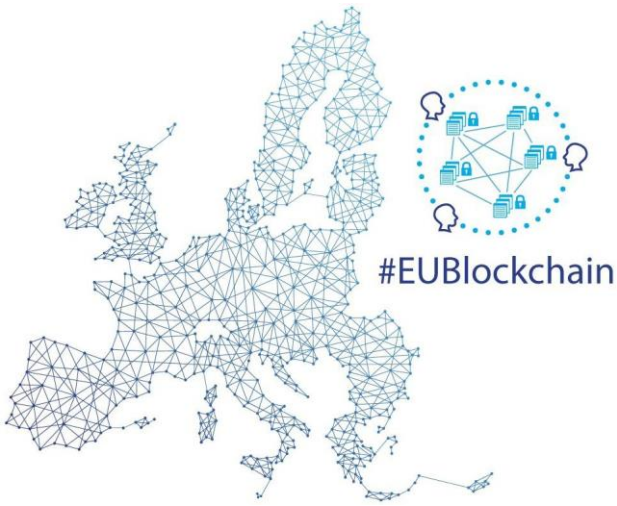
EU BLOCKCHAIN OBSERVATORY & FORUM

Convergence of Blockchain with AI and IoT (EU Blockchain Week 2021) – Online Video Conference, 21 September 2021



By the European Commission, Directorate-General of Communications Networks, Content & Technology.

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WELCOME

Helen Kopman, Deputy Head of Unit Digital Innovation & Blockchain, European Commission welcomed everyone to the workshop organised by the EU Blockchain Observatory and Forum in the frame of the EU Blockchain Week 2021, under the auspices of the Slovenian Presidency of the EU, and noted that the intersection between IOT, Artificial Intelligence and blockchain and how these technologies can work together is a very interesting topic and that the industry is already working in that direction.

The European Blockchain Week organizers, commenced the workshop and gave the floor to Dr. John Soldatos, R&D Consultant and Innovation Delivery Specialist at INTRASOFT International.

PRESENTATION ON «BLOCKCHAIN BASED DATA PROVENANCE FOR TRUSTED AI AND INDUSTRIAL IOT SYSTEMS», JOHN SOLDATOS, INTRASOFT INTERNATIONAL

John Soldatos, R&D Consultant, and Innovation Delivery Specialist at INTRASOFT International, started the presentation noting that there are some things that are compatible about blockchain and AI, but there are also some incompatibilities, especially in the sense that when building artificial intelligence, there are usually very large volumes of data for training algorithms which require more scalable big data infrastructures.

Dr Soldatos referred to a H2020 project called "STAR" which is about Technology for Trusted AI in manufacturing, and develops technology for making AI trustworthy, reliable, explainable, and transparent to users. The project is developing blockchain technology to ensure the provenance and reliability of industrial data. In addition, when deploying AI, another requirement is to have a strong cyber security before the AI system.

He presented some use cases of blockchain in manufacturing and explained that blockchain in industrial applications should be used when there is a need for a shared database, or a need for a database with multiple writers or a need for interactions between transactions in the database. One of these use cases is Blockchain systems for data provenance and traceability where there is convergence between blockchain and artificial intelligence. To ensure the reliability of industrial data, blockchain infrastructure can be leveraged, not only to provide basic data provenance and traceability but also to extend these to parameters of algorithms, the AI outcomes, in order also to alleviate potential adversarial attacks. The research community has been proposing this as a blockchain application in the last two or three years, and there are similar systems coming from universities such as the Tennessee State University and the University of Texas at Dallas.

STAR Project value propositions though are the reliable algorithms (provenance of AI algorthims metadata and configurations-"Sealed" algorithms) and the reliable AI Outcomes (provenance of AI analytics outcomes –"Sealed Outcomes").

