NGI THINK NEXUS

D2.6 – Thematic Workshop #3 report

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Task leader/Main author	Daniela Coutinho (SPI)
Contributing partners	Lisa Pourcher and Marc Pattinson (GAC), Jose Gonzalez (AUSTRALO), Wouter Tavernier (IMEC), Maritini Kalogerini (ATC)
Reviewer(s)	Lisa Pourcher and Marc Pattinson (GAC)

Abstract

This deliverable, 'Thematic Workshop #3 report' gathers the inputs linked to Think NEXUS technical workshop, which took place on April 21st, 2021. The Workshop was titled "Key NGI technologies in the EU-US context – second workshop".

This Workshop provided the chance to further define priorities for EU-US cooperation on NGI topics. This will, ultimately, provide inputs to the European Commission and the National Science Foundation and identify elements of roadmap for cooperation.

Keywords

Next Generation Internet; EU-US collaboration; Workshop; European Commission; National Science Foundation

Revisions

Version	Submission date	Comments	Author
v0.1	23/04/21	Definition of the deliverable's contents	Daniela Coutinho and Susana Figueiredo (SPI)
v0.2	26/04/21	Validation of the workshop transcript	Daniela Coutinho and Susana Figueiredo (SPI)
v0.3	27/04/21	Inputs from GAC	Lisa Pourcher, Marc Pattinson (GAC)
v0.4	26/05/21	Integration of inputs	Daniela Coutinho (SPI)

Disclaimer

Think NEXUS project

The Internet of the future should be more open, provide better services, more intelligence, greater involvement and participation. It needs to reflect the European values. EU's Next Generation Internet initiative is a key opportunity to rethink the way the Internet works today and develop a vision involving voices from across Europe, the US, and beyond, an Internet that embodies the values Europe holds dear, such as openness, inclusivity, transparency, privacy and cooperation.

Thinking globally, the NGI will be successful only if a worldwide consensus is found, enabling the internet a Human-centric process. To that end, collaboration between the EU and the US is essential, both areas being strongly committed to develop the future of Internet, to shape a sustainable landscape for NGI developments. Indeed, the NGI initiative should design specific actions for policy collaboration, shared technology development and interaction between user-communities, with other initiatives in the world where parts of the NGI infrastructure are designed and deployed; and the US are one of the main places where such activities are held.

Think NEXUS aims to reinforce EU-US collaboration, through its dedicated think tank, involving major stakeholders (researchers, entrepreneurs, policy makers) from both sides of the Atlantic on NGI-related thematic in three Focus Areas: Science and Technology, Innovation and Entrepreneurship and Policy. Its mission is to become an important and lasting entity, involving stakeholders and disseminating NGI visions in a collaborative approach for tackling NGI challenges, and benefit society at large. More specifically, Think NEXUS is expected to boost the strategic research, industrial partnerships and policy compliances among the respective communities of the NGI areas and thus, result in substantial socio-economic benefits in both the EU and US regions.

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Executive summary

The Think NEXUS Workshop #3 "titled "Key NGI technologies in the EU-US context – second workshop" was held on April 21st, 2021 through a virtual means (Zoom). The Workshop took place between 5pm and 7pm CEST and brought together some 30 experts from Europe and the United States (US) on Next Generation Internet-related domains.

This Workshop built upon the outcomes of the workshop organised on February 17th, 2021. During the previous workshop participants identified the main technologies to prioritise for EU-US cooperation on Next Generation Internet (NGI). Therefore, this Workshop provided participants with the chance to further define priorities for EU-US cooperation on NGI topics. The outcomes of this Workshop will be provided to the European Commission (EC) and the National Science Foundation (NSF) as part of a relevant roadmap for cooperation.

The event started with a short introduction to the Workshop's framework and logistical aspects. After that, experts were divided in two breakout rooms according to the two thematic priorities that had been decided for the Workshop, one for Data and the other one for Infrastructure. After having selected the key technologies, domains and mechanisms enabling the developments of NGI, a last plenary session enabled the experts to merge the outcomes of the previous discussions to get a common view on the main priorities in terms of key technologies and domains for future EU-US cooperation.

