Web GIS

Introduction

Course Rationale

- To explore web GIS technology & its architectures
- To explore components involved in web GIS application development
- To explore web GIS application development tools and techniques
- To utilize different tools for making a comprehensive web GIS application/system, which provides powerful functionalities over the internet

Course Contents

- Background
- Basics of computer networks
- Web technology
- Fundamental architectures of web GIS
- HTML and HTML5
- Styling web pages using CSS
- Client and server side scripting
- Spatial database management system
- OGC web services
- Mapping/GIS servers
- Mapping applications
- Mobile GIS
- Cloud GIS
- Real-time GIS

Course Assessment

- Home assignments
- Class interaction
- Mid term exam
- Mini project
- Final term exam

Web GIS

Web + GIS

Web

- The Web or the World Wide Web (WWW, W3) is an information system of interlinked hypertext documents that are accessed via the Internet

- Individual document pages on the web are called web pages and are accessed with a software application running on the user's computer, commonly called a web browser

- Web pages may contain text, images, videos, and other multimedia components, as well as web navigation features consisting of hyperlinks

Geographical Information Systems (GIS)

- Is it a Digital Map?
- Is it a Database?
- Is it an Analysis Tool?

Geographical Information Systems (GIS)

- Everything that happens, happens some where
- Knowing "what" is "where", and "why" it is there is critically important for making decisions
- GIS is the technology as well as science for handling the "where" type of questions and for making intelligent decisions based on space and location

Geographical Information Systems (GIS)

GIS: A Formal Definition

- A system for capturing, storing, checking, Integrating, manipulating, analyzing and displaying data which are spatially referenced to the earth

- A powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world

GIS = Maps + Database

Geographical Information Systems (GIS)

Component of GIS

Input

- Data Acquisition
  - Remote Sensing
  - Field Sampling
- Analogue data conversion
  - Scan and Digitize

Management & Analytical Modules

- Management
  - Data storage
  - Data Retrieval
  - Query
- Analytical Modules
  - Data conversion
  - Data manipulation
  - Modeling

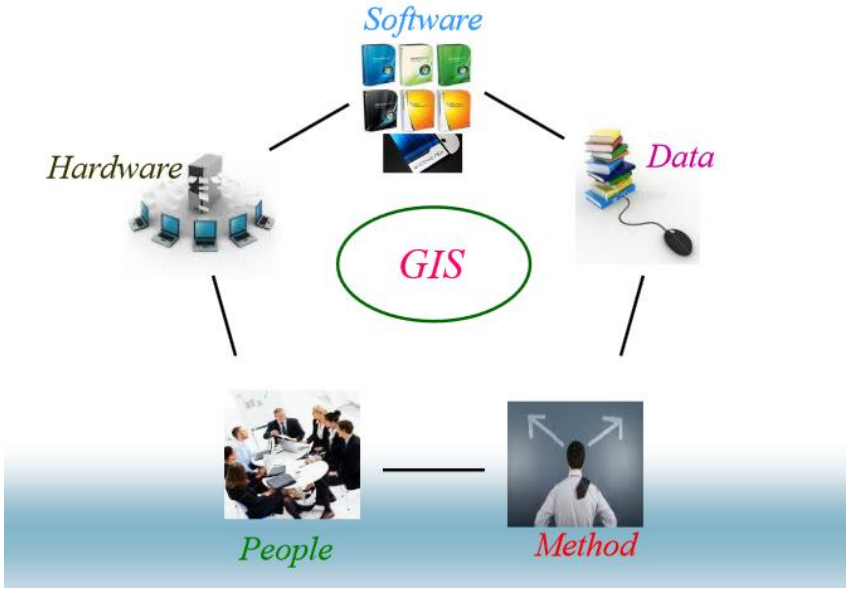
Output

- Output
  - Visual Presentation
  - Maps
  - Reports

Geographical Information Systems (GIS)

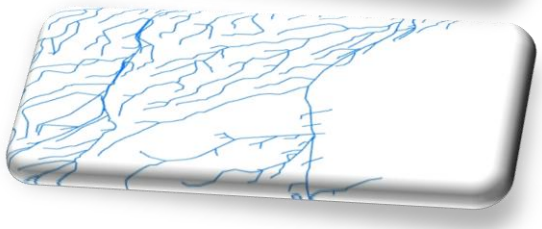
Elements of GIS

- A system of hardware, software, people, data, organization and institutional arrangements for collecting , storing, analyzing and disseminating information about the areas of the earth



Geographical Information Systems (GIS)

Outlets



Irrigation Network

Administrative Boundary

Real World

GIS abstracts the real world into data models consisting of multiple layers, where each layer represents a different theme of real world

Geographical Information Systems (GIS)

- GIS data represents real objects (such as roads, land use, elevation, trees, water ways, etc.) with digital data determining the mix

- Real objects can be divided into two abstractions: discrete objects (house, etc.) and continuous fields (rainfall amount, elevation, etc.)

- Two methods to store the data in GIS
  - Raster
  - Vector

Why GIS?

- Better maintenance of geospatial data in a standard format
- Revision and updating is made easier
- Information easier to search, analyse and represent
- Value added products can be generated
- Data can be shared and exchanged easily
- Better decision making

Why GIS?

Activity	GIS	Manual
Storage	Standard and integrated	Different standards and scales
Retrieval	Digital database	Paper maps, tables
Updating	Digital	Manual
Overlay	Systematically done	Expensive/time consuming
Query	Fast	Time consuming
Analysis	Fast	Inefficient
Display	Excellent/user friendly	Expensive and inflexible
Reporting	Digital	Cumbersome

The questions which GIS can answer

- What is the value of function z at position x?
- How large is B?
- How many occurrences of type A are there within distance D of B?
- Where is A in relation to B?
- What objects are next to objects having certain combination of attributes?

The questions which GIS can answer

- Location: What is present at points x1, x2, etc.?
- Trends: What has changed since ….?
- Proximity: What are the characteristics of an area surrounding a feature?
- Reclassify: Regroup objects having certain combination of attributes
- Networking: Which is the path of least cost or distance along the ground from X to Y?

