CHINA'S IoT AND TELECOMMUNICATION EQUIPMENT MARKET
INDEPENDENT MARKET STUDY

Frost & Sullivan

2022

Content

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Analysis of IoT Market in China
Definition and Value Chain Analysis

- The Internet of things, or IoT, refers to a network connecting all sorts of information sensory devices to the Internet with the aim of connecting all things to the network for easy identification and management. The IoT market in the PRC consists of upstream hardware and software, midstream IoT solutions and downstream IoT applications.

- The general structure of IoT solutions includes four layers, namely perception layer, connectivity network layer, platform layer and application service layer. The perception layer is equipped with certain sensing and telecommunication devices, such as chip and communication module. The connectivity network layer is embedded between perception layer and application service layer for connecting the sensing and telecommunication devices with IoT applications in the application service layer. IoT solutions sometimes set up a platform layer between the connectivity network layer and application service layer, providing big data and AI analysis services, which is optional upon the request by customers. In the application service layer, IoT solution providers deploy various IoT applications for transforming and managing the data collected from sensing and telecommunication devices. The downstream refers to various IoT applications, mainly including manufacturing, logistics, transportation, agriculture, mining, healthcare, energy and others.

- The upstream side is mainly composed of sensing devices and telecommunication devices, such as sensors, antennas and routers or gateways, and software, which is deployed to sensing devices and telecommunication devices for operations. As to the midstream, IoT market players aim to offer IoT solutions to their customers for addressing the connectivity of sensory devices and the collection and transformation of data. The downstream refers to various IoT applications, mainly including manufacturing, logistics, transportation, agriculture, mining, healthcare, energy and others.

Upstream	Midstream	Downstream
Hardware and Software	**IoT Solutions**	**End Applications**
	Perception Layer	Manufacturing
	• Perception Equipment, Chip, Communication Module and others	Logistics
Hardware		Transporation
• Sensors	**Connectivity Network Layer**	Agriculture
• Antennas		Mining
• Router/Gateways	• Wifi, 4G, 5G, Bluetooth, and others	Energy
• Others		Healthcare
Software	**Platform Layer**	Retail
	• Intelligent Platform, Big Data and AI Analysis Platforms	Others
	Application Service Layer	
	• Various IoT Applications	

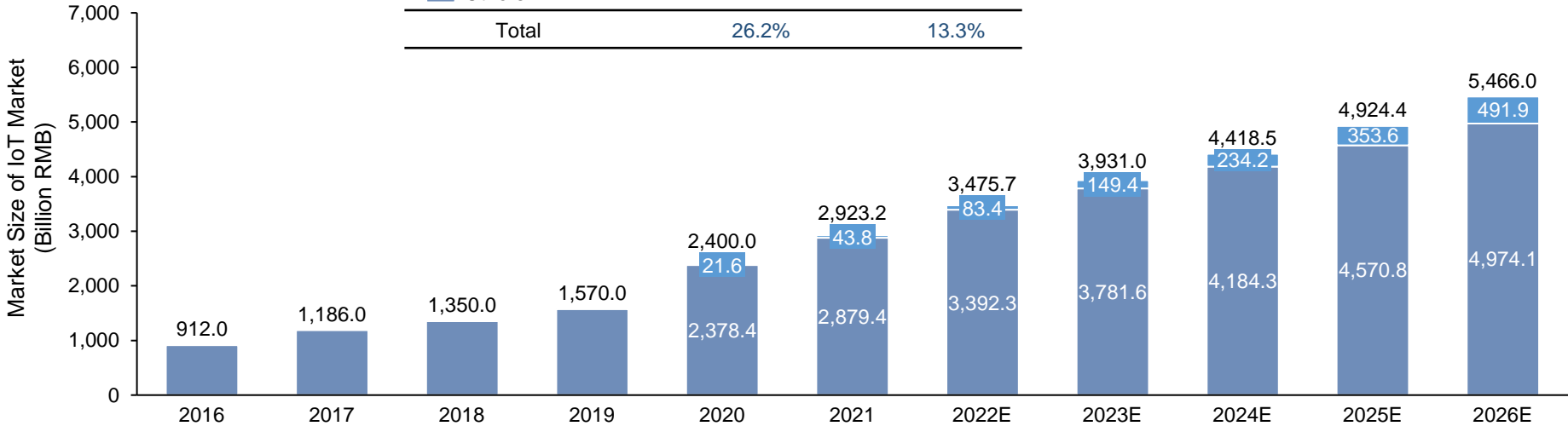*Source: Frost & Sullivan Analysis*

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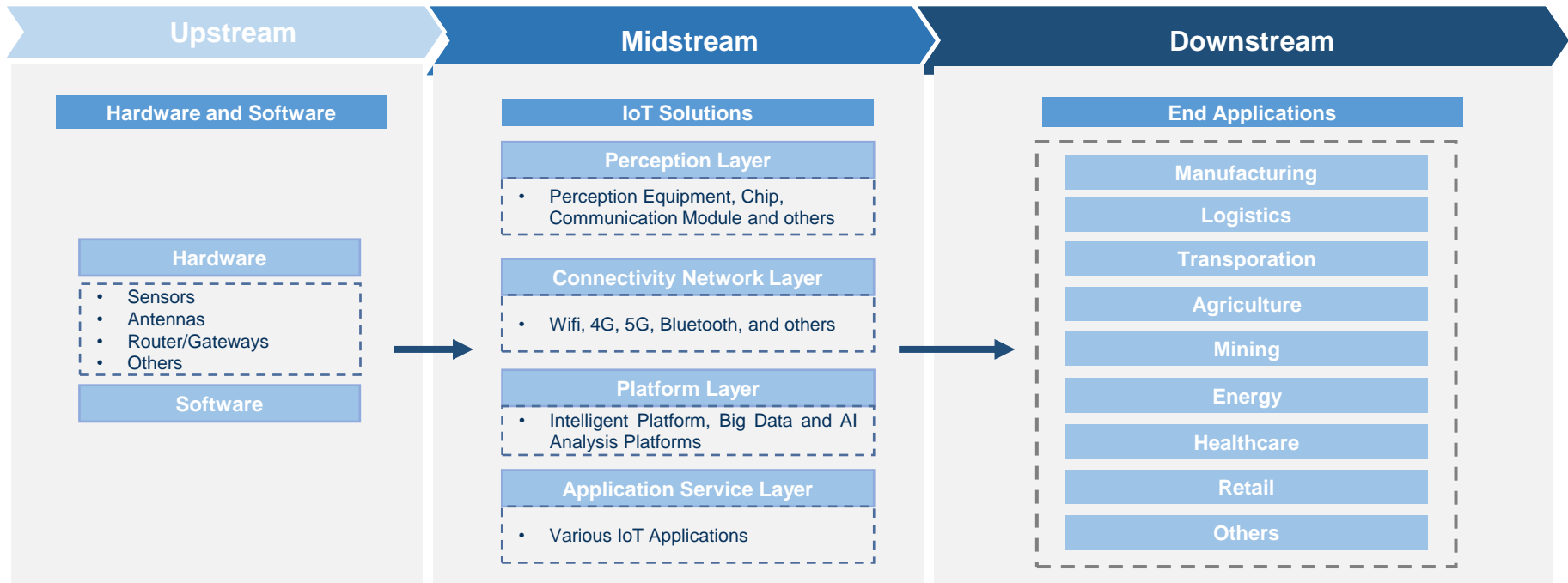
Analysis of IoT Market in China
Market Size of IoT Market

Market Size of PRC IoT Market, 2016 – 2026E, in terms of Revenue

CAGR	2016-2021	2021-2026E
5G-Based	NA	62.2%
Others	25.9%	11.6%
Total	26.2%	13.3%

Market Size of IoT Market (Billion RMB)

Year	Others	5G-Based	Total
2016			912.0
2017			1,186.0
2018			1,350.0
2019			1,570.0
2020	2,378.4	21.6	2,400.0
2021	2,879.4	43.8	2,923.2
2022E	3,392.3	83.4	3,475.7
2023E	3,781.6	149.4	3,931.0
2024E	4,184.3	234.2	4,418.5
2025E	4,570.8	353.6	4,924.4
2026E	4,974.1	491.9	5,466.0

- Leveraging favorable government policies and growing introduction of the advanced technologies, the revenue of the IoT market in the PRC experienced a rapid growth with a CAGR of 26.2% from RMB912.0 billion in 2016 to RMB2,923.2 billion in 2021, and is expected to further grow at a CAGR of 13.3% from 2021 to 2026, reaching RMB5,466.0 billion in 2026.

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Entry Barriers

High Technical Barriers

- The IoT market is a technology-driven industry. Technologies adopted in the IoT market are subject to continuous technical innovation, update and upgrade. Considering the specific technical requirement by IoT customers and the application scenarios, not all technologies are suitable for IoT application, and different wireless technologies have distinct roles that are suitable for IoT applications. Factors like power consumption, battery life and range of coverage should be considered as technical barriers for IoT application. Industrial IoT applications even requires higher internet speed, stability, and security of data collection and transmission. For example, low-power and wide-area networks are specifically developed for industrial IoT applications. Leading IoT market players, who have large number of technology patents and professional teams with technical knowledge, are able to offer comprehensive and advanced solutions services to their downstream customers. Under such circumstances, it is difficult for new entrants to gain solid technical strength and competitiveness in such a technology-driven industry.

Customer Base

- IoT market players strive to maintain a loyal customer base. The downstream customers mainly include enterprises, public institutions and government agencies, who have high demand and specific requirements for the quality of products and after-sales services. IoT market players aim to establish a stable and mature customer base through long-term technical services and market promotion. Besides, due to the customization of and huge investment in IoT solutions, the costs of replacement on IoT solutions are relatively high, which reinforces the customer stickiness and creates a significant barrier for new entrants to the IoT market.

Industry Experience

- The enterprises in the downstream industries require IoT market players to offer customized solutions according to the characteristics and development trends of the industry it operates. The downstream customers of the IoT market, especially large enterprises, also pay much attention to the proven track record of IoT market players. The IoT market players, who can fully understand customers' needs and provide high quality products as well as in-depth technical supports, are well-positioned to capture the market opportunities. New entrants without relevant project experience are likely to have some difficulties in building mutual trust with downstream customers.

