Celtic-Plus Newsletter 2/2016

More secure data centres in Europe – SENDATE kick-off event

SIGMONA – Software Defined Mobile Networks

How Sweden manages the Celtic-Plus project process

Editorial

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IMPRINT

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Dear readers,

Is there a framework for collaborative international research that is closer to the market's needs than the EUREKA Clusters and Celtic-Plus? I am convinced that the structure of Celtic-Plus, which is controlled by a core group that brings together the most important industry players in our technological field, is quite unique. Furthermore, the experts who are evaluating the incoming proposals and who are doing the review of the running or finishing projects are mostly from industry and have a clear view on the market's needs.

Together with the bottom-up approach that allows industry and their partners to bring in any R&D subject that might become the next hot topic, the Celtic-Plus framework ensures the focus on technologies that are needed for the market. This view is shared by many of our customers. One of them, the Swedish funding agency VINNOVA, explains their view on the bottom-up, simple and agile Celtic-Plus process in this newsletter.

In 2016, two new members have joined the Celtic-Plus Core Group: Netaş from Turkey and imec from Belgium. Netaş is a fast-growing Turkish ICT company with a strong focus on innovation, and imec is an important Belgian research laboratory that has obtained an observer status in the Celtic-Plus Core Group. Both organisations have already proven their dynamism and their value for Celtic-Plus in giving decisive help for the organisation of the Proposers Days in Istanbul and in Leuven. You can read about both events in an article in this issue.

Also the Celtic-Plus Management team changed in 2016. Jukka Salo retired from Nokia and from his role as Celtic-Plus Vice-Chairman. I would like to express my gratitude for the huge work that Jukka has contributed during all these years in his role as Celtic Vice-Chairman, and I wish him all the best for his new life phase in his house in Finland. The Core Group has decided to strengthen the management team. In addition to the Celtic-Plus Chairman Jacques Magen and the Vice-Chair Valerie Blavette from Orange, the Core Group appointed two new Celtic-Plus Vice-Chairs: Jari Lehmusvuori from Nokia and Riza Durucasugil from Netaş. We welcome both and we are glad having their support that will be very much appreciated. Both new Celtic-Plus Vice-Chairs will be introduced to you in a separate article.

One of this year's highlights for Celtic-Plus was the start of a new flagship project: On 17 October 2016, the Celtic-Plus flagship project SENDATE was officially launched at a high-level event in the centre of Berlin. Read more about the project and the event in this issue.

SENDATE was not the only new project: In 2016 12 new Celtic-Plus projects secured funding and could start their work. In the same period 9 new projects were labelled, 5 in the Spring Call and 4 in the Autumn Call. 11 labelled projects are still in the set-up phase – the big challenge is to get also these projects funded and running.

Finally, we present in this newsletter three very successful Celtic projects that finished their work in the last year: SIGMONA, SHARING and TILAS.

For 2017, the Celtic-Plus Core Group has already fixed three important dates: On 21 February, we will organize the next Proposers Day at the Telecommunication Innovation Laboratory of Deutsche Telekom in Berlin. A preliminary programme is available on the Celtic-Plus Website; the registration will open in December. The date of the Spring Call has been decided, it will be on 7 April 2017. The Call information is available on the Website, and I hope that we will receive many very innovative project proposals. Next year we will organize the Celtic-Plus Event in Barcelona on 18-19 Mai 2017. It will be collocated with the EUREKA Innovation Week that will be hosted under the Spanish EUREKA Chairmanship.

I would like to express a big thank you to our very dynamic community. More than 50 project pitches at this year's Proposers Days in Madrid, Stockholm, Istanbul, and Leuven are proof of the strong commitment. I hope that we will meet again next year in Berlin, Barcelona and other nice places all over Europe.

Peter Herrmann
Editor-in-chief

New Celtic-Plus Vice-Chairs: Riza Durucasugil and Jari Lehmusvuori

In the Celtic-Plus Core Group meeting on 22 November 2016, the Core Group members elected two new Celtic-Plus Vice-Chairs: Riza Durucasugil from Netaş and Jari Lehmusvuori from Nokia.

Riza Durucasugil
Director of Technology Solutions at Netaş

Riza Durucasugil is Innovation and R&D Strategies Director. Previously, Mr. Durucasugil worked in Netaş as Director of Technology Solutions, Software Design Team Senior Manager and Software-Development Manager and Software Designer. He is also the Steering Board Member of ARGEMİP R&D Center's Communication and Cooperation Platform, member of R&D committee of YASED International Investors Association and member of the R&D committee of TUSIAD, the Turkish Industry and Business Association. He graduated in Electronics and Communication Engineering and has a Bachelor of Science degree from Istanbul Technical University.

