

# **GTI Report on Vertical Requirements for 5G S-Modules and Devices**

The logo consists of the letters 'GTI' in a bold, white, sans-serif font, centered on a dark blue background. The background features a glowing blue grid pattern that recedes into a bright light source, creating a sense of depth and technology.

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# ***GTI Report on Vertical Requirements for 5G S-Modules and Devices***



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# 1 Executive Summary

This paper analyzes the current situation of the development of 5G, the status and development of high-speed modules , mainly focused on the research of 5G vertical industry demand, fully communication with all walks of life and research, including AR/VR, hd video, Real-time UHD Video Surveillance, connected drones, ACPC, connected automotive, smart grid, smart POS and robot, mining the demand for 5G terminals and module from industry, such as communication ability, ability of software and hardware requirements and performance requirements, etc., mainly analyzes the industry for module encapsulation, size, capacity requirements, summarizes three types of module type: Basic, Smart and All-in-one, to lower the threshold of industrial application and facilitate the rapid application of 5G.

## 2 introduction

### 2.1 Background

With the development of mobile communication technology, people's lives are changing quietly. In particular, the 4G era has changed people's lifestyles. What changes will 5G bring to society? As smart phone shipments shrink, shipments of medium and high speed communication modules continue to grow, as shown in figure 1. The 3G module maintained steady growth. After 4G was commercialized in 2014, the module shipment growth of 4G has been increasing exponentially year by year. This means that the industry needs more and more high-speed communications. The arrival of 5G brings new vitality to the industry. AR/VR, hd video, connected drones, Internet of vehicles, power grid, etc. have put forward higher demand for the network. With the development of 5G industry, in order to make 5G modules to be applied quickly, we bring in 5G s-modules. According to the industry requirement , we give the detail recommendations about the 5G s-module.

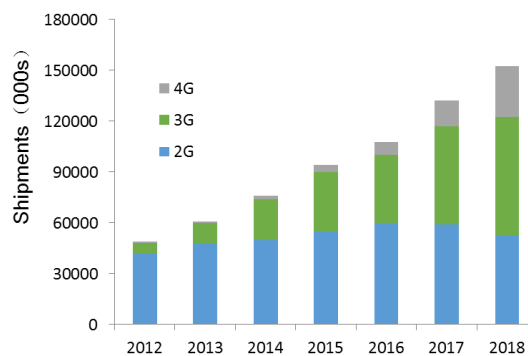


Figure 1 Cellular M2M embedded module forecast (2012-2018)

### 2.2 Objectives of this report

By analyzing the development status of 5G and the development and application of medium-high speed modules, this paper hopes to study the possible vertical industry demand of 5G, summarize several types of modules that can be used universally, and facilitate the rapid application of 5G in the industry. Through sufficient communication and investigation with various industries, the requirements of 5G terminals and modules in the industry are fully explored, including communication capability, software capability, hardware requirements and performance requirements, etc., to form a guideline that can guide the application development of 5G modules and the industry.

## 3 Global carriers 5G network status

### 3.1 China

China mobile: Targeting for commercial launch of 5G in 2020, the global telecommunication operators, network, chipset and device vendors, test instrument manufacturers and solution providers are deeply involved to promote end-to-end maturity of standard and industry. 5G technology development and trial activities comprise some main phases, such as Key technology feasibility validation, Prototype development and trials, Pre-commercial product development, Lab tests and Field trials for pre-commercial and commercial product, Commercial Launch and so on.

Currently China mobile plan frequency band 2.6Ghz for n41 and 4.8Ghz for n79.

China Telecom General strategy of 5G: In the initial stage of 5G network construction, the development of 5G not only needs to fulfill requirements of emerging services and scenarios, but also should fully consider the compatibility with 2G, 3G and 4G networks. China Telecom's 5G network evolution strategy is divided into two phases: the near-term (for commercial 5G service in 2020) and the mid-to-long-term (for CTNet2025 network transformation). Facing collaboration and fixed mobile convergence, China Telecom will promote the application of AI in 5G network management, resource scheduling, energy conservation, and edge computing to provide a smart 5G network

Currently China Telecom plan frequency band for 3.5Ghz.

