

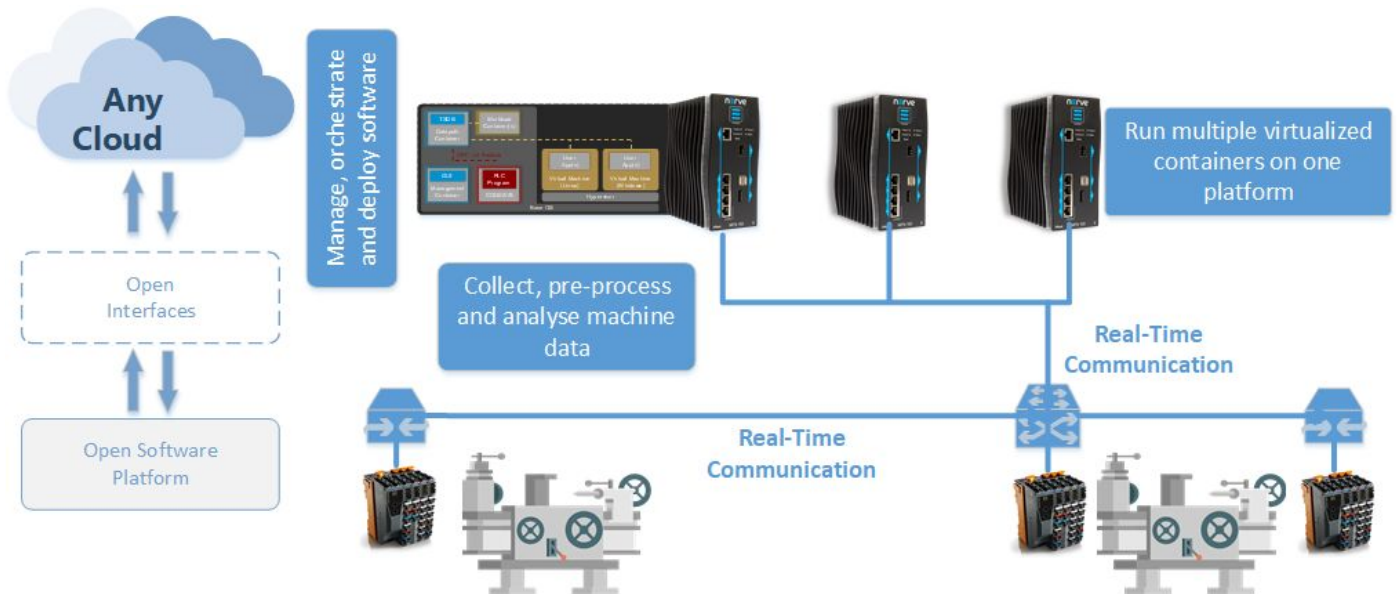
Newsletter

Winter 2019/2020 | Issue 2

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FORA – Fog Computing for Robotics & Industrial Automation

Dear readers,

Welcome to the second FORA newsletter. Within this newsletter, you will find information about the progress of the FORA International Training Network (ITN) since August 2019. We report on the AADL workshops conducted in late 2019 and early 2020, and the FORA meetings which took place in Vienna. Furthermore, we want to inform you about the latest FORA activities, deliverables, and publications.

In general, FORA has reached all its planned goals until this point of time, and has partially exceeded the expected outputs by a large degree. We are very happy about the progress of our training network, and we are looking forward to the next activities.

Paul Pop (Technical University of Denmark)
& Stefan Schulte (TU Wien)

* FORA project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 764785,

Upcoming

D1.2 D5 Fog Infrastructure Reference Architecture document
Available on: March 31, 2020

2nd FORA Summer School
Date & Venue: June 15-19, 2020,
Mälardalen University, Västerås,
Sweden

Publications

19 papers have been published since the last newsletter, 16 are already published open access.
Link: fora-etn.eu/publications

FORA Use Case Meeting at TTTech

On October 16th, TTTech and TU Wien organized a FORA meeting for the Early Stage Researchers (ESRs) located in Vienna, Austria. The local ESRs were joined by ESRs from MDH, Sweden, that were having their secondment at TTTech during the same time.

The objective of the meeting was to get an insight into industrial use cases available to TTTech. To that end, Gerald Fritz from TTTech Industrial presented three use cases. The presentation was followed by an interactive session in which the attending ESRs gave a short introduction to their respective research. Then, applications for each ESR's research in the given use cases were identified.

