BROADBAND QUALITY OF SERVICE EXPERIENCE (QOSE) INDICATORS[i]

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1 Introduction

Price is not the only dimension that interests broadband users and regulators. The quality experienced by the user is integrally connected to price and plays a prominent role when benchmarking broadband packages in the market.

The AT-Tester (developed based on a methodology defined in collaboration with a team headed by Professor Timothy Gonsalves of IIT Madras) is a tool that tests different parameters of quality that affect a user's online experience, described further in section 2. This report presents the results of diagnostics carried out in selected South Asian and South East Asian cities.

2 Dimensions of Quality of Service (QoS) tested

Throughput (Kbps)	Referred to as the "actual amount of useful data sent on a transmission"[ii]. **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)**, more commonly referred to as download or upload speeds. 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). 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. Therefore the testing has included throughput for both local (ISP) and international (yahoo.com) servers.
Latency (ms)	Referred to as "delays when voice packets transverse the network"[iii]. 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. Latency less than 300 ms is considered acceptable in this report. **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).**
Jitter (ms)	Referred to as "uneven latency and packet loss"[iv]. 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. 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. [v] In this report we consider jitter less than 50ms as acceptable. **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).**
Packet Loss (%)	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. Packet loss less than 3% is considered good in this report. **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).**

3 Results of QoSE testing

Fixed Broadband

Table 1 - Packages and colour keys

Region	Country	Tested city	Provider	Label	Speed in Kbps
South Asia	India	Bangalore	BSNL	BSNL (1Mbps)-Bangalore,IN	1024
	India	Chennai	BSNL	BSNL (4Mbps)-Chennai,IN	4096
	India	Delhi	BSNL	BSNL (4Mbps)-Delhi,IN	4096
	Maldives	Male	Dhiraagu	Dhiragu (512kbps)-Male,MV	512
	Nepal	Kathmandu	NTC	NTC (512kbps)-Kathmadu,NP	512
	Pakistan	Karachi	PTCL	PTCL (4Mbps)-Karachi,PK	4096
	Sri Lanka	Colombo	SLT	SLT (2Mbps)-Colombo,LK	2048
	Sri Lanka	Colombo	Dialog LTE	Dialog LTE (4Mbps)-Colombo,LK	4096
South East Asia	Indonesia	Jakarta	Telkom Speedy Instant	Telkom Speedy Instant (512kbps)-Jakarta,ID	512
	Indonesia	Jakarta	Internux LTE	Internux LTE (72Mbps)-Jakarta,ID	73728
	Thailand	Bangkok	True online	True online (10Mbps)-Bangkok,TH	10240
	Thailand	Bangkok	3BB	3BB (10Mbps)-Bangkok,TH	10240

Note:

1. All packages were tested at six time slots except Nepal – The tested time slots are 0800, 1100, 1500, 1800, 2000 and 2300 hours. Exception: Nepal testing was up to 2000 hours.
2. Bhutan test results were not included in this report as the tests were carried out for a leased line to the regulatory agency (BICMA). Bhutan test results are included in Annex 1.
3. LTE packages in the graphs are denoted in a dotted line. They are included with the fixed broadband plans and they are offered as an alternative fixed broadband solution.
4. In Indonesia, the location of the tests has to be taken in to account as they were carried out at the edge of the LTE coverage area. At the operator's sales counter download speeds of 27 Mbps were achieved.
5. Thailand's fixed operator, True Online was not included for comparison. A proxy server that intercept http requests has been installed and it is highlighy likely that the test URL was cached. Therefore, extreme high download speeds were obserevd. Please see Annex 2.

