Strategic MC-IoT Market Assessment

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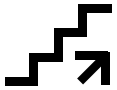


- The adoption of Internet-of-Things (IoT) technology dedicated to the needs of mission critical users (in particular, public safety agencies in the context of connected officers) is a growing market that will surpass 4 million active connections by 2030 driven by the implementation of data-centric transformation of PPDR operations.
- Timely delivery of national critical network rollouts, increased device market availability and favorable regulations could act as market catalysts increasing the installed base up to 1.5 times surpassing 7 mission active IoT connections.

- The availability of spectrum resource dedicated to public safety operations will act as a catalyst to the adoption of video-centric IoT surveillance. Omdia estimates the fastest growth will be experienced in the video camera market at a 60.7% CAGR (Compound Annual Growth Rate) from 2020 to 2030.

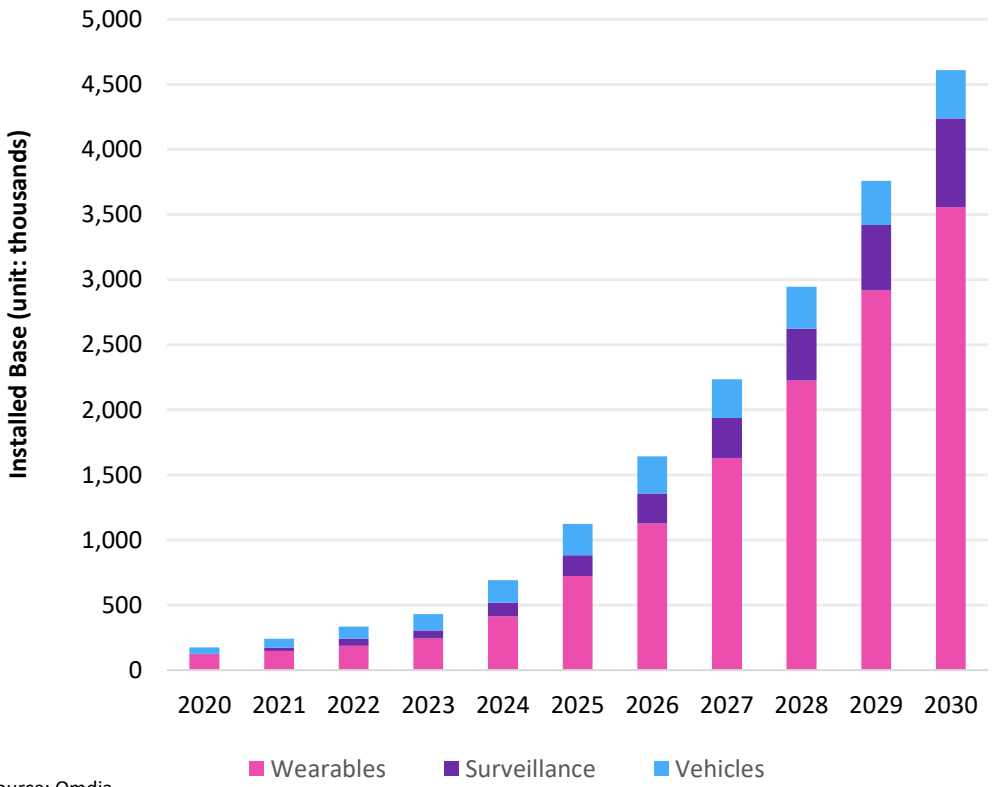
- The concept of the “connected- officer” empowering first responders with real-time data feeds and automated sensing/trigger capabilities will represent the largest proportion of cellular mission critical IoT systems in public safety networks.

- Law enforcement is expected to be the “most connected” critical agency collectively: 64% of active cellular IoT connections will be in this category.

- Drones are expected to take a more prominent role in public protection and disaster relief operations (47.3% CAGR growth from 2020 to 2030).

Executive Summary (2/2)

Cellular IoT System Overview: Europe - Public Safety



Source: Omdia

- Many European nations currently rely on some smart city sensors and asset tracker/situational awareness capabilities (e.g. TETRA sensors). The adoption of cellular mission critical IoT (MC IoT) devices by the public safety community will be heavily linked to national government decisions to adopt critical communication broadband technology which is expected to start materializing from 2024 and gain momentum during the second half of the decade. If national policies were to deploy at a faster rate, higher adoption rates of MC IoT systems should be expected.
- Video-centric applications are one of the first use cases enabled by Mission Critical Cellular IoT. These are bandwidth-hungry applications as opposed to low payload sensors/actuators. The feasibility of these initiatives are directly linked to the availability of spectrum resources.
- Omdia expects the investments on cellular MC IoT technology for public safety purposes to be implemented with localized trialing and proof-of-concept phases before reaching scalability.
- Ensuring data, network and device security (cybersecurity) as well as ensuring data privacy or governance are the greatest challenges in the adoption of mission critical cellular IoT systems. Additionally, common concerns among decision-makers focus on the complexity involved with integration with command-and-control rooms and implementing effective mechanisms to provide information to first responders while avoiding information overload.

IoT Applications

Methodology – Wearables

IoT-enabled wearable devices can be used by first responders to enhance their safety, track their location, monitor vital signs, and request immediate assistance if needed. The wearables market is subdivided into two categories:

- **Body-worn Cameras:** A body-worn camera that is specifically designed to record video as a primary function. Usually, video that is recorded for evidential, liability, or safety purposes. Data has been extracted from Omdia's syndicated research.
- **Wearable Cellular IoT:** A (non-exhaustive) list of cellular IoT wearable devices includes connected personal protection equipment (PPE), smart wrist devices, shot/fall detection personal alarms, automated holster actuators, biohazard sensors, equipment sensors, location tracking, biometric sensors, audio-relay controls, smart suits/body armour, AR goggles, connected helmets, and smart scanners.

It should be noted that:

- Only devices independently connected to the broadband network were accounted for in this study. Tethered devices using protocols like Wi-Fi , Zigbee or Bluetooth were out of scope.
- Omdia has considered the regulatory landscape and range of commercially available cellular IoT solutions that are currently suitable for mission critical users when implementing our forecasts. Should key conditions and assumptions around national broadband adoption rollout, spectrum allocation for PPDR use, or data protection regulation relax then Omdia's forecasts could change.

Methodology – Connected Vehicles

Connected public safety vehicles are equipped with advanced camera systems that enable video and data analytics, provide relay capabilities for multiple sensors and asset tracking mechanisms as well as integration with other IoT systems. Furthermore, they provide legacy LMR communication systems interoperability, command and control room integration to help first responders, software, voice command for safer driving and the latest TETRA radio solutions, helping frontline teams gather and process large amounts of information locally.

Connected vehicles support first responder teams with data and tools, generate a series of automated actions, and help optimize the sharing and recording processes required during a crisis response operation.

Omdia has modelled the adoption of cellular IoT enabled vehicles using the following key parameters:

- Individual country police, ambulance and fire truck engine installed bases.
- Penetration percentages based on area coverage, population distribution, and system lifecycles/procurement projects.
- Omdia estimated an individual cellular module per vehicle. Tethered devices linked to the vehicle are therefore out of scope.

Methodology – Surveillance

Cellular–enabled connected video surveillance cameras use AI and computer vision techniques to analyse real-time video streams and provide in-advance or immediate alert and/or notification to property owners and authorities. There are multiple applications beyond public safety like military, smart cities, smart buildings, logistics, retail, and manufacturing.

Among some of their application we can find facial and object recognition, license plate recognition, traffic management, building security, workflow monitoring, and thermal cameras.

Omdia has supplemented the market study of cellular enabled surveillance with two other categories in addition to IoT networked cameras:

- **Automatic Number Plate Recognition (ANPR):** Cameras must be explicitly designed for ANPR. These cameras are distinguished from standard video surveillance cameras due to their ability to read and digitalize vehicles' number plates in real time. Penetration percentages based on area coverage, population distribution, and system lifecycles/procurement projects.
- **Drones:** Professional unmanned aerial vehicle belonging to a public safety agency capable of collecting data and sharing it through a cellular connection.