The half-day meeting was a good opportunity for the ESRs to gain an idea of their fellow ESR's current research, and to put their own research into perspective with respect to real life use cases.

FORA Project Meeting at TU Wien



On November 15th, the FORA team met on the premises of TU Wien, Vienna, Austria, in order to discuss the current progress of the training network and to lay the foundations for the upcoming deliverables.

Especially, the three core use cases of FORA, which will take place at

Activities

FORA AADL Workshop
2020, Feb. 25-26, Copenhagen

FORA AADL Workshop
2020, Feb. 10-11, Västerås

FORA AADL Workshop
2019, December 11-13, Vienna

FORA Project Meeting
2019, November 15, Vienna

FORA Use Case Meeting
2019, October 16, Vienna

FORA TC2 Webinar
2019, September 25

FORA TC3 Webinar
2019, September 23

Secondments

Koen Pieter Tange
Sysgo, April-May 2020

Jia Qian
TUKL, March-June 2020

Zeinab Valojerdi Bakshi
TU Wien, March-May 2020

Cosmin Avasalcai
MDH, March-April 2020
DTU, November 2019

Alexandre Silva Venito
Sysgo, October-March 2020

Eleftherios Kyriakakis
TTTech, October-December 2019

ABB, TTTech, and Danfoss, were presented in detail. Afterwards, Bahram Zarrin (DTU) presented an approach to integrate the different parts of the FORA Reference Architecture, using an *Architecture Analysis and Design Language* (AADL). This approach has later been discussed in more detail at the single FORA AADL workshops in Vienna, Västerås, and Copenhagen (see below). Furthermore, Paul Pop presented the process towards the compilation of deliverable D5, which will present the aforementioned FORA Reference Architecture. The ideas were discussed within the plenum, and the next steps were reviewed and accepted by the attendants. Towards the end of the meeting, initial planning for the summer school planned for 2020 was started.

Overall, thirteen project participants from DTU, TUKL, TTTech, MDH and TU Wien participated in the meeting.

FORA AADL Workshop

The FORA AADL Workshop, in collaboration with the Institute of Information Systems Engineering of TU Wien, took place December 11-13, 2019, at the Distributed Systems Group of TU Wien, Austria.

The FORA AADL Workshop was a three-day event, organized by Bahram Zarrin (DTU), with focus on the introduction of the AADL in use cases related to fog computing and industrial applications.



During the course of this event, the participants had the chance to

News from ESRs

Lan Van Dao, MDH

In May 2019, Lan presented his paper "Reliability and Fairness for UAV Communication Based on Non-Orthogonal Multiple Access" at the IEEE International Conference on Communications (ICC) in Shanghai, China. His paper provides a closed-form expression for the power allocation coefficient of each user and also proposes an algorithm for finding the optimal altitude of an unmanned aerial vehicle (UAV), required to satisfy the fairness condition for all users.

In February 2020, Lan attended the International Conference on Green and Human Information Technology (ICGHIT) in Hanoi, Vietnam, to present the paper "Temperature Beat Sensor for Energy Efficient, Long Range Smart Monitoring Systems". The presented approach combines a new technique of Beat sensor with a long range (LoRa) communication protocol. With the compact circuit size and the low energy consumption, the proposed sensor can be applied for Internet of Things-based smart monitoring systems.

Patrick Denzler, TU Wien

In November 2019, Patrick Denzler participated in the four days 4diac and IEC61499 workshop at Johannes Kepler University Linz. The intention was to explore the possibility of using

receive hands-on training, and to discuss the FORA AADL model which is planned to be used for describing the FORA Reference Architecture for fog computing.

This workshop was the first of a series consisting of three similar events that aim at training the next generation scientists in AADL, in Austria (at TU Wien), Denmark (at Technical University of Denmark), and Sweden (at Mälardalen University).

Paper Highlights

Since the last FORA newsletter, 19 papers have been published by the researchers involved in our training network — a full list can be found on the next page. Out of these, we want to highlight three papers:

Jia Qian (ESR 14) co-authored the paper “A Noble Double Dictionary based ECG Compression Technique for IoTH” that was published in the IEEE Internet of Things Journal in 2020. In this paper, the authors propose a novel compression technique using unsupervised dictionary learning, which targets healthcare applications. The IEEE Internet of Things Journal publishes the latest advances related to Internet of Things-enabling technologies, and is one of the leading journals in this field.

