

*TF-NOC Software Tools*  
**Survey Results: Analysis  
and Dissemination**

**December 2011**



« *networking the networkers* »

## Contributors

**Maria Isabel Gandía Carriedo (CESCA - [www.cesca.cat](http://www.cesca.cat))**

**Stefan Litröm (NORDUnet - [www.nordu.net](http://www.nordu.net))**

**Suzy Limberg (Sentry - [www.sentry.com](http://www.sentry.com))**

**Pevle Vuletic (ARNES - [www.arnes.si](http://www.arnes.si))**

**Péter Szegedi (TERENA - [www.terena.org](http://www.terena.org))**

## Editors

**Jim Buddin (TERENA)**

**Laura Durnford (TERENA)**

**Cora Van den Bossche (TERENA)**

## Contact Details

Péter Szegedi  
TERENA Secretariat,  
Singel 468D,  
1017AW Amsterdam,  
The Netherlands

Email: [szegedi@terena.org](mailto:szegedi@terena.org)

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## 1 Executive Summary

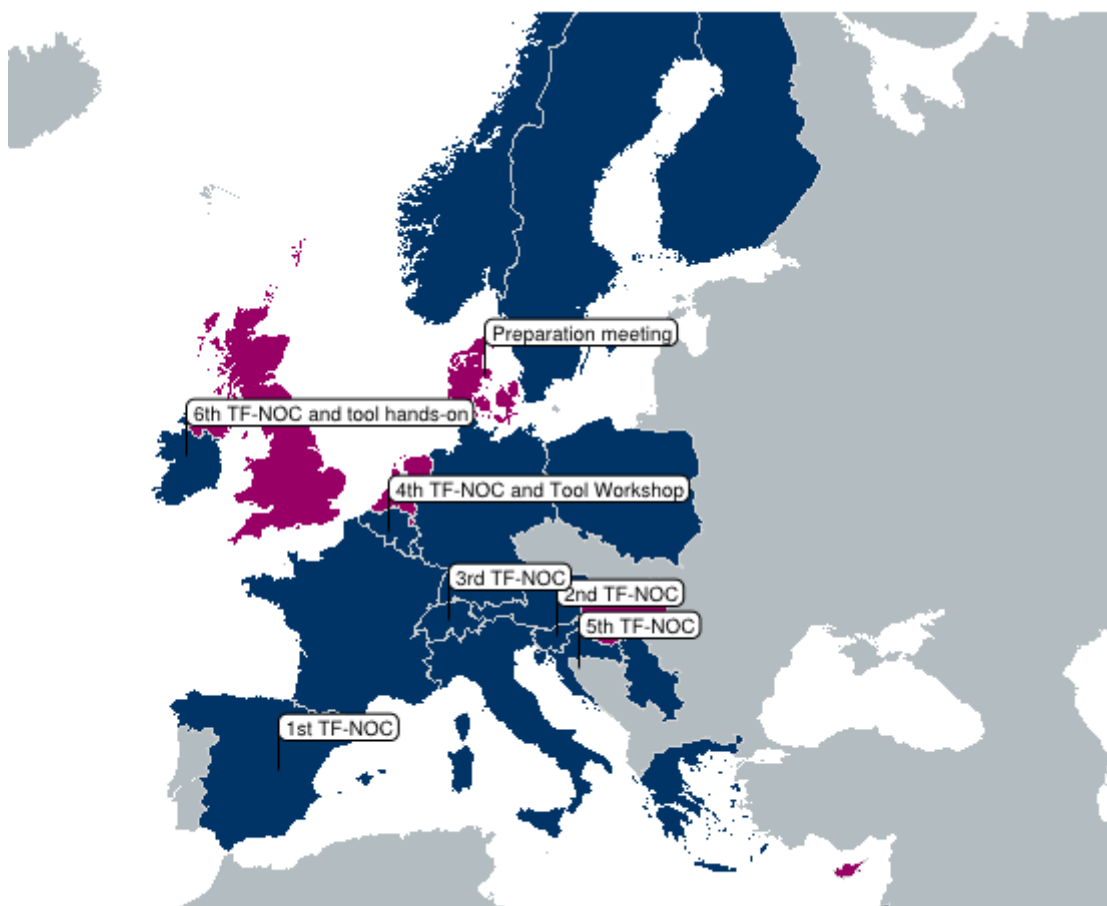
The TERENA Task Force on Network Operations Centres (TF-NOC), which runs from September 2010 until August 2013, was initiated by national research and education networking organisations (NRENs) in Europe. It provides a forum that facilitates knowledge exchange and collaboration between leading staff members of Network Operations Centres (NOCs) in order to foster the development and improvement of NOCs, primarily within the research and education community.

TF-NOC initiated a survey focusing on software tools used by NOCs to operate their networks and services. The survey results are considered a great success and a valuable achievement by TF-NOC. The majority of the task force participants (approx. 180 people from 35 organisations) say that the results are highly relevant to their daily operations, providing them very useful information. This report is to disseminate the survey results to the broader community.

## 2 Introduction

Today's network operations centre (NOC) functions are essential, costly, and critical in respect to NRENs' main business, as well as that of regional, metropolitan and campus network providers and infrastructure development projects. However, there is extreme diversity in terms of NOC organisation, structure and roles across various domains. It is also hard to find information about common practices related to day-to-day NOC operations. This has created a situation where NOCs usually cope with similar issues but in very different ways (i.e. various tools, procedures, workflows, etc.).

The TERENA Task Force on Network Operations Centres (TF-NOC) brings together NOC managers, engineers, developers, operators, controllers and project managers interested in NOC functions in order to share experiences and knowledge as well as to investigate the possibility of creating best common practices.



European countries actively participating in TF-NOC with their Research and Education Network as well as regional, metropolitan and campus network NOCs (November 2012)

Brief introductions (both AV recordings and presentation slides) to the participating NOCs can be found at <http://www.terena.org/activities/tf-noc/nocs.html>

TF-NOC initiated an online survey to collect information about the software tools that NOCs use to operate networks and services. NOC tools and their functions (such as monitoring, problem solving, performance, change management, ticketing, reporting and communication) were primarily investigated in the survey. Open text boxes were used to collect practical experiences, assessments and recommendations for each tool. Taxonomy questions were only included where they were relevant from the NOC tool assessment point of view. It was recommended that the survey be filled out by an experienced NOC engineer with an overview of the whole NOC operations.

The survey was made available from 11 July 2011 to 12 October 2011. Out of 89 responses collected from 4 continents, 43 were reliable and detailed enough to be analysed in this document. We maintain the anonymity of the survey participants.

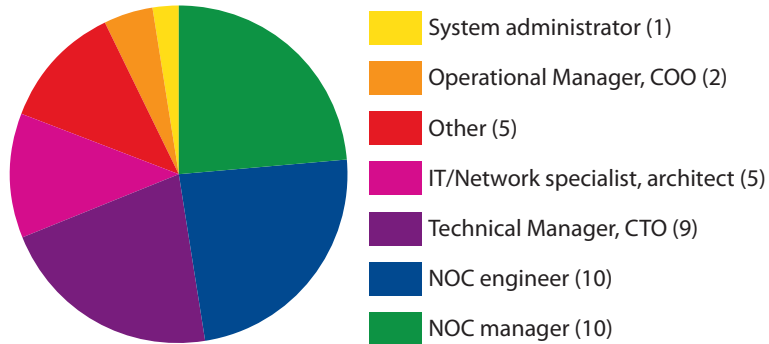
The survey contained 54 questions divided into the following 7 thematic groups:

1. Basic information (3)
2. NOC taxonomy (6)
3. Network and services (6)
4. NOC tools (29)
5. Communication and front end (6)
6. Collaboration and best practices (3)
7. Closing (1)

The detailed results of the NOC tools group are also available in a so-called NOC Tool Matrix attached to this document.

### 3 Basic information

#### 3.1 What is your role at your organisation?



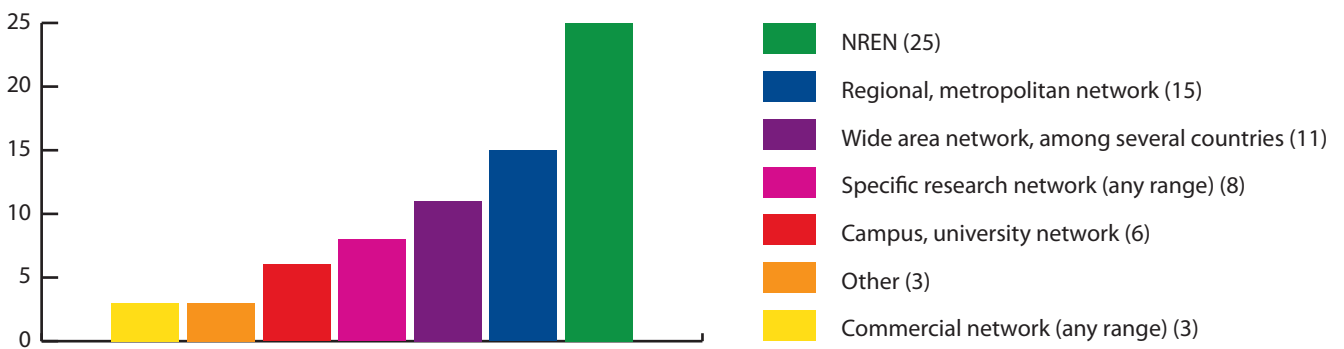
'Other' includes:

- NOC Support Engineer Incident Manager
- Project Manager
- NOC Technical Coordinator
- Head of Networks
- NOC & Operations Manager

#### 3.2 Type (range) of the network that your organisation is responsible for

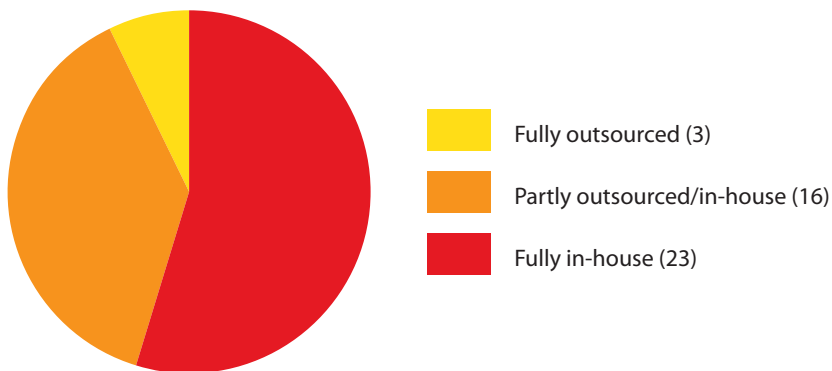
'Other' includes:

- 2 internet exchanges
- 1 provincial Research and Education Network (REN)

