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Abstract:

This document provides a report of the 1st 6NET Open Workshop held on 21 May 2003 in Zagreb, Croatia.

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Introduction

The 1st 6NET Open Workshop was held on 21 May 2003 in conjunction with the TERENA Networking Conference (TNC-CNC 2003) in Zagreb, Croatia. The objective was to publicise the 6NET and Euro6IX project activities, IPv6 in the 6th Framework Programme, and other relevant IPv6 developments. It also provided an opportunity for feedback from the European research networking community.

The workshop discussed various aspects of IPv6 deployment and how to make the transition from legacy networks. It focused on the current state of the technology, with particular reference to multicasting, security and mobility. In addition, it considered the leading role that 6NET and related projects such as Euro6IX play in the development of the next generation of networks.

One feature of the workshop, was the use of videoconferencing to allow one of the speakers to give their presentation from Madrid. This worked extremely well, and demonstrated that given suitable network, video and audio facilities, remote speakers can participate in events as though they were physically present.

Unfortunately, one of the original speakers was unable to attend the workshop due to unforeseen circumstances. The organisers would therefore like to express their thanks to Stig Venaas who agreed to stand-in at short notice.

The workshop ran from 09.00 to 15.30 and was divided into three sessions. Presentations and attendance figures were as follows:

09.00-10.30 Chair: Peter Tomsu Attendance: 74

- 6NET Update – *Kevin Meynell, TERENA*
- Euro6IX Update – *Jordi Palet Martinez, Consulintel*
- IPv6 on GÉANT – *Marian Garcia Vidondo, DANTE*
- IPv6 in the 6th Framework – *Bernhard Fabianek, European Commission*

11.00-12.30 Chair: Theo de Jongh Attendance: 84

- IETF IPv6 Update – *Harald Alvestrand, Cisco*
- Liberouter: a PC-based IPv6 Router – *Ladislav Lhotka, CESNET*
- IPv6 - Good for Grid: a position statement – *Stig Venaas (on behalf of Saleem Bhatti, UCL)*
- Management of IPv6 Networks with IPv4/IPv6 SNMP Gateway – *Wiktor Procyk, PSNC*

14.00-15.30 Chair: Kevin Meynell Attendance: 56

- The M6Bone: International Experiments with IPv6 Multicast – *Stig Venaas, Uninett*
- What are the new challenges in securing IPv6 networks? – *Eric Marin, Cisco*
- Roaming Real-time Applications: Mobility Services in IPv6 Networks – *Thomas Schmidt, FHTW Berlin*

The full proceedings of the workshop can be found on the 6NET website at:

http://www.6net.org/events/workshop-2003/

6NET Update
Kevin Meynell, TERENA

6NET is a three-year IST project that started in January 2002, and aims to prepare the next generation of the Internet. It is one of the largest projects in the European Union's IST Programme, and represents a total investment of EUR 18 million.

The objectives of the project are to install and operate a native IPv6 network, test the migration strategies for integration IPv6 networks with existing IPv4 infrastructure, introduce and test new IPv6 services and applications, and evaluate address allocation, routing and DNS operation. The project is also collaborating with other IPv6 activities such as Euro6IX and actively contributes to the IETF standardisation process. A further objective is to promote the use of IPv6 technology.

The project comprises thirty-five partners from the commercial, academic and research sectors, including four new partners (CESNET, HUNGARNET, PSNC and ETRI) who joined in September 2002. This enabled the geographical coverage of the network to be extended, and brought additional expertise into the project.

A 155 Mbps backbone has been established, primarily using native IPv6 connections. There are also interconnections with Euro6IX (via UK6X), Abilene (via SURFnet), NTT Japan (via UK6X), ETRI (via RENATER) and national IPv6 testbeds (e.g. JANET, RENATER and SWITCH). In addition, a NOC has been established to handle monitoring, maintenance and fault reporting.

The establishment of the network has allowed IPv4/IPv6 dual-stack operation has been tested, as well as IPv6 tunnelling over IPv4. Native IPv6 has also been deployed over wireless networks in Lancaster, Southampton and Tromsø. Transition scenarios for core, NREN and university networks have been considered and the missing pieces essential for IPv6 deployment have been identified.

A routing plan has been defined and IS-IS and BGP4+ are running on the backbone. DNS support for IPv6 and a multicast overlay (M6Bone) are also available, whilst DHCPv6, auto-configuration, service discovery and site-local addressing are currently being investigated.