### 3.2 American

In July 2016, the FCC formalized plans for 5G frequency bands. The current licensed frequency band is 27.5-28.35GHz; and the unlicensed frequency band is 64-71GHz. 600MHz will be used for the IMT system.

Globally, North America is expected to lead provision of 5G services. In 2017, Verizon implemented the access test of the WTTx technology. AT&T has followed suit, providing households with broadband services using 5G technology. The enthusiasm of both operators for WTTx is likely related to the low penetration rate of fibre broadband in the US. In 2018, AT&T has started to construct and test 5G mobile networks. T-Mobile has always been focused on 5G mobile network and has signed a super contract with Nokia valued at USD 3.5 billion. The US is expected to offer formal 5G commercial services by 2019.

AT&T will deploy NR mm-wave in 39GHz band (n260) with network option 3x 39 GHz band, with average holdings of more than 375 MHz in the top 100 markets AT&T expects to be the first U.S. Company to introduce mobile 5G NR service in a dozen markets by late 2018

AT&T NR Sub 6 Launch and Deployment, NR sub 6 will over time replace LTE technology.

mMIMO is being planned for mid/high NR bands. Deployment of Sub6 NR Radio equipment by AT&T has started. AT&T is planning nationwide Sub6 NR deployment in 2019. NR sub 6 Band priorities: 1st priority: B5n NR,AT&T have some spectrum available and expect to have more as UMTS usage declines. 2nd priority: Mid band NR: B2n and/or B66n. Future: B14n, 3.5GHZ may be added depending on FCC actions. NR sub 6 + LTE Dual connectivity will be essential for service migration.

### 3.3 Europe

swisscom: first completely standardized 5G network in Burgdorf

Swisscom is partnering with Ericsson to build a complete 5G network in Burgdorf which is based on the latest 5G standard. The first 5G data transfers have been successfully completed. With this network, Swisscom is testing the latest generation of mobile communications under real conditions in rural areas. The experience gained will follow into other 5G expansion projects at Swisscom.

Swisscom together with its network equipment supplier Ericsson is building the first complete 5G network in Switzerland in Burgdorf. From the core and transport networks through to the antennas, everything will run on the latest 5G mobile communication technology, which is based on the newest 5G standard from 3GPP. With a 5G-capable device from Intel (Intel 5G Mobile Trial Platform) . The first mobile data transmissions were successfully carried out on a purely 5G network and applications such as web browsing, voice connections and streaming were tested. "The experience that Swisscom has gained with the 5G network in Burgdorf are very important for the launch of 5G", said Heinz Herren CIO and CTO of Swisscom.

Swisscom performs a very early 5G launch by 2018

June 2017: public announcement on 5G strategy partnership with Ericsson.Q3/2017: Lab-test with a complete Test-Lab with draft 5G\_NR from based on Ericsson infrastructure.

Feb 2018: Swisscom CTO public announced 5G network rollout by Q4/2018.

NSA option 3x with NR+LTE max speed up to 3Gbps DL/ 0.5-1.0Gbps UL.





## 4 The module status

### 4.1 Status of 4G

4G modules are mainly used in automobiles, energy meters, industrial Internet of Things applications, walkie-talkies, intelligent payments, security, Smart City applications, and fields including medical and health, smart living, agriculture and environment and others.

#### 4.1.1 Automobiles

The automotive industry is moving in the direction of intelligence, Internet of Things and electrification. The Internet of Vehicles refers to the specific application of the Internet of Things in the automotive field. The Internet of Vehicles is able to collect and attribute dynamic and static information about vehicles and people, vehicles and other vehicles and vehicles and roads by means of sensing devices and wireless communication modules mounted on the vehicle. Utilizing mobile communication networks, satellite communication networks, navigation, intelligent information processing and other technologies and business platforms provides automotive users with more abundant businesses and services. In addition, the Internet of Vehicles helps vehicles and drivers to achieve more efficient, safe and comfortable vehicle management and to have a better user experience.

