Deliverable D4.2.6
ICT SHOK Future Internet Testbed Services

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www.futureinternet.fi

www.tivit.fi

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1. INTRODUCTION

1.1. Document and its scope

This document is the ICT SHOK Future Internet WP4 deliverable DA4.2.6. It describes the testbed services which were available and active at the time it was published. This work was supported by TEKES as part of the Future Internet program of TIVIT (Finnish Strategic Centre for Science, Technology and Innovation in the field of ICT).

1.2. Testbed architecture

The services on the ICT SHOK Future Internet testbed are divided on four architectural levels (Figure 1) each supporting a different kind of connectivity:

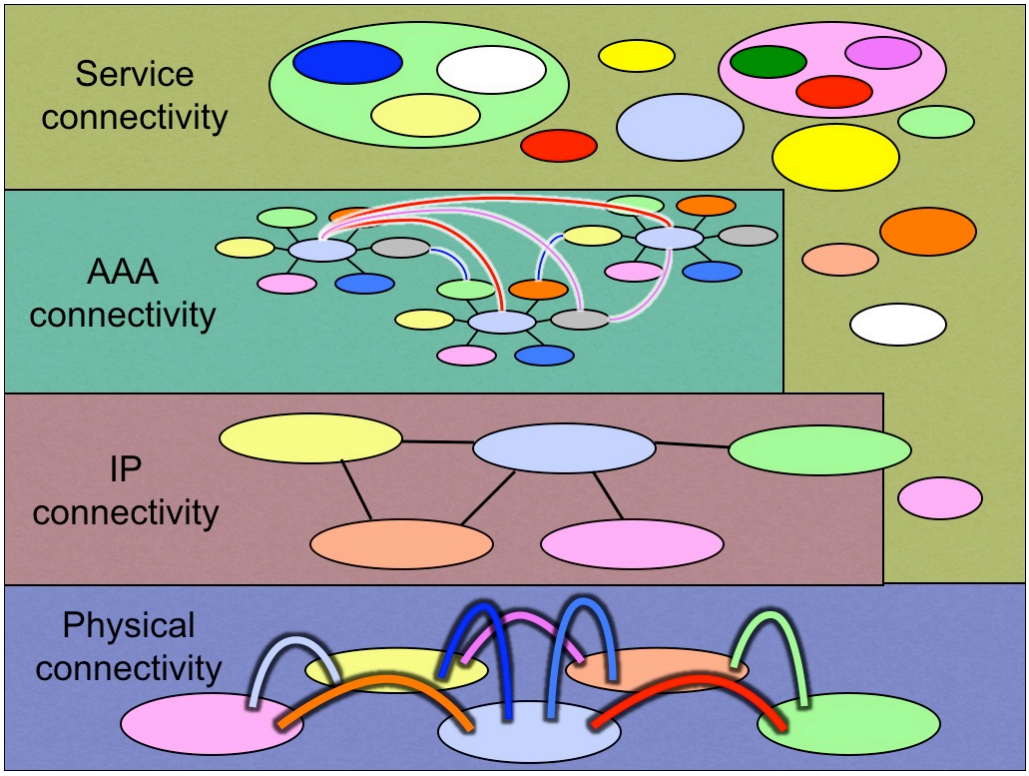

Figure 1: ICT SHOK Future Internet Testbed Architecture

The physical connectivity is for connecting organisations and services as well as research done below or instead of Internet Protocol (IP) connectivity. Examples of such research can be found within "next generation Ethernet" concepts and so-called Publish-Subscribe Internet Routing Paradigm [PSIRP]. The objective on this testbed level is to provide connectivity to the researchers that goes below the IP level, such as for example dark fiber backbone networks between various organisations.

The IP connectivity contains the research done to optimise and develop technologies and services to enhance and utilise IP connectivity. The technologies and services on this level include among others the optimisation of Internet routing tables, IPv6, non-

firewalled connectivity, and utilisation of IP multicast and the connectivity enhancement technologies and services both in the imperfect Internet now and in the future. The objective of the testbed on this level is to provide both the ideal IP connectivity (which is not often available to the researchers) and when needed also imperfect real-world IP connectivity for testing the future Internet solutions and technologies.

The authentication, authorisation and accounting (AAA) connectivity level is based on the assumption that in the future Internet as it is already in the current Internet, there will not exist only one dominating identity provider or collaboration federation between multiple providers, but instead several different ones. Various different identity providers and federations create the need for "routing" (in this context meaning usually "database lookup") and connecting these services on the authentication level to enable authentication connectivity without the need for every service provider to make direct connections to all other identity service providers. The objective of the testbed on this level is to provide the opportunity to connect to some of the authentication federations and not to limit the utilisation of other existing ones.

The service connectivity level is perhaps the least developed level in the current Internet. In the current Internet there already exists physical connectivity in the form of light paths, IP connectivity with both IPv4 and IPv6 and authentication connectivity with OpenID, Google/Yahoo/Microsoft accounts, SAML, eduroam etc., but inter-service connectivity exists usually only within one service provider. Some of the service providers have started opening up and standardising their service interfaces for service interconnectivity, but more research and work is still needed for fully open and standardised inter-service connectivity. This is, however, from the perspective of testbed development, only part of the larger concept, where in the testbed connecting completely unrelated services and solutions should be possible for creating inter-connected combination services.

For more information about the testbed information, please read the ICT SHOK Future Internet Testbed Architecture [FITestbedArch].

1.3. Testbed services

On a functional level the services are separated to seven service categories:

- Backbone and connectivity services
- Access network services
- Authentication services
- Infrastructure services
- Content delivery services
- Measurement and monitoring services
- Support services

A service in general belongs to one service category but may function on one or more architectural levels. Table 1 summarises the services in each service category and illustrates the architectural levels where the service can be utilised.

