The information contained in this section, unless otherwise indicated, has been derived from various official government publications and other publications generally believed to be reliable and the market research report prepared by Frost & Sullivan which we commissioned. We believe that the sources of such information are appropriate sources for such information and have taken reasonable care in extracting and reproducing such information. None of our Company, the Selling Shareholder, the Sole Sponsor, the [REDACTED], the [REDACTED], the [REDACTED], the [REDACTED] and the [REDACTED] or any of our or their respective directors, officers or representatives or any other person involved in the [REDACTED], has independently verified information from official government sources nor give any representation as to the accuracy or completeness of such information. As such, you should not unduly rely upon such information in making, or refraining from making, any investment decision.

SOURCE OF INFORMATION

We have commissioned Frost & Sullivan, an independent market research and consulting company, to conduct an analysis of, and to prepare a report on the Internet data centre business market and IDC solution service market in the PRC. The report prepared by Frost & Sullivan for us is referred to in this [REDACTED] as the Frost and Sullivan Report. We agreed to pay Frost & Sullivan a fee of RMB590,000 which we believe reflects market rates for reports of this type.

Founded in 1961, Frost & Sullivan has 40 offices with more than 2,000 industry consultants, market research analysts, technology analysts and economists globally. Frost & Sullivan's services include technology research, independent market research, economic research, corporate best practices advising, training, client research, competitive intelligence and corporate strategy.

We have included certain information from the Industry Report in this document because we believe this information facilitates an understanding of the Internet data centre business market and IDC solution service market in the PRC for prospective investors. Frost & Sullivan's independent research consists of both primary and secondary research obtained from various sources in respect of the PRC Internet data centre business market and IDC solution service market. Primary research involved in-depth interviews 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 data were obtained from historical data analysis plotted against macroeconomic data with reference to specific industry-related factors. Except as otherwise noted, all of the data and forecasts contained in this section are derived from the Industry Report, various official government publications and other publications.

In compiling and preparing the research, Frost & Sullivan assumed that the social, economic and political environments in the relevant markets are likely to remain stable in the forecast period, which ensures the steady development of the Internet data centre business market and IDC solution service market in the PRC.

The Directors confirm that, to the best of their knowledge and belief, there has been no adverse change in the market information since the date of the Frost & Sullivan Report which may qualify, contradict or materially impact the information of this section.

OVERVIEW OF INTERNET DATA CENTRE BUSINESS MARKET AND IDC SOLUTION SERVICE MARKET IN THE PRC

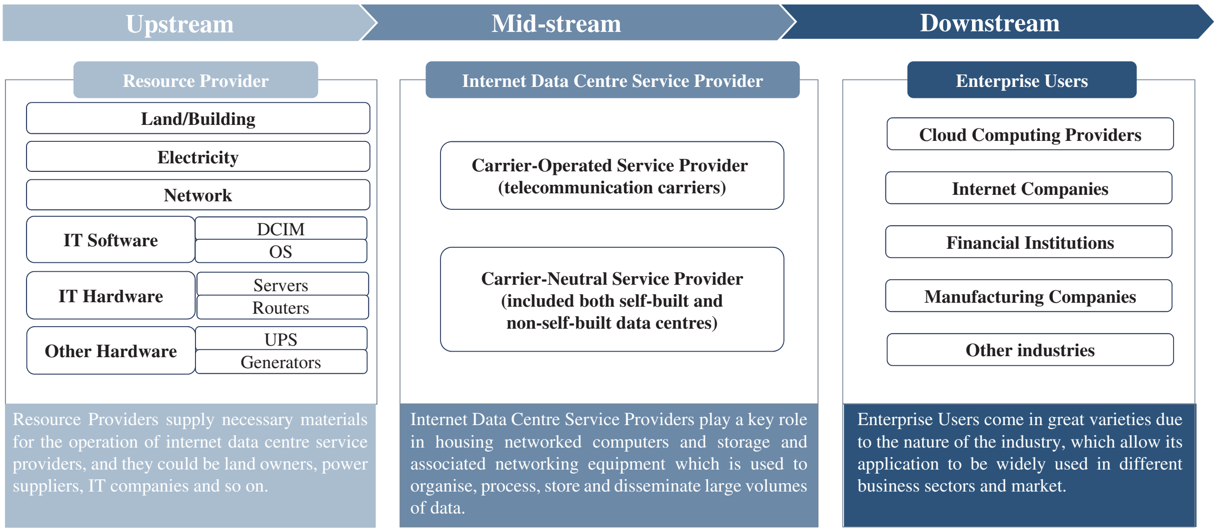
Definition and classification

Internet data centre ("**IDC**") refers to a facility designated to house server and storage and associated networking equipment which is used to organise, process, store and disseminate large volumes of data. Internet data centre can be outsourced to professional data centre service providers, who typically provide service in two models: colocation services which include the provision of basic infrastructure such as power supply, cooling and ventilating, and connection to the Internet for server custody; and infrastructure management services which include the full suite of data centre management services such as server monitoring, management and maintenance services, server load balancing service, emergency and disaster recovery, and firewall services.

Internet data centre can be categorised by types of carrier access, namely carrier-operated or carrier-neutral data centres. A carrier-operated data centre offers access to only one carrier that controls access to the facility. In China, carrier-operated data centres are dominated by the three state-owned telecommunications carriers, namely China Telecom, China Unicom and China Mobile, which develop data centres in part to facilitate the sale of related network services. On the other hand, carrier-neutral data centres may offer access to multiple network service carriers which allow their clients to enjoy the flexibility and redundancy of having access to more than one carrier.

Carrier-neutral data centre service providers may build and develop their own data centres ("**self-built**") or managed data centre space and cabinets owned by the three state-owned telecommunication carriers or other third parties ("**non-self-built**"). According to the Frost and Sullivan Report, it is common for a single data centre service provider to have both self-built and non-self-built data centre. Market players with majority of their managed data centre space and cabinets owned by third parties are considered to be running a more client driven business model than their competitors and generally offer the following advantages: (i) lower capital requirement given they do not engage in building and developing data centres and thus incur less relevant cost in acquiring property and construction of the data centres; (ii) better risk management as they do not own the data centre property; and (iii) more flexible and scalable as their services are not confined by locations of self-built data centres.

The following diagram sets out the value chain of Internet data centre industry in the PRC:



Source: Frost & Sullivan

Carrier-neutral data centres procure fibre resources from telecommunication carriers to meet their bandwidth needs. Carrier-neutral data centres may also acquire their network access from multiple telecommunication carriers to make their networks more efficient. It is a common market practice for state-owned telecommunication carriers to procure services from independent parties which have the relevant and reliable expertise. Common services procured include ICT services, such as the development of applications or platforms, network management, system integration and more.

In recent years, the data centre market share of telecommunication carriers has been gradually squeezed by carrier-neutral data centres. Telecommunication carriers in the PRC mainly make decisions on the site selection and construction scale of the new data centre from the group head office, which lead to slow response to market change, partial imbalance between supply and demand, and mismatch with needs of the market. Meanwhile, the industry is under pressure to reduce carbon emissions and inefficient data centres are becoming a burden as their energy costs rise. In addition, telecommunication carriers adopt a unified management approach to provide standardised products to clients. Their business model and development characteristics make it difficult for them to be as flexible and professional in the field of data centre services as carrier-neutral data centre solution providers.

