



GigaCampus 2006-2009

Final Report

Produced by UNINETT

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I. Introduction

In 2005, in response to the Norwegian Ministry of Education and Research, the Norwegian Association of Higher Education Institutions and the higher education (HE) sector, UNINETT launched a four-year programme entitled GigaCampus 2006-2009 [1]. The programme was granted financial support amounting to NOK 45.8 million in the Government's budget for 2006 and 2007. With these funds at its disposition, the programme has worked systematically for four years to achieve a standardised upgrading of campus networks and local ICT expertise at Norwegian universities and colleges. The programme has now been completed and this report provides a summary of the most important results.

I.1 Organisation

The management of the GigaCampus programme was assigned to UNINETT. The programme's management team has reported to the Programme Committee in which a wide range of ICT management personnel in the universities and colleges have participated. The Programme Committee's most important responsibility has been to ensure that the available funding has been used to the maximum benefit of the sector's institutions, and that the programme has achieved results in keeping with the original intentions. The Programme Management has held meetings four times each year to present reports on activities, results and financial matters and to plan the next three-month period. The Programme Committee's members have been:

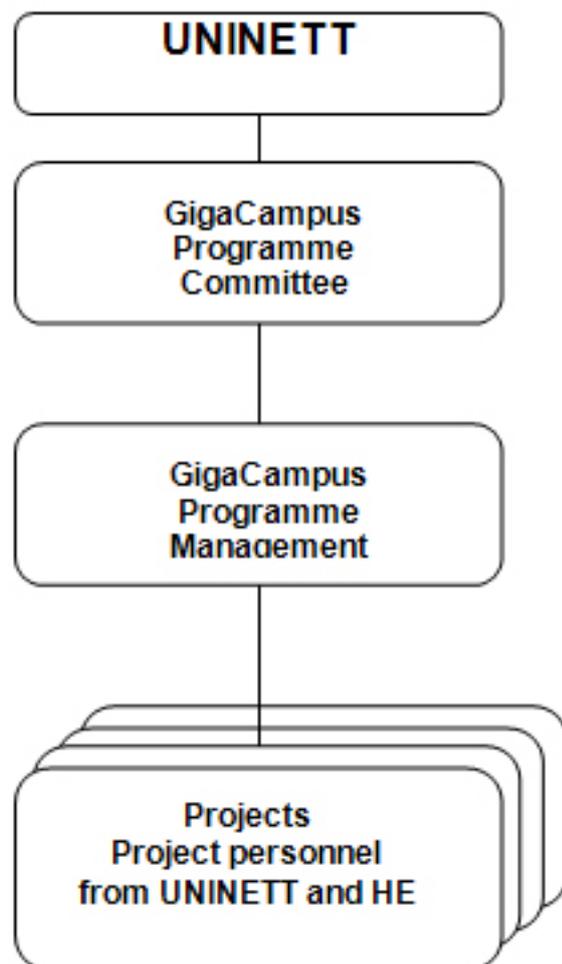
Petter Kongshaug, Managing Director, UNINETT (Programme Committee chairman)

- Magnar Antonsen, IT Director, University of Tromsø
- Arne Hatlen, IT Manager, Telemark University College
- Håvard Kvernelv, IT Manager, Narvik University College
- Lars Oftedal, IT Director, University of Oslo
- Egil Eik, IT Manager, University of Agder (until the summer of 2007)
- Thor-Inge Næsset, IT Manager, Norwegian School of Economics and Business Administration (from the summer of 2007)

The Programme Management consisted of:

- Vidar Faltinsen, UNINETT (programme manager)
- Olaf Schjelderup, UNINETT
- Gunnar Bøe, UNINETT (from 2008)
- Stein Nygaard, UNINETT (2006)

A full collection of all case documents and other documentation is available on the Programme Committee's web site.



1.2 Distribution of information

The Programme Management has carried on active work to distribute information, which in itself has been essential for achieving the goals of the programme. A dedicated web site (www.gigacampus.no) (in Norwegian) has been constructed and has been continuously updated and supplemented with new information. In addition, closed web sites (wikis) have been established for work groups.

The Programme Management have presented their results at UNINETT conferences and IT management meetings in the HE sector, as well as on numerous visits to individual institutions. GigaCampus was also presented internationally at the TERENA Conference in 2006, the NORDUnet Conferences in 2006, 2008 and 2009, and at other international meetings and fora.

A number of articles have been published in UNINETT's news bulletin, Uninytt, about the results of the programme, and nine newsletters have been published. These have briefly presented news and plans to the sector. A summary of informational activity is provided in Attachment A.

2. Vision, main objective and areas of involvement

The vision of the programme was defined as follows: *A co-ordinated, world-class campus ICT infrastructure which encourages innovation, collaboration and efficient research and education.* The focus of GigaCampus has been on communication infrastructure. The programme has worked in collaboration with the sector to achieve a standardised upgrading of campus networks and enhancement of local ICT expertise at Norwegian universities and colleges.

The intention was that GigaCampus would build the foundation for the ICT services of the future and respond to the challenges and requirements presented by research, education and administration. This also applied to the special requirements presented by the rapid expansion of e-science.

The programme has worked towards seven principal objectives (with references to the description of results in parentheses):

- Objective 1: By 2010, a broadly based and comprehensive raising of the level of expertise shall have been completed. The willingness and ability of the sector to co-operate will be crucial (Chapter 3.1-2). Cost-effective operation and development models shall be functional and appropriate purchasing collaboration shall have been established (Chapter 3.3).
- Objective 2: By 2010, the Norwegian HE sector shall provide a high-quality, fault-tolerant computer network with gigabit capacity at most workplaces. Special user groups shall be provided with higher capacity (Chapter 3.4-3.6).
- Objective 3: By 2010, the country's students, researchers and other employees shall be able to move about the campus freely using wireless network access on PCs and hand-held units such as PDAs (Chapter 3.7).
- Objective 4: By 2010, IP-based person-to-person communication shall have been made available. It shall be easy to set up real-time speech and video conversations through the network (Chapter 3.8-3.9).

- Objective 5: By 2010, the HE sector shall have properly co-ordinated security measures. Local Incident Response Teams (IRTs), shall have been set up and a common framework for security policy shall have been put into operation (Chapter 3.10).
- Objective 6: By 2010, there shall be stronger focus on proactive operation. Joint standards and recommendations shall have been implemented and tools and systems shall be in widespread use in the sector (Chapter 3.11).
- Objective 7: By 2010, there shall be effective means of discovering and remedying quality deterioration in services. We shall focus special attention on taking care of real-time requirements (Chapter 3.11).