STAR solution is based on Hyperledger Fabric from Linux Foundation, and the project uses some features offered such as the different channels for authentication and authorization purposes. The main idea though, goes into the Benchmarking for (Permissioned) Blockchain Selection and the need for a high-performance blockchain offering thousand transactions per second. Then, there is a Probes Modelling, a data collection system, called "run-time monitoring system" that collects data and tries meta data like statistical properties of the data to the blockchain, along with meta data of algorithms

and analytics outcomes. Dr Soldatos then presented an example of defending a poisoning attack and concluded his presentation by providing additional resources about this concrete case of convergence of blockchain with AI.

On a question by the moderator on how does blockchain technology supports IoT and what are the limitations, Dr Soldatos replied that there are many good applications for a multi-domain traceability for supply chains in different industries, so there is already a very good pool of proof of concepts and a very rich set of pilots about how to combine IoT with blockchain. What is currently lacking is something to scale as much as crypto has scaled in the digital finance sector.

PRESENTATION ON "RESPONSIBLE DIGITAL LEADERSHIP PROJECT AT STANFORD UNIVERSITY: MAKING A DILEMMA LIBRARY FOR LEARNING", SOREN JORGENSEN, RESEARCH FELLOW, STANFORD UNIVERSITY

Following Dr Soldatos' presentation, the floor was given to Soren Jorgensen, Research Fellow at Stanford University, who was joined by two researchers, Rodolfo Farias and Felix Roesner. Mr Jorgensen, began his presentation with a brief introduction of the project on Responsible Finance they have been working on along with European and international banks and insurance companies on how to integrate data ethics or ethical principles into business practices. Technologies like blockchain hold enormous possibilities but they also involve ethical challenges or ethical problems, which raise a high number of challenges such as asymmetrical power relations, energy consumption and compliance issues.

He referred to the need of balanced guidelines to ensure responsible data and responsible use of technology. The project reached out to about 10 universities all over the globe in Brazil, Nigeria, South Africa, India, Singapore, China, north America, and Europe, and brought together a team of about 50 mostly PhD or masters level students from these universities. The group also includes international financial sector institutions; it's a very diverse group that has geographical inclusivity.

With this intentionally diverse global effort, the project explores the risks of technology use, with a mission of future-proofing the financial sector against getting the ethics of data and AI wrong. In doing so, they seek to set in motion a global, culturally-conscience, ethically trained emerging workforce that has the potential to influence responsible technological innovation.

The team has created a research tool, a template for data gathering and description of findings. The process includes literature reviewing, interviewing experts and a design thinking approach in exploratory and solution-oriented paths. The two main outcomes from the team's work are: a) Research (white papers, blogs, articles etc.) and b) Technical Solution (analogue conversation platform and Game (VR). Mr Jorgensen gave a snapshot of the status of the project, as the team collects the dilemmas in in five tracks and is currently reviewing them and have identified about 50 ethical issues or ethical topics related to the use of technology in the financial sector. The team has identified issues such as the well-known issue of energy consumption, risks related to social exclusion and marginalized groups, money laundering etc. The intention of the project is to use the findings as a call for a learning platform for corporate learning and promote responsible culture within organizations.

Rodolfo Farias took the floor and expanded on the ethical dilemma on how far the regulation should go and what is the balance between allowing innovation and prohibiting new activities. The focus is to understand how regulators are addressing the problems related with blockchain, AI and IoT, and what

are the outcomes from these interferences as different jurisdictions have opted for different regulatory designs.

Felix Rosner joined in the presentation and talked about the current controversy between the right to be forgotten and the immutability of the blockchain. He referred to Article 17 of the GDPR and that the ethical issue raised is to what extend can privacy be assured when storing data and transaction on a blockchain. He raised the issue of the legal and technical perspectives on the implications of the "Right to be Forgotten" in the blockchain space and whether it should be reconsidered.

The moderator, Dr Konstantinos Votis, emphasized that these ethical issues that have been raised are important and that legal parties should incorporate people with technical backgrounds, so that they understand and try to solve these issues. Soren Jorgensen agreed, and mentioned that it's also important to learn how to bridge languages and cultures between faculties, relations between academics and industry and with regulators and politicians. On another question by Dr Votis about which region is more competitive in blockchain, based on the project, Mr Jorgensen replied that he would point to Asia where things are happening very rapidly.

