What technical challenges need to be addressed en route to 2020?

At Workshop “Open Source and Standards in 5G”

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Requirements & Architecture

May 25, 2016, San Diego, USA
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- The work of NGMN’s P1 project
  - Technical challenges
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    - Network slicing
    - Third party application deployment to edge locations
    - Security, reliability, availability for Enterprise market
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## NGMN Programme Overview

Requirements and Architecture is Project P1 in there

### Requirements & Architecture
- Architecture
- End-to-end Architecture
- NW Mgt & Orchestration
- Security

### Verticales
- US
- Europe
- Asia

### Better Broadband & Telco Services
- China Mobile
- docomo

### SDO Alignment
- docomo
- NOKIA

### Business Principles Group
- Verticals
- Business Architecture
- Capabilities / Value Drivers

### Spectrum
- Spectrum Requirements
- Evaluation on New Frequency Bands for 5G
- NGMN “5G Spectrum White Paper”

### IPR Forum
- SEP Declaration and Assessment
- Patent Pool Licensing
- Open Source
- NGMN “IPR White Paper”
Key results from NGMN Project P1

NGMN results have been shared with 3GPP, ETSI NFV

- **E2E Architecture:** D1: Network slicing concept: → 3GPP (SA2, SA1, SA, RAN) 1/16
- **Network management and orchestration:** D2: work on requirements in progress → 3GPP SA5, 11/16
- **Security:** D1: Virtualization paper. D2: Access NW/DoS security, D3: NW slicing. D2 shared with 3GPP, D3 shared with ETSI NFV, 3GPP 5/16
- **Verticals:** D1: Verticals White Paper – being shared for external review, finalization by end of May/16
- **BBTS:**
  - D1: 5G Use Cases, Deployment Scenarios and Framework of Requirements → 3GPP 5G RAN WS, 9/15
  - D2: NGMN requirement metrics and deployment scenarios for 5G → 3GPP RAN, 12/15
  - D3: Further elaboration on NGMN requirement metrics and deployment scenarios for 5G → 3GPP RAN 1/16
  - D4: Further elaboration on NGMN requirement metrics, deployment scenarios for 5G → ITU-R WP 5D 2/16
  - D5: NGMN requirements and deployment scenarios for 5G → 3GPP RAN, 3/16
- **SDO Alignment:** master-plan for sharing results with SDOs

**Status / Achievements**

**Next steps**

- **E2E Architecture:**
  - D2: Edge computing: → 3GPP SA2 7/16
  - D3: Consistent user experience: → 3GPP SA2 9/16
- **Security:** Work on MEC; Low Latency, Consistent User Experience
- **Verticals:** External reviews and finalization by end of May
- **BBTS:** Close discussion on area traffic capacity. Prepare LS to 3GPP RAN #72 6/16
The work of NGMN’s P1 project

**Technical challenges**
- Radio-related challenges
- Network slicing
- Third party application deployment to edge locations
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Role of Standards and Open Source

Conclusions
Radio-related challenges

### Delivery of NGMN Guidance to 3GPP for Better Mobile Broadband

- Defined **Key Performance Indicators** such as latency, user experienced data rates, energy efficiency, …

### Many Challenges Remain

- **Phasing, timing of standards** through 3GPP that meets NGMN members requirements (quality standard) whilst avoiding fragmentation
- **Alignment of common frequency bands** to drive economies of scale
- How to meet stretching requirements to ensure 5G is valid for very high performance **in urban dense deployments and wide area coverage**?
- **New Verticals**: formalise key requirements in order to guide further development of standards within 3GPP (in progress) for massive MTC and low-latency use cases
Network Slicing Challenges (1)

Elephant in the room - How will operators slice their 5G networks?

- By vertical market? Per enterprise customer within each vertical market slice type?
- Per user service (i.e. speech, messaging, mobile broadband)?
- Per QoS type for each user service?
  Will elasticity change the traditional QoS paradigm?
- Will the benefits of slicing outweigh the costs?

Will slices include the access network?

- Implies a programmable 5G radio scheduler design
- Dynamic partitioning of scheduler resource according to eMBB, MIoT, CriC demand in the same cell.
- Slices including virtual BBU, MEC servers, vBNG or vBRAS, small cell gateways, new aggregation points?
Network Slicing Challenges (2)

- **Shared non-sliced network parts**
  Are some NW functions best left centralised, called by service slices?
  - MME mobility management function? HSS? AuC? Subscriber database?

