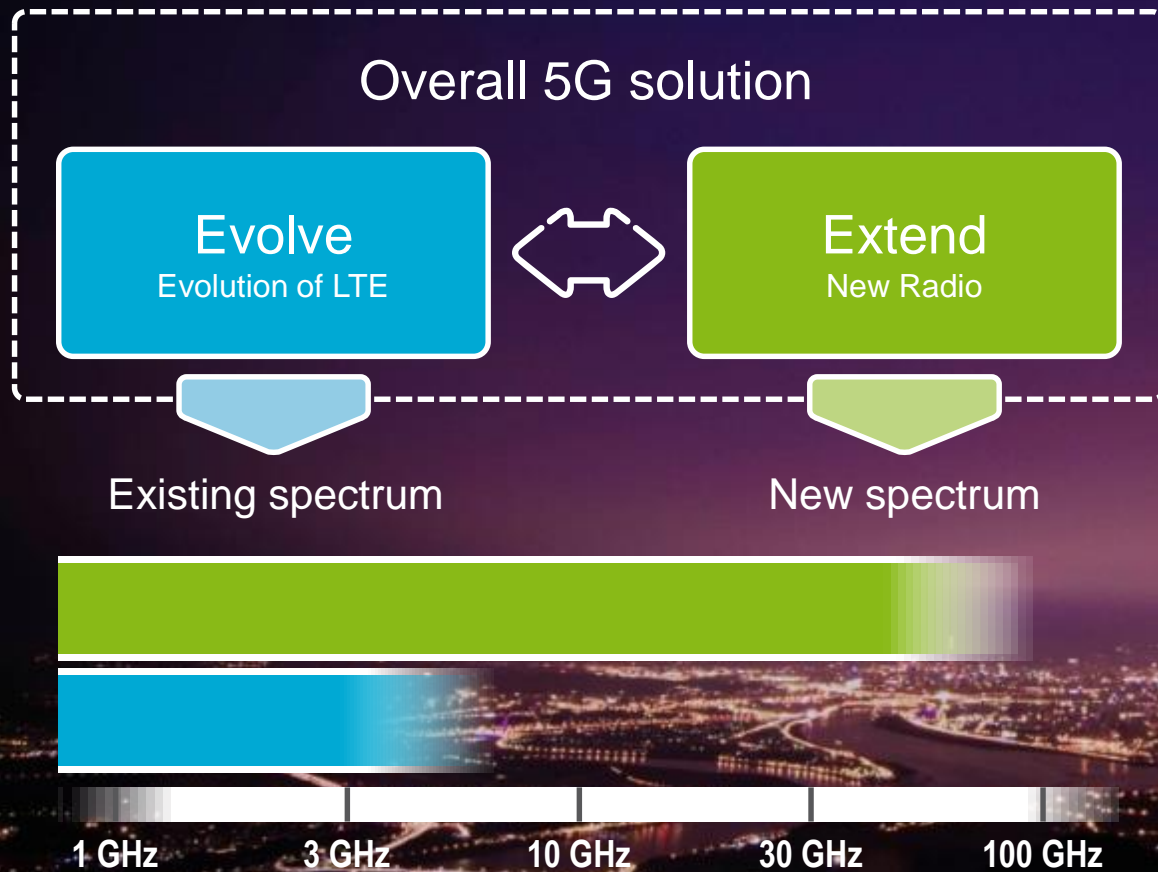




AUTOMOTIVE AND ITS: ON THE ROAD TO 5G

Stefano Sorrentino, Master Researcher
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5G RADIO ACCESS



- › Evolution of existing technology adding “New Radio” access
- › Tight integration allows rapid switching based on radio conditions
- › Gradual migration of new technology into existing spectrum

5G ITS STANDARDIZATION PLAN



2015 | 2016 | 2017 | 2018 | 2019 | 2020

SA1 Requirements

RAN study/work item V2V

RAN study/work item V2X

LTE

Pre-commercial LTE trials in China

NR

SI: NX

SI: NX enh.

SI: self-evaluation

NX Phase 1

NX Phase 2

NX evo

LTE evo

LTE evo

LTE evo

LTE evo

Rel-13

Rel-14

Rel-15

Rel-16

Rel-17

Phase 1 – early commercial deployments

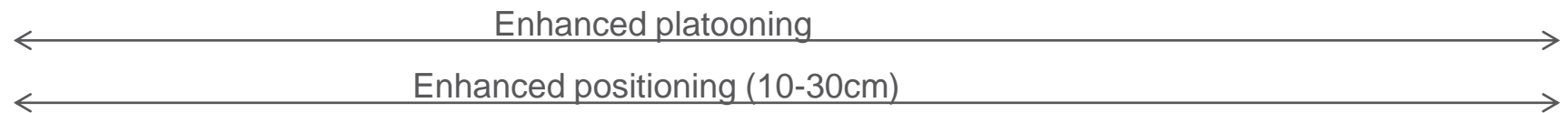
Phase 2 – full IMT-2020 compliance

ITS SERVICE EVOLUTION

EVOLUTION OF RADIO REQUIREMENTS



Status info exchange (phase 1)	Onboard sensors data exchange (phase 2)	Intentions exchange (phase 3)	Synchronized/cooperative driving (phase 4,5)
<ul style="list-style-type: none"> • Latency <100ms • User thp < 24kb/s • User density ~2500 cars/km² (urban slow) • 500km/h relative speed • Broadcast 	<ul style="list-style-type: none"> • Larger system capacity <ul style="list-style-type: none"> • See through → 10Mb/s • Bird's eye → 40Mb/s 	<ul style="list-style-type: none"> • Larger system capacity • Low latency, event-triggered transmission • Increased reliability 	<ul style="list-style-type: none"> • Latency <10ms • Further increased reliability

