intelligent Converged network consolidating Radio and optical access aRound USer equipment

DELIVERABLE: D6.3
2nd Year Dissemination, Communication, Standardisation and Exploitation: Plan and Report of Activities

<table>
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<th>644526</th>
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<td>iCIRRUS</td>
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<tr>
<td>Project title:</td>
<td>Intelligent converged network consolidating radio and optical access around user equipment</td>
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<td>Project duration:</td>
<td>1 January 2015 – 31 December 2017</td>
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<tr>
<td>Coordinator:</td>
<td>Nathan Gomes, University of Kent, Canterbury, UK</td>
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<tr>
<th>Editors:</th>
<th>Michael Georgiades (PrimeTel)</th>
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<tr>
<td>Contributing partners</td>
<td>PTL, UniKent, WT, ORANGE, IDCC, HHI, UESSEX, ADVA, TS, VIAVI, IAF</td>
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<tr>
<td>Internal reviewers</td>
<td>Nathan Gomes (UniKent)</td>
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Document history

Version 0.1: 19/12/2016 Table of contents
Version 0.2: 31/12/2017 Initial draft requesting partner contributions
Version 0.3: 13/01/2017 Second draft with initial partner contributions
Version 0.4: 20/01/2017 First version for internal review
Version 0.5: 25/01/2017 Revisions
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This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 644526
Abstract

This deliverable comprises a report of the activities that were carried out during the second year of the iCIRRUS project and the planned activities for the final year of the project. This work has been undertaken as part of WP6 of the iCIRRUS project and entails reporting from all tasks, namely Task 6.1 Dissemination, Task 6.2 Standardization, Task 6.3 Exploitation and Task 6.4 Communication.

Primarily, the various dissemination and standardisation activities, which relate to conferences, workshops, associated meetings attended and presentations presented are listed and described.

Regarding dissemination, future events aimed for year 3 are also summarised. For standardisation, a brief description of the standardisation strategy plan is also provided by the involved project partners, on how they aim to promote iCIRRUS within specific standardisation bodies.

The deliverable then defines the exploitation plans and associated strategies per individual partner as well as jointly for the consortium as a whole.

The final part of the deliverable provides a detailed description of the communication activities undertaken and the means of communication used by the iCIRRUS consortium gives an insight into what has been achieved in Year 2 of the project to increase the awareness and visibility of the project. Through the communication activities, the aim was to inform communities that may have a direct industry relevance, e.g. through academic or industrial events, government/public bodies, as well as the public through, e.g., social media sites.

A summary version of these activities will also be addressed in the annual report.
## Index of terms

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>3GPP</td>
<td>3rd Generation Partnership Project</td>
</tr>
<tr>
<td>5G</td>
<td>5th Generation</td>
</tr>
<tr>
<td>C2C</td>
<td>Clone to Clone</td>
</tr>
<tr>
<td>CHARISMA</td>
<td>Converged Heterogeneous Advanced 5G Cloud-RAN Architecture for Intelligent and Secure Media Access</td>
</tr>
<tr>
<td>D2D</td>
<td>Device to Device</td>
</tr>
<tr>
<td>DMP</td>
<td>Data Management Plan</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>ECOC</td>
<td>European Conference on Optical Communication</td>
</tr>
<tr>
<td>EU</td>
<td>European Union</td>
</tr>
<tr>
<td>EUCNC</td>
<td>European Conference on Networks and Communications</td>
</tr>
<tr>
<td>ICTON</td>
<td>International Conference on Transparent Optical Networks</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical and Electronics Engineers</td>
</tr>
<tr>
<td>IET</td>
<td>Institution of Engineering and Technology</td>
</tr>
<tr>
<td>MWC</td>
<td>Mobile World Congress</td>
</tr>
<tr>
<td>OFC</td>
<td>Optical Fiber Communication</td>
</tr>
<tr>
<td>NFOEC</td>
<td>National Fiber Optic Engineers Conference</td>
</tr>
<tr>
<td>OSA</td>
<td>Optical Society</td>
</tr>
<tr>
<td>PIMRC</td>
<td>Personal, Indoor and Mobile Radio Communications</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
</tr>
<tr>
<td>VTC</td>
<td>Vehicular Technology Conference</td>
</tr>
<tr>
<td>WWRF</td>
<td>Wireless World Research Forum</td>
</tr>
</tbody>
</table>
Contents

Document history ........................................................................................................... 2

Abstract .......................................................................................................................... 3

Index of terms ................................................................................................................ 4

1. Introduction .................................................................................................................. 7

2. Dissemination Activities .............................................................................................. 8
   2.1. Performed Dissemination Activities ................................................................... 8
       2.1.1. Journal Publications .................................................................................. 8
       2.1.2. Conference Publications .......................................................................... 8
       2.1.3. Book Chapters ........................................................................................... 10
       2.1.4. Invited Presentations .................................................................................. 10
   2.2. Planned Dissemination Activities ........................................................................ 13
       2.2.1. Potential Scientific Journals and Magazines .............................................. 13
       2.2.2. Planned and other Potential Conferences .................................................. 14
       2.2.3. Activities and plans for liaisons with other projects .................................. 15
       2.2.4. Open Air Interface (OAI) software alliance ............................................. 15
       2.2.5. Public iCIRRUS Deliverables ................................................................... 16

3. Communication Activities ........................................................................................... 17
   3.1. Performed Communication Activities .................................................................. 17
       3.1.1. iCIRRUS website ....................................................................................... 17
       3.1.2. Social Networks Accounts ....................................................................... 18
       3.1.3. iCIRRUS brochure .................................................................................... 19
       3.1.4. Other Publicity and Visibility ................................................................... 19
       3.1.5. Other events attended ................................................................................. 20
   3.2. Planned Communication Activities for Year 3 ....................................................... 20

4. Standardisation Activities ............................................................................................ 21
   4.1. Key standardisation activities in Year 2 ................................................................ 21
   4.2. Year 3 standardization considerations ................................................................ 23

5. Exploitation Planning .................................................................................................. 26
   5.1. Industrial Exploitation ......................................................................................... 27
       5.1.1. Wellness Telecom Exploitation Plan ............................................................ 27
       5.1.2. ADVA Optical Networking SE (ADVA) ...................................................... 29
       5.1.3. Orange S.A. (Orange) ............................................................................... 30
5.1.4. Telekom Slovenije, d.d. (TS) ____________________________________________ 30
5.1.5. PrimeTel PLC (PTL) ________________________________________________ 31
5.1.6. Viavi Solutions (VIAVI) ____________________________________________ 32
5.1.7. IAF GmbH Future Radio Technology (IAF) _____________________________ 32
5.1.8. InterDigital Europe LTD (IDCC) ______________________________________ 32
5.2. Academic Exploitation _________________________________________________ 33
5.2.1. University of Kent (UniKent) _________________________________________ 33
5.2.2. Fraunhofer Heinrich-Hertz- Institute (HHI) _____________________________ 33
5.2.3. University of Essex (UEssex) _________________________________________ 34
6. Conclusion __________________________________________________________________ 35
References ______________________________________________________________________ 37
List of Figures ____________________________________________________________________ 38
List of Tables ____________________________________________________________________ 38
Appendix I ______________________________________________________________________ 39
1. Introduction

D6.3 provides a summary of the WP6 activities undertaken in Year 2 relating to dissemination, standardisation, exploitation, communication and, hence, impact of the project’s outcomes and results.

