



# **H2020 INCOMING:** **IN**novation and excellence in massive scale **COM**munications and **IN**formation processing**G**

Project No. 856967

H2020-WIDESPREAD-2018-2020

<http://incoming.ftn.uns.ac.rs>

The INCOMING project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 856967



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# ICONIC – Centre for Intelligent Communications, Networking and Information Processing



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KONFERENCIJA O TEHNOLOŠKIM INOVACIJAMA  
ZA PAMETNE GRADOVE BUDUĆNOSTI

EE TRANSACTIONS ON

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# Project Partners (CHALMERS)



## Chalmers University of Technology, Sweden

- Department of Electrical Engineering
  - Communication Systems
- Chalmers AI Research Centre (CHAIR)



## Key personnel:



A. Graell i Amat



H. Wymeersch



T. Eriksson



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# Project Partners (AAU)



## Aalborg University, Denmark

- Department of Electronic Systems
  - Center for communication, media and IT (CMI)
  - Connectivity Section (CNT)
- AAU engineering ranked 4<sup>th</sup> in the world and 1<sup>st</sup> in Europe (MIT engineering list)



**AALBORG UNIVERSITY**  
DENMARK

## Key personnel:



C. Stefanovic



S. Kosta



P. Popovski



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# Project Partners (DLR)



## German Aerospace Centre (DLR), Germany

- Institute of Communication and Navigation
  - Satellite Networks Section
  - Information transmission and Satellite communication



