

# 4G-5G & wireless IoT devices

## A Technical-Commercial peek

Acal BFi Nordic  
2022-09-06

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# Wireless IoT for digital transformation

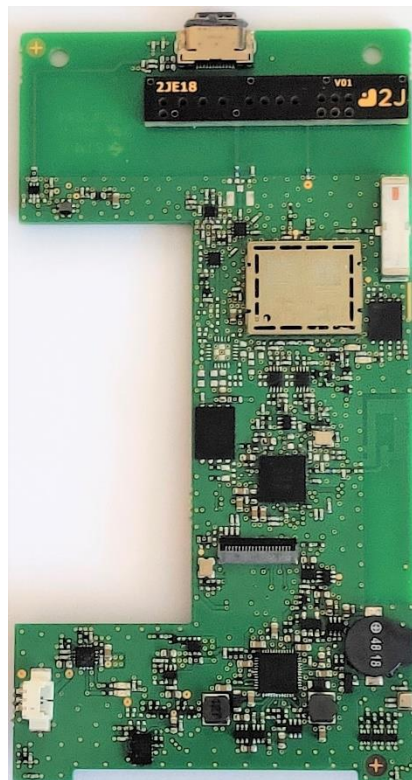


- 5G-NR
- 4G-LTE
- LTE LPWA
- cat M1, NB2/NB-IoT*
- WiFi, Bluetooth, LoRa
- GNSS, Navigation
- Antennas
- RF Semiconductors
- Thermal imaging
- Sensors
- Device-to-Cloud
- Connectivity (SIMs)
- Device Management

- Engineers with extensive R&D and RF experience
- Equipment for RF R&D in-house



- RF application support
- Design review
- Antenna matching
- Reference design



Customer project

### Radio

4G LTE cat M1/NB1  
GNSS  
BLE  
RFID

### Sensors

IMU, Light, Humidity,  
Pressure, Temperature

### System

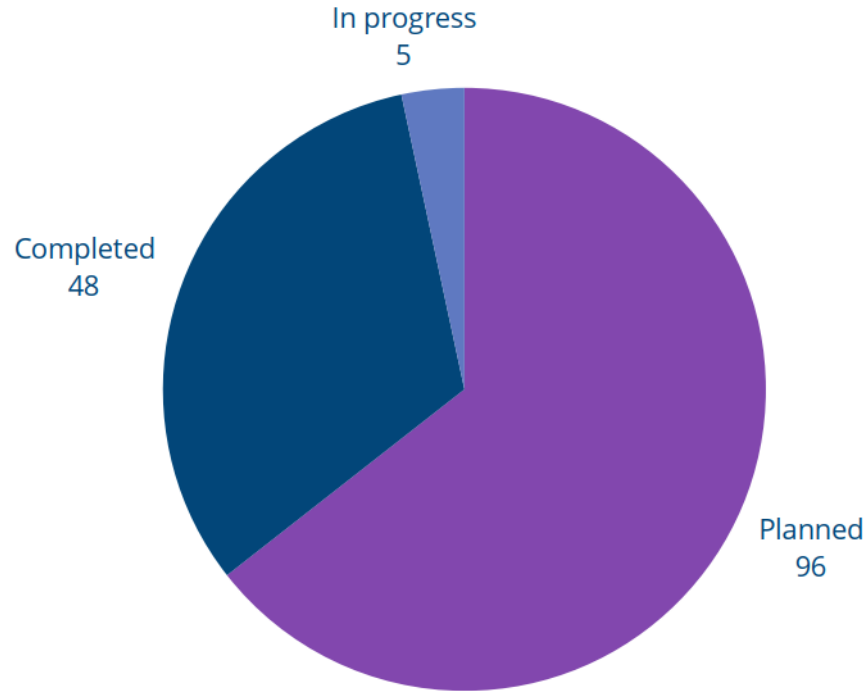
uP & Memory  
Display  
Buzzer  
Power & Battery