GIS Applications

- Facility Management
  - Underground Cables
  - Telecommunication Network Services
  - Gas Pipelines
- Street Networking
  - Car Navigation
  - Ambulance and Emergency Services
- Planning and Engineering
  - Urban Planning
  - Regional Planning

GIS Applications

- Land Parcel Based Application
  - Taxation
  - Ownership Maintenance
  - Farming

- Environmental and Natural Resource Management
  - Agriculture
  - Forests
  - Disaster management
  - ……

Why Mapping on the Internet

- Potential of GIS is not fully realized in terms of data accessibility, integrity and collaboration among various departments

- Internet make it open for accessing
  - User can access data from anywhere

- Establishing a scheme to share and integrate geo-spatial information
  - Contribute to the society

Web GIS

What is Web GIS?

- Web GIS is a type of distributed information system. The simplest form of web GIS should have at least a server and the client (a web browser, a desktop application or a mobile application)

Web GIS

Web GIS Functions

- Web mapping (Visualization)
  - Common and important function of web GIS
- Query
  - Ask for information about features displayed on map
  - Point based queries on map data
- Collecting/Editing geospatial information
  - Allow down-to-top information flow
  - Crowd sourcing up-to-date information
- Dissemination of geospatial information
  - Wide distribution of information
  - Seamless: No need to know servers & to copy huge data sets
- Analysis
  - Provide customized analytical functions

Web GIS

Advantages of Web GIS

- Global accessibility
  - Web removes the constraint of distance
- A large number of users
  - Desktop GIS supports one user at a time, while web GIS supports dozens and hundreds of users simultaneously
- Better cross-platform capability
- Low cost as averages by number of users
  - Investment on server side implementation only
- Makes spatial data accessible to non-technical people
  - User friendly websites
- Unified update
  - Simplifies software and application code versioning and upgrades
- Diverse applications

Web GIS

Web GIS History

- 1989-90: Birth of the WWW
- 1993-07: Xerox PARC Map Viewer, The first mapserver based on CGI/Perl, allowed re-projection styling and definition of map extent
- 1994: The World Wide Earthquake Locator, the first interactive web mapping mashup was released, based on the Xerox PARC map view
- 1994-06: The National Atlas of Canada, The first version of the National Atlas of Canada was released. Can be regarded as the first online atlas
- 1995: The Gazetteer for Scotland, The prototype version of the Gazetteer for Scotland was released. The first geographical database with interactive mapping

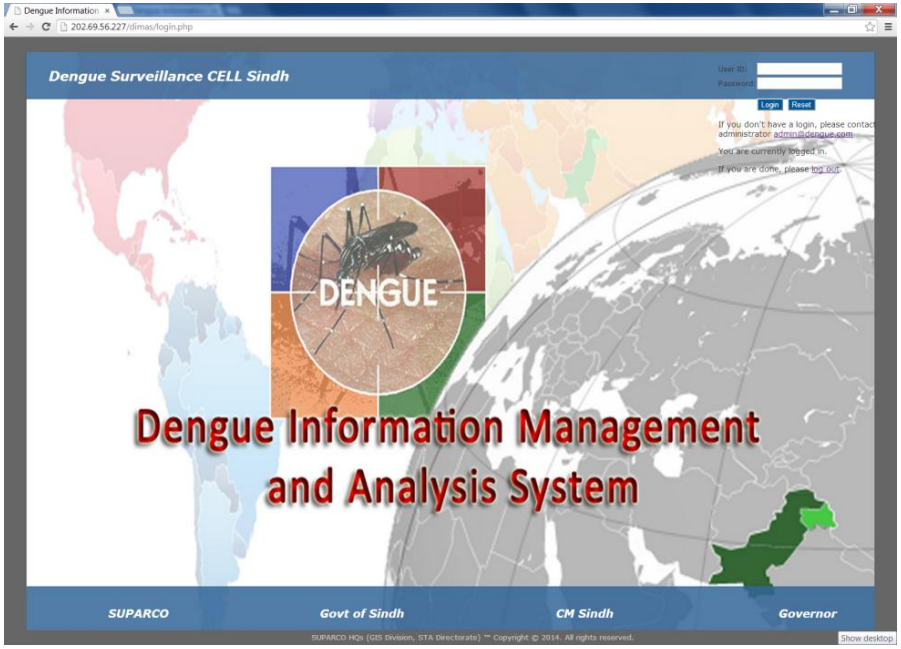
Web GIS

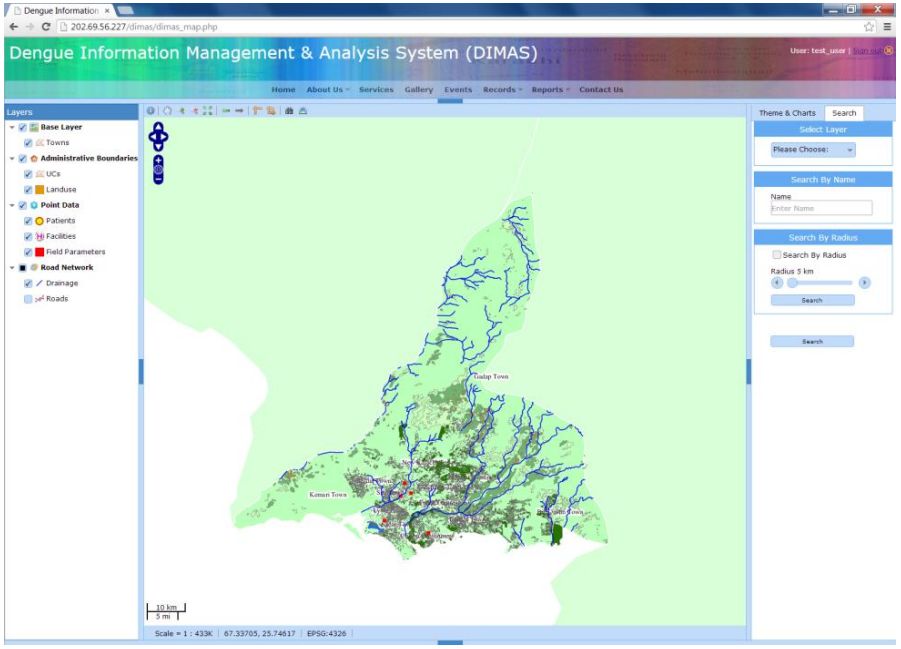
Web GIS History

- 1995: MapGuide, First introduced as Argus MapGuide
- 1996-02: Mapquest, The first popular online Address Matching and Routing Service with mapping output
- 1996-06: MultiMap, The UK-based MultiMap website launched offering online mapping, routing and location based services. Grew into one of the most popular UK web sites
- 1996-11: Geomedia WebMap 1.0, First version of Geomedia WebMap, already supports vector graphics through the use of ActiveCGM
- 1996-fall: MapGuide, Autodesk acquired Argus Technologies and introduced Autodesk MapGuide 2.0

