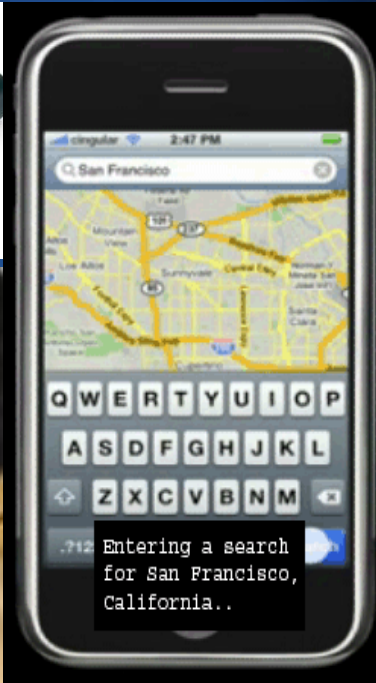


Mobile Environment and GIS



Prof. Dr. Taymoor M. Nazmy

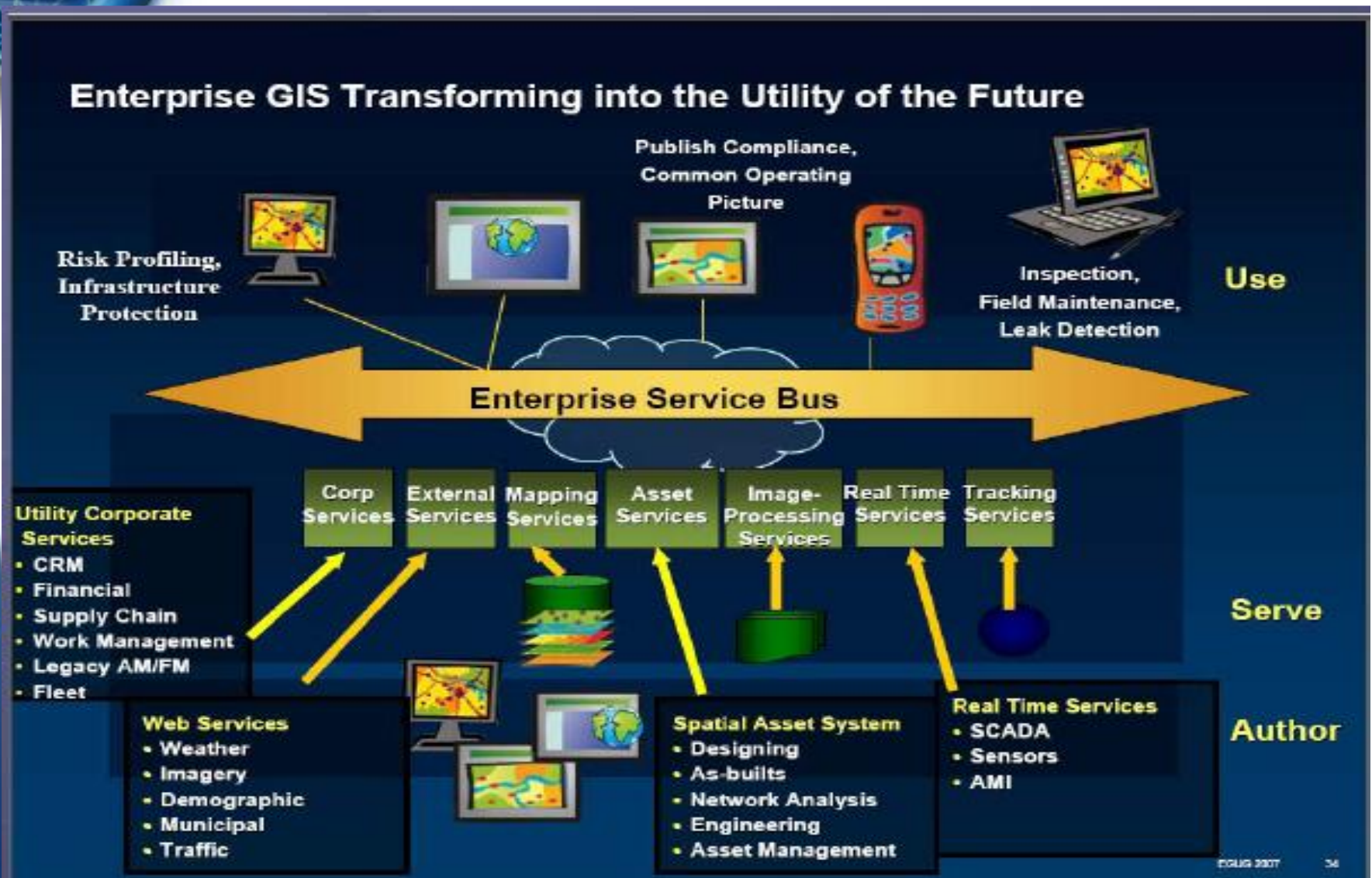
Vice dean faculty of computer science, Ain Shams
University