Single sided PCBA  
114 x 60 mm

# 3GPP Cellular

**2G, 3G, 4G, 5G**

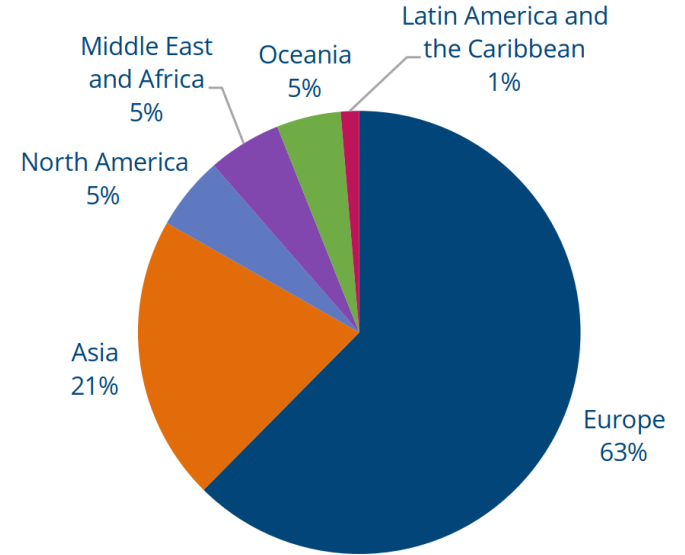
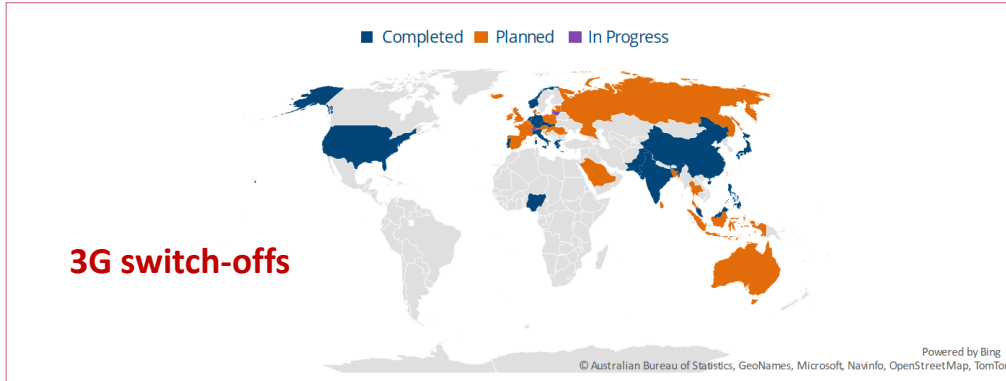
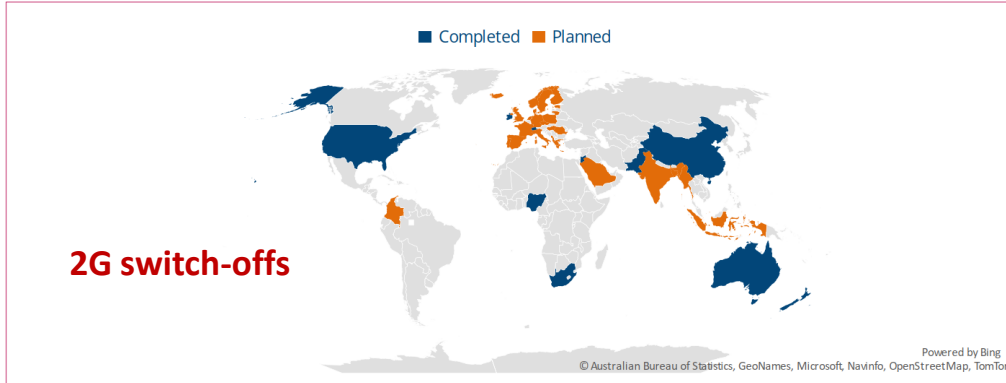
*GSM, GPRS, WCDMA, LTE, LPWA, MTC, NB-IoT, 5G-NR*

