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Recent trends in Satellite Navigation

GPS

- The Global Positioning System (GPS) is a satellite radio navigation system developed by the Department of Defense (DoD) of the USA. The system makes use of a medium earth orbit satellite constellation transmitting microwave signals allowing a GPS receiver to determine its position, velocity and time

- GPS (Global Positioning System) is a satellite navigation system that furnishes location and time information in all climate conditions to the user. GPS is used for navigation in planes, ships, cars and trucks also. The system gives critical abilities to military and civilian users around the globe. GPS provides continuous real time, 3-dimensional positioning, navigation and timing worldwide

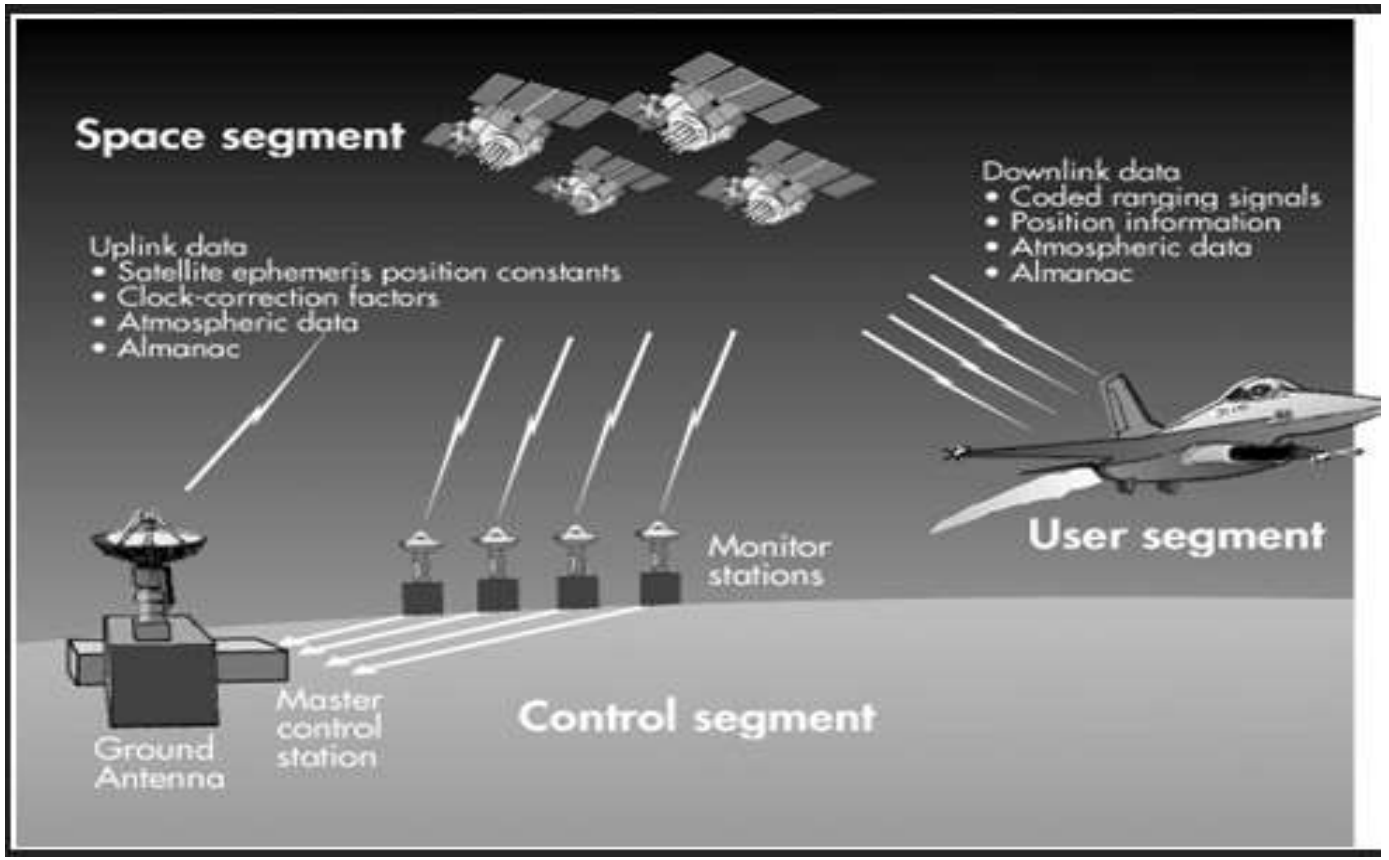
The GPS system consists of three segments:

