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TechTalk

Telit

5G IoT and the Enterprise:
The Current State of 5G and IoT Applications

Marco Contento

" ...the emergence of 5G signals a tipping point in the evolution of mobile from a mostly personal technology dominated phenomenon to a platform that enables new classes of advanced applications, fosters business innovation, and spurs economic growth.

IHS Markit concludes that, by 2035, 5G has the potential to stimulate $13.2 trillion in global sales activity across a broad spectrum of industries and use cases "
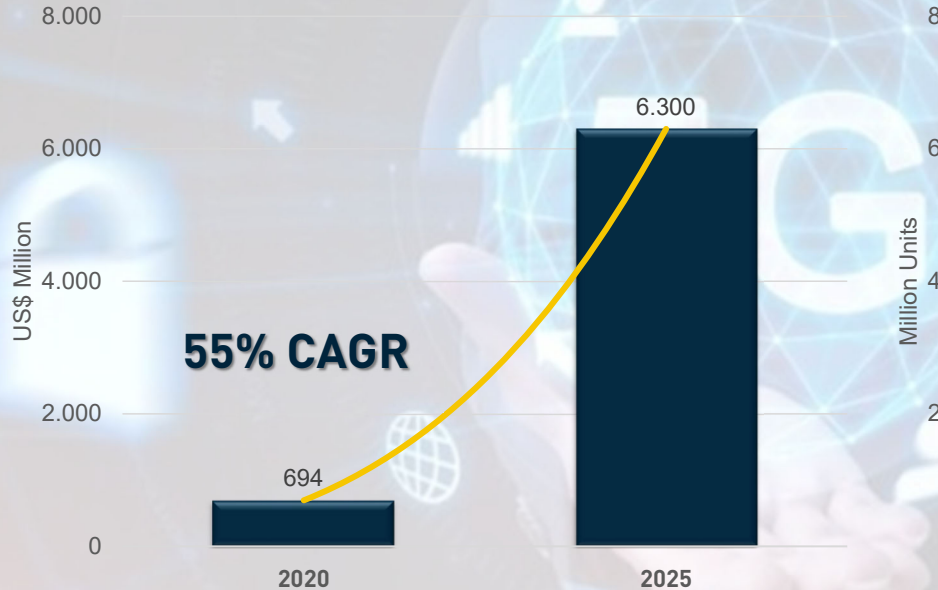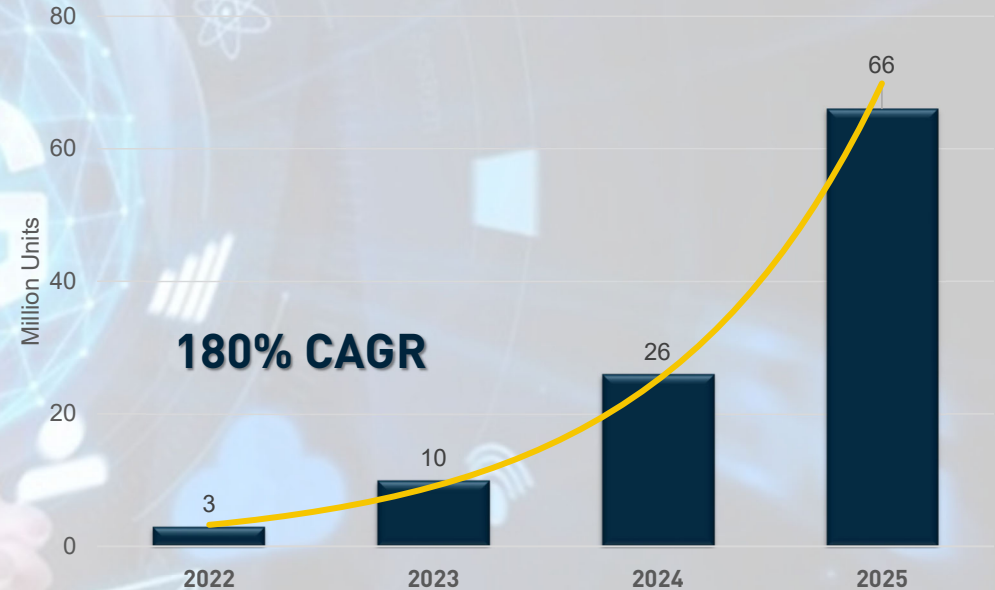
The 5G Economy, IHS Markit (now OMDIA), November 2019

Perspective on 5G World Market and Forecasts

5G IoT Revenues[1]

55% CAGR

US$ Million

- 2020: 694
- 2025: 6.300

5G Cellular Module Shipments[2]

180% CAGR

Million Units

- 2022: 3
- 2023: 10
- 2024: 26
- 2025: 66

1) Deloitte Technology and Telecom Predictions 2020
2) ABI Research, M2M Embedded Cellular Modules, Aug 2020

4G Evolution and the 5G Takeover - The Telit 5G Vision

Be first to market with integrated products and subscription services

Developed in collaboration with value chain partners

That anticipate needs in the public and private network solution domains

Evolving seamlessly from 4G into 5G

For all high-growth industry segments

20 Years Building the Corporate Machinery to Execute the 5G Vision

Industry-unique Intersection of 4 Ingredients Needed to Execute

Hardware expertise – 5G Radios at Apex of RF Engineering Complexity

Brand new 5G upgradable core network and nearly 30 years in connectivity

Award-winning Device, Connection Management and IoT, IIoT Platforms

Productizing Hardware, Value-added Services into "as-a-Service" Model

The 5G Standard Rests on 3 Application Pillars

eMMB

uMTC

mMTC

Massive Content
«extreme MMB»

eMMB

Use case:
Speed, Gb/s → Tb/s
3GPP Rel 15

Massive Control
«ultra-reliable/critical MTC»

uMTC

Use case:
Low latency, response 1ms
3GPP Rel 16

Massive Sensing
«massive MTC»

mMTC

Use case:
bit/sec over 10 years on
AAA batteries
3GPP Rel 17

Key benefits and Why 5G Will Revolutionize

More spectrum and more efficient use of the spectrum

Increased capacity

Increased/Layered coverage

Higher throughput

Lower latency and High Reliability (URLLC)