3.1 Download Speed

Figure 1 - Download from an International server

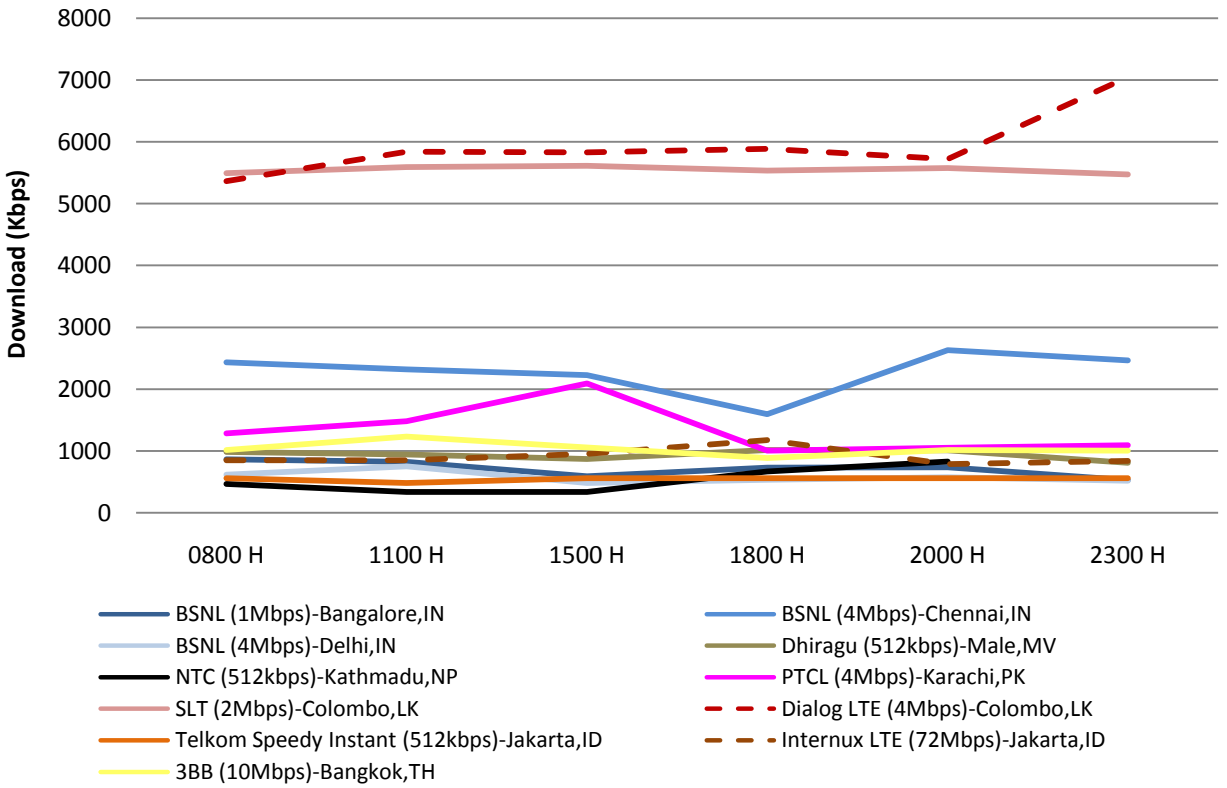
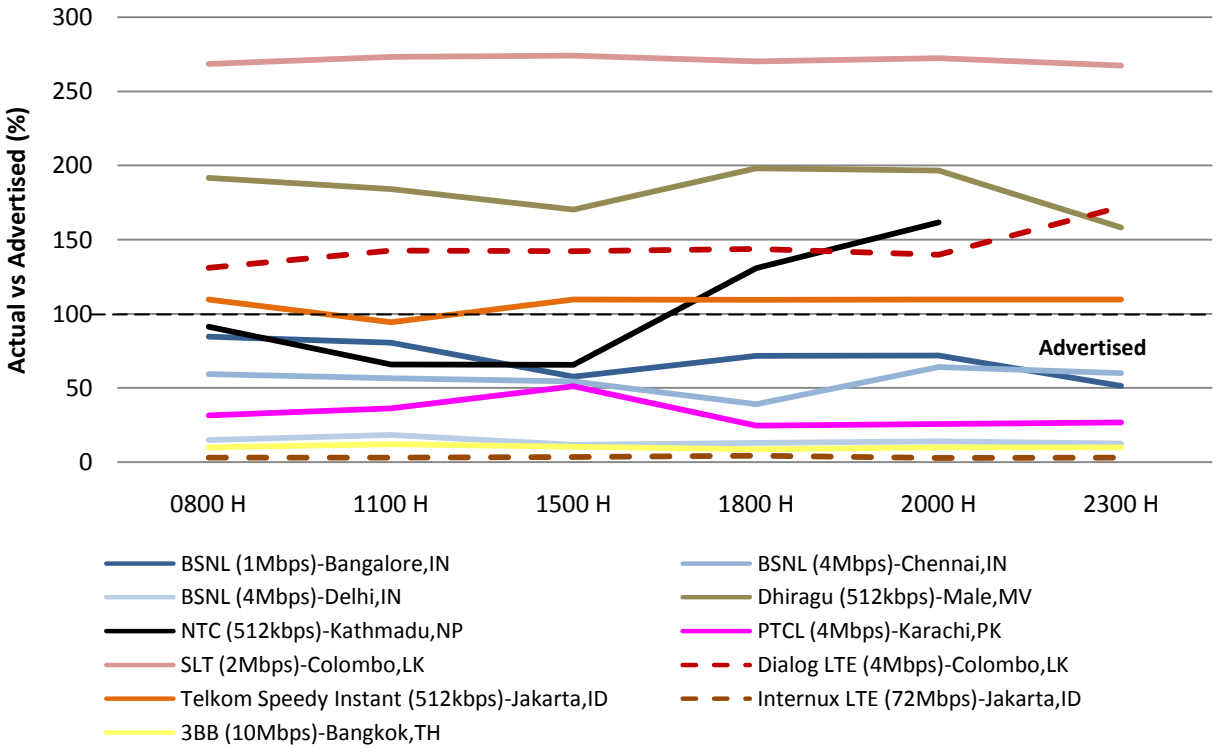
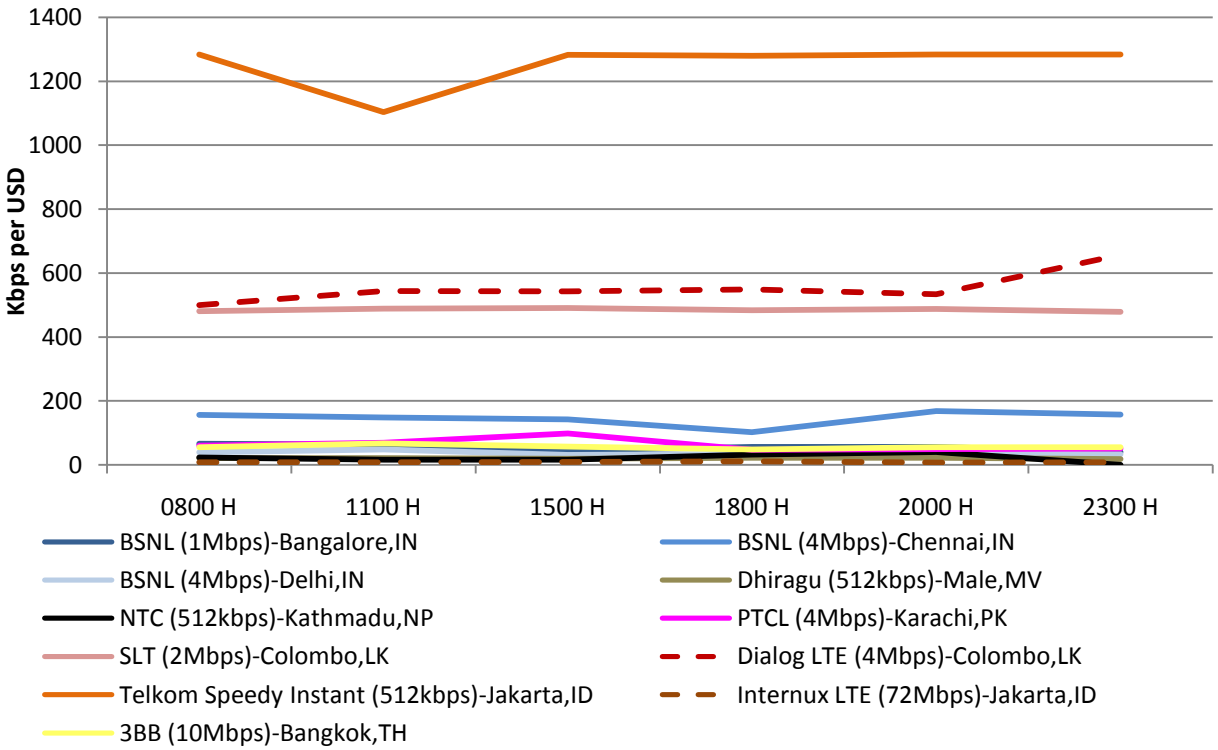