The project is also looking at mobile IPv6 implementations and running IPv6 over WLAN and cellular networks. This includes evaluation of access control mechanisms, QoS support, VPNs, and multihoming and renumbering solutions.

A core set of applications are being developed or ported to IPv6, in the areas of videoconferencing, streaming, online gaming, e-business solutions and proxy caching. Many of these will be demonstrated at an IPv6 showcase event towards the end of 2003.

A network management architecture is also being developed. This includes traffic measurement and visualisation tools, denial-of-service detection, and support for new IPv6 functions (e.g. auto-configuration and mobility).

Most the results are available on the project website (http://www.6net.org/), including 'cookbooks' on transition, migration and network management issues. In addition, quarterly newsletters were published, and several training events were held during the year. The project continues to liaise with Euro6IX in several activity areas.

Future plans include the expansion of the backbone network, further routing optimisation, and the introduction of OSPFv3, eACLs, 6PE and other network security. The work on mobility, wireless, VPNs, QoS, multihoming and network management solutions, and the application porting will also continue. Finally, there are plans to hold two further open workshops, additional training courses, and other publicity events (e.g. Global IPv6 Service Launch).

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/meynell.pdf

Euro6IX Update
Jordi Palet Martinez, Consulintel

Euro6IX is a three-year IST project to build a native IPv6 backbone of traffic exchanges across Europe. It aims to support the fast introduction of IPv6 in Europe and gain experience of designing and deploying such networks. The project consortium consists of seventeen partners from the telecommunications, industrial, academic and NGO sectors.

Eight IPv6 Internet Exchanges (IXs) have been established in London, Madrid, Lisbon, Turin, Zürich, Berlin and Paris, interconnected by 34 Mbps connections. These IXs provide a Layer 2 infrastructure, with Layer 3 mediation routers. This model (based on RFC 2374) aims to verify that customers could change their service providers without changing their addressing space, and that multihoming can be more easily realised. The IX therefore becomes a place where new services can be offered to the users, and in particular can act as an aggregation point for services such as multicasting.

The UK6X was the first IPv6 Internet Exchange in the UK, and is located in Telehouse London. It uses commercial IPv6 addresses and is open to anyone that wishes to connect. It is comprised of an Ethernet switch for Layer 2 peering, an ATM switch for additional customer access mechanisms, and a router for Layer 3 functionality. Looking Glass and ASpath-tree are used for maintenance.

The project is also working on a DNSSEC pilot for publishing security certificates. PKIv6 will be run as an IX service, using TSIG and later SIG to issue certificates. In addition, VPN policy control is been tested in conjunction with 6NET and 6WIND. This currently has to be trialled over IPv4, as Cisco IOS does not support IPsec over IPv6 at the moment.

Other services being developed include instant messaging based on Jabber. A server has already been deployed, and a Java-based GUI client is available. In addition, VOCAL has been ported to IPv6, and is being used by Euro6IX, 6NET and 6WINIT to provide voice-over-IP. The next stage is to integrate this with ENUM, but there are still a number of issues to sort out.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/paletmartinez.pdf

IPv6 on GÉANT
Marian Garcia Vidondo, DANTE

GÉANT is a 10 Gbps pan-European research network connecting thirty-two countries, and serving approximately 3,500 institutions across Europe. It also provides interconnectivity with other regions such as North America and the Asia-Pacific region. It is jointly funded by European NRENs and the European Commission.

GÉANT Juniper switches were configured in dual-stack mode in February 2003, and the first IPv6 connections were established in April 2003. A pilot service was due to be introduced in June 2003, with a view to making this a full production service in October 2003.

Only one IGP (IS-IS) is being used to handle both IPv4 and IPv6 routes. With BGP4+, a decision needed to be made whether to have separate TCP sessions for IPv4 and IPv6, but in the end it was

decided to have separate sessions. Laboratory tests showed that when using only one TCP session, the next-hop chosen by IPv6 NLRI was derived from the IPv4 address rather than the real IPv6 address exchanged by IGP, making the set-up more difficult.

RIPE has allocated the 2001:0798/32 address range to DANTE for use in different projects. 2001:0798:0/35 is being used for 6NET, 2001:0798:2/35 is being used for GÉANT, and 2001:0798:4/35 for other projects. Eight ranges of /36 have also been reserved for delegation to NRENs, whilst 2001:0798:E/35 has been reserved for migration. The backbone is using 2001:0798:20/40 and separate classes have been allocated in each PoP for VLANs, access links, tunnels, loopbacks and a testbed. GÉANT import routing policy is to accept 2002::/16, NREN prefixes from /35 to /32, and 6bone prefixes for a limited period of time. The export routing policy is to announce NRENs, Abilene, CANARIE, ESNET, SINET and the 2001:0798/32 assigned by RIPE.

