



# 5G Initiative – “5G Roadmap” Working Group

## Proposal for Contribution

*Cagatay Buyukkoc, AT&T*  
*Meryem Simsek, ICSI*

# IEEE 5G Initiative Roadmap

## Mission statement

- *Based on horizon scanning, interviews and expert knowledge, the mission of the 5G Roadmap working group is to identify short (~3 years), mid-term (~5 years) and long-term (~10 years) research, innovation and technology trends in the communications ecosystem. This will enable the development of a concrete innovation and engagement roadmap guiding the IEEE community towards maximum impact contributions across its societies, and in conjunction with its demand-side as well as the wider industry & standards ecosystem. The outcome shall be a live document with a clear set of (accountable) recommendations; the document shall be updated annually and be developed in conjunction with the other working groups.*

# IEEE SDN & 5G Initiatives OMEC Mission statement

- With a potential of fragmentation in the implementation of new technologies e.g., 5G, SDN/NFV, the main objective of IEEE 5G Preindustrial track committee is to create technical and economic conditions (with proper guidelines & direction) of interoperability and feasibility. A broad set of new technologies using software architectures and virtualization technologies within the industry and academia is currently being investigated in parallel to various standardization efforts. To help better alignment across the industry, the committee will analyze and evaluate various potential methodologies and make recommendations and create industrial agreements. This committee will look at opportunities for POC work and establish relationships with other groups doing relevant work in Europe, Asia, Americas, Africa, etc. to increase collaboration & reduce duplication.

■ *The mission of the 5G OMEC working group is to identify short (~2 years), mid-term (~4 years) and long-term (~6 years) plans on PoCs, research, and collaborative efforts to help prevent fragmentation at the edge architectures. The mobile edge clouds are identified as the centerpiece of the 5G ecosystem and this working group will work with other bodies towards a unified architectural framework. This will enable the development of a concrete innovation and engagement roadmap guiding the IEEE community, across its societies, and in conjunction with its demand-side as well as the wider industry & standards ecosystem. The outcome shall be a set of concrete proposals (or PoCs) with a clear set of (accountable) objectives and deliverables for each timeframe and will be updated periodically based on SDN/5G Initiative goals and objectives.*

## Open Mobile Edge Cloud

- An open cloud platform that uses some end-user clients and located at the “mobile edge” to carry out a substantial amount of storage, compute and networking capabilities (rather than relying primarily in cloud data centers including edge analytics) in real time, and a communication, control, policy and management functions (lightweight to be implemented at the edge and devices). In addition service delivery mechanisms close to end users is an essential component of OMEC.
- Develop an architecture to support this vision:
  - OMEC concept can be developed based on SD-RAN controller & fog networking amalgamation & distributed functional decomposition of both NG core and RAN functions on a common cloud platforms: ( Nebbiolotech, MCORD, Intel, Ericsson, New Edge Cloud elements being developed or other open platforms)
  - The Open framework will be emphasized so that an industrial consensus and POCs can be efficiently tested.

# Objectives: 5G Open Mobile Edge Cloud(OMEC)

- 5G requires a new E2E architecture: From UE, AP, BS, ME/CE, Core, and Applications & Services and C/S/N requirements.
- In particular in this work we define **Function, Deployment, Resource & Topology** views of the Architecture, OMEC brings applications & network services to close proximity to users to allow:
  1. *Business transformation: OTT services, faster TTM, Monetization*
  2. *Technical transformation: QoE, ULL, SDN/NFV/OMEC integration, Edge Analytics, Big data, Virtualization, Automation, AI, C->E, R->E*
  3. *Architectural transformation: 4 views “NORMA-like” Cloud, ECOMP, Flexible architecture (RAN, Core, CDN, Application delivery, Automation, IoT, fog,..)*
  4. *Industrial transformation: ICT&E*

The objectives are to evaluate various options on topology views that enable:

- Service agility, operational cost reduction
- Reduction of cost by deploying COTS/whitebox H/W & virtualization of RAN/Core functions, creation of C/S/N clusters for common processing at the edge
- & propose follow-up work in terms of POCs, roadmaps consistent with the IEEE 5G I roadmaps

