IPv6 network management

Contributions

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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?
  1. Configurations
  2. Inventory
  3. Topology
  4. Fault
  5. Security
  6. 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

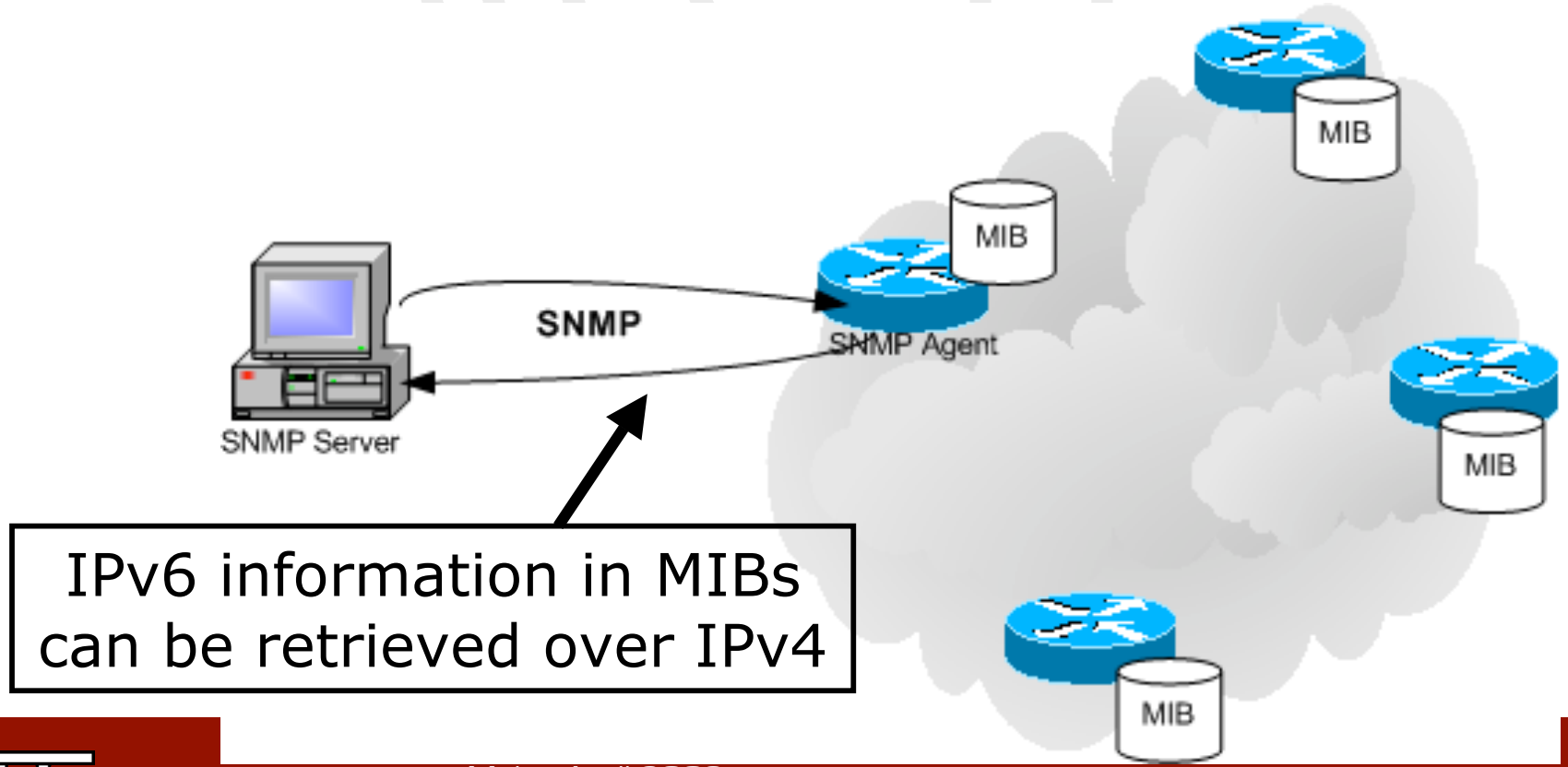
SSH/TELNET/TFTP...

- 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



IPv6 information in MIBs can be retrieved over IPv4

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 ...

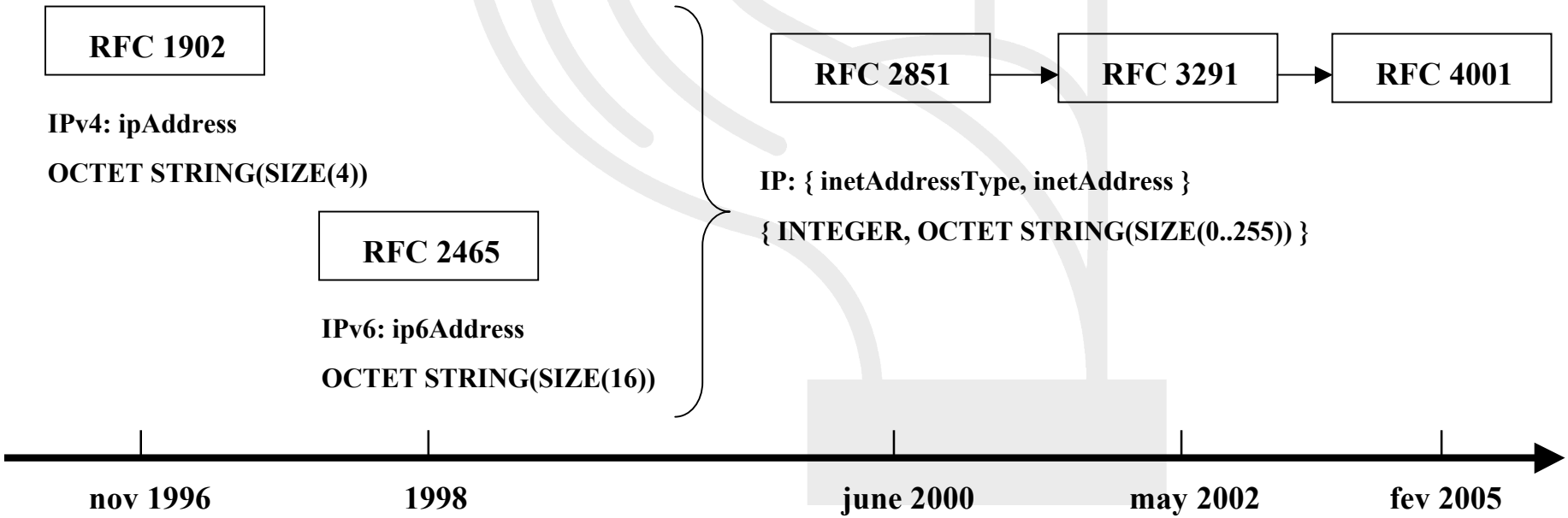
  => Need to have MIBs to collect IPv6 information as well as get MIBs reachable from an IPv6 address family.

