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# BROADBAND QUALITY OF SERVICE EXPERIENCE (QoSE) INDICATORS<sub>i</sub>

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**Q3 2010**  
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## 1 Introduction

Price is not the only dimension that interests broadband users and regulators. Quality of Service Experience (QoSE) is integrally connected to price: an increase in quality is an invisible decrease in price and vice versa.

Broadband quality can be evaluated through speed tests. Test sites provide a variety of information about the speed of a link. Careful design and implementation of tests can shed light on the exact segment where inadequate capacity constrains speed. Carefully implemented tests can also be the basis for Service Level Agreements (SLAs) between operators and users and for regulatory action.

In the present tests, the methodology has been developed in collaboration with a team headed by Professor Timothy Gonsalves of IIT Madras. The following dimensions of quality have been measured for two packages of two operators in Bangladesh (Dhaka), two packages from two operators in Bhutan (Thimphu), eight packages of three operators in India (Bangalore, Chennai, Mumbai and New Delhi), and three packages of three networks in Sri Lanka (Colombo) from South Asia. From South East Asia, two packages from two operators in Indonesia (Jakarta), two packages from two operators in Philippines and four packages from four operators in Thailand (Bangkok and Chiang Mai) have been put to the test.

## 2 Dimensions of QoS

<b>Throughput (Kbps)</b>	<p>Referred to as the “actual amount of useful data sent on a transmission”<sup>ii</sup>. <b>Defined by the ITU as “an amount of user information transferred in a period of time” (ITU-T X.641 (97), 6.3.3.16)</b>, more commonly referred to as download or upload speeds.</p> <p>A key advertised metric in broadband services is the download speed. It defines how much information a user can receive from a local or international server. Upload speed defines the speed at which the user can send information to local or international servers. It plays a significant role in responsiveness and real-time applications like VoIP (Voice over Internet Protocol).</p> <p>Throughput, or download and upload speeds, varies depending on the location of the server that holds the content. If the location is local, such as an ISP server, the throughput may be higher than it would be if the location is international.</p> <p>Therefore the testing has included throughput for both local (ISP) and international (yahoo.com) servers.</p>
<b>Latency (ms)</b>	<p>Referred to as “delays when voice packets transverse the network”<sup>iii</sup>. It is measured in milliseconds by using the Round Trip Time (RTT). This is significant in systems that require two-way interactive communication, such as voice telephony or in systems that use Transmission Control Protocol (TCP) where the RTT directly affects the throughput rate. .</p> <p>Latency less than 300 ms is considered acceptable in this report</p> <p><b>The ITU definition states that “Latency means transmission delay for FEC (Forwarding Equivalence Class) encoding, decoding, interleaving and de-interleaving” (ITU-T G.972 (04), 3025).</b></p>
<b>Jitter (ms)</b>	<p>Referred to as “uneven latency and packet loss”<sup>iv</sup>. It is the variation of end-to-end delay from one packet to the next within the same packet stream/connection/flow. Jitter is more relevant for real-time traffic like VoIP.</p> <p>E.g. Radio quality voice requires less than 1 ms Jitter, toll-quality voice requires less than 20 ms jitter and normal VoIP requires jitter to be less than 30 ms. Beyond 30 ms, the performance of VoIP will degrade.<sup>v</sup></p> <p>In this report we consider jitter less than 50ms as acceptable.</p> <p><b>Also defined by ITU as “Short-term non-cumulative variations of the significant instants of a digital signal from their ideal positions in time” (ITU-T G.701 (93), 2024).</b></p>

<b>Packet Loss (%)</b>	<p>Referred to as the number of packets (as a percentage) that does not reach the destination. Degradation can result in noticeable performance loss with streaming technologies, VoIP and video conferencing.</p> <p>Packet loss less than 3% is considered good in this report.</p> <p><b>ITU states that “in general, IP-based networks do not guarantee delivery of packets. Packets will be dropped under peak loads and during periods of congestion. NOTE – in case of multimedia services, when a late packet finally arrives, it will be considered lost” (ITU-T H.360 (04), 5.3.2.2).</b></p>
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### 3 Results of QoSE testing<sup>vi</sup>

