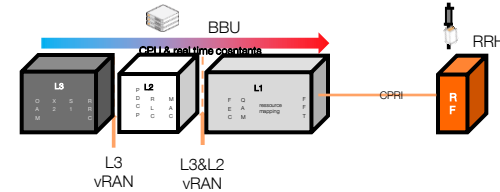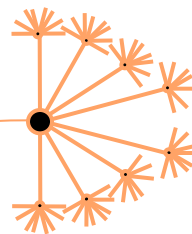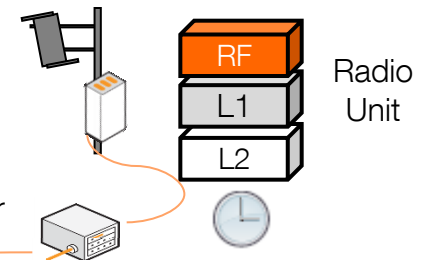
Outline

- For existing fronthaul interface (eg. CPRI)

  – green field

  – existing ODN

- For new functional split (ex. NGFI)

  – existing ODN

- **G.RoF understanding**

G.RoF and G.Suppl.RoF

- G.Suppl.RoF concerns **Digital** and **Analog RoF** description

- **G.RoF** concerns only **Analog RoF**. Why?

- <u>scope of G.RoF:</u> (copy from G.RoF draft 18th August 2015)

This recommendation develops a new type of optical access network based on radio-over-fiber (RoF) technologies. In general, RoF technologies can be classified into two groups, analog RoF and digital RoF. The digital RoF requirements may be satisfied by elements of the G.989 series with necessary enhancements. The analog RoF system is currently unspecified in any other recommendation. The recommendation will include consideration of the common applications, the requirements that stem from these, the <u>specification</u> of the <u>analog optical link</u> and/or the necessary <u>functions to digitally carry</u> the radio signals over various optical access systems, the associated signal processing, and the management aspects of the systems.

> Wording " function to digitally carry…" is related to:
> - Digital aggregation of analog RoF : section 7.3.1.2 of G.Suppl.RoF
> - Digital-signal-processing-assisted (DSP-assisted) analog RoF techniques : section 7.4 of G.Suppl.RoF
>
> It is not about Digital RoF (CPRI, ORI, OBSAI,….)

Conclusion

- Proposition of fronthaul standardization actions:

  - Stimulate vendors for providing PtP WDM : test event?
  - Generalization of PtP WDM (G.989) solution based on AMCC and OMCI for PHY layer based:
    - CWDM bidirectional (single fiber working)
    - uncooled DWDM bidirectional (single fiber working)
  - Amendment of G.989.2 for PtP WDM
    - Colorless by CWDM sub-band
  - For TDM or TWDM PON : description of FBA and low latency DBA
  - If operators agree with some of these actions:
    - include them in read out
    - present them to NG-PON plenary session

- G.RoF:

  - Do we have the same understanding of G.RoF scope: Not about digital RoF?
  - If yes, do operator agree?

Thank you
Merci
Gràcies
Danke
Grazie
Tack
谢谢
감사합니다
ありがとうございました