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# LTE Cat 1 and its Position in the 2/3G Sunset

—Choose the Right IoT Technologies for Your Use Cases after 2/3G Sunset

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### 1. Executive Summary

According to Machina Research, the number of global IoT connections will reach 27 billion by 2025. Among them, the total size of cellular IoT connections is expected to exceed 5 billion. Technologically, as the world is moving towards the 5G era, and 4G has become the mainstream mobile communication system, shortcomings of 2G/3G become increasingly obvious either regarding spectrum allocation efficiency, wireless performance, or operation and maintenance costs. The worldwide 2G/3G sunset is in progress with many countries giving their own timelines based on their needs for telecommunications networks (see Figure 1).

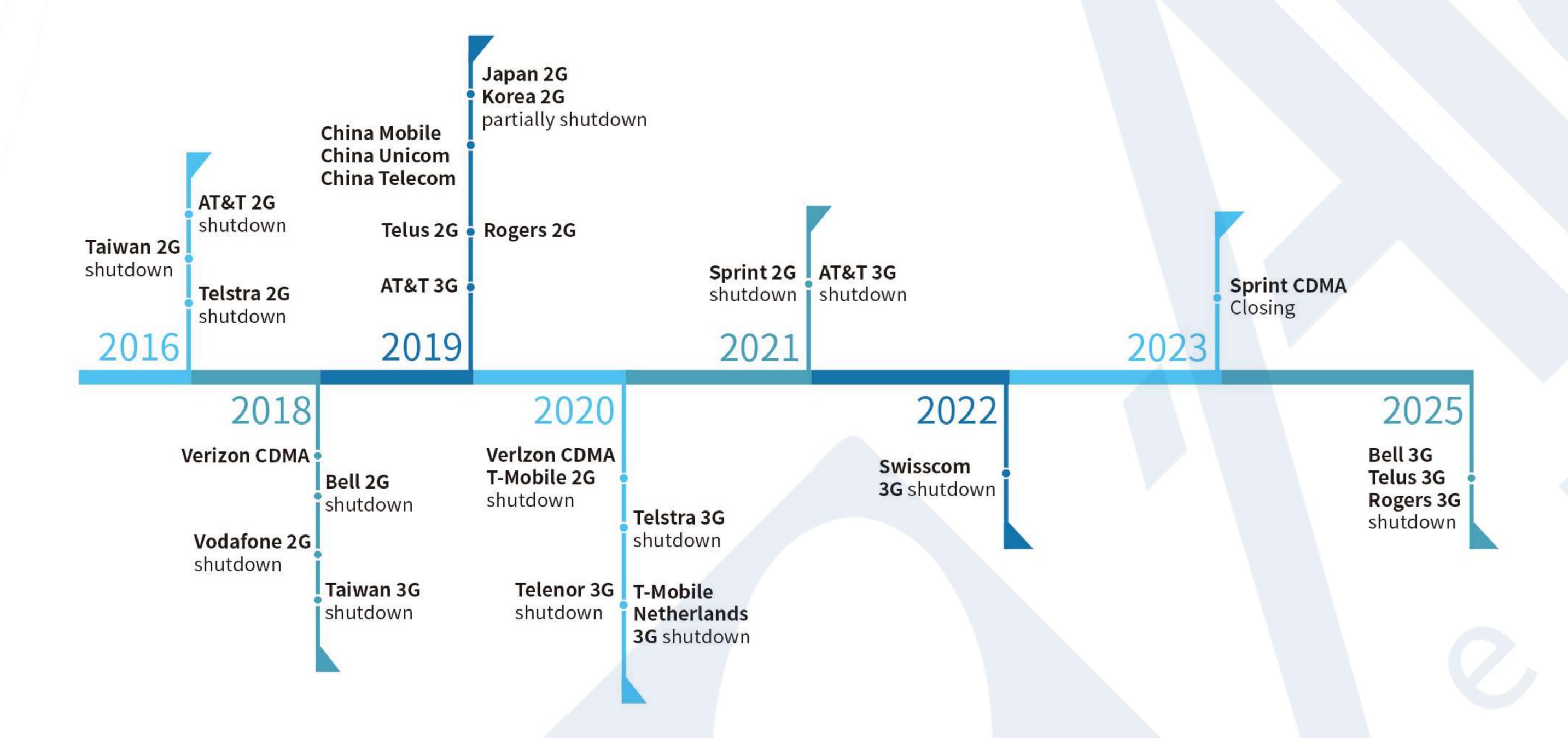


Figure 1:Global cellular carrier 2G/3G sunset dates (Source: Digi International Inc.)