#### Fixed Broadband

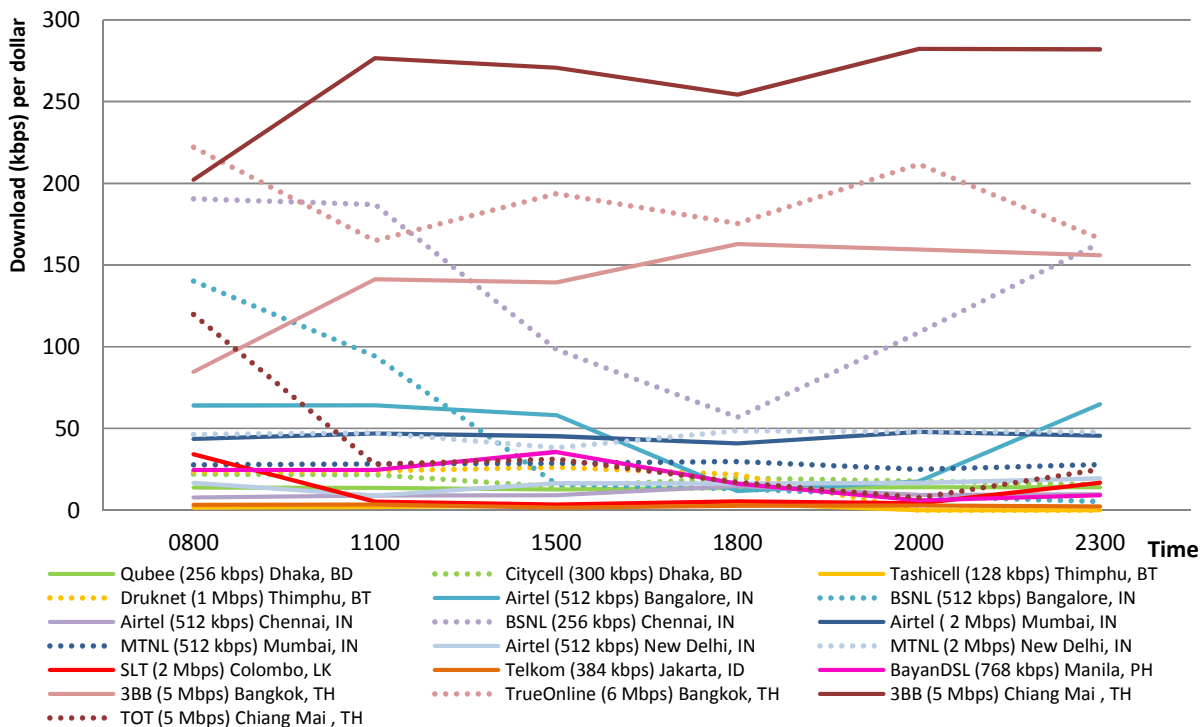
##### Packages and colour keys

Type	Region	Country	City	Provider	Label	Advertised Speed (kbps)	Price in USD
Fixed line	South Asia	Bangladesh	Dhaka	SkyBD	Qubee (256 kbps) Dhaka, BD	256	18.1554
			Dhaka	CityCell	Citycell (300 kbps) Dhaka, BD	300	12.3457
		Bhutan	Thimphu	Tashicell	Tashicell (128 kbps) Thimphu, BT	128	67.5157
			Thimphu	Druknet	Druknet (1 Mbps) Thimphu, BT	1000	48.605
		India	Bangalore	Airtel	Airtel (512 kbps) Bangalore, IN	512	20.239
			Bangalore	BSNL	BSNL (512 kbps) Bangalore, IN	512	16.8846
			Chennai	Airtel	Airtel (512 kbps) Chennai, IN	512	17.9877
			Chennai	BSNL	BSNL (256 kbps) Chennai, IN	256	5.62818
			Mumbai	Airtel	Airtel ( 2 Mbps) Mumbai, IN	2000	6.73131
			Mumbai	MTNL	MTNL (512 kbps) Mumbai, IN	512	13.4851
			New Delhi	Airtel	Airtel (512 kbps) New Delhi, IN	512	20.239
			New Delhi	MTNL	MTNL (2 Mbps) New Delhi, IN	2000	8.98258
		Sri Lanka	Colombo	SLT	SLT (2 Mbps) Colombo, LK	2000	49.284
		South East Asia	Indonesia	Jakarta	Telkom	Telkom (384 kbps) Jakarta, ID	384
	Philippines		Manila	BayanDSL	BayanDSL (768 kbps) Manila, PH	768	20.7529
	Thailand		Bangkok	3BB	3BB (5 Mbps) Bangkok, TH	7000	30.2372
			Bangkok	TrueOnline	TrueOnline (6 Mbps) Bangkok, TH	8000	30.2372
Chiang Mai			3BB	3BB (5 Mbps) Chiang Mai , TH	5000	19.8442	
Chiang Mai			TOT	TOT (5 Mbps) Chiang Mai , TH	6000	19.8442	

Note: The two packages in Bhutan were tested at 0800, 1100, 1500 and 1800 hours only. All other packages were tested at six time slots – 0800, 1100, 1500, 1800, 2000 and 2300 hours.

### 3.1 Fixed Broadband – Throughput (kbps)<sup>vii</sup>

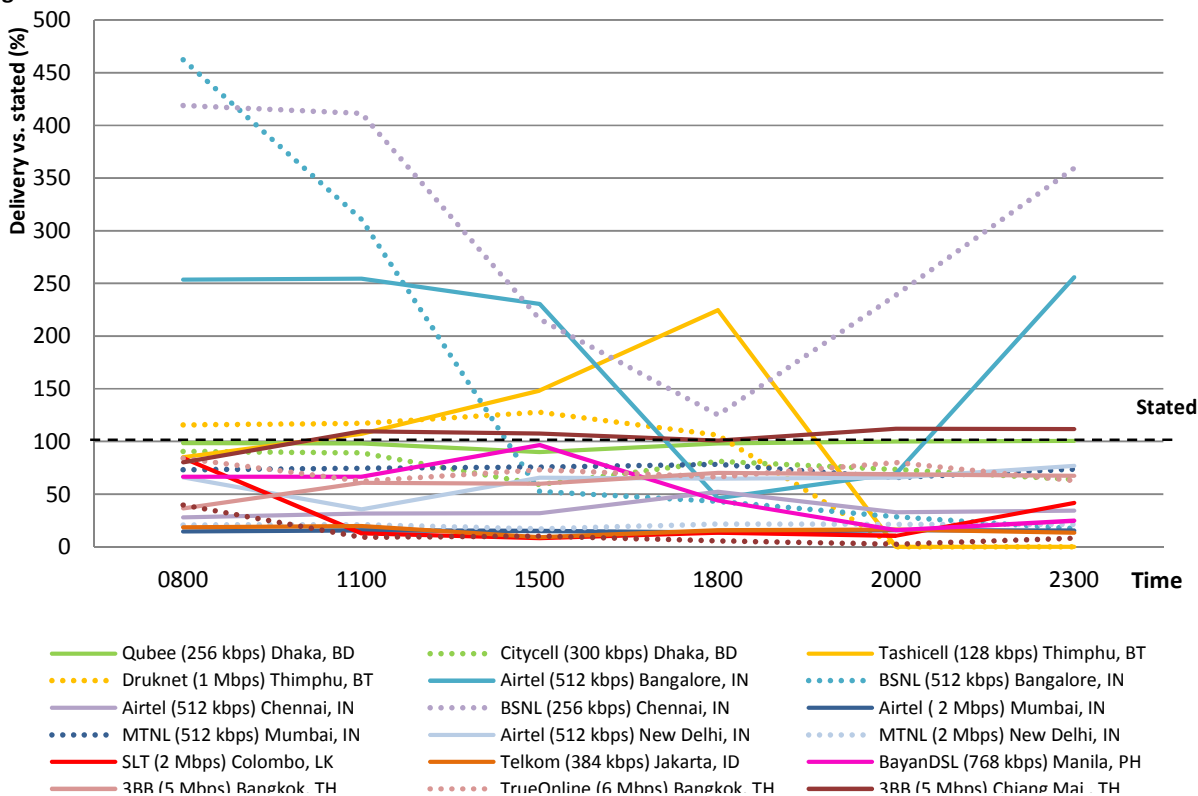
Figure 1 - Download from an International server - kbps per dollar