## Key personnel



G. Liva



H. Bischl



F. Clazzer

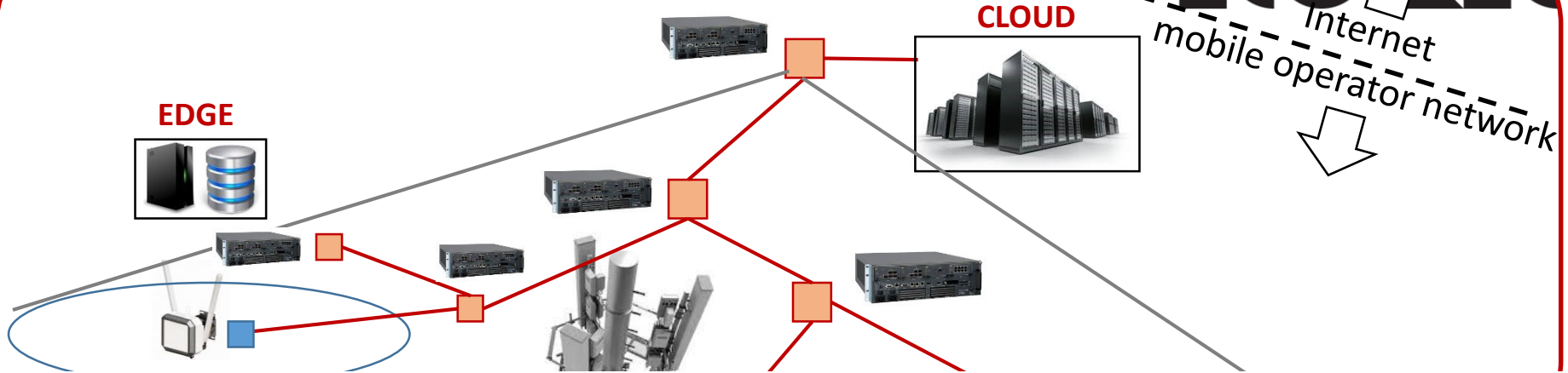


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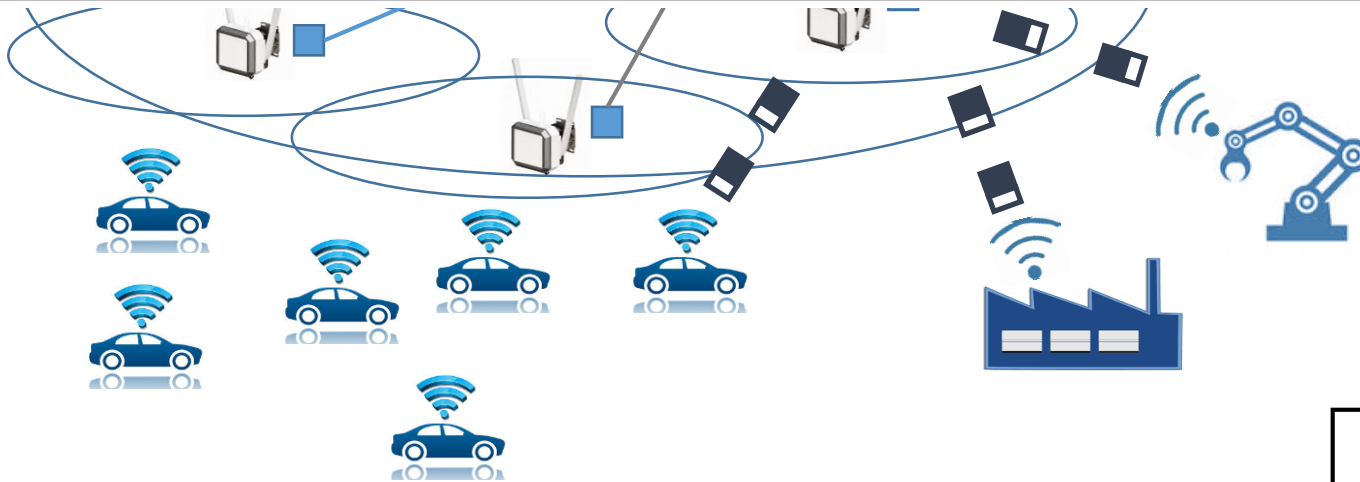


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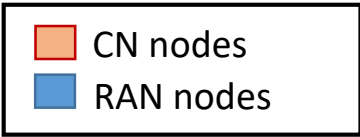
## 5G Core Network



The INCOMING project context is based on upcoming 5G technology supported by emerging cellular Internet of Things and Mobile Edge Computing. Research focus is on massive-scale data acquisition via IoT and large-scale information processing via MEC. Innovation aspect rests on open and reconfigurable hardware/software for fast prototyping of advanced communications and information processing solutions.



## 5G Radio Access Network



# Research Excellence (WP2 & WP3)



Enhance ICONIC research excellence:

## Massive Internet of Things (IoT)

- From fundamental information-theoretic limits to protocol design in emerging 4G/5G and beyond solutions for massive IoT

## Large-Scale Distributed Information Processing

- Scalable and distributed information processing algorithms (distributed optimization, statistical inference, probabilistic graphical models machine learning, deep learning)
- 5G Edge/Cloud computing network architecture and services

## Reconfigurable Hardware and System Design

- Embedded/SDR/FPGA/GPU solutions in above two domains



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# Innovation capacity (WP4)



INCOMING project will establish 5G Innovation and Technology Hub (5G-IT-Hub) as part of the ICONIC centre. 5G-IT-Hub will gather local/regional stakeholders in the domain of 5G technologies and applications, providing expert knowledge, training, networking, and stimulating innovation and entrepreneurship.

## 5G Innovation and Technology Hub

- 5G Seminar Series
- Startup Success Stories Seminar Series
- Meet the local ICT Industry Seminar Series

## ICONIC staff will

- Get training in IPR, Entrepreneurship, Fundraising
- Showcase the project results to wider community



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HOME NEWS EVENTS GALLERY | Q



**6G and Beyond:  
The Future of Wireless  
Communications Systems** **Monday  
October 5  
14:00h CEST**

[iconic.ftn.uns.ac.rs](http://iconic.ftn.uns.ac.rs)  
[5ghub.ftn.uns.ac.rs](http://5ghub.ftn.uns.ac.rs) **5G IT HUB**

**Ian F. Akyildiz**  
Russian Academy of Sciences Wireless  
Networks Lab, Moscow, Russia

Prof. Ian F. Akyildiz is Magagrant Leader with the Institute for Information Transmission Problems at the Russian Academy of Sciences, in Moscow, Russia. He is also Byers Chair Professor Emeritus in Telecommunications at the Georgia Institute of Technology, Atlanta, USA.



