GEO-INFORMATICS AND INFRASTRUCTURE MANAGEMENT FOR TELECOMMUNICATION UTILITIES

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Abstract:

Effective Planning is the most important factor for Utility project execution. Integrated Telecommunication utility maps combine with Geospatial Technology and Satellite Data provide a better view for the expansion and development of telecomm infrastructure within and between cities. Information on each cable segment and facilities path can be linked and highlighted using state of the art GIS technology on a digital intelligent map. This research paper discusses the methodology for collection and analysis of Out Side Plant (OSP) utilities data, for better field scenario analysis using Esri- ArcGIS Applications.

Keywords: GIS, Telecommunications Utilities Like: Manhole, Handhole, BTS etc.

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Introduction

Now a day's telecommunications system is the backbone of the country and emerging area of interest for government and private sectors. Planning and management of telecommunications utility is the most important factor for Telecommunications Infrastructure Management services. The Geographic Information System (GIS) with Integration of Differential Global Positioning System (DGPS) have extensive application to resolve various problems and optimization of efforts for planning of telecommunications utilities. The DGPS field surveys are versatile extension of traditional information and capable in providing accurate and efficient GIS data that is useful for planning and preservation of cumbersome data for future reference.

The various GIS Based techniques were identified and much more benefited for planning and management purposes that are as follows:

(i) Establishment of paper less system, Management and preservation of all valuable data and information

(ii) Promotion and Improvement of Business Process

(iii) Proper utilization of telecomm network for various purposes like; residential, commercial, industrial, institutional, recreation, transportation, agricultural & allied etc.

(iv) Online Monitoring to avid delay to get consumer and telecom asset utility information and calculation of its impact

(v) Easy to identify resources for restoration of fault at take place

(vi) Easy to build, promote and develop the guidelines and standards

(vii) To trace the Cable routes

(viii) Identify the attribute table for utility

(ix) Planning of new Towers (BTS), Handhole (HH), Manhole (MH) etc. locations on digital intelligent map

(x) Integrated network and Landbase data gives power to the planer to analyze and solve the field related problems remotely.

(xi) Monitor and manage assets over the long term etc.

The continuous research work is being carried out worldwide to address the issue of Telecomm Planning and Management using GIS Technology. Geographic information system (GIS) is an interdisciplinary of Computer Science, Geography, Surveying and Mapping, Cartography etc. And the development and application of GIS technology is the most striking technology in the past few decades [Bo Xiaoyinga et al]. Active database systems are primarily database management systems with the main task of storing large amounts of data and providing efficient access through a query language [Leonid Stoimenov et al]. GIS have been used extensively for facilities management (FM) in the public sector and private sector as well [Lotfy Azaz]. GIS data are now being used in a variety of planning and design systems, including those used for utilities, government processes and telecommunications. Telecom operators are now under the strain of increased competition and need an edge in order to attract customers and reduce expenses. While traditional network planning has relied on quite primitive techniques, GIS data allows the

streamlining of network design, as well as the ability to visually assess connection paths and solve complex connectivity problems [Dimitris Mavrakis et al].

The Out Side Plant (OSP) utilities mainly consist of BTS/Tower, Fiber, Manhole, Hand hole, Telecomm Poles etc. and considered for the present study. The research work done at MANIT Bhopal and indicates that mapping of telecommunications utilities and maintenance of geo-database must be a part of regular practice for the optimization of resource and planning for the telecommunications sector. We investigated and identified the physical locations, fiber utilization, trenching & ducting scope for the new customer site using up to date digital intelligent map. It is very helpful method to identify the Bill of Material for new customers.

Research Objective:

The main objective of the study is to create and maintain geo-database for the better planning and decision support of the telecommunications utility. The above objective was accomplished in the following steps:

(i) Identification of AOI
(ii) DGPS Survey for telecom utility
(iii) Creation of Geo-database
(iv) Attachment of the non Spatial information
(v) Integration of Spatial and Non Spatial Data
(vi) Preparation of composite plan for the planner to derive his action plan.