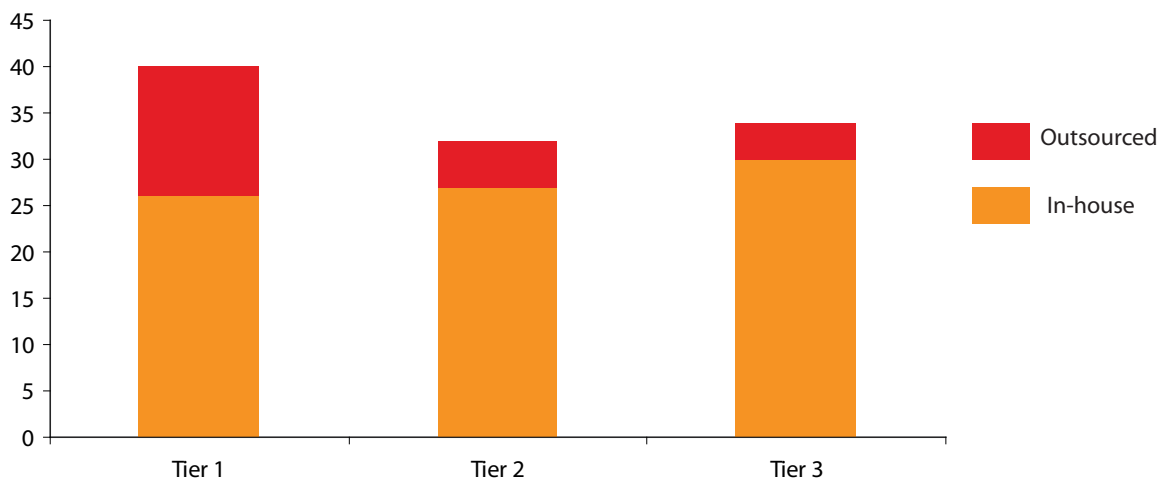


## 4 NOC taxonomy

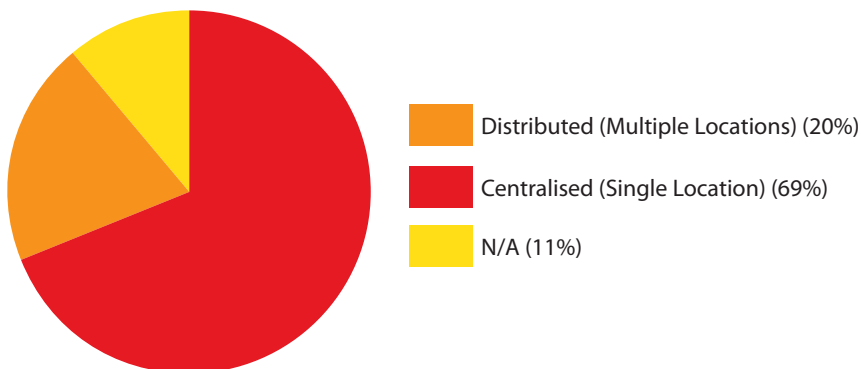
### 4.1 How is your NOC organised?



Knowledge remains inside the organisations.  
Partly inhouse/outsourced NOCs appear twice.

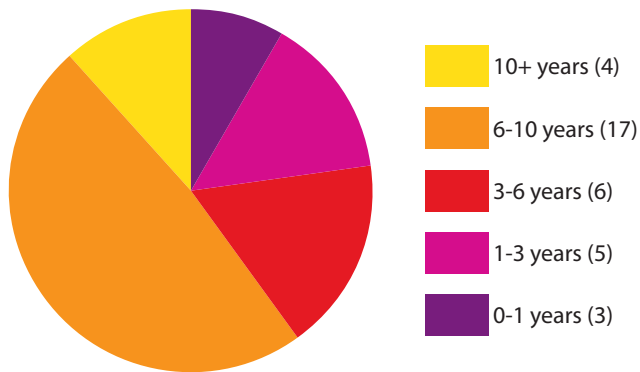


### 4.2 How is your in-house NOC structured?

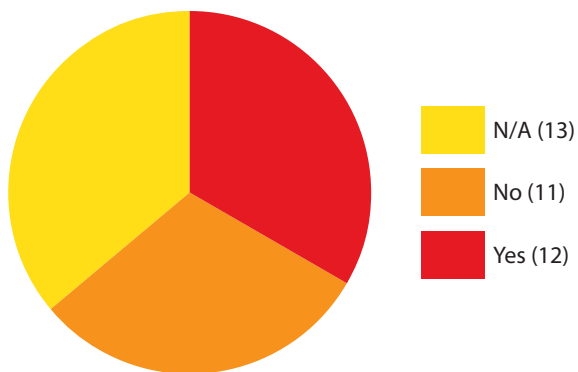




### 4.3 What is the average years of expertise that your NOC personnel have?



### 4.4 Are you measuring NOC performance, if so how?



#### Mostly key performance indicators based on trouble tickets:

##### Time to:

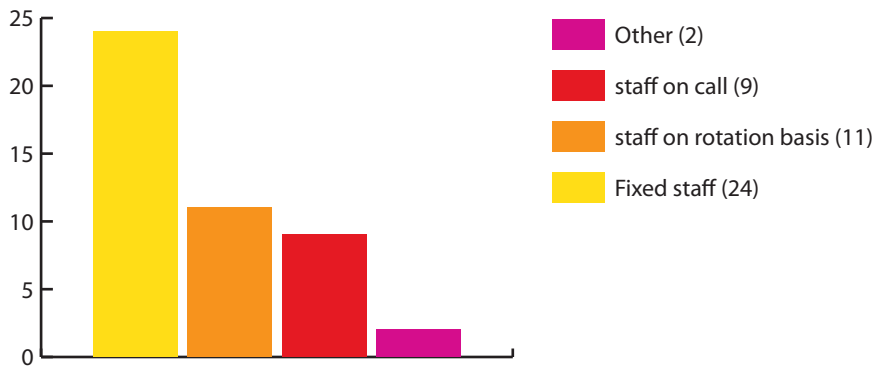
- Open a ticket for an alarm or e-mail / phone call
- Handle a ticket
- Assess the impact of an outage and update the ticket
- Solve a problem

##### Number of:

- Solved tickets
- Incidents
- Change requests

Customer satisfaction (form)

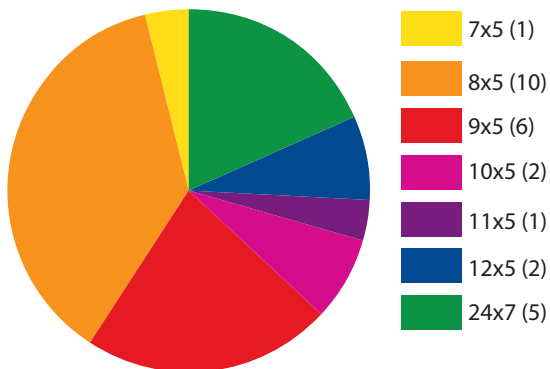
#### 4.5 How is your in-house NOC staffed?



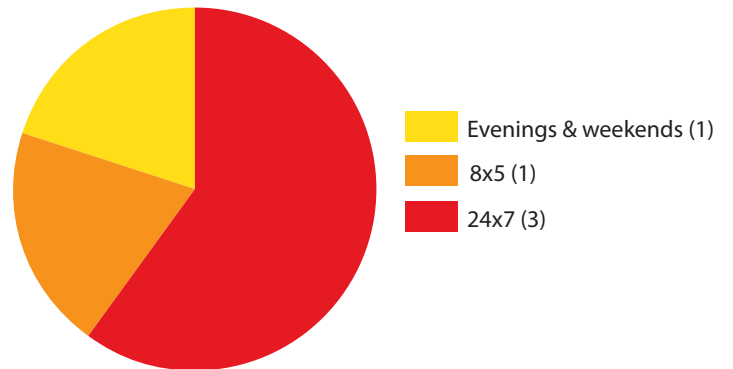
'Other' relates to "some rotation in out-of-office hours with rotations for holidays or illness".

