

Digital Land Surveying & Mapping (DLS&M)
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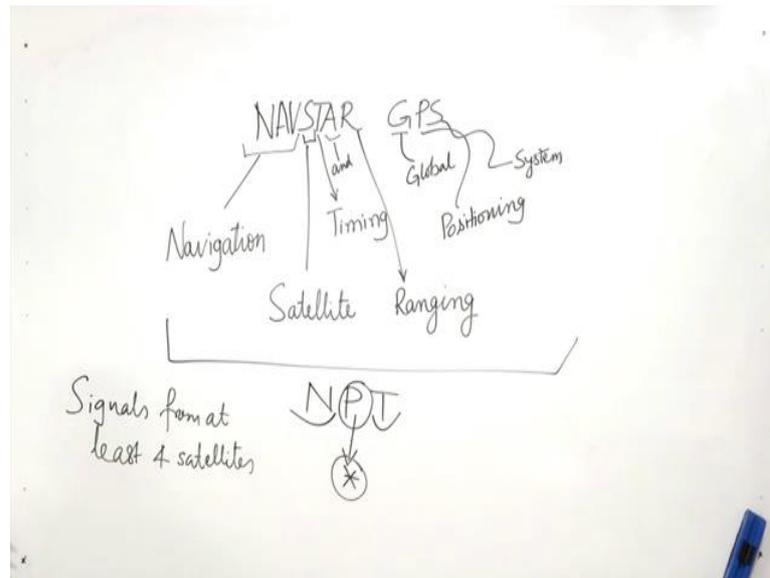
Lecture – 04
Global Positioning System (GPS)
Introduction

Welcome students, this is the 4th lecture on digital land surveying and mapping course. Today I will be discussing on global positioning system its introduction and I have already told in the last class that we make use of GPS for establishment of control point and by the name itself control point you can understand that that is the most important point and its location have to be very accurate. So, we should be very careful in getting the location of the point and for that we need to know thoroughly about how really GPS works and we end up with a good control point, good means should be accurate.

However before going to that part how to process that at a how to end up with a good solution for control point we need to know first about the system. So, today's class we will be talking on the system the global positioning system. Now this class I will discuss on with this content like first I will introduce what is GPS a global positioning system and then simply I will tell today about the architecture of the system; that means, really what are the components of a GPS system really we are having.

Now, actually GPS is a name, it is the small; that means, this (Refer Time: 02:13) we can say; its name is Navistar GPS; Navistar stands for navigational satellites for timing and ranging and GPS stands for global positioning system.

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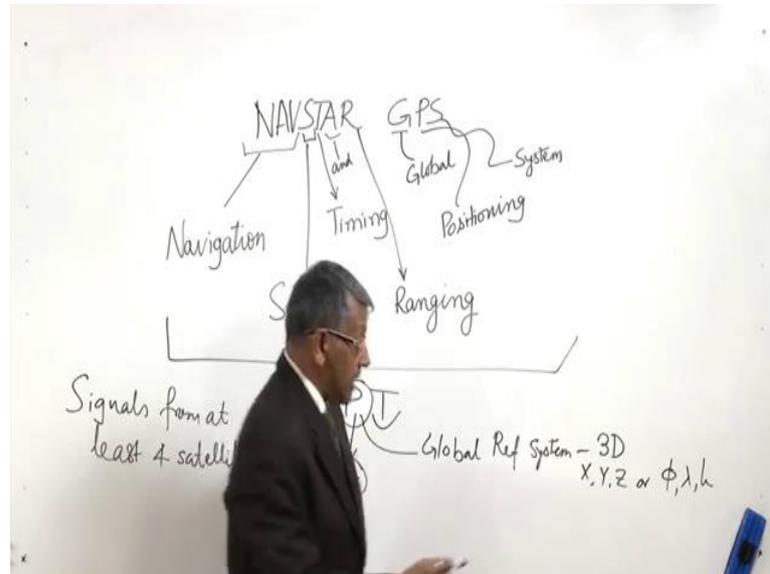
So, we are actually studying the system called Navistar GPS where Navi stands for navigation in navigation, S for satellite, T for timing, A for and R for ranging. So, navigation satellite for timing and ranging and G for global for P for positioning S for system, the navigational satellite for timing and ranging global positioning system this is what we are trying to learn in this course and the first model of the course.