IPv6 MIBs /2

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

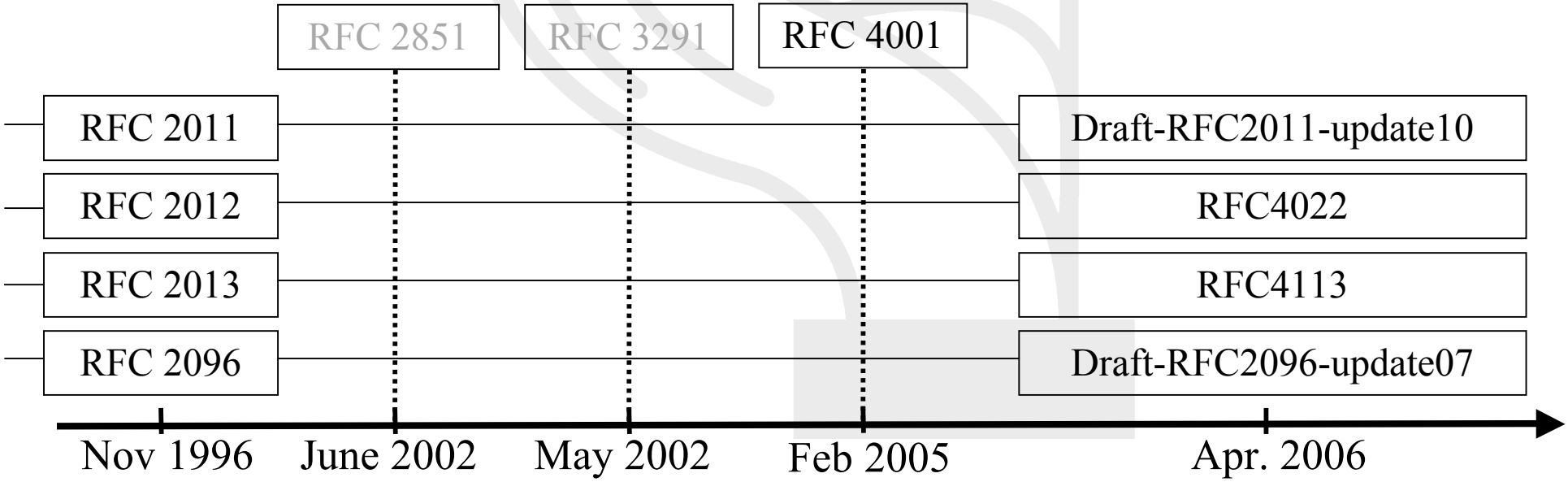
	IPv4	IPv6	Remarks
Textual Conventions	RFC1902	RFC2465	Definition of IP address format
IP MIB	RFC2011		
ICMP MIB		RFC2466	
TCP MIB	RFC2012	RFC2452	
UDP MIB	RFC2013	RFC2454	

IPv6 MIBs /3


RFC 1902
IPv4: ipAddress
OCTET STRING(SIZE(4))
RFC 2465
IPv6: ip6Address
OCTET STRING(SIZE(16))
RFC 2851
RFC 3291
RFC 4001
IP: { inetAddressType, inetAddress }
{ INTEGER, OCTET STRING(SIZE(0..255)) }
nov 1996
1998
june 2000
may 2002
fev 2005

IPv6 MIBs /4

- Standardization status at IETF
  - Today : **unified MIBs** are on standard track.



IETF MIB Status /5

- draft-ietf-ipv6-rfc2011-update-10.txt
  - **IP MIB** (05/2004)

  ?? In the RFC Editor's queue (06/2004)

- RFC4022
  - **TCP MIB** (03/2005)

- RFC4113
  - **UDP MIB** (06/2005)

- draft-ietf-ipv6-rfc2096-update-07.txt
  - **IP Forwarding Table MIB** (02/2004)

  ?? proposed standard RFC (in the RFC Editor's queue...)

IETF MIB Status /6

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

  Note that the same people are working on
  - draft-ietf-idr-bgp4-mib-15.txt (08/2004)
    - *This draft consider only IPv4 addresses:*
      - *« **IMPORTS IpAddress** » → 32 bits*

IPv6 MIBs implementions

IPv6 MIBs implemention/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 IPv4/IPv6 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 implemention/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 implemention/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 implemention/4

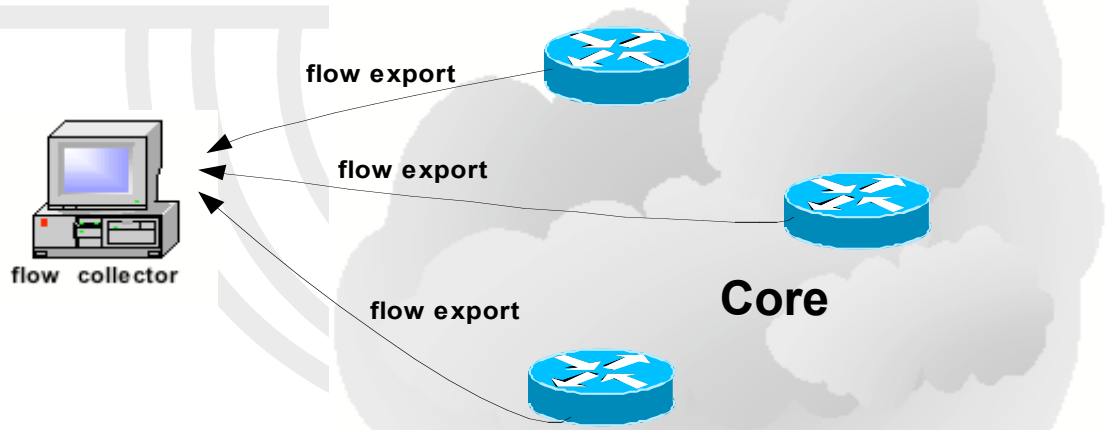
- 6WIND
  - MIBs based on RFC 2465 and RFC 2466
  - Checked at our lab.
  - Unified MIBs ?