For carrier-neutral data centres, they generally focus on providing one-stop services to their clients and improving their service and expertise, security, reliability and functionality, reputation and brand awareness, as well as geographic coverage. In addition, carrier-neutral data centres can provide multi-interface network access, which can meet the personalised needs of clients and respond to market demands more quickly.

Data Transmission in IDCs

Data is transmitted among end-users in IDCs by typically involving a client-server model.

1. Data Request: An end-user initiates a data request by accessing a website, sending an email, or using an application that requires data from the IDC.

2. Client-Side Processing: The end-user's device prepares the data request by packaging it into packets. This can involve breaking down the request into smaller units, adding headers, and applying necessary protocols.

3. Local Network: The end-user's device connects to the local network, which may involve connecting to a Wi-Fi network, a local area network, or a wide area network provided by an Internet content provider. The device's network interface communicates with the router to send the data packets.

4. Routing: The data packets are routed through the local network infrastructure, which may include switches, routers, and gateways. These devices direct the packets towards the IDC's network.

5. Internet Backbone: Once the data packets leave the local network, they traverse the Internet backbone, which is a network of interconnected routers and fiber optic cables. The packets are forwarded across various networks and independent service providers to reach the IDC's network.

6. IDC Network: Upon reaching the IDC, the data packets are received by routers and switches within the IDC's network infrastructure. These devices route the packets to the appropriate destination within the data center based on the destination address.

7. Server-Side Processing: The data packets reach the server responsible for processing the request. The server processes the request, retrieves the necessary data from storage systems (such as databases or file servers), and prepares a response.

8. Response Transmission: The server packages the response into data packets and sends them back to the end-user's device through the IDC's network infrastructure, following a similar routing process as described above.

9. Client-Side Processing: The end-user's device receives the response packets and processes them. This can involve reassembling the packets into a complete response, interpreting the data, and rendering it for the user to consume.

Comparison of Data Transmission between IDCs and Edge Computing

In both IDCs and edge computing, data is transmitted using various networking technologies. The specific technologies and protocols used for data transmission can vary depending on the infrastructure, network architecture, and requirements of the IDC or edge computing environment.

In IDCs, data is typically transmitted using a combination of wired and fiber optic communication technologies. The data transmission process is as follows:

1. Data Input: Data is generated by users accessing online services or by devices and sensors that are connected to the Internet. This data is typically in the form of packets.

2. Routing: The data packets are routed through the local network infrastructure within the IDC. This involves switches, routers, and other networking equipment that direct the packets to their intended destinations.

3. Backbone Connectivity: IDCs are connected to the Internet backbone through high-speed connections. These connections are usually established via Internet Content Providers (ICPs) or dedicated network providers. Fiber optic cables are commonly used for long-distance and high-bandwidth data transmission.

4. External Routing: Once the data packets reach the IDC's connection point to the Internet backbone, they are routed through various networks and routers to reach their destination. This may involve passing through multiple ICPs and network nodes.

5. Data Processing: Upon reaching the destination IDC or server, the data packets are processed by the servers and applications running within the data center. This may involve storage, computation, database queries, or other operations.

In the data transmission flow of edge computing, caches can be applied at different stages to improve performance and reduce latency.

- Edge nodes, positioned at the network's periphery, can incorporate local caches to store frequently accessed data or content that is likely to be requested by users in that specific edge location. Upon receiving a data request, the edge node can first check its local cache. If the requested data is available in the cache, it can be directly served from the edge node, minimising the need to retrieve it from the centralised cloud or data center. This cache utilisation reduces latency and enhances response times, as the data is in close proximity to the user.

- Additionally, caches can be employed during data transmission between edge nodes or from the edge to the centralised cloud or data centre. These caches can be placed at transit hubs or network points along the data path to temporarily store and serve frequently requested data. By doing so, the necessity to retrieve the data from the original source for subsequent requests is reduced, thereby enhancing overall transmission speed and efficiency.

Difference in the Technology Adopted for IDCs and Edge Computing

IDCs and edge computing employ different technologies and architectures to meet their distinct requirements.

Infrastructure Location: IDCs are centralised facilities designed to handle large-scale data processing, storage and network connectivity. They are typically located in secure, climate-controlled buildings with robust power and cooling systems. In contrast, edge computing brings computing resources closer to the data source or end-users. Edge devices and servers are deployed at the network edge, which can include locations such as cell towers, factory floors, retail stores, or IoT devices.

Data Processing and Storage: IDCs are optimised for high-performance computing and storage. They often employ large-scale server farms with powerful processors, massive storage arrays, and specialised hardware accelerators. IDCs are designed to handle demanding workloads and support applications that require extensive processing and storage capabilities. On the other hand, edge computing focuses on processing data locally at the edge devices or servers. These devices are often resource-constrained compared to IDCs but provide low-latency processing for real-time or time-sensitive applications.

Network Connectivity: IDCs rely on high-bandwidth, low-latency network connections to provide connectivity to the Internet backbone. They typically employ high-speed fiber optic links and establish connections with multiple ICPs for redundancy and improved performance. In edge computing, network connectivity requirements vary depending on the specific edge deployment. It can involve wired connections, wireless technologies like Wi-Fi or cellular networks, or dedicated links. Edge devices often have limited bandwidth and may operate in intermittent or unreliable network conditions.

Latency and Response Time: IDCs are designed to handle large volumes of data and serve geographically dispersed users. While IDCs strive to minimise latency, the distance between the data center and the end-users can introduce some delay. Edge computing, on the other hand, aims to reduce latency by processing data closer to the data source or end-users. This proximity enables faster response times and improved user experiences for latency-sensitive applications.

Scalability and Flexibility: IDCs are built to scale horizontally by adding more servers and storage infrastructure to meet increasing demand. They offer the ability to provide resources dynamically and adapt to changing workloads. Edge computing, due to its distributed nature, typically requires more localised scalability. Edge devices can be added or removed from the network to accommodate changes in demand or data sources.

Data Security and Privacy: IDCs typically have robust security measures in place to protect data, including physical security, firewalls, intrusion detection systems, and encryption protocols. Data in IDCs is often subject to strict compliance requirements. In edge computing, data security and privacy considerations are still important but can differ based on the specific edge deployment. Edge devices may have limited physical security and require additional measures to ensure data confidentiality and integrity.

The Different Needs Served by Edge Computing and IDCs

Edge computing and IDCs serve different needs in the computing landscape, and therefore do not compete with each other. Edge computing focuses on localised processing, low latency, and real-time analytics, while IDCs are designed for large-scale data processing, centralised services, and scalability. Edge computing and IDCs have their strengths and are often used in combination to create a hybrid computing infrastructure that optimises performance and efficiency based on specific application requirements. The comparison between edge computing and IDCs are as follows:

- Location and Proximity: Edge computing refers to the practice of processing and storing data closer to the data source or end-user, typically at the network edge. It involves deploying computing resources (servers, storage, and networking) in proximity to where the data is generated or consumed. On the other hand, IDCs are centralised facilities that house a large number of servers and other infrastructure components, often located in a specific geographic area.

- Latency and Response Time: Edge computing aims to reduce latency and improve response times by processing data locally, thereby minimising the delay caused by long-distance communication with a centralised data center. By bringing computing resources closer to the data source or end-users, edge computing enables faster processing and real-time decision-making. In contrast, IDCs are optimised for large-scale data processing and storage but may have higher latency due to the potential for longer network distances.

