Office of the Sr.GM(CNP)
Core Network Planning Cell,
BSNL Corporate Office,
Room No. 811, 8th Floor,
Bharat Sanchar Bhawan, Janpath,
New Delhi-110001
Ph: 011-23708027, Fax: 011-23708028
E-Mail: agmofcnp@bsnl.co.in

भारत संचार निगम लिमिटेड
(भारत सरकार का उपक्रम)
BHARAT SANCHAR NIGAM LIMITED
(A Govt. of India Enterprise)

No. 33-3/2009/TPL-(OF)/84

Dated: 21.10.2015

To
All Chief General Managers
BSNL Territorial Circles/ Projects/ Regions

Sub: Packet Transport Network in BSNL.

Transport network requirements of BSNL in the present scenario requires packet transportation, as all the new network elements are generating IP Traffic which is to be reliably transported. Based on this requirement, Packet Transport Network Planning guidelines have been prepared (Annexure-A) which outlines the basic concepts, technology & network architecture for the future transport network of BSNL. The network basically comprises of MPLS-TP based nodes.

2. It is requested that requirement for MPLS-TP/Packet Transport Network equipment may be assessed for CFA (NGN etc.), Mobile 3G IP-fication including aggregation and Enterprise (Leased Line) Access aggregation/ Managed Services and the quantities required for Type A1, A2, B1, B2 and C of MPLS-TP nodes (as per the configuration indicated at Annexure A) may be worked out and intimated to this office. It may be ensured that the equipment planning is based on actual requirements. The requirement of MPLS-TP/PTN considered in any other plan may be excluded. The equipment once made available shall be put to use during next one year period.

Equipment requirement for MPLS-TP nodes may be submitted to this office latest by 31/10/2015 through FAX on 011-23708028 and E-Mail on agmofcnp@bsnl.co.in.

This issued with the approval of DIR (ENT), BSNL.

21-10-15

(S.K.Gupta)
Addl. GM(CNP)

Encls: Annx-A - Planning Guidelines for Packet Transport Network (MPLS-TP)

Packet Transport Network

1.0 Introduction

1.1 BSNL transport network was designed and deployed to carry basically TDM traffic comprising of EIs, STM-1s & STM-16s. The network elements such as Switches, BTSs, BSCs& MSCs etc utilized TDM interfaces for transportation of information from one place to the other as part of service delivery. With the introduction of Broadband for which large number of DSLAMs were installed for high speed Broadband delivery, transport of Ethernet traffic was also introduced in BSNL network, through RPR Switches deployed in metro districts.

1.2 To carry TDM traffic efficiently & reliably SDH network comprising of STM-1 CPE, STM-1 ADM, STM-4, STM-16 ADM, STM-16 MADM and STM-64 has been extensively deployed which carried all type of TDM traffic. For long distance transport, linear DWDM systems (2.5G & 10G) were deployed which carried mostly SDH traffic through its λs (STM-1, STM-4, STM-16). During 2009 Digital Cross Connect (DXCs) were also introduced in BSNL network with granularity of STM-1 Cross Connect along with aggregation and ASON capability. Thus SDH, DXC and DWDM is presently the backbone of the transport network of BSNL.

1.3 From 2006 onwards, with the advent of Ethernet over SDH (EoSDH) all SDH, DWDM & DXC Equipment procured by BSNL had the capability of transporting Ethernet traffic over SDH frame through Generic Framing Protocol (GFP) and Virtual Concatenation. This technology enabled BSNL to adapt to the transition phase in the technological development curve where the network elements were progressively switching towards Ethernet Interfaces (FE, GE) but continued to support TDM interfaces too. Further with deployment of large numbers of RPR Switches and OCLAN Switches with Broadband network the requirement of Ethernet transport through traditional TDM transport backbone, was minimal.Even the routers of MPLS network (P&PE) had substantial TDM interfaces to enable the transportation of traffic in secure reliable media, utilizing BSNL's traditional TDM transport backbone.

1.4 But the situation depicted above is rapidly changing with 100% network elements being deployed by Mobile, Broadband and NGN for fixed access supporting only Ethernet interface for interconnection. Thus the volume of

transport requirement for Ethernet Interfaces has exponentially increased while requirement of TDM transport is rapidly vanishing. The network transportation requirement has clearly shifted from TDM with smaller portion of Packet to almost 100% Packet transport. As we move in the era of Packet transport, utilizing TDM network for the same becomes inefficient and costly. Moreover, the packet network gives support to different class of services, aggregation and dynamic statistical multiplexing etc. in transport layer for efficient delivery of services.

