

IPv6 network management

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6DISS Central Asia Workshop

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IPv6DISSemination and Exploitation

Contributions

- Simon Muyal, RENATER
- Bernard Tuy, RENATER
- Jérôme Durand, RENATER
- Ralf Wolter, Cisco
- Patrick Grossetête, Cisco
- Munechika Sumikawa, Hitachi
- Patrick Paul, 6WIND
- János Mohácsi, NIIF/HUNGARNET



Agenda

- Introduction
- Retrieving information from routers
 - TELNET/SSH/TFTP/FTP...
 - SNMP/MIBs and IPv6
 - Netflow
- Management platforms
- Management tools
 - 6NET work
 - Recommendations (LAN, WAN...)
 - Examples
- Conclusion & Demo



Introduction

- Network Management : What is it?
 - Configurations
 - Inventory
 - Topology
 - Fault
 - Security
 - Accounting
 - ...



Introduction

- IPv6 networks deployed:
 - Most are dual stack
 - LANs (campuses, companies, ...)
 - MANs
 - WANs - ISPs (Géant, NRENs, IIJ, NTT/Verio, Abilene, ...)
 - IX's
- Testbed, pilot networks, production networks
 - Management tools/procedures are needed
- What applications are available for managing these networks ?
 - Equipment, configurations, ...
 - **IP services** (servers : DNS, FTP, HTTP, ...)



Introduction

- Different types of networks
 - Dual stack IPv6 & IPv4 networks
 - IPv6 only networks (few of them)
- Important to keep in mind
 - Dual stack is not for ever
 - One IP stack should be removed... one day
 - No reasons for network admins to face twice the amount of work



Dual Stack IP networks

- Part of the monitoring via IPv4
 - Connectivity to the equipment
 - Tools to manage it (inventory, configurations, «counters», routing info, ...)
- Remaining Part needs IPv6
 - MIBs IPv6 support
 - NetFlow (v9)



IPv6 only networks

- Topology discovery (LAN, WAN ?)
- IPv6 SNMP agent
- SNMP over IPv6 transport

=> Need to identify the missing parts



SSH/TELNET/TFTP...

Basic requirements to manage a
network



SSH/TELNET/TFTP...

- All routers support IPv6 connections (SSH, TELNET)
 - Periodic scripts can retrieve information from the routers over IPv6
- TFTP/IPv6 as well supported on every equipment
 - Images can be downloaded over IPv6
- FTP/IPv6 not supported on CISCO routers

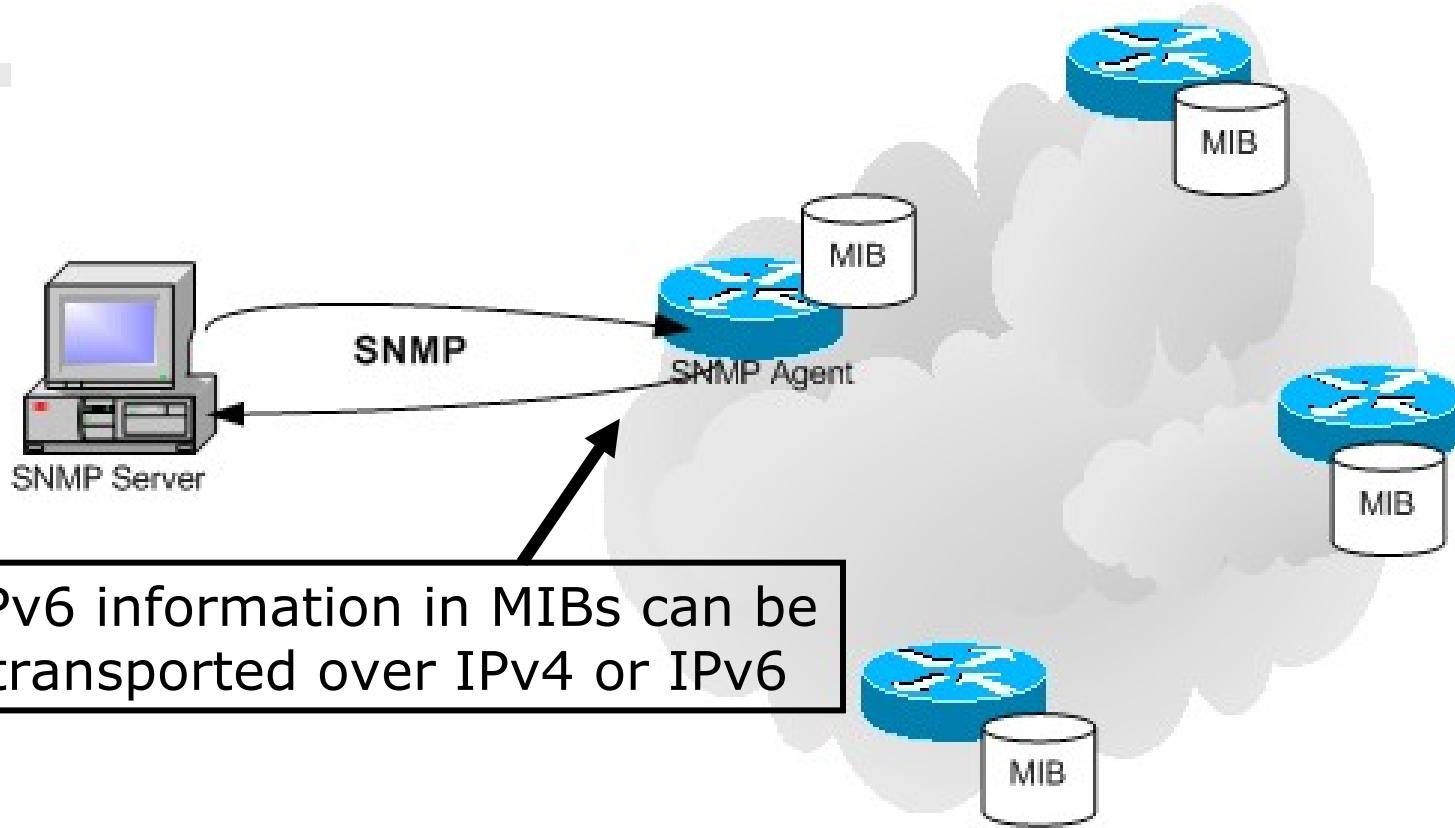


SNMP/MIBs and IPv6

- SNMP and IPv6
- IPv6 MIBs status
- Manufacturers implementations



SNMP model



SNMP over IPv6

- Cisco:
 - SNMP over IPv6 is available in 12.0(27)S and 12.3(14)T
 - IOS 12.4 & 12.4T too
 - More features available from 12.0(30)S
- Juniper, Hitachi, 6wind:
 - SNMP over IPv6 is available



IPv6 MIBs Status



IPv6 MIBs status

- MIBs are essential for the network management
- SNMP-based applications are widely used but others exist too (NetFlow, XML...)
- SNMP rely upon MIBs ...
=> Need to have MIBs to collect IPv6 information as well as get MIBs reachable from an IPv6 address family.



