

The WWRF IMT-2020 Evaluation Group

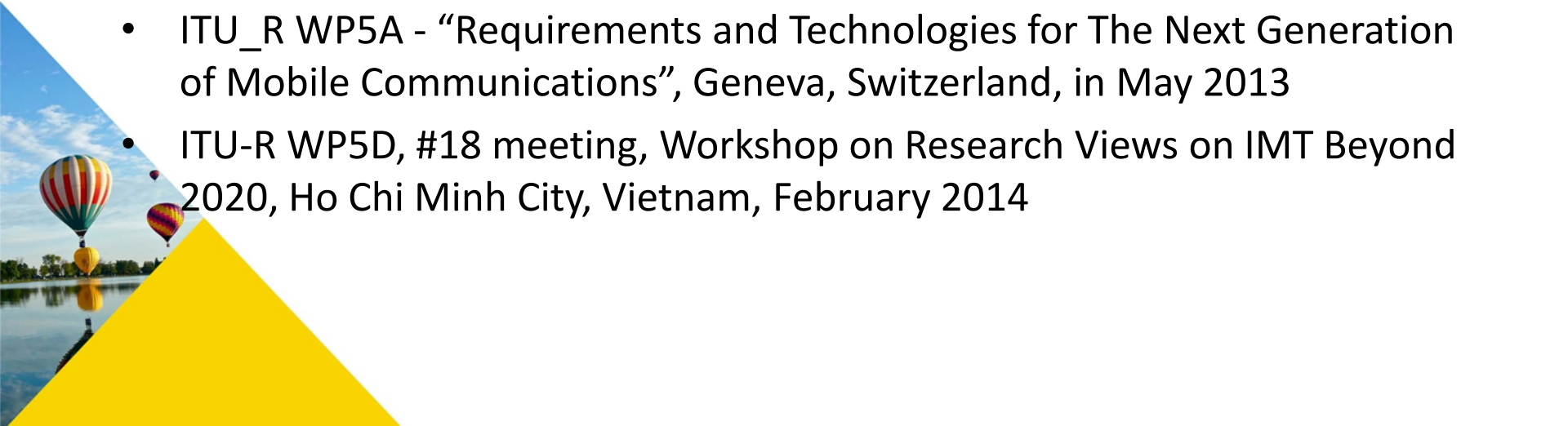
**WP5D Workshop on
IMT-2020 terrestrial radio interfaces
Wednesday 4 October 2017, 9:00-17:00,
Munich, Germany**



- Founded in 2001
- Formed from EU-funded Wireless Strategic Initiative
- Founder members: Nokia, Ericsson, Motorola, Alcatel, Siemens
- Now more global
- Huawei, Nokia, Intel, China Mobile are leading influences on Steering Board
- Many leading universities participate
- Two Forum meetings per year
- 5G Huddle event
- Publications, workshops, etc.



- Liaison with WP5D of ITU
- Participating in ITU IMT Evaluation Process
- Presentations to various ITU Workshops
 - *A New Generation of e-Health Systems*
 - *5G : on the count of three..... paradigm shifts*
 - *Future of IMT Systems: Wireless World Vision 2020*
- ITU-R WP5D, #13 meeting, Workshop on "Research views on IMT Technology Evolution", Geneva, Switzerland, July 2012
- ITU_R WP5A - "Requirements and Technologies for The Next Generation of Mobile Communications", Geneva, Switzerland, in May 2013
- ITU-R WP5D, #18 meeting, Workshop on Research Views on IMT Beyond 2020, Ho Chi Minh City, Vietnam, February 2014