In order to achieve these objectives, the programme has carried out work in seven areas of involvement:

1. Physical Infrastructure
2. High-capacity networks
3. Mobility
4. Person-to-person communication
5. Security
6. Operation and monitoring
7. End-to-end quality

3. Results and the achievement of objectives

3.1 Raising the level of expertise through work groups and seminars

GigaCampus has built on the good climate of co-operation in the sector and taken the initiative for a new, progressive professional alliance known as *UNINETT Engineering Task Force (UNINETT fagstyrke)*. The alliance has prepared recommendations and guidelines according to high professional, international standards, based on the sector's best practice. *UNINETT Engineering Task Force* is organised in the form of working groups in which the active participation of the sector is essential. Seven work groups have been established during the programme period. The fields covered are physical infrastructure, network architecture, mobility, person-to-person communication, security, operation and monitoring, and AV systems (since 2008).

The work groups have held a number of meetings and seminars. A total of 47 seminars have been arranged under the auspices of GigaCampus (see Attachment B for a full summary). The seminars have been of different types but have typically consisted of technical lectures, discussions and workshops or practical work sessions. The seminars have formed an important arena for bringing the sector's technical experts together for formal and informal dialogue, and have enhanced the sector's will and ability to collaborate.

3.2 Joint recommendations (UFS documents)

The work groups' most important product is the series of recommendations known as *UNINETT Technical Specifications* (UFS documents). A total of 22 such recommendations have been prepared (see Attachment C for a full list of the main contributors from the sector). The UFS documents represent an innovation in our sector. They are of considerable technical significance, thanks to the collective work method and a democratic approval process (with the work groups reaching consensus through discussion, after which the draft document is subjected to a four-week open consultative process). The UFS documents provide a joint standard for ICT infrastructure on campuses and implicitly encourage collaboration regarding shared systems in important fields.

3.3 Expedient purchasing co-operation

We have established comprehensive purchasing co-operation. During the programme period, 30 agreements have been entered into in 10 principal fields. The contractual procedures are comprehensive in nature, with a firm foundation in the sector. Selected technical personnel from the sector have made contributions connected with technical specifications and collaboration has also taken place in the sector with respect to contractual issues. A process typically takes nine months, going through the phases of needs analysis, supplier enquiry, approval, document preparation, competitive bidding, evaluation, contract work and finally, follow-up and administration.

The co-ordination of purchasing operations has resulted in a number of advantages for the sector:

- volume advantages (with regard to price and contractual terms)
- lower labour costs for the sector as a whole
- better technical work in connection with purchasing
- better logistics in connection with purchasing
- increased bargaining power in the administrative phase
- safeguarding of environmental and HSE issues in connection with purchasing.

In 2009 the total turnover in connection with the contractual portfolio was approximately NOK 450 million. A report by Capgemini has indicated very large overall savings (cf. Chapter 4.1). Attachment D describes the agreements which have been entered into.

3.4 Investment support

With its available investment funds, GigaCampus has been able to support a range of projects in the sector. This has been instrumental in achieving the necessary joint raising of standards towards principal objectives 2 and 3 (cf. Chapter 2). By means of dialogue with the sector, we have jointly arrived at appropriate solutions. As a general rule, there has been a condition that projects shall be 50 per cent self-financing. This rule has resulted in a good foundation for the projects while at the same time enabling more efficient utilisation of limited funds. The Programme Committee has ensured the fair distribution of funding throughout the lifetime of the

programme, based on what has provided the best results for the programme as a whole and for each individual HE institution. Attachment E provides a summary of the projects which have been supported.

At the completion of the programme we can demonstrate a marked improvement in the total capacity of the campus networks, with the majority of workplaces having the possibility of gigabit capacity. Fault tolerance has also been improved, though some work remains to be done here. A 10 gigabit infrastructure has also been established for the sector's high-performance computing environments.

3.5 Physical infrastructure

Five recommendations have been prepared in the field of physical infrastructure. These have been revised during the period and in December 2009 were in Version 3. The documents are used when planning new construction projects in the sector. GigaCampus has been continuously active as an advisor in the processes. We have also detected interest in, and use of, the recommendations outside the sector, for example in the Norwegian health sector and armed services. As an element of the work with the GEANT3 programme, the documents will be translated into English in 2010 and distributed to UNINETT's joint venture partners in Europe.

In 2009 a framework document, UFS121, was prepared which provides important guidelines for the design of HE buildings, focusing on the requirements for ICT and AV infrastructure. By means of status meetings, Statsbygg, the Norwegian public construction and property management agency, has been kept fully informed of our recommendations. It is important to consolidate this work further in 2010.

3.6 Campus networks

In the course of the programme period, the network architecture work group has prepared five UFS documents dealing with technical aspects of campus networks. GigaCampus has played an active role as an advisor in a number of campus development projects and has also contributed to putting them into operation. More than 30 campus installation projects have been implemented during the period of the programme.

Attention has been focused on IPv6 by means of workshops and pilot projects in the sector. A system has been developed for monitoring the expansion of IPv6 in the sector. Migration to IPv6 has been slower than expected. Most institutions have chosen to postpone its introduction, but the groundwork which has been carried out will make that introduction far simpler.

3.7 Mobility

Wireless networks have seen rapid development during the programme, and the vast majority of Norwegian students, researchers and other employees can now move around their campuses using wireless network access. GigaCampus has assisted the sector in providing security for the wireless networks (in accordance with a separate recommendation). We have also contributed to the establishment of *eduroam*¹. During the programme period, a total of 28 institutions have installed *eduroam*. A work group has also been in action in this field, arranging technical seminars and developing recommendations and other documents (practical guidelines).

¹ Eduroam is a secure, worldwide wireless access service developed for the international research community. It provides students, researchers and employees in participating organisations with Internet connectivity facilities on their own campuses and when visiting other campuses.

3.8 Person-to-person communication

This is a complex field for which highly ambitious objectives have been set up (Objective 4). Since early in the 1990s, UNINETT has co-ordinated work on the sector's telephony systems by means of joint upgrade activity, transition to IP communication between sub-exchanges, shared support systems, etc. Sooner or later, existing telephone exchanges will be replaced but progress has been slower than we expected.

During the programme, GigaCampus has worked with the development of an alternative IP-based architecture for person-to-person communication (SIP architecture). This architecture is open and based on standards. In addition to audio, video communication, real-time messaging, calendar and an expandable range of new services are provided. UNINETT has attached importance to a migration process for the HE institutions, enabling the gradual migration to the new platform, telephone by telephone. In this way, the investments can be spread over a number of years.

By means of pilot projects in the sector and testing on UNINETT's own premises, GigaCampus has amassed a great deal of valuable experience. In November 2009 we completed the architecture document "UNINETT SIP Infrastructure" [3]. This document forms the basis of work which will be an important element of UNINETT's future campus-based activities (cf. Chapter 5.1, field B3).