In the first year of the project the consortium was effectively active in all dissemination related tasks and the published work has been reported in been reported in D6.2 [D6.2]. Updated lists are included in this deliverable. Primarily, this deliverable describes all dissemination activities that took place in Year 2 with a list of all associated conferences attended, scientific journal and magazine articles accepted, and publications at relevant workshops and special sessions.

As part of the iCIRRUS contributions, and in parallel to the project’s ongoing innovation discussions the consortium partners have also been engaged in a number of relevant Standardisation bodies, promoting the iCIRRUS findings and hence impacting the standardisation discussions, and at the same time aligning the ongoing work of the project to standardisation as much as possible. This has been achieved mainly through key industrial partners who participate in these standardisation bodies meetings through presentations and discussion/engagement. The main presentations given at these meetings are listed in the Deliverable.

Further updates to exploitation activities since year 1 are also described in the deliverable. These include updates both from each partner as well as from the consortium as a whole. Part of the exploitation plans are based on short-term exploitation strategies such as post-doctoral opportunities as well as more long-term business goals to enhance existing products or services.

Finally, the deliverable describes the various communication activities for publishing the outcomes of the project to a wider audience. The various channels of communication established in year 1 have been used in year 2 as well, for propagating the projects updates and results to the wider audience. This has been achieved through project brochures, website news posts, updates through the existing projects social network pages and industrial workshops.

In addition, a strong emphasis is placed on interactions with other relevant EU projects and common research and development activities, and consequently common standardisation, exploitation and general impact in the research and standards communities.
2. Dissemination Activities

The dissemination activities target prestigious conferences, events, and workshops as well as scientific journals and magazine articles. Dissemination aims primarily to publish the project’s outcomes and results so as to inform the wider research community of the project’s novel findings and proposed innovative solutions.

Dissemination in the context of the project focuses on the scientific outcomes and results of iCIRRUS. Dissemination activities relating to less technical magazine articles, social media, project website, project flyers, etc. are covered in a later section under communication activities and the associated task. Hence, this activity aims mainly to present the project findings in the European and international scientific and industrial community.

The iCIRRUS consortium targets specifically high quality conferences and prestigious journals and scientific magazines particularly those which are published and supported by the IEEE, IET, OSA and other bodies of similar repute.

2.1. Performed Dissemination Activities

This section lists the project’s publications in conferences and journals published in the second year of the project. As with the first year, iCIRRUS has continued to contribute extensively to the research community in relevant calls. The main publications are listed below in the following subsections.

2.1.1. Journal Publications


2.1.2. Conference Publications


This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 644526


fronthaul combination with remote powering”, The Optical Networking and Communication Conference & Exhibition (OFC), Anaheim, USA, 20–22 March 2016.

C16. Nathan J. Gomes, Philippou Assimakopoulos, Mohamad Kenan Al-Hares, Usman Habib, Shabnam Noor, “The new flexible mobile fronthaul: Digital or analog, or both?”, in 18th International Conference on Transparent Optical Networks (ICTON) (Invited), Trento, Italy, 10-14 July 2016.


2.1.3. Book Chapters


2.1.4. Invited Presentations

This section provides a list of additional, mainly invited presentations, which took place at various other conferences, workshops, events during the second year of the project:

P1. Nathan Gomes, "iCIRRUS concepts", 5G PPP 1st 5G Architecture Workshop, Brussels (Belgium), 06 April 2016.


P4. Philippou Assimakopoulos (UniKent), Flexible Ethernet fronthaul, IEEE P1914, Rungsted, Denmark, 22-08 to 24-08-2016.


P6. Chris Murphy, "SON and NFV Self Configuration – Easy to do, Tough to do well?", Webinar, Athens, Greece, 24 June 2016.


Three workshops at three prestigious conferences were successfully co-organised by the iCIRRUS consortium in 2016 namely at ECOC 2016 [ECOC], WWRF 37 [WWRF], and EUCNC 2016 [EUCNC]:

**ECOC 2016 – European Conference on Optical Communication**

ECOC 2016 is the leading European conference in the field of optical communication. Here, the latest progress in optical communication technologies will be reported in selected papers, keynotes, presentations and special symposia.

The following workshop session was successfully organised by the iCIRRUS consortium at the ECOC 2016, 17-22 September 2016, European Conference on Optical Communication.

**Workshop WS03 (Short range optical transmission for emerging 5G fronthaul, DCI and Metro Networks),** Düsseldorf, Germany, Workshop was co-organised and moderated by iCIRRUS through Volker Jungnickel (HHI).

Parallel to the scientific conference, the ECOC exhibition covers a wide range of optical communications products and services. Therefore, ECOC is open to a variety of interested participants like researchers and students, product developers, sales managers and telecommunication market developers. Every year this international forum attracts more than 1,000 participants. Volker Jungnickel co-organised the workshop and was a chair and panel moderator.

The following presentations were presented by the iCIRRUS consortium in this workshop:
• Philippe Chanclou, "The required Fixed Access Network evolutions in order to be ready for 5G", ECOC 2016, Workshop WS03, Düsseldorf, Germany, 18-22 September 2016.

Other presentations included talks from Thomas Pfeiffer (Nokia Bell Labs, also iCIRRUS advisory board), Frank Effenberger (Huawei) and Bomin Li (Comcores, IEEE P1914.1 Chair). This workshop was attended by at least 200 attendees, and can hence be considered as the attainment of project milestone MS13.

European Conference on Networks and Communications 2016

Workshop co-organised by iCIRRUS at EuCNC 2016, Towards Converged X-Haul for 5G Networks – A joint workshop of the iCIRRUS, 5G-XHaul and 5G-Crosshaul projects, Athens, Greece, Workshop co-organiser from iCIRRUS: Jörg-Peter Elbers (ADVA), 27-30 June 2016. The following presentations were presented at this workshop:


The EuCNC workshop, and participation at EuCNC overall, was important not only for general dissemination but also for sharing information with other EU projects, especially the 5GPPP projects in relevant areas. This workshop was attended by at least 100 attendees.

WWRF - Wireless World Research Forum

Organised Workshop by iCIRRUS, WWRF 37, "New Businesses empowered by 5G" University of Kassel, Germany, Special Session on Next generation Ethernet-based fronthaul/xhaul Organised by Nathan Gomes (UniKent) and Michael Georgiades (PTEL) from iCIRRUS, 05-07 October 2016.

WWRF’s goal was to encourage research that will achieve unbounded communications to address key societal challenges for the future. “Wireless World” in this broad sense to address the support of innovation and business, social inclusion and infrastructural challenges for the creation of a range of new technological capabilities from wide-area networks to short-range communications, machine-to-machine communications, sensor networks, wireless broadband access technologies and optical
networking, along with increasing intelligence and virtualization in networks. The workshop was co-
moderated by Nathan Gomes and the following presentation were given by iCIRRUS partners:

- Philippe Chanclou, "Key technical considerations for the path forward for C-RAN and vRAN", WWRF 37, University of Kassel, Germany, 05-07 October 2016.
- Klaus Grobe, “The high-speed fiber future mobile fronthaul”, WWRF 37, University of Kassel, Germany, 05-07 October 2016.
- Howard Thomas, "OAM and SON considerations for the future fronthaul/xhaul", University of Kassel, Germany, 05-07 October 2016.

