Enhancement of Packet Loss for QoS in Wireless Mobile Data Networks

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Abstract:

We are living in the world of wireless communication in which the next generation is in the anticipation state of optimized 4G/5G mobile communication strategies. Enrichment in the communication medium towards the multiplicity of equipments is never an achievement until the quality of communication must be ensured by both the customers and the service providers. Nowadays the QoS in the Wireless Mobile Data Network defines the Service Provider to survive in this competitive corporate culture especially in India which proves it in the recent years with the reduced count of service providers compared earlier (10 to 4).This paper deals with the Packet loss of voice and data over a wireless mobile network which is the primal factor in deciding the QoS. The proposed enhancement method is a combinatorial approach with the unique individual implementation towards the fine tuning of Packet loss improvements. The results and discussions of our proposed method lead to the implementation of enhancement in data loss and throughput for the completion of QoS intensification.

Index Terms: Mobile, Wireless networks, Quality of Service, Packet Loss, and Enhancement

1.Introduction

Nowadays the mobile equipment not only handle voice but also with the Data, such that the data comprises the Surfing, Email, Application, Video call, File transfers, AV downloads etc. Maintaining the customer satisfaction by the service provider in this subsequent years are very tedious and serious issues in the near future unless they follows certain nomenclatures in their transmission technologies[8].The challenges associated with providing service guarantees are numerous, but the biggest challenge for traditional networks has been congestion. However, many more challenges exist for wireless and mobile networks above those in traditional networks [10]. For this reason, a completely different set of QoS techniques are required for wireless networks than for wired networks. The Mobile network service architecture and role of QoS are represented in Figure 1.1 and Figure 1.2 respectively.

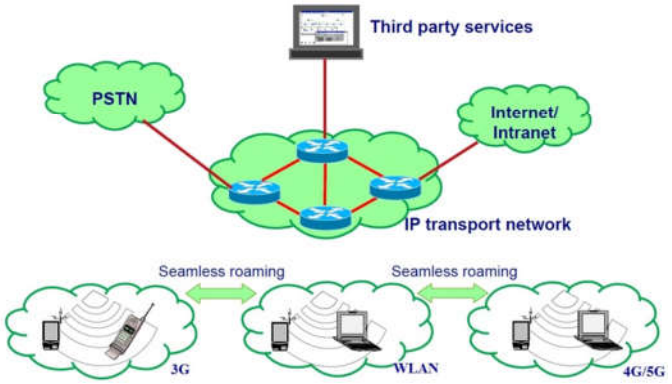

Figure 1. Mobile Network Service Architecture

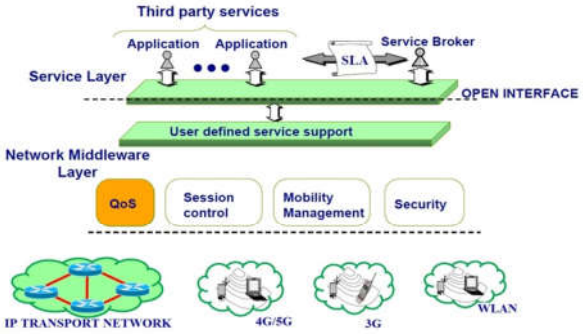

Figure 2: The Role of QoS in Wireless Mobile Data Networks

2. Quality Of Service Schema

The backbone of QoS in Wireless Mobile Data Networks lies with two entities, the QoS Guarantees and Quality of Experience (QoE) components. They are as follows [2],

2.1 QoS Guarantees

QoS contains four main features; they are as follows, [3].

G1: A guarantee of delay assures the sender and receiver that it will take no more that a specified amount of time for a packet of data to travel from sender to receiver.

G2: A guarantee of loss assures the sender and receiver that no more than a specified fraction of packets will be lost during transmission.

G3: A guarantee of jitter assures the sender and receiver that the delay will not vary by more than a specified amount.

G4: A guarantee of throughput assures the sender and receiver that in some specified unit of time, no less than some specified amount of data can be sent from sender to receiver.

