Qos Improvement in Mobile Satellite Networks-a Survey

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***Abstract*— Mobile satellite communication system performs its tasks in a outage known distributed propagation environment. Achieving the expected Quality Of Service (QoS) in a heterogeneous interworking distributed system will be a herculean task . Over the last two decades extensive works have been carried out to improve the quality of service in terms of delay, bit error rate, throughput and overhead along with optimal utilization of resources. Intelligent network operation have been evolved to automize the QoS control. Mobile agent cooperation and cross layer operation control are becoming important techniques for aiding the link adaptation towards achieving the expected quality of service. This paper exposes these techniques for the complex operation of Mobile Satellite Networks functioning for achieving the required QoS.**

Keywords:* *Mobile Satellite Networks , cross layered architecture , Intelligent MSC.

I. INTRODUCTION

Ever increasing demand of global coverage over thousands of kilo meters in the transmission of Multimedia information resulted in the application of mobile satellite communication to a large extent[1]. This kind of system is concerned with the interworking of heterogeneous network over the distance. During the flow of multimedia information to provide the matching quality of service, the resource allocation becomes a complex procedure. Moreover low earth orbit (LEO) satellites are employed for mobile communication environment to minimize delay towards the acceptable value. In recent years there is a tremendous demand for mobile communication with required QoS. This has improved heavy traffic over long distance in the network. Achieving the required Quality of Service with limited resource is a challenge to the designer. The advantages of mobile satellite communication includes coverage , bandwidth flexibility , multi point connectivity for various applications such as TV broadcasting, digital processing point to point and data communication.

Recent Satellite Personal Communication Networks(S-PCN) make use non geostationary satellites termed as LEO (Low Earth Orbit) satellites which are at 750 km to 2000 km above the earth. Space segment provides the connection between the users and Gateways. Direct connections between the users is also possible by using space segment. The Space segment consists of one or more satellite constellations of satellites to increase coverage. LEO satellite rely on Inter Satellite Links (ISLs) between the neighboring satellites. Satellite networks with ISL connections present two types [3] of handoffs namely connection handoff and link handoff. For ongoing communication connection handoff occurs due to relative motion between an end terminal and its corresponding satellite. Link handoff occurs when a satellite approaches the earth pole, the network needs to release some of its ISLs[3]. Link handoff can be averted by carefully selecting a particular ISL in the communications path. The satellite is monitored and controlled by TTC (Telemetry,Tracking & Command) station.[4]

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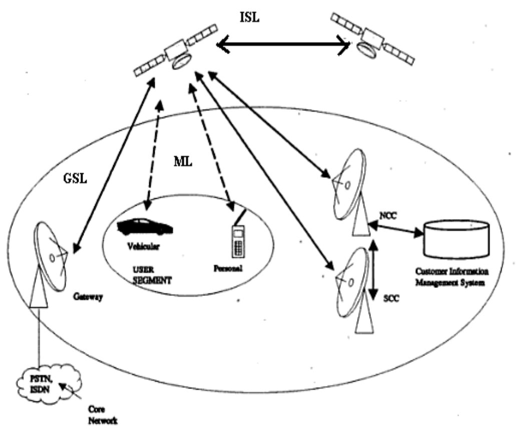
A typical mobile satellite communication system is as shown in fig.1. The mobile satellite communication system consists of i)Space Segment in which the satellites placed into orbit, ii)Control Segment having equipment and facilities responsible for the control of satellite for the desired operation, iii)User Segment having equipment and facilities that use the capabilities provided by the satellite[3].

The operation and maintenance of a mobile satellite system involves variety of complex activities. Satellite networks with on board processing and switching capabilities which allow direct interconnection between satellite terminals and user located in any satellite beam.[3] The real design challenge will be in allocation of the traffic management function between terminal, gateway, payload and network control centers for cost effective implementation at connection level and packet level. In the presence of changing environment, different packets are to be treated differently. The network infrastructure is capable of queuing the information sources for classifying the packets and scheduling them appropriately. Based on the queries, differential treatment will be adopted in handling the packets. Measuring, conditioning and monitoring the flow of packet steam is carried out. To achieve this, cross layer interaction is deployed in an adaptive manner to involve all layers in contributing the final Quality of Service. For example at the physical layer, bandwidth efficient modulation and coding techniques have to be used for improving the Bit Error Rate(BER) and power level performance to compensate the varying Quality of Service.



