Performance Assessment of Wireless Protocols for ATM Networks

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Abstract

The perception of wireless ATM is now being aggressively measured as a potential framework for next creation wireless communication networks accomplished of sustaining integrated multimedia services with diverse QoS requirements. Numerous key subsystem intend issues for wired ATM and wireless networks desires to be readdressed in the scope of the wireless ATM, which has the competence to expand the statistical multiplexing of wired ATM network into the wireless medium. One of the key subsystem issues is the expansion of apposite medium access control (MAC) protocol. The conservatory of the ATM network into wireless environment faces many interesting problems. The original ATM network was deliberate for high speed, noiseless, and reliable channels. None of this distinctiveness is relevant to the wireless channel. One of the critical aspects of a wireless ATM network is the Medium or Multi Access Control (MAC) Protocol used by the Mobile station (MS) to request service from the BS, which has to believe the Quality of Service (QoS) of the explicit applications. This paper analyses newly proposed MAC protocols, chiefly those of Demand Assignment Multiple Access protocols using TDMA technique with Frequency Division Duplex (FDD). It also gives performance measures of two best appropriate protocols for wireless network surroundings Distributed Queuing Request Update Multiple Access (DQRUMA) protocol and Adaptive Request Channel Multiple Access (ARCMA) protocol.

Keywords - *Multiple Access Control Protocols, ATM, DQRUMA and ARCMA.*

I. INTRODUCTION

The wired communication network will be conquered by the broad band ATM network, which is an incorporated multimedia wireless network. Consequently, the provisioning of translucent transmission packets between wireless and wired network in which packet header dispensation is kept to minimum, is highly pleasing. Hence the transmitted packets in the wireless medium are in the ATM format encapsulated with a supplementary header and trailer for the usage of wireless network protocols stacks. This scenario provides the following advantages, compatibility with wired ATM network and less processing time of wireless or wired interface. The conception of ATM is end-to-end communication that is in a Wide Area Network environment, the communication protocol will be the same i.e. ATM, and companies will no longer have to buy additional equipment like as routers or gateways to interconnect their LANs. Also ATM is measured to reduce the complication of the network and improve the elasticity while providing end-to-end deliberation of traffic performance.

A. ATM Cell

ATM is a fixed size packet-based switching and multiplexing technology planned to be a connection-oriented transfer mode that chains a wide range of services. Its communication scheme can operate at either constant or changeable bit rates. ATM also wires applications of dissimilar QoS, which specifies supportable cell delay and cell loss probability. The primary unit in ATM is called a cell. The ATM typical defines a fixed-size cell with a length of 53 bytes, which is collected of 5-byte header and a 48-byte payload. These fixed-sized cells diminish the complication of ATM switches and multiplexers allowing cells to be relayed at very high speeds. The distinctive bit rates at the terminals are 25 Mbps, 155 Mbps, and 622 Mbps. The conversion of user data into ATM cells, and vice versa, is performed by the ATM Adaptation Layer (AAL), which resides straight above the ATM layer of the network.

B. ATM Services

Users request services from the ATM switch in stipulations of destination(s), traffic, type(s), bit rates(s), and QoS. These necessities are usually grouped collectively and categorized in diverse ATM

classifications. The prototypical ATM services are categorized as follows,

1) ***Constant Bit Rate (CBR):*** Connection-oriented constant bit rate service such as digital voice and video traffic.

2) ***Real-Time Variable Bit Rate (rt-VBR):*** **A**nticipated for real-time traffic from burst sources such as condensed voice or video transmission.

3) **Non-Real-Time Variable Bit Rate (nrt-VBR):** Planned for applications that have burst traffic but do not necessitate tight delay guarantees. This type of service is apposite for connectionless data traffic.

4) **Available Bit Rate (ABR):** Intended for sources that accept time-varying accessible bandwidth. Users only surefire a minimum cell rate (MCR). An example of such traffic is LAN emulation (LANE) traffic.

5) **Unspecified Bit Rate (UBR):** Best effort service that is intended for non-critical applications. It does not supply traffic-related service guarantees.

II. MULTIPLE ACCESS PROTOCOLS

A multiple access protocol is a scheme to control the access to an ordinary communication medium surrounded by various users. Access protocols can be grouped according to the bandwidth allocation, which can be static or dynamic and according to the type of organize mechanism implemented. Multiple access protocols can be categorized into fixed assignment, random assignment and demand assignment.

