Magma for 5G
Exploring future feature development and testing

LFN Developer and Testing Forum
10 January 2022

https://www.magma-core.org/
https://github.com/magma/magma
Kader Khan  
SVP, Connectivity and Industry 4.0  
kader@wavelabs.ai  
(M): +1-647-998-1977

Suresh Gorijavalou  
AVP, Connectivity and Industry 4.0 Engineering  
suresh@wavelabs.ai  
(M): +91-9849868128

Parthiban Nalliamudali  
Architect, Connectivity and Industry 4.0  
parthiban@wavelabs.ai  
(M): +91-7022903371
Agenda

January 10, 2022

• How we test Magma 5G SA & Demo (from previous session)
• Features Under Development
• Magma and LFN
• 3GPP Standardization and Requirements
• TIP Private 5G Scenarios
• Magma Compliance to TIP FWA Requirements
• Requirement Validation for Network Slicing & Security Enhancements (Backup)
• Q&A
How we test Magma 5G SA

1. Start
2. Feature Development
3. Code Commit/PR with Unit Testing Coverage >= 80%
4. Integration Testing (Various Test Tools)
5. Regression Testing
   - PASS
   - FAIL
6. SIT - Physical Equipments & Perf/Scale Testing
7. Test Report (Release Validation)
8. Release/GA
## Automated CI Testing and Reporting

### Wavelabs 5G SA test result report.

**Magma build**: 1.7.0-1641529342-c1638c09

<table>
<thead>
<tr>
<th>Test Case Name</th>
<th>Test Run Result</th>
<th>Scenario Failed</th>
<th>Scenario Passed</th>
<th>Scenario Total</th>
<th>Steps Failed</th>
<th>Steps Passed</th>
<th>Steps Skipped</th>
<th>Steps Total</th>
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<tbody>
<tr>
<td>5G_Registration_PDU_Session_Establishment.feature</td>
<td>passed</td>
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<td>27</td>
<td>0</td>
<td>27</td>
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<td>NG_Setup_Failure_Unknown_PLMN.feature</td>
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<td>12</td>
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<td>NG_Setup_Request_Magma.feature</td>
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</table>
Demo – Let us see it running

Procedures / Features Available today

(1) Registration
(2) 5g specific Authentication
(3) PDU Session Establishment
(4) Idle mode and Paging
(5) Service Request
(6) UE initiated Session Release
(7) UE initiated De-registration
(8) Dynamic Policy support & 5G QOS
(9) Usage reporting & Charging
# Features under Development & Testing

## January & February 2022

1. **Stateless Network Function (Feature Parity)**
2. **Basic IPv6 Support**
   - IPv4v6 sessions
3. **Network Initiated Session modification**
4. **5G Testing, Scale and Hardening**
   - 200 (up to 600 UE), 12gNB, 5 attaches/sec, 4 policies per UE & 4 sessions per UE

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### Diagrams

1. **Stateless Network Function (Feature Parity)**

2. **IPv6 Support**
(3) Network Initiated Session modification

Network initiated session modification call flow
Rise in Adoption / Interest in Magma for 5G

- Community projects using magma 5G (e.g.) LFN 5G Super Blueprint
- Commercial projects using magma 5G (e.g.) vendor, network operators, service providers
LFN End to End 5G Super Blueprint

LF Open Source Component Projects for 5G
3GPP Standards and Requirement (1 of 2)

Started in 2015, consolidated into 74 use cases

Consolidated in to 4 major areas
- eMBB, URLLC, mMTC, Network Operations

Service requirements
- Basic capabilities
- Performance
- Security
- Additional verticals
- Additional service capabilities (V2X, IoT…)

Summary of Work Items for completed releases
- Rel-14
- Rel-15
- Rel-16
Summary of Work Items for ongoing releases
TIP Private 5G Scenarios and Use Cases

