

IPv6 network management

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Philippe.Bereski@alcatel.fr
Simon.Muyal@renater.fr
Bernard.Tuy@renater.fr



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IPv6 Dissemination and Exploitation

Contributions

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



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IPv6 Dissemination and Exploitation

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



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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, ...)



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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



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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)



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IPv6 only networks

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

=> Need to identify the missing parts



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SSH/TELNET/TFTP...

Basic requirements to
manage a network



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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



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SNMP/MIBs and IPv6

- SNMP and IPv6
- IPv6 MIBs status
- Manufacturers implementations

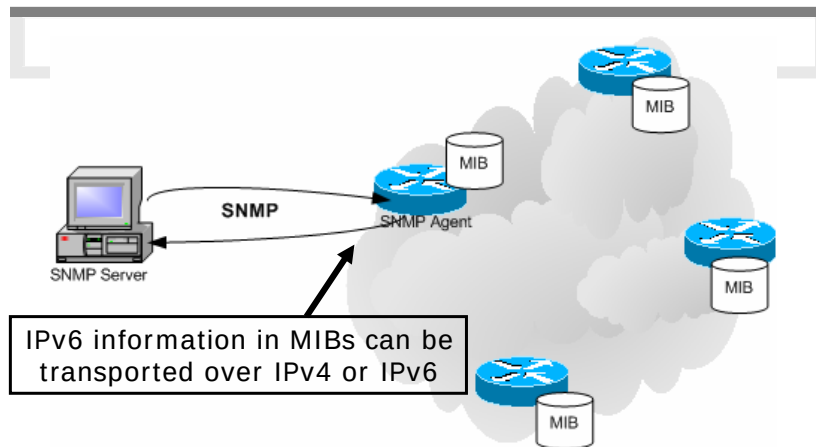


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SNMP model



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



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IPv6 MIBs /2

- Standardization status at IETF:

– At the beginning:

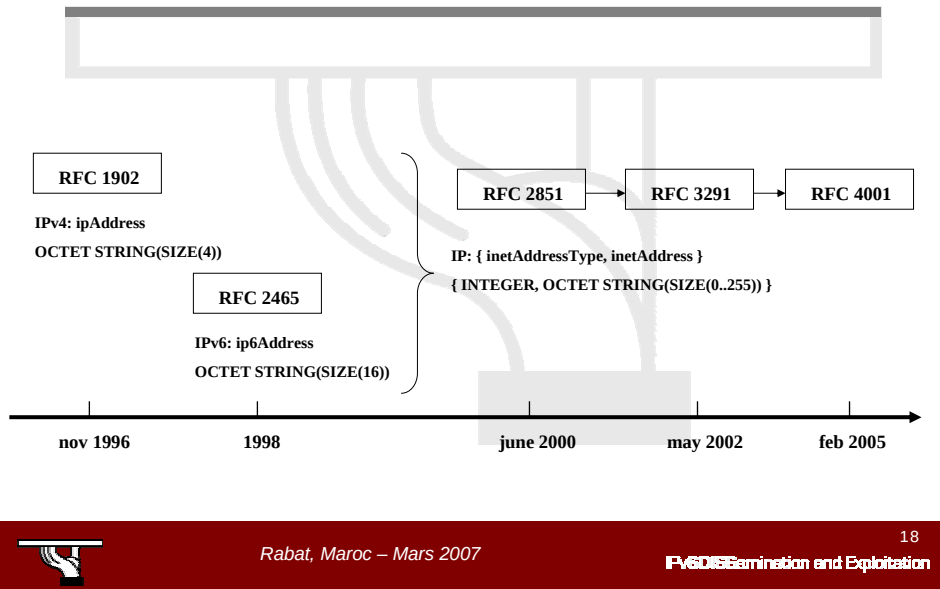
• IPv4 and IPv6 MIBs dissociated			
IPv4	IPv4	IPv6	IPv6
Textual Conventions	RFC1902	RFC2465	Definition of IP address format
IP MIB	RFC2011	RFC2466	
ICMP MIB		RFC2466	
TCP MIB	RFC2012	RFC2452	
UDP MIB	RFC2013	RFC2454	