The main uses of 4G modules in the automotive OEM include network cameras, network video recorders (NVRs), digital video recorders (DVRs), smart rearview mirrors, vehicle-mounted entertainment information integrated machines and automatic data acquisition systems (ADAS). Ex-factory vehicle-mounted applications include multimedia GPS navigators, vehicle-mounted 4G WIFI gateways for taxis, online hailing cars, trains, escort vehicles, rubbish trucks, school buses and others.

#### 4.1.2 Energy Meters

4G modules have been applied in electricity meters, water meters, gas meters, heat meters, smart grids, wind power generation, solar panels and charging piles. Charging piles, being electrical equipment for charging electric vehicles, has big prospects with the rapid development of new energy vehicles. Electrical equipment is being built on a large scale and as a result there is an increasingly high demand for safety management and convenience. China's power consumption is increasing

year by year. In order to better ensure the quality in power supply by the power grid, it is necessary to quickly deal with faults that occur and restore the power supply as soon as possible. The reliability of the power distribution network is directly related to living standards and economic development. An intelligent meter reading system can automatically use meter data to read users' energy consumption. A typical application of 4G module in this field involves collecting data in real time and directly implementing a remote automatic meter reading function in the central control room, achieving efficient and intelligent management.

### 4.1.3 Security

Public and personal security has received more and more attention in recent years. Wireless communication technology has started to play an active role in security systems with the rapid development of the Internet of Things. In 2018, the value of China's security market has exceeded 700 billion RMB. The security value chain is generally divided into three parts: security operations, security equipment, and security engineering. In terms of security equipment, video surveillance related services are the core market for 4G module applications. Compared with wired access, 4G cameras still have huge room for growth in the future.

### 4.1.4 Payment

The emergence of mobile payment services has led to rapid growth in the new retail and POS market. New retail is a data-driven pan-retail form centered on consumer experience. Different from any previous retail revolution, new retail will integrate data and business logics to reform production according to consumption patterns. In the latest statistics from iResearch, China's unmanned retail market (including vending machines) was expected to process nearly 20 billion RMB of transactions in 2017. This is expected to exceed 65 billion in 2020 and the compound annual growth rate in three years is about 50%. Intelligent POS has also developed rapidly. In addition to the functions of traditional POS, it also includes member management and marketing management, and supports a multitude of payment methods.

### 4.1.5 Smart Medical Care

With an aging population causing an increase of sufferers of chronic diseases and the shortage of medical resources, the service model of health care has also changed. The development of the Internet of Things has provided essential conditions for smart medical care. Today, M2M technology enables remote medical care and real-time monitoring of personal health at a low cost, making it the best

solution for medical care where there are a number of challenges. The introduction of mobile devices using M2M communication modules plays a substantial role in the four fields of prevention, diagnosis, treatment, and monitoring. For example, sufferers of chronic diseases can be monitored in real time to assess their health status, or remote diagnosis can be used to determine the patient's condition. This new Mobile Healthcare (mHealth) medical model not only reduces labor and material costs, but also combines various types of mobile devices, such as smart phones and tablet PCs. With the applications available on the mobile devices, it is now possible to keep track of the health status of loved ones and improve the reliability of medical care.

#### 4.1.6 Consumer Electronics and Wearables

As wearable technology becomes more important, interconnection between devices and smart phones using wireless connectivity technologies is key to tapping into the potential of these devices. For example, with Near Field Communication (NFC) technology, consumers can purchase new wearable devices and easily connect them to smart phones for fast and secure communication and without the need for other complex menus or cumbersome setup processes. Thanks to Bluetooth Smart and WiFi technologies, consumers can acquire data from wearables (e.g. calories consumed and heart rate) and transfer data to smart phones or into the cloud without consuming too much power. With the help of WiFi direct connection technology, consumers can directly connect two WiFi devices without access points or computers. In addition, wearables and positioning technologies such as GPS/BEIDOU/GLONASS can be combined to achieve some interesting new application features. For example, doctors can follow up a patient's condition in a clinical environment and retailers can send targeted advertising information to consumers.

