Coordinated Control and Spectrum Management for 5G Heterogeneous Radio Access Networks

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Authors

Mariana Goldhamer (4GC, Editor-in-Chief); Antonio Cipriano, Dorin Panaitopol (TCS); Adrian Kliks (PUT); Tao Chen, Aarne Mämmelä (VTT); Fang-Chun Kuo, Kostas Pentikousis (TP); Navid Nikaein (EUR); Roberto Riggio (FBK-CNET); George Agapiou (OTE); Heikki Kokkinen (FS)

Coordinator

Dr. Tao Chen

VTT Technical Research Centre of Finland Ltd

Tietotie 3

02150, Espoo

Finland

Email: tao.chen@vtt.fi

Disclaimer

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Version history

Version	Date	Remarks
0.1	15.2.2018	ToC issued
0.2	14.3.2018	Content issued
0.3	26.3.2018	Addressed comments in first review
0.4	13.4.2018	Addressed comments in 2nd review
1.0	17.4.2018	Final version

Executive summary

This Standardization Report presents the COHERENT activities in 3GPP RAN, RAN1, RAN2 and RAN3, ETSI BRAN and ECC PT1 aiming to introduce within standards and spectrum regulations the architecture and the protocols developed in COHERENT. The Report contains a description of the relevant Work/Study Items and includes the list of contributions submitted by the COHERENT partners.

COHERENT had a remarkable standardization activity, providing more than 80 contributions to 3GPP, ETSI and ECC PT1. The interaction with the 5G standardization activity has allowed to address in WP2, WP3 and WP4 a number of topics related to the active 5G Work Items.

It deserves a special attention on the standardization activity in ETSI, where COHERENT's partner 4GC together with supporting partners THALES, FS and FBK has initiated a Work Item finalized with the publication of ETSI TR 103 494 on Central Coordination in 5GHz.

This report includes the description of the target SDOs, their relevant committees and Work Items, followed by the list of attended meetings and contributions. Finally is presented some of the project impact.

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List of abbreviations

3GPP	3d Generation Partnership Project
C3	Central Control and Coordination
MP	Coordinated Multi Point
CP	Control Plane
CT	Core Network and Terminals
D2D	Device to Device
DRB	Data Radio Bearer
DySPAN-SC	Dynamic Spectrum Access Networks Standards Committee
ECC	Electronic Communications Committee
ECO	European Communications Office
EDGE	Enhanced Data rates for GSM Evolution
eNodeB	LTE base station
ETSI	European Telecommunications Standards Institute
E-UTRA	Evolved Universal Terrestrial Radio Access
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
F1	Fronthaul 1
F1-U	Fronthaul 1-User plane
FDD	Frequency Division Duplex
FFS	For Further Study
gNB	new generation Node B
HMN	Heterogeneous Mobile Networks
IAESI	Israeli Association of Electronics and Software Industries
ICT	Information and Communications Technologies
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IMT	International Mobile Telecommunications
IP	Internet Protocol
ISG	Industry Specification Group
ITU	International Telecommunication Union
LTE	Long Term Evolution
MFCN	Mobile/Fixed Communications Networks
mMTC	massive Machine Type Communications
NFV	Network Functions Virtualization
NFVRG	Research Group on Network Functions Virtualization
O&M	Operations and Management
OAM	Operations and Management, abbreviation used in 3GPP

NG	New Generation
NGN	Next Generation Networks
PHY	PHYsical layer
PT	Project Team
QoS	Quality of Service
RAN	Radio Access Network
RAT	Radio Access Technology
RLAN	Radio Local Area Network
RP	RAN Plenary
RPa	RAN Plenary Ad-Hoc
RRM	Radio Resource Management
RWS	RAN WorkShop
SA	System and Service Aspects
SDN	Software Defined Networking
SDNRG	Software Defined Networking Research Group
SDO	Standards Developing Organization
SI	Study Item
SID	Study Identification
SON	Self Organizing Network
TDD	Time Division Duplex
TB	Technical Body
ToR	Terms of Reference
TP	Transmission Point
TR	Technical Report
TS	Technical Specification
TSG	Technical Specification Group
UE	User Equipment
URLLC	Ultra-Reliable and Low Latency Communications
UP	User Plane
UTRAN	Universal Terrestrial Radio Access Network
WAPECS	Wireless Access Policy for Electronic Communication Services
WAS	Wireless Access Systems
WG	Working Group
WI	Work Item

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1. Introduction

COHERENT has targeted contributions to standardization mainly in 3GPP, ECC PT1 and ETSI BRAN.

In this document we provide an overview of the relevant standardization bodies, the relevant study items at this time and the already submitted contributions. In addition the partners' planned involvement in standardization is presented.

2. Bodies and groups of interest

We have identified below several standardization organizations which could benefit from the results of the COHERENT outcomes.

2.1 Wireless communications bodies

2.1.1 3GPP

2.1.1.1 Description (see [1])

3GPP produces Technical Specifications, to be transposed by relevant Standardization Bodies (Organizational Partners) into appropriate deliverables (e.g., standards). The six 3GPP Organizational Partners - from Asia, Europe and North America - determine the general policy and strategy of 3GPP. The organisational partners are shown in Fig. 1.

Figure 1 Organisational partners of 3GPP

Historically, 3GPP is the result of the cooperation agreements between ETSI (European Telecommunications Standardisation Institute) and the other partners. ETSI provides the support for 3GPP operation at the level of Secretariat and Testing specialists.
Any enterprise or academic body shall be a member of one of the above organisations for being allowed to participate in 3GPP work. The main difference between the ETSI rules and 3GPP rules is the weight of voting; in 3GPP every participant has a one vote, while in ETSI the voting rights depend on the enterprise income.

At the end of March 2018, the three Technical Specification Groups (TSG) in 3GPP are Radio Access Networks (RAN), Service & Systems Aspects (SA) and Core Network & Terminals (CT). Each of the three TSGs has a set of Working Groups, which meet at least four times a year. The Working Groups of interest to COHERENT are in RAN and SA areas and are shown below.

RAN Plenary
RAN Plenary has in its work scope the approval of the work programme, including the Work/Study Items (WI/SI) and the outcome of the work program executed in the subordinated Working Groups. However, the important Technical Reports (TR) addressing the 5G scenarios and requirements were

also developed in the RAN Plenary group. This work had involved an intensive activity in RAN e-mail list.