IPv6 MIBs implemention/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

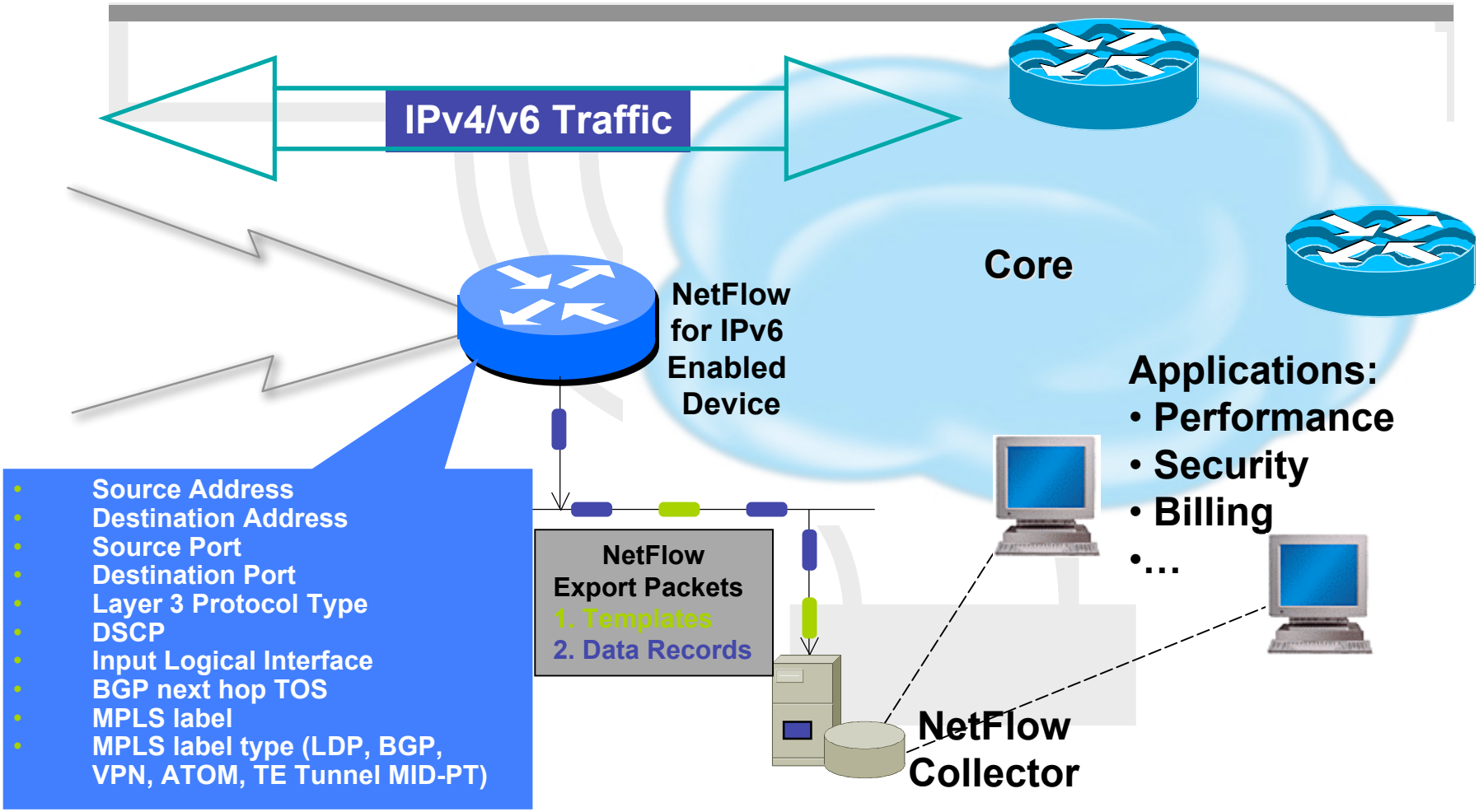
IPv6 flow monitoring

Netflow & IPFIX model

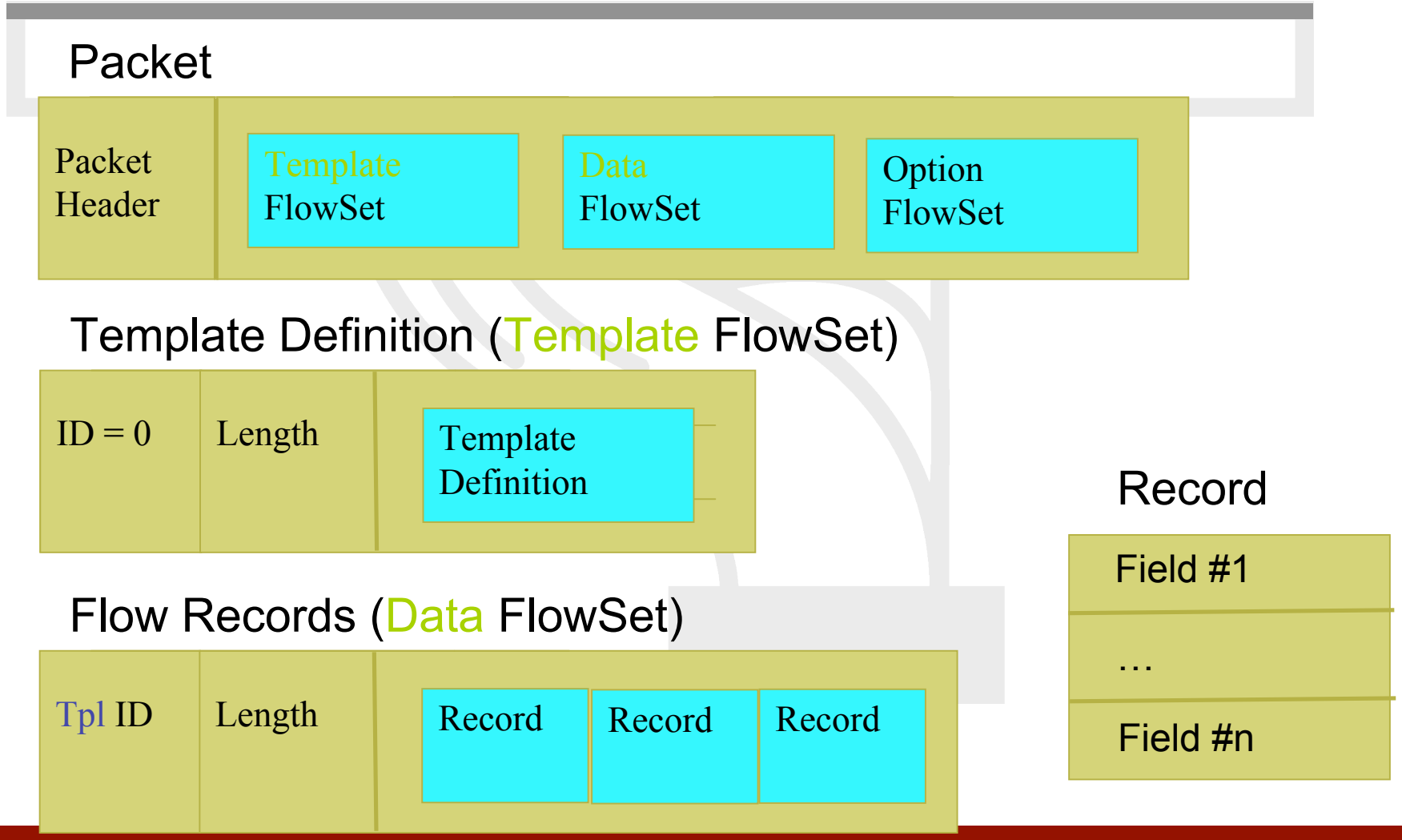


Flow= set of packets belonging to the same application between a Source/Destination couple

