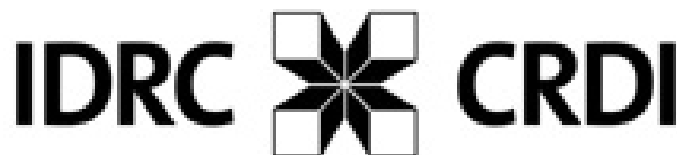


Broadband QoS Test Results Illustration

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**Expert Forum on ICT Sector Indicators
and Benchmark Regulation
for SAARC Regulatory Authorities,
Changi Village, Singapore
June 15, 2008**



Packages tested

| Packages tested | | Advertised Download Speed | Advertised Upload Speed |
|-----------------|-----------------|---------------------------|-------------------------|
| India | Airtel | 512 kbps | 512 kbps |
| | BSNL - Business | 2 Mbps | 256 kbps |
| | BSNL - Home | 2 Mbps | 256 kbps |
| | Hathway | 256 kbps | 256 kbps |
| Sri Lanka | Dialog | 2 Mbps | 512 kbps |
| | SLT - Business | 2 Mbps | 512 kbps |
| | SLT - Home | 512 kbps | 128 kbps |
| Singapore | StarHub* | 1 Mbps | 256 kbps |

* Partial testing

Test Results

❑ Throughput (Download speed/Upload speed)

Business Packages performance in

- ISP domain
- Local domain
- International level

Sri Lanka vs. India/Singapore performance

Business vs. Home performance

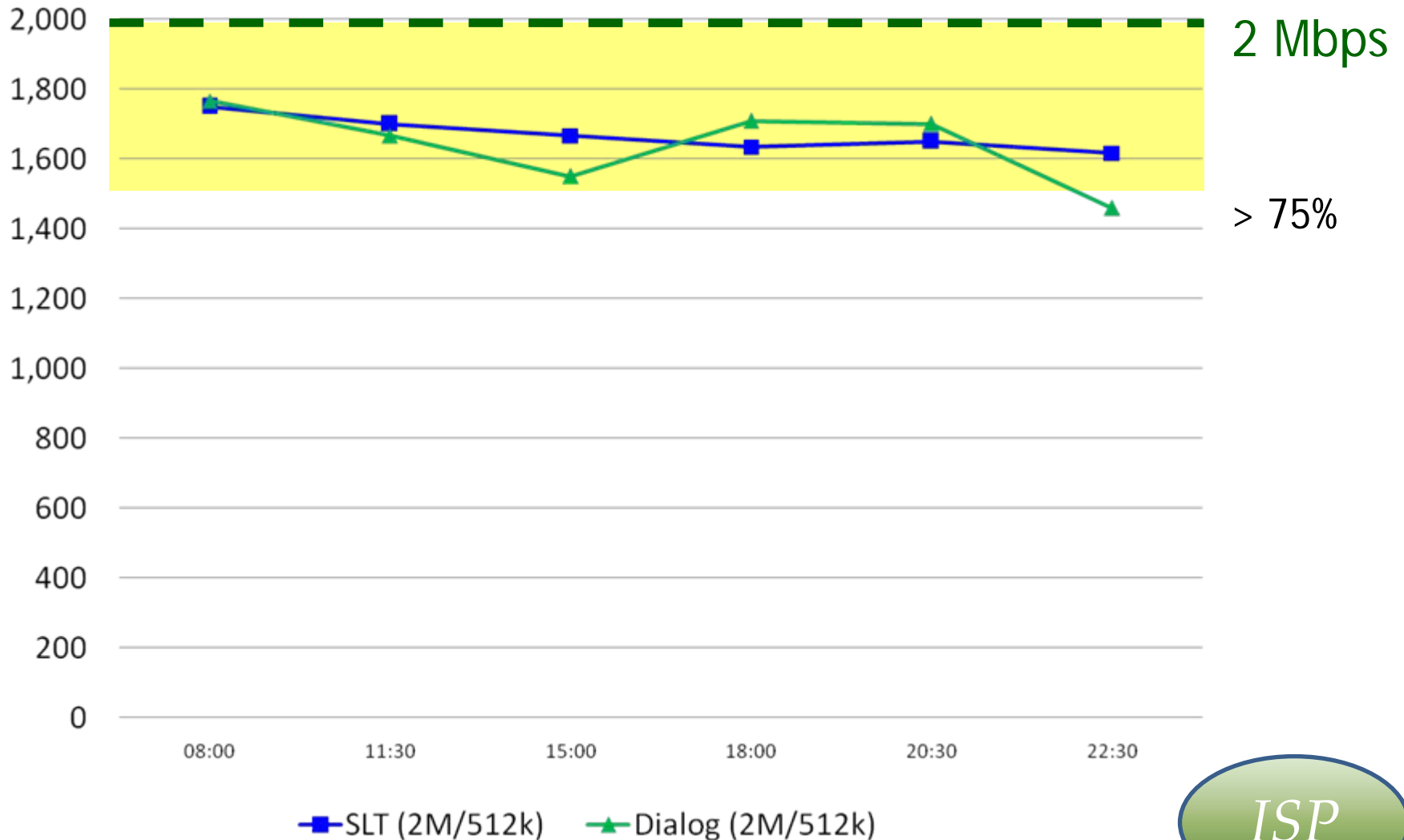
❑ Delay metrics (RTT/jitter)

❑ Loss metrics (Packet Loss)

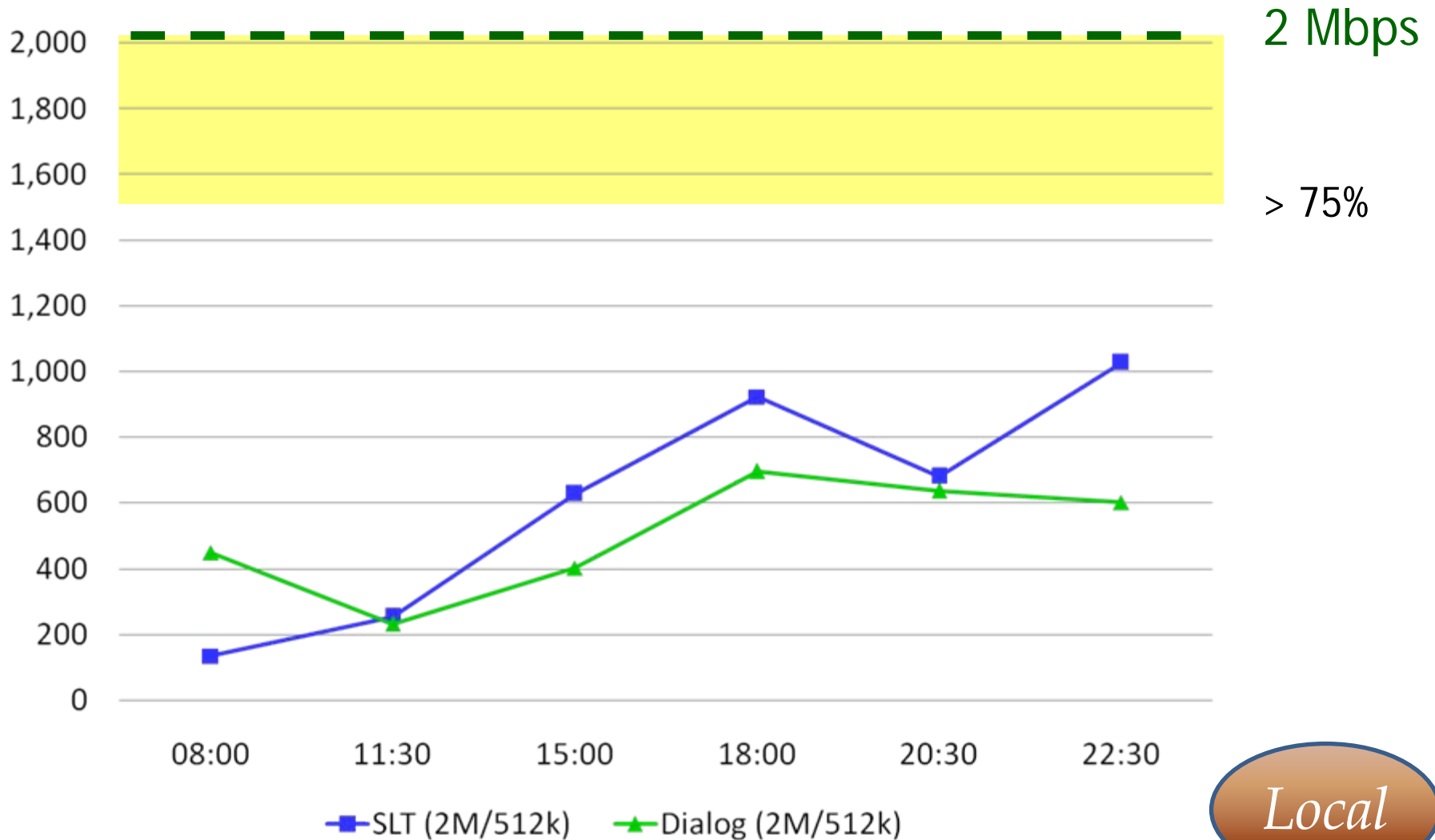
Test Results

Throughput - Download speed

Download speed (Business Packages): Relatively healthy in ISP domain...

