

# Quality of Service and Reliability Analysis of Wireless Networks

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## Abstract

Dependability is the fundamental worry in remote systems. Subsequently, assessing unwavering quality has turned out to be fundamental in frameworks. Many subsisting remote system steering conventions propose the accessibility of solid hubs. This, in any case, isn't a bona fide hypothesis given the elements of remote systems. Withal, because of continuous changes in topology, connect disappointments and hub disappointments are conceivable. Therefore, a credible technique is expected to assess the unwavering quality of remote systems in the event of such vulnerabilities. The unwavering quality of a remote system is constant by specific factors, for example, delay, throughput, dormancy, and overhead. For exploratory investigation, the system execution include that will be used in the test set up will be the throughput of the system. Throughput can be consigned as the volume or measure of information or activity that can saturate a system at a given time. Throughput can be habituated to evaluate arrange productivity and dependability. Very solid creations, gear, and foundation are required for a high gauge of unwavering quality.

**Keywords:** Reliability analysis, wireless network, component failure.

## 1. Introduction

The region of remote systems has gotten a wealth of consideration in the exploration network in the course of recent years. The world is ending up more reliant on remote administration, yet the office of remote system foundations to deal with the developing interest is controvertible. Unwavering quality is a system's facility to play out an assigned arrangement of capacities under specific conditions for assigned operational occasions. Dependability has for some time been a fundamental zone of research for remote systems [1,2]. This has brought about numerous corrections in an augmented controller, bearer, and seller focus on the plan and execution of useful exchanging, transmission, and flagging frameworks.

Remote Systems utilized infrared or radio recurrence signs to allot data and assets between inventions. Remote systems set up an association between hubs without use of wires. These system advancements are cost productive and they can be connected to conditions where wiring isn't conceivable or it is a best arrangement when contrasted with wired systems. There are four sorts of remote guidelines for remote systems administration and these sorts are caused by Organization of Electrical and Hardware Architects. They have set up the variation of transmission models: 802.11, 802.11a, 802.11b, 802.11g [3, 4].

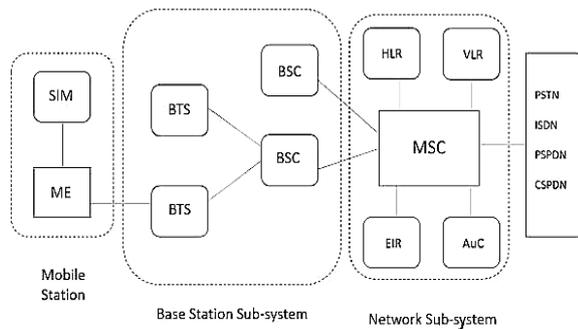
Genuine transmission speed may fluctuate and rely upon components, for example, number and size of physical obstructions in the system and any impedance in the radio transmission. These systems are dependable, however when impedance happens it diminishes range and nature of the flag. Impedance can be caused by different inventions working on a

similar radio recurrence and it is difficult to control these increments of beginning contraptions on a similar recurrence [3-5] Many kind of remote creations are accessible The rising third era cell systems has empowered an assortment of higher speed portable information administrations.

## 2. Component failures

Figure 1 displays, a communicationservice arrange foundation comprising of various parts, any of which could come up short, influencing diverse number of clients:

- A base station suits several portable clients in a given territory (cell) by apportioning assets that authorize clients to make early calls or propagate their calls on the off chance that they peregrinate to the phone.
- A base station controller gives changing help to a few neighboring base stations, obliging thousand of clients.
  - A portable exchanging focus is an all the more monstrously enormous switch that is equipped for obliging in excess of 100,000 clients.
- Home area & visiting area registers monitor clients who are sempiternally enlisted or simply visiting the territory.
- Signaling framework 7 performs call setup between versatile exchanging focuses and withal to the PSTN.
- High-limit trunks convey calls between versatile exchanging focuses & PSTN.



**Fig. 1:** Wireless infrastructure and components.

In this setup, a disappointment in a versatile exchanging focus, a home area enroll/visiting area enlist, a portable exchanging focus PSTN interface, Flagging framework 7, or PSTN trunk could influence proximately all supporters under a portable exchanging focus. Disappointment in different parts would be less thorough yet at the same time considerable. Regardless of whether segments are not at risk to bomb in times of months or years, disappointments in cosmically monstrous systems with a large number of parts are at risk to happen. Obviously, fluctuating degrees of excess in these variations of remote segments influence disappointment recurrence [5-9].

Utilizers powerlessness to part disappointment relies upon the accompanying elements:

- A potential number of remote clients affected by a specific remote segment disappointment.
- Mean-time to recover, which incorporates blame disconnection, repair or supersession, and testing times.

