IoRL Deliverable D7.10

Report on Dissemination Activities

Editor:	Furkan Cömert, Arcelik
Deliverable nature:	Report
Dissemination level: (Confidentiality)	Public (PU)
Contractual delivery date:	November 2020
Actual delivery date:	January 2021
Suggested readers:	Indoor communication experts and providers of indoor communication services, mobile network operators, designers and architects of indoor spaces
Version:	1.0
Total number of pages:	57
Keywords:	5G, Internet of Radio Light, millimeter Wave, Light Fidelity, Network Functions Virtualization, Software-Defined Networking, Visible Light Communications

Abstract

This deliverable summarises the dissemination activities and efforts in IoRL towards creating public awareness and transferring the knowledge generated in the project to the outside world. The document presents the activities and achievements with a particular focus on the period of 1st July 2019 until 30th November 2020 not covered earlier, structured according to the focus groups, delivery channels used and material produced. The document presents the statistical data about activities and achievements since the start of the project.

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Impressum

H2020 Internet of Radio Light

IoRL

WP7 - Dissemination and Exploitation

Task 7.3 Dissemination Activities

D7.10 Report on Dissemination Activities

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Executive summary

This document summarises and reports on the dissemination activities and actions accomplished during the third year of the IoRL project life both at project and partner levels.

This dissemination report is developed as part of the IoRL project Work Package 7.

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Abbreviations

5G	Fifth Generation (mobile/cellular networks)
5G PPP	5G Public Private Partnership
IoRL	Internet of Radio Light (project)
ITU	International Telecommunications Union
LiFi	Light Fidelity
mmWave	Millimeter Wave
NFV	Network Functions Virtualization
R&D	Research and Development
SDN	Software-defined Networking
VLC	Visible Light Communication

Definitions

Dissemination means sharing research results with potential users - peers in the research field, industry, other commercial players and policymakers). By sharing your research results with the rest of the scientific community, you are contributing to the progress of science in general. (as per http://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management/dissemination-of-results_en.htm)

Exploitation is the use of results for commercial purposes or in public policymaking. (as per http://ec.europa.eu/research/participants/docs/h2020-funding-guide/grants/grant-management/dissemination-of-results_en.htm)

1   Introduction

This is the third, and last document reporting on the dissemination activities performed by the IoRL project partners, complementing IoRL deliverables D7.4 [1] and D7.9 [2]. Its primary purpose is to highlight the latest achievements, but it also presents the overall picture, and puts a specific focus on the period 1st July 2019 until 30 November 2020, which is the second financial reporting period of the project.

IoRL project partners continued to increase awareness about IoRL and disseminate its research and development results with not only to the scientific community but also to the general public.

The project outcomes have been successfully disseminated world-wide throughout various activities. Activities performed included, but are not limited to the followings: Conference paper contributions, White-paper contributions, Exhibitions and demos, Presentations, Media Coverage, Invited talks, Workshops, Flyers, Keynote speeches, Journal papers, Interviews, Position papers, Poster sessions, Brochures, Software, and Video/Film/TV Clip.

Demonstrating the integration of the development results intensified the interest by others in the project. Dissemination of the development results highlighted the importance of the IoRL in the eco-system.

1.1   The role of dissemination in IoRL

It is highly important to promote and disseminate IoRL project results to make more users and potential partners aware and eventually benefit from its outcome.

The goal of this dissemination task is to record all project promotion related activities from consortium members of the IoRL project helping to transfer knowledge and sharing the project results wiht the outside world.

This deliverable is developed as part of the IoRL project Work Package 7 (Dissemination and Exploitation).

The main goal of us was to take every possible opportunity to make the concept and the progress of IoRL project known to the public as widely as possible. The onset of the Covid-19 pandemic and subsequent travel limitations forced our project to prioritise contributions to whitepapers and online events, as well as technical papers (journal or conference papers) over other means, including directly and physically interacting with an audience.

2   Project identity

The project logo and the templates that are used in project presentations (internal and external) had been established earlier and have been consistently used by project partners throughout the period. Also, in each communication channels including social media (YouTube and twitter), the same logo has been used. This has been contributing to the creation of a solid worldwide identity of the project.

3   Dissemination activities performed

3.1   Overall statistics

Following the predefined dissemination mechanisms: (1) Submission of papers to leading peer-reviewed conferences and journals, (2) Participation in program committees and editorial boards, through which participants can organise special sessions in conferences, special issues, etc., and (3) Participation in forums and industrial oriented events, IoRL consortium members have utilized different method to efficiently and effectively introduced the concept of IoRL, shared the project results within consortium and to the outside world.

All dissemination activities of the project were recorded by the partners using the EuresTools Tracker tool, which is a web based tool that was developed specifically for the purpose to track dissemination activities. Each record has a great detail and consist of the following fields: unique ID, Activity Type, Activity event material type, Papers / presentation title, Date, Venue, Responsible partner, Authors, Confidentiality level, Status of publication, download link, created By User, creation Time. Table 1 lists all the dissemination activities between the start and the end of the project by distinct category.

Table 1 - Dissemination activities by category throughout the whole duration of the project

Item	No. of activities
Proceedings	53
Conference Contributions	51
Journals	48
Exhibition / demo / booth	22
Presentations	13
Workshops	12
Media Coverage	8

Invited Talk	6
Video / Film / TV Clip	6
Flyers	4
Standards	3
Keynote	3
Moderation	3
Poster Session	2
Magazine	2
Web	3
Interview	2
Software	1
Course	1
Social Media Posts	1
White Paper	4
Press Releases	1
Brochures	1

The number of Proceedings leads the list. The number of Conference Contributions is the second highest in the list. The number of the Journals is the third highest in the list. These three are taking the majority (60%) of the total dissemination items since the project started in 2017. The Pie chart of the category statistic is shown in Figure 1.

The coverage of the items is quite well as the list consists of 23 distinct types of dissemination activities, meaning that the partners used a wide variety of activities in order to disseminate the project results.

Dissemination Items by Category

- Proceeding (53)
- Conference contribution (51)
- Journal (48)
- Exhibition / demo / booth (22)
- Presentation (13)
- Workshop (12)
- Media Coverage (8)
- Invited talk (6)
- Video/Film/TV Clip (6)
- Flyers (4)
- Standards (4)
- Keynote (3)

http://tracker.eurescom.eu
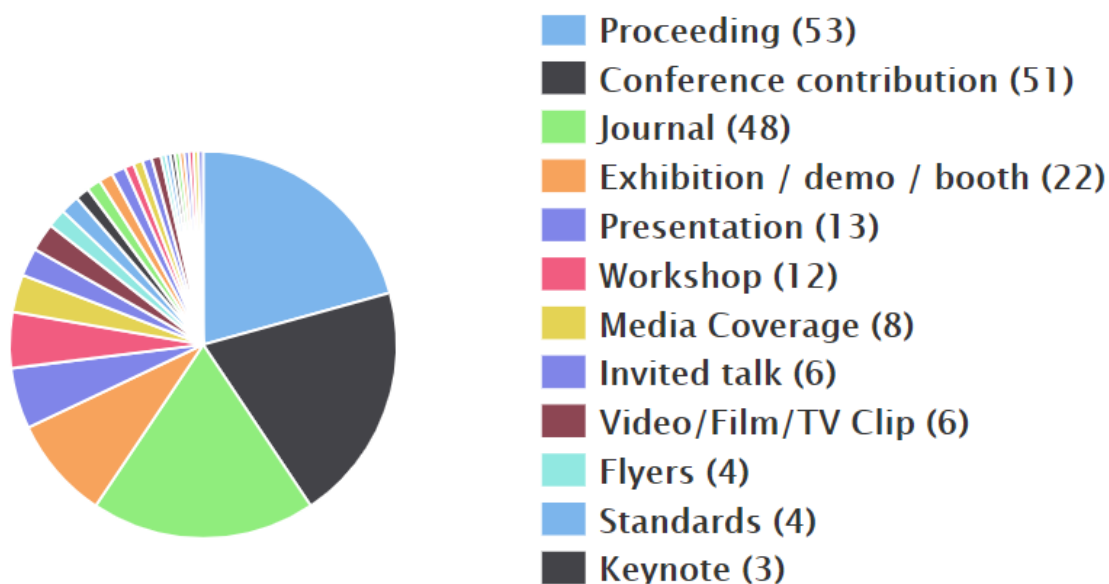
Figure 1 – Pie Chart of the total dissemination activities by category.

After checking the activities by category, we also look at activities distributions by year and the statistics is shown in Figure 2.
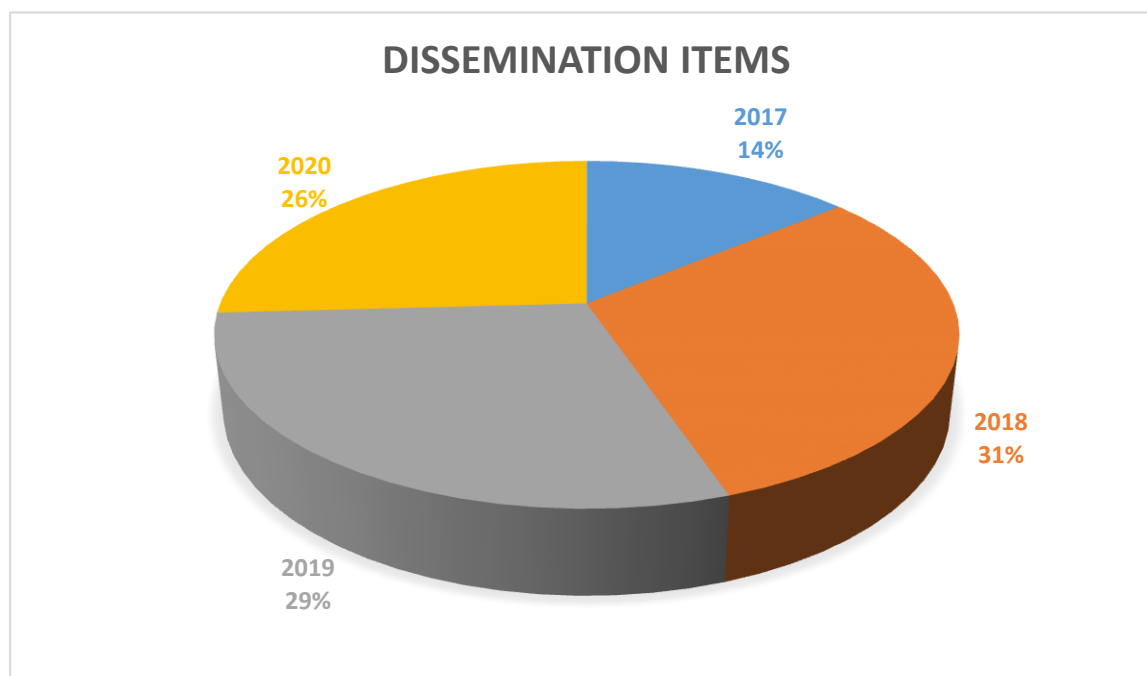
Figure 2 – Pie Chart of the total dissemination activities by Year

Because 2017 has been the first year of the project, and the project began in the middle of the year, it is appropriate that the number of dissemination activities in 2017 were the least. The pie chart also shows, that project has been clearly very active in the period of 2019 and 2020, which is the main focus of this report.

From the onset of the Covid-19 pandemic, approximately March 2020 most of the conferences turned to online. Thus, there we believe there is no point to analyse the dissemination activities by region. In any case, by March the project has already presented its results at global events outside of Europe.

3.2   IoRL dissemination activities as part of the 5G PPP

IoRL is part of the 5G Infrastructure Public Private Partnership (5G PPP), a joint initiative between the European Commission and European ICT industry (ICT manufacturers, telecommunications operators, service providers, SMEs and researcher Institutions). It is the ultimate ambition of IoRL not only to be successful on its own right, but to be a good team player and taking its fair share in contributing to the overall success of 5G PPP. As such IoRL has participates and contributes to programme level actions actively.

IoRL has participated in the preparation of the following White Papers together with other 5G PPP projects, in addition to what has already been reported earlier in IoRL deliverables D7.4 [1] and D7.9 [2].

3.2.1   5G for Indoors white paper [3]

IoRL has initiated the preparation of a 5G PPP white paper addressing the specificities of indoor 5G connectivity under the umbrella of the 5G PPP Technology Board. The purpose of the white paper from an IoRL perspective is to capture essential concepts from IoRL and put them into a broader context and outline valid alternative approaches. It also helps IoRL to measure itself against parallel 5G PPP projects addressing indoor aspects.

The white paper is currently under preparation in collaboration with the following projects: 5G Locus, Ariadne, Slicenet, 5G-CLARITY, 5G SMART, 5GROWTH, and personal contributions from Michael Fitch from University of Surrey. The white paper is due to be completed by the end of February 2021. Main editors of the white paper are Adam Kapovits, Eurescom GmbH, co-ordinator of IoRL and Prof John Cosmas, Brunel University, technical co-ordinator of IoRL.

