Design of Centralized Mini-Link for Optimal use in Telecom Network

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Abstract. Now a Days Microwave MINI-LINK are widely used for point to point communication. Microwave link has become an essential form of communication network because of frequent interruption of Optical Fiber Cable network due to other sector development work, non-feasible area for Optical Fiber Cable laying (digging is difficult for OFC) or any unseen reason, on the other hand mini link network become so adaptable because their small wavelength allows conveniently sized antenna to direct them in narrow beam which can be pointed directly at receiving end. This allows nearby mini link equipment to use same frequencies without interfering any other link. The aim of this paper is to create a mini link network in such a way so that operation and support maintenance work can be done from a central location without moving at site and without purchasing any software. Another objective of this paper is to describe how to use installed equipment completely (i.e. 100% utilization of equipment) which are being used by network.

Keywords: Operation and Maintenance (O&M), Key Performance Indicator (KPI), Network Monitoring system (NMS), Local Craft Terminal (LCT), Network Equipment (NE), Optical Fiber Cable (OFC), Indoor Units (IDUs), Online BTS Monitoring System (OBMS)

1. INTRODUCTION

Basically microwave radio relay is used for transmitting any type of data via analog and digital signal. Like long distance call, teleconferencing, and television program and computer data, between two locations on line of sight radio path. It works between two locations with directional antenna. The distance between two location approximately 48km or 65 km (30 or 40 miles). Since radio waves travels in narrow beam enclosed to line of sight path between two antennas. Antenna used in this highly directional. These antenna installed in elevated location i.e. on large radio towers (height from 40 to 60 meter) so that it can transmit across long distance.
Microwave communication is Line-of-sight wireless communication technology, since it uses very high frequencies therefore it is capable to communicate large quantities of information. By the use of microwave repeaters, it can also transmit data over extremely long distances. Comparing Microwave communication with other forms of data transmission such as Optical Fiber Network, wire-line technologies etc., microwave communication systems have relatively less installation costs and easy to maintain. As there is no requirement of expensive attenuation equipment or physical cables. Rooftops, hills and mountains can be used as tower which will be inexpensive base for these antenna. It does not require any cable connection, it may access more numbers of channels and high frequency/short wavelength signals require small size antenna.

MINI-LINK is the optimized form of microwave radio relay, which provides transport technology flexibility and advanced integrated traffic handling solution. Due to reduce in size, provide everything from cost-effective single hops to complete, managed microwave networks supporting fixed and mobile broadband. Mini-link also reduces the need for redundant links and on-hand spare parts, while cutting overall support costs. It also include advanced fault management system, which allows the entire transmission network to be managed from a single screen, in that way it further cutting installation cost of the system.

1.1 Problem Statement:
Frequent fault occurs, due to development work on the site, non-feasible area for Optical Fiber Cable laying and high cost of wired network etc.
Due to huge and growing network large manpower and vehicles are required for operation and maintenance (O&M) work as well as continuous monitoring is required.
In the absence of central monitoring system, fault of any down node will be rectify by going that site only. In this way fault rectification time delayed badly and network Key Performance Indicator (KPI) gets degraded.

1.2 Objectives:
Specific objective: - The aim of this paper is to modify an existing mini link network in such a way that all operation and support maintenance work can be done from a central location without purchasing any software. In the modification process no node get down (outage window is null).
General objective: - The second objective of this paper is to optimization of mini link network by changing some essential tools like installation points planning technique, database of network etc. by making all these changes equipment may be utilized 100%.

2. EXPERIMENTAL WORK:
2.1 Case Study of one Cluster having one Hub site:
Objective of this paper will be explained via a case study of cluster hub of Modinagr as shown in figure 1. In this Modinagr mini link network used as hub point and there are 10 other mini link sites which is connected by hub point. From the figure 1 it can be observed that, for one point to point mini link connection require two IDUs. So in this way 20 IDUs are involved in the below network. To handle such cluster at least one man power is required at each location. In real time for O&M work of this network, minimum 11 persons should be stationed at all location equipped with necessary tools and testers. In another way 2 persons and one vehicle stationed at cluster hub but by this method time consumption will be more. By the both method O&M work of the network consume more time and more manpower which is not going to be feasible. Objective of this paper is to reduce such type of complexity which will be explained step by step in this paper.

In real time network scenario, a single cluster contain 4 to 5 such type of hub networks. As mentioned earlier that aim is to design mini link network in such a way so that manpower, vehicle requirement and down time may be decreased without purchasing any costly software and most important without down time of any node while implementing this design. By implementing this design, able to access all 20 IDUs from a centralized position. For this LAN Cables from 0.5 m to 3.0 m required.
Figure 1 Cluster of Modinagar’s GSM Equipment connectivity

Figure 2 IDUs at Hub Location
Images of different location of hub is shown in figure 2 where so many IDUs are installed, for every site status login is required in each and every IDU. Detail description of single IDU is described in figure 3.

![Figure 3 Image of one IDU](image)

**LCT:** Local Craft Terminal is a useful port for the installation and maintenance. This port supports remote connection.
- Type: 10/100 Base-TX/ RJ-45
- Port number and interface: 1

**NMS:** This port is used to connect with the NMS server through the network.
Type: 10/100 Base-TX/ RJ-45
Port number and interface: 1

As shown in figure 4, login by using LCT then Setup IP address, Subnet Mask and Default Gateway as per given plan and check “connect NMS port to NMS” to YES for root NE which is connected with central location.

