

# **GMPLS Framework, (Signaling and Routing Extensions) for the control of B100G OTUCn/ODUCn Network**

**draft-zih-ccamp-otn-b100g-fwk**

**draft-izh-ccamp-b100g-routing-00 & draft-zihc-ccamp-otn-b100g-signalling**

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# What is the problem we are trying to solve

- The current GMPLS solutions defined in RFC7064, RFC7138 and RFC7139 includes coverage for all OTN capabilities defined in the 2012 version of G.709
- These documents provide framework, signalling and routing protocol extensions required to support GMPLS control of B100G capable OTNs defined in the 2016 version of G.709

# Framework

- Summary of B100G capabilities (see [I-D.zih-ccamp-otn-b100g-fwk])
  - OTUCn signals with bandwidth larger than 100G ( $n * 100G$ )
  - ODUCn signals with bandwidth larger than 100G
  - ODUflex signals with bandwidth larger than 100G
  - **One OTUCn is split into n instances of OTUC, and one or more OTUC instances are associated with one FlexO interface**
  - mapping client signals with bandwidth larger than 100G into the corresponding ODUflex containers
  - Tributary Slot Granularity of 5G
  - **Support of reduced rate OTUCn, i.e., OTUCn-M signal**

# Framework

- **Use cases**

- 100GE Client Service with a homogeneous chain of OTUC1 links
- 100GE Client Service with a mix of OTU4, and OTUC1 links
- 400GE Client Service with a mix of OTUCn links
- FlexE aware transport over OTUCn links
- FlexE Client transport over OTUCn links
- Multihop ODUCn link
- Use of OTUCn-M links
- Intermediate State of ODU mux

# Framework

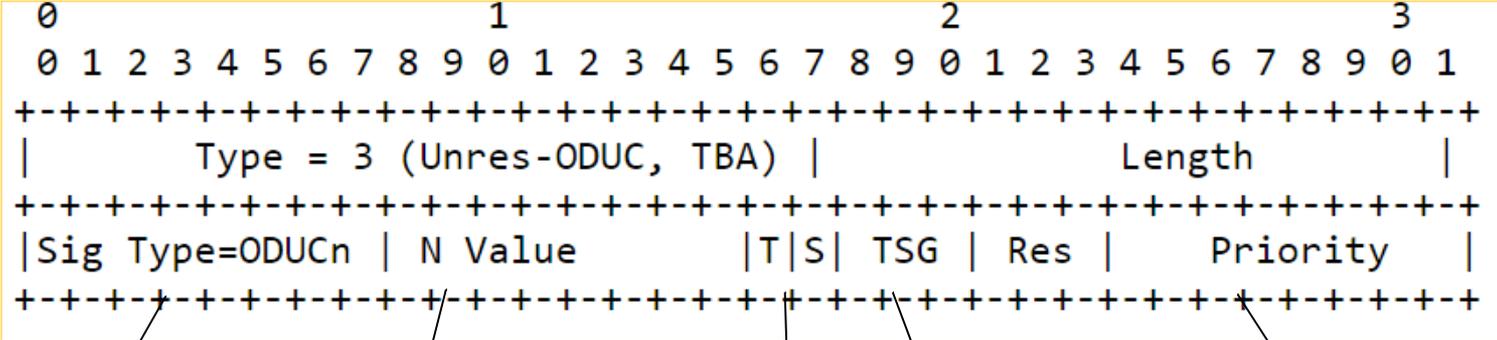
- GMPLS Implications

- ODU is modelled as a single-layer network with the bit rate as a parameter of links and connections.
- Routing shall be able to support new ODUCn encoding type, the advertisement of the termination, Switching and multiplexing Capabilities for ODUCn/OTUCn links.
- Signalling shall be able to support new OTUCn/ODUCn signal types, 5G granularity, TPN allocation, **setup of OTUCn-M connection, split of OTUCn/OTUCn-M signal over multiple different kinds FlexO interfaces.**

# Summary of Routing Extensions

- OSPF-TE must be extended to advertise the termination, Switching and multiplexing Capabilities for ODUCn/OTUCn links
- These capabilities are carried in the Switching Capability specific information (SCSI) field of the Interface Switching Capability Descriptor (ISCD) using formats defined in this document
- ISCD format extensions
  - This document defines a new encoding type
    - Encoding Type Field = G.709-2106 ODUCn
  - Switching Capability field = Same as defined in RFC7138
- SCSI format extensions
  - This document defines a new sub-TLV type 3 to advertise ODUCn
  - This document defines new signal types for ODUFlex

