Quality of Service Framework for Retail Fixed-Line Broadband Internet Access Services (Fibre Broadband Services)

This QoS framework is applicable to Broadband Access Service Providers (BASPs) providing fibre broadband services to residential and/or business end-users, and who have **a market share of 10% or more** in the fixed-line residential or business fibre broadband markets.

- Affected BASPs who offer higher or equivalent Service Level Agreements or Guarantees to their end users can request for an exemption from complying with the QoS framework. A BASP can also request for an exemption if it can demonstrate that its end users have agreed to accept a lower QoS standard.
- Where the BASP is not subject to IMDA's minimum quality of service standards or is exempted from compliance, the BASP has the responsibility to inform the end user of the service level it will be providing and the fact that it does not comply with IMDA's minimum quality of service standards.

(A)	Performance Indicators (For Compliance[1])	QoS Standards
(1)	**Network Availlability**[2]	> 99.9%
(2)	**Network Latency**[3] **(for round-trip) [see *]** In cases where more than one network latency figure is available for either the local or international network, BASPs must also submit one weighted average network latency figure for the relevant segment of the broadband network.	
(a)	Local Network Latency	≤ 30 msec
(b)	International Network Latency	≤ 300 msec
(3)	**Local Bandwidth Utilisation**[4] **[see *]** For any one segment of the broadband network with more than 1 link, the BASP will be required to monitor the bandwidth utilisation for each individual link in that segment, and submit the bandwidth utilisation figures for the individual links that exceed 80%. In addition, in these cases, the BASP must also submit one weighted average peak bandwidth utilisation figure for the relevant segment of the broadband network. [see Appendix 1]	≤ 90% [not to exceed 90% for 3 or more consecutive months]
	Segment between B'-C'	
	Segment between D'-E'	
(B)	**Performance Indicators (For Monitoring)**	**IMDA's Comment**
(4) (a) (b)	**Packet Loss**[5] **[see *]** Local Packet Loss International Packet Loss	For Monitoring
(B)	**Performance Indicators (For Monitoring)**	**IMDA's Comment**

(5)	**International Bandwidth Utilisation** [only for Internet Exchange Service Providers (IXSP) to provide on the behalf of BASPs]	For Monitoring
(6)	**Service Activation Time**[6] % of service accounts activated within 3 working days after a working fibre connection has been provisioned to the BASP by its upstream provider or on date agreed/specified by the customers	

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Frequency of Measurement: BASPs are required to make "Test Calls" at 5-minute intervals during the 4 busiest consecutive hours for fixed-line broadband Internet usage everyday. The "busiest hours" (or "peak hours") refer to the 4 busiest consecutive hours of a working week, excluding Saturdays, Sundays and public holidays. BASPs must inform IMDA of their 4 consecutive busiest hours when submitting their first QoS report – IMDA reserves the right to review the 4 busiest consecutive hours to determine if they should be changed, based on the MRTG Graphs and any other supporting documents.

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[1] For each instance of non-compliance, a financial penalty of up to S$50,000 per standard per month may be imposed. IMDA reserves the right to increase the quantum of the financial penalty for serious or continual breaches.

[2] Network Availability is the measure of the degree to which the network is operable and not in a state of failure or outage at any point of time. It measures the total downtime of the network, including the Optical Line Termination (OLT), multiplexers, routers, e-mail facilities (if provided) and connection to Internet Exchanges and/or Internet backbone over a month. All scheduled downtime for the purposes of maintenance and upgrading of the network system will be excluded from the calculation. However, all BASPs must keep their users informed of such maintenance times. Please note that reported downtime should include any downtime caused by upstream service providers.

$$\text{Network Availability} = \frac{(\text{Total operational minutes} - \text{Total minutes of service downtime})}{\text{Total operational minutes}} \times 100\%$$

[3] To measure latency, BASPs are required to send PING packets during each Test Call. For the avoidance of doubt, PING packets are ICMP echo requests, which are 32 bytes in size for MS DOS and 56 data bytes for UNIX/MAC. Local latency measures the round-trip time for test packets to travel between the test clients in Singapore and the BASP's test node(s) in its local Point-of-Presence ("PoP") i.e., from Point A' to Point E' of Appendix 1. International latency measures the round-trip time for test packets to travel between the test clients in Singapore and the BASP's test node(s) in its first US PoP i.e., from Point A' to Point G' of Appendix 1. The data for each month must be arranged in an ascending order and the 95th-percentile reading must be taken. The measurement, in "y msec", represents the maximum latency (for round-trip) experienced by end-users for 95% of the time during peak hours and the measurements should be less than 30ms and 300ms for the local and international latency tests respectively in order to meet IMDA's QoS standard.

