

6DEPLOY

IPv6 network management

6DEPLOY. IPv6 Deployment and Support

Contributions

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Patrick Grossetête, Cisco



Agenda

Introduction

Retrieving information from routers

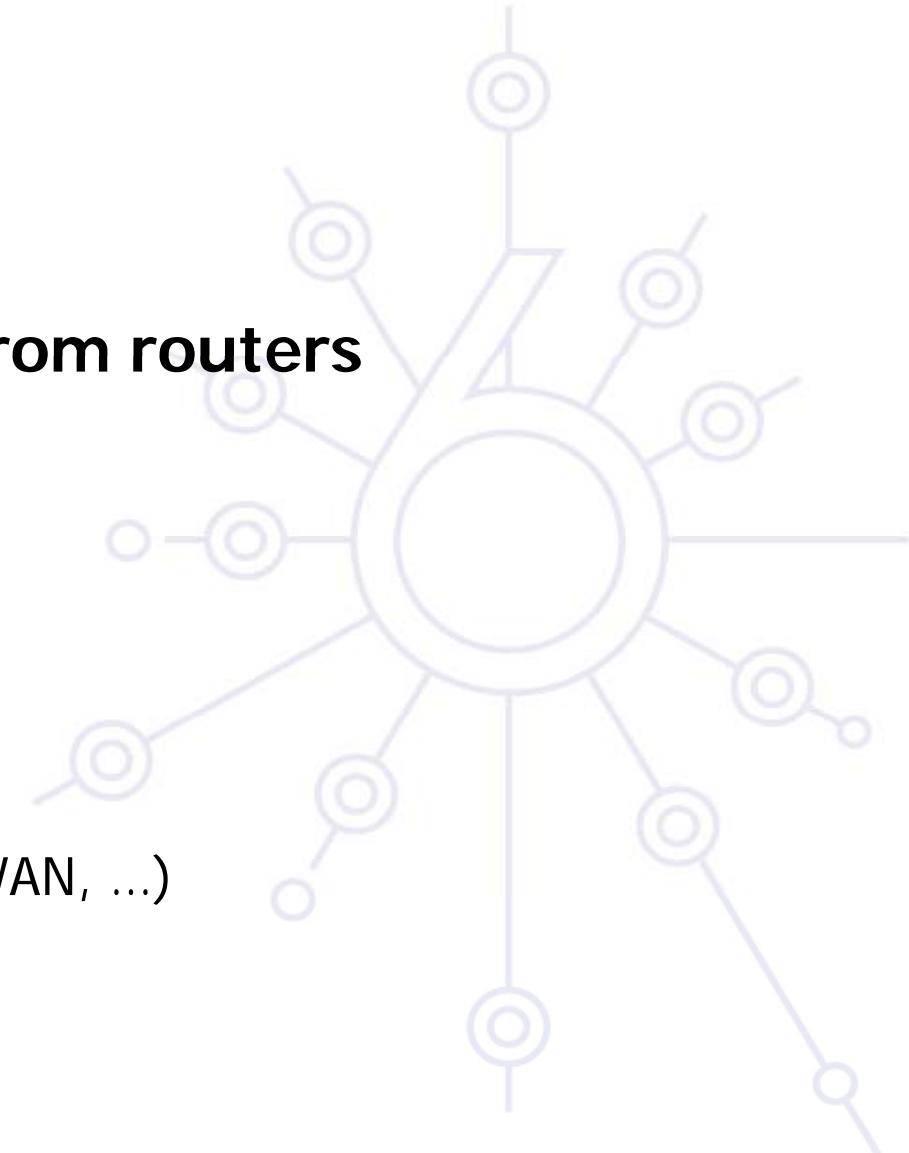
- TELNET/SSH/TFTP/FTP, ...
- SNMP/MIBs and IPv6
- Netflow

Management platforms

Management tools

- 6NET work
- Recommendations (LAN, WAN, ...)
- Examples

Conclusion



Introduction

IPv6 networks deployed:

- Most are dual stack
 - LANs (campuses, companies, ...)
 - MANs
 - WANs - ISPs (Géant, NRENs, IIJ, NTT/Verio, Abilene, ...)
 - IXs



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, ...)

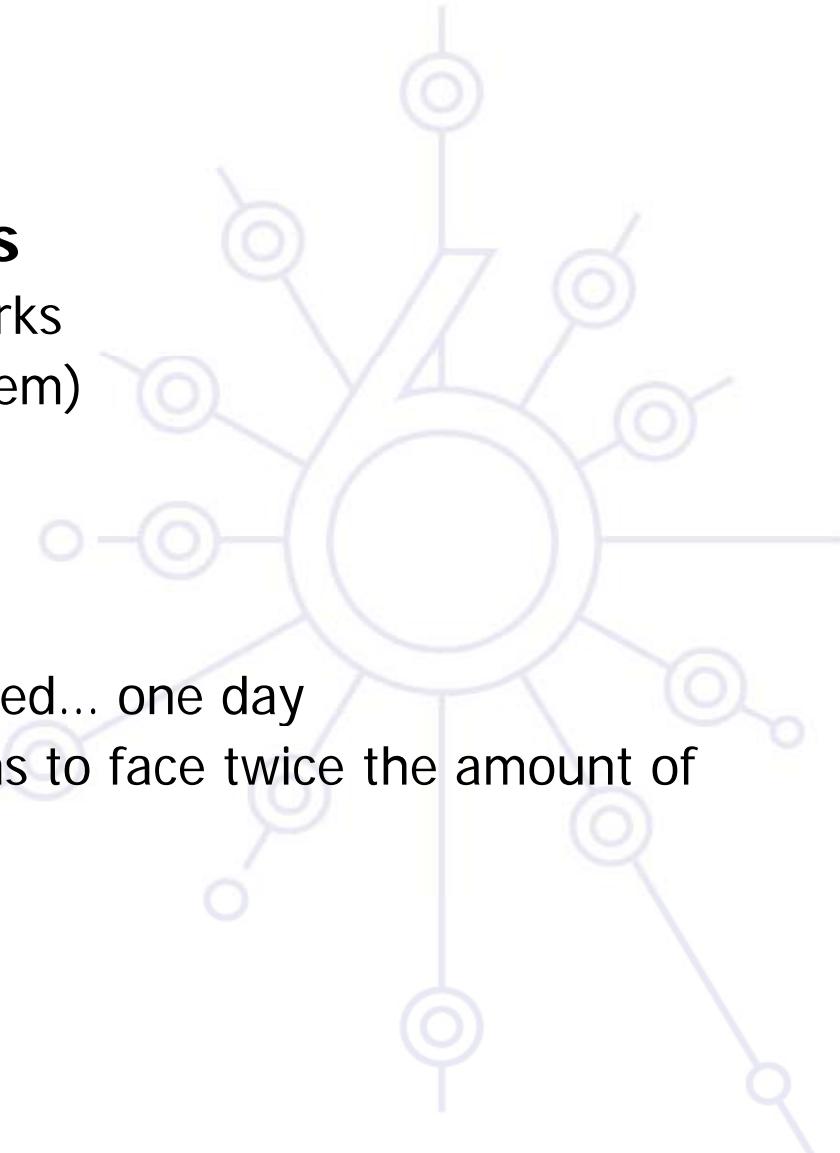
Introduction

Different types of networks

- Dual stack IPv6 & IPv4 networks
- IPv6 only networks (few of them)

Important to keep in mind

- Dual stack is not forever
- One IP stack should be removed... one day
- No reasons for network admins to face twice the amount of work



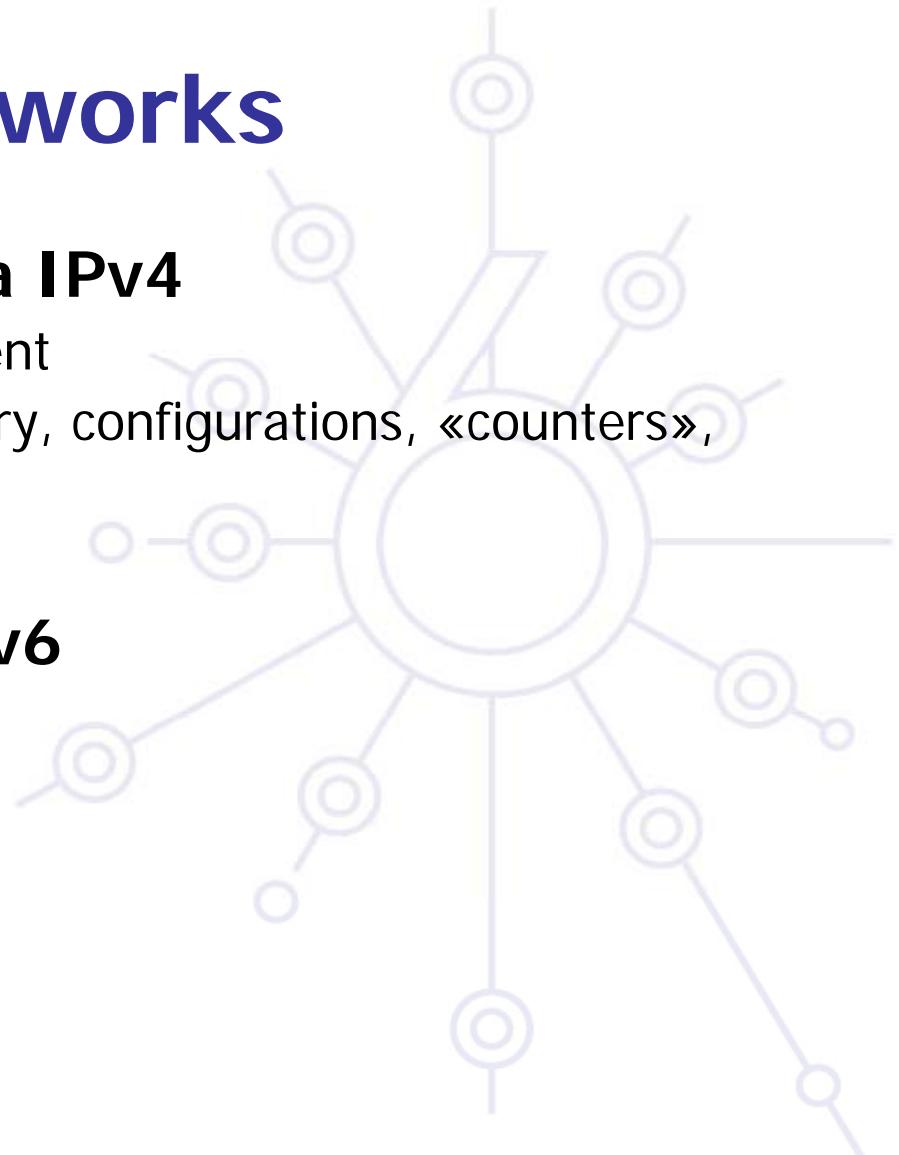
Dual Stack IP networks

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

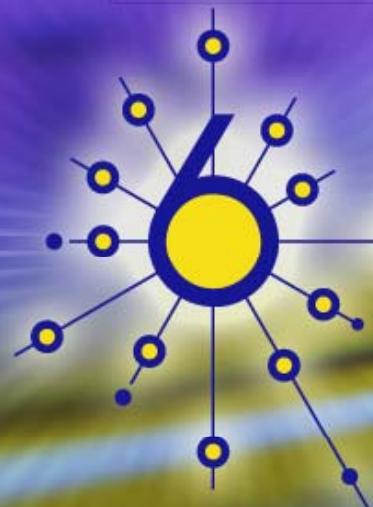
Topology discovery (LAN, WAN ?)

IPv6 SNMP agent

SNMP over IPv6 transport

=> Need to identify the missing parts





deploy

**SSH/TELNET/TFTP...
Basic requirements to manage a network**

SSH/TELNET/TFTP...