2.2 QoE:

The Quality of Experience deals as the customer side strong negotiator for ensuring the best experience obtained more or equal to the corresponding price band. [7]. QoE rates the following essential features:

- Efficiency
- Ease of use
- Reliability
- Customer loyalty
- Privacy
- Cost
- Security

Key environmental factors impact QoE assessment. These include:

- Hardware, such as wired or cordless devices
- Application criticality, for example, texting versus audio/video
- Working environment, for example, fixed or mobile

3.Implementation

3.1 Reducing the Packet Loss:

The primary reason which really affects the packet loss in mobile networks is the layer under Application.

The packet loss occurs when one or more packets transported across the network fail to reach their destination.

Some packets may fail to arrive when the buffer is already full. The primary causes of Packet loss in wireless Mobile networks in 4G/5G are as follows,

- Signal degradation.
- High network load or Network congestion.
- Defect in network elements.
- Interference caused by other systems.
- Multipath fading.
- Multiple obstacles [4].

This paper deals with the proposed methodology for enhancing the QoS in terms of reducing the packet loss strategy by providing the solutions or alternates for the issues in Mobile data transmission.

3.1.2 Proposed Methodology:

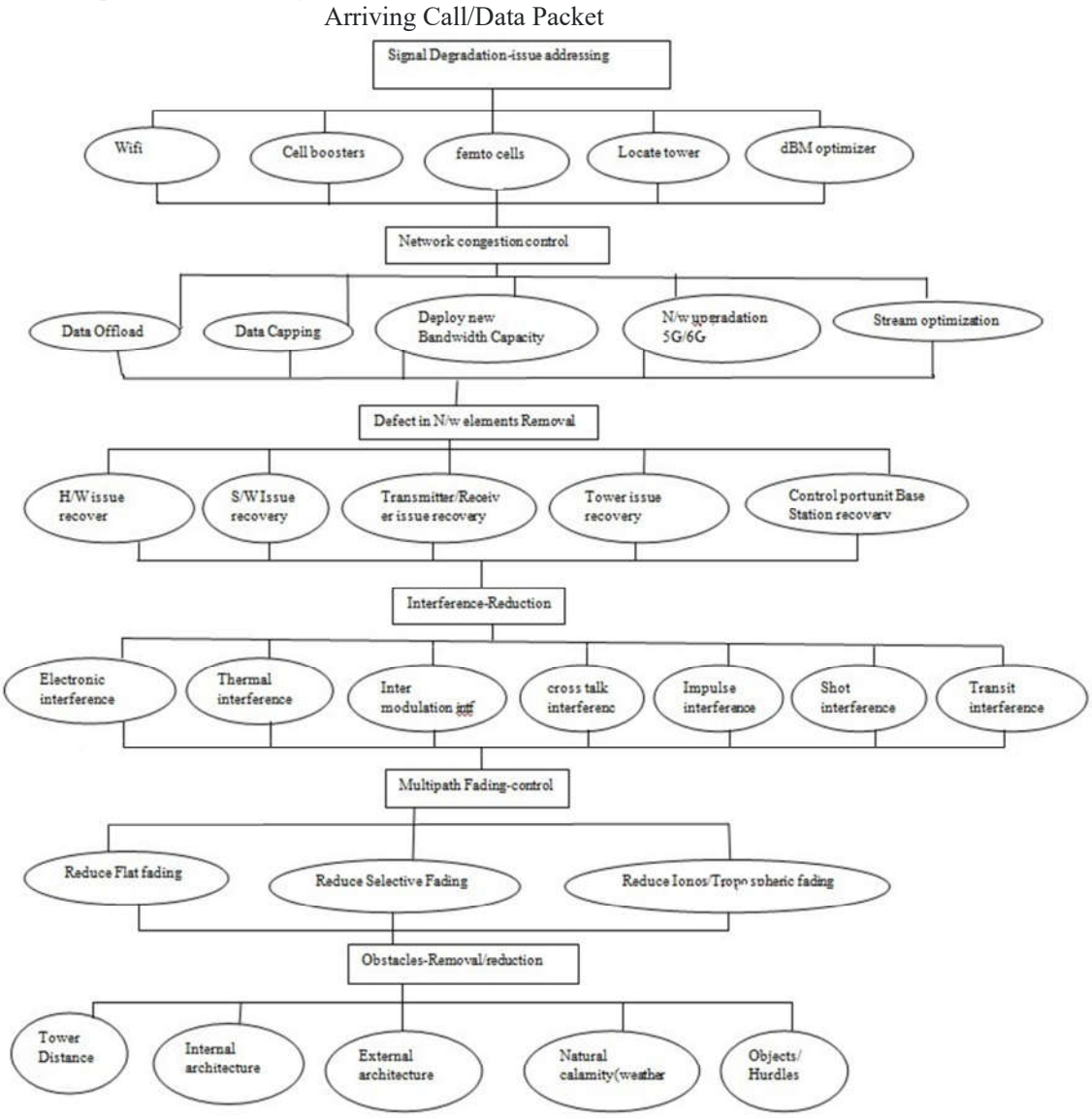

Figure 3. Proposed Packet Loss-QoS Enhancement in Mobile Data N/w

3.2 Signal Strength

Generally anything from -50 dBm to -95 dBm is considered good working signal. From - 95 dBm to -120 dBm, that's the thin margin where you get spotty service to a complete dead zone [1].

Let's see what happens when you get spotty to no service:

- Dropped calls
- Poor voice quality
- Slow internet
- Stuck text messages & email
- Still-connecting or endless loading screens.

➢ Wifi:

Using triple band antenna for wireless connectivity and stored in the openness area in the building.

➢ Cell Phone Signal Boosters

Cell phone signal boosters take existing cellular signal from the outside (no matter how weak) and amplify 3G & 4G LTE signal up to 32X.Eg: Webooster.

➢ Femto cells

Femtocells depend on having broadband landline internet with a minimum speed of 1.5 Mbps download & 256Kbps upload to have any decent results. Eg: Samsung Femtocells.

➢ Locate Tower: Locate our Nearest Cell Phone Tower using the app Antenna Search, Cell Reception, Airtel-Open N/w etc.
➢ dBM Signal level

Roam around our locality, the number closest to -50 dBm is where we get our best signal