The retirement of 2G/3G requires mature alternative technologies to meet the development needs of low and mid-speed IoT applications (within 10Mbps on the downlink and 5Mbps uplink) that account for 90% of the overall cellular IoT connections (see Figure 2). Among them, LTE Cat 1 is the preferred alternative option for IoT scenarios balancing between the consideration of both wireless performance and migration cost.

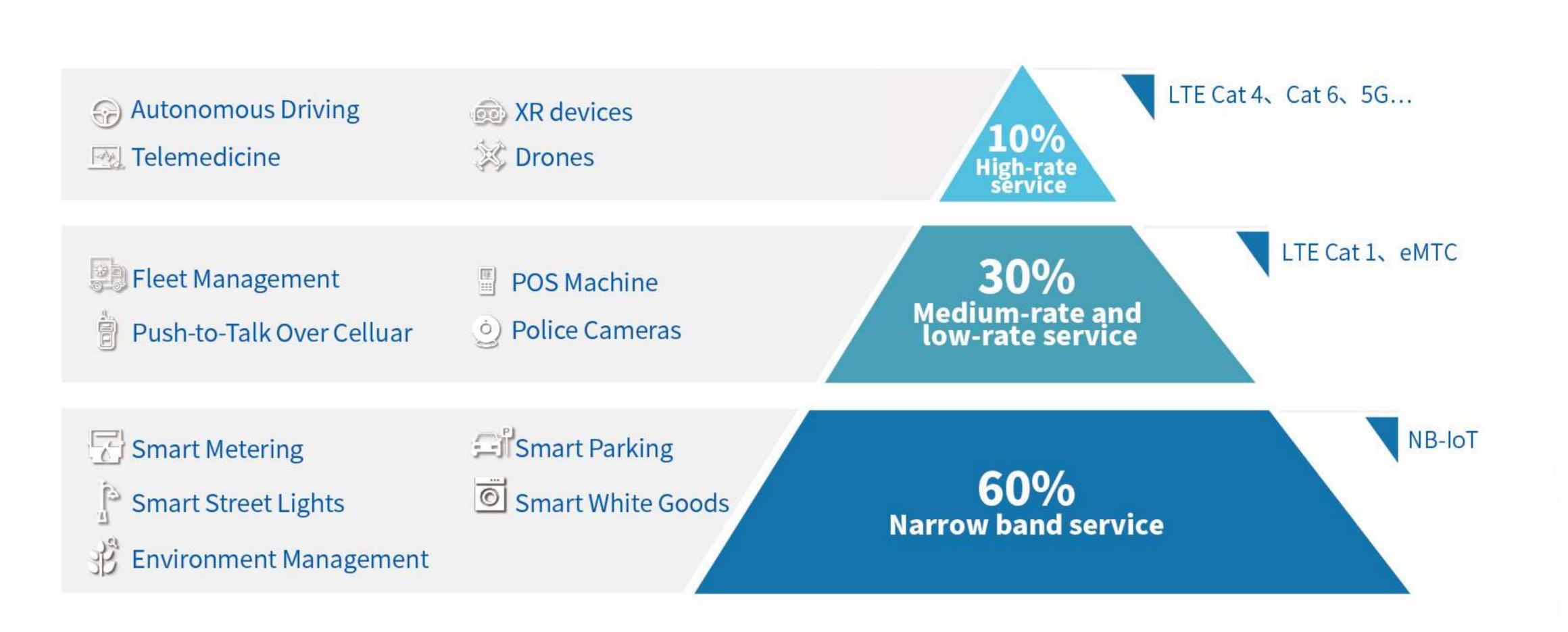


Figure 2: IoT business distribution per data speed

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# 2. LTE Cat 1 Offering All-Round Advantages