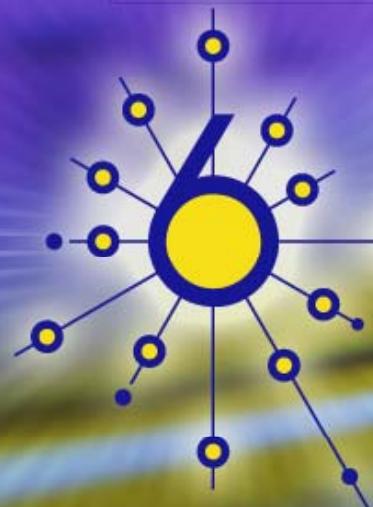
All routers support IPv6 connections (SSH, TELNET)

- Periodic scripts can retrieve information from the routers over IPv6

TFTP/IPv6 is also supported on all equipment

- Images can be downloaded over IPv6

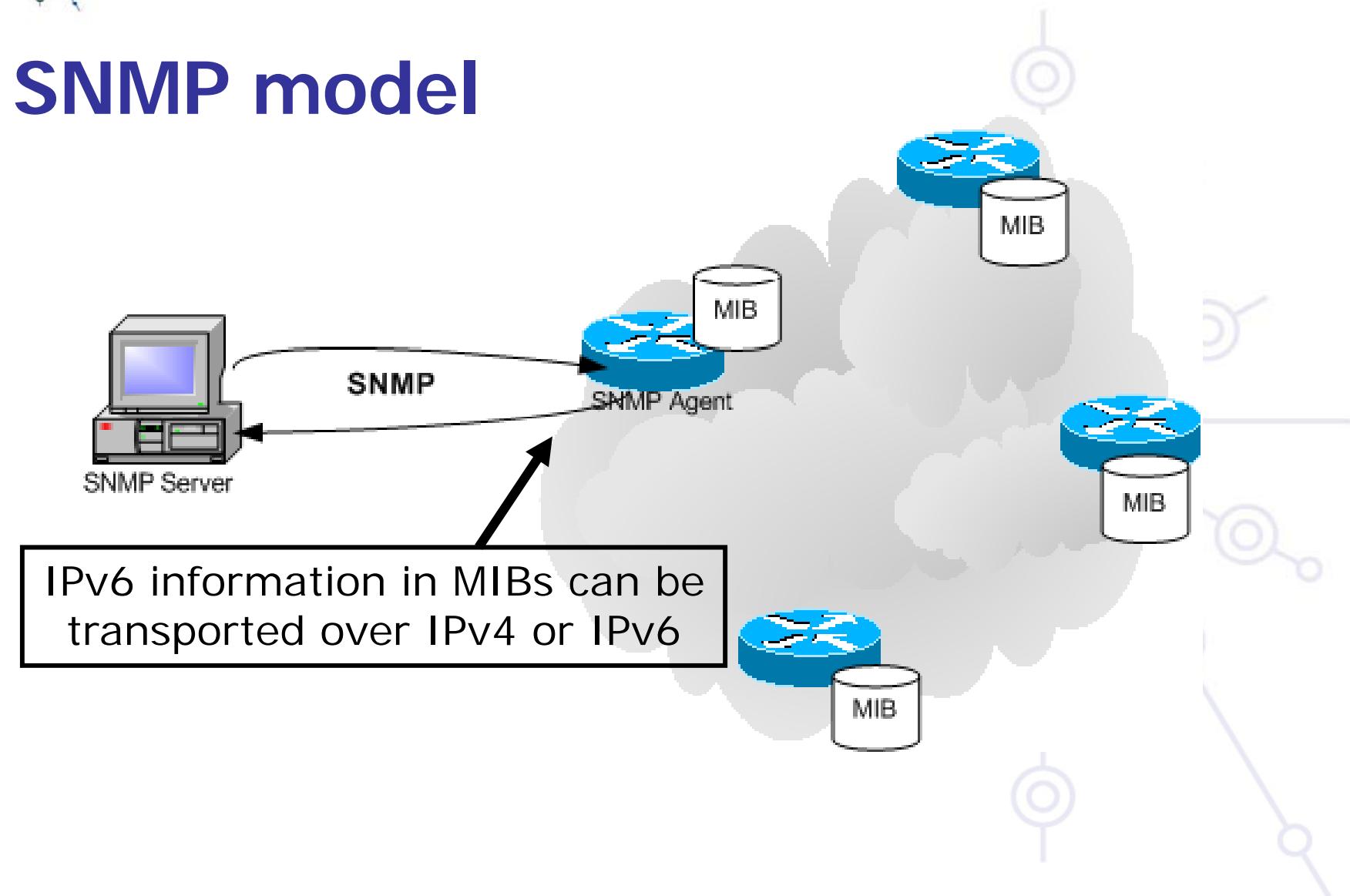
FTP/IPv6 is not supported on CISCO routers



deploy

**SNMP/MIBs and IPv6
SNMP and IPv6
IPv6 MIBs status
Manufacturer's implementations**

SNMP model



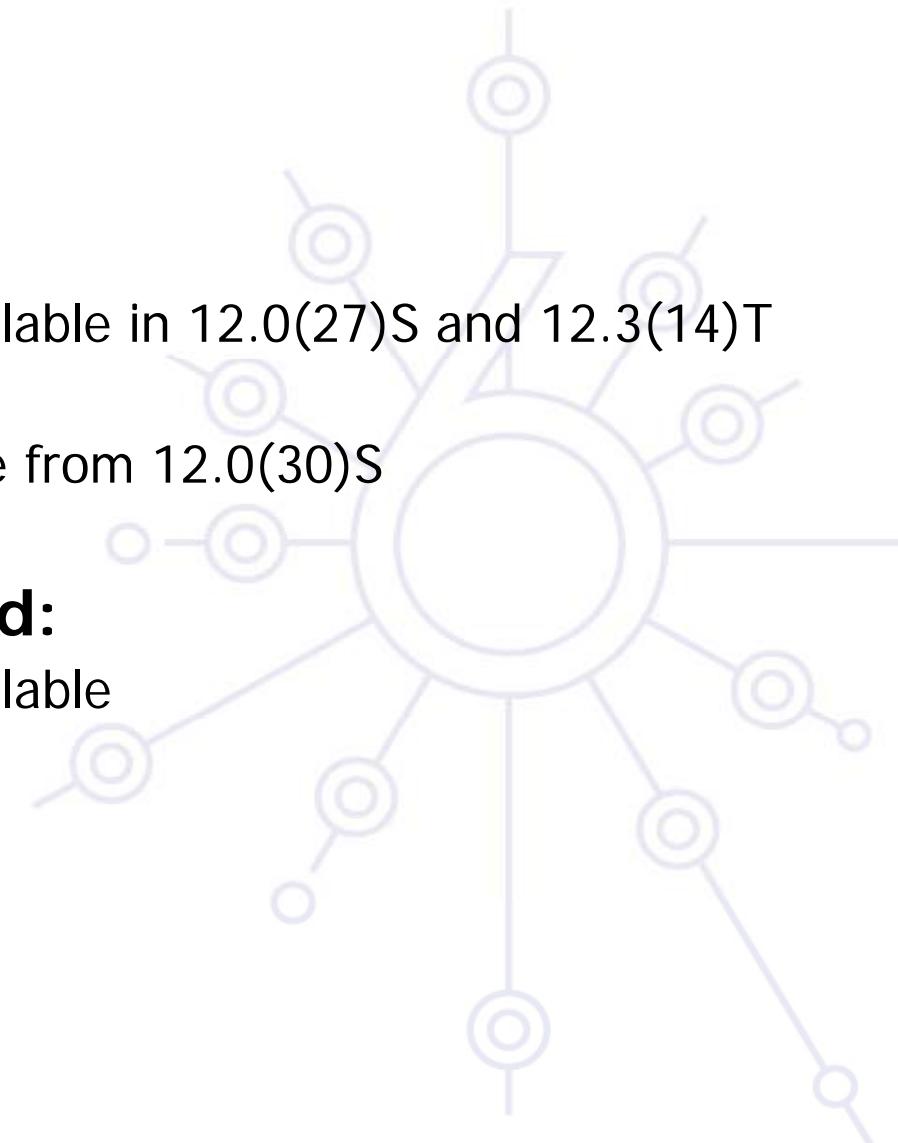
SNMP over IPv6

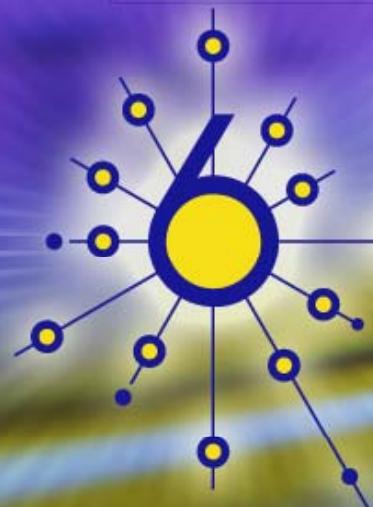
Cisco:

- 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





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IPv6 MIBs Status

IPv6 MIBs status /1

MIBs are essential for the network management

SNMP-based applications are widely used but others exist too (NetFlow, XML, ...)

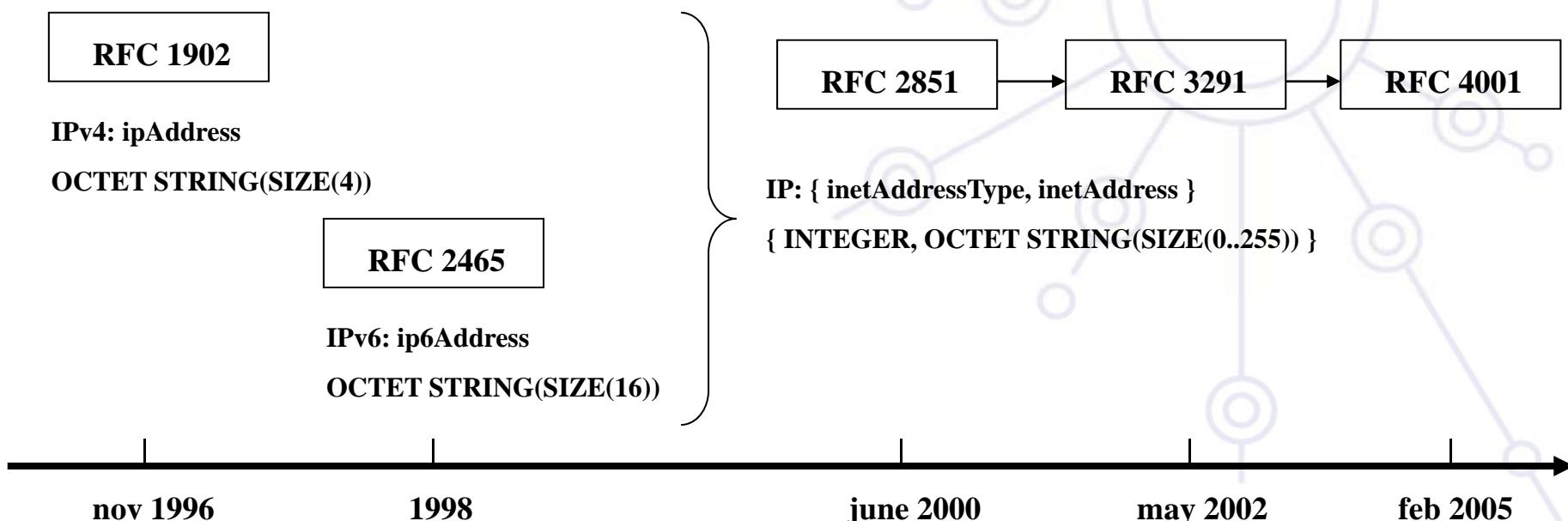
SNMP rely upon MIBs

=> 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:

