QOS STANDARDS FOR 3G PUBLIC CELLULAR MOBILE TELEPHONE SERVICE (with effect from 1 April 2012)

This is applicable to **Facilities-Based Operators ("FBOs") providing 3G Public Cellular Mobile Telephone Service ("PCMTS").** Please note that all FBOs providing 3G PCMTS will be required to submit to IMDA their QoS performance for the "Compliance Indicators" and "Monitoring Indicators" as set out below, on a quarterly basis. For consistency, IMDA will apply the same QoS standards for the 3G PCMTS performance survey conducted by IMDA.

(A)	Performance Indicators (for Compliance[1])	QoS Standards	With Effect From
(1)	**Service coverage**[2]		
(a)	Nation-wide outdoor coverage[3]	>99% coverage with signal strength of -100dBm or better (average across all outdoor space)	1 April 2012

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[1] For each instance of non-compliance, a financial penalty of up to S$50,000 may be imposed for each standard.

[2] The service coverage will be computed as follows:

$$\frac{Total\ number\ of\ sample\ test\ signal\ strength\ with -100\ dBm\ or\ better}{Total\ number\ of\ sample\ test\ signal\ strengths}\ x\ 100\%$$

FBOs may include measurements obtained from spectrum bands used to provide 3G mobile services.

[3] The nation-wide outdoor service coverage shall be tested with a minimum total sample of 100,000 test signal strength readings every month. FBOs' test routes should include all major and small roads and expressways, including parks and open spaces that are reasonably accessible by foot or vehicle.

FBOs shall take any complaint from end users seriously, and follow up to investigate each complaint and make reasonable efforts to improve service coverage for their end users.

(A)	Performance Indicators (for Compliance[1])	QoS Standards	With Effect From
(b)	In-building coverage[4]	>85% coverage with signal strength of -100dBm or better in each building[5]	1 April 2013[6]
(c)	Tunnels coverage	All new road and MRT tunnels shall have >99% coverage with signal	1 April 2012, except for the Central Expressway which will take effect from 1 January 2015

[4] Areas which are optional to be included in the in-building service coverage indicator: bomb shelters, storerooms, toilets within an individual's premises, lifts, plant rooms, M&E rooms, lift motor rooms, lift houses, water tank areas, warehouses, ventilation facilities, vaults, in-building carparks located at second level basement and below, all in-home basements of private landed residential properties, mechanical and plant facilities/rooms and emergency stairways. IMDA will leave it to FBOs to commercially negotiate in good faith with building owners for coverage at these areas.

FBOs shall take any complaint from end users seriously, and follow up to investigate each complaint and make reasonable efforts to improve service coverage for their end users in a timely manner. IMDA generally expects each complaint to be resolved within six months from the time of the complaint.

[5] For assessment of compliance, 100% of the buildings tested per month shall have >85% coverage with signal strength of -100dBm or better in each building. To be clear, even though the standard is >85% coverage for each building, it is unacceptable for an entire unit to fall within the 15% uncovered areas within a building such that it has absolutely no coverage.

FBOs may seek IMDA's approval to exempt an entire building (including single-tenanted buildings) from the QoS framework on a case-by-case basis if: (i) the building owners refuse to grant access for the FBOs to take mobile coverage measurements or install their equipment; (ii) the building owners reject the FBOs' proposal to enhance mobile coverage; (iii) the building is vacated or marked to be demolished; (iv) FBOs have yet to be allowed to deploy base stations at HDB blocks; (v) FBOs can show that building owners' requests are unreasonable; or (vi) FBOs can show that there are constraints that render further measures to improve service coverage technically infeasible.

For in-unit service coverage, FBOs will be relieved from the requirement to improve service coverage if: (i) the individual unit owner denies access or rejects all FBOs' proposals to enhance in-unit service coverage; or (ii) the individual unit rejects the installation of equipment within the units to improve in-unit coverage.

[6] Prior to 1 April 2013, the FBOs shall have >85% coverage with signal strength of -100dBm or better for public access areas. Public access areas refer to areas that are generally accessible to the public without any restriction. For the purpose of in-building radio coverage, the public access areas within a building are classified into three categories:

(a) Main Lobby Area
(b) High Traffic Area
    (i) Podium floors of tower building;
    (ii) Multi-storey car parks (above level ground); and
    (iii) Basement levels where services are made available to the public (e.g. shops, food courts, supermarkets)]
(c) Basement Car Park Area (refers to car parks at basement level 1 where the above (b)(iii) does not apply)

(A)	Performance Indicators (for Compliance[1])	QoS Standards	With Effect From
		strength of -100dBm or better in each tunnel[7]; All existing road and MRT tunnels shall have >95% coverage with signal strength of -100dBm or better in each tunnel[8]	
(2)	**Success rate for PSTN/mobile originated calls during busy hour ("Success Rate")[9]**		
(a)	Average monthly success rate across all cell localities[10]	>99%	1 April 2012
(b)	Average monthly success rate in the busiest cell locality[11]	>95%	
(c)	Average monthly success rate for each cell locality	>70%	

[7] All road and MRT tunnels in Singapore include any upcoming, new road and MRT tunnels, regardless of the length of the tunnels.

