Satellite-based navigation systems and their application in Kyrgyz Republic

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Satellite based location technologies

- GPS
- A-GPS
- GALILEO
- GLONASS
Navigation: How can I go there? DIRECTION from my position to another location

«Position: Where am I? Name THIS location»

«Proximity information: What is nearby? Name a FEATURE’S location near my position»
Navigation Technologies - Present

- Primary
  GPS (USA)
  GLONASS (Russia)
- Secondary
  WAAS (USA)  Partially operational
  EGNOS (Europe)  Deployed, not operational
  MSAS (Japan)  Deployed, not operational
Navigation Technologies - Future

- Primary
  Modernized GPS (USA)
  Modernized GLONASS (Russia)
  Galileo (Europe+India+China+)
  QZSS (Japan)
  IRNSS (India)
- Secondary
  WAAS (USA)
  LAAS (USA)
  EGNOS (Europe)
  MSAS (Japan)
  GAGAN (India)
Global Positioning System
GPS Defined

GPS is a space-based radio navigation and time-transfer system capable of providing navigation data to users on or near the surface of the Earth any-time, any-where and under any-weather conditions with immunity to intentional/unintentional jamming.
1973—NAVSTAR Global Positioning System developed
1978—first 4 satellites launched
Delta rocket launch
**Objectives:**
1. Maintain each satellite in its proper orbital position (station keeping)
2. Make corrections and adjustments to the satellite clocks and payload
3. Track the GPS satellites, generate and upload the navigation data to each satellite
4. Command major relocations in the event of satellite failure to minimize the impact

1985: Operational Control Segment (OCS) began operations

- **Master Control Station**
- 6 Monitor Stations
  - Hawaii
  - Colorado Springs
  - Cape Canaveral
  - Ascension Island
  - Diego Garcia
  - Kwajalein
- 4 Ground Antennas

*SAC Bobal Campus, Ahmedabad, July 2008*
Space Segment

GPS Constellation

- 24 satellites (Space Vehicles or SVs)
- 20,200 km altitude (12 hour orbit period)
- 6 orbital planes (55° inclination)
- 4 satellites in each plane

GPS Nominal Constellation
24 Satellites in 6 Orbital Planes
4 Satellites in each Plane
20,200 km Altitudes, 55 Degree Inclination
User Segment

- Satellite Ops - Ephemeris, Timing
- Personal Navigation
- Power Grid Interfaces
- Surveying
- Agriculture
- Trucking & Shipping
- Aviation
- Railroads
- Recreation
- Mining
- Offshore Drilling
- Communications - Network Synchronization & Timing
- Fishing & Boating
- Public Safety
- Construction/Civil Engineering
- Environmental Management
Differential GPS (DGPS)

DGPS correction = $x+(30-5)$ and $y+(60+3)$
True coordinates = $x+25$, $y+63$
Correction = $x-5$, $y+3$
• GLONASS is Russian equivalent of GPS
• First a launched in 1982
• FDMA technique is used
• Satellites are at 65 deg inclination and at 19 thousand KM orbit
Galileo is European equivalent of GPS
- A total of 30 satellites are planned
- Satellites shall be placed at 23616 km orbit
- The first experimental satellite is launched in January, 2006
Comparison of GNSS Systems

**GPS**
- 6 orbital planes
- 24 satellites + spare
- 55° inclination angle
- Altitude 20,200 km

**GALILEO**
- 3 orbital planes
- 27 satellites + 3 spare
- 56° inclination angle
- Altitude 23,616 km

**GLONASS**
- 3 orbital planes
- 21 satellites + 3 spare
- 64.8° inclination angle
- Altitude 19,100 km
LBS
(Location Based Services)
What is LBS?

- Information services accessible with mobile devices
- Through mobile wireless network
- Presenting mobile device position by using GIS for an application
GIS / Spatial DataBases

WEB GIS

LBS

Internet

Mobile GIS

Mobile Internet

NICTs/ Mobile Devices
Components of LBS

1. Mobile Device (User)
2. Geodatabase
3. Positioning
4. Communication Network
5. Service and Content Provider
LBS Components and Information Flow

Positioning

Communication Network

User/device

Internet

Content/Data Provider

Services
- restaurant finder
- car navigation
- best friend locator
- vicinity map
- tourist city guide

company X
LBS Users in Western Europe and North America

- Street maps/mobile mapping
- Turn by turn driving directions
- Local traffic updates
- Pedestrian directions
- Mobile city guide (restaurants, shopping, etc)
- Location based games
- Child tracking
- Location enabled dating/mobile Matchmaking/date finder
- Friend finder/social network building
- Other

Years: 2003 to 2011

Users (M/ln): 5,000 to 30,000
Some examples of location-based services

- Requesting the nearest business or service, such as an ATM or restaurant
- Turn by turn navigation to any address
- Locating people on a map displayed on the mobile phone
- Receiving alerts, such as notification of a sale on gas or warning of a traffic jam

For the carrier, location-based services provide added value by enabling services such as:

*Resource tracking with dynamic distribution.* Taxis, service people, rental equipment, doctors, fleet scheduling.

*Resource tracking.* Objects without privacy controls, using passive sensors or RF tags, such as packages and train boxcars.

*Finding someone or something.* Person by skill (doctor), business directory, navigation, weather, traffic, room schedules, stolen phone, emergency calls.

*Proximity-based notification (push or pull).* Targeted advertising, buddy list, common profile matching (dating), automatic airport check-in.

*Proximity-based actuation (push or pull).* Payment based upon proximity (EZ pass, toll watch).
Applications: Location Based Services

1. Emergency Services - Search & Rescue, vehicle breakdown location
2. Navigation Services - Point to point route, Information on traffic etc.
3. Information Services - Local maps, Notification of near by places of interest.
4. Tracking and Management Services - Mobile supply chain management, Vessel/vehicle monitoring etc.
5. Billing Services - Dynamically charge particular users of a particular service depending upon their location when using or accessing the service.
Conclusion

After all, we need measurements of space and time for almost all our activities and LBS provides these.

Hence, LBS will influence our life more than any other technological advent.