The Impact of Residential Broadband Traffic on Japanese ISP Backbones

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Outline

• Introduction
• Motivation
• Data collection
• Many graphs
• Conclusion
• (The details are in CCR, vol. 35, no. 1, 2005)
Increase in residential broadband subscribers in Japan

![Graph showing the increase in residential broadband subscribers in Japan from 2000/1 to 2004/1, with DSL, CATV, and FTTH represented by different line styles. The number of subscribers is measured in millions, and the year is marked on the x-axis.]
Traffic growth at 6 major Japanese IXes
Objective of this study

- Characterize macro-level impact of residential broadband user traffic
  - Volume, growth, and usage pattern
  - Residential users vs. academic/office users
  - Major IXes vs. private-peering
  - Regional differences
Data collection

- 7 major Japanese ISPs (iiij, japan telecom, kddi, k-opticom, ntt-c, poweredcom, ybb)
- Duration: Aug(trial)/Sep/Oct/Nov 2004
- Raw data: 1-month mrtg/rrdtools (2 h. bin) data per interface in a router
- We reconstructed aggregated traffic time series from 7 ISP’s data each for 6 categories
Traffic groups for data collection

• (A1) RBB customer: ADSL/CATV/FTTH
• (A2) Non-RBB customers: leased lines, data centers, dialups
• (B1) External 6 IXes: JPNAP/JPIX/NSPIXP
• (B2) External other domestic: local IXes, private peering
• (B3) External international
• (C) Regional: 47 prefectures
(A1) RBB customer traffic

- Traffic is about 100Gbps, and 70% of traffic is constant
- Peak hours: 21:00-23:00
- Difference between weekdays and weekends
- In/out volume are almost symmetric
(A2) Non-RBB customer traffic

- Leased lines, data centers, dial-up users, 2nd (or 3rd) level ISPs
- Peak hours: 21:00-23:00
- Higher activity in daytime on weekdays
Academic traffic

- ABILINE (Internet2)
- Peak hours: 10:00-14:00
- Lower activity in weekends
(B1&B2) 6 major IXes & other domestic traffic

- Both traffic are dominated by RBB customer traffic
Comparison with other data

<table>
<thead>
<tr>
<th></th>
<th>(B1) 6 IXes (our data)</th>
<th>All 6 IXes (directly measured)</th>
<th>ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>sep</td>
<td>30.9</td>
<td>74.5</td>
<td>41.5</td>
</tr>
<tr>
<td>oct</td>
<td>31.8</td>
<td>77.1</td>
<td>41.2</td>
</tr>
<tr>
<td>nov</td>
<td>33.0</td>
<td>80.3</td>
<td>41.1</td>
</tr>
</tbody>
</table>

unit: Gbps

- Our data covers about 40% of all traffic
(B3) International traffic

- In/Out traffic are asymmetric
- Triggered from domestic side
## Summary of traffic groups

<table>
<thead>
<tr>
<th></th>
<th>(A1) RBB customer</th>
<th>(A2) RBB other</th>
<th>(B1) 6IXes</th>
<th>(B2) Other domestic</th>
<th>(B3) International</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in/out</td>
<td>in/out</td>
<td>in/out</td>
<td>in/out</td>
<td>in/out</td>
</tr>
<tr>
<td>sep</td>
<td>98.1/118.1</td>
<td>14.0/13.6</td>
<td>35.9/30.9</td>
<td>48.2/37.8</td>
<td>25.3/14.1</td>
</tr>
<tr>
<td>oct</td>
<td>108.3/124.9</td>
<td>15.0/14.9</td>
<td>36.3/31.8</td>
<td>53.1/41.6</td>
<td>27.7/15.4</td>
</tr>
<tr>
<td>nov</td>
<td>116.0/133.0</td>
<td>16.2/15.6</td>
<td>38.0/33.0</td>
<td>55.1/43.3</td>
<td>28.5/16.7</td>
</tr>
</tbody>
</table>

- Growth rate: 6-7% per month (= 200% per year!)
- Other domestic (private peering) is NOT negligible
- International traffic accounts for 23% of all external traffic
- RBB customer traffic in Japan is 330Gbps (= 133.0Gbps/40%)
(C) Metropolitan vs Rural (1)
• Traffic volume is proportional to population of prefecture
• Prob. of finding a heavy user is constant
CDF of pref. traffic

Cumulative distribution

Traffic [Mbps]

Population [x 10000]
Traffic per user by NetFlow

- 96% users use less than 2.5GB/day
- Traffic is asymmetric for < 2.5GB
Metropolitan vs. Rural (again)

- Same behavior except for number of samples
- Prob. of finding a heavy user is the same
Symmetry of in/out traffic

- Out is 10 times larger than In in for $< 10^8$
- 2 regions appear for $> 10^8$
  - out is restricted (because of ADSL?)
  - in and out is symmetric (because of fiber?)
Summary

- We analyzed residential broadband traffic in Japanese ISPs.
- Main results:
  1. RBB traffic in Japan is about 330Gbps, and in/out traffic are symmetric
  2. Backbone is dominated by RBB traffic
  3. RBB traffic increases at 200% per year
  4. Traffic through private peering is NOT negligible
  5. RBB traffic is proportional to the population
Concluding remarks

- Future work
  - Improve the accuracy
  - Compare with traffic in other countries
  - Microscopic analysis
    - Locality of flows & application types
- Collect 1 month’s data at 6 month intervals