www.iirneasia.net

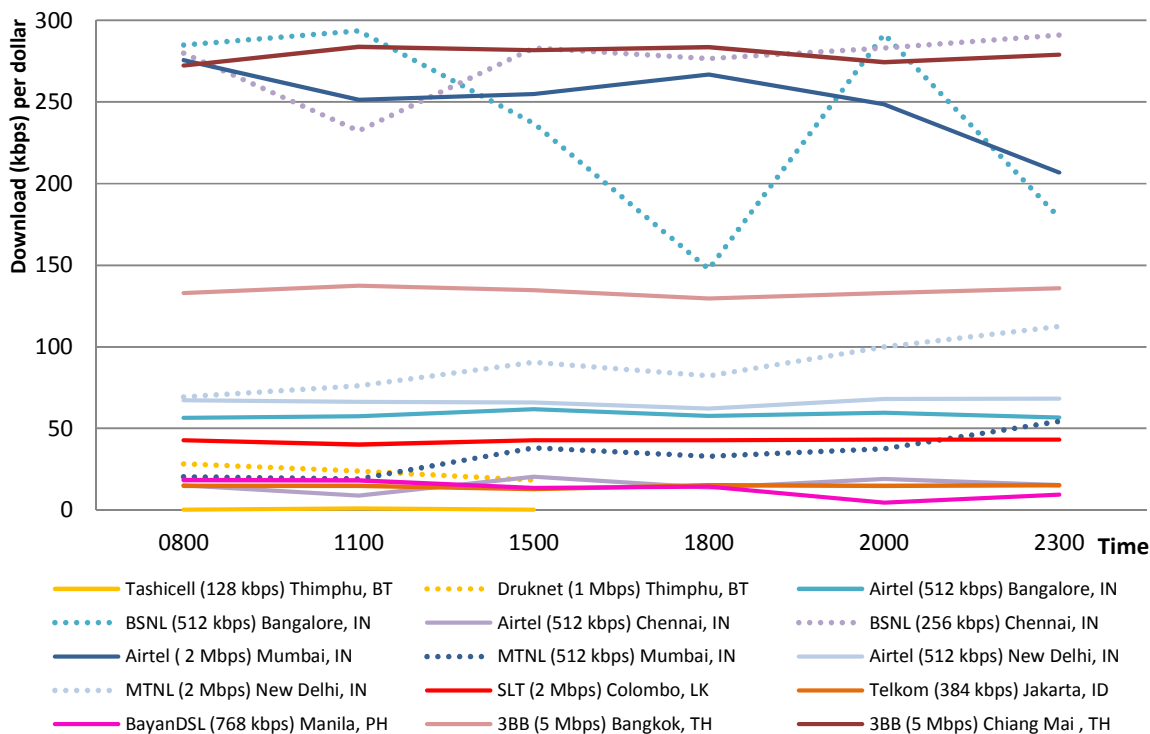
NB: See annex for data

Figure 2 - Download from an International server –Delivered vs. Stated



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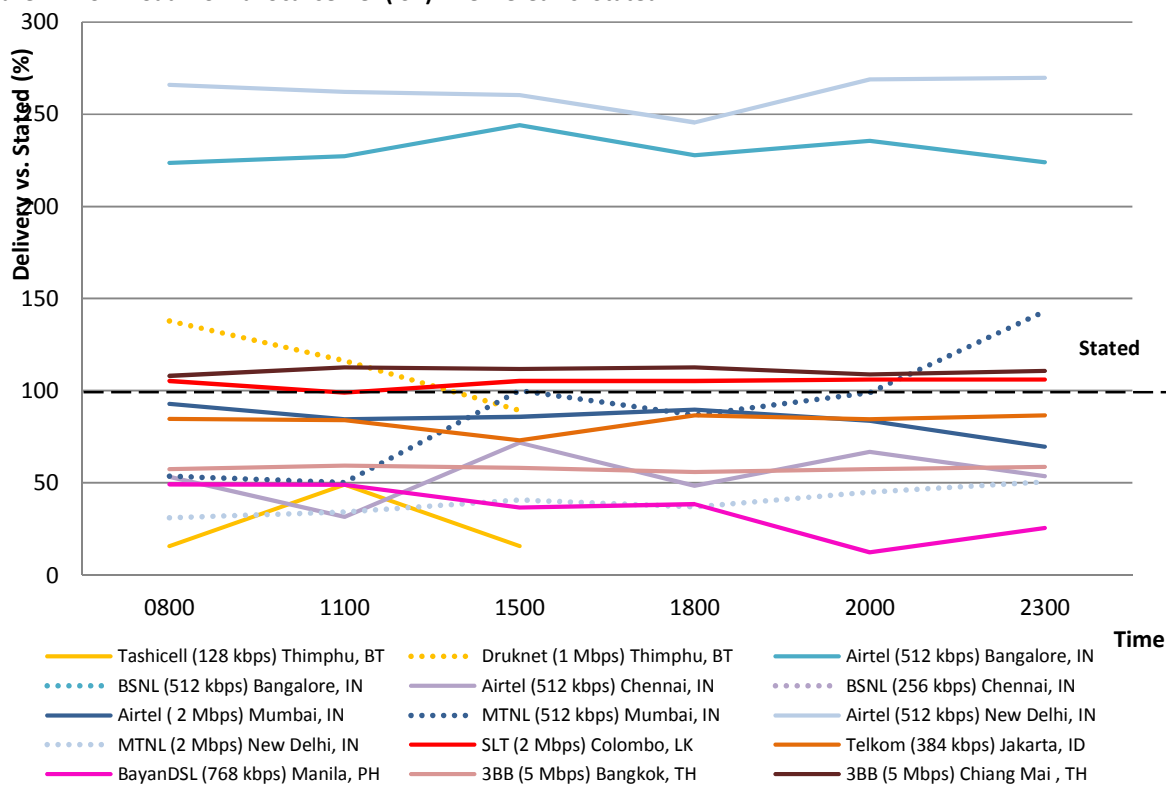
Figure 3 - Download from a local server (ISP) - kbps per dollar<sup>viii</sup>