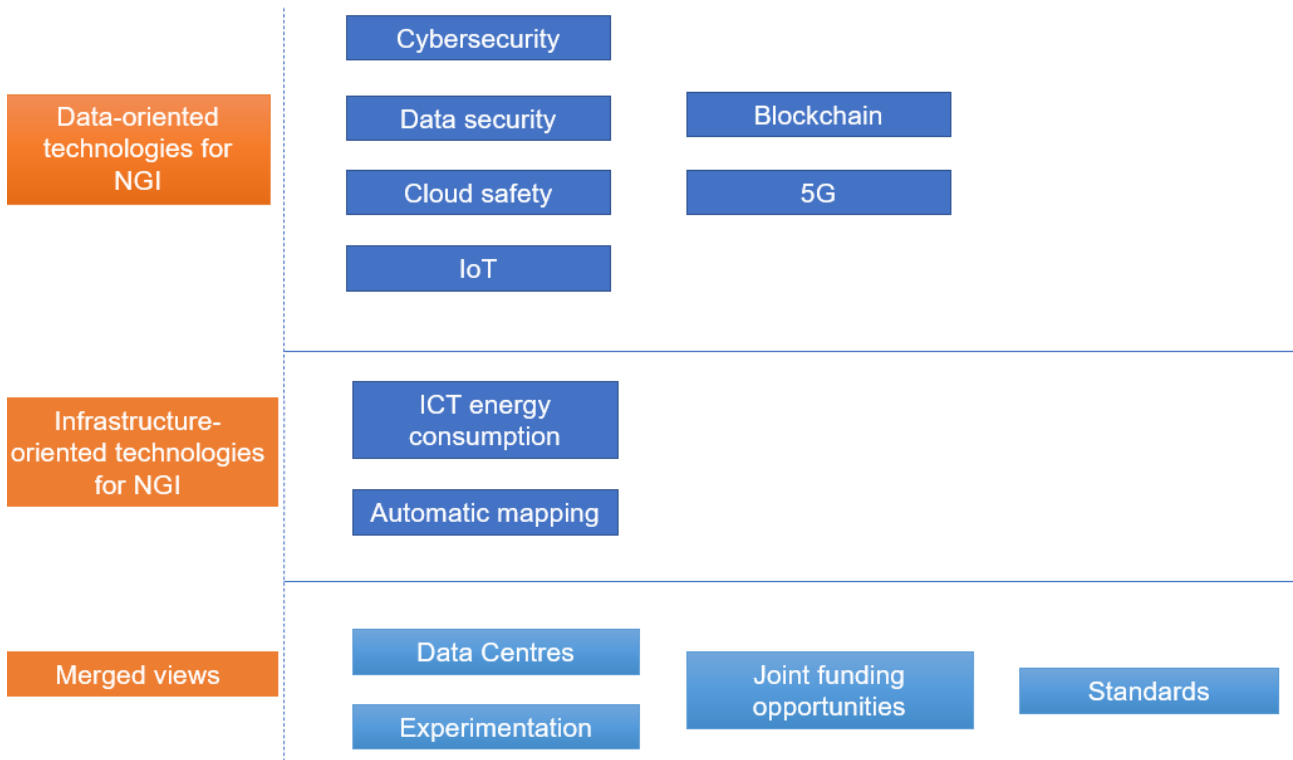The main topics discussed during the Workshop's sessions are presented in Figure 1.

Figure 1. Main topics discussed during the Workshop

1. Introduction

This document presents the key information and contributions collected during Think NEXUS' Workshop #3 "titled "Key NGI technologies in the EU-US context – second workshop", which was held virtually on April the 21st, 2021.

This was an invitation-only Workshop, which included the participation of 30 experts from EU countries and the US. The experts were carefully selected and invited through personalised e-mails and direct contacts done by Think NEXUS' partners and built upon the expert participation from previous Workshops to ensure a certain degree of continuity.

Figure 2. Dissemination banner

1.1. Context and objectives

In a changing world, facing a pandemic, it is essential to build bridges and provide decision makers with common views on the future of the Internet and the Digital Economy.

The European Commission (EC) recently published its new Digital Agenda for the next 5 years, that includes the Digital Services and Digital Market Acts. In parallel, the US has a new administration that will undoubtedly pave the way for new transatlantic cooperation opportunities in internet-related areas (Figure 3).
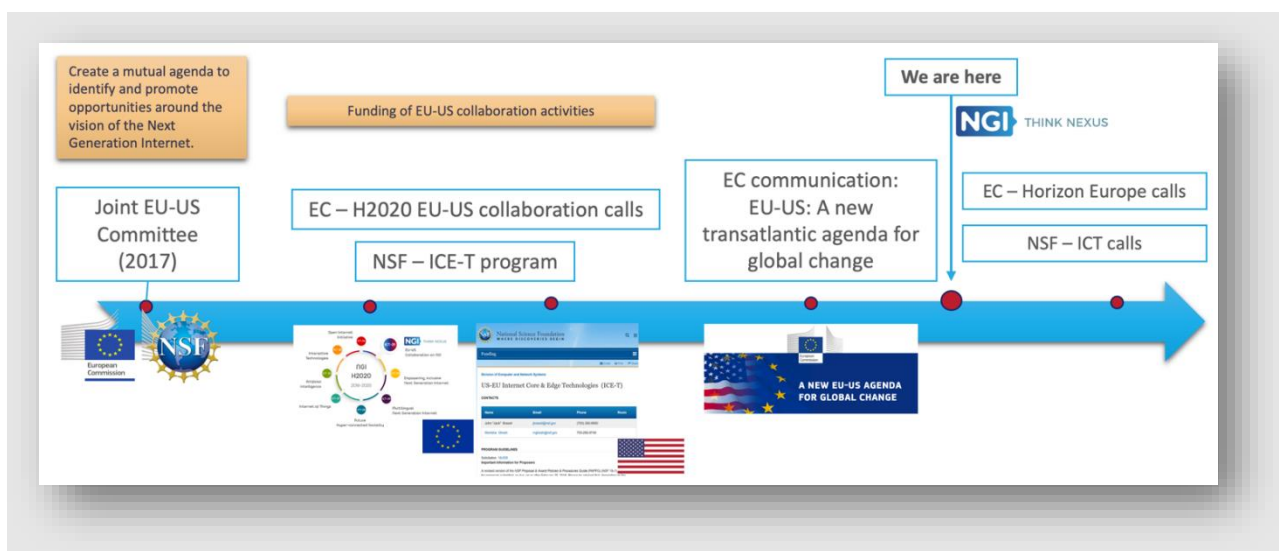
Figure 3. High-level timeline of EU-US cooperation on NGI

