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Cloud for Holography and Augmented RealITY

Cloud for Holography and Cross Reality

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Abstract

This interim report is a compilation of dissemination, communication and standardisation activities performed by the CHARITY project consortium during the first 18 months of the CHARITY project life cycle.

In the scope of CHARITY dissemination and communication, such activities follow the Communication and Dissemination Strategy defined in D5.1 (M06). This strategy has been improved and refined with complementary actions to ensure the accomplishment of the objectives committed by the project consortium.

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Disclaimer

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Executive Summary

The CHARITY project aspires to leverage the benefits of intelligent, autonomous orchestration of cloud, edge, and network resources, to create a symbiotic relationship between low and high latency infrastructures that will facilitate the needs of emerging applications.

To maximise the value of the project results, a dedicated Work Package (WP5) defines and supports an impact creation strategy that covers all the tasks and activities needed for this purpose. Such impact can be assessed by the project's innovations, i.e. any result that, by being used, delivers a benefit to someone or addresses a need, being these benefits not only economic but also societal, research, environmental, or educational.

Within the context of WP5, partners are reflecting on how to make society aware of the project and its benefits (**communication**), how to discuss with the scientific community about the project results and collect their feedback (**dissemination, collaboration**) and how to foster industry adoption of its features (**standardization**).

This deliverable reports on the activities conducted in WP5 in the first 18 months of the project, namely T5.1, T5.2 and T5.4. During this period, the consortium has actively participated towards its goal by creating CHARITY's visual identity and website, the main communication channel used by the project to deliver relevant content to external audiences. In addition, the project's social media accounts on LinkedIn, Twitter and Facebook have been used for promotional purposes and to promote interactions among key target audiences. A CHARITY YouTube channel has also been created to present the progress of the technical development and its results visually. To date, CHARITY project partners have produced different types of communication material (posters, social media banners, newsletters), which have been used at events for increasing project visibility.

Generating impact and disseminating the project's findings and results among research and academic communities have been mainly done through the active development of papers and their posterior presentation and publication at important conferences and in journals. In addition, CHARITY project partners have also participated in external events and have organised events/webinars.

CHARITY project closely monitors standardisation activities and fosters collaboration with standardisation bodies to assist with forming strategies and ensure that the project's objectives are met. CHARITY project partners recognise open-source communities as essential pillars to ensure the sustainability of the project results and uptake by third parties.

This document aims at providing an impact assessment on Communication, Dissemination and Standardisation activities carried out until M18, and will also outline the ongoing and planned activities until M24 in the aforementioned fields.

Table of Contents

Executive Summary **3**
Table of Contents **4**
List of Figures **6**
List of Tables **7**
Abbreviations **8**
1 Introduction **9**
1.1 Purpose of this document 9
1.2 Rationale of content 9
1.3 Methodology 9
2 Communication and Dissemination activities **10**
2.1 CHARITY Website (KPI 01) 10
2.2 Social Media (KPI 02) 12
2.2.1 LinkedIn 12
2.2.2 Twitter 15
2.2.3 Facebook 17
2.2.4 YouTube 18
2.3 Communication Materials (KPI 03) 19
2.3.1 Newsletter releases 21
2.3.2 Press release 22
2.3.3 Poster 1 (Project Presentation) 23
2.3.4 Poster 2 (CHARITY project architecture) 23
2.3.5 Flyer and Leaflet 24
2.3.6 Roll-up 26
2.3.7 Partner Interviews (Youtube) 26
2.3.8 Banner 27
2.4 Participation on 3rd party events (KPI 04) 28
2.5 Organisation of local workshops (KPI 05) 34
2.6 Collaboration with other H2020 projects (KPI 06) 36
2.7 Participation on EC Events (KPI 07) 38
2.8 Publications (KPI 08) 39
2.9 Contribution to Open-Source repositories (KPI 09) 47
2.10 Advanced Training (KPI 10) 47
2.11 Community Building (KPI 11) 48

2.12 Summary of dissemination and communication activities 48
3 Standardisation activities 50
3.1 Performed Activities 50
3.1.1 3GPP 51
3.1.2 MPEG 52
3.1.3 IETF Detnet and ITU-T Network 2030 53
3.1.4 ITU-T SG13 54
3.1.5 ETSI Multi-Access Edge Computing AND ISG Network Functions Virtualization 54
3.1.6 ETSI Zero touch network & Service Management (ZSM) 55
3.1.7 ETSI Augmented Reality Framework 55
3.1.8 Khronos group 56
3.2 Next steps on standardization 56
4 Conclusions and next steps 57

List of Figures

Figure 1: Homepage of http://www.charity-project.eu. 10
Figure 2: CHARITY project website, Google Analytics data. 11
Figure 3: Average session duration of users on www.charity-project.eu. 11
Figure 4: Users analysis by country for the period of 1st January 2021 to 15th May 2022. 12
Figure 5: The company page of the CHARITY project partners “CHARITY EU Project” 13
Figure 6: Metrics - Engagement rate of May, April and May 2022 of the CHARITY account on LinkedIn. 13
Figure 7: Visitors demographic background of the CHARITY account on LinkedIn 14
Figure 8: Visitors metrics of the CHARITY account on LinkedIn (June 2021 - June 2022). 14
Figure 9: Followers performance of the CHARITY project account on LinkedIn (M02-M17). 15
Figure 10: Tweet impressions during the months of March, April and May of the @CHARITYproj Twitter account. 15
Figure 11: Average engagement rate of @CHARITYproj account during March, April and May 2022. 16
Figure 12: Followers performance of the CHARITY project account on Twitter (M02-M17). 17
Figure 13: CHARITY project’s Facebook account @CharityEUProject. 17
Figure 14: Interactions of followers on the CHARITY project’s Facebook account. 18
Figure 15: Follower performance of the CHARITY project account on Facebook (M02-M17). 18
Figure 16: YouTube channel of the CHARITY project (M17). 19
Figure 17: CHARTITY project website with dedicated Newsletter section. 21
Figure 18: Call to action for newsletter subscription. 21
Figure 19: Dedicated site to easy subscription to the newsletter for interested visitors. 22
Figure 20: Poster 1 of the CHARITY project - General Project presentation 23
Figure 21 Poster 1 of the CHARITY architecture 24
Figure 22: Project Flyer available for download on the project website. 25
Figure 23: Project Roll-up 26
Figure 24: YouTube channel with interviews of CHARITY project partners. 27
Figure 25: Banner to be used within email exchanges with externals 27
Figure 26: Banner used in partner website to promote the CHARITY project. 28
Figure 27: Overview of Webinar #1 organised by CHARITY partners. 34
Figure 28: FRAME workshop website: https://www.accordion-project.eu/frame-2nd-workshop-on-flexible-resource-and-application-management-on-the-edge/ 35
Figure 29: CHARITY project contribution to October 2021 H-CLOUD newsletter release. 36
Figure 30: Social Media posting about the CHARITY project participation at the workshop organised by the ARETE & iv4XR projects 37
Figure 31: Mr. Pearse O’Donohue visiting the CHARITY project booth at EuCNC & 6G Summit 2022. 38

List of Tables

Table 1: Event participation along Y1..... 29
Table 2: Event participation along M13-M18). 30
Table 3: Events where CHARITY project partners will participate (organisation ongoing)..... 31
Table 4: Events which are under evaluation for Y2..... 33
Table 5: Webinars organised by CHARITY project partners. 34
Table 6: Planned Webinars by CHARITY project partners for Y2. 34
Table 7: Collaboration with other H2020 projects since Y1 / 2021. 36
Table 8: Collaboration with other H2020 projects since Y2 / 2022. 37
Table 9: Publications generated by CHARITY project partners during Y1 (Jan-Dec 2021). 39
Table 10: Publications generated by CHARITY project partners during M13-M18 (Jan-Jun 2022). 41
Table 11: Contribution to open-source repositories by CHARITY project partners until M18. 47
Table 12: Support activities for advanced training by CHARITY project partners until M18. 48
Table 13: List of communities in the scope of the CHARITY project. 48
Table 14: CHARITY project's Dissemination and Communication KPIs to achieve by M24. 49
Table 15: CHARITY project's Dissemination and Communication KPIs to achieve by M36. 49
Table 16: List of CHARITY contributions to ITU-T. 50

Abbreviations

3D	Three dimensional
AR	Augmented Reality
E2E	End-to-end
GA	Grant Agreement
IoT	Internet of Things
KPI	Key performance indicator
MEC	Multi-access Edge Computing
NGN	Next-generation Network
QoE	Quality of experience
SEO	Search Engine Optimization
SDN	Software defined network
SME	Small and Medium size enterprise
VNF	Virtual network function
VR	Virtual Reality
WP	Work Package
XaaS	Anything as a service. Most popular terms are SaaS - Software, PaaS - Platform, IaaS - Infrastructure as a service
XR	Extended Reality
ZSM	Zero Touch Network and Service Management

1 Introduction

1.1 Purpose of this document

The WP5 objective is to maximise the project's impact, engage relevant stakeholder groups and provide visibility of the project goals, facilitating the adoption of its results. This deliverable reports the various communication, dissemination and standardization activities that CHARITY partners are conducting. Such activities follow the strategy described in D5.1, to ensure that the project findings and results reach the target audience and influence the relevant community and the relevant standards.

1.2 Rationale of content

The first three sections provide an overview of the communication, dissemination and standardisation activities performed during the first 18 months of the project life cycle. Then, a section follows where this effort is evaluated in light of the committed key performance indicators (KPI) established in the underlying Grant Agreement. Finally, the interim report's conclusions aim at extracting the essence of the presented content.

1.3 Methodology

The deliverable D5.1 (Dissemination and Communication Strategy, M06) defined suitable methods to ensure that the project research and practical outcomes are widely disseminated to the appropriate target audiences. The previously defined approaches have been applied and, whenever needed they were adapted in order to maintain the project on track. It is worth highlighting the following key approaches that were followed in this work package:

- Monthly WP5 meetings to synchronise the partner's efforts in terms of communication, dissemination and standardisation allowing to detect project risks in advance to further design and implement mitigation actions.
- Dedicated *ad-hoc* meetings: whenever it is required (e.g., for event participation, webinar organisation, standardisation activities, etc.) - the partners set up a dedicated online meeting to focus and make progress on specific items. Thanks to the minutes, partners (specially the absentees) can catch up with the discussed topics and provide their view and/or contribution, if needed, off-line.
- Only Office Tool: a common working space allows to share and edit online documents fostering collaboration and reducing administrative overhead making a more efficient use of the available resources.
- Tracker Tool: this tool allows partners to create and manage communication and dissemination items so that Task Leaders and WP leaders can perform a proper follow up of these items.

2 Communication and Dissemination activities

Communication and dissemination activities represent an essential effort of the project to raise awareness and maximise the visibility of the project results and progress among key stakeholders potentially interested in adopting the technologies and solutions developed within the CHARITY project, and among a wide range of audiences to demonstrate the commitment and interest of the European Commission to boost European innovation.

CHARITY project considers an efficient and complementary set of dissemination and communication activities. The first one refers to the public disclosure of the results to various stakeholders such as research peers, industry, potential end-users, policy-makers, standardisation bodies, and others that could adopt and integrate the results in their work. On the other hand, communication activities cover the promotion of the action and results to many audiences, including media and the public to build strong relationships and reach society.

This deliverable presents the report of communication and dissemination activities done by the Consortium partners until M18 of the project.

The following sections describe and report the specific activities achieved until M18.

2.1 CHARITY Website (KPI 01)

The project website (https://www.charity-project.eu/) was created on M01 considering various SEO best practices and requirements for enhancing the organic positioning on search engines, such as the monitoring and analysis of keywords, increasing the number of internal and external links, and fulfilling accessibility requirements to offer valuable content to visitors regardless of the type of device they use to visit the website.

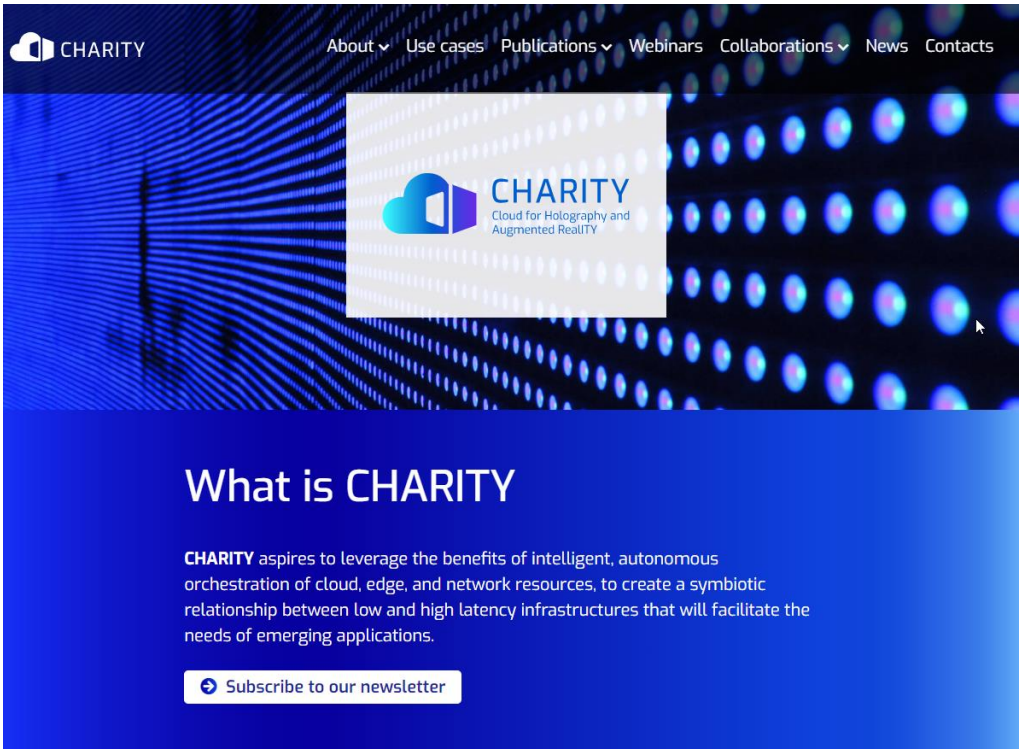

Figure 1: Homepage of http://www.charity-project.eu.