Forecasting Methodology

Project focus

Europe (excluding Russia)

- Western Europe
- Eastern Europe (excluding Russia)

Geography

Public Safety and Security:

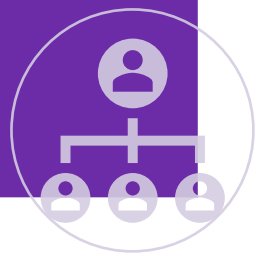
- Law Enforcement
- Fire & Rescue
- EMS (Ambulances)

Verticals

Cellular IoT systems:

- This study focuses on cellular IoT protocols (4G and 5G) which have higher data rates and lower latency than other Low Power Wide Area Networks (LPWAN).

Technology



Methodology

Wearables

Installed base of PPDR users by European country (total wearable installed base)

Estimated penetration coverage by country to 2030 (project based)

Estimated average number of unique connected devices per user

Output: Installed base of wearable IoT connectivity chips in PPDR applications

Vehicles

Installed base of police, fire and ambulance vehicles by European country (total vehicle installed base)

Estimated penetration coverage by country to 2030 (project based)

Assumed one active connection chip per vehicle

Output: Installed base of vehicle IoT connectivity chips in PPDR applications

Surveillance

Installed base of safe city cameras and drones by European country (total installed base)

Estimated penetration coverage by country to 2030 (project based)

Assumed penetration of cellular cameras with live-streaming capabilities

Output: Installed base of IoT connectivity chips in surveillance applications

Market Analysis

Mission Critical Cellular IoT Systems in Europe

Mission Critical Cellular IoT Systems: European Market, 2020-2030

Installed Base (thousands)

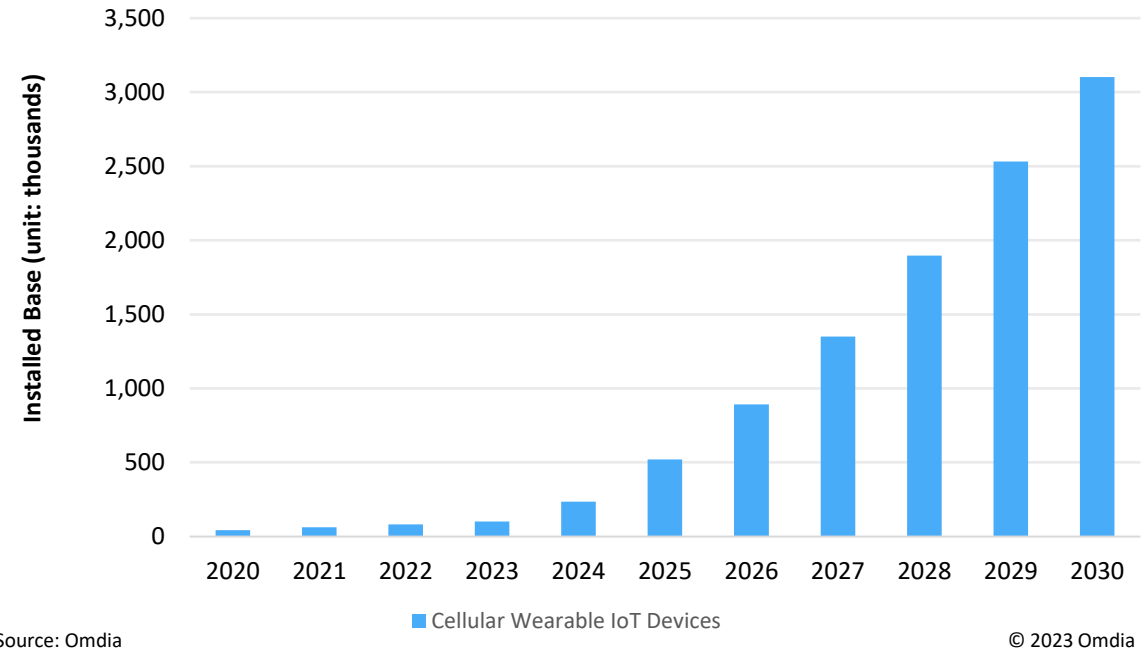
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	CAGR ('20-'30)
Wearable Cellular IoT	43.0	62.1	81.5	101.0	234.6	519.3	890.9	1,349.5	1,895.9	2,531.3	3,101.6	47.3%
Body Worn Cameras	77.5	84.9	106.1	141.8	179.1	202.7	238.4	280.5	329.9	388.1	456.7	19.4%
Wearables	**120.4**	**146.9**	**187.5**	**242.8**	**413.7**	**722.0**	**1,129.3**	**1,630.0**	**2,225.8**	**2,919.4**	**3,558.3**	**40.3%**
Vehicles - Law Enforcement	27.7	40.5	55.6	72.3	99.8	140.0	166.0	175.0	187.7	198.5	215.7	22.8%
Vehicles – EMS (Ambulances)	5.8	8.5	11.6	15.1	20.6	28.5	34.2	36.2	39.0	41.5	45.0	22.6%
Vehicles - Fire & Rescue	13.8	20.3	27.9	36.5	50.6	71.6	84.2	88.4	94.7	99.6	108.6	22.9%
Vehicles	**47.4**	**69.3**	**95.2**	**123.8**	**171.0**	**240.0**	**284.3**	**299.7**	**321.4**	**339.6**	**369.2**	**22.8%**
Surveillance	**5.9**	**25.5**	**52.2**	**62.8**	**105.3**	**161.4**	**228.7**	**306.1**	**396.9**	**501.0**	**680.9**	**60.7%**
TOTAL	**173.8**	**241.7**	**335.0**	**429.4**	**690.0**	**1,123.4**	**1,642.4**	**2,235.7**	**2,944.0**	**3,760.0**	**4,608.5**	**39%**

Source: Omdia

- By 2030, Omdia predicts that the wearables market will be the largest market for MC Cellular IoT systems with over 3.5 million installed devices. The market is expected to grow at a CAGR of over 40% between 2020 and 2030.
- Surveillance is forecast to be the second largest market in 2030, as well as the fastest growing market. There is a large installed based of video surveillance cameras for cellular IoT systems to penetrate and the drone market is gaining traction in the industry.
- Vehicles are expected to represent the smallest market opportunity. That said, there is an installed base potential of 370 thousand devices by 2030 and growth will exceed 20% CAGR across the forecast period.

