Digital Single Market

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Broadband - 'big pipes' of potential growth

The internet has become much more than a communication system. Today, it is the backbone of modern society, a platform for businesses, governments and citizens to exchange news and views, as well as to provide services, whether essential or trivial. EU policies aim to extend access to high-speed broadband internet and increase investment in fibre-optic infrastructure, while its support for research efforts ensure that the EU will have the technology available to meet the strain of constantly rising demands.

 [1]

If you think of the internet as billions of pipes that carry bits of information around the world, it stands to reason that the more data we try to pump through them, the higher the chances of backlogs or (data) traffic jams forming. And as the internet expands from a simple network of documents to an 'exchange' joining billions of tiny computers, sensors and objects - the so-called 'future internet' of things - we are going to need bigger pipes to handle all this flow.

Broadband internet is the 'information and communications technologies' (ICT) equivalent of these big pipes. In order to tap the full potential of the web, Europe is investing in digital technology to connect people - transcending boundaries and bringing communities together for a range of mutual benefits.

The Digital Agenda for Europe seeks to have broadband of at least 30 megabits per second (Mbps) for everyone by 2013, with half of European households accessing connections of 100Mbps or higher by 2020.

However, a number of obstacles have been identified which hinder broadband rollout across Europe, in particular the high investment costs of upgrading or building the necessary infrastructure. Up to 80% of the total broadband investment cost is related to civil infrastructure works.

'The cost is so high because of a lack of coordination of civil engineering projects, insufficient re-use of existing infrastructure and lack of cooperation between the various actors,' according to the European Commission. For example, water, energy, and railway companies often have their own infrastructure, and dig up roads without coordinating with telecoms companies. The Commission is conducting a public consultation until 12 July 2012 to explore ways to overcome the obstacles and reduce the costs of broadband rollout, including measures to simplify permit procedures and coordinate engineering works.

Building bigger pipes

The European Commission has set up the Connecting Europe Facility (CEF) to encourage greater public-private investment in broadband and digital infrastructure projects. The CEF seeks to unlock EUR 50 billion for network infrastructure - to strengthen Europe's transport, energy and digital networks - of which EUR 9.2 billion would be set aside for broadband and digital service infrastructure.

'We need to test practical ideas on how to cut costs and how to make it easier to access, re-use and share this infrastructure,' explains Commission Vice-President Neelie Kroes who is responsible for the Digital Agenda. 'There is nothing more annoying for citizens than road-digging, and nothing more annoying to businesses than pointless red tape.'

Importance of R&D

The EU supports scores of ICT collaborative projects under the Seventh Framework Programme (FP7) and the Competitiveness and Innovation Framework Programme (CIP). Projects focus on a range of subjects, including basic architecture, network optimisation and essential backbone infrastructure.

Indeed, demand for broadband - and the services and apps that run on it - is growing at such a rate that new bandwidth is quickly consumed as it becomes available. Experts predict that internet traffic in Europe will continue to grow around 40% annually as more and more on-demand video, photo-sharing and cloud services are rolled out. But EU researchers are not content to simply play catch up with the market.

For example, the '100-GET' [2] (100 Gigabits Ethernet) project, part of the Eureka telecommunications cluster Celtic-Plus, sought solutions that go beyond laying more fibre-optic cables to meet increasing bandwidth demand. Funded partly by the consortium partners and partly by national governments, the 100-GET project delivered a tenfold improvement on current 'gigabit ethernet' (GbE) rates of 10Gbps by seeking efficiencies in data transfer and networking aspects.

The project focused on physical-layer technologies, divided into five sub-projects: 100GET-AL investigated potential technologies and network architectures, while 100GET-ER looked at the system and component level - developing key building blocks when not available. 100GET-E3 took this R&D further, developing the next-generation of optical transport networks. Finally, 100GET-Metro targeted metro-area networks specifically, while 100GET.es sought to test-bed an end-to-end 100GbE solution.

'Getting to 100GbE by using the already installed 10GbE infrastructure was a big challenge,' notes project partner Dr Kurt Loesch from Alcatel-Lucent Deutschland. The team set what it thought was a realistic target of 40Gbps and ended up achieving more than double that, giving Europe's Digital Agenda broadband ambitions a valuable boost.

Companies worked closely with universities on elements of the project that met specific company goals, allowing proprietary research and technology to be shared without sharing strategic

information with direct competitors. The project resulted in 56 patent applications, the creation of 21 new products and the improvement of 15 existing products.

Alpha and Omega of high-speed homes

The EU-funded 'Home gigabit access' (OMEGA [3]) project has brought the value of ultra-fast broadband networks into the home or office. The project partners demonstrated how different wired, radio and optical communications technologies can be used to create a hybrid network for high-speed communications in a home environment.

People want to be able to transmit large amounts of data in local settings, such as streaming between a high-definition video application on the TV upstairs and a network device in the basement, suggests project partner Jean-Philippe Javaudin of France Telecom's Orange Labs. 'We wanted to bring the home network up to speed,' he says.

Up to now, gigabit networks have been limited to countries like Sweden that enjoy advanced telecoms infrastructure. But the research carried out by OMEGA makes it easier for other countries to set up their own high-speed networks. The extra speed is required for emerging data applications and it will deliver value-added services like 3D television, next-generation gaming, and remote medical diagnostics and elderly care.

