Confidential

Independent Market Research on Global Wireless Communication Module Industry

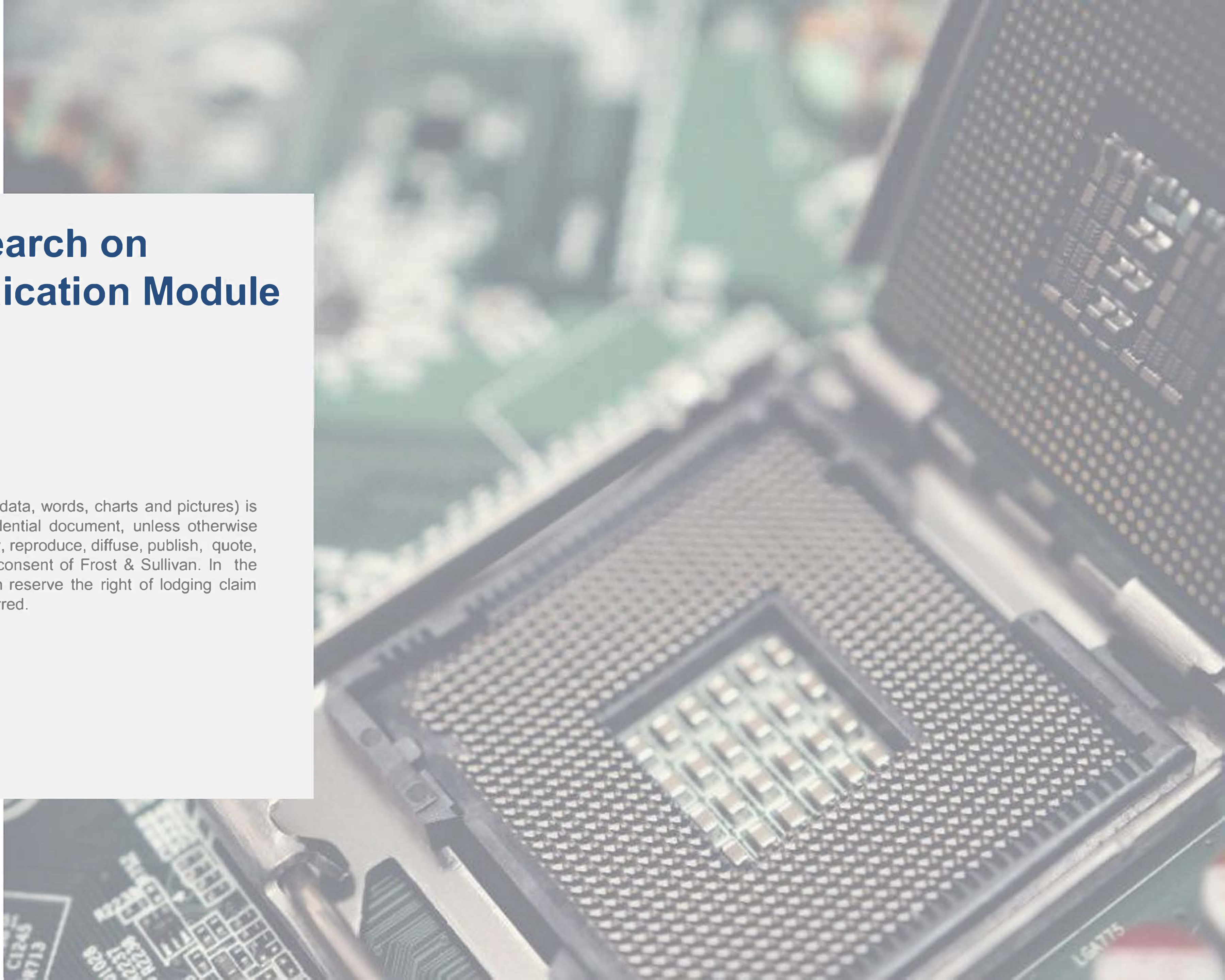
For MEIG 美格

Jan, 2026

Signature________________________

Date February 27, 2026

FROST & SULLIVAN
沙利文



Research Scope

Market Study of Global and China's Wireless Communication Module Industry

Research Period

- Base year: 2024
- Historical: 2020 to 2024
- Forecasting: 2025E to 2029E

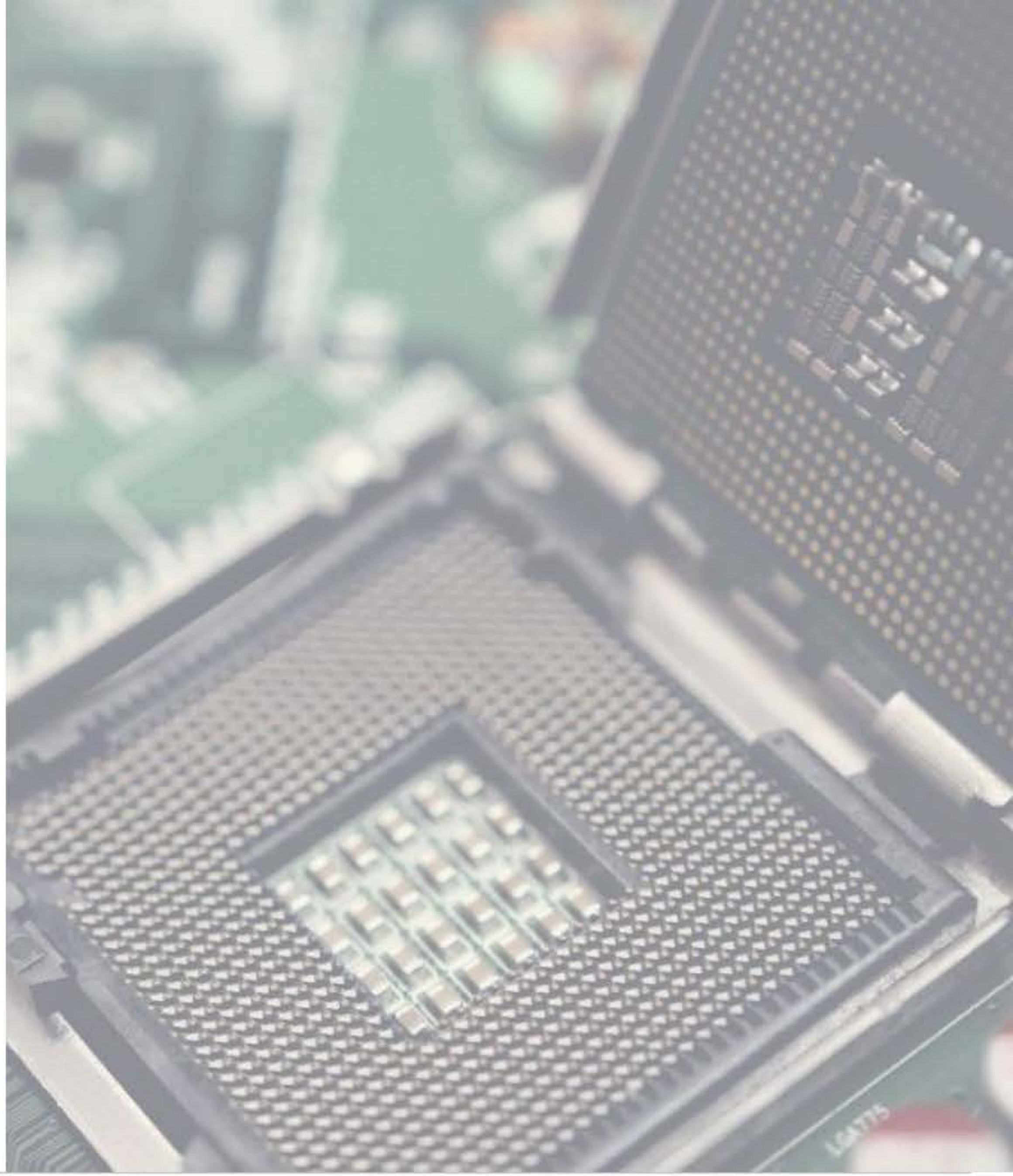
Service Market Scope

- Communication Module Market
    - Wireless Communication Module Market

Geographical Scope

- Global
- China

Agenda



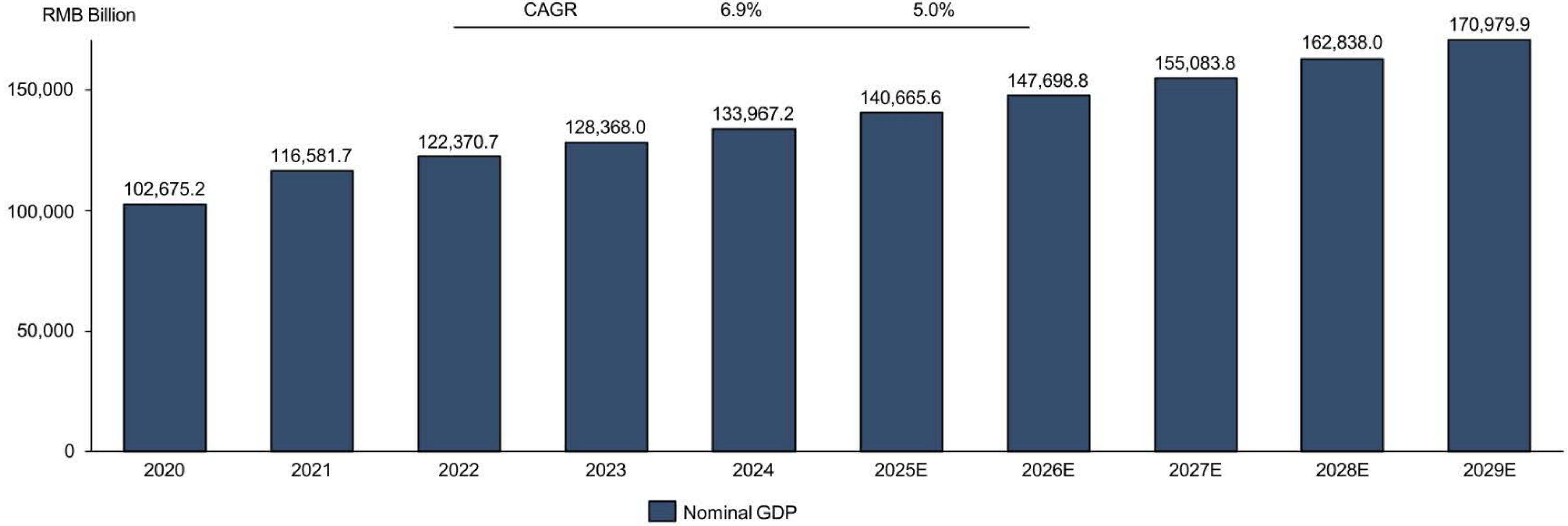
FROST & SULLIVAN 沙利文

Overview of Macroeconomic Environment in the PRC

Nominal GDP and Nominal GDP Per Capita (1/2)

Nominal GDP (China), 2020-2029E

	2020-2024	2025-2029E
CAGR	6.9%	5.0%



Source: National Bureau of Statistics of China, Frost & Sullivan

Overview of Macroeconomic Environment in the PRC

Nominal GDP and Nominal GDP Per Capita (2/2)

- The nominal GDP of the PRC has increased significantly from RMB102,675.2 billion in 2020 to RMB133,967.2 billion in 2024, indicating a CAGR of 6.9%. Despite the uncertainty regarding the tumultuous relationship between the United States and China, as well as the global pandemic that occurred from 2020 to 2022, the economic growth in the PRC has remained robust in recent years. This has been a result of effective government policies and the transformation of the domestic economy from an investment-driven to a consumption-driven economy, the growth of a consumption- driven economy has bolstered public confidence in consumer spending, and policies such as subsidies and tax exemptions for home purchases are also conducive to the growth of related real estate investment. Meanwhile, the rise in consumer spending suggests that the quality of life of the populace has been enhanced, which promotes the supply and innovation of high-quality residential, public, and commercial space in the property market, as well as the development of high-quality products and technological advancements in the construction industry. In the future, the nominal GDP of the PRC is forecasted to reach RMB170,979.9 billion by 2029, representing a CAGR of 5.0% from 2024 to 2029.
- The nominal GDP per capita increased considerably from RMB73.3 thousand in 2020 to RMB95.7 thousand in 2024, representing a CAGR of 6.8%, in alignment with the growth of the PRC's economy. The Chinese government aims to elevate its nominal GDP per capita to that of moderately developed countries in accordance with the "14th Five-Year Plan" (十四五规划). It is anticipated that the nominal GDP per capita will grow stably from RMB95.7 thousand in 2024 to RMB119.0 thousand in 2028,The national economy is anticipated to expand consistently in the future, in tandem with the sustained investment and consumption of local residents, as the economy is anticipated to recover from the global pandemic.

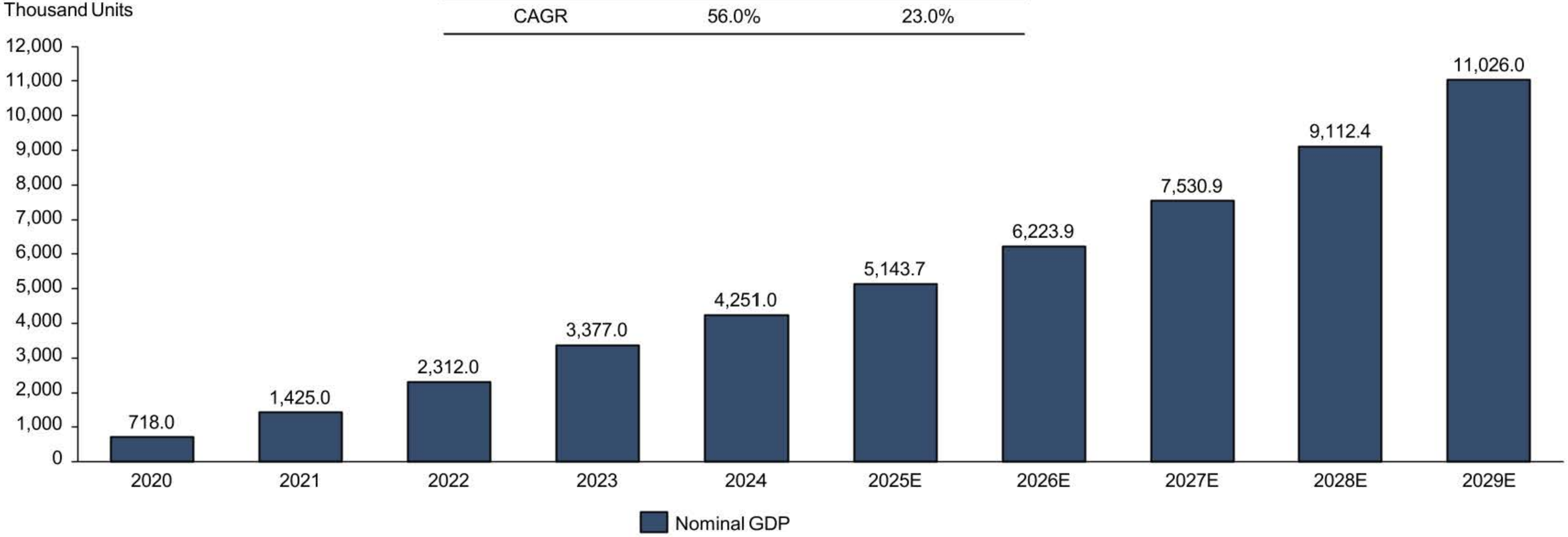
Source: National Bureau of Statistics of China, Frost & Sullivan

Overview of Macroeconomic Environment in the PRC

Number of 5G Base Stations (1/2)

Number of 5G Base Stations(China), 2020-2029E

	2020-2024	2025-2029E
CAGR	56.0%	23.0%



Source: Frost & Sullivan

Overview of Macroeconomic Environment in the PRC

Number of 5G Base Stations (2/2)

- The number of 5G base stations in the PRC has increased significantly from 718.0 thousand in 2020 to 4251.0 thousand in 2024, indicating a CAGR of 56.0%. China's 5G base station count surged as the government's infrastructure initiative and favorable spectrum allocations prompted operators to prioritize nationwide 5G rollout. Subsidies and streamlined permitting accelerated deployment in urban centers and industrial parks, meeting the explosive demand for high-bandwidth, low-latency mobile internet and enterprise applications. In the future, the shift to 5G Standalone architecture and the advent of 5G-Advanced will drive further base station expansion to support ultra-reliable low-latency communications and network slicing for vertical industries such as manufacturing, automotive, and smart cities. Thus, the number of 5G base stations will reach 11026.0 thousand in 2029, indicating a CAGR of 23.0% from 2025 to 2029.

