Quarterly Report on Monitoring of ICT Infrastructure

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Bhutan InfoComm and Media Authority

Royal Government of Bhutan

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1. Background

As a part of monitoring of ICT Infrastrcurure in the country, the InfoComm and Infrastrcuture divison has carried out monitoring of ICT Infrastructure- DWDM network and FTTH network in Bumthang and Trongsa region including the field visit to DR (Disaster Resilient) mobile core network of BTL in Jakar, Bumthang. The monitoring exercise was carried out with effect from 15th July till 19th July, 2024.

2. Findings

2.1 Monitoring of the DWDM network of BTL in Jakar BTL Network center.

The DWDM network installed at Jakar was monitored and observed that BTL has deployed new IP DWDM in addition to the existing DWDM network. The observation on DWDM deployment at Jakar network center is as follows:

i. Conventional DWDM transmission links are maintained at Jakar network center and it has the following installed capacity.

- 10 Gbps DWDM(Coriant) transmission ring network to Trongsa DWDM Via Yutongla DWDM

Figure 1: 10 Gbps DWDM(Coriant) transmission ring network to Trongsa DWDM Via Yutongla DWDM

- *10 Gbps DWDM(Coriant) transmission link to Yurmo DWDM*

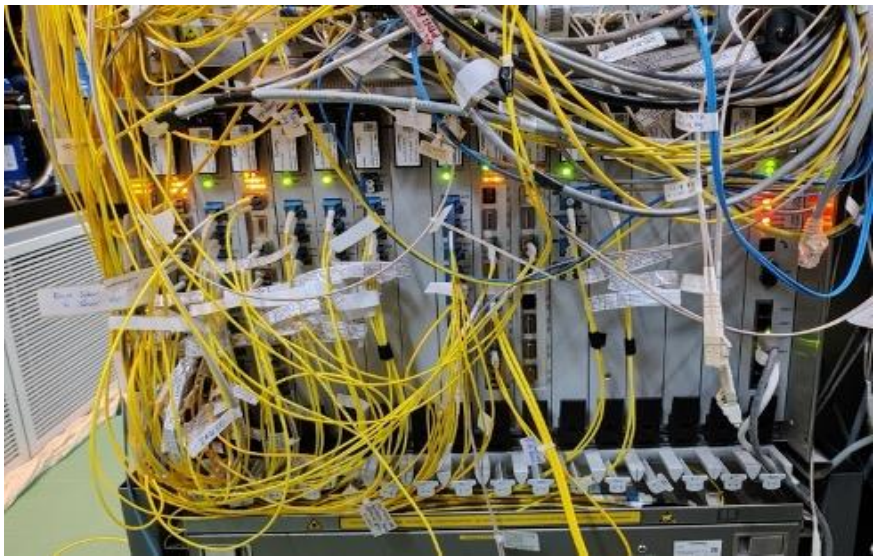

Figure 2: 10 Gbps DWDM(Coriant) transmission link to Yurmo DWDM

- 10 Gbps DWDM(Cinea) transmission ring network to Mongar DWDM via Tangsibi DWDM and Tangmachu DWDM

Figure 3: 10 Gbps DWDM(Cinea) transmission ring network to Mongar DWDM via Tangsibi DWDM and Tangmachu DWDM

ii. New IP DWDM transmission link established at Jakar network center and it has the following installed capacity.

- 100 Gbps IP DWDM link set up from Jakar to Thimphu via Yurmo DWDM, Trongsa
- 100 Gbps IP DWDM link set up from Jakar to Thimphu via Yutongla DWDM

- 100 Gbps IP DWDM link set up from Jakar to Kanglung, Trashigang via Tangmachu DWDM, Lhuntse

Figure 4: new IP DWDM installed at Jakar network center for IP DWDM connection to Thimphu and kanglung

2.2 Monitoring of Disaster Resilient Mobile Core Network of BTL at Jakar

The equipment inventory of the disaster resilient mobile core network of BTL has been recorded including its capacities and functionalities. The observation of the field visit is as in the following;

Legacy mobile Core network (2G/3G)

Some of the major components of conventional core networks are as highlighted in the following.

i. MSC (mobile switching center)

One MSC of BTL at Jakar is for redundancy for MSC of Thimphu and MSC is the main part of the core network for all existing mobile technologies like 2G and 3G. The MSC at Jakar carries a certain percentage of BTL's mobile network traffic of BTL even during normal operation days.

