EURESCOM message

The magazine for telecom insiders

Celtic-Plus
Newsletter 1/2017

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NEM Summit 2017 –
Smart Content by Smart Creators
Madrid, Spain, 29 – 30 November 2017

The 10th edition of the NEM Summit conference and exhibition will be held in the Spanish capital Madrid at the exciting venue of the Museo Reina Sofía. Reserve the event date and take part in discussions on the latest developments in European media, content, and creativity.

The NEM Summit is an international conference and exhibition, which has been organised by the NEM Initiative every year since 2008. It is for all those interested in the broad area of media, content, and creativity. Over the years, the NEM Summit has grown to become an annual not-to-be-missed event.

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Venue: Edificio Nouvel, Auditorio 400 and Auditorio 200. Museo Reina Sofía, entrance: Ronda de Atocha s/n, 28012 Madrid, Spain

More information about the NEM Summit 2017 and online registration are available on the NEM Initiative website at www.nem-initiative.org
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Join the Industry-Driven Research Programme
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Celtic-Plus Call for Project Proposals – Deadline: 16 October 2017

Do not miss the opportunity to participate in Celtic-Plus, the industry-driven European ICT and telecommunications research programme under the umbrella of EUREKA. Submission deadline for the next call for project proposals is 16 October 2017.

Celtic-Plus projects are collaborative private-public partnership R&D projects. All EUREKA member countries and associated countries can financially support them. More information on public funding and national contacts per country can be found on the Celtic-Plus Public Authorities Website. Please talk to your national contact early in the process.

Easy proposal process
Preparing and submitting a Celtic-Plus project proposal is easy. Just register on the Celtic-Plus online proposal tool, fill in the Web forms, and upload your proposal in pdf. Access to the proposal tool and to a proposal template is available via our Call Information page (https://www.celticplus.eu/call-information).

Benefits of participating in Celtic-Plus
- You are free to define your project proposal according to your own research interests and priorities.
- Your proposals are not bound by any call texts, as long as it is within the ICT/telecommunications area.
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- High-quality proposals have an excellent chance of receiving funding, with an average success rate of 60 %.
- The results of the evaluation will already be known in November 2017.

If you have any questions or need help, do not hesitate to contact us; we are pleased to help you.

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Dear readers,

Network management has rarely been a topic that excited a wider technology audience beyond the insider circles of network experts. Although on the surface, this is not really different today, something may have changed with the emergence of 5G.

In the networks of tomorrow, managing the network resources more effectively and making sure, there are mechanisms in place for assuring the security of networks, will become more important than ever. In a world of trillions of IoT devices, effective 5G network management could mean the difference between a properly working networking infrastructure and a network open to all kinds of disruptions. As the rollout of 5G is around the corner, or less metaphorically speaking is expected to happen in three years from now, the editorial team considered it to be the right time for a cover theme on network management in 5G.

In this issue of Eurescom message, we present a selection of contributions on network management in 5G from the forefront of European 5G research. The authors of our cover theme shed some light on different challenges and solutions of network management in 5G.

In the first article of the cover theme, Anastasius Gavras, Eurescom message editor and project manager at Eurescom, provides an overview on 5G network management. The following article by Kieran Sullivan from TSSG presents results of 5G-PPP project CognNet on how networks will become smarter through machine learning.

The next article presents solutions by 5G-PPP project SELFNET on their novel framework for autonomic self-organised network management. This is followed by an interview with Dr. Michael Barros from TSSG, the chairman of the 5G PPP work group on network management, quality of service and network security, on the new opportunities and challenges 5G offers for network management.

Concluding the cover theme, we present an article by Vladimir Yanover from Cisco and Klaus Martiny from Deutsche Telekom describing the vision of the NGMN Alliance on network management in 5G.

This edition of Eurescom message also includes a variety of further articles on different, ICT-related topics. See, for example, the new opinion article by Eurescom director David Kennedy on going retro in his column "The Kennedy Perspective". See also our events section, which contains a report on the 5G Global Event in Tokyo. Finally, in the latest "A bit beyond" article you can learn about the scary trends in brain hacking.

My editorial colleagues and I hope you will find value in this edition of Eurescom message, and we would appreciate your comments on the current issue as well as suggestions for future issues.

Milon Gupta
Editor-in-chief

Events calendar

28 – 29 June 2017
Net Futures
Brussels, Belgium
http://netfuturesconference.eu

1 – 6 September 2017
IFA 2017
Berlin, Germany
http://b2b.ifa-berlin.com

14 – 19 September 2017
IBC – International Broadcasting Convention 2017
Amsterdam, Netherlands
https://orpheus-audio.eu

18 – 21 September 2017
Helsinki 5G Week
Helsinki, Finland
http://www.helsinki5gweek.org

15 – 18 October 2017
Global Wireless Summit 2017
Cape Town, South Africa
http://gwsummit2017.org

6 – 8 November 2017
IEEE Conference on Network Functions Virtualization and Software Defined Networking (IEEE NFV-SDN)
Berlin, Germany
http://nfvsdn2017.ieee-nfvsdn.org

29 – 30 November 2017
NEM Summit 2017
Madrid, Spain
https://nem-initiative.org

26 February – 1 March 2018
Mobile World Congress 2018
Barcelona, Spain
https://www.mobileworldcongress.com

12 – 16 March 2018
CeBIT 2018
Hanover, Germany
http://www.cebit.de/en/

SNAPSHOT

"Oops, your files have been encrypted!"

This ransom note appeared on more than 230,000 Microsoft Windows computers in May 2017, which were infected by the WannaCry cryptoworm.
The WannaCry ransomware attack began on Friday, 12 May 2017, and affected Windows-operated computers in over 150 countries, hitting parts of Britain's National Health Service (NHS), Spanish network operator Telefónica, and German railway company Deutsche Bahn. Robert M. Wainwright, director of Europol, called the attack "unprecedented in its scale".

Further information is available on the ENISA website at https://www.enisa.europa.eu/publications/info-notes/wannacry-ransomware-outburst

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**Network
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Going retro

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Recently, I was amused to see that Nokia is rereleasing the famous 3310 mobile phone with selling points like a week's battery life and 2G connectivity. The first question is: who wants to go back in time? But when you think about it more, you realise that many products and services are plugging into a trend based on recreating the retro look and feel of a time, when we thought everything was simpler.

I was then trying to understand what it is that makes us think, the simpler past was better. Clearly, when your phone was just a phone, you didn't need to know as much to use it, and you didn't feel the need to keep looking at it to stay informed. In fact maybe it is not the phone but the lifestyle that was simpler.

When SMS was introduced, it took a little time to get established. But now there is a generation of people, the millennials, who have grown up with the mobile phone and who prefer texting to voice conversations. This means they get to pause in communications and can answer, when and what they want without anyone being embarrassed by long pauses in the conversation. It is an improvement on awkward conversations and having to think of answers on the spot. What's not to like?

SMS has been extended with the explosion of messaging apps that all promise to keep you in touch with your friends – as long as they are using the same app – for a very low cost. Actually, do we even know how we pay for these services? What is the real cost? Maybe we need to see what the opportunity cost of the time online is. Who has had to wait for a friend while out walking, because they were checking their messages on the way?

Photo: Public Domain, Source: https://commons.wikimedia.org/wiki/File:Nokia_3310_blue.jpg

And then we slowly realise that we are at risk of being addicted to constant communication with our friends. We send them pictures of our cats and invite them to comment on our lifestyles and activities. Some of my friends have even bought selfie sticks.

And now we are back to my first question: why are retro things appealing? Well, because in our continuously connected lives, we are magically in regular contact with friends across the world, with whom we would have lost contact years ago, if we had to write letters. We are overloaded with information and communication. But something is missing. At the end of the day, we are still basically social animals, and we need to meet and greet people to have good interactions. We need to make sure we're not replacing friendships with electronic placebos.

I like old cars, because they let me have control. I like new communications, because they let me keep up contacts and send/receive messages to my heart's content. But sometimes we need the Nokia 3310 approach so that we don't overdo the retreat into the online world and actually interact with real people. Trust me, when you don't go to meet friends in the real world because you are too busy online, it is time to go retro.

Network Management in 5G
Old and new challenges and solutions

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Network management is as old as telecommunication and computer networks. It encompasses all activities related to maintaining a healthy status of the network. 5G is not going to change the fundamentals of network management. However, some new concepts in 5G will require new management solutions.

Network management has evolved from simple network management with manual intervention over integrated network and service management to more sophisticated management technologies including cognitive and autonomic features. For telecoms operators management is an inter-administrative domain topic in which the management tasks relate to the end-to-end network service provisioning. Hence collaboration is an imperative approach to provide a global healthy network, whether in standardisation or through collaborative projects and initiatives.

The FCAPS model

A telecommunications network is one of the highest distributed artefacts that mankind has built. It lies in the nature of the distribution that some element or some function somewhere will fail and be unavailable, with the consequence of performance degradation or complete network service outage. It is the task of network management to identify and locate the fault and initiate remedial measures. It is also the task of network management to ensure security and provide accountability for all actions affecting the network. Probably the most accepted standardised model in this area is the FCAPS model, which separates network management tasks into five categories: (i) Fault, (ii) Configuration, (iii) Accounting, (iv) Performance, and (v) Security. FCAPS originated in the ISO/ITU-T Telecommunications Management Network (TMN) model and framework.

What is new in 5G?

After many decades of standardisation in ISO/ITU-T, the TeleManagement Forum and other bodies, you may think that we have solved the problem of how to manage networks. However, in the scope of the new 5G network infrastructure, management surfaced again as a topic of increased attention. 5G introduces new paradigms in many areas, which requires at least adjustments in the way we manage the 5G network infrastructure. In some areas we potentially need new approaches.

Two of the key 5G concepts are virtualisation and complete softwarization of the network. They promise a reduction of CAPEX (capital expenses) and OPEX (operational expenses), higher flexibility as well as faster and increased service revenues. This will be achieved through enabling infrastructure and resource sharing in the radio access network, the transport network, and the core network as well as the use of commoditized, and thus cheaper hardware. At the same time, these concepts introduce a higher degree of network complexity that needs to be managed.

The network slicing concept

The role of a 5G network operator is to deliver to its customers tailored telecommunication systems, which are composed of functions at different levels and domains. The primary targeted customers are vertical industries, which have expressed very diverse requirements for the 5G network infrastructure. To meet the customer requirements and to provide the expected service experience under ever-increasing business dynamicity, the concept of slicing has emerged as a solution.

The definition of a slice has not been finally agreed yet in the standards. A definition promoted by the Next Generation Mobile Networks (NGMN) Alliance distinguishes between "slice blueprint" and "slice instance". The blueprint is the complete description of the structure, configuration, plans, and workflows for instantiating and controlling the network slice instance during its lifecycle. The instance is the set of run-time network functions, along with physical and logical resources to run these network functions, forming a complete instantiated logical network to meet certain network characteristics. An extended definition of slicing that includes

Extended network slicing concept

computing and storage resources beyond network functions is depicted in the figure.

The 5G management framework

The concept of slicing is likely to be the reason for a new approach to network management. So far a network operator has basically managed one or, at most, a few separate networks. Each slice instance, however, represents a separate isolated virtual network. Due to the business dynamicity and the high number of customers with specific run-time requirements, the number of slice instances will be very high, posing an unprecedented challenge on network management.

The separation of ownership and the ability to control and manage certain network resources is a further concept that has emerged in 5G and which adds flexibility but was not considered so far in the design of network management systems.

All this flexibility and adaptability cannot be achieved without developing a dynamic integrated 5G management environment, which exhibits cognitive and autonomic properties.

Support policy and business

The 5G action plan by the European Commission and the recent resolution of the European Parliament from 1st June 2017 on the deployment of 5G stress the need for co-ordinated efforts and investments across Europe so that the 5G infrastructure supports the business dynamicity of all vertical sectors.

Business dynamicity in itself differs in terms of speed and scale for each supported vertical stakeholder. It requires the ability to flexibly integrate and manage the infrastructure resources. More specifically, it requires offering tailored slices to various stakeholders ranging from multinational players to regional and local micro-in-

dustries. This is in line with the keen interest of regulators and policy-makers to support these stakeholders through the future 5G infrastructure.

Conclusion

Network management is an important element for meeting the targets of the EC's 5G action plan. A number of initiatives and projects are underway to design the framework and develop solutions for 5G network management. Based on the established FCAPS model, it requires the use of new technologies, such as autonomic management, machine learning, cognitive management and others.

Overall, the development of 5G in Europe has largely progressed according to plan. However, until the planned roll-out of 5G networks in Europe by 2020, a number of network management issues, including security, still need to be addressed.

Further information on the work related to network management in the 5G PPP is available at https://5g-ppp.eu

Smarter networks through machine learning
Results of 5G PPP project CognNet

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Consumers and industry alike expect 5G to support billions of interconnected wireless devices. If the network is to have any chance of achieving this, it must make the best use of available spectrum and data transmission rates. This will facilitate as high capacity and Quality of Service as possible. Its sheer size and the number of devices connected means, the network will also be forced to manage itself, dealing with organisation, configuration, security, and optimisation issues.

To meet changing demands for resources, virtualisation will play an important role as the network needs to provision itself dynamically. The key to doing this is Network Function Virtualisation (NFV): virtualising network nodes, functions and links, rather than building a network to meet estimated maximum demands.

The 5G PPP project CogNet, which runs from 2015 to the end of 2017 under the EC's Horizon 2020 programme, has focused on the concept that autonomic network management, based on machine learning, is a key technology to achieve an almost self-administering and self-managing network.

Network software will be capable of forecasting resource demand through:
- Usage prediction
- Recognising error conditions
- Security conditions
- Rare outlier events such as fraud or faults

The software will then respond and take corrective actions.