At the present time, RedIRIS (Spain), RENATER (France), FCCN (Portugal), SURFnet (The Netherlands), HEANET (Ireland), GARR (Italy), PSNC (Poland), EENet (Estonia) and RoeEduNet (Romania) are natively connected. Tunnelled connections also exist to IUCC (Israel), SWITCH (Switzerland), CERN (Switzerland), LITNET (Lithuania) and ACOnet (Austria). However, a routing policy between 6NET and GÉANT still needs to be implemented, in order to provide transit between NRENs that are not connected to both networks.

Finally, a native IPv6 connection to Abilene has been established, and this provides transit to other networks in the North American, South American and Asia-Pacific regions. In addition, an experimental tunnel to Telia is operational, and there are plans to establish connections to ESNET (USA) and SINET (Japan).

More information is available on the GÉANT IPv6 Task Force website at http://www.join.uni-muenster.de/geantv6/, and on the DANTE website at http://www.dante.net/nep/.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/garciavidondo.pdf

IPv6 in the 6th Framework

Bernhard Fabianek, European Commission DG Information Society

The EU aims to promote new technologies such as IPv6 through the deployment of large-scale research networking testbeds. These technologies can then be integrated and validated in a user-driven environments.

The requirement for such testbeds is addressed in the 2nd IST Call of the 6th Framework Programme which makes approximately EUR 20-30 million of funding available. The deadline for submission of proposals is 15 October 2003, with projects starting around mid-2004.

The GÉANT and 6NET networks already provide IPv6 connectivity to several countries, but this is still largely experimental and only reaches a relatively small community. In order to improve upon this, IPv6 needs to offer the average user with advantages over IPv4. This may be the larger address space that allows end-to-end connectivity, or new applications that take advantage of the new features of IPv6.

To this end, the IST programme will continue to support GÉANT, but will also invest in GRID and photonic testbeds for the highly-demanding user communities. It is anticipated that IPv6 will feature prominently in these testbeds and the provision of an ‘eEurope’ infrastructure.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/fabianek.pdf

IETF IPv6 Update
Harald Alvestrand, Cisco

IPv6 is now stable and usable, and includes most of the functionality of IPv4. The protocol and addressing architecture have been defined, and most of the features (e.g. ICMP, DNS) are functional. Other features such as DHCPv6 and Mobile IPv6 are close to completion, and should be available in the near future. From this, it is certainly possible to build and operate a network.

Most of IETF Working Groups now accept IPv6 as a fact-of-life and specifications are written with IPv6 support in mind. A number of major vendors such as Cisco, Microsoft, Apple, IBM, Linux and BSD variants also routinely ship IPv6, and addresses are readily available through the usual channels (IANA-RIR-LIR).

Unfortunately, there are still some IPv6 specifications that do not yet have wide community acceptance to varying degrees. The address architecture specification was republished to remove the flawed TLA/NLA concept, and it was also necessary to clarify the use of AAAA as opposed to A6 records in the DNS. In addition, there was rough consensus to deprecate the use of site-local addressing, although this was still being debated.

Flow labels were always part of the IPv6 specification, but it was never clear how to use them. Some of draft proposals had ambitious goals whilst others were more modest in their scope; the latter gaining more acceptance. The most important agreement was on the flow-state lifetime, and the Working Group requested publication of the specification on 1 May 2003.

The v6ops Working Group decided to deal with the plethora of transition mechanisms (e.g. ISATAP, TEREDO, DSTM, 6to4 and 6over4) that have been proposed, by looking at different scenarios to try to understand what is actually required. Until then, the publication of the specification has been put on hold, even though some mechanisms have already been implemented.

The SEND Working Group is also looking at the problem of how to improve the security of the ARP and Neighbour Discovery protocols. These are not particularly vulnerable to attacks, but it is not considered desirable to leave security holes.

A bigger problem is that of multihoming, and the Multi6 Working Group was established to investigate this. The problems are not unique to IPv6, but it was hoped a new protocol would make it easier to find a solution. Unfortunately, the group has made little progress and the chairs were recently replaced. A number of solutions have been advanced, but there is little consensus on which to adopt.