Think NEXUS builds upon the insights and experiences of leading European and US experts on NGI for mapping key topics for forthcoming EU-US cooperation. It is within this context that Think NEXUS organised an online international workshop to further encourage and facilitate discussions and exchanges between the experts with the aim of identifying the main topics for future EU-US cooperation.

This Workshop built upon the previous Workshop organised on February 17th[1] and allowed participants to further define priorities for EU-US cooperation on NGI topics. In this sense, the Workshop fostered discussions around the following areas:

Data-oriented technologies for NGI:	Infrastructure-oriented technologies for NGI
- Cyberphysical systems / IoT and Cybersecurity; - Machine learning at the Edge (with Privacy and Security); - Cybersecurity technologies and applications; - Anonymity and privacy; and - Distributed ledgers	• Cloud at the Edge; • Network / Cloud / Edge infrastructures; • Green NGI / Green Edge Computing; • Increased resilience; • Latency reduction; • Future-proof capacity; • Host neutral infrastructures; and • Infrastructures in support AI/ML

1.2. Agenda

The agenda of the Workshop included one introductory session; two breakout rooms focused on respectively Data and Infrastructure-oriented topics; one plenary session with all the participants; and a conclusion session.

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[1] D2.5 – Thematic Workshop #2 report can be found at: https://thinknexus.ngi.eu/wp-content/uploads/2018/10/Think-NEXUS-D2.5-%E2%80%93-Thematic-Workshop-2-report_v1.0.pdf

All the sessions were facilitated by the project partners. The full agenda of the Workshop is presented below (Figure 4).

TIME	SESSIONS
15 min.	**Welcome & Introduction** Marc Pattinson (GAC) – Think NEXUS project coordinator
40 min.	**Preparatory session: Defining NGI topics of high importance for EU-US cooperation for the next years** This session aims at fostering discussions between experts, with the moderation of a Think NEXUS partner. During this session, two parallel sessions mixing EU and US experts will be organised over the technologies listed above. **Parallel session 1: Data oriented technologies for NGI – Moderated by Antonis Ramfos (ATC) – Think NEXUS Partner** Group #1 will focus on data-oriented technologies for NGI: • Cyberphysical systems / IoT and Cybersecurity • Machine learning at the Edge (with Privacy and Security) • Cybersecurity technologies and applications • Anonymity and privacy • Distributed ledgers **Parallel session 2: Infrastructure oriented technologies for NGI - Moderated by Peter van Daele (IMEC) – Think NEXUS Partner** Group #2 will focus on Infrastructure oriented technologies for NGI: • Cloud at the Edge • Network / Cloud / Edge infrastructures • Green NGI / Green Edge Computing • Increased resilience • Latency reduction • Future-proof capacity • Host neutral infrastructures • Infrastructures in support AI/ML
50 min.	**Plenary session: Merging views** The objective of this session is to merge the outcomes of the previous discussions to get a common view on the main priorities in terms of key technologies, and for EU-US cooperation. This session will promote an open discussion between EU and US experts, which will be moderated by José Gonzalez (AUSTRALO).
15 min.	**Wrap up and conclusions** Presented by Marc Pattinson

Figure 4. Workshop agenda

2. Methodology

2.1. Topics' definition

Due to the travel restrictions in place related with the COVID-19 pandemic, this Workshop was organised by virtual means (using Zoom). For enabling this event to provide Think NEXUS' consortium with relevant outputs, despite the lack of 'physical interactions', this event was carefully prepared in advance by all project partners.

As a first step, the main technologies identified as relevant for EU – US cooperation during the previous Workshop held on February 17th were considered as the basis for the discussions held during this Workshop. This list of technologies was validated with the European Commission and afterwards shared with the experts through the Workshop's agenda (Table 1) and previous Workshop report.

Table 1. Key domains / technologies identified in the Workshop organised on February 17th

AI technologies and applications	Cyberphysical systems / IoT and Cybersecurity	Cloud computing developments
• AI / Machine learning for networking systems • Machine learning at the Edge (with Privacy and Security) • Human in the Loop Control • AI governance and citizens challenges	• Machine learning at the Edge (with Privacy and Security) • Cybersecurity technologies and applications • Cloud at the Edge	• Data sovereignty • Anonymity and privacy • Quantum technologies and applications for cybersecurity • Homomorphic encryption for privacy • Distributed ledgers

In order to further explore these topics and better plan the flow of the discussions promoted during the Workshop; the project team prepared a dedicated questionnaire that was sent to the experts that registered to the Workshop. The questionnaire was sent to all the registered participants prior to the Workshop. Figure 5 provides a screenshot of one of the questionnaire's pages.

