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**DISTRIBUTED EUROPEAN INFRASTRUCTURE FOR  
SUPERCOMPUTING APPLICATIONS**

**European Community Sixth Framework Programme**  
**RESEARCH INFRASTRUCTURES**  
Integrated Infrastructure Initiative

Provision of a permanent monitoring tool for the DEISA net-  
work infrastructure

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| <b>RE</b>  | Restricted to a group specified by the consortium (including the Commission Ser- |   |
| <b>CO</b>  | Confidential, only for members of the consortium (including the Commission Ser-  |   |
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## Project and Deliverable Information Sheet

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## Document Control Sheet

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|                   | <b>Contributors:</b>  | NN  |       |
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| <b>Keywords:</b> | DEISA, high performance network infrastructure, “dedicated” network, network monitoring, SNMP, MRTG   |
| <b>Abstract:</b> | <p>The Service Activity 1 – Network Operation and Support is responsible for deploying the high performance network infrastructure for DEISA. In phase 1 of the project the main task has been the deployment of the infrastructure for all DEISA sites. The infrastructure is based on the tight coupling - using virtually dedicated bandwidth network interconnects (GEANT Premium IP service) - of supercomputer systems at DEISA sites, to provide a distributed supercomputing platform operating in multi-cluster mode.</p> <p>The network infrastructure is in most parts fully operational including services to measure performance and monitor the status.</p> <p>This document describes the provisioned permanent monitoring tool for the DEISA network infrastructure in detail. The implemented services, the provided information as well as the access to the information will be described.</p> |

Project and Deliverable Information Sheet; Document Control Sheet; Document Status Sheet; and Document Keywords and Abstract are internal handling information, which will be suppressed from the document prior to the submission of the deliverable to the EU.

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# 1. Introduction

## 1.1 *Executive Summary*

The Service Activity 1 – Network Operation and Support is responsible for deploying the high performance network infrastructure for DEISA. In phase 1 of the project the main task has been the deployment of the infrastructure for all DEISA sites. The infrastructure is based on the tight coupling - using virtually dedicated bandwidth network interconnects (GEANT Premium IP service) - of supercomputer systems at DEISA sites, to provide a distributed supercomputing platform operating in multi-cluster mode.

The network infrastructure is in most parts fully operational including services to measure performance and monitor the status.

This document describes the provisioned permanent monitoring tool for the DEISA network infrastructure in detail. The implemented services, the provided information as well as the access to the information will be described.

## 1.2 *References and Applicable Documents*

- [1] Distributed European Infrastructure for Supercomputer Applications, <http://www.deisa.org>
- [2] DEISA User and Network Administrator Monitoring Interface, <http://wwwnet.deisa.fz-juelich.de>
- [3] GÉANT - GÉANT/Dante description of the Premium IP service, <http://www.dante.net/server/show/nav.00700a003>
- [4] iperf – Network performance test program developed by NLANR (National Laboratory for Applied Network Research, [www.nlanr.net](http://www.nlanr.net)).
- [5] fping – advanced ping interface for two way delay measurement originally implemented by Roland J. Schemers III, Stanford University, <http://www.fping.com>
- [6] MRTG - The Multi Router Traffic Grapher by Tobias Oetiker from ETH Zürich, Switzerland, <http://people.ee.ethz.ch/~oetiker/webtools/mrtg/>
- [7] CGI - Common Gateway Interface - Standard for external gateway programs to interface with information servers such as HTTP servers, NCSA, <http://hoohoo.ncsa.uiuc.edu/cgi/intro.html>
- [8] M.Mathis, R.Reddy, J.Mahdavi, Advanced Network computing – Enabling High Performance, Data Transfers, <http://www.psc.edu/networking/projects/tcptune/>, March 2005

### **1.3 Document Amendment Procedure**

### **1.4 List of Acronyms and Abbreviations**

|             |                                    |
|-------------|------------------------------------|
| <b>NREN</b> | National Research Network          |
| <b>LSP</b>  | Label Switched Path                |
| <b>SNMP</b> | Simple Network Management Protocol |
| <b>MRTG</b> | Multi Router Traffic Grapher tool  |
| <b>CGI</b>  | Common Gateway Interface           |