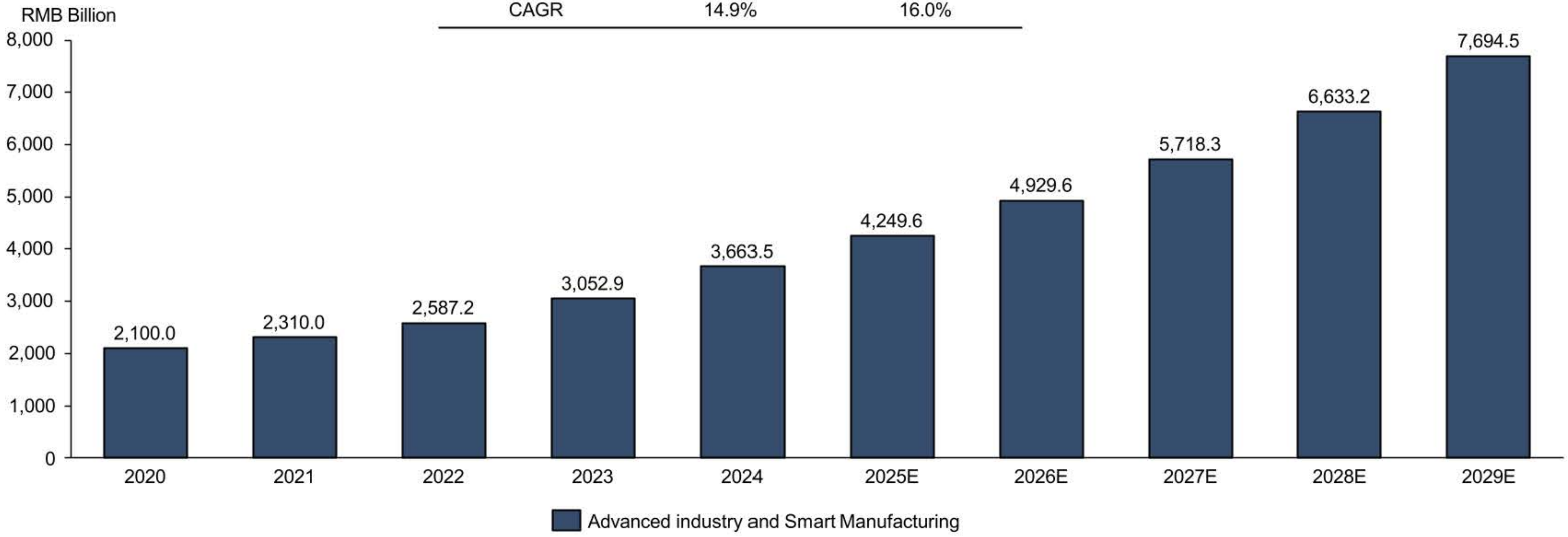
Source: Frost & Sullivan

Overview of Macroeconomic Environment in the PRC

China's Advanced industry and Smart Manufacturing (1/2)

Advanced industry and Smart Manufacturing(China), 2020-2029E

	2020-2024	2024-2029E
CAGR	14.9%	16.0%



Source: Frost & Sullivan

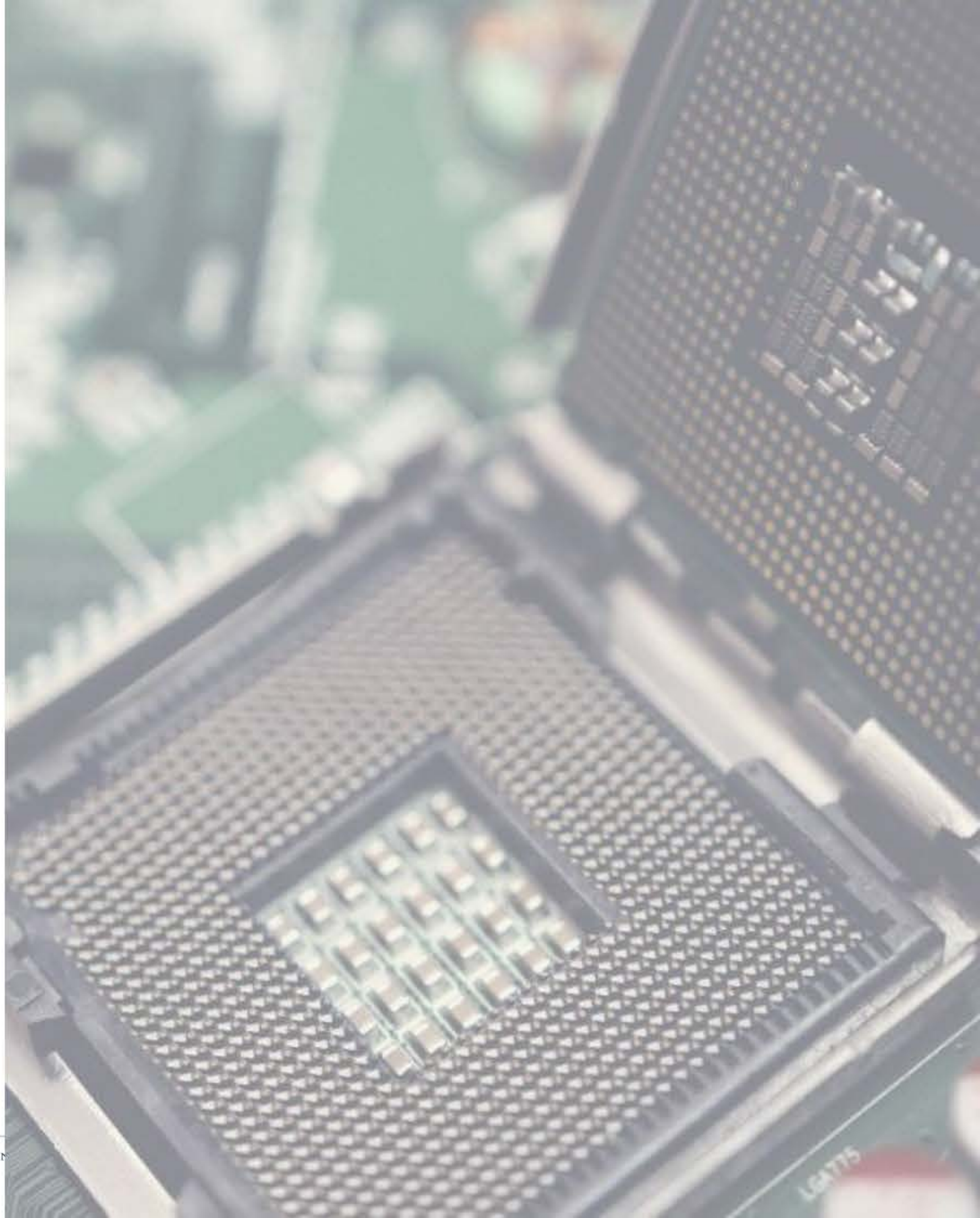
Overview of Macroeconomic Environment in the PRC

China's Advanced industry and Smart Manufacturing (2/2)

- The market size of advanced industry and smart manufacturing in the PRC has increased significantly from RMB 2100.0 billion in 2020 to RMB 3663.5 billion in 2024, indicating a CAGR of 14.9%. China's advanced industry and smart manufacturing market expanded rapidly under supportive government policies such as "Made in China 2025", which incentivized digitalization, automation, and AI integration across factories. In the future, the rollout of 5G-Advanced, edge AI, and digital twin technologies will enable real-time control and predictive maintenance at scale, while increasing emphasis on green manufacturing and supply-chain resilience will spur further upgrades in intelligent production lines. Thus, the market size of advanced industry and smart manufacturing will reach RMB 7694.5 billion in 2029, indicating a CAGR of 16.0% from 2025 to 2029.

Source: Frost & Sullivan

Agenda



Macro Industry Background

The Trend of AI Development (1/2)

4 **Embodied AI and Physical AI Era**

AI is Fully Integrated with the Physical World, and the Ability to Interact with the external world through Multimodal means has become the Core

3 **On-device Intelligence Era**

More Independent Intelligent Entities, Increased Information Interaction Interfaces, and Deepened Logic

2 **Edge Intelligence Era**

Lower Latency, Expanded Application Scenarios

1 **Cloud Intelligence Era**

Core Computing-power, Foundation For AGI

Virtual World ⟷ **Physical World**

	Cloud Intelligence	Edge Intelligence	On-device Intelligence	Embodied AI and Physical AI
On-device Module's AI Computing-power	-	-	Within Tens of TOPS Level	Ten to Hundreds of TOPS Level
Scale of Connection Count	1 billion	3 billion	10 billion	40 billion
Data Transmission	4G Dominant	4G-5G	5G Dominant	5G-6G

Source: Frost & Sullivan

Macro Industry Background

The Trend of AI Development (2/2)

- **The evolution from cloud and edge computing to embodied AI and physical AI:**

AI is transitioning from the virtual world to the physical world. The AI technology system has evolved from the cloud intelligence stage supported by centralized computing-power to the on-device intelligence stage of distributed collaborative processing. It is gradually building a collaborative system based on cloud-edge-device architecture, deploying computing-power closer to terminal equipment. AI models with physical carriers will perceive the real world with more detailed granularity and interact with it, corresponding to massive computing and data transmission demands.

AI computing-power will shift from “centralized training” to “local inference”. This trend is driving a fundamental transformation in the role of wireless communication modules. Wireless communication modules are no longer just communication interfaces but are taking on the role of local inference and intelligent perception computing tasks.

- **Core driving scenarios continue to upgrade:**

In different stages of AI development, the growth of the wireless communication module market is driven by different scenarios. For example, during the stage of moving from cloud to edge, the market focus is on the coverage of communication, communication stability, and transmission speed, with mobile broadband as the core driving scenario. In the on-device intelligence era, AI is gradually migrating to terminal devices, unlocking the vast application space of general IoT and ICV.

- **Data transmission speed, device connection numbers, and the overall scale of total computing-power are improving:**

The number of global smart terminal connections is expected to increase from the 1 billion level to over 40 billion, driving communication modules to support higher density device access. On-device module’s AI computing-power has evolved from within the level of tens to hundreds of TOPS. The collaborative leap of connection density, data traffic, and computing intensity is jointly driving the continuous upgrading of the communication module industry.

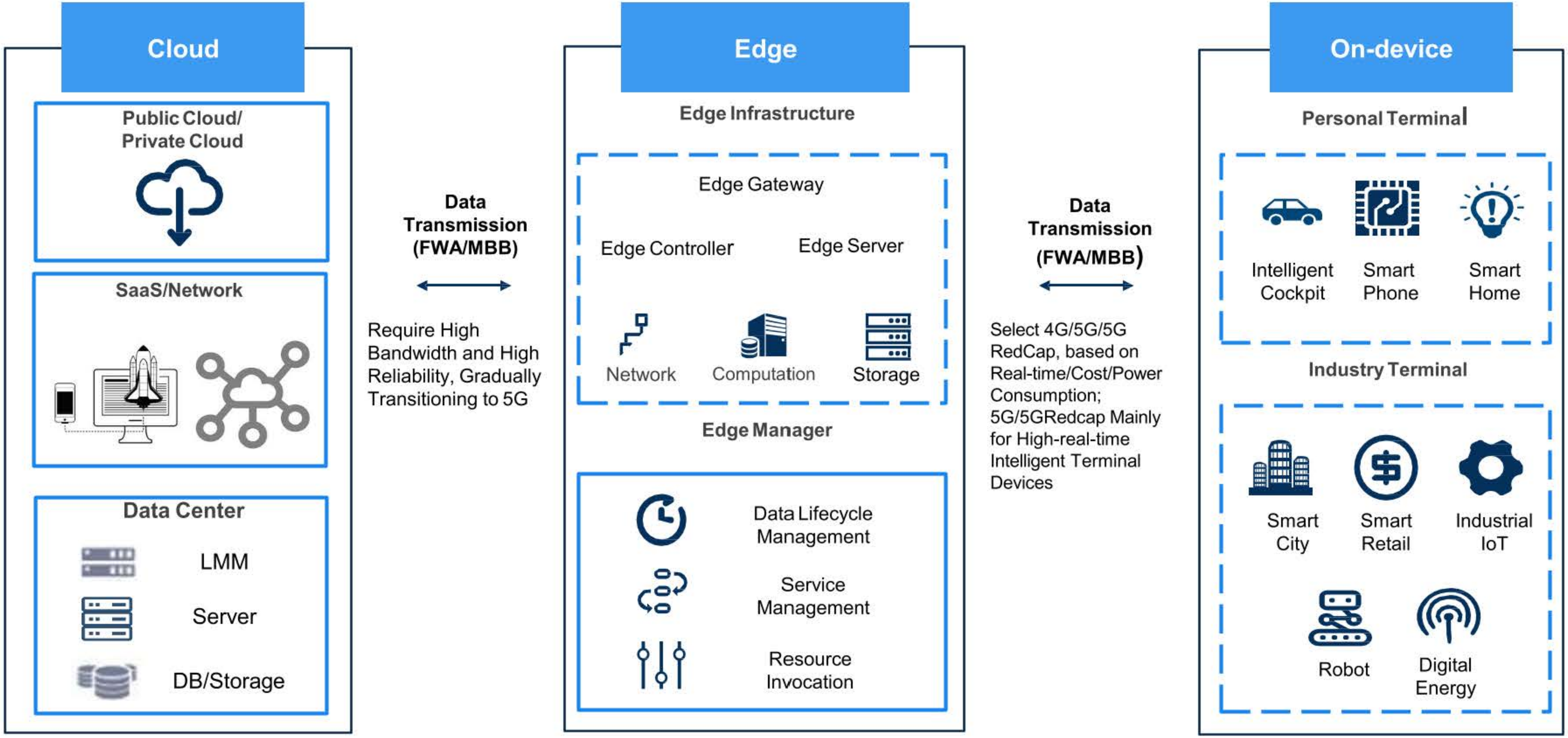
- **On-device AI computing-power and high-speed data transmission have become essential basic capabilities:**

We are currently in a critical development phase of on-device intelligence. With AI model migrating to devices, the competitive fields of smart modules are undergoing structural changes: single-module AI computing-power continues to upgrade, and will gradually approach the hundred TOPS threshold in the future; in the communication field, it is evolving from 4G/low-speed WiFi to high-speed low-latency communication protocols such as 5G, 5G-A and 5G RedCap; in addition, downstream applications are putting forward higher requirements for power consumption, packaging size, and temperature range adaptability, driving module products to iterate in the dual directions of high performance and high adaptability.

Source: Frost & Sullivan

Macro Industry Background

Wireless Communication Modules are part of the Important Infrastructure of the AI Intelligent Ecosystem (1/2)



Source: Frost & Sullivan

Macro Industry Background

Wireless Communication Modules are part of the Important Infrastructure of the AI Intelligent Ecosystem (2/2)

- **Development background of wireless communication modules:**

In the context of continuous deepening of digital transformation and expanding intelligent applications, the technical form of wireless communication modules has undergone a systematic evolution from "connection" to "computation". Early wireless communication modules primarily handled basic data transmission functions, widely applied in machine-to-machine communication and early-stage IoT scenarios. With the popularity of 5G cellular networks, they provide faster, more stable, and more secure wireless connections for application scenarios such as general IoT, ICV, and wireless broadband. On this basis, the accelerated deployment of AI further changes the functional positioning of wireless communication modules in the system architecture, driving the accelerated development of module forms with AI processing capabilities.

- **Cloud-edge-terminal architecture and data transmission mode:**

Cloud-edge-terminal architecture is a distributed model integrating cloud computing, edge computing, and terminal devices. The cloud is responsible for handling complex computing and big data storage (such as AI model training), while the edge layer completes local real-time analysis and wireless broadband connections. The terminal layer encompasses personal devices and industry terminals, performing perception, control, and local inference of the physical world. With AI models increasingly shifting to the end side and the continuous evolution of edge-cloud collaborative architectures, the data flow between cloud, edge, and end requires higher network capabilities. FWA and MBB, as next-generation wireless broadband access methods, based on 5G and 5G RedCap communication standards, provide high-speed wireless connections for smart terminals, effectively supporting typical application scenarios such as high-definition video transmission, task command delivery, and real-time data interaction.

Source: Frost & Sullivan

Macro Industry Background

On-device Intelligence Era Core Driving Scenarios Requirements for Module Capabilities

- **On-device AI market size**

On-device AI technology deploys AI functions to various terminal devices such as sensors and IoT terminals, enabling them to perform local data processing and decision-making. The global on-device AI market has experienced explosive growth, increasing from RMB90.2 billion in 2020 to RMB251.7 billion in 2024, with a CAGR of 29.3%. This growth is expected to accelerate further, with the market size projected to surge from RMB321.9 billion in 2025 to RMB1,223.0 billion in 2029, achieving a CAGR of 39.6%. Meanwhile, the China's on-device AI market has followed a similar upward trajectory, increasing from RMB23.6 billion in 2020 to RMB61.4 billion in 2024. Looking ahead, the Chinese market is expected to grow faster than the global market, rising from RMB80.2 billion in 2025 to RMB307.7 billion in 2029, with a CAGR of 39.9%. The rapid expansion of the on-device AI market is directly driven by its accelerated adoption in typical scenarios such as general IoT, ICV, and robotics. These fields require local inference, low-latency responses, and intelligent control, which align closely with the characteristics of on-device AI, forming its primary growth drivers.