Another EU project, 'Architectures for flexible photonic home and access' (ALPHA [4]), sought to define new network models and standards to deliver the highest possible Internet speed at the lowest possible cost and with the most logical upgrade path. ALPHA addressed the challenges of indoor networks, for example in the home and office, and researched special infrastructure to support a heterogeneous environment of converged wired and wireless technologies.

The project's work with multiplexing, the technique used to broadcast several streams of data over a single line, will be a key feature of future networks because it uses physical wires in the most efficient way. ALPHA developed a hybrid multiplexing system - combining the more efficient but expensive 'Wavelength division multiplexing' and the more affordable but lower-performing 'Time division multiplexing' - to deliver 10Gbps over a passive optical network (i.e. it requires no external electric power to run). This technology supports access networks, which supply broadband connections to the home or office, and it even supports radio-over-fibre, which supports mobile broadband via wired networks.

The multiplexer system is a key cross-over technology, according to the team, which enhances what is available now while paving the way for next-generation broadband. The team also achieved a world first by recording speeds of 20Gbps in real time using a new type of modem which creates multiple streams of data by modulating tone.

ALPHA also developed a low-cost gigabit modem for home networks that works with plastic optical fibres, a crucial bit of technology that would let users download a DVD-quality movie in just 60 seconds! ALPHA's work has led to many patent applications, dozens of peer-reviewed journal publications and contributed significantly to standardisation efforts.

Cost-effective and scalable infrastructure solutions are a premium for meeting growing broadband demand. Thus, the results of the 'Scalable advanced ring-based passive dense access network architecture' (Sardana [5]) project are important. Sardana has shown that data speeds of up to 10Gbps can be achieved at relatively little extra cost by tweaking existing fibre-to-the-home infrastructure and off-the-shelf components. The team's solution for connecting metro and access

networks into a smarter, more robust ring-based 'multiplexing technology' was duly rewarded with the 2011 Global Telecoms Business Innovators Award.

Finnish equipment vendor Tellabs tested the robustness of Sardana's new multiplexing technology, which enables different signals to be carried simultaneously on the same optical fibre using different wavelengths of laser light. These tests were followed by a field trial near France Telecom-Orange's facilities in Brittany and a demonstration at the Fibre to the Home Council in Milan, Italy.

Using emulation technology combined with real-world infrastructure, the tests showed that the network is able to serve between 1000 and 4000 users within 20 kilometres of the main trunk with symmetric internet connections at speeds of around 300Mbps (three times the EU's 2020 broadband speed target). Separately, the researchers also demonstrated that the technology could be used to transmit optical signals up to 100 kilometres from the central exchange, providing up to 250 homes with asymmetrical 10Gbps downstream and 2.5 Gbps upstream connections - massively faster than most internet users experience today.

Optical and professional networks

Though invisible to the end-user, some 90 % of all digital information is transported over optical networks. Fibre-optic communications is the real backbone of the information society, and is driving broadband developments on many levels. According to a recent Photonics21 [6] study, optical technologies leverage a telecommunication infrastructure market of around EUR 350 billion, corresponding to some 700,000 jobs in Europe.

Experts predict that, by 2020, at least a 10-fold increase in fibre capacity and Terabit per second per wavelength will be required. 'Fibre communication will move closer to the user and will become a critical infrastructure in datacentre, private, home, vehicle and sensor networks. Based on its strength and expertise, Europe is well positioned to respond to these challenges, if it continues to invest!' according to a Net!Works [7] report entitled 'Optical communications - an international success bolstered by EU-funded research'.

Many of the architectures, innovations and technologies in today's optical networks and, thus, broadband rollout have a heritage in collaborative EU-funded research projects, suggests Net!Works. What is more, consecutive Framework Programme funding for optical communications has led to the creation of a network of experts from industry and academia, supported education and training, and directly or indirectly generated tens of thousands of highly skilled jobs in Europe, the report concludes.

Indeed, this confirms that no single project, research line or technological development will deliver all the broadband infrastructure needs of Europeans today or in the future. But the actions mentioned in this article illustrate Europe's commitment to attaining its 2020 end-of-pipe ambition of 'smart, sustainable and inclusive' growth.

Projects mentioned in this report were funded under the FP7 'Cooperation' programme under collaborative research in information and communication technologies (ICT), the Competitiveness and Innovation Programme or the Eureka programme.

Useful Links:

- Europe 2020 [8]
- FIA [9]
- FP7 ICT programme [10]
- FP7 on CORDIS [11]
- Connecting Europe Facility [12]
- Celtic-Plus '100-GET' project [2]
- OMEGA [3]
- ALPHA [4]
- Sardana [5]
- Photonics21 [6]
- Net!Works [7]

Related Articles:

- A cheap and fully optical solution for ultra-fast internet [13]
- Future internet … A thing of beauty and promise [14]
- Meet the pioneers of future and emerging technology [15]
- Building a smarter internet [16]
- EUREKA Success Story: CELTIC 100GET — Internet could be 10 times faster than it is [17]
- Optical communications – an international success bolstered by EU-funded research [18]

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[2] http://www.celtic-initiative.org/Projects/Celtic-projects/Call4/100GET/Project-default.asp
[3] http://www.ict-omega.eu/
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