

Malaysian Communications and Multimedia Commission Suruhanjaya Komunikasi dan Multimedia Malaysia

NETWORK PERFORMANCE REPORT 2019

MEASURING MALAYSIA BROADBAND AND VOICE PERFORMANCE

PREFACE

This report contains results of measurement conducted by the Malaysian Communication and Multimedia Commission ("MCMC") on performance of the telecommunication network in delivering broadband and voice services to consumers in Malaysia. The results obtained were from measurement and analysis conducted by the MCMC from January to December 2019.

The type of services covered in this report are wireless (mobile) broadband access service, wired (fixed) broadband access service and public cellular service (voice). Network performance parameters discussed in this report are based on the Commission Determination on the Mandatory Standards for Quality of Service (MSQoS) set forth by the MCMC for all the services mentioned above. Methods of measurements for these services are conducted in accordance to the respective guidelines.

This report is intended to provide consumers and the public with useful information with regards to the network performance of the services, which are presented in a nationwide level. The publishing of this report is also in accordance with the MCMC's effort to conduct and publish research on quality of service experienced by consumers.

The key parameters measured:

Throughput – refers to how much data can be transferred per unit of time across a network from one location to another, experienced by end user as internet speed. Higher throughput means better internet speeds.

Network Latency – refers to the Round Trip Time (RTT) of data transfers on a network, how long it takes for the data to travel to its destination. Lower latency is considered better.

Packet Loss – refers to amount of data which was sent but unable to reach its intended destination. Low packet loss indicates the network able to transfer data from the user end to the destination host with high reliability.

Call Setup Success Rate (CSSR) – refers to voice calls made by user and successfully established, allowing communication. High CSSR indicates good network accessibility.

Dropped Call Rate (DCR) – refers to voice calls made by user and successfully established but was cut off before the speaking parties able to complete the intended call or before any one of them hang up. Low DCR indicates good network retainability.

Additional information on the data:

The data collected and presented in this report concerning wireless and wired broadband only relates to throughput, network latency and packet loss. Other factors relating to the consumer experience of using broadband services (such as traffic management policies, Over-the-Top (OTT) applications, data allowances, customer service, billing etc.) are not covered in this report.

In terms of mobile broadband and voice performance, the result may varies depending on a number of factors including location of the tests, distance from the base station and time of day.

The number of users concurrently accessing a network in the same location or area can also affect service performance. Hence, the performance available to any individual consumer will vary both by time and location.

This report represents information on recorded results of the related service performances during the measurement period at the locations in which tested by the MCMC.

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1. WIRELESS BROADBAND SERVICE PERFORMANCE

Nationwide overall performance

The MCMC conducted wireless broadband access service measurement nationwide from January 2019 to November 2019. The data collected are presented at an aggregated level across Malaysia in this section. The results of each service provider's network performance against the mandatory standards requirement are detailed in this section as well.

The network performance parameters stated in the mandatory standards require each service provider must be able to provide:

- at least 1 Mbps of download throughput for at least 80% of the time;
- not more than 250 ms packet round-trip time (RTT) for at least 70% of the time; and
- packet loss of not more than 3%.

Table 1 describes the results achieved by wireless broadband service providers for the measurement conducted in 2019.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	98.10%	99.77%	0.12%	23.17 Mbps	44.50 ms
Digi	97.97%	99.07%	0.02%	25.32 Mbps	41.55 ms
Maxis	98.76%	99.78%	0.00%	32.32 Mbps	39.15 ms
U Mobile	91.67%	99.26%	0.03%	14.40 Mbps	52.56 ms
TM/Unifi Mobile	89.29%	99.47%	0.00%	11.26 Mbps	42.73 ms
YES	98.16%	98.42%	0.00%	16.24 Mbps	60.09 ms

Table 1: Network performance results for wireless broadband service – Nationwide

Based on the throughput requirement stated in the mandatory standards, all service providers were able to deliver more than 1 Mbps for more than 80% of the time. Maxis recorded the highest percentage at 98.76% of the measurement samples which able to deliver more than the required speed of 1 Mbps nationwide. The lowest percentage was recorded for Unifi Mobile at 89.29%.