Source: Frost & Sullivan

Macro Industry Background

Upgrade Logic of Key Application Scenarios of the Wireless Communication Modules in the On-Device Intelligence Era (1/2)

Key Application Scenarios

The Upgrade Logic of Wireless Communication Modules

General IoT

- ✓ Smart retail equipment, Smart Logistics
- ✓ Industrial IoT, Consumer IoT
- ✓ Sharing Economy
- ✓ …

1. From Basic Connectivity to smart application Evolution
2. From Single Mode to Multi-mode Convergence Evolution
3. From One-way Upload to on-device Collaboration Evolution

ICV

- ✓ Intelligent Cockpit
- ✓ In-Vehicle T-Box
- ✓ …

1. From Communication Components to Intelligent Converged Platforms Evolution
2. From Peripheral Connection to Safety Control Hub Evolution

Communication Capabilities Supporting Intelligent Scenario Upgrades

Wireless Broadband Modules

- ✓ 4G/5G FWA
- ✓ Mobile Broadband
- ✓ …

1. From Basic Connectivity to High-speed Low-latency Communication Evolution
2. From Single Cellular Mode to Multi-protocol Convergence Evolution
3. From Passive Connection Modules to Network Intelligent Nodes Evolution

Source: Frost & Sullivan

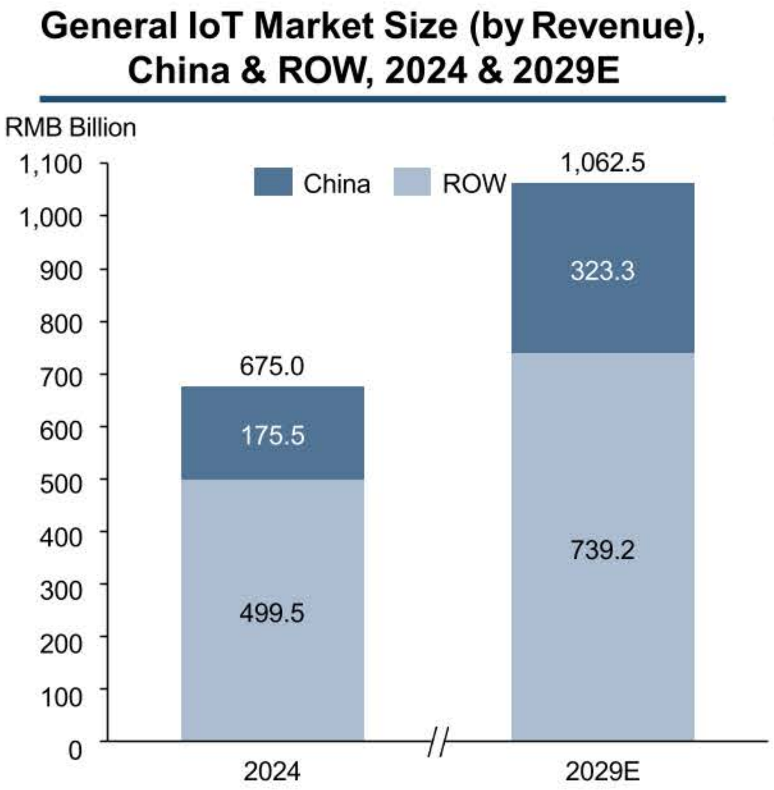
Macro Industry Background

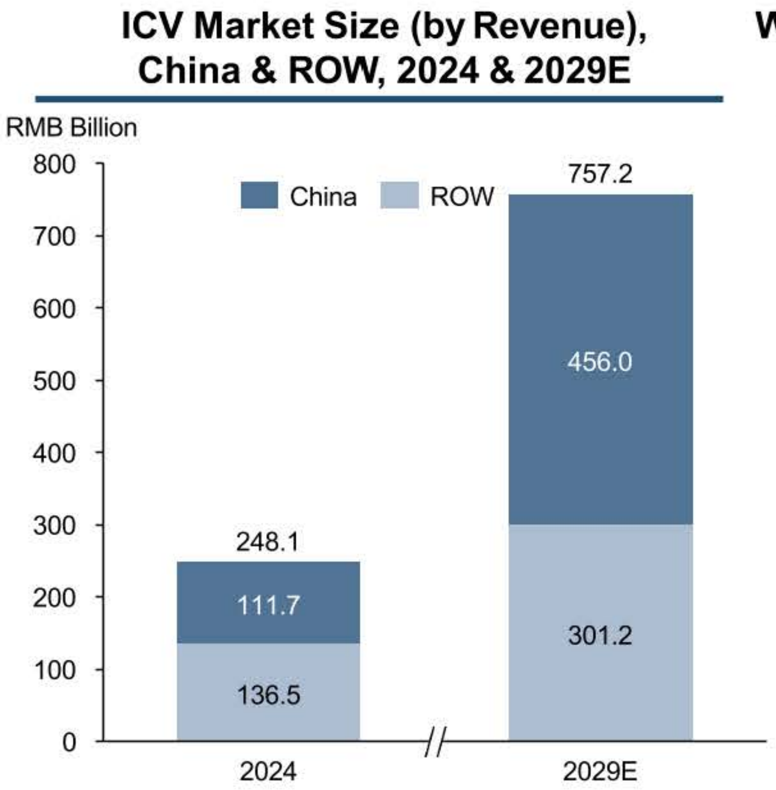
Upgrade Logic of Key Application Scenarios of the Wireless Communication Modules in the On-Device Intelligence Era (2/2)

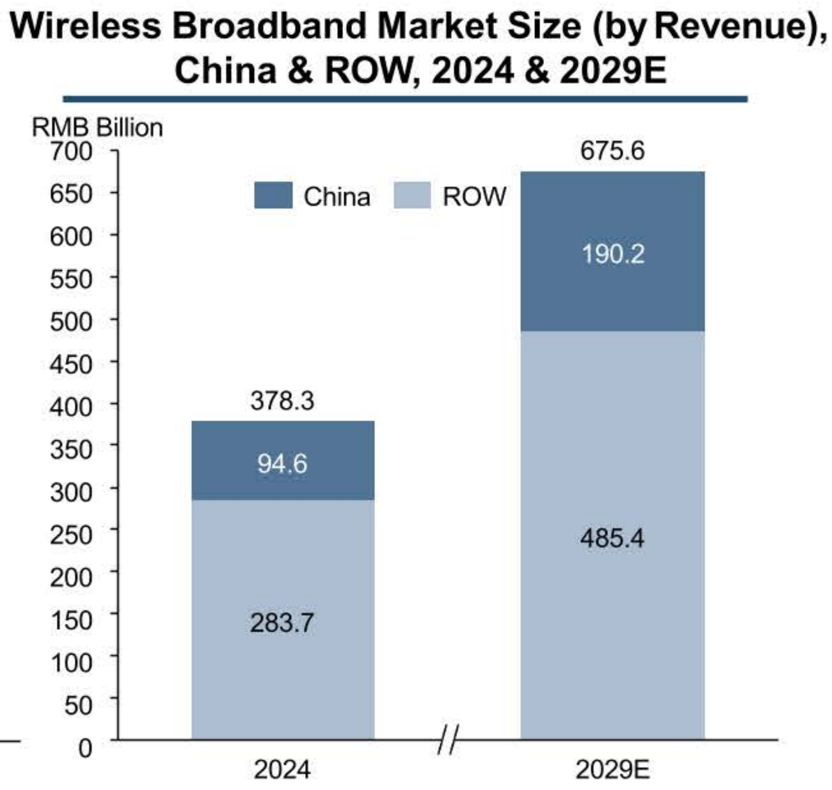
General IoT:	• The global number of connected devices is rapidly increasing in the era of on-device intelligence, and is expected to reach tens of billions. Communication modules are evolving from “simple connectivity” to “local light intelligence,” performing initial AI inference and status judgment at the terminal. With the maturity of the terminal-edge-cloud collaborative architecture in the future, modules will possess data filtering and edge preprocessing capabilities, enabling more efficient collaborative processing between local and cloud ends.
ICV:	• Intelligent cockpit and intelligent connectivity are core carriers of on-device intelligence applications in ICV. While 4G in-vehicle modules met basic requirements for streaming media playback and remote diagnostics. However, in the on-device intelligence era, wireless communication modules are evolving from 4G to 5G. The wide coverage and high communication capabilities of 5G enable faster, lower-latency data exchange both inside and outside the vehicle, providing more stable support for features such as multi-screen interaction, software updates. As such, wireless communication modules have become critical enablers for the evolution of ICV in the on-device intelligence era.
Wireless Broadband (FWA/MBB):	• Globally, wireless broadband access has become the mainstream choice due to its rapid deployability, controllable costs, and absence of need for large-scale wired infrastructure. As user demands for high-definition video, real-time interaction, and remote collaboration continue to rise, communication modules are accelerating their transition from 4G to 5G, to 5G-A and to 5G RedCap to deliver higher bandwidth, lower latency, and better energy efficiency. With the continuous improvement of 5G network coverage, module functions are evolving from single connectivity to intelligent network nodes with edge caching, protocol scheduling, and security management capabilities, serving as the core foundation for supporting the sustained expansion of the global wireless broadband market.

Macro Industry Background

Current core driving scenarios (1/2)







FROST & SULLIVAN
沙利文

Macro Industry Background

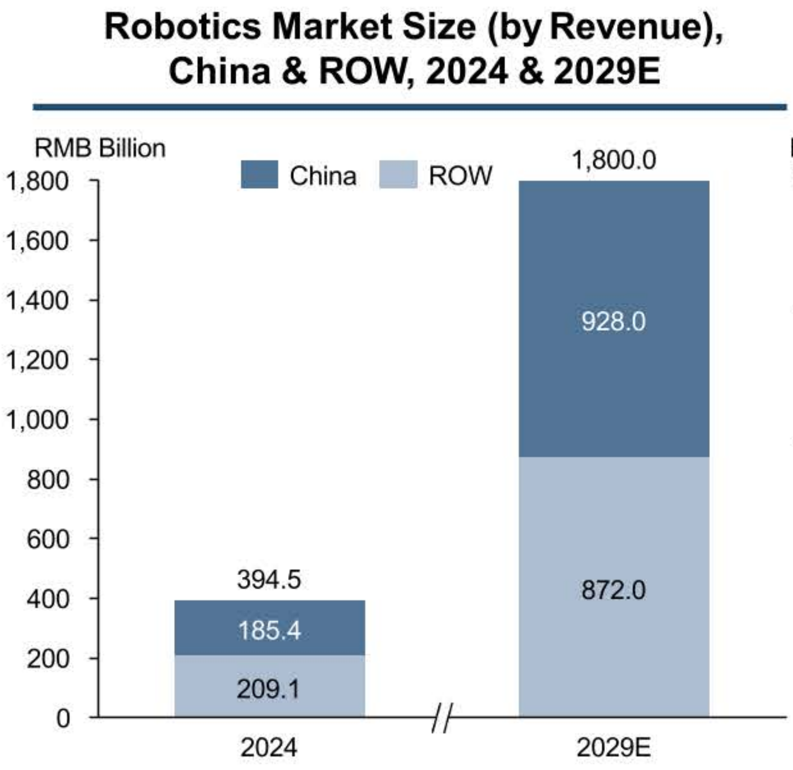
Current core driving scenarios (2/2)

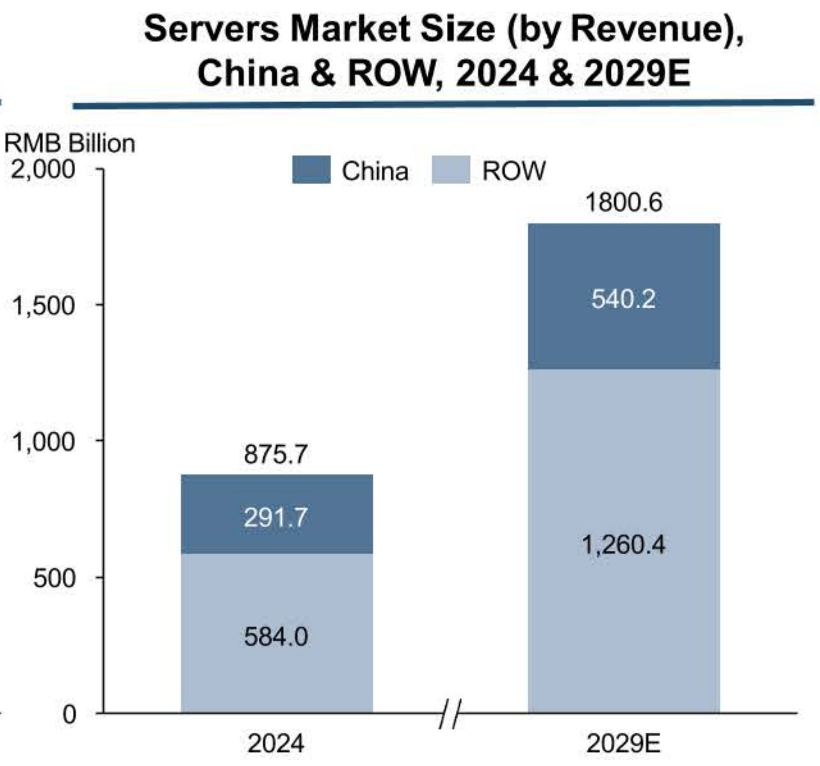
- **General IoT:** The diversity of general IoT terminal types is increasing, covering numerous sub-sectors such as industrial control and Smart Cities. On-device AI has become a key pathway to enhance device intelligence levels now, driving module products to evolve towards integrated computing-power, multi-protocol support, and edge algorithm adaptation, which imposes higher requirements on modules' edge processing capabilities and software-hardware integration. In China, the General IoT market is experiencing rapid expansion driven by national digital infrastructure policies and widespread industrial digitalization, resulting in a strong increase in connected devices, and the ROW market is larger in scale but growing at a steadier pace, with consistent demand from industrial IoT and smart city applications in developed economies such as North America and Europe.
- **ICV:** With the rapid penetration of functions such as intelligent cockpit in mid-to-high-end vehicles, OEMs are placing emphasis on high data rates, low latency, and local AI inference for in-vehicle modules. In on-device AI tasks such as multi-modal perception and real-time inference, high-computing-power modules are gradually replacing traditional communication modules, becoming critical nodes in intelligent architectures. Particularly in supporting automotive-grade interfaces, modules face higher comprehensive performance requirements. China's ICV market is accelerating due to the rising penetration of intelligent electric vehicles in domestic brands, driving strong demand for automotive-grade modules; the ROW markets started earlier and have a larger installed base, but face regulatory constraints and slower model renewal cycles, resulting in more moderate growth.
- **Wireless Broadband (FWA/MBB):** The communication capabilities of wireless broadband have become the core infrastructure for intelligent scenario upgrades, serving as a key enabler for connecting terminal intelligence and system collaboration. FWA/MBB are gradually replacing traditional wired broadband access, with rapid growth in demand for high data rates, multi-user concurrency, and remote management capabilities in households and enterprises. Wireless communication modules not only need to support multi-mode fusion communication such as 5G and Wi-Fi 6 but also need to undertake intelligent functions like user behavior analysis and local data scheduling, driving modules to evolve towards the "communication + edge intelligence" direction. The ROW markets, particularly in emerging regions like Southeast Asia and Africa, are seeing faster growth than China due to limited fixed-line infrastructure and surging demand for cost-effective broadband alternatives.

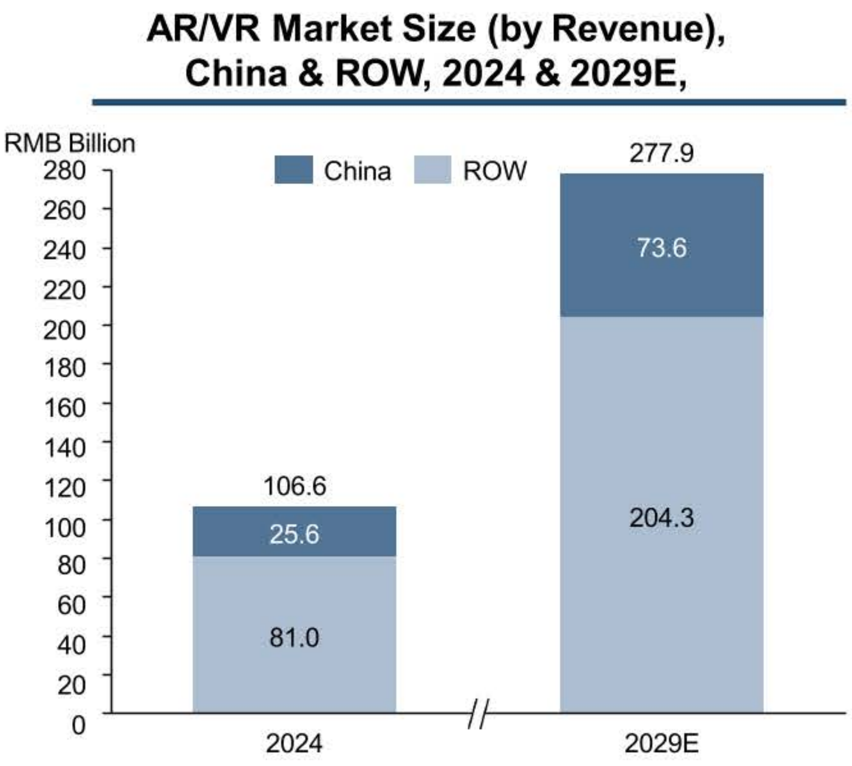
Source: Frost & Sullivan

Macro Industry Background

Future high-potential driving scenarios (1/2)







FROST & SULLIVAN
沙利文

Macro Industry Background

Future high-potential driving scenarios (2/2)

- **Robots:** As AI evolves from perception and understanding to autonomous decision-making and physical interaction, robots have become the most direct embodiment of AI modules and edge computing capabilities, widely applied in various operational scenarios. The demand for real-time and stable local AI inference and command control in robot terminals drives module products to develop towards integrating AI computing-power, sensor interfaces, and control scheduling capabilities. In China, the robotics market is undergoing rapid expansion beyond industrial applications, with strong policy support and demand surges in service, logistics, and public sector use cases; the ROW markets are more concentrated in industrial robots with slower adoption in non-industrial segments, leading to a narrower application scope and more moderate growth.
- **Servers:** Under the backdrop of rapid evolution in large AI models, server architectures are accelerating their shift from centralized computing-power to edge intelligence. As critical nodes in server systems responsible for local inference, parameter caching, and task scheduling, edge servers are increasingly becoming a critical component of the AI computing-power infrastructure. Edge servers impose higher demands on wireless communication modules in terms of high-speed data transmission, low latency, and multi-link reliability, making these module products an essential underlying support component for the stable operation of edge computing-power. Looking ahead, next-generation lightweight servers optimized for AI inference acceleration and edge deployment will widely integrate wireless communication modules. This integration will not only enable remote manageability and flexible deployment but also unlock significant market potential within ubiquitous intelligent infrastructure. In China, the growth of servers is fueled by localized AI deployments, alongside increased demand for domestically controlled computing infrastructure; the ROW markets benefit from the large-scale deployment of AI inference workloads by global tech giants, with stronger momentum in modular edge server adoption and wireless module integration.
- **AR/VR:** AR/VR devices, as representative forms of the integration of generative AI and immersive interaction, require support for high-intensity tasks such as ultra-high-definition video rendering, low-latency feedback, and real-time environmental sensing, imposing stringent requirements on local computing-power and wireless communication modules. To meet the collaborative demands of edge image processing and semantic understanding, module products must possess high-bandwidth, low-latency, and stable connection capabilities, while supporting multi-protocol access fusion access to ensure the smoothness and interactivity of cross-scenario immersive experiences. China's AR/VR market growth is tempered by limited consumer adoption and underdeveloped high-end hardware ecosystems, with demand concentrated in education and cultural tourisms; By contrast, ROW markets, particularly North America, are experiencing faster growth supported by flagship product launches from global tech giants and the convergence of generative AI and immersive interaction.

