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Research Article

LINK ADAPTATION FOR MOBILE SATELLITE NETWORKS

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A B S T R A C T

Mobile satellite performs its tasks under adverse channel working and propagation conditions over a long distance. To manage the critical changes occurring in the channel environment, middleware based mobile agent is proposed for the network to get adopted and provide the required quality of service. Resilient propagation parameter sensors along with the channel performance indicator are arranged by programming a suitable middleware built in a mobile agent. The up linking and down linking transmitters will query the agent for link adaptation to perform its operation for better QoS. The agent middleware relieves the burden of channel state sensing at ground and satellite stations. A detailed presentation explaining the system architecture along with the middleware to collaborate with ground and satellite system is provided. The channel impairments considered in this work are propagation attenuation, fading, noise and interference. Along with the sensors, dedicated micro computing facilities are also arranged in the middleware. The operating system available at appropriate range also is presented in detail. Simulation of the method developed establishes that better quality of service can be achieved in terms of throughput and BER. It is also established that the collaboration of the agent with channel down linking resulted in the improvement of life time of the satellite system with optimal utilization of the network.

INTRODUCTION

Mobile satellite communication system work in a distributed propagation environment to provide service worldwide. At the same time, it retains the flexibility to support a wide range of multimedia services and application in a cost effective manner[1]. Adaptive transmission bit rates in the range of 64Kbps to 4 Mbps need be supported currently in such systems. Network reconfiguration along with its link adaptation strategies has to be developed for matching the heterogeneous requirements for IP, Ethernet, ATM, Frame delay and ISDN during interworking. Extensive studies are being carried out towards developing software and data distribution techniques in processing information for business TV, Internet via satellite, video conference, distance learning, telemedicine and VoIP. The challenges towards providing widespread access to an increasing number of applications demand adaptive selection of design parameters. The communication system involves the creation and diffusion capabilities of creation with reliabilities, expendability and flexibility. The challenging task in these return involves adaptation of transmission rate in a relatively fast time varying environment.

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The long delay involved and the difficulty in mapping the parameters have to be handled in real time for required QoS. In all the efforts that are taken spectral efficiency with required outage probability has to be achieved under a given threshold. Statistical characterization of physical layer abstraction measure has to be carefully carried out[1]. Fading and shadowing are characteristic feature of the Land Mobile Satellite channel.

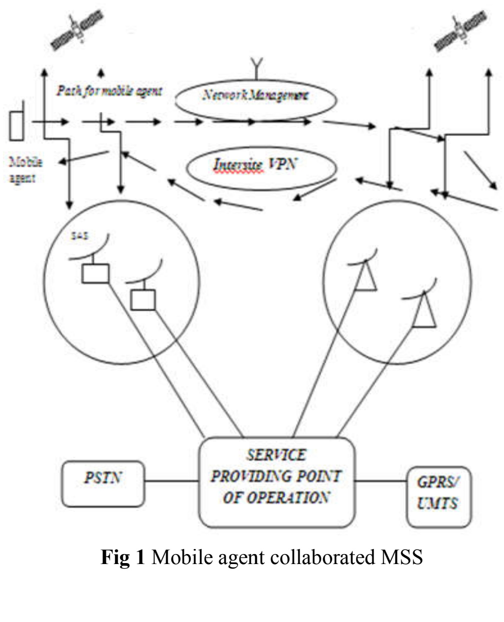

Fig 1 Mobile agent collaborated MSS

Fast and difficult to predict channel variations impose design constraint in the forward and return link. Closed loop control schemes are introduced for effective control of QoS. Although experienced delay is much higher, these methods offer better accuracy in its task. Advanced applications like VoIP, net browsing , varying network and traffic. Modern trends aims at low processing overheads per packet with high effective capacities utilization. The other factors to be considered in the development of the system architecture is modern transfer requirements at the processing stages.