Service category	Service	Physical connectivity	IP connectivity	AAA connectivity	Service connectivity
Backbone and connectivity services	Funet light path service	X	-	-	-
	Funet routed IP connection	-	X	-	-
	TREX interconnection services	X	X	-	X
Access network services	OpenVPN connectivity service	X	X	-	X
	Experimental networking with virtual machines	X	X	-	X
	Jyväskylä AMK SpiderNet research network services	X	X	-	X
	TUT research network services	-	X	-	X
Authentication services	Funet WLAN roaming services	-	-	X	X
	Haka authentication federation	-	-	X	X
Infrastructure services	Funet NTP service (IPv4/IPv6)	-	-	-	X
	Funet DNS recursive resolver service (IPv4 and IPv6)	-	-	-	X
	TREX DNS/Mail Secondary service	-	-	-	X
Content delivery services	Funet Antenna: IPTV broadcast of your own content ("Your Own Channel")	-	-	-	X
Measurement and monitoring services	im.funet.fi - network monitoring service	-	X	-	X
	PERT Live-CD - a simple user tool for network performance analysis	-	X	-	-
	iperf.funet.fi - a traffic volume based tool for network performance analysis	-	X	-	X
	Volume Statistics - traffic volume summaries	-	X	-	-
Support services	Funet NOC – network operations centre	X	X	X	X

Table 1: Testbed services

This document presents the services ordered by service categories.

2. BACKBONE AND CONNECTIVITY SERVICES

2.1. Introduction

Figure 2: Funet connections 2010

The physical connectivity services consists mainly on the light path services available from CSC. The Figure 2 shows the availability of Funet connectivity in 2010.

2.2. Funet light path service

2.2.1. Status

Available.

2.2.2. Availability, deployment time, costs

Available at locations shown on the Figure 2. Deployment time varies depending on existing infrastructure. From 2 to 16 weeks.

2.2.3. Contact details

noc@funet.fi

2.2.4. Description

A light path is a dedicated point-to-point connection. For example 1 Gigabit Ethernet and 10 Gigabit Ethernet are available and also other transport protocols are possible. DWDM- and CWDM-light paths are available.

Multipoint light paths are also available. They are implemented with an ethernet switch as a star topology.

International light paths are also available on request.

2.3. Funet routed IP connection

2.3.1. Abstract

A routed IP connection allows all IP-routed testbed members to connect to each other and to the rest of Funet-network. Funet is connected to FICIX and to the Internet and Geant via NORDUnet.

2.3.2. Status

Available.

2.3.3. Availability, deployment time, costs

Available to all partners but contract is needed. Deployment time depends on existing infrastructure. From 2 to 16 weeks.

2.3.4. Contact details

Administrative contact pekka.savola@csc.fi
Technical contact noc@funet.fi

2.3.5. Description

Customer network is connected to Funet IP-network. A typical interface option for a routed IP connection would be a Gigabit Ethernet interface. IPv6 routing and multicast are available.

2.3.6. Use cases

- academic internet connectivity for a research group
- academic internet connectivity for an experimental test bed
- special purpose connection for a single test setup

2.3.7. Additional information

Please, see the first year project deliverables for WP4.

2.4. TREX Interconnection services

2.4.1. Interconnection services

Private Research VLAN is a method to connect two L2 networks inside different TREX members' networks together.

Since CSC/Funet is already connected to TREX, it is possible to extend a Funet multi-point light path into another operator's network as a Private Research VLAN.

2.4.2. Network services

CSC/Funet provides DNS, MX and NTP services and IP and IPv6 addressing for testbed projects. However, some project members may have cases where Funet's services can't be used. TREX can also provide these services if needed.

2.4.3. Costs

Private Research VLAN

Costs associated with Private Research VLANs are based on configuration changes. If the VLAN doesn't require any changes after it has been set up, it won't cause extra billing either.

The configuration changes are billed by the hour: 100 euros + VAT per each starting hour.

TREX membership

If a project member wishes to get a direct connection to TREX, they need to join TREX. The contact point for joining TREX is sales-2009@trex.fi.

Membership automatically includes two ports. These ports can be either Gigabit Ethernet or Ten Gigabit Ethernet. Using both ports is not mandatory, the rationale is that members can use the ports for different kinds of traffic. (e.g. research vs production)

The connection fee is 1000 euros + VAT and membership fee is 100 euros + VAT per month, preferably billed annually or quarterly.

The TREX switch is located in Tampere city centre and members will need to acquire a fibre connection from their own premises to the building where the switch is located at their own expense.

Members can of course also use the existing connections of other members to access TREX services.

2.4.4. Network operations and monitoring

The contact point with technical network issues is noc@trex.fi (+358-45-6702048).

Traffic volume statistics

Traffic volume statistics graph from customers' interface in TREX switch are available using username/password authentication.

There is no method to construct graphs for individual virtual LANs at this point.

