Framework for GMPLS based control of Flexi-grid DWDM networks

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Oscar González de Dios, Telefónica

Ramon Casellas, CTTC

Fatai Zhang, Huawei

Xihua Fu, ZTE

Daniele Ceccarelli, Ericsson

Iftekhar Hussain, Infinera

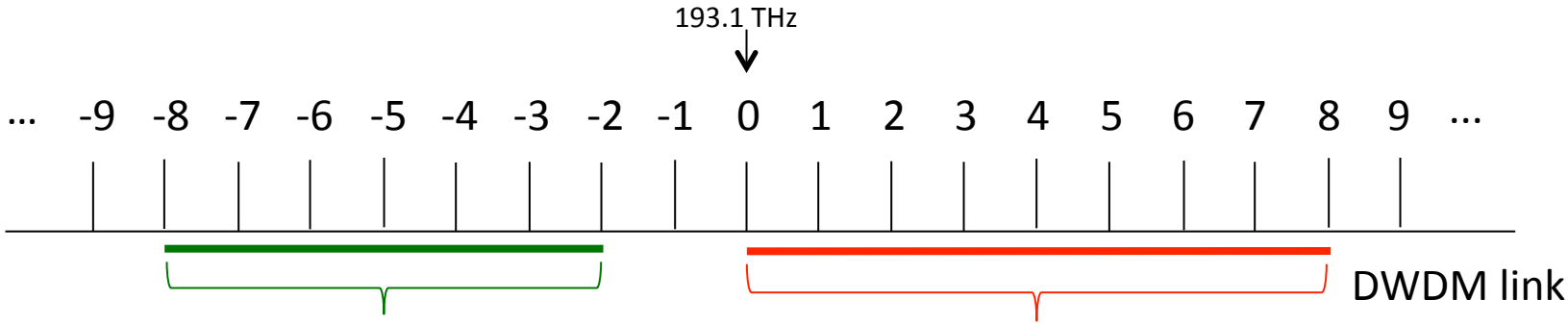
Contributors:

Qilei Wang, Malcolm Betts, Sergio Belotti, Cyril Margaria, Xian Zhang, Yao Li, Fei Zhang, Lei Wang, Guoying Zhang, Takehiro Tsuritani, Lei Liu, Eve Varma, Young Lee, Jianrui Han, Sharfuddin Syed, Rajan Rao, Marco Sosa, Biao Lu, Abinder Dhillon, Felipe Jimenez Arribas, Andrew G. Malis, Adrian Farrel, Daniel King.

What is the draft about?

- Goals
  - Establish a framework, for the purposes of GMPLS control, of ITU-T DWDM flexi-grid enabled networks, including
    - Terminology,
    - Data plane element models (i.e., “link and node characterization”),
    - Layered / hierarchical network model
    - Routing and Spectrum Assignment modes
  - Mapping of GMPLS concepts (e.g. TE-links, LSP) with flexi-grid data plane
    - Applicability of GMPLS procedures
  - Identify Control Plane Requirements
- Non Goals
  - Define protocol extensions / encodings → Separate solutions draft

Terminology (1/2)



Frequency slot 1:
Central frequency = 193.1 + 0.00625*(-5)
= 193.06875 THz
Slot width = 0.0125*3 = 0.0375 THz

Frequency slot 2:
Central frequency = 193.1 + 0.00625*(4)
= 193.125 THz
Slot width = 0.0125*4 = 0.05 THz

Flexi-Grid: a new WDM frequency grid defined with the aim of allowing flexible optical spectrum management, in which the Slot Width of the frequency ranges allocated to different channels are flexible (variable sized).

Frequency Slot: The frequency range allocated to a channel and unavailable to other channels within a flexible grid. A frequency slot is defined by its **nominal central frequency** and its **slot width**.

Central Frequency = 193.1 THz + n * 0.00625 THz

Slot Width : the full width (in Hz) of a frequency slot, a multiple (m) of 12.5 GHz.

Terminology (2/2)

Media Channel: a media association that represents both the topology (i.e., path through the media) and the resource (frequency slot) that it occupies.

As a topological construct, it represents a (effective) frequency slot supported by a concatenation of media elements (fibers, amplifiers, filters, switching matrices...).

Term used to identify the physical layer entity

Network Media Channel: a media channel that supports a single OCh-P network connection.

It represents the concatenation of all media elements between an OCh-P source and an OCh-P sink.