With so many network nodes, energy efficiency will also be a key requirement. As a result, there is also the possibility to reconfigure the virtualised network substrate. This could, for example, avail of cheaper or greener energy when it is available and suitable. Again, this is directly related to usage prediction both at a macro level, across an entire network, and at a micro level within specific cells.
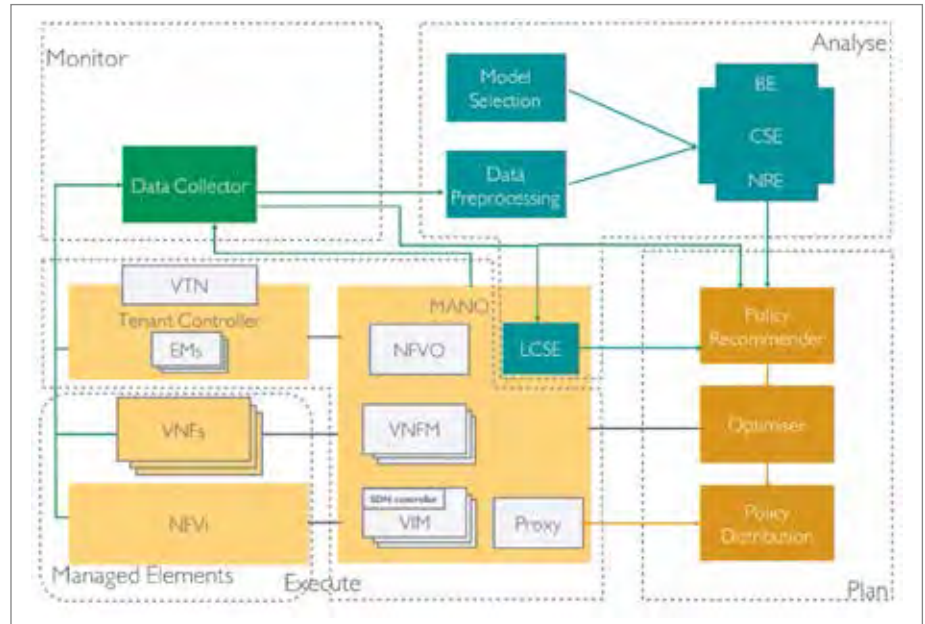

Figure 1: CogNet vision

Responding to insights, events, and conditions

Network management experts have also identified the current central management approach as problematic. Since there will be a proliferation of (virtualised) network nodes, coupled to the sheer volume of data expected from such individual nodes in 5G, it will be impossible to scale and centrally manage such nodes. Individual nodes will need self-management capabilities to determine (1) when to escalate a management issue and (2) the relevance of log data and generated events, such that they generate and submit only what matters to central network management. These are classification and relevance determination issues that can be addressed via a machine learning solution to form a self-organising network.

The CogNet project is making a major contribution towards autonomic management of telecoms network infrastructure through using available network data and applying machine learning algorithms. This is yielding insights, recognising events and conditions, and responding correctly to them. The project is exploiting leading research in the areas of data gathering, machine learning, data analytics and autonomic network management. Ultimately, the project will:
- Enable the larger and more dynamic network topologies necessary in 5G
- Improve the end-user QoS

- Lower capital and operational costs through improved efficiencies and the use of node, link and function virtualisation

Our overall approach is shown in figure 1.

Adding machine learning to the architecture

The CogNet architecture uses machine learning to help create an autonomic network management solution. One of the main features is the ability to dynamically adapt to changes by combining machine learning models and network management policies.

The architecture comprises the following main components:

CogNet Smart Engine (CSE): responsible for receiving the state and resource consumption records, pre-processing the records, selecting suitable algorithms, and then applying selected models to further process the received data. The CSE supports various machine learning modules that in turn help deliver different CogNet services. These include data gathering service, forecasting and prediction services, anomalies and fault recognition service, and policy or rule generation service for the policy engine.

Policy Engine: mainly responsible for mapping insights from the LCSE/CSE into appropriate policy actions that can be directly understood by related components in the Management and Orchestration functions.
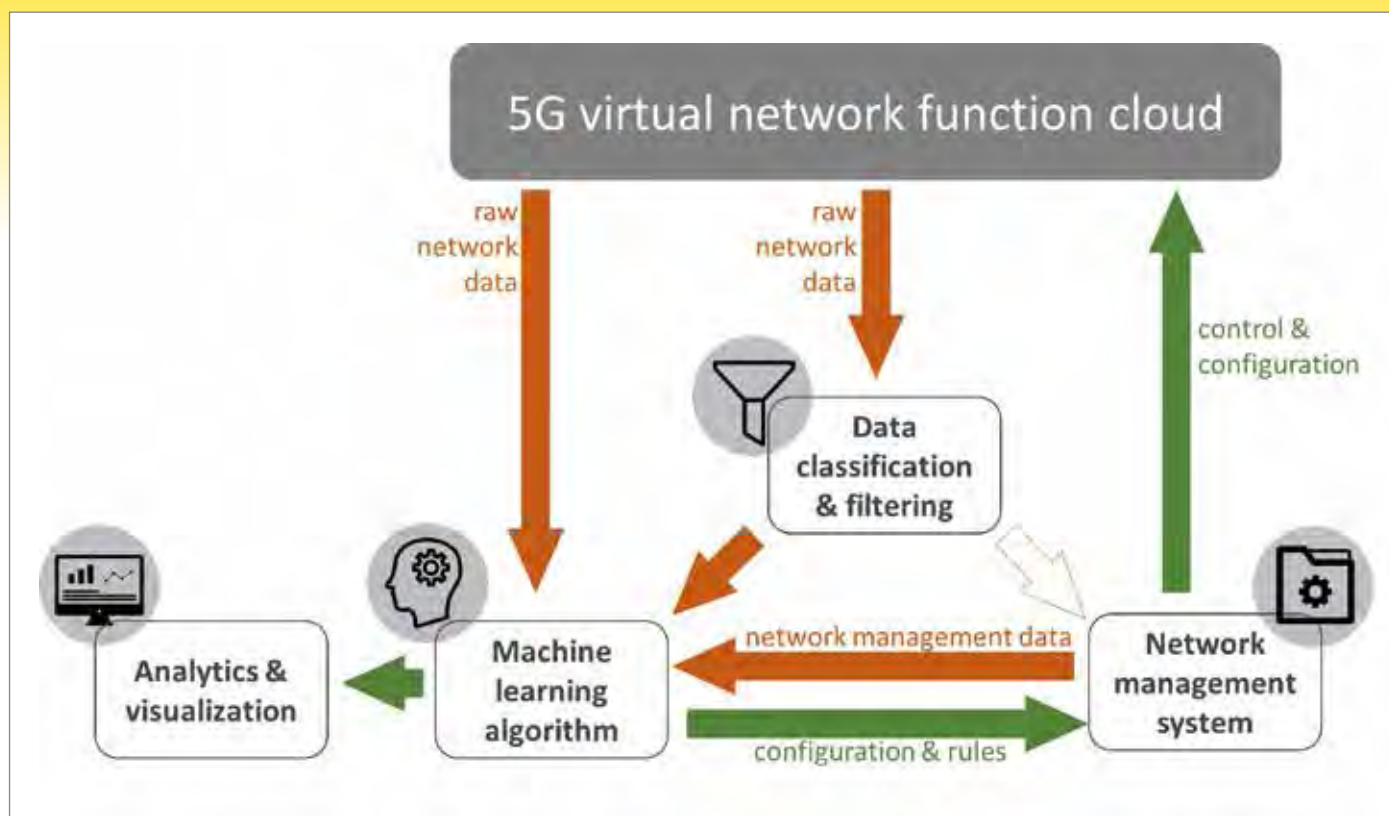
Figure 2: Architecture mapped to MAPE

Note: Data Sources = light orange, Data/Collection = green, Cognitive Elements = blue, Policy Engine Elements = dark orange

NFV Architectural Framework: leverages the ETSI NFV architecture. One key architectural innovation of CogNet is the adoption of network intelligence to NFV MANO. Specifically, the MANO block is enhanced by the Lightweight CogNet Smart Engine (LCSE), a processing component that offers similar functionality as CSE but is only equipped with the (Near) Real-time Processing Engine. Such a component is designed to be embedded into MANO, located as close to data as possible to reduce access and processing time.

Note that the proposed architecture can be described by the MAPE autonomic loop, as presented in figure 2, which executes the following actions in a loop manner:

Monitor: Data Collector gathers details from the managed network and its environment

Analyse: Collected information is forwarded for analysis to the (L)CSE, which is an intelligent component to perceive the network state and its external environment. It uses these insights to assist network management.

Plan: Output of the (L)CSE is sent to the Policy Engine, which recommends network policies to enact a desired alternation in the network infrastructure.

Execute on Managed Elements: Consequently, managed network resources, such as VNFs and NFV Infrastructure (NFVI), are adjusted through MANO and other controllers based on the recommended actions.

Outlook

Combining machine learning with existing work on autonomic network management is helping to realise the network required to support 5G. This approach enables the further virtualisation of network functions and moves us closer to the vision of a self-administering, self-managing network.

CogNet's architecture and its service offerings have kick-started the move towards smarter networks. The autonomic MAPE loop provides the framework for further advances in the area.

Integration into appropriate vertical sectors, such as eHealth, agriculture, and transport, has now appeared on the horizon for this work. It is within these environments that the flexibility, reliability, and capacity of the 5G network can be fully examined. Only then can we truly determine, if the CogNet approach enables more dynamic network topologies, improves end-user QoS, and lowers costs through virtualised nodes, links, and functions.

Further information on CogNet is available at: http://www.cognet.5g-ppp.eu

Autonomic self-organised network management
New framework developed by 5G-PPP project SELFNET

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The use of Software-Defined Networks (SDN) and Network Function Virtualization (NFV) has changed the vision for networking infrastructures from the traditional monolithic approaches with high maintenance cost and complex upgrade procedures to a more flexible, customisable and cost-efficient platform of services.

To support this paradigm shift at the network management level, the Horizon-2020 5G-PPP project SELFNET [1] introduces a novel intelligent network management framework consisting of a smart integration of state-of-the-art technologies in SDN, NFV, Self-Organizing Networks (SON), cloud computing, artificial intelligence, Quality of Experience (QoE) and next-generation networking.

At the network management level, SELFNET explores SDN, NFV and cloud computing technologies, together with novel algorithms, to achieve a highly intelligent paradigm for smart self-management of complex networking scenarios.

Impact on 5G networks

SELFNET is implementing an autonomic network management framework for achieving self-organizing capabilities in managing 5G network infrastructures by automatically detecting and mitigating a range of common network problems that are currently still being manually addressed by network operators, thereby reducing significantly the operational costs.

The SELFNET architecture is implemented mainly using commercial off-the-shelf network devices and was inspired by an ever-growing commoditised NFV and SDN apps market, essential in the development of 5G networks.

At the system level, SELFNET explores a software-based autonomic management system, which combines an innovative Health of Network (HoN) monitoring approach with intelligent algorithms to analyse network state and autonomously deploy virtualised network function assets to maintain the health of the network. By removing the reliance on costly, vendor-specific hardware and applying software-based networking solutions, SELFNET notably decreases the capital and operational costs for 5G network operators, and significantly contributes to achieving the 5G PPP key performance indicator of reducing the average service creation time cycle from 90 hours to 90 minutes.

Network management architecture

The figure on page 12 presents the SELFNET network management architecture, which is compliant with the 5G Multi-access Edge Computing (MEC) vision [2], expected to boost the performance of users' applications.

The infrastructure layer provides the resources required for the instantiation of virtual functions (compute, network and storage) and supports the mechanisms for that instantiation. To achieve its functionality, this layer encompasses different sublayers. The physical sublayer provides physical connectivity, networking, computation and storage capabilities over "bare metal". The virtualization sublayer provides capabilities to instantiate virtual infrastructures. Finally, the cloud computing sublayer provides multi-tenancy support to the infrastructure layer together with a centralized point for facilitating the management of the infrastructure.

The virtualized network layer represents the instantiation of the virtual networking infrastructures created by the users of the infrastructure as

part of their normal operational plan and those created by the SELFNET framework as part of the SON capabilities. In the context of SELFNET, network functions can be either virtual or physical functions and they can be chained across the integrated virtual and physical network infrastructure.

The SON control layer contains the applications that enable the collection of data from sensors deployed through the entire system (SON sensors) and the applications that are responsible for enforcing actions into the network (SON actuators) as part of the enabling mechanisms to provide network intelligence in 5G networks.

The SON autonomic layer provides the mechanisms for network intelligence, collecting from the network pertinent information about the network behaviour and using that information to diagnose the network condition and decide the tactics to accomplish the system goals, guaranteeing the organized enforcement of the actions that are determined.

The NFV orchestration & management layer manages the life-cycle of the NFV/SDN apps through the VNF Manager (VNFM+) and integrates the Virtualized and Physical Infrastructure Managers (VIM+ and PIM+). Moreover, it interworks with the SELFNET orchestrator in deploying network services on demand.

The SON access layer encompasses the interface functions that are exposed by the framework. Despite the fact that internal components may have specific interfaces for the particular scope of their functions, these components contribute to a general SON API that exposes all aspects of the autonomic framework, which are "used" by external actors, like business support systems or operational support systems.

A Graphical User Interface (GUI) is provided on top of the SON API, where a network administrator can interact and configure SELFNET and also obtain the complete status of the network, acting as a command and control centre. This GUI enables the network administrator to stop, verify or manually enforce any of the actions that SELFNET is governing, allowing network administrators always to have control over their infrastructure.