GSL- Gateway Switching Link
ML - Mobile Link
ISL - Inter Satellite Link

Fig.1.Mobile Satellite Communication System

For example at the physical layer, bandwidth efficient modulation and coding techniques have to be used for improving the Bit Error Rate(BER) and power level performance to compensate the varying propagation scenario. Superior QoS is achieved by providing guaranteed bandwidth at data link layer[7].

LEO system are non – geosynchronous in its operation which limit the availability of them only to a limited duration for a particular area on the global.[4] A prior knowledge about the availability of these satellite over an area has to be provided to the ground station. Handing over procedure need to be well developed for service area and duration. Hand over and resource managements need be arranged for the reliable operation and error free environment.[3]

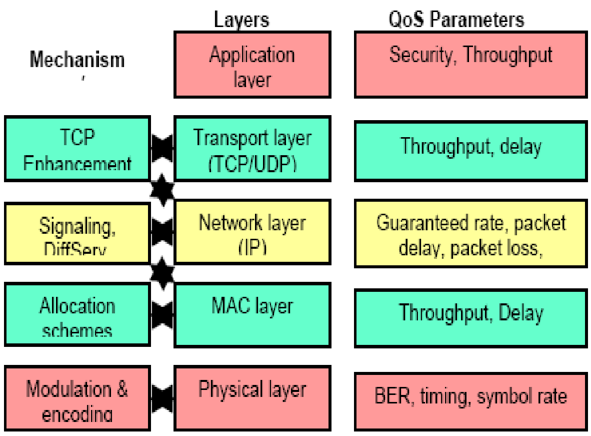


Fig.2. End-to-End QoS Reference Model

Propagation model in the wireless space communication need be available for the adoption of Channel to match its condition and limitation. The information available called Channel State Information (CSI) is quite useful for channel adaptation. Fading and non –fading happening has to be sensed in real time for effective control. Direction antenna system using diversity reception and multi carrier modulation with MIMO is the current technique for supporting the above activities. Adaptive control based smart antenna provide the required throughput with minimization outage in the system. In the next few sections, the techniques used for higher QoS are explained.

II. MOBILITY MANAGEMENT

Mobility management consists of two important aspects . Firstly location management concerned with network functions that allow mobile stations to roam freely within the network coverage areas and secondly hand over management [7] . There are two stage processes for effective transfer of linking one satellite to other.

In the call delivery stage, the network queries the users location profile and locates the current position of the mobile terminal by sending polling signals to all candidate access ports. For LEO satellite systems the satellite network has to take care of both the satellites motion and that of the terminal for appropriate call delivery.[3]

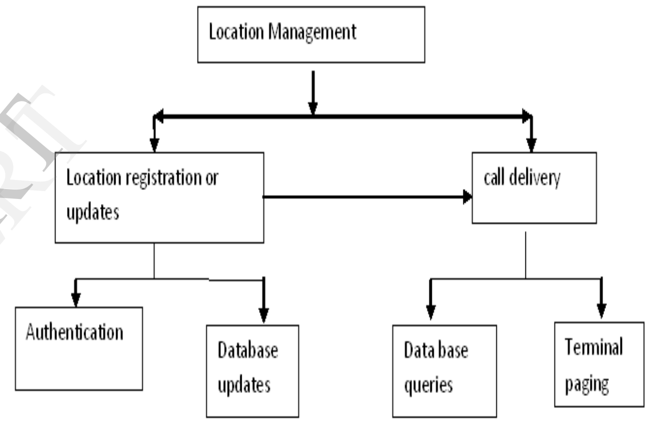


Fig. 3.Mobility Management

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Handover management involves network function that allow mobile station to change their current access point or ground station during a connection. It ensures the continuity of an ongoing connection.[3]There are three phases in handover management. Firstly Handover initiation in which the gathering of information related to radio link measurement is the main task, if radio link is below threshold the handover is initiated. Secondly Handover decision phase, based on the measurement in handover initiation phase, the target resources will be selected, In handover execution phase, new connection are established and old connection are released by performing signaling exchanges between the mobile terminal and the network.