**5G and Beyond 5G  
Seminar Series**



**A Tutorial on 5G  
Non-Terrestrial  
Networks** **Thursday,  
December 3<sup>rd</sup>  
14:00h CEST**

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**Stefano Cioni**  
European Space Agency  
Noordwijk, The Netherlands

Stefano Cioni is a telecommunication systems engineer within the Radio Frequency Systems, Payload and Technology Division, European Space Agency



**5G and Beyond 5G  
Seminar Series**



**Programmable Testbeds  
for Experimentation with  
Advanced Wireless and  
Edge Computing Concepts** **Monday,  
December 14<sup>th</sup>  
14:00h CET**

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**Ivan Seskar**  
Chief Technologist + Director, WINLAB,  
Rutgers University, New Jersey, USA

Ivan Seskar is the Chief Technologist and Director at WINLAB, Rutgers University responsible for experimental systems and prototyping projects. He is currently the program director for the NSF CDSMOS project.



**5G and Beyond 5G  
Seminar Series**



# Kick-off Meeting and 1st Brainstorming Week



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# Twinning Methodology 1



## TM1: Enhancing research excellence through **staff exchanges**

- To engage in joint high-quality research activities
- To transfer knowledge to ICONIC researchers (especially ESRs)
- To learn best practices concerning 5G research and development
- To obtain hands-on experience on EU partner lab equipment
- To train ICONIC researchers in complementary skills
- **Asymmetric (mainly from ICONIC to EU partners)**
  - **34 total (20 from ICONIC and 14 from EU partners)**
- **Focused on ESRs (longer visits)**
- **Fundamentally contribute to research activities in WP2 and WP3**
- **Measures: No of staff exchanged, ESR/ER balance, gender balance**
- **Outcomes: Research (no of conference and journal papers)**  
**Implementation (no. of mini projects + technical reports)**



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# Twinning Methodology 2



**TM2: To provide expert training to ICONIC researchers through summer schools and individual on-site trainings**

- **Summer Schools**
  - Three annual summer schools
  - Two tracks: Massive IoT and Large-Scale Info Proc & ML
  - Shift from theory to applications (title: 5G technology fundamentals, implementation and applications)
- **Expert Training**
  - 8 training sessions (4 per each WP2 and WP3)
- **Measures:** No of ESRs/ERs attending schools/training classified as ICONIC members/EU partner members/Out-of-consortium memb.
- Report duration, no and duration of lectures, ESR/ER and gender structure, benefit from training (questionnaires)



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# 1st Summer School (Online Format)



Recording

You are viewing Gianluigi Liva's screen View Options

INCOMING School on Massive IoT, Distributed and Decentralized Information Processing – 5 November 2020

## Channel Coding in the Short Blocklength Regime

Gianluigi Liva, gianluigi.liva@dlr.de  
German Aerospace Center, DLR

Knowledge for Tomorrow

Unmute Start Video Participants 25 Chat Share Screen Reactions Leave




Gianluigi Liva



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Massive Internet of Things (WP2)	Large-Scale Distributed Information Processing (WP3)	M
Brain-storming Week 1 (activity planning)		2-3
First staff exchanges initiated. Focused research-oriented staff exchanges; for massive IoT domain: fundamental limits of massive connectivity; for large-scale distributed information processing: theoretical properties of distributed detection, estimation, learning and inference.		5-7
1st Summer School on 5G Technology Fundamentals		8
Continuation of focused research-oriented staff exchanges. The topics will gradually shift from theoretical to system implementation; for massive IoT domain: protocol design for massive connectivity, and for large-scale information processing: network architectures and concepts (MEC/MCC, SDN, NFV).		9-10
Expert Training 1: Short-Packet Coding Techniques (Dr G. Liva - DLR) 	Expert Training 1: Large-Scale Probabilistic Inference (Prof. H. Wymeersch - CHALMERS)  	11
Continuation of focused research-oriented staff exchanges in both fundamental theory and system design		12-13
Brain-storming Week 2 (activity planning)		14
First implementation-oriented staff exchanges to start in parallel with research-oriented staff exchanges. Former will focus on SDR and FPGA prototyping of selected PHY and MAC solutions, as well as FPGA/GPU-based design of selected machine learning algorithms.		15-16
Expert Training 2: Wireless Communications for Massive IoT (Dr C. Stefanovic - AAU)	Expert Training 2: Distributed Coding, Storage and Computation (Prof. Alexandre Graell i Amat - CHALMERS)	17
Continuation of focused research-oriented and implementation-oriented staff exchanges in both fundamental theory and system design.		18