Additional invited presentation took place at the event including:

- Philippe Sehier, "The future of transport networks towards 5G", (presentation co-prepared by Rudolf Winkelmann), WWRF 37, University of Kassel, Germany, 05-07 October 2016.
- Bomin Li, Fronthaul Standardisation in IEEE P1904.1 TF and the current Comcores vision, University of Kassel, Germany, 05-07 October 2016.

Note that Philippe Sehier is also on the iCIRRUS advisory board. This workshop was attended by at least 50 participants including a large number of subscribed industrial members hence this can be considered as the attainment of the project milestone MS16.

2.2. Planned Dissemination Activities

As described in D6.2, iCIRRUS will continue to publish in high quality journals, technical magazines, conferences and present at prestigious events in Year 3 of the project as well. Even more tangible technical results are expected to be available in Year 3, which will offer a better ground basis for a wider dissemination of iCIRRUS in the industry, as well as in the scientific community. Details of potential scientific journals that will be targeted by iCIRRUS are given in Table 1.

2.2.1. Potential Scientific Journals and Magazines

<table>
<thead>
<tr>
<th>Journal</th>
<th>Publisher</th>
<th>Thematic Area</th>
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<tbody>
<tr>
<td>Optical Communications and Networking</td>
<td>IEEE/OSA</td>
<td>Optical Networks</td>
</tr>
<tr>
<td>Journal of Lightwave Technology</td>
<td>IEEE/OSA</td>
<td>Optical Communications</td>
</tr>
<tr>
<td>Photonics Journal</td>
<td>IEEE</td>
<td>Photonics</td>
</tr>
<tr>
<td>Photonics Technology Letters</td>
<td>IEEE</td>
<td>Photonics</td>
</tr>
<tr>
<td>Optics Express</td>
<td>OSA</td>
<td>Optics</td>
</tr>
<tr>
<td>Transactions on Communications</td>
<td>IEEE</td>
<td>Telecoms</td>
</tr>
<tr>
<td>Transactions on Wireless Communications</td>
<td>IEEE</td>
<td>Wireless</td>
</tr>
<tr>
<td>Communications Letters</td>
<td>IEEE</td>
<td>Communications</td>
</tr>
<tr>
<td>Wireless Communications Letters</td>
<td>IEEE</td>
<td>Wireless Communications</td>
</tr>
<tr>
<td>Journal Selected Areas in Communications</td>
<td>IEEE</td>
<td>Communications: depends on theme area</td>
</tr>
<tr>
<td>Transactions on Vehicular Technology</td>
<td>IEEE</td>
<td>Vehicular (incl. communications)</td>
</tr>
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</table>
2.2.2. Planned and other Potential Conferences

Below are some of the planned publications in 2017 conferences:

- Invited papers at OFC 2017 and ICTON 2017
- Cloud Forward Conference (October 2017)
- IDC Predictions (May 2017, Barcelona)

Table 2 lists potential scientific conferences that could be targeted by the iCIRRUS consortium.

<table>
<thead>
<tr>
<th>Conference</th>
<th>Description</th>
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<tbody>
<tr>
<td>ICNI 2017, 20th ICIN Conference Innovations in Clouds, Internet and Networks</td>
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<tr>
<td>IEEE Global Communications Conference GLOBECOM</td>
<td></td>
</tr>
<tr>
<td>ICT 2017, 24th International Conference on Telecommunication, &quot;Intelligence in every form&quot;</td>
<td></td>
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<tr>
<td>WCNC 2018: IEEE Wireless Communications and Networking Conference</td>
<td></td>
</tr>
<tr>
<td>EUCNC 2017, European Conference on Networks and Communication</td>
<td></td>
</tr>
<tr>
<td>IEEE International Conference on Communications ICC</td>
<td></td>
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<tr>
<td>European Conference on Optical Communications (ECOC)</td>
<td></td>
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<tr>
<td>Mobile World Congress (MWC)</td>
<td></td>
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<tr>
<td>IEEE Personal and Indoor Mobile Radio Communications PIMRC</td>
<td></td>
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<tr>
<td>Wireless World Research Forum (WWRF)</td>
<td></td>
</tr>
<tr>
<td>IEEE/OSA Optical Fiber Communications Conference/National Fiber-Optics Exhibition and Conference OFC/NFOEC</td>
<td></td>
</tr>
<tr>
<td>IEEE Vehicular Technology Conference VTC</td>
<td></td>
</tr>
<tr>
<td>European Communications and Networking Conference EuCNC</td>
<td></td>
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<tr>
<td>IEEE International Conference on Transparent Optical Networks ICTON</td>
<td></td>
</tr>
<tr>
<td>CLEEN 2017: Fifth International Workshop on Cloud Technologies and Energy Efficiency in Mobile Communication Networks (CLEEN 2017)</td>
<td></td>
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<tr>
<td>INFOCOM 2018, IEEE Conference on Computer Communications</td>
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</table>

Table 2: Scientific Conferences
2.2.3. Activities and plans for liaisons with other projects
Liaison activities with relevant EU projects have two main objectives:

(a) Identify opportunities for joint scientific and technical activities in order to maximize results focusing on the particular aspects investigated within the iCIRRUS project and vice versa for the other projects.

(b) Cooperation with the other projects through the organisation of joint events or meetings to discuss common areas of novelty and innovation, community awareness in the common research area, and respective alignment with standardisation activities.

To achieve this, iCIRRUS liaison responsible contacts are in communication with other relevant EU projects to identify key research, scientific and technical areas for collaboration. In the case a partner happens to be involved in both projects it makes the established communication easier to achieve and will make that partner ideal to act as the liaison contact.

We were invited to and attended the concertation/5G PPP Collaboration and Clustering Day on 1st March, 2016 in Brussels. The CAON cluster meeting was also attended. There was discussion about the visibility of optical communications in EU ICT funding calls.

Informally, we have had contact from the 5G-Xhaul project requesting information such as recent deliverables. A number of iCIRRUS partners are already members of 5G PPP projects, such as 5G-Crosshaul and CHARISMA. We also attended the 5GPPP-organised Architecture workshop on 6th April. Attendance, visibility and interaction at EuCNC is seen as important for continuing this activity with other projects in 2017.

The consortium has carried out interactions with other European projects including:

- **CloudOpting Hackathon**: Carlos Rubia, from WT, took an active role in this cooperative event:
  - Technical day (November 2, Sant Cugat, Barcelona (Spain) – Vita Entrepreneurship Center)
  - Networking day (December 1, Sant Cugat, Barcelona (Spain) – Vita Entrepreneurship Center)

- **CHARISMA**: A new joint proposal was submitted by members of the CHARISMA and iCIRRUS projects for the 5GPPP call in November 2016.

2.2.4. Open Air Interface (OAI) software alliance
The iCIRRUS consortium had strong participation at the 1st and 2nd OAI meetings with a number of contributions associated to iCIRRUS’s outcomes and results. More specifically, there was participation at the 1st Open Air Interface (OAI) software alliance meeting, Paris, France, 22 January 2016 by Philippos Assimakopoulos from the University of Kent who presented the "Evolved fronthaul design within the iCIRRUS project". This was followed by participation at the 2nd OAI Workshop EURECOM France, 17-20 May 2016 by the University of Kent with a presentation by Philippos Assimakopoulos entitled "Towards a flexible fronthaul implementation for 5G" and by Chathura Magurawalage, from University of Essex on "Resource management in Mobile Cloud Computing".

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 644526
2.2.5. Public iCIRRUS Deliverables
First direct results of the iCIRRUS work are the public deliverables generated from the project. In Year 2 the following public deliverables were delivered and are available on the project’s main website.