Telecom operators worldwide are facing this challenge and most of them have either planned or already implemented the Packet Transport Network.

What is Packet Transport Network ?

Attributes required for Ethernet transport.

Attributes	**Packet Network**	**Transport Network**	**Packet Transport Network**
Connection Mode	Connectionless	Connection oriented	Connection oriented
OAM /Operation& maintenance)	Out of Band	In band	In band
Protection Switching	Control Plane depend	Data Plane Switching	Data Plane Switching
BW efficiency	Statistical Multiplexing	Fixed Bandwidth	Statistical Multiplexing
Data rate granularity	Flexible	Rigid SDH Hierarchy	Flexible
QoS	QoS differentiation	Single Class	QoS differentiation

Packet Transport →Packet efficiency + Transport grade.

2.0 Transport network requirement

Transport Network
Reliable aggregation of any client traffic type, of any scale at the lowest cost per bit

Scalability	Multi Service	Quality	Cost Efficiency
Ability to support any number of Client traffic Instances whatever Network size from access to core	Ability to deliver any type of client traffic	Ability to ensure that client traffic is reliably delivered and monitored for e2e performance	Ensuring low processing complexity and easy operations.
* Layering * Partitioning	*Client agnostic L1, L2 & L3	*Connection Oriented *Strong OAM complexity (L1&L2)minimum * resilience *Traffic engineering & Control	*Capex -low as protocol * OPEX-Unified Management

2.1 MPLS-TP

The Internet Engineering Task Force (IETF) and International Telecommunication Union (ITU-T) undertook a joint effort to standardize a new transport profile for the Multi-Protocol Label Switching (MPLS) technology that intends to provide the basis for the next generation Packet Transport Network. The fundamental idea of this activity is to extend MPLS where necessary with operations, Administration and Maintenance (OAM) tools that are widely applied in existing transport network technologies such as SDH. MPLS-TP is considered to be a carrier grade packet transport technology.

Characteristics:

- Strictly connection oriented
- It is client-agnostic (Can carry L1,L2, L3 Services)
- It provides strong Operations, Administration and Maintenance (OAM) functions similar to those available in traditional optical transport networks ; these OAM functions are an integral part of the MPLS-TP data plane and are independent from the control plane.
- It provides several protection schemes at the data plane similar to those available in traditional optical transport networks.
- Allows network provisioning via centralized NMS
- Transport & distribution of synchronization clock is possible.

- CROSS CONNECT provide protection for up to 64 kbps hence protection can be provided at 64kbps level, E1 level, and at STM1 level as desired if we go for CES mode (circuit emulation).
- GMPLS control plane is also applicable to the MPLS-TP Client or server layers and allows to use a common approach for management and control of multilayer transport networks.

2.2 BSNL Network Evolution:

It is seen that BSNL requires immediate introduction of Packet Transport Network in order to provide reliable connectivity to the additional network elements and to meet the exponential growth in IP traffic. MPLS-TP enabled nodes with different configurations (as per the network requirement) may be planned for transportation requirements in place of STM-1,16,64 MADMs etc. where ever transportof packets is required. There is provision of carrying STM1 and E1 also in such devices.

2.3 Features:-

1. As these equipments are going to be used in place of SDH/TDM devices , which will be capable of servicing both TDM as well as packet (FE,GE etc.) clients, we need to have functionality similar to them and at the same time inefficiency of utilization of available bandwidth is to be minimized . Hence for the user it should look like a SDH equipment. OAM (operation , administration and maintenance) like SDH are available in these equipments. Some of them are:-
   i. Point to point circuits can be provisioned.
   ii. The devices can be connected in ring /mesh.
   iii. End to end monitoring of each circuit is possible.
   iv. Protection 1:1(PW) or even 1:n(LSP) can be provisioned.
   v. It can transport synchronization information.
2. As switching in these devices are packet based ,it has features of packet based devices also. Some of these are:-

i. Point to multipoint or multipoint to multipoint circuits can be created.
ii. Services can be provisioned at L1 or L2 layer.
iii. QoS can be defined for individual customers.