- Data Processing and Workload: While IDCs are designed to handle massive workloads and process vast amounts of data, edge computing focuses on localised processing and real-time analytics. Edge computing is particularly useful for applications that require immediate data processing, such as IoT devices, autonomous vehicles, and industrial automation. IDCs, on the other hand, are well-suited for applications that involve heavy computation, big data analytics, and centralised services like cloud computing.

- Bandwidth and Network Traffic: Edge computing can alleviate the strain on network bandwidth by processing data locally and sending only relevant information to the centralised data center. This approach reduces the amount of data that needs to be transmitted over the network, leading to more efficient network usage. IDCs, being central points of data processing and storage, typically handle large volumes of network traffic, which may require robust network infrastructure and high bandwidth connectivity.

- Redundancy and Scalability: IDCs often incorporate redundancy measures and high-availability configurations to ensure continuous operations and minimise downtime. They are designed for scalability and can accommodate the increasing demand for resources in a centralised manner. In contrast, edge computing may involve a distributed network of smaller-scale computing resources, which can provide localised redundancy and scalability but may require additional coordination and management.

Edge Computing and IDCs together establish a flexible, efficient, and scalable computing and data infrastructure to meet the growing demands of various applications, including cloud computing, IoT, and big data applications.

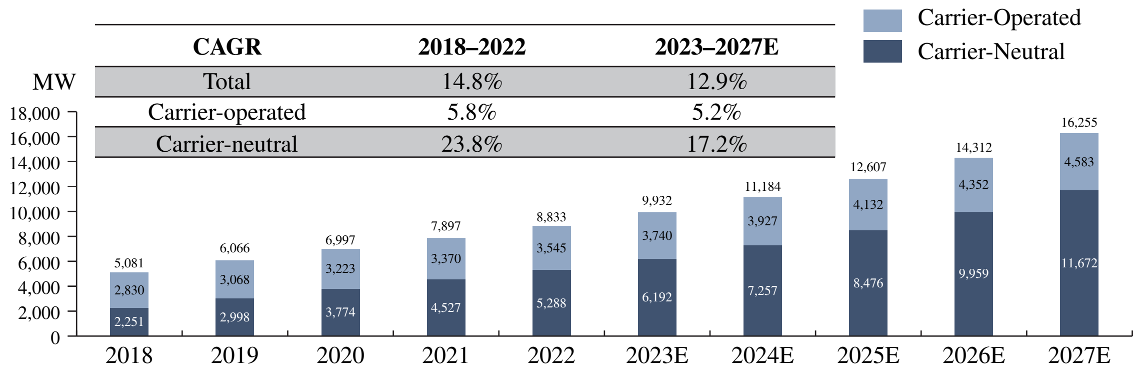
IDCs excel in hosting large-scale applications, cloud services, and centralised data storage. They cater to a wide range of services, including web hosting, cloud computing, SaaS (Software-as-a-Service), and data-intensive applications. IDCs usually cater to the needs of large-scale cloud services providers in first-tier and second-tier cities. Edge computing, on the other hand, is specifically designed for applications that demand low latency, real-time processing, and localised data management. It is particularly valuable for IoT deployments, autonomous systems, video streaming, and immersive experiences that require immediate and localised responses. Other applications in second-tier and third-tier cities also include e-commerce, gaming, social media, audio and education.

Market size

Rapid development of technology, such as cloud computing, blockchain and IoT, significantly promoted the growth of Internet data centre industry in the PRC. The market size of the Internet data centre industry in the PRC in terms of capacity increased from 5,081.0 MW in 2018 to 8,833.0 MW in 2022, representing a CAGR of 14.8% from 2018 to 2022. The total capacity is expected to reach 16,255.0 MW by 2027, growing at a CAGR of 12.9% from 2023 to 2027. The market size of data centre services industry increased from RMB68.0 billion in 2018 to RMB190.1 billion in 2022, representing a CAGR of 29.3% from 2018 to 2022. Moving forward, China's data centre services are expected to grow at a CAGR of 11.4% from RMB209.8 billion in 2023 to RMB323.0 billion in 2027. Among data centre service market, the carrier-neutral data centre services market has gained growing momentum in the past few years and the market share of carrier-operated data centre market has been gradually reduced, mainly due to the advantages of multi-network access and the continuous improvement of quality of service of carrier-neural data centres.

Market Size of Internet Data Centre Industry by Capacity in the PRC, 2018–2027E

CAGR	2018–2022	2023–2027E
Total	14.8%	12.9%
Carrier-operated	5.8%	5.2%
Carrier-neutral	23.8%	17.2%

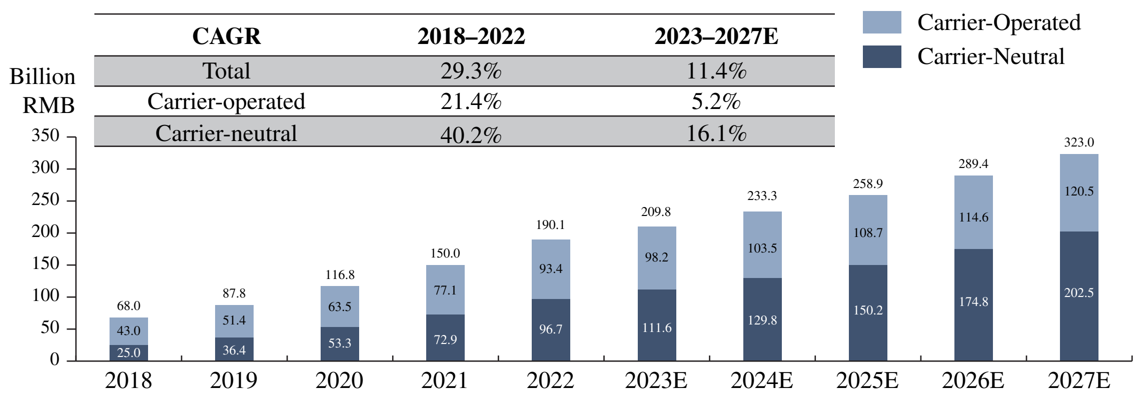


Note: MW refers to megawatt, a unit of measuring electricity consumption and is indicative of the capacity of a data centre

Source: China Academy of Information and Communication Technology, Frost & Sullivan

Market Size of Internet Data Centre Business Market by Revenue in the PRC, 2018–2027E

CAGR	2018–2022	2023–2027E
Total	29.3%	11.4%
Carrier-operated	21.4%	5.2%
Carrier-neutral	40.2%	16.1%

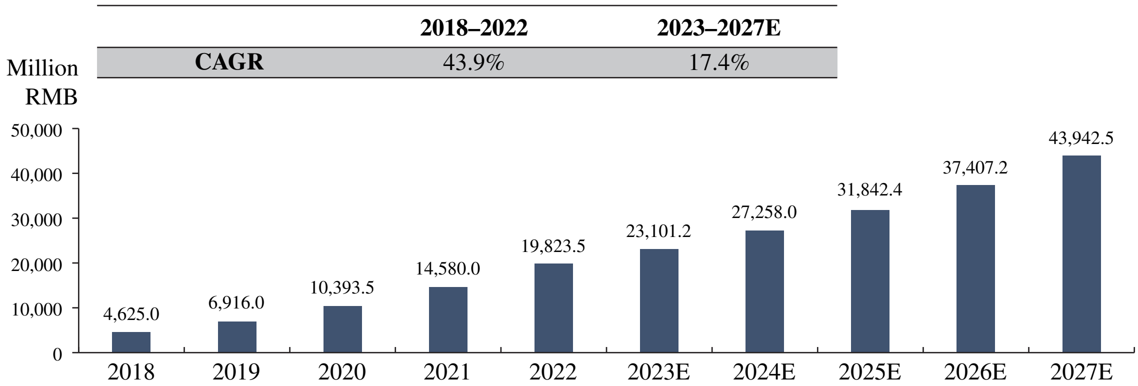


Source: China Academy of Information and Communications Technology, Frost & Sullivan

For smaller businesses that lack the means to invest in their own data centre infrastructure, using non-self-built data centres can result in cost savings compared to the expenses of constructing and managing one in-house. The cost savings and flexibility of business model further promote the growth of non-self-built data centres in the PRC. The market size of Internet data centre solutions service industry in the PRC is expected to rise at a CAGR of 17.4% from 2023 to 2027.