A Mobile Switching Center (MSC) is a core part of the GSM/CDMA network system. It acts as a control center of a Network Switching Subsystem (NSS). The MSC connects calls between subscribers by switching the digital voice packets between network paths. It also provides information needed to support mobile service subscribers. Based on the size of the mobile operator, multiple MSCs can be implemented.

ii. HLR (Home Location register)

The Home Location Register (HLR) forms a critical part of mobile telecommunications networks. It serves as a central database that stores and manages mobile network subscriber information, such as authentication data, service profiles, and subscriber location. This facilitates service provisioning and mobility management within the network. There is one HLR unit in Jakar core network center for redundancy purpose

iii. SGSN (Serving GPRS Support Node)

SGSN is at the same hierarchical level as the MSC. SGSN ‘s tasks include packet switching, routing and transfer, mobility management (attach/detach and location management), logical link management, and authentication and charging functions of 2G or 3G network. SGSN processes registration of new mobile subscribers and keeps a record of their location inside a given service area. One SGSN installed and is in operation at Jakar DR mobile core network.

iv. GGSN (Gateway GPRS Support Node)

GGSN acts as an interface between the GPRS backbone network and the external packet data networks. GGSN ‘s function is similar to that of a router in a LAN. GGSN maintains routing information that is necessary to tunnel the Protocol Data Units (PDUs) to the SGSNs that service particular mobile stations. It converts the GPRS packets coming from the SGSN into the appropriate packet data protocol (PDP) format for the data networks like Internet or X.25. The GGSN also performs authentication and charging functions related to data transfers. One GGSN installed and operation at Jakar DR mobile core network.

v. MGW (media Gateway)

A Media Gateway is a translation device or service that converts media streams between dissimilar telecommunications technologies such as POTS, SS7, Next-Generation Networks (2G, 2.5G, 3G, 4G radio access networks) or private branch exchange (PBX) systems and enables multimedia communications across packet networks.

There is a single MGW at Jakar core network center as shown in picture below.

Figure 5: legacy Core network component- MSC, SGSN, GGSN and MGW

Evolved Packet Core Network (4G network)

It was observed that there is also the component of EPC (Evolved Packet Core) network hosted in Jakar DR core network and EPC core network are integrated into one or two units. Some of the major functionalities of EPC network components are as highlighted in the following.

i. HSS (Home Subscriber Server)

HSS stands for Home Subscriber Server. It is a key component of the core network in mobile communication systems, including 3G (UMTS) and 4G (LTE). The HSS serves as a centralized database that stores and manages subscriber-related information for a mobile network operator. The HSS is responsible for authenticating and authorizing subscribers, enabling secure access to the network, and facilitating mobility management. The HSS interacts with other network elements, such as the Mobility Management Entity (MME) in LTE, to ensure seamless and secure communication for mobile users.

ii. xGW(SWG/ PGW)

SGW (Serving Gateway)
The SGW node handles the user data traffic, but isn't responsible for the signaling data used. It transports IP data from UEs to the LTE Core Network. The SGW also routes incoming and outgoing IP packets for better system collaboration and serves as an anchor for the UE when it moves from one eNodeB to another.

PGW (PDN Gateway) PGW is the network node that connects the EPC to external IP networks. What the PGW does is that it routes packets to and from external IP networks. Beyond that, it also allocates an IP address to all UEs and enforces different policies regarding IP user traffic such as packet filtering.

iii. MME (Mobility Management Entity)

Mobility Management Entity (MME) is a key component of the standards-defined Evolved Pack Core (EPC) for LTE. It provides mobility session management for the LTE network and supports subscriber authentication, roaming and handovers to other networks.

Figure 6: EPC network component- MSS, PGW and CU

OSS (Operational Support System) or BSS (Business Support System) and IN (intelligent Network)

Operations Support System (OSS) / Business Support System (BSS) offers various functions including: Customer Care, Order handling, Customer Self-care, Voucher, Top-up, Billing & Payment, Policy Control.