He has broad management experience in information and communication technologies, technical and business leadership qualifications with 20+ years of hands-on experience in developing strategies and businesses, planning multi-million dollars budget, leading large organizations and proven ability in the development of innovative, cost-effective and competitive business solutions to increase revenue and customer service offerings with establishing high-tech businesses and technology organizations.

Jari Lehmusvuori
Head of Department at Nokia Bell Labs

Jari Lehmusvuori is a Head of Department at Nokia Bell Labs, the research unit of Nokia, in Espoo, Finland. He is responsible for research and innovation on the future mobile networks architecture with a special focus on the core networks. The main focus is on the 5G mobile networks by applying the latest technologies such as network functions virtualization, software-defined networking and cloud computing. He has long-term experience in the area of mobile networks and systems through his engagement in the research and definition of 3G and 4G mobile systems.

He has been involved in several European research projects, including the role of project coordinator for the Celtic-Plus projects MEVICO and SIGMONA. He and the research team in Nokia Bell Labs are playing a role in the TAKE-5 research project of the 5G Test Network Finland, the Finnish national activity on 5G under the Tekes programme 5thGear.

More secure data centres in Europe

SENDATE kick-off event in Berlin

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From left to right: Tor Björn Minde (Head of Research Strategy, Ericsson), Jörg-Peter Elbers (Vice President Advanced Technology, ADVA), Sigurd Schuster (Head of Business Operation MN CTO, Nokia), Bernd Sommerkorn-Krombholz (Manager Optical Technology & Performance, Coriant). [Photo: © 2016 Steffen Gebert]

On 17 October 2016, Celtic-Plus flagship project SENDATE was officially launched at a high-level event in Berlin. The 80 project partners from Finland, France, Germany, and Sweden will develop solutions for more secure data centres in Europe.

The main goal of the three-year project coordinated by Nokia is to pave the way to a new type of network through delocalised and securely connected date centres. SENDATE will work on a solution to connect European data centres through enhanced transport networks and improved networking concepts that will results in reinforced overall security. The project will lead to better control of data flows and new security concepts on the internet.

Dr. Ulf Lange from the German Ministry of Education and Research, BMBF, underlined at the kick-off event that current trends towards Industry 4.0 and autonomous driving are good news for Europe and its industries, as these technologies generate a strong need for new types of network functionalities and data centres with low latency. This, he explained, creates new demand for network architecture and network performance, and it offers European companies a unique opportunity to market new communication technologies made in Europe.

Dr. Lange stressed that no country can do this alone. He said that only when Europe's public and private actors join forces and bring together the political and technological capacities to act on this global issue, Europe can be successful. This is why policy makers and industry from Finland, France, Sweden and Germany have invested 70 million euro to initiate this common undertaking. They consider the project a central pillar for enabling the safe, reliable, and stable communication networks of the future.

Mr Benjamin Gallezot, Deputy Director General at DGE, France, underlined the importance of SENDATE for France and Europe. The main objectives of SENDATE are perfectly in line with the actual goals of the industrial policy defined by the French Ministry of Economy and Finance in its programme "Nouvelle France Industrielle". Mr Gallezot is convinced that SENDATE will set standards for European industry. He stressed that the project is very important for the whole European telecoms industry.

Dr. Raine Hermans, Director of International Operations at TEKES, Finland, talked about open innovation. In Celtic-Plus open innovation is built in through a structure of sub-projects that allows to continuously align objectives and to have even competitors jointly contribute to these objectives.

From left to right: Dr. Ulf Lange (Head of Unit, Communication Technologies, IT-Security, BMBF), Dr. Raine Hermans (Director, International Operations, TEKES, Finland), Benjamin Gallezot (Deputy Director General, DGE, France), Jon Simonsson (Deputy Director General at Ministry of Enterprise and Innovation, VINNOVA, Sweden), Jacques Magen (Celtic-Plus Chairman). [Photo: © 2016 Steffen Gebert]

According to Mr Hermans, this can be the starting point for contributing to future application spaces.