www.iirneasia.net

NB: See annex for data

Figure 4 - Download from a local server (ISP) - Delivered vs. Stated



www.broadbandasia.info

### 3.2 Fixed Broadband - Jitter<sup>ix</sup> and Packet Loss<sup>x</sup>

Figure 5 - Jitter when pinged to an International server

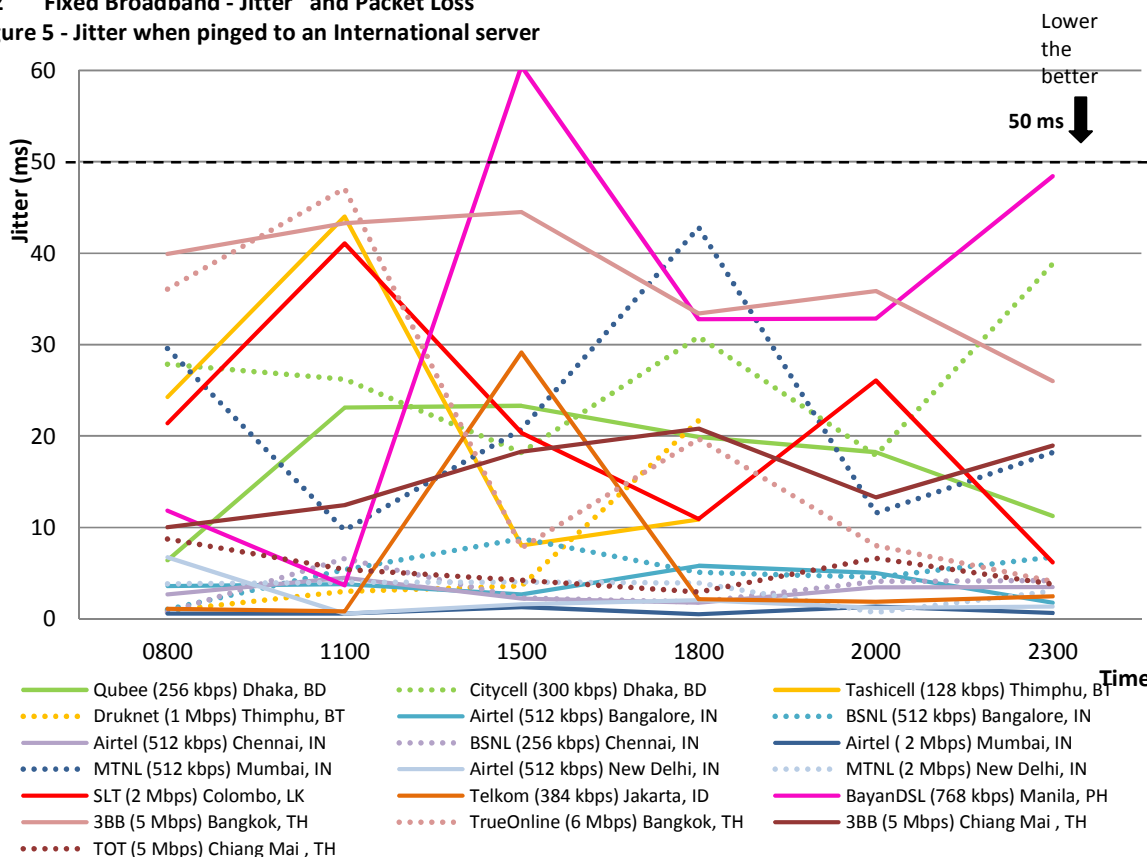
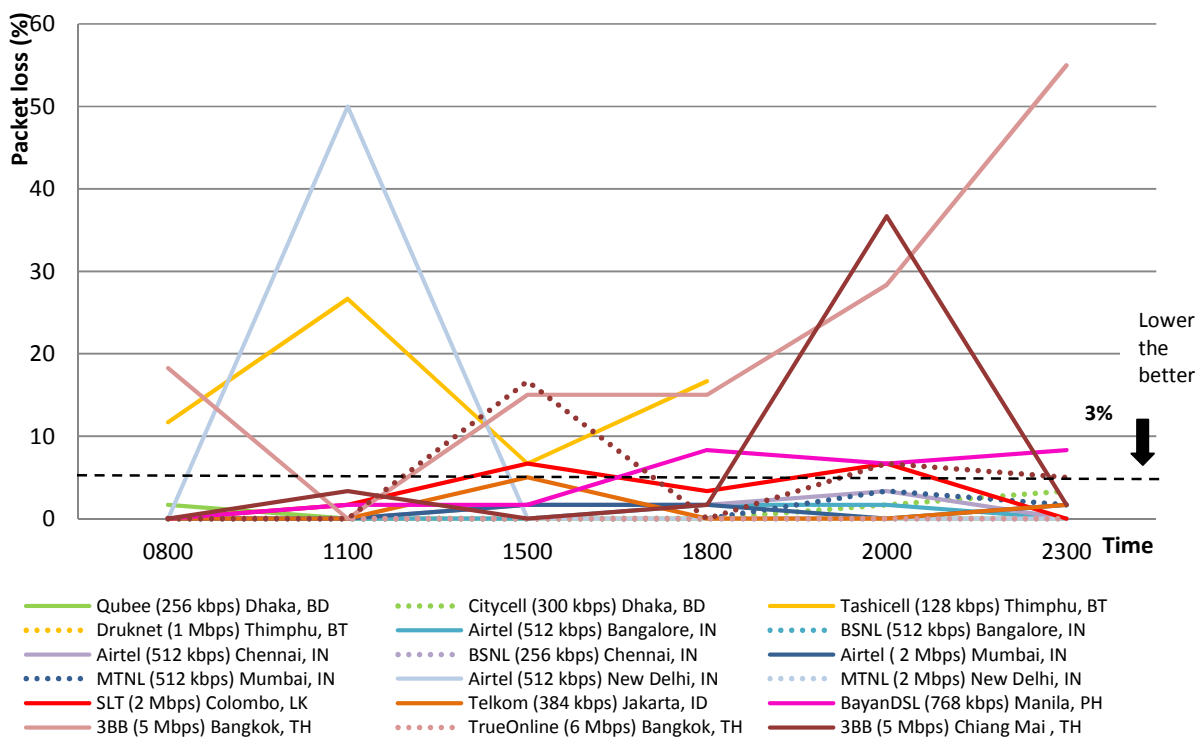
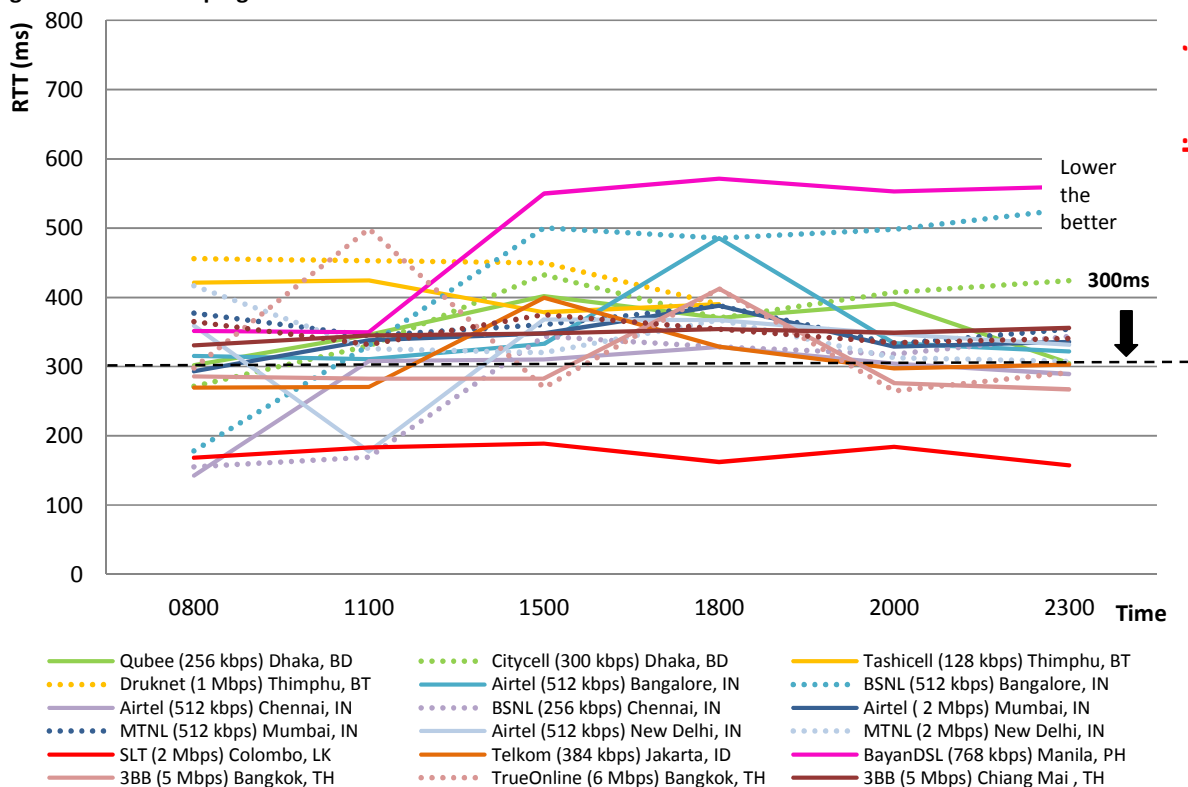


