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GIS Based Mapping of Optical Fiber Cable in a Part of ALWAR District, Rajasthan, India

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Abstract*: In digital era, internet is an essential component of human being. The population of Alwar district is using internet resources and technology in abundance. But in recent years, it experienced a huge development in technology that reached to dark zone. In this work, we have studied internet facility based on Gram Panchayat levels to spread fiber optical cable for its accessibility to daily users. We have identified fiber optical cable with fault detection based on joint activity of cable and splitter in order to map issues using GIS platform. The Fiber Fault Localization System (FFLS) operates on ensemble of algorithms that maps, extricates, correlate and localize the fault by utilizing geographic data with remote sensing images. Centralized fiber fault localization requires (Optical Time Domain Reflectometer) OTDR to be integrated at OLT. A particular OTDR is obligatory per OLT to provide all the PONs of an OLT.We can used mobile application to capture OLT, ONT, splitter,Joint,BJC,SJC line and other object for identifying actual position of asserts with physical check. In which test fiber line using PON OTDR from one OLT to other connected splitter and ONT in Gram Panchayat.

Index Terms: GIS, Fiber optical Cable, Optical Line Terminal, and Optical Network Terminal, Joint, FPOI, Splitter, and Route Indicator.

I. INTRODUCTION

Internet is one of the most valuable technological resources without which mankind cannot be able to communicate and connect with each other. Fiber cable is very well known and most important in providing internet in the region of Gram Panchayat. A Geo-Intelligence based FFLS is a system that locates the faults and observes the condition of optical fiber in the network. The FFLS detects and reports the faults in fiber in order to provide rectification near the beginning of fault. It facilitates the localization of fiber fault using spatial data and earth observation images in the system monitoring without disrupting the services. The motivation behind developing this system is to reduce operational charge and least downtime of network in optical fiber cable system.

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II. GIS INVENTORY FOR NETWORK DETERMINATION

In rural areas of India, the distance between two (Gram panchayat's) GPs (i.e. CPEs) are more than 2 kilometers. Due to poor road connectivity between two GPs, it is not possible to use Global Positioning System (GPS) logger to produce spatial database. It is also not possible to access those locations. The collection of spatial information, analysis and determination of Passive Optical Network (PON) of 2, 50,000 GPs is a foremost issue.

A. GIS DATA COLLECTION

Major requirements for a system to localize the faults over GIS platform are: x GPS logged PON port-wise point to point Optical Network Terminal to Optical Line Terminal (ONT to OLT) with connector and splitter information x Correct.

Geographic information of OLT, ONTs connected to OLT, all Fiber Point of Interconnect (FPOI) locations employed for connection to ONTs, splitter positions, Junction Boxes, Connectors, splices. It is possible to collect active element information i.e. OLTs, ONTs from OLT. While the passive element information i.e. fiber spools cannot be directly collected. For collecting this information a system based on extrapolation and a hypothesis subject to the verification of installed network is required.

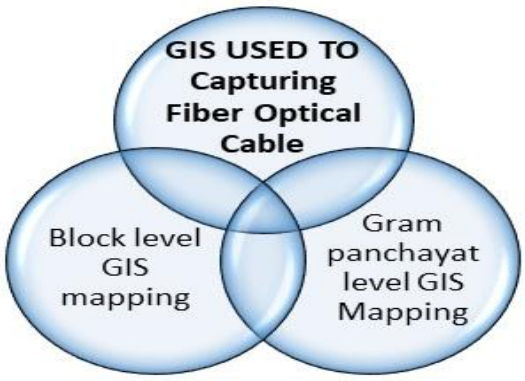

Fig-1 Fiber Optical cable cycle

B. GIS FAULT POSITION DETERMINATION STAGE

The optical distance was calculated and then correlated with its geographic location. A segment in GIS is a polyline (a set of latitude/ longitude information) which is actually multiline string.