He shared his vision about a future without hospitals. He pointed out that if we do not have a really challenging vision for the future, we are just incrementally improving today's solutions. We need to start building entirely new systems and systemic innovation. Mr Hermans challenged the SENDATE community to build a system, where individuals own there data and have the right to decide with whom they share their data in different contexts, including mobility, healthcare, grocery and others. In that case, we need extremely secure, safe, and stable systems where the individual data is treated in a way that nobody can threaten them and application spaces can be protected. Maybe SENDATE could become a platform where this can be applied in new ways, not only between Finland and Sweden, but between Finland, Sweden, Germany and France.

Jon Simonsson, Deputy Director General at the Swedish Ministry of Enterprise and Innovation, VINNOVA, said that he is happy to see that the five partner countries have joined forces to be part of an open innovation system creating an open arena where industries, public sector and universities can cooperate and integrate new technologies together. He underlined that the public sector in Sweden is very important and that this sector has become part of the testbed notion to allow much more experimentation than what has been done up to now. In this context, Mr Simonsson said that international openness is very important for Sweden. He considers the SENDATE project to be a great example of an international cooperation that VINNOVA is keen to fund.

■ Further information is available on the SENDATE website at http://www.sendate.eu

Celtic-Plus Proposers Days in Istanbul and Leuven

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In autumn 2016, Celtic-Plus held two proposers days: on 22 September in Istanbul, co-organised with the help of the Turkish funding agency TUBITAK and hosted by ITU; and on 23 November in Leuven, co-organised and hosted at imec, a major Belgian research organisation.

Celtic-Plus Proposers Days have mainly three purposes: inform potential proposers about public funding opportunities, discuss potential ideas for Celtic-Plus project proposals, and network with potential project partners.

Istanbul Proposers Day

For the Proposers Day in Istanbul, 150 people had registered. The host, ITU, provided a perfect local organisation for open and constructive discussions. In his opening statement, Memet Aslan, Technology and Innovation Funding Programmes Director at TUBITAK, stressed the importance of Celtic-Plus for Turkey.

Erdem Ergen from KoçSistem, who represented the CoMoSeF project on Co-operative Mobility Services of the Future, reported in his keynote about the large societal and commercial impacts of CoMoSeF in Turkey.

Mete Karaca informed the audience about the Turkish Celtic-Plus framework and the improvements in public funding. TUBITAK announced an important simplification of their national evaluation process. The Turkish national evaluation of new incoming proposals will be based on the labelled Celtic-Plus project proposal document that was previously evaluated by industry experts. This will avoid time consuming and costly translation of the document into Turkish by the proposers. TUBITAK's announcement was positively received by the participants of the Proposers Day.

Mehmet Aslan, Director at TUBITAK

Many of them considered this to be an important simplification of the evaluation process.

All three Turkish Celtic-Plus Core Group Members gave a presentation about the research and business interests of their companies and showed their current and past activities in Celtic. The presenters of the Celtic Core Group were Riza Durucasugil from Netaş, Bulent Kirval from Turkcell, and Mustafa Ergen from Turk Telekom.

One of the core elements of the Proposers Day was the presentation of 13 interesting project idea pitches, which were well received and thoroughly discussed.

Among the presented research ideas are 5G-related networks, IoT technologies big Data and applications.

The presentations are available at *https://www.celticplus.eu/event/celtic-plus-proposers-day-in-istanbul/*

Participants at the Proposers Day in Istanbul

Leuven Proposers Day

For the Proposers Day in Leuven, 50 people had registered. The host, imec, provided a perfect local organisation in the imec Tower. Celtic-Plus Chairman Jacques Magen welcomed the participants, followed by imec Program Director Thomas Kallstenius, who presented his research organisation.

Steny Solitude from Perfect Memory, who represented the MediaMap+ Project on Media Management from Acquisition to Publishing, reported in his keynote about the impacts of the project for his start-up company.

Mathilde Reumaux informed the audience about the funding conditions of Innoviris for organisations from the Brussels region, and Danny Van Steenkiste explained the new funding agency VLAIO and the funding conditions for organisations coming from the Flemish part of Belgium.

Another core element of the Proposers Day was the pitching of seven interesting project ideas that were presented by participants from Belgium, Finland, Germany, and Turkey. The Celtic Office added a summary of the Istanbul project pitches and a selection of the pitches from Stockholm. Intense discussions followed the presentations and it was reported that this resulted in some deeper discussions that could lead to Celtic project submissions in the next call in April.

Among the presented research ideas are 5G-related networks, safer software development methods and an interactive programme guide for multimedia applications.