Information on the expert

On which "side" of the Atlantic are you currently working ?

ⓘ Choose one of the following answers

○ USA

○ Europe

● No answer

What is/are your area(s) of expertise ?

ⓘ Check all that apply

☐ Artificial Intelligence related

☐ Cyberphysical systems / IoT

☐ Cloud computing

☐ Blockchain related

☐ Diversity, equity and inclusion in STEMs

Figure 5. Think Nexus Workshop #3 preparatory survey

The project team received 24 answers to the preparatory survey.

2.2. Preparatory questionnaire feedbacks

As abovementioned, 24 experts replied to the online preparatory questionnaire that was sent to all registered participants prior to the event.

Since none of the questions of the questionnaire was marked as mandatory, out of the 24 experts that replied to the questionnaire, 11 stated that they work in European countries and three work in the US.

Regarding the areas of expertise of the participants that replied to the questionnaire, 12 participants are experienced in Artificial Intelligence related fields; 8 participants are experts in Cloud Computing; 7 participants are experts in Cyberphysical systems / IoT; 3 participants are experts in Diversity, equity and inclusions in STEM, while 2 participants are experienced in Blockchain related areas (Figure 6).
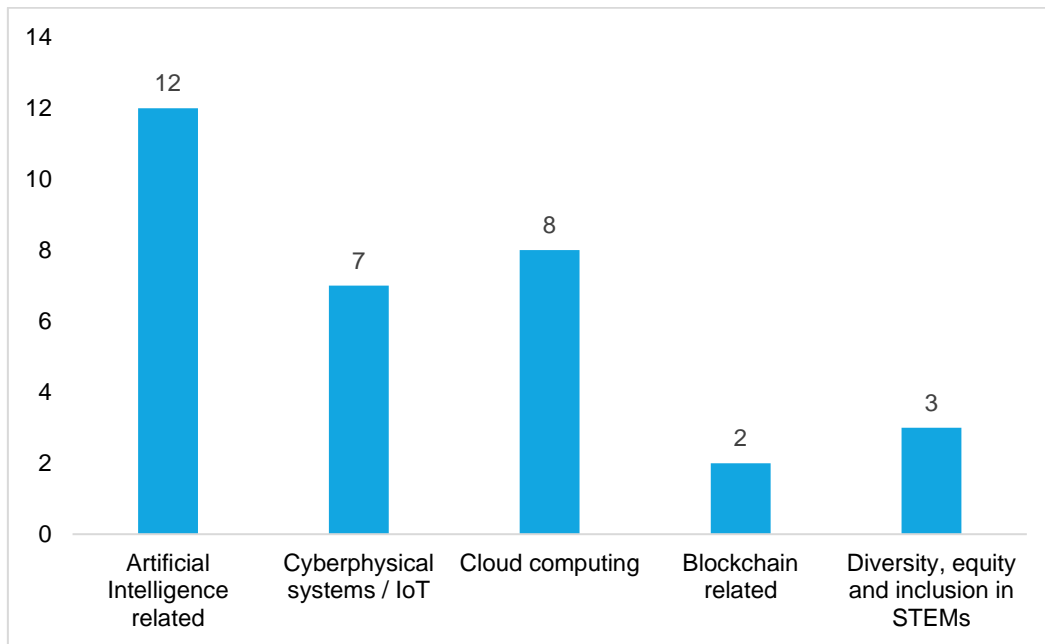
Figure 6. Areas of expertise of the participants that replied to the questionnaire

Furthermore, the participants were asked to select up to three technologies/areas among upon which they could provide European and US agencies with inputs. The results of this question are provided in Figure 7.

Figure 7. Main technologies for provision of inputs

The results of the preparatory questionnaire were used to better define the scope and outline of the sessions of the Workshop and structure the session animation led by the TN project moderators.