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IPv6 MIBs /3



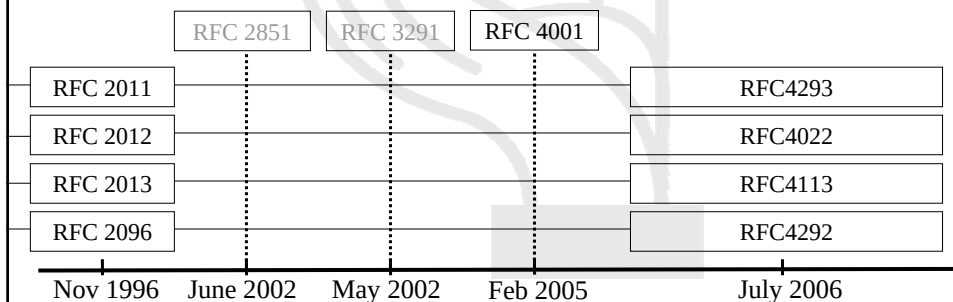
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IPv6 MIBs /4

■ Standardization status at IETF

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



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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 consider only IPv4 addresses:

- « *IMPORTS IpAddress* » → 32 bits



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IPv6 MIBs implementations



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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
 - ...



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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)



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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



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IPv6 MIBs Implementation and Exploitation

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.



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IPv6 MIBs Implementation and Exploitation

IPv6 MIBs implementation/4

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



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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



