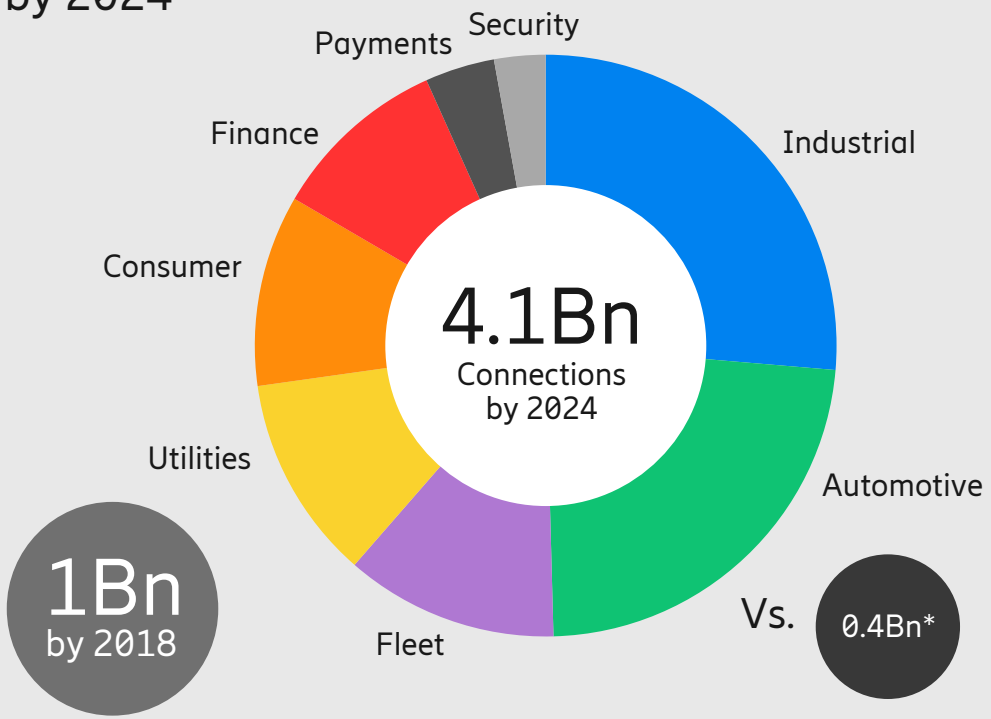
셀룰러 IoT와 5G

박동주 테크니컬 디렉터

Cellular IoT market outlook

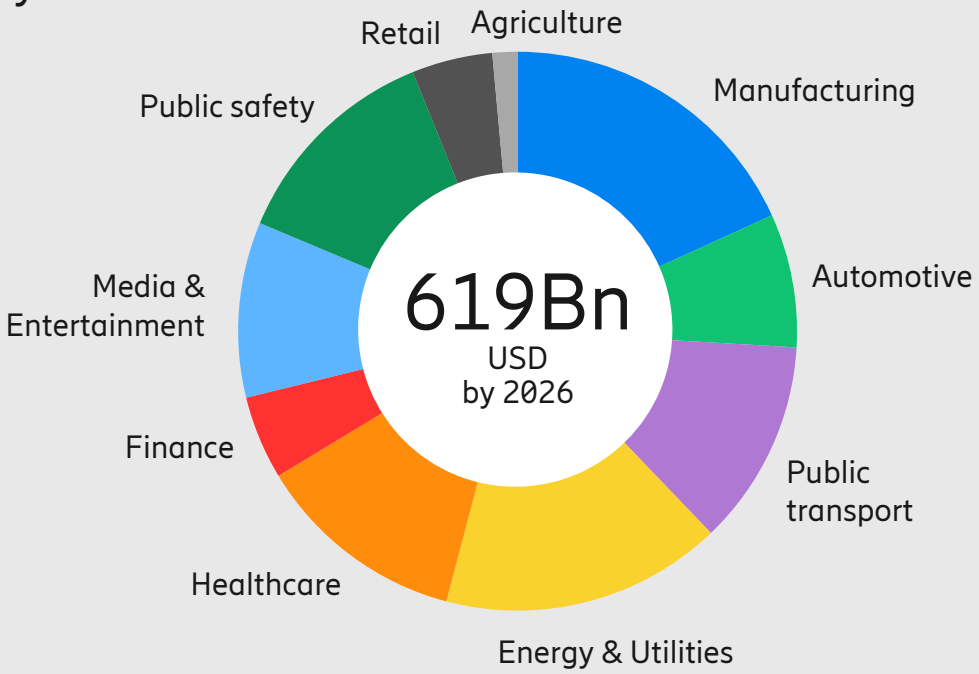
Cellular IoT connection by 2024



Source: Ericsson mobility report

*Wide Area non-cellular IoT connection by 2024

5G revenue potential from industry digitalization by 2026



Source: Ericsson and Arthur D Little's 5G revenue potential from industrial digitalization study

Cellular IoT evolution and segments

Commercial – Growth

Early pilots & Standardization

Massive IoT	Broadband IoT	Critical IoT	Industrial Automation IoT

One network – multiple use cases and industries

Smart Metering

Asset management

Fleet Management

Drones/UAV

VR/AR

Automotive C-ITS

Traffic Safety & Control

Smart Grid Automation

Collaborative robotics

Advanced Automation & Control

Massive IoT	Broadband IoT	Critical IoT	Industrial Automation IoT
Low cost devices, low energy Small data volumes Massive numbers	High throughput Low latency Large data volume	Ultra reliability Ultra low latency Very high availability	Industrial protocols Time sensitive networks Precise indoor positioning