The average download throughput gives an indication of how well the network able to cope with the demands of data centric users. The higher the average download throughput means consumers would be able to enjoy faster internet speeds for their favorite applications on a mobile device. Figure 1 illustrates the rank of service providers from highest to lowest in terms of average download speeds nationwide.

Meanwhile, the performance of service provider's network latency and packet loss gives an overview on the network capability to transfer data between one ends to the other. Quick response time is important for other internet activities that require minimal delay such as video calls and fast paced online gaming, and the reliability of the network to deliver packets to the intended destination are equally important for a seamless user experience. Figure 2 illustrates the average packet round-trip time (RTT) and average percentage of packet loss for all service providers nationwide.







Figure 2: Wireless broadband average packet round-trip time and packet loss – Nationwide

In summary, based on overall wireless broadband network performance measurement 2019, Maxis has once again maintained its position as the leader for wireless broadband service amongst all service providers by excelling in all criteria that includes download throughput, network latency and packet loss performance. Figure 3 describes the best performers for the relevant criteria.

Criteria	Best overall average download speed nationwide	Best peak download speed achieved	Best network latency nationwide	Lowest average packet loss nationwide
	maxis.	maxis.	maxis.	maxis.
	32.31 Mbps	140.87 Mbps	39.15 ms	0%

Figure 3: Wireless broadband best performers based on measurement – Nationwide

Regional results

This part of the report describes the aggregated measurement results of download throughput, network latency and packet loss for each state within the respective regions. The measurement focuses on areas that are well populated and expected to have moderate to high number of users. These areas include but not limited to, commercial areas, industrial areas, residential and township areas. The measurement also took samples from areas where users had complaints in regards to broadband services that are within the service providers' coverage area.

Central Region

The states covered for the measurement in central region were Wilayah Persekutuan Kuala Lumpur & Putrajaya, Selangor and Negeri Sembilan. The following figures will illustrate the outcome of the assessment for wireless broadband service performance for the respective states in terms of download throughput – higher value means faster internet speeds and network latency – lower value means quicker response time.



Figure 4: Average download speed by state in Central Region





Maxis recorded the highest average download speeds and fastest packet RTT for all states in central region. Table 2 summarizes the network performance based on the required standards in central region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	99.10%	99.73%	0.21%	30.16 Mbps	32.39 ms
Digi	97.81%	99.83%	0.01%	25.32 Mbps	28.34 ms
Maxis	99.70%	99.98%	0.00%	35.17 Mbps	24.58 ms
U Mobile	90.80%	99.38%	0.00%	13.59 Mbps	28.64 ms
TM/Unifi Mobile	94.03%	99.68%	0.00%	12.38 Mbps	32.59 ms
YES	99.39%	99.19%	0.00%	18.84 Mbps	38.32 ms

Table 2: Network performance results for wireless broadband service - Central Region

Northern Region

The states covered for the measurement in northern region were Kedah, Perlis, Perak and Pulau Pinang. The following figures show the performance for each state in northern region.





Figure 7: Average network latency by state in Northern Region



Maxis recorded the highest average download speed for all states in northern region, while Digi had the quickest average packet response time in two states i.e. Kedah and Perlis. U Mobile recorded the lowest average network latency in Perak. Table 3 summarizes the network performance in northern region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	98.91%	99.95%	0.26%	16.51 Mbps	39.02 ms
Digi	99.23%	99.56%	0.07%	21.65 Mbps	32.68 ms
Maxis	100.00%	99.99%	0.00%	29.11 Mbps	31.05 ms
U Mobile	96.02%	99.86%	0.01%	18.06 Mbps	39.39 ms
TM/Unifi Mobile	91.84%	99.44%	0.00%	11.98 Mbps	36.52 ms
YES	99.54%	97.52%	0.00%	14.91 Mbps	60.56 ms

Table 3: Network performance results for wireless broadband service - Northern Region

Eastern Region

The states covered for the measurement in eastern region were Kelantan, Terengganu and Pahang. The following figures show the performance for each state in eastern region.



