



HAL
open science

NetFlow, RMON and Cisco-NAM deployment

Frédéric Beck

► **To cite this version:**

Frédéric Beck. NetFlow, RMON and Cisco-NAM deployment. [Technical Report] 2007, pp.27. inria-00169995v1

HAL Id: inria-00169995

<https://inria.hal.science/inria-00169995v1>

Submitted on 6 Sep 2007 (v1), last revised 2 Nov 2007 (v3)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



INSTITUT NATIONAL DE RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE

NetFlow, RMON and Cisco-NAM deployment

Frédéric Beck

N° ????

August 2007

Thème COM

A large blue rectangular area containing the text 'Rapport technique' in a white serif font. To the left of the text is a large, stylized, light grey 'R' logo. A horizontal grey line is positioned below the text.

*Rapport
technique*



NetFlow, RMON and Cisco-NAM deployment

Frédéric Beck

Thème COM — Systèmes communicants
Projet MADYNES

Rapport technique n° ???? — August 2007 — 24 pages

Abstract: In this report, we present the deployment of NetFlow, RMON and the Cisco Network Analysis Module, Cisco-NAM, on the team testbed. First, we present the different technologies, and then we describe their deployment and how they were integrated in the teams testbed.

Key-words: IP, management, monitoring, network, netflow, rmon

Déploiement de NetFlow, RMON et le CISCO-NAM

Résumé : Dans ce rapport, nous présentons le déploiement de NetFlow, RMON et du module d'analyse de trafic CISCO-NAM sur le testbed de l'équipe. Nous présentons dans un premier temps les différentes technologies, avant de décrire toutes les étapes relatives à leur déploiement et intégration au testbed.

Mots-clés : IP, management, supervision, réseau, netflow, rmon

Contents

1	Introduction	5
2	Netflow	5
2.1	Protocol description	6
2.2	Network Flows	6
2.3	Netflow Record	6
2.4	Cisco's Sampled NetFlow	7
2.5	Versions	7
3	RMON	8
3.1	Overview	8
4	Cisco Network Analysis Module	10
4.1	Overview	10
4.2	NAM Network Interfaces	10
4.2.1	Analysis Module Interface	11
4.2.2	External NAM Interface	11
4.2.3	Internal NAM Interface	11
4.3	NM-NAM Operating Topologies and IP Address Assignments	11
4.3.1	Management Traffic	11
4.3.2	Monitored Traffic	12
5	Deployment	13
5.1	Testbed Architecture	13
5.2	NetFlow Deployment	14
5.2.1	Router Configuration	14
5.2.2	Collector Configuration	15
5.3	NM-NAM Deployment	16
5.3.1	Configuring the Analysis-Module Interface on the Router	17
5.3.2	Opening and Closing a NAM Console Session from the Router	18
5.3.3	Configuring the NAM	18
5.3.4	Configuring a Static Route to the NAM Through the Analysis-Module Interface	19
5.3.5	Enabling NAM Packet Monitoring	20
5.3.6	Enabling and Accessing the NAM Traffic Analyzer	21
5.3.7	Accessing the NAM Traffic Analyzer	21
5.4	RMON Deployment	21
5.4.1	SNMP Server	23
5.4.2	Configuring RMON support	23
6	Conclusion	23

List of Figures

1	Netflow Architecture	5
2	NAM Network Interfaces	10
3	Testbed Architecture	13
4	Ntop - Add NetFlow Device	16
5	Ntop - NetFlow Hosts Summary	17
6	NAM Traffic Analyzer Overview	22

1 Introduction

In this paper, we will present the deployment and configuration of Netflow [1] and RMON [4] on our testbed.

We will first present both technologies, and then present the configuration and deployment of each solution our testbed.

2 Netflow

NetFlow¹ is an open but proprietary network protocol developed by Cisco Systems to run on Cisco IOS-enabled equipment for collecting IP traffic information.

Figure 1 shows an architecture of Netflow deployment.

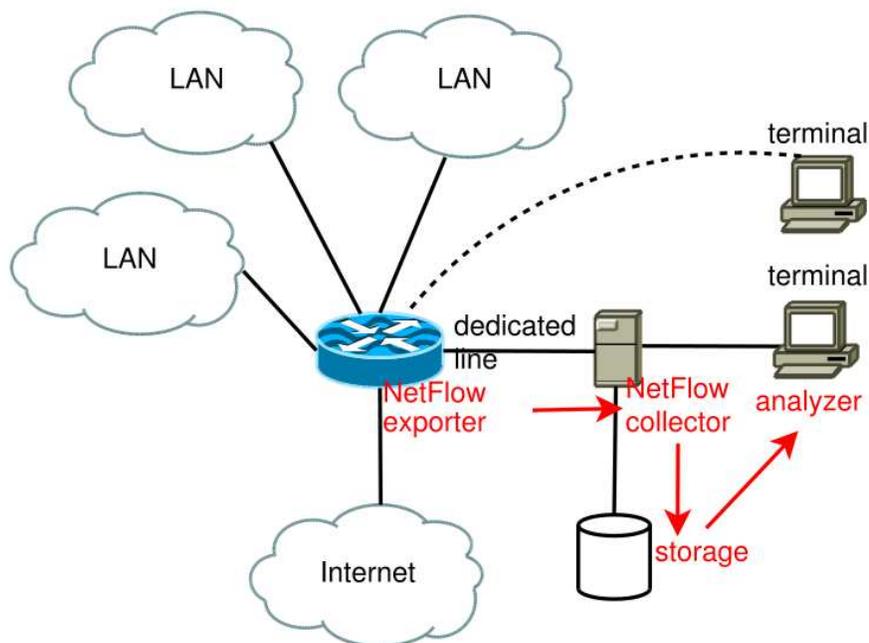


Figure 1: Netflow Architecture

¹Source:Wikipedia

2.1 Protocol description

Cisco routers that have the Netflow feature enabled generate netflow records; these are exported from the router in User Datagram Protocol (UDP) or Stream Control Transmission Protocol (SCTP) packets and collected using a netflow collector. Juniper Networks provides a similar feature for its routers called Jflow . Huawei Technology routers also support the same technology, but call it NetStream.

