Dropping of Call Due to Congestion in Mobile Network

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Abstract - **We might be observed so many time of call drop during our mobile conversation. Some time it becomes very annoying. I would go through various call scenarios in mobile communication (Mobile to Mobile & Mobile to Landline) & studied various research papers. So, that I can come to know that what are various reasons of call dropping & what are various states of call dropping.**

Index Terms – **BSS, BTS, BSC, RNC, MSS, HLR, SCN, OSS, BCCH, TRX, SDCCH.**

I. INTRODUCTION

A Mobile *network* can be defined as the group of multiple nodes like MS, BTS/Node B, BSC/RNC, MSS, HLR, etc. These nodes architecture are vendor dependent but in general it consist Specific hardware & software. Software is application specific & vendor proprietary. Nokia Siemens Network, Ericsson, Huawei are major manufacturer of telecom equipment & they implement the Mobile network architecture for Mobile Network Operator Word wide.

A mobile network can be classified in to mainly three parts of RAN, SCN, and OSS domain. BSS is responsible for providing the mobile connection at air interface while SCN is responsible for providing the control over BSS along with mobility management, Charging etc. OSS is responsible for providing the maintenance of the entire node connected in Mobile Network.

A call may drop due to various reasons of mobile; sometime it may be due to configuration, O&M activity, resource congestion, signaling, power, etc. or may be due to subscriber also. But we cannot control the subscriber behavior. So, we have to make all possible solutions for reducing the call drop, which arises due to Network configuration & resources. As per various analysis report maximum call drop occur at the air interface only because it's not possible to control the air interface behavior in network architecture.

Typical hardware components utilized in a networking environment are network interface cards, computers, routers, hubs, switch traffic channels, printers, and cabling and phone lines. Typical software components utilized in a

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networking environment are the network services and protocols needed to enable devices to communicate.

Generally, a stronger mobile network signal is easier to access in an urban area, though urban areas do have some "dead zones" where a mobile phone signal cannot be obtained contrary, many rural or minimally inhabited areas lack a signal or have a very weak mobile signal, but many mobile network service providers are attempting & trying to set up antenna in parts of those areas most likely to be occupied by users, such as along major highways. Even some parks, hill stations and other popular tourist destinations away from urban areas now have cell phone signal receptions.

In an area where the signal would normally be strong, certain other factors may have an effect on the reception, thereby making it either stronger or weaker, or may cause complete disturbance or interference. For example, a high-rise building or building with thick walls may prevent a mobile phone from being used. Many underground areas, such as tunnels and subway station, hills, mountains lack an obtained of signals. Additionally, the weather and volume of traffic in network may impact the signal strength.

Network congestion occurs when a link or node is carrying so much data which affect the quality of service. Typical effects include queueing delay & loss of packet or the blocking of new connections. A consequence of these two is that incremental increases in offered load lead either only to small increase in network thoughput, or to an actual reduction in network throughput. A state of network congestion even after the initial load has been reduced to a level which would not normally have induced network congestion. Thus, networks using these protocols can exhibit two stable states under the same level of load. The stable state with low throughput is known as **congestion collapse**.

Congestion collapse (also called **congestive collapse**) is a situation in which packets with traffic channeled computer network can reach, 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 becoming much more than outgoing bandwidth. Connection points between a LAN and a WAN are the most likely choke points. 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.

II. 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

Traffic jams are the most problematic situation in any case or area. The real problem here is that convergence, a term vendors loved to throw around 10yrs ago to describe networking situation, is finally coming true. But in contrast, it's happening on the network that no one thought much that

time. Ethernet was well poised to accept this challenge with ASIC-based, full-duplex, layer-three gigabit switch traffic channeling. But what we didn't realize was that the trigger for convergence would be smart phones and tablets – devices that can't use Ethernet.

Adding Internet connections to a network increases the network's complexity and opens the possibility for compatibility issues. 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 a directional cell has main and diversity antennas, the BCCH and SDCCH of the cell may be transmitted from different antennas. If the two antennas have different traffic channel angles or azimuths, the coverage areas of the two antennas are different. In this case, the following result may occur. MS can receive the BCCH signals from one antenna; when a call is made, the MS cannot seize the SDCCH transmitted by the other antenna and thus a call drop occurs.