Source: Frost & Sullivan Analysis

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Analysis of IoT Market in China
Market Drivers

Major Drivers	Description
Government Support	A series of policies issued by the Chinese government such as the "Notice on Further Implementing the Comprehensive Development of Mobile Internet of Things《关于深入推进移动物联网全面发展的通知》" in 2020 and "Industrial Internet Innovation Development Action Plan (2021-2023)《工业互联网创新发展行动计划(2021-2023年)》" in 2021, have supported the development of the IoT market. As a result, the number of mobile Internet of things connections reached 1.2 billion at the end of 2020. The supportive policies have promoted the wide applications of the Internet of things, which is expected to drive the IoT market.
Growing Adoption of Advanced Technologies	The advanced technologies lay the foundation for and promote the development of the IoT market in China. For example, 5G technology, which provide ultra-low latency, multi-Gbps peak data speeds, massive network capacity, increased availability, enhanced reliability and data security, broaden the application of the IoT. Leveraging the advanced technologies adopted, IoT is expected to be applied in various industries and application scenarios to boost performance, enhance data collection and improve predictive analytics.
Rapid Development of Industrial IoT	As technology advances, an increasing number of factories are being automated and the importance of connectivity among the equipment in the factories is increasing. When more factories are automated, communication between machines, robots, and computers will become increasingly important. With the rapid development of the Industrial IoT market, manufacturing facilities will become more productive, industrial robots will become more sophisticated to handle and more complex instructions, assembly lines, operations will be more streamlined and overall efficiency will increase. The Industrial IoT market is the major application scenario in the IoT market. In 2021, the total revenue of industrial IoT increased to RMB548.2 billion from RMB189.3 billion in 2016. From 2021 to 2026, the total revenue of the Industrial IoT market is anticipated to increase from RMB548.2 billion to RMB1,148.9 billion, with a CAGR of 16.0%. Also, in 2021, "The development of a digital economy during the 14th Five-Year Plan (2021-25)《"十四五"数字经济发展规划》" issued by the Chinese State Council, aims to reach 45% penetration rate of industrial internet platform applications by 2025. The increasing demand for factory automation and the importance of connectivity between machines, robots, and computers is expected to drive the development of the industrial IoT market.
Demand for Private 5G Network	Private 5G networks are wireless local area networks that utilize the 5G technologies as their communication medium to build private networks. These private networks offer unified connectivity with numerous advantages and optimized services. In the near future, private 5G networks are expected to become one of the preferred choices for enterprises, taking into account its vast bandwidth, high data rates, ultra-low latency, high security, reliability and scalability features. This is a game-changer for enterprises and industries, where private 5G networks are essential connection methods for business applications, such as autonomous vehicles, connected factories, connected healthcare, smart retail, and rural broadband connectivity. The developers of private 5G network also aim to cope with the huge rise in demand for the digital transformation of enterprise. Enterprises that require network slicing capabilities to separate mission-critical use cases within the same physical network will turn to adopt private 5G networks. China has adopted a positive approach toward popularizing the private 5G networks, which is anticipated to bring more opportunities to the IoT market players.

Source: Frost & Sullivan Analysis

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Analysis of IoT Market in China
Future Opportunities and Challenges

Future Opportunities	**Initiatives on Smart City Construction from Governments**	• Smart city is one of the primary application scenarios of IoT solutions. A smart city is a technologically modern urban area that uses various types of telecommunication methods, voice activation methods and sensors to collect specific data. Information gained from that data are used to manage assets, resources and services efficiency; in return, that data is used to improve the operations across the city. The smart city concept integrates information and communication technology, and various physical devices connected to the IoT network to optimize the efficiency of city operations and services and connect to citizens. The PRC Government has implemented a series of policies to regulate and support the development of smart city, including the Implementation of the Urban Renewal Initiative (《实施城市更新行动》) issued by the Ministry of Housing and Urban-Rural Development in 2021. Leveraging the support from the PRC Government, the construction of smart city is expected to accelerate, which will further promote the development of IoT market.
	Extensive Application of IoT Solutions	• The demand of digital transformation experiences a tremendous increase in various domains. IoT solutions take place in an array of scenarios, involving not only manufacturers in industrial engineering, but also enterprises in other industries requiring broadband and high transmission speed, such as retail, agriculture, financial services, automotive and healthcare. In the future, the extensive application of IoT technology is expected to bring more development opportunities for the market players in China.
	Adoption of Big Data Analysis Platforms	• The operation of IoT solutions involves collecting the massive amounts of data. The increase in the amount of data poses serious challenges to the collection, storage and analysis of these data. IoT solutions are expected to adopt new advanced analysis tools for processing and analyzing the large amounts of the data collected, where the adoption of big data and artificial intelligence analysis platforms is expected to be popularized.
Challenges	**Network Security Risks**	• With the development of wireless communication network and the deployment of IoT, people are easy to connect to wireless network and share massive amount data within the network and system deployed. As a result, a slew of new cyber threats has emerged. Malicious attacks have surged with the increasing adoption if IoT and wireless technologies. Many enterprises are exposed to the network security risks and they are inclined to protect their database and prevent data leakage by setting up their own private 5G networks.

Source: Frost & Sullivan Analysis

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Analysis of IoT Market in China
Ranking of IoT Market in China

Top Ten IoT Market Participants by Revenue in the PRC in 2021

Ranking	Company	Background Information	Market Share (%)
1	Company A	A leading global provider of information and communications technology (ICT) infrastructure and smart devices.	7.2%
2	Company B	A world-leading provider of better life and digital transformation solutions, focusing on the business of smart home and living, industrial internet and great healthcare.	4.1%
3	Company C	A listed leading technology company with smartphones, IoT products and internet business at its core.	2.9%
4	Company D	A world-leading provider of innovative security products and solutions.	1.9%
5	Company E	A partially state-owned Chinese technology company that specializes in telecommunication and information technology.	1.1%
6	Company F	A listed IoT company providing smart products and professional services for information interaction and human health in the PRC.	1.0%
7	Company G	A listed world-leading video-centric smart IoT solution and service provider	1.0%
8	Company H	A leading technology company that focuses on the IoT business, including VIoT, AIoT, and IIoT in the PRC.	0.4%
9	Company I	A leading technology company that focuses on the integration of computer information systems and software development related to communications and information operations.	0.2%
10	Company J	A listed well-known intelligent speech and artificial intelligence company in the Asia-Pacific Region.	0.2%
Top 10			20.0%
Others			80.0%
Total			100%

- The IoT market in the PRC is competitive and fragmented with more than 30,000 participants. There are many market participants competing in each layer of the IoT market in the PRC. The major participants in the IoT market include domestic and foreign companies, some of which are globally well-known, large-scale, and multinational enterprises. The diagram above sets forth the backgrounds and market shares of the top ten IoT market participants in the PRC by revenue in 2021. In 2021, our Group occupied approximately 0.006% market share of the IoT market in the PRC.
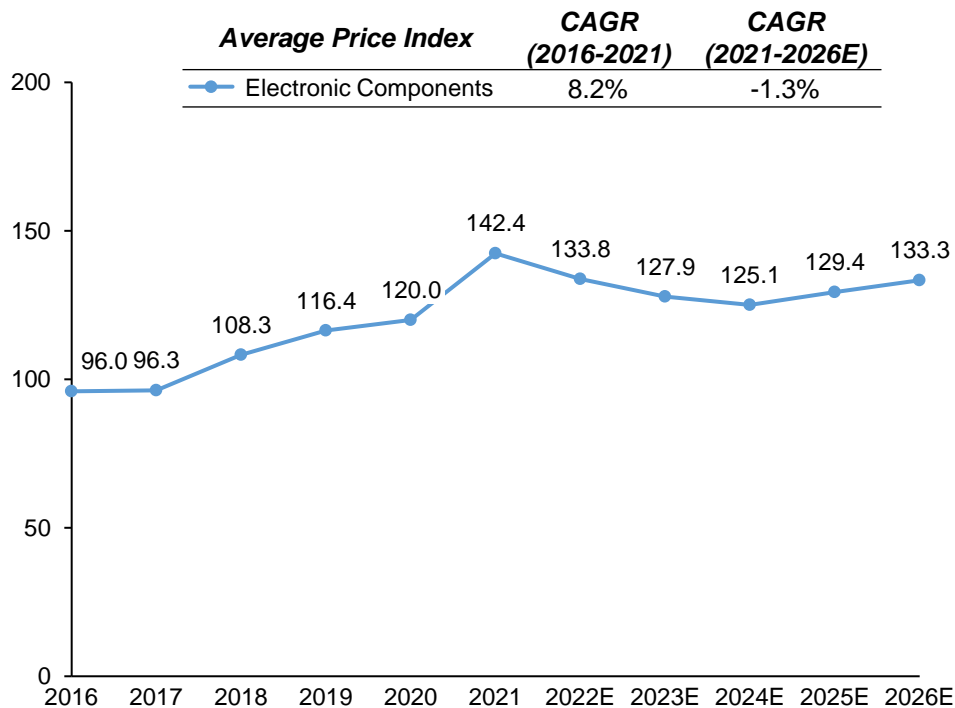
Source: Frost & Sullivan Analysis
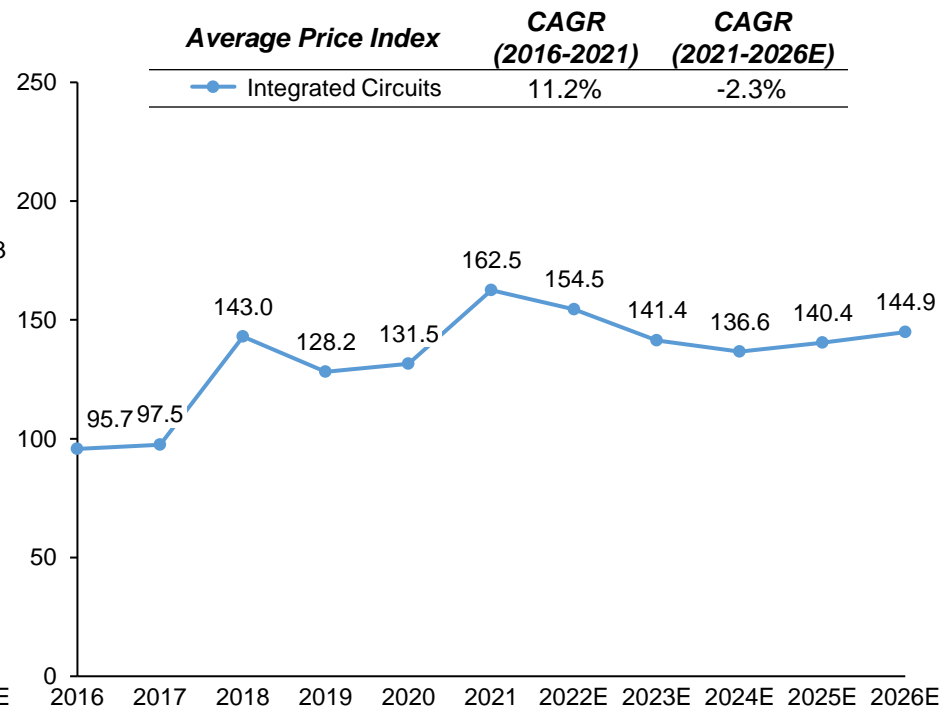
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Analysis of IoT Market in China
Average Prices of Raw Materials and Components

Price Index of Electronic Components (the PRC), 2016 – 2026E

Average Price Index	CAGR (2016-2021)	CAGR (2021-2026E)
Electronic Components	8.2%	-1.3%

Electronic Components values: 96.0 (2016), 96.3 (2017), 108.3 (2018), 116.4 (2019), 120.0 (2020), 142.4 (2021), 133.8 (2022E), 127.9 (2023E), 125.1 (2024E), 129.4 (2025E), 133.3 (2026E)

Price Index of Integrated Circuits (the PRC), 2016 – 2026E

Average Price Index	CAGR (2016-2021)	CAGR (2021-2026E)
Integrated Circuits	11.2%	-2.3%

Integrated Circuits values: 95.7 (2016), 97.5 (2017), 143.0 (2018), 128.2 (2019), 131.5 (2020), 162.5 (2021), 154.5 (2022E), 141.4 (2023E), 136.6 (2024E), 140.4 (2025E), 144.9 (2026E)

Base=100: weighted average price of selected products during the period from 11 August 2007 to 17 August 2007.