3.9 AV and multimedia

In 2008 a new work group was formed to handle the field of audiovisual (AV) communication. Because the HE sector did not have a joint arena, this UNINETT initiative was a popular one. The group has prepared two recommendations (UFS documents) for audiovisual infrastructure in classrooms and meeting rooms. Leading AV suppliers were consulted during the preparation of the documents, which form a solid foundation for UNINETT's new eCampus involvement (cf. Chapter 5.3).

In 2009 a bidding competition was announced for AV contractors and equipment suppliers, and agreements were signed with selected providers in November.

Since 2008, GigaCampus has also been considering solutions for video conferencing and collaborative tools. This work will be continued under the auspices of eCampus.

3.10 Security

In 2008, GigaCampus commenced the highly complex work of assisting the sector in the field of information security. This has improved the ability of the institutions to satisfy the requirements of the Norwegian Personal Data Act and associated regulations. We have carried on dialogue with the Norwegian Data Inspectorate and the Auditor General with the aim of ensuring the quality of processes and their content. Work has commenced on a security audit and a survey of status at the institutions in question. Improvement initiatives have been proposed in a report, and GigaCampus has in its turn assisted the institutions in preparing a security policy. The importance of the full involvement of management is emphasised.

In the course of the programme, GigaCampus has assisted 22 institutions, seven of which now have an approved security policy. In some cases, GigaCampus has also assisted institutions with risk and vulnerability assessments (RVAs), as well as initiating work on continuity and contingency planning.

To ensure effective co-ordination and a common framework, two UFS documents have been prepared dealing with security, which provide a recommendation for a layered security structure for the institutions. GigaCampus has assisted several institutions in implementing the new architecture.

GigaCampus has focused strongly on the organisation of operational security work by way of so-called Incident Response Teams (IRTs). A training programme has been developed and a total of six courses have been arranged in which 25 institutions have participated.

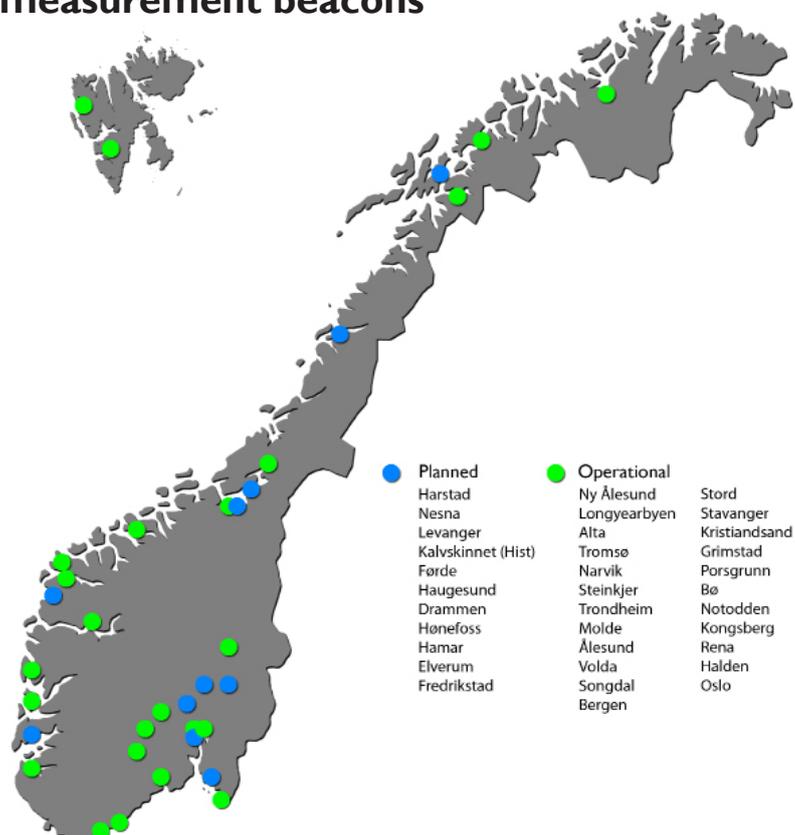
3.1.1 Operational tools and quality assessments

GigaCampus has focused on developing, integrating and putting into operation tools for monitoring campus infrastructure. Two server platforms, known as “toolboxes” and “measurement beacons”, have been rolled out. The toolboxes focus on monitoring individual campus networks, while the measurement beacons provide measurements of the quality of traffic into and out of campuses and between campuses. The development of software for the measurement beacons has been part of UNINETT’s collaboration with the centre for research excellence (Q2S) at NTNU, and as a contribution to a series of European research projects (Lobster, Scampi, GEANT2 and GEANT3).

In all, 31 toolboxes and 29 measurement beacons have been put into operation during the programme. Attachment F provides a description of all applications which run on these platforms.

We have emphasised the importance of training in the use of these tools, and have arranged a number of workshops and technical seminars on the subject. These have been popular, with high participation, and we have received positive feedback regarding the programme.

Locations of measurement beacons



4. Evaluation

4.1 Assessment of profitability

In 2008, Capgemini, an independent consulting firm, carried out an assessment of the profitability [4] of GigaCampus, concluding that the activities had a solid financial rationale and form the basis for a range of qualitative benefits. Co-ordinating and standardising infrastructure, bringing together technical communities for technical gatherings and agreeing on joint best practice by means of technical specifications (UFS documents) has clearly been of enormous value.

Capgemini's main conclusion was as follows:

“This report shows what alternative costs the colleges and universities would have had without the GigaCampus programme. The following fields have been considered:

<u>Field</u>	<u>Alternative costs</u>
Purchase agreements	NOK 114,300,000
Skills development	NOK 4,700,000
Consultancy	NOK 21,900,000
Cost-effective operation	NOK 30,000,000
TOTAL	NOK 170,900,000

A total of NOK 45.8 million has been allocated to the implementation of the GigaCampus programme. The cost of alternatives to the programme is shown by this report to be NOK 170.9 million in terms of elements such as purchasing agreements, consultancy, skills development and cost-effective operation. Some of the qualitative benefits have been discussed in the report, though these are difficult to quantify. What has not been discussed is how GigaCampus, providing a seamless system in all colleges and universities, facilitates simpler collaboration. Measurement beacons have also been erected which provide improved quality (uptime) in the network, which also contributes to more efficient work processes. Because finding clear quantitative figures has been a challenge, the minimum price of alternatives has been used throughout the report. Hence the alternative costs may be appreciably greater than those indicated in the report.”

This agrees well with the ambitious financial objectives expressed before the commencement of the programme (see Page 24 of the programme document [1]). In addition, the Norwegian HE sector has obtained a more broadly based ICT platform which, combined with UNINETT's hybrid network, provides far greater organisational flexibility.