Planned Events 2017-2018

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Oct 18th - 20th 2017	39th Meeting	Centre Tecnològic de Telecomunicacions de Catalunya, Barcelona, Spain
Spring 2018	40th Meeting	Meraka Institute, Council for Scientific and Industrial Research, Pretoria, South Africa
Fall 2018	41st Meeting	Kingston, UK
Spring 2019	42nd Meeting	Singapore
Fall 2019	43rd Meeting	Thessaloniki, Greece/Paris, France
Sept 24th - 27th 2017	IEEE VTC http://ieeevtc.org/vtc2017fall	Toronto, Canada
Jan 5th - 8th 2018	Hawaii International Conference on System Sciences (HICSS)	Hawaii, USA
Nov 22 -24 2017	Network of the Future 2017 (http://www.network-of-the-future.org/)	London, UK
April 15 - 18 2018	IEEE WCNC (http://wcnc2018.ieee-wcnc.org/)	Barcelona, Spain
Oct 4 2017	ITU-R WP5D IMT2020 workshop	Munich, Germany
Nov 15 2017	Future Forum 5G Summit	Beijing, China
Nov 29 - Dec 1 2017	EAI International Summit SmartCity360	Helsinki, Finland

40th Meeting of WWRF

Africa



- South Africa

- Status in Planning Stage
- 5G Huddle + 40th Meeting
- WWRF First Venture in Africa
- Interested Countries:
 - Kenya, Tanzania, Burkina Faso, Zimbabwe
- WWRF Members:
 - CSIR - Meraka Institute, South Africa
 - The Independent Communications Authority of South Africa (ICASA), South Africa



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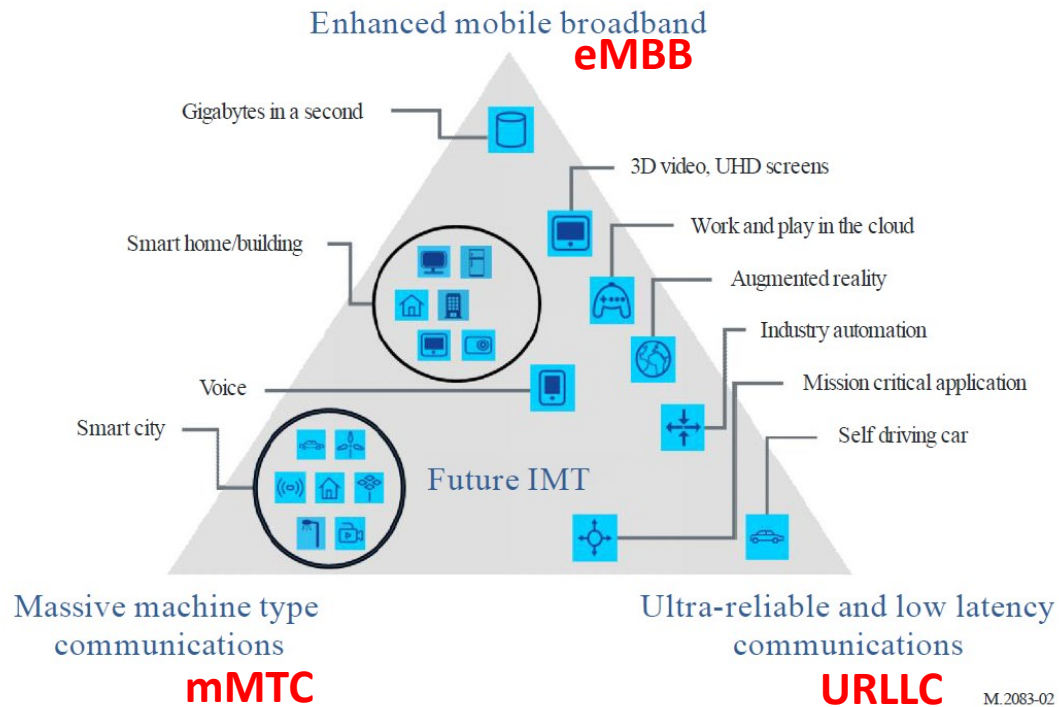
Vision and Differentiators