The website is the main communication channel used by the project to communicate with external audiences about motivation, progress, knowledge and various activities aiming to raise awareness and increase the visibility of the project.

All the new content uploaded to the website is highly promoted through the project and partners' social media accounts to maximise the reach, inform followers and interested parties, and then drive traffic to the website where visitors can get more information about a specific topic.

We use Google Analytics to monitor and measure relevant metrics that indicate the traffic of the website to understand if the content provided is well received by visitors. Figure 2 presents data on the number of users, session, page views, and average session duration for the given period.

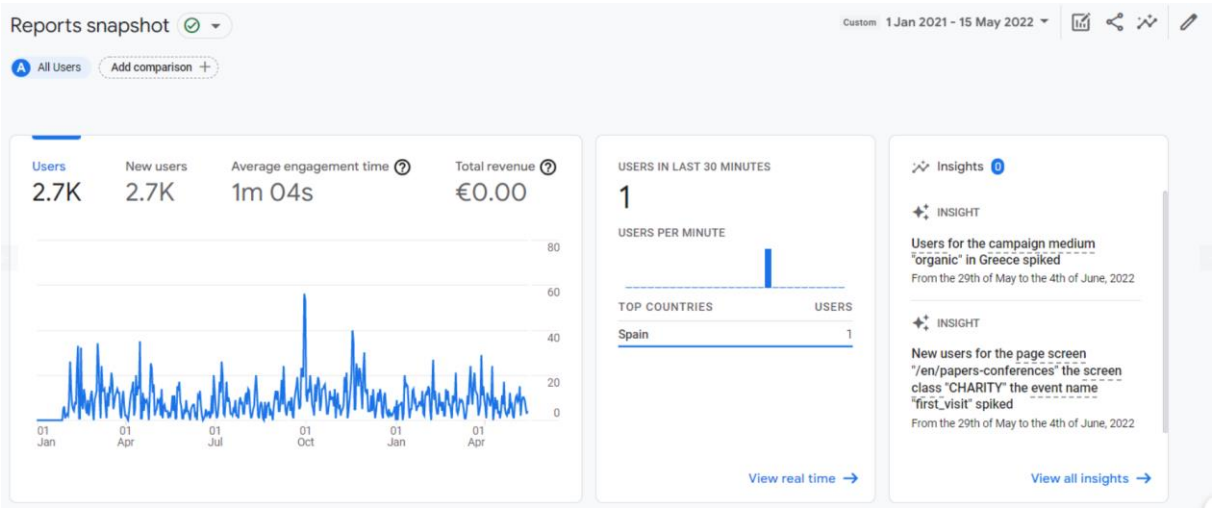

Figure 2: CHARITY project website, Google Analytics data.

According to the data presented, over the actual length of the project (until 15th of May 2022), there are 2,704 users who have initiated at least one session of the website. This number is a good indicator so far that we are meeting the objective of increasing the visibility of the project and raising awareness about its objectives and expected results. Also, we have had 2,975 sessions, which is the period of time a user is actively engaged with the website, resulting in over 5,000 page views of the different content regarding the CHARITY project. Regarding the average session duration, 1 minute and 4 seconds is a very good metric for an informative website as it is the purpose of CHARITY's by presenting general information about the project.

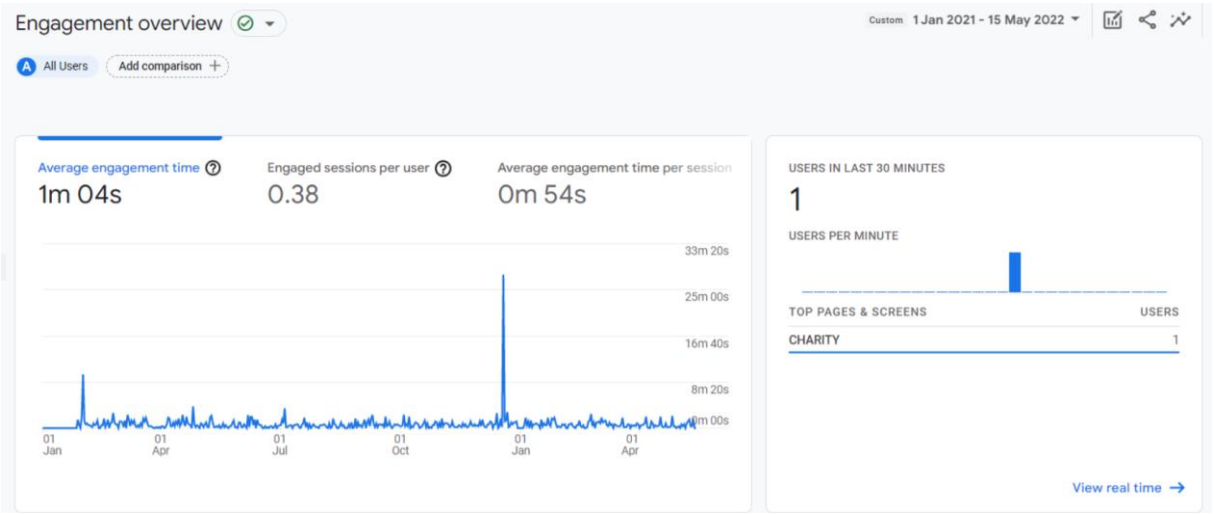

Figure 3: Average session duration of users on www.charity-project.eu.

Almost half of the traffic (44.3%) comes from direct search, which means visitors that entered the site address in the browser, accessed through a saved tab, or clicked on a specific link containing the website address. This is a result of the link-building strategy - publications on external websites that are adding information about the project, in some cases they link to the website.

The organic search (31.4%) is the traffic coming from unpaid search results on search engines such as Google, Yahoo, or Bing. This is directly related to the SEO positioning thanks to the monitoring and use of relevant keywords in the content provided, following accessibility guidelines and having a strong link-building strategy. Finally, the social traffic (19.6%) reflects that a good portion of visitors is coming from the publications made on social networks of the project, project partners and 3rd parties, especially on Twitter and LinkedIn, which is one of our main tactics to increase the traffic of the website.

It is interesting to see in Figure 4: Users analysis by country for the period of 1st January 2021 to 15th May 2022. that there are visitors from most EU countries and from non-EU countries such as the United States. Most of the visits come from countries where a project partner has its headquarters, but there are visits from users based in other EU countries, which means that the content and work done by the project partners is reaching other territories, driving innovation and research activities in the fields addressed by the CHARITY project.

Figure 4: Users analysis by country for the period of 1st January 2021 to 15th May 2022.

2.2 Social Media (KPI 02)

Social media accounts of the project on LinkedIn, Twitter and Facebook have been used to promote and give visibility to advancements and relevant information not only about the CHARITY project but about XR as a whole, leveraging the public interest in these technologies. Efforts have been made to identify related accounts, specifically other H2020 profiles, in order to reach a beneficial return in engagement and interactions among key shared target audiences, always with the goal of boosting the visibility and positioning of the project. Main posts are shared between these three platforms (LinkedIn, Twitter and Facebook), to multiply the reach of each specific update of the project, but each platform has a very different return. Twitter and LinkedIn are the main focuses of the project, while Facebook acts as a mirroring platform.

In addition, a YouTube channel has been set up dedicated to videos produced by the CHARITY consortium.

2.2.1 LinkedIn

CHARITY's company page on LinkedIn (CHARITY EU Project) is an essential part of the communication and dissemination strategy designed and outlined in D5.1 (M06). This social network targets more professional and technical audiences and connects the project with specialized profiles that could be potentially interested in the project results. In this case, what matters are the rates and metrics indicating reactions from followers, which indicate if the content is well received by followers.

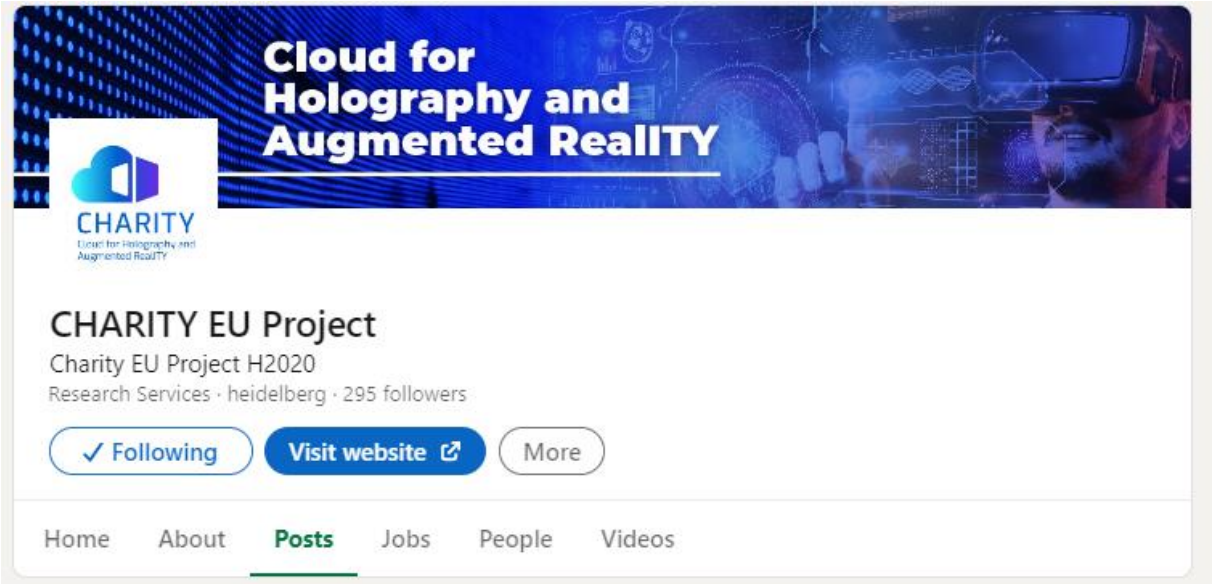

Figure 5: The company page of the CHARITY project partners "CHARITY EU Project".

For this purpose, the engagement rate is the main focus of analysis. The reactions percentage demonstrates that the project partners are providing quality content on LinkedIn that followers and visitors are interacting with. We have had an average engagement rate of 6,5% in the last trimester, reaching a peak of around 9% in the last 14 days alone. This is a really good indicator that the posts have meaningful interactions among those already interested in the topics developed in the project.

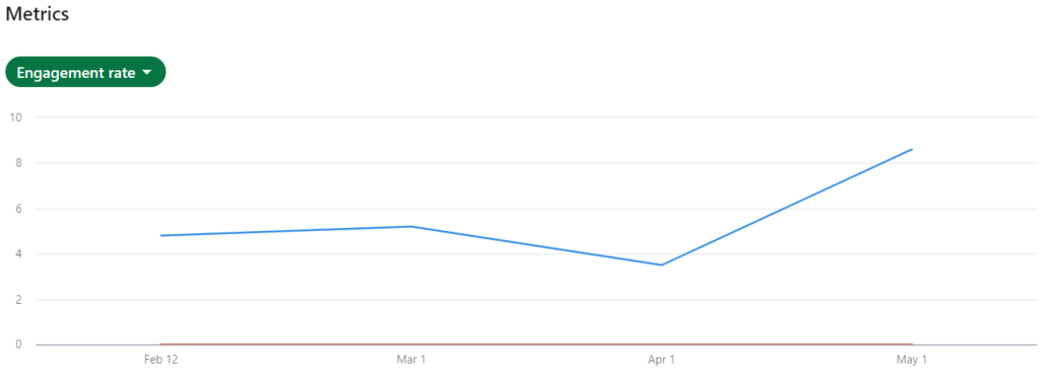

Figure 6: Metrics - Engagement rate of May, April and May 2022 of the CHARITY account on LinkedIn.

This assessment is only evaluating interaction, but also where that interaction is coming from. Figure 7 exposes the type of professional profiles is interested in the content provided by the CHARITY project account on LinkedIn. Around 40% of the audience comes from a technical and engineering background, which can be evaluated as optimal considering the key topics of the CHARITY project. However, there is another profile of visitors that comes from a business, marketing or project management background that is also relevant to the project as the CHARITY project aims at providing new business opportunities to European citizens, entrepreneurs, companies and organisations in general.

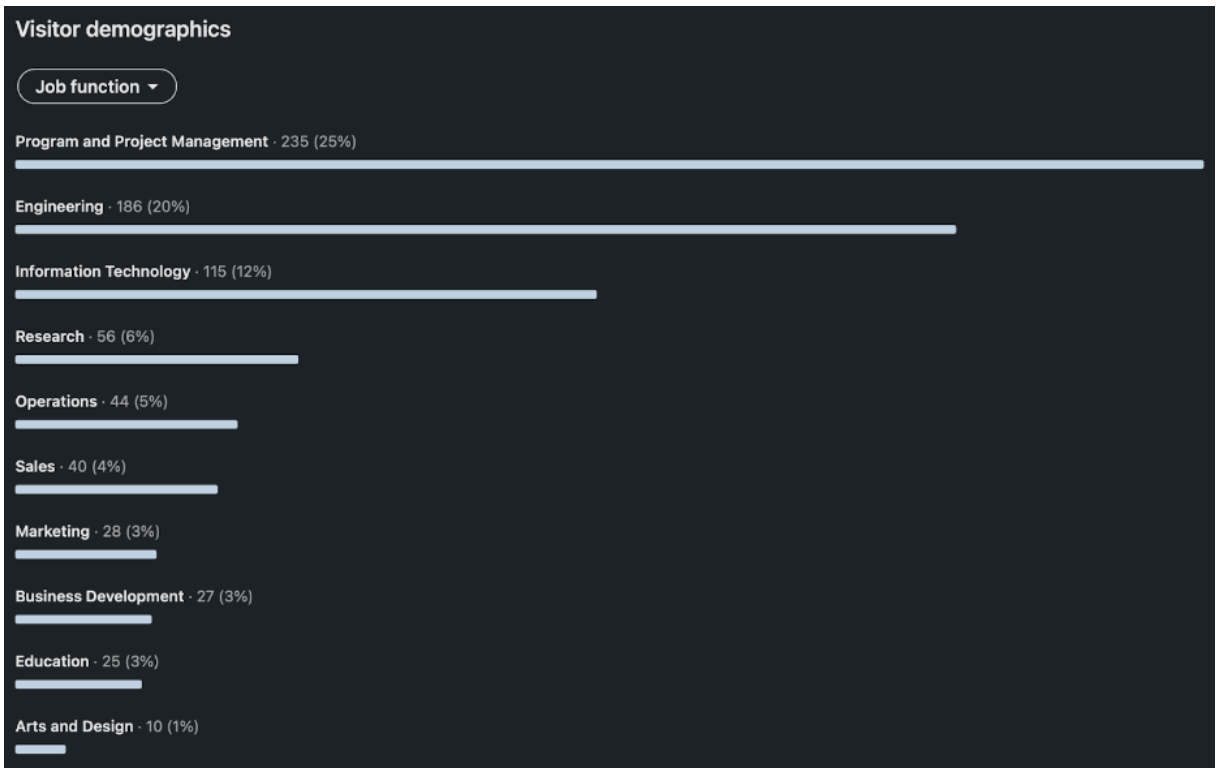

Figure 7: Visitors demographic background of the CHARITY account on LinkedIn.

