Evaluation of 3G Network Availability Based on Key Performance Indicators in Makassar City

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Abstract

BTS functions as an interconnection between the cellular system infrastructure and the Out Station. BTS must always monitor station exits that enter and leave the BTS cell. Ideally, one cell will be served by one BTS site. Topographic quality of BTS refers to the Key Performance Indicators (KPI). The parameters used are Availability, Call Drop Rate-Circuit Switch (CDR CS), Call Drop Rate-Packet Switching (CDR PS), Call Setup Success Rate-Circuit Switching (CSSR CS) and Call Setup Success Rate-Packet Switching (CSSR PS). The purpose of this research is to analyze the facts of cellular networks, especially 3G networks in Makassar City based on the standards set by the International Telecommunication Union (ITU). The results obtained from this study are the proportion of the KPI parameters. For the availability parameters, the best value obtained is 30. For the CDR CS parameter, the best value is 0.2436. For the CS CSSR parameter, the best value is 30. Whilst, for the CDR PS parameter, the best value is 0.0517. Whereas for the CSSR PS parameter, the best value is between 29.9515 to 29.9811.

Keywords: *evaluation, 3G, cellular, key performance indicators, mobile network operators*

1. Introduction

Cellular technology has evolved, and from generation to generation of technology. The use of the frequency spectrum will be very important in providing broadband services in densely populated areas, such as Makassar City. GSM network is usually called a 'cellular network' (as the whole coverage area is divided into different cells and sectors) and comprises a Mobile Station (MS) which is connected to the Base Transceiver Station (BTS) via air interface (Kumar et al., 2012). With the density of data traffic in busy areas, the speed of data access is very important, particularly in areas classified as urban areas. (Palinggi & Saputra, 2020; Rappaport, 2002)

Makassar is also one of the cities with the most populous population in Indonesia, with a figure of 1,652,305 people. As the city growth rate increases, the users or subscribers of cellular services are also increasing. The increase in the number of subscribers caused cellular traffic to also become denser so that cellular communication experienced a speed reduction and often there were frequent interruptions which made it difficult for customers to communicate, as was the case with the percentage of Call Drop Rate-Circuit Switch (CDR CS) and Call Drop Rate-Increased Packet Switching (CDR PS), or the percentage of Call Setup Success Rate-Circuit Switching (CSSR CS) and Call Setup Success Rate-Packet Switching (CSSR PS), as well as

Received Total Wideband Power (RTWP).

The number of Base Transceiver Stations (BTS) in Makassar City is owned by cellular operators until 2019 where XL operator owns 462 BTS, Telkomsel owns 1800 BTS, Smartfren owns ± 250 BTS and Indosat operators 380 BTS. According to the data from the Balai Monitor Frekuensi Spektrum Frekuensi Radio Kelas I Makassar, the number of BTS in Makassar City is 2,392 with the number of cellular operators as many as 9. Radio interference that was monitored during 2015 was 310 cases. When monitored in 2016, there were 400 cases, and in 2017 were 430 cases. But in reality, the distraction counts radio occurs more frequently than is observed. A major factor in the occurrence of radio interference is caused by interference. Radio interference that is monitored is generally the same case recurring every year. (Bazergan & Razak, 2018; Razak, 2018; Razak et al., 2019)

At the next level, there are general requirements that need to be considered in tower construction, namely the quality of telecommunications services. This is considered important because the location of the tower will ensure the quality function of telecommunications services both in terms of security and safety and health, the location of the tower is expected not to endanger the surrounding population. From an environmental perspective, it is hoped that the location of the tower will not harm the surrounding ecosystem, either due to the physical presence of the tower or its supporting infrastructure. In terms of spatial aesthetics, it is hoped that the location of the tower will not cause a decrease in the visual quality of space at the location of the tower and its surrounding areas. (Razak et al., 2019)

Ideally, one cell will be served by one BTS site. However, one BTS site may serve more than one cell. Each BTS site usually consists of one main tower and a support shelter. The placement of BTS sites is usually done on the ground, but for densely populated areas, BTS sites are placed on top of tall buildings. Tower height is adjusted to the needs and reach required. Cell towers are used to place various antennas. Such as sectoral antennas, antennas and radio transmission (mini link). The shelter is made of a similar iron material as a place to store various components of the BTS site, transmission equipment, Battery Fuse Unit (BFU), fan unit, cooling unit/air conditioner, and heating unit.

The existence of cellular towers provided by operators greatly supports the availability of 3G networks. The purpose of this study is to analyze the availability of cellular networks in Makassar City based on the standards set by the International Telecommunication Union (ITU) in the form of Key Performance Indicators which are an absolute requirement to be fulfilled so that cellular services provided can be maintained at a good quality level.

