

# **NGMN 5G Vision and Requirements, and an Outlook on the 5G Work Ahead**

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# The NGMN Alliance is supported by key industry players



## 28 Worldwide Leading Mobile Operators



## 33 Worldwide Leading Technology Vendors



## 26 Universities / Research Institutes



# NGMN 5G White Paper finalised



## NGMN 5G White Paper

1. Executive Summary
2. Introduction
3. 5G Vision
4. Requirements
5. Technology & Architecture
6. Spectrum
7. IPR
8. Way Forward

NGMN 5G White Paper,  
Version 1.0, 17<sup>th</sup> February -2015

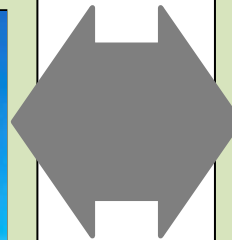
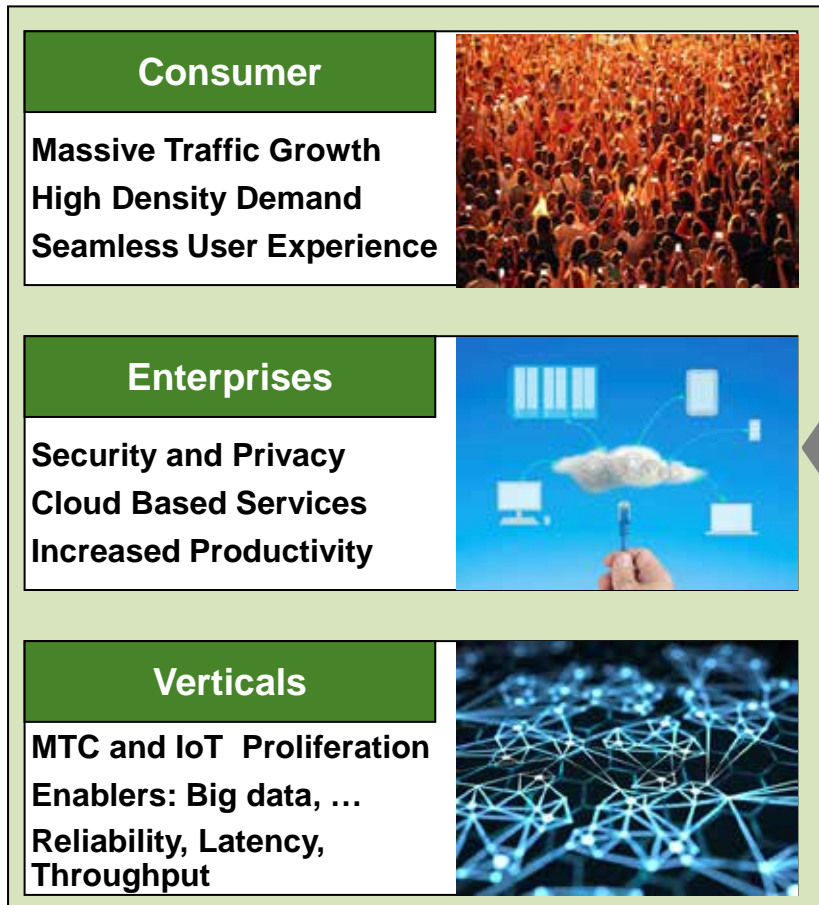
- § Global view
- § End-to-end scope
- § Specific, comprehensive requirements
- § High quality
- § Timely delivery
- § Business perspective, operator led

## NGMN Board Members

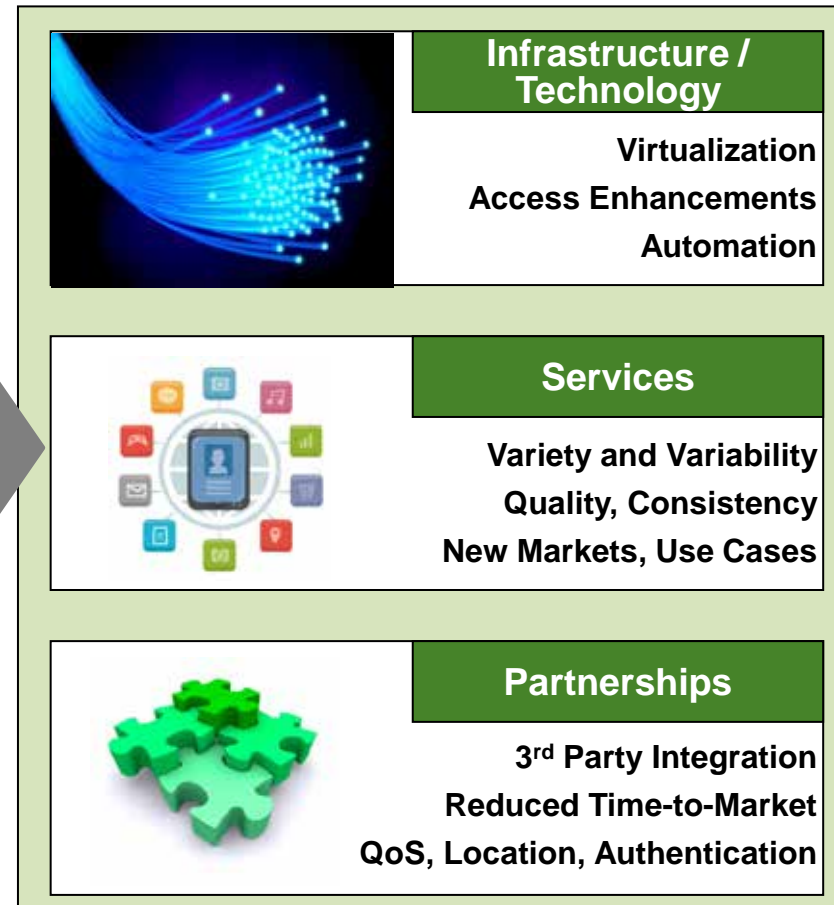


# Business context beyond 2020

## Customer Context



## Operator Context



# 5G Characterization

## The End-To-End Ecosystem



### Business context beyond 2020

#### CUSTOMER CONTEXT



#### OPERATOR CONTEXT











### 5G Vision

Use Cases

Value Creation

Business Models

## Overview 5G Use Case Families

<p><b>Broadband access in dense areas</b></p> <p><b>PERVASIVE VIDEO</b></p> 	<p><b>Broadband access everywhere</b></p> <p><b>50+ MBPS EVERYWHERE</b></p> 	<p><b>Higher user mobility</b></p> <p><b>HIGH SPEED TRAIN</b></p> 	<p><b>Massive Internet of Things</b></p> <p><b>SENSOR NETWORKS</b></p> 
<p><b>Extreme real-time communications</b></p> <p><b>TACTILE INTERNET</b></p> 	<p><b>Lifeline communications</b></p> <p><b>NATURAL DISASTER</b></p> 	<p><b>Ultra-reliable communications</b></p> <p><b>E-HEALTH SERVICES</b></p> 	<p><b>Broadcast-like services</b></p> <p><b>BROADCAST SERVICES</b></p> 