1) The space segment - the GPS satellites

2)The control system - operated by the U.S. military

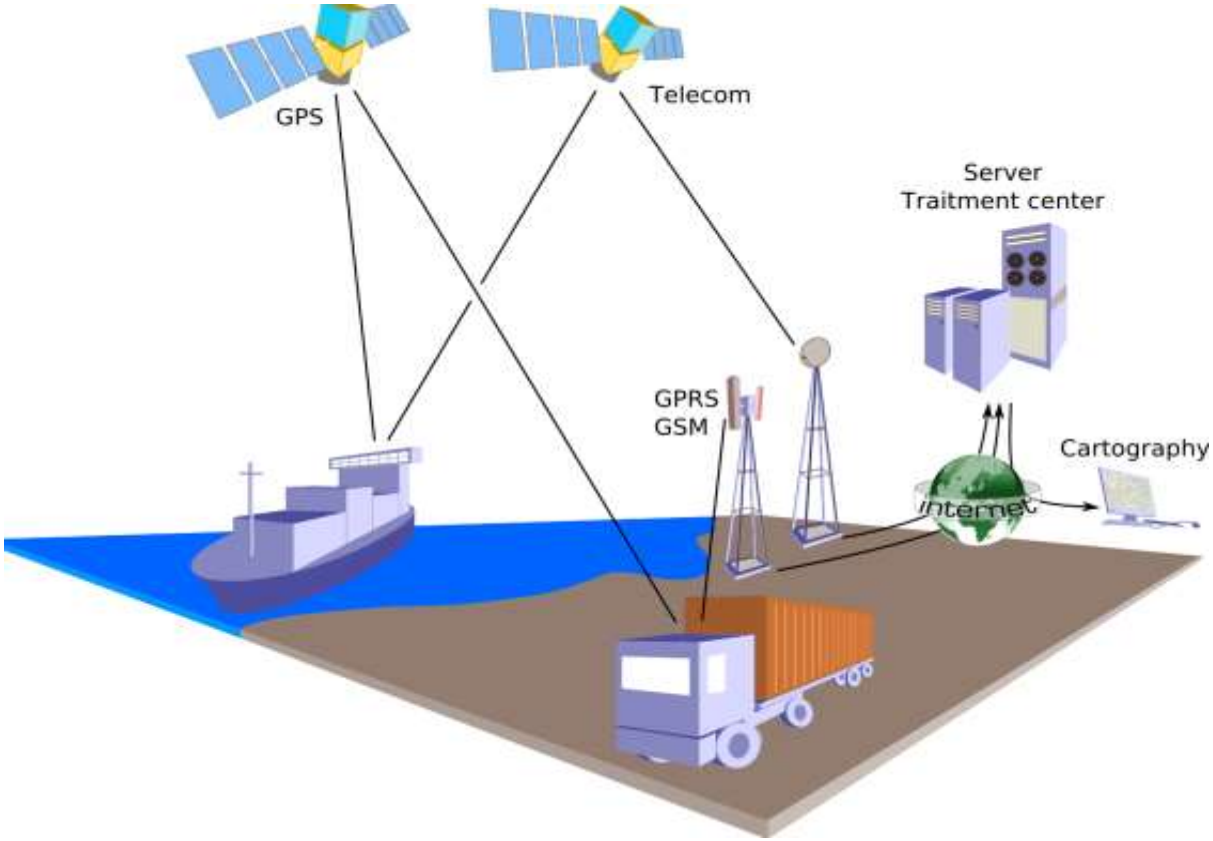
3) The user segment - which includes both military and civilian users and their GPS equipment