## **2. A monitoring tool for the DEISA network infrastructure**

### **2.1 Overview of the DEISA network infrastructure**

The Service Activity 1 – Network Operation and Support is responsible for deploying the high performance network infrastructure for DEISA. In phase 1 of the project the main task has been the deployment of the infrastructure for all DEISA sites. The infrastructure is based on the tight coupling - using virtually dedicated bandwidth network interconnects (GEANT Premium IP service [3]) - of supercomputer systems at DEISA sites, to provide a distributed supercomputing platform operating in multi-cluster mode.

The network infrastructure is in most parts fully operational including services to measure performance and monitor the status.

This document describes the implemented permanent monitoring tool for the DEISA network infrastructure in detail. The implemented services, the provided information as well as the access to the information will be described.

The full deployment of the dedicated DEISA [1] network infrastructure has proceeded in several steps, following the evolutions of the national and European research network infrastructures, and the adoption of the infrastructure by the user communities. During the first phase of the project, an initial high performance network infrastructure has been deployed as a “proof of concept” connecting four supercomputer systems at CINECA (Italy), FZJ (Germany), IDRIS (France) and RZG (Germany) in Q3 of 2004.

In April 2005 the fifth supercomputer system located at SARA (The Netherlands) has been connected. SARA has been the first site not using an IBM supercomputer system that has been connected to DEISA and this has been the first step on the way to heterogeneity.

Within the first week of July CSC, Espoo, Finland and LRZ, Munich, Germany have been connected to the DEISA infrastructure also. In the future an extension of the network to the DEISA sites ECMWF at Reading, UK, HLRS at Stuttgart, Germany, BSC at Barcelona, Spain, and EPCC at Edinburgh, UK, is planned.

The current DEISA “dedicated” network uses services of the national research networks DFN, Funet, GARR, NORDUnet, RENATER and SURFnet as well as the European research network GÉANT.

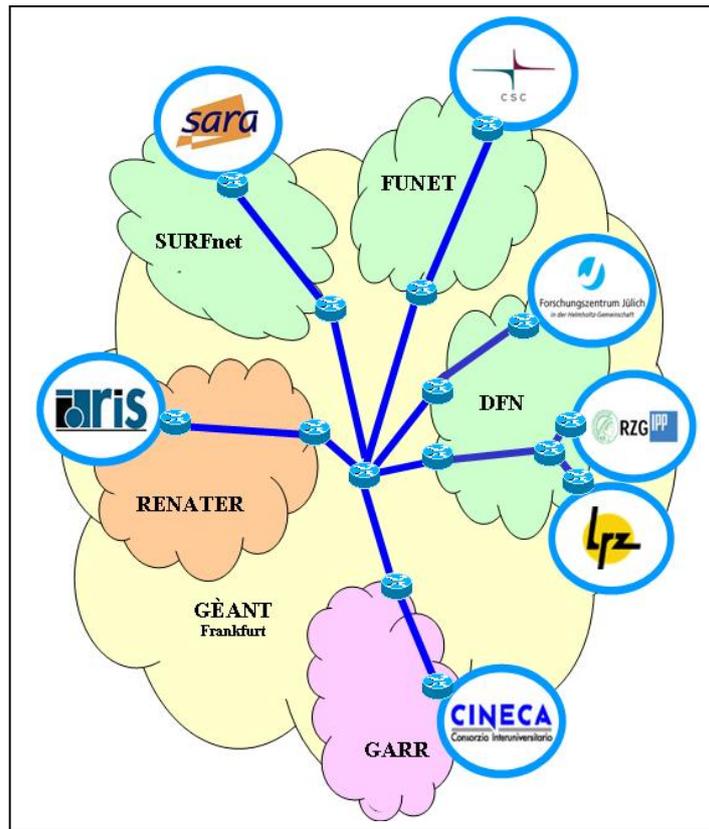


Figure 1: “Dedicated” DEISA network infrastructure (July 2005)

## 2.2 Web based network information access

The DEISA dedicated network involves the seven sites CSC, CINECA, FZJ, IDRIS, LRZ, RZG and SARA currently. Each site is connected with a 1 Gb/s communication link via its local NREN to the GEANT backbone. Within the GEANT backbone the different NRENs are linked via LSPs (label switched path). The logical configuration of the DEISA “dedicated” network infrastructure is sketched in Figure 1 above.