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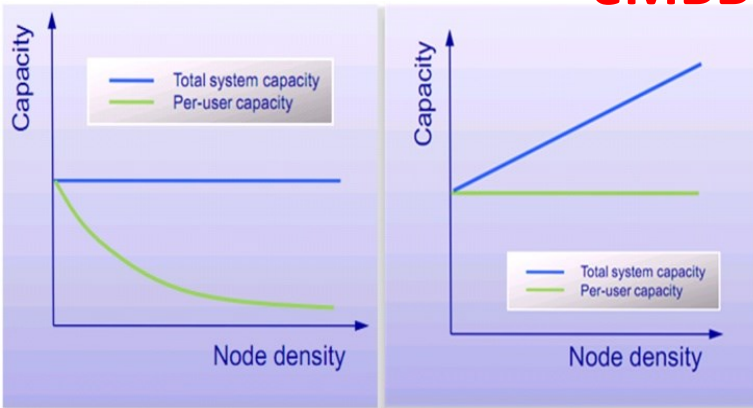
- **Objective**> Focus on Perform advanced technologies evaluation studies based on realistic channel and system modelling assumptions
- **Leveraging**> previous 3G and 4G expertise of members, academic excellence and industrial experience, a global technology perspective and a strategic insight on all factors of the wireless evolution technology chain



Usage scenarios of IMT for 2020 and beyond



eMBB

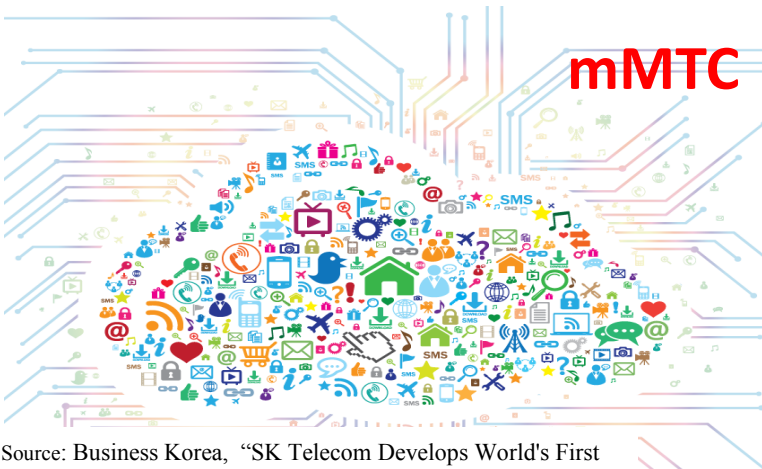


- Capacity scaling
 - *massive infrastructure deployment density over large geographical areas that is technologically and financially feasible*
 - *new niche and business opportunities*
 - *introduction of new value chain actors.*

eMBB



- Crowded Local Access
 - *massive data local access for dynamic crowds addressed through the interplay of technological and architectural innovations.*



- Massively Available Connectivity
 - 5G will accommodate for bursty IoT communications by providing the necessary infrastructure and operations to handle the vastly diversified QoS requirements.

Source: Business Korea, “SK Telecom Develops World's First Global Standard IoT Platform”, J.H. Park, Dec 2014

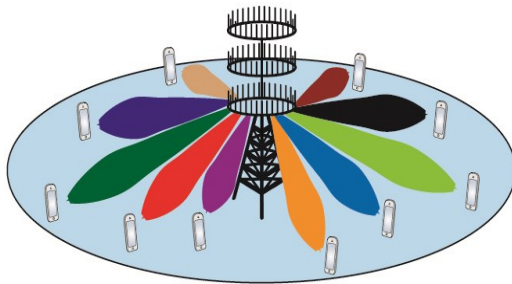


- Reliability and Latency or 5G as the ‘network of control’
 - The realization of **Tactile Internet** or the Network of Control will open up an “unforeseeable plurality of new applications, products, and services”.⁽¹⁾

Source: “The tactile internet: IoT, 5G and cloud on steroids”, M. Dohler, G. Fettweis, Telecomstechnews, Nov 2014

(1) Gerhard P. Fettweis, “The Tactile Internet – Applications & Challenges”, IEEE Vehicular Technology Magazine, Vol. 9, No. 1, pp. 64 – 70, March 2014