In general, the performance on this social network has been very good in accordance with the status of the project. Still, there's room for improvement as we can see in Figure 8. It is no surprise that November 2021 or March 2022 have provided more than double the visitors of the other months since it also has had more than double the posts (e.g. webinar#1 organisation). It can therefore be stated that increasing the number of posts with content such as the blog or project updates will positively impact the other metrics on reactions, page views, posts impressions and website visitors.

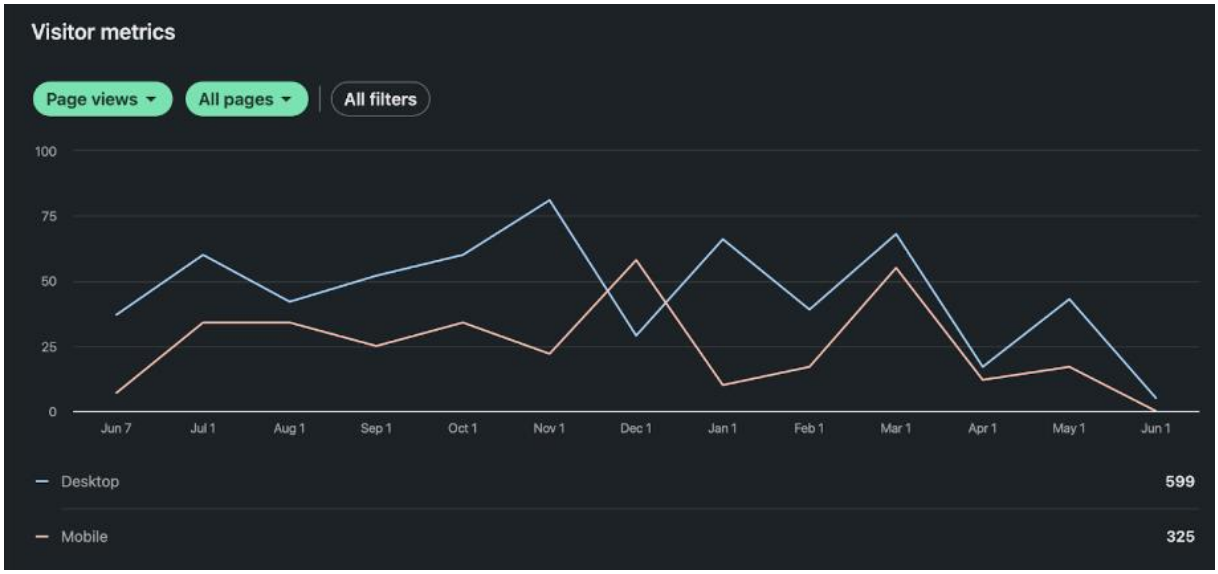

Figure 8: Visitors metrics of the CHARITY account on LinkedIn (June 2021 - June 2022).

As shown in Figure 9, it is demonstrated how the account has been getting followers at a steady pace that increases between 2 and 8 new followers each month. In the middle of M18 the account reaches 295 followers surpassing soon the 300 followers milestone which is an important and beneficial achievement for the project as a whole.

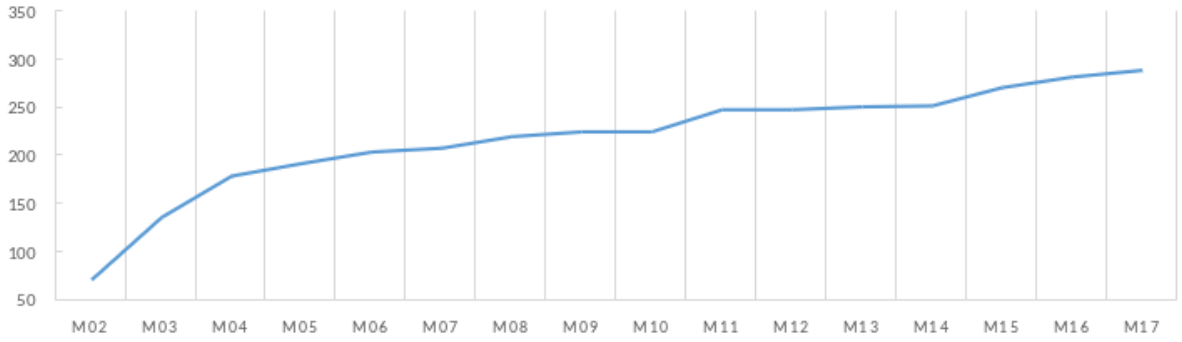

Figure 9: Followers performance of the CHARITY project account on LinkedIn (M02-M17).

2.2.2 Twitter

The Twitter account (@CHARITYproj) is specifically aimed at interacting and establishing a relationship with other related projects, either interested in XR or part of the H2020 ecosystem.

Content was posted regularly to provide followers with relevant information about topics related to the project. Also, information posted by other accounts is retweeted and liked to generate interaction with key accounts while also amplifying the scope of the content offered by CHARITY. In the last 3 months, a total of 27 tweets have been done at the CHARITY account. Of these 27 tweets, 16 have been published in March, which sees the best rate of interactions of the last trimester. The number of posts is related to the number of activities and events where the project is participating. It shows that social media results can therefore be directly related to the performance of the project visibility as a whole.

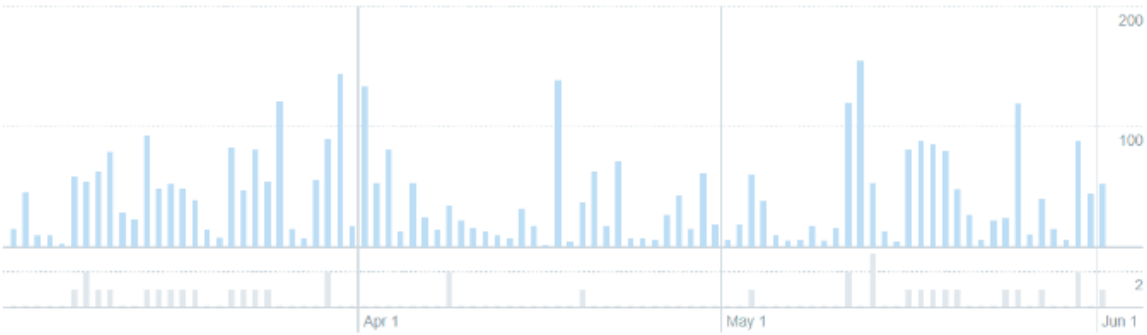

Figure 10: Tweet impressions during the months of March, April and May of the @CHARITYproj Twitter account.

Figure 10 shows Tweet impressions over the months of March, April and May 2022. We can extract several takeaways:

- Our Twitter strategy has been paying off as we are established at a current rate of 41 organic impressions per day, with 5 tweets in the last 3 months that have reached over 100 organic impressions each.
- To measure the level of interaction by followers from content created by the CHARITY project, the engagement rate indicates a percentage over the number of posts and interactions, which was presented on the previous image. As stated in Figure 11, the average engagement rate is at 2.0%, which is massively above the industry average of 0.037%[2], which means our audience is really keen on reacting to what we're doing.

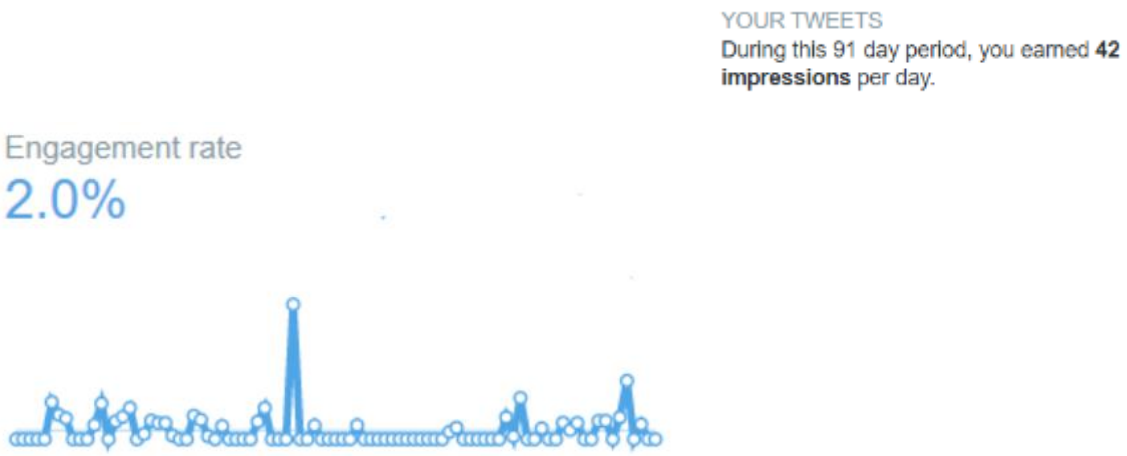

Figure 11: Average engagement rate of @CHARITYproj account during March, April and May 2022.

Some strategies we are considering in the upcoming months to continue this trend are:

- Monitor accounts of events, projects, thought leaders and organisations either working on similar topics, or potentially interested in adopting the project's results.
- Plan campaigns about specific topics in advance to guarantee variability of content and leverage all the communication opportunities arising from partners' activities.
- Make clear calls-to-action to drive traffic from social media accounts to the website of the project, which helps to increase the number of unique visitors.
- Use attractive banners, visuals and emotions to increase engagement rates and interaction of followers with the presented content
- The numbers accomplished align with the expectations especially considering the frequency of posts done per month. As mentioned previously, by guaranteeing more original posts per week it is expected to maintain and ideally increase these numbers. Also, the organization of and participation at events during 2022 will contribute to more relevant content to post and enhance interaction actions.

Figure 12 shows the overall follower performance of the CHARITY project account on Twitter which reached and surpassed on M14 the 100 followers milestone (M17 - 108 followers).

[2] According to our 2022 Social Media Industry Benchmark Report, the overall median engagement rate on Twitter is 0.037%. https://www.rivaliq.com/blog/social-media-industry-benchmark-report/

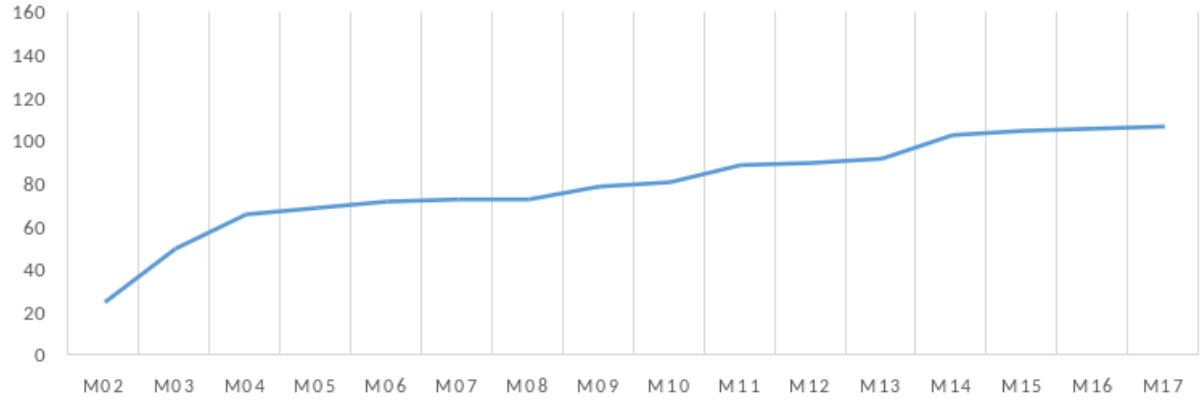

Figure 12: Followers performance of the CHARITY project account on Twitter (M02-M17).

2.2.3 Facebook

CHARITY project's Facebook account (@CharityEUProject) has been set-up. While LinkedIn covers the area of professional/technical audience and Twitter has the ability to reach a great amount of people through its platform and algorithm, Facebook targets a wider audience. Follows an analysis on the progress and the impact of CHARITY project's Facebook account on raising project visibility.

Figure 13: CHARITY project's Facebook account @CharityEUProject.

From February until May 2022 the number of accounts reached, increased in over 30% (compared to the previous months). Also, peaks in impressions have been more common, meaning our content strategy has definitely fit what our followers expect from the CHARITY project.