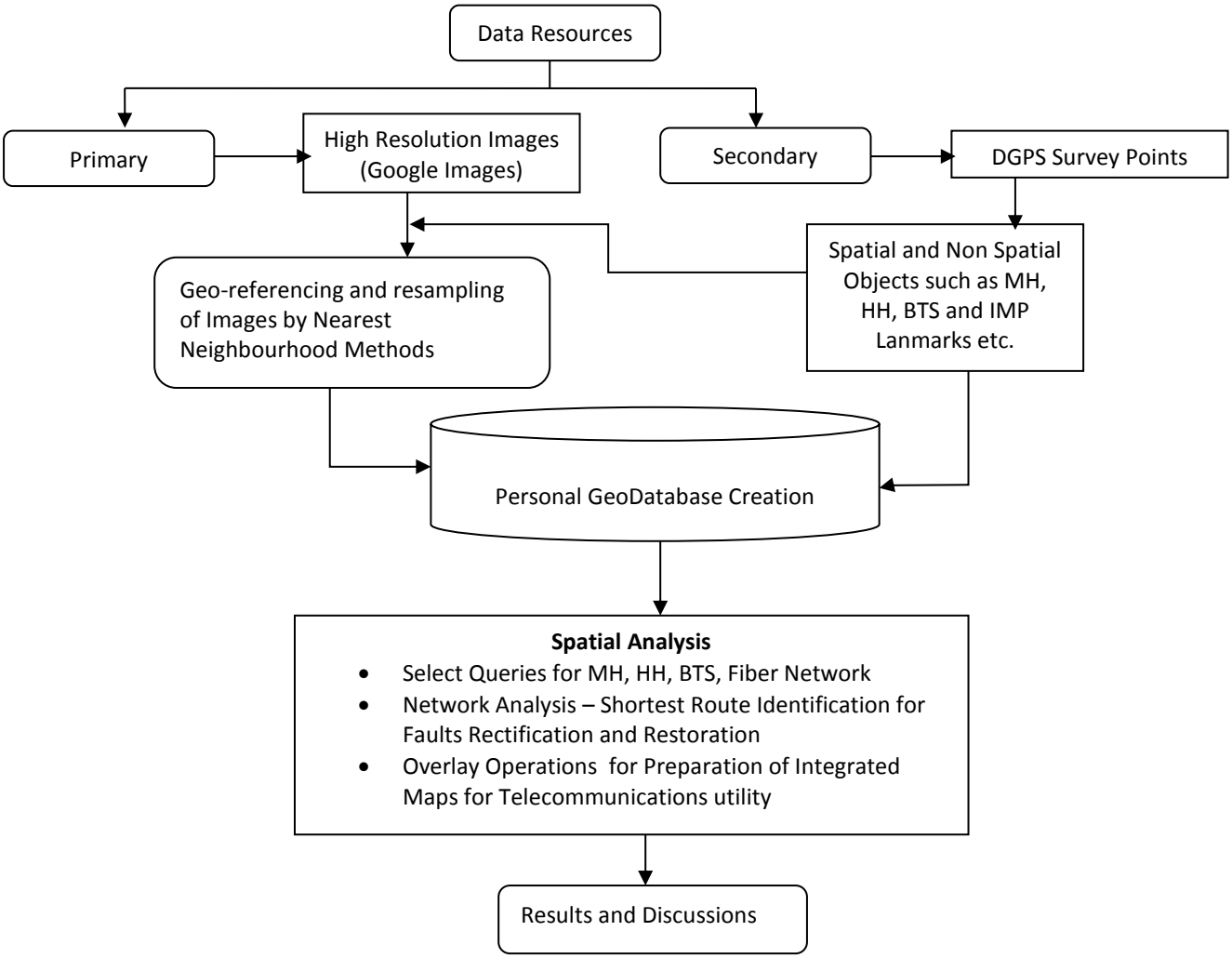
Study area and Data Resources:

The study area situated by the side of Malwa Plateau in the Northern –Eastern Part of state, Bhopal is the capital city of Madhya Pradesh. The geographical location of AOI (Area of Interest) lies within central part of Bhopal city and bounded by Longitudes 77.39 to 77.41 and Latitudes 23.21 to 23.22. The study area is most popular and adjacent to MANIT having many telecomm assets for maintenance like; Manhole, Handhole, Towers, OFC Cables, Telecom Poles, etc within the study area.

