Network Congestion Control in 4G Technology Through Iterative Server

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Abstract

During the last few decades, mobile communication has developed rapidly. The increasing dependency of people on telecommunication resources is pushing even more current technological developments in the mobile world. In Real-time multimedia applications, such as Live TV or live movie, video conferencing, VoIP, on-line gaming etc. are exciting applications to the success of 4G.In today's Internet these applications are not subject to congestion control, therefore the growth of popularity of these applications may endanger the stability of the Internet. In this paper, we propose a novel model to solve the network congestion problem through iterative server. In this model, when a client send a request to server then server will generate a individual iterative server for requesting client. After completing the request, the iterative server will be automatically destroyed.

Keywords: *Iterative Server, Congestion Control, WiMAX, LTE.*

1. Introduction

1.1 First Generation (IG)

Mobile networks were deployed in late 1970's and early 1980's, being a wholly analogue network, providing voice calls. Some of the most successful 1G system is Nordic Mobile Telephone (NMT) System and Advance Mobile Phone System (AMPS)[1].

I) Nordic Mobile Telephone (NMT) System: This system was developed in Europe in 1981. The two variants of NMT are: NMT-450 and NMT-900. The numbers indicate the frequency bands uses. NMT-900 was introduced in 1986 because it carries more channels than the previous NMT-450 network.

II) Advance Mobile Phone System (AMPS): This system was developed by U.S. Federal Communications commission in 1983 and allocated 666 duplex channels with 40 MHZ of spectrum in the 800 MHZ band and each channel have a one way bandwidth of 30 KHZ for each duplex channel for the U.S. AMPS.

1.2 Second Generation (2G)

Mobile networks was superseded in the 1990s, (GSM, initially Group Special Mobile later changing name to Global System for Mobile Communications) which being digital along with voice it introduced everyone to text messaging (SMS, Short Message Service). 2G technologies can be divided into TDMA-based and CDMA based standards depending on the type of multiplexing used [2] [3]. The main 2G standards are:

I) GSM (TDMA-based), originally from Europe but used in almost all countries on all six inhabited continents. Today, it accounts for over 80% of all subscribers around the world. Over 60 GSM operators are also using CDMA2000 in the 450 MHz frequency band (CDMA450).

II) IS-95 aka cdmaOne (CDMA-based, commonly referred as simply CDMA in the US), used in the Americas and parts of Asia. Today, it accounts for about 17% of all subscribers globally. Over a dozen CDMA operators have migrated to GSM.

III) PDC (TDMA-based), used exclusively in Japan.

IV) iDEN (TDMA-based), proprietary network used by Nextel in the US and Telus Mobility in Canada.

V) IS-136 aka D-AMPS (TDMA-based, commonly referred as simply 'TDMA' in the US), was once prevalent in the Americas but most have migrated to GSM.

1.3 Second and a half Generation (2.5G)

2.5G is used to describe 2G-systems that have implemented a packet-switched domain in addition to the circuit-switched domain. It does not necessarily provide faster services because bundling of timeslots is used for circuit-switched data services (HSCSD) as well.

The first major step in the evolution of GSM networks to 3G occurred with the introduction of General Packet Radio Service (GPRS). CDMA2000 networks similarly evolved through the introduction of 1x1RTT. The

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combination of these capabilities came to be known as 2.5G.

1.4 Third generation (3G)

Mobile telecommunication is a generation of standards for mobile phones and mobile telecommunication services fulfill the International Mobile Telecommunications-2000 (IMT-2000) specifications by the International telecommunication Union. Application services include wide-area wireless voice telephone, mobile Internet access, video calls and mobile TV, all in a mobile environment [3] [4].

To meet the IMT-2000 standards, a system is required to provide peak data rates of at least 200 kbit/s (about 0.2 Mbit/s).

The following standards are typically branded 3G:

I) the UMTS system, first offered in 2001, standardized by 3GPP, used primarily in Europe, Japan, China (however with a different radio interface) and other regions predominated by GSM 2G system infrastructure. The cell phones are typically UMTS and GSM hybrids. Several radio interfaces are offered, sharing the same infrastructure:

II) The original and most widespread radio interface is called W-CDMA.

III) The TD-SCDMA radio interface was commercialized in 2009 and is only offered in China.

IV) The latest UMTS release, HSPA+, can provide peak data rates up to 56 Mbit/s in the downlink in theory (28 Mbit/s in existing services) and 22 Mbit/s in the uplink.