Space Segment:

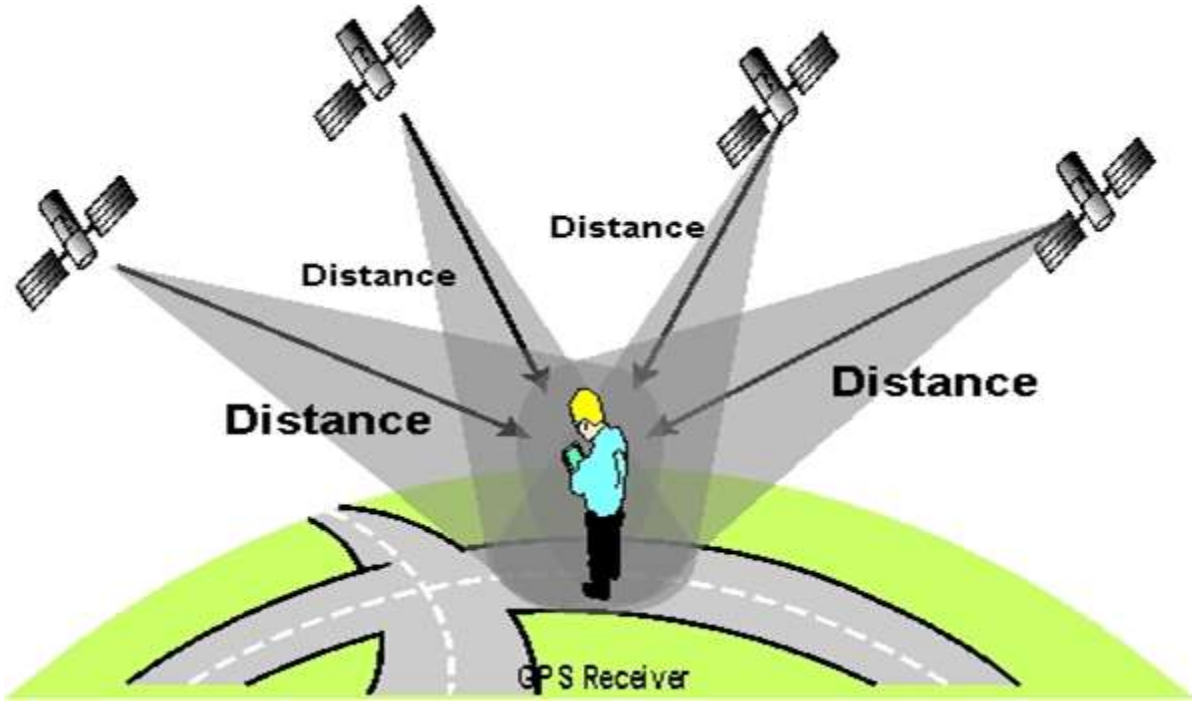


Control segment:

User Segment:



GPS Determines a Position



Advantages of GPS

- GPS satellite based navigation system is an important tool for military, civil and commercial users
- Vehicle tracking systems GPS-based navigation systems can provide us with turn by turn directions
- Very high speed

Disadvantages of GPS

- GPS satellite signals are too weak when compared to phone signals, so it doesn't work as well indoors, underwater, under trees, etc.
- The highest accuracy requires line-of-sight from the receiver to the satellite, this is why GPS doesn't work very well in an urban environment

