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Asynchronous Transmission Mode Unified Networking Standard for Quality of Service: A Systematic Review

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Abstract

Technologies that split data into smaller pieces have usually very low output. The data is lost during transmission andthe existing mechanisms are not enough to identify and retransmit the lost cells. In this situation, the solution that can resolve the problem is to perform the transmission process again. But it is not a good idea to transmit the entire data set repeatedly. An alternative method is to retransmit only those individual cells that are missing or lost. The ATM technology integrates to retransmit only those cells that were not properly provided in each packet. It also increases the performance of transmission at every network link by reducing the flow control activity. Recent surveys serve as an effective barometer to determine the evolution of ATM technology and provides how design solution shows unrivaled speed, scalability and fault tolerance through multiple meshed interconnected switches that enable network-wide load sharing. To contribute in this area of research, the present review paper is purposed to summarize the outcomes of the existing literatures on various approaches how asynchronous transmission mode networking standards are contributing to the improvement of quality of service in data transmission. Meanwhile, we also reviewed various types of service categoriesused for the utilization of spare bandwidth in asynchronous transmission mode networks.

Keywords: *Asynchronous Transmission Mode, Data Transmission Technologies, Fault Tolerance, Networking Standards, Quality of Service.*

1. INTRODUCTION

The present analysis puts together two very distinct 'worlds' of networking. One among them is Asynchronous Transfer Mode (ATM) networks. At present this technology is built to carry a wide range of data transmission traffic in text, audio, and video to increasethe popularity.Network users switch to ATM as a solution for applications that need high bandwidth or guaranteed performance.ATM is a significant step towards converging real-time and non-real time systems into a single communications network. ATM protocol is considered as the first protocol suite that allows true differentiation among the traffic classes and set standards for the determination of subsequent technologies. Indeed, the ATM approach towards QoS is the basis for mechanisms and terminology used in modern IP-based QoS-aware networks.

ATM was developed as the Broadband Integrated Services Digital Network (B-ISDN) transportation technology and a standard for new-generation communications. The ATM standard was developed to cater for the community of telecommunications and the community of inter-networking computers.ATM tried to carry all traffic modes and thus proved to be a complex technology. ATM design models support both circuit-switched and packet-based networking as an independent and single unified standard.ATM is a circuit-

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based technology virtually connected between the two endpoints to perform data transmission.

ATM is a key communication technology enabling new applications to be introduced to users and network service providers. It is also providing greater network capability with high bandwidth and cell-based architecture.The design for ATM cells is simplified to enable very fast switching. The ATM cell's fixed length simplifies cell transmission and reception compared with the Frame Relay and Ethernet variable-length packets.The ATM protocol suite's fundamental design goal is to deliver bandwidth to time/delay-sensitive, loss-sensitive, non-real time and real-time services like audio and video for computing data. This brief design led to the birth of the QoS concept.ATM networks provides several categories of services including constant bit rate (CBR), real-time/non real-time variable bit rate (rt/nrt VBR), variable bit rate (VBR), and unspecified bit rate (UBR). Significant attention has been paid to the problem of providing quality service support on packet switching networks like ATMs. The present review refers directly to the differential treatment of packets in the network by 'quality of service', usually depending on the specifications of the network applications or on administrative constraints.

Some types of remote-control applications need a short network delay to make operation practical and tolerable for the end user. The Tenet approach to real-time communication in packet-switching networks builds on quality-of-service and assured service. The Tenet approach offers strict, mathematically established performance guarantees that will maintain network load even under worst-case conditions. This technique puts many conditions on the network. Firstly, the data forwarding entities like routers and switches must use effective queuing and scheduling algorithms while handling network packets. In this case, a broad class of scheduling disciplines with Earliest Due Date, Hierarchical Round Robin, and Rate-Controlled Static Priority became major requirements.