A. Fixed Assignment

Time-division multiple access (TDMA) and frequency-division multiple access (FDMA) are fixed assignment techniques that include permanent sub channel obligation to each user. These conventional schemes perform well with stream-type traffic, such as voice but are unsuitable for integrated multimedia traffic because of the radio channel spectrum consumption. In a fix assignment environment, a sub channel is wasted each time the user has nothing to transmit. It is generally established that most services in the broadband environment are VBR. Such traffic wastes a lot of bandwidth in a fix assignment scheme.

B. Random Assignment

Representative random assignment protocols like ALOHA and Carrier Sense Multiple Access with Collision Detection (CSMA/CD) are more proficient in servicing burst traffic. These techniques distribute the full channel capacity to a user for short periods, on a random basis. These packet slanting techniques enthusiastically allocate the channel to a user on per-packet basis. Even though there are few versions of the ALOHA protocol, in its simplest form it allows users to broadcast at will. Every time two or more user transmissions overlap, a collision occurs and users have to retransmit after a random delay. The ALOHA protocol is intrinsically unstable due to the random delay. That is, there is an opportunity that a transmission may be delayed for an infinite time. In a plain CSMA protocol, a user will not transmit unless it sanity that the transmission channel is idle. The amalgamation provides a protocol that has a high throughput and low delay. Though, carrier sensing is a major problem for radio networks. However, it suffers from considerable limitations such as limited transmission rate, complex BS, and problems associated to the power of its transmission signal. The restriction in transmission rate is a considerable drawback to using CDMA for integrated wireless networks.

C. Demand Assignment

In this protocol, channel capacity is assigned to users on demand basis on desired. Demand assignment protocols classically involve two stages: a reservation stage anywhere the user requests access and a transmission stage someplace the actual data is transmitted. A small piece of the transmission channel, called reservation sub channel, is used exclusively for users requesting permission to transmit data. Short reservation packets are sent to request channel time using a number of simple multiple access schemes, characteristically, TDMA or slotted ALOHA. Once channel time is reticent, data can be transmitted throughout the second sub channel contention-free. This reservation technique allows demand assignment to evade bandwidth waste due to collisions. In accumulation, unlike fixed assignment schemes, no channels are exhausted whenever a VBR user enters an idle period. The assigned bandwidth will simply be billed to another user requesting access. Due to these features, protocols based on demand assignment techniques are most appropriate for integrated wireless networks.

III. DEMAND ASSIGNMENT MULTIPLE ACCESS PROTOCOLS

Most Demand Assignment Multiple Access (DAMA) protocols use time-slotted channels that are estranged into frames. Depending on the transmission rate and the type of services, the channel bandwidth can be representing by a single or multiple frame(s). Each frame is separated into uplink and downlink period.

These periods are further separated into two sub periods or slots. They can be partition on a slot-by slot or period basis. In the slot-by-slot method, each uplink and downlink period consists of a single time slot. In the means by period, the uplink and downlink period include multiple time slots, encapsulate as a frame. The uplink and downlink communications can be actually separated using diverse frequency channels or dynamically communal using the time-division duplex (TDD) system.

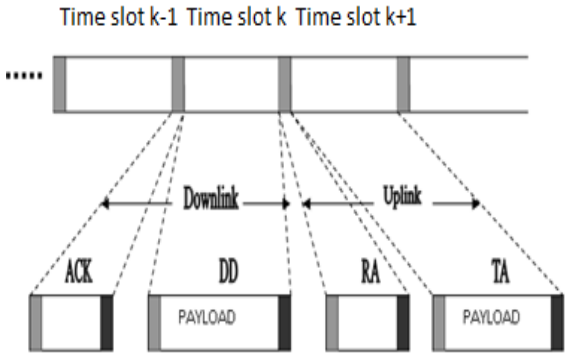

Fig 1. Radio Channel Classification: (Slot-By-Slot)

The uplink channel (mobile-to-base) is separated into the request access (RA) and data transmission access (TA) sub periods. On the other hand, the downlink is estranged into the acknowledgement (ACK) and the data downstream (DD) sub periods. A user desires bandwidth using the RA sub periods. When the BS hears a successful request it will notify the resultant user through the ACK sub periods. Flourishing users are then assigned bandwidth, if reachable, in the TA sub periods. The DD periods are used by the BS to transmit downstream data to mobiles. These sub periods also known as slots vary in length depending on the type and quantity of in sequence they carry. The RA and ACK slots are much smaller than the data slots; therefore their time intervals are called mini slots. Depending on the protocol, they may not have equal lengths. DD transmissions are proscribed by the BS and are performed contention free; characteristically using a time division multiplexing (TDM) broadcast mode. A mobile access request uses random access schemes like ALOHA or slotted ALOHA.

