



H2020 DAEMON Project
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Deliverable 6.2

Report on Communication, dissemination and exploitation results and updated CoDEP for Y2

Abstract

This deliverable summarizes the results attained by the project in year 1 of the H2020 DAEMON project, in terms of dissemination and communication, standardization and open-source activities, and exploitation and innovation. Moreover, it presents the communication, dissemination, and exploitation plan for year 2 (CoDEPv2). Here we provide the list of the achieved and planned activities as well as the targeted metrics. In addition, we revisit the initial standardization roadmap, including the identification of relevant standard development organizations and relevant open-source projects.

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Disclaimer

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List of Acronyms

3GPP	– Third Generation Partnership Project
5GPPP	– 5G Public Private Partnership
AI	– Artificial Intelligence
B5G	– Beyond 5G
CoDEP	– Communication, dissemination, and exploitation plan
DOI	– Digital Object Identifier System
ETSI	– European Telecommunications Standards Institute
FOSS	– Free and open-source software
IEEE	– Institute of Electronics and Electrical Engineering
IETF	– Internet Engineering Task Force
IPR	– Intellectual Property Rights
IRTF	– Internet Research Task Force
ITU-T	– International Telecommunications Union – Telecommunications standardization sector
KPI	– Key Performance Indicator
MANO	– Management and orchestration
ML	– Machine Learning
NFV	– Network Function Virtualization
NI	– Network Intelligence
O-RAN	– Operator Defined Next Generation RANG
PoC	– Proof of Concept
R&D	– Research and Development
RAN	– Radio Access Network
RIS	– Reconfigurable Intelligent Surface
SDO	– Standard Development Organization
SM	– Standardization manager
SME	– Small and medium-sized enterprise
TSG	– Technical Specification Groups
VNF	– Virtual Network Function
WG	– Working Group

Executive summary

The main contributions of this document are:

- Presentation of the main achievements during the first year of the project.
- Presentation of the communication, dissemination, and exploitation plan for the second year of the project (CoDEPv2).

DAEMON's CoDEP includes communication, dissemination, and exploitation activities. **Communication** includes all the activities related to the promotion of the project and its results beyond the project's own community. This includes explaining its research in layman's terms to the media and the public. **Dissemination** includes activities related to raising awareness of its results in a technical community working on the same research field. In general, this will be done through publications, and participation and organization of technical events. Finally, **exploitation** (in accordance with the European IPR Helpdesk) covers activities aiming at using the results in further research activities other than those covered by the project, such as developing, creating and marketing products or processes, creating and providing a service, or standardization activities.

The **Raise Awareness phase**, during the initial stages of the project, was focused on communication activities (e.g., setting up the web portal, social media accounts and high-level project presentations) to make the project known not just to the technical community but to a larger audience outside the project topics, including the public. Dissemination and standardization activities also started in this phase with preliminary technical ideas. In the **Presentation of Results phase**, dissemination and exploitation activities increased their intensity, since the architecture and NI design efforts have produced some initial research outcomes. Initial demonstrations of specific concepts of the architecture and NI solutions were also provided during this phase. However, it is in the **Demos and PoCs phase** where demonstration activities involving multiple blocks of the architecture working in an integrated way are expected. Finally, the **Long-lasting Impact phase** refers to other research or exploitation actions taken once the project is finished. This includes shaping the topics and framework of future research projects, exploiting DAEMON NI concepts in a market-oriented way by incorporating them into products and services, and leaving a footprint in standards through project contributions. The plan defines the various undertaken activities, and defines related target metrics.

Below, we highlight the main outcomes of Year 1:

- Communication
 - Eight press articles covering DAEMON have been released.
 - Four videos have been published.
 - Two webinars, two workshops and a special session were organized.
 - Three DAEMON public deliverables were submitted.
 - DAEMON web page, as well as social media profiles (Twitter, Facebook, Instagram, LinkedIn, YouTube) were created.
- Dissemination
 - 23 publications in scientific conferences and workshops (including many top-ranked venues like ACM SIGCOMM, ACM MobiCom, ACM CoNEXT, IEEE INFOCOM or AAAI).
 - 10 publications in scientific journals.
 - Participation in various working groups to join efforts with other 5G PPP projects.
- Exploitation, including standardization
 - Participation in standardization activities and contributions.
 - Identification and monitoring of relevant open-source projects.
 - Master, PhD Theses/Courses and Internships.

1 Introduction

DAEMON's Communication, Dissemination, and Exploitation Plan (CoDEP) covers the following three types of activities:

- **Communication activities:** These activities encompass all actions concerning the promotion of the project and its results beyond the project's own community. In this way, the target of this activity is the general public, i.e., non-specialists, and the message is encoded in a way that is understood by this audience.
- **Dissemination activities:** These activities have the goal of raising awareness of DAEMON's results in a technical community, i.e., working in the same field of research. These activities are usually performed through peer-reviewed publications in scientific conferences and journals, and through participation and organization of technical events (e.g., workshops, tutorials, etc.).
- **Exploitation activities:** These activities cover initiatives that foster further research activities, i.e., other than those covered by DAEMON. These include:
 - activities to develop, create and market products or processes,
 - activities to create and provide a service, and
 - standardization activities.

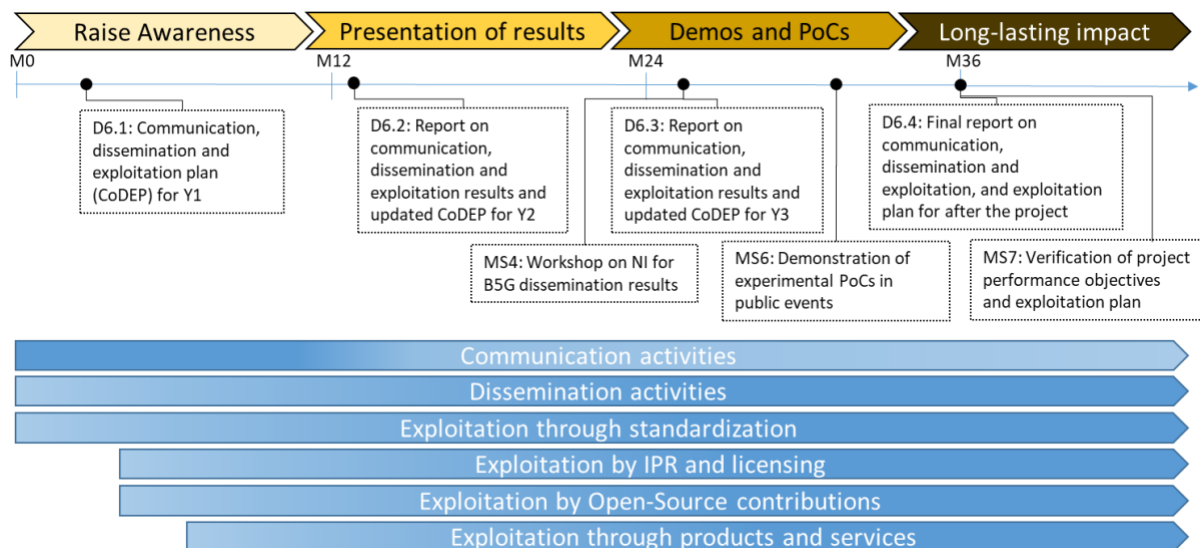


Figure 1. DAEMON Communication, dissemination, and exploitation plan.

Figure 1 presents the different project milestones and deliverables that concern the implementation of the CoDEP, as well as the different activities and phases during the project execution. All these activities are executed in parallel; however, special emphasis is given to the appropriate one depending on each phase of the project.

In detail, during the "Raise Awareness" phase, at the beginning of the project, the focus was on communication activities such as setting up the website, social media coverage, and high-level overview presentations. The goal hence, at this early stage of the project, was to make the project known, not only within the research community, but also to a larger audience including the general public. As depicted in the previous figure, dissemination and standardization activities also started at this phase of the project, with preliminary technical contributions. Specifically, this early stage was focused on the following set of activities:

- Website and social media accounts.
- Project brochure.
- Press releases.
- High-level project presentation and participation at events to explain project scope.
- Participation in events for a general audience (e.g., open science week).
- Lectures at university courses.

Although the aforementioned activities were allocated more effort at the beginning of the project to raise project awareness, they continue throughout the whole timespan of DAEMON.

During the "Presentation of results" phase, DAEMON will increase focus on dissemination and exploitation activities. Although we are in M13 of the project, we have already published a substantial number of research papers with our initial research outcomes. Further analytical results gathered via simulations are expected during this stage (e.g., in top-tier scientific conferences and workshops), but also preliminary demonstrations (e.g., at events such as Mobile World Congress or EuCNC). In more detail, our focus is put into the following set of activities:

- Dissemination
 - Publication of research results in scientific conferences, workshops and journals.
 - Enrolment of PhD and Master students on the topics of the project.
 - Participation in public exhibitions and demonstrations.
 - Organization of special events (e.g., technical workshops).
 - Collaboration with other projects.
- Exploitation
 - Identification of products and services, integrating NI spawning from DAEMON work.
 - Issuing patents and licensing.
 - Contribution to relevant open-source software projects.
 - Contribution to standardization bodies.

During the "Demos and PoCs" phase, DAEMON will re-focus its efforts into the development of demonstration and proof-of-concept (PoC) prototypes of designed NI-aided systems. These activities will help to validate the NI mechanisms derived in other work packages but also, in the context of WP6, will help disseminating and communicating the results of the project to both the scientific community and the general public at large.

The final stage of the CoDEP is named "Long-lasting impact", which will begin towards the end of the project implementation and will last several months after DAEMON has finished. During this stage, partners of DAEMON will keep disseminating results of the project and exploiting network intelligence designed and developed during DAEMON, by impacting on the product or service portfolio of the vendors in the consortium, or through enforcing IPR and licenses.

This CoDEP is periodically updated (this deliverable presents the plan for Y2) throughout the lifetime of the project. This allows us to accommodate new activities such as new collaboration or dissemination opportunities should they appear. In the rest of this document, we present the major achievements during the first year of the project, as well the plan of communication, dissemination and exploitation activities for the second year of the project.

This document presents the main achievement of Y1 and the revised plan for Y2. The main achievements are summarized as follows:

- DAEMON published 8 press releases.
- DAEMON webpage & Twitter, Facebook, Instagram, LinkedIn, YouTube profiles were created.
- DAEMON published 3 project deliverables.
- DAEMON published four videos and contributed to two 5G PPP webinars.
- DAEMON organized 2 academic workshops, co-organized one special session, and co-edited one journal special issue.
- DAEMON produced the 34 scientific publications. Many of these publications happened at top-tier venues like ACM SIGCOMM, ACM MobiCom, ACM CoNEXT, IEEE INFOCOM, or in IEEE Transactions. This is not only on track, but significantly exceeding the (already very ambitious) target of 80 scientific publications set forth in the Technical Annex. The majority of these publications are the result of collaborations among two or more partners of the project, which highlights the highly cooperative nature of the cutting-edge research carried out in DAEMON.
- DAEMON carried out a set of activities with other projects in the framework of 5G PPP and/or jointly with other projects.
- DAEMON made several SDO achievements in terms of approved standardization contributions made by the project partners related to the DAEMON innovations and use cases.
- DAEMON facilitated the involved academic project partners to recruit and train Master / PhD students and postdoctoral fellows, as well as to enrich the existing Master courses.

2 Achievements in year 1

In this section, we highlight the accomplishments for approximately three months since the DAEMON project has officially started. They are on track with the work plan detailed in the sections above.

2.1 Communication activities

In this section, we report the achievements of the project related to the communication activities. The following sections will deal with some specific aspects of communication activities since the project kick-off on January 18, 2021 through Microsoft Teams. The first official project press release was released online on February 12 2021. More details can also be found on the different sites of our project website <https://h2020daemon.eu/>. All our communications comply with the proper references, acknowledgments and regulations from EU H2020, 5GPPP, and other private regulations from industrial partners.

2.1.1 News and press releases

Eight press articles covering DAEMON have been released. Specifically:

1. DAEMON: Beyond 5G with (Network) Intelligence by M. Fiore (IMDEA): <https://networks.imdea.org/daemon-beyond-5g-with-network-intelligence/>
2. DAEMON: Más allá del 5G con Inteligencia de Red by M. Fiore (IMDEA): <https://networks.imdea.org/es/daemon-mas-alla-del-5g-con-inteligencia-de-red/>
3. DAEMON: Network Intelligence Beyond 5G by B. McAuliffe and P. Sutton (SRS): <https://www.linkedin.com/feed/update/urn:li:activity:6770742691748745216/>
4. A project investigates how to improve 6G network intelligence technology by M. Gramaglia (UC3M): https://www.uc3m.es/ss/Satellite/UC3MInstitucional/en/Detalle/Comunicacion_C/1371306399719/1371215537949/A_project_investigates_how_to_improve_6G_network_intelligence_technology
5. Un proyecto investiga cómo mejorar la inteligencia de red de la tecnología 6G by M. Gramaglia (UC3M): https://www.uc3m.es/ss/Satellite/UC3MInstitucional/es/Detalle/Comunicacion_C/1371306398356/1371215537949/Un_proyecto_investiga_como_mejorar_la_inteligencia_de_red_de_la_tecnologia_6G
6. Building Beyond 5G systems with NEC technology for next-generation mobile services (NEC): <https://www.neclab.eu/about-us/press-releases/detail/building-beyond-5g-systems-with-nec-technology-for-next-generation-mobile-services>.
7. Albert Banchs talks about the present and future of 5G in 'La Aventura del Saber': <https://networks.imdea.org/albert-banchs-talks-about-the-present-and-future-of-5g-in-la-aventura-del-saber/>
8. DAEMON Eyes Greater Network Intelligence in 6G by M. Fiore (IMDEA): <https://www.6gworld.com/exclusives/daemon-eyes-greater-network-intelligence-in-6g-systems/>

Four videos have been published:

1. Category Theory Framework for Variability Models with Non-Functional Requirements by UMA: <https://doi.org/10.5281/zenodo.5122321>
2. Insights from operating an IP exchange provider by TID: <https://blog.apnic.net/2021/11/19/insights-from-operating-an-ip-exchange-provider/>
3. Teoría de Categorías Aplicada a Variabilidad by UMA: <https://doi.org/10.5281/zenodo.5554873>
4. Demonstrating a Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs by NEC and TUDelft: <https://doi.org/10.5281/zenodo.5752983>

We contributed to two webinars:

1. 5G-PPP Webinar: Europe accelerates towards 6G by IMDEA and NEC: <https://5g-ppp.eu/event/5g-ppp-webinar-europe-accelerates-towards-6g/>
2. 5G-PPP Software Network WG by NBL: <https://5g-ppp.eu/5g-ppp-software-network-wg-paper-cloud-native-and-5g-verticals-services/>

Two workshops were organized:

- MobileServerless 2021 - 1st Workshop on Serverless Mobile Networking for 6G Communications by NEC, UC3M, IMDEA and TID: <https://www.it.uc3m.es/mbsvless21/>
- 1st International Workshop on Autonomous Network Management in 5G and Beyond Systems (ANSM 2022) by IMEC and NBL: <https://h2020daemon.eu/workshop-ansm-2022/>

A special session in a conference was organized:

- Special session on RIS-empowered Communications and Localization for Smart Radio Environments by IMDEA and NEC: <https://www.eucnc.eu/special-sessions/special-session-9>

We have also made available DAEMON public deliverables:

- Deliverable 2.1 Initial report on requirements analysis and state-of-the-art frameworks and toolsets: <https://doi.org/10.5281/zenodo.5060979>
- Deliverable 3.1 Initial design of real-time control and VNF intelligence mechanisms: <https://doi.org/10.5281/zenodo.5745433>
- Deliverable 4.1 Initial design of intelligent orchestration and management mechanisms: <https://doi.org/10.5281/zenodo.5745456>

2.1.2 Web, social media, and project communication material

The project website has been established at the beginning of the project and it is reachable through the following URL: <https://h2020daemon.eu/>. The landing page is shown in Figure 2.