Figure 8: Average download speed by state in Eastern Region





Maxis recorded the highest average download speeds in Kelantan and Pahang, while Digi had the highest average download speed in Terengganu. Maxis had the lowest network latency in all states in eastern region. Table 4 summarizes the network performance in eastern region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	98.59%	99.92%	0.00%	31.62 Mbps	38.09 ms
Digi	99.13%	99.30%	0.00%	32.86 Mbps	37.13 ms
Maxis	98.59%	99.90%	0.00%	35.91 Mbps	33.79 ms
U Mobile	85.76%	99.01%	0.00%	16.32 Mbps	52.97 ms
TM/Unifi Mobile	83.23%	99.74%	0.00%	10.01 Mbps	39.47 ms
YES	100.00%	99.09%	0.00%	16.15 Mbps	53.96 ms

Table 4: Network performance results for wireless broadband service – Eastern Region

Southern Region

Southern region measurement covered the states of Johor and Melaka. The following figures show the average download speeds and network latency for states in southern region.





Figure 11: Average network latency by state in Southern Region



In terms of average download speed in southern region, Digi recorded the highest in Johor while Maxis had the highest average download speed in Melaka. Digi had the best latency in both states of Johor and Melaka with the lowest average packet RTT. Table 5 summarizes the network performance in southern region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	95.26%	99.51%	0.01%	17.19 Mbps	50.23 ms
Digi	98.44%	99.62%	0.01%	28.47 Mbps	42.45 ms
Maxis	96.59%	99.11%	0.01%	30.55 Mbps	56.50 ms
U Mobile	84.25%	98.80%	0.00%	11.10 Mbps	54.57 ms
TM/Unifi Mobile	86.66%	99.48%	0.02%	10.92 Mbps	45.27 ms
YES	97.91%	98.82%	0.00%	18.89 Mbps	61.82 ms

Table 5: Network performance results for wireless broadband service – Southern Region

Sarawak Region

Measurements were conducted in state of Sarawak involving areas of Kuching, Kota Samarahan, Padawan, Serian, Bintulu and Miri. The following figures illustrate the average download speed and network latency performance of Sarawak.









Maxis recorded the highest average download speed and the fastest response of packet RTT in Sarawak. Table 6 summarizes the network performance in Sarawak region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	97.00%	99.52%	0.01%	13.33 Mbps	64.74 ms
Digi	96.28%	95.25%	0.02%	25.79 Mbps	76.08 ms
Maxis	96.76%	99.38%	0.00%	36.35 Mbps	54.27 ms
U Mobile	95.37%	97.79%	0.10%	10.93 Mbps	100.29 ms
TM/Unifi Mobile	94.58%	99.80%	0.00%	10.61 Mbps	61.15 ms
YES	89.49%	99.21%	0.00%	10.46 Mbps	79.54 ms

Table 6: Network performance results for wireless broadband service - Sarawak Region

Sabah Region

Measurement in the state of Sabah covered the areas of Kota Kinabalu, Kota Belud, Putatan, Telipok, Kundasang, Sandakan, Semporna and Tawau. The following figures show the average download speed and network latency in the state of Sabah.









Maxis recorded the highest average download speed in Sabah, while Digi had the quickest response in terms of packet RTT. Table 7 summarizes the network performance in Sabah region.

Service Provider	% of the time download throughput ≥ 1 Mbps	% of the time latency ≤ 250 ms	Packet loss %	Average download throughput	Average round-trip time (RTT)
Celcom	97.30%	99.77%	0.07%	19.27 Mbps	57.27 ms
Digi	95.68%	99.91%	0.00%	16.29 Mbps	50.33 ms
Maxis	98.67%	99.95%	0.01%	22.27 Mbps	52.78 ms
U Mobile	90.20%	99.02%	0.09%	14.28 Mbps	64.42 ms
TM/Unifi Mobile	87.06%	99.55%	0.00%	9.71 Mbps	54.29 ms
YES	97.78%	96.90%	0.00%	14.32 Mbps	79.86 ms

Table 7: Network performance results for wireless broadband service – Sabah Region

The average download throughput as a whole could be seen as improving, although there's a slight decrease for Maxis and YES (YTL). It must be noted that test locations may differ from previous year. Table below is the comparison of the average throughput for wireless broadband service for 2018 and 2019.