![Figure 4 Login Page of IP address](image)

Table 1 shows the hub location and default gateway IP address. In the case study, as we have assumed 10 IDUs at hub location, for all 10 IDUs IP Address and Default Gateway plan setup are required.
Table 1 Hub Location IDU IP Address with default Gateway

| S. No. | Hub Location IDU IP Address | Default Gateway |
|-------|-----------------------------|-----------------|
| 1     | 10.1.1.1                    | 10.1.1.2        |
| 2     | 10.1.1.3                    | 10.1.1.4        |
| 3     | 10.1.1.5                    | 10.1.1.6        |
| 4     | 10.1.1.7                    | 10.1.1.8        |
| 5     | 10.1.1.9                    | 10.1.1.10       |
| 6     | 10.1.1.11                   | 10.1.1.12       |
| 7     | 10.1.1.13                   | 10.1.1.14       |
| 8     | 10.1.1.15                   | 10.1.1.16       |
| 9     | 10.1.1.17                   | 10.1.1.18       |
| 10    | 10.1.1.19                   | 10.1.1.20       |

Figure 5  Set NMS Port
By making all these changes, NE port and NMS of IDU will enable as shown in figure 5, 6 and 7. After Login, all IDUs have to be configured as per IP plan as described in Table 1. 

Now Connect LAN cables NE port of IDU-1 to NMS Port of IDU-2,  
NE port of IDU-2 to NMS Port of IDU-3,  
NE port of IDU-3 to NMS Port of IDU-4,  
up to number of IDUs available at hub location as shown in figure 8.
After all these setting, now one hub location created, by logging in IDU-1 at NMS port then ping/open all IDUs connected to IDU-1 and all Far Ends of each IDUs installed at same location. In this way only one FE port 2MB is required between hub location and centralized location. If any network contains five hub location then five FE ports are required from each hub location to centralized location. At centralized all FE ports have to be clubbed by using simple switch and then connect to one PC. From this PC to all IDUs (Far End & near End both) can be ping or open. In other way, a batch file can be made to ping all IDUs. In every 2-3 Minutes intervals this batch file can execute. After successful implementation at each site this can be mapped with Online BTS Monitoring System (OBMS) also.
3. SOME SMALL PARAMETERS WHICH ARE USUALLY LEFT WHICH DO NOT AFFECT SERVICES MUCH BUT THESE ARE HAVING THEIR IMPORTANCE.

3.1 Time & Date setting:-
- This step is very important for future troubleshooting, for taking history, performance
- Navigate to “Program Utility”.
- Choose “Date/Time Setting”.
- Click [Modify].
- Set the right Date, Time & Time Zone, then press [OK].
- Also, you can mark on display PC Time then press OK

3.2 Modulation selection and E1 creation: -
It has been observed at so many sites that modulation selection is not properly done, due to this reason low bandwidth is available and due to unnecessary E1s creation available bandwidth is getting wasted. Proper modulation should be selected and only required number of E1s should be created in spite of all 16E1s creation. Now days mostly sites are working on FE media so no need to create E1.
Ideally above modulation and channel spacing as per Figure 10 may be selected to get maximum bandwidth of IDU.

In case of error bandwidth may be decreased to reduce error level.

In case of so many hopes on one tower (as shown in Figure 12), interference level may increase and there will be much difficulty to tune any new link. This type of situation can be handled by using different type of ODU (after 2 High ODU third one should be Low ODU) by using combination of High-Low ODUs this problem will be solved.

Now days sharing of infra are being done, other operators are also using same equipment which are having common Login details. At so many sites it is found that some operator’s configuration have been changed by other operator. So it is recommended that every IDU’s login credentials should be changed.

### Table 2 Single/Dual Transmission Capacity

| Modulation | Mode 1 7 MHz | Mode 2 14 MHz | Mode 3 28 (27.5) MHz | Mode 4 56 (55) MHz |
|------------|--------------|---------------|----------------------|-------------------|
| QPSK       | 14/28        | 28/56         | 57/114               | 114/228           |
| 16 QAM     | 28/56        | 57/114        | 114/228              | 230/460           |
| 32 QAM     | 35/70        | 71/142        | 143/286              | 287/574           |
| 64 QAM     | 42/84        | 85/170        | 172/344              | 345/690           |
| 128 QAM    | 49/98        | 99/198        | 200/400              | 402/804           |
| 256 QAM    | -            | 114/228       | 229/458              | 460/920           |

### Figure 11 Setting of network

- Ideally above modulation and channel spacing as per Figure 10 may be selected to get maximum bandwidth of IDU.
- In case of error bandwidth may be decreased to reduce error level.
- In case of so many hopes on one tower (as shown in Figure 12), interference level may increase and there will be much difficulty to tune any new link. This type of situation can be handled by using different type of ODU (after 2 High ODU third one should be Low ODU) by using combination of High-Low ODUs this problem will be solved.
- Now days sharing of infra are being done, other operators are also using same equipment which are having common Login details. At so many sites it is found that some operator’s configuration have been changed by other operator. So it is recommended that every IDU’s login credentials should be changed.
Sometimes after logging this type IDU image appears as shown in figure 13, it does not mean that IDU is faulty. This type situation comes in case of protection switch is on accidentally /unknowingly.

Earthling of ODU should be done properly for good connection as shown in figure 14.
For short distance higher frequencies and for larger distance smaller frequencies should be allocated.

Normally field units don’t have Link budget, for field engineer some tools are necessary like Link Budget, Atoll, MapInfo, Google earth, Binoculars etc.

4. CONCLUSION
Optimization of network has been achieved as the network structure discussed in the case study of hub point which is created for Modi Nagar site. All the changes have been tested in Modi Nagar, Hapur, Murad Nagar, Garh and Loni Hub by ping/open all IDUs from centralized location Ghaziabad (U.P.). The IP Plan for accessing each IDUs must be carefully planned and implemented. And able to ping or open any IDU connected in our network from centralized location

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