3. ACCESS NETWORK SERVICES

3.1. Introduction

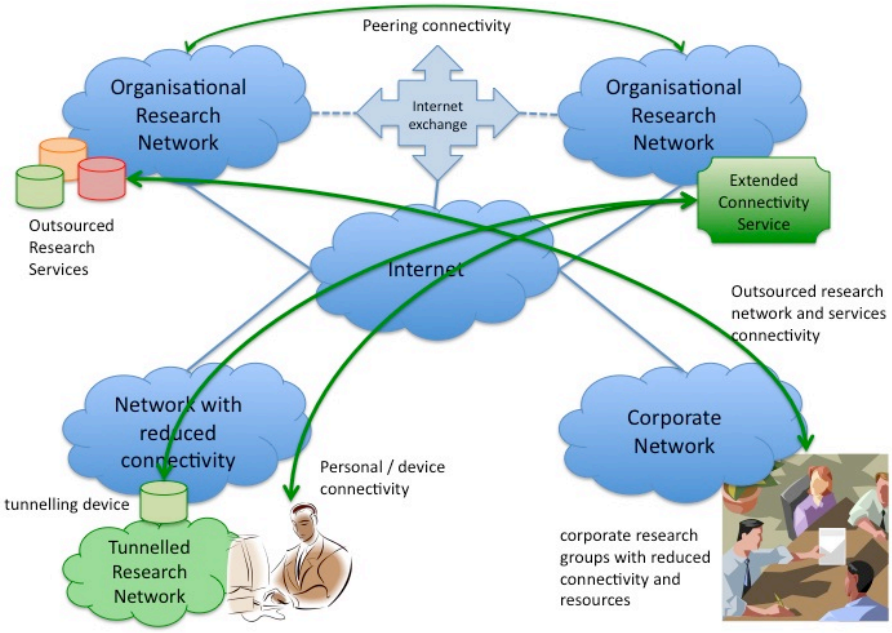

Figure 3: ICT SHOK Future Internet Testbed IP Connectivity Architecture

Testbed access network services consists of connectivity enhancement services (such as extended connectivity service in Figure 3) and separate outsourced research network services such as TUT Research Network and SpiderNet.

3.2. OpenVPN Connectivity Service

3.2.1. Status

OpenVPN Connectivity Service and its components [OpenVPNSuite] is available in different forms from various organisations. HIIT provides tunnelling device based connectivity solution and Aalto University Live-CD/USB stick [AaltoVirtualVPN] for connecting to the research networks. Tampere University of Technology and CSC can provide personal / device connectivity and tunnelling device services on request.

3.2.2. Availability, deployment time, costs

Available to all project participants. Deployment time will likely to be a week from initial contact. Costs depend on the chosen solution.

3.2.3. Contact details

Helsinki Institute for Information Technology (HIIT): Pekka Tonteri
pekka.tonteri@hiit.fi

Aalto University: Markus Peuhkuri markus.peuhkuri@aalto.fi

CSC – IT Center for Science: Pekka Savola pekka.savola@csc.fi

Tampere University of Technology (TUT): Karri Huhtanen karri.huhtanen@tut.fi

3.2.4. Description

OpenVPN connectivity service is designed to help organisations to easily gain access to research network resources and access offered by connectivity providers (for example Helsinki Institute for Information Technology, Aalto University, Tampere University of Technology and CSC). With the connectivity service organisations can gain routable or tunneled access to the networks, network technologies and services the connectivity providers are offering without having to setup a similar architecture, technologies and services inside their own network.

The connectivity service can also be used to gain better end-to-end connectivity for (for example) mobile terminals in cellular networks and behind network address translated (NAT) networks.

3.2.5. Use cases

- Enhanced connectivity to mobile terminals
- Outsourcing the research network / services

3.3. Experimental networking with virtual machines

3.3.1. Introduction

VPN for virtual machines allows rich networking to machines local to user even if local network infrasturcture does not support advanced networking. From user desktop a VPN tunnel is created and this tunnel has other end in research network supporting advanced networking features.

3.3.2. Problem

Research topics may require network access that is not possible within local network because of network policy or because some networking technologies (like IPv6 or multicast) is not implemented. Although some research tasks could be run in remote machines, this is not a good solution for task related to video and other media.

By running a test environment in virtualised computer without access to local network it is possible to test experimental applications and services without putting security of campus network into risk.

This would provide possibilities to study advanced networking in student projects. In a typical home ADSL or cable modem access the service is just basic IPv4 without multicast and some services limited. If students are provided with access to research network, they would have a possibility to study advanced networking.

3.3.3. Solution

The solution will have three components:

- Virtual machine and OpenVPN software installed into desktop computer
- OpenVPN server at research network
- User authentication and certificate distribution server

For the researcher ("user") desktop computer a virtualisation software and OpenVPN client is installed. The installation can be done by support personnel if it that is required by organisation policy. The user logs into authentication server using Haka federated authentication and can download OpenVPN configuration files and certificate.

Using certificate provided, user can create OpenVPN connection to a OpenVPN server at resesarch networks and have provide her virtual machine a research network access.

It is possible that there exists multiple gateways in different networks that will make possible for a user to study e.g. multihoming.

There may be multiple user authentication servers or then one using federated authentication. The user needs to authenticate only once to get certificate. The lifetime of certificate is limited (6 months for students, a year for researchers). The certificate can be put on blacklist if terms of service in research network is violated.