NB-IoT/Cat-M1 (LTE and NR)	LTE + NR	NR	NR

Massive IoT continues to evolve

- Cat-M1
- NB-IoT

- Coverage extension
- Battery Life
- Low complexity devices
- Flexible deployment
- 5G ready

- Focus on wide area

- For all industries

Global adoption

>80 commercial networks in 40 markets
both NB-IoT & Cat-M1 for diverse use cases

5G technologies

Meet 5G performance and capacity requirements fully co-existing with 5G NR

Ensured Long lifecycle

Replace legacy 2G technologies

Converged requirements (LPWA)

Multiple Industries and Use cases

Utilities – Smart metering
Wearables – Health surveillance
Smart Cities – Smart sensors
Transport – Fleet management

Massive IoT for 5G

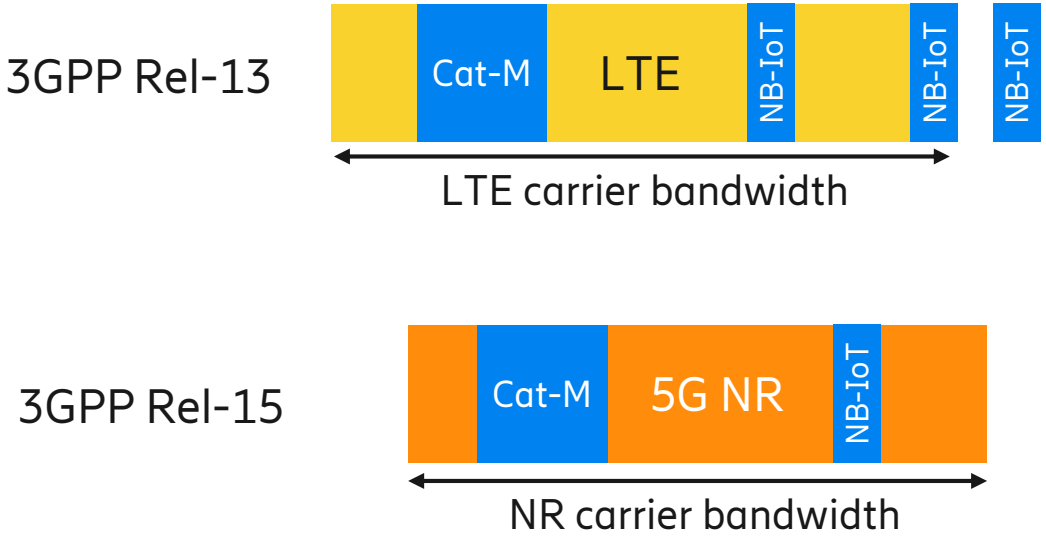
NB-IoT and LTE-M are part of 5G

	REQUIREMENT	LTE-M PERFORMANCE
CIoT Requirements		
Message latency	≤10 seconds	6.2 seconds
Battery life	≥10 years	10.4 years
5G Requirements		
Capacity 1 million devices per km2	≤50 MHz	70% of a 5 MHz system
Coverage	≥160 bps	UL 363 bps & DL 1200 bps*
Message latency	≤10 seconds	6.7 seconds*
Battery life	≥10 years	10.9 years*