Use cases

The SELFNET architecture is validated through three SON use cases that have served as the key drivers to determine the set of NFV apps and SDN apps implemented in the framework and
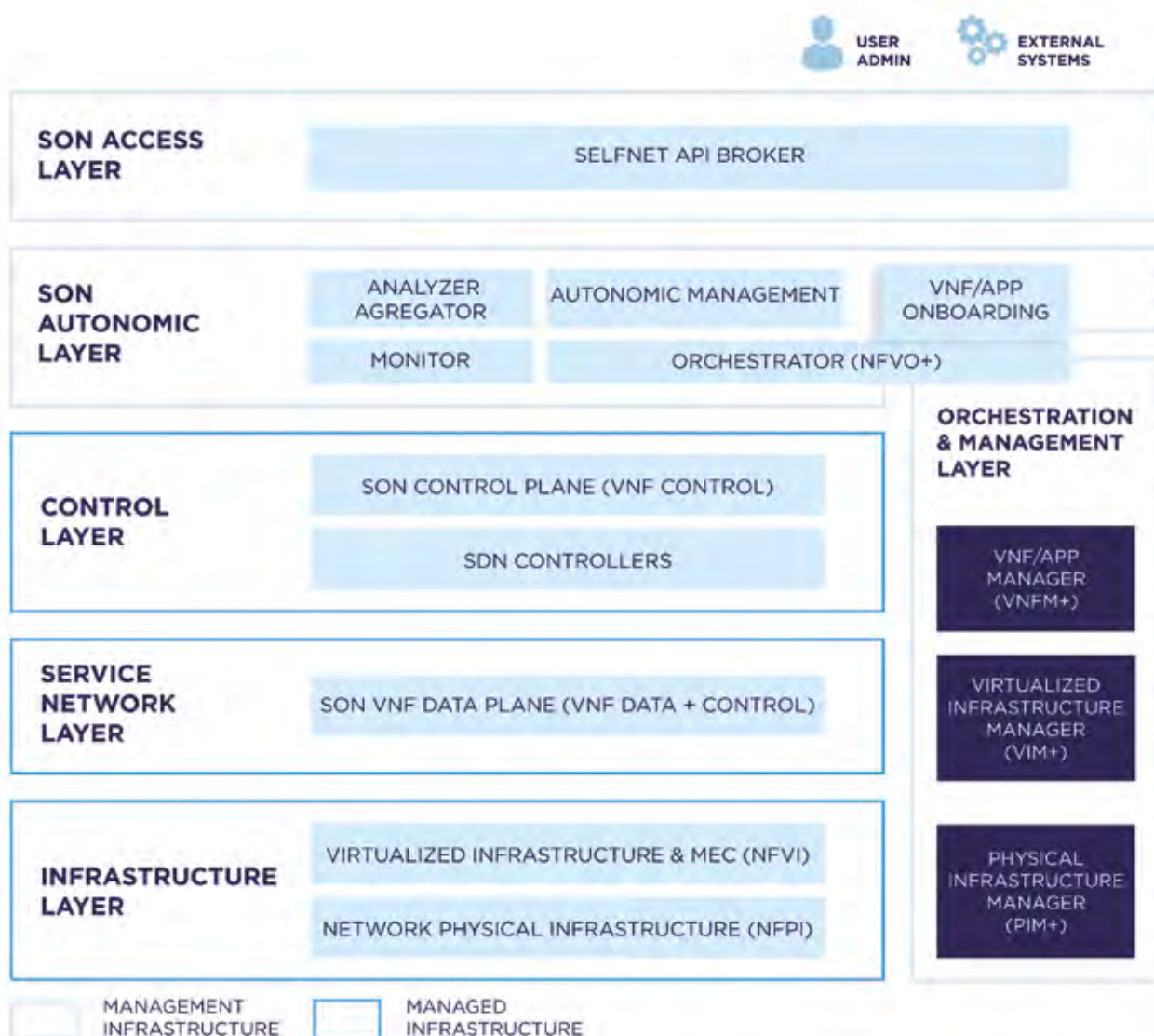
SELFNET network management architecture

intended to explore the main network management capabilities:

1. Self-protection capabilities of the network against distributed cyber-attacks, viruses and trojans, among other common security threats.
2. Self-healing capabilities of the network against failures of network infrastructures and services, achieving a self-repairing property in the network.
3. Self-optimization of the network capabilities through the dynamic insertion of specific networking functions – such as media-aware network elements – in critical places in order to dynamically improve the network performance and the QoE of the users.

Conclusion and outlook

The SELFNET autonomic network management framework applies key innovative functionalities to network management beyond the state of the art, such as automated physical and virtual infrastructures and services deployment, automated and enhanced network service monitoring and performance analysis, intelligence-based network management engine assuring the quality of running services, and integrated management and orchestration of SDN/NFV apps for on-demand service creation.

Starting in June 2017, the Horizon-2020 5G-PPP project SLICENET [3] will build on and integrate SELFNET results in a slice management framework for virtualised multi-domain and multi-tenant networks, advancing it in cognitive QoE monitoring, analytics, decision-making, and self-optimisation for autonomous multi-domain management.

References

[1] https://selfnet-5g.eu/
[2] http://www.etsi.org/technologies-clusters/technologies/multi-access-edge-computing
[3] https://5g-ppp.eu/slicenet

More intelligence in the network
Interview with Dr. Michael Barros from TSSG on network management in 5G

The emergence of 5G offers new opportunities and challenges for network management. Eurescom message editor-in-chief Milon Gupta asked someone about it who should know: Dr. Michael Barros from the Telecommunications Software & Systems Group (TSSG) at the Waterford Institute of Technology, Ireland, is chairman of the 5G PPP work group on network management, quality of service and network security.

What are the major challenges for network management in 5G?

Dr. Barros: The main network management challenges in 5G are management of virtual network resources, network scalability, quality of service, flexibility, sustainability, context awareness, and security. On top of that, more researchers are willing to implement the concept of Open Management, which means management policies can be accessed by vertical partners who wish to influence network performance. However, this issue should gain more weight when the new network management solutions will use this concept and make it a standard.

What new issues have emerged or become more relevant in 5G?

Dr. Barros: This question can be answered in two ways: one is related to who is designing the network, and the other one relates to who is managing the network. Controlling a large number of both physical and virtual resources requires more automation and intelligence inside the network. However, for those who concentrate on problems in designing the network, the integration of multiple high-frequency hardware and its relationship with network planning is more important.

What impact will network slicing and virtualisation in general have on network management?

Dr. Barros: They will have mainly scalability, quality of service and security impacts. The main objective of changing the network to aggregate network slicing and virtualization is to allow higher degrees of flexibility in order to obtain higher levels of performance. However, that contributes to an increase of network complexity based on the exponential increase of network entities, which makes it nearly impossible to manage the

Dr. Michael Barros from TSSG

network with current technologies. On the other hand, by increasing the complexity of both resources and management, new network threats can easily arise. The security of the network management solution needs to be very robust.

Which concepts are discussed in the 5G PPP to address network security?

Dr. Barros: Right now, there is a great amount of effort in anomaly detection and how to do it using machine learning. Because the increased complexity of the network is directly related to the increase of its vulnerability, there must be an efficient, robust and safe infrastructure that can detect and manage network attacks. This is closely related to the concept of network resilience, which has been studied extensively in the network engineering community.

How is cognitive management different from autonomic management?

Dr. Barros: Historically, autonomic management has gone as far as developing completely automated solutions in the network. The concept of self-x was introduced, in which network management is expressed through a mixture of approaches, including self-awareness, self-configuration, self-optimization, self-healing, and self-protection. With the advancements of infrastructure technology for accommodating the next generation of networks, the next level of network management has to incorporate the flexible manipulation of network resources and leverage it with the number of users, network traffic, SLAs,

and the required system performance. Machine learning has the capability of adapting an entire system based on historic data, which means that in 5G, the network management will monitor key metrics within the network, understand the configurable parameters, and optimally adjust their values for achieving a superior network configuration, indicated through a set of key performance indicators.

What progress has already been achieved in the 5G PPP towards novel network management solutions?

Dr. Barros: Many novel network architectures that incorporate cognitive network management have been proposed inside the 5G PPP phase one projects. In the CogNet project, there exists a main cognitive component that concentrates on adapting the network configuration based on the type of network traffic and also the different scenarios that this network traffic is in. Other projects have slightly different approaches, but also have the capability of network adaptation. For example, the SONATA project concentrates on network resource orchestration, while 5GEx looks at this problem at a higher level, considering multi-domain networks. And there is the SELFNET project, which looks into this problem with a focus on security issues. The common key feature of all these aforementioned projects is the machine-learning-enabled architecture.

By when will mature 5G network management solutions be available and what will be their main innovative features?

Dr. Barros: I suppose that will depend on the progress of innovation in the 5G-PPP projects across all phases. In the next 5G-PPP phases, it is expected to see more demos with novel features that will close the gap between the research that is being done and the potential commercial interest in this research. The benefits of cognitive network management are very clear to researchers. However, it still needs to be demonstrated how beneficial this technology is by adding the interests of telecoms companies in the solution as well. Nevertheless, the vision is that more and more intelligence is added to the network by learning more about the costumer's behaviours, application, services and adapting the resources accordingly, based on the 5G KPIs.

Network management in 5G
The vision of the NGMN Alliance

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In this article we present the vision of the Next Generation Mobile Networks (NGMN) Alliance on network management in 5G. The NGMN Alliance is a global partnership of network operators, telecoms and IT vendors as well as research institutes, which was founded in 2006.

The basis of the NGMN Alliance vision on 5G networks is a White Paper published in 2015 [1]. Many of the design principles outlined in the NGMN 5G White Paper require an innovative approach to network and service management, orchestration and optimization. For example, in the radio domain, NGMN highlights such 5G enablers as cost-effective dense deployments, integration of third-party deployments, automatic configuration as well as optimization and healing of the radio network. In the core, backhaul, and transport network, NGMN expects a strong move towards fixed and mobile convergence and a transition towards a RAT-agnostic core network. In addition, specific design principles for Operations & Management (O&M) have been outlined in the 5G White Paper, like general simplification of O&M, further automation and self-healing, integrated OAM and monitoring, functionality, collaborative management, and others.

The architecture vision in the NGMN 5G White Paper further includes the concept of an end-to-end management and orchestration entity that translates the use cases and business models into provisioning of network functions and slices, selecting and chaining network functions to satisfy the targeted application scenarios.

A network slice concept was developed to provide a basis for diverse services on the same network infrastructure. A network slice supports communication services of a particular type in terms of QoE. Each slice is composed of 5G network functions, some of which can be shared with other slices. Thus, a 5G slice can span multiple network domains: RAN, Core network, SGi-LAN domain, application domain, transport/backhaul, virtualization infrastructure, and more. Third-party entities can be given permission to control certain aspects of slices, thus enabling "Slice as a Service".

5G network and service management

Based on the principles outlined in the NGMN 5G White Paper [1], the project on Network Management & Orchestration (NWMO) within the NGMN Alliance developed a White Paper on "5G Network and Service Management including Orchestration" [2] that provides design principles, recommendations and requirements on network and service management, orchestration and optimization.
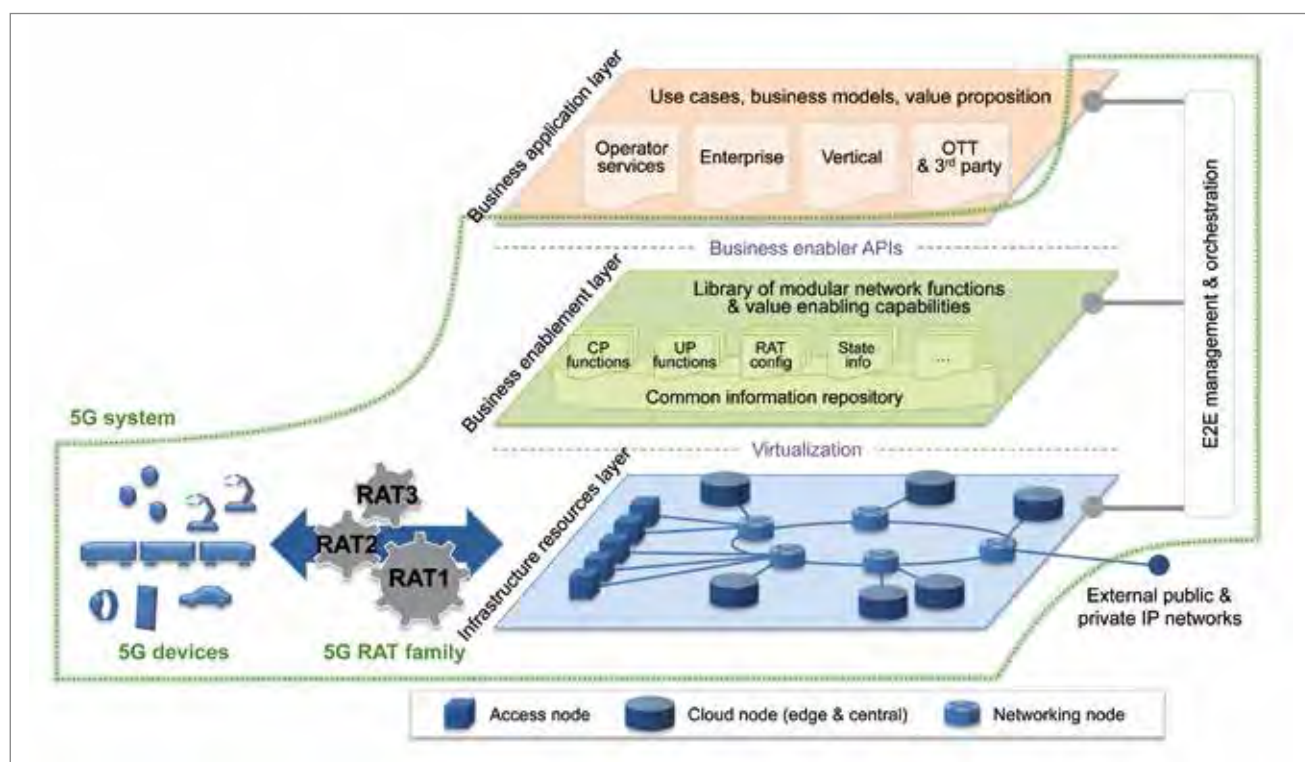

Figure 1: NGMN view of 5G architecture

Celtic-Plus
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Celtic-Plus Event in Barcelona

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E3 project – First live retransmission of awake brain surgery

Editorial

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Dear reader,

This issue of the Celtic-Plus Newsletter includes a new section about start-up companies that were created after successful Celtic projects. For the premiere of this section, we have chosen the oldest and the newest start-up company we know about. The Celtic project Gandalf, which received the Celtic Excellence Award in 2008, was at the origin of the Danish 2operate company that resulted from a real start-up adventure involving three successive start-up companies. Our other start-up success, Cumucore, is a direct spin-off of the SIGMONA project, which received the Celtic Excellence Award for Network Technologies in 2017. The article in this issue tells the story of how Cumucore has already been operating successfully in an international environment.

Shortly before the deadline of this Celtic-Plus Newsletter edition, we received great news from Celtic-Plus project E3. They had enabled the first live retransmission of an awake brain surgery, which took place in Nancy, France. I would like to congratulate the E3 team on their impressive achievement and feel proud that we at Celtic-Plus have facilitated their success.

You will also find in this issue a Project Highlights from another excellent Celtic-Plus project that has won the Celtic-Plus Excellence Award 2017 in the category Services & Applications, NOTTS.

In this issue, you can also read about our Proposers Day in Berlin, which was hosted by Deutsche Telekom, where we had 80 participants from 14 different countries. 14 was also the number of interesting projects ideas that have been presented and that allowed interesting discussion in the networking session.

This year's Celtic-Plus Event was exceptional. It took place in Barcelona, where we had 570 registered participants. Like last year, our event was collocated with the EUREKA Innovation Week, which was organized this time under the Spanish EUREKA Chairmanship. The event allowed us to show in the exhibition the results of 14 commercially relevant Celtic-Plus projects. Other highlights were the four keynote presentations in the fields of Automotive Telecom, M2M, IoT and Industry 4.0. In a round table we witnessed small meets big: the representatives of the above-mentioned start-up companies discussed about business impacts together with the Celtic-Plus innovation Award 2017 winning projects Co-MoSeF and SASER. On the second day, government representatives of nine EUREKA member countries explained their national research agendas and opportunities for public funding in their respective country. In the networking session the participants presented their expertise and project ideas in 24 project pitch presentations to find new collaborations for the projects that will shape the technologies of the future.

