Celtic-Plus
Newsletter 1/2018

Editorial

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Dear reader,

The second edition of our newsletter section Chairman's Corner is dedicated to a very important question: What will come after Celtic-Plus, when it has finished in December 2018? Our Vice Chair, Valerie Blavette from Orange, gives the answer: CELTIC-NEXT! The new cluster's goal is to keep the momentum that Celtic-Plus has created. The CELTIC Core Group has prepared the CELTIC-NEXT application, which has been accepted by EUREKA in June 2018. CELTIC-NEXT will succeed Celtic-Plus for another 8 years.

Start-ups are the ultimate "raison d'être" for research activities, because they are closest to the generation of business. In this issue we give again the word to two of them: aXenic, a British startup, and medVC, a Polish startup. aXenic was generated from the Celtic-Plus flag-ship project SASER. The start-up provides devices for intra- and inter-satellite communications. The initial target of the SASER project for this type of technological development were devices for terrestrial applications. So it comes as an unexpected side effect that SASER spinoff aXenic commercialises devices for space applications. medVC is a Polish spin-off from the award-winning Celtic-Plus project HIPERMED. medVC commercialises a video assistance system for doctors and for hospitals. The medVC technology can be used, for example, during a surgery to give doctors a remote colleague's opinion in case of a difficult medical decision.

The Celtic-Plus project GOLD has won this year's Celtic-Plus Excellence Award for Network Technologies. In this issue you can read about the trilogy of Celtic-Plus projects, 4GBB, HFCC/G.fast, and GOLD. All three created the G.fast broadband family of standards. The G.fast standard was realised in less than five years, and today this Gigabit technology is being rolled out to the customers.

This year's Celtic-Plus Event took place in Helsinki. Like in the two past years, our event was collocated with the EUREKA Innovation Week, which was organized this time under the Finnish EUREKA Chairmanship. The event allowed us to show in the exhibition the results of 13 commercially relevant Celtic-Plus projects. Other highlights were the two keynote presentations in the fields of Artificial Intelligence and IoT/ Industry 4.0. In a round table, we witnessed business impacts of Celtic-Plus projects: representatives of the Celtic-Plus projects GOLD, NOTTS, ReICO-vAir, SENDATE and SIGMONA presented and discussed their achievements.

You will also find in this issue a Project Highlight from another excellent Celtic-Plus project: NOTTS – it has won the EUREKA Innovation Award in the category "Competitiveness and Growth".

In the Celtic-Plus Spring Call that closed on 23rd April, we received five Celtic-Plus project proposals – they all received the Celtic-Plus Label in a meeting with Public Authorities and the Celtic-Plus Core Group that took place in Helsinki on 23rd May. Technical evaluations of the Group of Experts as well as evaluations of the Celtic-Plus Core Group and the Public Authorities have been realized in just one month showing how efficient the Celtic evaluation process is. It is expected that most of these projects will start in the course of 2018 and early 2019.

As you can see in this issue of our newsletter, Celtic-Plus is an exciting programme with a highly innovative community, which is constantly pushing the borders of ICT technology. If you are not yet part of the Celtic-Plus community and would like to join, there are opportunities like the Proposers Days in Madrid (26th September) and Stockholm (end of November), where you can present your project ideas. The ongoing call for proposals opened on 2nd July and will end on 15th October 2018. Feel free to talk to me or any other colleagues at the Celtic-Plus Office – I am looking forward to hearing from you.

Peter Herrmann
Editor-in-chief

CELTIC-NEXT
The next big thing after Celtic-Plus

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The Celtic-Plus cluster has achieved a lot in the past 8 years, as regular readers of the Celtic-Plus Newsletter will know. Recently, we have been working on the extension of this success story for 8 more years under the name CELTIC-NEXT. The new cluster is built on the core principles which have guided the Celtic community for the last 15 years. These principles include a bottom-up industry-driven approach and the concept of large flagship projects aimed at solving issues of strategic importance. However, there will also be important changes in CELTIC-NEXT, which reflect the changes of technology, industry, and society.

Changes in CELTIC-NEXT

In order to symbolise the change, we have chosen a new logo for CELTIC-NEXT (see figure) as well as a new motto for the cluster: Next Generation Telecommunications for the Digital Society. This is meant to indicate a deeper transformation. Public Authorities and Core-Group members jointly worked on improving the Celtic processes, in order to make it even easier than before for CELTIC-NEXT project proposals to get started and produce successful outcomes.

