Consumer Broadband Monitoring: A Proof-of-Concept

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A bit of history

- The purpose of TTM is to independently measure the performance parameters of the Internet using test traffic boxes located in the networks of participating ISP's.
- “limited deployment prototype with the purpose of assessing industry and consumer acceptance, functional requirements and technical issues” (Ripe Policy Proposal 2005-10).

Initial Requirements

- The device needs to be cheap, available worldwide and amenable to complete software customisation.
- It should preferably be a device that already exists in the home of the pilot audience.
- All measurements are between the home device and a designated TTM node located within the user's service provider's access network.

Measurement Requirements

- All measurements are between the home device and a designated TTM node located within the user's service provider's access network.
- The periodic measurements are: packet loss, delay and jitter. Bandwidth measurement should only be available on demand because of TTM node side load.

CBM Prototype: History [1/2]

- Project (phase 1) started as student project during the “Network Management” course at CS Dept of University of Pisa (May-June 2006).
- 15 students were part of the development team.
- Goal: define a monitoring architecture able to satisfy the project requirements

CBM Prototype: History [2/2]

- Outcome of Phase 1: implementation for a standard Linux-PC. Some probes deployed in the university network.
- Phase 2: refined the implementation, identified an embedded platform where the software has been ported and adapted to the environmental constraints/limitations (July-October 2006).

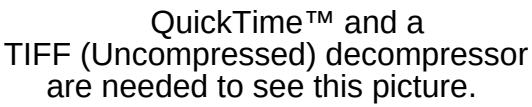
CBM Prototype: Goals [1/2]

- The main goal is to define a monitoring architecture and not to create a prototype able to measure just what was specified in the project proposal.
- The outcome is an extensible, distributed monitoring architecture where probes can run both on commodity PCs and most of low-cost broadband routers available on the market.

CBM Prototype: Goals [2/2]

- Probes and measurements are not “hard coded” as they are fully configurable and can be added as necessary.
- All measurements are performed on the user premises, in order to measure the real view of the Internet from the user’s perspective.

CBM Prototype: Architecture [1/3]



CBM Prototype: Architecture [2/3]

- A single TTM box can control many routers.
- A router is controlled/configured only by one TTM box, although it can provide measurement results to many TTM boxes (meshed architecture).
- All access are authenticated (http passwords, snmp community): no anonymous access is allowed.

CBM Prototype: Architecture [3/3]

- Routers are configured on the TTM box using a web interface.
- Probes download the measurement configuration (i.e. what a probe is supposed to measure) from TTM via http.
- Measurements can be both passive and active, either on-demand or periodic.

Measurement Provisioning

- Routers can provide measurement results in two modes:
  - Pop: the TTM fetches results, coded in XML, via HTTP (default).
  - Push: the router pushes results to the TTM box (useful for NAT-ed boxes).
- Users set for each router the operational mode via the TTM web interface.

CBM Prototype: Data Storage [1/2]

- The router stores in (volatile) memory the last (no history) measurement results as specified in the configuration file.
- Before running a new test session, the router transparently checks if its configuration has changed (via TTM web interface).

CBM Prototype: Data Storage [2/2]

- TTM stores configuration information on a DB (MySQL).

- Measurement results are stored on RRD databases as they:
  - Do not grow over the time (static file size).
  - Feature automatic data aggregation, trend calculation, anomaly detection (aberrant RRD behaviour).

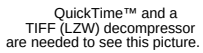
Measurements [1/2]

- Most of probes are wrappers to existing tools (e.g. ping or iperf).
- Active measurements:
  - Bandwidth, jitter (iperf)
  - Round-trip time, packet loss (ping)
  - Application performance:
    - DNS (nslookup)
    - http, smtp (custom)

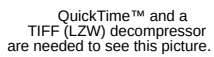
Measurements [2/2]

- Passive measurements:
  - Interface Counters
    (custom, SNMP MIB-II wrapper)
  - Lightweight honeypot
    (custom, Linux firewall rules and ulog)

Example Configuration [1/3]



Example Configuration [2/3]



Example Configuration [3/3]

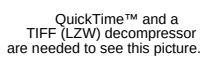
```
ping_ntop.tool=probe-ping
ping_ntop.descr=Test www.ntop.org round trip time
ping_ntop.enabled=true
ping_ntop.testtime=300
ping_ntop.param.1=3
ping_ntop.param.2=www.ntop.org
ping_ntop.result.1.name=rtt
ping_ntop.result.1.type=gauge
ping_ntop.result.1.unit=ms
ping_ntop.result.2.name=loss
ping_ntop.result.2.type=gauge
ping_ntop.result.2.unit=percentage
ping_ntop.verbose=0
```

General configuration
Input parameters (passed in order to the tool)
Output values with all necessary info for RRD

Measurement Results [1/3]

<test-session>
[…]
<session name="ping_ntop" time="1159399878">
<sessionResult name="rtt">104.6</sessionResult>
<sessionResult name="loss">0</sessionResult>
</session>
[…]
</test-session>

Measurement Results [2/3]



Measurement Results [3/3]

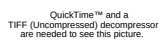
- A custom SNMP MIB has been developed for accessing the same data exposed via HTTP.
- The MIB is generic and it can accommodate new probes and measurements.
- An SNMP agent that supports the MIB has been implemented (based on net-snmp) and is part of the router distribution.

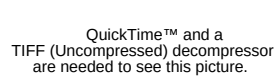
Router Platform [1/3]

- Low-cost (street price < 75 □) platform.
- Based on x86/MIPS CPUs, usually based on Broadcom boards.
- Wireless, with/without xDSL connectivity.
- Replaced original OS with Linux distribution named OpenWRT (MIPS cross compiler): same look and feel, and packaging across different router models.

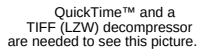
Router Platform [2/3]

- Prototypes have been tested two router models:
  - Linksys WRT54GS (Fon)
  - Asus WL-500g Premium





Router Platform [3/3]



Availability

- GNU GPL License
- Documentation: http://wiki.ntop.org/
- Source code CVSROOT:
  :pserver:anonymous@cvs.ntop.org:/export/home/cbm
  (password ntop).
- Binary Package for OpenWRT:
  http://cbm.ntop.org/packages
- TTM Console: http://cbm.ntop.org/