3.3.4. Current status

LiveCD based image [AaltoVirtualVPN] is available at:
http://www.netlab.tkk.fi/tutkimus/fi-shok/usecase.html

3.3.5. Requirements

User must be member of HAKA federation unless separate authentication (based on local or radius accounts) is established

3.3.6. Network diagram

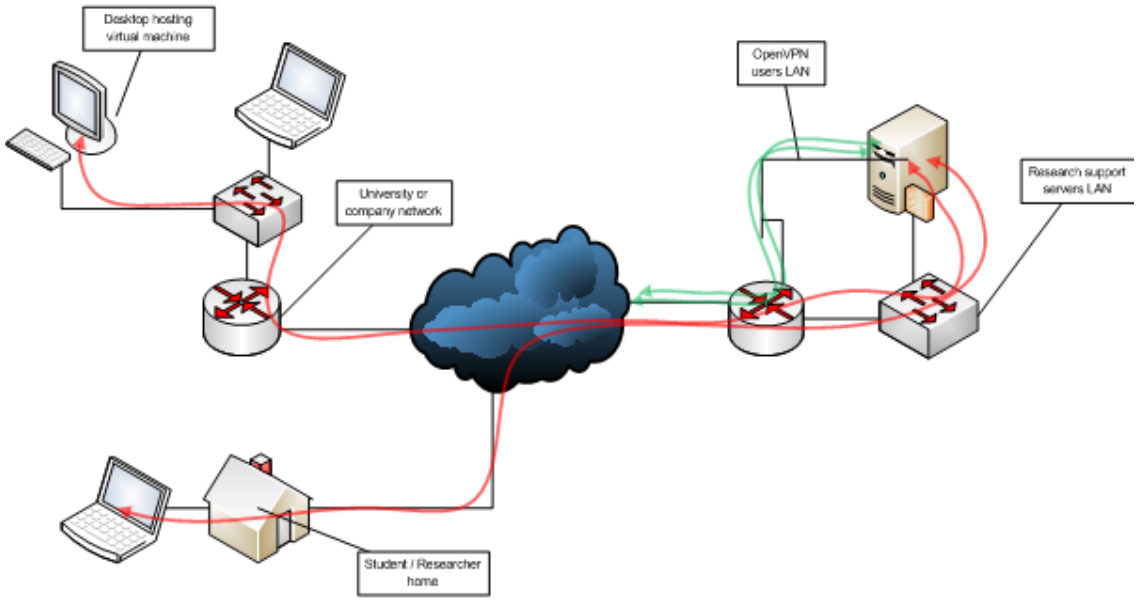

Figure 4: Providing rich network access to virtual machines on user's desktop

From Figure 4 the user authentication part (server and authentication infrastructure) is omitted.

3.4. Jyväskylä AMK SpiderNet research network services

3.4.1. Introduction

SpiderNet is a Data Network technology laboratory of JAMK University of Applied Sciences.

Spidernet is a completely remote controlled and isolated environment, which enables the testing of data network technologies in authentic environment with the real measuring equipment. SpiderNet is easily to be used for research purposes, and when needed, our experts can assist with implement the testing environment.

3.4.2. Status

Available now.

3.4.3. Availability, deployment time, costs

Available to all project participants. Deployment time will be as agreed. Costs to be confirmed as agreed with the contract.

3.4.4. Contact details

- Jamk University of Applied Sciences (JAMK): Jarmo Siltanen jarmo.siltanen@jamk.fi
- Jamk University of Applied Sciences (JAMK): Jari Hautamäki jari.hautamaki@jamk.fi

3.4.5. Description

SpiderNet is a Data Network technology laboratory of JAMK University of Applied Sciences, School of Technology. The SpiderNet laboratory has been developed more than ten years and it is ongoing developed to encompass new technologies that are used by network operators and service providers.

Until now, SpiderNet has been mainly used on several data network technology courses. These courses have multiple exercises, which familiarize students with the real life scenarios. Students have the possibility to learn and practice their networking skills on multivendor equipments (Airspan Networks, Cisco Systems, Extreme Networks and Juniper Networks). Exercises range from basic Local Area Network -configurations, like VLAN-routing, interior gateway routing protocols (EIGRP, IS-IS, OSPF, RIP) and ADSL, to more complex technologies such as ATM, BGP, MetroEthernet (QinQ, Mac-in-Mac), MPLS, Multicast, VPLS, VRRP and WiMAX. SpiderNet is companied with a virtualization server (VMWare ESX). The ESX server has three virtual machines per workgroup; one Linux server and two PC-workstations (Windows XP). Virtual machines give the opportunity for students to verify their Local Area Network and Wide Area Network configurations by providing different services and applications across their network.

The SpiderNet environment can also be used for testing different traffic queuing techniques. Especially, Quality of Service -solutions uses these equipments for traffic queuing purposes.

This is implemented using traffic generators and analyzers which can generate multiple streams with different packet header options (VLAN-ID, IP addresses, ToS-fields, etc.). With the analyzer you can generate graphical reports of generated traffic which has travelled through network back to the analyzer. In addition, SpiderNet can also be utilized a test bed for innovative R&D-projects.

The overall topology of SpiderNet is presented in Figure 5.