Now, it is a space based navigation system which provides us very accurate navigation position and time. So, though we are using the system for the positional purpose, but this system is also very good for navigation and also it is a very precise system for forming out time; however, we are concentrating much on this point to make use of GPS for finding out the position of any location or station and specifically in these course will be using GPS for finding out the location of our control point. Now the duty of this system is that this system is available all throughout the world at any time in a day any day in the year and at least 4 satellites are available at an instant of time.

So, signals from 4 at least 4 sig signals from at least 4 satellites are available at any location on the surface of the earth at any point of time whether it is day or in the night whether it is a sunny day or a winter or rainy day. So, that is; that means, it is an epicotylys system always it is available may use and we can make use of the same system by infinite number of people at the same instant of time that is another important

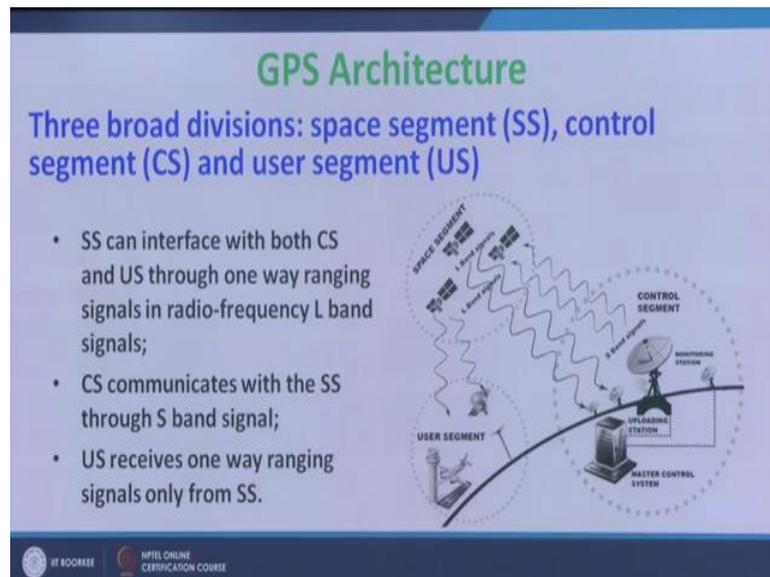
advantage or available T of this system not only that this system provides us the position in a global reference system that is also very important point global reference system.

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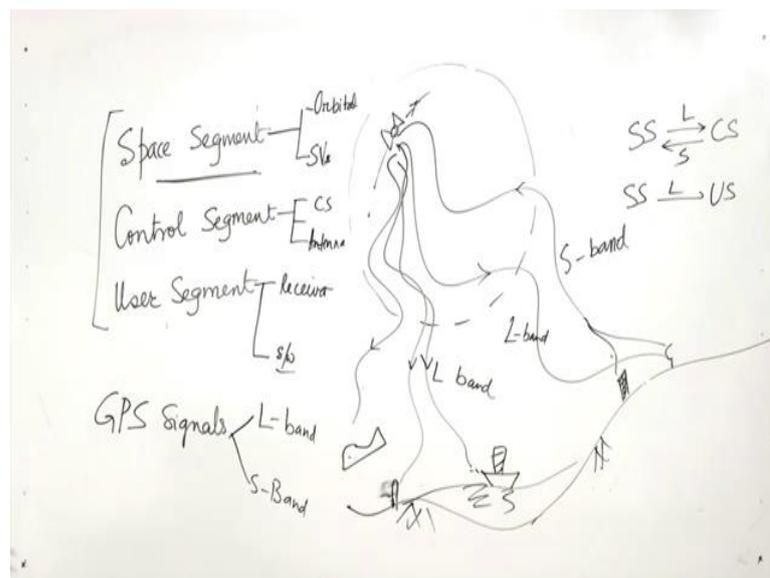


So, whatever position we get for any point that is respect some global references system and 3D position; that means, we will get the either in citation system X, Y, Z or in geodetic system latitude longitude and geodetic height. So, we can see that this system in easily available also it can provide us the position quite simply. So, thus economically and that is a reason why we are looking for this system for establishment of our control point.

