High-accuracy network monitoring using ETOMIC testbed

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***Abstract*—Obtaining an accurate picture of what is happening inside the Internet can be particularly challenging using end-to-end measurements. The ability to make high-precision timing measurements (one-way delay, interarrival times, ...) using probe packets is key to attain a clear picture of network performance.**

The European Traffic Observatory Measurement Infrastructure (ETOMIC) is a high-precision measurement infrastructure, distributed throughout Europe. With the ANME (Advanced Network Monitoring Equipment) boxes and their related software, ETOMIC offers users a versatile monitoring solution that performs both active and passive measurements to a very high level of precision.

***Index Terms*—High-accuracy, network monitoring, Internet testbed**

ETOMIC

ETOMIC (European Traffic Observatory Measurement Infrastructure) [1], [2] allows users to infer network topology and discover its specific characteristics, such as delays and available bandwidths. It also provides users with a dynamic, high-resolution, and geographically-distributed picture of global network traffic. ETOMIC's measurement and monitoring tools are distributed across locations throughout the European academic network.

ETOMIC is run in association with OneLab, an initiative that develops testbeds for the Future Internet, offering a shared experimental facility that allows European industry and academia to innovate today and assess the performance of their monitoring solutions.

Experimentation flexibility

A carefully planned web-based graphical interface (shown in fig 1) simplifies resource allocation and management. Thanks to that interface, creating a new experiment is as simple as clicking a few times and filling some text boxes.

ETOMIC offers both ready-made tools and the possibility to develop custom experiments in a flexible Linux environment. Once the binary files to be executed have been created, the user just have to upload them into the system and reference them from his/her experiment's description.

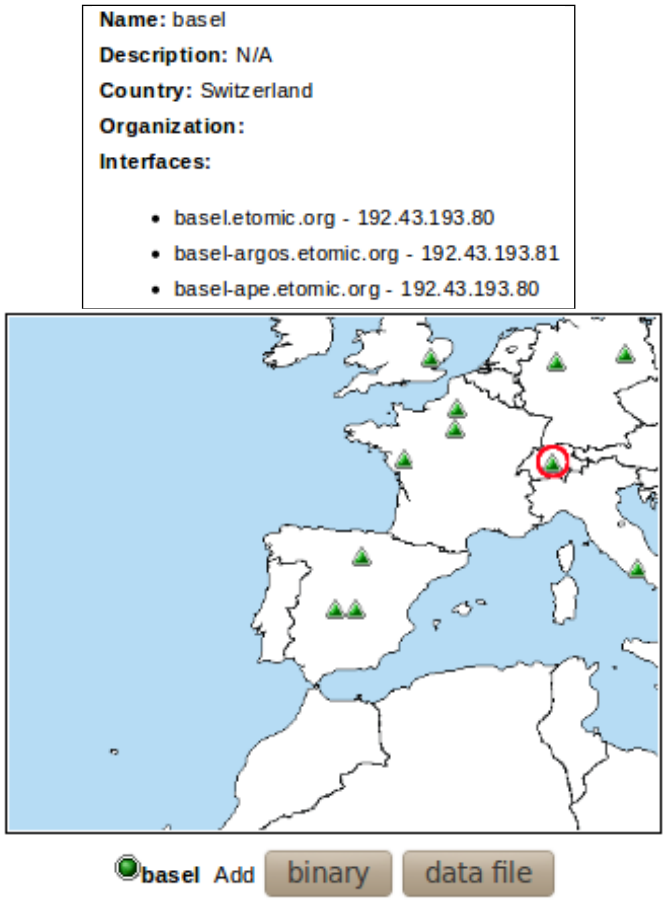

Fig. 1. ETOMIC graphical interface for experiment creation

Once the experiment has been executed, the results are stored by the tool and they can be obtained when needed,

In addition, ETOMIC regularly measures network charac-

teristics and stores this data in an easily-accessible repository.

