Global Navigation Satellite Systems and Applications
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Lecture – 20
GNSS: Opportunities in India

Hello everyone and welcome to the last lecture of this Global Navigation Satellite Systems and Applications course. Though it has been smaller course of only 10 hours, twenty lectures but we try to cover almost everything, sometimes maybe briefly about different aspects associated with GNSS that is Global Navigation Satellite Systems. I have also few times mentioned that this is a very fast growing technology as electronics and mobile technology is improving or increasingly becoming more reliable, so this technology is.

So the growth and future of this technology is going to be almost the same pace as smart phone technologies. In this particular lecture, we are going to focus basically the GNSS opportunities in India. How things are going to evolve based on the current and past experiences but as in the previous lecture, we have discussed that the hard thing in this GNSS thing is to predict the future. But anyway we will try to see that, what are the opportunities in India and how this can benefit the whole society.

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So, you know that one of the largest markets in Asia is located in India about GNSS market or users. And the users are having wide spectrum, users are there from navigations of all types of navigations; road, air and water navigations, maybe geographic data collections in the field service, civil engineering service, topographic service or even cadastral service and even in the census service, GNSS receivers are being used extensively because the availability and reliability is becoming very satisfactory as per the requirements.

Location based services also there. This market is growing in India. Agriculture also whoever is having large farming, they are looking these options how to improve, how to make more beneficial, profitable by employing new technologies including the GNSS. And one of the major users of GNSS facilities or opportunities is the disaster management that is basically search and rescue management. Whether it is during flood time or maybe in earthquake, maybe in cyclone, even in avalanches or trekking, this GNSS is there.

So, one by one we will look the current scenarios and future predictions in different sectors like in aviation sector, a spacecraft that IRNSS system is developed basically to reduce the country's dependency on GPS. When we started discussing during initial lectures of this course, we also discussed that why India has developed its own constellations or own navigation system rather than utilizing the others.

For example when in 1999, the Kargil war occurred and then USA stopped the services to India that is GPS services and our defense forces faced a big difficulties to handle that situation without having any navigation systems. So after that government decided that we will have our own navigation system rather than depending on others especially during in case of war or in case of some natural disasters, the services from others may not be available.

But mainly in war situation that was the main purpose. So, IRNSS was developed that is now called NAVIC and currently it is not open so far in the civilian world but army people, defense personals are definitely using their one. In aviation sectors also, they are using this one. And of course, there has to be in future that there will be more users once it becomes open to civilian and in all sectors.

And the first one was on the spacecraft to a limited extent then we go for aircraft that is civil aviation. So, like a civil aviation, Ministry of Civil Aviation in recent past has decided to implement an indigenous SBAS systems along with the of course, IRNSS so that within the Indian subcontinent, we can get the accurate navigation facilities. So, this Satellite Based Augmentation System is very much is there.

In the future, this civil sector is also likely to be used in non civilian aviation sectors like maritime applications, improved surveying and cartography there; basically in topographic surveys and in many scientific researches including studies related with crustal deformations or ground deformation studies.

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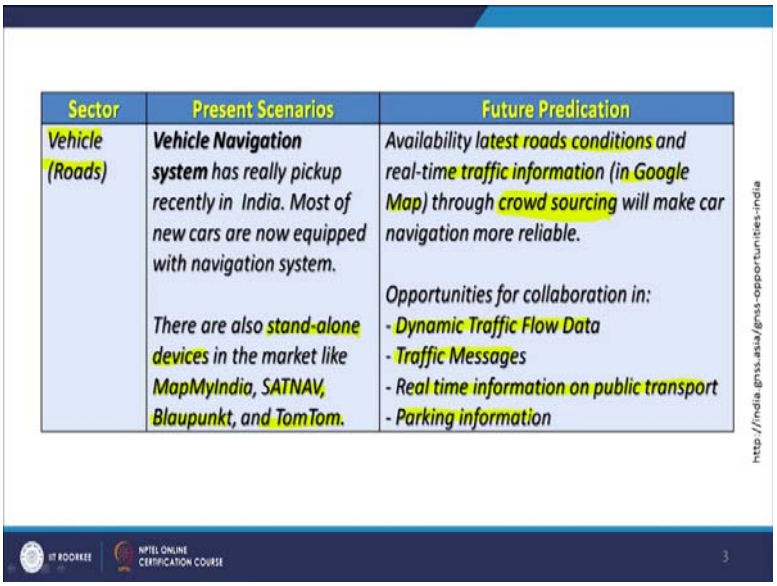

And if we focus over this sector that is the road sector; road navigation so as we have already discussed that lot of these vehicle navigation systems are there. New cars are fitted with their own navigation system. There were some stand-alone or a PDS were there which like MapMyIndia, SATNAV and Blaupunkt and Tomtom, several such systems are there. But nowadays more trends is that these cars will have their own system rather than stand alone system because the market in the stand-alone is on a decline because this is being replaced or compensated by the smartphone mobile.