V) The CDMA2000 system, first offered in 2002, standardized by 3GPP2, used especially in North America and South Korea, sharing infrastructure with the IS-95 2G standard. The cell phones are typically CDMA2000 and IS-95 hybrids. The latest release EVDO Rev B offers peak rates of 14.7 Mbit/s downstream, see figure 1.

Limitations of 3G:
1. It is difficult to extend to higher data rate in CDMA.
2. It is difficult to provide a full range of multi-rate services and not a fully integrated System.
3. There is also a propagation problem in CDMA; it may not work in a multi path systems from private to public and indoor to wide area [4] [5].

2. Related Works

Sneha Kumar Kasera et al. [6] proposed three congestion control mechanisms are admission control, diversity control, and router control, to maximize network capacity while maintaining good voice quality. They first proposed two new enhancements to CDMA call admission control that consider a unified view of both IP RAN and air interface resources. Next, they introduced a novel technique called diversity control that exploits the soft-handoff feature of CDMA networks and drops selected frames belonging to multiple soft-handoff legs to gracefully degrade voice quality during congestion.

Byeong Kil Lee et al. [7] Analyzed the characteristics of representative congestion control applications—scheduling and queue management algorithms, and proposed application-specific acceleration techniques that use instruction-level parallelism (ILP) and packet-level parallelism (PLP) in these applications. From the PLP perspective, proposed a hardware acceleration model based on detailed analysis of congestion control applications. In addition with get large throughputs, a large number of processing elements (PEs) and a parallel comparator are designed. Such Hardware accelerators provide large parallelism proportional to the number of processing elements added. A 32-PE enhancement yields 24 speedup for weighted fair queuing (WFQ) and 27 speedup for random early detection (RED). For ILP, new instructions set extensions for fast conditional operations are applied for congestion control applications.

Ken Burst et al. [8] explored an alternative to reservations based admission control called Delay Based Congestion Detection and Admission Control (DB a form of Endpoint Admission Control) is a method for edge devices, such as media gateways, to detect impending congestion in the core based on delay measurements and analysis. When impending congestion is detected, the edge devices refuse new incoming connections to the media gateways. To mitigate the congestion, this research examines the characteristics of AC and finds that AC is a promising alternative to a reservation based admission control approach for enterprise or carrier controlled IP Networks.

Chung-Ju Chang et al. [9] proposed congestion control using fuzzy/neural techniques for integrated voice and data direct-sequence code division multiple access/frame reservation multiple access (DS-CDMA/FRMA) cellular networks. The fuzzy/neural congestion controller is constituted by a pipeline recurrent neural network (PRNN) interference predictor, a fuzzy performance indicator, and a fuzzy/neural access probability controller. It regulates traffic input to the integrated voice and data DS-CDMA/FRMA cellular system by determining proper access probabilities for users so that congestion can be avoided and throughput can be maximized. Simulation results show that the DS-CDMA/FRMA fuzzy/neural congestion controllers perform better than conventional DS-CDMA/PRMA

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with channel access function in voice packet dropping ratio, corruption ratio, and utilization. In addition with, the neural congestion controller outperforms the fuzzy congestion controller.

3. 4G Technology

In telecommunications, 4G is the fourth generation of cellular wireless standards. It is a successor to the 3G and 2G families of standards. In 2009, the ITU-R organization specified the IMT-Advanced (International Mobile Telecommunications Advanced) requirements for 4G standards, setting peak speed requirements for 4G service at 100 Mbit/s for high mobility communication (such as from trains and cars) and 1 Gbit/s for low mobility communication (such as pedestrians and stationary users)[8] [9].

A 4G system is expected to provide a comprehensive and secure all-IP based mobile broadband solution to laptop, computer, wireless modems, smart phones, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users.

IMT-Advanced compliant versions of LTE and WiMAX are under development and called "LTE-Advanced" and "Wireless MAN-Advanced" respectively. ITU has decided that LTE Advanced and Wireless MAN-Advanced should be accorded the official designation of IMT-Advanced. On December 6, 2010, ITU recognized that current versions of LTE, WiMAX and other evolved 3G technologies that do not fulfill "IMT-Advanced" requirements could nevertheless be considered "4G", provided they represent forerunners to IMT-Advanced and "a substantial level of improvement in performance and capabilities with respect to the initial third generation systems now deployed".

4G mobile communication system is based on full IP network. It has load mechanism based on IP & network maintenance and management & control of network source based on IP. Core network is independent of concrete wireless access network and it can supply end-to-end IP service and can be compatible with current core network and PSTN. Core network is open structure and it has three properties; service, control and transport. These properties will be different from 3G properties [4] [10].