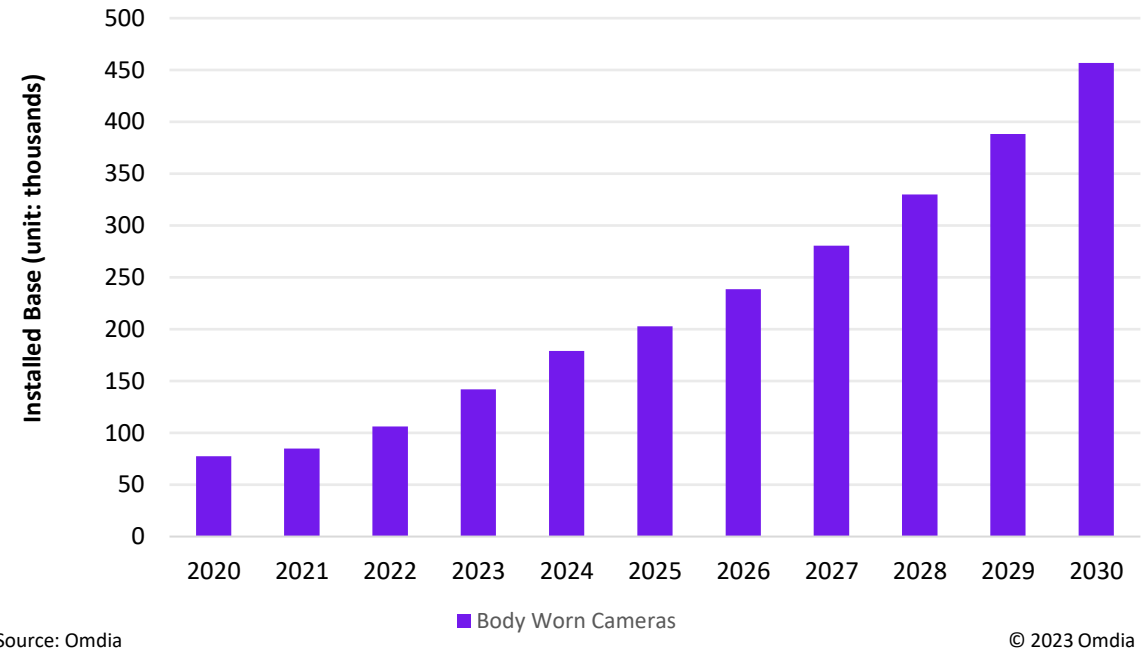
Mission Critical Cellular IoT Systems in Europe

Cellular Wearables: Europe - Public Safety



Source: Omdia

Cellular-Enabled Body-Worn Cameras: Europe - Public Safety



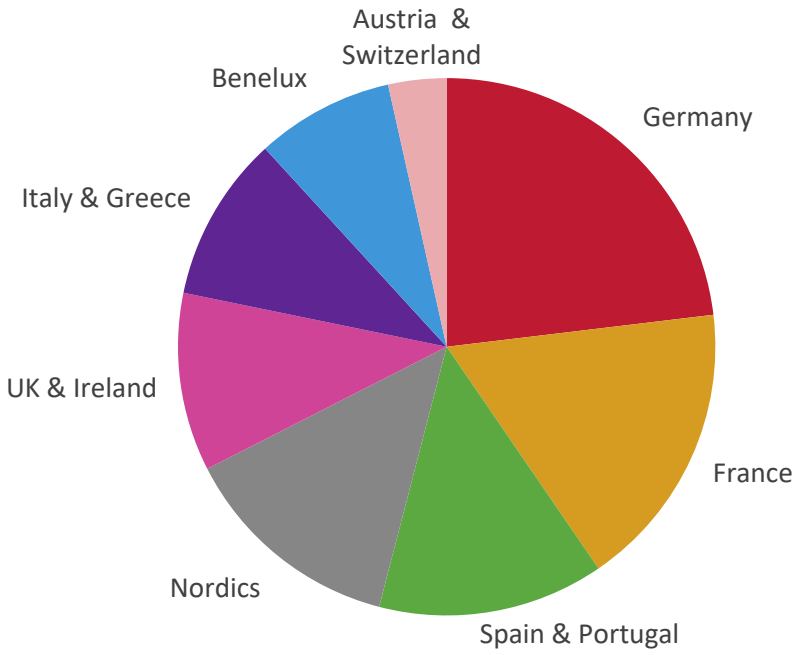
Source: Omdia

- The adoption of wearables will be linked to the development of critical communication broadband projects. Omdia foresees the adoption to be gradual and subject to trials and proofs-of-concept to justify ROI of necessary investments.

- Body-worn cameras (BWC) with live-streaming cellular capability have positive adoption potential in the market. The largest adopter of BWC in Europe is the United Kingdom, accounting for 27% of the European body-worn camera market, followed by France and Germany.

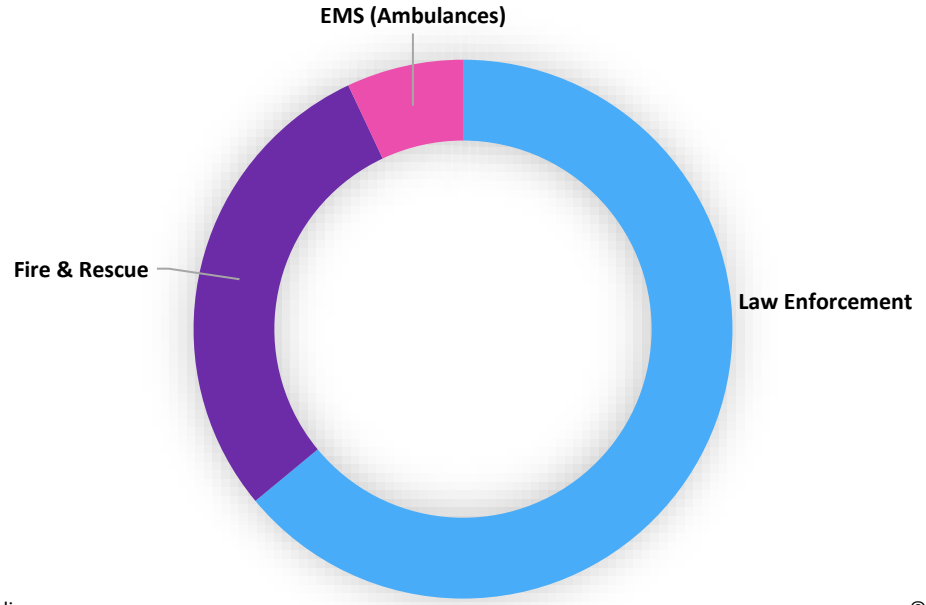
Mission Critical Cellular IoT Market

Regional Breakdown - 2030 Wearable Market



Source: Omdia

Public Agency Breakdown – 2030 Cellular IoT Connections

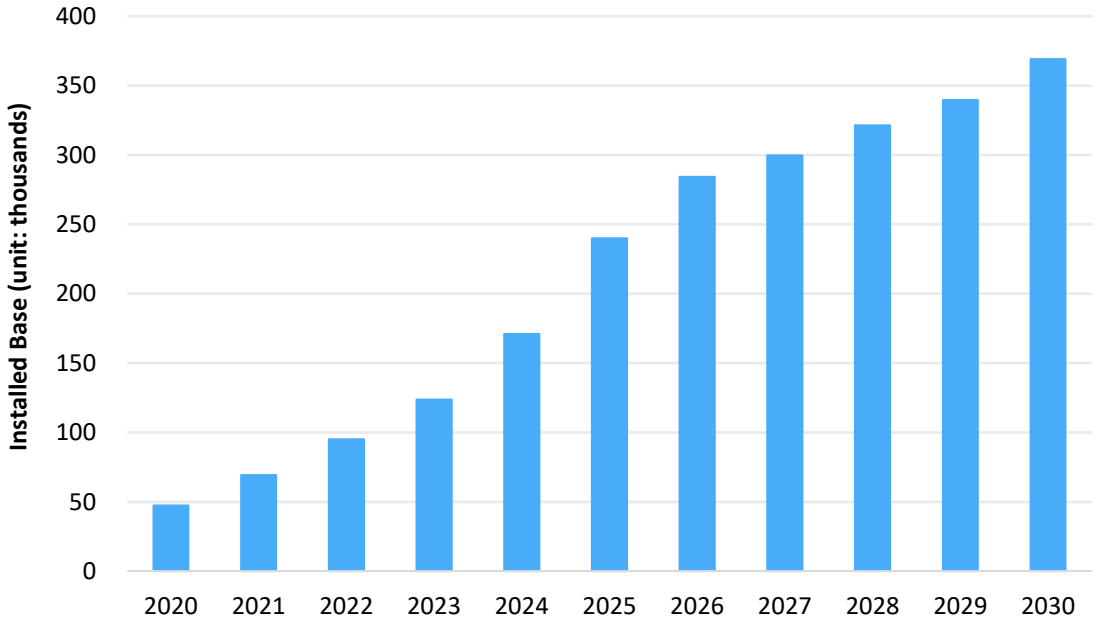


Source: Omdia

- Countries in the Benelux and Nordic areas are showing early adoption willingness with complete trials and proof-of-concepts. Omdia forecasts that by the end of the decade, most European countries will have active Cellular IoT deployments enhancing their public safety operations.
- While Law enforcement represent the most connected public safety agency, Fire & Rescue users are individually the most connected with the largest number of connected devices. Additionally, Fire & Rescue device certifications augment the go-to-market complexity for commercial IoT devices.

