Broadband Quality of Service Experience
QoSE
Test Results

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3 Nov 09

Testing Rounds

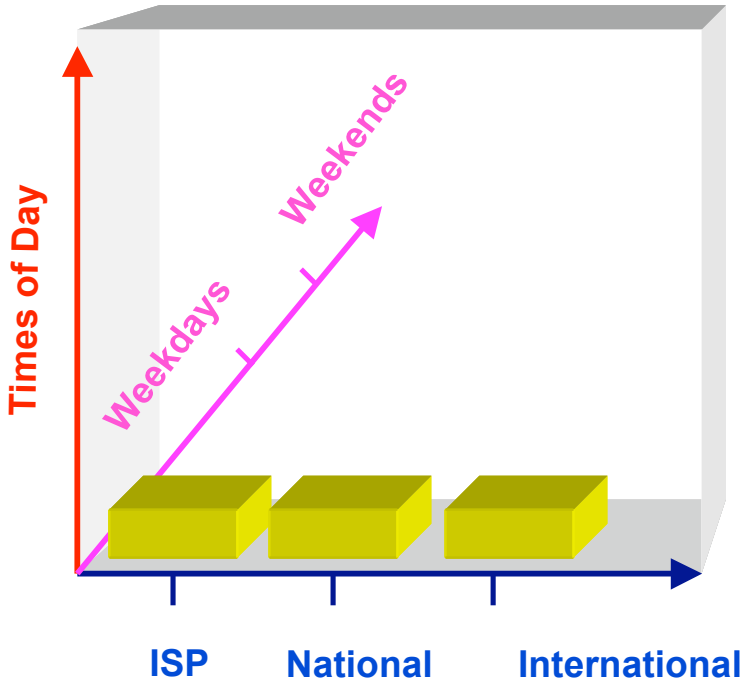
- Mar 08: India, Sri Lanka
- Oct 08: India, Sri Lanka, Bangladesh
- Mar 09: India, Sri Lanka, Bangladesh
- Oct 09: India, Sri Lanka, Bangladesh, US, Canada

This work was carried out with the aid of a grant from the International Development Research Centre, Canada and the Department for International Development, UK.

IDRC International Development Research Centre
CRDI Centre de recherches pour le développement international
DFID Department for International Development

Test Methodology

- Tests 6 parameters
  - Covers most aspects of subscriber QoE
- Tests three servers (ISP, National, International)
  - ISP local network, National Peering and International Bandwidth
- Repeated at different times of the day
  - Provisioning & Dimensioning of Network
- Repeated at weekdays and weekends
  - Provisioning & Dimensioning of Network



Automated by the ATTester http://www.broadbandasia.info

Tests Done in Oct 09

Using the ATTester http://www.broadbandasia.info

- Locations:
  - Delhi, Mumbai, Pune, Bangalore, Chennai
  - Tamilnadu
- Operators:
  - Airtel, BSNL, TATA, MTNL
- Packages:
  - Wired: 256 kb/s - 2 Mb/s, limited/unlimited
  - Wireless: 256 kb/s, limited (TN)
- Globally:
  - US: Verizon (3 Mb/s), Comcast (6 Mb/s)
  - Canada: Bell (6 Mb/s), Rogers (10 Mb/s)

Test Results

- Download speed, RTT, Jitter:
  - Sample results
  - All India metros: National/Int'l domains
  - India vs. N. America
- RTT Analysis
- Plan Analysis
  - Limited vs. unlimited
  - Tamilnadu vs. Chennai
  - Wired vs. wireless

Sample Test Results

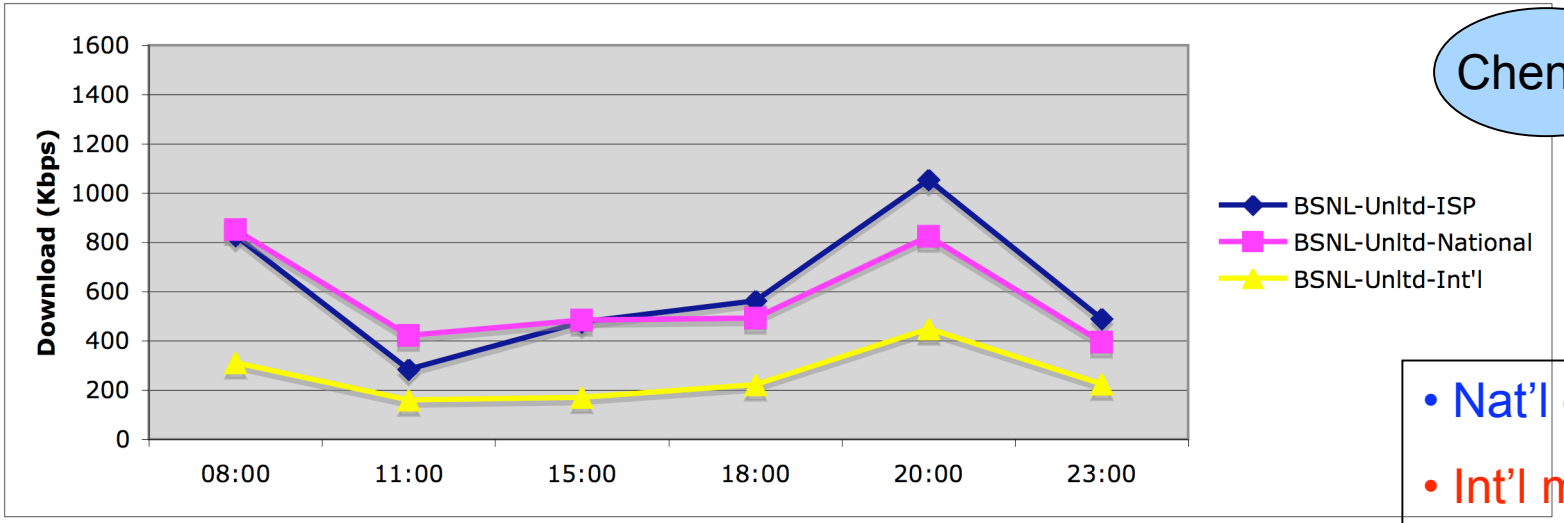
Download speed, RTT, jitter, loss metrics

LIRNEasia
www.lirneasia.net

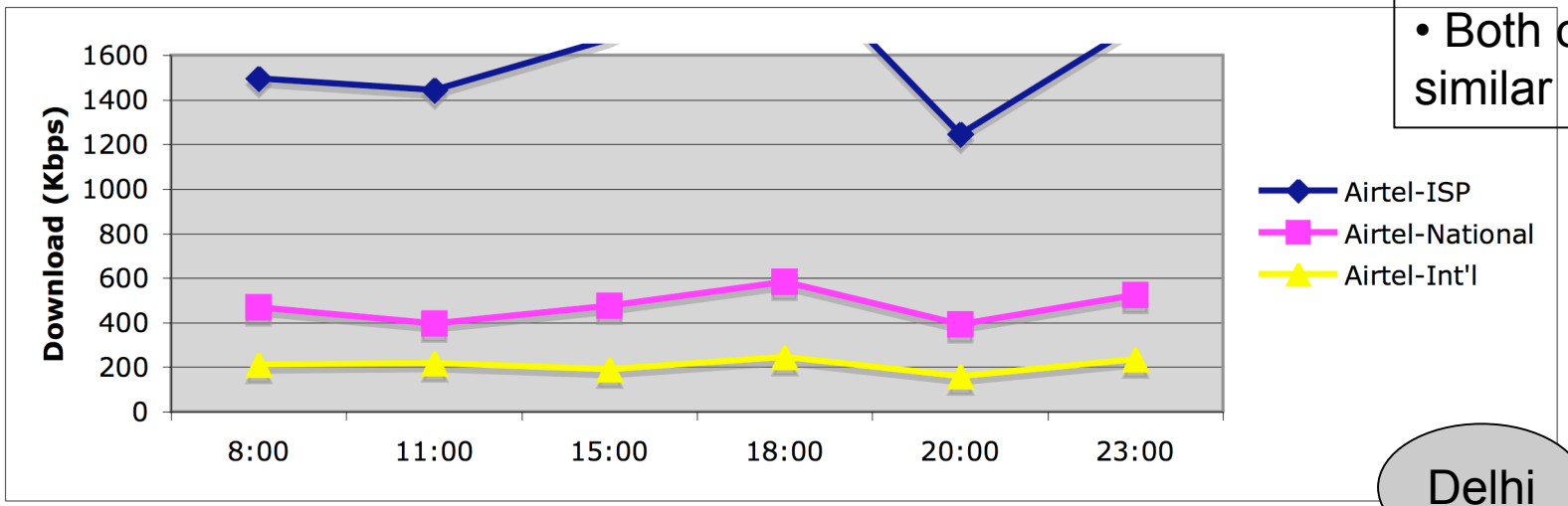
TeNeT

Download speed (Chennai/Delhi 256k unlimited):