Enables new use cases / new B2B opportunities

Early 5G Use Cases

Higher Speed, Lower Latencies, Higher Reliability, Massive Scale

High Bandwidth Video Camera Equipment

Enterprise Routers SD-WAN

3GPP Rel 15
Mobile Broadband

2018

Industry 4.0 Smart Factories

Laptops Tablets

Commercial and Residential CPEs

5G

Early Adopters Want to do Trials/PoC in the industry, learning by doing

Addressing Non-real-Time use cases

Guaranteed Connectivity and Privacy

Leveraging Private 5G deployments in Sub-6 spectrum

Leveraging SBA architecture

Wide Range of Use Cases

Potential convergence to 5G

5G

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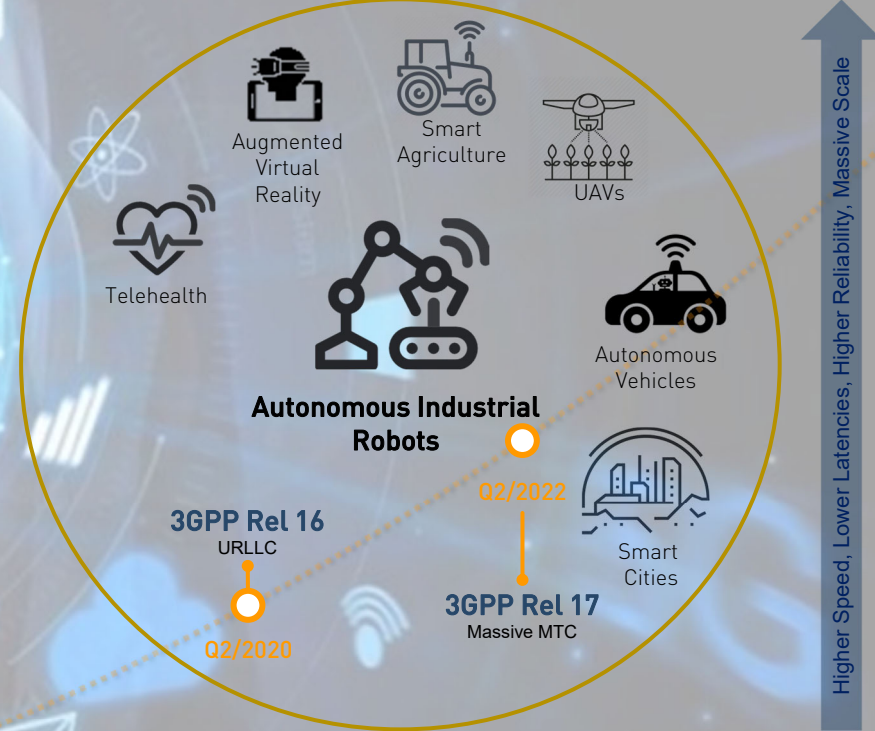Addressing mission critical and precise Positioning indoor/outdoor use cases

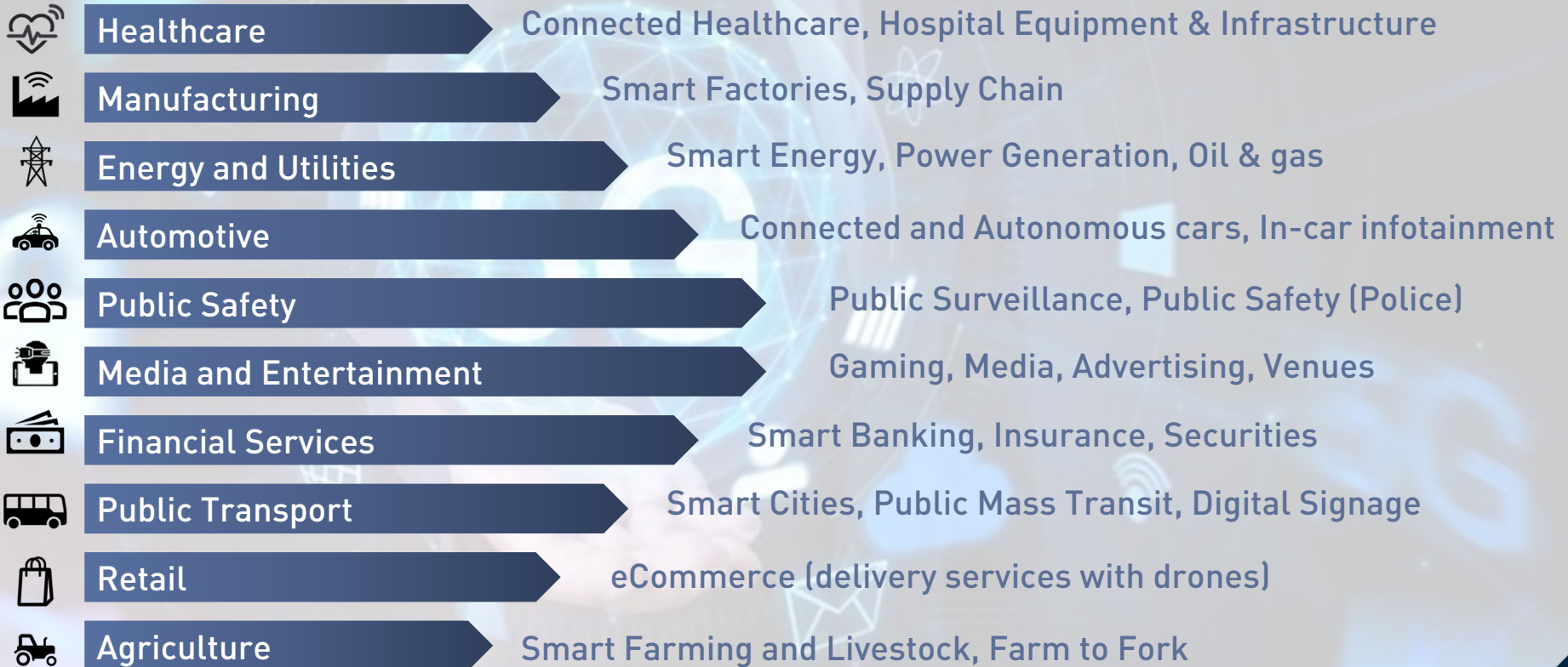Private deployments with dedicate resources