#### 4.6 What are the usual working hours for NOC personnel? [Tier-2 engineers]

Inhouse NOC

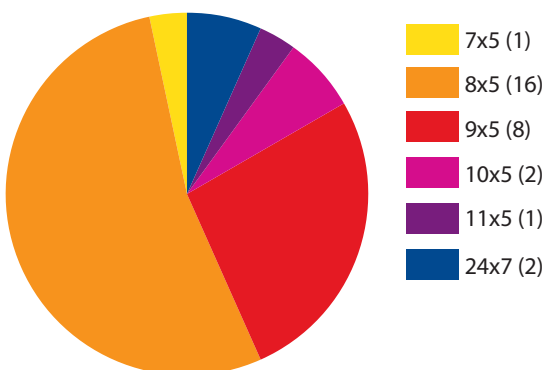


Outsourced NOC

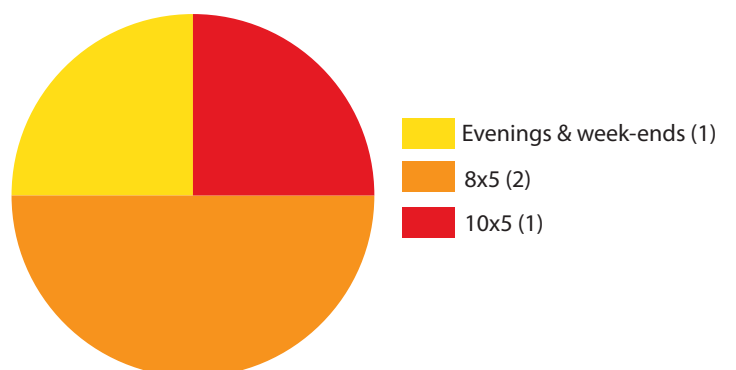


#### 4.7 What are the usual working hours for NOC personnel? [Tier-3 senior engineers, design/planning]

Inhouse NOC

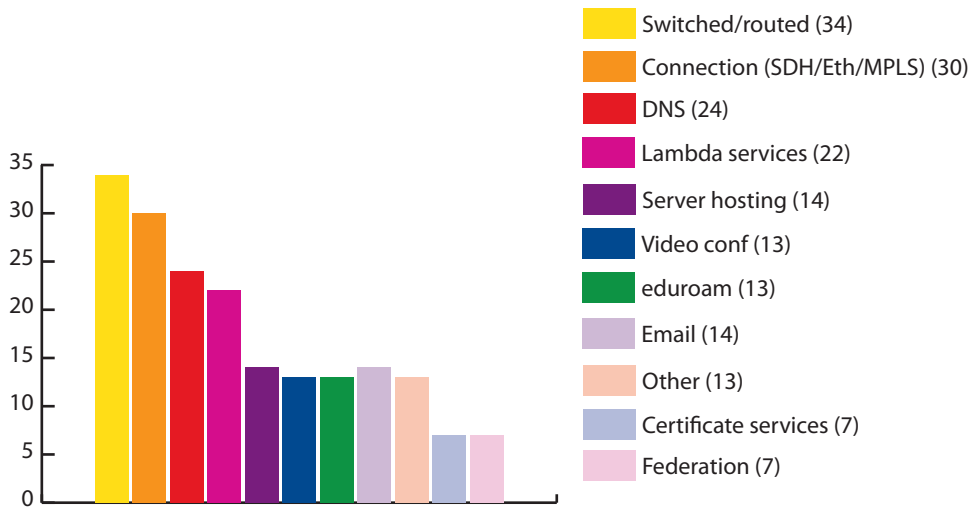


Outsourced NOC



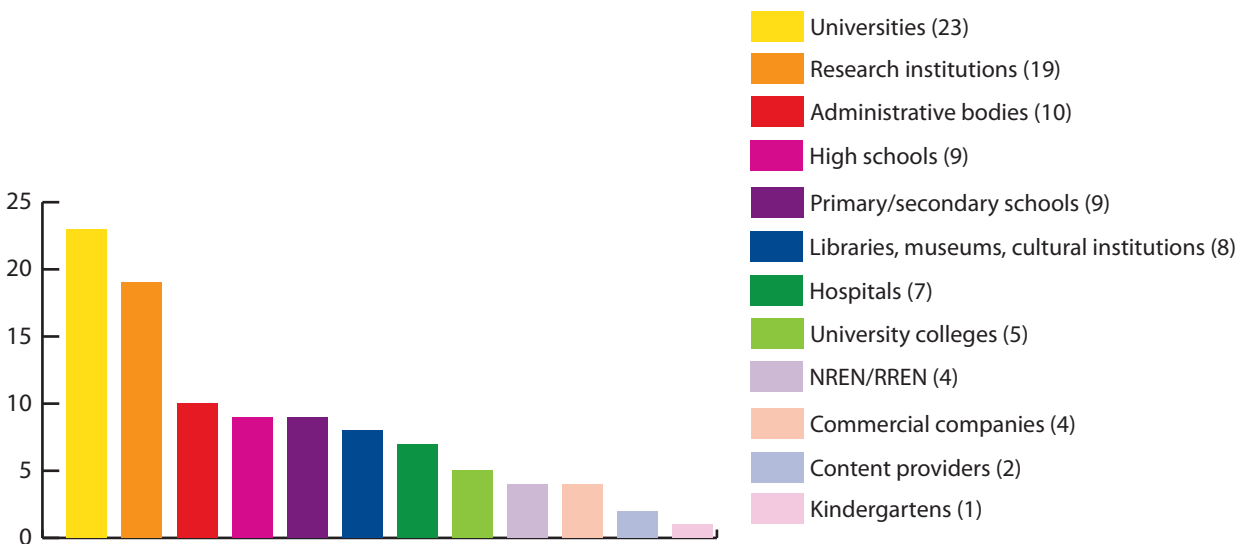
## 5 Network and Services

### 5.1 What kind of services is your NOC responsible for?

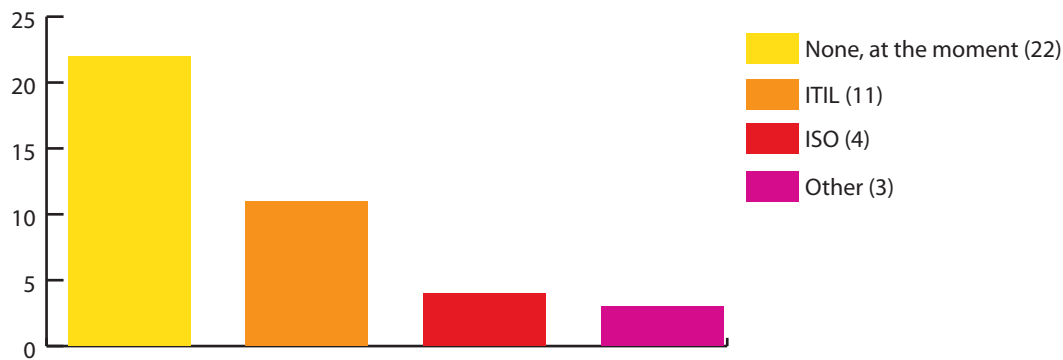


'Other' consists of PERT, security response, network engineering, e-learning, virtual machines, storage, content filtering, remote access (broadband /mobile/ DSL), webconferencing.

### 5.2 How many and what kind of organisations and users are connected to your network?



### 5.3 Does your NOC use any methodology or follow any standard based procedures?



'Other' represents those planning to start with ITIL, NIST, or FIPS.

### 5.4 If yes, what triggered your organisation to implement this methodology?

- To have uniformity to handle events;
- To create a visible overview of responsibilities;
- To follow a standard/best practices/guidelines which are also followed by the customer (common language, security);
- To have better performance;
- To improve user support;
- To get the accreditation;
- It was a proactive response when the financial industry changed their requirements.

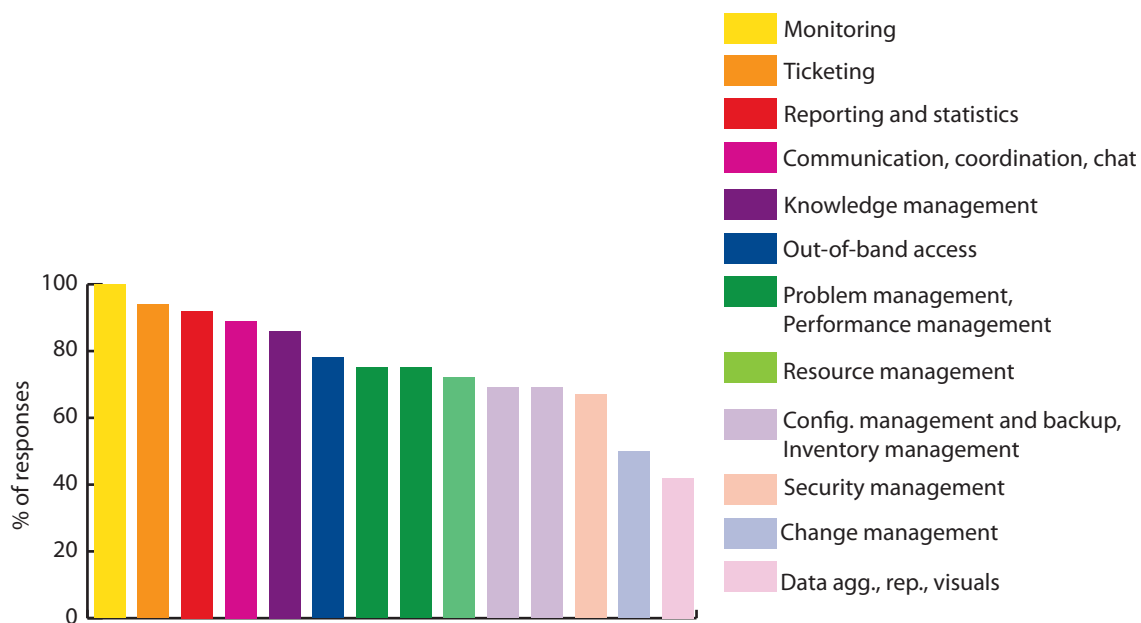
### 5.5 What are your experiences using it?

- User experience benefits from clear procedures and improved reporting;
- It adds more administrative work but it helps to follow procedures and requires less skills from some of the staff components;
- Sometimes this methodology leads to unwanted discussions and time loss;
- Difficulties in deciding to what extent the standards should be followed;
- Difficulties in motivating users and staff.

### 5.6 Are you planning to implement some of the methodologies?

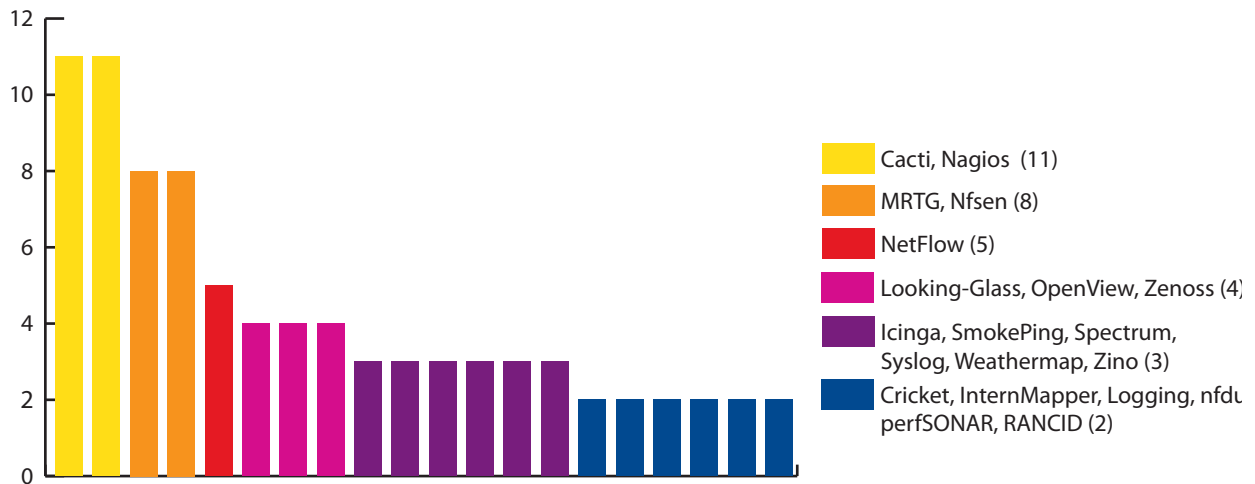
3 answered "yes, we are about to pick one".

## 5.7 Functions NOCs feel responsible for



## 6 NOC tools

### 6.1 Monitoring



#### 56 different tools are mentioned:

- 2 of the 56 tools are used by 11 institutions;
- 2 are used by 8 institutions;
- 1 is used by 5 institutions;
- 3 are used by 4 institutions;
- 6 are used by 2 institutions;
- 36 are used by 1 institution, probably because most of them are self-developed or vendor specific;
- 13 of the tools were built inside the organisations.

The tools used only by one organisation are:

Alcatel NMS, BCNET CMDB, Beacon, Big Brother, Ciena NMS, Ciena Preside, Cisco IPSLA, Cisco EEM, DUDE, Equipment specific NMS, Fluxoscope, FSP Network Manager, GARR Integrated, Hobbit, Monitoring Suite, ICmyNet.Flow, ICmyNet.IS, Kayako, Lambda Monitor, monALISA, Munin, NAV, Netcool, NetScout, Network Node Manager, NFA, NMIS, ntop, Observium, OpManager, Racktables, SMARTxAC, Splunk, TrapMon, WUG, Zabbix.

### 6.2 Please specify your tool(s) and give some recommendations, review comments (if possible)

Only 6 of 36 answers gave some recommendations/review about monitoring tools. 2 of them were not for a specific tool ("we need a more integrated set of tools / an umbrella system").

#### Dartware Internmapper:

- Reliable, informative, good value.

#### Cacti:

- Versatile, well established, easy on the eye, somewhat complex to configure;
- Evolution from MRTG. It adds more features but it also requires more time to adapt it.

#### CA Spectrum:

- Extensive fault management with good cause analysis, well designed topology view. Downside: price, integration of non-certified devices;
- Very stable and useful for our needs.

**MRTG:**

- Useful and very easy to use.

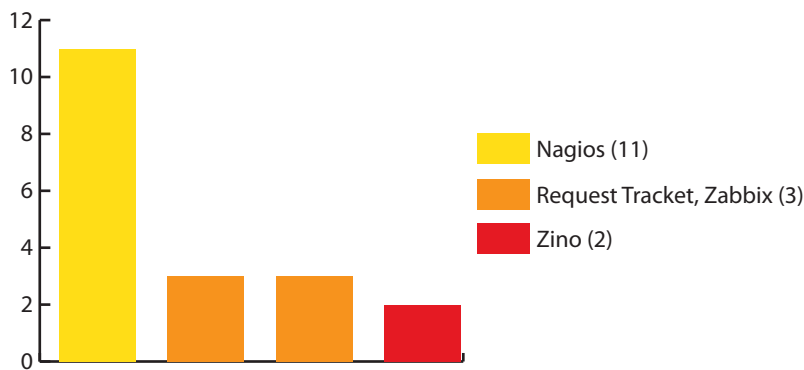
**Smokeying.**

- Flexible, easy to configure but it does not fit all our needs for alerting.

**perfSONAR:**

- Useful for multidomain circuits but it requires an extra effort to make it work.

The number of tools given as the answer to the question ranges from 1 to 11. It is likely that more than one answer is incomplete, where more than 1 tool is used but not mentioned. The majority of the most popular tools are based on SNMP (RRD) and NetFlow. The most popular tools are Cacti and Nagios. There are several proprietary tools, especially for optical equipment (such as Alcatel NMS, Ciena NMS). Some answers give the former names of tools that have now changed their name. We have not changed the answers (e.g. Big Brother and Hobbit). There is a large number of in-house developed tools (13). We do not have enough comments for the tools to have a separated valuable report for them yet.