# 5G Vision: Business Models



Role	Business Models	
<b>Asset Provider</b>	<p><b>XaaS: IaaS, NaaS, PaaS</b></p> <p>Ability to offer to and operate for a 3rd party provider different network infrastructure capabilities ( Infrastructure, Platform, Network) as a Service.</p>	<p><b>Network Sharing</b></p> <p>Ability to share Network infrastructure between two or more Operators based on static or dynamic policies (e.g. congestion/excess capacity policies)</p>
<b>Connectivity Provider</b>	<p><b>Basic Connectivity</b></p> <p>Best effort IP connectivity in retail (consumer/business) &amp; wholesale/MVNO</p>	<p><b>Enhanced Connectivity</b></p> <p>IP connectivity with differentiated feature set (QoS, zero rating, latency, etc..) and enhanced configurability of the different connectivity characteristics</p>
<b>Partner Service Provider</b>	<p><b>Operator Offer Enriched by Partner</b></p> <p>Operator offering to its end customers, based on operator capabilities (connectivity, context, identity etc.) enriched by partner capabilities (content, application, etc.)</p>	<p><b>Partner Offer Enriched by Operator</b></p> <p>Partner offer to its end customers enriched by operator network and other value creation capabilities (connectivity, context, identity etc.)</p>

# 5G Vision: Value Creation

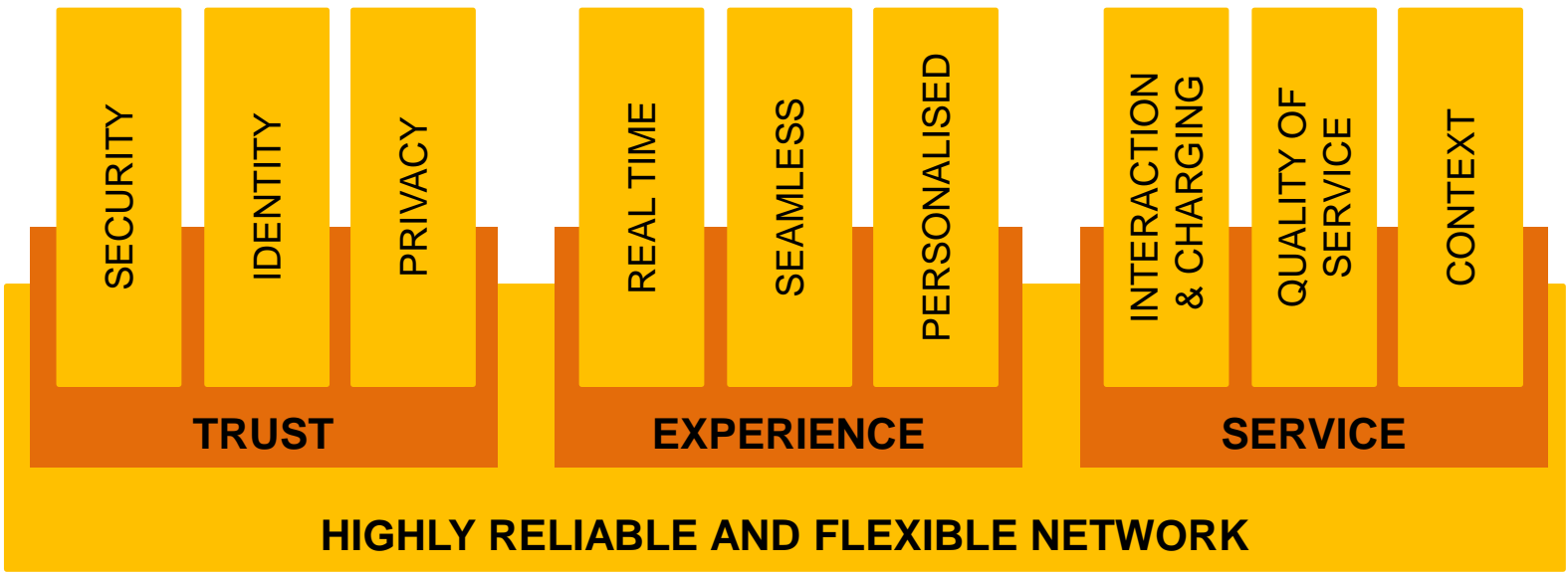


- § Available Anywhere-Anytime
- § Delivered with consistent experience
- § Accessible on multiple devices / interfaces
- § Support multiple interaction types
- § Supported transparently across technologies
- § Delivered in a personalised and contextual fashion
- § Enabled by trusted & reliable communications
- § Highly reliable and resilient network
- § Responsive and real-time

**Operators' value creation proposition**



**5G Value creation capabilities**  
– integrated into the 5G system and easily exposed through APIs





# Vision and Requirements

## NGMN 5G Vision ...

*“5G is an end-to-end ecosystem to enable a fully mobile and connected society. It empowers value creation towards customers and partners, through existing and emerging use cases, delivered with consistent experience, and enabled by sustainable business models.”*

