Assessment of Signal Strength for Communication Service Providers Using Network Monitor Application

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Abstract

Ensuring strong signal strength is crucial for facilitating seamless conversations and swift data transmissions, particularly as cell phones have become indispensable tools for individuals and businesses. The quality of communication by service providers directly impacts users' experience and productivity, emphasizing the importance of evaluating and comparing signal strengths. Hence, this study aims to assess the signal strength between two local communication service providers in an urban city in Malaysia. A network monitoring system was utilized to assess the signal strength at six base points. Signal strength data were collected at six locations using global positioning system (GPS) equipped devices. Measurements were conducted during afternoon hours on consecutive weekdays to account for temporal fluctuations. During both morning and evening drive tests, an analysis of the received signal strength (RSSI) values was conducted for Telco A and Telco B. In the morning, Telco A displayed an average RSSI value of -92.8 dBm, while Telco B exhibited an average of -92.2 dBm. Conversely, during the evening, Telco A's average RSSI was -92.2 dBm, while Telco B showed an average of -94 dBm. Given that increasing RSSI indicates better performance, the observed data leads to the conclusion that Telco B outperforms Telco A. These findings provide valuable insights into the performance of communication service providers and can inform decisions aimed at improving signal strength and overall network quality. By addressing areas of weakness identified through this study, providers can enhance the user experience and ensure optimal communication services for individuals and businesses.

Keywords: Signal Strength, Communication Service Provider, Net Monitor Application, Cellular Networks, Telco

1.0 Introduction

Drive testing is vital for assessing the coverage, capacity, and quality of service (QoS) of mobile radio networks. It involves using specialized equipment to examine the air interface, either in a test vehicle or as a portable device. Drive test systems can be remotely, or automatically [1]. Optimization and troubleshooting use drive test data to identify issues during network deployment or to address specific problems reported by customers during operation. This data helps to pinpoint the main cause of localized network faults [2]. Assessing signal strength is critical for ensuring reliable communication, with impacts on voice call quality, data transmission speeds, and overall user experience, thus highlighting the importance of comparing signal strengths among communication service providers to identify areas for improvement and enhance service delivery [3]. In urban areas, acceptable signal strength ranges typically fall between -85 dBm to -95 dBm for reliable voice calls and data connections [4].

Service quality monitoring includes the process of sending test calls over the network to evaluate the quality of multiple services. This approach focuses on the experience for end-users, allowing operators to address quality issues by analysing technical reasons using data obtained [5].

The strength of a cell phone signal is typically quantified in decibels (dBm), spanning from -30 dBm to -110 dBm, where higher values denote stronger signals [5]. Nowadays technologies in telecommunications and mobile communication, handover is a crucial mechanism through which cellular transmission, whether voice or data, seamlessly transitions from one base transceiver station (BTS) to another, ensuring continuous connectivity for mobile devices in motion [6]. Handover plays a pivotal role in establishing data sessions or facilitating phone conversations between mobile devices that are consistently on the move [7]. The evolution of mobile networks began with the analogue voice-focused 1G networks in the 1980s, and 5G currently enables transformative applications in our daily life [8]. One such example is the development, testing, and validation of switchable dielectric resonator antenna arrays [9].

To assess signal strength for communication service providers, a network monitor application has been used. The application will help evaluate coverage, capacity, and QoS of mobile networks. This study also emphasizes seamless handover mechanisms for continuous connectivity, reflecting the evolution from 1G to 5G networks.

2.0 Methodology

This research utilizes the Net Monitor Lite Application as shown in Figure 1 to monitor network signals and services across 2G Network: Global System for Mobile Communications (GSM), 3G Network: Universal Mobile Telecommunications System (UMTS) and 4G Network: Long-Term Evolution (LTE) networks, to collect and analyse the RSSI value [10].

Figure 1: Net monitor lite application

Net Monitor Lite offers various features, including displaying received signal strength indicator (RSSI) value in the status bar, presenting network information in notifications, storing extensive metrics in a database for offline access and providing measurement statistics. Furthermore, it enables data retrieval from the database through the integrated content provider for customized applications.