In addition, the Core-Group members defined the scope and research areas of the cluster for the next 8 years. This was a real challenge, as technologies are evolving so fast. Experts from telecom operators, telecom and IT manufacturers, and security providers have put their heads together to design the framework for future ICT R&D projects at European level. As a result, they have created a vision of future communications where the ongoing digitalization will result in the smart automation of many aspects of our lives.

Technological vision

CELTIC-NEXT is based on a technological vision for the next 10+ years. We will move from an era defined by the connection of people and simple things via Mbps of capacity and about 100 ms latency to one defined by Gbps of capacity and about 1 ms of latency. This shift is driven by the current enabling technology trends, like cloud-based services with dynamic and adaptive scaling, extensive virtualization, novel software-defined automated solutions, and wireless connectivity with the 5G mobile networks.

Users will benefit from 360-degree video, virtual and augmented reality as well as autonomous system control with associated cognitive systems that augment human capabilities. All this will demand a fundamentally different, distributed network architecture comprised of cloud processing resources, interconnected by optimized IP and optical edge networks, using a converged ultra-high capacity broadband access layer. The edge cloud network will need to support data rates of 10 Gbps, latency as low as 1 ms, and a trillion connected devices with 10+ years of battery life. Network slicing is a key capability underlying the new business model opportunities by which dedicated virtual networks to various customer groups will be provided much more economically than in the traditional model where these customers would build their own dedicated private networks. All these new capabilities will enable the communications networks to become a tool for the digitalization of various industry areas.

Expanding the CELTIC community towards verticals

What makes CELTIC-NEXT the perfect framework for providing customised and smart solutions for the different economic sectors and the whole society is its end-to-end approach. It includes connectivity, security, and cross-sector technologies such as Artificial Intelligence and Big Data.

A special focus of CELTIC-NEXT will be on applications and services serving vertical sectors, such as healthcare, smart cities, energy, mobility, automotive, smart home, agriculture, manufacturing, education, e-commerce, and fintech. Those verticals are equally important to advance, along with optimising and improving efficiency and reliability with the best end-to-end connectivity and security.

The evolution of ICT services over the next period will be achieved via a partnership model where the vertical sectors collaborate with ICT companies in determining their ICT solutions. This will be a key focus of the CELTIC-NEXT end-to-end perspective. Representatives from vertical sectors will be progressively invited to participate in the CELTIC-NEXT Industry Core Group to ensure the continuous cross-fertilisation of ideas. Therefore we expect that many of the CELTIC-NEXT projects will define and develop self-adaptable solutions, able to fit the needs of many different sectors and societal challenges.

EUREKA label application

In mid-April 2018, the CELTIC-NEXT EUREKA label application form was sent to the EUREKA Secretariat. I would like to thank everyone who contributed for their support and the work they put into preparing the application.

The application form includes the signed support from 16 Core-group companies as well as from the following countries, in alphabetical order: Belgium, Finland, France, Germany, Israel, Luxembourg, Korea, Spain, Sweden, and Turkey. In addition, some other countries have formally declared that they are interested. Other countries are welcome to support CELTIC-NEXT at a later stage.

At the EUREKA HLG/NPC meeting in Helsinki on 19–20 June, the formal decision was made, and the EUREKA label was granted to CELTIC-NEXT by the EUREKA High Level Group.

Conclusion

One of the strengths of CELTIC-NEXT is the coordinated approach of Public Authorities and industry. As we proved in the past years, we can achieve great things together: innovative products and services, business impact, job creation, European leadership, and even world records in technological performance.

Celtic-Plus Event in Helsinki

This year's Celtic-Plus Event took place under the Finnish EUREKA chairmanship in Helsinki, Finland, on 24 May 2018. It was held in conjunction with the EUREKA Innovation Week, which attracted more than 900 participants from 32 countries. More than half of the participants were from industry, and more than 75% came from abroad.

Opening session

The Celtic-Plus Event was opened by the Chair of the Finnish EUREKA Chairmanship, Heikki Uusi Honko from Business Finland, and by the Celtic-Plus Vice-Chair Valerie Blavette who welcomed the participants. The event presented achievements of Celtic-Plus projects and provided insight to the most recent developments in communications and ICT technologies.

