FANTASTIC

5G-PPP Project on 5G Air Interface below 6 GHz

EUCNC 2015

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Project - Details

Flexible Air iNTerfAce for Scalable service delivery wiThin wIreless Communication networks of the 5th Generation

- FANTASTIC-5G is part of the 5G-PPP pre-structuring model covering the air interface below 6 GHz
- Funding volume: ~8 million Euro
- Start: July 1. 2015
- Duration: 2 years

Project - Details

- Coordination: Frank Schaich (Alcatel-Lucent AG)
- Technical management: Berna Sayrac (Orange SA)
- Innovation management: Panagiotis Demestichas (WINGS ICT Solutions)

- Objectives (condensed version):
  1. To develop a flexible and scalable multi-service air interface
  2. with ubiquitous coverage and high capacity where and when needed
  3. being highly efficient in terms of energy and resource consumption
  4. being future proof and allowing for sustainable delivery of wireless services far beyond 2020.
  5. To evaluate and validate the developed concepts
  6. and build up consensus on reasonable options for the standardization of 5G.

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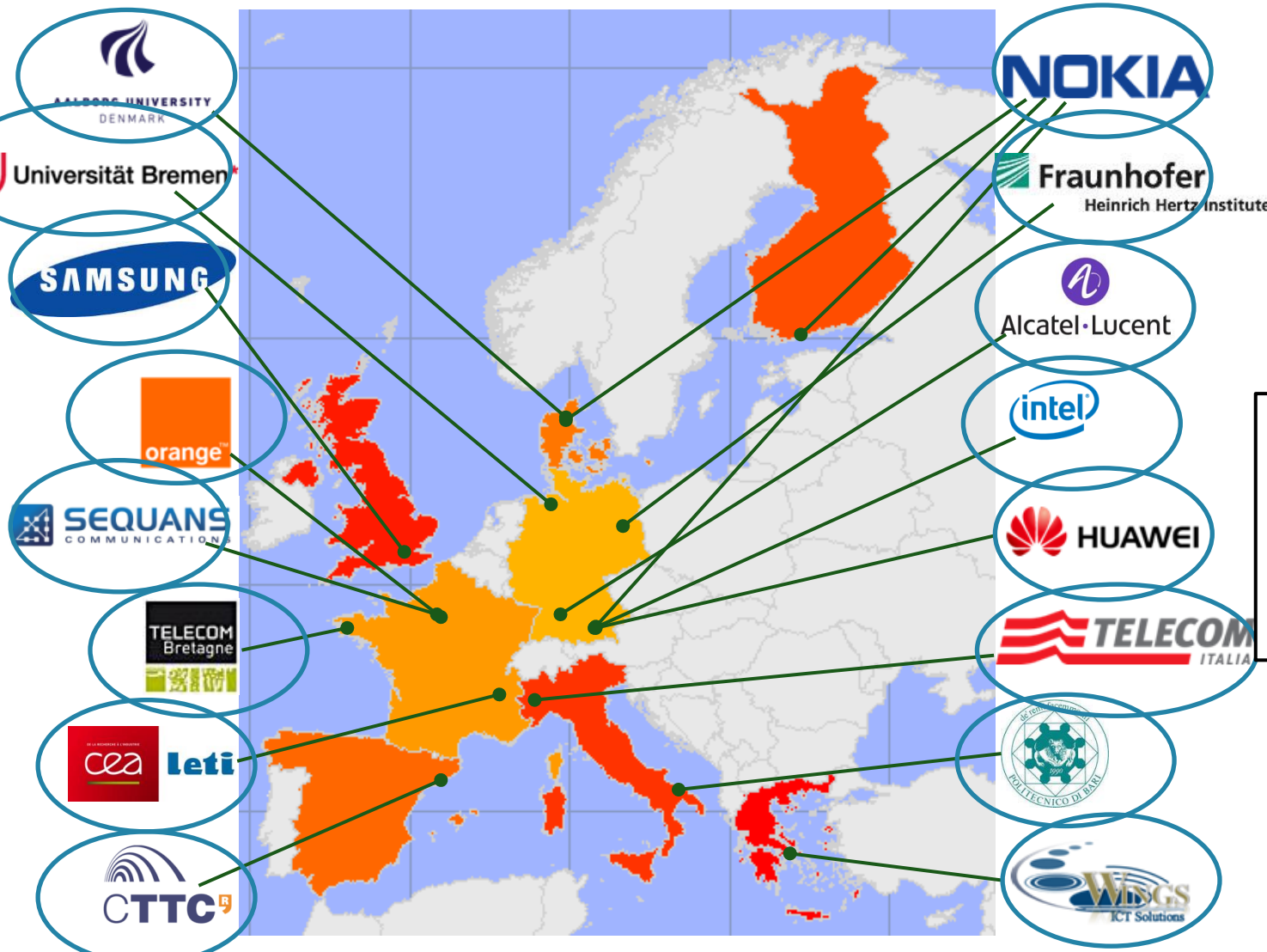
Consortium



