

# IEEE 802.11 in 5G

**Date:** 2015-07-12

**Author:**

<b>Name</b>	<b>Company</b>	<b>Address</b>	<b>Phone</b>	<b>email</b>
Max Riegel	Nokia Networks			maximilian.riegel@nokia.com

**‘5G’ means 5<sup>th</sup> Generation Mobile Networks not 5 GHz!**

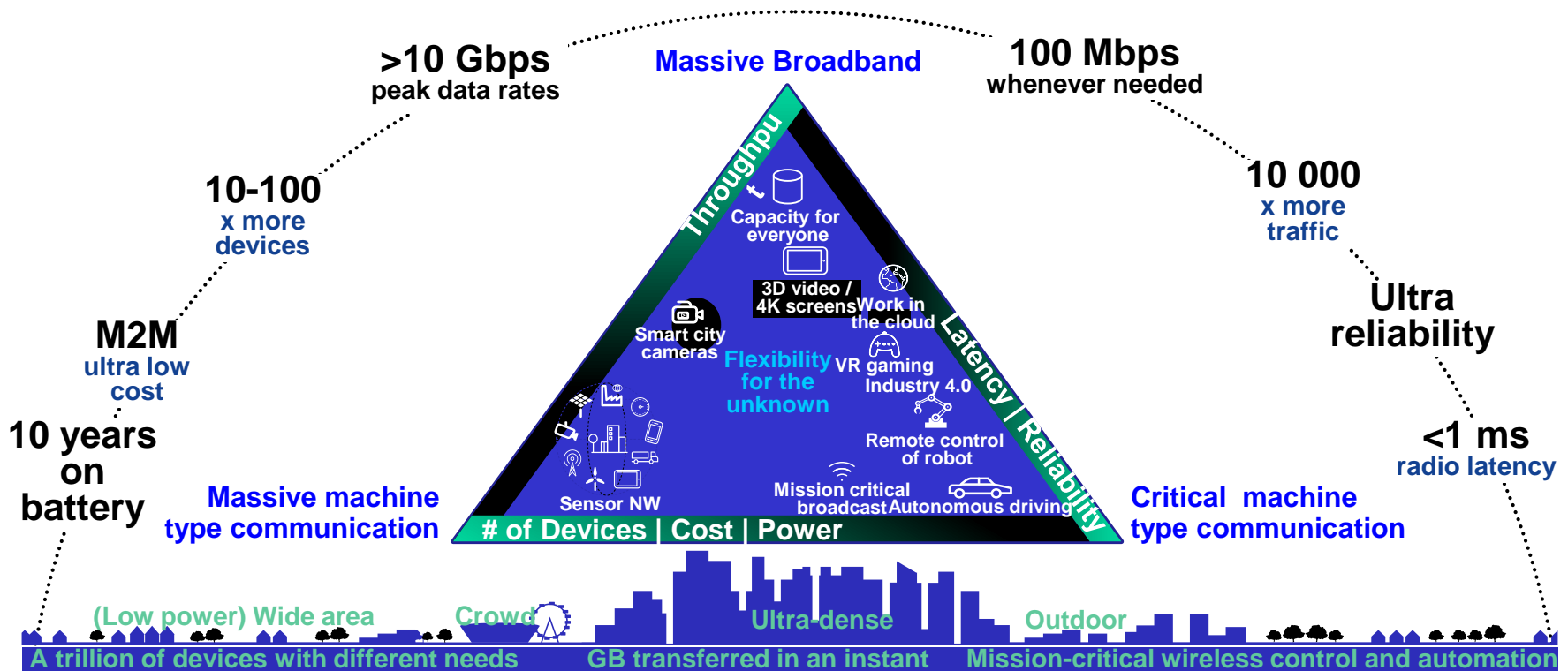
# Introduction

- **Discussions about 5<sup>th</sup> Generation Mobile Networks have reached significant intensity in industry, academia and among mobile operators.**
- **There is no common understanding what ‘5G’ means.**
  - All agree that there is no agreement what 5G will be.
- **A major source of current thinking might be the NGMN 5G White Paper by NGMN Alliance (February 2015)**

# Outline

- **Requirements**
- **Vision**
- **Network integration**
- **Timeline assumption**
- **Current treatment of IEEE 802.11**
- **Conclusion**