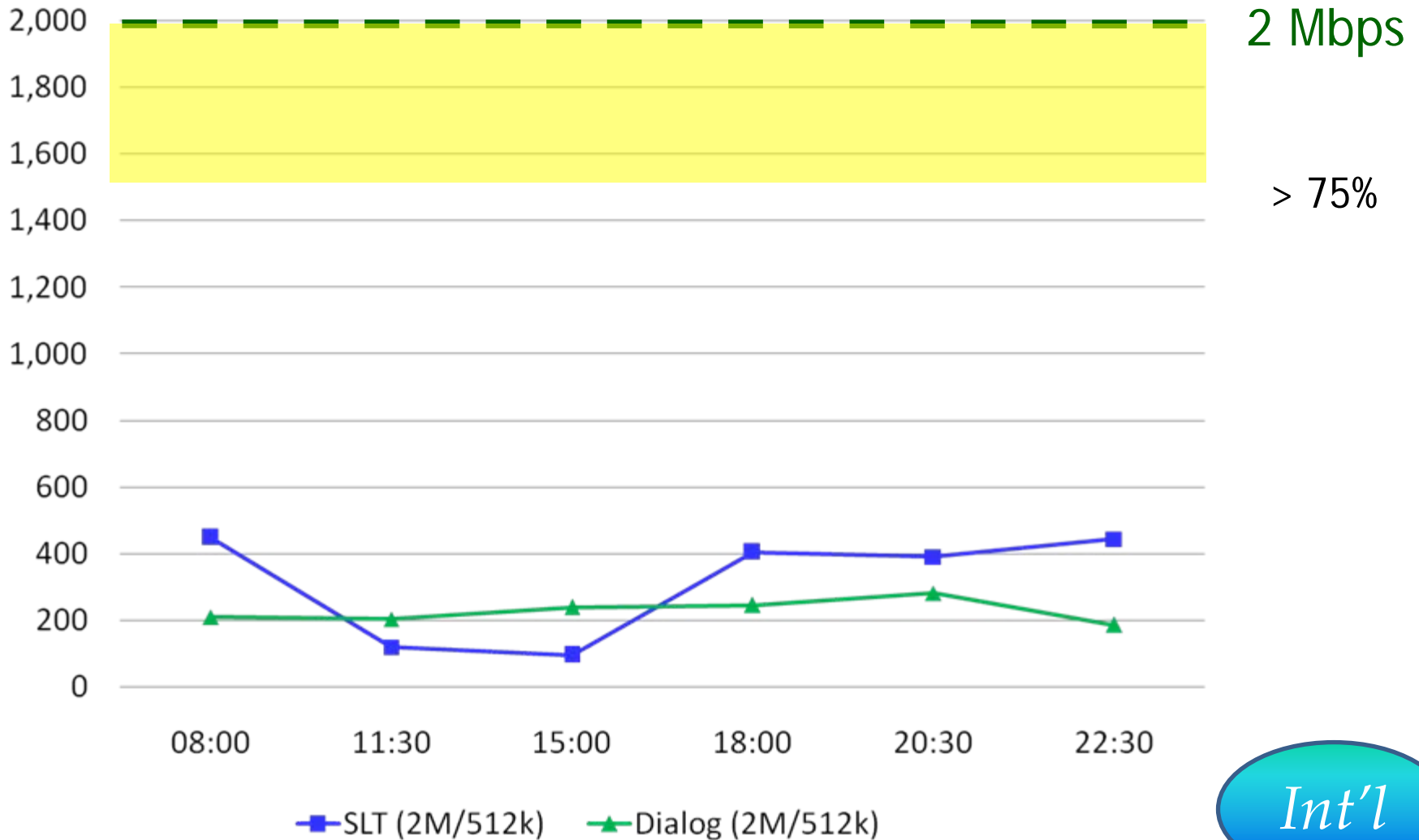


Download speed (Business Packages): ...poor in Local domain

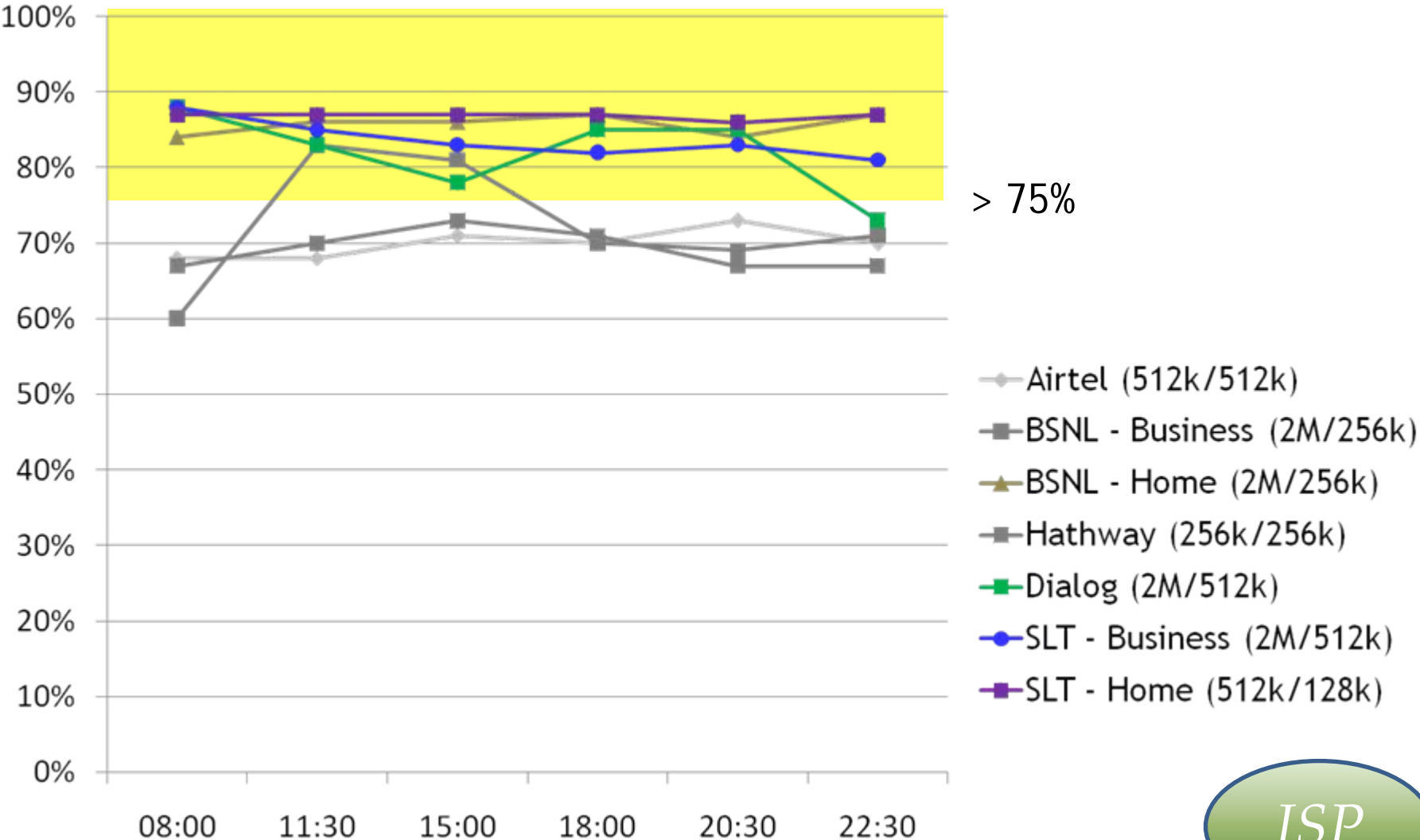


Download speed (Business Packages):

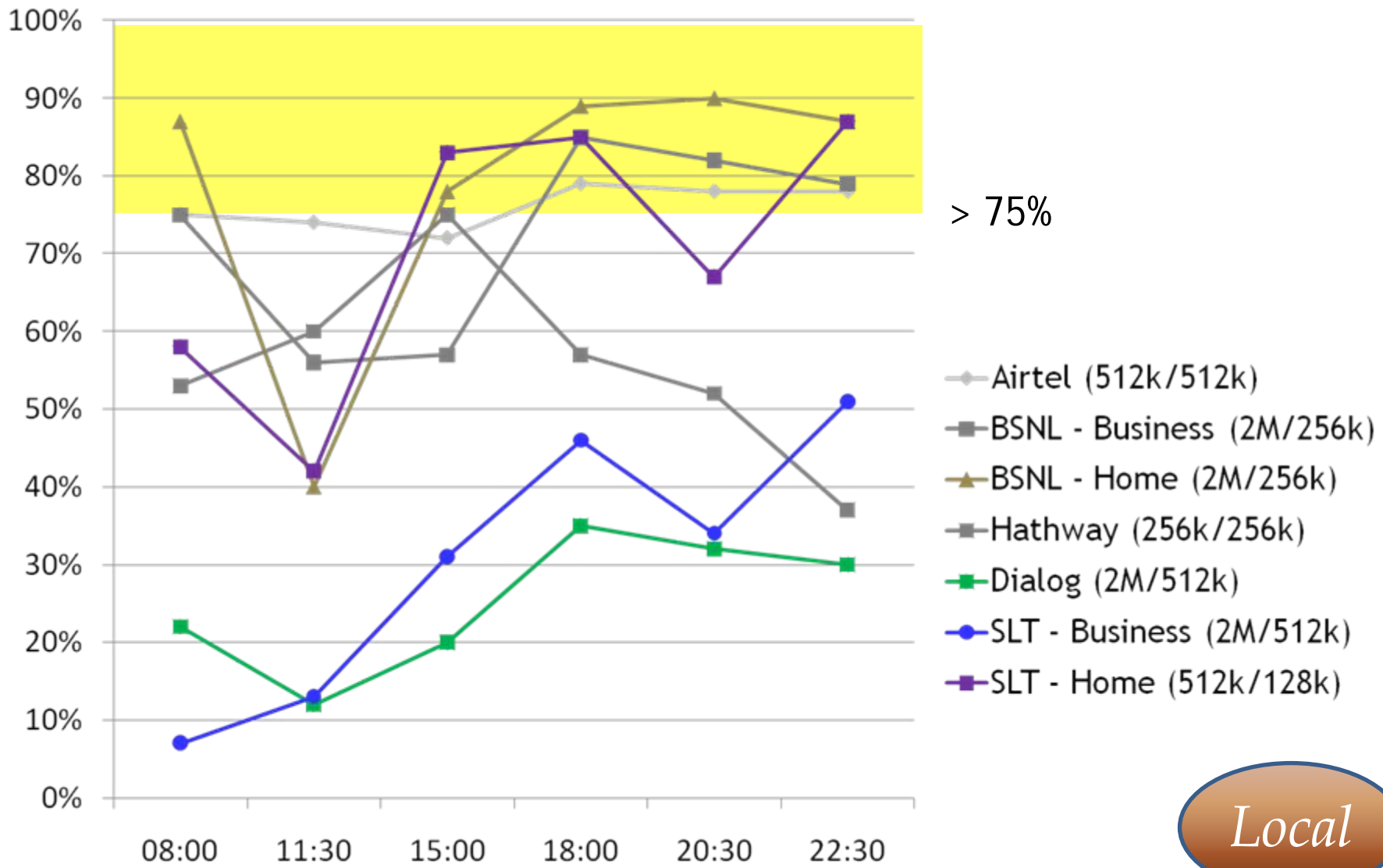
...even poorer when accessing International sites



Download speed: India and Sri Lanka (ISP Domain): Sri Lanka performs slightly better

