Mosaic5G® – Agile Network Service Delivery Platforms

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Why Mosaic-5G.io?

- Need for a software-based 4G-5G service delivery platforms for telecom to
  - Increase network flexibility
  - Add/customize network intelligent through control apps
  - Experiment new use-cases and business applications

<table>
<thead>
<tr>
<th>SaaS</th>
<th>Consume the service</th>
</tr>
</thead>
<tbody>
<tr>
<td>PaaS</td>
<td>Build the service and open APIs</td>
</tr>
<tr>
<td>IaaS</td>
<td>Host the service</td>
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</tbody>
</table>
Technology Enablers

**Application**
- Video Optimization
- Recommendation System
- IoT Gateway
- Data Analysis

**MEC**
- RESTful API, Message Bus
- Edge Packet Service
- Application Manager
- Radio Network Information
- SDN API Library

**SDN**
- SD-RAN controller
- SD-CN controller
- Forwarding Engine
- Datapath Driver

**Network Infrastructure**
- LTE eNodeB, NR, NB-IOT
- Xhaul transport network
- Switches, Routers
What is Mosaic5G.io?

- **Mosaic-5G.io** was formed to develop, promote, and share an agile network service delivery platforms
  - Transform today’s static RAN and CN infrastructures into extensible, software-based platforms as a service
  - Explore new ideas and use-cases for 4G-5G R&D
  - Bridge the gap between communication, computing, and data analysis
- Founded by Eurecom in 2015.
Objectives
Mosaic-5G Ecosystem

- A Flexible & Programmable SD-RAN Platform
- A Low Latency SDN-based MEC Platform
- An event-driven juju-based service orchestrator core
- A Flexible & Programmable SD-CN Platform
- Network function & application distribution Repository
- Remotely accessible experimentation testbed
Mosaic-5G Ecosystem
FlexRAN Platform

- RAN runtime
  - Abstraction and programmability of network functions
  - Extendable RAN APIs
  - Virtualized resources and state for a slice
- RAN realtime controller
  - Slice state and resources
  - C-plane SDK
- Slice control plane
  - Realtime and flexible RAN monitoring, configuration, control and programmability
  - Centralized and/or distributed control
- SB-IF interface
  - FlexRAN control protocol and controller
## Supported FlexRAN API Calls

<table>
<thead>
<tr>
<th>API</th>
<th>Target</th>
<th>Direction</th>
<th>Example</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Configuration (synchronous)</strong></td>
<td>eNB, UE, Slice</td>
<td>Controller → RAN</td>
<td>• UL/DL cell bandwidth, Reconfigure DRB, RSRP/RSRQ/TA</td>
<td>• Monitoring,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Reconfiguration,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• SON → cognition</td>
</tr>
<tr>
<td><strong>Statistic, Measurement, Metering (Asynchronous)</strong></td>
<td>List of eNB, UE, Slice</td>
<td>RAN → controller</td>
<td>• CQI measurements, SINR measurements, UL/DL performance</td>
<td>• Monitoring,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Optimization,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• SON → cognition</td>
</tr>
<tr>
<td><strong>Commands (synchronous)</strong></td>
<td>Agent</td>
<td>controller → RAN</td>
<td>• Scheduling decisions, Admission control, Handover initiation</td>
<td>• Hard Realtime Control,</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>• Soft realtime control</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• SON → cognition</td>
</tr>
<tr>
<td><strong>Event Trigger</strong></td>
<td>Master</td>
<td>RAN → controller</td>
<td>• TTI, UE attachment, Scheduling request, Slice created/destroyed</td>
<td>• Monitoring,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Control actions</td>
</tr>
<tr>
<td><strong>Control delegation</strong></td>
<td>Agent</td>
<td>Controller → RAN</td>
<td>• Update DL/UL scheduling, Update HO algorithm</td>
<td>• Programmability,</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• Multi-service</td>
</tr>
</tbody>
</table>
LL-MEC Platform

- Application manager (mp1)
  - low-latency: CoreAPI, MBus
  - Elastic: RestAPI, MBus

- Platform (mp2)
  - Edge packet service
    - Multi OF libs, OVS
    - Static and dynamic rules
  - Radio network information
    - Real-time control and monitoring
  - Event manager

- Abstraction
  - Data plane APIs: OpenFlow protocol
  - C-plane Radio API: FlexRAN protocol
## Supported LL-MEC APIs

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<th>API</th>
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<th>Example</th>
<th>Applications</th>
</tr>
</thead>
</table>
| Configuration (synchronous)      | MME, X-GW               | CN $\rightarrow$ LL-MEC | • UE IP  
• Bearer ID, TEIDs,  
• X-GW IPs                     | • Monitoring,  
• Reconfiguration, |
| Statistic, Measurement, Metering (Asynchronous) | List of eNB, UE, Slice | OVS $\rightarrow$ LL-MEC   | • byte_count, packet_count  
• direction, in_port  
• duration_sec  
• Priority, table_id | • Monitoring,  
• Optimization, |
| Commands (synchronous)           | OVS                     | LI-MEC $\rightarrow$ OVS | • Copy  
• Redirect               | • Analytics  
• Programmability |
JoX Platform

- **JoX Core**
  - NB-IF for Slice templates
  - Slice controller
  - Distributed Slice DB
  - Interface to Juju VNFM

- **Plugins frameworks**
  - _fast reaction to the underlying network and infrastructure_
  - Passthru

- **Stores**
  - Local store
  - Charm store
Net Store

- Network function & control application distribution Repository to recompose the network service across a reusable modules
  - OAI Charms
  - Network Service templates
    - Juju bundles
    - JoX templates
  - SDKS
    - FlexRAN, LL-MEC, and JoX
- Control network applications
  - Monitoring apps
  - FlexRAN RAN sharing apps (RRM+SMA)
  - LL-MEC video optimizer app (local breakout+update of video transcoding)
  - Performance predictions app (RRM_KPI)
License models

- Mosaic5G Platforms’ licenses
  - FlexRAN and FlexCN
    - FlexRAN Controller: MIT → OSA license
    - FlexCN controller: Apache v2.0 or OSA license
  - LL-MEC: Apache v2.0 or OSA license
  - JoX: Apache v2.0 or OSA license
  - Store: Apache v2.0 or OSA license

- Contributors
  - Recommend OSI compatible license
EXAMPLE UCS
RAN Sharing Demo
@MWC, ITU, MobiCom, EUCNC
Video Optimization Demo
@ETSI, MWC, MEC Congress, MobiCom
Success Stories

MWC 2016, 2017
ITU, FG-13, 2016, 2017
ETSI 2016, 2017

EUCNS 2015, 2016, 2017
OPNFV 2016
Mobicom 2014, 2016, 2017

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Info

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