In future, the road conditions whatever the current trend whatever you know the traffic conditions basically the latest road conditions that is there in real time traffic information that is like if we see in the Google Map and a big one is the crowd sourcing. So, let me

discuss in little detail about this thing the crowd sourcing that is the data or inputs are coming through this crowd sourcing in the Google Map.

As we say nowadays that when you are navigating using Google Map for navigation say for example road navigation, what do you see a road is shown in three colors generally many times; one is in blue color, yellow color and red color. So part of a road suppose if I put from Roorkee to Delhi then at several places, I might be seeing road is shown as blue color and in some parts it is yellow and maybe in some parts in red color. So, there it has got the meaning.

The meaning is that wherever I find a blue color road that means the traffic is running very smoothly and there is no jam or neither it is slow. It is a in a normal speed whereas if it is yellow colored road that means that traffic is not moving smoothly, it is rather slow and third one is the red one that means basically it is crawling and either a complete jam or moving very-2 slowly not as per a normal conditions. And the information to Google Map is coming through this crowd sourcing.

Crowd sourcing means here that mobiles which are on the roads inside the vehicles or in people pockets; they are connected with some tower or another all the time. So, when these mobiles are moving from one place to another in a quite good speed and that road is marked as a blue. When these mobiles are not moving, not changing tower from one to another at a normal speed, it is slow. So, then it is marked yellow and if it is not moving at all or moving at a very slow pace then it is marked as red. The crowd sourcing data is coming through basically the mobiles.

Very recently you might have heard that currently that is the discussion in the country about that Indian Air Force, they hit a target in Pakistan especially in the Balakot, where lots of terrorists were assembled in a big building and that estimates about 300 mobiles were on that came directly from this crowd sourcing. So, this crowd sourcing has given a big clue to the Indian Air Force to learn before hitting the target that how many mobiles were active or on. And say around 3 AM in the morning and they were not moving at all. That means people we are at resting or sleeping. And since we knew that terrorists are there and it has been hit.

Now, it has been mentioned that 300 mobiles were on. So, some people are keeping one or two or sometimes three mobiles so, it be reduced by that number at least 250 or 220 –

230 people definitely were there because after that target which was hit by the Indian Air Force, all these mobiles became nonfunctional and they were no signals whatsoever.

So, crowd sourcing is becoming a very-2 good input to estimate certain things; to estimate the not only location of the people, the crowding and where the more vehicles are there, where the more people are there and even counting is possible to some extent where large gathering is happening. So, based on this crowd sourcing, lots of things are coming, lots of applications are there. Very intelligently if they are used like air force has used it can really bring happiness to the country.

So, there are further opportunities in GNSS overall market which is related with road is the Dynamic Traffic Flow Data which tells you that whether traffic is moving is correctly or not or at normally speed. One source is of course, crowd sourcing. And then traffic messages if there is a jam or something, you get a beforehand before so that you can exit that road may go to some other road; country road, may be smaller road but at least you would be moving. Real Time Information on public transportation that is also the future and the parking information also.

Many of these things have already been implemented through Google Maps but in future these things will become much more efficient or more accurate as these devices becomes.

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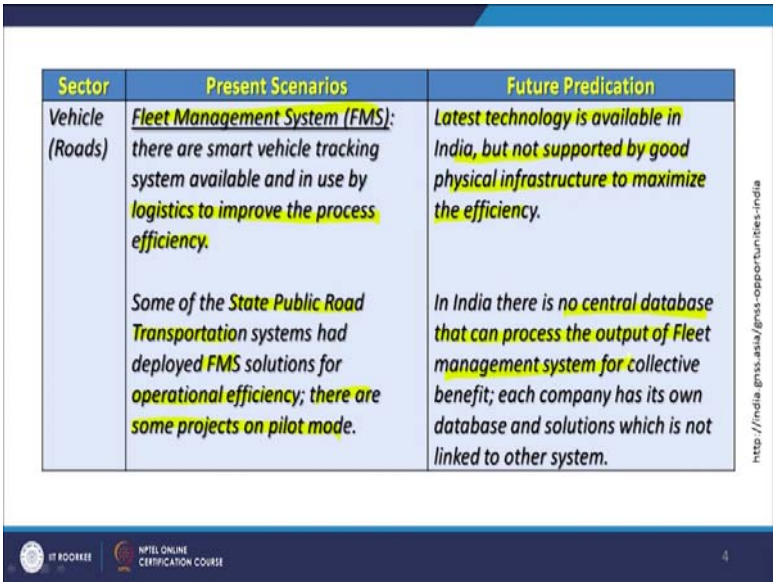

And further in the fleet management systems as we have seen the one of the examples from taxi services which is on roads. Similarly the big trucks operators, big transporters, they too have implemented many of them the fleet management system there for the logistics to you to improve the process efficiency. Even in the taxation system, many fleet managers or management systems or truck operators, they have installed these GNSS receivers in their trucks and they would like to know that how this truck is moving, where it is standing.