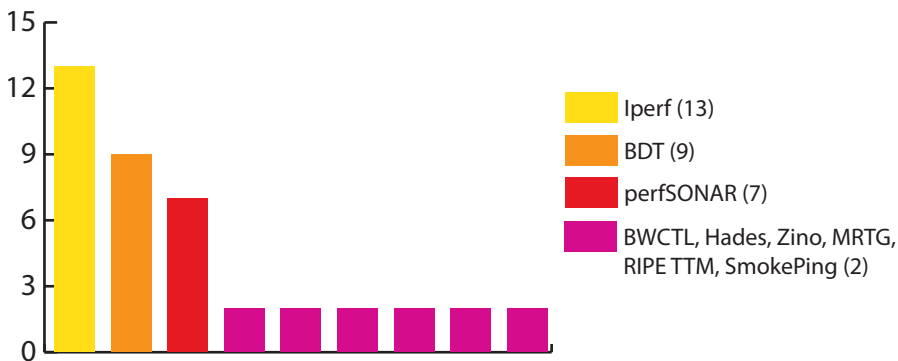
**6.3 Problem management****21 different tools are mentioned:**

- 1 is used by 11 institutions;
- 2 are used by 3 institutions;
- 1 is used by 2 institutions;
- 17 are used by 1 institution;
- 2 of the tools were built in-house.

The tools used only by one organisation are: ARS, CA spectrum, Hobbit, HP Insight Manager, HP Service Center, HP Service Manager, Icinga, ICmyNet.IS, ITIL, Jira, Monitor One, Proprietary NMS, ServiceNow, Splunk, Vigilant\_congestio, Wiki, Zenoss.

The answers did not include reviews and recommendations on problem management tools.

## 6.4 Performance management



### 31 different tools are mentioned:

- 1 is used by 13 institutions;
- 1 is used by 9 institutions;
- 1 is used by 7 institutions;
- 7 are used by 2 institutions;
- 23 are used by 1 institution;
- 2 of the tools were built in-house.

The tools used only by one organisation are: Atlas, BC NET CMDB, Cisco IPSLA, dynaTrace, IPPM, Jitter, MGEN, Munin, Nagios, nfdump, NetFlow, NetMinder, OpsMgr, OWAMP, Ping, Prosilent, QoS, Speedtest, StorSentry, Traceroute, tcpdump, Wireshark, Zenoss.

### 2 of 27 answers gave reviews/recommendations:

#### NDT:

- Useful for troubleshooting with customers;
- Easy for users to use, it helps to debug problems.

#### IPerf:

- Easy to use but it requires users to have some prior knowledge;
- perfSonar: useful for multidomain circuits but it requires an extra effort to make it work.

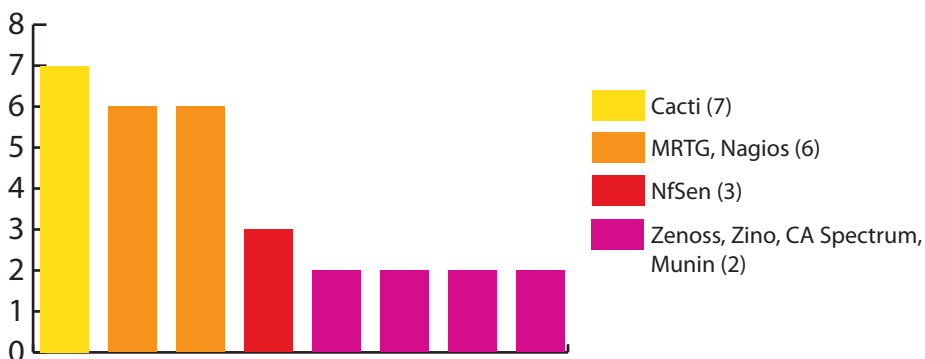
#### MGEN:

- Easy to configure and it does not require prior knowledge by the user.

#### Speedtest from ookla:

- Our users love the interface.

## 6.5 Reporting and statistics





**28 different tools are mentioned:**

- 1 is used by 7 institutions;
- 2 are used by 6 institutions;
- 1 is used by 3 institutions;
- 4 are used by 2 institutions;
- 20 are used by 1 institution;
- 4 of the tools were built in-house.

The tools used only by one organisation are: BCNET CMDB, Business Object Data Marts, Confluence, Cricket, Excel, GINS, HP Service Desk, Hobbit, Icinga, ICMYNet.IS, InfoVision, Jira, monALISA, MSR, NetFlow, SmokePing, Splunk, Stager, StorSentry, Zabbix

**4 of 33 answers gave reviews/recommendations:**

**In-house tool:**

- Tailored to the institution, but took a lot of effort to implement.

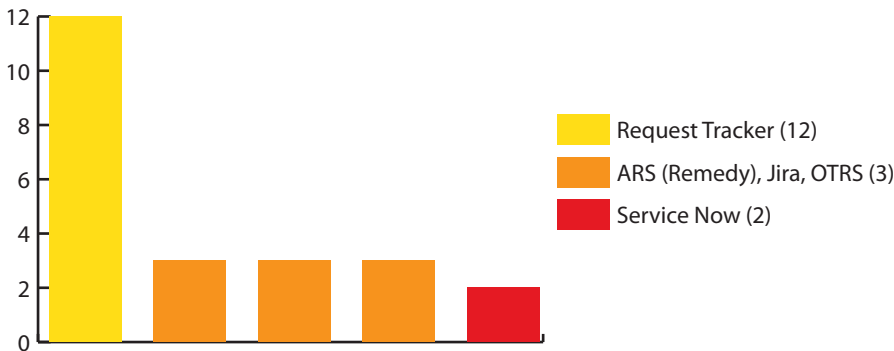
**MRTG:**

- Plain text configuration files, easy to tailor for specific needs;
- This tool is good for showing statistics about bandwidth utilisation.

**Cacti:**

- It can make hundreds of self-configured reports.

**6.6 Ticketing**



**11 different tools are mentioned:**

- 1 is used by 12 institutions;
- 3 are used by 3 institutions;
- 1 is used by 2 institutions;
- 6 are used by 1 institution;
- 6 of the tools were built or tailored in-house.

The tools used only by one organisation are: BMC Service Express, EasyVista, HP Service Center, HP Service Desk, HP Service Manager, Kayako Help Desk.

**5 of 34 answers gave reviews/recommendations:**

**BMC Service Desk Express (SDE):**

- Pros: reliable, low maintenance, very configurable;
- Cons: not great looking, not very efficient (number of clicks required), user web access is poor.

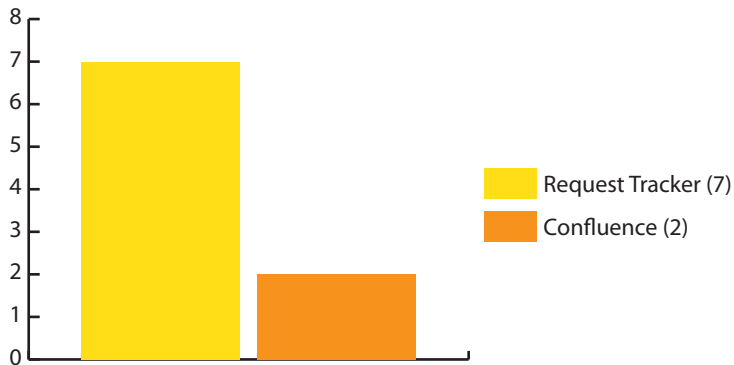
**Request Tracker:**

- Pretty good but not great at tracking longer term issues. As a result, statistics can be poor.

- It is basic to tracking any previous problem.
- It is very useful although it requires a lot of tuning to make it work appropriately.

**Recommendation: don't outsource your ticketing system.**

## 6.7 Change management



### 11 different tools are mentioned:

- 1 is used by 7 institutions;
- 1 is used by 2 institutions;
- 9 are used by 1 institution;
- 7 of the tools were built or tailored in-house.

The tools used only by one organisation are: EditGrid, HP Service Manager, RANCIID, Redmine, Savannah, SharePoint, Telemater, Trac, VC-4 CMDB.

### 2 of 34 answers gave reviews/recommendations:

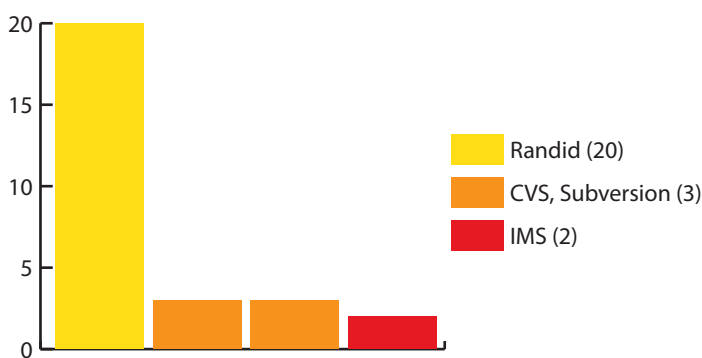
#### SharePoint Collaboration:

- Easy to set up and manage.

#### Request Tracker:

- It requires a lot of tuning to make it work appropriately, but it is useful.

## 6.8 Configuration management and backup



### 9 different tools are mentioned:

- 1 is used by 20 institutions;
- 2 are used by 3 institutions;

- 1 is used by 2 institutions;
- 4 are used by 1 institution;
- 3 tools were built or tailored in-house.

The tools used only by one organisation are: CFEngine, CiscoWorks, NetBackup, ViewVC.

**3 of 25 answers gave reviews/recommendations:**

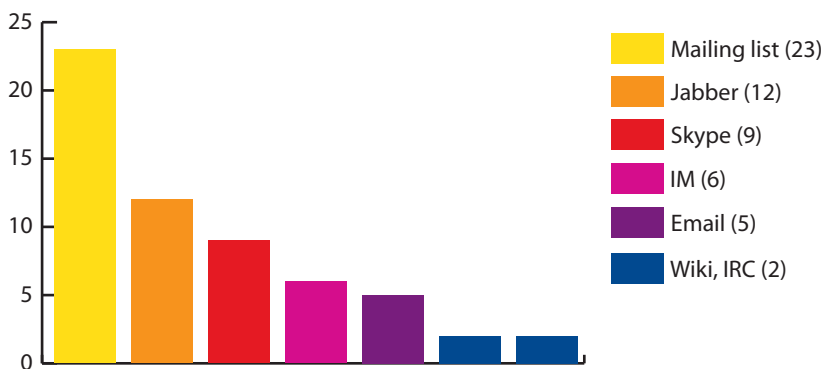
**Rancid:**

- I recommend rancid for backups;
- It does the job;
- Pros: for basic purpose, easy to use and reliable;
- Cons: somewhat simple. No advanced features that I'm aware of.

**In-house tool:**

- Pros: tailored for the institution;
- Cons: large effort required to maintain.

**6.9 Communication, coordination, chat**



**22 different tools are mentioned:**

- 1 is used by 23 institutions;
- 1 is used by 12 institutions;
- 1 is used by 9 institutions;
- 1 is used by 6 institutions;
- 1 is used by 5 institutions;
- 2 are used by 2 institutions;
- 15 are used by 1 institution.
- No tools were built in-house.

The tools used only by one organisation are: Adobe Connect, Davical, Desktop Video, EVO, Google Talk, HP Service Center, HP Service Manager, iChat, MSN Phone, Pidgin, Sametime, Scopia Desktop, VoIP, WebEx.

**2 of 32 answers gave reviews/recommendations:**

**Jabber:**

- Can be bad during an outage.

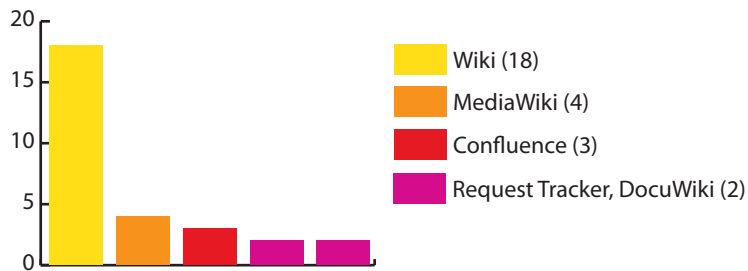
**Pidgin:**

- The use of rooms is the most useful feature of this tool.