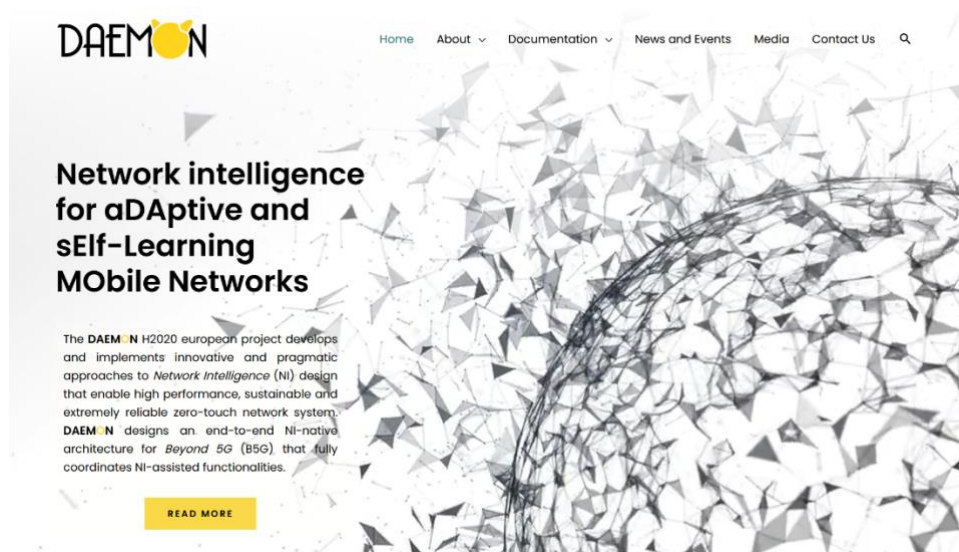


Figure 2. DAEMON website's landing page.

We are collecting visibility metrics based on many analytic services. Based on Advanced Page Visit Counter, we present their analytics in Figure 3, where 13500 total page loads are reported, from which 1300 are just from October, leaving 404 from its last week. Additionally, the landing page (i.e., Home) has been the most visited.

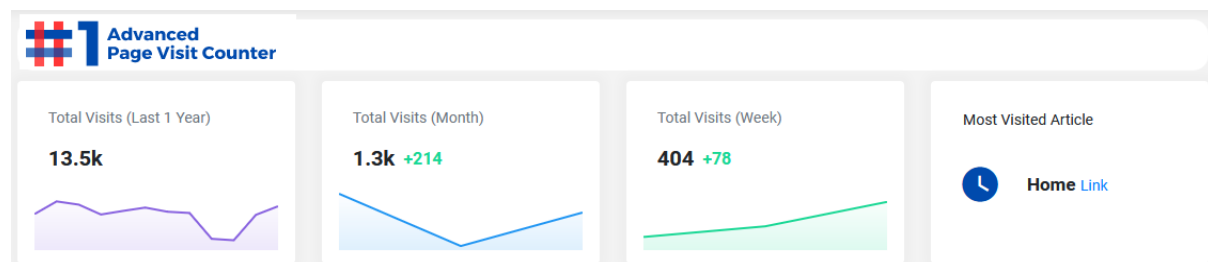


Figure 3. Total DAEMON website visits.

Google analytics provide the results of Figure 4. It can be observed that from the 13500 loads, 3537 were unique website visits, from which 1000 of them are of totally different IPs. Again, Home, Consortium, Publications and Events did catch the largest attention, which are good results for just the first year of project, as it suggests that they are already following DAEMON progress.

Page title and screen class	+ Views	Users	New users	Views per user
Totals	3,537 100% of total	1,029 100% of total	1,022 100% of total	3.44 Avg 0%
1 Home - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	1,443	861	820	1.68
2 Consortium - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	225	179	21	1.26
3 Publications - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	205	119	12	1.72
4 Deliverables - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	198	139	7	1.42
5 About - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	186	123	8	1.51
6 Overview - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	160	115	9	1.39
7 News and Events - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	149	88	4	1.69
8 Objectives - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	137	94	4	1.46
9 Media - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	128	57	5	2.25
10 Documentation - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	122	61	6	2.00
11 Home - H2020 DAEMON: Network intelligence for aDAptive and sEIF-Learning MOBILE Networks	120	61	59	1.97
12 Methodology - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	93	74	19	1.26
13 Contact Us - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	68	44	10	1.55
14 Consortium - H2020 DAEMON: Network intelligence for aDAptive and sEIF-Learning MOBILE Networks	61	22	2	2.77
15 ANSM'22 - DAEMON: Network intelligence aDAptive sEIF-Learning MOBILE Networks	41	35	28	1.17
16 Overview - H2020 DAEMON: Network intelligence for aDAptive and sEIF-Learning MOBILE Networks	30	15	0	2.00

Figure 4. Google Analytics Report of most visited pages.

Further, based on the results of Figure 5, our followers tend to access through a Desktop or Laptop devices, occasionally through mobile devices, and anecdotally through tablets.

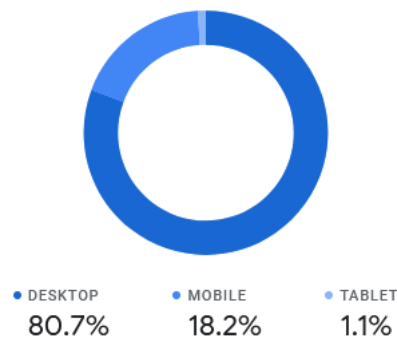


Figure 5. Google Analytics Report of devices used to access DAEMON site.

Then, based on the results of Figure 6, visitors mostly use Chrome web explorer, far followed by Safari, Firefox, and UC Browser. Anecdotally, they use Internet Explorer and Samsung OEM explorer.

The statistics from Google Analytics include demographics in Figure 6, showing worldwide impact in terms of visits to the web site, from the whole European Union, United States of America and China.

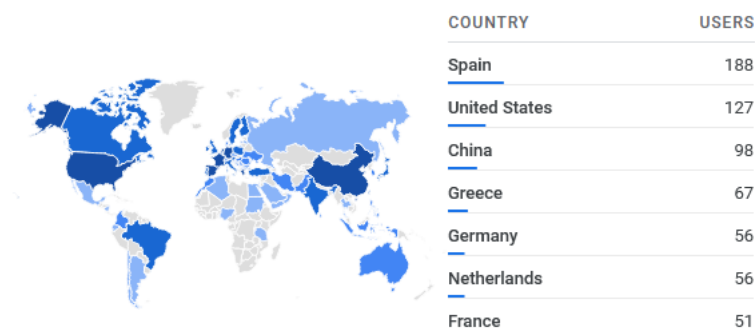


Figure 6. Google Analytics Report of DAEMON site demographics.

On another hand, DAEMON social network profiles are:

1. Twitter: <https://twitter.com/h2020daemon>
2. Facebook: <https://www.facebook.com/h2020daemon>
3. Facebook Page: <https://www.facebook.com/h2020daemoneu/>
4. Instagram: <https://www.instagram.com/h2020daemon/>
5. LinkedIn: <https://www.linkedin.com/in/daemon-daemon-717591202/>
6. Youtube: https://www.youtube.com/channel/UCbccd2DulaSMX_69uaLZy7A

All these accounts are shared on our webpage, and Twitter and Facebook feeds are displayed in real-time throughout it. A total of 176 meaningful posts have been shared (35 per social network besides one in YouTube). In Twitter we have reached the best numbers; a total of 12000 impressions. In Figure 7, we can see its analytics of the last 3 months, where a conference publication was the most popular, followed by a journal publication and the successful Advisory Board Meeting.

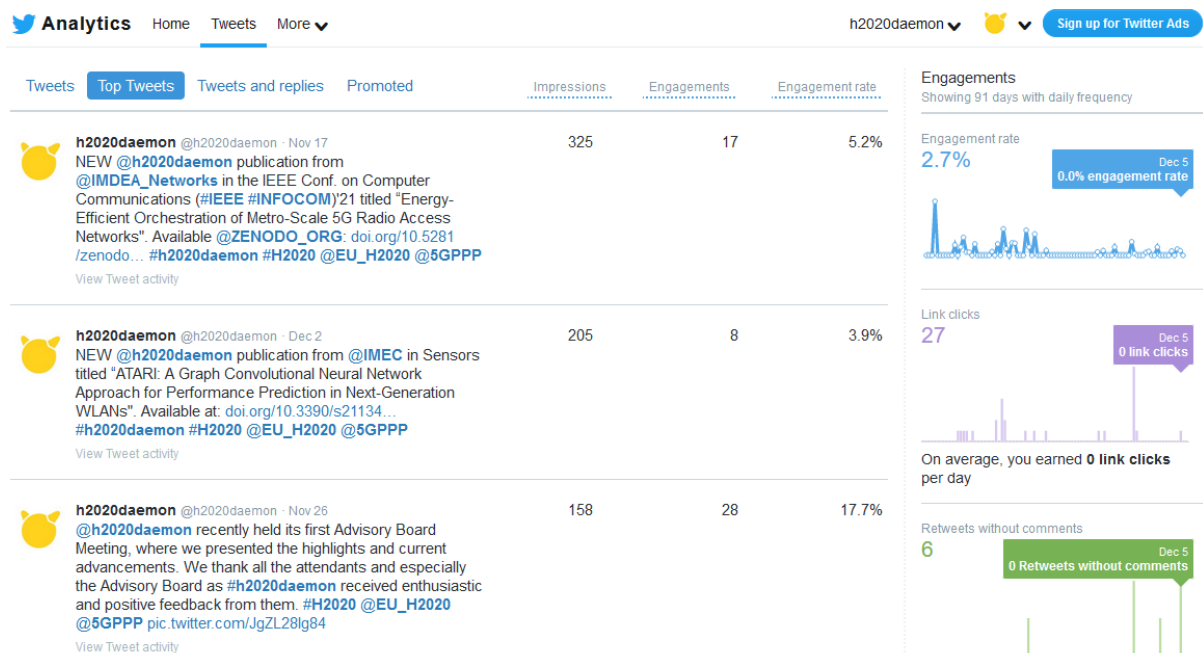


Figure 7. Twitter Analytics Report of tweets impressions and engagement of the last 3 months.

Figure 8 is the Twitter profile of DAEMON, which shows that 55 accounts are subscribed to our news.



Figure 8: Official Profile of DAEMON in Twitter.

The rest of the social networks show similar analytics. An example is LinkedIn analytics of the last week in Figure 9, with 11 profile visits, and 17 time the posts were read. Obviously, there is a correlation between how large is the number of users of a specific social network, and its analytics.

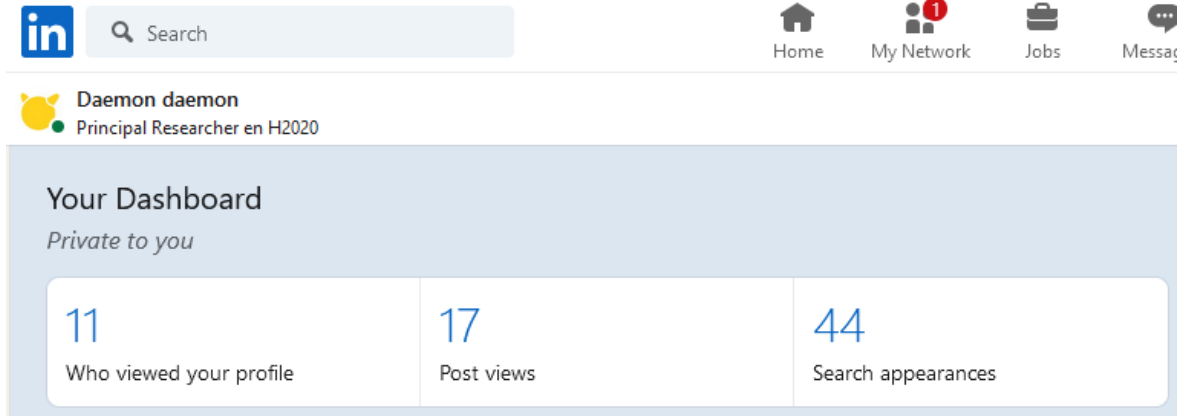


Figure 9: Official DAEMON analytics from LinkedIn.

We can observe the same with Facebook and Instagram analytics in Figure 10.

Posts	Date published	Reach	Engagement	Reactions/Likes
NEW @h2020daemon publication... Boost post	2 December 2021 at 19:18	4 People reached	--	0 Likes
NEW @h2020daemon publication... Boost post	2 December 2021 at 19:17	1 People reached	0 Post engagements	0 Reactions
NEW @h2020daemon publication... Boost post	1 December 2021 at 16:43	2 People reached	--	1 Likes
NEW @h2020daemon publication... Boost post	1 December 2021 at 16:41	2 People reached	0 Post engagements	0 Reactions
@h2020daemon recently held its f... Boost post	26 November 2021 at 10:21	6 People reached	--	1 Likes

Figure 10: Official DAEMON analytics from Facebook and Instagram.

Looking at Figure 11, we see that the official DAEMON YouTube channel has been populated, and we plan to add more videos as the project advances.

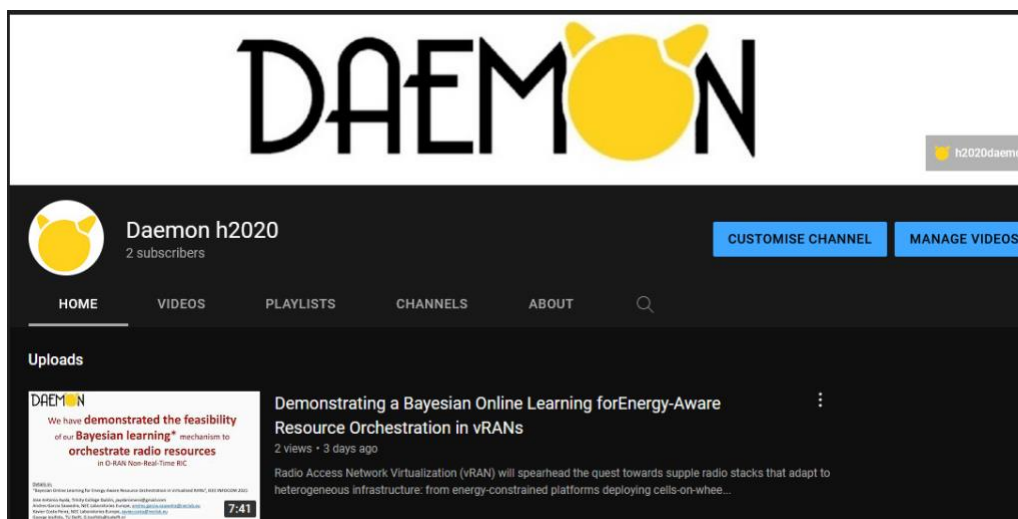


Figure 11: Official DAEMON youtube channel.

In addition, the DAEMON Project Tri-Fold Kick-off Brochure was submitted and distributed as Open Access on 10th March 2021. It also contains analytics, for the number of digital views, downloads, and QR scans. While Figure 12 shows its A-side, it is completely accessible, and ready to cite, using the following DOI: <http://doi.org/10.5281/zenodo.4593899>.