As you can see in this issue, the Celtic-Plus community is vibrant and dynamically developing into new areas. If you are not yet part of the community and would like to join, there are ample opportunities, like, e.g., our proposers days – the next one on "FinTech meets ICT" is planned for autumn 2017 in Luxembourg – and, of course, the next call for proposal, which ends on 16 October 2017. Feel free to talk to me or any other colleagues at the Celtic-Plus Office – I look forward to hearing from you.

Peter Herrmann
Editor-in-chief

Funding opportunities and business impact

Celtic-Plus Event in Barcelona

This year's Celtic-Plus Event took place under the Spanish EUREKA chairmanship in Barcelona, Spain, on 18 – 19 May 2017. It was held in conjunction with the EUREKA Innovation Week, which attracted more than 1,000 participants from 41 countries.

Opening session

The Celtic-Plus Event was opened by the Coordinator of the Spanish EUREKA Presidency at CD-TI, Oscar Fernandez Moyano, and Celtic-Plus Chairman Jacques Magen. The event presented achievements of Celtic-Plus projects and provided a glimpse on the future of information and communications technologies. The major annual event of EUREKA Cluster Celtic-Plus also offered ample matchmaking opportunities for developing new project ideas and partnerships in the area of ICT.

Keynotes

In the first keynote, Alessandro Coda, Chief Technology Officer of CLEPA, the European Association of Automotive Suppliers, presented the upcoming trends in automotive telecoms. He explained that the automotive telecoms of the future will combine Intelligent Transport Systems (ITS) and the next mobile network technology (5G). As a result, according to Mr Coda, connected and automated driving will become a reality, using short-range, cellular and satellite communications together.

In the second keynote, Riza Durucasugil, R&D Director at Turkish ICT solution vendor Netaş, talked about the future of M2M and IoT. According to Mr Durucasugil, new IoT ecosystems need a new security and privacy paradigm, which he considers an open challenge in IoT. He is convinced that automation drives security and vice versa. In order to underline the importance of security, he pointed out the target of 5G to provide an infrastructure for connecting 7 trillion things.

Industry 4.0 was the topic of the next keynote speaker, Jordi Hernandez, Senior Consultant for Digital Manufacturing at Atos. According to Mr Hernandez, Industry 4.0 is an evolution in manufacturing that involves connectivity and interaction of work processes. He reported that more than 300 million security alerts were managed by Atos during the last Olympic Games of Rio 2016 with zero impacts.

In the final keynote on the second day, Jean-Pierre Tual, VP Industrial Relations at ICT security firm Gemalto, talked about how to connect and securely monetize IoT. According to Mr Tual, M2M brings IoT into a new phase of business transformation and a new value chain. In this context, establishing trust in IoT is key. Mr Tual is convinced that IoT can provide a reliable framework for secure connectivity and will result in agile monetization of this emerging ecosystem.
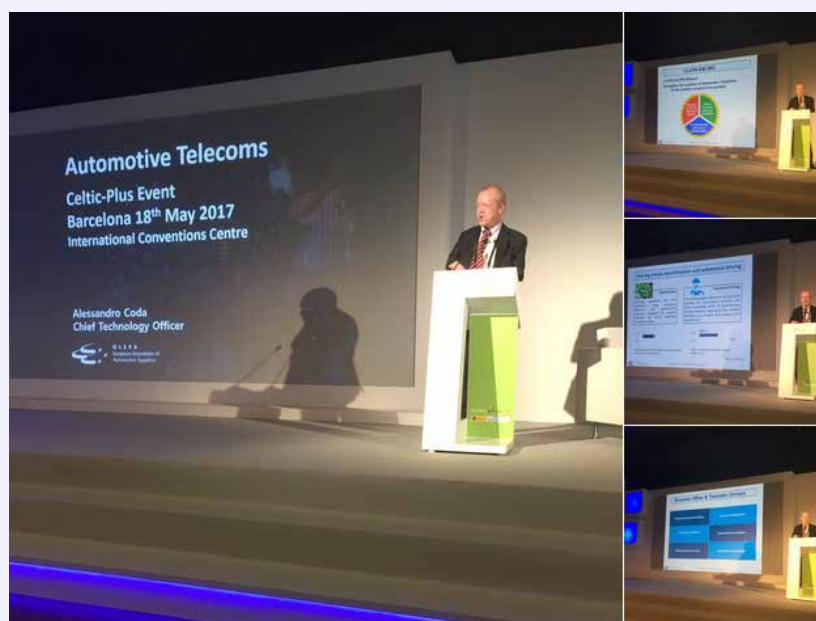

Riza Durucasugil, R&D Director at Netaş and Vice-Chair of Celtic-Plus

Jordi Hernandez, Senior Consultant for Digital Manufacturing at Atos

Jean-Pierre Tual, VP Industrial Relations at Gemalto

Alessandro Coda, Chief Technology Officer of CLEPA, the European Association of Automotive Suppliers

Panel on business impacts of Celtic-Plus projects

The keynotes were followed by a panel on business impacts of Celtic-Plus projects, which was moderated by Randy Zadra from NRC Canada. A number of start-ups that emerged from Celtic-Plus projects were represented in the panel.

One of them is the newly funded start-up Cumucore, which is a direct spin-off from Celtic-Plus project SIGMONA. Costa Requenta, CEO of Cumucore, said that his company focuses on niche markets and realizes pilots in Africa to grow. Cumucore offers a disruptive solution that integrates Network Function Virtualization (NFV) and Software Defined Networking (SDN) to deliver flexible and affordable mobile services to truly connect the world.

Another start-up that benefited from Celtic-Plus is ViLynx. According to ViLynx CEO Oscar Chabrera, the company is improving their technology and adapting it to the e-health sector thanks to Celtic-Plus projects HIPERMED and E3. The solutions developed in these projects allow professionals to directly access the relevant video content, which saves time and improves medical diagnostics.

Celtic-Plus flagship project SASER (Celtic-Plus Innovation Award winner 2017) has led to three start-up companies, according to Marco Hoffmann from Nokia. In addition, the 80-million-euro project generated 27 new products and 28 improved products that are commercialized by the 61 project partners.

Patricia Ortiz from Innovalia highlighted the fast commercialization of new products in the automotive telecoms area based on Celtic-Plus project CoMoSeF (Celtic-Plus Innovation Award winner 2017). The solutions developed in CoMoSeF enable the communication of traffic-related information between cars, road infrastructure, transport agencies and others to warn drivers of upcoming hazards and keeping the traffic flow smoother.

The panel session was followed by a Best of Celtic-Plus Projects session, moderated by Celtic-Plus Chairman Jacques Magen, and the Celtic-Plus Awards (see next article).

Round table on national funding and research topics

The second day of the Celtic-Plus Event started with a session moderated by Celtic-Plus Vice Chair Valerie Blavette from Orange. The session was dedicated to funding and research topics in different EUREKA countries and included the Public Authorities (PAs) of nine EUREKA countries – Belgium, Canada, Spain, Finland, France, Korea, Portugal, Sweden, and Turkey.

One of the main messages from the panel was that Celtic-Plus projects are bottom-up but need

Round table on national funding and research topics at the Celtic-Plus Event – from left: Valerie Blavette (Vice-Chair Celtic-Plus, Orange), Ricardo Migueis (ANI, Portugal) Cheon Kyo Park (KIAT Europe Office, Korea), Serge Bodjrenou (DGE, France), Jessica Swennebring (VINNOVA, Sweden), Hannu Nurmi (Tekes, Finland), Juana Sanchez (CDTI, Spain), Geert Thorrez (VLAIO, Belgium), Randy Zadra (NRC, Canada)

Celtic-Plus project idea pitches in Barcelona

to fulfil the national research strategies of the different countries that are involved in the projects. Thus, it is important that proposers contact their national authorities to check beforehand, if the idea matches the national priorities.

In addition, each PA representative explained specific conditions in their respective country.

Geert Thorrez from Belgian PA VLAIO explained that there is no change and enough money available for Flanders and the Brussels region.

Randy Zadra from Canadian PA NRC said that NRC is funding mostly SMEs. NRC's partner search platform for SMEs can be used by the Celtic-Plus community.

Hannu Nurmi from Finnish PA Tekes explained the research priorities of Finland, which include the following topics: Industry 4.0, 5G and bits of e-health. As in other countries, there is no dedicated Celtic-Plus budget reserved, which means proposers are competing with projects from other EUREKA or national programmes.

Serge Bodjrenou from French PA DGE said that there are two funding possibilities in France, direct funding by DGE or funding through FUE, which is a national cluster.

Ricardo Migueis from Portuguese PA Agencia Nacional Inovaçao (ANI) said that many companies and research infrastructures in Portugal are aligned with Celtic-Plus. There is a small state budget and the possibility of structural funds available in Portugal. A larger state budget will become available soon, the funding process will take about two months. In general, he said, there is a streamlined and fast decision procedure for funding in place. Research Institutions can also apply, provided the project is led by an SME. There is no maximum time after labelling to apply for funding.

Peter Herrmann from the Celtic Office explained the German funding situation. The BMBF and BMWI are the main funding sources but not the only ones, as also the ZIM for German SMEs is very attractive. In addition, funding from DFKI (German Research Center for Artificial Intelligence) is available for German research participants.

Cheon Kyo Park, Head of the European Office of KIAT, the Korean PA, said that there is no big difference along the funding system. There are four different programs in Korea as well as bilateral and multilateral programmes, with a total budget of 62 million euro. Collaboration of Korean partners in Celtic-Plus is dramatically increasing. The global collaboration budget in Korea might increase as well.

Jessica Swennebring from Swedish PA VIN-NOVA said that the funding in Sweden increased from 3 to 6 million euro and that there is a fast funding decision process in place.

Discussing new proposal ideas at the Celtic-Plus Event 2017
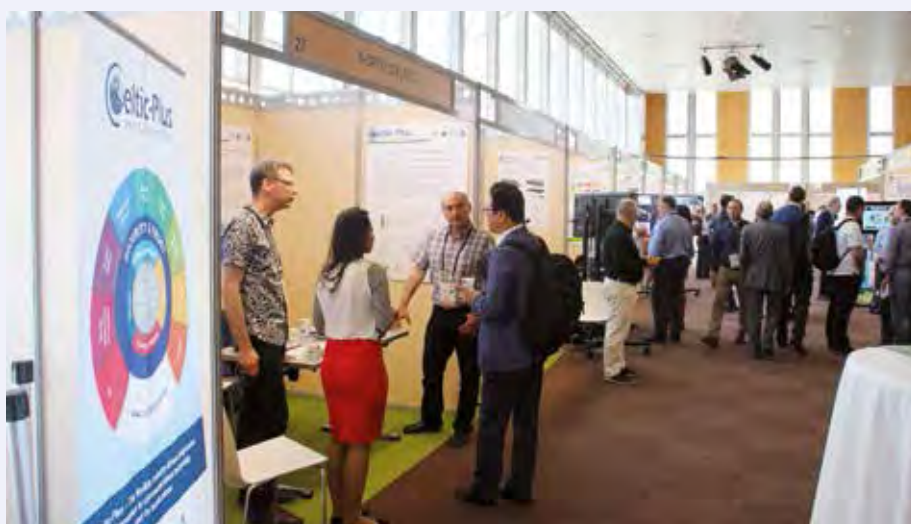
14 Celtic-Plus projects presented their results in the exhibition

Juana Sanchez from Spanish PA CDTI said that the Innoglobal call is eligible for funding, if the Celtic-Plus label is obtained until this year October. At CDTI, projects can also apply to an open call without restrictions. There is also MINE-TAD research funding available. CDTI provides a partner search template, which proposers are asked to use and send back to CDTI to foster their partner search.

Mete Karaca from Turkish PA Tubitak said that Tubitak funds 75 % SMEs and industry with 16 % of eligible costs. There is no dedicated funding for Celtic-Plus in Turkey, but also no budget limitation, which means all good projects can be funded. Submission should be done one month after receiving the Celtic-Plus label. Research areas include IoT and telecoms, and this will stay for the upcoming years. Usually 90 days after national application submission the decision is taken. 40 % of the current Celtic-Plus projects include Turkish participants showing that Turkish organisations have been more successful over the last 2 years. The funding process in Turkey will become easier and quicker this year.

Pitches of project ideas

Inspired by the funding opportunities presented in the panel, the Celtic-Plus Event later on the second day featured 24 short elevator pitches of innovative project ideas for the next call of Celtic-Plus.

14 Celtic-Plus projects in the exhibition

The Celtic-Pus Event was complemented, as usual, with an exhibition of projects. The exhibition included 14 Celtic-Plus projects that presented their results, which attracted many participants who engaged in intensive discussions and networking. The project booths showed real prototypes that were either hardware or software implementations.

- Further information on the Celtic-Plus Event 2017, including the presentation and pitch slides is available at https://www.celticplus. eu/event/celtic-plus-event-in-barcelona/

Five Winners at Celtic-Plus Awards 2017 in Barcelona

Photo: © 2017 @CDTIoficial

Winners of the Celtic-Plus Awards 2017 and officials from Finland, France, Germany, Spain and Celtic-Plus

At the Celtic-Plus Event in Barcelona on 18 May 2017, five projects were awarded for their outstanding work. Three projects received the Celtic-Plus Excellence Award and two projects the Celtic-Plus Innovation Award.

The awards were presented to the winners by Celtic-Plus chairman Jacques Magen and by representatives of the public authorities of coordinating countries – Finland: Hannu Nurmi (Tekes), France: Serge Bodjrenou (DGE), Germany: Andrea Hesse (DLR) and Spain: Juana Sanchez (CDTI). The Celtic-Plus Event was part of the EUREKA Innovation Week that was organized by the Spanish EUREKA chairmanship.

Celtic-Plus Innovation Award
CoMoSeF – Co-operative Mobility Services of the Future

CoMoSeF provided safer driving via new traffic information solutions. COMOSEF's solutions are able to disseminate traffic-related information between cars, the road infrastructure, transport agencies and others to warn drivers of upcoming hazards and keeping the traffic flow smoother.

The driver is now able, for example in foggy weather, to have a clear view of the street and get warned of pedestrians crossing the road ahead via his mobile device.
Project leader: Mobisoft Oy, Finland
Duration: July 2012 – June 2015
Website: http://www.comosef.eu/

Celtic-Plus Innovation Award
SASER – Safe and Secure European Routing

SASER, which stands for "Safe and Secure European Routing", achieved a plethora of results that have contributed to making communications networks in Europe faster, more cost-effective, safer and more secure.

