Selection of the Most Suitable Locations for Telecommunication Services in Khartoum

BY

Amir Abdelrazig Merghani (ID:g201004180)

and

Faisal Mukhtar (ID: g200901510)

INSTRUCTOR:

Dr. BAQER M.AL-RAMADAN

May 15, 2012
Contents

Abstract ..................................................................................................................................... 4

1. Introduction ........................................................................................................................... 4

2. Background .......................................................................................................................... 6
   2.1 Geographic Information System (GIS) ............................................................................. 7
   2.2. Layers concept in GIS ...................................................................................................... 7
   2.3. Source of geographic information .................................................................................. 7
   2.4. GIS components and functional elements ..................................................................... 7
   2.5 Geo-processing ............................................................................................................... 8
   2.6. The Improvement of GIS ................................................................................................ 8

3. Importance of GIS in the field of communications ............................................................... 9

4. Case Study ............................................................................................................................. 9

5. Analysis and processing of information: - ........................................................................... 10
   1-Switches ........................................................................................................................... 11
   2-Columns ........................................................................................................................... 11
   3-Towers .............................................................................................................................. 11
   4- Cables .............................................................................................................................. 12
   5-Streets .................................................................................................................................. 12
   6- Blocks ................................................................................................................................ 13
   7- Buildings .......................................................................................................................... 13

8. Scheme of the system ........................................................................................................... 13

9. Schemes for some queries .................................................................................................... 17

Results ..................................................................................................................................... 19

Conclusion: - ............................................................................................................................ 20

Suggestion for Future Work .................................................................................................... 20

Reference:................................................................................................................................ 21
# Table of Figures

Figure 1: Typical overall work flow that is integrated into by Telecommunications companies. .......................................................... 5

Figure 2: Typical window of a GIS software of a company in which call center operators can access all the information on a customer and the associated network based on location. 5

Figure 3: Attribute table for switches ........................................................................ 11

Figure 4: Attribute table for the columns ................................................................ 11

Figure 5: Attribute table for towers ........................................................................ 11

Figure 6: Attribute table for Cables ........................................................................ 12

Figure 7: Attribute table for streets ....................................................................... 12

Figure 8: Attribute table for blocks ........................................................................ 13

Figure 9: Attribute table for buildings/parcels ....................................................... 13

Figure 10: Schematic Diagram of the Communication System ............................... 14

Figure 11: Atlas showing the African Continent ..................................................... 15

Figure 12: Map showing the Sudan Country ............................................................ 15

Figure 13: Map showing the capital city of Sudan (Khartoum) ............................... 16

Figure 14: Closer view of parcel’s arrangement of the study area ......................... 17

Figure 15: Distribution of towers ......................................................................... 17

Figure 16: Distribution of towers’ coverage area ..................................................... 18

Figure 17: Work plan showing the distribution of the switches ............................. 18

Figure 18: Distribution of Columns: ................................................................. 19
Abstract

This project summarizes the applications of Geographic Information Systems (GIS) in the telecommunication sector. The study area is located in the South-eastern part of Khartoum City at AL-Maamora District. The main objectives of the study are to find the suitable locations for telecommunication services for the study area and design suitable plan for towers spacing. For this purpose, information about the study area was collected for the following items: 1) major towers length and offset 2) minor towers and their associated cable length. 3) streets 4) switches 5) building distribution, and 6) customer services. The resulting buffer suggested that the major towers should be ranged from 200 to 400 m apart depending on the geography of the area. One tower is expected to cover an area of approximately about 1000 m$^2$. The connected cables between towers and switches are of different length and size depending on the area of connection. This study highlights the importance of using GIS in telecommunication industry. It indicated that GIS may provide best location selection not for telecommunication services only, but also for other services needed in residential areas.