# Bandwidth Sub-TLV – Type 3



**Sig Type** : MUST be set to ODUcn

**Priority**: Same as in RFC 7138

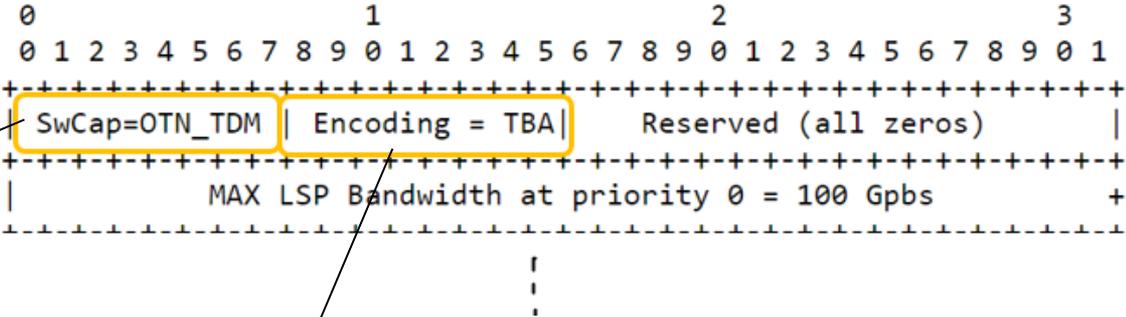
**N** : MUST be set in 1-256 range to Indicate the value of 'n' in ODUcn

**TSG** : MUST be set to 4 [TBA] to indicate 5G

**T Flag** : MUST be set to 1 to indicate terminated

**S Flag** : MUST be set to 0 to indicate non- switchable

## ISCD – Switching and Encoding Fields

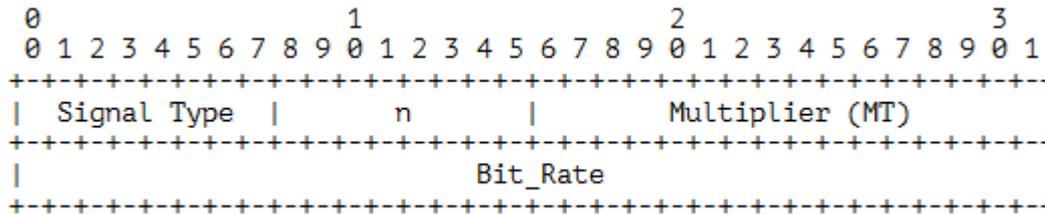


Same as RFC7138

New encoding type

# Summary of Signalling Extensions

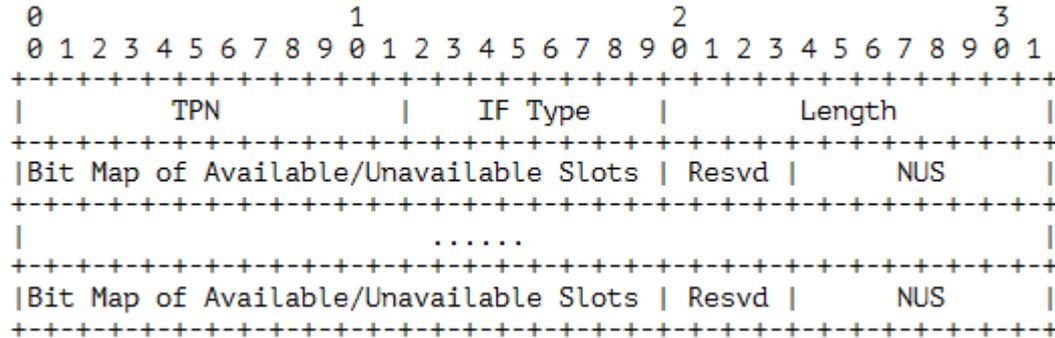
- Redefinition of Traffic Parameters for OTUCn/ODUCn



- “n ” is used to represent the bandwidth resource being requested.
- “NVC” is not used any more, because virtual concatenation is not support.

# Summary of Signalling Extensions

- Label



- IF (Interface) Type (8 bits): indicate the interface type of the port that provide support for OTUCn/OTUCn-M/ODUCn, which can be 100G/200G/400G Ethernet PHY interfaces.
- Bit map: when the label is used to set up OTUCn-M path, this field is used to represent the position of unavailable slots, when the label is used to set up ODUCn path, this field is used to represent the slots resource allocated for client.
- NUS (Number of Unavailable Slots): indicate the number of unavailable slots.