Figure 2 illustrates the research procedural flow involved in the assessment of signal strength. This research identifies six checkpoints, which are highly frequented by people and likely to experience low signal strength due to high network demand from both telecommunication companies.

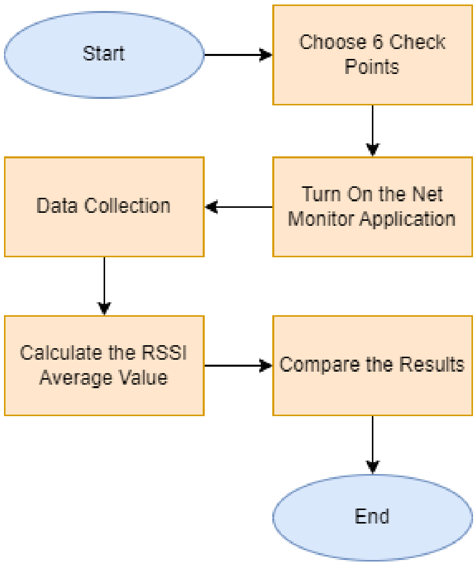

Figure 2: Research procedural flow

3.0 Results and Discussion

Drive test studies between two network providers, Telco A and Telco B, were conducted in Shah Alam, Malaysia. Net Monitor Lite Application was used to gather and observe data. The drive test was measured along the route near the Politeknik Sultan Salahuddin Abdul Aziz Shah campus, as indicated in Figure 3. It takes roughly 60 minutes to gather all the data for the journey, which ends at Giant Section 13, Shah Alam. The signal quality (dBm) and number of neighbours cells were gathered at two distinct times, morning, and evening.

3.1 Checkpoint and Coordinate Locations

Several checkpoints with specific coordinate locations in Shah Alam city were selected for drive testing for signal strength assessment. The detail information is tabulated in Table 1. These checkpoints include Politeknik Sultan Salahuddin Abdul Aziz Shah, AEON Shah Alam, Lotus Shah Alam, Masjid Sultan Salahuddin Abdul Aziz, PKNS Shah Alam, and Giant Hypermarket Section 13.

The coordinates for all locations were recorded using a cell phone and then transmitted to Google Earth. The signal strength assessment was conducted for two periods of time which includes morning and evening sessions. Figure 3 shows the Google map's view of the six selected checkpoints.

Table 1: Selected checkpoints and specific coordinate locations

No	Checkpoint	Coordinate Location
1	Politeknik Sultan Salahuddin Abdul Aziz Shah	3.0874945,101.5572224
2	AEON Shah Alam	3.0767493,101.5479766
3	Lotus Shah Alam	3.0719402,101.5386630
4	Masjid Sultan Salahuddin Abdul Aziz	3.0787324,101.5205838
5	PKNS Shah Alam	3.0706989,101.5173962
6	Giant Hypermarket Seksyen 13	3.0843403,101.5489319