4.2 Feedback from universities and colleges

In December 2008, a questionnaire regarding GigaCampus and its possible continuation was distributed to IT managers in the sector. The survey [5] indicated that there is a generally high level of satisfaction with GigaCampus and that 90 per cent of HE institutions would like to see a continuation of the programme. Fields which are mentioned particularly are purchase agreements, accessibility of tools, technical seminars and UFS documents (recommendations). Consultancy and skills development are also important.

In March 2009, a GigaCampus II strategy seminar was held for all IT managers in the sector. A summary and presentation of the meeting has been published [6]. The seminar confirmed the results of the survey and provided the programme managers with a number of important suggestions for fields on which UNINETT should concentrate in the continuation of the programme.

4.3 Experience

In the course of the programme, UNINETT has amassed a range of experience which it is important to take into consideration in future work. We would particularly like to mention the following:

1. The model with work groups consisting of representatives from the sector who *collaborate and prepare joint recommendations* is good. The greatest challenge is achieving active participation. The leading experts in the sector are naturally very busy and primarily occupied with taking care of their own organisations. We have been very successful in obtaining participants for technical discussions, and the experts have provided comments on draft documents, but have only to a small extent been used as technical authors. We believe the international dimension (cf. Chapter 5.2) can and will stimulate even stronger participation in future.
2. *Investment funding has been very important* in highlighting and creating approval for the recommendations. The funding has triggered a number of projects which have raised the quality of campus infrastructure to a level approaching the programme's goals. A failure of centrally financed incentive funding would clearly have reduced our ability to supply concrete results to the sector.
3. *Involvement is important.* The primary role of GigaCampus has been as a catalyst. For example, UNINETT cannot *itself* introduce a security policy in an institution. A local project group is needed, with allocated resources, milestones and its own objectives. UNINETT can assist in the process by providing expertise, advice and encouragement.
4. *The management of GigaCampus has been successful.* A competent, enthusiastic Programme Committee has functioned as a very effective link between UNINETT and the sector. The programme managers have been attentive to the advice of the sector. We have made course corrections and initiated new activity. The Programme Committee meetings have also provided favourable conditions for valuable discussion of fields peripheral to GigaCampus's field of operations.

4.4 Environmental benefits

By means of the standardisation of IT infrastructure and services, facilitating increased capacity and quality and co-ordinated purchasing processes, GigaCampus has laid the foundations for significant long-term environmental benefits. For example:

- High quality, high capacity infrastructure ensures effective communication and reduces the need for travel.
- Standardised tools and guidelines lay the foundations for the co-ordination of operational assignments in and among institutions, with potential for significant energy savings.

- The infrastructure will contribute to the realisation of the restructuring now taking place in the HE sector with institutions combining forces or entering into binding collaboration without the need for far-reaching moving or building processes.
- Co-ordinated purchase agreements ensure that the suppliers comply with requirements with regard to the environment and HSE.

5. The future

5.1 Campus activity will become a regular part of UNINETT's business activities

Based on feedback received from IT managers (cf. Chapter 4.2), the Programme Management prepared a GigaCampus II draft programme. The document was subjected to several rounds of discussion by the GigaCampus Programme Committee and was submitted to UNINETT's Board of Directors in October 2009. The document proposes a list of activities which may be appropriate for continued work.

UNINETT's Board concluded that campus activity should be a permanent part of the company's business activities from the beginning of 2010. Financing shall be assured by means of an increase in the service fee (fully effective from 2011), as well as compensation through UNINETT's participation in GEANT3 (see Chapter 5.2). The following activities will be continued (referred to in [7] as Level A and Level B):

- A1: Purchase agreements
- A2: UFS development, work groups and technical seminars
- A3: Continued purchasing, operation and development of campus network tools
- A4: Additional UFS documents, including English translations
- A5: GC II technical work groups to take part in collaborative fora at European level
- B1: Consultancy, co-ordination and roll-outs in the fields of networks and security
- B2: Data security
- B3: National infrastructure for person-to-person and person-to-group communication (based on SIP)
- B4: Roll-out of network-related support for IPv6, multicast and hybrid networks.

The target group comprises the same 37 state-owned universities and colleges (including the University Centre in Svalbard and the University Graduate Centre in Kjeller) which are included in GigaCampus.

The plan for future operations is in line with the guidelines of the Norwegian Government's budget for 2010:

“The GigaCampus programme – a technological undertaking to improve the quality of and access to campus networks in the university and college sector – has received allocation of funding in the budget until 2009. It is desirable to continue parts of this programme as part of the general business activities of UNINETT AS. We envisage financing partly by means of service fees from the institutions and partly through allocations in the national budget.”

5.2 European continuation through GEANT3

GigaCampus has also been the object of positive attention in the rest of Europe. In the spring of 2009 the programme managers were invited to submit a project proposal in connection with the GEANT3 programme. The proposal was approved and UNINETT is now in charge of the four-year project “NA3/T4 Campus Best Practice” (2009-2013) under the auspices of GEANT3. This is initially a collaborative project between Norway, Finland, the Czech Republic and Serbia, with the objective of organising national activities according to the GigaCampus pattern, focusing on work groups and the production of best practice documents. A number of workshops and technical seminars will be arranged in which other European countries will also participate. The project has its own web site, <http://gn3campus.uninett.no>, in which results are presented and seminars will be announced continuously.

5.3 eCampus will carry on the good work

Simultaneously with the continuation of important GigaCampus activities as permanent services, a new programme is to be launched: eCampus Norway [2]. eCampus focuses particularly on building modern infrastructure for research, education and information dissemination.

The AV and multimedia activities of GigaCampus, among other things, will be continued by eCampus. Three pilot activities have already been launched:

- Pilot 1: Video recording, storage and retrieval of lectures
- Pilot 2: National organisation of video conferences
- Pilot 3: Mobile systems

GigaCampus's programme model has functioned well and will be carried further in eCampus. An eCampus Programme Committee will be appointed by the Board of UNINETT. The committee will propose activities, provide advice regarding projects, discuss strategy and follow up the work in eCampus. By means of work groups, seminars and pilot projects, the programme will continue the effective dialogue that GigaCampus has established in the sector. The participants will be employees both in the HE sector and in UNINETT itself. A special architecture group will work in close integration with other ICT architecture activity in the sector.

The eCampus project will not be fully financed in 2010, but is planned to be fully operational from 2011 to 2015.