SASER set the basis for secure communication, as it is required for future industry 4.0 needs, while keeping excellent market results for cybersecurity needs.

Many of the latest developments regarding Smart Cities, digital mobility services, etc. would not have been possible without cyber security.
Project leader: Alcatel-Lucent Deutschland AG (now Nokia), Germany
Duration: August 2012 – December 2015
Website: http://projects.celticplus.eu/saser/

Excellence Award for Network Technologies:
SIGMONA – SDN Concept in Generalized Mobile Network Architectures

SIGMONA's software-defined networking and network function virtualization architecture lowers the initial network investment, energy consumption, and network management costs for mobile operators. SIGMONA's solution provides network managers the flexibility to configure, manage, secure, and optimize network resources to adapt to changing business needs.

SIGMONA was on the forefront of emerging 5G technology providing operators the facility to adapt 5G technology by themselves without the need to wait for features embedded in vendors' proprietary and closed software environments.
Project leader: Nokia Oy, Finland
Duration: June 2013 – April 2016
Website: https://www.celticplus.eu/project-sigmona/

Excellence Award for Services and Applications:
NOTTS – Next Generation Over-The-Top Multimedia Services

NOTTs developed a scalable and robust video-over-the-top streaming solution able to deliver adapted contents to heterogeneous devices and networks.

One highlight of this project was the fine-granular analysis of the Quality of Experience in different European countries to achieve high customer's satisfaction.
Project leader: INDRA Sistemas, Spain
Duration: May 2013 – March 2016
Website: http://projects.celticplus.eu/notts/

Excellence Award for Multimedia:
H2B2VS – HEVC Hybrid Broadcast Broadband Video Services

The project combined the broadcast network with the broadband market by providing enabling technology. One highlight is the standardization of the TEMI protocol enabling the synchronization mechanisms for hybrid networks.
Project leader: Thomson Video Networks, France
Duration: January 2013 – November 2015
Website: http://h2b2vs.epfl.ch/

Focus on Mobility and Industry 4.0 at Celtic-Plus Proposers Day in Berlin

On 21 February 2017, Celtic-Plus organised a Proposers Day in Berlin, together with Deutsche Telekom, who hosted the event. Celtic-Plus Chairman Jacques Magen and Riccardo Pascotto from Deutsche Telekom welcomed 75 participants from 14 European countries on the 20th floor of the Telekom Innovation Laboratories tower. The Proposers Day provided information on funding opportunities and project topics. This time the focus of the presentations was on mobility and Industry 4.0.

Mobility

The first session was dedicated to automotive telecoms. Luc Jansseune from EATA, the European Automotive Telecom Alliance for Connected and Automated Driving, presented first-hand information on the newly established Alliance, which brings together major telecoms operators and telecoms system suppliers as well as major car manufacturers and suppliers. He provided a timeline towards the full-scale launch of semi-autonomous driving. In contrast to fully autonomous driving, the driver must still be able to take over control of the car. According to Mr. Jansseune, we can expect semi-autonomous cars driving through the Brandenburg gate in the early 2020s.

Mobility needs powering – that was the key topic of Heiko Lehmann from Deutsche Telekom. In ICT-managed powering, mobility, energy and ICT systems are combined. According to Mr Lehmann, load levelling using the batteries of thousands of electric cars is not the conclusive way forward. Multiple control criteria need to be taken into account, and ICT is needed to manage the flow of electrical energy in the power grid for future mobility needs. Decentralised power generation, micro-grid controllers managing the power flows, and 5G will transform ICT networks to adapt to new business processes, said Mr Lehmann.

Industry 4.0

The second key topic session about Industry 4.0 was presented by Marlene Gerneth from Deutsche Telekom. She focused her keynote presentation on digitalization of production and the digitalization of products. Today industry automation and ICT are still two different worlds. She explained how the complementary areas of highly resilient but isolated local networks of factories will merge with global Cloud-based networks. A key for this will be the convergence of the related standards. Deutsche Telekom focuses not only

The skyline of Berlin, seen from the Telekom Innovation Laboratories tower.

on customer applications but also on smart logistics, smart energy using several horizontal services, and different connectivity solutions and devices.

Project funding and ideas

Dimitar Kroushkov from VDI/VDE informed the audience about the funding conditions of the German ministry of education and research (BMBF), and Matthias Kuom from DLR explained the funding conditions of the German ministry of economics (BMWi). Both underlined that it is important to contact the German authorities as early as possible in the submission process of a new Celtic-Plus project.

Another core element of the Proposers Day was the pitching of projects. 14 proposers presented their ideas on a wide range of ICT topics. They included 5G-related technologies, automotive telecoms, smart agriculture, security, and gamification for learning. The presentations were followed by productive discussions with the audience. Some of these discussions could lead to interesting new Celtic-Plus project proposals.

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

Speakers at the Celtic-Plus Proposers Day (from left): Jacques Magen, Celtic-Plus chairman; Riccardo Pascotto, Deutsche Telekom; Dimitar Kroushkov, VDI/VDE; Marlene Gerneth, Deutsche Telekom; Luc Jansseune, EATA; Matthias Kuom, DLR, and Heiko Lehmann, Deutsche Telekom.

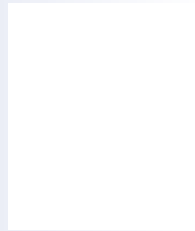Numerous audience at the Celtic-Plus Proposers Day in Berlin

Combining SDN and NFV for unique network solutions

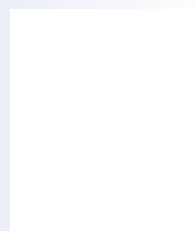## How startup Cumucore emerged from Celtic-Plus project SIGMONA

José Costa-Requena   Vicent Ferrer

Jesus Llorente   Oscar Santolalla

[Jose.costa-requena, jesus.llorente, Vicent.ferrer, oscar.santolalla]@cumucore.com Cumucore

Cumucore is a good example of a successful spin-off from an R&D project. The core idea of our start-up based in Espoo, Finland, is to combine SDN and NFV to boost operators' businesses. It all started with Celtic-Plus project SIGMONA.

In October 2012 a team of researchers at Aalto University, Finland, were successfully completing Celtic-Plus project MEVICO (Mobile Networks Evolution for Individual Communications Experience). Nokia, one of the main research partners in MEVICO, expressed their interest in doing further research in this area. This triggered the SIGMONA project (SDN Concept in Generalized Mobile Network Architectures), in which major mobile technologies power houses (Aalto University, Nokia, Ericsson, Coriant, EXFO, etc.) joined forces to create a common testbed, which was used as first proof of concept of SDN mobile backhaul in ETSI standardisation with the collaboration of an external mobile operator (Telecom Italia).The aim of this new project was to look towards 5G by testing two hot technologies: Network Function Virtualization (NFV) and Software Defined Networking (SDN).
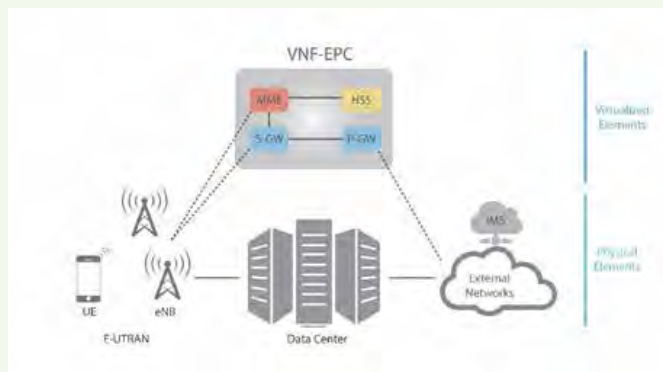
Novel mobile network architecture based on NFV and SDN technologies

Novel network ideas

The logical next target for the Aalto team in SIGMONA was to develop the proof of concept for a virtualized Evolved Packet Core (vEPC) using NFV. In addition to that, José Costa-Requena proposed to integrate SDN in the access network (mobile backhaul) and remove GTP (GPRS Tunneling Protocol). The main goal of this second concept was to provide more fine-grained quality of service (QoS) to operators.

Validation of ideas

In March 2015, José Costa-Requena and his team successfully presented their proof of concept at the Aalto University premises. The main results were:
- Aalto researchers designed and implemented a cloud-based vEPC with the help of Nokia and other industry partners. This vEPC allowed the deployment of a LTE network with the key network elements in just 3 minutes.
- SDN mobile backhaul implemented with OpenFlow switches that allowed enforcing of fine-grained QoS, per tenant or user.

Aalto's SIGMONA team at a Celtic-Plus event

An innovative mobile network architecture based on NFV and SDN technologies as designed and deployed by our team is shown in the figure.

Standards contribution to ETSI

One of the best outcomes of the project was the contribution to ETSI. The PoC named "virtual EPC with SDN Function in Mobile Backhaul Networks" was submitted to the ETSI Industry Specification Group for Network Functions Virtualization (ETSI ISG NFV) in 2015.

A start-up is born

Once the Aalto team technically validated the concept, the team members realized that nobody in the market was offering such a solution. The opportunity was tremendous given the added value to operators, and it was worth to commercialize the concept. In January 2015 the team decided to establish the start-up as a limited liability company in Finland under the name Cumucore to bring the best of cloud-based software to empower core networks. The SIGMONA project helped through enabling research to become a tangible commercial solution including the concrete development of components.

Today Cumucore is gaining traction as a trusted partner for mobile operators in Europe and Africa. We are very proud of being part of the Cumucore team, currently seven people, and of helping the company to expand its business globally. The opportunities are out there for us to capture them all.

- Further information
- CUMUCORE website – www.cumucore.com
- SIGMONA website –www.celticplus.eu/project-sigmona/

Artificial intelligence in mobile network operations

How Celtic project GANDALF enabled the 2operate start-up

Lars Moltsen
2operate
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In 2003, after four years at Nokia, I wanted to start my own company. Celtic project GANDALF became the enabler for the successful launch of my start-up 2operate in 2009.

My career as an entrepreneur started in 2003, when I launched my first one-man consultancy company. In the beginning, I primarily utilized my own technical skills in telecommunications and software development, working on short-term contracts for local companies in Aalborg, Denmark, including my former employer, Nokia, as well as Texas Instruments.

Joining GANDALF against all odds

The GANDALF project consortium was gathering in 2004. I learned about it through friends at Malaga University, with whom I had worked at Nokia. The project proposed to investigate aspects of multi-technology network operations, including better quality-of-service monitoring. This was very close to the work in which I had been involved at Nokia, and I was very interested in joining the project.

Unfortunately, the financial conditions were not good, as national Danish funding was not an option for EUREKA projects. In spite of that, I wanted to get started developing a real product, and GANDALF was the perfect environment for testing prototypes. Thus, I decided to reduce my contractor activities and allocate two days per week for R&D work in GANDALF.

The project was approved by Celtic, and the other partners – Orange Labs, Telefonica I+D, Ericsson Ireland, Malaga University, and University of Limerick – had their funding secured. The formal kick-off meeting took place in April 2005.

Artificial intelligence

One of the elements which I brought to the project was an artificial intelligence methodology used for network element diagnostics. At Nokia, I had been working on new ways to automate operational processes at network operators together with researchers at Malaga University. One idea was to apply algorithms originally used for automated medical diagnostics for speed-diagnosing network elements with performance degradations. Alarms and performance data from the network elements would serve as "symptoms" and a range of known faults were "diseases".

The concept was developed during the GANDALF project, and a prototype solution was tested on data from an advanced simulator at Orange Labs and live data from Telefonica. Results were promising, and shortly after the end of the project in early 2007, I sold my company, which now had three employees, to the Danish telecoms-software company Wirtek.

Celtic-Plus award and financial crisis

In 2008, the GANDALF project received the Celtic-Plus Excellence Award for great project results and its impact on the telecommunications industry. Wirtek had allocated a strong team of developers and sales staff to commercialise the auto-diagnostics solution. Unfortunately, Wirtek almost went bankrupt in 2008 as a direct result of the financial crisis. Three main business activities of the company died in less than 6 months, and the team around the auto-diagnostics project were made redundant.

Two former colleagues and myself secured the rights to the activity, raised 300,000 euro of start-up financing through an incubator investor, and launched a new company called 2operate in early 2009.

Expansion beyond Europe

Today, 2operate has 10 employees and a growing customer base of 8 network operators, and it has been profitable since 2015. 2operate made its first sale outside Europe to the Bangladeshi satellite operator BTRC in 2016 and in early 2017, 2operate made its first sale in the Americas to a small mobile network operator, TelCell, operating in Sint Maarten in the Caribbean.

When asking customers, the main benefit of the auto-diagnostics solution, now branded as 2solve, is increased network visibility and understanding. Traditional network management tools only present raw data (alarms and KPIs), which can only be interpreted by engineers. 2solve presents conclusions such as "interference", "transmission problem", and "antenna fault", which can be understood by non-technicians in customer support and management. This speeds up incident management processes significantly, and engineers can focus more on new technology (see figure).

2operate's growth is still mainly generated from the auto-diagnostics solution based on the GANDALF project. However, the company has recently also started to develop new products, which will reach the market in 2017 and 2018.

- ◾ Further information:
- • 2operate website –www.2operate.com
- • GANDALF website –www.celticplus.eu/project-gandalf/
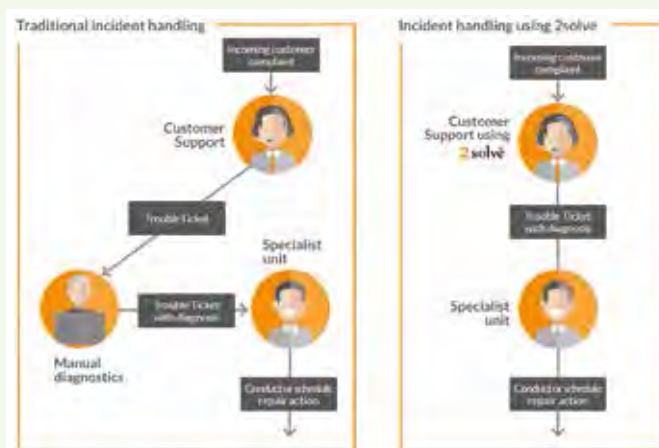
2operate concept for better incident handling

First live retransmission of awake brain surgery
Performed by Celtic-Plus project E3

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On 26 May 2017, Celtic-Plus project E3 enabled the first live retransmission of an awake brain surgery. The transmission from Nancy, France, was done in collaboration with the Nancy University Hospital, the Faculty of Medicine of Nancy, the TELECOM Nancy engineering school, the CRAN laboratory in Nancy, and medVC from Poland.