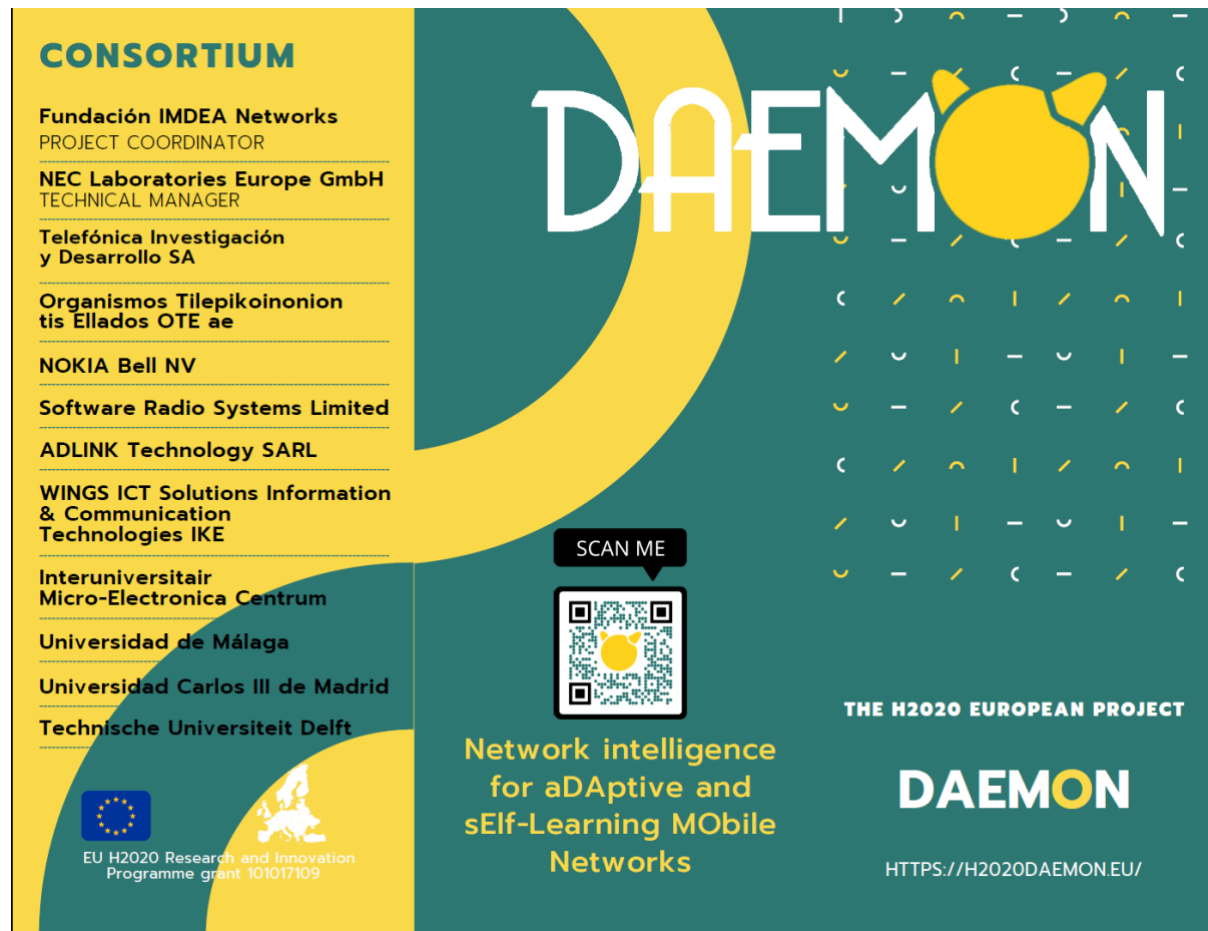


Figure 12: The H2020 European Project DAEMON Tri-Fold Kick-off Brochure.

In terms of communication KPIs in numbers:

- We committed to publish 2 press releases per year, and currently accomplished 8.
- We committed to organise a total of 2 academic workshops/conferences, and currently accomplished 2 plus a session in a conference.
- We committed to organise a total of 2 industrial workshops/conferences, and to attend to 10 events. We are currently organising two for 2022 and 2023, and planning to attend others if the pandemic allows it.
- We committed to advertise our website to reach over a 75% of the visits from outside of the consortium, and it is currently rounding that number considering the ones from USA, China, UK, Brazil, etc.
- One demonstration video is published in our YouTube channel and Zenodo (<https://doi.org/10.5281/zenodo.5752983>), as well as two videos and PowerPoint slides from conference presentations in DAEMON Zenodo community. Likewise, the brochure is published, and leaflets and flyers are planned for when on-site events resume. They are also automatically populated to DAEMON OpenAIRE profile.

2.2 Dissemination activities

In this section, we report the dissemination activities of the project. DAEMON has carried out multiple dissemination activities, even if the project is still at its early stage, this included presentations in multiple conferences, seminars and forums.

2.2.1 Publications and technical dissemination

The following tables presents DAEMON peer-reviewed articles in scientific journals and studies, demos, and posters in scientific conferences.

Table 1 presents 23 publications scientific conferences and workshops at top-tier venues like IEEE INFOCOM, ACM SIGCOMM and MobiCom. Table 2 presents 11 publications in top-tier scientific journals, like IEEE Transactions on Mobile Computing, IEEE Transactions on Wireless Communications, IEEE/ACM Transactions on Networking.

Table 1. Publications in scientific conferences and workshops.

Date	Title	Conference	Authors	Open Access DOI
21/02	CloudLSTM: A Recurrent Neural Model for Spatiotemporal Point-cloud Stream Forecasting	The Thirty-Fifth AAAI Conference on Artificial Intelligence (AAAI-21)	C. Zhang, M. Fiore, I. Murray, P. Patras (IMDEA)	https://doi.org/10.5281/zenodo.5524838
21/02	Experimental Evaluation of Power Consumption in Virtualized Base Stations	IEEE International Conference on Communications 2021 (ICC'21)	J. Ayala-Romero, I. Khalid, A. Garcia-Saavedra, X. Costa-Perez, G. Iosifidis (NEC, TU Delft)	http://doi.org/10.5281/zenodo.4966356
21/05	Energy-Efficient Orchestration of Metro-Scale 5G Radio Access Networks	The 40th Annual IEEE Conference on Computer Communications (INFOCOM'21)	R. Singh, C. Hasan, X. Foukas, M. Fiore, M. K. Marina and Y. Wang (IMDEA)	https://doi.org/10.5281/zenodo.5524774
21/05	Bayesian Online Learning for Energy-Aware Orchestration in vRANs	The 40th Annual IEEE Conference on Computer Communications (INFOCOM'21)	G. Iosifidis, A. G. Saavedra (NEC, TU Delft)	http://doi.org/10.5281/zenodo.4966637
21/05	AutoML for Video Analytics with Edge Computing	The 40th Annual IEEE Conference on Computer Communications (INFOCOM'21)	G. Iosifidis (TU Delft)	http://doi.org/10.5281/zenodo.4966558
21/05	Demonstrating a Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs	The 40th Annual IEEE Conference on Computer Communications (INFOCOM'21)	G. Iosifidis, A. G. Saavedra (NEC, TU Delft)	http://doi.org/10.5281/zenodo.4966737
21/05	When Deep Learning May Not Be The Right Tool For Traffic Classification	The 6th IEEE/IFIP International Workshop on Analytics for Network and Service Management (AnNet 2021)	K. Ismailaj, M. Camelo and S. Latré (IMEC)	http://doi.org/10.5281/zenodo.4923689
21/06	No-Regret Slice Reservation Algorithms	IEEE International Conference on Communications 2021 (ICC'21)	J. B. Monteil, G. Iosifidis, L. DaSilva (TU Delft)	https://doi.org/10.5281/zenodo.4966897
21/06	Category Theory Framework for Variability Models with Non-Functional Requirements	23 rd International Conference on Advanced Information Systems Engineering (CAISE'21)	D. J. Munoz, D. Gurov, M. Pinto, L. Fuentes (UMA)	http://doi.org/10.5281/zenodo.4599585 Slides: https://doi.org/10.5281/zenodo.5062144
21/07	Traffic-Driven Sounding Reference Signal Resource Allocation in (Beyond) 5G Networks	IEEE International Conference on Sensing, Communication	C. Fiandrino, G. Attanasio, M. Fiore, J. Widmer (IMDEA)	http://doi.org/10.5281/zenodo.4599585

		and Networking (SENCOM)'21		
21/07	Network Intelligence in 6G: challenges and opportunities	ACM MobiArch 2021	A. Banchs, M. Fiore, M. Gramaglia, A. Garcia-Saavedra (UC3M, IMDEA, NEC)	https://doi.org/10.5281/zenodo.5524560
21/08	Insights from Operating an IP Exchange Provider	ACM SIGCOMM'21	A. Lutu, D. Perino, M. Bagnulo, F.E. Bustamante (TID)	https://doi.org/10.5281/zenodo.5722464
21/09	Teoría de Categorías Aplicada a Variabilidad	Congreso Español de Informática (CEDI)	Daniel-Jesus Munoz, Monica Pinto, Lidia Fuentes (UMA)	http://doi.org/10.5281/zenodo.4974524 Slides: https://doi.org/10.5281/zenodo.5554914
21/09	Despliegue Energéticamente Eficiente de Aplicaciones Distribuidas en Infraestructuras en el Borde Heterogéneas	Congreso Español de Informática (CEDI)	A. Cañete, A. Rodríguez, M. Amor and L. Fuentes (UMA)	https://doi.org/10.5281/zenodo.5075287
21/10	Decentralised Blockchain-based Solutions for Electronic Healthcare Record with Interacting Social Networking Components	International Conference on Innovation and Intelligence for Informatics, Computing, and Technologies 3ICT 2021	D.J. Munoz, D.A. Constantinescu (UMA)	https://doi.org/10.5281/zenodo.5554351 Slides: https://doi.org/10.5281/zenodo.5554578
21/10	Nuberu: Reliable RAN Virtualization in Shared Platforms	ACM Annual International Conference on Mobile Computing and Networking (MobiCom 2021)	G. Garcia-Aviles, A. Garcia-Saavedra, M. Gramaglia, X. Costa-Perez, P. Serrano, A. Banchs (UC3M, NEC, IMDEA)	https://doi.org/10.5281/zenodo.5599123
21/10	Demonstrating Nuberu: A Reliable DU Design Suitable for Virtualization Platforms	ACM Annual International Conference on Mobile Computing and Networking (MobiCom 2021)	G. Garcia-Aviles, A. Garcia-Saavedra, M. Gramaglia, X. Costa-Perez, P. Serrano, A. Banchs (UC3M, NEC, IMDEA)	https://doi.org/10.5281/zenodo.5599123
21/11	Zenoh-based Dataflow Framework for Autonomous Vehicles	EEE International Symposium on Autonomous Vehicle Software 2022	G. Baldoni, J. Loudet, L. Cominardi, A. Corsaro, Y. He (ADLINK)	https://doi.org/10.5281/zenodo.5734287
21/12	Building Realistic Experimentation Environments for AI-enhanced Management and Orchestration (MANO) of 5G and beyond V2X systems	IEEE Consumer Communications & Networking Conference 2022	N. Slamnik-Kriještorac, M. Camelo, L. Cominardi, S. Latré, J. M. Marquez-Barja (IMEC, ADLINK)	https://doi.org/10.5281/zenodo.5767768
21/12	Realistic Experimentation Environments for Intelligent and Distributed Management and Orchestration (MANO) in 5G and beyond	IEEE Consumer Communications & Networking Conference 2022	N. Slamnik-Kriještorac, M. Camelo, L. Cominardi, S. Latré, J. M. Marquez-Barja (IMEC, ADLINK)	https://doi.org/10.5281/zenodo.5767796
21/12	EdgeBOL: Automating Energy-savings for Mobile Edge AI	ACM International Conference on emerging	J. A. Ayala-Romero, A. Garcia-Saavedra,	https://doi.org/10.5281/zenodo.5734868

		Networking EXperiments and Technologies CoNEXT 2021	G. Iosifidis, X. Costa-Perez (NEC, TU Delft)	
21/12	Towards Autonomous VNF Auto-scaling using Deep Reinforcement Learning	The Eighth International Conference on Software Defined Systems (SDS-2021)	P. Soto, D. De Vleeschauwer, M. Camelo, Y. De Bock, K. De Schepper, C. Chang, P. Hellinckx, J. F. Botero, S. Latré (NOKIA, IMEC)	https://doi.org/10.5281/zenodo.5767618
21/12	Requirements and Specifications for the Orchestration of Network Intelligence in 6G	1st International Workshop on 6G: Visions, Use Cases and Technologies (6G'22)	M. Camelo, L. Cominardi, M. Gramaglia, M. Fiore, A. Garcia-Saavedra, L. Fuentes, D. De Vleeschauwer, P. Soto, N. Slamnik-Kriještorac, J. Ballesteros, C.-Y. Chang, G. Baldoni, J.M. Marquez-Barja, P. Hellinckx, S. Latré (IMEC, ADLINK, UC3M, IMDEA, NEC, UMA, NOKIA)	https://doi.org/10.5281/zenodo.5767618

Table 2. Publications in scientific journals.

Date	Title	Journal	Authors	Open Access DOI
21/01	Energy-efficient Deployment of IoT Applications in Edge-based Infrastructures: A Software Product Line Approach	IEEE Internet of Things Journal	A. Cañete, M. Amor and L. Fuentes (UMA)	https://doi.org/10.5281/zenodo.4605644
21/01	vrAI: Deep Learning based Orchestration for Computing and Radio Resources in vRAN	IEEE Transactions on Mobile Computing	A. Garcia-Saavedra, M. Gramaglia, A. Banchs (NEC, UC3M, IMDEA)	https://doi.org/10.5281/zenodo.5037024
21/05	ProDSPL: Proactive self-adaptation based on Dynamic Software Product Lines	Journal of Systems and Software	I. Ayala, A.V. Papadopoulos, M. Amor and L. Fuentes (UMA)	https://doi.org/10.5281/zenodo.4616618
21/05	Elastic Femtocaching: Scale, Cache and Route	IEEE Transactions on Wireless Communications 2021	J. Kwak, G. Paschos, G. Iosifidis (TU Delft)	https://doi.org/10.5281/zenodo.4967023
21/06	Managing the far-Edge: are today's centralized solutions a good fit?	IEEE Consumer Electronics Magazine	G. Baldoni, L. Cominardi, M. Groshev, A. De la Oliva, A. Corsaro (ADLINK, UC3M)	https://doi.org/10.5281/zenodo.4923688
21/06	ATARI: A Graph Convolutional Neural Network Approach for Performance Prediction in Next-Generation WLANs	MDPI Sensors	P. Soto, M. Camelo, K. Mets, F. Wilhelmi, D. Góez, L. A. Fletscher, N. Gaviria, P. Hellinckx, J. F. Botero, S. Latré (IMEC)	https://doi.org/10.3390/s21134321
21/07	Supporting IoT applications deployment on edge-based	Journal of Systems and Software	A. Cañete, M. Amor and L. Fuentes (UMA)	https://doi.org/10.1016/j.jss.2021.111086

	infrastructures using multi-layer feature models			
21/10	O-RAN: Disrupting the Virtualized RAN Ecosystem	IEEE Communications Standards Magazine	G. Garcia-Aviles, A. Garcia-Saavedra, X. Costa-Perez (NEC, i2CAT)	https://doi.org/10.5281/zenodo.5734889
21/11	Orchestrating Energy-Efficient vRANs: Bayesian Learning and Experimental Results	IEEE Transactions on Mobile Computing	J. A. Ayala-Romero, A. Garcia-Saavedra, X. Costa-Perez, G. Iosifidis (NEC, i2CAT)	https://doi.org/10.1109/TMC.2021.3123794
21/12	A General Approach for Traffic Classification in Wireless Networks using Deep Learning	IEEE Transactions on Network and Service Management	M. Camelo, P. Soto, S. Latré (IMEC)	https://doi.org/10.5281/zenodo.5767584
21/08	Birkhoff's Decomposition Revisited: Sparse Scheduling for High-speed Circuit Switches	IEEE/ACM Transactions on Networking	V. Valls, G. Iosifidis, L. Tassiulas (TU Delft)	10.1109/TNET.2021.3088327

Also, we contributed to a whitepaper: 5G PPP Architecture Working Group - View on 5G Architecture, Version 4.0 by UC3M accessible through <https://doi.org/10.5281/zenodo.5155656>

Finally, we are co-editors of a journal special issue titled "Network management for beyond 5G systems" by IMEC/NEC/U3CM for the "Journal of Network and Systems Management" accessible in <https://www.springer.com/journal/10922/updates/18448680>.