1. Introduction

To be competitive, telecommunications providers depend on a smoothly functioning work flow process that integrates information for marketing, demand forecasting, engineering, customer management, operations support, and fleet management. Although telecommunications providers generally have the same needs for information, how the work flow is organized can vary significantly from company to company.
In today's competitive telecommunications market, customer service is the number one differentiator for companies. Customer relationship management (CRM) applications improve the relationship between the company and its customers. Timely service provisioning, response to customer queries, and reporting on network performance are aspects of CRM. With GIS, call center operators can access all the information on a customer and the associated network based on location. Databases containing information on outside plant infrastructure, signal quality, and equipment can be integrated using GIS and made available using a corporate Intranet.
Wireline Engineering

Wireline engineering systems are GIS applications that work with the design and geographic layout of a company's outside plant infrastructure. Engineering applications allow for quick review and modeling of network routes, automation of the work order process, and high volume cartographic output to support technicians in the field.

For many residents in developing cities, informal settlements are the sole avenue of access to shelter and basic services, however poor in quality. The need to improve the living conditions in such areas is once again receiving high priority on the international and national development agendas. Current approaches to settlement upgrading favor the adoption of community-based, participatory styles of planning and management. Upgrading inevitably also requires the use, in cooperation with local residents, of more traditional planning and design methods which depend in part on the ability to analyze the physical setting of a given settlement and prepare appropriate solutions to specific problems.

The GIS systems are designed in the modern age and they provide and enormous help in the decision-making at higher levels. It can also be found in the planning of infrastructure of cities and telecommunications networks, electricity, water and other networks and the development plans.

2. Background

The study of the potential of geographic information systems in supporting the urban governance process compels us to carry out this study. In essence, the work comprises of two main topics. The first will be about the information systems and GIS, the
Improvement and Importance of GIS to Urban Development. Secondly, the application of GIS in communication in Sudan will be taken as a case study.

2.1 Geographic Information System (GIS)

“A system of hardware and software that supports the capture, management, manipulation, analysis, and display of geographic information.” (Al-Ramadan, 2005). Geographic information data basically consist of two data components, namely: (1) locational data that describe features with exact location, and (2) descriptive attributes that describe defined features. Geographic features could be manmade (e.g. buildings and roads) or natural (e.g. geological outcrops and rivers) (Al-Ramadan, 2005). In GIS an automated link between any given feature location and its descriptive attribute is established and maintained.

2.2. Layers concept in GIS

Geographic areas are consisting of many features. In GIS database, these features are represented as a number of related layers, where each feature is stored in a separate layer.

2.3. Source of geographic information

Generally remote sensing images such as aerial photographs and satellite images are the primary sources for spatial component of a GIS database.

2.4. GIS components and functional elements

GIS consist of four components and four functional elements. GIS components are: Software, Hardware, Database and Users. Functional elements are: Data input, Data Management, Data Manipulation and analysis, and Data Output.
2.5 Geo-processing

Geo-processing is the processing of geographic information, one of the basic functions of a geographic information system (GIS). It provides a way to create new information by applying an operation to existing data. Any alteration or information extraction performed on data involves a geo-processing task. It can be a task such as converting geographic data to a different format, or it can involve multiple tasks performed in sequence, such as those that clip, select, and then intersect datasets.

2.6. The Improvement of GIS

According to Steven (1998) GIS was originally developed as an environmental technology. Tomlinson (1998) coined the phrase geographic information system in the early 1960s when he led a project to map Canada’s natural resources. During the same decade, Edgar Harwood, a professor of civil engineering and planning at the University of Washington, wrote some of the earliest computer mapping software, founded the Urban and Regional Information Systems Association, and conducted a number of highly influential short courses and conferences (Chrisman, 1998, 2006, and Tomlinson, 1998). In the early 1990s, GIS began expanding into the business market, and as GIS became available on personal computers it became available for a much broader spectrum of business users (Castle, 1993). Industries with deep pockets and clear geospatial needs, such as public utilities, transportation companies, and logistics firms were early adopters.