Table 8: Average download throughput comparison year on year

Service Provider	2018	2019	Difference
Celcom	19.92 Mbps	23.17 Mbps	+16.3 %
Digi	23.10 Mbps	25.32 Mbps	+9.6 %
Maxis	35.02 Mbps	32.32 Mbps	-7.7 %
U Mobile	13.10 Mbps	14.40 Mbps	+9.9 %
TM/ Unifi Mobile	9.73 Mbps	11.26 Mbps	+15.7 %
YES	17.52 Mbps	16.24 Mbps	-7.3 %

2. WIRED BROADBAND SERVICE PERFORMANCE

Nationwide overall performance

Results for wired broadband performance are illustrated by table shown below. Wired broadband measurements are segregated between two different technologies; Gigabit Passive Optical Networks (GPON) or fibre, and Digital Subscriber Line (DSL). The requirements stated in MSQoS for Wired Broadband include throughput, network latency and packet loss as follows:

- Fibre download and upload throughput must be ≥ 90% of subscribed speed for at least 90% of the time.
- DSL download and upload throughput must be ≥ 70% of subscribed speed for at least 90% of the time.
- Network latency for both DSL and fibre ping RTT must be ≤ 85 ms for at least 95% of the time and packet loss ≤ 1%.

Table 9 shows the headline result for the key metrics aggregated level across Malaysia for wired broadband access service measured from January to December 2019.

Service Provider	Fibre					DSL		
	Perce	entage of time)		Perc	entage of time	e	
	UL speed ≥ 90% subscribed speed	DL speed ≥ 90% subscribed speed	Ping RTT ≤ 85 ms	Packet loss %	UL speed ≥ 70% subscribed speed	DL speed ≥ 70% subscribed speed	Ping RTT ≤ 85 ms	Packet loss %
Maxis	93.7%	93.7%	95.4%	0.5%	39.5%	96.6%	96.6%	0.2%
Time	95.1%	95.7%	100.0%	0.0%	N/A			
ТМ	98.8%	92.2%	98.9%	0.2%	100.0%	99.9%	96.2%	1.0%

Table 9: Network performance results for wired broadband service - Nationwide

Broadband test were performed on Maxis, TIME and TM for fiber-optic technologies as a last mile. While test on copper (DSL) as a last mile only involves Maxis and TM. Table 9 above shows all service providers are able to meet the mandatory standard requirement except for Maxis. Maxis was not able to comply with the upload speed parameter for DSL connection.

The measurement conducted is based on various consumers' subscribed packages ranging from 1 Mbps to 30 Mbps for DSL and 30 Mbps to 1 Gbps for fibre.

Figure 16 below, depicts the average network latency (RTT) performance measured nationwide based on access technologies for each service provider.

Figure 16: Wired broadband average network latency – Nationwide:



Regional results

This part of the report describes the aggregated measurement results of download throughput, network latency and packet loss for each state within the respective regions. The measurement also took samples from areas where users had complaints with regards to wired broadband services. The following section shows the wired broadband service performance by states according to the respective parameters.