Remote transporters will normally focus on segments that effect the vast majority of the clients, however they withal ought to focus on increasing interim among disappointments and decrementing mean time to remodel in order to limit the recurrence of disappointments and to recover all the more versatilely from those disappointments that do happen. Switch disappointment will routinely have a high effect, with most supporters unfit to get to convenience and many utilizer's association disjointed. Various focal office switches, which are extremely dependable when helpfully conveyed and worked, are designed and sent as exchanging focuses. Remote systems, databases, base stations, inventions, and connections can fall flat. Each remote system has a database to store, keep up, and refresh area data for clients. To shun disappointment, the server can reflect and duplicate databases at numerous spots in the system [10-19]. Base station disappointments can be diminished through repetitive segments which is an overlay design.

### 3. Probable cause of failures

In the occurrence reports four classes of main drivers have been sketched out, what's more with one classification that is utilized related to one of the other four classes.

#### 3.1. Normal wonders

This classification incorporates occurrences caused by extreme climate, seismic tremors, surges, pandemic ailments, rapidly spreading fires, natural life, et cetera.

#### 3.2. Human mistakes

This classification incorporates episodes caused by mistakes submitted by representatives of the supplier or outside the supplier, amid the activity of gear or offices, the utilization of

devices, the execution of strategies, and so forth e.g. an excavator removing a link.

#### 3.3. Pernicious assaults

This classification incorporates occurrences caused by a ponder demonstration of somebody or some association, e.g. a Refusal of Administration assault upsetting the administration, or a link burglary.

#### 3.4. Framework disappointments

This class incorporates occurrences caused by specialized disappointments of framework, for instance, caused by equipment disappointments, programming bugs or imperfections in manuals, strategies or arrangements.

#### 3.5. Outsider Disappointments

This classification incorporates occurrences caused by a disappointment or episode at an outsider. The class is utilized in conjunctions with one of the other four main driver classifications.

## 4. Reliability measure of network

There subsist various unwavering quality measures for a remote system relying upon the system and its applications [10, 20]. For a media transmission organize, it is prominently correspondence issues that meet certain availability essentials. While for the sensor arrange, center is around data collecting, handling and correspondence issues to meet the inclusion and network essentials.

Every unwavering quality measure is worried about the office of a system to be accessible to give wanted convenience to the suspension utilizer. Diverse criteria can be considered with the end goal to express or measure the unwavering quality of a system [21, 22]. The primary ones are as specified:

1. Reliability proportion of availability falls inside any of the classes, which are 2-terminal dependability, k-terminal unwavering quality, all terminal unwavering quality and numerous sources to terminal unwavering quality.
2. Hardware unwavering quality measures are MTTR and MTRF;
3. The inclusion dependability measure is guaranteed with desired level of inclusion (at any rate k-inclusion) of occasion or focus consistently figured by either Boolean detecting model or synergistic detecting model [6];
4. Capacity/Max stream measure is characterized as the likelihood that greatest stream of system isn't not as much as given interest.
5. QoS unwavering quality measure is guaranteed information exchange auspicious and guaranteed transfer speed information accuracy convenient, contingent on utilizer/applications request [7];
6. Information unwavering quality learns that hubs transmit to sink just data concerning important occasions or targets.

#### 4.1. Reliability and availability parameters

Reliability analysis (Jan-16 to Dec-16) for 3G wireless service providers [19] is given in table 1, table 2, table 3, and table 4.

Consider the performance of three months (July, August and September) is 3.14 for 3G wireless service providers. Then  
 Total Time in Hours = 92 x 24 = 2208  
 Unavailable Time = (2208 x 3.14) / 100 = 69.33  
 Available Time = 2208 – 69.33 = 2138.66  
 Mean Up Time (MUT) = 2138.66/3 = 712.88 hrs.  
 Mean Down Time (MDT) = 69.33/2 = 34.66 hrs.  
 Failure Rate ( $\lambda$ ) = 1 / MUT = 0.0014027 (1)  
 Repaire Rate ( $\mu$ ) = 1/ MDT = 0.0288 (2)  
 The reliability of the network  
 $R = e^{-\lambda T}$  (3)  
 Where T = the total duration of the call (24hrs),  
 $\lambda$  = total failure rate.