And slowly-2 this GST charges are also being clubbed with these GNSS receivers installed on these big trucks. So that exactly, it will know that from where that truck has lifted the goods and where it has delivered and how much time it is taken so many things are there. So, this GST because they have to start with the E-Way bill and that E-Way bill can is being linked with this fleet management system through this GNSS. So, that is another current trend. In future, it will become almost necessary to all these truck owners to have a fleet management system along with GPS. So, these things can be monitored and a proper taxation can be done.

There is straight public road transportation; almost each state is having their own buses to carry the people. So, there also this FMS that is a Fleet Management System can be employed. It is already being used which will increase the efficiency and convenience and comforts to the passengers. So in some places, they are being run in pilot mode but in very near future, it will become a very normal thing for public state transport.

And other technologies which are available is the latest in India but not supported by good physical infrastructure to maximize efficiency in future. And in India, there is no central database that can process output of fleet management. But it is not very difficult. In future, I am sure lot of work will be done on this fleet management for the road sector.

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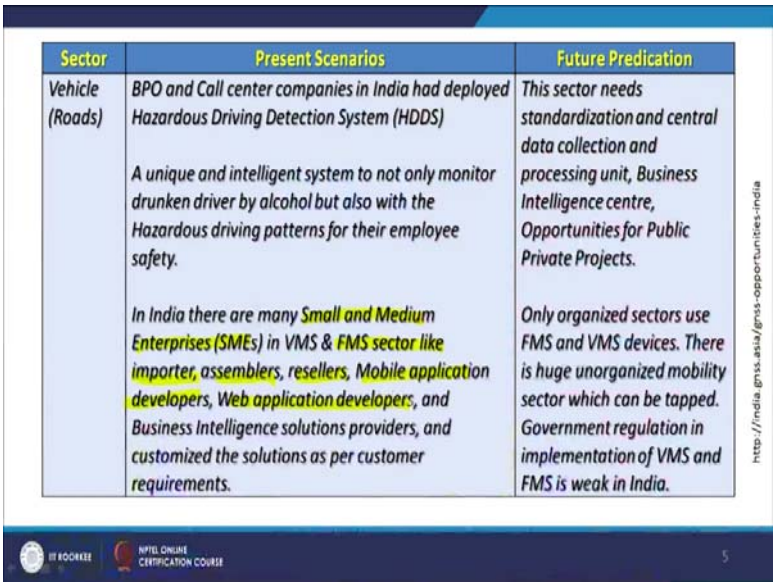

Now, these call centers, BPOs, they deployed this hazardous driving detection system for different purposes. We hear lot of incidents related with their employees and these things if they are fitted with GNSS receivers and they are managed through a controlled center or control room, then lot of these problems can be solved. Especially if their movements; these taxis or vehicles which are carrying the workers of these call centers, if their movement is also monitored and recorded then passengers can become very safe.

In India, there are many small and medium enterprises that we call them as SMEs and they too are in this FM sector that is fleet management sector and importers, assemblers, resellers, mobile application developers, web application developers and many-2 more, they too are using these. Future for all those scenarios is the improvement, efficiency and convenience almost in all these.

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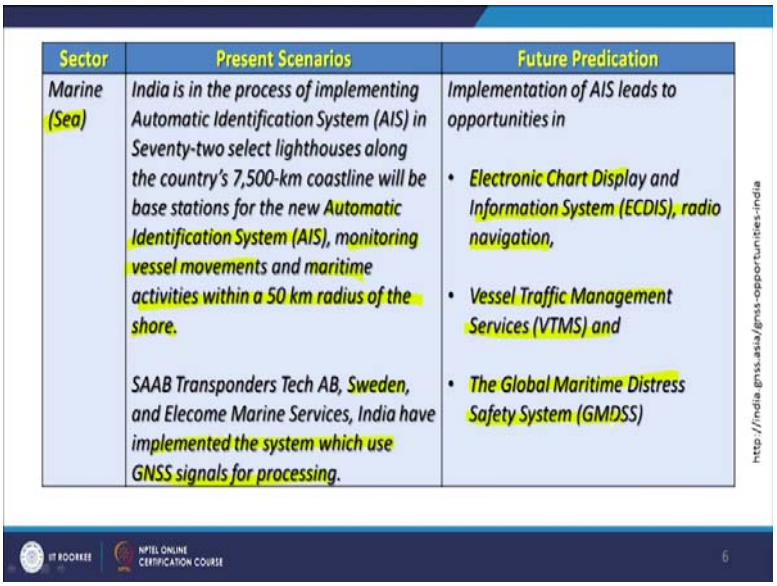