2.3. Workshop outline and management

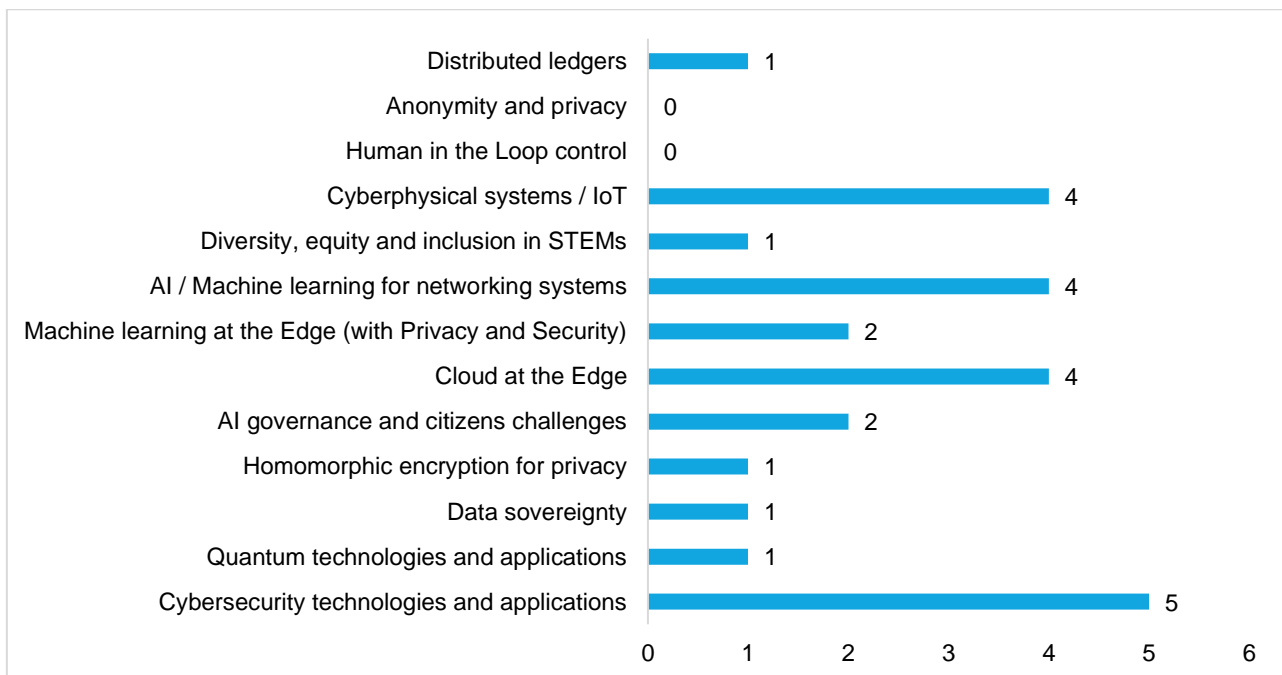The project partners designed a Workshop that allowed experts to contribute to discussions through a highly collaborative and open manner. In this sense, the team decided to divide the experts into two technology-focused breakout rooms, namely "Data-oriented technologies for NGI" and "Infrastructure-oriented technologies for NGI".

Contrarily to the methodology used in the Workshop held on February 17th, the experts were not distributed by regions, which means that there were no EU and US tracks. In this Workshop, the experts from Europe and US were distributed taking into account their technological background ensuring greater interactions from the outset between the two geographical entities.

The breakout rooms were focused on the following main domains/technologies (Table 2).

Table 2. Main domains/technologies per breakout room

Data-oriented technologies for NGI:	Infrastructure-oriented technologies for NGI
- Cyberphysical systems / IoT and Cybersecurity; - Machine learning at the Edge (with Privacy and Security); - Cybersecurity technologies and applications; - Anonymity and privacy; and - Distributed ledgers	- Cloud at the Edge; - Network / Cloud / Edge infrastructures; - Green NGI / Green Edge Computing; - Increased resilience; - Latency reduction; - Future-proof capacity; - Host neutral infrastructures; and - Infrastructures in support AI/ML

The moderation of the sessions was done by the Think NEXUS' partners. The introduction and conclusions sessions were moderated by Marc Pattinson, from GAC, while discussions within the breakout rooms were moderated by Antonis Ramfos, from ATC (Data breakout room), and Peter van Daele, from IMEC (Infrastructure breakout room). The plenary session on merging views was moderated by José Gonzalez from AUSTRALO. SPI provided technical support to the sessions.

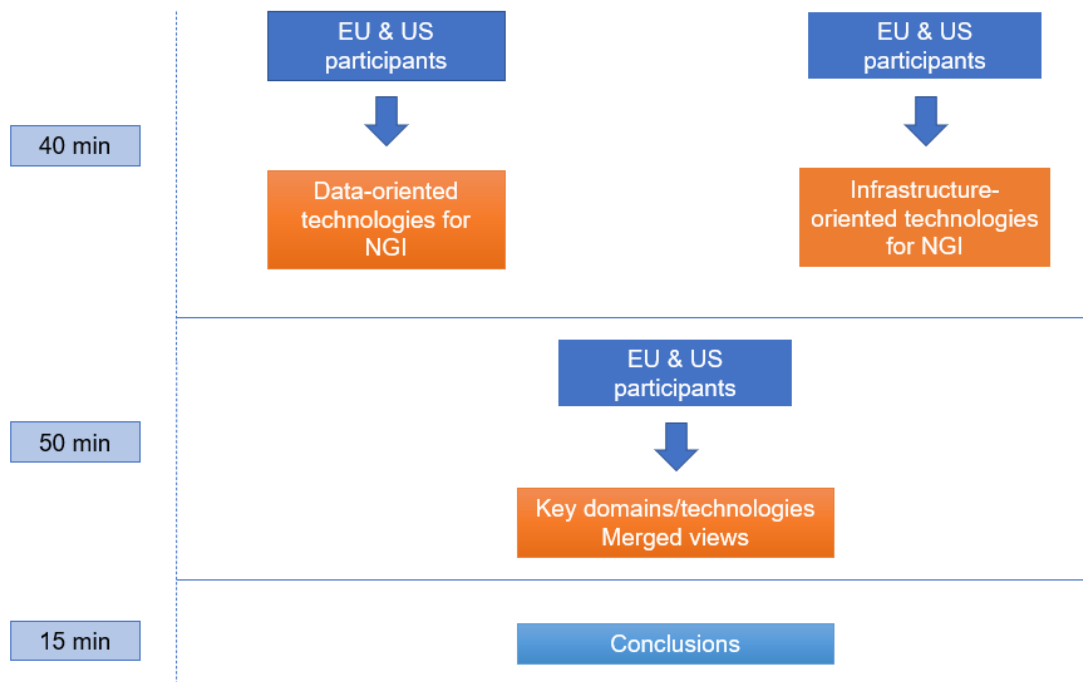Figure 8 provides an overview of the Workshop's format.