Figure 6 - Packet loss when pinged to an International server



### 3.3 Fixed Broadband - Latency<sup>xi</sup>

Figure 7 - RTT when pinged to an International server



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www.broadbandasia.info



**4 Broadband via USB Modem**
**Packages and colour keys**

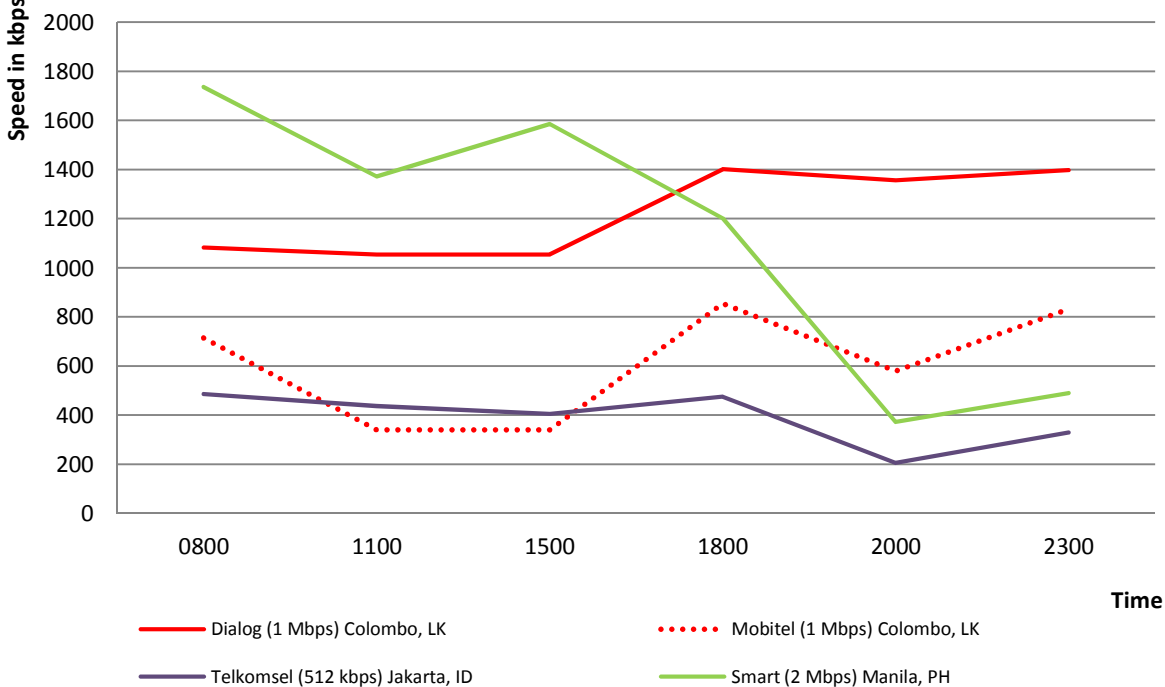
Type	Region	Country	City	Provider	Label	Advertised Speed (kbps)
Mobile Connection	South Asia	Sri Lanka	Colombo	Dialog	Dialog (1 Mbps) Colombo, LK	1000
			Colombo	Mobitel	Mobitel (1 Mbps) Colombo, LK	1000
	South East Asia	Indonesia	Jakarta	Telkomsel	Telkomsel (512 kbps) Jakarta, ID	512
		Philippines	Manila	Smart	Smart (2 Mbps) Manila, PH	2000

**Note:**

1. Tests were carried out using 3G/HSDPA USB modems plugged in to personal computers. No mobile handsets were used. The speeds may vary when laptops are used while in motion.
2. As these tests were carried out while stationary, the results are that of a simulated wireless environment, although underlying technologies differ.
3. To avoid confusion with mobile broadband tests LIRNEasia carries out annually, this section has been named 'Broadband via USB Modem'
4. Dialog, Mobitel and Telkomsel are post paid packages whereas Smart is prepaid

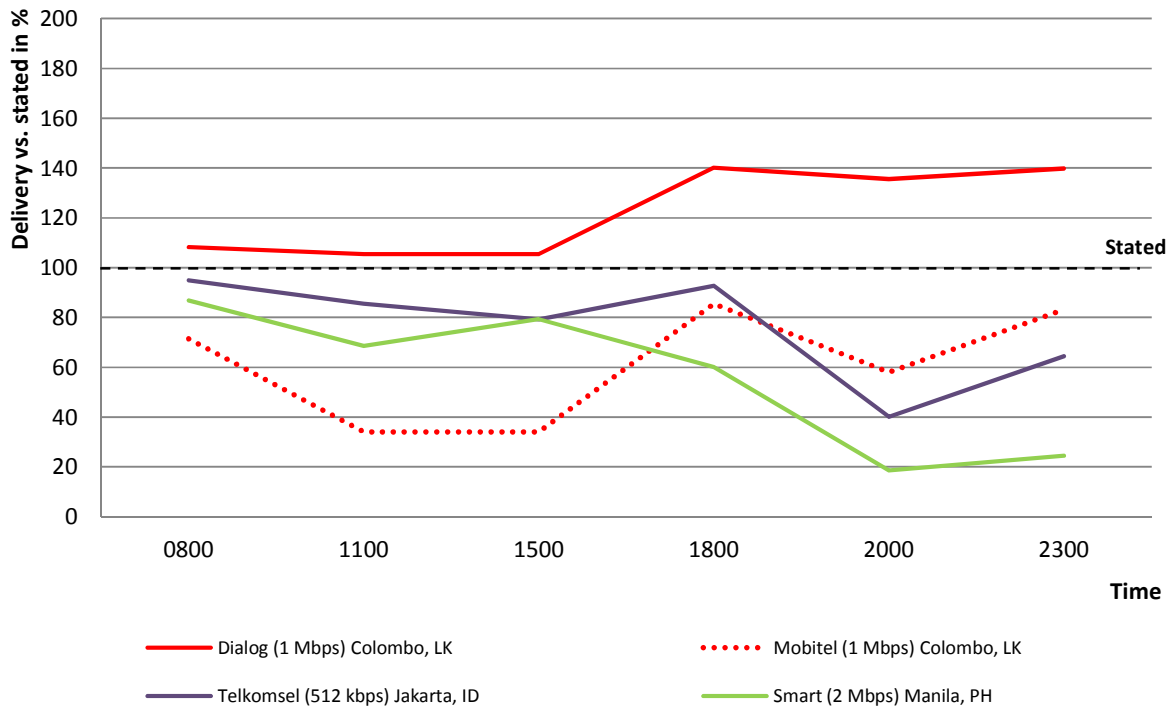
4.1 Broadband via USB Modem– Throughput (kbps)

Figure 8 - Download from an International server



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Figure 9 - Download from an International server - Delivered vs. Stated



www.broadbandasia.info

Figure 10 - Download from a local server (ISP)

