Publication date:
09 February 2021
Author:
Shen Wang

Next-Generation Full-Stack Data Center: Rearchitect the Data Center Through Fully Modular Design

Brought to you by Informa Tech

Contents

Pain points in traditional data center construction

Since the dawn of the 5G era, vigorous network constructions have triggered a lot of forward thinking about the future development of players in the digital industry. A huge number of applications and new industries have emerged with the enhancement of communication networks and repeated upgrade of digital devices. Meanwhile, the demand for remote work and study during the COVID-19 pandemic is skyrocketing. With work and education applications flooding the internet, multiple network traffic peak hours are putting pressure on operators and other data center owners to address the surge of demand. It means that they should make every effort to maintain the normal online operation with the existing facilities, while also rapidly increasing the capacity and computing power of their data centers through buildouts and expansion.

However, different regions, industries, and customers have various business requirements. Operators need to carry out strict planning for each new data center and sophisticated coupling between the facilities and computer room environment, with a high degree of customization. The principle is “one deployment for one project” and “one server for one application.” This method needs to go through the land construction, pipe and network, computer room, cabinet, testing, and other stages, and often the next stage can only be carried out after the completion of the prior one. For this type of data center, time to market could be more than 20 months.

In addition to its long lead time, the expansion of existing facilities also faces considerable time pressure. In the initial planning of the traditional data centers, it is difficult to consider current or future business pressures. With the server highly bound to auxiliary equipment such as water and electricity, cooling, and operation and maintenance systems, all will be affected by the IT equipment expansion – including power supply, water supply, cooling, infrastructure, and network systems. This all-round transformation also means a long cycle and high cost.

Apart from the higher capital investment and time cost, the traditional data center is risky due to its limited flexibility. Operators often spend dozens of months constructing and testing the computer room before looking for customers, being unable to predict future customers’ needs and construct accordingly. This causes problems such as low occupancy rate and high vacancy rate in the early operation, resulting in low IT load rate, and increased overall power usage effectiveness (PUE) and unit operating costs. Besides, the rapid evolution of technology is accelerating the upgrading of cabinets’ computing power and storage performance. After long-term planning and construction, the newly built data center may have fallen behind the advanced level when put into use.

Modular solution enables on-demand construction and rapid deployment

Problems such as long lead time, lack of business flexibility, and difficulty in capacity expansion have become key pain points faced by operators when they further expand and upgrade their data center. It is crucial to reduce upfront investment and increase deployment flexibility to achieve the goal of flexible expansion, green energy efficiency, and low-cost construction in this new market context. Therefore, on-demand construction and rapid deployment have become the focus for operators in building next-generation data centers.

The modularization of IT equipment and facilities creates new possibilities for solving these key points. Every cabinet, power distribution cabinet, uninterruptible power supply (UPS), cooling system, and other equipment appears as a standalone, enclosed, and standard module, and each module can be regarded as a building block with a specific function. Through the similarly standardized building, electrical, and network interfaces, fast and seamless integration with other subsystems can be achieved. Thus, a modular data center can be freely built on specific needs. In addition, for future upgrade or maintenance, the modules can also be upgraded or replaced easily.

To ensure the load as well as the anti-seismic, fireproof, and endurance level of the equipment, a data center is usually constructed with a steel and concrete structure with or without the shear wall structure. It is mostly a one-time investment. Many factors need to be considered during the design and construction stage, from the positional relationships between computer rooms, to the volume of various types of equipment, cabling, air flow of the air conditioning or cooling water flow path, which leads to high investment, long lead time, and limited expansion flexibility.

These disadvantages promote the further development of the modular solution, which enables the modularization at computer room level. Integrating the subsystems with specific functions into the standardized and containerized room module in light steel structure replaces the traditional cast-in-place method dominated by steel and concrete structure to some extent. With the on-site land construction underway, the production, assembly, and testing for the computer room module can be carried out in the plant, followed by on-site installation. In this way, the delivery time is reduced to only two to four months. Through standardized interface design, different functional modules can quickly and easily be connected to reduce the workload of on-site configuration and connection, while also meeting the same design requirements as traditional structures for earthquake and fire protection. By this parallel method, the lead time from design and construction to delivery of the data center is reduced to 40–60%, which greatly improves the business flexibility of the operator. When the demand for the data center increases, computer room equipment suppliers can provide customers with off-the-shelf products through mass prefabrication to further shorten the lead time.