III. MIDDLEWARE TECHNOLOGY

The term middleware is widely used to denote a layer comprised of generic services sitting below user application. The middleware adopts a service approach in which the network is seen as a service provider for user application. The main services provided by the middleware system are the interpretation of application needs and the selection of best network protocol and configuration based on those needs.

A middleware seeks primarily to hide the underlying complexity of the network environments by insulating application from dealing with explicit protocol handling, network faults and parallelism issues. Middleware is essential for migrating mainframe applications to client/server applications, or internet-protocol based applications, and to provide communication across heterogeneous platforms.

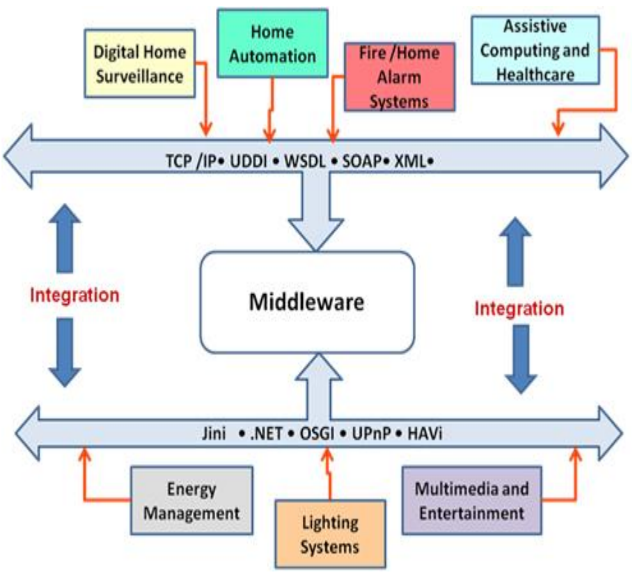

Fig .4. Middleware System

Middleware, which is quickly becoming synonymous with enterprise applications integration (EAI), is software that is invisible to the user. It takes two or more different applications and makes them work seamlessly together. This is accomplished by placing middleware between layers of software to make the layers below and on the sides work with each other .On that broad definition, middleware could be almost any software in a layered software stack. Further, middleware is a continually evolving term. Since much of the software business is driven through the perceptions of the "hottest" current technologies, many companies are giving their software the name "middleware" because it is popular. Middleware, or EAI, products enable information to be shared in a seamless real-time fashion across multiple functional departments, geographies and applications. Benefits include better customer service, accurate planning and forecasting, and reduced manual re-entry and associated data inaccuracies.

IV. MOBILE AGENT CONCEPT

Mobile agent is defined as a program that is able to finish user tasks automatically and not bound to the system where it executes, and transport its code within the network, then continue to execute on the destination system. Mobile agent (MA) is an independent object-driven application program, MA can move within heterogeneous network environment according to some rule and look for proper computing resource and information resource to handle these resources and MA can keep its status during moving and continue executing after moving. Mobile agents reduce the work load of network[10] and reduce network delay. A mobile agent containing many operations is sent the managed node and executes code locally, consequently this mechanism reduces communication between the manager and the managed nodes to avoid network delay. In view of the characteristics of satellite network, mobile agent technology is quite suitable for future satellite network management.

