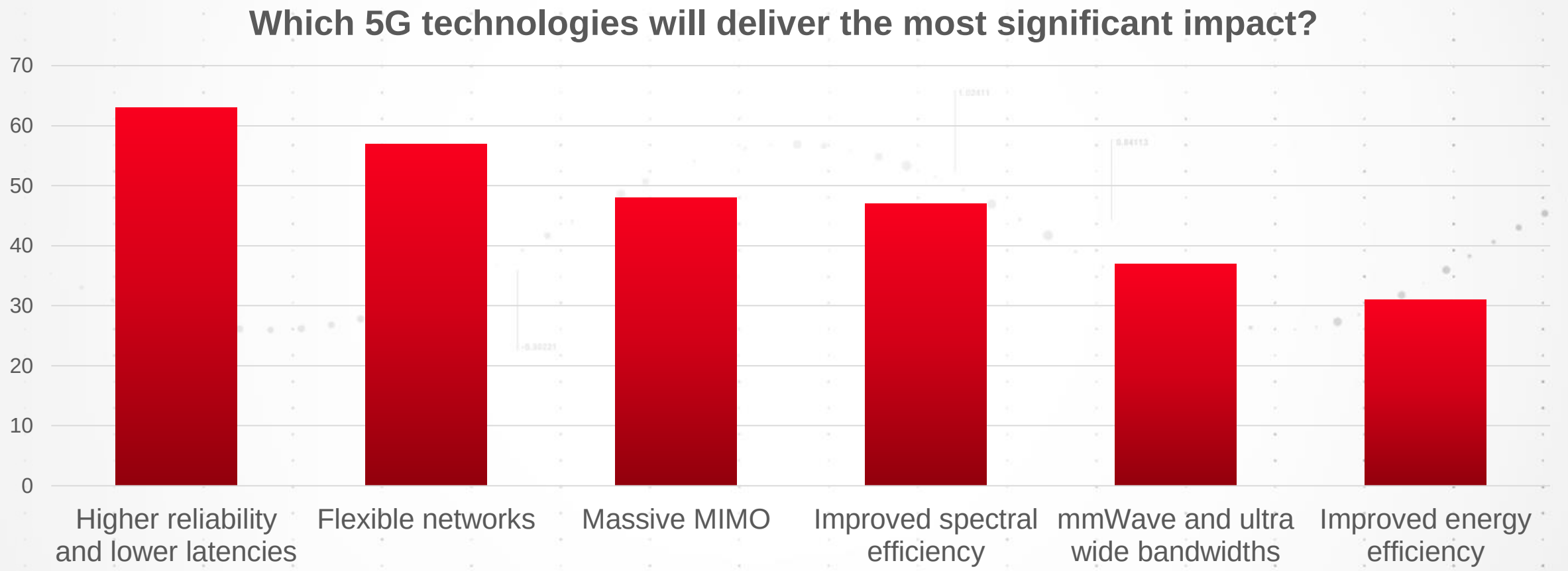
Accelerating 5G Innovation
5G Standards, Trends & Opportunities