- Affected by the outbreak of COVID-19 pandemic, the production volume of integrated circuits decreased due to the lockdown of manufacturing sites for a period. However, electronic product manufacturers increased their inventory of integrated circuits resulting from the trust crisis in global supply chain, whilst the growing scenarios of working and studying at home and the recovery of economic activities from the COVID-19 pandemic stimulated high demand for electronic products, which accordingly increased the demand for integrated circuits. Therefore, in 2021, global market faced the shortage in supply of integrated circuits, which resulted in an increase of average integrated circuit price in 2021 by approximately 20% compared with the average price in 2020. Primarily due to the same reason, the average price of electronic components experienced similar fluctuations for the same periods as that of integrated circuits.

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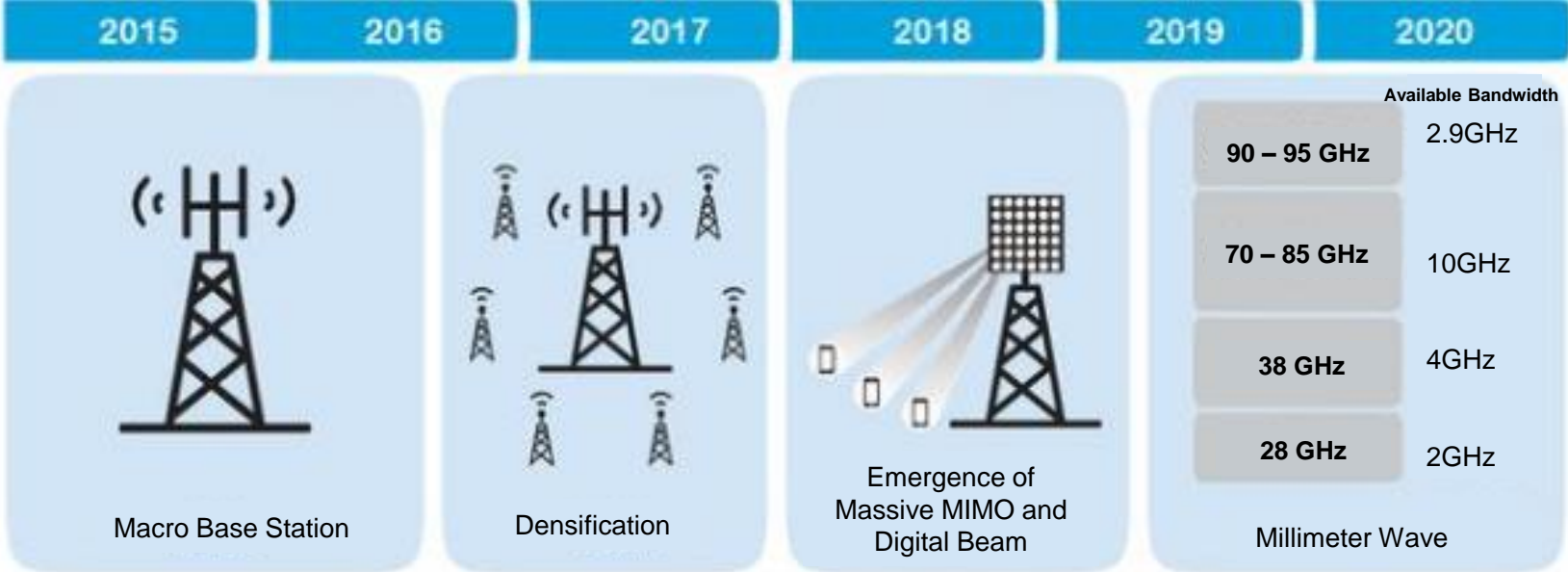
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Analysis of Private 5G Network Market in China
Overview and The Development of 5G Technology

2015	2016	2017	2018	2019	2020

Available Bandwidth

90 – 95 GHz	2.9GHz
70 – 85 GHz	10GHz
38 GHz	4GHz
28 GHz	2GHz

Macro Base Station	Densification	Emergence of Massive MIMO and Digital Beam	Millimeter Wave
• 2.7GHz - 6GHzFrequency • Increase bandwidth • Increase the frequency	• Small base station • DAS • LTE-U	• Bandwidth of 6GHz • Array antennas	• Ultra-high bandwidth • Ultra-high throughput

- 5G is the 5th generation mobile network. The 5G technology was first defined in a 2015 white paper published by The Next Generation Mobile Networks (NGMN) Alliance. Between 2015 and 2016, 5G technology went through testing and pre-studying. In 2017, 3GPP set up the standards for 5G, and the technology trials began, which accelerated the development of supplementary technology, such as DAS, LTE-U. In 2018, massive MIMO and digital beam were developed to enhance the signal of 5G and meet the end user's needs. The frequency of 5G reached to 6GHz. The Sub-6GHz frequency bands and the millimeter wave spectrum are two frequency specifications defined and used for 5G technology. Sub-6GHz refers to mid and low-frequency bands under 6GHz, and millimeter wave refers to higher frequency radio bands over 24GHz with a wavelength of less than 10mm. Currently, the Sub-6GHz is the most commonly used in 5G technology in the PRC. As for 2020, the millimeter wave was suggested for possible integration with 5G technology, with its ultra-high bandwidth and ultra-high throughput. Nonetheless, the millimeter wave communication technology in the PRC is still in the R&D stage. It has not yet been commercialized and has not yet been applied to 5G technology in the PRC so far.
- 5G technologies are meant to deliver higher multi-Gbps peak data speeds, ultra-low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users. Up to 100 times faster than 4G, 5G is creating never-before-seen opportunities for people and businesses. In particular, 5G accelerated the expansion of IoT application scenarios, such as consumer applications and industrial applications. Since 2020, 5G technologies have been introduced for commercial use.
- As compared with the standards of previous generations, 5G standard is a much more unified standard across the world. 5G was initially introduced in 2018 by the freezing of 3GPP's Release 16 (5G phase II), which has been commonly adopted by the member countries of the 3GPP (3rd Generation Partnership Project).
- The IoT market is expected to benefit from the high transmission speed and low latency of 5G technologies. By breaking through the capabilities of the 4G technologies, 5G technologies create a friendly ecosystem for IoT with faster speed, higher bandwidth and lower latency as compared to 4G technologies. The total revenue of 5G-based IoT solutions in the PRC is expected to increase from RMB43.8 billion in 2021 to RMB491.9 billion in 2026, with a CAGR of 62.2% from 2021 to 2026.
- The value chain of private 5G network market in the PRC includes upstream manufacturers of components of telecommunication equipment; midstream manufacturers of 5G micro base station, 5G core network, 5G aggregation network and solution providers; and end users in the downstream application scenarios, which include government entities, military units, police, corporate and others.
- The private 5G network solutions that we offered cover production of 5G base stations for our customers and do not rely on any existing 5G base stations in the PRC.

Source: Frost & Sullivan Analysis

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Analysis of Private 5G Network Market in China
Market Driver