Service Provider Managed Private 5G

Private 5G with RAN and Control Plane Sharing

Private 5G with RAN Sharing

Neutral Host Private 5G
## TIP Private 5G Scenarios and Use Cases

<table>
<thead>
<tr>
<th>OCN</th>
<th>Scenario 1 SPM-PSN</th>
<th>Scenario 2 PSN-RS</th>
<th>Scenario 3 PSN-RCS</th>
<th>Scenario 4 NPSN</th>
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</thead>
<tbody>
<tr>
<td>OCN</td>
<td>SNPN</td>
<td>PI-NPN, MOCN, MVNO</td>
<td>PI-NPN, Slicing, APN, DNN</td>
<td>SNPN</td>
</tr>
<tr>
<td>3GPP</td>
<td>Standalone non-public networks</td>
<td>Standalone non-public network - Non-public network in conjunction with public networks</td>
<td>Standalone non-public network and control plane</td>
<td>Standalone non-public networks</td>
</tr>
</tbody>
</table>

### Use Case 1: Standalone Private Local Network
- **Industry**: Manufacturing (Factories)
- **Radio Owner**: Enterprise Owns Radio
- **OCN**: Scenario 1, 4

### Use Case 2: Private Local Network + MNO Roaming
- **Industry**: Hotel Chains, Retail Chains
- **Radio Owner**: Enterprise Owns Radio
- **OCN**: Scenario 1, 4

### Use Case 3: Full Neutral-Host Shared Network (MNO Pays)
- **Industry**: CNO CBRS Network Operator (e.g., MNO)
- **Radio Owner**: MNO Runs Radio Network
- **OCN**: Scenario 2

### Use Case 4: Mining
- **Industry**: Mining
- **Radio Owner**: 3rd Party Radio
- **OCN**: Scenario 1, 4

### Use Case 5: MNO SDN + Private Core
- **Industry**: Local Gov, Education, Hospitals
- **Radio Owner**: MNO Runs Radio Network
- **OCN**: Scenario 2

### Use Case 6: MNO SDN + Macro Sice
- **Industry**: Automotive (connected car)
- **Radio Owner**: 3rd Party Radio
- **OCN**: Scenario 3

### Use Case 7: Neutral host with MNO tenants
- **Industry**: Tower Companies
- **Radio Owner**: Shared/Poolled/ Site Network
- **OCN**: Scenario 1, 4

### Use Case 8: APN, Managed Networks
- **Industry**: Enterprises, Public Safety
- **Radio Owner**: National/WAN (MNO 2nd Party Radio)
- **OCN**: Scenario 5

### Use Case 9: Specialist B2B Networks
- **Industry**: National IoT, Regional Gov. (4)
- **Radio Owner**: Scenario 2, 3

### Use Case 10: Private National Network
- **Industry**: Rail, Utilities
- **Radio Owner**: Scenario 1, 2

### Use Case 2: Shared with PLMN (Licensed)
- **Industry**: Private
- **Radio Owner**: Shared with PLMN
- **OCN**: Scenario 1, 4

### Use Case 3: Shared with PLMN (Licensed)
- **Industry**: Private
- **Radio Owner**: Shared with PLMN
- **OCN**: Scenario 1, 4

### Use Case 4: Shared with PLMN (Licensed)
- **Industry**: Private
- **Radio Owner**: Shared with PLMN
- **OCN**: Scenario 1, 4
## Architectural Requirements (Total = 15; Magma Compliance = 8)

