Design study report on protocol design of CDMA based mobile satellite network for voice and data

Supervisor

Mr. R. K. Uppal
DEAL, Dehradun, India

Mr. V.S. Yadav
ESEID
SAC, Ahmedabad, India

A Mobile Satellite Network has to be developed for restricted users. It is necessary to include certain special features like Message Security and anti jam capability. Because of this and it's other advantages like resistance to Multi path Fading etc. in mobile environment, CDMA has been chosen as the Multiple Access Scheme. In this project theoretical study for design work and Signaling System for CDMA based MSS Network is carried out. The network Signaling System design will consist of Network Access Protocol for both Inbound and Outbound links for Mobile to Mobile call, Mobile to PSTN Subscriber and PSTN subscriber to Mobile. To design the Signaling Messages and their formats that will be exchanged with-in the Network to satisfy its requirement. The Performance Analysis of the Network Signaling in terms of Maximum number of Mobiles can be serviced by the System and Average delay incurred by the Mobiles in accessing the services.

Project report on mobile satellite communication system

Supervisor

Mr. Parimal Majithiya
Space Application Centre
Ahmedabad, India

Mr. A.K. Sisodia
PSED
SAC, Ahmedabad, India

Satellite based personal mobile communications has become increasingly significant, with growing and important requirements and applications. In this project, Geostationary Earth Orbit (GEO) satellite based payload architecture for personal mobile communications service has been defined. The requirements of Satellite-International Mobile Telecommunication 2000 (S-IMT-2000) have been considered while designing this payload architecture for seamless voice and data communication. The requirements of handheld user terminal shall be met for the proposed payload configuration. The proposed satellite payload architecture includes a multiple beam antenna system with large reflectors; on-board processing; and Satellite Switched Code Division Multiple Access (SS/CDMA) to permit single hop inter connectivity between handheld user terminals. CDMA is one of the major requirements for the S-IMT2000 standard; a novel satellite switched Code Division Multiple Access (SS/CDMA) technique has been selected. Code Division Switch (CDS) has been applied in SS/CDMA networks for routing CDMA traffic channels. There is no onboard

demodulation, channel decoding or buffer and non-blocking. This payload architecture will be suitable for S-IMT-2000. This system will support 4.8 kbps for voice and 9.6 kbps for data communications. The project includes the details of payload architecture, link analysis, power and weight estimates. It also includes the details of payload and technological issues of the major subsystems of the payload.

Study of satellite communication systems for military applications

Mr. Ajay Malik
DEAL, Dehradun, India

Supervisors
Mr. K. Bandopadhyay
SAEG
SAC, Ahmedabad

Mr. V.S. Palsule
ACTD/ADCTG
SAC, Ahmedabad, India

Military has unique concerns with respect to communication network design, security, interoperability, multimode, multiband system which are re-configurable and guaranteed assured access, highly survivable and hardened communication systems. The trend in general is the requirement of a small handheld, pocket size communication terminal with low data rate for voice and data communication. Also there is increase in volume of data transfer and a mixture of services on highly mobile, very small platforms which can provide communication on the move for Airborne / Marine / Tactical users. Most likely the existing MILSATCOM bands (UHF / SHF / EHF) shall be used in future also and Military all over the globe tends commercial satcom in large scale. The commercial sector itself is making the migration easier for the defense by bringing its systems using he right mix of military and commercial assets. The latest trend is to use commercial satcom capacity for everyday needs and dedicated military system for surge (crisis) uses (Special Requirements). The most heavily used MILSATCOM systems uses UHF band, and EHF band has tremendous potential for military applications. Looking from the point of view of military applications i.e. narrow beam, cost, complexity, more satellite life, less number of gateways, simple operation Regional GEO based SATCOM systems are best suited for military communication application. Mostly these systems provide voice/fax/data to mobile users using small handheld terminals which are usually dual mode. Also virtually all the US and national military communication satellite are stationed in Geo-stationary orbit. The benefits of using commercially available systems are discussed and recommendation are also made for future systems for military communications.