A detailed description of the network infrastructure has been given in D-SA1-1.2, “Provision of a high performance network infrastructure (all sites)”.

The main web page which is accessible via <http://wwwnet.deisa.fz-juelich.de> by authorized persons only is divided into several independent parts.

Part one lists links to the different supercomputer sites involved in DEISA (DEISA partners) to give fast access to site specific information or contact persons.

Part two provides access to topology maps of the sites connected to the DEISA infrastructure. Here detailed networking information is available concerning local configuration and topology.

Link statistics from local DEISA sites are available at the third part of the web site.

Through the links provided in part four of the main DEISA network page information about GEANT and involved NRENs as well as link statistics can be accessed.

The next two sections provide information about network staff members at the different DEISA sites to be contacted in case of network problems (“DEISA network staff: contacts”) and about the used DEISA IP address space (subnets of the DEISA sites, “DEISA network addressing: DEISA IP address ranges”). Information concerning the connected supercomputer systems may be accessed under the last topic “supercomputer at DEISA sites”.

Home | Project Organisation | Partners

# DEISA

DISTRIBUTED EUROPEAN INFRASTRUCTURE FOR SUPERCOMPUTING APPLICATIONS

DEISA Supercomputing Grid Infrastructure | **Project Organisation** | Users' Corner | Press Corner | News & Events | Links

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**DEISA supercomputer sites connected to the DEISA network infrastructure**

- CSC - Finnish Information Technology Centre for Science (CSC), Espoo, Finland
- CINECA - Consorzio Interuniversitario (CINECA), Bologna, Italy
- FZJ - Forschungszentrum Jülich, Germany
- National Supercomputer Centre "John von Neumann-Institute for Computing (NIC)"
- IDRIS - Institut du Développement et des Ressources en Informatique Scientifique (IDRIS-CNRS), Orsay, France
- LRZ - Leibniz Computing Centre of the Bavarian Academy of Sciences and Humanities, München, Germany
- RZG - Rechenzentrum Garching of the Max Planck Society, Garching, Germany
- SARA Computing and Networking Services, Amsterdam, The Netherlands.

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**DEISA network topology maps**

- DEISA "proof of concept phase" topology
- DEISA "current" topology
- DEISA site specific network configurations
  - DEISA-SC-Layout-FZJ (jpg)
  - DEISA-SC-Layout-RZG (jpg)
  - DEISA-SC-Layout-CINECA (jpg)
  - DEISA-SC-Layout-IDRIS (jpg)
  - DEISA-SC-Layout-CSC (png)
  - DEISA-SC-Layout-GEANT (jpg)

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**Link statistics at local DEISA sites**

- **Stats collected at Jülich:**
  - DEISA partitions reachability
  - DEISA network statistics at FZ-Jülich
  - DEISA performance test matrix
  - DEISA Iping Round Trip Times matrix
- **Stats collected at Garching**
  - Interface statistics Router DFN-Garching
  - Tests made at Garching by Klaus Desinger
- **Stats collected at IDRIS**
  - DEISA network statistics at IDRIS
- **Stats collected at Bologna:**
  - Interface statistics Router GARR-Cineca
  - Interface statistics Cisco Switch Cineca

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**Links to Geant and the NRENS currently providing services to DEISA**

- GEANT - Europe
  - GEANT - General network tools portal
  - GEANT - DEISA - Network tool portal (day statistics)
  - GEANT - DEISA - Network tool portal (week statistics)
  - GEANT - DEISA - Network tool portal (month statistics)
  - GEANT - DEISA - Network tool portal (yearly statistics)
- DFN -Germany
- RENATER - France
- GARR - Italy
- SURFnet - The Netherlands
- NORDUnet - Scandinavia
- FUNet - Finland