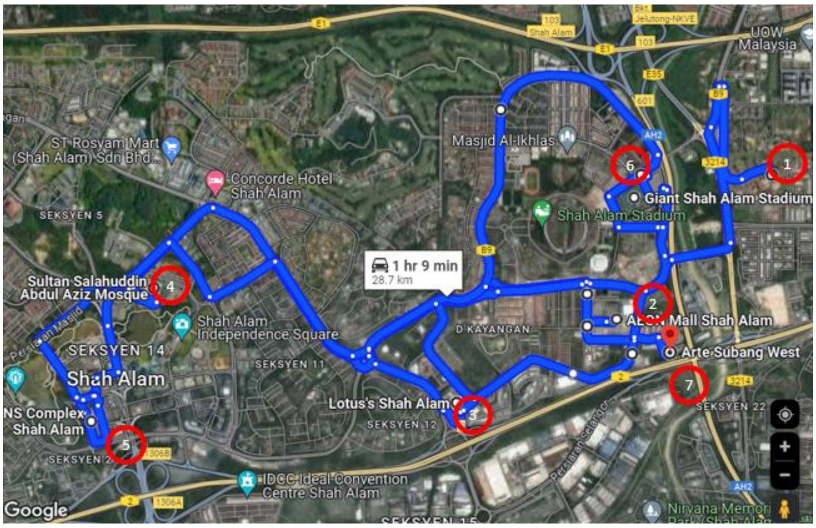

Figure 3: Selected checkpoints in Google map's view

3.2 Driving Test Measured Data: Morning

Table 2 shows the measured data obtained for Telco A and Telco B during the morning session assessment. In the morning data collection, Telco A and Telco B exhibited average signal strengths of -92.8 dBm and -92.2 dBm, respectively, in the Shah Alam region. Despite Telco A having a slightly lower average signal strength, both providers demonstrated comparable performance overall. However, Telco B displayed a more consistent signal strength across various checkpoints compared to Telco A. Figure 4 indicates the path with RSSI indication from Net Monitor Lite Application.

Table 2: Data captured for Telco A and Telco B in the morning session

Time Stamp (24 Hours)	Telco A		Telco B	
	RNC / Cell ID	Strength (dBm)	RNC / Cell ID	Strength (dBm)
CP 1 00:01:00	20441 / 102	-97	210347 / 1	-108
00:02:34	15961 / 73	-97	216237 / 11	-94
00:05:13	33481 / 102	-86	210400 / 12	-102

00:06:55	67922 / 103	-78	701822 / 10	-81
00:08:47	67922 / 103	-86	260686 / 11	-104
CP 2 00:09:41	67922 / 103	-87	260686 / 11	-104
00:10:48	20471 / 101	-101	211352 / 2	-103
00:11:09	15481 / 103	-97	211352 / 41	-91
00:12:09	20471 / 101	-103	211352 / 3	-101
00:15:08	20451 / 103	-84	701719 / 20	-89
CP 3 00:15:33	20451 / 103	-83	701719 / 20	-94
00:18:28	20611 / 101	-105	211268 / 12	-91
00:19:59	20471 / 102	-104	211268 / 12	-96
00:21:51	21061 / 102	-103	210234 / 3	-111
00:24:22	12461 / 101	-108	210381 / 83	-102
CP 4 00:25:37	12461 / 101	-104	210381 / 83	-104
00:26:13	12461 / 101	-81	211758 / 41	-97
00:28:46	20601 / 102	-85	211758 / 2	-80
00:30:11	12501 / 101	-97	211758 / 2	-91
00:31:38	12501 / 101	-93	211758 / 2	-83
CP 5 00:31:57	12501 / 101	-94	211758 / 2	-85
00:33:16	12301 / 102	-103	211758 / 3	-83
00:39:10	20611 / 101	-106	210381 / 1	-103
00:41:38	80552 / 72	-82	210210 / 181	-91
00:44:56	17491 / 101	-89	211163 / 41	-82
CP 6 00:45:36	17491 / 101	-88	211163 / 11	-91
00:47:31	33481 / 101	-86	216237 / 1	-77
00:49:57	15481 / 102	-82	210391 / 43	-76
00:51:35	15481 / 72	-91	212666 / 46	-77
00:52:11	52382 / 104	-84	212666 / 46	-75

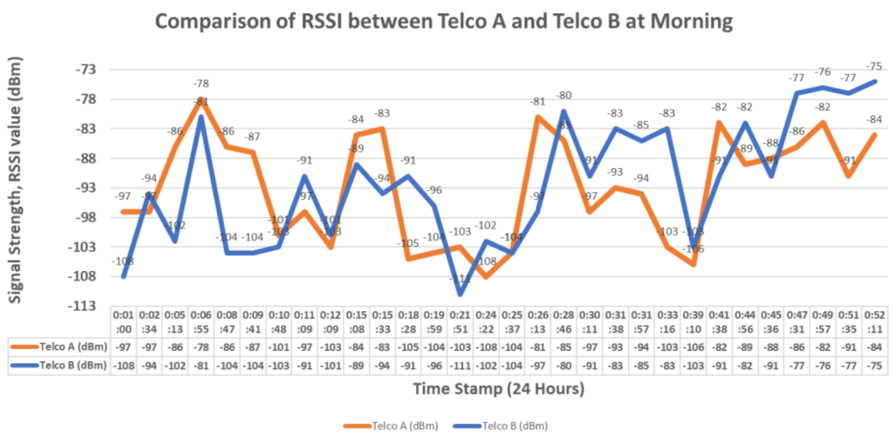

Figure 4: RSSI vs time graph (morning)