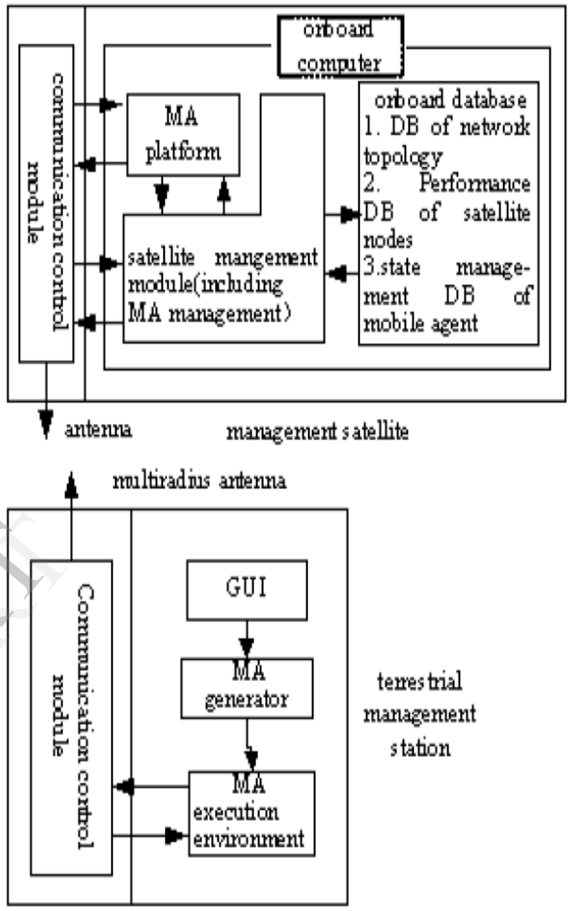

Fig .5.Satellite Network Management with Mobile Agent(MA)

The main parts included in a management station are GUI(Graph User Interface) , Mobile agent generator, Execution environment for mobile agent and Communication control module. GUI is used to manage the whole network by the user. According to the mission type, a mobile agent is generated by the Mobile agent generator, which includes data, status and transferring nodes. Execution environment for mobile agent includes a serial operation methods and modes of communication, security authorization and so on. Communication control module adjusts the antennas on the management stations on the ground and establishes communication with management satellite layer.

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V. CROSS LAYER TECHNIQUE

The concept of Cross Layer design is based on architecture where the layers can exchange information in order to improve the network performance.[5] The layering principle is based on isolating the functions of different conceptual layers into a closed structures with minimum interaction through specified interfaces between the layers. Cross layer architectures diverge from the existent network design approaches where each layer of the protocol stack operates independently and the data between the successive layers is exchanged in a very strict and systematic manner.

Cross layer processing adapts the link, network and transport layer parameters to the channel and the application instantaneous requirements.[5] To support multimedia applications . the specification and management of quality of service (QoS) is important in the network[6]. Location aware services and applications require information on a user's geographical location. Context aware applications require not only the location, but also the user's context which includes characteristics of the particular computing device being used and the information about the users current environment. The application then adapts the information presentation or quality of service provided to the user's current context.[5]

Context aware adaptation could include migrating data between systems as a result of mobility , changing user interface to reflect location dependent information of interest. The QoS experienced is also dependent on awareness of context and appropriate adaptation to that context.

The system performance of LEO satellite network will be improved by cross-layer design[5]. Cross layer Interaction Model (CLIM) as shown in Fig.8 could serve as a simple way to implement cross layer optimization. Cross layer interaction may be local to or distant within a network node[1].