In terms of dissemination KPIs in numbers:

- We committed to provide a total of 80 high tier publications, and currently accomplished 11 Journals, 23 conferences and 1 whitepaper. 2 slides have been also published.
- We committed to publish a total of 4 demonstrations, and we currently succeeded with 3.
- We committed to edit 2 special issues, and currently published one.

Finally, in Figure 13 we can see an example of the analytics for DAEMON publications. In general, each asset has at least 100 views and 80 downloads.

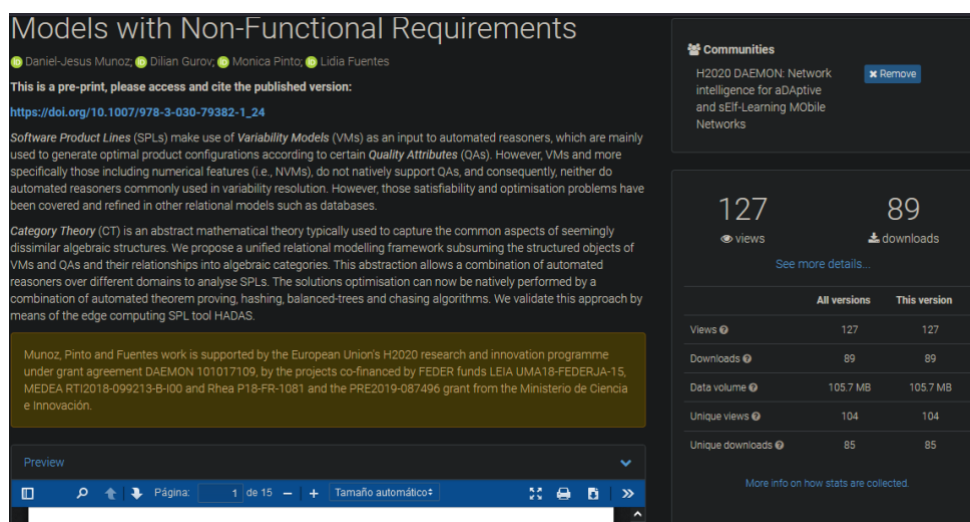


Figure 13. Zenodo analytics for each published asset in the DAEMON community.

2.2.2 Synergies with other projects

The DAEMON project carried out during Y1 collaborative activities with other projects funded under 5G PPP calls towards a coordinated action inside the 5G-PPP. Such activities are summarized in Table 3 below, and include joint research and publication of scientific results, participation in 5G PPP boards and Working Groups (WG), and contributions to white papers, webinars, brochures and special sessions.

Table 3. Activities carried out by the project in the framework of 5G PPP and/or jointly with other projects.

Item	Explanation
Joint paper	Joint scientific publication with ICT-19 project 5Growth on "Experimental Evaluation of Power Consumption in Virtualized Base Stations" at IEEE ICC 2021
Joint paper	Joint scientific publication with ICT-19 project 5Growth on "Bayesian Online Learning for Energy-Aware Resource Orchestration in Virtualized RANs" at IEEE INFOCOM 2021
Joint paper	Joint scientific publication with ICT-19 project 5Growth on "Demonstrating a Bayesian Online Learning for Energy-Aware Resource Orchestration in vRANs" at IEEE INFOCOM 2021
Joint paper	Joint scientific publication with ICT-23 project 5G-DIVE on "Managing the far-Edge: are today's centralized solutions a good fit?" at IEEE Consumer Electronics Magazine
Joint paper	Joint scientific publication with ICT-19 project 5Growth on "No-Regret Slice Reservation Algorithms" at IEEE ICC 2021
Joint paper	Joint scientific publication with ICT-52 project Hexa-X on "Nuberu: Reliable RAN Virtualization in Shared Platforms" at ACM MobiCom 2021
Joint paper	Joint scientific publication with ICT-53 project 5G-Blueprint on "Realistic Experimentation Environments for Intelligent and Distributed Management and Orchestration (MANO) in 5G and beyond" at IEEE CCNC 2021
Joint paper	Joint scientific publication with ICT-19 projects 5Growth and 5G-TOURS on "vrAI: Deep Learning based Orchestration for Computing and Radio Resources in vRANs" at IEEE Transactions on Mobile Computing
Joint paper	Joint scientific publication with ICT-19 project 5Growth on "Orchestrating Energy-Efficient vRANs: Bayesian Learning and Experimental Results" at IEEE Transactions on Mobile Computing
5G PPP board	Participation in Steering Board (M. Fiore – IMDEA)
5G PPP board	Participation in Technical Board (A. Garcia-Saavedra – NEC)
5G PPP WG	Participation in 5G Architecture WG (Xi Li – NEC, M. Gramaglia – UC3M, M. Camelo – IMEC)
5G PPP WG	Participation in Vision and Societal Challenges WG (M. Fiore – IMDEA)
5G PPP WG	Participation in Software Networks WG (C.-Y. Chang – NOKIA, J. Marquez-Barja – IMEC)
5G PPP WG	Participation in 5G Automotive WG (J. Marquez-Barja – IMEC)
5G PPP WG	Participation in Test, Measurement and KPIs Validation WG (A. Garcia-Saavedra – NEC, V. Kosmatos – WINGS)
5G PPP WG	Participation in Pre-Standardization WG (M. Gucciardo – IMDEA)
5G PPP WG	Participation in Open Smart Networks and Services WG (A. Garcia-Saavedra)
5G PPP phase 3 project brochure	Joint brochure with all 5G PPP projects funded in calls ICT-17, ICT-18, ICT-19, ICT-20, ICT-41, ICT-42, ICT-52 and ICT-53. Available at: https://5g-ppp.eu/wp-content/uploads/2021/06/5GPPP_Phase3_Brochure_WEB-2.pdf
5G PPP white paper	Joint white paper of the 5G PPP Architecture Working Group on "View on 5G Architecture, Version 4.0". Available at: https://doi.org/10.5281/zenodo.5155656
5G PPP webinar	Joint webinar with all ICT-52 projects on "Europe accelerates towards 6G": https://5g-ppp.eu/event/5g-ppp-webinar-europe-accelerates-towards-6g/
Special session	Joint special session organized with the ICT-52 project RISE-6G during the EuCNC 2021 conference on "RIS-empowered Communications and Localization for Smart Radio Environments"

2.3 Exploitation activities

According to the exploitation plan of DAEMON described in Section 5, each partner category, ('vendors and service providers', 'network operators', 'small and medium enterprises', and 'academia and research centers') started their activities towards their exploitation objectives.

Network operators: the definition of relevant use-cases for different operators and network platform. Start of prototype design and definition of requirements for the NI module to best fit the needs of each stakeholder.

SMEs: the analysis of potential contributions to open-source projects and training courses on SDN, NFV, and MEC architectures and cloud platforms has started.

Universities and R&D centers: definition and analysis of scope of their work (on topics such as multi-domain orchestration and slicing) in a 5G context towards potential exploitation has started.

2.3.1 Standardization

The following Table gathers the SDO achievements in terms of approved standardization contributions made by the project partners related to the DAEMON innovations and use cases during the first year the of the project.

Table 4. DAEMON SDO approved contributions.

Target SDO	Type of Contribution (Date)	Partner	Status	Contribution Descriptions (Describe the content of the planned Contributions)	Rations to the related DAEMON Innovations and use cases (Describe the rationale and relations to the DAEMON Innovations)
O-RAN	Standard contribution (Feb. 03 2021)	NEC	Approved	<u>CR0002</u> : Add definition of "Function" in the Non-RT RIC Architecture TR	DAEMON innovations related to the non-RT RIC applications can fit to the "Function" introduced in this contribution, in terms of a logical entity that plays the roles of services producer and/or service consumer.
O-RAN	Standard contribution (Feb. 09 2021)	NEC	Approved	<u>CR0003</u> : Add Service registration and registration function, Authentication and Authorization Function, and Data Collection and Repository Function in the Non-RT RIC Architecture TR	DAEMON innovations related to the non-RT RIC applications will benefit from this contribution on the defined functions for Service registration, Authentication and Authorization, as well as Data Collection and Repository.
O-RAN	Standard contribution (June 09 2021)	NEC	Approved	<u>CR0006</u> : Definitions of R1 service exposure functions and R1 termination in the Non-RT RIC Architecture TS	DAEMON innovations related to the non-RT RIC applications can benefit from this contribution on their service exposure.

O-RAN	Standard contribution (June 09 2021)	NEC	Approved	<u>CR0007</u> : Definitions of Data management and exposure functions in the Non-RT RIC Architecture TS	DAEMON innovations related to the non-RT RIC applications can benefit from this contribution on related data management and exposure capabilities.
O-RAN	Standard contribution (June 28 2021)	NEC	Approved	<u>CR0008</u> : Definitions of Non-RT RIC architecture diagram and its description in the Non-RT RIC Architecture TS	DAEMON innovations related to the non-RT RIC applications can have an impact on Non-RT RIC architecture design in terms of required functions and interfaces and related information models.
O-RAN	Standard contribution (Oct. 21 2021)	NEC	Approved	<u>CR0009</u> : Definitions of data producer and data consumer in the Non-RT RIC Architecture TS	DAEMON innovations related to the non-RT RIC applications can make an impact on this contribution in terms of defining the data producer and data consumer entities and their functionalities.
O-RAN	Standardization contribution (July, 2021)	NBL	Approved	E2SM-RCv01.00 Section 7.6.9	Reflects DAEMON technical inputs of WP3 on the application-aware RAN based on the concept of "Explicit UE list"
ITU-T FG-AN	Standard Contribution (Feb. 2-4, 2021)	UC3M	Approved	FGAN-I-014: Presentation "Machine Learning for Network Automation: Some ideas on the topic"	Discussion on the DAEMON approach to NI
ITU-T FG-AN	Standard Contribution (Oct. 28, 2021)	UC3M	Approved	FGAN-O-013 "Use cases of autonomous networks"	DAEMON contributions to the use cases definition

2.3.2 Open-Source activities

Up to this point, there have been no contributions to FOSS projects. We have identified the relevant projects and have liaised with consortium members involved in the relevant projects to help align our open-source plan. The identified projects include srsRAN and Eclipse Zenoh. SRS are the project maintainers for srsRAN, while the Eclipse Foundation are responsible for Zenoh; which ADLINK are members of. It is hoped we will begin integration of these projects to the DAEMON framework in 2022. The project has identified how we will contribute to these projects. Contributions to srsRAN will be made via a DAEMON specific fork of the srsRAN on the DAEMON GitHub. Contributions to Zenoh will be made directly to the mainline code repository of the project.

2.3.3 Bachelor, Master, PhD Theses/Courses and Internships

Table 5. DAEMON-related bachelor, master and PhD theses, and internships

Type	Title	University
Master Thesis	Online Learning for Edge Network Caching	TU Delft
PhD Thesis	Optimization Algorithms for Robust Network Intelligence	TU Delft
PhD Thesis	Energy-efficient tasks assignment for heterogeneous deployment architectures on Edge Computing	UMA
PhD Thesis	Achieving Energy Efficiency with a Software Product Line Engineering Approach	UMA
PhD Thesis	Network intelligence for resource management in 6G mobile networks	IMDEA, UC3M
PhD Thesis	Tailoring machine learning for zero-touch network and service management	IMDEA, UC3M
PhD Thesis	Integration and demonstration of remote sensing functionalities in future-generation mobile network architectures	IMDEA, UC3M
Postdoc	Design and implementation of network intelligence in the user plane of 6G mobile networks	IMDEA
Postdoc	Tailoring of Artificial Intelligence models for network orchestration	IMDEA
MSc Course	5G Standards	UC3M
MSc Course	B5G Operation Requirements	TU Delft

3 Communication plan for year 2

H2020 DAEMON continues in the second year with the set of necessary presentation materials targeted for various audience types. We present additions without deviations with regards to the 1st year:

A **communication package** that will be used as the core communication measure to promote the project. The communication package considers the official website serving as a central hub for obtaining detailed information about the action. The project website includes pointers to all the documentation, code and data repositories generated by the action. Presentation material is also part of the communication package, including flyers, leaflets, and posters to be used in all occasions for communication, and displaying an easily recognized official DAEMON logo specifically designed for the project. Due to the pandemic, on-site events are cancelled, hence assets as flyers as delayed till those events resume, while in the meantime we focus on online events, brochure, etc. All assets of sufficient quality are made publicly available under a Creative Commons Attribution (CC BY) 4.0 license, and uploaded to the Zenodo repository with their respective open access DOIs in order to facilitate search, linking and citations. Allowing others to use our assets with attribution increases the project's exposure and impact. Media assets are made available to visualise in DAEMON's website, uploaded to DAEMON's YouTube channels, and downloadable and citable in Zenodo with respective open access DOI. They are also promoted in DAEMON's profiles in the suitable social networks such as Twitter and Facebook. The project partners carry out a number of communication activities tailored to each specific audience, as detailed next. Table 6 summarizes the different activities in the DAEMON communication plan, the metrics, and the current state that allows to assess DAEMON success.

Communication to the general public. DAEMON establishes a presence on the most popular social media largely used by the non-expert public, which currently are Twitter, Instagram, Facebook and LinkedIn, where regular updates on the action progress are posted. Social media is fully integrated with the project website, and are used to advertise DAEMON's results, announce events such as conferences and showcases, inform about the most recent results and reports, and provide a platform for discussion. In addition, the official social media accounts of all partners are linked (e.g., via following, re-posting, or re-tweeting) to the DAEMON accounts, so as to maximize its reach and visibility. The streaming platform YouTube is leveraged to publish videos showcasing trials and panels in order to provide a simple and effective way of accessing the project results and main ideas. Webcasts are planned to be employed as an effective way to share slightly more technical information about the knowledge and tools produced by DAEMON, for instance with hands-on sessions explaining the fundamentals of the project solutions. Finally, the partners will produce white papers aimed at explaining the evolutions of network technologies to the public. We are also focus on reaching out to traditional media such as newspapers, TV, or radio, as this is a very effective way to make the general public aware of the benefits to society resulting from research projects. When addressing these media, emphasis is placed on the benefits of the project for society. Indeed, use cases such as the ones related to culture or education may raise the interest of the general public, which may help to reach this kind of audience. It is worth noting that several project partners have dedicated communications offices, excellent track records of public engagement activities, and well-established links with the media; they have already succeeded in having impact on mass media (e.g., the New York Times, the Irish Times, Forbes, Spectrum, De Standaard, De Morgen, Flanders Today, The Financial Times, The Guardian, The Times, O Globo, Il Corriere della Sera or El Pais), as well as on national broadcasters like RTE (Ireland) and VRT (Belgium), to name just a few. In addition, internal magazines published by project partners and aimed at the general public, such as the IMEC magazinell, will be used to communicate the project results.

Communication to students and prospective researchers. The approaches to NI integration in future-generation mobile networks developed by DAEMON are getting included in teaching material presented to students of courses on 5G technologies, including classes of the Master programs in Telematics Engineering, Telecommunications Engineering and Big Data Analytics at UC3M, classes of the Data Science and Technology Master at TU Delft, and Master of Computer Science, Educational Master of Science and Technology, and Master of Informatics at University of Antwerp. Industrial partners will present the DAEMON activities during seminars they regularly hold as integral part of university courses, such as that on "5G Service Automation" offered by the University of Antwerp. Internships for graduate students and industrial PhD programmes will be offered by the industrial partners on the research topics of DAEMON, exposing such students to problems and solutions investigated by the project, and starting their training in developing the necessary skills to address the challenges of 5G systems. Furthermore, NBL has a PhD working for six months on DAEMON. In addition, partners will take full advantage of open research events and science fairs to showcase the project results to the public, and in particular to students. This will include participation in initiatives such as those in the context of European Researchers' Night¹ or broadcasted talks.