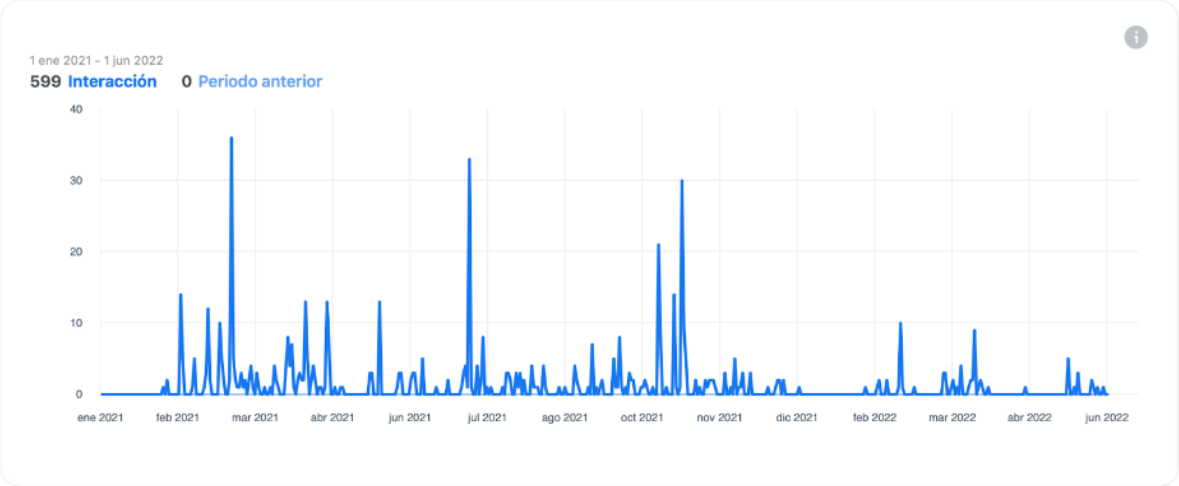

Figure 14: Interactions of followers on the CHARITY project's Facebook account.

This can be further seen in Figure 14, which measures interaction events from the audiences in the same period of time. In this case, interaction rate has increased by a strong 62.5% over the last comparable period. Events like reactions, shares or mentions all contribute to this tally, that reflects an evolution in the interest of the audience reached.

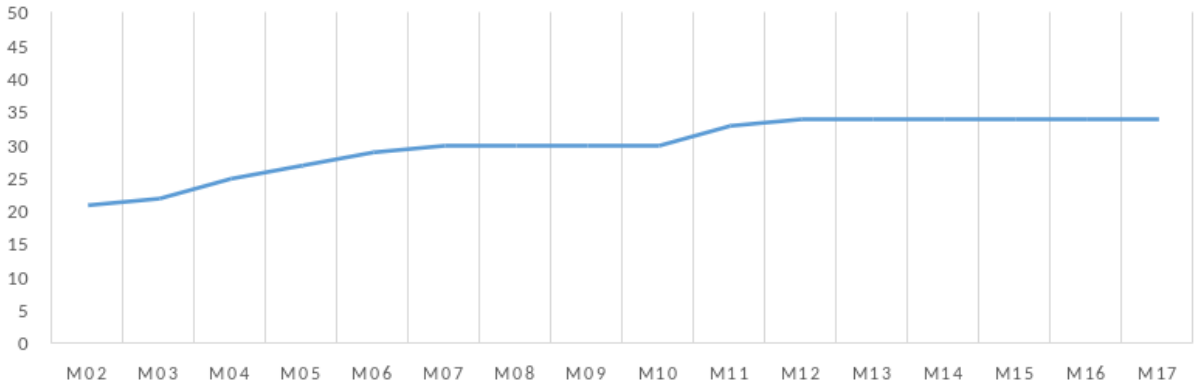

Figure 15: Follower performance of the CHARITY project account on Facebook (M02-M17).

2.2.4 YouTube

A YouTube channel dedicated to the CHARITY project was created on M09 to upload different types of videos such as video interviews with partners presenting and explaining the project Use Cases and recordings of webinars produced by the project partners to present the progress of the technical development and its results in a visual way. At M17, the channel had 19 subscribers and 5 videos had been uploaded, with a total of views over 236 viewers.

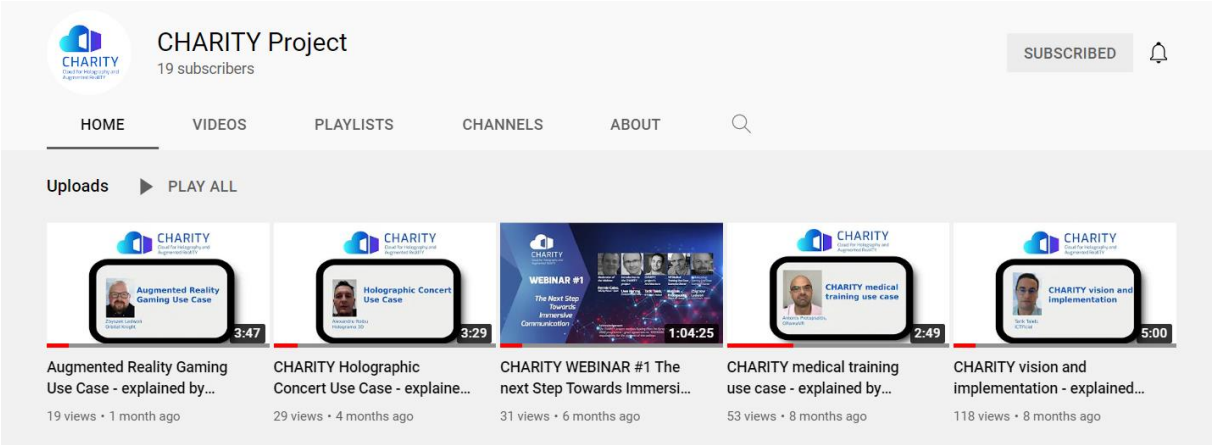

Figure 16: YouTube channel of the CHARITY project (M17).

2.3 Communication Materials (KPI 03)

The CHARITY project consortium produced several promotional materials about the CHARITY main goals and achievements of the project, such as Newsletters, Posters or Roll-ups.

During the first 12 months (Y1), following communication activities and materials have been created:

Item	Description	Estimated # persons reached
Website	www.charity-project.eu	2.213 visitors
Flyer	The Next Step Towards Immersive Communication. Creating new business opportunities for the European Industry (https://www.charity-project.eu/en/brochures-flyers).	86 website views
Leaflet	The Next Step Towards Immersive Communication. Creating new business opportunities for the European Industry (https://www.charity-project.eu/en/brochures-flyers).	50 copies
Poster 1	Project Overview (https://www.charity-project.eu/en/brochures-flyers)	86 website views
Newsletter #1	The Next Step Towards Immersive Communication (https://www.charity-project.eu/en/newsletters/newsletter1)	9 subscribers
Newsletter #2	Innovating in the field of next-gen applications (https://www.charity-project.eu/en/newsletters/newsletter2)	14 subscribers
Newsletter #3	At the forefront of live data processing (https://www.charity-project.eu/en/newsletters/newsletter4)	16 subscribers
Newsletter #4	Creating new business opportunities for all Europeans in the field of immersive communication applications (https://www.charity-project.eu/en/newsletters/newsletter4)	19 subscribers
Press Release	CHARITY Press Release (https://www.charity-project.eu/en/news/charity-press-release-march-2021)	3800 followers 55 website views

H-CLOUD Newsletter contribution	H-CLOUD Newsletter contribution, October 2021 release https://www.h-cloud.eu/news/charity-project-towards-achieving-immersive-communication/	301 subscribers
Charity Interviews (YouTube)	CHARITY medical training use case - explained by Antonis Protopsaltis (https://www.youtube.com/watch?v=-9vf4H4OyX8)	53
CHARITY Interviews (YouTube)	CHARITY vision and implementation - explained by Tarik Taleb (https://www.youtube.com/watch?v=osp2ZH4y8r0)	115
CHARITY Webinar (YouTube)	Webinar #1 - Recorded version of the webinar (https://www.youtube.com/watch?v=nEfs7T7nCq4)	28
Banner	Banner used in emails and on partner websites	200

Along the next 6 months (M13-M18, Y2), following activities have been performed:

Item	Description	Estimated # persons reached
Website	www.charity-project.eu	970 visitors
Newsletter #5	The future of XR services in the wake of 6G new businesses (https://www.charity-project.eu/en/newsletters/newsletter5)	21 subscribers
Roll up	CHARITY project presentation (https://www.charity-project.eu/en/brochures-flyers)	80 views
Poster 2 - UC Presentation	EuCNC Event (https://www.charity-project.eu/en/brochures-flyers)	80 views
Poster 3 - Architecture	EuCNC Event (https://www.charity-project.eu/en/brochures-flyers)	80 views
Website - UC Minisites	7 Dedicated sites for each UC (https://www.charity-project.eu/use-cases)	40 views
H-CLOUD Newsletter contribution	H-CLOUD Newsletter contribution, Jan 2022 release https://www.h-cloud.eu/news/charity-project-latest-updates/	410 subscribers
Magazine	Eurescom message - 5G-Enabled XR Medical Training 4.0 Using XR to effectively educate healthcare personnel (https://www.charity-project.eu/news/eurescom-message-summer-2022-extended-reality)	2.150 copies sent 52 times downloaded
Charity Interviews / Youtube	Augmented Reality Gaming Use Case - explained by Zbyszek Ledwon (ORBK)	19 visitors
Charity Interviews / Youtube	Holographic Concert Use Case - explained by Alex Roibu (Holo3D)	29 visitors
Banner	Banner used in emails and on partner websites	100 views

The planned activities for the remaining months of Y2 are:

- Release of CHARITY newsletter #6, #7 and #8
- Release of H-CLOUD newsletter (June/July 2022) with contribution of CHARITY project (subscribers so far: 510)
- Elaboration of Interviews to project partners presenting their work (YouTube)
- Creation of communication material needed to attend events
- Promote on social media project accounts CHARITY project related news, outputs, event participation, event organisation, etc.

Along the following sections, the communication activities performed are described more in detail.

2.3.1 Newsletter releases

The project partners committed to 4 newsletter releases per year. During the first year (2021) Newsletter #1, #2, #3 and #4 were designed, elaborated and released. During the second year of the project the same approach will be performed. At the moment of the elaboration of this Deliverable, Newsletter #5 has been released and the release of #6 is ongoing so that at the end of M18 the Newsletter #6 can be shared with the newsletter subscribers (by email) and made available on the project website for all visitors.

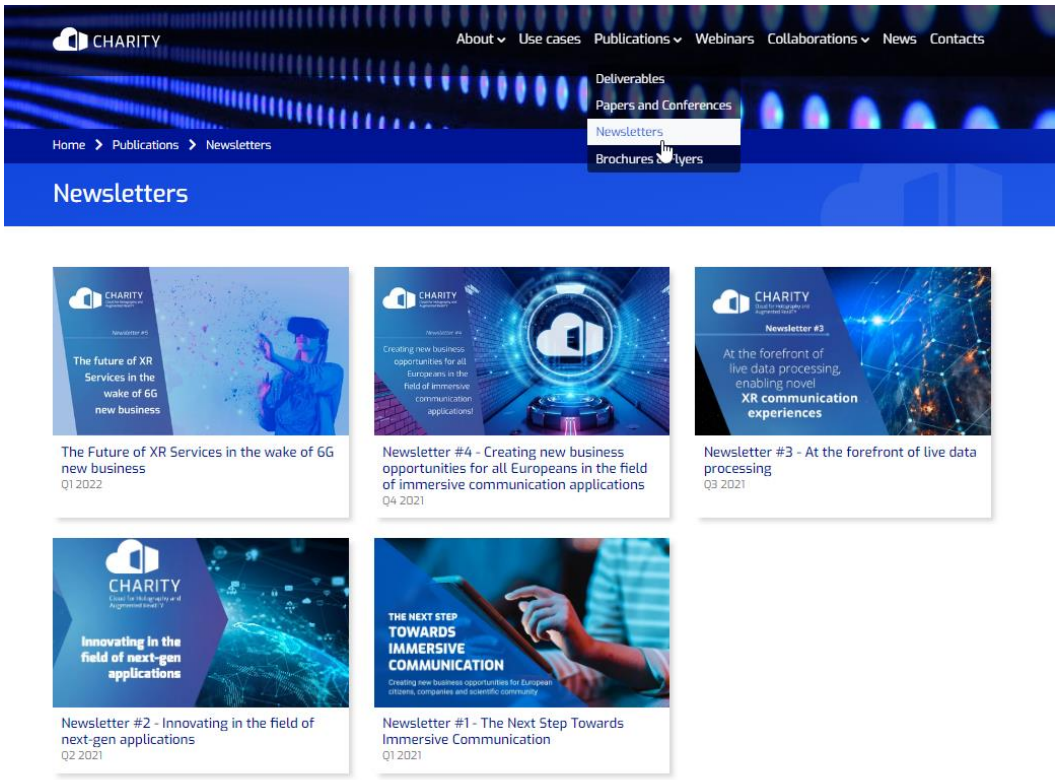

Figure 17: CHARTITY project website with dedicated Newsletter section.

All available newsletters are available on the Newsletter section within the CHARITY project website (Figure 17).

Figure 18: Call to action for newsletter subscription.

A call to action on the homepage (Figure 18) and a dedicated site (Figure 19) are available for new visitors so they can easily subscribe to the newsletter as well as manage their subscription.

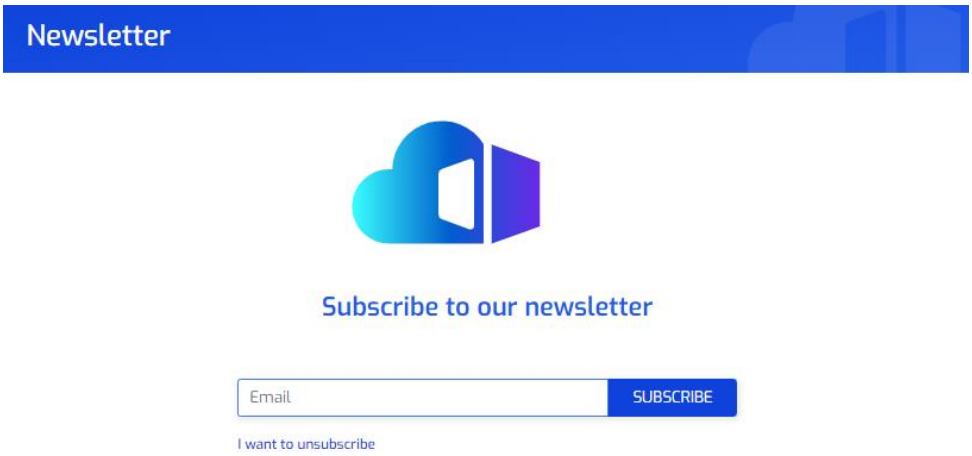

Figure 19: Dedicated site to easy subscription to the newsletter for interested visitors.