### Mailing lists:

- For non-urgent issues.

## 6.10 Knowledge management / documentation



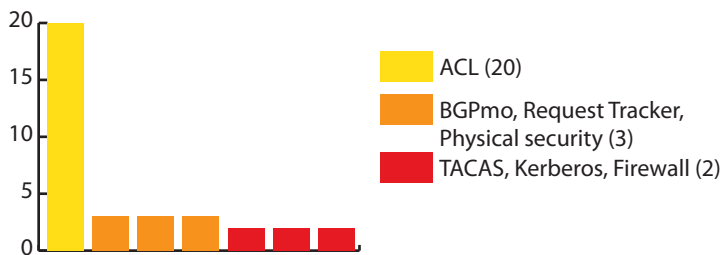
### 17 different tools are mentioned:

- 1 is used by 18 institutions;
- 1 are used by 4 institutions;
- 1 is used by 3 institutions;
- 1 is used by 2 institutions;
- 12 are used by 1 institution;
- 1 tool was built or developed in-house.

The tools used only by one organisation are: EditGrid, HP Service Center, In-house dev, Intranet (Web), Joomla, MoinMoin, Plone, SharePoint, SilverStripe, Telemator, TWiki, WordPress.

No reviews/recommendations on 31 answers.

## 6.11 Security management



### 25 different tools are mentioned:

- 1 is used by 20 institutions;
- 2 are used by 3 institutions;
- 3 are used by 2 institutions;
- 18 are used by 1 institution;
- 2 tools were built or developed in-house.

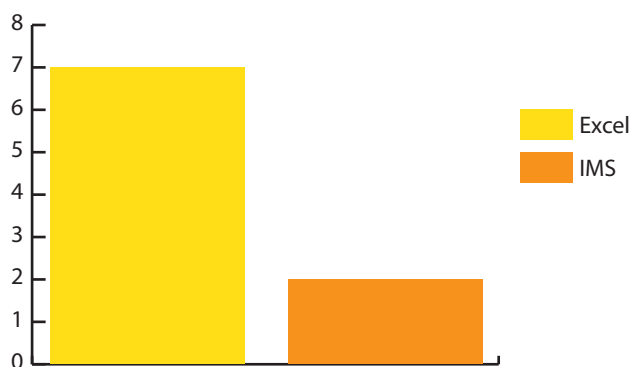
The tools used only by one organisation are: Bastion host, Copp, Cyclops, DNSSEC, Drupal based TTS, Firewall Builder, iBGPlay, ICmyNet.flow, KeePass, LDAP, NfSen, OTRS, Radius, Routing authentication, RtConfig, RTIR, Two-factor token, VPN.

1 of 32 answers gave a review:

### ACLs:

- Not good enough.

## 6.12 Inventory management



### 16 different tools are mentioned:

- 1 is used by 7 institutions;
- 2 are used by 2 institutions;
- 18 are used by 1 institution;
- 8 tools were built or developed in-house.

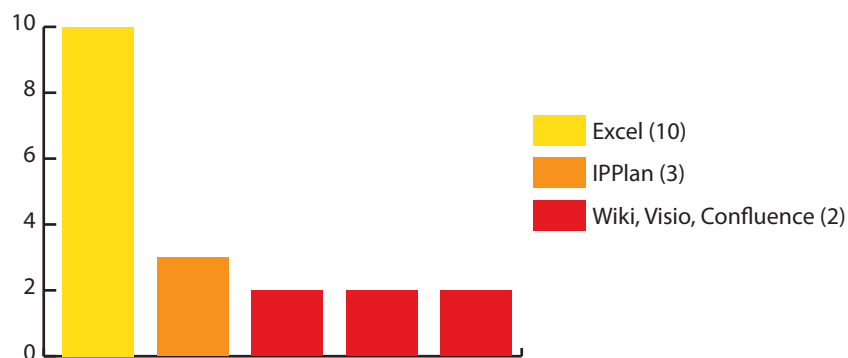
The tools used only by one organisation are: BCNET CMDB, BDCops, EditGrid, HP Service Desk, Insight Manager, LDAP, MOT2, Navision, NOClook, RANCID, Telemator, VC-4 CMDB, Wiki.

### 1 of 25 answers gave a review:

#### LDAP:

- Not great, very cumbersome.

## 6.13 Resource management



### 14 different tools are mentioned:

- 1 is used by 11 institutions;
- 2 are used by 3 institutions;
- 2 are used by 2 institutions;
- 9 are used by 1 institution, most of them are self-developed;
- 9 tools were built or developed in house: BCNET CMDB, Telise, MOT2, IP-range, racktables, Pinger, Access, Textfiles, Bdcops.

### 3 of 25 answers gave reviews/recommendations:

#### IPPlan:

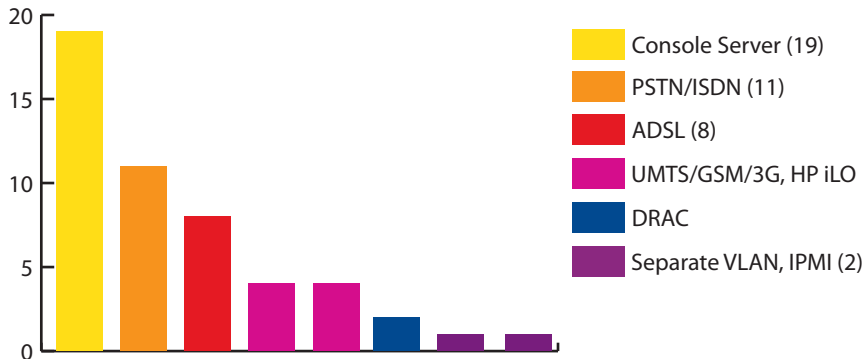
- It does not support IPv6, and we need to find a replacement;

- It is important to have registered all the resources, even in a basic way (text files).

**Visio:**

- Easy to use.

**6.14 Out-of-band access**



**6.15 Data aggregation, representation, visualisation**



**15 different tools are mentioned:**

- 2 are used by 3 institutions;
- 11 are used by 1 institution;
- 5 tools were built or developed in-house.

The tools used only by one organisation are: CMDB, Google maps, IMS, monALISA, Munin, NAV, NetFlow, Splunk, Stager, Zenoss, Zino.

**1 of 25 answers gave a review:**

**Weathermap:**

- Great way to show traffic on a high level.

**6.16 The most voted functionalities**

- Monitoring (36)
- Ticketing (34)
- Reporting and statistics (33)
- Communication, coordination and chat (32)
- Knowledge management and documentation (31)
- Out-of-band access (28)
- Problem management (27)

- Performance management (27)
- Configuration management and backup (25)
- Inventory management (25)
- Security management (24)
- Change management (18)
- Data aggregation, respresentation, visualisation (15)
- Resource management (10)

### **6.17 And the Oscar goes to...**

- Cacti and Nagios for Monitoring (11)
- Nagios for Problem management (11)
- Iperf for Performance management (13)
- Cacti for Reporting and Statistics (7)
- Request Tracker for Ticketing (12)
- Request Tracker for Change management (7)
- RANCID for Configuration management and backup (20)
- Mailing lists for Communication, coordination and chat (23)
- Wiki for Knowledge management and documentation (18)
- ACLs for Security Management (20)
- Excel for Inventory management (7)
- Excel for Resource management (10)
- Console Server for Out-of-Band Access (19)
- Cacti and Weathermap for Data aggregation (3)

**... Only if we do not take our self-developed tools into account!**

### **6.18 What we do in house**

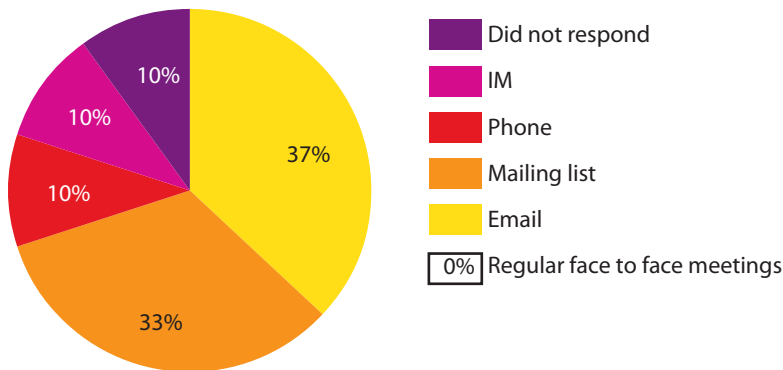
- Monitoring (13/36) 36%
- Ticketing (6/34) 17%
- Reporting and statistics (4/33) 12%
- Communication, coordination and chat (0/32) 0%
- Knowledge management and documentation (1/31) 3%
- Out-of-band access (0/28) 0%
- Problem management (2/27) 7%
- Performance management (2/27) 7%
- Configuration management and backup (3/25) 12%
- Inventory management (8/25) 32%
- Security management (1/24) 4%
- Change management (7/18) 39%
- Data aggregation (5/15) 33%
- Resource management (9/10) 90%

## 7 Communication and front end

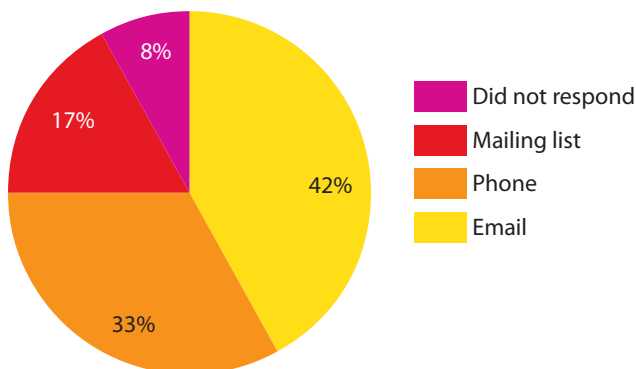
### 7.1 Is there any function and/or tool that your NOC uses that is not covered here?

- Client portal also implemented using the BCNET CMDB and a custom confluence plugin;
- Release management: to keep track of all equipment soft- and hardware releases at the vendor site. End Of support/manufactured discontinued;
- Google Apps are used for holding restricted access documents and shared calendars. We are looking at project management tools that integrate with Google Apps;
- SMS alerting system Status displays at the NOC pymetric (homegrown routing simulation) distributed beacon servers (maalepaale);
- Our organisation “tails” all router log files to monitor event. These log files are aggregated to a single system where the appropriate messages are displayed and managed via Swatch.

### 7.2 What are the preferred ways of internal communication (within NOC)?

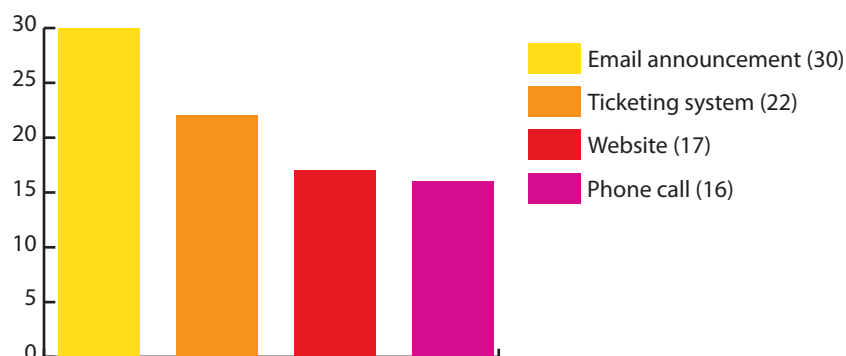


### 7.3 What are the preferred ways of external communication (outsourced functions, other departments, external suppliers, etc.)?





