EURESCOM mess@ge
2/2006
The magazine for telecom insiders

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Mobile TV

In focus
EUREKA and its Clusters

Project reports
Community interaction

European issues
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Dear readers,

While you are reading this issue of *Eurescom mess@ge*, the football world cup in Germany is in full swing. Expectations have not only been high among football fans, but also among the telecoms community. The world cup has been targeted by network operators, service providers, and mobile phone manufacturers as the practical test for a new, exciting service: mobile TV.

Although most of the editors of this magazine are immune against the football virus, we decided that the timing is right for a cover theme on mobile TV. A number of exciting technological developments have happened in the past few years, which have made mobile TV currently one of the most promising new applications in telecoms. There is a variety of delivery technologies for mobile TV. In his introduction article, *Eurescom mess@ge* editor Peter Stollenmayer provides a concise overview on the main technologies and the business prospects of mobile TV. The Tutorial by CELTIC director Heinz Brüggemann explains the difference between the various mobile TV technologies in more detail. Articles by internationally renowned experts cover a wide selection of subjects related to mobile TV, including the results of European DVB-H field trials, a new project on DMB-based mobile TV services and results from EU project Daidalos mobile on multicast for multimedia content delivery.

Our section "In focus" this time features an exclusive inside report on EUREKA by Michel Vieillefosse, head of the EUREKA Secretariat. In this issue's Viewpoint, *Eurescom mess@ge* editor Anastasius Gavras argues that there is no consistent strategy on Internet regulation in Europe. Readers are encouraged to agree or disagree and share their opinion with us.

A controversial response could also be expected for the Eurescom study report on community interaction – is it a source of new revenue for telcos? Read what the experts from the Eurescom study team found out.

European research is now at the eve of Framework Programme 7 (FP7). In an exclusive article for *Eurescom mess@ge*, Joao da Silva, head of Directorate D in the DG Information Society and Media of the European Commission, explains in our section "European issues" his technological visions and goals in the context of FP7. In the same section, Eurescom director David Kennedy presents an overview on the IST research funding landscape in Europe.

There are many more topics covered in this issue, and we hope you will find some of the articles interesting and useful.

With this issue, *Eurescom mess@ge* contains CELTIC News, the new newsletter of EUREKA cluster programme CELTIC, which is the only EUREKA cluster fully dedicated to telecoms. CELTIC News will present the latest results from ongoing projects and important information for those who would like to submit a project proposal in the upcoming CELTIC calls. With this cooperation, *Eurescom mess@ge* will deliver even more value to its readers.

We would appreciate your feedback on any of the articles in this issue. If you would like to suggest a topic or offer a contribution to *Eurescom mess@ge*, this is equally welcome. If you would like to provide feedback on CELTIC News, please send an e-mail to the CELTIC Office at office@celtic-initiative.org

Enjoy reading this issue.

Your
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Events calendar

4 – 6 June 2006
IST Mobile & Wireless Communications Summit 2006
Myconos, Greece
http://mobilesummit2006.org

11 – 13 June 2006
ICT for an Inclusive Society
Riga, Latvia
http://www.ist-daidalos.org/daten/events/events.htm

19 – 23 June 2006
Euro-Southeast Asia ICT Forum
Singapore
http://www.eusea2006.org

29 June 2006
DAIDALOS I Final Workshop
Secure network infrastructures for pervasive, personalised services
Brussels, Belgium
http://www.ist-daidalos.org/daten/events/events.htm

30 August – 2 September 2006
45th FITCE Congress – Telecom Wars: The Return of the Profit
Athens, Greece

8 – 12 September 2006
IBC 2006 – The world of content creation, management, delivery
Amsterdam, The Netherlands
http://www.ibc.org

26 - 27 September 2006
Net-atHome™ – Connected Home Developments
Cannes, France
http://www.net-athome.com

14 November 2006
2nd General Assembly of the eMobility Technology Platform
Heidelberg, Germany
http://www.emobility.eu.org

15 – 17 November 2006
Wireless World Research Forum Meeting 17 – Serving and managing users in a heterogeneous environment
Heidelberg, Germany
http://www.wireless-world-research.org

22 – 24 November 2006
IST 2006 – Strategies for Leadership
Helsinki, Finland
http://europa.eu.int/information_society/istevent/2006/index_en.htm

Sn@pshot

Who needs a human goalie?

Robot goalkeeper at Robocup 2005 in Osaka.

RoboCup is an international collaborative project to promote artificial intelligence and robotics. The ultimate goal of the project is to develop a team of fully autonomous humanoid robots that can win against the human football world champion team by the year 2050. At this year's Robocup in Bremen, Germany, on 14-20 June, visitors can see for themselves how well the robo-kickers are doing in comparison to their human counterparts at the world cup for humans in Germany.

Website: *http://www.robocup.org*

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+++ News in brief +++ News in brief +++

ICANN rejects .xxx porn domain

On 10 May 2006, Internet regulator ICANN rejected plans to create a domain for pornography websites ending with the .xxx suffix. The idea for an .xxx sponsored top level domain (sTLD) was first circulated in 2001. A final decision on approving the exclusive porn domain has been delayed several times, most recently in December 2005. ICM Registry, the company that proposed the .xxx suffix, said the domain would have made it easier to find and filter pornographic web contents.

Plans for the .xxx domain have been criticised by a number of people and organisations, among them former ICANN board member Karl Auerbach and conservative religious groups in the US.

Critics said that because signing up for .xxx was voluntary, there was no guarantee owners of porn websites would move material to the new domain, in particular because many of them already have established, well-known sites.

Further information is available at
http://www.icann.org

Launch of satellite for broadband Internet services in 2008

British satellite operator Avanti Screenmedia Group PLC announced on 15 May the launch of a communication satellite called HYLAS (Highly Flexible Satellite), which is planned for end of 2008. HYLAS is a hybrid Ka Band/Ku Band satellite with European coverage and will be used mainly to provide broadband Internet access and to distribute and broadcast High Definition Television (HDTV).

The 2,300kg satellite will operate from its UK orbital position of 33.5 degrees West and cover 22 countries in western and central Europe. Total project cost is estimated to be 120 million euro. About one third, 34 million euro, is financed by the European Space Agency (ESA), the rest is privately financed. The supplier of the HYLAS Satellite is EADS Astrium Limited.

The satellite is expected to help bridge the digital divide in Europe by delivering broadband services to remote rural areas. "We have a problem in Europe in that broadband is still not a universal service," said Giuseppe Viriglio, director of EU and Industry Programmes at ESA. "To do this we need to provide an infrastructure – even to the remotest areas – where fibres do not go; and satellite can do that."

Giuseppe Viriglio, director of EU and Industry Programmes at ESA.

In August 2005, Avanti was awarded by British regulator OFCOM the right to use the geo-stationary orbital position at 33.5°W with 3.6GHz of radio spectrum to operate satellites.

Further information is available at
http://www.space.eads.net

Iceland leads in OECD broadband survey

Iceland has replaced South Korea as the country with the highest concentration of broadband users. In a survey by the Organisation for Economic Co-operation and Development (OECD) Iceland leads with a percentage of 26.7% broadband subscribers of the population in front of South Korea (25.4%), the Netherlands (25.3%), Denmark (25.0%), and Switzerland (23.1%).

By comparison, the United States were ranked 11th with 16.8%. However, the US still have the most broadband users, with more than 49 million. Japan followed the US in the largest number of broadband users, with 22.5 million, in front of South Korea (12.2 million), Germany (10.7 million), and the UK (9.5 million).

Japan leads in fibre-to-the-premises usage, with 4.6 million fibre subscribers by the end of 2005. The number of fibre subscribers in Japan now outnumbers the total of broadband users in 21 of the 30 OECD countries.

In Korea, fibre-based broadband connections grew 52.4% during the second half of 2005. However, despite the growth in the number of users connecting via fibre, the statistics reveal that DSL remains the leading broadband technology in 28 of the 30 OECD countries, claiming an overall market share of 62%. Cable accounts for 31% of broadband subscriptions, and other platforms – including satellite, fibre, and fixed wireless – for 7%.

Overall broadband subscriptions in OECD countries jumped from 136 million to 158 million in the six months to December 2005. The study also found the rate of people taking up broadband remained at an average of 15%.

Further information is available at
http://www.oecd.org/sti/ict/broadband

Mobile TV

The next European mega trend?

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Thirty years ago, most of us had not considered it possible that everybody can talk to everybody from everywhere. Meanwhile this dream has become true for nearly a quarter of the world population who own mobile phones. Today, most of us cannot imagine that we could watch TV wherever we are. Tomorrow, this will be just as normal as making a mobile phone call.

The time has never been as good as now for a boom in mobile TV. Technologies and mobile terminals are maturing fast, and, most importantly, there is a worldwide event coming up creating tremendous demand for watching content on the move: the football world cup 2006 in Germany. Furthermore, the European Commission is enthusiastic about the new emerging mobile TV service. The EU information society and media Commissioner Viviane Reding said at CeBIT, Hanover, in March 2006: "Mobile TV is an opportunity for Europe. I see this issue as a matter of urgency".

As always there are a few threats. The rivalry between several technologies in the mobile TV area and restrictions concerning available spectrum could limit the success of this new service.

Market forecasts look mostly good

The analysis of one of the first commercial mobile TV pilots early 2005 in Helsinki shows that 41% of the pilot participants would be willing to purchase mobile TV services; a monthly fee of 10 euro was considered reasonable.

At the mobile Entertainment Summit in September 2005 in San Francisco, analysts from the Yankee Group and Frost & Sullivan estimated that the mobile TV market in the US is worth between 16 and 28 million dollar in 2004 growing to 750 to 1,020 million dollar by 2008.

A recent forecast by Credit Swiss First Boston estimated the world market for mobile TV handsets to hit 40 million units in 2007, and 150 million units in 2009.

There are also less optimistic market forecasts, which suggest that people don't want to pay extra fees for mobile TV services. In this case the required income for the service providers could, for instance, come from advertisements or from selling value-added services.

Unicast versus broadcast

There are different ways of bringing a TV picture to a mobile device.

The most natural approach for telcos would be streaming: a UMTS or HSDPA (High-Speed Downlink Packet Access) connection could be used to stream a specific TV channel to an individual terminal. This has already been offered as a commercial service by various service providers and will also be available during the world cup. T-Mobile is offering 20 games via UMTS. The service is ideal for on-demand personalised video services. However, it is costly and not feasible for very large numbers of users. It will probably develop into a kind of niche market for personalised and on-demand video streaming. The article from FP6 project Daidalos within this cover theme sheds some light on the QoS aspects of this type of service.

Alternatively a terrestrial or satellite broadcast technology could be used. Because mobile terminals are small and have limited battery and computing power, normal broadcast services like DVB-S or DVB-T are not very suitable for this purpose. Broadcast technologies tailored to mobile use are for example DVB-H, DMB and MediaFLO. Since it is a broadcast service, all viewers get access to the same channels. The great advantage is that unlimited numbers of users can access the service.

Think about the several thousand spectators at a football match in a stadium, who want to watch again the last goal in slow motion. Such a request would easily overload and crash a UMTS service, whilst there is no problem if a broadcast service is used.

No spectacular offers of mobile broadcast are expected during the world cup, but some limited offers of DVB-H and DMB services will happen.

Winners and losers

Analysts expect that the revenues will be redistributed amongst the different players. Unless personalised mobile TV to individual terminals will become the mass market, the lion's share is expected to go to the content providers, the broadcasters and the mobile terminal manufacturers. There is probably very little money for the mobile operators. "You don't need mobile operators' networks to broadcast", said Eleanan Liew, Gartner's telecoms analyst in Singapore.

Competing technologies

One of the biggest technological challenges for mobile TV broadcasting is probably spectrum availability, and one of the largest business threats is most likely the existence of at least three major competing technologies.