Figure 8: Workshop methodology

With the aim of enabling a participatory approach during the discussions, the project team used shared Word files. In this sense, the participants and the moderators were able to collect real-time inputs during the discussions and these were subsequently used in the plenary session and in the workshop report write-up.

3. Main discussed topics

3.1. Data-oriented technologies for NGI

Following the aim of this Workshop, during the breakout session "Data-oriented technologies for NGI" participants were asked to provide their views regarding the following questions:

- How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?
- What technologies and schemes should be prioritised for enabling these developments?
- In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach

Main outcomes of the discussions:

How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?

- ➢ Cybersecurity, data security, and cloud safety are highly important for EU-US cooperation. There have been recent attacks that breached the cloud. Thus, currently hardware is the root of trust. In this sense, one of the things to be considered is uncovering the layers of the modern computers.

- ➢ The EC has been doing an effort to promote data spaces and data hubs for data sharing and open access. These spaces allow people to do experiments in a secure environment. The US Government has also been trying to promote the creation of similar spaces through the NSF Big Data Hubs initiative.

- ➢ Regarding Internet of Things (IoT) it is very important to ensure security under this domain.

- ➢ IoT is a very important topic for EU-US cooperation. In this sense, there are already robust partnerships between industry and associations in the US. In fact, in the US, IoT is progressing to an ISO standard due to the need for creating baseline standards in this domain.

- ➢ Common privacy standards may be explored as well as taking into account the EU's General Data Protection Regulation and the willingness of some US states to create their own standards.

- ➢ 5G is also highly relevant for EU-US cooperation. It is important to create more storage options and rapid communication paths due to the high volume of data that is generated.

What technologies and schemes should be prioritised for enabling these developments?

- ➢ Data hubs and data at the edge are domains that can be leveraged through Horizon Europe. In fact, the draft version of Horizon Europe Cluster 4 "Digital, industry and space" already highlights topics such as standards and standardization. Therefore, joint proposals between EU and US organisations under these domains could be a way to foster international cooperation.

> There is a need to capitalise funding opportunities to data spaces for healthcare. This is a highly important area that generates large data volumes.

> Electronic records have to be top-down. New data is exploding and, therefore, there is a need to create new data policies and new agreements.

> The EU's Digital Innovation Hubs and the NSF Big Data Hubs are key instruments to foster cooperation on data.

> The COVID Information Commons serves as an open resource to explore NSF-funded research addressing the COVID-19 pandemic. The COVID Information Commons is an open website to facilitate knowledge sharing and collaboration across various COVID research efforts, initiated by the NSF Convergence Accelerator. This is a leading instrument in terms of data and knowledge sharing.

> The continuous changes in the NSF board are a negative factor for EU-US cooperation since it makes it more difficult to foster long standing relations between the NSF and the EC.

In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach?

> Health, agriculture, and manufacturing are leading areas of interest for EU-US cooperation.

> Blockchain is going to be a strong independent contributor for IoT, data governance, and privacy.

> Fake news, misinformation and disinformation are topics of increasing importance. It is highly relevant to find ways to fight misinformation and understand the true source of information. Stronger legislation against missing information is important and needed.

> Liability and cybersecurity are important topics for the development of joint studies between EU and US organisations.

> Energy monitoring is a big opportunity in terms of data. However, the GDPR is not suitable for energy monitoring. Thus, open science is a key term and data hubs are crucial to foster energy monitoring.

> The skills from the data scientists need to be brought to the sectors. Thus, the development of training programmes is highly important to link data scientists to the existing sectoral needs in the data context.

Table 3 summarises the main topics of discussion per question raised during the breakout session "Data-oriented technologies for NGI".

Table 3. Summary of the main topics of discussion on breakout session "Data-oriented technologies for NGI"

Questions	Main topics of discussion
How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?	• Cybersecurity, data security, and cloud safety • Data spaces and data hubs • IoT • Privacy standards • 5G
What technologies and schemes should be prioritised for enabling these developments?	• Horizon Europe • Digital Innovation Hubs • NSF Big Data Hubs • COVID Information Commons
In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach?	• Health, agriculture, and manufacturing • Blockchain • Fake news, misinformation and disinformation • Liability and cybersecurity • Energy monitoring • Data training programmes

3.2. Infrastructure-oriented technologies for NGI

Following the same methodology defined for the breakout session "Data oriented technologies for NGI", the participants of this breakout session were asked to provide their views regarding the following questions:

- How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?
- What technologies and schemes should be prioritised for enabling these developments?
- In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach?