These were:

- D2.2 - Refined iCIRRUS architecture definitions and specifications (M18)
- D3.2 - Preliminary Fronthaul Architecture Proposal (M18)
- D3.3 - SLA and SON Concept for iCIRRUS (M24)
- D4.3 - Mobile cloud networking and virtual mobile (M18)
- D6.3 - 2nd year Dissemination, Communication, Standardisation and Exploitation: Plan and Report of Activities (M24)
3. Communication Activities

This section describes the communication activities of the iCIRRUS project, which aim to make the project as visible as possible to the audience of interest and promote important outcomes and results of the project.

3.1. Performed Communication Activities

3.1.1. iCIRRUS website

As described in D6.2, the iCIRRUS website is available at http://www.icirrus-5gnet.eu/. The website has been live since M1 of the project with regular updates since. The website home page is shown in Figure 1.

The webpage organises the information in tabs with a home tab, a consortium tab providing information about all involved partners, motivation and vision of iCIRRUS, project overview, activities, a media centre tab which contains all public reports including Deliverables, Publications, Presentations, Demonstrations, Press Articles, Press Releases, Open Research Data and a final contact us tab with the necessary contact data.

The “Latest News” orange window on the right of the homepage is regularly updated with the most major recent events participated or milestones achieved that are sensible to promote publicly.
3.1.2. Social Networks Accounts

The iCIRRUS consortium has continued to maintain and regularly update its pages in the main social sites including Facebook, Linkedin and Twitter.

Facebook Page: The Facebook page is accessible via https://www.facebook.com/Icirrus-5G-748941148509013/. The Facebook page provides live news on the project’s recent outcomes and main participations. All followers are instantly updated when something new is uploaded on the site. The Facebook page is shown in Figure 3.

![Figure 3: iCIRRUS Facebook Page](image-url)

Figure 4: iCIRRUS LinkedIn Group

Twitter: Twitter page accessible via https://twitter.com/Icirrus5g

3.1.3. iCIRRUS brochure

Brochure: The iCIRRUS promotional brochure is a double-sided information sheet about the project. The project brochure has been disseminated in various events where iCIRRUS was represented. The brochure is available in D6.2.

The brochure contains overview information about iCIRRUS, the system concepts, information regarding D2D and C2C communications, introduces the fronthaul architecture and finally lists the iCIRRUS benefits to the end-users.

The latest version of the brochure can be found in Appendix I.

3.1.4. Other Publicity and Visibility

The following section presents other sources of communication including magazine articles, social networks, partner’s websites, exposure of project within partner’s organisations e.g. universities.

1. Introduction of iCIRRUS on the PrimeTel R&D website  
   Web: http://primetel.com.cy/research/icirrus/
2. Regular updates regarding iCIRRUS on the PrimeTel Innovation Facebook page  
   Web: https://www.facebook.com/primetel.innovation
3. iCIRRUS Project visible on the HHI website linking to the iCIRRUS website.  
4. University of Kent student projects run on D2D resource allocation and Ethernet in fronthaul, exposing project topics to our students.

This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 644526.
5. Adjacent Government e-magazine article: A feature describing how work in iCIRRUS (and related projects) contributes to the development of 5G technology has been published in Adjacent Government e-magazine (p. 286 – 287)

http://edition.pagesuite-professional.co.uk/Launch.aspx?EID=e8f6dc5e-d43f-45e6-90b2-7e3a198ad050

3.1.5. Other events attended
A number of events were also attended by partners (not listed above) which incorporated involvement in bilateral meetings, session discussions, and opened possibilities for collaboration and/or future collaborations. These included:

- ICT Proposers' Day 2016 (September 26-27, Bratislava (Slovakia) - Incheba Conference Center): ICT Proposers' Day 2016 was held in Bratislava, Slovakia on 26 and 27 September. It was a networking event promoting European ICT Research & Innovation and focusing on the Horizon 2020 Work Programme for 2016-17. WT has participated in several bilateral meetings to share our H2020 expertise.

- Dell EMC Forum 2016 (November 29, Madrid (Spain) - Barclaycard Center): Dell EMC Forum is a unique day on technology in which ICT professionals learn about the main market trends, innovations related to cloud technology and innovative case studies, and share experiences and knowledge with leading specialists and other professionals of this sector. The cloud session was attended here.

3.2. Planned Communication Activities for Year 3
- Regular updates on the website and maintenance
- Regular updates of iCIRRUS social network pages
- Regular updates of PrimeTel Innovation Hub on iCIRRUS news
- Regular press releases in relevant magazines/website by all partners
4. **Standardisation Activities**

Several partners of the iCIRRUS consortium are heavily engaged in standardisation forums and represent the consortium. One of the main aims during participation is the attempt to support suggestions proposed in the standards with ideas that are backed up with validated outcomes and results of the iCIRRUS project.

4.1. **Key standardisation activities in Year 2**

Described below are the main activities that took place in Year 2 activities in the various standardisation bodies:

**Standardisation FSAN/ITU-T SG15Q2**

FSAN/ITU-T SG15 Q2 contribution in April, June, November 2016. Philippe Chanclou and/or colleagues from Orange led and/or contributed to the following activities:

i) Fronthaul transport over TDM, TWDM and PtP WDM PON
ii) Roadmap FSAN definition
iii) Mobile services

FSAN operators reviewed the latest draft of fronthaul white paper and agreed the following next steps:

- The fronthaul paper is mature, operators will complete and correct the current content and release it to all FSAN members by the end of 2016.
- Two follow-on white papers on fronthaul solutions will be developed jointly by operators and vendors, one on T(W)DM and another on PtP WDM. Vendor volunteer co-editors will be needed (to join AT&T, Orange, SK Telecom, China Telecom, China Unicom).

FSAN operators discussed the need for enhanced PtP and CWDM sub-band technologies and the potential implications on standardization:

- A standardized CWDM sub-band capability is needed.
- Enhancements to PtP standards are needed for 10 Gbps and beyond for business and backhaul
- Potential standardization paths were discussed. The preferred option was not yet clear since it depends on the relationship of a CWDM sub-band capability to existing NG-PON2 standards and to G.metro, and clarifying operator requirements.

**3GPP**

Close monitoring on the new fronthaul interface timeline for specification in 3GPP. This is managed for iCIRRUS mainly through the participation of Philippe Sehier, Nokia Bell Labs France, who is on the advisory board and has attended a number of our face-to-face and virtual meetings. IDCC has also closely monitored fronthaul related progress in 3GPP with the delegation of Jim Miller.
IEEE1914.3 (RoE) / IEEE1914 (NGFI)

The following participations and presentations took place:

Philippos Assimakopoulos (UniKent), Jörg-Peter Elbers (ADVA), IEEE1914.3 (RoE) / IEEE1914 (NGFI), 25-04 to 28-04-2016 San Jose, USA, Next Generation Fronthaul Interface Use Cases & Requirements.

Philippos Assimakopoulos (UniKent), IEEE P1914, 22-08 to 24-08-2016, Rungsted, Denmark, Presentation: Flexible Ethernet fronthaul

In addition to attendance from Philippos Assimakopulos (UniKent) and Jörg-Peter Elbers (ADVA), Philippe Chanclou (Orange) and Nathan Gomes (UniKent) monitor the activities, and Philippe Sehier (NBLF, advisory board member) is a regular attendee.