Source: Frost & Sullivan

Agenda

1 China Macro Economic Overview

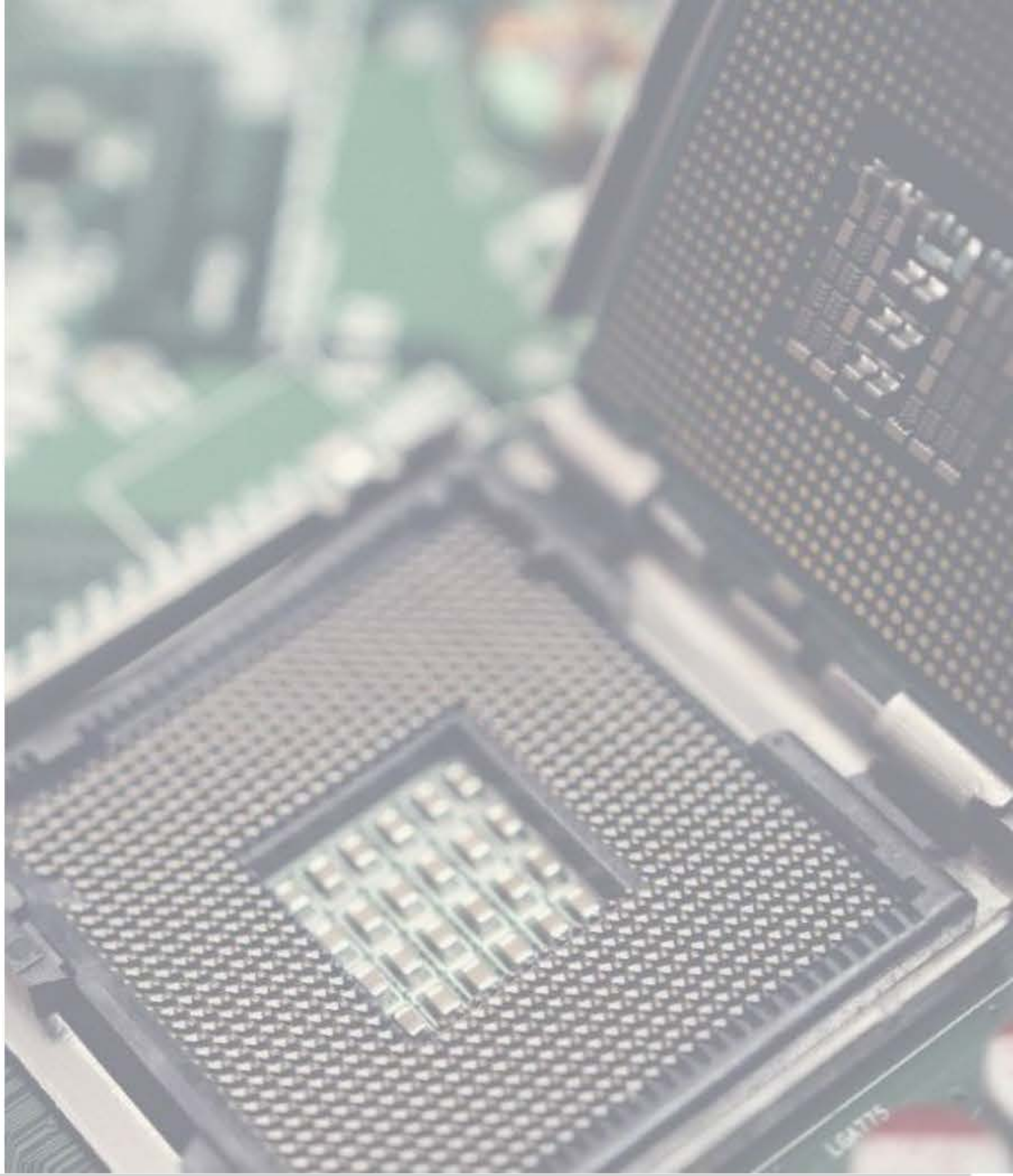
2 Macro Industry Background

3 **Global Wireless Communication Module Market Overview**

4 Global Data Transmission Module, Smart Module And High-Computing-power Module Market Overview

5 Market Competition Analysis

6 Appendices



FROST & SULLIVAN 沙利文

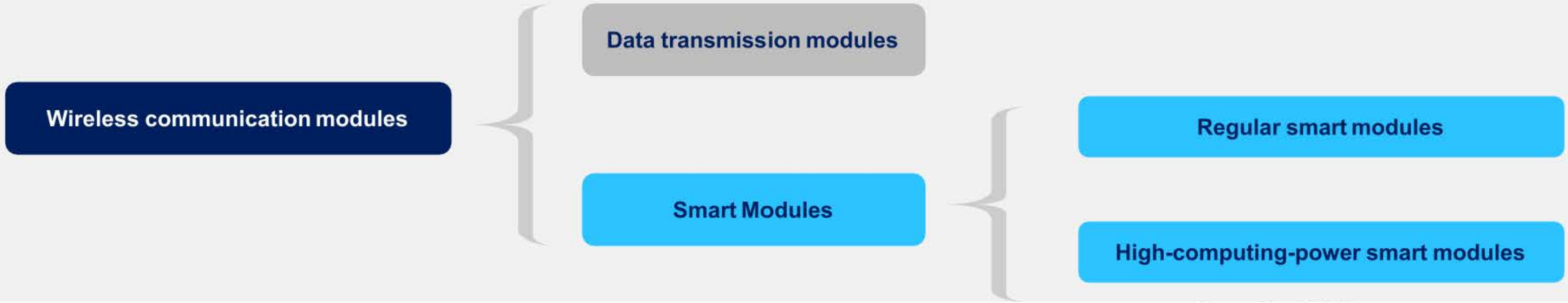
Global Wireless Communication Module Market Overview

Definition, classification and introduction of wireless communication modules (1/2)

- **Definition of wireless communication modules:** Communication modules refer to integrated hardware units that combine baseband chips, RF chips and related components to provide plug-and-play cellular or short-range wireless communication functions for terminal products. Among them, wireless communication modules integrate core elements such as RF transceivers, baseband processors, antenna interfaces, and protocol stacks, providing communication and local computing functions, and supporting application scenarios such as general IoT, ICV wireless broadband, and robotics. Wireless communication module can be classified into data transmission modules and smart modules based on their functions and levels of intelligence.
- **Data transmission modules:** Data transmission modules refer to traditional wireless communication modules primarily responsible for data transmission. It focuses on secure and high-throughput data exchange prioritizing the reliable connection of raw or pre-processed data between edge devices and integrated systems. These modules can be categorized by network standards into 2G 3G 4G and 5G types with 4G and 5G modules currently dominating the market.
- **Smart Modules:** Smart modules refer to hardware modules that integrate application processors (CPU), operating systems and open development environments on top of traditional wireless communication modules. They enable terminal devices to perform local data processing, image rendering and application execution edge intelligence capabilities. While smart modules have evolved to provide enhanced computing power and open operating environments, they fundamentally retain wireless connectivity functions inherited from traditional communication modules. Therefore, they are recognized in the industry as a core sub-category of wireless communication modules, despite their extended capabilities beyond connectivity.

  The industry typically classifies smart modules based on chip platforms, integrated systems and computing-power scale. With the development of downstream customer needs, the integrated computing-power measured by TOPS has gradually become an important criterion for smart modules while the presence of communication capabilities is no longer a necessary condition for defining smart modules.

Definitions and Classifications of wireless communication modules



Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Definition, classification and introduction of wireless communication modules (2/2)

- **Regular smart module:** Primarily used to support lightweight applications such as basic data collection, edge control, audio and video playback, and graphical user interface (GUI) interaction. Leveraging mid-to-low power consumption CPU platforms tailored for scenarios with lower computational demands, such as smart wearables and smart home systems, with a focus on balancing system integration and cost efficiency.
- **High-computing-power Smart module:** An intelligent module integrating a computing power of 8 TOPS or above, with dedicated AI accelerators like TPU and NPU embedded, capable of performing machine learning inference terminal-side or hosting AI models. This kind of module achieves efficient real-time analysis and processing by locally loading and optimizing pre-trained models. With the support of computing power, terminal devices can perform intelligent processing of high-density information at the edge or locally. This significantly reduces reliance on cloud resources, enhances system responsiveness and data privacy protection, and strongly supports AI deployment across various terminals. The industry generally uses 8 TOPS as the technical starting point for high-computing-power smart modules. Mainstream scenarios that need 8 TOPS or higher power for stable deployment and good commercial operation include, intelligent cockpit interactive AI model deployment, and XR device-side generative image model deployment.

	Data transmission module	Smart module	High-computing-power smart module
Components	Baseband chips, memory chips, RF chips	SoC (integrated CPU, GPU, etc.), supporting memory chips, RF chips, PCBs, power management chips	High-performance SoC (integrated NPU or AI accelerator), supporting large-capacity memory chips, RF chips, PCBs, power management chips
Local processing capability	Weak	Equipped with a general-purpose CPU, it supports basic applications such as multimedia, multiple cameras, and multi-screen display	Integrated with high-performance heterogeneous computing units, it supports on-device complex AI model inference and features edge intelligence capabilities such as high-density data processing and image recognition
Smart application capability	Weak	It can run smart functions, such as simple recognition and basic speech processing	It can deploy complex AI models locally, including tasks such as multi-stream video analysis, target detection, multimodal perception fusion
Computing power	/	<8 TOPs	≥8 TOPs

Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Wireless Communication Module Industry Value Chain Analysis (1/2)

Upstream

- Chips
  - Baseband chips
  - RF chips
  - Memory chips
- PCB
- Structural component

Midstream

- Wireless Communication Module

Downstream

- General IoT
  Such as smart logistics, smart retail device, smart city
- ICV
  Such as Intelligent Cockpit , In-vehicle T-Box
- Wireless Broadband (FWA/MBB)
  Such as 4G/5G FWA
- Others

Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Wireless Communication Module Industry Value Chain Analysis (2/2)

- The wireless communication module industry chain comprises three segments: upstream dominated by core components such as baseband chips and RF chips, primarily supplied by chipmakers and component vendors; midstream providing standardized module designs and customized solutions, led by module suppliers specializing in hardware and software integration; downstream connecting end-application scenarios including general IoT, ICV wireless broadband, and robotics.
- Positioned in the midstream of the industry chain, wireless communication modules serve as the vital link between upstream chips and downstream application scenarios. Its core function is to integrate various key components, such as baseband chips, RF devices, antennas, and memory, through hardware and software integration. These components are then encapsulated into standardized or customized module products. This process provides stable and high-performance wireless communication capabilities, making it easier for downstream terminal manufacturers to quickly deploy them in various smart devices. Wireless communication modules not only perform the important functions of technical integration and system adaptation, but also serve as a critical enabler for the large-scale implementation of advanced communication technologies such as 5G and IoT.
- As downstream customers' requirements for product intelligence, customization, and integration continue to rise, wireless communication module enterprises not only need to provide connectivity capabilities but also possess comprehensive technical capabilities such as system integration, heterogeneous computing power deployment, and software adaptation. The value creation stages are gradually shifting from upstream standard chip supply to midstream module manufacturers, with modules becoming a key hub for facilitating collaborative innovation between upstream and downstream players and driving application implementation.

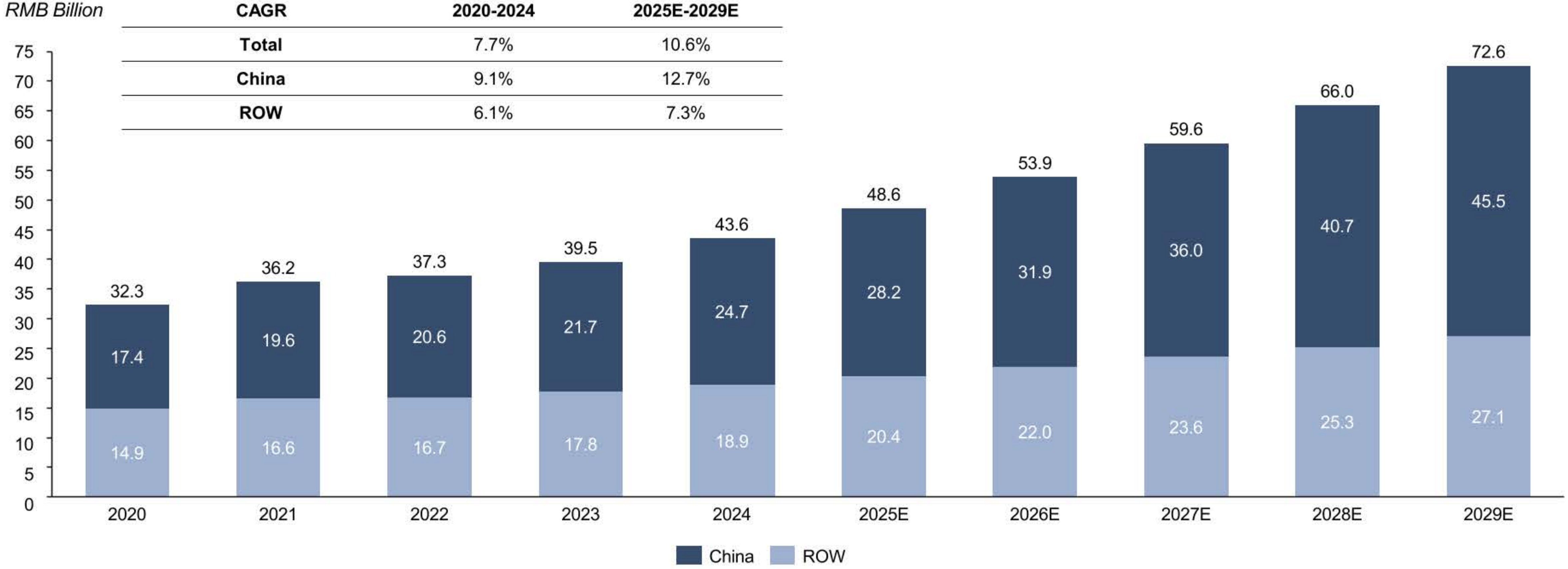
Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Type, 2020-2029E (1/2)

Global Wireless Communication Modules Market Size, 2020–2029E, by Revenue

CAGR	2020-2024	2025E-2029E
Total	7.7%	10.6%
China	9.1%	12.7%
ROW	6.1%	7.3%



Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Type, 2020-2029E (2/2)

- The global wireless communication module market has witnessed rapid growth, expanding from RMB32.3 billion in 2020 to RMB43.6 billion in 2024, with a CAGR of 7.7%. From a regional perspective, China's market size has surpassed that of other regions in the world, growing from RMB17.4 billion in 2020 to RMB24.7 billion in 2024, achieving a CAGR of 9.1% during the period. The global high-tech industry's accelerated growth has driven the wireless communication module market to expand continuously. Rising customer demand for highly customized and higher-value-added solutions has pushed wireless communication module companies to develop more technology-intensive products for higher profits. This will likely speed up global market growth further. From 2025 to 2029, it is expected to grow at a CAGR of 10.6%, reaching RMB72.6 billion by 2029, exceeding its historical growth rate. Meanwhile, Chinese enterprises' leading position in manufacturing has caused China's demand for wireless communication modules to exceed the global average. China is projected to achieve a CAGR of 12.7% during the same period, surpassing other regions. By 2029, its market size is expected to reach RMB45.5 billion.

