



TestbedConnectivityEstablishmentReport

Added by Kaisa Haapala, last edited by Pekka Savola on May 29, 2009

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Introduction

This document is the ICT SHOK Future Internet WP4 deliverable DA4.2.2. It reports the progress achieved in coordination, connecting the project participants and the services. The lessons from the procedures are also discussed.

Coordination actions

WP4 has actively tried to advance the project to the field testing phase. Besides the actual constructing work the service framework has been developed and the first wave of the testbed services have been defined. Partner needs have been probed and the needed solutions have been investigated. After the preparation phase the WP4 newsletter has been edited and submitted on the project mailing list on a monthly basis. WP4 has an [internal wiki page](#) that's maintained and provides a summary and links to researchers interested in testing.

The successfully resolved end-organization connection cases are covered in the section Access networks (physical connections). There's a set of stalled cases where the preliminary investigation work has not yet produced "go-ahead" decisions for various reasons. These are listed on the [internal wiki](#). However, all of these have required a considerable amount of work, which consist of the investigating the actual customer needs, preliminary solution planning, fiber accessibility survey, documentation and bookkeeping. In some cases, the surveys were performed using a call for tender process.

In a finalized case, there was additional negotiation and agreement phase between necessary parties, physical installation and configuration work and finally testing of the delivery.

On the whole one can conclude that the project partners did not quite reach the field testing phase in their studies on a large scale. There were some early adopters especially among the partners of the WP4, but others didn't use the services available from the WP4 to the fullest. There have been about half a dozen [more or less baked ideas](#), most of which are still in the progress of waiting for other participants or being refined by the researchers.

The WP4 has been publishing a small newsletter which is meant for the project internal use. The newsletter news items have been edited in the [project Wiki](#) and the resulting letter has been announced in the project mailing list. The newsletters have covered the topical issues at WP4: the progress reports, achieved milestones and other success stories. Calls for testing partners received from researchers have also been promoted.

The coordination work concerning the physical networks have been performed mainly by CSC. The network services, templates and newsletters have been done jointly by the WP4 members. The editor in chief for the newsletter has been from CSC.

Evolution of Funet DWDM network

The new Funet DWDM network and the connectivity and communications services it offers are the foundation for the testbed. The Funet infrastructure enables high-speed connections between the Finnish cities and abroad for research purposes.

The procurement and deployment process of the new fiber optical Funet network has been underway. The new network has been acquired to replace leased SDH/SONET connections on the existing router network. The main difference between leased lines and routers and an optical system and routers is that the latter system allows several optically separated networks to exist in the same infrastructure. This has enabled a new approach to research networking which is put immediately in use e.g. in this project. Now the researchers can be given a physically separate and powerful network connectivity.

Building the DWDM network has been a lot of work, for example including the following kinds of tasks most of them laying the groundwork for tasks done later in ICT SHOK FI:

- network planning, feasibility studies, getting intimate with fiber and DWDM subject matter (2006-2007)
- tendering and contracting process for fibers (multiple suppliers), DWDM equipment, maintenance services (mainly 2H2007 - 1H2008)

The following tasks have been underway during the project (mainly 2H2008-2010):

- implementing DWDM monitoring systems, building custom fault analysis and diagnostics mechanisms, integrating with existing processes
- site visits, project planning and managing the installs, electricity and cooling install work required for new systems
- implementing new GE, 10GE, SDH circuits on DWDM system, moving existing circuits to DWDM
- advertising, productization, etc. of light path service

Figure 1 shows Funet DWDM network coverage in April 2009 (darker color), and the expected coverage at the end of 2009 (lighter color). Arbitrary testbeds and testbed connections can be easily deployed using the network. DA4.1.1 (the testbed architecture) describes this in more detail.



Figure 1: Funet DWDM network (12/2009 coverage lighter color)

Metropolitan CWDM rings

A [CWDM ring](#) has been built in Oulu to enhance and enable cost-effective redundant connectivity options in the area. The ring connects all Funet members in Oulu. It also enabled connecting to FICIX3 exchange point, providing research connections, and

providing experience in metropolitan networks.