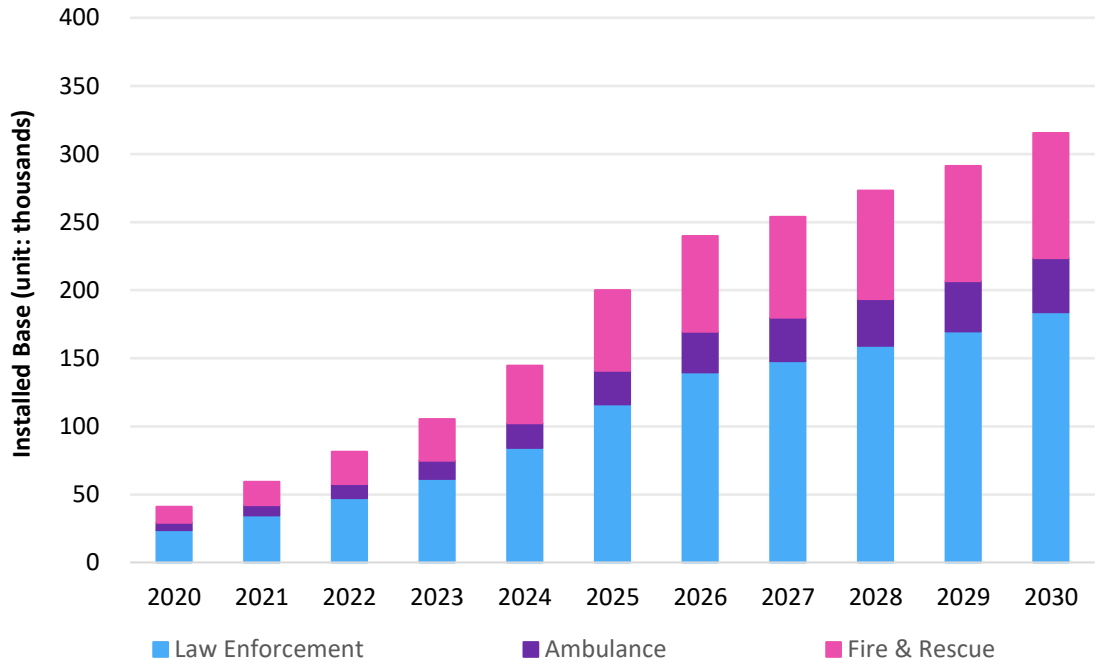
Mission Critical Cellular IoT - Vehicles

European IoT Connected Vehicles



Source: Omdia

Connected Vehicle - Western Europe

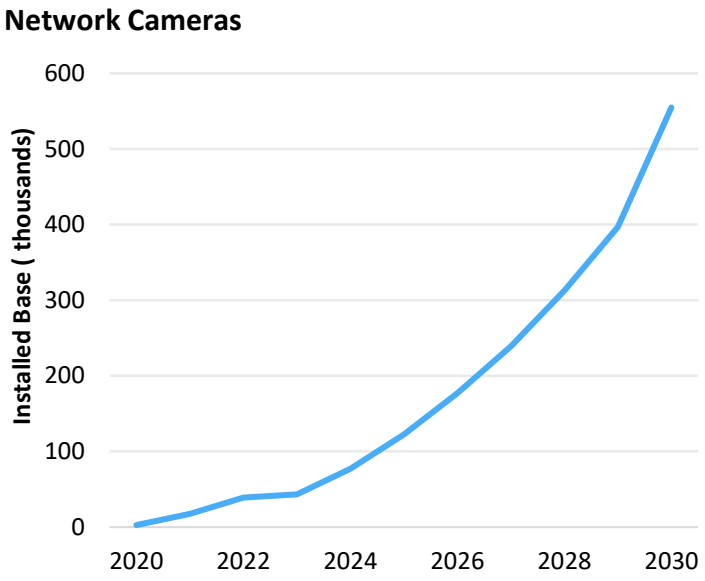


Source: Omdia

- Cellular IoT-enabled public safety vehicles will be one of the first use cases adopted by the mission critical community. Omdia forecasts that close to 80% of public safety vehicles will be equipped with cellular connectivity by 2030 in Western Europe and 65% in Eastern Europe.

Surveillance

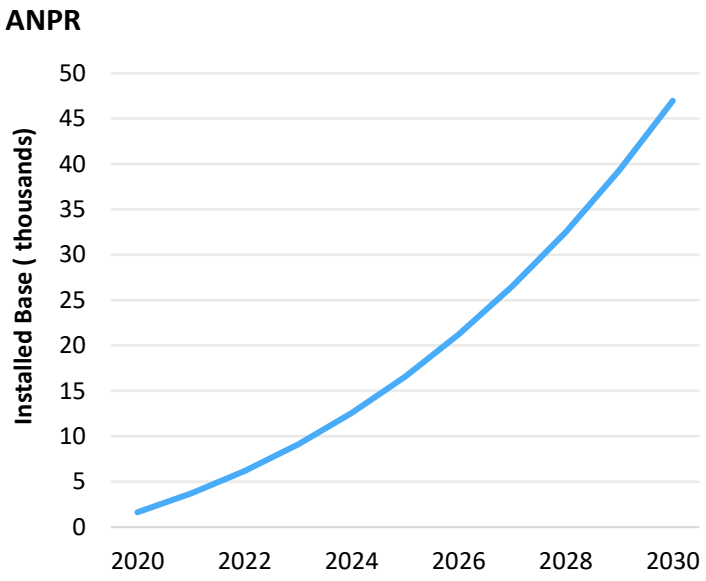
Network Cameras



Source: Omdia © 2023 Omdia

- Network Cameras connected to critical broadband networks represent the fastest growing IoT technology from the markets tracked in this study, at a 72% CAGR from 2020-30

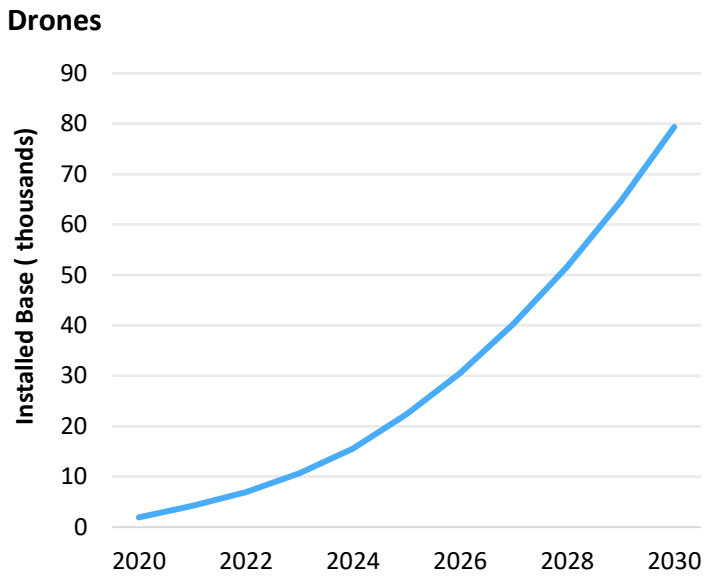
ANPR



Source: Omdia © 2023 Omdia

- Automatic Number Plate Recognition cameras are a prominent Public Safety IoT use case for law enforcement operations representing 8% of the total IoT connected camera market for surveillance in 2030.