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**DEISA network staff: Contacts**

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**DEISA network addressing: DEISA IP address ranges**

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**Supercomputer at DEISA sites**

- Supercomputer at Research Center Jülich, Germany
- Supercomputer at RZG Garching, Germany
- Supercomputer at IDRIS, France
- Supercomputer at CINECA, Italy

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DEISA Network Team. Last Updated 04.05.05 11:15 Intranet | Sitemap | Homepage | Print page

Figure 2: DEISA network web page, <http://wwwnet.deisa.fz-juelich.de> (Aug 2005)

### **2.3 Link statistics at local DEISA sites**

There are many ways to provide network and link statistic information for network management and user communities. Within DEISA a web based approach has been implemented since network equipment from different administrative domains has to be monitored. Most networking equipment information concerning interface statistics could be collected via the SNMP protocol, having explicit privileges to read data from the network equipment. This information has been processed by the Multi Router Traffic Grapher (MRTG) tool and can be accessed via a normal web client at <http://wwwnet.deisa.fz-juelich.de> from authorized sites only.

Some installations generate this kind of information for their local network management services already, because of the usage of this equipment statistics for internal purposes also. So it seemed ideal to collect this information only once. Therefore a CGI-tool [6] was implemented. This CGI-script acts as a proxy service giving access to the available information. The locally generated pages will not be accessible to external users. So the CGI-script mentioned above acts as a security gateway also, allowing access to these DEISA pages for DEISA users only. Other local site specific information is not accessible.

A similar approach has been implemented to provide information to GEANT web pages protected by UserID and password. Though GEANT does not provide detailed network statistics to general user communities, it is necessary to provide these statistics to the DEISA network staff members and parts of these to application programmers also. A special CGI-script was implemented which collects the information provided by GEANT and presents parts of this to the DEISA community only. Through this mechanism the UserID and password, provided to the network management staff of DEISA, needs not to be publicly offered.

Explicit links to the interface statistics of DEISA network equipment have been included within the DEISA web pages where possible.

A DEISA user does not see any differences in accessing this information. All services are implemented transparently without any special delays.

An example MRTG page provided by the DEISA network web server is shown in figure 3 below. The information has been collected every five minutes so that the graphs show the average traffic within five minute time intervals.

## J39D1's Link to the DEISA network

Port: 5/12 on Switch zam118

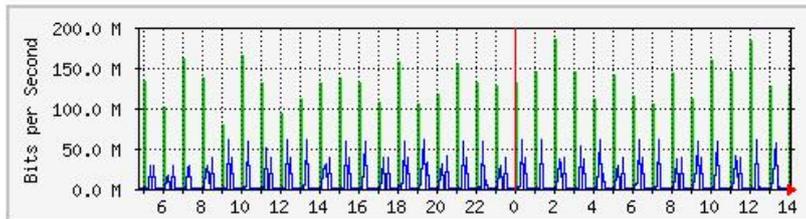
Maintainer: O. Mextorf, Tel. 2519 oder 74-502

Interface: Gigabit-Ethernet

Max Speed: 1000.0 MBit/s

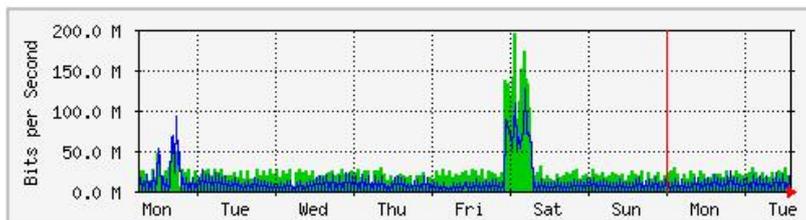
The statistics were last updated **Tuesday, 26 April 2005 at 14:09**,  
at which time 'zam118.zam.kfa-juelich.de.zam.kfa-juelich.de' had been up for **286 days, 2:53:27**.

