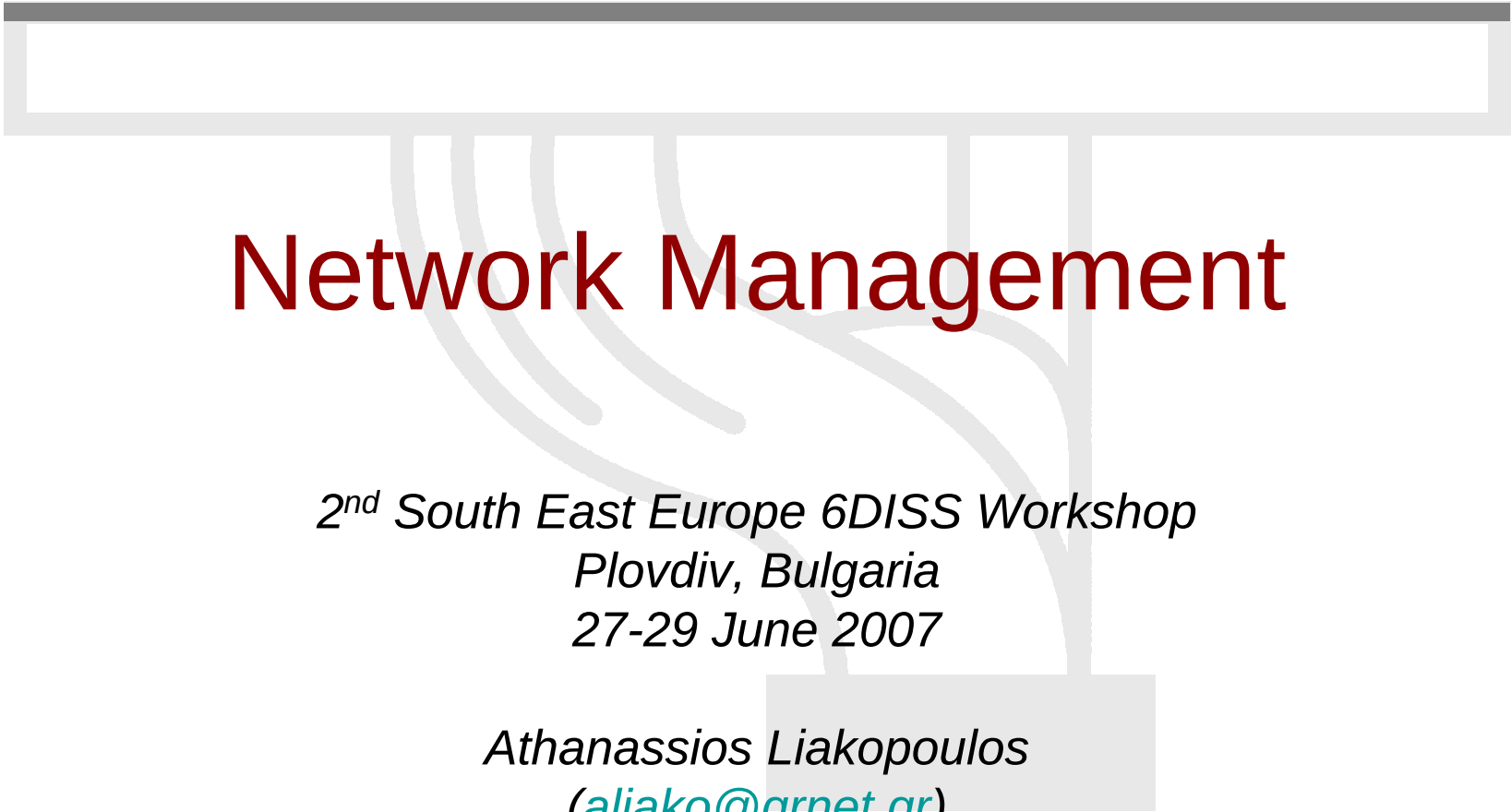




Network Management

*2nd South East Europe 6DISS Workshop
Plovdiv, Bulgaria
27-29 June 2007*

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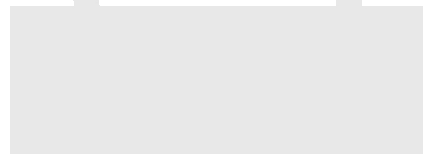
Outline

- Introduction
- Basic Network Management Protocols
- MIBs & IPv6 support
- Flow Monitor
- Management platforms and tools
- Conclusions



Introduction

- Network Management : What is about?
 1. Configuration
 2. Inventory
 3. Topology
 4. Fault
 5. Security
 6. Accounting
 - ...



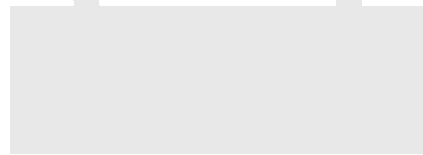
Introduction

- Deployed IPv6 networks
 - LANs (e.g. campuses, companies, ...), MANs, WANs (e.g. GÉANT, NRENs, IJ, NTT/Verio, Abilene, ...), IX's
 - Most are dual stack but there are few IPv6-only networks
 - Testbed, pilot networks, production networks
 - In all cases, the appropriate management tools and procedures are required.
- Important to keep in mind
 - Dual stack network will not last for ever!
 - One IP stack should be removed ... eventually!
 - No reasons for network admins to face twice the amount of work



Dual stack IP networks

- Part of the monitoring can be done via IPv4
 - Connectivity to the equipment
 - Tools to manage the network, e.g. inventory, configurations, «counters», routing info, ...
- Remaining part (of monitoring) needs IPv6
 - MIBs with IPv6 support
 - NetFlow (v9)



IPv6-only networks

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

Need to identify the missing parts!