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IPv6 flow monitoring

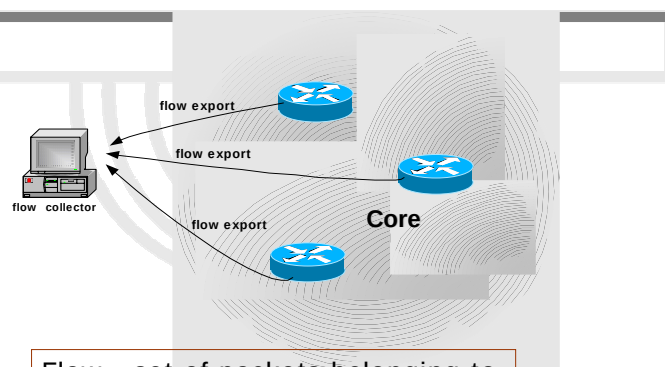


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Netflow & IPFIX model



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

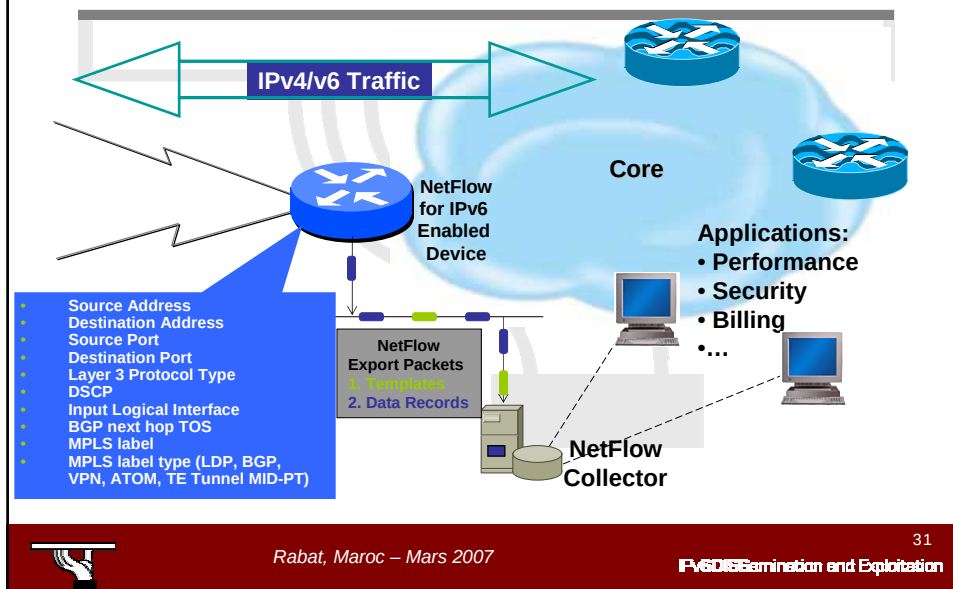


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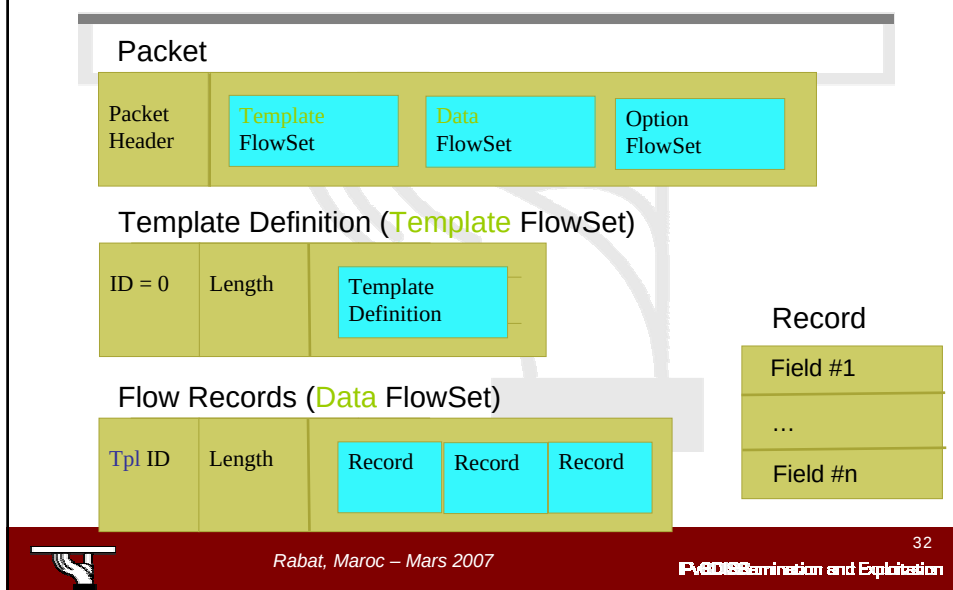
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NetFlow for IPv6



NetFlow Version 9



NetFlow Version 9 Example for Template Definition

Template A	Template B
Flow Set ID (0 for Template)	Flow Set ID (0 for Template)
Length of Template Structure	Length of Template Structure
1001	1002
(Template ID)	(Template ID)
3	4
(# of Fields)	(# of Fields)
SRC_AS_NUMBER	SRC_IP_PREFIX
2	4
DST_AS_NUMBER	SRC_AS_NUMBER
2	2
L4_PROTOCOL	PACKET_COUNT
2	2
	BYTE_COUNT
	2



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Example for Export Packet

Packet

As defined in the previous slide

Template ID for Template B

Packet Header	Template B	1002	2	1.1.1.1	2.2.1.1	Template A	1001	35
				20	64			
				365	20			
				92894	1000			
						Template A	1001	700
				23				
Number of Records for Template B		Record 1			Record 2			
Data for Template B		Data for Template A						



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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**)



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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)



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Commercial Management platforms



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Commercial platforms

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

- **HP-0V** 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 »



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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

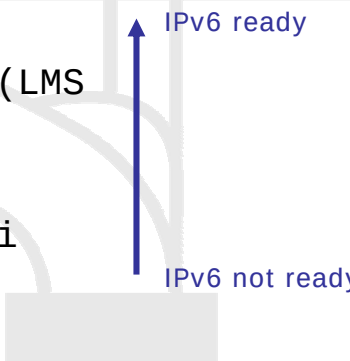


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« Top ten » ...