Web GIS

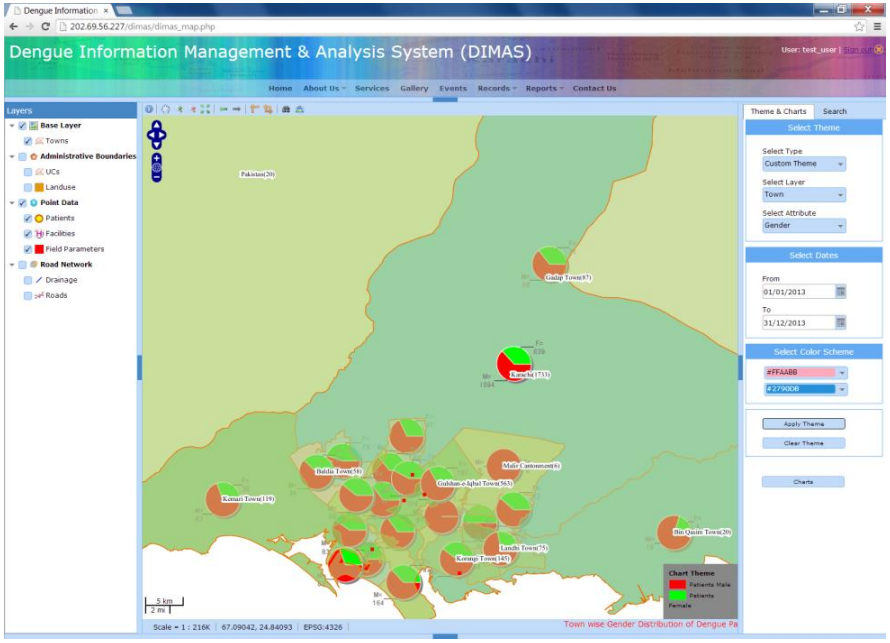
Application Examples

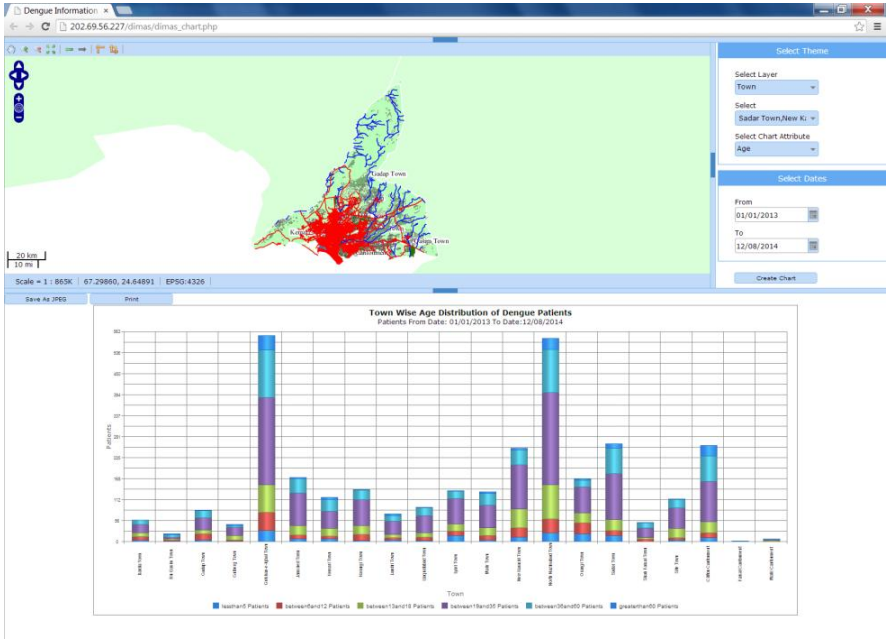




Web GIS

Application Examples





Web GIS

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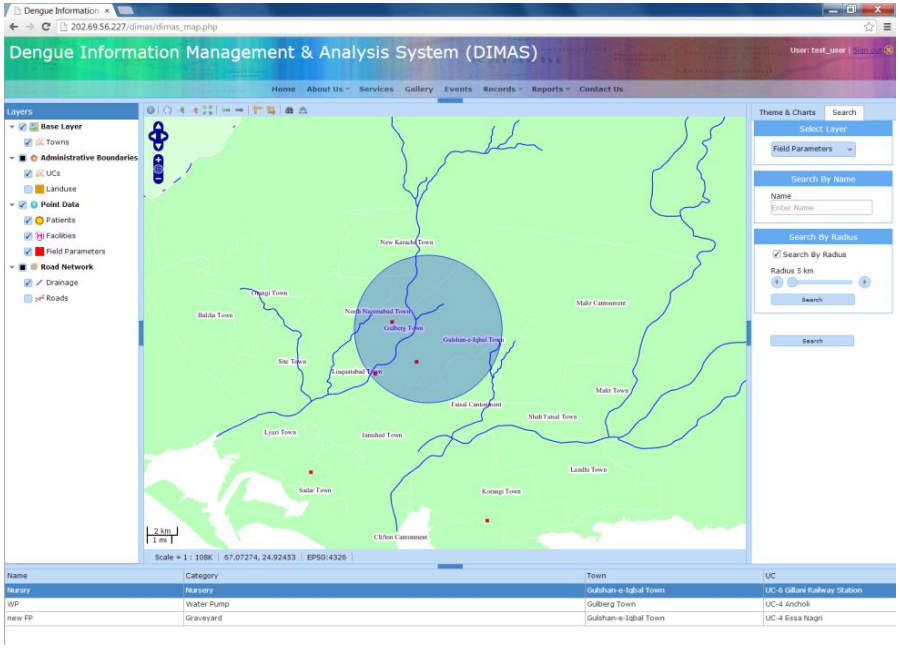