GIS software was originally developed as a specialized, proprietary application, with its own arcane scripting and programming languages (e.g., the Arc/Info macro language, AML) which isolated it from mainstream information technology (IT). In
many local governments and universities, central IT departments focused on mainstream database management systems and office automation applications (e.g., word processing and spreadsheets) leaving those with geospatial needs to support their own applications. This severely limited the pool of potential GIS managers, developers, and programmers. However, in the last five years commercial GIS software has been moving toward more mainstream software development platforms

3. Importance of GIS in the field of communications

1- Identification of the actual need of telephone lines in any area.
2 -Helps in providing the information needed to make the right decisions such as determining the locations and cable paths of telecommunications networks, wireless and fiber optic and mobile communication towers sites.
3 - To facilitate maintenance operations through information provided by topographic maps.
4 -Helps in determining the intensity of use and areas of suffocation.
5 – Provides enough information to get rid of the problem of overlap with other service projects.
6 – Helps in organizing complaints and customer assistance

4. Case Study

Selection of the most suitable locations for telecommunication services and how to develop works and study the region.

1- Length of the Towers and the distance between them
2- Column cables
3- Cable or Microwaves
4- The streets
5- Switches
6- Customer information
7- Buildings
8- Sectors

5. Analysis and processing of information: -

1- Tower is the primary conduit for communication and ranges in height from 200 m to 400 m depending on the nature of the area covered by the tower and covers an area of 1000 m (1 km)
2- Poles are used to connect the wires to homes and have a typical height of about 6m
3 - Cable is the carrier of the signal between the towers and the switches and are of different sizes
4 - The streets
5 - Switches are the link between towers and poles using the cable
6 - Information for various customers such as customer name, phone number, etc. ..
7 - Building numbers and dimension
8 - Sectors contains a collection of buildings to be connected to the network

8. Explanation of components of the system tables and attributes: -
1-Switches

![Switches Attribute Table]

Figure 3: Attribute table for switches

2 - Columns

![Columns Attribute Table]

Figure 4: Attribute table for the columns

3-Towers

![Towers Attribute Table]

Figure 5: Attribute table for towers
4- Cables

Figure 6: Attribute table for Cables

5- Streets

Figure 7: Attribute table for streets
6- Blocks

![Figure 8: Attribute table for blocks](image)

7- Buildings

![Figure 9: Attribute table for buildings/parcels](image)

8. Scheme of the system

The system consists of *towers* which send signals to the *switches* by *cable*, which in turn send a signal to the *columns* by cables and is linked to *home phone lines* by *columns* through copper wires. A schematic diagram of the system is shown in Figure 10.
Figure 10: Schematic Diagram of the Communication System
Satellite image as background

Figure 11: Atlas showing the African Continent

Figure 12: Map showing the Sudan Country
Figure 13: Map showing the capital city of Sudan (Khartoum)
9. Schemes for some queries

Figure 11 is the plan that shows the buffer working and a query to know the development and distribution of the Towers, 500 meters from each other.
Figure 16: Distribution of towers’ coverage area

Figure 17: Work plan showing the distribution of the switches.
Results

At the end of this study and after the analysis of the result, the following points are arrived at.

1 - Locating towers in the area concerned was confirmed possible
2 – Knowing the distance between the towers
3 - Used to determine the scope of Buffering was the signal for the towers was also define the scope of the switches and houses needed to take from that signal .
4 - The implementation of a set of queries such as selection of sites of towers
5 - A total of 3 towers, 10 switches, and 152 cables of different lengths should be provided in the case study considered in this project.
6 - The project has resulted in reduction of labor and overtime costs that would have been needed to carry out the actual work on site.
Conclusion:

Upon establishment of the proposed system by geographic information systems and identification of all its components, a thorough analysis and processing such as building the following set of queries was achieved; distribution of, and the areas covered by the towers and switches as well as the distribution of cables/wires and poles. This study highlights the importance of using GIS in telecommunication industry. It can be concluded that GIS may provide best location selection not for telecommunication services only, but also for other services needed in residential areas.

Suggestion for Future Work

- Study to help in identifying which customers would be out of signal if a switch is opened.

- GIS may be used to provide best location for selection of not only telecommunication services, but also for other utilities needed in residential areas of Khartoum city.
Reference:


2- Richard Sliuzas; 2002; Opportunities for enhancing communication in settlement upgrading with geographic information technology-based support tools; Habitat International 27 (2003) 613–628

3- Ayman M. Nour ; 2011;The Potential of GIS Tools in Strategic Urban Planning Process; as an Approach for Sustainable Development in Egypt ; Journal of Sustainable Development