CELTIC-NEXT

Peter Herrmann, director of Celtic-Plus introduced CELTIC-NEXT the cluster that is proposed to follow the Celtic-Plus cluster that will terminate at the end of this year. CELTIC-NEXT will focus on "The next generation of telecommunication for the Digital Society" enriched with advanced communication capabilities in vertical sectors such as Automotive Telecom, Industry 4.0, IoT and others. CELTIC-NEXT will contribute to the digital society and will be the key to the development of the next generations of enabling telecommunications technologies and services. It will reflect the evolving needs of businesses in all sectors and citizens in Europe and beyond and generate a broad range of new applications and solutions.

Keynote 1: Artificial Intelligence, a disruption to digitalization of industries

In the first keynote Leo M. Kärkkäinen from Nokia presented his view on "Artificial Intelligence, a disruption to digitalization of industries". He asked the question on what are trends that will change the rules: Moore's law; price of DNA sequencing; Mobile Network with increased amount of base stations and Optical Networks with more wavelengths inside a fibre. He also compared the timescale for decisions of humans with the one of machine algorithms and he argued if and how we will lose the sovereignty on our decisions to machines.

Heikki Uusi Honko, Chair of the Finnish EUREKA Chairmanchip, opening the Celtic-Plus Event

Valerie Blavette, Celtic-Plus Vice Chair from Orange opening the Celtic-Plus Event

Panel on business impacts of Celtic-Plus projects

Mrs Juana Sanchez, Public Authority from CDTI in Spain, highlighted the business impact of Celtic-Plus projects in the business panel. She asked the five panellist about the main outcomes of their projects.

Mr. Les Humphrey from the UK operator BT presented break thoughs in Broadband Connectivity realized by the GOLD project. After the 4GBB and the HFCC-G.fast it is the third project developing this new G.fast technology. Les emphasised the short time to standardisation of this technology in only 5 years (compared to 12 years of the preceding ADSL technology). Today BT rolls out this technology to 10 million of their customers.

Mr. Antonio Cuadra Sanchez from the Spanish technology provider INDRA presented the Celtic project NOTTS that implemented Quality of Experience control in OTT networks. NOTTS is this year's EUREKA Award winner for Competitiveness (see next article).

Mr. Dieter Kreuer from Qosmotec, a German provider of test automation systems for wireless networks, presented the project on Reliable Industrial Communication Over the Air, ReICOvAir. This project works on secure wireless solutions allowing the use of wireless technologies in the manufacturing environment. Secure wireless solutions will open the way to fast set up of production cycles in the fully atomised factory. He

Peter Herrmann Celtic-Plus Office Director presenting the follow up Cluster CELTIC-NEXT

underlines that international Celtic-Plus projects allow to be more ambitious and achieve a higher impact in standardisation.

Mr. Tauno Vähä-Heikkilä, Vice President at VTT responsible for the Connectivity Business Area, presented the 73 million euro flagship project SENDATE. SENDATE is still a running project that is very active in generating intellectual property rights and transforms the generated knowledge into standards. Participating countries are Finland, France, Germany and Sweden.

The last project was presented by Mr. Jari Lehmusvuori from the network provider Nokia who presented the 5G breakthroughs of the SIGMONA. He said it was good that the project partners had the opportunity to introduce SDN technologies at an early stage in 4G and 5G networks.

Panel on business impact (from left): Jari Lehmuvuori (Nokia), Tauno Vähä-Heikkilä (VTT), Les Humphrey (BT), Dieter Kreuer (Qosmotec) and Juana Sanchez (Moderator from CDTI)

SIGMONA developed early Software-defined networking (SDN) concepts that are today widely used in LTE and 5G networks. This has allowed much more efficient network management and speeds up the deployment of new networks.

Keynote 2: IoT and Industry 4.0

In the second keynote, Mesut Sen, Product Operations Director at Turkish ICT solution vendor Netaş, talked about "IoT and Industry 4.0". He presented his views on disruption in the fourth digital revolution and how digital disruption waves are coming over us, one after the other. One of his suggestions is: "Be disruptive against yourself, before someone else does".

The second keynote was followed by the the 2018 Celtic-Plus Awards session, moderated by the Celtic-Plus Vice-Chairs Valerie Blavette from Orange and Riza Durucasugil from Netas.

- Further information on the Celtic-Plus Event 2018, including the presentation slides, is available at https://www.celticplus.eu/event/celtic-plus-event-in-Helsinki/

EUREKA Innovation Award Winner 2018
Celtic-Plus Project NOTTS – Smart content delivery for the digital age

The Celtic-Plus project NOTTS has won the this year's EUREKA Innovation Award in the category of "Competitiveness and Growth".