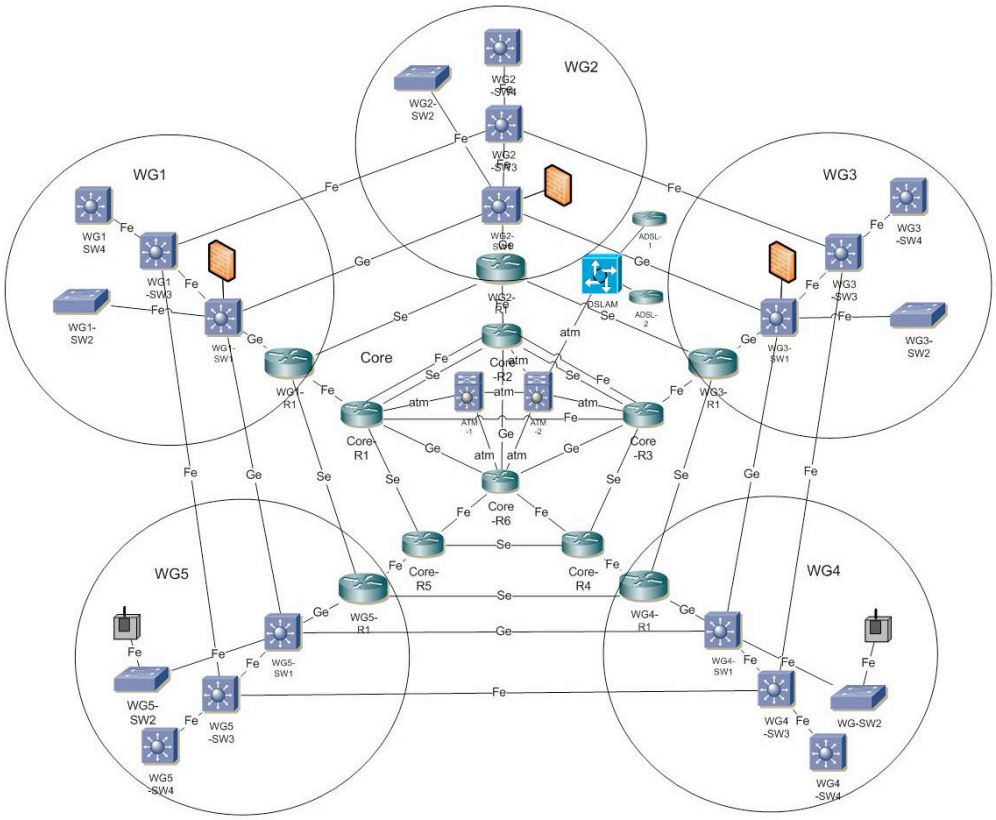

Figure 5: SpiderNet topology

3.4.6. Use cases

SpiderNet is also an inspiring environment for innovative Bachelor's Theses. Here are a few examples of Theses which are made utilizing and improving the SpiderNet:

- KANERVIRTA, Antti (2009), QoS in MetroEthernet
- NYMAN, Vesa (2008), MetroEthernet in Spidernet environment
- KOHO, Juha-Pekka (2008), Planning multicast routing in SpiderNet laboratory environment
- MARTIKAINEN, Sami (2008), QoS network in SpiderNet environment
- PEKKANEN, Teuvo (2007), Building IPV6-environment to SpiderNet laboratory environment
- POHJOLA, Marko (2007), Traffic engineering measurements in SpiderNet
- RITVANEN, Timo (2006), Implementation of IP phone system to SpiderNet
- VÄISÄNEN, Arto (2006), MPLS TE techniques in Spidernet environment
- TARVAINEN, Pasi (2004), Label switching techniques in SpiderNet

In addition, there has been versatile cooperation with companies and institutions, such as staff training utilizing SpiderNet environment. Further, the model and methods of SpiderNet has been exploited in international and local R&D projects, for example: Edinet (http://www.svc-edinet.eu/web/)

The main aim of the project is to create an e-learning and e-research environment (semi-virtual campus) based on the ideas of a life-long learning for the students, teachers, researchers and other experts in special focus promoting data network management competences. The project has been funded with support from the

European Commission and was launched on 1st October 2007 and runs until the end of September 2009. (Six European partners)

Spiderlab 1 and 2

Spider-Lab1

In Spider-Lab 1 -project aim was to increase the use of laboratory in teaching of data networks technology, by changing courses to be based in PBL (Problem Based Learning). Biggest difference to traditional e-learning environments is that all exercises are done using actual equipment. Environment can also be used to test freely different configurations. Target groups: the students of JAMK University of Applied Sciences.

Spider-Lab2

The goal of this project was to increase the utilization rate of the environment by offering it to other universities, polytechnics and companies. This has been achieved by developing a web-based user/admin interface, which was the output of this project. The idea of SpiderLab2-project was to design and implement an advanced eLearning and research environment, which could be used from anywhere, assuming that users are granted to do so. There is no simulation involved with the SpiderNet; the equipment is real and when one access the devices one has complete control over their use and configuration. Target groups: the students of JAMK University of Applied Sciences, Satakunta Polytechnic and Tampere University of Technology and ICT-companies. Partners: Satakunta Polytechnic, Tampere University of Technology, TietoEnator, TeliaSonera, Ementor. (Schedule 1.10.2004 - 31.3.2006)

3.4.7. Additional Information

SpiderNet:
http://student.labranet.jamk.fi/index.php?option=com_content&task=view&id=70&Itemid=44

3.5. TUT Research Network Services

3.5.1. Status

Available.

3.5.2. Availability, deployment time, costs

Available for all project participants, but requires a research contract with TUT. Deployment time is 1-2 weeks from signing the contract and depending on the required setup. The costs depend on the access and resources required.

3.5.3. Contact details

- TUT Research Network Wiki: https://wiki.tut.fi/bin/view/TUTResearchNetwork
- Tampere University of Technology (TUT): Karri Huhtanen karri.huhtanen@tut.fi
- Tampere University of Technology (TUT): Tuure Vartiainen tuure.vartiainen@tut.fi

3.5.4. Description

The TUT Research Network is a research network connected to the TUT and Funet network, but the resources of which are available for all TUT research partners. In the TUT Research Network it is possible to utilise existing and new network technologies and services with full end-to-end connectivity without having to go through building a research network inside your own organisation's network.