The presentations are available at *https://www.celticplus.eu/event/celtic-plus-proposers-day-in-leuven-belgium/*

Thomas Kallstenius, imec, Program Director Distributed Trust

SIGMONA – Software Defined Mobile Networks

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Traffic volumes in mobile networks are increasing and end-user needs are changing rapidly. Mobile network operators need more flexibility, lower network operating costs, faster service roll-out cycles and new revenue sources for their 4G (LTE) networks. A key network solution is software-defined networking (SDN) with network functions virtualization (NFV).

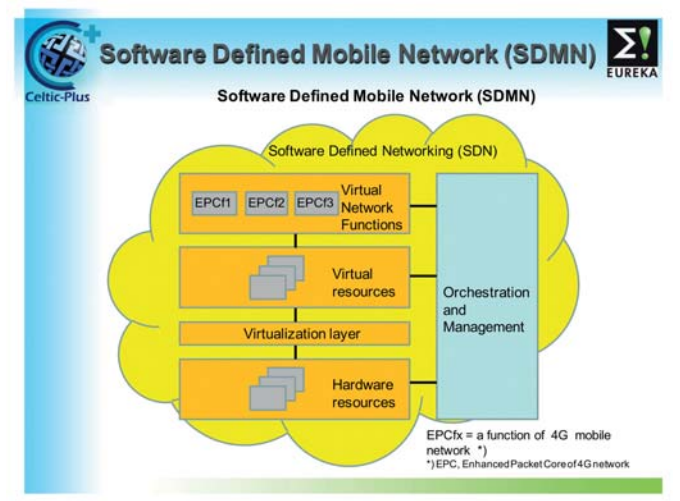
The research project SIGMONA successfully applied these novel technologies in the mobile networks. The project ended in April 2016. This innovative project realized multiple experimental systems and showed exciting demonstrations of these technologies that will change the world of communication.

The changing market

End users expect fast connections and high-quality services for their smart phones at any time and any place with affordable pricing. In addition, the ICT market, including the mobile networks, is shifting from dedicated hardware to software, including open source software, and cloud technologies which, with SDN, will change the mobile core network. The transformation means migration of application software from proprietary, application-specific hardware platforms to virtualized compute servers deployed in a few large-scale data centers.

Flexible end-to-end network architecture for LTE (4G)

SDN integrated in the mobile network with OpenFlow protocol implies the separation of the control plane from the data plane in networking equipment. NFV refers to executing the control and management plane functions in virtual machines or containers using cloud computing. The mobile network architecture is considerably changed to optimize for the virtualization and cloud computing principles as shown in the Figure. This approach adds flexibility and supports the gradual introduction of high network throughputs, optimal flow management, and traffic engineering possibilities.



Software Define Mobile Network concept with virtual resources and SDN.

Conclusion

The novel LTE/4G network architecture concepts with NFV and SDN were validated with test systems, and demonstrated for example in the Mobile World Congress 2015 and 2016.

New or improved products for the virtualized 4G/LTE networks emerged from the project results. A start-up company, Cumucore (www.cumucore.com), was established for business on a virtual 4G network.

Standardization contributions were provided to the major industry initiative on Network Functions Virtualization (NFV) in ETSI Industry Specification Group (ISG) NFV. Open Source software was submitted to OpenStack cloud platform.

A very high number of publications and conference presentations highlight the academic qualifications of the project work. A book on the Software Defined Mobile Networks (SDMN) was edited and published (Wiley ISBN-13: 978-1118900284).

SIGMONA, among other related research projects, has provided a solid baseline on NFV and SDN for the 5G research in-progress, for example in the EU H2020 projects.

A White Paper was made to summarize the key results of the project. The White Paper, as well as the research Deliverables, can be found on the project website at www.sigmona.org.

The SIGMONA project, run at the same time as the industry initiative ETSI ISG on NFV, was in the position to provide research results in time for the major mobile networks transformation that is taking place.

- Further information is available on the project page at https://www.celticplus.eu/project-sigmona/