Central Region

Figure 17: Throughput results for fibre and DSL in Central Region











Figure 19: Packet Loss results for fibre and DSL in Central Region





Northern Region

Figure 20: Throughput results for fibre and DSL in Northern Region



	Thr	roughput DSL - Northern Region
		Download Upload
ang	TM	100.0%
u Pin	TIME	
Pula	Maxis	95.0%
	TM	
Perlis	TIME	
-	Maxis	
	TM	100.0%
Perak	TIME	
-	Maxis	
_	TM	
ƙedah	TIME	
×	Maxis	

Figure 21: Latency results for fibre and DSL in Northern Region







Figure 22: Packet Loss results for fibre and DSL in Northern Region

Southern Region

Figure 23: Throughput results for fibre and DSL in Southern Region







Figure 24: Latency results for fibre and DSL in Southern Region

Figure 25: Packet Loss results for fibre and DSL in Southern Region





Eastern Region

Figure 26: Throughput results for fibre and DSL in Eastern Region



Figure 27: Latency results for fibre and DSL in Eastern Region







Figure 28: Packet loss results for fibre and DSL in Eastern Region

Sabah and Sarawak

Figure 29: Throughput results for fibre and DSL in Sabah and Sarawak





Figure 30: Latency results for fibre and DSL in Sabah and Sarawak

Figure 31: Packet Loss results for fibre and DSL in Sabah and Sarawak



3. PUBLIC CELLULAR SERVICE PERFORMANCE

Public Cellular Service (PCS) standards focus on the quality of voice calls. Areas for PCS measurement are divided into two categories; (i) Designated routes and (ii) Nationwide route. Designated routes consist of routes within Putrajaya areas, Cyberjaya areas, MEX highway, KLIA to Subang Airport via ELITE highway and Subang Airport to Jalan Duta via NKVE highway. The Nationwide route consist of route other than the Designated route.

In accordance to Mandatory Standards, two parameters were measured for PCS which are Dropped Call Rate (DCR) and Call Setup Success Rate (CSSR). The mandatory standards state that the DCR must be **not more than 3% nationwide** and **not more than 2% for the Designated routes**. Meanwhile, the CSSR must be **not less than 95% in all areas**.

The results shown in this section are key metrics aggregated across Malaysia for PCS measured from January to December 2019.

Designated Route Result

Measurement for Designated routes were conducted on quarterly basis. Figure 32 shows the overall results for Designated routes on DCR and CSSR.

All service providers met the Mandatory Standards requirements on DCR and CSSR for Designated routes for 2019.

Figure 32: Overall result of Public Cellular Service for Designated Route Assessment



Quarterly results for DCR and CSSR on Designated routes are shown in Figure 34 and 35 below, while the test routes are shown in Figure 36, 37 and 38.



Figure 33: DCR for Designated Routes in Q1, Q2, Q3 and Q4







Figure 35: Test route for Putrajaya & Cyberjaya

Figure 36: Test route for MEX



Figure 37: Test route for KLIA – Jalan Duta



Nationwide Result

Nationwide measurement were conducted in all states once every six months. The test routes during the first half are then repeated in the second half to gauge the improvement of network performance.

Figure 39 shows the overall results for Nationwide route based on MSQoS for Public Cellular Services on Dropped Call Rate and Call Setup Success Rate.

All service providers met the Mandatory Standards requirements on Dropped Call Rate and Call Setup Success Rate Nationwide for 2019.

Figure 38: Overall result of Public Cellular Service for Nationwide Assessment dio celcor umobile Dropped Call 1.72% 1.41% 1.29% 1.73% *Rate* (≤ 3%) Call Setup 99.18% 99.44% 99.29% 98.59% Success Rate (≥ 95%)

Figure 39: DCR Nationwide for H1 and H2







Regional results

The following section shows the Dropped Call Rate and Call Setup Success Rate according to regions and states in Malaysia for first half and second half of 2019. The test routes are also included for each of the respective regions.