- **Isolation of slices**
  Once a slice has been granted to a 3rd party, can the slice breathe without impacting other slices?

- **Achieving efficiency**
  How to realise slices of mixed requirements (high versus low reliability, availability) without over-engineering the infrastructure?

- **Strategy issues**
  Will operators want to share how they slice the network?
  - May expose business cases and topologies which are usually not shared.
Split the “Orchestrator” into Service and Domain Orchestrators

- SO above DO layer.
- SO composes service slices, some multi-domain.
- Domains: L3, L4 domains can be 3GPP IP Core, Access, SGi-LAN, L4 Transport, etc.
- E2E service composed of multiple domains.
- Enable multi-layer virtual overlay networks for enterprise customers and operator services.

Per service or per enterprise customer slices enable bespoke performance and resource metrics

- Enterprise SLAs easier to manage.
- Operator service performance measurable on per-service basis.
- New service level analytics or real-time performance metrics needed.
Third party application deployment to edge locations (1)

- **Open APIs between Application and Edge Platform**
  - Get the largest number of potential Network Edge application developers.
  - APIs in best-in-class format to appeal to widest possible developer community
  - This is **expected from ETSI MEC**:
    - RESTful, HTTP v1.1, representations (JSON, XML), response / request schemas, links and response status codes supported, tool support, single API entry point.
  - Publication in ETSI or better on GitHub.

- **Security considerations**
  - Current NW Operator conservatism / NW protection mechanisms add too much delay.
  - Need to embrace “try many, fail fast”.
  - Could an isolated app quarantine area e.g. in the vBBU or aggregation point help?
Third party application deployment to edge locations (2)

- **Dual integration of edge computing locations**
  - **Operator view:**
    - Desired: For MANO integration with NFV, see (1)
  - **Enterprise application developer view:**
    - Desired: One-stop shop for application development & deployment (e.g. private cloud + edge compute)
    - Multi-cloud deployment → integration with main clouds of interest, see (2 – 4)

- **Challenges**
  Stakeholders: For MANO: telco operations team. For cloud integration: enterprises.
  - How to best serve both stakeholders and meet their benchmark expectations?
  - Can we use multi-cloud integration mechanisms from cloud computing?
High security, reliability, availability for Enterprises

- **Required by some new vertical markets**
  - Unmanned aerial vehicles (inc. drones)
  - Cloud robotics (inc. manufacturing)
  - etc.

- **Largely implementation based?**
  - SecurityaaS is a selling point for NW Operators
  - Elasticity and hot failover via cloud methods can help reliability and availability (e.g. also cloud-native applications)
    - But only if they are fast enough for low latency services where service interruption time is also < 10ms.
Ultra-low latency on application level

- **Latency is contributed by many factors**
  - Devices, access, core, Internet, Cloud
  - Many factors still in place with edge computing

- **Key challenges**
  - **Controlling all latency factors** E2E for service level agreements?
  - How to achieve **predictable latency** (latency < x milliseconds at certain confidence level)?
  - How to control latency when E2E network consists of several administrative domains?
  - How to handle required low latency in **roaming situations**?
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Role of Standards and Open Source

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Role of Standards and Open Source

Twin action: 5G networks to benefit from both standards and open source

Standards

- **Benefits**
  Interoperability, avoids fragmentation, 2 steps: from spec to compliant product

- **Downsides**
  - Sometimes long lead times
  - Doesn’t address burden sharing for foundational code and tools
  - Most often cannot reference non-standard but latest cutting edge technology

Open Source

- **Benefits**
  - Cost sharing for foundation code, tool chains, “crowd-sourced”
  - Easy to set up new projects

- **Downsides**
  - Often 3 steps: from code to commercial wrappers to products
  - Early releases often suffer from quality issues (e.g. OpenStack)
  - Potential confusion, fragmentation due to plethora of OS projects
  - Not simple to influence OS projects from outside (pushing requirements upstream)
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Conclusions

- NGMN has so far largely shared requirements with SDOs
- Both standards and open source are required, also for 5G
- For 5G, a number of technical challenges remain
- Several of them will be addressable by SDOs
  - Often certain SDO groups excel in particular subject matter areas
  - Thus, address the challenges with the right experts
- It helps for SDOs to define an overall accepted system architecture, in which open source can be embedded (see e.g. ETSI NFV and VIMs, SDN controllers etc.)
- Requires further discussion what best to solve via open source.
Thank You