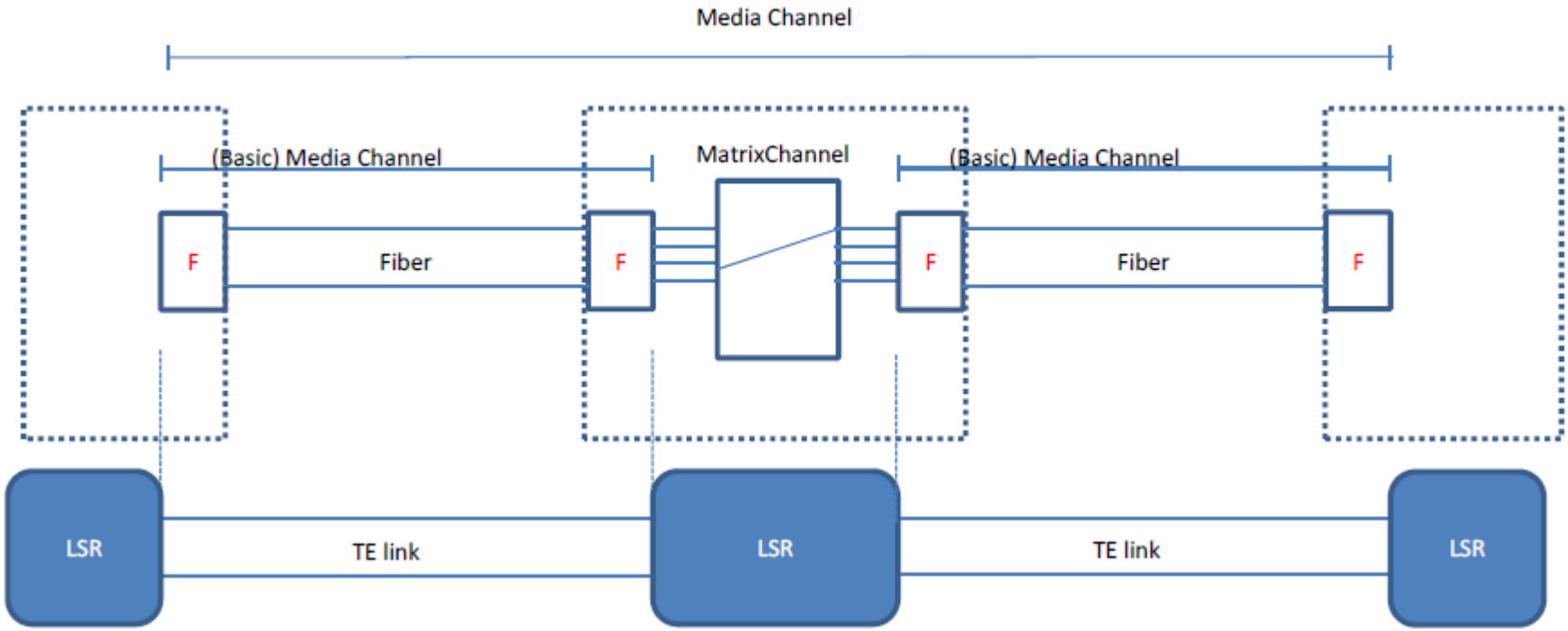
Media element: only directs the optical signal. Examples include optical filters, switching matrices, fibers.

GMPLS modeling (1/2)

1. The framework is related to the management of spectrum i.e. Media Channels and Media Elements. Management of optical signal is out of scope

2. TE-link: TE links represent the association of a filter and a fiber.

- Supported/Available central frequencies (N)
- Supported/Available slot width/granularity (M)
- Spectrum availability



GMPLS modeling (2/2)

3. LSP: The flexi-grid LSP is seen as a control plane representation of a media channel.
- Open question: An LSP can also be a group of media channels.

4. LABEL: As in flexi-grid the switched element is a frequency slot, the label represents a frequency slot. Consequently, the label in flexi-grid must convey the necessary information to obtain the frequency slot characteristics (i.e, center and width, the n and m parameters). The frequency slot is locally identified by the label.

Q1 – What is the relation between optical signal layer (OCh) and media layer?