Cellular grade security

mmWave as a good complement to mid-bands for in factory deployments, to enable system capacity, bandwidth and lower latency

Easier coex between indoor shop floor networks and outdoor networks, as mmW is easier to confine within buildings
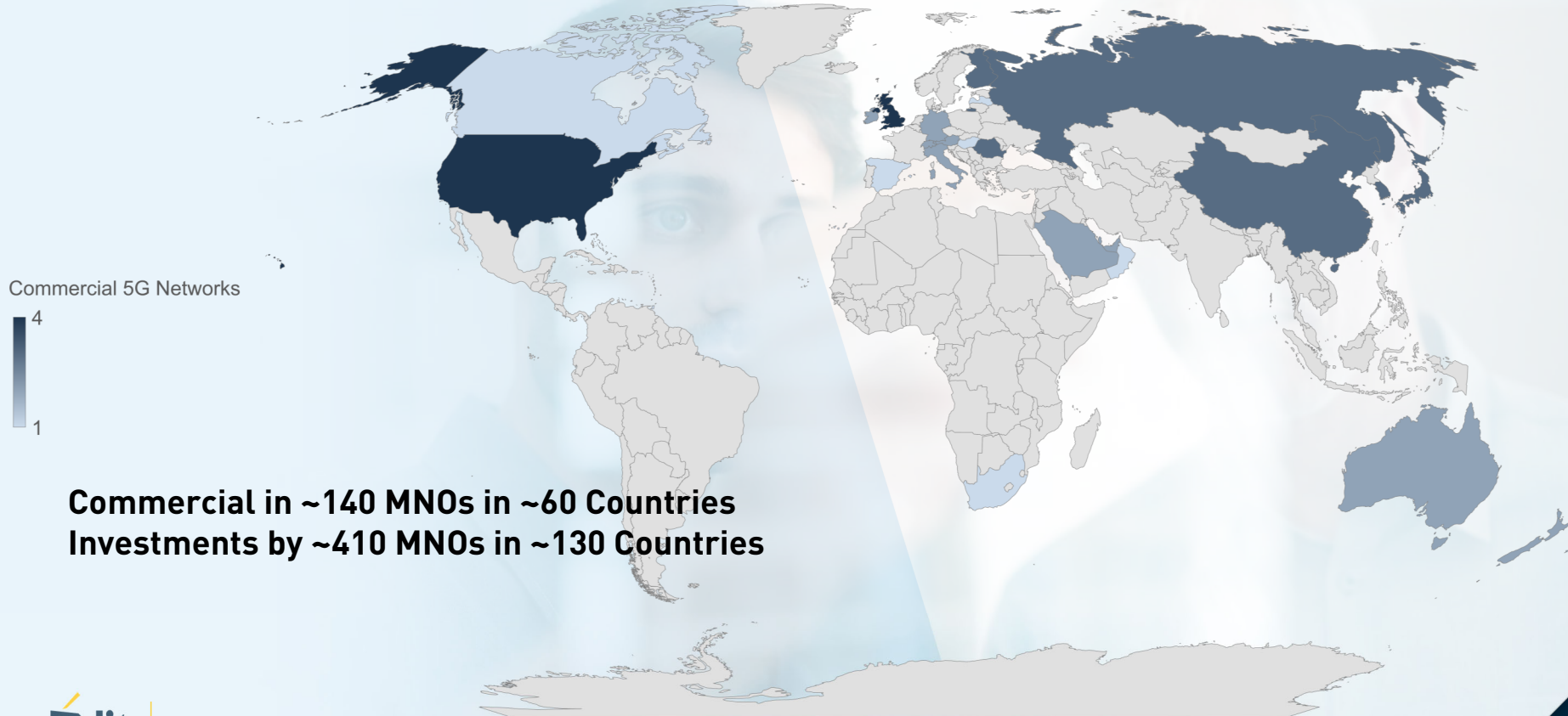
Next Wave 5G Use Cases

Augmented Virtual Reality

Smart Agriculture

UAVs

Telehealth

Autonomous Vehicles

Autonomous Industrial Robots

Q2/2022

3GPP Rel 16
URLLC

Smart Cities

3GPP Rel 17
Massive MTC

Q2/2020

Higher Speed, Lower Latencies, Higher Reliability, Massive Scale

5G

5G to Accelerate the Digital Transformation Across Pivotal Economic Sectors

Healthcare — Connected Healthcare, Hospital Equipment & Infrastructure

Manufacturing — Smart Factories, Supply Chain

Energy and Utilities — Smart Energy, Power Generation, Oil & gas

Automotive — Connected and Autonomous cars, In-car infotainment

Public Safety — Public Surveillance, Public Safety (Police)

Media and Entertainment — Gaming, Media, Advertising, Venues

Financial Services — Smart Banking, Insurance, Securities

Public Transport — Smart Cities, Public Mass Transit, Digital Signage

Retail — eCommerce (delivery services with drones)

Agriculture — Smart Farming and Livestock, Farm to Fork

Global Fully Commercial 5G Service as of February 2021

Commercial 5G Networks

4

1

Commercial in ~140 MNOs in ~60 Countries
Investments by ~410 MNOs in ~130 Countries