<table>
<thead>
<tr>
<th>TIP OCN REQ ID</th>
<th>Requirement description</th>
<th>Magma compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQ-ARC-03</td>
<td>Several 3GPP network functions may optionally be combined into an integrated OCN network function. In cases where several network functions are combined and implemented as a combined OCN network function, the interfaces between network functions may be simplified or modified by the implementation. However, any interfaces outside the combined OCN network function must remain compliant with the relevant 3GPP and/or OCN specifications.</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-ARC-04</td>
<td>Each Network Function of OCN shall be able to stand alone and operate as an independent Network Function.</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-ARC-05</td>
<td>Each Network Function of OCN shall be able to interoperate with Network Functions provided by other vendor’s Network Functions using standard 3GPP reference point interfaces.</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-ARC-11</td>
<td>OCN shall offer simple, templated onboarding with a bundled baseline schema.</td>
<td>partially compliant</td>
</tr>
<tr>
<td>REQ-ARC-12</td>
<td>OCN shall be managed using automation and orchestration tools.</td>
<td>partially compliant</td>
</tr>
<tr>
<td>REQ-ARC-13</td>
<td>It shall be possible to deploy OCN in a variety of configurations supporting differing user needs for capacity, reliability, scalability, and performance.</td>
<td>partially compliant</td>
</tr>
</tbody>
</table>

## Software Implementation Requirements (Total = 10; Magma Compliance = 5)

<table>
<thead>
<tr>
<th>TIP OCN REQ ID</th>
<th>Requirement description</th>
<th>Magma compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQ-SW-02</td>
<td>Software components of OCN shall be constructed to scale horizontally (duplicating network functions)</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-SW-06</td>
<td>Software components of OCN may support IO acceleration technologies</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-SW-08</td>
<td>Software components of OCN shall provide open metrics and monitoring capabilities.</td>
<td>partially compliant</td>
</tr>
<tr>
<td>REQ-SW-09</td>
<td>Software components of OCN shall publish metrics on a standard exporter endpoint(s) compliant with CNTT specifications.</td>
<td>partially compliant</td>
</tr>
<tr>
<td>REQ-SW-10</td>
<td>Software components of OCN may publish metrics by other APIs or methods (event streams, SNMP, etc.)</td>
<td>Partially compliant</td>
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</tbody>
</table>
## Functional Requirements  \( (\text{Total} = 19 ; \text{Magma Compliance} = 10) \)

<table>
<thead>
<tr>
<th>TIP OCN REQ ID</th>
<th>Requirement description</th>
<th>Magma compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>REQ-OCN-02</td>
<td>OCN shall support basic firewall functionality. If FW rules are global (not user specific) then may be handled outside UPF by FW appliance</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-OCN-03</td>
<td>OCN shall support performance to handle typical fixed ISP bandwidth (speeds/feeds to be specified)</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-OCN-04</td>
<td>Support of IPv4 user sessions is required, IPv6 support is highly desirable</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-OCN-11</td>
<td>It is mandatory to support CDR (charging data records) creation, where CDR contains network usage information</td>
<td>partially compliant</td>
</tr>
<tr>
<td>REQ-OCN-13</td>
<td>It is desirable to support open API to integrate OCN on-line charging with service provider’s customer care or billing system</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-OCN-14</td>
<td>It may be required to support CG-NAT (carrier grade NAT) as a large inventory of public IP is likely unavailable.</td>
<td>not compliant</td>
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<tr>
<td>REQ-OCN-17</td>
<td>It may be required to support LI (Lawful Intercept) functions, depending on regulatory requirements in the market/country of deployment</td>
<td>not compliant</td>
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<tr>
<td>REQ-OCN-18</td>
<td>It may be required to support simple DPI (deep packet inspection)/App Detection</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-OCN-19</td>
<td>Application Function support for private services provided to customers (i.e., video services) is an option.</td>
<td>not compliant</td>
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</table>