# What are the next steps

- Invite comments and feedback on the draft

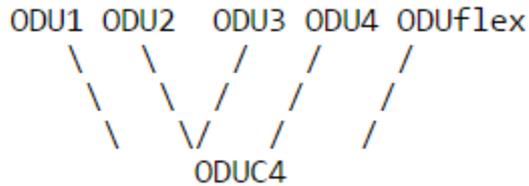
# References

- [I-D.zih-ccamp-otn-b100g-fwk] Wang, Q., Zhang, Y., Valiveti, R., Hussain, I., Rao, R., and H. Helvoort, "GMPLS Routing and Signaling Framework for B100G", draft-zih-ccamp-otn-b100g-fwk-00 (work in progress), February 2017.
- [ITU-T\_G709\_2012] ITU-T, "ITU-T G.709: Optical Transport Network Interfaces; 02/2012", <http://www.itu.int/rec/T-REC-G..709-201202-S/en>, February 2012.
- [ITU-T\_G709\_2016] ITU-T, "ITU-T G.709: Optical Transport Network Interfaces", <http://www.itu.int/rec/T-REC-G..709-201606-P/en>, July 2016.
- [RFC7138] Ceccarelli, D., Ed., Zhang, F., Belotti, S., Rao, R., and J. Drake, "Traffic Engineering Extensions to OSPF for GMPLS Control of Evolving G.709 Optical Transport Networks", RFC 7138, DOI 10.17487/RFC7138, March 2014, <<http://www.rfc-editor.org/info/rfc7138>>

# Backup

# Example of Single-Stage Muxing

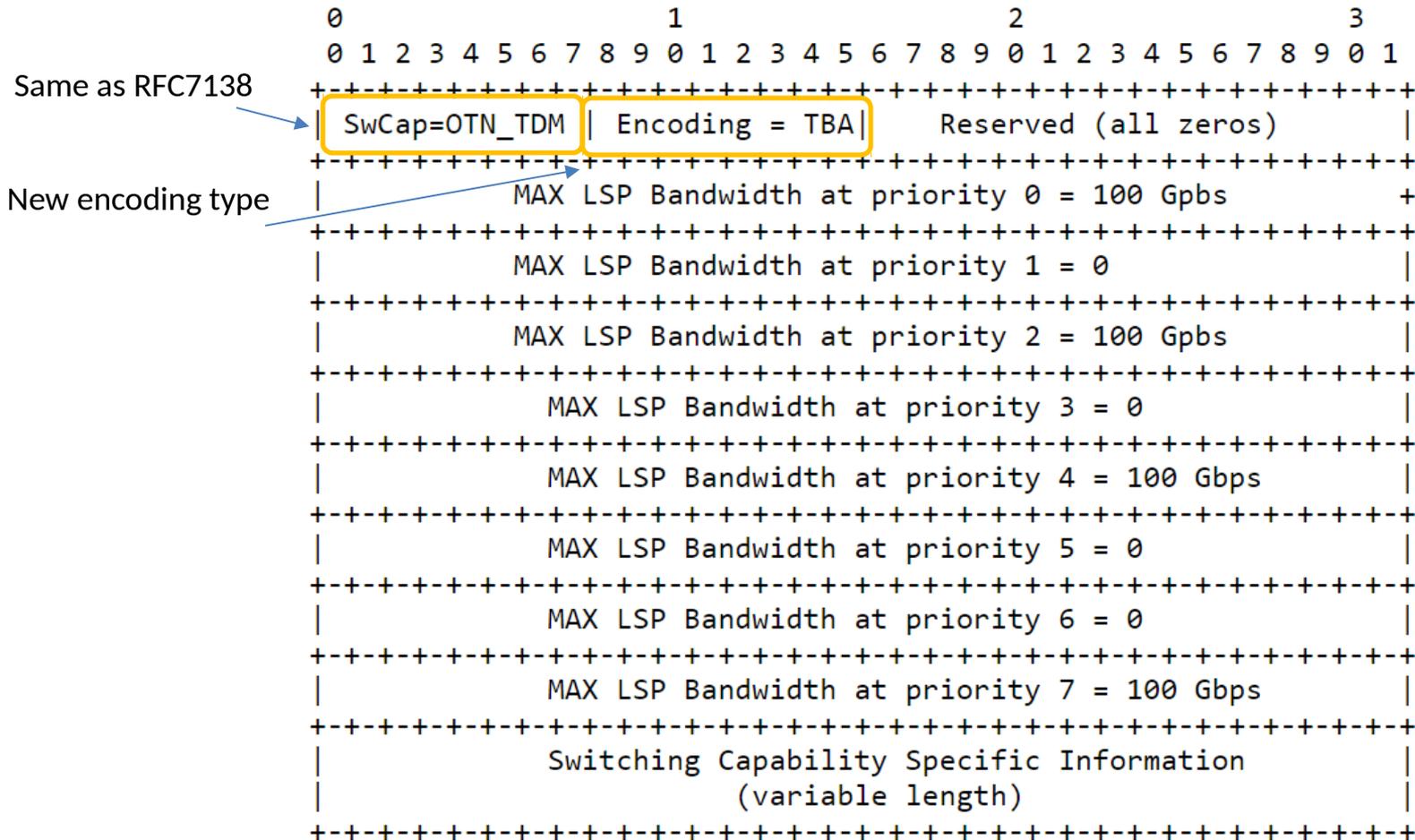
- Suppose there is 1 OTUC4 link supporting single-stage muxing of ODU1, ODU2, ODU3, and ODUflex (see hierarchy below)
- For simplicity, assume that only priorities 0 and 3 are supported.
- The SCSI fields for this case would be as depicted on the right.