### Use Cases

Support countless emerging use cases

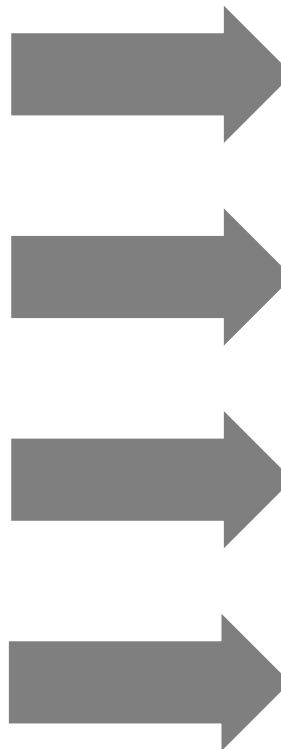
### Value Creation

Leverage key strength and assets to provide value to customers

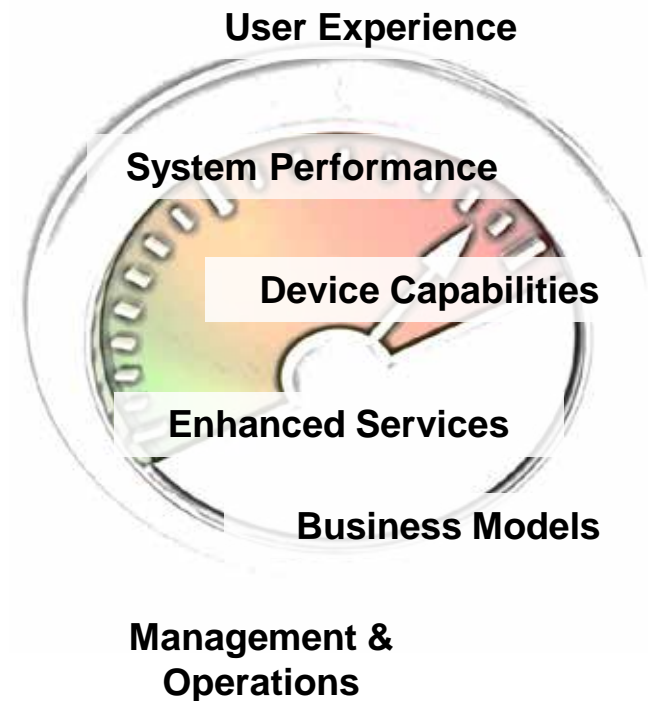
### Business Models

Enable evolution of current and development of new business models

... drives and shapes ...



... NGMN 5G Requirements





## Excellent and consistent User Experience



- § **Consistent** user experience across time and service footprint in a highly heterogeneous environment, dependent on use case
- § **Much higher user data rates**, required to be available in at least 95% of locations (including cell-edge) for at least 95% of the time:
  - Dense urban: 300Mbps DL
  - Smart office: 1Gbps DL
  - Multi-Mbps data rates everywhere – including in stadiums, airplanes and areas currently not connected to the Internet
- § **Much lower latency**: Less than 1ms E2E latency for certain car-2-car and industry automation communication needs
- § **Seamless service experience** to moving users (up to 500 km/h) and also static/nomadic users/devices

**Note: Requirements are defined 'per use case category' instead of 'one-fit-for-all'**



## System Performance



***Significantly expanded network capabilities to cope with the variety and variability of use cases***

§ Connection/Traffic Density:

- **Users in a crowd:** Several tens of Mb/s for tens of thousands of users in crowded areas
- **Smart office:** 15Tbps/km<sup>2</sup> traffic density for smart office
- **Massive sensor deployments:** Up to several 100,000s simultaneous connections per km<sup>2</sup>

§ **Significantly enhanced spectral efficiency** (average and cell edge, across bands) to keep number of sites reasonable

§ **Enhanced resource and signaling efficiency** to minimise resource and energy consumption

***Note: Requirements are defined 'per use case category' instead of 'one-fit-for-all'***



## Smart Devices with Growing Capabilities (HW, SW and OS)



- § High degree of **programmability and configurability** of any device by the network (**OTA**)
- § Flexible and dynamic **device capability handling**
- § Devices to support of **multiple bands simultaneously and multiple modes** (FDD, TDD, mixed) for true **global roaming**
- § Significantly increased **battery life**: at least 3 days for smartphones, up to 15 years for low-cost MTC device



## Enhanced Services



### *Value creation towards customers and partners through capabilities enhancing today's overall service delivery*

- § **Seamless** and always-best-experience connection without user intervention, across existing, new and **non-3GPP RATs**
- § **Unnoticeable mobility** across existing, new and non-3GPP RATs
- § **Network based positioning** with accuracy from 10 m to <1 m outdoor and <1m indoor, in real time
- § **Strengthened security** for services and network in highly heterogeneous environments, working also when user is roaming.
- § **Protection of users' trusted information**
- § **Ultra-high reliability** rate of  $\geq 99.999\%$  for specific use cases



## New Business Models



### *Expansion of current and creating opportunities for new business models within the 5G eco-system*

- § Partner Service Provider, XaaS Asset Provider:  
**Configure and manage services** e.g. via Open API – exposing NW capabilities in a flexible, configurable and programmable manner
- § Connectivity provider:  
Connectivity delivered using only necessary NW functions –  
**provisioning and configuration on demand** and in a programmable manner
- § Network Sharing Model:  
Enabling various sharing schemes to **maximise overall synergies of sharing agreements** and to allow for flexible / rapidly changing models and relationships