Central Region

Table 10: Overall results in Central Region

State	Service Provider	DCR	CSSR
Negeri	Celcom	1.07%	99.34%
	Digi	1.98%	99.22%
Sembilan	Maxis	1.33%	99.08%
	U Mobile	1.65%	98.78%
Colongon	Celcom	1.36%	99.70%
	Digi	1.50%	99.70%
Selangoi	Maxis	1.13%	99.33%
	U Mobile	1.06%	99.70%
Wilayah Persekutuan Kuala Lumpur	Celcom	0.66%	100.00%
	Digi	1.31%	100.00%
	Maxis	1.32%	99.56%
	U Mobile	0.44%	100.00%

Figure 41: DCR in Central Region



Figure 42: CSSR in Central Region





Figure 43: Test route for Negeri Sembilan

Figure 44: Test route for Selangor







Northern Region

Table 11: Overall results of Northern Region

State	Service Provider	DCR	CSSR
Ma da b	Celcom	1.31%	98.79%
	Digi	2.98%	99.42%
Redan	Maxis	2.15%	99.13%
	U Mobile	1.29%	98.24%
	Celcom	0.87%	99.18%
Dorok	Digi	1.63%	99.21%
Perak	Maxis	2.42%	98.80%
	U Mobile	1.88%	98.30%
	Celcom	0.44%	99.35%
Perlis	Digi	1.74%	99.78%
	Maxis	0.88%	99.56%
	U Mobile	1.78%	99.12%
Pulau Pinang	Celcom	0.42%	99.48%
	Digi	0.53%	99.89%
	Maxis	1.56%	99.59%
	U Mobile	0.31%	100.00%

Figure 46: DCR in Northern Region







Figure 48: Test route for Kedah



Figure 49: Test route for Perak



Figure 50: Test route for Perlis



Figure 51: Test route for Pulau Pinang



Figure 52: Test route for PLUS highway



Eastern Region

Table 12: Overall results in Eastern Region

State	Service Provider	DCR	CSSR
	Celcom	1.84%	99.01%
Kalantan	Digi	2.52%	99.63%
Kelantan	Maxis	1.71%	99.18%
	U Mobile	1.13%	99.15%
	Celcom	1.44%	99.51%
Dahang	Digi	1.95%	98.84%
Panang	Maxis	2.24%	99.48%
	U Mobile	1.81%	98.34%
Terengganu	Celcom	2.03%	99.36%
	Digi	2.59%	99.40%
	Maxis	2.43%	99.41%
	U Mobile	1.59%	97.89%





Figure 54: CSSR in Eastern Region



Figure 55: Test route for Kelantan (a)



Figure 56: Test route for Kelantan (b)



Figure 57: Test route for Pahang (a)



Figure 58: Test route for Pahang (b)



Figure 59: Test route for Terengganu (a)



Figure 60: Test route for Terengganu (b)



Figure 61: Test route for Terengganu (c)



Southern Region

Table 13: Overall results in Southern Region

State	Service Provider	DCR	CSSR
	Celcom	1.42%	97.18%
lahar	Digi	1.31%	99.32%
JOHOL	Maxis	1.43%	99.63%
	U Mobile	0.87%	99.32%
	Celcom	0.95%	99.44%
Melaka	Digi	0.56%	99.26%
	Maxis	1.31%	99.63%
	U Mobile	1.31%	99.26%

Figure 62: DCR in Southern Region



Figure 63: CSSR in Southern Region



Figure 64: Test route for Johor



Figure 65: Test route for Melaka



Sabah

Table 14: Overall results of Sabah state

State	Service Provider	DCR	CSSR
Sabah	Celcom	1.69%	99.16%
	Digi	1.20%	99.41%
	Maxis	1.50%	98.65%
	U Mobile	1.80%	97.00%

Figure 66: DCR in Sabah



Figure 67: CSSR in Sabah



Figure 68: Test route for Sabah (a)



Figure 69: Test route for Sabah (b)



Figure 70: Test route for Sabah (c)



Figure 71: Test route for Sabah (d)



Sarawak

Table 15: Overall results of Sarawak state

State	Service Provider	DCR	CSSR
Sarawak	Celcom	0.70%	99.91%
	Digi	0.60%	99.91%
	Maxis	0.80%	99.86%
	U Mobile	1.46%	98.98%

Figure 72: DCR of Sarawak state



Figure 73: CSSR of Sarawak state



Figure 74: Test route Sarawak (a)



Figure 75: Test route for Sarawak (b)



Figure 76: Test route for Sarawak (c)



Figure 77: Test route for Sarawak (d)



4. SUMMARY

Wireless Broadband Service Overall Performance

All wireless broadband service providers were able to maintain the consistency of achieving more that the mandated standards in terms of network performance quality of service. It is important for service providers to be able to meet the baseline of download throughput, network latency and packet loss as required to ensure end-users are able to enjoy a quality wireless broadband experience.