Outline

- Introduction
- **Basic Network Management Protocols**
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Basic Network Management Protocols

- SSH / TELNET

- Most commercial routers/systems supports them
- Periodic scripts can retrieve information from the routers over IPv6

- TFTP

- Software images/configuration can be transported over IPv6



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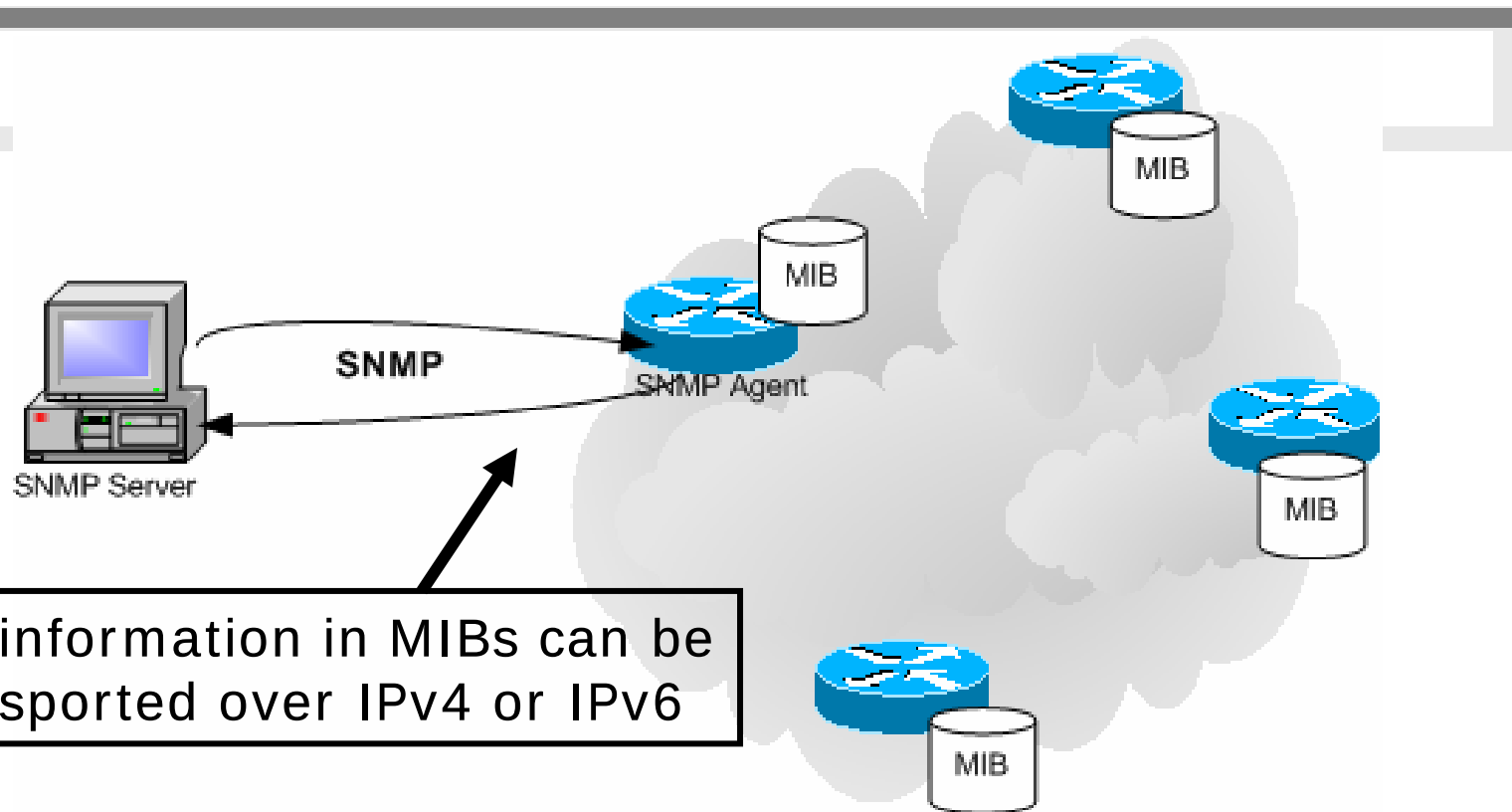


MIBs & IPv6 support

- SNMP over IPv6
- IPv6-related MIB status
- Implementation issues
 - Different levels of support; mixture of *private*, *IPv6-standard MIBs*, and *Unified MIBs*.



SNMP over IPv6



SNMP queries over IPv6 are supported by many vendors,
e.g. Cisco, Juniper, Hitachi, 6WIND



IPv6-related MIB status

- MIBs are essential for the network management
- SNMP-based applications are widely used but others applications may also be used, e.g. NetFlow, XML-based, ...
- SNMP rely upon MIBs ...
 - Necessity to have MIBs that collect IPv6 information as well as have MIBs reachable from an IPv6 address.



