PL-LAB: Polish initiative to develop laboratory infrastructure for testing Future Internet solutions

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I. INTRODUCTION

The motivation for establishing Polish national project entitled "Future Internet Engineering" (http://www.iip.net.pl) was to accelerate the research on Future Internet issues. The project collects 19 teams (more than 120 researchers) working on telecommunication and information systems from 9 leading technical universities and research centers in Poland. The project is scheduled for years 2010-2012. One of the project objectives is to develop national laboratory infrastructure for testing Future Internet solutions. The network of these laboratories we call as PL-LAB. As the first step, we plan to use PL-LAB for testing the IIP System that is currently under implementation phase. This system is Polish proposal for Future Internet network infrastructure and it assumes virtualization of network resources.

In this paper we provide a short overview of the IIP System and PL-LAB infrastructure.

II. THE IIP SYSTEM

We design the IIP System to show that we can essentially extend the capabilities of network infrastructure in providing more effective data transfer comparing to this what is offered by current TCP/IP-based Internet. New capabilities in our system mainly correspond to possibilities of supporting: (i) a number of Parallel Internets that share common physical network infrastructure, (ii) specific data and control planes for each Parallel Internet, not limited to TCP/IP.

In particular, each of Parallel Internets may serve traffic generated by a specific set of applications/services for which we can assure QoS guarantees for data transfer thanks to adequate data and control planes.

Finally, we stress that virtualization is an excellent way to implement Parallel Internets concept. Parallel Internets will operate on virtual nodes and links. For building them, we use devices enabling virtualization, as e.g. EZappliance, NetFPGA, XEN or others.

A. Architecture

Complete architecture of the IIP System consists of 6 levels. The lower four levels, from 1 to 4, correspond to telecommunication infrastructure while upper levels correspond to applications/services (Level 5) and users (Level 6). Moreover, management system is a part of the architecture. It is responsible for management at each architecture level as well as for communication between levels. More about the considered architecture one can find in [1], [2].

Level 1. Physical Infrastructure: the physical infrastructure of the IIP System consists of nodes enabling virtualization and links. The topology of the network is fixed and may have single or multi-domain structure. It has internal addressing scheme and management. The network may contain wired and wireless parts as well as access and core networks.

Level 2. Virtualization: this level corresponds to devices enabling virtualization and is responsible for creating and maintaining virtual nodes and links for Parallel Internets. Furthermore, at this level we need to provision each of Parallel Internets. The provisioning should allocate physical resources for virtual link and nodes.

Level 3. Parallel Internets: We use the term Parallel Internet for describing the network operating on virtual resources and specific data/control planes. We take into account three basic Parallel Internets that are: IPv6 QoS and two proposals for post-IP networks, that are Content Aware Network (CAN) and Data Streams Switching (DSS). Each of these network operates on different data format, addressing scheme, routing, traffic control, traffic engineering and management.

Level 4. Virtual Networks: this level is responsible for creating a number of dedicated virtual networks running on given Parallel Internet.

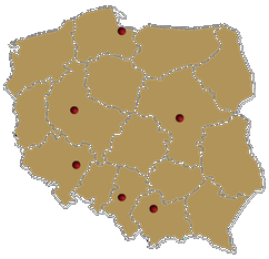

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Figure 1. List of partners and locations of PL-LAB laboratories.

III. PL-LAB ENVIRONMENT

PL-LAB network [3] consists of 9 laboratories in Poland, which are located now at the project partners premises. Fig. 1 lists the name of involved partners and shows locations of the laboratories.

Infrastructure of the PL-LAB network was divided into 3 main parts:

- Operational part, which assures connectivity between laboratories. Connections are configured for long term time scale. They use dedicated devices controlled by the administrators of the PL-LAB.
- Research part, which covers remaining devices present in the laboratories. PL-LAB administrators have limited control upon them, but for the most of cases they are able to restore the default state for each of them.
- Access system allowing the users to perform experiments.

A. Operational part

Operational part is realized by using PIONIER, a national research network, which allows to transfer data between sites. Each site is connected to PIONIER node by Gigabit Ethernet interface. At the laboratory side, the access link is managed by a dedicated access switch (Juniper EX3200 switch). The PIONIER node (Brocade MLX switch) receives the Ethernet frames and applies them to a dedicated VPLS (Virtual Private LAN Service) connecting all laboratories. Due to security reasons, PL-LAB administrators cannot control the service in the PIONIER network. Therefore, a monitoring system was applied in the laboratories to detect connectivity failures.

In the internal part of the laboratory, the traffic is separated by using VLAN feature. We distinguish 3 types of VLANs:

- Management network (with single VLAN tag), which allows to connect to each device in the research part of the laboratory.
- Network for performing backup operations (with single VLAN tag), which is used for transferring device images.
- Different networks created for user's experiments.

B. Research part

This part of PL-LAB provides different types of devices that are connected with Ethernet interfaces to the access switch.

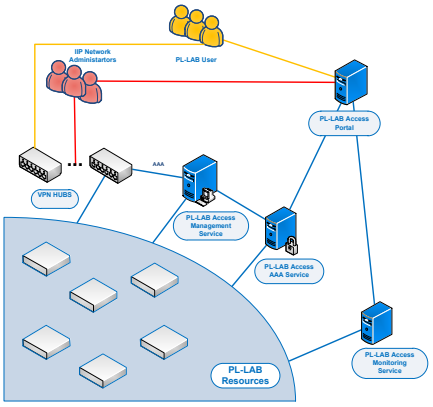

Figure 2. Structure of the PL-LAB access system.

Few examples:

- Programmable network switches with FPGA cards (NetFPGA) or network processors (EZapplicance),
- Virtualization servers,
- Traffic sources for different applications, e.g., 4K streaming.

C. Access system

Access system allows to create virtual networks for particular experiments. For this purpose a portal was created, where users manage their networks. Fig. 2 presents the structure of the access system in the PL-LAB. Besides the portal, there are management and AAA services for controlling the devices and access to the devices. Moreover, the VPN hubs allow users to use Ethernet connections in bridged mode. Finally, the monitoring service measures the quality of the interconnections in the PIONIER network.

IV. CONCLUSIONS

In the paper, we provided a short description of PL-LAB environment dedicated for testing solutions proposed for Future Internet with special focus on network virtualization, new architectures, mechanisms and protocols. In PL-LAB we use the programmable equipment allowing us for virtualization of network elements as links and nodes. In this environment we will test the IIP System but we believe that its functionalities will allow us for testing also other proposals for Future Internet.

REFERECES

[1] Burakowski W, et al., The IIP System: Architecture, Parallel Internets, Virtualization and Applications, Future Network and Mobile Summit Conference, Warszawa 15-17 June 2011

[2] Burakowski W., Tarasiuk H., Beben A., Zwierko P., Future Internet architecture based on virtualization and co-existence of different data and control planes, 5th Workshop on Future Internet Cluster, 15 June, Warszawa 2011

[3] Sliwinski J, et al., *Future Internet Experimentation in Poland,* FIRE research workshop, Budapest, May 2011, available at http://www.ict-fire.eu/events/fire-research-workshop.html