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RESEARCH ARTICLE

CALL DROP FACTORS AND POSSIBLE SOLUTIONS

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ABSTRACT

Of the numerous performance metrics applied to cellular telephone systems, probably none is more important for customer satisfaction than the system drop call rate. Customers are more sensitive to call dropping than to call blocking at initiation. Proper system design and operation involve keeping the drop call rate as low as possible. Today a number of mobile subscribers are grappling with the issue of frequent call disconnections or 'call drop ' Dropped call is the common term used for describing any unexpected termination of a wireless mobile call. There are numerous drop call causes in cellular networks with majority of them occurring due to lack of radio resources created by electromagnetic causes and user mobility (i.e. handover). Another important contributor of call rate is the traffic load in which, the call arrival rate and holding time play significant roles(1). Drop call probability is defined as the probability that a call is terminated due to one or all of the above-mentioned causes. Drop call probability has been the subject of several network performance studies and a major contributor to service optimization in established cellular. In this paper, we present an overview of drop–call probability factors in cellular networks.

INTRODUCTION

While the subscriber base in the country is growing very fast, the mobile telecom infrastructure is not growing at the same pace and immense is being put on to the existing facilities, leading to a dip in the quality of services (QoS) provided. Call drop, affecting the quality of experience of the subscribers, can take place due to a variety of technical issues, including inadequate coverage; problems with the quality of signal; interference; network congestion; and network failure (Mishra, 2004). The rural subscribers primarily face call drops because of lack of coverage, while in urban areas; this can be due to the increasing gap between the growth in subscriber base and lack of commensurate growth in investment in augmenting the network infrastructure, including setting up of additional base transceiver station(BTS) and establishing in-building coverage. Network congestion occurs when a link or node is carrying so much data which affect the quality of service (Ekiz *et al*., 2005). Typical effects include queuing delay &loss of packet or the blocking of new connection. When little or no useful communication is happening due to congestion. Congestion collapse generally occurs at choke points in the network, where the total incoming bandwidth to a node is becoming much more than outgoing bandwidth. Connection point between a LAN and a WAN are the most likely choke points.

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A DSL modem is the most common small network example, with between 10 and 1000 Mbit/s of incoming bandwidth and at most 8 Mbit/s of outgoing bandwidth channels which in turn may be caused by propagation factors such as distance losses, path loss, multipath fading, shadowing and RF interference (Lee, 1995; Wideband, ?; Digital Communication, ?). Other channel capacity varying factors include handover and service prioritization (Wireless Digital Communication, ?). Shadowing is caused by diffraction which is a phenomenon that takes place when a radio wave strikes a surface and changes its direction of propagation owing to the inability of the surface to absorb it (Lee, 1995). The loss due to diffraction depends upon the kind of obstruction in the path which may be high buildings or hills. It is known as shadowing because the mobile receiver is in the shadow of these structures. The rest of the paper is organized as follows: Section 2 discusses the influence of radio resources availability and utilization on drop-call probability. This is followed by a discussion about the effects of traffic parameters in section 3. In section 4 reasons for call congestion are discussed, followed by possible solution in section 5.

RADIO RESOURCES

In many network environments, the available network capacity varies unpredictably with time. For example, in a reservation-based network with multiple priority levels, high priority calls such as video conferences or emergency services may take

precedence over ordinary traffic. The network capacity available for low priority traffic thus varies with time based on high priority traffic demands. In wireless networks, capacity variation arises from the mobility of users (e.g., handovers) and the time-varying characteristics of the wireless propagation environment (Wireless Digital Communication, ?). Cellular systems use one or more of four different techniques of access (TDMA, FDMA, CDMA, and SDMA). In TDMA/FDMA cellular radio systems, Fixed Channel Allocation (FCA) is used to allocate channels to customers. In FCA, the number of channels in the cell remains constant irrespective of the number of customers in that cell. This, results in traffic congestion and some calls being lost when traffic gets heavy (Nawrocki *et al*., 2006). A better way of channel allocation in cellular systems is Dynamic Channel Allocation (DCA) which is supported by the Digital Cellular System (DCS) and other systems. DCA is a better way not only for handling bursty cell traffic but also in efficiently utilizing the cellular radio resources. DCA allows the number of channels in a cell to vary with the traffic load, hence increasing channel capacity with little costs. Another strategy commonly used by some of the service providers worldwide, is through the use of Hybrid Channel Allocation (HCA) strategies for channel allocation and queuing technique for Quality of Service (QoS) provisioning. HCA strategy considers new calls in Fixed Channel Allocation (FCA) method and handoff calls in Dynamic Channel Allocation (DCA) method to reduce call blocking and call dropping probabilities. The application of queuing technique applied to HCA strategy increases the efficiency of the cellular system performance especially in micro and Pico cellular environments, effectively utilizing available allocated radio spectrum. This leads to decrease in call blocking and dropping and an increased capacity for users in the available channels.