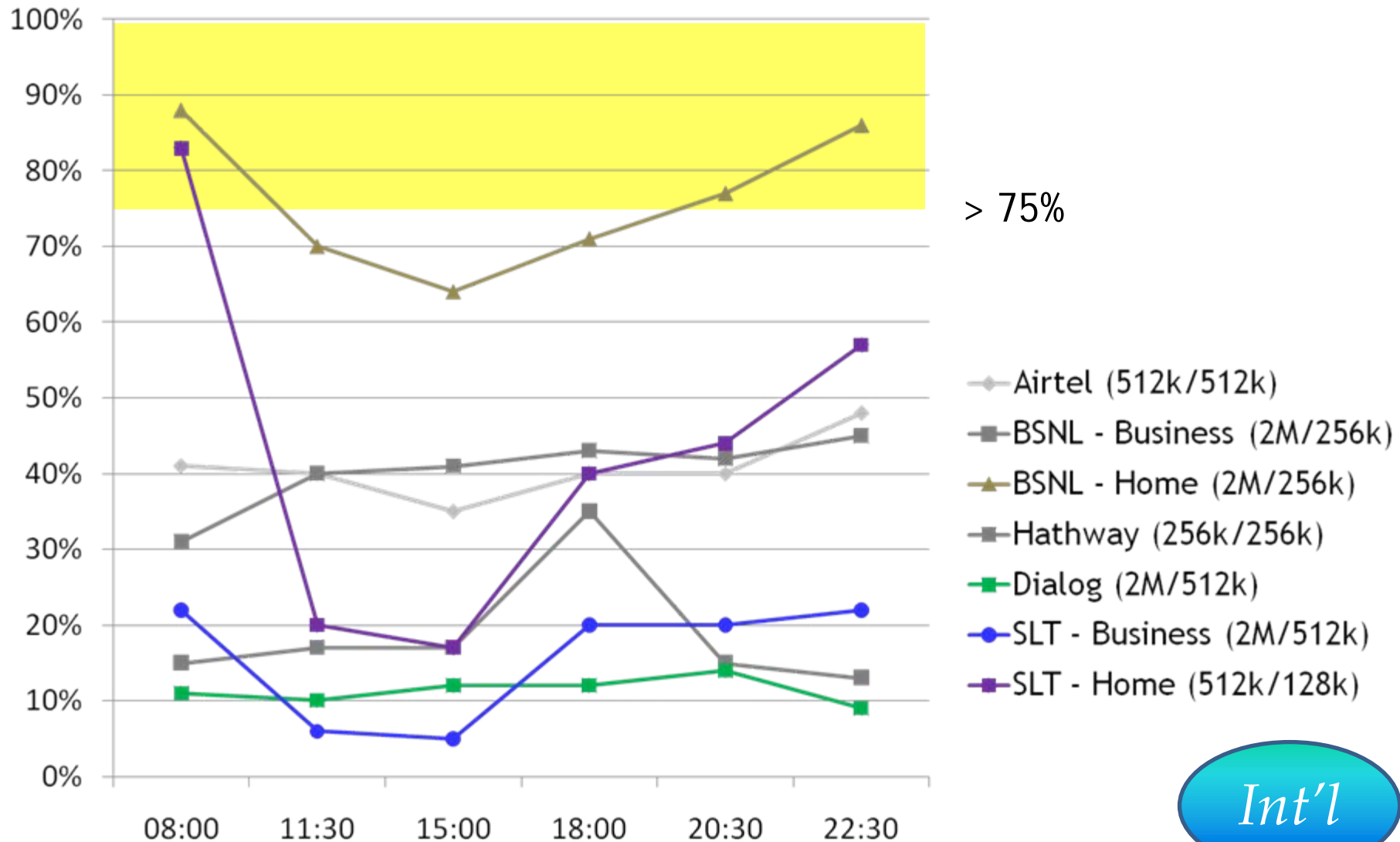


Download speed: India and Sri Lanka (Local Domain): India performs better

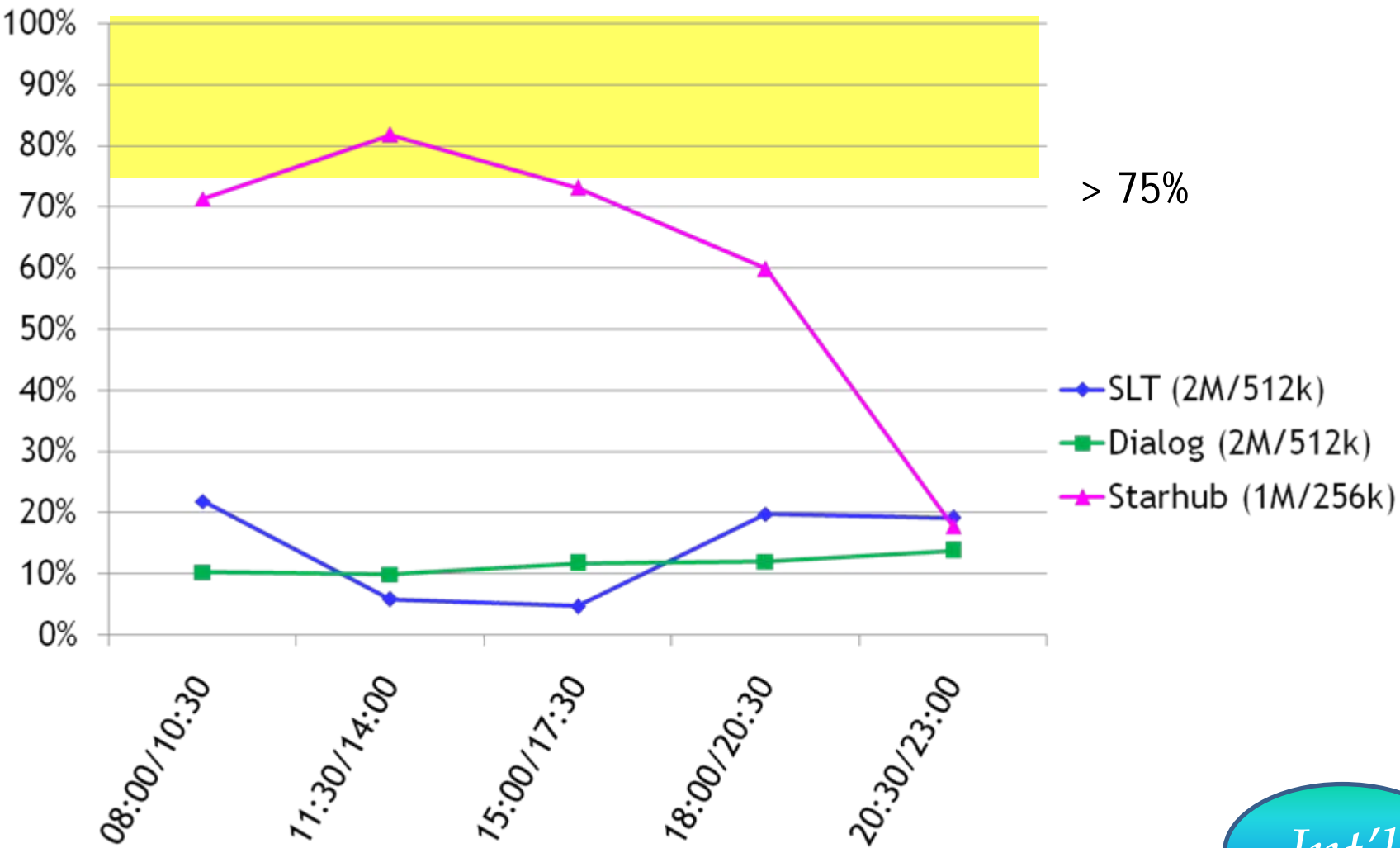


Local

Download speed: India and Sri Lanka (accessing International servers): India looks good



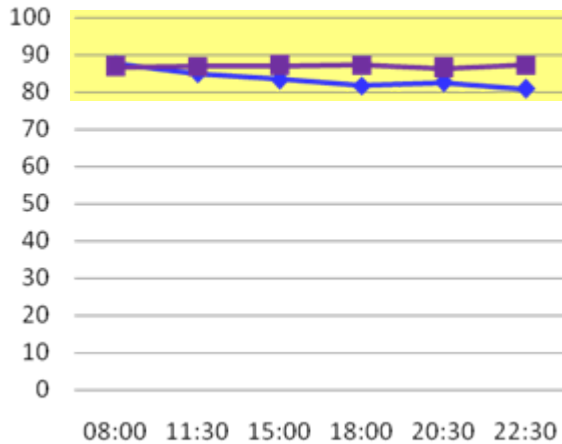
Download speed Sri Lanka and Singapore (accessing International servers): Singapore wins



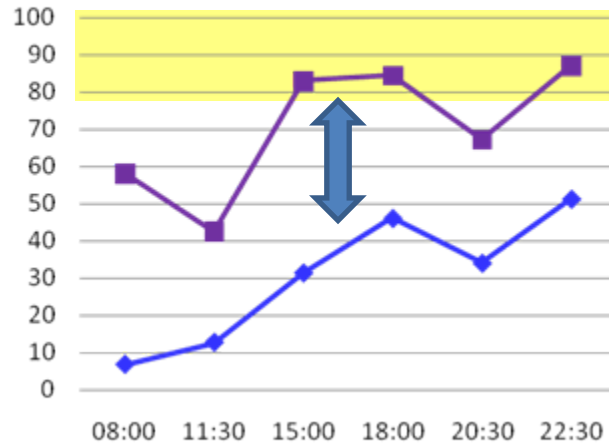
Download speed (SLT Business vs. SLT Home packages):

...in % terms, home is better than business

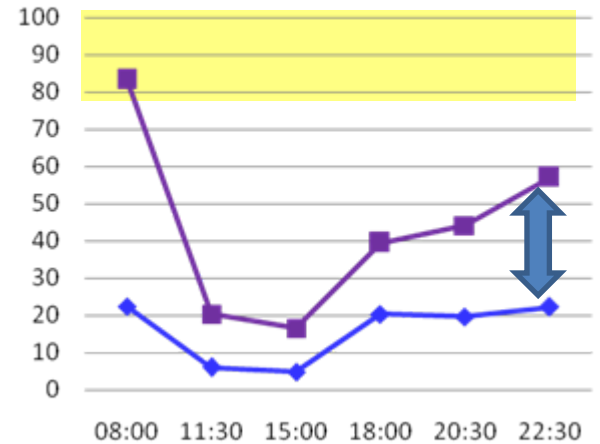
ISP/WD (%)