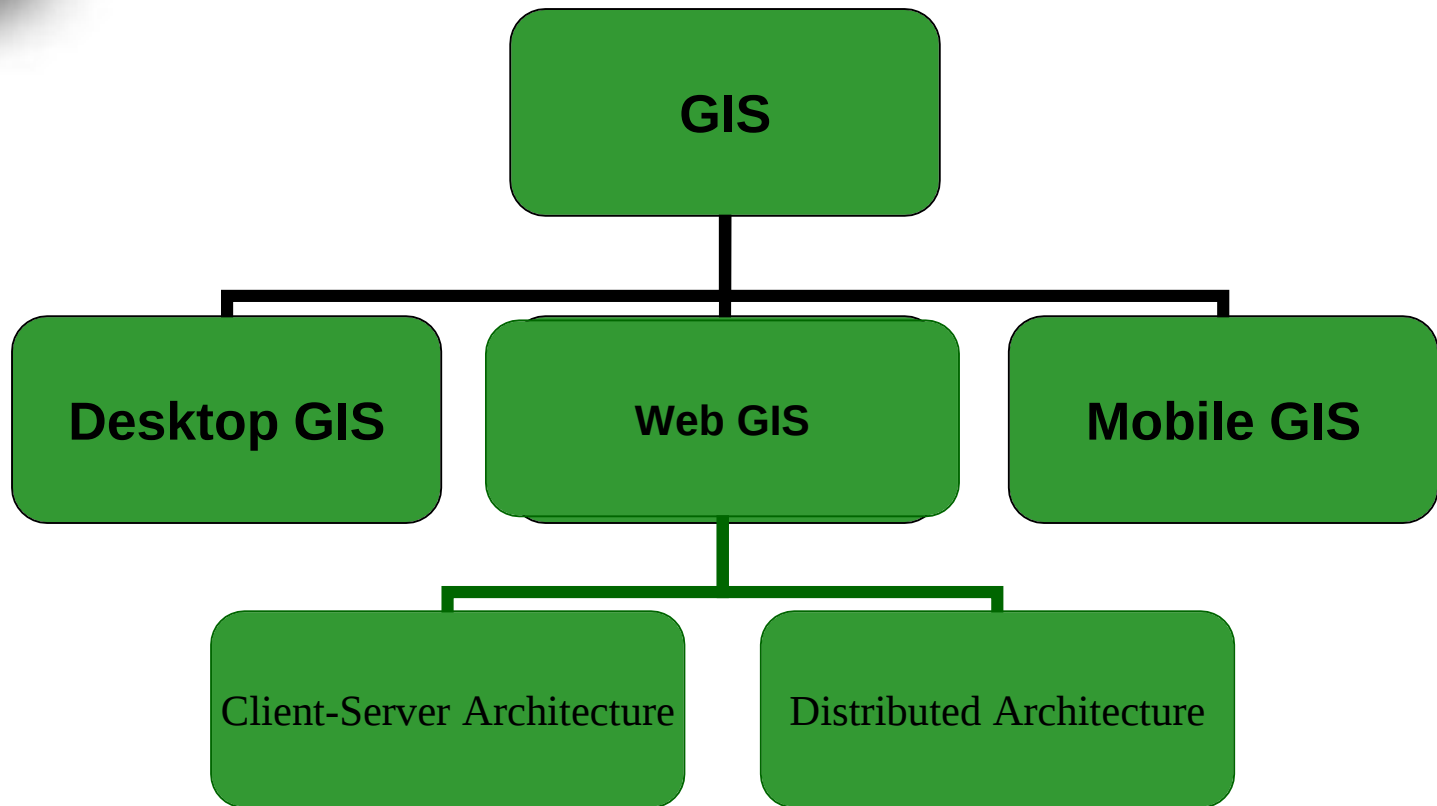
Agenda

- **Introduction**
- **Mobile GIS**
- **Typical End Use of Mobile GIS**
- **Applications for Mobile GIS**
- **Mobile GIS Architecture**
- **Internet GIS**
- **Characteristics of Mobile Environments**
- **Mobile Database**
- **Handheld GIS mobile**

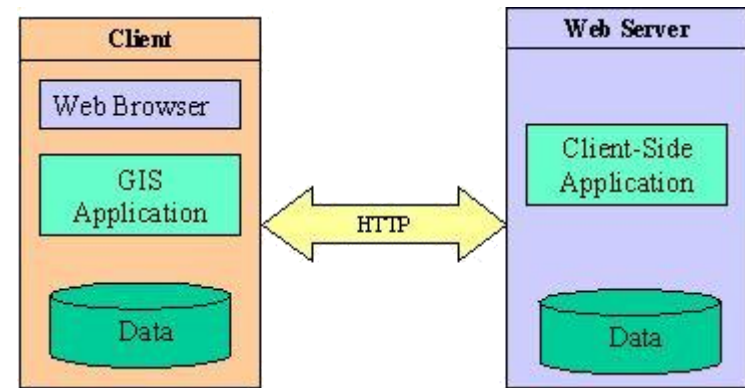
The Future of GIS in Utilities



Types of GIS

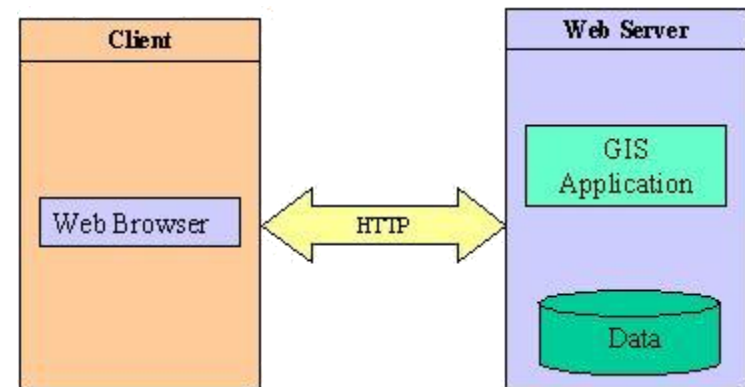


- Thick client (Client) :
Display client request.



