Celtic-Plus Newsletter 2/2014

HIPERMED
The high-performance low-cost telemedicine platform

SASER
Towards secure European telecommunication networks

Celtic-Plus opportunities
for international cooperation in Germany

Editorial

Table of Contents

IMPRINT

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Dear reader,

The Future Internet is emerging at great speed, Smart Cities and Internet of Things with billions of sensors and activators are very high on the agenda, the 5th Generation of mobile and wireless networks is one of the central themes in European research, ensuring security and privacy in telecommunication and IT systems became a very urgent request of European governments. It seems that European collaborative ICT research is peaking as never before.

At the height of these enormous opportunities and challenges our colleague Heinz Brüggemann, who has been Director of the Celtic Office for more than 10 years, returned to his parent organisation Deutsche Telekom in June. A big thank you for the huge amount of work Heinz did to bring Celtic-Plus to the status it has now in the telecommunication R&D community. Since July we have a new Celtic Office organisation with a higher emphasis on strategic developments.

In the first half of 2014 the ICT R&D community was very much focused on the Horizon 2020 Call. The improved funding mechanisms for big industry players led to more than 1,600 project proposals in the Horizon 2020 ICT area, of which probably only about 10% will be accepted for funding. The Celtic-Plus Programme had suffered a bit from the fact that all concentration went to Horizon 2020 during this first half year. The more we are happy that at our Autumn Call in October 2014 we received eight interesting project proposals. The Celtic-Plus programme benefits from its bottom-up research themes, low administrative overhead, high success rate, and the short time that is achievable between the project proposal and the start of the actual project.

We are very proud that the Celtic-Plus project HIPERMED (HIgh PERformance teleMEDicine) has won the prestigious EUREKA Innovation-Award. Celtic-Plus Chairman Jacques Magen congratulated the HIPERMED consortium on behalf of the Celtic Core Group for their outstanding achievement. Let me quote what he wrote: "I was already particularly proud that they were selected as a finalist as the best EUREKA project in the 'added value' category – added value and industrial impact are two essential objectives of Celtic-Plus. I am also very pleased about this award, due to the fact that the HIPERMED project is led by an SME and includes SMEs as well as larger companies and academic partners along with end users. This combination is an excellent basis for further successful exploitation of the project results on the market by the partners involved. I would also like to thank the public authorities from France, Poland, Spain, Sweden, and Turkey who also believed in this idea and supported the project. I am now looking forward to further exciting projects in the e-health area in the future within Celtic-Plus." If you are now curious what HIPERMED has done, read the Success Story article in this newsletter by HIPERMED project coordinator Oscar Chabrera from Spanish SME Merkum-ViLynx.

In June 2014, we had a very interesting high-level conference in Berlin, where results of the Celtic-Plus flagship project SASER (Safe and Secure European Routing) were presented. Major European communications technology companies signed a memorandum of understanding for the development of secure European network technologies. Many success stories could be reported. A few of them are explained on the next pages.

To keep our community informed about public funding possibilities we started a new category "Views from Public Authorities". In this issue we start with Germany, which is amongst the most active partners in the Celtic-Plus programme.

We included in this issue three articles from Celtic-Plus projects dealing with green terminals for next generation wireless systems (GREEN-T), technology improvements for large scale smart cities deployments (TILAS), and converged Infrastructure for emerging regions (CIER).

We hope you find the articles in this issue interesting and would welcome your comments.

Peter Stollenmayer
Editor

New Celtic Office organisation

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In June, our colleague Heinz Brüggemann, who has been Director of the Celtic Office for more than 10 years, returned to his parent organisation Deutsche Telekom. We used this occasion to renew the Celtic Office organisation and to split the responsibilities into operating the Celtic-Plus programme and developing new strategies.

Within the new organisation we have now two strands within the Celtic Office:

- Supervising and supporting the running Celtic-Plus projects and ensure starting of project proposals, headed by Peter Herrmann.
- Strategic programme planning, programme promotion and awareness, liaison and representation, proposal stimulation, headed by Peter Stollenmayer.

Celtic-Plus chair is Jacques Magen, InterInnov. Vice-chairs are Valérie Blavette, Orange, and Jukka Salo, Nokia.

This split into operations and strategy reflects the trend towards increased cross-programme cooperation, and increased horizontal cross-sector collaboration. Taking into account the limited resources of the European ICT research community we have to ensure that we generate as much synergy between the different activities as possible. Particularly towards the increased impact of the European Horizon 2020 Programme, and towards the other EUREKA Clusters, a lot of mutual benefit seems to be possible.

The full picture of the Celtic-Plus organisation becomes clear when we link the Celtic Office and Celtic Core Group via the Management Team. This structure supports and works closely with the national representatives of the EUREKA participating countries (see figure).

We expect that with this new structure, and particularly with the increased emphasis on strategic planning, a better awareness of the great benefits, which the Celtic-Plus Programme offers to European industry and research organisations, can be achieved.

In the medium term we intend to widen the community participating in Celtic-Plus projects.

We also want to intensify the contact within the existing Celtic-Plus community, including the Core Group members, the Public Authorities, and of course the participants in Celtic-Plus projects, where the added value is actually created. We from the Celtic Office are available to help project proposers and running projects to make the best out of this excellent collaborative research opportunity.