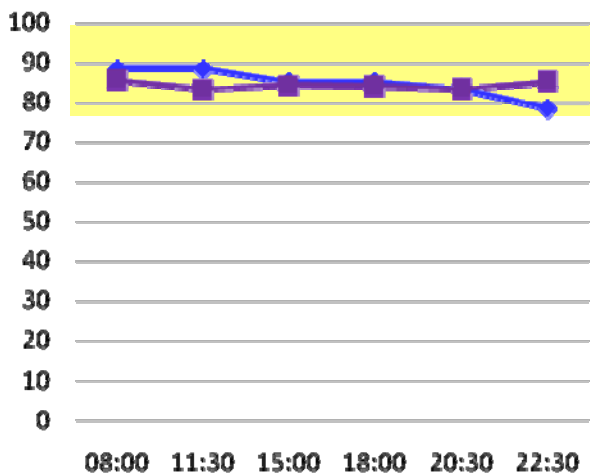
L/WD (%)



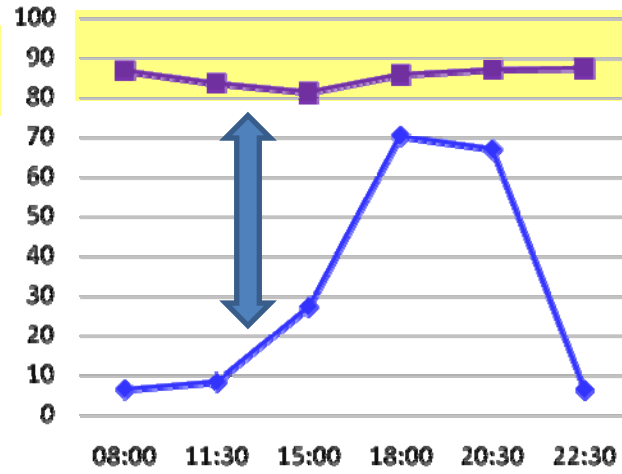
INT/WD (%)



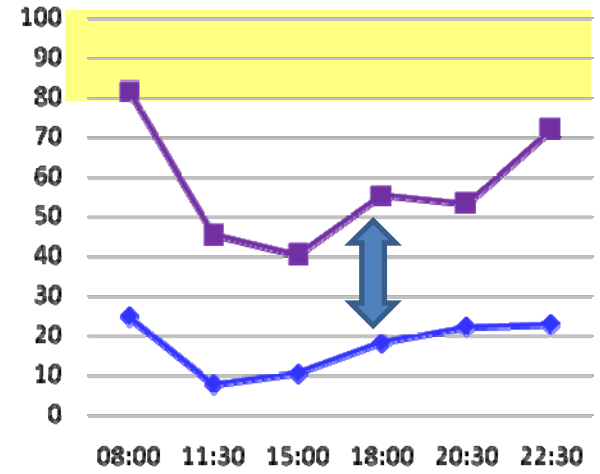
ISP/WE (%)



L/WE (%)



INT/WE (%)



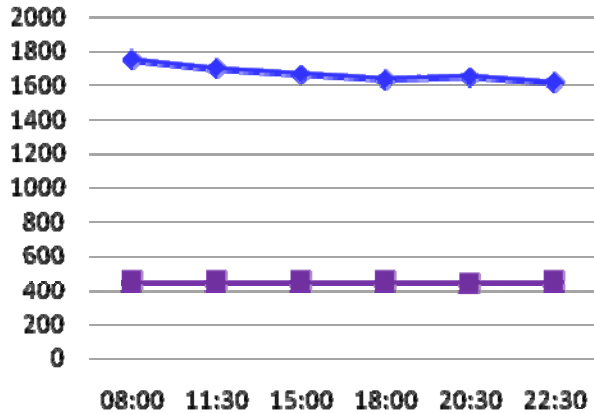
Business Home

Business Home

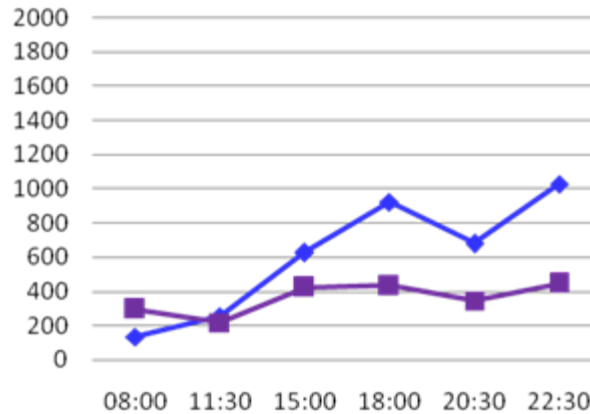
Business Home

Download speed (SLT Business vs. SLT Home packages): ...and comparable in reaching international sites

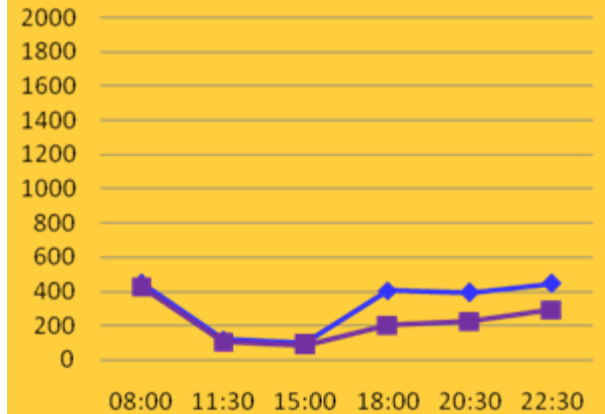
ISP/WD (kbps)



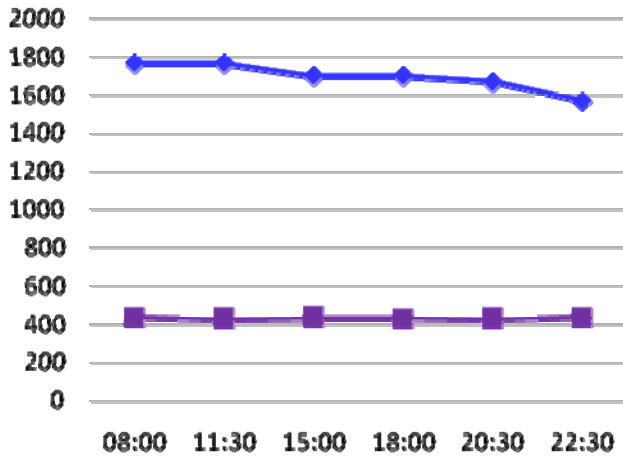
L/WD (kbps)



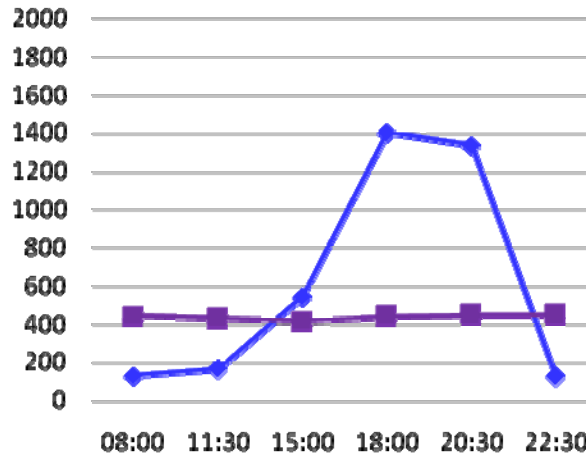
INT/WD(kbps)



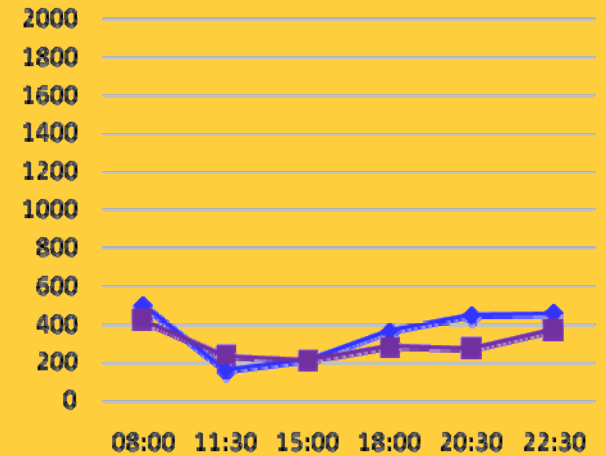
ISP/WE (kbps)



L/WE(kbps)



INT/WE (kbps)