LTE Cat 1 is initially introduced in 3GPP Release 8 in 2009. Undertaking the Cat 4 applications requiring less bandwidth, Cat 1 is the "Bridge" replacing the low bandwidth IoT connectivity after 2/3G sunset. It represents an early push towards connecting IoT devices using existing LTE networks. As the only fully-available cellular IoT option, Cat 1 can undertake the connective blank with its mature network construction and achieve the economical practicability under massive demands, which makes it a cost-effective ideal solution for scenarios requiring substantial medium-speed data transmissions, browser interface or voice. LTE Cat 1 has become one of the main choices for wireless connectivity for low and mid-speed IoT applications after 2G/3G has started to withdraw from the stage (see Figure 3). In China, the three major operators are deploying LTE Cat 1 technology for the mid-speed IoT businesses. Up to now, the scale of domestic LTE Cat 1 commercial chips in China has reached 10 million.

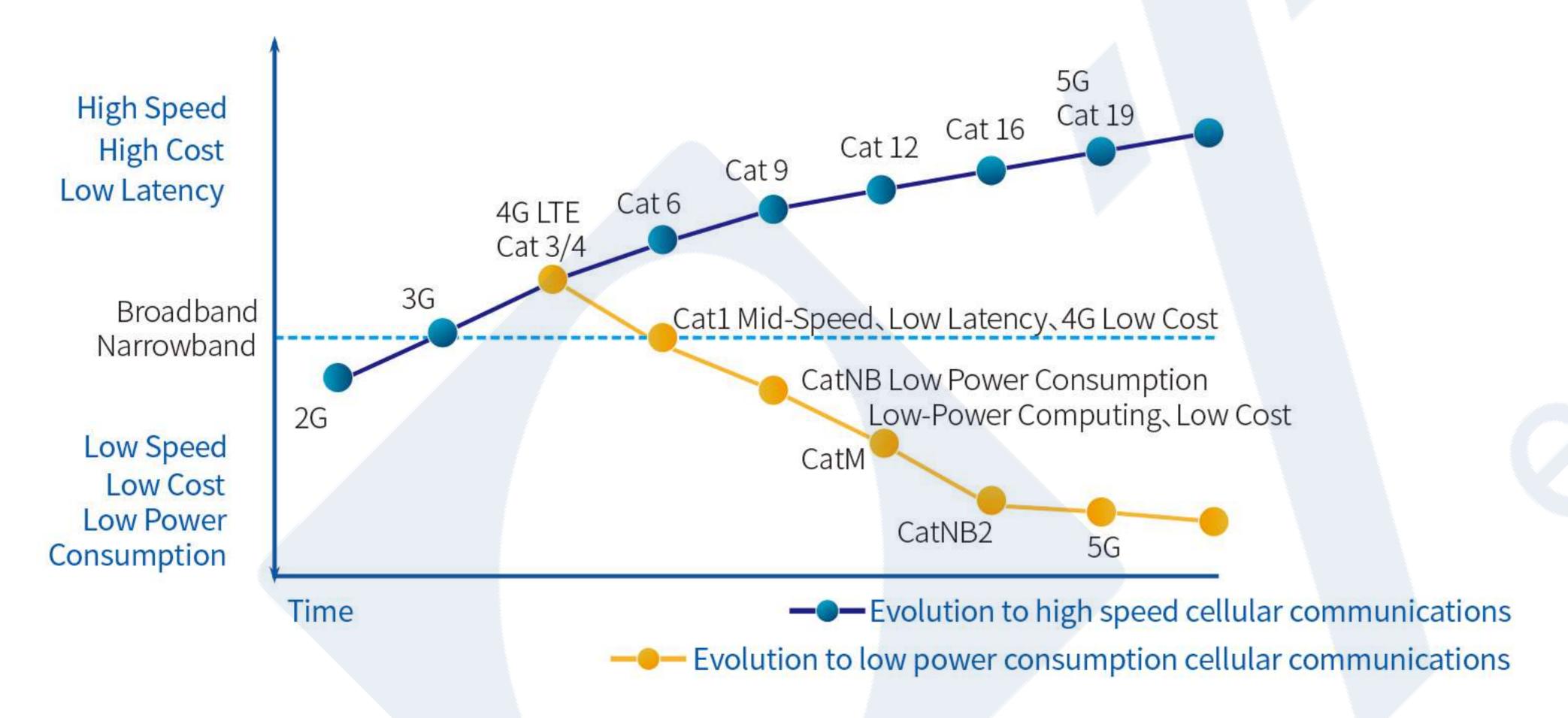


Figure 3: Cellular Technologies Evolution