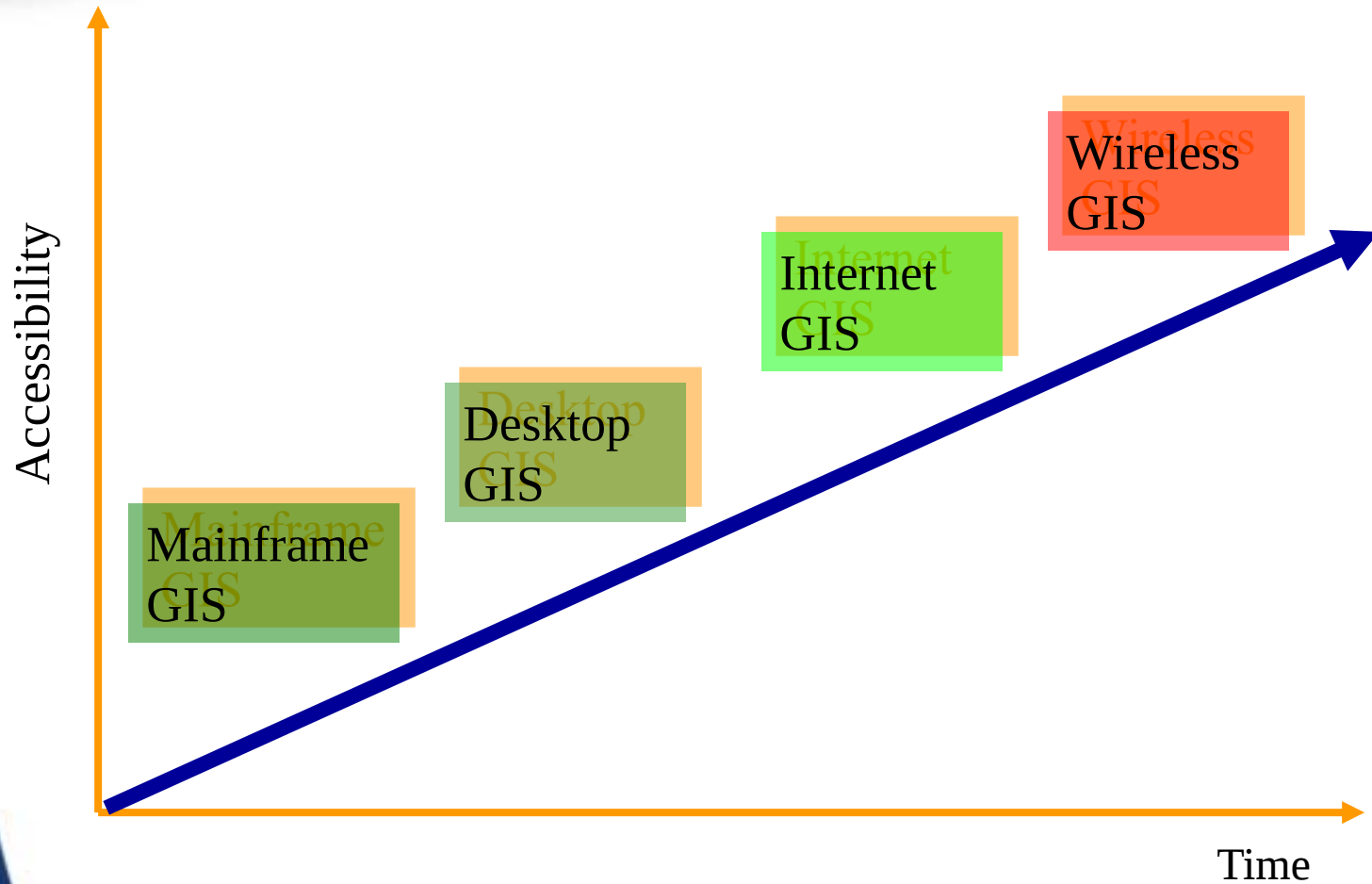
Client Side

- Thin client (Server) :
Store information and
executes client request



Server Side

Trend in GIS



Types of GIS...

- **Desktop GIS**

- Data creation
- Data editing
- Data analysis
- Data visualization

- **Server GIS**

- Data management
- Data archiving
- Data sharing – Internet GIS
- Data distribution – Internet GIS
- Data review – Internet GIS

- **Mobile GIS**

- Data collection
- Navigation





Future of GIS

- There are some challenges in developing GIS applications:
 - Data Source.
 - Data Model.
 - Standards.
 - Mobile GIS.
 - Specialized DBMS for GIS.
 - ...

Mobile GIS

- **Mobile GIS** refers to an integrated software/hardware framework for the access of geospatial data and services through **mobile devices** via wireline or wireless networks
- (Tsou, 2004).
- **WHY mobile GIS**
 - – **Field works:** data collection and validation process, with GPS and wireless communications.
 - – **Real-time** update / change
 - – **GPS** integration.



Mobile GIS Applications

- ❑ Two major application areas:
 1. Location Based Services
 2. Field based GIS





Typical End Use of Mobile GIS

- Typical End Use of Mobile GIS Includes the following, and more.
- **Business**
Unsolicited interaction between wireless patrons in the field (i.e. potential customers), 3rd parties (ex. a restaurant owner), and web-based GIS data providers (ex. Google Maps).
- **Field Work**
Real-time or temporal interaction between field technicians and their in-house operations. Through mobile GIS, field techs can receive priority work orders. Also, mobile GIS allows for simultaneous data collection and ground-truth confirmation, even streaming updates to enterprise datasets.
- **Location Based Services** (LBS)
Realistically, LBS are the gamut of mobile GIS. They include simple consumer-oriented data needs (i.e. locating restaurants, gas stations, residential addresses) as well as more serious community priorities related to emergency response. Right now fire (first responders), ambulance, and police personnel enjoy the most robust Mobile GIS deployments. Other examples can include online parcel tracking services offered by package handlers like FedEx and UPS, even pizza delivery.



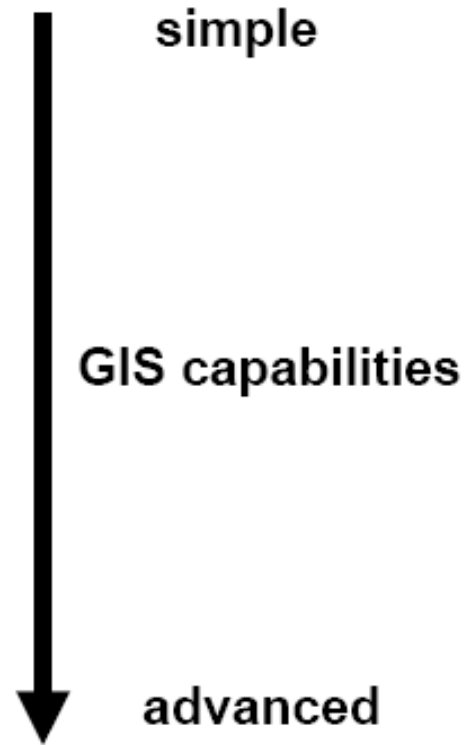
Dominated Trends in mobile GIS

- trends of mobile field systems are dominated by:
- § Wireless technology between sensor and TabletPC,
- § Move to data acquisition, go away from simply collect X, Y, Z
- § Field2Finish solution
- § Quality and Completeness control in the field
- § Seamless dataflow between office - field - office
- § No redundancies in data and workflows
- § With the approach of providing the entire geodatabase in the
- field, field crews can react on changing conditions
- § For survey crews the GIS is a “silent” partner



