

**CONFERENCE ON GLOBAL SPACE ISSUE AND INDIAN PERSPECTIVE.**  
**NEW DELHI 2<sup>nd</sup> MARCH**

**INAUGURAL ADDRESS BY G.MADHAVAN NAIR, FORMER CHAIRMAN ISRO**

Thank you Prof Sanat Kaul for the nice words of introduction. Fellow speaker Sri Amandeep Sing Gill distinguished delegates, and friends. It's my proud privilege to be here this morning inaugurating this conference and deliver the keynote address. I thank the organizers for giving this opportunity.

Space has become part and parcel of our day today life and is going to be the next frontier for human exploration. In that context, the theme of Global space issues and Indian perspective is quite appropriate. Issues related to space exploration and space law have become very important. As far as space law is concerned we have to go a long way. Some beginning has been made and we can be happy that a systematic way of working has come into existence to some extent but may not be to full satisfaction of everybody. Several countries have taken initiatives to get into the space and carry out exploration. Today at least there are about a dozen countries who are major players in this field and half a dozen countries have got full capability to access space and use the space resources for peaceful and other applications. We can be proud that India has taken a lead and has become one among the six major space players and we have the technology to build large rockets and orbit satellites for communication, earth observations, or scientific studies. Also we have established systems for communication both for entertainment strategic communication and for remote data sensing of terrestrial features from space. The pictures taken by the Indian remote sensing satellites are very precise and have entire global coverage. These achievements have placed India in a very enviable position especially considering that India is the only country which has carried out such activities for peaceful purposes. Whereas in other leading countries missiles were developed for military programs, during and after world war II and later they have been converted for space launches and they had a much earlier beginning about 20 years ahead of us. Military background and industries have given them the real strength and lead position in many areas whereas in India we are the other way round we have developed the space systems in the civilian domain. Industrial capacity also was developed parallelly. We have operationalised and provided services for meeting the societal needs and later some part of the resources are being used for the defence applications as well. The observation from space whether you use for the civilian or the military purposes the images are the same

only the way you look at it and interpret are different. Our satellite images have got a resolution of nearly a meter very fine resolution compared to most of the earth observation satellites and the multi spectral images have become extremely useful. In the communication area, today the DTH is entirely dependent on the satellites for rely of the TV programs. Hundreds of programs are available through a small dish which is on the roof top. The business communication through the VSATS has spread right across the country. It was reported that about an hour one of the satellites had some problem and that has resulted in something like Rs. 3000 crore loss of business in the stock exchange. So you can imagine the satellite connectivity is so powerful in managing the day today affairs or business in the country . I don't want to elaborate much on the military applications one of the speakers later will talk about it. But one thing is very clear when we have our forces deployed in the border areas and remote areas the communication becomes very important and there the satellite is the only means by which you can reach out simultaneously to all these places.

We have stressed more on the societal applications and thus the remote sensing images are used for agriculture, forestry management, ocean development, water resources management and so on. Some of the satellites are specifically tuned for a purpose, for example; we have the Ocean Sat which looks at the temperature, colour, wind conditions and other parameters of the ocean which are directly usable for scientific purposes and practical application such as identifying the regions where the fish school assemble and has the potential for larger yield. On agriculture monitoring of rainfall, drought conditions or flood and issuing advices to farmers have become routine operations. The Crop insurance fertiliser distribution etc are largely dependent on the images from space.

As far as India is concerned, Space resources have become absolutely an essential one and it has to be maintained perhaps enhanced to meet the future demand. The basic question is how do we protect these space assets. I don't know whether we have paid sufficient attention to this field. As I mentioned earlier, one satellite is not being available thousands of crores are lost per hour that's the economic impact. One can imagine the chaos if vital resource for communication or earth observation to the forces are cut off. Normally in a space operation what we do is to provide adequate redundancies. So if one source gets into problem then another one is pulled into operation. But even that in a hostile situation we may find it difficult to manage.

Today the technologies are being developed for anti-satellite weapons by many countries in a silent way., The technology is, I will say relatively simple, you don't require very huge rockets for shooting down a satellite because most of these operational satellites for the earth observations and low earth communication are less than 2000kms altitude and one can reach them with small missile which can reach up to the altitude but the real challenge lies in identifying the satellite keeping track of it and then precisely guiding to that location. These technologies are being developed by many countries. Again there are possibilities of using laser beams, iron beams etc for disabling a satellite., it could be ground based but will need very high power but one can think of scenario in which the space based weapon systems can very precisely come near the satellites and focus on it to cause damage to electronics and sensor systems . We have to think of how to protect our resources against such hostile environment which may rise in future lot of research needs to be carried out, Other one is policing . How do we keep track of hostile satellites and avoid them or take action to incapacitate them. US keep track of almost all the objects which are in the space and they publish their orbital parameters and one can get a reasonable idea, Before each launch we use this data to ensure that our satellite is placed at least about 10 kms away from all such objects . But to ensure that we have reliable data of space objects we should develop our own Radars for observation and computation systems.

The other aspect is with respect to the international norms to be followed in case of space launchers satellites and planetary explorations. The UN COPOUS in which about 60 countries of UN general assembly are members, meet and address the related technical and legal issues. India has played a very major role in this forum right from the beginning Indian representatives have participated in them and many of the policies and decisions were made by S&T committee as well as the legal committee where influenced by the Indian thoughts .More than that India had made significant contribution to the Unispace ie; meeting of all global leaders on space policies . There were three of them at 10 year intervals. During the first unisapce conference Dr. Vikram Sarabhai was the co-chair, in the second one was chaired by Prof YashPal and U R Rao was elected as chair for third one., Indian presence is very strong in the United Nations committee on peaceful use of out of space.