- Further information

Celtic-Plus Website: http://www.celticplus.eu/

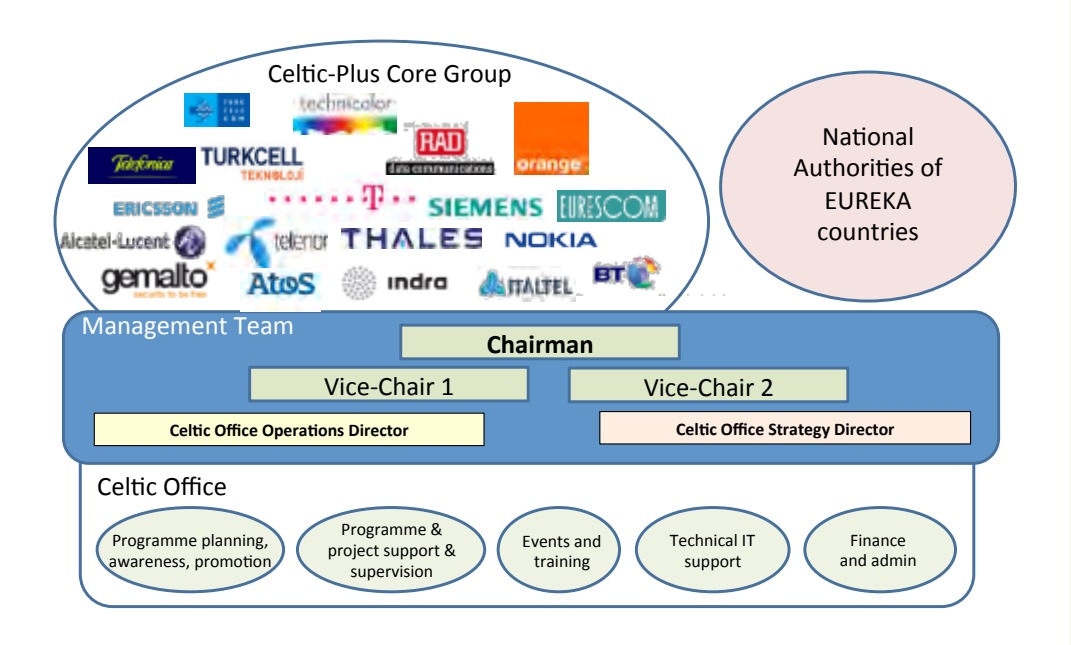

Figure: Celtic-Plus organisation with renewed Celtic Office

HIPERMED – The high-performance low-cost telemedicine platform

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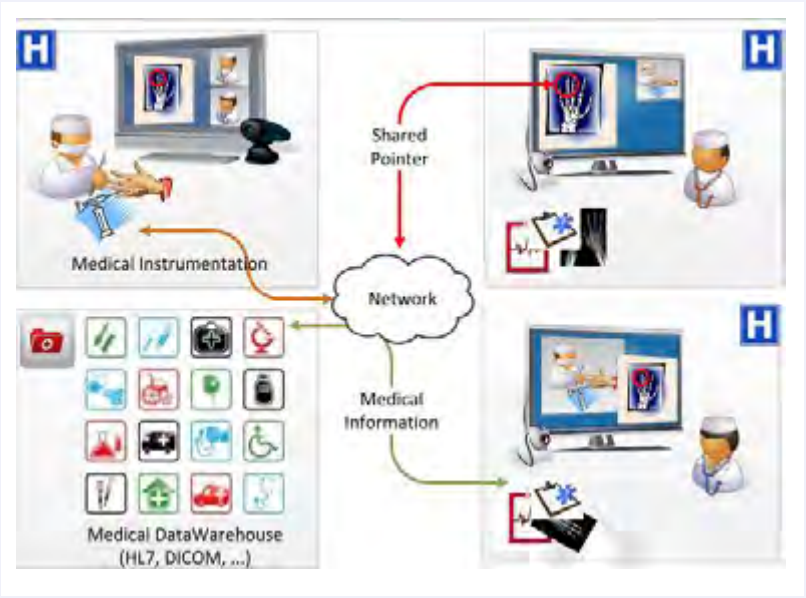

Figure 1: HIPERMED platform overview

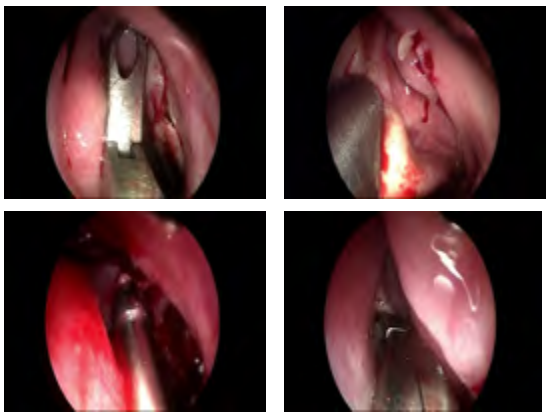

Figure 2: HIPERMED video test sequence

HIPERMED (HIgh PERformance low cost teleMEDicine platform) was the first CELTIC cross-domain project including partners from both ICT and e-health in all project stages from definition to validation. It has designed a common open high performance low cost telemedicine platform providing services over IP, and minimizing deployment costs by reusing in-home infrastructures. HIPERMED has a huge commercial potential. First real deployments of HIPERMED technology are happening. The HIPERMED project won the prestigious EUREKA Innovation Award and also received the EUREKA Award in the Category 'Added Value'.

Deployment and service cost reduction are the key factor to allow telemedicine at home and between regional and reference hospitals. The HIPERMED platform was implemented with a common methodology that allowed to generate 8 new products and to improve 8 existing products (see figure 1). HIPERMED has been tested and validated in healthcare systems of five EUREKA countries (France, Poland, Spain, Sweden and Turkey).

Video quality assessment

HIPERMED has enabled the development of the PROMETEE living lab in Nancy, France, dedicated to subjective image/video quality assessment by medical experts. The impact of lossy video compression for medical usages has been estimated. Results have shown that low bandwidth remote consultation connections could be allowed while maintaining the quality of ear, nose & throat (ENT) videos for medical decision making by using compression techniques (AVC/H.264), reducing the video bitrate from 3Gbps to just 3Mbps. Finally, the video sequences (see figure 2) have been proposed to the MPEG standardization group to be included as test sequences in the HEVC profile for screen content medical video.