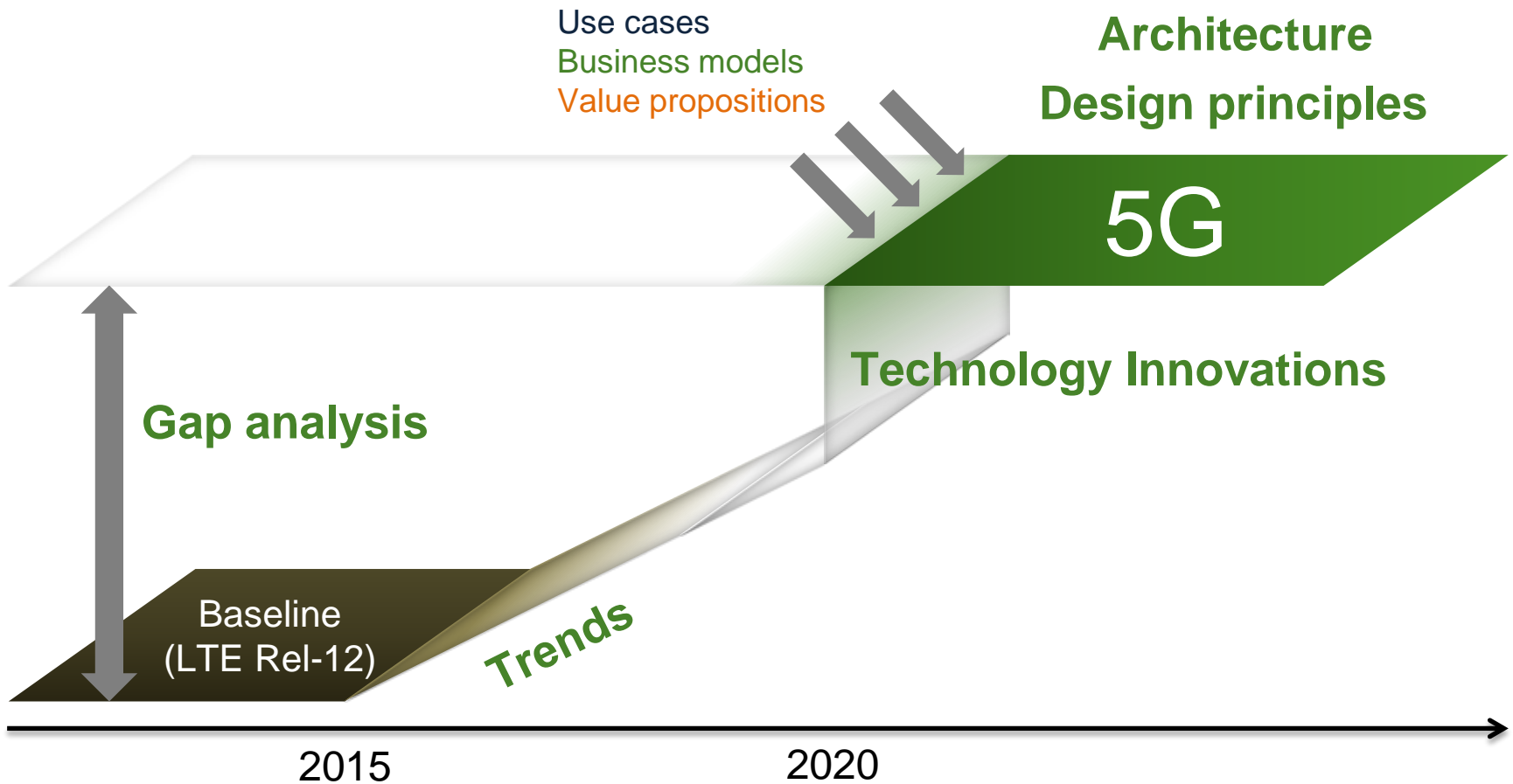
## Highly Efficient Network Operation



***High efficiency in cost, energy, innovation, deployment and O&M while minimizing Total Cost of Ownership***

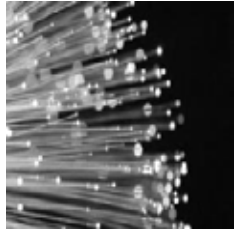
- § Half of total network **energy consumption** for 1000x traffic growth
- § Significant **reduction of O&M** complexity and cost
- § **Ultra low cost** for very low-ARPU areas and/or MTC services
  
- § **Flexible and fast introduction** of new services and technologies
- § **Ease of deployment:** Plug&Play, Self-configuration/heal etc.
  
- § **Flexibility and scalability:** Openness and multivendor capability at all levels, modular provisioning, functional split of Core/RAN network domains / elements, decouple HW and SW
  
- § **Fixed-mobile convergence**, for seamless user experience and unified subscriber management

# Technology and Architecture





# Step change performance increase requested



## Data rate

**> 10X**  
(avg & peak)  
**> 100X**  
(cell edge)



## Latency

**> 10X**



## Mobility

**> 1.5X**



## Connection density

**> 100X**

vs Rel-12



- § Not a single solution will satisfy all extreme requirements at the same time
- § However, several use cases to be active concurrently: High degree of flexibility and scalability of the network required

# Pillars of the design

## 5G

### RADIO



- § Leverage spectrum
- § Densification
- § Managed interference
- § Dynamic topology