References

- [1] GigaCampus 2006–2009 programme document (in Norwegian)
https://ow.feide.no/_media/gigacampus:gigacampus-program-web.pdf

- [2] eCampus Norway (in Norwegian)
<http://blog.ecampus.no/about/>

(includes programme proposals and a memorandum to the Norwegian Ministry of Education and Research)

- [3] UNINETT SIP Infrastructure (in Norwegian)
https://ow.feide.no/_media/gigacampus:uninett_sip_infrastruktur.pdf

- [4] GigaCampus profitability assessment, Capgemini, 4 July 2008 (in Norwegian)
https://ow.feide.no/_media/gigacampus:gigacampus-lonnsomhet.pdf

- [5] Results of the GigaCampus survey of IT managers, February 2009 (in Norwegian)
https://ow.feide.no/_media/gigacampus:samling:resultat-gc2-servey.pdf

- [6] GigaCampus II strategy seminar for IT managers, 3 March 2009 (in Norwegian)
https://ow.feide.no/gigacampus:samling:gc2_mar_2009

- [7] Draft programme: GigaCampus II (in Norwegian)
https://ow.feide.no/_media/gigacampus:gci-v1.0.pdf

- [8] GEANT3 programme
<http://www.geant.net/>

Attachments

A: GigaCampus information activities

Newsletters

In the period from October 2006 to September 2009, nine newsletters were published by GigaCampus. These may be read in their entirety (in Norwegian) at <https://ow.feide.no/gigacampus/nyhetsbrev>.

Articles in Uninytt

During the programme, eleven articles in Norwegian about GigaCampus were published in Uninytt:

- GigaCampus i 2006 [GigaCampus in 2006], Uninytt 1/06
- Med god hjelp fra GigaCampus [Abyly assisted by GigaCampus], Uninytt 1/06
- GigaCampus vekker internasjonal interesse [GigaCampus attracts international interest], Uninytt 2/06
- UNINETT arrangerer kurs for sikkerhetsteam [UNINETT arranges courses for security teams], Uninytt 2/06
- Fire nye innkjøpsavtaler i havn [Four new purchasing agreements completed], Uninytt 3/06
- GigaCampus innkjøpsavtaler omsetter for 300 millioner [GigaCampus purchase agreements worth NOK 300 million], Uninytt 2/07
- Sektoren vil ha mer GigaCampus [The sector wants more of GigaCampus], Uninytt 1/09
- GigaCampus til Europa [GigaCampus in Europe], Uninytt 1/09
- Virtualisering gir virkelige besparelser [Virtualisation gives real savings], Uninytt 1/09
- Ledelsen må involveres i sikkerhetsarbeidet [Management must be involved in security work], Uninytt 2/09
- AV fra GigaCampus til eCampus [AV from GigaCampus to eCampus], Uninytt 4/09

In addition a number of articles were published on subjects related to GigaCampus.



GigaCampus as front-page news and two articles in Uninytt No. 1, 2009.

B: GigaCampus seminars

<u>Date</u>	<u>Seminar</u>	<u>Place</u>
18-19 Jan 2006	IP Telephony Seminar	Oslo
25 Jan 2006	Template for Configuration of Switches and Routers	Trondheim
26 Jan 2006	Building Infrastructure	Trondheim
15 Feb 2006	NAV Planning Meeting and meeting about measurement beacon tools	Trondheim
16-17 Feb 2006	Mobility Course Part 1 – Radio Planning	Ålesund
7-8 Mar 2006	Incident Response Team (IRT) Course No. 1	Trondheim
15 Mar 2006	Participation in IT Managers' Meeting	Narvik
31 Mar 2006	Participation in IT Forum at University of Bergen	Hardanger
20-21 Apr 2006	Mobility Course Part 2 – Installation/ Configuration	Ålesund
6-7 Jun 2006	NAV Developers' Workshop	Tromsø
20-22 Jun 2006	UNINETT Conference 2006	Ålesund
17-18 Oct 2006	Toolbox Workshop No. 1	Trondheim
7-8 Nov 2006	Incident Response Team (IRT) Course No. 2	Trondheim
8-9 Nov 2006	Nortel Telephony Seminar	Trondheim
21-22 Nov 2006	Toolbox Workshop No. 2	Trondheim
11 Dec 2006	Wireless Workshop	Oslo
23-24 Jan 2007	Toolbox Workshop No. 3	Trondheim
1-2 Feb 2007	SIP Work Group	Trondheim
7-8 Feb 2007	Focus on Fault-tolerant Services	Trondheim
13-14 Mar 2007	Network Monitoring, Measurements and Security Tools	Trondheim
18-19 Apr 2007	Incident Response Team (IRT) Course No. 3	Trondheim
15-16 Oct 2007	Wireless Workshop	Tromsø
7-8 Nov 2007	Incident Response Team (IRT) Course No. 4	Trondheim
14-15 Nov 2007	Security Forum for UNINETT Regional Representatives	Trondheim
19-20 Nov 2007	Alcatel Forum	Trondheim
3 Dec 2007	Multimedia Workshop	Trondheim
4-6 Dec 2007	UNINETT Conference 2007	Trondheim
5 Feb 2008	Work Meeting No. 1 – Physical Infrastructure UFS Documents	Trondheim
6 Feb 2008	Course on Power Supply and Earthing	Trondheim
14 Feb 2008	Measurement Beacon Workshop	Trondheim
12 Mar 2008	Work Meeting – Functional Description, AV Equipment	Trondheim
14 Mar 2008	Work Meeting No. 2 – Physical Infrastructure UFS Documents	Trondheim
1-3 Apr 2008	Network Meeting for UNINETT Regional Representatives	Trondheim

7-8 Apr 2008	Wireless Seminar No. 1, 2008	Trondheim
15-16 Apr 2008	Incident Response Team (IRT) Course No. 5	Trondheim
9-10 Jun 2008	SIP Workshop No. 1 2008	Trondheim
15-16 Sep 2008	Wireless Seminar No. 2, 2008	Bergen
27-28 Oct 2008	AV Seminar No. 2	Trondheim
5-6 Nov 2008	Incident Response Team (IRT) Course No. 6	Trondheim
19 Nov 2008	Toolbox Workshop	Trondheim
4-5 Dec 2008	Storage Seminar	Trondheim
9-10 Dec 2008	Nortel Telephony Seminar	Trondheim
14-15 Jan 2009	IPv6 Workshop	Trondheim
3 Mar 2009	GigaCampus II Strategy Seminar	Oslo
2-3 Apr 2009	Virtualisation Seminar	Trondheim
21-22 Apr 2009	Wireless Seminar	London
29-30 Apr 2009	Multimedia and AV Seminar No. 3	Trondheim
6-7 Oct 2009	Tool Seminar	Trondheim
10-11 Nov 2009	AV Seminar	Trondheim
1-2 Dec 2009	Nortel Seminar	Trondheim
9 Dec 2009	Physical Infrastructure Technical Day	Trondheim