Despite these problems, IPv6 is ready to be deployed and it solves the shortage of addresses. It does not solve everything, but most of the remaining problems either already existed in IPv4, or are related to completely new features.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/alvestrand.pdf

Liberouter: a PC-based IPv6 Router
Ladislav Lhotka, CESNET

The Liberouter project aims to develop a flexible PC-based routing platform for network research. This is being developed with support from CESNET and 6NET, and will be released under an open-source licence.

CESNET has a long history of using software PC routers based around operating systems such as KA9Q, PC Route, Linux and BSD variants, running GateD or Zebra. These have proved to be useful and cost effective, and are still in use in some MANs, the national IPv6 backbone and the M6Bone. Unfortunately, the PC architecture (PCI and memory bus throughout, and interrupt handling) limits forwarding performance, and the need to use init scripts and configuration files can lead to inconsistent configuration.

Liberouter aims to overcome these problems by developing an FPGA-based adapter card that will provide hardware acceleration. The COMBO6 adapter will be installed in a PCI slot on a standard PC running NetBSD or Linux, and will offer at least 10 Gbps throughput. In addition, daughter cards will offer various network interface configurations (e.g. Gigabit Ethernet, 10-Gigabit Ethernet and POS).

The COMBO6 drivers present the card to the operating system as a standard 4-port Ethernet card. This allows most configuration to be undertaken with standard Unix utilities (e.g. ifconfig and route), and allows standard routing daemons to be used. It also provides support for tcpdump.

At the present time, four COMBO6 cards have been manufactured and tested at a cost of approximately EUR 3,500. These currently have 4 x GE interface daughter cards fitted. A low-level driver for both NetBSD and Linux has also been written, as well as a couple of development tools (comboctl and TCL scriptable).

The second part of the project is the Netopeer configuration system, which is now under development. This is a platform-independent environment for configuration large networks that uses XML as its internal data format, and features a central repository with version control. It will also convert this information into the necessary format for other routing environments, and currently supports Cisco IOS, JUNOS, Linux and NetBSD.

More information about the project can be found at http://www.liberouter.org/, and the development code is available via the CVS repository.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/lhotka.pdf

IPv6 – Good for Grid: a position statement based on a technical viewpoint
Stig Venaas, Uninett (on behalf of Saleem Bhatti, UCL)

The Grid provides another opportunity for the promise of distributed computing to be fulfilled. There are many potential users in the pure and applied science, high-energy physics and bioinformatics communities, and a lot of EU and national investment is going into area. Distributed computing obviously also requires networking, and therefore needs to take forthcoming developments into account.

The advantages of IPv6 for Grid computing are that it offers many of the advanced IPv4 features in a more integrated manner. The 128-bit address space also allows separation of addressing and routing, which enables security certificates to be bound to device addressees even when mobile. In

addition, it removes the need for NATs and allows for unique correlation of addresses and devices. Other useful features are intrinsic support for auto-configuration, security, authentication and multicasting.

Globus is the main Grid toolkit, and this is currently being ported to IPv6. GT2 was written in C and was fairly easy to port directly to IPv6, although making it dual stack proved more complicated. However, GT3 is the latest release and this is mostly written in Java. It was initially tested with JDK 1.3 which was not IPv6-enabled, but an easy transition was made to JDK 1.4 as only the IP calls needed to be modified.

A bit more work is required on the OGSA protocols and non-web services (e.g. Grid FTP) to fully port them to IPv6, and some specific IPv6 features still need to be tested. Once this is completed, the aim is get the underlying services to operate in a seamless fashion to allow for easy transition from the equivalent IPv4-based services.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/bhatti.pdf

Management of IPv6 Networks with IPv4/IPv6 SNMP Gateway
Wiktor Procyk, PSNC

There is currently no support for IPv6 in commercial management platforms such as HP OpenView, Tivoli NetView and CiscoWorks. An SNMP transition tool was therefore being developed to enable existing IPv4 management platforms to monitor and configure native IPv6 networks. This translates SNMP protocol messages between IPv4 and IPv6 networks using address translation tables, but does not interfere with SNMP queries. The tool can be managed with a GUI front-end based on Java 1.4, SSL and X.509, which provides for easy access and configuration.

The tool is currently undergoing trials on a testbed in Poznan, but there are plans to extend this in the near future. Future plans include the development of new modules (e.g. DNS and 6tunnel), trap forwarding, a sub-agent implementing the SNMP AgentX protocol, automatic address configuration and a number of MIB conversions.