Figure 9. Discussion breakout session "Infrastructure-oriented technologies for NGI"

Main outcomes of the discussions:

How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?

➢ There is a need to set objectives regarding the technological capacity growth of each country/region.

➢ Currently, the ICT energy consumption is very high and, therefore, it should be made as low as possible (focus on limiting growth). Greener solutions are required. One of the solutions to overcome this problem is the development of collaborative, experimental research activities conducted between EU and US organisations on infrastructure solutions.

➢ There is a need to conduct real market analysis, i.e., to develop demand modelling analysis beyond traffic projections (e.g., energy vs. latency).

➢ The development of automatic mappings from intent to specific programmable elements is also a pressing need in terms of EU-US cooperation.

➢ The applications developed should be people-centric and take into account the real needs of the people, at the same time that comply with all the security requirements.

➢ The systems that are develop should also be simple. Developers should avoid the creation of highly complex systems, which are not user-friendly.

➢ Experimental ideas and rapid prototyping should be encouraged.

> ➢ There is a need to develop a set of national/state standards to contribute to the increasing standardization of the infrastructure domains.

What technologies and schemes should be prioritised for enabling these developments?

> ➢ There is a need to develop schemes that foster network analysis, including data analysis, user analysis, and infrastructure analysis.

> ➢ Experimentation and the provision of infrastructures for experiments should be prioritised.

> ➢ "Softwarization" should also be promoted by new schemes.

In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach?

> ➢ The EU and the US can benefit from developing a collaborative approach on experimentation and shared infrastructure capacity.

> ➢ It is also relevant for EU-US cooperation to compare different solutions and develop a network "use" analysis.

> ➢ Precision telemetry in all aspects is also highly relevant for EU-US cooperation.

> ➢ Digital twins are also a pressing area for EU-US cooperation.

Table 4 summarises the main topics of discussion per question raised during the breakout session "Infrastructure-oriented technologies for NGI".

Table 4. Summary of the main topics of discussion on breakout session "Infrastructure-oriented technologies for NGI"

Questions	Main topics of discussion
How should these technologies / solutions be investigated and supported for developing and deploying the next Internet developments?	• ICT energy consumption • Joint collaborative and experimental projects • Automatic mapping • People-centric approach • Standards • Simplicity and rapid prototyping
What technologies and schemes should be prioritised for enabling these developments?	• Network analysis, including data analysis, user analysis, and infrastructure analysis

Questions	Main topics of discussion
	• Experimentation • Softwarization
In which of these trends does the US/ the EU have a clear advantage to cooperate and be supported in a collaborative approach?	• Experimentation • Comparison of different solutions • Precision telemetry • Digital twins

3.3. Plenary session

After the two breakout room sessions, experts were invited to discuss together and share and exchange their views on data and infrastructure. At the beginning of the plenary session, both moderators explained the main outcomes of each breakout session in order to provide the experts with information about simultaneous discussions. After that, the experts were invited to react and share their views on the main questions previously discussed.
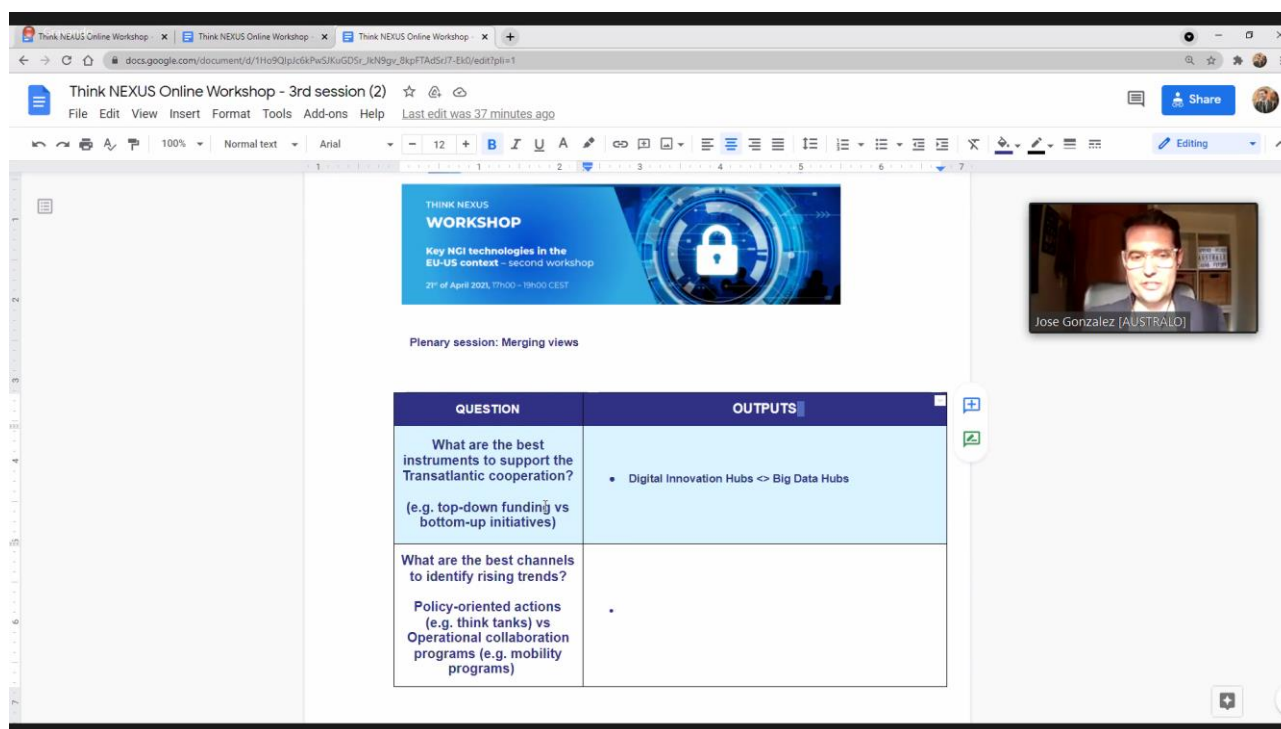