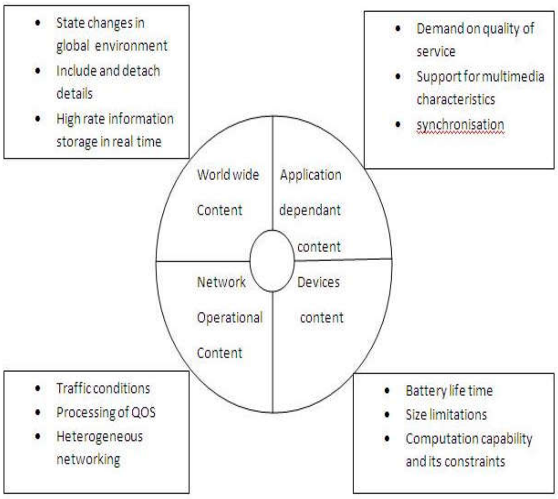

Fig 2 Middleware Learning Facilities

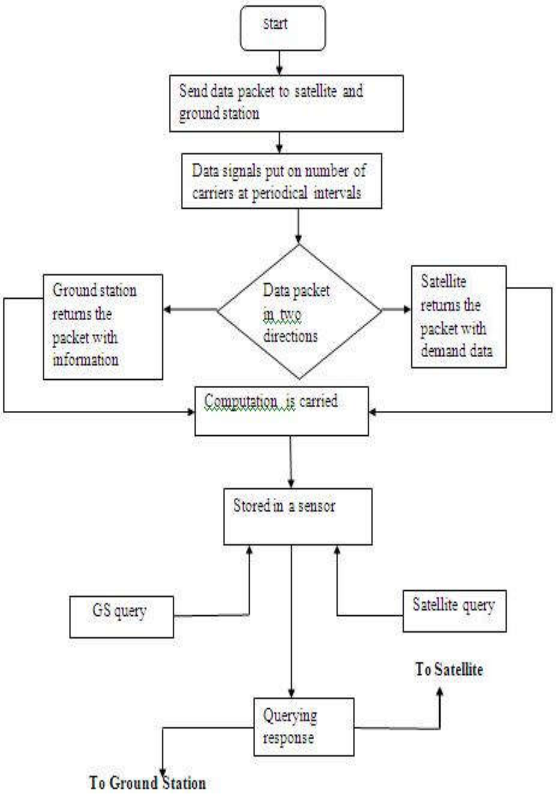

Fig 3 Flow chart of the agent at its task

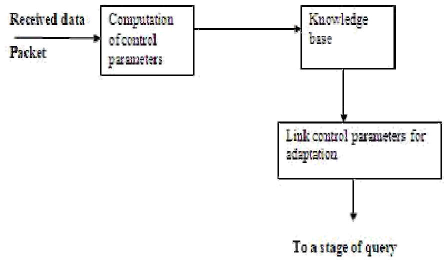

Fig 4 Operation during computation at the middleware

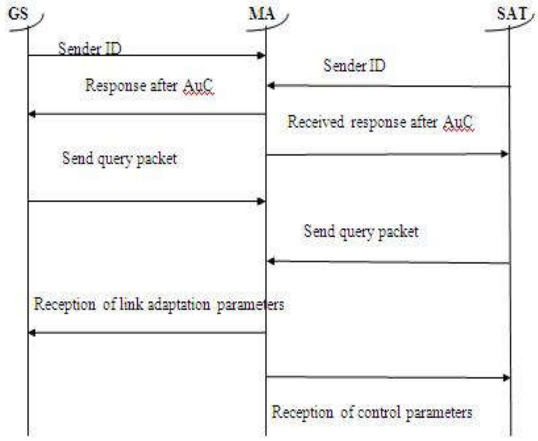

Fig 5 Procedure adopted for querying the Mobile agent

Proposed System Architecture

The proposed system is based on MIMO-OFDM techniques with link adaptation to provide better quality of service in heavy traffic environment. A full scale correction is incorporated by utilizing domain knowledge of traditional propagation model. A middleware is arranged for this purpose with sufficient memory, reliability and adaptation to impairment. Supervised learning techniques for requested SNR ordering is inbuilt at the middleware used in mobile agent. Line budget parameters considered are transmitter power P_t, its gain G_t, EIRP, free space path loss, system noise temperature, figure of merit of the receiver (G/T_s), carrier to thermal noise ratio and carrier to noise density ratio. The line parameters considered are operational threshold of line modulation scheme, coding gain, additional overheads, channel bandwidth and thermal noise power. Alternating with vertical and horizontal polarisation along with circular one are adopted to manage change in polarisation occurring due to rain and snow on the basis of details received from the agents. Dedicated microcontroller is deployed with the mobile agent for rearranging by running in a remote site. It gathers the results, cooperates with other sites to return to its home site after completing the assigned task. Such a mobile satellite system is shown in fig.1.

The satellite ground facility and on board facility are arranged with the network management layers. The collaborating source management algorithm query mobile agent which collect channel environment parameters from both up linking and down linking.[3]. In this kind of topology the middleware based mobile agent acts as the operational support system for the satellite and its ground station in performing their function at the expected level. The middleware learning facilities are shown in the fig 2. Modern middleware agents are known for collecting worldwide content, application dependant content, devices content and network operational content [5]. The agent is free to move in the operational region of the satellite uplink and downlink. The middleware make use of out of the band signalling for sensing the network parameters like path loss, fading nature interference details and SNIR ratio.