2.2 Network Flows

Network flows have been defined in many ways. In the case of NetFlow, Cisco uses the common 5-tuple definition, where a flow is defined as a unidirectional sequence of packets all sharing all of the following 5 values:

1. Source IP address
2. Destination IP address
3. Source TCP port
4. Destination TCP port
5. IP protocol

The router will output a flow record when it determines that the flow is finished. It does this by flow aging: when the router sees new traffic for an existing flow it resets the aging counter. Also, TCP session termination in a TCP flow causes the router to expire the flow. Routers can also be configured to output a flow record at a fixed interval even if the flow is still ongoing. In Flexible NetFlow (FNF) an administrator could actually define flow properties on the router.

2.3 Netflow Record

A NetFlow record can contain a wide variety of information about the traffic in a given flow. NetFlow version 5 (one of the most commonly used versions, followed by version 9) contains the following:

- Version number
- Sequence number
- Input and output interface snmp indices
- Timestamps for the flow start and finish time
- Number of bytes and packets observed in the flow

- Layer 3 headers:
 - Source and destination IP addresses
 - Source and destination port numbers
 - IP protocol
 - Type of Service (ToS) value
- In the case of TCP flows, the union of all TCP flags observed over the life of the flow.

Some routers will also include the source and destination Autonomous System (AS) number, though this information can be inaccurate. NetFlow version 9 can include all of these fields and can optionally include additional information such as Multiprotocol Label Switching (MPLS) labels and IPv6 addresses and ports,

By analyzing flow data, a picture of traffic flow and traffic volume in a network can be built. The NetFlow record format has evolved over time, hence the inclusion of version numbers. Cisco maintains details of the different version numbers and the layout of the packets for each version.

NetFlow records are usually sent via a UDP or SCTP in newer software, and for efficiency reasons, the router does not store flow records once they are exported. Therefore, if the NetFlow record is dropped due to network congestion, it is lost forever – there’s no way for the router to resend it (this is correct for UDP NetFlow only). The IP address of the netflow collector and the port upon which it is listening must be configured on the sending router but is usually either on ports 2055, 9555, or 9995. NetFlow is also enabled on a per-interface basis to avoid unnecessarily burdening of the router’s CPU. NetFlow is generally based on the packets input to interfaces where it is enabled. This avoids double counting and saves work for the router. It also allows the router to export NetFlow records for dropped packets.

2.4 Cisco’s Sampled NetFlow

Maintaining NetFlow data can be computationally expensive for the router and burden the router’s CPU to the point where it runs out of capacity. To avoid problems caused by router CPU exhaustion, Cisco provides “Sampled NetFlow”. Rather than looking at every packet to maintain NetFlow records, the router looks at every *n*th packet, where *n* can be configured (as in Deterministic NetFlow, used on Cisco’s GSRs) or it is a randomly selecting interval (as used in Random Sampled Netflow, used on all other Cisco platforms). When Sampled NetFlow is used, the NetFlow records must be adjusted for the effect of sampling - traffic volumes, in particular, are now an estimate rather than the actual measured flow volume.

2.5 Versions

Different versions of Netflow exist:

v1 First try

v5 Most used version

v6 Encapsulation information

v7 Switch information

v8 Several aggregation forms

v9 Template Based, allowing many combinations

IPFIX aka v10; IETF Standardized NetFlow 9 with Enterprise fields and other community input

3 RMON

The Remote Network MONitoring (RMON) ² MIB was developed by the IETF to support monitoring and protocol analysis of LANs. The original version (sometimes referred to as RMON1 [3]) focused on OSI Layer 1 and Layer 2 information in Ethernet and Token Ring networks. It has been extended by RMON2 [2] which adds support for Network- and Application-layer monitoring and by SMON which adds support for switched networks. It is an industry standard specification that provides much of the functionality offered by proprietary network analyzers. RMON agents are built into many high-end switches and routers (such as those built by 3Com and Cisco).

3.1 Overview

An RMON implementation typically operates in a client/server model. Monitoring devices (commonly called "probes" in this context) contain RMON software agents that collect information and analyze packets. These probes act as servers and the Network Management applications that communicate with them act as clients. While both agent configuration and data collection use SNMP, RMON is designed to operate differently than other SNMP-based products:

- Probes have more responsibility for data collection and processing, which reduces SNMP traffic and the processing load of the clients.
- Information is only transmitted to the management application when required, instead of continuous polling.

In short, RMON is designed for "flow-based" monitoring, while SNMP is often used for "device-based" management. The disadvantage is that remote devices shoulder more of the management burden, and require more resources to do so. Some devices balance this trade-off by implementing only a subset of the RMON MIB groups (see below). A minimal

²Source: Wikipedia

RMON agent implementation could support only statistics, history, alarm, and event.

