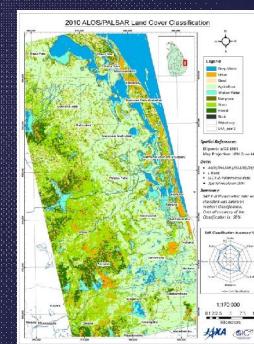
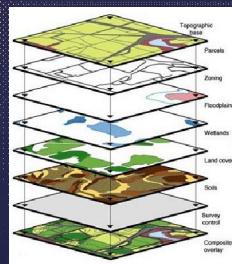


Introduction to WEB-GIS

Chathura H Wickramasinghe

Geographic Information Systems

- “Mapping” is inventory and presentation of spatial data.
- GIS means “Geographical Information System”
 - Its called that because there is information behind the map.



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GIS vs CAD

Difference between mapping software or CAD and GIS:

CAD

- Mapping 2D or 3D geospatial data

GIS

▫ Three levels of GIS applications:

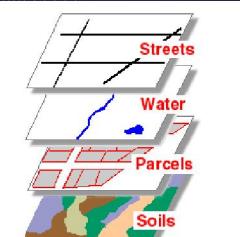
- Inventory (What is there?)
- Analysis (Answering questions)
 - Shortest distance
- Modeling (Making predictions)

CAD stands for Computer-Aided Design

GIC/AIT chat! 

A GIS is a software system that connects map layers with tables of information.

Location	None—everyone uses personal computers	Vary by population size	Vary by health needs	Vary by other factors	Other	Other Comments
Oklahoma	6%	15%	41%	37%	—	Very good
New Jersey	4%	15%	17%	44%	8%	Very good
Illinois	1%	25%	11%	10%	14%	Very good
Penns.	17%	17%	17%	17%	17%	Very good
Arkansas	20%	17%	19%	31%	17%	Very good
Florida	20%	17%	19%	31%	17%	Very good
Michigan	20%	17%	19%	31%	17%	Very good
Los Angeles	20%	47%	17%	31%	3%	Very good
Massachusetts	20%	31%	17%	41%	9%	Very good
Alabama	20%	25%	25%	25%	25%	Very good
Oregon	17%	21%	17%	37%	2%	Very good
Florida	20%	25%	17%	37%	8%	Very good
Washington	20%	25%	17%	37%	8%	Very good
Philadelphia	8%	25%	27%	30%	10%	Very good
Illinois	17%	25%	25%	44%	8%	Very good
Alaska	6%	17%	17%	37%	37%	Very good
Utah	17%	57%	9%	17%	—	67%
Wyoming	17%	57%	9%	17%	—	67%
North Carolina	17%	57%	9%	17%	—	67%
South Carolina	17%	57%	9%	17%	—	67%
Mississippi	17%	57%	9%	17%	—	67%
West Virginia	17%	57%	9%	17%	—	67%
Balt. Lake City	9%	1%	23%	51%	1%	26%