Intelligent Network (IN) allows functionality to be distributed flexibly at a variety of nodes on and off the network and allows the architecture to be modified to control the services. These networks can separate extra services from the call switching system, making it easier to add new value-added services to users.

Figure 7: OSS network, billing system and IN Network at Jakar Core network

Back up Government data center in Jakar core network center

It was observed that backup for the government data center has been set up along with BTL's DR mobile core network center at Jakar, Bumthang as shown in the figure below.

Further, it was also observed that a new data center of BTL has been built in Jakar with an advanced power system, disaster resilient infrastructure and network operation center. It was informed that all core network components and back up for the government data center will be shifted to the new data center when the set up for the new data center building becomes fully operational.

Figure 8: Back up for government center(left) and new data center of BTL at Jakar (right)

D. FTTH Network deployed in Bumthang

BTL has deployed Nokia GPON FTTH network in Bumthang. There is a single Nokia GPON OLT with 8 ports installed in the Jakar core network center and each port has the capacity to distribute 64 ONT customers in ideal cases. However, due to FTTH fiber losses, one port of GPON OLT at Jakar can distribute to 32 FTTH leased line customers. All 8 ports of Nokia GPON OLT have been utilized and it was informed that there are more than 200 FTTH leased line customers in Bumthang.

Figure 9: Nokia GPON OLT with splitters (FTTH network) in Jakar town and its peripheral areas

2.3 DWDM network of TIPL at Garpang Tx, Bumthang

TIPL has established DWDM networks in Garpang Tx, Bumthang and has a following the link;

- Link to Kewathang Tx, Trongsa with 10 Gbps DWDM link
- Link to Tangmachu Tx, Lhuntse with 10 Gbps DWDM link

Figure 10: DWDM network of TIPL at Garpang Tx, Bumthang

2.4 Monitoring of DWDM network of BTL at Trongsa BTL office

The DWDM network of BTL installed at Trongsa was monitored and observed that BTL has deployed only the DWDM network. The observation on DWDM deployment at Trongsa BTL office are as follows:

- 10 Gbps DWDM(Coriant) transmission link network to Jakar, Bumthang Via Yutongla
- 10 Gbps DWDM(Coriant) transmission link to Yurmo DWDM
- 10 Gbps DWDM(Coriant) transmission ring network to Lobesa DWDM via Pelela DWDM
- 10 Gbps DWDM(Coriant) transmission link to Zhemgang DWDM

