Issues, Challenges and its Future Application of Satellite Communication System

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Abstract **- Communication in the whole of the World is revolutionized with the advent of Satellites. Satellite Communication has served mankind in many ways e.g. to predict weather, storm warning, provide wide range of communication services in the field of relaying television programs, digital data for a multitudes of business services and most recent in telephony and mobile communication. It may not surprise world community, if satellite communication links may be used for voice and fax transmission to Aircraft on International routes in near future. GPS Navigation, Global telephony, Multimedia video and internet connectivity, Earth Imaging through Remote sensing satellites for resource monitoring, Telemedicine, Tele-education services etc. are other feathers in Satellite communication applications.**

Satellite communication system has entered transition from point-to-point high cost, high capacity trunks communication to multipoint to-multipoint communication with low cost. Satellite Communication has moved in many steps ahead like frequency reuse, interconnecting many ground terminals spread over the world, concept of multiple spot beam communications, Laser beam based communication through satellites and use of networks of small satellites in low earth orbit. In this paper satellite communication advancement, different application aspect present and future is discussed. Satellite communication has many application and market if we can pool our resources, come up with innovative and low cost solutions for world community.

Keywords – Satellites, GPS Navigation, Remote Sensing, Telemedicine, Frequency reuse, Networks of satellites**.**

I. INTRODUCTION

Satellite communication [1] service industry has grown more rapidly than was forecasted in 1992.This growth has been a global phenomenon as the economies of world have increased and improved a great extent requiring increased communication services for both business and consumer markets. With this increased demand and recent large, rapid expansion of business, consumer terrestrial mobile and internet communication services has opened new opportunities for satellite communication. Mobile and Internet transport access businesses have stimulated the demand for new multi- state satellite constellation to serve this market on both the national and international scale. Growth in above areas coupled with the global increase inTV viewer ship and high data rate transport have been responsible for the recent and future anticipated growth. There is also new demand for integrated satellite, terrestrial communications that will enable the transport of information seamlessly across these transport media. Theslarge and rapidly growing satellite based business opportunities have attracted the attention of government and industrial interests of many countries and these nations are making significant investments of new capital to enable them to participate in this growth market. Many countries have allocated funds for satellite R&D projects to ensure their long term presence in the commercial satellite industry. The expansion of satellites into new applications and the increased global demand for satellite communications services have attracted the attention of investment community.

This has resulted in the formation of new satellite service providers and stimulated mergers and acquisitions, the creation of new companies, the formation of global partnership and the privatisation of formerly public satellite service organisations. The satellite communication industry has grown tremendously and number of professionals and range of activities have grown as well [2]. In the past, commercialcommunication satellite manufacturing and service provider organisations tended to be conservative and to be hesitant about inserting new technology into satellites. This has changed in response to immediate need to serve customers burgeoning demand for entertainment programming TV, mobile communications and access to high bandwidth Internet data. Industry is inserting new technology into satellites at rapid pace.

Recent examples includes onboard processing and switching, more efficient solar cell, higher power components, more efficient heat dissipation techniques, electric-based station keeping thrusters, inter satellite links, large antennas, phased array antennas, antennas with numerous spot beams andimproved TWTAs.Increasingly, Satellite is no longer being viewed as a simple „bent pipe" but as an important component of a large global communications networking system, requiring interoperability between satellite and terrestrial communication components and thus compatible protocols and standards. This integration of satellites into the global network will require satellite industry to assume large software operations and develop new enduser services.

II. ELEMENT OF SATELLITE COMMUNICATION

Satellite communication has basic two elements [3] as shown in Fig.1 general view:

A.The Space Segment

Satellite itself is known as space segment and comprised of complex structure. It has some major subsystem like TTC system, Transponder, Fuel Tank called thrusters tank, Antenna system and Control system etc. Satellite transponder includes the receiving antenna to receive signals from ground stations, a broad band receiver, multiplexer and frequency converter which is used to reroute the received signals through high powered amplifier to downlink the ground stations. Satellite role is to transpond the received signal in other form of signal to be re transmitted to ground stations. For example of television broad cast where TV programs are up-linked to satellite, satellite transpond it and down linked over a wider region, so that it may be received by many different customers processing compatible equipment. Another use of satellite is observation wherein satellite is equipped with cameras, various sensors and it merely downlinks any information it picks up from its vantage point.