More particularly, IoRL experts contributed to section 2.1.1 "Private Homes", section 2.1.2 "Transport", section 2.1.3 "Public Buildings, Museums", section 2.1.4 "Commercial spaces", section 2.5.4 "Ultra High Definition TV Streaming", section 2.5.5 "Tetherless Augmented and Virtual Reality", section 2.5.6 "Location Monitoring & Guiding Follow-Me TV Service", section 2.5.7 "Dynamically Extensible Location Database", section 2.6.1 "4K Televisions", section 2.6.2 "5G Test User Terminal", section 3.2 "Effects of Building Materials on Radio Propagation", section 3.3 "Existing indoor infrastructures and facilities that can support 5G networking and service delivery", section 3.5 "Existing Indoor Localisation solutions", section

4.1.3 "Potential roles and function of edge cloud in providing 5G services indoors" section 4.3.5 "5G NR indoor small cells" and section 4.3.6 "Remote Radio Light Heads"

3.2.2 Empowering Verticals industries through 5G Networks - Current Status and Future Trends white paper [4]

This paper has been completed with IoRL contributing to Chapter 3 Architectural considerations for the verticals, Section 3.1 Architectural enhancements; Chapter 4 Supporting the Verticals in the context of the 5G PPP, Section 4.1.3 Media and Chapter 5 Enablers to Support Verticals, Section 5.1 Section 5.1 Smart Management of Streaming Services, Section 5.2 Distributed Network Security, Section 5.3 Indoor Location Services.

3.2.3 Edge Computing for 5G Networks white paper [5]

A contribution to this paper has been provided by IoRL project to Chapter 6 Key Technologies for 5G on Edge Computing, Section 6.7 Indoor Localization.

3.2.4 Artificial Intelligence and Machine Intelligence [6]

This paper is being prepared with contributions planned for Chapter 1 Optimization issue requiring AI/ML intervention, Section 1.4 Specific network and service functions, Section 1.4.4 Positioning Accuracy; and Chapter 2 AI/ML methods requirements for network optimization, Section 2.1 Suitable AI/ML methods, Section 2.1.6 Kalman Type Filtering .

3.2.5 Security Whitepaper

IoRL project contributed to the Security Whitepaper (second version) that has been prepared within 5G PPP Security Working Group, however, due to insufficient Phase 2 projects contribution it was decided not to release the document publicly.

3.3   Events organised and/or contributed to

3.3.1 IoRL at IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB) 2020

The IoRL project held a full day workshop on 26th October 2020 as part of IEEE BMSB 2020. The workshop was composed of two parts. A completely online part, and a session with physical presence at the end of the day. Given the long term involvement of the city of Issy-les-Moulineaux and ISEP, and bearing in mind the commitment of Issy to innovation and exposure to international projects, an additional session with a specific focus on local stakeholders was held at the end of the day to wrap up the views on the IoRL project results and contributions from the perspective of Issy-les-Moulineaux.

3.3.1.1   Virtual Workshop at ISEP

As part of the IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB) 2020 IoRL has organised a workshop on 26 October 2020 presenting its

results. The flyer advertising the workshop is shown in Figure 3, but also accessing on the web at https://bmsb2020.isep.fr/pdf/flyer-final-jpc-oled.pdf.

The workshop, as BMSB itself was held online. The whole workshop, the online presentations and discussions have been recorded. Participants and attendees were notified in advance that the workshop is going to be recorded.

Figure 3 – Flyer for BMSB 2020: EU H2020 5G IoRL Workshop

Video recording of the workshop presentations are published on the IoRL YouTube channel In the following we include the full programme of the workshop with the links to each presentation.

- ➢ **Welcome to IoRL Workshop** – Adam Kapovits, Eurescom
  - o Video Record of this section: https://www.youtube.com/watch?v=eyFHhEVyfOw&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG

- ➢ **Introduction to IoRL** – John Cosmas, Brunel University, IoRL Technical manager
  - o Video Record of this section: https://www.youtube.com/watch?v=_3Wh86MOf9c&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=2

- ➢ **Radio Access Network**
  - o 5G – Israel Koffman, RunEL
  - o mm-wave – Robert Müller, Fraunhofer IIS
  - o VLC - Xun Zhang, ISEP
  - o Video Record of this section: https://www.youtube.com/watch?v=gPEwqtQK1Ko&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=9

- ➢ **User Terminal**
  - o Test Terminal – Wei Li, Viavi Solutions
  - o VLC Receiver – Bastien Béchadergue, Oledcomm
  - o Video Record of this section: https://www.youtube.com/watch?v=gPEwqtQK1Ko&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=9

- ➢ **SDN-NFV**
  - o Security – Marcin Gregorczyk, Warsaw University of Technology
  - o Multisource Streaming – Mathias Lacaud, JOADA
  - o Location Algorithm/Database – Lina Shi, ISEP
  - o Location Data Fusion - Ben Meunier, Brunel University
  - o Follow Me TV – Nawar Jawad/Kareem Ali, Brunel University
  - o Load Balancing – Charilaos C. Zarakovitis, NCSRD
  - o Video Record of this section: https://www.youtube.com/watch?v=aN1UvUj0yG8&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=4

- ➢ **Applications**
  - o 4kTV – Furkan Cömert, Arçelik
  - o Location based Data Access, Monitoring and Guiding – Kareem Ali, Brunel University
  - o Measurement Campaign Setup – Ben Meunier, Brunel University
  - o Video Record of this section:

https://www.youtube.com/watch?v=g5nrZ-crt6I&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=7

- ➢ **Measurement Campaign Performance results and discussions** – Yue Zhang, University of Leicester

    - o Video Record of this section:
      https://www.youtube.com/watch?v=SwEhXzxigdc&list=PLEkSuXbp_WNRtTLMAhMR8ETsby8K0eFEG&index=8

- ➢ Project Demonstration Video

    - o Video link:
      https://www.youtube.com/watch?v=RZiR-MpFmCM

- ➢ **Round table discussion: 5G and Lifi in Issy-les-Moulineaux** – with Eric LEGALE, Issy Média, Xun ZHANG, ISEP, Jean-Pierre BIENAIME, Ubiquity Consulting, Denis BUTAYE, Musée Français de la Carte à Jouer and Jean-Pierre CASARA, Orange

    - o Video Record of the discussion:
      https://www.youtube.com/watch?v=0OCwKLeVz4Q,

IoRL Workshop Chat

09:25:49
From Adam Kapovits, IoRL co-ordinator : Dear all, we are here monitoring this channel. Please post your question here

09:42:20
From Borja Genovés : I have a question, why are you using 3.5GHz band for mmWave instead of 24GHz or 60GHz?

09:43:27
From Artur Krukowski : When do you expect for this technology to appear on the market as a product?

09:43:57
From John Cosmas (Brunel Uni, IoRL Tech Manager) : 60GHz solution was very expensive and had supply problem from US supplier

09:45:02
From John Cosmas (Brunel Uni, IoRL Tech Manager) : Runel solution was used in 5Genesis project

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09:46:37

From   Artur Krukowski : Do you have a way of reducing a risk of dependence on US suppliers?

09:47:38

From   John Cosmas (Brunel Uni, IoRL Tech Manager) : Robert Muller can answer that question in more depth

09:50:26

From Artur Krukowski : Have you also made any assessment of power consumption aspects and expected minimum form factor, considering ultimately a move from FPGA to custom IC implementation?

09:52:41

From Artur Krukowski : My application scenario is of micro-embedded sensors with ambient energy harvesting supply.

09:54:58

From   Adam Kapovits, IoRL co-ordinator : Moving to ASIC is clearly a major step. I would need to check with RunEL, the exact impact on power consumption and achievable minimum form factor. The system is still maturing, and currently tailored for the use in research project- i.e. retaining high flexibility and adaptability. Moving to IC is a major cost, especially for an SME such as RunEL. I let RunEL to go into further details

09:55:52

From Adam Kapovits, IoRL co-ordinator : Oh sorry, I only see the embedded system aspects now.

09:56:27

From   Adam Kapovits, IoRL co-ordinator : This field is still under heavy investigation within 3GPP under the name REDCAP - i.e. reduced capability

09:58:35

From   Adam Kapovits, IoRL co-ordinator : For those type of applications a special, reduced capability 5G system is still being specified. I expect 3GPP concluding those next year - system will come later

09:59:45

From Israel Koffman : The major reason for moving to ASIC is reducing cost in high volumes, secondary reasons are power consumption and speed (latency) that are important as well. However it is a costly process and time consuming.

10:02:04

From   Adam Kapovits, IoRL co-ordinator : As I wrote, for the particular sensing and energy harvesting type applications, the issue is that standardisation is still ongoing. Not event the big ones move, until this settles

10:03:44

From Artur Krukowski : Coordinator can arbitrarily mute all participants.

10:06:30

From Borja Genovés : Thanks a lot for the presentation! I have a question: This project focuses on downlink or are you considering also uplink? which technology do you use for UL?

10:07:04

From Robert(FhG) : To the question: Do you have a way of reducing a risk of dependence on US suppliers?

10:07:10

From Robert(FhG) : i will say no

10:08:35

From John Cosmas (Brunel Uni, IoRL Tech Manager) : mmwave Uplink is being integrated now.

10:09:02

From Adam Kapovits, IoRL co-ordinator : Reducing dependence on US suppliers - we faced issues in this regard, and currently we do not see a way around. Do you have any advice?

10:10:17

From Adam Kapovits, IoRL co-ordinator : mmWave is down and uplink

10:10:37

From Dayrene Frometa (IMDEA Networks Institute, Madrid, Spain) : One of the most attractive characteristics of VLC systems is their energy efficiency by using LEDs for communications. Could you give details about the power consumption of the VLC module for both communications and illumination?

10:14:34

From Adam Kapovits, IoRL co-ordinator : I will ask this question at the end of the talk, as I do not have an answer to that

10:16:09

From John Cosmas (Brunel Uni, IoRL Tech Manager) : Ben did compile a system power budget on request from Ferrovial

10:18:49

From Domenico Giustiniano : Why did you consider have so many small LEDs for illumination instead a smaller amount, but more powerful ?

10:19:52

From Adam Kapovits, IoRL co-ordinator : We will need to move on, but we willtry to answer further questions through the chat

10:32:21

From Jintao Wang _ TH : About the power consumption of the VLC module for both communications and illumination :

10:34:07

From Jintao Wang _ TH : The overall power consumption of our vlc design is less than 3.5W considering both comm and lighting.

10:39:28

From Domenico Giustiniano : Why did you use DMRS for positioning instead of PRS ?

10:40:16

From Domenico Giustiniano : positioning reference signal

10:40:50

From Domenico Giustiniano : PRS is standardized too

10:45:11

From Dayrene Frometa (IMDEA Networks Institute, Madrid, Spain) : Thank you very much for your answer, but you have mentioned different solutions (spot light, ceiling light, ...), Could you please say with which solution does this energy consumption correspond?

10:49:44

From xun zhang : VIAVI chooses DMSR is just for testing purposes. To integrate with 5G positioning protocol and whole 5G positioning protocol testing, PRS slot will be used.

10:50:41

From Jintao Wang _ TH : It's for ceiling light.

10:57:02

From Domenico Giustiniano : Did you use Open Air Interface for the 5G NR demonstration ?

10:57:04

From Adam Kapovits, IoRL co-ordinator : We reconvene at 11:15

10:57:22

From   Adam Kapovits, IoRL co-ordinator : Meanwhile, we are still open for receiving questions

11:04:57

From yue zhang : 5G NR demonstration is based on RunEL FPGA RAN solution. The UE is based on Viavi USRP SDR platform but not for open Air interface

11:29:59

From Adam Kapovits, IoRL co-ordinator : If you have any questions to Marcin, regarding the security solution in IoRL, please post it here, and we try to answer it

11:45:53

From Adam Kapovits, IoRL co-ordinator : Please post your question here

12:32:48

From Adam Kapovits, IoRL co-ordinator : After lunch we will resume at 14:00

If someone disconnects, you should reconnect using the same link / same Zoom meeting room as in the morning

12:33:41

From Anthony Bawa : 1) What is the most efficient algorithm for the load balancing in the VLC and mmWave networks

12:35:05

From Adam Kapovits, IoRL co-ordinator : Thanks, we will take that question up

14:04:20

From Adam Kapovits, IoRL co-ordinator : RE: We did not implement PRS, as it became part of   Rel   16   –   so   recently.

Also, the "standard" positioning accuracy with PRS is something like 3m, so in a different league   than   our   target.

In order to achieve cm accuracy, we still need some work around. We want long sequence for better processing gain and better SNR, so we are using long front loaded DMRS in the uplink PUSCH. Furthermore, we use high number of DMRS subcarriers attached to the user data. So when we want to measure location we can lower the code rate and the modulation to get   higher   number   of   RB   and   DMRS   for   the   needed   SNR   for   the   cm.

In summary, it is our plan to combine the two methods. So if the user is not actively transmitting then we may initiate standard PRS process and hop for long sequence to reach our target accuracy of cm.

14:04:59

From Adam Kapovits, IoRL co-ordinator : The above detailed answer is for the previous question: Why did you use DMRS for positioning instead of PRS ?

positioning reference signal

PRS is standardized too

14:14:24

From Adam Kapovits, IoRL co-ordinator : Please post your questions here

14:29:47

From Alexander Adolf : Any thoughts on how this will fit into my next laptop?

14:40:52

From Alexander Adolf : Understood; well done, and looking forward to your next results! 👍

15:36:14

From Adam Kapovits, IoRL co-ordinator : Dear all, do you have questions?