- DMB (Digital Media Broadcasting) is based on the Digital Audio Broadcasting (DAB) standard and is already heavily used in South Korea. Chances are high that it will also be introduced very soon in China. China is under some pressure to provide commercial mobile TV services at the Beijing Olympics in 2008. Europe is also active in the DMB area. The article by Peter Kettner in this cover theme reports on the project MI FRIENDS, which is focused on DMB and related field trials.

- DVB-H (Digital Video Broadcasting – Handheld) adapts the successful DVB-T system for use on handheld devices. Several successful field trials have been conducted on DVB-H, for example in Berlin, Helsinki, and Oxford. The article by Milon Gupta in this cover theme presents further information about DVB-H field trials in Europe.
- MediaFLO (Forward Link Only) is a development by Qualcomm.

For more details on the different technologies please see the Tutorial by Heinz Brüggemann in this issue.

The important business question is whether the existence of those rival technologies will cause customer acceptance problems. It definitely will to some extent, how much depends on the marketing strategies. If, for example, the terminals are heavily subsidized by mobile service providers, the customers will probably not care so much. If, however the terminals need to be paid by the users to a large extent, which could well be the case because of missing business cases for the service providers, the customers will very much care whether the technologies are future-proof or not.

Outlook

Mobile TV is a promising new service, which could provide tremendous revenues particularly to content providers, broadcasters and mobile terminal manufacturers. Mobile operators have to be careful not to be amongst the losers when mobile TV takes off. The time is right, and the football world cup 2006 as well as the Beijing Olympics in 2008 will give additional boots.

However the existence of several competing technologies could have negative impacts on the market take-up of the service. Good answers to the potential customers need to be provided very soon.

You can find more information on the following pages:

- On the take-up of mobile TV: *http://news.bbc.co.uk/2/hi/technology/3880069.stm*
- The European Commission view on mobile TV: *http://informitv.com/articles/2006/03/11/mobiletvmarket/*
- On mobile TV in Korea: *http://www.telecomasia.net/telecomasia/article/articleDetail.jsp?id=307392*
- On European DVB-H: *http://www.mobiletv.nokia.com/*
- On the Mobile DTV Alliance: *http://www.mdtvalliance.org/en/index.asp*
- On business cases: *http://news.yahoo.com/s/nm/telecoms_mobile_tv_dc*

DVB-H pilots

in four European countries

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From March 2005 to June 2006, pilot trials on mobile TV services via DVB-H have been conducted among consumers in Finland, the UK, Spain, and France The results indicate that a majority of the participating consumers have a positive attitude towards mobile TV and would be ready to pay for such services.

Each of the pilots involved Nokia and a broad spectrum of companies, including broadcasters, mobile operators and broadcast network providers. Each pilot also involved broadcasts of live digital TV content over DVB-H networks to the Nokia 7710 smart phone.

Interim results

Interim results from the pilot in Oxford, UK, revealed that 83% of participants were satisfied with the service and over three quarters (76%) said they would take up the service within 12 months. In France, 68% said they would pay for mobile TV services while over half (55%) in Spain were willing to do so. Nearly 75% of Spanish participants would recommend the service to friends and family.

Final results from Seville

In May, final results from Seville were published, which show on even more friendly picture: 80% of the participants would recommend the mobile TV service and consider the service "very easy" to use. News, series and magazine programmes are, in that order, the most popular content.

Pricing models

The most popular pricing model seems to be a monthly subscription for a package of channels. In the Helsinki pilot, half of those that took part thought 10 euro per month was a reasonable price to pay, while in France, 68% were willing to pay 7 euro per month for mobile TV services.

Viewing patterns

The UK results reveal a lunchtime viewing peak higher than the normal TV pattern, suggesting that viewers are enjoying their favourite TV content while on their lunch break. In France, participants watched mobile TV for 20 minutes on average per day with early morning, lunchtime and mid evening representing the periods of highest use. The Spanish pilot also reveals mobile TV viewing spread throughout the day with early evening representing peak viewing.

An interesting aspect of all the pilots was that many users watched mobile TV within their homes. Almost half of those taking part in the French and Spanish pilots claimed to mainly watch mobile TV at home. For almost a third of participants in the UK pilot, this represented their first taste of multi-channel TV.

Content

The overwhelming message from these pilots is that consumers want both a wide range of channels but also content that is suitable for watching on mobile devices. The most popular types of content were

news, sports, music, soaps and documentaries. Interactivity was also an important functionality with over half of Spanish users (58%) saying they wanted specific, interactive content adapted to shorter viewing times. In the Finnish pilot, the San Marino and Monaco Grand Prix as well as the UEFA Champions League match between Liverpool and AC Milan were among the top 10 programmes viewed.

About the pilot trials

The Finnish pilot took place between March and June 2005 with 500 users and involved Nokia, Digita, Elisa, Nelonen, Sonera, YLE and MTV.

The Oxford pilot commenced in September 2005 offering 16 channels to 375 pilot participants. The pilot is being conducted by O2, Arquiva and Nokia with the final results being announced in spring 2006.

There have been two Spanish pilots: one involved 500 users in Madrid and Barcelona and was conducted by Abertis Telecom, Nokia and Telefonica Moviles, the other trial, which started on 16 December, involved 300 consumers within the city of Seville. The French DVB-H pilot run by the Canal Plus Group, Nokia, SFR and Tower Cast was given the go-ahead on 13 September 2005 by the CSA. Since then, 500 pilot participants have had access to a range of TV channels and radio stations,

Nokia has been the driving force behind these trials, as the number one mobile phone manufacturer wants to push its DVB-H handsets. It remains to be seen, if the positive customer response in the field trials will translate into equally enthusiastic adoption rates after a mass-market launch.

Further information is available on Nokia's mobile TV Forum website at *http://www.mobiletv.nokia.com*

European DMB project MI FRIENDS kicks off

Preparing a successful future for mobile media

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MI FRIENDS stands for "Mobile Interactive-Favourite TV, Radio, Information, Entertainment and New Digital Services". MI FRIENDS was initiated by the Bavarian Regulatory Authority For Commercial Broadcasting (Bayerische Landeszentrale für neue Medien – BLM), Munich.

MI FRIENDS is a pilot project comprising four distinct phases:

1. DMB project Regensburg (Germany)
2. DMB project FIFA World Cup Munich 2006 (Germany)
3. DMB project Lake Constance, (Austria, Switzerland and Germany)
4. DMB project South Tyrol/TRANSALP (Austria and Italy)

In November 2005, the MI FRIENDS project was accorded the CELTIC label, in recognition of its contribution to the EUREKA programme.

All media in one device

In the near future, the reception and use of media at home or in the office will still be dependent on specialised devices, using different delivery systems (cable, satellite, terrestrial systems) to deliver a convenient service.

However, further down the road, the reception and use of devices for media on the way or on the road will be characterised by convergence of media by using one device. The key to a sustainable and future-compliant infrastructure capable of delivering Mobile Multi-Media Broadcasting and Media Services is the use of MPEG4 H.264 as an intermediary technology. This

doesn't mean a convergence in a narrower sense of a physical growing together but rather the development of compatible approaches in the sense of the interoperability of various technical standards.

Interworking infrastructures and technologies

A successful and sustainable infrastructure for mobile broadcasting and media services must be able to cover many different types of environments, including metropolitan areas, urban areas, and rural areas with low population densities.

In addition, it should cover different types of travel methods such as high-speed trains, motorways, secondary roads, and pedestrian precincts.

For this purpose we need:

- full coverage for all types of activities and in all types of environment
- flexible and (spatially) scalable coverage
- robust and "speed-independent" reception
- minimal power consumption (in the devices)
- an optimal cost-benefit-relation.

The DAB-EUREKA 147 (Digital Audio Broadcasting) standard and its latest development DMB (Digital Multimedia Broadcasting), which became a European ETSI-Standard in July 2005, already meet these requirements. The MI FRIENDS project is based on these standards, and it is intended to adopt 2G/3G standards, for interactive services.

Rather than adopting a single-technology-approach based on competing technologies, the MI FRIENDS project is designed as a "multi-standard-initiative" to create a sustainable mobile media future using compatible infrastructures and promoting collaboration between different and hitherto competing technologies. To this end, some project partners of MI FRIENDS are already working towards a combined solution of DAB/DMB plus DVB-H.

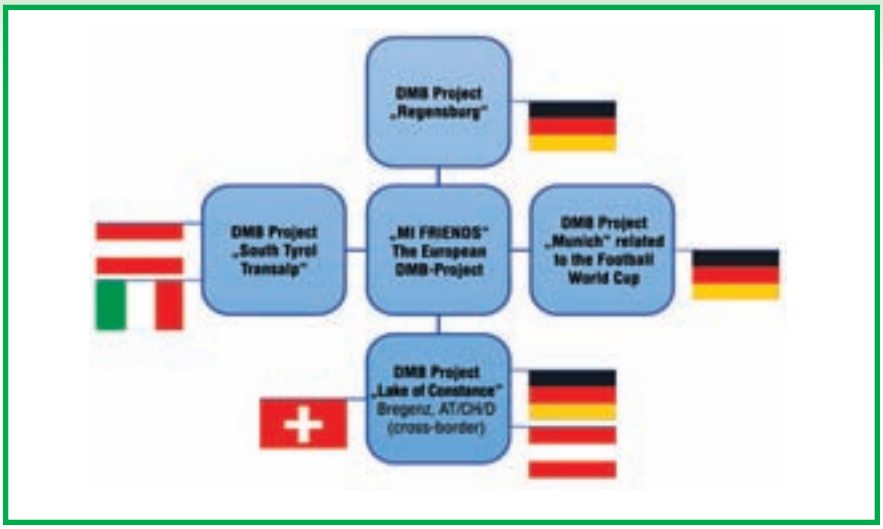
Scope and objectives

The goal of the MI FRIENDS project is to develop and test new media technologies from an economic point of view, paying particular attention to social and cultural aspects with the media consumer at its centre. The main emphasis of the project is on the development of new content and services providing mobile media for the local/regional area. Thus, the main aim of the project could be summed up as: making media available anywhere, anytime and anyway, for users across Europe.

The research and development activities of MI FRIENDS are intended to support the creation of new mobile media services beyond "mobile TV" such as the integration of radio and interactive services, as well as personalised multimedia services, using storage concepts like "tagging". Another very interesting research field of MI FRIENDS is a the development of 3D-DMB services capable of being used on handheld receivers.

Facts about the project

MI FRIENDS is geared up to deliver the major goal of a new architecture of infrastructures for services and applications in mobile multimedia, by testing integrated telecommunication solutions in a pan European 'laboratory' over a period of 24 months.



The MI FRIENDS project includes

4 phases performed in 4 EUREKA countries (Austria, Switzerland, Italy, Germany) with 75 designated project partners from 9 different countries. The project will be carried out in partnership with research institutes and universities, market leaders, and SME´s in the markets for "information and communication" and the market for "mobility". There will be 400 test users in each phase.

The Munich phase of the project is ready to start. The launch of this first MI FRIENDS showcase with multimedia offerings will coincide with the start of the FIFA World Cup in early June.

Conclusion

MI FRIENDS offers favourable conditions to generate a successful European growth engine for the new triple play of mobile voice, mobile internet, and mobile broadcasting. The project is a great opportunity for all stakeholders in digital broadcasting and new services to make this vision happen.

Further information about the project is available at
http://www.mi-friends.org

Better quality for mobile TV

QoS improvements for multicast distribution

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Mobile TV puts specific challenges to service providers in regard to the quality of service (QoS). Without significant improvements of multicast distribution, watching soccer matches on mobile devices will not be much fun. This article addresses reliable mobile multicast for multimedia content delivery in IP-based wireless networks, supported by proxy mechanisms and context transfer at access routers. It is part of the work that has been performed by the EU-supported IST research project DAIDALOS.