Working Groups

RAN WG 1

RAN1 is in charge of standards development pertinent to the physical layer of the Uu radio interface for UE, UTRAN, Evolved UTRAN, and beyond, covering both FDD and TDD modes, as well as the physical layer of the Un Interface for Relay Nodes. The work in RAN WG1 includes especially:

- Specification of physical channel structures
- Specification of the mapping of the transport channels onto physical channels
- Specification of the physical layer multiplexing, and channel coding and error detection
- Specification of the spreading and modulation
- Specification of the physical layer procedures
- Specification of definition of measurements and their provision by the physical layer to the upper layers RAN WG1 also carries out work related to handling of the physical layer related UE capabilities and to physical layer related parameters used in UE tests developed in TSG RAN.

RAN WG 2

RAN2 is in charge of standards development pertinent to:

- Specification of the radio interface architecture and protocol termination
- Specification of radio interface protocols between UE and RAN,
- For EUTRAN (LTE), specification of the radio interface parameters to be exchanged between eNodeBs in case of inter eNodeB handover
- Stage 2 Specifications of the services offered by the physical layer to upper layers
- Specification of Cell selection and re-selection procedures
- Specification of UE capabilities for UE - RAN interface (in collaboration with RAN WG1 for Layer 1 capabilities)
- Definition of Radio Resource Management (RRM) strategies to be supported by RAN
- For EUTRAN, specification of radio interface protocols between UE and positioning server
- Specification of radio measurements reported to the O&M domain and the radio interface protocols used to collect them.

RAN WG 3

RAN3 is in charge of the following interfaces relevant to COHERENT:

- Overall UTRAN and E-UTRAN architecture
- Synchronisation in UTRAN and E-UTRAN
- UTRAN and E-UTRAN OAM requirements
- Transport of implementation specific O&M between the Management System and Node B
- S1 and X2 interface protocol specifications including O&M aspects
- LTE Positioning Protocol A

RAN WG 4

RAN WG4 works on the Radio Frequency aspects of UTRAN/E-UTRAN. RAN WG4 performs simulations of diverse radio frequency system scenarios and derives the minimum requirements for transmission and reception parameters, and for channel demodulation.

RAN4 is responsible for:

- Radio specification for the Base Station and evolved Base Station, Repeater and Evolved Repeater, Terminal and evolved Terminal.
- Radio Link requirement specification
- Cell selection/reselection performance requirement specifications
- Performance requirements in support of Radio Resource Management

- Specification of the accuracy of measurements offered by the physical layer to the upper layers Radio system scenario analysis and simulation

SA (System and Service Aspects)

The TSG Service and System Aspects (TSG-SA) is responsible for the overall architecture and service capabilities of systems based on 3GPP specifications and, as such, have a responsibility for cross TSG coordination.

The following WGs are relevant to COHERENT:

SA WG1 (Services)
SA1, essentially the Operator-driven WG, is responsible for:

- Specification of features and use cases (stage1).
- Specification of services (stage 1).
- Specification of service capabilities (stage 1).
- Identification of requirements to support service operation.
- Identification of requirements for service interworking.
- Identification of requirements for service interoperability between networks.
- Charging and accounting requirements

SA WG2 (Architecture)
SA2 is in charge of developing the Stage 2 of the 3GPP network. Based on the services requirements elaborated by SA WG1, SA WG2 identifies the main functions and entities of the network, how these entities are linked to each other and the information they exchange. The output of SA WG2 is used as input by the groups in charge of the definition of the precise format of messages in Stage 3 (Stage 2 for the Radio Access Network is under TSG RAN's responsibility). The group has a system-wide view, and decides on how new functions integrate with the existing network entities.

2.1.1.2 Responsibilities in COHERENT

4GC coordinated the COHERENT standardisation work by proposing contributions in different meetings of the above-mentioned WGs. Furthermore 4GC submitted and supported these contributions in the 3GPP meetings.

2.1.2 ETSI

2.1.2.1 Description (see [2])

ETSI produces globally-applicable standards for Information and Communications Technologies (ICT), including fixed, mobile, radio, broadcast and Internet technologies. Our standards enable the technologies on which business and society rely.

ETSI is officially recognized by the European Union as a European Standards Organization.

2.1.2.2 ETSI BRAN

After the plenary meeting in June 2016, the ToR of BRAN includes the following activities:

- lower layer protocols;
- architectures, transmission and inter-working aspects;
- aspects of transport network interfaces related to architectures and protocols

which are suitable for COHERENT architecture and network graphs for coordination of heterogeneous networks.

2.1.2.2.1 Responsibilities in COHERENT

4GC (Mariana Goldhamer) was responsible with the drafting of contributions and support through ETSI process of the intended standardization.

2.2 Regulatory activities

WP4 focuses on the spectrum aspects in the context of future wireless systems, and as such it can provide contributions for regulatory area. Experiments envisaged in WP4 should be in the range of key international players in spectrum area. In particular, a specific task **T4.3 "Micro-area spectrum sharing and protocol development in HMNs",** includes an area of activities which may have a significant impact on the regulatory European activity: spectrum can be used with a flexible duplexing approach, implying the usage of FDD up-link channel for downlink transmissions, either as additional downlink or as secondary TDD cells. The target European regulatory body is ECC PT1.

2.2.1 Electronic Communication Committee (ECC)

2.2.1.1 Description (see [3])

The ECC considers and develops policies on electronic communications activities in European context, taking account of European and international legislations and regulations. ECC Project Team 1 (ECC PT1, IMT Matters) is responsible for implementing the WAPECS concept (the new European flexible approach based on technology and service neutral regulation) for mobile and fixed communications networks (MFCN) [1].

2.2.1.2 Responsibilities in COHERENT

4GC has led COHERENT contributions related to flexible duplex to be submitted to ECC PT1.

2.3 IETF and IRTF

2.3.1 Description

The **Internet Engineering Task Force (IETF)** focuses on issues of engineering and standards making and is the reference body for the standardization of protocols for the Internet while the parallel organization, the **Internet Research Task Force** (**IRTF**), focuses on research issues related to the Internet.

IRTF set up two dedicated research groups to coordinate pre-standardization of research lead initiatives in the SDN and NFV areas, namely Software-Defined Networking Research Group (SDNRG) and Network Function Virtualisation Research Group (NFVRG). The former group investigates SDN from various perspectives with the goal of identifying the approaches that can be defined, deployed and used in the near term as well identifying future research challenges. NFVRG brings together researchers and grows the community around the world in both academia and industry to explore research directions on NFV-related topics.

2.3.2 Responsibilities in COHERENT

EICT assumed initially the leading role in advancing research outcomes towards the expert groups in IETF and IRTF, aiming to adopt Internet Drafts by the respective groups. However EICT has reduced its activities in WP7, including in standardization, and in addition by June 2016 we did not find any wireless-specific activity in IETF SDNRG group. As result, we did not participate in IETF.