All of you aware of the five treaties which has been brought out by UN COPOUS and put out for signature. Most of the Countries have signed these treaties but the last one the moon treaty which is very important with respect to the

ownership of the property and assets in other celestial bodies is not wetted by country like United States so that is a real concern. The United Nations has declared that outer space as well as the planets and other objects are common property of humankind. Once we accept the principle of common property how do we handle ownership claims by various nations on moon or Mars.

When we were planning to send the Chandrayaan Dr. Abdul Kalam then President of India was very particular that we should see that our flag is there on the moon so that we can make a claim at a future time. This suggestion led to a midcourse correction in the spacecraft design. We had to make another capsule i.e. the moon impact probe with the flag on it as part of it. When the orbit had stabilised MIP was separated and sent down to crash land on the lunar surface depositing Indian National Flag along with it. Later this spot is named as a Jawaharstal. Though we have placed the Indian flag we have no legal right over the lunar region as it is a common property of humankind. The future conflicts are going to come when we want to tap the resources from moon or Mars.

The moon itself is interesting for future human exploration. It is our Chandrayaan which confirmed the presence of water on the moon along with NASA team. More than that there is a huge deposit of Helium three ( $He^3$ ). If you tap one ton of Helium three and bring to earth it is sufficient to run the fusion power plants meeting the energy requirements for one year in our country. That's a kind of potential which exists but the technological challenges are very many it is all embedded into metal hydrates in very small quantities. One has to first extract this and then bottle it at high pressure or in liquid form for transporting using rockets back to earth. Most of new technologies will have to be developed before this can become a reality. Other elements are almost like what you find on the earth so some of the nuclear fuel deposits may be there but further explorations are required.

Further we are looking at Mars as another source where we can find natural resources which could be beneficial to us. That's why there is renewed interest in exploration of Mars we have also sent the Mars probe which has reached there accurately and had taken some interesting pictures of the Mars at close distance. To establish a colony at Mars the challenges are very many. Martian atmosphere is hostile with about 95% carbon dioxide and Sulphur dioxide which is a corrosive element. Temperature are extreme swinging between minus two hundred to plus hundred and sixty Celsius. The first job is to create a tent which can support life. Oxygen can be generated from carbon dioxide and air

conditioning can be done using solar power. But all these need equipments to be transported from Earth. Such a mission will need tens of launchers for the conventional rockets before human being can travel to such a remote planet. Above all to planning the return journey the rockets will have to be assembled there, and fuel has to be found from Mars itself. Of course there are theoretical solutions if you carry Hydrogen from the planet earth, Hydrogen can be combined with the carbon dioxide to form methane which will be a good fuel along with locally generated oxygen. So this process involves a huge line up of technologies and series of launches the preliminary estimates shows that even the largest rockets available to humankind today we require about dozen launches to have one trip to Mars and back. So it is going to be prohibitively expensive. But the ultimate object is to find out if there are going to be some exotic elements which can benefit the human life.

You have heard in the news that NASA is very keen to cooperate with India and Europe also is keen to do that. So a global collaboration will emerge in Mars exploration and how we are going to manage policy and legal issues related to such complex situation has to be addressed to.

Then there are issues related to earth observation systems we know that there are powerful satellites owned by all leading nations and the small satellites are being flooded, many of the universities and schools are making small satellites with the observation capability. The images coming out of them are not classified it is available openly. You must be knowing that the google maps etc which are available in public domain expose many of the sensitive area in the country. What kind of norms are to be implemented for safeguarding national interest needs to be addressed.

Communication satellites are operating based on the norms issued by ITU and is well stabilised system. But in a hostile environment there can be satellites which can be used for jamming the signals and cut off the Communication system. How do you detect such jammers, how to react to such situations, that becomes a question mark.

And when you talk about space tourism etc the safety aspects will have to be addressed. As aircrafts were put into operation the parachute also were developed. Similarly when you have the space capsule is going into outer space what will you do, in case of a crisis. There has to be a good understanding among

space faring nations so that others space assets could be deployed for safe recovery.

Today private operators are coming up with proposals for human space flight. To start with they are trying to provide short trip to space and back may be for half an hour or so in almost like a aircraft like operation. The possibility of space stations providing conveniences like a luxury hotel is not far away. The US space stations provides such an opportunity but it is going to be decommissioned in a few years. But our neighbour China is going steady already about three or four capsules are been put into orbit and they may complete the space station a few years from now. Then they will be able to provide free service to the other countries the astronauts traveling to the space station living there and then coming back. So perhaps they may become the first operational space service provider for the common people in the world. The safety issues and other ethical issues are to be seen with a global outlook. India is yet to commence its human space flight programme. It may take at least a decade to catch up.

There are many open issues especially on the legal aspects related to space . As I mentioned earlier the treaties which are accepted by United Nations are the only operational documents today. They can at best be considered as guidelines. Some countries have their own space law they are very powerful but again the question arises as to how do you implement right across the globe. We do not have formal legal frame work at present but there are policy documents on satellite communication and earth observation. An Indian space law within the frame work of the international treaties is overdue. There has to be an effective way of implementing such law across territorial borders.

As you see in the programme several talks are scheduled during the conference on space industry policies and security needs, legal issues etc. I hope you will benefit by the presentation and discussions I wish the conference all success.

I declare this conference on Global space issues and Indian perspective inaugurated.