LTE Cat 1 is suitable for IoT applications that require relatively high mobility, high data rate and volume, as well as voice capabilities (see Figure 4). With similar or higher uplink and downlink data rates than 3G, Cat 1 is carried on the existing LTE network, which has good coverage worldwide. Therefore, operators do not need to upgrade the hardware configuration of their base stations, but only need to modify the parameters to enable the access of Cat 1 terminals to the LTE network. It is worth mentioning that, LTE Cat 1 bis is proposed in the Technical Review of 3GPP Release 13, so as to strengthen 1Rx antenna that will further drive down the Cat 1 terminal deployment cost.

		3 <b>G</b>	CAT1	CATM	NB-IoT	GSM
	Released	Rel.99	Rel.13	Rel.11	Rel.14	Rel.4
	Bandwidth	5MHz	20MHz	1.4MHz	200KHz	200KHz
<b>(b)</b>	Speed (UL/ DL)	384kbps(DL) 384kbps(UL)	10Mbps(DL) 5Mbps(UL)	375Kbps(DL) 1119Kbps(UL)	126.8Kbps(DL) 158.5Kbps(UL)	85.6Kbps (DL) 85.6Kbps (UL)
( <u>A</u> ))	Number of antennas		1		1	1
1)	Duplex mode/ Latency	Half duplex/<10s	Full duplex/<10ms	Half duplex/<1s	Half duplex/<10s	Full duplex/>100ms
<b>\$</b>	Receive bandwidth	5MHz	20MHz	1.4MHz	200KHz	200KHz
<b>(h)</b>	Transmit power	22.5dBm	23dBm	23dBm	23dBm	23dBm
17	Mobility	YES	YES	YES	YES	YES
	IP-based	YES	YES	YES	YES/NO	YES
	Power Consumption	sleep:5mA	sleep:2.2mA	sleep:1.4mA	sleep:1.4mA	sleep:1.4mA

Figure 4: 4G LTE IoT communications technologies comparison (Source: Internal Research)