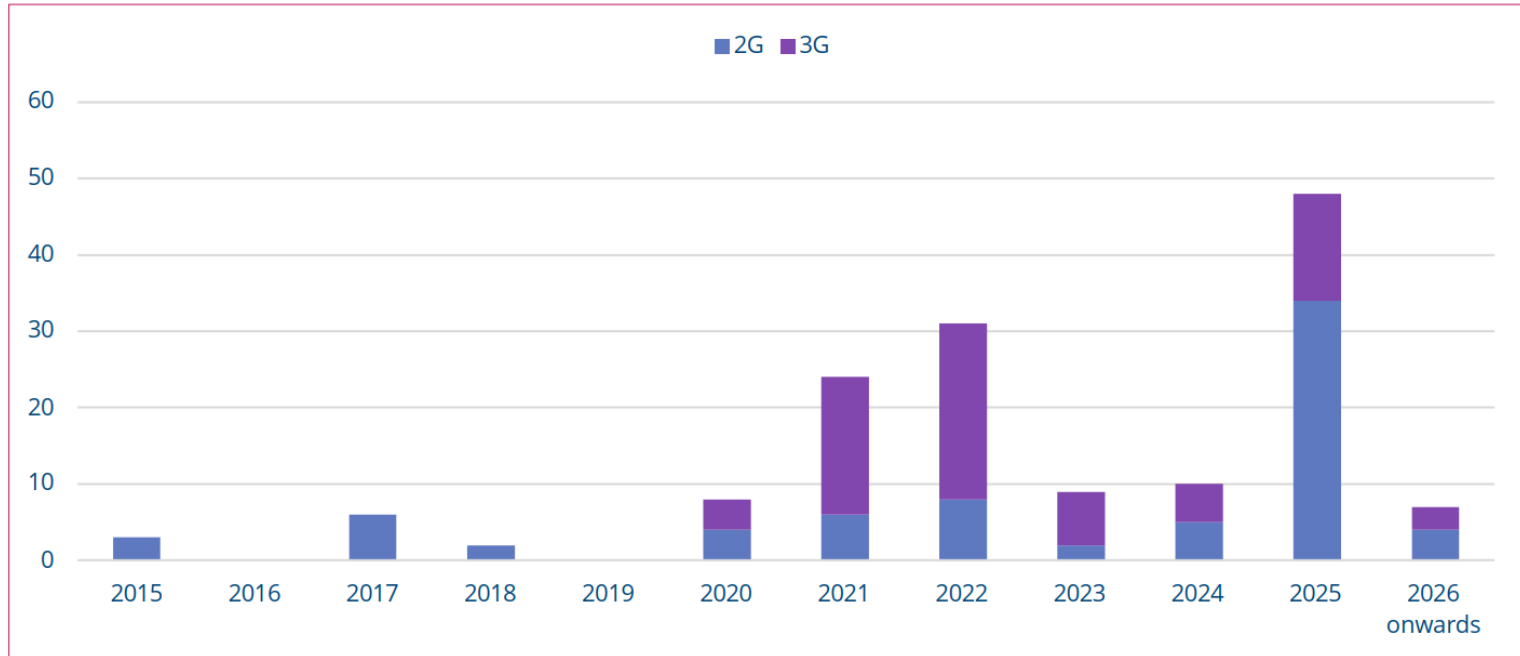


**Count of network operators that have completed, planned or are in progress with 2G and 3G switch-offs.**

# 2G and 3G network switch-offs by region

July 2022 update





**2G and 3G network switch-offs by year**

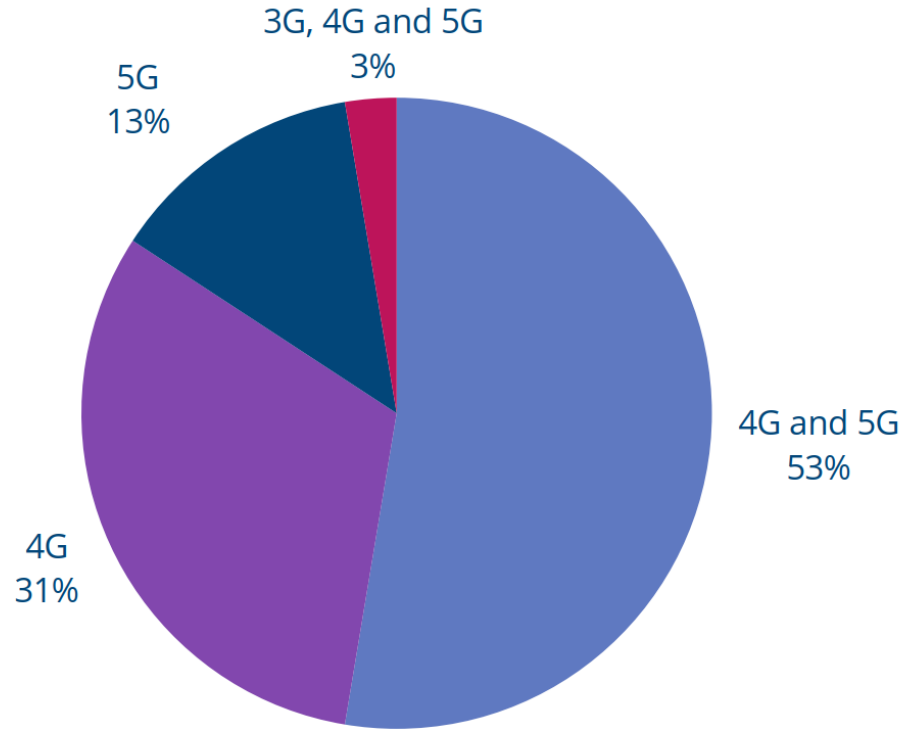
**2025**



# 4G-LTE & 5G-NR

5G is designed to co-exist with 4G

4G will be around for a long time



Countries without public LTE networks

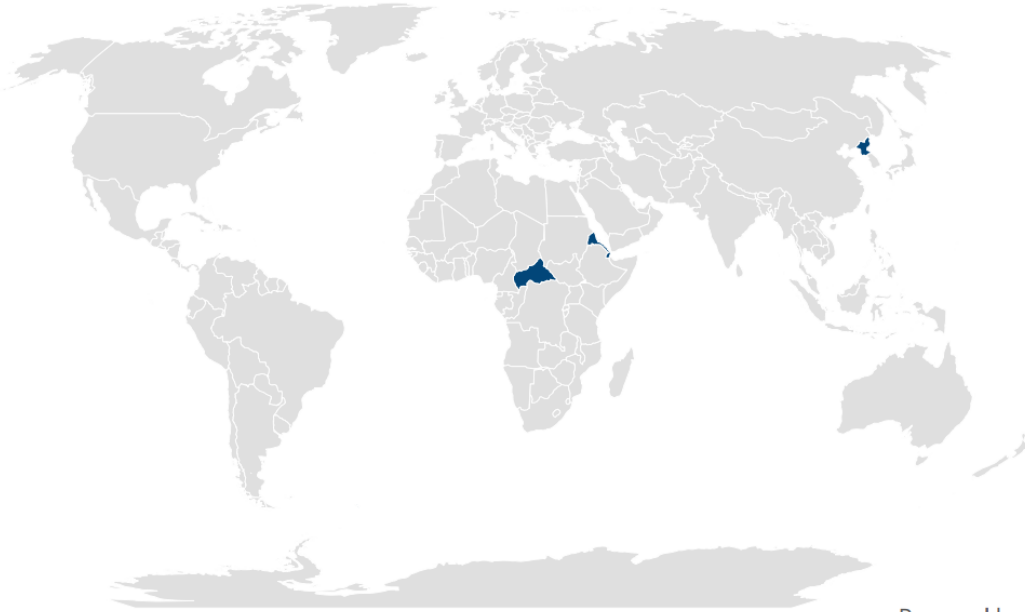


GSA, November 2018

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## Countries without public LTE networks