2.4 IEEE Dynamic Spectrum Access Networks Standards Committee

2.4.1 Description

Following the official web site (see [7]) of the IEEE Dynamic Spectrum Access Networks Standards Committee, the members of this committee work on new standards "in the areas of dynamic spectrum access, cognitive radio, interference management, coordination of wireless systems, advanced spectrum management, and policy languages for next generation radio systems"

The committee is working on the development of the whole family of standards devoted to cognitive systems and dynamic spectrum access. In that context, COHERENT results on the new system architecture including advanced radio access approaches, as well as developments on sophisticated spectrum sharing scenarios fall into the range of interest of IEEE DySPAN.

2.4.2 Responsibilities in COHERENT

PUT, as an active member of the IEEE DySPAN-SC, has led the COHERENT involvement in DySPAN-SC working groups, especially focusing on the spectrum usage aspects and our vision of network architectures.

3. High level overview of the topics of interest

3GPP, ETSI and ECC PT1 were the main target of COHERENT standardization activity.

3.1 Strategy in 3GPP

Our strategy, which was already applied in our contributions, targets to maximise the project impact on 3GPP, with a focus on RAN standardisation. We followed the steps below:

1. Identified the relevant open Work/Study Items
2. Announced the topics suitable for the next meeting
3. Distributed the next meeting agenda when available
4. Coordinated (4GC) with the partners the possibility of contributions
5. Initiated contributions, in general by 4GC, and encouraged the large participation of partners
6. Brought the contributions to the final forms, by incorporating the comments or text provided by partners
7. Participated in meetings for supporting the contributions
8. All partners attending a standardization meeting provided meeting reports, including the submitted contributions and targets for the next meeting.

3.1.1 Relevant Release 14 Study/Work Items

Due to problems related to the resource allocation in 3GPP meetings, the approval of some WI/SI targeting Release 14 was delayed. The WI/SIs approved by the SA Plenary in March 2015 and RAN Plenary of Dec. 2015 for Release 14 and relevant to COHERENT are reproduced below. A similar identification has been made after the March 2016 RAN Plenary meeting and in 2017 for Release 15.

3.1.1.1 Study on Scenarios and Requirements for NG Access Technologies [5]

Objective:
“The study item aims to develop deployment scenarios and requirements of next generation access technologies, and to provide guidance to the technical work to be performed in RAN WGs. In order to achieve this, the study item should fulfil the following objectives:

- Identify the typical deployment scenarios associated with attributes such as carrier frequency, inter-site distance, user density, maximum mobility speed, etc.
- Develop specific requirements for next generation access technologies for the identified deployment scenarios.

To complete the above work, the inputs from other organizations could be referred to.”

We contributed to this study in RAN meetings and through email activity.

3.1.1.2 Study on New Services and Markets Technology Enablers [6]

This SA1 SI is known as ”SMARTER”.

"The objective of this study is to **develop high-level use cases** and **identify the related high-level potential requirements** to enable 3GPP network operators to support the needs of new services and markets.
Analysis will also be made on which legacy services and requirements from the existing 3GPP systems need to be included, if fall-back mechanisms to them need to be developed, or if they are not necessary. "

We provided contributions to this study in a SA1 meeting.

3.1.1.3 Study on New Radio Access Technology [4]

The following objectives were relevant for COHERENT:

<Start quote>

(1) Target a single technical framework addressing all usage scenarios, requirements and deployment scenarios defined in TR38.913 including
   - Enhanced mobile broadband
   - Massive machine-type-communications
   - Ultra reliable and low latency communications

(2) The new RAT shall be inherently forward compatible

……

(3) Initial work of the study item should allocate high priority on gaining a common understanding on what is required in terms of radio protocol structure and architecture to fulfil objective 1 and 2, with focus on progressing in the following areas
……
   - Radio interface protocol architecture and procedures
   - Radio Access Network architecture, interface protocols and procedures,
     Study on the above 2 bullets shall at least cover:
     - Study the feasibility of different options of splitting the architecture into a "central unit" and a "distributed unit", with potential interface in between, including transport, configuration and other required functional interactions between these nodes [RAN2, RAN3];
       - Study the alternative solutions with regard to signaling, orchestration, …, and OAM, where applicable [in co-operation with SA5];
     - Study and outline the RAN-CN interface and functional split [in co-operation with SA2] [RAN2, RAN3];
     - Study and identify the basic structure and operation of realization of RAN Networks functions (NFs). Study to what extent it is feasible to standardize RAN NFs, the interfaces of RAN NFs and their interdependency [RAN3];
     - Study and identify specification impacts of enabling the realization of Network Slicing [in co-operation with SA2] [RAN2, RAN3];
     - Study and identify additional architecture requirements e.g. support for QoS concept, SON, support of sidelink for D2D [RAN1, RAN2, RAN3].

……..

(4) Study and identify the technical features necessary to enable the new radio access to meet objective 1 and 2, also including:

- Tight interworking between the new RAT and LTE
- Interworking with non-3GPP systems
- Operation in licensed bands (paired and unpaired), and licensed assisted operations in unlicensed bands
  - [Standalone operation in unlicensed bands is FFS]
- Efficient multiplexing of traffic for different services and use cases on the same contiguous block of spectrum
- Stand-alone operation in licensed bands

- Study and identify technical solutions that enable support for wireless relay.

<End Quote>

We contributed to the study of the objectives (3) and (4) above with numerous contributions mainly in 3GPP RAN3.

3.1.2 Relevant Release 15 Study/Work Items

3.1.2.1 Study on New Radio Access Technology [7]

The following objectives are relevant for COHERENT:

<Start quote>

Radio Access Network architecture, interface protocols and procedures for functional split between central and distributed units, covering:

- Normative stage-2/3 specification of one higher layer split (appropriate selection from option 2 and option 3-1 shall be determined in April 2017 meeting of RAN3).

- Support for network slicing [RAN2, RAN3];.

<End quote>

We contributed to the study of the objectives above with numerous contributions mainly in 3GPP RAN3.

3.1.2.2 Study on Separation of CP and UP for split option 2 [8]

The following objectives were relevant for COHERENT:

<Start quote>

1. From TR 38.801, study the scenarios, the feasibility and the benefits of the separation of the CU-CP (control plane instance of PDCP /RRC protocols) and the CU-UP (the user plane instance of PDCP (and SDAP) protocols).

2. Identifying details solutions e.g. introducing a standardised control plane interface between the CU-CP and CU-UP part of the gNB to enable the possibility of optimizing the physical location of different RAN functions based on the scenario and desired performance.