[4] BASPs are to provide the Highest Bandwidth Utilisation, where Highest Bandwidth Utilisation = (peak utilisation level in each segment) / (total bandwidth available for that segment). BASPs are required to run "Daily" MRTG Graphs at 5 minute average during peak hours. The highest bandwidth utilisation is the peak utilisation level in each segment over the total bandwidth available for that segment (as shown in Appendix 1) for each month. BASPs are required to run "Monthly" MRTG Graphs to obtain average bandwidth utilisation for each month for every segment. The Monthly Graphs are to be submitted to IMDA. BASPs should closely monitor their links when the loading level exceeds 80%. However, BASPs will only be required by IMDA to purchase additional bandwidth if the bandwidth utilisation of the terrestrial links exceeds the 90% loading level for a period of at least 3 months and if there is no better alternative plan to maintain the QoS. Should a BASP have more than one link within one segment of the broadband network, it will be required to monitor the bandwidth utilisation for each individual link in that segment, and submit the bandwidth utilisation figures for the individual links that exceed 80%. For example, if a BASP has 3 separate links to its IXs (i.e. 3 separate links within the D'-E' segment), it should submit separate bandwidth utilisation returns for each of the 3 links, if the bandwidth utilisation figures for each of the 3 separate links exceed 80%. In addition, in these cases where the BASP has more than one link within

one segment of the broadband network, the BASP must also submit one weighted average peak bandwidth utilisation figure for the relevant segment of the broadband network. For instance, in the above example, the BASP must also submit one weighted average peak bandwidth utilisation figure for the D'-E' segment, taking into account the peak bandwidth utilisation of each of its 3 separate links to its IXs. The above requirements will also apply to BASPs' submission for International Bandwidth Utilisation. The weights are given by the maximum activated bandwidth of each link as a percentage of the total maximum activated bandwidth of all the links in the same segment.

[5] To measure packet loss, BASPs will be required to send PING packets to its test nodes located in its local PoP (i.e., from Point A' to Point E' in Appendix 1) and its first U.S. PoP (i.e, from Point A' to Point G' in Appendix 1) during each Test Call. For the avoidance of doubt, PING packets are ICMP echo requests, which are 32 bytes in size for MS DOS and 56 data bytes for UNIX/MAC. If a response is not received within two seconds from the time the packet is sent, the packet is considered lost. The daily packet loss during the "busiest hours" is computed as follows:

$$\frac{Number\ of\ packets\ lost\ that\ day}{Total\ number of\ packets\ sent\ that\ day}$$

The packet loss for each month is calculated by arranging the daily packet loss values in an ascending order and taking the 95th percentile reading. The measurement, in "y %", represents the maximum packet loss experienced by end-users for 95% of the time during peak hours.

[6] Service Activation Time should be computed from the date a working fibre connection is provisioned to the BASP by its upstream provider. The computation of this indicator should be based on the orders submitted in a particular month, even though the order may be fulfilled by the BASP in a different month. For example, an order submitted in January but fulfilled by the BASP in February will be considered as a January order. If the BASP is relying on the upstream provider's fibre to provision an order, the Service Activation Time will start once the BASP's upstream provider, such as NetLink Trust, hands over a working fibre connection to the BASP. Should a BASP deploy its own fibre connections, the service activation time can be measured based on the BASP's ability to provision the service orders on the date agreed with / specified by the end-user. For the avoidance of doubt, if the BASP is also relying on an Operating Company, such as Nucleus Connect Pte Ltd, the Service Activation Time includes the time taken by the Operating Company to provision a working service to the BASP.

Fibre Broadband Network Topology

ONT

A'

OLT

Fibre broadband network

B'   <90% loading

Local Network latency:
<30ms
Local Packet loss:
For Monitoring

International Network latency:
<300ms
International Packet Loss:
For Monitoring

C'

BASP

D'
E'   <90% loading

Local IX

International Hops

F'

G'

Overseas PoP

Local Bandwidth Utilisation: Point B' to Point C'
Point D' to Point E'

Intl Bandwidth Utilisation: Point F' to G'