For iphone-Dial and Call *3001#12345#* and go for signal service level on LHS
For Android Settings menu Settings about phone-Network-signal.

Table 1. Signal degradation issue Solution Enhancement

Device/Gain	Using Wifi	Signal Boosters	Femto Cells	Locate Tower	dBM optimizer
Apple	30%	10%	5%	30%	35%
Samsung	25%	20%	30%	25%	20%
ASUS	30%	35%	20%	20%	25%
Xiomi	20%	25%	15%	15%	10%

3.3 Network Congestion

A cell phone tower can connect to a few hundred users. What happens when everyone tries to access that tower at the same time? When you're at a concert, festival, crowded public event, or major sports game, there's bound to be a horde of picture taking, Face book and Snap chat selfees out there[5]. With so many people and their smart phones and

tablets, it's bound to overwhelm the cell tower or base station. Which leads to the following problems?

Dropped calls
Poor call quality
Slow internet
Super slow uploads & downloads
Stuck text messages
Spotty service

In order to avoid network congestion various operators equip their 4G/5G networks with the following features

- Data offload to Wifi networks-Transfer the global control of tower to local networks to reduce the load by installing large number of wifi-port stations. Eg-JIO wifi tower in smart cities of Tamilnadu for 4G-LTE.
- Data Capping-Reduce the abnormal surfer or dedicated surfer or channel capturer by limiting the data transfer amount.
- Deploying New Capacity-Increasing the Bandwidth capacity for the required or frequent accessible areas.
- Upgrading networks to new technology like LTE or faster versions of 4G.Eg 4G-VOLTE
- And finally, optimizing the streams that go through the networks-Using compression algorithms and reduce the data transfer packet size for fast transfer and release the channel as early as possible. Eg-Whatsapp video/photo sharing [6].

Table 2. Proposed Methodology for Network Congestion Enhancement

Network/DNS Lookup	Packet Loss Before(Random cases)	Packet Loss After	Gain%
Data offload	30/100	10/100	66%
Data Capping	35/100	15/100	57%
Deploying Bandwidth	36/100	11/100	69%
Upgrading networks	45/100	08/100	82%
Stream optimization	32/100	15/100	53%

3.4 Defects in Network Elements Removal:

The following problem arises from the network elements during Data transmission. They are as follows,
Hardware Issues-problems in frequency exhibitors, coverage indicator errors. It will be solved by the service provider to establish alternate arrangement or components for reserved in the area of frequent traffic flow coverage areas.