3. Study the necessary protocol functions down to the procedure and message level related to the possible identified solutions e.g. a standardised control plane interface to enable set-up, modification, and release of the DRB related resources in the CU-UP, including handling of security keys in the CU-UP for RAN security activation and configuration. This also needs to take the agreed F1 interface general principle, and gNB-CU/DU architecture principle into account.

<End quote>

Three partners from COHERENT (IAESI, Thales, Fairspectrum) officially supported the Work Item. We contributed to this study and will continue the contributions in the rest of 2018.

3.2 Strategy in ETSI

In the Workshop "From Research to Standards" organized by ETSI in May 2016, were presented a number of alternatives for involving H2020 projects in ETSI standardization.
We have analyzed two possibilities:

- Opening a WI for a Technical Report in BRAN, targeting use cases and the COHERENT architecture
- Founding a new ISG, possibly named RAN-SDN, which require bigger efforts but can increase dramatically the visibility of our approach.

After analysing the pros and contras of the two variants, we have decided as the best way forward the ETSI BRAN variant.
The following Liaison Letter was sent to ETSI BRAN plenary meeting on June 24th, posted as BRAN(16)000096:

Letter to ETSI BRAN, posted as BRAN(16)0096 and reproduced below:

Mr. Edgard Vangeel, ETSI TC BRAN Chairman
E-mail : evangeel@cisco.com

Cc: Mr. Martin Arndt, BRAN Technical Officer
E-mail : Martin.Arndt@etsi.org

Mr. David Boldy, BRAN Vice-Chairman
E-mail : david.boldy@broadcom.com

Mrs. Mariana Goldhamer – Leader of COHERENT WP7 on Dissemination and Exploitation
E-mail: mariana@4GCelleX.com

Date issued:	02 June 2016
Source:	H2020 project COHERENT
Subject:	New BRAN ToR and standardisation by H2020 COHERENT

Dear Edgard,

Part of the Workshop "From Research to Standards" organized by ETSI in May 2016, were presented a number of alternatives for involving H2020 projects in ETSI standardization.

H2020 project COHERENT develops a new control approach for radio access networks.

See for more details: http://www.ict-coherent.eu/

We have found that ETSI BRAN may be suitable for our standardization targets, as BRAN ToR indicates support for architectures and inter-working aspects in wireless access networks.

We target bringing together the industry specialists in this competence area. We need a suitable framework allowing us to establish our meetings at dates and locations not constrained by the BRAN work in the different competence regulatory area. We count on having ETSI support for giving high visibility to our work, at a level similar with an ISG.

We respectfully request to reflect our intentions in the new ToR and preserve BRAN as a suitable standardisation venue for EC – funded projects.

Kind Regards,

Dr. Tao Chen, COHERENT Project Coordinator
VTT Technical Research Centre of Finland Ltd.
Email: tao.chen@vtt.fi

In November 2016 we have successfully submitted and approved a WI in ETSI BRAN with the following content:

New Work Item Form

Form to be used when proposing new Work Items for adoption onto the ETSI Work Programme.

Work Item details

Which Technical Body is responsible? **BRAN**	**Sub Group:** BRAN **Project:**
WI reference number (if known): DTR/BRAN-000060021 *(number will be allocated by Secretariat if not shown)*	**PWI reference:** PWI_BRAN_1602_v5
Formal title of deliverable:	**Broadband Radio Access Networks (BRAN); Study of central coordination of RLANs operating in the 5 GHz frequency band**
Working title: Coordination in 5 GHz	**Scope of work to be undertaken:** *To review the architectures and the protocols supporting the central coordination of RLANs operating in the 5 GHz band, including the information to be provided by the wireless entities and the coordination of the operation of these entities. The deliverable will not address any regulatory issues and not address mandatory requirements such as those related to article 3.2 of Directive 2014/53/EU.*
Rapporteur (named individual person): name: Mariana Goldhamer organisation: 4GCelleX e-mail: marianna001@gmail.com	**Supporting ETSI Member organisations: (name at least four)** 1 THALES 2 AT&T GNS Belgium SPRL 3 ASSOCIAZIONE CREATE-NET 4 Fairspectrum Oy 5 4GCelleX

Deliverable document details:

What type of document will be produced? **EN[ ] EG[ ] ES[ ] TS[ ] TR[X] SR[ ] GS [ ]** For EN deliverables only: – Is the draft EN to be approved by EN Approval Procedure or Two-step Approval Procedure (*)? – Candidate harmonized standard? – Directive: * TAP may be used for ENs produced jointly with a co-operating partner (e.g. CEN or CENELEC)	**Is it a new document or a revision of an existing one?** **New** **If a revision, state the deliverable (e.g. TS 102 987 v1.1.1) *being revised*:** edition / version
Hierarchy: if this Work Item fits in a hierarchical tree (see TWP clause 1.6.1), its position shall then be indicated here by giving the reference of its **parent node** (WI reference / deliverable number / topic name).	

Work schedule:

Milestone name	Target date
• TB adoption of WI	2016/11/25
• Early Draft	2017/06/30

• Stable Draft	2017/09/30
• Draft for approval	2017/11/30
• WG approval (delete if no WG)	
• TB approval	2017/12/16
To be published as version:	**V 1.1.1**

Remarks: The main objective is to capture the outcome of the H2020 project **COHERENT** relative to scope of the WI.

3.3 Strategy in ECC PT1

After a first presentation to the ECC decision persons (Per Christensen – ECO Director, Peter Faris – ECO responsible for ECC PT1, Stella Lyubchenko – ECO responsible for academic research), we have submitted a contribution (see section 5) to ECC PT1 in September 2016.

4. Attended meetings

4.1 Attended 3GPP meetings

The table below indicates the meeting attended in the report period.