The RMON1 MIB consists of ten groups:

1. Statistics: real-time LAN statistics e.g. utilization, collisions, CRC errors
2. History: history of selected statistics
3. Alarm: definitions for RMON SNMP traps to be sent when statistics exceed defined thresholds
4. Hosts: host specific LAN statistics e.g. bytes sent/received, frames sent/received
5. Hosts top N: record of N most active connections over a given time period
6. Matrix: the sent-received traffic matrix between systems
7. Filter: defines packet data patterns of interest e.g. MAC address or TCP port
8. Capture: collect and forward packets matching the Filter
9. Event: send alerts (SNMP traps) for the Alarm group
10. Token Ring: extensions specific to Token Ring

The RMON2 MIB adds ten more groups:

1. Protocol Directory: list of protocols the probe can monitor
2. Protocol Distribution: traffic statistics for each protocol
3. Address Map: maps network-layer (IP) to MAC-layer addresses
4. Network-Layer Host: layer 3 traffic statistics, per each host
5. Network-Layer Matrix: layer 3 traffic statistics, per source/destination pairs of hosts
6. Application-Layer Host: traffic statistics by application protocol, per host
7. Application-Layer Matrix: traffic statistics by application protocol, per source/destination pairs of hosts
8. User History: periodic samples of user-specified variables
9. Probe Configuration: remote config of probes
10. RMON Conformance: requirements for RMON2 MIB conformance

4 Cisco Network Analysis Module

In this chapter, we will summarize all the required informations from the different official Cisco documentations which permit to understand what is the Cisco Network Analysis Module and how it works.

4.1 Overview

The Network Analysis Module ³ (NM-NAM) is a network module installed in Cisco ⁴ routers that monitors and analyzes network traffic. The NAM Traffic Analyzer is software embedded in the NAM that gives you browser-based access to the monitoring features of the NAM. You use this software to troubleshoot and monitor network availability and health. This software runs on a Linux Distribution embedded in the NAM.

The NAM Traffic Analyzer can be access through a WEB interface. Nevertheless, it has strong requirements for the WEB browser used, as shown at <http://www.cisco.com/en/US/products/sw/cscowork/p>

4.2 NAM Network Interfaces

The NAM uses three interfaces for communication (see Figure 2):

1. Analysis Module Interface
2. External NAM Interface
3. Internal NAM Interface

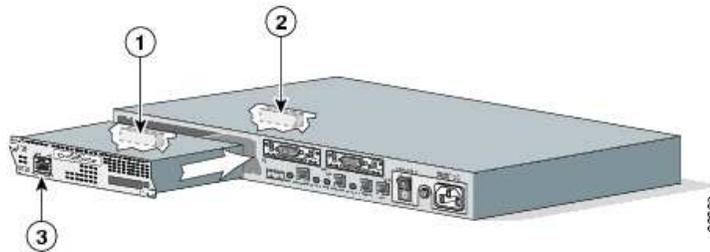


Figure 2: NAM Network Interfaces

³<http://www.cisco.com/go/nam>

⁴Images and text in this chapter are mainly from cisco.com WEB site

4.2.1 Analysis Module Interface

Use the Analysis-Module interface to access the NAM console for the initial configuration. After configuring the NAM IP parameters, use the Analysis-Module typically only during NAM software upgrades and while troubleshooting if the NAM Traffic Analyzer is inaccessible.

Visible only to the Cisco IOS software on the router, the Analysis-Module interface is an internal Fast Ethernet interface on the router that connects to the internal NAM interface. The Analysis-Module interface is connected to the router's Peripheral Component Interconnect (PCI) backplane, and perform all configuration and management of the Analysis-Module interface from the Cisco IOS CLI.

4.2.2 External NAM Interface

Use the external NAM interface to monitor LAN traffic. You can also select the external NAM interface as the management interface for the NAM.

Visible only to the NAM software on the NM-NAM, the external NAM interface is the Fast Ethernet interface on the NM-NAM faceplate. The external NAM interface supports data requests and data transfers from outside sources, and it provides direct connectivity to the LAN through an RJ-45 connector. You must perform all configuration and management of the external NAM interface from the NAM software.

4.2.3 Internal NAM Interface

Use the internal NAM interface for monitoring traffic that passes through router interfaces. You can also select the internal NAM interface as the management interface for the NAM.

Visible only to the NAM software on the NM-NAM, the internal NAM interface is the Fast Ethernet interface on the NM-NAM that connects to the Analysis-Module interface on the router. The internal NAM interface is connected to the PCI bus on the NM-NAM, and you must perform all configuration and management of the internal NAM interface from the NAM software.

4.3 NM-NAM Operating Topologies and IP Address Assignments

4.3.1 Management Traffic

Select either the internal or external NAM interface to handle management traffic such as IP, HTTP, SNMP, Telnet, and SSH. You cannot send management traffic through both NAM interfaces at the same time.

External NAM Interface for Management Traffic

If you select the external NAM interface to handle management traffic:

- For the Analysis-Module interface (in Cisco IOS CLI), we recommend that you use the IP unnumbered interface configuration to borrow the IP address of another router interface. The subnet does not need to be routable.
- For the NAM system (in NAM CLI), assign an IP address from the subnet that is connected to the external NAM interface.