2.3.2 Press release

A press release was published during the first months of the project life cycle at a consortium level in order to present the project to the community and start creating awareness about the potential results which can arise from the research activities to be conducted by the project partners in the scope of the CHARITY project.

This press release was sent to several media by each partner. The press release was published on the Cluster TIC Galicia website as news item. This organisation is followed by more than 3.800 followers (only on LinkedIn). In addition, this content was made available on the CHARITY website (News section) and published on all project social media accounts.

2.3.3 Poster 1 (Project Presentation)

Figure 20: Poster 1 of the CHARITY project - General Project presentation.

A concise project presentation depicted on a poster is a visual aid to use while the work is being presented and a way to guide the audience through the project.

This poster is available on the project website for download and can be used any time by the partners for presentation on on-site events or sent as promotional material via online channels.

At the beginning of the project this poster was used several times to underline social media content.

As shown in Figure 20 several sections are available on the poster:

- Project Logo
- Image that communicates the idea of immersive communication using headsets
- EC logo
- Consortium presentation
- Partner logos
- Links to online website and accounts
- EC acknowledgement

2.3.4 Poster 2 (CHARITY project architecture)

The CHARITY platform has its basis on the innovative CHARITY architecture, whose 5 layers are explained in this dedicated poster.

This poster is available on the project website for download and can be used any time by the partners for presentation at on-site events or sent as promotional material via online channels.

Figure 21 Poster 1 of the CHARITY architecture

2.3.5 Flyer and Leaflet

The project Flyer and Leaflet are available for download on the project website. These communication items can be used by partners to introduce the project briefly to other interested parties (online and off-line). They are used on several social media posts to raise awareness about the project.

Figure 22: Project Flyer available for download on the project website.

2.3.6 Roll-up

The project partners designed a roll-up to be used on events which is available for download on the project website. This advertising displays are composed of a canvas, on which the design is printed, which is rolled up at the base of the structure. They are self-sustaining objects, which means that thanks to their structure they remain upright and stable without the need for any other accessory. They are a very versatile and functional advertising tool for any type of event or fair due to their easy transport and assembly. They have a great power in attracting attention of visitors.

Figure 23: Project Roll-up

As shown in Figure 23 several sections are available on the roll-up:

- Project Logo
- Image whose main objective is to reflect the idea of immersive communication
- Summary of the planned project outcome and its goal
- Use Case icons
- Partner logos
- EC funding acknowledgement

This roll-up provides a high-level overview of CHARITY project vision, use cases and partners. It was produced for the EuCNC & 6G Summit (Grenoble, France) which took place on June 2022.

2.3.7 Partner Interviews (Youtube)

Several interviews have been conducted to present different aspects and areas of the CHARITY project during the first 12 months of the project:

- CHARITY vision and implementation - explained by Tarik Taleb
- CHARITY medical training use case - explained by Antonis Protopsaltis

From M13-M18 following interviews have been produced and distributed:

- Holographic Concert Use Case - explained by Alex Roibu (Holo3D)
- Augmented Reality Gaming Use Case - explained by Zbyszek Ledwon (ORBK)

The interviews are embedded in the project website as news items and available on the project Youtube channel.

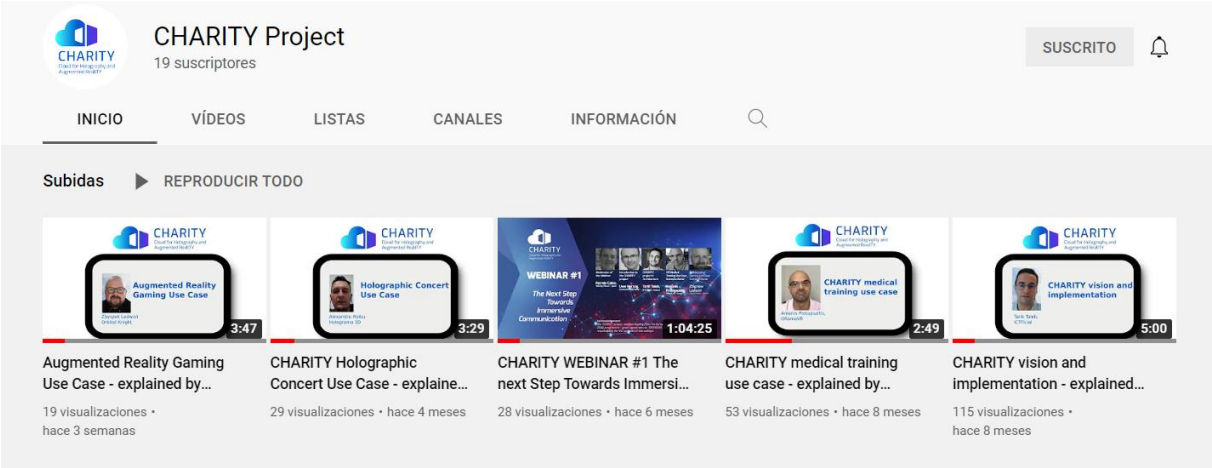

Figure 24: YouTube channel with interviews of CHARITY project partners.

2.3.8 Banner

A project's brand represents who it is and what it does. After all, it goes far more than just a logo or graphic element. Therefore, it is essential for branding to be used and displayed correctly in every possible medium, including corporate email. Corporate email is often a medium where branding goes amiss, despite being the most common business communication method. Consistent branding is important. This is from your project logo to the colour palette and font size. Standing out from the crowd is critical in today's marketplace, particularly over email. In the context of email, CHARITY project identity needs to stand out in crowded inboxes to have any impact. An email that conforms to a project's brand guidelines has a much higher chance of doing so.

Figure 25: Banner to be used within email exchanges with externals.

A consistent and clear identity lets externals know what to expect when they interact with CHARITY project partners. There is no uncertainty, which is key. Branded email signatures create a sense of trust. If the recipient of an email recognizes a brand, they're more likely to reply or engage. In Figure 25: Banner to be used within email exchanges with externals. an example of how the project banner is being used for email exchanges with external recipients.

In addition, and whenever the company policy allows it, project partners use the banner within their website to promote the CHARITY project. Figure 26 shows the banner within ORBK's website.

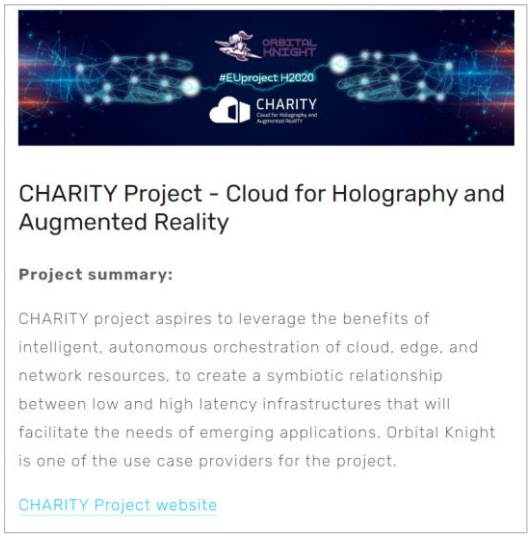

Figure 26: Banner used in partner website to promote the CHARITY project.

2.4 Participation on 3rd party events (KPI 04)

The participation in third party events which may be co-located within bigger and renowned venues has contributed to raising awareness of the project, increasing visibility of the work that is being done and to potentially engage with key stakeholders. The latter is a key benefit that so far, we haven't had the chance to experience at its fullest since most of the events where the project has been presented had been online.

Online events are great in terms of reaching a wide audience located anywhere in the world, while physical events have only limited number of attendees. Moreover, the availability of the recording of the sessions allows the project to reuse these contents to promote them on the website and social media channels and increase the impact and reach after the participation of the event. However, online events don't foster great engagement as people are more used to joining them to receive a talk on a specific topic, rather than connecting to establish meaningful connections on virtual booths. For this purpose, CHARITY project aims at promoting its participation in physical events whenever it is possible to foster new and relevant connections with participants and attendees that could be beneficial for the dissemination of the project's results.

The following table presents a list of **12 events where CHARITY project partners participated between M1 and M18, reaching over 650 persons (estimated[3])** of different role and background such as researchers, academics, industry, standardisation body, among others. Participation and format have varied from presentations, invited talks, booth, demo sessions, etc. All events have been uploaded to the website as news items and highly promoted on social media channels.

[3] This figure was calculated based on the sum of the estimated reached persons on Y1 and Y2, see Table 1 and Table 2.

During the first year of the project life cycle (until M12) CHARITY project partners participated in the events shown in the table below (Table 1: Event participation along Y1.).

Table 1: Event participation along Y1.

#Y	Event Name	Venue	Date	Type of Participation	Description	Estimated # of persons reached	Link
Y1	XR Start-Up Connect: European Kick-Off	online	30/03/2021	Presentation	Yago Rozas (PLEXUS) presented in a keynote the relationship between edge computing and the XR environment.	38	https://www.vdc-fellbach.de/termine/2021/03/30/xr-start-up-connect-european-kick-off/
Y1	Web Summit Lisbon 2021	Lisbon, Portugal	01/11/2021	Booth	Joao Ferreira and Ariaan Spronk (DOTES) presented their use case on a booth.	70	https://websummit.com/
Y1	IEEE International Conference on Cloud (Cloud Net 2021)	online	08/11/2021 - 10/11/2021	Presentation	Antonis Makris (HUA) presented a joint paper ("Cloud for Holography and Augmented Reality").	25	https://cloudnet2021.ieee-cloudnet.org/
Y1	ISTI Day	Pisa, Italy	16/11/2021	Presentation	Massimiliano Corsini (CNR) presented the CHARITY project.	100	https://www.isti.cnr.it/en/research/isti-day-2021
Y1	International Symposium on 6G Networking 2021 (6G Net 2021)	Lisbon, Portugal	22/11/2021	Invited Talk	Luis Cordeiro (ONE) presented in the future of XR Services, their upcoming network and computing challenges and the role of 6G in addressing them.	30	http://6g-net.org/

Y1	Conference on emerging Networking EXperiments and Technologies (CoNEXT)	online	01/12/2021 - 03/12/2021	Presentation	Aravindh Raman (TID) presented paper "Exploring content moderation in the decentralised web: the pleroma case"	50	https://www.sigcomm.org/events/conext-conference
Y1	Horizon Cloud Summit 2021	online	09/12/2021	Presentation	CHARITY's Holographic Assistant Use Case presented by Uwe Herzog, Project Coordinator, in section "Success Stories and Use Cases from the European Cloud Community"	60	https://www.h-cloud.eu/event/horizon-cloud-summit-2021/

During the first 6 months of the second year (M13-M18) CHARITY project partners participated in the events shown in the table below (Table 2: Event participation along M13-M18).):

Table 2: Event participation along M13-M18).

#Y	Event Name	Venue	Date	Type of Participation	Description	Estimated # of persons reached	Link
Y2	7th International XR Conference	Lisbon, Portugal	28/04/2022	Keynote presentation	Joao Rodrigues (DOTES) presented Cyango and the role of CHARITY project	30	https://arvrconference.wixsite.com/arvrconference
Y2	ARETE & iv4XR workshop: Second workshop on the future of XR: Current ecosystem and upcoming opportunities	online	11/05/2022	Presentation	Fermin Calvo (PLEXUS/SM2) presented the highlights of the project developments.	20	n/a

Y2	EXPO Dubai 2020	Dubai, United Arab Emirates	22/02/2022	Presentation	George Papagiannakis (ORAMA) presented "Let's Accelerate World's Transition to Medical VR Training"	100	https://www.expo2020dubai.com/en
Y2	European Conference on Networks and Communications (EuCNC) and the 6G Summit	Grenoble, France	07/06/2022 - 10/06/2022	Booth Poster Roll up Video presentation	Adriaan Sponk (DOTES), Alex Roibu (HOLO3D), Luis Rosa (ONE) and Uwe Herzog (EURES) present the CHARITY project and showcase 2 use cases.	80	https://www.eucnc.eu/
Y2	ACM Web Conference (WWW)	online	25/04/2022 - 29/04/2022	Presentation	Aravindh Raman (TID) presented paper "Jettisoning Junk Messaging in the Era of End-to-End Encryption: A Case Study of WhatsApp".	50	https://www2022.thewebconf.org/accepted-papers/

The organisation of the participation on following events is ongoing (M18), see Table 3: Events where CHARITY project partners will participate (organisation ongoing)..

Table 3: Events where CHARITY project partners will participate (organisation ongoing).