#### 4.1.7 Smart City

Nine years ago, just one and half years before the landmark iPhone4 came to China, and four and a half years before Germany proposed "Industry 4.0", 3G was just a buzzword. A world in which all things were interconnected and digitized seemed to exist only in ones' imagination. Now, in 2018, in almost all of China's provinces, practical examples of the application of the Internet of Things for smart cities can be found. In Fujian, a province in southeast China, the indoor smoke detector is coupled with the NB network to provide protection for small and micro-locations that are difficult for supervision yet have a high fire risk. In Gansu, a province in

northwest of China, the intelligent water affairs system makes automatic meter readings in residential communities. In Guizhou, a province in Midwest China, the atmospheric monitoring system uses wireless networks to collect and transmit data in real time. In Nanjing, a city in Midwest China, the Internet of Things has become a handy tool for the river-chief/lake chief to manage the water quality and water conditions. Yingtian City, Jiangxi Province, has witnessed great developments in both NB-IoT and eMTC. Here, smart street lamps, smart parking, and smart trash cans constitute a smart community. Shanghai uses a large amount of sensory monitoring data for management of its megacity.

## 4.2 Status of 5G

Since the concept was formed, 5G has targeted ultra-clear video communication, VR/AR, and automatic driving and other cutting edge applications. Highly anticipated by many countries as new communication technology, 5G is a new impetus for industrial upgrading and a new growth point for economic development. 5G technology has been defined by a variety of "super descriptions" such as enhanced mobile broadband, super low latency, massive connectivity, and ultra-high reliability. However, to achieve high performance in such diversified applications, the whole industry is now facing complex conditions such as non-frozen protocols and possible multi-carrier and multi-terminal protocols. However, despite these complexities, the industry must keep up with the speed at which demand is generated.

## 5 requirements from Vertical application

### 5.1 Virtual & Augmented Reality

Thanks to the significant technological progress and great competitive advantages in professional fields such as medical and transportation as well as consumer fields such as entertainment, from its beginning, VR/AR has received a lot of attention. At present, VR/AR is still in the primary stage, focusing mainly on local rendering and action-based local closed loop. The huge amount of computation and storage VR/AR requires restricts the cost of terminal devices, and therefore the growth of related applications. The integration of 5G and cloud computing provides an evolution route for VR/AR. Real-time content download and real-time modelling and rendering will provide the ultimate experience for mixed reality applications. Moving computing and storage to the cloud will greatly reduce the cost of the terminal devices. Meanwhile, 5G ultra-high-bandwidth and ultra-low-latency networks are responsible for transmitting the large amounts of data. 5G S-Module can be used in VR/AR devices to meet the needs of devices requiring ultra-high bandwidth and significant data transmission.

This year, KT took the lead in testing 5G network demonstration services including 360°VR, 5G video security surveillance system, Sync View, and holographic images at the PyeongChang Winter Olympics. Orange launched terminal devices with dual operating platforms of Android and iOS, which were embedded with Orange VR 360 application.

### 5.2 TV:UHD 8K Online Video OR living broadcast

The resolution of 8K video is 7680 x 4320. Currently, 8K video in the industry is usually coded and decoded by h.265 /HEVC, with the frame rate up to 30FPS. In this case, the code flow rate is 120Mbps. It is generally believed in the industry that the transmission rate of real-time large flow services such as UHD 8K online video should be 1.5 times of the code flow rate to guarantee the quality of service.

8K video is expected to support the frame rate up to 60FPS. In this case, the code flow rate is 350Mbps. The transmission rate should be approximately 525Mbps to guarantee the quality of 8K video.

Currently, the main code and decode scheme of 8K video in the industry is H.265, a new video coding standard developed by ITU-T VCEG after H.264. H.265 standard retains some of the original technologies in H.264 while improving some of the

related technologies to enhance the coding quality. It is generally believed that H.266 should be adopted as the code and decode scheme in the next generation of 8K video.