2nd Summer School on 5G Technology Implementation		19
For research-oriented staff exchanges, the will focus will gradually shift towards specific solutions; for mMTC, 5G IoT standards will be considered in detail; for large-scale information processing, integration of distributed information processing and elements of virtualized 5G core architecture will be in focus.		20-22
Expert Training 3: 5G MU-MIMO Implementation Aspects (Prof. T. Eriksson - CHALMERS)	Expert Training 3: SDN and NFV in 5G Networks (Dr Tomaso de Cola) DLR	23
First demo showcase based on SDR and FPGA/GPU implementations of selected mMTC solutions and information processing/machine learning modules.		24-25
Brain-storming Week 3 (activity planning)		26
Research-oriented staff exchanges will continue with focus on the applications in 5G ecosystem such as Smart Grids, Connected Industry and Connected Vehicles. Implementation-oriented staff exchanges will continue producing mini-projects that output demo showcases presented within 5G-IT-Hub.		27-28
Expert Training 4: 5G Ultra-Reliable Low-Latency Communications (Prof. P. Popovski - AAU)	Expert Training 3: Mobile Edge and Mobile Cloud Computing (Dr Sokol Kosta - AAU)	29
3rd Summer School on 5G Technology Applications		30
Final set of staff exchanges targeting finalization of research-oriented and implementation-oriented tasks, setting up plan for post-project collaboration, preparation of joint research proposals, discussion on innovation and commercialization activities.		31-34
Brain-storming Week 4 (future projects and research/development collaboration)		35-36



# Twinning Methodology 3



**TM3: To establish strong links of ICONIC researchers within and outside of consortium through research-oriented networking and dissemination events**

- **Brain-Storming Weeks (Internal)**
  - Four events (start of each year and end-of-project)
- **Workshops and Special Sessions**
  - Three events (ideally at major IEEE conferences)
- **Dissemination and Outreach**
  - Major IEEE conferences, regional/global events
- **Measures:** Brain-storming weeks (No of senior staff), Workshops (No of papers/participants internal and external to the project), No of presentations and regional/global networking, dissemination and outreach events.



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# Twinning Methodology 4



**TM4: To stimulate ICONIC innovation activities and promote 5G technology and its impacts on economy and society through ICONIC 5G Innovation and Technology Hub (5G-IT-Hub)**

- **5G Seminar Series (8 seminars)**
- **Startup Success Stories Seminar (6 seminars)**
- **Meet the Local ICT Industry Seminar (6 seminars)**
- **Innovation training activities**
  - **IPR in ICT Seminar (2-part seminar)**
  - **Entrepreneurship in ICT Seminar (2-part seminar)**
  - **Fundraising and EU funding in ICT Seminar (2-part seminar)**
- **Measures:** No of participants (open to students and wider community), No of demo showcase events



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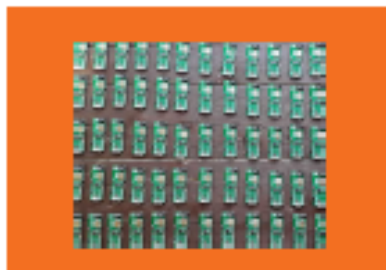
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ⓔ **H2020 INCOMING kick-off meeting**

took place on 20/01/2020 in Novi Sad (Serbia) and was followed by 4-day Brainstorming week, a workshop-like event that brought partners together to present their ongoing research and plan future joint research activities. INCOMING advisory board member Prof. Branka Vucetic presented a keynote at the event.