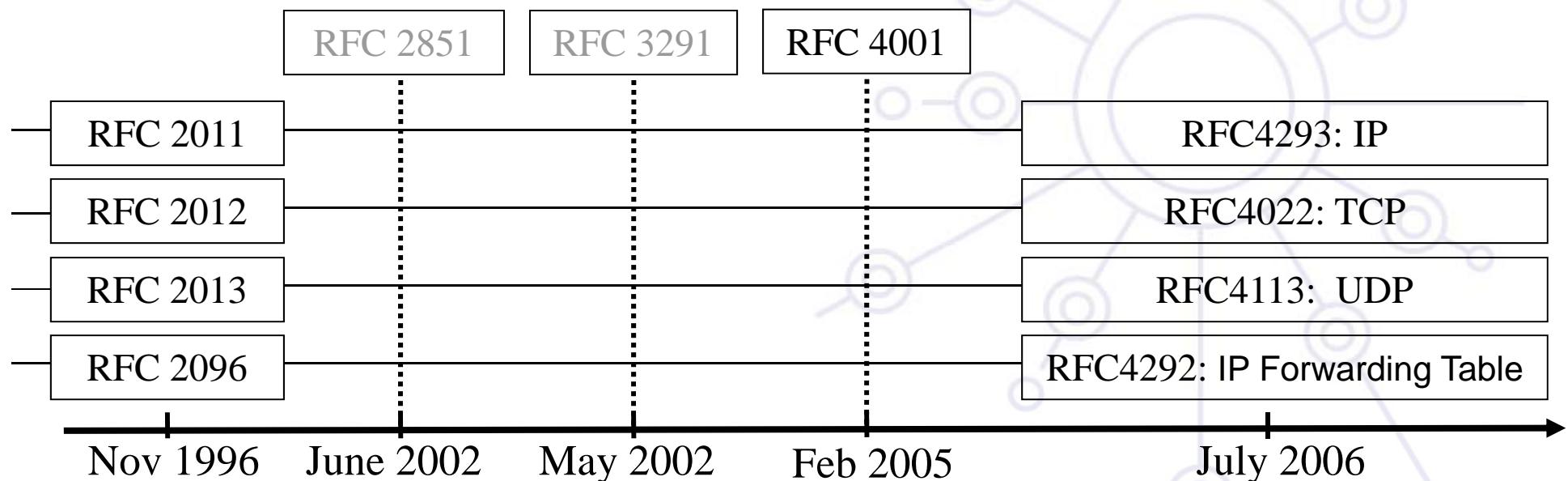
- At the beginning:
 - IPv4 and IPv6 MIBs were **disassociated**
- Currently, IPv4 and IPv6 use unified MIBs



IPv6 MIBs /3

Standardization status at IETF

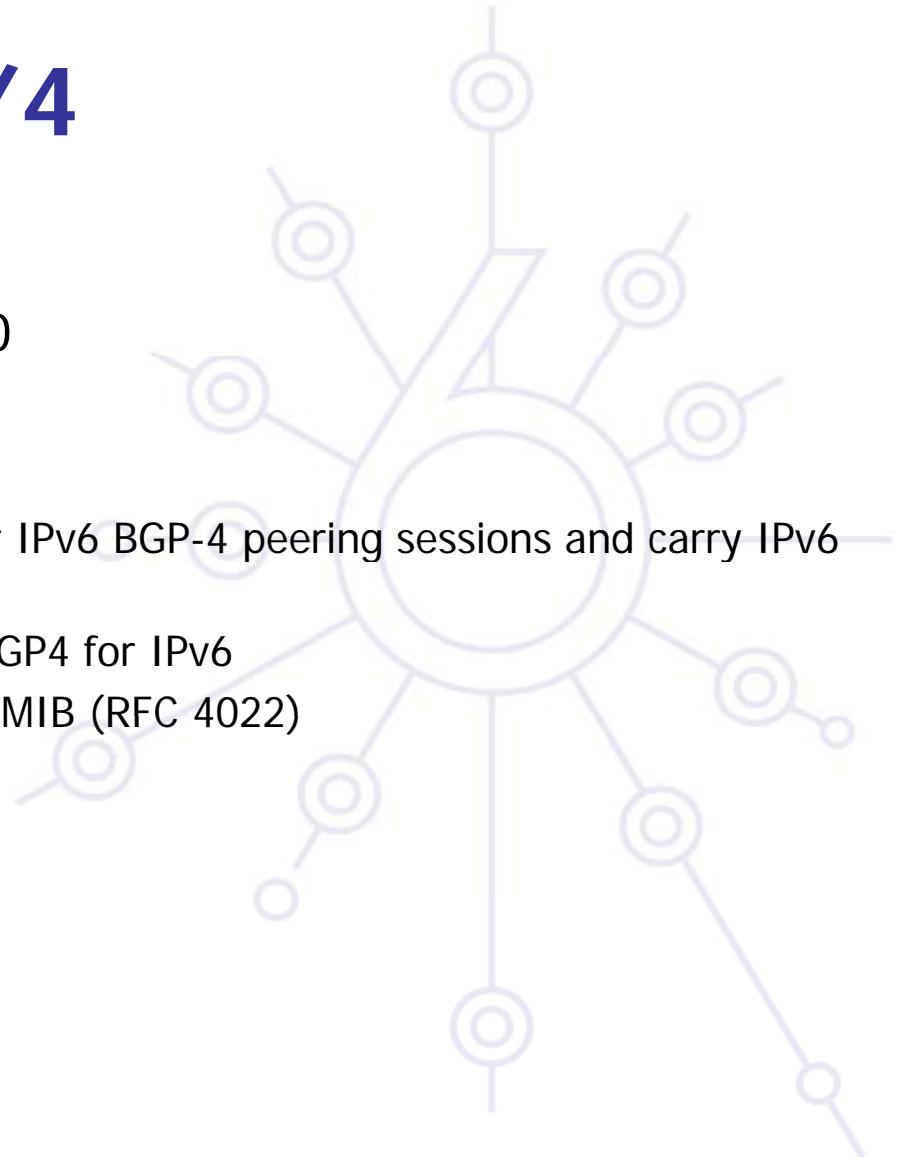
Today : **unified MIBs** are on standard track.

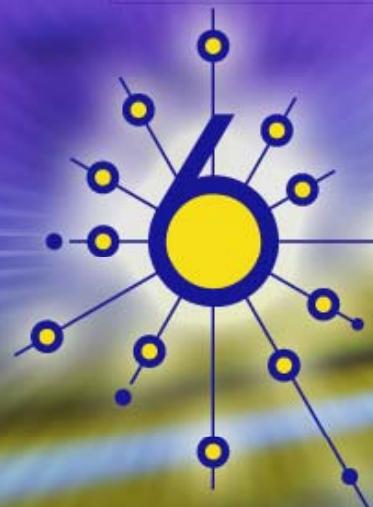


IETF MIB Status /4

BGP MIB v6:

- draft-ietf-idr-bgp4-mibv2-10
 - Expires in August 2010
 - Includes IPv6
 - Add the ability to monitor IPv6 BGP-4 peering sessions and carry IPv6 reachability
 - Reference to RFC2545: BGP4 for IPv6
 - Reference to unified TCP MIB (RFC 4022)





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IPv6 MIBs implementations

IPv6 MIBs implementation/1

Cisco

- Cisco has long supported IP-MIB and IP-FORWARD-MIB in IPv4.
- CISCO-IETF-IP-MIB and CISCO-IETF-IP-FORWARDING-MIB are IPv6 MIBs that are defined as being protocol-independent, but are implemented only for IPv6 objects and tables.
- In Cisco IOS Release 12.2(33)SRC, IP-MIB and IP-FORWARD-MIB were updated to RFC 4293 and RFC 4292 standards
- Also, information available from CLI (if private MIBs not available)
 - show interface accounting

...

Cisco: IPv6 CLI

“show interface accounting”

Differentiate IPv4/IPv6 counters at the interface level for all Cisco routers, except for:

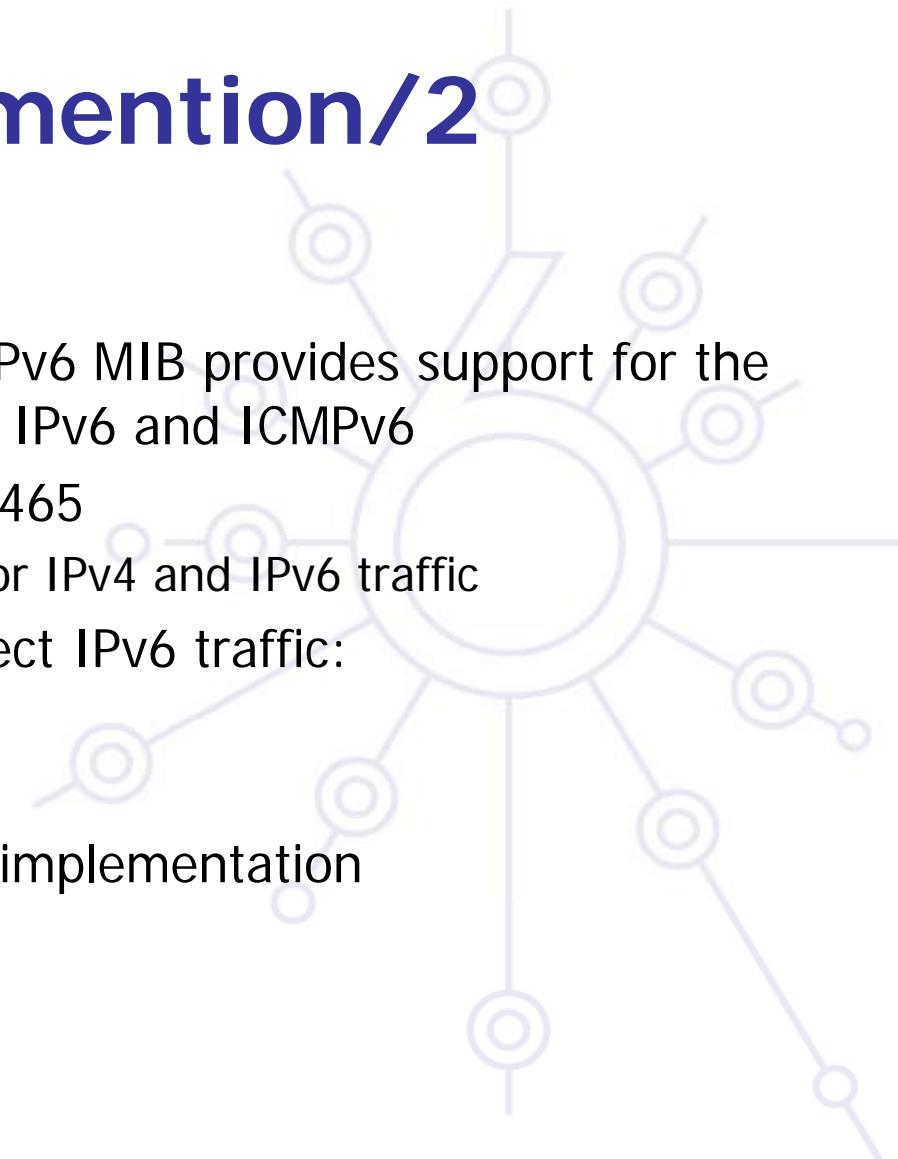
- Catalyst **6500** / Cisco **7600** supervisor engine 720:
Counts only for packets that are software switched, not the hardware switched packets
- GSR:
 - ‘show interface counters’ correctly counts IPv6 traffic and separates ingress and egress traffic
 - **Engine 3:**
 - * OUTPUT IPv6 traffic is counted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

IPv6 MIBs implementation/2

Juniper

- The JUNOS IPv6 and ICMPv6 MIB provides support for the JUNOS implementation of IPv6 and ICMPv6
- MIB based on (old) RFC 2465
 - with different counters for IPv4 and IPv6 traffic
- Or based on filters to collect IPv6 traffic:
 - Eg: Geant monitoring