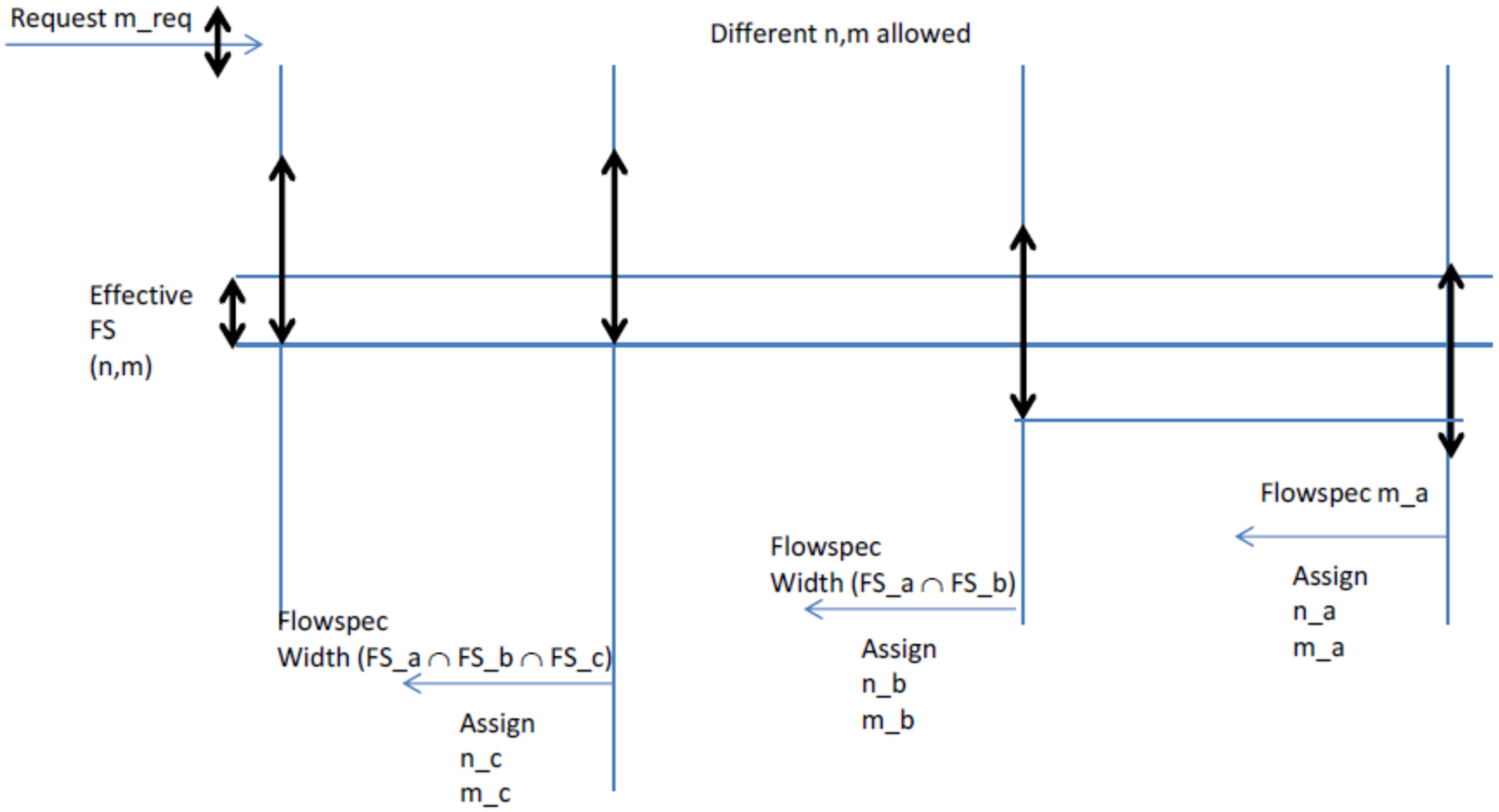
- Which are the allowed combinations?
  - 1. Single Och over single Network Media Channel (trivial)
  - 2. Single Och over multiple Network Media Channel? (inverse multiplexing)
  - 3. Multiple Och over single Network Media Channel? (no by definition?)
- Do we need to consider express channel?
  - Multiple (Network) Media Channels over a single Media Channel
  - If yes, what is contemplated:
    - Network media channel over media channel?
    - Media channel over media channel?
- THIS IS IMPORTANT FOR GMPLS AS IMPLIES MANAGING HIERARCHIES. Which hierarchy (if any) must be considered?
  - Signal over Media
  - Media over Media

Q2 – How do we characterize links and nodes?

- What are the attributes of a link?
  - Supported/Available central frequencies (N)
  - Supported/Available slot width/granularity (M)
  - Portion of spectrum available
  - Are there other attributes that can't be expressed via M and N?
- What are the attributes of a node?
  - Connectivity matrix
- Anything else????

Q3 – Resource allocation

- Different M are allowed, what about different N?
- If different N are allowed, how is it possible to ensure valid effective frequency slot?



