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Delay- and Disruption – Tolerant Networking – at the Crossroads by Elwyn Davies, Folly Consulting Ltd.

Upcoming events:

N4C FIRE work shop
User Driven Development for Communication Challenged Communities at the FIRE event 1–2 July 2009 in Luleå.

[Download program!](#)

[Open for registration!](#)

Extremecom

Work shop 8–14 August 2009 in Padjelanta National Park.

Read more:

<http://www.extremecom.org>



The European year 2009 for Creativity and Innovation

Read more!

Tannak AB was awarded a Silver Medal for their business plan. Read more!



is funded by the European Commission's FP7 ICT programme's FIRE initiative



Networking for Communications Challenged Communities – N4C



User Driven Development for Communication Challenged Communities is the theme of N4Cs work shop during the FIRE week 1-2 July 2009 in Luleå. This is not coincidental. User Driven Development is one the cornerstone in research at Luleå Technical University. At its best this research is showing how user involvement can benefit economy and society.

The project N4C emanated from a gender project run by the LTU and Sámi women and evolved into a project where Delay- and Disruption-Tolerant Networking is being used. N4C is financed by FP7 and is conducting field trials of architecture, design, infrastructure and applications in cooperation with users in Swedish Lapland and the Kočevje region in the Slovenian mountains. At its best, N4C is also showing how cooperation between teams from first class universities, ICT industry, research institutes and SMEs can jointly work together and hopefully develop an ICT infrastructure for Communications Challenged Communities with users in Arctic regions and applications to go with that.

N4C will present research results at meetings (seminars and international workshops), on our web page (www.n4c.eu) and wiki and in newsletters (totally 6 issues are planned). Welcome to N4C Newsletter issue 2!

Dr. Maria Udén, Project Manager

Test Beds and Living Labs

N4C is developing two Test Beds in challenged areas where the DTN and other suitable technologies will be tested. The Test Beds are located in:

- Swedish Lapland
- Kočevje region in Slovenian mountain

What is a test bed?

A **test bed** is “a platform for experimentation for large projects” which allows for rigorous, transparent and replicable testing of scientific theories, computational tools, and other new technologies. The term is used across many disciplines to describe a development environment.

In Sweden we use the word in ICT industry but also in space and vehicle industry where tests also are being conducted.



What is a Living Lab?

A **Living Lab** is the organizational partnerships between citizens, businesses and public authorities. The Living Labs model allows people and industries to test tomorrow's best innovations in Information and Communications Technologies (ICT).

It is expected that a Living Lab will benefit citizens, industry and research giving end-users influence over the development of innovative services and products that eventually could benefit the whole society.

Living Labs will allow industry to develop, validate and integrate new ideas in collaboration with other companies and thus to increase their chances of success.



What is the difference then between a Test Bed and a Living Lab?

Well to put it bluntly – they are interconnected! The European Commission have funded a large number of Living Labs. In the staff report i2010 test-beds are presented as a part of the European Network of Living Labs. A Test bed is a tool for “*Strengthening Innovation and Investment in ICT research to promote growth and more and better jobs*”. “*Developing a European Network of Living Labs in the concept of eWork, providing services of large deployment to the industry, bringing technology **test-beds** into real-life user environments.*”