Internal NAM Interface for Management Traffic

If you select the internal NAM interface to handle management traffic:

- For the Analysis-Module interface (in the Cisco IOS CLI), assign an IP address from a routable subnet. To conserve IP address space, you can configure the Analysis-Module as an IP unnumbered interface and borrow the IP address of another router interface, such as a Fast Ethernet or loopback interface. The borrowed IP address must come from a routable subnet.
- For the NAM system (in the NAM CLI), assign an IP address from the same subnet that is assigned to the Analysis-Module interface.

4.3.2 Monitored Traffic

It is possible to use either or both the internal and external NAM interfaces for monitoring traffic. The same interface can be used for both management traffic and monitored traffic simultaneously.

Internal NAM Interface - Monitor LAN and WAN Traffic

When you monitor traffic through the internal NAM interface, you must enable NAM packet monitoring on each router interface that you want to monitor. NAM packet monitoring uses Cisco Express Forwarding to send a copy of each packet that is received from or sent out of the router interface to the NAM.

Monitoring traffic through the internal NAM interface enables the NAM to see any encrypted traffic after it is decrypted by the router. It is recommended to use the internal NAM interface to monitor WAN interfaces.

External NAM Interface - Monitor LAN Traffic

Monitoring traffic through the external NAM interface does not impact router resources. Therefore, we recommend that you use the external NAM interface to monitor LAN traffic.

To monitor ports on Ethernet switching cards or modules (NM-16ESW-x, NMD-36ESW-x, HWIC-4ESW, or HWIC-D-9ESW), configure a Switched Port Analyzer (SPAN) session whose destination is the Ethernet switch port that connects to the external NAM interface.

5 Deployment

5.1 Testbed Architecture

Figure 3 presents the architecture of our testbed.

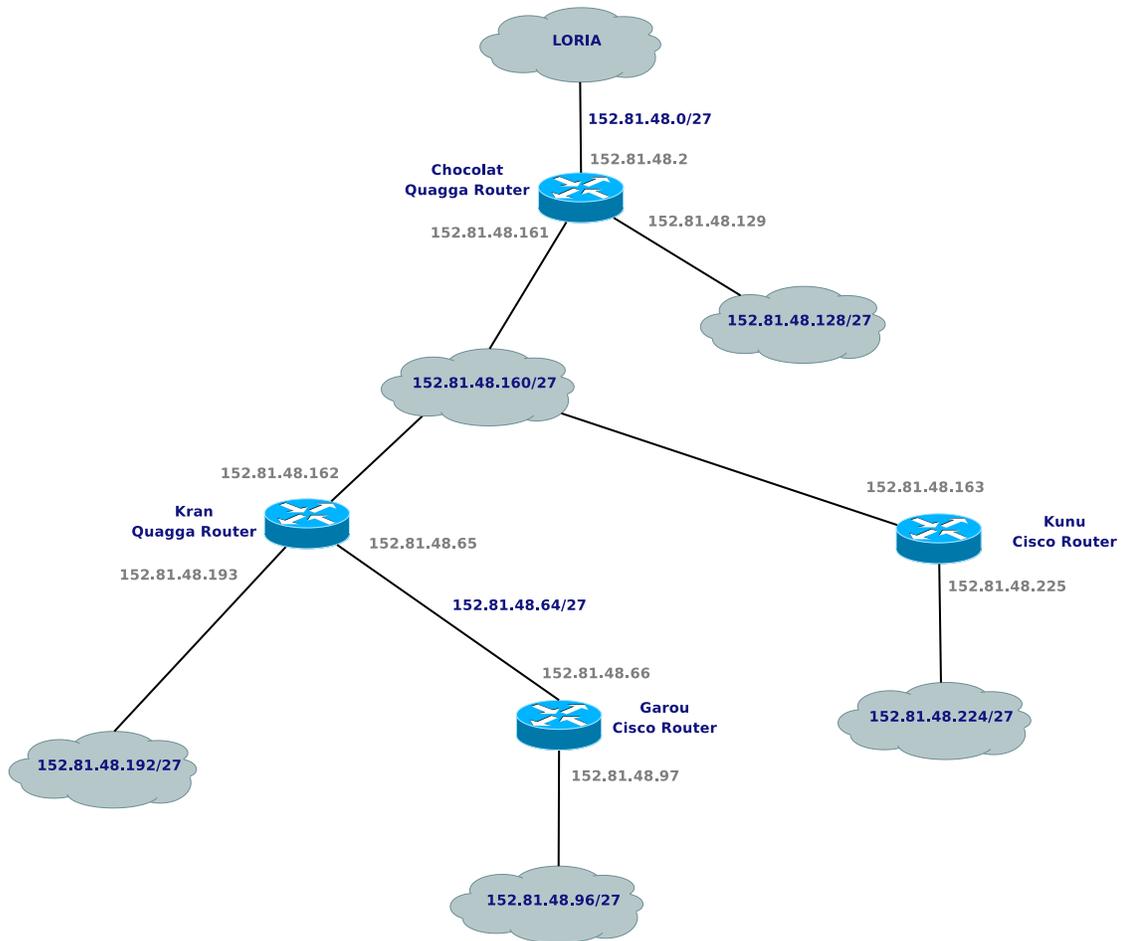


Figure 3: Testbed Architecture

The testbed runs a dual-stack IP network. The IPv4 prefix is $152.81.48.0/24$ whereas the IPv6 prefix is $2001:660:4501:3200::/56$. The interconnection with the Loria IPv6 network

is performed through the subnet *2001:660:4501:32::/64*. IPv6 addresses are not assigned permanently yet, as the testbed is used for a study on IPv4 to IPv6 transition.