NetFlow for IPv6



NetFlow Version 9

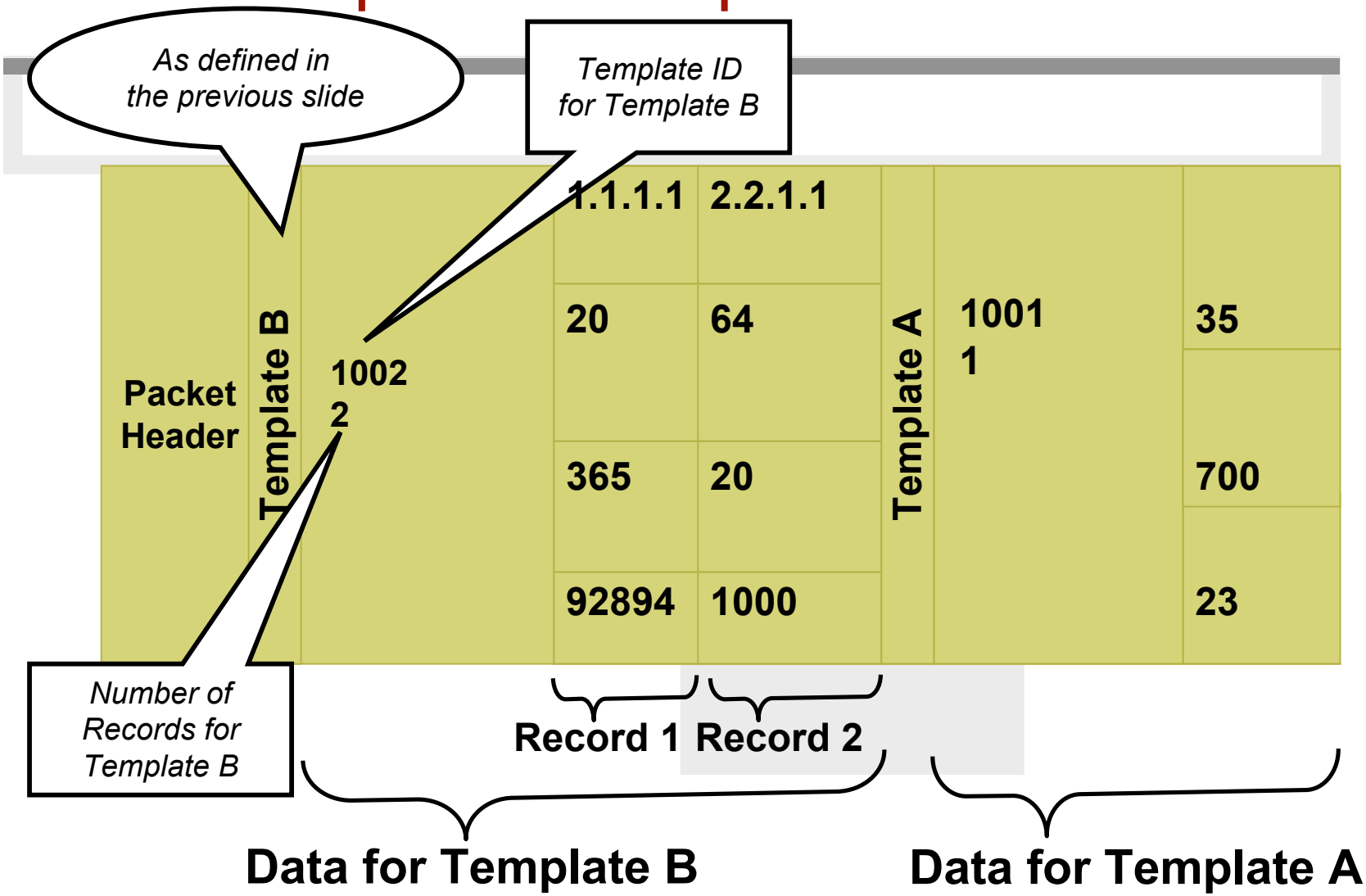


NetFlow Version 9
Example for Template Definition

Template A
Flow Set ID (0 for Template)
Length of Template Structure
1001 (Template ID)
3 (# of Fields)
SRC_AS_NUMBER
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 (**Renetcol**)

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)

- **HP-OV** proposes a version with IPv6 features: NNM 7.0 (sept 2003). Need some hack for automatic IPv6 discovery of CISCO routers.
- **Ciscoworks**: 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)

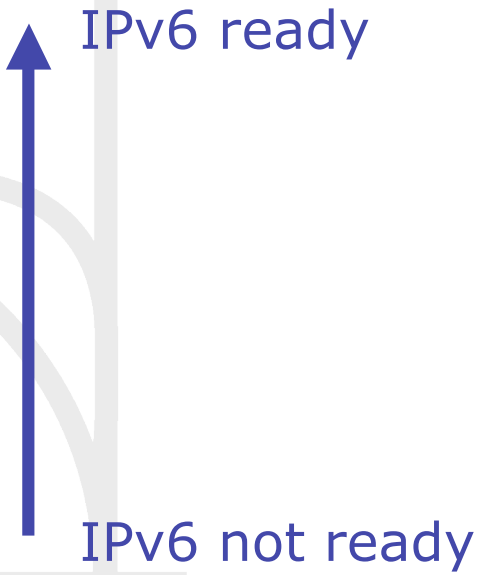
  Application note on IPv6 management
- **Tivoli Netview** doesn't propose any IPv6 features
- **Infovista** : « no IPv6 plan at the moment »

Cisco: NMS Application Support for IPv6

- Cisco NetFlow Collector (NFC) 5.0
  - Full support for IPv6 records
  - Note: device export still IPv4 only
- CiscoWorks
  - Campus - Functional test has started
  - RME -Functional test starts soon
  - CiscoView - under development
- Cisco Network Registrar (CNR):
  - Phase 1 (1H2005): Manage IOS DHCPv6 servers
  - Phase 2: Add DHCPv6 and DNS-over-IPv6

« Top ten » ...

- HP Openview
- Ciscoworks 2000 (Campus Manager)
- IBM Netview
- Infovista, Tivoli
- ...



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/

LAN - recommendations

- Traffic & service management (web, DNS, SMTP, IMAP...)
  - A single tool: **Argus, Nagios** or **Ntop**
- End-to-end performance of the IPv6 network
  - **Iperf** or **Pchar**
- Configuration management
  - **Rancid**
- Analysis of packets on shared links for occasional troubleshooting
  - **Ethereal**, **tcpdump** or **Ntop**
- IPv6 multicast management
  - **Multicast (D)beacon**

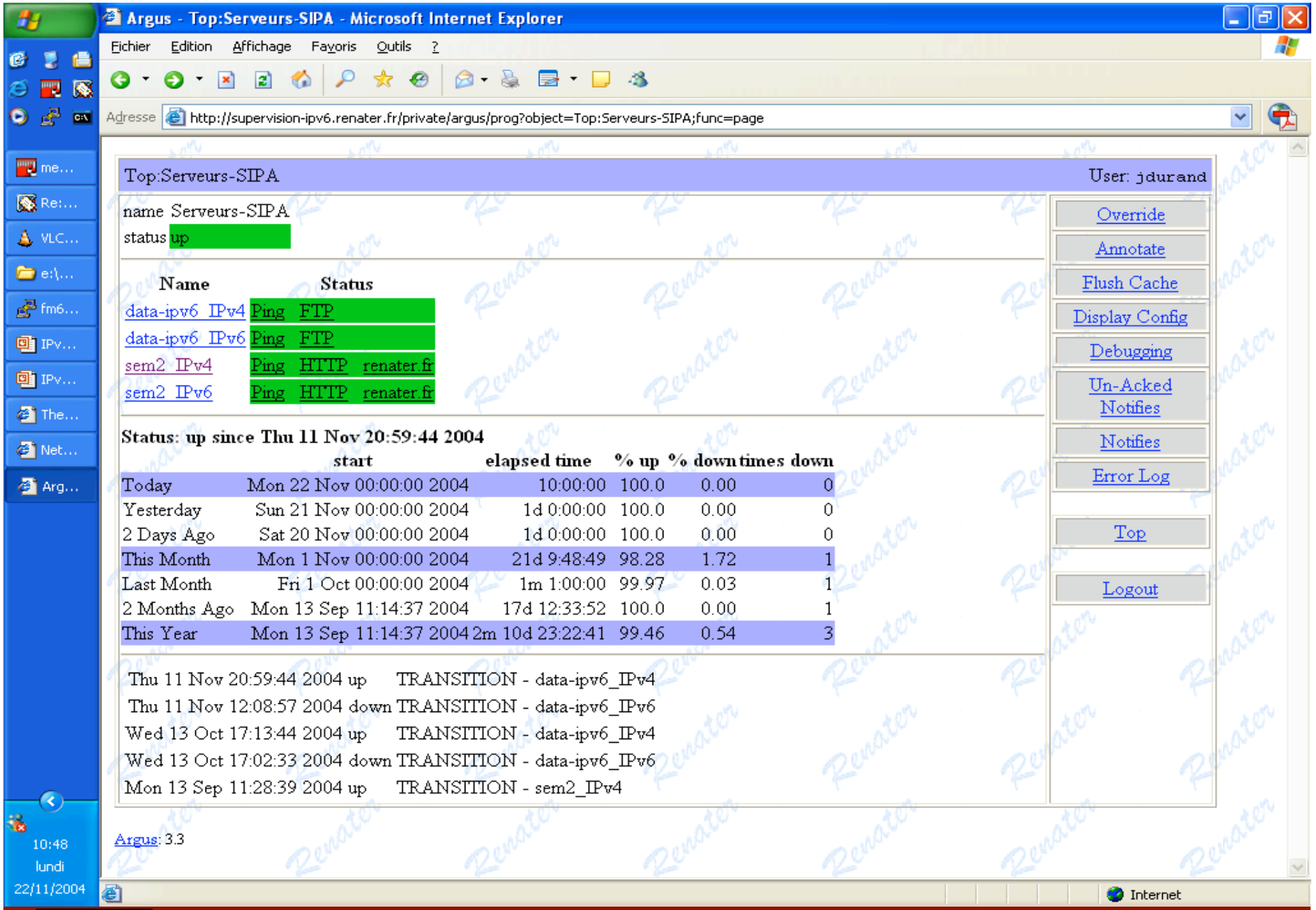
WAN - recommendations

- Plotting monitoring data
  - **MRTG**, **Cricket** or **Nagios**
- Equipment and link status:
  - **Intermapper** or **Nagios**
- Routing management:
  - **ASpath-tree** (routing policy check)
  - **Home-made scripts** (routing fault management)
- For accounting management:
  - **Ipflow**, **CISCO NFC v5.0** or **Home-made collectors**
- Configuration management:
  - **Rancid**, **Home-made inventory tool**
- **Looking-glass** for customers