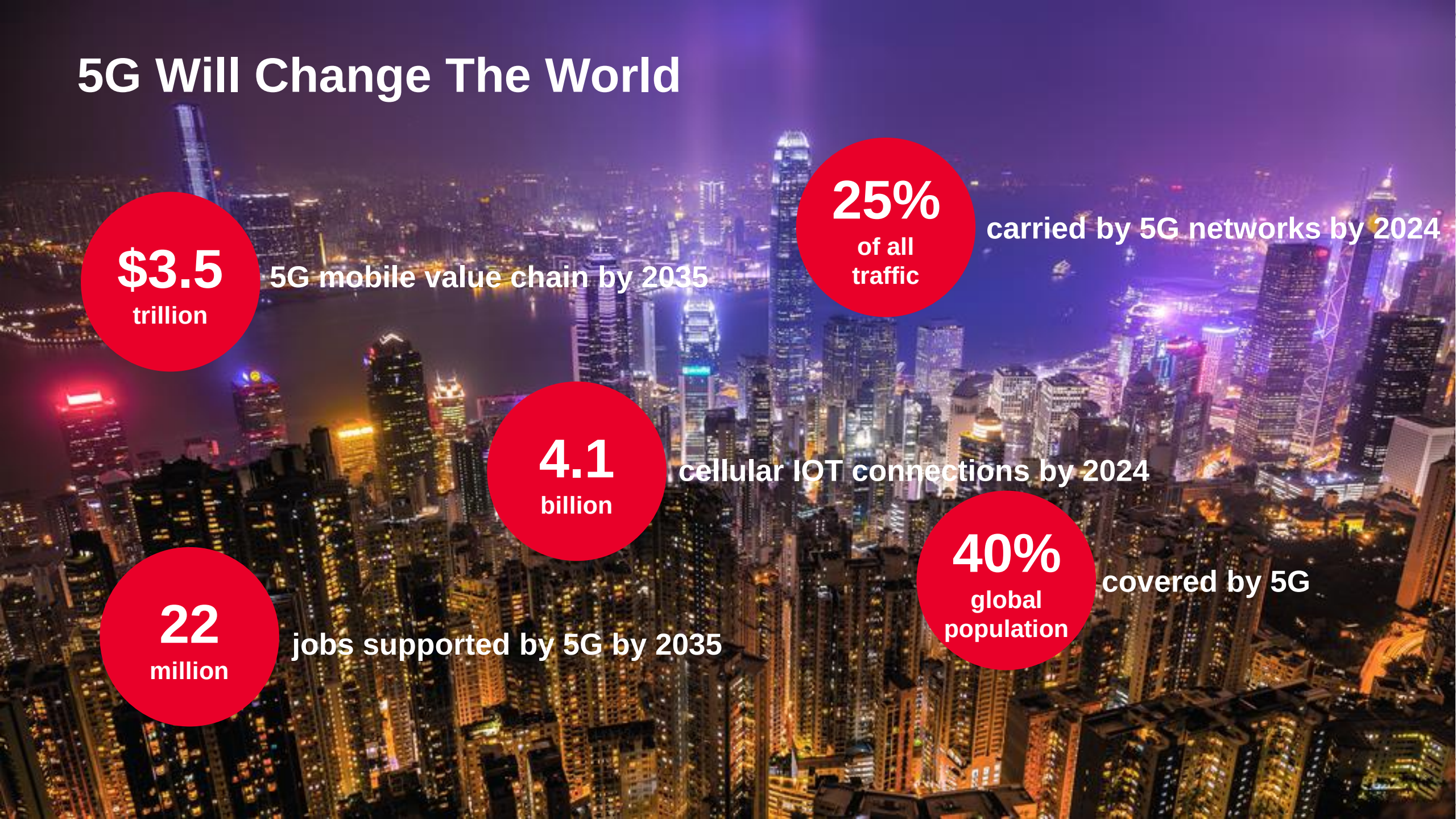
Sandeep Kapoor	27.06.2019
Director Marketing	

Market Leadership Key Driver for 5G Investments

TO ACHIEVE HIGHER RELIABILITY, LOWER LATENCIES AND FASTER NETWORKS



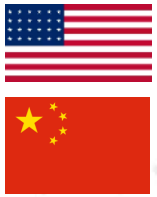
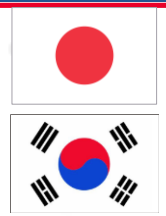
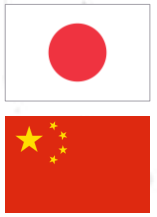
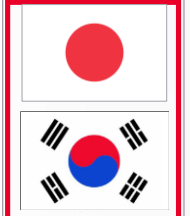
Keysight 2018 State of 5G (Survey)


5G Will Change The World
$3.5
trillion
5G mobile value chain by 2035
25%
of all
traffic
carried by 5G networks by 2024
4.1
billion
cellular IOT connections by 2024
40%
global
population
covered by 5G
22
million
jobs supported by 5G by 2035