BTS functions as an interconnection between the cellular system infrastructure and the Out Station. BTS must always monitor the outstation that enters or leaves the BTS cell. The coverage area of the BTS is greatly influenced by the environment, including topography and tall buildings. BTS plays a very important role in maintaining GSM quality, especially in terms of frequency hopping and antenna diversity.

As the availability of telecommunication networks, especially cellular in Makassar City is rocketing, it is necessary to conduct a study that investigates for the quality of the services. Research on cellular network quality is pivotal considering that cellular operators in Indonesia need to provide the best service for their users. The determinants of the quality are Key Performance Indicators.

KPI (Key Performance Indicator) is parameters that become quality indicators of the

GSM network performance. The parameter which becomes indicators in this KPI includes Call Setup Success Rate (CSSR), Call Drop Rate (CDR), and Call Success Rate (CSR). Therefore, Key Performance Indicator analysis was performed (KPI) on the GSM telecommunications network to maximize the performance of the network (Khotimah et al., 2017). KPIs are used to evaluate the performance of an operational GSM network (I Kehinde et al., 2017; Upadhyay et al., 2014).

Moreover, the Quality of Service (QoS) in cellular networks is defined as the capability of the network carriers to provide a satisfactory service which includes voice quality, signal strength, low call blocking and dropping probability, high data rates for multimedia and data applications (Mojisola & Gbolahan, 2015). Performance and quality of service (QoS) evaluation are vital to the mobile operators as the revenue generation and customer satisfaction are directly related to network performance and quality. The Network needs to be under continuous monitoring and control to maintain and improve the performance of the system. (Ozovehe & Usman, 2015)

Topographic quality of BTS refers to the Key Performance Indicators (KPI). The use of the term KPI already exists in the telecommunications world, especially cellular operators, according to some sources, KPI has definitions, namely quantifiable and measurable parameters that are very important for a cellular operator. KPI is a reference for the reliability of a GSM network as a whole. The KPI parameter is Received Total Wideband Power (RTWP). This is the total power received on the WCDMA (Node-B) network. This RTWP value can be used as an indicator or parameter as a reference for a site experiencing uplink interference or not and can help analysis and solutions for handling uplink interference at a relevant site. (Khotimah et al., 2017; Razak et al., 2019)

2. Method

The research method used in this research is a quantitative method which uses primary data which is empirically obtained from cellular operator data. In this study, 14 BTS locations were taken randomly and processed using the XXAMPP application using the database. The database was taken from the Balai Monitor Frekuensi Spektrum Frekuensi Radio Kelas I Makassar from 01 May 2019 to 30 May 2019. Sampling was done randomly, based on a predetermined location. From the existing sample, the results of this study were to determine BTS with the best stability, thus describing the communication services in Makassar City statistically. Through the XXAMPP application, a topography was made from the location of the BTS that has been determined. The operator data used was the operator Indosat Tbk.

3. Results and Discussions

In this study, the number of BTS used was 14 BTS, thus, the total data used was 420 data for the 14 BTS, in a total observation time of 30 days.

In measuring network availability, the parameters used include the call drop rate (CDR). In telecommunications, CDR is a parameter used to measure network quality by measuring the number of dropped calls events that occur while the call is in progress. A call attempt will call the call setup procedure, and if successful, the result is connected. But in some cases, the calls that have been connected suddenly disconnect before the user or the other party end the call due to technical reasons. This is known as a dropped call. CDR is divided into 2, namely CDR-CS

and CDR-PS. In accordance with KPI, standards determined by the International Telecommunication Union-Telecommunication (ITU-T) for the CDR target is ≤ 1.5%.

Apart from the parameters mentioned above, the Call Setup Success Rate (CSSR) also includes parameters. CSSR in telecommunication is a value used to measure the level of network availability in providing services in the form of video calls, voice calls and SMS, in other words, it can open the way of communication and sometimes for various reasons, not all attempts to make a call (call attempt) can be connected. to the destination number. Standardization of the percentage of call success rate by the availability of voice channels that have been allocated to determine the success of the call, indicated by the tone when connected to the other person's cell phone. CSSR is divided into 2, namely Call Setup Success Rate – Circuit Switch (CSSR-CS) and Call Setup Success Rate – Packet Switch (CSSR-PS).

