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Euro6IX:

Pan-European IPv6

Internet Exchanges Backbone

Executive Summary v2.0

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Abstract:

Euro6IX is the larger research project up to now funded by the European IST Program. The goal of the Euro6IX project is to support the rapid introduction of IPv6 in Europe. Towards this target, the project has defined a work plan. This describes the Pan-European network design (native IPv6), network deployment, research on advanced network services, development of applications (that will be validated through the involvement of user groups and international trials), and active dissemination activities, including events and conferences, contributions to standards (IETF and RIPE among others), publication of papers and active promotion of all the publicly available project results through the project web site.

Keywords:

IPv6, native, Europe, Internet Exchanger, CoS/QoS, MIPv6, next generation applications, multicast, security, policy languages

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1.   <u>Introduction</u>

The project will research, design and deploy a native Pan-European IPv6 network, called the Euro6IX test bed. It will include the most advanced services obtainable from present technology and will follow the architecture of the current Internet (based on IPv4). It will consider all the levels needed for the worldwide deployment of the next generation Internet. The infrastructure of Euro6IX will consist of the following different network levels:

- **IX-level:** Regional native IPv6 exchanges.
- **Backbone-level:** Pan-European core network that interconnects the regional exchanges and creates the highest level in the network hierarchy.
- **Node-level:** Service providers, ISPs and other providers accessing the core network to provide IPv6 services and end user access. The users will be connected by means of a variety of access technologies, including legacy IPv4 networks and services whenever no IPv6 native links are available or feasible. This level includes a set of academic, research and non-commercial trial users who will use native IPv6 services and generate IPv6 native traffic.

A high **abstract level scheme** of the Euro6IX test-bed concept is pictured as follows.
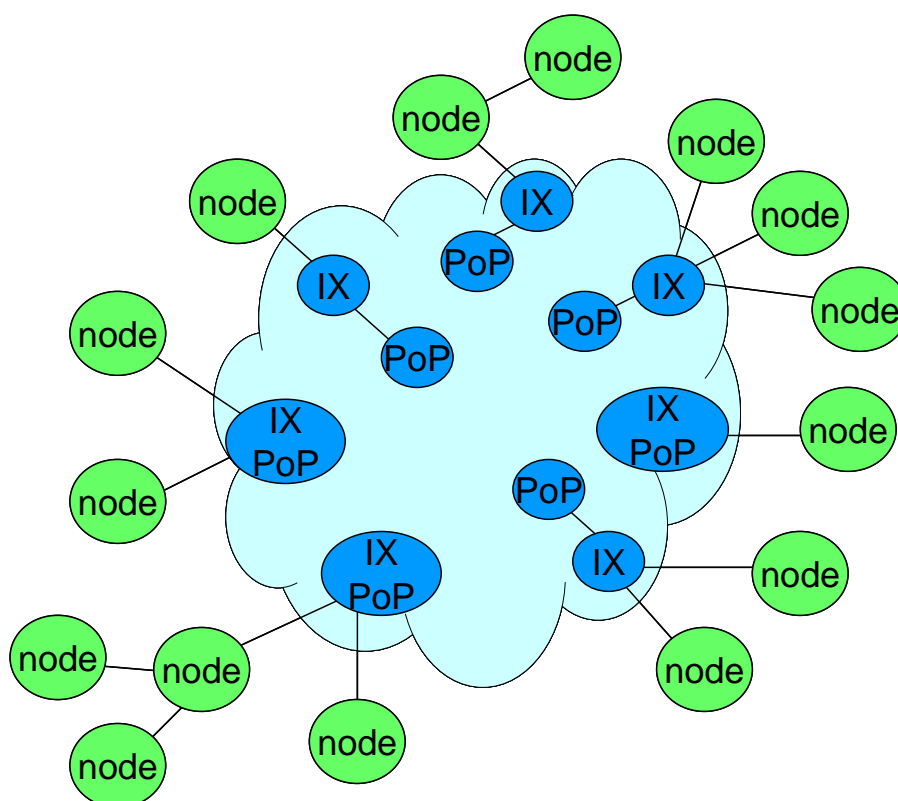
Euro6IX will offer advanced network services, and a repository of IPv6 enabled applications, which have been ported, adapted or enhanced, and made available for trials both within Euro6IX and to third parties.

The native IPv6 traffic will be the result of both, specific and generic applications tuned for IPv6 (e.g., IPv6 enabled Web browsers).

The validation will be performed in a realistic context where the different actors and roles, which exist in the present Internet, are extrapolated to the IPv6 based next generation Internet. This validation will be made through the involvement of existing and

new user groups created by the project with the daily use of the network by project partners and through both, internal and public trials and other events.

Additional dissemination, liaison and coordination activities will be performed in clusters, standards organizations or with interested third parties in order to give to the results of the project the highest visibility and to achieve the largest impact.

The success of the Euro6IX project will be measured against the achievement of:
- Provision of efficient interconnectivity and advanced network services, for the complete IPv6 European level Internet.
- Involvement of research entities and non-commercial trial users (user groups) in order to validate the network, advanced services and applications.
- Promotion of the IPv6 interests by ISPs and users, standardization bodies and other related projects.

2.   Objectives of the Project

The **first objective** of the Euro6IX project is to research an appropriate architecture to design and deploy the first Pan-European non-commercial IPv6 Internet Exchange (IX) Network. It will connect several regional neutral IPv6 Internet Exchange points across Europe, and achieve the same level of robustness and service quality as currently offered by IPv4 Internet Exchange Networks. That is:

- To research and design a native IPv6 network which follows the hierarchical architecture of the global Internet by including:
    1. A set of regional native IPv6 Internet Exchanges;
    2. A core network to interconnect the exchanges;
    3. A second/access level of nodes, for ISPs, sites, corporations and users.
- To deploy the native IPv6 network based on the proposed architecture.
- To test, tune and improve the main protocols, algorithms and techniques needed to deploy and operate the network and the advanced services.