Cosmin Avasalcai (ESR 10) co-authored the paper “Decentralized Resource Auctioning for Latency-Sensitive Edge Computing”, which was presented at the 3rd IEEE International Conference on Edge Computing (EDGE) in Milan, Italy. Within the paper, the authors present an approach to manage resources in latency-aware edge environments. IEEE EDGE is one of the leading conferences in the field of edge computing.

Koen Pieter Tange (ESR 11) co-authored the paper “Foundations and Evolution of Modern Computing Paradigms: Cloud, IoT, Edge, and Fog”, which was published in IEEE ACCESS in 2019. Here, the authors discuss the relationships among state-of-the-art paradigms in distributed systems, and also discuss important open research questions in the field of fog computing. IEEE ACCESS is one of the leading open access journals in computer science and related areas.

function block modelling for the detection of unexpected emergent systems behaviour and initiate a collaboration for further research.

Marine Kadar, SYSGO

On November 27th 2019, Marine gave an introduction session at TU Kaiserslautern to an undergrad class on the industrialization of real-time systems. During the presentation, Marine discussed how to develop and productize real-time hypervisors, providing insight on PikeOS hypervisor development and certification at SYSGO.

Vasileios Karagiannis, TU Wien

In September 2019, Vasileios attended the 24th IEEE Conference on Emerging Technologies and Factory Automation (ETFA). There, he presented the paper “Automatic Application Placement and Adaptation in Cloud-Edge Environments”, which discusses the execution of industrial applications at the edge of the network.

In October 2019, Vasileios presented his research topic at TU Wien, according to the standard procedure for doctoral degrees at TU Wien. During the presentation, Vasileios discussed research problems and challenges of fog computing, which are addressed in the context of FORA, such as fault tolerance and proximity awareness.

Further News from ESRs

Jia Qian, DTU

Jia started her secondment at TU Kaiserslautern in March 2020, under the supervision of Prof. Marius Kloft who leads a very active and competitive Machine Learning group.

The paper “A Noble Double Dictionary based ECG Compression Technique for IoTH” (co-authored by the ESR) was accepted by IEEE Internet of Things Journal in February. It designs a two-dictionary framework for ECG compression in IoT healthcare. The proposed compression scheme achieves both energy and space efficiency, low reconstruction error, and it is robust to noise during the wireless transmission and aware of the dynamic statistics change during compression.

Nitin Desai, MDH

In January 2020, Nitin presented a workshop paper titled “Enhancing Fault Detection in Time Sensitive Networks (TSN) using Machine Learning” at the COMSNETS conference in Bangalore, India. In addition, he did his first secondment at TTTech in Vienna from September to November 2019. During his secondment, Nitin worked on TSN configuration management and relevant standards.

Publications

- Qian J, Tiwari P, Gochhayat SP, Pandey HM. A Noble Double Dictionary based ECG Compression Technique for IoTH. In IEEE Internet of Things Journal. February 2020. ([link](#))
- Desai N, Punnekkat S. Enhancing Fault Detection in Time Sensitive Networks using Machine Learning. In Workshop on Machine Intelligence in Networked Data and Systems (MINDS). January 2020. IEEE. ([link](#))
- Bakhshi Z, Rodriguez-Navas G. A preliminary roadmap for dependability research in fog computing. In ACM SIGBED Review. January 2020. ([link](#))
- Kyriakakis E, Sparsoe J and Schoeberl M. InterNoC: Unified Deterministic Communication For Distributed NoC-based Many-Core. In Junior Researcher Workshop on Real-Time Computing (JRVRT). November 2019. ([link](#)) *Best Junior Paper Award*
- De Donno M, Tange K, Dragoni N. Foundations and Evolution of Modern Computing Paradigms: Cloud, IoT, Edge, and Fog. In IEEE Access. October 2019. 15(7). ([link](#))
- Tsigkanos C, Avasalcai C, Dustdar S. Architectural Considerations for Privacy on the Edge. In IEEE Internet Computing. October 2019. 23(4). ([link](#))
- Struhár V, Ashjaei M, Behnam M, Craciunas SS, Papadopoulos AV. DART: Dynamic Bandwidth Distribution Framework for Virtualized Software Defined Networks. In Annual Conference of the Industrial Electronics Society (IECON),

Eleftherios Kyriakakis, DTU

In October 2019, Eleftherios Kyriakakis started the first part of his external stay (i.e., secondment) at TTTech Computertechnik AG in Vienna, Austria. In collaboration with the chip department, he investigated hardware/software clock synchronization design using the AS6802 standard.