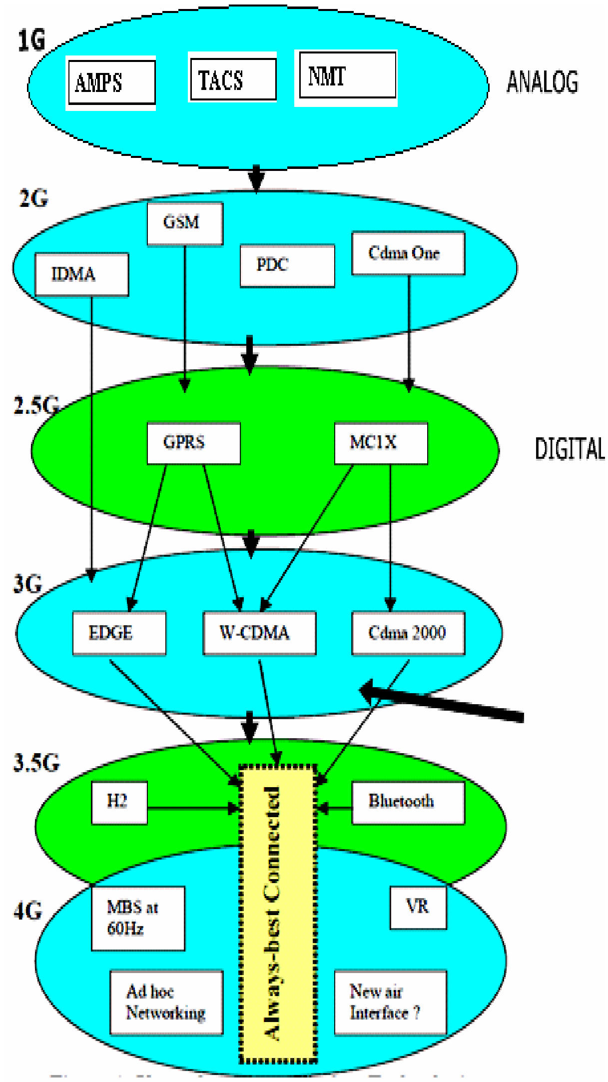

Fig. 1 Evolution of Wireless Technology

3.1 Advanced Features of 4G Technology

1. Wider mobile coverage area
2. Smoother quicker handoff.
3. Broader bandwidth - higher data rates
4. WLAN for hot spots, an extension of 2G and 3G.
5. Terminal Heterogeneity and Network Heterogeneity.
6. Global roaming and inter-working between different access technologies.
7. Better scheduling and call admission control techniques.
8. User Friendliness and User Personalization.
9. Support interactive multimedia, voice, video, wireless Internet and other broadband services [10].

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3.2 Protocols & Modulation:

Internet Protocol version 6 (IPv6) is considered to be the evolved IP protocol for mobile systems providing:

1. Enhanced address space
2. Security
3. Extension headers

3.3 Session Initiation Protocol (SIP)

It has a flexible structure and can be easily extended. Therefore, it plays a role of true multimedia protocol that controls and transports:

1. Emails 2. Pictures
3. WEB links 4.Videos Service scripts
5. Speech 6. Multiparty sessions

3.4 Wideband Code Division Multiple Accesses (WCDMA)

It is a wideband direct sequence CDMA system. User information bits are spread over a wide bandwidth by multiplexing. The high data bit rates (2Mbps) can be support by use the variables Spreading factor and Multicode Connection. The Most important feature of WCDMA is Power Control, Particularly on uplink [11].

4. 4G working

When users send request to main server then server allot the free port to users. If port is not free then network is congested because users' request in wait state, see figure 2.

If $N_{p} = C_i$ then network is normal.
If $N_p > C_i$ then ports are not free and network is congested.