5G – State of the Industry Deployments Are Accelerating

5G Deployment Map

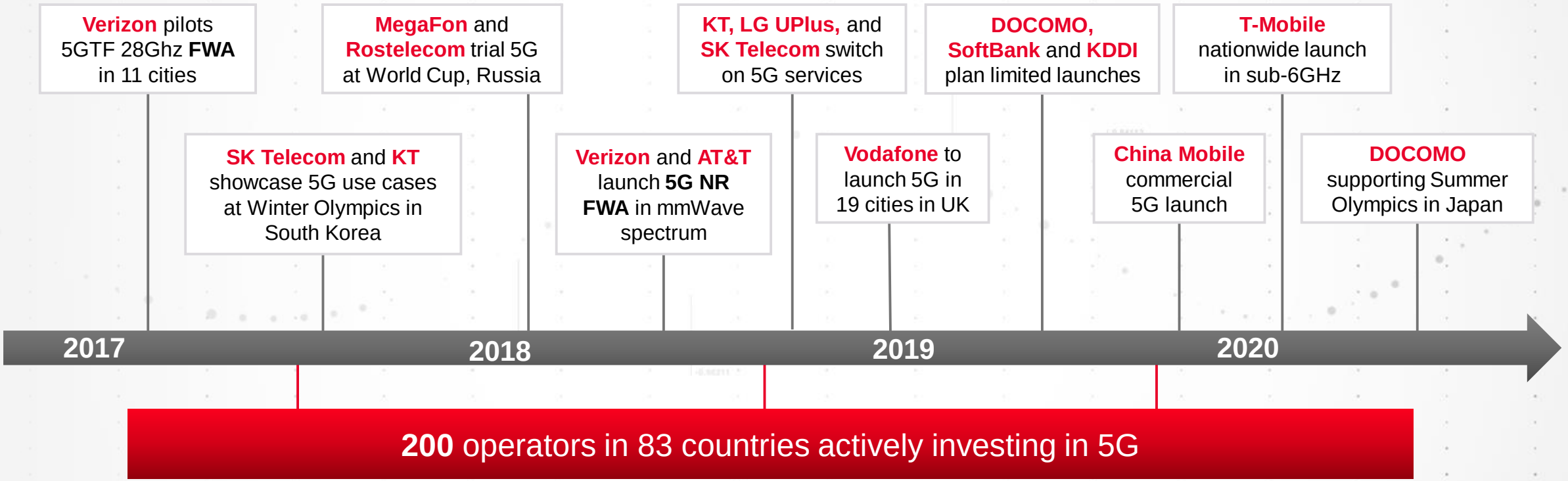
5G BECOMING GLOBAL AND MAINSTREAM

	FR1 (Sub-6GHz)							FR2 (mmWave)		
Spectrum	**<1GHz**	**2.5GHz**	**3.4 – 3.7GHz**			**4.4 – 4.9GHz**	**ISM**	**28GHz**		**39GHz**
GEOGRAPHY										
OPERATOR	AT&T T-Mobile	Sprint 中国移动 China Mobile	orange EE vodafone 3 TIM	中国电信 CHINA TELECOM	docomo kt SK	docomo SoftBank 中国移动 China Mobile		verizon AT&T T-Mobile	docomo SoftBank kt SK	verizon AT&T T-Mobile
COMMERCIAL SERVICES	**Launch** T-Mobile 2019 AT&T 2020	**Launch** Sprint Early 2019 CMCC 2020	**Launch** Vodafone Orange EE Three TIM 2019/ 2020	**Launch** CTC 2020	**Launch** Docomo 2020 KT & SKT 2019	**Launch** CMCC 2020 Docomo / Softbank 2020		**Launch** VZW 2018 AT&T, T-Mobile 2019	**Launch** Docomo / Softbank 2020 KT & SKT 2020	**Launch** AT&T 2018 Verizon, T-Mobile 2019

KEYSIGHT TECHNOLOGIES

Global 5G Deployments

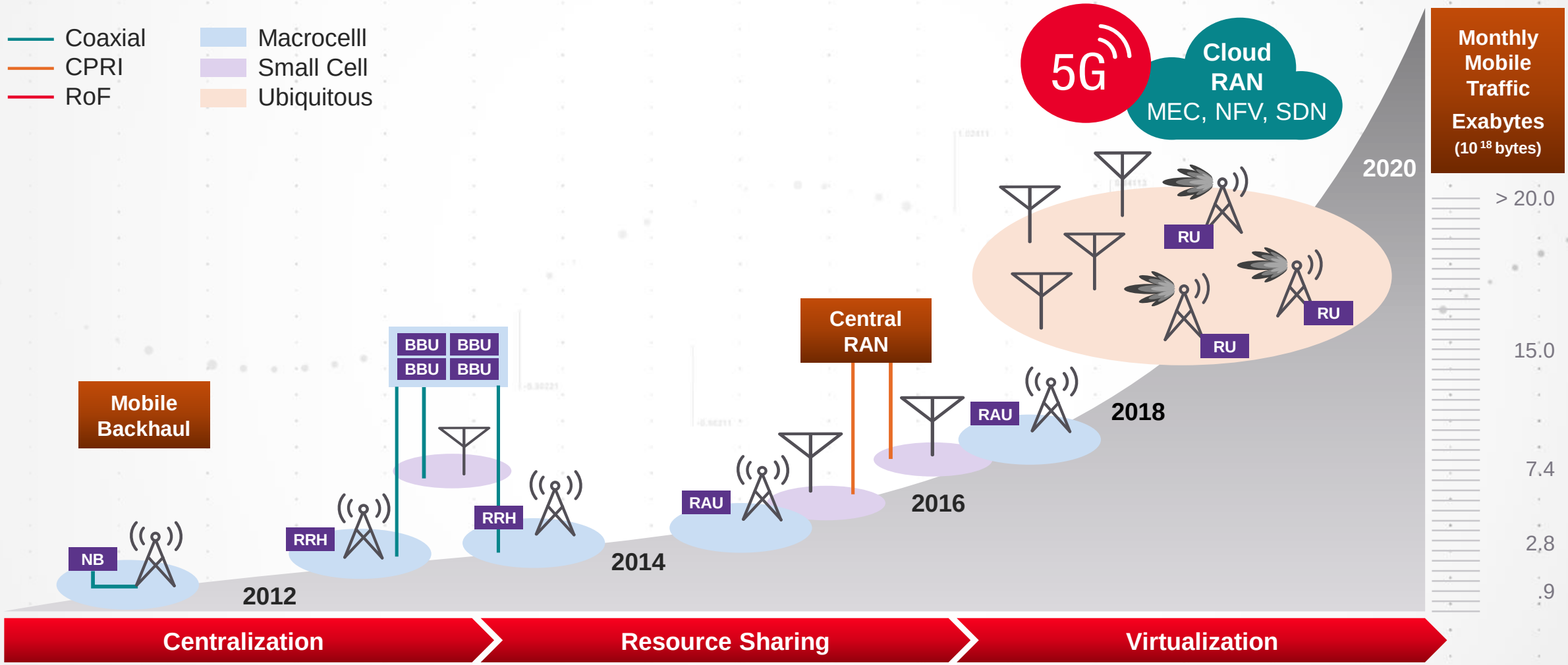
KEY MILESTONES



5G is About Network Transformation
Vertical Industry Demands and Challenges

New Network Architecture

ENABLING NEW BUSINESS MODELS



Heterogenous Networks

INCREASING DEPLOYMENT COMPLEXITY

Core Network

- Multi-RAT Management
- Routing/Scheduling to address each vertical
- Interference management