IEEE 802.1

The following participation and presentation took place:

Daniel Muench (ADVA), IEEE 802.1 Budapest, Hungary-05 to 26-05 2016, Discussion IEEE 802.1CM time-sensitive networking for fronthaul, 802.1Qbv time-aware shaper, 802.1Qbu frame pre-emption, 802.1Qch cycling queuing and forwarding.

While others in the consortium monitor activities, Daniel Muench (ADVA) is a regular attendee and feeds back more detailed information.

ITU-T Q13 (Synchronisation and Timing)

In ITU-T Q13 ADVA (Nir Laufer and Dominik Schneuwly) contributed to Inter-site Carrier Aggregation Synchronization, the G.8272.1 holdover specification, the PTP to NTP conversion and to recommendations for PRTC/ePRTC GNSS receiver configuration.

IEEE 1588

In IEEE 1588, ADVA (Opher Ronen) contributed an amendment to Optional Parameters of Layer-1 based synchronization performance enhancement and contributed to the organization of tree structure of data sets for management.

IEEE 802.11ay

IDCC contributed to 802.11ay by proposing novel beamforming and single-carrier waveform technologies for mmW systems. IDCC also provided mmW channel models for various 802.11ay related use-case scenarios.

IRTF

IDCC actively proposed new network virtualization technology enabler which are led by Akbar Rahman. IDCC provided contributions on network virtualization gap analysis with the technical whitepaper authored by Akbar Rahman et.al.

ETSI

In ETSI, IDCC’s proof-of-concept technology, “FLIPS-Flexible IP-based Services”, is accepted as the mobile edge computing technology demonstration platform. FLIPS is developed in-house at IDCC and now serves as the official platform for ETSI MEC technology verification.
4.2. Year 3 standardization considerations

The standardisation experts of the iCIRRUS consortium will continue to be active in the aforementioned standardisation bodies and working groups of interest. Moreover below is a list of additional possibilities for consideration to monitor and where possible contribute to the development of standards within the aforementioned activities in Year 3 of the project as well.

**Standards Organisation – Telecommunication Standardization Sector (ITU-T)**

ITU Telecommunication Standardization Sector (ITU-T) is one of the three units of the International Telecommunication Union (ITU). It coordinates standards for telecommunications. The ITU-T aim is to ensure the efficient and timely production of standards covering all fields of telecommunications on a worldwide basis. As part of its mission it targets to define also tariff and accounting principles for international telecommunication services.

**Expected Interactions**

- Fronthaul over Ethernet and to verify selected PLL multiplier/divisor settings. Contributions to ITU-T SG15Q13 Synchronization group
- ITU-T SG15 Q2 through FSAN (see below)

**Standards Organisation - Full Service Access Network (FSAN)**

FSAN has one main WG Optical Access Network (OAN) with tasks on Operation and Engineering and Next Generation PON (NG-PON) with leading members in the leading experts in BPON, GPON, XG-PON, XGS-PON and NG-PON2 technologies. FSAN has more than 70 member organizations, including more than 20 Network Operators. The FSAN member companies typically offer contributions to ITU-T SG15 Q2, based on completed FSAN work items that are intended to promote the development of global PON standards. The iCIRRUS consortium contributed heavily to this work in Year 2 and will continue to do so in Year 3. Some of the planned actions are listed here:

Planned meetings for Standardisation in FSAN/ITU-T SG15Q2 in 2017 include:

- April (Japan) : beginning of the edition of two new white paper about fronthaul for PtP WDM and T(W)M(A) technologies with vendors and clarification of ITU standardization effort for PtP WDM
- September (France) : consolidation of the white papers
- November (China) : finalization of the white papers

**Standards Organisation: IEEE 802**

The consortium is active in 802.1 Bridge Specifications, 802.3 physical layer, IEEE802.1TSN, interface specifications, modulation methods and MAC specification, and is part of the 802.11 Architecture Standing and IEEE 802 Executive Committees. In these WGs, the iCIRRUS consortium has a number of active members who plan to further contribute in activities related to Ethernet transport requirements, synchronization.
and mapping of Fronthaul/Midhaul into packet services; optical, high speed transmission. Interactions are expected in the following areas:

- **802.1** - Latency sensitive and specific Ethernet requirements to support Fronthaul and Midhaul
- **802.3** – High-Speed formats >100G, modulation schemes etc., possible compression facilities and interface mappings
- **802.11** - Wireless technologies that might require amendments to existing or new specifications for the backhaul, front haul or access. Moreover, since January 2017, there is an additional Technical Interest Group (TIG) for Light Communications (LC) in 802.11. It aims at bringing the technology further into the mass market. Fraunhofer HHI actively contributed to the discussion in TIG LC [TIGLC].
- **802.15** - In January 2017 Fraunhofer HHI (Volker Jungnickel, Pablo Wilke Berenguer, Dominic Schulz) has made a full proposal [TG7R1] to 802.15 in TG7r1 working towards a new standard for Optical Wireless Communications (OWC), which was embedded into the drafts D0 and D1 of the task group. The networking concept behind the proposal is a Cloud-RAN using the new functional split and a centralized control. In what follows, the drafts were commented by the task group and HHI participated in the comment resolution process. At the Atlanta Meeting, however, it was criticized at the working group level that the standard now covers two totally different technologies, i.e. optical camera communications (OCC) aiming at low speed and Li-Fi operating at high speed, and becomes overlong. Hence it was decided to split the task group accordingly and to offer the Li-Fi subcommittee the opportunity to form a new task group and make an own standard independent of 802.15.7 (i.e. no longer a revision) for Gigabit Optical Wireless Communications. A new PAR and CSD have been worked out and sent to the EC.

**Standards Organisation – 3GPP**

The 3rd Generation Partnership Project (3GPP) brings together partners from various telecommunications standard development organizations namely ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, and TTC, and offers an environment to support 3GPP collaborations and specifications. 3GPP has 3 Three Technical Specification groups namely on Radio Access Networks (RAN), Services & Systems Aspects (SA), Core Network & Terminals (CT).

**Expected Interactions**

- Eng Wei Koo (Viavi) is active in 3GPP RAN in the area of NGFI developments and will continue to participate and contribute in 2017.
- IDCC actively participates in 3GPP standardization, particularly in the areas of 5G NR. IDCC is currently the chair of RAN2 (Ms Diana Pati) and will monitor and provide contributions during 2017.
- IDCC is also actively involved in 3GPP RAN1 through the delegation of Shahrokh Nayed Nazar. Being one of the lead contributors to 3GPP RAN1, IDCC will continue to provide contributions to 3GPP which are relevant to ICIRRUS technology development and its
outcomes. The primary contributions will be in the areas of device-to-device communications and mmW technologies.
5. Exploitation Planning

The project consortium is placing significant emphasis on the exploitation of iCIRRUS outcomes and results.

In particular, and through the industrial partners, iCIRRUS is currently active in promoting and targeting the largest possible impact towards product development and standardisation.

Moreover, and mainly through the Academic partners iCIRRUS aims to address research exploitation plans by aligning future research and development activities, upgrading their research labs with equipment and setups to support future related research, hire new staff and research students to further support related key research areas.

These were successfully undertaken in Year 2, and even more weight on this task will be placed in Year 3 of the project.