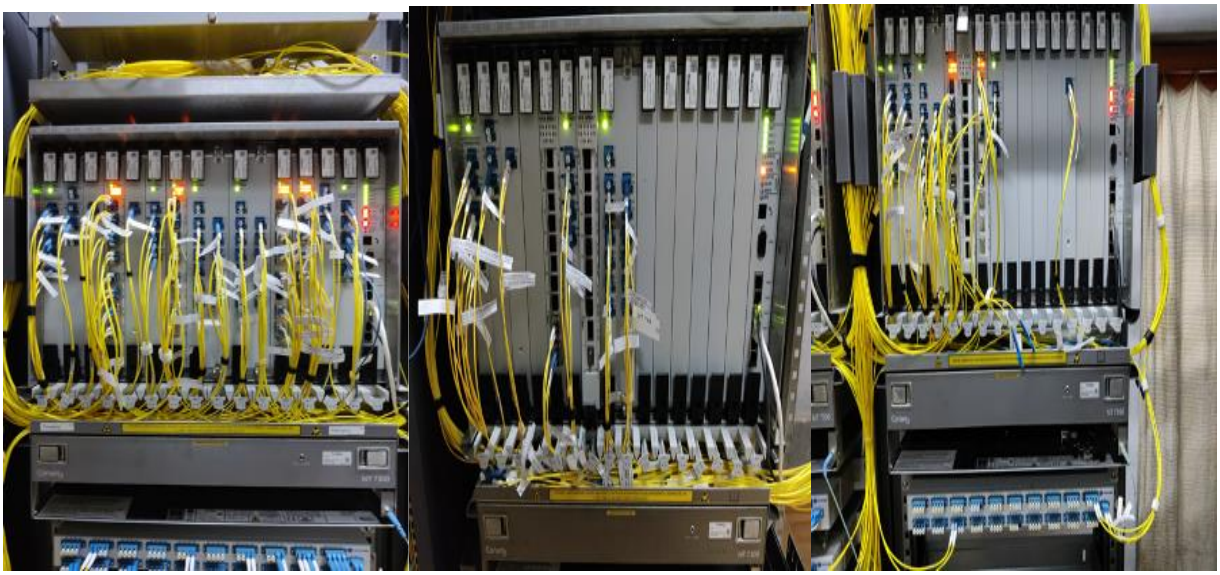

Figure 11: DWDM network of BTL at Trongsa BTL Office

2.5 Monitoring of DWDM of TIPL in Kewathang Tx, Trongsa

The DWDM network of TIPL installed at Kewathang Tx, Trongsa was monitored and Observation are as follows:

- Link to Garpang Tx, Bumthang with 10 Gbps DWDM link via Yurmo substation colocation
- Link to Tingtibi Tx, Zhemgang with 10 Gbps DWDM link via Yurmo substation colocation
- Link to Lobesa Tx, Punakha with 10 Gbps DWDM link via Tashiling Tx, Trongsa

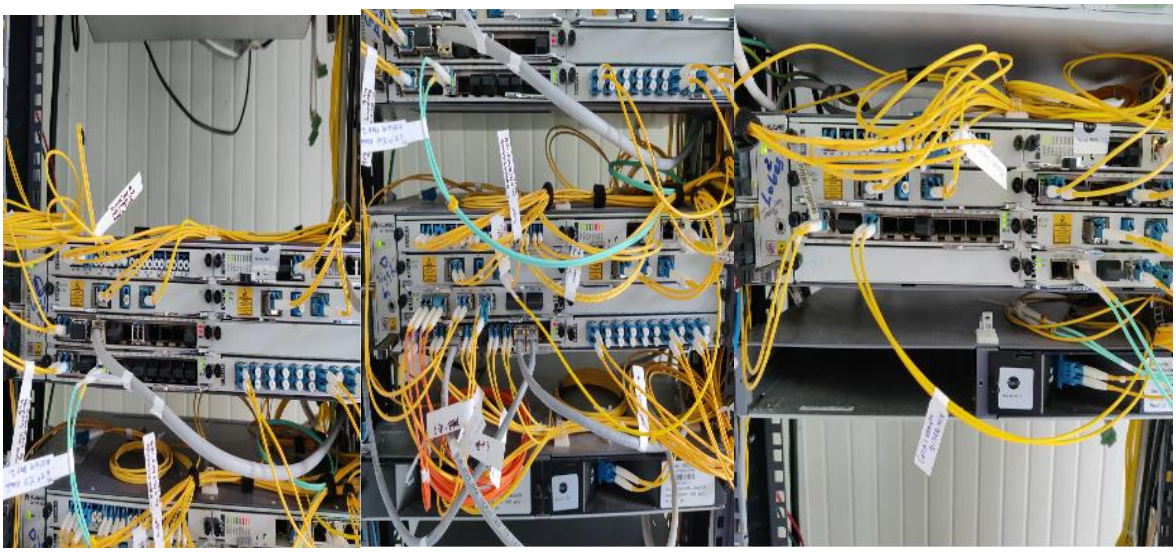

Figure 12: DWDM network of TIPL at Kewathang Tx, Trongsa

Note: There is no FTTH network in Trongsa for both BTL and TIPL. Internet Leased line for BTL is distributed through fiber router and TIPL used wireless radio for internet leased line services.

3. Actions Taken based on the field visit

- Based on this report, we have compiled the information details on the fiber backbone network of both BTL and TIPL including its bandwidth utilization.

- Compiled report for recording and future references especially on FTTH network, Disaster Resident core network, backbone fiber network.

- The report provides clarity on the need to do further monitoring of ICT Infrastructure

4. Recommendation/ Way Forward

- To carry out further detailed monitoring of ICT Infrastructure especially the core network and Disaster Resilient core network to have proper recording and for necessary regulatory intervention based on this information.

- To carry out monitoring of backbone fiber networks of both telcos to validate and audit the information details submitted by telcos on fiber backbone network.