Same in this mari-time or in the marine or in the sea that currently these vehicles or vessels rather or many of them, the big one are already fitted with the navigation systems but in future, they will be having their own systems along with automatic identification so these vessels monitoring can be done; their movements and maritime activities within a 50 kilometer radius of the shore that can be controlled through these GNSS systems.

And there are you know, augmentation systems like in different countries are there which has implemented many systems. In India, we have implemented the system which uses GNSS signals or processing. In future, electronic chart display and information system, radio navigation that is going to happen with this mari-time or the sea movement. And Vessels Traffic Management Services are already there, will also come in a big way and of course, distress conditions. For distress safety systems, there is already a system; Global Mari-time Distress Safety System. So, that also uses these GNSS devices.

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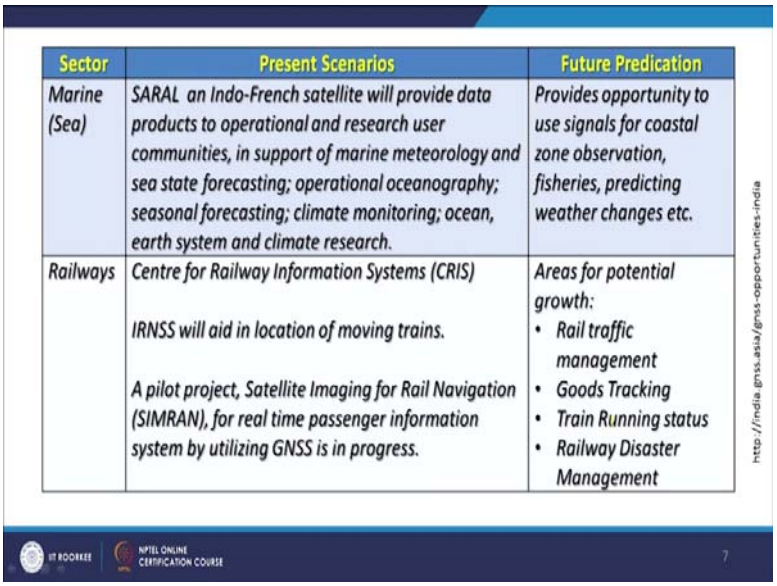

Further the GNSS, there is a Indo-French system which has been developed which is called SARAL, will provide data products to operational and research user communities, in support of maritime meteorology and sea state forecasting; how is the condition in the sea, whether it is rough or it is smooth, operational oceanography; seasonal forecasting, climate monitoring and earth sciences and climate research.

So, for a lot of things because location is important, accuracy of that location data estimation are important, GNSS is going to play. More opportunities are going to come in future especially for fisheries, predicting weather changes etcetera in the sea, once these systems becomes much more common even in a small boat or a vessel.

Railway; Center for Railway Information Systems this CRIS, they have already thought about that IRNSS belayed in location moving of the trains. A pilot project is coming which is a Satellite Imaging for Rail Navigation; SIMRAN, for real time passengers information system by utilizing GNSS is in progress. So, that is already on, currently it is a pilot project but hopefully after some time, it may be full-fledged system in the rail navigation sector in India.

And the areas where the rail sector is going to grow utilizing GNSS and multi constellation or our own Indian system that is in real traffic management, goods tracking which we have discussed in earlier lecture that how these fleet management or railway engines or railway goods trains can be monitored and managed. Train running status, we

already knows, currently much of information is coming from different stations. When this train crosses than the stationmaster updates that the train has crossed and through these train running softwares, we know that train has passed this station or will be reaching certain station.

But once they are fitted with the GNSS devices, then live every metre movement can be seen through these softwares on our own smart mobiles devices. So, this is going to be used. So, accurate timings when train will reach to a particular station, we will be getting very soon. Railway Disaster Management also, it is going to play a very big role in future in India.

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A BCI magazine which is online of course, offline; both the versions are there. A geospatial word which says that Indian railways to use GIS portal, satellite imagery and GPS to monitor trains, manage its assets. Basically, here it though it has been mentioned GPS but the meaning here is GNSS; multi constellation. Not only the single constellation GPS but multi constellation including IRNSS is going to be used along with satellite images and in the background, a GIS map also or GIS portal.