Business Home

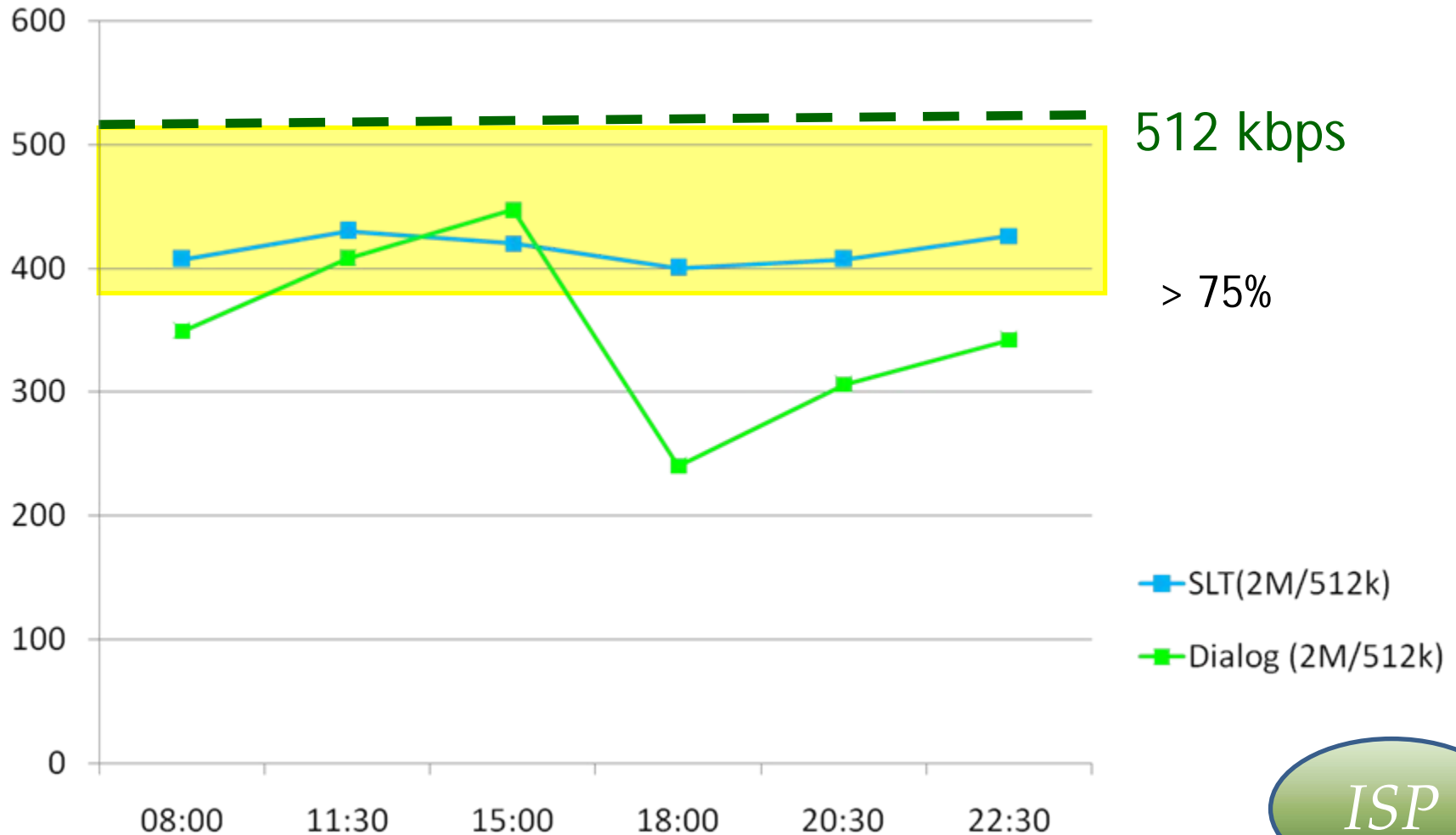
Business Home

Business Home

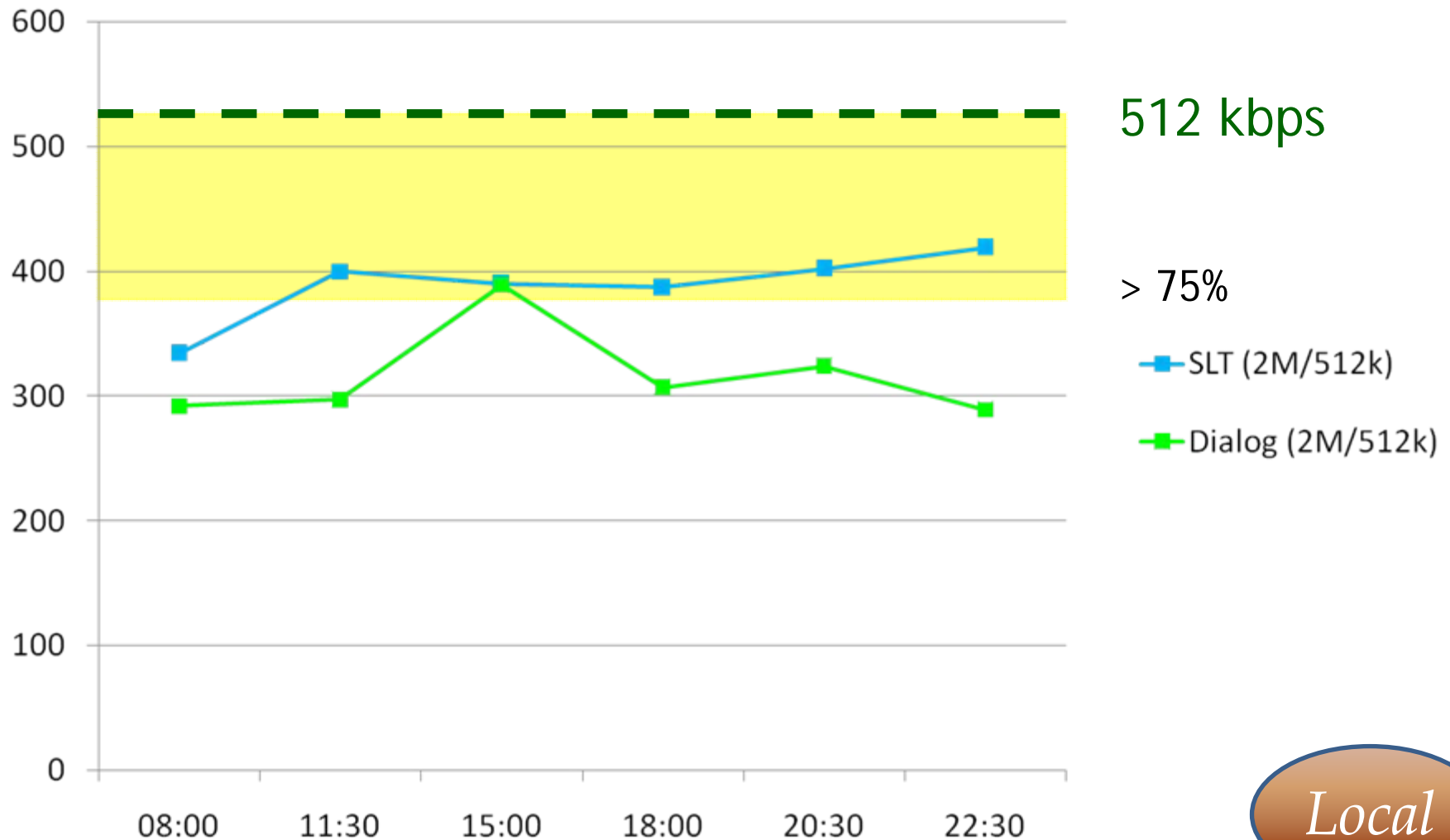
Test Results

Throughput - Upload speeds

Upload speed (Business packages): Somewhat healthy in ISP domain

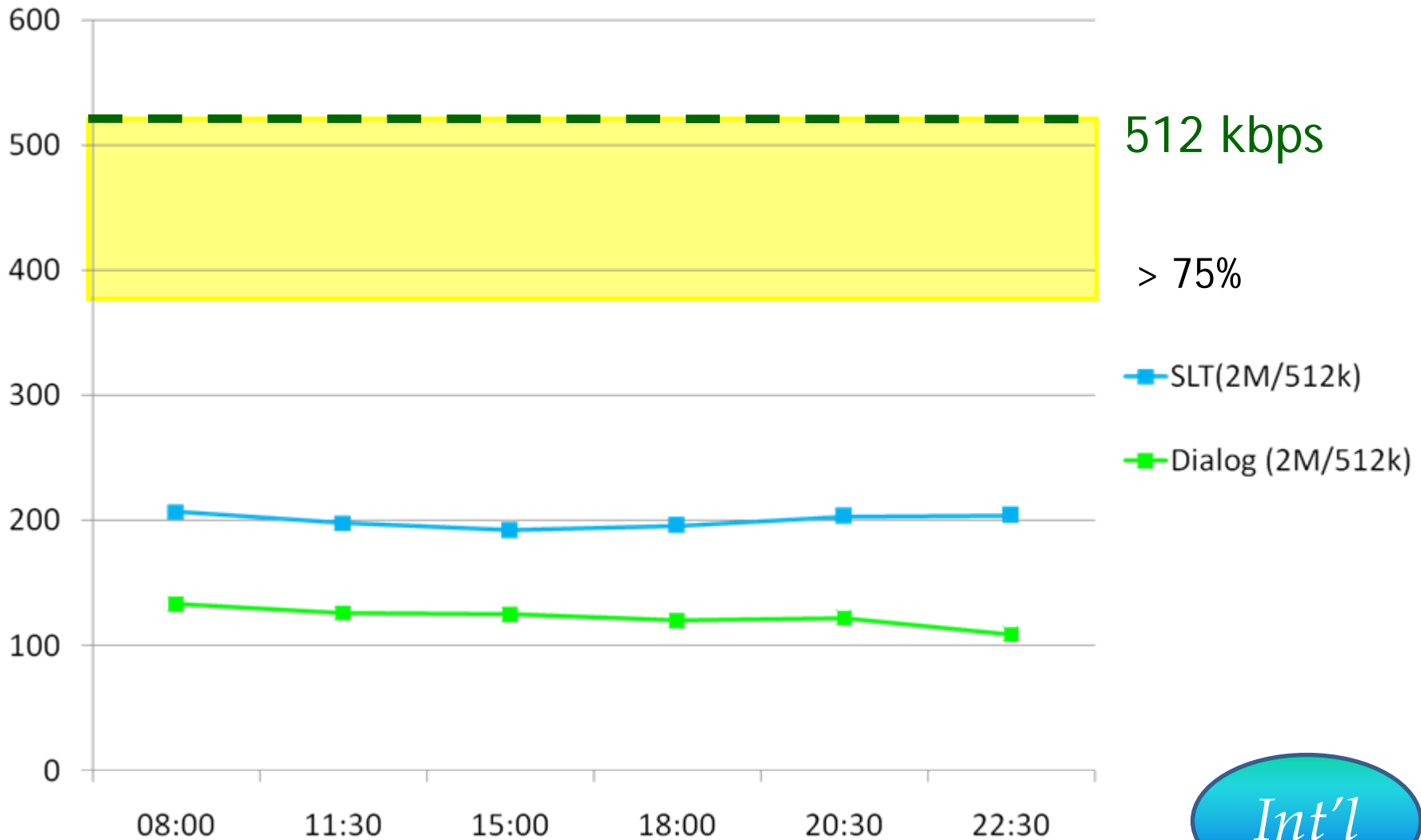


Upload speed (Business packages): ...a bit down at Local Domain

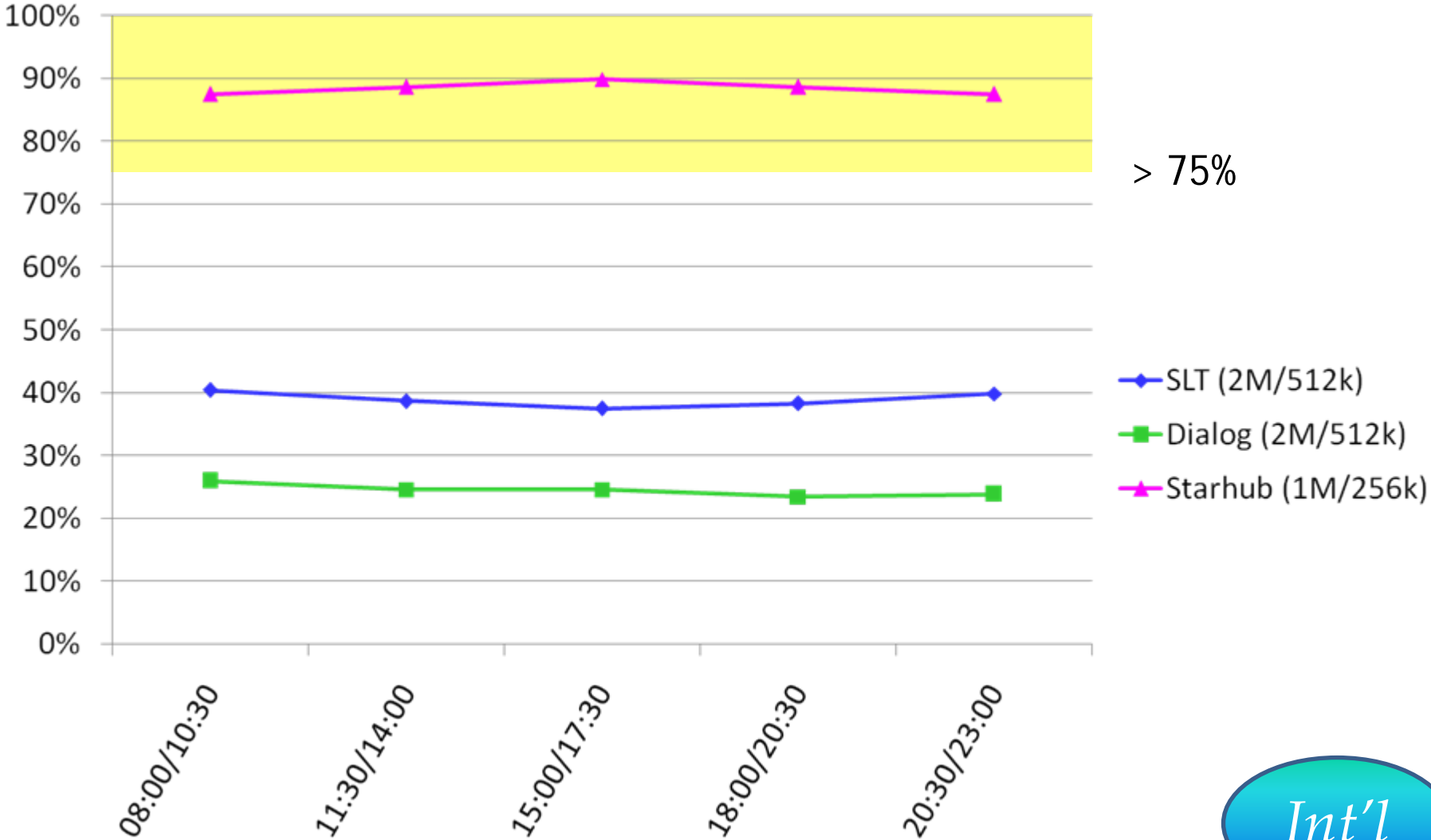


Upload speed (Business packages):

...and poor in accessing International sites

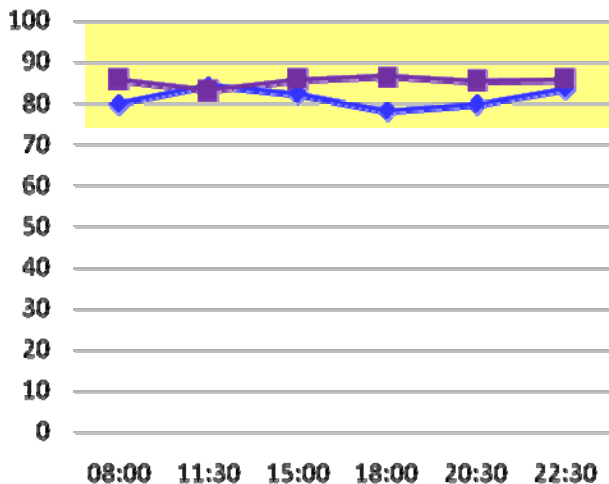


Upload speed Sri Lanka and Singapore (accessing International sites): Singapore wins

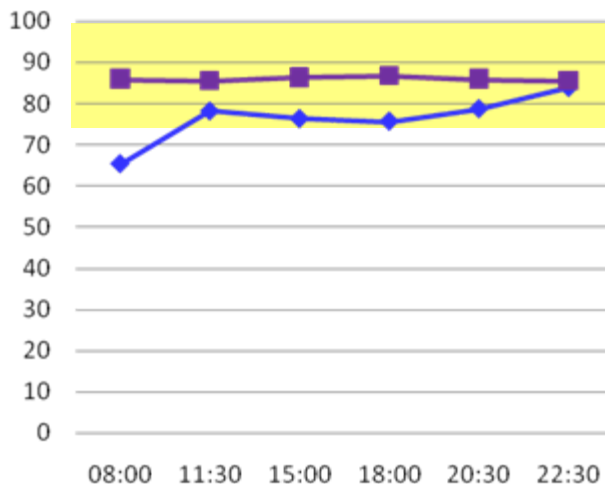