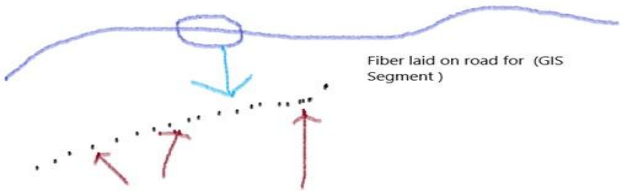

Fig-2 Fault localization in polyline (Source: Dalela, et al. 2015)

C. **OBJECTIVES:** The objectives of the present work are given as:

1. Participatory GIS Survey of Fiber Optical Distribution Area.
2. Generating locate the exact fault location of the OFC network area from surveyed results.
3. Preparation of Fiber capturing plan o Evacuation prioritization o Site suitability of OFC network system through Fiber Fault Locator System (FFLS) developed automatic or manual system etc.

III. STUDY AREA

Alwar District is situated in the north eastern part of Rajasthan, The study of Tijara Block of Alwar district of Rajasthan state lies geographically at a latitude 27.9337° N and longitude and 76.8531° E. The study of Tijara Block of Alwar district of Rajasthan state lies geographically at a latitude 27.9337° N and longitude and 76.8531° E. Tijara, Rajasthan, India elevation is 295 meters.

M/4 of scale factor 1:50,000 from Survey of India cover entire study area. Tijara block is the largest urban centre located between Delhi and Jaipur connected by national highway no. 8 and western railways. The block is near quadrilateral in shape. The Aravalli ranges are a conspicuous feature. The hills occupy a total areas of about 1554 sq. km. Tijara is a Tehsil / Block (CD) in the Alwar District of district code of Tijara block is 00496. Total area of Tijara is 701 km² including 631.69 km² rural area and 69.06 km² urban area. Tijara has a population of 3, 96,575 peoples. There are 72,272 houses in the sub-district. There are about 189 villages in Tijara block.

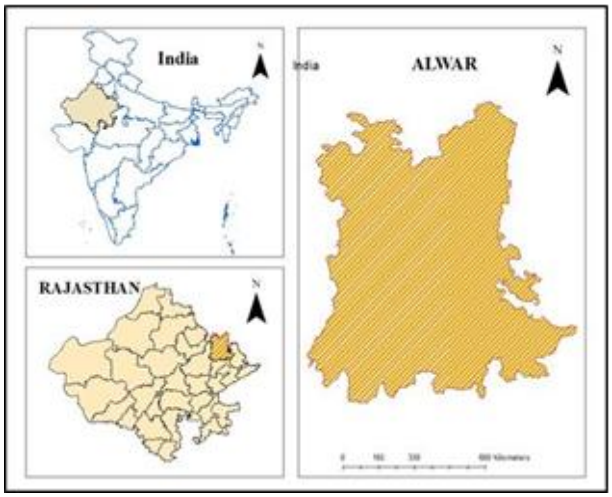

Fig-3 Study Area Map

A. STUDY RID (ROUTE INDEX DIAGRAM) AND MOBILE SURVEY DISCUSSION

Nodal Officer to assist and guideline for capturing Optical fiber network related work for Tijara Route Index Diagram (RID) are provided Annexure -Heengwara Panchayat boundary data captured using route index diagram with mobile application. Read route index diagram and install mobile application to capturing field.

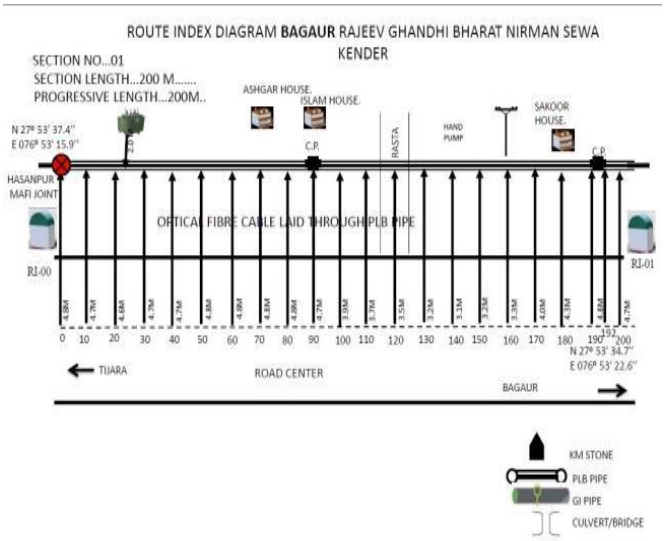

Fig 4 RID Diagram (Source BBNL 2018-19)