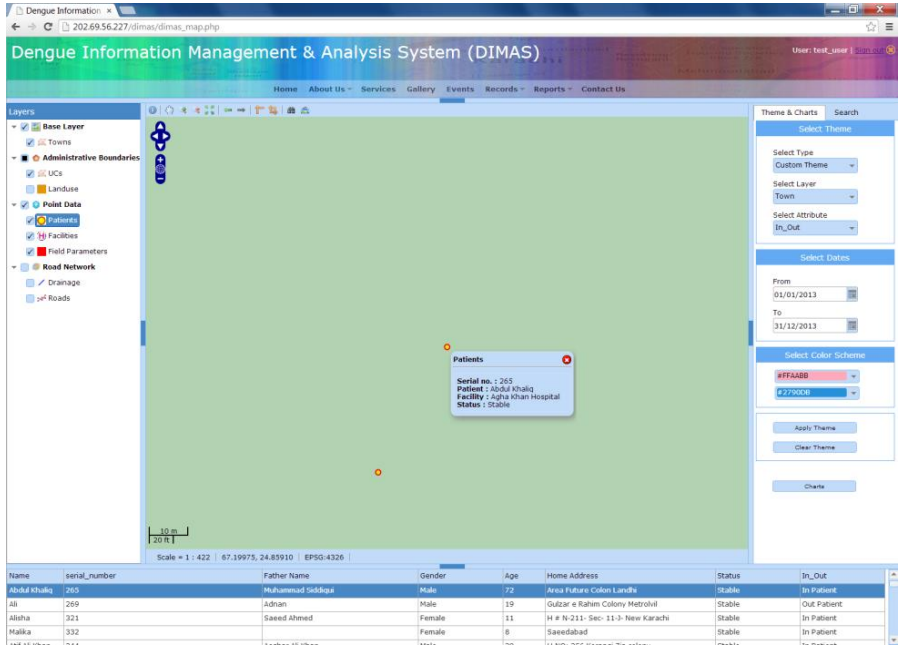

Web GIS

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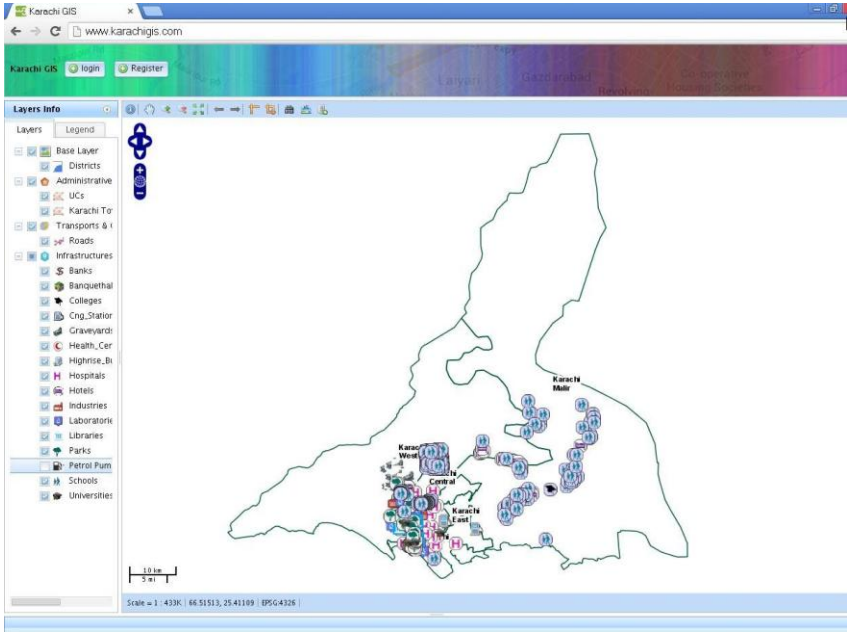