0				1				2				3											
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3
Type = 3 (Unres-fix)				Length = 8																			
Sig type=ODUCn   N-value=4				1 0  4  0 0 0 0 0 0 0 0 0 0																			
Type = 1 (Unres-fix)				Length = 12																			
Sig type=ODU1   #stages= 1				X X X X X 0 0 0 1 0 0 1 0 0 0 0																			
Stage#1=ODUCn				Padding (all zeros)																			
Unres ODU1 at Prio 0 =160				Unres ODU1 at Prio 3 =160																			
Type = 1 (Unres-fix)				Length = 12																			
Sig type=ODU2   #stages= 1				X X X X X 0 0 0 1 0 0 1 0 0 0 0																			
Stage#1=ODUCn				Padding (all zeros)																			
Unres ODU2 at Prio 0 =40				Unres ODU2 at Prio 3 =40																			
Type = 1 (Unres-fix)				Length = 12																			
Sig type=ODU3   #stages= 1				X X X X X 0 0 0 1 0 0 1 0 0 0 0																			
Stage#1=ODUCn				Padding (all zeros)																			
Unres ODU3 at Prio 0 =10				Unres ODU3 at Prio 3 =10																			
Type = 2 (Unres/MAX-var)				Length = 24																			
Sig type=ODUCn   N-value=4				1 0  4  0 0 0 0 0 0 0 0 0 0 0																			
S. type=ODUflex   #stages= 1				X X X X X 0 0 0 1 0 0 1 0 0 0 0																			
Stage#1=ODUCn				Padding (all zeros)																			
Unreserved Bandwidth at priority 0 =400 Gbps																							
Unreserved Bandwidth at priority 3 =400 Gbps																							
MAX LSP Bandwidth at priority 0 =400 Gbps																							
MAX LSP Bandwidth at priority 3 =400 Gbps																							



# OTUC4 TE-Link Max LSP BW Advertisement Example at T0



- Consider an OTUC4 link with supported priorities 0,2,4,7
- At time T0, the MAX LSP Bandwidth Fields in the ISCD would be advertised as shown above

# OTUC4 TE-Link Max LSP BW Advertisement Example at T1

```

      0          1          2          3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
| SwCap=OTN_TDM | Encoding = TBA|   Reserved (all zeros)   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 0 = 100 Gbps  |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 1 = 0         |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 2 = 40 Gbps   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 3 = 0         |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 4 = 40 Gbps   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 5 = 0         |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 6 = 0         |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                MAX LSP Bandwidth at priority 7 = 40 Gbps   |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+
|                Switching Capability Specific Information     |
|                (variable length)                            |
+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+

```

- At time T1, an ODU3 at priority 2 is set up.
- Once the ODU3 is carried over the ODUC4, the unreserved bandwidth reduces to 60G and consequently MAX LSP Bandwidth is advertised as ODU3, since no more ODU4s are available and the next supported ODUj in the hierarchy is ODU3.