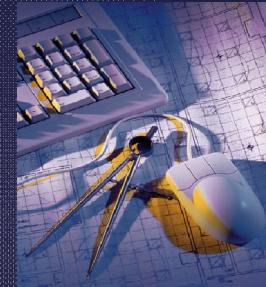
GIS MAP

GIC/AIT chat! 
Image: ESRI course Learning ArcGIS Desktop

Importance of Geographic Data

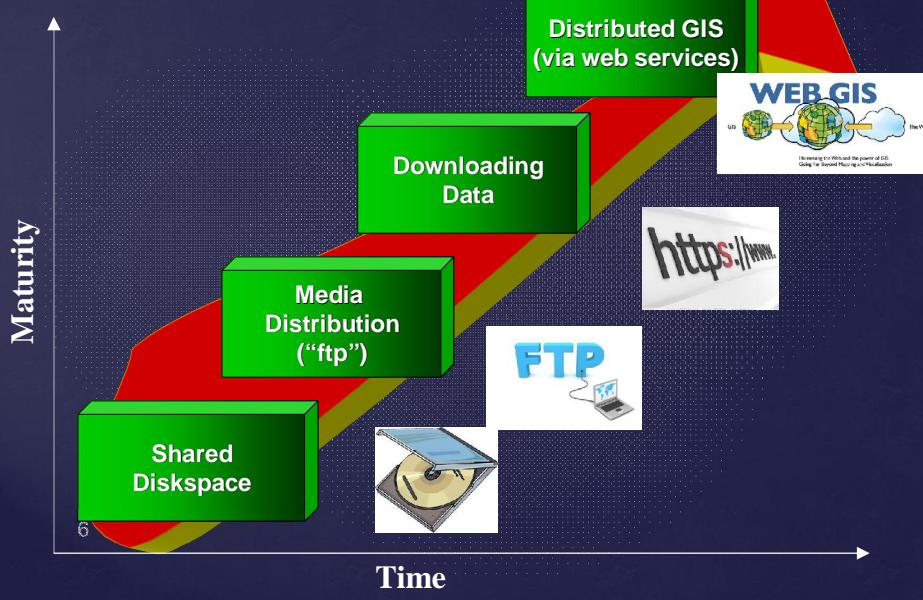
- ▀ **GIS is different than most applications**
- ▀ **Word processing, Spreadsheets... are entirely dependent on input of YOUR data**
- ▀ **GIS users nearly always require reference map data (e.g., streets, boundaries) that are maintained by others**
- ▀ **As GIS users, we rely heavily on “external” data sources**

Data has to be shared



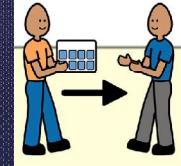
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Evolution of Data Sharing



Issues with typical/traditional Data Sharing Methods

- ▀ **Getting all the data**
- ▀ **Vintage**
- ▀ **Format**
- ▀ **Coordinate System/Projection**
- ▀ **Media Compatibility**
- ▀ **File Size**
- ▀ **Bandwidth**
- ▀ **Metadata Distribution**



Typically requires data manipulation prior to use (reformatting, reprojecting, clipping, etc.)



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Distributed GIS Model

USGS NYS DEC NYS CSCIC US EPA



DEM

Wetlands

Orthos

**Real-time
access to
geographic
data and
services**

Virtually Any Client



Mashup

- An application that combines data from multiple sources
- Referred to as “content aggregation”
- Combines similar types of data (e.g., maps,) from different systems/services
- Term originated from music industry when a new song was made from several existing tracks



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Distributed GIS Advantages

- Format is irrelevant
- Guarantees latest data
- No media involved
- Size is irrelevant (only requested data needed)
- Software independent



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Distributed GIS Advantages

▀ **Device independent (PC, phone)**



▀ **Saves Time!**

▀ **Data security**

- **Only view data**
- **Download data**
- **Data upload and editing**



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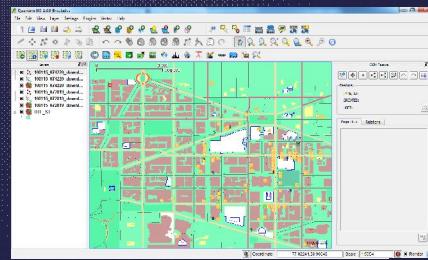
Distributed GIS Advantages

▀ Desktop software's also support WMS

- QGIS
- ArcGIS

○ Advantages

- Carryout advance GIS operations on the data.
- Use as source data for GIS analysis.
- Easy to search and access data.



Distributed GIS Disadvantages

- **Dependent on server availability**
- **Dependent on internet availability**
- **Users need to be aware of web service**