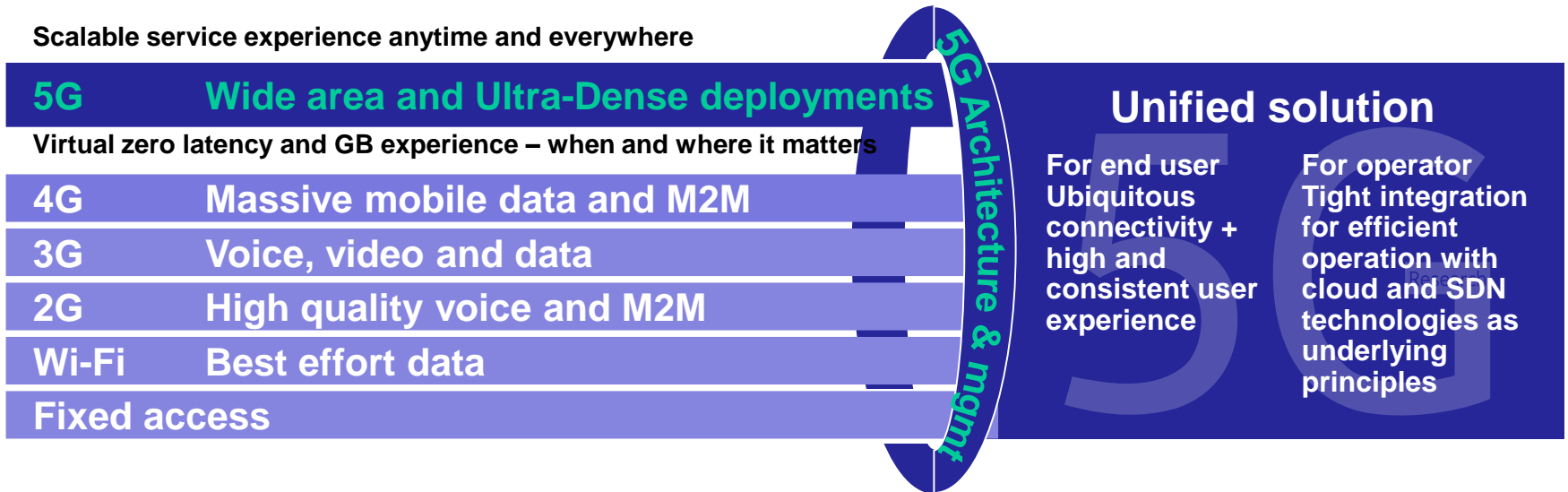
# A broad range of requirements are taken into account for 5G



(Source: Nokia)

# Towards the 5G vision: 5G integrates well with the existing technologies

Scalable service experience anytime and everywhere



(Source: Nokia)

# Assumptions about network integration of the various Radio Access Technologies

From the NGMN Alliance 5G whitepaper:

	Option 1	Option 2	Option 3
<b>Pros</b>	<ul style="list-style-type: none"> <li>No changes to 4G RAN</li> <li>No need for revolutionary 5G NW functions design</li> </ul>	<ul style="list-style-type: none"> <li>No changes to 4G RAN</li> <li>5G NW functions/ new RAT design can be optimized to fully benefit from new technologies (e.g., virtualization)</li> </ul>	<ul style="list-style-type: none"> <li>5G NW functions/ new RAT design can be optimized to fully benefit from new technologies (like virtualization)</li> <li>Solves mobility issues of option 2</li> <li>Provides a sound migration path</li> </ul>
<b>Cons</b>	<ul style="list-style-type: none"> <li>Tied to the legacy paradigm for all the use cases (which may be expensive)</li> </ul>	<ul style="list-style-type: none"> <li>New design could only be utilized where there is new RAT coverage</li> <li>Potential signalling burden due to mobility if the new RAT does not provide seamless coverage</li> </ul>	<ul style="list-style-type: none"> <li>Potential impact on legacy RAN to operate concurrently with legacy CN functions and 5G NW functions.</li> </ul>

NW Network  
 EPC Evolved packet core  
 RAN Radio access network  
 RAT Radio access technology