### Daily' Graph (5 Minute Average)



Max In:186.1 Mb/s (18.6%) Average In: 11.5 Mb/s (1.2%) Current In:131.3 Mb/s (13.1%)  
Max Out: 60.5 Mb/s (6.1%) Average Out:7997.4 kb/s (0.8%) Current Out: 2203.9 kb/s (0.2%)

### Weekly' Graph (30 Minute Average)



Max In:197.0 Mb/s (19.7%) Average In:16.7 Mb/s (1.7%) Current In:2856.0 b/s (0.0%)  
Max Out:127.2 Mb/s (12.7%) Average Out:10.8 Mb/s (1.1%) Current Out: 14.6 kb/s (0.0%)

### Monthly' Graph (2 Hour Average)

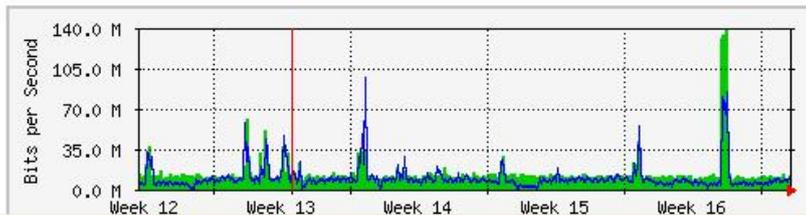


Figure 3: DEISA statistics at Research Centre Jülich supercomputer node 39

## 2.4 Testing the DEISA network infrastructure with iperf and fping

After having deployed the 1 Gb/s network infrastructure, the main task has been configuring and testing the quality and throughput of the connections between the supercomputer systems of the “proof of concept” sites. Further on stability and reliability of the network infrastructure was tested and verified. The performance was optimized especially to support GPFS. It has been shown that instead of the default configurations of the IBM supercomputer systems especially the network option parameters have to be changed to get this optimized performance. The proposed changes to default system parameters have been documented at the DEISA network web site described below. Since these default options may vary from operating system version to operating system version and different options influence each other these tests have to be verified after each system upgrade. After optimizing these network configuration parameters data communication with the network performance test tool *iperf* [3] led to tcp and udp throughput values of up to 940 Mb/s between remote DEISA supercomputer systems.

The network options used in most systems are the following:

|                   |         |
|-------------------|---------|
| ipqmaxlen         | 512     |
| rfc1323           | 1       |
| rfc2414           | 0       |
| sack              | 0       |
| sb_max            | 6553600 |
| tcp_ecn           | 0       |
| tcp_mssdflt       | 1460    |
| tcp_newreno       | 1       |
| tcp_nodelayack    | 0       |
| tcp_pmtu_discover | 1       |
| tcp_recvspace     | 2621440 |
| tcp_sendspace     | 2621440 |
| udp_pmtu_discover | 1       |
| udp_recvspace     | 655360  |
| udp_sendspace     | 655360  |
| use_isno          | 0       |

For a detailed description of the different parameters and its influences on network throughput see the man pages of the diverse operation system or adequate papers (e.g. [8]).

Network performance is critical for any kind of application and can vary over time, dependent on network parameters, routing, and e.g. parallel network load. Therefore it seemed reasonable to have a monitoring tool which tests periodically network throughput values.

Here a small application has been programmed which collects on an hourly basis network throughput between all DEISA sites. At every location iperf TCP and UDP servers have been installed to which all DEISA sites (one node of every DEISA supercomputer) connect and measure performance data.

An example web page output is shown in Figure 4.