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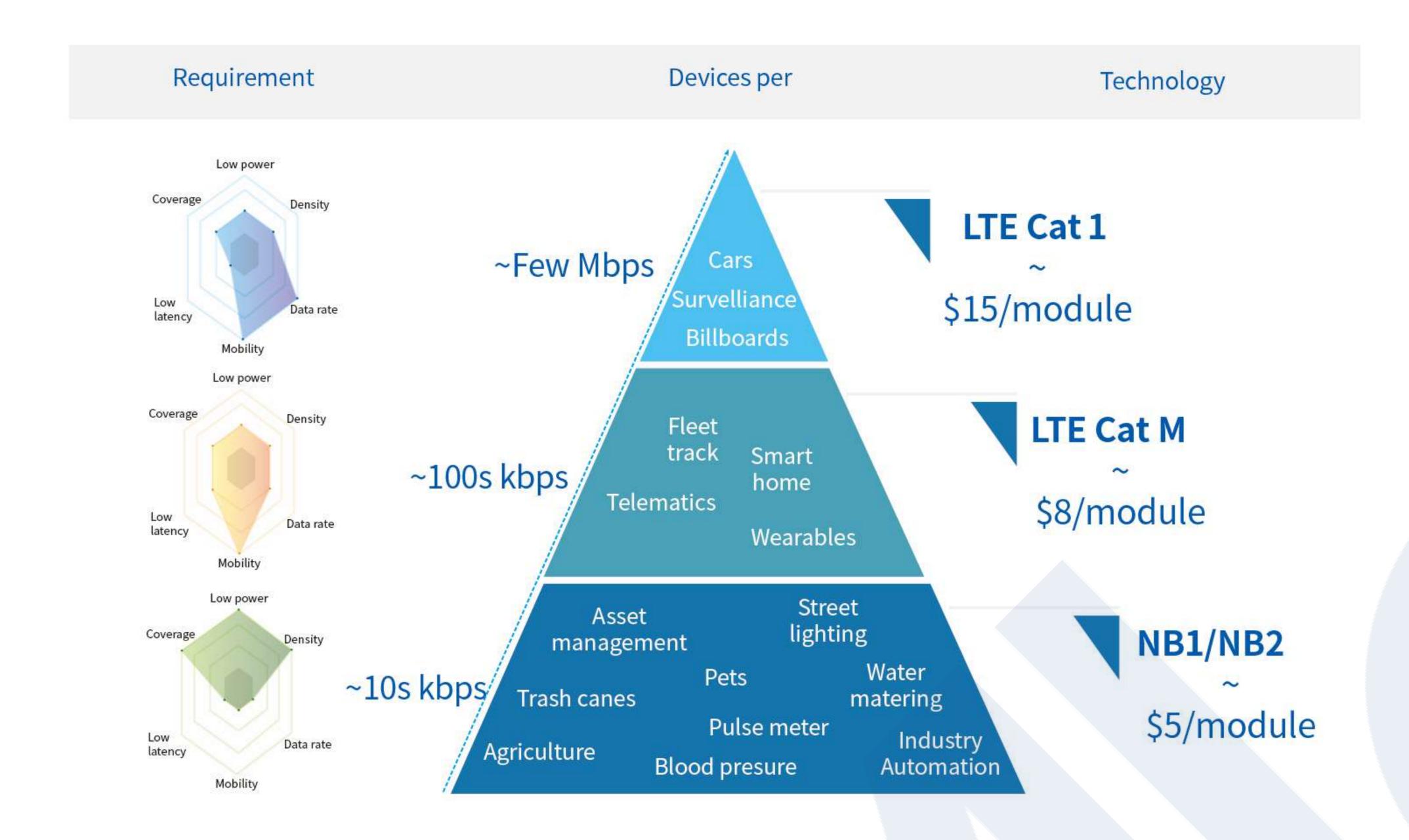


Figure 5: Cat 1&Cat M & NB-IoT Comparison (Source: Keysight)

#### Cat 1 vs. NB-loT

NB-IoT requires new base stations and additional hardware resources, and the existing NB-IoT network coverage is much lower than that of the LTE network where Cat 1 is operated on.

### Cat 1 vs. Cat M

Operators with existing LTE base stations that want to support Cat M will need to pay additional fees to upgrade their networks, which is also not a cost concern for Cat 1 on the existing LTE network.

### Cat 1 vs. Cat 4

Cat 1 is compatible with Cat 4 on the existing LTE network, and has the same advantages of Cat 4 in terms of latency, bandwidth, and mobility. Furthermore, Cat 1 bis offers a single-antenna, low-storage solution design, along with simpler hardware architecture, higher integration capability as well as lower power consumption and cost.