When the data packet, that little piece of information, has made it over many miles of cable network infrastructure from the distributor close to the customer, the last hop often turns out to be the worst part of the journey. It's not cable, it's air, it's radio, it's interference and reflection, and several other possible causes for loss.

While fixed networks have a well-defined behaviour, are under control of the operators and only have to cope sometimes with overloading, the last hop is still under control of physics. Making things worse, our nice mobile phones with GPRS or WiFi interfaces allow us to move, causing another challenge to the reliable delivery of real-time multicast streams.

Last hop reliability

The most likely source of packet loss in a wireless access networks are bit-errors due to the transmission over the wireless link. Traditional end-to-end retransmission requests for lost packets are not feasible in many environments. For real-time services, they are too slow, which would cause the soccer game you are watching to stop, because it has to wait for some data retransmissions. For multicast distributions, with possibly millions of receivers and thousands of lost packets, it might lead to a complete service termination if the traffic source would have to cope with every lost packet somewhere in the world. After all, we want reliable transmissions, no black bricks in our soccer game video.

The solution to this problem is a combination of multiple mechanisms, standardised as building blocks by the Reliable Multicast Transport (RMT) working group in the Internet Engineering Task Force (IETF). For reliable delivery of mobile TV, an approach based on forward error corrections (FEC) and local negative-acknowledgement (NACK) seems to be most appropriate.

The FEC algorithms are well established. Their deployment in access routers (down-

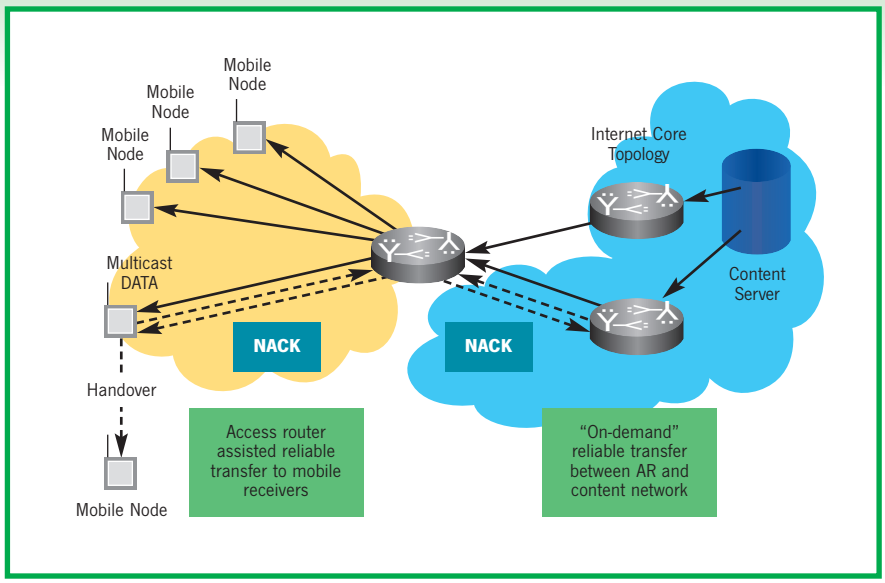

Figure: Scenario for access-router-supported reliable mobile multicast

stream towards the receiver) limits the overhead introduced by the FEC to the only one hop where it is useful: the radio link. Many transmission errors can then be handled by the receiving terminal alone, just based on the additional information that is provided with every data packet.

The support for NACK-based retransmissions is not so obvious if we do not want to have the data source involved – and if we want to support mobility, as we will see later. If the receiving terminal is not able to reconstruct lost data, it issues a NACK message towards the radio access router. The router has buffered the incoming multimedia content. This allows it to retransmit lost data immediately. Since this retransmission source is only one (or a few hops) away, it is very fast. And since the scheme is distributed over all access routers, it scales well even for very large multicast distributions.

The multicast mobility challenge

The current access router has the required information for retransmission, since all data targeted for the mobile terminal went through this router. In case of a handover from one access router to another, this context has to be made available to the new access router. The two access routers are responsible to transfer and update the reliable multicast transport context.

When resilient transport is required, the retransmission context, buffered at access routers, is kept only for specified time periods. The benefit of access router assistance is that in case of handover the reliable multicast transport for the mobile node can be continued without interruption.

Conclusion

Local retransmission schemes are able to provide a significant improvement of the perceived QoS of real-time streams. Supported by context transfer, they are also applicable in the mobile environment. With the mechanisms described above we are able to properly enjoy a soccer game or any other streamed video information on our mobile devices.

More information on the DAIDALOS project is available at:
http://www.ist-daidalos.org

EUREKA and its Clusters

Shaping tomorrow's innovations today

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The EUREKA Initiative enables small and large businesses, research centres, universities and national administrations to join forces in realising near-market research and development (R&D) through transnational collaborative projects. Since its launch 21 years ago, this intergovernmental network has continued to prove highly effective in mobilising Europe's capability to innovate through helping to dramatically transform key industry sectors – and to produce an abundance of new products, materials and processes that enhance our everyday quality of life.

No constraints on imagination

The idea for EUREKA, a decentralised network, came when the USA launched its Strategic Defence Initiative – popularly known as Star Wars; its military objective was clear, but it was also clear to European political leaders that major expenditure of this kind would stimulate development of the most advanced technology. And Europe urgently needed an effective civilian initiative to kick-start technology.

EUREKA's greatest strength is its 'bottom-up' approach: European politicians did not want to decree at government level what would be good for industry, and decided to listen to the proposals of researchers and industrialists, and, at the same time, encourage transnational collaboration between these communities.

According to Professor Hubert Curien, the former French Research Minister who

Michel Vieillefosse, Director of the EUREKA Secretariat, and the Finance Minister of Luxembourg, Jeannot Krecké, at EUREKA's 20th anniversary event in Luxembourg in 2005.

convinced François Mitterand and Helmut Kohl to create EUREKA: "We did not want to put any constraints on imagination. The field was open to ideas of all kinds. Bureaucracy had to be avoided." And so, EUREKA was born.

Establishing leadership in microelectronics

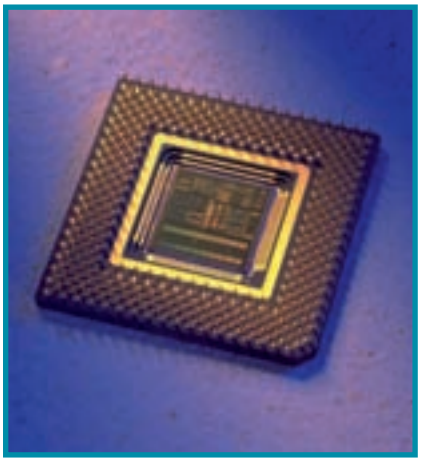
Work on what proved to be the largest and most enduring collaboration began in 1990. E! 127 JESSI, launched with a budget of 3.8 billion euro. It brought together large and small companies and institutions from 13 countries, with the goal of regaining ground lost to Asia and the USA in microchips.

This large-scale, bottom-up collaboration is widely credited for its major part in averting total domination of the European semi-conductor industry by US and Japanese competitors. In fact, by the end of the project, all three major European chip manufacturers – Infineon Technologies, Philips Semiconductors and STMicroelectronics – had joined the top ten of global semiconductor companies. Lessons learned during the eight-year life of JESSI helped to frame the concept that was embodied in its successor E! 1535 MEDEA. This became the first initiative to be described officially as a EUREKA 'Cluster'.

Driving industrial leadership on the world stage

EUREKA Clusters show how public-private partnerships can produce breakthroughs in high technology sectors of significant economic and social importance to Europe. Such a strategic approach is crucial to the development of the European Research Area and to future competitiveness and employment opportunities in a globalised economy.

Because of their high profile, Clusters play a key role in promoting their industry sectors and persuading national governments and financial organisations to provide the support necessary to meet the clear objectives identified by industry itself. Each Cluster establishes a roadmap defining the most important strategic domains and develops a programme of individual projects to meet the needs of this strategic review, with regular calls to attract participants from around Europe. The flexibility of operation under EUREKA means that, in response to the rapidly changing technological environment and market



demands, rolling updates can be made each year to roadmaps and projects.

The value of such cooperation transcends the competitive differences between individual partners, helping to ensure that Europe maintains its global leadership in areas of existing strength, and enhancing its position in emerging technology-driven markets. Equally importantly, it helps shape the formulation and adoption of common standards, and promotes the interoperability of products.

EUREKA's lean bureaucracy also minimises overhead costs, as is indicated by the original MEDEA programme. This included over 50 projects with more than 150 partners in 12 countries. The input was equivalent to some 9,400 person-years, costing a total of around 1.7 billion euro. Of this sum, management, administration and reporting accounted for less than 0.8%. The vertical and horizontal cooperation in projects between companies led to more than critical mass, linking together semiconductor suppliers and electronics systems houses. The result: a much better understanding of where to focus tight resources.

EUREKA today

Despite the general slowdown in European research investment, EUREKA continues to forge ahead in developing life-enhancing solutions that are helping to maintain Europe's competitive edge and technological advantage. In 2005, a total of 184 new projects were announced, with a value of 320 million euro, while the budget for ongoing projects within the EUREKA Clusters exceeded 1.26 billion euro.

The Clusters show the way

The Clusters can be seen as the leading model for transnational, co-operative, pre-competitive research in the world, demonstrating how collaboration cuts development time, risk and cost.

Self-generated integration and monitoring at both programme and project level are the underlying reasons for the strength of the Clusters. In the field of ICT, five Clusters (MEDEA+, ITEA, CELTIC, EURIMUS II and PIDEA+) coordinate

research by over 1,000 companies from 27 EUREKA member countries in 217 strategic projects with a potential value of over 5.8 billion euro. Some 8 billion euro has been invested in initiatives such as high-definition TV and microchips, shifting European companies into top-ranking positions in their respective sectors. And the launch of the CELTIC Cluster at the end of 2003 now offers a unique approach through the development of comprehensive integrated communications system solutions, including platforms and test vehicles.

CELTIC is already bolstering effort to bring broadband access and affordable mobile services to all European citizens. Its remit embraces audio-visual and multimedia, public safety, e-governance, healthcare and access to the ubiquitous services that will become increasingly prevalent in tomorrow's world.

The strong business case for its existence is to maintain the momentum of a sector that in 2002 recorded a turnover of 236

continued on page 13

CELTIC
Telecommunication Solutions
N • E • W • S

CONTENT

EDITORIAL

Staying up-to-date with CELTIC

Dear reader,

Since CELTIC was launched by end 2003 it has rapidly become the third largest Eureka ICT cluster after MEDEA+ and ITEA2. Currently around 30 projects are running with a total budget of over 250 million euro. 18 countries and about 320 different companies are involved in these projects. This successful start enabled us to set up a meaningful work programme that already generated first noticeable impacts by project results on one side and by cooperation discussions with the newly defined European Technology Platforms of Framework Programme 7 on the other side.

To keep all interested readers and actors in the ICT domain updated on the progress, achievements and new directions of CELTIC, the CELTIC Core Group decided to issue a periodic CELTIC newsletter. As CELTIC is an organisational unit of Eurescom, this newsletter will be published as insertion of the Eurescom mess@ge, which has already been well established since several years. We hope that this addition will be appreciated by most readers.

In this first release of CELTIC News we selected three successful projects: BANITS, MADEIRA, and FIRM, which all started in 2004.