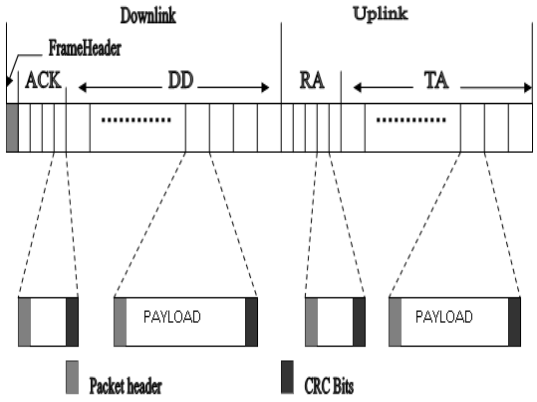

Fig 2. Radio Channel Classification by Period

A. DQRUMA

The Distributed Queuing Request modernizes Multiple Access protocol is calculated particularly for data packet networks. It attempts to supply a competent bandwidth-sharing system that can gratify QoS parameters and carry various types of ATM services. Obviously, DQRUMA is considered for fixed-length packets incoming at the mobile at some burst random rate. The uplink and downlink periods are configured on a slot-by-slot basis. The uplink slot comprises a single data transmission slot and one or more RA slots.

B. ARCMA

This new protocol scheme is based on the DQRUMA protocol while incorporate the periodic traffic management of PRMA. In addition, this protocol attempt to diminish collisions in the RA channel by using a resourceful adaptive request strategy. Consequently, protocol is called Adaptive Request Channel Multiple Access (ARCMA) protocol. ARCMA is fundamentally a demand assignment multiple access protocol with dynamic bandwidth allocation. Its basic building is modeled after the DQRUMA protocol. This scheme is considered to function in a cell-based wireless network with many Mobile Stations (MS) communicate with the Base Station (BS) of their particular cell. Transmissions are done on a slot-by-slot basis without any frames.

IV. PERFORMANCE ANALYSIS

1) Simulated Protocols

In this simulation protocols, ARCMA and DQRUMA are compared beneath identical network environment and condition. DQRUMA and ARCMA have proven to be an effectual multiple access protocols that can carry incorporated traffic in a wireless packet network. Both these protocols are implemented using the FIFO scheduling policy in the Request Table and slotted ALOHA with Binary Exponential Back off

algorithm is worn as the random access scheme in the RA channel.

*2) **Performance Measures***

The simulation involves two diverse multiple access schemes performing a variety of traffic conditions. Special traffic is simulated by anecdotal the data arrival rates to the mobile's buffer. The number of active mobiles in the cell and the burst is also different. The performance measures are,

*1) **Channel Throughput (TPc):***

TPc is definite as the ratio of the total numeral transmitted packets and the total time number of time slots. To facilitate is, TPc = PT/TTL, where PT is denote as the total number of transmitted packets, and TTL is the total number of time slots. In our simulations, the TTL is the time period for each our simulation, which is preset to 1000 time slots. TPC is deliberate as the number of packets transmitted per slot.

*2) **Average Transmission Delay (DAVG):***

DAVG is definite as the ratio of the total packet transmission delay and number of active mobiles. Therefore, DAVG = DTL/M, where DTL is the total packet transmission delay and M is the number of active mobile. Every delay is defined as time taken, when a packet primary arrives at the mobile's barrier to the time the packet reaches the BS. M is predefined in each simulation. DAVG is calculated by the number of time slots.

*3) **Average Queue Length (LAVG):***

LAVG is distinct as the ratio of the total number of packets in the entire mobiles shield and the number of active mobiles. Thus, LAVG = LTL/M, where LTL is the total number of packets in all the buffer, and M is the digit of active mobiles. LTL is the total time taken at the end of simulation. LAVG is considered by number of packets.

V. CONCLUSION

Wireless ATM is measured as a talented technique for future broadband wireless networks and is under research prototyping at different institutions. This paper focuses on the role of the medium access control protocol in sustaining multimedia traffic and QoS. Protocols for multimedia wireless ATM are still growing. Many protocols have been proposed, and the majority of them are only diverse in details of implementation, or alternate design for specific wireless architectures. This paper presents association for protocols, which contain most distinctiveness of existing available channel access protocols for wireless ATM. Even though all the compared protocols have their advantages and restrictions when it comes to wireless data packet networks, DQRUMA and ARCMA seem to offer the most proficient scheme for wireless ATM.

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