[Read more: incoming.ftn.uns.ac.rs/events/](http://incoming.ftn.uns.ac.rs/events/)



ⓘ **Massive NB-IoT testbed**

comprising 100 NB-IoT nodes is installed as a part of ICONIC centre research infrastructure for massive cellular IoT.

[Read more: iconic.ftn.uns.ac.rs/massive-nb-iot-testbed-of-iconic-centre](http://iconic.ftn.uns.ac.rs/massive-nb-iot-testbed-of-iconic-centre)



Ⓣ **H2020 INCOMING School on 5G and Beyond 5G technology fundamentals**

will be realized in virtual and distributed fashion during November 2020. Each week, for five consecutive weeks (02/11/2020 – 03/12/2020), PhD students will have one school day of lectures presented by leading experts in the field.

[Read more: incoming.ftn.uns.ac.rs/events](http://incoming.ftn.uns.ac.rs/events)



Ⓣ **5G innovation & technology hub (5G IT HUB)**

is established as part of ICONIC centre to bring world-leading lecturers on 5G/ B5G technologies to Novi Sad.

01/01/2020  
H2020 INCOMING started

20/01/2020  
H2020 INCOMING Kick-Off meeting in Novi Sad

21-24/01/2020  
1<sup>st</sup> Brain Storming Week held in Novi Sad

01/03/2020  
ICONIC Centre and H2020 INCOMING webpages active:  
[iconic.ftn.uns.ac.rs](http://iconic.ftn.uns.ac.rs)  
[incoming.ftn.uns.ac.rs](http://incoming.ftn.uns.ac.rs)

15/03/2020  
COVID-19 Crisis and Travel restrictions in place across Europe

01/04/2020  
H2020 INCOMING research activities on massive IoT (WP2) and large-scale information processing (WP3) started via online collaboration until research visits become possible

**ACCEPTED!**

④ **First joint conference paper accepted!**

Congratulations to ICONIC and DLR teams whose collaboration reached the 1<sup>st</sup> milestone!

[Read more:](#) [incoming.ftn.uns.ac.rs/first-joint-conference-paper-accepted](http://incoming.ftn.uns.ac.rs/first-joint-conference-paper-accepted)



④ **Two new H2020 projects**

INCISIVE and MARVEL will involve ICONIC researchers! Congratulations to scientists in charge Tatjana Loncar-Turukalo and Dragana Bajovic!

[Read more:](#) [iconic.ftn.uns.ac.rs/projects](http://iconic.ftn.uns.ac.rs/projects)



① **Research in UAV-enabled massive IoT at ICONIC kick-started through Serbian Science Fund project AVIOTION.**

[Read more:](#) [iconic.ftn.uns.ac.rs/projects](http://iconic.ftn.uns.ac.rs/projects)



⑤ **INCOMING expert training:**

Advanced random access for MTC presented by Andrea Munari and Federico Clazzer (DLR) to ICONIC staff members on 26-28/10/2020.

05/10/2020

⑤ **6G and Beyond: The Future of Wireless Communications Systems**

Ian F. Akyildiz, Russian Academy of Sciences Wireless Networks Lab, Moscow, Russia

[Read more:](#) [5ghub.ftn.uns.ac.rs/events](http://5ghub.ftn.uns.ac.rs/events)



15/05/2020

First joint conference paper involving ICONIC and DLR teams accepted for presentation at IEEE CSNDSP 2020

01/06/2020

5G IT Hub established as an event-organizing part of ICONIC  
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30/09/2020

H2020 INCOMING Newsletter No. 1

05/10/2020

First 5G IT Hub lecture: Ian F. Akyildiz  
6G and Beyond: The Future of Wireless Communications Systems

26-28/10/2020

DLR Expert Training: Advanced random access in MTC

11/2020

1<sup>st</sup> INCOMING School on 5G and Beyond  
5G technology fundamentals



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