So, which will manage, monitor the train movements, manage their assets and other things of the railway. So, in order to give a power boost to its service, Indian railways is all set to use satellite imageries of high resolution, GPS and GIS to monitor, maintain and manage its assets across the country. Say, one of that second largest railway

networks in the world. So, definitely new technologies are required to manage, monitor and think about the future as well.

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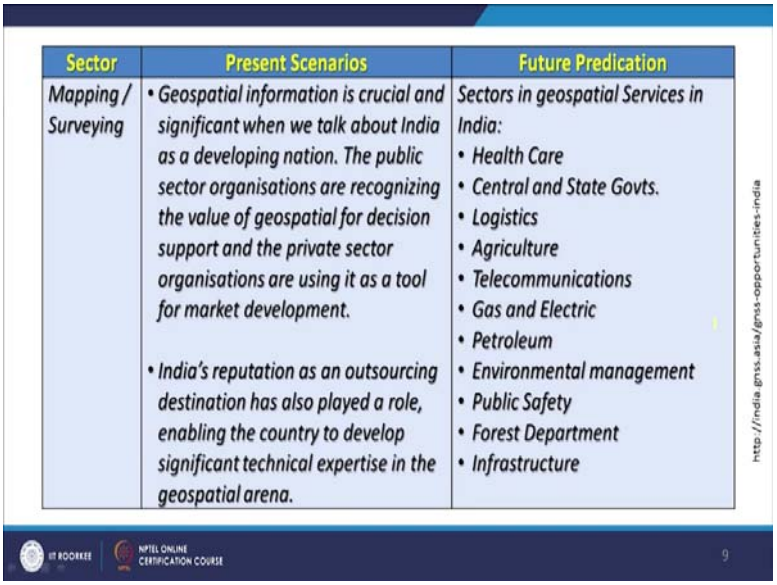

In the mapping sector, surveying and in topographic surveying, in civil engineering or in geological surveying. Even in the botanist have started using and there are many types of service are there. So, this is very crucial information about the location. The geospatial information is crucial and significant, when we talk about the India as a developing nation. So currently, it is already extensively being used. Though earlier we have been using only GPS but multi constellations is there, IRNSS or NAVIC will also come in a big way.

And, India is also known for outsourcing destinations. So there, it is also going to play very important role about geospatial technologies and also which includes your GNSS. The future prediction in the mapping survey scenario in India that in healthcare also, which is already a big scheme has been recently launched by government of India. So, again location will be there, which will might be getting attached with your Aadhar card and other things. And then logistics, central and state governments, agriculture, telecommunication, gas and electric supply, petroleum, environmental management and public safety, forest department, forest management, infrastructure.

Forest departments and in forest management, there are already uses of satellite images, GIS and of course, GNSS systems but this is going to be become more prudent, it will

penetrate further and more innovations will be done. Further in this mapping and surveying, as we have also discussed that different states are coming for their digitization requirements, land records, taxation which are based on these technologies may be in integrated like GIS, GNSS, remote sensing together. So, that is there.

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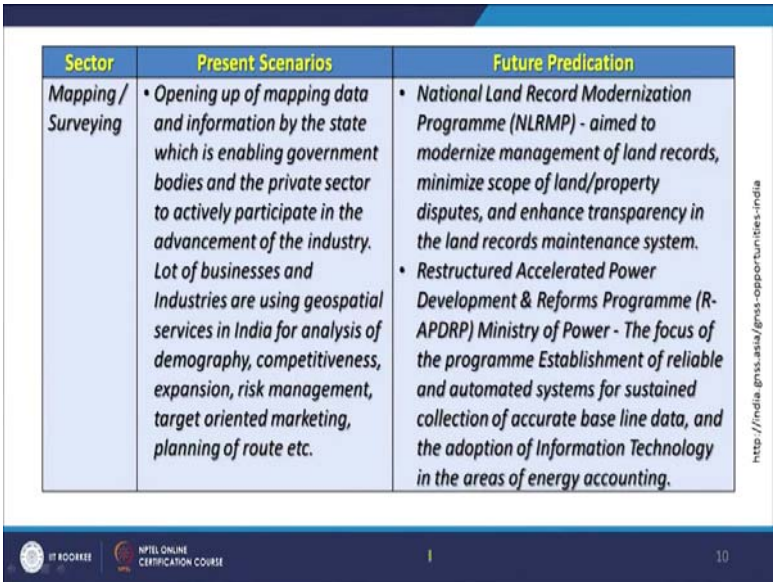

Not only for you know, having records of the land which makes development projects to operate or run very easily, once everything on a computer system or a platform but also there are other advantage. So, we have also discussed about demography means how people are there; their distribution and so on. So there also, it is going to play then competitiveness, expansion, risk management, target oriented marketing, planning of routes etcetera.