3.0 Proposed configuration of nodes:-

Type-A1 : (DC Powered Type)

Uplink	---	1GE (optical) -- 2
Downlink	---	FE--4
		FX--4
		GE—2(Electrical)
		STM1--2
		E1-8

Cross Connect Capacity -- Minimum 5Gbps

Type-A2 : (AC Powered Type)

Uplink	---	1GE (optical) -- 2
Downlink	---	FE--4
		FX--4
		GE—2(Electrical)
		STM1--2
		E1-8

Cross Connect Capacity -- Minimum 5Gbps

Type –B1:

Uplink	10GE(optical)-- 2	
Downlink	1GE--16 (8Electrical+8 optical)	
	FE	--16
	FX	--16
	STM1	--8
	E1	--64

Cross connect capacity -- 40 Gbps.

Type –B2:

Uplink	10GE(optical)-- 2	
Downlink	10GE (optical)-- 2	
	GE	--32 (16 Electrical+16 optical)
	FE	--16
	FX	--16
	STM1	--8
	E1	--64

Cross connect capacity -- 80 Gbps.

Type C:

Uplink 40GE (optical) -- 2

Downlink 10GE (optical) -- 12
FE/ GE -- 64 (32 optical + 32 Electrical)
(10/100/1000)
STM-1—8
E1-64

Cross connect capacity -- 240 Gbps

(Uplink- Line Side, Downlink- Traffic Side)

4.0 Distance between two nodes:-

Type A1/A2 - 30 Km.

TypeB1/B2 - 50 Km.

Type C - 50 Km.

5.0 Power Supply:-

Type A1/A2- AC Type or DC Type.

Type B1/B2- DC Type.

Type C- DC Type.