Commercial deployments

Sweden: HIPERMED results are considered for deployment in the Swedish public sector.
Turkey: Turk Telecom is deploying HIPERMED Speech Therapy solutions connecting remote regions to regional hospitals, for example in Anatolia.
Spain: The Red Cross is deploying a professional-to-patient videoconferencing system, while several mutual occupational accident insurance companies are deploying a remote consultation system between primary care and reference hospitals.
France: ENT Department of Nancy University Hospital is going to deploy HIPERMED Videoconference solutions for learning purposes before possible massive deployment in other departments and hospitals of Lorraine Region. 30 elderly persons' homes and two hospitals in Paris are deploying HIPERMED Videoconference solutions for remote consultation.
Poland: Deploying HIPERMED remote consultation solutions in the Otolaryngology Department Clinical Hospital of the Poznan University of Medical Sciences before a possible massive deployment using the PIONIER Network interconnecting all clinical hospitals in Poland.

Conclusion

HIPERMED has developed 16 medical services based on a common open platform that offers high-performance low-cost professional telemedicine services and reuse in-home infrastructure to minimize deployment costs. All relevant stakeholders such as doctors, patients, hospital administration, medical service operators have been included in the validation process allowing HIPERMED solutions to be widely adopted and more and more medical services and hospitals are taking up the HIPERMED solution.

■ More information is available at http://www.hipermed.org

SASER – Towards secure European telecommunication networks

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Figure 1: After signing the SASER memorandum of understanding (from left):Dr. Andreas Leven (Site Lead Bell Labs Germany, Alcatel-Lucent), Christoph Glingener (CTO of ADVA), Dr. Georg Schütte (State Secretary, BMBF – German ministry for education and research), Alain Maloberti (Senior VP Network, Orange France), Dr. Hermann Rodler (Managing Director, NSN Germany), Cornelia Rogall-Grothe (State Secretary, BMI – German ministry of the interior), Jacques Magen (Chairman of Celtic-Plus), and Wilhelm Dresselhaus (CEO of Alcatel-Lucent Germany). (copyright: hannibal/BMBF)

The Internet has developed into a crucial infrastructure. We have reached the point where a reliable Internet is seen as a normal part of citizens' lives. Not to forget the enormous economic impact of the Internet on all kinds of sectors. For the future telecommunications infrastructure, safety and security are amongst the most important factors. The Celtic-Plus flagship project SASER (Safe and Secure European Routing) aims at mitigating security vulnerabilities of today's IP networks and will propose a new architecture for energy- and cost-efficient networks for the time frame 2020.

The project works on the two main challenges in today's communication networks:
The new SASER system will allow more security in the network that will become less vulnerable to unauthorized procurement of information.
The new technology will provide an increased bandwidth of existing networks and will help to cope with the increasing use of the Internet that doubles its capacity every two years.
In June 2014, SASER held a high-level conference in Berlin to show their interim results, and the big potential impacts the project will have on the European telecommunications landscape.

Agreement for secure European network communications

Within and beyond the SASER project for "Safe and Secure European Routing", Alcatel-Lucent, Nokia Siemens Networks, ADVA Optical Networking, Orange and Deutsche Telekom Laboratories agreed in a memorandum of understanding (MoU) to coordinate their joint R&D efforts over the next five years for a secure, robust, and reliable network.

World premiere: demo of configurable network

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Software Defined Transport Networks (T-SDN), i.e. the programmability of optical transport networks, is set to revolutionize how optical networks are operated. T-SDN enables that networks can quickly be configured and adapted to changing traffic demands via network operator or customer applications. This is an important step into the virtualization and automation of future networks.

Alcatel-Lucent, coordinator of the SASER-SaveNet sub-project, exhibited a joint live demonstrator with component partners in the SASER conference exhibition in June 2014 in Berlin. It was a world premiere: for the first time a reconfigurable network was shown which consists of configurable flexible optical nodes and software defined adaptive transponders that incorporate electronic as well as optoelectronic components from the horizontal project partners Fujitsu and Finisar. In this demonstrator a central SDN controller utilizes the standardized OpenFlow protocol for packet networks with extensions towards the lower transport layers (Transport-SDN) to steer the programmable hardware like optical switches and transponders. These extensions to the OpenFlow protocol were developed by the researchers of Alcatel-Lucent within the project.

The demonstrator consists of flexible optical nodes comprising wavelength selective switches (WSS) in combination with flexible transmitters and coherent receivers. To enable an agile transport network the transmitters can adjust their wavelength, modulation format, their baud rate and thus the spectral bandwidth of the transmitted optical channels.

The demonstrator permitted the realization of different real network scenarios. For example, the network operator can adjust the bandwidth or the modulation format of the signal to achieve, e.g., either the longest possible transmission distance or transmit a higher data volume on a shorter range. Set up of a new optical lightpaths and shut down of others is possible as well as re-allocating WDM traffic to other spectral channels.

With the introduction of network virtualization, e.g. slicing of physical resources, applications can modify their own logical network. Software-defined solutions allow partitioning of the network and enable to route critical data within predetermined boundaries, a concept called network slicing. This measure can significantly increase resource utilization and enhance safety and network security.

If protocol encryption is applied in Transport-SDN additionally, e.g. by using a protocol engineering suite developed by Alcatel-Lucent within SASER, which simplifies creation and deployment of secure protocols, a further important step towards secure networking can be made.

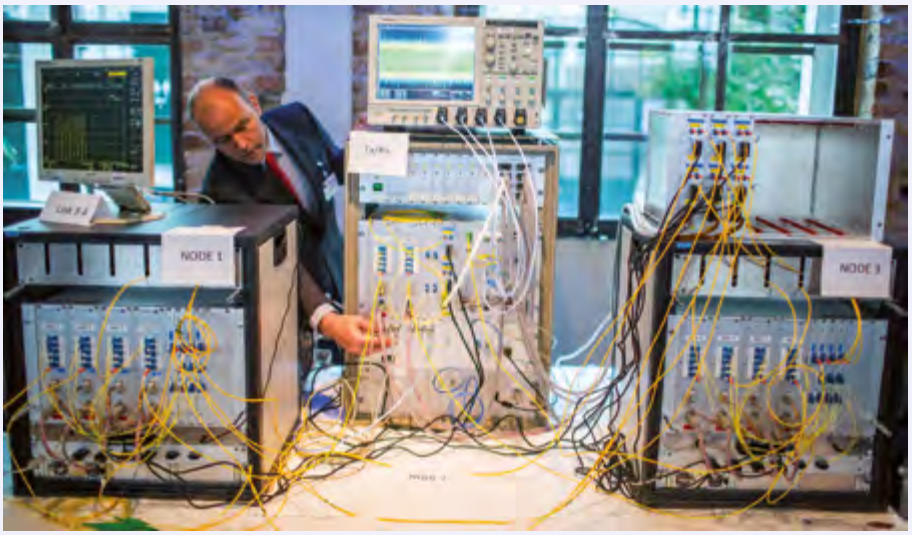

Figure 2: Demo at the SASER Event in Berlin, June 2014 (copyright: hannibal/BMBF)