Lot of things which we are not visualizing, we are unable to visualize today about the GNSS future but as I have been mentioning that as these things will become user friendly, efficient and reliable, more new users will come forward because of better technology. So, this is the situation. There is also program which is going on, will take better shape in future so that almost at national level, all record modernization program is there which will aim to modernize management land records, minimize scope, dispute and all other things are there.

So, all these things are happening, will happen further because technologies are becoming more reliable.

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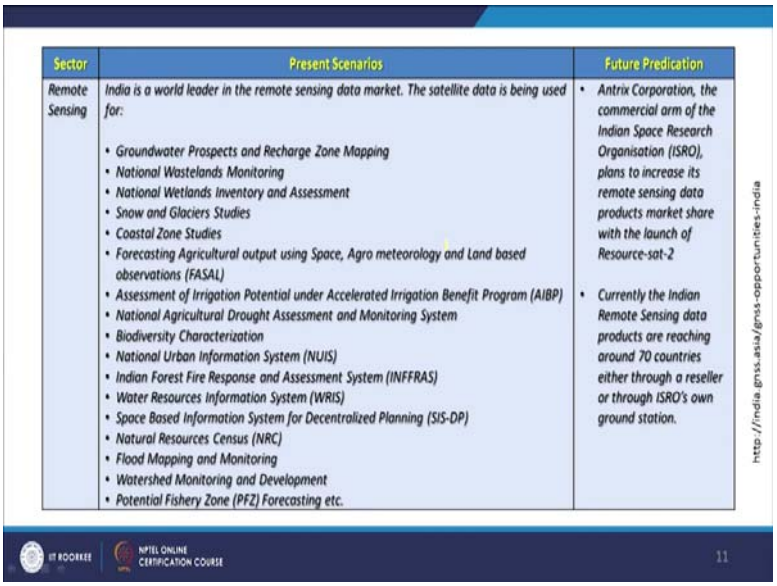

If we look this remote sensing sector; of course this remote sensing, GIS and GPS or GNSS, they are having three things in common. One is all three technologies are spatial technologies that is, they deal with the locations and in brief this is what I can say about the spatial technologies. And secondly, all these three technologies are digital also and therefore, the integration of these technologies with each other becomes much-2 easier and you know, they are complementary to each other as well.

So, that is the advantages of these technologies; GIS, remote sensing and GNSS that they are spatial, they are digital technologies and there is a continuity of these technologies. So, all are growing almost at a very fast or you know, in a synchronized manner.

So, if we look from how in remote sensing sector, this will help GNSS. There are various things, few I can just mention that Groundwater Prospect and Recharge Zone Mapping is a big thing which is required in this country, it is being done. It is national watershed monitoring, national wetland inventory, glacier and snow studies, coastal zone studies, forecasting of a agriculture output which we have already discussed in agriculture sector. There is already a system which is called FASAL and so on so forth. So, everywhere it is going to play very important role because location information is very-2 important.

A future one of you knows, corporation or one of the commercial arm of ISRO which is Antrix Corporation; they are planning to increase the usage of remote sensing data products to increase that market share and also launching of new satellites like Resource-

sat-2, 3 and maybe in future, we are having more high spatial resolution satellite images as well.

Currently as you know the Indian remote sensing data products are reaching around 70 countries in the world either through resellers or through ISRO's own Ground Stations. Not only Ground Stations or Satellite Earth Stations are in India of ISRO satellite but in some other countries also. So, these are all going to make GNSS percolate further.

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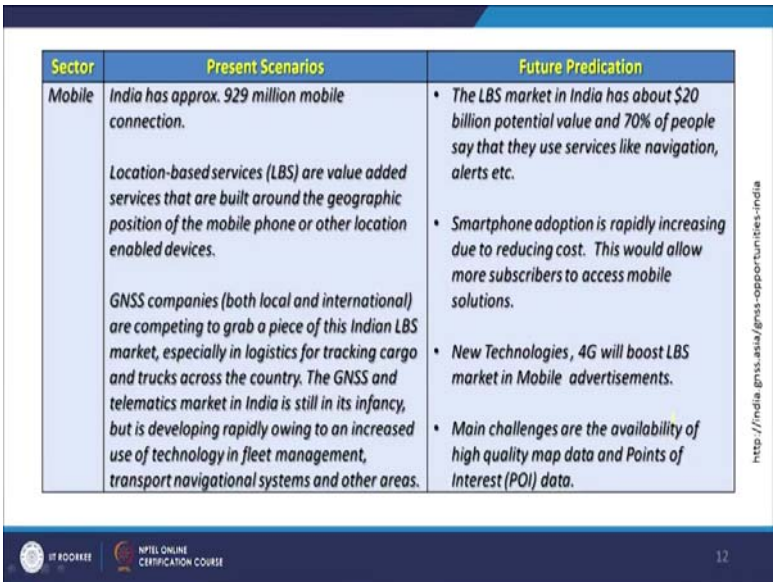

In mobile sector, we have been discussing lot. So, I will quickly cover this part that this mobile sector in India has grown perhaps we are having the maximum number of users of mobiles in India. And especially, the smart mobiles are integrated nowadays with these multi constellation GNSS receivers.