Table 4-1 Attended 3GPP meetings

4GC participates as IAESI

Date	Meeting	Location	Participating partner	Report submitted
15-18/9/2015	RAN/SA/5G Workshop	Phoenix, USA	4GC	Y
19-21/10/2015	SA1 on SMARTER	Vancouver, Canada	4GC	Y
7-8/12/2015	RAN #70	Sitges, Spain	4GC	Y
28-29/1/2016	RAN – Next Generation Access	Barcelona, Spain	4GC	Y
7-10/03/2016	RAN #71	Gothenburg, Sweden	4GC	Y
11-14/4/2016	RAN2#93bis	Dubrovnik, Croatia	4GC	Y
23-27/4/2016	RAN3#92	Nanjing, China	4GC	Y
22-26/8/2016	RAN1#86	Gothenburg, Sweden	4GC	Y
22-26/8/2016	RAN3#93	Gothenburg, Sweden	4GC	Y
10-14/10/2016	RAN3#93bis	Sophia Antipolis, France	4GC	Y
14-18/11/2016	RAN3#94	Reno, USA	4GC	Y
13-17/02/2017	RAN3#94	Athens, Greece	4GC	Y
17-19/01/2017	RAN3#NR	Spokane, USA	4GC	Y
03-07/04/2017	RAN3#95bis	Spokane, USA	4GC	Y
15-19/05/2017	RAN3#96	Hangzhou (CN)	4GC	Y
25-29/8/2017	RAN3#97	Berlin (Germany)	4GC	Y
09-13/10/2017	RAN1#90bis	Prague (Czech Republic)	4GC	Y
09-13/10/2017	RAN3#97bis	Prague (Czech Republic)	4GC	Y
27-30/10/2017	RAN3#98	Reno, USA	4GC	Y
26-30/02/2018	RAN1#92	Athens, Greece	4GC	

4.2 Attended ECC-PT1 meetings

Table 4-2 Attended ECC-PT1 meetings

Date	Meeting	Location	Participating partner	Report submitted
12-16/9/2016	ECC PT1 # 53	Budapest, Hungary	4GC	Y

4.3 Attended ETSI-BRAN meetings

4GC participates as 4GCelleX in ETSI BRAN.

Table 4-3 Attended ETSI-BRAN meetings

Date	Meeting	Location	Participating partner	Report submitted
20-24/06/2016	BRAN#88	Sophia Antipolis, France	4GC	Y
21-25/11/2016	BRAN#90	Sophia Antipolis, France	4GC	Y
6-9/3/2017	BRAN#92	Sophia Antipolis, France	4GC	Y
10-13/4/2017	BRAN#93	Sophia Antipolis, France	4GC	Y
3-6/7/2017	BRAN#94	Sophia Antipolis, France	4GC	Y
7-10/9/2017	BRAN#95	Sophia Antipolis, France	4GC	Y
4-7/12/2017	BRAN#96	Diegem, Belgium	4GC	Y

5. Contributions submitted to 3GPP

5.1 Initiated in COHERENT

In this section the contributions submitted from September 2015 to February 2018 are listed. 4GC attended the meetings, being registered as a delegate of IAESI. The contributions to RAN Plenary are numbered after the prefix RP, while the contributions to SA1 are numbered after the prefix S1. The RAN Workshop uses the prefix RWS and the RAN ad-hoc uses the prefix RPa.

Please note that most of the contributions submitted to SA1 were revised several times during the meeting, but the revised contributions are not included in the table.

Table 5-1 Contributions to 3GPP RAN submitted in the report period

No.	ID	Title	Authors	Meeting, Revision, COHERENT Deliverable
9.	**RP-160168**	Changes to 5G SI related to new architecture	IAESI*, Thales	3GPP RAN#71 **D2.2**
8.	**RP-160527**	General description of NG Architecture	IAESI*, Thales, Fairspectrum	3GPP RAN#71 Revised from **RP-160173** **D2.2**
7.	**RP-160174**	Coverage requirement in TR 38.913	IAESI*, Thales, Fairspectrum	3GPP RAN#71 **D2.1**
6.	**RP-160175**	Deep-indoor deployment scenario for mMTC and eHealth	IAESI*, Thales	3GPP RAN#71 **D2.1**

5.	**RPa160029**	A proposal for changes to ToC	IAESI*, THALES, Fairspectrum	3GPPRAN-Next Generation Access
4.	**RPa160028**	Requirements for the architecture of 5G cellular networks	IAESI*, THALES, Fairspectrum	3GPPRAN-Next Generation Access **D2.2**
3.	**RPa160027**	A deployment scenario for utility meters	IAESI*, THALES, Fairspectrum	3GPPRAN-Next Generation Access **D2.1**
2.	**RP-151762**	Prioritization of higher-layer 5G technology studies	IAESI*, FAIRSPECTRUM	3GPP RAN#70
1.	**RWS-150086**	COHERENT Vision on Software Defined Networks for 5G	IAESI*, THALES, VTT, FAIRSPECTRUM, EICT, EURECOM, CREATE-NET, OTE, POLITECHNIKA POZNANSKA	3GPP RAN/SA/5G Workshop; Up-date of RWS-150022 **COHERENT Description of Action**

*4GC signs as ETSI member IAESI

Table 5-2 Contributions to 3GPP SA1 submitted in the report period

No.	ID	Title	Authors	Meeting, Revision, COHERENT Deliverable
7.	**S1-153034**	Spectrum use case	IAESI*, Thales	3GPP SA1 on SMARTER; Also contributed VTT, PUT, OTE; **D2.1**
6.	**S1-153033**	SDN concepts applied to lower layers of 3GPP system	IAESI*, Thales	3GPP SA1 on SMARTER **D2.1**
5.	**S1-153032**	Update of clauses 5.45 and 5.46 (Industrial Automation)	IAESI*, Thales	3GPP SA1 on SMARTER **D2.1**
4.	**S1-153031**	Update of use case 5.34 “Mobility on demand”	IAESI*, Thales	3GPP SA1 on SMARTER; revised to **S1-153202; D2.1**
3.	**S1-153030**	Update of clause 5.33 “Connected vehicles”	IAESI*, Thales, GM Onstar	3GPP SA1 on SMARTER; General Motors has co-signed; revised to **S1-153195; D2.1**
2.	**S1-153029**	Update of use case 5.2 “Network slicing”	IAESI*, Thales	3GPP SA1 on SMARTER; **D2.1**
1.	**S1-153028**	Up-date of use case 5.1 Ultra-reliable communications	IAESI*, Thales	3GPP SA1 on SMARTER; revised to **S1-153192; D2.1**

Table 5-3 Contributions to 3GPP RAN1 submitted in the report period

No.	ID	Title	Authors	Meeting, Revision, COHERENT Deliverable
3.	R1-1802053	Incorrect path loss calculation in TS 38.213	IAESI, Thales, Fairspectrum, VTT	3GPP RAN1#92, **D3.1**

2.	R1-1718261	Wrong naming of coupling loss	IAESI, Thales, Fairspectrum, VTT	3GPP RAN1#90bis, **D3.1**
1.	R1-167088	Simulation assumptions related to new measurements and LTE architecture	IAESI*, Thales, Fairspectrum	3GPP RAN1#86, **D3.1**