Software Issues-problems in open network software issues, tower updation and message queue maintenance errors. It will be rectified by the recruitment network administrators with surplus amount of service engineers.

Transmitter/Receiver side issues-Component errors are maintained by Annual Maintenance Team allocated through contract basis that will be the responsible authority to replace it with buffer stocks.

Tower issues-Sub private contracts on tower management are available in India to handle these issues properly.

Control port issues (Base Station)-BST authorities from the network service provider must be assigned with proper care and maintenance.

3.5 Interference Issues:

- **Electronic noise**

Created in the radio or network systems that transmit data, or in the medium -- such as wire and air -- through which signals are transmitted. Using ISO standard insulated cables reduced this noise.

- **Thermal noise**

Thermal noise occurs in all transmission media and communication equipment. The higher the temperature of the components or the medium, the greater the level of thermal noise. The components with standard material manufacturing policies avoid this issue. Nowadays prime mobile manufacturers adopt this technology.

- **Intermediation noise**

Intermediation (IM) effects result when two or more signals pass through a nonlinear device or medium and interact with each other in ways that produce additional signals, such as harmonics and sub harmonics of input signal frequencies. Unique ID for different frequency band implementation in 4G-LTE/5G reduced this issue.

- **Cross-talk**

Cross-talk refers to signals interfering with each other electromagnetically. Removing the multilane serial interface connection defective filters or poor filter design reduced this issue.

- **Impulse noise**

Impulse noise is a noncontiguous series of irregular pulses or noise spikes of short duration, broad spectral density and of relatively high amplitude. Separate the communications cable near a source of intermittent.

- **Shot noise**

Shot noise, also called quantum noise, is the variation in a signal that is caused by the quantized nature of the light and electricity making up the signal. Placing the mobile device as a beam of light or a stream of electrons, as being non uniform:

- **Transit-time noise**

Transit-time noise is a similar phenomenon to shot noise in that it affects systems more as they get smaller due to the quantized nature of electricity. On uniform electric signal receiver on mobile devices reduced this issue.

- **Acoustic noise**

Which encompasses sounds in an environment, such as Continuous noise, Low-frequency noise and Workplace noise?

Using the mobile device in acoustic controlled environment is the feasible solution [9].

3.6 Multipath fading.

Packet loss due to differential routing channel of paclets.Multipath fading can affect radio communications channels in two main ways. This can give the way in which the effects of the multipath fading are mitigated.

Flat fading: This form of multipath fading affects all the frequencies across a given channel either equally or almost equally. When flat multipath fading is experienced, the signal will just change in amplitude, rising and falling over a period of time, or with movement from one position to another.

Selective fading: Selective fading occurs when the multipath fading affects different frequencies across the channel to different degrees. It will mean that the phases and amplitudes of the signal will vary across the channel. Sometimes relatively deep nulls may be experienced, and this can give rise to some reception problems.

Some form of equalization may be needed and digital signal formats are used to solve this issue.

3.7 Obstacles

Mobile users are frequently facing the network signal issue which lead to packet loss is because often obstacles present between the mobile equipment and the network tower, this can be observed by raising the phones or moving to a window, users are basically trying to reduce the interference between the cell phone and cell tower.

That's because there are about 5 main causes of poor cellular signal:

- Cell tower distance.
- External interference (trees, hills, mountains, valleys, metal structures & high buildings)
- Building material & construction (metal, concrete, thick walls, energy-efficient installations, etc.)
- Internal interference (electronics, metal objects, anything magnetic or electronic can interfere with cell waves)
- Weather.

Some simple tips that help:

- Move outside or get near a window.
- Avoid standing under or near tall structures
- Reduce interior clutter

Get higher. Usually the second floor of the home gets better signal.

4.Results And Discussion

This paper focuses on several factors affecting the packet loss in wireless mobile data networks. The QoS in 4G-LTE/5G entirely focuses on fast transmission with negligible packet loss and optimized throughput.