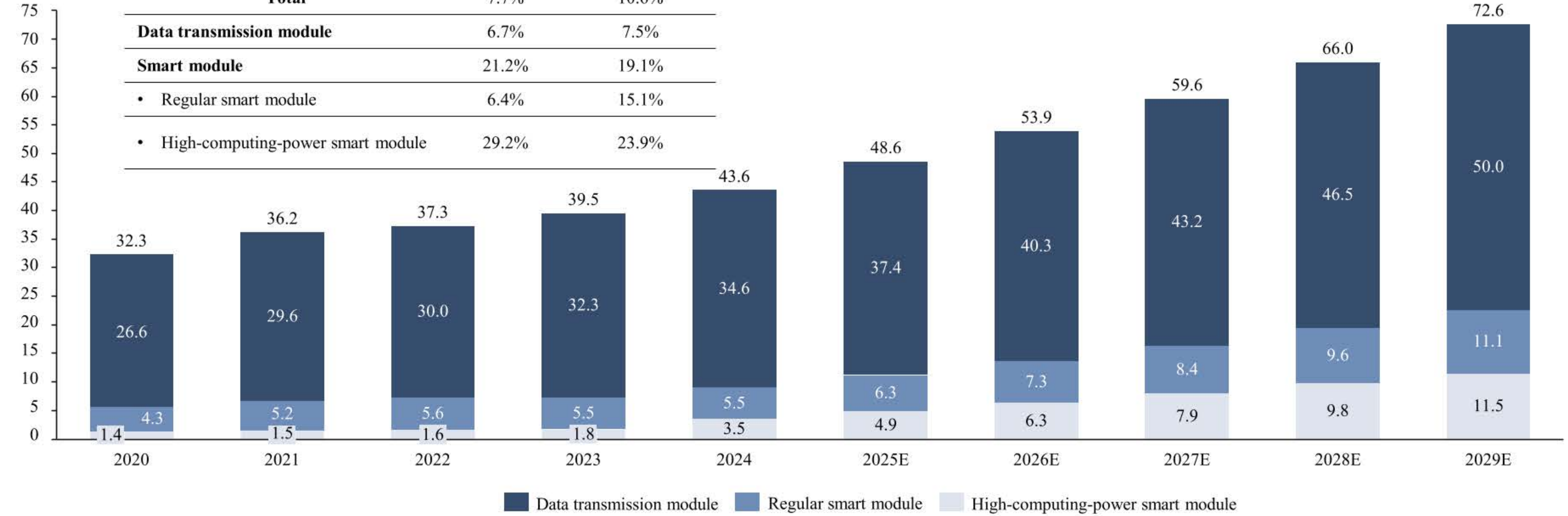
Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Type, 2020-2029E (1/2)

Global Wireless Communication Modules Market Size (by Module Type), 2020–2029E, by Revenue

CAGR	2020-2024	2025E-2029E
Total	7.7%	10.6%
Data transmission module	6.7%	7.5%
Smart module	21.2%	19.1%
• Regular smart module	6.4%	15.1%
• High-computing-power smart module	29.2%	23.9%



Source: Frost & Sullivan

FROST & SULLIVAN
沙利文

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Type, 2020-2029E (1/2)

- By wireless communication module type, the market size for data transmission modules increased from RMB26.6 billion in 2020 to RMB34.6 billion in 2024, representing a CAGR of 6.7%. Given the anticipated growth in downstream demand, the data transmission module market is projected to accelerate, growing from RMB37.4 billion in 2025 to RMB50 billion in 2029, representing a CAGR of 7.5%. Driven by the rapid adoption of lightweight smart module applications like digital payment and smart home, the global regular smart modules market is expected to increase from RMB6.3 billion in 2025 to RMB11.1 billion in 2029, representing a CAGR of 15.1%. However, with the rapid deployment of high-complexity AI tasks such as large models, video structuring and local generation at the edge, industry demands for module computing-power have significantly increased. Some applications originally handled by regular smart modules are shifting towards high-computing-power smart modules, leading to a migration of the growth potential of smart modules more towards high-computing-power smart modules. For instance, in the field of ICVs, T-Box units that previously required only basic connectivity are now expected to support advanced functions such as real-time voice interaction, high-definition streaming, pushing automakers to replace regular smart modules with high-computing power smart modules. In comparison, the high-computing-power smart module market increased from RMB1.4 billion in 2020 to RMB3.5 billion in 2024, representing a CAGR of 29.2% will expand from RMB4.9 billion in 2025 to RMB11.5 billion in 2029, representing a CAGR of 23.9%, due to the surge in high-computing-power applications in theAI field.

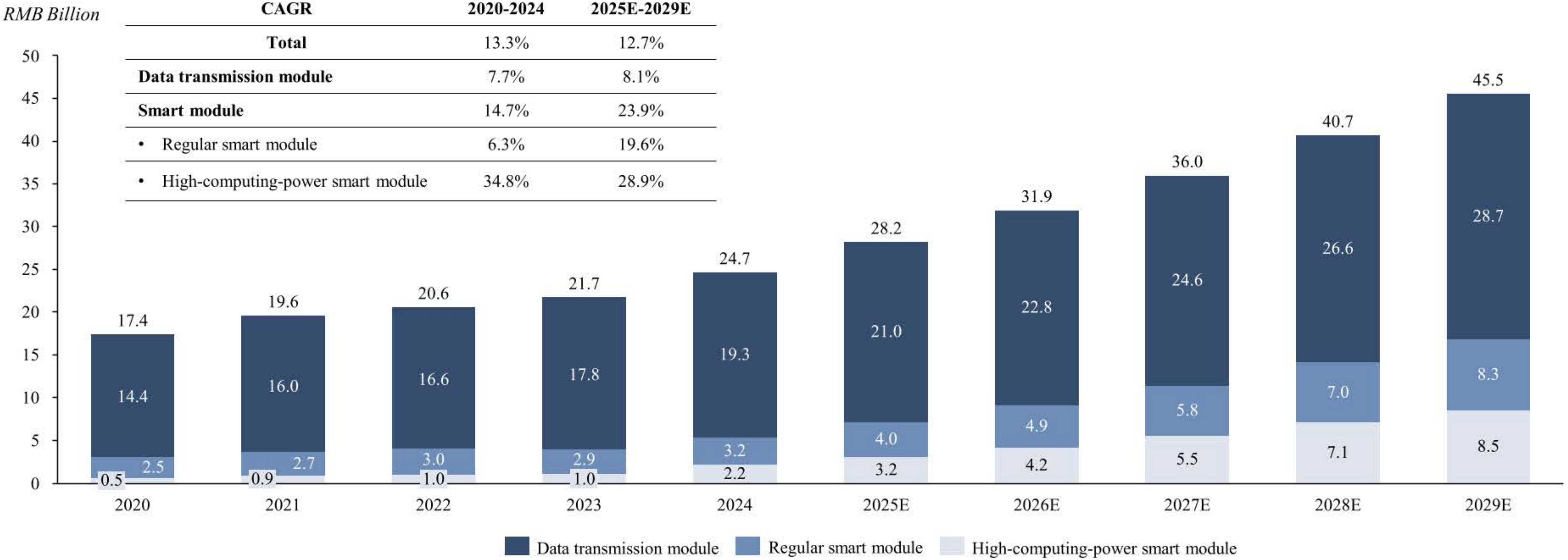
Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

China's Wireless Communication Module Market Size Analysis by Type, 2020-2029E (1/2)

China's Wireless Communication Modules Market Size (by Module Type), 2020–2029E, by Revenue

CAGR	2020-2024	2025E-2029E
Total	13.3%	12.7%
Data transmission module	7.7%	8.1%
Smart module	14.7%	23.9%
• Regular smart module	6.3%	19.6%
• High-computing-power smart module	34.8%	28.9%



Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

China's Wireless Communication Module Market Size Analysis by Type, 2020-2029E (2/2)

- In line with the global trend, China's wireless communication modules market has grown steadily across data transmission, regular smart modules and high-computing-power smart modules, supported by the migration from 4G to 5G, the adoption of RedCap, the rise of AI-enabled applications, as well as favorable policies, a complete industry chain.
- By segment, the market size for data transmission modules increased from RMB 14.4 billion in 2020 to RMB 19.3 billion in 2024, representing a CAGR of 7.7% during 2020 to 2024, and is expected to further expand to RMB 28.7 billion by 2029 with a CAGR of 8.1% during 2025 to 2029. The market for regular smart modules grew from RMB 2.5 billion in 2020 to RMB 3.2 billion in 2024, recording a CAGR of 6.3% during 2020 to 2024, and is forecasted to reach RMB 8.3 billion by 2029 with a CAGR of 19.6% during 2025 to 2029. The high-computing-power smart modules market expanded rapidly from RMB 0.56 billion in 2020 to RMB 2.1 2billion in 2024, achieving a CAGR of 34.8% during 2020 to 2024, and is projected to reach RMB 8.5 billion by 2029 with a CAGR of 28.9% during 2025 to 2029.

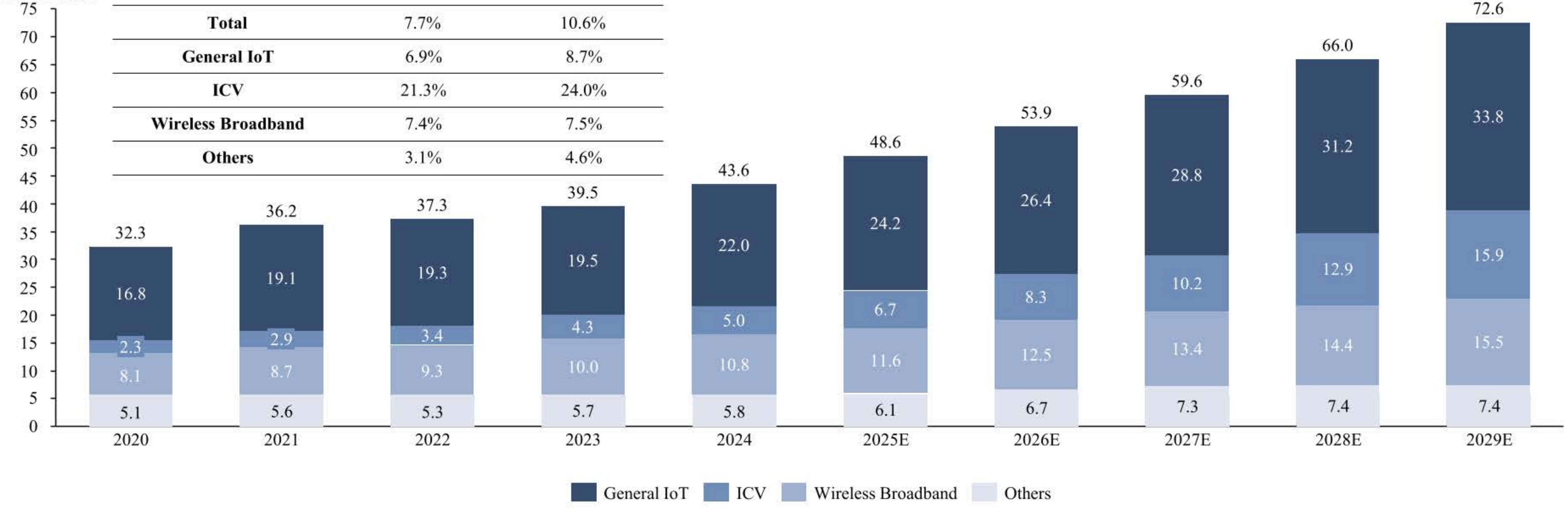
Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Downstream Application, 2020-2029E (1/2)

Global Wireless Communication Module Market Size (by Downstream Application Scenarios), 2020-2029E, by Revenue

CAGR	2020-2024	2025E-2029E
Total	7.7%	10.6%
General IoT	6.9%	8.7%
ICV	21.3%	24.0%
Wireless Broadband	7.4%	7.5%
Others	3.1%	4.6%



Source: Frost & Sullivan

FROST & SULLIVAN
沙利文

Global Wireless Communication Module Market Overview

Global Wireless Communication Module Market Size Analysis by Downstream Application, 2020-2029E (2/2)

- In terms of downstream application scenarios for wireless communication modules, the market size of wireless communication modules for general IoT scenarios grew from RMB16.8 billion in 2020 to RMB22.0 billion in 2024, representing a CAGR of 6.9%. Due to the anticipated expansion of niche application scenarios in the general IoT sector, the market size of the general IoT sector is projected to accelerate, increasing from RMB24.2 billion in 2025 to RMB33.8 billion in 2029, representing a CAGR of 8.7%. Driven by continuous advancements in intelligent connected vehicle technologies, particularly the proliferation of in-vehicle infotainment, and demand for wireless communication modules will surge significantly to support high-speed data transmission, low-latency communication, and multi-device coordination. The market size for wireless communication modules in intelligent connected vehicle scenarios grew from RMB2.3 billion in 2020 to RMB5.0 billion in 2024, representing a CAGR of 21.3%. As the penetration rate of ICV in the existing vehicle market continues to rise, the demand for wireless communication modules in ICV will expand simultaneously. It is expected that market growth in the ICV sector will continue to accelerate, increasing from RMB6.7 billion in 2025 to RMB15.9 billion in 2029, representing a CAGR of 24.0%. Meanwhile, with the accelerated deployment of FWA/MBB in household broadband substitution and enterprise wireless access, the demand for high-performance, multi-standard integrated wireless communication modules in wireless broadband continues to grow. It is expected that the market size of the wireless broadband sector will grow from RMB11.6 billion in 2025 to RMB15.5 billion in 2029, representing a CAGR of 7.5%.

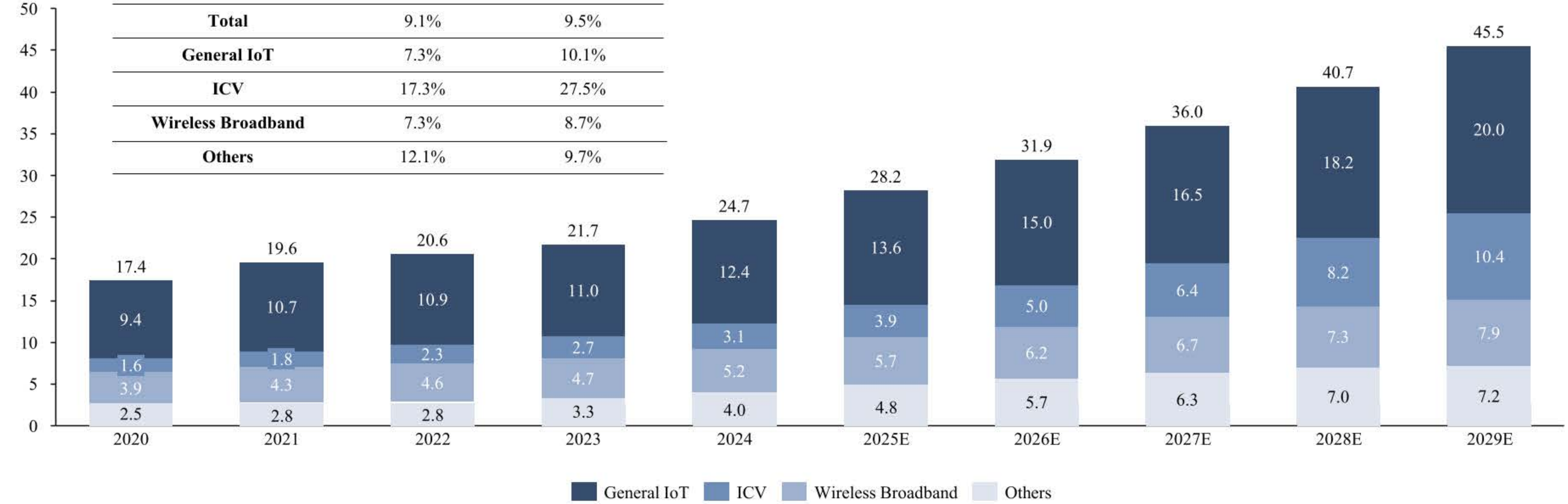
Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

China's Wireless Communication Module Market Size Analysis by Downstream Application, 2020-2029E (1/2)

China's Wireless Communication Module Market Size (by Downstream Application Scenarios), 2020-2029E, by Revenue

CAGR	2020-2024	2025E-2029E
Total	9.1%	9.5%
General IoT	7.3%	10.1%
ICV	17.3%	27.5%
Wireless Broadband	7.3%	8.7%
Others	12.1%	9.7%



Source: Frost & Sullivan

FROST & SULLIVAN 沙利文

Global Wireless Communication Module Market Overview

China's Wireless Communication Module Market Size Analysis by Downstream Application, 2020-2029E (2/2)

- China's wireless communication modules market by application scenarios presents several distinctive characteristics. In the General IoT segment, the market size increased from RMB 9.4 billion in 2020 to RMB 12.4 billion in 2024, representing a CAGR of 7.3% during 2020 to 2024, and is expected to reach RMB 20.0 billion by 2029 with a CAGR of 10.1% during 2025 to 2029. China demonstrates particularly large application scale, where the extensive deployment of standardized IoT use cases results in a market size and growth trajectory broadly consistent with global trends but with higher deployment density. In the ICV segment, the market size expanded from RMB 1.6 billion in 2020 to RMB 3.1 billion in 2024, representing a CAGR of 17.3% during 2020 to 2024, and is projected to reach RMB 10.4 billion by 2029 with a CAGR of 27.5% during 2025 to 2029. Growth in China outpaces the global average, reflecting the country's position as the world's largest new energy vehicle market, which has accelerated module adoption. In the wireless broadband segment, the market size grew from RMB 3.9 billion in 2020 to RMB 5.2 billion in 2024, representing a CAGR of 7.3% during 2020 to 2024, and is forecasted to reach RMB 7.9 billion by 2029 with a CAGR of 8.7% during 2025 to 2029, the overall growth trend is consistent with the global market.

Source: Frost & Sullivan

Global Wireless Communication Module Market Overview

Development Trends of Wireless Communication Modules

- **5G RedCap and 5G-A standard accelerates the evolution of wireless communication modules:** 5G RedCap is a lightweight 5G standard designed for medium-speed IoT scenarios. By addressing the high-power consumption, cost, and size of traditional 5G modules, RedCap lowers deployment barriers and accelerates the shift from 4G to 5G in cost-sensitive applications. Compared with conventional 5G modules, RedCap retains essential performance while streamlining RF and protocol design, greatly enhancing cost-efficiency. It is now widely adopted in use cases such as logistics tracking and smart wearables, supporting broader 5G-A adoption across the IoT ecosystem. 5G-A drives the performance frontier of 5G networks and paves the way toward 6G. In parallel, 5G RedCap offers a cost-effective, lightweight 5G option for medium-speed IoT applications. By simplifying hardware and reducing power consumption, RedCap lowers the barriers to 5G adoption in scenarios like logistics tracking and smart wearables. 5G-A and RedCap enable wireless modules to meet diverse performance and cost requirements, speeding up the industry-wide shift from 4G to 5G.
- **ICV have become key application scenarios for 5G communications:** The sector of ICV is one of the application scenarios with the fastest penetration and best development of 5G communication modules. In 2024, the shipment volume of 5G in-vehicle modules in the ICV related sector reached approximately 2.51 million units. With the continuous evolution of the increasing demand for low-latency and high-bandwidth communication capabilities, the shipment volume of this market is expected to reach approximately 5.27 million units by 2029, representing a CAGR of 16%.
- **Module functions evolve towards smart integration:** Wireless communication modules are shifting from traditional connectivity — focused components to integrated intelligent components that combine communication, computing, and management. On one hand, module products are gradually introducing capabilities such as local processing, data preprocessing, and OTA updates, enhancing their independent operational capability and system support capability in general IoT terminals; on the other hand, with the growing demand for collaborative device-platform management, the access capability of modules is also evolving toward platformization, assuming more remote configuration and platform management functions, and becoming key access nodes in the general IoT ecosystem.