A scalable and robust video streaming solution has been developed to deliver adapted media content to smart devices, with the level of quality that customers increasingly expect and demand. The NOTTS solution makes it easier for content providers to deliver Over the Top (OTT) services directly to consumers. A total of 27 new improved products were created through the project and are now on the market, enabling media service providers to guarantee quality of service and thus attract more customers. NOTTS has also contributed significantly to trendsetting standards in this field.

- Further information on the EUREKA Innovation Award 2018 is available at http://www.eurekanetwork.org/content/eureka-innovation-award-winner-2018-smart-content-delivery-digital-age

Antonio Cuarda Sanchez receives the EUREKA Innovation Award for the Celtic-Plus project NOTTS

Gigabit broadband to the home

G.fast standards developed by 3 Celtic-Plus projects

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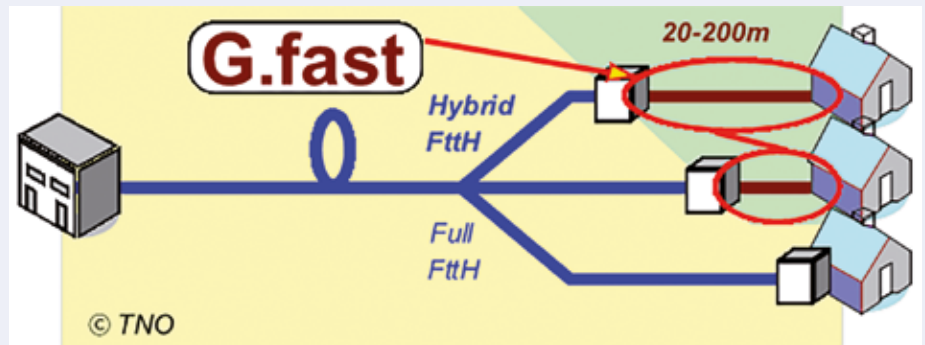per.odling@eit.lth.se

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Internet access and other broadband services have become a vitally important part of European life and business. The value creation and life-style options brought by having Internet access accelerates Europe forward and is fuelled by increasing bitrates and increased availability. This article tells the story of how the trilogy of Celtic-Plus projects, 4GBB, HFCC/G.fast, and GOLD, created the G.fast broadband family of standards.

About ten years before GOLD was completed, around 2008, there was a political push for bringing 100 megabits/second solutions to European homes. The envisaged solution was to bring optical fibre to every European home. However, there were no public funding schemes supporting this ambition, nor were there many customers willing to pay several thousand euros for a connection they would then have to pay again to subscribe to. Operators had not amassed sufficient funds to undertake such an epic investment and grand fibre-to-the-home projects were dropped globally as cost killed them.

However, a closer look at the costs revealed that a large portion was associated with the last meters of deployment and with entering the homes to install the terminals. These costs were partly related to obvious causes like that the last meters of digging were to individual homes and the cost could thus not be shared by many customer, or just that installing equipment and testing the installation is cumbersome and takes time.

But there were also a lot of unexpected costs and delays, like customers having strong opinions about where to dig the last meters, say to avoid rose bushes and the like, or where the connector should be placed and how the fibre should be drawn inside the home. It was even common that customers who had ordered fibre to the home rejected the installation when it dawned on them that drilling holes in their homes was needed to pull the fibre through.

Another frequent event was that the customer simply was not at home when the installation crew knocked on the door, or that no male field staff could enter a home for religious reasons, if no adult male living there was at home.

G.fast – combining fibre and copper

Given the pressure to deliver higher bit-rates and the insight that most of the cost of bringing fibre into the homes was associated with the last few meters, it was not far-fetched to look for a solution where new fibre was combined with reusing the last meters of the existing copper cables. The disadvantage this would bring was that active equipment would not only be in the central node and the home, but also in a place near the home. However, this is then compensated by the ease of installation where the customer is not bothered. The G.fast modem can be left in a bag hanging on the door handle and can be connected by the customer.

New knowledge

At the start of the project series, little was known about the high-frequency characteristics of telephony copper cables and there was a widespread belief that they could not be used for signalling at hundreds of MHz due to their poor quality. There was also concern that the noise at these frequency ranges would be prohibitively high. The first project in the series, 4GBB, removed these concerns and concluded that the telephony cabling was surprisingly noise-free and generally would be able to deliver fibre-like bitrates often exceeding a gigabit per second.