Exploitation is mainly considered on an independent basis by an individual consortium partner, but joint consortium exploitation plans are also considered:

- **Individual exploitation** aims to improve mainly a company’s individual products and/or services both technologically as well as business wise (targeting improved customer satisfaction) and in the case of an academic partner/research institutes to improve upon their R&D engagement, facilities, labs, research direction etc.
  - **Industrial exploitation** plans relate specifically to companies and should elaborate on the way to best transfer project research R&D results and outcome into new products and services. Any technological advances resulting from this impact will provide a leadership position for the company in the new market. In this case the exploitation target audience can be internal to members of the consortium and stakeholders who are directly related to the iCIRRUS consortium partners, e.g. customers, clients, or external to a wider community, e.g., through standardisation.
  - **Academic exploitation** is carried out by universities and research institutes aiming at exploring novel approaches and innovative solutions, to improve their research direction, methods, strategies, facilities and research groups’ knowledge. Associated knowledge will also be passed on to postgraduate as well as undergraduate students and in case of novel ideas patent applications will be filed. In this case, the exploitation target audience are the academic staff members, research staff, postgraduate student and undergraduate students.

- **Joint consortium exploitation** targets common exploitation plans where possible, e.g. exploitation of the proposed architecture. This could involve separate agreements between partners, to further exploit outcomes after the end of the project. It could even contain a mix between industrial and academic partners, particularly if developments were achieved by the academic partners as key test results or prototypes.

Figure 5 shows the split between Academic and Industrial partners.
The following sections report on the partner’s individual intentions to exploit the iCIRRUS solution and the project results with respect to business considerations and plans.

5.1. **Industrial Exploitation**

Each partner has already generated an exploitation plan which is included in D6.2 [D6.2]. Moreover, each partner has been active in Year 2 updating their proposed plans according to the project’s progress and new findings.

5.1.1. **Wellness Telecom Exploitation Plan**

Wellness Telecom is a company that specializes in New Technologies for Telecommunications. It works to put the potential of telecommunications services and technology at the service of our more than 100 customers for improving competitiveness, productivity and security of IT processes.

WT has a complete catalogue of services and solutions, adapted to companies and organizations’ needs in order to improve their efficiency and competitiveness such as communications consultancy, unified communications or cloud computing services. In the framework of iCIRRUS, the main targeted sectors for WT are:

**Network and IT Systems**

- WT offers an expert comprehensive consultancy service on telecommunications and IT Systems.
- WT provides tangible solutions on deployment and maintenance of infrastructures, no matter the size.
• WT assists companies to offer the best service, to improve their productivity and to save costs.

**Cloud Computing**

• WT created the first cloud in the South of Spain
• Companies can contract IT resources
• Systems can be deployed rapidly, both infrastructure and software solutions

The business cases described below come to leverage WT’s business strategy, aimed at providing a strong, on-trend commercial offer. From Wellness Telecom innovation area, we coordinate the relation between marketing and business unit dealing with network areas to transfer the knowledge, collect their needs and study the product exploitation possibilities.

According to the results expected from the project, 2 business cases are of commercial interest for Wellness Telecom:

**Exploitation related to the WT business case 1: Clone as an IaaS**

As a CSP, WT is interested in providing a Mobile Clone Service to complete its offer and catalogue for one of its key clients: communications operators. This business case gives the Communications Operators the business opportunity to foster the provision of this service to their clients and to keep their infrastructure up-to-date.

This service is strongly aligned with WT’s strategy as a CSP, becoming a key product in order to define a penetrating commercial strategy towards Communications Operators.

The competitive advantages of these products for WT’s clients, under a B2B model, are:

• Distinctiveness: value added for final users (battery life and storage of multimedia content). Improved loyalty policies.
• Cost reduction: efficient usage of bandwidth.
• Optimization of resources for processing tasks.
• Adaptation to new solutions and trends: mobile clones may progressively become a commodity, required by final users.

**Differential value proposition**

Compared with an alternative approach, such as Mobile Bank-end as a Service, iCIRRUS clone-based solution is enriched by the implementation of an intelligent system in the cloud, able to perform a real-time analysis of traffic and load. Indeed, iCIRRUS solution provides an offloading task as a controlled, intelligent process, designed to improve the performance of the system, without causing any disturbance.

**Exploitation related to the WT business case 2: Corporate Mobile Clone**

The second business case focuses on a solution for corporate environments. “Corporate Mobile Clone” is a new service for those companies which want to improve their Enterprise Mobility Management
Our proposal is based on the concept BYOM: the employees are invited to use their own mobile devices at work, by means of a partition aimed at host all the corporate information and tools.

In this way, all the corporate content is contained in the mobile clone, while the employee can access it through his or her own mobile device by the use of corporate tools. This corporate content is kept safe in the cloud, easily deployed in a new mobile device and rapidly updated and maintained without the need to perform any action on every mobile device. Additionally the content could be removed or anonymized (clone disassociated from the device) when the employee leaves the enterprise.

The competitive advantages that this service can offer to WT’s clients are:

- Control of corporate resources
- Security
- Productivity: easy deployment of corporate tools in every new device
- Employee’s satisfaction: the company does not impose the use of a specific device

This service perfectly fits into WT’s commercial offer. In fact, Wellness Telecom already provides a specific service aimed at preserving organizations’ data, by means of back-up copies conveniently saved and protected, as knowledge and information is a key resource for any company. With this new service, WT will provide a global, on-trend solution, aimed at satisfying the new needs born from mobility trends, as it is based on cutting-edge, sustainable technologies, with a promising evolution within the following years.

**Differential value proposition**

Based on the previous analysis, we consider that virtualization tools applied to corporate environments are direct competitors for this business case, as they come to solve the same specific need, from a functional point of view. However, our clone-based solution includes an additional intelligence, as the system will evaluate and analyze the suitability of offloading a certain task. And it does not only observe the situation of the device or the characteristics of the specific task, but also the situation of the network and servers that are supposed to support the process. Therefore, our solution can guarantee efficiency and a good user experience, as it takes the network into consideration.

**5.1.2. ADVA Optical Networking SE (ADVA)**

ADVA Optical Networking SE (ADVA) is a global provider of telecommunications equipment. With innovative Optical, Ethernet and Control transport solutions, ADVA SE builds the foundation for high-speed, next generation networks. The company’s FSP product family adds scalability and intelligence to customers’ networks while removing complexity and cost. ADVA SE is a global market leader in Ethernet Access Devices. The combination of Optical and Ethernet transport technologies, programmable edge devices, and a powerful software virtualization and control is a key success factor for future converged 5G access networks.

The intention of ADVA Optical Networking as a telecom system vendor is to investigate the architecture proposed in iCIRRUS to explore the application of existing and future potential product
features for Carrier Ethernet and Time Sensitive Networking for mobile fronthaul network applications.

5.1.3. Orange S.A. (Orange)

Orange is undertaking some field trials of BBU hotel with existing commercial equipment in C-RAN and vRAN context. C-RAN and vRAN are gaining great interest and have potential gain to bring reduced costs, improved performance and fixed/mobile convergence. Cost benefits come from the fact that leaving on site only RUs with compact power supply, cell site engineering is simplified, footprint is reduced, time to install and to repair are shorter and renting cost is lower. This is especially true in dense urban areas where operational people face more and more roll out difficulties. Additional economies will come from significant reduction of power consumption and are expected with DU pooling (lower DU capacity to support same number of sites). Radio performance gains and better performance in mobility are enabled by Coordinated Multi-Point (CoMP) implementation thanks to the very low latency between DUs in the same CO (or DU pool). vRAN is a novel architecture that aims at bringing cost and efficiency benefits compared to legacy RAN by use of the virtualization model. It aims at offering flexible, scalable, and on-demand RAN resources, dynamically adapted to geographical and temporal load variations.