#Y	Event Name	Venue	Date	Type of Participation	Description	Link
Y2	FRAME: 2nd workshop on Flexible Resource and Application Management on the Edge	online	27/06/2022 - 01/07/2022	Presentation	Theodoros Theodoropoulos (HUA) will present the paper "An Automated Pipeline for Advanced Fault Tolerance in	http://wikicfp.com/cfp/servlet/event.showcfp?eventid=15720

					Edge Computing Infrastructures"	0&copyownerid=174036
Y2	FRAME: 2nd workshop on Flexible Resource and Application Management on the Edge	Online	27/06/2022 - 01/07/2022	Presentation	Antonios Makris (HUA) wil present the paper "Towards a Distributed Storage Framework for Edge Computing Infrastructures"	http://wikicfp.com/cfp/servlet/event.showcfp?eventid=157200&copyownerid=174036
Y2	SIGGRAPH 2022	Vancouver, Canada	08/08/2022 - 10/08/2022	Presentation	ORAMA will present paper "Realistic soft-body tearing under 10ms in VR"	https://s2022.siggraph.org/
Y2	SIGGRAPH 2022	Vancouver, Canada	08/08/2022 - 10/08/2022	Presentation	ORAMA will present paper "Assessing unconstrained surgical cuttings in VR using CNNs"	https://s2022.siggraph.org/
Y2	SIGGRAPH 2022	Vancouver, Canada	08/08/2022 - 10/08/2022	Presentation	ORAMA will present paper "Recording and replaying psychomotor user actions in VR"	https://s2022.siggraph.org/
Y2	EGI Conference 2022	Prague, Cz.Republ	19/09/2022 - 23/09/2022	Lighting Talk	HUA will present submitted paper (if accepted).	https://www.egi.eu/event/EGI2022/
Y2	ACM Special Interest Group on Data Communication (SIGCOMM)	Amsterdam, Netherlands	22/07/2022 - 26/07/2022	Conference contribution	TID will present accepted paper (but not public yet).	https://conferences.sigcomm.org/sigcomm/2022/

Y2	Immersive Global Summit 2022 (IGS 2022)	Madeira, Portugal	28/09/2022 - 30/09/2022	Presentation	DOTES will give a presentation.	https://www.immerseglobalnetwork.com/igs-europe
Y2	International Conference on Mobile Systems, Applications, and Services (ACM MOBISYS 2022)	Portland, USA	27/06/2022 - 01/07/2022	Conference contribution	TID will present accepted paper (but not public yet).	https://www.sigmobile.org/mobisys/2022/

There are other events which the CHARITY project partners are currently evaluating in terms of relevance and feasibility which are exposed in .

Table 4: Events which are under evaluation for Y2.

#Y	Event Name	Link
Y2	AWE EU 2022, https://www.awexr.com/eu-2022/	https://www.awexr.com/eu-2022/
Y2	VRDay Tech Week	https://vrdays.co/
Y2	Web Summit Lisbon 2022	https://websummit.com/author/websummit-main
Y2	XR Week 2022	https://xr-week.converve.io/VRAR2022CFP.html

2.5 Organisation of local workshops (KPI 05)

Due to the pandemic, the organisation of face-to-face meetings during 2021 (Y1 of the project) had a very limited possibility of gathering participants. Therefore, the consortium decided to organise a series of online Webinars, which neutralizes the barrier of Covid-19 restrictions.

Table 5: Webinars organised by CHARITY project partners.

#Y	Event Name	Venue	Date	Persons reached	Link
Y1	CHARITY - Webinar #1: The Next Step Towards Immersive Communication	Online	30/11/2021	23	https://www.charity-project.eu/en/webinars/charity-project-webinar-1-the-next-step-towards-immersive-communication

The event was recorded and made available for reproduction on CHARITY's Youtube channel. In addition, this video was embedded in a news item created on the project website and used for further communication activities on social media and newsletters releases.

Figure 27: Overview of Webinar #1 organised by CHARITY partners.

Currently there are several webinar organisations ongoing which are detailed in Table 6: Planned Webinars by CHARITY project partners for Y2..

Table 6: Planned Webinars by CHARITY project partners for Y2.

#Y	Event Name	Venue	Date	Link
Y2	FRAME 2022: The 2nd Workshop on Flexible Resource and Application	Minnessota, USA	27/06/2022 - 01/07/2022	https://www.accordion-project.eu/frame-2nd-workshop-on-flexible-

	Management on the Edge, USA, Minneapolis, Minnesota			resource-and-application-management-on-the-edge/
Y2	CHARITY Webinar #2 (Joint webinar between CHARITY & ACCORDION)	Online	July 2022	Organised by TID.
Y2	CHARITY Webinar #3 (joint webinar CHARITY&iv4XR)	Online	September 2022	Organised by DOTES.
Y2	CHARITY Webinar #4 (holographic applications)	Online	September 2022	Organised by SRT.
Y2	CHARITY Webinar #5 (Mixed Reality Interactive Applications)	Online	November 2022	Organised by CAI.
Y2	CHARITY Webinar #6 (CHARITY project related (e.g., edge/cloud computing)	Online	November 2022	Organised by CNR.

All envisaged webinars may be sought in collaboration with other H2020 projects providing not only a wider perspective of the presented content but also aims at reaching a broader audience which benefits all involved parties while boosting awareness and impact generation.

Figure 28: FRAME workshop website: https://www.accordion-project.eu/frame-2nd-workshop-on-flexible-resource-and-application-management-on-the-edge/

2.6 Collaboration with other H2020 projects (KPI 06)

The consortium has made important efforts in terms of identifying concrete opportunities and performing collaborative activities with other H2020 projects.

The consortium has conducted several joint activities with following H2020 funded projects, which are listed on the project website (Collaborations > H2020 Collaborations).

In Table 7 the collaboration activities conducted since the first year of the project life cycle (2021) are presented.

Table 7: Collaboration with other H2020 projects since Y1 / 2021.

#Y	Event Name	Collaboration areas
Y1	H-CLOUD project https://www.h-cloud.eu/	– Participation on monthly Communication Task Meetings (exchanging with up to 10 other European funded projects the current work status, upcoming events and collaboration opportunities) – Participation at H-CLOUD Summit 2021 – Contribution to periodic H-CLOUD Newsletter releases (Oct 2021 - 301 subscr., Jan 2022 - 410 subscr., June/July 2022 - 506 subscr. so far) – Social Media promotion of events and activities
Y1	ACCORDION project https://www.accordion-project.eu/	– Contribution to CHARITY Newsletter – Social Media promotion of events and activities
Y1	SWforum.eu project	– Hosting of CHARITY project minisite within Project Hub Section, https://swforum.eu/project-hub/cloud-holography-and-augmented-reality – Social Media promotion of events and activities – Promotion of CHARITY Webinar #1: https://swforum.eu/events/charity-project-webinar-1-next-step-towards-immersive-communication

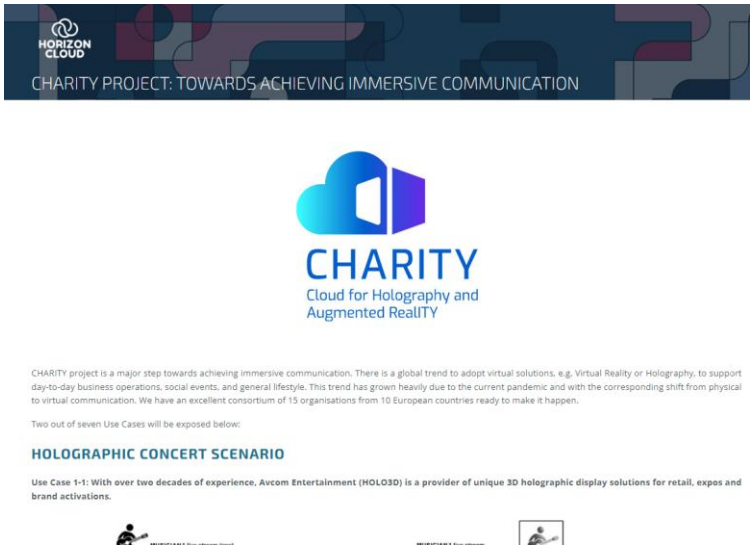

Figure 29: CHARITY project contribution to October 2021 H-CLOUD newsletter release.

In Table 7 the collaboration activities conducted since the second year of the project life cycle (2022) are presented.

Table 8: Collaboration with other H2020 projects since Y2 / 2022.

#Y	Event Name	Collaboration areas
Y2	ARETE project, https://www.areteproject.eu/	– Participation at workshop organised by ARETE &iv4XR projects. – Social Media promotion of events and activities – Project contribution for CHARITY Newsletter #5 release
Y2	iv4XR project, https://iv4xr-project.eu/	– Participation at workshop organised by ARETE &iv4XR projects. – Social Media promotion of events and activities Planned activities: joint Webinar between CHARITY and iv4XR projects in the field of VR applications.
Y2	ARtwin project, https://artwin-project.eu/	– Collaboration areas to be defined along June / July.
Y2	PHYSICS project, https://physics-faas.eu/	– Collaboration areas to be defined along June / July.
Y2	HUB4CLOUD project, https://www.h-cloud.eu/ict_40-projects/hub4cloud/ Project start: Sept 2022	– Collaboration areas to be defined from September. HUB4CLOUD takes on the baton from H-CLOUD to extend and build upon its activities and outreach to foster the European Cloud Computing ecosystem

Figure 30: Social Media posting about the CHARITY project participation at the workshop organised by the ARETE & iv4XR projects.

2.7 Participation on EC Events (KPI 07)

#Y	Event Name	Venue	Date	Type of Participation	Description	Estimated # of persons reached	Link
Y2	European Conference on Networks and Communications (EuCNC) and the 6G Summit	Grenoble, France	07/06/2022 - 10/06/2022	Booth Poster Roll up Video presentation	Adriaan Sponk (DOTES), Alex Roibu (HOLO3D), Luis Rosa (ONE) and Uwe Herzog (EURES) present the CHARITY project and showcase 2 use cases.	80	https://www.eucnc.eu/

As highlight of the EuCNC & 6G Summit participation it can be mentioned that Mr. Pearse O'Donohue visited the CHARITY booth at EuCNC & 6G Summit experiencing first-hand the selected use cases explained by the CHARITY project partners.

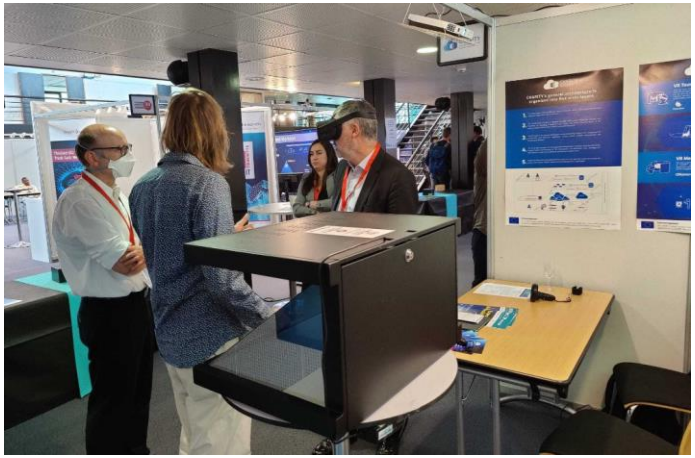

Figure 31: Mr. Pearse O'Donohue visiting the CHARITY project booth at EuCNC & 6G Summit 2022.

Pearse O'Donohue is Director for the Future Networks Directorate of DG CONNECT at the European Commission, dealing with policy development and research supporting the Digital Single Market in the areas 5G networks, IoT, cloud and data flows.

The CHARITY project partners plan to participate in more events organised by the EC to wider the impact of the project dissemination and awareness.

2.8 Publications (KPI 08)

Generating impact and disseminating the project's findings and results among research and academic communities has been mainly done through the active development of papers and its posterior presentation and publication at important conferences and journals.

All papers are uploaded to the project website (Publications > Papers & Conferences) whenever the PDF becomes available at the respective conferences' proceedings or publication of the journal. Moreover, this content is promoted through social media and included in the project's newsletter.

Table 9 presents the 7 scientific papers that have been submitted and published in journals and at conferences between M1 and M12.

Table 9: Publications generated by CHARITY project partners during Y1 (Jan-Dec 2021).

Type	Title	Authors	Date	Status	Confid. level	Link
Journal	Federated Machine Learning: Survey, Multi-Level Classification, Desirable Criteria and Future Directions in Communication and Networking Systems	Tarik Taleb (ICT-FI)	Feb-21	public	published	https://www.researchgate.net/publication/349194533_Federated_Machine_Learning_Survey_Multi-Level_Classification_Desirable_Criteria_and_Future_Directions_in_Communication_and_Networking_Systems

Magazine	AI-based Resource Management in Beyond 5G Cloud Native Environment	Tarik Taleb (ICT-FI)	Mar-21	public	published	https://www.researchgate.net/publication/349909636_AI-Based_Resource_Management_in_Beyond_5G_Cloud_Native_Environment
Magazine	Asynchronous Time-Sensitive Networking for 5G Backhauling	Tarik Taleb (ICT-FI)	Mar-21	public	published	https://www.researchgate.net/publication/349906021_Asynchronous_Time-Sensitive_Networking_for_5G_Backhauling
Magazine	Immersive Services over 5G and Beyond Mobile Systems	Tarik Taleb (ICT-FI)	Aug-21	public	accepted	
Conference	An Encoder-Decoder Deep Learning Approach for Multistep Service Traffic Prediction	Theodoros Theodoropoulos (HUA), Angelos-Christos Maroudis (HUA), John Violos (HUA), Konstantinos Tserpes (HUA)	Aug-21	public	published	https://ieeexplore.ieee.org/abstract/document/9564320
Conference	Cloud for Holography and Augmented Reality	Antonios Makris (HUA), Abderrahmane Boudi (ICT-FI), Massimo Coppola (CNR), Luís Cordeiro (ONE), Massimiliano Corsini (CNR), Patrizio Dazzi (CNR), Ferran Diego Andilla (TID), Yago Gonzalez Rozas (PLEXUS), Manos Kamarianakis (ORAMA), Maria Pateraki (ORAMA), Thu Le Pham (CAI), Antonis	Oct-21	public	accepted	

		Protopsaltis (ORAMA), Aravindh Raman (TID), Alessandro Romussi (HPE), Luís Rosa (ONE), Elena Spatafora (HPE), Tarik Taleb (ICT-FI), Theodoros Theodoropoulos (HUA), Konstantinos Tserpes (HUA), Enrico Zschau (SRT), Uwe Herzog (EURES)				
Conference	Exploring content moderation in the decentralised web: the pleroma case	Aravindh Raman (ICT-FI)	Dec-21	public	published	https://dl.acm.org/doi/abs/10.1145/3485983.3494838

Table 10 presents the 20 scientific papers that have been submitted and/or published in journals and conferences between M13 and M18. Some of them will be presented at Conferences to be held in August 2022 (M20).