In addition, following the growing demand for data centre services, coupled with government support, the market size of Internet data centre solutions service industry in the PRC increased from RMB4,625.0 million in 2018 to RMB19,823.5 million in 2022, at a CAGR of 43.9%.

Market Size of IDC Solution Service Market by Revenue in the PRC, 2018–2027E



Source: China Academy of Information and Communications Technology, Frost & Sullivan

Market drivers, opportunities and trends

Implementation of 5G Network — As 5G network begins its commercialisation progress, the speed of mobile connectivity will be greatly enhanced, facilitating the growth of mobile applications reliant upon data centre. 5G networks offer significantly higher data speeds and lower latency compared to previous generations of mobile networks. This enables faster downloads, smoother streaming, and improved user experiences for mobile applications and services. As a result, users are likely to consume more data, leading to increased data traffic that needs to be processed and stored in data centre, which is likely to fuel the demand for data centre services. 5G networks also provide enhanced connectivity and support for a massive number of Internet of Things (IoT) devices. These devices generate vast amounts of data that require processing, analysis, and storage. Data centres play a crucial role in handling the data generated by IoT devices, as they provide the infrastructure for managing and processing IoT data.

Rapid Growth of Cloud Service Utilisation and Demand from Internet Giants — Cloud computing revolutionises the way IT resources are being deployed, configured, and managed. With the increase in the use of cloud computing, storage environment has also changed. The increasing number of users, AI adoption and more devices are pushing the storage environment to a new level. As the number of users accessing online services, websites, and applications increases, the overall data consumption rises. Each user generates data through various activities such as browsing the websites, streaming videos, uploading files, and interacting with online platforms. Such data needs to be processed, stored, and delivered efficiently, which drives the demand for data centres services. AI applications often involve complex algorithms and models that require substantial computational power and storage capacity. Training deep learning models, running machine learning algorithms, and performing real-time inference tasks demand significant computational resources. Data centers provide the necessary infrastructure, such as high-performance servers, GPUs, and specialised AI accelerators, to support these computationally intensive AI workloads. The use of big data is also a rising trend and it encompasses diverse data types, including text, images, videos, social media posts, sensor data, and more. Processing and analyzing such varied data require specialized tools and infrastructure, leading to increased demand for data processing capabilities in data centers. These technologies are not only driving the cloud market, but also pushing the use of data centres that support cloud computing. Cloud service providers and internet giants are seeking for data centres storing data and information with cost-effective solutions to improve agility and flexibility.

Favourable Governmental Policies — The PRC government has taken multiple actions to promote the healthy growth of the data centre industry. In March 2020, the PRC government announced it would accelerate the construction of new large-scale quality data centre and 5G networks infrastructures, as part of the "new infrastructure" campaign of the six key investment areas, along with the industrial internet, inter-city transportation and inner-city rail systems, ultra-high voltage, and new energy vehicle charging stations, in order to boost sustainable growth and transform China into a digitalised economy. In February 2022, the National Development and Reform Commission and other PRC government agencies jointly approved a plan to build eight national computing hubs and ten national-data centre clusters, as part of a long-term initiative known as "Eastern Data and Western Computing" (東數西算). The initiative aims to have data gathered from the more prosperous cities in China's eastern region and send to the less developed western region for processing and storage, thereby balancing the high demand for network processing capacity in eastern China and the ample land and resources in western China. Further, representative from the National Development and Reform Commission has announced a shared goal of the initiative to increase the current data centre shares in the western region from 10% to approximately 25% by the end of 2025. The initiative is expected to boost infrastructure investment in the form of data centres, computers, and supporting facilities. In particular, state-owned telecommunication carriers and renowned internet companies such as Tencent and Alibaba which have the financial capacities have announced plans to build data centres in the western regions. Self-built data centres are expected to capitalise on the subsidies and incentives given to develop data centres in the western region and expand their client base while non-self-built data centres can take advantage of the rapid development of telecommunication carriers into these areas and further expand their geographical coverage. In addition, in 2023, the Central Committee of the Communist Party of China and the State Council issued the "Digital China Construction Overall Layout Plan" ("**the Plan**") to promote digitalisation in the PRC by 2025 and targets intake lead in digital development in the world by 2035. Digitalisation, which refers to the transformation of analog processes and information into digital formats, leads to the generation of vast amounts of data. As organisations and individuals digitise their operations, processes and interactions, data is created at an unprecedented rate. This includes data from online transactions, social media interactions, IoT devices, sensors and various digital platforms. Data centers are crucial for storing, processing, and managing this exponentially growing data. The Plan makes deployments to solidify the foundation of digital infrastructure, namely data centers, cloud storage services, content delivery networks, distributed database systems, data lakes and data warehouses, in the PRC to empower economic and social development, with a focus on the digital infrastructure. Following the implementation of the plan, the overall level of application infrastructure would be improved and the digitalisation and intelligent transformation of traditional infrastructure, namely on-premises servers, local storage devices, tape libraries, database servers, local area networks, backup and recovery systems, would be promoted.

Cost Savings of Non-self-built data centres — Non-self-built data centres can offer cost savings compared to building and operating a data centre in-house due to the economies of scale and lower capital expenditure. Non-self-built data centre providers can achieve economies of scale by spreading the cost of infrastructure and operations across multiple customers. This can result in lower costs per unit of capacity or usage, making data centre services more cost-effective for customers. Building and operating a data centre in-house requires a significant upfront investment in infrastructure, including servers, storage, networking equipment, and cooling systems. Non-self-built data centres allow companies to avoid this capital expenditure, which can free up resources for other business needs. The benefits of cost saving has further promoted the development of IDC solution service providers in the PRC.

Surging demand from the Popularity of AI program — ChatGPT is a sophisticated AI program that requires a lot of computational power to run effectively. As ChatGPT becomes more popular, there will be an increase in demand for computing power and data centre resources. To receive the impetus from the market growth, it is expected that data centres will expand their capacity and invest in more powerful hardware, including the increase in the number of servers, faster processors, and better cooling systems. On the other hand, there may be a need for more sophisticated data management and storage systems, such as high-speed data connections, distributed storage systems, and advanced data analytics tools, to handle the large amounts of data that AI programs generate. Overall, the growing popularity of ChatGPT and other AI programs would contribute to the increased demand for computing power and data centre.

Market Consolidation — With increasing complexity of the Internet data centres, the market participants are extending their services cope to fulfill the rising client's expectations. As the market develops into a mature stage, large-scale services providers are seeking expansion opportunities through horizontal or vertical integration and business portfolio diversification which leads to an increase in merger and acquisitions activities in the PRC IDC solution service market. Some established IDC solution service providers in the PRC have been consistently seeking opportunities that can further expand its business scale and diversify its revenue stream thorough merger and acquisition. With the integration of other companies, the revenue size and business scale is expected to be enlarged and thereby bringing greater diversity in the business portfolio.

Emergence of Full-Stack and/or Bespoke Solutions Service Providers — IDC solution service providers will continue to increase their investment in products and services related to new technologies and strive to support the rapid changes of enterprise business at a deeper level. The emergence of IDC solution service providers with strong capability to provide one-stop, multi-layered solutions and a comprehensive suite of value-added services has become clear. This has also become a strategic focus of IDC solution service providers as an avenue to diversify their revenue streams, increase average recurring revenue per client and enhance client relationship. For example, services including internet access management, system security and disaster management, backup archiving and CDN are increasingly demanded by business enterprises.

Shift of Tier-1 Cities to Satellite Cities on Data centres — Internet data centres demanded by large enterprises are required to be located in areas within large metropolitan cities to enhance connectivity and shorten latency initially. Due to Power Usage Effectiveness (PUE) restrictions imposed by the Chinese government on the construction of new data centres in tier-1 cities (including Beijing, Shanghai, Guangzhou, and Shenzhen) as well as limited and costly land and power resources, there is a growing trend of building new data centres in the outskirts of tier-1 cities. Furthermore, many local governments in areas surrounding tier-1 cities actively support data centre projects by offering favourable policies in terms of land-use rights and power cost to support the local economy and labour market. In the meantime, as there are fewer data centre infrastructures in lower-tier cities and the demand for fast, secure and stable network connections in these cities continues to increase, the demand for content delivery network services also anticipates growth.

Growing Trend of Client Outsourcing — Enterprises are increasingly outsourcing IT infrastructure to third-party data centres in an effort to reduce complexity, address staffing and budget constraints, and more effectively cope with dynamically changing IT needs to support key business objectives. Third-party data centres are able to bring value to companies and are helping IT departments manage increasing complexity and do more with less. In addition, outsourcing should always be more cost-effective than managing systems internally, as third-party data centre solution providers split their costs across multiple clients and can pass the resultant economies-of-scale to clients. Moreover, many business are seeking for agility to take advantage of new market opportunities, and third-party data centres can typically deliver a critical project faster than internal IT. Due to the strong growth of China's digital economy and cloud services, the demand for data centres with high power density cabinets and centralised and modular data centre infrastructure has been increasing significantly, capable of supporting a variety of specifications for Internet leaders and cloud service providers. Major cloud services providers and large-scale internet giants are outsourcing the construction and operation of hyperscale data centre in order to significantly reduce upfront capital expenditures, enjoy flexibility and cost advantages, and focus on their core businesses.

[*Rising Investment in Facilities* — As IT infrastructure becomes more complex, increasing number of clients are turning to IDCs to help manage their technology stack and they lack the specialised expertise required to manage complex IT environments. There is an increasing need for value-added services such as database administration, application management, and other specialised services, to help clients streamline their IT operations. Accordingly, some IDC solution service providers invest related facilities to provide clients with dedicated servers and routers to ensure that their clients' data and applications are hosted on reliable hardware that is maintained and monitored by experienced professionals. Dedicated servers can provide clients with faster and more reliable access to data and applications. By eliminating the need for shared resources, dedicated servers can reduce latency and improve data transfer speeds. Investment in related facilities is a rising trend in IDCs solution service industry in the PRC. On the other hand, some IDC solution service providers are also engaged in the provision of edge computing that reduces the amount of data that needs to be transmitted to the cloud or data centre, reducing bandwidth requirements and lowering costs. Having self-own edge devices, they are able to perform local processing and filtering, reducing the amount of data that needs to be processed in the cloud or data centre.]

Introduction of edge computing

Edge Computing Service or edge cloud is a form of infrastructure and computing service distinguishable from our IDC Solution Services in that they enable our clients and their customers to build, secure and deliver digital experiences, at the edge of the Internet. This service represents the convergence of the CDN with functionality which has been traditionally delivered by hardware-centric appliances such as DDoS solutions, a solution against distributed denial-of-service attacks by decentralising content origins and increasing the number potential targets and thus increasing the cost of disrupting services of hosts connected to the Internet. In addition, CDN aims to move computing power and logic as close to the end-user as possible. The edge cloud uses the emerging cloud computing, in which the cloud provider runs the server and dynamically manages the allocation of machine resources.

The origins of edge computing lie in content-distributed networks that were created to serve web and video content from edge servers that were deployed close to users. In the early 2000s, these networks evolved to host applications and application components on edge servers, resulting in the first commercial edge computing services that hosted applications such as dealer locators, shopping carts, real-time data aggregators, and ad insertion engines.

The applications of edge computing are as follows:

1. Edge application services reduce the volumes of data that must be moved, the consequent traffic, and the distance that data must travel. That provides lower latency and reduces transmission costs. Computation offloading for real-time applications, such as facial recognition algorithms, showed considerable improvements in response times, as demonstrated in early research. Further research showed that using resource-rich machines called cloudlets or micro data centres near mobile users, which offer services typically found in the cloud, provided improvements in execution time when some of the tasks are offloaded to the edge node. On the other hand, offloading every task may result in a slowdown due to transfer times between devices and nodes, so depending on the workload, an optimal configuration can be defined.

2. IoT-based power grid system enables communication of electricity and data to monitor and control the power grid, which makes energy management more efficient.

3. Another use of the architecture is cloud gaming, where some aspects of a game could run in the cloud, while the rendered video is transferred to lightweight clients running on devices such as mobile phones and VR glasses. This type of streaming is also known as pixel streaming.

4. Other notable applications include connected cars, autonomous cars, smart cities, Industry 4.0, and home automation systems.

Edge Computing Services offer several value-added benefits compared to traditional Internet data centre solutions in the following aspects:

1. Reduced Latency — Edge computing brings computing resources closer to the data source, minimising the distance data needs to travel, which reduces latency, enabling real-time processing and faster response time for time-sensitive applications.

2. Enhanced Reliability — Edge computing employs a decentralised architecture by spreading computing resources across multiple locations. This distribution enhances reliability by reducing the vulnerability of having a single point of failure. In the event of one edge node failing, the remaining nodes can seamlessly carry on with data processing.

3. Improved Bandwidth Efficiency — With edge computing, data is processed locally at the edge devices or nodes, reducing the need to transmit large amounts of raw data to centralised data centres for processing. This approach optimises bandwidth usage and reduces network congestion.

4. Data Privacy and Security — Through edge computing, sensitive data can undergo local processing and analysis, eliminating the need for transmitting it to a central data centre. This safeguarding measure significantly bolsters data privacy and security by minimising the potential exposure of sensitive information during the transmission process.

5. Real-time Insights and Decision-making — Processing data at the edge empowers organisations to acquire real-time insights and swiftly make informed decisions based on the analysed data. This capability proves especially advantageous for applications with time-critical requirements, such as industrial automation, autonomous vehicles, and remote monitoring, where immediate responses are essential.

In terms of computing infrastructure, traditional Internet data centres typically have large-scale centralised servers and storage facilities. These centres require substantial physical space, cooling systems, and power supply. In contrast, edge computing relies on distributed computing resources, including edge devices, gateways and local servers placed closer to the data source. These edge nodes are often smaller in size and can be deployed in various locations, such as offices, factories, or even on IoT devices.

Regarding the applications of advanced technologies, edge computing enables the integration of various advanced technologies in different domains:

1. IoT — Edge computing is instrumental in IoT deployments, allowing efficient processing and analysis of data generated by IoT devices at the edge. It enables real-time monitoring, predictive maintenance, and local decision-making in IoT environments.

2. Artificial Intelligence (AI) and Machine Learning (ML) — Edge computing brings AI and ML capabilities closer to the data source, reducing latency and enabling real-time inferencing. This is beneficial in scenarios where rapid decision-making is crucial, such as autonomous vehicles or smart surveillance systems.

3. Augmented Reality (AR) and Virtual Reality (VR) — Edge computing enhances AR and VR experiences by reducing latency and enabling real-time processing and rendering of immersive content. This enables more responsive and interactive AR/VR applications.

4. Video Analytics — Edge computing allows real-time processing and analysis of video streams at the edge, enabling applications like video surveillance, object detection, and facial recognition with reduced latency and enhanced privacy.

The development of edge computing services is subject to the following operational constraints or limitations in the PRC:

1. Network Infrastructure — Edge computing relies on robust and reliable network infrastructure to ensure low-latency communication between edge devices and the centralised cloud or data centre. In areas with limited or unreliable network connectivity, the effectiveness of edge computing services may be hindered.

2. Scalability — Scaling edge computing services can be difficult. Investment and time are required for coordinating a multitude of edge devices, confirming their correct functioning, and moderating data handling and storing across distributed locations.

3. Security — Edge computing involves distributing data processing and storage closer to the network edge, which can introduce security risks. Securing edge devices, managing access controls, and protecting data transferred between edge devices and the central infrastructure require robust security measures.

4. Resource Constraints — Edge devices typically possess constrained computational capabilities, storage space, and energy resources compared to centralised cloud infrastructure. Crafting resourceful algorithms and optimising resource application are essential to guarantee optimal functioning and miximise the potential benefits of edge computing services.

5. Management and Maintenance — Managing and maintaining a large number of geographically distributed edge devices can pose operational challenges. Regular software updates, troubleshooting, and ensuring consistent performance across diverse edge environments require effective management strategies and monitoring tools.

6. Regulatory and Compliance — There may be specific regulations and compliance requirements related to data privacy, security, and local data storage in the PRC. Adhering to these regulations while deploying edge computing services may present operational challenges.

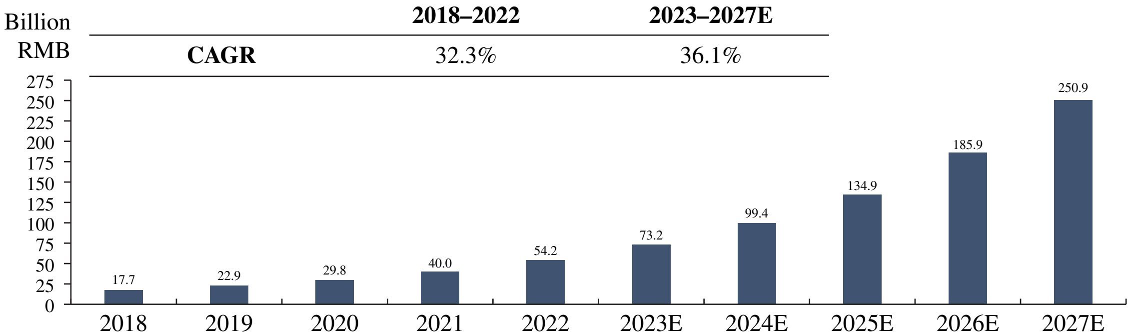
Market outlook of edge computing

Edge computing is a form of computation that is performed on-site or adjacent to a specific data source, which minimises the need to process data remotely in the data centre. Driven by the extensive applications, including security and medical monitoring, self-driving cars, and video conferencing, and the increased utilisation of edge computing alongside the cloud, the market size of edge computing in the PRC increased from RMB17.7 billion in 2018 to RMB 54.2 billion in 2022, representing a CAGR of 32.3% from 2018 to 2022.

The expansion of Internet of Things (IoT) applications and the blossoming Web 3.0 market drive the growth of edge computing in the PRC. The PRC is the world's largest IoT market and is projected to take the biggest slice of the Web 3.0 market in the next few years too. In addition, edge computing is increasingly being used in conjunction with Web 3.0 technologies to create more powerful and efficient decentralised applications (dApps). Web 3.0 is the next generation of the web, which is characterised by a more intelligent, connected, and decentralised network. It is built on the principles of blockchain technology, which provides a secure and transparent way to store and exchange data. Edge computing 3.0 refers to the integration of edge computing and Web 3.0 technologies to create a decentralised and secure computing environment. This environment is designed to support the development and deployment of dApps that can leverage the power of edge computing to process data locally, while also using the security and transparency of the blockchain to store and exchange data. The market size of edge computing in the PRC is estimated to reach RMB250.9 billion in 2027, at a CAGR of 36.1% from 2023 to 2027.

Market size of Edge Computing in the PRC, 2018–2027E

	2018–2022	2023–2027E
CAGR	32.3%	36.1%



Source: China Academy of Information and Communication Technology, Frost & Sullivan

Edge computing is specifically designed for applications that demand low latency, real-time processing, and localised data management. It is mainly applied in e-commerce, gaming, social media, audio and education in rural areas and new territories, where IDCs might not be available.

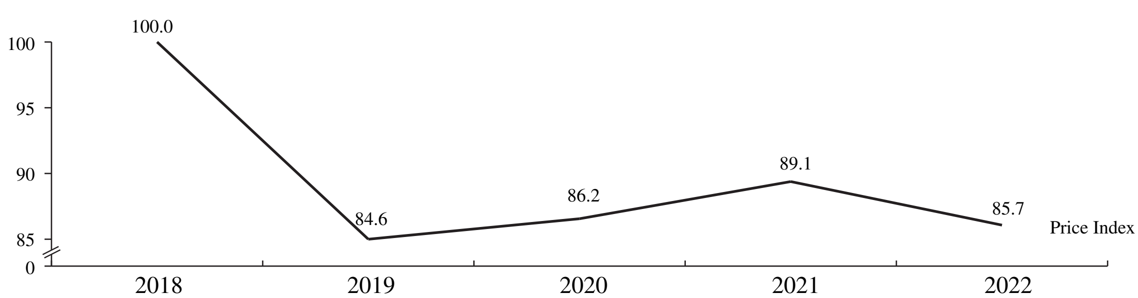
As set out in the Action Plan for the Integrated Development of Virtual Reality and Industrial Applications (2022–2026) ("虛擬現實與行業應用融合發展行動計劃(2022–2026年)"), the Government targets to develop cloud-based computing resource pools, live streaming platforms, high-performance transmission networks, and other content editing and transmission tools. It also includes the establishment of dedicated information infrastructure to meet the needs of virtual reality-specific businesses such as video content, graphic rendering, and spatial computing. In particular, integrated information infrastructure would be developed for virtual reality that supports cloud computing, edge computing, immersive computing, and other multi-node computing capabilities, achieving efficient and secure collaboration between cloud, network and edge. The supportive government policies have translated into the market growth for the edge computing in the PRC, particularly in rural areas and new territories.

E-commerce platforms are expanding their reach into rural areas, connecting rural businesses with consumers and enabling online transactions. This trend has created a demand for edge computing to support the infrastructure required for e-commerce operations, including website hosting, data storage, and order processing. On the other hand, cloud computing has become a crucial technology for businesses of all sizes, enabling remote access to data and services. Rural enterprises and organisations are increasingly adopting cloud-based solutions to streamline their operations, collaborate with partners, and access advanced technologies. Edge computing in rural areas can provide the necessary infrastructure for cloud computing services, reducing latency and improving connectivity for local users. The expansion of e-commerce platforms and the wider adoption of cloud computing have increased the demand for edge computing in rural areas of the PRC.

Cost Analysis

As more telecom and internet providers have entered into the Chinese market, the competition has become more intensified, forcing companies to lower prices to attract and retain customers. In addition, the Chinese government has implemented policies to encourage more competition and lower internet access costs. In addition, network technologies have advanced significantly, allowing providers to offer higher speeds at lower costs. This includes the rollout of broadband and fibre optic networks. Accordingly, the price index of bandwidth in the PRC decreased from 100.0 in 2018 to 85.7 in 2022.

Price Index of Bandwidth in the PRC, 2018–2022



Source: Academy of Information and Communication Technology, Frost & Sullivan

COMPETITIVE LANDSCAPE OF INTERNET DATA CENTRE BUSINESS MARKET IN THE PRC

The IDC business market in the PRC is a competitive and fragmented market, with an estimated number of over 400 market participants on various scales adopting different business models and each having a distinctive service offerings and customer network. The Group ranked 14th in the IDC business market in terms of revenue in 2022 with a market share of 0.3%. The top 20 market participants account for 58.8% of market share by revenue in 2022.

Top 20 Service Providers in the Internet Data Centre Business Market (2022)

Rank	Company	Revenue (RMB Million)	Market Share
1	China Telecom Corporation Limited (中國電信股份有限公司)	33,247.7	17.5%
2	China United Network Communications Group Co., Ltd (中國聯合網絡通信集團有限公司)	24,846.1	13.1%
3	China Mobile Communications Group Co., Ltd (中國移動通信集團有限公司)	20,760.0	10.9%
4	GDS Holdings Ltd (萬國數據服務有限公司)	8,626.2	4.5%
5	VNET Group, Inc. (世紀互聯數據中心有限公司)	7,065.2	3.7%
6	Chindata Group Holdings (秦淮數據集團)	3,186.1	1.7%
7	Range Intelligent Computing Technology Group Company Limited (潤澤智算科技集團股份有限公司)	2,714.7	1.4%
8	Kehua Data Co., Ltd (科華數據股份有限公司)	2,475.1	1.3%
9	Beijing Sinnet Technology Co., Ltd (北京光環新網科技股份有限公司)	2,077.8	1.1%
10	Shanghai@hub Co., Ltd (上海數據港股份有限公司)	1,455.1	0.8%
11	CINSPGROUP Technology Co., Ltd. (中聯雲港數據科技股份有限公司)	1,247.9	0.7%
12	Aofei Data International Limited (奧飛數據國際有限公司)	747.6	0.4%
13	Hotwon Group (浩雲長盛集團)	696.7	0.4%
14	**Company**	**538.7**	**0.3%**
15	Capitalonline Data Service Co., Ltd. (北京首都在線科技股份有限公司)	533.4	0.3%
16	CEICloud Data Storage Technology (Beijing) Co., Ltd. (中經雲數據存儲科技(北京)有限公司)	415.6	0.2%
17	Dr. Peng Group (鵬博士集團)	397.5	0.2%
18	Shanghai Yovole Networks Inc. (上海有孚網絡股份有限公司)	300.0	0.2%
19	Wangsu Science & Technology Co., Ltd (網宿科技股份有限公司)	263.4	0.1%
20	China International Data System Co. Ltd (國富瑞數據系統有限公司)	204.9	0.1%
	Top	111,799.7	58.8%
	Others	78,300.3	41.2%
	Total	190,100.0	100.0%

Source: Frost & Sullivan

The Group ranked 11th in the IDCs industry among carrier-neutral service providers in terms of revenue in 2022 with a market share of 0.6%. The top 20 market participants account for 34.5% of market share by revenue in 2022.

Top 20 Carrier-neutral Service Providers in the Internet Data Centre Industry (2022)

Rank	Company	Revenue (RMB million)	Market Share
1	GDS Holdings Ltd. (萬國數據服務有限公司)	8,626.2	8.9%
2	VNET Group, Inc. (世紀互聯數據中心有限公司)	7,065.2	7.3%
3	Chindata Group Holdings (秦准數據集團)	3,186.1	3.3%
4	Range Intelligent Computing Technology Group Company Limited (潤澤智算科技集團股份有限公司)	2,714.7	2.8%
5	Kehua Data Co., Ltd. (科華數據股份有限公司)	2,475.1	2.6%
6	Beijing Sinnet Technology Co., Ltd. (北京光環新網科技股份有限公司)	2,077.8	2.1%
7	Shanghai@hub Co., Ltd. (上海數據港股份有限公司)	1,455.1	1.5%
8	CNISPGROUP Technology Co., Ltd. (中聯雲港數據科技股份有限公司)	1,247.9	1.3%
9	Aofei Data International Limited (奧飛數據國際有限公司)	747.6	0.8%
10	Hotwon Group (浩雲長盛集團)	696.7	0.7%
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16	Wangsu Science & Technology Co., Ltd. (網宿科技股份有限公司)	263.4	0.3%
17	China International Data System Co., Ltd. (國富瑞數據系統有限公司)	204.9	0.2%
18	Shanghai Baosight Software Co., Ltd. (上海寶信軟件股份有限公司)	185.6	0.2%
19	Beijing Yuntai Shutong Internet Technology Co., Ltd. (北京雲泰數通互聯網科技有限公司)	175.9	0.2%
20	MCC Meili Cloud Computing (中冶美利雲產業投資股份有限公司)	50.0	0.1%
	Top 20	33,357.4	34.5%
	Others	63,342.6	65.5%
	Total	96,700.0	100.0%

Source: Frost & Sullivan

Key factors relevant to market competition

Relationship with telecommunication carriers — Carrier-neutral data centres procure fibre resources and acquire network access from telecommunication carriers to meet their bandwidth needs and enhance the efficiency of their network. Developing a good relationship with telecommunication carriers allow stable supply of resources at favourable price, which enable a sustainable development of IDC solution service market. As for non-self-built data centres, it is particularly important to maintain a good relationship with telecommunication carriers in order to secure long-term procurement of data centre space and cabinets, as well as develop a stable distribution partnership.

Relationship with clients — As the engagement with IDC solution service market providers are more often in recurring form instead of a one-off service type and the switching cost for clients is relatively high, enterprise tend to choose services providers with rich operation and management experience, good reputations and guaranteed long-term service stability. Market players with reputable clients network is more likely to attract new clients. Further, clients network of non-self-built data centres also act as a determining factor in its partnership with telecommunication carriers and other third parties in terms of data centre space and cabinets distribution to downstream client.

Technology innovation — Market players in the IDC solution service market compete on their range of service offerings and technology innovation. The market is one of the fastest growing industries over the past years owing to the nationwide scale digital transformation and the development of related technology are advancing faster than ever, besides, industry standards and guidelines are being updated simultaneously. Market players often compete to keep updated with the latest technology and provide the best solutions for end-clients.

Geographical location — The land and power resources are scarce in first-tier cities in China, making it difficult for IDC solution service market to source for the ideal location for data centre which include a number of features such as sufficient power supply and good grid construction quality. Further, operators with a broad geographic coverage and in close proximity to city centres are more favoured by large enterprises as it allows faster interconnectivity across multiple cities. On the other hand, IDC solution service providers enjoy a higher degree of flexibility as their services are less confined by locations of the data centres.

Competitive landscape

The IDC industry in the PRC is a competitive and fragmented market, with a number of market participants adopting different business models and each having distinctive service offerings and customer networks. The Group ranked 11th in the internet data centre industry among carrier-neutral service providers in terms of revenue in 2022 with a market share of 0.6%. The top 20 market participants account for 34.5% of market share by revenue in 2022. The IDC solution service market is a highly fragmented and competitive market, with an estimated number of 400 players on various scales.

Entry barriers

Relationship with state-owned telecommunication carriers — IDC solution service providers procure fibre resources and acquire network access from telecommunication carriers to meet their bandwidth needs and enhance the efficiency of their network. Particularly for IDC solution service providers, a well-established relationship with state-owned telecommunication carriers is key to securing data centre space and cabinets procurement, and hence stable business operation. As state-owned telecommunication carriers favour partnering with reputable data centres who acquire vast network access volume from them, new entrants without financial capacity and business track record will find it difficult to establish a relationship with them.

Technical know-how — The IDC solution service market is evolving faster than ever before, successful market players often demonstrate the capability to evolve with new technology which is built upon the technical know-how of the Company. Service providers are required to have strong technical competency, deep industry know-how, as well as strong business development capability to cater to clients' various needs.

Track record — With the increasing adoption of centralised procurement procedures by major internet companies and telecommunication carriers, the industry standard has heightened in terms of quality. New entrants without a track record of experience or smaller players will be difficult to compete and are more likely to face consolidation by larger players.

Client network — Service providers who accumulate a large and diversified client base are well positioned to maintain healthy long-term recurring revenues as the industry client churn is generally low, especially for IDC solution service provider as clients will incur high switching costs if they move to other data centre facilities. These factors pose barriers for new entrants as it will take time and cost to build client network.

COMPETITIVE LANDSCAPE OF EDGE COMPUTING MARKET IN THE PRC

As estimated, there are more than 100 market participants in the industry. The edge computing industry in the PRC is relatively consolidated, with the top five market participants accounting for 21.5% of market share in 2022. The Group recorded revenue of RMB5.2 million, accounting for the market share of 0.01% of the edge computing industry in the PRC in 2022.

Top 5 Edge Computing Service Providers in the PRC, in terms of revenue (2022)

Rank	Company	Revenue (RMB Million)	Market Share
1	Huawei Technologies Co., Ltd. (華為技術有限公司)	3,573.4	6.6%
2	China United Network Communications Group Co., Ltd. (中國聯合網路通訊集團有限公司)	2,710.5	5.0%
3	China Telecom Corporation Limited (中國電信股份有限公司)	2,138.2	3.9%
4	China Mobile Limited (中國移動有限公司)	1,876.4	3.5%
5	Alibaba Cloud Computing Co. Ltd (阿里雲計算有限公司)	1,355.6	2.5%
	Top Five	11,654.1	21.5%
	Others	42,545.9	78.5%
	Total	54,200.0	100.0%

Source: Frost & Sullivan analysis which takes into account the information published on the websites of companies and the annual report of a listed company

Entry Barrier

Investment in infrastructure — Edge computing requires a vast network of data centres, computing nodes, and edge devices located close to end users. Building this type of infrastructure requires a massive upfront investment in hardware, real estate, and networking. In particular, maintaining this infrastructure can be capital-intensive and time-consuming. New entrants would have difficulty replicating the infrastructure of established players in the PRC.

Technical expertise — Edge computing is a complex and emerging technology that requires specialist knowledge in areas like low-latency networking, distributed computing, and device management. It also involves a range of technologies, including Artificial Intelligence, Internet of Things, and networking solutions. Edge computing infrastructure and applications are required to be tailored to specific use cases and customer needs. Established players have built up this expertise through years of R&D and experience. For example, companies have developed proprietary algorithms, software stacks, and hardware designs to optimise performance for their solutions. Technological expertise, therefore, serves as the entry barrier in the edge computing industry in the PRC.

Network effects and switching cost — As edge computing networks grow by connecting more devices and users, the value of these networks also increases. This creates a cycle that further solidifies the positions of established players and makes it hard for new entrants to gain a foothold.

On the other hand, once companies create their edge computing infrastructure and integrate it with customers' systems, it becomes costly for customers to switch to a different provider. The barrier to switching providers further strengthens the positions of established edge computing companies.

INTRODUCTION OF INFORMATION AND COMMUNICATIONS TECHNOLOGY SERVICES INDUSTRY

Information and Communications Technology ("**ICT**") services refer to the services provided for the collection, storage, processing, transmission and presentation of information (including voice, data, text, and images). For example, ICT services may be comprised of cloud computing, information security, network and data centre services. The broader and more efficient use of ICT is a major driving force in modern economies, given that it facilitates broader and quicker transmission of knowledge, greater productivity and advancement in establishing knowledge-based economies. As such, many countries have adopted national and regional policies aimed at nurturing and supporting the development of ICT service industry.

IMPACT OF COVID-19 OUTBREAK

The coronavirus (COVID-19) outbreak in 2020 has caused widespread concern and economic hardship across the globe. Soon after the outbreak of COVID-19, the Chinese government imposed a series of measures to contain the spread of viruses, these include stringent lockdown measures, contact tracing system, and mass-scale testing campaigns whenever a new cluster of infections was discovered. While effective in containing the outbreak, these measures have hindered daily economic activities and there was a slowdown in information technology ("**IT**") spending during the first half of 2020, especially on hardware business including devices and IT equipment. The outbreak soon got under control in the second half of 2020 and while the Chinese government still maintains the strictest hygiene and safety measures to prevent further outbreak, the economic activity in China revives and has displayed a "V-shaped" recovery. In particular, the internet and IDC services industry were positively impacted as companies were driven to adopt and implement digital transformations amid restrictions under the pandemic. For instance, according to the National Bureau of Statistics of China, the total revenue of software industry in the PRC has increased by 13.2% and 16.4% year-on-year, respectively for 2020 and 2021, during the pandemic. On 8 January 2023, the PRC has reopened its borders to international visitors for the first time since it imposed travel restrictions in March 2020. Incoming travellers will no longer be subject to rigorous quarantine measures and they are required to provide proof of a negative PCR test taken within 48 hours of travelling. The border reopening will serve as the driver to the economic growth in the PRC. It is expected that the IT spending to grow continuously, in particular, the telecommunication service has become an elevated essential service amid social distancing and self-isolation measures and is anticipated to continue to grow in demand.

COMPETITIVE STRENGTHS OF OUR GROUP

For details of competitive strengths of our Group, please refer to the paragraph headed "Business — Our Strengths" in this document.