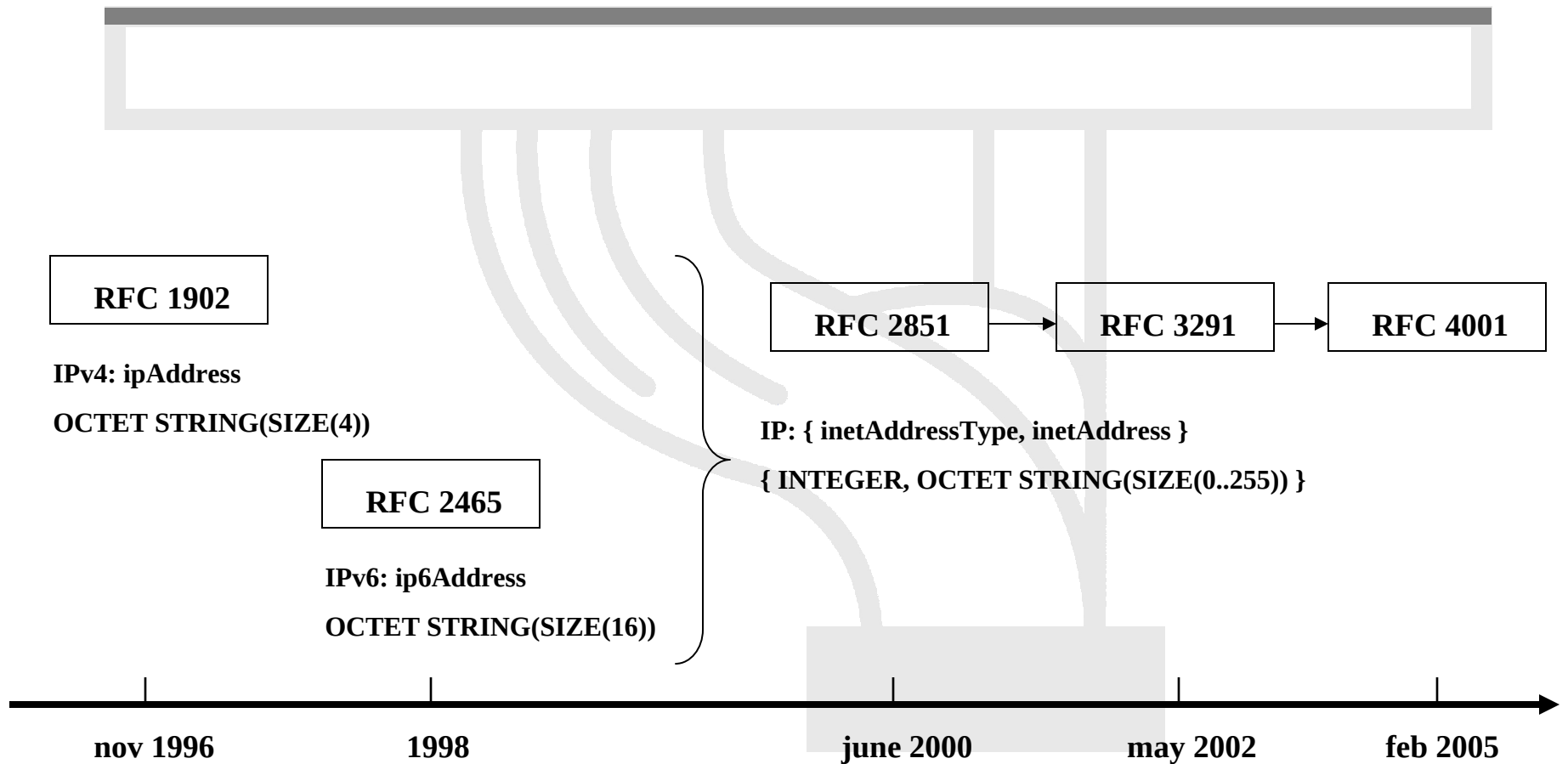
IPv6-related MIB status #2

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

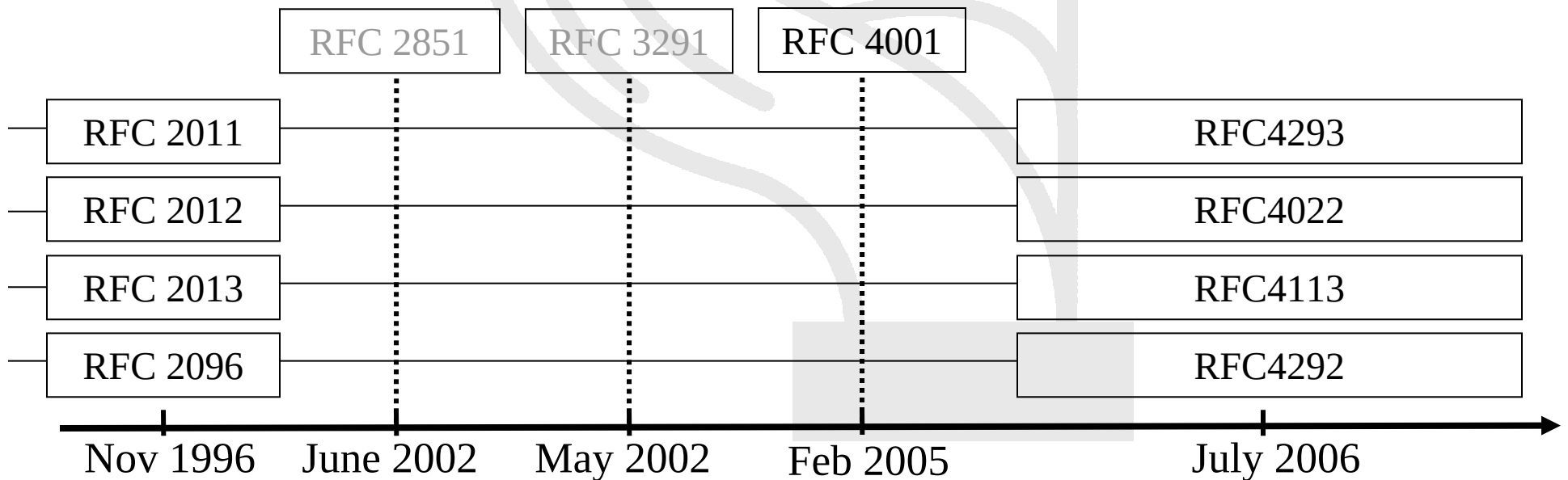


IPv6-related MIB status #3



IPv6-related MIB status #4

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