B. SATELLITE IMAGES

We can take Satellite image for Alwar District in block Tijara, in which satellite image to find out to area location wise OLT, ONT points and routes data. We can define different type of data to use identified in fiber optical cable distribution using satellite images to decide future scope for fiber laid work.

Fig 5 Satellite Image from Google earth for Study Area (source Google)

IV. METHODOLOGY

We used fiber optical cable and other assets capturing method with the help of existing geographical coordinates in terms of latitude and longitude of each location.

The mobile application specially designed and developed based on the SOW data model envisaged for OFC Network GIS Survey for this POC execution in order to capture the points as input data of OFC network various assets are described below that have process to handle step by step work in which capture data using mobile application and mobile data store on Geo server and we take data from database server then refine data and digitalization to it. Modify data save on server and create map for every assets to handle data visualization purpose.

Firstly we can click on login page and enter user id and password to capturing mobile data for this page valid user id and password enter and login then shows home page to successful login and then show list of asserts to show every assets. The deviation of distance was more than double of those of the other applications (60 meters). As is measurement was far from a straight-line running track. The deviations were massively high between the detachments and rise contrasts that are evaluated by the applications. While the different precision levels directly off the bat exhibit a quality situating of the separated applications this examination besides adds to the consistent learning base by qualifying the discoveries of past investigations in the field. Worldwide investigation results demonstrate that GPS conveys diverse outcomes on a similar gadget. The differences found in this work cannot be directly attributed to different GPS components used in the devices. Additionally, the differences found in positioning accuracy may be because of different location technologies used for individual device setting (WLAN versus a combination of WLAN, GPS, ID).

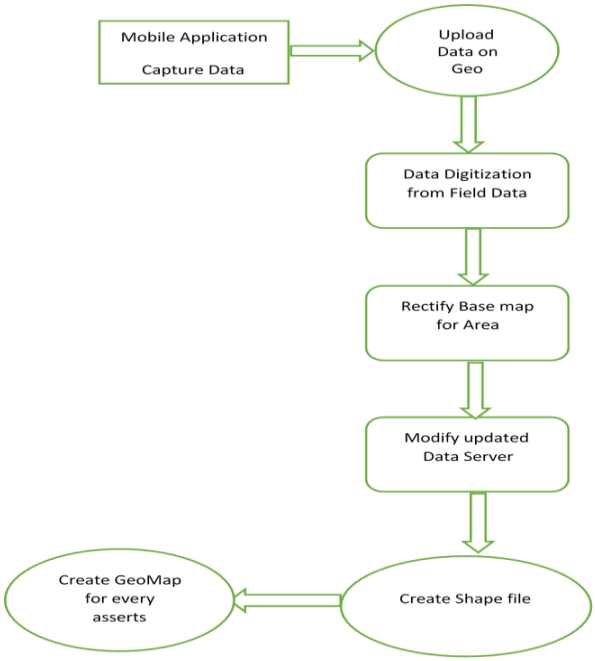

Fig 6 Flow Chart.

A. SURVEY FROM MOBILE APPLICATION

We can study data and assets for NOFN (National Optical Fiber Network).and capture all assets from field using mobile application. All data upload on server and see GPS location for all assets.

