

Smart Devices Sensors

Smart Device Sensors

❖ Accelerometer

- Measures acceleration
 - Rate of change in velocity
- MEMS (Micro Electro Mechanical System) Sensor
- Uses Gyroscope sensor information
- Applications
 - Smartphones & Smart Watches
 - Flight & Driving Stabilization
 - Drones, Airplanes, Missiles, Cars, Buses, Trains, etc.

Smart Device Sensors

❖ Accelerometer

- Sensing Measurements
 - Acceleration due to Earth's gravity
 - Inertial navigation systems
 - Vibration
 - Machinery Rotation
 - Upright & Tilted Positions
 - etc.

Smart Device Sensors

❖ Gyro (Gyroscope Sensor)

- Measures changes in
Orientation & Angular Velocity
- Gyroscope Sensor Types
 - Microchip packaged MEMS gyroscopes
 - Commonly used in smart devices
 - Solid-state ring lasers gyroscopes
 - Fiber optic gyroscopes
 - Quantum gyroscopes

Smart Device Sensors

❖ Heart Rate Sensor

- Optical Infrared Light Sensor
- Operation Mechanism
 1. Infrared light absorbed by the blood is measured
 2. Infrared light darkening occurs from an increase in the amount of blood due to a heart pulse
 3. Infrared light darkening period is the estimated Heart Rate

Smart Device Sensors

❖ Barometer

- Measures atmospheric pressure
- Used in meteorology & atmosphere sensing
- Atmospheric pressure is used in altitude estimations
- Barometers & Pressure Altimeters

Smart Device Sensors

❖ Barometer

- Barometers & Pressure Altimeters
- Barometer
 - Stationary sensor used in measuring subtle pressure changes in the weather
- Altimeter
 - Transportable barometer device used for on-site atmospheric pressure measurements

Smart Devices
GPS

Smart Device GPS

❖ GPS (Global Positioning System)

- Created by the U.S. Army in 1978
- GPS device communicates with 4 or more satellites to determine its exact location
- Location Coordinates
 - Longitude, Latitude



Smart Device GPS

❖ A-GPS (Assisted GPS)

- Uses information from GPS satellites with help from position information from the mobile network assistant servers
- Works the same way as GPS
- Location Coordinates: Longitude, Latitude
- Accurate time information of the mobile network can help to improve accuracy

Smart Device GPS

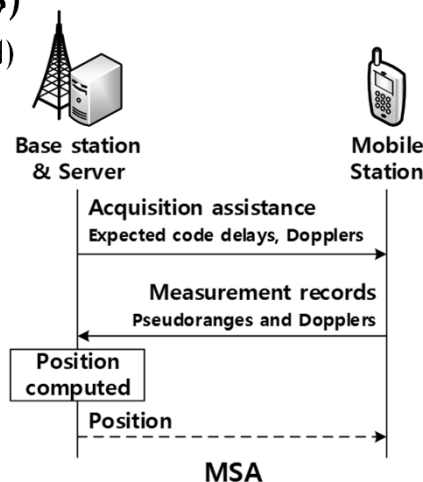
❖ A-GPS (Assisted GPS) Types

- MSA (Mobile Station Assisted)
 - Position calculation is done by the server using information from a mobile station
 - Mobile station captures a snapshot of the GPS signals and receives help from the A-GPS server to find its location
 - A-GPS server has good GPS satellite signal reception and plentiful computation power

Smart Device GPS

❖ A-GPS (Assisted GPS)

- MSA (Mobile Station Assisted)
 - Mobile station receives acquisition assistance
 - Mobile service provider continuously logs GPS information from GPS satellites with help from the A-GPS server
 - A-GPS server calculates the position and sends it to the mobile station



Smart Device GPS

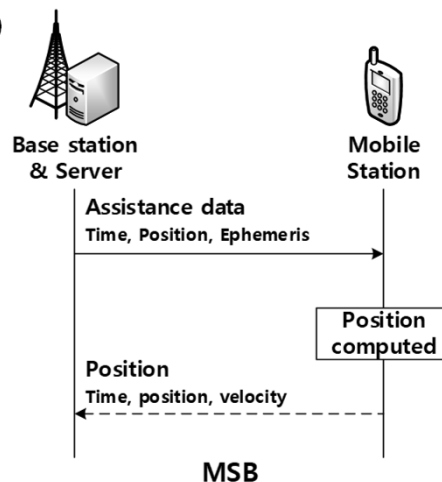
❖ A-GPS (Assisted GPS) Types

- MSB (Mobile Station Based)
 - Information is used to acquire satellite positioning signals more quickly
 - Supplies orbital data or almanac for the GPS satellites to the mobile stations
 - Enables the mobile station to lock on to the satellites more rapidly (in some cases)
 - Mobile network can provide precise time

Smart Device GPS

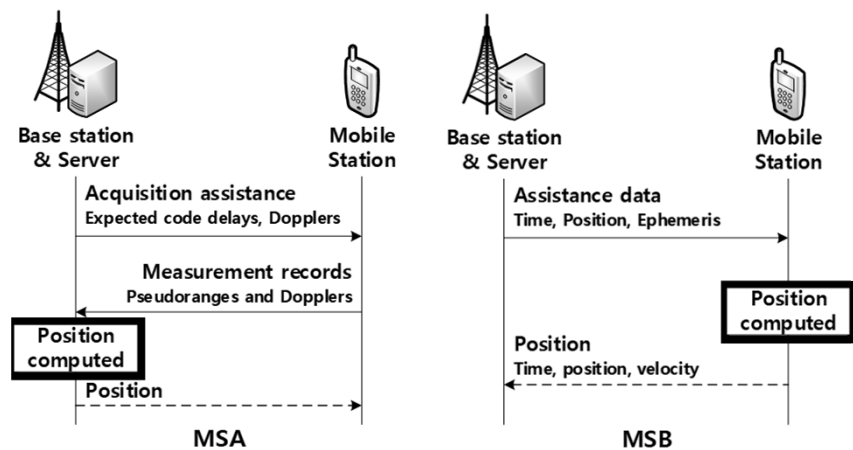
❖ A-GPS (Assisted GPS) Types

- MSB (Mobile Station Based)
 - Mobile station receives assisting data from the A-GPS server
 - Mobile station receives signals from the visible GPS satellites and calculates its position



Smart Device GPS

❖ A-GPS Type Comparison



Smart Device GPS

❖ GPS & A-GPS Comparison

	A-GPS	GPS
Signal Information	GPS satellite signals & assistance servers	GPS satellite signals
Speed	Faster location coordinate determination (by using connectivity with cellular base stations)	May take several minutes to determine location (requires connectivity with 4 or more satellites)

Smart Device GPS

❖ GPS & A-GPS Comparison

	A-GPS	GPS
Reliability	A-GPS could be slightly less accurate than GPS	Can achieve within 1 meter accuracy (with sufficient GPS signals)
Cost	Cost of mobile network usage	No cost
Usage	Mobile phones, smart devices, etc.	Cars, planes, drones, robots, ships, boats, etc.

Smart Device GLONASS & BDS

❖ GLONASS (Global Navigation Satellite System)

- Operated by the Russian Aerospace Defense Force
- Satellite navigation system for vehicle and aviation navigation



❖ BDS (BeiDou Navigation Satellite System)

- China's second generation satellite navigation system



Smart Devices References

References

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Image sources

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References

Image sources

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