Upload speed (SLT Business vs. SLT Home packages): ...here too in %, home is better than business, but not in actual speeds

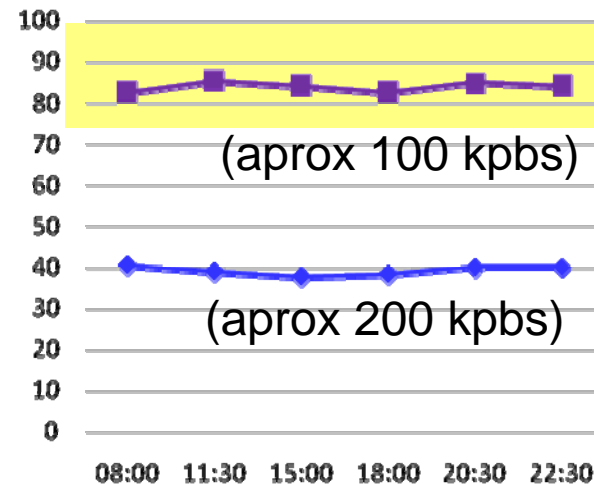
ISP/WD (%)



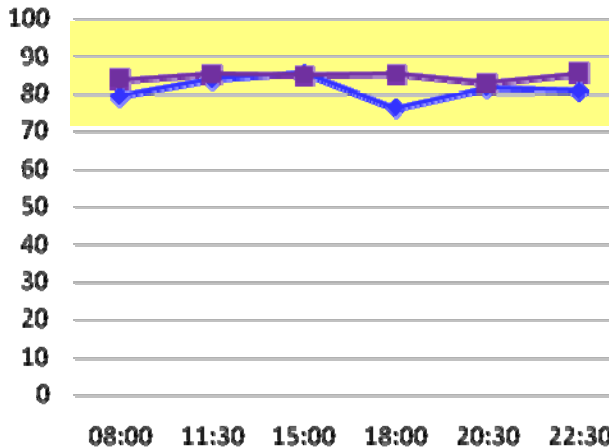
L/WD (%)



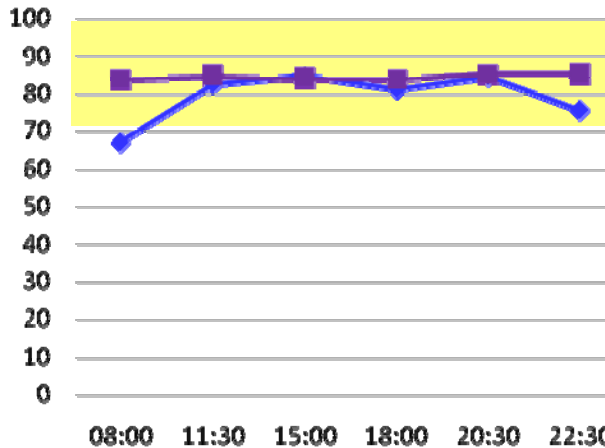
INT/WD (%)



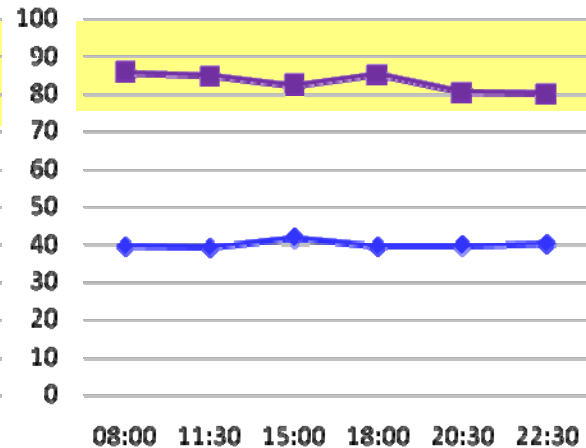
ISP/WE (%)



L/WE (%)



INT/WE (%)



Business Home

Business Home

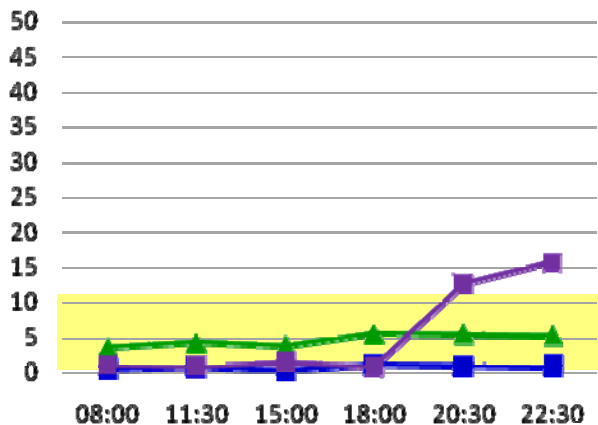
Business Home

Test Results

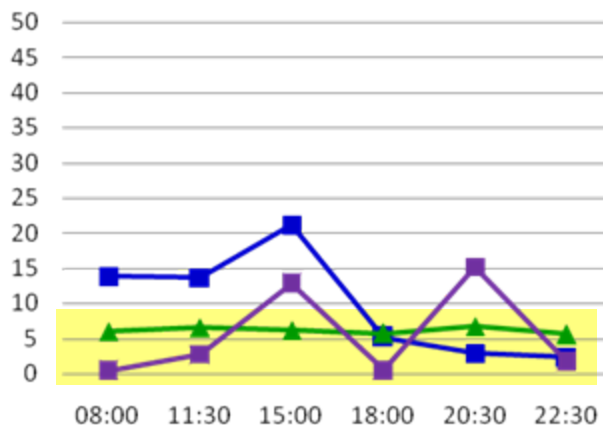
Jitter and Packet Loss

Jitter : Sometimes not enough quality for video/high quality audio ($\pm 10\text{ms}$) but satisfactory for other apps