The second criterion is that network sources must be able to define their traffic characteristics and their output specifications like delay or delay jitter, peak and average sending rate. Usually, this information will be given to the network at the initialization time of a connection. When a link is approved by the network, the creation of the link is regarded as a contract between the application and the network, whereby the network agrees to provide the requested output if its traffic characteristics are respected by the application.Finally, there is a need of a protocol for newly established communications and conducting admission control. Based on the current state of allocated network capital, an admission control process decides whether the network will approve a new link and still meet all its promised guarantees. Notice that the tests for admission control must consider the worst-case traffic conditions, according to the traffic characteristics of the sources, andalways ensure that all assurances will still apply.

The purpose of this review article is to understand how ATM standards are contributing to the quality of services during data transmission in networks and the service categories that carries the efficient network traffic with new control mechanisms.

The organization of this paper is follows: The section 2 is a research methodology chapter describes how the entire process of review is carried out and the organization of the entire content. Section 3 includes the implementation issues of ATM technology with open

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challenges. Section 4 summaries the need for the future work followed by conclusion in section 5.

2. RESEARCH METHODOLOGY

This section provides a step-by-step procedure followed to identify the appropriate information related to contribution of ATM networks towards QoS and the set of some service categories that can improve the efficiency of data transmission during inconsistent network traffics.Figure 1 depicts the flow chart followed to organize this paper. Table 1 shows the list of keywords used during the search process.

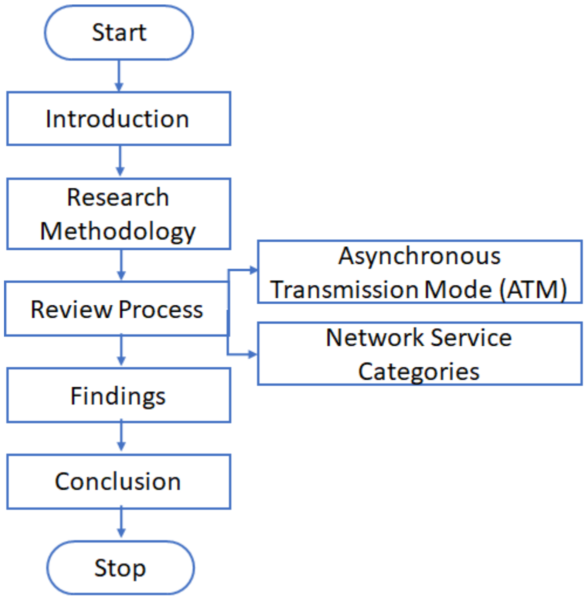

Figure 1. Research Methodology Process

Table 1. List of Keywords

Data Transmission	Network Technologies
Quality of Service	Asynchronous Transmission Mode
Network Services	Network Service Categories
Network Traffic Parameters	Network Frameworks

A. Literature on ATM for QoS

This subsection aims to introduce the fundamental aspects of asynchronous transfer mode networks. Most of the content covers all the important aspects of ATM networks [1-2]. In recent years, the technological aspects behind ATM technology and its intense development have contributed to a large and diversified literature. Most of the references cited are reviews of documents or articles from the ATM. Active readers are directed to the corresponding articles and the references therein for more comprehension of the individual topics.

Different network applications require greater bandwidth and generate a heterogeneous combination of network traffic. Existing network technologies does not provide the data transmission facilities with various service specifications to effectively support a variety of traffic. ATM has been designed to potentially support heterogeneous traffic like data, voice,

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and video in one transmission and fabric switching technology. It offered higher integration capabilities and services including more flexible access towards network and cost-effective operations.

ATM network is a cell switching and multiplexingtechnology thatincludes the advantages of circuit switching with the benefits of packet switching. The key purpose of the implementation of ATM network is to support BISDN (Broadband Integrated Digital Network Infrastructure) infrastructure. It offers flexible bandwidth ranging from a few Mbps to several Gbps. Sophisticated traffic and resource management systems are required to meet the demands of multi-service networking, that the traffic of varying bandwidth and latency specifications must be serviced simultaneously. ATM switch uses a shared-memory architecture[4] which offers enhanced traffic management and congestion control capabilities to serve these needs.