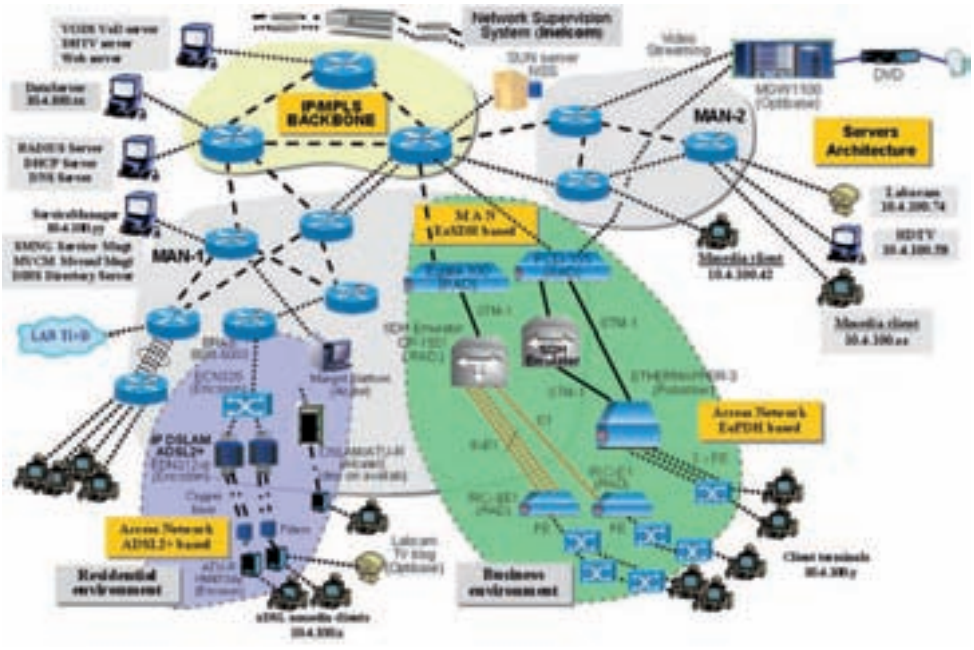
Heinz Brüggemann
Director CELTIC Office

Call 4 and cooperation with Technology Platforms

Our latest call for projects starting in 2007 was very successful; we received 29 proposal outlines. These proposals add up to an overall budget of about 200 million euros. Differently to former calls, the proposals were invited to focus also on the strategic research agendas of the new technology platforms NEM, eMobility, NESSI, and ISI. With these platforms CELTIC has already established, or is in progress to establish, some cooperation agreements to align the national research agendas with those of the technology platforms. We consider this approach as very important to maximise the impact of the research programmes and to achieve the best use of public funding in Europe.

Broadband Access Networks Integrated Telecommunication System – BANITS

THE BANITS METHOD FOR A SUCCESS STORY



BANITS network architecture

BANITS has extended the knowledge in the area of telecom networks and enabled delivery of new advanced multimedia services by maximizing the utilization of the existing network infrastructure including technologies like xDSL, SDH, and Ethernet.

BANITS started from today's network solutions and investigated new ways to extend their use both in time and in service availability. BANITS also focused on the weak points that challenge network operators by implementing a service testbed, covering all areas, which enables multi-service offerings to business and residential users. Using this testbed, BANITS investigated access and metropolitan networks targeting the following features:

- Low CAPEX and OPEX: reduction of capital expenditure and operating expenses for network operators by using existing infrastructures combined with Ethernet.
- Multi-service capabilities: for provisioning new services with the appropriate service attributes (Performance, Quality of Service, Security) while maintaining the traditional services over a single infrastructure.
- Well integrated end-to-end view: effective inter-working between different network infrastructures (DSLAM, SDH, GbE metro, IP/MPLS) and various network types (metro/core networks and home networks).

End users	Yes	Ourselves
Service provider	Yes	Telefónica
Operator	Yes	Telefónica
Management systems	Yes	Inelcom
System vendors & equipment developers	Yes	Ericsson, Alcatel Bell, RAD, Optibase
Technology providers	Yes	Robotiker, UpZide Labs
Academic research	Yes	K.U. Leuven R&D

Table 1: The BANITS vertical integration approach

BANITS testbed and method

The BANITS testbed aggregates the expertise of all partners involved; from SMEs, and Academia to industrial partners including market and technology leaders. BANITS testbed covers all relevant roles through a vertical integration approach, as represented in Table 1.

Main results

The main results of BANITS are:

- An access network where the Ethernet traffic is efficiently transported.
- An edge network, where the traditional ATM-based DSLAM evolves to include native Ethernet traffic with QoS.
- A Metropolitan Network based on legacy equipment but enabling carrier-grade Ethernet provisioning with minimum investment.
- Advanced multimedia services using the solutions for the different network elements with relevant service attributes (QoS, performance, scalability, etc.).
- An integrated testbed for all areas and technologies covered in the project. The testbed has proved the viability to access different services using end-to-end Ethernet connections, and thus avoiding the costly link layer protocol translations while still using legacy equipment.

Technical achievements

BANITS' main technical achievements are: system definition, specification and design of an integrated network; testbed design and integration; and service specification and deployment over BANITS testbed. Successful service deployment is the highlight of the project's technical achievements. The deployed services are, among others: VoD (HDTV included), video distribution, multi-videoconferencing and TV blog.

Impact

BANITS' achievements have impact in all relevant stages of the telecom industry:

- **Services**
  - Telefonica I+D multi-video conference prototype
- **Products**
  - RAD E-gate 100 (with Robotiker know-how)
  - Optibase Multimedia Server
  - INELCOM Supervision and Access System IMUX
  - Ericsson Ethernet DSL Access (EDA)
  - Alcatel DLM package integrated in the 5530 Network Analyser
  - Robotiker Ethermapper prototype for EoSDH
- **Unified technology development**
  - Standards – about 45 contributions

Dissemination

BANITS' dissemination contribution record is:

- Contributions to standardisation bodies: 45
- Academic publications: 20
- Commercial dissemination: 15

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Conclusion

BANITS is a successful arena for cooperation between some of the largest telco players in Europe. It concentrates and coordinates significant expertise onto the development of access and metropolitan networks. It gives real impact on products, standards, and services enabling new business on legacy networks.

Madeira: Distributed Network Management System

ACHIEVING SCALABILITY AND SELF-MANAGEMENT USING PEER-TO-PEER DISTRIBUTION TECHNIQUES

The Madeira Project is building a prototype Network Management System (NMS) that addresses the issues of scalability, discovery, flexibility, openness, heterogeneity, automatic deployment of services, and reliability. This is achieved by distributing the management functionality onto the network elements using a hybrid peer-to-peer methodology.

The issues of scalability and self-management are critical in order to successfully manage Next Generation Networks, which are significantly larger and more heterogeneous than existing networks. Current management approaches such as the Telecommunications Management Network are based on a hierarchical structure and use rigid interoperability standards that limit their use in evolving large-scale dynamic networks. Madeira applies peer-to-peer distributed techniques in a novel way to the domain of network management in order to achieve scalability and self-management, and this is demonstrated in the areas of configuration and fault management. This leads to vital reductions in operating expenditure for network operators, and improves overall system performance.

The Madeira project is an international collaboration comprising: Ericsson R&D Ireland (project leaders), Siemens AG Austria/PSE, BT Group, Ericsson Research Sweden, Telefónica Investigación y Desarrollo Spain, Universitat Politècnica de Catalunya Spain, Telecommunications Software & Systems Group Ireland.

Madeira architecture

The Madeira architecture is illustrated in figure 1. This software is distributed onto all network elements, and facilitates both east-west and north-south management communication. The management software includes the following:

- Network Element Adaptor which is customised for the underlying transport network
- Peer-to-Peer Platform which includes Lifecycle, Notification, Directory, Connectivity, Persistency, and Code Distribution Services

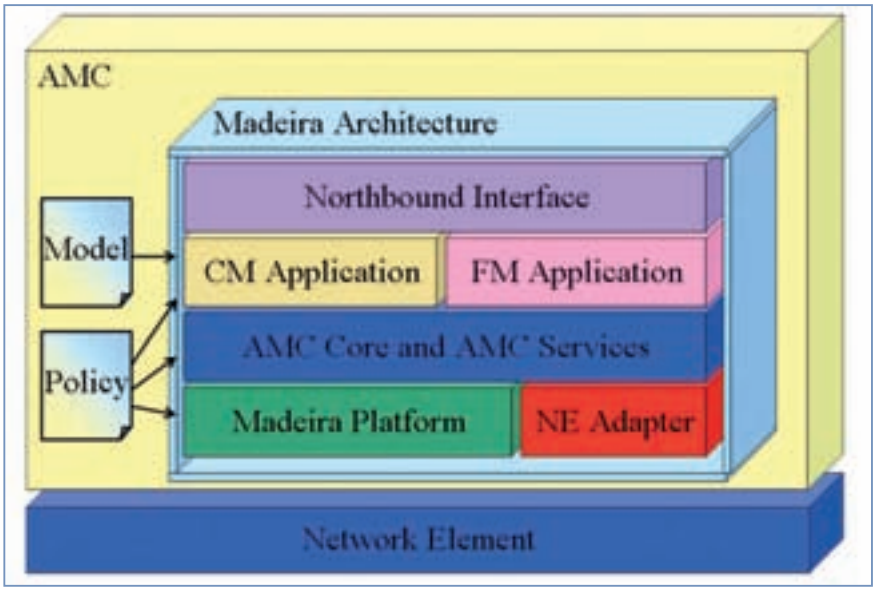

Figure 1: Madeira architecture

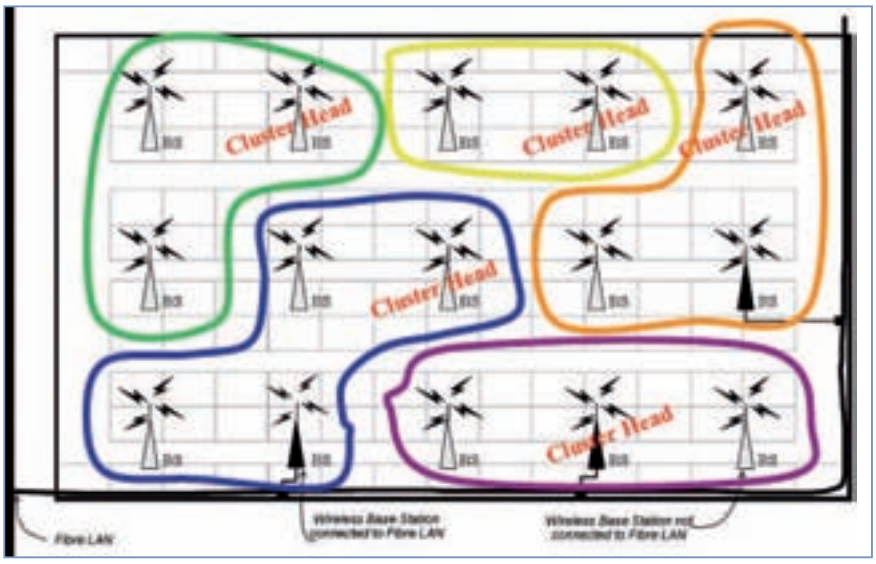

Figure 2: Cluster formation

Dr Sandra Collins
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- Adaptive Management Component which allows the management applications to communicate with each other
- Policy Based Management System which allows management logic to be dynamically fed into the system without changing or restarting any applications
- Configuration Management Application which tracks and configures the complete network topology and inventory, and can be queried at any network element
- Fault Management Application which correlates alarms into a single root cause alarm for the operator and automatically repairs faults where possible
- Web-Services based Northbound Interface which facilitates communication with an external OSS.

Madeira management clustering

Madeira applies a novel clustering mechanism to perform distributed management tasks, which is crucial to achieve scalability. The clustering mechanism is the formation of a multi-level hierarchical logical overlay management network, which is facilitated by the peer-to-peer east-west interface. Cluster formation is illustrated in Figures 2 and 3. Clusters and Cluster Heads are elected using policies which are optimised for the underlying physical transport network. This management overlay network allows management tasks for the configuration and fault management applications to be distributed and executed on the network elements themselves, and enables self-management of the network nodes at cluster level, hence improving scalability, response time, and automatic fault repair. The management clusters also remove the need for a single central server, eliminating single point of failure and high-redundancy requirements.