Table 10: Publications generated by CHARITY project partners during M13-M18 (Jan-Jun 2022).

Type	Title	Authors	Date	Status	Confid. level	Link
Journal	Deterministic Latency/Jitter-aware Service Function Chaining over Beyond 5G Edge Fabric	Tarik Taleb (ICT-FI)	Feb-22	public	accepted	https://ieeexplore.ieee.org/document/9714258

Journal	Cloud-based XR Services: A Survey on Relevant Challenges and Enabling Technologies	Theodoros Theodoropoulos (HUA), Antonios Makris (HUA), Abderrahmane Boudi (ICT_FI), Tarik Taleb (ICT-FI), Uwe Herzog (EURES), Luís Rosa (ONE), Luís Cordeiro (ONE), Konstantinos Tserpes (HUA), Elena Spatafora (HPE), Alessandro Romussi (HPE), Enrico Zschau (SRT), Manos Kamarianakis (ORAMA), Antonis Protopsaltis (ORAMA), George Papagiannakis (ORAMA), Patrizio Dazzi (CNR)	Feb-22	public	published	https://iecscience.org/jpapers/100
Journal	DSM-MoC as Baseline: Reliability Assurance via Redundant Cellular Connectivity in Connected Cars	Aravindh Raman (TID)	Feb-22	public	published	https://ieeexplore.ieee.org/abstract/document/9718533
Journal	Intelligent Proactive Fault Tolerance at the Edge through Resource	Theodoros Theodoropoulos (HUA)	Feb-22	non-public	submitted	

	Usage Prediction					
Journal	Self-Attention Based Encoder-Decoder for Multistep Density Prediction	Theodoros Theodoropoulos (HUA)	Mar-22	non-public	submitted	
Magazine	Collaborative Cross System AI: Towards 5G System and Beyond	Tarik Taleb (ICT-FI)	Apr-22	public	published	https://ieeexplore.ieee.org/document/9409842
Journal	AI-based network-aware Service Function Chain migration in 5G and beyond networks	Tarik Taleb (ICT-FI)	Apr-22	public	published	https://ieeexplore.ieee.org/document/9409935
Conference	Jettisoning Junk Messaging in the Era of End-to-End Encryption: A Case Study of WhatsApp	Aravindh Raman (TID)	Apr-22	public	published	https://dl.acm.org/doi/fullHtml/10.1145/3485447.3512130
Journal	AI-based Autonomic &	Tarik Taleb (ICT-FI)	May-22	public	accepted	

	Scalable Security Management Architecture for Secure Network Slicing in B5G					
Journal	Toward Using Reinforcement Learning for Trigger Selection in Network Slice Mobility	Tarik Taleb (ICT-FI)	May-22	public	published	https://ieeexplore.ieee.org/document/9439923
Journal	AI-based Autonomic & Scalable Security Management Architecture for Secure Network Slicing in B5G	Tarik Taleb (ICT-FI)	May-22	public	accepted	
Magazine	Extremely-interactive and low latency services in 5G and beyond mobile systems	Tarik Taleb (ICT-FI)	Jun-22	public	published	https://ieeexplore.ieee.org/document/9464920
Conference	Towards a Distributed Storage	Antonios Makris (HUA), Evangelos Psomakelis (HUA), Theodoros	Jun-22	public	accepted	(Publication two months after event planned)

	Framework for Edge Computing Infrastructures	Theodoropoulos (HUA), Konstantinos Tserpes (HUA)				
Conference	An Automated Pipeline for Advanced Fault Tolerance in Edge Computing Infrastructures	Theodoros Theodoropoulos (HUA), Antonios Makris (HUA), John Violos (HUA), Konstantinos Tserpes (HUA)	Jun-22	public	accepted	(Publication two months after event planned)
Conference	Global Mobile Network Aggregators: Taxonomy, Roaming Performance and Optimization	Aravindh Raman (TID)	Jun-22	public	accepted	
Journal	Optimization of Flow Allocation in Asynchronous Deterministic 5G Transport Networks by Leveraging Data Analytics	Tarik Taleb (ICT-FI)	Jul-22	public	published	https://ieeexplore.ieee.org/document/9496182
Conference	Realistic soft-body tearing	Antonis Protopsaltis (ORAMA), Manos Kamarianakis (ORAMA),	Aug-22	non-public	submitted	

	under 10ms in VR	George Papagiannakis (ORAMA)				
Conference	Assessing unconstrained surgical cuttings in VR using CNNs	Manos Kamarianakis (ORAMA), Antonis Protopsaltis (ORAMA), George Papagiannakis (ORAMA)	Aug-22	non-public	submitted	
Conference	Recording and replaying psychomotor user actions in VR	George Papagiannakis (ORAMA), Manos Kamarianakis (ORAMA)	Aug-22	non-public	submitted	
Conference	Experiences from the IPFS Network: Deployment and Performance	Aravindh Raman (TID)	Aug-22	public	accepted	

The Consortium will continue developing relevant papers to share the work done within the project and demonstrate its progress and results at important venues targeting key stakeholders.

2.9 Contribution to Open-Source repositories (KPI 09)

CHARITY is actively contributing to the open-source community, both in the form of contributions to already existing open-source projects to be used in the project and by means of making finalized software components developed in the project publicly available.

Table 11 outlines the achieved contributions to ongoing open-source projects and contributions of full systems until M18.

Table 11: Contribution to open-source repositories by CHARITY project partners until M18.

Type (Ongoing, Full)	Title / Topic	Link	Date	Partner	Names
Full	An-Encoder-Decoder-Deep-Learning-Approach-for-Multistep-Service-Traffic-Prediction: Deep Learning models which were developed in the context of the paper named "An Encoder-Decoder Deep Learning Approach for Multistep" Service Traffic Prediction"	https://github.com/theodorosthd/An-Encoder-Decoder-Deep-Learning-Approach-for-Multistep-Service-Traffic-Prediction	01/06/2021	HUA	Theodoros Theodoropoulos
Full	d-LOOK - A deep learning toolkit; d-LOOK is an automated way to execute various supervised deep learning models	https://github.com/AntonisMakris/d-LOOK	23/09/2021	HUA	Antonios Makris, Konstantinos Tserpes
Ongoing	Dynamic Lifecycle Framework: Dynamic Lifecycle Framework for dynamic volume provisioning in K3s	https://github.com/AntonisMakris/datashim	05/12/2021	HUA	Antonios Makris

2.10 Advanced Training (KPI 10)

CHARITY project partner support advanced training activities, providing support for MSc and PhD research thesis directly related with the project topics and promoting the use of the CHARITY concept and tools in specialized training courses provided by the academic and public research institutions involved (with the support of the other members of CHARITY consortium), such as advanced master courses.

Table 12 outlines the performed support activities related to advanced training until M18.

Table 12: Support activities for advanced training by CHARITY project partners until M18.

Y#	Type (MSc, PhD, Training Program)	Title / Dissertation Topic	Start Date	End Date	Partner
Y1	MsC	MSc. Interactive Media	Jun-21	Dec-21	CAI
Y2	MsC	Intelligence Orchestration in Cloud Native	Sep-21	Jun-22	ONE
Y2	MsC	Resource Allocation		end of Y2	TID
Y2	PhD	Middleware development for the optimal replica placement in distributed key-value stores	-	end of Y2	HUA
Y2	PhD	Identification and modeling of behavioral factors for policy making support	-	end of Y2	HUA

2.11 Community Building (KPI 11)

Table 13: List of communities in the scope of the CHARITY project. provides an overview of the already formalized communities.

Table 13: List of communities in the scope of the CHARITY project.

Y#	Type	Title / Description	Start Date	Current status	Partner
Y1	Facebook Group	Cyango Virtual Storrytelling (https://www.facebook.com/groups/storytellingvirtualtours)	Jan-21	Ongoing	DOTES

2.12 Summary of dissemination and communication activities

Dissemination and communication activities performed by the CHARITY project partners have been successful within M1 and M18 of the project life cycle. The different number of activities established, the participation on events, the submission of papers, and the increasing digital visibility that the project has gotten are clear indicators that the project as a whole is reaching the objectives set and is successfully raising awareness among the target audience. The latter will be essential on upcoming phases of the strategy where the project partners intend to actively engage with key stakeholders by reaching out to potentially interested end-users/adopters of the results of the project and involve them in activities that will be necessary to support exploitation and business modelling activities. Table 14 presents the KPIs established to measure the success and effectiveness of the strategy presented in D5.1, which have been closely monitored on a monthly basis to identify any deviations in time or determine if any other actions should be executed to guarantee the effective accomplishment of the committed figures.

Table 14: CHARITY project's Dissemination and Communication KPIs to achieve by M24. provides an overview of the committed KPI to be achieved until the end of Y2 including the corresponding section number for each KPI detail.

Table 14: CHARITY project's Dissemination and Communication KPIs to achieve by M24.

KPI #	Description	KPI to achieve by M24	KPI achieved by M18	Section
KPI 01	Website	6200	3183	10
KPI 02	Social Media	300 followers	295 f. Linkedin 108 f. Twitter 34 f. Facebook	2.2
KPI 03	Promotional Materials	8 newsletters released	5 released + 1 ongoing	2.3.1
KPI 04	Participation in Conferences and other 3rd party events	12	12 participations + 9 planned particip. (Y2)	2.4
KPI 06	Collaboration with other H2020 projects	9	8	2.6
KPI 08	Publications	13	27 (7 in Y1 and 20 in Y2)	2.8

Table 15 provides an overview of the committed KPI to be achieved until the end of Y3 (as they were defined in the "Description of Action") including the corresponding section number for each KPI detail.

Table 15: CHARITY project's Dissemination and Communication KPIs to achieve by M36.

KPI #	Description	KPI to achieve by M36	KPI achieved by M18	Section
KPI 05	Org. of local workshops and int. seminars	500 participants reached	23 part. reached	2.5
KPI 07	EC Dissemination Mechanisms	Total events = > 6	1	2.7
KPI 09	Open-Source repositories	Contribution to ongoing open-source projects = >6 Contribution of full system =>10	Contr. Ongoing: 1 Full Systems: 2	2.9
KPI 10	Advanced Training	Concluded Thesis MSc = > 24 Concluded Thesis PhD = > 6 Impacted training programs => 3	MsC: 4 PhD: 2	2.10
KPI 11	Community Building	# of members > 50	1700	2.11

These figures provide evidence that, on an overall basis, the KPIs performance are on a good track for their successful accomplishment by the end of the project.

3 Standardisation activities

The standardization activities encompass the investigation of relevant activities from which CHARITY can benefit and ideally can contribute to. The most tangible expectation in terms of successful activities, is to identify the standards that would resolve certain CHARITY challenges and adopt them.

3.1 Performed Activities

Already, at the proposal phase, the consortium had identified several standardization bodies that were relevant to the work that we were planning to conduct. Some missing standardization bodies have been also identified by the consortium during the realization of the Task 5.4. Those bodies and standards are presented in Table 1. Based on our experience, a contribution to a standard normally takes longer than a project duration and a stronger commitment than normally feasible in the frame of a collaborative project. As such, we started with a preliminary analysis of technical contributions that the project is inevitably focusing on with its corresponding standards. The objective of this analysis was to identify the contributions that could potentially benefit standard bodies.

Table 16: List of CHARITY contributions to ITU-T.

Relevant body (and standardization)		**Applicable CHARITY functionalities**
3GPP	SA4	Specifications of speech, audio, video, graphics and other media codecs for the CHARITY use cases.
	RAN1	Communication of XR devices and other components in the XR service deployment plane.
MPEG	MPEG_MAR	Mixed and Augmented Reality Reference Models established to define required modules, minimal functionalities and the associated information content.
	G-PCC	Provides a procedure to include and compress 3D points in a lossless manner by using an octree approach. For the use case Holographic Assistant, a suitable 3D point cloud data format as like as its real time capable generation, compression and decompression are a strong requirement.
	OMAF	Omnidirectional Media Format supports three degrees of freedom which enables omnidirectional media applications - 360° video, images and audio.
	MBNP	The Network-Based Media Processing standard for defining interfaces, media formats, and metadata to provide a standardised way to perform omni-directional media processing on any Edge and Cloud computing architectures.

IETF	detnet	To facilitate synchronization of specific traffic flows and enable lowend-to-end latency.
	dinrg	Decentralized infrastructure for XR service deployments and distributed store management via blockchain.
ITU-T	SG-12	Contribution to quality assessment methods for XR applications.
	SG-13	Contribution to design aspects of network virtualization supported by the CHARITY use case
	Network 2030	To guarantee low end-to-end latency and near-optimal utilization of available bandwidth for holographic applications.
ETSI	ISG MEC	To leverage the benefits of deploying services and enabling service migration across MEC hosts/cloud domains.
	ISG ZSM	Orchestration across multi-domain XR service ecosystem within a cloud native environment.
	ISG NFV	For creating self-managed end-to-end network slices and implementation of the reference architecture of Open-source MANO.
	ARF	Augmented reality framework for interoperation in the highly heterogeneous ecosystem of providers for AR-related use cases.
Khronos Group	OpenXR	To establish a platform independent connection between XR devices and 3D game engines and 3D frameworks.
	gITF	Efficient transmission and rendering of 3D scenes and models created by the holographic applications.
EUROCAE, RTCA		Aviation related standards especially for supporting use case 3

3.1.1 3GPP

3GPP (3rd Generation Partnership Project) is a worldwide consortium of organizations focused on development and maintenance of mobile standards. Ensuring the compatibility in the heterogeneity of the network is the main goal of both 3GPP standard bodies and CHARITY.

5G End-to-End Network Slicing is a recurrent topic addressed in CHARITY WP1 and investigated further in WP2. This topic is also present in the different projects developed during the latest three frozen releases (Release 15, 16 and 17[4]). This property of the 5G Systems allows to use multiple types of services and apply them to different network requirements (latency, priority, type of users, etc.) at the same time. This feature is important for the design and implementation of the Charity architecture, and also for the interoperability between operators and service providers.