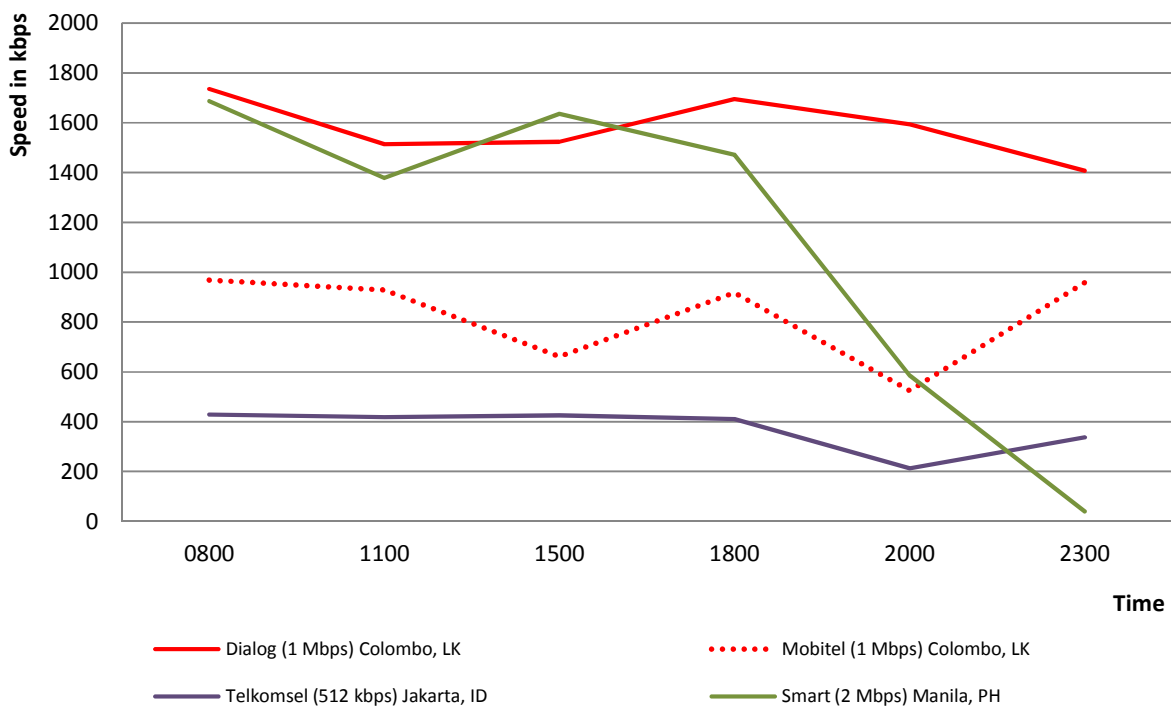
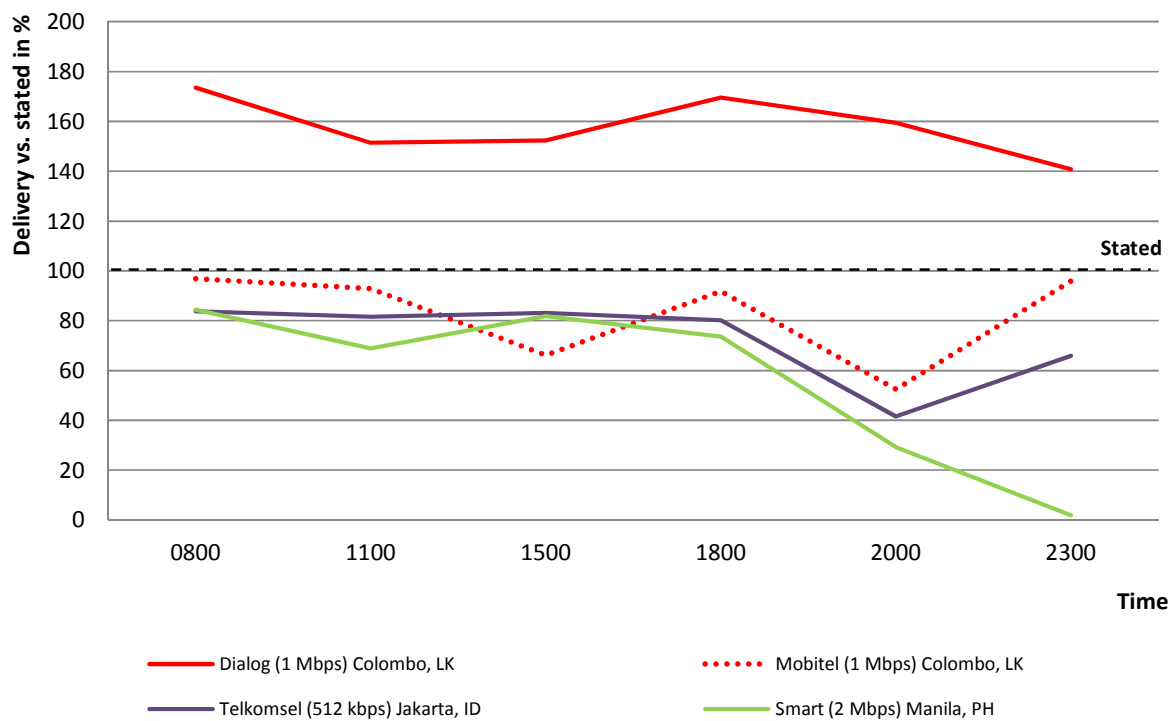