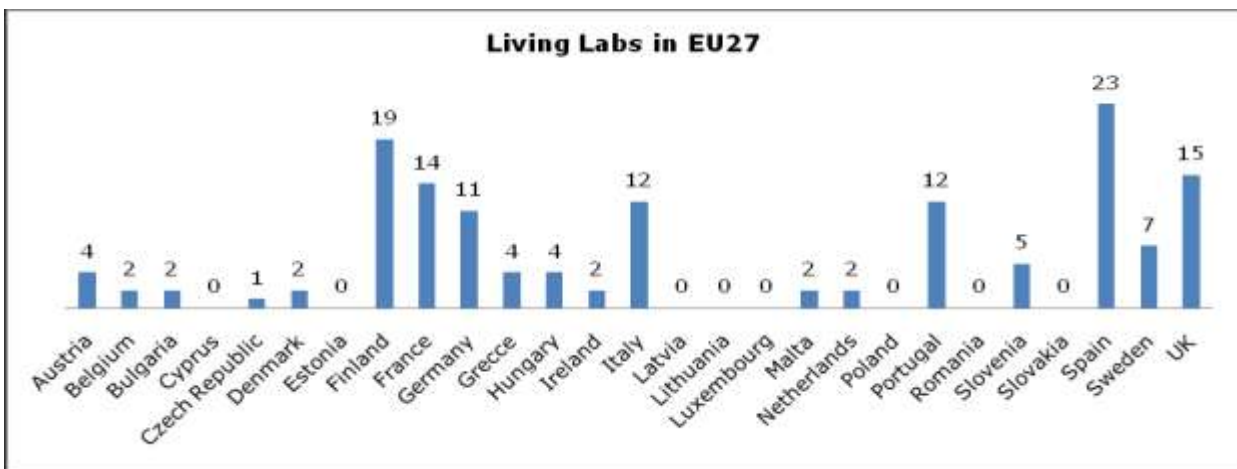
In the i2010 Second Annual Report the Living Labs role is presented as “*The European Network of Living Labs creates a platform where firms, public authorities and citizens can work together on developing and **testing** new technologies, business models and services in real-life contexts. The ultimate aim is to set up a new European Innovation Infrastructure where users play an active role in innovation.*”

So a test bed is a **necessary but not sufficient prerequisite** for a Living Lab.

Testbeds and Living Labs?

In total there are 143 Living Labs enlisted in the European Network of Living Labs in Europe (EU27). Living Labs have been funded under different calls so they are now listed as wave 1, 2 and 3. The first 2 (wave 1-2) had 81 and in third wave 62 were listed as members. The Member States that have invested in Living Labs (wave 1, 2 and 3) are presented in the diagram.

Some Member States obviously regard Living Labs as a tool for Innovation Infrastructure to a greater extent than others. In countries like Malta, Finland and Slovenia the number of Living Labs in proportion to population is quite high (Malta 205 145, Finland 278 973 and Slovenia 405 173). It is reasonable to believe that the dominance of the ICT industry at least in Finland and Slovenia is the explanation.



Tannak AB awarded a Silver Medal for their business plan

Tannak AB was awarded a Silver Medal for their business plan by Venture Cap and a place in the final Swedish race taking place 2 June 2009. To go with it was a prize of 1,000 euro. At the prize-giving ceremony Tannak also was awarded the entrepreneurship award from IQubes, a Swedish organisation that promotes new entrepreneurs and to go with that award was also a prize of 1,000 euro. We congratulate Susanne Spik and Karin Kuoljok and wish them all success in the final Swedish Venture Cap.

Northern technology transfer during “European year 2009 for Creativity and Innovation”

LTU Innovation is the technology transfer office at Luleå University of Technology (LTU) which supports students, employees and researchers during the commercialization process in areas such as legal advice, finance and business development. The role of LTU Innovation is also to encourage creativity and foster new ideas at the university.

Together with five other projects, LTU Innovation is part of “DARE – development arena for research and entrepreneurship”, which is funded by the EU's structural funds. This project includes a number of projects that aims to create a more sustainable foundation for commercialization at the LTU.



Viktoria Mattsson, head of LTU Innovation, and Lars Stebn, deputy vice-chancellor of LTU, at the opening of LTU Innovations new premises.

The DARE project is a joint project with the Umeå University. During 2009, the European year for Creativity and Innovation, LTU Innovation has scheduled a number of activities for example the 24hour race.

The 24hour race for students

The annual week of entrepreneurship at LTU takes place in October 2009. Together with different departments at the university, LTU Innovation is arranging a 24hour race for students. A group of students will then develop their business ideas with the help of LTU experts. After 24 hours, the students will present their results, and a winner will be awarded.

Increased support for space science innovations

At Kiruna campus, there is an increase of ideas within the area of space science. Therefore, LTU Innovation has opened up a new office at the department of Space Science in Kiruna, Sweden, in order to help out with any innovation and commercialization issues.