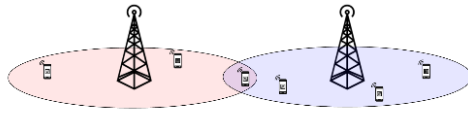
- Large/Massive/Network-MIMO:**



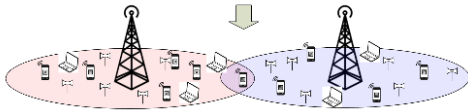
(Image Credits : Linkoping Univ, Emil Bjornson)

- Ultra Dense Networks ('Cell-less' wireless)**

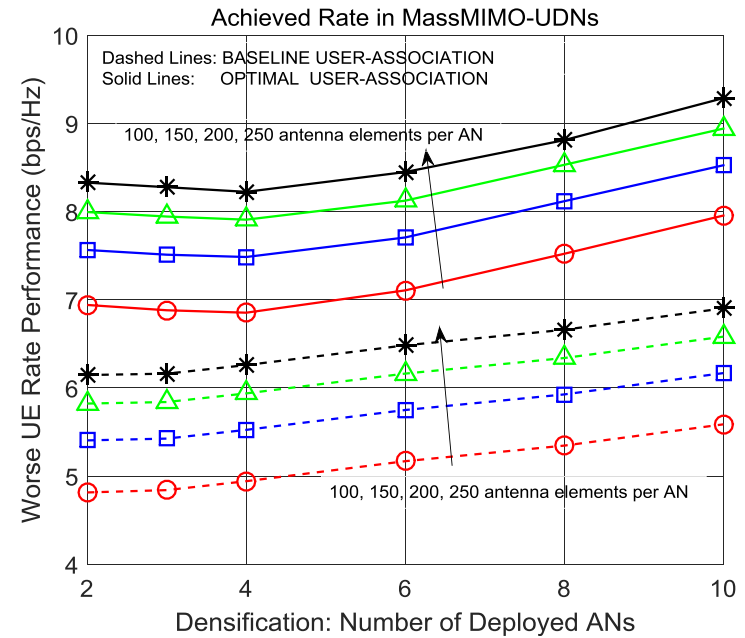
Topologies and densities of traditional networks



Traditional network with increased and diverse traffic requirements

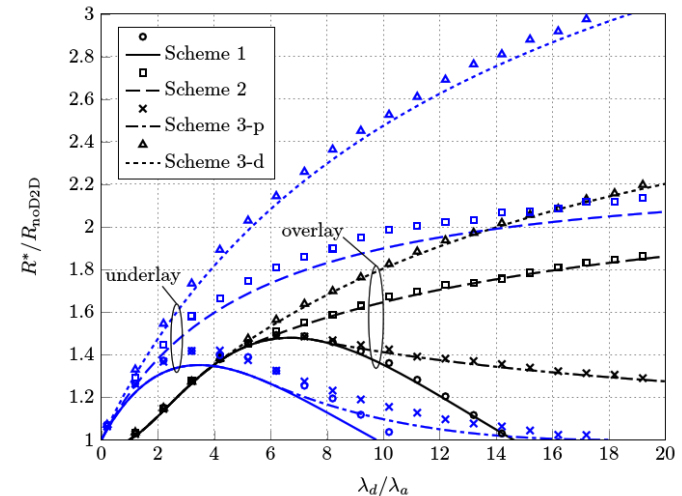
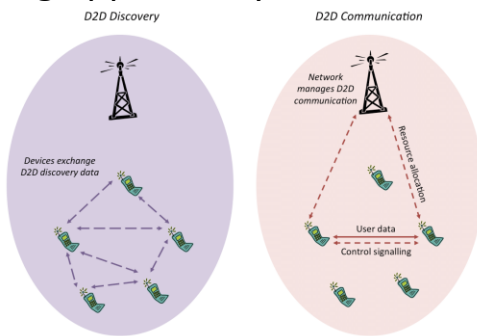