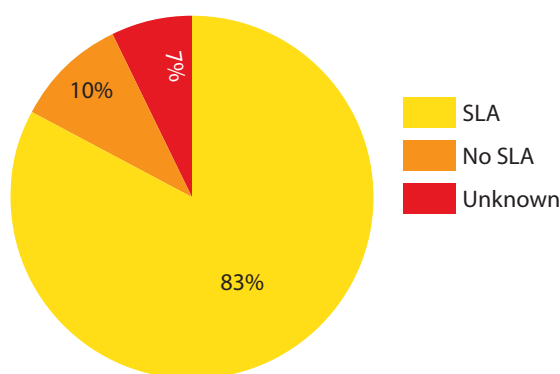
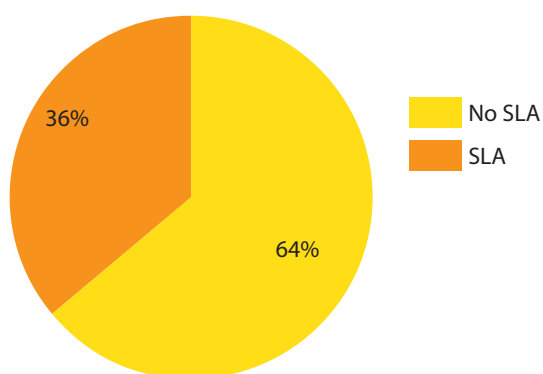
## 7.4 How does your NOC inform its customers about problems?



## 7.5 What kind of agreements (SLA) does your NOC (organisation) have...

...with customers

...with providers



Not many SLAs with customers, many SLAs with providers.

## 7.6 What kind of agreements (SLA) does your NOC (organisation) have with customers? How are they enforced and measured?

Responses showed that there are not many SLAs among the community, but where they are, they are measured by:

- The 'clarify' system used by support department;
- Customer satisfaction;
- Statistics / reports;
- Service incident reports sent to the management;
- Zabbix.

SLAs' are:

- Published in the contract with the customer;
- Published on a webpage/intranet (sometimes detailed SLA published internally on Wiki);
- Same SLA that is provided by the suppliers applies to the users as well;
- SLA is often measured in hours of availability according to the timers in the ticketing system.

## **7.7 What kind of agreements (SLA) does your NOC (organisation) have with suppliers? How are they enforced and measured?**

They measure:

- Availability of our services / downtime of links /time to fix a problem;
- Packet loss;
- Jitter;
- They cannot really enforce, just claim penalties in case of long outage.

Measured by:

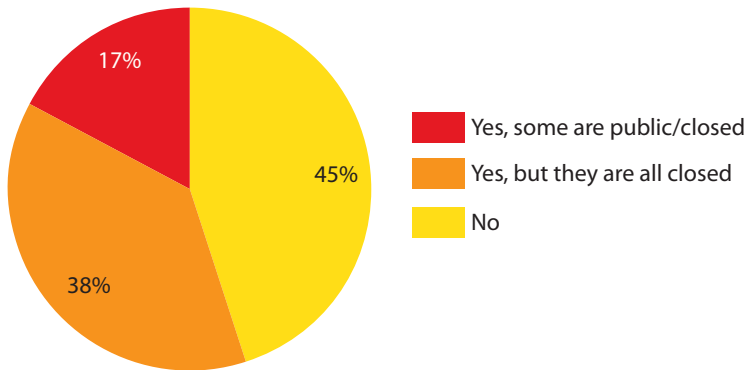
- Monthly reports;
- In-house software;
- NOC engineer;
- Ticket follow-up;
- Zabbix;
- monALISA;
- Cisco IP SLA;
- Nagios.

## **7.8 What is the main communication problem that your NOC wants to solve?**

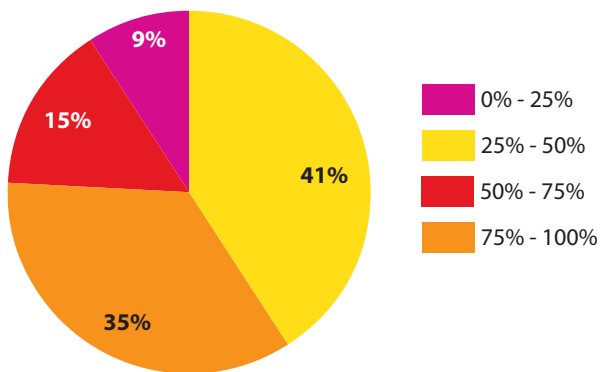
- Targeted outage notification, instead of a broadcast email;
- The volume of email (particularly for the senior engineers and manager) is very large;
- Customer contact information( connected customers) /reaching local contacts;
- RT;
- We could improve handover between NOC shifts better;
- Misunderstandings (e.g. language) when communicating with other NOCs;
- We are trying to enhance inter-NOC communication;
- Usage of several ticketing, tracking and information management systems;
- Integration of network management tools and communication tools;
- Faster and more frequent updates towards the customer;
- Process management;
- Internal and external ticket handover from/to NOC identifying and alerting affected customers on outages and planned work;
- Dissemination of new technologies from the engineering team to the NOC;
- Offered services awareness for the end users;
- Some of our connected institutions are small or with non technical staff. It is therefore difficult to establish procedures or talk about technical details;
- How to handle request tracker tickets for multidomain circuits;
- To have NOC staff call versus relying on a generic email for communications.

## 8 Collaboration and best practices

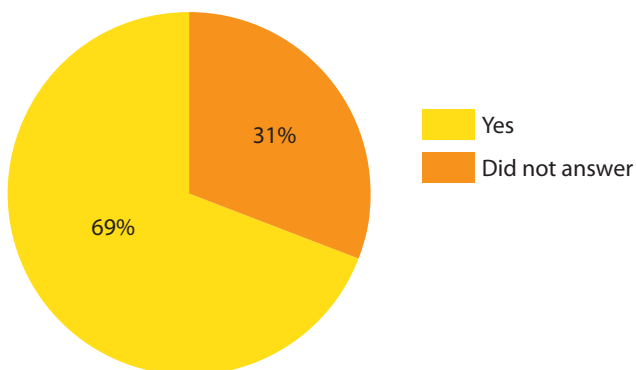
### 8.1 Do you have best common practice documents publicly available?



### 8.2 What percentage of the NOC procedures are documented?



### 8.3 Are you willing to collect/create best common practices?



## 9 Key conclusions and some recommendations from the survey

Sharing information and knowledge among existing NOCs is important, however, due to the strict – sometimes confidential – nature of NOC procedures this is not always a clear-cut task. The TERENA TF-NOC facilitates the face-to-face, informal discussions among NOC representatives (primarily acting in the research and education sector). In principle, participation is open to all, however, the list of actual meetings and mailing list attendees are filtered and monitored carefully by TERENA. This creates an optimal environment for NOC representatives to share experiences and knowledge.

The NOC surveying exercise clearly showed that different NOCs speak different languages. The actual operational tools, procedures, and practice highly depend on the taxonomy of the NOC. Standardisation efforts are therefore very important in order to harmonise procedures and facilitate inter-NOC communications.

The investigation about NOC tools highlighted that the most important NOC function is tight monitoring followed by ticketing and reporting of statistics. Among the concrete tools available, Cacti and Nagios were rated as the most popular and efficient monitoring and problem management tools. These tools can easily be tailored to the actual needs of the NOC as this is facilitated by their modular architecture and wide variety of plug-ins. The ‘Cacti and Nagios plugin fest’ organised by TF-NOC showed that there is significant interest in the NREN community to develop its own plugins.

This survey has collected the most important NOC tools (used by the community) and the associated NOC functions. It is now possible to dig deeper into a given tool or function and investigate more detailed experiences.

## Appendix I - NOC Tool Survey Results

### MONITORING

No. of users	Tool	User organisations
13	In-house dev	AMRES, ARNES, BCNET (Vancouver, Canada), CESCA, DFN-Verein, Funet, GARR, NORDUnet, NTUA, PSNC - PIONIER and POZMAN operator, RESTENA, SWITCH, USLHCNET
11	Cacti	AARNIEC - RoEduNet, ARNES, BCNET (Vancouver, Canada), CARNet, CESCA, DANTE, FCCN, Netsumo Ltd, NTUA, SigmaNet, TSSG/WIT
11	Nagios	Belnet, DFN-Verein, FCCN, Funet, GRNET, Netsumo Ltd, NIIFI, NORDUnet, NTUA, RESTENA, SWITCH
8	NfSen	AARNIEC - RoEduNet, ARNES, CARNet, Netsumo Ltd, NIIFI, RESTENA, SigmaNet, RESTENA
8	MRTG	CESCA, DFN-Verein, IUCC, KazRENA, RedIRIS, RESTENA, SigmaNet, TSSG/WIT
5	NetFlow	CARNet, GARR, IUCC, SWITCH, TSSG/WIT
4	Looking Glass	AARNIEC - RoEduNet, DFN-Verein, PSNC - PIONIER and POZMAN operator, SigmaNet
4	OpenView	Belnet, DFN-Verein, GRNET, PSNC - PIONIER and POZMAN operator
4	Zenoss	CARNet, SURFnet, Telindus-Isit, Telindus-ISIT (operating for SURFnet)
3	Icinga	ARNES, DFN-Verein, Netsumo Ltd
3	SmokePing	CESCA, Netsumo Ltd, PSNC - PIONIER and POZMAN operator
3	Spectrum	CERN, Esnet, TVC SA
3	Syslog	AMRES, ARNES, CARNet
3	Weathermap	AARNIEC - RoEduNet, CARNet, SWITCH
3	Zino	Funet, NORDUnet, UNINETT
2	Cricket	NIIFI, SWITCH
2	InterMapper	BCNET (Vancouver, Canada), DANTE
2	Logging	NIIFI, RESTENA
2	nfdump	ARNES, DFN-Verein
2	perfSONAR	CESCA, USLHCNET
2	RANCID	CARNet, Telindus-Isit
<p>Tools used by only one organisation: Alcatel NMS, BCNET CMDB, Beacon, Big Brother, Ciena NMS, Ciena Preside, Cisco IPSLA, Cisco EEM, DUDE, Equipment specific NMS, Fluxoscope, FSP Network Manager, GARR Integrated, Hobbit, Monitoring Suite, ICmyNet.Flow, ICmyNet.IS, Kayako, Lambda Monitor, monALISA, Munin, NAV, Netcool, NetScout, Network Node Manager, NFA, NMIS, ntop, Observium, OpManager, Racktables, SMARTxAC, Splunk, TrapMon, WUG, Zabbix</p>		

## TICKETING

No. of users	Tool	User organisations
12	Request tracker	AARNIEC - RoEduNet, AMRES, CARNet, CESCO, Funet, IUCC, KazRENA, RedIRIS, SigmaNet, TSSG/WIT, UNINETT, USLHCNET
6	In-house dev	DFN-Verein, GARR, NIIFI, NTUA, PSNC - PIONIER and POZMAN operator, SWITCH
3	ARS	SURFnet, Telindus-Isit, Telindus-ISIT (operating for SURFnet)
3	Jira	BCNET (Vancouver, Canada), GRNET, NORDUnet
3	OTRS	ARNES, DFN-Verein, RESTENA
2	ServiceNow	CERN, ESnet
Tools used by only one organisation: BMC Service Express, EasyVista, HP Service Center, HP Service Desk, HP Service Manager, Kayako Help Desk		