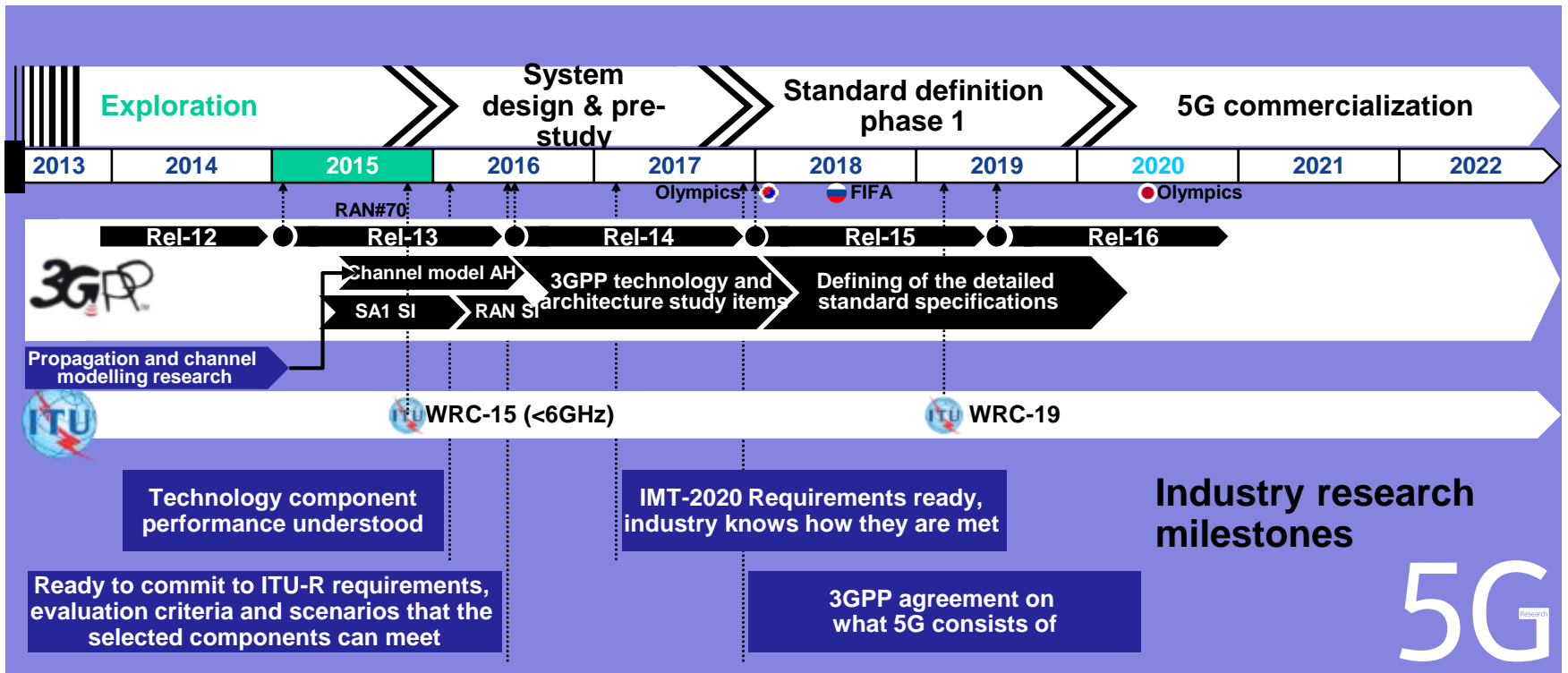
— Defined interface/ reference point  
 - - - Potential interface/ reference point

# NGMN Alliance thoughts on 5G interface options

- **Option 1 has minimal impact to existing RATs but limitations to introduce full 5G performance services**
- **Option 2 allows for full evolution of network services for 5G but requires new interfacing with EPC and Fixed/Wi-Fi**
- **Option 3 would be the most comprehensive approach by integrating LTE, 5G and Fixed/Wi-Fi but has manifold implications.**
  - NGMN mandates further research into Option 3 before drawing conclusions.
- **BTW: Currently it looks like, that initially 5G will be introduced with Option 1 and evolves in a later release into Option 2.**

# Timeline

(assumption, no industry consensus yet)