Design of Multi-Carrier Demultiplexer & Demodulator (MCDD) regenerative payload

Supervisors

Mr. Himanshu Shah
OPD/CTG/SAPA,
Space Application Centre
Ahmedabad, India

Dr. K.S. Dasgupta
ADCTG

V. Ramakrishna, OSPD,
SAC, Ahmedabad, India

The new generation satellite communication systems with regenerative transponders provides, Eb/No advantage and thereby promises substantial benefits in overall system engineering. The Multi-carrier De-multiplexer and Demodulator (MCDD) performs demodulation of multiple FDMA signals and thus provides advantage in cost, weight and power compared to conventional multiple demodulators. The two main functions to be implemented for MCDD are trans-multiplexing i.e. conversion of input FDMA signal to TDM mode and Multi-carrier demodulation i.e. demodulation of each channel of TDM signal. In this project, the Multi-Carrier De-multiplexer and Demodulator (MCDD) are designed for GSAT-4 regenerative satellite. This payload will provide 8 channels of narrow band service and one channel of wide band service in each of the 8 Ka-band spot beams with on-board connectivity on experimental basis to the country. A number of design approaches are studied for trans-multiplexer and for multi-carrier demodulator. After careful analysis, the selection of approach has been made. For the implementation of trans-multiplexer and multi-carrier demodulator, there are two approaches viz. DSP processor based implementation and FPGA based implementation. The hardware as well as software for DSP processor based implementation was worked out. The hardware for FPGA based implementation was designed. After evaluating both the design in terms of power consumption, size of the cards and reliability, the FPGA based approach has been selected for implementation. The results are verified with MatLab simulation.

Project report of applications of propagation models to design geostationary satellite links operating in Ka band over Indian rain zones

Supervisor

Mr. Damodar M. Magdum
Kolahapur Univercity
Kolahapur, India

Mr. E.P. Balasubramanian
PSED
SAC, Ahmedabad, India

The frequency spectrum below 15 GHz is in extensive use in communications through satellite and terrestrial links. The 20-30 GHz radio-frequency band offers three major advantages for satellite communications over the lower frequencies. These advantages are spectrum availability, reduced interference potential and reduced equipment size. However,

beyond a Ka band, propagation impairments strongly limit the quality and availability of satellite communication links. Attenuation due to rain plays a significant role in tropical regions especially countries like India, where great diversity of climatic conditions exist. Propagation studies are essential for estimation of attenuation and other effects, so that Ka-band satellite links operating in different parts of Indian region can be designed appropriately. In this project, "Applications of Propagation Models to Design Geostationary Satellite Links Operating in Ka-Band Over Indian Rain zones", rain data over finer grid have been calculated over Indian region, which is long-term data measured by European Centre for Medium Range Weather Forecasts (ECMWF) U.K., for more than 20 years. The surface water vapour densities and integrated liquid water contents have been calculated using data from National Centre for Environmental Prediction (NCEP), NOAA, U.S.A. National Oceanic & Atmospheric Administration (NOAA), part of the US department of Commerce, monitoring and predicting the global data from oceans and the atmosphere since 1970. By analyzing this data, rain zones have been modified and attenuation due to rain, gas, clouds and scintillation over Indian region are calculated using ITU models. Accordingly satellite links at different regions have been designed. This work is useful for prediction of attenuation over Indian region. The value of rainfall rate, water vapour densities and integrated liquid water contents strongly varies in tropical regions. For validation of the results calculated using ITU models, it is necessary to perform long-term data measurements of above factors over Indian tropical regions.

Study report on the reliability aspects of earth station

Mr. Mostofa Torabian
Telecommunication Company of Iran
Iran

Supervisor
Mr. P. Dhar
R & QA
SAC, Ahmedabad, India

This report is prepared keeping in mind to classify earth station as per the application and to access its reliability and suggest ways for improving the reliability. Reliability software was used to estimate the failure rates of various subsystems used in transmit and receive chain of the earth station. For this purpose circuit diagrams, part details as available in equipment manuals were used. In case, where complete details were not available in the equipment manuals engineering judgment was used to complete the work. Earth Station Reliability has been studied with the experience of large earth station operations with the following factors, which contribute to achieve high reliability. Understanding stress factors imposed on subsystems/hardware by its operating environment. Controlling stress factors through selection of conservative design criteria. Appropriate analysis to identify and track high stress point in the design. Careful selections of redundancy alternatives that will provide the necessary functions should failure occur. Human/operator's error during operation of the earth station (Human reliability). Training of earth station operational staff or skill of the operational staff. Maintenance philosophy. Spare/Inventory control philosophy. Test equipment and its documentation.