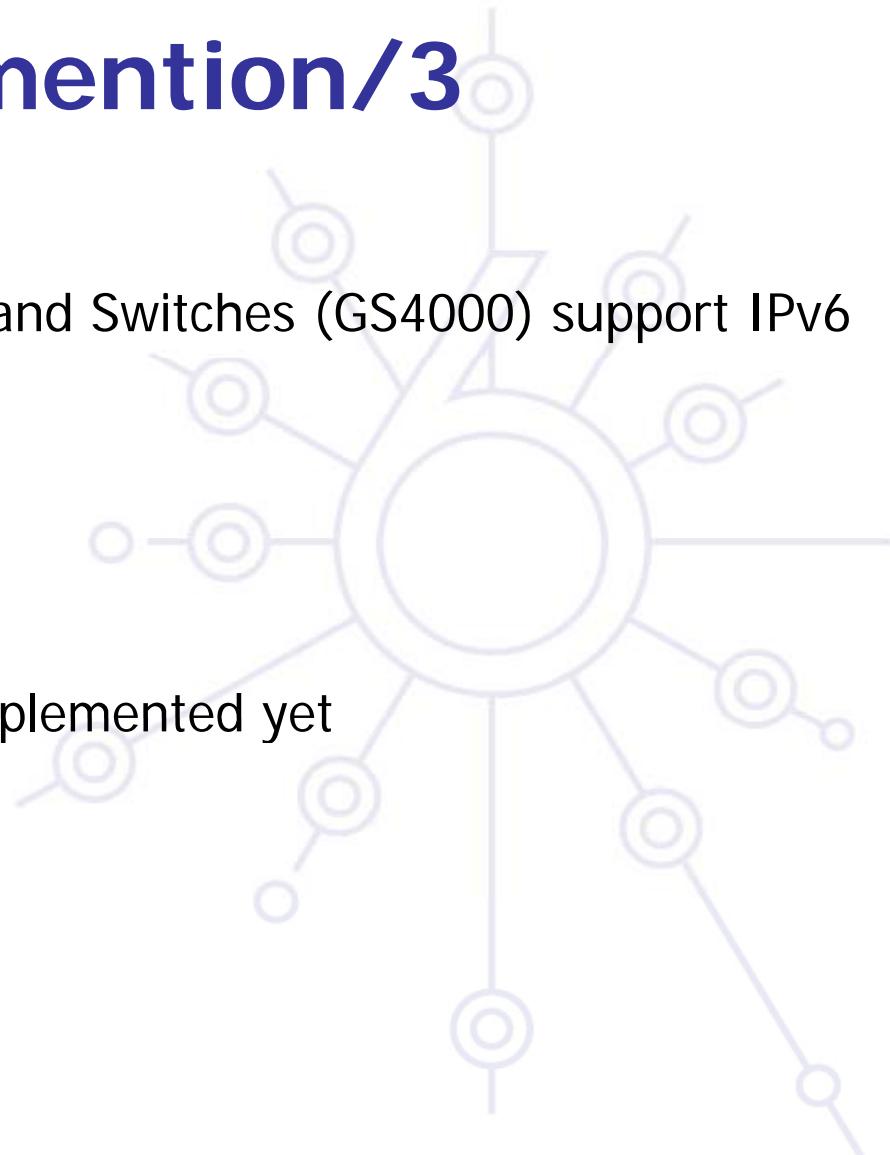
=> Expected : unified MIBs implementation



IPv6 MIBs implementation/3

Hitachi

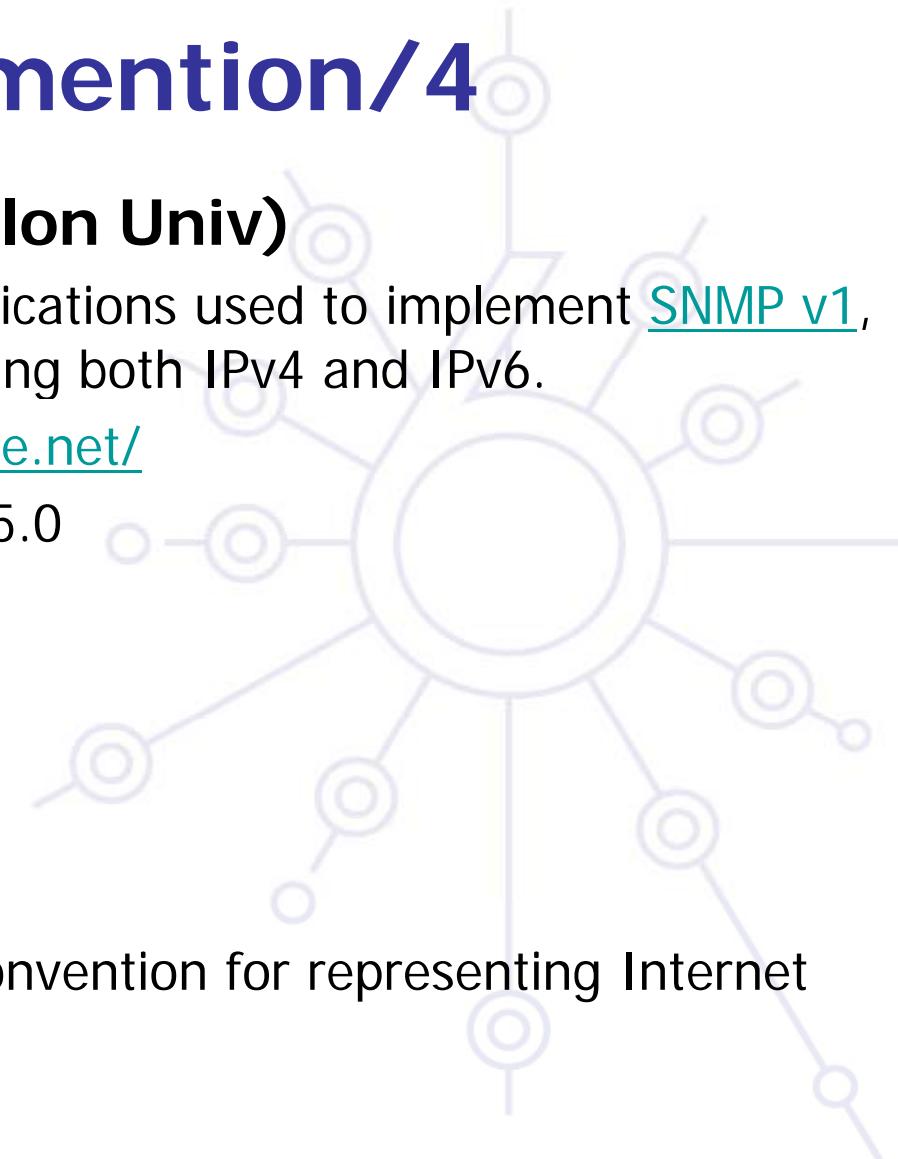
- Routers (GR2000/GR4000) and Switches (GS4000) support IPv6 standard MIBs:
 - RFC 2452: TCP/IPv6
 - RFC 2454: UDP/IPv6
 - RFC 2465: IPv6
 - RFC 2466: ICMPv6
- The unified MIBs are not implemented yet

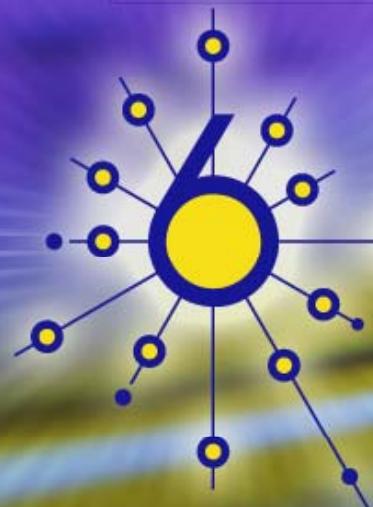


IPv6 MIBs implementation/4

Net-SNMP (Carnegie Mellon Univ)

- Net-SNMP is a suite of applications used to implement [SNMP v1](#), [SNMP v2c](#) and [SNMP v3](#) using both IPv4 and IPv6.
- <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