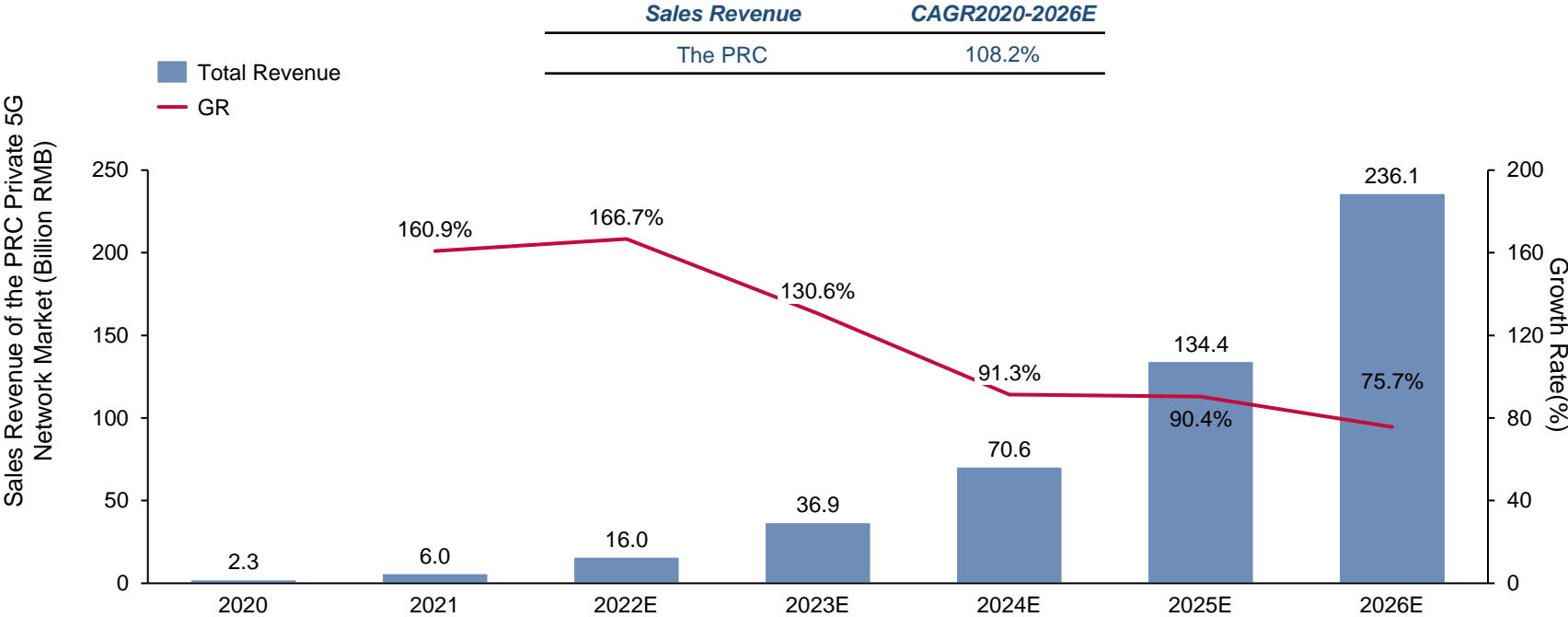| Major Driver	Description
Favorable Government Initiatives and Policies to Promote Private 5G Network in the PRC	• In 2021, the number of 5G base stations per 10,000 people reached 10.1 in the PRC. In order to accelerate the development of the 5G industry, the PRC government issued several favorable policies. According to the 5G Application "Sailing" Action Plan (2021-2023) (《5G應用"揚帆"行動計劃(2021-2023年)》), the average annual growth rate of 5G IoT end users will exceed 200%, and every 10,000 people in the PRC will enjoy more than 18 5G base stations as the country steps up efforts to improve 5G coverage by 2023. The PRC government also claims that each key industry creates more than 100 5G application benchmarks, and will have a 35% penetration rate of 5G applications in the industrial industry by 2023, while more than 3,000 virtual private 5G networks will be set up by 2023. As of July 2022, the number of virtual private networks in the 5G industry had reached 6,518. • To achieve those goals, the government stated the following initiatives: (i) improving 5G application support capabilities. The government encourages the industry giants in the telecommunication industry, the information and communication technology industry, and other related industries to combine their strengths to develop integrated 5G applications. Specifically, leading telecommunication operators are encouraged to accelerate the construction of 5G networks and expand the urban and rural coverage of 5G network, leading telecommunication tower infrastructure service providers are encouraged to enhance the deployment density of 5G base stations, and leading information and communication technology enterprises are encouraged to develop advanced 5G technologies in various industries; (ii) establishing the 5G application standards system; and (iii) enabling 5G applications in key fields, including smart logistics, smart mining, smart agriculture, and others.

Source: Frost & Sullivan Analysis

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Analysis of Private 5G Network Market in China
Total Revenue

Total Revenue of the PRC Private 5G Network Market, 2020 – 2026E

Sales Revenue	CAGR2020-2026E
The PRC	108.2%

Legend:
- Total Revenue
- GR

Y-axis (left): Sales Revenue of the PRC Private 5G Network Market (Billion RMB)
Y-axis (right): Growth Rate(%)

Year	Total Revenue	GR
2020	2.3	
2021	6.0	160.9%
2022E	16.0	166.7%
2023E	36.9	130.6%
2024E	70.6	91.3%
2025E	134.4	90.4%
2026E	236.1	75.7%

- The private 5G network market has been generating revenue in the PRC since 2020. The total revenue of the private 5G network market in the PRC was RMB2.3 billion in 2020. The private 5G network market accounted for about 0.2% of the IoT market in the PRC in 2021, with a total revenue of RMB6.0 billion. With the acceleration of digital transformation in various industries, the total revenue of the private 5G network market in the PRC is expected to reach RMB236.1 billion in 2026, with a CAGR of 108.2% from 2021 to 2026.

Source: Frost & Sullivan Analysis

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Analysis of Private 5G Network Market in China
Future Opportunities and Challenges

Future Opportunities	**Development of Emerging Technologies**	• The development of 5G applications provides huge opportunities to the private 5G network market. With the expansion of 5G application scenarios, new application scenarios such as industrial IoT, which require high multi-Gbps peak data speeds, ultra-low latency, reliability and high security, increase the demand for private 5G network. The private 5G network is committed to optimizing the product performance by providing high-speed, reliable and secured network. For example, massive MIMO in 5G micro base station, as a core technology in the private 5G network, is developed to enhance spectrum efficiency and system capacity. In the future, the development of emerging technologies is expected to broaden the downstream applications of private 5G network and further drive the rapid development of private 5G network market.
	Increasing Demand for Private 5G Network	• In the future, 5G networks can support the various scenarios of intelligent manufacturing, including the extremely low millisecond latency required for the coordinated control of robotic arms, the high bandwidth and millisecond low latency required for advanced production assistance systems when applying augmented reality. With the awareness of data security and requirements for low latency in data processing, increasing number of enterprises are expected to build their own private 5G networks, with the characteristics of low cost and easy deployment will become an important part of enterprises' network coverage plan.
	Integration of Micro Base Stations in Private 5G Network and Edge Computing	• The continuous exploration of 5G application scenarios will create a huge demand for edge computing, which refers to a distributed computing framework that brings applications closer to data sources such as IoT devices or local edge servers. The edge data center is close to the information source and can perform simple data processing locally, which greatly reduces network latency, makes feedback faster, and also improves user experience and reduces network congestion. The micro base stations in the private 5G network are highly compatible with edge computing platforms in terms of high density, easy deployment, self-optimization, and low cost. The increase in demand for edge computing in the future will promote the sales of 5G micro base stations, and accelerate the development of private 5G networks.
Challenges	**Insufficient Talents**	• With the popularization of emerging technology in 5G network, there is an increasing demand for professional talents in research and development, engineering application as well as operation and management in both 5G network, IoT industry and relative vertical industries. As 5G and IoT are newly emerged industries, there is a relatively large gap between the market demand and talent supply. Besides, the relevant education and skill training may not be able to catch up with the fast development of 5G and IoT industries.

Source: Frost & Sullivan Analysis

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Analysis of Private 5G Network Market in China

Ranking of Participants in Private 5G Network Market

Ranking of Participants in Private 5G Network Market (China), 2021

Ranking	Company Name	Background Information	Market Share (%)
1	Company A	A leading global provider of information and communications technology (ICT) infrastructure and smart devices.	62.0%
2	Company E	A partially state-owned Chinese technology company that specializes in telecommunication and information technology.	19.1%
3	Company K	A leading global system provider for end-to-end communications solutions and telecom infrastructures.	4.8%
4	Company L	A large-scale state-owned high-tech enterprise in the PRC, specializing in 5G technical development.	2.7%
5	Company M	A leading information and communication network product and solution provider in China.	2.4%
6	Company N	An industry leader in the provision of digital solutions in China, offers a full portfolio of digital infrastructure products and provides a comprehensive one-stop digital platform.	1.6%
7	Company O	A global leading solution and service provider of wireless and information communications systems with its R&D facilities, manufacturing base, and sales and service.	1.4%
8	Our Group	See "Business"	1.2%
9	Company P	A leading global provider of professional communications technologies and solutions in communications industry.	0.7%
10	Company Q.	A leading software company of 3G/4G/5G core network with flexible development, customized services and end-to-end mobile core solution.	0.4%
Top 10			**96.3%**
Others			**3.7%**
Total			**100.0%**

- The private 5G network market in the PRC is concentrated and dominated by a few market leaders. There were only about 20 participants in the private 5G network market in the PRC in 2021. In 2021, the total revenue of top ten participants accounted for approximately 96.3% of the total revenue of private 5G network market in the PRC.

- In 2021, our Group's revenue generated from both private 5G network solutions and products amounted to RMB72.9 million, ranking the eighth among all market players with a 1.2% market share. In addition, our Group's business covered connectivity network layer and platform layer. The private 5G network business of the telecommunication giants is more focused on large-scale projects, such as installing private 5G networks for government, military, and infrastructure, while other top players can cater to more diverse business needs. For example, our Group strategically focus on providing cost-effective and customized IoT solutions and telecommunication equipment to enterprises with higher management flexibility and shorter product delivery period as compared to other large-sized major participants.
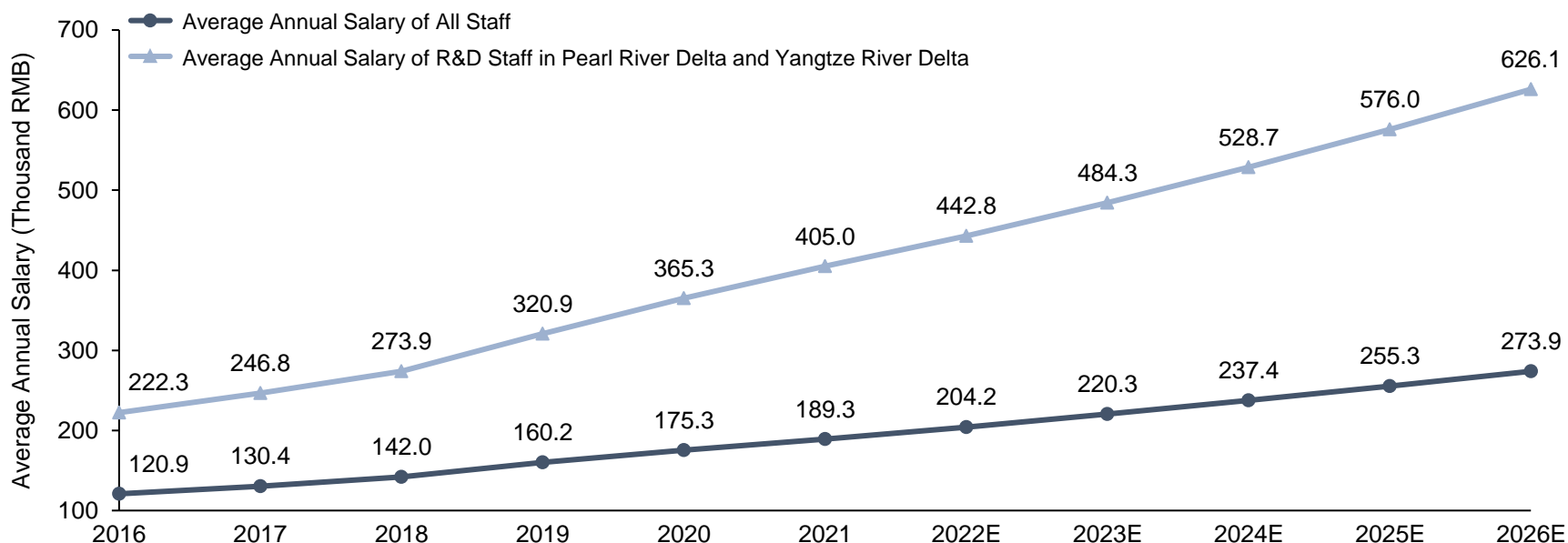
Source: Frost & Sullivan Analysis

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Analysis of Private 5G Network Market in China
Average Salary

Average Annual Salary of Staff in Private 5G Network Market (China), 2016 – 2026E

Average Annual Salary	CAGR (2016-2021)	CAGR (2021-2026E)
All Staff, China	9.4%	7.7%
R&D Staff, Pearl River Delta and Yangtze River Delta	12.7%	9.1%

- From 2016 to 2021, the average annual salary of staff in the PRC private 5G network market experienced a rapid growth. The average annual salary of all staff in the PRC is increasing from RMB120.9 thousand in 2016 to RMB189.3 thousand in 2021, representing a CAGR of 9.4%. While the average annual salary of R&D staff in Pearl River Delta and Yangtze River Delta increased from RMB222.3 thousand in 2016 to RMB405.0 thousand in 2021, with a CAGR of 12.7%.