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Global 5G Millimeter Wave Commercial Service as of November 2020
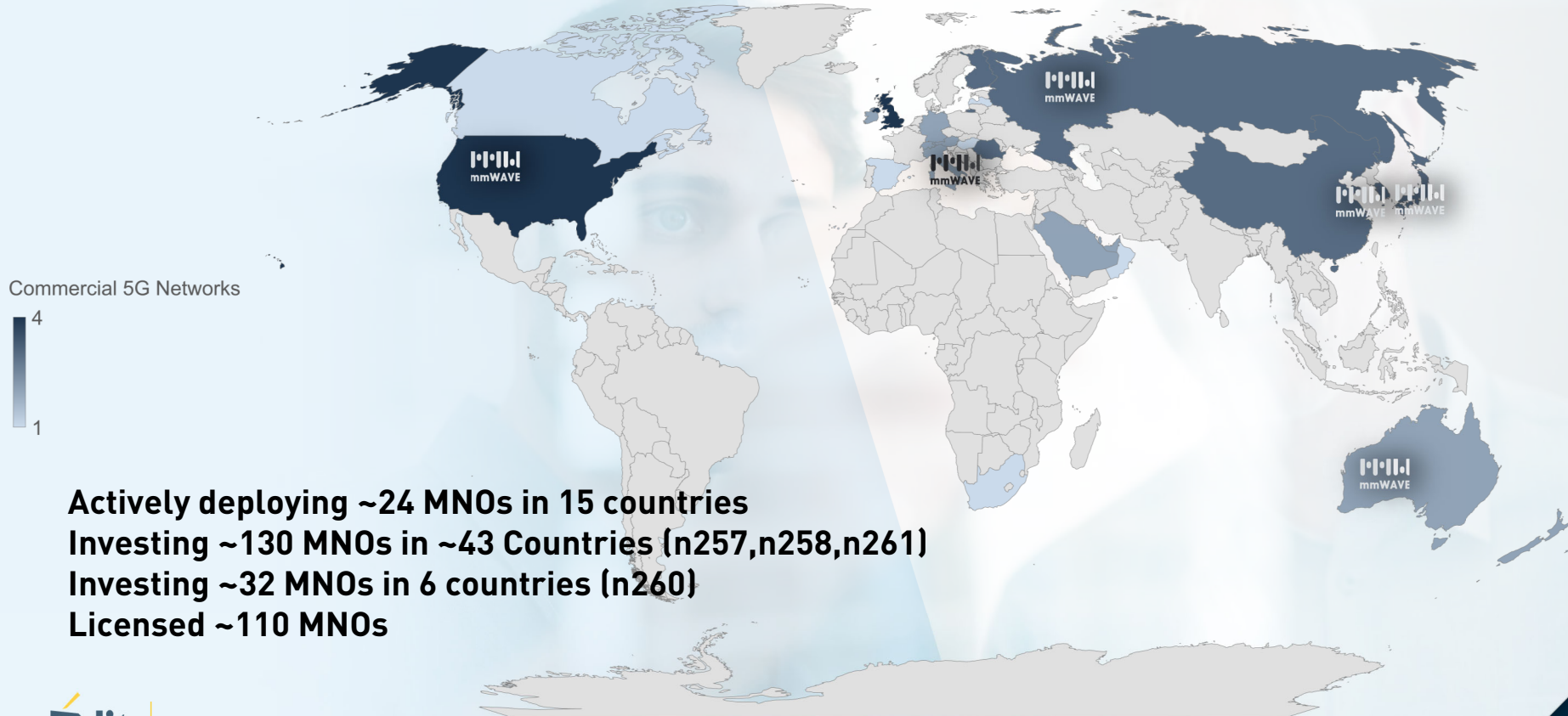
Commercial 5G Networks

4

1

Actively deploying ~24 MNOs in 15 countries
Investing ~130 MNOs in ~43 Countries (n257,n258,n261)
Investing ~32 MNOs in 6 countries (n260)
Licensed ~110 MNOs

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Global 5G Commercial Coverage as of September 2020 – North America MNO Detail

Verizon
(6) GHz | mmWAVE

Commercial launch Q2 '19
5G mmW Mobile ~36 cities live
Sub-6 GHz – 3.7-3.8 GHz trials
DSS with 4G bands

T-Mobile
(6) GHz | mmWAVE

mmW launched June 2019 in 7 cities.
Sub-6 launched nationwide in Dec 2019
Covering more than 250 million people
across 1.3 million square miles.
Launched standalone 5G network

AT&T
(6) GHz | mmWAVE

Pre-commercial Q4 2018
5G network is now available nationwide
5G network reaches 205 million
mmW rolled out in 35 markets

Sprint
(6) GHz

9 markets now live with mobile 5G
Will use mid-band 2.5GHz/n41 for initial rollout
Focused around adding massive MIMO radio
support to LTE as 5G is being rolled out

mmWAVE

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Global 5G Commercial Coverage as of September 2020 – EMEA MNO Highlights

Vodafone

Launch in '19 in Italy, UK and Germany.
DSS on in Germany in the 700MHz band,
covering 10 M people.
Launch in Spain, 21 cities May '20

Deutsche Telekom

Launch in over 3,000 towns in Germany, with 40 M people
coverage.
Target covering half of Germany's pop by end of '20.
2.1GHz and 3.6GHz bands.

Orange

Launch in Romania in 3 cities. In Spain in
September '20 in 5 cities, ~20%. Plan for
~40% of Spanish population in '21, 70% in '22,
90% in '23 and 95% in '24.