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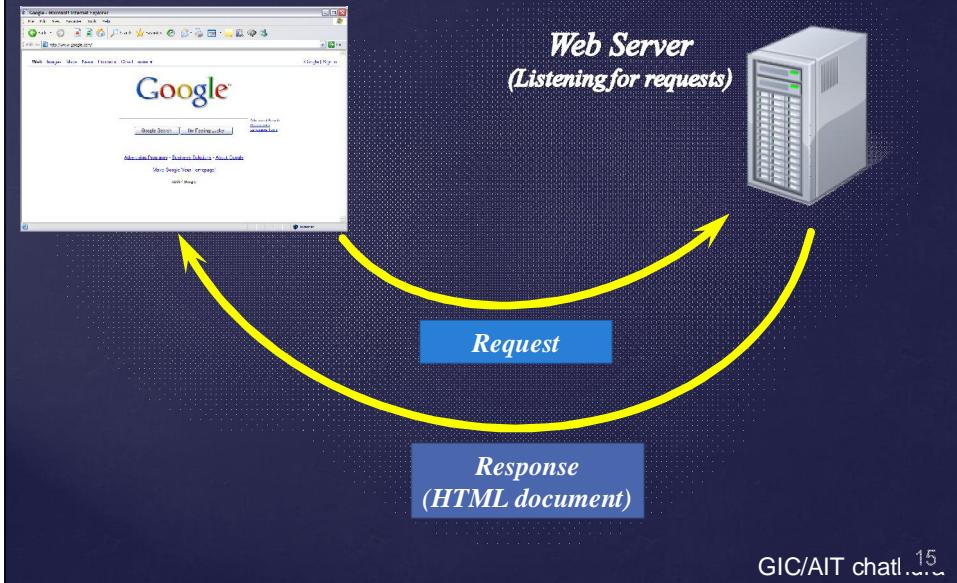
Service Oriented Architecture

- Architecture that is based on integrating “loosely coupled”, interoperable services
- Loosely coupled means NOT physically bound or compiled like an EXE or DLL
- These services can be invoked and consumed remotely over a network
- Data and messages are exchanged between clients and services

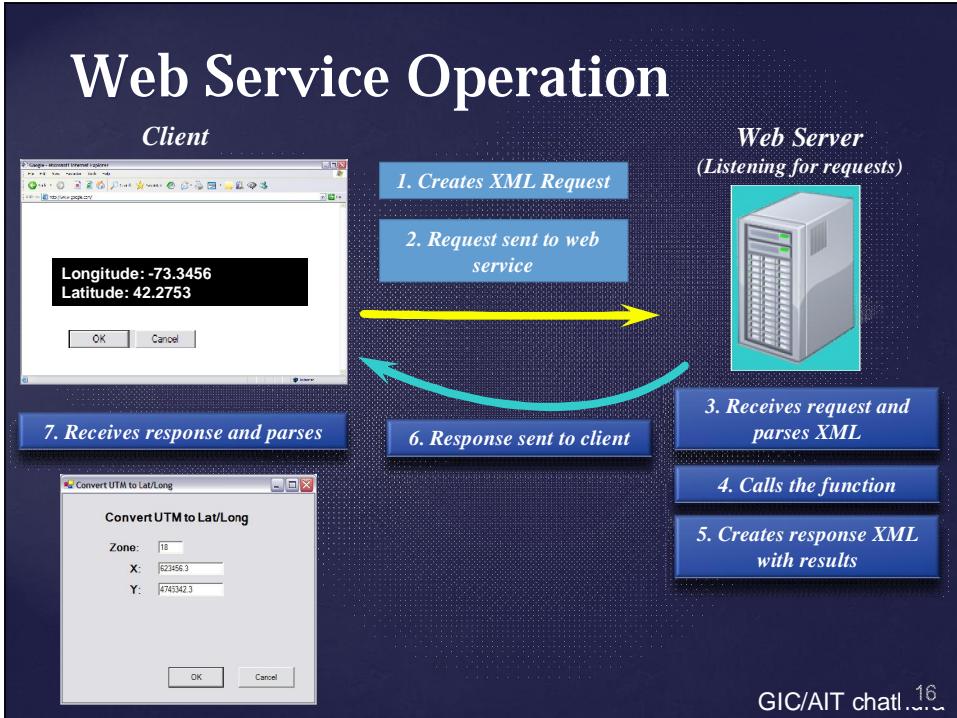


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Basic Web Page Operation



Web Service Operation



Types of Geospatial Web Services

- Map/Data Oriented Services

- Map Services (Image)
 - Feature Services (Vector)
 - Coverage Services (Grid)

- Task Oriented Services

- Routing Services
 - Geoprocessing Services



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Map Services

- Client requests a map from a server for a specified geographic extent
- Map Server renders the requested map internally and converts to an image file (e.g., JPG, PNG, GIF) and returns the map image to the client for display
- Fast map display is possible.