In this context, if an iCIRRUS prototype is sufficiently mature for application in the field, Orange will consider this opportunity. In any case, a laboratory trial is considered during the project. The laboratory trial will be equipped with:

- Commercial RAN equipment BBU&RRH from NOKIA and E///: compatible for CPRI over Eth.
- Radio test equipment:
  - Using Rohde & Schwarz SMW20A vector signal generator and FSW signal and spectrum analyzer: generation of RF signal 4G or 3G
  - CPRI testers VIAVI, EXFO, Anritsu, Absolute Analysis) with and without spectrum analyzer and BBU/RRH emulator.

The evaluation of services over RAN could be performed only with commercial RAN equipment in order to address the regular EPC.

5.1.4. Telekom Slovenije, d.d. (TS)

Telekom Slovenije is the national leading telecommunications operator, delivering a comprehensive portfolio of fixed-mobile services and state-of-the-art Information and communications technology solutions via its modern proprietary network.

With the possibility to operate with a wide range services and infrastructure, we are continuously looking for the synergy benefits of network and technology diversity and interconnection. New services deployment, network capacity, efficiency and overall cost optimization is a continuously running progress.

From this perspective, being part of the iCIRRUS project is very valuable for TS. All knowledge, technical possibilities and issues identified in the project are very useful for the future network
evolution. Research on: C-RAN, cloud services and high throughput mobile communication are in our focus and we expect direct and indirect exploitation effect of the project results.

5.1.5. PrimeTel PLC (PTL)

PrimeTel PLC is an electronic communications and information technology company established in Cyprus on the 18th of June 2003. It develops and offers Fixed and Mobile Telephony, Internet and TV. The company is licensed by the Office of the Commissioner of Electronic Communications and Postal Regulation (OCECPR) to establish and operate a fixed public telecommunications network and to provide fixed-line electronic communications.

PrimeTel delivers innovative services to consumers thanks to its autonomous island-wide fiber-optic network that also allows it to compete on differentiation and operate with higher capital efficiency. PTL’s network infrastructure currently reaches more than 300,000 premises in the Republic of Cyprus. The company also offers a wide range of broadband services for the corporate and residential market. PTL owns and operates an international network, providing network connectivity, data communications and IP-based services with a constant commitment to provide comprehensive solutions with competitive packages of broadband services. The range of products offered by PTL also includes mobile and fixed telephony, IPTV and WiFi hotspots throughout the island. PTL is a pioneer in telecommunications in Cyprus, with additional products such as automotive fleet monitoring and management, VPN subscriptions, the only SMS API in the island and other.

As a service provider, PrimeTel maintains a high-performance data centre in its premises offering various services such as IPTV, online storage and web hosting. In the mobile area, PrimeTel offers mobile telephony and broadband Internet as a Network Operator. In order to cope with the increasing high capacity, high power efficiency and low operational cost demands, all operators should have green strategies for their Radio Access Network deployments and operations. A great percentage of power consumption is spent in the base station cell.

As mentioned in D6.2, according to China Mobile, the CRAN can help mobile operators save up to 15% CAPEX and 50%. OPEX compared to distributed BTS 3G networks. Also, a CRAN is estimated to save up to ~70% energy consumption compared to traditional RAN systems. PrimeTel is already investigating the exploitation of the latest project developments and in exploring the use of Ethernet in the CRAN “fronthaul”. Some of the benefits that Primetel is interested in for benefits of the use of Ethernet in C-RAN are for intelligent monitoring, control and management of all the functions.

PrimeTel is very interested in the use of the proposed mobile clone mobile cloud solutions particularly for better service provisioning to customers as well as improved energy saving solutions. In Year 2, further progress has been achieved in this area and initial results illustrate that it is worth investigating mobile cloud architectures as proposed and worked on in iCIRRUS. In Year 3, the consortium will continue to work on the proposed solutions targeting reduced latency, improved performance and hence improved quality of service. Also with elastic mobile cloud computing, new on demand services will arise offering more ‘per usage’ type of services for mobile subscribers.
5.1.6. Viavi Solutions (VIAVI)
Viavi Solutions Inc’s Network and Service Enablement Business provides end-to-end solutions for network test, monitoring and assurance to communications service providers and enterprises and their ecosystems worldwide that provide in-depth performance visibility and analytics.

Within iCIRRUS, the work of Viavi includes provision of expertise and access to test equipment for all the aspects of the communications link OAM life-cycle from development/lab test, through turn-up test and assurance. In particular, Viavi is customising its Packet Portal probe-based measurement system to collect performance information from the Ethernet-based fronthaul together principally with UniKent, but which will be deployed also in the operator testbeds. Additionally, Viavi will be applying its subscriber-centric radio network optimisation approach to the issue of joint RAN and fronthaul optimisation.

The exploitation of the research and development within the iCIRRUS project is assisting with the understanding of the potential market directions in the test and assurance space where the necessity of deploying Time Sensitive Network Ethernet techniques as a whole or in part to support fronthaul is a topical issue. Additionally, the research is helping to illuminate the potential for joint RAN-fronthaul optimisation.

5.1.7. IAF GmbH Future Radio Technology (IAF)
The company IAF is a developer of system solutions for future wireless standards. Our main fields of work are hardware development, digital signal processing algorithm development and system integration. Within iCIRRUS the work of IAF includes the hardware development and production of the iCIRRUS FPGA platform and the development and implementation of signal processing algorithms for the Ethernet based fronthaul. The iCIRRUS FPGA hardware platform will be used together with the partners ADVA, TS, HHI and UKent for realisation of testbeds.

The exploitation of the research and development within the iCIRRUS project will lead to product development particular for the following applications:

- 5G hardware platform: the iCIRRUS FPGA platform with embedded ComExpress is well-suited for many applications in the area of 5G mobile communication: CPRI /Ethernet conversion with synchronized Ethernet, software defined base station development with 5G enhancements like new fronthaul via Ethernet with functional split, media conversion 10G Ethernet/100 G Ethernet / CPRI

- CPRI / Ethernet conversion IP: development of CPRI Ethernet conversion based on synchronized Ethernet with PtP for realisation of Ethernet based new fronthaul. This implementation will be done on the iCIRRUS FPGA platform, but it is also portable to, other hardware platforms

5.1.8. InterDigital Europe LTD (IDCC)
In Y2, IDCC pursued its effort to integrate device virtualization and cloning technology with its mobile edge computing technology platform called FLIPs. In this regard, FLIPs platform is enhanced to incorporate operating system mirroring and distributed computation features, which are the essential
blocks of iCIRRUS device virtualization technology. In Y3, IDCC is planning to have an integrated solution where its FLIPs platform hosts and enables the functionalities of iCIRRUS device virtualization solution.

5.2. Academic Exploitation

5.2.1. University of Kent (UniKent)

The Communications Research Group in UniKent has significant expertise on wireless and fibre-wireless communication systems. UniKent is keen to integrate developed techniques and algorithms into practical systems.

For example, currently, UniKent is starting to work on testing the performance of a resource management (RM) scheme for device-to-device communications in LTE software base station platforms, as well as working with TS to evaluate the practical signalling overhead for developed D2D discovery and RM algorithms, in order for TS to set up its own business model for D2D applications. It has also been working on a fronthaul testbed using software base stations, functional splitting, software (SDN) control of switches in an evolved fronthaul, and algorithms for queuing and buffering of packets in a time-sensitive fronthaul. Exploitation of all of these developments is of interest, including through working with project partners such as Viavi and ADVA.