Drones

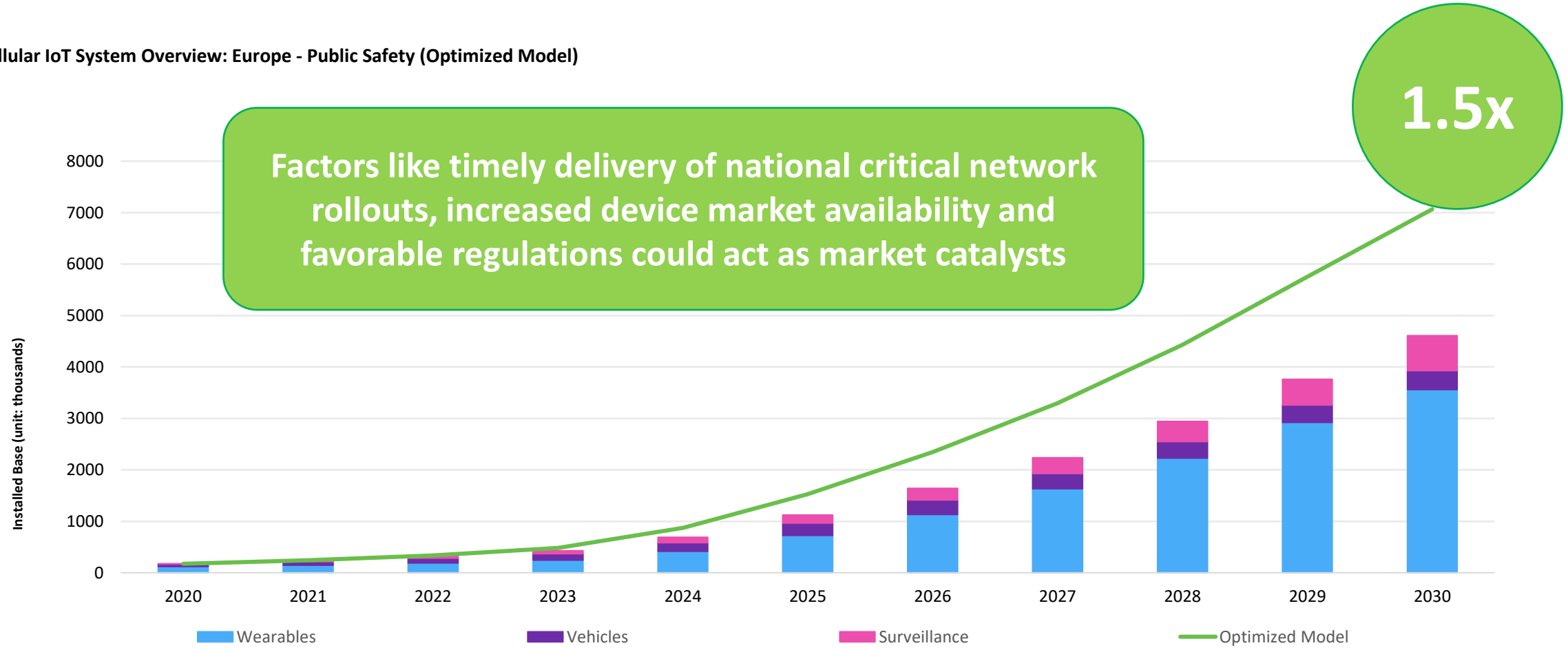


Source: Omdia © 2023 Omdia

- Professional drones are a promising use case for multiple agencies including law enforcement, fire and rescue and emergency services growing at a 45% CAGR. They are capable of enhancing situational awareness beyond line-of-sight.

Mission Critical IoT market – accelerated adoption

Cellular IoT System Overview: Europe - Public Safety (Optimized Model)



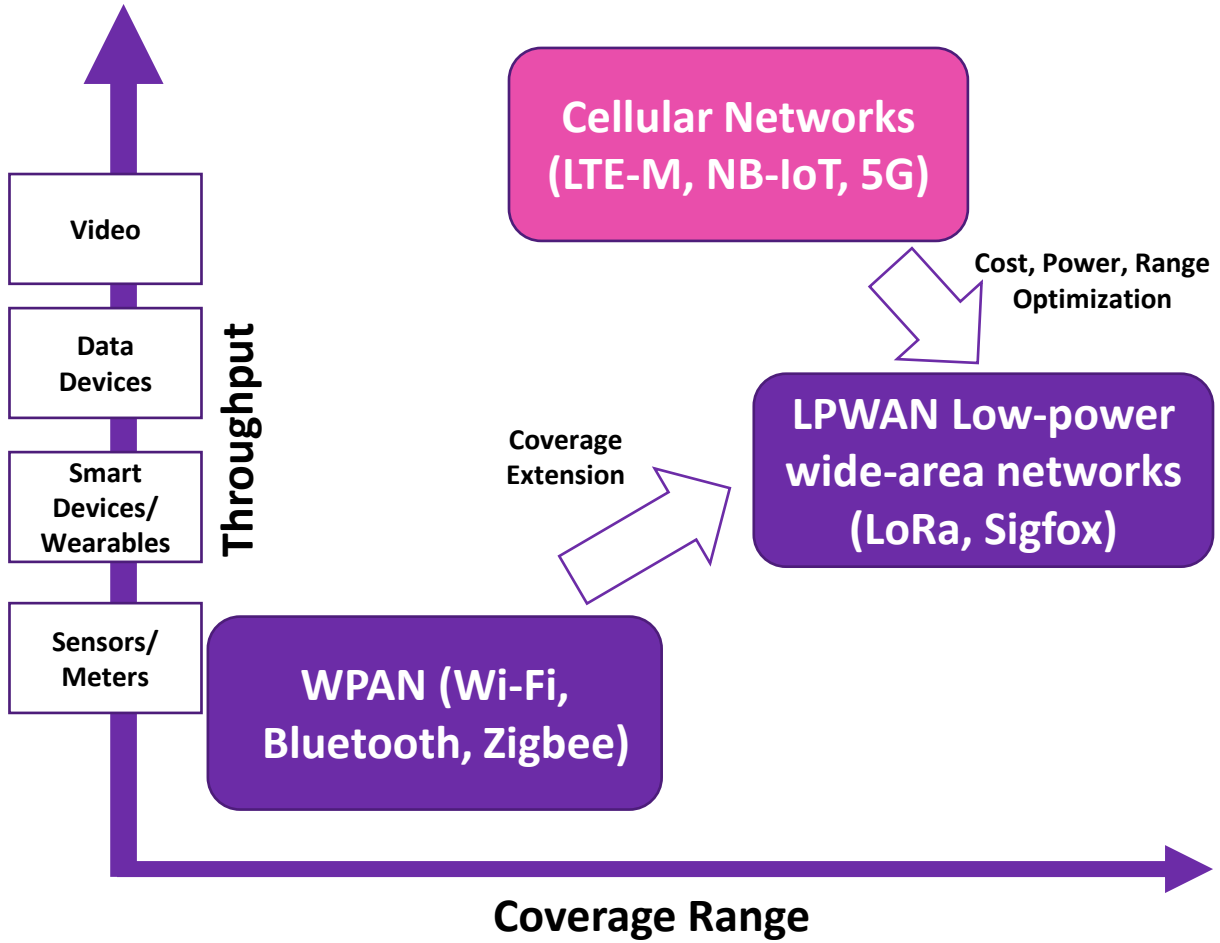
Source: Omdia

Market Trends, Drivers and Barriers

Internet of Things Technology

The Internet of Things technology is constantly evolving and expanding drastically. The range of applications and verticals it addresses is extremely varied. Consequently, there are different wireless technologies suitable for IoT connectivity:

- Wireless Private Networks (WPAN) are a network of devices operating close to the body or within a range of ~10 meters. These devices are usually centered around an individual and are tethered to a gateway (typically a cellular broadband phone device). Typical IoT technologies in this category are Zigbee, z-Wave and Bluetooth. Currently, the majority of the commercially available wearables rely on WPAN technologies.
- Wide Area Networks (WAN) are for larger geographical distances. Here we can find all Cellular IoT connectivity covered in this study (LTE-M, NB-IoT, 5G Cellular IoT)
- Low Power Wide Area Networks are a cost optimization approach to IoT connectivity for wider coverage range and lower power consumption. It is suitable for applications that require low bandwidth like safe city and asset tracking sensors. These technologies use low-frequency spectrum bands like LoRA and Sigfox and also TETRA connectivity.
- Despite an increasing number of low Earth orbit (LEO) satellite constellations being launched, the percentage of enterprises using satellite is still marginal, with 15% using them last year, falling to 11% this year.