So, Location Based Services are there and built around GIS and for their various purposes; navigation and other things. GNSS companies both local and international are completing to grab the piece of this Indian LBS market; Location Based Service market especially in the logistic for tracking cargo trucks across the country. Lot applications are coming in this one and very difficult to predict future about this market especially the mobile and GNSS.

LBS market in India will grow further and 70 percent of the people say they use the services like navigation and alerts. In coastal areas, the alerts are being you know,

forecasted and people are using very sincerely and lives are you know being saved during especially in cyclones and other time. Smartphone adoption is rapidly increasing due to reducing cost and of course, becoming reliable, efficient and this would further allow the subscribers to access the more mobile solutions. New technologies, 4G will boost LBS market and Mobile advertising. And main challenges are availability of high quality map data.

And that is also improving with the availability of high spatial resolution satellite data so the quality of the maps that means quality means here the accuracy and updation; updated information available on a GIS platform can be made with high spatial resolution data. So, that is also there but more and more requirement would be there for this. So, this is about the mobile sector.

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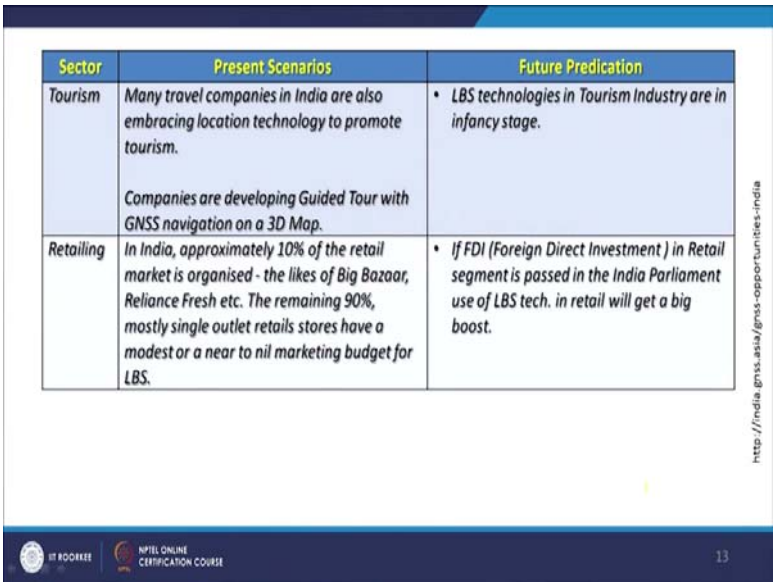

Tourism; in tourism sector already, there are users. Many travel companies are using this one. And recreational and adventurous companies are there in many parts of India. And they are too are using guided tours with the GNSS navigation on a 3D map. This is also coming and this has got much bigger future. LBS technologies in touring industry; it is at not a big stage but very soon it will take a central stage.

And retailing; in marketing also people are using like Big Bazaars, Reliance Fresh, they have already started using. Remaining 90 percent of the most single outlet retail stores have a modest or near to nil market budget for LBS. They are not using but big

companies have already implemented the GNSS or integrated system to make their market or malls accessible to others and also through service, they find out about you know, requirements of the customers.

In a Foreign Direct Investment in retail segment is passed to the Indian parliament use this LBS technology and it is again going to be a big boost for future in the retailing of India.