3. 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 signaling load

Due to some festival season / new year when most of the people started to make call or started to send bulk wishing messages. Instant messaging or other push applications are running in the background but more and more people are doing that these days, too handed over to neighboring cells which creates quite a significant amount of signaling, hence the network needs to work more to maintain the established but not really required radio bearer after background push/pull requests.

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

These numbers are obviously for someone who doesn't move a lot and who is in good coverage area. The young generation of now days often sends and receives more SMS messages a day. In total that's easily 100 signaling events on the PS (Packet Switching) side per day. Compared to the 15 signaling events on the CS (Circuit switching) side for voice and SMS, that's quite a difference, not only for the network but also for the mobile, i.e. the impact on the battery charging interval is significant.

C. Network Congestion through Bandwidth Management

Deep Packet Inspection (DPI) solutions for broadband, mobile customers that help them see what traffic traverses their network, what is causing congestion, and enforce policies that remove these bottlenecks in a non-disruptive fashion. Each market has unique needs and utilizes DPI technology in different manners, but all recognize the strategic value of the technology in operating their networks. Network operators need fine-grained awareness

on the behavior of their network and subscribers, sophisticated analysis tools for business planning, and real-time control of their networks.

The following coverage problems may also affect the call drop rate:

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). An 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 or the BCCH TRX is faulty, 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.

Only after the hardware is installed and configured, operating systems and software be installed into the network node. The operating systems, which install on computers, are considered the main software components within the network infrastructure. This is due to the operating system containing network communication protocols that enable network communication to occur. The operating system also typically includes applications and services that implement security for network communication.

Another concept, namely *network infrastructure,* is also commonly used to refer to the grouping of physical hardware and logical components which are needed to provide a number of features for the network, including these common features:

- Connectivity
- Routing and switch traffic channeling capabilities
- Network security
- Access control

The network or network infrastructure has to exist before a number of servers needed to support applications which are needed by users can be deployed into your networking environment.

- File and print servers
- Web and messaging servers
- Database servers
- Application servers

When you plan your network infrastructure, a number of key elements need to be clarified or determined:

- Determine which physical hardware components are needed for the network infrastructure that you want to implement.
- Determine the software components needed for the network infrastructure.
- Determine the following important factors for your hardware and software components:
  o Specific location of these components
  o How the components are to be installed.
  o How the components are to be configured.

When you implement *a* network infrastructure, you need to perform a number of activities that can be broadly grouped as follows:

- Determine the hardware and software components needed.
- Purchase, assemble and install the hardware components.
- Install and configure the operating systems.

The physical infrastructure of the network refers to the physical design of the network together with the hardware components. The physical design of the network is also called the network's topology. When you plan the physical infrastructure of the network, you are usually limited in your hardware component selection by the logical infrastructure of the network.

The logical infrastructure of the network is made up of all the software components required to enable connectivity between devices, and to provide network security. The network's logical infrastructure consists of the following:

- Software products
- Networking protocols/services.

It is therefore the network's logical infrastructure that makes it possible for computers to communicate using the routes defined in the physical network topology.

The logical components of the network topology define a number of important elements:

- Speed of the network.
- Type of switch traffic channeling that occurs.
- Media that will be utilized.
- Type of connections that can be formed.

E. Overloading of network Equipments
Due to on broadband services for so many aspects of their lives, including public safety and national security, it is critical for the FCC to gain a better understanding of the survivability of existing networks and explore potential measures to reduce network vulnerability to failures in network equipment or severe overload conditions in emergencies. Some festival season / New year when most of the people started to make call or started to send bulk wishing messages.

The ability of existing broadband networks to withstand significant damage or severe overloads as a result of natural disasters, terrorist attacks, pandemics or other major public emergencies, as recommended in the National Broadband Plan.

F. Mobile subscriber is moving with high speed
When send and receive fewer SMS messages text messaging distributed throughout the world and these exchanges are usually also not required to be had in real time. But usually make and receive more than two calls, try to minimize calls when moving it impolite to talk on the phone while on a public transport and also prefer some privacy when calling. Handed over to neighboring cells which creates quite a significant amount of signaling, hence the network needs to work more to maintain the established but not really required radio bearer after background push/pull requests.

G. Installed software is not compatible with hardware
After the BTS version or BSC version is upgraded, the BTS version may be incompatible with the BSC version, and the parameters and algorithms in the new version may be changed. In this case, the call drop rate increases.