Surgeons use awake brain surgery to teach students to decide, which parts of a brain tumour can be removed at an operation. Up to now, this has never been done via live transmission, which limited the number of students who could watch it to those present at the operation theatre. The transmission by E3 has changed this. In the future, live retransmission of an awake brain surgery could be watched by thousands of medical students around the world.

Professor Jean Marie Moureaux, Assistant Director of TELECOM Nancy engineering school and researcher at CRAN laboratory in Nancy, France, explained that neurosurgeons perform awake brain surgery for tumours that have spread throughout the brain. Awake brain surgery is based on real-time brain stimulations and can shrink these tumours, allowing neurosurgeons to remove most of the brain tumour while preserving a high-level quality of life of the patients.

Dr Fabien Rech, neuro-surgeon at Nancy University Hospital, said that the only way to really understand brain anatomy and function is to see it live. Awake surgery provides a unique access for students to see how the brain is working. However, nowadays it is not possible to give physical access to the operating room to every medical student. Thanks to the E3 videoconferencing solution, awake surgery can now be diffused to large group of students via multisite, live transmission.

This solution allows live interactions between students and surgeon throughout the surgery thanks to high-definition video streaming, which leads to a new way to teach anatomy, and especially functional anatomy. This connected living anatomy gets closer to the new generation of medical students helping them to better understand a very connected organ.

The awake surgery retransmission scenario is based on the medVC telemedicine platform as well as video coding and video quality assessment developed in E3. It relies on the transmission of 6 simultaneous HD and Full HD encoded video streams over the IP network, in this case to three different locations: an auditorium of TELECOM Nancy engineering school, a surgery room, and an auditorium of Nancy University Hospital.

E3 is a multinational cross-domain project including 12 partners from 5 countries (Spain, Finland, France, Poland, Turkey) who represent both the ICT and the health sector, who collaborate in all project stages from definition to validation. The E3 project aims to facilitate the deployment of e-health solutions everywhere and for everybody by including the medical actors from definition to validation, thus preparing the ground for future go-to-market activities.

- Further information about the E3 project is available at https://www.celticplus.eu/project-e3/

The awake brain surgery was transmitted live to three locations.

NOTTS

Next generation over-the-top multimedia services

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Celtic-Plus project NOTTS (Next generation Over-The-Top multimedia Services) has been a product-oriented R&D project that gathers the main stakeholders on OTT (over-the-top) technologies in order to establishing an ecosystem for assuring OTT content delivery.

20 companies and institutions from Spain, France, Sweden, Poland, Finland and Portugal collaborated in NOTTS from 2013 to 2016 under the coordination of Spanish IT company Indra.

The project developed a scalable and sustainable integrated solution to guarantee OTT content delivery from the customer's perspective for the whole content distribution chain, which includes:

- New media distribution architectures, including peer-assisted solutions and local caching, were analysed, using real traffic data from our partners, and a context-aware and media-aware delivery platform was developed.
- Novel cross-disciplinary approaches to optimize the distribution of OTT contents were explored.
- User demand patterns have been analysed, and the impacts of new consumption patterns have been investigated in terms of OTT traffic analysis.
- Methods for QoE estimation and Quality Assurance monitoring tools for CDN/OTT were developed.
- Models where traditional network operators get their share of the raising OTT business have been investigated.

The figure shows the overview of the ecosystem developed in the NOTTS project.

Business impact

NOTTS has provided technological solutions that involve a new business line for all stakeholders so that as a result of this project a NOTTS prototype has been provided. This way, NOTTS supplies the European OTT service providers with opportunities to take revenue from the improved business. The project has also investigated business models in which traditional network operators can be part of the OTT business. NOTTS contributes to this objective with a combination of technical network solutions and business development.

In addition, the advanced methods for content distribution and technology for monitoring and controlling QoE of OTT services developed by NOTTS have a direct impact on the end users. Given that the contents and services they demand will be offered with a better quality, it directly impacts on customers' satisfaction.

The main objectives have been achieved: a scalable and robust video streaming solution able to deliver adapted contents to heterogeneous devices, and networks that include quality assurance technology to improve customer satisfaction of OTT contents.
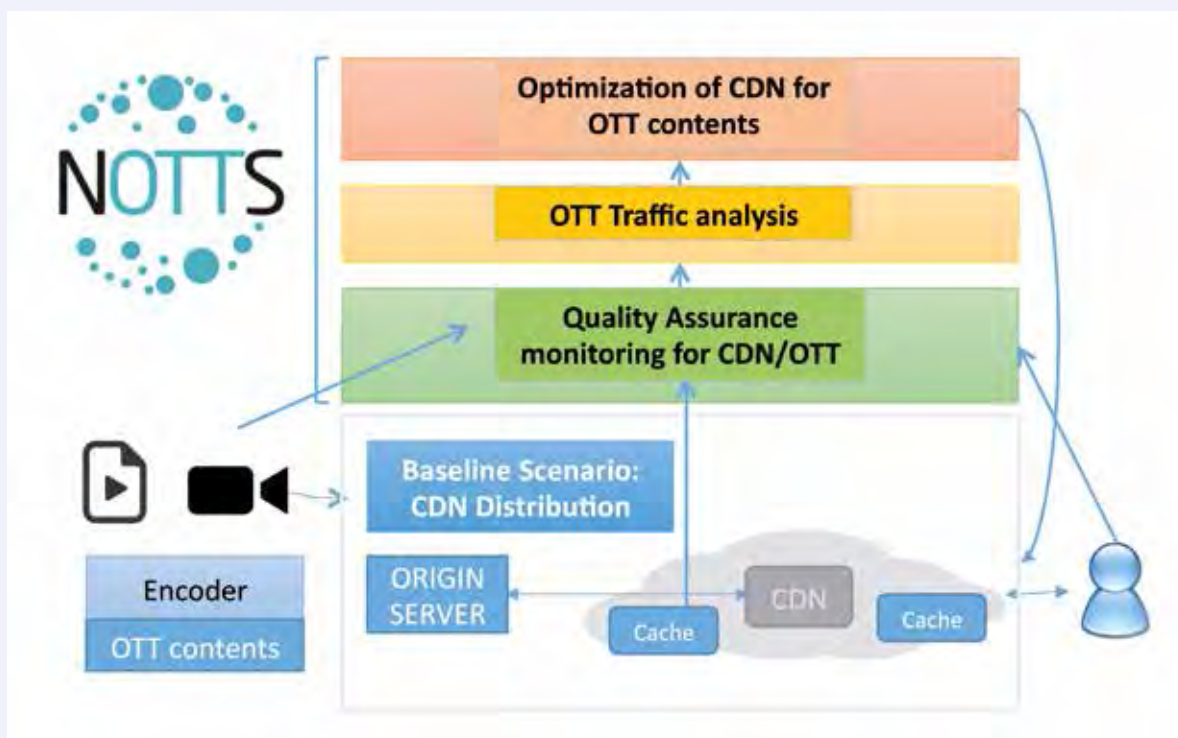
NOTTS ecosystem

The project has developed methods to monitor and analyse detailed content demand patterns of over-the-top media services. Results have been produced in academic submissions and project deliverables. 27 products from four product lines have been impacted by the project. In addition, all partners reported that NOTTS has significantly improved their business position in comparison with their direct competitors.

Business and dissemination outcomes

NOTTS generated 7 contributions to standardization bodies (ISO MPEG/DASH Ad-hoc group, DASH Industry forum, VQEG and TM Forum), 77 scientific publications in leading international journals and magazines (15), conference publications (46) and book chapters (16). In addition, 17 PhD & MSc theses have been realized and the project participated in 10 dissemination events (Celtic Event, Conference Organizations, NEM, FN&MS and IWQM).

Finally, we had very good feedback from customers, partners and end users during the exhibitions and booths carried out, such as the Celtic Events, and the commercial presentations we made for main European telecommunication operators. Besides, NOTTS has demonstrated a high level of innovation and business relevance by winning the Celtic-Plus Excellence Award 2017.

Outlook

The successful joint business impact achieved by the consortium has led to new research projects, such as the EIT Digital project NFMD (Networks for Future Media Distribution), where NOTTS partners have consolidated their activities in this research line. In addition, the collaboration between the partners is continuing in a new research line under the Celtic-Plus project MONA-LIS, where most NOTTS partners will develop new activities.

You can find more information on NOTTS at https://www.celticplus.eu/project-notts/

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.
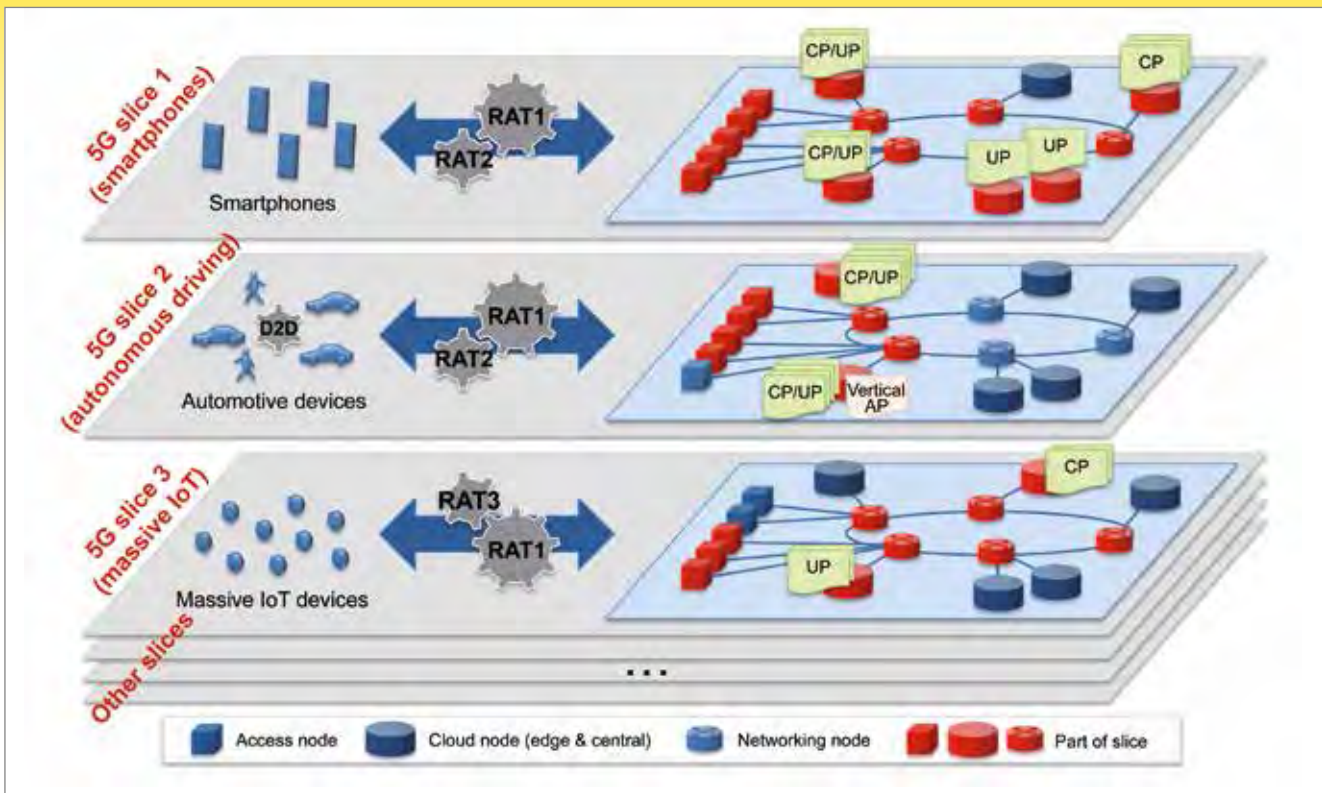
www.celticplus.eu

Figure 2: 5G network slices implemented on the same infrastructure

This covers both, the "classic" network management functions of Fault, Configuration, Accounting, Performance, and Security management (FCAPS) and 5G-specific aspects, such as management of network slices and management of virtualization.

The NWMO White Paper assumes a multi-domain network infrastructure. Such an infrastructure can be composed of 5G RAT(s), 4G RAT, maybe 2G / 3G RAT, Fixed Access, non-3GPP RATs, backhaul technologies, EPC core, or a 5G core. It can contain virtualized and non-virtualized network functions. In order to manage such a network, the network domains expose their capabilities via certain APIs.

The industry considers a 5G network and service management system to include also editors for various items and definitions, including high-level network objectives, policy generators , ETSI MANO components, SDN controllers, legacy OSS (NMS/ EMS), and end-to-end service orchestration functions.

Example 1: management and orchestration of network slices

One example of the capabilities supported by the architecture is the creation of a network slice as outlined below:

Following the request to create a new network slice satisfying specific service requirements, the end-to-end service orchestration translates these requirements into the configuration of required resources, virtualized and non-virtualized. The

configuration of resources may be for the actual amount of resources or the policy of their allocation at a later time, when the service is activated.

The end-to-end service orchestration further triggers the components of the network and service management including orchestration system to apply the configuration of the required resources, which in some scenarios result in their actual allocation. In other scenarios, the resources are actually allocated at the time of service activation, according to the configuration and policies.

Example 2: end-to-end service management

Another example is end-to-end service management when the network service spans multiple network domains. This requires deployment of an end-to-end service management function to manage the whole chain of involved network functions. Such a scheme can be applied in various scenarios, such as converged networks (fixed and mobile), RAN and core, virtualized and non-virtualized networks, cloud based services/applications and infrastructure, multiple administrative domains.

Requirements

The NWMO White Paper sets the following functional requirements: self-configuration and monitoring of services by users such as MVNOs, self-

optimization artificial intelligence methods, a model driven and modular approach, which will provide for efficient management of complex networks with easy extensibility and reduction of functionalities on demand.

The functional requirements also include integration of service design and execution framework E2E service management in network slices with real-time service assurance, scalability, optimization and self-healing of end-to-end services that target certain QoE properties of the service (KQIs).

Other requirements include:
- Standardized or at least open network management protocols and interfaces.
- Support for the scalability of network and service functions, and for their management including orchestration.
- Automated testing capabilities for the QoE
- Support for big data, proactive monitoring and simulation capabilities regarding network(s) and End-to-end services.
- Support for network and service modelling.
- Easy installation, modification and termination of services, also by customers
- Orchestration functionalities to ensure reliability of End-to-end services in terms of QoS and QoE.

Network and service optimization

5G Network and Service Management including network orchestration must support the automated optimization of multi-domain network infrastructure across various technologies.