15:36:50

From Adam Kapovits, IoRL co-ordinator : This is now the time to post / ask your questions

15:53:58

From Alexander Adolf : Fly's eye -> Fresnel lens config + grid sensor? Just off the top of my head…

15:54:25

From Adam Kapovits, IoRL co-ordinator : Thanks

15:59:51

From Bastien Béchadergue : @Alexander: Grid sensors are definitly interesting solutions for light communication performance (data rate and coverage) improvement as they would allow MIMO and even wavelength division multiplexing when coupled with adapted optical filters

16:04:00

From Adam Kapovits, IoRL co-ordinator : Here this is the ronde table meeting link: Topic: 5G AND   LIFI   IN   ISSY-LES-MOULINEAUX   –   A   ROUND   TABLE   DISCUSSION Time: Oct   26,   2020   04:30   PM   Paris

Join   Zoom   Meeting https://us02web.zoom.us/j/87877137349?pwd=NFdnU2ZmTnZtRnNaNUJ1QXU4YWI2QT09

The session will be in French with English subtitle.

16:26:27

From isabelle Siaud : Thank you very much for this very interesting workshop. I will take time also to consider deliverables of the project. mm-wave bands combined with VLC may provide powerfull use cases and scenarios

16:26:59

From isabelle Siaud : Many thanks again Adam

Figure 4 – Workshop Chat Text

3.3.1.2 Physical Workshop at ISEP

The objective of the Round Table was to wrap up after a full day workshop dedicated to the IoRL project that took place online. The workshop held at ISEP was followed by a round table with local actors from Issy-les-Moulineaux, such as Orange and the Muséé de la Carte à Jouer who could testify the importance and the role of IoRL in the development of the use of VLC in the local museum.

There were 5 speakers in total who physically attended and intervened at ISEP premises, except for Mr Bienaimé (5GPPP) who connected remotely:

- Eric Legale, General Director at Issy Media: he made the introduction to the conference by giving a quick background on the project. He illustrated its aim to improve lifi and mentioned the 20 international partners involved, some examples of how lifi was deployed amongst a few partners (practical ones were shared on the metro in Madrid, buildings in United Kingdom and supermarkets in China) and sponsors. He also introduced the other speakers.
- Dr Xun Zhuang, Professor and Researcher at ISEP: he explained how ISEP actively took part of the project and mentioned how IoRL was part of the 5G projects co-financed by the European Union.
- Denis Butaye, Director of the "Musée Français de la Carte à Jouer": he focused on the deployment of lifi within the Museum. He explained how the architecture of the Museum made it very hard to set up a network connection within its walls and hence how the idea of using lifi was the good solution to improve visitors' experience, making it enhanced, personalized and more comfortable.
- Jean-Pierre Bienaimé, General Secretary of 5GPPP: he gave an overview of the 5G deployment in Europe.
- Jean-Pierre Casara, Head of 5G projects at Orange, shared a view on 5G from the network operator perspective.

The attendance of the workshop as expected, considering the circumstances. There were 12 people physically present in the meeting room (Florent Aziosmanoff – Living Art, Pierre Ferrer – Pferrer Conseil, Ariel Gomez – Smart City Mag, Xavier Mazingue-Desailly - IXemel, Patricia Morshedi, Ioana Ocnarescu -Strate Design, Johan Roirand - Metropole Advisory, Benoît Rolland – Orange, some ISEP students), and 45 online.
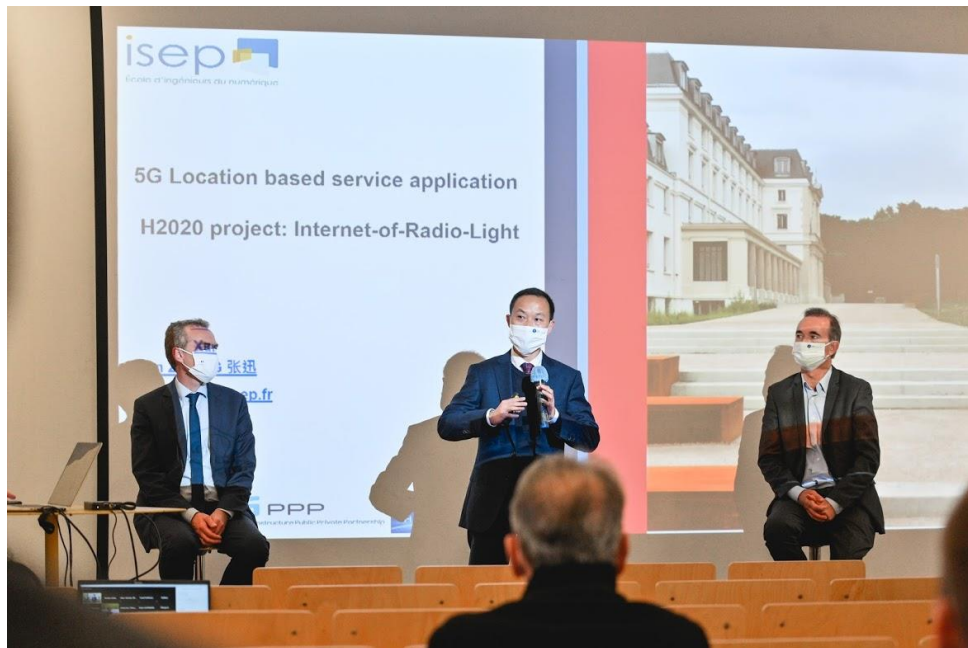
Figure 5 – Final round table at the workshop at the workshop at ISEP[1]

Figure 6 – Pictures of the Audience

The conference was mixed between physical participation (12 people physically present in the meeting room[2]), and 45 online.

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[1] From the left to the right: Mr. Butaye, Director of the Musée de la Carte à Jouer, Dr. Zhang, Phd and professor at ISEP, and Mr. Casara, 5G Innovation expert at ORANGE.

This session was recorded and broadcasted on Zoom with a real time translation (from French to English) proposed through subtitles. The video is available on [Youtube](#).

Marketing material

ISEP produced the following material (pictures and pdf version of the flyers available below) :

- Masks with the IoRL logo: we ordered 100 of them as we counted a maximum of 70 people physically present in the room and took an extra marge for staff and just in case

- 2 identical kakemonos which we played one at the entrance of the campus and one just outside the conference room

- 100 flyers of the event

- 2 banners we planned to install at each side of the speakers' stand (we ended up using only one as the other could not be captured by the camera)

- a consolidated presentation including all slides to support the speakers' speech (only Dr Xun and Mr Bienaimé provided these)

Figure 7 – Masks with IoRL Logo

Figure 8 – IoRL Kakemonos

Figure 9 – Flyers of the event

3.3.2 5G Network Security workshop (5G NS 2019) at the International Conference on Availability, Reliability and Security (ARES) 2019

At the ARES 2019 conference which was held in Canterbury (UK), IoRL was responsible for organizing and chairing the 5G Network Security (5G NS 2019) workshop. It was a joint effort of the IoRL project and two other H2020 projects, 5GDrones and INSPIRE-5Gplus under the umbrella of the 5G Infrastructure Association Security Working Group. WUT team was leading the organization of the event including selecting a keynote by professor Raimo Kantola from Aalto University, Finland, who gave a talk on Cooperative Security for 5G and

the Internet. Moreover, Wojciech Mazurczyk and Krzysztof Cabaj organized papers into sessions and were chairing and moderating them. During the workshop Piotr Żórawski presented also a paper on IoRL security-related aspects.

3.3.3 5G Network Security workshop at the International Conference on Availability, Reliability and Security (ARES) 2020

Within the ARES 2020 conference IoRL was responsible for organizing and chairing the 5G Network Security workshop which was a joint effort of IoRL together with two other H2020 projects, 5GDrones and INSPIRE-5Gplus under the umbrella of the 5G Infrastructure Association Security Working Group. Apart from organizing and chairing all the sessions by Wojciech Mazurczyk and Krzysztof Cabaj from the WUT team two papers on IoRL security-related aspects have been presented.

3.3.4   Brunel Institute of Digital Futures Virtual Exhibition 2020

The virtual exhibition is hosted online for the foreseeable future – and features on the main homepage Entrance Hall, choice to enter Room 1, Room 2 or Planetarium. IoRL stand is in Room 1. https://berrystudiointernal.com/MqkhMHU/idf-tutorial

Entering the exhibition is shown in Figure 10. After navigating to the end of the entrance, you are presented with choices to enter Room 1, Room 2 and Planetarium in Figure 11.

Entrance of Room 1 of the exhibition hall is shown in Figure 12 and approaching IoRL stand is shown in Figure 13. The IoRL posters are shown in Figure 14 and a closer view of project description and system concept is shown in Figure 15 and the project poster in Figure 16. The project power point presentation is shown in Figure 17.

In Figure 18 the project video is shown featuring researchers Ben Meunier and Kareem Ali and in Figure 19 it is shown featuring researchers John Cosmas and Yue Zhang.