C: GigaCampus work groups and UFS documents

The following GigaCampus work groups have been active:

1. Physical Infrastructure (gc-fysisk@uninett.no)
2. Network Architecture (gc-nettarkitektur@uninett.no)
3. Mobility (gc-mobilitet@uninett.no)
4. Person-to-Person Communication (gc-ip-telefoni@uninett.no)
5. Security (gc-sikkerhet@uninett.no)
6. Operation and Monitoring (gc-overvakning@uninett.no)
7. AV Systems (gc-av@uninett.no)

The following 22 UFS documents have been produced during the programme:

Group	No.	Title	Category
-	UFS101	Definition of UNINETT Engineering Task Force and UNINETT Technical Specification (UFS)	definition
Physical	UFS102	Requirements for Generic Cabling Systems	recommendation
Physical	UFS103	Requirements for the Design of ICT Rooms	recommendation
Physical	UFS104	Fire Prevention Requirements for ICT Rooms	recommendation
Physical	UFS107	Power Supply Requirements for ICT Rooms	recommendation
Physical	UFS108	Ventilation and Cooling Requirements for ICT Rooms	recommendation
Physical	UFS121	Guidelines for the Design of HE Buildings, ICT and AV Infrastructure	recommendation
AV	UFS116	AV Functional Description for Auditoriums and Meeting Rooms	recommendation
AV	UFS119	Technical and Functional System Requirements for AV Equipment	recommendation
AV	UFS120	Operational Support System and Audiovisual Transmission	recommendation
Network	UFS105	Recommended Configuration of Switches in Campus Networks	recommendation
Network	UFS109	Cookbook for Configuring Cisco IOS Switches in Campus Networks	cookbook
Network	UFS110	Cookbook for Configuring Alcatel Switches in Campus Networks	cookbook
Network	UFS111	Cookbook for Configuring HP Switches in Campus Networks	cookbook
Network	UFS114	Fault-tolerant Campus Networks	recommendation
Network	UFS115	Recommended Client Configuration for Optimal Long-Distance Performance	recommendation
Wireless	UFS112	Recommended Security System for Wireless Networks	recommendation
Wireless	UFS113	Radio Planning of Wireless Networks on Campuses	recommendation
Security	UFS106	Best Practice for Packet Filtering in the HE Sector	recommendation
Security	UFS122	Recommended ICT Security Architecture in the HE Sector	recommendation
Telephony	UFS123	Telephony Routing Requirements in the HE Sector	recommendation
Telephony	UFS124	Telephony Service Requirements in the HE Sector	recommendation

The process leading to the final approval of a UFS is described in UFS101. The principle is that the work group arrives at an approximate consensus in the form of an edited draft, followed by a four-week open consultative process in the sector (published through it-ledere-uh@uninett.no). Proposals for modifications are considered and a final version is created and published. When the work group considers it appropriate, typically after some years, the UFS document is updated and is subjected to a new approval process.

The work groups have had many members:

Physical Infrastructure

- Børge Brunnes, UiTø
- Knut Carlsen, NTNU
- Jan Ellertsen, UiB
- Kurt Larsen, NTNU
- Per Markussen, UiTø
- Rune Kittelsen, UiA
- Tore Kristiansen, UNINETT
- Bjørn Lindemann, UiA
- Anders Schjelderup Lyng, HiO
- Arild Nybråten, NTNU
- Stein Nygård, UNINETT & COWI
- Kjetil Otter Olsen, UiO
- Joachim Stavang Pedersen, HiO
- Christian Ramstad, HiO
- Olaf Schjelderup, UNINETT
- Frode Storvik, UNINETT
- Roald Torbergsen, UNINETT

AV systems

- Trond Bakaas, HiHm
- Andreas Bergstrøm, HiHm
- Gunnar Bøe, UNINETT
- Frank Børø, NTNU
- Jon Fagertun, UiTø
- Knut A. Fjørtoft, HiAls
- Thorleif Hallen, NTNU
- Stian Hubener, HiO
- Trond Indergaard, HiST
- Kenneth Isaksen, UMB
- Geir O. Jensen, UNINETT
- Carl Morten Karterud, HiHm
- Bjørn Lindemann, UiA
- Odd Erik Loftesnes, HiSF
- Morten Petterson, UMB
- Rune Risdal, UiA
- Frode Gether-Rønning, AHO
- Lars Sellie, HiST
- Bård Støfringsdal, COWI
- Roald Torbergsen, UNINETT
- Wenche Vårdal, UiB

Network Architecture

- Børge Brunnes, UiTø
- Gunnar Bøe, UNINETT
- Håvard Eidnes, UNINETT
- Jan Ellertsen, UiB
- Vidar Faltinsen, UNINETT
- Einar Lillebrygfjeld, UNINETT
- Lasse Karstensen, NTNU
- Per Markussen, UiTø
- Kjetil Otter Olsen, UiO
- Roar Pettersen, UiB
- Margrete Raaum, UiO
- Olaf Schjelderup, UNINETT
- Trond Skjesol, UNINETT
- Vidar Stokke, NTNU
- Hege Trosvik, UiO
- Stig Venås, UNINETT
- Knut-Helge Vindheim, NTNU

Operation and monitoring

- Kolbjørn Barmen, UNINETT
- Nils Olav Bekken, HiOf
- John Magne Bredal, NTNU
- Morten Brekkevold, UNINETT
- Vidar Faltinsen, UNINETT
- Kjetil Forselv, HiN
- Ole Sigurd Hansen, HiT
- Jon Kåre Hellan, UNINETT
- Ståle Johansen, UiO
- Rune Kittelsen, UiA
- Olav Kvittem, UNINETT
- Kjartan Malde, UiS
- Asbjørn Prøis, UiO
- Peder Sefland, HiVolda
- Rune Sydskjør, UNINETT
- Harald Terkelsen, HiO
- Gro-Anita Vindheim, NTNU
- Roger Aas, HSH
- Arne Øslebø, UNINETT

Mobility

- Petter Bjørbak, UiO
- Andreas Knudsen, HiOf
- Tore Kristiansen, UNINETT
- Jardar Leira, UNINETT
- Erling Paulsen, UiTø
- Patrick Mostad, NTNU
- Roar Pettersen, UiB
- Vidar Stokke, NTNU

Security

- Gunnar Bøe, UNINETT
- Øyvind Eilertsen, UNINETT
- Jan Ellertsen, UiB
- Per Arne Enstad, UNINETT
- Espen Grøndahl, UiO
- Ingeborg Hellemo, UiTø
- Hans Morten Kind, UiB
- Morten Knutsen, UNINETT
- Rune Nilsen, UiT
- Arild Nybråten, NTNU
- Margrete Raaum, UiO
- Rune Sydskjør, UNINETT
- Stig Henning Verpe, NTNU