Ku - Band VSAT network for Nepal

Mr. Dinesh Dev Pant
Nepal Telecommunications Corporation
Nepal

Supervisor
Dr. R. Ramani
NSD
SAC, Ahmedabad, India

This project report includes the assessment of the service requirement, link budget calculations, system engineering in items of number of channels, bandwidth and power, dimensioning of the terminals and space requirement, rain attenuation calculations and brief subsystems specifications. The geographic distribution of Nepal and telecommunication services were presented for the explanation of VSAT system necessary for Nepal domestic communication. System definition is described with various features to be required for VSAT system. Availability of different VSAT technologies are explained to select appropriate VSAT system for Nepal. Link budget calculation for both Ku-Band and C-Band operation also mentioned with rain attenuation calculation. Specifications of the different VSAT subsystem were mentioned for Nepal.

Project report on satellite based emergency communication system for Nepal

Mr. Lok Raj Paneru
Nepal Telecommunications Corporation
Nepal

Supervisor
Mr. V.S. Yadav
ESEID
SAC, Ahmedabad, India

Nepal is prone to various types of natural disasters due to her rugged and fragile geophysical structure. As in most of the cases, the available communication system, if any, goes out of order especially in the case of nature disasters like earthquake, flood etc and immediate communication set up through the usual communication system become almost impossible. Hence the solution in such situation can be achieved through the use of satellite based communication system only. Though there are three types of emergency communication system, the scope of this project is limited to the study and design of an appropriate emergency communication system for Post-Disaster relief operation for the Kingdom of Nepal.

In Summary, the study work carried out under this project work includes:
- Identify the disasters that are more frequent
- comGet the necessary information in the existing Disaster Management System.
- Study the various satellite systems that are available/applicable for such application in Nepal
- Perform the technical and financial analysis of these system.
- Design the Communication system selecting the system components so that the system bees economical and reliable.

Development of computer based training on satellite communications

Supervisor

Ms. Erkhembaatar Narantuya   Mr. D.A. Dhond

School of Telecommunication & Information Engineering   SAC, Ahmedabad, India

Mongolia Technical University

Mongolia

Education is basic building block of development. We still are continuing the use of same traditional way of teaching in the classroom. Blackboard, posters, specimens, projectors, slides, transparent sheet, TV programs, audio visuals are still being used, every now and then, along with classroom lectures to create more impact on students. These aids create more interest and enthusiasm in the students and thus teaching becomes easy. Innovative people experimented with new kind of teaching aids which takes less time to prepare, more effective in teaching, cost effective and easy to navigate as per choice of the subject and topic. Computer based training is the youngest among all teaching method and is effective of all. This is relatively less time consuming and cost effective to its counterparts. Use of test, posters, still and motion pictures, audio effects, animations etc. has become easy due to design and development of products for multimedia applications. A computer based technical training software, will be able to give learners an ample conception, reference and they can also test their knowledge through some tests. An attempt is made in this project to explore the technology of Computer based teaching and studying Satellite Communications. The new paradigm of Interactive Computer Based Training is also discussed in this report.

Study report effect of the troposphere on radio communication

Supervisor

Mr. Min Kyung Hyun   Mr. Raghubir Singh

DACOM Corporation,   AD

Republic of Korea   SAC, Ahmedabad, India

DACOM Corporation, one of the common carriers in Korea is planning to provide Direct Broadcast Service through linearly polarized 12 GHz Satellite downlink by 1999. However, the actual attenuation data due to precipitation, which is a major factor in degradation of Satellite Communication link at 12 GHz is not available for Korea. Hence, it is proposed to carry out the study of rain attenuation on satellite link at 12 GHz in Korea. The scope of the project was to collect direct rain attenuation data by using satellite beacon signal for one year, analyse the data and compare the result with that of the existing prediction model.