¹https://ec.europa.eu/research/mariecurieactions/actions/get-funding/european-researchers-night-2021_en.

The following table includes the targeted audience, the related activities, the timing, and the metrics of the communication activities, including quantified goals. DAEMON aims to register and publish open-access communication related assets and advertise them in the main social networks.

Table 6. H2020 DAEMON communication plan.

Audience	Activity	Timing	Metric
All, General public, Research	Project website. DAEMON shares its concepts, results and achievements through its dedicated project website. The website is dynamically synchronized with DAEMON's social network accounts, and is the primary tool of communication and promotion of it.	Cont. update	Google, Twitter, Facebook, and Zenodo Analytics, and Advanced Page Visit Counter readings. That includes country of access, number of unique visits per page, total number of visits, prints, and retention. We aim to at least 75% of the audience coming from countries outside the consortium.
All, General public	Press releases, posters, leaflets. DAEMON prepares and distributes project posters, press releases and leaflets to raise public awareness.	Event-driven	Updated leaflets and posters. Published press releases (target: at least two per year. Assets with open access DOIs published in Zenodo with certain metrics as number of online reads and downloads, as well as Twitter prints of the DOI.
General public	Public Communication. DAEMON project, including its impact on the transformation of vertical industry, is regularly promoted through participation and organization of events for society at large and distribution through social media. We also make use of EC communication tools and magazines.	Event-driven	Num. of events organized / attended (target: at least one org. per year) Assets with open access DOIs published in Zenodo with certain metrics as number of online reads and downloads. Likewise, Twitter prints.
All, General public, Research	Social Networks. DAEMON is present on the main social network with official profiles and project pages. DAEMON social network profiles gradually advertise all outputs from all the work packages, including WP6. Additionally, these profiles constantly inform by short feeds of the main results and events from DAEMON and collaborators.	Cont. update	Twitter, Facebook, LinkedIn and Instagram analytics, including number of likes, re-publishing, prints, and number and types of comments.
General public, Interest groups	Video. DAEMON has already created public videos to advertise the proposed network scenarios and their capabilities. New videos will be created focused on research outcomes and demo activities.	Event-driven	Videos of all demo activities available in the web, its Youtube channel, and Zenodo (open access DOIs). Number of likes, views and downloads.
Students	Lecture materials related with DAEMON are introduced in academic courses and webinars taught by partners	Potentially every 6 months	Number of related courses where project topics are introduced

4 Dissemination plan for year 2

The purpose of the dissemination plan is to guarantee that all concepts and technologies developed in the DAEMON project are disseminated adequately to relevant entities, including standards development organizations. Dissemination and Collaboration (primarily within the 5G-PPP) activities are already conducted since Year 1 to help promote the project concept and results to the large European and more International R&D community and raise opportunities for synergy with other projects and activities. The plan pursues the following goals: (i) creating a radical shift in the mindset of the networking research and development community that span both industry and academia towards a pragmatic, holistic integration of AI into future network architectures and equipment; (ii) foster the widespread adoption of the AI-based architecture and solutions developed by DAEMON beyond the manufacturers and operators of the consortium; (iii) protect the project findings to secure the commercial advantage of DAEMON partners while fostering the adoption of the technology beyond the consortium.

This section presents the continuation of the plan in Year 1 into Year 2, and reports the achievements for dissemination and collaboration activities. The dissemination activities are carried out continuously when there is the appropriate combination of availability of project results and opportunity. In this respect, project milestones are a key source of dissemination. As far as dissemination is concerned, the following activities are continuously expected:

Publications in selected journals and magazines, such as IEEE/ACM journals, transactions and magazines (e.g., IEEE TMC, ACM/IEEE TON, IEEE JSAC, IEEE TNSM, IEEE Communications Magazine, IEEE Network) and reputed international conferences (e.g., IEEE INFOCOM, IEEE ICC, IEEE GLOBECOM, ACM MobiCom, ACM CoNEXT, AAAI, ICML, IEEE SECON, IFIP/IEEE IM, IFIP Networking, IEEE/IFIP NOMS, IEEE CNMS).

Collaborations with EU and other research projects through 5G-PPP working groups, network2020, and other H2020 projects in support of the 5G-PPP commitments and towards the realization of the B5G vision.

Presentations and participation in research-oriented workshops, industry-oriented workshops (e.g., ETSI workshops on standardization), technology platforms and any other similar forum, including participation in panels organized in these events. During Year 2 we will give more emphasis to industrial events.

Participation in public **exhibitions and demonstrations** for academia (e.g., demonstrations in conferences) and industry (e.g., Mobile World Congress, EUCNC, IWPC, Edge Computing World, Bell Labs Future X days, Eclipse IoT and Native Edge day, SDN and NFV World Congress or equivalent) to disseminate research work to create awareness of DAEMON technology and applications.

Organization of events, such as tutorials and/or workshops, collocated with well-established conferences (e.g., CONNECT, EUCNC, IEEE ICC, IEEE Globecom) to showcase DAEMON results.

In general terms, DAEMON openly publish most of its results and assets, whether they are more related to research and industry (e.g., papers, data-sets), or to public communications (e.g., slides, general documents). They will all have an open-access DOI, optimizing citations and/or re-usability of our results and supporting the freedom of sharing DAEMON results while avoiding limits to knowledge distribution. The resources will be hosted in Zenodo, the general-purpose open-access repository developed under the European OpenAIRE program and operated by CERN. Hence, the main Daemon project and resources indexer is OpenAIRE – an H2020 Research and Innovation programme under Grant Agreement No. 777541. Figure 14 summarizes the workflow, where the main points to highlight are:

- All DAEMON results are provided as resources, and uploaded in Zenodo. We request an open-access DOI if the resource does not have one, otherwise the original open-access DOI is used.
- In case of copyrighted documents, pre-prints are uploaded with an open-access DOI. The new DOI is linked in Zenodo with the copyrighted DOI to compute the total analytics jointly.
- Related resources are referenced by their different DOIs (e.g., a conference paper with the data-set generated in the experiments, and the slides of its presentation in the venue)
- We have created a Zenodo community for the DAEMON consortium, where we are managing all open-access resources. It is accessible at <https://zenodo.org/communities/h2020daemon/>.
- The H2020 DAEMON project itself is indexed in OpenAIRE by the grant agreement No. 101017109. The displayed information is based on the CORDA repository and Zenodo resources. It is accessible at https://explore.openaire.eu/search/project?projectId=corda_h2020::4184e4627d0cae4849077e9275689c2f.
 - H2020 DAEMON resources define as a funding acknowledgment the European Union's Horizon 2020 Research and Innovation Grant No. 101017109. OpenAIRE auto-indexes resources uploaded to Zenodo with the DAEMON OpenAIRE page mentioned in the point above.
 - Last, but not least, analytics such as number of reads and downloads, are calculated by Zenodo and automatically populated to OpenAIRE.

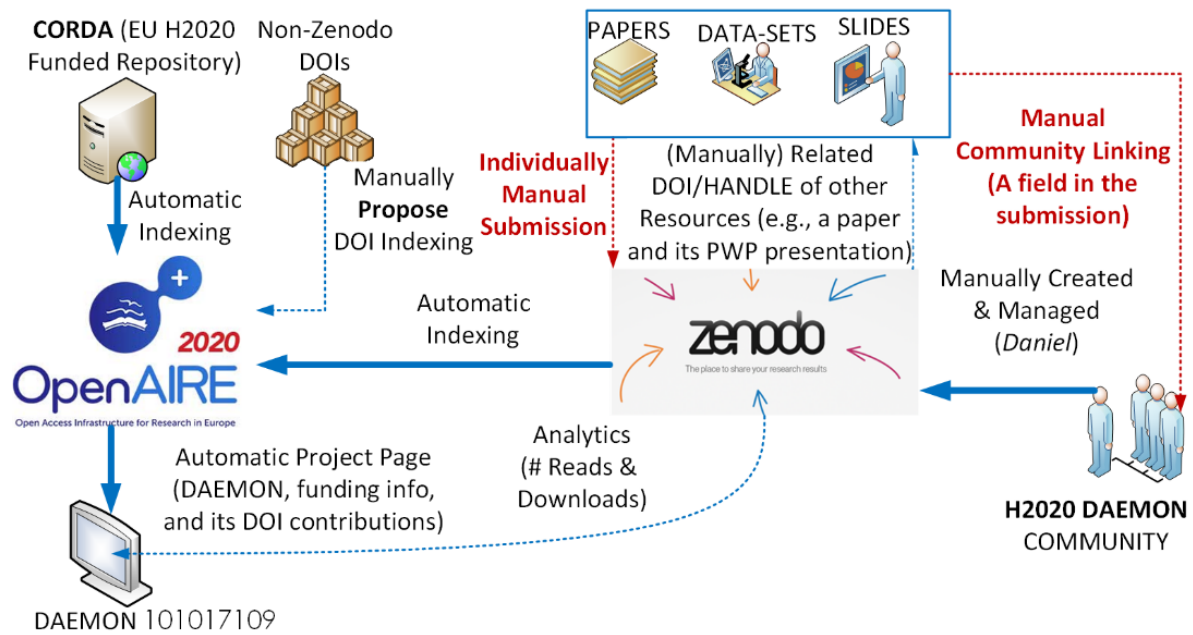


Figure 14. Resources repository with Open Access DOIs dissemination workflow.

4.1 Dissemination work plan

The dissemination activities will be steered towards generating impact through peer-reviewed publications, presentations, talks, demonstrations, panels, workshops, and events. We plan to accomplish at least the same goals set for Year 1, including:

- Additional submission of at least 20 scientific articles for publication at reputed conferences and journals by Year 2.
- Additional submission to accomplish at least 30 contributions to SDOs, such as 3GPP, IETF, ETSI, IEEE, ITU over the lifetime of the project.
- Additional submission of at least 2 joint documents scientific / articles / publications for publication at reputed conferences and journals together with EU and international research projects, e.g., through 5G-PPP working groups, or working groups of other platforms, such as networkworld2020).
- Additional demonstrations of project related prototypes or solutions at least 1 flagship event (e.g., MWC / EUCNC) on Year 2.
- Organization of at least 1 research- or industry-oriented workshop on year 2.
- Participation in at least 1 research- or industry-oriented workshop on year 2.
- Participation in at least 1 open-source project over the lifetime of the project.
- Filing at least 20 patent applications over the lifetime of the project.
- Addition of core skills for technology development within the project into academic curriculums, along with the proposal of PhD and MSc theses on specific topics on DAEMON research agenda.

The following table summarizes the dissemination plan.

Table 7. H2020 DAEMON dissemination plan.

Audience	Activity	Timing	Metric
Academic and industrial research	DAEMON aims at publishing its work in selected, high impact-factor journals and magazines on communications/networking (e.g., IEEE Communication Magazine, IEEE JSAC), and reputed international conferences (e.g., ICC, Mobicom, Globecom, CoNEXT, EUCNC). An appropriate balance between academic and industrial awareness is considered.	Continuous	At least 20 publications per year in top-tier scientific journals and conferences.

Other research projects	Collaboration with other EU and international research projects (e.g., through 5G-PPP working groups, or working groups of other platforms, such as network2020) will also be key towards a coordinated action inside the 5G-PPP and with other H2020 projects related with the design of B5G technologies	5G-PPP WGs & ad hoc bi-lateral collaboration	Num. of meetings attended (target: at least two per year). Num. of joint documents generated (target: at least two per year).
Mostly academia, but also industry	Organization, presentations and participation in the organization of events (e.g., panels, targeted workshops, workshops co-located with relevant conferences, special sessions) and participation as keynote speaker, panelist, etc., thanks to important vendors, technology providers and operators, high-tech SMEs, and reputed academic organizations within the consortium.	Participation in one event per year One workshop organized	Organization of one 30-people workshop co-located with a major conference (e.g., EUCNC, IEEE WCNC, ICC, INFOCOM) with 70% satisfaction in the workshop quality poll for attendees. Participation in workshops: we measure the number of events (target: at least one per year), we will measure the metrics (web access, cites) of work presented to assess its impact.
Industry	Exploitation workshop. Chaired by the innovation manager and specifically devoted to maximizing the exploitation outcomes of the project in terms of standardization, patenting/licensing, and products and services. Experts on innovation from the various companies representing all industrial sectors already in the project (verticals, operators, vendors, and SMEs and external experts acting as advisors on maximizing the exploitation outcome of the project.	Two workshop org. before M28	One 30-people exploitation workshop before the end of the project with 70% satisfaction in the poll for attendees.
Mostly industry, but also academia	Technology demonstration. The project team believes that the realization of proofs-of-concept is the key to maximize innovation potential. DAEMON will participate in demonstrations of key project components in exhibition booths in fairs, such as those of EUCNC, or industrial events, such as Mobile World Congress (MWC), where some of partners have regularly exhibited.	Approx. every 6 months	Technology demonstration in at least two events per year. More demonstrations in several events are targeted.
Industry	Though being part of exploitation activities, the participation in standardization efforts of DAEMON also offers an indirect way to disseminate the results of the project to the industrial community. Nevertheless, there are other non-traditional ways of standardizing (e.g., OPNFV, OpenStack) , such as contributing, and publishing open-source software (part of DAEMON exploitation plan), which may become a de facto standard.	Continuous meetings Participation in at least one open-source project.	Participation in at least one open-source project.

4.2 Synergies with other projects

In this section we have identified a set of ongoing projects (by the time the project starts), which have results that may impact DAEMON. For all these projects, there is a DAEMON partner involved, hence we can use this already established relation to maintain a cooperation between projects. Only a selection of projects is listed below.

Table 8. Synergies with other projects.