Top Mobile GIS Tasks

- 1. View/Navigate
- 2. Identify
- 3. Find/Query
- 4. Modify Attribute Values
- 5. Mark/Redline
- 6. Modify Geometry
- 7. Integrate with office data





Applications for Mobile GIS

- Asset Inventories: Create and maintain an inventory of asset locations and attribute information
- Asset Maintenance: Update asset location, condition, and schedule maintenance
- Inspections: Maintain digital records and locations of field assets for legal code compliance and ticketing
- Incident Reporting: Document the location and circumstances of incidents and events for further action or reporting
- GIS Analysis and Decision Making: Perform measuring, buffering, geoprocessing, and other GIS analysis while in the field

Markets for Mobile GIS

		Industry			
		Government	Utility and Infrastructure	Environment	Public Safety
Task	Field Mapping	- Recording Building Footprints - Right of Way Mapping - Base Mapping	- Centerline Review and Mapping - Facility Mapping	- Forrest Boundary Mapping - Trail Mapping - Geochemical Mapping - Volcanic Deposit Mapping - Wetlands Delineation	911 Address Mapping - Minefield Mapping - Military Fieldwork and Mapping
	Asset Inventory	- Street Sign Inventory - Municipal Assets Inventory (GASB34) - Tree Survey - Census Data Collection - Housing Condition Survey - Cemetery Inventory	- Recording Installations - Storm Water Inlet Inventory - Storage Tank Mapping	- Toxic Inventory - Mineral Exploration - Vegetation Survey - Wetland Survey - Archaeological Site Survey	- Aerial Survey - Fire Perimeter Mapping
	Asset Maintenance	- Road Condition Survey - Street Light Survey - Patient Registration	- Power Pole Maintenance - New Equipment Installation - Pavement Condition Assessment	- Crop Management - Vacant Land Condition Management - Timber Harvest Management - Drainage System Management	- Locating Buried Infrastructure - Recording Avalanche Observations - Facility Maintenance Survey
	Inspections	- Road Pavement Management - Code Enforcement - Health Inspection - Housing Condition - Water Rights Enforcement	- Meter Reading - Septic System Inspection - Documentation - Compliance Monitoring - Dam Safety Inspection	- Habitat Studies - Weed Abatement - Well Sampling - Wildfire Sightings	- Damage Inspection - Tracking Violations - Street Sign Inspection - Flood Risk Assessment
	Incident Reporting	- West Nile Virus Incidents - Public Nuisance Surveys	- Locating Outages - Regulatory Compliance	- Animal Migration Tracking - Oil Spill Assessment - Radioactive Contamination Tracking	- Property Damage Assessment - Accident Reporting
	GIS Analysis	- GIS Data Validation - Routing to Locations - Property Records Management	- Locating Customers for Meter Reading and Billing - Routing to Locations - Tracing Network Outages	- Agricultural Statistics - Vegetation Boundary Validation	- Locating Customer Addresses for investigations - Emergency Identification of Affected Areas - Navigating to Accident