3 network equipment vendors

2 chipset vendors

1 device/UE vendor

2 operators

1 provider of network management and optimization solutions

3 research institutes

4 universities

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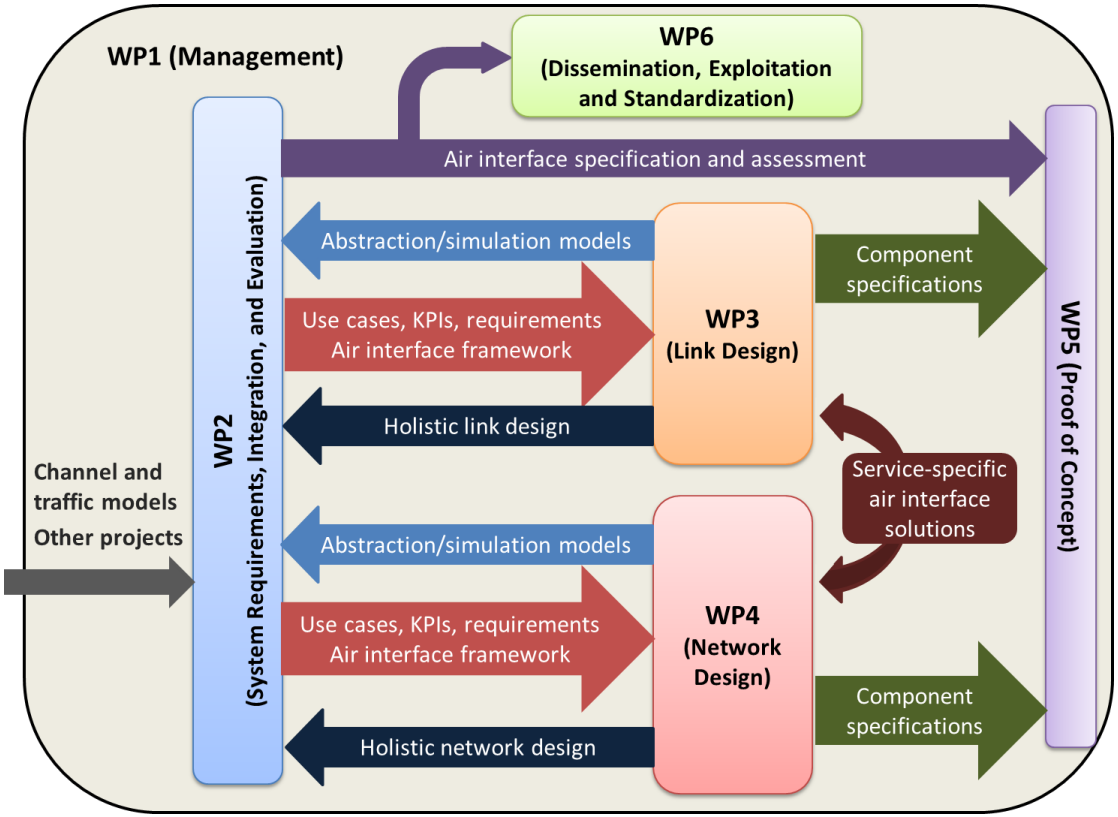
Implementation