Chocolat and Kran are Quagga routers, whereas Kunu and Garou are Cisco 2821 routers. Chocolat is the border router. It is the gateway of our network. It runs a TFTP/FTP server for saving of all routers configurations, a DNS server for the domain *madynes.loria.fr* and various network management/monitoring applications such as Ntop ⁵.

All Quagga routers are configurable by Telnet, whereas Cisco ones also have the possibility to be configured by SSH. The password for connecting to the Quagga routers is *dfgdfg*, and the couple user/password to use for Cisco routers is *admin/dfgdfg*.

5.2 NetFlow Deployment

NetFlow has been activated on the router named kunu. In this section, we will present the configuration of the router itself and the collector.

5.2.1 Router Configuration

The configuration of the router is quite simple for IPv4. First, we need to enable NetFlow on interfaces:

1. Connect to the router
2. enable
3. configure terminal
4. interface *interface type* *interface number*: specifies the interface on which we want to enable NetFlow
5. ip flow *egress—ingress*: enable NetFlow for outgoing/incoming traffic.
6. exit
7. Repeat steps 3 through 5 to enable NetFlow on other interfaces

Then, we need to configure the exportation of the collected data.

1. Connect to the router
2. enable
3. configure terminal
4. ip flow-export destination *ip address* *UDP port*: specifies the IP address or host-name of the NetFlow collector

⁵<http://www.ntop.org/>

5. Repeat step 3 once to configure a second NetFlow export destination (optional)
6. `ip flow-export source` *j* `interface type` *j* `interface number` *j* (optional): specifies the source IP address of the UDP packets sent to the collector
7. `ip flow-export version` *j*—5—9*j* (optional): specifies the version of NetFlow to be used

For IPv6, the same operations can be done, simply by replacing the keyword `ip` by `ipv6`. These steps applied on *kunu*, we obtain the following configuration:

```
!  
interface GigabitEthernet0/0  
description Configured by Telnet...  
ip address dhcp  
duplex auto  
speed auto  
!  
interface GigabitEthernet0/1  
ip address 152.81.48.225 255.255.255.224  
ip flow ingress  
ip flow egress  
duplex auto  
speed auto  
!  
ip flow-export source GigabitEthernet0/0  
ip flow-export version 5  
ip flow-export destination 152.81.48.2 1664  
!  
ipv6 flow-export source GigabitEthernet0/0  
ipv6 flow-export version 5  
ipv6 flow-export destination 152.81.48.2 1665  
!
```

5.2.2 Collector Configuration

Once the router is configured for collecting and exporting the data, we have to configure a collector to receive, treat and display these informations. We chose to use the Open Source NetFlow plugin for Ntop ⁶. The configuration procedure is the following one:

1. select the Stats menu (top menu)
2. select the Plugins links from the left menu
3. select the NetFlow plugin

⁶<http://www.ntop.org/netflow.html>

4. select Configure
5. select Add Device

At this step, fill all the informations about the flow received as shown in figure 5.

NetFlow Configuration	
Incoming Flows	
NetFlow Device	kuru-netflow <input type="button" value="Set Interface Name"/> <input type="button" value="List NetFlow Interfaces"/>
Flow Collection	Local Collector UDP Port 1664 <input type="button" value="Use a port value of 0 to disable collection"/> <input type="button" value="Set Port"/> <small>If you want ntop to display NetFlow data it receives from other hosts, i.e. act as a collector, you must specify the UDP port to listen to. The default port used for NetFlow is 2055.</small>
	Virtual NetFlow Interface Network Address 152.81.48.224/255.255.255.224 <input type="button" value="Set Interface Address"/> <small>This value is in the form of a network address and mask on the network where the actual NetFlow probe is located. ntop uses this value to determine which TCP/IP addresses are local and which are remote. You may specify this in either format, <network>/<mask> or CIDR (<network>/<bits>). An existing value is displayed in <network>/<mask> format. If the NetFlow probe is monitoring only a single network, then this is all you need to set. If the NetFlow probe is monitoring multiple networks, then pick one of them for this setting and use the -m -local-subnets parameter to specify the others. This interface is called 'virtual' because the ntop host is not really connected to the network you specify here.</small>
Flow Aggregation	None (no aggregation) <input type="button" value="Set Aggregation Policy"/> <small>ntop can aggregate (combine) NetFlow information based on a number of 'policies'. The default is to store all NetFlow data (perform no aggregation). Other choices are:</small> <ul style="list-style-type: none"> • Port Aggregation combines all traffic by port number, regardless of source or destination address. For example, web traffic to both 192.168.1.1 and 192.168.1.2 would be combined into a single 'host'. • Host Aggregation combines all traffic to a host, regardless of source or destination port number. For example, both web and ftp traffic to 192.168.1.1 would be combined into a single 'port'. • Protocol Aggregation combines all traffic by TCP/IP protocol (TCP, UDP or ICMP), regardless of source or destination address or port. For example, all ICMP traffic would be combined, regardless of origin or destination. • AS Aggregation combines all NetFlow data by AS (Autonomous System) number, that is as if the source and destination address and port were all zero. For more information on AS Numbers, see RFC 1538 and the high level assignments at IANA.
Filtering	White List <input type="button" value="Set White List"/> <small>This is a list of one or more TCP/IP host(s)/network(s) which we will store data from when these host(s)/network(s) occur in the NetFlow records.</small>
	Black List <input type="button" value="Set Black List"/> <small>This is a list of one or more TCP/IP host(s)/network(s) which we will exclude data from (i.e. not store it) when these host(s)/network(s) occur in the NetFlow records.</small>
<ul style="list-style-type: none"> • Changes to white or black lists take effect immediately, but are NOT retro-active. • Use a space to disable a list. • Use a.b.c.d/02 for a single host in a list. • The white/black lists accept both <network>/<mask> and CIDR <network>/<bits> format. Both formats may be used in the same list. For example, 192.168.1/024 means all addresses with 24 bits of network and thus 8 bits of host, or the range from 192.168.1.0 to 192.168.1.255. Similarly, the list 192.168.1/24, 192.168.2/255.255.255.0 means the range from 192.168.1.0 - 192.168.2.255. • The white list and black interact this way: <ul style="list-style-type: none"> ◦ if present, the black list is processed FIRST. Data from any host matching the black list is simply thrown away. ◦ if no black list is specified, no hosts are excluded. ◦ if present, the white list is processed SECOND. Data from any host NOT matching the white list is thrown away. ◦ if no white list is specified, the value 0.0.0.0 (ALL hosts) is used. 	
General Options	
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="button" value="Set FTP Policy"/>	