Figure 10 – Entering the virtual exhibition hall
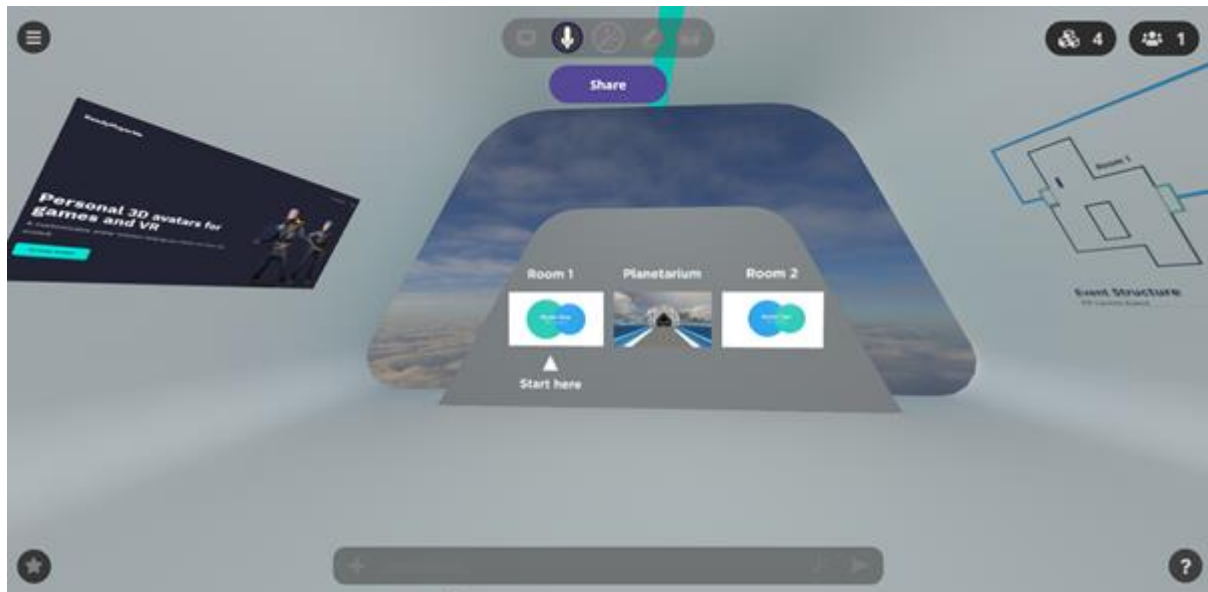
Figure 11 – Entering the rooms in the exhibition hall
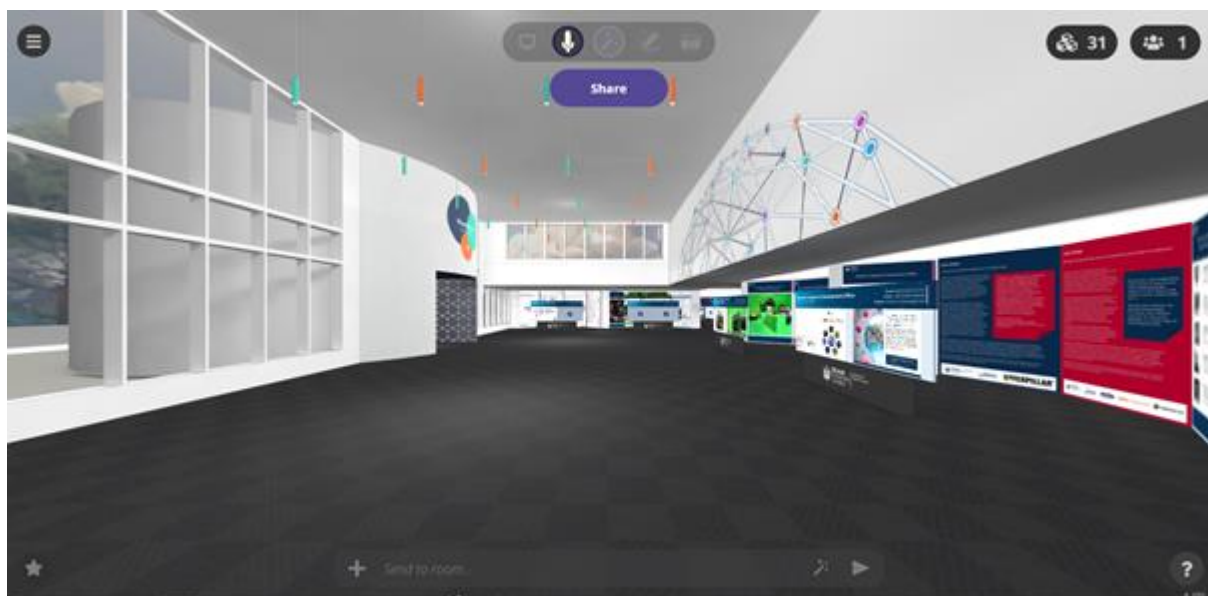
Figure 12 – Entrance of room 1 in exhibition hall
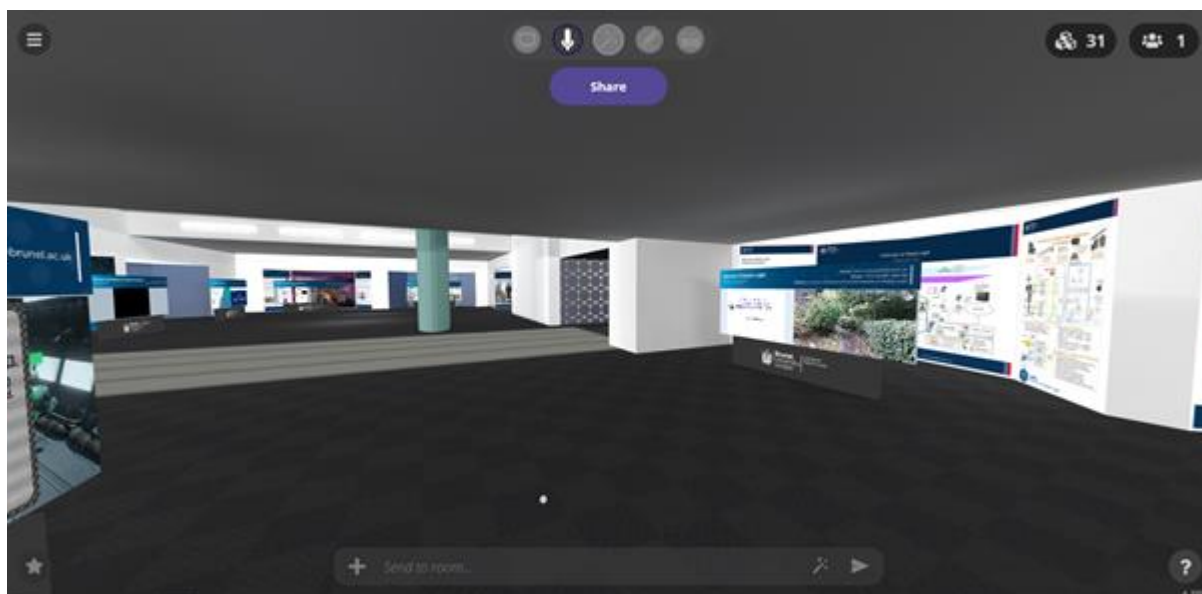
Figure 13 – Approaching the IoRL Stand
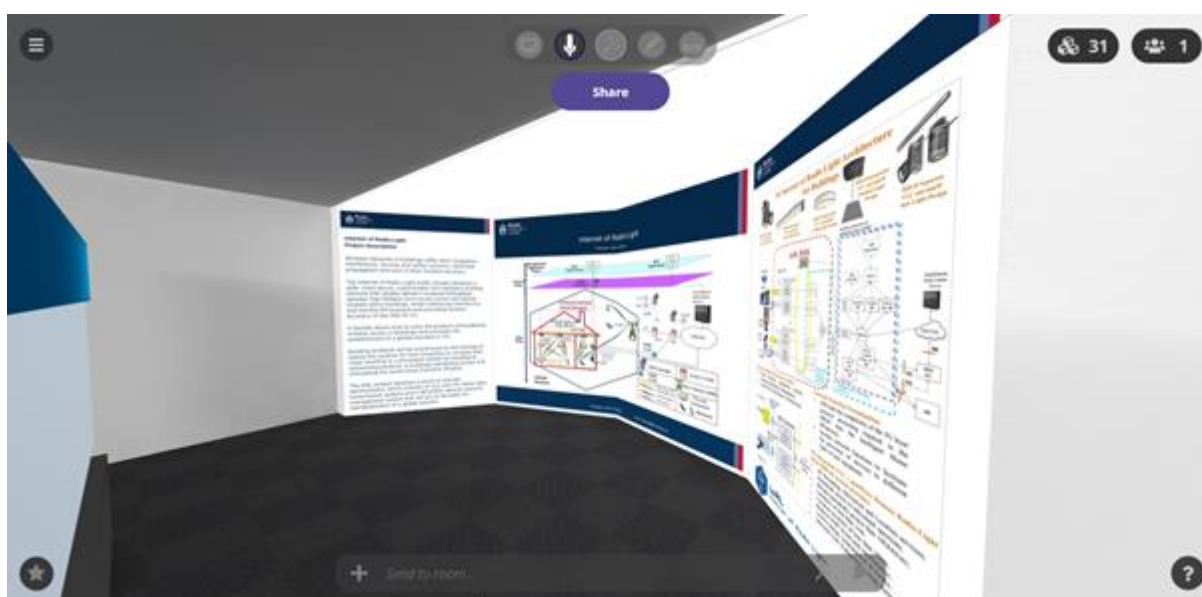
Figure 14 – IoRL stand information posters
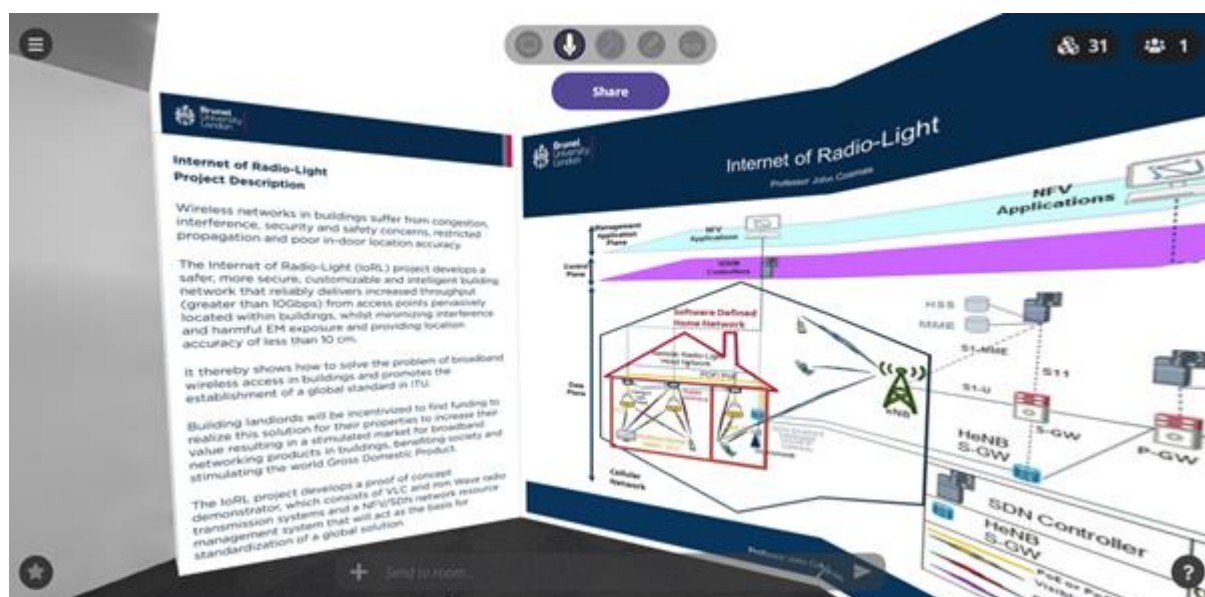
Figure 15 – Closer view of project description and system concept IoRL posters
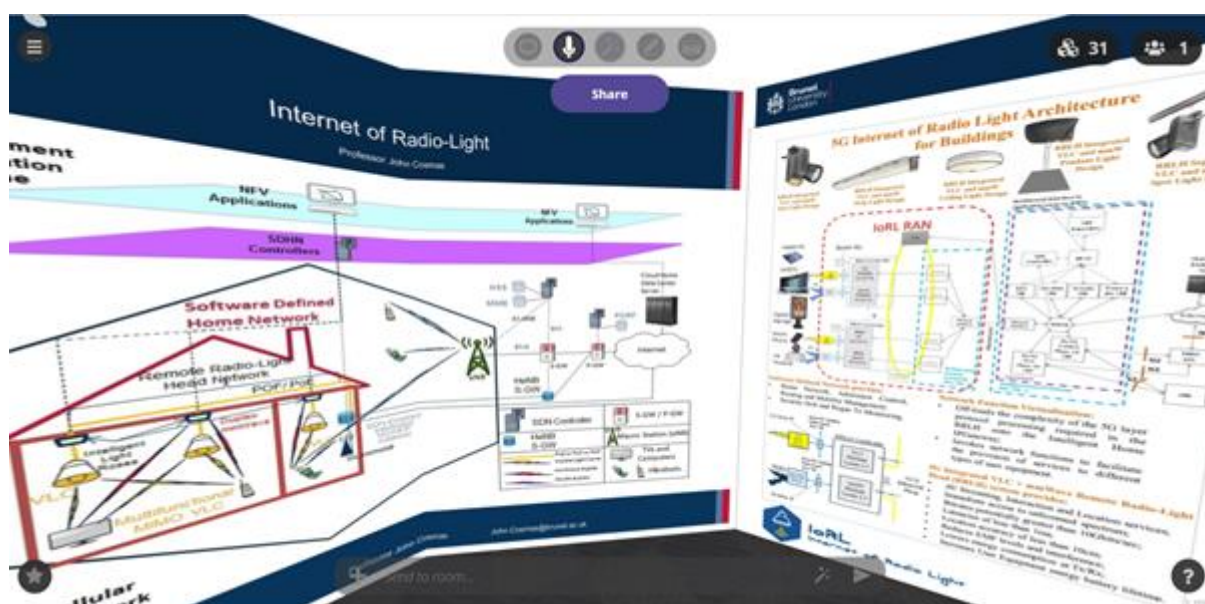
Figure 16 – Closer view of IoRL project poster
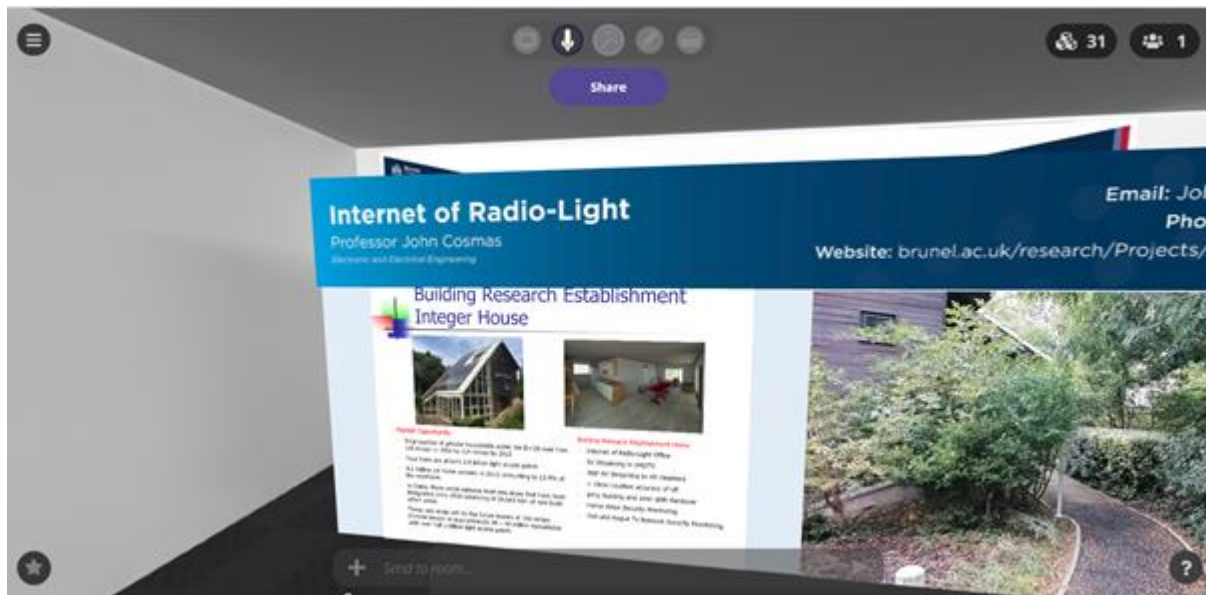
Figure 17 – Viewing the IoRL power point presentation
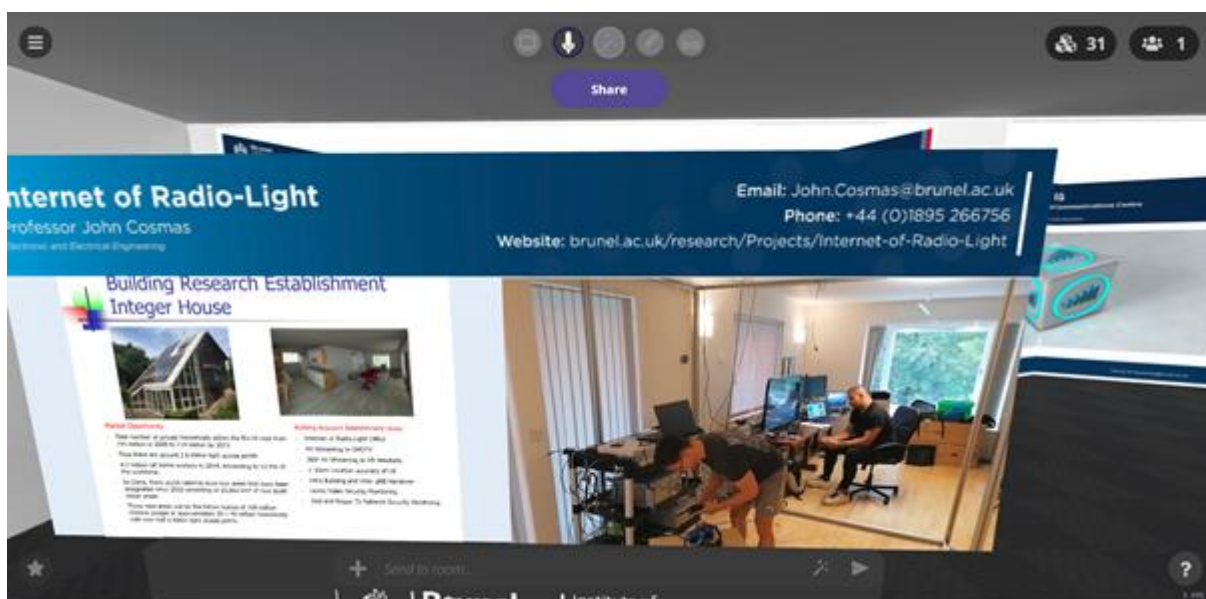
Figure 18 – Watching the IoRL video
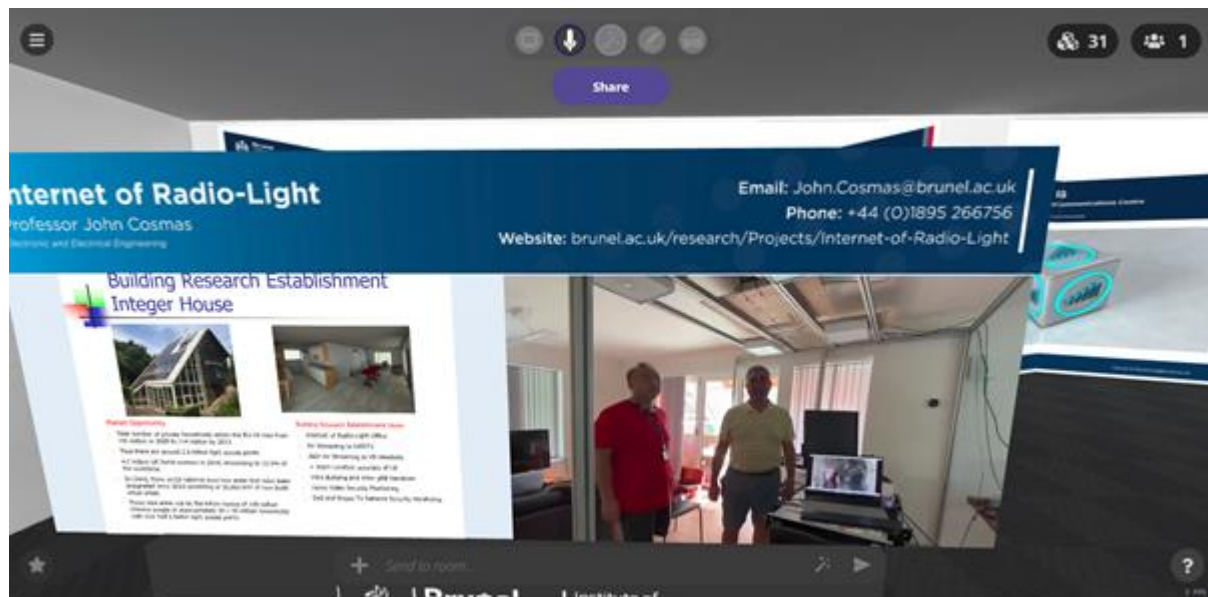
Figure 19 – Watching the IoRL video