Channel Utilization

The utilization factor is the ratio of the time that the network is in use to the total time that it could be in use. Utilization factor is the traffic load in the cellular network. Traffic load signifies the strength of the offered traffic in the network(9). By definition, the traffic load is the ratio between the arrival rate of calls and the service rte of the calls arriving. Utilization factor gives the product of total traffic offered and the mean service time.

Utilization factor = Traffic Load = Average Traffic Intensity (A) x Mean holding time (H)

TRAFFICE PARAMETERS

In this section, the basic principles of some of the key drop-call probability related traffic parameters will be discussed (Wireless Communication, ?). They are as follows:

Call Arrival Rate

Call arrival rate, λ , refers to the traffic offered expressed as the number of call attempts per unit time, To relate call arrival rate to the performance of a network, the term grade of service (GOS) denoted by B is used. The GOS can be mean proportion of time for which congestion exists, or probability of congestion or blocking probability, or probability that a call will be dropped due to congestion. It is defined in as (Cragin, 2006):

B= traffic lost/traffic offered

It is obvious that drop call-probability varies inversely with call arrival rate, that is, drop-call probability decreases as call arrival rate increases. This leads to the deduction that system performance improves as the traffic entering the system increases.

Call Duration

Call duration is another parameter that can affect the quality of service in a cellular network, hence it is considered when planning the network (Communication system, ?; Mishra, 2004). Call duration or mean call holding time is defined as the time a mobile station takes to complete a call connection. Mathematically, call duration is given by:

$H = A / \lambda$

Where A = traffic intensity in Erlangs, λ = call arrival rate

Thus call arrival rate varies with call duration the same way it varies with drop-call probability. Thus drop-call probability increases with a decrease in call duration.

REASONS OF CALL CONGESTION

There are various reasons for congestion in mobile network & some of them are as follows.

A. Heavy call traffic in peak hour

Adding Internet connections to a network increases the network‘s complexity and opens the possibility for compatibility issues (Madan *et al*., 2006). The following antenna system problems may affect the call drop rate:

1. If the transmit antennas of two cells are improperly connected; the uplink signal level in each cell is much lower than the downlink signal level in the cell. Therefore, call drops are likely to occur at places far away from the BTS.
2. If the feeder is damaged, water leaks in the feeder, or the feeder and the connector are not securely connected, both the transmit power and receiver sensitivity of the antenna are reduced. Thus, call drops may occur.

B. Increase of signalling load

With the rising use of the mobile, the amount of signalling required to set-up and maintain radio bearers are changing. While in pre-mobile times, radio and core networks were mainly dealing with location updates and signalling due to SMS and voice calls, always-on smart phones are used quite differently

C. Coverage Problems

1. Discontinuous coverage (blind areas)

The voice quality at the edge of an isolated BTS is poor and calls cannot be handed over to other cells. In this case, call

drops may occur. In complex terrains such as mountains regions, the signals are blocked and thus the transmission is discontinuous, leading to call drops.

2. Poor indoor coverage

Densities distributed building and thick walls cause great attenuation and low indoor signal level, which cause call drops.

3. Cross coverage (isolated BTS)

The serving cell causes cross coverage due to various reasons (such as excess power) (Satellite Communication, ?). A mobile station cannot be handed over to another cell due to no suitable neighboring cells. In this case, the signal level becomes low and the voice quality of the mobile station deteriorates. Thus, call drops occur.

4. Insufficient coverage

If the signal from an antenna is blocked ,call drops may occur because of discontinuous coverage. In complex terrains such as mountains regions, the signals are blocked and thus the transmission is discontinuous, leading to call drops.

D. Wrong Configuration in mobile network

Network audit is necessary to judge the network performance and maintain QoS standards. The network audit identifies inconsistencies or limitations in current overall network design, helps to improve processes resulting in optimized network and improved quality of service. Radio Access Network audit includes many aspects of network like performance; neighbor cell, RF parameter, frequency, competitive benchmark audits. In real GSM Radio Access network evaluated, and different issues, findings, trials and improvements have been summarized and observations/recommendations have been listed to correlate the practical aspects of RF optimization, which affect the performance.