B-ISDN will provide users with the services of text , image , audio, and video transmission. B-ISDN uses the ATM technique[6] that transmits all kinds of information into small and fixed-size packets called cells. The integrated traffic in ATM networks can transport data with a variety of features and requirements for QoS.Congestion control mechanisms [7-9] are essential to support the ABR service in order to provide fair and efficient allocation of bandwidth among the applications. The rate-based congestion control promises an efficient data communication and traffic management when compared with the congestion schemes in ATM networks. Cell emission rate for each source end device is controlled in the rate-based congestion control mechanism according to the congestion information returned by the network.

Congestion generally results in loss of cells in ATM networks. The cells that compete for the same output line could be lined based on time limit and priority.Depends on company characteristics. Priority management algorithm, one of the congestion control algorithms is used to provide various QoS bearer services that can be introduced in the ATM switching nodes using threshold methods, cells with specific deadlines and priorities could be managed pursuant to necessity[3].ARC relies on window sliding technique[5]. The size of the window is based on the rate of traffic from source, cell drop rate and cell delay. When a cell reaches and there is no cell decline, the cell is immediately transmitted without delay. If there is a cell drop, the cell will be dropped and placed in a queue, waiting for retransmission. In this way the Adaptive Rate Control Scheme modifies the size of the window to beat the drop of the cells. The maximum cell delay time is equal to CDVT (Cell Delay Variation Tolerance) for achieving QoS (Quality of Service) Adaptive Rate Control scheme. Cells that wait longer in the queue than CDVT are simply thrown out of the queue.

B. Literature on ATM Service Categories

In this section, we review the service categories based on cost and performance. It is observed that available bit rate (ABR) service category provides much better performance in the present emerging internet-based technologies for better end-to-end quality of service. Several years ago, an international non-profit organization, the ATM Forum, was founded with the primary objective of encouraging and expanding use of ATM products or services. The Forum's ATM standard describes the client-network interface; that is, the way a private user-owned computer can connect to the network and interact through it. Five different

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systems are available for this, and they are used by various contact types[10] like constant bit rate (CBR), variable bit rate (VBR), available bit rate (ABR), unspecified bit rate (UBR), and guaranteed frame rate (GFR).

Table 1. Comparative analysis of ATM service categories

Category	Nature
CBR	Gives strict guarantees, but requires the user to define its traffic characteristics and QoS requirements, and is unsuitable for bursty traffic (little statistical multiplexing gains).
rt-VBR	Gives strict guarantees, but requires the user to define traffic characteristics and QoS requirements.
nrt-VBR	Gives loss guarantees, but requires the user to define traffic characteristics. Requires large network buffers.
UBR	Extremely simple, but gives no guarantees.
GFR	Gives loss and rate guarantees, but network elements must perform frame-level tagging/policing, scheduling or buffer allocation functions.
ABR	Gives loss and rate guarantees, but sources and network elements must perform a number of complex functions. Provides adaptive closed-loop feedback, and hence gives excellent control and utilization. Pushes queues to edge routers, with small queues inside the ATM network.

The ATM Forum introduced the tariff based ABR operation congestion control scheme[10]. Within this scheme specific rate control messages are transferred to the sources through special cells named as resource management (RM) cells from intermediate nodes. The purpose of this congestion management mechanism among the ABR sources is to share equally the bandwidth left over from high-priority traffic (CBR and VBR) while reducing the use of the links across the network.A generic ATM network is designed with several interconnected nodes called switches via bidirectional linkages. It is observed that the cell rate of incoming ABR at any of its output ports is greater than the rate available for serving the ABR cells, a switch is bottle necked. Clearly, there might be multiple bottlenecks in the network at a given instant, as in Figure 1.