Figure 11 - Download from a local server (ISP) - Delivered vs. Stated



## 4.2 Broadband via USB Modem (Simulated testing) - Jitter<sup>xii</sup> and Packet Loss<sup>xiii</sup>

Figure 12 - Jitter when pinged to an International server

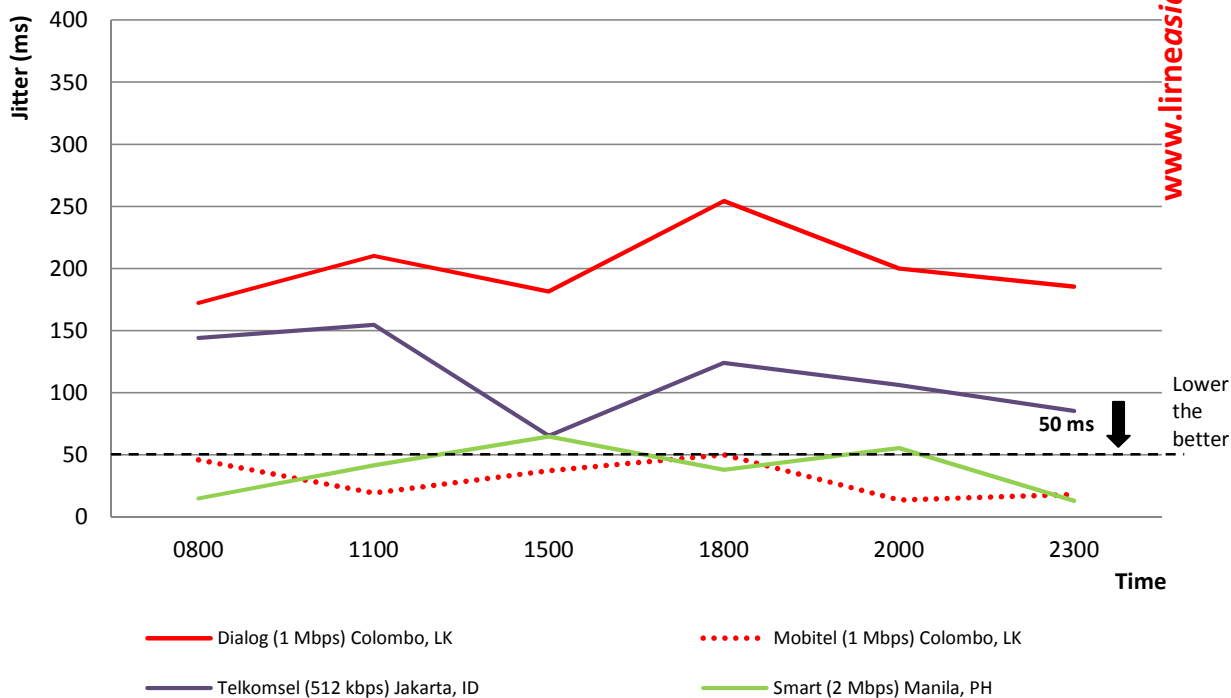
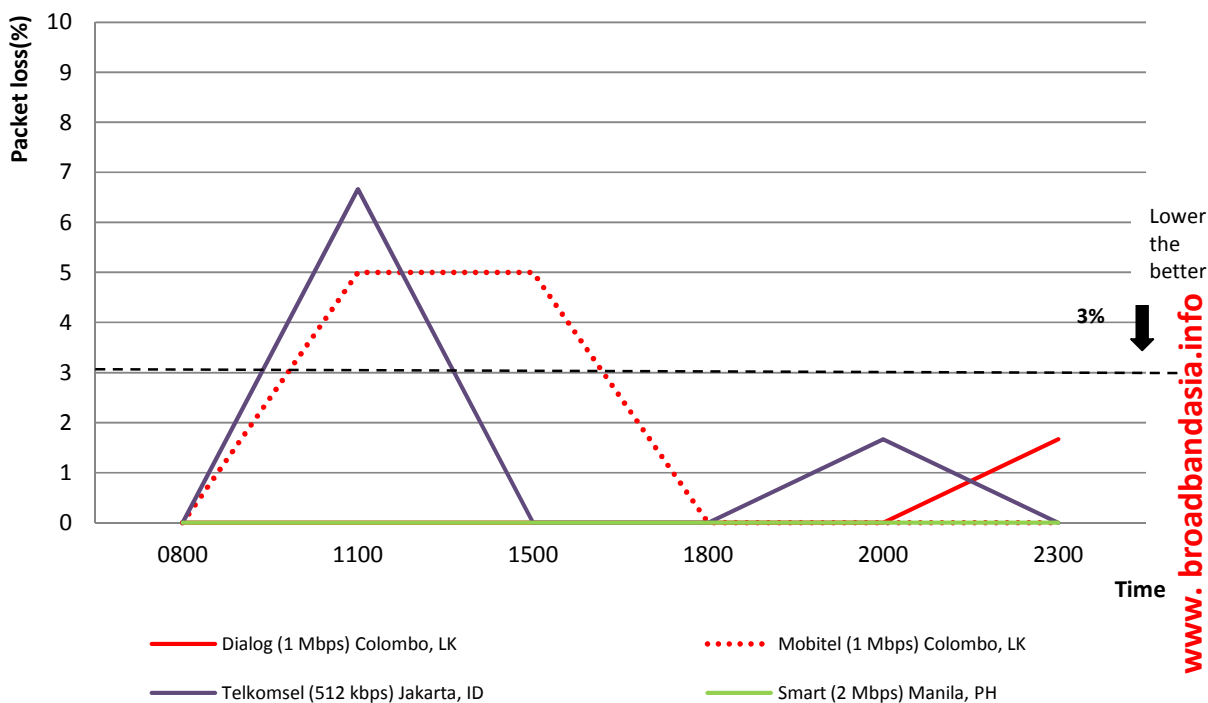
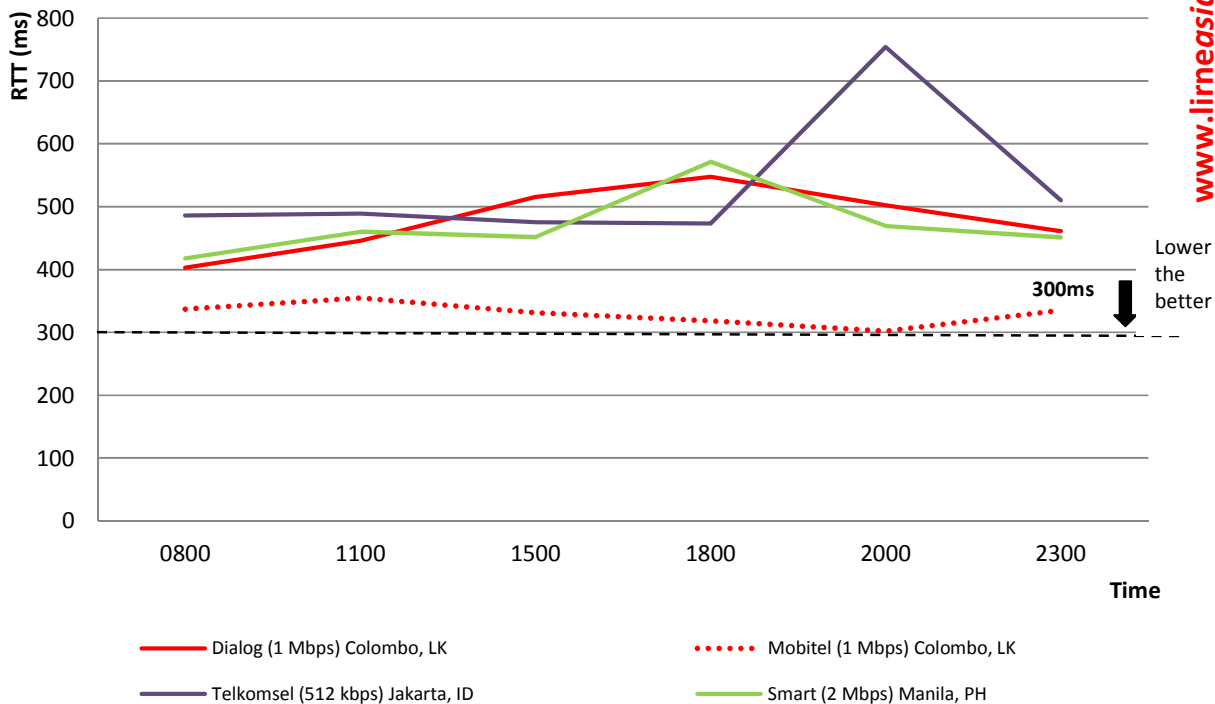