TILAS – Large-scale urban IoT deployments

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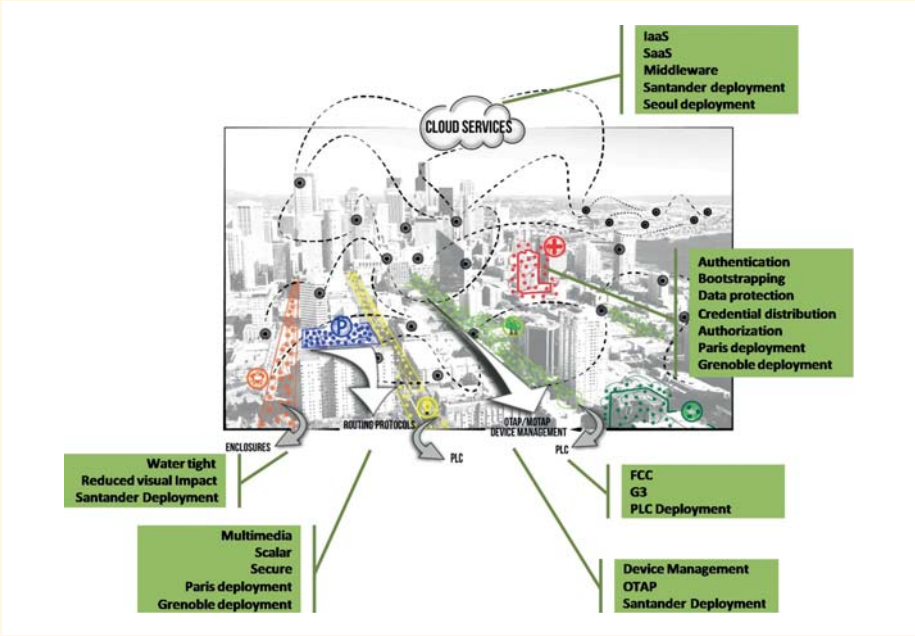

TILAS concept for large-scale Smart City deployments

The Internet of Things (IoT) is becoming a mature technology, and it plays a key role in the urban context. Both efficiency and sustainability are fundamental concepts, which have driven the evolution of cities towards a new dimension. In this evolution IoT plays a core role, which has been assessed in the TILAS project.

Predictions indicate that around the year 2050, more than 70 % of the world population will be concentrated in urban areas. Thus, city players are analysing how to address the new demands imposed by such a population concentration whilst guaranteeing a high quality of life. The goal of Celtic-Plus project TILAS (Technology improvements for large-scale Smart City deployments) is to provide solutions and guidance to the technical community for addressing massive IoT deployments in the urban context.

The initial experimental IoT deployments have revealed important missing components which are critical when facing a massive IoT deployment in hostile environments with no control on the environmental conditions, propagation behaviour or interference presence. The TILAS consortium has designed a wide number of innovative solutions to address the challenges linked to massive IoT deployments. All of them have been deployed on top of large-scale testbeds running in several cities and laboratories.

Approach and results

TILAS worked on different scenarios, use cases and business models to develop a system concept in which the corresponding innovations are covered and aligned with already existing IoT/M2M (Machine-to-Machine) standards. Among them it is worth highlighting the following ones:

- Customized housing embedding antennas aiming at overcoming visual impact problems.
- Robust multihop over-the-air programming (MOTAP) techniques aiming at easing network management and reconfiguration of large-scale IoT infrastructures.
- Design and implementation of a flexible hardware and software architecture aiming at accommodating the myriad of standards operating in the market.
- Design and implementation of a security framework.
- The design and implementation of a middleware able to feed the collected information to the applications running in the cloud.

NO_2 and O_3 sensors deployed in the city of Santander, Spain

Field trials and demonstrations

A vehicle traffic pattern monitoring platform based on NO_2 and O_3 sensors has been deployed in the city of Santander. The above developments have been tested on top of several devices, which have been integrated with the large-scale IoT platform running in the city.

The project has also supported additional activities in other cities, such as Seoul, in which – based on the contributions described above – a real-time water monitoring framework has been deployed. Last but not least, image/video surveillance was demonstrated in Paris, and the security framework has been assessed in the city of Grenoble linked to an environmental monitoring application.

Conclusion

The TILAS consortium has designed, implemented and assessed a number of practical tools, which will provide the basis for future massive IoT deployments. The cities participating in TILAS and several others have already showed additional interest in exploiting further urban services aiming at optimizing current performance.

- Further information about TILAS is available on the project page at https://www.celticplus.eu/project-tilas/

How Sweden manages the Celtic-Plus project process

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Vinnova is the Swedish public authority for granting national funding of Celtic-Plus labelled international projects. As a EUREKA Cluster, Celtic-Plus is highly regarded in Sweden, because it is based on the principles of EUREKA, according to which both European and global participants are welcome in the projects. This article explains Vinnova's view on the benefits of Celtic-Plus and how Vinnova manages the process for getting the best out of Celtic-Plus projects.