PANEL DISCUSSION: CONVERGENCE OF BLOCKCHAIN WITH AI AND IOT

Moderated by Dr. Konstantinos Votis

- Dr Tatjana Evas, AI Unit, DG CNECT, European Commission
- Rolf Riemenschneider, IoT Unit, DG CNECT, European Commission
- Fabrizio del Maffeo, CEO of Axelera AI
- Dr Bruno Lepri, Head of Mobile and Social Computing (MobS) Lab, FBK

Objectives of the session:

- To explore policy and industry perspectives on the convergence of blockchain with AI and IoT
- To explore the ethical issues and challenges raised by the convergence of blockchain with AI and IoT

Main outtakes from the session:

- The moderator, **Dr Konstantinos Votis** presented the panelists and initiated the discussion.

- The first question was about legal issues and how they should be taken into consideration for using data and having AI algorithms analyze these data. **Dr. Tatjana Evans**, DG CNECT, European Commission, took the floor to discuss the European Framework on Artificial Intelligence. She went on to explain that the Proposal for a Regulation AI Act builds on the existing regulation but the Act is looking into horizontal rules aiming to turn Europe into the global hub for trustworthy AI. The objective is to ensure the safety and fundamental rights of people and businesses, while strengthening AI uptake, investment, and innovation across the EU. The Act tries to build a future-proof, innovative level playing field for everybody who are planning to put into service or bring it into the market. AI technologists will be subject to the same rules. Dr Evans highlighted that in addition to this regulation, where the key focus is to boost the trust, the coordinated plan on AI was proposed and adopted. It's a strategic document between the European Commission and 27 EU member states, which looks at strategic sectors and enables the conditions needed to boost excellence and European competitiveness in AI. The EU sees both the blockchain and the AI as one of the priority areas and invest heavily in both. Dr Evans concluded her remarks explaining the funding that the EU plans to invest in the

next years through the Digital Europe Programme, the Horizon Europe Programme and the Recovery and Resilience Facility.

- On a follow-up question about the ethical considerations on the combination of AI, IoT and blockchain, Dr Evans replied that ethical guidelines are very important, but cannot substitute legal requirements.
- **Dr Bruno Lepri** followed, referring to both high risk and less risky type of AI system and to his research about building AI system and computational models that try to interact with human beings and take mixed decisions with human beings. There are aspects related to the profiling and personalization type of method that requires some type of regulation and some type of standards. This means that for example, the type of system that is introduced in the market needs to avoid discrimination or biases, and this is an aspect taken very seriously into consideration by policymakers in Europe. Dr Lepri mentioned that AI has a lot of things that need to improved but it is way to develop good technology.
- **Fabrizio del Maffeo** joined the discussion and said that AI is moving to the edge because it's not possible to send all data to the cloud. More and more data are in the form of images and video and the problem of what happens to the images and videos must be solved by filtering, validating and protecting the data. He raised the severe concern of what the camera is recording and how AI can filter those recordings (images or videos) to be sure that whatever the camera is pointing to, it's should not be transferred and the information should stay locally and make sure that what is transferred through a protocol of trust is approved by the user. He concluded that the European Commission did an extremely good job in identifying the ethical risks and the framework that sooner or later will be used, to allow AI to be used in the edge application.
- **Rolf Riemenschneider**, IoT Unit, DG CNECT, European Commission presented the HORIZON CL4 and a project called “From Cloud to Edge to IoT for European Data” and referred to the need of a strategy for cloud considering the transition from cloud to edge, to IoT for data. The trouble of IoT today is that the majority of IoT data is directly transferred to clouds. On top of that, it's transferred to the cloud of new manufacturer of the device, so, it should be combined in different devices, and data will be in a cloud somewhere and it will be in a silo. One issue related to that is the attacks surfaced from IoT devices. What the user needs is to have some intelligence around them, understanding what's happening, the context, the situation, and do some reasoning before taking action. There are a lot of issues related to privacy from the IoT point of view such as how to identify devices and validate the devices in the environment, and also about the idea of identification of the devices on the security side. That’s why Europe focuses to shift from cloud to edge, to IOT devices, to have a new way of orchestration. Particularly in the area of AI, it would make sense to have more intelligence at the edge and decisions decentralized.
- On a question about federated learning and federated models training, **Dr Bruno Lepri** said that it’s about having AI that is distributed and in particular a permit to work on data that doesn't move from the premises of company or in the case that there are personal data from the personal device of individuals. The idea is to have personal data stored and that as a user, as a citizen you have the control of your own personal data. One of the solutions envisioned is that data are never moved, but the algorithm is moved or even better there is a federated learning on the node of the company or on the node of the individuals’ devices that can learn things, and then they share a parameter and insight without sharing their own information. He referred to INFINITECH, a H2020 flagship project, where a system is built, a framework to activate a personal data market between entities (citizens). The idea is that learning is completely distributed and federated and one of the things that INFINITECH does, is to use blockchain to record the transition and the exchange of insights. There is a cooperative type of learning approach between different entities, and they need to share these insights to solve a task together. These exchanges are recorded on the blockchain and together with the usage of a token, they give a sort of economic value of this type of exchange to solve a task. The important