### NETWORK



- § Common composable core

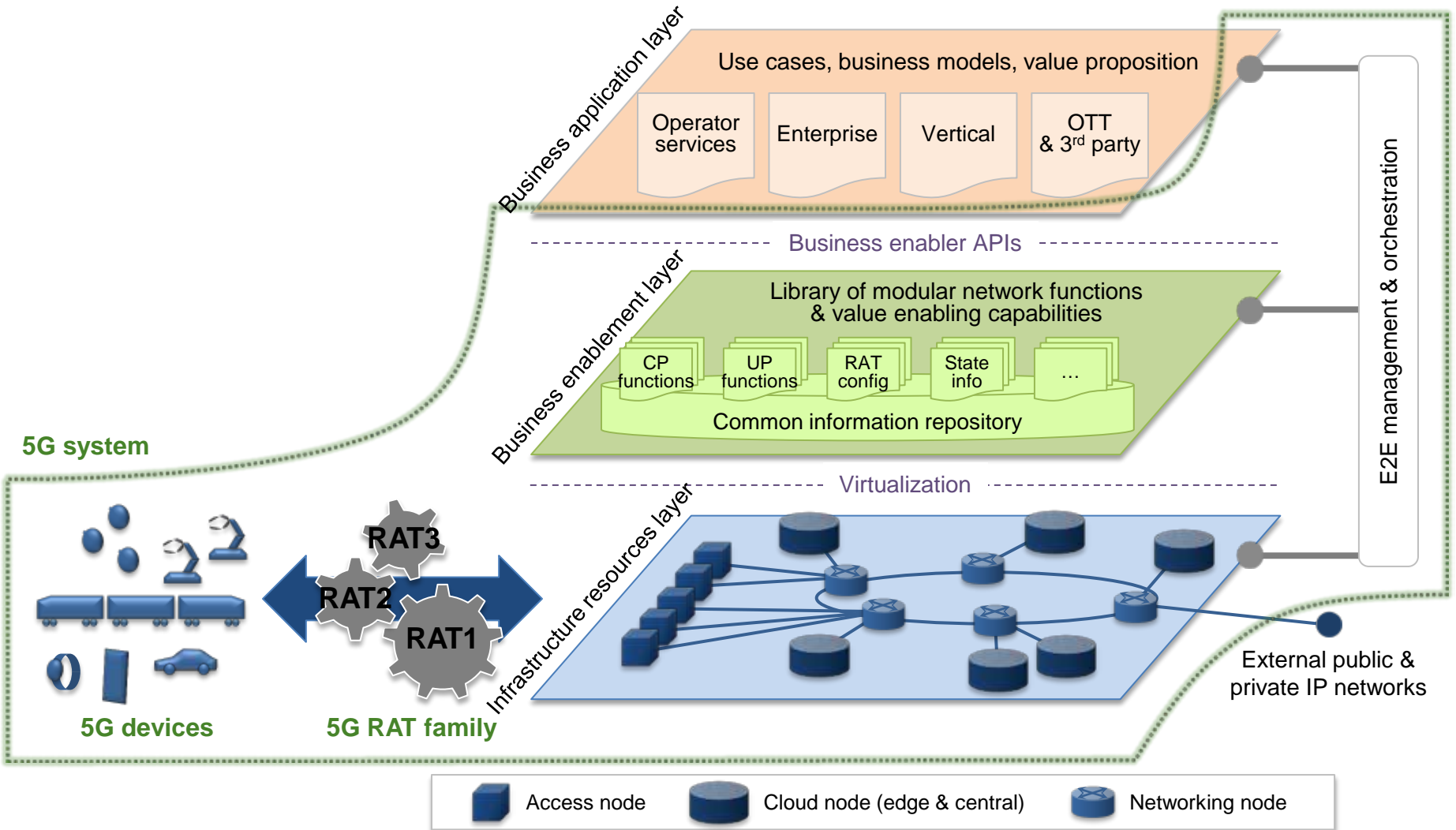
### OAM



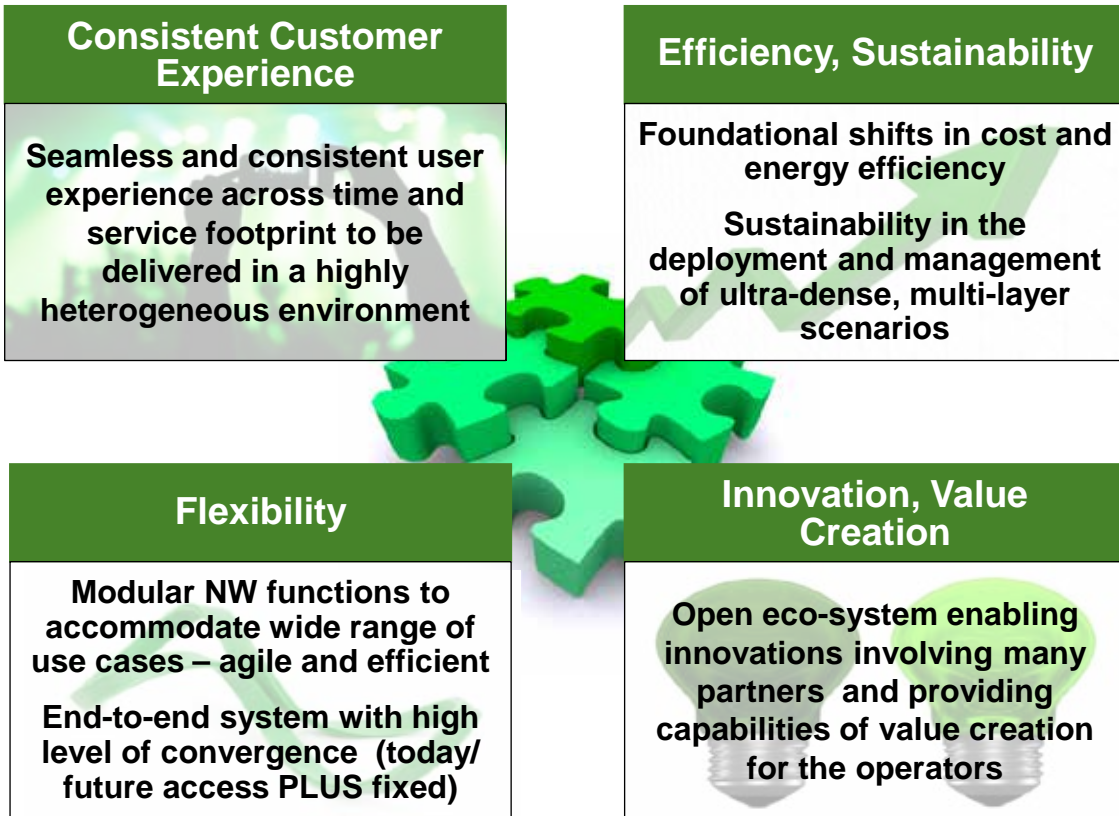
- § Simple OAM

- § Flexible functions
- § Value creation features
- § Security & privacy

# Flexible and scalable architecture



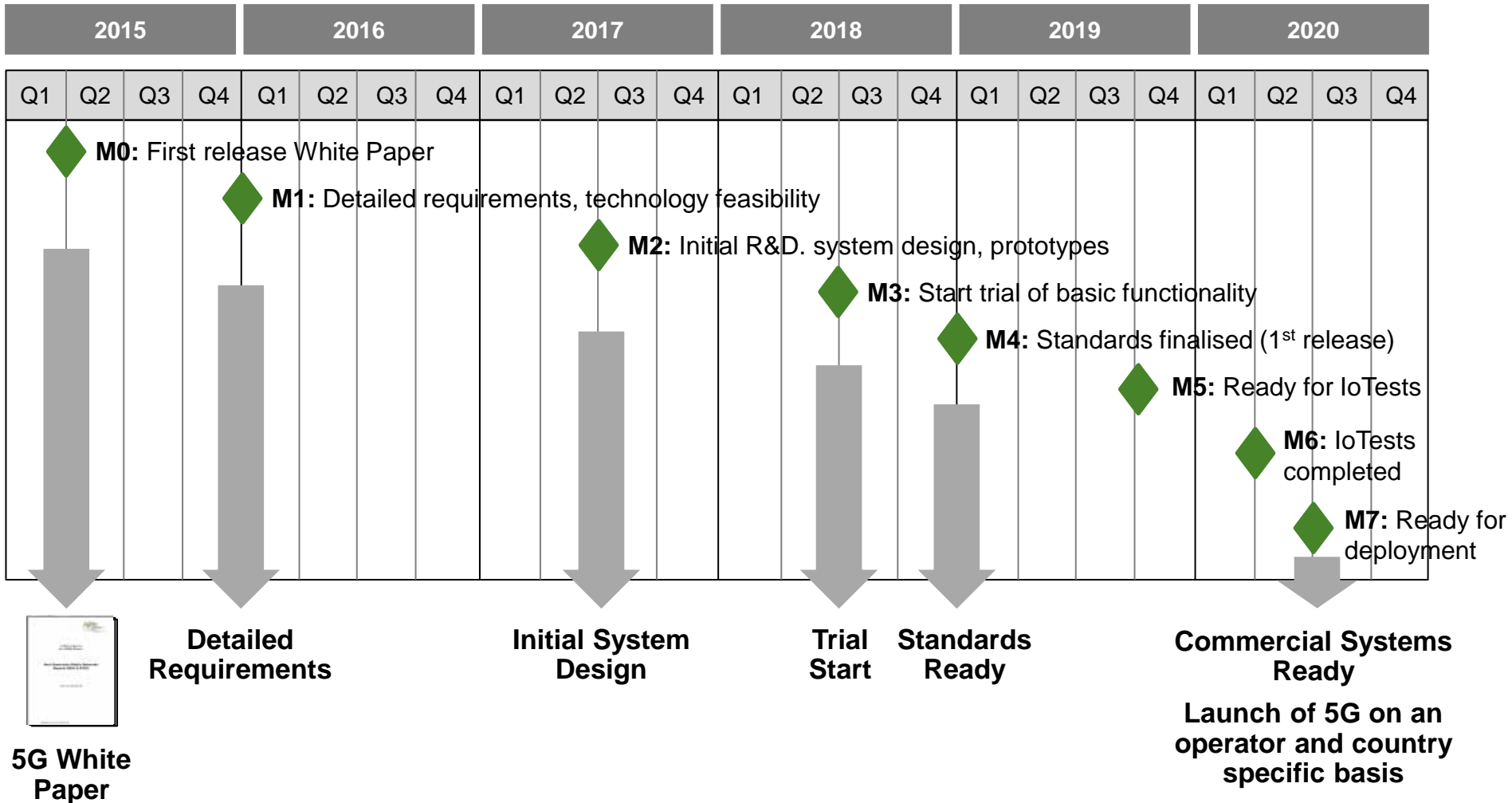
# Key 5G building blocks



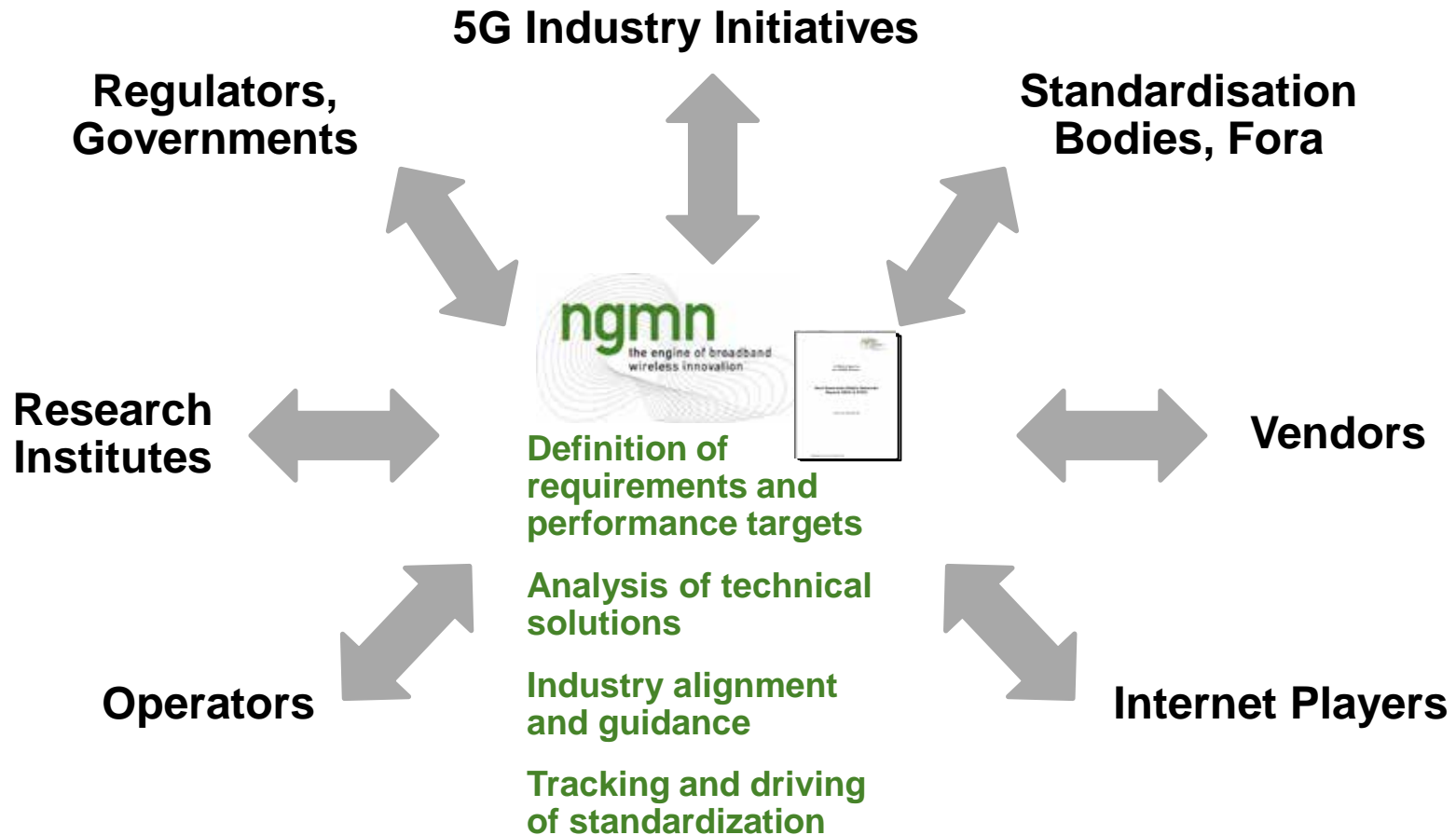
## Enabled by

- § **Spectrum:** Additional spectrum for mobile broadband and needs to be supported by flexible spectrum management capabilities
- § **IPR Regime:** More transparent and predictable IPR eco-system for 5G, to foster innovation, enable new use cases and business opportunities, and at the same time, reward innovators appropriately
- § **Roaming and Interconnect:** Roaming and interconnect in a way that allows faster and more cost-efficient implementation, and global reach