E. Channel Interference

In cellular networks, co-channel and adjacent channel frequency interference is mainly caused by neighbouring cells. Thus cells in the coverage area of the serving cell should be checked. The distances between base stations are much longer in rural areas than in cities. Thus, the cell coverage radius in rural area is much larger than in cities. The cell coverage is then usually indicated by the base station site layer and the azimuth award side (the antenna). Co-channel and adjacent channel interference can also be responsible for dropped calls in a wireless network (Satellite Communication, ?). Neighboring cells with same frequencies may interfere with each other to deteriorate the quality of service and cause dropped calls (Ganguly *et al*., 2003). Through drive test the C/I ratio could be checked for levels of the signal strength of the current serving cell to that of the signal strength of undesired (interfering) signal components.

V. POSSIBLE SOLUTIONS FOR REDUCING THE CALLDROP

Increase the number of different route for same call. To avoid network congestion is the explicit allocation of network resources to specific flows. One example of this is the use of Contention-Free Transmission Opportunities.

1. Flexibility in Customer Service

The customer behaviors require an extraordinary amount of service. It starts with the realization that what is the need of that time.

- Choose the priority of work
- Choose to give others a better service

2. Creation of more signalling database

Occasionally, the cause of these space issues is just poor capacity planning. In other words, the growth in file size was entirely predictable, but someone failed to plan for it. Predictable growth patterns are something that should be analyzed right at the start. A mobile phone signal (also called reception) is the strength of the connection to the mobile phone with its network. Depending on various factors, such as proximity to tower obstructions like buildings or trees etc. The signal may vary.

3. Expensive call can get more priority

We can give priority to expensive call particularly in busy hour. As we know that if subscriber is making an ISD call or call to value added services. (Value added services call maybe recognizing as calling to Tele-voting system, calling for selection of ring tone, caller tune, cricket news etc. It's understood that call to ISD, STD, always give more money & lead to increase to build up a good relation with operator.

4. Steps to be taken by service providers

In cellular networks, Time Division Multiple Access (TDMA) based dynamic channel allocation in heavy load conditions is one of the methods adopted by various service providers to reduce the call drop probability in their networks. A bandwidth window is applied, where the bandwidth window changes its size according to changing network traffic conditions (Satellite Communication, ?). With this solution, higher priority and real time handover calls (vice and multimedia calls get the requested bandwidth while the lower priority handover calls (Data calls) get minimum bandwidth and the probability of dropping of handover call is reduced to minimum. Hence, larger number of users can be served by the network with the bandwidth usage being maximised.

5. Use of Signal Booster

A mobile phone signal (also called reception) is the strength of the connection to the mobile phone with its network. In an area where the signal would normally be strong, certain other factors may have an effect on the mobile phone signal, thereby making it either stronger or weaker, or may cause complete interference. Additionally, the weather and volume of network traffic may also impact the signal strength.

6. Prioritization Schemes

Prioritization of handoff calls over new calls is employed, since it is desirable to complete an ongoing call rather than

accepting a new one. Such schemes permit high utilization of bandwidth while guaranteeing the quality of service of handoff calls. Basic methods of handoff prioritization schemes are auxiliary station, guard channels, call admission control (CAC), handoff queuing schemes. Some of these schemes can be combined together to get better results.

7. Distributed Antenna System

Distributed Antenna System (DAS) (Aziz Basi and Murthy, 2005) is a network of spatially separated antenna nodes connected to a common source that provides wireless service within a geographic area or structure. DAS can serve many telecom service providers simultaneously. Such shared DASs are commonly referred to as neutral host systems.

Analysis

In light of the reasons discussed above the increase in call drops, it must be realised that mobile towers do not have an unlimited capacity for handling the current network load. There is an urgent need to increase the number of the towers so as to cater to the demands of a growing subscriber base. At the same time, problems like removal of towers from certain areas by Authorities should be adequately addressed. This problem is particularly evident in urban areas. Moreover, with the increase in the usage of 3G networks, the growth rate of mobile towers supporting 2G networks has reduced. This must be addressed. Measures like Dynamic Channel Allocation, multiple call routing and optimised resource management can be employed. Some prioritization schemes like MBPS, CAC, Guard Channels, Handoff Queuing and Auxiliary Stations essentially need to be incorporated to reduce call drop.

Conclusion

It provides a good understanding of various reason of call dropping & also providing the solution for resolving the same. I have gone through various document based on books, Internet, research papers to present a summarize material over call dropping & methods of their reductions. It may be helpful to various people who are working in telecom sectors & working in operation & maintenance activities. Almost every telecom operator worldwide is facing problem of call dropping & they are upgrading their network at hardware & software level for reducing the call drop as much as possible. As it directly related with customer satisfaction & revenue of network operators. As per ITU, 3GPP, if call drop rate is 1 out of 1000 call in busy hour then it can be assumed a good network & good customer satisfaction.

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