On the deployment of Network Processors in Operational and Testing Network Devices

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***Abstract*-Flexibility and performance are two key features of modern and future network equipments. Our demo aims at illustrating the work carried out on the development of high-performance, quickly-reconfigurable network devices oriented to operation and testing of convergent networks and based on different Intel IXP Network Processor platforms. Network Processors are extremely appealing components specifically designed for packet processing operations which, differently from the more expensive and rigid ASIC solutions, allow to be software programmed on a two-level hierarchy.**

I. Description

The core element of the demo (whose overall architecture is depicted in Fig. 1) is the ERP, an Enhanced RTP Proxy developed on a IXP 2350 platform from ADI Engineering [1]. RTP Proxies are Media gateways whose application in operator's VoIP architectures allows to address a wide range of needs, from mere NAT traversal issues to more specific requisites such as Lawful Interception or security policies enforcement. Hence, RTP Proxies are crucial points of these architecture, since they must be able to cope with a very large number of media flows, without introducing losses, delay or jitter, whilst being able of performing configurable actions on a per-flow basis (e.g. duplicate to a third party in case of Lawful Interception, or do some header inspection as far as security aspects are concerned). Measurements carried out on the prototype have shown that it is able to forward minimum size (66 byte) UDP packets up to over 2.9 millions packets per second (such value is limited not by the device itself but by having saturated the two full duplex Gbps interfaces), with no loss and a mean transit delay of less than 1 microsecond. Same performance in terms of loss and delay are obtained using packet sizes corresponding to actual audio encoders (which are noticeably larger than the minimum size); as an example, using 87-bytes long GSM06.10-encoded RTP packets, Gbps full-duplex saturation is achieved at a packet rate of about 2.34 millions packets per second, corresponding to about 12000 concurrent bidirectional voice calls.

As far as signalling is concerned, an RTP proxy is usually driven by a SIP Proxy server which (at least) notifies it which 2-uple of UDP port to open to allow the forwarding of a new media flow. In the demonstration, a Proxy based on the SIP Express Router (SER) software is used to provide these input to the ERP. Measurements show that the ERP manages to accept over 4000 new calls activation (i.e. 8000 flows) per second, with a 0% message loss (in turns, call block).

Performance evaluation of the ERP would not be possible without a device able to generate such a huge rate of UDP packets per seconds. Commodity PCs with standard packet generation software are not even able to saturate a single direction 100 Mbps Fast Ethernet link, while preserving the desired traffic characteristic, such as packet inter-departure times; on the other hand, dedicated hardware tools are extremely expensive and usually lack the necessary flexibility, although they have the necessary horsepower to actually stress the device under test.

In our efforts to develop high-performance but customizable devices for network testing, we have realized a fully-functional prototype of traffic generator, named BRUNO [2], based on an Intel IXP 2400 board form Radisys. With reference to Fig.1, BRUNO is able to feed the ERP with "high-quality" UDP traffic, where the term high-quality is related to the actual packet inter-departure times with respect to the desired ones. Shortly, BRUNO exploits the two-layer hierarchy of IXP Network Processors at best, using the core ARM processor to evaluate a sequence of packet departure timestamps, while the various microengines are in charge of the actual transmission at the exact time.

The third component of the testbed is an high-performance traffic sniffer based on Network Processor [3]**.** This tool is composed of two kind of elements: the NP-Probes responsible for packet classification and timestamping and standard PCs for traffic analysis. The main feature of the probe is the ability of capturing packets with accurate timestamp at line rate over Gbps links thanks to the pure performance granted by the Network Processors, and then transfer such information to standard PCs in a libpcap-compatible format, hence ready to be displayed on screen using any available traffic analysis tool, such as Wireshark.

More in details, the NP-probe is able to perform at the wire speed the following operations:

- packet timestamping: recording the arrival time of each packet in the standard UTC format;
- packet classification and filtering: selecting only those packets useful for the user and assigning each packet a unique flow identifier based on a rule set;

- header striping: getting only the necessary information (e.g. the first n bytes);
- batch frame crafting: collecting data in batch frames, each containing information of several packets;
- sending batch frames to commodity PC.

On the PC side (which is incapable by itself to capture packets at wire speed), the batch frame is received, dissected, and off-line processed. The main advantages of the resulting architecture are:

- timestamping accuracy, in that it is performed by the NP card without the interrupt latency typical of a PC;
- heavy CPU offload, as unwanted packets are dropped at the NP level and are not delivered to PC and since a pre-classification is performed on packets, bringing even more CPU offload (for example in flow identification).