Currently available services:

- Full end-to-end IPv6 and IPv4 connectivity with public addresses
- Reduced / firewalled connectivity also possible when needed
- DNS services
- IP-DSLAM based service provider network with ADSL connections
    - possible to test applications, services, network access, network address translation in a ISP/home/consumer network environment and still have the access to all log and debug information

3.5.5. Use cases

- Outsourcing the research network / services
- Enhanced connectivity to mobile terminals

4. AUTHENTICATION SERVICES

4.1. Introduction

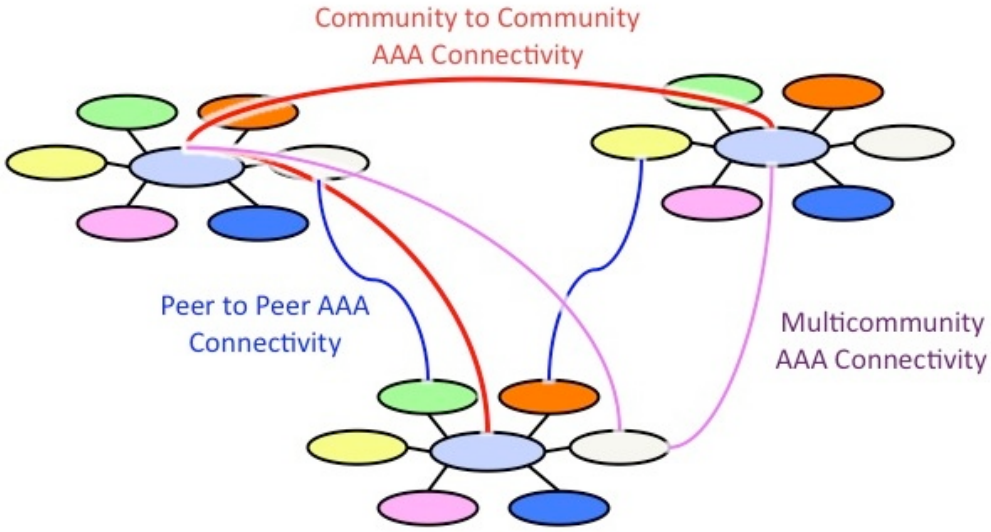

Figure 6: AAA Connectivity Architecture

The authentication services provided by the testbed include federated authentication services for both network and service level access and identity management.

4.2. Funet WLAN Roaming Service

4.2.1. Abstract

Funet WLAN roaming gives free wireless access. The connectivity is available in sites where the responsible organization has joined the roaming. The SSID may differ from site to site.

4.2.2. Status

Available now

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4.2.3. Availability, deployment time, costs

Available for all project participants willing to open bilateral network access from their WLAN networks. Unilateral or research access to the Funet WLAN Roaming Service must be negotiated with the coordinator. Deployment time for Funet organisation is few days (includes pairing the RADIUS server with the root roaming server), for others depends on the access required. Costs depend on the access required, no fees for participating fully to the Funet WLAN Roaming.

4.2.4. Contact details

- Coordinator:
  - CSC IT Center for Science: Wenche Backman <wenche.backman@csc.fi>
- Technical Support:
  - Arch Red Oy support@archred.com

4.2.5. Description

Funet WLAN Roaming Service is a RADIUS hierarchy based roaming federation which connects almost all Funet organisations in Finland to a WLAN coverage area where the users can utilise their home network user credentials to gain access in the visited organisations.

Most organisations are capable for standard RADIUS authentication and eduroam(tm) compatible ones are capable for also WPA/WPA2-authentication. The Funet Roaming Service does not limit the used EAP methods so it is also possible to test for example EAP-SIM/EAP-AKA and other EAP authentication in the networks available in several locations around Finland.

For testing purposes a test RADIUS server may be attached to the hierarchy. The forwarding of authentication requests within the hiearchy is based on domains and for testing purposes new subdomains can be added, eg. @mytest.myorganisation.fi for the @myorganisation.fi-domain.

Use cases

- Mobile authentication in access networks

4.2.6. Additional information

- eduroam(tm) pages in Finnish: http://www.eduroam.fi/
- eduroam(tm) international pages: http://www.eduroam.org/

4.3. Haka Authentication

4.3.1. Abstract

Haka is the identity federation of the Finnish universities, polytechnics and research institutions. Users (students, teachers, researchers, and administration in member institutions) are able to access federation services using a single user account and password. User identities are provided by the users home organizations.

4.3.2. Status

Available now.

4.3.3. Availability, deployment time, costs

All project partners may provide services (Service Provider aka "SP") to the identity federation. Only university partners may provide user identities (Identity Provider aka "IdP") to the federation. As a result, in practise services can be provided to the existing userbase of Haka federation.

For a service provider, joining costs 1000 EUR and there is an annual fee of 1000 EUR. However, if the service is made on behalf of a university (e.g. via subcontracting or procuring), service charges are waived.

A contract and filling application form is needed (see below).

4.3.4. Contact details

- Coordinator for WP4 testbed: Pekka Savola <pekka.savola@csc.fi>
- Support and general contact: haka@csc.fi

4.3.5. Description

Haka is the identity federation of the Finnish universities, polytechnics and research institutions. Users are able to access federation services using a single user account and password. User identities are provided by the users home organizations.

Haka authentication may only be used in support of research and education in its member institutions. In ICT SHOK FI context, it could be used for piloting research projects of authentication infrastructures that might be deployed in commercial service provider environments in 3..5 years (e.g.: TeliaSonera may be providing similar authentication infrastructure commercially in the future).

Haka has been in production since August 2005. As of 2009/01, its usage numbers were as follows:

- 37/46 universities and polytechnics
- 290 000 end users (88%), registered IdPs for 250 000
- 3.8 million Haka sign-ins in 2008.