thing is that raw data are never moved and never recorded on the blockchain, only the insight of the parameter of the learning algorithm is recorded.

- On a question about the new opportunities or challenges related to governance and privacy, Dr **Tatjana Evans** said that the EU strongly holds to GDPR and remains strong in data protection rules. With all the difficulties and intersections, GDPR still plays a very important role in giving protection to personal data and additional work should be done with governance, regulators and technological solutions.
- **Fabrizio del Maffeo** added that it's also important to consider that the European economy is based on SMEs, and the problem of SMEs is that they don't have data so it's important to have a framework of exchanging data between small and medium enterprises, which is the key to develop AI. Exchanging data is not simple for protocol reasons, for GDPR reasons, for different legislation in different countries but this problem needs to be solved to develop and deploy intelligent systems.
- On a question about blockchain and its support on open decentralized marketplaces, **Dr Bruno Lepri** mentioned that one of the things explored in the INFINITECH project, is that blockchain is used both to activate the market with the token that activates the exchange of value in charge of the data and also keep track of these things, such as the information that is shared (i.e. the information can be shared with some specific node of the network and not with everyone).
- **Dr Konstantinos Votis**, concluded the discussion by saying that the convergence of blockchain with AI and IoT is going to be a long-term process due to the different involved technologies that eventually will have to be applied in different industries.

Appendix

Workshop slides

- Presentations from the workshop can be found here:

Workshop videos

- Videos from this and all other workshops can be found on the EU Blockchain Observatory and Forum website under the section Reports
- Videos specific to this workshop: EU Workshop on Convergence of Blockchain with AI and IoT recording

Official agenda

Time	Activity
13.00	**Welcome**, *Helen Kopman, Deputy Head of Unit Digital Innovation & Blockchain, EC*
13.05	**Blockchain based Data Provenance for Trusted AI and Industrial IoT systems,** *John Soldatos, R&D Consultant, and Innovation Delivery Specialist at INTRASOFT International*
13.25	**Responsible Digital Leadership project at Stanford University: Making a Dilemma Library for learning,** *Soren Jorgensen, Research Fellow, Stanford University*
13.45	**Panel Discussion – Convergence of Blockchain with AI and Iot**, *moderated by Dr Konstantinos Votis, EUBOF* • Dr. Tatjana Evas, AI Unit, DG CNECT, European Commission • Rolf Riemenschneider, IoT Unit, DG CNECT, European Commission • Fabrizio del Maffeo, CEO of Axelera AI • Dr Bruno Lepri, Head of Mobile and Social Computing (MobS) Lab, FBK
15.00	**End of event**