GPS Receiver

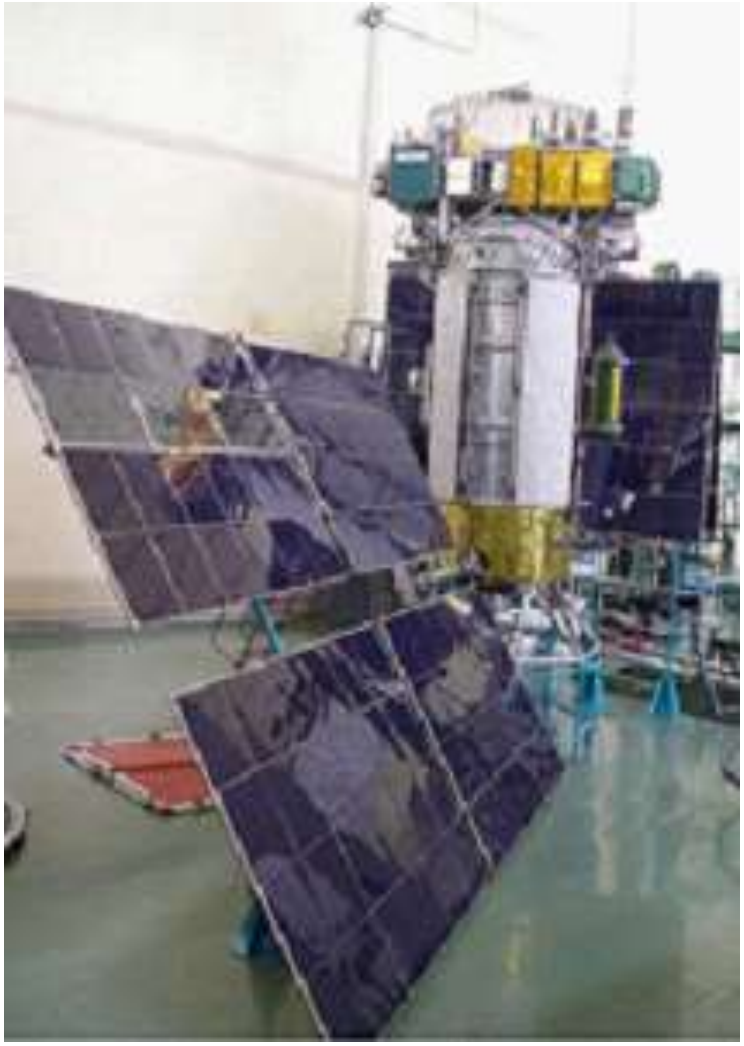
There are several different models and types of GPS receivers. While working with a GPS receiver it is important to have :

- A compass and a map
- A downloaded GPS cable
- Some extra batteries
- Knowledge about the memory capacity of the GPS receiver to prevent loss of data, decrease in accuracy of data, or other problems
- An external antenna whenever possible, especially under tree canopy, in canyons, or while driving
- A set up GPS receiver according to incident or agency standard regulation; coordinate system
- Notes that describe what you are saving in the receiver

GLONASS

- GLONASS (Global Navigation Satellite System) is a radio-based satellite navigation system initially developed for the use by the Soviet military. It was the Soviet's second generation satellite navigation system, improving their Tsikada system which required one to two hours of signal processing to calculate a location with high accuracy.

- The time of observing more than four satellites is limited because GLONASS does not form a complete GNSS currently. But according to state policy, GLONASS is proposed to be full operational by the year 2010, and at the same point to be compatible and interoperable with GPS and future Galileo. The GLONASS development goal is to create more opportunities for the GNSS application developers, allowing them to provide value-added services to end-customers



GLONASS-M satellite

Current, generation of satellites, known as Uragan-M (also called GLONASS-M), were developed beginning in 1990 and first launched in 2001. These satellites possess a substantially increased lifetime of seven years and weigh slightly more at 1,480 kg. Laser corner-cube reflectors are installed as aid for precise orbit determination and geodetic research. GLONASS satellites are equipped with Caesium clocks onboard to provide time and frequency standards.