Detecting known and novel attacks by analyzing SDN user and the control traffic

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Today safety and security are addressed through diverse security actions, such as encryption, software-enabled security functions, backdoor and anomaly detection, and many others. The SASER project will bring these bits and pieces together, towards the definition of a suitable security scenario that is an important step towards secure communications in Europe and in the world.

SASER's main objective is the development of secure and energy-efficient network architectures for upcoming technologies such as Software Defined Networking (SDN) and Network Function Virtualization (NFV). These new technologies are key-enablers in the future telecommunication environment but also include new security challenges. Within the project we focus on analysing and designing mechanisms to ensure secure deployment of SDN and virtualization in a Telco Cloud environment.

After a thorough analysis of the SDN architecture in a Telco Cloud environment, the threats were identified and countermeasures have been defined. This comprises mainly authentication and authorization measures as well as integrity and confidentiality protection between all involved entities (Applications, SDN Controllers, Network Hypervisors and SDN Switches). Additionally encryption techniques on the transport layer enable secret communication by protecting the confidentiality and the privacy of the transmitted user data on the network.

While today's and even more future communication networks are able to transport high volumes of data, there is a tendency that large portions of the bandwidth are misused for dubious purposes, e.g. recently there has been a dramatic growth in high volume Denial-of-Service attacks. In SASER we provide techniques to detect known and novel attacks by analysing the SDN user traffic as well as the SDN control traffic. Rapidly detecting and classifying malicious activity contained within a large amount of network traffic is a challenging task. As network operators are overwhelmed with data from the network monitoring tools, we provide visualization methods to facilitate and promote situational awareness taking maximum advantage of the fact that the human mind is capable of fast visual processing.

Software backdoors pose an extremely dangerous attack vector. It is important to employ various techniques to explicitly search for potential backdoors, to make them easier to detect and to make their insertion harder. In SASER we design and implement software architectures to prevent authentication backdoors in server applications (proactive approach). Furthermore, we design and implement an analysis tool for mostly automated detection of specific backdoors in server applications (reactive approach).

risks. To achieve this we need joint efforts in Europe. SASER is a sparkling example of how we can improve digital sovereignty through joint efforts."

About SASER

SASER (Safe and Secure European Routing) is an 80 million euro public-private partnership project comprising 61 companies, research organisations, and universities from Germany, France, Finland, Denmark, and the UK. The project runs from August 2012 to September 2015 under Celtic-Plus, the EUREKA Cluster for a Smart Connected World, and is partly publicly funded by the research ministries / agencies BMBF (Germany), DGCIS (France), and TEKES (Finland).

■ Further information
SASER Project Website:
http://saser.eu/
SASER Event news release:
http://www.celticplus.eu/Events/SASER-Event-Berlin/ReportEvent.asp
SASER information video:
https://www.youtube.com/watch?v=MD1tkNMzq6Y
SASER Demo in IEEE:
http://goo.gl/sYDkcK

Celtic-Plus opportunities for international cooperation in Germany

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Celtic-Plus project CIER – Connecting the rural areas past the fiber-reach in the rural municipality of Bruneck / South Tyrol with WiBACK (Wireless Backhaul), developed in the Finnish-French; source: Fraunhofer FOKUS

Presentation of CELTIC-Plus project CRUMBS at CeBIT 2013; source: PT-DLR

Two German ministries have supported the strategic initiative for European cooperation in the telecommunication area, Celtic, within the EUREKA network since its creation in 2003. They have been member in the public authority board of Celtic and its successor Celtic-Plus ever since.

EUREKA is an intergovernmental network of more than 40 members and associated members to foster international research, development and innovation (RDI) projects. The EUREKA clusters are industry-driven bottom-up initiatives, focusing on strategic topics like telecommunication or software intensive systems. They are complementary to the instruments of the EU, though more flexible regarding the choice of partners from non-EU countries. They particularly aim at facilitating cooperation within the European Research Area (ERA). In principle they draw on national sources of European public funding for innovation.

Celtic projects in Germany since 2005

107 RDI project participations of 61 German organisations have been performed between 2005 and 2013. These projects account for a total budget of almost 130 million euro. Until 2013 finished Celtic and Celtic-Plus projects which included German partners received about 61 million euro of funding in total from the Federal Ministry of Education and Research, BMBF, and the Federal Ministry of Economics and Energy, BMWi.

One example for a successfully finished Celtic project with German participation is the flagship project "100GET", which received several awards. Another outstanding project is "CIER" (see figure 1), which deals with "Converged Infrastructure for Emerging Regions". The Celtic-Plus project "CRUMBS" is an example for a project funded by BMWi (see figure 2). Among the currently running projects, "SASER, Safe and Secure European Routing" is the current flagship project of BMBF-funded projects, including 61 partners from 5 countries with an overall total budget of about 80 million euro.

Funding in Germany

EUREKA is an international network and not a funding program. Project partners have to secure the financing of their project participation themselves. They may approach their national funding bodies. Funding opportunities are different in the various member countries.

Germany has no earmarked funds for EUREKA projects including the clusters. Applicants may take advantage of the complete funding landscape. According to current rules the "Bund" and the "Laender" can provide national and regional funding for German partners in Celtic-Plus projects. However two ministries are mostly involved in funding German Celtic-Plus project partners, BMBF and BMWi.