Benefits of Mobile GIS

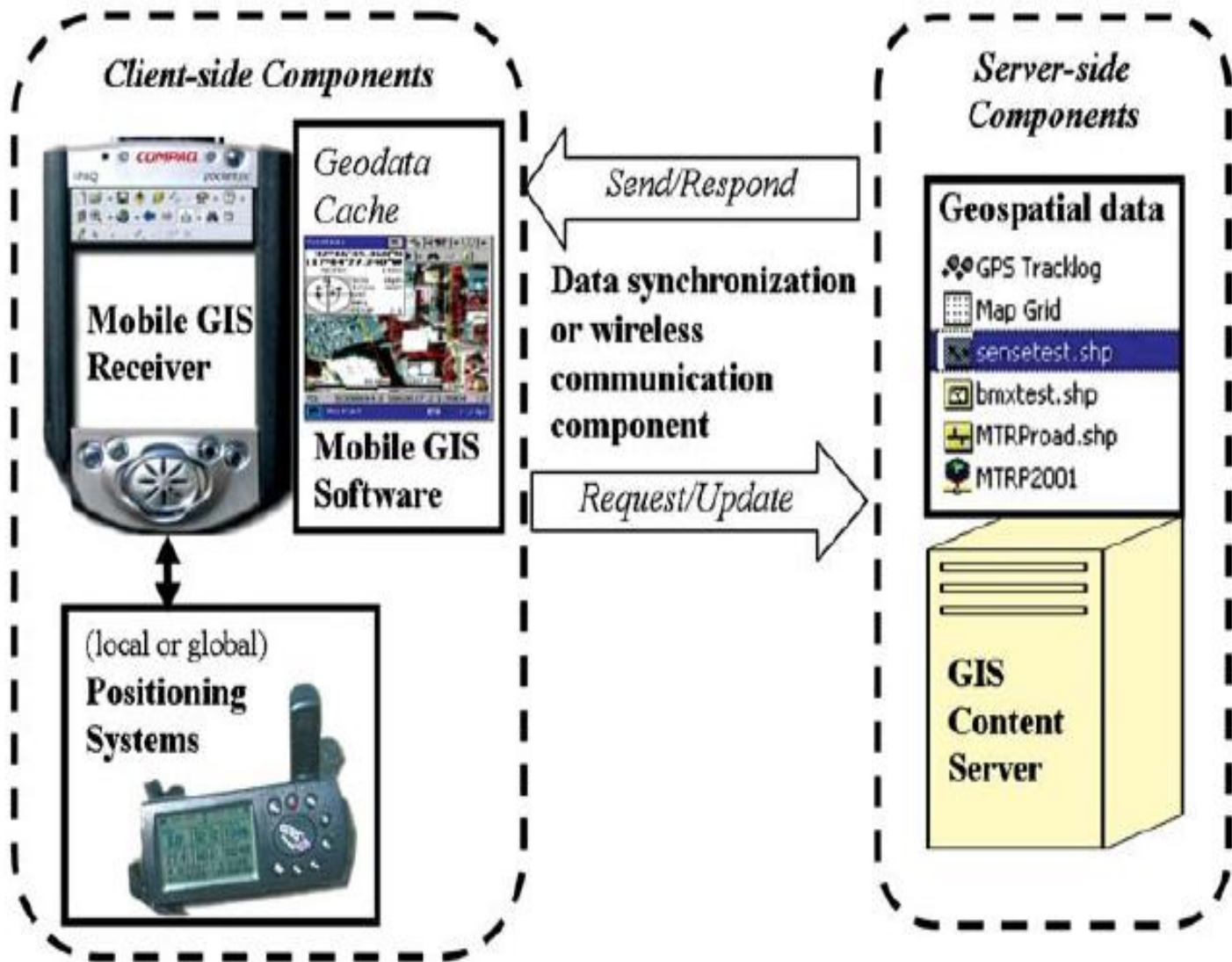
Manual Data Collection

- Paper maps
- Handwritten notes
- Manual data transfer
- Approximate spatial location

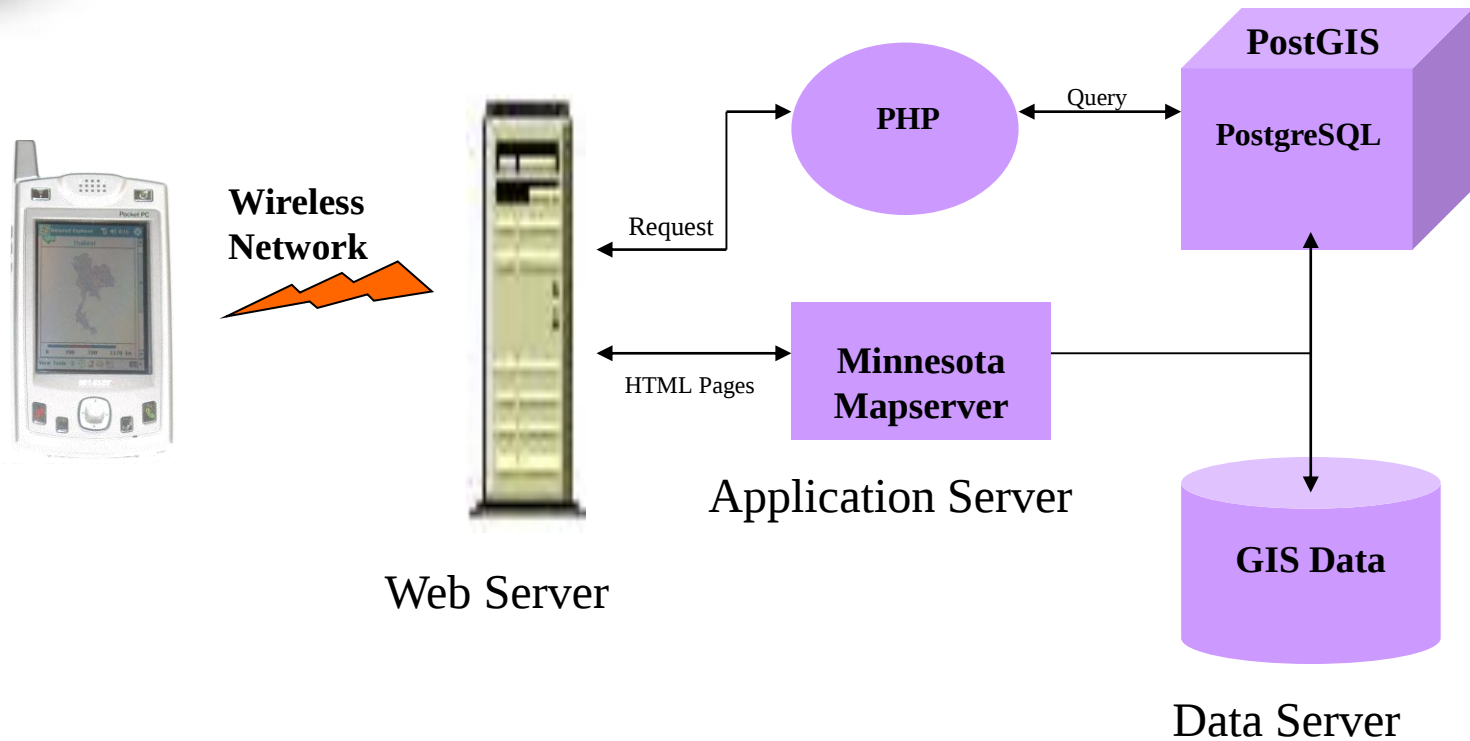
Mobile GIS

- Integrate GPS, rangefinders, digital cameras
- “Point and click” streamlined data collection
- Data held in spatially references datasets

Mobile GIS Architecture



Prototype Development





Internet GIS...

- **Internet Map Services**
 - Serving data/information
 - in the form of interactive maps
- **GIS Servers**
 - • Providing GIS functionality
 - via the Web
- **GIS Portals**
 - • True Portal with many Internet
 - Map Services and GIS Web Services
 - • Searchable metadata catalogue
- **Globe Services**
 - (3D globes on the Web)



Internet Map Servers and Wireless **Communication**

- WHY Internet Map Server (IMS)?
 - The storage problems in mobile devices (too small)
 - Multiple users access
 - Data Update for multiple users at the same time.
- **Internet Map Server → Intranet Map Server**
- Local access ONLY via Wireless LAN.
- (Wi-Fi or Wi-Fi5 broad bandwidths)



Characteristics of Mobile Environments

- Communication latency
 - Intermittent connectivity
 - Limited battery life
 - Changing client location
-
- All of these Characteristics impact data management in mobile computing.
 - The latency involved in wireless communication makes scalability a problem.
 - Since latency increases the time to service each client request, so the server can handle fewer clients.
 - Servers can use **Broadcasting** to solve this problem.
 - Broadcast well reduces the load on the server, as clients do not have to maintain active connections to it.
 - For example weather broadcasting.
-
- Client mobility also poses many data management challenges:
 - Servers must keep track of client locations in order to efficiently route messages to them.
 - Client data should be stored in the network location that minimizes the traffic necessary to access it.
 - The act of moving between cells must be transparent to the client.
 - Client mobility also allows new applications that are *location-based*.