* Assumes four receive and two transmit antennas at the base station and +4 dB downlink PSD boosting

Evaluation of LTE-M towards 5G IoT requirements, March 2018, GSMA

NB-IoT and LTE-M will coexist with other 5G components



*Mobile IoT in the 5G future , April 2018, GSMA

Broadband IoT leveraging MBB capabilities

- LTE
- 5G NR

- Multi-Gigabit
- Reduced latency
- Large data volume

- Focus on wide area

- For Automotive, Drones, Manufacturing, Utilities

Cooperative Intelligent Transport System (C-ITS) – V2X In Car MBB Services

Utilities – Smart Grids
Connecting grid elements beyond meters

Train Networks
Public Safety Networks

Drones – UAVs
Delivery, Infrastructure inspection, Agriculture

Advanced wearables
Health monitors, smart watches

Critical IoT
for ultra reliability, low latency

- 5G NR
- URLLC

- 99.999% reliability
- 1ms one-way

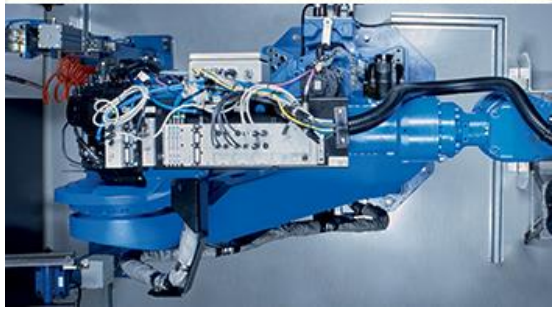
- Local area/Wide area

- Automotive
  Utilities,
  Smart Manufacturing
  in industry campus

- Autonomous vehicles
- Deeper integration with C-ITS systems
- Platooning

- Utilities – Smart Grids
- Renewables integrated into Grid
- Real time control

- Real time control of industrial systems
- Fully immersive AR/VR



Critical IoT use cases and spectrum bands

	Wide area use cases	Local area use cases	
High bands (24GHz– 40GHz)			- Extremely low latency - Ultra-high reliability - High capacity - Limited coverage
Mid bands (1GHz – 6GHz)			- Extremely low latency (with FDD/latency favorable TDD) - Ultra-high reliability - Decent coverage & capacity
Low bands (sub-1GHz)			- Extremely low latency - Ultra-high reliability - Wide area coverage - Limited capacity

Industrial Automation IoT for advanced smart manufacturing

- 5G NR
- eURLLC
- Deterministic networks

- Ethernet support
- Time sensitive networking

- Local Area / Non-public networks

- Smart industries

- Smart Manufacturing, Railways, Power generation and distribution
- Automation for Robotics, Control systems and Process optimization

- Native ‘Ethernet over NR’ to support industrial protocols
- TSN and QoS
- Precise positioning