- **WP2:**
  - **Identify use cases, KPIs, requirements;**
  - **integrate the technical solutions from WP3 and WP4;**
  - **align the system level simulations**
- **WP3:**
  - **Focus on technical components related to the design of the service specific links.**
  - **PHY/MAC abstraction models.**
  - **How to design the service specific links,**
  - **how to achieve a holistic link design.**
- **WP4:**
  - **Focus on technical components related to multi-user/multi-cell aspects.**
  - **Design of MAC, RRM, efficient cross-layer optimization, integration with physical layer functionalities.**
  - **How to use/control functionalities offered by the physical layer.**



Trends driving the need for 5G – 5G needs to enable …

- … an increase in available capacity
  - 1000x higher mobile data volumes, 10-100x higher end user rates [1]
- … an increase in number of connected devices
  - By a factor of 10-100 → up to 300000 devices per access point [1]
- … an increase in offered reliability
  - 99.9999% for e.g. mission critical communications, control functionalities [2], [3]
- … a decrease of Latency
  - reduction of up to a factor of 5 [4]
- … an increase in efficiency
  - resource utilization (e.g. energy and spectrum) [5]

But typically not at the same time for the same connection!

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Structuring the manifoldness of 5G via 5 'core services'

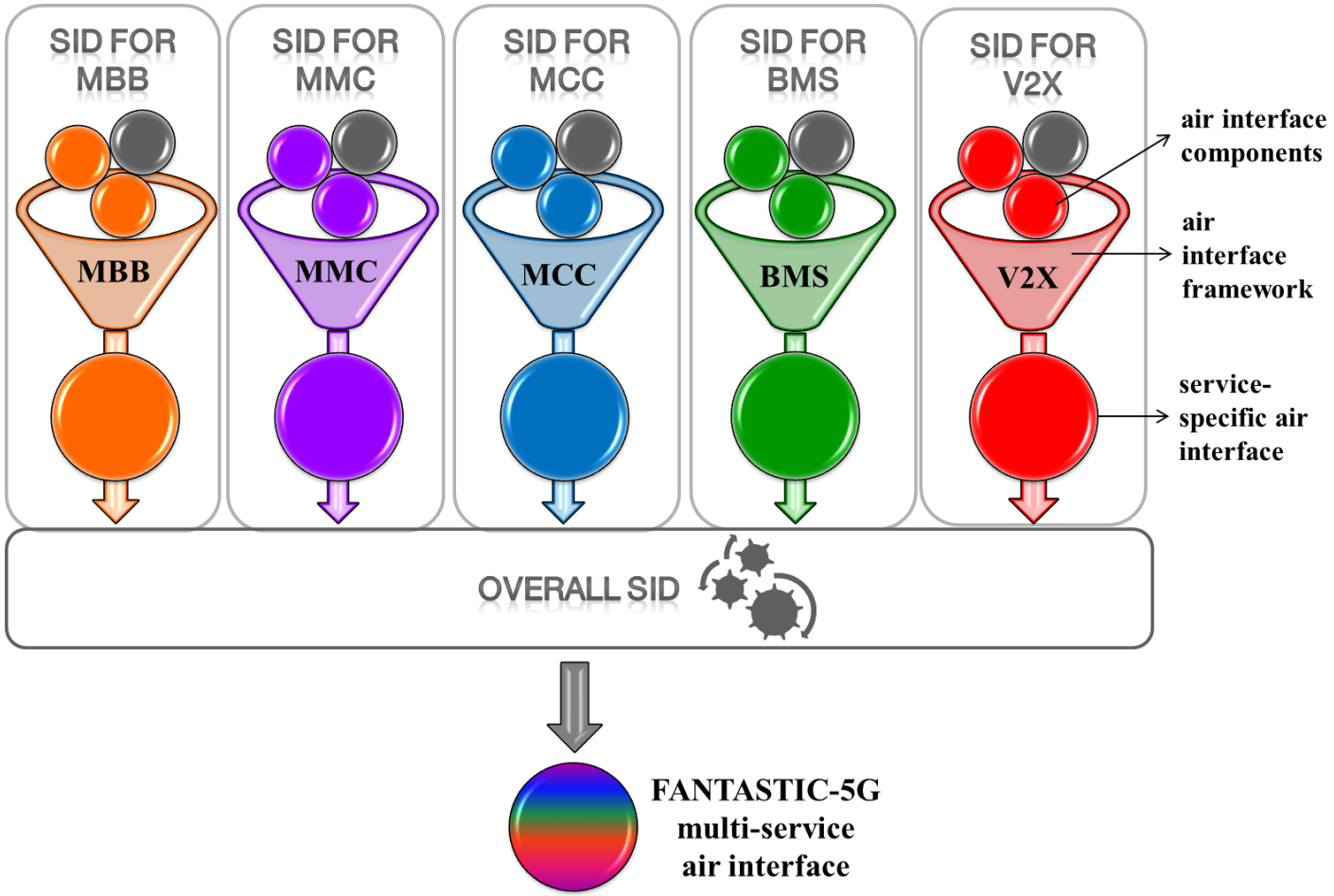
- A 'core service' involves a given set of device types and/or traffic/transmission characteristics, leading to a respective KPI-map
  - Mobile Broadband (MBB)
  - Massive Machine Communications (MMC)
  - Mission Critical Communications (MCC)
  - Broadcast/Multicast Services (BMS)
  - Vehicle-to-vehicle and vehicle-to-infrastructure communications (V2X)