Telefonica

Launch in UK in '19 in 6 cities. Up to over 60 cities in '20.
Launch in Germany's 5 largest cities, target 30 cities in '22.
5G launch in Spain at the end of '20 or at the latest in early '21, with 50%
population coverage.
5G NSA initially, with SA evolution
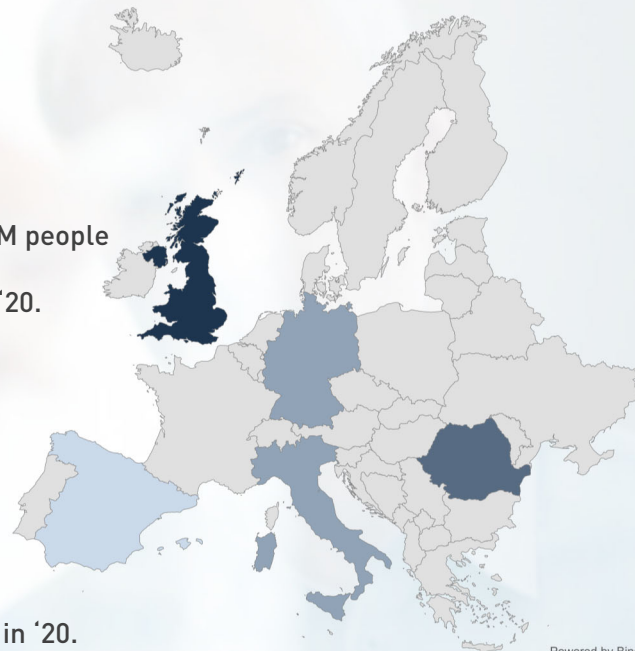
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Global 5G Commercial Coverage as of September 2020 – APAC MNO Highlights

China Mobile

6 GHz

2020 launch commercial service, SA and NSA mode Deployed >180k gNB 2.6G(LTE+NR)+4.9GHz(NR) in 50 cities

China Unicom

6 GHz

Full commercial service mid 2020 SA mode. Deployed >260k gNB

China Telecom

6 GHz

Pre-commercial launch in mid 2019, full commercial service mid 2020 SA mode

NTT DoCoMo SoftBank KDDI

6 GHz mmWAVE

Softbank, KDDI and DoCoMo launched commercial SA network by Mar 2020

SKT KT LGU+

6 GHz mmWAVE

First commercial launch in March 2019. Strong focus in IoT/Industrial markets. South Korea current NSA networks use 3.5GHz spectrum. SA mode will launch before end of '20

Telstra Optus VF

6 GHz mmWAVE

Telstra 5G coverage in selected areas of 47 cities and >50% of coverage Optus rolled out 5G in 2019. Now testing 5G mmWave using 26GHz. Expected available in 2021. Strong focus on FWA and mobile applications. VF rolling out 5G network to selected areas in major cities, since mid-2020

Chinese 5G terminals must support SA mode after Jan '20 New 5G band n28 for broadcasting network

Fujitsu was granted Japan's first commercial Private 5G(28.3GHz) and LTE(2575MHz) radio station license
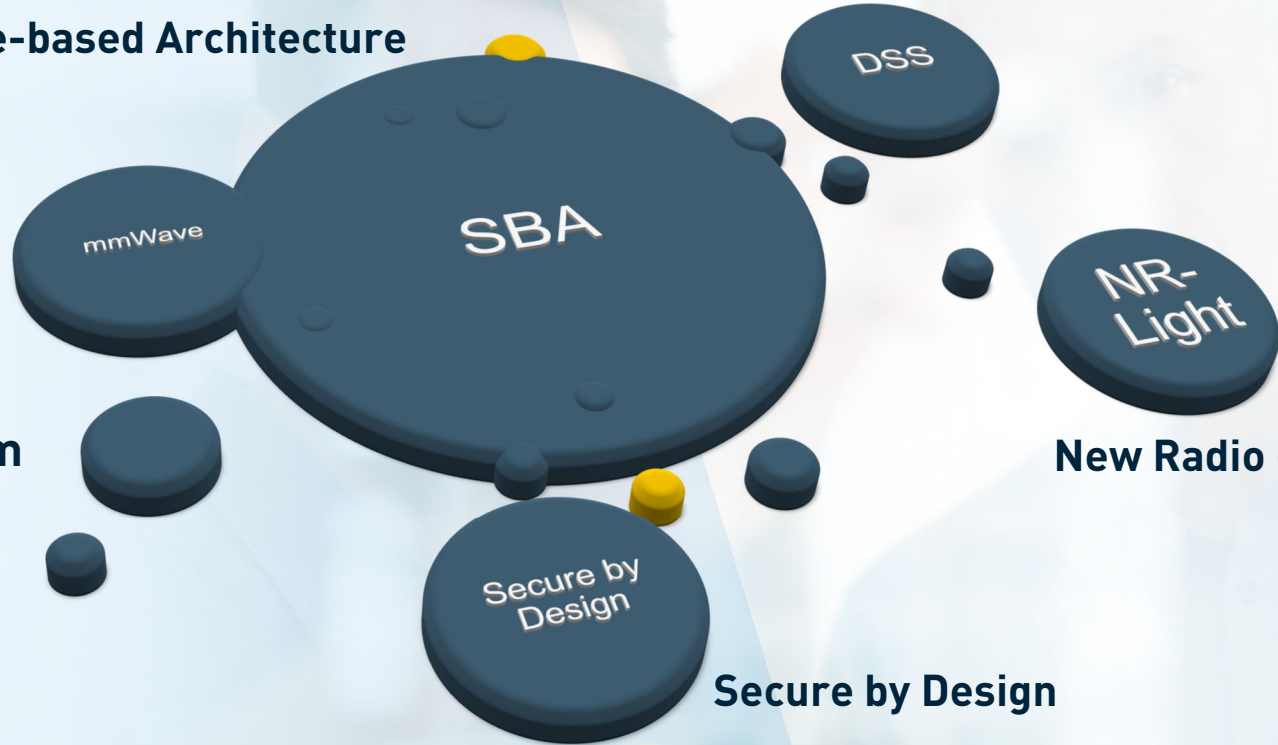
mmWAVE mmWAVE

mmWAVE

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Foundational Technologies in 5G that You Need to Know