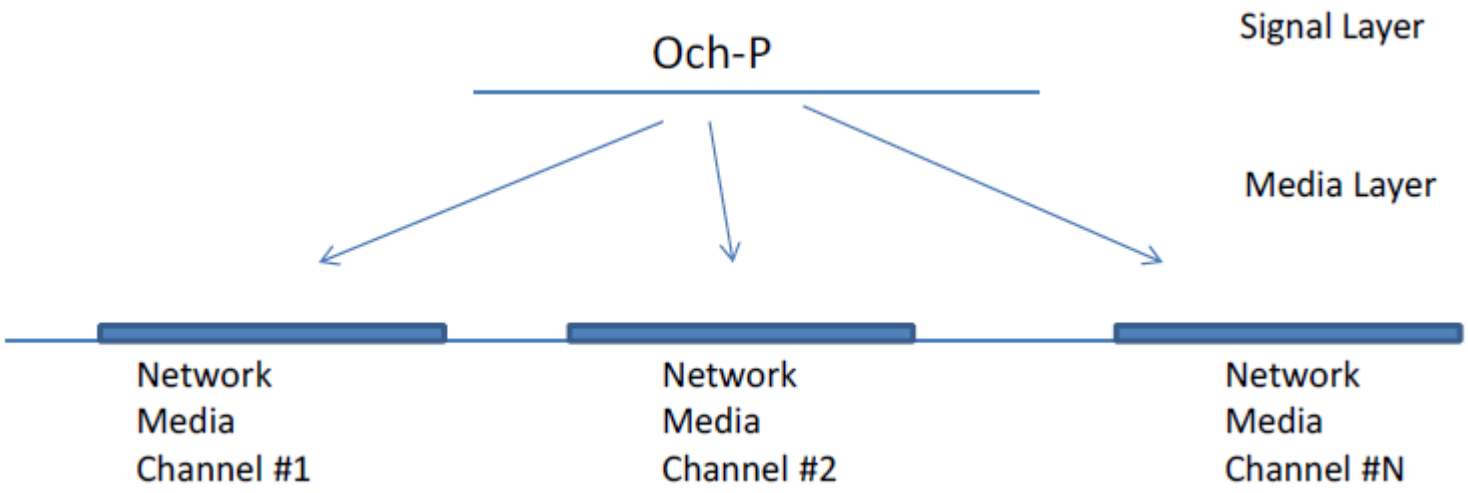
Q4 – Additional link properties?

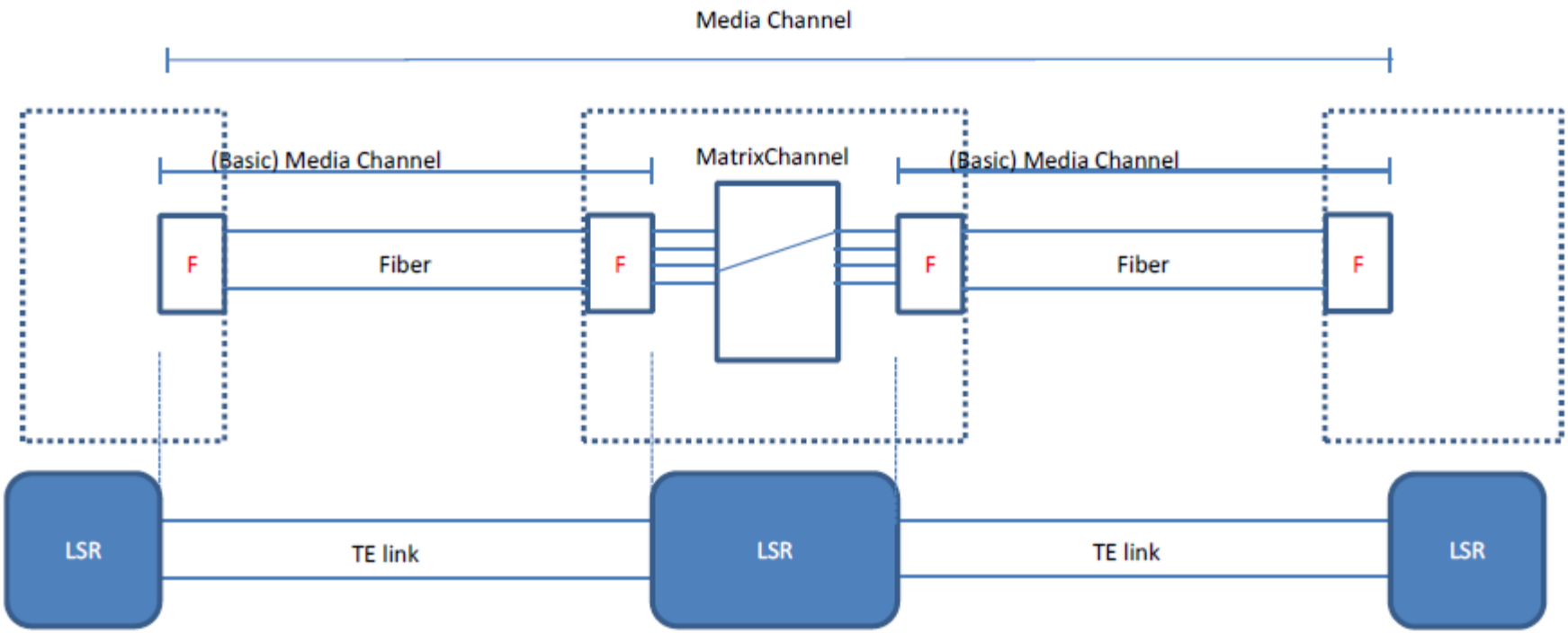
- Is it envisioned to consider the impact of signal characteristics on the link information?
- How it would be represented in the control plane?