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Now, the system architecture of the system; that means, really what are the components or what are the now the GPS system consists of 3 broad segments that you can say the space segment and then another is called control segment and the user segment now from the minute cell we can understand the space segment means it is the part of the GPS system which is available in the space and the space segment actually consists of 2 parts one is that the a orbital part; that means, the there are some certain orbits around the earth along each the satellite VAC of the other part satellite vehicles voted around the earth. So, the orbital part and the satellite vehicle parts are the 2 parts which constitute

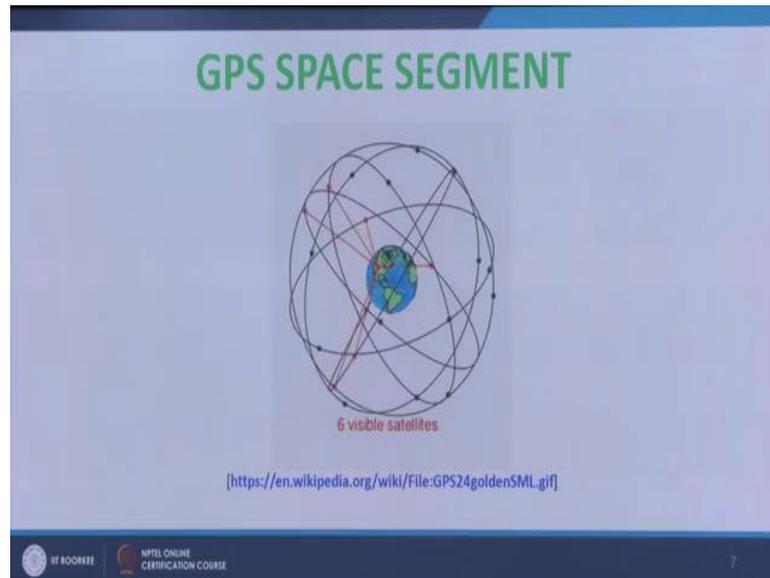
the space segment and the control; that means, then over control segment actually control segment consists of some control stations and some antenna the control station controls the activity of the GPS.

This is the surface of the earth some antenna are there some control stations are there. So, these control stations and the controls the activity of the GPS satellites and antenna is made used to receive our sending the signal to send to satellite vehicle and then our user segment which is of 2 part again, one is that our GPS receiver and some surfer to process the data that will be (Refer Time: 10:17). So, you can say that anybody person someone is using; that means, aircraft nowadays use the then your ship always than human being. So, apart from that actually they this all these they are the GPS signals. Now there are 2 types of GPS signal one is called L band and another is S band (Refer Time: 11:09) actually the space segment get connected to control segment by S band; that means, antenna in the control segment sends signal to the space segment through S band and; however, it receives signals from the space segment using L band

And the; that means, between space segment and control segment there are 2 way communication is placed possible from space segment to control segment it is the L band and from control segment to it is the S band; however, the (Refer Time: 12:16) only gets signal from space segment; that means, (Refer Time: 12:20) segment have no connectivity with the control segment.

So, it only the (Refer Time: 12:26) signal from space segment. So, that is what in short about the GPS architecture. Now in the space segment there are actually some fixed orbital lines which is designed along with these satellite vehicles both and they are designed in such a way that as I told you GPS will be available for any person at any point at any time on the surface of the earth at least 4 satellites or signal from 4 satellites will be available. So, that is the way how the orbital path has been designed and the spacing of the satellites were kept.

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So, here is the figure you can see at any point in this figure you can see that at any point on the surface of the earth that the say this is the orbit along which satellite shown by black or red dots and which are revolving around the earth and at any point on the surface of the earth the signals from satellite are coming which is shown by red line and if you see that at any point on the surface of the earth every (Refer Time: 14:17) instead of time there will be at least 4 satellites that will be variable at this signals from 4 satellites will (Refer Time: 14:30). Now I am finding that signals are coming from six seven eight sometimes nine or ten even more than that in many other places. So, this is what is the space segment.

So, the only which is most important thing about this space segment with respect to user segment is that the signals from at least 4 satellites should be available to us at any instant of time and next control segment as I told you control segment then they really consists of 2 part one is that control stations and antenna.

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CONTROL SEGMENT

Comprises :
2 Master Control stations (MCS)
16 Monitoring stations
12 Ground Antennas

Monitoring station

- Check position, speed, altitude and health of tracked SVs
- Collects GPS signals, navigation data, atmospheric data, gravity measurements and their variations.
- Pass collected information to MCS.



Geo-locations of Control Stations

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Now, control stations are going up 2 types: master control station and monitoring station. Now, master actually there are 2, 16 monitoring stations which are spread all over the world. In this, where you can see the monitoring station given by round dots. So, these are monitoring stations and these are spread over all over the world. One more thing you can note down: initially, the monitoring station was near the equator (Refer Time: 16:04) plane, and later it has been taken up to twenty-third or thirty-degree latitude plus minus. Most of them are there, but if you would divide them, they are mostly concentrated with the mean zone.