Small Cell

Macro

More complex:

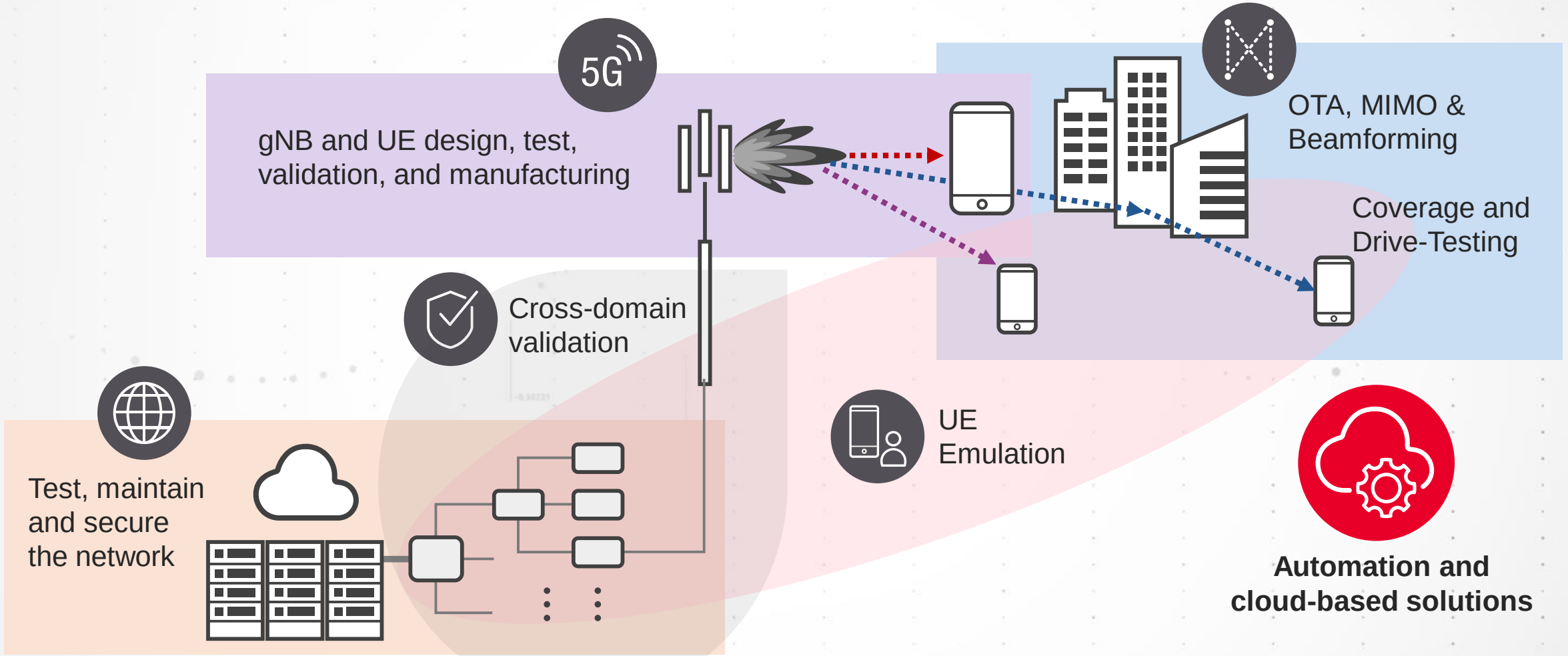
- Site acquisition
- Network planning
- Resource management