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



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Monitoring tools



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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/>



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Examples



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Pv6DISSEmination and Exploitation

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



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Pv6DISSEmination and Exploitation

Top-Servers-SIPA

name: Servers-SIPA
status: up

Name	Status
data-gw6_IPv4	up - TTL
data-gw6_IPv6	up - TTL
rem2_IPv4	up - TTL2 - router2
rem2_IPv6	up - TTL2 - router2

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

	start	elapsed time	% up	% downtimes	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	14:00:00	100.0	0.00	0
2 Days Ago	Sat 20 Nov 00:00:00 2004	14:00:00	100.0	0.00	0
This Month	Mon 1 Nov 00:00:00 2004	214:9:48:49	98.2%	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-gw6_IPv4
Thu 11 Nov 12:08:57 2004 down - TRANSITION - data-gw6_IPv6
Wed 13 Oct 17:13:44 2004 up - TRANSITION - data-gw6_IPv4
Wed 13 Oct 17:02:33 2004 down - TRANSITION - data-gw6_IPv6
Mon 13 Sep 11:28:39 2004 up - TRANSITION - rem2_IPv4

Agave 3.3

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Pv6Dissemination and Exploitation

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 ?

Host Status Totals

Up	Down	Unreachable	Pending
5	1	0	0

Service Status Totals

Ok	Warning	Unknown	Critical
1	0	1	3

Host Status Details For All Host Groups

Host	Status	Last Check	Duration	Status Information
192.168.1.1	DOWN	08-12-2003 15:28:43	148d 21h 58m 44s	binping -n -U -c 1 193.49.159.67
192.168.1.2	UP	08-12-2003 15:27:43	148d 21h 55m 22s	(Host assumed to be up)

2 Matching Host Entries Displayed

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Pv6DIS: Examination and Exploitation

ASpath-Tree

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

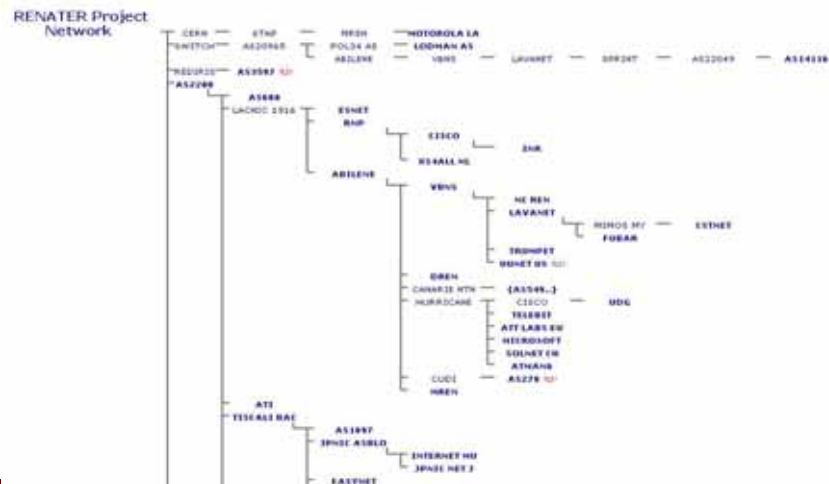
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Pv6DIS: Examination and Exploitation

ASpath-Tree

Renater The whole IPv6 BGP table

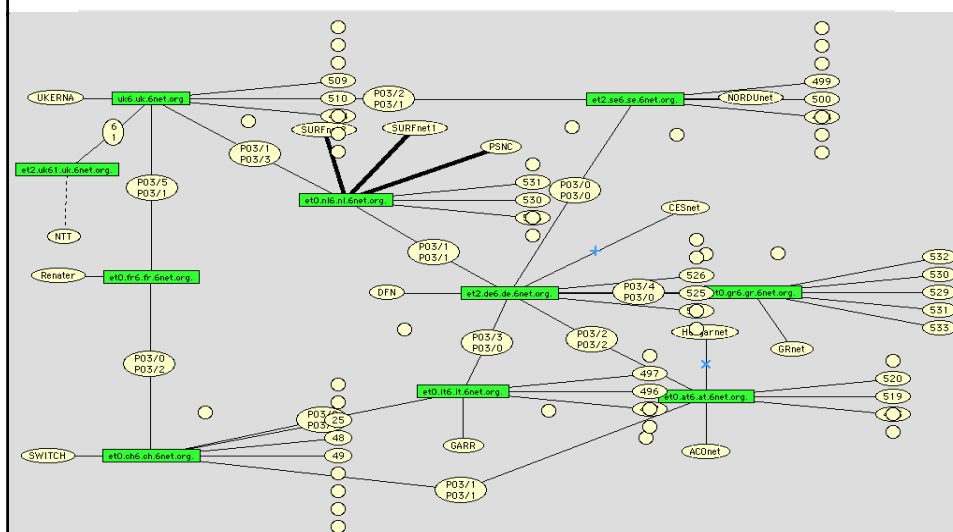


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Py6DISSEmination and Exploitation

Intermapper



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PyODSS Examination and Exploitation

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



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Pv6DISSEmination and Exploitation

Looking Glass

RENATER Looking Glass

BGP tables ☒ show bgp IPv6 routing table routing table summary neighbors	BGP with regular expression ☐ show bgp IPv6 regexp regular expression 2: Don't use the character "!"
☐ IPv6 traffic ☐ IPv6 interface ☐ IPv6 tunnels ☐ IPv6 neighbors ☐ IPv6 route	☐ Ping XXXX ☐ Traceroute XXXX ☐ show ip bgp XXXX ☐ show ip bgp summary ☐ show ip bgp dampening dampened-paths ☐ show ip mroute summary ☐ show ip mroute active ☐ show ip mibgp summary ☐ show ip mibgp XXXX ☐ IPv4 address: ☐ IPv6 address: ☐ name address IPv4: ☐ name address IPv6:
Router: Toulouse submit Reset	

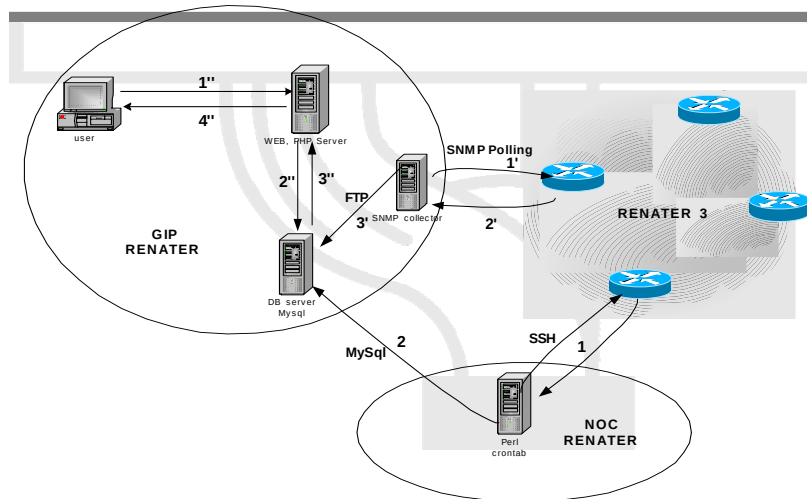


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Pv6DISSEmination and Exploitation

Inventory : interfaces & peerings

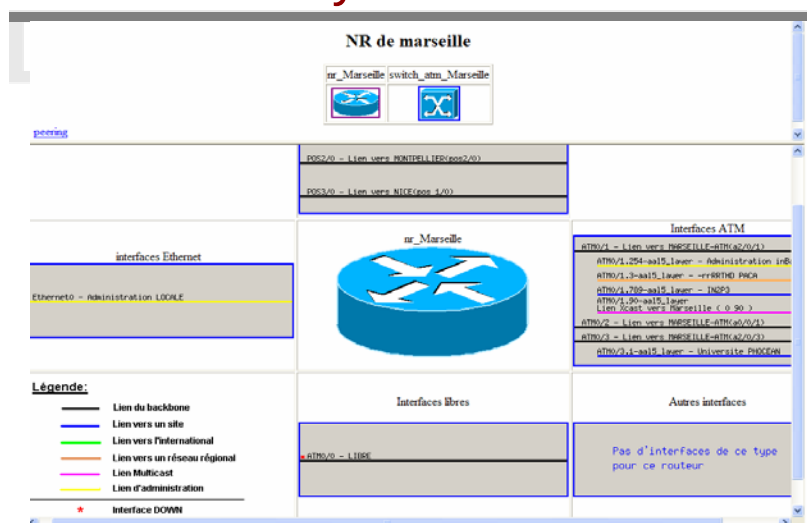


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Pv6088 Examination and Exploitation

Inventory: Interfaces



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Pv6088 Examination and Exploitation

Inventory: BGP Peerings

NR de PROJETS

PROJETS_GSR-NIO PROJETS_GSR-6NET PROJETS_7200-MCAST PROJETS_M5

surfaces

Routeur PROJETS_GSR-NIO

Peering BGP

peering iBGP

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 eBGP

Established	*** eBGP NRI-A RENATER3 ***	AS 2200 - FR-RENATER
Established	*** eBGP RENATER3 IPv4 ***	AS 2200 - FR-RENATER
Active	*** eBGP @IPS++ KWAK : demand@renater.fr ***	AS 65004 -
Active	*** eBGP @IPS++ PETRA : demand@renater.fr ***	AS 65004 -



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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

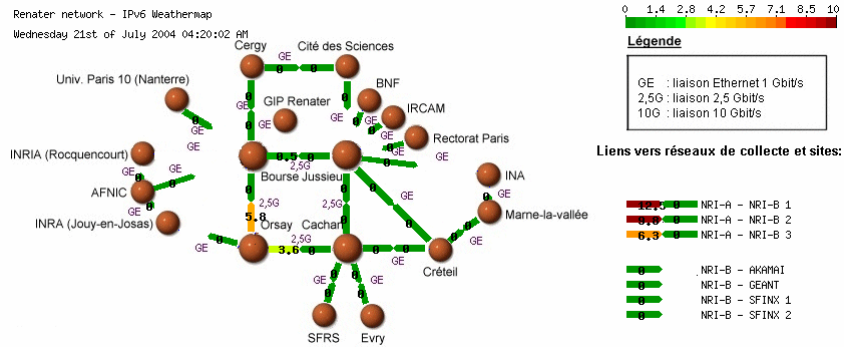


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IPv6 Examination and Exploitation

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IPv6 traffic on Cisco routers



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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 ?



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Retrieve this information ...

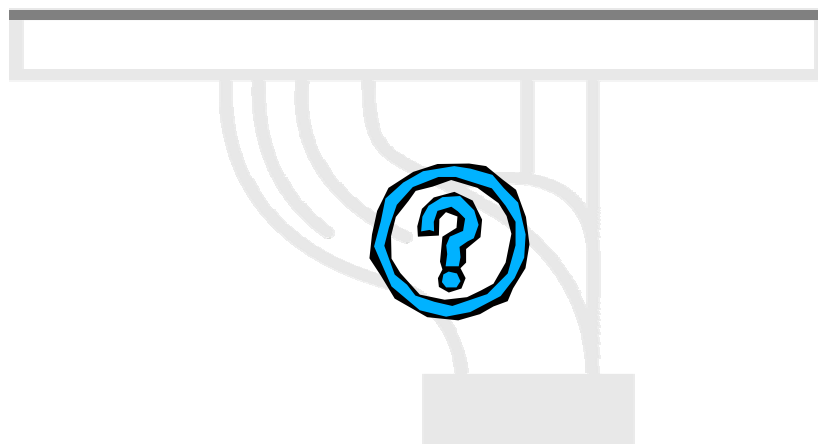
- <http://www.renater.fr> > users > training courses
 - > Presentations
- <http://www.renater.fr> > research & innovation > bibliographie
 - > Bibliography, RFCs, ...



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