Figure 4: Ntop - Add NetFlow Device

Once the device is created, it is mandatory to **change the NIC to display informations received on this device**. This is done in the menu *Admin->Switch NIC*. Then, all the informations displayed in the various menus and items are the ones sent by the probe. Figure ?? shows the host summary information Ntop generated thanks to the data sent by the probe.

This screen and other informations collected are available at the URL <http://152.81.48.2:3000>.

5.3 NM-NAM Deployment

The configuration of the NAM is done in two steps:

- Configure the analysis-module interface in the router
- Configure the NAM itself in its own interface

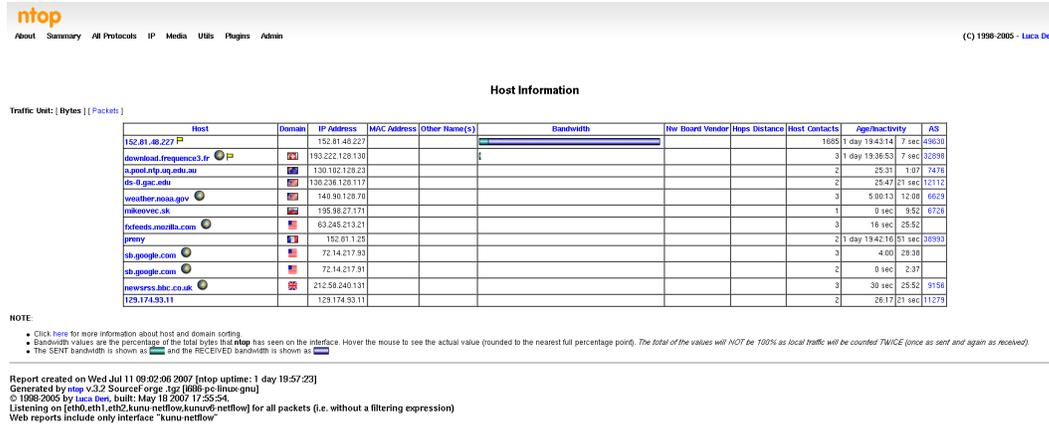


Figure 5: Ntop - NetFlow Hosts Summary

5.3.1 Configuring the Analysis-Module Interface on the Router

1. Connect to the router
2. enable
3. configure terminal
4. interface `<interface type> <interface number>`: (Optional) Configures an interface, and enters interface configuration mode. Perform this step if you plan to configure the Analysis-Module interface as an IP unnumbered interface.
5. interface analysis-module slot/0
6. ip unnumbered interface number: Configures the Analysis-Module interface as IP unnumbered and specifies the interface whose IP address is borrowed by the Analysis-Module interface.
7. **or** ip address ip-address mask: Sets an IP address and mask on the Analysis-Module interface.
8. no shutdown
9. end

In our testbed, we decided to use an unnumbered interface. Therefore, we borrowed the address of the second Ethernet slot:

```
interface Analysis-Module1/0
ip unnumbered GigabitEthernet0/1
hold-queue 60 out
```

5.3.2 Opening and Closing a NAM Console Session from the Router

In order to connect to the NAM configuration interface (at least the first time), we have to use the following procedure:

1. Connect to the router
2. enable
3. service-module analysis-module slot/0 session
4. Press Return.
5. At the login prompt, enter root.
6. At the password prompt, enter your password.
7. Perform the tasks that you need to perform in the NAM CLI. When you want to end the NAM console session and return to the Cisco IOS CLI, complete Step 8 to Step 11.
8. exit
9. Hold Ctrl-Shift and press 6. Release all keys, and then press x.
10. disconnect
11. Press Enter.

In our case, the password for the user root is *dfgdfg*.

5.3.3 Configuring the NAM

This section describes how to configure the NM-NAM to establish network connectivity and configure IP parameters. This task must be performed from the NAM CLI. For more advanced NAM configuration, use the NAM Traffic Analyzer.