Advantages of the Celtic-Plus programme

From a Swedish point-of-view, the main advantage of Celtic Plus is the bottom-up approach of the industry-driven projects, which is well in line

Figure 1: International networking through Celtic-Plus is appreciated by Swedish enterprises for its bottom-up, simple and agile process

with the strategy of Vinnova. For the participants, EUREKA clusters, such as Celtic-Plus, present an opportunity to expand their network and enter new markets.

Furthermore, the easy and simple administration of Celtic-Plus increases the potential of getting both large companies and SMEs interested in joining. For new Swedish participants entering a Cluster project for the first time, the well-organized and structured programme of Celtic Plus is appealing. Another advantage is the availability of standard project documents, like for example collaboration agreements regarding intellectual property and other complex questions.

Regular project evaluation and monitoring of ongoing projects ensure the highest possible value creation of the project. Also, most important, to mirror the rapid industrial development within telecoms, the pragmatic approach within Celtic Plus, allowing for easy change request processes resulting in an agile way of working, is both appreciated and required for successful project results.

SENDATE-EXTEND – a case study

Let us look at a recent example, the newly started Celtic-Plus project SENDATE-EXTEND. The acronym stands for "Secure Networking for a Data Center Cloud in Europe – extended data center solutions". The project is funded by Vinnova. The total cost is estimated to be 50.7 million Swedish crowns (5.3 million euro) over three years. The project involves both several large Swedish companies as well as academia and SMEs. SENDATE-EXTEND will take a holistic approach on automation of control, management and orchestration across the different layers of a data center, as shown in Figure 2.

Continuous improvements of efficient national funding process

Vinnova, as the Swedish public authority, has a central budget for all EUREKA Clusters. It means that all labelled projects in Celtic-Plus also compete against projects with a label from other EUREKA Clusters. The internal review process includes a Swedish board of experts and often interviews with all candidates. Important factors in these discussions are the Swedish aspects of future growth potential, value creation and local attractiveness within each project.

At Vinnova we strive for simpler and faster processes in order to give the highest quality and service to our customers, the applicants. For the cluster partners the time is running fast, and to shorten the time to grant, Vinnova is focused on ensuring that our internal processes are continuously improved and made more efficient.

During the last years, the number of applicants has increased, and this is a very positive trend, showing the increased awareness of the importance of industry-driven funding alternatives.

Conclusions

From a Swedish perspective, the main advantages of Celtic-Plus is the industry-driven bottom-up approach of the programme, the simple administration and the pragmatic process concerning change requests for a running projects. All of which defines an agile structure allowing businesses to follow the current market evolution. In this context, Vinnova is focused on delivering an efficient national funding process for our customers, the applicants.

The newly started Celtic-Plus project SENDATE-EXTEND, funded by Vinnova, is an excellent example of the fruitful collaboration between several Swedish players, including large companies, academia and SMEs.

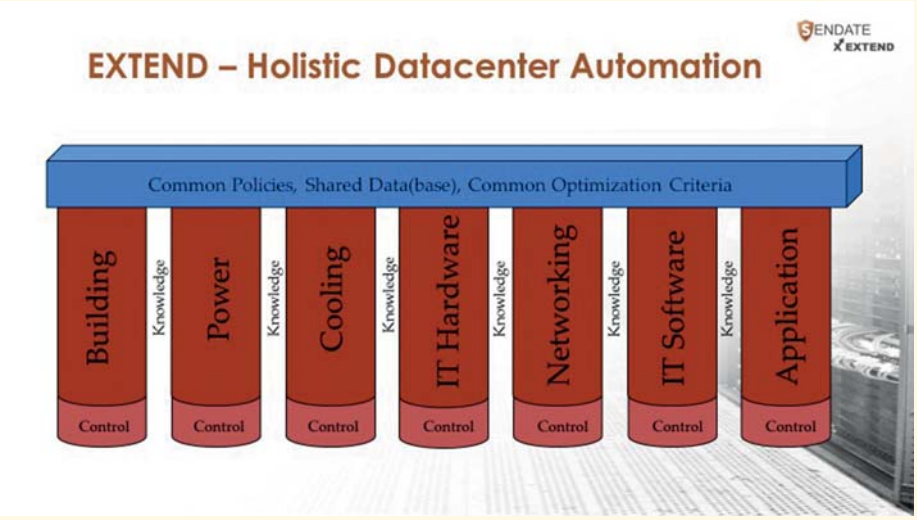

Figure 2: SENDATE-EXTEND is focusing on cross-layer automation and monitoring in data centers

SHARING – SMart Advanced Radio Technologies for 4G networks

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The SHARING project was created to stimulate the 4G evolution towards 5G mobile networks by developing innovative technologies designed to improve network performance and user experience.