Figure 2 - Download from an International server – Actual vs. Advertised



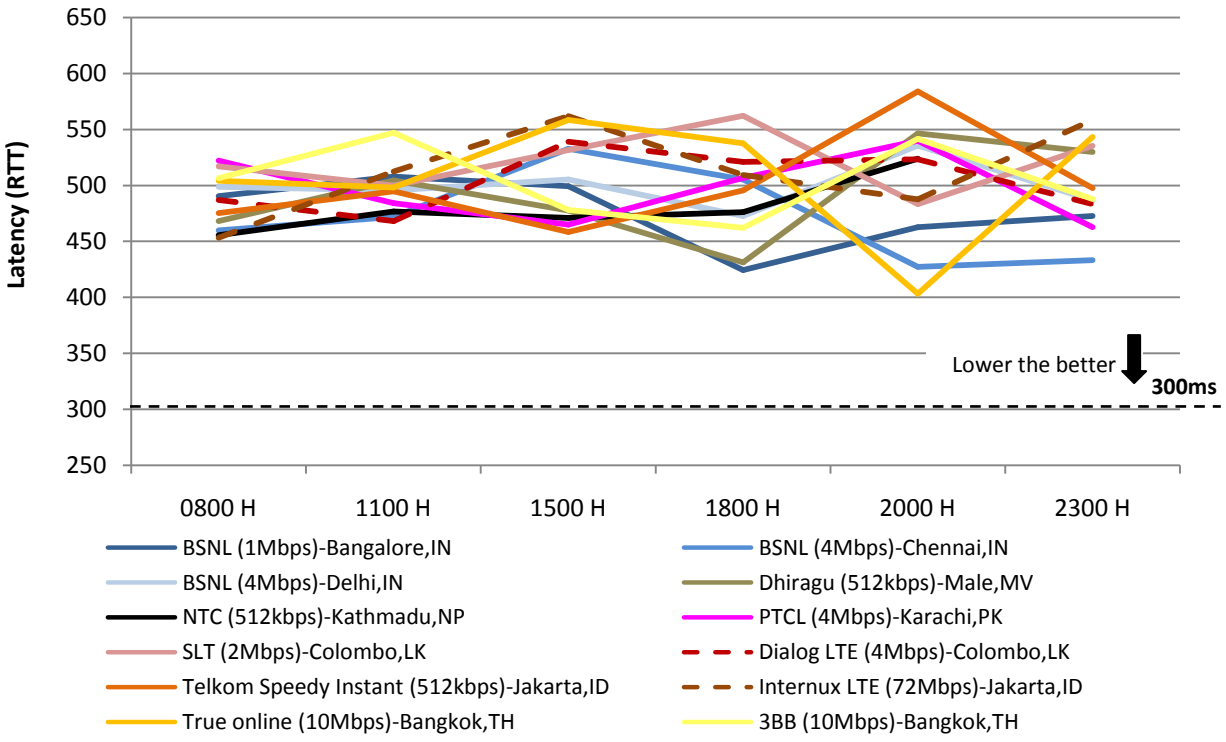
3.2 Value for money

Figure 3 – Kbps per USD



3.3 Fixed Broadband - Latency[vi] / Round Trip Time (RTT)

Figure 4 - RTT when pinged to an International server



Mobile broadband (via USB Modem)

Table 2 - Packages and color keys

Region	Country	Tested city	Provider	Label	Speed in KBPS
South Asia	Bangladesh	Dhaka	Banglalion*	Banglalion (512kbps)-Dhaka,BD	512
	Bangladesh	Dhaka	Qubee*	Qubee (1Mbps)-Dhaka,BD	1024
	Bangladesh	Dhaka	Grameenphone*	Grameenphone (512kbps)-Dhaka,BD	512
	India	Bangalore	Airtel 3G	Airtel 3G (4Mbps)-Bangalore,IN	4096
	India	Chennai	Tata	Tata (3.1Mbps)-Chennai,IN	3174.4
	India	Delhi	Airtel	Airtel (4Mbps)-Delhi,IN	4096
	India	Bangalore	Airtel LTE	Airtel LTE (4Mbps)-Bangalore,IN	4096
	Maldives	Male	Ooredoo Data 99*	Ooredoo Data 99 (7Mbps)-Male,MV	7168
	Maldives	Male	Dhiraagu Data 200	Dhiraagu Data 200 (1Mbps)-Male,MV	1024
	Nepal	Kathmandu	Ncell*	Ncell (7.2Mbps)-Kathmandu,NP	7372.8
	Pakistan	Karachi	PTCL Evo	PTCL Evo (9.3Mbps)-Karachi,PK	9523.2
	Sri Lanka	Colombo	Dialog	Dialog (2.16Mbps)-Colombo,LK	2211.84
	Sri Lanka	Colombo	Etisalat	Etisalat (7.2Mbps)-Colombo,LK	7372.8
	Sri Lanka	Colombo	Mobitel	Mobitel (3.6Mbps)-Colombo,LK	3686.4
South Easta Asia	Indonesia	Jakarta	Telcomsel Flash Ultima	Telcomsel Flash Ultima(3.6Mbps)-Jakarta,ID	3686.4
	Philipines	Manila	SMART Bro*	SMART Bro Starter Plug-it (7.2 Mbps)-Manila,PH	7372.8
	Philipines	Manila	Globe Tattoo prepaid stick*	Globe Tattoo Prepaid (3.6 Mbps) -Manila,PH	3686.4
	Philipines	Manila	Sun Broadband Plan 799	Sun Broadband Plan 799 (3.6Mbps)-Manila,PH	3686.4
	Thailand	Bangkok	Truemove H iSmart	Truemove H iSmart (42Mbps)-Bangkok,TH	43008
	Thailand	Bangkok	AIS 3G iSmart	AIS 3G iSmart (Speed)-Bangkok,TH	

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. Banglalion (mobile Wimax), Qubee (mobile Wimax), Grameenphone, Ncell, Globe Tattoo and SMART Bro are prepaid packages (marked with a *). 30 days validity of the pre paid cards was used as a monthly fee equivalent to post paid packages when generating the Kbps per USD graph.