H. Imbalance between Uplink and Downlink
The difference between the uplink signal and the downlink signal level may be high in the following situation:
1. The Transmit power of the BTS is high.
2. The tower mounted amplifier (TMA) or BTS amplifier does not work as they desired.
3. The antenna and the connector are not properly connected.
As a result, call drops may occur at the edge of the coverage area.

I. Repeater Problem
If a repeater is installed in a cell, network coverage problems may occur in the case that the repeater has any fault or that the uplink and downlink gain is inappropriately set. Therefore, the traffic channel call drop rate increases. If a wide-frequency repeater is used and the gain is set to a great value, strong disturbance may be caused. As a result, the network quality is affected and the call traffic channel drop rate increases.

III. POSSIBLE SOLUTIONS FOR REDUCING THE CALL DROP FOR WHICH WE NEED TO PERFORM DETAIL ANALYSIS

To avoid the negative effects of network congestion is implementing priority schemes, so that some packets are transmitted with higher priority than others. Priority schemes do not solve network congestion by themselves, but they help to alleviate the effects of congestion for some services.

A. 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.

We would like to set that all calls to a specific destination, were commuted to a Gateway A, and if all lines are busy, these calls are routed by Gateway B. You cannot have two identical route patterns on the same partition.

B. 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

When situation is under control, we refuse to be victims of circumstance, or of Network weaknesses. We take charge of our lives and of the situations that we face. The second most important customer service phrase of times a day .There is a premium in the labor market for outstanding customer service providers. More important, we have the opportunity to constantly increase both our short-term and long-term income by applying our customer service skills.

C. Creation of more signaling 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 a tower, obstructions like buildings or trees etc. The signal may vary. Most mobile devices use a set of bars of varying heights to display the strength of the signal where the device is located. Traditionally five bars are used. 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. For example, a building with thick walls may prevent a mobile phone from being used. Many underground areas, such as tunnels and subway station, lack of mobile phone signal. Additionally, the weather and volume of network traffic may impact the strength.

D. Reduce the value added services

Stop providing the some services for a moment like we can withdraw the sending delivery report of message during busy hours.

As consumers, every day we use services of telecommunications everywhere with in network. Customers are not always happy with the quality and value of the services they receive. People complain about late deliveries, rude or incompetent personnel, inconvenient service hours, poor performance, and needlessly complicated procedures. They grumble about the difficulty of finding to help & express frustration about mistakes & shake their heads over the complexity of new self-service equipment, mutter about poor value, and they are forced to wait in line almost everywhere they go. Suppliers of services often seem to have a very different set of concerns than the consumer. Many suppliers complain about how difficult it is to make a profit, how hard it is to find skilled and motivated employees, or how difficult it has become to please customers. A few even give the impression that they could run a much more efficient operation if it weren't for all the stupid customers who keep making unreasonable demands. Fortunately, in almost every industry there do pleasant and competent employees staff service suppliers who know how to please their customers while also running a productive, profitable operation most effective ways to manage the different types of services found in today's economy service:

An act or performance that creates benefits for customers by bringing about a desired change in or on behalf of the recipients.

What Is a Service?

Because of their diversity, services have traditionally been difficult to define. The way in which services are created and delivered to customers is often hard to grasp since many inputs and outputs are intangible. Most people have little difficulty defining manufacturing or agriculture, but defining service can elude them. Here are two approaches that capture the essence of the word. A service is an act or performance offered by one party to another. Although the process may be tied to a physical product, the performance is essentially intangible and does not normally result in ownership of any of the factors of production. Services are economic activities that create value and provide benefits for customers at specific times and places, as a result of bringing about a desired change in-or on behalf of the recipient of the service. More humorously, service has also been described as "something that may be bought and sold, but which cannot be dropped on your foot."

Decide the priority of maturing the voice call before data call. We can make a provision to mature a voice call before data call if resource limitation is there particularly in peak hour. As, we know numbers of voice subscribers are more as compare to data subscriber.

Voice call need bandwidth of 64 kbps per call which can offer by reserving one channel into network but a data subscriber always need more bandwidth than a voice call which need to reserve more than one traffic channel. Voice call is also more expensive as compare to data call. So, if we give priority to voice call then we can make more satisfaction in subscriber & get more money as network operator.

E. 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 may be 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.

IV. CONCLUSION

It provides a good understanding of various reasons 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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