- In the future, the average annual salary of staff in the private 5G network market is expected to maintain a steady growth. The average annual salary of all staff in the PRC is expected to reach RMB273.9 thousand in 2026, with a CAGR of 7.7%, while the average annual salary of R&D staff in Pearl River Delta and Yangtze River Delta is anticipated to reach RMB626.1 thousand in 2026, with a CAGR of 9.1%.
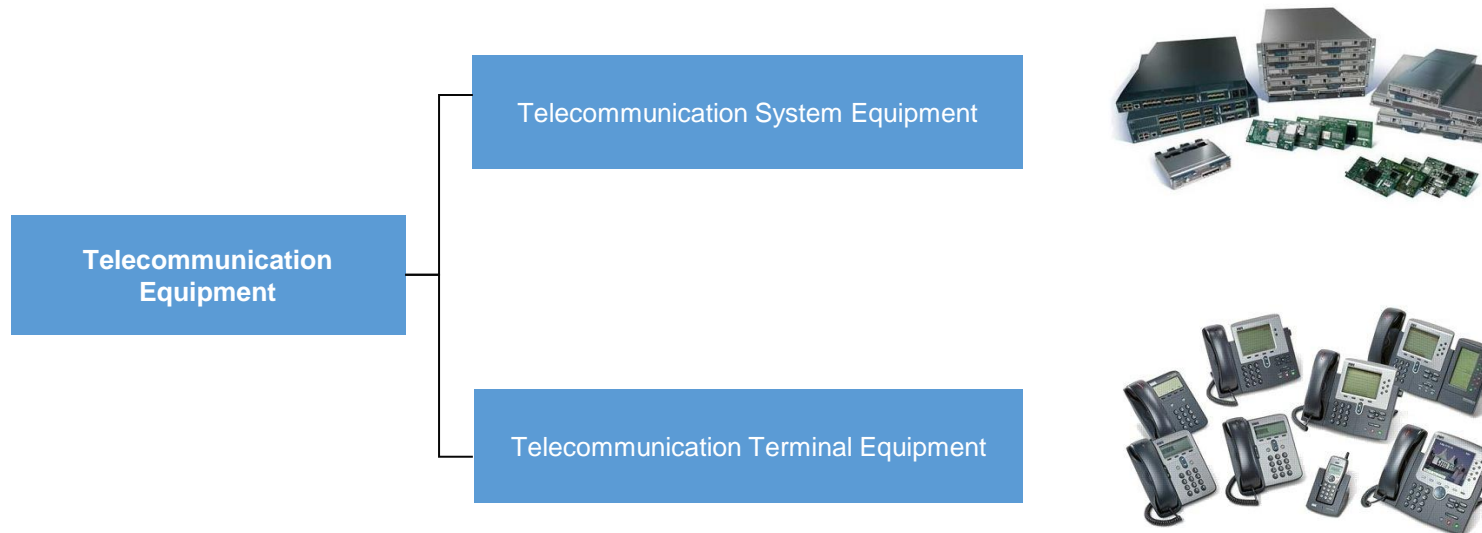
Source: Frost & Sullivan Analysis

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Analysis of Telecommunication Equipment Market in China
Overview and Introduction

- The telecommunication equipment includes a much broader range of equipment with more sophisticated devices and more embedded functions as technology evolves. The telecommunication equipment can be classified as (i) telecommunication system equipment and (ii) telecommunication terminal equipment.

- The telecommunication system equipment mainly includes wired and wireless communication transmission equipment, such as modems, routers, circuit switches, and others. While the telecommunication terminal equipment mainly includes mobile communication equipment, such as mobile phones, wearable devices, and others.

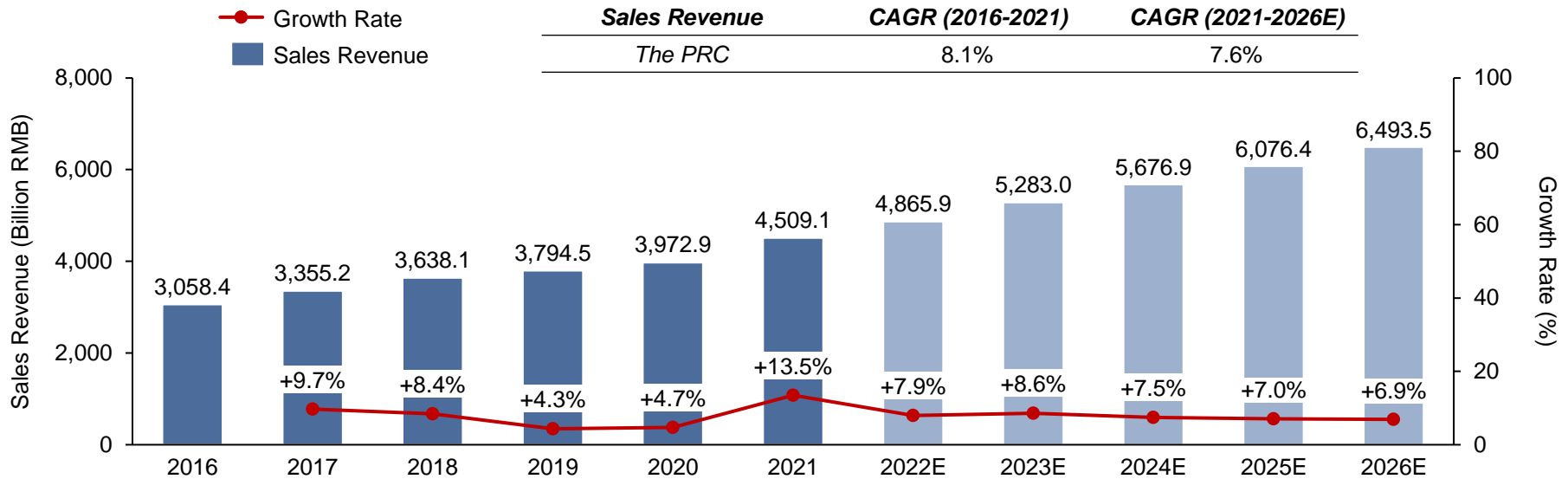### Classification of Telecommunication Equipment

Telecommunication Equipment

Telecommunication System Equipment

Telecommunication Terminal Equipment

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Analysis of Telecommunication Equipment Market in China

Market size of Telecommunication Equipment Market in China

Sales Revenue in the PRC Telecommunication Equipment Market, 2016 – 2026E

Sales Revenue	CAGR (2016-2021)	CAGR (2021-2026E)
The PRC	8.1%	7.6%

- Growth Rate
- Sales Revenue

Sales Revenue (Billion RMB):
- 2016: 3,058.4
- 2017: 3,355.2 (+9.7%)
- 2018: 3,638.1 (+8.4%)
- 2019: 3,794.5 (+4.3%)
- 2020: 3,972.9 (+4.7%)
- 2021: 4,509.1 (+13.5%)
- 2022E: 4,865.9 (+7.9%)
- 2023E: 5,283.0 (+8.6%)
- 2024E: 5,676.9 (+7.5%)
- 2025E: 6,076.4 (+7.0%)
- 2026E: 6,493.5 (+6.9%)

- From 2016 to 2021, the sales revenue in telecommunication equipment market in the PRC experienced a stable growth, increasing from RMB3,058.4 billion to RMB4,509.1 billion, with a CAGR of 8.1%, and is expected to reach RMB6,493.5 billion in 2026, representing a CAGR of 7.6% from 2021 to 2026
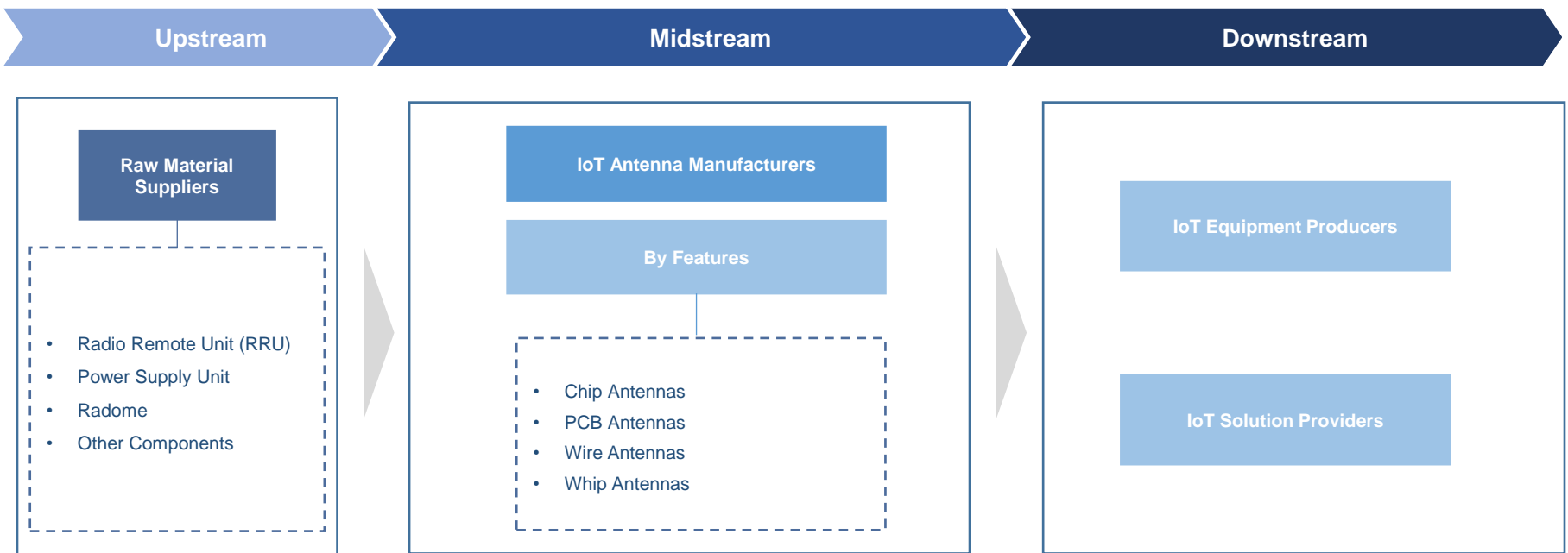
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Analysis of IoT Antennas Market in the United States
Overview and Value Chain Analysis

- The antenna is the tool by which an IoT device receives and broadcasts signals to the outside world and therefore is a fundamental element of an IoT device. IoT antennas enable fast and easy integration into connected systems, such as Wi-Fi, Bluetooth, Zigbee and WLAN devices.