Mobile Data Collection System

- Often referred as “Photo Logging”, “Right-Of-Way Imaging”
- A set of images are captured from a moving vehicle, with
- location and orientation information attached to them
- Images are cataloged for user-friendly retrieval
- Popular tool for managing transportation infrastructure asset
- data

Mobile Database

- Portable devices and wireless technology led to **mobile computing**.
- Portable computing devices and wireless communication allowed the client to access data from any ware and any time.
- There are some HW and SW problems that must be solved to make maximum exploitation of mobile computing.
 - i.e. Database recovery.
- Hardware problems are more difficult.
 - Wireless coverage.
 - Battery.
 - Changes in network topology.
 - Wireless Transmission Speed.





Mobile Database

- Mobile Ad-Hoc Network (MANET):

- In a **MANET**, co-located mobile units do not need to communicate via a fixed network, but instead, form their own using cost-effective technologies such as Bluetooth.
- In a **MANET**, mobile units are responsible for routing their own data, effectively acting as base stations as well as clients.
- **MANET** must be robust enough to handle changes in network topology.
 - Such as arrival or departure of mobile units.
- **MANET** can fall under P2P architecture.

1. Handheld computers

- Involves a GPS-enabled PDA (personal digital assistant)
- Diluted desktop GIS software; for example, ESRI UK's ArcPad
- Data; ideally, MasterMap from Ordnance Survey



2. What do PDAs provide?

- A voice recorder
- Word processor
- Spreadsheet
- Data logger
- Graphic calculator
- Digital camera
- Mobile phone
- Personal organiser
- Wireless communication device
- Email service

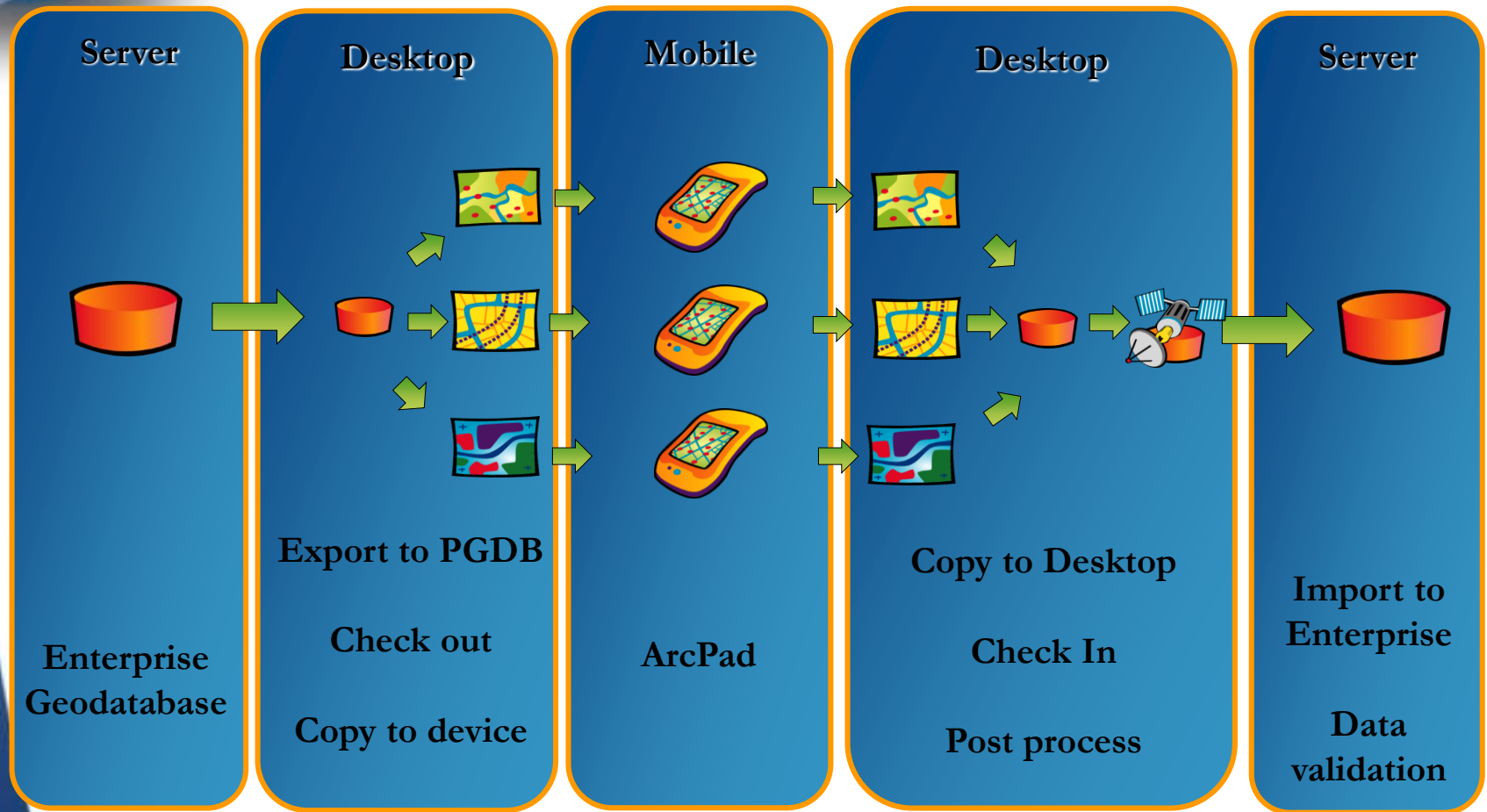




What is ArcPad?