	KPI 1	KPI 2	KPI 3	KPI 4	KPI 5	KPI 6	KPI 7	KPI 8
	Data throughput per area	Latency	Coverage	Mobility	Number of connected devices	Reliability, availability	Low cost	Low energy
MBB								
MCC								
MMC								
BMS								
V2X								

		Primary			Secondary			Tertiary

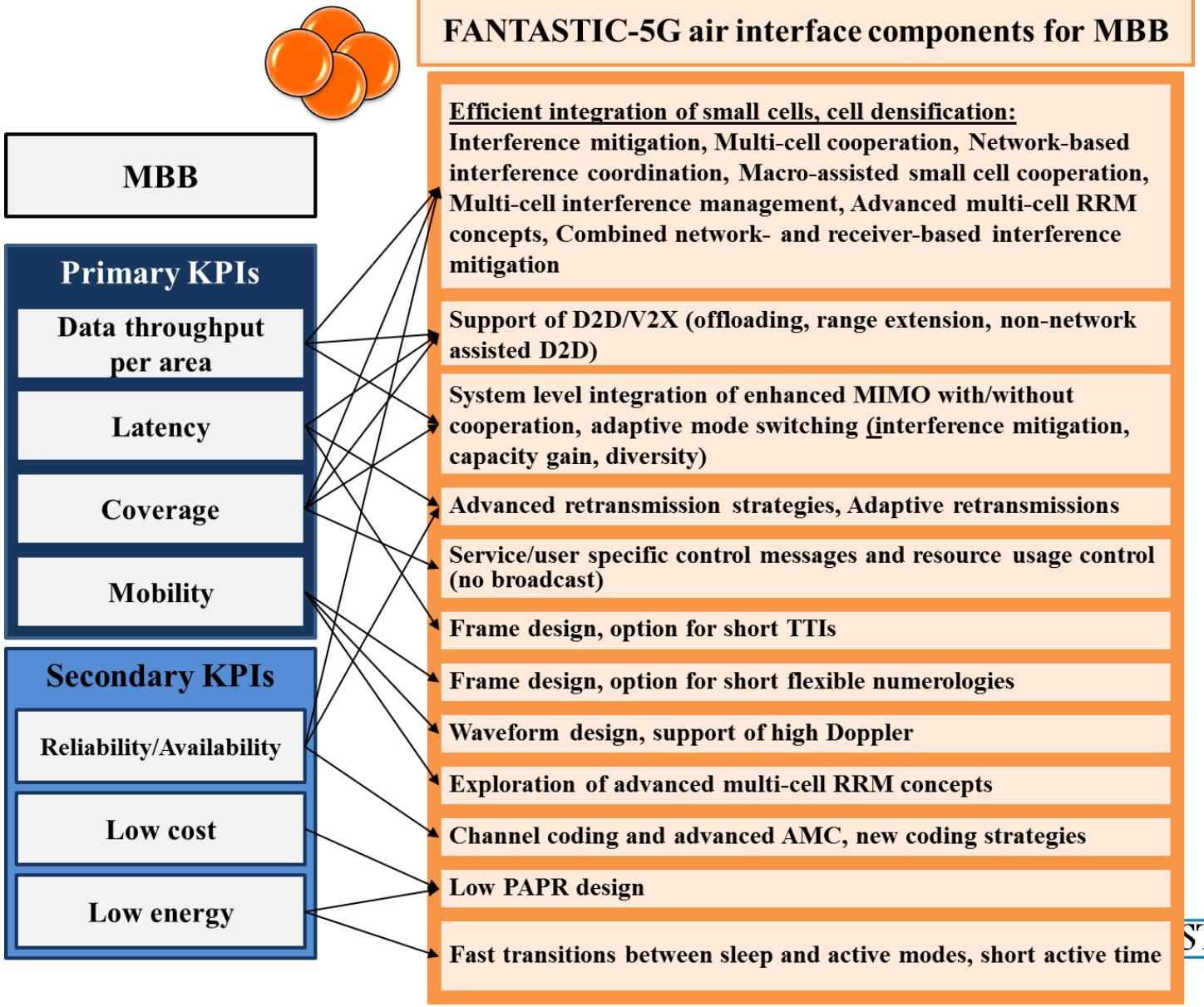
We have to avoid a one-fits-all solution!