4.3.6. Use cases

- Wiki authentication for all Funet users (no need for new usernames and passwords for the wiki)
- Making a change of address notification electronically (www.muuttoilmoitus.fi) – this is a borderline case of "in support of research and education")
- Accepting all users with a student status.
- Accepting all users which belong to an organization unit called "tietohallinto" or equivalent
- A long list of already available services: http://www.csc.fi/english/institutions/haka/Services
- Web service authentication utilising Haka federation

4.3.7. Additional information

- http://www.csc.fi/english/institutions/haka/join
- http://www.csc.fi/english/institutions/haka/

5. INFRASTRUCTURE SERVICES

5.1. Introduction

Infrastructure services are the services needed for normal Internet service provider operations. Because it is not efficient for everyone to setup services such as time and domain name service, these services are already provided as a part of the testbed services.

5.2. Funet NTP service (IPv4/IPv6)

5.2.1. Abstract

NTP is a method to keep devices connected to internet in reasonably good time. At best the accuracy is of the order 10ms.

5.2.2. Status

In production.

5.2.3. Availability, deployment time, costs

Available for all project participants. Deployment is done by end users as the Funet IP network connectivity is done and functioning. The service is included in the basic IP connectivity package with no extra fees.

5.2.4. Contact details

Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

5.2.5. Description

The deploying of NTP is a method to syncronize the clocks of the end devices. The accuracy is easily below one (1) second for end hosts. However, even 10ms accuracy can be reached with careful software and physical configuration.

The service is based on the Funet NTP servers, ntp1.funet.fi and ntp2.funet.fi. Both IPv4 and IPv6 are supported. These servers are stratum 2 servers which are connected to stratum 1 MIKES (Finnish national Center for metrology) atom clocks and an independent GPS clocks. MIKES clock sources and are physically in the Funet network. The time service has very good quality.

5.2.6. Use cases

- basic configuration of end hosts
- time syncronization of laboratory computers: if all the computers have a uncongested connectivity to NTP all the logs have correct time stamps
- time stamping service: documents or other material can be timestamped

5.3. Funet DNS recursive resolver service (IPv4 and IPv6)

5.3.1. Abstract

DNS resolver is needed for end host for resolving IP addresses and domain names.

5.3.2. Status

In production.

5.3.3. Availability, deployment time, costs

Available for all project participants. Please contact prior to using in order to add IP addresses to the access list. Deployment is done by end users as the Funet IP network connectivity is done and functioning. The service is included in the basic IP connectivity package with no extra fees.

Contact details:

- Funet NOC <noc@funet.fi>, tel. +358-9-457 2704 (if usage problems)

5.3.4. Description

Funet has a end-host resolver service for IPv4 and IPv6. The service is built redundant and fail-safe. It is load-balancing on DNS level.

```
;; QUESTION SECTION:
;ns-cache.funet.fi.          IN      ANY

;; ANSWER SECTION:
ns-cache.funet.fi.      14321   IN      AAAA    2001:708::53:2
ns-cache.funet.fi.      14321   IN      AAAA    2001:708::53:1
ns-cache.funet.fi.      14317   IN      A       193.166.4.25
ns-cache.funet.fi.      14317   IN      A       193.166.4.24
```

The service removes the need for configuring a local resolver.

5.3.5. Use cases

- basic configuration on end-site computers and network devices

5.4. TREX DNS and mail secondary service

5.4.1. Abstract

If a work package needs a new domain name or sub-domain name for some purpose, and additional external authoritative name servers and secondary mail servers for the domain, TREX can provide these services.

5.4.2. Status

Available

5.4.3. Availability, deployment time, costs

This service is available to all TREX members for no extra cost.

5.4.4. Contact details

Aleksi.Suhonen@trex.fi +358456702048

5.4.5. Description

The TREX name server is ns.trex.fi and the secondary mail server is minni.trex.fi.

5.4.6. Use cases

Possible use cases include domains that are not under the FI ccTLD.

5.4.7. Additional information

http://www.trex.fi/joining.html

6. CONTENT DELIVERY SERVICES

6.1. Introduction

Content delivery services require usually more bandwidth and more storage space than deploying and using regular services such as WWW service. Setting up this kind of content delivery infrastructure only for one research project is not feasible alone. Because of these issues, the testbed offers content delivery services, which can be utilized by all programme participants.

6.2. Funet Antenna service: IPTV broadcast of your own content ("Your Own Channel")

6.2.1. Abstract

Funet Antenna is an IPTV service for the Funet network. It allows Funet member organizations to receive free-to-air domestic transmissions, as well as other academic and commercial content. Broadcasting organization's own material to Funet Antenna is also possible.

6.2.2. Status

In production.

6.2.3. Availability, deployment time, costs

Service is available to Funet customer organizations. Service subscriptions are made at the organization level. For example, a person responsible for the IT management of a research institute, student housing complex, or a higher education institution, makes a contract with CSC on the service subscription. At the same time, the organization's network is checked for suitability for the multicast transmission technology utilized in Funet Antenna to save the network bandwidth

The deployment time comes out of two parts:

- agreement settlement
- technical installation or upgrade delay

The basic service is free of charge.

6.2.4. Contact details

- Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

6.2.5. Description

Funet Antenna is a free IPTV service to Funet member organizations. It enables viewingpublic free-to-air TV channels, special Funet Antenna broadcasts and the own materialof the member organizations. The broadcasts can be seen from the viewers' own computersor television sets equipped with an IPTV set top box.

Funet Antenna enables transmission of broadcast-quality, digital television over a normaldata network. Hence, no separate television cabling is needed. The channels can also beviewed through computers connected to the Funet network. This makes the broadcasts easilyvisible in, for example, a classroom or an auditorium without digital set top boxes -in the simplest case, just by opening the IPTV portal in a web browser.