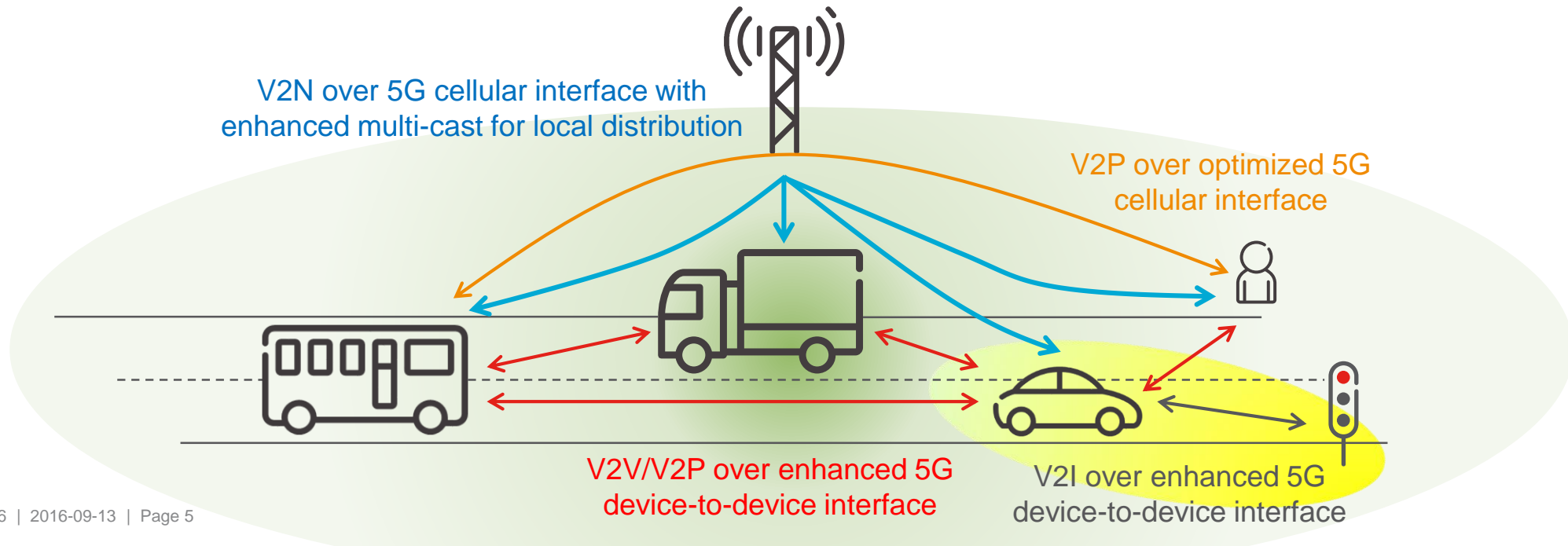


› Note: security requirements not shown here

5G-BASED V2X



- › Integrated technology for vehicle access to other **vehicles** (V2V), **infrastructure** (V2I, V2N) and **pedestrians** (V2P)
- › **Any** Spectrum, **500km/h** relative speed, **high vehicles density**, **QoS**
- › Operative **within and outside** 5G network infrastructure



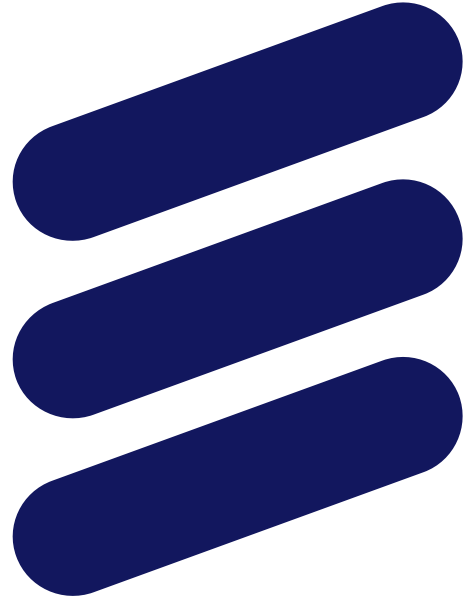
SPECTRUM EVOLUTION



- › New ITS safety services require increasing amounts of protected spectrum
 - Spectrum is a scarce resource and potential backwards compatibility issues need to be predicted

- › US/EU: 7x10MHz ITS channels at 5.9GHz
 - Initial G5 deployments require a small fraction of this spectrum
 - How to handle technology migration towards 5G for spectrum at 5.9GHz?
 - › Inband coexistence, detect and vacate, channelization?

- › In EU ECC assigned 1GHz of ITS spectrum at 63GHz
 - Suitable only for short range communication



ERICSSON

SOME 5G TECHNOLOGICAL COMPONENTS



- › New carrier frequency including mm-waves and larger bandwidth
- › Massive MIMO enables higher spectral efficiency
- › Hybrid centralized/distributed resource management
- › Ultra-lean design with reduced fixed overhead