Source: Frost & Sullivan

Agenda

1 China Macro Economic Overview

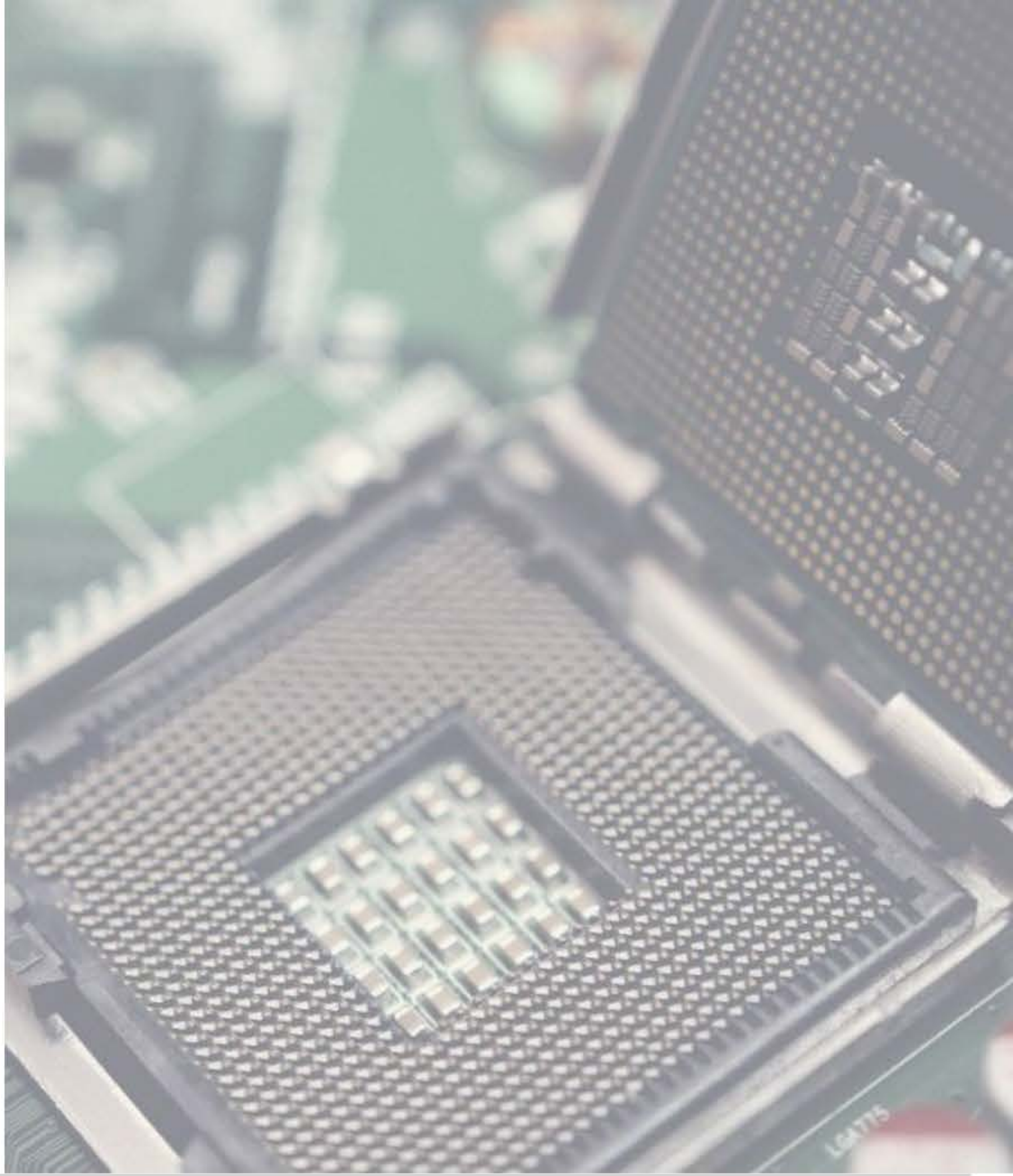
2 Macro Industry Background

3 Global Wireless Communication Module Market Overview

4 Global Data Transmission Module, Smart Module And High-Computing-power Module Market Overview

5 Market Competition Analysis

6 Appendices



FROST & SULLIVAN 沙利文

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Analysis of Data Transmission Module

- Data transmission modules primarily provide stable connectivity for terminal devices across various IoT scenarios. They are widely used in high-volume applications such as wireless broadband terminals and industrial monitoring devices, where the key requirements are low latency, large-scale deployment and cost efficiency rather than advanced on-device processing. Benefiting from the ongoing expansion of IoT endpoints and the global transition from legacy 2G/3G networks to LTE and 5G technologies, the data transmission module market has maintained steady growth in recent years and is expected to remain a core segment of the wireless communication module industry over the medium term.

Source: Frost & Sullivan

Cost Analysis of Key Components in Wireless Communication Modules

Historical Cost and Future Trend Analysis

Wireless communication module key cost components mainly include memory chips, SoCs, RF chips, PCBs and PMICs.

- **Memory chips:** The market for memory chips is known for its cyclical and often sharp price fluctuations. For example, price of memory chips experienced a period of price declines in 2022 and 2023 due to market overcapacity and weak consumer demand, and began to rebound in 2024 and 2025, driven by factors including surging demand for AI servers and production cuts by major manufacturers. Prices are expected to trend upward in the near term on tight supply for mainstream products.
- **SoCs:** Adjusted downward in 2023 but remained at a relatively high level through 2024. Prices are expected to stay structurally elevated due to persistently high wafer and packaging costs.
- **RF chips:** Weakened in 2023 and showed a mild recovery in 2024. Future pricing will largely follow terminal demand with potential upgrades driven by next-generation wireless standards.
- **PCBs:** Softened in 2023 and rebounded in 2024 alongside higher copper prices. Future trends remain highly sensitive to commodity price movements.
- PMICs: Normalized in 2023 and stabilized in 2024. Prices are expected to remain broadly stable, underpinned by structural demand from automotive and industrial applications.

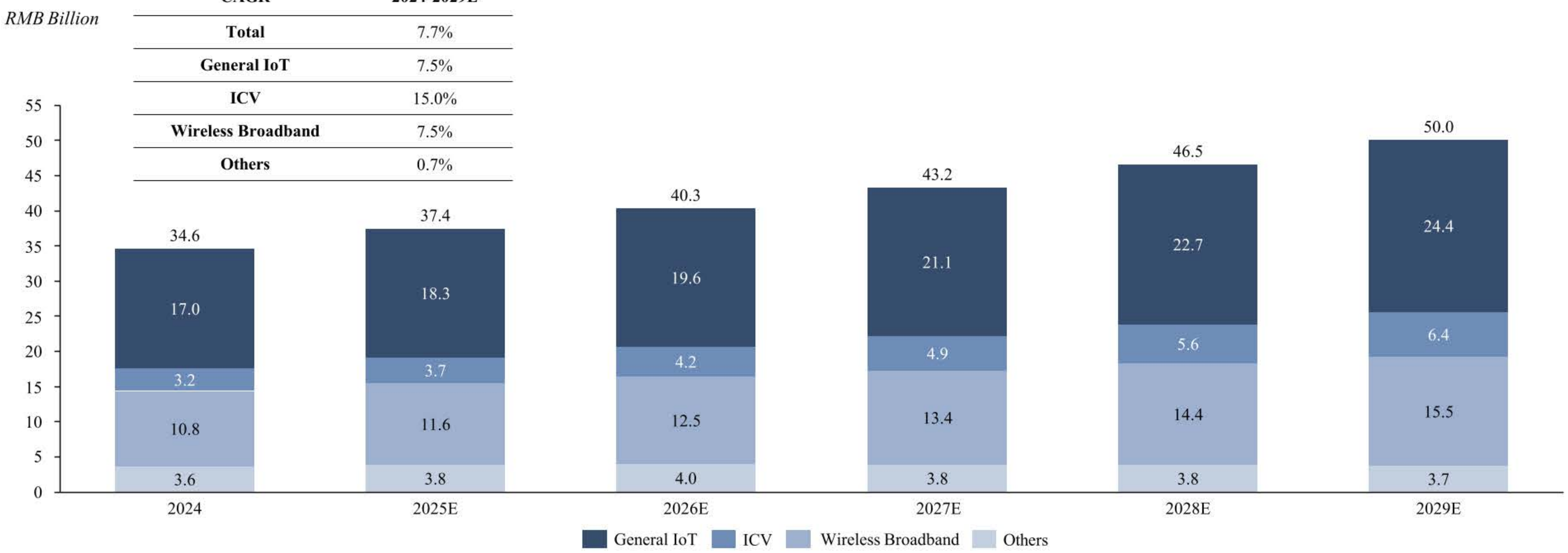
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Data Transmission Module Market Size Analysis by Downstream Application, 2024-2029E (1/2)

Global Data Transmission Module Market Size (by Downstream Application), 2024-2029E

CAGR	2024-2029E
Total	7.7%
General IoT	7.5%
ICV	15.0%
Wireless Broadband	7.5%
Others	0.7%



Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Data Transmission Module Market Size Analysis by Downstream Application, 2024-2029E (2/2)

- From the perspective of downstream application scenarios, General IoT, wireless broadband, and ICV currently account for the majority of the data transmission module market. Specifically, benefiting from the steady increase in connected device deployments across industrial, consumer, and infrastructure sectors, the market size of data transmission modules for General IoT is expected to grow from RMB17.0 billion in 2024 to RMB24.4 billion in 2029, representing a CAGR of 7.5%. Demand from the ICV is anticipated to accelerate significantly, with market size increasing from RMB3.2 billion in 2024 to RMB6.4 billion in 2029, reflecting a CAGR of 15.0% driven by the rapid adoption of vehicle connectivity solutions in NEVs and smart transportation systems. Wireless broadband applications are expected to rise from RMB10.8 billion in 2024 to RMB15.5 billion in 2029, representing a CAGR of 7.5%, supported by continuous upgrades of fixed wireless access and home CPE devices.

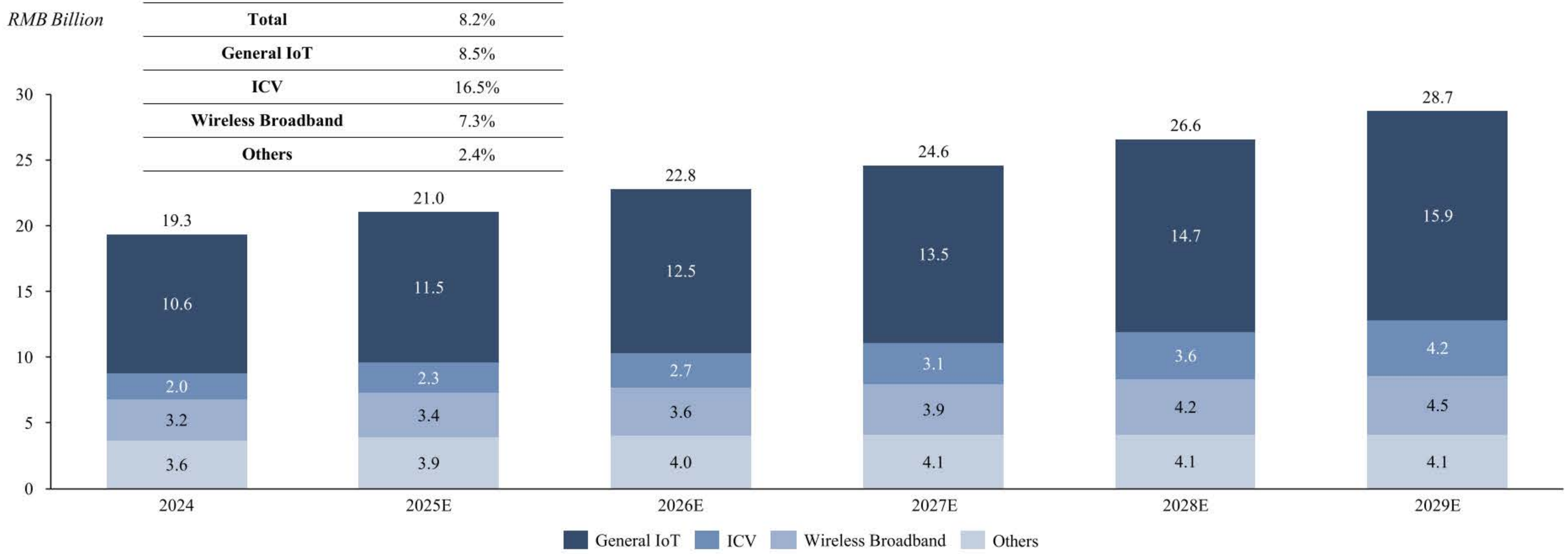
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Data Transmission Module Market Size Analysis by Downstream Application, 2024-2029E (1/2)

China's Data Transmission Module Market Size (by Downstream Application), 2024-2029E

CAGR	2024-2029E
Total	8.2%
General IoT	8.5%
ICV	16.5%
Wireless Broadband	7.3%
Others	2.4%



Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Data Transmission Module Market Size Analysis by Downstream Application, 2024-2029E (2/2)

- In line with the global market, China's data transmission modules show a broadly consistent growth trajectory across major application scenarios. The market size for General IoT is expected to increase from RMB 10.6 billion in 2024 to RMB 15.9 billion in 2029, representing a CAGR of 8.5%. The ICV segment is projected to expand from RMB 2.0 billion in 2024 to RMB 4.2 billion in 2029, with a CAGR of 16.5%. The wireless broadband segment is forecasted to rise from RMB 3.2 billion in 2024 to RMB 4.5 billion in 2029, representing a CAGR of 7.3%.

Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Analysis of Regular Smart Module Market

- With the rapid expansion of general IoT device deployment, regular smart module has been widely adopted in real-time and cost-sensitive scenarios such as smart gateways and wearable devices, leveraging their balance of connectivity and edge processing capabilities. Their openness and customizability make them the standardized module choice for intelligent device implementation across multiple industries, and the market size has been steadily growing with the expansion of terminal types.

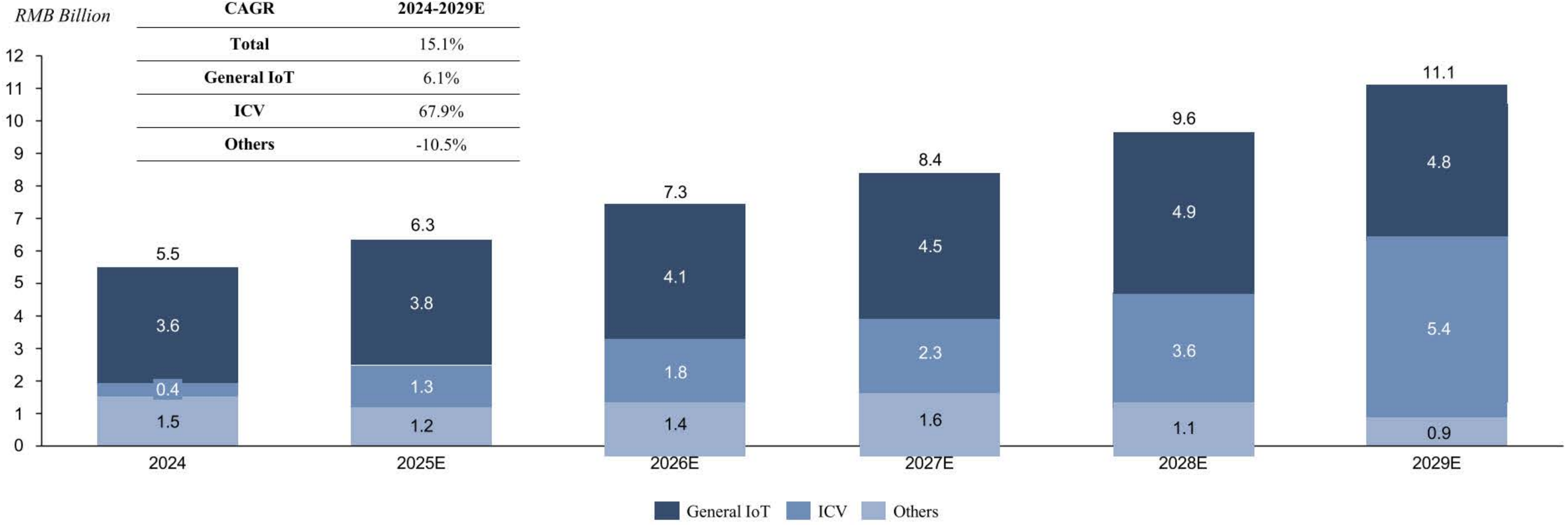
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Regular Smart Module Market Size Analysis by Downstream Application, 2024-2029E (1/2)

Global Regular Smart Module Market Size (by Downstream Application), 2024-2029E

CAGR	2024-2029E
Total	15.1%
General IoT	6.1%
ICV	67.9%
Others	-10.5%



Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Regular Smart Module Market Size Analysis by Downstream Application, 2024-2029E (2/2)

- From the perspective of downstream application scenarios, General IoT and ICV are expected to remain the primary drivers of the regular smart module market over the forecast period. The General IoT segment is projected to grow steadily, with market size increasing from RMB3.6 billion in 2024 to RMB4.8 billion in 2029, representing a CAGR of 6.1%, supported by wider adoption of smart gateways, POS terminals and other mid-tier intelligent devices. The ICV is anticipated to expand rapidly, rising from RMB0.4 billion in 2024 to RMB5.4 billion in 2029, representing a CAGR of 67.9% as the penetration of intelligent cockpit, and edge-computing vehicle modules accelerates. Other applications are expected to decline from RMB1.5 billion in 2024 to RMB0.9 billion in 2029, with a negative CAGR of 10.5%, mainly due to the transition of certain application scenarios from regular smart modules to higher-performance module solutions, many applications requiring real-time decision-making, or AI workloads are increasingly adopting high-computing-power smart modules.