**Tab. 1:** Reliability Analysis (Jan-16 to Mar-16) for 3G Wireless Service Providers [19]

Parameter	Service Provider	Service Area	Mean Down Time(hrs)	Mean Up Time(hrs)	Reliability	Availability
BTs and Node-B's Accumulated Downtime(not available for service)(%age)	Aircel	North East	61.05	693.5	0.966	0.919
Worst affected Node B's due todowntime (%age)	Aircel	Assam	126.85	651.43	0.964	0.837
	BSNL	Kolkata	54.87	699.42	0.999	0.927
Worst affected cells having morethan 3% Circuit Switched VoiceDrop Rate	Aircel	Assam	102.12	667.92	0.965	0.867
	BSNL	West Bengal	83.91	680.06	0.965	0.890

**Tab. 2:** Reliability Analysis (Apr-16 to Jun-16) for 3G Wireless Service Providers [19]

Parameter	Service Provider	Service Area	Mean Down Time(hrs)	Mean Up Time(hrs)	Reliability	Availability
BTs and Node-B's Accumulated Downtime(not available for service)(%age)	Aircel	North East	85.23	679.18	0.965	0.888
Worst affected Node B's due todowntime (%age)	Aircel	Assam	239.57	576.29	0.959	0.706
	BSNL	Kolkata	52.66	700.89	0.966	0.930
Worst affected cells having more than 3% Circuit Switched Voice Drop Rate	Aircel	Assam	90.97	675.35	0.965	0.881
	BSNL	West Bengal	92.19	674.54	0.965	0.879

**Tab. 3:** Reliability Analysis (July-16 to Sep-16) for 3G Wireless Service Providers [19]

Parameter	Service Provider	Service Area	Mean Down Time(hrs)	Mean Up Time(hrs)	Reliability	Availability
BTs and Node-B's Accumulated Downtime(not available for service)(%age)	Aircel	North East	142.86	688.38	0.966	0.828
Worst affected Node B's due todowntime (%age)	Aircel	Assam	246.08	571.95	0.959	0.699
	BSNL	Kolkata	44.16	706.56	0.967	0.941
Worst affected cells having more than 3% Circuit Switched VoiceDrop Rate	Aircel	Assam	81.26	681.83	0.965	0.894
	BSNL	West Bengal	81.91	681.39	0.965	0.893

**Tab. 4:** Reliability Analysis (Oct-16 to Dec-16) for 3G Wireless Service Providers [19]

Parameter	Service Provider	Service Area	Mean Down Time(hrs)	Mean Up Time(hrs)	Reliability	Availability
BTs and Node-B's Accumulated Downtime(not available for service)(%age)	Aircel	North East	51.78	701.48	0.966	0.931
Worst affected Node B's due to downtime (%age)	Aircel	Assam	86.11	678.59	0.965	0.887
	BSNL	Kolkata	30.14	715.91	0.967	0.959
Worst affected cells having morethan 3% Circuit Switched VoiceDrop Rate	Aircel	Assam	57.85	697.43	0.966	0.923
	BSNL	West Bengal	84.13	679.92	0.965	0.889

### 5. Quality of service

The concept of quality of service (QoS) is described in wireless networks in terms of diminutive size, low cost, low puissance, routing and capacity of wireless networks. By providing quality of accommodation support in wireless networks is a hospital budding part of the research. Due to exorbitant resources constraint, bandwidth and power sources in wireless networks and additionally cutting-edge emerging challenges of quality of

accommodation. There are different protocols required for wireless networks on a substratum of subsisting challenges, we can ascertain reliability in wireless networks [21]. Several control mechanism is indispensable in order to assure the reliability, these are load capacity, bandwidth, flow control, an end to culminate transmission in the wireless communication networks.

## 6. Problems related To QoS wireless networks

In view of the asset hindrances and dynamic nature of remote systems, it is particularly considerable to have the capacity to give QoS. QoS support in remote systems incorporate issues at the application layer, pass on layer, arrange layer, Macintosh layer and physical layer [8]. In remote systems, there are a few interesting issues and challenges that don't have any significant bearing to the customarily wired web foundation. The most foremost issues are recorded underneath.

### 6.1. Flighty Connection Properties

Remote media is exceptionally impulsive and bundle impacts are an ineluctable outcome of remote systems. Flag proliferation faces challenges, for example, blurring, obstruction, and multipath revocation. These properties of the remote system make measurements, for example, data transfer capacity and deferral of the connection whimsical.

### 6.2. Hub versatility

Kineticism of hubs in the remote system causes a dynamic system topology. Connections will be progressively created when two hubs move into transmission scope of one another and are removed down when they move from transmission run.

### 6.3. Restricted battery life

There are constrained by the intensity of inventions that set up the hubs in the remote system because of restrained battery lifetime. The system used in QoS provisioning

### 6.4. Shrouded and uncovered terminal issue

In the Macintosh layer with customarily transporter sense numerous entrance (CSMA) convention, the multihop bundle transferring presents "concealed terminal" pickles. The obnubilated terminal bind unfolds when flag of two hubs, verbally express An and B, that are far from one another's transmission run, crash at a predominant beneficiary, verbally express hub C. With the equivalent nodal setup, an uncovered terminal difficulty will result from a situation where hub B attempts to transmit information (to somebody other than An or C) while hub C is transmitting to hub A. Bearer sense various access with crash shirking (CSMA/CA) diminishes the impact of obnubilated terminal predicament, however there is no answer for the uncovered terminal difficulty today. Obnubilated and uncovered terminal issue isn't just a QoS quandary yet is a common bind through the part of the remote system.