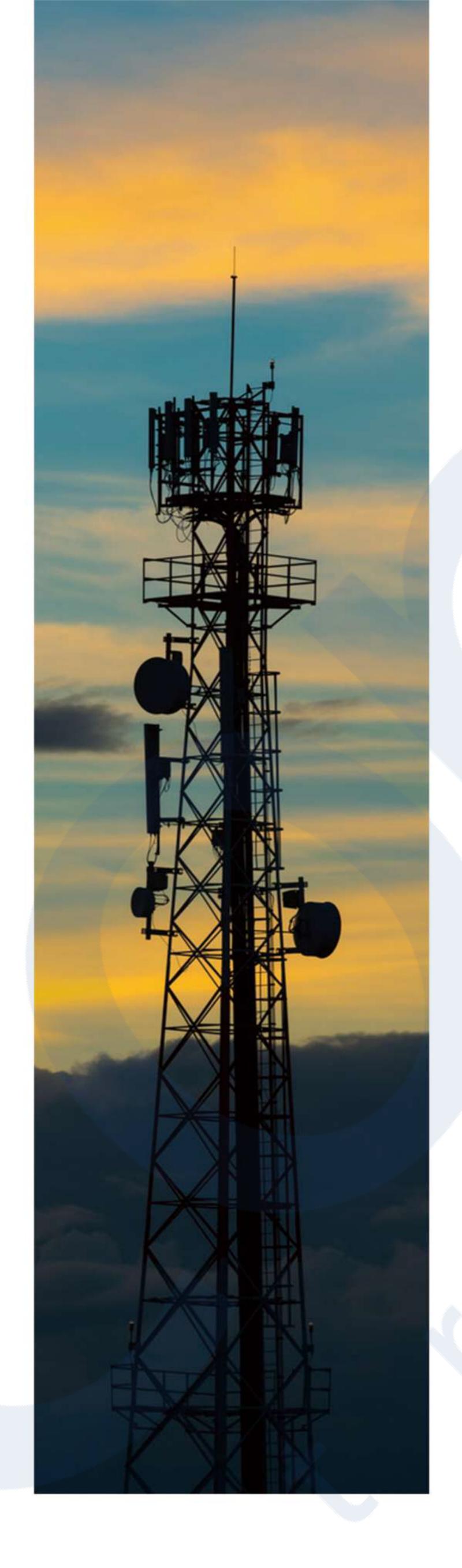


## 3. IoT Use Cases Nurtured by LTE Cat 1

With low latency, good mobility and VoLTE, Cat 1 fits for a wide spectrum of IoT applications such as industrial controller, electric meter, smart grid, video surveillance, kiosk, digital signage, sharing economy devices, mobile POS, vehicular entertainment, push-to-talk, and police enforcement recorder, etc.

#### Hello Shared E-bike

As a local shared mobility and life service platform in China, Hello leverages digital technology to provide people with more convenient mobility and inclusive local services of higher quality. The Hello e-bikes powered by the 4G network have better coverage and less latency than typical two-wheelers that use the 2G network. By utilizing the Fibocom 4G Cat 1 module L610, locking and unlocking times may be reduced by over 30% on average. Furthermore, the faster network will enable Hello e-bikes to deliver more diversified services to customers, such as providing LBS-based dynamic weather prompts and pushing commercial advertising.



### Vodofo 4G C-V2X Smart Terminal

Shenzhen Vodofo Science and Technology Co., Ltd. is a national high-tech enterprise specializing in R&D, production, sales, and operation of Internet of Things (IoT) location services. Embedded with Fibocom's LTE Cat 1 module MC615, Vodofo's smart terminal is able to provide location services for vehicles, objects (such containers), smart warehouses, big data platforms, etc. The product leverages the extensive network coverage of MC615, with high integration level, robust extensibility, numerous interfaces and cost efficiency, empowering logistics, fleet management, remote e-bike monitoring, BMS (Battery Management System) and so on.

### Northmeter Smart Energy Devices

Shenzhen Northmeter Co., Ltd. is a company focused on smart energy, who provides a full range of technical services from cloud, pipe and end devices suitable for smart communities, smart campuses and smart cities. Fibocom's L610 modules are embedded in the Northmeter smart gateway, split AC (Air Conditioner) controller and smart charging pile, which make full use of the scale, stability and low power consumption of LTE Cat 1 connectivity in static scenarios.





