Technical Proposal for One Day Workshop on

Fog and Edge Computing for Beyond IoT Services and Opportunities

IEEE 7th World Forum on Internet of Things New Orleans, Louisiana, USA

Workshop Title:

Fog and Edge Computing for 6G Networks/IoT Services and Opportunities

1. Preamble

As we evolve toward the Internet of Things (IoT), our 5G/6G and future mobile networks must support a much wider range of applications, including vehicular networking, automated manufacturing, smart cities, drones, smart grids, e-health, and the many emerging AI-enabled applications such as Virtual Reality (VR) and Augmented Reality (AR). The cloud computing plus communication pipe model is no longer adequate for supporting these emerging applications. Connecting every device directly to the cloud can often be impractical due to factors such as limited resources on the devices, software and management complexity, limited network agility and cognition, and system scalability. In such scenarios, users will desire local services. Future mobile networks will also require computing capabilities inside or close to the radio access networks (RANs) to enable advanced networking capabilities, such as establishing radio connections more timely and adjusting radio channel coding dynamically in response to changing user needs and communication environments, and allow user applications to be hosted in the RANs that are closer to the users.

These and the many other new requirements call for a new computing paradigm – fog/edge computing and networking. Fog/Edge envisions an open and standards-based horizontal architecture for distributing functions (from computing to storage to control and to networking functions) closer to users, not just to any specific type of network edge device but anywhere along the cloud-to-thing continuum that can best meet user requirements. Fog/Edge will integrate with the cloud to provide a seamless end-to-end computing platform along the cloud-to-thing continuum. Fog/Edge services and user applications can be deployed anywhere along this computing continuum to best meet user requirements.

Fog/Edge is also gradually becoming a popular key research area. Starting from 2017, one of the first industrial panels was held to discuss Fog computing and networking in the IEEE 2017 IM in Lisbon, Portugal. Since then, similar events such as IEEE Fog Summer School in Shanghai (June, 2018), Second Winter school on Fog/Edge Computing (December 2020), and the 2nd Fog World Congress (October, 2018) in San Francisco. Three industrial panels had been also organized in 2019 such as the IEEE 5th World Forum on IoT was held in Ireland in April; the 53rd IEEE ICC was held in Shanghai on May 20 – 24; the IEEE Globecom was held in Big Island, Hawaii on December 9 – 13. All of those industrial panels had attracted many attendees to join discussions

2. Objective(s) of the Workshop

The primary objectives of this workshop are to investigate the optimization of resources that are virtualized, pooled, and shared to respond to changing networking environments and requirements which may be unpredictable today. Fog /Edge Networking revisits the role of clients in network architectures as an integral part of the control plane that monitors, measures, and manages the network. Fog/Edge Computing & Networking combines the study of mobile communications, fog-based radio access network (F-RAN) in future 6G research, distributed systems, and big data analytics into an exciting new area. Keeping this goals in mind, the specific objectives of this workshop are

- We propose to hold a one day workshop at IEEE WF-2021. The target audience will be students, engineers, and industry executives.
- Future Research Directions and the ICT Convergence for Entrepreneurs in the area of Fog/Edge Computing and Networking will be addressed in this workshop.
- We will discuss current views on how to identify potential road blocks and then solve these technical challenges in Fog and Edge computing for future 6G wireless Networks and IoT Services.

- We plan to educate and inspire the students and the industry on fog and edge computing. We expect to attract a large number of attendees for this workshop.

- We will have academic and industry experts on fog and edge computing to give presentations on fog/edge computing technologies, current industry status and trends, challenges, and potential ways forward.

- This workshop will support the goals of the IEEE-WF 2021 to be a leading event in the education of emerging technologies in IoT and to establish the Forum's relevance and leadership in the academia/industry.

3. Broad Topics to be covered

Future Research Directions in Fog and Edge Computing for IoT and beyond , as well as Technology Commercialization for entrepreneurs leveraging Fog Computing & Networking will be covered in this workshop. Discussions on roadblocks and challenges with a view into mitigating strategies for 6G wireless in the future will be held. Case studies on select next generation emerging IoT services shall be presented by notable invited speakers from both high-tech startups and academia from across Europe, Asia and US. Topics related to "technology commercialization for vertical services", along with other new topics will also be addressed in this school. Specifically the following topics will be addressed

- Drivers of fog/edge computing in the future
- The vision of beyond IoT and 5G/6G with fog/edge Computing
- Fog/Edge Computing solutions of the future

Several cutting edge topics will be covered by several distinguished speakers in the one day workshop .

4. Expertise and Experience

This workshop proposal is backed by a very strong team as described below.