IPv6 MIBs /2

- Standardization status at IETF:
 - At the beginning:
 - IPv4 and IPv6 MIBs **dissociated**

	IPv4	IPv6	Remarks
Textual Conventions	RFC1902	RFC2465	Definition of IP address format
IP MIB	RFC2011	RFC2466	
ICMP MIB			
TCP MIB	RFC2012	RFC2452	
UDP MIB	RFC2013	RFC2454	

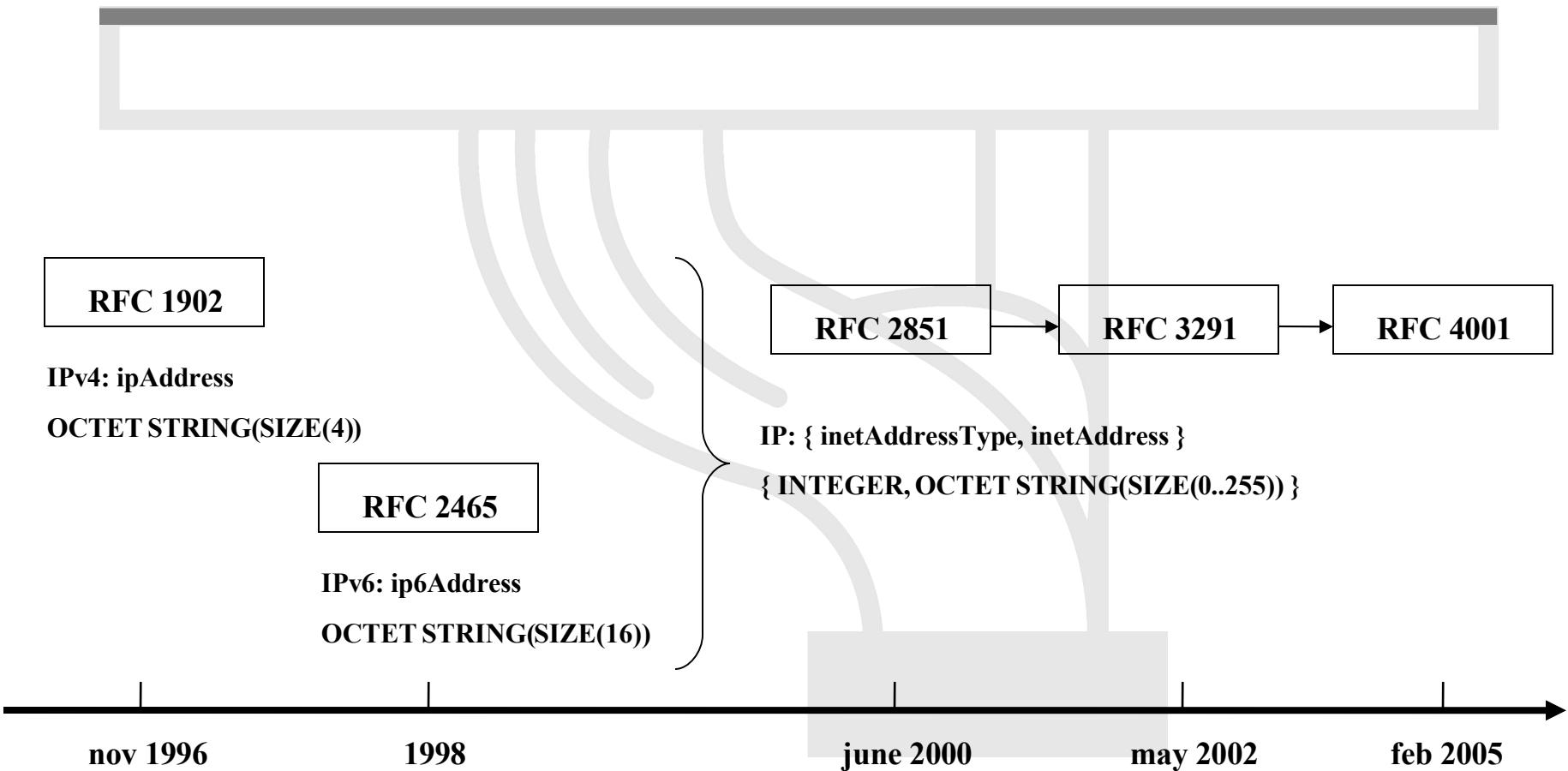


IPv6 MIBs /3 (Hidden)

- Standardization status at IETF: Unified MIBs
 - Definition of new Textual Conventions (TC) taking into account both versions of IP:
 - **RFC 2851:**
 - IP: { InetAddressType, InetAddress }
 - **RFC 3291** (Obsoletes RFC2851):
 - New TCs: InetAddressPrefixLength, InetPortNumber, InetAutonomousSystemNumber
 - **RFC 4001** (Obsoletes RFC3291):
 - New TCs: InetZoneIndex, InetScopeType, InetVersion



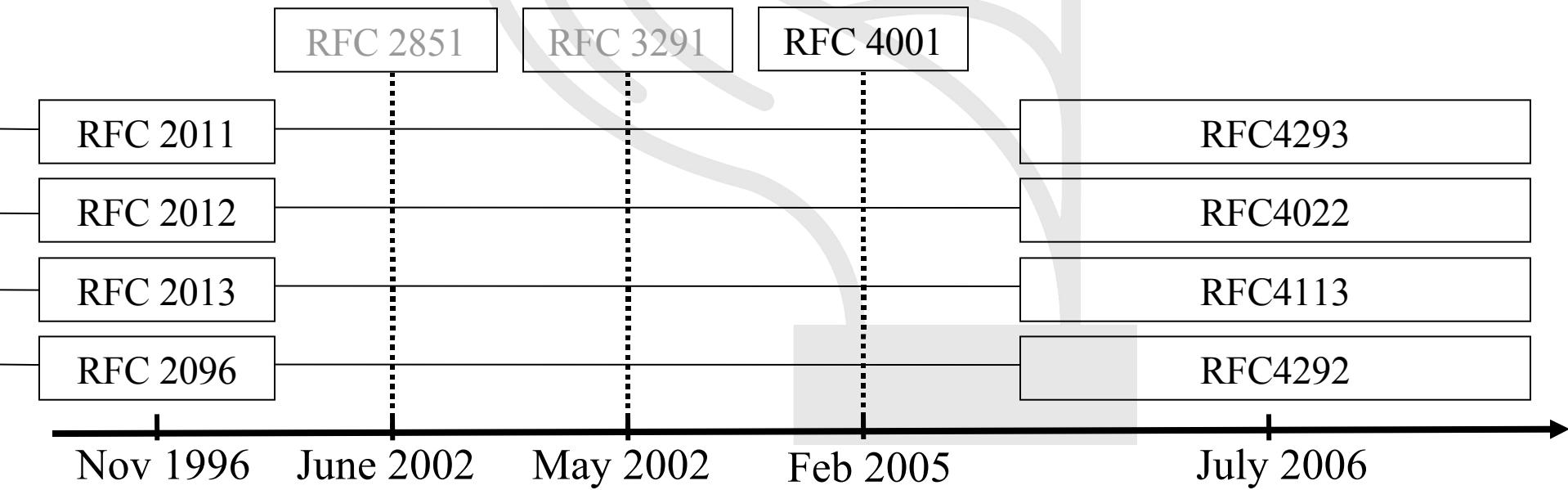
IPv6 MIBs /3



IPv6 MIBs /4

■ Standardization status at IETF

- Today : **unified MIBs** are on standard track.