- Part of ESRI overall mobile strategy
- A mobile GIS application for field mapping applications
- Designed for broad range of mobile systems
- Allows input from GPS receivers, rangefinders, digital cameras and other devices
- Provides a generic set of mobile GIS functionality
- Extensive customization capabilities
- Extends Geodatabase to the field through disconnected editing

Data Collection Workflow (server to server)



Trimble GeoXH

- Top of the Trimble product line
- Key Features:
 - Integrated GPS
 - Windows Mobile v5.0
 - 512mb onboard memory
 - Bluetooth & WLAN
 - \$5,295.00



TDS Recon X-Series

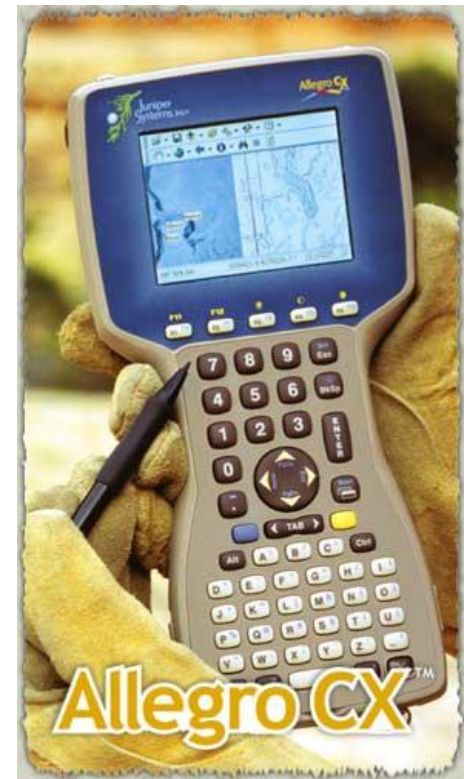
- Embedded Bluetooth & 802.11g WLAN
- Waterproof
- 17 ounces
- MIL-STD-810F & IP67
- 15 hours continuous typical use
- 200 or 400 MHz XScale processor
- Color display with front light
- 64MB RAM
- 128 or 256MB nonvolatile flash



Juniper Systems – Allegro CX

- Key Specifications:

- Intel XScale processor, 400 MHz
- Windows CE .NET V4.2
- 128M SDRAM
- 256M, 512M, or 1G Data Storage
- USB, COM1/2, Infrared, Bluetooth, 802.11b
- Color display (3.0”w x 2.3”h)
- Touchscreen, stylus, and keypad
- 10”h x 5.25”w x 1.5”d; 1.84lb
- MIL-STD 810F & IP67
- 12 to 20 hour battery life
- Integrated GPS



ITRONIX – GoBook Q.200

- Key features:
 - 400MHz Intel Xscale
 - Microsoft CE.NET 4.2
 - 128MB SDRAM
 - Compact flash slot
 - RS232, USB, IR
 - 10/100 Ethernet
 - 3.8” diagonal screen
 - 9.6” x 4” x 2.1”; 1.76lb
 - MIL STD 810F



Magellan – Mobile Mapper CE

- Key features:
 - 320 X 240 pixel touchscreen
 - Color & backlit
 - 7.7"x3.5"x1.8"; 1.05 lbs.
 - 128MB SDRAM
 - Expandable to 1 GB
 - 12-hour battery
 - Touch screen + keypad
 - RS-232, USB, Bluetooth
 - Integrated GPS



2T – Jett CE

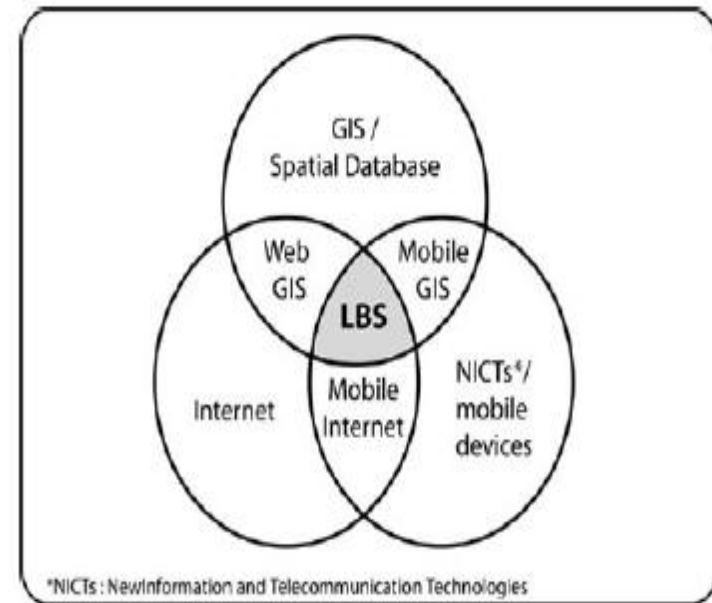
- Key features:
 - 320 X 240 pixel touchscreen
 - Color & backlit
 - 9.84"x4.75"x3.07"; 1.81 lbs.
 - 64MB SDRAM
 - Expandable to 2 GB
 - 8-hour battery
 - Touch screen + keypad
 - RS-232, Bluetooth
 - GPS not integrated



What is LBS ? ...