## Edge efforts



- **Mobile Edge Computing: ETSI/MEC:** “Mobile-edge Computing offers application developers and content providers cloud-computing capabilities and an IT service environment at the edge of the mobile network. This environment is characterized by ultra-low latency and high bandwidth as well as real-time access to radio network information that can be leveraged by applications...to deliver a standardized mobile edge computing architecture and industry-standardized APIs for 3rd party applications.”
- **Openfog: (Fog Computing)** “A network architecture that uses one or more end-user clients or near-user edge devices to carry out a substantial amount of storage (rather than stored primarily in cloud data centers), communication (rather than routed over backbone networks), and control, configuration, measurement and management (rather than controlled primarily by network gateways such as those in the LTE core)... Fog itself is made up of fog cloud computing components embedded in nodes in different network tiers, e.g. in the radio access network, the multi-service edge, the core network (on IP/MPLS routers/switches, at mobile packet core network gateways etc.”
- **Open Edge Compute:** “i) defining a system and creating algorithms that support low latency edge cloud computing and ii) implementing the relevant features in open source code as extensions to OpenStack cloud management software . Two key features are near-real-time, just-in-time provisioning of applications to edge nodes and handoff of virtual machine images from one edge node to the next edge node once a device has moved away from its first edge node and has come closer to a new edge node.

**SDO, Industrial Consortium, Open communities should all work on common POCs**

**Lets create a proposal!**



# Contribution: Open Mobile Edge Cloud (OMEC)

- **OMEC: Reconstruction the E2E functions and creation of Mobile Edge**
- **Relation to SDOs and other**
  - SDO: **ETSI Mobile Edge Computing (MEC) ISG**
    - Liaison with Open Fog Consortium
  - Industrial Consortium: **Open Fog Consortium**
    - Affiliated with IEEE, liaison with ETSI MEC
    - Microsoft, Dell, Cisco, GE, NTT, Fujitsu, Toshiba, Schneider, Nebbiolo, Intel, ARM, AT&T
  - Open Source Project: **Open Edge Computing (OEC)**
    - CMU Cloudlets, AT&T, Intel
  - IEEE SDN Pre-Industrial/5G Initiative: **Open Mobile Edge Cloud (OMEC)**
  - ETSI/MEC, Openfog and OEC has proposed architectures
- **Impact Horizon** (short, medium, long)
  - Short: Short term impact is large as the awareness of Mobile edge as a centrepiece of 5G era networks would prevent future fragmentation
  - Medium: A concerted effort of POCs that would combine diverging views on a common infrastructure
  - Long: A control plane combining all architectural views and a lightweight management and orchestration framework

# Contribution: Open Mobile Edge Cloud (OMEC)

## ■ Impact Horizon (short, medium, long)

### – Short:

#### 1. Organizing five workshop on (O)MEC in

- Germany: Deutsche Telekom and Vodafone
- China: China Mobile
- S America (Brazil or Mexico) *request sent to contact in Brazil*
- Africa Ooredoo (former Qtel) or Vodafone in Qatar, *South Africa?*
- N America AT&T

#### 2. IEEE online webinar on OMEC

- Presenters: Cagatay Buyukkoc, Meryem Simsek, Sven van der Meer,...

### – Medium: POCs:

- POCs to leverage ETSI/MEC, OEC, openfog developments in multiple locations TBD

### – Long:

- Creating a Unified Control framework to address all industrial initiatives
- Merging results of MEC (ETSI), Openfog, Open Edge Compute, and 5G (3GPP) into one unified framework.
- A unique architecture/solution capturing all (logical) entities and features together with required interfaces
- Proof of concept; OMEC POC with Mobility management as a CP functionality (DMM) and Security functions as part of A-A-A plug-n-play, several potential hosts are being investigated



# Contribution OMEC

## ■ Specific Contribution/Thought/Idea

- The key idea here is that 5G era architectures will require a new architectural element at the edge; Edge clouds are key in deployments of:
  - E2E slices for a variety of use cases
  - Tactile internet infrastructure
  - New areas requiring Edge Analytics in rt
  - Centralized RAN components for better resource utilization