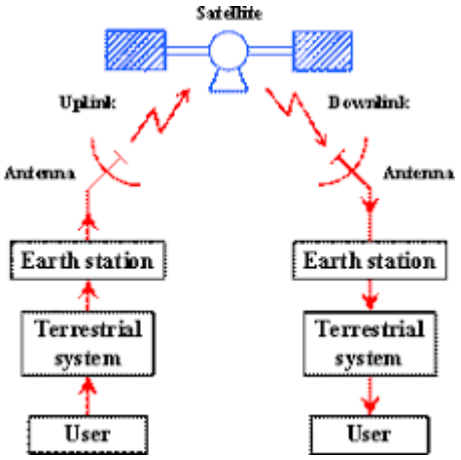

Fig.1 satellite communication

B. The Ground segment

The earth stations are ground segment of satellite communication. Earth Station has two fold roles. In case of uplink or transmitting station terrestrial data in the form of base band signals is passed through a base band processor, an up converter, a high powered amplifier and through parabolic dish antenna up to an orbiting satellite. In case of down link or receiving station vice versa job performed and ultimately converting signals received through the parabolic antenna to base band signal.

III. SATELLITE COMMUNICATION, ISSUES AND CHALLENGES

A. Issues and Challenges

1) New paradigm for satellite design, prototyping and manufacturing Satellite manufacturing traditional pattern of highly specialised, customised, designed and built a few at a time is now changing. More emphasis is placed now on the use of common buses and use of CAD tools to customise the communications payloads. Mass produced system is adopted and many satellites are produced at once in an assembly line environment. Integration and testing is highly automated. The extent and nature of testing is reduced after prototyping and initial production is accomplished.

2) New High Powered Platform

One of the key technical trends in response to the deployment of LEO and MEO satellites has been the design of large aperture GEO system with very high power system. Earlier commercial satellite power generation was limited to 7 to 12 KW. But new generation designers have begun to discuss large flexible of floppy solar array generating 50-60 KW. Also intensive efforts are underway to improve solar cell performance by using gallium arsenide/germanium, multi-junction cells with promise of solar cell efficiencies above 30%. There are parallel efforts to improve battery i.e. lithium ion and fuel cell technology in order to produce higher and higher powered satellites.

3) Critical Future Technologies

Critical technologies for future satellite communications are:

· Batteries
· Devices and structures for Phased
· Array and Multiple spot beam antennas on the ground and in space
· Fuels and combustion structures for launch vehicles
· High frequency (>20GHz) devices
· Materials for electronics devices
· Solar cell materials and structures
· Network technology for high data rate, integrated Space and terrestrial systems
· Optical components and sub systems
· Radiation resistant device structures and circuits
· Strong and light-weight material
· Thermal dissipation materials

In addition experimental satellites are needed that can be used to test out new technology that cannot easily be tested on the ground. At the systems level, the future of satellites could also be impacted by high altitude, long endurance platforms which would operate from 65,000 to 1,00,000 feet such as airships and loitering aircraft. Such systems could be used to substitute for satellite communication in regional applications or could be used in conjunction with satellites as a system capacity multiplier over populated areas.

4) Policies and Regulatory issues

In international satellite trade landing rights agreements, annual licensing fees for terminals, non-tariff barriers,allocation of frequencies and orbital slots, adequacy and effectiveness of intersystem coordination procedure,
security and privacy of information being relayed on satellite system etc are some issues to be resolved. Most important of all is the need to develop protocols for seamless interconnection of satellite, wireless and terrestrial fibre networks. In the 21st century interconnection of satellite systems, particularly inter-satellite links will be a key challenge. Connecting them to low latency terrestrial network is truly a challenge.

V. FUTURE APPLICATIONS

1) Frequency reuses application

Since Satellite system serve large areas such as countries or continent, a large number of beams need to share the available beam width. To circumvent this frequency reuse [4] scheme is often utilised. This is based on reusing the same frequencies in spatially isolated beams. Therefore available bandwidth is divided into a smaller number of beams in coverage area. The set of beams that share the total available bandwidth is known as cluster. The cluster is then repeated in the coverage area relaying on the fact that the beams operating at same bandwidth will be separated from each other sufficiently so that they do not interfere with each other. There are only a discrete set of possible cluster sizes, N, to accommodate a contiguous coverage of hexagonal geometry. The possible number of beams in cluster which would form tessellating shape is given by: $N=i2 + j2 + i \times j$ …….. (1)
Where N is the number of beams in cluster and i, j are non-negative integer numbers.

2)Use of Spot Beam Concept and its applications

NASA"s satellite ACTS uses hopping spot beam technique to combine the advantage of frequency reuse, spot beams and TDMA. Concept of multiple spot beams is also planned in future generation satellite of Italy, Italsat with six spot beam operating at 30GHz uplink and 20GHz downlink, the satellite interconnects TDMA transmissions between ground station in all the major economic centres of Italy.

3) Other Applications

►Laser beams based satellite communication.

►In finding Space debris solution

►Space Situational Awareness uses

►Use of constellation of spacecraft and inter satellite links for telecommunication purpose etc.

VI. CONCLUSIONS

In this paper satellite communication, its constituent's, advancement in the satellite communication, present and future applications are briefly discussed. In future application system will operates modern technology and gives an more advantages. It is lone attempt to bring brief sketch about satellite communication future applications. Details study of frequency reuse in satellite and mobile cellular is matter of research in our future works.

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