Conclusion

In order to demonstrate the feasibility of the peer-to-peer distributed approach applied to network management, and to evaluate the performance of the Madeira Distributed NMS, a challenging scenario has been identified, which is the configuration and fault management of large-scale dynamical mesh WLAN networks: their deployment, network formation and reconfiguration due to mobility, faults, and deployment of new services. A prototype is currently being developed and tested on a mesh WLAN testbed of up to twenty nodes. The scope of the project will be further expanded in 2007 to firstly build and integrate a seamless security solution, and secondly to evaluate and fine-tune the scalability of the distributed NMS.

You can find more information on Madeira at *http://www.celtic-madeira.org*

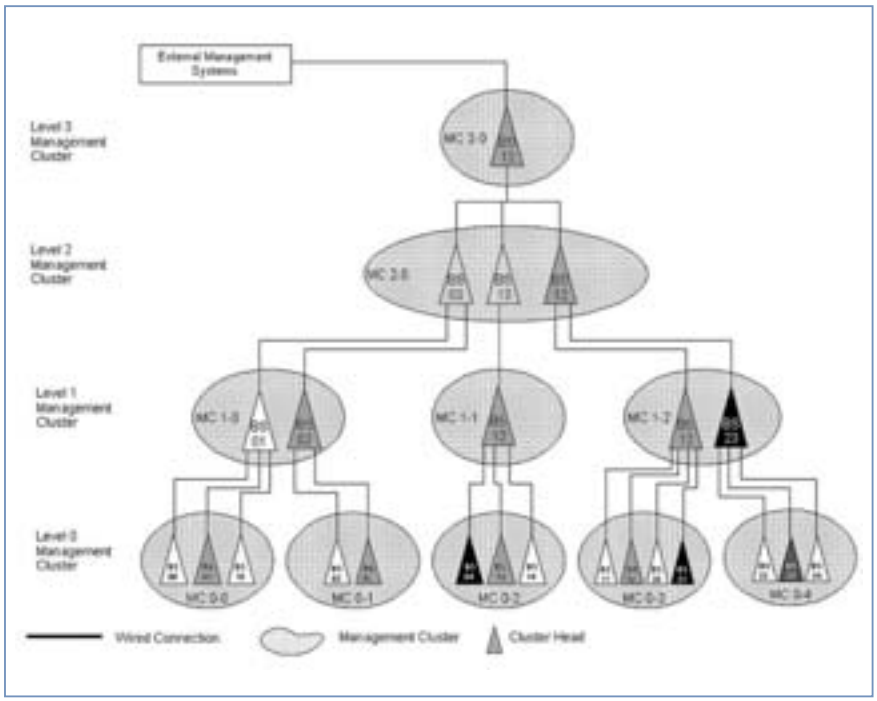

Figure 3: Cluster formation

Integrating GMPLS-enabled ROADMs

THE FIRM PROJECT EXPERIENCE

The FIRM project aims to deploy a field trial consisting on an optical metro network based on ROADMs (Reconfigurable Optical Add/Drop Multiplexing) with GMPLS (Generalised Multi-Protocol Label Switching) compliance to set up and tear-down light-paths dynamically in a real metro network environment, using advanced applications.

By using a novel technology of reconfigurable optical switches and tuneable transponders together with a unified control plane (GMPLS), the FIRM ROADM enables unprecedented flexibility in optical networks, allowing on-the-fly network reconfiguration, and reducing capital and operating expenditures (CAPEX and OPEX) and will enhance the delivery of new services and end-to-end connectivity.

OADMs on the market are either fixed or, at best, manually reconfigurable, and wavelengths can only be routed to a limited number of ports, thus leading to inherent limitations. The proposed innovative ROADM enables on-demand provisioning and improves the QoS provided to customers.

The FIRM consortium is made up of seven partners from four different countries, including a network operator (Telefónica I+D), academic and research institutions (Fundació i2CAT, UPC, and UPVLC), and equipment suppliers (Intune and Sercalo).

Optical node development

FIRM has developed an integrated system by turning a static OADM into a ROADM from discrete components, with tuneable transceivers, introducing embedded intelligence inside the system. A proper integration of the solution will be assured through a correct assembly of optical components from different providers, guaranteeing an efficient interoperability. The general architecture of the ROADM can be seen in figure 1.

The basic features of the FIRM ROADM were firstly showed in the last CELTIC Event in Dublin in February 2006, where a first integrated and assembled node was shown.

GMPLS control plane

The proposed ROADM architecture enables an intelligent networking and flexibility by means of an open CCI (Communications Controller Interface) supporting a GMPLS compliance control plane. Moreover, a basic Network Management System (NMS) has been adapted to trigger connection requests (soft-permanent), as well as to manage remotely the active optical devices of the FIRM ROADMs.

Field trial deployment

Currently, another two ROAMD units are being integrated, and the complete system will be assessed in a field trial over existing fibre, with access to end user applications and with a Pan-European scope. Over this infrastructure, the complete ROADM solution will be assessed with some representative broadband applications to stress the field trial network and test its performance, such as high-definition video.

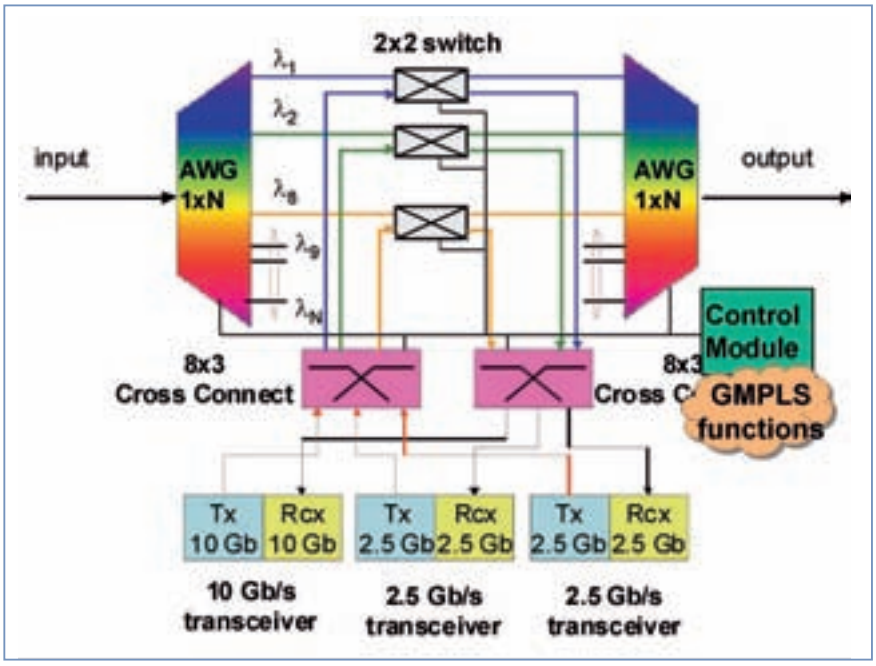

Figure 1: General architecture of the ROADM

Figure 2: Integrated and assembled node

Conclusion

The main result of the project is a reconfigurable, control- and management-enabled integrated ROADM which will allow a technology evolution without replacing currently static OADMs. By upgrading existing products with the integration of external devices, FIRM offers a cost-effective solution that could be available within a short time.

You can find more information at *http://www.celtic-initiative/FIRM*

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Successful projects – CELTIC comes to maturity

CELTIC has continued to consolidate its status as the third largest EUREKA Cluster. By May 2006 a total number of 28 CELTIC projects were running and 11 labelled projects will start their work in 2006. Altogether these projects represent a budget of about 240 million euros and a total effort of 2,400 person years.

The first projects from the first CELTIC Call are now closing. Most projects from the second Call are in the stage of the mid-term review and the first projects of Call three have been started. One of the interesting tendencies between the Calls is that the proposers know today much better how to build the consortia for a successful project. Important factors are that a strong consortium proposes innovative subjects of technical excellence. However, for being successful the proposers must also take into account the funding possibilities of the Public Authorities in the EUREKA member states. This has been improved from Call to Call, and the success rate of labelled projects, which were able to start has increased from 57% in Call 1 to 65% in Call 2, and for Call 3 it is expected that more than 70% of the projects that have received the CELTIC label will be able to successfully start their work.

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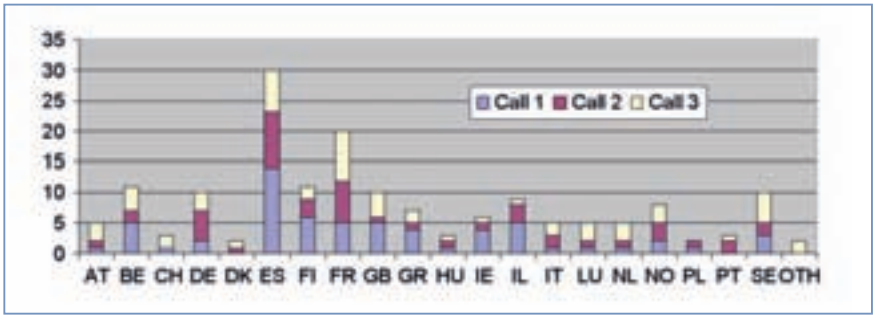
CELTIC Event in Dublin – the conference

By May 2006, 20 CELTIC projects were reviewed in a CELTIC mid-term review. 75% of the projects presented good results that met the expectations. About 25% of the projects even achieved excellent mid-term review ratings. Only very few project results were below the expectations.

From 23 to 24 February the first CELTIC Event was organised at Dublin Castle in Ireland. This event attracted about 200 participants from 30 countries, including numerous decision makers from industry and public administrations. The most advanced and the most exciting CELTIC projects presented their results at workshop sessions or at their demo-booths.

CELTIC Event in Dublin – the exhibition



Number of projects by countries

IMPRINT

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About CELTIC

CELTIC is a EUREKA cluster programme, which initiates and runs privately and publicly funded R&D projects in the field of telecommunications. The cluster, which runs until 2011, is supported by most of the major European players in communication technologies. CELTIC projects are focusing at telecoms networks, applications, and services looking at a complete system approach. The size of the CELTIC budget is in the range of 1 billion euro. CELTIC is open to any kind of project participants from all EUREKA countries.

billion euro, employed 1.25 million people and was responsible for 2.5% of EU GDP. Specific challenges include the convergence of telephones, televisions and home computers, as well as the development of innovative business models and revenue-generating communication services that meet the needs of both corporate and private customers.

A total budget of one billion euro has been defined for the eight-year duration. To date, 40 projects have been labelled, bringing together 438 partners from 22 countries.

Looking ahead

Plans are well in hand to raise the image of EUREKA and to strengthen its contribution to the emerging European Research Area by forging closer links with other European programmes – and particularly the EU Framework Programmes under Articles 169 and 171 of the European Treaty. At the same time, the Initiative is well placed to support the new Action Plan for Europe proposed by the EU to tackle the shortfall in R&D investment needed to meet the goals of the EU Lisbon strategy. The challenge will be to embrace the necessary changes without compromising the unique strengths that have made EUREKA an industry champion since 1985.

Further information on EUREKA can be found on *http://www.eureka.be*

To receive a printed copy of the EUREKA 20-year report (in English), please send an e-mail entitled '20 year report' with your name and postal address to *eureka.secretariat@es.eureka.be*

French, German, Spanish and Italian editions are available as downloadable pdf files on the EUREKA website.