# NGMN 5G Roadmap



# NGMN to reach out and co-operate with all ecosystem stakeholders relevant for 5G



**Eco-system: Truly global, free of fragmentation, open for innovations**

# NGMN 5G White Paper successfully delivered and positioned



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Version 1.0, 17-February-2015

## Communicated and presented

§ Press conference MWC



§ NGMN Industry Conference

§ NGMN Forum and 5G workshops

§ Press releases, twitter, linkedin

## Internationally recognized and appreciated as guidance

Referenced

§ in Vendor publications



§ by SDOs, industry associations



§ by analysts, press and other public sources



# 5G Work Programme launched



## NGMN 5G Work Programme: E2E guidance to the industry for the coming years

### Business Principles

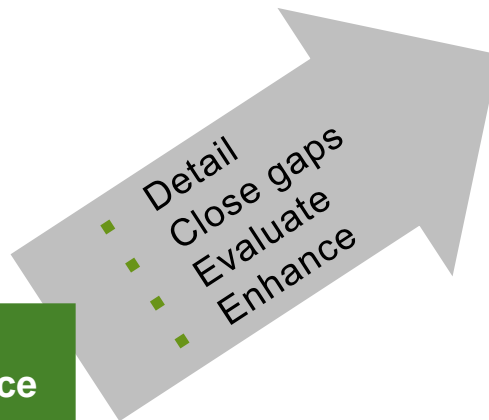
E2E Req. & Architect.