- 5G enabling Industry 4.0
- 5G-ACIA and other industry body collaborations

Cellular IoT for connected vehicle

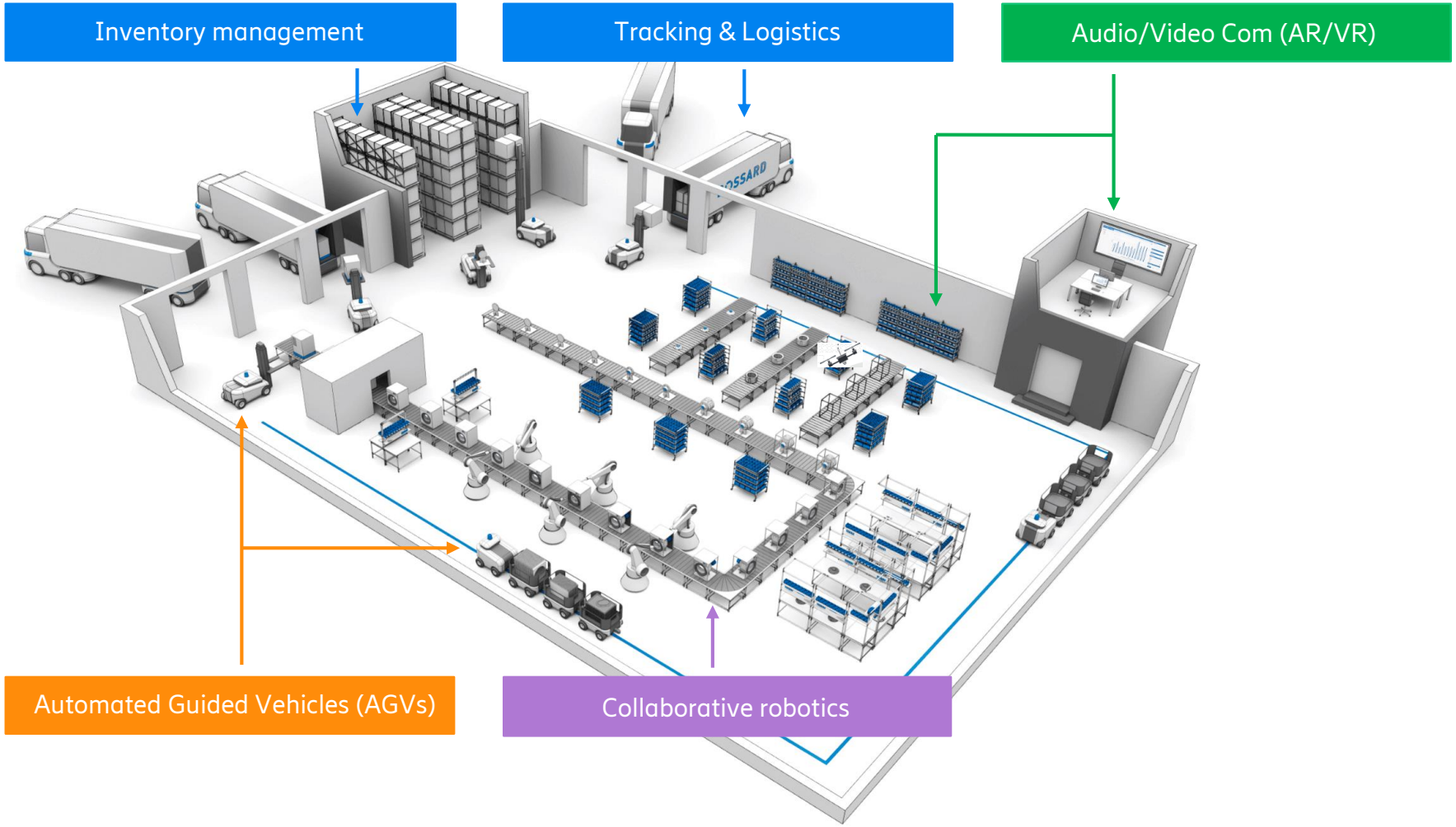
Broadband IoT

Massive IoT

Critical IoT

	Broadband IoT	Massive IoT	Critical IoT
Managing fleets	●	●	●
Sensor sharing	●	●	●
Telematics	●	●	
Software upgrades	●		
Infotainment	●		
HD maps	●		
Remote processing	●		●
Co-operative maneuvers	●		●
Remote driving	●		●
Co-operative safety	●		●
Autonomous driving	●		●

Cellular IoT segments for smart manufacturing

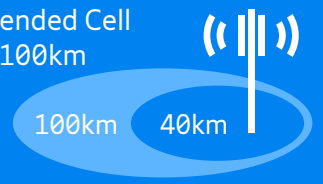


Ericsson's Massive IoT enhancements

: Optimizing service performance and enabling new use cases

Extended Outdoor Range

- NB-IoT Extended Cell Range up to 100km



Fleet management, Agriculture, Environmental

Improved Throughput

- Cat-M1 & NB-IoT Increased Throughput

Software/Firmware Upgrades, Wearables

Improved Device Positioning

- Cat-M1 & NB-IoT Enhanced Cell ID

Tracking, Wearables, Logistics

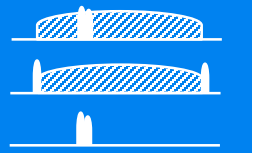
Improved Mobility

- Cat-M1 Higher Speed UE Support

Train, Automotive

Improved Network Capacity

- NB- IoT Multiple (Non-Anchor) Carriers



Warehouse, Smart City

Small Cells Support

- NB-IoT DOT support

Smart Building, Smart Manufacturing

Ericsson's Broadband IoT solutions

: Enabling more demanding use cases cross verticals, leveraging 4G and 5G

Reduced latency

- LTE Instant UL Access
(e2e Latency 10 ms or below)