Before doing this procedure, access the NAM console by performing Step 1 to Step 5 in section 5.3.2. Then, follow the procedure:

1. ip interface *j*internal — external*j*: Specifies which NAM interface will handle management traffic.
2. ip address ip-address subnet-mask: Configures the NAM system IP address.

3. `ip broadcast broadcast-address`: (Optional) Configures the NAM system broadcast address.
4. `ip gateway ip-address`: Configures the NAM system default gateway address.
5. `exsession on` or `exsession on ssh`: (Optional) Enables outside logins by Telnet or SSH.
6. `ip domain name`: (Optional) Sets the NAM system domain name.
7. `ip host name`: (Optional) Sets the NAM system hostname.
8. `ip nameserver ip-address [ip-address] [ip-address]`: (Optional) Sets one or more NAM system name servers.

In our testbed, we chose to use an internal interface, and to give it the address *152.81.48.99*. The NAM gateway is the second Ethernet slot on the router with the address *152.81.48.97*. This gives us the following configuration on the NAM:

```
ip interface internal
!
ip address 152.81.48.99 255.255.255.224
!
ip host "madyes-nam"
!
ip domain "madyes.loria.fr"
!
ip gateway 152.81.48.97
!
ip broadcast 152.81.48.127
!
ip nameserver 152.81.1.128 152.81.1.25
```

5.3.4 Configuring a Static Route to the NAM Through the Analysis-Module Interface

This procedure ensures that the router can route packets to the NAM by configuring a static route through the Analysis-Module interface.

If you select the internal NAM interface to handle management traffic, then configuring a static route to the NAM through the Analysis-Module interface is:

- Required when the Analysis-Module interface is IP unnumbered
- Recommended when the Analysis-Module interface is assigned a unique IP address

1. Connect to the router
2. enable

3. configure terminal
4. ip route nam-ip-address mask analysis-module slot/unit
5. end

In our case, the configured route is:

```
ip route 152.81.48.99 255.255.255.255 Analysis-Module1/0
```

5.3.5 Enabling NAM Packet Monitoring

This section describes how to enable NAM packet monitoring on router interfaces that you want to monitor through the internal NAM interface.

When you enable NAM packet monitoring on an interface, Cisco Express Forwarding sends an extra copy of each IP packet that is received from or sent out on that interface to the NAM through the Analysis-Module interface on the router and the internal NAM interface.

1. Connect to the router
2. enable
3. configure terminal
4. ip cef: Enables the Cisco Express Forwarding switching path.
5. interface *interface type* *interface number*: Selects an interface for configuration.
6. analysis-module monitoring: Enables NAM packet monitoring on the interface.

Repeat Step 4 and Step 5 for each interface that you want the NAM to monitor through the internal NAM interface.

7. end

We decided to monitor both Ethernet interfaces on the router:

```
interface GigabitEthernet0/0
ip address dhcp
duplex auto
speed auto
analysis-module monitoring
!
interface GigabitEthernet0/1
ip address 152.81.48.97 255.255.255.224
duplex auto
speed auto
analysis-module monitoring
```

5.3.6 Enabling and Accessing the NAM Traffic Analyzer

This procedure enables and accesses the NAM Traffic Analyzer (web GUI). You can use the HTTP server or the HTTP secure server and you cannot use both simultaneously.

1. Open a NAM console session from the router or Open a Telnet or SSH session to the NAM.
2. `ip http {secure} server enable`: Enables the HTTP or HTTPS server.
3. Enter a web username.
4. Enter a password.
5. Enter the password again.

We chose the couple username/password *admin/dfgdfg*:

```
web-user
user-name admin
account-mgmt enable
system-config enable
capture enable
alarm-config enable
collection-config enable
encrypted-password "ZGZnZGZnCg=="
exit
!
ip http port 80
!
ip http secure port 443
!
ip http secure server disable
!
ip http server enable
```

5.3.7 Accessing the NAM Traffic Analyzer

The NAM and its Traffic Analyzer are now configured. It is possible to access it with a web browser at the URL `http://152.81.48.99/`. After entering the username and password, we can configure or view the data captured.

Figure 6 shows an overview of the traffic captured.

5.4 RMON Deployment

The RMON option identifies activity on individual nodes and allows you to monitor all nodes and their interaction on a LAN segment. Used in conjunction with the SNMP agent