In 2018, enterprises including BOE launched display systems supporting 8K Super High Definition (SHD). The 2020 Tokyo Olympics and 2022 Beijing Olympics both will adopt 8K live broadcasting. Currently, where mobile phone screens have become the "first screen" for individuals, SHD online video supported by 5G technology will add mobile features for 8K technology. In addition, video sharing on mobile social networks, especially popular live broadcast platforms in China, will greatly benefit from the online live broadcast capacity using 5G technology. Now, 5G S-Module can fully meet these requirements.

In addition, WTTx is another way to support household 8K applications. 8K applications require bandwidths over 100Mbps. The NBN in Australia believes that the deployment of WTTx will save 30% to 50% of the cost of installing FTTH (fiber to the home). Verizon and AT&T in the US are also planning to deploy WTTx's 5G network service. Verizon believes that the difficulties associated with millimetre wave deployment will be reduced to an acceptable level with the maturing of certain other technologies (such as beam forming).

### 5.3 Real-time UHD Video Surveillance

With 4G wireless network transmission, surveillance devices can perform video surveillance in the mobile environment, such as police patrol car surveillance, traffic police surveillance, and personnel mobile command. 5G technology will further expand the applicability of SHD video surveillance in emergency response scenarios including urban security, urban emergency management, and major accident live broadcasting. For example, the current technology implements 4M video surveillance for trains and subways, which is poor in timeliness and clarity. 5G uRLLC scenario, featuring high reliability and low delay, will provide new technical support for scenarios like this. According to calculations, video surveillance at 6M, 8M pixels or even 4K resolution requires bandwidth above 50M, while real-time HD images at 8K 60fps require transmission bandwidth above 120M.

The requirements for 5G S-Module by video surveillance include:

- 1) The air-interface-based uplink bandwidth being no less than 40Mbps, which can support 4-way 4K HD;
- 2) The price shall not exceed 200RMB; It is better to keep the price of the current 4G module at around 150 for promotion.

- 3) Support electronic sim card, and replace physical sim with software number burning;
- 4) Gap delay <50ms @100km @1530bit
- 5) Support the national network communication frequency band;
- 6) The international frequency band is best if it can COMB.
- 7) Support GPS to clip and select;
- 8) The software has a standard excuse or SDK to facilitate docking with the platform;
- 9) Having a large-scale operator certificate or related certification;
- 10) Being compatible with 4G networks, including electrical characteristics and protocols.

## 5.4 Connected Drones

A variety of practical applications of drones have been developed since drones were used for live broadcasting at the G20 summit in Hangzhou, China. For example, Huawei uses drones to conduct observation and inspection of communication stations. Agritech companies use drones to monitor crops or spray pesticides.

There is still space for drones to be used to detect electromagnetic signals and heat. The current application mainly focuses on the exploration and monitoring of public buildings and their surrounding environments. The application of 5G can significantly increase data transmission, enabling drones to detect and transmit more parameters of different types with less delay. Drones equipped with LiDAR technology, for example, require bandwidth over 200M to support the real-time transmission of large amounts of data generated by LiDAR scans.

T-Mobile (as a 5G operator with a low frequency band of 600M), or operators including China Mobile, China Unicom, and China Telecom who are interested in building nation-wide 5G network, are expected to lead the application of eMBB applications depending on wide-area coverage. The eMBB application device is crucial for 5G S-Module.

## 5.5 Always connected PC

The portability and performance of computers has always been contradictory and required a weigh up of sorts. Strong performance means the computer will be more bulky, while high portability comes at the expense of computing and storage. However, cloud computing offers a whole new way to think about portable



computers. In many enterprises, the "desktop cloud" has become a pragmatic choice. Employees only need input and output devices, while computing and storage are done in the data centre. 5G service, equipped with transmission capability which is on par with wired transmission, will provide cloud computing solutions with better mobility. Wearable smart assistants or portable computers with only input and output devices will be supported by the cloud AI, thus breaking the contradictory constraints of performance and portability. In addition, the computing performance and convenience of these devices will be far superior to existing devices. Ordinary 5G S-Module can be used in such a way to meet the application scenario of ACPC.