3.4   IoRL publications

The following two tables, Table 2 and Table 3 summarises and reflect the impact of IoRL work from a scientific and citation point of view. Table 2 and Table 3 comprises the publications from 1st July 2019 to the end of the project. The previous publications were reported in IoRL deliverable D7.4 [1].

Table 2 – IoRL journal and book publications

Publication title	Journal / Book	Partner	Citations	Date
A visible light RGB wavelength demultiplexer based on silicon-nitride multicore PCF	Optics &Laser Technology, Vol.111, 2019, pp.411-416	MostlyTek	21	2019-04-01
A visible light RGB wavelength demultiplexer based on polycarbonate multicore polymer optical fiber	Optics & Laser Technology, Vol 116, 2019, pp.239-245	MostlyTek		2019-08-01
Compression Based LMMSE Channel Estimation with Adaptive Sparsity for Massive MIMO Systems	IEEE Systems Journal	University of Leicester		2019-09-14

Deep Learning based Channel Estimation Algorithm over Time Selective Fading Channels	IEEE Transactions on Cognitive Communications and Networking	University of Leicester		2019-09-15
Performance Analysis for Multihop Cognitive Radio Networks With Energy Harvesting by Using Stochastic Geometry	IEEE Internet of Things Journal	University of Leicester		2019-11-12
Receiver design for Alamouti coded FBMC system in highly frequency selective channels	IEEE Transactions on Broadcasting	University of Leicester		2019-09-02
Deep Reinforcement Learning for Smart Home Energy Management	IEEE Internet of Things Journal	University of Leicester		2020-04-04
Improved Multiple Bit-Flipping Fast-SSC Decoding of Polar Codes	IEEE Access (Volume: 8)	University of Leicester		2020-01-08
A Distributed Framework for Task Offloading in Edge Computing Networks of Arbitrary Topology	IEEE Transactions on Wireless Communications (Volume: 19 , Issue: 4 , April 2020)	University of Leicester		2020-01-28
Frame Repetition: A Solution to Imaginary Interference Cancellation in FBMC/OQAM Systems	IEEE Transactions on Signal Processing (Volume: 68)	University of Leicester		2020-02-02
Sniffing Detection Based on Traffic Probing and Machine Learning	IEEE Access	Warsaw University of Technology		2020-03-01

5G Internet of Radio Light Positioning System for Indoor Broadcasting Service	IEEE Transactions on Broadcasting	ISEP		2020-01-28
Media Casting as a Service: Industries Convergence opportunity and caching service for 5G indoor gNB	IEEE Transactions on Broadcasting	Brunel University		2019-10-01
Special issue for Future Generation Computer Systems on Advancements in 5G Networks Security	Special issue on Advancements in 5G Networks Security	Warsaw University of Technology		2019-12-01
A High-Precision Positioning Scheme under Non-Point Visible Transmitters	IEEE Open Journal of the Communications Society	Tsinghua		2020-07-13
Full Field Radiant Flux Distribution of Multiple Tilted Flat Lambertian Light Sources	IEEE Open Journal of the Communications Society	OLEDCOMM		2020-07-13
Security and Communication Networks	Characterizing Anomalies in Malware-Generated HTTP Traffic	Warsaw University of Technology		2020-04-14
Feature Topic on Challenges and Novel Solutions for 5G Network Security, Privacy and Trust for IEEE Wireless Communications	Feature Topic on Challenges and Novel Solutions for 5G Network Security, Privacy and Trust	Warsaw University of Technology		2019-12-01
EU Annual Journal 2020	EU	Brunel University		2020-01-02
Special issue on Advances in 5G Networks Security	Special issue on Advances in 5G Networks Security for the Sensors journal	Warsaw University of Technology		2020-06-01
Internet of radio and light: 5G building network radio and edge architecture	Intelligent and Converged Networks	Brunel University		2020-09-21

Improved NSC decoding algorithm for polar codes based on multi-in-one neural network	Computers & Electrical Engineering	BRE		2020-09-01
User Identity Linkage via Co-Attentional Neural Network From Heterogeneous Mobility Data	IEEE Transactions on Knowledge and Data Engineering	Tsinghua University		2020-04-01
Joint Optimization of Path Planning and Resource Allocation in Mobile Edge Computing	IEEE Transactions on Mobile Computing	Tsinghua University		2020-06-01
Efficient Selection on Spatial Modulation Antennas: Learning or Boosting	IEEE Wireless Communications Letters	Tsinghua University		2020-04-01
Device Activity Detection and Non-Coherent Information Transmission for Massive Machine-Type Communications	IEEE Access (Volume: 8)	Tsinghua University		2020-02-01
Minimizing Age of Information With Power Constraints: Multi-User Opportunistic Scheduling in Multi-State Time-Varying Channels	IEEE Journal on Selected Areas in Communications	Tsinghua University		2020-03-01
Scheduling to Minimize Age of Synchronization in Wireless Broadcast Networks With Random Updates	IEEE Transactions on Wireless Communications	Tsinghua University		2020-03-01
Low-Complexity OFDM-Based Hybrid Precoding for Multiuser Massive MIMO Systems	IEEE Wireless Communications Letters	Tsinghua University		2019-07-01
Joint Transceiver Optimization for Wireless Communication PHY Using Neural Network	IEEE Journal on Selected Areas in Communications	Tsinghua University		2019-08-01

Table 3 – IoRL conference publications

Paper title	Conference name	Venue	Partner	Citations	Date
Average SER Analysis for Layered Division Multiplexing System with Index Modulation	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		University of Leicester		2019-06-05
Free-form Compound Concentrators for Optical Wireless Communications	Global LiFi Congress 2019		Jorge Garcia-Marquez		2019-06-12
Low-Complexity Multiuser Detection for Generalized Media-Based Modulation Systems	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		Tsinghua University		2019-06-05
Genetic Algorithm Based Optimization Method of Single Frequency Network Planning for DTMB	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		Tsinghua University		2019-06-05
Optics-Radio Hybrid Single Frequency Network for Digital Television Terrestrial Broadcasting	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		Tsinghua University		2019-06-05

High Accuracy Indoor Visible Light Positioning Considering the Shapes of Illuminators	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		Tsinghua University		2019-06-05
Performance Analysis on Hybrid OOK-and-OFDM Modulation in VLC System	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB2019)		Tsinghua University		2019-06-05
Positioning System based on DTMB: Design, Laboratory Test and Field Trail	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB2019)		Tsinghua University		2019-06-05
Energy-Efficient Mixed-Timescale Hybrid Precoding for Multiuser Massive MIMO Systems	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB2019)		Tsinghua University		2019-06-05
Which LiFi's apps may fit mostly to 5G and beyond-5G Technology?	Global LiFi Congress 2019		MostlyTek		2019-06-12
RGB Demultiplexer Based on Multicore Polymer Optical Fiber	EUCNC 2019		MostlyTek		2019-06-19

Deep Convolutional Auto-Encoder based Indoor Visible Light Positioning Using RSS Temporal Image	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB2019)		Xun Zhang		2019-06-05
PAPR reduction based on deep autoencoder for DCO-OFDM VLC system	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2019)		Xun Zhang		2019-06-05
A Set-membership Approach for Visible Light Positioning with Fluctuated RSS Measurements	The tenth edition of the International conference on Indoor Positioning and Indoor Navigation		Xun Zhang		2019-09-28
Securing Modern Network Architectures with Software Defined Networking	International Conference on Computational Science and Computational Intelligence		Warsaw University of Technology		2019-12-05
Experimental indoor tracking testbed based on Visible Light Communication	IEEE ICECS		ISEP		2019-11-27
The Performance Measurement of the 60GHz mmWave Module for IoRL Network	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting	Paris, France	Leicester U, Viavi, Brunel U, Isep, Tsinghua U, Fraunhofer IIS,		2020-10-29

	(BMSB 2020)				
Effect of Illumination Intensity on LED Based Visible Light Communication System	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2020)	Paris, France	ISEP		2020-10-29
IoRL Real-Time Video Lan Client Player Streaming through SDN Network	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2020)	Paris, France	Brunel U		2020-10-29
Network and Application Layer Services for High Performance Communications in Buildings	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2020)	Paris, France	Brunel U, Leicester U, WUT, Viavi, Joada, Ferrovial,Ci3, Demokritos		2020-10-29
Using 5G to Bring More than Bits to Homes	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2020)	Paris, France	Brunel U, Leicester U, Demokritos,		2020-10-29
Virtual Gateway: Local Multimedia Services and mobility management for 5G Internet of Radio Light gNB	IEEE International Symposium on Broadband Multimedia Systems and Broadcasting (BMSB 2020)	Paris, France	Brunel University		2020-10-29
Distributed Packet Inspection for Network Security Purposes in Software-Defined Networking Environments	Proceedings of the 15th International Conference on Availability, Reliability and Security (ARES 2020)		Warsaw University of Technology		2020-06-01

A Device Identification Method Based on LED Fingerprint for Visible Light Communication System	ARES Conference 2020		ISEP		2020-06-01
Social Weak-tie Assisted Cross-domain Short Video Recommendation	IWCMC 2019		Tsinghua University		2019-06-14
CROSS - Cross-platform Recommendation for Social E-Commerce	42nd International ACM SIGIR		Tsinghua University		2019-07-13
Multi-resolution CSI Feedback with Deep Learning in Massive MIMO System	ICC 2020		Tsinghua University		2020-06-07
Minimizing the Age of Synchronization in Power-Constrained Wireless Networks with Unreliable Time-Varying Channels	IEEE INFOCOM 2020- Conference on Computer Communications Workshops		Tsinghua University		2020-07-06
Scheduling to Minimize Age of Information in Multi-State Time-Varying Networks with Power Constraints	57th Annual Allerton Conference on Communication, Control, and Computing (Allerton)		Tsinghua University		2019-09-24
On RF-Chain Limited Spatial Modulation Aided NOMA: Spectral Efficiency Analysis	2019 IEEE Globecom Workshops		Tsinghua University		2019-12-09

3.5 Press coverage

The Table 4 comprises all press coverage of IoRL Project from the start to the end of the Project phase.