Technical approach – structuring the project activities via service integration drivers (SIDs)

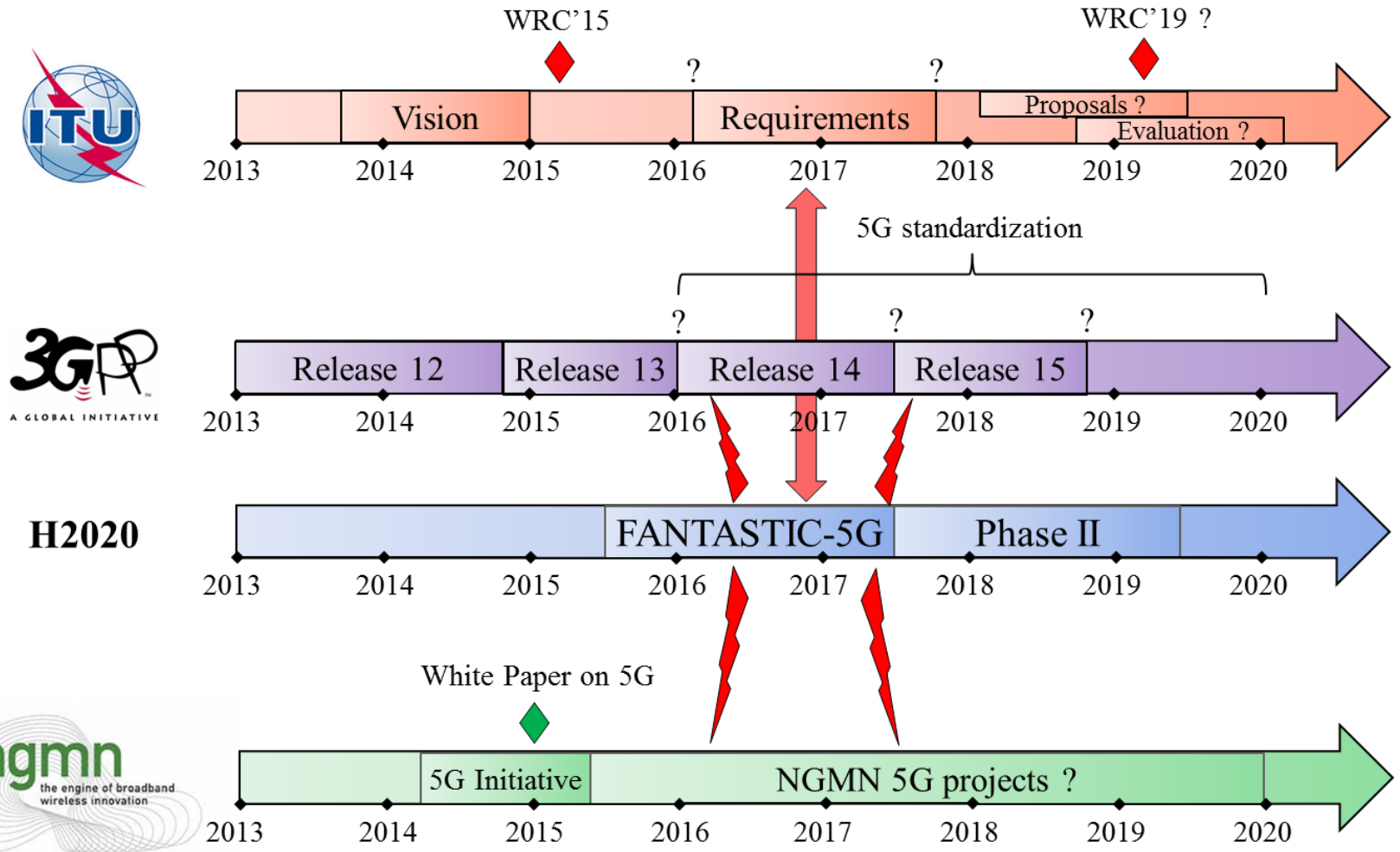


Start service-specific, analyse synergies/conflicts, harmonize, merge and integrate!

Technical approach – example: Air Interface Components for MBB



Positioning of FANTASTIC-5G with respect to ITU, 3GPP and NGMN



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Thanks!

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Objectives (long version)

- **Objective 1**: To develop a highly ***flexible, versatile and scalable*** air interface to enable the in-band coexistence of highly differing services, device types and traffic/transmission characteristics.
- **Objective 2:** To design an air interface enabling ***ubiquitous coverage*** and ***high capacity*** where and when required.
- **Objective 3:** To develop an air interface being highly efficient in terms of energy and resource consumption.
- **Objective 4**: To render 5G more ***future-proof*** than former generations through easier introduction of new features.
- **Objective 5:** To ***evaluate and validate the developed concepts*** by means of system level simulations and hardware proof of concepts for selected components.
- **Objective 6**: To ***build up consensus*** on reasonable options for 5G standardization among the major industrial partners of the project that are also voting members in 3GPP and to ***push the innovations*** of the project for ***standardization*** (through study items).

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Technical approach – Air Interface Components for MCC

MCC

Primary KPIs

- Coverage
- Latency
- Reliability/Availability

FANTASTIC-5G air interface components for MCC

- **Efficient integration of small cells, cell densification:** Interference mitigation, Multi-cell cooperation, Network-based interference coordination, Macro-assisted small cell cooperation, Multi-cell interference management, Advanced multi-cell RRM concepts, Combined network- and receiver-based interference mitigation
- System level integration of enhanced MIMO with/without cooperation, adaptive mode switching (interference mitigation, capacity gain, diversity)
- Service/user specific control messages and resource usage control (no broadcast)
- Support of D2D/V2X (offloading, range extension, non-network assisted D2D)
- Frame design, option for short TTIs
- Advanced retransmission strategies, adaptive retransmissions
- Channel coding and advanced AMC, new coding strategies
- Service classification techniques for service prioritization