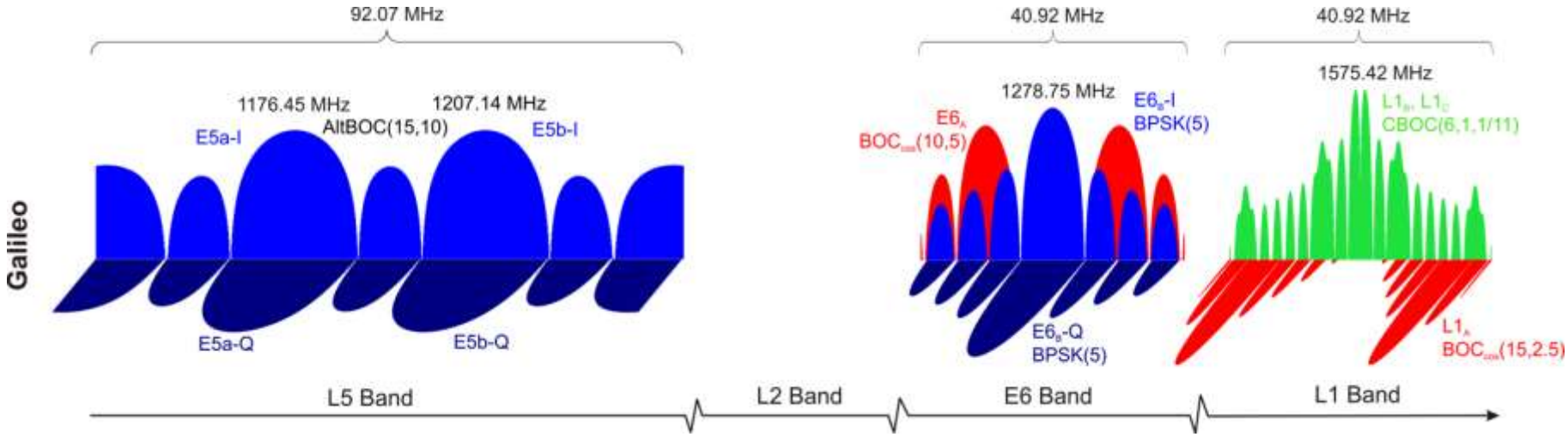
GALILEO

- Galileo has recently been discussed because of its benefit due to its improved technical capabilities compared to the American GPS but mainly because of the delay of satellite launches, problems in funding and questions of competence within the European Union. Based on the Communication [EC, 1999] of the European Commission on February 9, 1999, the development of Galileo has been decided.

Carrier frequencies and Signal definitions of Galileo.

It can be seen, that Galileo uses three frequency bands:

- In the lower L-Band
- E5a (overlapping with the future GPS L5)
- E5b with a bandwidth of 24 MHz each



Galileo Signal Definition

Navigation Satellites of different countries

System	BeiDou	Galileo	GLONASS	GPS	NAVIC	QZSS
Owner	China	EU	Russia	United States	India	Japan
Coverage	Regional, global by 2020	Global by 2020	Global	Global	Regional	Regional
Coding	CDMA	CDMA	FDMA	CDMA	CDMA	CDMA
Altitude	21,150 km (13,140 mi)	23,222 km (14,429 mi)	19,130 km (11,890 mi)	20,180 km (12,540 mi)	36,000 km (22,000 mi)	32,000 km (20,000 mi)
Period	12.63 h (12 h 38 min)	14.08 h (14 h 5 min)	11.26 h (11 h 16 min)	11.97 h (11 h 58 min)	23.93-23.94 h	
Rev./S. day	17/9	17/10	17/8	2		
Satellites	15 in orbit (Sep 2018) 30 by H1 2020[17]	26 in orbit 6 to be launched[17]	24 by design 24 operational 1 commissioning 1 in flight tests[18]	**31**,[19] 24 by design	3 GEO, 5 GSO MEO	4 by the late 2010s, 7 final goal
Frequency	1.561098 GHz (B1) 1.589742 GHz (B1-2) 1.20714 GHz (B2) 1.26852 GHz (B3)	1.164–1.215 GHz (E5a/b) 1.260–1.300 GHz (E6) 1.559–1.592 GHz (E2-L1-E11)	~1.602 GHz (SP) ~1.246 GHz (SP)	1.57542 GHz (L1) 1.2276 GHz (L2)	1176.45 MHz(L5) 2492.028 MHz (S)	

Reference

- NPTEL
- Internet