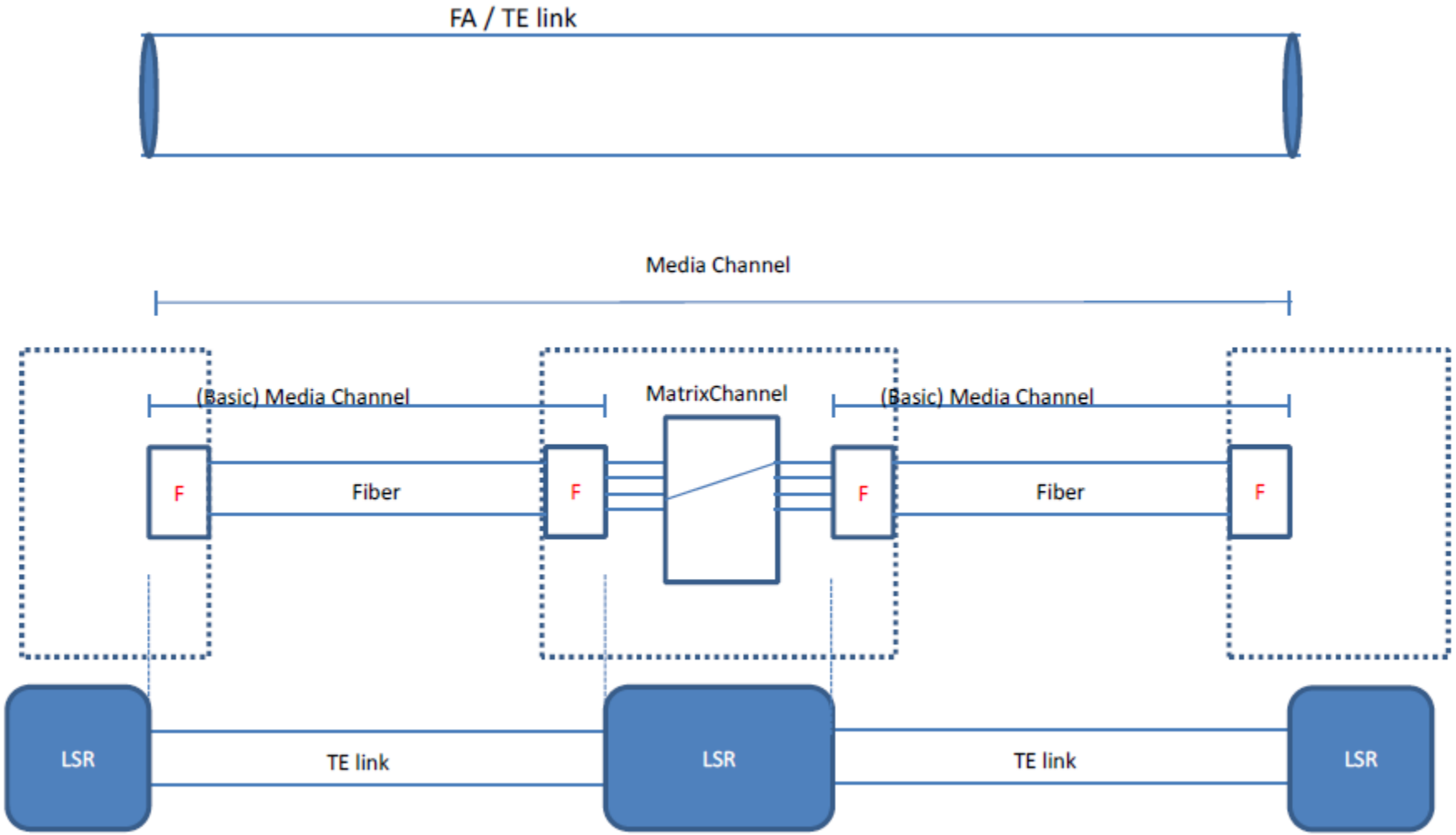
Next steps

- Receive feedbacks from WG and Q6
- Clean up text
- Remove editor‘s note
- Adopt as working group after doing what above

BACKUP


Signal Layer
Och-P
Media Layer
Network
Media
Channel #1
Network
Media
Channel #2
Network
Media
Channel #N


Media Channel
(Basic) Media Channel
MatrixChannel
(Basic) Media Channel
F
Fiber
F
F
Fiber
F
LSR
TE link
LSR
TE link
LSR


FA / TE link
Media Channel
(Basic) Media Channel
MatrixChannel
(Basic) Media Channel
F
Fiber
F
F
Fiber
F
LSR
TE link
LSR
TE link
LSR