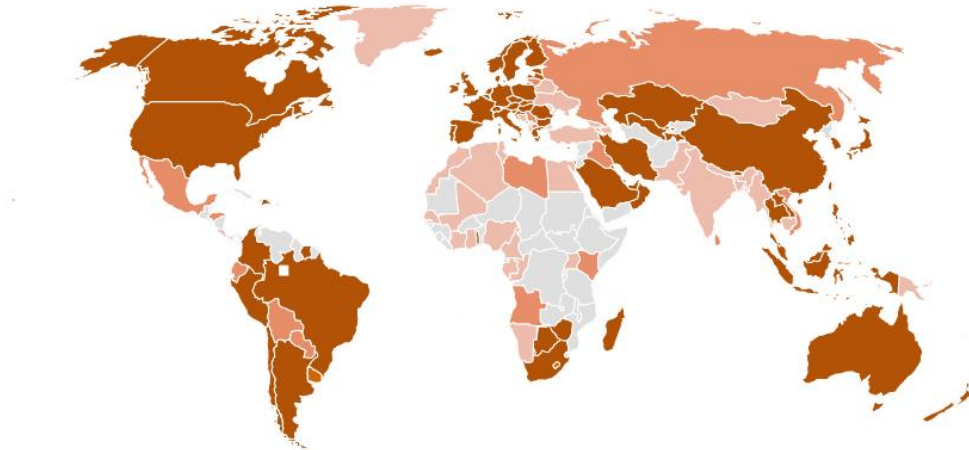


**LTE has >6,6 billion subscribers  
expected peak at ~7 billion 2022-23**

**Deployed networks,  
760 operators in 210 countries**

**Investing,  
977 operators in 244 countries**

- 5G deployed in network, services launched
- 5G deployed in network, soft launch
- Deploying/deployed, precommercial
- Planning/evaluating/testing/trialling

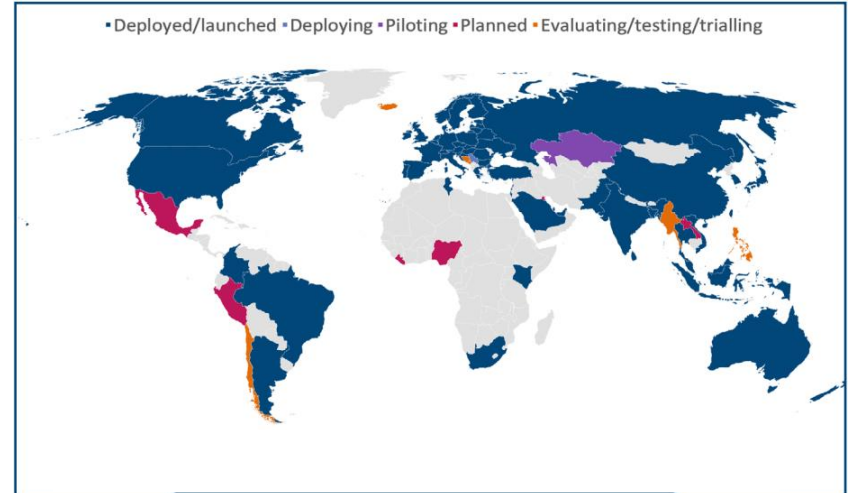
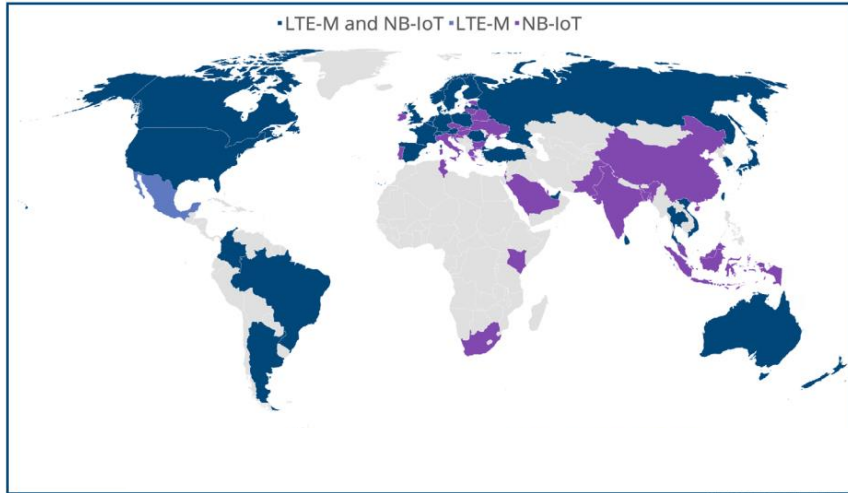