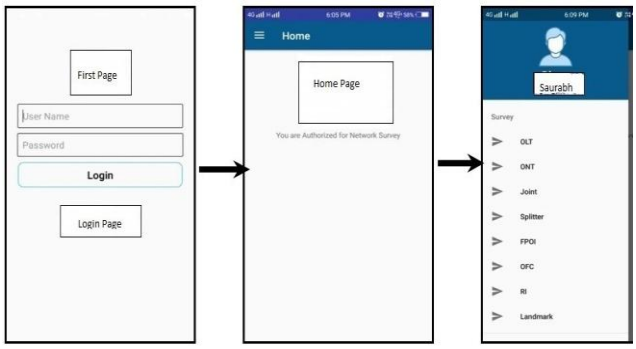

Fig 7 Mobile Application in Login pages (Source BBNL 2018-19)

V. RESULTS AND DISCUSSION

OFC network once developed and published will remain same as it is geo-referenced in any format of GIS platform. Developed once in Digital Format for record and archival purpose of Area of Interest (AOI).we can used to identified area in which have to capture data and see output data and find out different types of information from field in it.

A. OUTPUT DATA ON VECTORIZED MAP & SATELLITE IMAGE

The output of OFC network along with attributes data captured during the field survey now integrated on Vectorized 1: 1000 Scale land base map. Sample Gram Panchayat (GP) Heengwara OFC Total Route shown in Figures are integrated and superimposed on both Google Satellite Image and Vectorized Land base Map mentioned below. This is in order to. Demonstrate the difference and prove over observations and recommendations as discussed in detail.

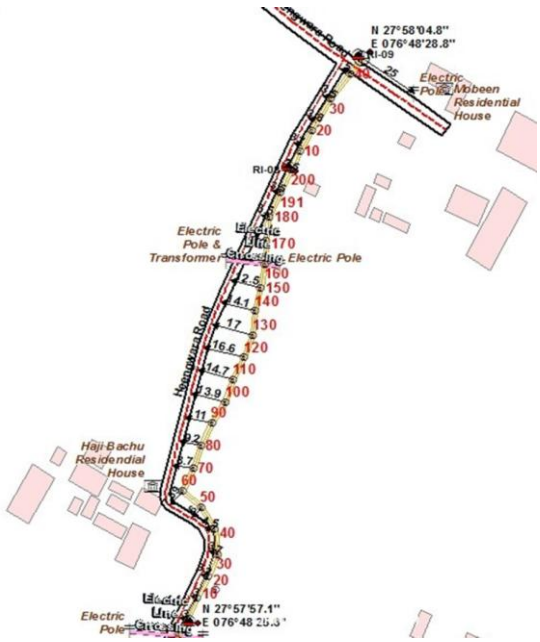

Fig 8 Heengwara GP OFC Route on Vectorized Land base Map without Satellite Image (Source BBNL 2018-19, Google)

Fig 9 Heengwara GP OFC Route on Google Satellite Image (Source BBNL 2018-19, Google)

We can test for fiber fault in which tow point firstly we identified route point.

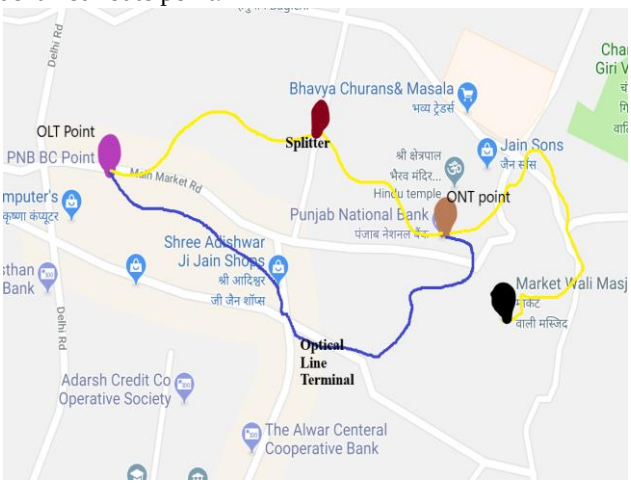

Fig 10 Mapping with route of asserts (Source Google)