LSP representing a simple media

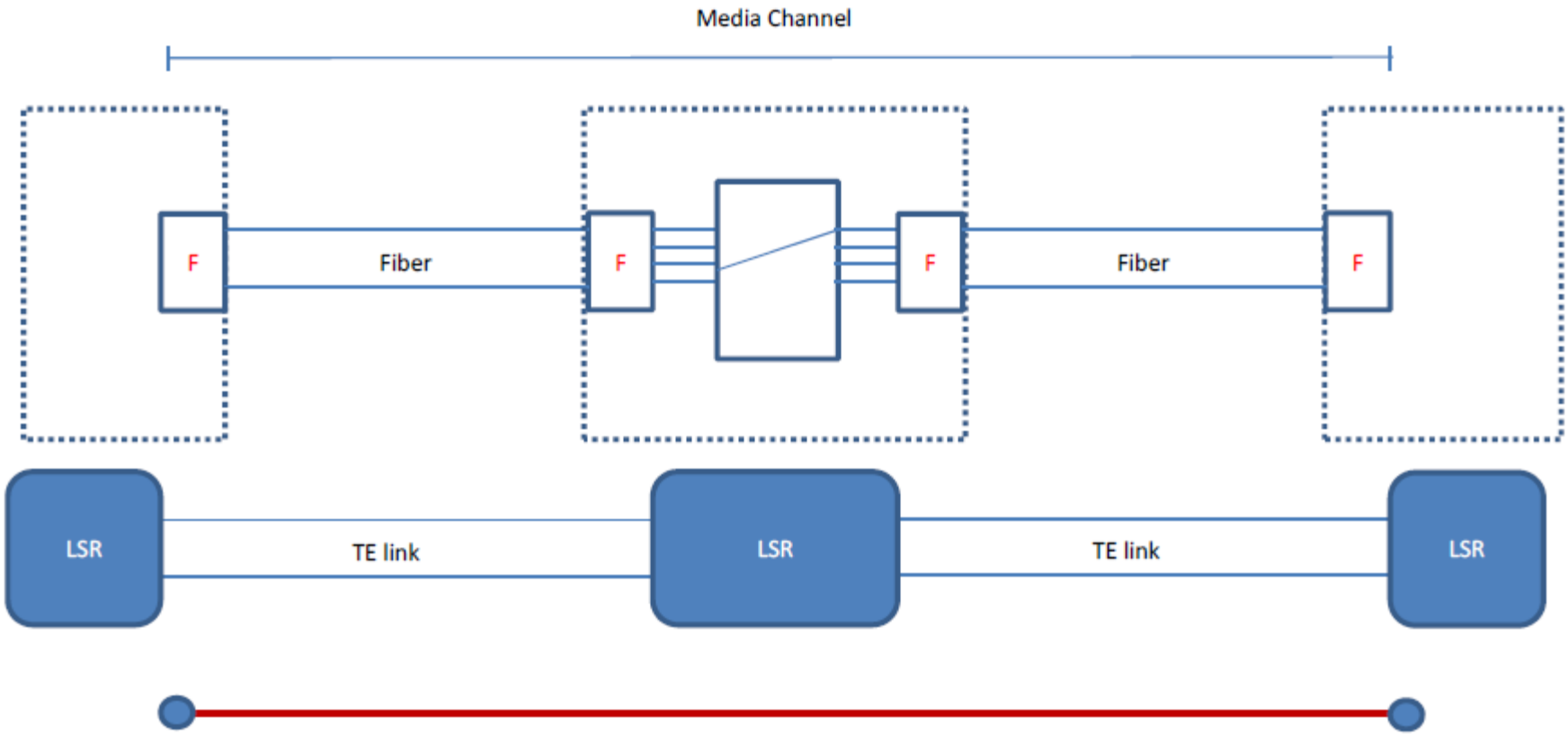


Figure 1: A) LSP representing a generic media channel

LSP representing a network media channel

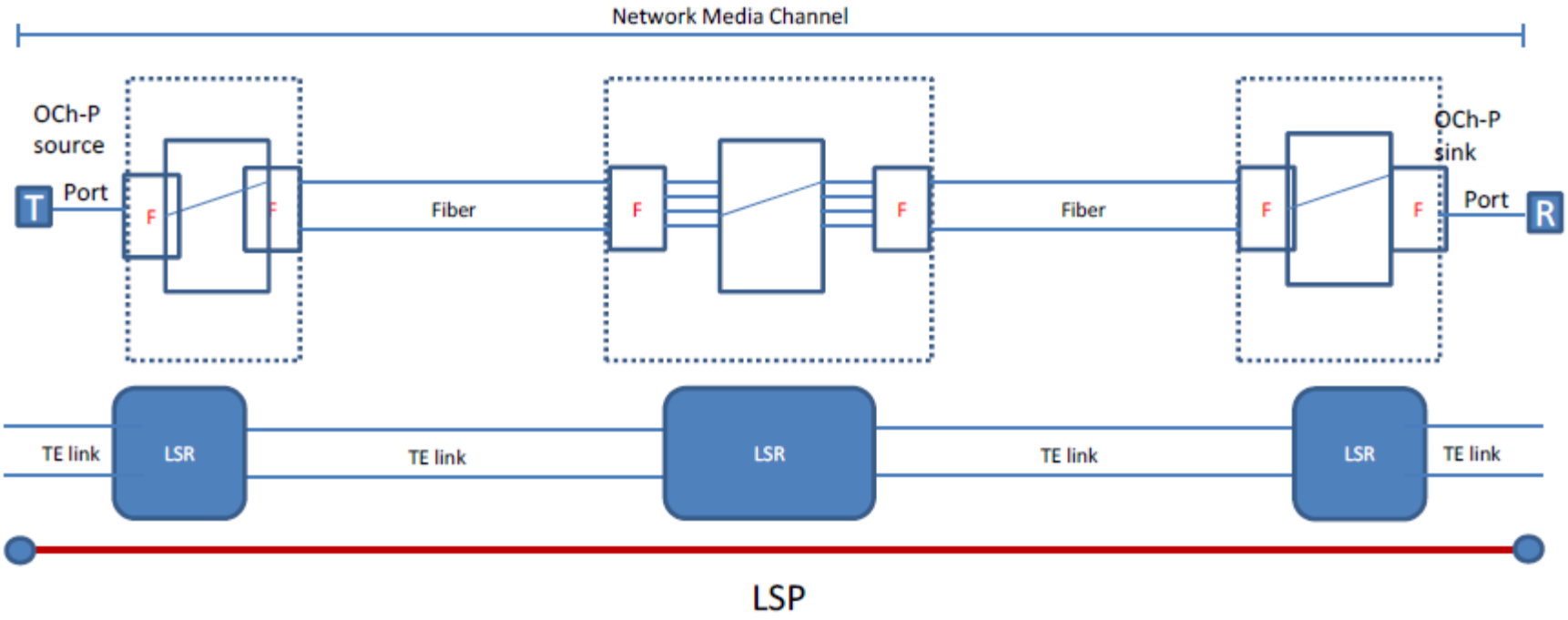


Figure 2: B) LSP representing a network media channel (corresponding to OCh-Trail)