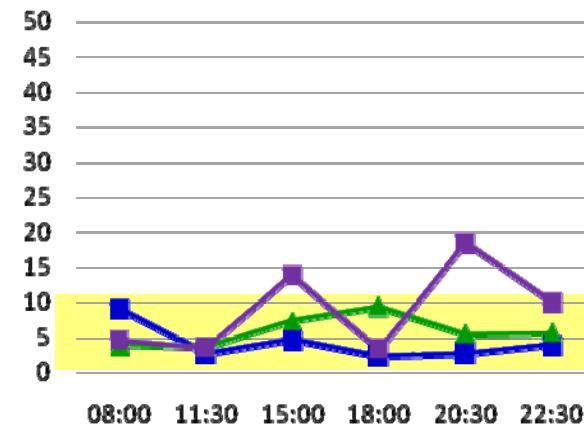
ISP -weekday



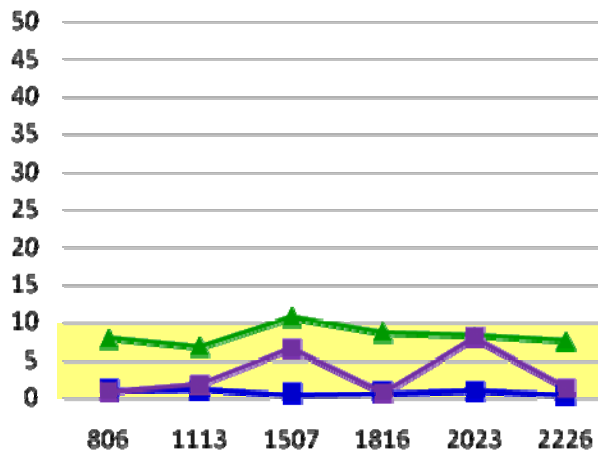
Local - weekday



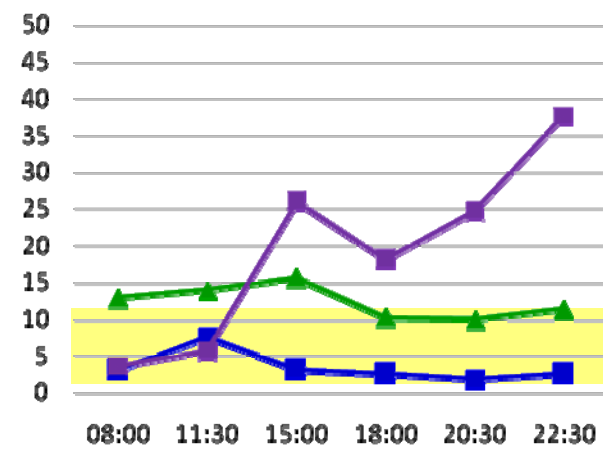
INT-weekday



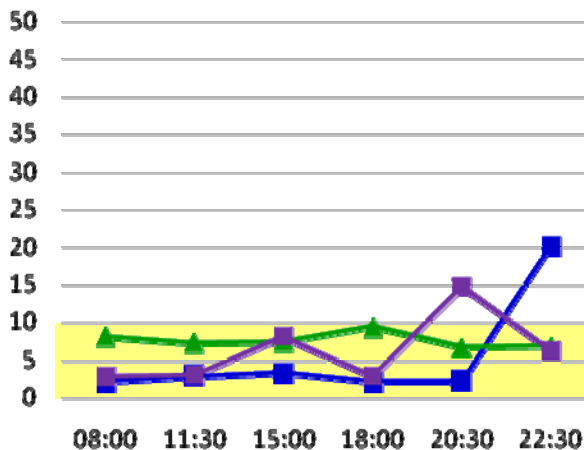
ISP- weekend



Local - weekend



INT -weekend



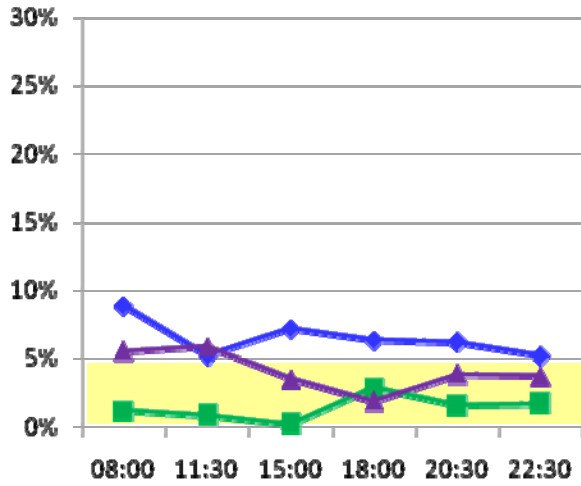
■ SLTB ▲ DialogB ■ SLTH

■ SLTB ▲ DialogB ■ SLTH

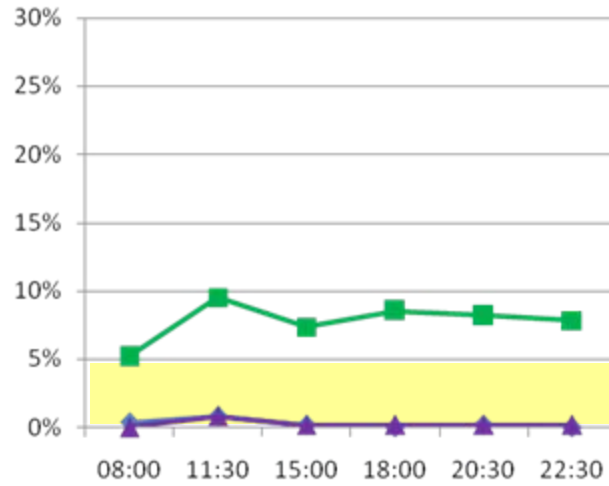
■ SLTB ▲ DialogB ■ SLTH

Packet Loss : Most of the times, but not always, within acceptable limits (5%)