The components dealt in this paper are categorized with the responsibilities in our current and next generation mobile data network accesses.

The following table 4.1 illustrates the responsibilities,

Table 3.Packet loss resolution responsibilities

Component	Responsibility Hierarchy level
Signal Strength boosters	Mobile Manufacturer, Service provider, User
Network congestion control	Service provider, Mobile Manufacturer
Defect in N/w elements	Service provider
Interferences	Mobile Manufacturer, service provider, User
Multipath fading	Service provider, Mobile manufacturer
Obstacles	User, Service provider, Mobile manufacturer

The following table 4.2and 4.3 illustrates the enhancement results obtained through the proposed methodology.

Table 4. Signal degradation issue Solution Enhancement

Device/Gain	Using Wifi	Signal Boosters	Femto Cells	Locate Tower	dBM optimizer
Apple	30%	10%	5%	30%	35%
Samsung	25%	20%	30%	25%	20%
ASUS	30%	35%	20%	20%	25%
Xiomi	20%	25%	15%	15%	10%

The resultant graph for the signal degradation recovery is as follows,

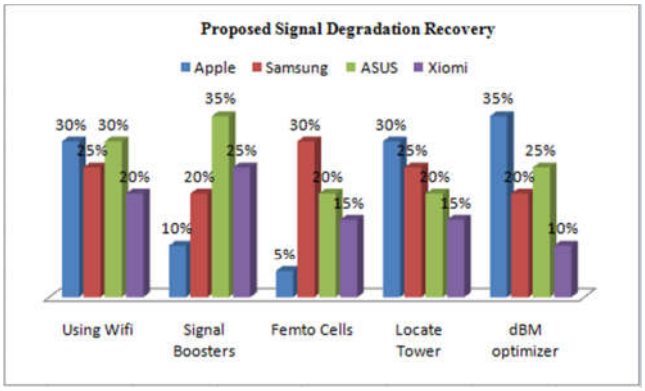

Figure 4. Resultant graph for Mobile devices signal booster approach

Table 5. Proposed Methodology for Network Congestion Enhancement

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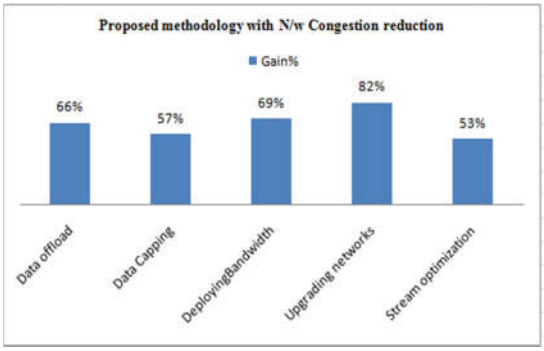

Figure 5. Resultant Graph for Network Congestion Reduction Approach

The proposed methodology yields the optimization in packet loss by minimum 53 % for 4G/5G Mobile data networks.

5.Conclusion

The packet loss in wireless Mobile Data networks is the key factor which affects the customer satisfaction in a specific amount of impishness. The QoS in 4G-LTE and 5G mobile networks must ensure the guaranteed packet transfer levels with less amount of significance. In this paper we deal with Signal strength improvement methods which yields a minimum level of guaranteed from the user side to enhance the data capture without packet loss in one sisal mode. But our network congestion control strategies and network element defect removal approaches must be implemented from the service provider side for the maximum level of guaranteed in data transmission. The obstacles are reduced by the advanced design of mobile equipment with specific transmission and reception capability. The proposed methodology focuses on the reducing the packet loss or enhancement in the wireless mobile data networks. The stage by stage wise implementation of signal strength, network congestion, defect, interferences, fading and obstacles are tuning the results with various levels of implications in packet loss reduction along with specific enhancement. The packet loss reduction enhancement produces minimum 53% optimization in the proposed research methodology. The fine tuning of throughput in wireless mobile data networks can also be enhanced by identifying the specific amount of guaranteed time for transferring the voice and data between sender and the receiver through 4G-LTE or 5G networks. In near future this proposed methodology will be extended to deal with data loss and throughput components of QoS using Neural networks concepts.

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