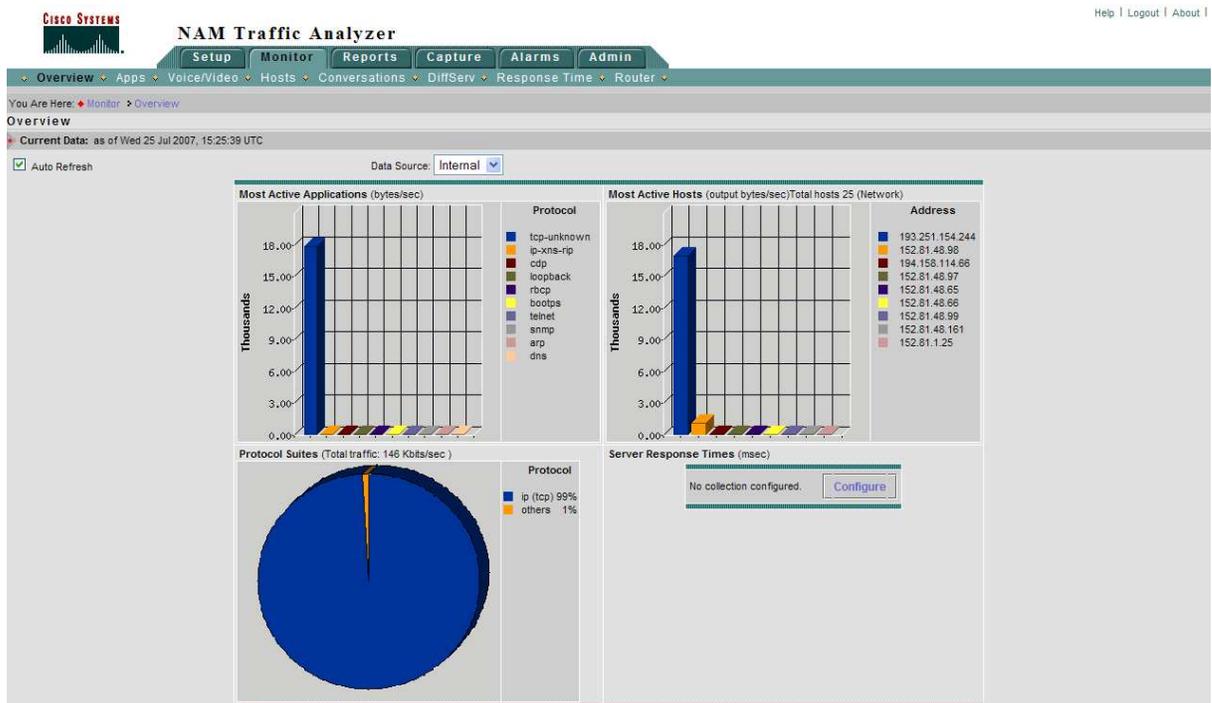


Figure 6: NAM Traffic Analyzer Overview

in a router, RMON allows you to view both traffic that flows through the router and segment traffic not necessarily destined for the router. Combining RMON alarms and events (classes of messages that indicate traffic violations and various unusual occurrences over a network) with existing MIBs allows you to choose where proactive monitoring will occur.

Full RMON packet analysis (as described in RFC 1757) is supported only on an Ethernet interface of Cisco 2500 series routers and Cisco AS5200 series universal access servers. RMON requires that SNMP be configured (you must be running a version of SNMP on the server that contains the RMON MIB). A generic RMON console application is recommended in order to take advantage of the RMON network management capabilities. This feature supports RFCs 1757 and 2021.

Therefore, in our testbed, the router *garou* and especially the NAM are implementing RMON.

5.4.1 SNMP Server

The NAM runs a SNMP server. It is configured as follows:

```
snmp community madynes-nam rw
!
snmp contact "Frederic Beck - frederic.beck@loria.fr"
!
snmp location "LORIA B113, Nancy, France"
!
snmp name "MADYNES-NAM"
```

We have a read and write access to SNMP data on the host via the community *madynes-nam*

5.4.2 Configuring RMON support

On the router, integrated in the IOS, we can configure a limited RMON support, with only alarms and events groups (<http://www.cisco.com/univercd/cc/td/doc/product/software/ios122/122cgcr/ffun>

Basing itself on the packet captured, the NAM fills the RMON MIBs at the OID *1.3.6.1.2.1.16* or *mib-2.16*.

All configuration issues are performed through the WEB interface, in the tab *Capture*. For more informations about the NAM Traffic Analyzer, refer to <http://www.cisco.com/en/US/products/sw/cscowor>

6 Conclusion

Several technologies are deployed on the testbed (Cisco NAM, Netflow, RMON, SNMP...) and are ready to be used.

Have fun playing with them !

References

- [1] B. Claise. Cisco Systems NetFlow Services Export Version 9. RFC 3954 (Informational), October 2004.
- [2] S. Waldbusser. Remote Network Monitoring Management Information Base Version 2 using SMIV2. RFC 2021 (Proposed Standard), January 1997.
- [3] S. Waldbusser. Remote Network Monitoring Management Information Base. RFC 2819 (Standard), May 2000.
- [4] S. Waldbusser, R. Cole, C. Kalbfleisch, and D. Romascanu. Introduction to the Remote Monitoring (RMON) Family of MIB Modules. RFC 3577 (Informational), August 2003.



Unité de recherche INRIA Lorraine
LORIA, Technopôle de Nancy-Brabois - Campus scientifique
615, rue du Jardin Botanique - BP 101 - 54602 Villers-lès-Nancy Cedex (France)

Unité de recherche INRIA Futurs : Parc Club Orsay Université - ZAC des Vignes
4, rue Jacques Monod - 91893 ORSAY Cedex (France)

Unité de recherche INRIA Rennes : IRISA, Campus universitaire de Beaulieu - 35042 Rennes Cedex (France)

Unité de recherche INRIA Rhône-Alpes : 655, avenue de l'Europe - 38334 Montbonnot Saint-Ismier (France)

Unité de recherche INRIA Rocquencourt : Domaine de Voluceau - Rocquencourt - BP 105 - 78153 Le Chesnay Cedex (France)

Unité de recherche INRIA Sophia Antipolis : 2004, route des Lucioles - BP 93 - 06902 Sophia Antipolis Cedex (France)

Éditeur
INRIA - Domaine de Voluceau - Rocquencourt, BP 105 - 78153 Le Chesnay Cedex (France)
<http://www.inria.fr>
ISSN 0249-0803