Project name	Short description	Technical relationship	DAEMON contact
Ongoing EU H2020 projects			
RISE6G	NEC is Technical Manager in both DAEMON and RISE6G. The focus of RISE6G plans of reconfigurable intelligent surfaces (RIS) matches perfectly Task 3.3.	Innovations on intelligent reconfigurable surfaces	NEC
5Growth	5Growth has designed a management and orchestration platform for vertical services using (shared) 5G infrastructure. 5Growth's innovations on AI/ML-as-a-service and next-generation RANs are highly related to many tasks in DAEMON's WP2 and WP3.	Smart orchestration and control, AI/ML platform, next-generation RANs	NEC, UC3M, NBL, TID
5G-TOURS	UC3M is beneficiary partner for both DAEMON and 5G-TOURS. As 5G-TOURS is setting up innovative use-cases related to the adoption of 5G, DAEMON will seek collaboration for the possible deployment of NI into these large-scale testbed	AI Orchestration, Machine Learning	UC3M, WINGS
HEXA-X	Hexa-X is the flagship project for the research on 6G communications. Through the partners that work on both projects, DAEMON will foster the collaboration in some of the most innovative topics such as deep learning and reconfigurable intelligent surfaces.	Deep Learning, RIS	UC3M, WINGS, TID, NBL
5G-CARMEN	The objective of 5G-CARMEN is to leverage on the most recent 5G advances to provide a multi-tenant platform that can support the automotive sector delivering safer, greener, and more intelligent transportation with the ultimate goal of enabling self-driving cars. DAEMON will seek collaboration toward the possibility of bring some of the architectural designs of the multi-tenant infrastructure and use them to deploy and test AI-based resource management at the edge in the Smart Highway tested located in the Belgium zone.	AI Orchestration and resource management at the edge	IMEC, NEC, WINGS
National and internal projects			
Smart Highway project	Belgian national project on connected and automated vehicles. The infrastructure resulting from the Smart Highway project will be enhanced by DAEMON's edge computing resource allocation and services	AI-based multitenant resource allocation at the edge	IMEC
Content and Context based Adaptation in Mobile Networks	French national project aiming at evaluating analytics for classification, prediction and anomaly detection using real-world high-detail mobile network data, for applications to cognitive networks	Data-driven AI design for network management	IMDEA
Methods and Tools for the Deployment of	Spanish national project aiming to propose techniques and tools to reduce the energy	Smart energy consumption	UMA

Eco-efficient Applications in the Edge	consumption and latency of application on Edge Computing systems	and latency of deployments in the Edge	
Languages and Ecosystems for the Variability Analysis, Derivation, Resolution and Materialization Focused in the Architecture and Quality Attributes	Spanish national project that will provide an advanced variability modelling tools for several contexts, aiming to automatically generate optimal and eco-efficient solutions	Advanced model-driven analysis to orchestrate network quality attributes	UMA
Efficient Deployment of Augmented Reality in the Edge	Spanish national project on a framework for the optimal deployment of augmented reality applications in the Edge	Smart deployment of advanced applications in the Edge	UMA
Automated Network Intelligence for 5G evolution and 6G systems	Spanish national project on developing NI solutions that are usable by mobile network operators, via intent-based and explainable NI modelling paradigms	AI for network orchestration	IMDEA

Furthermore, project partners participate to multiple 5GPPP working groups, namely:

- Pre-Standardization
- Vision and Societal Challenges
- 5G Architecture
- Software Networks
- 5G Automotive
- Test, Measurements and KPI Validation
- Open Smart Networks and Services WG.

Their scope is described at: <https://5g-ppp.eu/5g-ppp-work-groups/>. This participation includes presenting and representing the project in all periodic meetings that are organized and participation in joint actions (e.g., co-organization of events, joint documents/papers, joint demonstrations).

Additionally, the project also participates in the 5GPPP boards towards a tight coordination with the rest of 5GPPP projects: the project coordinator in the steering board and the technical manager in the technology board.

5 Exploitation plan for year 2

The DAEMON vision is to set forth a pragmatic approach to NI design. The project will carry out a systematic analysis of which NI tasks are appropriately solved with AI models, providing a solid set of guidelines for the use of machine learning in network functions. For those problems where AI is a suitable tool, DAEMON will design tailored AI models that respond to the specific needs of network functions, taking advantage of the most recent advances in machine learning. Building on these models, DAEMON will design an end-to-end NI-native architecture for 5G that fully coordinates NI-assisted functionalities.

DAEMON's exploitation plan puts forward processes and structures for monitoring innovation throughout the lifetime of the project. The objectives of the exploitation plan include:

- Identification and dynamic management of the exploitation management approach.
- Continuously monitor market, technology and policy trends related to NI.
- Liaise with stakeholders to acquire their feedback on the usability of the services to be offered.
- Continuously monitor all major project activities related to the deliverables with high innovation potential.
- Continuously sync with Work Package leaders to assess the innovation level of the activities executed therein against the Exploitation plan.
- Assess the level of innovation at project level, utilizing **Innovation Metrics**, a set of performance indicators, which are related to the **Key Innovation Areas** of DAEMON.

Most importantly, we aim to achieve a good understanding and continuous (throughout the whole lifetime of the project) monitoring of the NI landscape/domain, in terms of market needs, developments and opportunities. Within this landscape, we aim to assess how DAEMON results align and integrate, while responding to real needs from stakeholders.

DAEMON defined a series of performance metrics (Table 9) that we will use throughout the lifetime of the project to capture its status in term of exploitation of the work. We extended the set of KPIs to include the four last rows, which speak towards the overall innovation activity in DAEMON.

We further adjusted the exploitation plan to address the potential interaction with the Innovation Radar. Our goal is to select for submission to the Innovation Radar several innovations from the set of new methods, tools, systems, services and processes supporting NI service provisioning.

Table 9. Key Exploitation Metrics.

KPI	Target	Relevant Initiatives for Target
Submitted contributions to standards	10	3GPP, ETSI, O-RAN, ITU, ONF, IETF
Patent applications	7	Contributions in the main innovation areas DAEMON targets.
Open-source contributions	3	srsRAN (formerly srsLTE), Eclipse Zenoh
Participation in industry events	3	MWC, IWPC, etc.
Demonstrators	2	Radio, Orchestration, Management, Edge
Organized industrial workshops	1	Over 30 attendees each
Number of new business models developed to support native NI via DAEMON	1	Innovation in the business category
Number of commercially available and exploitable DAEMON NI tools and methods	2	Patented innovation tools and/or methods, under exploitation within a business unit
Number of new methods, tools, systems, services and processes supporting NI services provision	3	The main areas of innovation aim to address map to the NI-assisted functionalities addressed by DAEMON

5.1 Products and services

The main areas of DAEMON innovation aim to address map to the NI-assisted functionalities addressed by DAEMON, which are as follows:

- F1: RIS Control
- F2: Multi-timescale Edge resource management
- F3: In-backhaul support for service intelligence
- F4 Compute-aware radio scheduling

- F5 Energy-aware VNF placement
- F6 Self-learning MANO
- F7 Capacity forecasting
- F8 Automated anomaly response.

5.1.1 Vendors and service providers

Vendors participating in DAEMON are set to lead the future market of B5G technologies by developing novel hardware, software platforms and services. Three time-frames were defined:

1. Short term – Opportunity to get their R&D efforts into focus and evolve their current product portfolio with vertical requirements as input.
2. Medium term – Use findings to understand verticals requirements and needs related to the various industry markets, and to identify gaps in 5G End-to-End connectivity platforms in order to develop innovative, flexible solutions for B5G systems
3. Long term – Exploitation of results by further feeding their product and business units.

Table 10. Exploitation plan for vendors and service providers.

Partner	Brief exploitation plan
NEC	<p>NEC plans to use the results and findings from DAEMON to evolve the current vRAN and O-RAN product portfolio, and to develop an added-value management and orchestration platform that brings the flexibility of SDN/NFV to NEC line of products, impacting the Mobile Radio Access Networks and Mobile Wireless Networking business units.</p> <p>The project results will be used to demonstrate the benefits of the designed orchestration platform both to NEC development groups and potential customers, e.g., European network operators. NEC expects to derive a converged view about gaps and choke-points in today's technology for mobile carrier networks, the collaborative definition of requirements and findings about new concepts for B5G that shall support NEC's strategy and approach in directing its standardization roadmap in global Standards Development Organizations, such as O-RAN Alliance and the 3rd Generation Partnership Project (3GPP), in different areas to build a solid standards and technology base for the 5G communication system. With the motivation to serve a variety of verticals as well as mobile and stationary device types with different communication characteristics, requirements, duty cycles, traffic patterns, constraints and functional capabilities, NEC believes that the 5G Control- and Data-Plane can optimize the use of network resources on one hand, and ensure the end-to-end service quality experienced through end devices on the other hand, by enabling smart connectivity and associated tailored provisioning, selection and configuration of basic and value-adding services.</p>
NBL	<p>NBL plans to use the project results to evolve the current NOKIA product portfolio on orchestration solutions, towards an automated service life-cycle management that can facilitate an energy-efficient and elastic slicing of the network. Specifically, DAEMON's (NI-based) orchestration and scaling solutions is aimed to be integrated into the several NOKIA product families. NBL will also exploit DAEMON's solution platform via demonstrating internally under the umbrella of NOKIA or externally to the customers in order to explore and expand NOKIA's future product portfolio. The DAEMON project results will be presented to and discussed with the relevant NOKIA business units, as well as with the NOKIA teams actively participating in standardization. NOKIA expects that on the one hand through these interactions the product innovation will be improved and standards (IETF, 3GPP, ETSI, etc.) will be influenced, and, on the other hand, the DAEMON research will solve imminent real-world problems.</p>

5.1.2 Network operator

Network operators will evaluate how to best fulfil the requirements and service portfolio to vertical industry over their network, as well as how to shape their relationship with them. Three time-frames were defined:

1. Short term – Foresee a direct enhancement of their service portfolio by integrating novel forecasting and resiliency workflows into their production systems.
2. Medium term – Operators will gather the know-how for the planning and design of B5G networks.
3. Long term – Operators will apply the experience gained during the development of DAEMON innovations to contribute to the definition of B5G services for their customers.

Table 11. *Exploitation plan for network operators.*

Partner	Brief exploitation plan
TID	TID aims at exploiting DAEMON's results jointly with the business and Telefonica's operation units as follows: (i) improve or develop new methods to operational assessment of network systems, (ii) derive innovative products or services based on DAEMON technology, and (iii) submit patents to protect TID findings. TID will work to create new products that offer better network management, with particular emphasis on pro-active approaches to tackle anomalies. The team involved in DAEMON is currently leading the internal innovation project ARIANA (ARtificial Intelligence for Automated Network Actions), which aims to integrate artificial intelligence models within Telefonica's network operations for cognitive maintenance. Through internal innovation processes, TID will implement DAEMON AI-based solutions for anomaly detection in the big data platforms of linked stakeholders, including mobile operators such as O2 UK, as well as global platform operators, such as Telefonica Global Solutions Roaming platform.
OTE	OTE is highly interested in accelerating the development and deployment of modern and innovative telecommunication services and facilities, as those intended to be developed in DAEMON. Thus, OTE intends to exploit the anticipated DAEMON-based findings in terms of delivering pioneering services with strong user engagement by further promoting his competencies in the field of the telecommunication networks market arena at national and at European level. The modern and quite innovative features of the DAEMON findings may be able to influence, to a significant extent, future market-related policies, by offering important advantages for a more effective usage either of existing or of planned -to be developed- facilities. The related DAEMON-based solutions may have dramatic effects on the market sector and this might be a beneficial advantage for the company, especially to offer competitive solutions that could facilitate the market transition towards a real environment.

5.1.3 Small and medium enterprises

SMEs plan to evolve their products in their specific fields of interest. Three time-frames were defined:

1. Short term – SMEs will exploit from the technology created by DAEMON by contributing to open-source projects and training courses on SDN, NFV, MEC architectures and cloud platforms.
2. Medium/Long term – SMEs could design novel concepts, inspired from DAEMON results to feed-back their product portfolio, which will foresee in the long term an increase in their competitiveness for consultancy services.

Table 12. *Exploitation plan for small and medium enterprises.*

Partner	Brief exploitation plan
ADL	ADLINK seeks to exploit DEAMON innovations related to AI-based management applied to edge and fog infrastructure and data-critical platforms. Specifically, the expected innovations of DAEMON will enable ADLINK to augment its current intelligent computing platform for Edge Computing with a more dynamic management of the resources and services provisioned at the Edge. ADLINK seeks the transfer of the developed technologies by first fostering open-source projects to later build a complete value chain. Part of DAEMON innovations will be fed into the open-source project Eclipse Zenoh & Eclipse Zenoh-Flow currently led by ADLINK. The aim of Eclipse Zenoh is to provide a protocol suite for adaptive and distributed data-sharing, to enhance data distribution and flexibility. The aim of Eclipse Zenoh-flow is to provide a dataflow programming framework for computations that span from the cloud to the device enabling user to declare a dataflow graph that represents a set of nodes (sources, operators, or sinks) and linking them for dynamic load at run time.
SRS	SRS is an Irish SME providing full-stack SDR solutions for 4G and 5G systems. SRS UE and eNodeB/gNodeB stacks target x86, ARM and FPGA hardware platforms and our open, modular architecture supports highly customized, special-purpose systems. SRS adopts a unique business model that combines open-source and commercial licenses. Thanks to DAEMON, SRS will push forward its UE and gNodeB solutions, expanding and improving them for B5G systems. Specifically, the activities carried out in DAEMON will allow testing and strengthening the SRS 5G product portfolio, supporting the company in the addition of new features and improved performance. On the one hand, this will benefit the overall R&D community, which uses SRS' open-source solutions; on the other hand, it will allow SRS to present new

	product offerings to its commercial partners, promoting and accelerating the development of SRS' B5G product suite.
WINGS	WINGS is an SME that delivers solutions (software and hardware) for various verticals, namely for the areas: (1) environment (air quality/pollution, sea and land aspects), (2) networks and infrastructures (water/energy/gas, transportation, construction infrastructures); (3) production and manufacturing, which covers industry 4.0, logistics, aquaculture and food safety; (4) service sectors, with an emphasis on health. The solutions rely on: (a) IoT devices with embedded intelligence, (b) advanced wireless connectivity, cloud and big data platforms; (c) AI mechanisms; (d) visualization, which range from mobile applications and dashboards to AR/VR. The WINGS AI mechanisms resources for achieving a high performance and resilient operation. In this respect, through DAEMON, WINGS will enhance its AI competences, especially in the direction of obtaining resilient / robust and trustworthy AI, i.e., mechanisms capable of identifying and negotiating on infrastructure resources, and others capable of managing protecting the vertical AI mechanisms. The developed functionality will be exploited in the WINGS platforms, which will have advanced functionality in the vertical domain.

5.1.4 Academia and research centers

The Universities and R&D centers participating in DAEMON are interested in building on and further developing existing research in the networking research community. Two time-frames were defined:

1. Short/Medium term – academia will improve the knowledge in 5G and B5G, multi-domain orchestration, and slicing, transferring it to the industry.
2. Medium/Long term – the patent and license rewards will help to undertake future European and international research, which will contribute towards further collaborative research possibilities with the project partners and others.

Table 13. Exploitation for academia and research centers.