Current topics of high interest

BMBF promotes applied research and development at the pre-competitive stage. The technical scope should be on the focal topics of "Communication Systems", IT-Safety and Security" or

"Living in the Digital World". Integrative R&D approaches that are linking these topics are relevant as well. The last Calls of BMBF Unit "Communication Systems; IT Security" reveal current topics of high interest:

- Reliable Wireless Communication in Industry
- Critical Infrastructures
- Secure Cloud-Computing

In addition current topics of BMWi, Unit "Development of convergent ICT" are:

- Internet of Services
- Internet of Things
- Internet of Energy

BMWi as well promotes applied research and development at the pre-competitive stage, particularly for SMEs (Small and Medium Enterprises). The aim is to accelerate the process of transferring scientific findings into the development of marketable high-tech technologies with high potential for practical applications. All of the research projects that receive funding involve model users who pilot the developments in order to establish their technical and economic viability. The focus will be on Smart Services.

National contacts

German partners and interested parties in Celtic-Plus proposals are invited to contact directly the EUREKA/COST Bureau and/or the Project Management Agencies of BMBF and BMWi at an early stage of their proposal.

Conclusions

The Federal Ministry of Research and Education as well as the Federal Ministry of Economics and Energy have been supporting the EUREKA-Cluster Celtic and its successor Celtic-Plus from the very beginning and still invest several millions of Euros per year in funding German partners in international Celtic-Plus RDI projects. Despite these efforts project partners from industry, SMEs and academia will need continuous support in the future to contribute to European innovation and standards to keep pace with the fast technical developments worldwide.

Acknowledgements

Many thanks to Peter Herrmann, Bernhard Wybranski and Matthias Kuom for their contributions to this article.

- Find more information on Funding German Celtic participants at
http://www.vdivde-it.de/kis
http://www.pt-ikt.de/ and
http://www.eureka.dlr.de/
and on funding in Germany at
http://www.foerderdatenbank.de

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Green-T – Green mobile terminals for the future

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Today, users are enjoying a plethora of new advanced applications on their smart mobile devices, thanks to advances in the technology of mobile networks and devices. However, such advancements do not come for free: the energy consumption of mobile devices is rapidly increasing due to power hungry features, such as larger high-definition displays and more interactive applications. Unless a proactive stance is taken, the increase in energy consumption of mobile devices will continue, rapidly depleting the battery; hence confining mobile users to locations near power outlets; taking away the freedom of roaming promised by mobile networking.

There is an urgent need for intelligent solutions to reduce the energy consumption of mobile devices, if users were to fully enjoy roaming freely, while experiencing a wide range of advanced online applications. The Green-T project, a Celtic-Plus European collaborative research effort, was the vehicle to investigate innovative solutions to limit the energy consumption of mobile devices targeting two main objectives: i) decreasing the whole energy consumption of mobile networks; hence contributing to the Green targets of the EU for decreasing the carbon footprint of the ICT sector and ii) prolonging the battery lifetime of smart mobile devices, and hence increase user-friendliness.

Energy and batteries of mobile devices

Every new release of a smart phone spurs new applications and services, with advanced screens to deliver an exceptional quality of experience to end-users. However this comes at a cost placing stringent demands on mobile battery consumption. On the other hand, the progress of the battery industry is failing to catch up with the energy demands of power hungry mobile devices and applications, with no foreseen breakthrough in the near future. It is clear there is a continuously growing gap between the energy requirements of emerging mobile devices and what can be achieved through progress in battery technology and circuit design. This gap is experienced by today's mobile users, who have to re-charge their mobile smart devices so often that they are always searching for power sockets.

Communications and energy

Despite the high energy consumption of the advanced features of mobile devices, communications functionalities still contribute to large portions of the power draining of today's mobile devices. Moreover, the trend of having multiple interfaces enhances the user experience, but adds huge burdens on the already high energy requirements of mobile devices. The Green-T approach aims at reducing the energy consumption

of communication functionalities of mobile devices.

Intelligent cooperation and roaming

Mobile systems are based on a non-cooperative networking approach, where each mobile device needs to establish a connection with a base station (BS). This concept results in differentiated levels of quality of service, favouring users close to BSs, whereas users near the edges of a coverage area usually receive degraded services requiring higher energy. Green-T exploits the concept of cooperation among mobile devices and intelligent roaming among different networking technologies. Within the Green-T approach, the resources of mobile devices and networks are treated as one pool of resources, which are collectively used to provide energy efficient connectivity to all mobile devices within the network. For instance, mobile devices can forward their data through other mobile devices, thus benefiting from better connectivity due to shorter distances.

On the other hand, Green-T takes advantage of the availability of multiple networking paradigms, by introducing smart roaming based on provided quality of service and energy requirements at the device location. This is illustrated in Figure 2, where a user is connected to an LTE network, but the connection deteriorates due to obstacles on the way. The mobile device decides to switch to WiFi experiencing better energy efficiency. When a mobile device is connected through one interface, other interfaces are switched off to save energy. All the solutions of Green-T are automated and performed without user involvement.

An Intelligent Green Networking Summer Day

For a better understanding of the concept, an example of a usual summer day is used for illustration (Figure 3). Susan is using her mobile device at home to surf the internet and download some files for work. At home, Susan has her own WiFi. The mobile device hence connects through the WiFi to the Internet. Susan then goes out to enjoy the day. She first drives to a coffee shop. On her way, the mobile device realizes that the speed is high, so it connects to the LTE network and switches the WiFi off. Susan sits at the coffee shop to enjoy her coffee. The mobile device uses its intelligence to learn about its surroundings; it finds out that the building is equipped with a shared Femto cell. The mobile device switches to Femto access.