The next parameter is availability. Availability is the availability of a system design that is utilized by the network user community, to state whether a network is good for users. A network is classified as good if it serves users at any time. This means that network users in the area served can use the network 24 hours a day and 7 days a week. However, network availability must also be accompanied by reliability. The reliability of a network service is called perfect if every time the user uses it, the network user is well served without experiencing a service failure. For example, when the standard availability reaches 99,999%, this means that a telecommunications operator is only allowed 0.001% to experience failure in network provisioning.

Some formulas used to calculate KPI parameters can be explained in real terms and will affect the results obtained, among others, explained in the following provisions (Abdullahi, 2018):

$$CSSR = \frac{Number\ of\ Unblocked\ Call\ Attempts}{Total\ Number\ of\ Call\ Attemps}\ x100\% \quad (1)$$

$$CDR = \frac{Number\ of\ Drop\ Calls}{Total\ Number\ of\ Call\ Attemps}\ x100\% \quad (2)$$

Based on the formula shown above, using the total data from 14 Base Stations as sample data, empirical conclusions can be drawn. The formula mentioned above is used to solve problems in evaluating the performance given by cellular operators. With the amount of data totalling 420 data with a retrieval duration of 30 days, then statistically, it can be described more simply through tables and graphs.

Table 1 shows the 3G Cell based on Availability parameters. From Table 1, it is known that 3 BTS reach the highest Availability value, namely BTS ID 3G_AL_MARKAZ_CM1, BTS ID 3G_MARISO_MKS_CM1 and BTS ID 3G2IP_BTP_DUA_PL1. The graph is shown in Figure 2.

Table 1. 3G BTS ID Based on Availability Parameter

BTS ID	3G Cell Availability

3G_AL_MARKAZ_CM1	30
3G_BTN_ANTARA1	29.9903
3G_HERTASNING_BARU1	29.9981
3G_MARISO_MKS_CM1	30
3G2_PETTARANI21	29.996
3G2_RAPPOKALLING_PL1	29.9855
3G2IP_BATUA_RAYA_PL1	29.9999
3G2IP_BORONG_INDAH_AG1	29.9991
3G2IP_BTN_ASAL_MULA_PL1	29.9998
3G2IP_BTP_DUA_PL1	30
3G2IP_BULUROKENG_PERMAI_PL1	29.9983
3G2IP_CENDRAWASIH_MKS1	29.9991
3G2IP_JL_RACING_CENTRE1	29.9954
3G2IP_SUDIANG3_PL1	29.9984

Table 2. 3G BTS ID Based on CDR CS Parameter

BTS ID	UMTS CDR CS
3G_AL_MARKAZ_CM1	0.2436
3G_BTN_ANTARA1	0.0137
3G_HERTASNING_BARU1	0.0531
3G_MARISO_MKS_CM1	0.1127
3G2_PETTARANI21	0.0714
3G2_RAPPOKALLING_PL1	0.088
3G2IP_BATUA_RAYA_PL1	0
3G2IP_BORONG_INDAH_AG1	0
3G2IP_BTN_ASAL_MULA_PL1	0.0366
3G2IP_BTP_DUA_PL1	0.0299
3G2IP_BULUROKENG_PERMAI_PL1	0.0674
3G2IP_CENDRAWASIH_MKS1	0.0662
3G2IP_JL_RACING_CENTRE1	0.0218
3G2IP_SUDIANG3_PL1	0.0507

Table 2 shows the 3G Cell based on CDR CS parameter. From Table 2, it is known that 1 BTS reaches the highest CDR CS value, namely BTS ID 3G_AL_MARKAZ_CM1. The graph is shown in Figure 3. Table 3 shows the 3G Cell based on CSSR CS parameters. From Table 3, it is known that 2 BTS reach the highest CSSR CS value, namely BTS ID 3G_MARISO_MKS_CM1 and BTS ID 3G2IP_BORONG_INDAH_AG1. The graph is shown in Figure 4. Table 4 shows the 3G Cell based on the CDR PS parameter. From Table 4, it is known that 1 BTS reaches the highest CDR PS parameter value, namely BTS ID 3G2IP_CENDRAWASIH_MKS1. It is graphically shown in Figure 5. Table 5 shows the 3G Cell based on the CSSR PS parameter. From Table 5, it is known that 3 BTS reach the highest CSSR PS parameter values, namely BTS ID 3G_MARISO_MKS_CM1, BTS ID 3G2IP_BATUA_RAYA_PL1 and BTS ID

3G2IP_BORONG_INDAH_AG1. It is graphically shown in Figure 6.

Table 3. 3G BTS ID Based on CS CSSR Parameter

BTS ID	UMTS CSSR CS
3G_AL_MARKAZ_CM1	29.9778
3G_BTN_ANTARA1	29.9702
3G_HERTASNING_BARU1	29.8409
3G_MARISO_MKS_CM1	30
3G2_PETTARANI21	29.9868
3G2_RAPPOKALLING_PL1	29.9843
3G2IP_BATUA_RAYA_PL1	29.9852
3G2IP_BORONG_INDAH_AG1	30
3G2IP_BTN_ASAL_MULA_PL1	29.9751
3G2IP_BTP_DUA_PL1	29.9725
3G2IP_BULUROKENG_PERMAI_PL1	29.9879
3G2IP_CENDRAWASIH_MKS1	29.9317
3G2IP_JL_RACING_CENTRE1	29.9741
3G2IP_SUDIANG3_PL1	29.9457

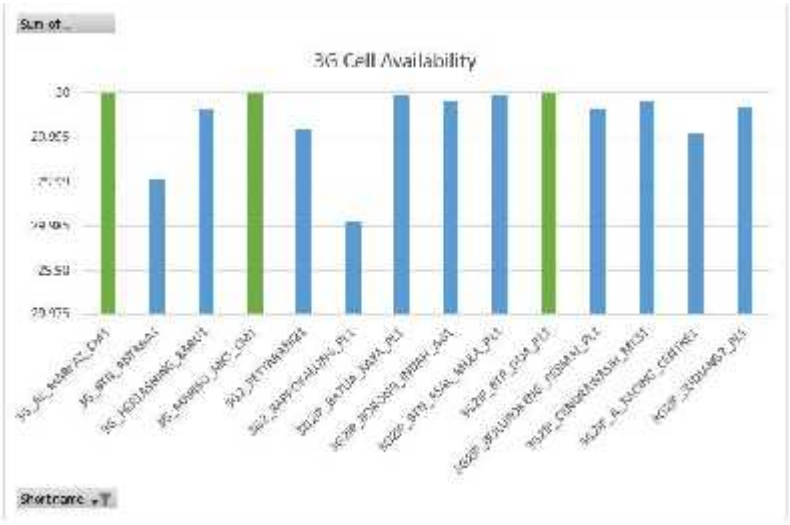

Figure 2. Availability Parameter Graph

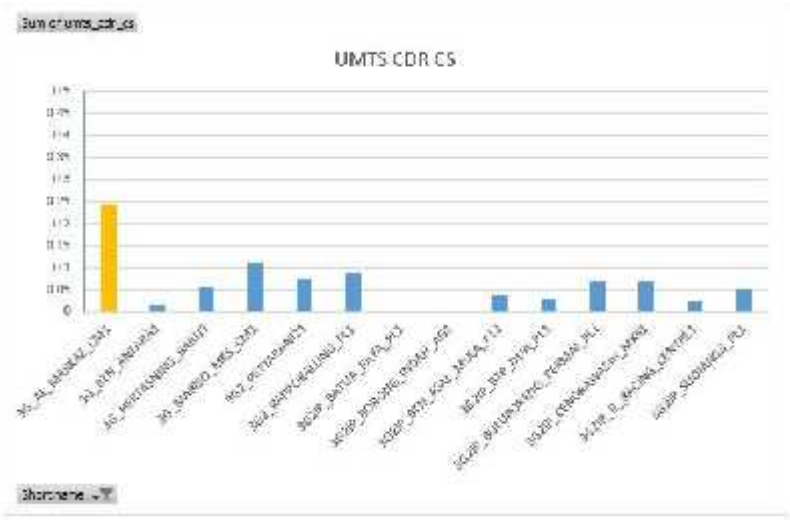

Figure 3. CDR PS Parameter Graph

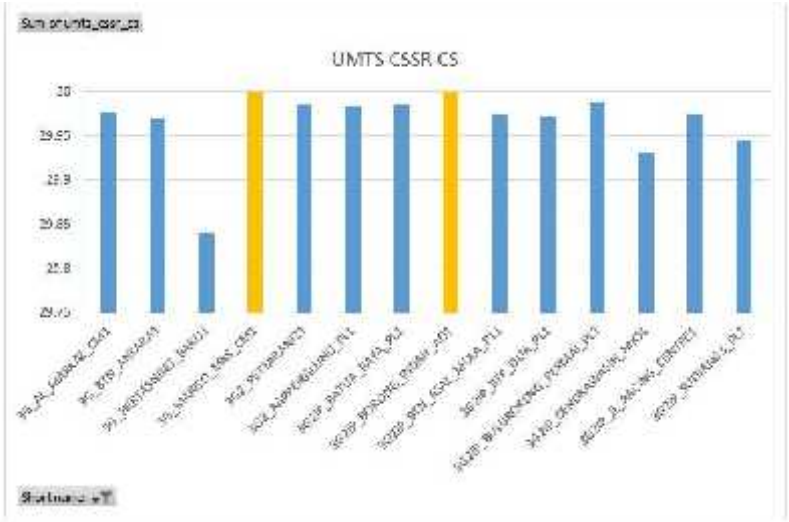

Figure 4. CSSR CS Parameter Graph

Table 4. 3G BTS ID Based on CDR PS Parameter

BTS ID	UMTS CDR PS
3G_AL_MARKAZ_CM1	0.0208
3G_BTN_ANTARA1	0.0153
3G_HERTASNING_BARU1	0.0239
3G_MARISO_MKS_CM1	0.0099
3G2_PETTARANI21	0.0166
3G2_RAPPOKALLING_PL1	0.0225
3G2IP_BATUA_RAYA_PL1	0.0098
3G2IP_BORONG_INDAH_AG1	0.0146
3G2IP_BTN_ASAL_MULA_PL1	0.0286
3G2IP_BTP_DUA_PL1	0.0187
3G2IP_BULUROKENG_PERMAI_PL1	0.0175
3G2IP_CENDRAWASIH_MKS1	0.0517
3G2IP_JL_RACING_CENTRE1	0.0219

3G2IP_SUDIANG3_PL1	0.0393

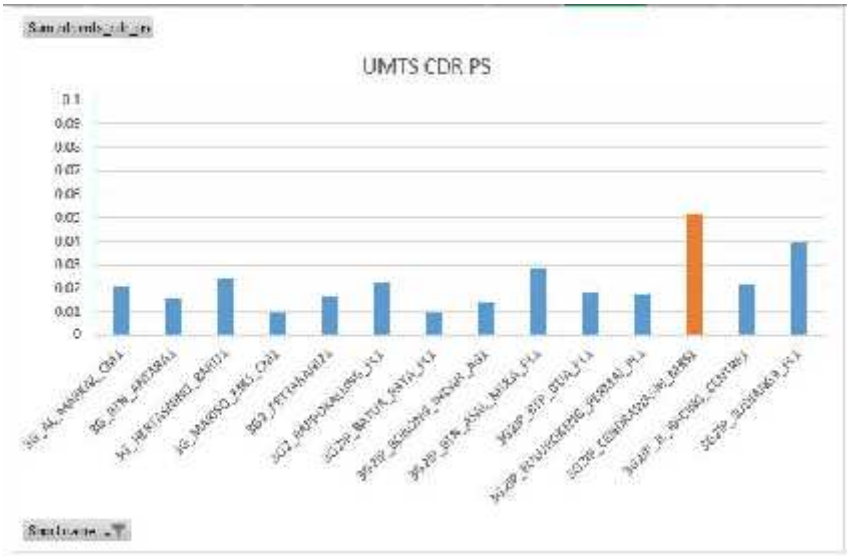