Internet regulation
No consistent strategy in Europe

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In the US a very heated discussion has been triggered by the loud thinking of some network operators to start with differentiated charging for transporting the content. In their view, the network should not be blind anymore, seeing only bits in the pipe, but charge a higher fee for the bits that belong to a premium customer. Deutsche Telekom has triggered this discussion in Europe as well by the statements of Kai-Uwe Ricke to ask for more money if the Deutsche Telekom network prioritises premium traffic.

Neutrality and regulation

There are several problems, and they are accumulating faster than we are able to solve them. The Internet today is a critical infrastructure. It transports a lot of "value" from different sectors, like banking, or logistics, and supports other infrastructures. For example, communications supporting transportation and utilities such as the power distribution network run over the Internet. An evil hacker probably could literally "click" out the lights. So, the first problem is that, as a critical infrastructure, the Internet must stay neutral, at least to some extent. And it is a global responsibility to ensure this neutrality by policy setting. And this is the second problem. The Internet grew to what it is today because of the openness and non-regulation that it enjoyed since it was commercialised. But asking for policy setting means regulation, and perhaps the right question to ask is: "How little regulation is too much regulation?"

The Internet as utility

There exist many companies and individuals who act as if the end customer has unlimited budget to pay for a fancy new Internet with lots of premium content and services. In reality the whole discussion is about a re-distribution of the cake, and of course of market power. The overall market size will only expand very slowly, so the only way to expand your business faster than the market growth is to try to chunk it off other stakeholders in the value chain. Finally, there is obviously a market for more bandwidth. Many operators are investing in more fibre, potentially fibre to the home (FTTH). The market here is actually disturbed by some municipalities who decided to invest public funds to offer FTTH to their citizens. So, the public sector is starting to see the Internet as a utility.

The societal value

Currently, there is a run to provide premium content at premium subscription rates to the end customer. And, believe it or not, the company that has the ability or the right-of-way to transport the premium content will have a say on who will be able to receive whose content. All companies are positioning themselves to get the best piece of the cake, whether they are the network operators, the service providers, the content owners, or the content distributors. Whether the carrier should differentiate or not when transporting the bits is the question that the regulator will have to answer. However, I believe that this is a broader question and needs to be discussed holistically by the society, because it will affect all information that is transported over the Internet including information belonging to critical infrastructure functions.

If we accept that the Internet is a basic infrastructure for the society, we should compare it with other infrastructures. Society has decided to accept models, which differentiate premium users who pay a higher fee. The best examples are the toll roads, for which you pay toll for using them, allowing you to get faster to your destination. Also in the energy sector you have to pay a higher electricity bill if the power company delivers you a higher level of assurance for uninterrupted power supply. Why should a new emerging infrastructure as the Internet be treated differently than other infrastructures established long ago?

Conclusion

The subtle difference is that the Internet is a global issue, requiring a true global consent. Europe, so far, has not followed a consistent strategy with respect to its position regarding the Internet. On the one side you find arguments against proposals for exempting higher bandwidth networks from regulation, on the other side you find arguments for stronger liberalisation of the markets, yet on the other side public funds are invested in the deployment of FTTH networks which disturb natural market evolution.

Finally, the high standards of European backbone networks cannot be sustained in the long run to function as a critical infrastructure, if there is not enough preparedness of the society to adequately pay for it.

mCDN workshop in Milan

A new paradigm for content delivery networks

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The IST project mCDN on Multimedia Content Discovery and Delivery Network organised a workshop to present its results and publicly demonstrate the prototype developments of the project. Around 50 experts from the different stakeholders attended the workshop, discussed the findings of the project, and had the opportunity to experience in live demonstrations various aspects of the services, which are directly exposed to the end user.

The workshop was held at the premises of Siemens in Cinisello Balsamo near Milan, Italy, on 27 April 2006. It was also used to evaluate the final prototypes of the project from a telecom operator point of view. Eurescom attended the workshop and evaluated the demonstrators against the requirements that were gathered and consolidated by Eurescom at the start of the project, and which were provided by different telecom operators.

The first part of the workshop was dominated by invited presentations that delivered solutions to similar problems in the content delivery domain, such as the approaches presented by Mr. Timmerer from the University of Klagenfurt, who presented an overview of project DANAE, and Mr. Hesselman from Telematica Institute, who presented aspects of the project SPICE. Mr. Giordano presented the deployed content delivery network at the campus of University of Pisa and the e-learning applications that run on it.

The rest of the workshop was all about the mCDN project and was structured in logical sessions that guided the audience through the different achievements of the project, starting from the high-level business modelling issues and user requirements, down to very detailed technical solutions. After each short introduction to a problem space addressed by the project, a demonstration of the prototype implementation was shown. As a contribution to the lively discussion, the different demonstrations were designed to be interactive, allowing the participants to also "touch and feel" the services offered by the demonstrator.

Tiziana Toniatti from Siemens guided the audience through the storyline for the demonstrations of these parts of the system, which directly contribute to the user experience.

Besides novel features, such as augmented and

From top:
Klaus-Peter Eckert, Fraunhofer (right);
Tiziana Toniatti, Siemens;
Yannis Matalas, Intracom

personalised content search, efficient content and meta-data distribution, as well as discovery and delivery, the project also demonstrated solutions to monitor, evaluate and adapt to the dynamic network performance. "Quality of Service is still a major challenge, and it is very difficult to convince the customer to pay for services delivered in high quality, if you cannot provide hard facts about the network conditions", said Mr. Joachim Sokol from Siemens.

"The main message is that mCDN delivers an architecture with dedicated reference points and open, well specified interfaces, enabling new actors to assume roles in an extended content discovery and delivery value chain", said the project co-ordinator Bennet Heirwegh from Intrasoft.

The project's web site is available at: ***http://www.comtec.eecs.uni-kassel.de/content/projects/mcdn/***

ePerSpace workshop
on services integration

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The objective of IST project ePerSpace was to significantly increase the user acceptance of networked audiovisual systems and applications at home and virtually anywhere by developing innovative interoperable value-added networked services. Approaching its conclusion, the project presented its results at a workshop. The workshop was followed by a visit to Telefónica's intelligent home demonstration where the services developed and integrated by ePerSpace were shown.

The workshop took place on 5 April. It was hosted by Telefonica I+D in Madrid and attracted some 65 people. Presentations at the workshop covered the challenges in the ePerSpace platform design the project had to face. The wide range of ePerSpace services were described and services introduced. A detailed analysis of the business case for such services was also provided. Invited speakers from IST projects TEAHA and Amigo together with a speaker from the Home Gateway Initiative provided information helping to put ePerSpace and its results into a broader context.

The IST platform NEM, which aims to advance research in the field of networked audio-visual services and home platforms, was also presented. Finally, a presentation about home networks and services in the upcoming EU Framework Programme 7 provided an outlook to future European research in this area.

The talks were followed by a visit to Telefónica's intelligent home demonstration where the services developed and integrated by ePerSpace were shown. The following services were demonstrated, among others:

- The Local Service Portal, which is accessed by the user whenever he connects with a terminal to his Home Area Network. After authentication, the user can access services in the areas of home automation, security, and multimedia applications.

José Jimenez, Director Innovation Strategy at Telefónica Investigación y Desarrollo, giving his welcome speech.

- The doorkeeper service allowing an intelligent management of visitors and a video conference with residents wherever they are.
- Mypaper, a personalised newspaper that takes into account the interests of the user and is accessed via web pages customised for the user.
- Different advanced authentication means for the local portal: fingerprint, mobile-phone-based and RFID-based authentication, etc.
- My PVR, an advanced personal video recording service which features attractive notification and programming possibilities for users being away from home through their mobile phones. The workshop was broadcasted to other facilities of Telefónica I+D in Valladolid, Barcelona and Huesca.

Conclusion

ePerSpace successfully developed and integrated some 30 audio-visual services, primarily aiming for the home, but also being available seamlessly from outside the home.

These were presented and demonstrated at the workshop. Partners in ePerSpace plan to continue their work in this area in the 7th Framework Programme.

More information and all the presentations given at the workshop are available on the website of the ePerSpace project at: ***http://www.ist-eperspace.org***

Eurescom study on community interaction

A new paradigm for content delivery networks

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The community buzz has made its way onto the agenda of telecoms professionals. Many are wondering how the concept of community interaction or group communication in general may change the carrier business. Will it extend its reach from the Internet to the fixed and mobile phone? Are there attractive business opportunities? How can telcos turn a profit out of this phenomenon and what are the technological prerequisites to do so?

The Eurescom study "Community Interaction (P1558)", carried out by professionals from Portugal Telecom, Síminn (Iceland Telecom), Telekom Austria, and Deutsche Telekom Laboratories supported by Trommsdorff + Drüner, addresses the above questions.

Community scenarios

The study analyzes the communities on four levels (target groups, communication media, content, and motivation) and identifies three deep dive topics (kids interaction, user-generated content, gaming).

Children and teenagers are a target group generally neglected by carriers. According to the "2003 Baur-Kids Verbraucher-Analyse" survey, the 6 million children aged 6-13 in Germany represent a purchasing power of 6 billion euro. More than 1.6 million of them have mobile phones.

In a community context children use phones and the Internet to make appointments for group outings, sports, and to match their clothes, or swap homework before school.

Using communities to distribute user-generated content and for gaming is also hardly studied in a professional manner. Most hobby photographers, artists, and musicians like to share their work with friends and family or draw a profit out of their favourite pastime. Using platforms like flickr.com or podcasting are increasingly popular ways to do so drawing millions of subscribers and visitors.

Massive multiplayer games like EVE Online stimulate the building of "clans" and draw large numbers of fans to the various forums around the game. Here, voice and messaging as well as a helpdesk for the rather complicated games are excellent opportunities for telcos.

Business rationale

The Eurescom study aims at understanding the factors that influence the success of community businesses. For this reason, a typology of community success factors has been implemented. The problem of cannibalization of traditional revenues is of major interest for telcos. Although community services do have benefits that are not visible in the bottom line (e.g. customer loyalty, etc.), the estimated cannibalization has to be considered for any community service offered.

In order to enable telcos to evaluate existing and future community offerings, an Excel-based tool called "Community Evaluation Tool" (COMET) was developed as part of the study. The COMET takes into account the community success factors as well as the cannibalization threats, and can thus assist decision makers faced with the choice to implement community services.

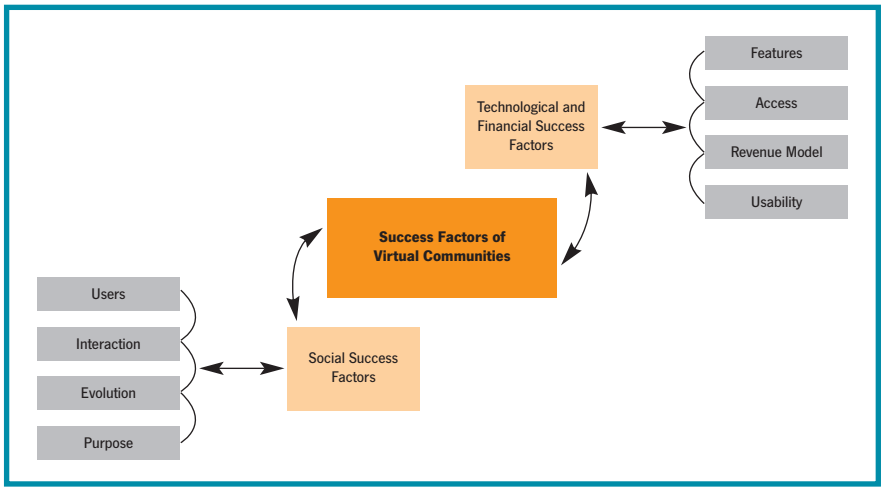

Figure: Success factors of virtual communities

Technical feasibility

Today, community interaction is mostly happening in an Internet environment. VoIP services emerging from the Internet find it much easier to integrate into existing virtual communities and profit from this interaction than large carriers. With the upcoming IP-Multimedia Subsystem (IMS) incumbent telcos have the possibility to put a stop on this inequality, and offer consumers safe, interoperable services with guaranteed quality of service and flexible charging. The IMS framework also provides the required key community enablers, like presence, profiling and matching, group management, and push services.