3.4 Mobile Broadband via USB Modem – Download Speeds

Figure 5 - Download from an International server

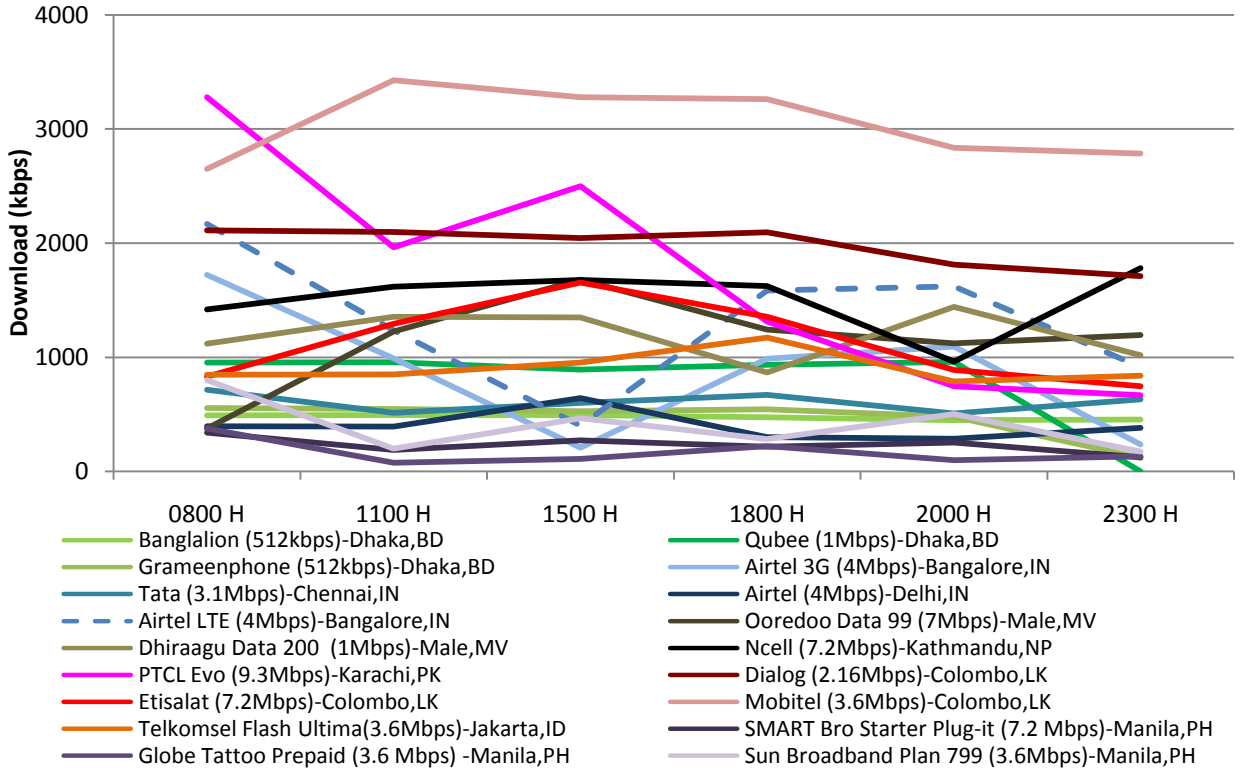
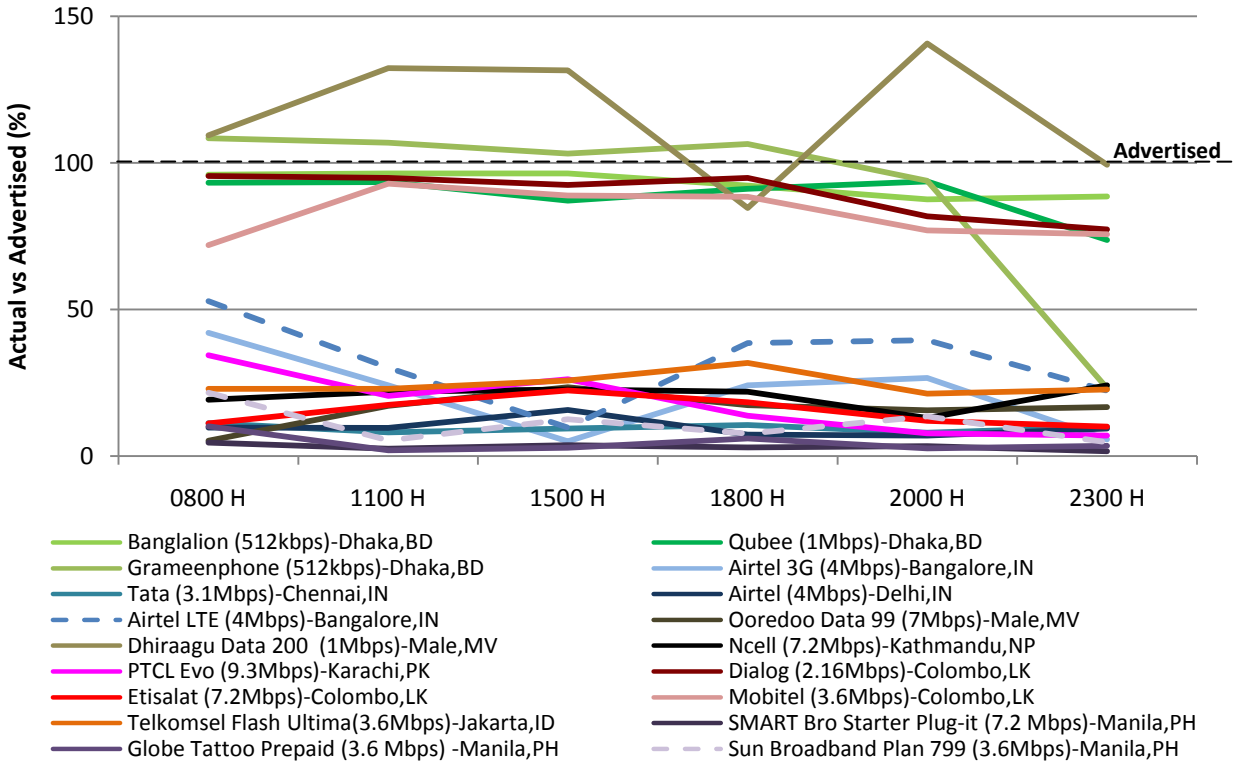


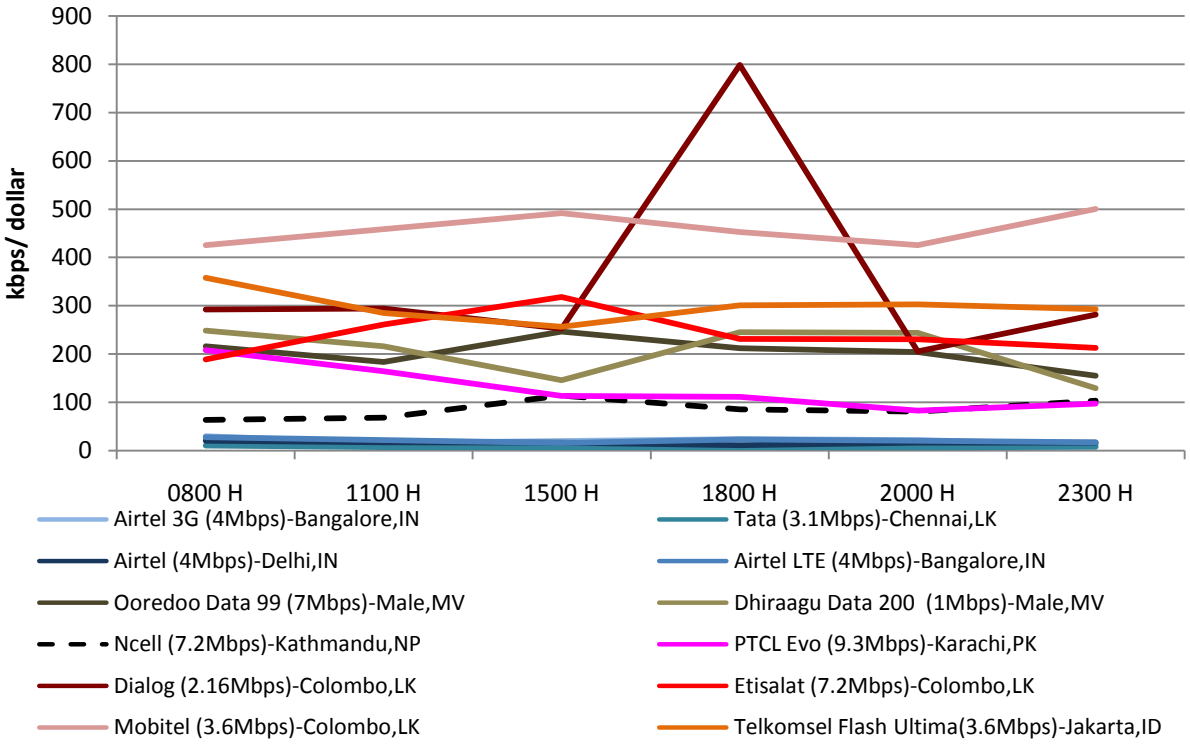
Figure 6 - Download from an International server - Actual vs. Advertised



Notes: Thailand mobile operators (Truemove H iSmart, AIS 3G iSmart) werent included in this graph because the speeds are high due to caching. The data of download speed and actual vs advertised speed of mobile broadband in Thailand is in Annex 3