Table 5-4 Contributions to 3GPP RAN2 submitted in the report period

No.	ID	Title	Authors	Meeting, Revision, COHERENT Deliverable
2.	**R2-162231**	High level view of 5G access architecture	IAESI*, Thales, Fairspectrum	3GPP RAN2#93-BIS **D2.2**
1.	**R2-162230**	Network graphs supporting central coordination as 5G design target	IAESI*, Fairspectrum	3GPP RAN2#93-BIS **D3.1**

Table 5-5 Contributions to 3GPP RAN3 submitted in the report period

No.	ID	Title	Authors	Meeting, Revision, COHERENT Deliverable
43.	R3-174347	Load management function in TS 38.470	IAESI, Thales, Fairspectrum, VTT	3GPP RAN3#98, **D3.1, D3.2**
42.	R3-174348	On measurement function in TS 38.470	IAESI, Thales, Fairspectrum, VTT	3GPP RAN3#98, **D3.1, D3.2**
41.	R3-174349	On gNB-DU control in TS 38.470	IAESI, Thales, Fairspectrum, VTT	3GPP RAN3#98, **D2.2**
40.	R3-173875	Control of PHY layer parameters	IAESI	3GPP RAN3#97bis, **D2.2, D3.1**
39.	R3-173624	Architecture details of split gNB-CU	IAESI, Thales, Fairspectrum, VTT	3GPP RAN3#97bis, **D2.2**
38.	R3-173623	Procedures for information request and transmission	Procedures for information request and transmission	3GPP RAN3#97bis, **D2.2, D3.1, D3.2**
36.	R3-172817	Introduction to gNB-CU architecture for information exchange	IAESI*, Thales, Fairspectrum	3GPP RAN3#97, **D2.2**
35.	R3-172819	Identifiers for the NR	IAESI*	Revised to R3-173364 3GPP RAN3#97, **D2.2, D3.2**
34.	R3-172826	Central RRM functionality (IAESI, Thales, Fairspectrum, VTT)	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#97, **D2.2**
33.	R3-172821	CP functions of split gNB-CU	IAESI*	3GPP RAN3#97, **D2.2**
32.	R3-171817	Central RRM functions and high level information	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**
31.	R3-171474	Corrections to draft TS 38.401	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**
30.	R3-171475	Central RRM functions and gNB-DU reporting	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**

29.	R3-171476	Cell selection in NR RAN	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**
28.	R3-171477	General aspects and functions for F1 UP and CP	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.1**
27.	R3-171478	TP for functions and frame formats for F1-U protocol	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**
26.	R3-171479	TP for TS 38.800	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#96, **D2.2, D3.2**
25.	R3-170974	Control plane functions for High Layer split	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#95bis, **D2.2**
24.	R3-170973	Option 2 split with performant and reliable CU-DU connection	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#95bis, **D3.2**
23.	R3-170974	Control plane functions for High Layer split	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#95bis, **D2.2**
22.	R3-170501	TP for CU-DU interface principles and functions	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#95, **D2.2**
21.	R3-170500	CU-DU interface principles and functions	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#95, **D2.2**
20.	R3-170096	TP for DU reports over the CU-DU interface	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#NR1, **D2.2, D3.1, D3.2**
19.	R3-170095	TP for central solutions for interactions between NR functions	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#NR1, **D2.2, D3.1**
18.	R3-170094	TP on RRM functions pertinent to DU	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#NR1, **D2.2**
17.	R3-170093	Central solutions for interactions between NR functions	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#NR1, **D2.2**
16.	R3-170092	RRM functions pertinent to DU	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#NR1, **D2.2**
15.	R3-162804	TP on benefits of the hierarchical Central Coordination	IAESI*, Thales, Fairspectrum	3GPP RAN3#94, **D2.2**
14.	R3-162802	TP for hierarchical CP architecture	IAESI*, Thales, Fairspectrum	3GPP RAN3#94, **D2.2**
13.	R3-162800	Functional benefits of Central Coordination	IAESI*, Thales, Fairspectrum	3GPP RAN3#94, **D2.2**
12.	R3-162799	Benefits of hierarchical centralized control architecture	IAESI*, Thales, Fairspectrum	3GPP RAN3#94, **D2.2**
11.	R3-162618	Joint Text Proposal for 38.801 on CP/UP separation	Deutsche Telekom, AT&T, Telecom Italia, Ericsson, Huawei, Samsung, IAESI, THALES, Fairspectrum, VTT	3GPP RAN3#93bis, **D2.2**
10.	R3-162250	Control functions handled by a Central Coordinator	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93bis, **D2.2**
9.	R3-162249	Solutions for UP-CP separation in access network	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93bis, **D2.2**
8.	R3-161973	5G access – a heterogeneous deployment scenario	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93, WP2, Revision of R3-161683; **D2.2**

7.	R3-161684	Distributed and centralized gNB-gNB mobility scenarios	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93, **D2.2**, **D3.1**
6.	R3-161685	RAN-based solution for LTE tight interworking with NR	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93, **D2.2**
5.	R3-161686	Additional NR RAN specific functions	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#93, **D2.2**
4.	R3-161945	Response to R3-161805 and R3-161574	IAESI*, VTT	3GPP RAN3#93, **D2.2**
3.	R3-161474	5G access architecture with UP/CP separation	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#92 Revision of R3-161120, **D2.2**
2.	R3-161119	New functions of 5G access architecture with UP/CP separation	IAESI*, Thales, Fairspectrum, VTT	3GPP RAN3#92, **D2.2**
1.	R3-161118	Some definitions and acronyms for 5G access architecture	IAESI*, Thales, Fairspectrum	3GPP RAN3#92, **D2.2**

5.2 Collaboration with members of other 5G-PPP projects

The following contributions indicate the collaboration with 5G-PPP member companies.

Table 5-6 Collaboration with 5G-PPP members

No.	ID	Title	Authors	Meeting, COHERENT Deliverable
1.	RPa160075	Scenario and requirements for Smart Energy verticals for inclusion in TR38.913	Orange, ABB, IAESI*, Telecom Italia, Telia Sonera	3GPPRAN-Next Generation Access **D2.1**
2.	RPa160074	Scenario and requirements for eHealth verticals for inclusion in TR38.913	Orange, IAESI*, Telecom Italia	3GPPRAN-Next Generation Access D2.1

*4GC signs as IAESI

6. Contribution submitted to ECC PT1

Table 6-1 Contributions submitted to ECC PT1

No.	ID	Title	Authors	Meeting, COHERENT Deliverable
1.	ECC PT1 Info 4	Flexible duplex – COHERENT approach	4GCelleX, VTT, PUT, Aalto University	ECC PT1 # 53 **D4.1**

7. Contributions submitted to ETSI BRAN

Table 7-1 Contributions submitted to ETSI BRAN

Rapporteur was Mariana Goldhamer, 4GcelleX. 4GC signed as 4GCelleX in ETSI BRAN.