## Non-Functional Requirements  \( (\text{Total} = 10 ; \text{Magma Compliance} = 3) \)

<table>
<thead>
<tr>
<th>TIP OCN REQ ID</th>
<th>Requirement description</th>
<th>Magma compliance</th>
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</thead>
<tbody>
<tr>
<td>REQ-NFUN-01</td>
<td>OCN shall target service availability of 99.999%</td>
<td>not compliant</td>
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<tr>
<td>REQ-NFUN-02</td>
<td>Network Functions shall support horizontal scaling (i.e., scaling by adding replicas)</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-NFUN-03</td>
<td>Each Network Function shall scale independently from other functions (i.e., scaling one network function does not lead to or require scaling of any other network functions)</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-NFUN-04</td>
<td>Network Functions may be vertically scalable (e.g., increasing CPU, RAM resources.) Note: vertical scale may be increased by horizontal scaling of the microservices that make up the Network Function</td>
<td>not compliant</td>
</tr>
<tr>
<td>REQ-NFUN-08</td>
<td>Network Functions shall be independently re-startable without impact to other functions</td>
<td>Not compliant</td>
</tr>
<tr>
<td>REQ-NFUN-09</td>
<td>Network Functions shall be upgradeable independently</td>
<td>Not compliant</td>
</tr>
<tr>
<td>REQ-NFUN-10</td>
<td>OCN interfaces shall be versioned allowing forward and backward compatibility</td>
<td>Not compliant</td>
</tr>
</tbody>
</table>
Requirement Validation for Network Slicing

Backup
Network Slicing Requirement (1 of 3)

Slice Instance Onboarding

1. SliceManager first validates if the requested PLMN list, TA list, NodeList specified in the SliceProfile are part of the network and raise error accordingly.

2. On successful Slice Profile validation, list the AGW nodes belonging to the PLMN, TA list.

3. Create NSSI entry in DB and return the response.

4. SliceManager shall send NSSI create event with the list of AGW Nodes where slice shall be deployed to CloudDomainProxy.

5. CloudDomainProxy shall load the SliceTemplate based on the sliceType and deploy slice instances in the AGW nodes.

6. On completion of VNF/CNF deployment in AGW nodes, set the status of NSSI as Active in DB.
Network Slicing Requirement (2 of 3)

Network Slice Selection Function

1. NSSF shall periodically fetch Slice instance data in Orchdr through gRPC channel. Orchdr shall populate the details if slice instance status is active (onboarding completed).

2. NSSF shall periodically fetch slice rules through gRPC channel.
Requirement Validation for Security Enhancements

Backup
Security Enhancement Requirement (1 of 4)

Hard coded user roles propagation to Magma Orc8r

Magma NMS Improvement areas
Security Enhancement Requirement (2 of 4)

Magma NMS

Improvement areas

Solution

Hard coded user roles propagation to Magma Orc8r
Orc8r is not exposed to the tenant user. Tenants will not have granular control over the REST API endpoints and attributes of the Orc8r.
Orc8r is not exposed to the tenant user. Tenants will not have granular control over the REST API endpoints and attributes of the Orc8r.
MAGMA 5G SA SUPPORT

Dedicated Channel for demo, integration support for 5G

Try it! We are Ready to Support it!

Magma Orchestrator in AWS

Magma AGW in any of your Hardware
Wavelabs is an ardent proponent of 'OPEN X' network vision that enables unprecedented innovation, agility, choice, cost efficiency, and speed to market.

We help our clients to overcome challenges and realize the vision of the open and disaggregated 'White Box' connectivity products and solutions a reality.
Enabling engagement, collaboration, and adoption of Magma for 5G

- Wavelabs Opensource Magma Distro
  - Equipment Vendors (OEM, ISV, Silicon)
    - Integrated or Joint solution
    - Engineering, value added and support Services
  - Service Providers (Telecom, WISP, Satellite)
    - Lab, PoC or Commercial deployments
    - Consulting, delivery, integration, support, value added and managed services
  - Hyperscales (AWS, Azure, Google)
    - Wavelabs Magma distro in Hyperscales Market Place
    - Consulting, delivery, integration, support, value added and managed services
  - Enterprises (Education, Manufacturing..)
    - Lab, PoC or Commercial deployments
    - Consulting, delivery, integration, support, value added and managed services
  - System Integrators (E2E, RAN, Orchestration..)
    - Integrated or Joint solution
    - Consulting, delivery, integration, support, value added and managed services

Fixed Wireless Access | Private Wireless Network