Maxis once again maintained its position as the best wireless broadband service provider based on the measurement conducted in 2019. Maxis recorded the highest average download throughput and the lowest network latency in most of the states in Malaysia. With low packet loss percentage recorded for all service providers, this gives an overview that the network is reliable in delivering data from one end to the other.

Peak download throughput of more than 100 Mbps could be observed in some parts of the measurement locations. The high peak download throughput is achieved in LTE-Advanced coverage areas. Service providers' continuous effort and investment in expanding the network to deliver LTE-Advanced and beyond is beneficial in the long run for consumers in general as it will greatly improve the download throughput for end-users to experience with their compatible smartphones.

Wired Broadband Service Overall Performance

Overall results have shown improvements for wired broadband service performance across all service providers. TM has successfully complied with all parameters required by the Mandatory Standards. As compared to 2016, where TM failed to comply with 5 parameters and subsequently 3 parameters in 2017. In 2018, TM failed to comply with one parameter only. Over the years, TM has exhibited substantial improvements in enhancing the quality of the internet nationwide.

TIME has consistently complied with all mandatory standards parameters since 2016. For 2019, TIME has shown the highest overall percentage of download speed for fibre, in achieving more than 90% of the subscribers' subscription package. TIME also managed to achieve on average the lowest network latency for fibre technology.

Within the past 4 years, Maxis has failed to comply with the Mandatory Standards twice. In 2017, Maxis failed the DSL latency standard and now in 2019, the DSL upload speed. Based on the measurements, it was discovered that the main reason for Maxis' upload speed failure was due to the user's profile setting, which was not configured as per subscribers' subscribed speed. Therefore, Maxis should be aware of their customers' profile configuration and packages subscribed.

Public Cellular Service Overall Performance

All service providers are able to meet the Mandatory Standards of Call Setup Success Rate and Dropped Call Rate for both Nationwide route and Designated route.

All Service providers showed commendable performance in providing voice call services to the subscriber based on overall results. Service providers recorded a Dropped Call Rate between 0.63% - 1.72% in Designated routes and 1.29% - 1.73% in Nationwide route. Meanwhile for Call Setup Success Rate all service providers were able to achieve more than 98% of call connectivity.

Maxis had the lowest DCR in Designated routes, while Celcom recorded the lowest DCR nationwide. For CSSR, all operator shared the same CSSR result with 99.63% in Designated route. For Nationwide route, Digi recorded the best CSSR with 99.44%.

Based on MCMC's measurements, some of the issues found causing the Call Dropped and Call Setup Failure were:

- Poor coverage and signal quality due to blocking.
- Overshooting cell.
- Uplink interference.
- Frequency overlapping.
- Handover issue.
- 3rd party outage (due to fiber cut, power failure etc).

Overall Performance

All operators met the Mandatory Standards for Quality of Service (MSQoS) for 2019 with the exception of Maxis for one parameter on Wired Broadband Access Service which is upload throughput.

Several wireless broadband service providers have re-farmed or in the middle of re-farming part of their 2G and 3G frequency bands to be utilized for LTE. Upgrades on existing LTE network is also underway to support LTE-Advanced which could provide higher throughput, provided the user equipment does support the upgrades.

Although the demands for broadband service are the focus at the moment, PCS standards or voice calls, are measured as there are still quite a number of users who are relying on 2G or 2G/3G only phones for voice calls and do not own smartphones.

In terms of wired broadband technology, fibre broadband is considered to be more reliable compared to DSL broadband. In order for home users to fully utilize the fibre access network, the router needs to have similar or higher capability as the fibre internet package.