Computer games – a growing area

Computer games is a fast growing area at the LTU. But to commercialize a computer game and other related products is quite difficult, since it is a very special line of business.

To be able to provide better support for these entrepreneurs, LTU Innovation has been focusing on building efficient business networks which includes game providers, specialized incubators and targeted legal advice for these types of spin-offs.

An example of good spin-off!

The company “BehavioSec”, which is a LTU spin-off, was in April 2009 awarded “the second most innovative IT-security product in the world” at the RSA Conference in San Francisco.

Contact LTU Innovation: <http://www.ltu.se/ltuinovation>

Delay- and Disruption-Tolerant Networking at the Crossroads

by Elyn Davies

DTN research started a little over ten years ago when Vint Cerf and colleagues started examining what would be needed to extend the burgeoning Internet beyond the confines of Planet Earth coining the phrase Interplanetary Internet. During this time the initiative has continued to push back the boundaries into space but has also come back down to earth first as Delay-Tolerant Networking and then as Delay- and Disruption-Tolerant Networking.

The primary aim of N4C is to demonstrate that Delay- and Disruption-Tolerant Networking (DTN) can extend the 'broadband' Internet experience to users living in or visiting communities that are unlikely to be served by the conventional infrastructure that delivers high-bandwidth connectivity to more densely populated regions. We call these areas communications challenged communities, and the challenge is usually driven by the economics of sparsely populated regions exacerbated by environmental issues. Installing the infrastructure in these communities is expensive and the return on investment is likely to be low.

N4C will concentrate on building a system which requires very little permanently installed equipment and uses predominantly low end, commodity equipment so that potential users can get the benefits without a lot of investment and with low running costs – the decision to participate should be an 'impulse purchase' rather than a major investment decision. This is very important to the N4C concept because we want *the user to be the network*; so the network will be better the more users participate.

But it will only work really well if many of the users (and hence the network) are *nomadic*. We need the users to move around and encounter others – a population of hermits will not be useful!

We want these users to be able to have an experience with applications that is as compelling as the one that has driven the explosive growth of the conventional Internet, so that they will be able to use it to support business, education and leisure in the communications challenged areas without forcing unwelcome cultural changes on the users. Achieving this means that the N4C system needs to be well-integrated with the conventional Internet and provides applications that are well-adapted to the DTN environment and manage human expectations to avoid provoking frustrations when responses are not instant.

Major assumptions of the existing Internet are that messages need only be stored transiently and communications along the forwarding path are relatively rarely disrupted or interrupted. DTN seeks to provide usable Internet-style communications even where the delay between transmission and reception or request and response at the end points of the communication is far greater than either would be acceptable to the humans using today's applications or feasible using today's communication protocols. It also aims to facilitate communication where there is no guarantee that messages can be forwarded 'immediately' upon arrival at an intermediate waypoint, such as a router.

DTN stands at a crossroads because to date much, although not all, research has concentrated on a building an ‘overlay’ transport network that can transfer files or bundles from place to place without worrying too much about how this capability would integrate with applications that humans would find useful and without being overly concerned with integrating DTN capabilities with the existing Internet. To show that DTN is a useful technology to extend the Internet into communication challenged regions, we need both to make the infrastructure robust and design applications that provide useful, secure capabilities for business, education and leisure when running over a combined DTN and existing Internet infrastructure.

Succeeding with this aim goes beyond providing a niche solution applicable to a small portion of the population, however technically, socially and culturally laudable this aim may be. The steady growth of the conventional Internet and the growing complexity of both applications and

the network infrastructure tends to come at a price: while the bits may travel end to end at near light speed, the responses seen by humans and applications at the end points may be subject to significant delay, because of additional computing, message round trips, setup delays and authorization requirements that result from added complexity in networks and applications.

Applications today often behave in a very user unfriendly manner when the underlying network does not exhibit low delay, reliable connectivity.