Femto cells still use LTE technology, but with higher data rates and better energy ratings due to limited distances. Susan finally arrives at the park. Some of the downloads are still continuing, and the battery level is getting low. Understanding its surrounding, the mobile device is aware of other nearby devices. Susan's mobile device then negotiates with other devices and reaches an agreement with one mobile device to relay its data. Now, the mobile device switches to WiFi to connect to the helping device, which uses LTE to access the network. The best part is that all the process was automated without the need for Susan's interaction. Therefore, Susan was able to enjoy the day outside downloading data without worrying about running out of battery.

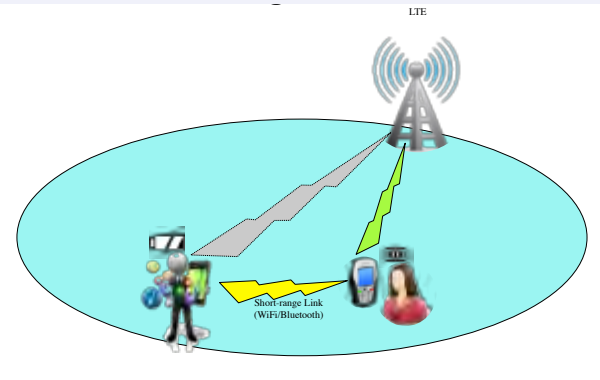

Figure 1: Mobile devices forwarding their data through other mobile devices

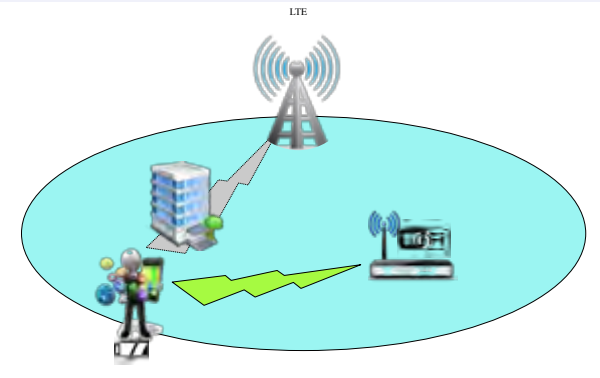

Figure 2: Switching to other mobile systems

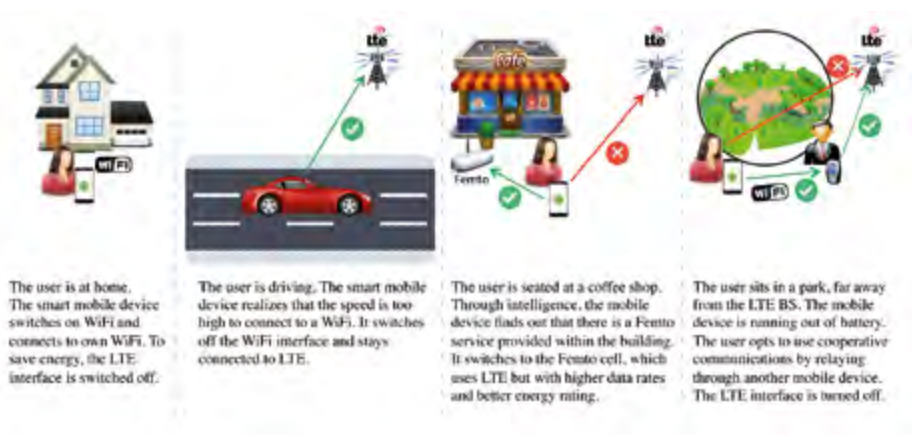

Figure 3: Example scenario "a usual summer day"

Conclusion

You are able to enjoy a variety of advanced applications on your smart mobile device, but you have to manage your device energy consumption so as to avoid running out of battery and get confined to locations with access to power outlets. Green-T offers you the freedom by providing a new intelligent cooperative and roaming concept, where mobile and network resources are pooled together to provide energy efficient services to smart mobile devices. Green-T achieves up to 40% extension in battery lifetime. All processes are automated so you do not worry about available networks or finding other devices, nor bother about switching ON/OFF interfaces to get best connectivity or save energy.

- More information: http://greent.av.it.pt

TILAS – Technology improvements for large-scale Smart City deployments

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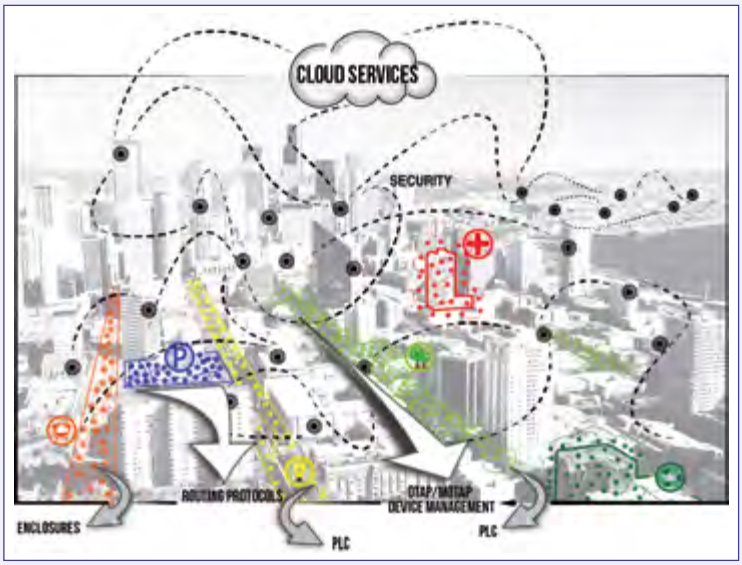
The Celtic-Plus project TILAS (Technology improvements for large-scale Smart City deployments) exploits the initial outcomes of different Smart City related projects with an associated large-scale IoT test-bed deployment. The proposed innovations overcome the problems caused by moving from typical experimental laboratory tests to integrated large-scale implementations. This project aims at addressing some of these key challenges and aligning them to the particularities of the Internet of Things (IoT) paradigm.