Person-to-person communication

- Andreas Bergstrøm, HiOf
- Geir Olav Jensen, UNINETT
- Olav Kvittem, UNINETT
- Jardar Leira, UNINETT
- Anders Lyng, HiO
- Lars Nesland, UiA
- Bjørnar Nicolaysen, UiTø
- Anders Nordby, HiT
- Kjetil Otter Olsen, UiO
- Bernhard Krogh Riiser, UMB
- Roald Torbergsen, UNINETT
- Hege Trosvik, UiO
- Audun Vaaler, HiOf

D: Signed purchase agreements

A number of joint purchases have been organised by GigaCampus in the field of ICT for the HE sector. The agreements have arisen as a result of widespread collaboration with the major organisations, with the Universities of Oslo and Bergen taking part in all the purchases. At the same time, more than half of the organisations in the sector have been represented by one or more work groups connected with the purchases.

The co-ordination of purchasing activity has resulted in a number of advantages for the sector:

- ***Volume advantages***

Joint agreements have resulted in better price and contractual conditions than can be achieved by institutions (particularly the smaller ones) on their own.

- ***Lower labour costs***

Co-ordination of processes results in reduction of processing costs for the institutions.

- ***Better technical work in connection with purchasing***

Through the collaboration of several institutions, an improved technical focus is achieved, as well as better access to resources than would be the case if each were to make purchases alone.

- ***Better logistics in connection with purchasing***

More efficient co-ordination of logistics with the suppliers is achieved with respect to ordering systems, e-business solutions, customer follow-up and reporting.

- ***Increased bargaining power in the administrative phase***

Larger agreements provide better potential for achieving favourable terms.

Before 2006 the agreement material was primarily used by the colleges, while the large universities had their own framework agreements. Since 2006, GigaCampus has collaborated with the largest universities with regard to joint framework agreements for the entire HE sector.

The outcome of this activity has been just over 30 agreements in ten principal fields.

The following agreements have been entered into during the GigaCampus programme:

FIELD OF AGREEMENT	SUPPLIER	DATE SIGNED
Network equipment	Multidata	31/03/2006
	Siemens	07/06/2006
	Atea	16/06/2006
Wireless network equipment	Atea	01/09/2007
PC/server/Mac	HP	14/06/2006
	Dell	15/06/2006
	Atea	16/06/2006
	Itum	26/06/2006
	OfficeLine	13/07/2006
ADSL	Umoe IKT	31/08/2006
Software	Inmeta	12/06/2007
	Crayon	12/06/2007
	Atea	12/06/2007
	Protego	19/06/2007
	SPSS	20/07/2007
	Statsoft	21/01/2008
Microsoft dealer	Inmeta	21/12/2005
Printing systems	Atea	09/05/2008
	Xerox Norge	09/05/2008
	Ricoh Norge	09/05/2008
Data storage devices	OpenSystems	01/04/2009
	Dell	01/04/2009
	Atea	01/04/2009
	Umoe IKT	01/04/2009
Fixed-line telephony	TDC	14/09/2009
Mobile telephony	TDC	14/09/2009
	NetCom	14/09/2009
	Umoe IKT	14/09/2009
Audiovisual (AV) equipment	Umoe IKT	01/11/2009
	YIT	01/11/2009
	FotoPhono	01/11/2009
	AV Design	01/11/2009

The total sales in each agreement field has increased year by year. In 2009 the total turnover in connection with the agreement portfolio was approximately NOK 450 million.

E: Investment Support Projects

Institution	Allocation
University of Oslo	Preparation of UiO's backbone network for 10 gigabit operation, upgraded server room infrastructure, basic infrastructure upgrade for wireless network. Upgrade of campus network infrastructure for HPC, resulting in GRID preparation with 10 Gbps support.
NTNU	Upgrade of campus backbone network to 10 Gbps. Cooling system for main building and other upgrading of physical infrastructure. Laying of fibre-optic cable on and outside campus. 10 Gbps HPC infrastructure.
University of Bergen	Fibre cable from the High Technology Centre at Haukeland University Hospital and in the route on the eastern side of Store Lungegårdsvann. 10 Gbps HPC infrastructure.
University of Tromsø	Upgrade of campus backbone network, including 10 Gbps fibre-optic cable. 10 Gbps HPC infrastructure. 10 Gbps upgrade of the old teachers' training facility in the fibre-optic ring. Fibre-optic cable laying.
University of Life Sciences	Laying of redundant fibre-optic access cable to the campus at Ås. Upgrade of core switch (supervisor 720 in Catalyst 6509). New 250 kVA generator.
Agder University College	New redundant core switch in Kristiansand (10 Gbps-capable).
University of Stavanger	Upgrade of backbone network with new Catalyst 6509 core switches and HP chassis switches.
Akershus University College	Campus switch at Fornebu, upgrade of core switch to more scaleable platform (6509). Fibre-optic cable. Edge switches.
Bergen University College	Upgrade of main locality in Nygårdsgaten with new core switch (6509). Fibre-optic cable from the High Technology Centre to Møllendalsveien.
Bodø University College	New redundant core switch (Cisco Catalyst 6509).
Buskerud University College	Upgrade of network in Kongsberg with gigabit switches.
Finnmark University College	Expansion of the campus fibre-optic system with connection between Finnmark University College and Kunnskapsparke. Improved fault tolerance in equipment room, with UPS installation and fire alarm system.
Gjøvik University College	Upgrade to gigabit switches in campus network.
Harstad University College	Upgrade of supervisor. Generator system.
Hedmark University College	Upgrade of wireless network with Cisco controller system.
Lillehammer University College	Gigabit fibre-optic module for Cisco 6513 core switch.
Molde University College	Upgrade of core switch to more scaleable platform (6509).
Narvik University College	Improved fault tolerance in campus network with the introduction of second core switch (6509) at locality No. 2.
Nesna University College	Upgrade to new (4506) core switch in Nesna, with NetFlow support. New Cisco 3560 switch in Sandnessjøen.
Nord-Trøndelag University College	Upgrade to new (4506) core switch in Namsos, with NetFlow support. New server room in Levanger with new Catalyst 6509 core switch and edge switches.
Oslo University College	Single-mode fibre on campus, also in connection with construction of new server room. New Catalyst 6509 for new server room with WISM and 6708 with X2 modules. HP ProCurve 2910 with SFP+ 10 Gb modules.
Sogn og Fjordane University College	New UPS system for new server room connected with new main node in Sogna-hallen.