Main focus

The SHARING project defined reference scenarios and explored new concepts with a special focus on interference management, cost-power efficient small cell deployments, LTE-A / WiFi convergence, network-controlled device-to-device communications, meshed relay-assisted networks, Self-Organized Network (SON) features and architecture evolutions for heterogeneous networks.

The project's main achievements include, among others: (1) rationale and forecasts (2015-2020) for worldwide and European small cells, carrier WiFi, D2D and relay markets; (2) advanced techniques required to cope with traffic increase, and to fulfil the objective of "services for everyone everywhere" such as coordinated multi-point, advanced receivers and carrier aggregation; (3) methods that can significantly reduce (up to 50%) average network energy consumption while still maintaining the desired quality of service; and (4) a software solution designed to improve user localization in heterogeneous 3GPP / WiFi networks. Impact on network architecture of all project innovations was assessed giving a hint on compatibility with current standards and implementation straightforwardness.

Approach

SHARING aimed to achieve a major capacity increase by leveraging on:

- Advanced Self-Organizing Network (SON) mechanisms and advanced cooperation technologies.
- Multi-layer and multi-RAT offloading of macrocell traffic to (a) outdoor small cells, (b) indoor femto cells and Wi-Fi, and (c) enabling Device-to-Device (D2D) communications.
- A flexible interference management approach combining the advantages of interference avoidance and interference cancellation.

Achieved results

SHARING developed innovations which consolidate small cell-technologies related to heterogeneous multi-RAT and multi-layer networks. These innovations are in the following areas:

- Flexible air interface consisting of multi-point coordination transmitters, interference cancelling receivers and coordinated interference management tailored for future heterogeneous networks.
- Novel strategies for seamless intra- and inter-RAT traffic offloading.
- Self-organized methods for managing mobility, interference, spectrum and radio resources.
- Fronthaul solutions covering advanced relaying and device-to-device communications.
- Heterogeneous network architecture enablers needed by device-to-device communications.

The project also developed cost-efficient technologies and solutions, namely:

- Effective interference mitigation and management in heterogeneous networks.
- Smart and efficient traffic steering strategies taking into account the actual operational conditions.
- Innovative cost effective fronthaul architectures for heterogeneous networks.
- RF front-end (reconfigurable energy efficient power amplifier and miniature frequency agile antenna), as enablers for Carrier Aggregation.

SHARING contributed to taking current offload solutions to next-generation smart Multi-RAT HetNets, thereby contributing significantly to economic and energy-efficient access networks.

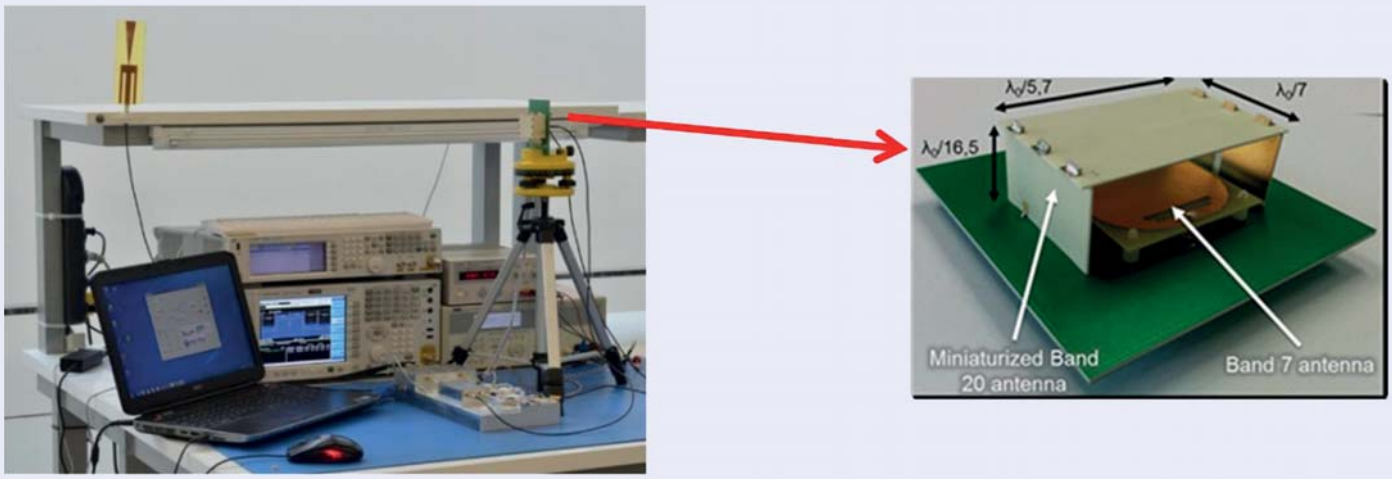

Figure 1: Carrier aggregation demonstrator setup comprising the reconfigurable RF front-end (including a dual band miniature antenna), the control PC and the measurement equipment