Spectrum

IPR Forum

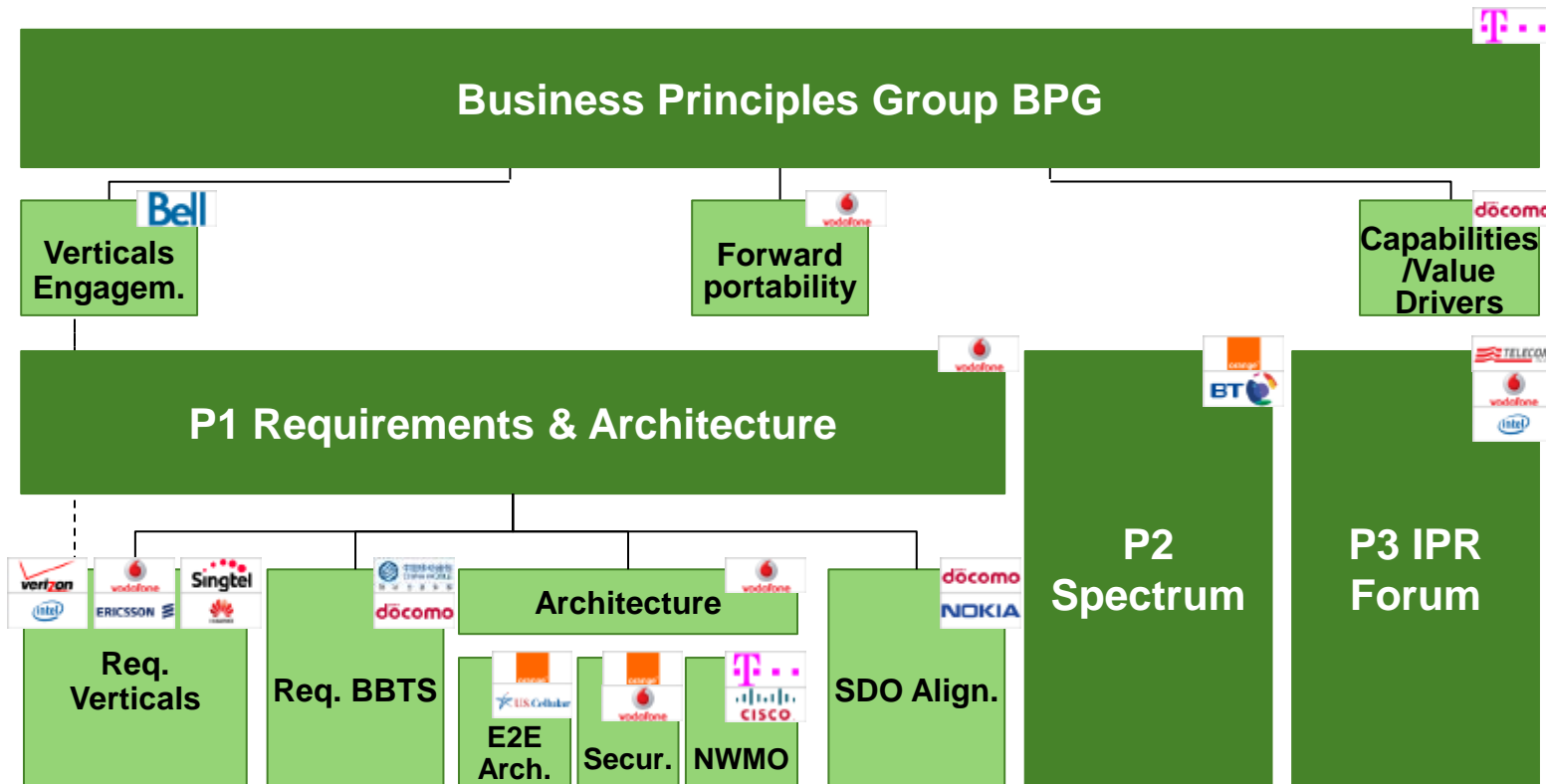


### NGMN 5G White Paper





# 5G Work Programme overview



# Work-programme achievements and events



- § Project P1 WS3 “Better Broadband Telco Requirements”:
  - Input to 3GPP 5G RAN workshop September
  - Face-to-face workshops July, Germany and November, China
  - Input to 3GPP RAN meeting December
- § Project P2 Spectrum – first external deliverables finalised and published:
  - NGMN Press Release for WRC-15
  - Briefing paper on “Future IMT mobile spectrum goals for ITU WRC-15”
- § Co-operation, discussion with GSMA, ETSI, TM Forum, IEEE
- § IPR Forum meeting September, US – next meeting December, Austria
- § NGMN Forum and Board meeting review of end-to-end work-programme in October , Canada
- § 5G Board Committee set-up and launched
- § P1 WS2 “Verticals Requirements”/ BPG “Verticals” interaction with vertical industry representatives and face-to-face meeting December, Taiwan
- § Liaison to 3GPP on “NGMN view of 5G as an end-to-end ecosystem - Alignment of 3GPP SA and RAN”

# P1 WS3 “Requirements BBTS” input to 3GPP



Deployment scenarios (1/2)		
Indoor hotspots	Dense urban	Urban coverage
<b>Deployments</b>	<b>Deployments</b>	<b>Deployments</b>
"Indoor deployment for indoor hotspots, e.g., office, residential and shopping mall"	"Hotspot, e.g., two layers, micro/macro cells with small cells."	"Homogeneous deployment with macro cells"
<b>Attributes</b>	<b>Attributes</b>	<b>Attributes</b>
"Indoor base stations "Indoor users "Very high data rate "Low mobility "Very high user density "Both low and high frequency"	"Outdoor base stations (possibility of outdoor base stations w/ FFS) "Indoor and outdoor users "High data rate "Low mobility "High user density "High-rise/mid-rise buildings "Both low and high frequency"	"Outdoor base stations "Indoor and outdoor users "Medium to high data rate "Low to medium mobility "Medium user density "Low frequency"