Dynamic Spectrum Sharing

Service-based Architecture

DSS

SBA

mmWave

NR-Light

Millimeter Wave Spectrum

New Radio - Light

Secure by Design
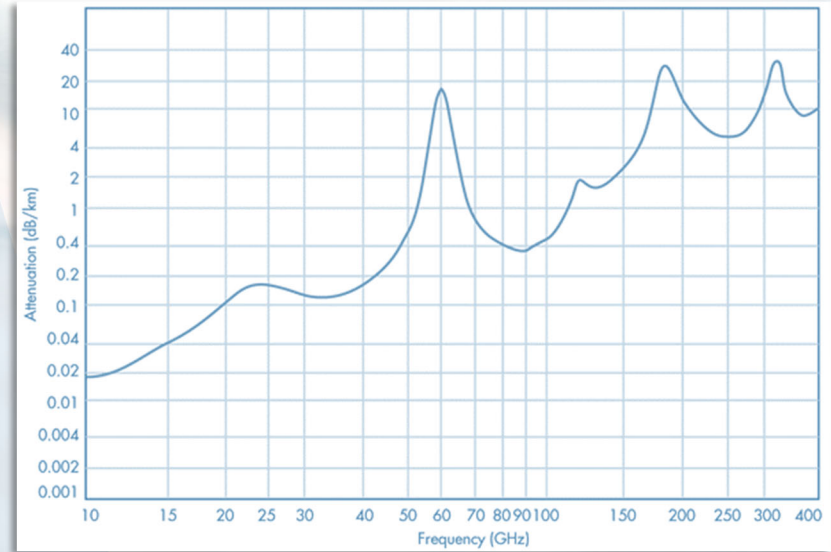
Secure by Design

# Foundational Technologies in 5G – The Millimeter Wave Spectrum

- Superior data-carrying capacity

- Broadly open swath of RF spectrum available for allocation to cellular globally

- Requires high-density MIMO, Beam-forming

- Suffers significant atmospheric attenuation specially from Oxygen at 60GHz

- Telit's FN980 family SUPPORTS mmWave

Frequency Band (GHz)	Path Loss Exponent (PLE) dB		Rain Attenuation @ 200m		Oxygen Absorption @200m
	LOS	NLOS	5 mm/h	25 mm/h	
28	1.8~1.9	4.5~4.6	0.18 dB	0.9 dB	0.04 dB
38	1.9 ~2.0	2.7~3.8	0.26 dB	1.4 dB	0.03 dB
60	2.23	4.19	0.44 dB	2 dB	3.2 dB
73	2	2.45~2.69	0.6 dB	2.4 dB	0.09 dB

Foundational Technologies in 5G – Dynamic Spectrum Sharing (DSS)

- Accelerate scaling of 5G coverage

- No need to re-farm legacy 4G spectrum for 5G on a site-by-site basis

- Software upgrade can be pushed to base stations to enable DSS

- DSS provides a bridge to transition from NSA to SA deployments without compromising the coverage layer

- Telit's FN980 family SUPPORTS DSS
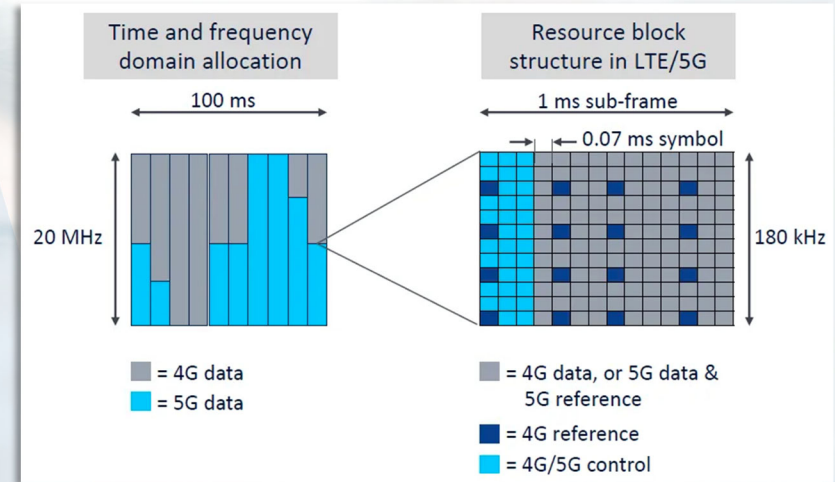
DSS enables existing LTE carriers to operate 5G New Radio (NR) and LTE simultaneously

DSS applies an intelligent scheduler algorithm making it possible for the mix of 4G and 5G device data in the network to be adjusted about 100 times a second

Foundational Technologies in 5G – Service Based Architecture (SBA)

> "5G is <u>revolutionary</u> because it replaces the hardware components of the network with software that 'virtualizes' the network by using the common language of Internet Protocol (IP)" *
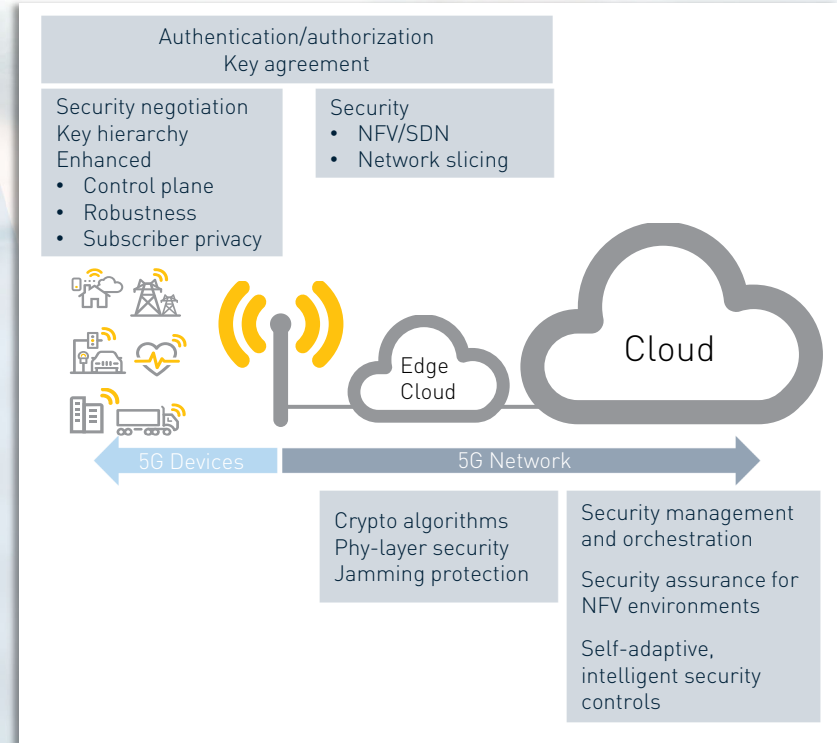
- Brand **new paradigm** in the mobile industry