Table 4 – Press coverage in IoRL project

Israeli companies leading	17.06.2020	https://www.calcalistech.com/ctech/articles/0,7340,L-3833773,00.html	RunEL	Local

global 5G revolution				
Issy-les-Moulineaux, une des premières villes à travailler sur le « Lifi », l'internet de la lumière par la 5G	2017-07-11	http://www.calameo.com/read/0007627957c44097d8ac4	Issy	Local
Un nouveau projet européen pour Issy : Internet of Radio Light (IoRL)	2017-07-10	http://seineouestdigital.fr/projet-iorl	Issy	Local
IoRL - Internet of Radio Light: a brand new EU project is coming to Issy	2017-07-10	**http://www.issy.com/en/node/18149**	Issy	European/International
Issy-les-Moulineaux choisie pour préparer l'Internet par la lumière	2017-07-19	**https://5g-ppp.eu/iorl-internet-of-radio-light-project-launch"**	Issy	National
La nouvelle révolution numérique passe par Issy avec l'internet de la lumière	2017-09-01	http://www.leparisien.fr/issy-les-moulineaux-92130/issy-les-moulineaux-choisie-pour-preparer-l-internet-par-la-lumiere-09-08-2017-7184880.php#xtor=AD-1481423553	Issy	National
Ici on passe l'internet de la lumiére	2017-09-01	Hardcopy of "Le Parisien"	Issy	National
Issy named in ICF Smart21 Communities of the	2017-11-05	**https://fr.calameo.com/read/000762795badbd74b62c8**	Issy	International

Year				
Issy classée parmi les "Smart21 Communities" 2018	2017-11-08	**"http://www.issy.com/en/node/19217**	Issy	National
Dossier Smart Issy	2017-12-01	https://fr.calameo.com/read/000762795cb4e2e4c1ae0	Issy	National

In this list, it has to be highlighted that some news have an important coverage, such as the articles written by the French National newspaper "Le Parisien" that made a coverage about Issy, including also IoRL, following Issy's press release over the summer 2017.

4 Dissemination material produced

4.1 Project website

The IoRL website has been set up early on in the life of the project. The project website serves as the main interface and online presence of the project. WordPress was selected as the platform for the IoRL website. The website is hosted by Eurescom and partners have access with editing rights to enter news items on the website.

In the following we present some basic statistics regarding the access and use of the website during the period.

Figure 20 – General overview of the IoRL site audience and visitors

Figure 21 – Origin of the interest and hits on the IoRL website

Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	3,051 % of Total: 100.00% (3,051)	2,592 % of Total: 100.00% (2,592)	00:02:22 Avg for View: 00:02:22 (0.00%)	1,693 % of Total: 100.00% (1,693)	64.91% Avg for View: 64.91% (0.00%)	55.49% Avg for View: 55.49% (0.00%)	$0.00 % of Total: 0.00% ($0.00)
1. /	1,075 (35.23%)	839 (32.37%)	00:01:53	790 (46.66%)	46.20%	51.07%	$0.00 (0.00%)
2. /publications/	546 (17.90%)	506 (19.52%)	00:05:06	408 (24.10%)	91.67%	83.33%	$0.00 (0.00%)
3. /consortium/	260 (8.52%)	233 (8.99%)	00:02:54	88 (5.20%)	68.18%	55.00%	$0.00 (0.00%)
4. /deliverables/	143 (4.69%)	134 (5.17%)	00:04:37	66 (3.90%)	80.60%	65.03%	$0.00 (0.00%)
5. /demo-videos/	132 (4.33%)	120 (4.63%)	00:03:23	37 (2.19%)	78.38%	51.52%	$0.00 (0.00%)
6. /framework/	108 (3.54%)	99 (3.82%)	00:02:02	19 (1.12%)	52.63%	30.56%	$0.00 (0.00%)
7. /use-cases/	107 (3.51%)	102 (3.94%)	00:02:00	14 (0.83%)	64.29%	24.30%	$0.00 (0.00%)
8. /news/	83 (2.72%)	65 (2.51%)	00:00:55	12 (0.71%)	27.27%	22.89%	$0.00 (0.00%)
9. /objectives/	77 (2.52%)	75 (2.89%)	00:01:10	11 (0.65%)	72.73%	25.97%	$0.00 (0.00%)
10. /events-participation/	59 (1.93%)	49 (1.89%)	00:02:51	30 (1.77%)	60.00%	57.63%	$0.00 (0.00%)
11. /event/iorl-workshop-at-ieee-bmsb-2020/	57 (1.87%)	37 (1.43%)	00:00:29	30 (1.77%)	73.33%	52.63%	$0.00 (0.00%)
12. /internet-of-radio-light-project-demonstrates-world-first-5g-indoor-system-at-global-5g-event-and-eucnc/	46 (1.51%)	43 (1.66%)	00:02:29	23 (1.36%)	78.26%	67.39%	$0.00 (0.00%)
13. /event/workshop-on-5g-networks-security-5g-ns-2019/	43 (1.41%)	42 (1.62%)	00:00:24	41 (2.42%)	92.68%	93.02%	$0.00 (0.00%)
14. /ofcom-is-looking-to-make-26ghz-band-available-to-support-5g-indoor-applications/	39 (1.28%)	34 (1.31%)	00:06:56	33 (1.95%)	84.85%	84.62%	$0.00 (0.00%)
15. /contacts/	35 (1.15%)	34 (1.31%)	00:00:24	9 (0.53%)	66.67%	37.14%	$0.00 (0.00%)
16. /promotional-material/	31 (1.02%)	22 (0.85%)	00:05:24	4 (0.24%)	0.00%	35.48%	$0.00 (0.00%)
17. /internet-of-radio-light-iorl-workshop-monday-26-october-2020-isep/	24 (0.79%)	14 (0.54%)	00:04:24	10 (0.59%)	50.00%	45.83%	$0.00 (0.00%)
18. /ares-2019/	14 (0.46%)	14 (0.54%)	00:01:22	6 (0.35%)	100.00%	50.00%	$0.00 (0.00%)
19. /from-the-crystal-palace-to-glass-light-fixtures-a-brief-outlook-on-design-and-its-rolls-as-seen-through-the-internet-of-radio-light-iorl-project/	14 (0.46%)	12 (0.46%)	00:10:16	7 (0.41%)	85.71%	71.43%	$0.00 (0.00%)
20. /workshop-on-5g-networks-security-5g-ns-2019/	13 (0.43%)	10 (0.39%)	00:01:47	5 (0.30%)	80.00%	53.85%	$0.00 (0.00%)
21. /events/list/	12 (0.39%)	11 (0.42%)	00:00:20	0 (0.00%)	0.00%	41.67%	$0.00 (0.00%)
22. /iorl-at-eucnc-2019-in-valencia/	12 (0.39%)	11 (0.42%)	00:00:27	4 (0.24%)	75.00%	41.67%	$0.00 (0.00%)
23. /comparison-table-with-state-of-the-art-in-mmw/	10 (0.33%)	6 (0.23%)	00:02:15	6 (0.35%)	50.00%	50.00%	$0.00 (0.00%)
24. /?p=567&preview=true	9 (0.29%)	1 (0.04%)	00:04:23	1 (0.06%)	0.00%	0.00%	$0.00 (0.00%)
25. /event/5g-and-lifi-in-issy-les-moulineaux-a-round-table-discussion-at-the-end-of-the-iorl-workshop-at-ieee-bmsb-2020/	9 (0.29%)	5 (0.19%)	00:00:56	0 (0.00%)	0.00%	33.33%	$0.00 (0.00%)

Figure 22 – Distribution of interest across the different parts of the IoRL website

Finally, since this is the final dissemination report of the project we present the website statistics also for the whole duration of the project providing a full overview over the lifetime of the project.

Figure 23 – General overview of the IoRL site audience and visitors over the lifetime of IoRL