Fig 11 Mapping and Correlation of Logical over GIS (Source: Dalela, et al. 2015)

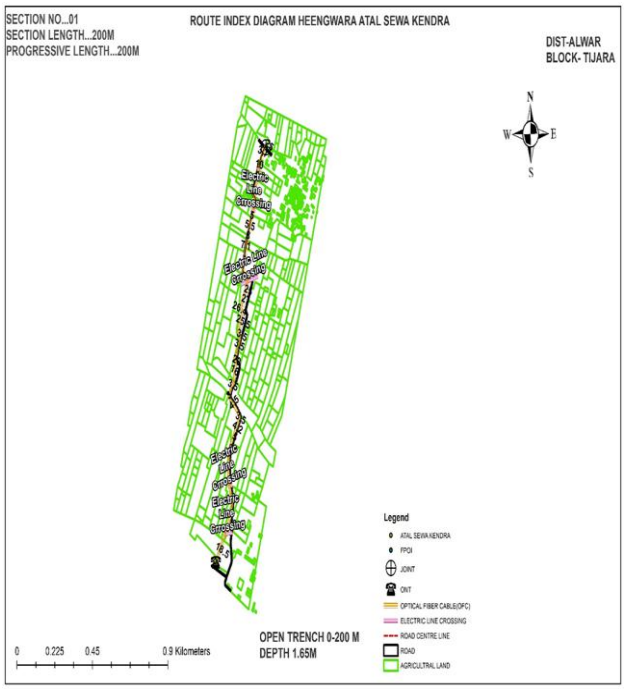

Fig 12 Heengwara GP OFC Route on Vectorized Land base Map

VI. CONCLUSION AND FUTURE SCOPE

In the case of Tijara Block field survey – This comes under the scenario where the As Build Diagram (ABD) / Route Index Diagram (RID) was provided by the BSNL. During the field survey, GIS survey team came across various challenges with respect to the RID, These are the following

- Time Lapped (Waiting for want of Resources).
- Lack of Ownership (Due to Negligible or No Information about the subject matter).
- Delay in Record Collection from Office and its Verification about OFC assets attributes.

In the wake of executing the POC according to the rules of BSNL on the suggestions of BBNL, with respect to the GIS Technical Scope of Work (SOW) for the BharatNet venture. Following focuses requests URGENT consideration as for a definitive goal of OFC organize Operation and Maintenance in future in these rustic towns where OFC arrange was set somewhere around the open digging technique and the authentic records are kept up by BSNL. It raises enormous difficulties whether the GIS Mapping done under current SOW of GIS might be useful/Not for Fault Tracing the careful area with the assistance of GIS Map at present situation for example Fiber Fault Locator System (FFLS) created by C-DOT. In our down to earth perception following is the result of the subject POC. These are as per the following:-

VECTORIZED LAND BASE MAP (SCALE 1: 1000)

The OFC Network Connecting Block HQ/Atal Seva Kendra to Gram Panchayat (GP) in the rural area to be developed on basic GIS objects POINT, LINE and POLYGON where, all OFC assets attributes can be stored in spatial dataset instead of point object only as in the current practice under this project.

The importance of Vectorized Land base map with different OFC Assets Layers is must for such a business critical application as demonstrated and highlighted above instead of Google satellite Image. Fundamental GIS Objects such as Point, Line and Polygon should be judicially used in Data model for designing the GIS application.

EXACT LOCATION OF OFC FAULT LOCATION THROUGH GIS DIGITAL MAP

The lat-long taken as Point object only and its publishing on Google Satellite Imagery may not serve the objective. The objective of exact location from GIS Vectorized Land base ap is possible only by proper lat-long taking methodology from Google Map through Mobile Application survey with respect to Reference of Topographical Land base features marked during proper GIS field survey enabling to developing OFC Network as highlighted during POC Mentioned above. This entire project demands dedicated Enterprise Level GIS Business Application with RDBMS databases such as MySQL database for proper business reporting and dashboard.

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