Multi-Mode Devices

- NSA & SA
- FDD & TDD
- FR1 & FR2

New Test Strategies Are Needed to Offer New Insights

ACROSS MULTIPLE RF AND PROTOCOL DOMAINS

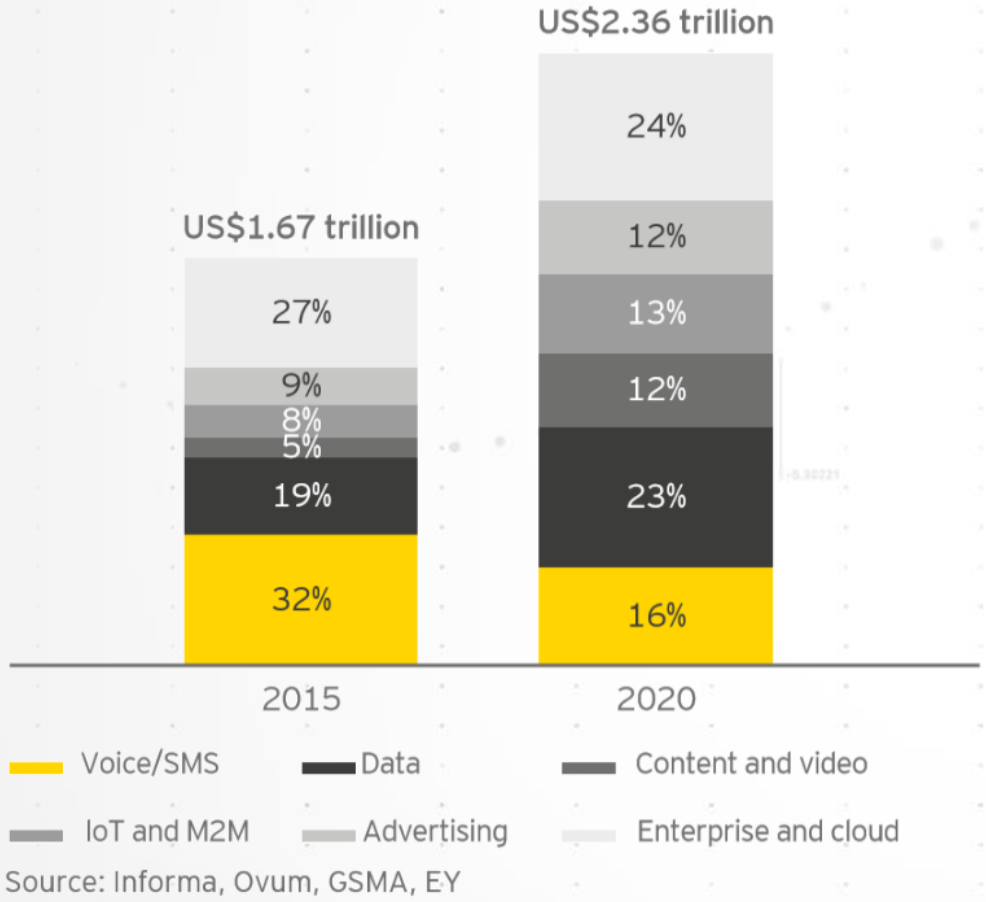


Promise of 5G
New Use Cases and Business Models

5G Enables Newer Business Models

OPERATORS DRIVE DIGITAL TRANSFORMATION

Connecting People and Things



Source: Informa, Ovum, GSMA, EY

Value Added Services

Professional Services

Big Data

Cloud

Connect

Network
- Capacity
- Coverage

Devices
- eMBB
- Massive IoT

Industry Verticals

Industry 4.0

Healthcare

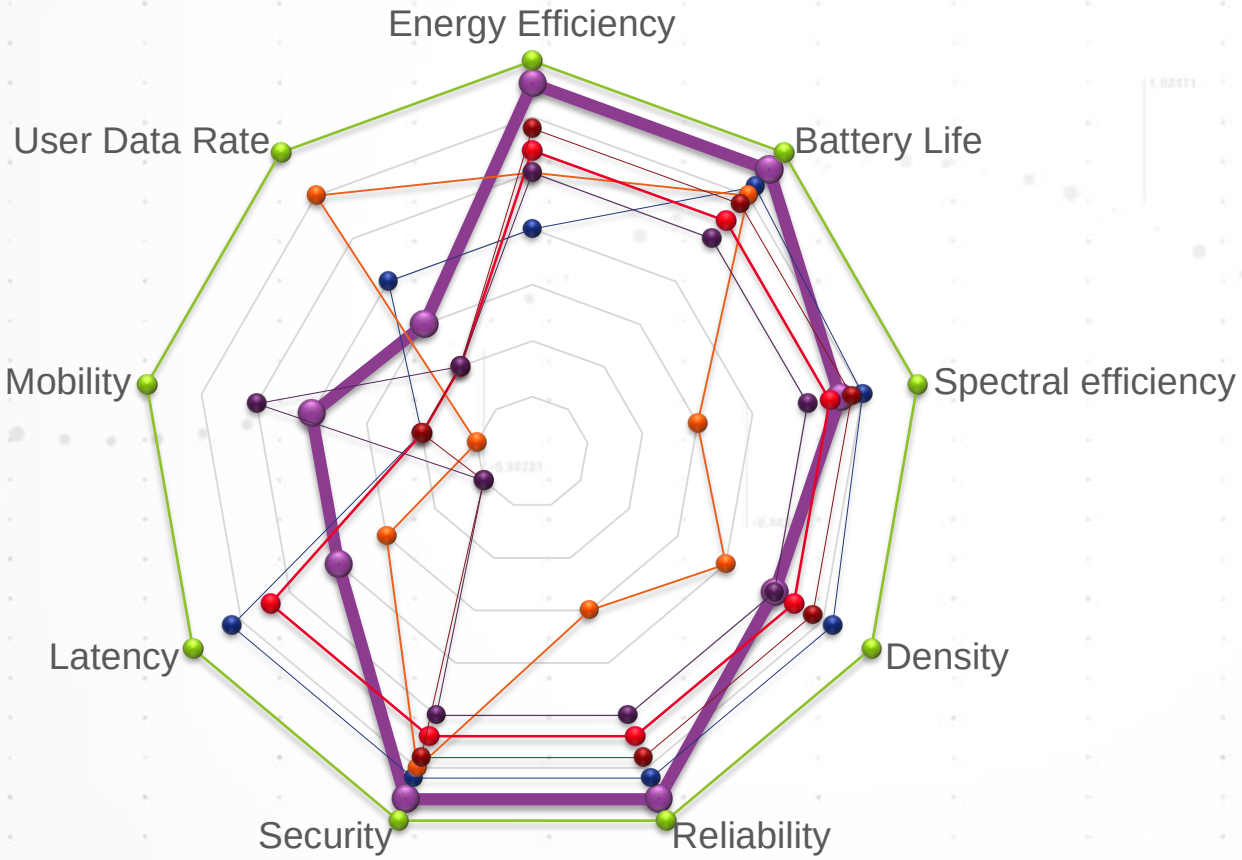
5G
New value creation

Enable
- Ecosystem Orchestration
- Flexible & service based architecture

Transform
- End-to-End Service Provision
- Big Data, Analytics, AI

Vertical Industry Applications Require Dedicated SLAs

