IPv6 networks deployments

6DISS dissemination and exploitation

training at AfriNIC 03

CAIRO December 2005

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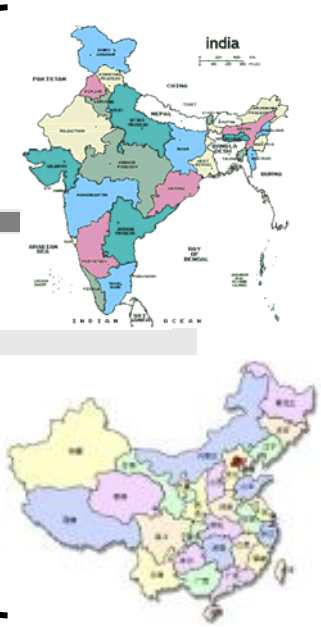
Agenda

- 6DISS: IPv6 dissemination and exploitation
- Stories of IPv6 and IPv4 coexistence
  - 6NET : 3 years experience european Back Bone
  - Géant : IPv6 services
  - GSN : Greek Schools Network and IPv6 deployment
- Managing IPv6 networks
  - 6NET and Renater examples
- IPv6 for what ?
  - Quick look at available applications

6DISS : Objectives

Also exchange with such Org. In China and India (attend to local events)



Transfer knowledge
Deployment experience

Several technical approaches to meet the goal

Build constituencies,
Raise awareness,
Exchange best practices,
prepare future IST projects

Research network operators,
Universities, .com organizations,
Governments and regulators

Technical approaches

Expertise & material from 6NET, Euro6IX, Géant, NRENs, …

Personal expertise & Cookbooks

IPv6 modules tuned for each Workshop

Material preparation

Workshop organisation & technical support

Dissemination

Support for IPv6 deployment & future IST participation

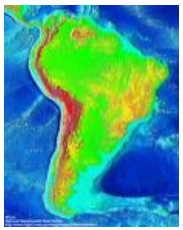
Longer-term assistance

Balkan

Caribbean

N.I.S

Central



South America

Mediterranean

Sub-Saharan Africa

Southern Africa

Southern Asia

6DISS other technical approaches

1. "Tiger team" (1 expert per topic for backup-up technical support, maintaining FAQ, lists, etc.) helpdesk@6diss.org
2. IPv6 Training sessions (hands-on)
   - Cisco in Brussels
   - Renater in Paris
3. "Training the trainers" (people can be trained in all topics and go back to their regions to teach others)
4. E-learning (on-line guide to where reference information can be found – eg. 6NET Cook books)
5. Look at http://www.6diss.org/ for accurate status

Information Society Technologies

6NET

A pan european research IPv6 network

Extensive IPv6 Test-beds

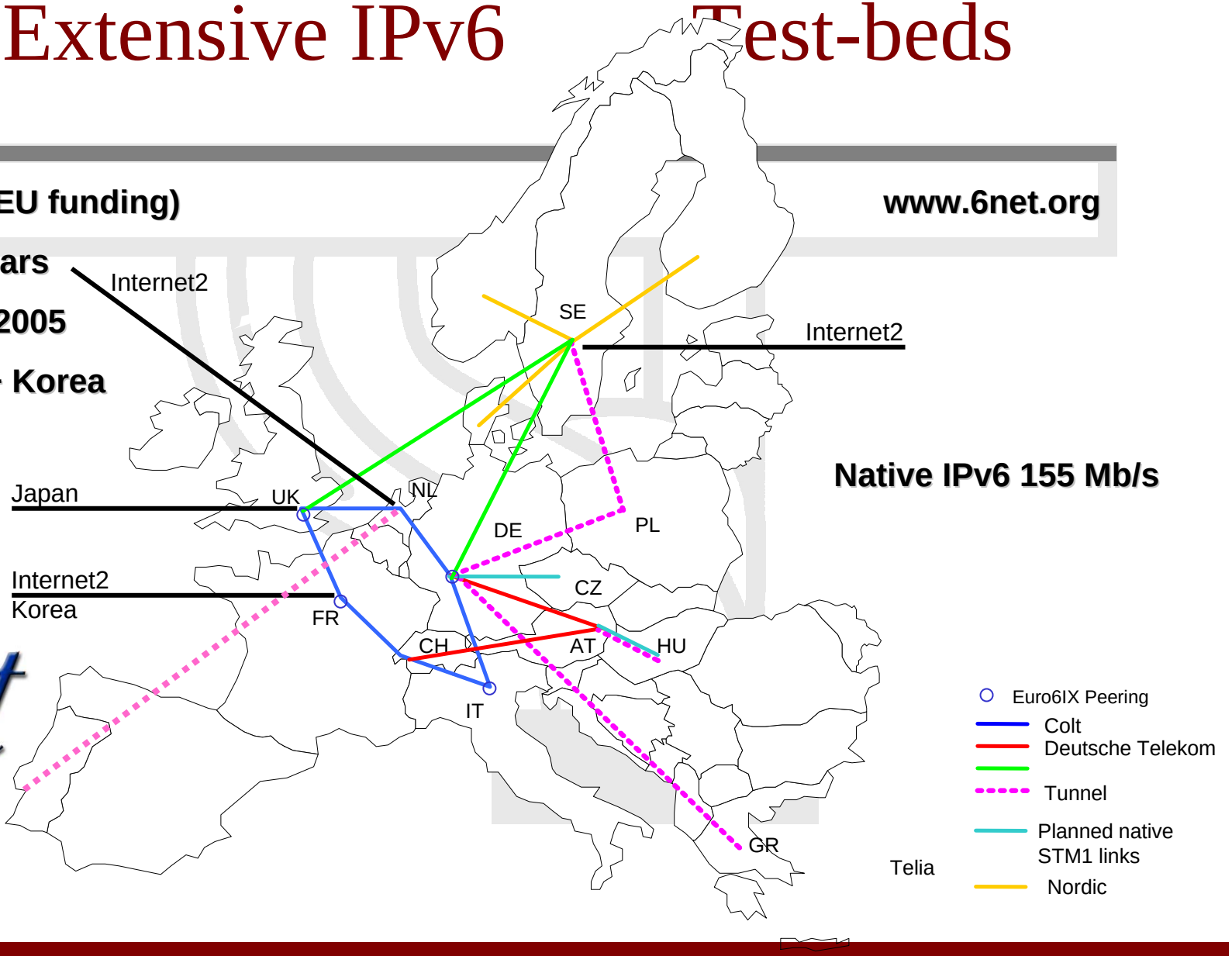
17.7 M€ (10.3 EU funding)

115 person years

01/2002 - 06/2005

15 countries + Korea

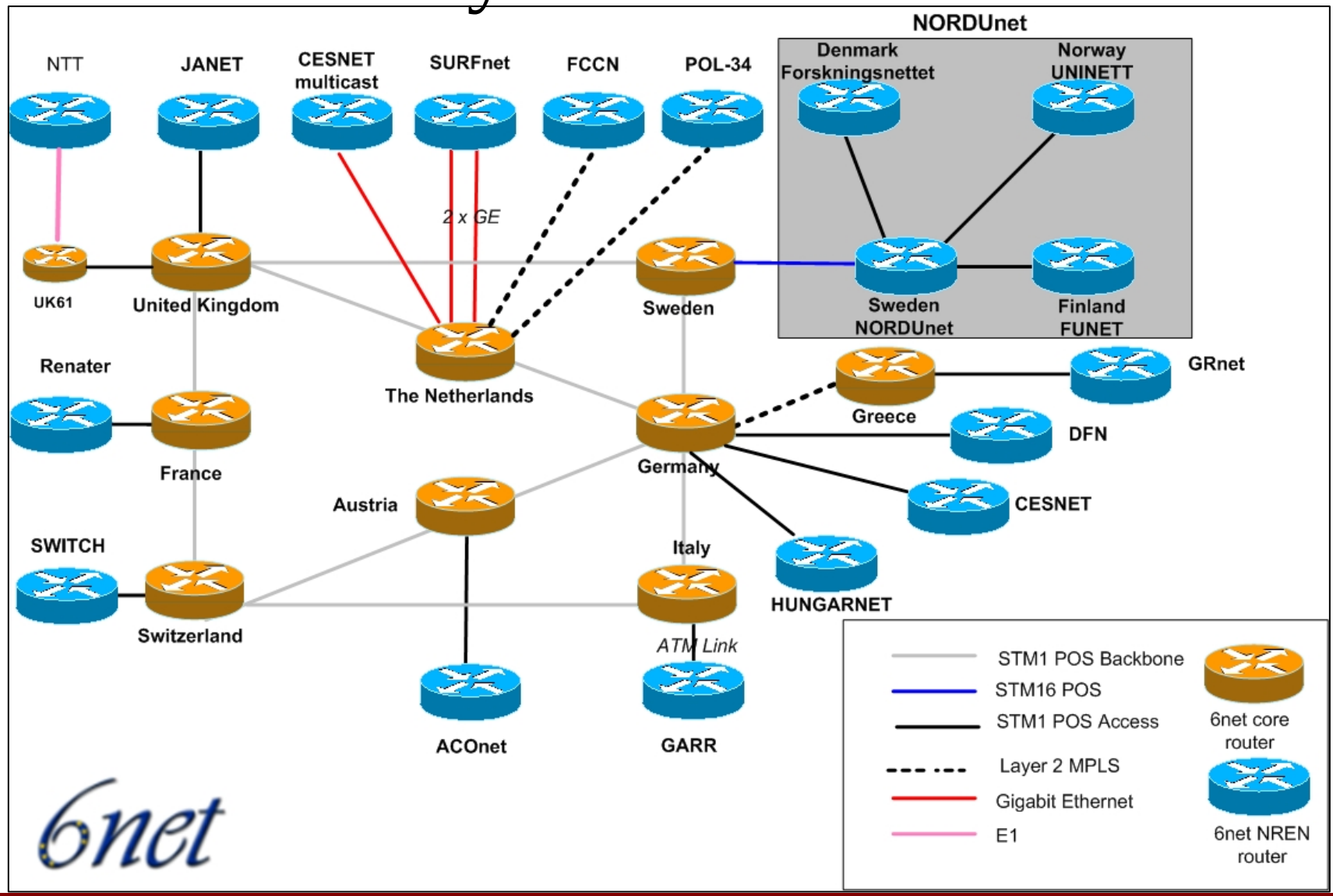
www.6net.org



Native IPv6 155 Mb/s

6net

The 6NET Layout



Routing

- igp IS-IS
  - Use the same process for V4 and V6 unlike OSPF
  - **IIH and ISH password authentication**
  - Passive interfaces:
    - loopback interfaces and NRENs access
- BGP4 (i+e)
  - **md5 Authentication for eBGP and iBGP peering sessions**
  - Each 6NET AS-border router is configured with a ‘2001:0798::/35’ to the null0 interface
  - This route will be used for summary reason.
  - This route will be filtered for iBGP sessions, and not filtered for eBGP sessions
  - Goal: very stable summary /35 prefix for 6NET environment

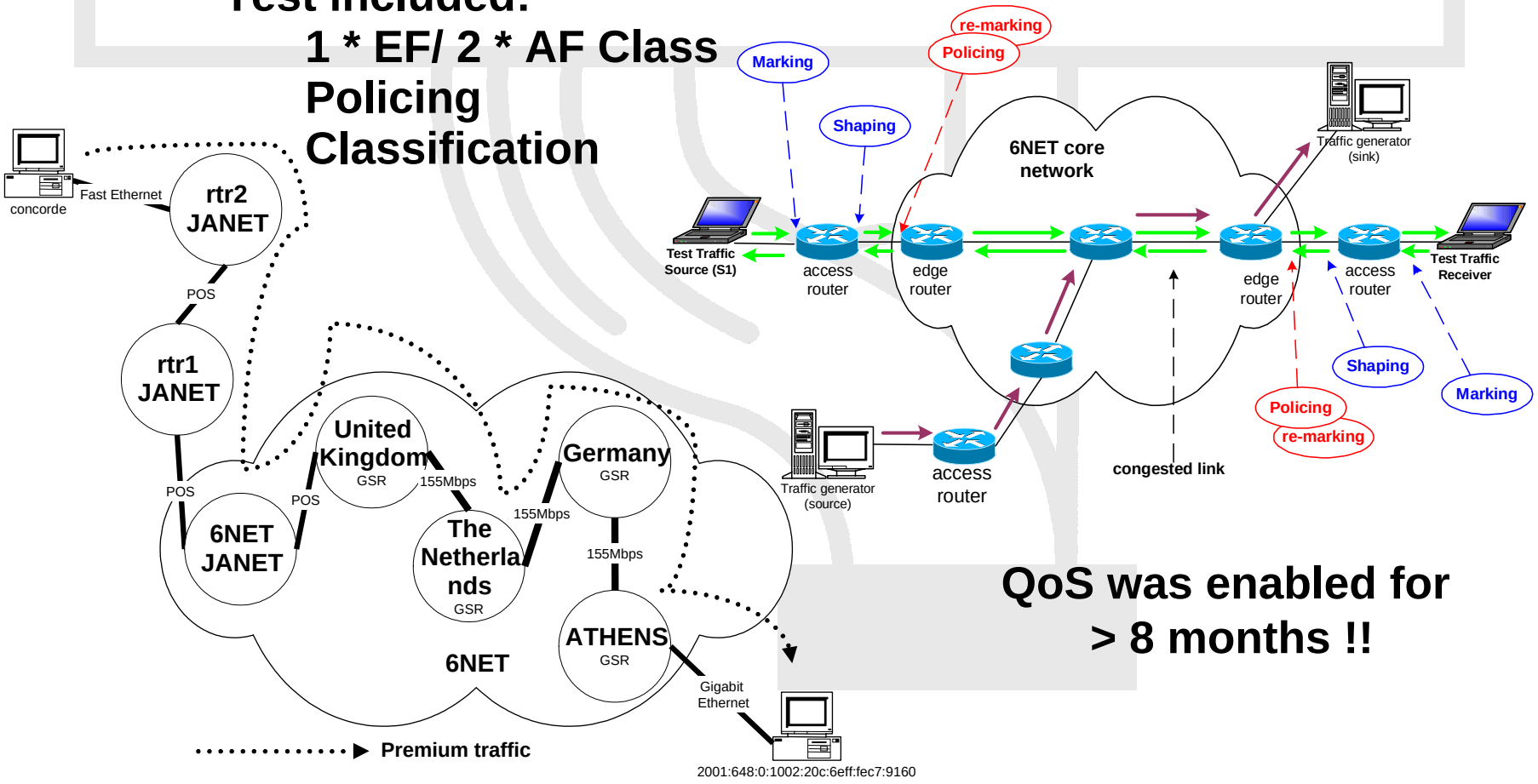
6NET QoS

Test included:

1 * EF/ 2 * AF Class

Policing

Classification



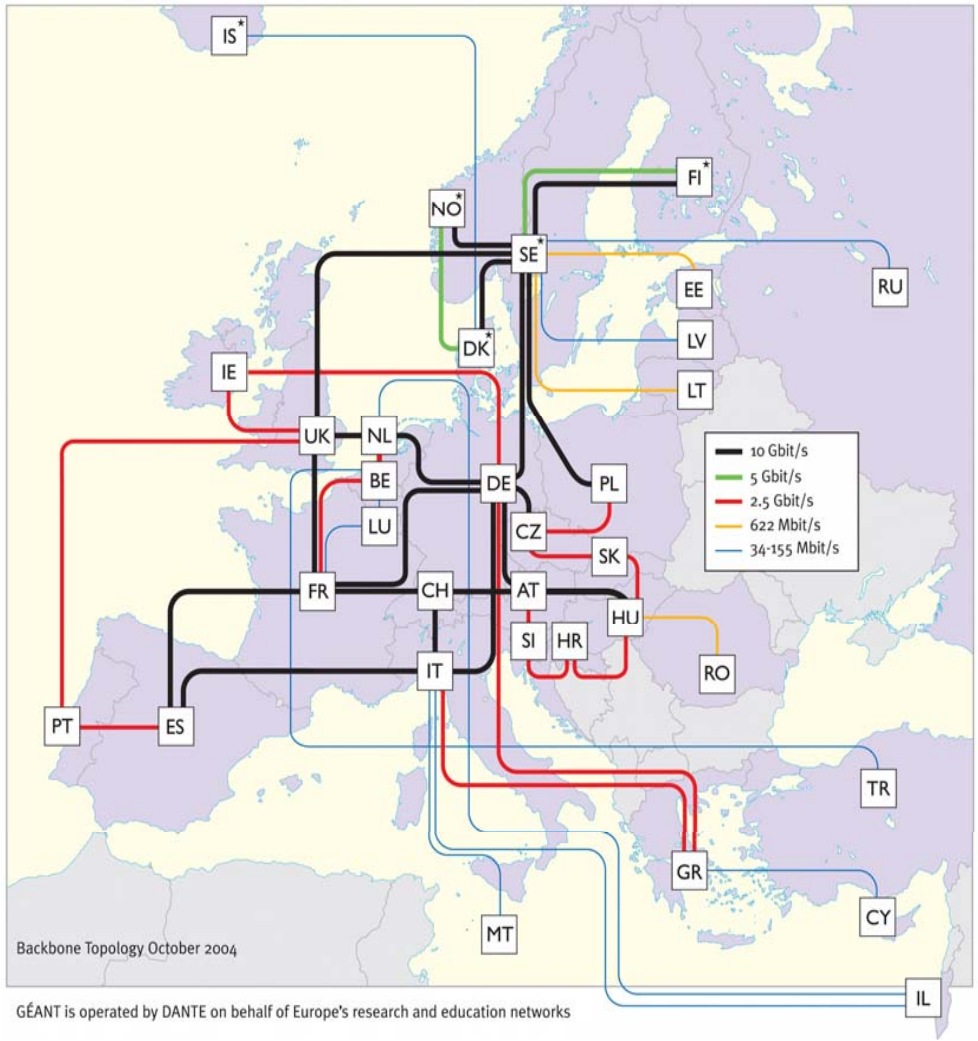
QoS was enabled for > 8 months !!

Information Society Technologies

Géant

The Trans-European Research Network

Géant topology



- **Connecting :**
  - **33 EU countries**
  - **and 27/30 NRENs**
  - **23/27 native IPv6**
- **Backbone capacity :**
  - **155Mb/s-10Gb/s**
- **Routers :**
  - **Juniper M-series**
- **~500 routes announced to NRENs**
  - only 2001::/19-/35 & 2002::/16 (and already some 2003::/16) are allowed
  - No 6bone routes are allowed from EU NRENs

IPv6 connectivity to non-EU Research Networks

ESnet (US) => Native link
Ca-net (CA) => Native in three links
SINET (JP) => Tunnel in New York
APAN (KR) via RENATER (FR)

ARIN Region:
DoD (22), VBNS (145), Univ.Wiscosin (2381),
Univ.Indiana (22398)
LACNIC Region:
RNP (1916), Retina (3597)
APNIC Region:
Taiwan RN(7539),WIDE (2500), Australian NREN (7570),
Singapore NREN (7610), Thailand Ministry (4621),
Chinese Uni.of Hong Kong (3662)

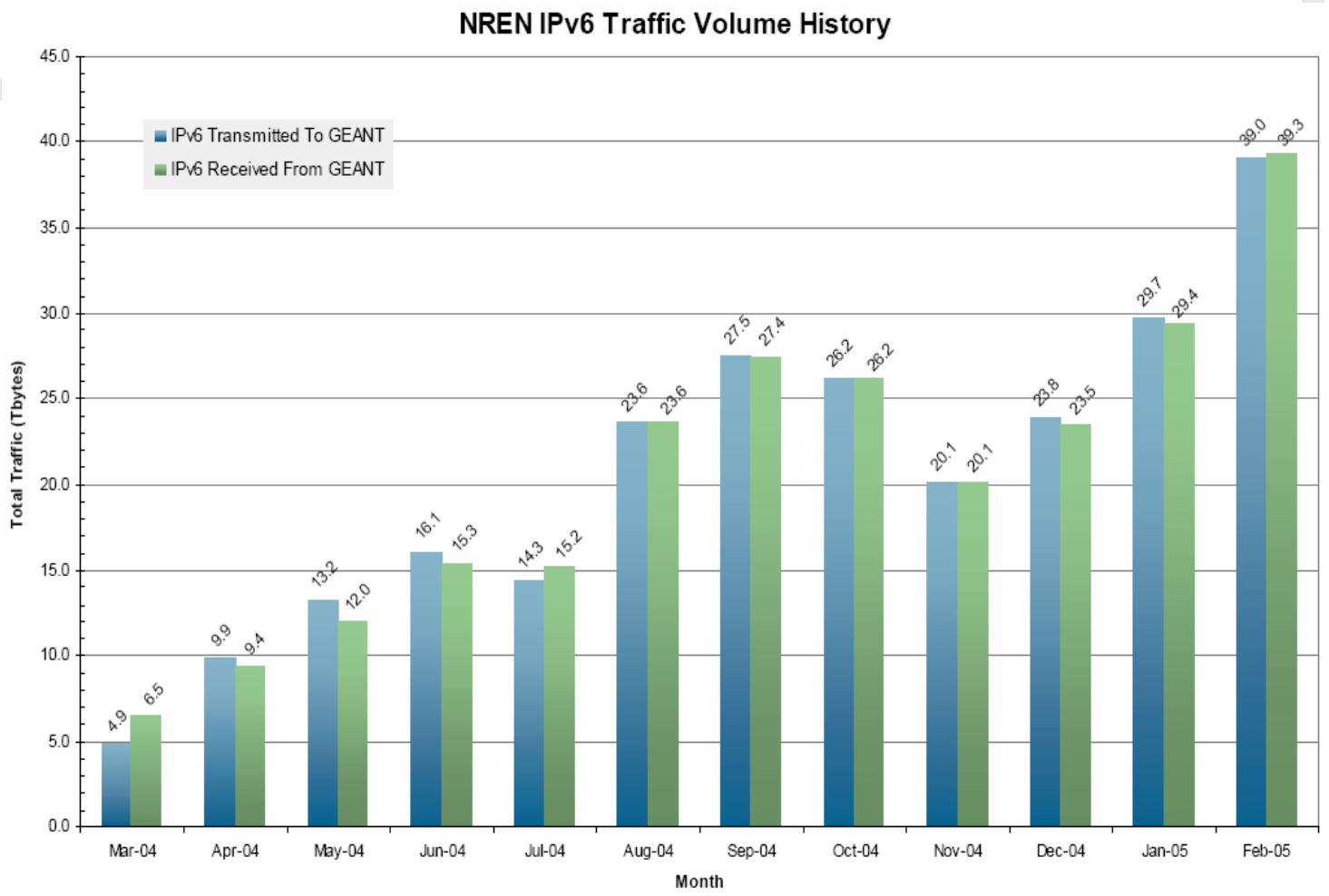
IPv6 implementation on Géant

- Implementation of dual stack in Géant – Feb 2003
  - First NRENs v6 connected in April 2003 :
    - Renater (Fr) and RedIRIS (Es)
    - FCCN (Pt) and Surfnet a week later.
  - Géant IPv6 service operational since Oct 2003
- Free interconnection for European NRNs to the whole Internet-v6
  - Tunnel connections to ISPs,
  - Encouraging ISP to develop their networks in IPv6
- Access to Euro6IX and Eurov6 partners
  - And other IST projects

Addressing Plan

- 2001:0798::/32 has been allocated to DANTE
  - 2001:0798:0000::/35 for 6NET
  - 2001:0798:2000::/35 for Géant
  - 2001:0798:4000::/35 Reserved for delegation of /40 and /48 for projects
  - 8 ranges of /36 reserved for NRNs delegation
  - 2001:0798:E000::/35 reserved for migration

Géant : IPv6 transit traffic



Greek School Network (GSN)

IPv6 into operation at a large scale …

Greek School Network

Objectives:

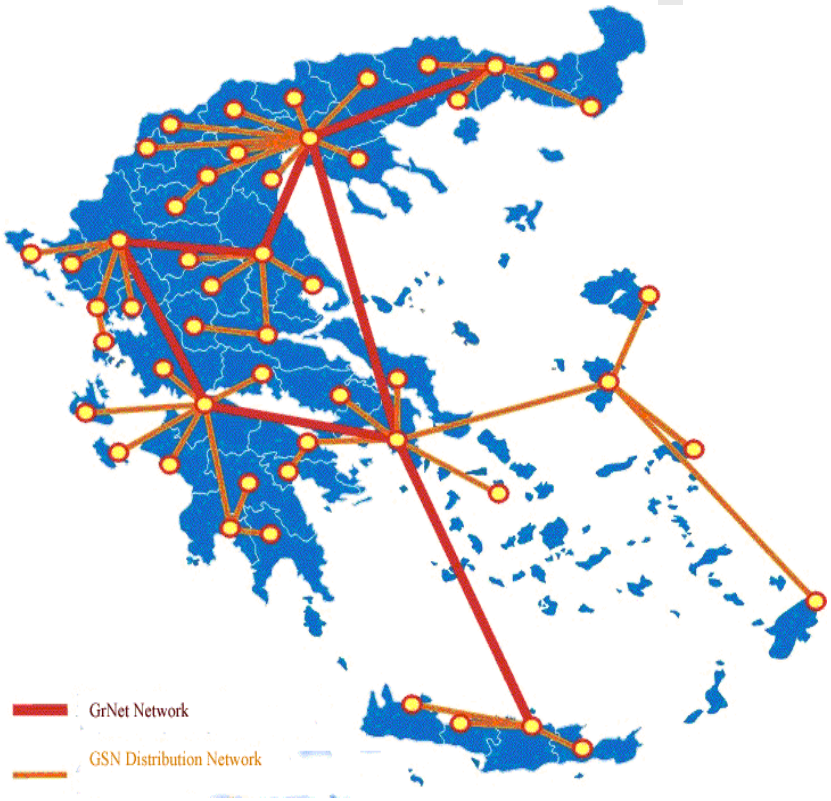
- Interconnect all the primary and secondary schools in Greece (~13K nodes).

Services:

- Broadband Internet access
- E-mail, mailing lists
- Remote network access (dialup)
- Personalised web portal and Web hosting
- Content filtering
- Asynchronous distance learning, Video on Demand (VoD), Teleconference, Webcasting
- Electronic Magazine, News and discussion forums

Network :

- Three layer topology; core, distribution, access.
- 8 major PoPs – Interconnection with the *GRNET (Greek NREN)*
- 52 distribution nodes, 71 servers!
- >13K access routers connected via PSTN/ISDN, Leased Lines, xDSL, WiFi.



www.sch.gr

IPv6 deployment phases (1/2)

- Study and define transition strategy
- Prepare the IPv6 addressing and routing plan
  - Get IPv6 address from the LIR
- Upgrade the core and distribution network
  - Dual stack network – No need for tunnels
  - No major problems with the support of IPv6 in commercial products
- Select the methods for address allocation to school access networks
  - Multi-vendor access routers exhibited different capabilities. So, different models were tested.
  - Minimize the management overhead. Prefer DHCP prefix delegation (DHCP-PD) when possible.

IPv6 deployment phases (2/2)

- Enable IPv6 to basic and advance services
  - Difficult to identify software dependencies between commercial, open-source and in-house developed software
  - Update management tools to monitor and control the network
  - DNS *(BIND)*, Email *(Qmail, Courier-IMAP)*, Web portal *(Apache)*, Directory Services *(iPlanet),* Web filtering *(Squid web proxy)*, multiple in-house built tools, etc.
- Select a small group of schools as a testbed
  - Gradual extend IPv6 interconnection to all access nodes (in progress)
- Extend IPv6 services to PC-based LANs (in progress)
  - Use IPv6 Autoconfiguration

IPv6 Addressing

- GRNET (LIR) allocated a /35 from the 2001:648::/32 for GSN
- Assign /56 address prefix to each school network
- School prefixes are aggregated into /48 prefixes
  - Address allocation follows the hierarchical structure of the GSN
  - One /48 prefix is advertised by each of the 8 core nodes
  - Assign an extra /48 prefix for the backbone
- Long term addressing plan
  - Get a /32 address prefix from RIPE in order to accommodate future student devices inside schools, i.e. PDA, mobile phones.

Routing Scheme

- OSPFv3 as *IGP* for distributing IPv6 routes in GSN
- OSPF instead of IS-IS because
  - familiarity with OSPFv2 used for IPv4
  - supported by most low-edge access routers
  - increased granularity with area management
- BGP used to exchange IPv6 prefixes among GSN and GRNET

Other issues

- Avoid any impact to IPv4 interconnection services
  - Good planning, extended testing
- Upgrade hardware and software
  - Add IPv6 specifications in your long-term procurement plans
- Educate NOCs
  - Lack of experience of network engineers may be a problem in large and distributed networks
- Use open-source software
  - IPv6 ready and easily adapted to fulfil GSN requirements, e.g. WEB content filtering.

Get extra in from 6NET Deliverable D5.14 at www.6net.org

or contact 6net@sch.gr

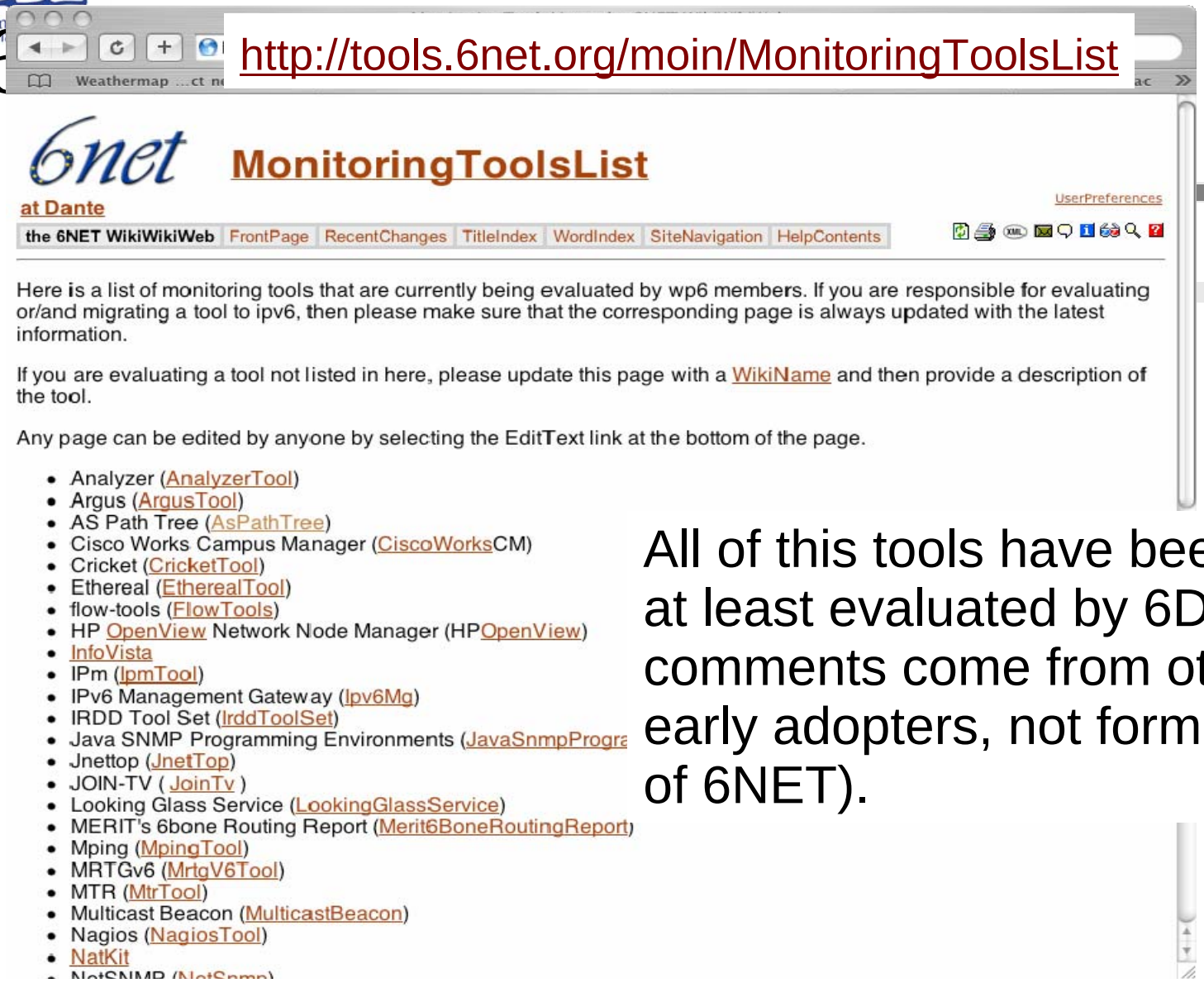
Monitoring IPv6 Networks

6NET and Renater examples

Managing the network

- 6NET activity :
  - Network management architecture
  - Network monitoring tools, applications, platforms
    - 40+ « tools » : tested, ported …
- http://tools.6net.org/moin/MonitoringToolsList
- Tools implemented in NRENs and … 6Net core network
  - http://tools.6net.org/

http://tools.6net.org/moin/MonitoringToolsList



6net at Dante

MonitoringToolsList

UserPreferences

the 6NET WikiWikiWeb | FrontPage | RecentChanges | TitleIndex | WordIndex | SiteNavigation | HelpContents

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.

If you are evaluating a tool not listed in here, please update this page with a WikiName and then provide a description of the tool.

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

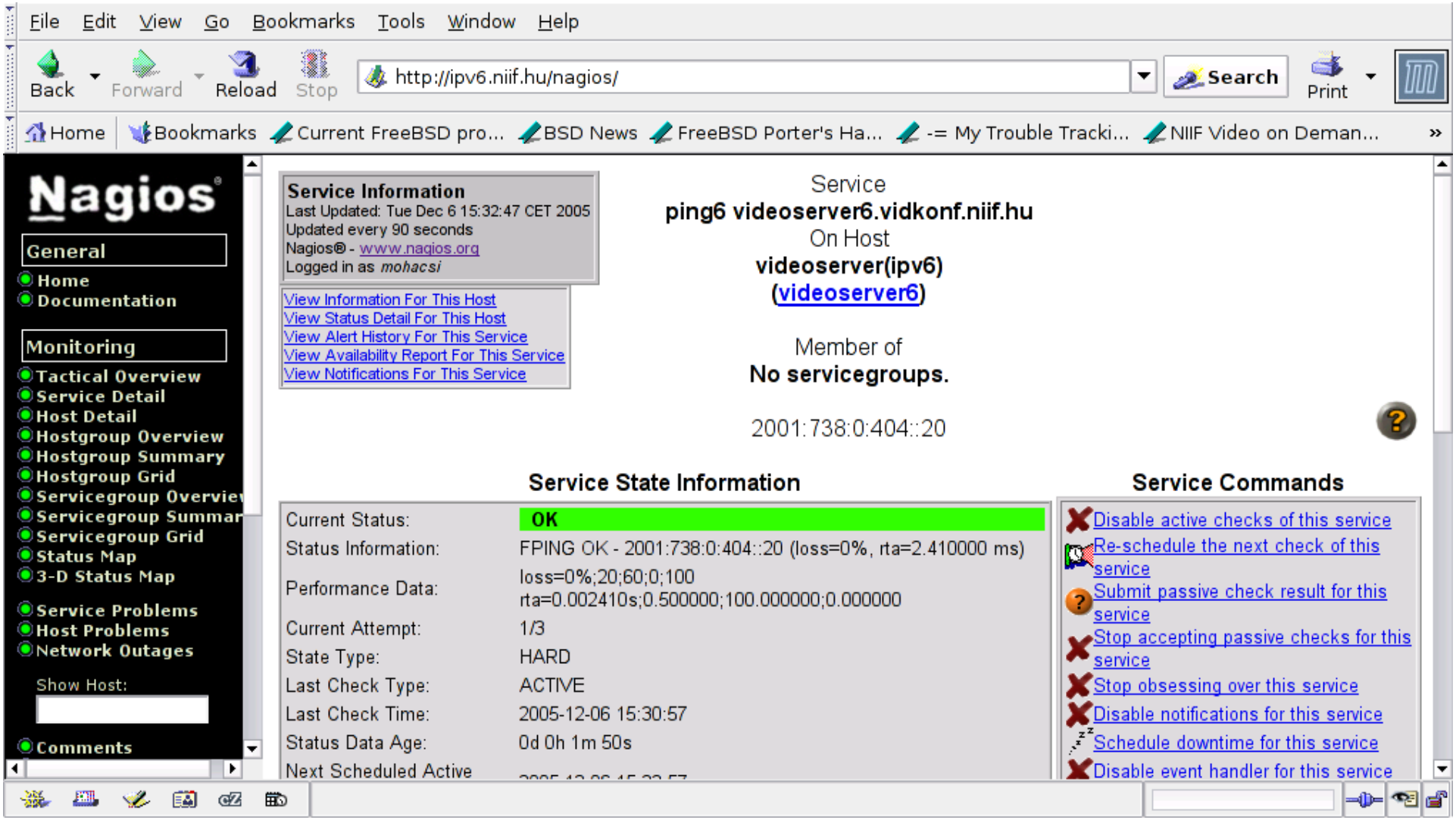
- Analyzer (AnalyzerTool)
- Argus (ArgusTool)
- AS Path Tree (AsPathTree)
- Cisco Works Campus Manager (CiscoWorksCM)
- Cricket (CricketTool)
- Ethereal (EtherealTool)
- flow-tools (FlowTools)
- HP OpenView Network Node Manager (HPOpenView)
- InfoVista
- IPm (IpmTool)
- IPv6 Management Gateway (Ipv6Mg)
- IRDD Tool Set (IrddToolSet)
- Java SNMP Programming Environments (JavaSnmpProgra
- Jnettop (JnetTop)
- JOIN-TV (JoinTv)
- Looking Glass Service (LookingGlassService)
- MERIT's 6bone Routing Report (Merit6BoneRoutingReport)
- Mping (MpingTool)
- MRTGv6 (MrtgV6Tool)
- MTR (MtrTool)
- Multicast Beacon (MulticastBeacon)
- Nagios (NagiosTool)
- NatKit

All of this tools have been tested or at least evaluated by 6DISS. (Some comments come from other IPv6 early adopters, not formal partners of 6NET).

Managing IPv6 networks

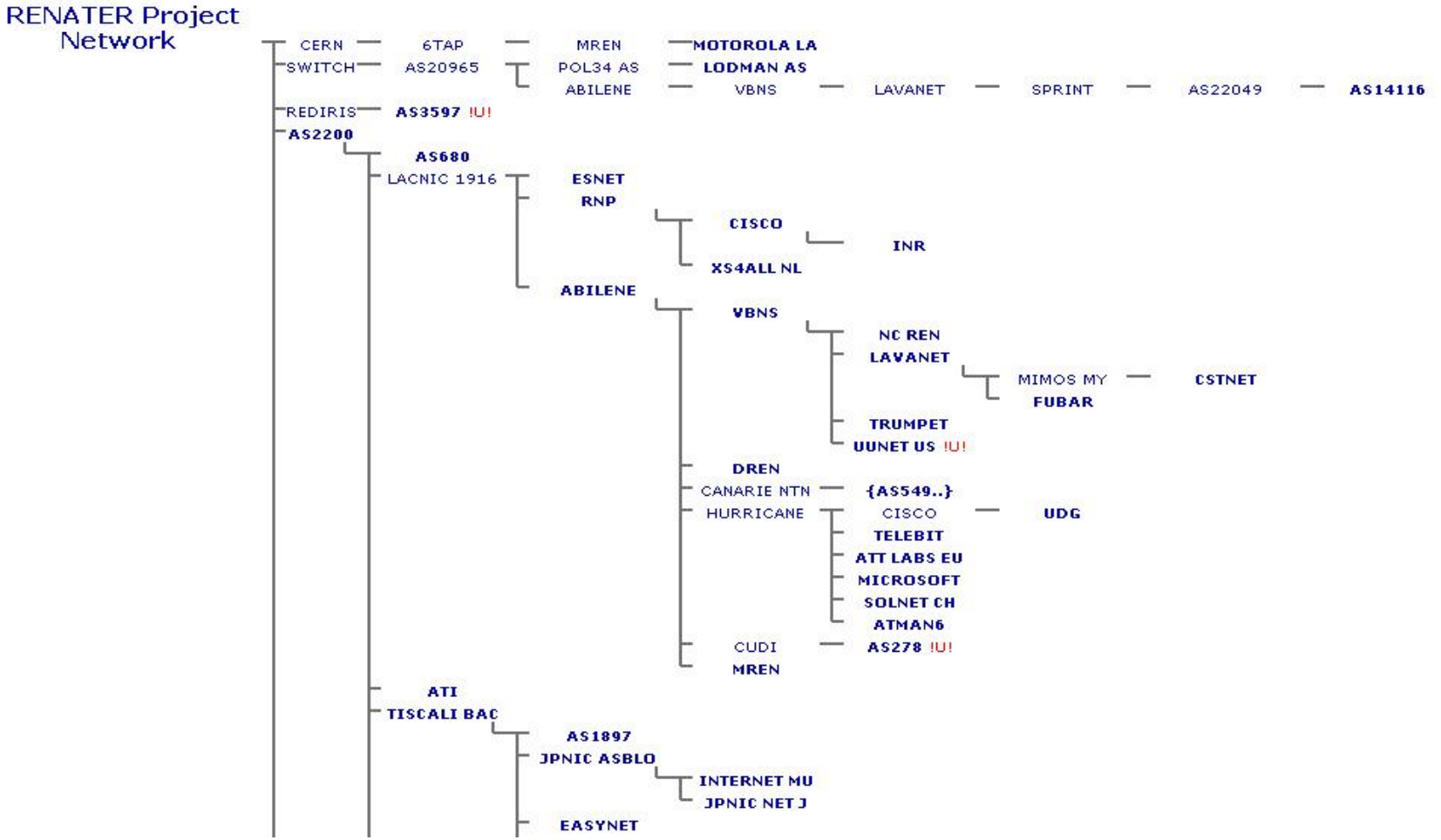
- MIBs standardization & implementation
  - Still some work to be done by manufacturers …
- SNMPv6
- NetFlow v9 and IPFIX conformance
- Tools for network segments :
  - LAN, MAN ,WAN
- Trials with commercial platforms :
  - Cisco
    - Campus Manager
    - Cisco NetFlow collector v5
  - HP Openview

Nagios : http://www.nagios.org

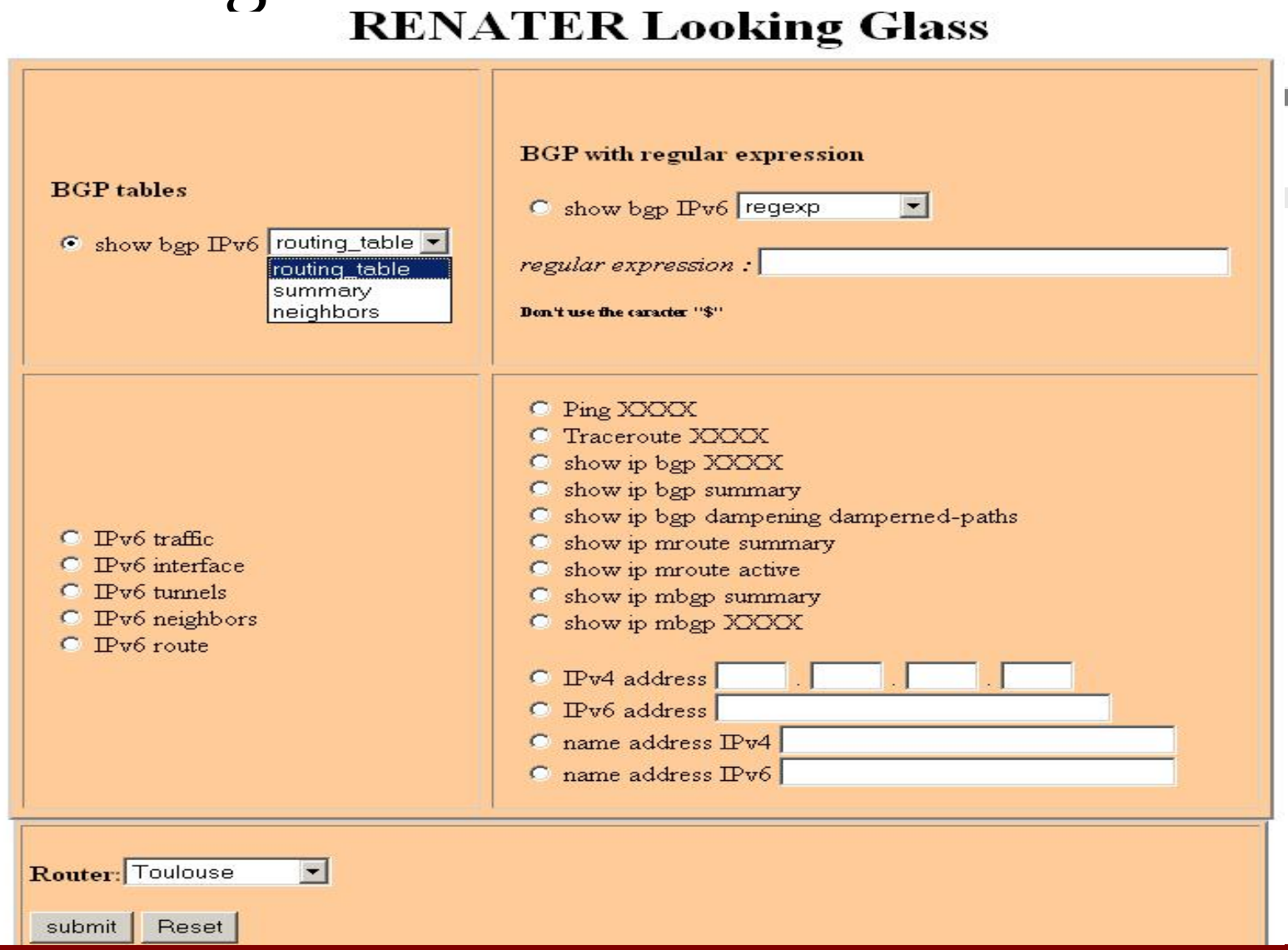


ASpath-Tree

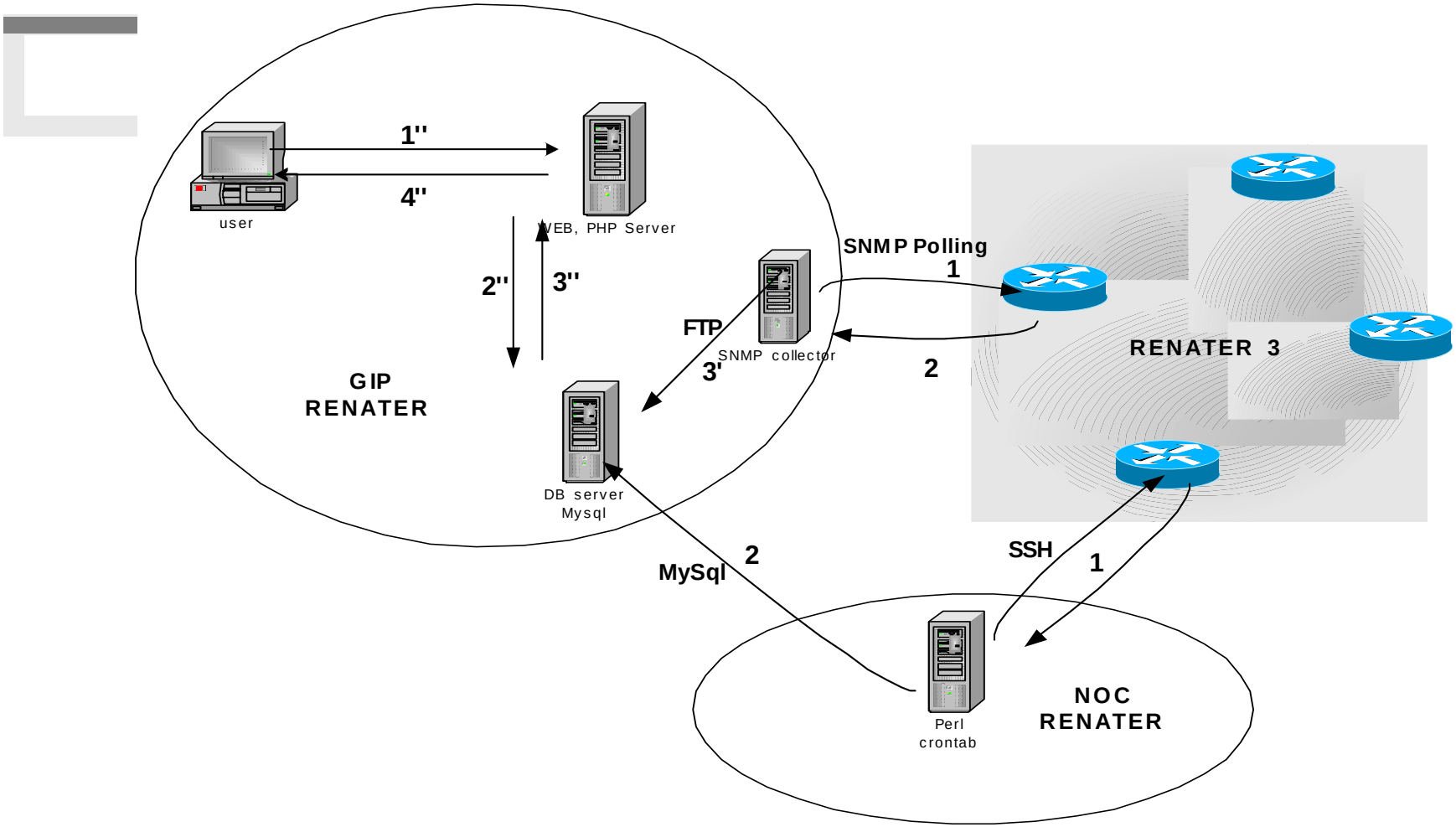
Renater The whole IPv6 BGP table



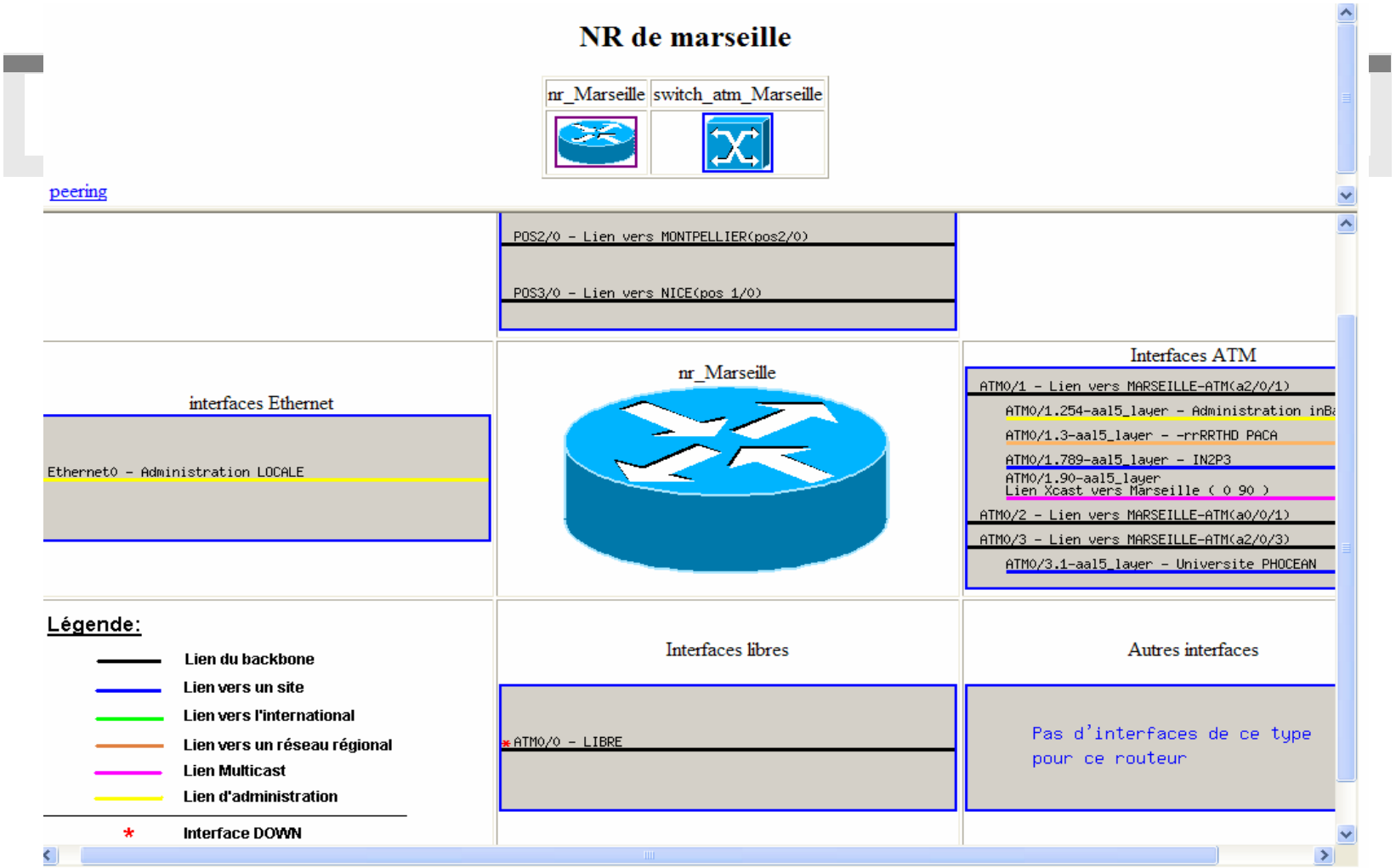
Looking Glass



Inventory : interfaces & peerings



Inventory: Interfaces



Inventory: BGP Peerings

NR de PROJETS

PROJETS_GSR-NIO	PROJETS_GSR-6NET	PROJETS_7200-MCAST	PROJETS_M5
			

interfaces

Routeur PROJETS_GSR-NIO	Peering BGP

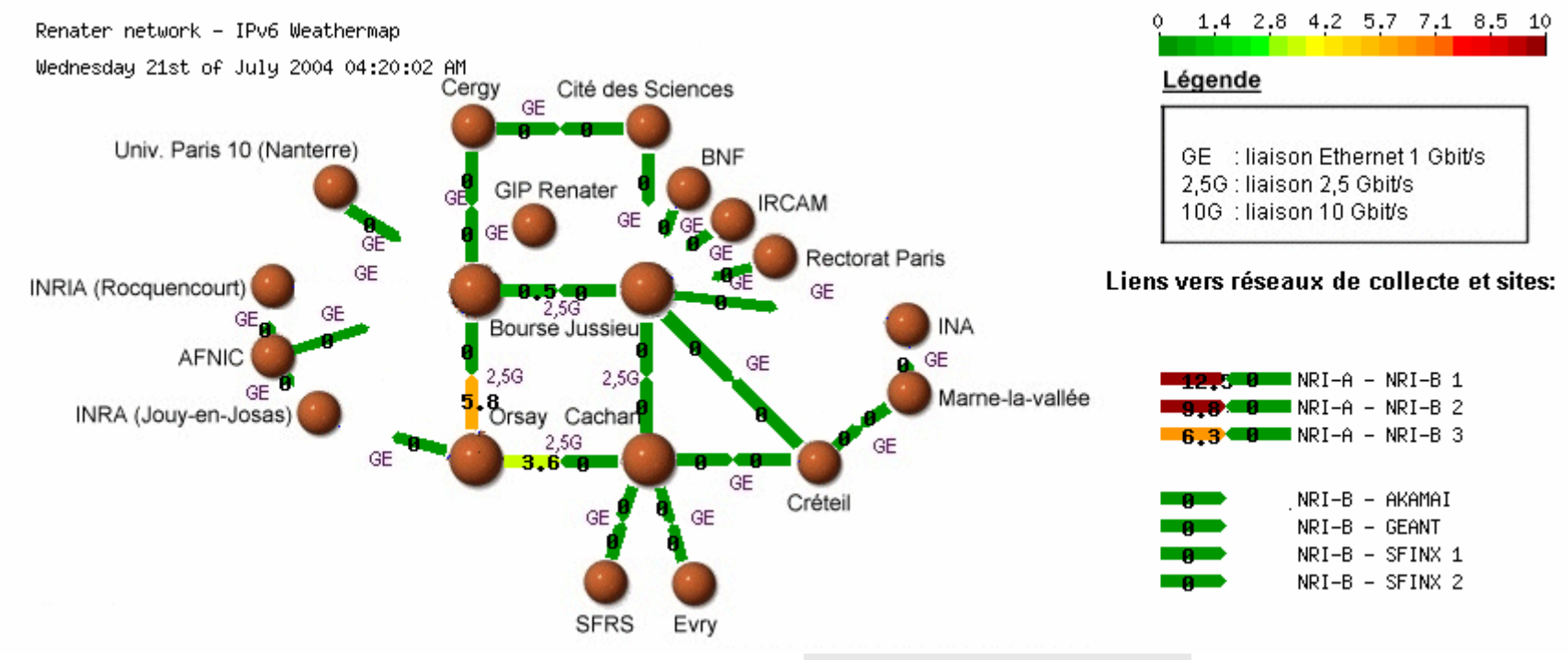
peering iBPG

Established	*** Peer-group de tous les routeurs IBGP ***	AS 1717 - FR-RENATER-PROJETS
Established	*** Peer-group de tous les routeurs IBGP ***	AS 1717 - FR-RENATER-PROJETS
Established	*** Peer-group de tous les routeurs IBGP ***	AS 1717 - FR-RENATER-PROJETS

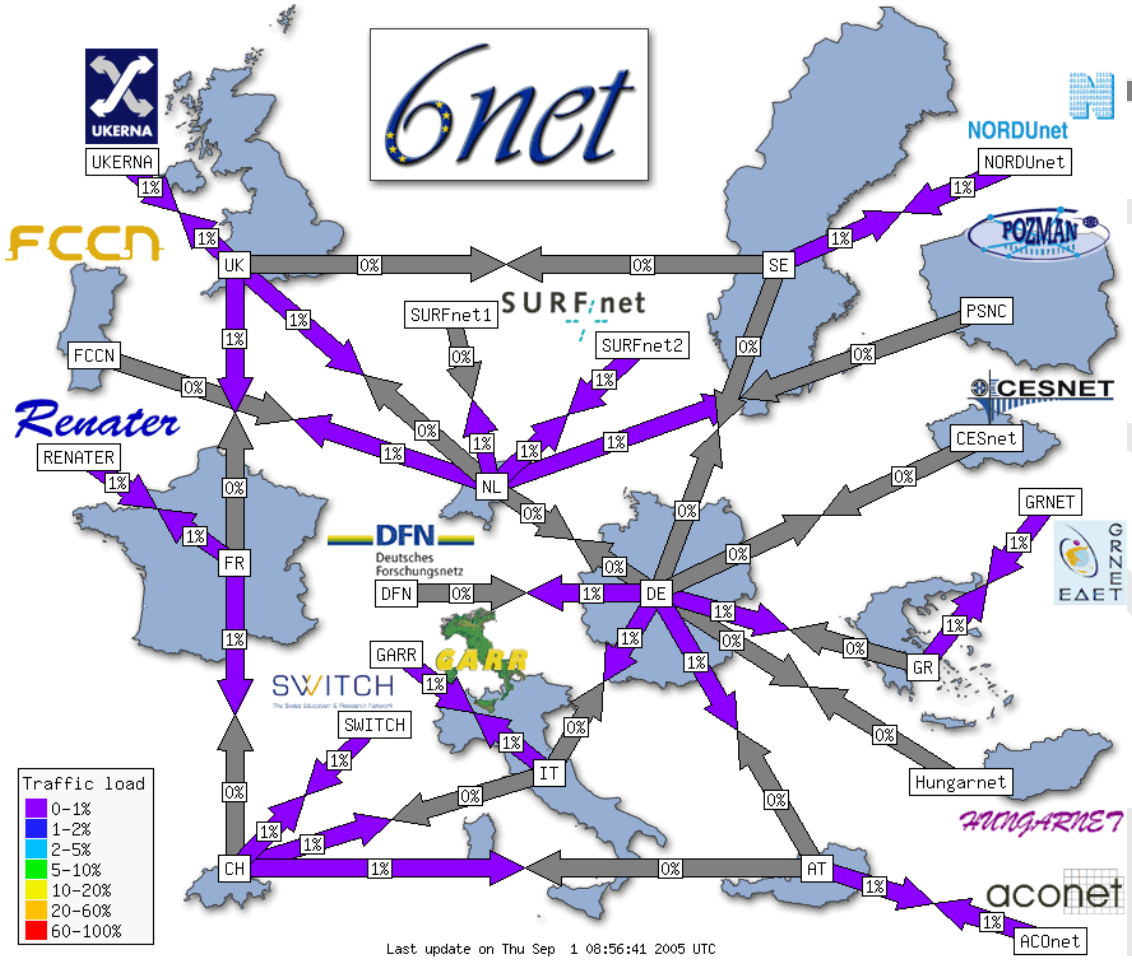
peering eBPG

Established	*** eBGP NRI-A RENATER3 ***	AS 2200 - FR-RENATER
Established	*** eBGP RENATER3 IPv4 ***	AS 2200 - FR-RENATER
Active	*** eBGP @IRS++ KWAK | durand@renater.fr ***	AS 65004 -
Active	*** eBGP @IRS++ PIETRA | durand@renater.fr ***	AS 65004 -

IPv6 traffic on Renater



6NET weathermap



MRTG inputs
Perl::GD scripts

Update via cron

Web access to
“Active map”

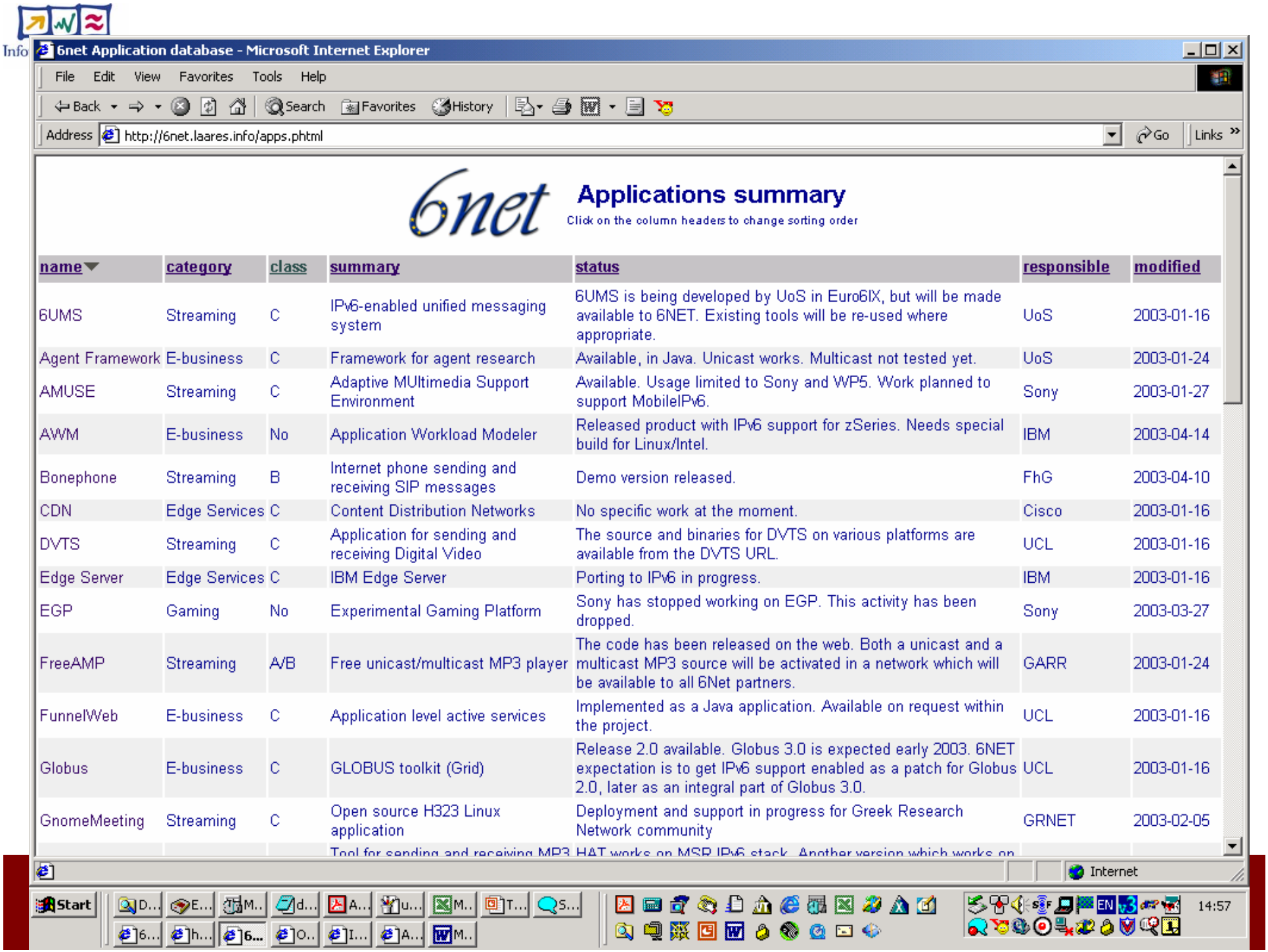
http://netmon.grnet.gr/weathermap/

IPv6, OK but for which applications?

Quick look at available applications

6NET applications summary

- In addition to traditional “Unix” applications (ssh, telnet, web servers, …)
- 6Net has run the following applications trials :
  - **VoIP with SIP** (SIP Express Router) + voice user agent (eg. Kphone IPv6) + PSTN gateway + MCU + VPN functionality
  - **Streaming** between **mobile hosts**, including MIP6
  - AccessGrid
  - Globus (GT3)
  - Open H323 + Open VPN
  - Flute
- And listed the following available applications …


6net Application database - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites History
Address http://6net.laares.info/apps.phtml
Go Links
6net
Applications summary
Click on the column headers to change sorting order
name category class summary status responsible modified
6UMS Streaming C IPv6-enabled unified messaging system 6UMS is being developed by UoS in Euro6IX, but will be made available to 6NET. Existing tools will be re-used where appropriate. UoS 2003-01-16
Agent Framework E-business C Framework for agent research Available, in Java. Unicast works. Multicast not tested yet. UoS 2003-01-24
AMUSE Streaming C Adaptive MUltimedia Support Environment Available. Usage limited to Sony and WP5. Work planned to support MobileIPv6. Sony 2003-01-27
AWM E-business No Application Workload Modeler Released product with IPv6 support for zSeries. Needs special build for Linux/Intel. IBM 2003-04-14
Bonephone Streaming B Internet phone sending and receiving SIP messages Demo version released. FhG 2003-04-10
CDN Edge Services C Content Distribution Networks No specific work at the moment. Cisco 2003-01-16
DVTS Streaming C Application for sending and receiving Digital Video The source and binaries for DVTS on various platforms are available from the DVTS URL. UCL 2003-01-16
Edge Server Edge Services C IBM Edge Server Porting to IPv6 in progress. IBM 2003-01-16
EGP Gaming No Experimental Gaming Platform Sony has stopped working on EGP. This activity has been dropped. Sony 2003-03-27
FreeAMP Streaming A/B Free unicast/multicast MP3 player 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. GARR 2003-01-24
FunnelWeb E-business C Application level active services Implemented as a Java application. Available on request within the project. UCL 2003-01-16
Globus E-business C GLOBUS toolkit (Grid) 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. UCL 2003-01-16
GnomeMeeting Streaming C Open source H323 Linux application Deployment and support in progress for Greek Research Network community GRNET 2003-02-05
Internet
Start
14:57

Conclusion / trends / recommendations …

Tentative of …

Observations

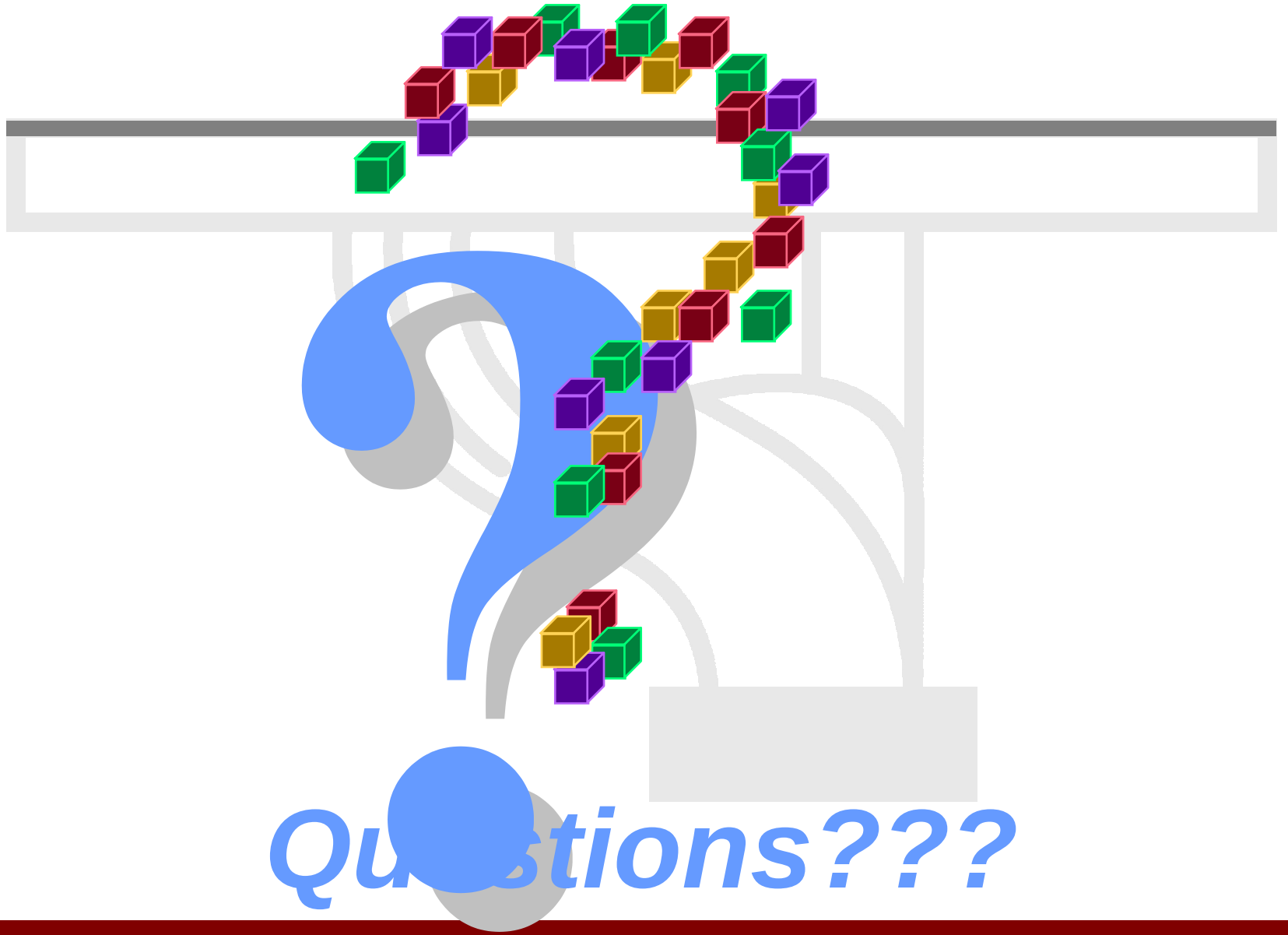
- Testbeds and pilots are more than useful
- But not for ever :
  - Some « fools » have already made the move
- Dual stack is the preferred technique
  - but at the end of « *the day* », a single IP stack will / must remain to do the job …

Recommandations

- Important things to do yet :
  - Inventory the missing apps / services
  - Understand how to port them
  - Who can / must do it
  - Put the pressure on these folks
- And keep in mind
  - Addressing / allocating prefixes : visible part of the iceberg
  - Security policy
  - Management and monitoring

Information

- 6NET : http://www.6net.org
- Géant : http://www.geant.net/server/show/conWebDoc.786
  http://www.geant.net/server/show/nav.00700a001003
- M6bone : http://www.m6bone.net/
- Greek School Network : http://www.sch.gr
- 6DISS : http://www.6diss.org
- Renater Web site : http://sem2.renater.fr


Questions???

6DISS : Key Data

EU IST FP6 project : EUR 900 K

Partners:

- Martel
- Cisco, Alcatel
- RENATER, GRNET, FCCN, Hungarnet
- TERENA
- University College London,
- University of Southampton

Duration:

- 1st April 2005, for 30 months