So, that is the advantage; there will be some advantage from the design point of view which is beyond the scope of this (Refer Time: 16:25) anyway. So, monitoring stations monitor the satellites that are revolving around the earth and they receive signals from the satellites and then they make use of also they take many other data from the satellites as it is written here, and those data from the monitoring station they send it to the master control station. The master control station is given by a red star. Now, actually there are 2 master control stations, but of these one at (Refer Time: 17:06) that is the main master control station and another near California that is a subsidiary master control station earlier.

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CONTROL SEGMENT....

MCS

- computes space coordinates of SVs
- Evaluates health of SVs
- Generates navigation data
- Performs satellite maintenance
- Resolves satellites' performance anomalies
- Maintain optimal GPS constellation.
- Through ground antennas, MCS provides commands, keeps control and uploads navigation messages and other data to the GPS satellites.

Ground Antennas

- collects, stores data from MCS
- CS provides commands and keeps control on satellites;
- Uploads to the GPS satellites using S band signals (2–4 GHz).

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So, all these monitoring stations and the data that has been captured from the satellites revolving around and send it to the monitoring master control station actually whole control most of the control has been with the master control station; master control station once it receives the data from monitoring station they do make all the processing. And then they compute the location of the satellite vehicles at define instant of time they (Refer Time: 17:52) the health of the satellite vehicle they generalize the navigation data and all other control information they generates and owns master control station generates the information they send it to ground antenna. Now ground antenna collects stores data from master control station and it keep some watching these satellites that is moving around and when (Refer Time: 18:25) whenever it track some satellites is moving above it its founded whether that satellite for that satellites there is very information it has stored or not

If it has store then it compose using the S band signal. So, that is what about the ground antenna. So, ground antennas actually upload the data to the satellites vehicles. So, in that way control segment works, but that is in the background we need to know, but we do not have much to have this (Refer Time: 18:59) with the control segment as a user for user it is the user segment which is most important.

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USER SEGMENT....

The user segment of GPS system consists of an electronic hardware, the GPS receiver and software.

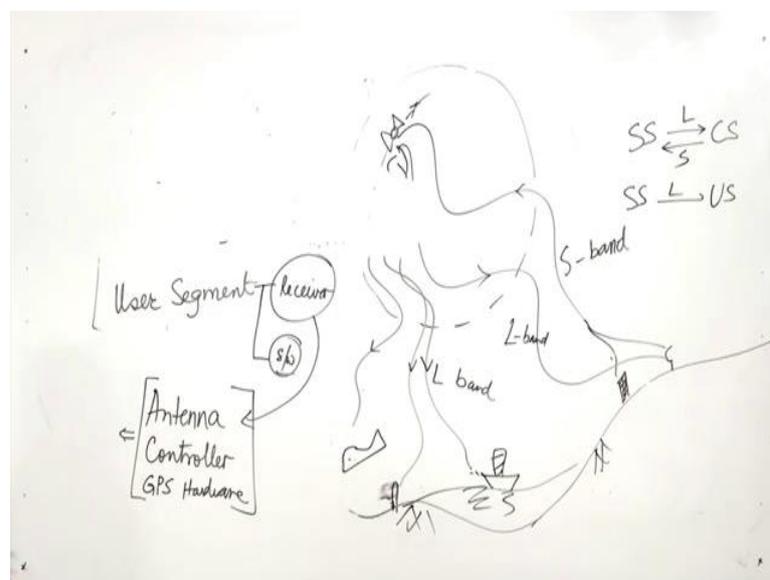
- GPS receivers fundamentally consist of three basic constituents: antenna, GPS receiver and controller and a controller.
- Interconnected



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So, we need to know in the goal about the user segment and also we need to know about the signal. So, in this class I will rustic up to user segment in the next class, I will go for GPS signal.