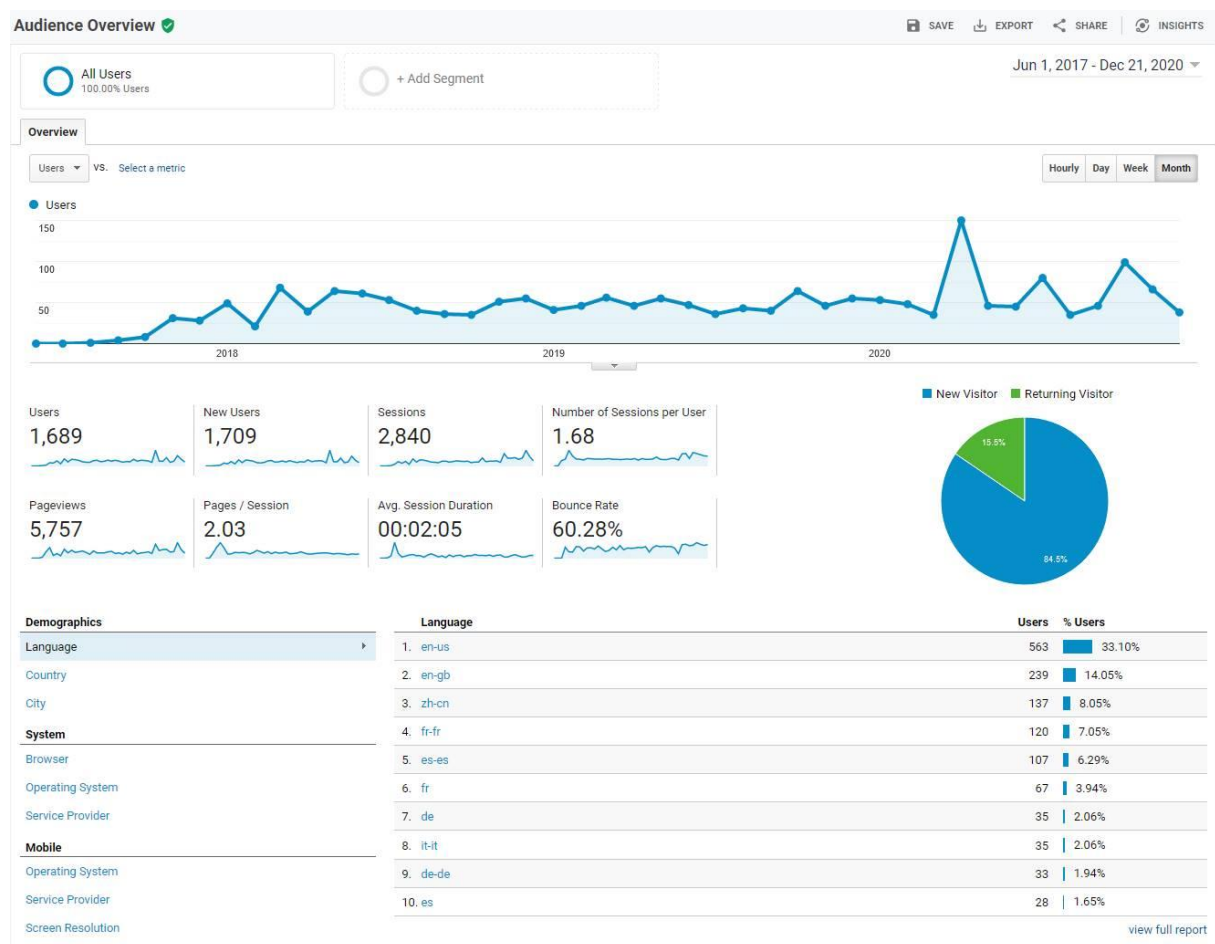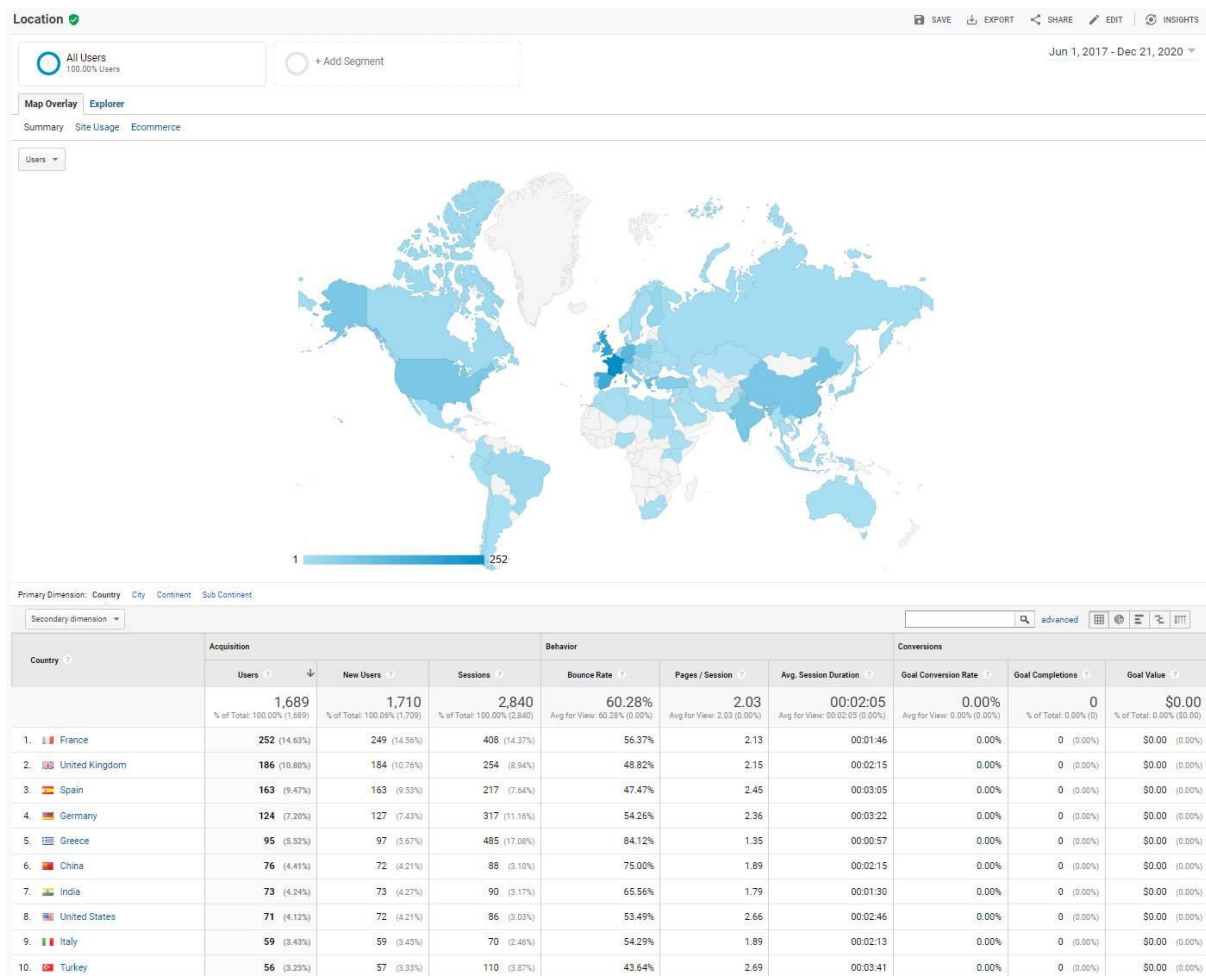**Figure 24 – Origin of the interest and hits on the IoRL website over the lifetime of IoRL**
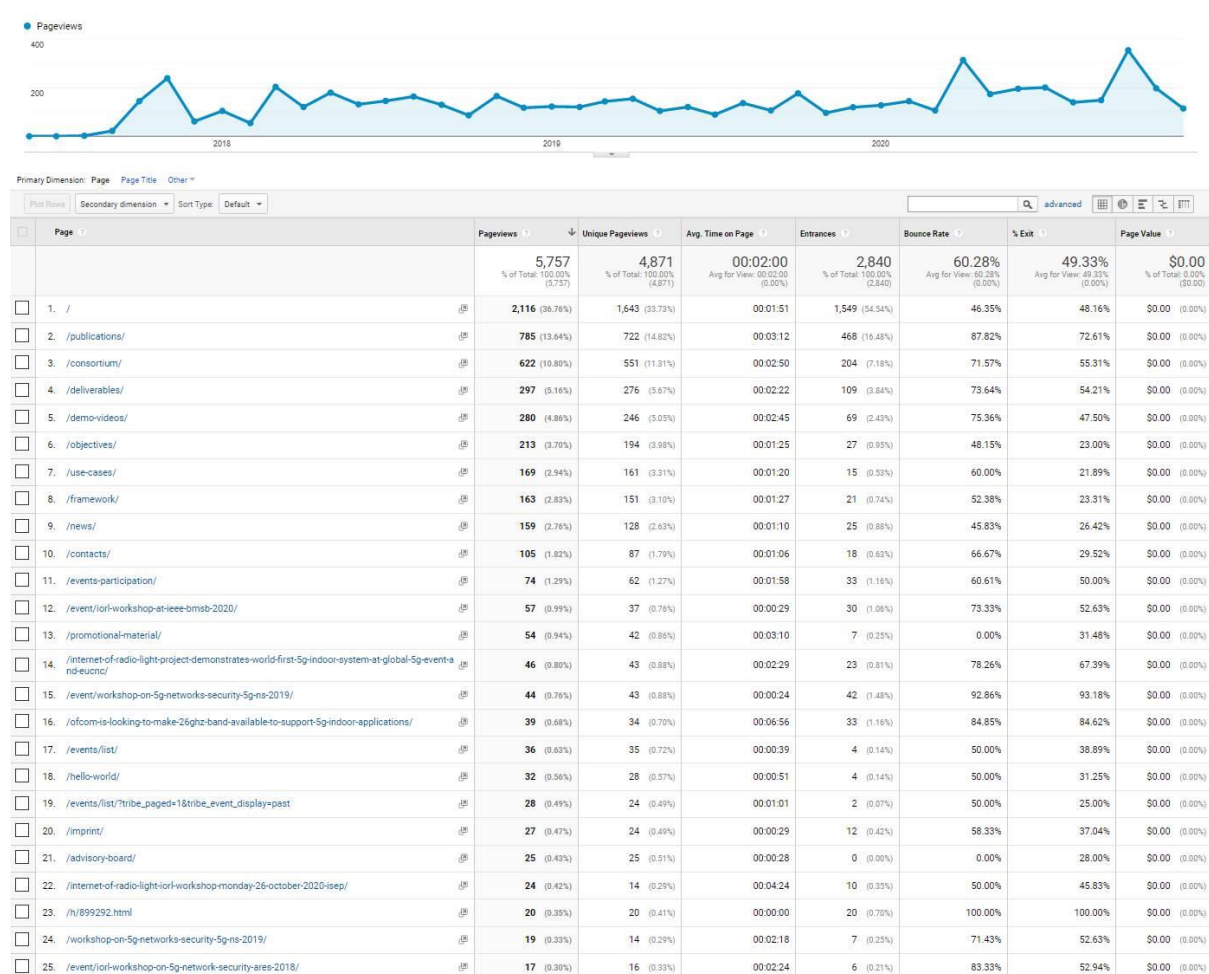
Page	Pageviews	Unique Pageviews	Avg. Time on Page	Entrances	Bounce Rate	% Exit	Page Value
	5,757 % of Total: 100.00% (5,757)	4,871 % of Total: 100.00% (4,871)	00:02:00 Avg for View: 00:02:00 (0.00%)	2,840 % of Total: 100.00% (2,840)	60.28% Avg for View: 60.28% (0.00%)	49.33% Avg for View: 49.33% (0.00%)	$0.00 % of Total: 0.00% ($0.00)
1. /	2,116 (36.76%)	1,643 (33.73%)	00:01:51	1,549 (54.54%)	46.35%	48.16%	$0.00 (0.00%)
2. /publications/	785 (13.64%)	722 (14.82%)	00:03:12	468 (16.48%)	87.82%	72.61%	$0.00 (0.00%)
3. /consortium/	622 (10.80%)	551 (11.31%)	00:02:50	204 (7.18%)	71.57%	55.31%	$0.00 (0.00%)
4. /deliverables/	297 (5.16%)	276 (5.67%)	00:02:22	109 (3.84%)	73.64%	54.21%	$0.00 (0.00%)
5. /demo-videos/	280 (4.86%)	246 (5.05%)	00:02:45	69 (2.43%)	75.36%	47.50%	$0.00 (0.00%)
6. /objectives/	213 (3.70%)	194 (3.98%)	00:01:25	27 (0.95%)	48.15%	23.00%	$0.00 (0.00%)
7. /use-cases/	169 (2.94%)	161 (3.31%)	00:01:20	15 (0.53%)	60.00%	21.89%	$0.00 (0.00%)
8. /framework/	163 (2.83%)	151 (3.10%)	00:01:27	21 (0.74%)	52.38%	23.31%	$0.00 (0.00%)
9. /news/	159 (2.76%)	128 (2.63%)	00:01:10	25 (0.88%)	45.83%	26.42%	$0.00 (0.00%)
10. /contacts/	105 (1.82%)	87 (1.79%)	00:01:06	18 (0.63%)	66.67%	29.52%	$0.00 (0.00%)
11. /events-participation/	74 (1.29%)	62 (1.27%)	00:01:58	33 (1.16%)	60.61%	50.00%	$0.00 (0.00%)
12. /event/iorl-workshop-at-ieee-bmsb-2020/	57 (0.99%)	37 (0.76%)	00:00:29	30 (1.06%)	73.33%	52.63%	$0.00 (0.00%)
13. /promotional-material/	54 (0.94%)	42 (0.86%)	00:03:10	7 (0.25%)	0.00%	31.48%	$0.00 (0.00%)
14. /internet-of-radio-light-project-demonstrates-world-first-5g-indoor-system-at-global-5g-event-and-eucnc/	46 (0.80%)	43 (0.88%)	00:02:29	23 (0.81%)	78.26%	67.39%	$0.00 (0.00%)
15. /event/workshop-on-5g-networks-security-5g-ns-2019/	44 (0.76%)	43 (0.88%)	00:00:24	42 (1.48%)	92.86%	93.18%	$0.00 (0.00%)
16. /ofcom-is-looking-to-make-26ghz-band-available-to-support-5g-indoor-applications/	39 (0.68%)	34 (0.70%)	00:06:56	33 (1.16%)	84.85%	84.62%	$0.00 (0.00%)
17. /events/list/	36 (0.63%)	35 (0.72%)	00:00:39	4 (0.14%)	50.00%	38.89%	$0.00 (0.00%)
18. /hello-world/	32 (0.56%)	28 (0.57%)	00:00:51	4 (0.14%)	50.00%	31.25%	$0.00 (0.00%)
19. /events/list/?tribe_paged=1&tribe_event_display=past	28 (0.49%)	24 (0.49%)	00:01:01	2 (0.07%)	50.00%	25.00%	$0.00 (0.00%)
20. /imprint/	27 (0.47%)	24 (0.49%)	00:00:29	12 (0.42%)	58.33%	37.04%	$0.00 (0.00%)
21. /advisory-board/	25 (0.43%)	25 (0.51%)	00:00:28	0 (0.00%)	0.00%	28.00%	$0.00 (0.00%)
22. /internet-of-radio-light-iorl-workshop-monday-26-october-2020-isep/	24 (0.42%)	14 (0.29%)	00:04:24	10 (0.35%)	50.00%	45.83%	$0.00 (0.00%)
23. /h/899292.html	20 (0.35%)	20 (0.41%)	00:00:00	20 (0.70%)	100.00%	100.00%	$0.00 (0.00%)
24. /workshop-on-5g-networks-security-5g-ns-2019/	19 (0.33%)	14 (0.29%)	00:02:18	7 (0.25%)	71.43%	52.63%	$0.00 (0.00%)
25. /event/iorl-workshop-on-5g-network-security-ares-2018/	17 (0.30%)	16 (0.33%)	00:02:24	6 (0.21%)	83.33%	52.94%	$0.00 (0.00%)

Figure 25 – Distribution of interest across the different parts of the IoRL website over the lifetime of IoRL

4.2   Building Research Establishment Video

A video was prepared on the measurement campaign and published on YouTube, as shown in Figure 26.
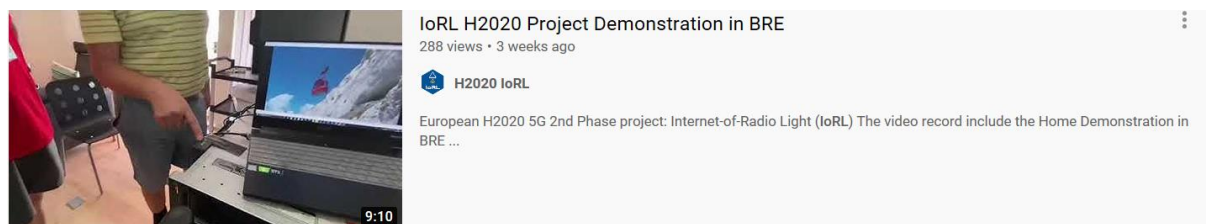

Figure 26 – Video of the IoRL measurement campaign at BRE on YouTube

The video is available on YouTube at https://www.youtube.com/watch?v=RZiR-MpFmCM&t=469s

01 Introduction to Building Research Establishment 30 s

Building Research Establishment (BRE) provides research, advice, training, testing, certification and standards for organisations in the UK and abroad.

02 Motivation for Internet of Radio Light Concept 45 s

The Innovation Park at Watford site is open to public, and has welcomed over 20000 visitors, including guests from the construction industry, local authorities, Government, academia, school groups and international leaders. These visitors come to see the innovations in building technologies demonstrated on the BRE Innovation Park.

