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Transport of IEEE 10GBASE-R in optical transport networks (OTN)

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Supplement 43 to ITU-T G-series Recommendations

Transport of IEEE 10GBASE-R in optical transport networks (OTN)

Summary

Supplement 43 to ITU-T G-series Recommendations describes several approaches for transport of 10G LAN PHY over SDH and OTN transport networks. As some of these approaches use rates, formats and mappings that are not defined in ITU-T Recommendations, this supplement analyses various attributes of the different approaches to provide guidance regarding their applicability to different network contexts.

This supplement relates to Recommendations ITU-T G.872, ITU-T G.709/Y.1331, ITU-T G.798, ITU-T G.707/Y.1322, ITU-T G.8010/Y.1306, ITU-T G.8012/Y.1308, ITU-T G.959.1 and ITU-T G.696.1.

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FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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Supplement 43 to ITU-T G-series Recommendations

Transport of IEEE 10GBASE-R in optical transport networks (OTN)

1 Scope

This supplement describes different approaches for transport of 10GBASE-R signals in optical transport networks via an ODU2 or non-standard ODU2-like frame format (i.e., rates, formats and mappings that are not defined in ITU-T Recommendations). This supplement includes descriptions related to multiplexing the non-standard ODU2-like structures into ODU3-like signals. Different attributes of the varying solutions are described to help provide guidance on which approaches are appropriate to which network contexts.

Including a currently non-standard mapping in this supplement does not preclude considering that mapping for standardization at a future date.

2 References

- [ITU-T G.694.1] Recommendation ITU-T G.694.1 (2002), *Spectral grids for WDM applications: DWDM frequency grid*.
- [ITU-T G.696.1] Recommendation ITU-T G.696.1 (2005), *Longitudinally compatible intra-domain DWDM applications*.
- [ITU-T G.707] Recommendation ITU-T G.707/Y.1322 (2007), *Network node interface for the synchronous digital hierarchy (SDH)*.
- [ITU-T G.709] Recommendation ITU-T G.709/Y.1331 (2009), *Interfaces for the Optical Transport Network (OTN)*.
- [ITU-T G.798] Recommendation ITU-T G.798 (2006), *Characteristics of optical transport network hierarchy equipment functional blocks*.
- [ITU-T G.870] Recommendation ITU-T G.870/Y.1352 (2004), *Terms and definitions for optical transport networks (OTN)*.
- [ITU-T G.872] Recommendation ITU-T G.872 (2001), *Architecture of optical transport networks*.
- [ITU-T G.959.1] Recommendation ITU-T G.959.1 (2006), *Optical transport network physical layer interfaces*.
- [ITU-T G.7041] Recommendation ITU-T G.7041/Y.1303 (2008), *Generic framing procedure (GFP)*.
- [ITU-T G.8001] Recommendation ITU-T G.8001/Y.1354 (2006), *Terms and definitions for Ethernet frames over Transport (EoT)*.
- [ITU-T G.8010] Recommendation ITU-T G.8010/Y.1306 (2004), *Architecture of Ethernet layer networks*.
- [ITU-T G.8012] Recommendation ITU-T G.8012/Y.1308 (2004), *Ethernet UNI and Ethernet NNI*.
- [ITU-T G.8251] Recommendation ITU-T G.8251 (2001), *The control of jitter and wander within the optical transport network (OTN)*.

[IEEE 802.3] IEEE 802.3-2005, *Information Technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications.*
<http://ieeexplore.ieee.org/servlet/opac?punumber=10531>

3 Definitions

None.