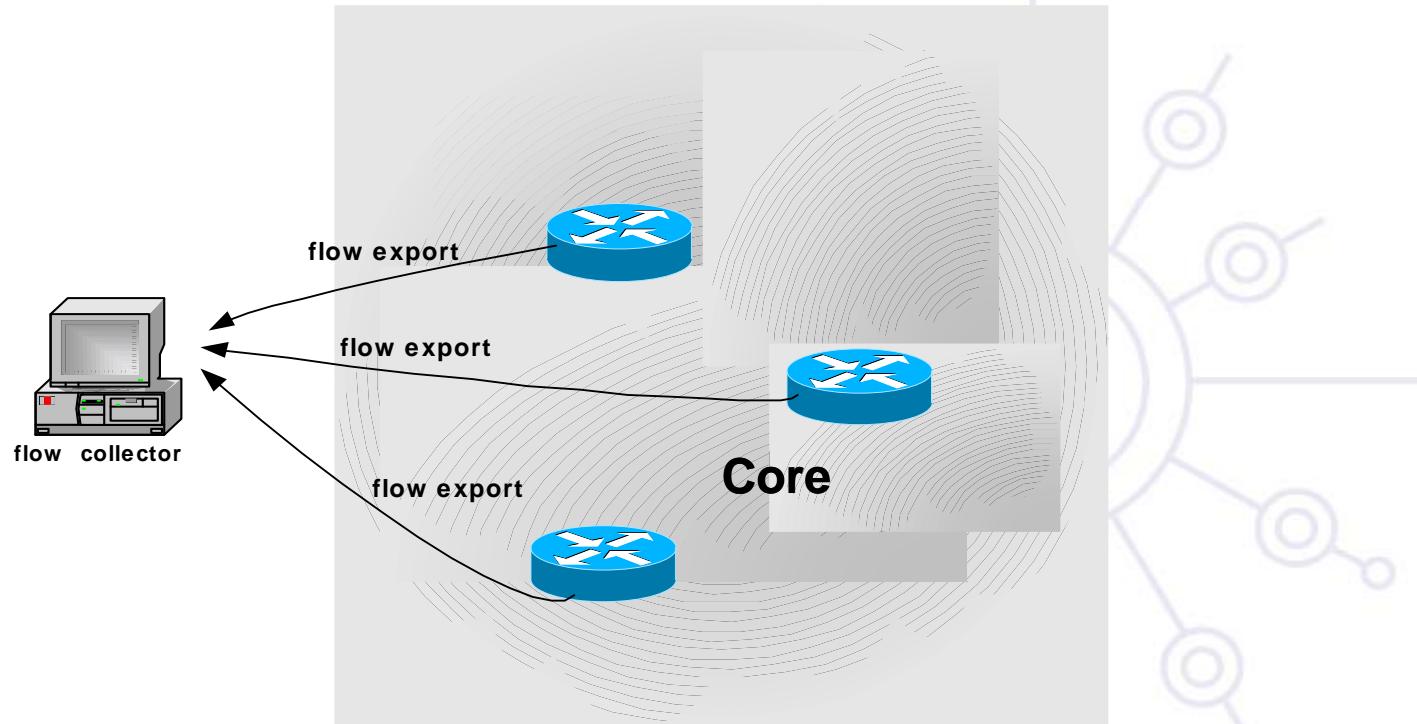




deploy

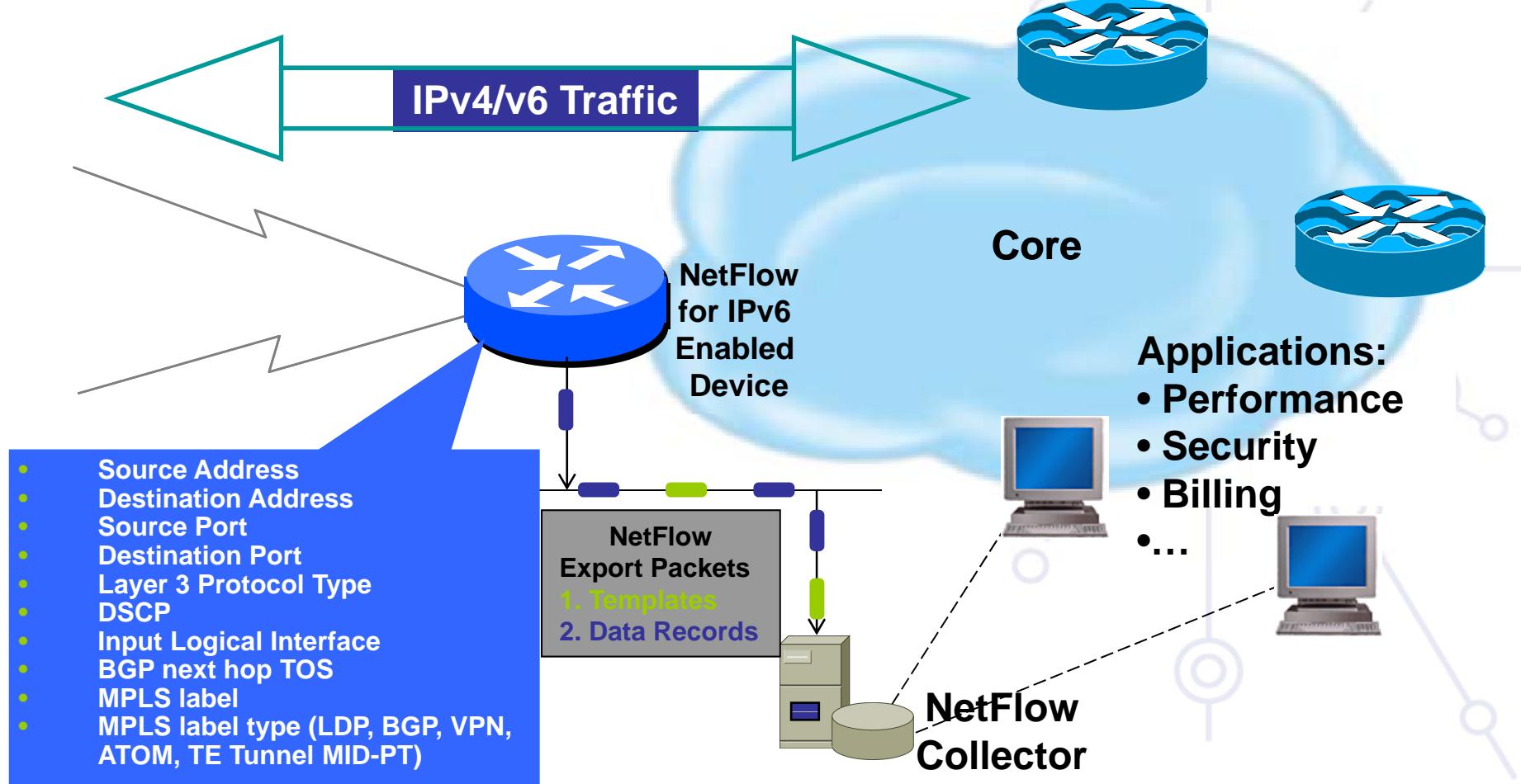
IPv6 flow monitoring

Netflow & IPFIX model



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

NetFlow for IPv6



NetFlow for IPv6

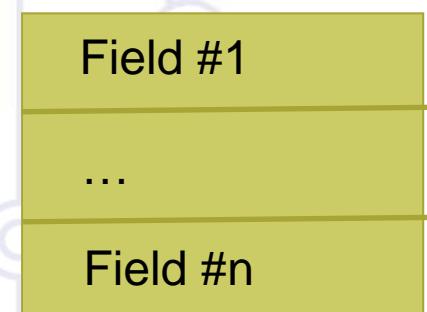
Packet



Template Definition (Template FlowSet)



Record



Flow Records (Data FlowSet)



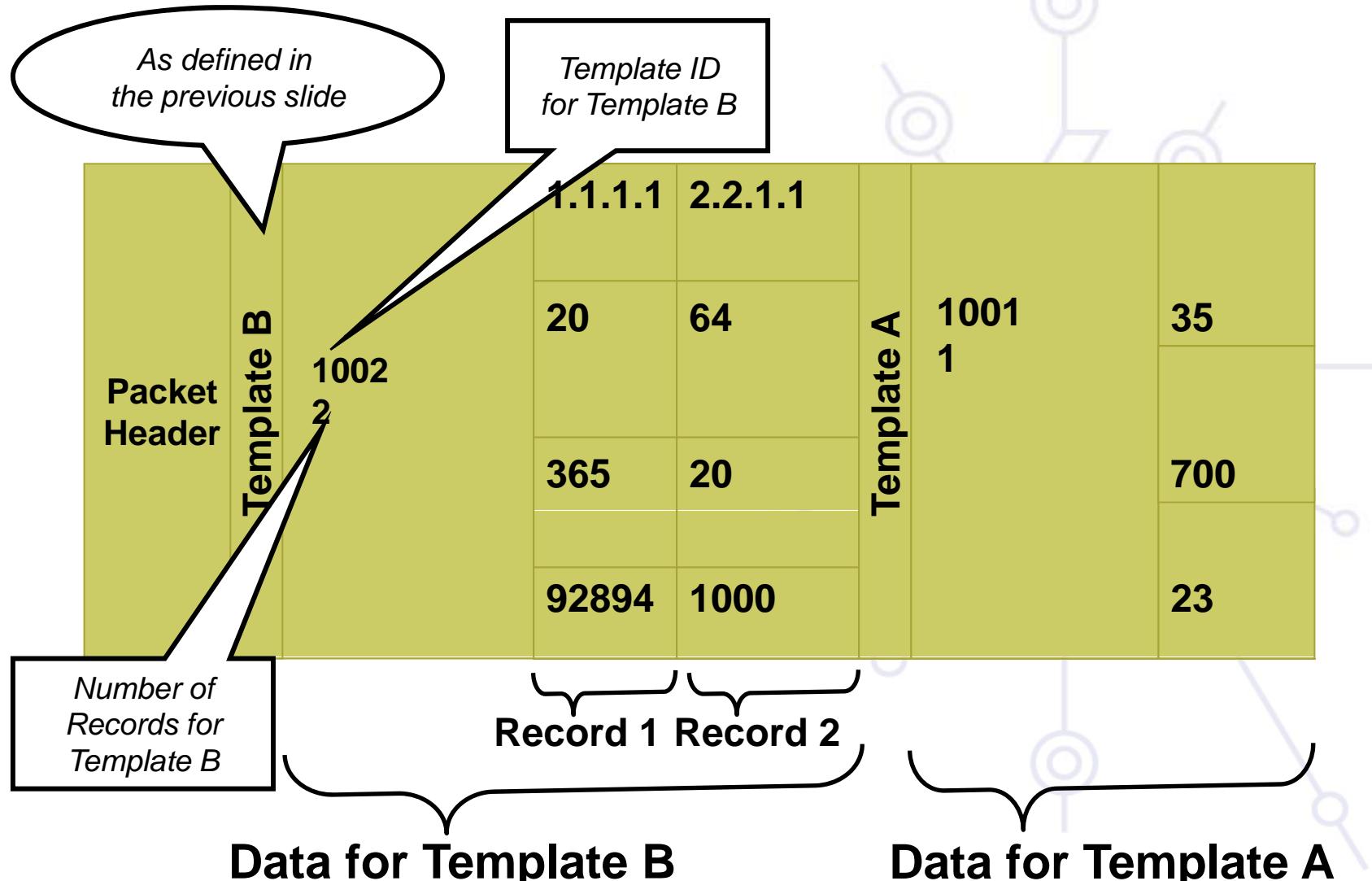
NetFlow Version 9

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	
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	

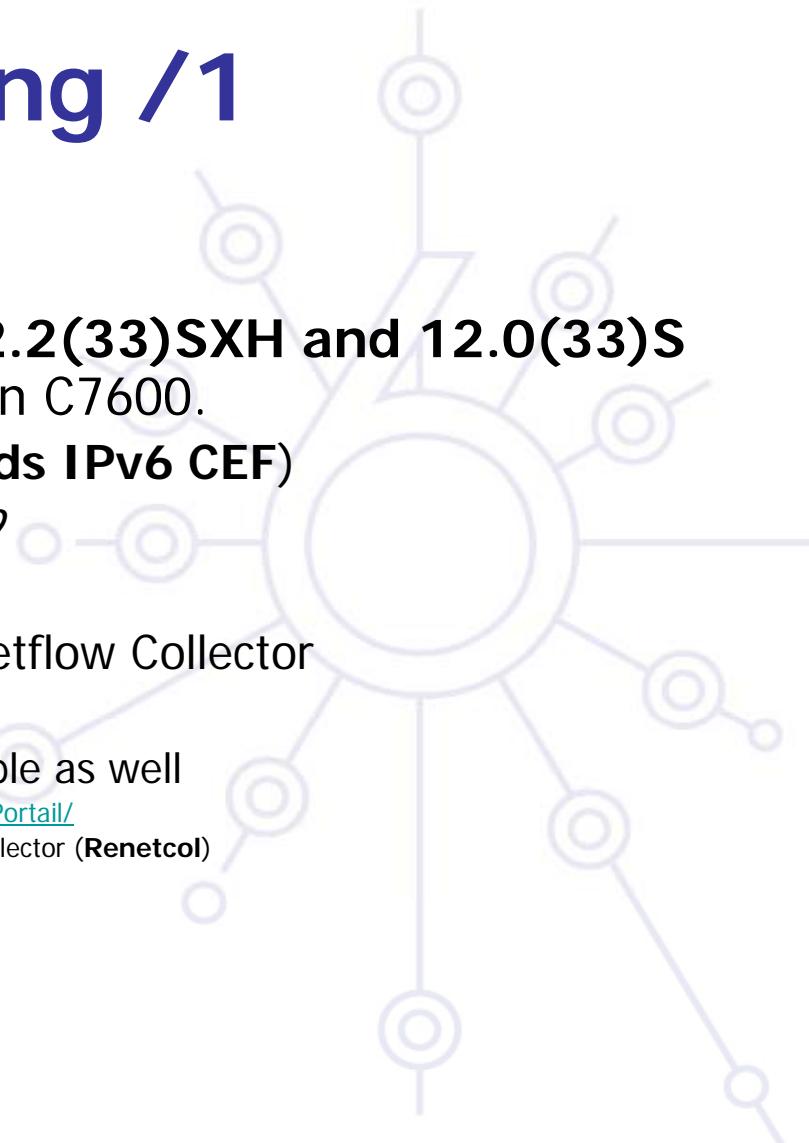
Example for Export Packet



IPv6 flow monitoring /1

Cisco

- Available in IOS 12.3(7)T, **12.2(33)SXH** and **12.0(33)S** and later version. Available on C7600.
 - 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 ?