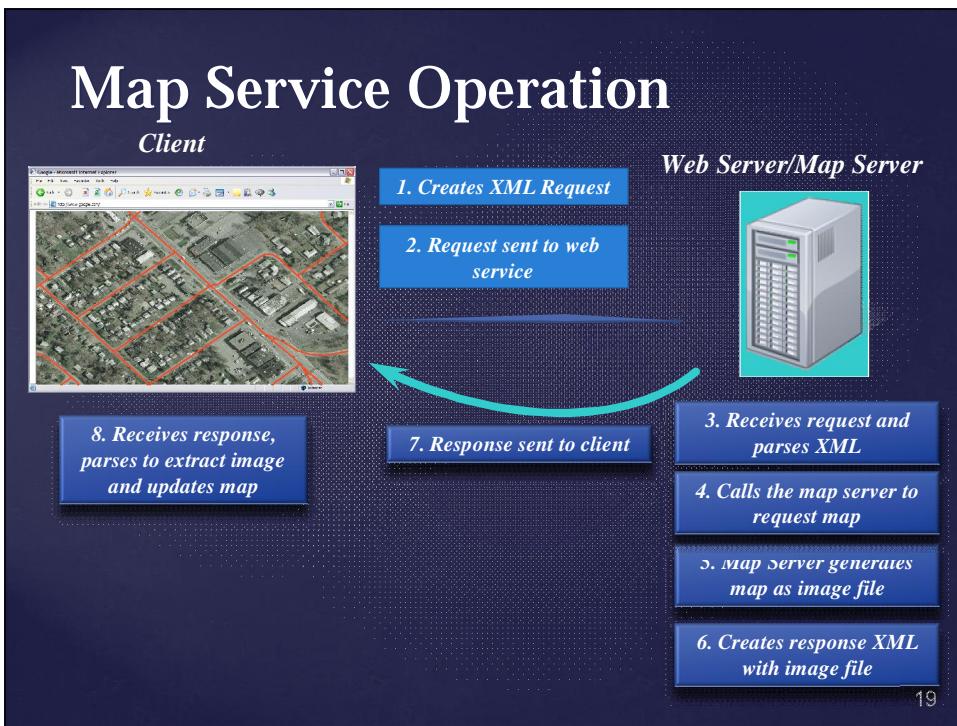


99% of current activity's in Web GIS Map/Image Serving



"Google Map" made way for WebGIS popularity

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Sample site

- ▀ <http://www.wunderground.com/radar/map.aspx>
- ▀ <http://maps.esonettheforest.or.id/>
- ▀ <https://mapsengine.google.com/map>

The slide displays three screenshots of map service websites:

- Wunderground Radar:** A screenshot of the Wunderground radar interface showing a map of Denver, Colorado, with various weather patterns and data overlays.
- Esonettheforest Radar:** A screenshot of the Esonettheforest radar interface showing a map of a forested area with radar data.
- Google Maps Engine Lite:** A screenshot of the Google Maps Engine Lite interface, showing a blank canvas with tools for drawing, importing, organizing, and styling maps.

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Need for standardization

- ▀ Every one was creating own standards
 - Google maps
 - Bing Maps
 - USGS
- ▀ Make universal data sharing possible.
- ▀ Overcome technical challenges.
- ▀ Make way for rapid development in WebGIS.