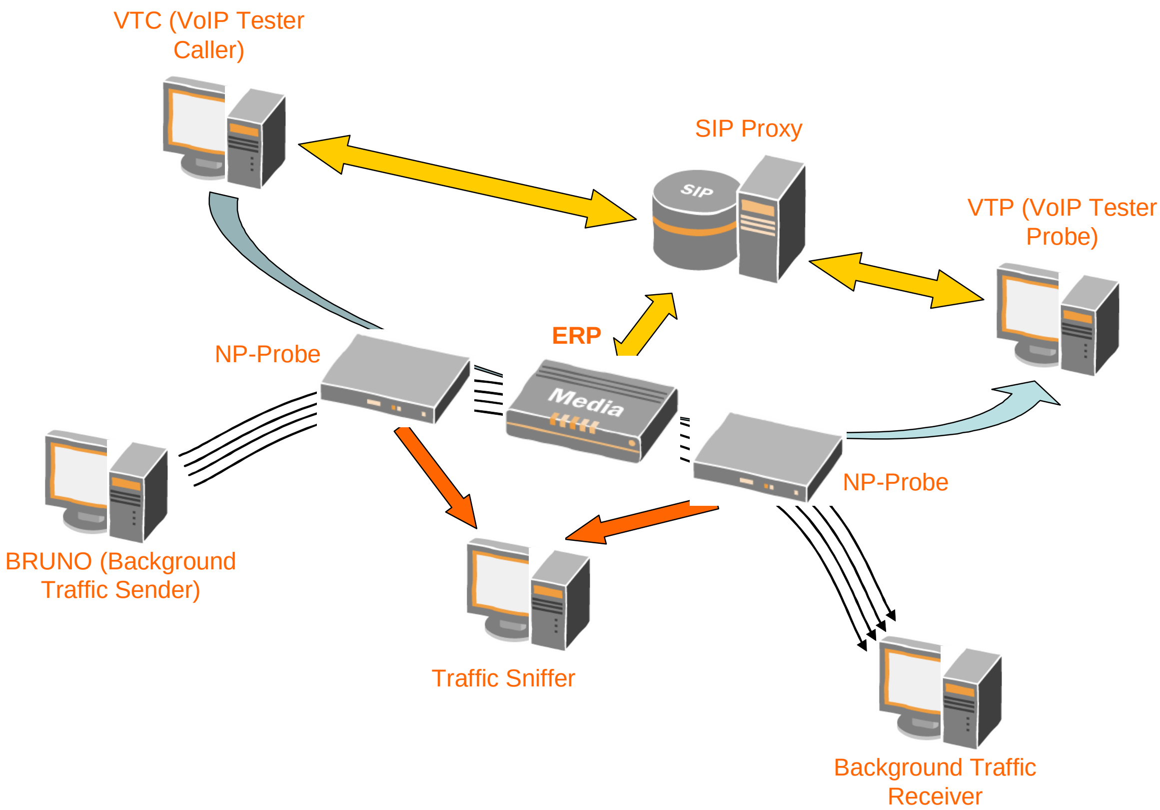

Fig. 1 Testbed Overview

The last component that will be deployed in the demo is the SIP-Tester. This tool, completely developed using the NetResults VoIP-Toolkit, aims to assess the quality of a VoIP/SIP audio communication . The tool is composed by two distinct modules:

- the VoIP-Tester Caller (VTC)
- the VoIP-Tester Probe (VTP)

The main module is the VTC one responsible for the setup of SIP calls and the injection of pre-recorded audio messages. Such audio messages are known in advance by both modules. Before each call setup the VTC communicates to the VTP, by means of a SIP MESSAGE, the ID of the next audio message that will be sent as well as the deployed audio codec. In turn, the VTP modules is able to receive and record the audio message and then to compare with the original one. The original message and the received one are used to feed the PESQ (Perceptual Evaluation of Speech Quality) algorithm which computes an objective quality index. This index is sent back to the VTC via a SIP MESSAGE. This way the VTC will be able to display in a table the resulting index obtained for each call in the test session.

After having introduced the different devices which compose the testbed, in the following we illustrate the proposed demonstration. The goal is to highlight both the pure performance and the flexibility of the devices developed using Network Processor platforms. Hence, we use BRUNO to load the ERP with an increasingly higher number of UDP flows, monitoring its performance (namely the transit delay and its jitter) by means of the traffic sniffer, which extracts the packets belonging to a specified flow at both the ingress and egress interfaces of the RTP proxy, and transfers these traces to a host PC which computes and graphically shows the measurement results.

In order to further highlight the seamless traverse of the ERP by the VoIP calls, we take advantage of another tool that we have developed. This time, it consists of an application able to evaluate, starting from the acquisition of two traffic traces, the PESQ value of one or more specific calls. With reference to Fig.1, this tool runs on a commodity PC; it sets up one or more VoIP calls between two peers associated to its two interfaces. In this way, both the transmitted audio and the received one are available, and an objective quality assessment can be made taking advantage of the PESQ algorithm.

REFERENCES

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