On the other hand, UniKent is a European university with several campuses in different European countries. Providing taught modules covering advanced technology to students and training the next generation of researchers for future communication and networking is one its important goals. The testing platform set up for iCIRRUS is being used for student projects and skills training to enhance their knowledge, which will be very valuable in their future career development.

5.2.2. Fraunhofer Heinrich-Hertz- Institute (HHI)

HHI has been very active in Year 2 in promoting iCIRRUS research results in outcomes in major events including OFC and ITG. As part of the Fraunhofer research organisation, HHI’s remit is to work for the benefit of industry and societal needs. Members of staff are engaged in both research as well as teaching and have the opportunity to incorporate major findings, which have been accepted by the wider community as part of its programs’ syllabuses. By including latest cutting edge and novel technologies engagement as part of its research and teaching HHI is able to open research positions at the master (postgraduates), PhD and beyond PhD levels, as well as make undergraduate teaching material more attractive by incorporating the latest hot topics and associated activities in the area. In Year 2 one master thesis had been finalized which focussed on the realisation of a modified functional split between baseband unit and remote radio head for an Ethernet-based fronthaul.

Strategically, Fraunhofer HHI also aims to foster its research areas making the most of the work performed in iCIRRUS and thus develop new ideas for new project research proposals both on the international and national levels. During the second year, the SESAM project proposal for the German Ministry of Education and Research (BMBF in German) was further processed. The project focused on the further investigation of an intelligent C-RAN architecture for indoor visible light communication application. Additionally, HHI submitted another project proposal in the Horizon 2020 ICT call for the further investigation of aspect initially developed in iCIRRUS.
HHI aims also to exploit the strong synergy it has with the projects consortium partners. Especially in the case of industrial partners HHI gains the opportunity to validate new developments and prototypes, have the opportunity to promote fully fletched solutions developed and in general have industrial engagement. This does not only apply for iCIRRUS outcomes but the collaboration could be exploited further in other areas of mutual interest.

For instance, HHI has worked closely with IAF and ADVA on the development of the iCIRRUS demonstrators, and sees significant potential for joint exploitation. Secondly, during the realization of the project and in its context, HHI has also made new contacts which have opened new business opportunities.

5.2.3. University of Essex (UEssex)

Being an executive member and a founding member of the IEEE Intercloud initiative, jointly sponsored by the IEEE Cloud Computing Initiative, IEEE Cloud Computing Standards Committee, and IEEE Standards Association, UEssex aims to engage in providing maximum impact based on insights from iCIRRUS outcomes and results. This initiative also aims to create a global lab to prove/improve technology and provide a springboard for the Intercloud to become a commercial reality and UEssex is engaged in contributions towards this, something which can then be exploited for further research and development.

With regards to novel technologies, research achieved within iCIRRUS and more specifically innovation on mm-wave wireless technologies emerging from WP4, as well as the 5G architectures from WP2, will be exploited by the Access Networks Group (ANG) of the photonics research team within the school of Computer Science and Electronic Engineering (CSEE), for the provisioning of novel postgraduate research topics. In the case of major impact and standardization influence, the relevant contributions from iCIRRUS could also be incorporated on the undergraduate programs, research masters degrees, and PhD programs as part of the syllabus. Based on this, new research positions could also be opened in these areas within ANG.

UEssex hosts business and technology meetings on a regular basis and will use these to promote the iCIRRUS vision to business leaders and infrastructure providers, for example, UEssex is also active in promoting rural broadband and the use of iCIRRUS technologies will help provide future-proof throughput to sustain business growth in the local county of Essex region and beyond. The business outreach unit at UEssex at will aim to patent novel ideas arising from the research, and to exploit opportunities for licensing of patent ideas and/or setting up spinout ventures for this exploitation.
6. Conclusion

This Deliverable report has summarised the main activities of the project involving dissemination, communication, standardisation and exploitation that took place in the 2nd Year of the project.

With respect to dissemination, the consortium was highly active submitting quite a number of high quality publications in major conferences including OFC 2016, VTC 2016, ICC 2016, EuCNC 2016, ECOC 2016, ICTON 2016 and CISS 2016.

Moreover, it submitted several scientific articles in prestigious journals namely OSA/IEEE Journal of Communications and Networks, IEEE Transactions on Cloud Computing and Journal of Optical Communications and Networking.


Besides “competitive call” conference paper submissions, there have also been quite a large number of invited talks and presentations at various events, conferences and workshops including 5G PPP 1st 5G Architecture Workshop, 2nd OAI Workshop EURECOM France, 5G World London, NGON, ECOC 2016, EuCNC 2016, WWRF #37. For the last three iCIRRUS organised and/or co-organised Workshop sessions namely the:

- Workshop WS03 “Short range optical transmission for emerging 5G fronthaul, DCI and Metro Networks”, at the ECOC 2016, Düsseldorf, Germany, 17-22 September 2016.
- Workshop co-organised by iCIRRUS, “Towards Converged X-Haul for 5G Networks – A joint workshop of the iCIRRUS, 5G-XHaul and 5G-Crosshaul projects”, at EuCNC 2016 Athens, Greece, Workshop
- Organised Workshop by iCIRRUS, WWRF 37 (New Businesses empowered by 5G) University of Kassel, Germany, Special Session “Next generation Ethernet-based fronthaul/xhaul”.

With this achievement, the iCIRRUS consortium has already addressed its targeted workshop objectives of the project.

The communication related activities were also described relating to the website, the social network sites, the iCIRRUS brochure and relevant updates in each case. Effort is placed to maintain these pages up to date with the latest news updates of the iCIRRUS project. An associated article on iCIRRUS was also published in the Adjacent Government e-magazine, May 2016.

The deliverable also summarised the participation in standardisation bodies which took place in Year 2 and additional considerations for Year 3. In Year 2 the iCIRRUS consortium contributed and had impact in the following standardisation bodies FSAN/ITU-T SG15Q2, IEEE1904.3 (RoE)/ IEEE1914 (NGFI), IEEE 802.1, 3GPP, IEEE1914.3 (RoE) / IEEE1914.1 (NGFI), IEEE 802.1, ITU-T Q13 (Synchronisation and Timing), IEEE 1588, and IEEE 802.11ay.
Finally, both industrial as well as academic partners described their exploitation plan updates based on the new insights obtained during Year 2 emphasising on the maximum possible impact by their organisation.
References


[ECOC] ECOC - European Conference on Optical Communication - Online – Available at: http://www.eurel.org/home/Events/SC/Pages/ECOC.aspx


[AGEM] Adjacent Government e-magazine, May 2016 edition (p. 286-287) Available at: adjacentgovernment.co.uk

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List of Figures

Figure 1: iCIRRUS Website: Homepage ................................................................. 17
Figure 2: iCIRRUS Website: Latest News ............................................................... 18
Figure 3: iCIRRUS Facebook Page ........................................................................ 18
Figure 4: iCIRRUS LinkedIn Group ...................................................................... 19
Figure 5: iCIRRUS Consortium .............................................................................. 27

List of Tables

Table 1: Scientific Journals ...................................................................................... 14
Table 2: Scientific Conferences ............................................................................... 14
Appendix I

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