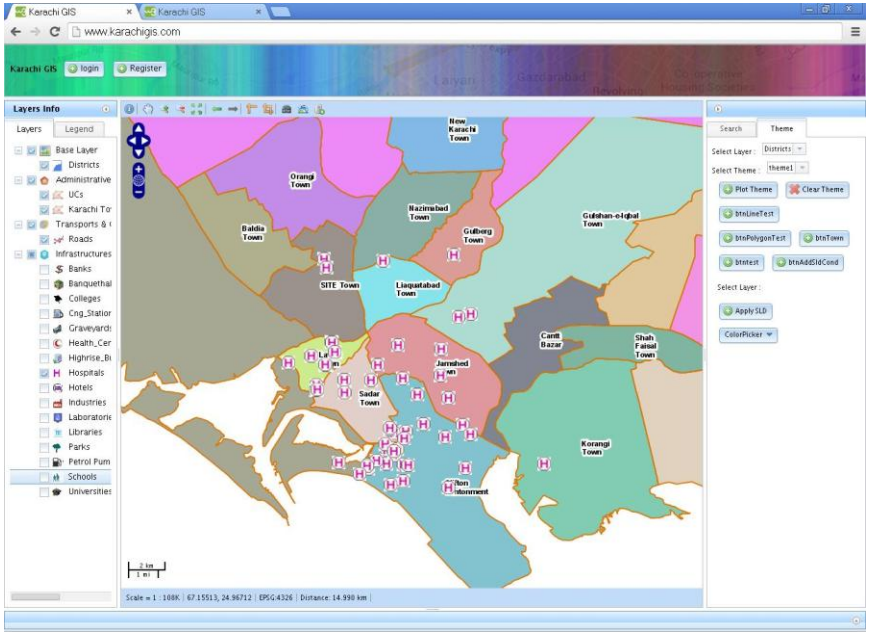

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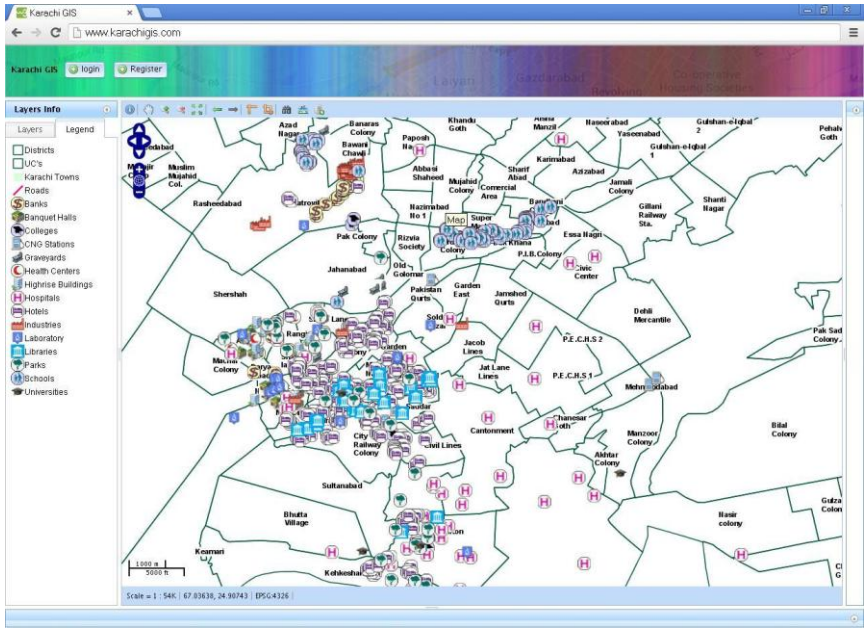
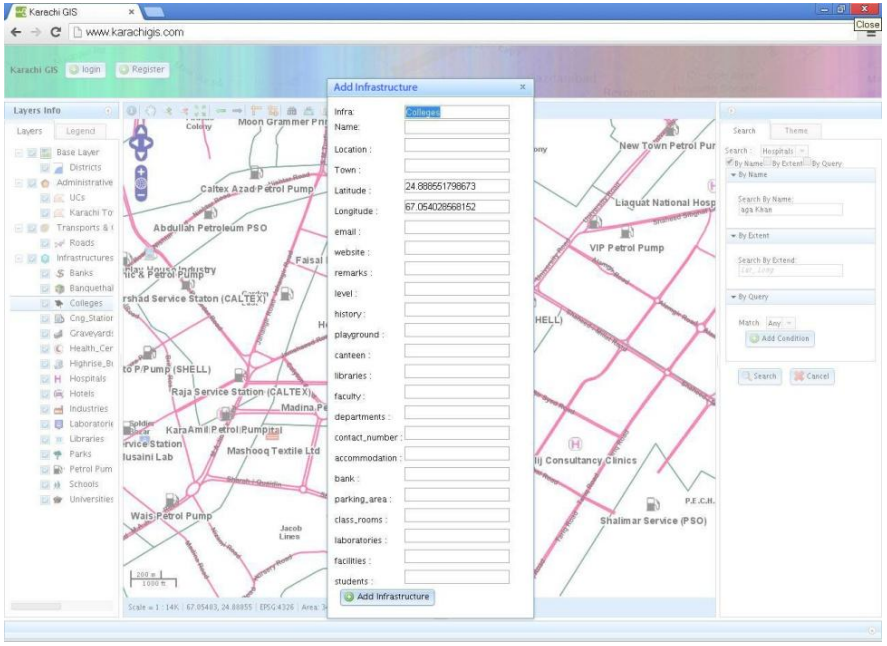




Mobile GIS

What is Mobile GIS?

- Mobile GIS is the expansion of a geographic information system (GIS) from offices to any place around the globe, It makes your GIS accessible at every location

- Mobile GIS integrating various ICTs

Mobile GIS

Mobile GIS Functions

- Mobile mapping (Visualization)
- Query
- Real-time tracking and location identification using GPS
- Real-time data collection from field
- Limited map processing
- Location Based Services (LBS)
- Augmented Reality (AR) using camera, GPS, compass and GIS data

Mobile GIS

Advantages of Mobile GIS

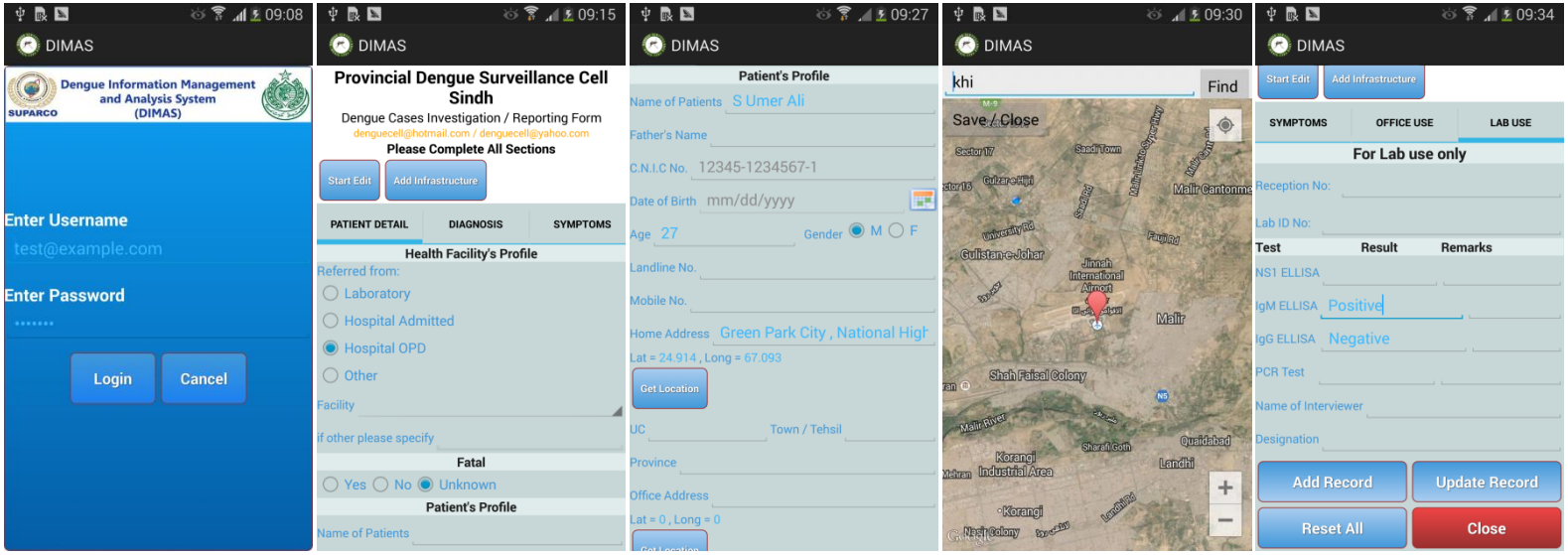
- Mobile solutions that are easy to use and inexpensive can eliminate technology boundaries, allowing greater access and input from field personnel

- It enables users to obtain, edit & analyse geographical information in the field and helps in faster decision making.