Conclusion and outlook

Community interaction holds many opportunities for carriers if they can quickly adopt IP related network architectures like IMS and fend off the competition from VoIP services. To further explore the opportunities, more market and technology research is needed. Attractive community-enabling services need to be developed and marketed in a way that acknowledges the social ties between users.

You can find more information on the following Web pages:

Official P1558 Web page:
http://www.eurescom.de/public/projects/P1500-series/P1558/default.asp

The podcast directory:
http://www.podcast.net

Flickr.com photo handling:
http://flickr.com

EVE online multiplayer game:
http://www.eve-online.com

Mobile TV technologies

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Mobile TV, Mobile Broadcast, Mobile Media Services, or Handy-TV in Germany, sometimes in combination with the adjective "interactive", are different terms, basically meaning the same: bringing video and audio content and services to mobile devices. The concept is currently heavily discussed, and expected to offer new promising mobile services and new sources of income. This tutorial intends to clarify some of the most prominent mobile TV technologies and will summarize the basic conceptual issues, potentials, and, to a certain degree, their advantages and disadvantages.

Mobile TV technologies

Depending on who the main driver for the new technologies basically are, broadcasters or network operators, two main approaches can be distinguished: broadcasted TV and streamed mobile TV. Main technologies considered for mobile broadcasting (terrestrial or via satellite) are currently DVB-H (Digital Video Broadcasting – Handhelds) and DMB (Digital Multimedia Broadcasting), while other technologies, like ISDB (Integrated Services Digital Broadcasting) or MediaFLOTM (Forward-Link-Only), developed by Qualcomm, are,

currently, less important. Mobile streaming services are mainly based on UMTS, WiFi, or WiMax mobile network technologies.

Broadcasted mobile TV

When talking about mobile-TV the first assumption is that the current home TV is going mobile. This understanding assumes that the TV content is brought to the viewer through broadcast channels, either using terrestrial or satellite transmission. The handheld, in this case, needs to be equipped with a digital TV receiver. Two main technologies are currently competing on broadcasted mobile TV: DVB-H and DMB.

DVB-H (Digital Video Broadcast for handhelds) is a standard for mobile digital TV derived from the DVB standard as already under deployment for DVB-T and DVB-S (terrestrial or satellite based) digital broadcasting. DVB-H provides additional support optimised for mobile handheld reception, e.g. through better battery saving mechanisms (using time-slicing), or improved error protection for increased robustness of the transmission paths.

DVB-H could provide about 30 different TV channels over one full UHF channel, which is the currently preferred frequency spectrum. Currently DVB-H still has a rather high zapping time of 2-5 seconds between channels. The biggest obstacle for DVB-H is the availability of free UHF channels. Furthermore, the availability of a sufficient density of DVB-H repeaters will take some time. In Europe DVB-H is strongly supported by important mobile device manufactures.

Mobile TV phone from Samsung

Mobile TV phone from Nokia

A competing mobile-TV standard to DVB-H is DMB (Digital Media Broadcast). This standard has recently been introduced in South Korea where it is already used by over 400.000 users at home (satellite-based) and by 40.000 users on mobile devices via terrestrial broadcast. DMB is an enhancement of the Eureka 147-DAB (Digital Audio Broadcast) standard, which is already largely deployed (the coverage in Germany is about 80%). However, it has not yet been sufficiently accepted by users. DMB uses a DAB channel with a bandwidth of about 1.5 MHz. This allows a simultaneous transmission of 3 to 4 TV channels with a zapping time of roughly 0,5 seconds between channels.

Streamed mobile TV

Mobile TV via down-streaming of TV or media channels over mobile networks, like UMTS, WiFi, or WiMAX, is an alternative approach. It is particularly suited for personalised services, like video-on-demand and pay-per-view services, or interactive, mobile network-related services where audio-visual media are used (e.g. advertisements, location-/web-based services, virtual tourist guide). However, simultaneous transmission of TV content through live video streams could rapidly become problematic due to network congestions, if too many users are down streaming the same channel.

Controversial discussions are still going on, which content and which services may be best suited for mobile TV. Watching a full movie on a tiny handheld screen seems to be less likely than providing shorter TV streams or TV loops, for instance news, sports, music videos, or trailers. It might also be interesting to combine mobile TV content (e.g. indexed or tagged for easy retrieval) with mobile-phone back channels for interactive, value-added services. Furthermore, the inclusion of IP-based services offers a whole new portfolio of new media-based services.

Conclusion

Mobile TV, undoubtedly, is a hot topic today. After a number of field trials in the past, the 2006 football world cup is expected to be an ideal platform to demonstrate this new medium, and it could become the breakthrough for the new technology. However, many experts are still sceptical that this event may still come a bit too early as no exciting services can yet be shown. In addition, the different, incompatible systems may confuse potential users. Numerous problems – frequencies, services, different technologies – are also not yet finally solved, nor is it yet fully clear, if and how mobile TV could become a business, to what extent users will accept the new medium, and how they could be charged for mobile TV services.

The Eurescom Study Programme

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Short and focused studies have been part of Eurescom's offer to its members from the beginning. The most substantial change to the study programme was in 2001 when it became an optional service for the members. Today the study programme is funded through upfront payments by those members subscribing to the programme.

The Eurescom study programme is an efficient way of addressing topics of common interest and has over the years demonstrated its flexibility both in bringing conclusions to specific topics and paving the way for larger collaborative efforts amongst partners.

With its annual budget it has been possible to fund up to nine studies per year. The results of the studies are exclusively available to the members of the study programme so that the study subscriber organisations are having a direct competitive advantage from collaborative work.

The study programme is currently evolving. However, the fundamental principle will remain, namely that of collaboration. Any network operator or service provider may become a subscriber of the study programme and participate in it, if he shares the interest in having the substantial issues facing the telecoms community addressed in a collaborative way.

In 2006, and following a call for proposals at the end of 2005, the Study Management Group recommended three studies, which are currently running. The issues addressed range from fibre optics over machine-to-machine (M2M) communication up to service oriented architectures for service delivery.

The first study on "Fibres in Access Network Greenfield Scenarios (FANGS)" aims at providing technical and techno-economic analysis and comparison of Fibre to the Home (FTTH) alternatives.

The second study on "M2M opportunities in new service paradigms" analyses the current status of M2M technology and is extracting the new requirements posed by M2M and the pervasiveness paradigms to determine how operators can meet these business and technological challenges.

Finally, the study on "Service Oriented Architectures (SoA) for convergent Service Delivery Platforms (SDPs)" is evaluating the technical and business impact of SoA on the creation and management of new services.

The second call for 2006 is about to be launched, allowing new studies to start in September 2006.

For more information on the study programme, or if you are interested to subscribe to the study programme, please visit the Eurescom web at ***http://www.eurescom.de***

Eurescom study FANGS

Greenfield deployment of optical access

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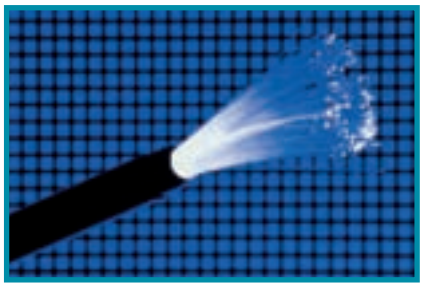
The new Eurescom study FANGS – Fibre in Access Network Greenfield Scenarios – will investigate optical access network solutions in greenfield environments for residential customers to support network operators meeting the challenge coming from alternative providers.

In the broadband access market traditional network operators face strong competition, for instance from power utilities, and must respond to this challenge by improving their offering. Laying a traditional copper network is hardly a suitable answer to the utilities´ fibre offerings. Despite the recent advancement in modulation techniques enabling the delivery of multi megabit speeds over copper wires in the access network, there is a general consensus that the possibilities of copper will be soon exhausted and its limits will be met, and only fibre represents a truly future proof solution that can meet the ever increasing demand of customers fixed networking needs.

The objective of this study is to support network operators in selecting the right technology for greenfield access network installations and make a transition from copper to fibre.



To facilitate this, the study will compare fibre based point-to-point Ethernet and PON solutions, from the following aspects:

- Impact on network design and topologies
- Status and availability of customer premises equipment
- Service provisioning
- Security
- Scalability and flexibility to meet the requirements of future services and the growth of demand

Active and passive solutions will be considered, including active star and passive fibre network topologies with single or multi-stage splitting.

In addition to the above aspects, the comparison will cover the following more specific issues:

- Local exchange complexity, versus many distribution points
- Initial investment costs
- Operational expenditures
- Expected component cost evolution trends
- Operational and maintenance issues, such as possible failures and measurability

The study will also provide a high-level economic comparison to the legacy copper network.

Last but not least, the study will consider the legislation and regulatory prerequisites for fibre roll-out in the access network. It will provide a survey of the regulatory situation in the US and in Europe regarding fibre unbundling with the aim to identify whether the regulatory framework in Europe is friendly towards and supportive of fibre roll-out in the access network. The study plans to contribute in this regard to ETNO's regulatory group. The study is planned to conclude and report its findings in Septemer 2006.

More information is available on the study website at ***http://www.eurescom.de***

FP7 – the pervasive networking dimension

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With more than 2 billion mobile terminals in commercial operation world-wide and about 1 billion Internet connections, wireless, mobile and Internet technologies have enabled a first wave of pervasive communication systems and applications with significant impact on daily life and business organisation.

This has in turn created novel business opportunities that telecommunication operators have largely benefited from. The underlying convergence phenomenon has also accrued competition and offered market entry opportunities to new players, with large benefits for the consumers. Whilst this networking trend has acquired an irreversible dimension, there are undoubtedly new networked business and social challenges to conquer, with technologies such as RFID currently contemplated with a deployment potential of trillions of tags.

Simple tags of today will evolve towards smarter networked objects with increased storage, processing, and sensing capabilities, leading to the development of widespread applications in an unlimited number of domains. An "Internet of things" will emerge with billions of objects reporting their location, identity, and history over wireless and Internet enabled connections, in application areas as diverse as entertainment, knowledge, residential or businesses.

Further evolution of wireless, broadband and Internet technologies will be at the heart of such a networked future, which will in addition require the availability of trusted service platforms, allowing seamless adaptation to the fast varying and context dependent requirements coming from a broad spectrum of applications and business models. Network composability across multiple domains and scalability issues are expected to become critical. At the periphery of the network, huge numbers of devices will drive the development of novel wireless access architectures and flexible spectrum management. Short range radio communication and unlicensed bands acquire an accrued importance.

"Simple tags of today will evolve towards smarter networked objects"

Flexibility is also expected to become a key driver, enabling networks to more easily reconfigure and dynamically adapt to variable load and usage conditions implied by an ever growing number of components and applications such as P2P, broadcasting, narrowcasting, multipoint or point to point coupled with ever larger quality and control of service requirements.

Programmability is hence needed to enable optimised protocols and to leverage the huge capabilities of the underlying "unlimited" bandwidth infrastructure. Edge network architectures become key to control anticipated changes in user/device generated traffic patterns and symmetry according to application requirements.

"The resulting network and service architectures will support fully converged environments"

New classes of networking technologies are also expected to emerge, such as self organised networks with dynamically varying node topologies, dynamic routeing capabilities and service advertisement capability. Under such dynamic operational constraints, network management tools require increased adaptability and self organisation/configuration capability of network and service resources.

From a service perspective, service-oriented architectures are expected to emerge as technologies capable to solve the shortcomings of the current services as provided by Internet and the Web, hence boosting the transition towards a market of ICT enabled services. The service architecture will overcome today's limitations of "static" services and make possible dynamic intelligent service composition with availability of context information, semantic description of services and advanced features for fault management, self healing and management.