- 5G conceived on a **software and service-oriented** architecture

- Architecture is foundation for implementation of **Network Slicing**

- **Flexible, on-demand service composition** delivers faster TTM

- New flexibility to **enable new business models**, opportunities
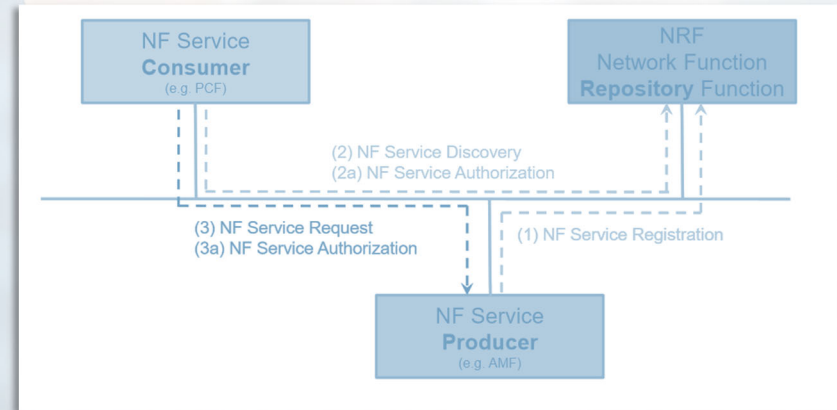
Service based Interfaces using RESTful APIs over HTTP/2 and TCP transport, to consume or deliver services

* Source: Tom Wheeler, Visiting Fellow – Brookings Governance Studies, Center for Technology Innovation

Foundational Technologies in 5G – Changing the paradigm with 'Secure by Design'

- 5G is built on a software and service-based architecture and therefore susceptible to cyberattacks

- 5G standards therefore must be developed with 'Secure by Design' principles

- 5G improves confidentiality and integrity of user and device data

- 5G networks are layered and virtualized

- Mutual Authentication is employed as well as encryption of all information transferred either inter or intra network

Authentication/authorization
Key agreement

Security negotiation
Key hierarchy
Enhanced
- Control plane
- Robustness
- Subscriber privacy

Security
- NFV/SDN
- Network slicing

Cloud

Edge Cloud

5G Devices

5G Network

Crypto algorithms
Phy-layer security
Jamming protection

Security management and orchestration

Security assurance for NFV environments

Self-adaptive, intelligent security controls

Complete 5G Security requires operation of mobile devices under a 5G core network

Foundational Technologies in 5G – NR-Light, Rel 17 – closing the gap

NR-Light

- A new class of device more capable than eMTC/NB-IoT but less than URLLC or eMBB

- Super-efficient 100 Mbps of downlink and 50 Mbps of uplink speeds from 10 or 20 MHz of bandwidth

- Successor to the successful application areas currently using LTE Cat 1, Cat 4 and not needing to increase speed

- Telit NR-Light modules are aligned to be first to market in sync with network rollouts ~2022-23
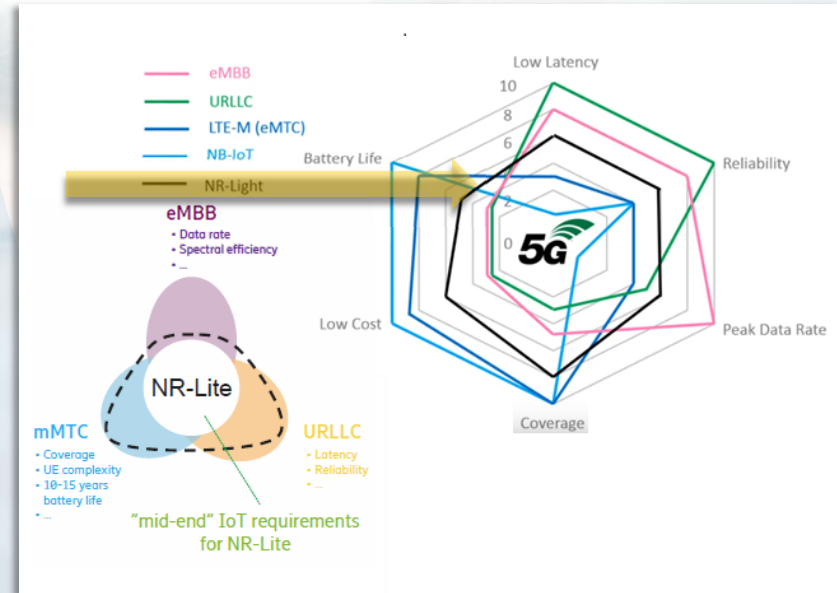
Suitable for mid-tier 5G NR devices

Industrial wireless sensors
Low end wearables
Power constrained devices
Module cost comparable to LTE

Video surveillance cameras
Latency tolerant devices
10+ Mbps throughput

SD-WAN / Enterprise Routers

Customer Problem	Telit Solution
Fulfill the demand for QoS (business continuity, bandwidth, latency) / better user experience (UX)	High speed 5G single SKU data card for WW deployments
Improve performance and solve connectivity bottlenecks	Best in class performance in DL as well as in UL
Provide agility and flexibility to the communications service providers (CSPs)	Certified on major carriers WW
	Fallback on 3G/4G for service continuity in 5G-less areas

Retailers, construction sites, teleworking, branch offices, etc

IoT Gateways

Customer Problem	Telit Solution
Optimize operations, reduce OPEX	Certified on major carriers WW
Increase efficiency	Fallback on 3G/4G for service continuity
Security	Secure-by-design
Decrease downtime	Support of industrial temperature range
Support first responders	Embedded GNSS
	FirstNet ready certified