Pseudo Code:

Step 1: Ms=Main Server, Sp=Server Port, Client= C;

Step 2: C_i=M_s(Client request to server)

If (S_p==Available)

Then assign port to Client;

Else if

Server port is busy wait;

Else

Server can not Connected, server is unavailable;

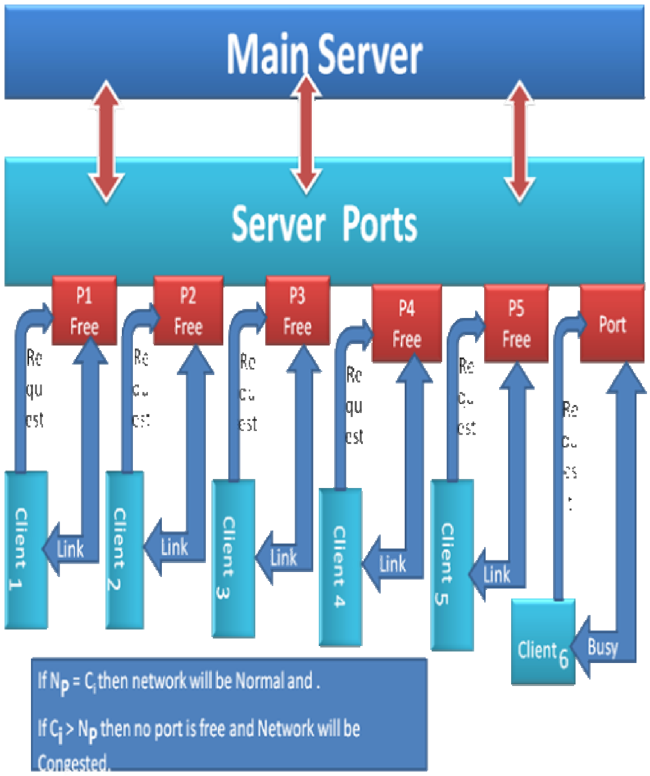

Fig. 2 4G Architecture

Step 3: for C_i=Np; i.e. if [no of client request is = no of port];

For (C_i=1; Ci<=N_p; $_{Ci}$++)

Assign Np = C_i;

Step 4: Repeat while (N_p>=C_i);

Step 5: End;

5. Purposed Work

The purposed model is depending on the iterative server mechanism. When any client will send any request then the client listener module will listen the client request and then it will send notification to the main sever about the requested client, then the main server will instruct to the client listener and client listener will generate new temporary server for the requested client which is known as the iterative server.

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The idea behind proposed model is that when any client will send his request for connecting to the server then the client request will be listen by the client listener and the client listener will send a request to the main server. The main server will generate a iterative server for the requested client. As the client will complete his task then this server will be automatically destroyed. So by using this policy, network congestion can be avoided because there is no waiting policy is used as we are using in current technology, see figure 3.

Iterative server: A server that listen only one client request at a time.

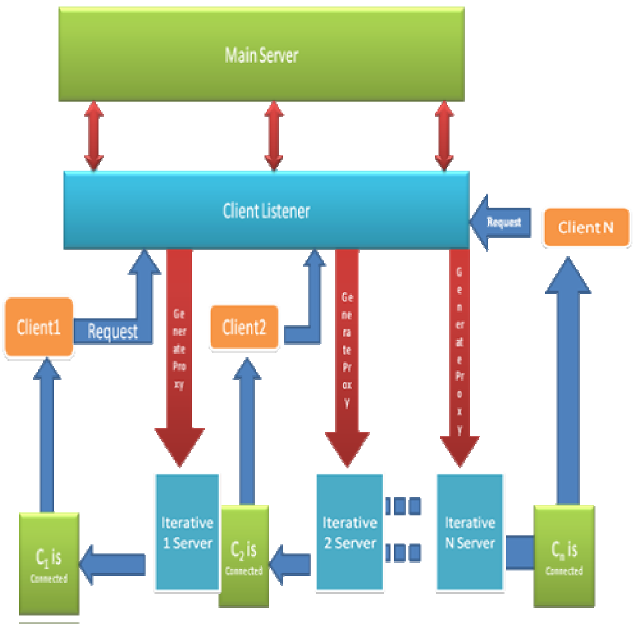

Fig. 3 Working of Proposed Model

Pseudo Code:

Step 1: create a socket (iterative server)

Step 2: bind to a well-known port

Step 3: place in passive mode

Step 4: while (1)

{

Accept the next connection

Step 5: while (client writes)

{

read a client request perform requested action send a reply

}

close the client socket

}

close the passive socket

6. Conclusion & Future work

Mobile communication is very exciting technology in today time for communication and internet access. As the mobile technology has grown exponentially in future, the user will be totally depend on the mobile. So due to this reason, we have required such kind of technology so that a user can be easily use it as much as possible. The problem raised in today time of network congestion when accessing the internet. So, our future work will be implementing to mitigate the congestion control and accessing speed of the internet via mobile should be very fast and there will not be any congestion situation arises while accessing data from WWW on Internet**.**

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