## REPORTING AND STATISTICS

No. of users	Tool	User organisations
7	Cacti	AARNIEC - RoEduNet, ARNES, CESCO, DANTE, Netsumo Ltd, NTUA, SigmaNet
6	MRTG	Belnet, CESCO, GRNET IUCC, NTUA, PSNC - PIONIER and POZMAN operator
6	Nagios	DFN-Verein, Esnet, Funet, KazRENA, NORDUnet, TSSG/WIT
4	In-house dev	CARNet, NTUA, SWITCH, Telindus-Isit
3	NfSen	ARNES, Netsumo Ltd, NIIFI
2	CA Spectrum	CERN, ESnet
2	Munin	GRNET, UNINETT
2	Zenoss	CARNet, Telindus-ISIT (operating for SURFnet)
2	Zino	NORDUnet, UNINETT
Tools used by only one organisation: BCNET CMDB, Business Object Data Marts, Confluence, Cricket, Excel, GINS, HP Service Desk, Hobbit, Icinga, ICmyNet.IS, InfoVision, Jira, monALISA, MSR, NetFlow, SmokePing, Splunk, Stager, StorSentry, Zabbix		

## COMMUNICATION, COORDINATION AND CHAT

No. of users	Tool	User organisations
23	Mailing list	AMRES, ARNES, CARNet, CERN, CESCA, DANTE, DFN-Verein, Esnet, Funet, GARR, IUCC, KazRENA, Netsumo Ltd, NIIFI, NORDUnet, NTUA, PSNC - PIONIER and POZMAN operator, SigmaNet, SURFnet, Telindus-Isit, TSSG/WIT, TVC SA, USLHCNET
12	Jabber	Belnet, CARNet, CESCA, DFN-Verein, GRNET, NIIFI, NORDUnet, NTUA, PSNC - PIONIER and POZMAN operator, RedIRIS, TSSG/WIT, UNINETT
9	Skype	CARNet, CESCA, DANTE, GARR, NIIFI, NORDUnet, NTUA, PSNC - PIONIER and POZMAN operator, SigmaNet
6	IM	ARNES, BCNET (Vancouver, Canada), Esnet, KazRENA, RESTENA, SURFnet
5	Email	NORDUnet, RESTENA, SIAMCO, Telindus-ISIT (operating for SURFnet), TVC SA
2	IRC	Netsumo Ltd, UNINETT
2	Wiki	BCNET (Vancouver, Canada), DFN-Verein
Tools used by only one organisation: Adobe Connect, Davical, Desktop Video, EVO, Google Talk, HP Service Center, HP Service Manager, iChat, MSN Phone, Pidgin, Sametime, Scopia Desktop, VoIP, WebEx		

## KNOWLEDGE MANAGEMENT AND DOCUMENTATION

No. of users	Tool	User organisations
18	Wiki	AARNIEC - RoEduNet, ARNES, Belnet, Esnet, Funet, GARR, GRNET, IUCC, NIIFI, PSNC - PIONIER and POZMAN operator, RESTENA, SigmaNet, SURFnet, SWITCH, Telindus-Isit, Telindus-ISIT (operating for SURFnet), UNINETT, USLHCNET
4	MediaWiki	CARNet, DFN-Verein, PSNC - PIONIER and POZMAN operator, USLHCNET
3	Confluence	BCNET (Vancouver, Canada), NORDUnet, TVC SA
2	DocuWiki	Netsumo Ltd, SWITCH
Tools used by only one organisation: EditGrid, HP Service Center, In-house dev, Intranet (Web), Joomla, MoinMoin, Plone, SharePoint, SilverStripe, Telemator, TWiki, WordPress		

## OUT-OF-BAND ACCESS

No. of users	Tool	User organisations
19	Console Servers	ARNES, CARNet, CERN, DFN-Verein, ESnet, Funet, GRNET, KazRENA, Netsumo Ltd, NIIFI, NORDUnet, NTUA, PSNC - PIONIER and POZMAN operator, RESTENA, SURFnet, SWITCH, TSSG/WIT, UNINETT, USLHCNET
11	PSTN/ISDN modem	ARNES, Belnet, CARNet, DFN-Verein, Esnet, GARR, GRNET, IUCC, SWITCH, UNINETT, USLHCNET
8	ADSL	CESCA, GARR, GRNET, KazRENA, Netsumo Ltd, RedIRIS, SWITCH, TVC SA
4	HP iLO	NTUA, RESTENA, TVC SA, UNINETT
4	UMTS/GSM/3G	ARNES, FCCN, NIIFI, SWITCH
2	DRAC	NORDUnet, NTUA
Tools used by only one organisation: IPMI, Separate VLAN		

## PERFORMANCE MANAGEMENT

No. of users	Tool	User organisations
13	lperf	AMRES, ARNES, Belnet, CESCA, DFN-Verein, FCCN, GARR, KazRENA, NIIFI, NTUA, RedIRIS, SURFnet, Telindus-ISIT (operating for SURFnet)
9	NDT	AMRES, ARNES, Belnet, CESCA, DFN-Verein, GARR, NTUA, RESTENA, SWITCH
7	perfSONAR	BCNET (Vancouver, Canada), DFN-Verein, USLHCNET, Esnet, NIIFI, RedIRIS, SWITCH
2	BWCTL	FCCN, GARR
2	Hades	DFN-Verein, GARR
2	In-house	IUCC, USLHCNET
2	MRTG	DFN-Verein, IUCC
2	RIPE TTM	DFN-Verein, NIIFI
2	SmokePing	DFN-Verein, SWITCH
2	Zino	NORDUnet, UNINETT
These tools received only one vote: Atlas, BC NET CMDB, Cisco IPSLA, dynaTrace, IPPM, Jitter, MGEN, Munin, Nagios, nfdump, NetFlow, NetMinder, OpsMgr, OWAMP, Ping, Prosilent, QoS, Speedtest, StorSentry, Traceroute, tcpdump, Wireshark, Zenoss		



### CONFIGURATION MANAGEMENT AND BACKUP

No. of users	Tool	User organisations
20	RANCID	AARNIEC - RoEduNet, ARNES, BCNET (Vancouver, Canada), Belnet, CARNet, CESCO, DANTE, DFN-Verein, GARR, GRNET, Telindus-Isit, Netsumo Ltd, NIIFI, NORDUnet, NTUA, RESTENA, SURFnet, SWITCH, TSSG/WIT, USLHCNET
3	CVS	NIIFI, NTUA, SWITCH
3	In-house dev	CERN, DANTE, DFN-Verein
3	Subversion	ARNES, RESTENA, TSSG/WIT
2	IMS	SURFnet, Telindus-ISIT (operating for SURFnet)
These tools received only one vote: CFEngine, CiscoWorks, NetBackup, ViewVC		

### INVENTORY MANAGEMENT

No. of users	Tool	User organisations
8	Excel	AMRES, BCNET (Vancouver, Canada), CESCO, IUCC, NIIFI, PSNC - PIONIER and POZMAN operator, SigmaNet, TVC SA
8	In-house dev	ARNES, CARNet, CERN, DFN-Verein, GARR, GRNET, i2CAT, RedIRIS
2	IMS	SURFnet, Telindus-ISIT (operating for SURFnet)
These tools received only one vote: BCNET CMDB, BDCops, EditGrid, HP Service Desk, Insight Manager, LDAP, MOT2, Navision, NOClook, RANCID, Telemator, VC-4 CMDB, Wiki		

### CHANGE MANAGEMENT

No. of users	Tool	User organisations
7	In-house dev	ARNES, CARNet, DFN-Verein, IUCC, NIIFI, Telindus-Isit, Telindus-ISIT (operating for SURFnet),
7	Request Tracker	AARNIEC - RoEduNet, CESCO, CARNet, Funet, KazRENA, UNINETT, USLHCNET
2	Confluence	DANTE, NORDUnet
These tools received only one vote: EditGrid, HP Service Manager, RANCID, Redmine, Savannah, SharePoint, Telemater, Trac, VC-4 CMDB		

## SECURITY MANAGEMENT

No. of users	Tool	User organisations
20	ACL	AARNIEC - RoEduNet, AMRES, ARNES, CARNet, CESCA, DFN-Verein, Esnet, GARR, GRNET, IUCC, KazRENA, Netsumo Ltd, NIIFI, NORDUnet, PSNC - PIONIER and POZMAN operator, RESTENA, SigmaNet, SWITCH, TSSG/WIT, USLHCNET
3	BGPmon	AARNIEC - RoEduNet, CESCA, IUCC
3	Physical Security	CARNet, PSNC - PIONIER and POZMAN operator, TSSG/WIT
2	Firewall	RESTENA, USLHCNET
2	In-house dev	DFN-Verein, NIIFI
2	Kerberos	NORDUnet, TVC SA
2	Request Tracker	AARNIEC - RoEduNet, AMRES
2	TACAS	NORDUnet, PSNC - PIONIER and POZMAN operator

These tools received only one vote: Bastion host, Copp, Cyclops, DNSSEC, Drupal based TTS, Firewall Builder, iBGPlay, ICmyNet.flow, KeePass, LDAP, NfSen, OTRS, Radius, Routing authentication, RtConfig, RTIR, Two-factor token, VPN

## DATA AGGREGATION, REPRESENTATION, VISUALISATION

No. of users	Tool	User organisations
5	In-house dev	GARR, GRNET, NTUA, RESTENA, TVC SA
4	mrtg, RRD	ARNES, GRNET, RESTENA, UNINETT
3	Cacti	FCCN, GRNET, NTUA
3	Weathermap	BCNET (Vancouver, Canada), CARNet, FCCN

These tools received only one vote: CMDB, Google maps, IMS, monALISA, Munin, NAV, NetFlow, Splunk, Stager, Zenoss, Zino

## RESOURCE MANAGEMENT

No. of users	Tool	User organisations
10	Excel	AARNIEC - RoEduNet, AMRES, ARNES, BCNET (Vancouver, Canada), CESCA, KazRENA, PSNC - PIONIER and POZMAN operator, RedIRIS, SigmaNet, TVC SA
7	In-house dev	CARNet, CERN, DFN-Verein, GARR, GRNET, NTUA, Telindus-Isit
3	IPPlan	AARNIEC - RoEduNet, Netsumo Ltd, USLHCNET
2	Confluence	NORDUnet, TVC SA
2	Visio	CESCA, USLHCNET
2	Wiki	BCNET (Vancouver, Canada), RESTENA
These tools received only one vote: Access, BCNET CMDB, BDCops, IP-range, MOT2, Pinger, Racktables, Telise, Textfiles		



## Appendix III - TF-NOC survey questions

### TF-NOC survey

The TERENA Task Force on Network Operation Centres (TF-NOC) wants to collect information about the **software tools that NOCs use** to operate networks and services. The survey can be completed by either the NOC responsible for network operations or by the NOC responsible for both network and service operations. Since the survey is mainly focusing on tools and operation practices it is recommended to be filled out by an **experienced NOC engineer** who has an overview on the whole NOC operations.

There are 54 questions in this survey

#### Basic information

##### 1 [1]Name (acronym) of your organisation \*

Please write your answer here:

##### 2 [3]What is your role at your organisation

Please choose **only one** of the following:

- Technical Manager, CTO
- Operational Manager, COO
- NOC manager
- NOC engineer
- NOC operator
- Software/System engineer, developer
- System administrator
- IT/Network specialist, architect
- Service specialist, architect
- Other

##### 3 [2]Type (range) of the network that your organisation is responsible for

Please choose **all** that apply:

- Wide area network, among several countries
- National research and education network (NREN)
- Regional, metropolitan network
- Campus, university network
- Specific research network (any range)
- Commercial network (any range)
- Other:

## NOC taxonomy

### 4 [5]How is your NOC organised?

Please choose **only one** of the following:

- fully outsourced
- partly outsourced/inhouse
- fully inhouse

### 5 [4]How is your in-house NOC structured?

**Only answer this question if the following conditions are met:**

\* Answer was 'fully inhouse' or 'partly outsourced/inhouse' at question '4 [5]' (How is your NOC organised?)