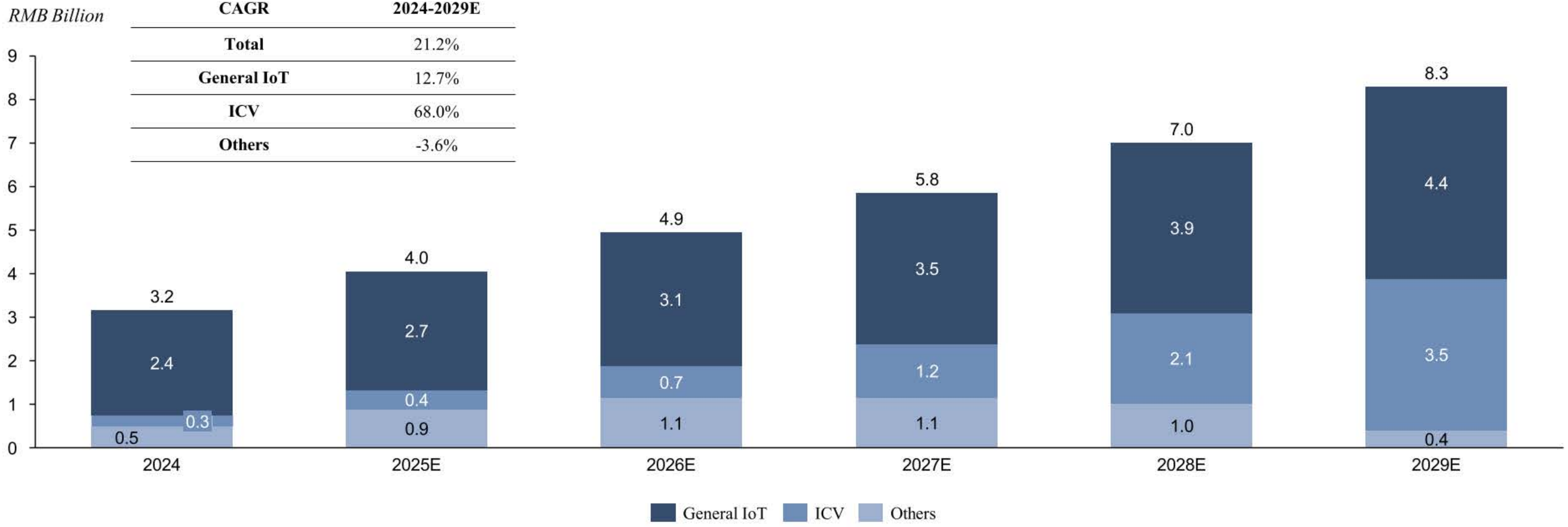
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Regular Smart Module Market Size Analysis by Downstream Application, 2024-2029E (1/2)

Global Regular Smart Module Market Size (by Downstream Application), 2024-2029E

CAGR	2024-2029E
Total	21.2%
General IoT	12.7%
ICV	68.0%
Others	-3.6%



Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Regular Smart Module Market Size Analysis by Downstream Application, 2024-2029E (2/2)

- In line with global trends, General IoT and ICV are also the primary drivers of the regular smart module market in China. The General IoT segment is expected to grow from RMB 2.4 billion in 2024 to RMB 4.4 billion in 2029, representing a CAGR of 12.7%, supported by the continuous expansion of China's IoT industry and large-scale deployment of diversified application scenarios. The ICV segment is projected to expand from RMB 0.3 billion in 2024 to RMB 3.5 billion in 2029, representing a CAGR of 68.0%, reflecting the rapid adoption of intelligent cockpit functions and edge-computing modules.

Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Analysis of High-Computing-Power Smart Module Market

- Facing complex AI application requirements such as semantic understanding, image structuring, and natural language processing, high-computing-power smart modules, relying on AI computing power exceeding or equal to 8 TOPS, have become key carriers for realizing terminal side intelligence in emerging scenarios like in-vehicle terminals and robots. As technologies such as generative AI and edge large models further drive the sinking of computing power, high-computing-power smart module are driving the smart module market to expand into more cutting-edge fields.

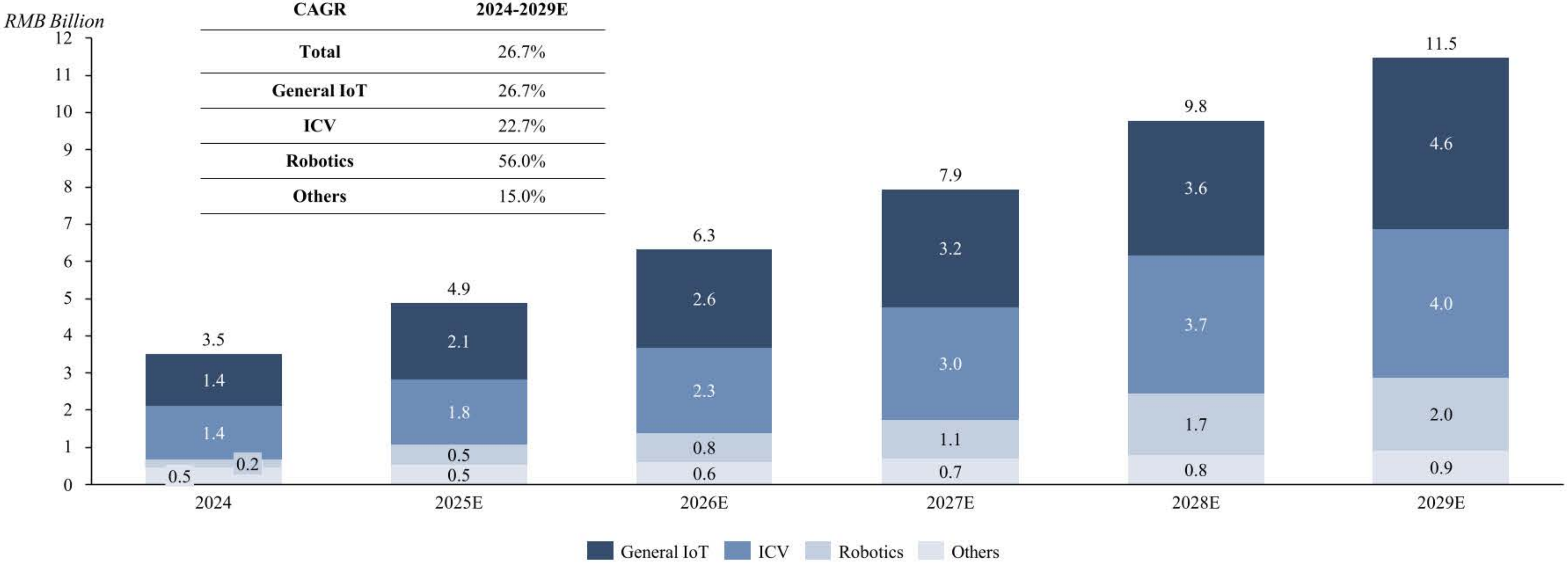
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Market Size Analysis of High-Computing-Power Smart Module by Downstream Application, 2024-2029E (1/2)

Global High-Computing-Power Smart Module Market Size (by Downstream Application), 2024–2029E

CAGR	2024-2029E
Total	26.7%
General IoT	26.7%
ICV	22.7%
Robotics	56.0%
Others	15.0%



* Driven by the rapid development of embodied intelligence, robotics has become a key application scenario for high-computing-power smart modules

Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Global Market Size Analysis of High-Computing-Power Smart Module by Downstream Application, 2024-2029E (2/2)

- From the perspective of the downstream application structure of high-computing-power smart modules, general IoT and intelligent connected vehicles currently serve as the primary application domains and contribute the most to the high-computing-power smart module market. Specifically, benefiting from the accelerated advancement of edge intelligence and terminal device upgrades, the market for high-computing-power smart module applied in the general IoT industry is expected to grow from RMB1.4 billion in 2024 to RMB4.6 billion in 2029, representing a CAGR of 26.7%. The market size of high-computing-power smart modules for this sector will increase from RMB1.4 billion in 2024 to RMB4.0 billion in 2029, representing a CAGR of 22.7%.
- In addition, as emerging application directions with long-term growth potential, robotics are expected to achieve rapid development with the release of demands for smart unmanned systems and multi-modal perception. The market size of high-computing-power smart module for robotics is expected to increase from RMB0.2 billion in 2024 to RMB2.0 billion in 2029, representing a CAGR of 56.0%.

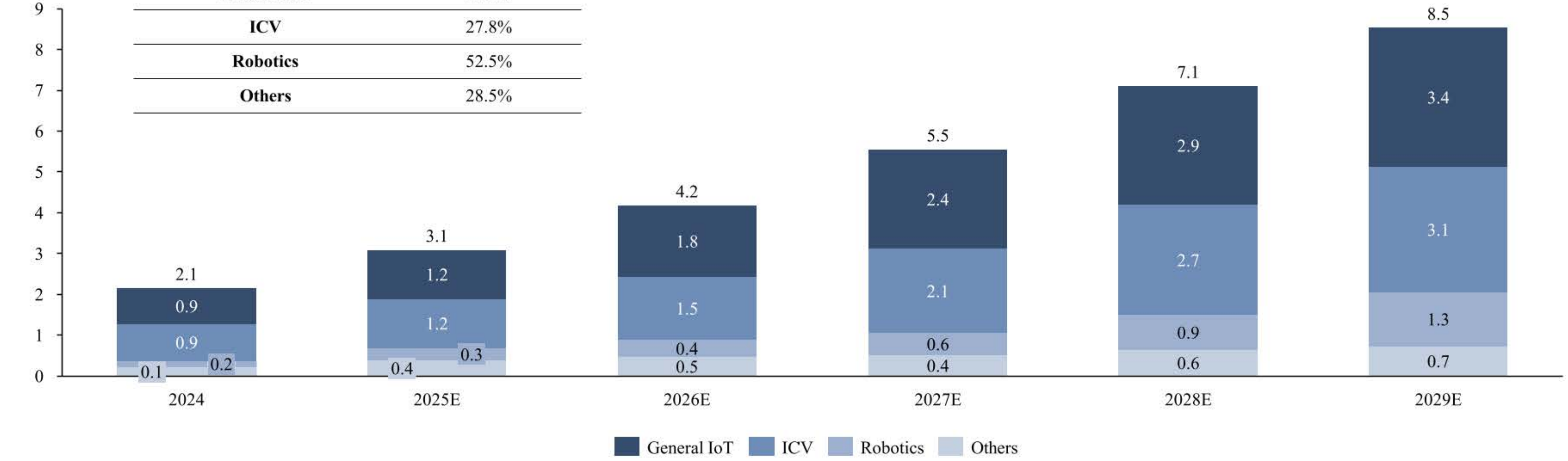
Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Market Size Analysis of High-Computing-Power Smart Module by Downstream Application, 2024-2029E (1/2)

China's High-Computing-Power Smart Module Market Size (by Downstream Application), 2024–2029E

CAGR	2024-2029E
Total	31.8%
General IoT	31.1%
ICV	27.8%
Robotics	52.5%
Others	28.5%



* Driven by the rapid development of embodied intelligence, robotics has become a key application scenario for high-computing-power smart modules

Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

China's Market Size Analysis of High-Computing-Power Smart Module by Downstream Application, 2024-2029E (2/2)

- In line with global trends, General IoT, ICV and robotics are the primary application domains for high-computing-power smart modules in China. The General IoT segment is expected to grow from RMB 0.9 billion in 2024 to RMB 3.4 billion in 2029, representing a CAGR of 31.1%, driven by the large-scale deployment of IoT devices in China and the increasing demand for computing power arising from the integration of AI into IoT applications.. The ICV segment is projected to expand from RMB 0.9 billion in 2024 to RMB 3.1 billion in 2029, representing a CAGR of 27.8%. The robotics segment is forecasted to grow from RMB 0.2 billion in 2024 to RMB 1.3 billion in 2029, representing a CAGR of 52.5%, reflecting robust momentum as China accelerates the adoption of unmanned systems and robots.

Source: Frost & Sullivan

Global Data Transmission Module, Smart Module And High-computing-power Module Market Overview

Market Drivers for High-computing-power Smart Modules

The "computing-power as a service" concept has been widely accepted

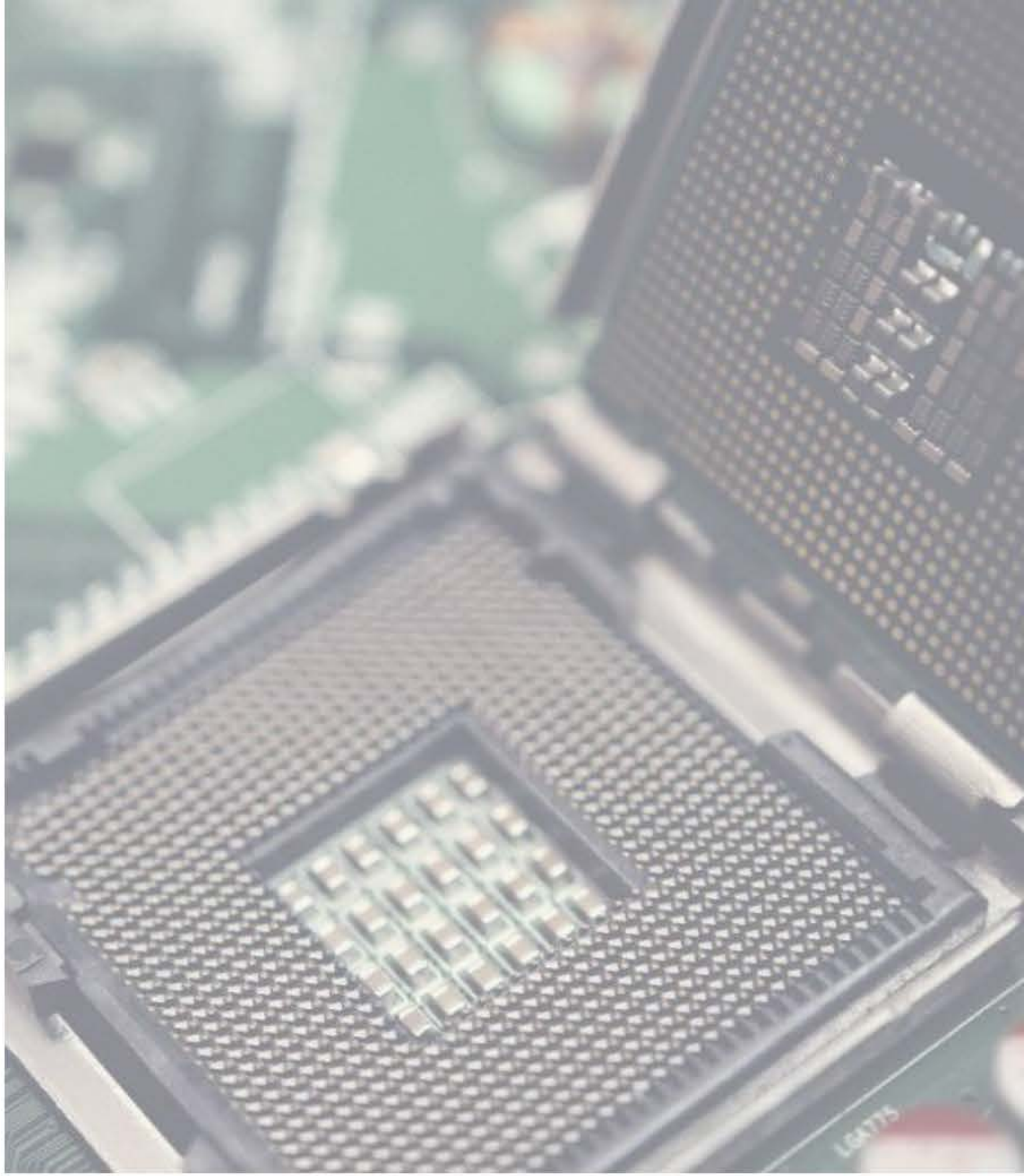
- High-computing-power smart modules not only support the intelligent experience of end products but also create new revenue streams for customers on the business side. With the implementation of the "computing-power as a service" concept, high-computing-power smart modules are gradually becoming a key component for customers to enhance the intelligence premium and operational efficiency of their products. This value realization model has driven customers to shift from a "cost-oriented" to a "capability-oriented" approach in module selection.

"Modularization of computing power" has driven the evolution of modules into smart units

- To address the demands for the rapid evolution of AI algorithms and the accelerated iteration of end products, the industry will accelerate the shift towards a "modularization of computing power" architecture centered on smart modules, and provides device with independent and replaceable smart computing units through high-computing-power modules, so as to enhance system flexibility and maintenance efficiency. This model has been rapidly applied in scenarios with high local intelligence requirements, such as robots and low-altitude aircrafts, driving modules towards standardization and upgradability.