4 Abbreviations and acronyms

This supplement uses the following abbreviations and acronyms:

CBR10G	Constant Bit Rate signal of 9 953 280 kbit/s ± 20 ppm (see [ITU-T G.870])
CBR2G5	Constant Bit Rate signal of 2 488 320 kbit/s ± 20 ppm (see [ITU-T G.870])
FCS	Frame Check Sequence
FEC	Forward Error Correction
GFP	Generic Framing Procedure
GMP	Generic Mapping Procedure
IaDI	Intra-Domain Interface (see [ITU-T G.870])
IPG	Inter-Packet Gap
IrDI	Inter-Domain Interface (see [ITU-T G.870])
JC	Justification Control
JOH	Justification Overhead
MAC	Media Access Control
MFAS	MultiFrame Alignment Signal
MSI	Multiplex Structure Identifier
NJO	Negative Justification Opportunity
OCC	Optical Channel Carrier with full functionality (see [ITU-T G.870])
OCCr	Optical Channel Carrier with reduced functionality (see [ITU-T G.870])
ODU	Optical Data Unit
OH	Overhead
OPU	Optical Payload Unit
OTU	Optical Transmission Unit
PHY	Physical layer
PJO	Positive Justification Opportunity
PT	Payload Type
SDH	Synchronous Digital Hierarchy
SFD	Start-of-Frame Delimiter
SONET	Synchronous Optical Network
TS	Tributary Slot

TSOH	Time Slot Overhead
WAN	Wide Area Network

5 Conventions

Transmission order: The order of transmission of information in all the figures in this supplement is first from left to right and then from top to bottom. Within each byte, the most significant bit is transmitted first. The most significant bit (bit 1) is illustrated at the left in all the figures.

6 Standard mappings

6.1 10GBASE-W (WAN PHY) via STM-64

[IEEE 802.3] has defined a WAN interface for compatibility with SDH/SONET transport. In the Ethernet domain, this interface is supported via a WAN interface sub-layer (clause 50 of [IEEE 802.3]) that limits the effective data rate of the XGMII from 10 Gbit/s to 9.95328 Gbit/s prior to 64B/66B coding and insertion in an SDH/SONET format frame. The mapping of this data into the frame of an SDH STM-64 (VC-4-64c) is illustrated in Annex F of [ITU-T G.707].

Even if the interface provides only the ± 20 ppm clock accuracy required by clause 50 of [IEEE 802.3], rather than SDH clock tolerances (± 4.6 ppm), this can be transported via ODU2 according to the mapping specified in clause 17.2.2 of [ITU-T G.709].

6.2 GFP-F mapping of 10GBASE-R (LAN PHY) payload only into OPU2

A payload information transparent mapping can be performed according to clause 17.4 of [ITU-T G.709] using the following process:

- Terminate (sink) the 64B/66B line code, preamble, SFD and IPG as per [IEEE 802.3].
- Apply GFP-F framing.
- Encode into an OPU2 according to clause 17.4 of [ITU-T G.709].

On the assumption that MAC frames do not on average exceed the maximum size specified by [IEEE 802.3] (1518 octets excluding the preamble, SFD and IPG), the bit rate required is for a signal that is +100 ppm from the nominal bit rate, approximately 9'922'968.791 kbit/s.

If maximum size jumbo frames are used, the bit rate required for a signal that is +100 ppm from the nominal bit rate is approximately 9'995'002.399 kbit/s.

Note that in the mapping of GFP frames into OPU_k specified in clause 17.4 of [ITU-T G.709], the entire OPU2 payload area of 9'995'277 kbit/s is available (i.e., the fixed stuff bytes of the CBR10G mapping are not present). For an OPU2 that is running at the minimum rate of -20 ppm from the nominal value, this is reduced to 9'995'077.058 kbit/s.

With standard IEEE 802.3 termination, this mapping can fully transport every ETH_CI traffic unit from a 10GBASE-R signal over an OPU2. Refer to Table V.4 of [ITU-T G.7041], where a characterization is given of the MAC rate throughput (not counting overhead) of 10GBASE-R signals versus GFP mappings. The MAC rate throughput of a 10GBASE-R interface, assuming a worst case situation of 9618-byte jumbo-frames is 9'986'502 bit/s. The MAC rate throughput of GFP mapping of the same MAC frames into ODU2 is 9'986'970 bit/s, which is greater than what is required to carry the entire MAC payload from a 10GBASE-R signal.

7 Non-standard mappings

This means rates, formats and mappings that are not fully defined in ITU-T Recommendations.