Relatively healthy in National domains, Int'l much lower



Chennai

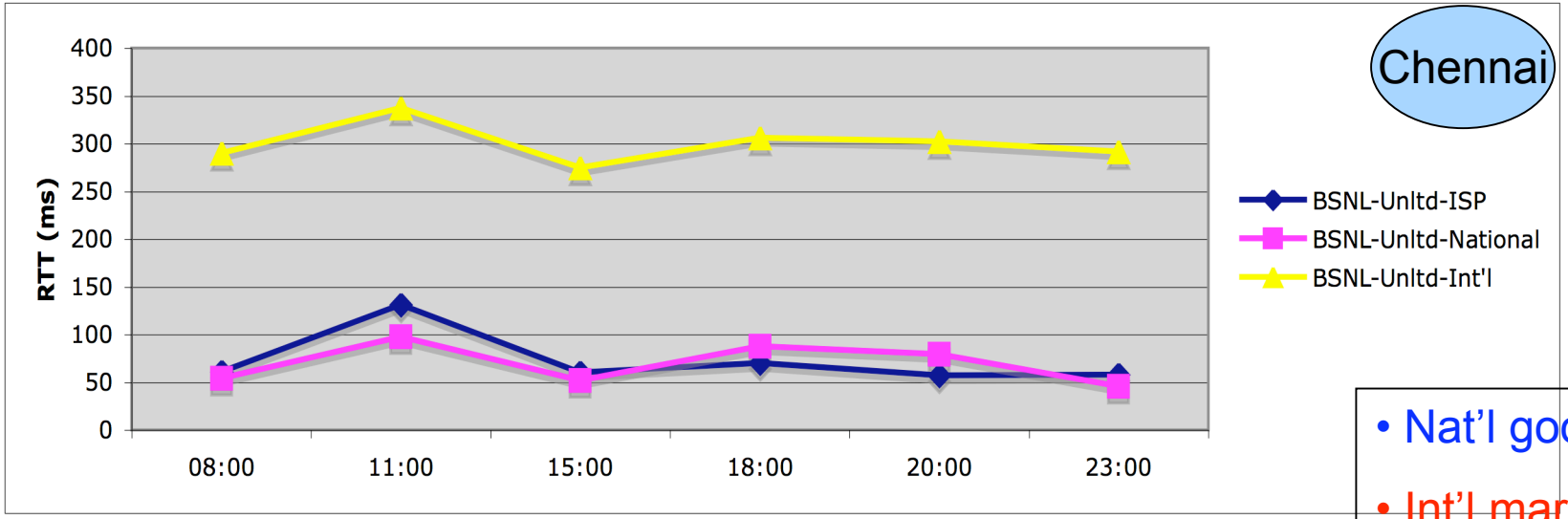


Delhi

- Nat'l good
- Int'l marginal
- Both operators similar

Round-trip time (RTT) (256k unlimited):

TRAI: <350 ms, Singapore <300 ms VOIP needs <100 ms (one way)



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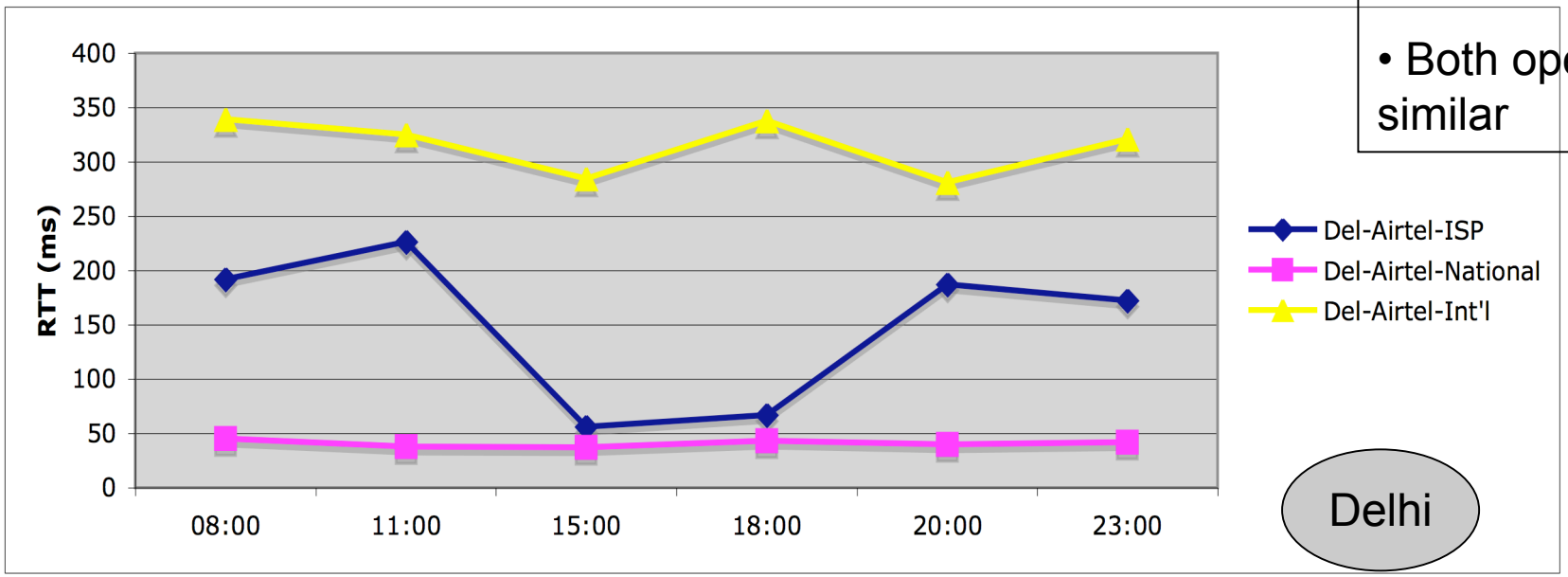
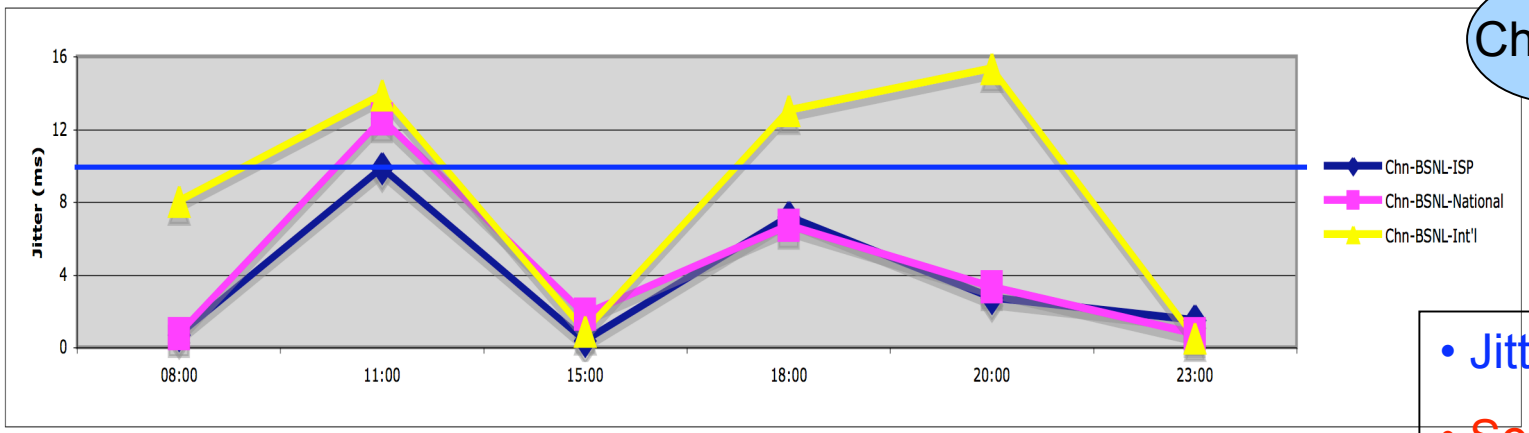


Delhi

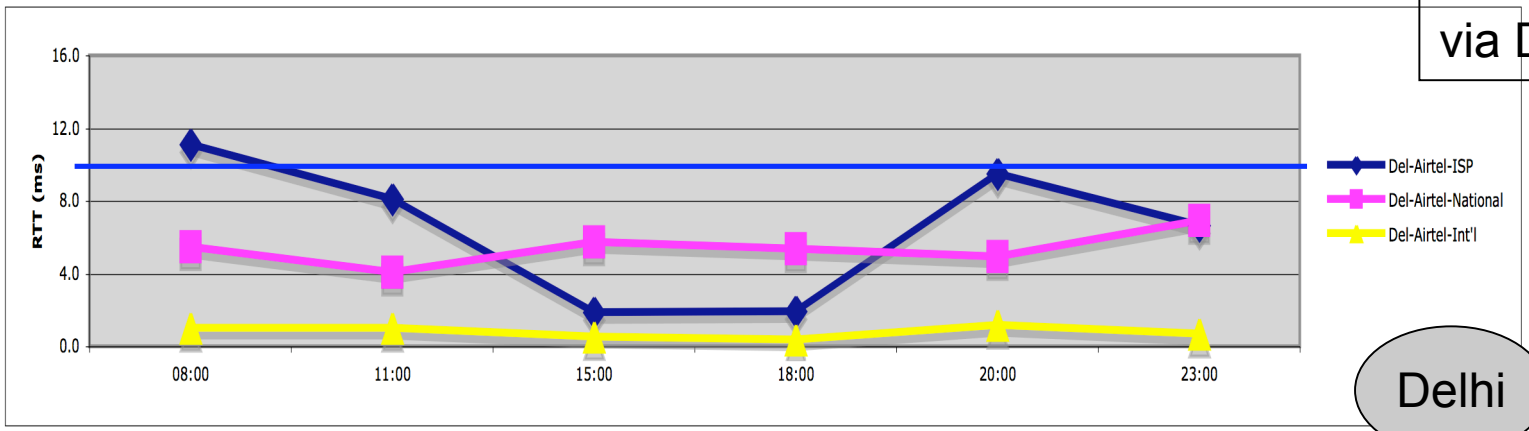
Jitter (256k unlimited):

<10 ms very good, peaks >50 ms affect VOIP



Chennai

- Jitter mostly good
- Some random variation
- Chennai poorer as it uses Int'l gateway via Delhi?