3.3 Driving Test Measured Data: Evening

The evening data collected for Telco A and Telco B networks in the Shah Alam region reveals that Telco A maintains an average signal strength of -92.2 dBm, slightly stronger than Telco B's average of -94 dBm. Despite this, Telco B demonstrates more consistent signal strengths across various checkpoints, with fewer fluctuations compared to Telco A. Tables 3 shows the data captured for Telco A and Telco B in evening session. Results indicate what was discovered in the evening for Telco A and Telco B network providers radio network controller (RNC), Cell ID, and signal strength.

Based on Table 3, Telco A displays a 0/0 results, it indicates that a 2G signal was detected during that time frame. However, this signal did not provide internet access and only allows for very low-quality calls when in that area. Figure 5 depicts a comparison of the RSSI values of Telco A and Telco B in the evening.

Table 3: Data captured for Telco A and Telco B in evening session

Time Stamp (24 Hours)	Telco A		Telco B	
	RNC / Cell ID	Strength (dBm)	RNC / Cell ID	Strength (dBm)
CP 1 13:08:05	20471 / 101	-103	210403 / 83	-98
13:09:39	41981 / 102	-94	210403 / 93	-91
13:11:04	0 / 0	-24	701748 / 30	-83
13:15:16	52382 / 101	-86	210391 / 1	-82
13:17:52	67922 / 103	-89	260686 / 11	-102
CP 2 13:18:10	67922 / 103	-89	260686 / 11	-109
13:19:36	15481 / 103	-104	211352 / 2	-110
13:21:54	67922 / 102	-94	701822 / 20	-73
13:23:33	20451 / 103	-97	211462 / 46	-101
13:24:45	20451 / 103	-82	210922 / 2	-92
CP 3 13:26:07	20451 / 103	-102	210922 / 2	-91
13:27:54	20471 / 101	-102	702049 / 30	-100
13:29:13	20611 / 201	-106	701803 / 20	-105
13:31:47	20421 / 102	-91	210234 / 3	-80
13:33:59	12461 / 101	-106	210381 / 93	-107
CP 4 13:35:02	12461 / 101	-106	210381 / 73	-110
13:36:13	12461 / 101	-88	210434 / 2	-99
13:37:57	12461 / 103	-85	210434 / 2	-85
13:38:20	20601 / 103	-80	210434 / 2	-98
13:39:56	20601 / 102	-93	211758 / 12	-88
CP 5 13:40:27	20601 / 102	-99	211758 / 12	-99
13:44:17	12461 / 101	-104	211268 / 3	-108
13:49:14	20611 / 101	-108	210381 / 1	-101
13:50:43	62932 / 202	-97	211268 / 2	-90
13:58:51	17491 / 101	-97	211163 / 71	-86
CP 6 14:00:48	17491 / 103	-98	211163 / 2	-102
14:01:57	33481 / 101	-85	216237 / 11	-81
14:03:16	15481 / 103	-83	216237 / 2	-78
14:04:07	67922 / 102	-89	210391 / 13	-97
14:05:52	52382 / 73	-85	212666 / 46	-74