### 6.5. Course upkeep

The dynamic idea of the system topology and the transmuting deportment of the correspondence medium make the exact upkeep of system state data exceptionally strenuous. Since hubs can join and leave remote system condition as they satisfy, set up steering way might be broken whenever notwithstanding

amid the procedure of information exchange. Therefore, purpose emerges of steering ways with negligible overhead and postponement. Since QoS-careful directing would require reservation of assets at the switches (hubs), the scrape of an intensely transmuting topology system may end up lumbering [23, 24].

## 6.6. Security

Without sufficient security, unapproved get to and use may encroach QoS transactions [23]. The idea of communicates in remote systems conceivably results in greater security introduction. As a result of the laborious properties of versatile remote systems, there has been a recommendation of using delicate QoS. The meaning of Delicate QoS is that after an association setup, there may subsist transient timeframes when QoS assignments are not awarded. Be that as it may, we can evaluate the gauge of QoS happiness by the portion of aggregate disturbance time over aggregate association time. The physical layer should deal with transmutations in transmission quality, for instance by adaptively increasing or decrementing the transmission puissance. Correspondingly, the connection layer should respond to the changes in connection blunder rate, including the use of programmed repeat ask for (ARQ). A more modern method includes a versatile blunder correction component that augmentations or abatements the measure of mistake amendment coding in replication to transmutations in the transmission nature of wanted QoS. As the connection layer deals with the variable piece mistake rate, the principle impact seen by the system layer will be a transmutation in effective throughput (transfer speed) and postponement.

## 7. Results and discussion

As of now, remote systems are more inclined to disappointment and loss of access than their wired partners. Disappointment can include at least one of the remote system's segments—switches, base stations, databases, contrivances & remote connections. The execution for various quarters is given as-

### 7.1. Execution amid Apr to June

The execution has enhanced in the quarter (Apr to Jun) when contrasted with the past quarter (Jan to Blemish) in regard of the accompanying parameters:-

- a. Worst influenced BTSs and Hub B's because of downtime (%age)
- b. Call Set Up Progress Rate (inside the licensee's very own system)
- c. SDCCCH/Paging Channel and RRC Blockage (%age)
- d. TCH and Circuit Exchanged RAB Blockage (%age)
- e. Call drop and Circuit Exchanged Voice Drop Rate (%age)
- f. Most exceedingly terrible influenced cells having over 3% TCH drop (call drop) and Circuit Exchanged Voice Drop Rate:- CBBH

The execution has decayed in the quarter (Apr to Jun) when contrasted with the past quarter (Jan to Blemish) in regard of the accompanying parameters:-

- a. Connection with great voice quality and Circuit Switch voice quality (CSV Quality)

b. Point of Interconnection (POI) Blockage.

### 7.2. Execution amid July to Sep

The execution has enhanced in the quarter (July to Sep) when contrasted with the past quarter (Blemish to Jun) in regard to the accompanying parameters:-

- a. Worst influenced BTSs and Hub B's because of downtime (%age)
- b. SDCCH/Paging Channel and RRC Clog (%age)
- c. Worst influenced cells having over 3% TCH drop (call drop) and Circuit Exchanged Voice Drop Rate:- CBBH
- d. Connection with great voice quality and Circuit Switch voice quality (CSV Quality)

The execution has crumbled in the quarter (July to Sep) as thought about to the past quarter (July to Sep) in regard to the accompanying parameters:-

- a. Fault occurrences (No. Of shortcomings/100 subs/month)
- b. Fault repaired by next working day for urban territories
- c. Mean Time Blame repaired inside 5 days (for urban territories)
- d. Response time to the client for Help Availability of callcenter/Client care.

### 7.3. Execution amid Oct to Dec

The execution has enhanced in the quarter (Oct to Dec) as contrasted with the previous quarter (Oct to Dec) in regard to the accompanying parameters:-

- a. BTSs and Hub B's Amassed downtime (not accessible for administration) (%age)
- b. Worst influenced cells having over 3% TCH drop (call drop) and Circuit Exchanged Voice Drop Rate:- CBBH

The execution has decayed in this quarter when contrasted with the past quarter in regard to the accompanying parameters:-

- a. Point of Interconnection (POI) Clog.

## 8. Conclusions

As per the execution of different administrators in various areas it has been discovered that the unwavering quality and accessibility of the systems is predominantly influenced by human mistakes and framework disappointments, this can be enhanced by giving appropriate preparing to the framework administrators and occasional preventive and restorative support additionally by giving legitimate excess to the segments more touchy towards the untimely disappointments. The malignant assaults can likewise be moderated by giving appropriate self-testing programs in the frameworks to determine the related issues as quickly as time permits.

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