For automated optimization, the multi-domain network infrastructure should expose its capabilities to the network management system via open and standard interfaces. The network infrastructure should be equipped with Management and Orchestration Functions as appropriate, including ETSI MANO components in case when some network nodes are virtualized, SDN Controllers, legacy OSS (Network Management / Element Management) functions, and end-to-end service orchestration.

On the base of the functionalities provided by the network infrastructure, the 5G network and service management system 5G needs to support optimization for the following optimization goals:

- utilization of the network infrastructure, virtualized and non-virtualized as determined by certain KPIs
- user experience as determined by appropriate metrics of user experience, where needed, per slice
- business service and application performance (as determined by certain metrics and KPIs), where needed, per slice

A 5G network infrastructure and management system should support Data Collectors at the network nodes to collect network and service data, (for example performance data,) which can be delivered to the entities subscribed to the data such as analytics software and optimization applications.

In addition, management systems should include analytics software for processing of the network performance data, such as statistics computation and pattern recognition.

In order to make full use of the network and service data collected by Data Collectors, the network should include optimization applications that receive and analyse the network performance data and provide (re)configuration of the network nodes and/or network policies to achieve the optimization targets defined by the operator. The optimization targets (metrics) may be set as required by the network operator down to a per slice level where and when needed.

To achieve the optimization goals, the optimization applications should be able to execute (re) configuration of the network nodes and/or policies via network APIs and management and orchestration functions.

At the same time, each domain can receive policy/control instructions from a higher domain or a multi-domain orchestrator. This implies that each domain can provide capability such as data and insights to policy or orchestrator.

Slice management principles

For slice management support, the multi-domain network infrastructure shall expose its capabilities via standardized and open, interfaces.
NGMN foresees that in case the interfaces are not exposed in certain network domains, slicing management in such domains may not be possible. This would affect the differentiation between network slices, which in some cases may result in the degradation of the QoE of certain services.

For slice management support, the multi-domain network infrastructure should be equipped with Management and Orchestration functions as appropriate. This can be realized for example through

- ETSI MANO components (NFVO, VNF Manager, VIM) in case when some network nodes are virtualized,
- SDN Controllers

- Legacy OSS (network management/ Element Management functions)
- End-to-end Service orchestration

The management and orchestration functions may be domain specific.

For slice management support, the network infrastructure and service management should support Data Collectors at the network nodes to collect the network and service data (e.g. service performance metrics) restricted to specific network slice. Such performance data can be delivered to the entities subscribed to the data such as analytics software and optimization applications.

Conclusion

It is still a long way to go before fully functional 5G networks will be commercially deployed. However, in order to ensure successful 5G deployment, it is essential to have an effective and efficient network management system. Network operators as well as end customers rely on the standardization organisations and equipment vendors to provide them with outstanding equipment, software and standards to make 5G a reality by 2020.

References

[1] 5G White Paper By NGMN Alliance. Version 1.0, 17-February-2015
[2] 5G Network and Service Management including Orchestration by NGMN Alliance, Version 2.12.7, 07-March-2017

Further information about the NGMN Alliance is available at http://www.ngmn.org

Crossover collaboration on 5G
Global 5G Event in Tokyo

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The third Global 5G Event attracted 270 participants from five continents, who met in Tokyo, Japan, on 24 – 26 May 2017. Their purpose was to cooperate on building global consensus on 5G among the world's 5G promotion organizations. The theme of the event was "Creating the Crossover Collaboration for 5G Eco-Society".

The event consisted of a two-day workshop at the Hilton Tokyo Odaiba hotel (24-25 May) and an exhibition at Tokyo Big Sight Inc. as part of WTP 2017, the Wireless Technology Park.

The Host: 5GMF

The Global 5G Event was organised by the Fifth Generation Mobile Communications Promotion Forum (5GMF), the leading organisation promoting the vision of 5G in Japan.

The 5G promotion organisations from the other parts of the world contributed to the event: the 5G Forum from Korea, 5G Americas, the IMT-2020 (5G) Promotion Group from China, and the 5G Industry Association from Europe. The event was already the third in a series of events, which started in 2016 with the 1st Global 5G Event in Beijing, China, and the 2nd event in Rome, Italy.

The 5GMF (http://5gmf.jp/en/) was founded in 2014 and has been conducting a variety of activities related to fifth-generation mobile communications systems. Activity areas of the 5GMF include 5G standardization, along with liaison and coordination with related organizations, and dissemination of results. The 5GMF activities aim to contribute to the sound development of the 5G eco-society towards the realisation of 5G by 2020.

Vision of "crossover collaboration"

In his keynote speech, Prof. Emeritus Susumu Yoshida from Kyoto University, the Chairman of 5GMF, explained the 5GMF vision of a "crossover collaboration", which he defined as a barrier-less cooperation between various industries on the 5G platform that has enhanced capabilities. Prof. Yo-

Keynote by Prof. Emeritus Susumu Yoshida, Chairman of 5GMF (photo courtesy of Prof. Giovanni Emanuele Corazza, Euro-5G project)

shida is convinced "that this is a key to maximize the true value of 5G".

Beyond high-level statements, the event in Tokyo presented also practical steps towards realising 5G in the 2020 timeframe. At the event, Japan's 5G field trial project, which started in May 2017, was presented. In addition, the participants discussed the latest global topics related to 5G spectrum harmonization, collaboration with verticals, and more.

European perspective

The European 5G delegation consisted of Pearse O'Donohue, Acting Director for Future Networks at the EC's DG CONNECT, Bernard Barani, Acting Head of Unit Future Connectivity Systems at the EC's DG CONNECT, Dr. Colin Willcock, Chairman of the Board of the 5G Infrastructure Association, Jean-Pierre Bienaimé, Secretary General of the 5G Industry Association, Dr. Didier Bourse, Senior Director for European R&I Programs at Nokia, and Prof. Giovanni Emanuele Corazza from University of Bologna, Member of the Board of the 5G Infrastructure Association.

Dr. Willcock, chairman of the 5G Industry association, summarised his experiences as first-time participant at a global 5G event by saying: "It was an excellent event to understand the overall global 5G status and future plans. In addition, it provided a unique opportunity to get to know the key 5G stakeholders from around the world. The key words that stood out, according to Dr. Willcock, were "Vertical Markets" and "Trials". In his view, the automotive sector appears to be the most advanced amongst the verticals in terms of 5G trials.

Prof. Corazza stated that the 3rd Global 5G Event has clearly shown the worldwide momentum in the development of the future 5G eco-

system. He sees the current emphasis on four areas: standardisation actions in 3GPP, spectrum harmonisation at regional and global level, trials with international cooperation, and integration with vertical industries. He said: "Europe has confirmed its positive ability for coordinated action and is going to display a wide set of 5G tech-

Workshop session on new trends of industrial interest towards 5G (from left): Prof. DongKu Kim, Chair of Executive Committee, 5G Forum; Ms. Zhiqin Wang, Vice Chair of IMT-2020 (5G) Promotion Group; Mr. Chris Pearson, President of 5G Americas; Mr. Jean-Pierre Bienaimé, 5G-IA Secretary General; Prof. Hiroyuki Morikawa (Moderator), University of Tokyo, Chairman of Strategy & Planning Committee in 5GMF (photo courtesy of Prof. Giovanni Emanuele Corazza, Euro-5G project)

nology demonstrations in a large number of cities, although other regions might achieve slightly faster roll-out for specific features." Notwithstanding this race for early demonstrations, Prof. Corazza argues that 5G research shall continue for several years, as these systems require continuous evolution to reach full maturity. In his opinion, operators are in general favourable to a gradual approach leading to the full exploitation of both 4G and 5G opportunities.

Outlook

The Global 5G Event continued the thread of discussion between the main players shaping the global five 5G networks of tomorrow. In the run-up towards the goal of implementing 5G networks in the 2020 timeframe, there is still global coordination work to do. This work will be discussed at the next, the 4th Global 5G Event, which will be held in Seoul, Korea, on 22-24 November 2017, hosted by the 5G Forum (https://www.5gforum.org).

➹ **Further information** about the Global 5G Event in Tokyo is available on the 5GMF website at http://5gmf.jp/en/news/20170405105240/

Event website of the 4th Global 5G Event in Seoul: https://www.4th-g5ge.org/

Smart city innovations at CeBIT
reTHINK project results at T-Labs booth

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One of the focal points at CeBIT 2017 was smart cities. Horizon 2020 project reTHINK presented its solution in the context of smart city applications to the over 200,000 visitors who came to Hannover, Germany, from 20 to 24 March 2017.

Cooperation with German lighthouse smart cities

reThink cooperated with the three German lighthouse smart cities Cologne, Hamburg, and Munich at a joint CeBIT booth, which was organised by reTHINK partner Telekom Innovation Laboratories. These three smart cities are also part of the EU's Horizon 2020 programme via their respective projects: Grow Smarter (Cologne), mySMART-Life (Hamburg), and Smarter Together (Munich).

The stand was visited by a large number of very interested guests from all over the world. Next to German and European visitors at large, visitors came from China, Japan, Brazil, South Africa, Russia and other countries. Often visitors engaged detailed technical discussions about the reTHINK solution, an excellent sign that the results are offering indeed innovative solutions to interoperability and privacy preservation. These properties were the most prominent in the context of smart city solutions.

d!conomy tour

Being among the over 3,000 exhibitors from 70 countries was already special for the project. It

Many interested visitors at the reTHINK/ Smart Cities stand
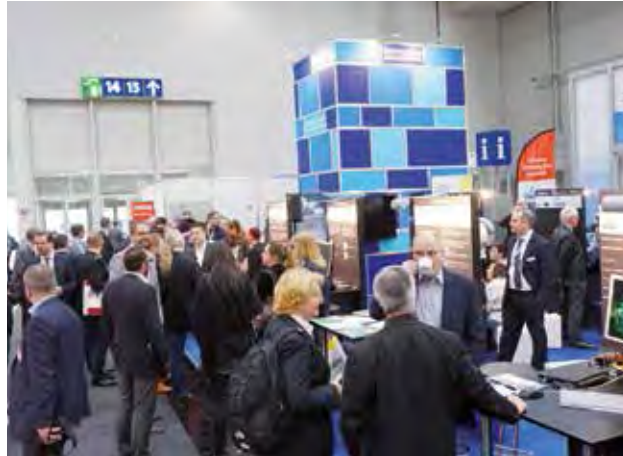
Interested crowd in the smart city area at CeBIT 2017

was even more special that reTHINK was part of the d!conomy tour, which presented 27 top innovations to visitors participating in the guided tour. The artificial term stands for digital economy. The tour was dedicated to this year's CeBIT theme: ''d!conomy – no limits''. The selected top innovations gave visitors a glimpse of the almost unlimited opportunities for improving our lives in the digital societies and Smart Cities of tomorrow.

ReTHINK solution for smart cities

The reTHINK solution presented at CeBIT is highly relevant for smart cities. It combines new concepts with existing technologies and introduces interoperability by design as well as decentralised service delivery. From a user perspective, one of the most import aspects of the reTHINK solution is that it gives users back control over their data, empowering them to protect their privacy.

To this purpose, reTHINK transforms standard telecommunication enabler technologies, such as privacy assertion, identity, Quality of Service, and brokerage. The reTHINK solution utilises hybrid service concepts for communication between humans and objects, and allows decoupling identity and service. Thus, reTHINK enables users to retain data sovereignty in a smart-city environment where billions of objects are connected and communicate data directly or indirectly related to user behaviour.

reTHINK partner T-Labs and EU project Smarter Together have jointly worked on a smart-city application in Munich. The app shown at CeBIT demonstrated how the reTHINK framework can be effectively used for applications in a smart-city environment.

Smart City München app
demonstrated at CeBIT

In addition to the booth in the exhibition, the reTHINK solution was also presented at the smart city forum workshop that took place during the CeBIT. Joachim Schonowski from reTHINK partner T-Labs gave a presentation on how smart cities re-invent citizen participation and how to disrupt social network lock-ins.

Full room at the smart city forum workshop

In conclusion, reTHINK managed to demonstrate to a large audience at CeBIT that the reTHINK framework can enable almost unlimited opportunities in a smart-city environment that protects the data privacy of users.

Further information
- CeBIT 2017 after-show report – http://www.cebit.de/en/exhibition/after-show-report/
- reTHINK project website – https://rethink-project.eu
- Presentation slides on disrupting social network lock-ins by Joachim Schonowski – https://bscw.rethink-project.eu/pub/bscw.cgi/d46358/reTHINK-SmarterTogether_CeBIT2017_presentation_18032017.pdf

News in brief

Mariya Gabriel nominated as new Commissioner for the Digital Economy and Society

Mariya Gabriel, designated Commissioner for the Digital Economy and Society (source: Mariya Gabriel, license: Creative Commons Attribution-Share Alike 4.0 International)

On 16 May 2017, European Commission president Jean-Claude-Juncker nominated the Bulgarian Christian Democrat Mariya Gabriel as Commissioner for the Digital Economy and Society. She will be the new Bulgarian Commissioner, replacing former Member of the Commission Kristalina Georgieva, who is the current chief executive officer of the World Bank. In January 2017, German Christian Democrat Günther Oettinger had become Georgieva's successor as Commissioner for Budget and Human Resources. The Digital Economy and Society portfolio had been temporarily assigned to Commission Vice-President Andrus Ansip.
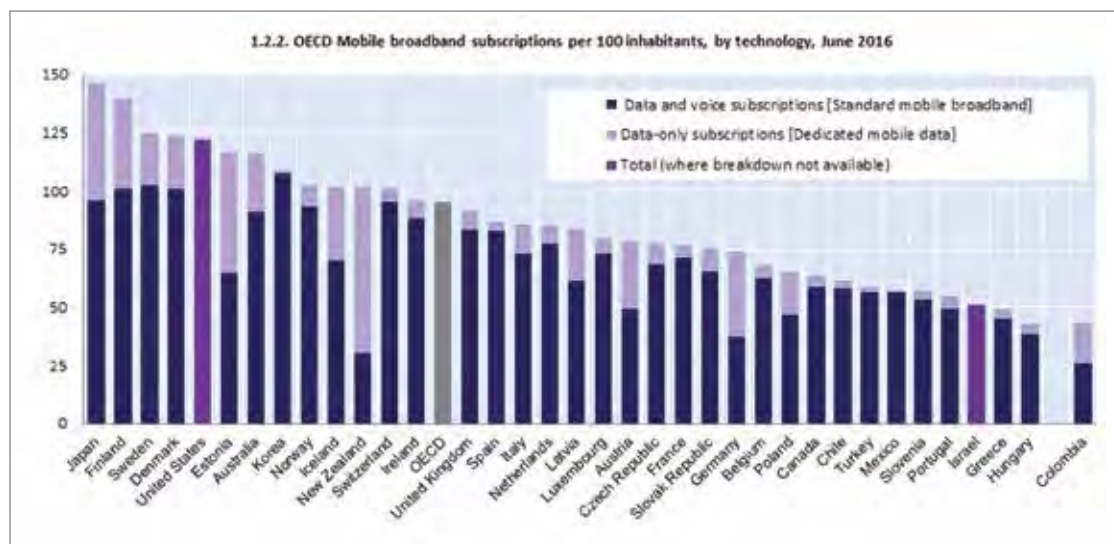
Before joining the Commission, the 38-year old Gabriel has been Member of the European Parliament since 2009. Like her predecessor, Mr Oettinger, she does not have any prior experience in the digital domain. Ms Gabriel has a Master degree in Comparative Politics and International Relations, and a PhD from the Academy for Political Science in Bordeaux, France.