Chairs of the Workshop

The proposed chairs of the Workshop are :

Tao Zhang, NIST USA

Rajesh M Hegde, IIT Kanpur India

Christopher Brinton, Purdue University USA

Leadership Team

The leadership team members are

Tao Zhang, NIST USA

Prof Abhay Karandikar, Director, IIT Kanpur

Kaushik Pillalamarri, Wistron AI Edge

Prof. Hung-Yu Wei, National Taiwan University

Prof. Ai-Chun Pang, National Taiwan University

Prof. Yang Yang, Shanghai Tech (Chair of 1st Fog Summer School)

Dr. Doug Zuckerman, Chair of the IEEE Fog/Edge Industry Community

Rajesh M Hegde, IIT Kanpur India

Christopher Brinton, Purdue University USA

Prof. T. Russell Hsing, National Chiao Tung University

These leadership team members are pioneers and leaders in fog and edge computing include the co founders of the Open Fog Consortium, leaders of the IEEE Communications Society's Industry Community on Fog/Edge Computing and Networking" (aka IEEE Fog/Edge Industry Community), and coauthors or editors of books on fog computing, seasoned volunteer leaders on the IEEE and volunteers who have served on many leadership roles in organizing IEEE conferences.

4. Schedule

The proposed workshop will have keynotes, and talks, from eminent researchers in the area of Fog/Edge computing and AI, The tentative schedule (see Table 1) covers three keynotes, and Nine talks. However we may expand the schedule to include more talks in the final program. All keynotes and talks will be of 30 minute duration including question and answer session.

In case the workshop goes online we are also open to the idea of live delivery in a webinar mode as was done in the highly successful Second Winter school on Fog/Edge Computing held in December 2020.

Table 1: Tentative Schedule of the proposed workshop on Fog/Edge Computing

Time Slot	**Activity**
8.50 – 9.00	Opening Remarks
9:00 – 9.30	Keynote 1
9.30 – 10.00	Talk 1
10:00 – 10.30	Talk 2
10:30 - 11:00	Talk 3
11:00 - 11:30	Keynote 2
11.30 – 12.00	Talk 4
12:30 - 1:00	Lunch Break
1.00 – 1.30	Keynote 3
13:30 - 14:00	Talk 5
14:00 - 14.30	Talk 6
14.30 - 15:00	Talk 7
15:00 - 15:30	Talk 8
15.30 – 16.00	Talk 9
16.00 – 16.30	Concluding Remarks and Whats Next ?

5. Tentative List of Speakers

We have put together a team of pioneers and leaders in the field of fog and edge computing, including many who have been involved in the successful Second IEEE Winter School on Fog/Edge Computing, organized by IIT Kanpur India (sponsored by the IEEE SA, IEEE ComSoc) and held virtually in December 2020. The tentative list of distinguished speakers and their topics are illustrated in Table 2

Table 2: Tentative list of distinguished speakers for the proposed workshop on Fog/Edge Computing

Speaker	**Affiliation**	**Tentative Topic**
Abhay Karandikar	IIT Kanpur India	Fog Computing in Future Telecom Networks
Tom Dailey	Dailey Strategic USA	5G/6G as Innovation Drivers
Junshan Zhang	Arizona State University, USA	Edge AI
Yoshiki Sasaki	Japan Strategic, Japan	Assisted Living IoT Innovations
Tao Zhang	NIST, USA	The Future of Edge Computing
Shamik Basu	Verizon, USA	Innovations in IoT and Beyond
Rahul Karnik	Ericsson, USA	Voice over NR and Future Telecom Networks
Venu Krishnamoorthy	Radical, LLC, USA	IoT on cruise ships
Mael Tannou	Pernod Ricard	Internet of Bottles
William Ruh	GE Digital, USA	IoT at GE
Vinay Solanki	Napino, India	IoT and Fog Computing
Graeme Gackland	Williams F1 Team	F1 Race Cars and IoT

Christopher G Brinton	Purdue University, USA	Federated learning for IoT and Beyond
Hung-Yu Wei	National Taiwan University	Edge/Fog Management and Orchestration
Jianwei Huang	Chinese University of Hong Kong	Fog Learning for Beyond IoT Services
John Barrett	Cork Institute of Technology (CIT), Ireland	Fog Computing for Beyond IoT Services
Rajesh Hegde	IIT Kanpur India	AI/ML for for Fog/Edge Computing

6. Deliverables

The main deliverable will be a one day workshop at the IEEE WF-IoT 2021. The materials presented at the workshop will be made available to the IEEE for distribution online. Case studies on select next generation emerging IoT services shall be presented by notable invited speakers from both high-tech startups and academia from across Europe, Asia and US. We expect a large number of participants given the hugely successful completion of the second IEEE Winter School on Fog/Edge Computing (Virtual) held in Dec 2020, where more than one thousand participants took part.