Please choose **only one** of the following:

- Distributed (multiple locations)
- Centralised (single location)

### 6 [7]What is the average year of expertise that your NOC personnel have?

Please choose **only one** of the following:

- 0-1 years
- 1-3 years
- 3-6 years
- 6-10 years
- 10+ years

### 7 [6]Are you measuring NOC performance, if so how?

Please write your answer here:

e.g. using KPIs (Key Performance Indicators)

### 8 [41]How is your in-house NOC staffed?

**Only answer this question if the following conditions are met:**

\* Answer was 'partly outsourced/inhouse' or 'fully inhouse' at question '4 [5]' (How is your NOC organised?)

Please choose **all that apply**:

- fixed staff
- staff on rotation basis
- staff on call

Other:

### 9 [1]What are the usual working hours for NOC personnel?

**9 [1]What are the usual working hours for NOC personnel?**

	In-house	Outsourced
Tier-1 front end	<input type="text"/>	<input type="text"/>
Tier-2 engineers	<input type="text"/>	<input type="text"/>
Tier-3 senior engineers, design/planning	<input type="text"/>	<input type="text"/>

E.g., 24x7, 9:00-17:00, weekends

**Network and Services**

**10 [3]What kind of services is your NOC responsible for?**

Please choose all that apply:

- lambda services
- connection (SDH/Eth/MPLS) services
- switched/routed services
- server hosting
- DNS
- certificate services
- federation
- eduroam
- video conferencing
- e-mail
- Other:

**11 [8]Please describe the size of your network and the number of services offered on the network**

Please write your answer here:

Number of PoPs, locations, links, equipment, virtual machines, services managed by the NOC, etc...

**12 [5]How many and what kind of organizations and users are connected to your network?**

Please write your answer here:

Number of universities, research institutes or end-users, students, etc.

**13 [6] Does your NOC use any methodology or follow any standard based procedures**

Please choose all that apply:

- ISO
- eTOM
- ITIL
- OSSTMM

**14 [7] If yes, what triggered your organization to implement this methodology and what are your experiences using it?**

Please write your answer here:

**15 [1] Are you planning to implement some of the methodologies?**

Only answer this question if the following conditions are met:

° Answer was 'ITIL' at question '13 [6]' (Does your NOC use any methodology or follow any standard based procedures)

Please choose only one of the following:

- No plans yet
- Yes, we are about to pick one
- Maybe in the longer term

**NOC tools**

What kind of functions is your NOC responsible for (and what tools do you use for those functions)?

Please do note:

- If you use more than one tool for a given function, do not forget to specify all.
- If you use home-grown tools that are not commonly known, please include further reference.
- Feel free to share brief practical experience with each of the tools.

**16 [1] Monitoring**

Please choose only one of the following:

- Yes
- No

The term **network monitoring** describes the use of a system that constantly monitors a [network](#) or system for slow or failing components and that notifies the [network administrator](#) (via email, pager or other alarms) in case of outages. It is a subset of the functions involved in [network management](#).

It includes: Traffic monitoring, Fault monitoring, Physical Infrastructure monitoring, Flow monitoring, Routing monitoring, Multicast monitoring, Logging, etc.

Examples: MRTG, looking-glass

**17 [11] Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '16 [1]' (Monitoring)

Please write your answer here:



### 18 [2]Problem management

Please choose **only one** of the following:

- Yes
- No

**Problem Management** is the process responsible for managing the lifecycle of all problems. The primary objectives of [Problem Management](#) are to prevent problems and resulting [incidents](#) from happening, to eliminate recurring [incidents](#) and to minimize the impact of [incidents](#) that cannot be prevented.

Examples: Nagios, Zabbix

### 19 [21]Please specify your tool(s) and give some recommendations, review comments (if possible):

**Only answer this question if the following conditions are met:**

° Answer was 'Yes' at question '18 [2]' (Problem management)

Please write your answer here:

### 20 [3]Performance management

Please choose **only one** of the following:

- Yes
- No

*This entry describes performance management in an Information Technology context. See [Performance Management](#) for a description of performance management in a more general context.*

**IT performance management** is a term used in the [Information Technology \(IT\)](#) field, and generally refers to the monitoring and measurement of relevant [performance metrics](#) to assess the performance of IT resources. It can be used in both a business or [IT Management](#) context, and an [IT Operations](#) context

Examples: IPerf, perfSonar

### 21 [31]Please specify your tool(s) and give some recommendations, review comments (if possible):

**Only answer this question if the following conditions are met:**

° Answer was 'Yes' at question '20 [3]' (Performance management)

Please write your answer here:

### 22 [4]Reporting and statistics

Please choose **only one** of the following:

- Yes
- No

**Analysis of data** is a process of inspecting, cleaning, transforming, and modeling [data](#) with the goal of highlighting useful [information](#), suggesting conclusions, and supporting decision making. Data analysis has multiple facets and approaches, encompassing diverse techniques under a variety of names, in different business, science, and social science domains.

Examples: Cacti, Nagios

**23 [41]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '22 [4]' (Reporting and statistics)

Please write your answer here:

**24 [5]Ticketing**

Please choose **only one** of the following:

- Yes
- No

An **issue tracking system** (also **ITS**, **trouble ticket system**, **support ticket** or **incident ticket system**) is a [computer software](#) package that manages and maintains lists of [issues](#), as needed by an organization. Issue tracking systems are commonly used in an organization's [customer support call center](#) to create, update, and resolve reported customer issues, or even issues reported by that organization's other employees.

Examples: RT, Jira

**25 [51]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '24 [5]' (Ticketing)

Please write your answer here:

**26 [6]Change management**

Please choose **only one** of the following:

- Yes
- No

**Change Management** is an [IT Service Management](#) discipline. The objective of Change Management in this context is to ensure that standardized methods and procedures are used for efficient and prompt handling of all changes to control IT infrastructure, in order to minimize the number and impact of any related [incidents](#) upon service.

Examples: RT, Trac

**27 [61]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '26 [6]' (Change management)

Please write your answer here:

**28 [7]Configuration management and backup**

Please choose **only one** of the following:

- Yes
- No

**Configuration management (CM)** is a field of [management](#) that focuses on establishing and maintaining consistency of a system or product's performance and its functional and physical attributes with its requirements, design, and operational information throughout its life.

Examples: rancid, subversion

**29 [71]Please specify your tool(s) and give some recommendations, review comments (if possible):**

**Only answer this question if the following conditions are met:**  
° Answer was 'Yes' at question '28 [7]' (Configuration management and backup)

Please write your answer here:

**30 [8]Communication, coordination, chat**

Please choose **only one** of the following:

- Yes
- No

**Collaborative software** (also referred to as **groupware**, **workgroup support systems** or simply **group support systems**) is computer software designed to help people involved in a common task achieve their goals. It is usually associated with individuals not physically co-located, but instead working together across an internet connection. It can also include remote access storage systems for archiving common use data files that can be accessed, modified and retrieved by the distributed workgroup members.

Example: IM, mailing lists, skype

**31 [81]Please specify your tool(s) and give some recommendations, review comments (if possible):**

**Only answer this question if the following conditions are met:**  
° Answer was 'Yes' at question '30 [8]' (Communication, coordination, chat)

Please write your answer here:

**32 [9]Knowledge management / documentation**

Please choose **only one** of the following:

- Yes
- No

**Knowledge Management (KM)** comprises a range of strategies and practices used in an organization to identify, create, represent, distribute, and enable adoption of [insights](#) and [experiences](#). Such insights and experiences comprise [knowledge](#), either embodied in individuals or embedded in organizational [processes](#) or practice.

Examples: wiki, plone

**33 [91]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '32 [9]' (Knowledge management / documentation)

Please write your answer here:

**34 [10]Security management**

Please choose **only one** of the following:

Yes

No

**Security Management** is a broad field of management related to asset management, physical security and human resource safety functions. It entails the identification of an organization's information assets and the development, documentation and implementation of policies, standards, procedures and guidelines.

Examples: access-lists, RT, BGPMon

**35 [101]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '34 [10]' (Security management)

Please write your answer here:

**36 [11]Inventory management**

Please choose **only one** of the following:

Yes

No

An **inventory control system** is a process for managing and locating objects or materials. In common usage, the term may also refer to just [the software components](#).

Examples: excel, plone

**37 [111]Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '36 [11]' (Inventory management)

Please write your answer here:

**38 [12]Resource management**

Please choose **only one** of the following:

- Yes
- No

In [organizational studies](#), **resource management** is the efficient and effective deployment for an organization's resources when they are needed. Such resources may include financial resources, inventory, human skills, production resources, or information technology (IT).

Examples: excel, IPAM

**39 [121]Please specify your tool(s) and give some recommendations, review comments (if possible):**

**Only answer this question if the following conditions are met:**

° Answer was 'Yes' at question '38 [12]' (Resource management)

Please write your answer here:

**40 [13]Out-of-band access**

Please choose **only one** of the following:

- Yes
- No

In [computing](#), **out-of-band management** (sometimes called **lights-out management** or **LOM**) involves the use of a dedicated management channel for device maintenance. It allows a [system administrator](#) to monitor and manage [servers](#) and other network equipment by remote control regardless of whether the machine is powered on.

Examples: ADSL router, console server

**41 [131]Please specify your tool(s) and give some recommendations, review comments (if possible):**

**Only answer this question if the following conditions are met:**

° Answer was 'Yes' at question '40 [13]' (Out-of-band access)

Please write your answer here:

**42 [14]Data aggregation, representation, visualization**

Please choose **only one** of the following:

- Yes
- No

Aggregate live data from various tools and represent/visualize them in a human readable way.

Examples: SNAPP

**43 [141] Please specify your tool(s) and give some recommendations, review comments (if possible):**

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '42 [14]' (Data aggregation, representation, visualization)

Please write your answer here:

**44 [15] Is there any function and/or tool that your NOC use that is not covered here?**

Please write your answer here:

**Communication / front-end**

**45 [1] What are the preferred ways of internal communication (within NOC)?**

Please number each box in order of preference from 1 to 10

- regular fact to face meetings
- phone
- e-mail
- e-mail list
- skype
- video conferene
- web conference
- instant messaging
- telefax
- telepresence

**46 [2]What are the preferred ways of external communication (outsourced functions, other departments, external suppliers, etc...)?**

Please number each box in order of preference from 1 to 10

- regular face to face meetings
- phone
- e-mail
- e-mail list
- skype
- video conference
- web conference
- instant messaging
- telefax
- telepresence

**47 [4]How does your NOC inform its customers about problems?**

Please choose all that apply:

- website
- e-mail announcement
- phone call
- ticketing system
- Other:

**48 [5]What kind of agreements (SLA) does your NOC (organization) have with customers, how are they enforced and measured?**

Please write your answer here:

e.g. SLAs published on internal wiki with monthly statistical followups

**49 [6]What kind of agreements (SLA) does your NOC (organization) have with suppliers, how are they enforced and measured?**

Please write your answer here:

e.g. SLAs published on internal wiki with monthly statistical followups

**50 [10]**

**What is the main communication problem that your NOC wants to solve?**

Please write your answer here:

## Collaboration / best common practices

### 51 [3]What percentage of the NOC procedures are documented?

Please choose **only one** of the following:

- 0% - 50%
- 50% - 70%
- 70%-80%
- 80%-90%
- 90% - 95%
- 95% - 99%
- 99% - 100%

### 52 [1]Do you have best common practice documents publicly available?

Please choose **only one** of the following:

- Yes, but those are all closed
- Yes, some of them are public/closed
- Yes, and those are all public
- No, don't have

### 53 [2]Are you willing to collect/create best common practices?

Please choose **only one** of the following:

- Yes
- No

## Closing

### 54 [3]If you want to be informed about the survey results, please, leave your e-mial address:

Please write your answer here: