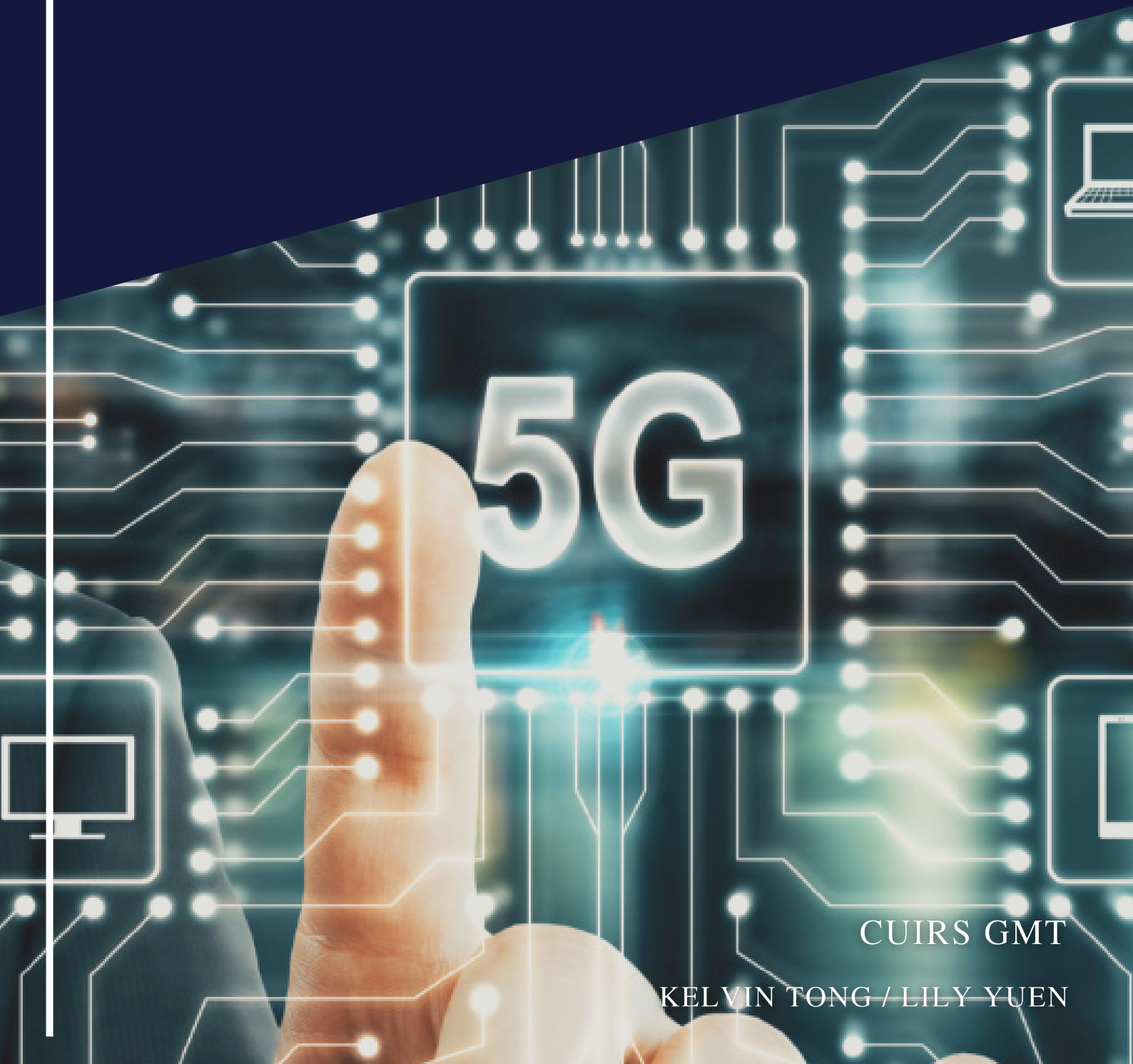


2023.02.10

GLOBAL 5G CHIPSET INDUSTRY OUTLOOK



CUIRS GMT

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Global 5G Chipset Industry Outlook

Industry View

Over-Weight

Geographic Coverage

Global

Introductions

Backgrounds – Realizing Higher Internet Speed

Today, there are rising preferences for high-speed data access by customers worldwide, driving the growth of the 5G chipset market. The 5G chipset is a crucial component of the 5G device – **The chipset manages the flow of data through the computer to ensure the machine’s proper functioning.** With the advancement into the 5G era, users of different gadgets will have better satisfactory experiences and faster access to the next-generation networks with 5G chipset deployment. In addition, the development of network coverage and the implementation of IoT in different settings support the market’s growth.

Future Prospect – A World Indispensably Geared to 5G

Smartphone OEMs and major telecom players are gearing toward adopting 5G chipsets in industrial processes and services on a massive scale. On top of that, rising demand for broader internet coverage, high-speed networks, and adoption of M2M at IoT retail stores, smart cities, and smart homes are building a solid foundation for market development. Furthermore, governments worldwide are actively planning for the smart city. All these factors provide promises about the growth of the 5G chipset market in the foreseeable future.

Challenges – Material Supply and US-China Tension

On the other hand, the high cost has been the biggest constraint to growth. For example, in 2022, the ASP of 5G smartphones was US\$ 616, more than three times that of 4G smartphones. As a result, 5G chipsets are primarily utilized in high-end gadgets, while the cost is expected to decrease as the technology matures.

Currently, China has heavy control over the raw material, gallium, for making chipsets. Also, the US-China tension is developing in an unclear direction, harming the stability of the raw material supply chain and global cooperation in the innovation of chipsets. These two obstacles could be the major headwinds for industry to grow as expected.

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Industry Analysis

Total Addressable Market (TAM)

The global 5G chipset market size was estimated at **US\$ 14.7 bn in 2021**, and it is expected to hit around **US\$ 126.4 bn by 2030**, poised to grow at a **CAGR of 27.2%** from 2022 to 2030 through estimating the **segmental growth of chipset frequency, processing node, and deployment (Exhibit 1)**. In 2021, across different frequency types, the sub-6GHz dominated the sector with a market share of 65%. In terms of the processing node type, the 7 nm category accounted for 64.6% of the market share, given that the major global players widely adopted 7nm processor nodes when building 5G chipsets. On top of that, with a 55% market share, the smartphone/tablet sector was the market leader when evaluating the chipset market by deployment type.

Exhibit 1. 5G Chipset Market Size From 21A – 30E (Precedence Research, 2022)

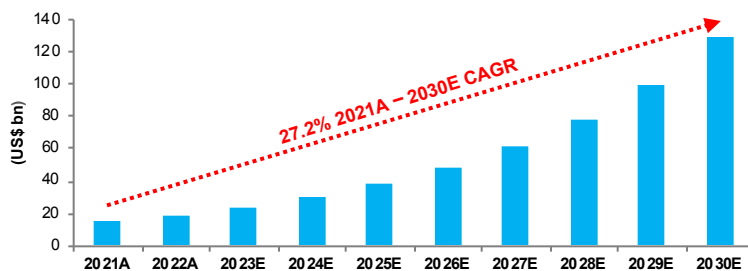


Exhibit 2. 5G Chipset Market, End-Use Segment Size (Emergen Research, 2021)

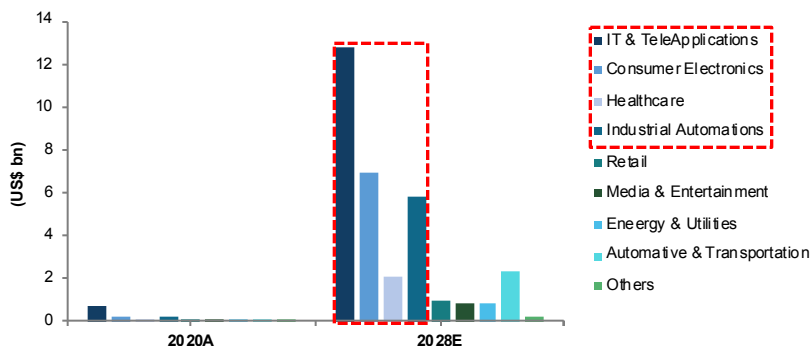
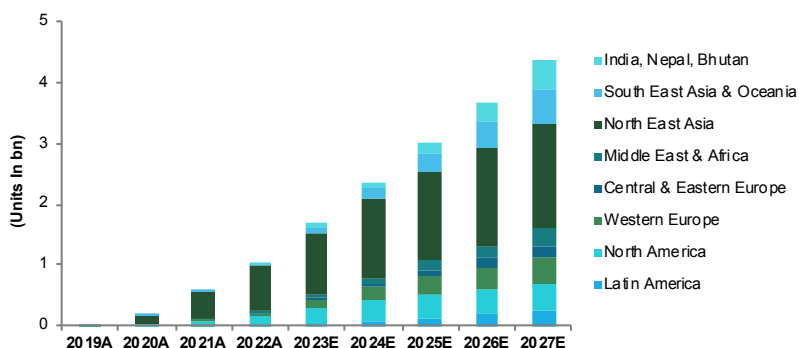


Exhibit 3. Forecast Number Of Mobile 5G Subscriptions Worldwide By Region From 2019 – 2027 (Statista, 2022)



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Industry Analysis

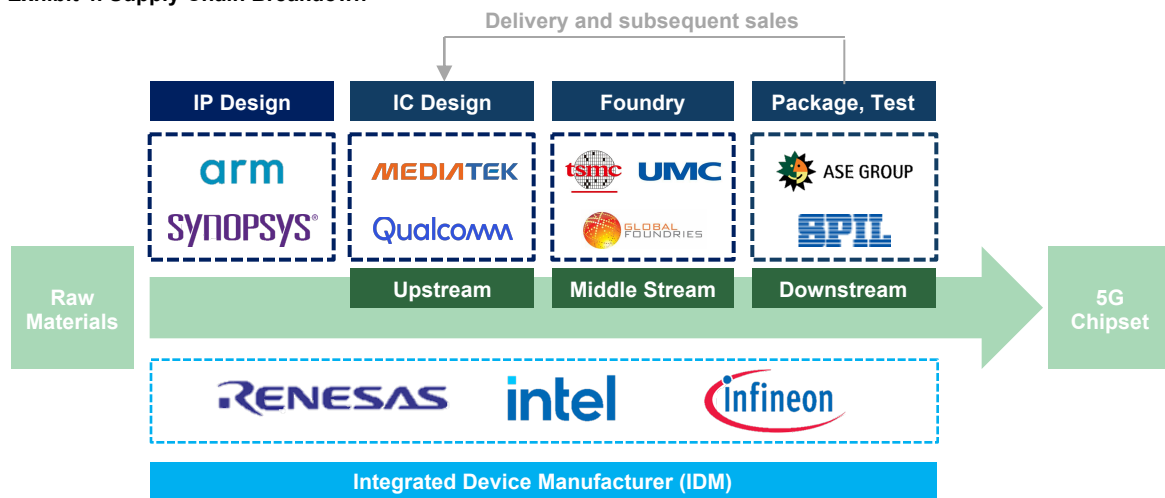
Business Model

IC design engineers first plan the functions that the chip needs to have and the distribution area of the functions on the chip, and then use "Hardware Description Language" (Hardware Description Language) to describe the chip functions into program codes, and then through "Electronic Design Automation" (EDA, Electronic Design Automation) tool, allowing the computer to convert the program code into a circuit diagram. After the chip is designed, a design house will find a foundry to manufacture the chip and then sell it.

Value Chain

IC design is in the upper stream of the 5G chipset supply chain. It only needs to design and sell its IC chips. As it does not have a manufacturing plant, it usually needs to cooperate with foundries in product testing and R&D. **Therefore, the relationship with the mid-stream and downstream industries is interdependent. Currently, Qualcomm and Mediatek are the leading manufacturers of 5G chipsets.**

Exhibit 4. Supply Chain Breakdown



Latest Development and Research Motivation

5G is an essential milestone for the whole world. In the era where everything is connected to the Internet, 4G is insufficient despite its high speed because it is only possible to realize multiple IoT devices directly accessing the Internet with a 5G network.

In the future, through the low-latency characteristics of 5G wireless networks, information can be transmitted through more powerful cloud computing, and most devices can be connected to the Internet, which would further penetrating the end use market in **smart homes, smart cities, and intelligent chemical factories.**

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Industry Analysis

Company Highlight and Competitive Landscape

Six major chip design houses demonstrate advanced techniques in making 5G chipsets with considerable market share, Taiwanese fabless player MediaTek and US Fabless giant is leading the market, with Apple designing in-house chip for ecosystem, following by Korean Samsung Group covering wide product portfolio. For the rest two major players, UNISOC grew rapidly since 2021 and overtook Huawei HiSilicon's market position (Exhibit 5)

Exhibit 5. Global Smartphone SoC Market Share (GSMrena, 2021)

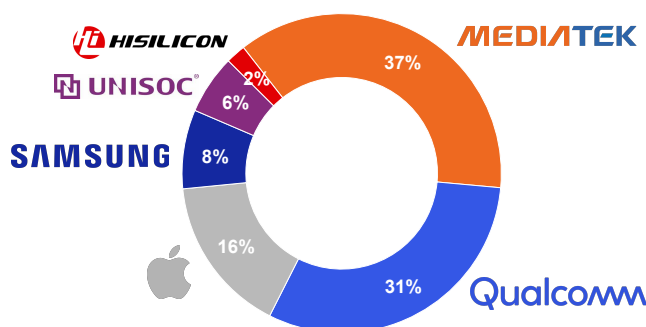


Exhibit 6. Peer Comparisons – 5G Chip Designers Excluding Apple

Company	MediaTek	Qualcomm	Samsung	UNISOC	Huawei HiSilicon
Logo					
Ticker	2454 TT	QCOM US	005930 KS	Private	Private
Founding Year	1997	1985	1969	2001	1987
Headquarter	Taiwan	USA	South Korea	China	China
Flagship Products	Dimensity	Snapdragon	Exynos	T820	Balong
R&D Target	Develop product lines and continue to main a broad product portfolio	Strengthen R&D capabilities within Europe for the evolution of 5G	Advanced research for memory and system semiconductors	Expand product portfolios and power digitalization in downstream applications	Support 5G connectivity of its smartphones by 2023
Key Highlights	Advanced R&D setup with competent workforce and reputation	Large installed customer base with long term contracts	Diversified product portfolio	Grew rapidly since 2021	Competitive pricing
Key Concern	Reliance on China market	Reliance on China market	Heavily dependent on the American Markets	Concern around chip's vulnerability due to reports in Jun'22	Rapidly losing out since US sanction

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Industry Analysis

Company Background

MediaTek

It is best known for its smartphone chips. Its Density 5G family chipsets have been powering 5G technology to the mass market, such as smartphones, PCs, routers, and mobile hotspots. Currently, twenty kinds of chipsets support 5G connectivity in different devices.

Qualcomm

It developed the Snapdragon™ 5G Mobile Platform, a comprehensive modem-to-antenna system solution for 5G multimode devices. Their technology supports 5G systems in smartphones, mobile computing, automotive, etc. Moreover, Qualcomm is the exclusive supplier of modems for iPhones.

Samsung

It has developed the Exynos Modem family chipsets. Applications of their modems mainly include smartphones, automobiles, and wearables. It won the Google Pixel's 5G chip order and broke into the US market.

UNISOC

It launched its 5G and 4G platform covering multiple products in consumer electronic (5G Intelligence Terminals, Smart Phone, Smart Wear) and Industrial Electronic (AIOT, Indoor/Professional Wireless Networking, Automotive and Smart Display)

Huawei HiSilicon

It developed the 5G multi-mode chipset Balong series, which supports a broad range of 5G products such as smartphones, home broadband devices, vehicle-mounted devices, and 5G modules. However, it now turned to less advanced chips to bypass penalties due to US sanctions.

Exhibit 7. Company Current Milestone

Company	Description
MediaTek	Dominance in the <\$299 price tier, entered the premium band (>\$500) with the Dimensity 9000.
Qualcomm	Industry benchmark of premium smartphones, focusing on the mid-high (\$300-\$499) and premium (>\$500) market for revenue growth.
Samsung	Share in the premium segment declined by 11% to 23% from Q1 2021 to Q1 2022.
UNISOC	Rapidly grew in 2021 by expanding customer base globally including Honor, Realme, Motorola, ZTE, Transsion, Samsung smartphones and Nokia
Huawei HiSilicon	Limited to 4G due to the US sanctions though started using Qualcomm SoCs.

Recent Technological Development

MediaTek has announced the Dimensity 8200, which is designed for producing premium 5G smartphones. The chipset is built on the 4nm fabrication technology of TSMC. This newest chipset delivers higher power efficiency and amplification of sub-6GHz performance. Sub-6 base stations are easy to deploy, have long transmission distances and wide coverage, and have become the main development direction of 5G in many countries.

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Industry Analysis

Industry Entry Barrier

Barriers mainly fall into two areas: patents and expertise. First, leading companies with already-developed technologies and products prevent the market entry of other smaller companies. Second, radio Frequency Front End (RFFE) expertise, power management, and Mobile Network Operator (MNO) certification are the three expertise hurdles.

For the RFFE, It takes a higher level of radio frequency (RF) know-how for 5g modem development as the number of mode combinations (3G/4G/5G) and frequency-band increase exponentially. For power management, it is hard to develop a modem that operates in both a power-limited and battery-operated environment, so that the performance is not compromised. In order to obtain the MNO certification, it requires time and cost. The actual time needed may even delay if there are any technical issues that arise during the certification process.

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Growth Factors – Demand Side

Demand Analysis

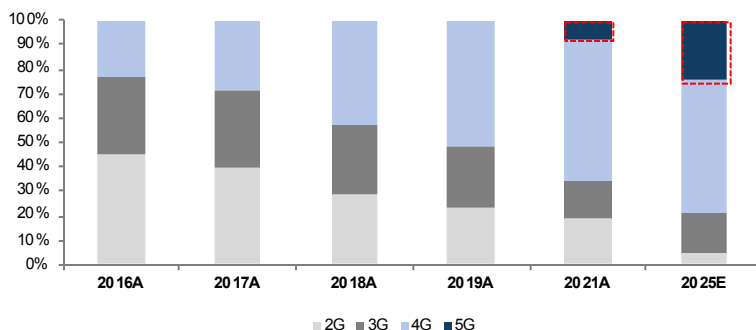
In the following section, the growth factors of the 5G chipset market will be analyzed. They will be further broken down into demand-side analysis, focusing on the rising needs of customers and global governments, and supply-side analysis regarding technological breakthroughs in lowering production costs.

Growing demand for high-speed internet and telecom adoption

Accelerated by the pandemic and the transformation in consumers' behaviour, mobile services nowadays require faster data transmission and broader network coverage. Moreover, other than consumer mobile traffic, more industries rely on fast and stable network coverage – for example, live business streaming, remote education, telemedicine, autonomous driving, etc. Growing demand for high-speed internet and information processing from different industries thus stimulates the need for 5G chipsets (Exhibit 8).

To meet the rising demands, the telecom industry is actively investing in deploying the 5G network infrastructure. Prominent global telecom leaders: Verizon, AT&T Inc Communications, and China Telecom Corporation Limited are aggressively searching for transformation to stations equipped with 5G chips. Accompanied by nine major companies that sell 5G radio hardware and 5G systems for carriers: Altiostar, Cisco Systems, Datang Telecom Fiberhome, Ericsson, Huawei, Nokia, Qualcomm, Samsung, and ZTE, the market share of telecommunication technologies globally will expand to 25% in 2025 from 8% in 2021.

Exhibit 8. Market Share of Mobile Telecommunication Technologies Worldwide from 2016 to 2025, by generation (Statista, 2022)



Rising consumer demand for 5G devices and OEM adoption

With the lifestyle change, consumers spend more time on the internet watching videos, streaming, and using cloud services in many areas. These have been contributing to the rapid growth of data volume usage. They are not only looking forward to having a faster network but also devices that can support 5G usage.

Apart from smartphones, there is a rising application of 5G capability in a wide range of consumer electronics, such as ultra-HD video-on-demand content, 3D TVs, AR, VR.

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Growth Factors – Demand Side

Demand Analysis (cont.)

Owing to the rising consumer demand, OEMs of smartphones and other consumer electronics are actively adopting the 5G chipsets, and an influx of 5G devices has been witnessed. In 2022, the number of announced 5G devices reached 1,276, of which nearly 900 were available commercially, representing a 50.7% increase in the number of which since the end of December 2021 (Exhibit 9). The strength of 5G adoption is expected to continue as the market has yet to mature.

Exhibit 9. Growth of 5G Devices, Announced and Commercially Available (GSA, 2022)

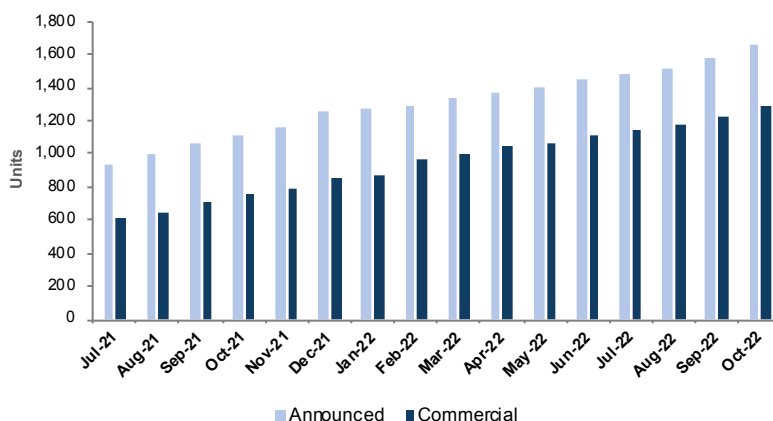
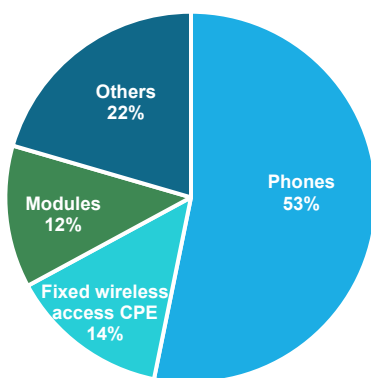


Exhibit 10. Announced 5G Devices, by Form Factor (GSA, 2022)



Government policy support

Governments worldwide have paid attention to the importance of 5G developments. Many support regulations that create suitable environments for 5G adoption and encourage 5G deployments in different industries. For instance, in the Asia-Pacific region, China aims to raise the penetration rate of 5G in the consumer industry to 40% by 2023. The Korean government has set up a detailed time plan for 5G deployment and commercialization. Meanwhile, the US FCC began drafting regulations for 5G technology, making itself the first country to allow high-band spectrum. Besides, the 5G Action Plan that primarily focuses on the commercialization of 5G also aims to expand to all citizens and businesses across the EU.

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Growth Factors – Supply Side

Supply Analysis

Lowering chipset production cost

The average price of a 5G system-on-a-chip that performs diversified functions is between \$40 to \$45. The price is expected to drop to \$20 by early 2023. Economies of scale facilitated by cheaper cost will enable mobile-phone makers to adopt 5G chips in various consumer electronics. Thus, 5G capability will likely witness penetration to at least 80% of mobile devices globally.

Exhibit 11. Average Selling Price for 5G, 4G Smartphones Worldwide, USD (Insider Intelligence, 2022)

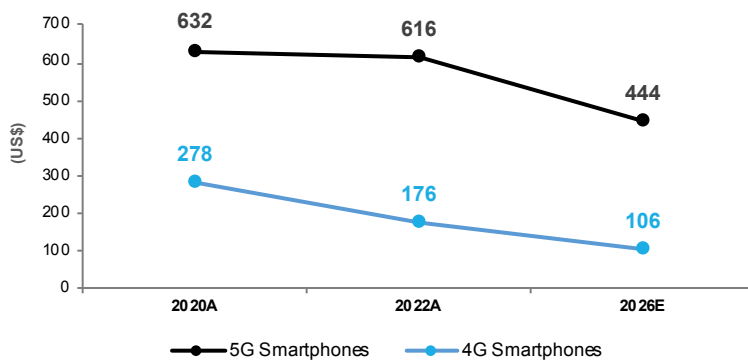
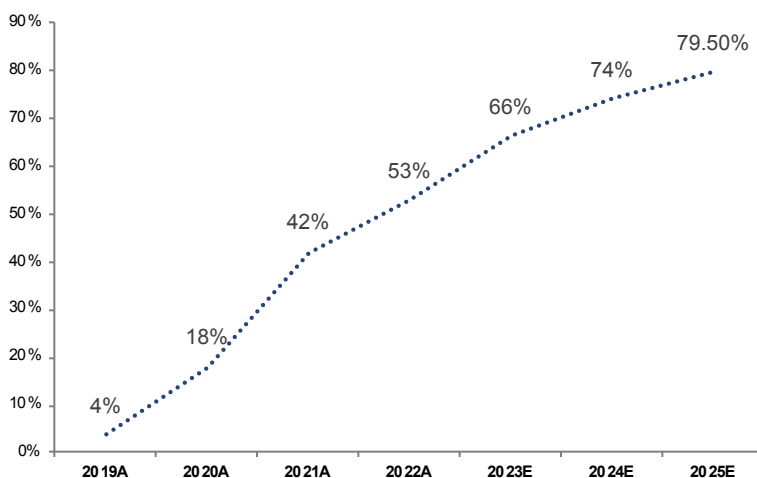