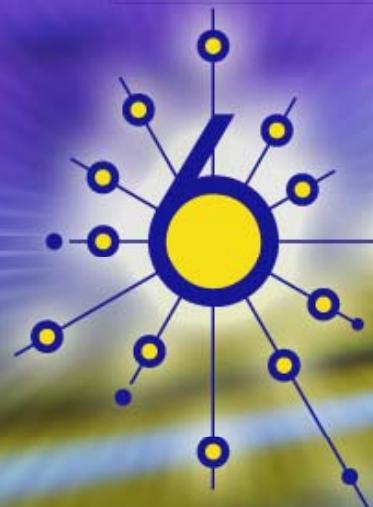
6WIND:

- Not available

Juniper:

- **Cflowd** (#Netflow)
- Flow tools





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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** : plan to support IPv6

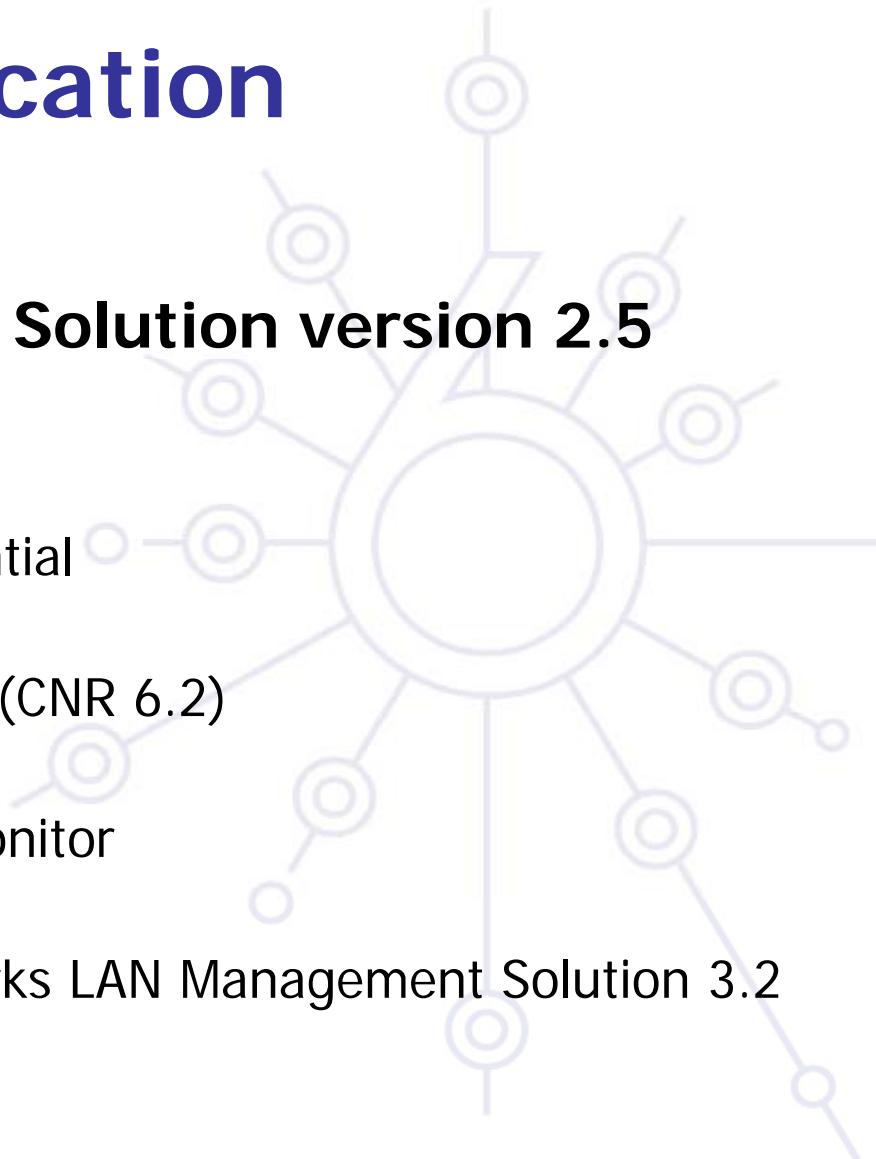
Cisco: LMS Application supports IPv6

LMS: LAN Management Solution version 2.5

Includes :

- Campus Manager 4.0.3
- Resource Manager Essential
- CiscoView version 6.1
- Cisco Network Registrar (CNR 6.2)
- Device Fault Manager
- Internet Performance Monitor
- Common services

Current Version: CiscoWorks LAN Management Solution 3.2



« Top ten » ...

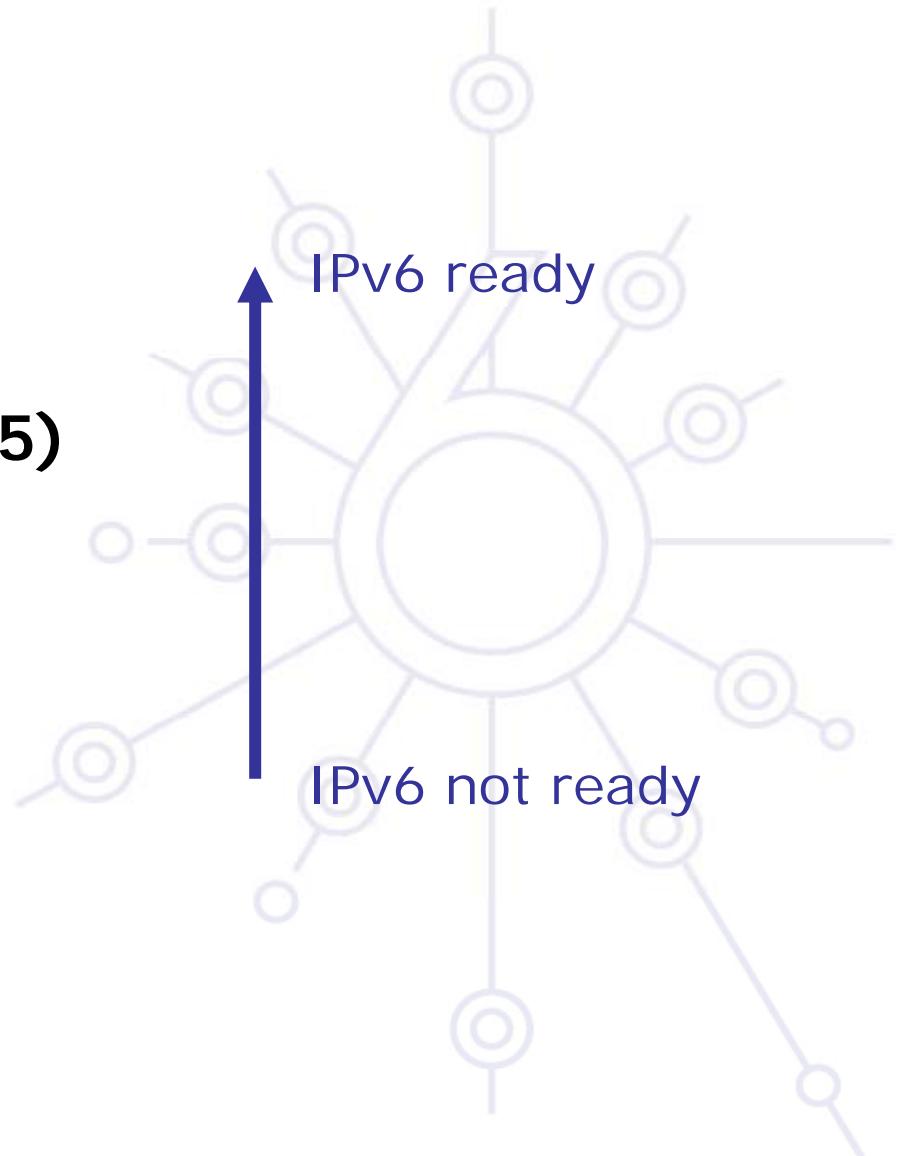
HP Openview

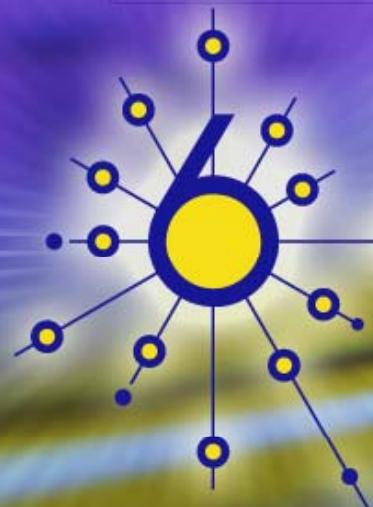
Ciscoworks 2000 (LMS 2.5)

IBM Netview

Infovista, Tivoli

...





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Monitoring tools

6Net and IPv6 monitoring tools

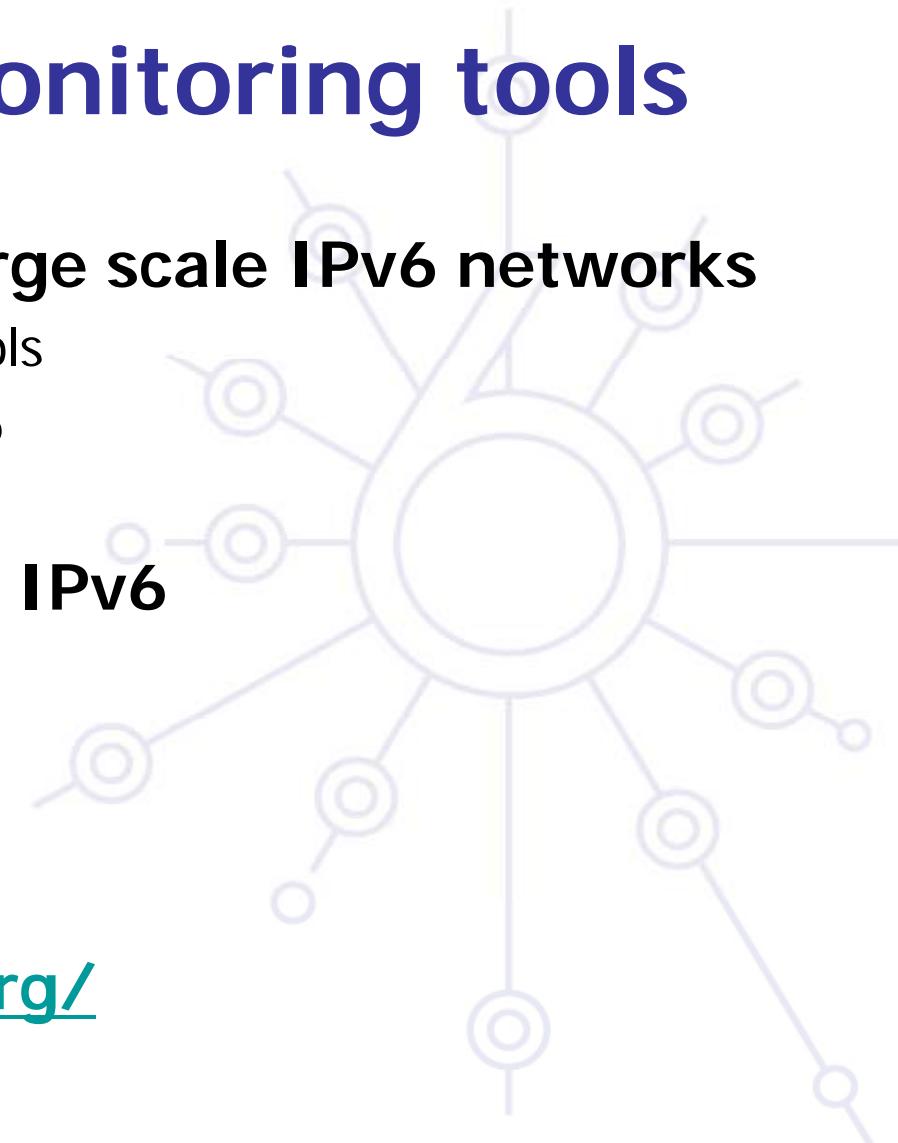
6Net WP6 : managing large scale IPv6 networks