Examples

Argus

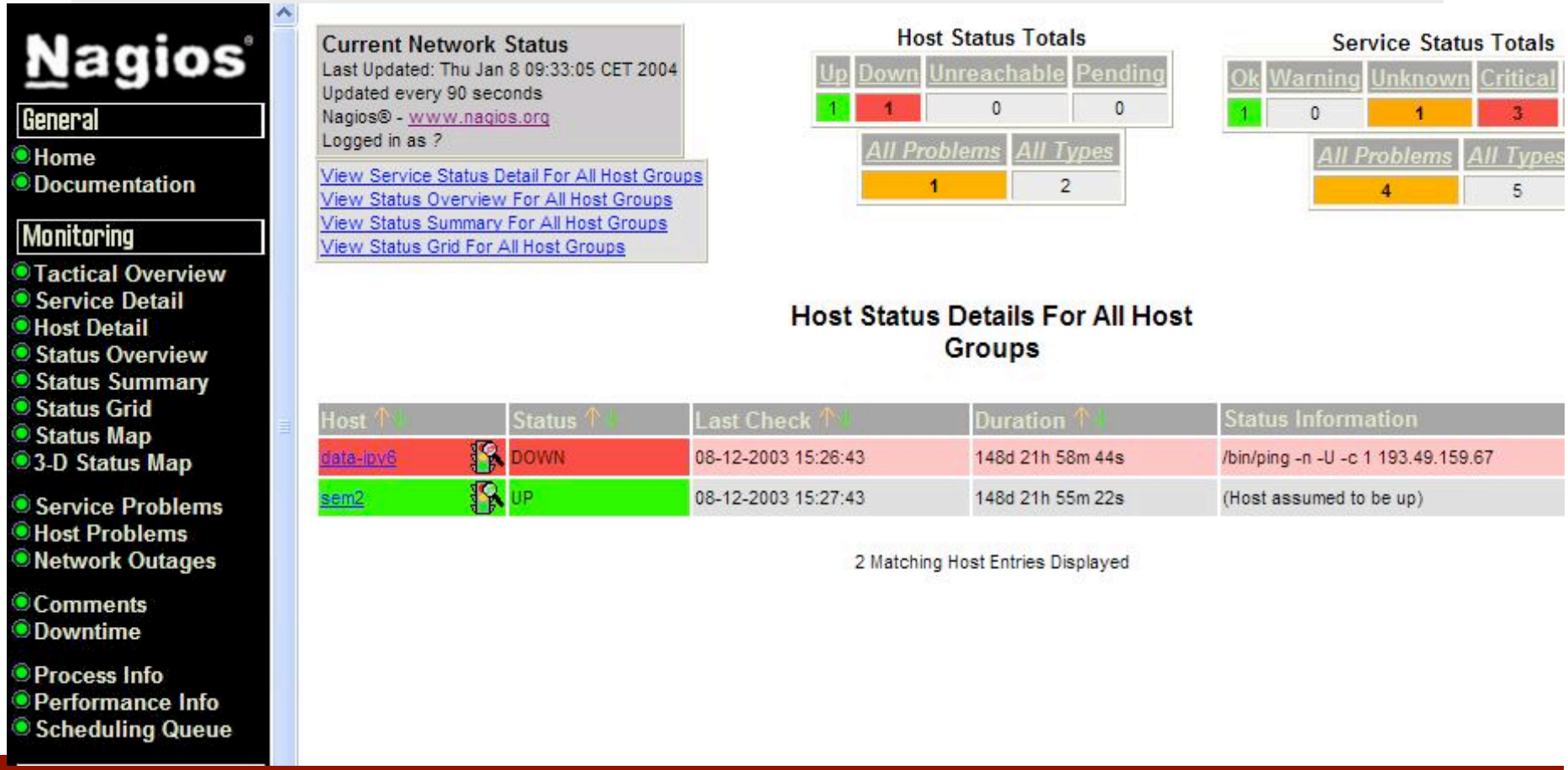
- Administration of network:
  - PCs, Switches, Routers
  - Availability
  - Traffic on the network
- Administration of services:
  - http, ftp, dns, imap, smtp...
- Evolution: new features can be easily added


Argus - Top:Serveurs-SIPA - Microsoft Internet Explorer
Fichier Edition Affichage Favoris Outils ?
Adresse http://supervision-ipv6.renater.fr/private/argus/prog?object=Top:Serveurs-SIPA;func=page
Top:Serveurs-SIPA
User: jdurand
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
Override
Annotate
Flush Cache
Display Config
Debugging
Un-Acked Notifies
Notifies
Error Log
Top
Logout
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