6.0

Typical Network Topology for MPLS-TP Nodes

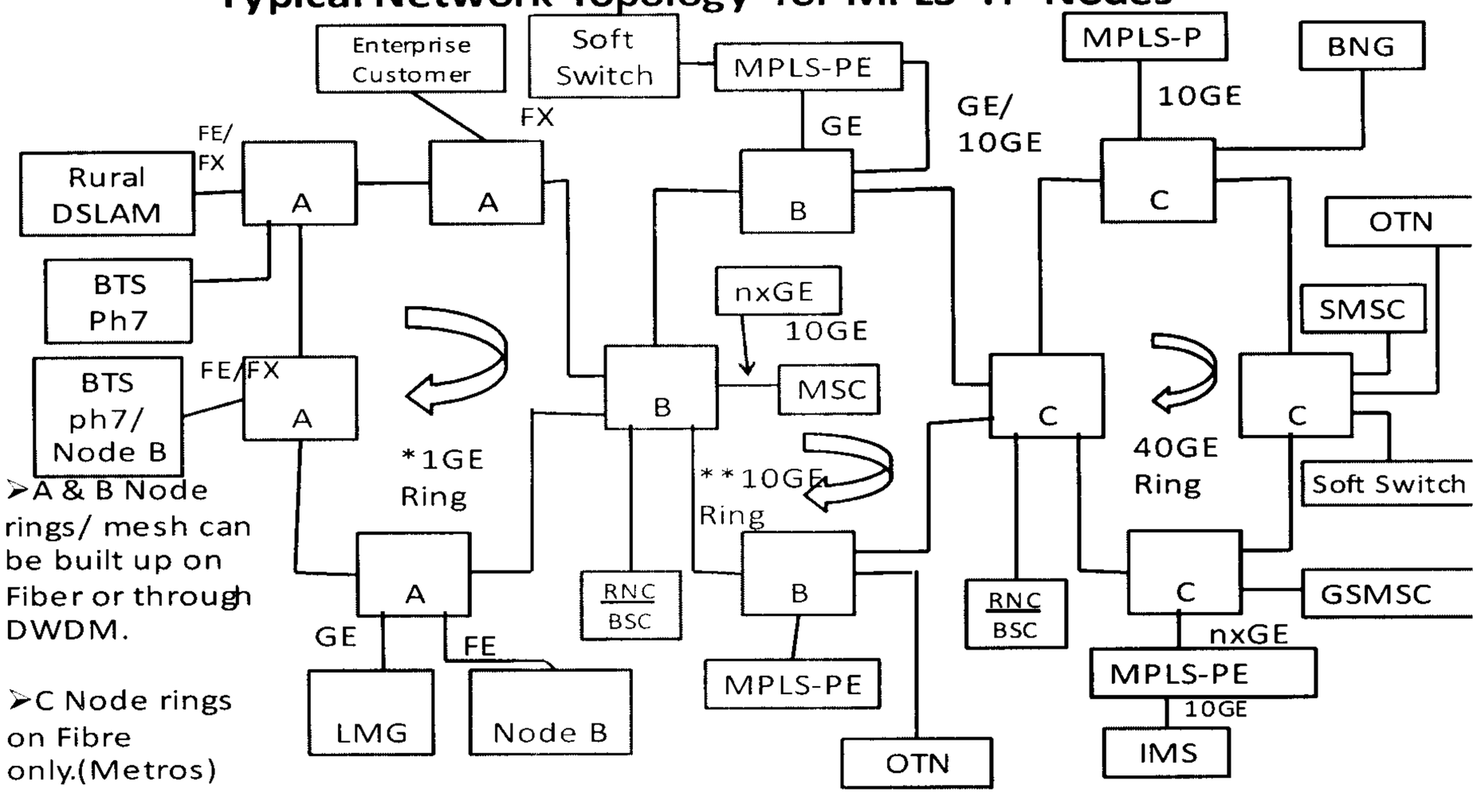

Figure 1

- Co-located network elements connected directly while the traffic between non co-located ones is transported through packet transport network.
- Nodes to comply to the MPLS TP standards for OAM, Protection, Architecture, Synchronization etc.
- **There will be minimum TDM interface and the existing infrastructure of SDH/DWDM will cater to the existing TDM traffic of BSNL where ever possible.**
- Lower type nodes can be directly terminated on the interfaces of the higher level nodes i.e. 1GE Uplink of Type-A node can be terminated on the 1GE interface of Type-B nodes similarly 10GE Uplinks of Type-B node can be terminated on 10GE interface of Type-C nodes.
- Type-A,B& C shall have control card, switching fabric and power supply redundancy while Type-A will have only power supply redundancy.
- Exchange of traffic with MPLS will be through PE Routers on UNI interface at multiple points of connectivity.

7.0 The planned A,B & C Nodes will perform the function of transport & aggregation of traffic from all access points such as BTS, Node Bs, RNCs, MSCs, MPLS-PE Routers, FTTH OLTs, DSLAMs etc. All the traffic aggregation in major cities with high traffic between PoPs located within same city will be served by Type C nodes. Thus the functions presently being done by STM-1 CPE, STM-1 ADM, STM-16 MADM and STM-64 will be done by MPLS-TP enabled packet transport nodes with configurations as shown above for all the future packet transport requirements. Number of nodes in a ring will depend on the amount of client traffic at each node.

Type A nodes can be very effectively used to replace present CPEs. Normally it will be used to give connectivity to standalone small capacity nodes like BTSs, consumers demanding higher BW, small capacity DSLAMs etc. In such cases they can be used in linear mode also.

7.1 Guiding factors for selection of equipment:-

1. Traffic originating from the node.
2. Availability of fiber- Linear or in multiple directions.
3. Future requirement- Minimum 3 years projected requirement should be taken into account.
4. Care should be taken that total traffic in uplink (assuming 20% traffic is being pumped from any downlink port) should not be more than uplink capacity. This principal is to be followed only at the lowest level i.e rings with Type A nodes.
5. B1 or B2 should be chosen on the basis of traffic originating from that node. For smaller nodes B1 may be chosen. B1 or B2 can be used in same ring as there is no change in the uplink bandwidth i.e. 10G only.
6. At higher levels i.e. rings with B1/B2 or C type nodes uplink capacity and loading on downlink ports should be almost same . We can take traffic from downlink ports as 70% of downlink port capacity .
7. Mesh networks can also be made in place of rings depending on the availability of fiber and requirement. Normally it should be done in the case of 40 GE rings. It may be noted that downlink ports can be used in uplink directions also for making mesh network.
8. Care should be taken not to project requirement of these equipments if traffic requirement is being met by MNG-PAN/OC-PAN.
9. 2.5G requirement to be met by existing equipments in the network or through forthcoming OTN network.