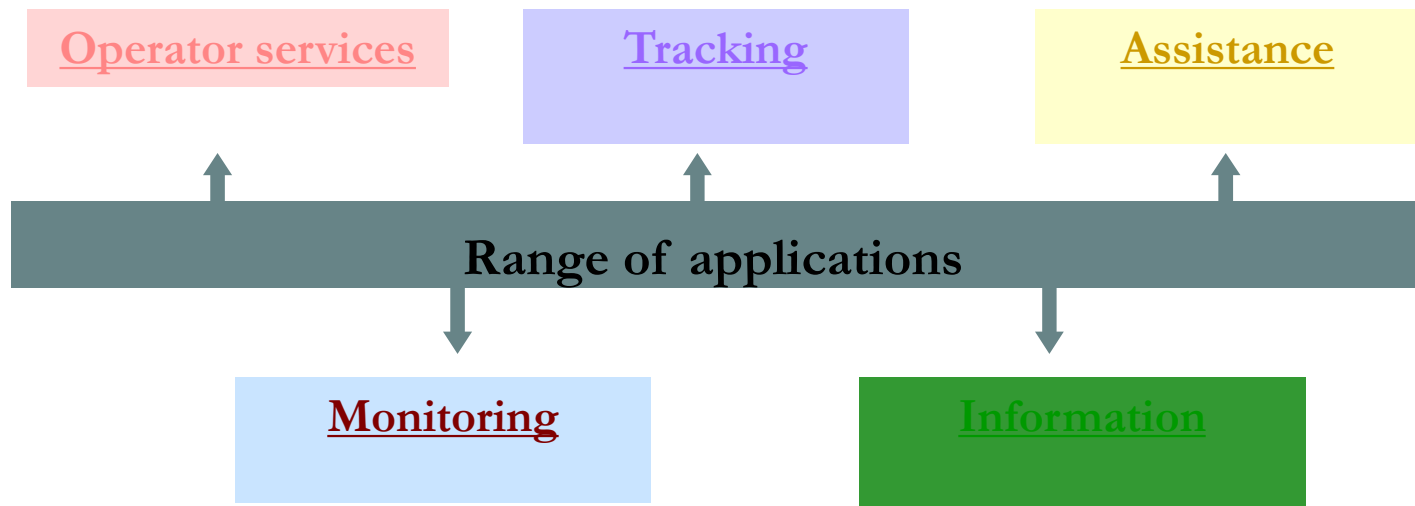
□ Definition 1 (OGC, 2005)

A wireless-IP service that uses geographic information to serve a mobile user. Any application service that exploits the position of a mobile terminal.



What is LBS ?

- ❑ Provide personalized services to mobile users based on their current location
 - Where am I?
 - What is the nearest restaurant, cinema ect.

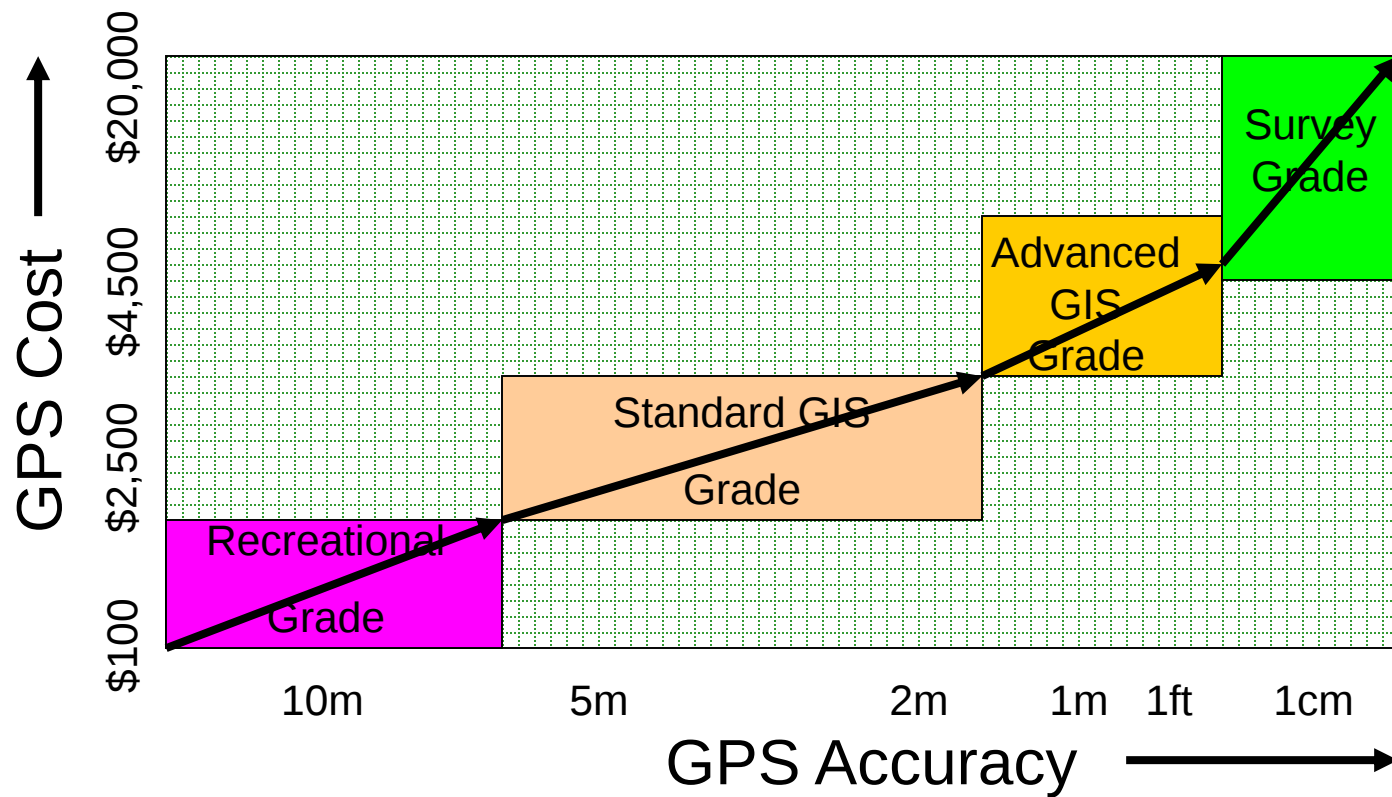




Mobile GIS Players

- Software vendors:
 - ESRI – ArcPad
 - multiple ArcPad extensions/customizations
 - Intergraph – Intelliwhere
 - MapInfo – MapXtend, MapInfo Mobile
 - Strata – PenMap
 - JTMaps – Todarmal
 - Bentley – PowerMap Field

Cost vs. Accuracy





Thank You