Source: Frost & Sullivan

Agenda



Market Competition Analysis

Summary of the Global Wireless Communication Module Competitive Landscape

- The global wireless communication module industry is relatively concentrated in terms of market share. Although leading enterprises dominate in terms of scale and revenue, the diversity of enterprises at various levels ensures continuous technological progress and a vibrant competitive environment. In 2024, the competitive landscape in global wireless communication module market was relatively concentrated, with the five largest manufacturers accounting for 76.8% of the market share in total.

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global Wireless Communication Module Market (1/2)

Ranking in Global Wireless Module Market, by Revenue from Wireless Communication Module Business, 2024			
Ranking	**Company**	**Revenue （RMB Bililion）**	**Market Share(%)**
1	Company A	18. 6	42. 7%
2	Company B	7. 0	16. 1%
3	Company C	3. 0	6. 9%
4	**The Company**	**2. 8**	**6. 4%**
5	Company D	2. 1	4. 8%
	Others	10. 1	23. 1%
	Total	43. 6	100%

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global Wireless Communication Module Market (2/2)

- The wireless communication module industry has high requirements for modular design, software-hardware collaborative development, and large-scale manufacturing capabilities, resulting in a high degree of market concentration. In terms of 2024 global revenue of wireless communication module providers, our Company ranks fourth, accounting for 6.4% of the global market share. The following table sets forth the 2024 global ranking of wireless communication module providers by revenue from wireless communication module:

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global 5G In-vehicle Module Market（1/2)

Ranking in Global 5G In-vehicle Module Market, by Revenue, 2024			
Ranking	Company	Revenue (RMB 100Million)	Market Share(%)
1	The Company	991. 3	35. 9%
2	Company A	825. 0	29. 9%
3	Company B	587. 6	21. 3%
	Others	357. 1	12. 9%
	Total	2761. 0	100%

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global 5G In-vehicle Module Market (2/2)

- ICV have emerged as one of the representative scenarios driving the accelerated adoption of 5G application. The high-bandwidth, low latency and high-reliability communication capabilities of 5G in-vehicle modules provide critical support for terminal side intelligence processing at the vehicle terminal side widely used in intelligent cockpits and intelligent connectivity, it serves as a critical communication component for smart vehicles to achieve information interconnection and edge intelligence. Due to the high requirements for functional integration, reliability certification, and scenario adaptation capabilities, coupled with the long-term deep cooperation cycles with vehicle OEMs and leading customers, this market segment exhibits high concentration. In terms of 2024 global revenue of 5G in-vehicle modules, our Company ranks first, accounting for 35.9% of the global market share.

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global High-computing-power Smart Module Market (1/2)

Ranking in Global High-computing-power Smart Module, by Revenue from High-computing-power Smart Module Business, 2024			
Ranking	Company	Revenue (RMB 100Million)	Market Share(%)
1	**The Company**	10. 2	29. 0%
2	Company A	6. 2	17. 7%
3	Company B	5. 6	16. 0%
	Others	13. 1	37. 3%
	Total	35. 1	100%

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global High-computing-power Smart Module Market (2/2)

- High-computing-power smart modules, as a key carrier for the deployment of AI at the edge, are emerging as the core bridge connecting computing-power, algorithms, and industrial applications, characterized by both advanced technological sophistication and high commercial value. High- computing-power smart module have stringent requirements for heterogeneous computing architecture design, software-hardware collaborative optimization, and system-level integration capabilities. They also require deep adaptation and algorithm co-debugging for diverse industry scenarios, resulting in high entry barriers and complex product delivery. As a result, this market segment exhibits strong technical barriers and high concentration. In terms of revenue from high-computing-power smart module business, our Company ranks first, accounting for 29.0% of the global market share. The following table sets forth the 2024 global ranking of high-computing-power smart module providers in terms of revenue from high-computing-power smart module business:

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global Data Transmission Module Market (1/2)

Ranking in Global Wireless Module Market, by Revenue from Data Transmission Module Business, 2024			
Ranking	Company	Revenue （RMB 100Mililion）	Market Share(%)
1	Company A	165. 0	47. 7%
2	Company B	30. 5	8. 8%
3	Company C	19. 5	5. 6%
4	Company D	15. 0	4. 3%
5	**The Company**	9. 6	2. 8%
	Others	106. 4	30. 8%
	Total	346. 0	100. 0%

Source: Frost & Sullivan

FROST & SULLIVAN 沙利文

Market Competition Analysis

Ranking in Global Data Transmission Module Market (2/2)

- In terms of revenue from the data transmission module business, our Company ranks fifth globally, with revenue of RMB 960 million, accounting for 2.8% of the global market share. The following table sets forth the 2024 global ranking of data transmission module providers in terms of revenue from the data transmission module business.

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global Regular Smart Module Market (1/2)

Ranking in Global Wireless Module Market, by Revenue from Regular Smart Module Business, 2024			
Ranking	Company	Revenue （RMB 100Mililion）	Market Share(%)
1	Company B	30. 9	56. 2%
2	Company A	9. 8	17. 8%
3	**The Company**	8. 3	15. 1%
	Others	6. 0	10. 9%
	Total	55. 0	100. 0%

Source: Frost & Sullivan

Market Competition Analysis

Ranking in Global Regular Smart Module Market (1/2)

- In terms of revenue from the regular smart module business, our Company ranks third globally, with revenue of RMB 830 million, accounting for 15.1% of the global market share. The following table sets forth the 2024 global ranking of regular smart module providers in terms of revenue from the regular smart module business.

Source: Frost & Sullivan

Market Competition Analysis

Company Profile

Company A	• Company A is a listed company, founded in 2010 and headquartered in Shanghai, China. It is a global supplier of cellular and GNSS modules, specializing in providing high-performance, high-quality wireless communication modules for various industries.
Company B	• Company B is a listed company, founded in 1999 and headquartered in Shenzhen, China. It is a specialized provider of IoT communication solutions and wireless communication modules, delivering modules and solutions across multiple sectors, including connected vehicle intelligent security, smart cities, and smart homes.
Company C	• Company C is a private company, founded in 2005 and headquartered in Beijing China. It operates in the telecommunications sector, focusing on the development and provision of communication technologies and solutions.
Company D	• Company D is a listed company, founded in 1997 and headquartered in Beijing, China. It is one of the world's largest mobile network operator, providing mobile voice and multimedia services through its nationwide mobile telecommunications network across China.

Source: Frost & Sullivan

Market Competition Analysis

Market Entry Barriers

Customer/Solution Barrier:

- High-computing-power smart module are often deeply embedded in the whole machine systems of downstream customers and are highly integrated with operating systems, application layers, peripheral components, etc. In the initial development stage, multiple processes such as communication protocol adaptation, software-hardware joint debugging, and scenario-based deployment is required to be completed, Once a cooperation is established, subsequent updates and iterations are mostly carried out on the original platform. The replacement cost is high, resulting in strong customer stickiness. Therefore, module manufacturers with the ability of software-hardware collaborative development and a rapid customized response mechanism are more likely to provide customized services to downstream customers and establish stable cooperative relationships in different scenarios, thus having a greater advantage in continuously acquiring customers.

Technical Barrier

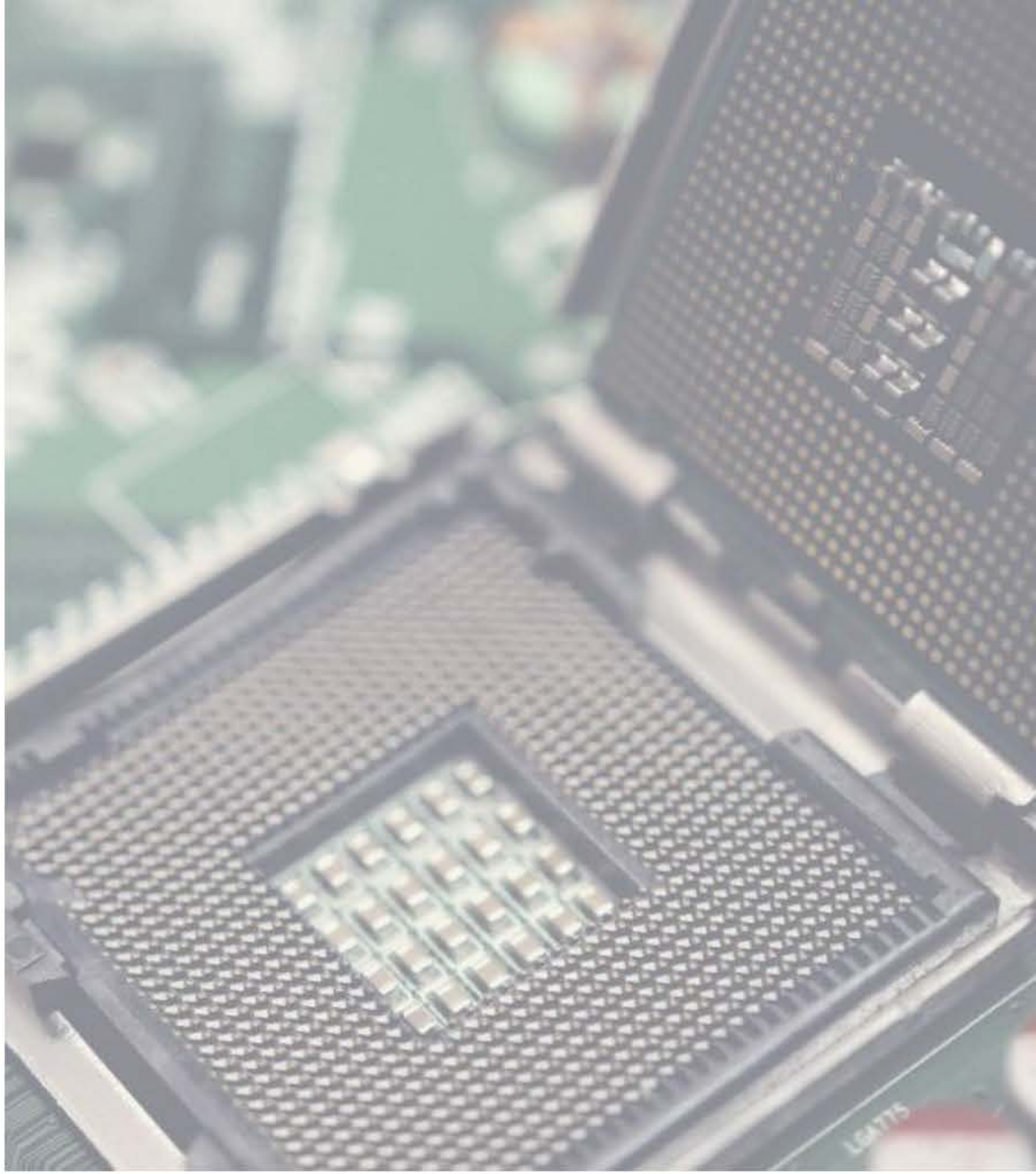
- High-computing-power smart module involves complex technical systems such as SoC platform development, heterogeneous computing scheduling, in-depth customization of Android/Linux, AI engine integration, and power consumption control, which is required to have the ability of hardware structure design, system-level optimization, and AI algorithm adaptation simultaneously. Technical capabilities are not limited to hardware but are reflected in the ability to provide overall solutions across chip platforms, operating systems, and industry requirements.

Capital Barrier

- The research and development of smart module, especially high-computing-power products, highly depends on long-term and stable capital investment. It covers multiple high-cost aspects such as chip platform connection, human resource allocation, sample iteration, compatibility testing, and certification adaptation. In particular, the realization of edge AI capabilities requires continuous investment in software toolchains, development platforms, and scenario-based algorithm development, resulting in a significant R&D capital-intensive nature.

Source: Frost & Sullivan

Agenda



Appendices (1/3)

- It is common industry practice in China's wireless communication module sector to adopt an outsourced manufacturing model, whereby production is operated by EMS providers with established supply chains and cost advantages, in order to reduce costs and enhance scale efficiency.
- Among wireless communication module companies with annual revenue exceeding RMB 1 billion, the company's average R&D expenditure as a percentage of total revenue for the period from 2022 to 2024 was higher than the three-year industry average for other leading companies
- It is a prevalent commercial practice in China's wireless communication module industry for customers to settle payments via third-party payment platforms
- There has been a growing demand from overseas customers for integrated modules supporting edge AI capabilities, in line with the global trend toward intelligent integration and high-performance wireless communication modules.
- The decline in demand from the wireless broadband segment is consistent with the industry's transition from traditional broadband access to more advanced technologies such as 5G RedCap.
- It is estimated that there are over 50 companies globally with technological capabilities, product synergies, or channel value that meet the criteria for potential strategic acquisitions or partnership opportunities.
- The Company was among the first in the world to achieve mass production of 4G wireless data terminals, with 4G module production beginning in 2013.
- Although smart modules may or may not have cellular wireless communication capability, they are still considered as "wireless communication modules" because smart modules were originally designed with cellular wireless communication capabilities that were later less emphasized due to changes in customer preference and downstream applications.
- Procurement rebates were offered by the supplier in accordance with market practice and supply terms. This rebate arrangement is in line with industry practice in the wireless communication module industry.
- Among wireless communication module companies with annual revenue exceeding RMB 1 billion, from 2022 to 2024, the Company's percentage of total workforce consisted of R&D and technology personnel exceeded that of other leading companies in the industry.
- Among wireless communication module companies with annual revenue exceeding RMB 1 billion, the company's revenue contribution of 5G-related modules and solutions in 2024 was higher than the average of other leading companies in the industry.

Source: Frost & Sullivan

Appendices (2/3)

- In 2014, the company launched smart modules related products, becoming the first company globally to launch smart module products.
- In 2019, the company launched its 5G transmission module products and was among the first companies globally to release 5G transmission modules.
- In 2021, as a supplier of 5G smart modules to a new energy vehicles brand, the company facilitated the large-scale adoption of 5G smart modules in new energy vehicles and became the first company globally to achieve such deployment. It was also the first to supply 5G smart modules to this leading new energy vehicles manufacturer.
- In 2023, the company launched high-computing-power smart modules with AI computing power reaching 48 TOPS and initiated research on generative AI on these modules, becoming the first company globally to develop a 48 TOPS high-computing-power smart module.
- In 2023, the company successfully ran a text-to-image generative AI model on our high-computing-power smart modules, is the first company globally to successfully run this kind of AI model on high-computing-power smart modules.
- In 2023, the company launched 5G-A and 5G RedCap module product and was among the first companies globally to launch 5G-A and 5g RedCap module products
- Among wireless communication module companies with annual revenue exceeding RMB 1 billion, in 2024. the revenue contribution of the company's 5G-related modules and solutions was higher than that of other leading companies in the industry.
- In 2025, the company deployed its high-computing-power smart modules in the prototype humanoid robot of a leading technology company, where the modules served as the main control units, making the company the first globally to apply high-computing-power smart modules in humanoid robot prototypes.
- The company is among the first globally to launch high-computing-power smart modules based on next-generation mobile SoC platforms, with AI computing power of up to 64 TOPS.
- The market for memory chips is known for its cyclical and often sharp price fluctuations. For example, price of memory chips experienced a period of price declines in 2022 and 2023 due to market overcapacity and weak consumer demand, and began to rebound in 2024 and 2025, driven by factors including surging demand for AI servers and production cuts by major manufacturers.
- Chip platform is an-industry jargon used to describe their SoC products, which Qualcomm believes are more comprehensive than a single processor or chip. Qualcomm markets their SoCs as a "platform" to convey that it provides a comprehensive, integrated solution, rather than just a standalone processing chip. This terminology is now common in the industry to ·describe such integrated solution

Source: Frost & Sullivan

Appendices (3/3)

- The gross profit margin of specific application sector inadvertently discloses the gross profit margin of certain large customers, given that customers are concentrated in certain application sectors
- The global semiconductor industry experienced a significant supply shortage from late 2021 through 2022, driven by pandemic-related manufacturing disruptions, logistics challenges, and a surge in downstream demand from the 5G, electric vehicle and remote work sectors.
- The global semiconductor industry has, in recent years, experienced volatility, including supply shortages and cyclical price fluctuations, which can impact our operations.
- The global wireless communication module market is highly concentrated, with the three largest players accounting for 65.7% of global market revenue in 2024 (the largest player alone holding a 42.7% market share), compared to our 6.4% market share despite ranking fourth.

Source: Frost & Sullivan

Research Methodologies

- Frost & Sullivan is an independent global consulting firm, which was founded in 1961 in New York. It offers industry research and market strategies and provides growth consulting and corporate training. Its industry coverage includes automotive and transportation, chemicals, materials and food, commercial aviation, consumer products, energy and power systems, environment and building technologies, healthcare, industrial automation and electronics, industrial and machinery, and technology, media and telecom.
- The Frost & Sullivan's report includes information on independent market research on China's Geotechnical Industry.
- Frost & Sullivan has conducted detailed primary research which involved discussing the status of the industry with certain leading industry participants and conducting interviews with relevant parties. Frost & Sullivan has also conducted secondary research which involved reviewing company reports, independent research reports and data based on its own research database. Frost & Sullivan has obtained the figures for the estimated total market size from historical data analysis plotted against macroeconomic data as well as considered the above-mentioned industry key drivers.
- Frost & Sullivan's Market Engineering Forecasting Methodology integrates several forecasting techniques with the Market Engineering Measurement-based System. It relies on the expertise of the analyst team in integrating the critical market elements investigated during the research phase of the project. These elements include:
    - ✓ Expert-opinion forecasting methodology
    - ✓ Integration of market drivers and restraints
    - ✓ Integration with the market challenges
    - ✓ Integration of the Market Engineering Measurement trends
    - ✓ Integration of econometric variables
- In compiling and preparing the Report, Frost & Sullivan has adopted the following assumptions:
  - ✓ The social, economic and political environment of the world and China is likely to remain stable in the forecast period
  - ✓ Related industry key drivers are likely to drive the market in the forecast period

Source: Frost & Sullivan