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OGC and Open Web Mapping

- ▀ The Open Geospatial Consortium (OGC) was founded in 1994
- ▀ An international consortium of 346 organizations that lead the development of open standards and specifications to enable the interoperability of geospatial and location based services
- ▀ They have developed a series of open standards for geospatial web services such as:
 - Geography Markup Language (GML)
 - Web Mapping Services (WMS)
 - Web Feature Services (WFS)
 - Web Coverage Services (WCS)
- ▀ Referred to as “OpenGIS®” standards



"Making location count"

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OGC Web Services (OWS)

▫ Web Map Service (WMS)

- Web Map Service Interface Standard (WMS) provides a simple HTTP interface for requesting geo-registered map images from one or more distributed geospatial databases. A WMS request defines the geographic layer(s) and area of interest to be processed. The response to the request is one or more geo-registered map images (returned as JPEG, PNG, etc) that can be displayed in a browser application.

▫ Web Feature Service (WFS)

- The WFS operations support INSERT, UPDATE, DELETE, LOCK, QUERY and DISCOVERY operations on geographic features using HTTP as the distributed computing platform. It is the function of a web feature service, in its interaction with the data storage system used to persistently store features, to ensure that changes to data are consistent.

▫ Web Coverage Service (WCS)

- The OpenGIS® Web Coverage Service Interface Standard (WCS) defines a standard interface and operations that enables interoperable access to geospatial "coverages" [http://www.opengeospatial.org/ogc/glossary/c]. The term "grid coverages" typically refers to content such as satellite images, digital aerial photos, digital elevation data, and other phenomena represented by values at each measurement point.

Web Mapping Services (WMS)

- WMS is the OGC specification for implementing a map (image) service
- Does not allow for cached map services
- WMS provides 3 functions for clients to access functionality
 - Two functions are mandatory to be implemented, the third function is optional
 - This results in two general “types” of WMS Services
 - Basic
 - Queryable



Web Mapping Services (WMS)

Basic WMS Service

Every WMS service MUST support the following two functions:

- GetCapabilities – Describes the capabilities and available layers
- GetMap – Generates a map image based on input parameters

Queryable WMS Service

The following function is optional for WMS services:

- GetFeatureInfo – Gets the attributes for a specified feature

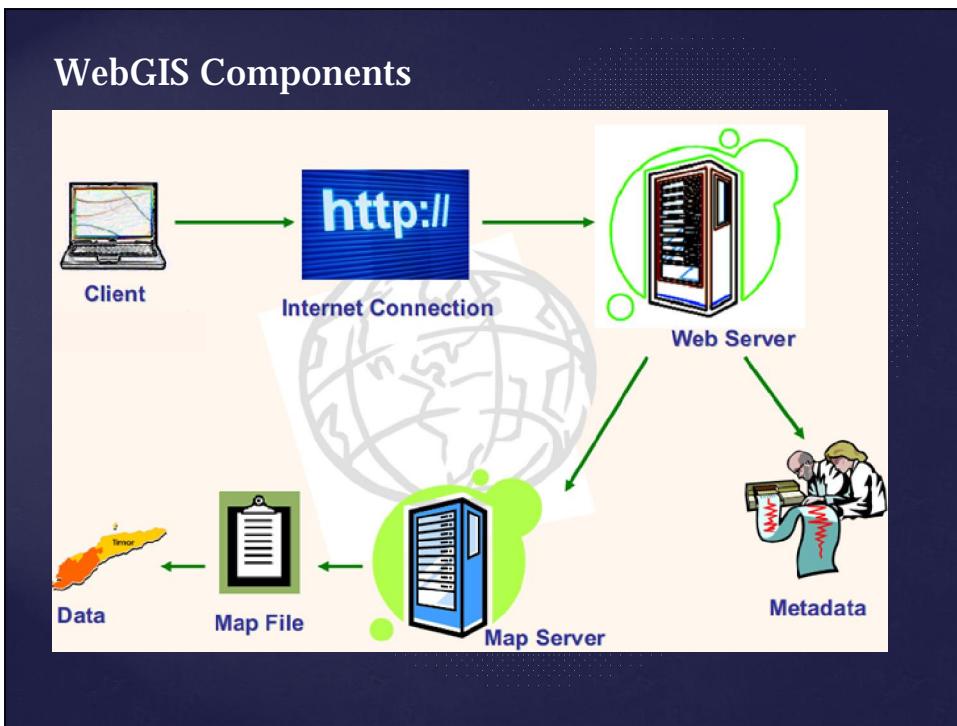
<http://www.opengeospatial.org/standards/wms>

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What can be done with a WMS service?