IETF MIB Status /5

- RFC4022
 - **TCP MIB** (03/2005)
- RFC4113
 - **UDP MIB** (06/2005)
- RFC4292
 - **IP Forwarding Table MIB** (04/2006)
- RFC4293
 - **IP MIB** (04/2006)



IETF MIB Status /6

- BGP MIB v6:
 - draft-ietf-idr-bgp4-mibv2-05.txt (07/2005)
 - Expired

Note that the same people are working on

- draft-ietf-idr-bgp4-mib-15.txt (08/2004)

→RFC 4273

- *This draft considers only IPv4 addresses:*
 - « **IMPORTS IpAddress** » → 32 bits



IPv6 MIBs implementations



IPv6 MIBs implementation/1

- Cisco
 - Private Cisco MIBs implement RFC 2011 (IP) & 2096 (Forwarding) updated drafts
 - Work on implementing the new standards
 - No distinction between IPv4 and IPv6 traffic at the interface level from the MIBs (available when new IETF MIB get implemented)
 - Information available from CLI
 - show interface accounting
 - ...



Cisco: IPv6 CLI

“show interface accounting”

- Differentiate Pv4/Pv6 counters at the interface level for all Cisco routers, except for:
 - Catalyst 6500 / Cisco 7600 supervisor engine 720:
Counts only for packets that are software switched, not the hardware switched packets.
 - GSR:**
 - ‘show interface counters’ correctly counts IPv6 traffic and separates ingress and egress traffic
 - **Engine 3:**
 - * OUTPUT IPv6 traffic is counted under IPv6 (correct)
 - * INPUT IPv6 traffic is counted under IP (will get corrected)



IPv6 MIBs implementation/2

- Juniper
 - MIB based on (old) RFC 2465
 - with different counters for IPv4 and IPv6 traffic
 - Or based on filters to collect IPv6 traffic:
 - Ex: Geant monitoring
- => Expected : unified MIBs implementation



IPv6 MIBs implementation/3

- Hitachi
 - Routers (GR2000/GR4000) and Switches (GS4000) support IPv6 standard MIBs:
 - RFC 2452: TCP/IPv6
 - RFC 2454: UDP/IPv6
 - RFC 2465: IPv6
 - RFC 2466: ICMPv6
 - The unified MIBs are not implemented yet.



IPv6 MIBs implementation/4

- 6WIND
 - MIBs based on RFC 2465 and RFC 2466
 - Checked at our lab.
 - Unified MIBs ?



IPv6 MIBs implementation/5

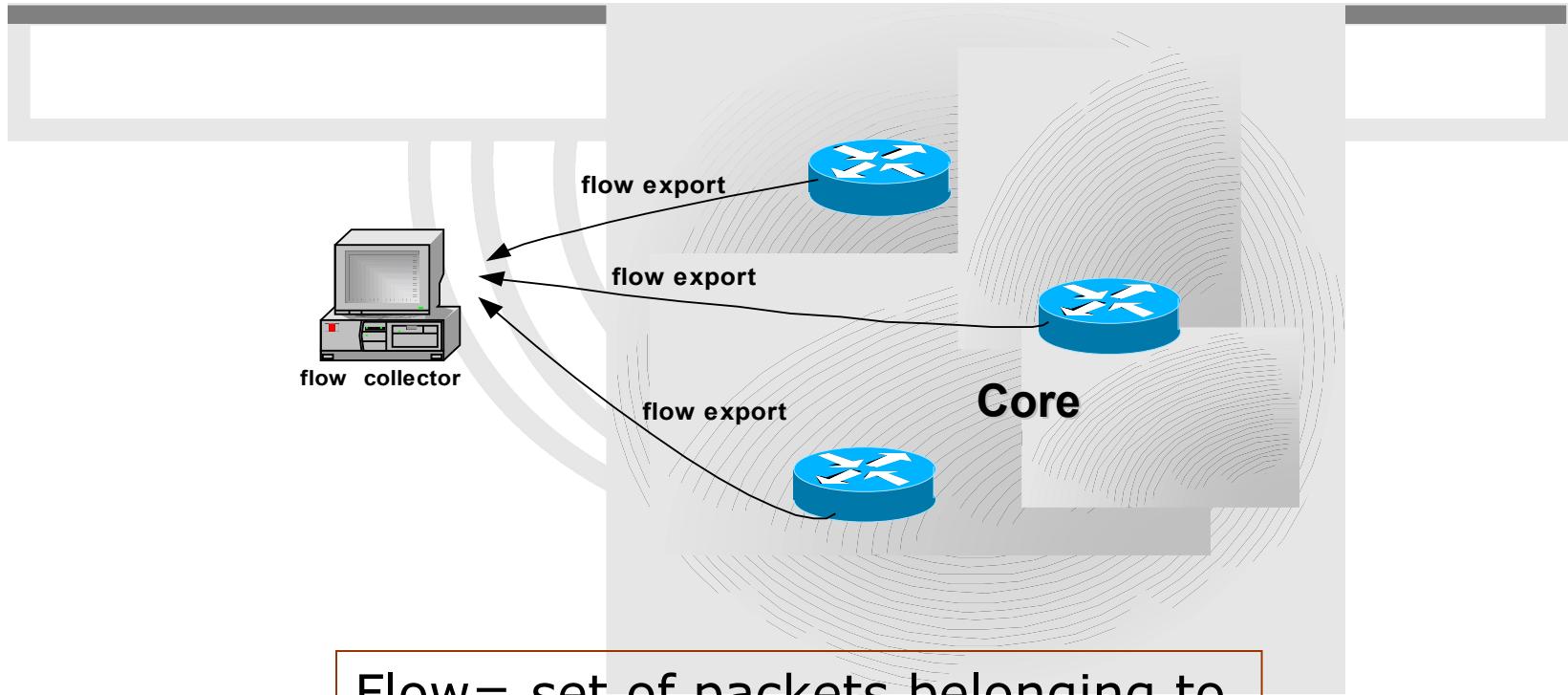
- Net-SNMP (Carnegie Mellon Univ)
 - <http://net-snmp.sourceforge.net/>
 - IPv6 support from version 5.0
 - RFC 2452: TCP/IPv6
 - RFC 2454: UDP/IPv6
 - RFC 2465: IPv6
 - RFC 2466: ICMPv6
 - RFC 3291: (new) textual convention for representing Internet Addresses