Partner	Brief exploitation plan
IMDEA	IMDEA is committed to support the transfer of technology to the industrial sector, in order to improve its capacity for innovation and competitiveness, as well as to spin-off-companies in order to promote the release of new products and services to the global market. In this context, DAEMON will offer new opportunities to IMDEA researchers to develop novel NI solutions to be transferred into products through the wide network of collaborations that IMDEA has established with the telecommunication industry. In addition, DAEMON will support the deployment of a new programmable network testbed at IMDEA consisting of three 32-port 100-Gbps Wedge programmable switches equipped with Barefoot Tofino chipsets and two Dell PowerEdge servers with 100-Gbps-capable interfaces used for emulation, monitoring and control purposes. Finally, DAEMON will allow IMDEA to recruit and train PhD students and postdoctoral fellows, creating new expertise at the interface of machine learning and mobile networking critical to the European industry.
IMEC	IMEC is a research institute that realizes exploitation of its R&D results to industry via industrial affiliation programs, bilateral projects, IP transfer and licensing, and occasionally through the creation of spin-off companies. The research carried out as part of DAEMON will help IMEC to develop novel solutions of industrial value in wireless communications and AI applied on network management (MEC orchestration, spectrum sharing, and collaborative learning). The knowledge and expertise gained from DAEMON will be very relevant to extend IMEC's 5G test facilities, which are an important asset for both the research community and industrial partners. Moreover, the IMEC IDLab is also embedded within the University of Antwerp, and the knowledge gained from the project will be exploited to support advanced engineering master courses to train future wireless engineers.
UMA	UMA plans to exploit the results of the DAEMON project, applying them to other ongoing research projects like MEDEA: MEthods and tools for the Deployment of energy-efficient Edge computing Applications and LEIA: Efficient Deployment of Augmented Reality Environments on the Edge. The DAEMON project gives us the opportunity to increase our knowledge of 5G technologies so that we can extend our energy efficient software solutions including the particularities of 5G networks. This will allow us to broaden the venues where to publish the research group results with top-rated conference and journals in the networks area. We also plan to continue our high publication rate in forums like SPL conference, and Information

	<p>and Software Technology, Ad hoc networks or Future Generation of Computer Systems journals.</p> <p>On the other hand, the team at UMA has a strong relationship with many of the software companies located at the Andalusia Technology Part (http://www.pta.es/), and our participation in DAEMON will allow us to increase our visibility in the area of sustainable 5G solutions. We plan to contact some of these companies to invite them to contribute to the validation of the DAEMON project results in industrial environments. UMA will be in position to offer technical advice to companies about software sustainability in 5G/Edge/IoT environments, and offer the open-source results of the DAEMON to the network communication community.</p> <p>Regarding the academic activities at UMA, we expect to enrich existing Master courses about advance telecommunication networks and Telematics Engineering with the results of this project, and to offer tutorials, organize workshops and different teaching activities to disseminate the new expertise acquired under this project to the academic and industrial community in Malaga and Spain.</p>
<p>UC3M</p>	<p>UC3M plans to use the results of the DAEMON project mainly along three lines.</p> <ul style="list-style-type: none"> • Strengthen the academic leadership: the leading role of UC3M in this area has been recognized by the research community, and the participation of UC3M in the DAEMON project allows to publish research results in top-rated conferences and journals, which helps to further strengthen UC3M's position and increase its visibility as one of the top academic institutions active in the field of the application of Artificial Intelligence to networks. In particular, UC3M has already published some of the results in top venues such as ACM MOBICOM, IEEE INFOCOM AND IEEE JSAC, among others. • Foster the technology transfers to enterprises: technology transfer to enterprises is one of the key activities of UC3M. This is being achieved through the standardization and open-source software development, among other activities. DAEMON will reinforce this kind of activities. In particular, UC3M is very active at ETSI ENI and ITU-T standards groups, where it is collaborating with other companies, which are also part of the consortium. • To consolidate the academic courses portfolio: according to several national rankings, UC3M is classified among the top universities in Spain for computer science and telecommunication network studies. The knowledge achieved from the participation in DAEMON provides innovative content to the courses being taught. In particular, UC3M is teaching several master's degrees closely related to DAEMON which are being fed with the knowledge gained from the project: the Big Data MSc, the 5G MSc, the SDN/NFV MSc, the Connected Industry 4.0 MSc, and the MSc in Telematics Engineering.
<p>TUD</p>	<p>TU Delft plans to leverage the results of DAEMON in the following three ways:</p> <ul style="list-style-type: none"> • Strengthen the academic leadership: the research activities and the multifaceted collaboration activities with the partners of the project are expected to reinforce the academic profile of TUD in this area. Furthermore, we plan to leverage this opportunity in order to increase our research portfolio with problems that are related to next generation mobile networks and with data-driven evaluation techniques for network orchestration algorithms. First-tier conference and journal venues will be targeted for publication of our results; while we plan to participate in the organization of conference workshops, special issues in journals, and tutorial lectures in relevant venues. • Technology transfer: we will explore potential venues for technology transfer, in collaboration with the industry partners of the consortium, but also with the locally-based enterprises and using the technology transfer program of TU Delft. • Funding Diversification: we will use the results and our experience in DAEMON to apply for additional funding, towards the end of its lifetime, in national funding agencies, and other suitable venues. • Enrich relevant academic courses: the learning outcomes of DAEMON will feed existing courses that are organized in the Software Technology Department of TU Delft, but we will also explore the possibility of developing new courses entirely dedicated to and aligned with the mission of DAEMON (network intelligence algorithms and techniques).

5.1.5 Exploitation plan of products and platforms for vendors and SMEs

In the following table, a detailed description of the platform and products for vendors and SMEs according to the exploitation plan is reported.

Table 14. Exploitation for vendors and SMEs.

Partner	Product / platform	Description of impact on platform/product	DAEMON innovation Area
NEC	NEC O-RAN product portfolio	NEC's RAN Intelligent Controllers for O-RAN Compatible RANs will be highly benefited with the outcome of DAEMON's research. The objective is to derive data collection and decision-making entities both at near-real-time and non-real-time timescales.	RAN orchestration
	NEC 5G orchestration platform	SDN/NFV-based centralized resource management orchestrator for mobile transport domains and network slice orchestration. NEC's orchestration platform comprises a series of tools and automated decision-making entity that merge prediction and machine learning to derive cost-efficient network slicing mechanisms. DAEMON novel orchestration solutions for SLA monitoring and management, and automated network slice management will have a potential impact on the evolution of this product.	End-to-end orchestration
	Net2Vec	Net2Vec is a flexible high-performance platform that allows the execution of deep learning algorithms in the communication network. The monitoring platform of DAEMON and its interfaces with high-speed data processing platforms can have an impact on the evolutions of this product.	All NI
	NEC E-RAN (MEC platform)	NEC's In-Building Small Cell Solutions are easy to install and can be used for WIFI like fast deployment. DAEMON innovations on control loops for service orchestration and programmable traffic management schemes can potentially be integrated in the evolutions of this product. http://www.nec.com/en/global/solutions/nsp/sc2/sol/s02.html	Edge orchestration
NBL	Digital Operations Center	The DO Center provides an agile and modular orchestration for managing service orchestration across virtualized and hybrid networks. It is expected that DAEMON results on, e.g., intelligent placement of VNFs, scaling up/down and in/out, cooperation of controller operating at different timescales, will steer DO innovation.	End-to-end orchestrator
	CloudBand product family	The CloudBand product family, consisting of an NFV resource and network service orchestrator built for OpenStack and VMware, provides two main functions. As a network service orchestrator, the system onboards network services, automates their lifecycles, and provides monitoring and troubleshooting tools. As a resource orchestrator, it administers, monitors and optimizes NFV infrastructure resources across geographically distributed NFV infrastructure nodes. DAEMON innovation pertaining to energy-aware placement and close loop control are expected to impact the (future) list of features of the CloudBand product family.	End-to-end orchestrator
	FlowOne	The research carried out in DAEMON will allow enhancing FlowOne, which provides an agile and modular orchestration for managing service orchestration across virtualized and hybrid networks	Edge orchestrator

WINGS	AIRWINGS	Product platform regarding Air Quality. Includes an AI component and is delivered over wireless infrastructure. Advanced components for having advanced, robust, resilient and trustworthy AI mechanisms: resource request and reallocations, means for improving the AI performance. As all the products have an AI component, it will be important to have mechanisms (at infrastructure and vertical domains) for management, in order to guarantee resilience and also generate trust.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
	ARTEMIS	Product platform regarding Utilities. Includes an AI component and is delivered over wireless infrastructure. Impact as described above.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
	WINGSPARK	Product platform regarding Transportation and Parking. Includes an AI component and is delivered over wireless infrastructure. Impact as described above.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
	AQUAWINGS	Product platform regarding Aquaculture. Includes an AI component and is delivered over wireless infrastructure. Impact as described above.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
	STARLIT	Product platform regarding the Health sector. Includes an AI component and is delivered over wireless infrastructure. Impact as described above.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
	AGNES	Product platform regarding Food safety. Includes an AI component and is delivered over wireless infrastructure. Impact as described above.	Energy-aware VNF placement (F5), Self-learning MANO (F6), Automated anomaly response (F8)
ADL	Eclipse Zenoh	Eclipse zenoh provides a protocol suite for adaptive and distributed data-sharing, to enhance data distribution and flexibility. DAEMON monitoring platform and its interfaces with high-speed data processing can have an impact on the evolutions of this product..	Distributed data-management
SRS	srsRAN	srsRAN is a fully open-source 4Gand 5G suite including complete UE, RAN and Core network implementations. During 2021, srsRAN will provide one of the first FOSS 5G NSA RANs for public use. With this srsRAN became the new name for srsLTE, as the project begins to focus more on the RAN element of	RAN Orchestration

		5G networks. Within the DAEMON project, srsRAN will be leveraged to develop and demonstrate the AI-enabled Network Intelligence envisaged by the project. It is hoped that the advancements made during the DAEMON project will inform the ongoing design and development of srsRAN with features and interfaces to support NI assisted network orchestration and optimization.	
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5.2 Patents and licensing

DAEMON project addresses an area that provides significant opportunities for standard essential patents. All partners are committed to producing European IPR as important channel for exploiting the project's outcomes. Partners have a strong background with over 40 patents related to DAEMON's agenda. At least 20 patents are expected to be filed in the context of DAEMON or in topics closely related to DAEMON.

It has to be noted that, after submitting a patent application, it typically takes about one to three years to be granted, sometimes significantly longer. It is also common to file additional divisional/continuing applications several years after the original filing. This means it can take several years before the final protection scope is known, and the time may vary significantly.

Manufacturers can also use patented systems or patented methods in products of their portfolio. In this case, the patent department inside the company typically activates a continuous monitoring of possible infringement typically targeting main competitors operated on the same market segment. Infringement detection and the relevant legal contention can also bring to additional revenues from the invention.

Finally, patents may lead to subsequent licensing, depending on the interests of the partners in exploiting their inventions for their products/solutions or by selling the license to 3rd parties leveraging on licensing revenues. The licensing options are also available for patents filed by academic institutions in the consortium.

5.3 Standardization plan

Maximizing the impact of the project innovations on present and future standardization bodies and industry forums, has been set as a key objective to help create opportunities for commercial exploitation of the project outcome. To this aim, DAEMON has appointed Dr. Xi Li, from NEC, as Standardization Manager (SM) to centralize and coordinate all the effort that has the potential of contributing to relevant SDOs.

This section presents the updated plan for the activities and achievements that will be undertaken on standardization. These contributions are expected to successfully influence SDOs activities, for example in 3GPP Releases 17, 18 and 19, ETSI ENI and ZSM, ITU-T FG-AN, O-RAN, and IETF/IRTF, leveraging the bridging role of industrial partners with leading and active experts in these SDOs.

5.3.1 Standardization work plan

The project has set the following three objectives for the standardization activities:

- Create and maintain a project standardization activity roadmap per year. This roadmap will capture the standardization activities that may influence or get influenced by the project technological innovations. It will keep track of existing or upcoming industry specifications or recommendations that may affect the project technological choices and identify opportunities for the project to contribute its proposed solutions to present and future standardization groups.
- Disseminate the project into the standardization forums to raise awareness and help create an opportunity for standardization exploitation.
- Contribute through the partners (individually or jointly) with project-related technology proposals into the relevant standardization forums.

The above objectives remain applicable over the whole project duration. With the focus on Year 2, it is anticipated that the efforts and activities will be mainly focused on contributing with the designed DAEMON innovations and related technology solutions to project selected and identified SDOs according to the overall project standardization activity roadmap, to enhancing the project standardization exploitation on standardization dissemination and contributions.

5.3.2 Standardization Update

This section presents an update of the relevant standardization bodies.

5.3.2.1 3GPP

5G-Advanced will introduce artificial intelligence and machine learning technologies across the RAN, core and management network domains. 3GPP will also study how 5G system capabilities can be used to assist AI/ML applications running over the whole network. Operators could offer their networks as optimized platforms for distributed AI/ML services between application servers and application clients. In particular, 3GPP RAN3 has recently started a new Release-17 study on the applications of AI/ML to RAN. The most obvious candidate for AI/ML in RAN is Self-Organizing Networks (SON) functionality, currently part of LTE and NR specifications. With SON, the network self-adjusts and fine-tunes a range of parameters according to the different radio and traffic conditions, alleviating the burden of manual optimization for the operator. The algorithms behind these SON functions are not standardized in 3GPP and are typically rule-based. One of the main differences between SON and the envisioned AI-based approach is the switch from a reactive paradigm to a proactive one.

The AI/ML study has just started and focuses on the functionality and the corresponding types of inputs and outputs (massive data collected from RAN, core network, and terminals), and on potential impacts on existing nodes and interfaces; the detailed AI/ML algorithms are out of scope of RAN3. Within the RAN architecture defined in RAN3, it is planned to consider energy saving, load balancing, and mobility optimization. The aim is to define a framework for AI/ML within the current NG-RAN architecture.

In Release 18 the work on the use of AI/ML in the NG-RAN will continue and also the use of AI/ML for the Air interface will be considered (e.g., Use cases to focus, KPIs and Evaluation methodology, network and UE involvement, etc.)

5.3.2.2 ETSI

ETSI is the European Telecommunication Institute, a recognized European Standards Organization dealing with telecommunications, broadcasting and other electronic communication networks and services. Most of the standardization work at ETSI is carried out in committees. Different tasks require different types of committees. Main types are:

- a) Technical Committee (TC) – addressing a number of standardization activities in a specific technology area.
- b) ETSI Project (EP) – similar to a Technical Committee but established for a fixed period of time.
- c) ETSI Partnership Project – established when there is a need to co-operate with other organizations to achieve a standardization goal. 3GPP is one of them.
- d) Industry Specification Group (ISG) – operating alongside the traditional standards-making mechanisms and focusing on a very specific activity.

The committees typically meet between two and six times a year, either on ETSI premises or on other locations. ETSI members will decide what work to be done by each committee, establishing and maintaining a work program which is made up of individual items of work.

For DAEMON project, there are opportunities to demonstrate and validate proposed standards, and to contribute project results to them. We aim to make contributions to two ETSI ISGs (all focused on *network transformation*) that are directly related to DAEMON:

- a) **ENI**, on AI-enabled network management. The Cognitive Network Management system based on AI proposed by the ETSI Industry Specification Group on 'Experiential Network Intelligence' (ISG ENI) allows operators to improve the flexibility in the network operation, by automating network configuration and monitoring processes. The overall objective is to reduce the expenditure and improve the use and maintenance of the network. *DAEMON outcomes can contribute to ETSI ENI along different axes. First, the NI architecture proposed by DAEMON may complement current proposals by the ISG with an approach based on the concertation of NI operations at different timescales. Second, the novel NI-assisted functionalities proposed by the project will allow for the automated scaling the infrastructure needed to support onboarded services. Finally, DAEMON demonstrators set can contribute to the ongoing Proof-of-Concept (PoC) programme held by the ISG (e.g., by promoting one of the planned PoC activity).* The ETSI ENI PoC framework is responsible to provide real feedback from the implementation of the ETSI ENI defined use cases to the continuous architectural definition.
- b) **ZSM**, on network service automation. ZSM is working on the definition of a network architecture that supports different functionality such as the End-to-End Network Service Management, Network Slice as a Service, Testing and Tracing. *Here DAEMON will promote the developed NI models based on self-learning techniques to ISG ZSM, as NI models are explicitly targeted by the objectives of this ISG.*

Contributions to the individual groups are prepared as documents, including the requested changes to the current version of the draft work-item results. The contributions are discussed in online or F2F meetings and the contributions comply with ETSI IPR rules.

DAEMON partners have a solid history of contributions to the relevant ETSI ISGs. UC3M authored a use case definition and is member of two PoCs, and in one of them also WINGS is a supporting partner.

Also, we are exploring the possibility of proposing a new PoC based on the DAEMON testbeds. Along this scope, TID's solution on anomaly detection in collaboration with Telefonica Global Solutions is the base for this PoC we aim to contribute to ENI.

5.3.2.3 IETF/IRTF

In IETF/IRTF (NMRG) TID and WINGS on behalf of the project contributed to the IRTF Network Management Research Group (NMRG) group. The planned contribution is about IETF Network Slice Intent. Specifically, slicing at the transport network is expected to be offered as part of end-to-end network slices, fostered by the introduction of new services such as 5G. The contribution explores the usage of intent technologies for requesting IETF network slices.

Also, the contribution leverages current industry trends in the definition of end-to-end network slices. The final objective is to describe intents that can be used to flexibly declare the operational aspects and goals of an IETF network slice, meaning that the customer could declare what kind of IETF network slice is needed (the outcome) and how to achieve the goals of the IETF network slice.