Speakers Biographies

John Soldatos (http://gr.linkedin.com/in/johnsoldatos) holds a Ph.D. in Electrical & Computer Engineering from the National Technical University of Athens (2000) and is currently Senior R&D Consultant and Innovation Delivery Specialist with INTRASOFT International (2000-present) and Honorary Research Fellow at the University of Glasgow, UK (2014-present). He was the Head of the Internet of Things (IoT) Group at the Athens Information Technology (AIT), Greece (2006–2019), and Adjunct Professor at the Carnegie Mellon University, Pittsburgh, PA (2007– 2010). Dr. Soldatos is an expert in Internet-of-Things (IoT) and Artificial Intelligence (AI), including applications in smart cities, finance, and industry (Industry 4.0). Dr. Soldatos has experience in working as a consultant with large multi-national firms and as an advisor to several high-tech startups. He has played a leading role in the successful delivery of more than 70 (commercial-industrial, research, and consulting) projects. He is co-founder and co-creator of the OpenIoT open source project. He has published more than 200 articles in international journals, books, and conference proceedings. Dr. Soldatos is a regular contributor in various international magazines and blogs, on topics related to IoT, AI, Industry 4.0, and Cybersecurity. Moreover, he has served in various standardization working groups, expert groups, and advisory boards of enterprises and think tanks. He has recently co-edited and co-authored six edited books on IoT and AI-related topics. He is the author of the book "A 360 Degrees View of IoT Technologies" published by Artech House in December 2020.

Søren Juul Jørgensen, is a fellow at the Center for Human Rights and International Justice at Stanford University. Founder of the strategy firm ForestAvenue established in Silicon Valley, Brussels, and Copenhagen. Previously Consul General of Denmark for California and CEO for the Danish Innovation Center in Palo Alto focused on tech innovation and tech industry related engagement supporting startups, corporate innovation and research. Worked as a diplomat for the Danish foreign service and for international tech companies such as Mærsk Data and IBM with international sales and business development. Taught law at the University of Copenhagen. Mentor and advisor for tech startups, causes and organizations.

Tatjana Evas is a Legal and Policy Officer at the European Commission DG Connect. Her current work at the Commission focuses on the regulatory framework for artificial intelligence and the Coordinated Plan on AI, with a particular focus on the mobility sector. Before joining Commission Tatjana was Policy Analyst in the European Parliamentary Research Service, where, among other things, she scientifically coordinated European Parliament's public consultation on Robotics and AI (2017), published European Added Value Assessments on Liability of Autonomous Vehicles (2018), on European framework on ethical aspects of AI, robotics and related technologies (2020) and civil liability regime for AI (2020), as well as a Cost of Non-Europe Study on AI in Transport (2020). Prior to joining European public service, Tatjana hold various research and academic positions including at the Columbia Law School, Riga Graduate School of Law, Tallinn University of Technology, Jean Monnet Centre for European Studies, Bremen and European University Institute, Florence. She holds PhD in European Union Law from Bremen University, Germany.

Rolf Riemenschneider is involved in the research and innovation programme Horizon 2020 where he gained experience in research and innovation project management and European policies in the following areas: Advanced Computing, Cyber Physical Systems, Factories of the Future and Internet of Things. From 2009-2015, he managed the ICT activities of the Public-Private Partnership Factories of the Future (PPP FOF). Since 2015, he coordinates the cross-cutting activities related to Internet of Things in Horizon 2020 across different policy streams with DG AGRI, DG ENER, DG MOVE and DG GROW.

Inside DG Connect, he leads the research, innovation and deployment of the next generation of the IoT with strong computing capacity at the edge exploring features like device virtualisation, interoperability, real-time, energy efficiency and distributed intelligence. As an emerging innovation domain, his key objective is to establish European supply and value chains in cloud to edge to IoT applications and the tactile internet by integrating relevant elements of computing, connectivity, IoT, DLT/blockchain and AI.