**5G to reach 1 billion subs 2022**

**Deployed networks,  
221 operators in 87 countries**

**Investing,  
499 operators in 150 countries**

245 : EMEA  
146 : Americas  
108 : APAC

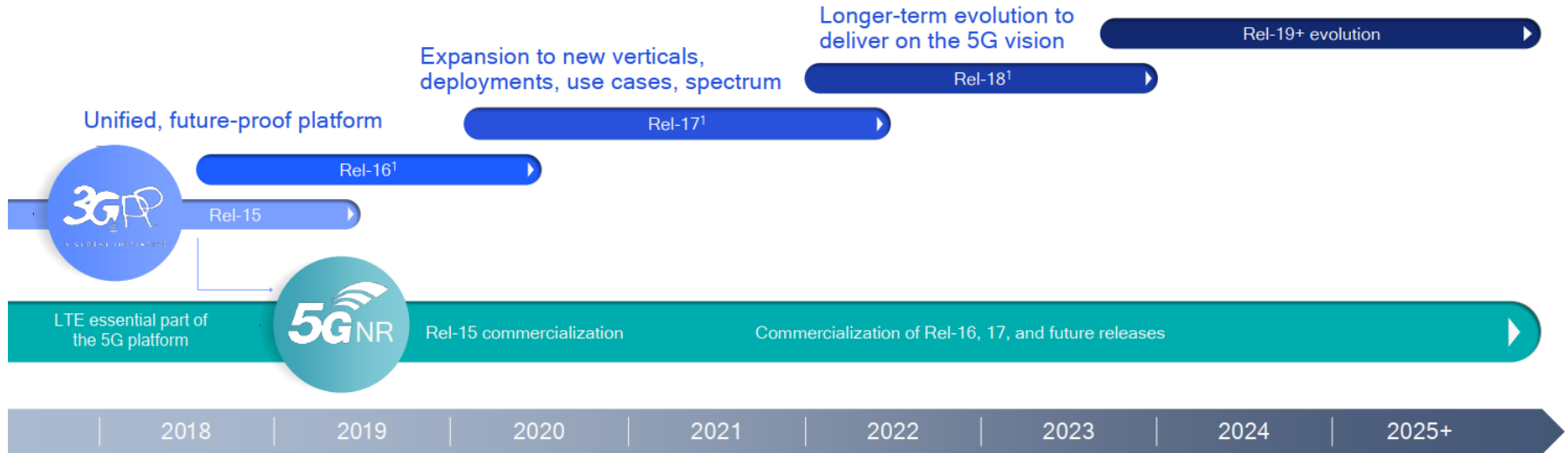


Deployed networks,

- **139 operators in 64 countries**
  - 34 : LTE-M & NB-IoT
  - 29 : NB-IoT only
  - 1 : LTE-M only

Investing,

- **NB-IoT : 165 operators in 80 countries**
- **LTE-M : 74 operators in 41 countries**



### Rel-15 eMBB focus

- 5G NR foundation
- Smartphones, FWA, PC
- Expanding to venues, enterprises

### Rel-16 industry expansion

- eURLLC & TSN for IIoT
- NR in unlicensed
- 5G V2X sidelink multicast
- In-band eMTC/NB-IoT
- Positioning

### Rel-17 continued expansion

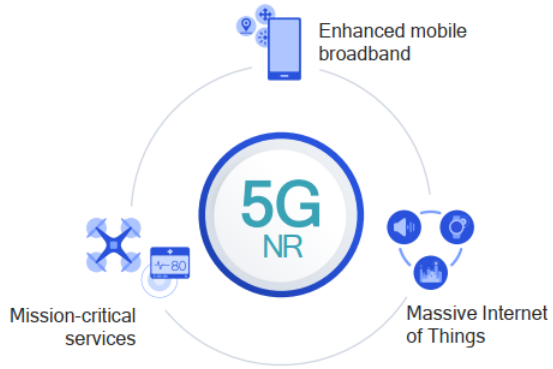
- Lower complexity RedCap
- Higher precision positioning
- Improved IIoT, V2X, IAB, and more...

### Rel-18+ longer-term evolution

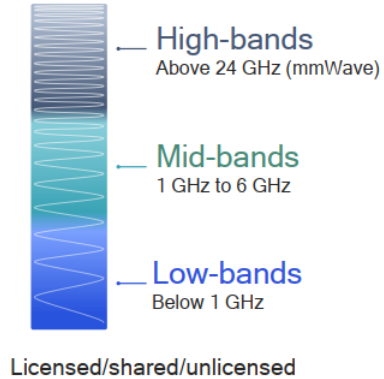
- Next set of 5G releases (i.e., 18, 19, 20, ...)
- Potential projects in discussions
- Rel-18 expected to start in 2022

1. 3GPP start date indicates approval of study package (study item->work item->specifications), previous release continues beyond start of next release with functional freezes and ASN.1