Her tasks as Commissioner for the Digital Economy and Society will include continuing the work on topics related to the Digital Single Market, like the European copyright reform and the creation of a European telecoms market. In this effort, she is expected to work closely with Commission Vice-President Ansip, who leads the Digital Single Market portfolio.

✒ **Further information** at: http://europa.eu/rapid/press-release_IP-17-1328_en.htm

Mobile broadband penetration at 95% in OECD area

1.2.2. OECD Mobile broadband subscriptions per 100 inhabitants, by technology, June 2016

DSL remains the prevalent technology with 44.7% of fixed broadband subscriptions. However, it continues to be gradually replaced by fibre, now accounting for 20.1% of subscriptions, due to a 16% increase in fibre subscriptions since June 2015. Cable (32.2%) covered most of the rest.

Data on machine-to-machine communications, such as for Internet-connected vehicles, show that Sweden, New Zealand, Norway, Finland, and the Netherlands remain the leaders in the number of M2M SIM cards in use, with the caveat that data are not yet fully comparable for all countries. Sweden counts 77 M2M SIM cards per 100 inhabitants – a much higher level than for most other OECD countries that provided data. Overall, M2M and embedded mobile cellular subscriptions grew by almost 20% in the last year in countries where data were available.

High-speed Internet use continues to grow in the 35 OECD countries. Mobile broadband penetration had reached 95 subscriptions per 100 inhabitants in June 2016, up from 86 per 100 in June 2015, according to OECD data.

The addition of 123 million new mobile broadband subscriptions in the OECD area is equivalent to an annual rise of 11.3%. It increased the OECD total to 1.21 billion subscriptions in a population of 1.27 billion people. The increase was driven by continued growth in the use of smartphones and tablets.

Twelve countries – Japan, Finland, Sweden, Denmark, the US, Estonia, Australia, Korea, Norway, Iceland, New Zealand, and Switzerland (in descending order of mobile subscriptions per capita) – now lie above the 100% penetration threshold, up from nine countries in 2015.

Fixed-line broadband subscriptions in the OECD area reached 380 million as of June 2016 (average penetration: 29.8%), up from 363 million in June 2015 (28.6%). Switzerland is on top with a penetration rate of 51 subscriptions per 100, followed by Denmark (43%), the Netherlands (42%), France (41%), and Korea (40%).

✒ **Further information** at: http://www.oecd.org/internet/broadband-statistics-update.htm

Digital society in Europe: progress and remaining gap

The 2017 edition of the Digital Economy and Society Index (DESI) shows that the 28 EU Member States have made progress on a wide range of areas, from connectivity and digital skills to the digitisation of businesses and public services. However, the results published by the European Commission in March also highlight the remaining gap between top digital players and lower-performing countries.

Overall the EU has progressed and improved its digital performance by 3 percentage points compared to the 2016 report. The performance varies across Member States: the digital gap between the most and least digital countries is now 37 percentage points, compared to 36 percentage points in 2014. Denmark, Finland, Sweden and the Netherlands lead the DESI this year, followed by Luxembourg, Belgium, the UK, Ireland, Estonia, and Austria. The top-three EU digital players are also the global leaders, ahead of South Korea, Japan and the United States. Slovakia and Slovenia are the EU countries which have progressed the most. Despite some improvements, several Member States – including Poland, Croatia, Italy, Greece, Bulgaria and Romania – are still lagging behind in their digital development compared to the EU average.

The Digital Economy and Society Index (DESI) shows that connectivity has improved, but is still insufficient to address future needs. 76% of European homes can access high-speed broadband (at least 30 Mbps), and in some Member States a significant proportion of these households can already access networks capable of providing 100 Mbps or more. Over 25% of households have taken up a subscription to fast broadband. Mobile data subscriptions are increasing: from 58 subscribers per 100 people in 2013 to 84 in 2016.

4G mobile services cover 84% of the EU population. However, the EC considers this not enough to address the growing needs for speed, quality and reliability of connections in the future. Europeans are getting more digital: 79% of Europeans go online at least once per week, up by 3 percentage points on 2016. Internet traffic is growing by 20% annually and by more than 40% each year on mobile networks.

The EU has more digital specialists than before, but skills gaps remain: There are more ICT specialists in the workforce – 3.5% in 2015 as opposed to 3.2% in 2012. At the same time, almost half of Europeans (44%) still lack basic digital skills such as using a mailbox, editing tools or installing new devices.

Businesses are becoming more digital, yet e-commerce is growing slowly. European businesses are increasingly adopting digital technologies, such as the use of business software for electronic information sharing (from 26% in 2013 to 36% of businesses in 2015) or sending electronic invoices (from 10% in 2013 to 18% of in 2016). E-commerce by SMEs also grew slightly (from 14% in 2013 to 17% of SMEs in 2016). However, less than half of these companies sell to another EU Member State.

Europeans use more public services online: 34% of internet users submitted forms to their public administration online instead of handing in a paper copy (up from 27% in 2013).

Andrus Ansip, Vice-President for the Digital Single Market, commented the DESI results saying: "Europe is gradually becoming more digital, but many countries need to step up their efforts. All Member States should invest more to fully benefit from the Digital Single Market. We do not want a two-speed digital Europe. We should work together to make the EU a digital world leader."

Further information at: http://europa.eu/rapid/press-release_IP-17-347_en.htm
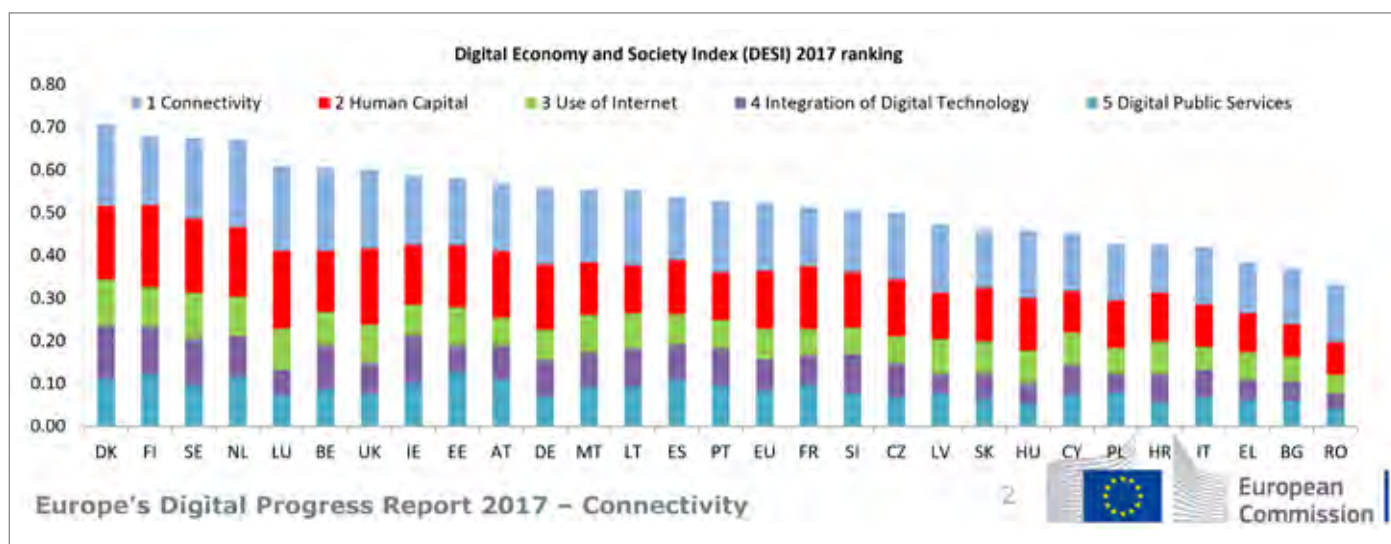
Digital Economy and Society Index 2017

Spy in the brain
Security risks of brain-computer interfaces

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Half a century ago, Canadian singer-songwriter Gordon Lightfoot lyrically mused about what would happen "If you could read my mind". Now we know, and it is not as romantic, as the bearded bard had imagined. Expressions like "picking your brain" and "sharing my thoughts" are changing their meaning from metaphorical to literal.

Visions of connected brains

The movers and shakers of our digital future in the Silicon Valley seem to have decided that reading our social media updates and identifying us on shared photos is only the first step in getting to know us better than we do ourselves. In their ambition to sustain an ad-based business model founded on data-driven user profiles, they want to go a step further and read our minds. That is, of course, not how they sell the idea. Instead they praise the benefits of plugging your brain directly into the network, without cumbersome graphical user interfaces.

Already in 2004, Google cofounder Larry Page told the editor of technology portal Backchannel, Steven Levy, about his vision for the future of search, which included a brain implant for thought-based search: "If you think about a fact, it will just tell you the answer." At the time, Page's vision was mostly discarded as science fiction. However, at the time of this statement, DARPA, the Defense Advanced Research Projects Agency of the U.S. Department of Defense, had already been conducting research on brain-computer interfaces. The first scientific paper describing an experiment in which a monkey controlled a computer cursor with its brain was published in 2002 (Science 2002; 296:1829-1832).

Today, brain-computer interfaces are a reality, currently mainly used for medical purposes. However, the visionaries at DARPA and the Silicon Valley consider this only an initial step.

EEG electrodes attached to model head, SOLA©fotolia.de

Neural lace

In 2016, DARPA put up 60 million dollars for research into an implantable chip that would connect the human brain to a computer. In March 2017, news emerged that Elon Musk, founder of Tesla and SpaceX, would become involved in Neuralink, a company founded 2016 in San Francisco, which is dedicated to producing brain-computer interfaces and neuroprosthetics.

Neuralink is developing the so-called ''neural lace'' technology, which would allow people to communicate directly with machines without going through a physical interface. The website of Neuralink at www.neuralink.com is at the time of writing (June 2017) just a big job ad. It is interesting to see that besides traditional qualifications like "electrochemist" new ones like "in-vivo electrophysiologist" are required.

Another startup from California, Openwater, is creating a device that "can enable us to see inside our brains or bodies in great detail", as they say on their website at www.opnwatr.io. The wearable device developed at Openwater is like a ski cap that can analyze the thoughts of its wearer.

Merging biological and digital intelligence

Mary Lou Jepsen, the CEO of Openwater, is excited about the possibilities her mindreading device opens up: "If we could communicate at the speed of thought, we can augment our creativity with the low-level stuff that AI and robots and 3-D printers and fab labs and all that do."

Elon Musk even went a step further. In spring 2017, he explained the need for humans to become cyborgs, if humankind is to survive the rise of artificial intelligence. CNBC quoted him saying: ''Over time I think we will probably see a closer merger of biological intelligence and digital intelligence.'' For Musk, ''it's mostly about the bandwidth, the speed of the connection between your brain and the digital version of yourself, particularly output.''

Oops, my brain has been hacked

Corresponding to the excitement of Musk and Jepsen is the concern of some experts about the risks that brain-computer interfaces bring to users like a Trojan Horse. Already in 2004, professor Paul Root Wolpe, the first Chief of Bioethics at NASA, raised ethical concerns about the risks
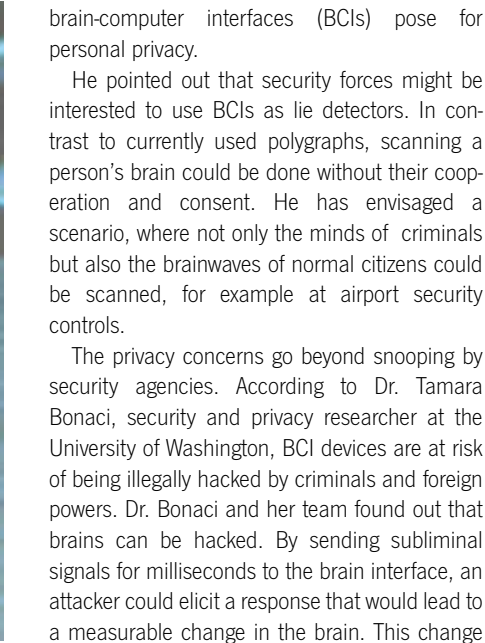
Elon Musk, co-founder of neurotechnology start-up Neuralink (Photo: Steve Jurvetson License: Creative Commons Attribution 2.0 Generic - https://creativecommons.org/licenses/by/2.0/deed.en)

brain-computer interfaces (BCIs) pose for personal privacy.

He pointed out that security forces might be interested to use BCIs as lie detectors. In contrast to currently used polygraphs, scanning a person's brain could be done without their cooperation and consent. He has envisaged a scenario, where not only the minds of criminals but also the brainwaves of normal citizens could be scanned, for example at airport security controls.

The privacy concerns go beyond snooping by security agencies. According to Dr. Tamara Bonaci, security and privacy researcher at the University of Washington, BCI devices are at risk of being illegally hacked by criminals and foreign powers. Dr. Bonaci and her team found out that brains can be hacked. By sending subliminal signals for milliseconds to the brain interface, an attacker could elicit a response that would lead to a measurable change in the brain. This change in the brain would alter the brainwave pattern. As neuroscientists are gaining an ever better understanding of cognitive functions and their locations in the brain, this changed brainwave pattern could provide insights on all kinds of personal thoughts and attitudes.

What to do

Considering that almost every week a major data security breach is reported, the prospect of running around with a connected skullcap or brain implant does not really evoke unequivocal joy in everyone. However, as the spread of BCIs for communication purposes may become as unstoppable as smartphones, we better invest now in security standards and technology to avoid that someone is taking over what once has been your brain.

3d rendering of human brain on technology, MONSITJ ©fotolia

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