

# Workshop Track 13.6 (Work6): “The Digital Twin and the Internet of Things”

## Description

Digital Twins (DTs) represent a methodology that is an important aspect of the Internet of Things landscape and is likely to impact a wide range of IoT applications and use cases. There are at least four major high level categories where DTs are likely to have broad adoption, including: manufacturing, products, services, and processes. The foremost aspects of DTs is the use of a digital representation of physical objects/artifacts and of physical/procedural activities. Just as important is the development of digital models that capture the dynamics of the object/artifacts under varying conditions. That in turn implies the instrumentation of the actual objects/artifacts with sensors to create a feedback loop that improves the fidelity of the DTs to predict or express their dynamic state – that is to capture the past, understand the present, and be able to predict the future of the object/artifact. In dealing with complex or compound objects the Digital Twin may in turn be composed of a federation or orchestration of many DTs that must interact with each other, and accurately represent the components or sub-systems of the object.

The value and importance of DTs is to help make decisions, whether autonomously using the DTs to control activities/procedures of physical objects, or to provide the information and analysis that allows end-users and operators to make better decisions, or to improve their experience. The vision within the DT community is that DTs will be able to operate anywhere and have access to a powerful ubiquitous and distributed infrastructure at any time, thus lowering threshold for their common use and deployment. That journey has already started but is far from complete and there are considerable opportunities within the research community to contribute to the underlying science and technology.

The Workshop will be exploring Digital Twins in the context of the role that they can play within the Internet of Things. The emphasis is on solving problems in an organized way and contributing to innovation, new business and organizational models, manufacturing and process efficiency, elimination of risks, better product design, and services that greatly improve the customer experience. The workshop will consist of three sessions that address:

- (1) Basic aspects of Digital Twins: why they are important and where are they likely to create value, where they fit within the IoT ecosystem, and what implications do they have for organizational design, new business models, and the role of standards and open source.
- (2) The technological underpinnings of Digital Twins: architectures for Digital Twins, the basic support infrastructure including connectivity, computing, storage, the data sciences, modeling methods and techniques, representation of DTs, the use of AI/ML, Virtual and Augmented Reality, and Additive Manufacturing among others.
- (3) Use cases and examples of DT: exposing the range of applications and use cases for the Digital Twin concentrating on actual deployments. This includes the four areas cited above

and for specific verticals such as industrial manufacturing, personal assistants, healthcare, construction, aerospace, cultural heritage, and smart cities.

The workshop will conclude with an online panel discussion about the current state and future of Digital Twins.

## Workshop Co-Chairs



**Noel Crespi, Professor, Head of Data Intelligence and Communication Engineering Lab, Institut Mines-Telecom, Paris, France**

**Noel Crespi** received the master's degree from the University of Orsay (Paris 11) and the University of Kent, U.K., the Diplome d'ingenieur degree from Telecom ParisTech, and the Ph.D. and Habilitation degrees from Paris VI University (Paris-Sorbonne). Since 1993, he has been with CLIP, Bouygues Telecom, and then at Orange Labs, in 1995. He took leading roles in the creation of new services with the successful conception and launch of Orange prepaid service, and in standardization (from rapporteur ship of IN standard to coordination of all mobile standards activities for Orange). In 1999, he joined Nortel Networks as a Telephony Program Manager, architecting core network products for EMEA region. In 2002, he joined the Institut Mines-Telecom, where he is currently a Professor and the Program Director leading the Service Architecture Laboratory. He coordinates the standardization activities for Institut Mines-Telecom at ITU-T, ETSI, and 3GPP. He is also an Adjunct Professor with KAIST, an Affiliate Professor with Concordia University, and a Guest Researcher with the University of Goettingen. He is the Scientific Director of the French-Korean Laboratory ILLUMINE. His current research interests include service architectures, softwarization, social networks, the Internet of Things/services, and Digital Twins.



**Roberto Minerva, Maitre de Conferences, Institut Mines-Telecom, Paris, France**

**Roberto Minerva** holds a Ph.D in Computer Science and Telecommunications from Telecom Sud Paris, France, and a Master Degree in Computer Science from Bari University, Italy. He is Maitre de Conference (Associate Professor) at Institut Mine-Telecom, Telecom Sud Paris, part of the Institut Polytechnique de Paris. His research topics and contributions fall in softwarization and networks (edge computing, virtualization and SDN), Internet of Things and Digital Twin, Artificial Intelligence and Machine Learning. He was the Chairman of the IEEE IoT Initiative, an effort to nurture a technical community and to foster research in IoT. Roberto has been for several years in TIMLab, leading research lines and carry out research on network intelligence and programmability, service architecture, SDN/NFV, 5G, Big Data, architectures for IoT. He is authors of many papers published in international journals, magazine, conferences, and several books



**Adam Drobot, Chairman, OpenTechWorks Inc., Wayne, PA USA**

**Adam Drobot** is an experienced technologist and manager. His activities are strategic consulting, start-ups, and industry associations. He is the Chairman of the Board of OpenTechWorks, Inc and

serves on the boards of multiple companies and no-profit organizations. In the past he was the Managing Director and CTO of 2M Companies, the President of Applied Technology Solutions and the CTO of Telcordia Technologies (Bellcore). Previous to that, he managed the Advanced Technology Group at Science Applications International (SAIC/Leidos) and was the Senior Vice President for Science and Technology at SAIC. Adam is a member of the US FCC Technological Advisory Council. In the past he was on the Board of the Telecommunications Industry Association where he Chaired the Technology Committee; the US Department of Transportation Intelligent Transportation Systems Program Advisory Committee; and the University of Michigan Transportation Research Institute External Advisory Board. In 2017 and 2018 he chaired the IEEE Internet of Things Initiative Activities Board. He has published over 150 journal and magazine articles and holds 27 patents. In his professional career he was responsible for the development of several major multi-disciplinary scientific modeling codes and specialized in developing tools and techniques for the design, management, and operation of complex scientific facilities, discrete manufacturing systems, and large-scale platforms, for government and industry. His degrees include a BA in Engineering Physics from Cornell University and a PhD. in Plasma Physics from the University of Texas at Austin.