Large Scale International IPv6 Pilot Network (6NET)

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Greek Research & Technology Network (GRNET)

III Global IPv6 Summit
November 2004
Presentation Outline

- Project Overview & Objectives
- Network Details
- Transition to IPv6
- Basic & Advanced Services
- Applications & Monitoring Tools
- Dissemination & Demonstrators
- Conclusions
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Project Overview

- One of the largest Internet research projects funded from the European Commission
  - More than 18.4 MEuros budget
  - 50% funded by EC for industry and major research institutes; 100% for Universities
- Around 37 partners from Industry, National Research Networks (NRENs) and Academic Community (Universities and Research Institutes)
- A 3-year project, started in 1st of January 2002
  - Currently, 6NET is extended 6 more months, a.k.a. until June 2005
Project Objectives

- Built and operate a dedicated international IPv6 network
  - Avoid using tunnels for interconnection links
- Gain experience from the deployment of IPv6 protocols, applications, and services in the 6NET testbed network
  - Use this experience to accelerate the deployment of IPv6 technology to the production networks.
- Participate in the evolution of IPv6 technology
  - Validate new concepts and protocols, identify missing parts in the IPv6 implementations and provide feedback to the standardisation bodies.
- Disseminate results from the 6NET tests to the research and industrial community
Project Workflow

WP0: Project management and technical management
WP7: Dissemination and exploitation

WP1: Build & operate the IPv6 network
WP2: IPv4-IPv6 coexistence, interworking & migration
WP5: IPv6 application trials
WP3: Basic Network Services
WP4: Application & service support
WP6: IPv6 network management architecture & tools
Work Packages

- **WP1**: Build and Operate the IPv6 Network
  - Operation, interoperability tests.
- **WP2**: IPv4-IPv6 coexistence, interworking and migration
  - Transition mechanisms for core and university networks.
- **WP3**: Basic Network Services
  - DNS, DHCP, Multicast, Security, Renumbering, etc.
- **WP4**: IPv6 application and service support
  - Application support, IPv6 mobility, QoS, VPNs, IPv6 Wireless LANs, etc.
- **WP5**: IPv6 middleware and user application trials in demanding environments
  - Videoconferencing, Media Streaming, e-bussiness
- **WP6**: IPv6 network management architecture and tools
  - Definition of management architecture, development of tools
- **WP7**: Dissemination and Exploitation of Results
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Logical network topology (June 2004)

Operational since 2Q2002!
Interconnection links
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IPv6 to IPv4 Transition Studies

- Investigate ISPs/NRENs transitions methods
  - "IPv4 to IPv6 Transition Cookbook for ISPs and Backbone Networks"
    - Methods: Dual stack, IPv6 over MPLS (6PE), IPv6 over ATM, tunnel brokers, 6to4 relay routers, etc.
    - Include case studies from multiple NRENs

- Investigate University network transitions methods
  - "IPv4 to IPv6 Transition Cookbook for End-sites"
    - Methods: Configured tunnel, tunnel brokers, automatic tunnels, 6to4, 6over4, ISATAP, Toredo, etc.
    - Include IPv6 translation methods and few case studies
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Basic and Advanced Network Services

- DNS and DNSSEC
  - Deploy IPv6 DNS nameservers throughout the network. Perform tests with DNS proxies.
  - DNSSEC secures the data exchange. Standardisation process in progress.
- Multicast
  - Provide the needed infrastructure for other tests, e.g. WP5 application tests.
- DHCPv6
  - Missing available products delayed the tests.
- Routing policies and RPSLng
  - Extend RPSL (Routing Policy Specification Language) to describe routing policies for IPv6. 6NET tested prototype RPSLng registry and tools.
- Security
  - Define the security policy in the 6NET network
- “Routing, DNS, Interdomain Multicast, and Security Cookbook”
  - Implementation details (a.k.a. configuration) for multiple routing protocols, multicast, ACLs and bind.
Multicast

- 6NET provides native IPv6 multicast services since 2003.
- Deployment in multiple phases
  - Phase 1: PIMv2 – SM/SSM, MLD, Static RP configuration, etc
  - Phase 2: Embedded RP, MLDv2, Scoped BSR, PIM boundaries, etc.
- Application tests
  - Videoconferencing: VIC/RAT, VideoLAN, WMPlayer9, etc
  - Radio broadcast: Freeamp
  - Other: SDR, beacon monitoring, NTE, etc
- Multicast gateway (MG)
  - Allows IPv6 hosts to receive / send data to IPv4 multicast groups
  - MG is a “IPv6 PIM router+RP (/96 prefix)” combined with an “IPv4 host (IGMP)”
  - [http://www.uninett.no/testnett/multicast/mcgw/](http://www.uninett.no/testnett/multicast/mcgw/)
- Multicast reflector
  - Receive multicast streams and resend them as unicast streams and the opposite (two way communication).
  - Supports IPv6/IPv4 multicast groups or unicast streams.
Service Support

- **MIPv6**
  - Multiple MIPv6 Home Agents deployed and tested.