On November 6-7, 2019, Eleftherios Kyriakakis attended the 27th International Conference on Real-Time Networks and Systems (RTNS'19), where he presented his work titled “InterNoC: Unified Deterministic Communication For Distributed NoC-based Many-Core” as part of the 13th Junior Researcher Workshop on Real-Time Computing. His work was awarded the “Best Junior Paper Award”.

The highlights of the conference as identified by the ESR was the industrial session. The session highlighted the importance of minimizing task execution jitter in modern multi-tasking automotive systems as it has an immediate effect on both noise and CO2 production. Also, on-going investigations for applying Time Sensitive Networks in energy distribution networks were a prominent research topic.

Alexandre Venito, TU Kaiserslautern

On October 21, 2019, Alexandre Venito started his secondment at SYSGO. During the stay at SYSGO, Alexandre attended the

- October 2019. IEEE. ([link](#))
- Desai N, Punnekkat S. Safety-oriented flexible design of Autonomous Mobile Robot systems. In International Symposium on Systems Engineering (ISSE). October 2019. IEEE. ([link](#))
- Cervin A, Pazzaglia P, Barzegaran M, Mahfouzi R. Using jittertime to analyze transient performance in adaptive and reconfigurable control systems. In International Conference on Emerging Technologies and Factory Automation (ETFA). September 2019. IEEE. ([link](#))
- Meixner S, Schall D, Li F, Karagiannis V, Schulte S, Plakidas K. Automatic Application Placement and Adaptation in Cloud-Edge Environments. In International Conference on Emerging Technologies and Factory Automation (ETFA). September 2019. IEEE. ([link](#))
- Bakhshi Z, Balador A. An Overview on Security and Privacy Challenges and Their Solutions in Fog-Based Vehicular Application. In International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC Workshops). September 2019. IEEE. ([link](#))
- Bakhshi Z, Rodriguez-Navas G, Hansson H. Dependable Fog Computing: A Systematic Literature Review. In Euromicro Conference on Software Engineering and Advanced Applications (SEAA). August 2019. IEEE. ([link](#))
- Kadar M, Tverdyshev S, Fohler G. System Calls Instrumentation for Intrusion Detection in Embedded Mixed-Criticality Systems. In International Workshop on Security and Dependability of Critical Embedded Real-Time Systems (CERTS). July 2019. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik. ([link](#))
- Avasalcai C, Tsigkanos C, Dustdar S. Decentralized Resource Auctioning for Latency-Sensitive Edge Computing. In International Conference on Edge Computing (EDGE). July 2019. IEEE. ([link](#))
- Qian J, Gochhayat SP, Hansen LK. Distributed Active Learning Strategies on Edge Computing. In International Conference on Cyber Security and Cloud Computing (CSCloud)/International Conference on Edge Computing and Scalable Cloud (EdgeCom). June 2019. IEEE. ([link](#))
- Murturi I, Avasalcai C, Tsigkanos C, Dustdar S. Edge-to-Edge Resource Discovery using Metadata Replication. In International Conference on Fog and Edge Computing (ICFEC). May 2019. IEEE. ([link](#))
- Dao LV, Tran H, Girs S, Uhlemann E. Reliability and Fairness for UAV Communication Based on Non-Orthogonal Multiple Access. In International Conference on Communications Workshops. May 2019. IEEE. ([link](#))
- Dustdar S, Avasalcai C, Murturi I. Edge and Fog Computing: Vision and Research Challenges. In International Conference on Service-Oriented System Engineering (SOSE). April 2019. IEEE. ([link](#))
- Salman SM, Struhar V, Papadopoulos AV, Behnam M, Nolte T. Fogification of industrial robotic systems: research challenges. In Workshop on Fog Computing and the IoT (Fog-IoT). April 2019. ACM. ([link](#))

regular customer training about real-time systems and PikeOS, which are addressed in the objectives and expected results in FORA. The architecture solution to address such objectives as proposed by Alexandre was improved after the training, and implementation of the architecture has been started.

Václav Struhár, MDH

Václav presented his paper “DART: Dynamic Bandwidth Distribution Framework for Virtualized Software Defined Networks” at the 45th Annual Conference of the IEEE Industrial Electronics Society (IECON’19) in Lisbon, Portugal, on 14.10.2019. The paper focuses on a flexible network bandwidth distribution in virtualized SDN networks. The framework aims to maintain Quality of Service in large virtual networks utilizing the same physical infrastructure. The ESR also did his first secondment at TTTech in Vienna from September to November 2019, working on a real-time extension for container-based virtualization and orchestration of real-time containers.