For the definition of the main TILAS topics, the project has taken the Santander City Deployment as a reference. It can be considered a relevant case, as Santander has 180,000 inhabitants, about 12,000 IoT devices, deployed in the SmartSantander project, and more than 25,000 downloads of the Smart City smartphone application. Based on the analysis of the existing infrastructure, two kinds of problems were detected:

- Problems derived from technical challenges – such as node testing, multihop networking, security, housing solutions for outdoors and node reprogramming.
- Challenges derived from societal aspects – such as visual impact of devices, pertinence of services created and lack of engagement

TILAS focuses on the aforementioned technical problems and additionally on solving visual impacts of devices deployed in the street. The scope of the project is to facilitate and boost the development of novel solutions based on the exploitation of the IoT paradigm in cities. The provision of reliable and efficient communication capabilities demands the improvement of current solutions on device level and network level.



High level overview of the detected working points in Smart Cities

Security architecture

The Smart Cities and IoT concepts demand a new security approach able to deal with the huge amount of devices that will take part in the new scenario. In the traditional security model, several weak points exist due to the heterogeneity of the parties involved in the end-to-end communication. The project proposes a new element in charge of centralizing credentials, and thus avoiding the current vulnerabilities and moreover increasing the dynamic adaptation in the whole system with a capacity for granting and denying access to information.

Routing protocols

Devices deployed in Smart Cities follow the architecture of traditional wireless sensor networks; they are self-organized and multi-hop networks, demanding as a group a huge amount of resources. On the other hand there is a need for minimizing power consumption at device level. Currently, there is no universal routing solution outperforming all the others and the protocol selection is done based on some particular requirements. The main drawbacks of current procedures are the lack of mechanisms for managing communications between different networks and the limited coverage. TILAS focuses on providing solutions for continuously interoperating a large numbers of autonomous nodes in an efficient way, to guarantee the reliability with node mobility and heterogeneity and finally also to manage failures.

Remote device reprogramming

As mentioned above, multihop mesh networking is a common situation both in IoT and Smart Cities. Current device reprogramming standards work in a point-to-point way, which implies to run one full procedure per device. Nevertheless, many times the same firmware is installed in multiple devices in the same network, so TILAS focuses on providing a standard-compliant solution for optimizing the way this procedure is done, notably reducing the power consumption and the load in the network.

Housing solution for IoT devices

Device enclosure is a key topic that has not been considered in the early deployments of smart cities. The use of a standard box is not suitable for elements that will be deployed in streets. Additionally the external radiating elements provide an unsafe feeling that increase citizens' rejection of new technologies. TILAS works on a twofold approach, firstly to design novel enclosures that fit better in city streets, secondly to design novel antennas that combine different technologies and are suitable for being installed inside the enclosures.

IPv6 over PLC

Powerline communications (PLC) technology is a key player in the provisioning of Internet services in many different environments where wireless communications cannot address the existing requirements. It is also a potential enabler of cost-effective communications for metering wap-

plications. The key innovation provided by TILAS is the integration of IPv6 communication capabilities from end-to-end. This way meters will be accessible in a secure way from any point of the Internet, and additionally security is assured by the solution provided by the project.

Conclusion

The work done in the first half of the project shows the benefits obtained by the different proposals. During the second half of the project, the efforts will focus on the development of experimental trials to demonstrate the improvements of the new features in a real environment. A key aspect that will be considered is the suitability of the trials for the assessment of the benefits in a large-scale environment.

In summary TILAS is pushing state-of-the-art technologies in some of the most challenging aspects – security, efficient routing, reconfiguration of cloud resources, device reprogramming, PLC interoperability and novel antenna/housing design. Thus, TILAS will help to boost the IoT concept by overcoming its current barriers.

■ Further information on TILAS is available at http://www.tilas.eu

CIER – Connecting the unconnected

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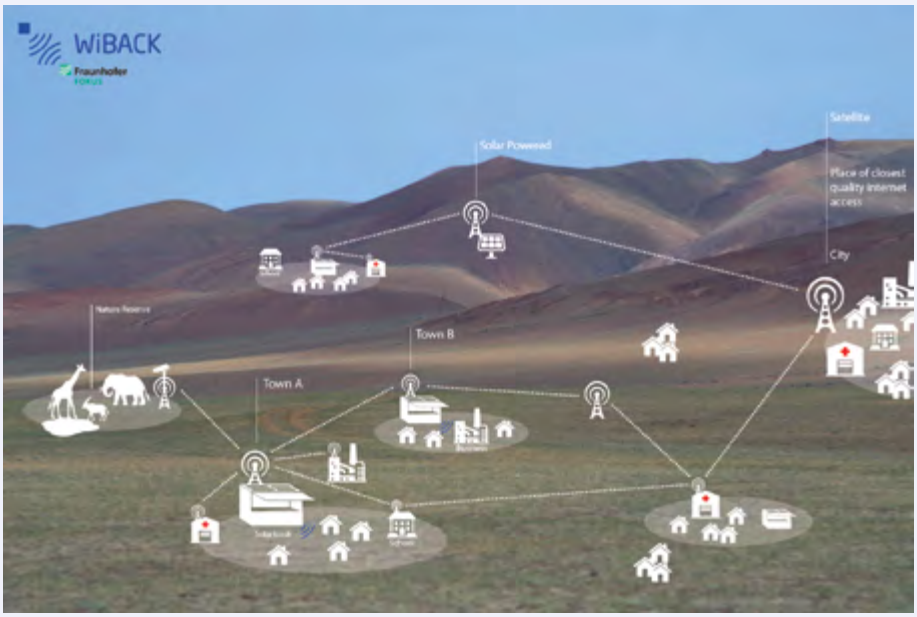

Figure 1: A typical CIER use case

Rural areas in emerging regions often lack sufficient or affordable access to the Internet. This is problematic, as it restricts their access to education, health, governmental services or general access to knowledge, and it leaves these regions behind, compared to urban areas. The major limiting factors are high cost (CAPEX and OPEX) due to the large distances, difficult terrains and low population densities to spread the costs.