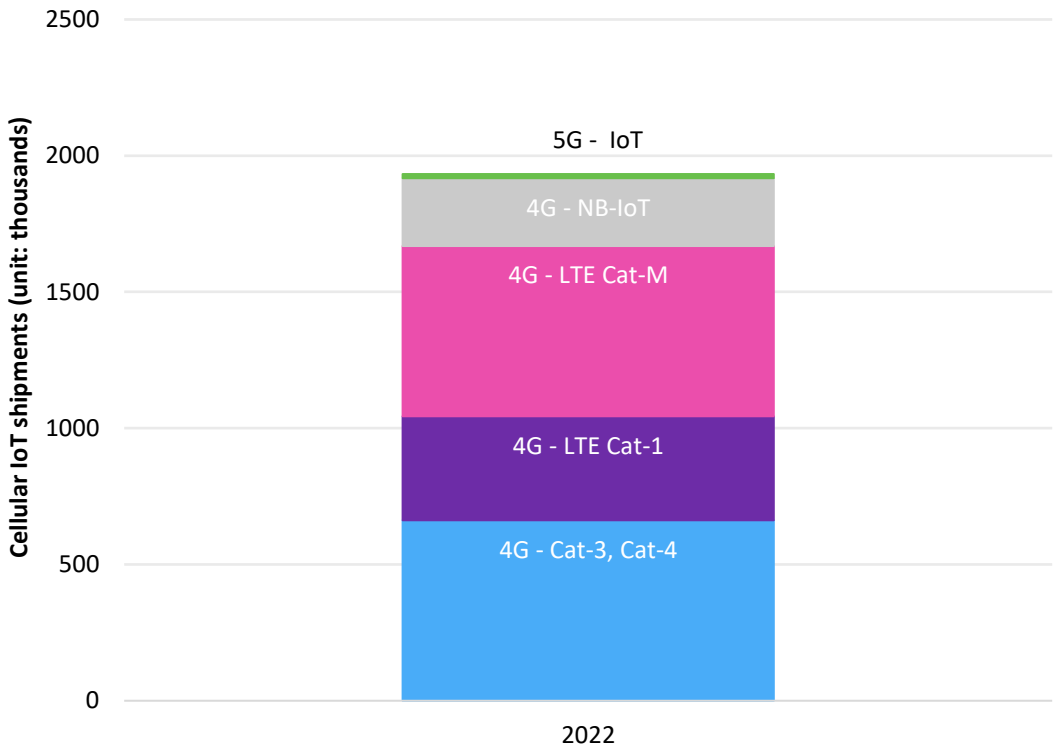
Cellular Internet of Things

Traditional broadband cellular networks in 4G and 5G are not always suitable for IoT applications due to the cost and power consumption. IoT applications typically use smaller amounts of data that is transmitted infrequently.

Cellular IoT technology initiatives are addressing the needs for better low-power vs long-range trade off requirements. The most used Cellular IoT technologies covered in this report are the following:

- LTE-M (Officially known as LTE CAT-M) is compatible with the existing LTE network creating a very low entry access barrier for adoption of devices and applications providing the highest data rates. It is the most popular cellular IoT solution
- Narrow Band IoT (also known as CAT-M2) optimizes spectral resources even further and could potentially be the less expensive option since the need for a gateway is also eliminated. However, since it does not support current LTE bands, it has higher upfront costs to deploy, and it does not currently support mobility.
- 5G Cellular IoT – Unlike the options above, 5G has yet to be officially standardized. The promise of massive connectivity makes 5G a potentially disruptive technology for IoT adoption.

Cellular IoT Market for Safe Cities: Europe, 2022

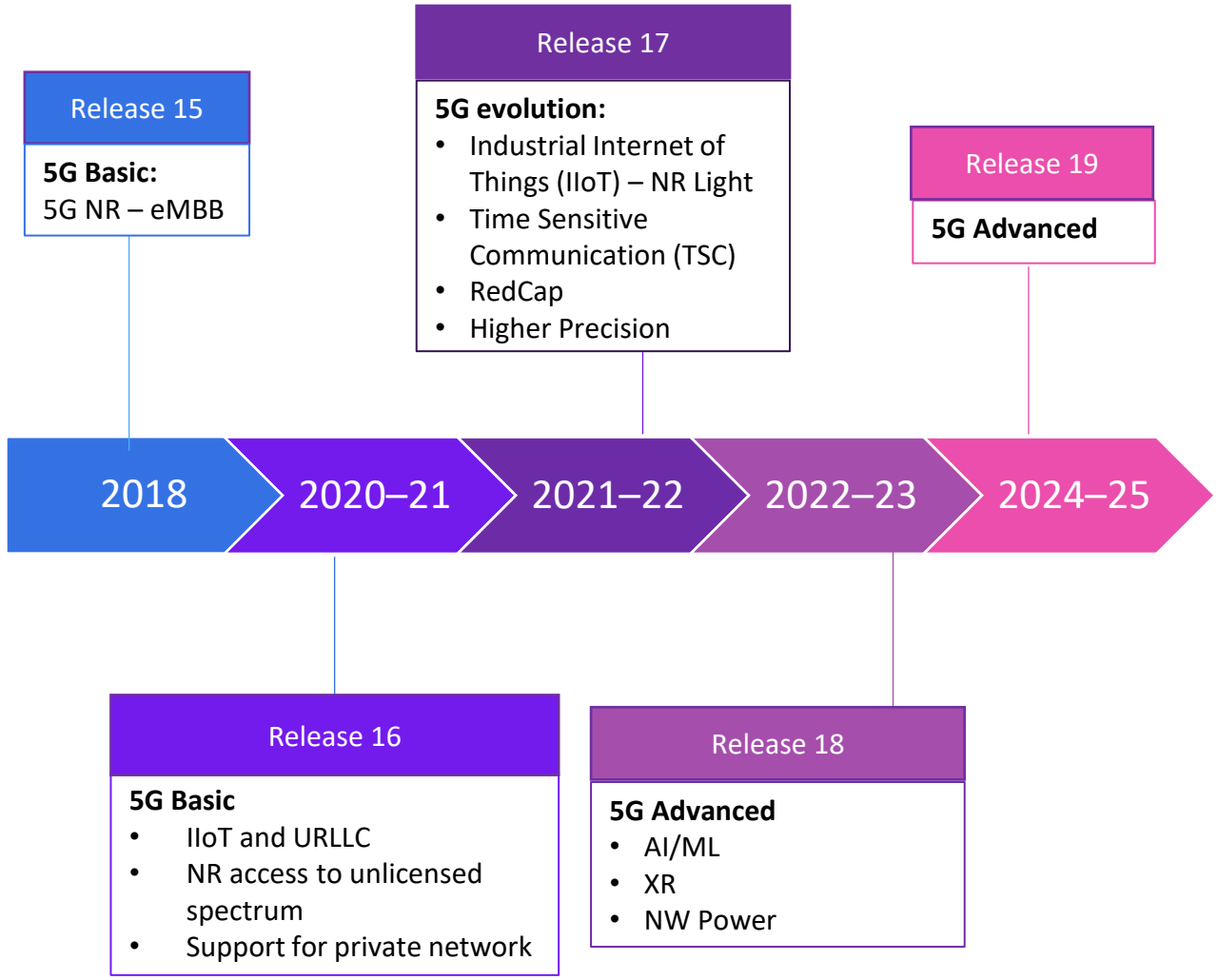


Source: Omdia

Standards

The full range of planned 5G capabilities was not available in the initial 5G launches and will instead be implemented in a phased approach over the next few years.