Study report on low rate voice codec development

Mr. Lassana Weeratunge
Arthur C Clarke Centre for Modern Technologies
Sri Lanka

Supervisor
Mr. R.N. Mutagi
BPD
SAC, Ahmedabad, India

This project includes study of several low rate voice coders like ASPCM, APC, SBC, ATC, LTC, CELP and MPLPC. Their algorithms and performances are discussed in details in respective chapters. The Performance, features and applications are also included in brief separately. Detailed study and algorithm programming of CCITT Rec.G.721 for 32 kbps ADPCM is attempted. The simulation of algorithm programmes and its performance are verified. Circuit design for a single channel ADPCM transcoder has also been worked out.

Study and review of video and data compression techniques for satellite based multimedia applications

Mr. M. Saman H. Cooray
Arthur C Clarke Centre for Modern Technologies
Sri Lanka

Supervisor
Dr. K.S. Dasgupta
OBP/CTG
SAC, Ahmedabad, India

The data can either be image or text (non-image) etc. In image data, the most important relationship is the two dimensional dependency of values. In non-image data, it is the temporal relationship that is most important for compression. The two most important classes of algorithms in image coding are the predictive coding algorithms and the transform coding algorithms. Apart from most trivial algorithms, data compression requires considerable processing power. Very often, the only way to obtain the required throughput is to use several processors in parallel to obtain a throughput of approximately 4.8 Mbits/s for the transform coding algorithm. The development of digital video telephony in the 1980's has made it possible to use digital video compression for a variety of telecommunication applications, teleconferencing, digital broadcast and video telephony etc. The computer/ telecommunication industry and the consumer electronics industry are increasingly sharing the above technology. A major driving force is the ongoing partial merging of TV and computers in interactive multimedia services involving digital TV and applications in areas like information (news), education, medical, entertainment, etc. A major target is to maximize inter-operability of video services at all levels, including various resolutions, different transmission, as well as bit rates. The maturity of compression techniques, needs for digital video storage and transmission, and the establishment of international standards for digital TV representation, like MPEG2, have greatly contributed in this transformation. Motion estimation has been applied for video coding with dramatic improvements in bit rate

reduction. The most popular method is the block-matching algorithm. The motion vector can be obtained when the best-matched block is based on a matching criterion such as the minimum Mean Absolute Difference (MAD). Several other search algorithms have developed In the last decade. The Full Search Algorithm (FSA) gives the optimal performance at the cost of very expensive computation. To reduce the computational load, many fast search algorithms have been developed. The fast search algorithms often converge only to a local minimum, thus resulting is a worse performance.

Design and analyses of 3 m dia. earth station antenna

Supervisor

Mr. B.Sh. Usmonov
Uzbek State Space Agency
Uzbekistan

Mr. D.S. Purohit
AMSD
SAC, Ahmedabad, India

The scope of the present work is to use state-of-the-art (MCAE) Mechanical Computer Aided Engineering domain for conceptualizing, analyzing and designing a 3 M dia Earth station antenna. The approach synthesis involves conceptualization of the reflector and mount geometry, development of a geometric model on CAD package, viz. Autocad R1.12, ported on a Pentium platform; Finite Element Modeling (FEM)-pre/post processing through high-end general propose FE software NISA ported on SUN CLASSIC+workstation under Solaris 2.4 OS with Open Windows 3.4 This geometry eventually has to be checked for specified design specifications.A wide gamut of standard design codes, technical research papers have been scanned to understand the modus-operandi involved in calculating the exact Operational and Survival wind loads for various angles of attack on reflector skin and back-up structure respectively. Gust evaluation factor approach was used to estimate the equivalent static by standard design depending on the terrain conditions as specified by standard design codes. Matlab software has been used to estimate total Drag, Lift and Moment loads on the antenna using the concept of zero-lift theorem, based on resulting pressure coefficient values. Parabolic reflector co-ordinates were also generated for the parabolic profile at an interval of 5 mm each, after understanding the concept of paraboilds and the effect of F/D ratio in the design concepts. The geometric model was superimposed by FEM and details like load cases, boundary conditions, real constants were given to generate a customized NISA input file for GFRP (Glass Fibre Reinforced Plastic) reflector and steel mount. Post processing of the results was done using DISPLAY III V.4.5, post processor by consulting the Experts in the Antenna Design Division.