There has already been a less comprehensive CWDM ring in Helsinki-Espoo area. It has already been used to provide testbed connectivity without having to acquire new fibers.

CWDM solutions have also been employed in various other locations and situations, for example to provide HUT Comnet's connectivity on the same fibers as HUT's production connection.

Access networks

Physical connections

[Tampere University of Technology \(TUT\) Research network](#) has been running and connected for a couple of years already. It's able to function as a testbed site. TUT Research Network concept has successfully combined the interests of both departments doing the research and the interests of IT management maintaining both research and production networks and services. It can also be used as a case example how researchers, research departments and IT management can work together to enhance the research and work efficiency in a organisation.

Helsinki University of Technology (HUT) Comnet's Funet IP routed connection was added in February 2009. BGP routing was added in May 2009. IPv6 has been pending an address allocation which in this case is a bit more complicated than usual. The connection also provides connectivity to Nokia Research Lablet in the same premises. Over 850 Mbit/s performance was tested with iperf in April. The network connection will be used to run experiments that would be difficult carry within normal HUT campus network for security or policy reasons. Those include hosting [Caida Ark](#) node and other shared research infrastructure such as [Planetlab](#). Also many experimental services are better suited if they are run outside of campus network. Those include experimental WLAN services that need also access to Internet.

Helsinki Institute of Information Technology (HIIT) has had one Funet IP routed connection for a couple of years for experimental purposes (e.g. PlanetLab and HIP). Another is being set up to different premises. The fiber infrastructure is ready. It has been planned to use this for Internet simulation testing, WP4 related connectivity testing and possibly providing access to testbed for organisations unable to get their own testbed connections relatively shortly (e.g. using OpenVPN).

Several other options have also been investigated and in some cases the investigations are in progress.

Tunneled solutions - OpenVPN

There has been significant interest and synergy in tunneled solutions space, and it is one of the focus areas for the next year in WP4. Current solutions leverage OpenVPN to build tunnels across less than ideal network connectivity to provide better connectivity, for example tunneling through NATs to provide public IPv4, IPv6, and multicast-enabled connectivity.

TUT's OpenVPN solution has been used e.g. for [enhanced connectivity to mobile terminals](#), e.g. Maemo-based internet tablets. The terminals are capable of utilising technologies such as IPv6 and multicast with the help of tunnelling even in cellular networks. The terminals are also capable of providing terminal based services such as content sharing via mobile WWW servers etc. This enhanced connectivity was possible by running a OpenVPN server in [TUT Research Network](#) and OpenVPN clients in terminals.

HIIT (and Helsinki University) has developed a fanless embedded device, an "OpenVPN box" that can be plugged anywhere, and it provides Ethernet connectivity (including VLANs if needed) to the user. The tunnel concentrator at Helsinki University network also provides multicast and IPv6 connectivity through the tunnel. E.g. watching IPTV through the tunnel has been demoed in a couple of events, e.g. TIVIT strategy event on 14.4.2009.

HUT Comnet has been working on a [virtual image solution](#) to allow researchers access the testbed from a workstation, or a virtual image running on a workstation, from home, etc.

Services

In addition to connectivity, CSC/FUNET also provides some basic services to the network users:

- [DNS recursive resolver service](#) at ns-cache.funet.fi
- [NTP service](#) at ntp1.funet.fi and ntp2.funet.fi
- [Funet NOC operations, monitoring and ticketing](#)
- Ping monitoring of routed IP connections (statistics and quality publicly available at <http://im.funet.fi>)
- Traffic volume statistics of routed IP connections

In addition to these basic services, project participants and also third parties provide [other services](#), including:

- [outsourced research network connectivity and services](#): at least TUT and Jyväskylä Polytechnic
- Funet WLAN roaming and HAKA authentication infrastructure
- TREX DNS and mail secondary service, internet exchange interconnection service
- Various kinds of OpenVPN tunneled connectivity services (TUT, HIIT, HUT)
- Measurement services such as PlanetLab, Caida ARK, iperf.funet.fi, Funet PERT Live-CD for network performance investigations, <http://im.funet.fi>, etc.

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