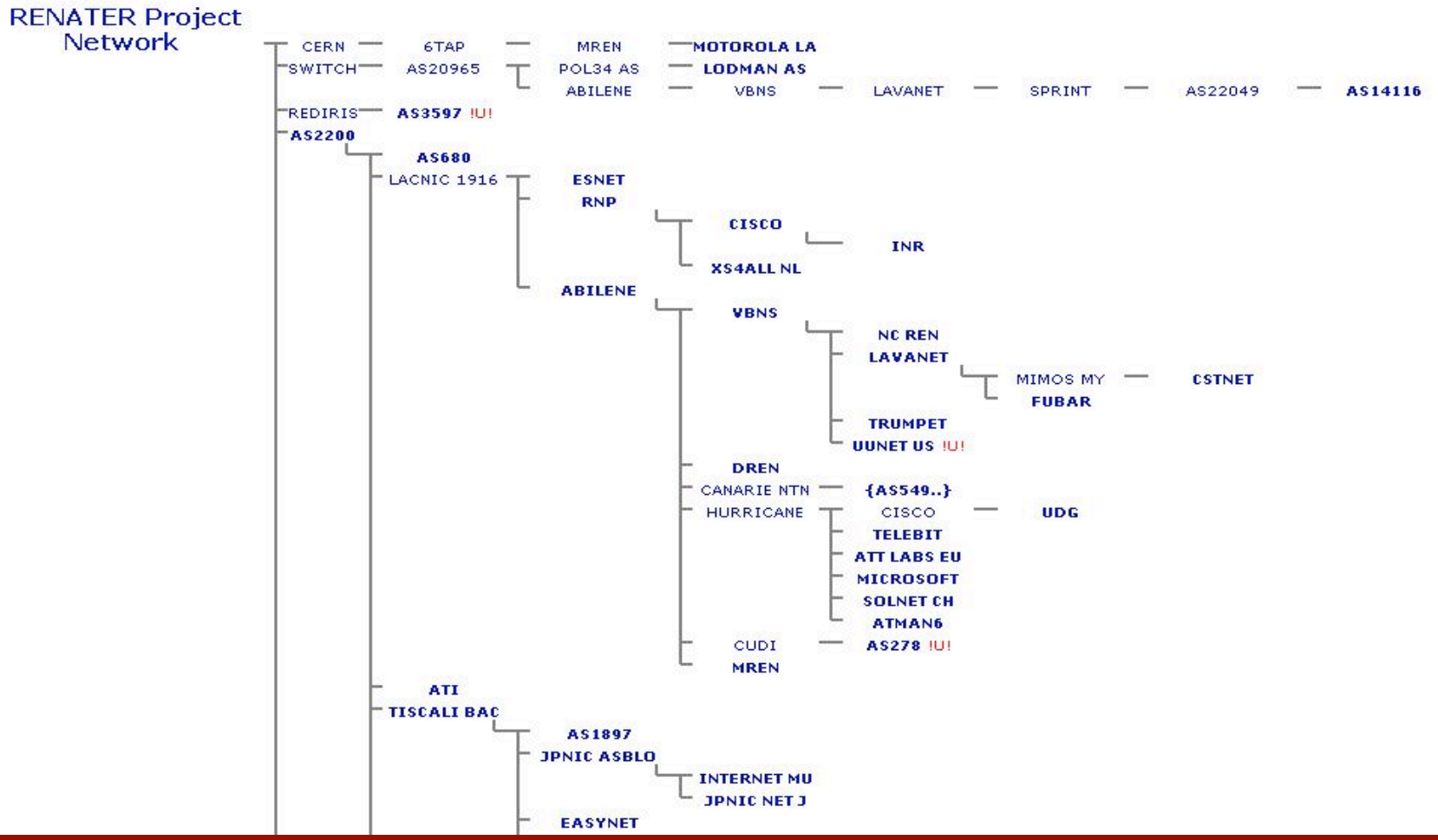

Nagios
General
Home
Documentation
Monitoring
Tactical Overview
Service Detail
Host Detail
Status Overview
Status Summary
Status Grid
Status Map
3-D Status Map
Service Problems
Host Problems
Network Outages
Comments
Downtime
Process Info
Performance Info
Scheduling Queue
Current Network Status
Last Updated: Thu Jan 8 09:33:05 CET 2004
Updated every 90 seconds
Nagios® - www.nagios.org
Logged in as ?
View Service Status Detail For All Host Groups
View Status Overview For All Host Groups
View Status Summary For All Host Groups
View Status Grid For All Host Groups
Host Status Totals
Up Down Unreachable Pending
1 1 0 0
All Problems All Types
1 2
Service Status Totals
Ok Warning Unknown Critical
1 0 1 3
All Problems All Types
4 5
Host Status Details For All Host Groups
Host Status Last Check Duration Status Information
data-ipv6 DOWN 08-12-2003 15:26:43 148d 21h 58m 44s /bin/ping -n -U -c 1 193.49.159.67
sem2 UP 08-12-2003 15:27:43 148d 21h 55m 22s (Host assumed to be up)
2 Matching Host Entries Displayed

ASpath-Tree

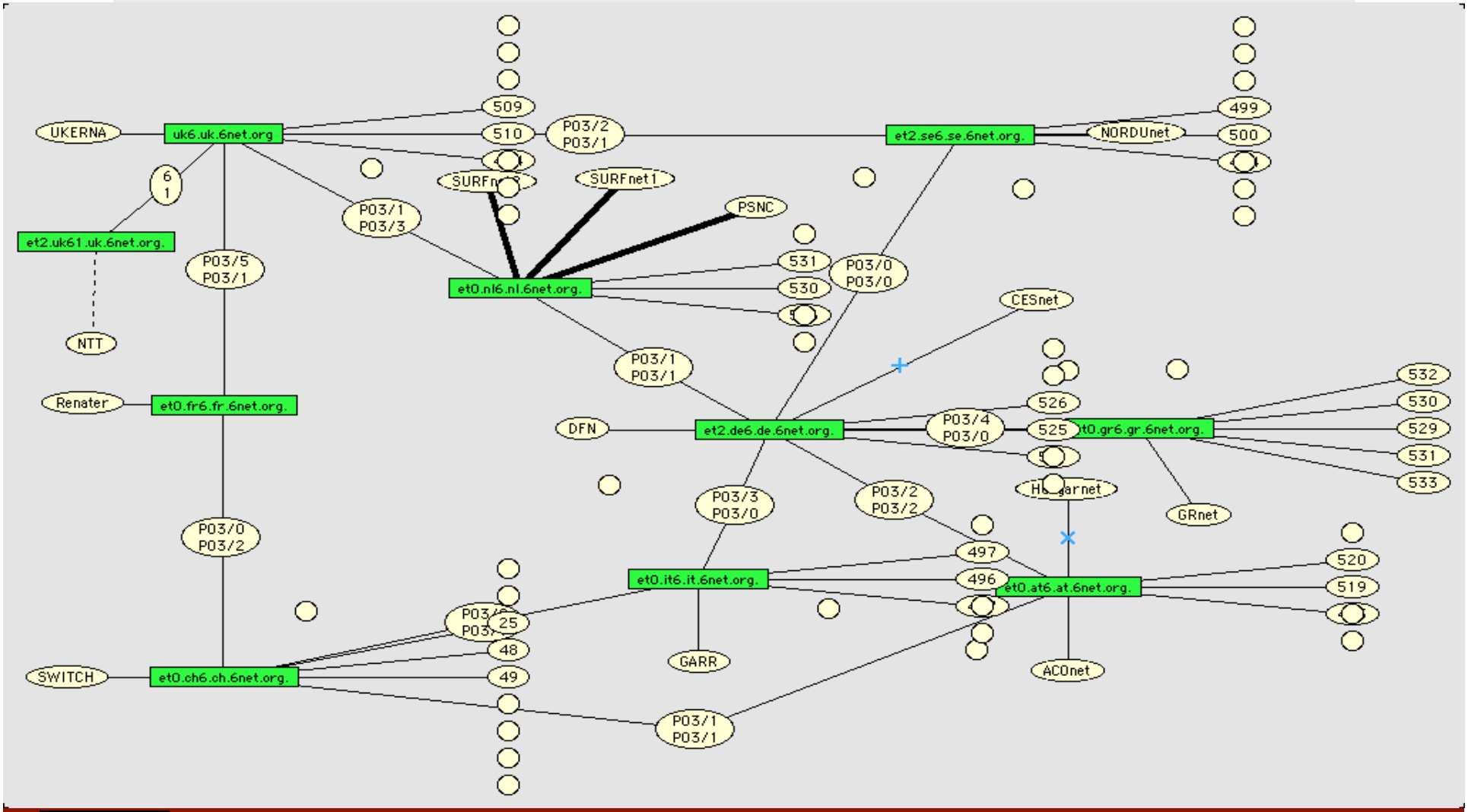
- Display BGP4+ « topology » from
  - BGP4+ routing table
  - Retrieved from connection to routers (RSH/SSH…)
- Generate HTML pages.