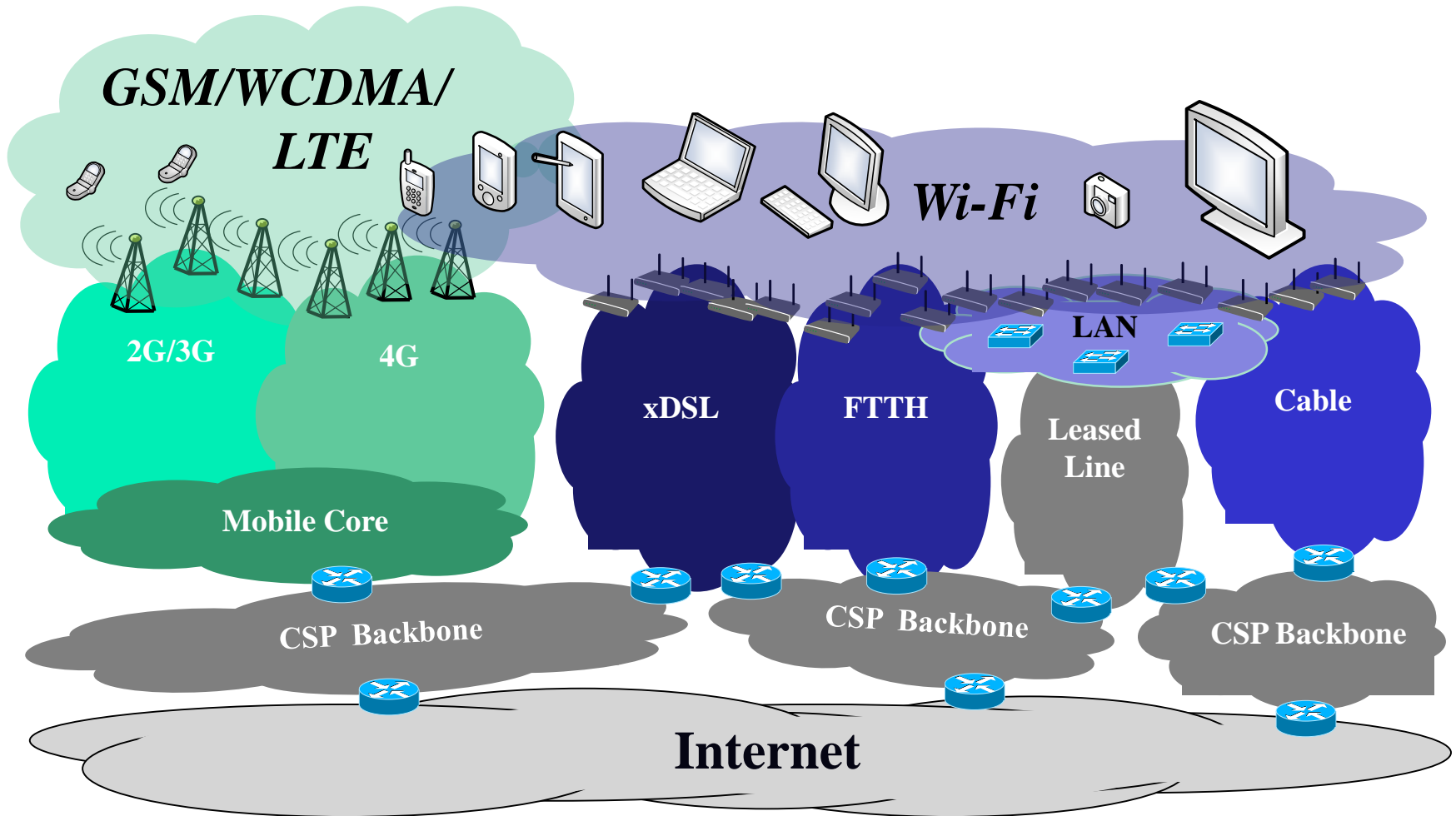
(Source: Nokia)



# IEEE 802.11 in 5G discussions

- **IEEE 802.11 is present but not a focus topic**
  - 5G is mainly about a new 3GPP radio interface and its integration with LTE
- **Integration models for IEEE 802.11 mainly based on current 3GPP approaches**
  - S2a/TWAG
  - LWA
- **No signs of more revolutionary discussions of integration of IEEE 802.11 in mobile networks**
  - But there are discussions about the evolution of the EPC

# IEEE 802.11 in communication networks



## Conclusion

- **There are enormous efforts behind ‘5G’.**
- **Definition of ‘5G’ is still vague and not settled yet.**
- **It is expected that there will be standardization of a new 3GPP radio interface for ultra dense deployments with commercialization starting around 2020.**
- **IEEE 802.11 integration into ‘5G’ seems to adopt current 3GPP models for LTE.**

# Thank you. Comments, questions?