## 5G-NR is a unified, more capable air interface



Diverse services



Diverse spectrum



Diverse deployments

**10x**

Decrease in end-to-end latency

**10x**

Experienced throughput

**3x**

Spectrum efficiency

**100x**

Traffic capacity

**100x**

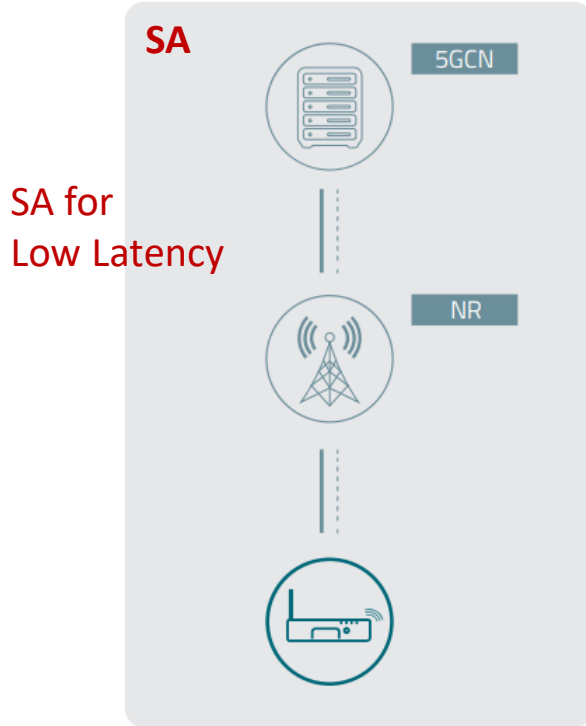
Network efficiency

**10x**

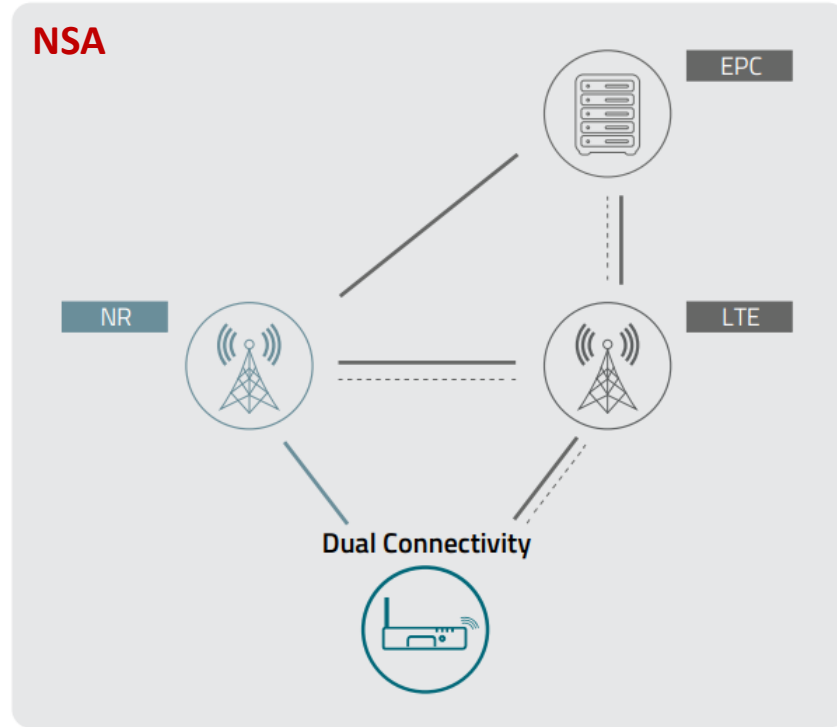
Connection density



# 5G, Stand Alone (SA) vs. Non-Stand Alone (NSA)



NR : New Radio (5G)  
5GCN : 5G Core Network



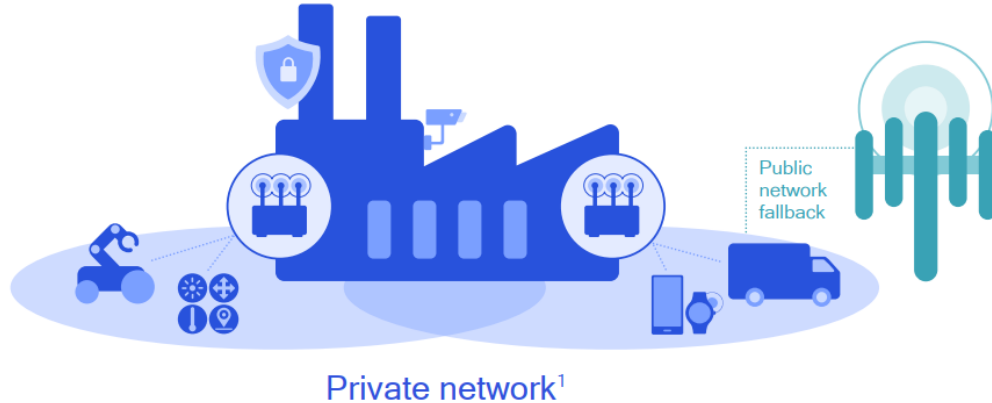
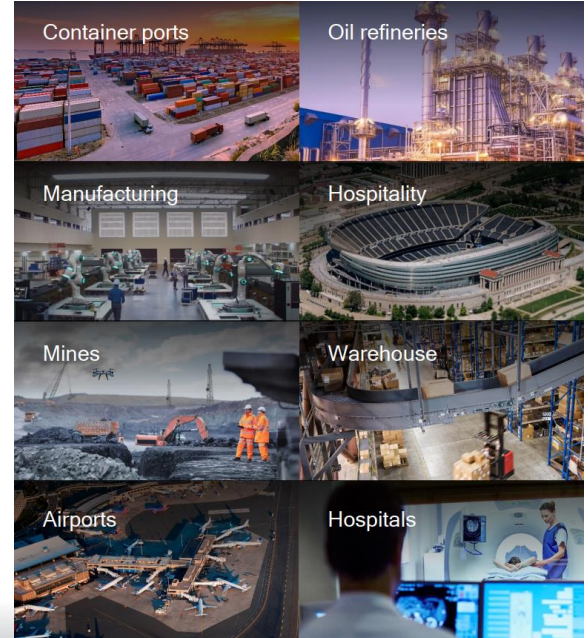
LTE : Long Term Evolution (4G)  
EPC : Evolved Packet Core (4G)

## Distributed Functionality Trend



# 5G private networks

Brings benefits to industry and enterprise



## Coverage, capacity, and mobility

Outdoor/indoor, high data speeds, seamless handovers, public network fallback

## Reliability and precise timing

Industrial grade reliability, latency and synchronization (eURLLC<sup>3</sup> and TSN<sup>4</sup>)