- The commencement of true 5G came with the launch of networks and devices compliant with Release 15 of the 3GPP.
- Release 16 was finalized in mid-2020 and unlocked many new 5G opportunities beyond the traditional mobile broadband services and introduced ultra-reliable low latency communications.
- In 2022, the 3GPP finalized the 5G Release 17. Release 17 supports more advanced use cases (e.g., factory automation/mobile robots) and includes enhanced latency and high accuracy positioning. Release 17 also supports for RedCap user equipment (UE) that reduces cost and power consumption.
- 5G Release 18 (or the first release of 5G Advanced) aims to introduce more intelligence and improvements in the areas of AI, ML, and extended reality (XR). Release 18 will also optimize energy consumption, data traffic management, and low latency radio allocation to better support apps like remote drone control.



Source: Omdia

Frequency Spectrum

Compared to public networks, dedicated spectrum resources and private networks are better placed to meet the control and security needs of mission critical use cases that may not want to depend on a public network for their public safety and critical infrastructure operations needs.

- Spectrum resource availability is of paramount importance with the shift from voice-centric applications to data & multimedia solutions. IoT applications range from very low bandwidth requirements like connected sensors and meters all the way to heavy requirements.

- The ability to bring coverage in a targeted way, sometimes in areas that lack public broadband coverage, is also a factor supporting the development of private LTE and 5G networks.

That is why ongoing conversation regarding dedication of specific bands (e.g.: band 68) are crucial for the development of commercial solutions as well as innovative applications.

Cellular IoT Frequency Bands

Cellular IoT Technology	Region	LTE Bands	Name	Bandwidth	3GPP Rel.
NB-IoT	Global	1	2100	60	13
		3	1800+	75	13
		8	900 GSM	35	13
		31	450	5	14
	EMEA	20	800DD	30	13
		72	450	5	15
	EU	28	700 APT	45	13
LTE CAT1 & M1	Global	1	2100	60	8
		3	1800+	75	8
		8	900 GSM	35	8
		31	450	5	12
		41	TD2500	194	10
	EMEA	7	2600	70	8
		20	800DD	30	9
		72	450	5	15
	EU	28	700 APT	45	11

Source: Omdia

Mission Critical IoT Drivers

Improved first responder safety

The research conducted in this study has revealed that the biggest driver for IoT connectivity in public safety agencies is the direct improvements in the safety of first responders.

Law enforcement and fire & rescue agencies aim to leverage data extracted from video and other sensors to be able to identify possible threats to their agents in the field.

01

Shorter crisis response time

Response time is a parameter of paramount importance for public protection and disaster relief agencies. Public Safety agencies and decision makers strongly believe the adoption of data sensors will result in direct improvements in early threat detection and faster reaction in the event of a crisis.

02

Operations efficiency or productivity gains

Governments and public safety agencies are seeing, or expecting to see, benefits to their operational efficiency beyond crisis response. Post-incident management and evidence management will benefit from IoT data connectivity integrated into command and control rooms and analytics will improve the pattern analysis for threat prediction.

03

Cost saving

04

The adoption of IoT connectivity will effectively increase the return of investment made by governments and public safety agencies enhancing their critical communication networks with broadband connectivity. Mission Critical IoT will help improve inefficiencies and consequently save time resources and costs.

Greater insights into operation status

05

One important driver for the adoption of Mission Critical IoT, as well as safe cities IoT connectivity, focuses on the enhanced visibility into existing operations enabling improved process quality and efficient designs.