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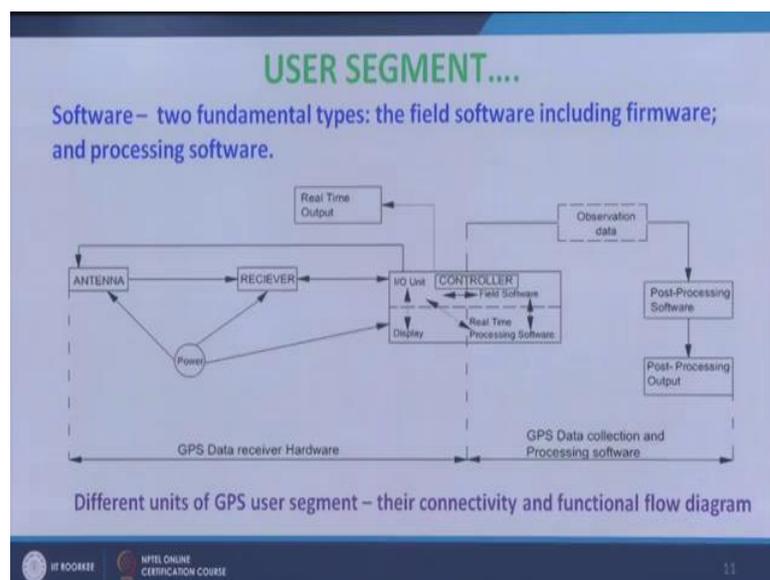
Now, that user segment consists of a receiver and (Refer Time: 19:34). Now GPS receiver it is an electronic instrument, it has 3 fundamental parts the most important the constituents are antenna and then controller as well as P; GPS hardware, these are the 3 components of receiver; GPS receiver. Now how depending upon the type of the receiver

these components may be independent unit which has to be connected before we use or in some cases these 3 n components are put together or in some cases (Refer Time: 20:33) 2 of this may be composed together.

So, depending upon what receiver will use now in these case you can see the 3 components are independent this is the antenna which has been placed on a tripod stand. So, this is the control point or station on which we want to take the GPS data this is the part which is the controller and this is the part with is the GPS receiver hardware. So, and there is a there is a connectivity between receiver with the antenna and there is a connectivity between the controller and the receiver. So, and in these the antenna actually receives the GPS signal which it conveys through this connection to the receiver. Now the antenna will receive the data from the GPS receiver e as per the guideline it receives from controller through receiver and also controller has connectivity with receiver and receiver also receives the signal from antenna as per the instruction it provide it gets from the controller.

So, controller actually a part of the instrument which controls whole activity of the GPS receiver and now here and one more thing these activities the controller does making use of some software.

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So, they are like the use of software, now in this flow diagram, it is shown how the different parts of the GPS receiver works together you can see you here this is the

antenna this is the receiver this in the controller, now antenna is connected with the receiver and also antenna is connected with the controller. So, as we (Refer Time: 23:06) all these are having the power and this is the part which I am taking as the GPS data receive hardware and this is the part which is related to GPS data collection and software.

Now, as we make the power on. So, after all the parts get connected if we make the power on controller will provide some instruction to antenna and as per the instruction of the controller antenna will receive signal from satellites. Once it receives the signal from the GPS satellites it will send the satellite signal to the receiver and receiver will receive the signal as per the instruction given by the controller. So, controller is controlling not only the reception of the signal from GPS satellites, but also the reception of the signal from antenna to receiver.

Now, within this receiver there are software which it uses to receive the signal from antenna as well as it process the data and the data processed has to be stored within the receiver or it will convert to the controller depending upon what the controller instructed. Now you can see here the input output unit controller is also having input output unit (Refer Time: 24:41) which it provides input or it gives the output take out output there is a display unit in the controller there is a free software which process the data also and real time processing software. Now controller once it receives data from receiver or it can directly tell to take out the observation data. Now these data may be stored either in the receiver or in the controller, now, as per the instruction from the controller this absorbed data may be transferred to the computer having the post processing software.

Now, post processing software who; that means, this is the importing of the data as I told in the last class. So, after the data has been imported either from the receiver or from the controller it will get processed and the process data will be the output, which is the location of the GPS control point. So, this is in short how the user segment work. Now here you can see a part of this in the GPS receiver hardware and a part of this is the GPS software. So, that is what constitute the user segment and in future we will learn more about it now.

So, with this I would like to conclude today's class, but before I would like to summarize about today's class GPS if the full name is Navistar GPS it is a radio navigation system

which is available for the user to use all throughout the day and all days in a year and at an instant of time we will be getting signal from at least 4 satellites and it is a very efficient and economic system for finding out the position.

Also it provides very good navigation as well as we can go for very precise estimation of time GPS consists of 3 segments the space segment control segment and user segment; however, we as a user it is a user segment which is most important consisting of GPS receiver hardware and processing software. And the GPS you see the hardware consists of a antenna which receives signals from GPS satellite it transport the signal to the GPS receiver from the it may go to the controller and by using some software this data or the process to get the position of control point in WGS 84 coordinate system which is a global reference system.

So, with these I would like to conclude and there is some relocations given to you which you should prepare after this going through these slides and in the next class I am going to talk on GPS signal which we like to receive form GPS satellite vehicle.

Thank you.