The increased use of Wireless Local Area Networks (WLAN) communications in buildings is causing congestion and interference, whilst modern building materials are restricting the propagation of Radio Frequency (RF) waves within them. Therefore, building owners have been increasingly turning to the deployment of cellular home networks (HeNBs) in their buildings because they operate in licensed spectrum that can avoid interference and congestion.

03 Introduction to Integer House 30 s

The Innovation Park features full-scale demonstration buildings that have been developed by industry partners. These buildings display innovative design, materials and technologies which combine to address the development challenges facing regions across the world. Technology demonstration, research, testing, training and dissemination are key activities which underpin the operation and development of the Innovation Park, making this the ideal place to demonstrate the Internet of Radio Light system in a home scenario in its famous Integer House, which has been showcasing new home technology for over 20 years. The INTEGER House was also built with a variety of intelligent home automation technologies and advanced communication technologies such as a telephone service distributed via a local building exchange, digital satellite and terrestrial television, WebTV, and closed-circuit television (CCTV). <Video of approach to Integer House>

04 Introduction to Internet of Radio Light Concept 30 s

The Internet of Radio-Light (IoRL) project develops a safer, more secure, customizable and intelligent in building network using millimetre Wave (mmWave) and Visible Light Communications (VLC). The conceived solution reliably delivers increased throughput (greater than 10Gbps) from access points pervasively located within buildings. It does so, whilst minimizing interference and electromagnetic exposure and providing location accuracy of less than 10 cm at the same time. Here we see two project researchers, Ben and Kareem, working in the house measuring the performance of the 5G indoor system. <Video of IoRL with 4k TV playing>

<Video of whole IoRL system with 4k TV playing>

05 Introduction to Demonstrator Streaming Video over VLC and mmWave 15s

So, for example distribution of 4k TV services can be provided throughout a home. Here you see video streaming to a 4k TV over a 5G VLC link being presented by two of the project's

researchers Yue and John. When the 5G VLC signal from the communication LED is blocked the TV stops playing and when 5G VLC signal no longer blocked the TV resumes the streaming audio video service. <Video of TV being blocked and allowed>

06 is deliberately left out.

07 Remote Radio Light Head 45s

5G remote radio light heads are pervasively located in 10Gbit/sec optically networked home, which distributes a 5G compliant multicomponent carrier VLC and mmWave signals to each room from communication LEDs and mmWave antennas.. <Pan out to show all four RRLHs

08 DRAN and RRLH Controller 60 s

The networked home consists of an Openstack Multiaccess Edge Computing server, a Layer 2 Processor, a Distributed Radio Access Network providing a fully 5G compatible radio communications signal within Ethernet packets using a 10Gbit/sec ethernet ring network to one Remote Radio Light Head controller per room and its four Remote Radio Light Heads in a parallel processing pipeline. <Point to Remote Radio Light Head Controller, Distributed Radio Access Network, Layer 2 Processor and Intelligent Home IP Gateway>

09 Intelligent Home IP Gateway and Layer 2 Server 45s

The Multiaccess Edge Computing server consists of a Software Defined Network and a Network Function Virtualisation system, which hosts Virtual Network Functions that are used to provide network services. A Security Virtual Network Function sniffs packets to ascertain Denial of Service and Rogue Transmitter attacks. Location Database Virtual Network Function stores distance estimation data from the VLC Received Signal Strength and the mmWave Time Difference of Arrival measurements. The Location Server Virtual Network Function processes this data to estimate the location of users in the room environments. The Multisource Streaming Virtual Network Function transmits video streaming packets both though the 5G RAN and a lower resolution video through the WIFI network to ensure service continuity. A Load Balancing Virtual Network function distributes load equally between 5G RAN and WLAN network. <Point to Intelligent Home IP>

10 4k TV 15s

A 5G Home Network is able to stream 4kTV, 360 degree and conference call video and support Interactive Multiplayer Gaming. It is also be able to support Location Based Data Access applications on smart phones or augmented reality headsets. Here you see video streaming to a 4k TV over a 5G VLC link being presented by Yue and John with and without the presence of illumination LEDs. As you can see the communication LED's performance is unhindered by the illumination LEDs since video continues to be streamed even when the illumination LEDs have been turned on. <Point to the Application Layer Services>

11 Test Receiver 30s

The test receiver records 5G received signal's QAM constellation diagram, mean and probability distribution of Error Vector Magnitude (EVM), EVM evolution with time, Block Error Rate (BLER) and Throughput for Physical Downlink Shared Channel (PDSCH), Physical Broadcast Channel (PBCH) and Physical Downlink Control Channel (PDCCH). Here you see a mmWave recording being taken at table top height 0.7m and the performance of the received Physical Downlink Shared Channel signal being recorded by Kareem who is one of our project researchers. <silence to the end of this video sequence>

12 VLC PD Receiver 30 s

Taking VLC measurements requires positioning the photodiode receiver on a grid, angling it towards communication LED transmitter and measuring performance on test receiver. A two degree of freedom gimbal is used to rotate the VLC photodiode receiver towards the communication LED in order to maximise the received signal and hold it in a fixed direction for measurement. <show Ben locating gimbal and pan to Kareem taking measurement on test receiver>

13 mmWave Receiver 30 s

Taking mmWave measurements requires choosing transmitter angle, positioning the receiver on a grid, angling it towards transmitter and measuring performance on test receiver. The two degree of freedom gimbal was enhanced to be able to do this autonomously. <show Ben locating gimbal and pan to Kareem taking measurement on test receiver>

14 Taking VLC measurements and Performance 30 s

Results from VLC measurements show that the coverage has a diameter of about 1m and maximum propagation distance of 2m. Angling the receive LED improves the quality of the received signal. Received signal strength results have also been used to locate positions with a minimum location error of 3.5cm and 80% of all location measurement errors of less than 10cm.

<show Ben taking a measurement and Kareem recording and presenting coverage results on screen>

15 Taking mmWave measurement and Performance 30s

Results from mmWave 64 QAM transmissions have shown that for a transmit antenna pointing vertically down, the coverage area has a diameter of around 2m at ground level with improved performance for measurements taken on a table top level (0.7m above ground) and with improved performance when the receiver is rotated towards the transmitter.

Pointing the transmit antenna 30 degrees from vertical, the coverage area can be better than 2m x 1.6m. The performance of the mmWave system slightly varied from one day to the next and so is dependent on external factors which could not be identified. <show Ben taking a measurement and Kareem recording and presenting coverage results on screen>

> 16 Implications of performance results on future direction of research 30s
>
> This project demonstrator has shown the viability of a 5G networked home with just four mmwave radio heads required to provide sufficient coverage and location services for a family sized sitting room. It has shown that VLC technology is a good personal area network solution but requires its propagation distance and coverage area to increase by a factor of two to make it a commercially viable. <Pan out and show Ben and Kareem busy working away>

Figure 27 – The narrative text of the video

4.3   Social media

The project has discussed the use of various social media channels already at its kick-off meeting. Social media is the key to disseminate the project over general public. IoRL Project used "YouTube" and "twitter" for this purpose.

IoRL YouTube channel: https://www.youtube.com/channel/UCx7iquE3GHoGEgjduswZ7iw

Up to now, 9 videos are shared on IoRL YouTube channel. Shared videos include following topics:

- Demonstration videos
- Dissemination of symposium, conference and workshop calls,

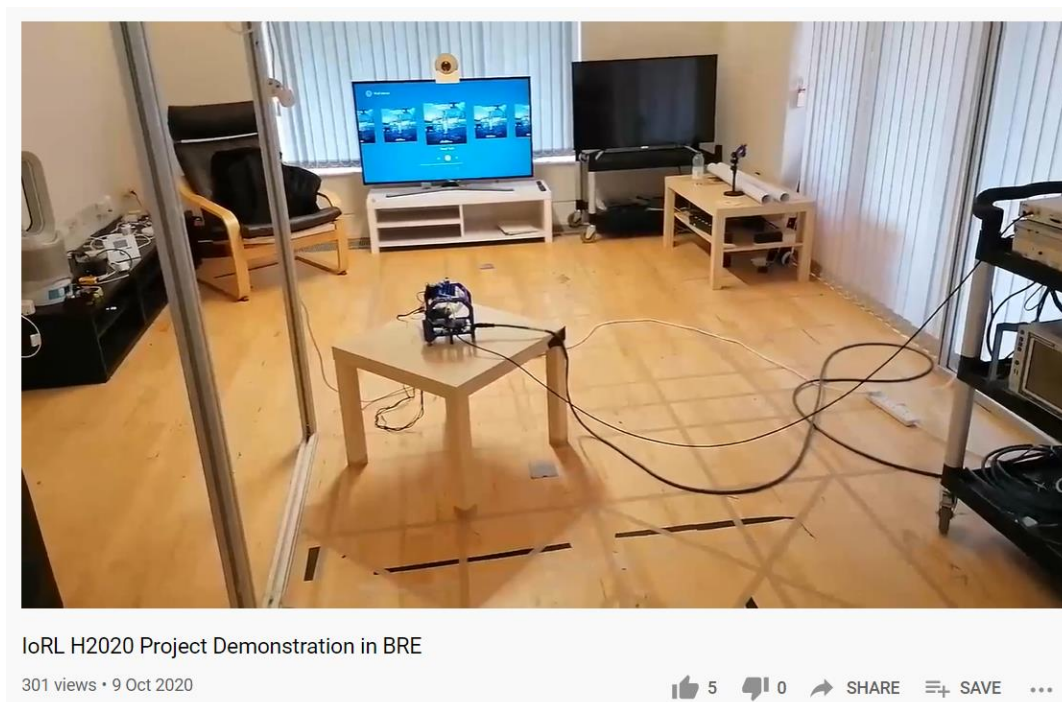As an example, please check Figure 28.

IoRL H2020 Project Demonstration in BRE

301 views • 9 Oct 2020   👍 5   👎 0   ➤ SHARE   ≡+ SAVE   •••

Figure 28 – Screenshot of BRE Demonstration video posted on the IoRL YouTube channel.

IoRL Twitter account: @5GIoRL

Up to now, 171 tweets are shared on the IoRL Twitter page and its followed by 145 followers.

Shared posts include following topics:

- Demonstration videos
- News from IoRL partners about LiFi,
- Major news from 5G PPP and EU Commission,
- Dissemination of symposium, conference and workshop calls,
- Tweets of IoRL members during meetings and conferences.

As an example, screenshots of some Twitter posts are added below.

Figure 29 – Screenshot of a tweet in the twitter account of IoRL

Inet of Radio Light
@5GIoRL

IoRL was represented at the 5G PPP Technology Board workshop and meeting in Málaga 8-10 October by Anastasius Gavras, Eurescom

4:16 PM · Oct 10, 2019 · Twitter Web App

Figure 30 – Screenshot of a tweet in the twitter account of IoRL

Inet of Radio Light
@5GIoRL

Please find the video records and presentations of the IoRL Workshop in this link: iorl.5g-ppp.eu/internet-of-ra

...

Inet of Radio Light @5GIoRL · Oct 8

You are invited to Internet-of-Radio Light (IoRL) Workshop

Date: 26 October 2020
Time: 09:00 – 16:30
Venue: Online
Workshop Agenda: bmsb2020.isep.fr/pdf/flyer-fina...

European H2020 5G 2nd Phase project: IoRL

4:20 PM · Nov 20, 2020 · Twitter Web App

Figure 31 – Screenshot of a tweet in the twitter account of IoRL

4.4 Poster and flyers

An IoRL poster was designed in the initial year of the project, but the project used it throughout its entire duration.

A dedicated flyer was designed and used for the IoRL workshop at IEEE BMSB 2020 (see Figure 3).

5   Conclusions and dissemination performance assessment

In our assessment the IoRL project partners have demonstrated a solid performance regarding dissemination. The project pursued a broad range of channels to create awareness and distribute its results, starting with its website, ranging through social media channels such as Twitter and YouTube and being present and contributing to scientific events and also being present in the press and media. Doing so it addressed a wide range of groups from the general public through industry interest groups, such as the 5G PPP community, to 5G experts and scientists.

Among the many dissemination activities the organisation of a series of events, workshops that were part of high profile and prestigious conferences stand out, and here we refer to the two 5G Network Security workshops at ARES 2019 and ARES 2020, and the project final workshop at IEEE BMSB 2020.

We find that the high number of publications and contributions made by project partners (currently we list 135 of those on the project website) demonstrate and reflects well the commitment and level of activity by the project team.

References

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        https://doi.org/10.5281/zenodo.3429301

[3]   Adam Kapovits et al. "5G for Indoors" 5G PPP Technology Board, Date: to be
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[4]   Alex Kaloxylos et al "Empowering Vertical Industries through 5G Networks - Current
        Status and Future Trends" 5GPPP Technology Board & 5G IA Verticals Task Force,
        Date: 20-08-2020   Version:1.0   DOI   10.5281/zenodo.3698113   URL
        http://doi.org/10.5281/zenodo.3698113

[5]   David Artuñedo et al "Edge Computing for 5G Networks" 5GPPP Technology Board
        & 5G IA Verticals Task Force, Date: to be decided

[6]   Halid Hrasnica et al "Artificial Intelligence and Machine Learning" 5G PPP
        Technology Board, Date: to be decided.