IPv6 flow monitoring

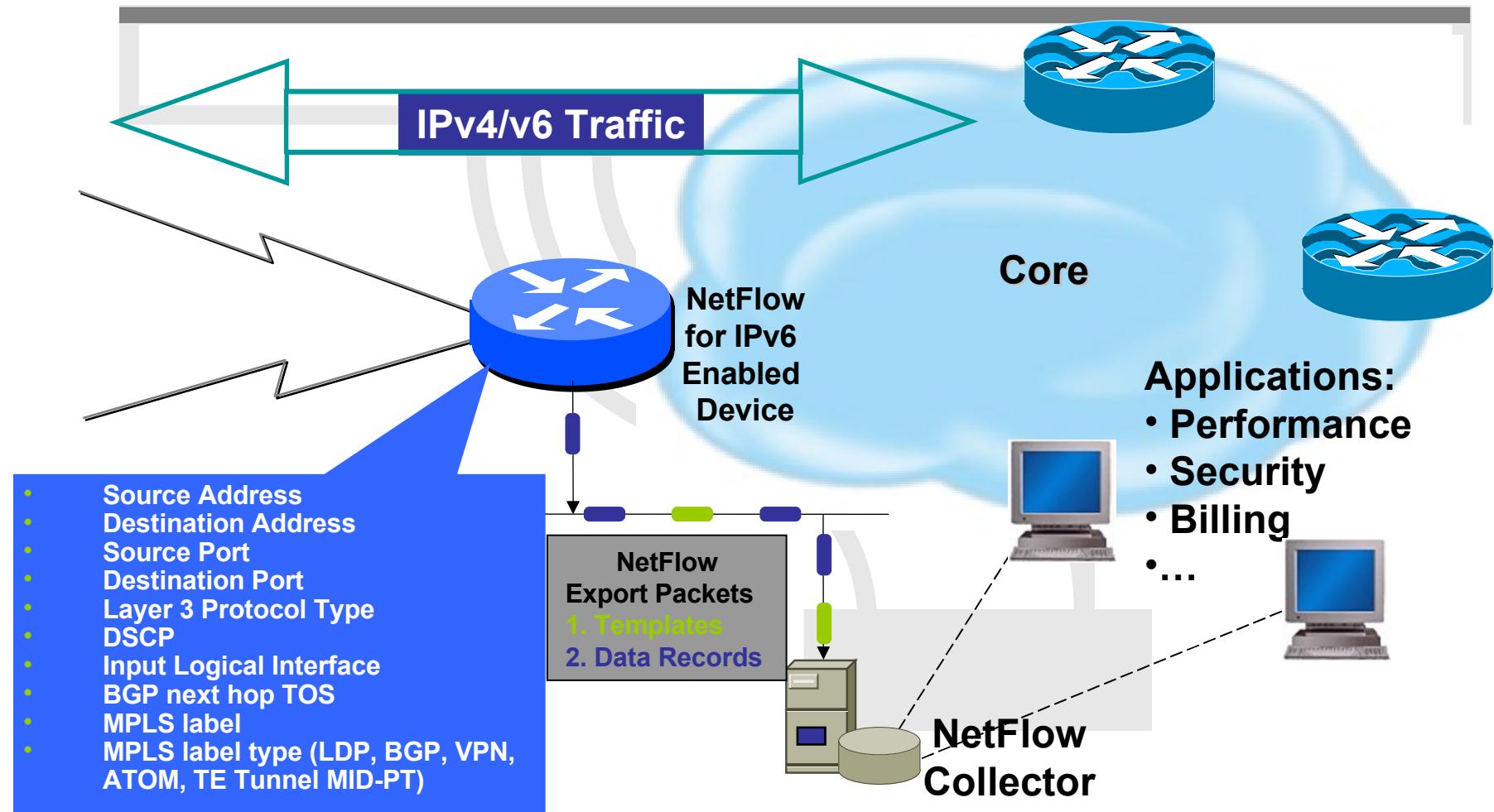


Netflow & IPFIX model



Flow= set of packets belonging to the same application between a Source/Destination couple

NetFlow for IPv6



NetFlow Version 9

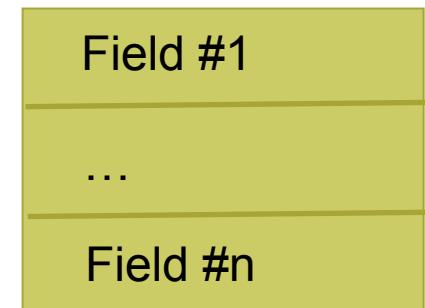
Packet



Template Definition (Template FlowSet)



Record



Flow Records (Data FlowSet)



NetFlow Version 9

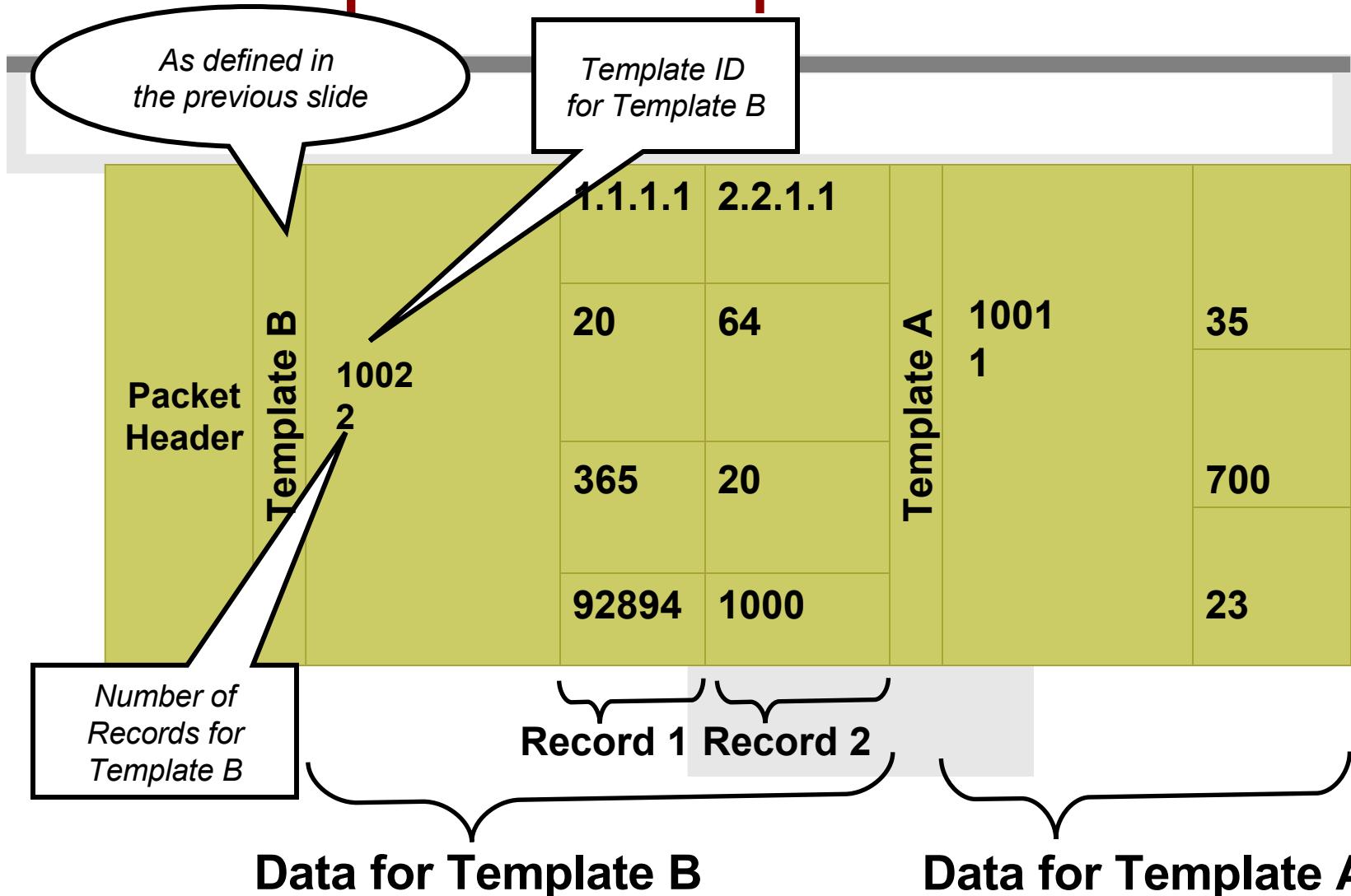
Example for Template Definition

Template A	
Flow Set ID (0 for Template)	
Length of Template Structure	1001
(Template ID)	3
# of Fields	SRC_AS_NUMBER
SRC_AS_NUMBER	2
DST_AS_NUMBER	2
L4_PROTOCOL	2

Template B	
Flow Set ID (0 for Template)	Length of Template Structure
1002	(Template ID)
4	# of Fields
SRC_IP_PREFIX	4
SRC_AS_NUMBER	2
PACKET_COUNT	2
BYTE_COUNT	2



Example for Export Packet



IPv6 flow monitoring /1

- Cisco
 - Available in IOS 12.3(7)T and later version
 - IPv6 packets captured (**needs IPv6 CEF**)
 - Export done with *Netflow v9*
 - Still uses *IPv4 transport*
 - Need to update your own Netflow Collector
 - Cisco NFC v5.0 available
 - Other collectors are available as well
 - » <http://supervision-ipv6.renater.fr/Portail/>
 - » Netflow v9 collector : Renater's collector (**R enetco1**)



IPv6 flow monitoring /2

- Hitachi
 - Support **Sflow** RFC 3176 (<http://www.sflow.org/>)
 - and Netflow is on the roadmap ?
- 6WIND:
 - Not available
- Juniper:
 - **Cflowd** (#Netflow)



Commercial Management platforms



Commercial platforms

Commercial ISPs use to have integrated management platforms
(NRENs mainly use GPL or home-made tools)

- **H P - O v** proposes a version with IPv6 features: NNM 7.0 (sept 2003). Need some hack for automatic IPv6 discovery of CISCO routers.
- **C iscow orks**: IPv6 version for
 - LMS 2.5 : LAN Management solution
 - Includes a set of functionalities (Campus Manager 4.0, Ciscoview 6.1, ...)
 - CNR 6.2 : Cisco Network Registrar (Naming & addressing services)

Application note on IPv6 management
- **T ivoliNetview** doesn't propose any IPv6 features
- **I nfovista** : « no IPv6 plan at the moment »



Cisco: LMS Application supports IPv6

LMS: LAN Management Solution version 2.5

- Includes :
 - Campus Manager 4.0
 - Resource Manager Essential
 - CiscoView version 6.1
 - Cisco Network Registrar (CNR 6.2)
 - Device Fault Manager
 - Internet Performance Monitor
 - Common services



« Top ten » ...

- HP Openview
 - Ciscoworks 2000 (LMS 2.5)
 - IBM Netview
 - Infovista, Tivoli
 - ...
- 

IPv6 ready

IPv6 not ready



Monitoring tools



6Net and IPv6 monitoring tools

- 6Net WP6 : managing large scale IPv6 networks
 - Tests lots of IPv6 ready tools
 - Many others ported to IPv6
- 30+ monitoring tools for IPv6
 - Tested
 - Implemented
 - Documented
- URL: <http://tools.6net.org/>



Examples



Argus

- Administration of network:
 - PCs, Switches, Routers
 - Availability
 - Traffic on the network
- Administration of services:
 - http, ftp, dns, imap, smtp...
- Evolution: new features can be easily added



Argus - Top:Serveurs-SIPA - Microsoft Internet Explorer

Eichier Edition Affichage Favoris Outils ?

Adresse: http://supervision-ipv6.renater.fr/private/argus/prog?object=Top:Serveurs-SIPA;func=page

User: jdurand

- [Override](#)
- [Annotate](#)
- [Flush Cache](#)
- [Display Config](#)
- [Debugging](#)
- [Un-Acked Notifies](#)
- [Notifies](#)
- [Error Log](#)
- [Top](#)
- [Logout](#)

Top:Serveurs-SIPA

name Serveurs-SIPA
status up

Name	Status
data-ipv6_IPv4	Ping FTP
data-ipv6_IPv6	Ping FTP
sem2_IPv4	Ping HTTP renater.fr
sem2_IPv6	Ping HTTP renater.fr

Status: up since Thu 11 Nov 20:59:44 2004

	start	elapsed time	% up	% down	times down
Today	Mon 22 Nov 00:00:00 2004	10:00:00	100.0	0.00	0
Yesterday	Sun 21 Nov 00:00:00 2004	1d 0:00:00	100.0	0.00	0
2 Days Ago	Sat 20 Nov 00:00:00 2004	1d 0:00:00	100.0	0.00	0
This Month	Mon 1 Nov 00:00:00 2004	21d 9:48:49	98.28	1.72	1
Last Month	Fri 1 Oct 00:00:00 2004	1m 1:00:00	99.97	0.03	1
2 Months Ago	Mon 13 Sep 11:14:37 2004	17d 12:33:52	100.0	0.00	1
This Year	Mon 13 Sep 11:14:37 2004	2m 10d 23:22:41	99.46	0.54	3

Thu 11 Nov 20:59:44 2004 up TRANSITION - data-ipv6_IPv4
 Thu 11 Nov 12:08:57 2004 down TRANSITION - data-ipv6_IPv6
 Wed 13 Oct 17:13:44 2004 up TRANSITION - data-ipv6_IPv4
 Wed 13 Oct 17:02:33 2004 down TRANSITION - data-ipv6_IPv6
 Mon 13 Sep 11:28:39 2004 up TRANSITION - sem2_IPv4

Argus: 3.3

10:48 lundi 22/11/2004

Internet



Nagios

- <http://www.nagios.org>
- Very complete tool
 - Services monitoring
 - Network monitoring
- Can be complex for a small network
- Evolution: new features can be added with plug-ins
 - BGP monitoring
 - ...



Nagios

The screenshot shows the Nagios web interface with the URL <http://6net.iif.hu/nagios/> in the address bar. The interface includes a navigation menu on the left and various status summary tables.

Current Network Status:
Last Updated: Mon Jun 16 16:48:09 CEST 2003
Updated every 90 seconds
Nagios® - www.nagios.org
Logged in as 6core

Host Status Totals:

Up	Down	Unreachable	Pending
26	0	0	6

Service Status Totals:

Ok	Warning	Unknown	Critical	Pending
29	2	0	2	0

Status Summary For All Host Groups:

Host Group	Host Status Totals	Service Status Totals
6NET ping hosts (6netcore-pinghosts)	5 UP 4 PENDING	9 OK 2 WARNING 1 CRITICAL
6NET Core Routers (6netcore-routers)	9 UP	9 OK
HBONE6 ping hosts (hbone6-pinghosts)	4 UP 2 PENDING	4 OK 1 CRITICAL
IPv6 Routers (ipv6-routers)	10 UP	10 OK



IPv6 status

■ Monitoring

- Ping over IPv6 OK – with plugin
- TCP services over IPv6 OK – with plugin
- UDP services over IPv6 OK – with plugin
- SNMP over IPv6
on it Not yet - working



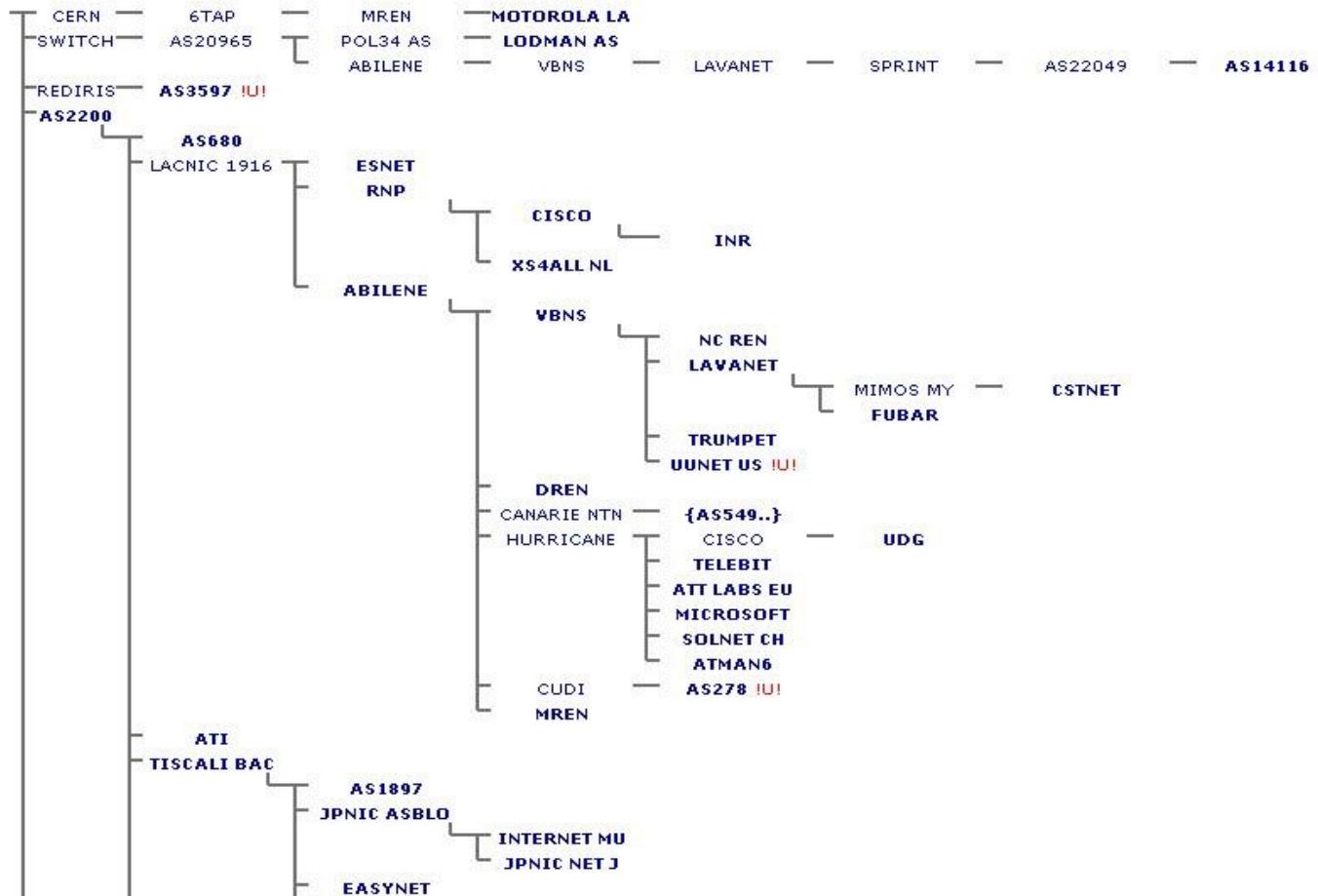
ASpath-Tree

- Display BGP4+ « topology » from
 - BGP4+ routing table
 - Retrieved from connection to routers (RSH/SSH...)
- Generate HTML pages.

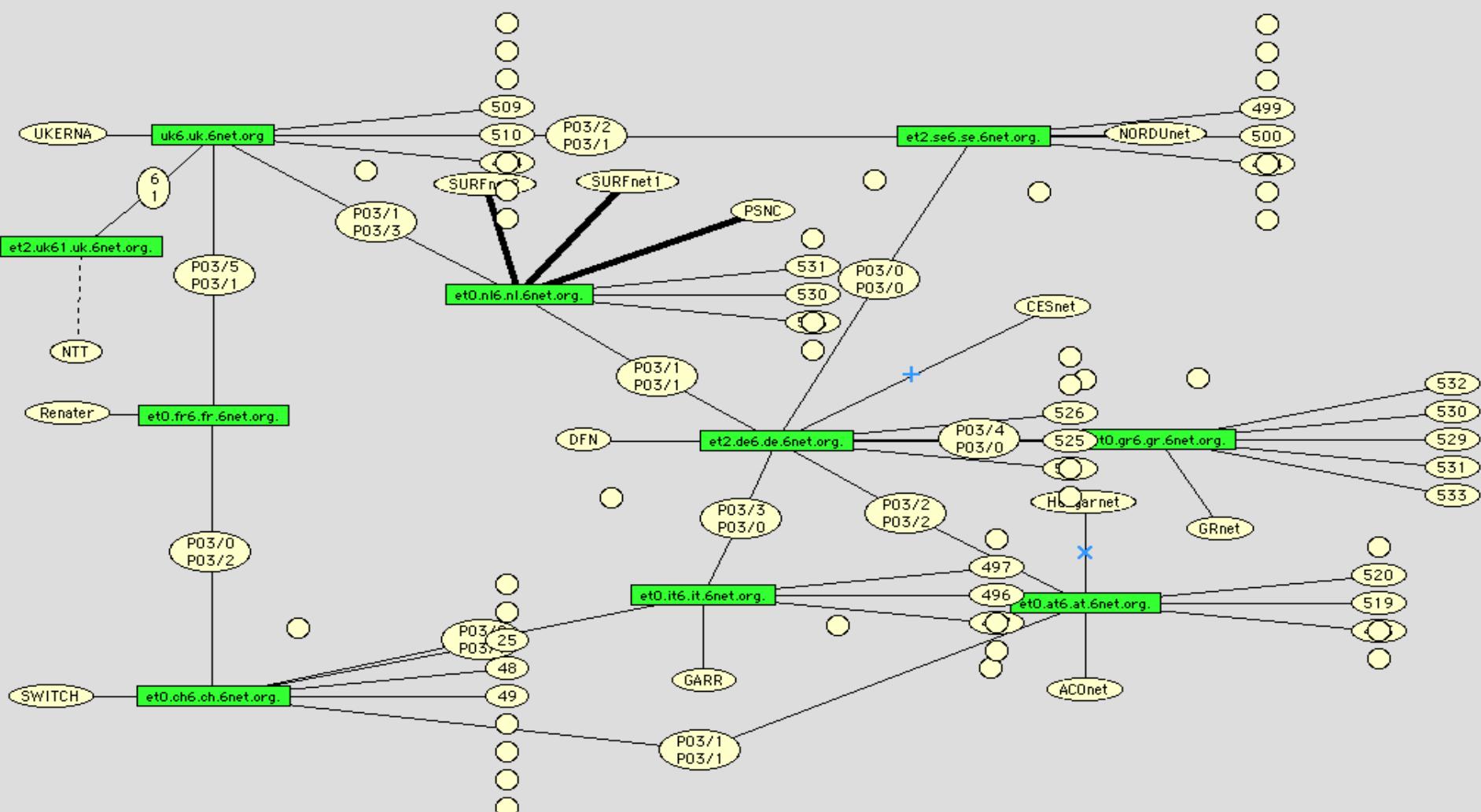
ASpath-Tree

Renater The whole IPv6 BGP table

RENATER Project Network



Intermapper



Looking Glass

- Get information on a router w/o direct connection
- Web Interface
- Final user don't need a login
- Allows the user to detect causes of failures w/o asking the NOC or netadmin



Looking Glass

HUNGARNET - Looking Glass - Mozilla Firefox

File Edit View History Bookmarks Tools Help

mozilla.org Latest Builds

http://diag.vh.hbone.hu/lookingglass/lg.cgi

Google

B

HUNGARNET

Looking Glass

Query:

- ip bgp
- ip bgp summary
- ipv6 bgp
- ipv6 bgp summary
- dampened-paths
- flap-statistics
- ip msdp summary
- environmental
- ping
- trace

Address: [] Router: gsr16

Submit | Reset

Please email questions/comments or things you would like added to net-admin@niif.hu.

Download Software

Done

Start | ... | Microsoft Power... | BT 0.0% (0.00 MiB) ... | HUNGARNET - L... | EN | 18:46

Router: Toulouse

submit | Reset



RANCID: Really Awesome New Cisco Conflg Differ

- Web-based CVS repository of configuration changes
- Unix cron jobs at regular intervals check configured routers for configuration changes
- If a change is detected, RANCID e-mails all the engineers with the changes and updates the CVS repository
- Web-based CVS repository allows engineers to choose arbitrary dates to view configuration changes
- Can alter scripts to grab any information from the router that you want to track



Output of Rancid

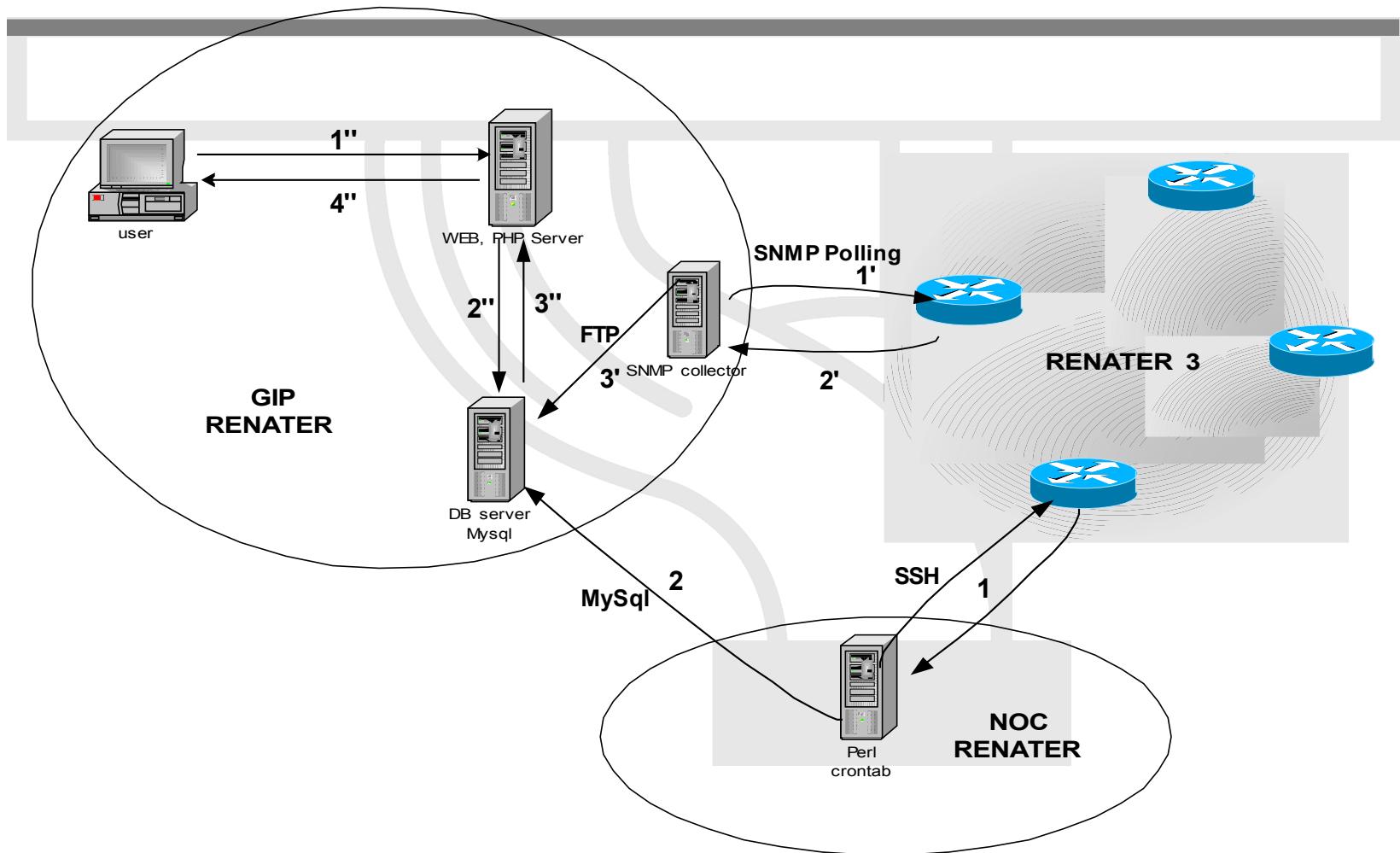
The screenshot shows a web browser window with the following details:

- Address Bar:** http://6net.niif.hu/routerconfig/6net/configs/cntrl.6net.hbone.hu?rev=1.156
- Toolbar:** Back, Forward, Reload, Stop, Search, Print.
- Menu Bar:** File, Edit, View, Go, Bookmarks, Tools, Window, Help.
- Navigation Bar:** Home, Bookmarks, Current FreeBSD pro..., BSD News, FreeBSD Porter's Ha..., Ticketing System, HUNGARNET-NIIF 6N..., LXR.
- Breadcrumbs:** Return to cntrl.6net.hbone.hu CVS log, Up to [6NET router configs] / 6net / configs.
- File Information:** File: [6NET router configs] / 6net / configs / cntrl.6net.hbone.hu, Revision 1.156: download - view: text, annotated - select for diffs - revision graph.
- Timestamp:** Thu Aug 5 16:15:10 2004 UTC (5 weeks, 3 days ago) by mohacsi
- Branches:** MAIN
- CVS tags:** HEAD
- Section:** updates
- Content:** The main area displays a configuration dump in Cisco-style text:

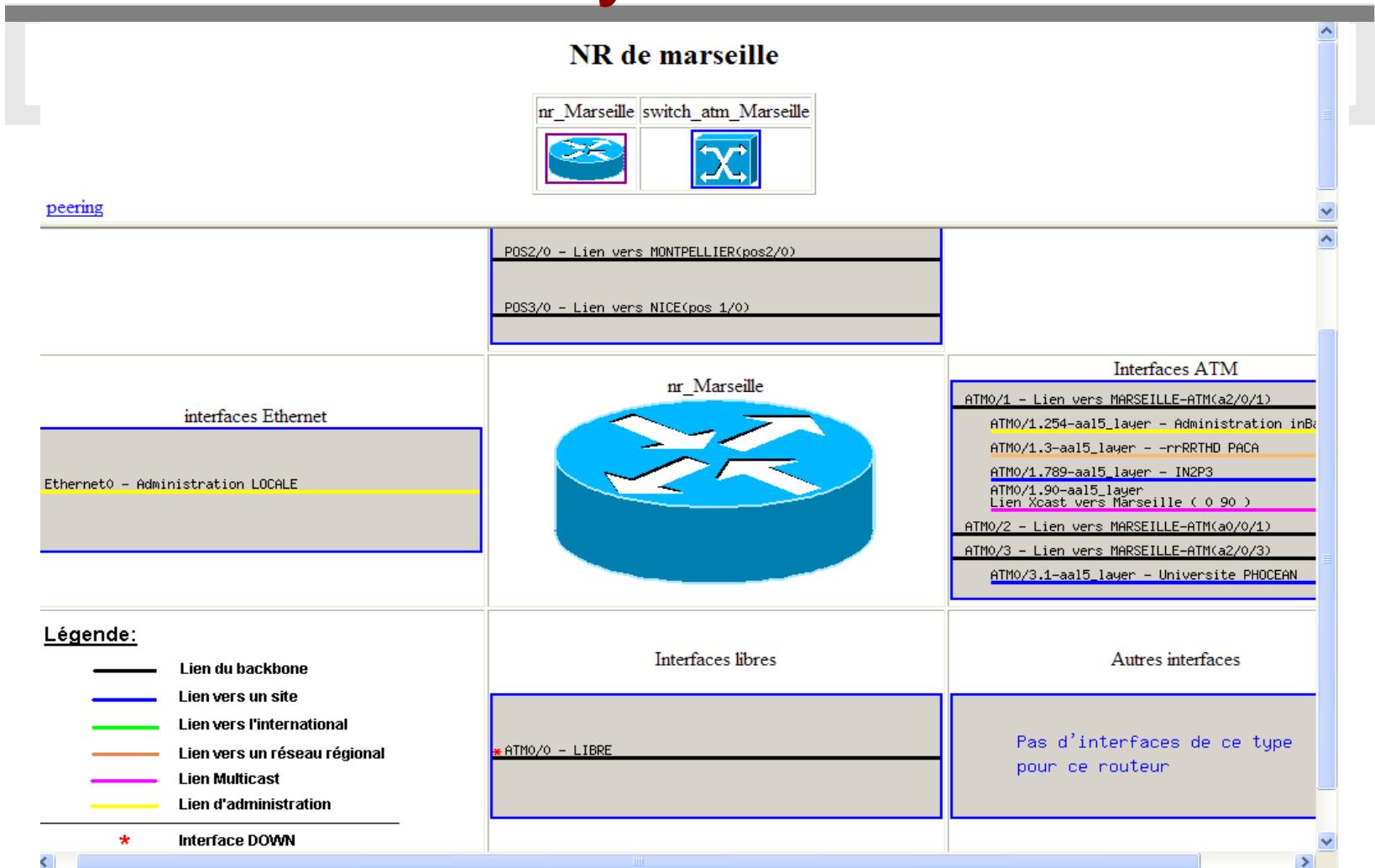
```
!RANCID-CONTENT-TYPE: cisco
!
!Chassis type: 7206VXR - a 7200 router
!CPU: NPE400, R7000 CPU at 350MHz, impl 39, Rev 3.3, 256KB L2 Cache
!
!Memory: main 491520K/32768K
!Memory: nvram 125K
!Memory: bootflash 8192K
!Memory: pcmcia ATA slot0 125952K
!
!Processor ID: 28712851
!
!Power: Power Supply 1 is ZYTEK AC Power Supply. Unit is on.
!Power: Power Supply 2 is ZYTEK AC Power Supply. Unit is on.
!
!Image: Software: C7200-P-M, 12.3(7)T1, RELEASE SOFTWARE (fc2)
!Time Generated Wed Jul 21 14:04:22 2004 UTC
```



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 -

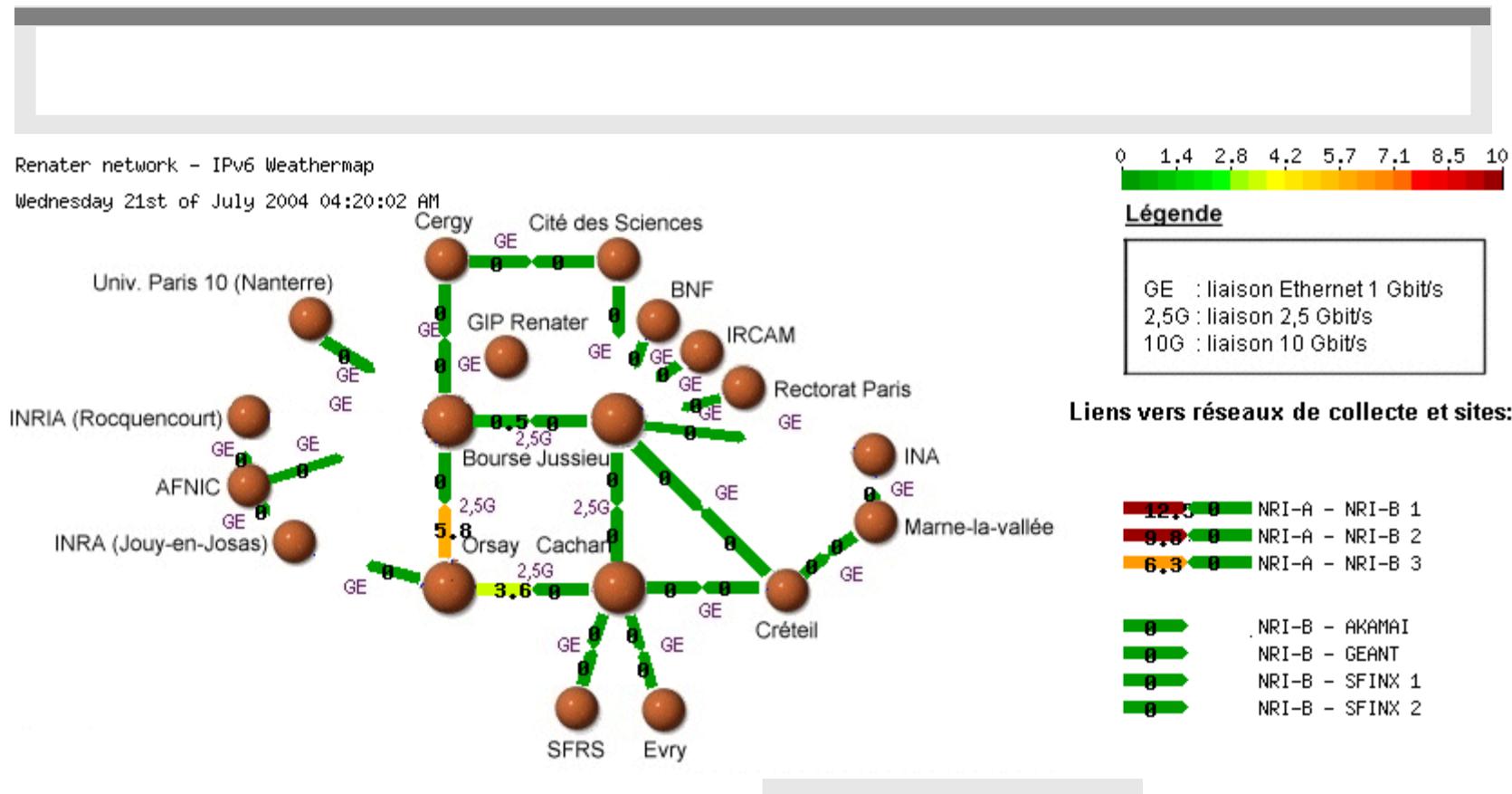


IPv6 traffic on Cisco routers

- Based on CLI program
 - "show interface accounting"
 - Differentiate IPv4/IPv6 counters at the physical interface level
- One query per hour
→ IPv6 Weather Map of RENATER



IPv6 traffic on Cisco routers



Conclusion

- ISPs –and any other organizations– need monitoring tools to launch a new service/protocol into production
- Most of management protocols are on standard track
- Lots of monitoring tools are now ready for IPv6 networks
- But :
 - Q1: are my usual tools (used for IPv4 monitoring) available for IPv6 too ?
 - Q2: what do I need to stress to my favourite vendor to be ready and manage my IPv6 network ?