The agent middleware is arranged to collect and compute global location details of the point of data also. The environmental parameters thus collected will be stored in the form of a suitable table for easy access and retrieval[8]. The ground station and the satellite management controllers will query the middleware for appropriate resource allocation and its control in real time. A detailed querying algorithm is shown in fig 3 and fig 4. The procedure adopted during querying is explained in fig 5. The data base architecture of the middleware arranged is illustrated in fig.6.

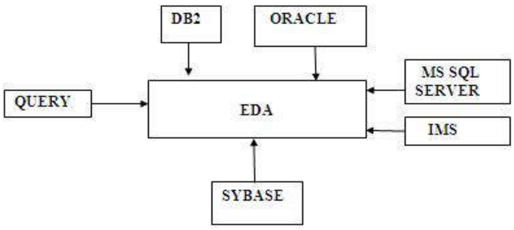

Fig 6 Database Middleware

RESULTS & DISCUSSION

The effect of speed on outage of the system has been studied. During the simulation the results have been shown in fig.7. It can be noted from the results obtained that, with adaptation the outage gets reduced. In fig.8 the effect of SNR on outage is presented. It can be noticed that with adaptation the outage probability gets reduced.[2] It can also be noted that higher average SNR results in lower outage probability. In fig.9 it can be noted that average spectral efficiency improves with the proposed adaptation. It may also be noted that, with average increase in SNR, the spectral efficiency gets increased. The effect of SNR over probability of error has been presented in fig.10. It may also be noted that, with adaptation the probability of error may get reduced. This may result in better reliability of the system.

Fig.11 depicts the comparison in utilization of the adapted channel. It may be noted from the results obtained that, with adaptation the average throughput increases. It may also be noted that the throughput increases with speed of transmission of information. The energy requirement during link utilization has been explained. With link adaptation it is noted that higher energy is required to activate the closed loop control system. Higher energy required is the cost to be paid for achieving the quality of service. With the simulation conducted the proposed method improves the quality of service, better utilization of resources however higher energy to be spent to accrue the advantages of adaptation. The QoS achievements in terms of various parameters with link adaptation are as shown in table.1