The resulting network and service architectures will support fully converged environments, such as the extended home networks, with myriads of intelligent devices in our homes, offices, or on the move providing an extensive set of applications and multimedia contents, tailored to the device, the network, and the application requirements. This is in turn expected to provide new business opportunities, in particular to service/technology providers and to system integrators.

The full range of issues and challenges pertaining to networking, service and security architectures, as sketched above, will be the subject of intense and focussed efforts within the 7th Framework Programme. In this context a unique collaborative opportunity will be provided to the industrial and research community to put forward a bold and visible action that will give Europe the means to drive the service innovation of the future and set the architecture of our networked future.

Further information on EU Framework Programme 7 (FP7) is available at ***http://cordis.europa.eu/fp7***

The views expressed in this article are those of the author and do not necessarily reflect the official European Commission's view on the subject.

Funding research – the challenge for Europe

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In today's modern society, there are many discussions about what should be done, what could be done, how, by whom and why. But very quickly the discussion comes down to who is going to pay.

In the IST sector there are many foreseeable opportunities, but most of them require social, technical and legal issues to be resolved before they can be realised. There is a common interest from all European governments in seeing that the commercial organisations take steps to protect their future by generating new products and services. There is clearly a similar interest in the industrial sector. And, of course, the banking and financial institutions want to make sure the business is generated as well.

It is actually one of these perpetual motion issues – if the governments seed research on national and European level business opportunities, develop. If the companies can seize these opportunities, we have employment, financial growth, high commercial activity and more tax revenue for the governments. This will allow the governments to invest more in research.

Now obviously this is a little simplistic, but the principle is the point. We need to make it as easy as possible to stimulate activity at any point in this circle.

The big question is what type of financial help is appropriate for different companies in different stages of both company and product development, and how can we ensure these companies are able to find the appropriate support. We also need to think how these companies can find the right partners and communities of common interest to share their work.

The first step is to consider what types of finance are necessary at what stages of development.

For the early stages of applied research, support is needed in the form of grants. This means that a company has an idea that it needs to develop but it cannot afford to take the entire cost of developing the solution. Here programmes like the EU framework programmes, or the Eureka clusters, funded by the national authorities, are accessible for most companies, and the programme organisers share the interest with the company to see the projects produce useful and exploitable results.

Framework Programme 7

The European Union will launch its 7th framework research programme toward the end of 2006, and this will provide incredible opportunities for practically every industrial sector in Europe. In the ICT services sector the EC has the benefit of four European Technology Platforms (ETPs). These ETPs are willing to contribute a Strategic Research Agenda identifying priorities for the sector for the next research period. The key point of these research agendas is that industry is prepared to invest in these issues just as much as the European Commission. The four technology platforms in the forefront of the ICT services and networks sector are all working to ensure the research programmes reflect what is interesting and useful to the business sectors.

"Maybe the time is right for a partnership between the big industry players and the EIB"

Eureka Clusters

The national authorities in Europe are also active within the Eureka Clusters – the CELTIC cluster is the key one for the end-to-end ICT work – and many national level initiatives to complement these programmes. The CELTIC programme has annual calls and is very supportive to companies looking to participate.

The combined research investment planned in the 7th Framework Programme is the most significant investment that has ever been seen in European history. It is a pity that it still falls short of US and Asian research levels and even falls below the EUs own research investment target of 3% of GDP as set in Lisbon.

Commercialisation of results

Anyway, back to helping companies achieve commercial success. Once a company has an exploitable result from this early phase, it has the problem of how to fund the commercialisation of this result. Really there are only two options: get venture capital or get a loan.

Raising venture capital is never easy, but if an idea has sound commercial potential there will always be investors. Raising loans is also difficult as most banks ask for security beyond the small companies capability. The question to be asked here is what innovative approach could be adopted to make this more workable.

One thought could be to develop new partnerships on the venture capital or loans side. For example, the telcos need many small companies to be successful in bringing new products and services to the market. On the other hand the European Investment Bank (EIB) is interested in stimulating small companies but is not able to do all the due diligence on small technical companies because they do not know the technologies. Maybe the time is right for a partnership between the big industry players and the EIB to have a common approach and sharing of risk/reward that would allow them to provide a comprehensive support service for the organisations seeking capital. Each case could be investigated and if the industry sector sees a potential and is prepared to take some of the risk, the bank would be more encouraged to invest. Eurescom will consider hosting a workshop on this if there is interest in the telco community. The EIB would be interested.

So, the opportunity to stimulate the market is available now – can we organise ourselves to take advantage of the opportunity?

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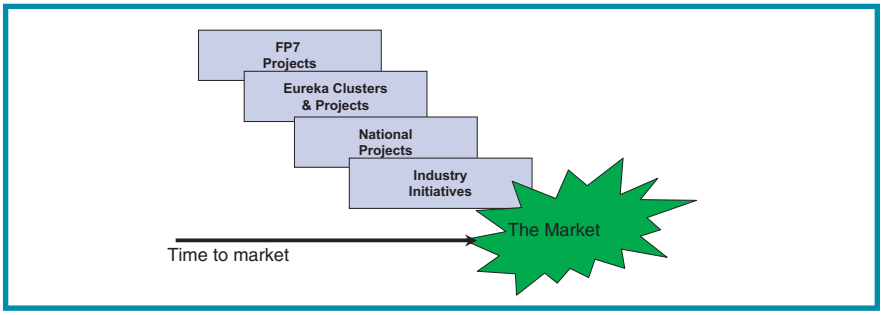

Figure: European research funding sources in a market perspective

Ringtones from the coffin

Ever more mobile phones are buried with their owners

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One of the good things about death is that you can have a quiet time in your coffin, without the permanent noises of a networked civilisation. At least this is how it used to be. However, burial habits are changing, and cemeteries are becoming a part of the networked society. As ever more deceased humans are being buried together with their mobile phones, the pious hope "Rest in peace" might not always come true.

In a number of countries, there is a growing trend of people wishing to be buried or cremated with their mobile phones when they die. According to research by The Future Laboratory, an international trend-spotting think-tank, the trend began in South Africa and has spread to Ireland, Australia, Ghana, Chad, and the United States.

Fear of being buried alive

The first cases of people asking to be buried with their phone occurred in Cape Town. Due to the widespread belief in witchcraft, some people feared to be put into a death-like sleep by an ill-meaning wizard. In order to take precautions against falling under a spell, which would result in being put to sleep and being buried, they were asking for the phones to be put into the coffins with them in case they woke up. In order to avoid taking chances, one service in South Africa will put a number of batteries in the coffin just in case the dead person wakes up much later and finds his or her own batteries have run out.

The fear of being buried alive is also an important reason why people in Ireland ask for a mobile phone in their coffin. According to Keith Massey, an Irish funeral director, some of his clients take the possibility of waking up in the coffin very seriously into consideration. "Some people are superstitious and insist the phone is turned off so that, if they do wake up, they will have battery power when the phone is turned on again," Mr. Massey said. The request to turn phones off is in line with the needs of the living. Peter Flanagan, another Irish funeral director, is encouraging families who are burying phones with their loved ones to either turn the phones off or switch them to silent or vibration alert. "Obviously you don't want a phone ringing inside a coffin during a funeral," Mr. Flanagan said.

Experience shows that mourners are not particularly delighted when ringtones sound from the coffin. Back in 2003, the Belgian family of a deceased motorcyclist sued the funeral firm, after the dead man's mobile phone started ringing from inside the coffin. The night before the inhumation, the family had gathered at the funeral parlour for a final private farewell, when they heard the sound of his mobile phone ringing from within the sealed coffin. Several distressed members of the family left the scene in a state of shock whilst staff rushed to remove the handset.

Lifestyle symbols

However, most people still regard the probability of being buried alive as lower than to be kidnapped by aliens. Thus, the major motif for people to be buried with their handsets is that it reflects their lifestyle. Especially in Australia, the underlying motif was to show the deceased's affluence. "People wanted to be buried with the totems that they felt represented their lifestyle," Martin Raymond, director of The Future Laboratory, explained.

In order to underline their importance in life, some people are buried like celebrities, which includes that the status symbols of their wealth and power accompany them on their last journey. The phone is put in the coffin along with diamonds, jewellery, expensive suits, and gold watches. "We came across one guy who asked to be buried with his mobile phone and his Blackberry, and also with his laptop," Mr. Raymond said.

The practice as such is not new, only the choice of items has changed. In ancient Egypt, it was commonplace that Pharaohs and other powerful and wealthy people were being buried along with their possessions. This was done because people in the days of King Tutankhamen believed literally that the objects would be available to them in the afterlife.

Nowadays, most people don't expect to take their belonging to afterlife. However, they like the idea of being buried or burying their relatives with items representing important aspects of their life.

According to the different individual preferences, diverse items like teddy bears, football-fan scarfs, cigarettes and matches, whiskey bottles, and, of course, mobile devices are used as burial objects. Especially for young people, the importance of mobile phones is very high. That is why coffins of people who deceased early in their life are estimated to have the highest share of buried mobile phones.

Phones in the crematorium

In some cases, mobile phones even accompany their deceased owners into cremation. In the US state of South Carolina, people were being incinerated without the crematorium operators knowing that they had handsets in their jackets. This led to unexpected results: due to the heat in the oven, mobile phone batteries exploded, which is how funeral directors started noticing this trend. Some funeral directors will now arrange for the phone put into the box with the ashes following the cremation.

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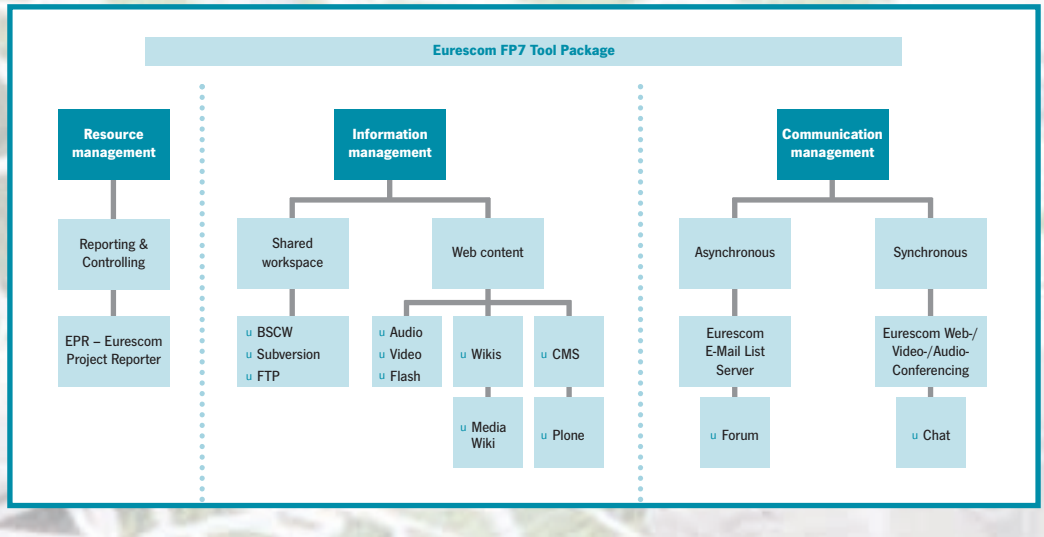

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Further information about the Eurescom FP7 Tool Package is available at **www.eurescom.de/services**

Contact us at **services@eurescom.de** if you would like to discuss the tools you need and to get an offer from us.

"The Eurescom Project Reporter is an invaluable tool. Its deployment by Eurescom on the NM2 project is a key reason for NM2's smooth and efficient running."

John Wyver, Chairman, Illuminations Television, Project partner in EU Integrated Project NM2

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