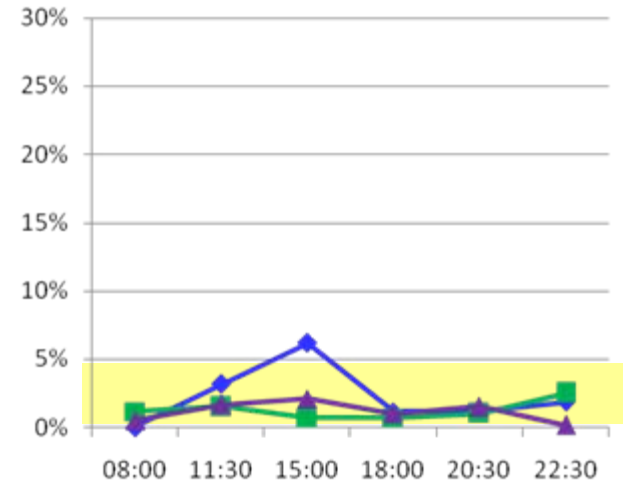
ISP –Week Day



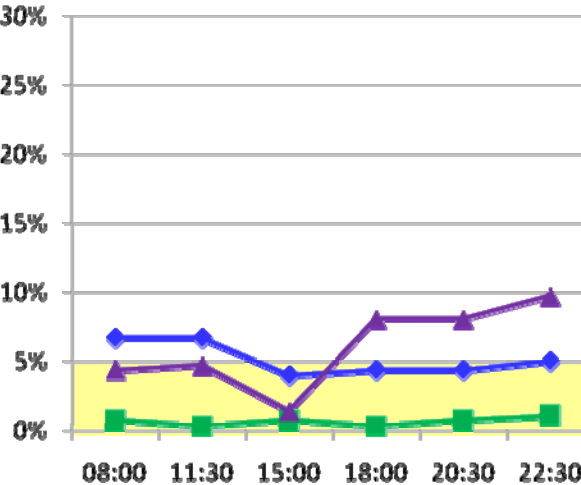
Local –Week Day



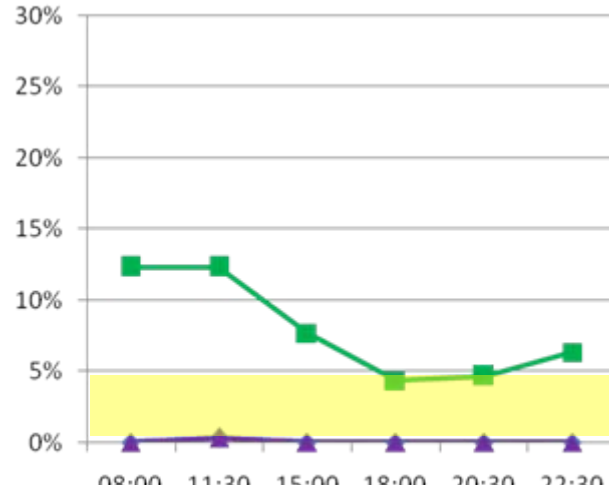
INT –Week Day



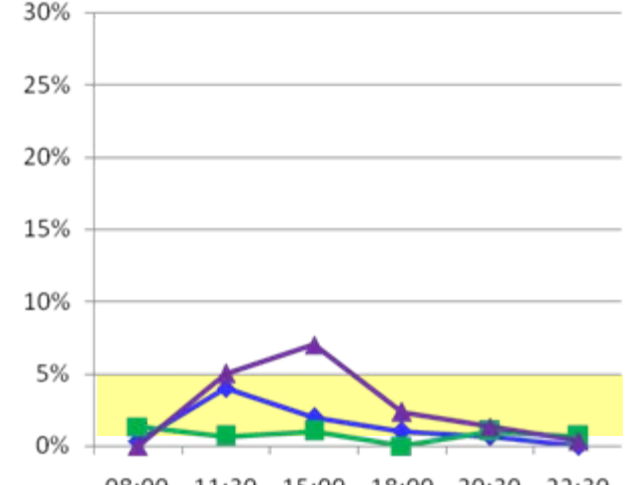
ISP –Weekend



Local –Weekend



INT –Weekend



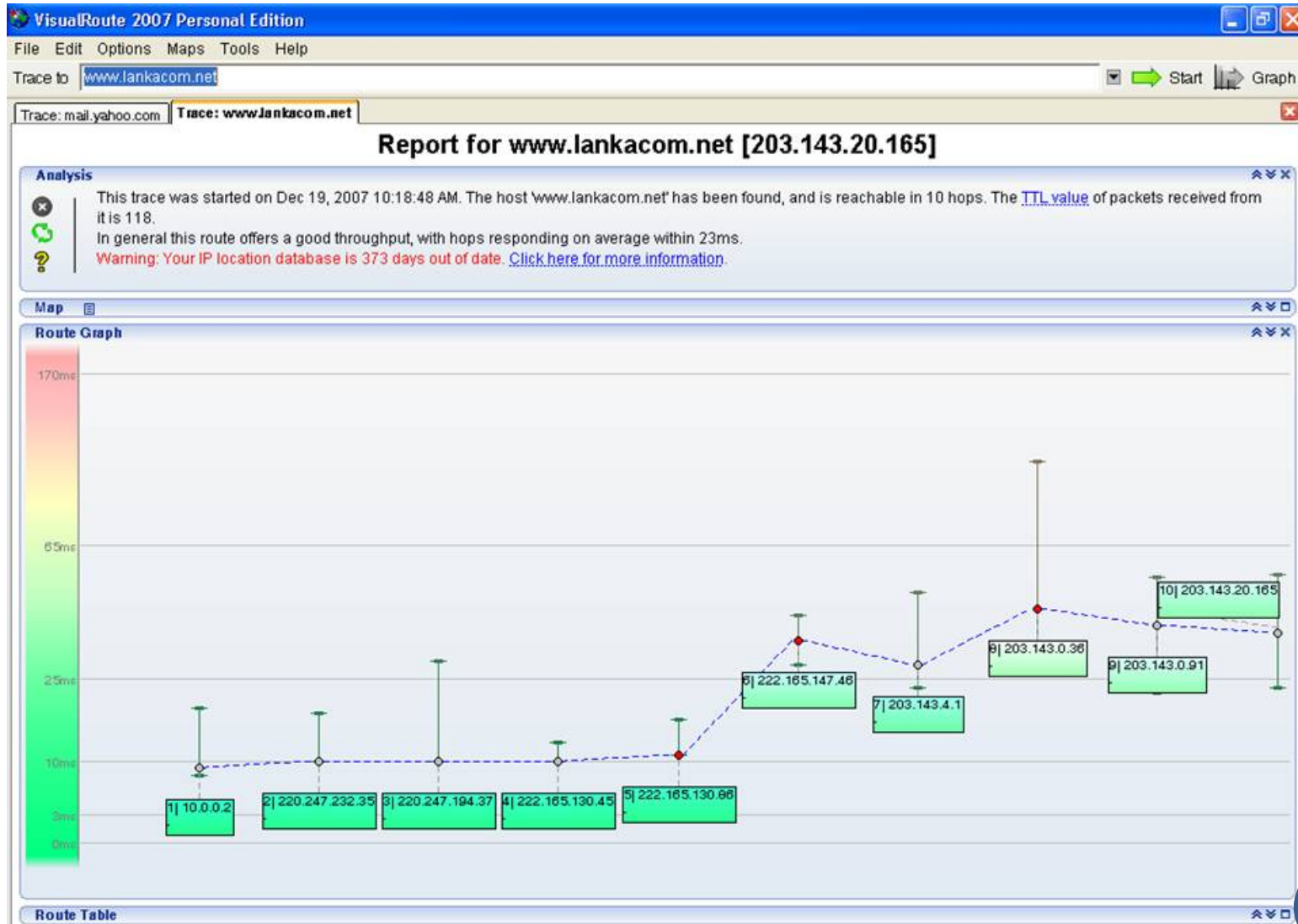
◆ SLTB ■ Dialog ▲ SLTH

◆ SLTB ■ Dialog ▲ SLTH

◆ SLTB ■ Dialog ▲ SLTH

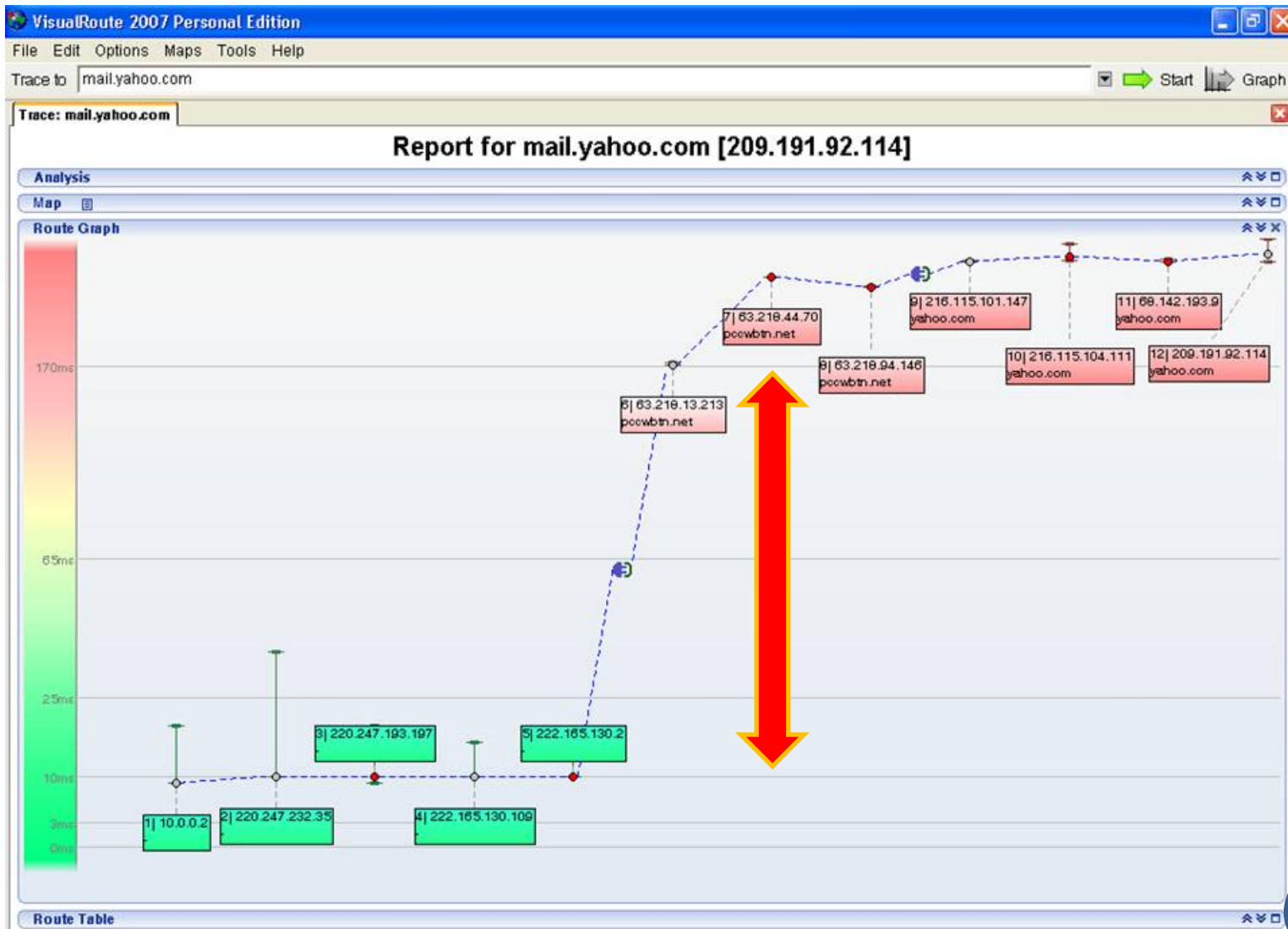
Where is the bottleneck?

Accessing www.lankacom.net through SLT (2M/512k)



NB: All IP addresses are within SL (www.whois.net)

Accessing www.yahoo.com through SLT (2M/512k)



170 ms

65 ms

25 ms

10 ms

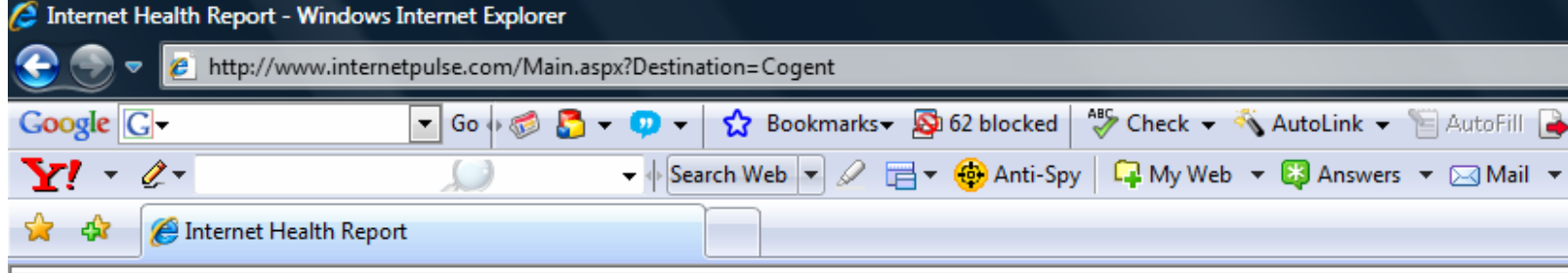


NB: Upto 5th hop IP addresses are within SL (www.whois.net)

What's next?

- A decentralised approach based on 'Volunteer Computing'*
- Automating the manual test process (otherwise too resource consuming and cumbersome)
- Need to conduct tests from different point (take Last Mile issues into account)
- A software application that tests with the minimal involvement from the user
- Volunteers report test results to a web site that stored and presents on-line QoS data

* **Volunteer computing** is a type of distributed computing in which computer owners donate their computing resources (such as processing power and storage) to one or more "projects". It is distinct from Grid computing, which involves sharing of managed computing resources within and between organizations.



Focus: From: AT&T To: Cogent Metric: Latency (ms) Period: Last 1 Hour

View: Destination by Origin Metrics by Origin

Example:
www.internetpulse.com

All Metrics - Cogent - Last 1 Hour

| | Latency | Network Availability | Packet Loss |
|-----------------|---------|----------------------|-------------|
| AT&T | 38 | 100 | 0 |
| Savvis | 25 | 100 | 0 |
| SBC | 28 | 100 | 0 |
| Sprint | 24 | 100 | 0 |
| XO | 30 | 100 | 0 |
| Cogent | 22 | 100 | 0.72 |
| Verizon | 39 | 100 | 0 |
| Level3 | 33 | 100 | 0 |
| Internap | 37 | 100 | 0 |
| IHR | 38 | 100 | 0 |
| NTTcom | 56 | 100 | 0 |
| Global Crossing | 42 | 100 | 2.08 |
| Qwest | 42 | 100 | 4.21 |

Origin

Healthy < 90ms Latency. Warning < 180ms Latency. Critical > 180ms Latency.



Thank You!

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