No.	ID	Title	Authors	Meeting, COHERENT WP and Comments
19.	BRAN(17)096030r1	Draft 0.0.8 of TR 301 494	4GCelleX	BRAN#96, Addressed Intel comments in meeting; **Approved for publication**
18.	BRAN(17)096030	Rapporteur input - Draft 0.0.7 of TR 301 494	4GCelleX	BRAN#96 Addressed BRAN meeting comments
17.	BRAN(17)096030r1	Draft 0.0.6 of TR 301 494	4GCelleX	BRAN#96 Included changes based on ETSI EditHelp review
16.	BRAN(17)096007	Rapporteur input - Draft 0.0.5 of TR 103	4GCelleX	BRAN#96 Included changes based on contributions in BRAN#95
15.	BRAN(17)000123	Proposal for Conclusions of TR 103 494	Thales, Sony Europe	BRAN#96 Included a proposal for conclusions
14.	BRAN(17)000100r2	TR 103 494: Details on C3 operation	4GCelleX,VTT,THALES,Fairspectrum Oy	BRAN#95 **D2.2, D3.2**
13.	BRAN(17)000099r2	TR 103 494: Proposed new reports	4GCelleX,VTT,THALES,Fairspectrum Oy	BRAN#95 , **D3.2**
12.	BRAN(17)000098r1	TR 103 494: Relevant measurements in 3GPP LTE standards	4GCelleX,Fairspectrum Oy,THALES,VTT	BRAN#95, **D3.2**
11.	BRAN(17)000097r2	TR 103 494: Architecture for heterogeneous technologies	4GCelleX,VTT,THALES,Fairspectrum Oy	BRAN#95, **D3.2**
10.	BRAN(17)000091	Rapporteur input - Draft 0.0.4 of TR 103 494	4GCelleX, as Rapporteur	BRAN#95 Includes the approved contributions from the previous meeting
9.	BRAN(17)000080	Functional mapping of BRAN(17)000066 to the existing architecture	THALES; Fairspectrum Oy; 4GCelleX	BRAN#94 **D2.2, D3.2**
8.	BRAN(17)000060	TR 103 494: Measurements and Reports in IEEE 802.11 standard	4GCelleX; THALES ; Fairspectrum; VTT	BRAN#94 **D2.2, D3.2**
7.	BRAN(17)000059	Rapporteur input - Draft 0.0.3 of TR 103 494	Rapporteur *	BRAN#93 **D2.2, D3.2**; includes the approved contributions from the previous meeting
6.	TR 103 494 Draft 0.0.2	Central control and coordination in 5GHz	Rapporteur *	BRAN#92 **D2.2, D3.2**

5.	BRAN(17)000038	Additional contribution to TR 103 494	4GCelleX; EURECOM ; THALES ; VTT	BRAN#92 **D2.2, D3.2**
4.	TR 103 494 Draft 0.0.1	Central control and coordination in 5GHz	Rapporteur *	BRAN#91 **D2.2, D3.2**
3.	BRAN(17)000005r2	Basic concepts for control / coordination and initial architecture	4GCelleX ; THALES ; FBK ; Fairspectrum Oy ; VTT	BRAN#90 **D2.2**
2.	BRAN(16)000195r4	Central control and coordination in 5GHz	4GCelleX Thales, Fairspectrum	BRAN#88 New Work Item proposal; WP2-WP3
1.	BRAN(16)000096	New BRAN ToR and standardization by H2020 COHERENT	COHERENT	BRAN#88 COHERENT Liaison

8. Contributors

The table below presents the actual capability from partner to monitor, contribute and support the contribution in standardisation. The definition of monitor, contribute and support are the following:

- **Monitor**: a partner monitoring a standard is able to report to the project progress status of the standard, open topics which can accept contributions, calendar for contributions and all information (administrative, context, trend etc.) that could help writing the contribution. Although not mandatory, it is helpful to attend regularly to the meeting.
- **Contribute**: a partner contributing to a standard is someone who produces the technical content that could fit into a standard contribution. This material should be aligned with the open calls, context, study items, etc. information obtained through monitoring. For 3GPP, even if more partners have the technical capability to contribute, are listed only those recognized as 3GPP members by the end of 2015.
- **Support**: a partner supporting a contribution is a partner presenting the contribution during the standard meeting on behalf of the Contributors. The support partner should thus regularly attend meetings and be in good relations with people attending.

Table 8-1 Summary of partners' contributions to standards

		4GC	TCS	FS	VTT	EUR	CNET	PUT	CMA
3GPP (Note 1)	Monitor	Y	Y						**Y**
	Contribute	Y	Y	Y	Y	Y			
	Support	Y							
ECC PT1	Monitor	Y			Y				
	Contribute	Y		Y	Y				
	Support	Y			Y				
IEEE Dyspan SC	Monitor							Y	
	Contribute								
	Support							Y	
ETSI BRAN	Monitor	Y					Y		
	Contribute	Y	Y	Y	Y	Y	Y		
	Support	**Y**							

9. COHERENT Research Reflected in Standards

9.1 Methods of work

Standardization is a process requiring participation and contributions in every meeting. After each meeting are known the new requirements and the open issues, which require contributions for the following meeting. This information allows writing contributions which are relevant for the meeting and for the progress of the WI.
For integrating in the process were taken the following steps:

- Identification of the Work Items relevant to COHERENT
- Participation in meeting
- Providing after each attended meeting a Report in which were included the meeting decisions and the open issues and new requirements, if any. In this way the WP7 members were informed about the treatment of our contributions and the relevant developments in the attended meeting.
- Establishing the Action Items for the contributions to the next meetings.

Based on this working method, we have been able to impact on a number of standards and Work Item proposals.

10. Impact

10.1 ECC PT1

COHERENT presentation in ECC PT1 had a big impact on European Administrations who agreed, based also on the 5G Workshop in early November 2016, to introduce the point A5 in the CEPT Roadmap reflected in the document ECC (16)110 Annex 17 (see [9])

This Roadmap includes a comprehensive list of actions, including allocations of new frequency bands, regarding the fifth generation of mobile technology (5G) named “CEPT roadmap for 5G”.

Point A5 says:

<Start quote>

A.5 Consider the impact of future “flexible duplex” on the management of existing FDD bands	ECC/PT1 to consider this issue which is not expected to arise in the short term.