The GIS software was utilized in this research is ArcGIS-9.3, that provides data visualisation, Image Enhancement, Geometric Network Analysis, Spatial and non Spatial query and analysis capabilities with powerful data creation and editing environment. The high frequency DGPS equipment was used for collection of latitude and longitude information of Telecom poles, Manhole, Handhole, Tower Locations, OFC Cable Route Marking, Important Landmarks etc. of covering entire research area. The Google Earth Images were utilized to extract various layers of Research Area for Creation of Geometric Network along with Land Base Features for Telecomm Utility Mapping. The collected data represented in Table-1, Table-2 and Table -3 respectively against Latitude and Longitude information of Fiber Network, Tower/BTS and Handhole sites.

Methodology:

An Assessment Phase we were analyzed the requirements, solutions, goals, objectives and benefits for development of Geo Informatics Telecomm Information System. It is provided the baseline description and directions to the planners. The Secondary data like: Tower, Electric/Telecomm Pole, Fiber Route, Manhole, Handhole etc. has been collected from Bhopal Municipal Corporation. The collected Data has been verified and captured, while doing detailed DGPS Survey of an AOI. The field data or surveyed data imported into the GIS Environment using ESRI ArcGIS 9.3, software. The symbology of maps and various attributes considered for the preparation of maps. The various layers like Road with lanes, Settlements, Electric/Telecomm Poles, Residential, Commercial, Public, Private, government land marks are marked on the map for the preparation of land base map. The location of cables, MH, HH, BTS sites, are marked while preparation of Telecomm utility map for the study area. The google earth images are utilized for the preparation of maps. Final Output created after the integration of Spatial and Non Spatial database. A Schematic representation of the methodology is shown in the flow chart.



Results and Discussion

The following result has been derived from the data which was collected from the field using Geo Informatics technology.

(i) Overlay Operations:

- The Overlay Operations were carried out to superimpose various layers like Tower, MH, HH, HT, LT, Telecom/Electric Pole, Transformers, Road, Fiber Network and Landmarks etc. The result of the overlay operation is shown in fig. 1.

(ii) Route Identification and Optimal Path Findings:

- The Route Identification and Optimal Path Finding services are enough capable to overcome or restore the telecom failure situations rapidly. Any fault occurs at any place and customer lodged the complaints, than repairmen can see and observe the scenario in advance. He can verify consumer details and confirm connectivity from BTS/MH/HH etc. The Repairmen can identify optimal route based on different situations from its current position for failure sites or locations shown in fig.1.

(iii) Spatial Query:

- Spatial Queries were generated to get all the information about the Telecomm Utilities Like; BTS, MH, HH, Fiber Network and Details of Fiber etc. and queried for Fiber Network, where the feature intersects the HH or MH and software highlighted in Query Window. The results were displayed in ArcGIS window.

(iv) Planning:

- The dummy customer we planed and identified the location on map. The proposed customer is 182.6 Meters away and planner can release plan for connectivity from Aaradhana BTS, shown in fig. 2.
- The Blowing & Ducting scope has also finalized for customers from Aaradhana BTS (200 Meters Approximately including 20 Meter Loop Length at customer end).
- Length of OFC measured from Tower Location and Looping points HH/MH considered for the generation of planning Maps for new customer.
- Proposed plan can be issued for new customer connectivity to construction team for the construction of new fiber Route.

(v) Management:

- All the spatial and non spatial data stored into the Geodatabase for further reference. This data is enough capable to Import in Other Software's and ESRI Suite of Software's for analysis purposes.

(vi) Field and Terrain Information:

- Land base map prepared using Google Earth Images and Surveyed Data using ArcGIS Software for the development of the digital intelligent maps. We were able to see all the details like, Trees, Landmarks, Roads, Buildings etc, for planning of Telecomm Facilities.