Additional challenges for such regions are the lack of access to power and especially access to skilled labor. 24/7 operation of cell sites is therefore a very costly task. Especially technical experts are often barely available and/or expensive and might have to come a long way to a critical site. To address those issues, the Celtic-Plus project CIER has developed a carrier-grade broadband backhauling technology, which is energy efficient, self-managing and with good performance figures. This technology can complement, extend or even replace traditional operator equipment.

Typical CIER use case

Figure 1 depicts a typical use case where Internet access is typically available at the outer border of a city, but not in the surrounding villages or settlements. There is often no business case for covering such under-served areas due to the cost structure of the available equipment and the given rural area's specific challenges. CAPEX and OPEX are too high to be sufficiently covered by the revenue expected from the often sparse local population.

The CIER project proposes to connect one or more central locations (i.e. schools, hospitals, government offices) in each village or settlement with long distance point-to-point links via the back-haul network to bring capacity into such locations. Sometimes repeater stations might be required to bridge longer distances or to reach beyond a hill or mountain. Preferably, the physical network topology should allow for 'ring' structures to increase the network's resilience to damage, theft, or other temporary outages. In cases of permanent node failures, the plug-and-play CIER hardware can easily be replaced without the need for any manual configuration and, thus, without the need for a highly skilled technician.

The CIER low-power hardware features a typical power consumption between 6 and 10W and is therefore ideally suited for cost-effective solar/battery energy-supply solution, which is crucial if a stable power grid is not available or for repeater nodes mounted on, e.g., isolated hilltops.

Within the connected locations, customers can be reached via standard access technologies, such as WLAN hotspots, 3G/4G femto cells or even xDSL into individual homes.

The network operator or service provider may configure the capacity or QoS level available at each location. This includes the management of overbooking of 'best effort' capacity while ensuring loss-free, low-latency connectivity for voice or video conferencing services. The typical latency in the Voice Class is <2ms per hop making this technology suitable for VoIP back-hauling even in multi-hop scenarios with up to ten hops.

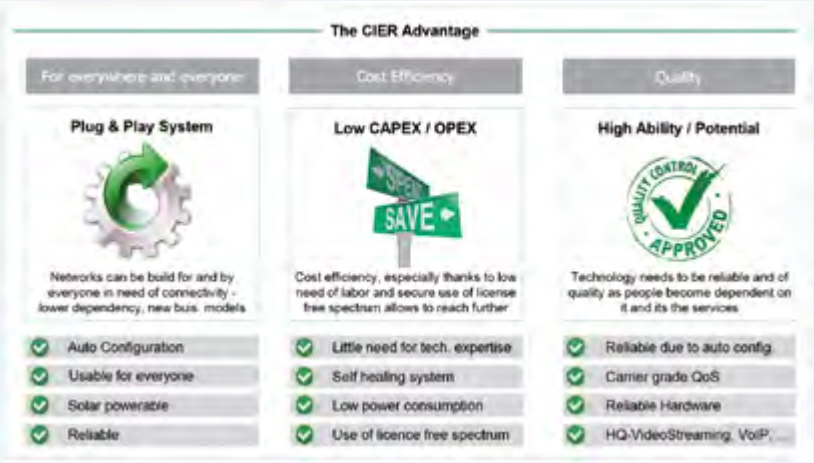

Figure 2: Advantages of the CIER technology

The CIER technology advantage

The self-management capabilities of the CIER technology are the main advantage and pose significant progress over alternative technologies. While directional radio technologies have been available for decades, being "Plug & Play" does make an important difference for its multi-hop utilization in rural areas.

This results in:

- only limited need for expensive or unavailable technical experts,
- local staff that can be trained easily in the utilization of the technology,
- very limited effort required to set up a network, which
- is running reliably in licence-free spectrum
- builds meshed networks (redundant network paths)
- includes quality ensuring mechanisms like automatic traffic prioritization or traffic load balancing
- a very reliable system, which addresses errors automatically, informs network managers or is easily repaired if necessary – exchanging a node can be done by anyone; all to be done is to mount the new node and to re-attach all cables.

With traditional directional radio technologies the setup, operation, repair, and configuration can require significant effort. Such problems had prevented a Fraunhofer FOKUS team to sustainably connect a hospital in rural Zambia. The case showed the need for an improved solution and inspired the CIER project. The resulting CIER technology requires minimal effort and technological experts and thus allows for networks that can be set up and run sustainably.

Deployments in Europe, Sub-Saharan Africa and Central America

The CIER technology is already in commercial operation in Germany, Italy, Colombia and Tanzania. A further network is to be set up in rural Namibia in November 2014. These networks connect schools, agricultural information centres, governmental offices, hospitals, companies and people.

A small network in rural Colombia is a good example for the CIER technologies' ease-of-use, see Figure 3. Here an NGO, which provides an eLearning solution to schools, uses the CIER technology to provide the required QoS-ensured connectivity. The CIER technology, being efficient and simple, allows this NGO to take on this matter by itself. Additionally, its energy efficiency allows operation in an off-grid area as the Andes.

Conclusion

The CIER project successfully developed a new solution to bring broadband connectivity at reasonable costs to rural areas and to overcome the so-called digital divide. The CIER technology is not only a cost-efficient solution, but also a tool available for everyone – not just for big telecommunication companies. Hence, smaller and more flexible companies can tackle the lack of broadband connectivity.

- For further information on the exploitation and the availability of the CIER technology, please visit http://wiback.org.
For commercial requests, please contact: info@defutech.com

Figure 3: School network in Colombia

Celtic-Plus
Smart Connected World

www.celticplus.eu

About Celtic-Plus

Celtic-Plus is an industry-driven European research initiative to define, perform and finance through public and private funding common research projects in the area of telecommunications, new media, future Internet, and applications & services focusing on a new "Smart Connected World" paradigm. Celtic-Plus is a EUREKA ICT cluster and belongs to the inter-governmental EUREKA network. Celtic-Plus is open to any type of company covering the Celtic-Plus research areas, large industry as well as small companies or universities and research organisations. Even companies outside the EUREKA countries may get some possibilities to join a Celtic-Plus project under certain conditions.