The basic service is available presuming that the organization has paid its normal television fees and a special agreement on carrying the signal is made. Currently the channels available consist of the public digital TV channels plus additional ones such as ResearchChannel, which broadcasts programs produced by American universities and research institutes around the clock. In addition, there are a growing number of events that are broadcast specially in Funet Antenna; the Open Science Forum arranged by the University of Helsinki broadcasted almost 100 hours of top lectures on three parallel channels in five days, and AssemblyTV in August 2009 was the Antenna's first HD-quality broadcast covering the whole Assembly Summer 2009 event.

Certain additional services are provided for a payment, such as IPTV set top boxes for connecting TV displays, access to additional pay TV channels, and the possibility to run an organization's own channels using a dedicated channel management system. Broadcasting organisations' own channels and programs with their own equipment is free of charge.

6.2.6. Use cases

- iptv.funet.fi: Funet IPTV portal hosted by Maxisat
- Funet PERT live-CD is enabled for viewing
- test signal source for multicast usability checking

7. MEASUREMENT AND MONITORING SERVICES

7.1. Introduction

To ensure service availability, latency or bandwidth use, testbed also offers measurement and monitoring services to be used both with production systems and research services and hosts requiring accurate measurements and monitoring.

7.2. im.funet.fi – network monitoring service

7.2.1. Abstract

Im.funet.fi is a simple network quality measurement system.

7.2.2. Status

In production.

7.2.3. Availability, deployment time, costs

Service is available to all CSC/Funet customer organizations. The deployment time depends on the speed of changes in the customer equipment and Funet servers. The probable outcome is few days.

The service is free of charge.

7.2.4. Contact details

- Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

7.2.5. Description

The service consists of a pinger server and public web statistics. The pinger service sends a ping burst to the defined hosts every three minutes and saves the results. The results reflect the general usability of the connection.

The statistics go back to year 2000. In the year 2009 130 different target hosts are monitored.

7.2.6. Use cases

- Statistics at public web pages:http://im.funet.fi

7.3. PERT Live-CD - a simple user tool for network performance analysis

7.3.1. Abstract

Funet PERT Live-CD is an end-user tool for analyzing network capabilities.

7.3.2. Status

In production.

7.3.3. Availability, deployment time, costs

Funet PERT Live-CD is available to all Funet customers and research partners. The expected delivery time is few days for a physical disk or digital images. The CD is free of charge.

7.3.4. Contact details

Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

7.3.5. Description

The Funet PERT Live-CD is a bootable Linux CD which is tuned for network testing. The user interface is intended to a user who has limited understanding of underlaying technologies. As the CD is inserted into a computer the system reboots into a graphical user interface. The user is given a simple set of options with which he can determine some basic facts on his network connectivity.

The CD gives also an opportunity to send the results directly to the Funet experts for analysis. As well, the user can open a tunnel to the Funet expert to come and take a look into the network where he is in.

The Live-CD includes a complete Linux system, which can be used to several purposes in able hands. As well, e.g. the Funet Antenna service is supported. This means that the user can have a test drive with live multicast IPTV if that service is available in the network.

7.3.6. Use cases

- the acceptance tests of the SHOK-FI network connections
- identifying problems in access networks
- delivering information to support service (PERT team)

7.4. iperf.funet.fi - a traffic volume based tool for network performance analysis

7.4.1. Abstract

Iperf.funet.fi is an end-user tool for analyzing network capacity.

7.4.2. Status

In production.

7.4.3. Availability, deployment time, costs

Funet Iperf-service is generally available. The deployment and start of use is dependent on
installing the client software on the end hosts. The service is free of charge.

7.4.4. Contact details

- Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

7.4.5. Description

The iperf is an open source program, which is available at:

- http://iperf.sourceforge.net/

The basic idea is to have a server which responds to the client streams. The clients are expected to install a local client program. When executed the clients generate a defined traffic stream which the server consumes or reflects. The analysis of the operation reveals some basic properties of the network connectivity.

The Funet Iperf server (iperf.funet.fi) enables the following tests:

- IPv4 TCP: client (send) -> iperf.funet.fi
- IPv4 UDP: client (send) -> iperf.funet.fi
- IPv6 TCP: client (send) -> iperf.funet.fi
- IPv6 UDP: client (send) -> iperf.funet.fi

As well, the following delayed services are available:

- iperf-delay50.funet.fi -> 25ms+25ms (typical roundtrip time from Finland to Middle Europe)
- iperf-delay150.funet.fi -> 75ms+75ms (typical roundtrip time from Finland to US)

The service is pretty reliable in stream rates from 0 to 100Mbps. Higher rates are available, but the results should be taken with a grain.

7.4.6. Use cases

- the network performance emergency team (PERT) work at Funet

7.5. Volume statistics - traffic volume summaries

7.5.1. Abstract

CSC is gathering traffic volume statistics, which are available on request.

7.5.2. Status

In production.

7.5.3. Availability, deployment time, costs

Service is available to all CSC/Funet customer organizations. After the request, a reply is given in few days. The service is free of charge.

7.5.4. Contact details

- Funet NOC <noc@funet.fi>, tel. +358-9-457 2704

7.5.5. Description

Traffic volume statistics graph from customers' interface in Funet router can be made available upon request. The statistics are gathered by 24/7/365 on all Funet routed interfaces. The information is used mainly on network monitoring and error analysis and fixing. The resolution is order of minutes.

There is no method to construct graphs (by Funet) for light paths at this point. Customers may collect statistics from light path by themselves.

In special network testing is is recommended to have an own separate system for traffic sniffering. The volume statistics service doesn't provide information on individual IP packets.

7.5.6. Use cases

- test or event verification and analysis
- yearly reports on the interface usage

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