### DEISA partition performance tests

last page update: 2005-09-05 11:00:26

| Desthost                | FZJ<br>134.94.60.209 |             |             | IDRIS<br>130.84.240.135 |             |             | CINECA<br>130.186.27.18 |             |             | RZG<br>130.183.13.21 |             |             | SARA<br>145.100.19.5 |             |             | LRZ<br>195.37.7.1 |             |             | CSC<br>128.214.250.4 |             |             |
|-------------------------|----------------------|-------------|-------------|-------------------------|-------------|-------------|-------------------------|-------------|-------------|----------------------|-------------|-------------|----------------------|-------------|-------------|-------------------|-------------|-------------|----------------------|-------------|-------------|
| Function tested         | iperf (TCP)          | iperf (UDP) | iperf (PPL) | iperf (TCP)             | iperf (UDP) | iperf (PPL) | iperf (TCP)             | iperf (UDP) | iperf (PPL) | iperf (TCP)          | iperf (UDP) | iperf (PPL) | iperf (TCP)          | iperf (UDP) | iperf (PPL) | iperf (TCP)       | iperf (UDP) | iperf (PPL) | iperf (TCP)          | iperf (UDP) | iperf (PPL) |
| Sourcehost              |                      |             |             |                         |             |             |                         |             |             |                      |             |             |                      |             |             |                   |             |             |                      |             |             |
| FZJ<br>134.94.60.209    |                      |             |             | 868                     | 836         | (0%)        | nda                     | nda         | nda         | 744                  | 836         | (0.12%)     | 259                  | 587         | (30%)       | 286               | 613         | (27%)       | 221                  | 819         | (2.4%)      |
| IDRIS<br>130.84.240.135 | 487                  | 840         | (0%)        |                         |             |             | nda                     | nda         | nda         | 794                  | 840         | (0%)        | nda                  | nda         | nda         | nda               | nda         | nda         | 290                  | 818         | (2.6%)      |
| CINECA<br>130.186.27.18 | 26.0                 | 840         | (0.00014%)  | 20.4                    | 840         | (0.00014%)  |                         |             |             | 26.5                 | 840         | (0.00014%)  | 8.22                 | 535         | (35%)       | 36.5              | 739         | (12%)       | 13.1                 | 819         | (2.4%)      |
| RZG<br>130.183.13.21    | 636                  | 836         | (0.44%)     | 663                     | 839         | (0%)        | nda                     | nda         | nda         |                      |             |             | 432                  | 620         | (26%)       | nda               | nda         | nda         | 229                  | 818         | (2.3%)      |
| SARA<br>145.100.19.5    | nda                  | nda         | nda         | nda                     | nda         | nda         | nda                     | nda         | nda         | nda                  | nda         | nda         |                      |             |             | nda               | nda         | nda         | nda                  | nda         | nda         |
| LRZ<br>195.37.7.1       | 664                  | 655         | (0.43%)     | 695                     | 647         | (0.014%)    | nda                     | nda         | nda         | 662                  | 582         | (0%)        | 0.00                 | nda         | nda         |                   |             |             | 232                  | 719         | (0.33%)     |
| CSC<br>128.214.250.4    | 264                  | 820         |             | 344                     | 819         |             | nda                     | nda         | nda         | 126                  | 818         |             | nda                  | nda         | nda         | 55.9              | 770         |             |                      |             |             |

To compare traffic from/to DEISA sites on a day/week/month/year basis click [here](#)

#### DEISA functions description

|                      |  |
|----------------------|--|
| Funktionen getestet: |  |
| iperf(TCP)           | iperf -w2500K -f m -c                          |
| iperf(UDP)           | iperf -f m -u -c -b 800M                       |
| iperf(PPL)           | shows percent of packets lost using iperf(UDP) |
| ping                 | ping -c 10000 -s 1472 -f (ping packet loss)    |

**Figure 4: DEISA partition performance tests matrix**

An overview of the measured data can be accessed at:

<http://wwwnet.deisa.kfa-juelich.de/cgi-bin/getdeisamatrix.cgi>

This page will be updated permanently. Clicking onto a single cell within the matrix table leads the user to a graphical overview showing daily, weekly, and monthly network throughput graphs between this client and server selected. Additionally real logging data is available here also.