5.3.2.4 ITU-T

Within the ITU-T, the Autonomous Network Focus Group on "Autonomous Networks" (FG-AN) studies how to provide an open platform to perform pre-standards activities related to this topic and leverage the technologies of others where appropriate. More concretely, this includes, among other aspects, the study of the meaning and characteristics of autonomous network, to study and propose technical enablers for evolution in autonomous networks, to provide guidelines to enable higher levels of autonomy through real-time responsive experimentation, and to specify requirements and architectures for adaptation in future networks to enable autonomy.

DAEMON contributed to this FG for the first deliverable on use cases FGAN-O-013, which stemmed from the presentation FGAN-I-014 delivered for the kick off meeting of the Focus Group. The goal of delivering a NI-native architecture for beyond 5G Network perfectly fits the goals of the Focus Group, so it is expected that future synergies will follow.

5.3.2.5 O-RAN

The O-RAN Alliance was founded by mobile operators to evolve the radio access network. Future RANs will be built on a foundation of virtualized network elements, white-box hardware and standardized interfaces that fully embrace O-RAN's core principles of intelligence and openness. The O-RAN Alliance defines future RAN requirements and helps building a supply chain eco-system following two principles: (i) Openness – the specification of open interfaces is essential to build agile and cost-effective next-generation RANs, such that smaller vendors and operators can quickly introduce new services; and (ii) Intelligence – the advent of 5G and beyond result in highly complex networks, with high densification and richer and more demanding applications. To tame such complexity, networks in the O-RAN vision must be self-driving, leveraging new learning-based technologies to automate operational network functions and reduce operational costs. *DAEMON is perfectly aligned with the O-RAN vision, and very well positioned to influence the design of interfaces to accommodate the NI needed for the operation of virtualized RANs, including the coordination between radio and computing resources and the coordination between real and non-real-time data collection, model training and NI execution.*

The relevant working groups of ORAN for DAEMON project:

- 1) WG1: Use Cases and Overall Architecture Workgroup
- 2) WG2: The Non-real-time RAN Intelligent Controller and A1 Interface Workgroup
- 3) WG3: Near-Real-time RIC and E2 Interface Workgroup
- 4) WG6: Cloudification and Orchestration Workgroup.

Contributions to ORAN are made by O-RAN Alliance members (both operators and vendors, NBL and NEC are two of the active members). The contributions are discussed in periodic meetings and the approval is consensus-based. There are releases in O-RAN alliance for the different specifications, interfaces and software. ORAN milestones are not scheduled and there is not O-RAN Alliance wide roadmap.

DAEMON partners have been actively following the activities in O-RAN, which is quite relevant for DAEMON. In this line, NEC and NBL are the active members of O-RAN and also participating in regular meetings. During the first year of the project, NEC and NBL have together contributed in total seven approved contributions to O-RAN WG1 and WG2, In Year 2, we expect to bring even more contributions with the DAEMON use cases and innovations on defining NI related functionalities to the Non-RT and

Near-RT RIC design with novel architecture components and interfaces, aligned with the scopes of the O-RAN WGs (WG1, WG2, WG3 and WG6). Also, we will explore the possibilities of proposing new PoC based on the DAEMON testbeds.

5.3.3 DAEMON standardization roadmap update

This section presents an updated SDO roadmap in the following sub-sections. First subsection is mapping the standardization activities to technical innovations and use cases of DAEMON project and the second section is visualizing the timeline of main standards entities towards 2023.

5.3.3.1 Mapping of standardization activities to Technology Area and Use Cases

Based on the standardization activities identified above, a classification of the standardization activities per technology development area (or topic) in the project is first attempted.

Table 15. Mapping of DAEMON innovations to SDOs.

DAEMON innovation	SDO	Rationale
RIS control	O-RAN, 3GPP RAN	Reconfigurable Intelligent Surfaces (RIS) are raising interest in both O-RAN and, especially, 3GPP as a means to increase spectrum efficiency in the RAN. DAEMON can contribute with the specification of interfaces that would enable enforcing policies on the RIS controller and exchanging information (e.g., wireless channel estimates) between gNBs and RIS controller.
Multi-timescale resource management	ETSI ENI	DAEMON may contribute to support multi-timescale NI <i>with novel functionalities proposed by the project to allow for the automated resource management required to support onboarded services.</i>
In-backhaul support for service intelligence	ETSI ENI	In-backhaul NI methods, functional blocks, and interfaces designed in DAEMON may induce extensions in ETSI ENI architecture. Moreover, computing-capable network forwarding elements, such as smart switches, may embed AI-capable NFVs to process data flows while they traverse the mobile backhaul system.
Compute-aware radio scheduling	O-RAN	This NI functionality is at the forefront of O-RAN jurisdiction where joint optimization of O-Cloud and O-DU/CU resources are to be expected. Innovations at both Non-RT RIC and Near-RT RIC, in addition to A1, O1, O2 and E2 interfaces are within the scope of DAEMON.
Energy-aware VNF placement	IETF/IRTF NMRG	Energy-awareness VNF placement could be included into the standardization path of IETF SFC and ETSI NFV by i) consolidating orchestration algorithms that take this aspect into consideration, ii) including the energy consumption of VNFs in the VNFs catalog data and, iii) including such monitoring information from the VIM.
Self-learning MANO	ETSI ENI, IETF/IRTF NMRG, ITU-T FG-AN	ETSI NFV captures multi administrative domain instantiations of the architecture, however the Self Learning

		MANO (which takes into account vertical requirements) may require an extension of the interfaces. The same concept may also apply for the ETSI ENI Architecture.
Capacity forecasting	3GPP, O-RAN	Capacity forecasting is a concept that can be applied to several entities in the standardization landscape. 3GPP (for the analytics related to the NWDAF) or O-RAN, for the capacity related to the radio.
Automated anomaly response	3GPP, ITU-T FG-AN	3GPP TS23.288 [8] defined a procedure for the “Abnormal UE behaviour” analytics which may be further refined with the DAEMON findings. The ITU-T FG-AN is also looking for new solutions, where DAEMON is working, on the autonomous networks to automatically monitor, operate, recover, heal, protect, optimize, and reconfigure themselves.
NI orchestration layer	ETSI ENI, ETSI ZSM	The coordination of different NI entities is in scope with the ETSI ENI framework and the ETSI ZSM fabric, especially for MANO related purposes.

5.3.3.2 Updated Timeline

The following figure presents an updated timeline of the identified DAEMON SDOs for the remaining lifetime of the project.

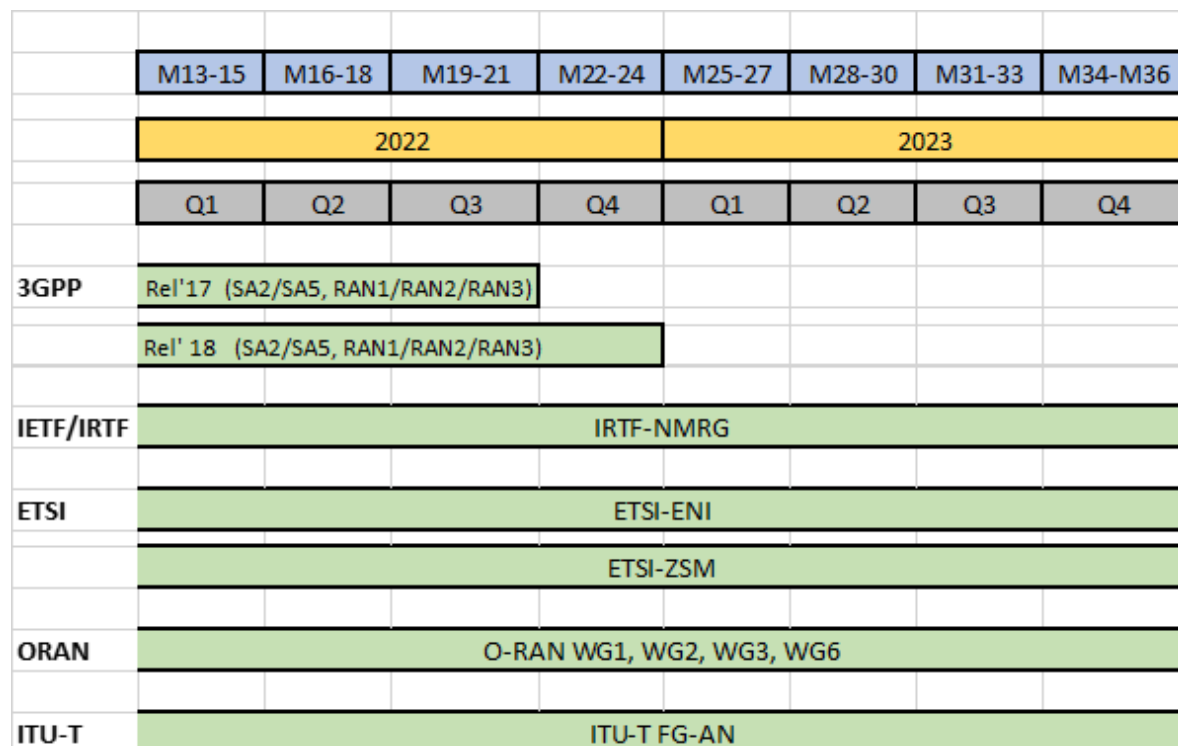


Figure 15. Updated Timeline of SDOs relevant to DAEMON.

5.4 Open-Source plan

Contributions to open-source platforms is a key objective, set out to maximize the impact of the project. By fostering the integration of advancements to NI made by DAEMON into the relevant open-source projects, the project can ensure a significant impact on the open-source community, and in leading platforms used in both academia and industry. Any contributions made to the relevant projects should be impactful and significant. They should aim to clearly demonstrate the advancements made to each platform as a result of innovations made by DAEMON.

The project has outlined a goal of 6 contributions to open-source projects over the course of the project, as one of the main KPIs for WP6. As mentioned previously the following open-source platforms have been identified as those most relevant to DAEMON, while also having strong links to project partners: srsRAN, and Eclipse Zenoh.

5.4.1 Open-Source work plan

The second year of the project will bring many technical innovations and advancements to the targeted areas of NI. These will include modifications to the open-source projects being used. Some of these modifications may be DAEMON specific, and others may be beneficial to wider use cases of the open-source projects. The modifications will form the contributions we will make to these open-source projects. As a result, the open-source work plan for Y2 will focus on the following:

- Identification of the specific areas of each project that DAEMON should contribute to
- Make initial contributions to open-source projects
- Active engagement with the communities of the above open-source projects

A concrete roadmap for open-source activities in Y3 and beyond. Contributions should be made to the relevant areas of each open-source project. We aim to identify the key areas of each project that apply most to DAEMON as technical work progresses in Y2. Thus, helping the project to make impactful contributions to each open-source project. This will also help to identify which element(s) of each open-source project DAEMON will use. Doing this will also aid in the identification of any modifications that must be made in order to ensure stable interoperability between the DAEMON framework and the open-source elements being leveraged.

In line with the goals set out in the project proposal we aim to make three contributions across the identified project in Y2, and three further contributions in Y3. This will ensure the KPI is met. Once each of the open-source projects being leveraged has been integrated into the DAEMON framework, we hope to begin making these contributions. The initial contributions should assist in championing the integration of advancements to NI made by DAEMON. Helping the project to ensure a significant impact on the open-source community, and in leading platforms used in both academia and industry.

We hope to actively engage with the communities of the above open-source project once these initial contributions have been made. As a result, we will be aiming to highlight the importance and potential impact, DAEMON could have for the open-source community. This engagement will be ongoing throughout the duration of DAEMON, so as to continue to promote the work being done between contributions to open-source projects. This may take the form of tutorial like publications, public demos or involvement in open-source oriented conferences/ conventions.

As all of this work is being done it will be important to continually assess progress being made with open-source activities. By keeping an up-to-date log of all activities, and by actively reviewing our road-map and progress on a monthly basis, it is hoped that the impact of these activities will be as meaningful as possible. It will also be important for us to plan for Y3 and beyond.

Overall, the work-plan for Y2 will focus on further identification of the elements needed from each open-source project, integration of these elements into the DAEMON framework, initial contributions to open-source projects and the promotion of DAEMONS involvement in the open-source community.

5.4.2 Relevant Open-Source activities

This section presents the open-source activities used or contributed by DAEMON project.

5.4.2.1 srsRAN

The SRS software radio suite (srsRAN) provides an open-source, flexible and robust framework for B5G network R&D, prototype development and real-world deployment. The suite provides complete UE and RAN applications and is widely used for mobile wireless R&D in both academia and industry. Recognized for its stability, performance and code quality, srsRAN has provided the foundation for a broad range of successful R&D projects, featuring as a key tool in more than 200 peer-reviewed articles [3]. On the GSMA mobile security hall of fame [4], srsRAN has been leveraged by researchers making 8 of the most recent 11 Coordinated Vulnerability Disclosures (CVDs).

Under DAEMON, SRS will provide complete 5G RAN and UE solutions which can be leveraged, modified and extended to develop and demonstrate the AI-enabled Network Intelligence envisaged by the project.

DAEMON modifications and extensions will be developed on a fork of the main srsRAN project repository. This work will be released publicly under the open-source AGPLv3 license for other researchers to assess and use, supporting reproducibility of DAEMON research outputs. Use of the AGPLv3 license also ensures full compatibility with the underlying srsRAN software. Using a repository fork in this way ensures that DAEMON-specific work can easily be rebased and updated as new srsRAN software releases become available. It further allows modifications or extensions to be contributed back into the underlying srsRAN software where appropriate using the standard contribution and peer-review mechanisms used by the project.

5.4.2.2 *Eclipse*

The Eclipse Foundation, more in particular the Edge Native Working Group initiative fosters openly accessible solutions for Edge and Fog computing, and has taken a major lead in this domain. It provides Open-Source edge compute platforms to solve the complex challenges in decentralized environments at the mobile network edge. ADLINK, a partner in DAEMON, is a founder and steering member of the Edge Native Working Group.

Under DAEMON, ADL has provided a release for the Eclipse Zenoh v0.5.0-beta.9 on November 24, 2021 and is available in the official repository [5]. ADL will continue to actively participate in the different events of Eclipse IoT and Eclipse Edge, for example the presentation of the 2021 IoT and Edge Developer Survey Results [6].

5.4.3 DAEMON open-source time line

The following figure presents a timeline of DAEMON open-source projects over its lifetime.

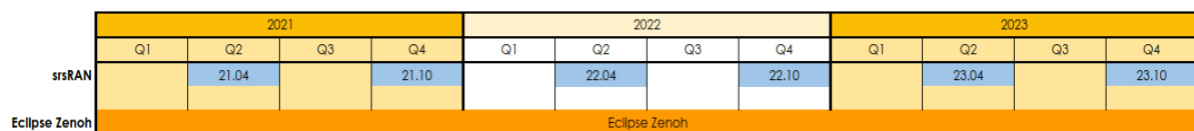


Figure 16. Open-source time plan.

srsRAN follows a 6-month release timeline, releasing in April and October of each year. The first 5G elements have already been made available to the DAEMON project via the public repository of srsRAN. Release 21.04 and 21.10 have brought the 5G NSA UE and 5G NSA eNB/ gNB to srsRAN, with the first 5G SA gNB coming in Q2 2022. The 5G SA UE implementation will be available at a later date.

ADL do not have a specific timeline release for Eclipse zenoh project. However, depending on the features being implemented in the scope of the project, and as well as external contributions, it is expected to have 1-2 releases per year. It should be remarked that Eclipse Zenoh follows an open call for roadmap definition where next steps are discussed and decided within the opensource community. For this reason, at the time of writing this deliverable, it is not possible to identify the right quarter for the next releases. Eclipse zenoh is currently available to download from the open-source repositories [5]. The Eclipse Foundation does not follow a set release schedule, with updates being driven by ongoing projects and occurring in a more ad hoc manner than that of srsRAN.

These releases should be added to the project GitHub repository as soon as they become available. We should plan to make two contributions per year, one per project, to ensure we meet the aims set out in the project proposal.

6 References

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