IPv6-related MIB status #5

- 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

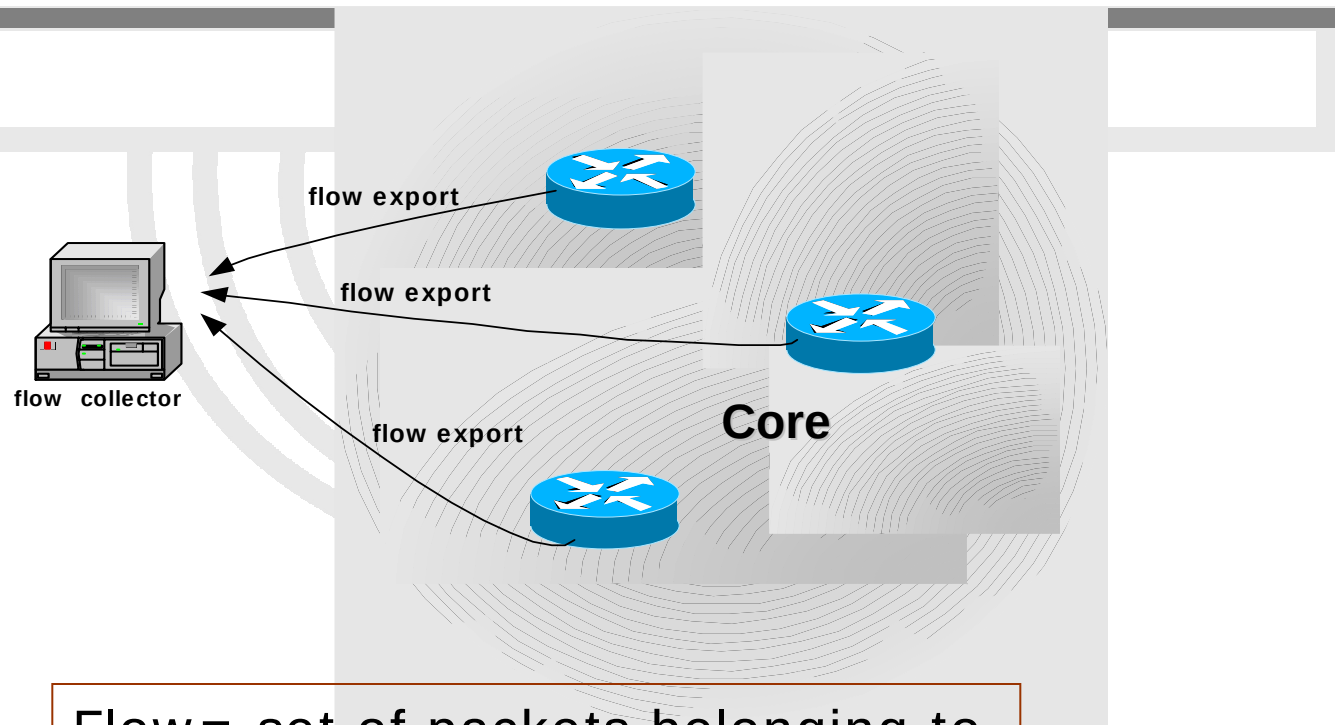


Outline

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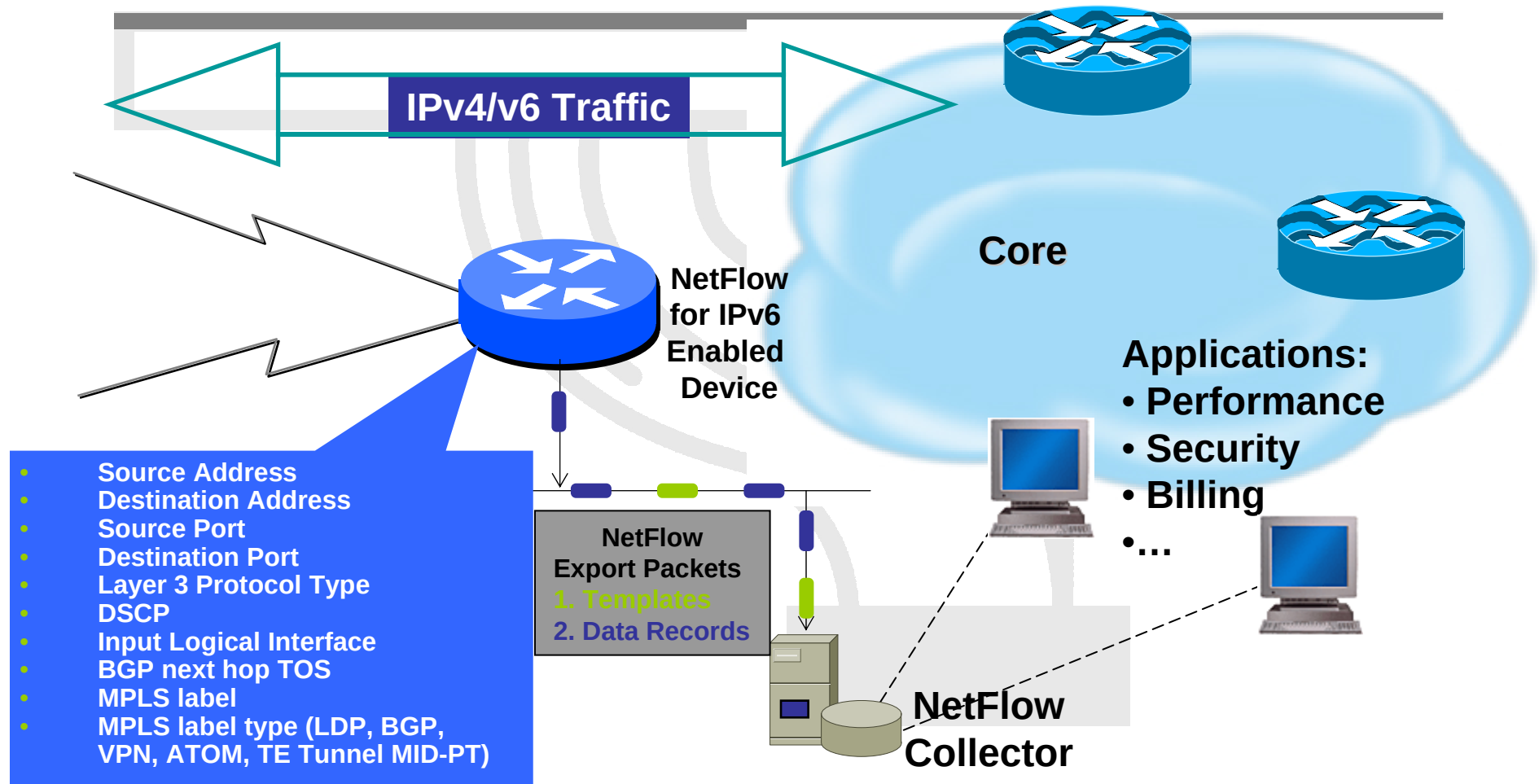
Netflow & IPFIX model



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



NetFlow ver.9 & IPv6



Netflow ver. 5/7/8 are *unable* to handle IPv6 packets



IPv6 flow monitoring

- Cisco
 - *Netflow v9*
 - IPv6 packets captured (needs IPv6 CEF)
 - Still uses *IPv4 transport*
 - May need to update your own Netflow collector
- Juniper:
 - *Cflow*
- Hitachi
 - Sflow (RFC 3176)



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Commercial platforms

- Commercial ISPs usually have integrated management platforms
 - **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** : (still?) «no IPv6 plans at the moment »
- NRENs mainly use *open-source* or *home-made* tools



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



Tools (routing, performance)

- AS Path Tree
 - Displays inter-domain network "topology" using BGP routing table
 - <http://carmen.ipv6.tilab.com/ipv6/download.html/>
- Looking Glass
 - Collect information from network nodes without direct connection.
 - <http://w6.loria.fr/>
- Mping
 - A tool for collecting statistics for ping RTT/loss.
 - <http://mping.uninett.no/>
- RIPE Test Traffic Measurement Service
 - Monitor & diagnose network problems.
 - <http://www.ripe.net/ttm/>
- Open_Eye / Panoptis
 - Tool to detect and block DoS/DDoS attacks
 - <http://panoptis.sourceforge.net/>



Tools (monitor)

- Argus
 - A system and network monitoring application
 - <http://argus.tcp4me.com/>
- Nagios
 - A host, service and network monitoring program
 - <http://www.nagios.org/>
- Cricket
 - System for monitoring and visualizing network traffic.
 - <http://cricket.sourceforge.net/>
- MRTG & Weathermap
 - <http://netmon.grnet.gr/weathermap/>
- Wireshark / Ethereal
 - Network protocol analyzers
 - <http://www.wireshark.org/>
 - <http://www.ethereal.com/>



Tools (troubleshoot)

- iperf / pchar
 - Network performance tools
 - <http://dast.nlanr.net/Projects/Iperf>
 - <http://www.employees.org/~bmah/Software/pchar/>
- Multicast Beacon / dbeacon
 - Multicast tools that provides statistics and diagnostic information.
 - <http://dast.nlanr.net/Projects/Beacon/>
 - <http://dbeacon.innerghost.net/>
- ssm ping / asmping
 - Tools for troubleshooting multicast SSM/ASM.
 - <http://www.venaas.no/multicast/ssmping/>
- ntop
 - A network traffic probe that shows the network usage
 - <http://www.ntop.org/>

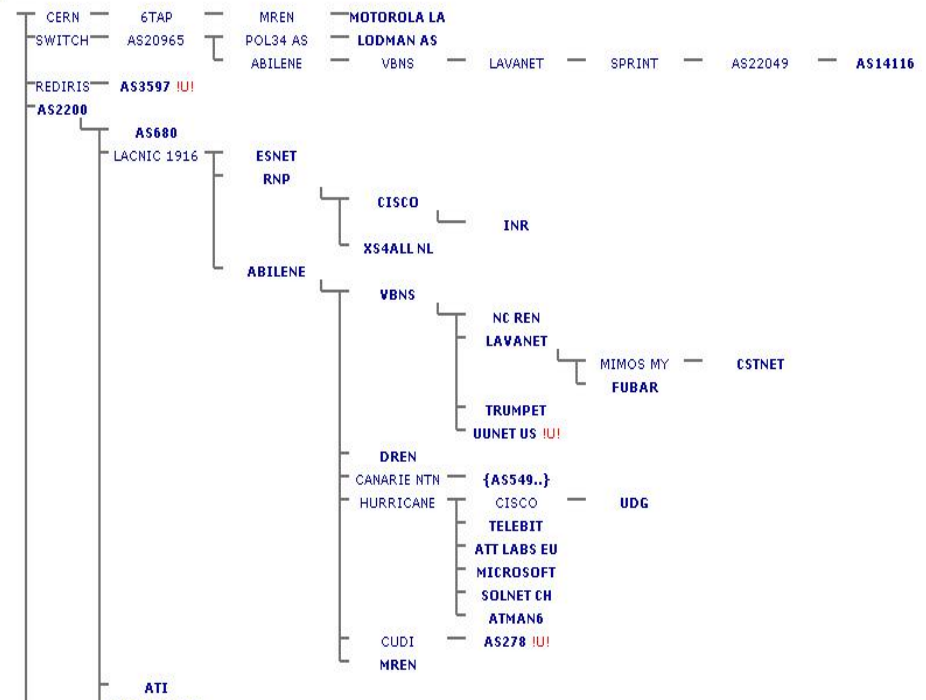


ASpath-Tree

- Displays inter-domain network "topology" collecting BGP routing table
- Automatic generation of HTML pages.

Renater The whole IPv6 BGP table

RENATER Project Network



<http://www.join.uni-muenster.de/bgp/bgp.html>

EASYNET



Looking Glass

- Get information from a router via a Web interface
- End user don't need to login to router
- Allows the user to detect causes of failures w/o asking the NOCs

Greek Research & Technology Network
MINISTRY of DEVELOPMENT
GENERAL SECRETARIAT for RESEARCH & TECHNOLOGY

GRNET Looking Glass (IPv4/IPv6)

Router:

- ☐ athens.gnet.gr
- ☐ athens-2.gnet.gr
- ☒ athens-3.gnet.gr
- ☐ ilissos.gnet.gr
- ☐ acropolis.gnet.gr
- ☐ athens.gnet.gr
- ☐ 6net.gnet.gr
- ☐ thessaloniki.gnet.gr
- ☐ thessaloniki-2.gnet.gr
- ☐ patra.gnet.gr
- ☐ patra-2.gnet.gr
- ☐ heraklio.gnet.gr
- ☐ heraklio-2.gnet.gr
- ☐ larissa.gnet.gr
- ☐ larissa-2.gnet.gr
- ☐ ioannina.gnet.gr
- ☐ ioannina-2.gnet.gr
- ☐ syros.gnet.gr
- ☐ xanthi.gnet.gr
- ☐ athens-1.gnet.gr

IPv4 Query:

- ☐ show ip route <ip address>
- ☐ show interface <interface>
- ☐ show ip ospf database external <ip address>
- ☐ show ip bgp <ip address>
- ☐ show ip bgp summary
- ☐ show ip bgp dampening dampened-paths
- ☐ show environment all
- ☐ show ip bgp dampening flap-statistics
- ☐ show ip mroute <ip address>
- ☐ show ip rpf
- ☐ show ip mbgp <ip address>
- ☐ show ip sdr
- ☐ show ip sdr detail
- ☐ show ip mshp sa-cache <as number>
- ☐ show ip mshp sum
- ☐ show ip mshp count
- ☐ show ip mshp peer <ip address>
- ☒ ping <ip address>

IPv6 Query:

- ☐ show ipv6 route <ipv6 address>
- ☐ show ipv6 interface <interface>
- ☐ show bgp ipv6 <IPv6 prefix network/length>
- ☐ show bgp ipv6 summary
- ☐ show bgp ipv6 flap-statistics
- ☐ ping ipv6 <ipv6 address>
- ☐ trace ipv6 <ipv6 address>

MPLS Query:

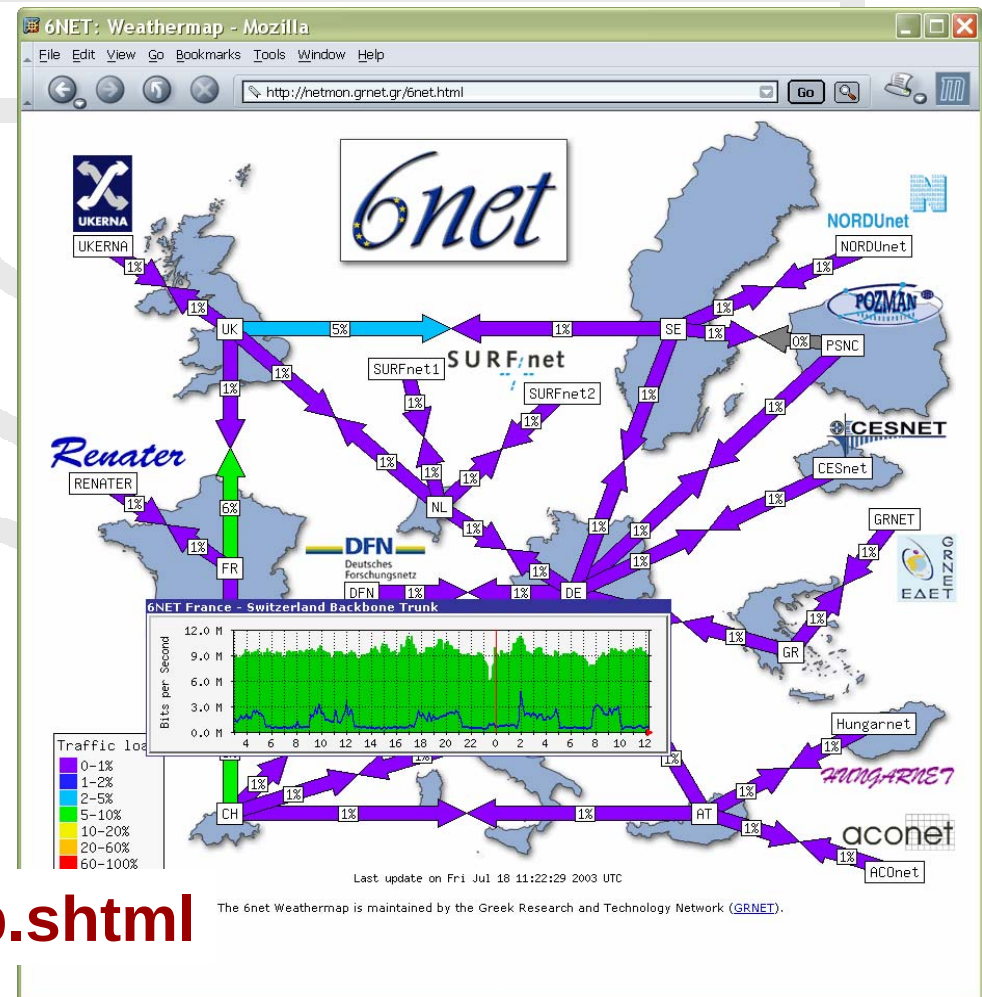
- ☐ show mpls l2transport vc
- ☐ show mpls l2transport vc detail
- ☐ show mpls forwarding-table <interface>
- ☐ show ip vrf
- ☐ show ip vrf detail
- ☐ show ip route vrf <VPN name>
- ☐ ping vrf <VPN name> <ip address>
- ☐ trace vrf <VPN name> <ip address>

<http://netmon.grnet.gr/lg.shtml>



Weathermap

- SNMP-based network traffic grapher
- Monitor the link utilisation



<http://netmon.grnet.gr/map.shtml>



2nd SEE 6DISS Workshop (Plovdiv, 27-29 June, 2007)

IPv6DISSemination and Exploitation

Argus

- Monitor network element status, (PCs, switches, routers, etc.), node availability, traffic, services, (http, ftp, dns, imap, smtp, etc)
- Easily extendible

Argus - Top:Serveurs-SIPA - Microsoft Internet Explorer

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

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

- Monitor services and networks
- Could be a complex tool for a small network
- New features can be added with plug-ins, e.g. BGP monitoring

The screenshot displays the Nagios web interface. On the left is a navigation menu with sections: General (Home, Documentation) and 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). The main content area includes:

- 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
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:**

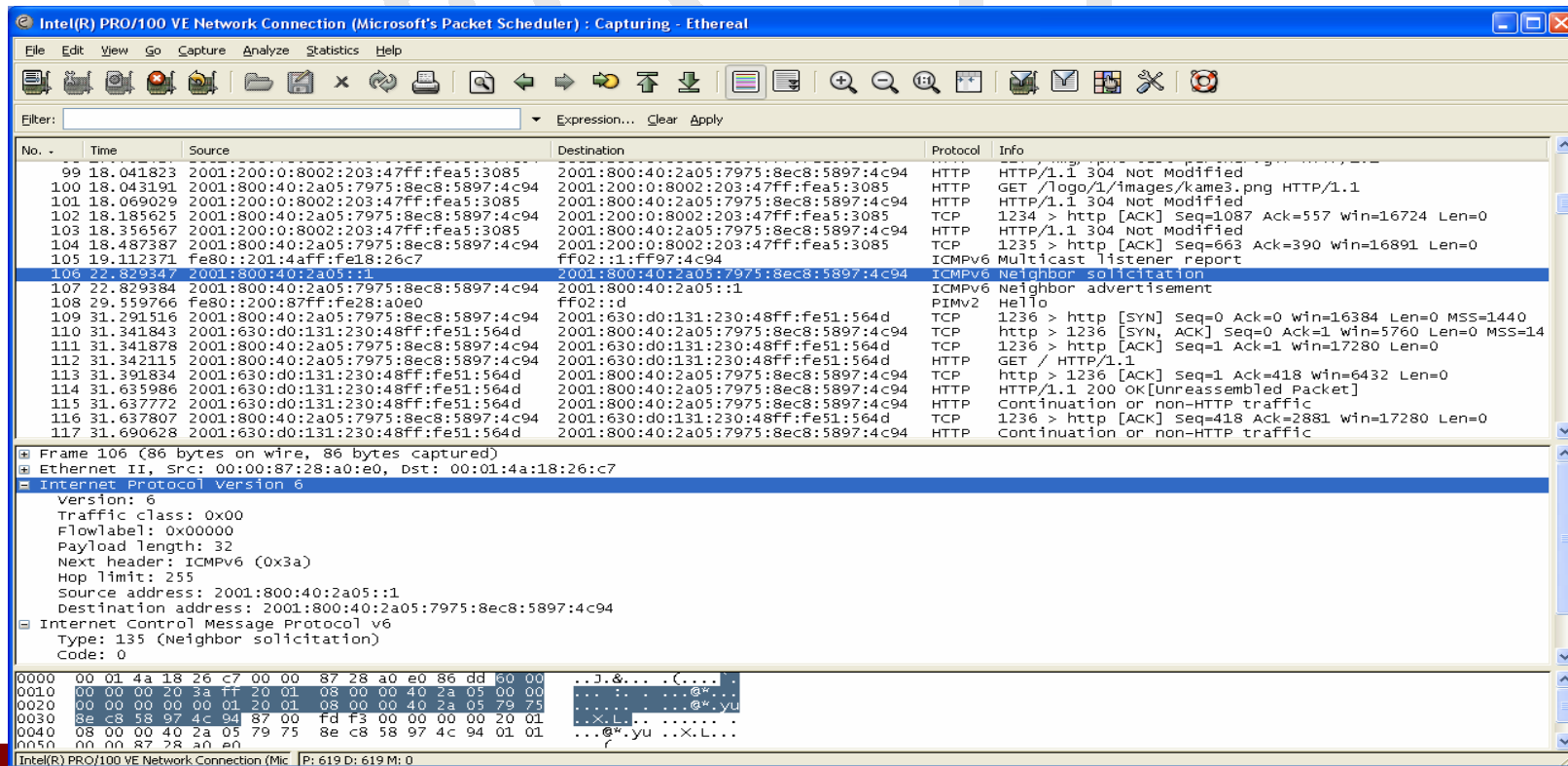
Host	Status	Last Check	Duration	Status Information
data-ipv6	DOWN	08-12-2003 15:26:43	148d 21h 58m 44s	/bin/ping -n -U -c 1 193.49.159.67
sem2	UP	08-12-2003 15:27:43	148d 21h 55m 22s	(Host assumed to be up)

2 Matching Host Entries Displayed



Wireshark / Ethereal

- Packet capturing tools
- Useful for connectivity and troubleshooting
- Available for most platforms



Multicast dbeacon

- Supports IPv4 and IPv6, ASM and SSM
- Written in C, light and easy to install
- No central server, ASM used for signaling

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S23	S24	S25
New York University	HS-MRD6 R1		12	12	9	6	13	4	7	8	8	7	5	8	7	5	6	5	5	9	7	7			
	R2	12			4		10	12	12		13	12	10	13	12	10	11	10		10	12		12		10
	CNR Pisa R3	12	14		10			12	12		13	12	10	13	12	11	11	10	10	10	12		12	10	10
6pack.org	R5	6	10		7		11	9	9		10	9	4	10	9	7	8	7	9	5	9		9	9	7
Internet2-Ann Arbor	R6	13	10		7			13	13		14	13	11	14	13	11	12	11	11	11	13		13	11	11
ITIN-IABG	R7	4	12	12	9	6	13		7	8	8	7	5	8	7	5	6	5	5	9	7	7			
RENATER	R8	7	12		5			7			4	3	5	4	3	5	6	5	5	5	3		3	5	5
emp1.switch.ch	R9	8	10	9	7		11	8	8		9	8	6	9	8	9	7	6	8	8	8	9	8	8	6
Phocean	R10	8	13		6			8	4			4	6	5	4	6	7	6	6	6	4		4	6	6
canet.u-strasbg.fr	R11	7	12	12	9	9	13	7	3	8	4		12	4	3	10	6	5	9	9	3	10	3	9	5
ssmping.uninett.no	R12	5	13		10	4	14	5	12		13	12		13	12	10	11	10	12	10	12		12	12	10
Universite-Paris13	R13	8	13		6			8	4		5	4	13		4	6	7	6	10	6	4		4	10	6
ITIN-Renater	R14	7	12	12	9	9	13	7	3	8	4	3	12	4		10	6	5	9	9	3	10	3	9	5
CESGA	R15	10	13	11	10	10	14	10	10	9	11	10	13	11	10		9	8	6	10	10	11	10	6	8
CESNET2	R17		11	12	8		12			8									11					11	
UC3M	R18	9	12		9	9	13	9	9	8	10	9	7	10	9	6	8	7		9	9		9	3	7
UofA-ERG	R19	9	10	12	7	5	11	9	9	8	10	9	10	10	9	7	8	7	9		9	6	9	9	7
IUT_Colmar	R20	7	12	12	9	9	13	7	3	8	4	3	12	4	3	5	6	5	9	9		10	3	9	5
ECS Southampton	R21	7	11	13	8	2	12	7	10	9	11	10	5	11	10	8	9	8	10	6	10		10	10	8
hadron.switch.ch	R22	9	11	10	8	9	12	9	9	2	10	9	12	10	9	10	8	7	9	9	9	10	9	9	7



ssmpping

- A tool for testing SSM multicast connectivity
- Behavior “similar” to unicast ping
- A server must run ssmppingd
- Sssping server replies with both unicast and multicast ssmpping replies

```
$ ssmpping -4 -c 5 ssmpping.beacon.ja.net
ssmpping joined (S,G) = (193.60.199.162,232.43.211.234)
pinging S from 158.38.63.22
  unicast from 193.60.199.162, seq=1 dist=16 time=39.331 ms
  unicast from 193.60.199.162, seq=2 dist=16 time=39.394 ms
  multicast from 193.60.199.162, seq=2 dist=16 time=43.905 ms
  unicast from 193.60.199.162, seq=3 dist=16 time=39.542 ms
  multicast from 193.60.199.162, seq=3 dist=16 time=39.547 ms
  unicast from 193.60.199.162, seq=4 dist=16 time=39.137 ms
  multicast from 193.60.199.162, seq=4 dist=16 time=39.142 ms
  unicast from 193.60.199.162, seq=5 dist=16 time=39.535 ms
  multicast from 193.60.199.162, seq=5 dist=16 time=39.539 ms

--- 193.60.199.162 ssmpping statistics ---
5 packets transmitted, time 5000 ms
unicast:
  5 packets received, 0% packet loss
  rtt min/avg/max/std-dev = 39.137/39.387/39.542/0.292 ms
multicast:
  4 packets received, 0% packet loss since first mc packet (seq 2)
  recvd
  rtt min/avg/max/std-dev = 39.142/40.533/43.905/1.958 ms
$
```



MonitoringToolsList - the 6NET WikiWikiWeb - Microsoft Internet Explorer

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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 ([IrrddToolSet](#))
- Java SNMP Programming Environments ([JavaSnmpProgrammingEnvironments](#))
- 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](#)
- NetSNMP ([NetSnmp](#))
- Netflow/IPFIX ([NetflowIpFix](#))
- Netflow: IPv6 Support for Netflow v9 in IOS ([NetFlowIos](#))
- Netflow: UTC collector ([NetFlowUtc](#))
- NMIS: Network Management Information System ([NmisTool](#))
- NTOP ([NtopTool](#))
- NTPv4: Meinberg Lantime ([NtpMeinberg](#))
- Open-eye: ([OpenEye](#))
- PCHAR ([PcharTool](#))
- Rancid ([RancidTool](#))
- SNMP Session ([SnmpSession](#))
- SNMP Proxy ([SnmpProxy](#))
- Lan Topology Discovery Service ([LanTopologyDiscoveryService](#))
- Polyphemus ([PolyphemusTool](#))
- Ripe NCC Test Traffic Tools ([RipeNccTestTrafficTools](#))
- Tunnel Trace ([TunnelTrace](#))
- Weathermap ([WeathermapTool](#))

the 6NET WikiWikiWeb Internet

Conclusions

- Management tools are absolutely needed in every IPv4/6 network
- Network engineers 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. However, question yourself ...
 - Are your management tools (used for IPv4 monitoring) available for IPv6 too ?
 - What do I need to stress to my favourite vendor to be ready and manage my IPv6 network ?



Questions?

Thanks for your attention!

Contact

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