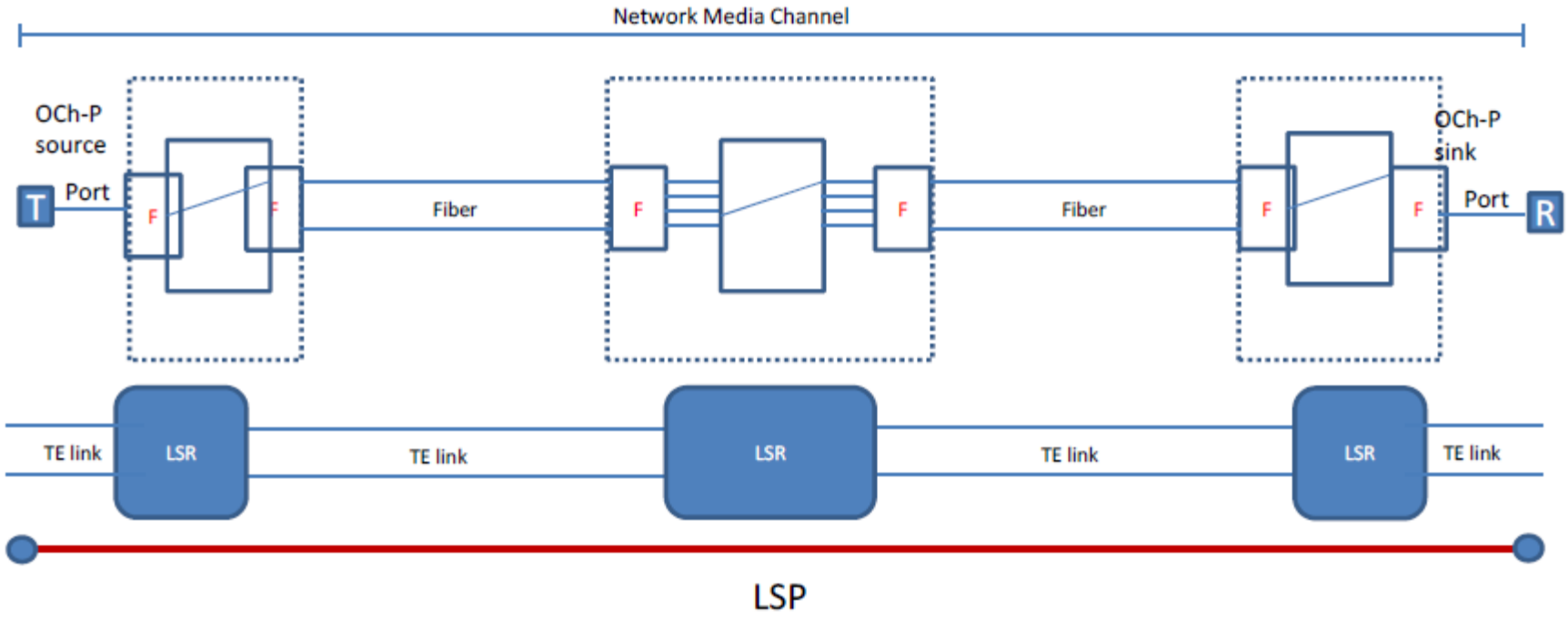
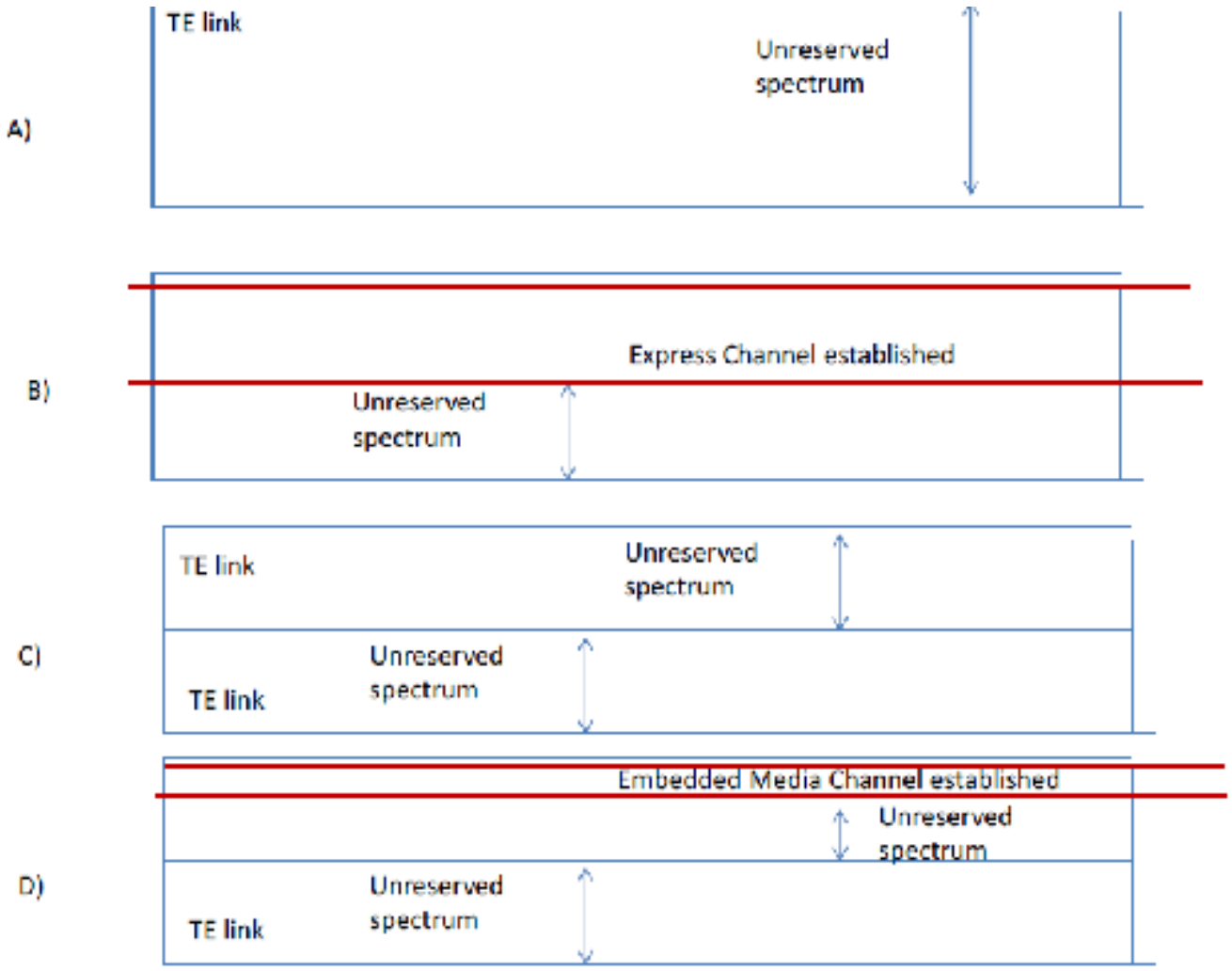


Figure 2: B) LSP representing a network media channel (corresponding to OCh-Trail)


A)
TE link
Unreserved
spectrum
B)
Express Channel established
Unreserved
spectrum
C)
TE link
Unreserved
spectrum
TE link
Unreserved
spectrum
D)
Embedded Media Channel established
Unreserved
spectrum
TE link
Unreserved
spectrum

Different M allowed