- Each client application (e.g., ArcView, MapInfo, Google Earth, etc.) handles WMS services differently
- However, generally the following functions are available:
 - Map Display and navigation
 - Zoom to layer
 - Layer Control
 - Identify feature (only with Queryable Map services)
- Anything else is not available
 - No feature selection
 - No geoprocessing
 - No attribute table/browser display
 - Menus/Buttons are greyed out and disabled

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Web GIS Components (Cont)

- **Client:**
 - Internet Browser such as Internet Explore, Mozilla firefox etc
- **Internet Connection:**
 - Performance of a web mapping site largely depends on the bandwidth of the Internet connection
 - Higher the bandwidth better the performance
- **Web server**
 - Handle the requests from Web Browser (user) and Return the web page
 - Apache,IIS
- **Meta Data**
 - data about data
 - Including Server URL, Owner etc

Web GIS Components (Cont)

•Map Server

- The Map Server is the engine behind the maps you see on a web page.
- The Map Server needs to be configured to communicate between the web server and assemble data layers into an appropriate image.

•Map viewer

- Renders the maps on the client side
- The relationships among Objects
 - Map Extent
 - Map Size
 - Reference Map (Key Map)
- Point Map Server where to locate data
- Define how things are to be drawn
 - Colors
 - Labeling etc...

WEB GIS Software

Category	Commercial	Free
Operating Systems	Windows 	Linux 
Database SW	ORACLE , MSSql  	Mysql , Postgresql  
Spatial Database SW	ORACLE Spatial 	MySQL Spatial, PostGIS 
RS\GIS Applications	ArcGIS, ERDAS, ENVI   	ILWIS, GRASS, QGIS   
Web GIS Applications	ArcIMS  ArcGIS Server/ ArcSDE  	MapServer, GeoServer   Mapbender, OpenLayers  

Open WEB-GIS components

Map Servers

Rendering spatial data (maps, images, and vector data) for the web

- Minnesota MapServer
- GeoServer



<http://mapserver.org/>



<http://geoserver.org>

Map Viewer

It provides a data model and web based interfaces for displaying, navigating and querying OGC compliant map services

- Mapbender
- OpenLayers



www.mapbender.org/



openlayers.org/

WebGIS using open source tools

Example: The following WebGIS application was developed using GeoServer & OpenLayers



Open Web GIS solutions

GeoNode

GeoNode is a web-based application and platform for developing geospatial information systems (GIS) and for deploying spatial data infrastructures (SDI).



geonode.org/

GeoNetwork opensource

GeoNetwork is a catalog application to manage spatially referenced resources. It provides powerful metadata editing and search functions as well as an embedded interactive web map viewer. It is currently used in numerous Spatial Data Infrastructure initiatives across the world.



<http://geonetwork-opensource.org/>

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Core components



- Upload Vector & Raster data
- Metadata support.
- Create Maps
- Print maps as pdf



- Up- and downloading data, graphics, documents, pdf files
- Online editing of metadata
- Scheduled harvesting and synchronization of metadata
- Support for OGC-CSW 2.0.2 ISO Profile, OAI-PMH, Z39.50 protocols.



Web Server



Map Viewer

GeoEDGE

Compilation of Free Open source Web GIS resources Powerful tool that support

- o Map services
- o GIS spatial operations
- o Map display
- o Advance Spatial analysis
- o Automatic Geocoding
- o Geo reference map views
- o Interactive multi user digitizing

Web Processing Services

PostgreSQL

GeoServer

OpenLayers™

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Web Processing Service

- The OpenGIS® Web Processing Service (WPS) Interface Standard provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay.
- The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to those processes. The data required by the WPS can be delivered across a network or they can be available at the server.

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WPS

Advantages

- GIS Operation online
- No need of GIS applications
- Easy to use
- No need of GIS knowledge
- Can be done on any device (mobile / pc)

Disadvantages

- Need powerful server

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Thank You

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