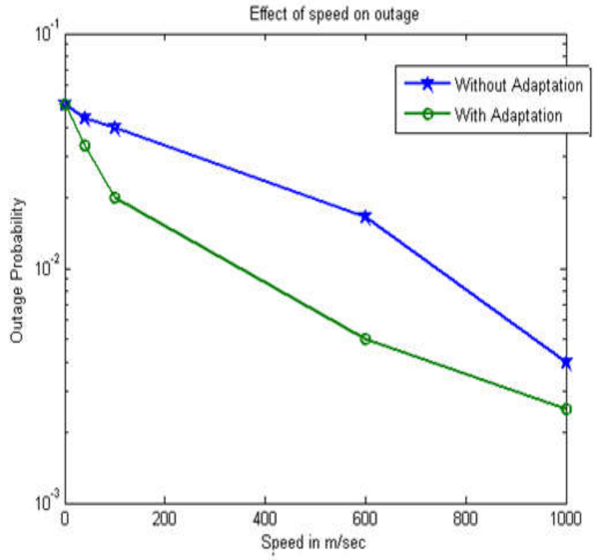

Fig 7 Effect of Speed on Outage

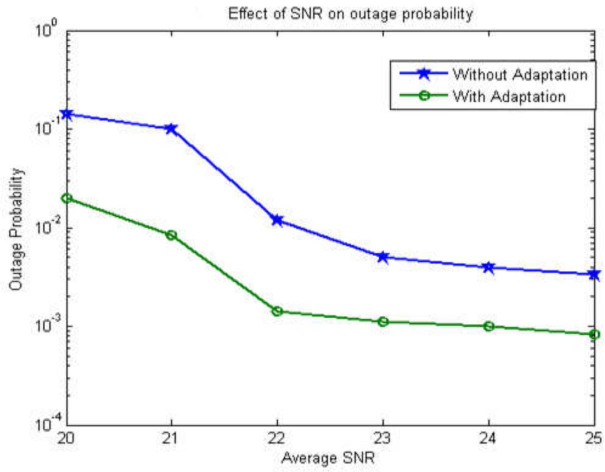

Fig 8 Effect of SNR on OutageProbability

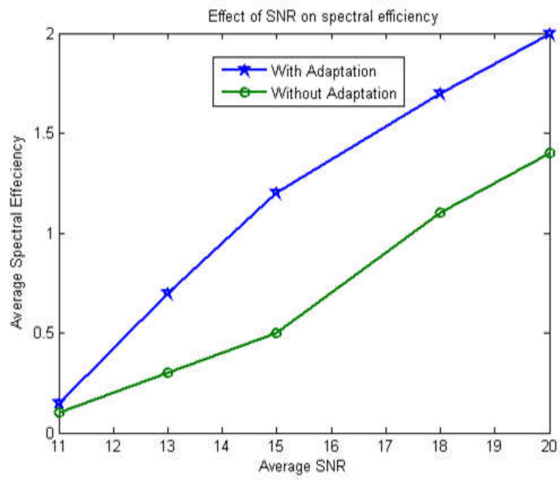

Fig 9 Effect of SNR on Spectral Probability

PARAMETERS	VOICE		DATA		VIDEO	
	Without Adaptation	With Adaptation	Without Adaptation	With Adaptation	Without Adaptation	With Adaptation
DELAY	150-200msec	<100 msec	<200 msec	18-50 msec	150-200msec	18-50 msec
PACKET LOSS	< 3%	1%	< 1%	0. 1%	<1%	0. 1%
BER	10^{-2}	10^{-3}	10^{-4}	10^{-6}	10^{-4}	10^{-6}
DATA RATE	4-8 Kpbs	8.2Kpbs	< 28.8Kpbs	1-100 Mpbs	32-384 Kpbs	1-20 Mpbs
TRAFFIC	Continuous	Continuous	Burst	Burst	Continuous	Continuous

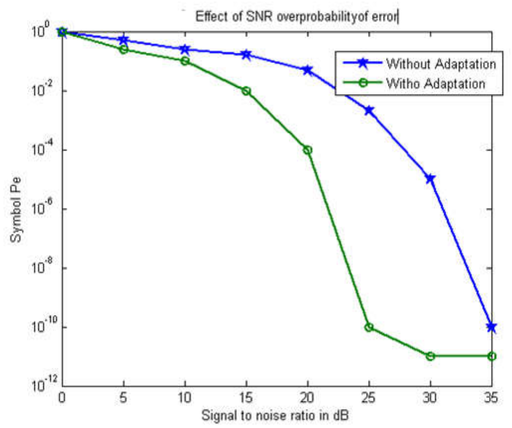

Fig 10 Effect of SNR Over Probability of Error

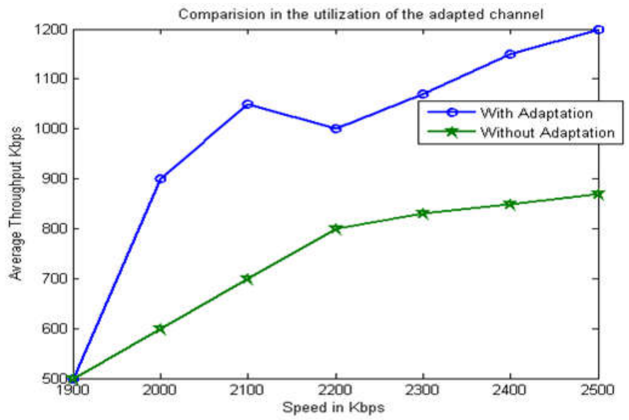

Fig 11 Comparison in the Utilization of the Adapted Channel

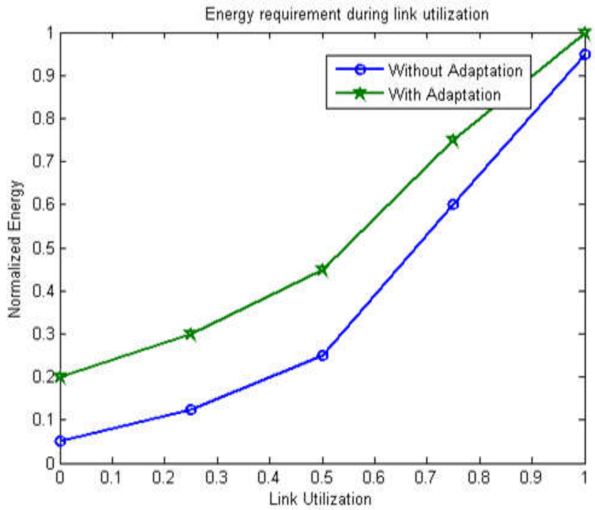

Fig 12 Energy Requirement during Link Utiliztion

CONCLUSION

By using mobile agent based middleware, the performance of mobile satellite communication is increased with link adaptation. Simulation results prove the improvements in the performances such as throughput and symbol error rate for better quality of service. It is evident that the collaboration of the agent with channel down linking resulted in the improvement of life time of the satellite system with optimal utilization of network. The proposed algorithm for link adaptation provides better quality of service.

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