Figure 10. Discussion of the Plenary Session

Main outcomes of the discussion:

What are the best instruments to support the Transatlantic cooperation? (e.g., top-down funding vs bottom-up initiatives)

- ➢ The creation of related activities, such as Digital Innovation Hubs and NSF Big Data Hubs shows that the EU and the US have shared priorities related with data.

- ➢ There is a need to foster networking between similar small scale (e.g., NSF Fabric and NGIAtlantic) and large-scale initiatives (e.g., NSF GENI and FIRE).

- ➢ The European and US funding agencies need to be flexible to accommodate shared internet-related priorities. The launch of open calls would be away to foster EU-US cooperation on topics of shared interest.

- ➢ Another way to foster EU-US cooperation is to fund excellence. In this case, the projects that already received financial support and achieved valuable outcomes would be able to receive a new round of funds.

- ➢ There is a need to attract new talent and motivate researchers to be more ambitious. The researchers should have an agile culture.

What are the best channels to identify rising trends?

Policy-oriented actions (e.g., think tanks) vs operational collaboration programmes (e.g. mobility programs)

- ➢ Experimentation is key for EU-US collaboration.

- ➢ Data is a good instrument for EU-US cooperation and a common baseline.

- ➢ There is a need to foster joint discussions on data analytics and biases.

- ➢ There is a need to identify specific topics for EU-US cooperation rather than matchmaking efforts (e.g., digital twins). This can help define and design experiments.

Table 5 provides an overview of the main outcomes of the plenary session.

Table 5. Summary of the main outcomes of the plenary session

Questions	Main outcomes
What are the best instruments to support the Transatlantic cooperation? (e.g., top-down funding vs bottom-up initiatives)	• The Digital Innovation Hubs and NSF Big Data Hubs are an important example of the existence of shared priorities. • The EU and US funding agencies should launch funding schemes for joint calls.
What are the best channels to identify rising trends? Policy-oriented actions (e.g., think tanks) vs operational collaboration programmes (e.g., mobility programs)	• Experimentation is key for EU-US collaboration. • Data is a highly important topic for EU-US collaboration.

4. Conclusions

The Thematic Workshop #3 was held virtually on 21st of April 2021 and was attended by 30 participants from EU countries and the US.

During the discussions promoted in this Workshop, participants from both regions identified and agreed on the importance of developing collaborative activities in NGI-related areas. Collaboration should focus on some key data-related domains/technologies, such as **cybersecurity, data security, cloud safety, IoT, privacy standards, blockchain** and **5G**. During the discussion of the Data breakout room, **health, agriculture, manufacturing** and **energy** were identified as the main sectors for cooperation as regards to the domains/technologies highlighted.

Moreover, the participants also highlighted the importance of infrastructure-related domains/technologies for EU-US cooperation, such as **ICT energy consumption, automatic mapping,** and **standards**. **Simplicity, rapid prototyping and experimentation** were highlighted as key areas for cooperation.

The role of the EU's **Digital Innovation Hubs** and the **NSF Big Data Hubs** was also highlighted as an important topic for EU-US cooperation. These represent a good example of how the EU and the US have similar priorities as regards to data.

In terms of the available funding schemes and instruments, the role of the **EU and US funding agencies** was considered to be key to foster joint projects and experimentation. These agencies should also implement mechanisms that promote excellence through the provision of follow up/next rounds of funding to projects that achieved valuable results.

Overall, the Thematic Workshop #3 provided experts with a valuable opportunity to share their opinion regarding the main technologies/domains and schemes for EU-US cooperation. The outcomes of the Workshop are highly valuable to pave the way for the EU-US cooperation on NGI related topics both in the short and medium term.