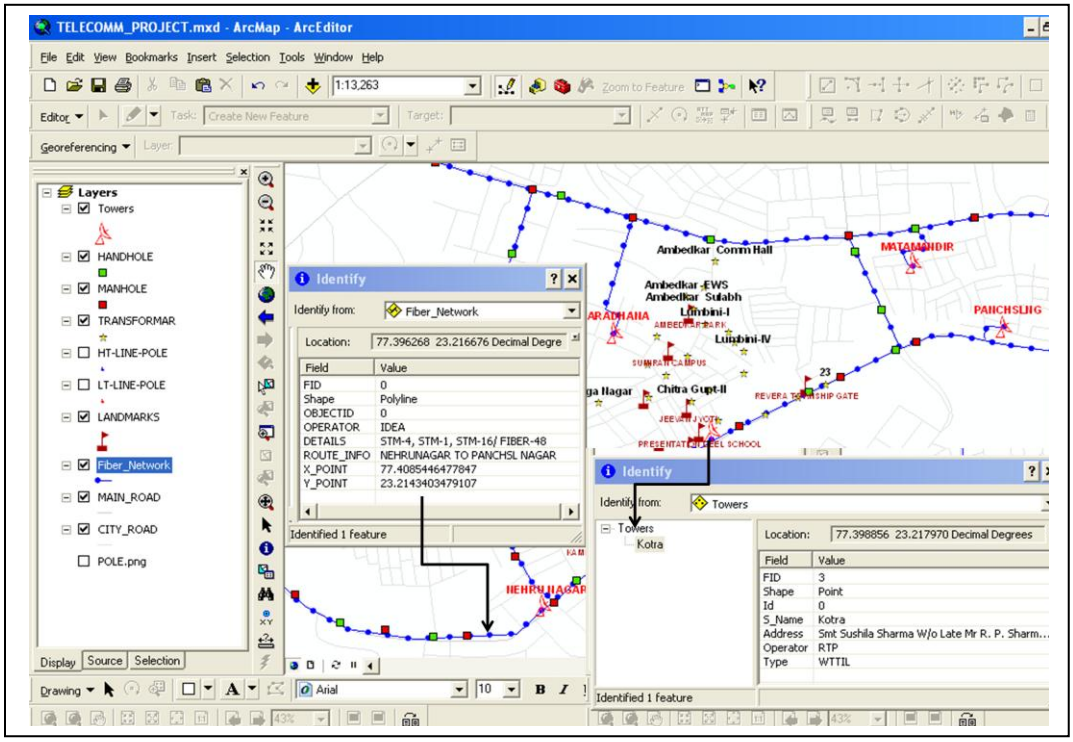


Fig:1 – Fiber Network and Tower Location

(Attribute Information of Fiber_Network and Tower Location)