- The IoT antenna products can be divided into radio frequency identification ("RFID") antennas, wearable or implantable antennas, on-chip package antennas, multi-physical sensing antennas and energy harvesting antennas by function, and chip antennas, PCB antennas, wire antennas and whip antennas by type.

- The value chain of IoT antenna market generally includes upstream raw material suppliers, midstream IoT antenna manufacturers, and downstream IoT equipment producers and IoT solution providers.

Value Chain of IoT Antenna Market

Upstream	Midstream	Downstream

Upstream

Raw Material Suppliers

- Radio Remote Unit (RRU)
- Power Supply Unit
- Radome
- Other Components

Midstream

IoT Antenna Manufacturers

By Features

- Chip Antennas
- PCB Antennas
- Wire Antennas
- Whip Antennas

Downstream

IoT Equipment Producers
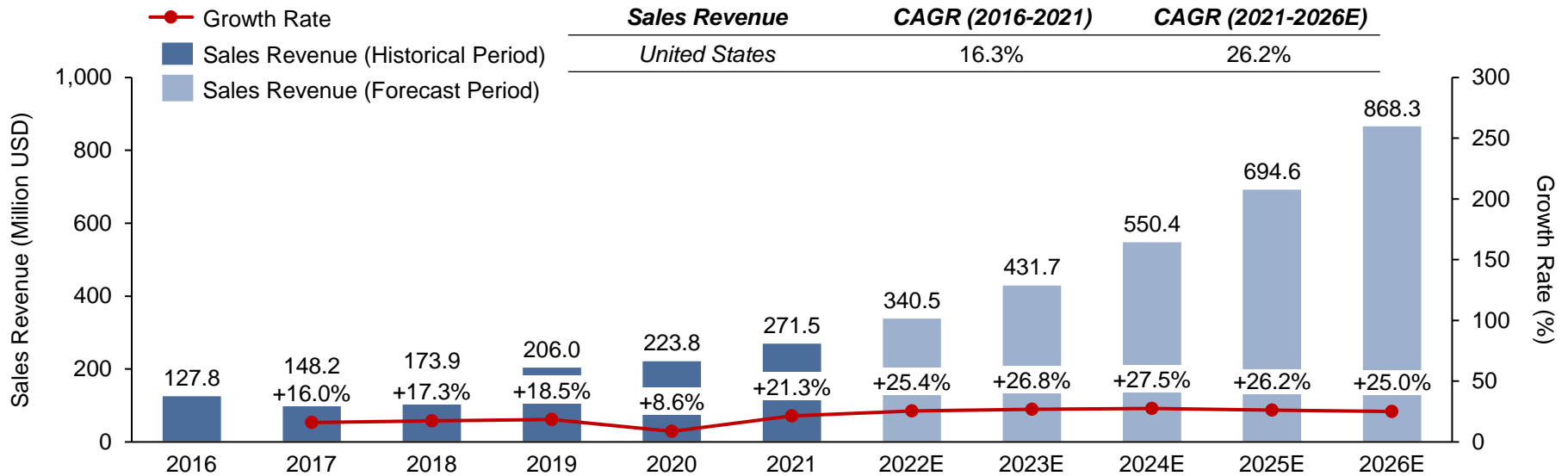
IoT Solution Providers

Source: Frost & Sullivan Analysis

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Analysis of IoT Antennas Market in the United States

Market size of IoT Antennas Market in the United States

Sales Revenue in IoT Antennas Market (United States), 2016 – 2026E

Sales Revenue	CAGR (2016-2021)	CAGR (2021-2026E)
United States	16.3%	26.2%

Legend:
- Growth Rate
- Sales Revenue (Historical Period)
- Sales Revenue (Forecast Period)

Sales Revenue (Million USD):
- 2016: 127.8
- 2017: 148.2 +16.0%
- 2018: 173.9 +17.3%
- 2019: 206.0 +18.5%
- 2020: 223.8 +8.6%
- 2021: 271.5 +21.3%
- 2022E: 340.5 +25.4%
- 2023E: 431.7 +26.8%
- 2024E: 550.4 +27.5%
- 2025E: 694.6 +26.2%
- 2026E: 868.3 +25.0%

- Due to the rapid development of the IoT market, the total sales revenue of IoT antennas market in the United States experienced a continuous growth in recent years, which increased from USD127.8 million in 2016 to USD271.5 million in 2021, representing a CAGR of 16.3% from 2016 to 2021.

- The IoT market in the United States will continue to be driven by a number of innovations in technology through research and development efforts, acquisitions by large players to gain foothold in the IoT market and strong synergy between market players to develop industry standards to govern platform architecture and protocol. Driven by (1) the rapid development of 5G technologies in the United States with more than 280 cities covered by 5G network and (2) favorable policies to support the development of IoT industry, such as the Infrastructure Investment and Employment Act enacted by the United States Congress that allocates a total funding of USD550.0 billion in infrastructure investment covering roads, bridges, water supply, broadband and power grid, the sales revenue of IoT antennas market in the United States is expected to witness a significant growth since 2021. As such, the total sales revenue of IoT antennas market in the United States is expected to reach USD868.3 million in 2026, with a CAGR of 26.2% from 2021 to 2026.

Source: Frost & Sullivan Analysis

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Analysis of IoT Antennas Market in the United States

Future Opportunities and Challenges

<table>
<tr>
<td rowspan="3">Future Opportunities</td>
<td>Increasing Investment in Infrastructure Further Stimulates Demand for IoT Antennas</td>
<td>• In August 2021, the United States Congress passed the Infrastructure Investment and Employment Act, which proposed to allocate a total funding of USD550 billion in infrastructure investment covering roads, bridges, water supply, broadband and power grid. The increasing investment in broadband and power grid is expected to further stimulate the downstream demands for IoT antennas, which will promote the development of IoT antennas market in the United States in the future.</td>
</tr>
<tr>
<td>Diversified and Complex Product Applications</td>
<td>• Along with the development of IoT industry, the growing breadth of IoT devices and use cases, combined with additional radio spectrum and protocols, is creating more complexity in designing and integrating antennas into products. Moreover, diversified and complex product application put forward higher requirements for IoT antennas on electrical characteristics, structural complexity and manufacturing process. For instance, RFID (radio frequency identification) antennas may work in the environment with further limited volume and more complex propagation characteristics, which raises high requirements for the miniaturization and broadband design. Therefore, in the future, IoT antennas producers have to improve their R&D capability to satisfy the growing requirements for diversified and complex product applications.</td>
</tr>
<tr>
<td>Development of IoT Antenna System</td>
<td>• As the IoT ecosystem turns to support high-density and low-latency networks and continues to incorporate various new features into radios and overall system layouts, the antenna system plays a more important role in IoT solutions. Therefore, in the future, the IoT antennas producers not only regard IoT antennas as ancillary products to communication modules, but also develop IoT antenna systems as an indispensable solution for establishing IoT applications and intelligent environments. With the development of IoT antennas market in the United States, the IoT antennas producers, especially those leading ones, have been dedicated to provide comprehensive antenna solutions to IoT device producers that lack the skills to tackle inherent technological complexity of antenna design.</td>
</tr>
<tr>
<td>Challenge</td>
<td>Intensified Competition</td>
<td>• As the wide application of IoT promotes the development of new-generation information technology, the increasing number of telecommunication product manufacturers, including producers of antennas, electronic component and communication modules, have been participating in this market, intensifying the competition. Those small and medium-sized IoT antenna producers who serve mid- and low-end customers may face price competition, which may reduce their profitability.</td>
</tr>
</table>

Source: Frost & Sullivan Analysis

Analysis of IoT Antennas Market in the United States
Ranking of IoT Antennas Market in the United States

Top Ten China's IoT Antenna Producers by Revenue in the United States' IoT Antenna Market in 2021

Ranking	Company	Background Information	Market Share (%)
1	Company R	A developer and producer of various electronic components and modules related to RF, such as antenna modules, wireless charging modules, EMC/EMI products, and others.	12.6%
2	Company S	A global designer and manufacturer of cable assembly and connector system solutions for consumer, enterprise, cloud, automotive, and medical applications.	10.8%
3	Company T	A leading company in global mobile communication industry.	8.0%
4	Company U	A leading company specialized in research and development, manufacture and sales of terminal antennas for wireless communications.	6.3%
5	Company V	A company that focuses on main businesses including mobile communication equipment and elevator manufacture.	4.0%
6	Company O	A global leading solution and service provider of wireless and information communications systems with its R&D facilities, manufacturing base, and sales and service teams.	1.7%
7	Company W	A leading listed company that specialized in antenna, radio frequency, communications products, and solutions of Cloud WiFi series.	1.1%
8	Our Group	See "Business"	0.9%
9	Company X	A listed large high-tech enterprise providing wireless access system solutions.	0.6%
10	Company Y	A leading private IoT antenna supplier in China.	0.3%
Top 10			46.3%
Others			53.7%
Total			100%

- Most of the United States' IoT antenna brands outsourced their production to overseas original equipment manufacturers ("OEM"), such as OEMs in the PRC, and conducted product sales through both direct sales and distributors. There is a large number of OEMs in the PRC that manufacture IoT antennas for the United States' market. Therefore, the market shares of these OEMs in the PRC are rather fragmented.