Connected Car, AR/VR,
Drones, Camera Surveillance, Remote control

Higher peak rate

- Multi-Gigabit LTE with
7CC Carrier Aggregation

2Gbps

Connected Car, AR/VR,
Drones, Camera Surveillance, Remote control

Drone solutions

- Drone detection
(AI based)

Drones – UAVs for Delivery,
Infrastructure inspection, Agriculture

RAN slicing

— QoS
— Radio Resource
Partitioning

Public Safety, Train operation, Utilities, Private NWs

Extended coverage

- Extended Coverage for
higher Category devices

Automotive, Transport & Logistics, Wearables

Subscriber differentiation

- Advanced Subscriber
Group Handling

Connected Car, Train operation, Utilities

5G - One network for multiple use case and industries

10-100x
End-user data rates

1000x
Mobile data volumes

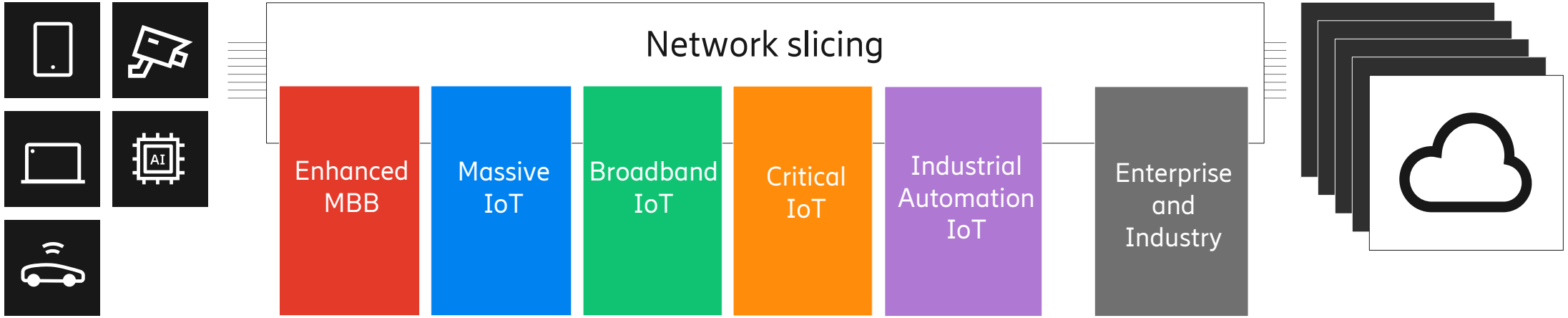
5x
Lower latency

100x
More devices

Low cost
Device cost reduction

5x
NW energy efficiency

3x
Spectral efficiency



Ericsson is leading in Cellular IoT

Massive IoT

- 50% of commercial networks (RAN)
- 40% of commercial networks (Packet Core)
- First Cat-M1 networks (AT&T, Verizon)
- First NB-IoT extended cell range 100km (Telstra) (DISH)
- First Massive IoT enabled Smart factory (China Mobile)

Broadband IoT

- Drone solutions (AT&T, Vodafone)
- Smarter wireless manufacturing joint solution with PTC
- Private LTE for Mining (Ambra)
- Private virtualized networks for Industrial 4.0 (Telefonica)
- Network slicing for train applications (Swisscom)

Critical IoT

- First 5G use case of BLISKs trial (MTU Aero Engines)
- 5G for automotive manufacturing (Audi)
- Autonomous vehicles and platooning
  - Scania
  - Veoneer
  - Einride & Telia

Industrial Automation IoT

- Founding company of 5G-ACIA
- 5G for Industrial 4.0
  - ABB
  - SKF
  - Boliden
  - Ericsson's own factories and labs

Summary

Cellular IoT

New segments, new opportunities

One Network

Multiple use cases across different industries

Start today

Enhance with 4G, expand with 5G

ERICSSON | LG