Technical approach – Air Interface Components for MMC

MMC

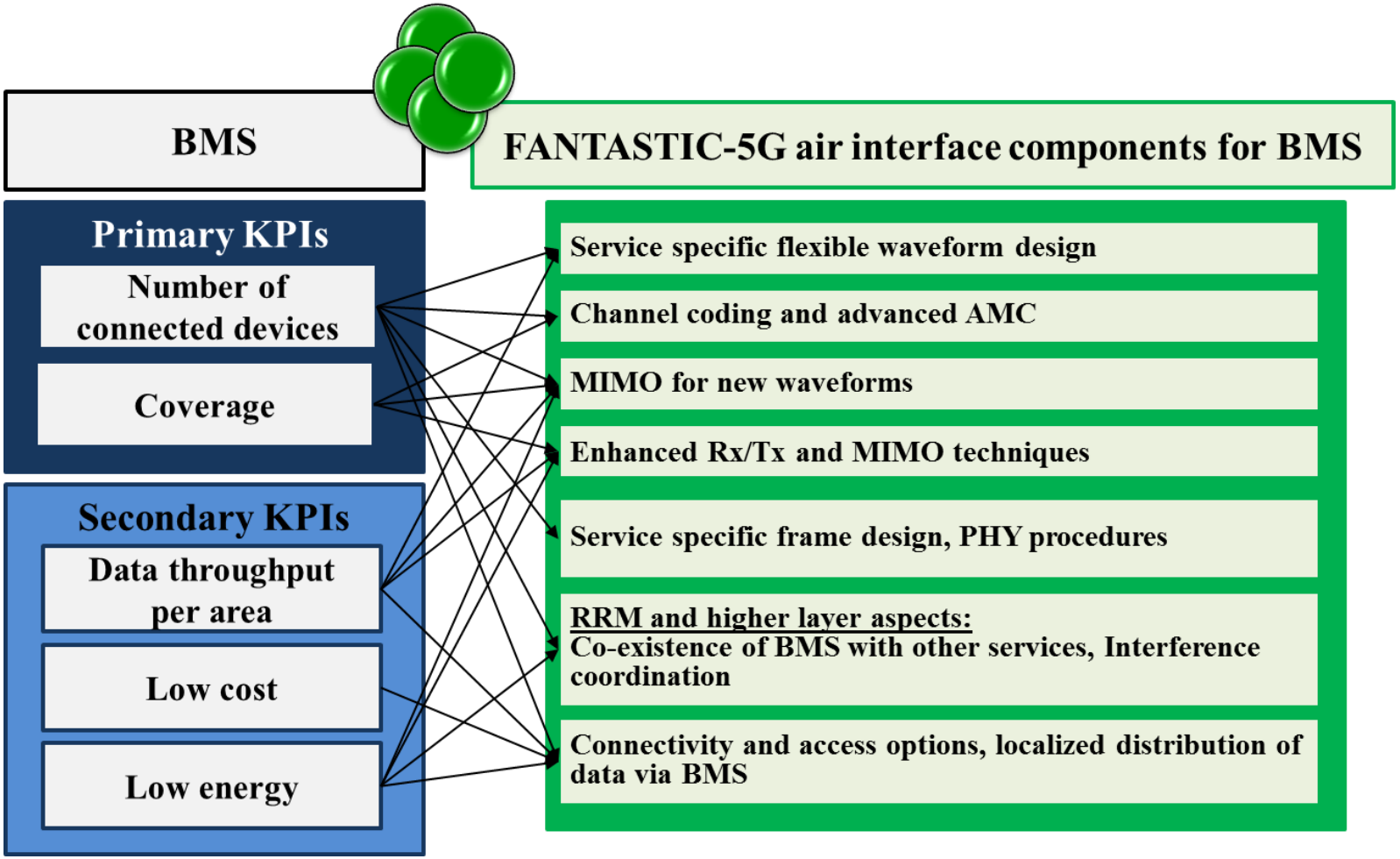
Primary KPIs

- Coverage
- Number of connected devices
- Low cost
- Low energy

FANTASTIC-5G air interface components for MMC

- Diversity mechanisms:
  New coding strategies
  Multi-antenna receive diversity, MIMO for new waveforms
  Multi-cell receive diversity
- Support of D2D (range extension)
- Sparse Code Multiple Access for user overloading
- Efficient massive access protocols
- Connectionless access:
  Waveform design, robustness to relaxed synchronism
  One shot transmissions, tailored control signalling
  Advanced multiuser detection
- Channel coding and advanced AMC, new coding strategies
- Low PAPR design
- Fast transitions between sleep and active modes, short active time
- Enhancement of the base station receiver to improve robustnes against collisions

Technical approach – Air Interface Components for BMS



Technical approach – Air Interface Components for V2X