MULTI-DOMAIN KPIS DEFINE QOS AND QOE



QoS and QoE depend on the cumulative performance of the entire network:

- Devices
- RAN
- Core
- Transport layer
- Cloud

SLA – Service Level Agreement

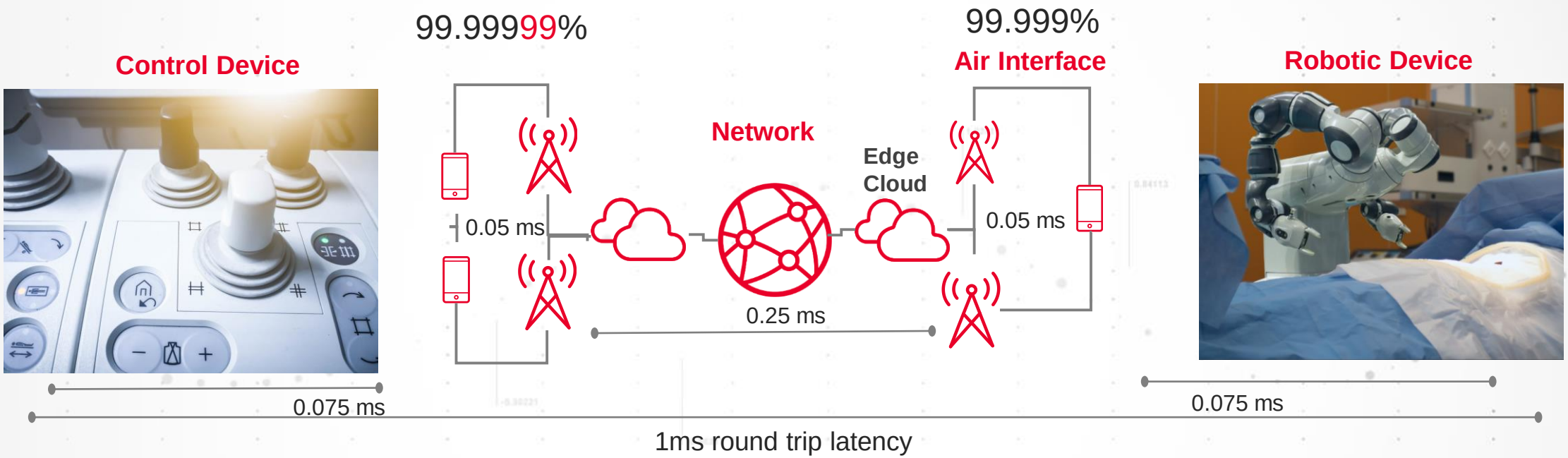
QoS – Quality of Service

QoE – Quality of Experience

KPI – Key Performance Indicator

Making Remote Surgery a Reality

WITH 5G REDUNDANT CONNECTIVITY, BEAMFORMING & DEDICATED EDGE CLOUD



QoE

- Instant remote control and haptic feedback
- High definition & real-time audio/video streams
- Extended Battery life for extended surgery time

QoS

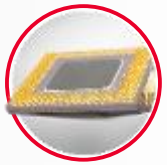
- Near-zero connection downtime
- Minimum packet loss and no video freeze
- Malware and intruder proof

How does Keysight Enable the Industry?