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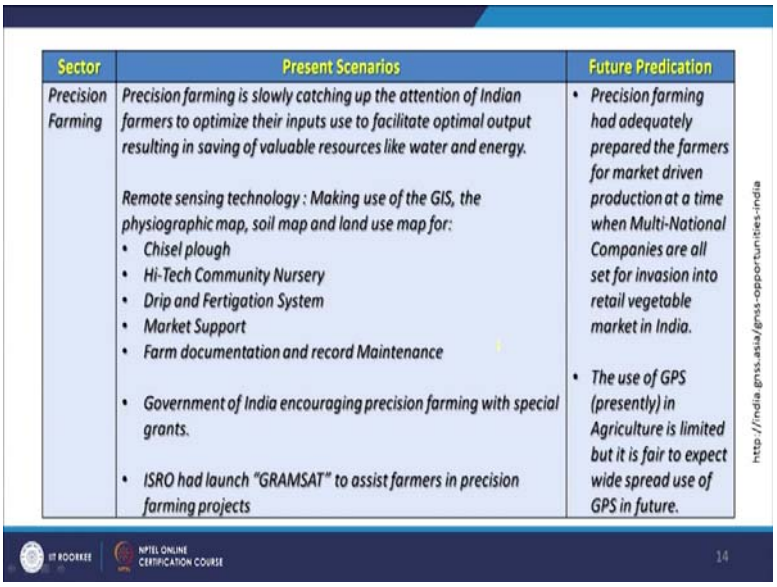

Precision farming; we have already compared to Western countries or especially in US, Canada and India that this is also one of the sectors which is going to grow in India that is the GNSS applications in precision farming. Government of India is already given encouragement or incentives for precision farming with some subsidies or special grants. And there is a GRAMSAT satellite which has launched by ISRO which assist farmers to precision farming projects that is there, along with precision farming and the UAV market is also growing.

So future, it will may become very common thing to use GNSS based devices for precision farming in India also.

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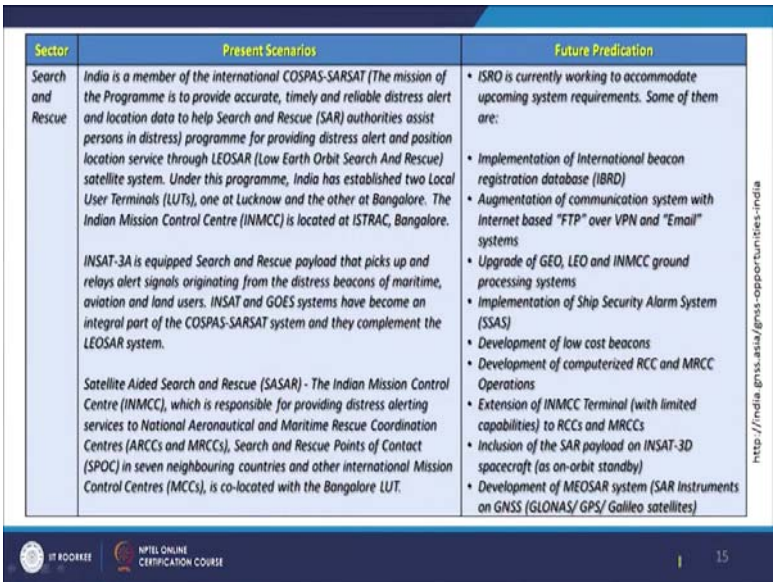

Search and rescue has been already big user of a GNSS services and in future also, each country and group of countries are putting their resources and efforts to have a such systems in place before any such disasters occurs in their country. India is also having our INSAT and GOES systems which are integral part of these COSPAS and SARSAT which is the mission of the program is to provide accurate timely and reliable distress alert and location data to help search and rescue that is SAR. Search And Rescue authorities assist persons in distress; maybe in case of cyclone, maybe in case of earthquakes, maybe in case of tsunami.

So, these systems are already like SASAR; Satellite Aided Search And Rescue system is there already by the Indian Mission Control Center INMCC. And there are some other maritime rescue coordination center is there in some other centers it they are, depending on where such disasters may occur and so on so well.

Further work is being done in India. In future also, like ISRO is working to accommodate upcoming system requirements like for example the implementation of international beacon registration and database. Augmentation of communication systems with internet based FTP and VPN, Email systems and then upgradation of this GEO, LEO and INMCC which is a part of IRNSS and continuous upgradation is there. Development of MEOSAR system that is SAR instruments on GNSS, GLONAS, GPS and Galileo satellites.

So, whatever the current technology is available which is going to be used for search and rescue operations which are very serious sector but very much required, directly saves the life's of the human. So, this brings to the end of this course also and to this current discussion that is 20th lecture which I have just discussed about the opportunities in India about GNSS and some future about that. And I hope you have enjoyed this course.

And of course, a few new things will be coming in future and few more development will take place in this domain but the basic things which most of the time, I have spent time which will remain same that how GPS or GNSS system operates and what are the different systems, what are the error components, how these can be minimized, what are the you know current solutions for more accurate or precise locations estimations and what are the current applications as I have been mentioning that future is difficult to predict. And what are the upcoming technologies associated with a GNSS for more accurate not only position but timing and other applications as well.

So, this brings to the end of this course. This is last cartoon of this course. So, enjoy and have a smile.

Thank you very much.