More information about the project can be found at http://www.ipv6.man.poznan.pl/6net/ttsnmp-frame/

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/procyk.pdf

The M6Bone: International Experiments with IPv6 Multicast
Stig Venaas, Uninett

The M6Bone is an IPv6-based multicast network (http://www.M6Bone.net/) that was established in 2001 by the Aristote Association, G6 and RENATER. It currently connects around forty sites in four continents, and aims to provide an environment to test multicast-related hardware and software, learn about deployment issues, and provide a conferencing infrastructure.

This tunnelled network is running PIM Sparse Mode with multiple RPs, and a global RP operated by RENATER. BSR is used for distributing RP configuration information, and routes are exchanged with RIPng. As most routers still cannot separate unicast and multicast traffic, unicast routing tables are used for RPF checks, and the routers are used for multicast only. The routers

currently in use include FreeBSD, BSD and KAME, Cisco, 6WIND and Hitachi, and the hosts are based on Windows XP, Linux and BSD variants.

About fifteen 6NET partners have now been directly connected to the M6Bone, and native multicast is being deployed across 6NET. This is in turn connected to the global M6Bone via RENATER, and constitutes one zone of non-global scope. As 6NET uses Cisco routers that support multicast routes, the unicast and multicast topologies can be divergent. There are still some problems with interdomain multicast as MSDP is not available, and there is no global IPv6 ASM or SDR service. This is not a major issue whilst there are relatively few nodes, but will not scale to global usage. One solution might be SSM and embedded RP as this works well for fixed sources, but it becomes much more complex when there are many dynamic sources.

A number of IPv6-enabled multicast reflectors have been tested by the 6NET project, but unfortunately these need to be manually run for each multicast group. Furthermore, whilst they generally work with applications that send before receiving, they don't work with receive-only applications at all. An IPv4 to IPv6 gateway solution has therefore been deployed that embeds IPv4 multicast group addresses into IPv6, and allows IPv6 hosts to receive from and send to IPv4 multicast groups.

As well as the common mbone applications (i.e. sdr, vic, rat, nte and wb), it is also possible to run versions of Freeamp (MP3 over RTP), MIM (MPEG-1 over RTP). ttcp, iperf and Multicast Beacon over the M6Bone. There are also a number of sources of content available, including the NRK (Norwegian State Broadcasting) radio channels, Trondheim Underground Radio, and all global IPv4 multicast sessions.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/venaas.pdf

What are the new challenges in securing IPv6 networks?
Eric Marin, Cisco

All IPv6 implementations are required to support authentication and encryption headers. Authentication separate from encryption should also be possible where encryption is prohibited or prohibitively expensive. Key distribution protocols are under development, but support for manual key configuration is required.

Despite this, IPv6 has a number of security exposures. These include stateless configuration and discovery (auto-configuration), ICMPv6, and the duplicate address detection mechanism. There are also problems with source routing which cannot be turned-off as it is required for mobile IPv6. One possible solution is to implement extended access control lists (eACL), although these are difficult to apply in a consistent manner if nodes are using multiple addresses. As with IPv4, firewalls and proper handling of fragmentation will be necessary.

Mobile IPv6 has particular security problems as nodes have to move across networks. In principle, IPsec could be used to configure tunnels back to the original node, but this will also affect routing performance. Many of these issues still need to be resolved.

Finally, it should be mentioned that a number of hacking tools for IPv6 are already available, and there have already been attacks using IPv6. It is therefore critical to resolve the security flaws as soon as possible.

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/venaas.pdf

Roaming Real-time Applications: Mobility Services in IPv6 Networks
Thomas Schmidt, FHTW Berlin

The challenges of running real-time applications over mobile IPv6 networks are considerable. For example, the requirements for good videoconferencing are latency and disruptions less than 100 ms, jitter less than 50 ms and less than 1% packet loss.

The daViCo videoconference software provides multicast/multipoint video communication, a high-efficient video codec, buffer latencies around 100 ms and application sharing. This application scenario motivated the analysis and testing of handover performance using Mobile IPv6.

The conclusion was that MIPv6 can be made suitable for real-time communication, but it needs proxying and handover hiding. The multicast handover scenario needs careful redefinition as well. Based on an Hierarchical Mobile IPv6 approach, a seamless handover scheme suitable for unicast and multicast communication was presented, the temporal behaviour of which no longer depends on roundtrip distances between the mobile node, and the home agent or correspondent node respectively.

There needs to be further analysis and simulation of the proposed scenarios, to validate and further optimise the set-ups. More information can be found at http://www.rz.fhtw-berlin.de/projekte/ipv6/terena-paper.pdf

This presentation can be found on the web at:

http://www.6net.org/events/workshop-2003/schmidt.pdf