- In terms of sales revenue derived from IoT antennas in 2021, our Group accounted for approximately 0.9% in the IoT antenna market in the United States.
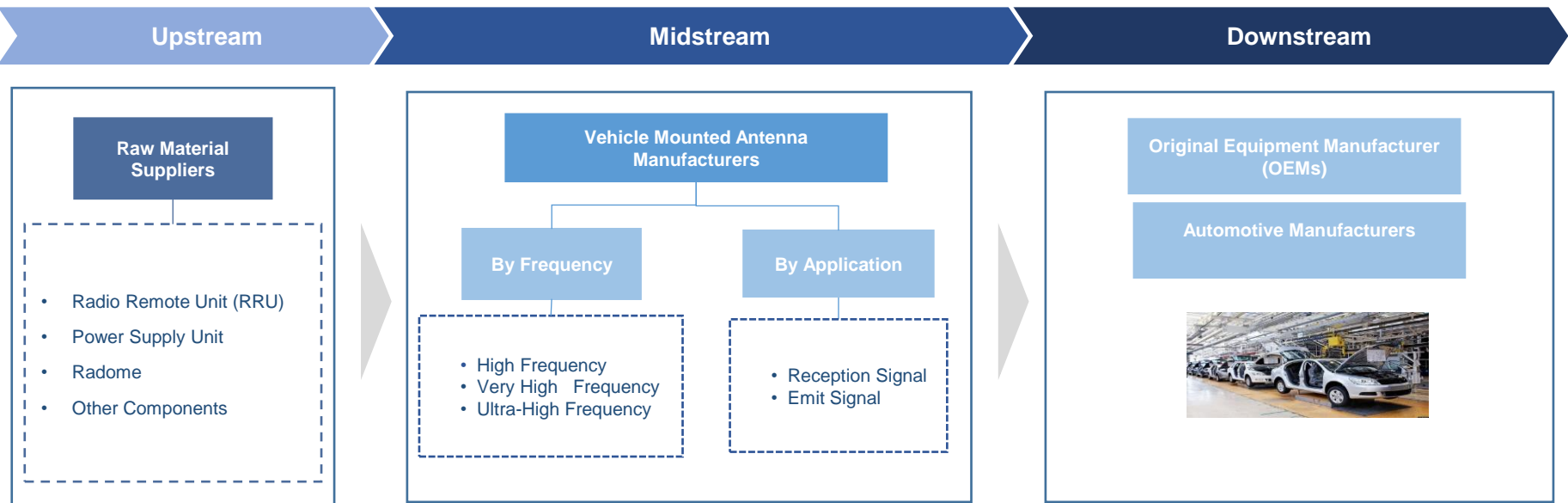
Source: Frost & Sullivan Analysis

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Analysis of Vehicle Mounted Antennas Market in Russia
Overview & Value Chain Analysis

- The vehicle mounted antennas are used for identifying spatial signal signatures, such as the direction of arrival ("DOA") of the signal, and calculating beamforming vectors, which are used for tracking and locating the antenna beam on the vehicle. The automotive industry is transitioning to smart automobiles, which are fully connected via vehicle-to-infrastructure ("V2I") and vehicle-to-vehicle ("V2V") communication to enhance safety and performance. The vehicle mounted antenna plays an important role in smart automobiles as it links various functions such as mobile communication, GPS, TV, radio and others.

- The vehicle mounted antenna products can be divided into high frequency (0-800 MHz), very high frequency (800 MHz-2.5 GHz), and ultra-high frequency (2.5 GHz-6 GHz) by frequency; reception signal and emit signal by application; and light duty vehicle, commercial vehicle, and electric vehicle by vehicle type.

- The vehicle mounted antenna reduces the overall cost and weight of the automobile. With connectivity in the automobile improved, the user's experiences, such as active steering, stronger interface immunity, and better connectivity, have been enhanced. Thus, it is expected the new and advanced features will drive the growth of the vehicle mounted antenna market.

- The value chain of vehicle mounted antenna market generally includes upstream raw material suppliers, midstream vehicle mounted antenna manufacturers, and downstream automotive manufacturers and OEMs.
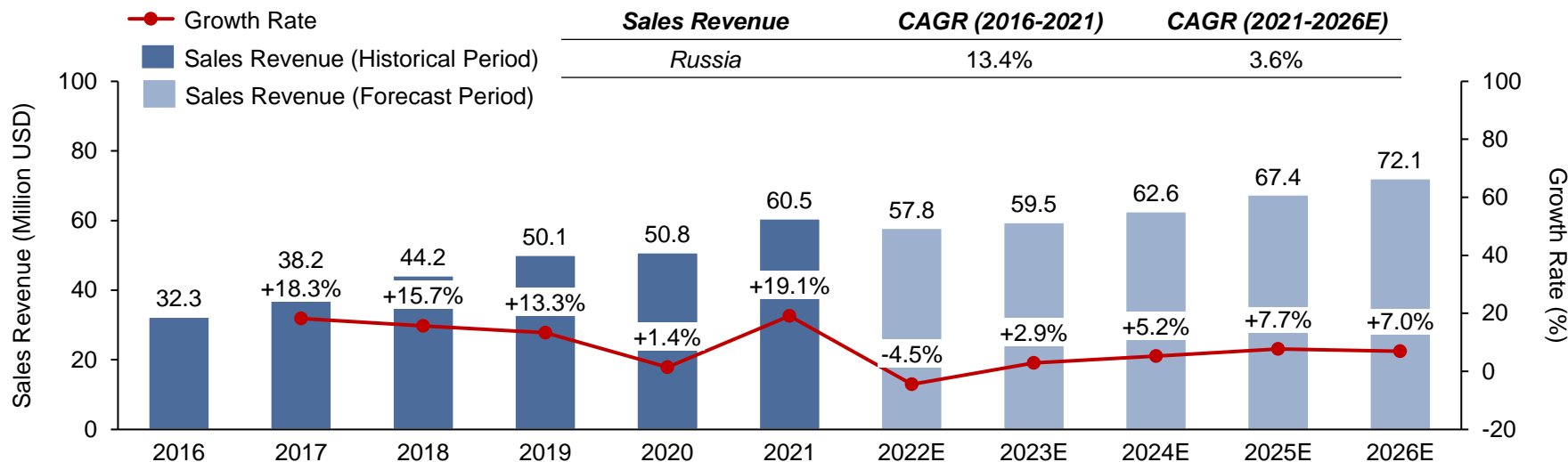
Value Chain of Vehicle Mounted Antenna Market

Upstream	Midstream	Downstream

Upstream

Raw Material Suppliers

- Radio Remote Unit (RRU)
- Power Supply Unit
- Radome
- Other Components

Midstream

Vehicle Mounted Antenna Manufacturers

By Frequency
- High Frequency
- Very High Frequency
- Ultra-High Frequency

By Application
- Reception Signal
- Emit Signal

Downstream

Original Equipment Manufacturer (OEMs)

Automotive Manufacturers

Source: Frost & Sullivan Analysis

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Analysis of Vehicle Mounted Antennas Market in Russia
Market size of Vehicle Mounted Antennas Market in Russia

Sales Revenue in Vehicle Mounted Antennas Market (Russia), 2016 – 2026E

Sales Revenue	CAGR (2016-2021)	CAGR (2021-2026E)
Russia	13.4%	3.6%

Legend:
- Growth Rate
- Sales Revenue (Historical Period)
- Sales Revenue (Forecast Period)

Sales Revenue (Million USD):
- 2016: 32.3
- 2017: 38.2 (+18.3%)
- 2018: 44.2 (+15.7%)
- 2019: 50.1 (+13.3%)
- 2020: 50.8 (+1.4%)
- 2021: 60.5 (+19.1%)
- 2022E: 57.8 (-4.5%)
- 2023E: 59.5 (+2.9%)
- 2024E: 62.6 (+5.2%)
- 2025E: 67.4 (+7.7%)
- 2026E: 72.1 (+7.0%)

- Along with the increasing production volume of vehicles and the growing application of diversified vehicle mounted antennas in Russia, the total sales revenue of the vehicle mounted antenna market in Russia increased from USD32.3 million in 2016 to USD60.5 million in 2021, with a CAGR of 13.4% from 2016 to 2021.

- From 2019 to 2020, the growth rate of the sales revenue of the vehicle mounted antenna market in Russia was only 1.4% primarily because the production volume of vehicles decreased by 16.5% from 2019 to 2020 due to the outbreak of COVID-19 pandemic. In 2021, the production volume of vehicles in Russia has witnessed a quick rebound by 9.1%. Moreover, in September 2021, the Russian government planned to provide subsidies with 25% of purchase price of any Russian-made electric vehicle to a maximum amount of USD8,570 to stimulate demands and production of electric vehicles. Therefore, the sales revenue of the vehicle mounted antenna market in Russia in 2021 experienced a significant increase by 19.1%, reaching USD60.5 million in 2021. The Russia-Ukraine war and economic sanctions starting in 2022 are expected to become obstacles to the growth of Russia's automobile industry. Although the demand for the vehicle mounted antennas from vehicles of domestic brands in Russia increases, the growth of the vehicle mounted antennas market in Russia is likely to slow down in the future. The total sales revenue in the vehicle mounted antennas market in Russia is anticipated to reach USD72.1 million in 2026, representing a CAGR of 3.6% from 2021 to 2026.

Source: Frost & Sullivan Analysis

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Analysis of Vehicle Mounted Antennas Market in Russia
Future Opportunities and Challenges

Future Opportunities

The Potentials from Internet of Vehicles

- The Internet of Vehicles ("IoV") uses the network infrastructure to allow vehicles to be connected to new radio technologies, which can be supported by 5G networks. Within the IoV, the vehicles can create and share digital information between infrastructures, such as Vehicular Cloud, organizations, and other vehicles. Along with the wide application of the IoV, the industrialization process of 5G+V2X will be accelerated, which will promote the development of vehicle-mounted communication equipment to reach the new standard level of vehicles. As such, the potential development of IoV is expected to further stimulate the development of vehicle-mounted communication equipment.

Increasing Demand for Electric Vehicles ("EV")

- The demand for EVs is expected to increase in the coming years because of favorable subsidy policies and an increase in the adoption of strict emissions norms by the governments of various countries. In September 2021, the Russian government plans to cover 25% of the purchase price of any Russian-made electric vehicle to a maximum of $8,570, to stimulate demand and production of EVs. Also, EVs may be able to drive for free on toll roads in the future. These favorable policies on EVs, attract more foreign automakers to produce models in Russia. Russia aims to achieve 220,000 units of EV annual production by 2030.

The Development of Autonomous Vehicles

- Leading technology players and automakers have been increasing their investments in the development of autonomous vehicles during the recent years. Autonomous vehicles are expected to benefit us in various aspects, such as reducing accident rates and increasing productivity at workplace. The development of autonomous vehicles stimulates the digital transformation of vehicles, in which the vehicle mounted antenna plays an important and fundamental role. As such, the digital transformation of vehicles is expected to boost the demand for vehicle mounted antennas.