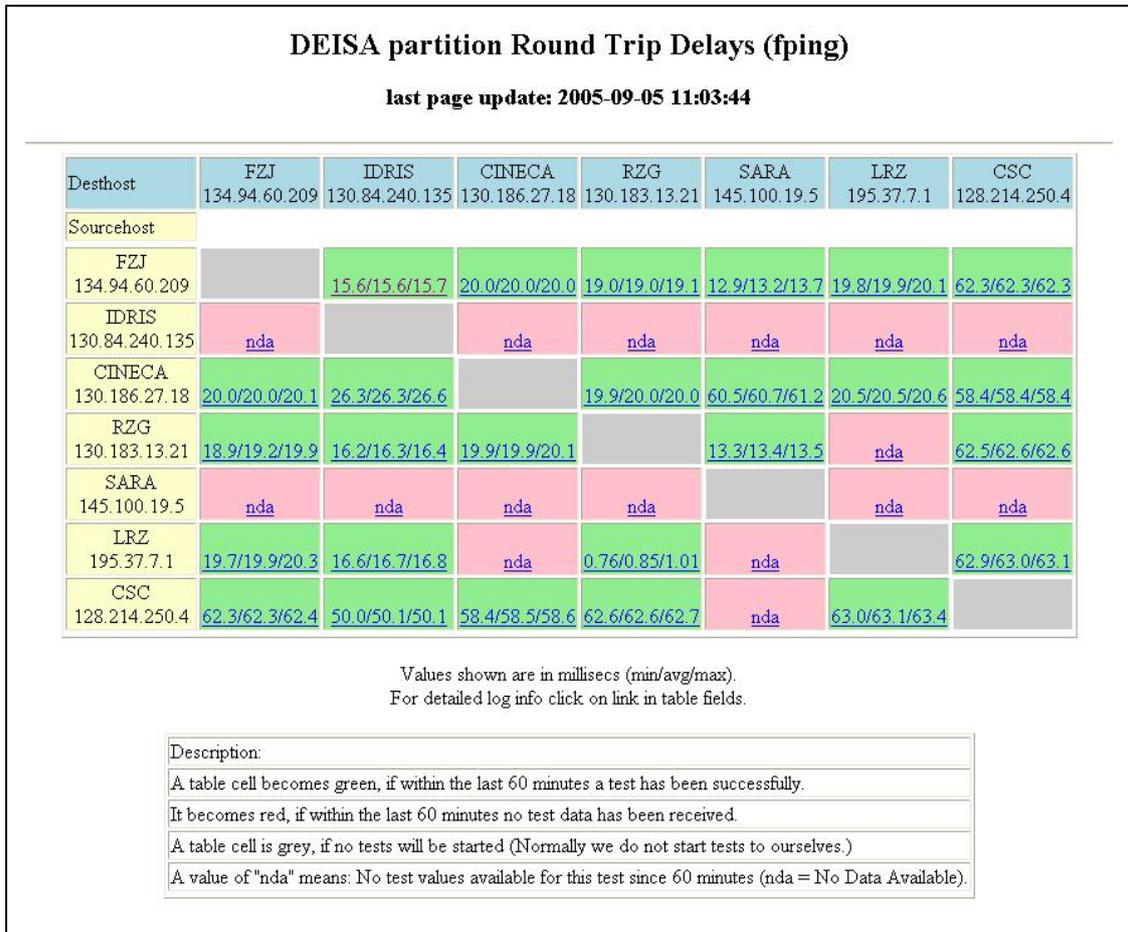
To allow a comparison between traffic load, throughput and availability of DEISA sites a special web page can be accessed also which allows arranging of these graphs on a day, week, month and year basis and/or on a source and destination basis.

The implemented matrix displays successful connection attempts and the results within green cells. If a test was not successful the cell will be red. Therefore it can be easily seen if a client could not access on system only (one cell will become red, see figure 4 client RZG, server LRZ) or if the client has not been started or the site is down (one row will become red, see figure 4 client SARA).

If a server has not been started a column will become red (see figure 4 destination CINECA). The iperf tests can not differentiate between client or server down or host

down. Therefore a second matrix has been implemented testing with ping command the reachability of nodes.

This ping information matrix shows two way delays between DEISA supercomputer systems. At every installation one node has been selected to which ping requests will be made. The minimum, average, and maximum of five consecutive two way delays will be displayed. Here logging information is available also.



**Figure 5: DEISA partition Round Trip Delay Matrix (Fping)**

For live data see:

<http://wwwnet.deisa.kfa-juelich.de/cgi-bin/getdeisafpingmatrix.cgi>

A further page can be accessed which shows the reachability of the different partitions of the DEISA supercomputer systems. Here you can see if a node is up and running (from the network point of view). This page will be replaced by monitoring information provided by service activities 3 and 4 in the near future.