Figure 5. CDR PS Parameter Graph

Table 5. 3G BTS ID Based on CSSR PS Parameter

BTS ID	UMTS CSSR PS
3G_AL_MARKAZ_CM1	29.7784
3G_BTN_ANTARA1	29.7993
3G_HERTASNING_BARU1	29.7606
3G_MARISO_MKS_CM1	29.9515
3G2_PETTARANI21	29.755
3G2_RAPPOKALLING_PL1	29.799
3G2IP_BATUA_RAYA_PL1	29.9702
3G2IP_BORONG_INDAH_AG1	29.9811
3G2IP_BTN_ASAL_MULA_PL1	29.6945
3G2IP_BTP_DUA_PL1	29.8704
3G2IP_BULUROKENG_PERMAI_PL1	29.7885
3G2IP_CENDRAWASIH_MKS1	29.6216
3G2IP_JL_RACING_CENTRE1	29.9111
3G2IP_SUDIANG3_PL1	29.7796

Figure 6. CSSR PS Parameter Graph

4. Conclusions

From the results of this study, some conclusions can be drawn as follows:

a. For the availability parameter, the best value obtained is 30. The value for the CDR CS parameter is 0.2436, while the CSSR CS parameter is 30. The value for the CDR PS parameter is 0.0517, whereas the CSSR PS parameter is in between 29.9515 to 29.9811.
b. The availability of 3G networks in Makassar City is very good. This is influenced by the stability of the cellular service network obtained by subscribers who already have KPI standards as determined by ITU with a sample of 14 BTS.

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