## § Input to 3GPP 5G RAN workshop September

- Summary use cases
- Deployment scenarios, requirements framework
- List of requirement metrics
- Key aspects eMBB

2 HIGH LEVEL DESCRIPTION OF DEPLOYMENT SCENARIOS		
Table 1: High level description of deployment scenarios		
Usage scenario	Deployment scenario	High level description
eMBB	<b>Indoor hotspot (eMBB-IH)</b> Challenge High capacity, high density, consistent user experience. Example environments include indoor office, shopping mall and stadium.	Carrier frequency A) above 6 GHz B) above 6 GHz and below 6 GHz [If A) cannot meet requirements, use B)] Network layout Indoor floor ISO 20 m
	<b>Dense urban (eMBB-UM)</b> Challenge High capacity, high density, consistent user experience.  Deployment options 1) macro cells only 2) macro cells with outdoor small cells 3) outdoor small cells only	Carrier frequency Deployment option 1) A) below 6GHz B) above 6 GHz C) below 6 GHz and above 6 GHz combined  Deployment option 2) A) below 6GHz for both macro and small cells B) above 6 GHz for both macro and small cells C) below 6 GHz and above 6 GHz combined for macro and small cells D) below 6 GHz for macro and above 6 GHz for small cells  Deployment option 3) above 6 GHz

## § Input to 3GPP RAN meeting December

- High level description of deployment scenarios
- Key performance indicators

# P1 WS2 “Verticals Requirements”: Input from vertical representatives



## Service description

#devices	one to many vs. one to one
geographic spread	(mainly) outdoor vs. indoor
frequency / timing of usage	device to device vs. device to NW
traffic generated / density	...

## Potential similar services

Shortcomings, improvement potential, ...

## Role of the operator and value proposition



## Service requirements

bit rate	speed / mobility
latency (UP, CP)	handover interruption
reliability	security
resilience	density
device power consumption	user experience
operations	...

## Operator capabilities to be provided

Dynamic negotiation of parameters (e.g. QoS), ability to receive information on device reachability, user presence, ...

# Project P2 Spectrum: Achievements



- § Synthesis of company positions on options for WRC-19 agenda item proposal, including spectrum bands.
- § First external deliverables finalised and published:
  - NGMN Press Release for WRC-15
  - Briefing paper on “*Future IMT mobile spectrum goals for ITU WRC-15*”

Note 1: The briefing paper has been published on the NGMN website and mentioned in the press release

# NGMN Liaison to 3GPP on “NGMN view of 5G as an end-to-end ecosystem “

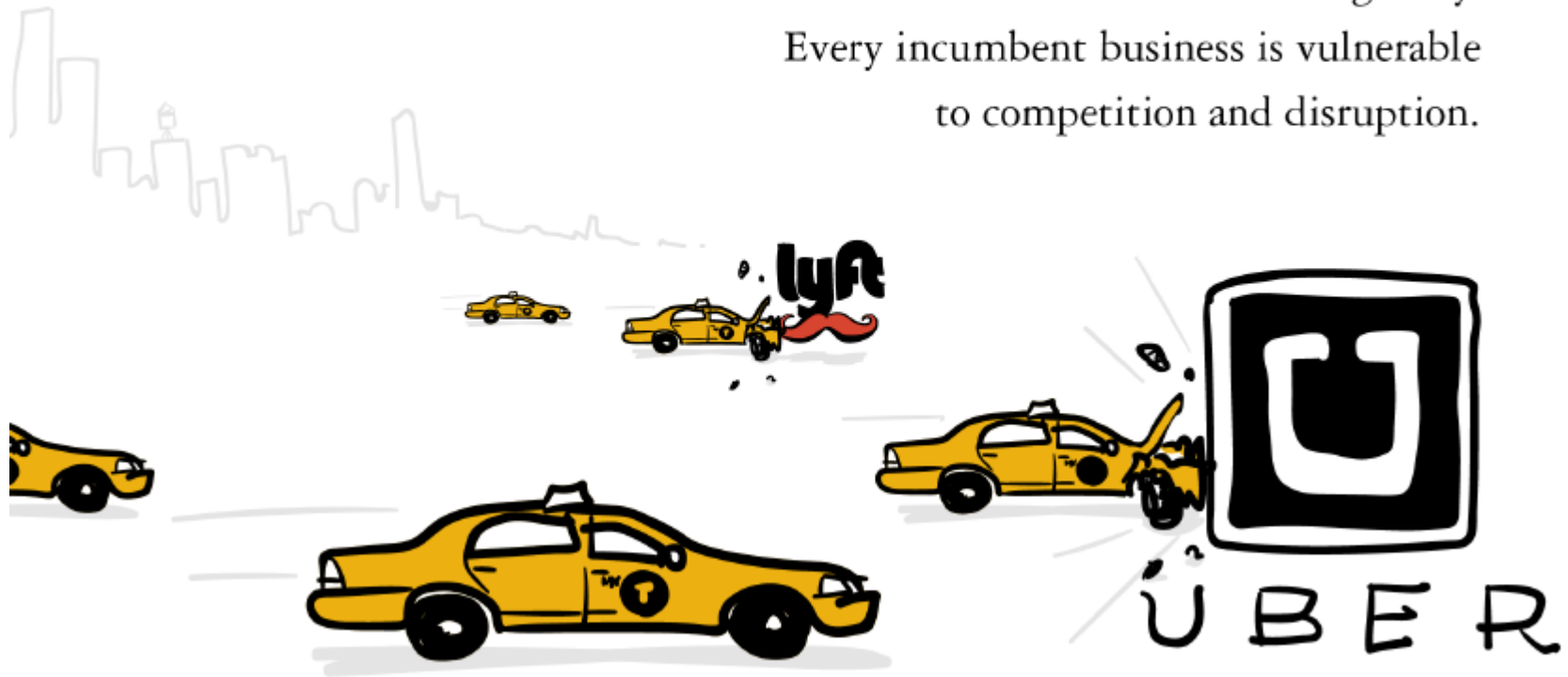


NGMN has reviewed the summary of the 3GPP TSG RAN workshop on 5G. NGMN notes that the summary broadly takes into account the views of NGMN, however **NGMN would like to emphasise the importance for the 5G RAN studies and SA studies to be synergetic and believes that the whole design should focus on the e2e service level requirements and goals for the whole 5G system.** Therefore, we kindly request 3GPP to ensure continued inter-TSG coordination toward this goal as 5G studies progress.

# Today's business environment: Major transformation ongoing



barriers to entry that have stood for decades are melting away. Every incumbent business is vulnerable to competition and disruption.



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# Questions?