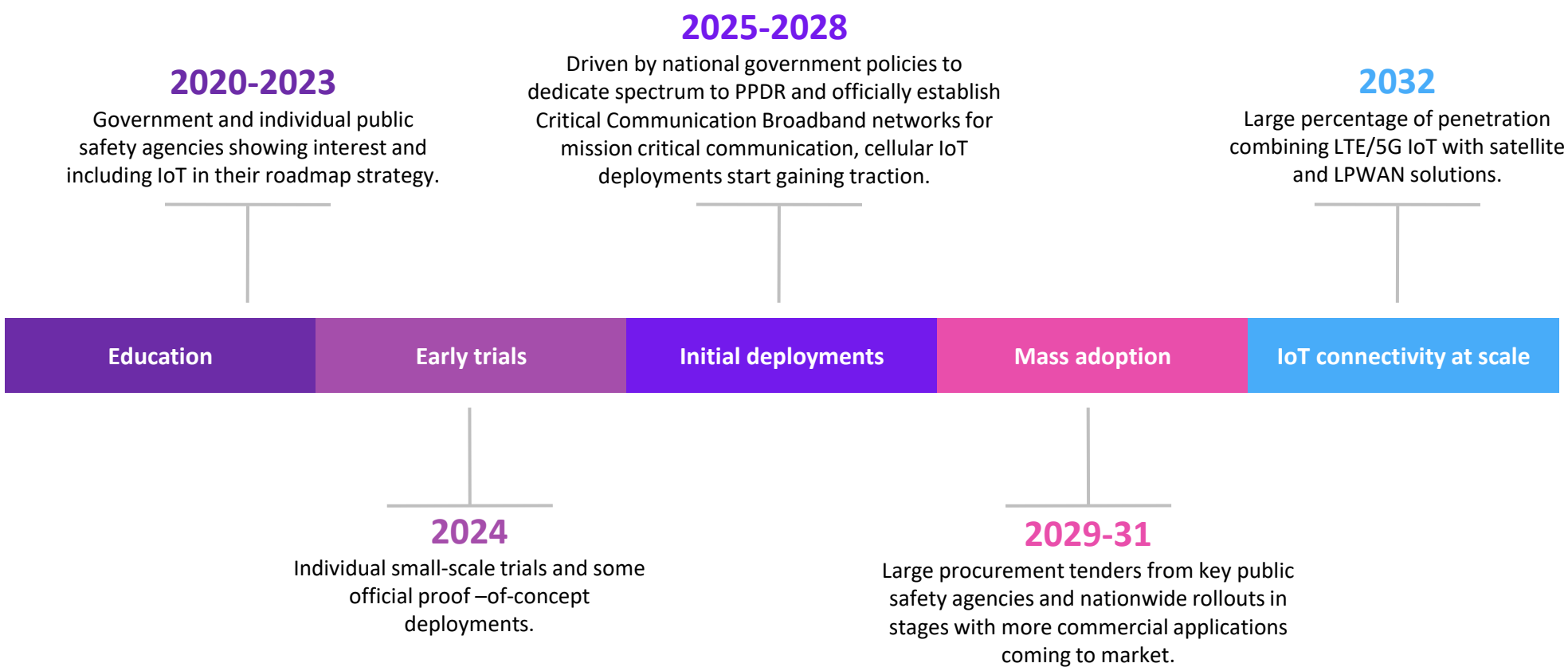
Improved sustainability

06

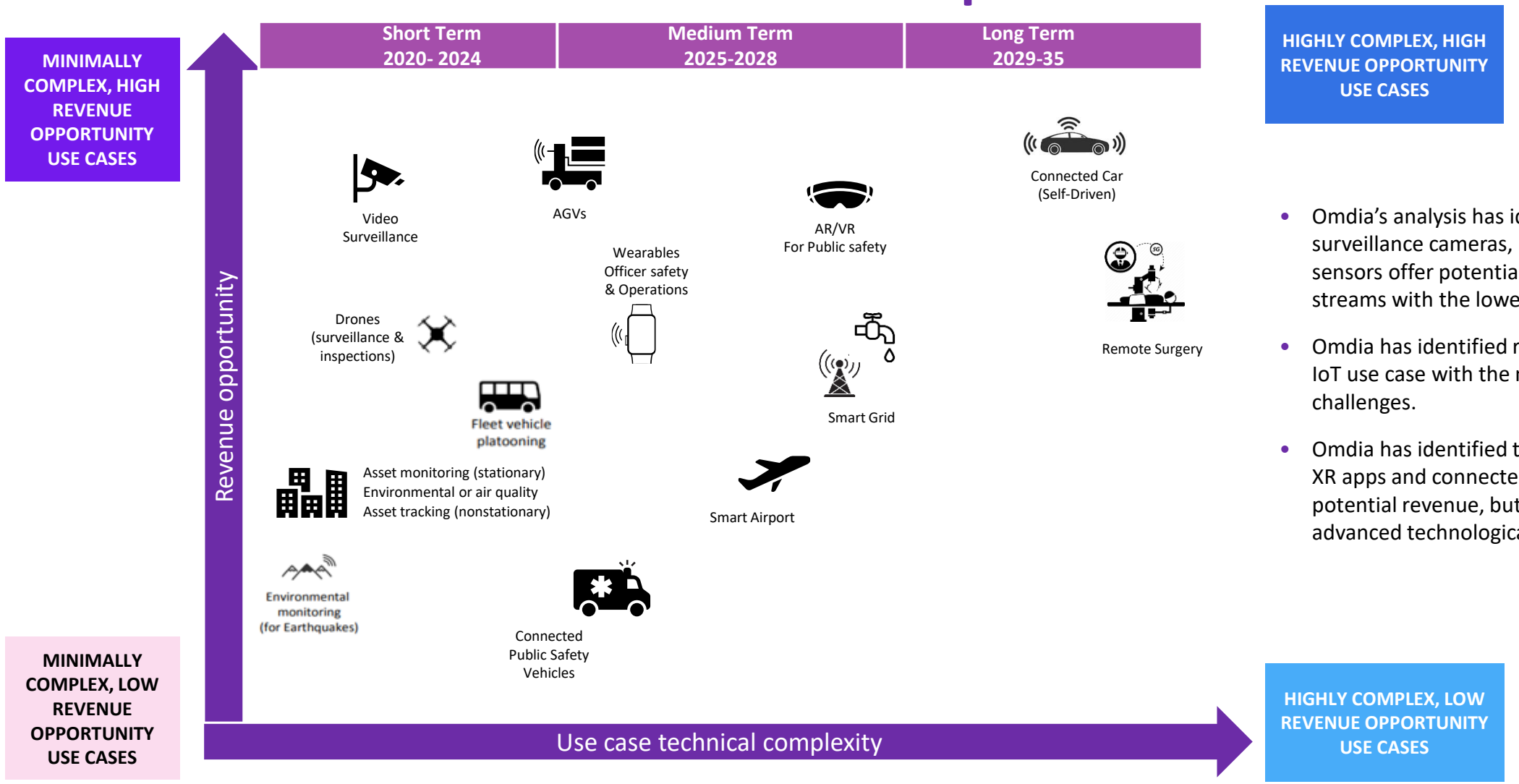
Although most enterprises have environmental sustainability targets, governments are not currently subjecting their public safety operations to sustainability targets. Omdia believes this is still a goal that will permeate all public decisions. Many governments are including these goals as part of longer-term national critical infrastructure plans that have yet to be prioritized.

Use Cases and Adoption

Adoption Timeline



Mission Critical IoT - Use Cases Examples



HIGHLY COMPLEX, HIGH REVENUE OPPORTUNITY USE CASES

- Omdia's analysis has identified that video surveillance cameras, drones and safe city sensors offer potentially large revenue streams with the lowest technical barriers.
- Omdia has identified remote medical as the IoT use case with the most technological challenges.
- Omdia has identified that Augmented reality XR apps and connected cars can reach high potential revenue, but they have to meet advanced technological requirements.

Cellular IoT – Public Safety

Example: 5G connected ambulance by BT and the University Hospitals Birmingham NHS Foundation Trust (UHB)

In November 2019, BT, in collaboration with South Central Ambulance NHS Foundation Trust, demonstrated the concept of a 5G connected ambulance. The demonstration was hosted at the Medical Devices Testing and Evaluation Centre (MD-TEC).

By leveraging a VR headset, the clinician, who was based 2 miles away, was able to visualize what the paramedic saw in the ambulance. With the assistance of a joystick, the clinician was able to remotely guide the paramedic in real time (who wore a haptic glove) to perform any necessary treatment for the patient. The glove created small vibrations that directed the paramedic's hand to where the clinician wanted.

The ambulance was equipped with a camera that transmitted a high definition (HD) video of the inside of the ambulance, including the paramedic and the patient.

Omdia view

- High speed vehicles like ambulances require a reliable and low latency network in order to transmit real-time video streams and data with zero delay.
- Broadband technology enables 360° 4K/8K video streaming on the ambulances. Medical experts can leverage AR/MR headsets and gain a better understanding of the type and the condition of the emergency in advance.
- The COVID-19 pandemic prompted the need for healthcare digitization; the connected ambulance is a promising use case that is not only life saving, but expected to enhance hospital operations (e.g., reduce waiting times).
- A connected ambulance is a critical use case and requires deployments with 100% broadband coverage, which will take years to support in both urban and rural areas.
- The connected ambulance collects and transfers to the hospital large volumes of patient data; therefore, it is essential to adopt cybersecurity protocols (e.g., VPN, DMZ) to mitigate network security risks to protect patients' sensitive information. In the long term, the connected ambulance will be able to exchange information with other vehicles and smart city applications in order to optimize routes and avoid traffic.

Cellular IoT – Public Safety

Example of Connected Surveillance: 5G EarthCam, unveiled a 5G-ready security camera (October 2020)

In October 2020, EarthCam, a webcam technology provider, introduced the StreamCam 5G, which is a 5G construction camera, along with multi-network 5G options for its entire line of cameras that will assist in the next generation of solutions to transfer Gigapixel RAW image files.

The StreamCam 5G can transmit a high number of visual datasets from the job site that can be accessed immediately. The company claims that by using a 5G network, it takes less than five minutes to access a full day of security recordings, while using 4G takes up to two hours. The StreamCam 5G enables 4K live streaming and security analytics applications.

Omdia view

- Omdia believes that video surveillance cameras powered with broadband connectivity are among the fastest growing PS IoT use cases. 5G surveillance cameras do not require high investment costs (thanks to lower hardware and data storage prices), promise faster ROI, and, most importantly, can be supported with current 5G releases. Also, 5G video surveillance cameras can be tested on a small scale before proceeding to a higher scale.
- Cellular video surveillance cameras are key drivers for smart city deployments. More and more governments plan to adopt smart cameras with AI to automate decision-making tasks, fight crime, and respond to urgent scenarios.
- 5G video surveillance cameras unlock opportunities for new business models and the launch of new services, such as video as a service (VaaS), licenced video analytics, AI video services, security, and video storage.
- The scaled installation of security surveillance cameras may raise privacy and security concerns. However, video processing at the edge can address privacy issues and ensure individuals' anonymity.
- Device providers need to have a clear understanding of the 5G/IoT security challenges in order to tackle issues at the hardware layer.

Thank you!

ILDEFONSO DE LA CRUZ

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Company

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Based in London, Ildefonso is the lead analyst for the Critical Communications (LMR & Broadband) group, providing market data and strategic insights into the evolution of the international landscape of critical communication solutions for government public safety and private industrial connectivity.