- Tests lots of IPv6 ready tools
- Many others ported to IPv6

30+ monitoring tools for IPv6

- Tested
- Implemented
- Documented

URL: <http://tools.6net.org/>

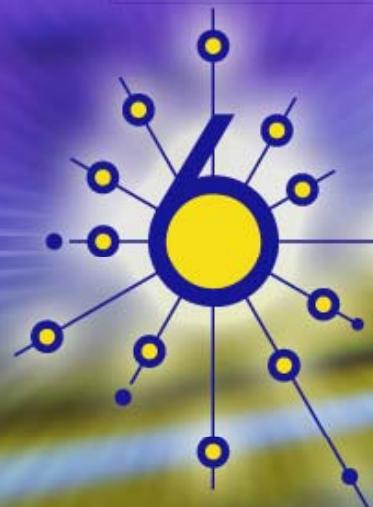


IPv6 monitoring tools - WANs

- **AS-path-tree** (<http://carmen.ipv6.tilab.com/ipv6/tools/ASpath-tree/>)
- **6NET looking glass** (<http://tools.6net.org> , <http://w6.loria.fr>)
- **IPflow** (<http://www.rrt.cr-picardie.fr/~fillot/nf6/>)
- **IPv6 support for netflow v9 in IOS**
(<http://www.cisco.com/go/netflow/>)
- **Mping** (<http://mping.uninett.no>)
- **RIPE TT server** (<http://www.ripe.net/ttm//ttm-ipv6.html>)
- **Cricket** (<http://cricket.sourceforge.net/>)
- **MRTG** (<http://people.ee.ethz.ch/~oetiker/webtools/mrtg/>)

IPv6 monitoring tools - LANs

- **Argus** (<http://argus.tcp4me.com>)
- **Ethereal** (<http://www.ethereal.com>)
- **Multicast Beacon** (<http://dast.nlanr.net/Projects/Beacon/> and <http://noc.man.poznan.pl/noc/> strony/aplikacje.html)
- **Pchar** (<http://www.employees.org/~bmah/Software/pchar>)
- **Iperf** (<http://dast.nlanr.net>)
- **Ntop** (<http://www.ntop.org>)
- **IPv6 management gateway** (<http://www.ipv6.man.poznan.pl>)
- **Nagios** (<http://www.nagios.org>)
- **Rancid** (<http://www.shrubbery.net/rancid/>)



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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>

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

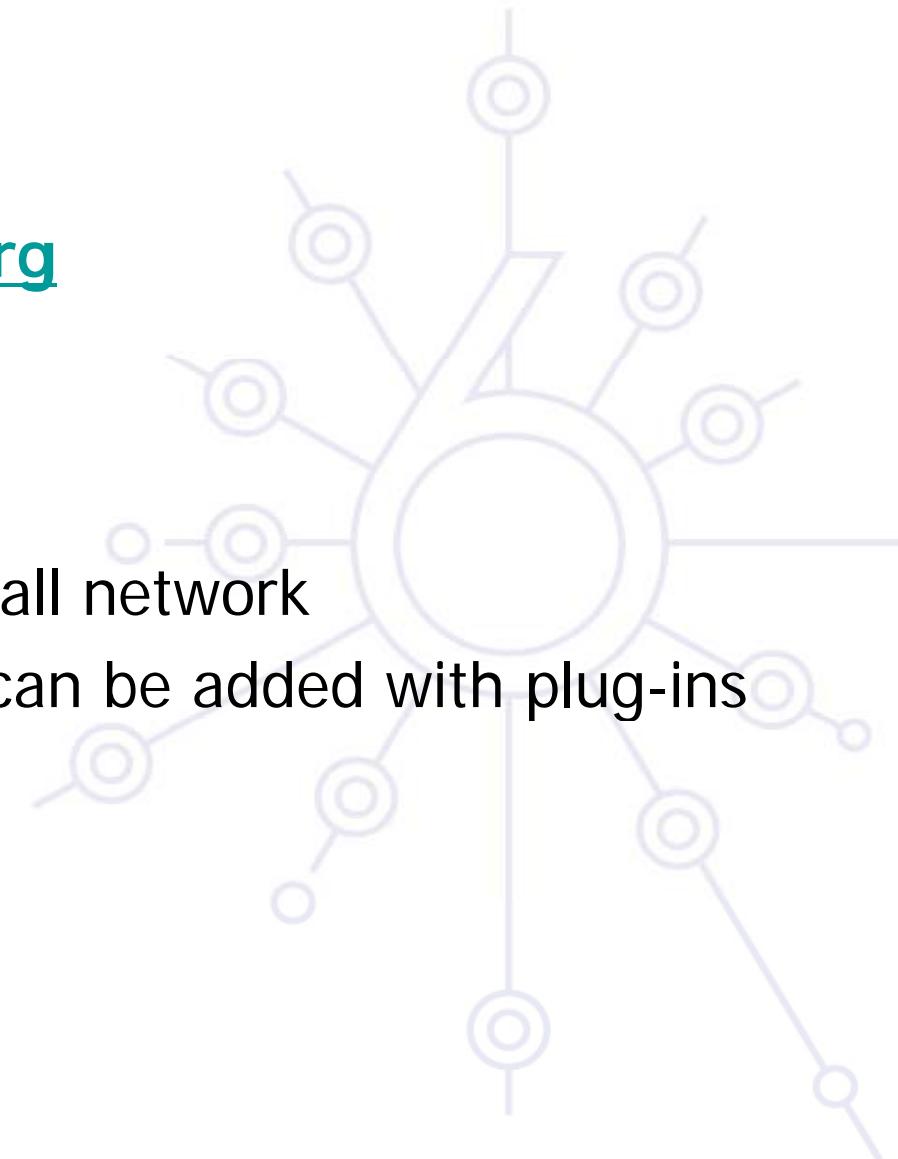
[Argus](#) 3.3

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

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](#)

Up	Down	Unreachable	Pending
1	1	0	0
All Problems	All Types		
1	2		

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-ipv8	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)

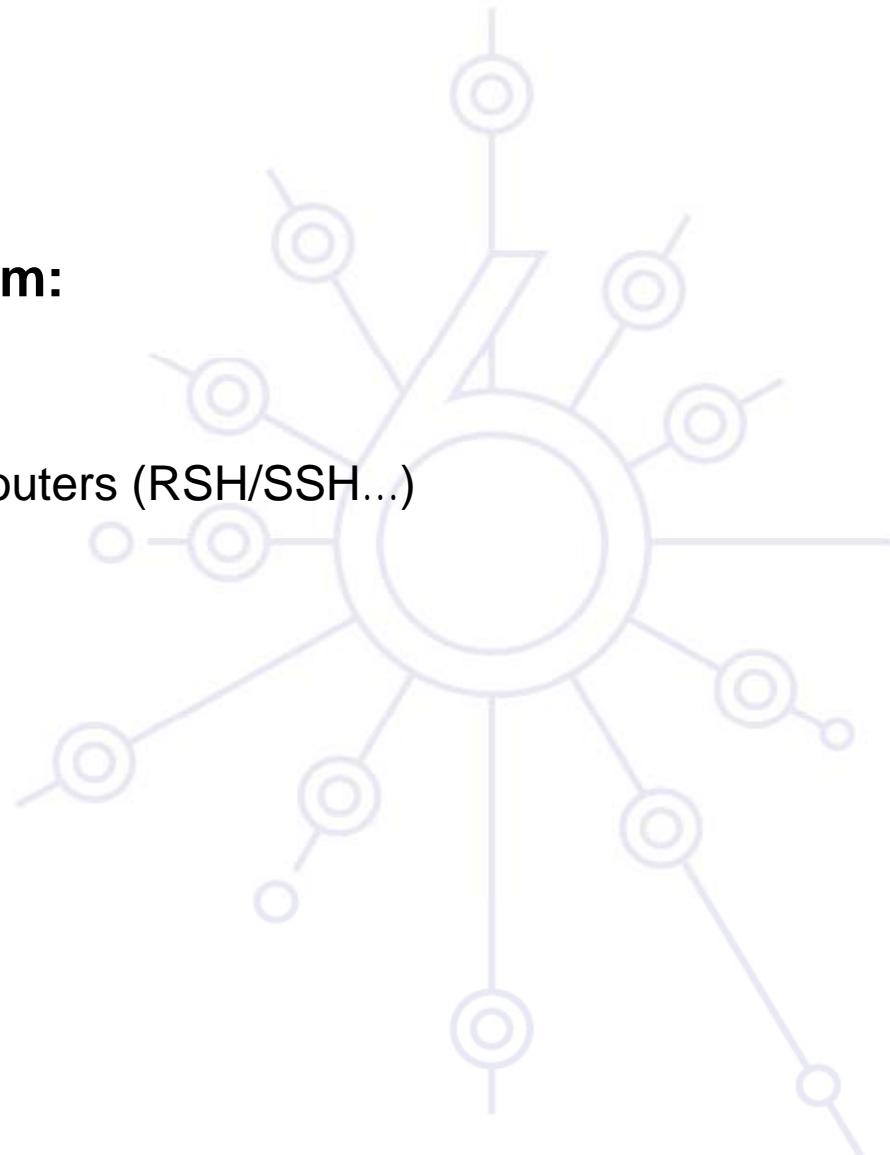
2 Matching Host Entries Displayed

ASpath-Tree

Display BGP4+ « topology » from:

- BGP4+ routing table
- Retrieved from connection to routers (RSH/SSH...)