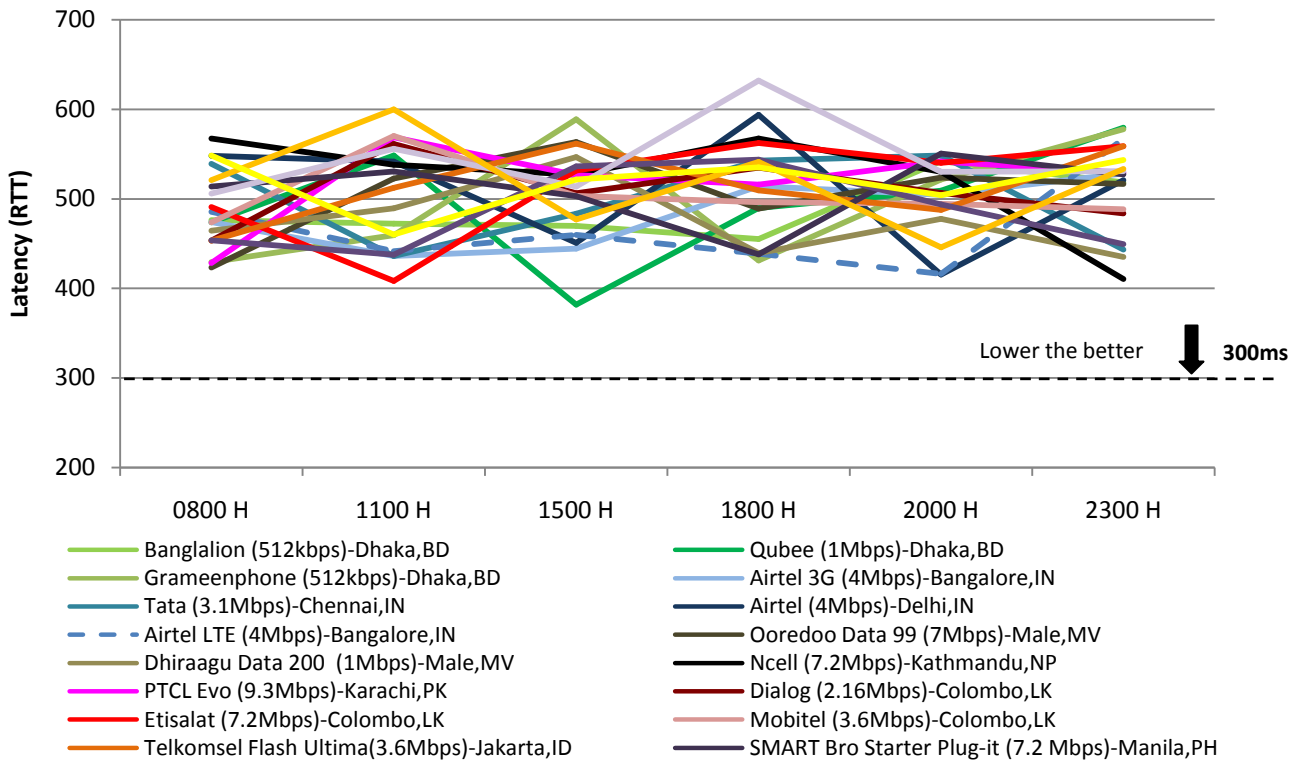
3.5 Value for money

Figure 7 – Kbps per USD



3.6 Broadband via USB Modem - Latency[vii] / Round Trip Time (RTT)

Figure 8 - RTT when pinged to an International server



4 Fixed Broadband: ISP vs. International Comparisons

Figure 9 - Download from a local server

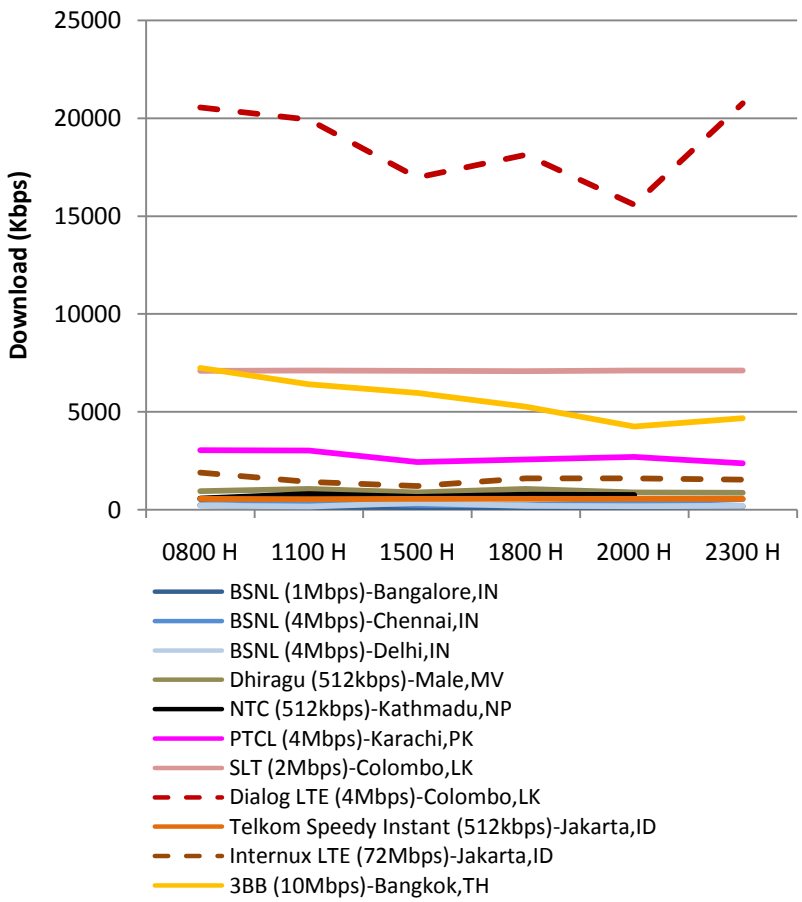


Figure 10 - Download from an international server

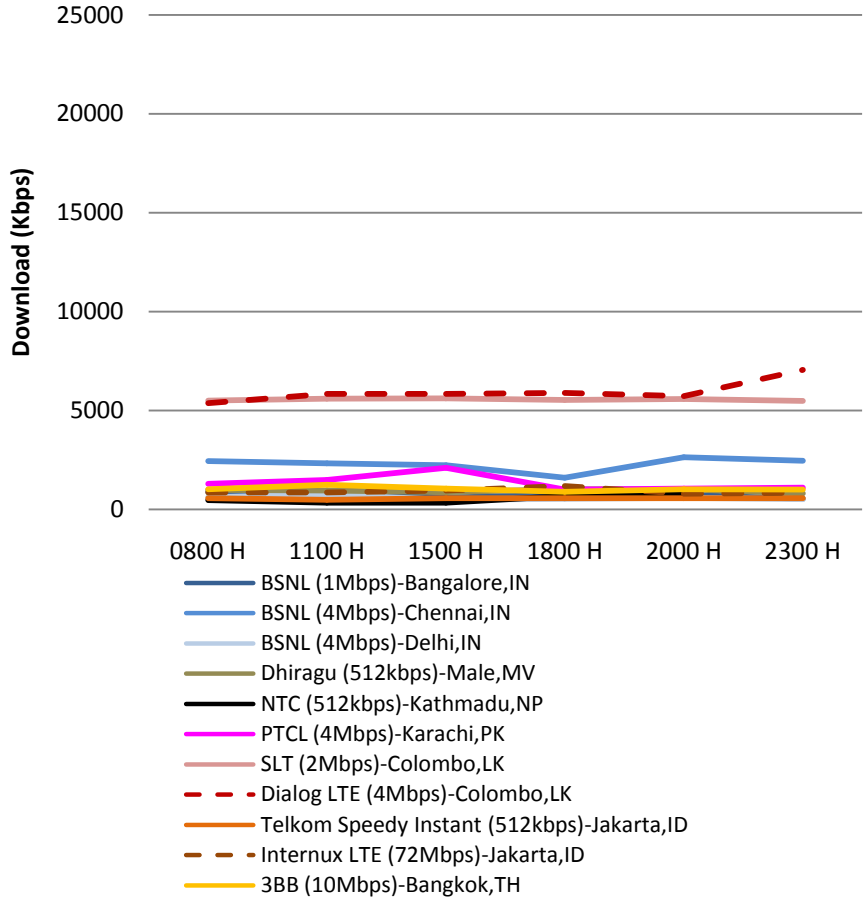


Figure 11 – RTT (local server)

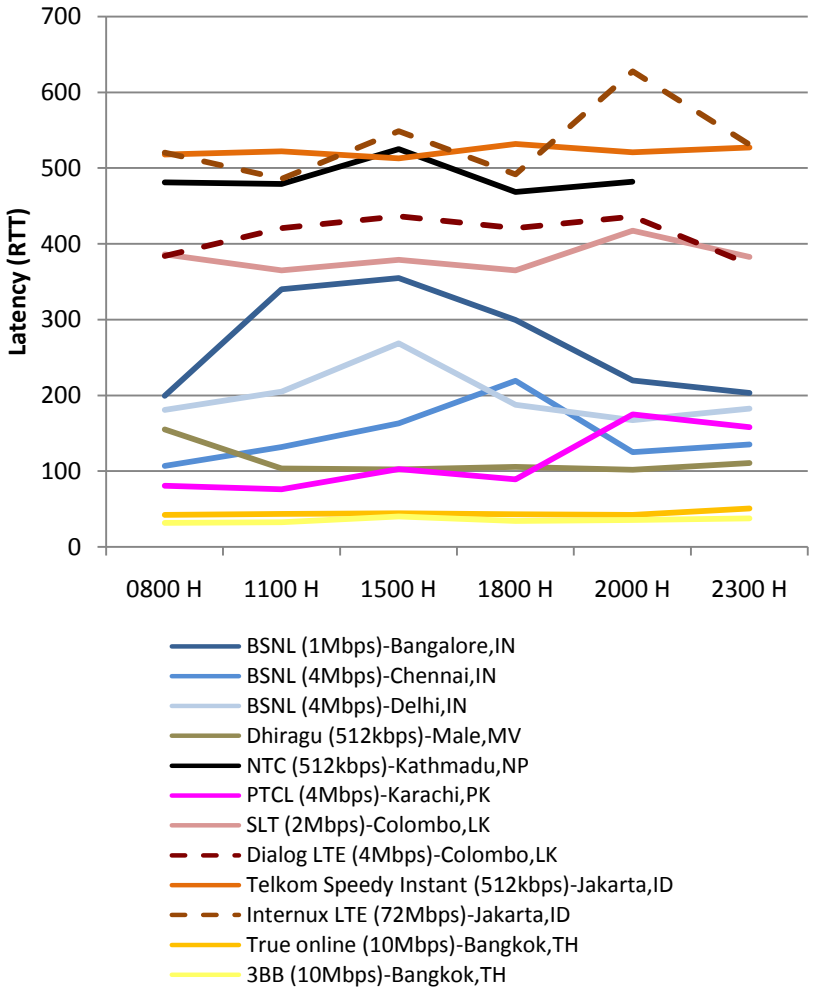
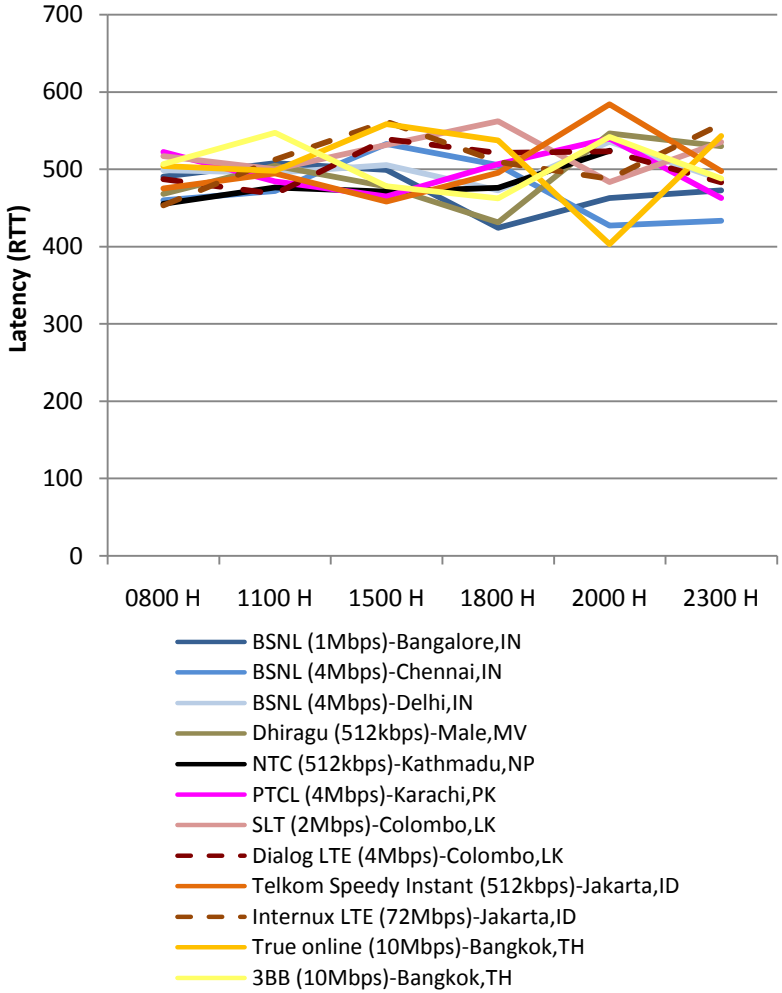


Figure 12 - RTT (international domain)



5 Mobile Broadband: ISP vs. International Comparisons

Figure 13 - Download from a local server

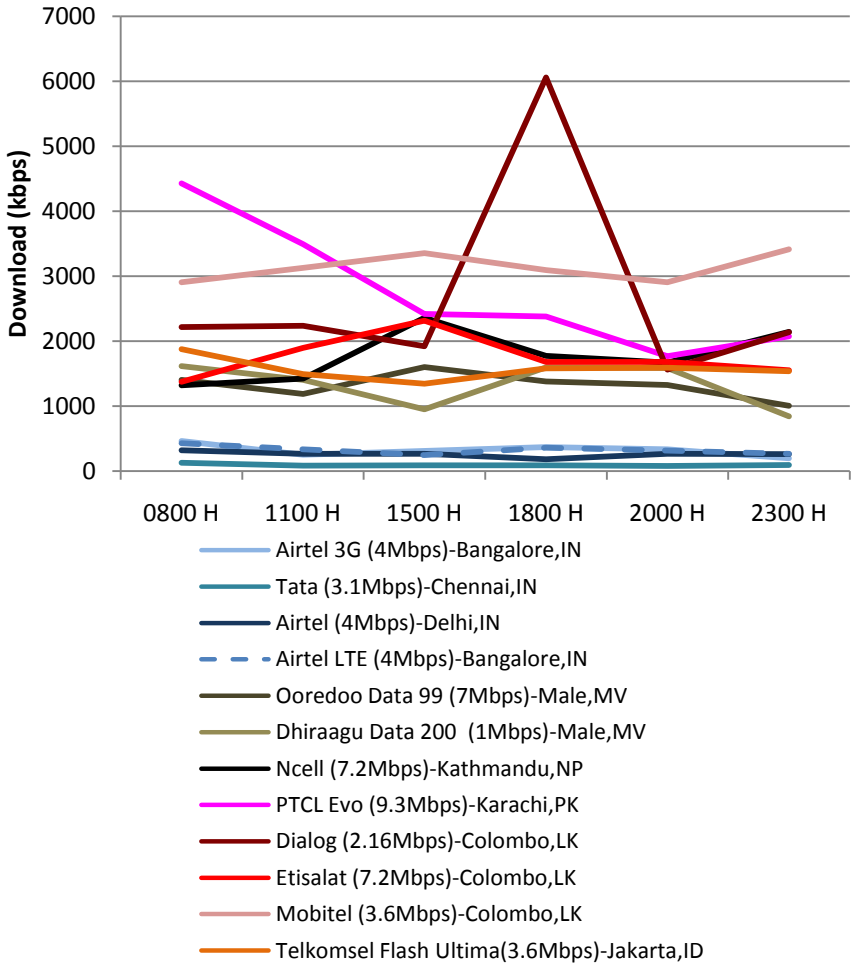


Figure 14 - Download from an International server

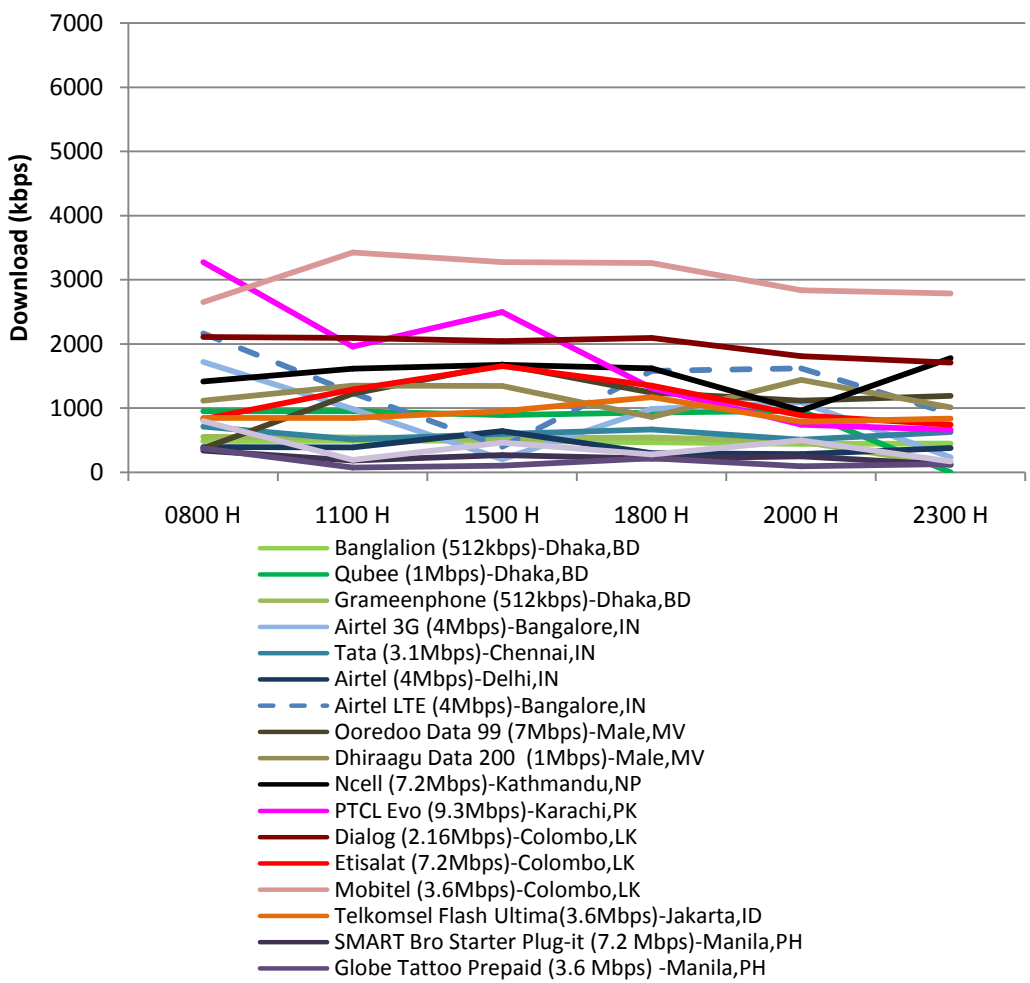


Figure 15 – RTT (local server)

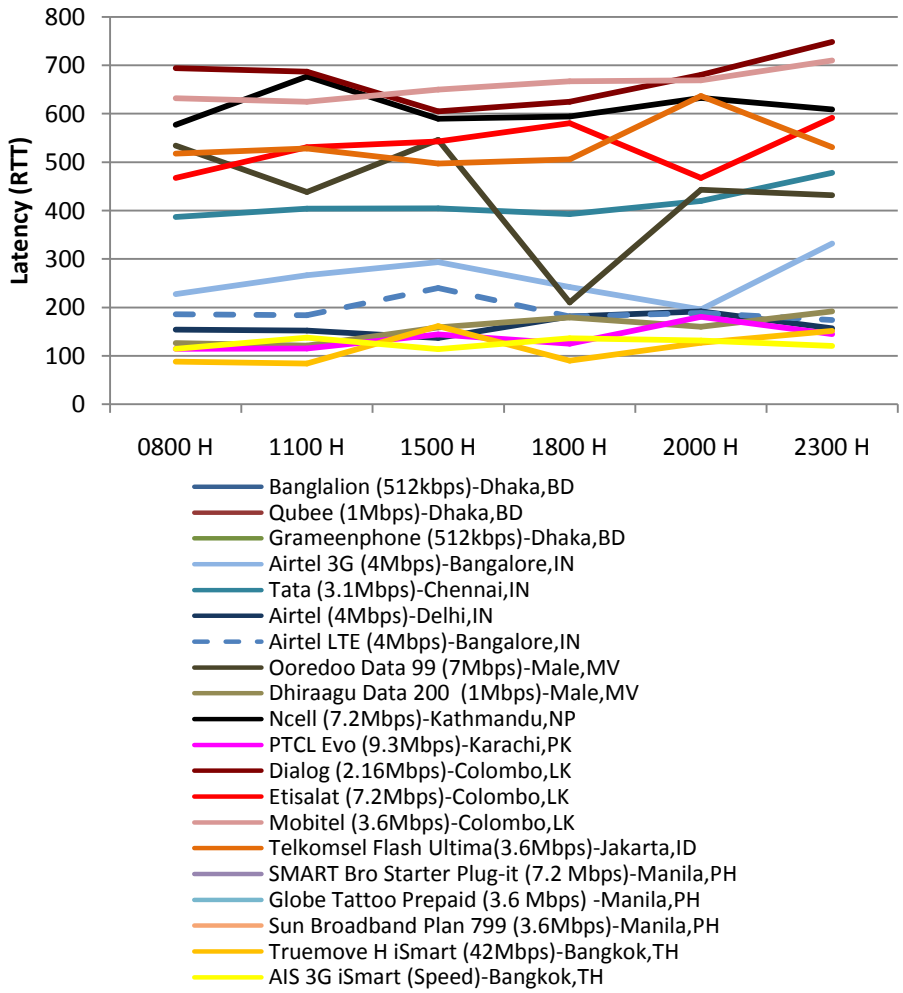
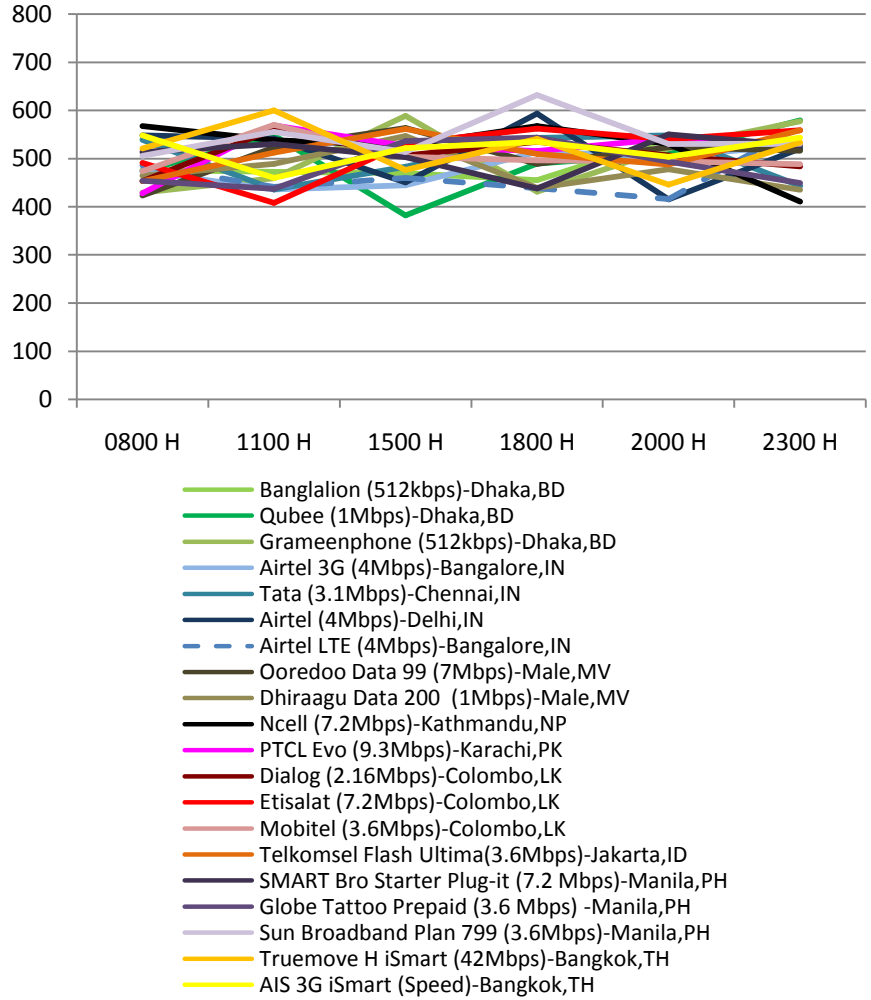


Figure 16 - RTT (international domain)



Annex 1

Table 3: Bhutan Telcom ISP test results

	Download Speed	Latency	Jitter	Packet Loss
0800 H	8225.75	303.50	57.25	0.00
1100 H	8365.00	348.50	107.00	0.00
1500 H	5667.25	406.25	78.25	0.00
1800 H	5563.00	324.25	78.50	0.00
2000 H	6436.00	298.25	33.75	0.00
2300 H	5359.75	317.50	57.00	0.00

Table 4: Bhutan Telcom International test results

	Download Speed	Latency	Jitter	Packet Loss
0800 H	6139.50	509.75	308.00	0.00
1100 H	5559.25	538.25	278.50	0.00
1500 H	3217.75	538.50	298.50	0.00
1800 H	4919.75	513.75	276.75	0.00
2000 H	4226.00	518.00	223.25	0.00
2300 H	3775.50	464.25	292.75	0.00

Annex 2

Table 5- Download from an International server in Thailand fixed broadband

	True online (10Mbps)-Bangkok,TH
0800 H	1202649
1100 H	1254084
1500 H	1226467
1800 H	1204872
2000 H	998874.8
2300 H	894848

Table 6- Download from an International server – Actual vs. Advertised (%)

	True online (10Mbps)-Bangkok,TH
0800 H	11744.62
1100 H	12246.91
1500 H	11977.21
1800 H	11766.32
2000 H	9754.636
2300 H	8738.75

Note: When the monthly data transfer limit exceeded In Thailand the download speed is dropped, but the connection is uninterepted. This is known as the Fair Usage Policy.

Annex 3

Table 7 - Download from an International server

	Truemove H iSmart (42Mbps)-Bangkok, TH	AIS 3G iSmart (Speed)-Bangkok, TH
0800 H	1264.25	329742.25
1100 H	225409	427443
1500 H	867	695586.75
1800 H	15516.8	609105.25
2000 H	15533	462814.5
2300 H	15620	657667

Table 8 - Download from an International server – Actual vs. Advertised (%)

	Truemove H iSmart (42Mbps)-Bangkok, TH
0800 H	2.93
1100 H	524.10
1500 H	2.01
1800 H	36.07
2000 H	36.11
2300 H	36.31

Notes

i http://lirneasia.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 time taken for traffic to reach a particular destination.
vii The time taken for traffic to reach a particular destination.