[8] For existing tunnels, the revised QoS standard of >99% will be used as a monitoring standard. If the service coverage falls below 99% for any existing tunnel after 1 April 2012, IMDA will not impose financial penalties but reserves the right to require the FBOs to initiate a review of their tunnel infrastructure and assess the need to fine-tune the networks, or begin to plan for upgrading works to move towards a revised standard of >99% within a reasonable timeframe.

[9] A successful call attempt refers to a call from a calling party who is successfully switched through to the called party, or receives busy tone when the called party is engaged speaking.

[10] Average monthly success rate across all cell localities will be computed as follows:

$$\frac{Total\ number\ of\ successful\ calls\ established\ during\ daily\ network\ busy\ hour\ across\ all\ cell\ localities\ for\ the\ entire\ month}{Total\ number\ of\ call\ attempts\ during\ daily\ network\ busy\ hour\ across\ all\ cell\ localities\ for\ the\ entire\ month}\ x\ 100\%$$

[11] Average monthly success rate in the busiest cell locality, where the busiest cell refers to the cell with the highest volume of traffic in the network, will be computed as follows:

$$\frac{Total\ number\ of\ successful\ calls\ established\ during\ daily\ network\ busy\ hour\ for\ the\ busiest\ cell\ locality\ for\ the\ entire\ month}{Total\ number\ of\ call\ attempts\ during\ daily\ network\ busy\ hour\ for\ the\ busiest\ cell\ locality\ for\ the\ entire\ month}\ x\ 100\%$$

(A)	Performance Indicators (for Compliance[1])	QoS Standards	With Effect From
(3)	**Drop call rate of PSTN and mobile originated calls ("Drop Call Rate")**[12]		
(a)	Average monthly drop call rate across the entire month[13]	<1%	1 April 2012
(b)	Average monthly drop call rate during busy hour[14]	<2%	
(c)	Average monthly drop call rate during hour with worst performance[15]	<2%	

[12] The drop call rate refers to the percentage of actual calls originated from the PSTN and mobile phones that are terminated abnormally. This include calls that failed due to: (a) mobile subscribers moving into poor cell coverage areas; (b) subscribers moving into cells that are experiencing congestion; or (c) calls that are not properly terminated.

[13] Average monthly drop call rate across the entire month will be computed as follows:

$$\frac{Total\ number\ of\ failed\ calls\ registered\ by\ the\ radio\ network\ for\ the\ entire\ month}{Total\ number\ of\ successful\ call\ attempts\ made\ for\ the\ entire\ month}\ x\ 100\%$$

[14] Average monthly drop call rate during busy hour will be computed as follows:

$$\frac{Total\ number\ of\ failed\ calls\ registered\ by\ the\ radio\ network\ during\ daily\ network\ busy\ hour\ for\ the\ entire\ month}{Total\ number\ of\ successful\ call\ attempts\ during\ daily\ network\ busy\ hour\ for\ the\ entire\ month}\ x\ 100\%$$

[15] If the busy hour is not the hour with worst performance, the performance for both during busy hour and the hour with worst performance should be reported. Average monthly drop call rate during busy hour or hour with worst performance will be computed as follows:

$$\frac{Total\ number\ of\ failed\ calls\ registered\ by\ the\ radio\ network\ during\ hour\ with\ worst\ performance\ for\ the\ entire\ month}{Total\ number\ of\ successful\ call\ attempts\ during\ hour\ with\ worst\ performance\ for\ the\ entire\ month}\ x\ 100\%$$

(B)	Performance Indicators (for Monitoring)	QoS standards
(1)	**Network Availability**[16]	For monitoring
	Base Stations (BS)	
	Mobile Switching Centre (MSC)	
(a)	Total outage time (hrs/min) in a month	
(b)	No. of day with >15min outage	
(c)	Worst outage time over 24hr period in a month	
(2)	**Network Congestion During Busy Hour**[17]	For monitoring
(a)	Total number of base stations/cells as at end period	
(b)	% of network congestion for the busiest cell during busy hour	
(c)	% of cells with >5% reduced GOS during busy hour	
(3)	**Average Call Set-up Time for**[18]	For monitoring
(a)	Land to mobile calls	
(b)	Mobile to land calls	
(c)	Mobile to mobile calls	
(4)	**Complaints on coverage per 1000 subscribers**	For monitoring

Note: The "busy hour" refers to the one-hour of the day with the highest traffic Erlang based on 24-hour daily measurement, for the whole month including weekends and public holidays.

[16] Network availability is a measure of the degree to which the BSs/MSCs are operable and not in a state of failure or outage at any given point of time. It measures the downtime of the BS and the MSC over a month but excludes all planned service downtime for any maintenance or software upgrades.

[17] The acceptable congestion level experienced within the network should be such that not more than 5% of cells should be experiencing > 5% reduced GoS during busy hour and/or at any one time.

[18] The average call set-up time refers to the total time taken for setting up a call, i.e., from the time when the last key is depressed to the time when a tone or signal from the network for successful connection. The call set-up time shall include all time taken for encryption and authentication features, but shall exclude additional delay caused by any call forwarding features.