Our Role in Making 5G a Reality

A Comprehensive Solutions Portfolio

COVERAGE OF ENTIRE COMMUNICATIONS INDUSTRY



Components & Chipsets

Devices

Base Stations

Hyperscale and Data Centers

Enterprise

Layers 2-7

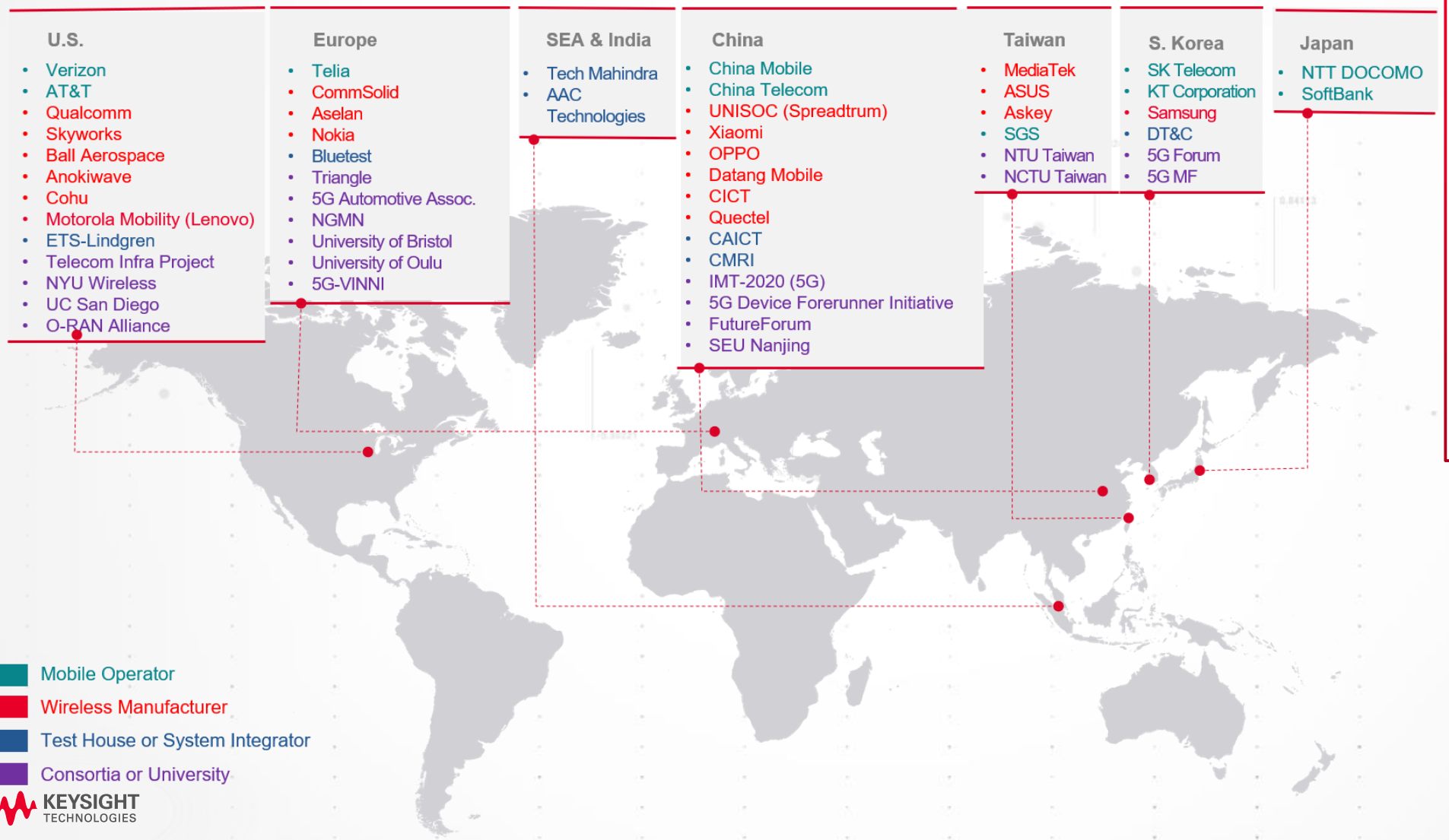
Layer 1

Protocol Design & Acceptance		Field & Drive Test	Network Security	
Over-The-Air (OTA) Test	Key Performance Indicators	WiFi Coexistence	Network Monitoring	
Beamforming	MIPI[1] Digital Test and LP/DDR5	Channel Emulation	Network Loading	
mmWave Parametric	Circuit Simulators	5G Waveforms	100G / 400G	Gen 5 PCIe & Memory

Solutions: Keysight Classic | Ixia | Anite | AT4

Extensive Collaborations Around The World

OUR 5G WORK BEGAN EARLY

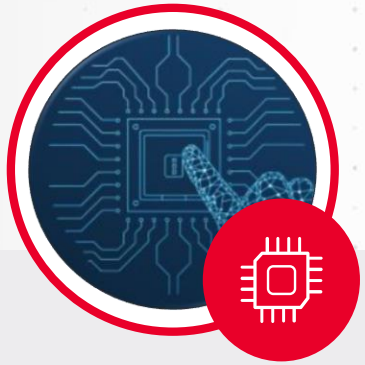


- Engaged early with 5G industry leaders across the connected ecosystem
- Delivered end-to-end 5G solutions to accelerate development