END-TO-END QOS MONITORING

The ETOMIC testbed infrastructure offers synchronized high-precision active network measurement capabilities, accurate to the order of $\sim$ 10ns. This is achieved thanks to an advanced network monitoring equipment (ANME) including both Endace's DAG cards and the ARGOS network monitoring card (shown in fig 2). ARGOS is a low-cost monitoring card which has been developed at the Universidad Autonoma de Madrid (UAM).

All nodes having an ARGOS card are globally synchronised, i.e. a timetamping accurady in the order $\sim$ 10ns for end-to-end measurements. The node-level synchronization is achieved using a GPS-based mechanism.

Traditionally, timestamping is made at the driver level inside the receiving machine. This process does not only introduce a measurement overhead (due to the IO and networking stack delays) but it is highly dependent on the machine CPU usage: as the computing load is increased, additional non-constant delays are introduce due to resource scheduling.

Using the ARGOS card, a low-level timestamping approach is used. This approach is capable of assigning the accurate timestamps to the incoming network packets at the moment of their arrival from the network cable. The result is timestamping accuracy regardless of the host load.

Having such an accurate timestamping infrastructure, all the traditional passive standard measurements based on timestamping procedures can transparently experience a significant accuracy improvement. By transparency we mean that the hardware timestamp replaces the traditional software (driver-level) timestamp without the OS noticing a special behaviour. That way, upper level layers, for instance libpcap, get the accurate timestamp when they work with the ARGOS card just as they would do with a traditional NIC.

Furthermore, the fundamental difference between ARGOS and other high-accuracy cards such as Endace's DAG is that ARGOS has been integrated in the linux kernel as another network interface cards, namely packets can be easily snooped using a promiscuous socket.

Another distinguishing feature that ARGOS monitoring card offers is the ability of programming the departure of accurately-sent UDP packet trains. The card does not only allow to accurately choose both the inter-packet and the inter-burst departure times, but it also provides the ability of adding a timestamp (inside the UDP payload) pointing out the time at which the first byte of the packet was transmitted through the wire. That way, if those UDP packets are received by another ARGOS card, an accurate one-way network delay measurement is obtained.

ONE-WAY DELAY EXPERIMENT

Our purpose is to show an usage example of the ETOMIC tool, running a high-accuracy network delay measurement.

The idea is not to focus on the experiment itself, but to show the potential and high flexibility if this monitoring tool.

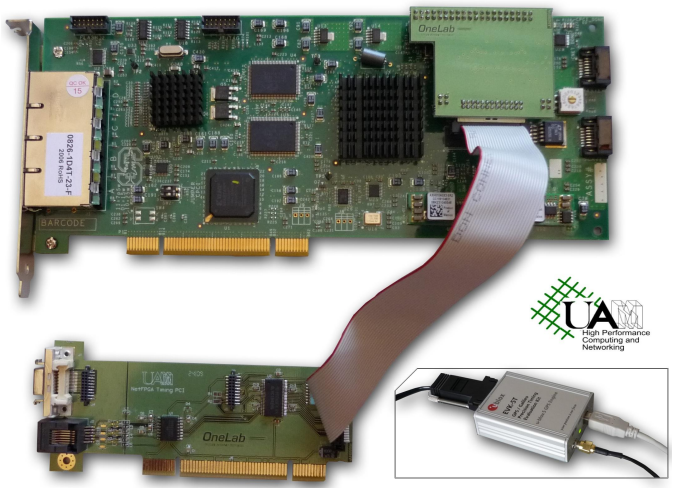

Fig. 2. ARGOS monitoring card

During the demo we intend to reproduce in detail the whole experimentation process.

The general guidelines of what is intended to be shown are:

- Applying for an ETOMIC account and logging into the tool.
- Creating a new experiment
  1) uploading the binary files to be executed
  2) attaching nodes to the experiment
  3) selecting what (and when) is going to be executed in each node
- Scheduling the execution of the experiment.
- Retrieving the results of the experiment.

An example of what is pretended to be shown can be found at the following link: http://www.dailymotion.com/video/xbd3v9_testing-argos-monitoring-equipment_tech.

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