Video streaming / broadcasting

Customer Problem	Telit Solution
Bringing live video from anywhere	Best in class performance for uplink centric use cases
Fast and reliable internet on-the-move	Fallback on 3G/4G for service continuity in 5G-less areas
less costly alternative to traditional telecom, satellite, fiber and microwave connections (reducing operational costs)	high speed 5G single SKU data card for WW deployments
Facilitate mobility	FirstNet ready certified

Live broadcast equipment, video professionals and first responders

Private 5G networks

Customer Problem	Telit Solution
Leverage dedicated TDD spectrum for Industry 4.0 (e.g. US CBRS US, Germany 3.7-3.8GHz, etc)	Support of TDD 3.5GHz / C-band
	Support of standalone mode (SA)
Secure and real-time monitoring of the factory	Support of network slicing and dedicated QoS

Flexible production floor, autonomous AGV, AR / VR applications

Smart Grid

Customer Problem	Telit Solution
High penetrations of renewable energy sources	Best in class performances both in downlink and uplink
Need of real time voltage and time synchronization	Support of standalone mode (SA)
Increased level of data transmission	Support of network slicing and dedicated QoS
Mitigate outages	Secure-by-design
Security	
Power grid protection and control	

Mobile Computing

| Customer Problem	Telit Solution
Provide best in class internet access (speed and latency)	high speed 5G single SKU data card for WW deployments
Accessing internet from anywhere in the world	Best in class performance in DL as well as in UL
	Certified on major carriers WW
	Fallback on 3G/4G for service continuity in 5G-less areas

Consumer, commercial and industrial notebooks, tablets, handhelds

FN980 (sub-6) / FN980m (mmW) specification

	Telit FN980m
Market segment	Fixed Wireless Access (FWA), Indoor/outdoor CPE, high power CPE, router and gateways
Product grade	Industrial grade
Form factor	M.2, key B
Size	30 x 50 x 3.5 mm
5G FR1 bands	LB: n5/8/12/20/28/71; MB: n1/2/3/25/66; HB: n7/38/40/41/48/77/78/79
5G FR2 bands	n257/258/260/261 - **FN980m only**
5G SRS	Supported on band n78
4G LB	B26(5/18/19)/8/12(17)/13/14/20/28/29/71
4G MB	B1/2(25)/3/4(66)/32
4G HB	B7/30/34/38/39/40/41/42/46/48
4x4 MIMO DL	4G: B1/25(2)/3/66(4)/7/30/40/41(38)/42/43/48/32/46/48 5G: n1/2/3/66/7/41/77/78/79
3G bands	B1/2/3/4/5/6/8/9/19
RF connectors for LTE/5G sub-6	4, on the upper side
mmWave antennas supported	Up to 4, low power antennas QTM525 as well as HP antennas QTM-527 – **FN980m only**
GNSS connector	1 dedicated connector for L1 band (required by CPE customers), L5 band shared with cellular
Interface	1 x PCIe gen 3 + USB 3.1 gen 2
USIM supported	1
eSIM (optional)	1
Digital audio interface	Supported
VoLTE	In planning, no PoR yet
VoNR	In planning, no PoR yet
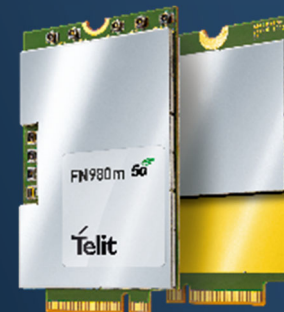
Applications:
CPE, routers, gateways, SD-WAN, video broadcasting, Industry 4.0

FN982m specification

	Telit FN982m				
Market segment	Mobile Computing, size constrained devices, consumer grade				
Product grade	consumer grade				
Form factor	M.2, with thermal pad / laser marking				
Size	20 x 42 x 2.6 mm				
Bands	**Low Band**	**Middle Band**		**High Band**	
	FDD	**FDD**	**TDD**	**FDD**	**TDD**
5G (FR1)	n5/8/12/20/28/71	n1/2/3/66	-	n7	n38/41/77/78/79
5G (FR2)	not supported				
4G	B5/8/12/13/14/17/18/19/20/26/28/29/71	B1/2/3/4/25/32/66	B34/39	B7/30	B38/40/41/42/46/48
3G	B5/6/8/19	B1/2/4/9	-		
4X4 MIMO	No 4X4 MIMO on low band	B1/2/3/4/25/66 n1/2/3/66	-	B7/30 n7	B38/40/41/42/48/41/77/78/79
LTE Cat	ue-CategoryUL 13 (UL: 150Mbps) + ue-CategoryDL 20 (DL: 2Gbps); 7xDL CA, 2xUL CA (Intra-band), 4X4 MIMO up to 5CA (cat 20)				
WCDMA Cat	HSPA+ Rel8 (DL/UL: 42/11 Mbps)				
GNSS	Dual-Frequency GNSS: L1:GPS/Glonass/Beidou/Galileo, L5 : GPS/Beidou/Galileo GNSS RF line shared with cellular				
eSIM	Dual SIM with eSIM on board (eSIM is option) , dual standby and single active				
Interfaces	PCIe gen 3, reserve USB2.0 as debug port in initial stage. 4pcs MHF4 type and 3pcs of 2in1 connectors for mmWave IF interface				

30mm

FN982m

Telit

42mm
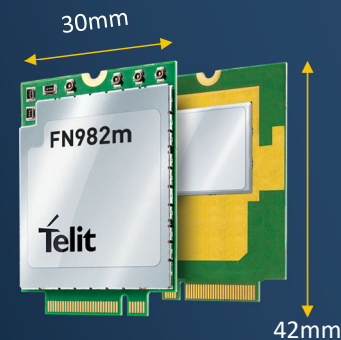
Applications:
Mobile computing, size constrained devices consumer grade

Thank You!