The following projects, HFCC/G.fast and GOLD, also had new concepts to deal with. It was quickly realized that generally no power would be available at the points near the homes where G.fast was to be installed and that it would be expensive to arrange power there. Thus, it was decided that G.fast should have the capability of reverse power feeding, i.e. that the customer modem sends power from the users' homes to the network-side modem, the distribution-point unit. A whole new ETSI standard was needed for this.

This also meant that G.fast could lose power by natural causes, i.e. if all customers of a node switched off their modems, also the network-side modem would lose power. Normally when a node loses power, alarms go off in the operator's management system and technicians are promptly dispatched to fix the problem. To avoid this, the concept of the persistent management agent was invented. The agent runs on a cloud server and speaks for the modems as if they were always on. The agent then talks to the modems when they are available, conveying the wishes of the management system. A number of similar new inventions were needed, as G.fast is architecturally quite different from earlier technology. G.fast is more of an extension of the home network to reach the fibre feed, than a traditional DSL system.

Outlook

The trilogy of projects ending with the GOLD project jointly produced and presented more than 600 standardization contributions and completed the first version of the G.fast standard about five years quicker than previous DSL-type standards, in spite of the large number of new concepts needed. Work is continuing in two directions: towards higher bandwidths and higher bitrates in the G.mgfast standardization and towards merging the access and in-home networks, including the WiFi-drops, into a single managed network solution. This work is supported by a new Celtic-Plus project named FU5ION.

HIPERMED-based start-up medVC
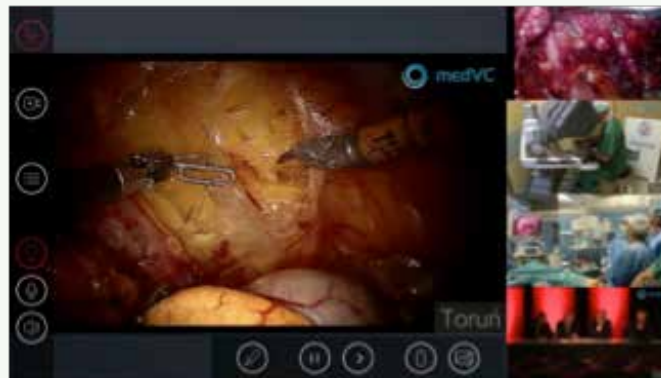## A remote collaboration tool for medical professionals

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It is not an easy task to turn R&D project results into market ready products, but we have succeeded. medVC.eu sp. z o.o. is an SME from Poznań, Poland that offers on the European markets a telemedical platform based on research conducted within the Celtic project HIPERMED.

"HIPERMED – High Performance Telemedicine Platform" was a very successful Celtic project that ended in December 2013. It was awarded the "Celtic Excellence Award" and the "EUREKA Innovation Award" in 2014 as well as the "Celtic-Plus Innovation Award" in 2016 due to its very promising outcomes. In 2014, I spent 3 months at Stanford University in the US, attending a course on Science Management and Commercialization, and there I was bitten by the entrepreneurial bug. Since then I have known that I want to bring the results of HIPERMED to the market.

Incubating

At this time, I had already been working for over 10 years as a researcher at the Poznań Supercomputing and Networking Center (PSNC). Together with the Directors of PSNC, we worked out a plan of creating a market-ready product based on the prototypes from HIPERMED. NETICTECH, an incubator working within the business support environment of PSNC, was chosen to help us bootstrap our start-up. What we needed was money for a year of product development. NETICTECH managed to acquire 250,000 euro from the FICHe project, which was part of the FIWARE Acceleration Programme. With this funding and the business development support from NETICTECH and FICHe, in one year's time we were able to develop the medVC telemedical platform and to create our own company.

What is medVC?

medVC is a remote collaboration tool for medical professionals allowing real-time audio-video communication and the usage of specialised medical services. It is based on hardware devices designed to be installed in operating rooms, conference rooms and doctors' offices and makes it possible to send multiple high-definition video streams coming from medical cameras, microscopes, endoscopes and other medical equipment. medVC terminals are controlled using a touch-screen that allows doctors to pause videos, draw on the picture, take snapshots, collaboratively work on DICOM images, record a session or even broadcast it live over the Internet. Furthermore, medVC can transmit stereoscopic (3D) video from surgical robots or 3D endoscopes. All these features make medVC a superb remote collaboration and education tool for medicine. The pictures above show medVC in action.