5G Laptop based Eco-system target but not limited below cases;

1) Cloud Game



a)

- 2) Cloud Slicing Service: 4K/8K HID; Massive IOT etc
- 3) Smart City: Higher Capacity, More Mobility/ high reliability connections
- 4) Smart Office: Seamless Working; Remote Access/Sync etc
- 5) Smart Home: Family Data Centre
- 6) Laptop 5G Module Integrated Design
- 7) Band Support: TBD
- 8) Module Size: it's better standard M.2 30X42 S3
- 9) I/F: PCIE as preferred;
- 10) Have capacity for 4X4MIMO or Multi-MIMOs
- 11) Antenna:
  - a) Sub6G Antenna design integrated,
  - b) mmWave as better to have;
  - c) Have capacity to fall back 4G or 3G;
- 12) Better to have eSIM feature or data support;
- 13) Compatibility SA and NSA network;
- 14) Certification: Should cover 5G device mandatory certifications;
- 15) Battery life: better >XX H with 5G network;

## 5.6 Connected Automotive

Under the layout of operators, Internet manufacturers, and automotive manufacturers, the growth rate of the connected automotive market in China has

reached 50%. Connected automotive is a vertical service based on high-speed wide-area network, which is closely related to the development of 5G network. For example, autonomous driving requires a delay of less than 1ms, which falls within the requirement for 5G standards. China telecom conducted an autonomous driving test in Baiyangdian, Xiong'an New Area. Under the condition of 300-500Mbps downstream and network delay of less than 10ms, the application of autonomous driving technology with speeds of less than 60km/h can be supported.

The introduction of C-V2X technology provides the most important technical guarantee for the application of 5G in the automotive industry. Communication modes including PC5 interface and Uu interface can simultaneously meet the demand of cellular wide-area communication and short distance direct communication between terminals within the speed of 500km/h. The automotive grade 5G S-Module can be applied using vehicle-mounted communication tools.

## 5.7 Smart pos

Since being proposed by E-commerce enterprises including Alibaba and Jingdong, "New Retail" has witnessed rapid growth from a ten-billion market to a trillion market. The annual compound growth is expected to be as high as 160%. Smart hardware is represented by unmanned retail, smart POS and unmanned containers. These aspects require a lot of man-machine interaction and M2M work, including advertisement, identification of user behavior and payment security. Our 5G S-Module smart module with AP meets Smart POS requirements. POS manufacturers need only add a colored screen in order to make a Smart POS.

## 5.8 power grid

The application of 5G technology on the grid will mainly result in the improved capacity in three scenarios. First, the realization of smart distribution automation. Manual power distribution operations result in power outages for hours. The power outage time can be reduced to minute level by using the centralized power distribution automation on the fiber optic network. This solution requires the network time delay to be no longer than 100ms. However, fiber construction comes with high cost, complex engineering and a long business cycle. The application of 5G technology has the potential to realize smart distributed power distribution automation featuring high security isolation, ultra-low delay and no power failures. In addition, the cost for special network construction can be saved due to the shorter business cycle. Secondly, accurate load control. The traditional network removes load by cutting off the entire distribution line. In contrast, using accurate control,

non-important load can be cut off first to reduce the impact on important users as much as possible. The state grid operation specification requires that the load switch shall be completed within 650ms. At present, the optical fiber network uses about 400ms. 5G technology brings hope for more accurate control in less time. Thirdly, the collection of low-voltage electricity utilization information. Automatic collection of power consumption information in high frequency and high concurrency is required to introduce staggered tariffs and guide users in reserving and using power. In these three ways, 5G S-Module can also be used to meet the requirements of Smart Grid.

## 5.9 Robot

Mobile robots and mobile platforms, such as automatic guided vehicles (agvs), have numerous applications in industrial and internal logistics environments and will play an increasingly important role in future factories. Mobile robot systems are characterized by maximum mobility relative to the environment, with a certain degree of autonomy and perceptive ability, that is, they can perceive and respond to their environment.