<End quote>

10.2 ETSI

The big COHERENT achievement in ETSI was the successful finalization of TR 103 494 (see [4]) developed in Broadband Radio Access Networks (BRAN) and including a ”Study of central coordination of WAS/RLANs operating in the 5GHz frequency band” which was published in January 2018.

In November 2016 we proposed a New Work Item (DTR/BRAN-60022 – see [10]) which was approved by the BRAN meeting.

The COHERENT supporting companies were: 4GCelleX (Rapporteur), THALES, ASSOCIAZIONE CREATE-NET (now FBK), Fairspectrum Oy. In addition the WI was supported by AT&T GNS Belgium SPRL.

The Scope of the work was “To review the architectures and the protocols supporting the central coordination of RLANs operating in the 5 GHz band, including the information to be provided by the wireless entities and the coordination of the operation of these entities.”

TR 103 494 is based on contributions reflecting COHERENT deliverables D2.2, D3.1 and D3.2 and on contributions from Sony Europe. The COHERENT contributions is acknowledged in the Introduction:

<Start quote>
“Developing technologies for 5G Broadband Systems is one of the objectives of the European Commission. The EC H2020 project COHERENT [i.14], "Coordinated Control and Spectrum Management for 5G Heterogeneous Radio Access Networks" has addressed topics related to the application of the basic principles of wired Software - Defined Networks (SDN) to wireless networks. The present document includes the main outcome of the project and the results of additional studies.
....
Some results incorporated in the present document received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 671639.”
<End quote>

The content of TR 103 494 is summarized by the common Thales, Sony, 4GCelleX, Fairspectrum contribution BRAN (17)000123 from which we quote below:

<Start quote>
The present document contains studies of architectures and protocols supporting the central coordination of Wireless Access Systems operating in the 5 GHz band. The document presents use cases of coordinated or uncoordinated WAS/RLAN deployment, including ad-hoc or single/multiple Operator deployments.
Are listed possible requirements for coexistence management between coordinated and uncoordinated WAS/RLAN deployed by one or multiple operators. In addition are presented possible requirements on spectrum, mobility and radio resource management.

Since the coordination of the RLAN/WAS operating in the 5 GHz band is an open issue, is investigated centralized and hierarchical control/coordination which it is foreseen to bring benefits in the shared bands.
The document presents then main concepts pertaining to central control/coordination, namely hierarchical control and its possible extensions in the multi-operator case, abstractions, network slicing and slice-specific network views. Examples of abstractions are given mainly by using the concept of graph applied to the wireless network.

Then, the system architecture, the system entities and their role are described in particular concerning the control plane architecture. Extensions of the single operator architecture are presented in order to consider coordination with multiple operators and coordination for spectrum management.

Are listed available measurements, reports and management procedures in IEEE 802.11TM – 2012 and 3GPP LTE and are proposed new reports, control/coordination messages and procedures involving the central control and coordination (C3) entity and the wireless entities of the system.
The document also illustrates with examples of algorithms using graph theory to efficiently provide spectrum and channel (re)assignment, selection of serving C3 instances for mobile nodes, and network coordination.
<End quote>

10.3 3GPP

The following topics reflected in COHERENT contributions had influenced the 5G system use cases, requirements and architecture:

Topic	*3GPP WG*	*Description*	*Outcome*
5G use cases	SA1	Introduced requirements on network congestion, high throughput downlink video support for connected vehicles, URLLC for public safety and industrial automation	Requirements introduced in TR 22.891 (SMARTER) [11]
Requirements for the architecture of 5G cellular networks	RAN Plenary	Introduced requirements of control plane/user plane separation and central coordination	Requirements introduced in TR 38.913 [12]
Requirements for coverage of 5G cellular networks	RAN Plenary	Criticized the existing definition of coupling loss and provided guidance	Text in 38.913 [12] on coverage reflect the essence of our contribution.
Central coordination of scheduling	RAN2	Coordinated scheduling and central coordinator	Reflected in TR 38.801[13] and TS 38.473 [14]
Architecture with control plane/user plane separation	RAN3	Architecture and initial functional definition	Reflected in TR 38.801 [14] and the new RAN3 WI initiated by Ericsson on UP/CP separation with disaggregated architecture
Hierarchical architecture for UP/CP separation	RAN3	CP is split between the Central Unit and the Distributed Units depending on required decision latency	Reflected in TR 38.801 [13] and TS 38.470 [15]
RRM functions pertinent to CU	RAN3	RRM is split between CU and DU	Reflected in TS 38.470 [15]
gNB-DU definition	RAN3	gNB-DU is controlled by gNB-CU	Reflected in TS 38.801 [13]

11. CONCLUSIONS

COHERENT had a rich standardization activity in 3GPP (5G system), ETSI (Central Coordination in 5GHz) and ECC PT1 (flexible duplex). The initial targets were extended to the ETSI standardization, which was successfully finalized with the approval and publication of ETSI TR 103 494. With more than 40 contributions to 3GPP we had a serious influence on the 5G system architecture, control plane functions and control plane split.

References

[1] http://www.3gpp.org/about-3gpp
[2] http://www.etsi.org/about
[3] https://cept.org/ecc/
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[6] 3GPP SP-150142, "Study on New Services and Markets Technology Enablers", TSG SA Meeting #67, Shanghai, RPC, 11-13 March 2015.
[7] http://grouper.ieee.org/groups/dyspan/
[8] 3GPP RP-172831, "Study on Separation of CP and UP for split option 2", TSG RAN Meeting #75, West Palm Beach, USA, June 5-8, 2017.
[9] ECC(16)110 Annex 17, "CEPT roadmap for 5G", 43rd Meeting, Prague, 15 – 18 November 2016
[10] WI DTR/BRAN-60022 https://portal.etsi.org/webapp/workprogram/Report_WorkItem.asp?WKI_ID=50947
[11] 3GPP TR 22.891 V1.1.0 (2015-11), "Technical Specification Group Services and System Aspects; Feasibility Study on New Services and Markets Technology Enablers; Stage 1 (Release 14)"
[12] 3GPP TR 38.913 V14.1.0 (2016-12), "Technical Specification Group Radio Access Network; Study on Scenarios and Requirements for Next Generation Access Technologies; (Release 14)"
[13] 3GPP TR 38.801 V14.0.0 (2017-03), "Technical Specification Group Radio Access Network;Study on new radio access technology: Radio access architecture and interfaces (Release 14)"
[14] 3GPP TS 38.473 V15.0.0 (2017-12), "Technical Specification Group Radio Access Network; NG-RAN; F1 application protocol (F1AP) (Release 15)"
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