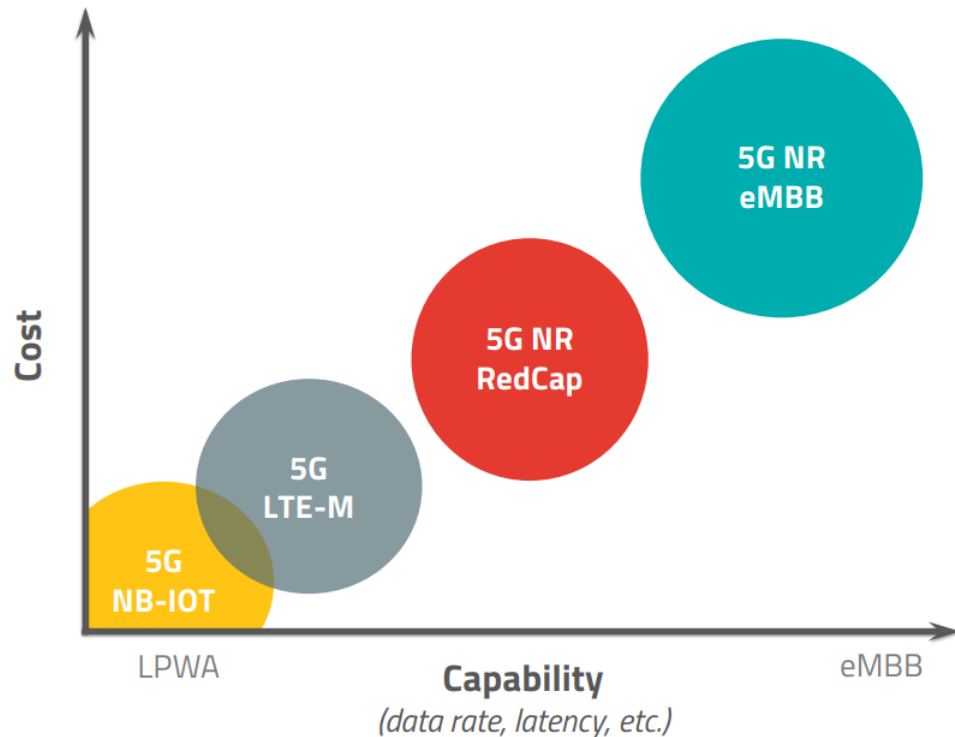
## Interoperability

Global standard, vast ecosystem, future proof with rich 5G roadmap

1. Also referred to as non-public network (NPN); 2. Quality of service; 3. Enhanced ultra-reliable low-latency communication; 4. Time sensitive network

## 5G-NR Reduced Capability – RedCap (NR Light)

- Target use cases
  - Wearables and high end IoT
  - 4G-LTE cat 4 replacement
  - Data rate 50-100 Mbps
- Cost & capability reductions
  - Only 1 antenna
  - Lower min BW requirements
  - Half duplex FDD
- Release 17 feature
- Requires new network functionality
- Commercial ~2023-2024





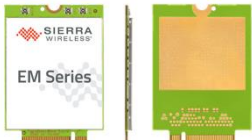
mPCIe, 30 x 51 mm

**MC74x1, LTE cat 7/13, Regional**  
*300 Mbps DL / 150 Mbps UL*



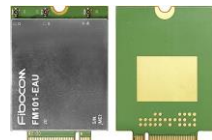
mPCIe, 30 x 51 mm

**L610-xxx, LTE cat 1, Regional**  
*10 Mbps DL / 5 Mbps UL*  
**NL668-xxx, LTE cat 4, Regional**  
*150 Mbps DL / 50 Mbps UL*



M.2, 30 x 42 mm

**EM74x1, LTE cat 7/13, Regional**  
*300 Mbps DL / 150 Mbps UL*  
**EM7590, LTE cat 13, Global**  
*400 Mbps DL / 150 Mbps UL*  
**EM7565/7511, LTE cat 12/13, Global**  
*600 Mbps DL / 150 Mbps UL*