Breaking the cellular barrier with an H-UDN approach



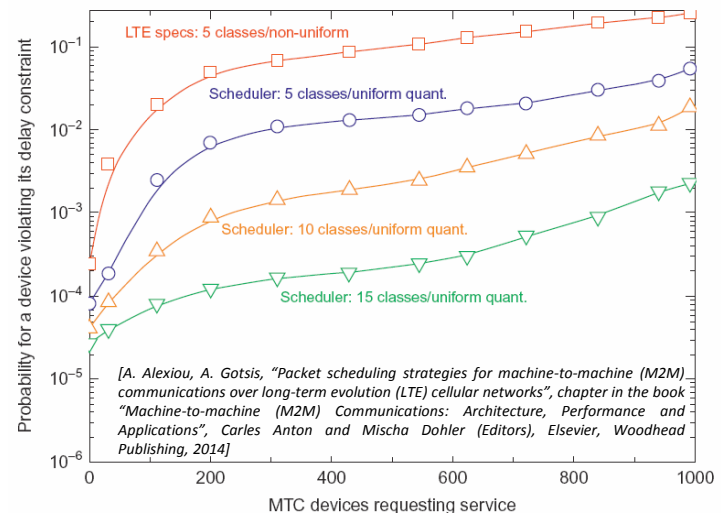
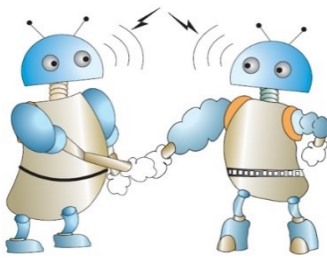
[A. G. Gotsis, S. Stefanatos, and A. Alexiou, "Optimal User Association for Massive MIMO Empowered Ultra-Dense Wireless Networks," IEEE ICC 2015 - Workshop on Advanced PHY and MAC Techniques for Super Dense Wireless Networks (ICC'15 - Workshops 13), Jun. 2015, London UK]

- **D2D**: exploiting intelligence at the edge of the network with Device-to-Device (D2D) connectivity and/or smart caching at the mobile side may offer an excellent network load balancing opportunity.



[S. Stefanatos, A. G. Gotsis, and A. Alexiou, "Operational Region of D2D Communications for Enhancing Cellular Network Performance," *IEEE Transactions on Wireless Communications*, 2015, to appear (available on arXiv)]

- **M2M** supporting a massive number of low-rate devices in the future IoT, in a plethora of diverse scenarios, and very-low-latency data transfers.



[A. Alexiou, A. Gotsis, "Packet scheduling strategies for machine-to-machine (M2M) communications over long-term evolution (LTE) cellular networks", chapter in the book "Machine-to-machine (M2M) Communications: Architecture, Performance and Applications", Carles Anton and Mischa Dohler (Editors), Elsevier, Woodhead Publishing, 2014]

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*Candidate Technologies and
Evaluation Methodology (3)*

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- **Modelling:** Classification of 5G resources, propagation and channel modelling, node topology (geometry, density, ..)
- **Theoretical Tools to formulate and analyze problems:** Stochastic geometry, Information theory, Mathematical Programming
- **Management models & algorithms:** Understanding the fundamental performance levels. Centralized & Distributed approaches for dynamically assigning resources and assessing performance (be means of system level simulations)



- **Members** > spanning all stakeholders, bringing in a global perspective, and connecting with all 5G regional initiatives, namely
 - industry (Huawei, Intel, ..),
 - operators (China Mobile, ..),
 - academic research (Carleton University, CTTC, Univ. of Piraeus, CSIR (South Africa), Surrey ..)
 - Europe, North America, Asia, Africa
 - 5GPPP, 5G Forum, 5GMF, ..
- **Expertise/experience** > advanced technologies research and assessment, ITU-R WP5D procedures, system modelling and requirements specifications, large scale system level evaluations



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Timelines and expected output

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- Working meeting of the WWRF IMT-2020 Evaluation Group to be held in upcoming WWRF meeting (starting from WWRF 39th meeting in Barcelona, 18-20 October 2017)
- The evaluation results and conclusions will be reported as inputs to WP 5D



39th Meeting of the WWRF

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Ready 'n' Go – 5G trials and testbeds

- The 39th Meeting of the WWRF will be hosted by the Centre Tecnològic de Telecomunicacions de Catalunya (CTTC) in Castelldefels (Barcelona), Spain, from 18th to 20th October, 2017



Contacts

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