- **QoS activity**
  - Phase 1: Investigate the performance of QoS mechanism in limited size testbeds. Identify supported (or missing) functionality in core / edge routers.
  - Activate QoS services in 6NET network. Large-scale tests planned in the following month.

- **VPN deployment and testing**
  - Initial deployment of XBone and DVC.
  - Tests with OpenVPN.

- **Multihoming**
  - Limited work – Follow the standardisation process.
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Applications

- Real-time videoconference and media streaming
  - Gnomemeeting, OpenMCU, VideoLAN, DVTS, MPEG4IP(DSS), VIC/RAT, NTE etc.
- On-line games
  - Quake
- E-business solutions
  - WEBsphere portals
- http://serverwas.lab.telin.nl/ WP5Apps/
<table>
<thead>
<tr>
<th>name</th>
<th>category</th>
<th>class</th>
<th>summary</th>
<th>status</th>
<th>responsible</th>
<th>modified</th>
</tr>
</thead>
<tbody>
<tr>
<td>6UMS</td>
<td>Streaming</td>
<td>C</td>
<td>IPv6-enabled unified messaging system</td>
<td>6UMS is being developed by UoS in Euro6x, but will be made available to 6NET. Existing tools will be re-used where appropriate.</td>
<td>UoS</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>AWM</td>
<td>E-business</td>
<td>No</td>
<td>Application Workload Modeler</td>
<td>Released product with IPv6 support for zSeries. Needs special build for Linux/Intel.</td>
<td>IBM</td>
<td>2003-04-14</td>
</tr>
<tr>
<td>Bonephone</td>
<td>Streaming</td>
<td>B</td>
<td>Internet phone sending and receiving SIP messages</td>
<td>Demo version released.</td>
<td>FHG</td>
<td>2003-04-10</td>
</tr>
<tr>
<td>CDN</td>
<td>Edge Services</td>
<td>C</td>
<td>Content Distribution Networks</td>
<td>No specific work at the moment.</td>
<td>Cisco</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>DVTS</td>
<td>Streaming</td>
<td>C</td>
<td>Application for sending and receiving Digital Video</td>
<td>The source and binaries for DVTS on various platforms are available from the DVTS URL.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>Edge Server</td>
<td>Edge Services</td>
<td>C</td>
<td>IBM Edge Server</td>
<td>Portal to IPv6 in progress.</td>
<td>IBM</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>EGP</td>
<td>Gaming</td>
<td>No</td>
<td>Experimental Gaming Platform</td>
<td>Sony has stopped working on EGP. This activity has been dropped.</td>
<td>Sony</td>
<td>2003-03-27</td>
</tr>
<tr>
<td>FreeAMP</td>
<td>Streaming</td>
<td>A/B</td>
<td>Free unicast/multicast MP3 player</td>
<td>The code has been released on the web. Both a unicast and a multicast MP3 source will be activated in a network which will be available to all 6Net partners.</td>
<td>GARR</td>
<td>2003-01-24</td>
</tr>
<tr>
<td>FunnelWeb</td>
<td>E-business</td>
<td>C</td>
<td>Application level active services</td>
<td>Implemented as a Java application. Available on request within the project.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>Globus</td>
<td>E-business</td>
<td>C</td>
<td>GLOBUS toolkit (Grid)</td>
<td>Release 2.0 available. Globus 3.0 is expected early 2003. 6NET expectation is to get IPv6 support enabled as a patch for Globus 2.0, later as an integral part of Globus 3.0.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>GnomeMeeting</td>
<td>Streaming</td>
<td>C</td>
<td>Open source H323 Linux application</td>
<td>Deployment and support in progress for Greek Research Network community.</td>
<td>GRNET</td>
<td>2003-02-05</td>
</tr>
<tr>
<td>HAT</td>
<td>Streaming</td>
<td>B</td>
<td>Tool for sending and receiving MP3 audio</td>
<td>Tool for sending and receiving MP3 audio</td>
<td>HAT works on MSR IPv6 stack. Another version which works on Microsoft Tech Preview IPv6 will be released.</td>
<td>UCL</td>
</tr>
<tr>
<td>-----------------</td>
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<td>------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Hypemedia LS</td>
<td>E-business</td>
<td>A</td>
<td>Hypermedia Link Services</td>
<td>Hypermedia Link Services</td>
<td>Two servers available to experiment with an IPv6-enabled link service (output of EVINET)</td>
<td>UoS</td>
</tr>
<tr>
<td>IRC</td>
<td>E-business</td>
<td>A</td>
<td>Internet Relay Chat communication system</td>
<td>Internet Relay Chat communication system</td>
<td>Works.</td>
<td>GARR</td>
</tr>
<tr>
<td>MCastG</td>
<td>Streaming</td>
<td>B</td>
<td>Tool for multimedia streaming in a computer network</td>
<td>Tool for multimedia streaming in a computer network</td>
<td>Open source initiative. Mature versions will be widely available in the Internet. Architecture is designed to make other parties capable to change, adjust or add new modules.</td>
<td>PSNC</td>
</tr>
<tr>
<td>MMCR</td>
<td>Streaming</td>
<td>No</td>
<td>Multicast MultiMedia Conference Recorder</td>
<td>Multicast MultiMedia Conference Recorder</td>
<td>Running. MMCR is fairly stable, and provides good performance.</td>
<td>UCL</td>
</tr>
<tr>
<td>MUD</td>
<td>Gaming</td>
<td>C</td>
<td>MUD gaming environment</td>
<td>MUD gaming environment</td>
<td>Local to UoS. Can connect from anywhere via Telnet.</td>
<td>UoS</td>
</tr>
<tr>
<td>MUST</td>
<td>Streaming</td>
<td>C</td>
<td>MBONE Web-interface</td>
<td>MBONE Web-interface</td>
<td>Deployment and support in progress for Greek Research Network community</td>
<td>GRNET</td>
</tr>
<tr>
<td>NTE</td>
<td>Streaming</td>
<td>C</td>
<td>Network Text Editor</td>
<td>Network Text Editor</td>
<td>NTE is currently fairly stable, and provides good performance. Further work is required on transcoding and support for interleaved formats.</td>
<td>UCL</td>
</tr>
<tr>
<td>PKI</td>
<td>E-business</td>
<td>C</td>
<td>Public Key Infrastructure</td>
<td>Public Key Infrastructure</td>
<td>Available on request within the project from the PKI URL.</td>
<td>UCL</td>
</tr>
<tr>
<td>Portals</td>
<td>E-business</td>
<td>C/A</td>
<td>IBM WebSphere Portal Technology</td>
<td>IBM WebSphere Portal Technology</td>
<td>Equipment being prepared by IBM.</td>
<td>IBM</td>
</tr>
<tr>
<td>Quake</td>
<td>Gaming</td>
<td>C</td>
<td>Multiplayer FPS action game</td>
<td>Multiplayer FPS action game</td>
<td>Works. Used at GARR.</td>
<td>Sony</td>
</tr>
<tr>
<td>RAT</td>
<td>Streaming</td>
<td>A</td>
<td>Robust Audio Tool (audio)</td>
<td>Robust Audio Tool (audio)</td>
<td>RAT is currently fairly stable, and provides good performance. Further work is required on transcoding and support for interleaved formats.</td>
<td>UCL</td>
</tr>
</tbody>
</table>

Note: The table above provides a summary of various services and technologies related to IPv6, including tools, applications, and services that support IPv6, along with their descriptions and release dates.
<table>
<thead>
<tr>
<th>Port</th>
<th>Type</th>
<th>Cat</th>
<th>Application</th>
<th>Description</th>
<th>Provider</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>IBM WebSphere Portal Technology Equipment</td>
<td>IBM WebSphere Portal Technology Equipment being prepared by IBM.</td>
<td>IBM</td>
<td>2003-03-20</td>
</tr>
<tr>
<td>Quake</td>
<td>Gaming</td>
<td>C</td>
<td>Multiplayer FPS action game</td>
<td>Works. Used at GARR.</td>
<td>Sony</td>
<td>2003-01-17</td>
</tr>
<tr>
<td>RAT</td>
<td>Streaming</td>
<td>A</td>
<td>Robust Audio Tool (audio conferencing)</td>
<td>RAT is currently fairly stable, and provides good performance. Further work is required on transcoding and support for interleaved formats.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>RCM</td>
<td>Streaming</td>
<td>C</td>
<td>RTP Quality Matrix (background tool for testing)</td>
<td>RCM is currently fairly stable, and provides good performance.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>SCS</td>
<td>Streaming</td>
<td>A</td>
<td>Secure Conference Store of conference information</td>
<td>SCS is currently fairly stable, and provides good performance.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>SDR</td>
<td>Streaming</td>
<td>No</td>
<td>Session Directory Tool</td>
<td>Not stabilised.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>SPAR</td>
<td>Streaming</td>
<td>A</td>
<td>SDP Parser Applet (component of SCS)</td>
<td>SPAR is currently stable, and provides good performance.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>TAG</td>
<td>E-business</td>
<td>C</td>
<td>Transcoding Active Gateway</td>
<td>Implemented in Java. JDK1.4 required if used in IPv6 environment. Initial release available for download to project partners.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>TZI-Gateway</td>
<td>E-business</td>
<td>C</td>
<td>Call signalling and media transcoding gateway</td>
<td>Supports IPv6 for SIP and H.323 on Linux-2.4 and Solaris (Intel). Tested with a number of agents/clients.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>VIC</td>
<td>Streaming</td>
<td>A</td>
<td>Video Conferencing Tool</td>
<td>VIC is currently fairly stable, and provides good performance. Further work is required on use of direct video display and integration of more codecs.</td>
<td>UCL</td>
<td>2003-04-30</td>
</tr>
<tr>
<td>VideoLAN</td>
<td>Streaming</td>
<td>A</td>
<td>Streaming video server and player</td>
<td>Works. Ported to IPv6 by Btexpert for 6WinIT. May be good multicast and QoS demonstrator.</td>
<td>SURFnet</td>
<td>2003-05-08</td>
</tr>
<tr>
<td>VIP</td>
<td>Streaming</td>
<td>No</td>
<td>Video over IP (search and retrieval system)</td>
<td>Active at Telin. Central service would be delivered from Telin DataCenter through Surfnet</td>
<td>Telin</td>
<td>2003-01-17</td>
</tr>
<tr>
<td>VOCAL</td>
<td>Streaming</td>
<td>B</td>
<td>SIP-based VoIP client</td>
<td>The SIP user agents have been ported for use with IPv6 and are undergoing testing. Supports ENUM.</td>
<td>UoS</td>
<td>2003-01-20</td>
</tr>
<tr>
<td>WBD</td>
<td>Streaming</td>
<td>C</td>
<td>Whiteboard for conferencing</td>
<td>WBD is currently fairly stable, and provides good performance.</td>
<td>UCL</td>
<td>2003-01-16</td>
</tr>
<tr>
<td>XPIlot</td>
<td>Gaming</td>
<td>C</td>
<td>Network game</td>
<td>Ported to IPv6. Field trial started.</td>
<td>UNINETT</td>
<td>2003-01-22</td>
</tr>
</tbody>
</table>
Multiple management tools were ported to IPv6.

- Some of the tools are used in the everyday operation of 6NET network, e.g. ASPath, Looking Glass, Weathermap, IRRToolSet, Mping, MRTG, Nagios, rancid, etc.

- [http://tools.6net.org/](http://tools.6net.org/)

- “IPv6 Network Management Cookbook”
Here is a list of monitoring tools that are currently being evaluated by wp6 members. If you are responsible for evaluating or/and migrating a tool to ipv6, then please make sure that the corresponding page is always updated with the latest information.

Any page can be edited by anyone by selecting the EditText link at the bottom of the page.

- Analyzer (AnalyzerTool)
- Argos (ArgosTool)
- AS Path Trie (ASPathTrie)
- Cisco Works Campus Manager (CiscoWorksCM)
- Cricket (CricketTool)
- Ethercat (EthercatTool)
- FlowTools (FlowTools)
- HP OpenView Network Node Manager (HPOpenView)
- InfoTools
- Ipm (IpmTool)
- IPv6 Management Gateway (IPv6MGw)
- RDD Tool Set (RDDToolSet)
- Java SNMP Programming Environments (JavaSNMPProgrammingEnvironments)
- Jetnet (Jetnet)
- JOIN-IV (JOIN-IV)
- Lookup Class Service (LookupClassService)
- MERRIT's IPone Routing Report (MERRIT's IPoneRoutingReport)
- Ming (MingTool)
- MRTGv6 OdynaVTool
- NCTE (NCTE)
- Multicast Beacon (MulticastBeacon)
- Nagios (NagiosTool)
- NagRt
- NetSNMP (NetSNMP)
- NetBorder1,2 (NetBorder1,2)
- NetFlow Support for Hollowv9 in IOS (NetFlowV9)
- NetFlow UEC Collectors (NetFlowUEC)
- NMSIS Network Management Information System (NMSIS)
- NTOP (NTOP)
- NTPv4 Monitor (NTPv4Monitor)
- Open-see (OpenSee)
- P2P (P2PTool)
- Riscml (RiscmlTool)
- SNMP Session (SNMPSession)
- SNMP Proxy (SNMPProxy)
- Lan Topology Discovery Service (LanTopologyDiscoveryService)
- Polysphere (PolysphereTool)
- Ripe NCC Test Traffic Tools (RipeNCCTestTrafficTools)
- TpmonTrace (TpmonTrace)
- Weathermap (WeathermapTool)
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Dissemination

- Organise or participate to IPv6-related workshops
  - Global IPv6 Launch Event (co-organised with European Commission and Euro6IX), 6NET Spring Event, TERENA Conferences, etc.
  - Support multiple 6NET partners to organise local IPv6 workshops

- Organise technical training programs
  - Network administrators get practical training on all aspects of IPv6 deployment and management.
  - Target to NREN NOC members.

- Support IPv6 deployment in other regional networks, e.g. SEEREN network in Balkan area.

- Built a website that concentrates all the cookbooks, tutorials, presentation, papers, newsletters produced within the project.
Demosntrators

- Cross-WP activities that try to integrate multiple IPv6 technologies, a.k.a. “puts different pieces together”.
- Seek for wide deployment of IPv6 applications or services.
- Planned in 2005
  - SIP-based VoIP
  - SSM Multicast & Flute
  - Mobile Streaming
  - OpenH.323 and OpenVPNs
  - Globus Toolkit (GT3)
  - Home Networking
  - IPv6 support in Greek School Network
  - IPv6 Satellite connectivity to SILK region

Moscow, Nov. 2004

III Global IPv6 Summit
SIP-based VoIP

- Components: SER (SIP Express Router), Voice user agent (e.g. IPv6 Kphone), PSTN gateway, MCU, VPN functionality
- Integrate: QoS, Mobility, VPNs, management and monitoring.
Mobile Streaming

- Demonstrate mobility in multimedia context
- Components: mobile nodes (laptop, iPAQ), correspondent node (laptop), home agents.
- Integrate/investigate: MIPv6, QoS(?), transition, etc.
H.323 conferencing

- Use together IPv6 applications ported within 6NET, e.g. GnomeMeeting, OpenMCU.
- Integration: IPv4-IPv6 interworking via MCU, Open VPNs, QoS(?),
IPv6 support in Greek School Network

- Deploy IPv6 services to the national School Network in Greece, i.e. upgrade more than 5000 primary and secondary access (and core) routers.
- Plan a smooth migration of the network avoiding degradation of basic production services, e.g. email, dialup, web filtering, etc.
- Support advanced services over IPv6, e.g. synchronous distance learning, asynchronous distance learning and Video on Demand.
Standardisation activities

- Internet Engineering Task Force (IETF)
  - RFC 3627: Use of /127 Prefix Length Between Routers Considered Harmful
  - Submitted more than 40 internet drafts (I-Ds) related with Multicast, DHCPv6, v6ops, Multihoming, renumbering.
  - http://www.6net.org/publications/standards/

- Global Grid Forum (GGF)
  - Participate to GGF IPv6 WG
  - Guidelines for IP version independence in GGF specifications
  - Survey of IPv4 Dependencies in GGF specifications
  - Status of Java Developers Kit API for IPv6
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Conclusions

- 6NET ...
  - ... has proved the feasibility of deploying and running a native IPv6 network
  - ... has successfully addressed a large number of problems related to IPv6 and provided valuable feedback to standardisation bodies and router vendors
  - ... leverages the expansion of IPv6 technology by disseminating the gained experience.
6NET contact details

http://www.6net.org

info@6net.org