Mobile robot systems can operate in indoor and outdoor areas as well as indoor and outdoor areas. These environmental conditions have an impact on the requirements of the communications system (such as switching processes) to ensure the required cycle time, and the main use of the interior is the transport of semi-finished products of light cargo, which can be measured in metres to hundreds of metres, possibly in different plants. The outdoor is mainly used to automate the port's container transport of unit-load vehicles, several meters to several kilometers, in the container terminal or open pit. Indoor and outdoor refers to the combination of factory buildings and open areas, such as traction vehicles running between inventory and production, cows/animal-feeding robots on farms, automatic forklifts, etc.

Mobile robots have the following potential requirements for network performance:

- 1) The requirements for delay, availability of communications services, and certainty are stringent. Communication service availability > 99,9999%, time delay specific requirements as follows
  - a) 1ms, precision collaborative robot motion control
  - b) 1ms to 10ms, machine control
  - c) 10ms to 50ms, co-driven
  - d) 10ms to 100ms, remote control for video operation
  - e) 40ms to 500ms, standard mobile robot operation and flow management cycle time jitter < 50%
- 2) For video frames in the remote control of video operation, the message size of the application layer is 15 kilobytes to 150 kilobytes. The size of all other

messages in all use cases, for example, control messages to the executor, is 40 to 250 bytes. The data transmission rate of each mobile robot: > 10 MBPS

- 3) There are very strict requirements for clock synchronization between different mobile robots.
- 4) Potentially high-density mobile robots.
- 5) Due to the mobility of robots, good 5G coverage is required in indoor (from basement to roof), outdoor (workshop/factory range) and indoor/outdoor environments.
- 6) The 5G system should support ground speed of user equipment up to 50 km/h.
- 7) The 5G system should support unified and clear parameters of interfaces for reliability monitoring.

## 6 Recommendations for 5G S-Module

Different industries have different requirements for 5G communication module. Through the investigation and analysis of the vertical industry, the requirements and application scenarios of 5G and 5G module in various industries were fully explored, and the following three types of modules can be achieved: basic type, smart type and all-in-one type. The features and application scenarios of the three types of modules are described below.

### 6.1 Basic type

In 5G era, the basic type of 5G module will be the most widely used module for most of scenarios such as Real-time UHD Video Surveillance, Connected Drones, Connected Automotive, Always connected PC, UHD 8K Online Video, and Industrial Router. The basic type of 5G module is recommended to be smaller than 60mm\*70mm, and provide 4 kinds of form factor: LGA, LCC, mini PCIe, and M.2, with high speed serial bus such as USB3.0 or PCIe.

### 6.2 Smart type

Applications such as artificial intelligence and Virtual & Augmented Reality require high performance computing power to process real-time data. Therefore, the smart type of 5G module is recommended to be smaller than 60mm\*80mm, provide 2 kinds of form factor with high speed serial bus: LGA and LCC+LGA, contain a processor operating at 1.3GHz or higher, more than 2GB of RAM, and more than 8GB of ROM.

### 6.3 All-in-one type

The All-in-one type of 5G Module is used as 5G USB dongle for laptop or PC. So other than the high speed serial bus, the All-in-one type of 5G module is recommended to provides a built-in antenna and a USB 3.0 port.

## 7 Conclusion

With the rapid development of communication technology, people's life will change dramatically. The era of 5G changing society is coming. The biggest difference between 5G and previous communication technologies lies in its closer connection with all walks of life. The era of interconnection of everything requires us to strengthen communication and communication with vertical industries, fully explore the needs and pain points of all walks of life, and drive social innovation through the innovation of communication technologies.

5G universal modules lower the threshold for adoption of 5G technology in all industries. At the present stage, there is no unified planning and design for the hardware interface, packaging and size of the terminal communication module, which will greatly affect the speed and scale of 5G communication capacity introduction in the industry. To accelerate the development of application scale of 5G industry, China mobile joint industry released the plan of "5G Superior Universal Module " at the GTI summit in June 2018.5G general module forms unified communication capability requirements, software and hardware technical requirements and module performance requirements through the integration of industry application requirements, so as to achieve the effect that industry users use and use, and will promote the industry to quickly realize 5G network connection.