Moreover, CHARITY project has three main fields of uses cases: virtual reality, extended reality and cloud gaming. One of them, Extended reality, is also present in the studies of Release 17 by evaluating firstly the performance of XR in terms of power consumption, capacity, mobility and coverage. Therefore, the outcome of CHARITY use cases could help on providing more insights on new Releases.

3.1.1.1 CHARITY support of 3GPP Media Streaming

3GPP media streaming focuses on Release 16[5] centres on a one-way download and thus envisages frame buffering (on the client and potentially at the edge) as a core component; whereas CHARITY tackles a different problem that focuses on streaming media to a user who has no interactive role in composing that media. However, there are a number of interesting characteristics and design attributes in the 3GPP architecture that can prove useful for CHARITY.

CHARITY aims to be deployable on heterogeneous cloud data networks – whether on the public clouds or private clouds of enterprises – and optimize media delivery either directly to the 5G User Plane Function or to the specialized 5G Media Streaming downlink (5GMSd) Application Server. New features of the CHARITY media streaming infrastructure spanning the edge and cloud will be considered to support 3GPP Media Streaming.

3.1.2 MPEG

3.1.2.1 Mixed and Augmented Reality (MAR)

The MAR Standard is a reference model established to define required modules, minimal functionalities and the associated information content and models for applications, components, systems and services that must claim compliance with MAR systems. This reference model is agnostic to platforms, used devices and algorithm and does not specify how MAR applications should be designed, developed, and implemented. The main objective of MAR reference model is to establish a principled way (definitions, main concepts, and architecture overview) needed to create mixed and augmented reality systems or applications as need in CHARITY use cases.

Therefore, CHARITY may contribute an extension to this XR standard in the direction of AR streaming services over 5G cellular systems since the MPEG-MAR XR standard drove the design of the CHARITY platform to suit accordingly the AR (and possibly Holographic) use cases.

3.1.2.2 GeOMETRIC BASED POINT CLOUD COMPRESSION (G-PCC)

Suitable point cloud formats with the support of real time capable generation, compression and decompression are a strong requirement, especially for the CHARITY use case “Holographic Assistant”. This type of content representation is the ideal input for generating high quality 3D holograms to be presented on holographic 3D display devices based on diffraction and interference of light. Currently, the existing 3D Point Cloud Standards, i.e., G-PCC, are not 100% compatible with CHARITY

[4] https://www.3gpp.org/specifications/releases.

[5] https://www.3gpp.org/specifications/releases.

requirements. Real time capability / high performance and compatibility with holographic 3D are some of the key requirements; hence some extensions or a simplified solution developed and optimized for operation in the CHARITY cloud could potentially impact the standard.

Omnidirectional Media Format (OMAF)

OMAF is a virtual reality system standard developed by the Moving Picture Experts Group (MPEG to enable omnidirectional media applications - 360° video, images, audio and timed text (text media synchronised with other media).

For CHARITY, especially for the Virtual Reality based use cases, several publicly available implementations compatible with OMAF v2 must be evaluated since OMAF v2 fully supports three degrees of freedom (3DOF) at the time of writing this deliverable. The support for six degrees of freedom (6DOF) is still progressing, and will allow for translational user movement to prompt the rendering of overlays and for multiple viewpoints. The evaluation of these implementations could improve further versions of the OMAF standards related to CHARITY use cases.

3.1.3 IETF Detnet and ITU-T Network 2030

Deterministic Networking (DetNet) provides a capability to carry specified unicast or multicast data flows for real-time applications with extremely low data loss rates and bounded latency within a network domain.

Charity aims to leverage the DetNet paradigm, as well as take inspiration from the design of the New IP initiative, which was introduced by the ITU-T Network 2030 Focus group, in order to provide guarantees regarding the network's ability to keep up with the established QoS requirements. Towards this goal, it is essential for a data flow template to be established. This template shall entail information regarding the source, the destination and the desired upper bound of latency. There are two distinct classes of time-sensitive flows that Charity aims to facilitate. The first class is indicative of data flows that require extremely low end-to-end latency in the form of the aforementioned upper bounds of latency. This requirement is associated with time-sensitive data flows and more specifically with real-time applications. The second one is associated with the need to properly facilitate the various temporal correlations which are established among some specific data flows. The upper bound of latency which is provided by the next-gen developer will be regarded as a time-stamp which dictates the exact moment that each traffic flow has to arrive at its perspective destination node. The ability of each DetNet flow to arrive at its destination node at a specific moment is guaranteed via the use of Cyclic Queuing and Forwarding protocols like the ones which were examined above. The priority of each traffic flow is established based on how latency-sensitive it is. This type of flow prioritization will be leveraged by a Deep Reinforcement mechanism which will be in charge of formulating optimal routing strategies in accordance with the upper bounds of latency. Furthermore, a Traffic Prediction mechanism will be providing estimates regarding the traffic which is expected to take place in the near future. Alongside the information provided by the data flow template, it is essential to offer information about the topology of the network in order to implement centralized configurations in regards to routing and scheduling. These configurations are established via the SDN paradigm which is capable of configuring schedules on the hosts and the forwarding tables of the switches. The contributions on these mechanisms done in WP2 will improve the techniques used in Detnet: 1) reserving data plane resources for individual (or aggregated) DetNet flows in some or all of the intermediate nodes along the path of the flow; 2) providing explicit routes for DetNet flows that do not immediately change with the network topology; and 3) distributing data from DetNet flow packets over time and/or space to ensure delivery of each packet's data in spite of the loss of a path.

3.1.4 ITU-T SG13

ITU-T Study Group 13 works on next-generation networks and now caters to the evolution of Next-generation Networks (NGNs), while focusing on future networks and network aspects of mobile telecommunications.

Cloud computing is an important part of SG13 work, and the group develops standards that detail requirements and functional architectures of the cloud computing ecosystem, covering inter- and intra-cloud computing and technologies supporting XaaS (Anything as a Service). This work includes infrastructure and networking aspects of cloud computing models, as well as deployment considerations and requirements for interoperability and data portability. Given that cloud computing relies on the interplay of a variety of telecom and IT infrastructure resources, SG13 develops standards enabling consistent end-to-end, multi-cloud management and monitoring of services exposed by and across different service providers' domains and technologies.

An SG13 recommendation focuses largely on inter-cloud and in particular its functional architecture. There is a direct analogy between the inter-cloud relationships and the functionality that one provides to another, and the CHARITY cross domain concept. Even though the specification is complete and rather inactive since 2017, the decision is to keep studying the specification and adapt as many elements as possible.

3.1.5 ETSI Multi-Access Edge Computing AND ISG Network Functions Virtualization

Multi-access Edge Computing (MEC) offers application developers and content providers cloud-computing capabilities and an IT service environment at the edge of the network. This environment is characterized by ultra-low latency and high bandwidth as well as real-time access to radio network information that can be leveraged by applications. In concept this appears as the right answer to the CHARITY application demands.

MEC is largely dependent on ETSI ISG NFV, a group that is charged with developing requirements and architecture for virtualization for various functions within telecom networks. The NFV Evolution and Ecosystem (EVE) define management and orchestration aspects of a VNF focusing on a new set of management functions about the creation and lifecycle management of the needed virtualized resources for the VNF. VNF Management functions are responsible for the VNF's lifecycle management including operations such as

- Instantiate VNF (create a VNF using the VNF on-boarding artefacts).
- Scale VNF (increase or reduce the capacity of the VNF).
- Update and/or Upgrade VNF (support VNF software and/or configuration changes of various complexity).
- Terminate VNF (release VNF-associated NFVI resources and return it to NFVI resource pool).

Moreover, three main categories of use cases and applications have been already identified as part of the MEC specification: Consumer-oriented services (e.g., augmented and assisted reality, and cognitive assistance), Operator and third-party services (e.g., active device location tracking, big data, security and safety, and enterprise services) and last but not least network performance and QoE improvements (content/DNS caching, performance optimization or video optimization). In the scope of CHARITY, these scenarios will be further researched to understand how they align with the envisioned next generation of distributed AR/VR and Holography-based applications.

Similar in spirit to MEC, CHARITY intends to leverage the benefits of deploying services (i.e., the next generation applications) across the edge/cloud and enabling service migration across MEC hosts/cloud domains - when needed. The previous and extensive MEC work of identifying relevant use cases and architectural solutions is of vital importance to understand the requirements and challenges of these

scenarios, i.e., how to decouple these use cases into multiple services and how specific components can be leveraged to manage them. All of this work can be used to better understand, identify the components and tailor the CHARITY architecture to XR services. Moreover, the multi-domain problem, a key topic already part of the MEC specification, can be seen as foundational research towards the service orchestration across different domains developed on WP2 and could easily contribute on both standards.

3.1.6 ETSI Zero touch network & Service Management (ZSM)

ISG ZSM from ETSI was formed to discuss relevant use cases, requirements, and specify an E2E management reference architecture that allows such end-to-end service deployments. First, ZSM Management Services, exposed through specific endpoints, allow a more consistent and standardized way to expose different management capabilities across the overall deployment. This is an important factor given the discussed scenarios comprise services spanning over different domains. Second, the ZSM framework specifies an E2E Service Management Domain. Among others, the E2E Service Management domain is responsible by end-to-end orchestration across different domains, E2E closed loop management, E2E analytics, and data collection.

More than E2E deployments, the underlying idea of ZSM is to achieve a level of automation where closed-loop processes and algorithms (e.g., machine learning based orchestration mechanisms) can drive more efficient and flexible scenarios (e.g., a self-monitoring and optimization of the network) and ultimately reduce (or eliminate) the need for human intervention. Indeed, the concept of Closed Loops can occur at both Management Domain and E2E Domain levels.

This ZSM specification is of utmost importance towards the standardization of how applications and services spanning across multiple domains can be fully realized. Such specification includes the definition of how common orchestration functions could be implemented and how the different components can communicate. Inspired by that, CHARITY framework was conceived to achieve such notion of E2E orchestration across multiple domains which will be used to support the deployment of next-generation applications (i.e., the XR services) within a cloud native environment in WP2. Moreover, CHARITY also leverages the notion of closed loops as a structured approach to enable the deployment of both service-related orchestration functions and XR specific mechanisms (e.g., adaptive video streaming, to allow applications to adjust to network conditions based on the metrics collected in the real-time or to implement a given security function).

3.1.7 ETSI Augmented Reality Framework

ETSI, as part of its standardization efforts, is currently specifying an Augmented Reality Framework (ARF) whose objective is to provide a transparent architecture for interoperation in the highly heterogeneous ecosystem of providers and technologies that stimulate developers. A reference AR functional architecture was also specified in the same document by the ISG AR group. This architecture targets both fully embedded AR systems and implementations spread over IP networks (e.g. edge/cloud environments).

ETSI specifies relevant components and interfaces required for an AR solution through a set of six use cases centred in industry, whose objective is reducing costs using virtual prototypes and decreasing time-frames of procedures. Each use case contains a description of how their functional steps map into the proposed AR architecture. For some of them, it was stressed the benefits of having different functions running on local, edge or cloud, which ultimately allows a better resource exploitation.

This use case description and specification is a key aspect explored in CHARITY, but it should be evaluated with the Virtual Reality use cases or whether a unified approach for Mixed Reality Scenarios can be devised.

3.1.8 Khronos group

3.1.8.1 OpenXR

OpenXR is an open standard to connect XR devices and 3D game engines or 3D frameworks with each other. The goal is to eliminate the various specific implementations to support an XR-device X in game engine Y on platform Z by providing a generic, cross platform application interface to any supported XR device within any supported game engine on multiple platforms.

Use cases which support VR/AR HMDs within their CHARITY applications could basically adapt to OpenXR to increase the bandwidth of supported end user devices. Hence, the various game engines and OpenXR core libraries can access and control the any supported XR / holographic 3D end user device.

3.1.8.2 GL Transmission Format

glTF™ (GL Transmission Format) is a royalty-free specification for the efficient transmission and loading of 3D scenes and models by engines and applications. glTF minimizes the size of 3D assets, and the runtime processing needed to unpack and use them. glTF defines an extensible, publishing format that streamlines authoring workflows and interactive services by enabling the interoperable use of 3D content across the industry.

3.2 Next steps on standardization

The next steps on standardization activities include conducting a more detailed analysis of aforementioned standards, especially in the light of the work that the project members have conducted after the passing of 1.5 years and the research directions that the project is inevitably focusing on. The main goal of this analysis was to highlight standards that the project can focus on, understand their relation with different research project activities, and put together all of its resources to make an impact but also benefit from.

Based on such analysis, each standard and contribution will be marked as “monitoring”, implying that the project is monitoring them, “contributing”, implying that the project is actively contributing to those standards, “dropped”, implying that the project will not monitor and will not pursue any contributions to these standards, and “pending”, implying that further analysis will take place during the following months to decide whether to drop or not the item.

4 Conclusions and next steps

This deliverable provided a detailed overview of the WP5 activities of the project in its first 18 months of the project life cycle. In addition, planned activities have also been outlined. As mentioned within the document, the CHARITY project consortium has made excellent dissemination progress and achieved several important KPIs. Ultimately, the project partners as a whole have been successfully raising awareness of the project on several fronts and are excited about the overall response and interest we have received.

From a WP5 perspective, partners will join efforts to support the planned technical activities as well as participating in relevant events by developing communication items and dissemination activities to reach the target audience. In addition, all communication material will be available on the website and disseminated widely via social media accounts, both through the various project accounts and H2020 projects CHARITY is collaborating with. Additional projects, including H2020 projects will be invited to spread the word across their communication and dissemination channels.

The CHARITY project partners are also committed to the organisation of several webinars in different areas such as Cloud and XR together with other H2020 projects, widening the target audience and possible participant number with the aim of boosting CHARITY project impact on the scientific and societal ecosystem within Europe.

The outlined upcoming milestones and communication, dissemination and standardization activities will be essential to the overall dissemination strategy and ultimately, the project success. In addition, the CHARITY project partners intend to continue and actively engage with key stakeholders by reaching out to potentially interested end-users/adopters of the project's results and involving them in activities that will be necessary to support the exploitation and business modelling activities.