KEYSIGHT TECHNOLOGIES

5G Solutions – E2E Workflow Based Approach

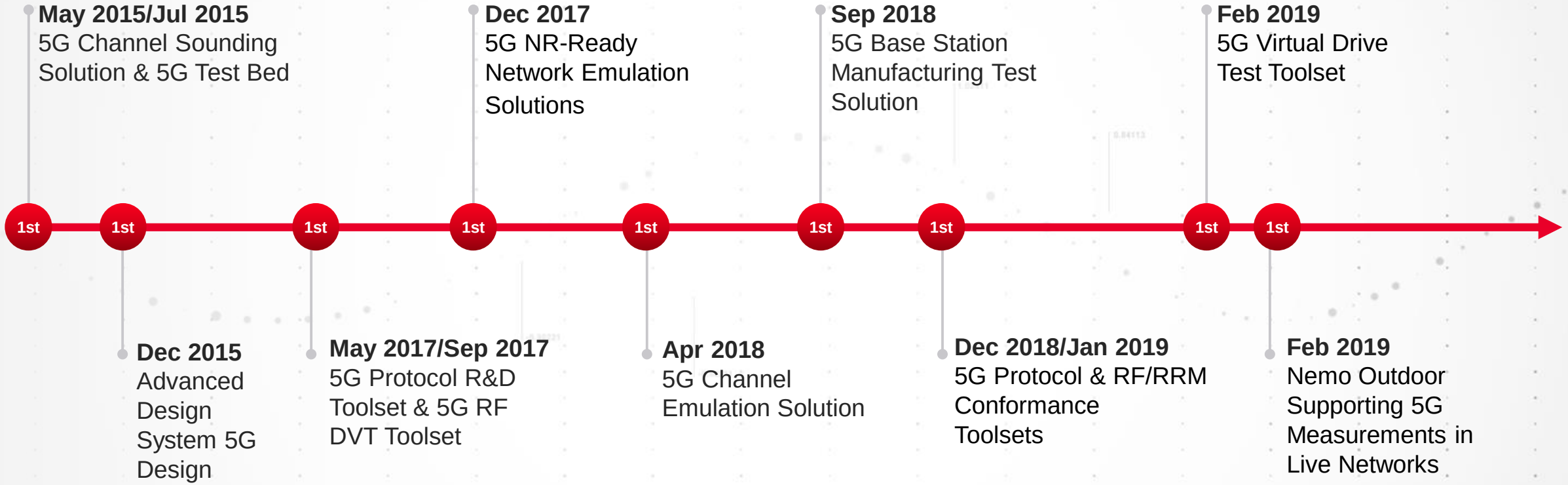
FOCUS ON ENABLING OUTCOMES

Design & Validation	Conformance & Acceptance	Manufacturing	Deployment & Operations
			
Advanced Design Simulation mmWave Test Bed Network & UE Emulation	Protocol Conformance RF/RRM Conformance Carrier Acceptance	RFFE / RFIC Mfg. Base Station Mfg. Device Mfg.	Field Test Drive Test Monitoring & Security

PATHWAVE **Connects the Workflow: Open, Scalable, Predictive**

Keysight's Contributions & Proof Points

INDUSTRY-FIRST SOLUTIONS



Enabling Market Leaders

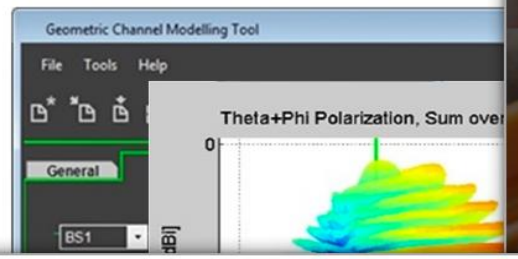
FierceWireless

WIRELESS TECH 5G IOT

Wireless

Keysight going strong

by Monica Alleven | Aug 23, 2018 7:35am



telecoms.com

Keysight claims first 5G device testing toolset

TG TRANSSEED GROUP

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Keysight Technologies inks 5G deal with China Telecom

The U.S. firm also secured a 5G collaboration agreement with Korean carrier SK Telecom

RCRWireless News

INTELLIGENCE ON ALL THINGS WIRELESS

Keysight Technologies inks 5G deal with China Telecom

sdx central

SD-WAN 2 5G 9 Edge 10 IoT 4 SDN 7 NFV 7 Container
Security 8 AI 9 Data Center 4 Storage 4 APM/NPM 2 Op

Keysight Provides NTT DoCoMo With 5G Network Emulation for 5G NR Devices

Ali Longwell
August 21, 20
11:45 am MT

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Qualcomm, Keysight Achieve 2-Gbps Wireless Downloads

PODCA

Partner with Keysight and gain market leading end-to-end insights to innovate, transform, and realize your 5G goals
Thank you!
KEYSIGHT TECHNOLOGIES

5G Charges Ahead

Mobile operator deployments are accelerating

Network architecture is transforming

5G NR standards are evolving

First wave of devices available for trials