The involvement of the major/incumbent European Telcos in this project, covering also the bigger areas that have a higher Internet user growth rate, reflects the strategic importance of the fast and timely introduction of IPv6 in Europe.

The **second objective** is to use the deployed IPv6 IX infrastructure to research, test and validate IPv6-based applications and services, such as:

- Investigations on the maturity of advanced IPv6 network services, as well as the feasibility of their inclusion in the Euro6IX test-bed, for example CoS/QoS, Mobility, Anycast and multicast, security, multihoming, renumbering, and policy languages.
- The development, porting, adaptation, or enhancement of IPv6 enabled applications, which will be made available for project trials and to third parties.
- The research of the legal implications of the project related to users, networks, and service providers addressing, personal data protection, and privacy concerns about IPv6 addressing.

As a **third objective**, the network built within the Euro6IX project will be open to specific user groups (existing and to be created), who will be connecting to the Euro6IX network by means of a variety of access technologies – mobile, xDSL, cable – and internetworking with legacy IPv4 networks and services, to test the performance of future IPv6 networks, and non-commercial native IPv6 advanced services and applications. The network's Acceptable Use Policy (AUP) excludes the possibility of carrying commercial traffic.

The network will be used and tested by the user groups to validate and assess the feasibility, features and potential of the Next Generation Internet through daily, routine use of the services, internal trials and also in highly visible events and public trials.

The **fourth objective** of the project will be dissemination, liaison and coordination with clusters, fora, standards organizations (e.g. the IETF and RIPE) and third parties, with particular consideration for interworking and coordination with peer projects, such as GÉANT, 6WINIT, LONG, MIND, 6NET and any other projects related to our work, that might be available during the Euro6IX project lifetime.

3.   Innovation and the State of the Art

Some other key aspects that are innovative in this project are:

- Bringing together major network providers of Europe to deploy and test new IPv6 networks and services to allow the ISPs and users to have hands-on experience with new technologies, gaining experience in inter-domain IPv6 network operation.
- Interoperability testing between different "IPv6 Ready" platforms in large-scale networks. Such tests will allow all the vendors to work together when using native IPv6 in large networks, and this has not been done so far.
- Testing of interoperability between Internet Exchanges: IPv6 to IPv6 and IPv6 to IPv4. We will test BGP4+ mechanisms on a very large scale, and internetworking with BGP (IPv4) peers.
- Deployment of mobility in both, wireless and fixed networks, as a native and very important new feasible feature of IPv6.
- Testing of address aggregation schemes between mixed ISP/IX networks. This is a new feature of IPv6, since IX (Internet Exchanges) can delegate public address space. This new technical approach that IPv6 offers hasn't been tested further than single IX PoPs.
- Definition and verification of the IPv6 IX technical and business concepts, not totally investigated and deployed as of yet.
- Interconnection of metropolitan broadband networks. The IPv6 Internet Exchange is a tool to allow new networks, new infrastructure providers, small and large carriers, to concentrate local traffic in order to maximize the use of the bandwidth resources, over the regional, national or international links, thus reducing latency and making better use of the networks in general.
- Massive access to an IPv6 network, such as through xDSL/cable and other ("IPv6 over any transport media").
- Testing of large scale Multi-homing, renumbering, DNS, DHCPv6, and other IPv6 features to validate IPv6 technology.
- Using multicast over native IPv6 networks.
- Deployment of QoS in IPv6 native networks.
- Evaluation of the UniDirectional Link Routing (UDLR) protocol with IPv6. Digital satellite, Digital terrestrial, and similar networks can be used in such way that the upstream/downstream data flows are carried over physically separate links.
- Evaluation of AAA mechanisms for IPv6 networks.
- Large scale transition trials with legacy Internet services and applications.
- The availability of an IPv6 address to anyone who wants it is one of the big advantages of IPv6, due to the larger global address space provided by IPv6.
- Establish a set of test suites to allow developers to test their IPv6 systems.
- Testing current IPsec implementations in real end-to-end (not tunneling over IPv4) IPv6 networks.
- Testing VPNs, and virtual communities with IPv6.
- Implementation of a policy framework (able to provide dynamism and distribution to current communication infrastructures).
- Offering a trial IPv6 platform for operators/ISPs.
- Innovative applications supporting Next Generation Networks require new services, emphasizing the new features of IPv6. These applications will take advantage of the differentiated advanced services provided by the IPv6 network. The following applications over IPv6 would be highly innovative:
    1. IPv6 based On-line Education tool, using multicast over IPv6.
    2. IPv6 based instant messaging application.
    3. Voice over IPv6 based on SIP.

4. Web tools for IPv6 address delegation, and management of third parties willing to connect to the IX network.
5. IPv6 web/pop3/smtp mail tools.
6. IPv6 billing tools (contents/traffic/time/bandwidth/others).
7. IPv6 network operation and management tools.

4.   The Network

Next picture shows the basic connectivity and the core network. We expect an evolution and additional meshing of the network, depending on the available resources and the incorporation of other participants, sponsors, and international links (US, Canada, Australia, Korea, Japan, China, Taiwan, India, Latin America, etc.). We expect also connectivity to some Universities. Academic/Research Networks, and with other related projects.