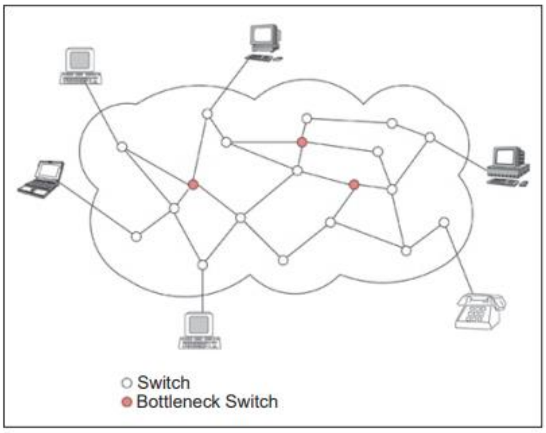

Figure 1. Generic Asynchronous Transmission Mode (ATM) network

Despite the standardization of the rate-based congestion control schemes, it is still an open challenge to develop the algorithms with a good explicit rate computation. The delay-bandwidth ratio (i.e., the delay ratio of the round-trip propagation and the capacity of a link) is that as the link speeds continue to increase. An important problem that occurs in this

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context is how action delays are handled with is the time that control information is transferred to a source before it takes action that affects the state of the switch triggered at some order. In this article, we find a mathematical model focused on control that helps us tackle this problem. ATM networks supports multiple categories of services that can provide quality of service requirements of various applications [11]. The list of service categories provided in this section are aimed to support voice, audio, video, and other applications that are synchronous. They are designed to support primarily the data related applications.

Management of congestion requires the design of systems and schemes to statistically restrict the operating expense mismatch or dynamically regulate traffic sources when such a problem exists. Congestion problem is associated with network load dynamics and bandwidth it's been shown that static approaches such as allocating more buffers or having faster links or faster processors do not Indeed the temporary deployment of these variable alternatives has resulted in more homogeneity in the network and increased congestion possibilities.

Note that congestion management is about matching the demand and availability of a single class of network traffic. Also, for a single traffic class, traffic management deals with the problem of ensuring that the network bandwidth buffer and computational resources are used efficiently while fulfilling the specific Quality of Service (QoS) assurances provided as part of a traffic contract to the sources. The general network traffic management issue includes all the traffic groups available. The general traffic management issue in ATM networks includes the mechanisms required to regulate the multiple traffic classes such as CBR, VBR, ABR, and UBR while ensuring all traffic contracts are fulfilled. The traffic management components other than the congestion management schemes include scheduling traffic management systems admission regulation and traffic enforcement. In this study we deal with the question of designing traffic management mechanisms in ATM networks for one member of the ABR service class.

Our general methodology to tackle this problem using techniques of experimentation and simulation rather than mathematical analysis. This technique allows us to build models that are closer to systems in the real world than mathematical models. However, to ensure the reliability of the developed system we rely on basic analytical tools and techniques such as metric design and controlling feedback correlation.

3. FUTURE SCOPE

Different service types of ATM networks such as ABR, RT-VBR, NRT-VBR, GBR support inconsistent traffic but all have their own limitations. Several principles and frameworks such as the specification of traffic parameters using the GCRA, the rate-based flow control scheme for ABR traffic, and the type of GFR operation to support non-real time applications. New control mechanisms that operate on layers above ATM are required to efficiently and cost-effectively carry Internet traffic over an ATM network. Fast resource management (Congestion control and Traffic shaping) is required by efficient use of spare bandwidth to send burst traffic with less congestion possible and without bits or cells loss or less. The review findings have brought a scope to design and develop an ATM based network using NIST or GNS2 Network simulators utilizing the spare bandwidth for inconsistent traffic levels.

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4. CONCLUSION

The paper has discussed various ATM network technologies with congestion control mechanisms. During the review of ATM network services categories, it is observed that available bit rate or ABR is a most unique feature of feedback control. As per Table 1. It is very clear that the service categories show high QoS by allowing the user to specify the characteristics and requirements of the network. ABR provides efficient and fair utilization of network bandwidth and shows good performance even with the comply operations of end systems. ABN is more unique because of the feedback controlling. The category allows to handle drop priorities and preferences and can utilize the buffering added. The analysis of present review indicates that a well-designed implementation of ATM network services is capable of flexible traffic management.

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