Stord/Haugesund University College	New Catalyst 6509 core switch in Stord.
Sør-Trøndelag University College	Fibre-optic ring in Trondheim (ring structure linking all study locations).
Telemark University College	Infrastructure for end-to-end gigabit in the college's entire network. Upgrade of wireless network with support for 802.1X and eduroam.
Vestfold University College	New ice water cooling installation. New Catalyst 6509 gigabit fibre-optic module.
Volda University College	Single-mode fibre laying on campus (linking buildings, conduit laid in trenches). UPS system.
Østfold University College	Wireless controller (WISM). Gigabit switches.
Ålesund University College	Upgrade of wireless network (ahead of UNINETT 2007). New diesel generator.
Oslo School of Architecture and Design	Upgrade of core switch (4510) with NetFlow support and more gigabit ports.
Bergen National Academy of the Arts	NetFlow card. New switches for new premises in Vaskerelven 8.
Oslo National Academy of the Arts	New core switches in Ullevålsveien 5 and St. Olavsgate 32. Upgrade of core switch (4506) with NetFlow support.
Norwegian School of Economics and Business Administration	Construction of redundant campus network infrastructure with duplicated core (6509) switches in two separate computing centres.
Norwegian School of Sport Sciences	Upgrade of telephony systems with IP telephone sets.
Norwegian Academy of Music	Upgrade to new (4506) core switch with NetFlow support.
Norwegian School of Veterinary Science	Upgrade and rebuilding of main server room with UPS, cooling, racks, etc. Fibre-optic cable to Stakkevollveien in Tromsø.
Sámi University College	Upgrade to new (4506) core switch in Kautokeino, with NetFlow support.

F: Availability of toolboxes and measurement beacons

GigaCampus has developed a set of monitoring tools using two separate server platforms, known as “tool boxes” and “measurement beacons”. The servers are located on campuses in the sector and are made available to local ICT personnel on a “help to self-help” basis. During the Giga-Campus programme we have extended the number of tools and improved the functioning of individual tools. The tools available as of 1 January 2010 are described below.

Toolboxes

Toolboxes have been deployed on a total of 31 campuses. The focus of the toolboxes is on monitoring of one’s own campus infrastructure, including networks, servers and other machine installations. Mobile telephones are connected to the toolboxes which can send SMS alarms in the event of faults. They can also send alarms by e-mail. The following tools are included:

- NAV (Network Administration Visualized): A network monitoring system developed by UNINETT and NTNU (co-operating over a period of 10 years), with contributions from the Universities of Tromsø and Oslo. NAV monitors routers, switches, access points and servers. In the event of failure of “boxes” or services, NAV sends alarms via its central alarm system. Operations managers set up their own alarm profile and receive alarms by e-mail or SMS. NAV automatically detects the topology of the network and tracks the locations of machines. It also makes use of historical data. NAV also has a subsystem which can block the access of machines to the network, for security reasons. NAV offers traffic statistics and reports and can display networks graphically in different ways.
- NfSen (NetFlow Sensor): The toolbox is configured to receive NetFlow data from campus network routers. These data provide an overview of who is talking to whom on which ports, at what times and with what traffic volumes. NfSen provides a web interface to visualise these data and search among them. The tool is used by authorised security personnel.
- Stager: Stager was developed by UNINETT and complements NfSen by visualising NetFlow data. Stager is good at handling trend statistics but can also work in-depth in the same way as NfSen. Stager also has a broader focus than NetFlow and can be used to present other data (including Qflow, Qstream and mping data) statistically.
- Hobbit: Hobbit provides service monitoring. The set of services to be monitored can easily be expanded by adapting the Hobbit agent applied to the server to be monitored. Both Linux and Windows servers are supported. The visualisation has a hierarchical system with green and red lamps which provide a clear overview of the status of the campus network. We have created integration between NAV and Hobbit, enabling among other things the reception of Hobbit alarms via the NAV central alarm station.
- Configuration archive for network electronics: This is essentially a TFTP server with version control (RCS). In other words, it is a place where one can simply save the configuration of routers and switches and where the system itself arranges version control of this archive.
- Syslog server: By configuring all routers, switches and access points or controllers to transmit log messages (syslog) to the toolbox, a complete syslog overview of the network is obtained. If desired, this can be read by NAV’s syslog analyser to provide a web-based structural display sorted according to alarm level.

Measurement beacons

The measurement beacon concept has been developed by UNINETT and been part of the collaboration with the centre for research excellence (Q2S) at NTNU, and of a series of European research projects (Lobster, Scampi, GEANT2 and GEANT3). The results have been installed in UNINETT's measurement beacon infrastructure which consisted of 29 servers as of 1 January 2010. The tools included are offered for use by local ICT personnel and are used by UNINETT itself. Training is provided at annual tool seminars.

Measurement beacons have passive and active tools, respectively:

Passive applications

The beacons are equipped with an additional special purpose network card which by means of an optical splitter "passively" listens to traffic into and out of the campus network. By analysing this traffic, it is possible both to study traffic quality and analyse traffic for security purposes. Only personnel with special authorisation according to a security directive are able to analyse the data from a measurement beacon's passive network card. Applications include:

- Qflow: Qflow has been developed by UNINETT, partly under the auspices of the European GEANT2 and GEANT3 projects. Qflow studies packets more thoroughly than is the case in connection with NetFlow analysis. Among other things, we can with certainty recognise applications which use a varying set of TCP/UDP ports. An example is BitTorrent, which is frequently used in file-sharing.
- Mapidump: Mapidump is used by security experts to search for unwanted traffic based on a security incident alarm.
- DNS analysis: This is also a security tool for studying so-called fast flux DNS incidents.

Active applications

Active applications do not use the passive measurement card, but make use of the fact that the measurement beacons are distributed over the entire country and hence form suitable monitoring points in the research network.

- NDT: Provides a web interface for measuring network performance between a client and a monitoring point. It is popularly referred to as an "Internet speedometer".
- Multicast beacon: This provides a picture of the multicast connectivity of a network. It also provides good measurements of one-way delay and packet loss in the network. Most measurement beacons are equipped with GPS antennas for accurate time synchronisation, which is necessary for effective multicast beacon measurements.
- Rude & crude: This is used by UNINETT for studying routing convergence when lines and routers in the research network drop out. The measurement beacon infrastructure hence becomes an important tool for continuously improving and optimising redundant routing configuration in the research network.
- Mping: Mping provides measurements of two-way packet loss and response time which are presented by Stager.
- Qstream SIP: We configure regular SIP communication between selected measurement beacons and study the quality of this SIP traffic using our specially developed Qstream SIP application. The data are visualised by Stager.
- Qstream IPTV: This enables us to listen to multicast traffic from IPTV transmitters in the research network and study the quality of this traffic.