ASpath-Tree

Renater The whole IPv6 BGP table



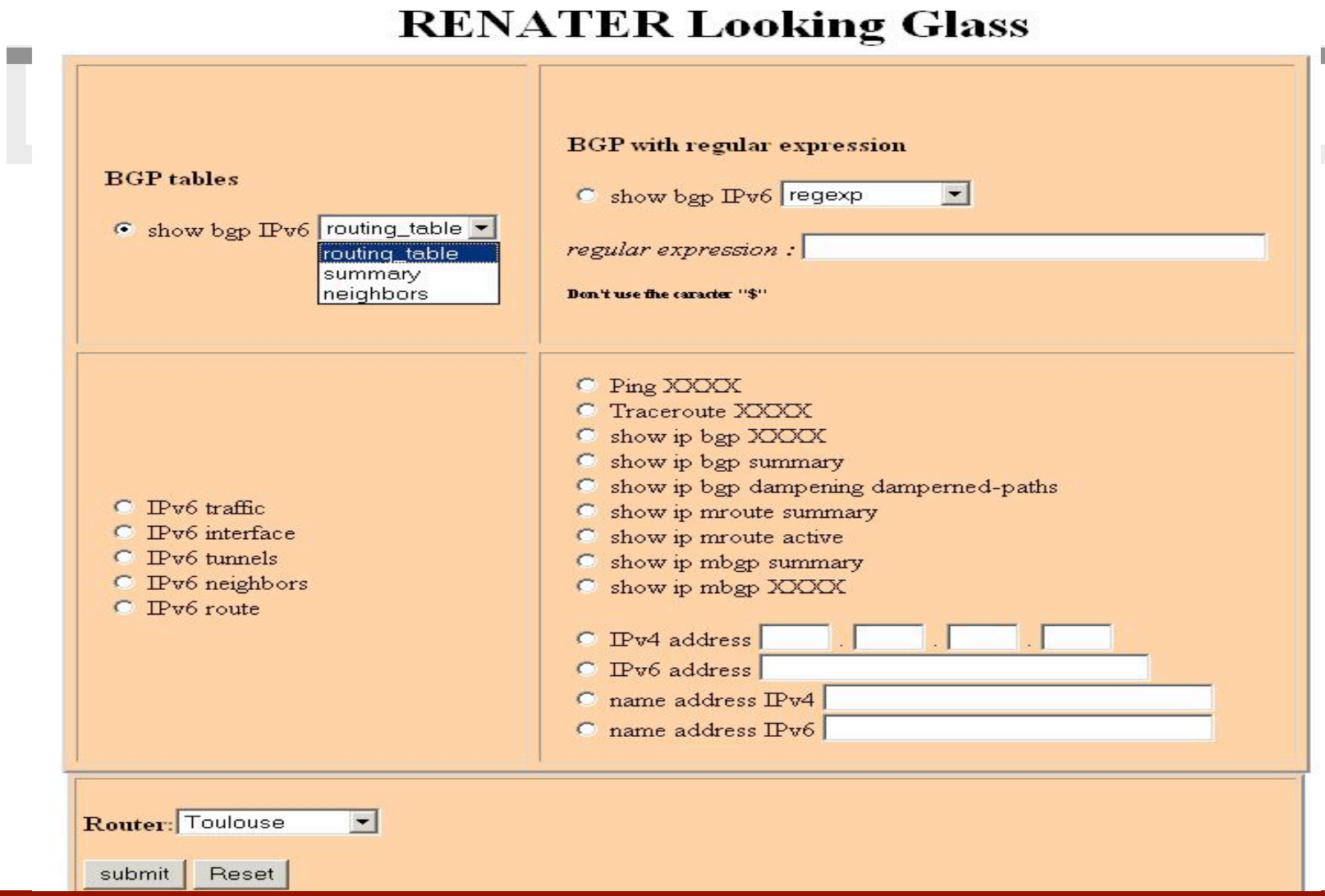
Intermapper



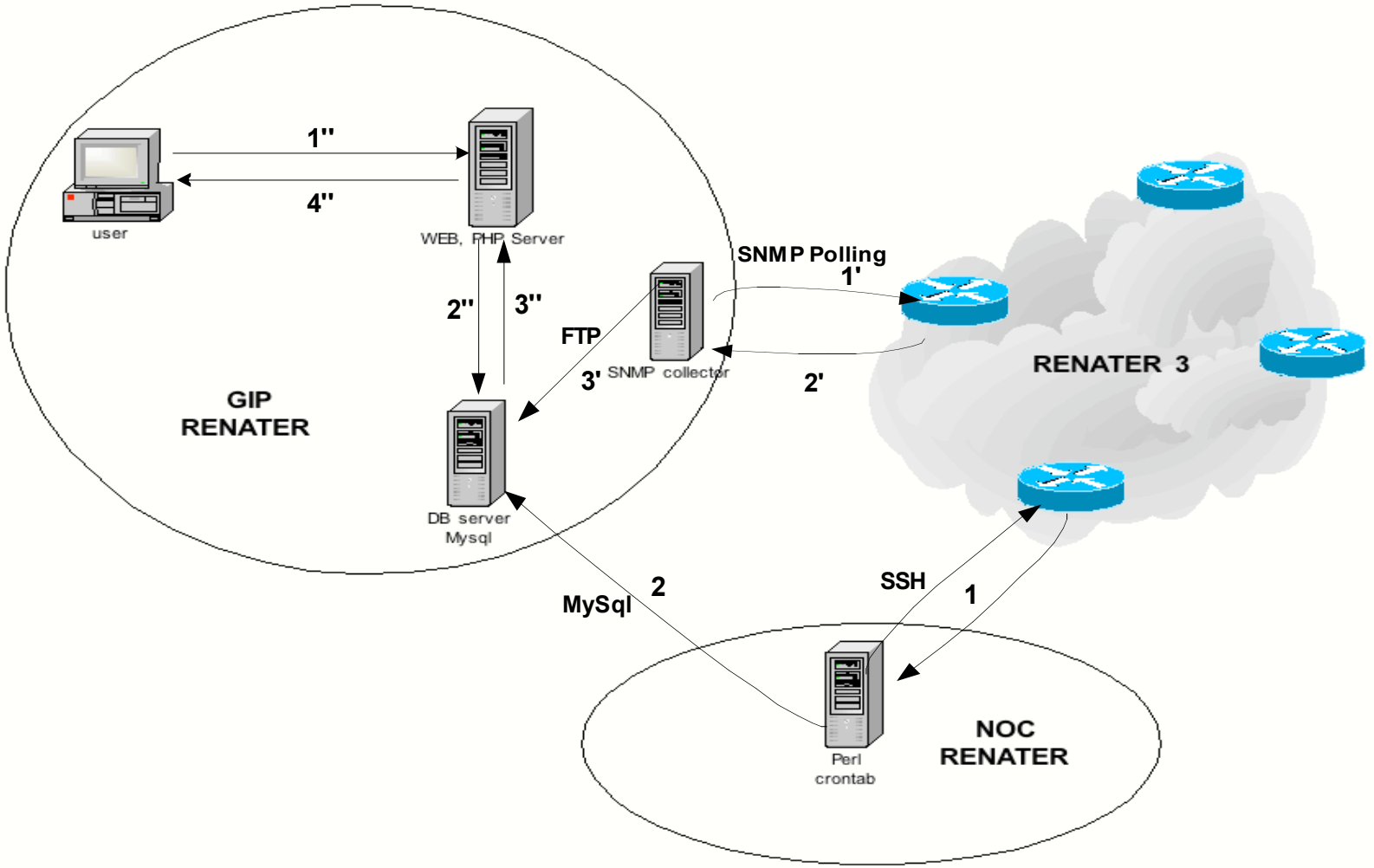
Looking Glass

- 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

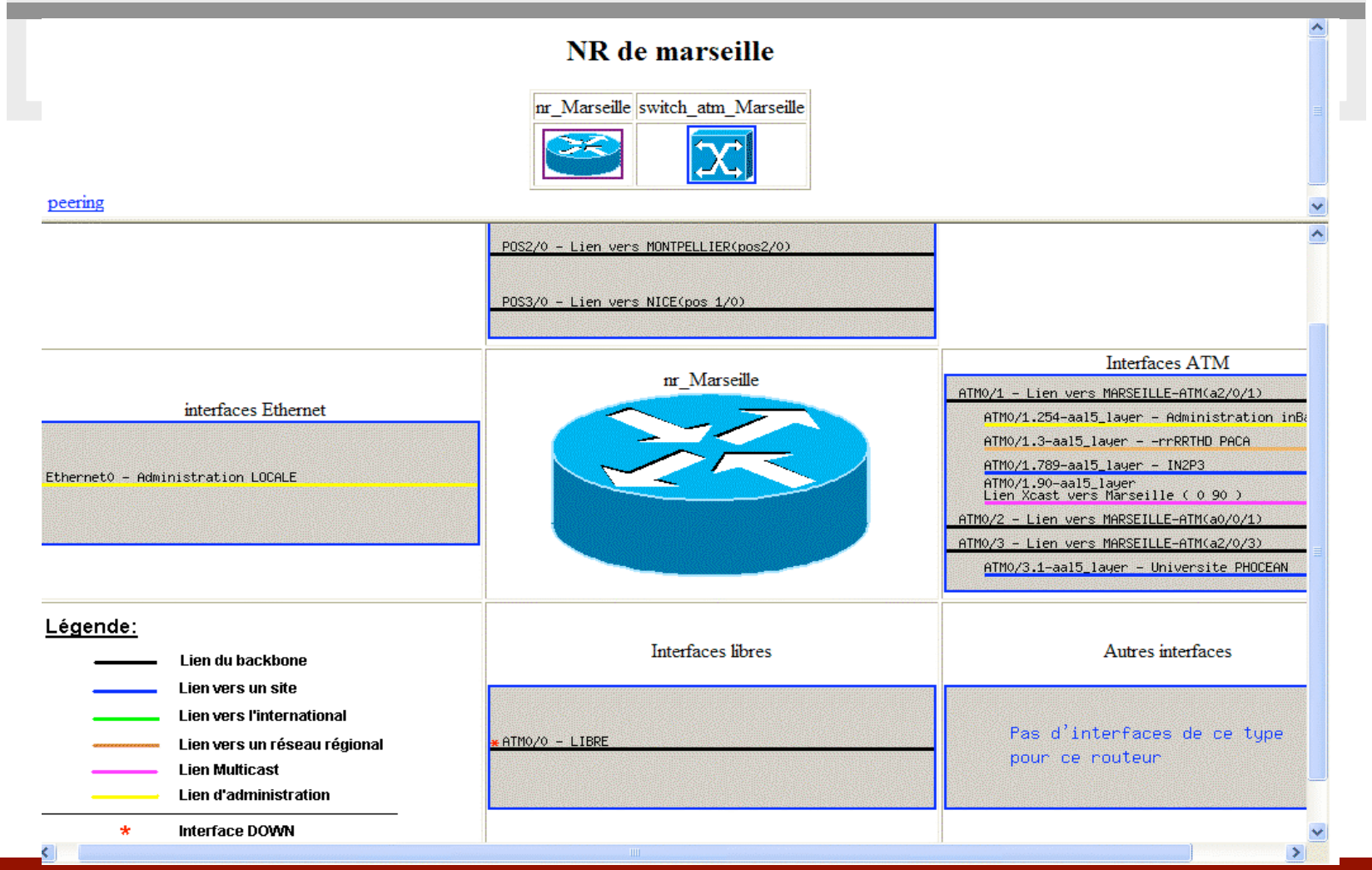
Looking Glass



Inventory : interfaces & peerings



Inventory: Interfaces



Inventory: BGP Peerings

NR de PROJETS

PROJETS_GSR-NIO	PROJETS_GSR-6NET	PROJETS_7200-MCAST	PROJETS_M5
			

interfaces

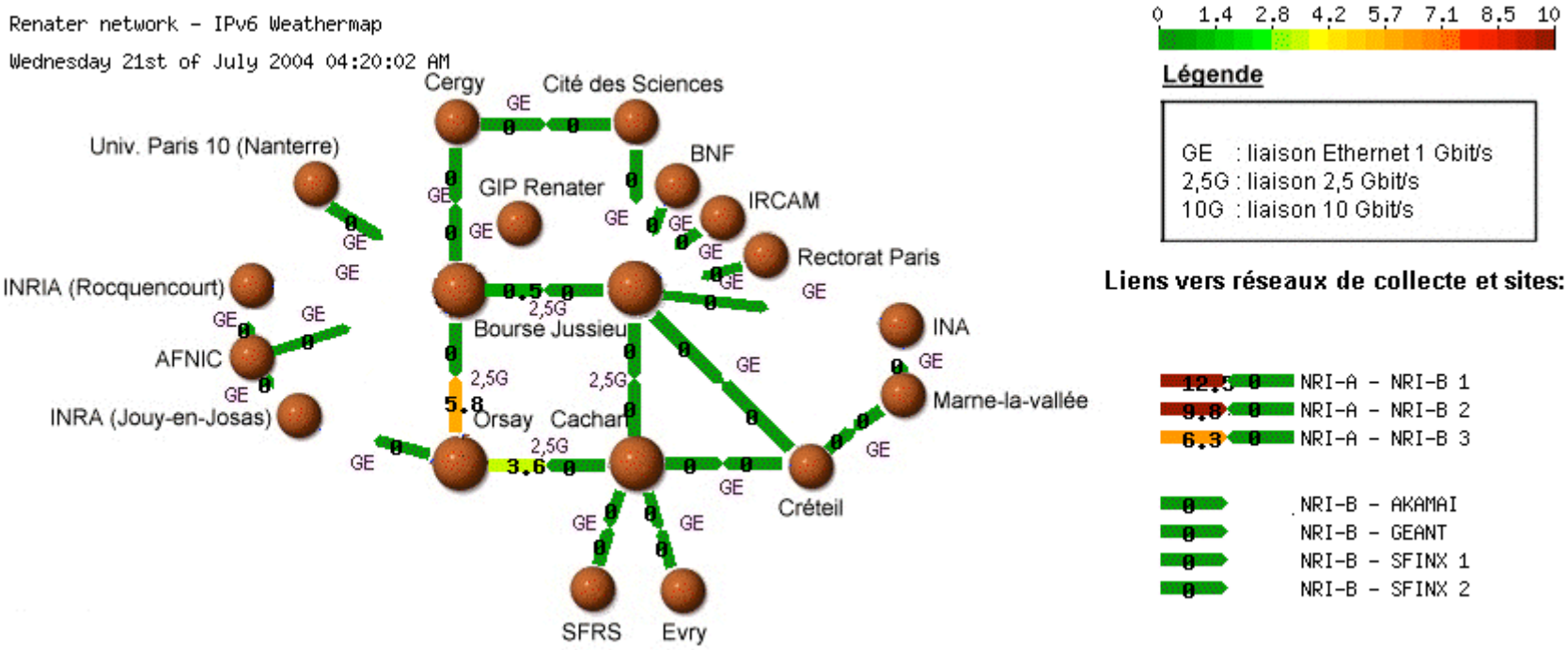
Routeur PROJETS_GSR-NIO	Peering BGP
	peering iBPG Established *** Peer-group de tous les routeurs IBGP *** AS 1717 - FR-RENATER-PROJETS Established *** Peer-group de tous les routeurs IBGP *** AS 1717 - FR-RENATER-PROJETS Established *** Peer-group de tous les routeurs IBGP *** AS 1717 - FR-RENATER-PROJETS 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 ?

Retrieve this information ...

- http://www.renater.fr **> users > training courses**
  - -> Presentations
- http://www.renater.fr **> research & innovation > bibliographie**
  - -> Bibliography, RFCs, ...