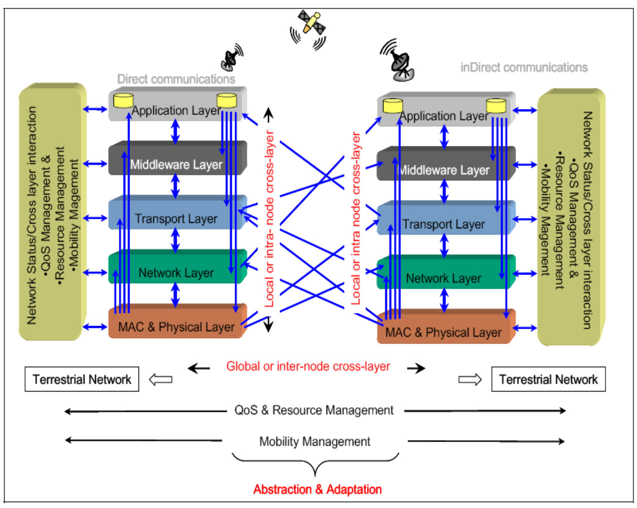

Fig. 7. Cross-layer adaptation and optimization in satellite network

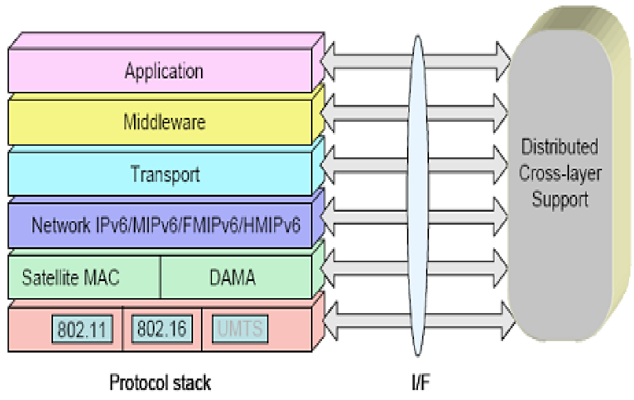

Fig. 8 Cross-Layer Interaction Model

Local communication between protocols of non- neighbour layers are done through a local interface that must be created for all layers involved in cross layer interaction. CLIM is as shown in figure. CLIM has 2 components namely QoS and resource management and mobility management.

VI. CHALLENGES IN DEPLOYING THE TECHNIQUE

Cross-layer design is not an easy task, as co-operation among multiple protocol layers has to be coordinated without leading to conflicts.[6] A common drawback is the lack of a systematic approach for cross-layer designs overall, not just its interactions. Individual optimizations run at cross purposes, violating the structural architecture principles for only shortsighted performance gains, and could lead to serious consequences through unexpected feature interactions. Cross-layer interactions in a controlled way, and preferably through a common optimization interaction interface is not that much easy to do.[7]. To meet the future application demands the standard organizations require to co-ordinates their activities.[7]. The technical challenges for future satellite network will be to ensure seamless integration between satellite and wireless systems and without compromising QoS.

CONCLUSION

This paper provided an overview of the mobile satellite networks for better Quality of Service in terms of minimum delay, optimal resources, higher throughput, lower overhead. A brief report on space segment, operation concept, cross layered architecture and mobility management in mobile satellite networks for the improvement of Quality of Service are addressed. An intelligent cross layered architecture to be done with cross layer manager for the improvement of Quality of Service in mobile satellite heterogeneous networks. An innovative QoS-aware middleware is expected to play an important role in protocol integration and QoS architecture commercialization processes. A few QoS-aware middleware systems, based on wired line networks have been proposed and developed recently.[10] The technical challenges for future satellite networks have been addressed.

REFERENCES

[1] Mohamed Ibnkahla, Q.M.Rahman, A.Sulyaman, "High-Speed Satellite Mobile Communications: Technologies and Challenges", Proceeding of the IEEE, vol. 92, No.2,2004.

[2] Chini Paolo , Giovanni GiambeneA,y and Sastri Kota,"A survey on mobile satellite systems,"International Journal Of Satellite Communications Syst.Network 2010; 28:29–57.

[3] Mobile satellite communication By Roy E.Sheriff & Y.Fun Hu- Wiley India Edition

[4] Mobile satellite communication – Principles and Trends by M.Richharia – Pearson Education

[5] I.Melhus, L. Fan, H. Cruickshank, F. Arnal, C. Baudoin, F. Nivor, T. Gayraud, F. Rodriguez, A. Pietrabissa, L. Lei, Z. Sun "Cross-layer Optimization in the Next-generation Broadband Satellite Systems"

[6] Giovanni Giambene and Sastri Kota: "Cross-layer protocol optimization for satellite communications networks: A survey", Int. J. Satell. Commun. Network. 2006

[7] Sastri L . Kota, " Satellite Multimedia Networks and Technical challenges" Microwave review , Nov 2006

[8] H.Tsunoda , K.Ohta, N.Kato and Y.Nemoto, "Supporting IP/ LEO Satellite Networks By Handovers- Independent IP Mobility Management" ,IEEE Journal of Selected Areas in Communications, vol. 22, no.2, February 2004, pp. 300-307

[9] S.Kota and M. Marchese, "Quality of service for satellite IP networks: a survey", International Journal of Satellite Communications and Networking, vol. 21, no. 4–5, pp. 303–349, Jul. 2003.

[10] Jianli Zhao, Qiuxia Sun, "A Satellite Network Management Architecture based on Mobile Agents and SNMP" 2012 4th International Conference on Computer Research and Development IPCSIT vol.39 (2012) © (2012) IACSIT Press, Singapore

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