- The use of mobile GIS helps in improving the quality and speed of data collection and stimulates the real-time collaboration between field and office staff

Mobile GIS

Application Examples



Mobile GIS

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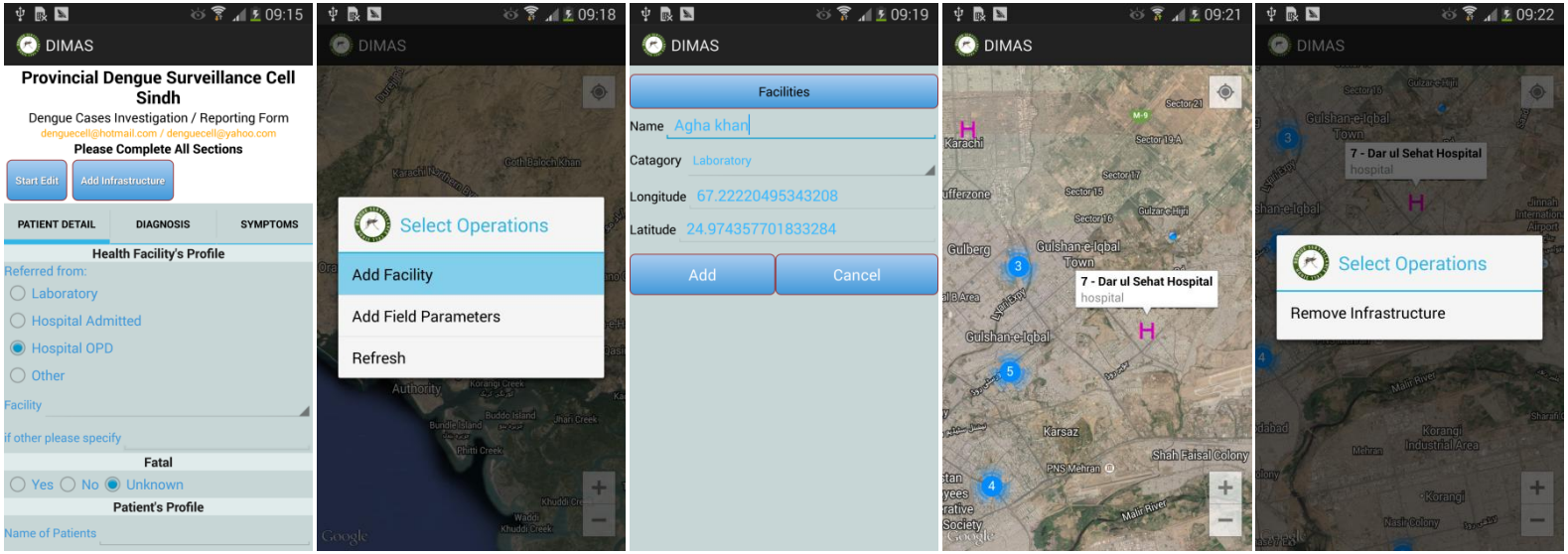

Mobile GIS

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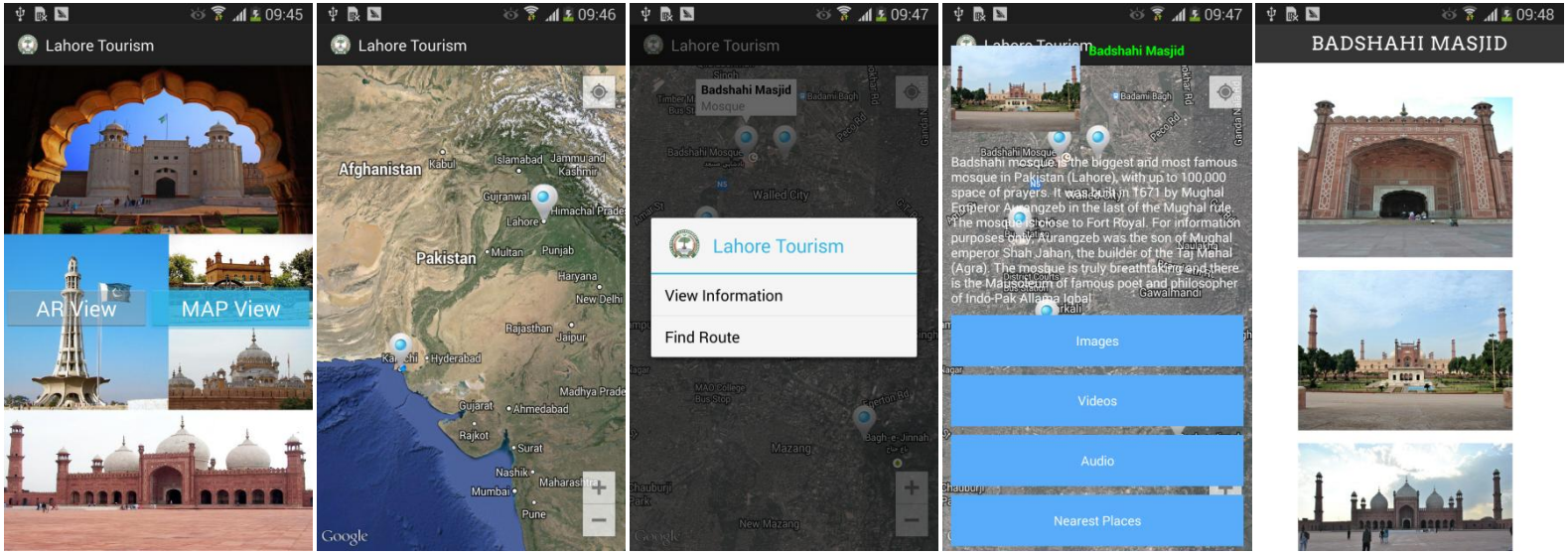