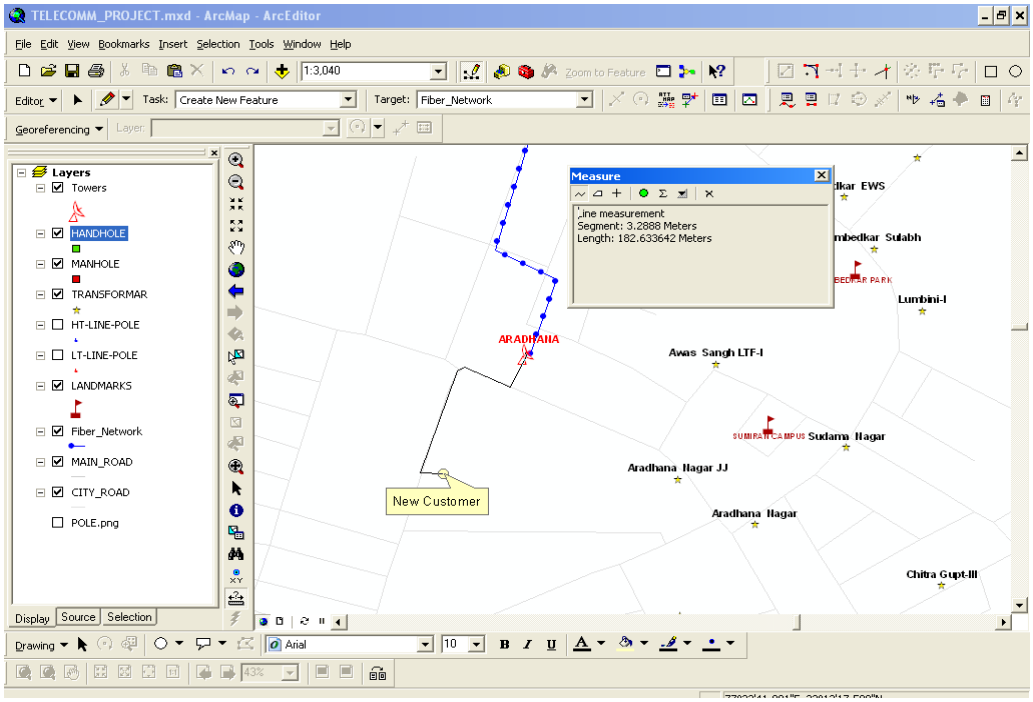


Fig:2 – Fiber Network and Customer Connectivity Planning

(Proposed Customer Connectivity Plan)

Table 1 : The Fiber Laying Details of AOI

SINO	LAT	LONG
	X_POINT	Y_POINT
1	77.4085446477847	23.2143403479107
2	77.4086075438133	23.2204727107028
3	77.4037959976226	23.2295611868408
4	77.3925061604822	23.2130824273379
5	77.4022550449209	23.2250326727789
6	77.4042520602442	23.224850045643
7	77.4070607884858	23.2213785837714
8	77.395005348168	23.2252287505745

Table 2: The Handhole Details of AOI

SINO	LAT	LONG
1	23° 12' 49.580" N	77° 23' 37.980" E
2	23° 12' 56.013" N	77° 23' 43.360" E
3	23° 13' 2.212" N	77° 23' 47.921" E
4	23° 13' 10.984" N	77° 24' 3.710" E
5	23° 13' 15.740" N	77° 24' 13.326" E
6	23° 13' 20.224" N	77° 24' 11.781" E
7	23° 13' 26.890" N	77° 24' 8.857" E
8	23° 13' 29.463" N	77° 24' 15.523" E
9	23° 13' 28.193" N	77° 23' 52.834" E
10	23° 13' 33.206" N	77° 23' 36.225" E
11	23° 13' 26.608" N	77° 23' 30.758" E
12	23° 13' 14.607" N	77° 23' 26.682" E
13	23° 13' 1.814" N	77° 23' 26.003" E
14	23° 12' 43.265" N	77° 23' 22.073" E
15	23° 12' 44.785" N	77° 23' 11.664" E
16	23° 12' 51.625" N	77° 23' 2.455" E

Table 3: The Tower Details of AOI

SINO	S_Name	Address	Operator	LAT(N)	LONG (E)
1	MATAMANDIR	LIG 31,Harshwardhan Nagar Infront of Saraswati Vidya Pratishtihan	Airtel /Idea	23° 13' 25.680"	77° 24' 15.840"
2	PANCHSLNG	House Number 23/1, Panchslnagar Bhopal	Reliance	23° 13' 18.480"	77° 24' 25.920"
3	ARADHANA	C/O SHRI UTTAM SAXENA, 186, ARADHANA NAGAR, KOTRA , BHOPAL	Airtel / Vodaforne	23° 13' 17.760"	77° 23' 42.720"
4	KOTRA	Smt Sushila Sharma W/o Late Mr R. P. Sharma ,7 Chitragupta Nagar Kotra Bhopal . Ph No 0755 2766581	WTTIL	23° 13' 6.636"	77° 23' 53.506"
5	VAISHALINAGAR	Plot-75,At Police Co-OpHousing Society,KotraSultanabad,Khasara-159-160	Airtel	23° 12' 55.692"	77° 23' 49.992"
6	NEHRU NAGAR	Jain tower, Nahru Nagar square, nehru nagar ,Bhopal	Idea	23° 12' 46.800"	77° 23' 34.800"

Conclusion:

Till the near past, telecomm Planners have handled networks related data by large-formats manually, drafted on paper drawings. Now GIS represents the specialized information system dedicated to the storing, retrieval, analysis, processing and visualization of geocoded (i.e. referenced to geographic coordinates) information. Management of the telecommunication cable network including MH, HH and BTS using GIS technology, with great performance and qualitative improvements and benefits in all management activities have been clearly presented and well established. This paper is dedicated to Geo data base development activities to support all creation activities needed for telecommunication network planning, design, construction and implementation.

This research is a reference study could be treated as a unified framework for telecomm facility management and makes provision for services in today's complex telecom environment.

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