Challenges

Rising Manufacturing Cost

- The demand for vehicle mounted antennas is expected to grow due to the rapid technological upgrade and market needs. However, the high manufacturing and maintenance costs are estimated to restrain the growth of the vehicle mounted antenna market, especially as the vehicle mounted antenna market is still in its early stage of the development. In addition, with the rise of wage standard, the labor costs are expected to continue to increase, which may reduce manufacturers' profit.

Source: Frost & Sullivan Analysis

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Analysis of Vehicle Mounted Antennas Market in Russia

Ranking of Vehicle Mounted Antennas Market in Russia

Top Ten PRC Exporters by Revenue in Russia's Vehicle Mounted Antenna Market in 2021

Ranking	Company	Background Information	Market Share (%)
1	Company R	A developer and producer of various electronic components and modules related to RF, such as antenna modules, wireless charging modules, EMC/EMI products, and others.	11.5%
2	Company S	A global designer and manufacturer of cable assembly and connector system solutions for consumer, enterprise, cloud, automotive, and medical applications.	10.5%
3	Company T	A leading company in global mobile communication industry.	9.5%
4	Company U	A leading company specialized in research and development, manufacture and sales of terminal antennas for wireless communications.	8.2%
5	Company V	A company that focuses on main businesses including mobile communication equipment and elevator manufacture.	7.2%
6	Our Group	See "Business"	6.2%
7	Company X	A listed large high-tech enterprise providing wireless access system solutions.	5.1%
8	Company Z	One of the largest antenna manufacturers in China.	1.5%
9	Company AA	A listed company that focuses on communication antenna, automotive electronics, and high-performance RF devices.	1.0%
10	Company AB	A professional automotive antenna and feeder manufacturer integrating design, production and sales.	0.8%
Top 10			**61.5%**
Others			**38.5%**
Total			**100%**

- The vehicle manufacturers in Russia are primarily overseas brands, which accounted for over 60% of the total production volume of vehicles in Russia in 2021. The vehicle manufacturers of international brands generally establish the stable supplier systems of vehicle components, including vehicle mounted antennas. Meanwhile, the vehicle mounted antenna brands in Russia generally outsourced their production to OEMs, such as OEMs in the PRC. The market shares of OEMs in the PRC that manufacture vehicle mounted antennas for Russia's market are relatively fragmented.

- In terms of sales revenue derived from vehicle mounted antennas, our Group accounted for approximately 6.2% of the vehicle mounted antennas market in Russia.

Source: Frost & Sullivan Analysis

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Abbreviations and Terms

Limitations in Source of Information

- Interviews with end-users, venders and distributors are conducted to collect information for this report, based on a best-efforts basis.

- Frost & Sullivan will not be responsible for any information gaps where interviewees have refused to divulge confidential data or figures.

- In instances where information is not available, figures based on similar indicators combined with Frost & Sullivan in-house analysis will be deployed to arrive at an estimate.

- Frost & Sullivan will state the information sources at the bottom right-hand corner of each slide for easy reference.

Note to Numeric Calculations

- Value and percentage figures in this report are all rounded. Figures may not add up to the respective totals owing to rounding.

- The base year is 2021. The historic period is from 2016 to 2020. The forecast period is from 2022 to 2026.

Abbreviations and Terms

- **CAGR:** compound annual growth rate
- **China:** if not specified refers to mainland of China, excluding Hong Kong, Taiwan and Macau
- **GDP:** gross domestic product
- **R&D:** research & development
- **RMB:** Renminbi, the lawful currency of the PR

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Abbreviations and Terms

- **3GPP:** the 3rd Generation Partnership Project, refers to an umbrella term for a number of standards organizations which develop protocols for mobile telecommunications.

- **5G:** the 5th generation mobile network, refers to a new global wireless standard after 1G, 2G, 3G, and 4G networks.

- **AI:** artificial intelligence, refers to simulation of human intelligence by machines.

- **API:** the acronym for application programming interface, refers to a software intermediary that allows two applications to talk to each other.

- **Bandwidth**: it refers to a measure of the width of a range of frequencies, measured in hertz.

- **BBU:** base band unit, refers to a device in telecom systems that transports a baseband frequency, usually from a remote radio unit, to which it may be tied through optical fiber.

- **Broadband:** it refers to a signaling method that includes or handles a relatively wide range (or band) of frequencies, which may be divided into channels, the wider or broader the bandwidth, the greater the information-carrying capacity.

- **Capacity:** it refers to the tightest upper bound on the amount of information that can be reliably transmitted over the wireless communication channel.

- **CFR:** Crest Factor Reduction, refers to a technique to reduce the peak to average power ratio of a waveform to a desired value.

- **Channel Simulator**: it refers to specialized test equipment that provides test and interference signal generation capability.

- **Cloud:** it refers to a network of remote servers hosted on the Internet and used to store, manage, and process data in place of local servers or personal computers.

- **CU:** centralized unit, provides support for the higher layers of the protocol stack in base station.

- **DAS:** distributed antenna system, refers to a network of antenna that sends and receives cellular signals.

- **DFE:** digital front end, refers to the interface between the analog front-end and digital baseband modules in a wireless system.

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Abbreviations and Terms

- **DMP:** data management platform, refers to a software platform used for collecting and managing data.

- **DPD:** Digital Pre-Distortion, refers to a technique to increase linearity or compensate for non-linearity in power amplifiers.

- **DU:** distributed unit, provides support for the lower layers of the protocol stack in base station.

- **EDA software:** electronic design automation software, refers to a category of software for designing electronic systems.

- **Edge Computing:** it refers to a distributed computing paradigm that brings computation and data storage closer to the location where it is needed to improve response times and save bandwidth.

- **FEM:** the finite element method, refers to a popular method for numerically solving differential equations arising in engineering and mathematical modeling.

- **ERP:** enterprise resource planning, refers to a business process management software that allows an organization to use a system of integrated applications to manage the business and digitalize back-office functions relating to technology, services, and human resources.

- **FPGA:** field programmable gate array, refers to a type of semiconductor device that can be reprogrammed to desired application of functionality after manufacturing.

- **Fronthaul:** it refers to fiber-based connection in in RAN infrastructure between the Baseband Unit (BBU) and Remote Radio Head (RRH), which is established to supplement to the backhaul connection between the BBU and central network core.

- **Gbps:** Gigabits per second, represents billions of bits per second and is commonly used as a measure of bandwidth on a digital data transmission medium such as optical fibre.

- **Heterogenous network:** it refers to a network connecting computers and other devices where the operating systems and protocols have significant differences.

- **IEEE:** Institute of Electrical and Electronics Engineers, refers to the world's largest association of technical professionals established for the advancement of technology.

Abbreviations and Terms

- **IoT:** Internet of things, refers to a massive network connecting all sorts of information sensory devices, such as radio frequency identification units, ultra-red sensors, global positioning systems and laser scanners, to the internet with the aim of connecting all things to the network for easy identification and management.

- **LORA:** long Range, refers to a proprietary low-power wide-area network modulation technique.

- **LTE-U:** long-term evolution-unlicensed, refers to a standard for wireless broadband communication for mobile devices and data terminals.

- **MES:** manufacturing execution systems, refers to computerized systems used in manufacturing to track and document the transformation of raw materials to finished goods.

- **MIMO:** multiple-input multiple-output, a term used to describe the use of multiple antennas at both the transmitter and receiver to improve communication performance.

- **MU-MIMO:** it refers to multi-user, multiple-input, multiple-output technology, which allows a Wi-Fi router to communicate with multiple devices simultaneously.

- **Multi-TRP:** transmission and reception point, refers to a key technology that has been studied in fourth-generation (4G) mobile communication to alleviate the inter-cell interference via dynamic coordination between the multi-TRPs, to provide joint scheduling and transmissions or receptions.

- **Jitter:** it refers to the variation in time delay between when a signal is transmitted and when it is received over a network connection.

- **O-RAN:** open radio access network, refers to a network architecture integrating software and hardware which allows BBU and RRU components from different sources to work together seamlessly.

- **Parameter Tuning:** it refers to a process of adjusting all the related parameters, such as channel model, user traffic volume and application scenarios, of radio access network to match the actual communication environment.

- **Peak Throughput:** it refers to the maximum volume of data that can be transferred within a given timeframe. For example, when the peak throughput reaches 15Gbps, the maximum volume of data transferred within a second is 15G bits.

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Abbreviations and Terms

- **Protocol Stack:** it refers to a set of protocols used in a communication network to accommodate different network architectures.

- **pRRU:** pico remote radio unit, is used to the baseband unit.

- **Private Network:** it refers to a computer network that uses a private address space of IP addresses. These addresses are commonly used for local area networks (LANs) in residential, office, and enterprise environments.

- **Radio Frequency" or "RF":** it refers to the oscillation rate of an alternating electric current or voltage or of a magnetic, electric or electromagnetic field or mechanical system in the frequency range from around 20kHz to around 300 GHz.

- **rHub:** it refers to a switch device, which is converge and forward common public radio interface data to allow multiple pRRUs to serve multiple indoor floors or areas.

- **RRU:** remote radio unit, can be configured to communicate with a BBU via a physical.

- **Sensitivity:** it refers to the minimum magnitude of input signal that is required to produce an output signal which meet specified criteria.

- **Signal Analyzer:** it refers to equipment that can analyze the capabilities of modern radiofrequency signals.

- **Signal Generator:** it refers to a type of electronic devices that generates signals with set properties of amplitude, frequency and wave shapes and can be used as stimulus in designing, testing and troubleshooting.

- **Spectrum Analyzer:** it refers to equipment that measures the power of signal spectrum.

- **Wi-Fi:** it refers to the name of a wireless networking technology that uses radio waves to provide wireless high-speed internet and network connections.

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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 in the PRC 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 analysis of IoT market in China, analysis of private 5G network market in China, analysis of telecommunication equipment market in China, analysis of IoT antennas market in the United States, and analysis of vehicle mounted antennas market in Russia.

- The market research process for this study has been undertaken through detailed primary research which involves discussing the status of the industry with leading industry participants and industry experts. Secondary research involved reviewing company reports, independent research reports and data based on Frost & Sullivan's own research database.

- Projected total market size was obtained from historical data analysis plotted against macroeconomic data as well as specific related industry drivers.

- Frost & Sullivan's report was compiled based on the below assumptions:

  - China's macro economy is likely to maintain steady growth in the next decade;

  - China's social, economic, and political environment is likely to remain stable in the forecast period;

  - market drivers such as rising demands from downstream industries, advancement of technologies, favourable policies and regulations and others will drive the market;

  - COVID-19 will affect the economy and market in the short term.

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