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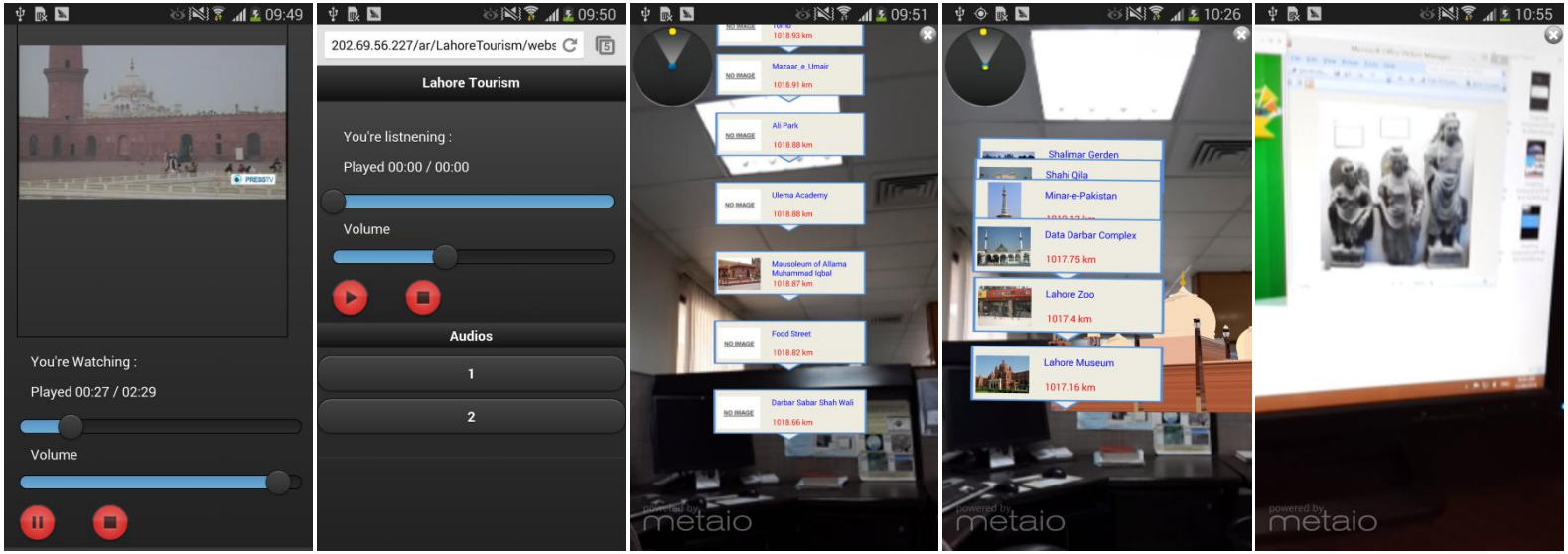


Cloud GIS

Cloud Computing

- Cloud computing is evolving as a key computing platform for sharing resources that include infrastructures, software, applications, and business processes
- Cloud computing is an emerging trend to deploy and maintain software and is being adopted by the industry such as Google, IBM, Microsoft, and Amazon
- Several prototype applications and platforms, such as the IBM "Blue Cloud" infrastructure, the Google App Engine, the Amazon Cloud, and the Elastic Computing Platform

Cloud GIS

What is Cloud Computing?

- Cloud Computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction

- Cloud Computing is often equated with the concept of a utility, in which an organization can "plug-in" to this virtual computing environment and use the computing resources available on an as-required basis

- Applications running on such a platform can be accessed via web clients, while the application software and data are kept at the (virtual) server side

Cloud GIS

What is Cloud Computing?

- Conceptually Cloud Computing can be perceived as having
  - Five key characteristics
    - On-demand self-service
    - Network access
    - Location-independent resource pooling
    - Rapid elasticity
    - Pay-per-use
  - Three delivery models
    - SaaS – Software as a Service
    - PaaS – Platform as a Service
    - IaaS – Infrastructure as a Service

Cloud GIS

What is Cloud Computing?

- Conceptually Cloud Computing can be perceived as having
  - Four deployment models
    - Private
    - Community
    - Public
    - Hybrid

Cloud GIS

Since

GIS is an Integrated System of computer hardware, software and spatial data (topographic, demographic, tabular, graphic image, digitally summarized)

and

GIS performs manipulative and analytical operations on this data to produce reports, graphics and statistics and controls geographic data processing workflows

Therefore

GIS Cloud based on cloud computing is the suggestive approach

Cloud GIS

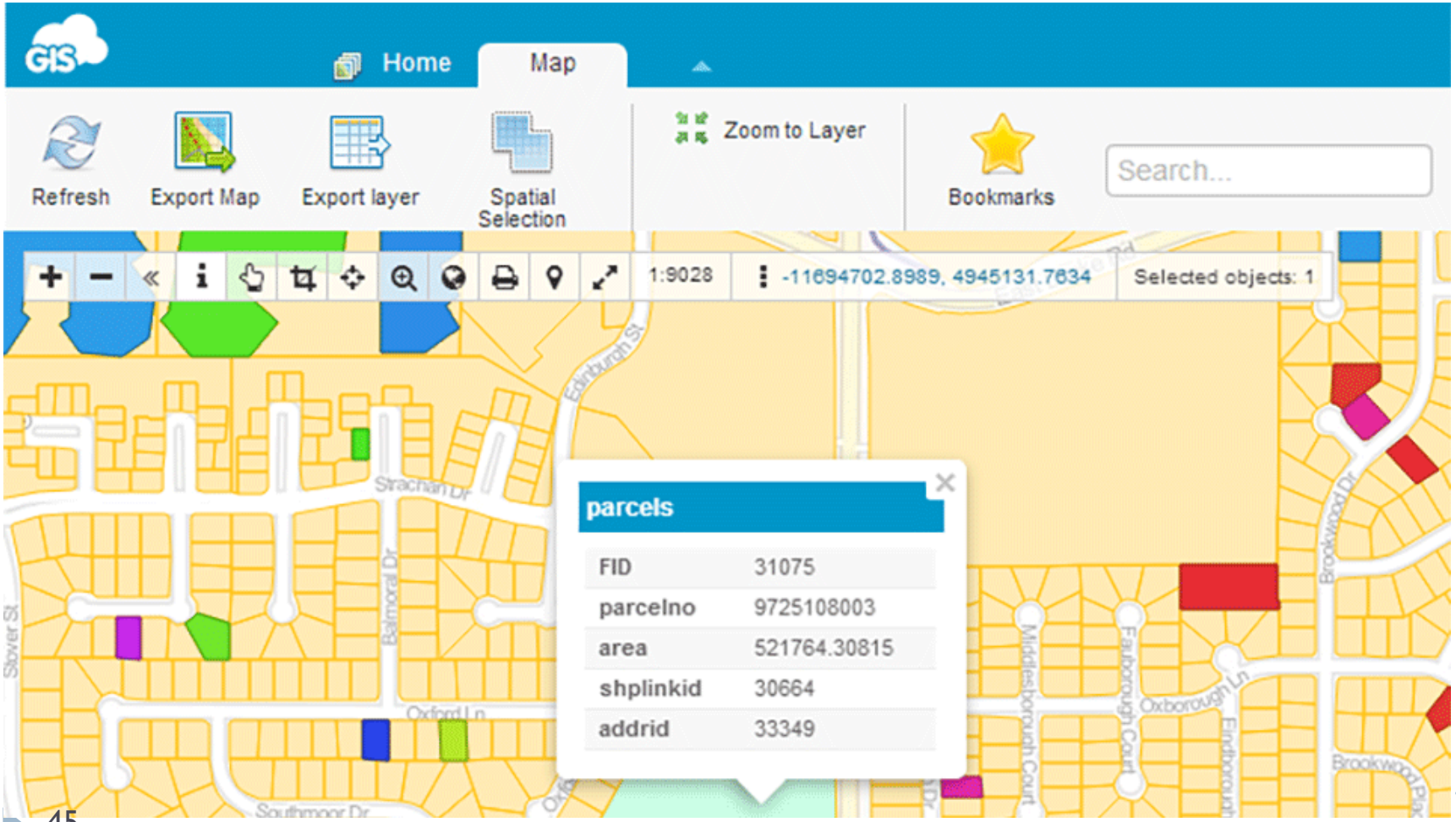
- Geographic Information Systems (GIS) applications have been moving into the cloud with increased drive

