Keynote: Advances and Challenges of Industrial IoT

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***Abstract*—The main challenges of the first Internet of Things generation were related to communication latency due to high physical and logical distance between end devices and server resources, vulnerability for network problems along the long routes as well as power consumption management. Thanks to the unveiling of the latest wireless technologies like 4G and 5G, WiFi 5 and 6 as well as BLE, the last-mile connection performance - communication latency in particular - is taking a huge leap, and therefore introducing new possibilities for industrial applications. However, many open challenges remain. These include smart and efficient analysis of massive data, automated management of the full life cycle of IoT devices, etc. The newest developments in Artificial Intelligence, massive softwarization and virtualization, technologies beyond 5G and WiFi 6 give hope for the unveiling of new potentials. This talk uncovers the above dynamics.**

***Index Terms*—IoT, Cloud Computing, 6G**

I. Introduction

We observe nowadays large global trends in the digitalization of many aspects of our everyday life. We see applications that can utilize information from sensors attached to things that can also communicate among each other over the Internet. This concept is commonly known as the Internet of Things (IoT) and provides us with services that are more personalized, automated, and have more intelligent behavior [1]. Accordingly, we observe trends in IoT for large scale data storage, big data analysis on a massive amount of gathered data from IoT sources, and incorporation of Cyber-Physical Systems (CPS) into machine to machine (M2M) systems. In the same time, much work is being done in the Industry 4.0 initiative, including smart cities, smart industry, factories of the future, and smart manufacturing that all together form the concept of Industrial IoT (IIoT) [2].

All this triggers the development of new industrial application scenarios where there is a need for low latency, high determinism, high bandwidth, and high resilience computation and communication in order to enable its real-time, intelligent, and autonomous decision-making. This can be required, e.g., in different smart appliances, such as smart vacuum cleaners that use sensor information available inside the house. But also, edge device video analysis, mobile big data analysis, connected autonomous vehicles, smart building control, and safety monitoring present appealing use cases in the IIoT context [1]. One of new trends on the factory shop floor is represented by different kinds of mobile vehicles, e.g., Unmanned Aerial Vehicles (UAV) and Automated Guided Vehicles (AGV), which cooperatively solve certain tasks. Some typical industrial applications include edge services such as industrial production robots, where the low latency and resilience of new services like Edge or Serverless Computing are paramount. Collaborative Robots (cobots) in a production line show a good and appealing example of the robotic cooperation on the factory floor.

First products are available in the IIoT market in this context, proving the benefits of the newest technologies. As an example, Bosch IoT Gateway presents an IIoT solution with support of open APIs, a variety of development tools for creation of edge applications, providing autonomy and intelligence at the logical edge [3]. The product is in use in many scenarios including IoT platforms with support for many smart services like intelligent data processing, optimization of electric vehicle charging and smart field device connectivity [4].

Being in its advanced state, IIoT shows still many challenges in dealing with massive data, co-integration of devices from different vendors, limited flexibility and mobility, etc. The merge of the latest communication and processing technologies has a potential to become a central nervous system for industries. Future trends like the fusion of sensing, communication and artificial intelligence can get the IIoT on the new level of its performance.

II. Short Biography

Dr. Alexander Artemenko is a research engineer within the Corporate Sector Research and Advanced Engineering of Robert Bosch GmbH. His recent research activities focus on development of next generation high reliability and low-latency wireless networks in the context of Industry 4.0 by combining mobile communication, MEC and AI.

References

[1] E. Harjula, A. Artemenko, and S. Forsström, *Edge Computing for Industrial IoT: Challenges and Solutions*. Cham: Springer International Publishing, 2021, pp. 225–240. [Online]. Available: https://doi.org/10.1007/978-3-030-51473-0_12

[2] L. Da Xu, W. He, and S. Li, "Internet of Things in industries: A survey," *IEEE Transactions on industrial informatics*, vol. 10, no. 4, pp. 2233–2243, 2014.

[3] "Edge computing: the perfect complement to the cloud in IoT," https://www.bosch-iot-suite.com/edge-computing/, accessed: 2021-02-05.

[4] "Connectivity and intelligence at the edge of IoT," https://developer.bosch-iot-suite.com/service/gateway-software/, accessed: 2021-02-05.