DTN, as a whole, can be seen as a tool to help adapt applications to networks with long or variable delays and intermittent connectivity, but it will also be essential to adapt applications to manage human expectations to ensure that the human user doesn’t feel that s/he is responsible for the ‘failings’ of the network. This kind of adaptation needs to become mainstream and DTN-oriented research such as N4C ought to provide insights that will be applicable across the whole network environment of the future.

Folly Consulting Ltd

The founder of N4C partner Folly Consulting Ltd, Elwyn Davies, has been involved with Delay- and Disruption-Tolerant research for about five years. Before N4C started, Elwyn was a volunteer in the Sámi Networking Connectivity (SNC) project, assisting with software development and looking at web caching applications. “I particularly remember the first major field trials in the Padjelanta National Park. In the usual way of things we found problems with the software and we ended up programming by candlelight in a turf hut at Kutjaure!”, Elwyn said.

Before becoming fully committed to DTN work, Elwyn had spent almost 20 years working first with applications using the conventional Internet protocols for communication and since 1998 working on the protocols themselves with Nortel Networks. Elwyn has been a regular participant in the IETF standards organization

since 1998, working on the Differentiated Services Quality of Service architecture and more recently on network signalling (NSIS) and IPv6. After taking early retirement from Nortel in 2004, Elwyn was appointed to the Internet Architecture Board of the IETF for a two year term.



He has also been particularly interested in Internet routing research working in the IRTF Routing Research Group and co-authoring with Avri Doria (N4C Technical Advisory Board chair and LTU researcher) two longstanding Internet Drafts looking at the history and future requirements for inter-domain routing – they hope that these will finally become RFCs this year! Elwyn is therefore very interested in all things to do with routing in DTNs. In view of the major challenges of scale that Internet routing is currently encountering as the network grows ever larger, Elwyn believes that getting a scalable naming, addressing and routing system in place for DTN is a vital step to allow DTN to achieve wider acceptance and be useful beyond the niche networks where it is currently being investigated. A significant part of his current work in N4C concentrates on these aspects.

Elwyn is acting as System Architect for N4C and is leading Work Package 2 as well as managing some of the N4C cooperation infrastructure including our wiki and mailing list system. He has recently edited a major N4C document looking at the state of the art in DTN. Outside the project Elwyn is also working on an implementation of DTN for use on Symbian-based mobile phones, and he hopes that he will be able to demonstrate this implementation during N4C field trials from this summer on. In the longer term Elwyn hopes that Folly Consulting will continue as a consultant for future DTN deployments and do further research in DTN. If you ask him, he will explain the origin of the name Folly Consulting; experience shows that the boundaries between genius and folly are very thin!



Winter Tests 2009

Swedish Lapland

At the end of February 2009 N4C tested the network and applications in Jokkmokk in Swedish Lapland. The test team was divided into three groups:

Team Tannak-UPM: tested devices for power for the reindeer application and for communication between different reindeer as well as between reindeer and the network.

Team NORUT: carried out test of PDA application in harsh environment including Auto Discovery tests.

Team FOLLY: test of equipment to reassure that equipment used delivers data correctly and test of usage of reindeer skin as to protect devices in harsh environment.

Winter tests 2009 in Slovenia

For the first winter test in Slovenia development of complete meteorological node and mobile node both based on embedded computer suitable for harsh winter environment was the main goal. These two types of nodes will be crucial components of larger topologies for climate watch network foreseen for further tests. Winter tests 2009 in Slovenia was carried out by the Slovenian partner MEIS.

N4C upcoming events:

Welcome to the

N4C work shop

**User Driven Development for
Communication Challenged Communities**

at the conference

FIRE & Living Labs – Future Internet by the People

Date and Venue: 2 July 2009, Luleå University of Technology

Download programme

Open for registration

Welcome to the

ExtremeCom 2009

Workshop on Communication

in the Padjelanta National Park in Lapponia Sweden

Workshop dates: August 8–14, 2009

More info: <http://www.extremecom.org>

PROJECT DETAILS:

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READ MORE ABOUT N4C: www.n4c.eu

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