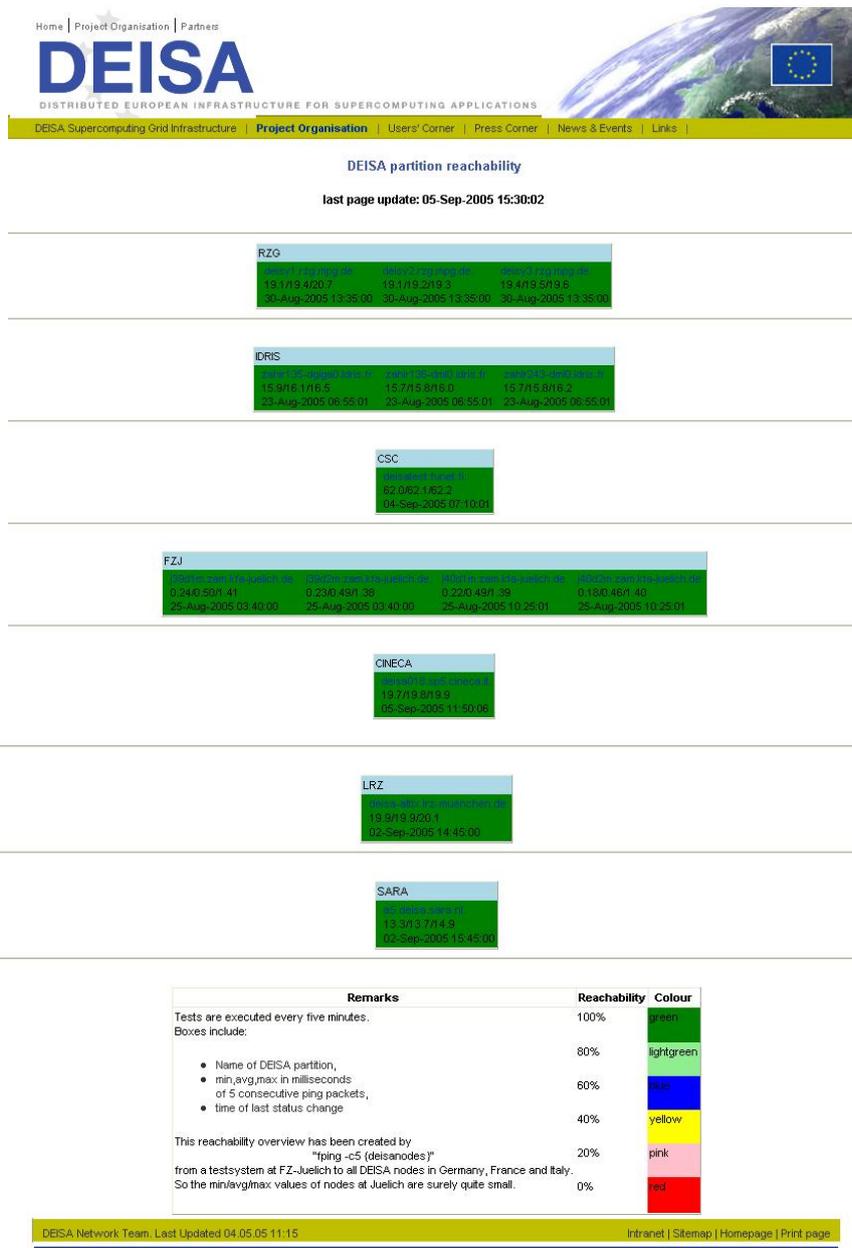


Figure 6: DEISA partition reachability (seen from FZJ)

For live data see:

<http://wwwnet.deisa.kfa-juelich.de/hostlist.html>

### **3. Network Monitoring tool demonstration**

The network monitoring tool (web pages) can be accessed by authorized hosts only. General access has not been provided so far. Publicly available information will be provided at a later stage of the project.

To get access to the web pages please contact the SA1 task leader at email: [r.niederberger@fz-juelich.de](mailto:r.niederberger@fz-juelich.de).