Delhi

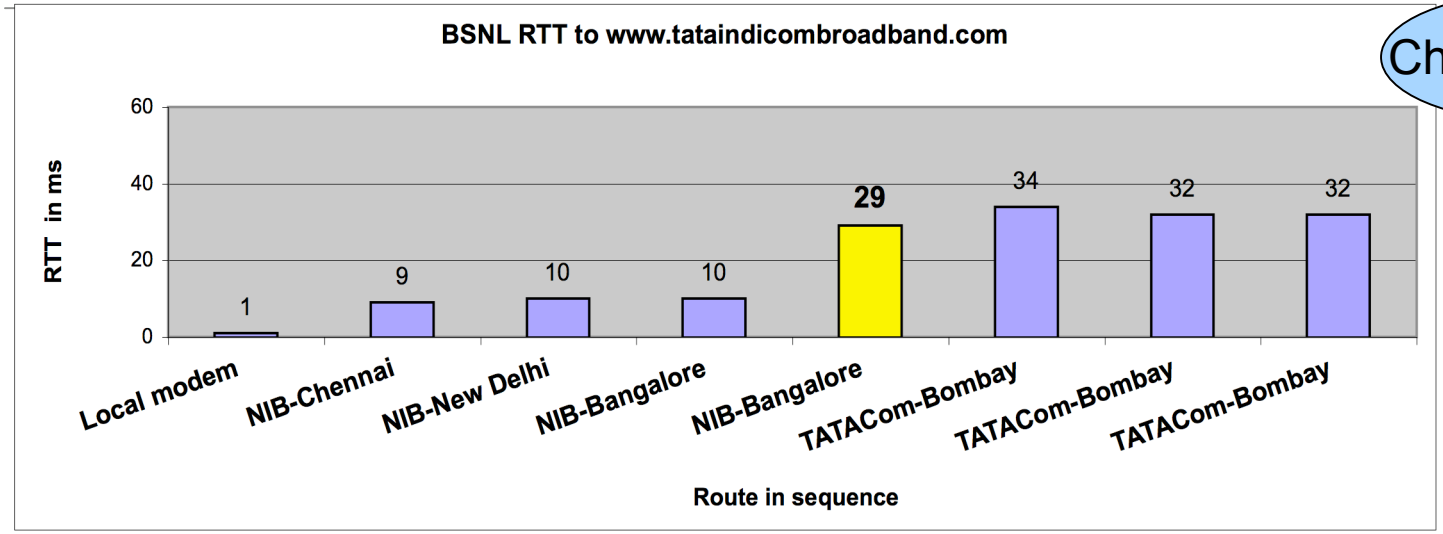
Where is the Bottleneck?

LIRNEasia
www.lirneasia.net

TeNeT

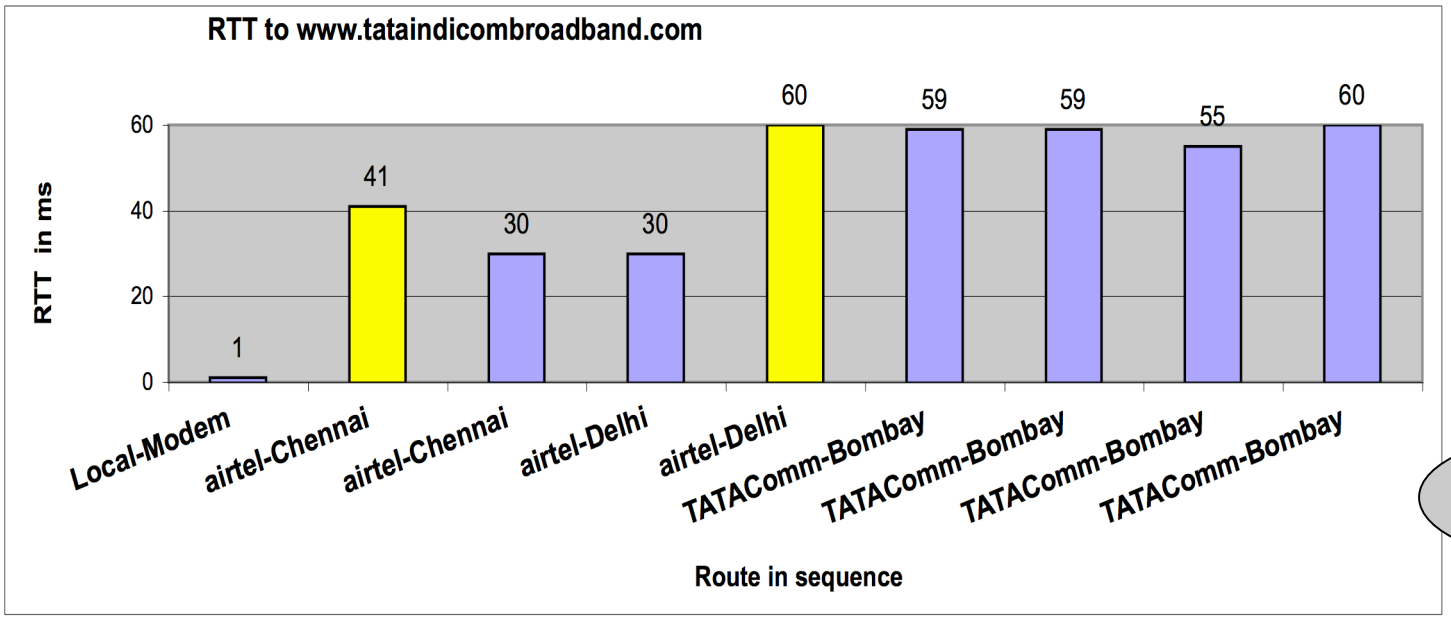
Nat’l Round-trip time -- hop-by-hop

Trace route from PC in Chennai to server



Chennai BSNL

- Gateway to other ISP is bottleneck
- RTT 10-15 ms achieveable

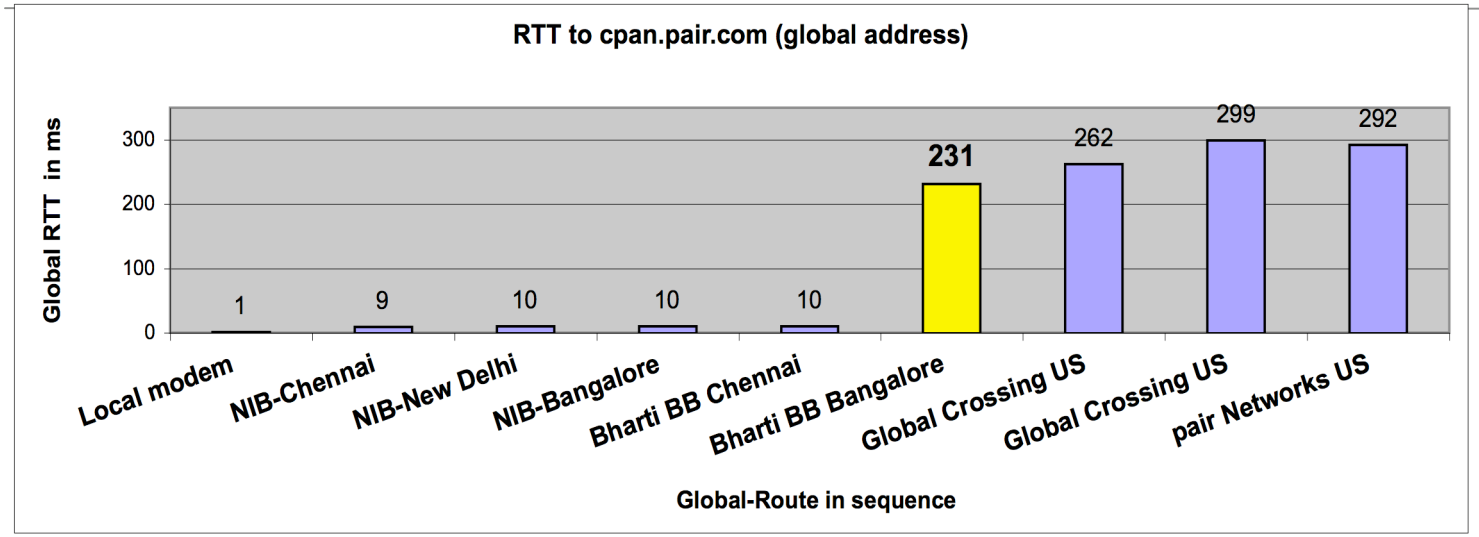


- Gateway to other ISP and ADSL link are bottlenecks
- RTT 10-15 ms achieveable

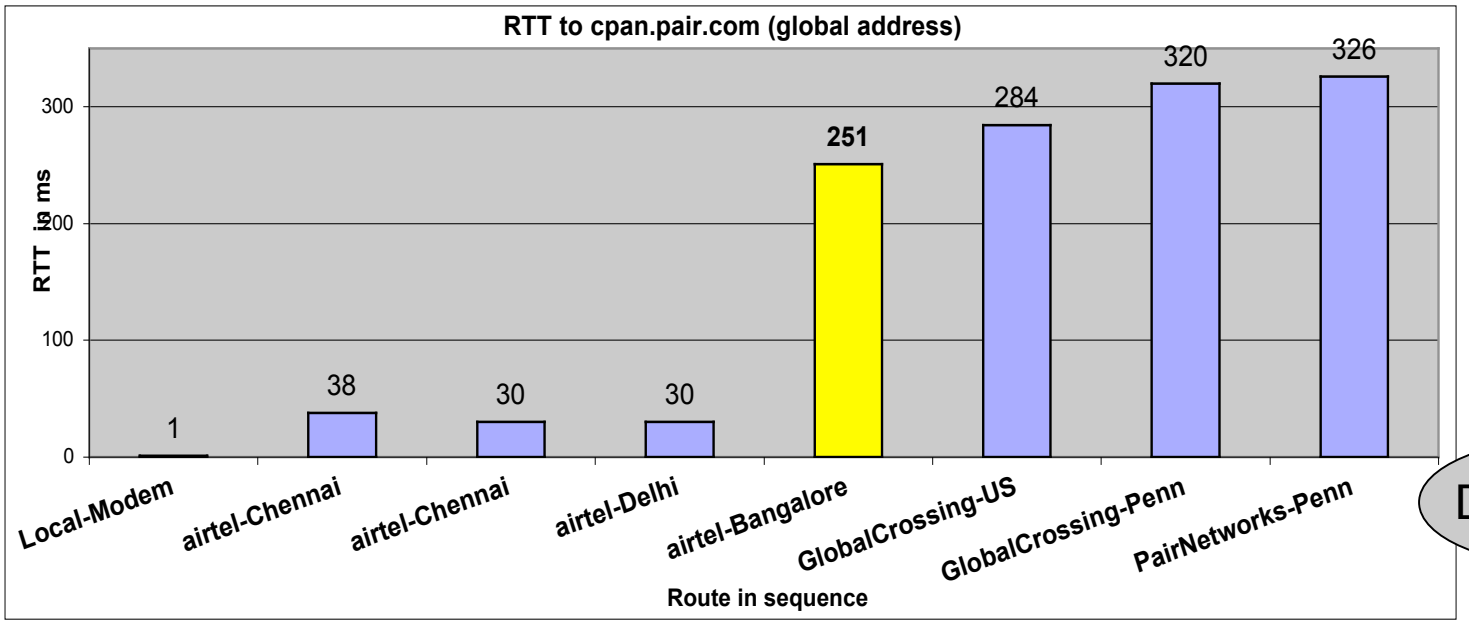
Delhi Airtel

Int'l Round-trip time -- hop-by-hop

Trace route from PC in Chennai to server



Chennai BSNL



Delhi Airtel

- Int'l gateway is bottleneck
- RTT 100-200 ms achieveable

Using RTT/latency in broadband QoS regulation

***National Network Latency (NNL)*: Round Trip Time (RTT) taken to access a national or site hosted within the country**

***Requirement:* NNL < 85ms for 95% of the peak time**

***International Network Latency (INL)* : Round Trip Time (RTT) to the first overseas entry point**

***Requirement:* INL < 300ms for 95% of the peak time**

Analysis of RTT

- RTT is key because of TCP behaviour
- Delay is due to link bandwidth, and router congestion
- TCP adapts speed to end-to-end metrics RTT and loss

$$Speed \propto \frac{1}{RTT} \times \frac{1}{Loss}$$

- Apparently unnecessary hops between cities
- National gateway between operators is a bottleneck
- Int'l gateway is the main bottleneck

Sample Results 256k unlimited: Points to ponder

- ISPs give much better than minimum advertised rate in ISP domain, but most users don't use ISP servers
- National download is much better than minimum, RTT meets international standards (<85 ms)
- Int'l download often does not meet minimum, RTT is higher than int'l/TRAI norms

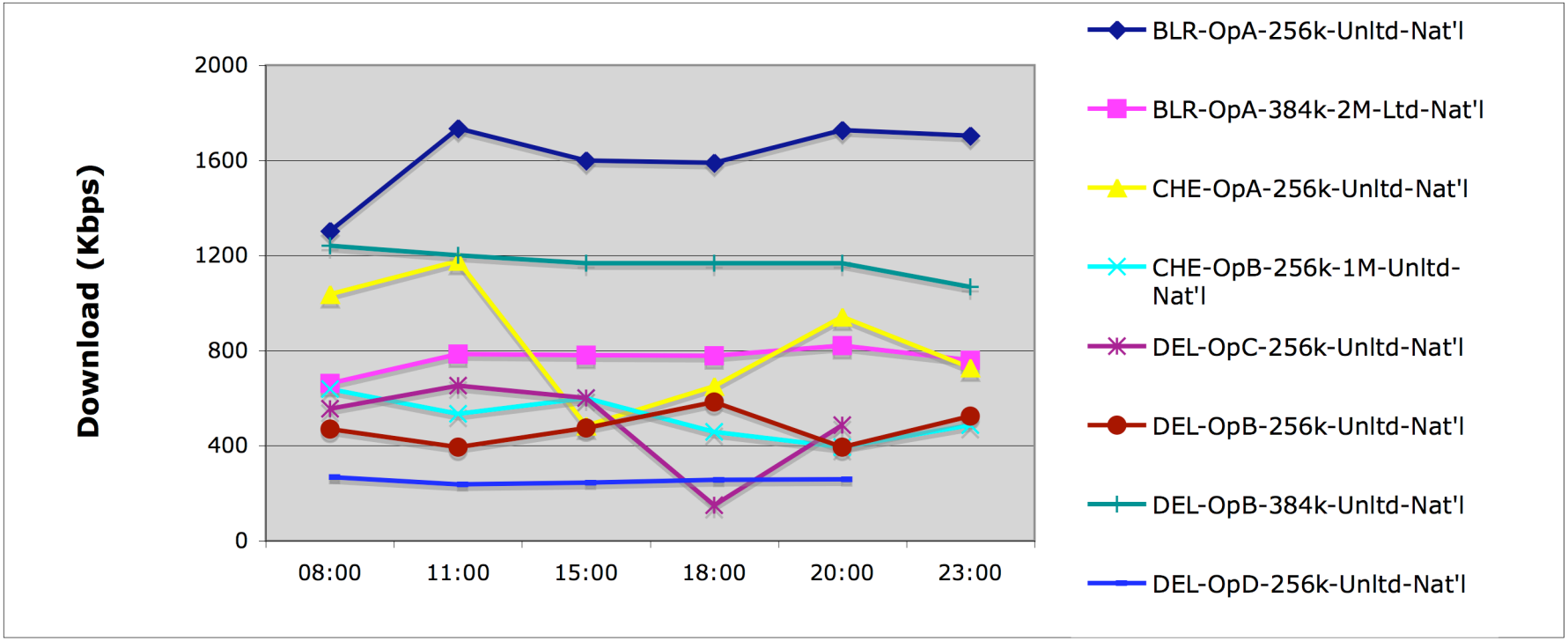
==> Need **tuning of gateway** + more int'l bandwidth
==> Need more caching/mirroring/hosting of content in India

All-India Metro Results

LIRNEasia
www.lirneasia.net

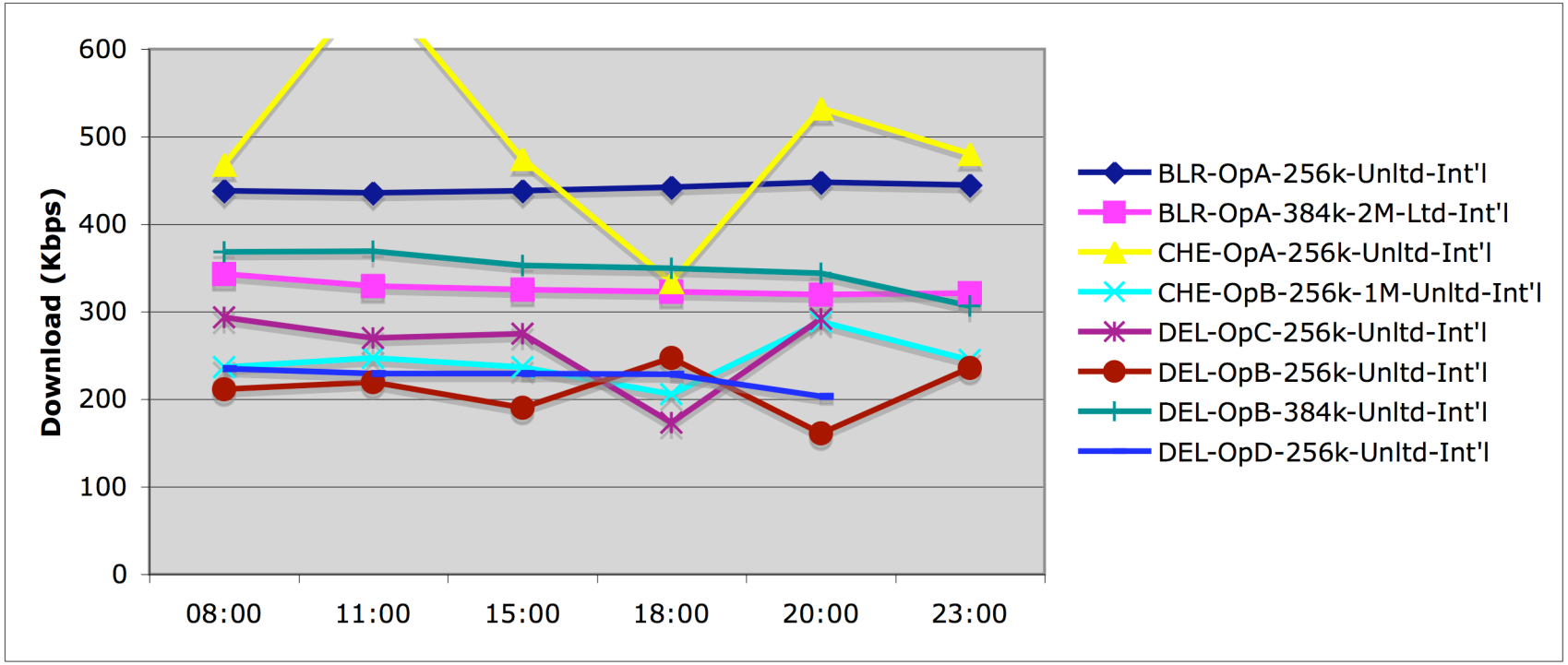
TeNeT

National Download speed (all India metro):
Relatively healthy in ISP/National domains…



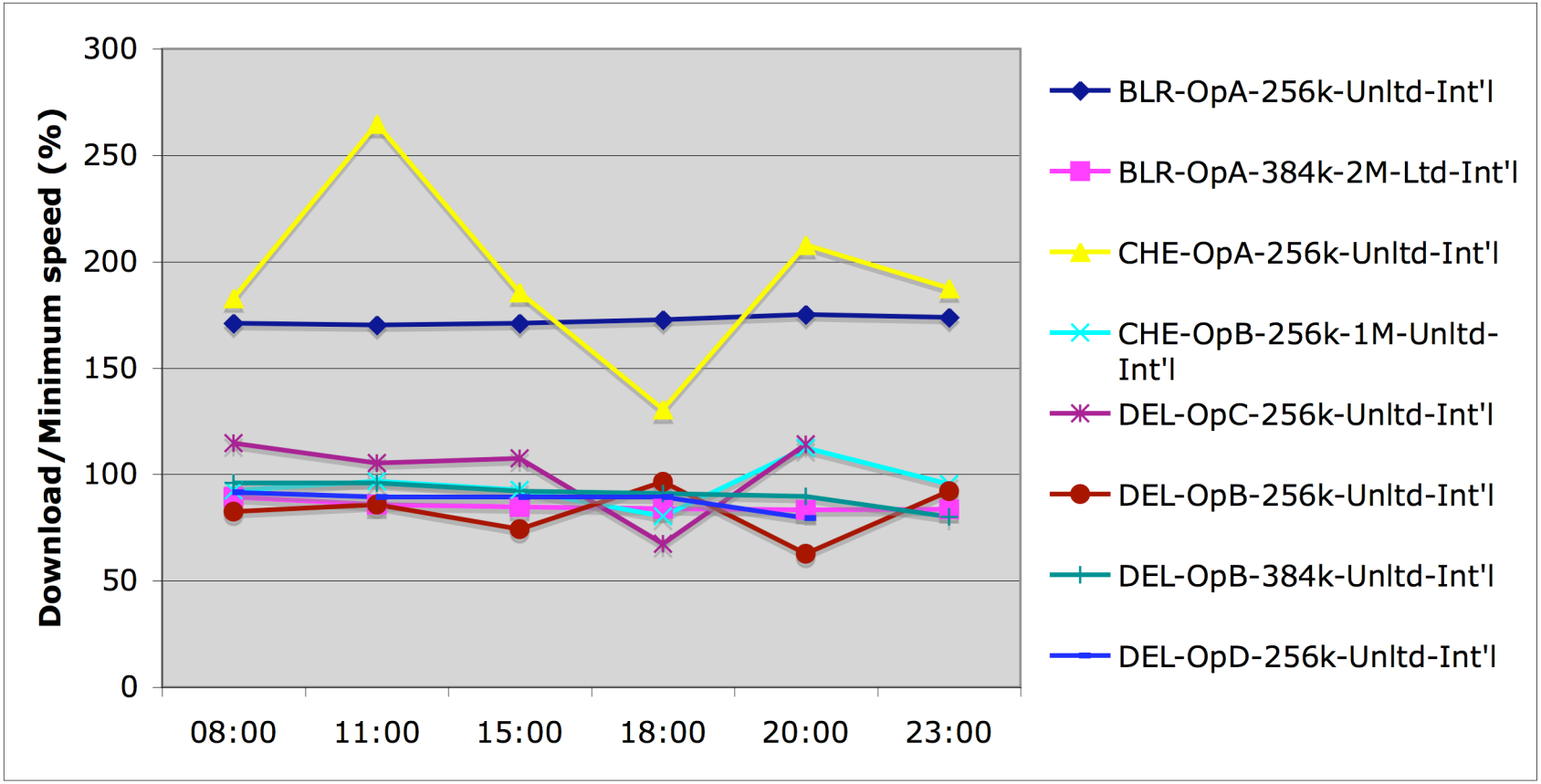
- Bangalore is OpA gateway to other operators, so BLR has good speed
- Most operators “average performance”

Int'l download speed (all India metro):



- Curiosity: OpA did better than OpB although OpA uses OpB for int'l connectivity
- QoSE of different plans not necessarily related to cost

Int'l download/minimum speed % (all India metro):



- Most plans under 100%
- OpA gave better than minimum

All India metro: Points to ponder

- National download speed is well above the plan minimum in most cases
- Int'l download speed barely reaches the plan minimum in most cases
- Subscribers in their operator's "gateway city" seem to get better QoSE
- *Caveat:* comparative results are only indicative, need many more tests for each ISP/plan to draw definite conclusions

India vs. N. America

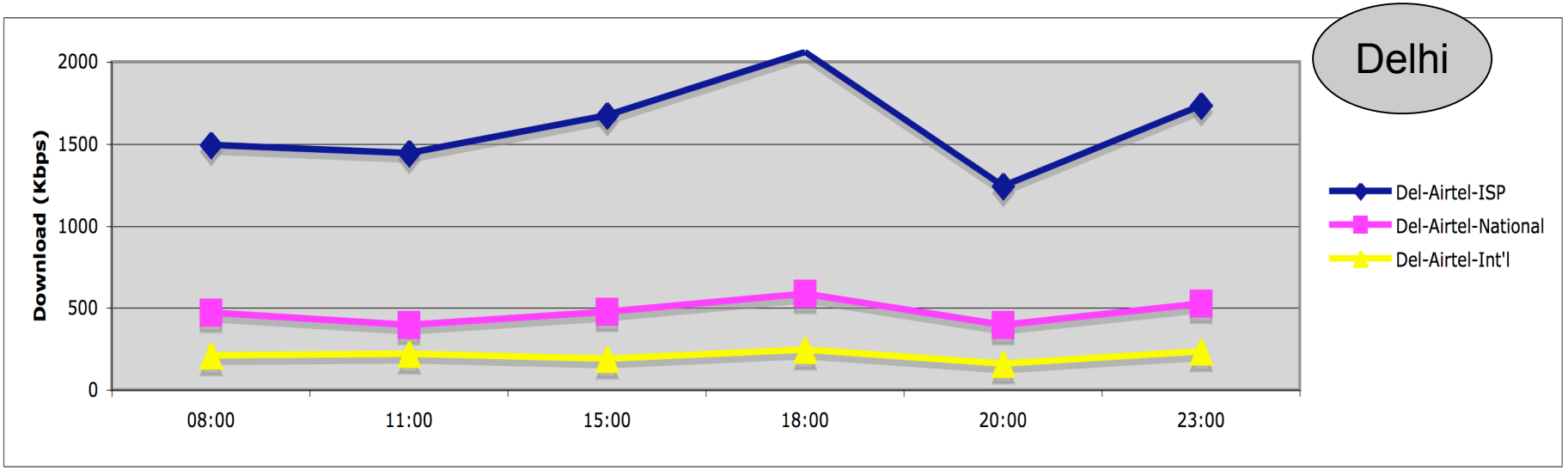
Throughput and Delay

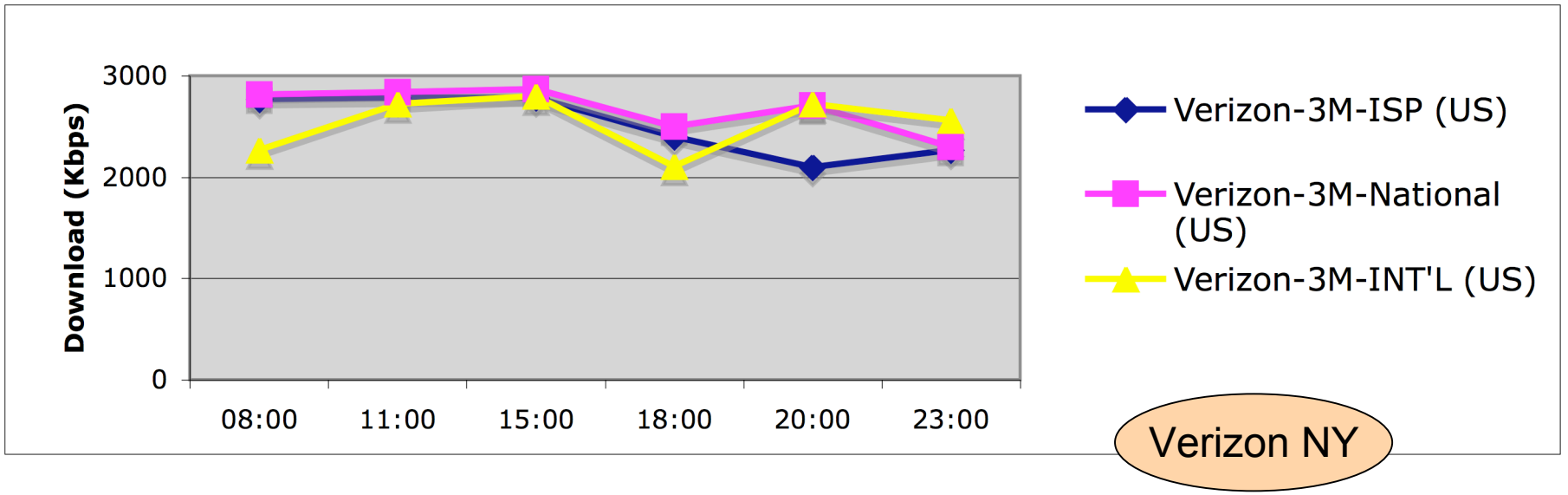
LIRNEasia
www.lirneasia.net

TeNeT

Download speed (India and US):

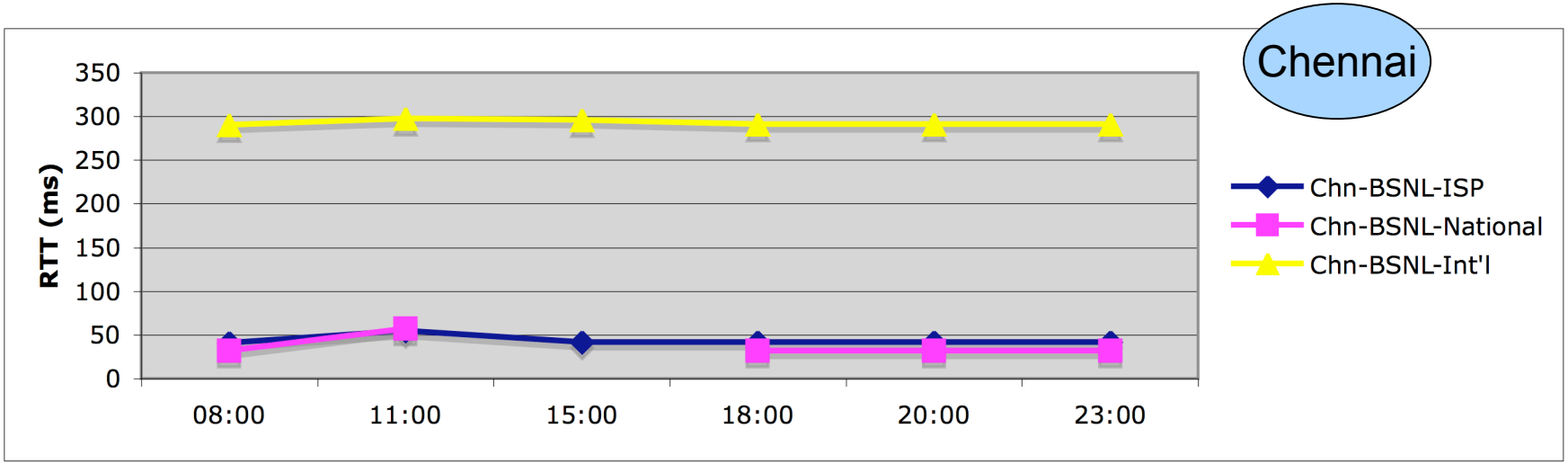
India: ISP good, big differences; US: only small differences

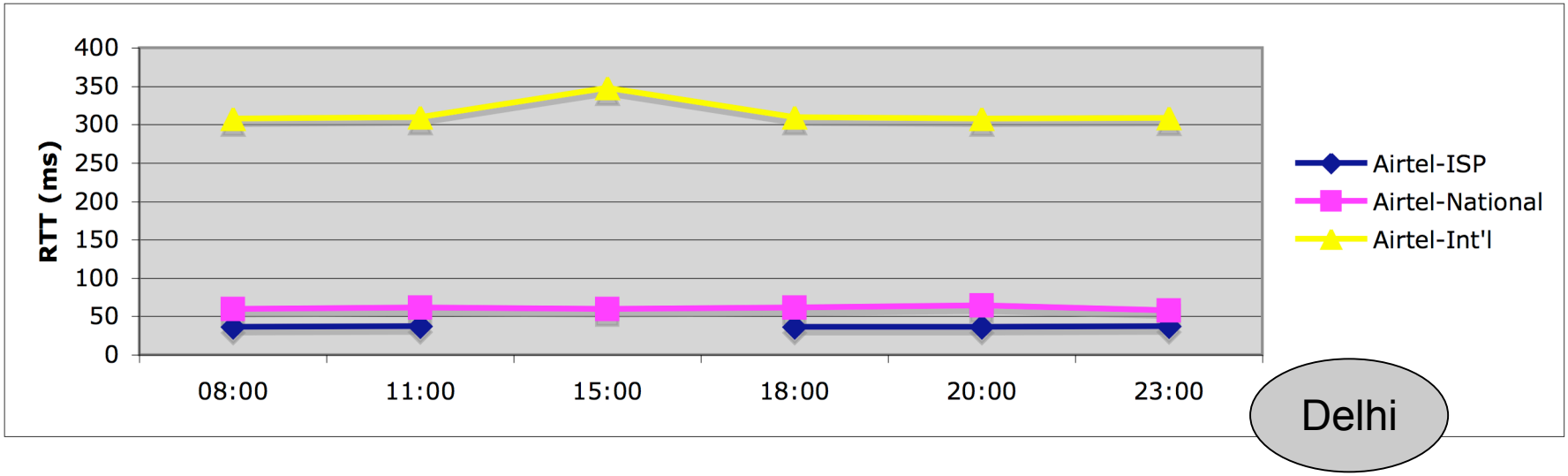




RTT (India):

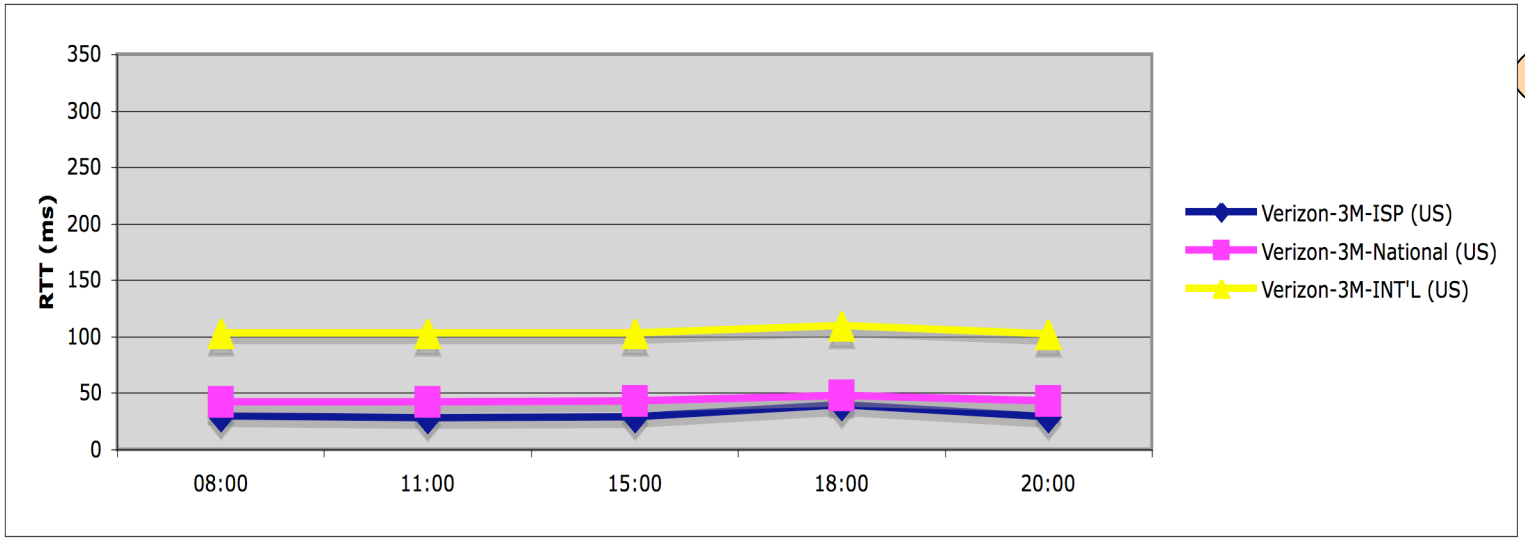
ISP/Nat'l: very good; Int'l: barely acceptable



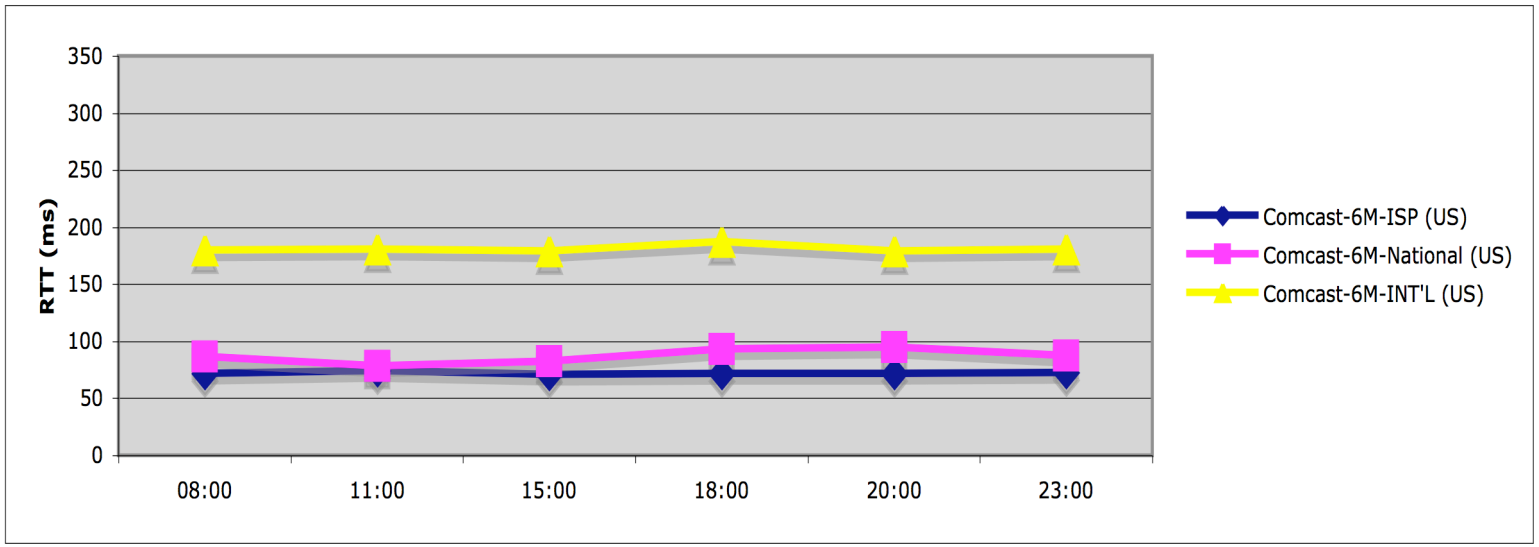


RTT (US):

ISP/Nat'l: very good; Int'l: good



Verizon NY



Comcast CO

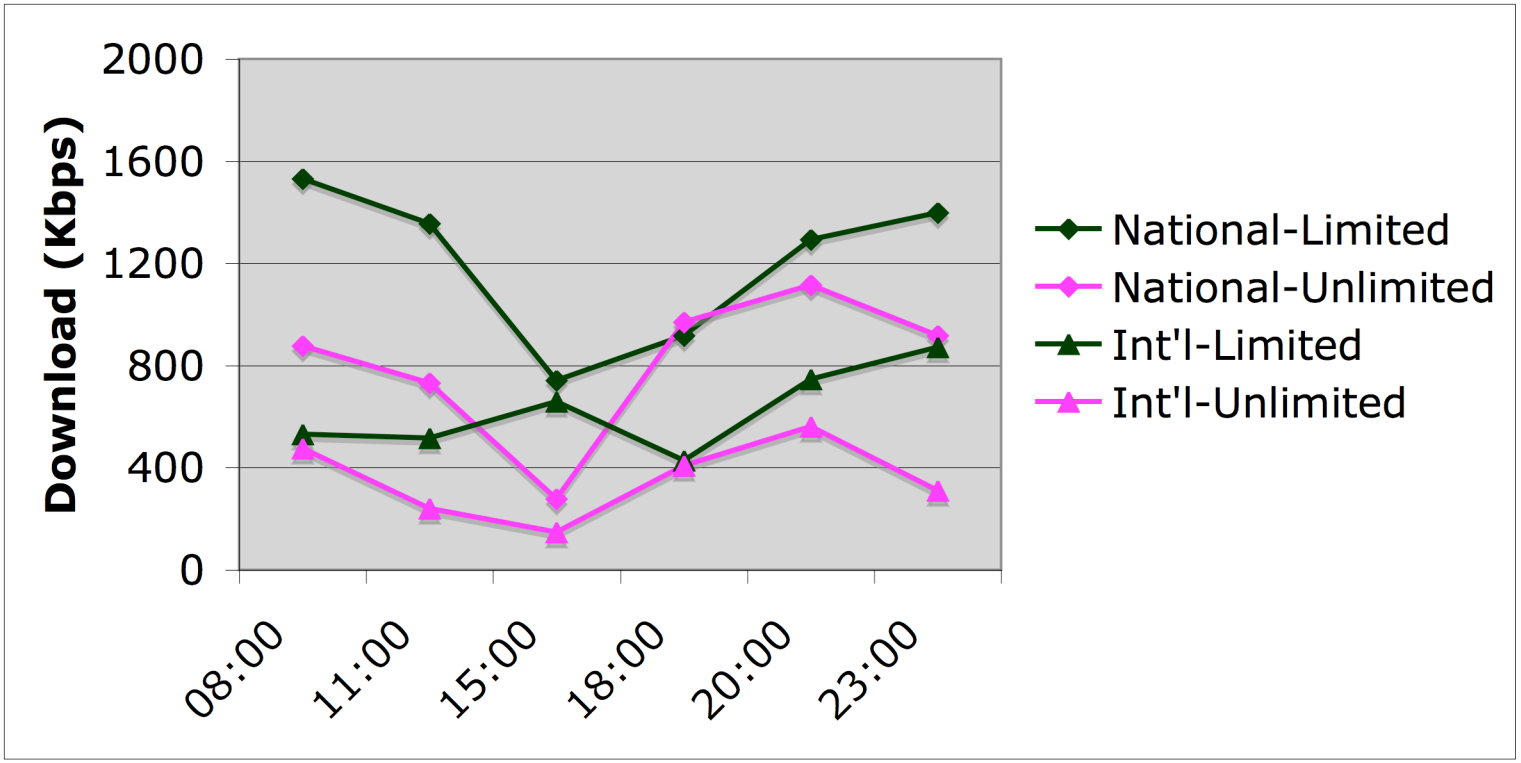
India vs. N. America: Points to ponder

- India
  - variation across time-of-day
  - very high difference between national and int'l
- N. America
  - uniformly good QoSE almost always -- due to over-provisioning and good network management

Analysis of Plans

256k-2M limited vs. 256k unlimited

Download speed

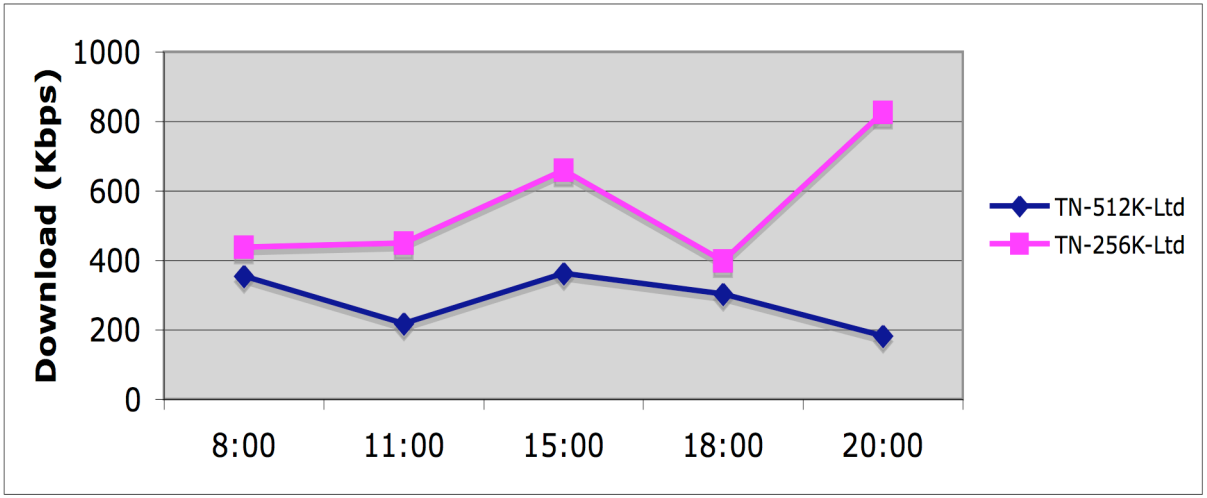


Unlimited gave lower QoSE than *limited*:
apparently less value for more money

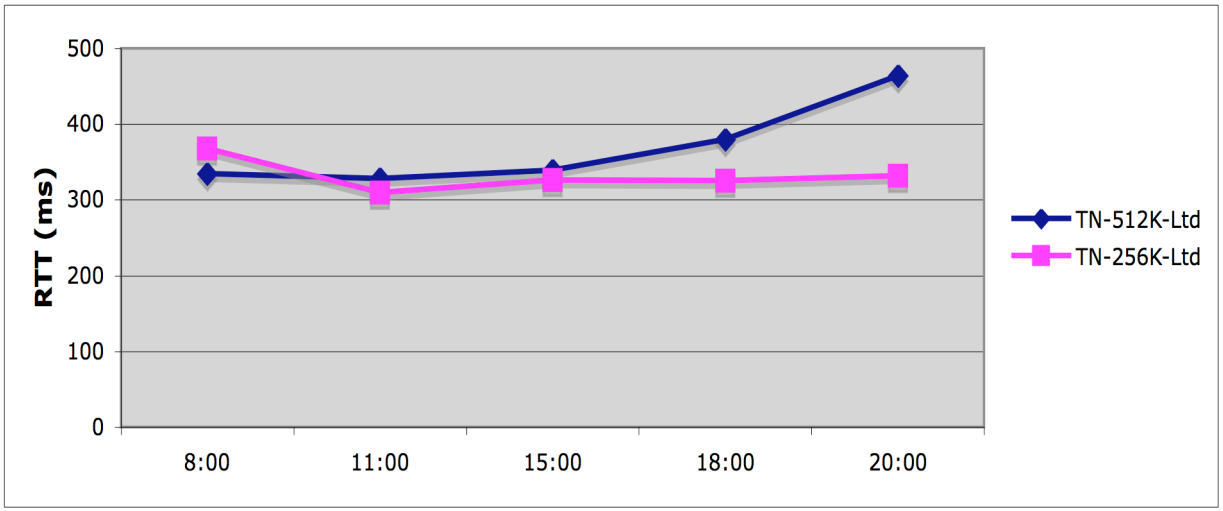
Of course, *Unlimited* gives more monthly download

Premium plans

QoSE may not increase with “higher” plans



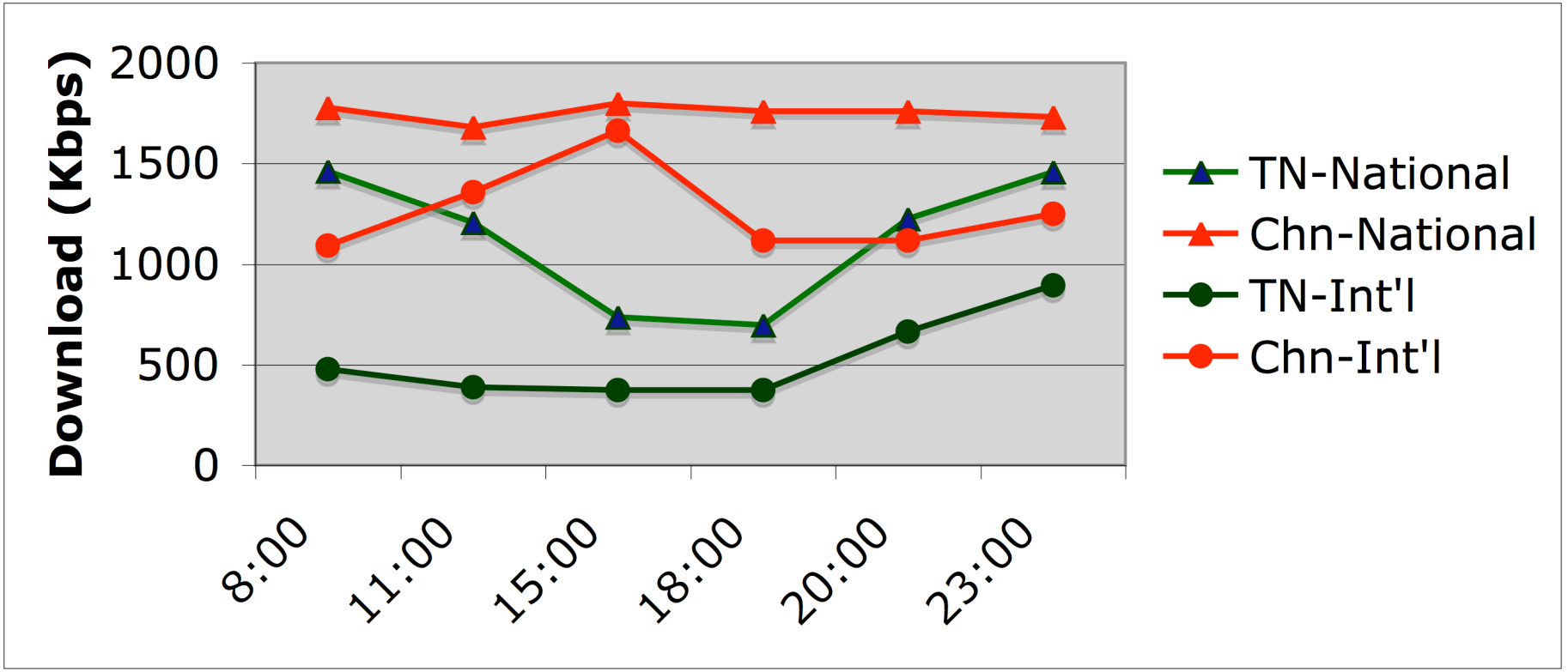
256K 512K



- Last-mile is not the bottleneck, so increasing minimum in it does not help
- End-to-end speed of TCP depends on RTT and loss (not raw bandwidth)
- Premium plans offer other benefits e.g. higher data transfer

Chennai vs. Tamilnadu (256k-2M limited):
The digital divide still exists

Also, power failures common in rural areas



CDMA Mobile 256K limited (one town in TN)

Download (Kbps)	8:00 AM	11:00AM	03:00PM
ISP	254	216	183
National	353	194	174
Int'l	317	167	136
RTT (ms)	8:00 AM	11:00AM	03:00PM
ISP	436	890	749
National	387	522	570
Int'l	644	576	628
Jitter (ms)	8:00 AM	11:00AM	03:00PM
ISP	327	613	600
National	235	462	460
Int'l	340	289	344

High RTT and very high jitter for all domains -- results in similar download speed for all domains -- does not meet nat'l/int'l standards

Points to ponder

- Paying more money does not imply better QoSE -- customer needs more technical awareness
- Rural urban divide still exists, could be reduced
- Wireless broadband may be very different from wired broadband

Other Drivers for Broadband

Infrastructure

Broadband costs are low: Rs. 2.5K-12K/year
Connectivity is rapidly proliferating

1. Power is very unreliable in rural areas
2. Needs a PC: Rs. 20K replaced every 3 years
   - Plus software, maintenance hassle

Solution: low-cost thin client such as Novatium's NetPC and Nova Navigator

- Maintenance-free, low power appliance
- Computing as a utility service, monthly co similar to broadband tariff

Conclusions

- All operators offer broadly similar QoSE
- Over-advertising is rare (thanks to TRAI and operators) but subscribers may misunderstand
- Routing of packets esp. between operators can be improved -- bigger role for NIXI?
- International QoSE is a bottleneck across the board -- scope for fine-tuning gateway parameters
- Definition of broadband should shift away from raw last-mile speed -- specify QoSE to reference servers?
- Infrastructure (power) and low-cost, reliable access terminals are key to expansion of rural broadband (70% pop.)

Thank You!

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