• Secure net In-vehicle Smart Surveillance Terminal
Shenzhen Secure net Technology Co., Ltd. is a high-tech company develop IoT products, business covering intelligent transportation, smart cities, shared mobility, unmanned service, artificial intelligence and other sectors. Embedded with Fibocom's LTE Cat 1 module L610, the in-vehicle smart surveillance terminal enables smooth communication and stable positioning signals, real-time online support and minimal network blind spots, high-precision BeiDou/GPS dual-mode positioning and compatibility with LBS/AGPS assisted positioning, as well as custom shell antenna design. The terminal consumes very little power, accurately detects all failures and quickly sends out warning when detecting problem.

## 4. Future-Proof Technology for Your IoT Project

With the retirement of 2G and 3G networks approaching, many IoT companies who deployed 2G and 3G connectivity as their solutions may find the transition very challenging. The critical issues for them to consider are what applications they apply and what will be the right solutions with the network capabilities of new LTE technologies.

- Specify whether you require data to be delivered in bursts or in a constant stream over time, and whether you need to transfer a few bytes or several GB per day.
- Determine whether data is required in real time or if a delay of a few seconds, minutes, or hours is acceptable, and then select the most cost-effective option.
- Evaluate whether your company's communication needs are localized within a building, facility, city, or even across a country or globally. Determine whether you need to be online all the times, and whether downtime could result in lost income, regulatory penalties, or safety breaches.
- Consider if your equipment will be used in environmental-stable locations or in severe, perhaps hazardous conditions. Determine whether there will be access to AC (alternating current) power or if battery or solar power will be the only choice.





### 5. Fibocom High-value LTE Cat 1 Modules for Low & Mid-Speed IoT Applications

Fibocom offers a variety of LTE Cat 1 wireless modules to support the global needs of large, low and mid-speed IoT applications, with excellent network performance, great reliability and mobility, as well as amazing cost performance, providing the perfect solution to a variety of verticals. With what Fibocom can offer, we look to lead the way in this constantly updating world.

Module	Features
MC116	<ul> <li>Air Interface: 4G, 3G</li> <li>LTE Cat 1 module with a theoretical downlink peaking at 10 Mbps and an uplink of 5 Mbps</li> <li>Adopts LCC+LGA form factor</li> <li>A rich set of interfaces, including SIM 1.8V/3.0V,USB2.0, UART, and 12C</li> <li>Applications across a wide range of IoT scenarios, including asset tracking, smart payments, public security, and Internet-of-Vehicles connectivity</li> </ul>
MC610	<ul> <li>Air Interface: 4G</li> <li>LTE Cat 1 bis module supporting VoLTE (Voice over LTE), Audio, Recording and SMS</li> <li>LCC+LGA form factor</li> <li>A rich set of interfaces, including USB, UART, SPI, and I2C</li> <li>Provides stable and secure connectivity for the low- and medium-rate IoT market</li> <li>Ideal for IoT scenarios such as smart payment, sharing economy, IIoT, asset tracking and telematics</li> </ul>
L610	<ul> <li>Air Interface: 4G</li> <li>LTE Cat 1 bis module with VoLTE (Voice over LTE), camera, LCD, keypad, and other functions</li> <li>Supports Open CPU as well as built-in Bluetooth and Wi-Fi Scan</li> <li>A rich set of interfaces, including USB, UART, SPI, I2C, and SDIO</li> </ul>

Figure7: Fibocom Advanced Modules

# 6. Proliferating LTE Cat 1 Wireless Connectivity Across the IoT Industries with Fibocom

Broadband IoT technology such as LTE Cat 1 is versatile in all aspects and will continue to develop fast in industries like video surveillance, smart grid, asset tracking and shared economy, to name it. With LTE Cat 1 network set to become the new "pop star" in a range of industries and applications, device manufacturers are increasingly incorporating Cat 1 accessibility into their products. Fibocom, in partnership with chipset companies and other IoT pioneers, is proud to be at the cutting edge of this innovation, driving the development and adoption of LTE Cat 1 wireless modules to help OEMs through the 2G/3G sunset. With the technology in place, we envision networks that are not only smarter, but will also deliver a safer, more efficient more connected future.