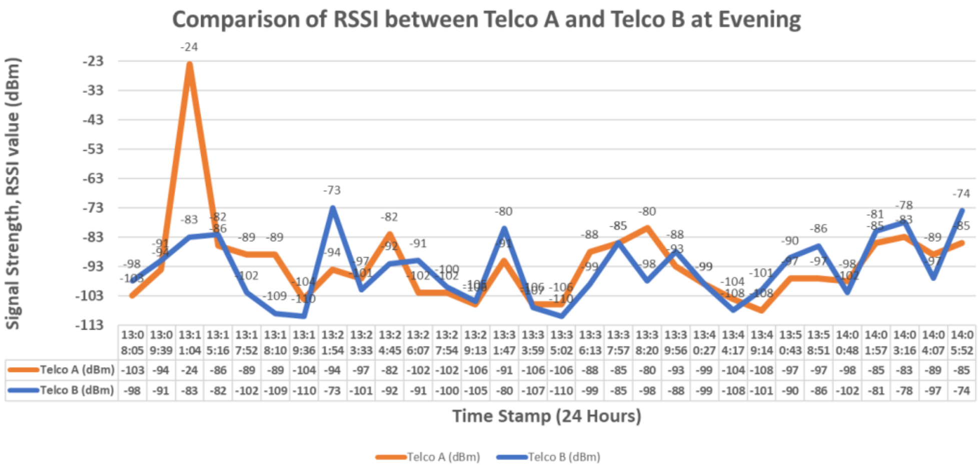

Figure 5: RSSI vs time graph (evening)

3.4 Neighbouring Cell

During the morning drive test, we noted the number of neighbouring cells for Telco A and Telco B networks at various checkpoints in Shah Alam. These findings give us valuable insights into the network layout and potential handover situations in the Shah Alam area for Telco A and Telco B networks. Table 4 shows the information about the neighbouring cell during the drive test. Neighbouring cells are cells near the serving cell, where a mobile device is currently connected. Neighbouring cells are crucial for smooth handover processes as a device moves between coverage areas. During a drive test, identifying the neighbouring cell can help to optimize handovers, planning to optimize network infrastructure, evaluate service quality, and mitigate interference. This data can help engineers with improving network coverage, enhancing user experience, and maintaining seamless connectivity [11].

Table 4: Neighbouring cell at every checkpoint for Telco A and B in morning session

Checkpoint	Telco A		Telco B	
	Current Cell (CID/PCI)	Neighbouring Cell (CID)	Current Cell (CID/PCI)	Neighbouring Cell (CID)
Politeknik Sultan Salahuddin Abdul Aziz Shah	103/371	73	11/441	1
AEON Shah Alam	103/465	101	20/464	3
Lotus Shah Alam	101/120	102	83/42	3
Masjid Sultan Salahuddin Abdul Aziz	101/61	102	2/166	41
Bangunan PKNS Shah Alam	101/132	72	41/222	1
Giant Seksyen 13	73/47	104	46/142	11

4.0 Conclusion

In conclusion, this research was able to measure and analyse the signal strength for Telco A and Telco B in the Shah Alam area using Net Monitor Lite Application by comparing the signal strength of two service providers during some selected hours. The research also studied the process of handover, identified the serving cells and the number of neighbouring cells, and determined the number of BTS involved in the surroundings. All the observations, summaries, and results attached above have been verified to be what was stated in theory. Based on the results, it was discovered that the Shah Alam region has complete 4G LTE network coverage, except for some areas near the campus, which only have 2G GSM service for Telco A. From the results obtained, it was discovered that Telco A outperforms Telco B in terms of average power received, as measured, and computed. Telco B offers superior signal quality than Telco A in the Shah Alam community.

This data informs our network deployment strategy aimed at enhancing coverage across Shah Alam, thereby facilitating current 5G network planning, and preparing for the imminent integration of 6G technology into our daily lives. This approach is grounded in empirical findings, ensuring an effective utilization of resources for optimal network performance. For future network planning, collaboration with a telecommunications provider in Malaysia is required, and data collection and observation may be done over a more extended period and in various locations over a larger region. This, when done, will allow the drive test data to be measured properly within the stated location of the Base Stations (BTS). The location where we wish to measure between checkpoints will also need to be planned well.

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Author Contributions

G. C. Wong: Conceptualization, Data Collection, Data Analysis, Writing-Original Draft Preparation; **A. Zamah Shari**: Supervision, Methodology, Software, Data Validation; **U. S. Dauda**: Writing-Reviewing, Technical Content, Proofreading.

Conflicts of Interest

The manuscript has not been published elsewhere and is not under consideration by other journals. All authors have approved the review, agree with its submission, and declare no conflict of interest in the manuscript.

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