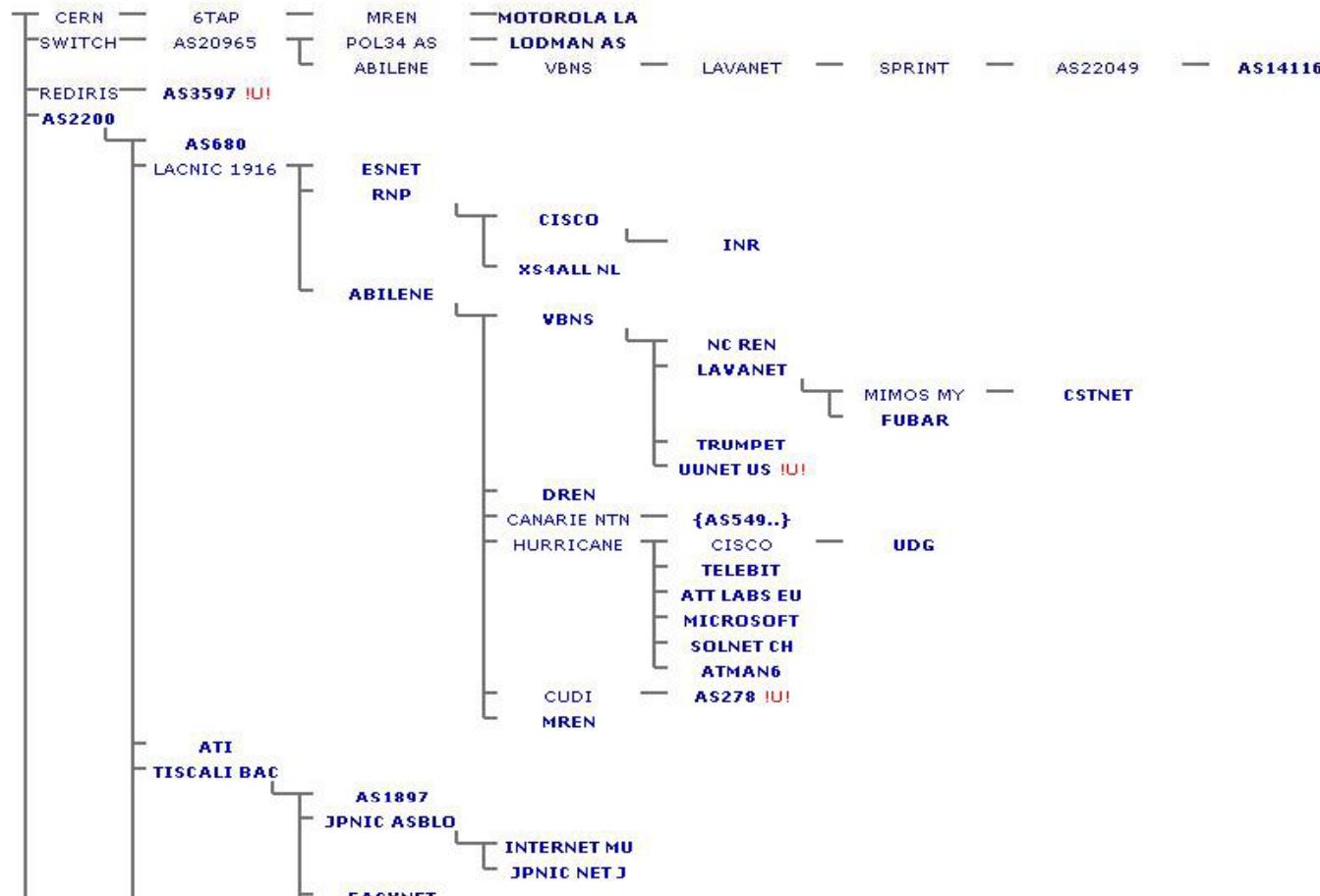
Generate HTML pages



ASpath-Tree

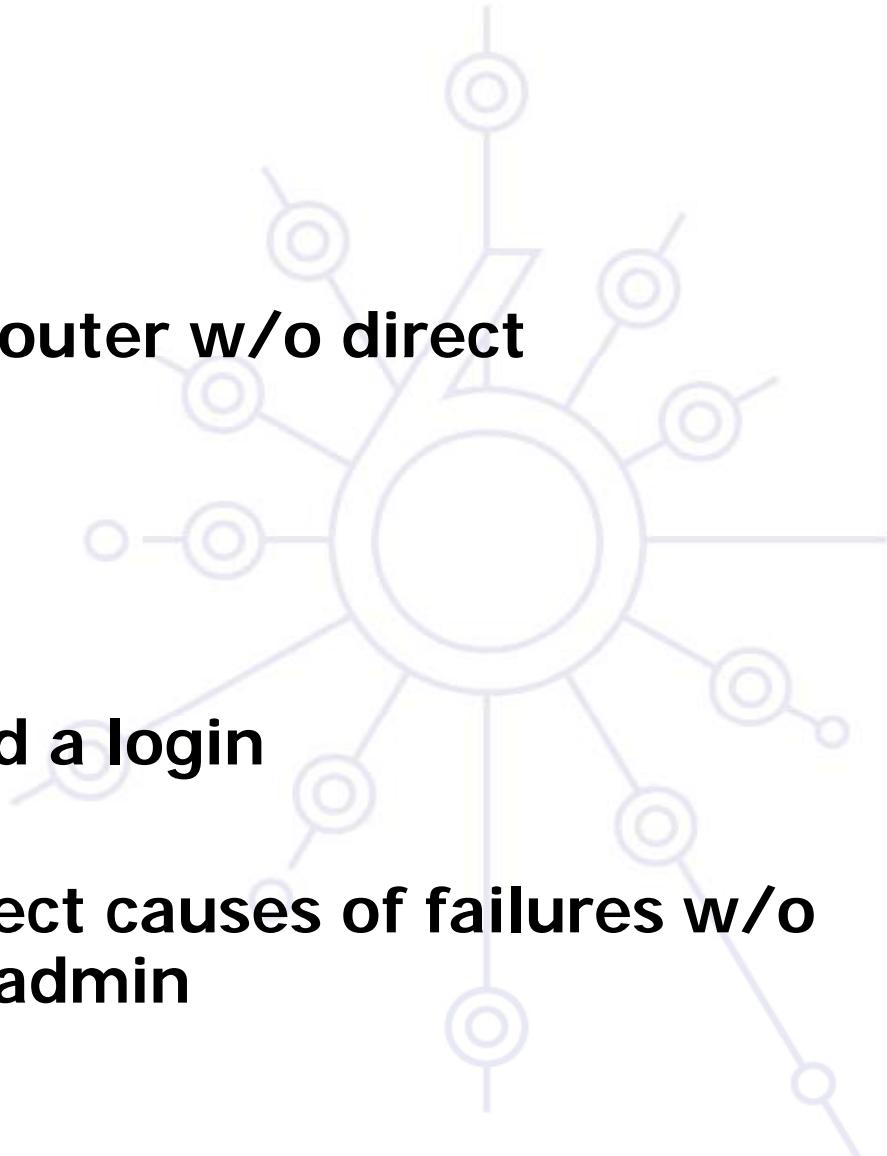
Renater The whole IPv6 BGP table

RENATER Project Network



Looking Glass

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



Looking Glass

RENATER Looking Glass

BGP tables

show bgp IPv6

BGP with regular expression

show bgp IPv6

regular expression :

Don't use the character "\$"

IPv6 traffic
 IPv6 interface
 IPv6 tunnels
 IPv6 neighbors
 IPv6 route

Ping XXXXX
 Traceroute XXXXX
 show ip bgp XXXXX
 show ip bgp summary
 show ip bgp dampening dampened-paths
 show ip mroute summary
 show ip mroute active
 show ip mbgp summary
 show ip mbgp XXXXX

IPv4 address . . .

IPv6 address

name address IPv4

name address IPv6

Router:

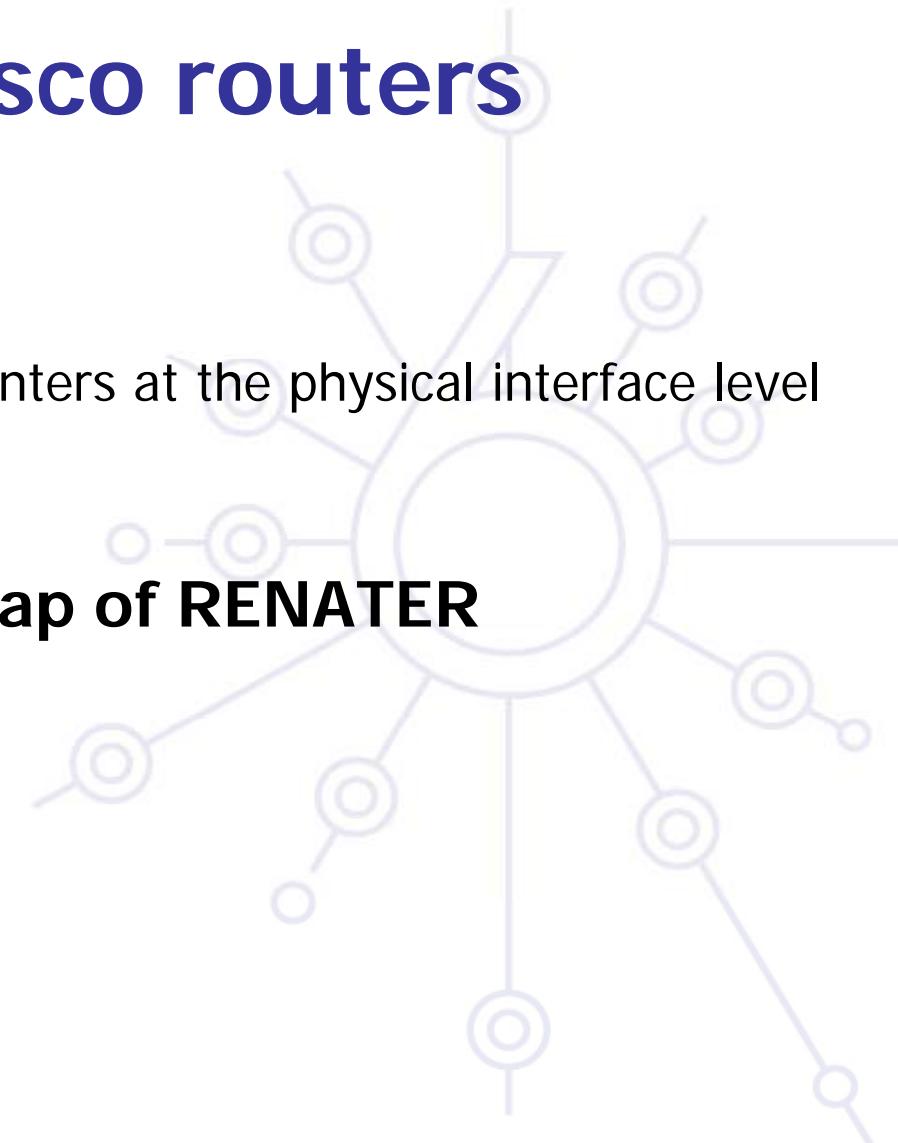
IPv6 traffic on Cisco routers

Based on CLI program

- "show interface accounting"
- Differentiate IPv4/IPv6 counters at the physical interface level

One query per hour

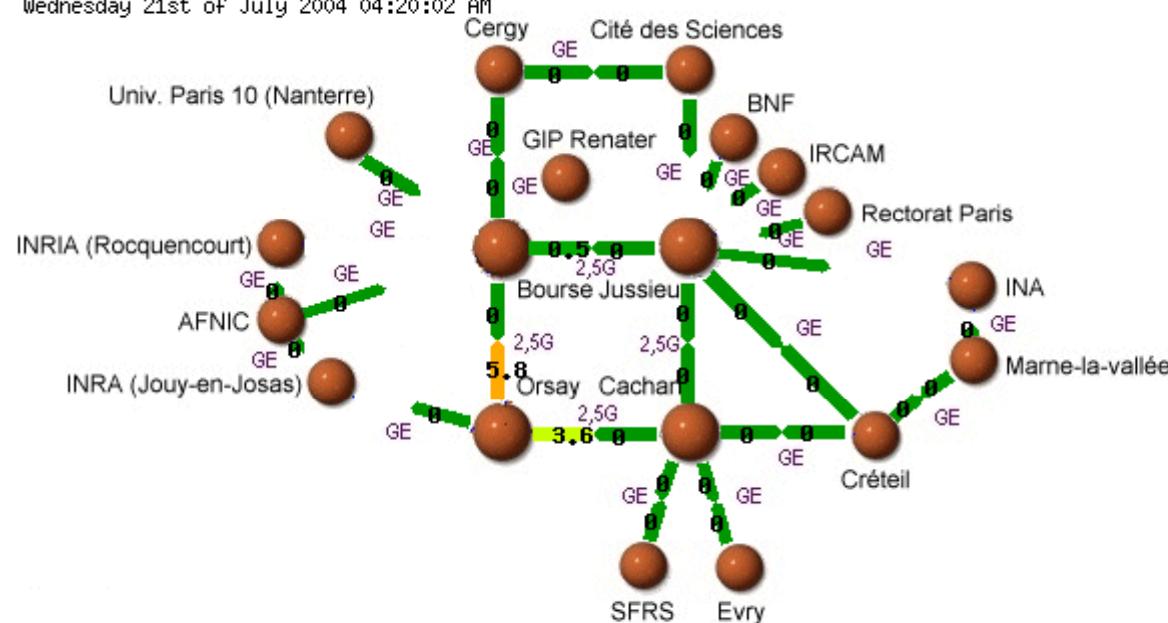
→ **IPv6 Weather Map of RENATER**



IPv6 traffic on Cisco routers

Renater network - IPv6 Weathermap

Wednesday 21st of July 2004 04:20:02 AM



Légende

- GE : liaison Ethernet 1 Gbit/s
- 2,5G : liaison 2,5 Gbit/s
- 10G : liaison 10 Gbit/s

Liens vers réseaux de collecte et sites:

- | | | |
|------|---|-----------------|
| 12.5 | 0 | NRI-A - NRI-B 1 |
| 8.8 | 0 | NRI-A - NRI-B 2 |
| 6.3 | 0 | NRI-A - NRI-B 3 |

- | | |
|---|------------------|
| 0 | . NRI-B - AKAMAI |
| 0 | NRI-B - GEANT |
| 0 | NRI-B - SFINX 1 |
| 0 | NRI-B - SFINX 2 |

Conclusion

**ISPs –and many 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, ...