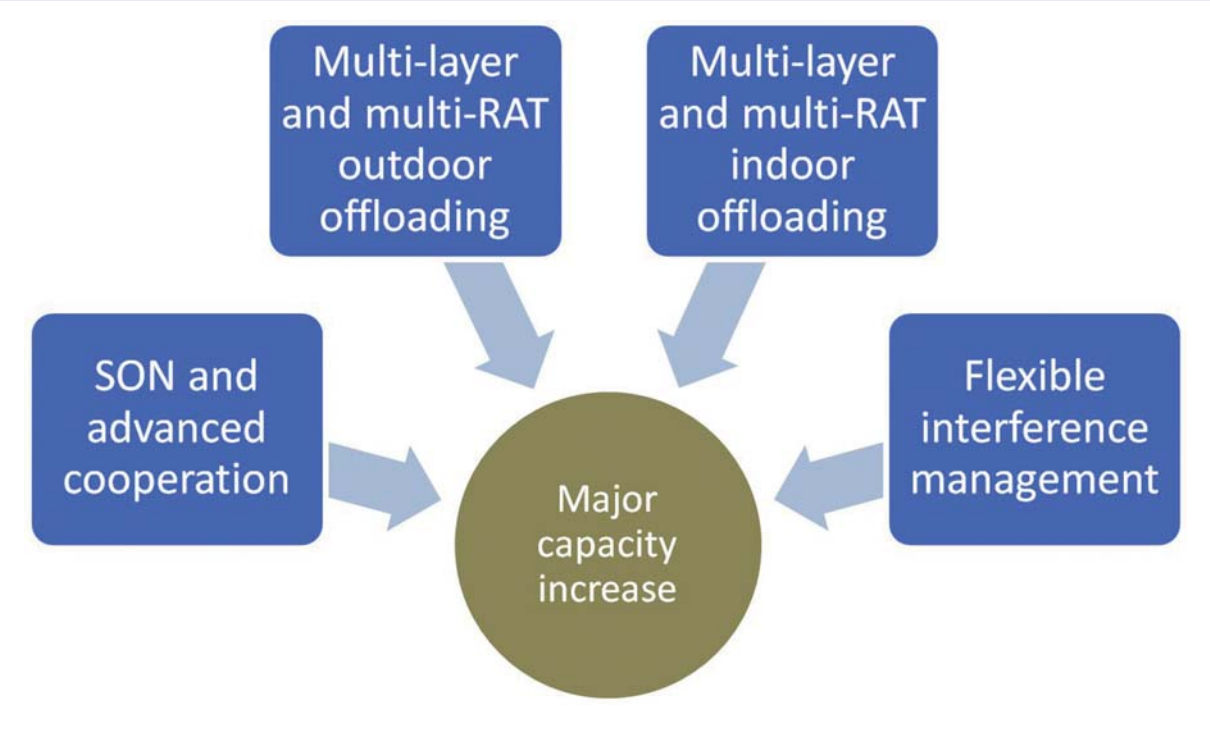

Figure 2: SHARING overall target

Impact

During the SHARING project the focus in 3GPP was on finalizing Release 12 and initiating the Release 13 specifications of LTE-Advanced systems. Some of 3GPP activities that are the most relevant to SHARING project are device-to-device communications, interworking between LTE and WLAN, ON/OFF energy savings and small cells. The project contributed to 29 technical contributions for 3GPP RAN1, RAN2 and RAN3.
SHARING also contributed to the improvement of a significant variety of products including power amplifiers, dual connectivity solutions, interference cancellation chipsets, relaying and carrier aggregation solutions, radio propagation models, and RF fingerprint positioning platform, and seamless multi-RAT connectivity solutions.

A great deal of effort was also spent on dissemination activities leading to a significant number of publications in prestigious conferences (78), journals (33) and workshops (11); and to the organisation or co-organisation of 6 workshops or special sessions. The project has also issued 1 book and has obtained 2 best paper awards.

- Further information is available on the SHARING project website at http://www-sharing.cea.fr

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.

EUREKA