One of the key horizontal activities related to achieving the targets of the Green Deal, encompasses the Digitisation of the Energy System, which includes IoT-driven interoperable solutions, innovative blockchain applications (like Proof of Origin) and products, available especially in the home and buildings, to enable an increased flexibility and greening of consumption, in energy consumption, foster the integration of renewable energy, and flexible charging of electric vehicles as well as innovative application and services across sectors like home, building, energy and mobility.

Fabrizio Del Maffeo, is CEO and Co-Founder of Axelera AI, a deep-tech startup which is developing a game-changing technology for AI acceleration. Axelera AI has been incubated by Bitfury where Fabrizio was Head of Artificial Intelligence and Managing Director of Bitfury AI.
Before joining Bitfury, Fabrizio was Vice President and Managing Director of AAEON Technology Europe, which is the AI and internet of things (IoT) computing company within the ASUS Group. During his time at AAEON, Fabrizio founded “UP Bridge the Gap,” a product line for professionals and innovators which is now a leading reference solution in AI and IoT for Intel. In 2018, Del Maffeo launched alongside Intel their “AI in Production” program. Previously, he served as country manager for France and Sales Director for Northern, Southern and Eastern Europe for Advantech, the largest industrial IoT computing company. In this role, he also led the intelligent retail division. He graduated with a master’s degree in telecommunication engineering from Milan Politecnico University.

Bruno Lepri leads the Mobile and Social Computing Lab at Bruno Kessler Foundation (Trento, Italy). Bruno has recently launched an alliance between MIT Connection Science and Bruno Kessler Foundation. Since August 2019, he is also the Chief AI Scientist of ManpowerGroup Italy where he advises the CEO on AI projects and innovations for recruitment and HR management as well as he is working at the global level for pushing an AI agenda for the group. Bruno is also the Head of Research of Data-Pop Alliance, the first think-tank on big data and development co-created by the Harvard Humanitarian Initiative, MIT Media Lab, Overseas Development Institute, and Flowminder. In 2010 he won a Marie Curie Cofund postdoc fellowship and he has held a postdoc position at MIT Media Lab. He holds a Ph.D. in Computer Science from the University of Trento. Recently, he co-founded Profilio, a startup active in the field of AI-driven computational marketing. His research interests include computational social science, personality computing, urban computing, network science, machine learning, and new models for personal data management and monetization. His research has received attention from several international press outlets and obtained the James Chen Annual Award for best UMUAI paper and the best paper award at ACM Ubicomp 2014. His work on personal data management was one of the case studies discussed at the World Economic Forum.

Moderator Biography

Dr. Konstantinos Votis is a computer engineer and a researcher Grade B' at Information Technologies Institute/Centre for Research and Technologies Hellas (CERTH-ITI) and director of the Visual Analytics Laboratory. He received an MSc and a Ph.D. degree in computer science and service oriented architectures from Computer Engineering and Informatics department, University of Patras, Greece. His interests extend in several areas of Human Computer Interaction, Internet of Things, BlockChain, information visualisation and 2D/3D modelling, machine learning in different domains with emphasis in health, mhealth, personalised medicine. He has published scientific articles on human-technology interaction and visualisation, mobile and ambient technologies as well as human-centred design. Since 2001, he has been involved in several R&D projects (CaregiversPRO-MMD H2020, myAirCoach H2020, MY-trac h2020, easyTV H2020, ACTIVAGE H2020VERITAS FP7, COG FP6, KWFGRID FP7, ACCESSIBLE FP7, AEGIS FP7, VERITAS FP7, ATIS4ALL FP7, APSIS4ALL FP7, CLOUD4ALL FP7, CLEAR SEE, NoTremor FP7). He has co-authored more than 100 publications for international journals and international conferences and events. Dr. Votis was/is the technical coordinator of FP7 NoTremor, myAirCoach H2020, CaregiverPRO H2020, Greek pilot Leader and WP leader in Large scale IOT project ACTIVAGE.