M.2, 30 x 42 mm

**FM101-xxx, LTE cat 6, Regional**  
*300 Mbps DL / 50 Mbps UL*



M.2, 30 x 52 mm

**EM7690, LTE cat 20, Global**  
*2 Gbps DL / 211 Mbps UL*



M.2, 30 x 52 mm

**NL952-xxx, LTE cat 12, Regional**  
*600 Mbps DL / 150 Mbps UL*



SMD-LGA, 22 x 23 mm

**RC76xx-1, LTE cat 1, Regional**

*10 Mbps DL / 5 Mbps UL*

**RC76xx, LTE cat 4, Regional**

*150 Mbps DL / 50 Mbps UL*



SMD-LGA, 22 x 23 mm

**Linux Application**

**Framework, Legato**

**WP76xx-1, LTE cat 1, Regional**

*10 Mbps DL / 5 Mbps UL*

**WP76xx, LTE cat 4, Regional**

*150 Mbps DL / 50 Mbps UL*

**WP7702, LTE cat M/NB, Global**

*20 kbps DL / 60 kbps UL*



SMD-LGA, 15 x 18 mm

**HL7810, LTE cat M/NB, Global**

*590 kbps DL / 1100 kbps UL*

**HL7812, LTE cat M/NB+2G, Global**

*590 kbps DL / 1100 kbps UL*

**HL7845, LTE cat M/NB, Metering**

*590 kbps DL / 1100 kbps UL*



**MC116-xxx, LTE cat 1, Regional**

*10 Mbps DL / 5 Mbps UL*

**L610-xxx, LTE cat 1 bis, Regional**

*10 Mbps DL / 5 Mbps UL*



**NL668-xxx, LTE cat 4, Regional**

*150 Mbps DL / 50 Mbps UL*

**L716-xxx, LTE cat 4, Regional**

*150 Mbps DL / 50 Mbps UL*

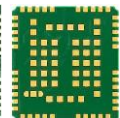
SMD-LGA, 32 x 29 mm



SMD-LGA, 24.2 x 26.2 mm

**MC610-xxx, LTE cat 1 bis, Regional**

*10 Mbps DL / 5 Mbps UL*



SMD-LGA, 22.2 x 20.2 mm

**MA510-GL, LTE cat M/NB (+2G), Global**

*590 kbps DL / 1100 kbps UL*

**N510-GL, NB-IoT, Global**

*65 kbps DL / 145 kbps UL*

## 5G-NR modules

Mobile Broadband & Industrial, M.2 and SMD-LGA



M.2, 30 x 52 mm

### EM9190, 5G-NR, 3GPP-R15, Global

*Sub 6 GHz & mm-wave  
5,5 Gbps DL / 3 Gbps UL*

### EM9191, 5G-NR, 3GPP-R15, Global

*Sub 6 GHz  
4,5 Gbps DL / 660 Mbps UL*



M.2, 30 x 52 mm

### FM160-xxx, 5G-NR, 3GPP-R16, Regional

*Sub 6 GHz  
3,5 Gbps DL / 900 Mbps UL*

### FM1xx-GL, 5G-NR, 3GPP-R16, Global

*Sub 6 GHz  
TBA Gbps DL / TBA Mbps UL*



M.2, 30 x 52 mm

### EM9291, 5G-NR, 3GPP-R16, Global

*Sub 6 GHz  
4,9 Gbps DL / 660 Mbps UL*

### EM929x, 5G-NR, 3GPP-R16, Global

*Sub 6 GHz & mm-wave  
TBA Gbps DL / TBA Gbps UL*



SMD-LGA, 41 x 44 mm

### FM160-xxx, 5G-NR, 3GPP-R16, Regional

*Sub 6 GHz  
3,5 Gbps DL / 900 Mbps UL*

# 4G & 5G routers and gateways

Rugged units for mission critical applications



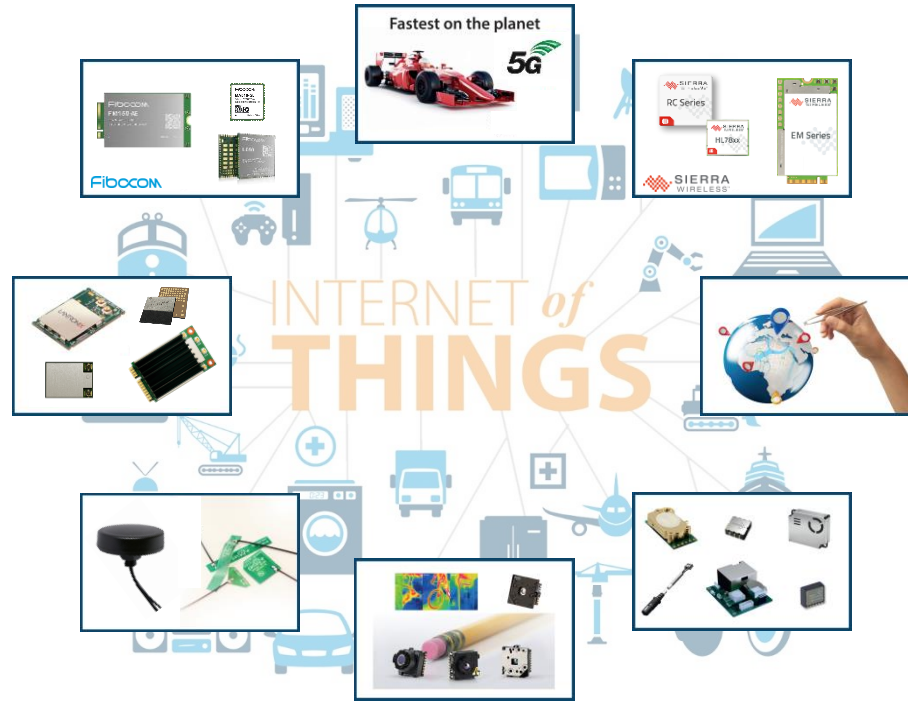
**4G routers**  
LX60, RV55  
FX30 (programmable gateway)



**5G routers**  
XR80, XR90



# Wireless IoT for digital transformation



- 5G-NR
- 4G-LTE
- LTE LPWA  
*cat M1, NB2/NB-IoT*
- WiFi, Bluetooth, LoRa
- GNSS, Navigation
- Antennas
- RF Semiconductors
- Thermal imaging
- Sensors
- Device-to-Cloud
- Connectivity (SIMs)
- Device Management



**Thanks for listening**

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## International presence

Acal BFi operate throughout Europe, with dedicated sales force and technical support teams for:

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- Embedded computing
- Displays
- Sensors
- Power suppliers
- Magnetic components
- Imaging
- RF components, MCM
- Frequency control
- Fiber optics
- Photonics