Conclusion

We have now been present on the market for two years already, and we are gaining more and more traction. medVC is already being used by hospitals in France, Italy, Germany, Luxembourg, Poland, Spain, and the Netherlands. We are regularly co-organising large telemedical events, like the European Laryngological Live Surgery Broadcast, with almost 10 000 viewers worldwide. We are improving medVC all the time, bringing new functionality and starting close co-operation with large partners from the medical industry. As the company grows, I can say with confidence that the results of the HIPERMED project are and will be enabling better healthcare services and enhancing medical education.

■ For more information please visit our website: https://medvc.eu/

Better optical data transmission in space
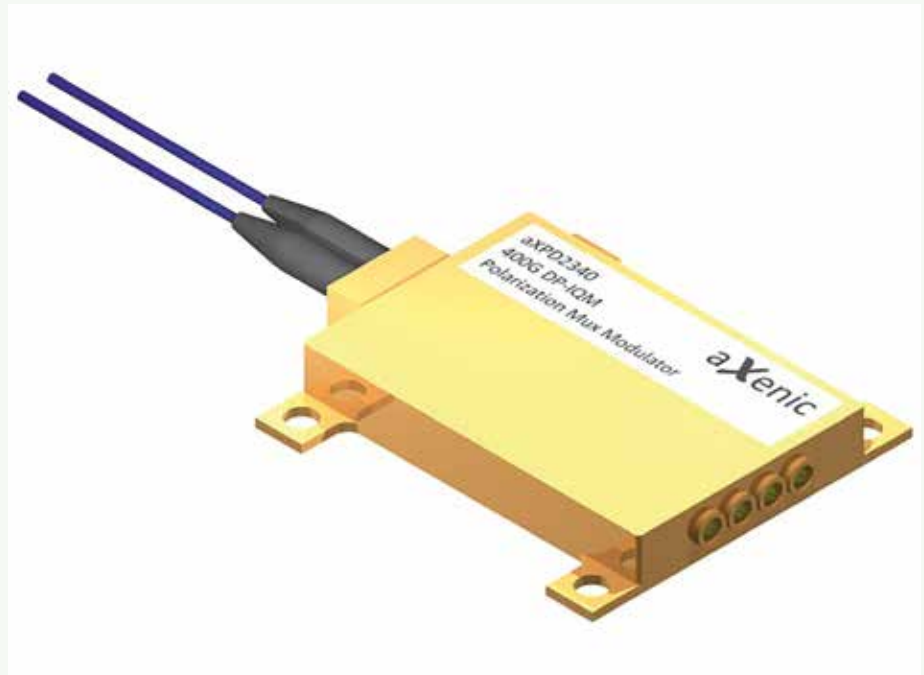## New 50 GHz modulators by SASER project spinoff aXenic

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aXenic, a start-up company spun off from Celtic-Plus flagship project SASER, has developed a novel solution for better optical data transmission in space. The aXenic solution based on SASER results consists of a folded package format and small gallium-arsenide semiconductor technology, which have been used to halve the size of optical modulators and increase the bandwidth to 50GHz and beyond.

Packaged Optical Modulator using Folded Optical paths developed in SASER

The devices developed in SASER were at first compatible with the format of competitor technology based on lithium niobate. The Celtic-Plus project went on to produce a folded format, which halved the size of the package and also halved the fibre handling space with weight and size advantages for many applications. The figure shows the package format for a four-channel RF input onto a folded optical path with fibre entry and output on the opposite side.

The work at aXenic since SASER has taken advantage of the reduced size to also improve the bandwidth of the devices to reach 50 GHz and beyond, which is a leading capability for high-performance modulators. At aXenic, a man-agement buyout which followed the completion of SASER, this capability has been exploited in aerospace applications, including for inter-satellite and intra-satellite communications.

The capabilities developed under SASER, together with advances in performance since then, have attracted significant interest from the space community, who see data transmission as a major bottleneck in the development of services on and between satellite constellations. The format is readily extended to arrays of devices within a single package providing further cost, size and weight reductions that are a key demand for future commercial satellite systems.

Conclusion

Development of folded-format optical devices under Celtic-Plus project SASER has allowed a halving in size and weight, which is ideal for use in space applications. Together with advances which provide very high-frequency capability using this format, the optical modulators produced by aXenic are positioned to enable the use of photonics in place of electronics. This will revolutionise the management of data in space within and between satellites.

www.celticplus.eu

About Celtic-Plus

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