Figure 13 - Packet loss when pinged to an International server



### 4.3 Broadband via USB Modem - Latency<sup>xiv</sup>

Figure 14 - RTT when pinged to an International server



**5 Annex**  
**Fixed broadband**

Table 1 - Download from a local server (ISP) - kbps per dollar

Package/Time	0800	1100	1500	1800	2000	2300
Tashicell (128 kbps) Thimphu, BT	0.30	0.93		0.30	-	-
Druknet (1 Mbps) Thimphu, BT	28.36	-	23.92	18.38	-	-
Airtel (512 kbps) Bangalore, IN	56.57	57.49	61.73	57.60	59.60	56.64
BSNL (512 kbps) Bangalore, IN	284.84	293.51	236.83	147.60	291.52	179.16
Airtel (512 kbps) Chennai, IN	15.16	8.97	20.42	13.78	19.01	15.25
BSNL (256 kbps) Chennai, IN	279.85	232.30	283.12	276.62	283.06	290.94
Airtel ( 2 Mbps) Mumbai, IN	275.70	251.31	254.82	266.87	248.63	206.73
MTNL (512 kbps) Mumbai, IN	20.39	19.06	38.01	32.96	37.57	54.29
Airtel (512 kbps) New Delhi, IN	67.28	66.30	65.87	62.10	68.04	68.24
MTNL (2 Mbps) New Delhi, IN	69.33	76.04	90.50	82.21	99.98	112.47
SLT (2 Mbps) Colombo, LK	42.72	40.11	42.72	42.74	43.04	43.03
Telkom (384 kbps) Jakarta, ID	14.87	14.76	12.85	15.22	14.86	15.22
BayanDSL (768 kbps) Manila, PH	18.24	18.11	13.56	14.20	4.53	9.43
3BB (5 Mbps) Bangkok, TH	133.00	137.45	134.67	129.61	132.99	135.97
3BB (5 Mbps) Chiang Mai , TH	272.39	283.83	281.82	283.71	274.32	278.96

Table 2- Download from an International server - kbps per dollar

Time/ Package	0800	1100	1500	1800	2000	2300
Qubee (256 kbps) Dhaka, BD	13.91	13.83	12.71	13.83	14.12	14.20
Citycell (300 kbps) Dhaka, BD	21.99	21.65	14.37	19.73	17.86	15.53
Tashicell (128 kbps) Thimphu, BT	1.61	2.04	2.81	4.26	-	-
Druknet (1 Mbps) Thimphu, BT	23.82	24.14	26.31	21.83	-	-
Airtel (512 kbps) Bangalore, IN	64.12	64.34	58.28	11.75	17.64	64.74
BSNL (512 kbps) Bangalore, IN	140.17	94.27	15.96	13.11	8.71	5.33
Airtel (512 kbps) Chennai, IN	7.94	9.06	9.11	14.91	9.40	9.74
BSNL (256 kbps) Chennai, IN	190.51	187.06	98.33	56.97	108.68	163.38
Airtel ( 2 Mbps) Mumbai, IN	43.58	46.95	45.21	40.86	47.92	45.75
MTNL (512 kbps) Mumbai, IN	27.83	28.28	28.76	29.78	25.01	27.96
Airtel (512 kbps) New Delhi, IN	16.68	9.03	16.61	16.38	16.65	19.49
MTNL (2 Mbps) New Delhi, IN	46.38	47.40	38.26	48.68	47.84	47.79
SLT (2 Mbps) Colombo, LK	34.21	5.22	3.40	5.50	4.26	16.94
Telkom (384 kbps) Jakarta, ID	3.26	3.48	1.60	2.78	2.93	2.34
BayanDSL (768 kbps) Manila, PH	24.63	24.68	35.73	16.25	5.97	9.18
3BB (5 Mbps) Bangkok, TH	84.72	141.31	139.24	162.91	159.51	156.10
TrueOnline (6 Mbps) Bangkok, TH	222.12	164.99	193.62	175.41	211.81	166.12
3BB (5 Mbps) Chiang Mai , TH	202.20	276.61	270.71	254.32	282.38	281.92
TOT (5 Mbps) Chiang Mai , TH	119.80	28.09	31.30	17.05	7.76	25.01

- Readings were not taken

## 6 Notes

i <http://irneasia.net/projects/2010-12-idrc-main-project/indicators-continued/benchmarks/>

ii Dodd, A. (2005), "The Essential Guide to Telecommunication" Fourth Edition, Pearson Education, p. 14

iii Dodd, A. (2005), "The Essential Guide to Telecommunication" Fourth Edition, Pearson Education, p. 60

iv Dodd, A. (2005), "The Essential Guide to Telecommunication" Fourth Edition, Pearson Education, p. 60

v Connection Magazine, <http://www.connectionsmagazine.com/articles/5/049.html>, CISCO Press Article

vi The connections were tested on:

Qubee (256 kbps) Dhaka, BD	13 Oct and 14 Oct 2010
Citycell (300 kbps) Dhaka, BD	13 Oct and 14 Oct 2010
Tashicell (128 kbps) Thimphu, BT	13 Oct and 14 Oct 2010
Druknet (1 Mbps) Thimphu, BT	14 Oct and 15 Oct 2010
Airtel (512 kbps) Bangalore, IN	29 Sep and 30 Sep 2010
BSNL (512 kbps) Bangalore, IN	29 Sep and 30 Sep 2010
Airtel (512 kbps) Chennai, IN	30 Sep and 01 Oct 2010
BSNL (256 kbps) Chennai, IN	30 Sep and 01 Oct 2010
Airtel ( 2 Mbps) Mumbai, IN	30 Sep and 01 Oct 2010
MTNL (512 kbps) Mumbai, IN	30 Sep and 01 Oct 2010
Airtel (512 kbps) New Delhi, IN	07 Oct and 08 Oct 2010
MTNL (2 Mbps) New Delhi, IN	05 Oct and 05 Oct 2010
SLT (2 Mbps) Colombo, LK	28 Sep, 29 Sep and 30 Sep 2010
Telkom (384 kbps) Jakarta, ID	29 Sep and 01 Oct 2010
BayanDSL (768 kbps) Manila, PH	06 Oct and 07 Oct 2010
3BB (5 Mbps) Bangkok, TH	14 Oct and 15 Oct 2010
TrueOnline (6 Mbps) Bangkok, TH	14 Oct and 15 Oct 2010
3BB (5 Mbps) Chiang Mai , TH	08 Oct and 11 October
TOT (5 Mbps) Chiang Mai , TH	11 Oct, 12 Oct and 13 Oct 2010
Dialog (1 Mbps) Colombo, LK	28 Sep, 29 Sep and 30 Sep 2010
Mobitel (1 Mbps) Colombo, LK	28 Sep, 29 Sep and 30 Sep 2010
Telkomsel (512 kbps) Jakarta, ID	04 Oct 05 Oct and 06 Oct 2010
Smart (2 Mbps) Manila, PH	06 Oct and 07 Oct 2010

vii The speeds at which the subscriber can receive traffic from the ISP server and a commonly used International server. (e.g. yahoo.com). It plays a significant role in responsiveness and real-time applications like VoIP.

viii Tariff of the packages are converted in to USD for comparison.

ix Jitter is the variation of end-to-end delay from one packet to the next within the same packet stream/ connection/ flow. It is increasingly relevant in real-time traffic like VoIP and should ideally be zero.

x The number of packets (in %) that does not reach the destination. This can result in highly noticeable performance issues with streaming technologies.

xi The time taken for traffic to reach a particular destination.

xii Jitter is the variation of end-to-end delay from one packet to the next within the same packet stream/ connection/ flow. It is increasingly relevant in real-time traffic like VoIP and should ideally be zero.

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