Exhibit 12. 5G-capable Smartphones Shipped to Retailers Around the World, In Percentage (WSJ, 2022)



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Catalyst & Risks

Catalyst

Price war might squeeze the margin while stabilize the industry

Qualcomm will launch low-cost 5G mobile phones in emerging markets next year, which is expected to trigger a price war for low-priced 5G single chips. MediaTek will follow up, which may further lower the average unit prices. Seizing market share in the emerging market is essential, and the balance between premium, mid-range, and low prices chipsets will further stabilize the revenue of the chip manufacturers.

Apple's in-house 5G chipsets

Apple is developing its own 5G chips for future iPhones. However, Qualcomm is still expected to be a modem supplier for all iPhone 15 and 16 series, suggesting that Apple's 5G chips will debut the earliest by 2025. It is estimated that Apple's chip division will become the 12th largest chip company in the world in terms of revenue. By the time Apple successfully develops its chips, Qualcomm will lose a large and stable customer as a result of its revenue. Apple may extend its reach to more 5G areas, establishing stronger dominance in the 5G chipset market.

Risk

China's control of chipset raw material

Currently, China dominates. It produces more than 95% of the world's gallium, the raw material for making high-frequency radio waves chipsets for 5G base stations. The US government has announced gallium as one of the 35 elements considered a national security concern. This poses a risk to companies on whether non-China-based 5G chip makers can access an adequate supply of the metal in the fast-growing stage of the 5G chip market.

US-China tension deterring industry progress

In October 2022, the US government announced a series of export limits that ban Chinese companies from purchasing chips and chip-producing equipment without a license. This will significantly threaten China's 5G progress and ambition. For example, it is banning Nvidia from exporting high-end chips to China. Moreover, the US had approached the UK to give up the plan to build its 5G network with Huawei. The tension between the two countries will only harm the global chip market as supply and demand are intricate, and innovation needs international cooperation.

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Conclusions

Key Summary

The global 5G chipset market size was estimated at **US\$ 14.7 bn in 2021**, and it is expected to hit around **US\$ 126.4 bn by 2030**, poised to grow at a **CAGR of 27.2% from 2022 to 2030**, and the **5G technology** will support next generation performance of products in consumer and industrial electronic end market.

Strong demand side factors are present in the yet-to-mature 5G chipset market as the need for machines-to-machine connections increases. Accelerating smartphone 5G adoption as consumer demand for faster connectivity increases, together with government policy support that creates a safe and regulated market, the 5G chipset market is believed to be the main driver of the world economy.

Production cost is going to decrease as the technology matures. It is predicted that the foreseeable price war will further push the price down. Also, Apple's ambition to develop its chips will contribute to the development of the market. However, risks associated with the supply of semiconductors are still a significant concern, where China has control over the gallium reserve; The political tension between two major countries of 5G development: the US and China, deter innovation in the market.

With rising consumer demand for high-speed data transmission and strengthening government support, coupled with the industrial usage such as Automotive, AIoT, we are positive toward the growth trajectory of 5G chipsets market.

In terms of competition landscape, we view that MediaTek, Qualcomm will still dominant the market in the next 3 to 5 years, with Apple focusing on its own ecosystem. While for the rest of the market having China and Korean players, we consider there will still be opportunity to see a change in market existences by various factors in product performance, geopolitical risk, downstream foundry reliance, end market demands and company's strategic deployments.

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