- Global organizations like ESRI, GIS Cloud Ltd etc have already taken a technological shift to Cloud Computing Paradigm and are committed to provide on-demand services to their extensive shades of users

- World's largest GIS Cloud infrastructure providers are Amazon (Amazon EC2 & S3), Microsoft (Microsoft Windows Azure, Windows Server Hyper-V), and IBM (IBM Cloud) which provide reliable and secure cloud IT infrastructure to the customers on-demand.

Cloud GIS

Application Examples

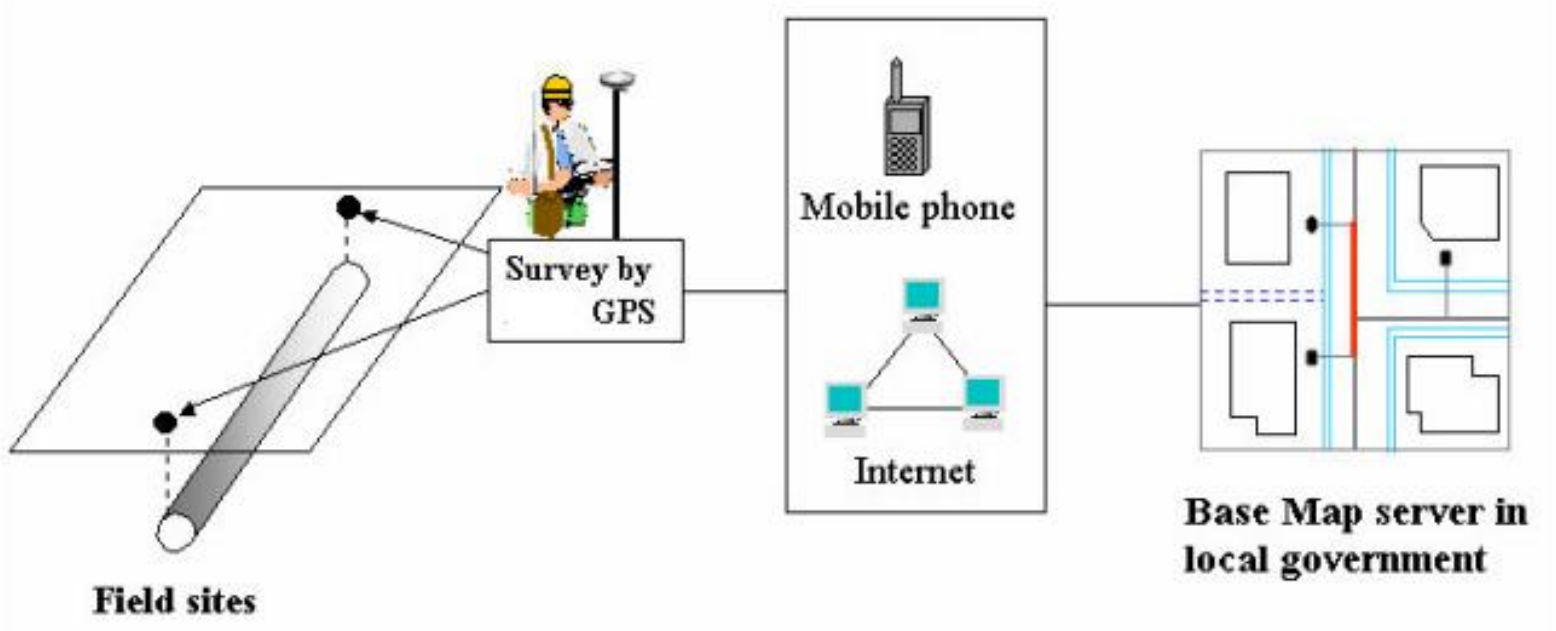


Real-time GIS

- The system for real time mapping and updating the map & database using GPS, sensor/GIS data

- It can be connected with cellular phone or Internet through which the stored data can be transmitted to the remotely placed host computer/server

Real-time GIS



Real-time GIS

- New GIS applications are emerging, where, the time is a critical factor
- For instance during disaster management, information must be collected in real-time, and made immediately available to a lot of potential users
- Another applications are for military purpose, where, information is needed to be transferred very quickly

Real-time GIS

- Take another example in environmental monitoring such as river and flood monitoring
- Several sensors are distributed along the river, regularly measuring several parameters, chemical, physical or biological, in addition to water height
- The sensors send the corresponding data to a control centre, by using any kind of telecommunication system (could be satellite-based, could be using cellular phones attached to the sensors, etc.)
- In the control centre, a frontend system manages the dialog with the sensors and stores the information into a database
- Then, another system visualizes this information to give the decision-maker relevant information about the river

THANK YOU