In the operation and maintenance stage, a modular solution can not only realize capacity on demand, but also enables the central utilization of auxiliary resources such as air conditioning, cooling, and UPS with an optimized space utilization rate within the module, reducing the capacity waste caused by space elements and over-provisioning in the traditional data center. Unified management and standardized processes are also beneficial to the operation and maintenance, taking the energy as well as operation and maintenance efficiency to a new level.

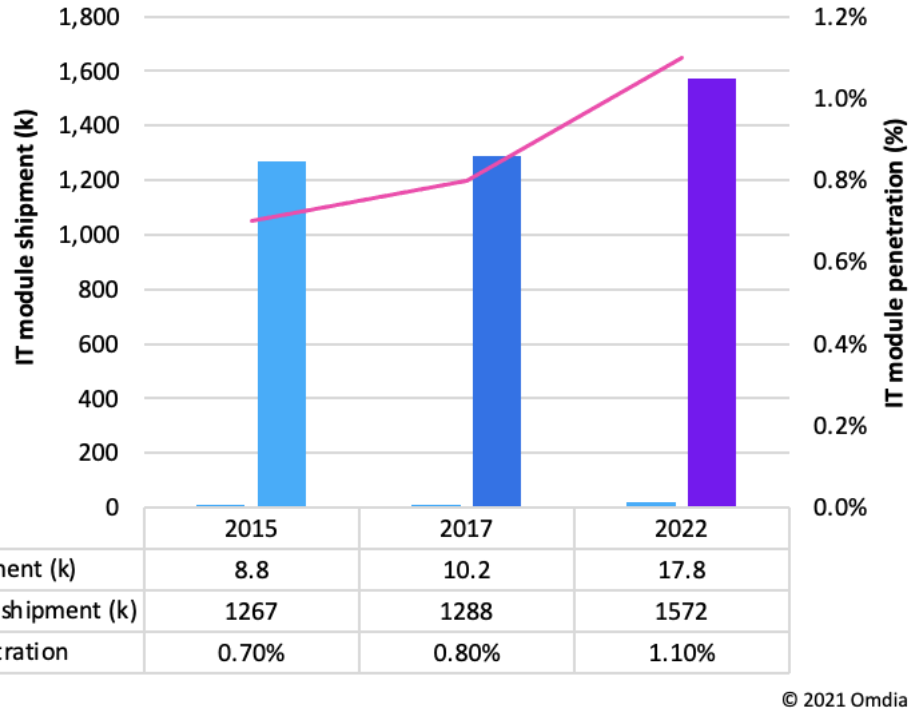
Prospects and drivers of the prefabricated modular data center market

Given the above-mentioned advantages, the prefabricated modular data center market has grown rapidly into a product landscape dominated by three types – the all-in-one module, IT cabinet module, and facility module:

- **All-in-one module.** An all-in-one module has the IT, power, and cooling infrastructure within one module. The single module holds all of the racks, power distribution, cooling, UPS, batteries, switchgear, cabling, fire suppression, monitoring, access control, etc.
- **IT cabinet module.** An IT module is an enclosure with multiple IT racks installed to house the servers, switches, and routers necessary for the computing load. The module does not have the full capability to operate on its own in the same way as an all-in-one module; instead, it needs power and cooling infrastructure from either a facility module or an existing bricks-and-mortar data center.
- **Facility module.** A facility module does not contain IT gear but contains the power and cooling infrastructure to underpin the IT load, supporting the management and monitoring of a data center. These units usually contain UPS, switchgear, a chiller, fire suppression, monitoring, and a generator, etc.

Take the IT cabinet module as an example. In 2015, 1.27 million IT cabinets for data centers were shipped globally, of which 8,800 were modular IT cabinets, accounting for only 0.7%. It is estimated that in 2022, the total shipments will reach 1.57 million units, with a compound annual growth rate (CAGR) of about 3%, while the shipment of modular IT cabinets is set to exceed twice the same period in 2015, reaching 17,800 units with a CAGR of 10.6% (see Figure 1). Although IT cabinet modules accounted for more than 50% of all module shipments in the past few years, the proportion of all-in-one and facility modules will increase slightly in the future. The former is due to the increased demand for remote environment, mobile applications, and edge network deployment from operators and some vertical industry customers. The latter is due to the increased demand for outside cooling and power distribution from cloud service providers and co-location service providers to better utilize the space inside the data center for higher-density deployment.

Figure 1: Penetration of modular IT cabinets for data centers (including IT cabinets from all-in-one modules and standalone IT cabinet modules)

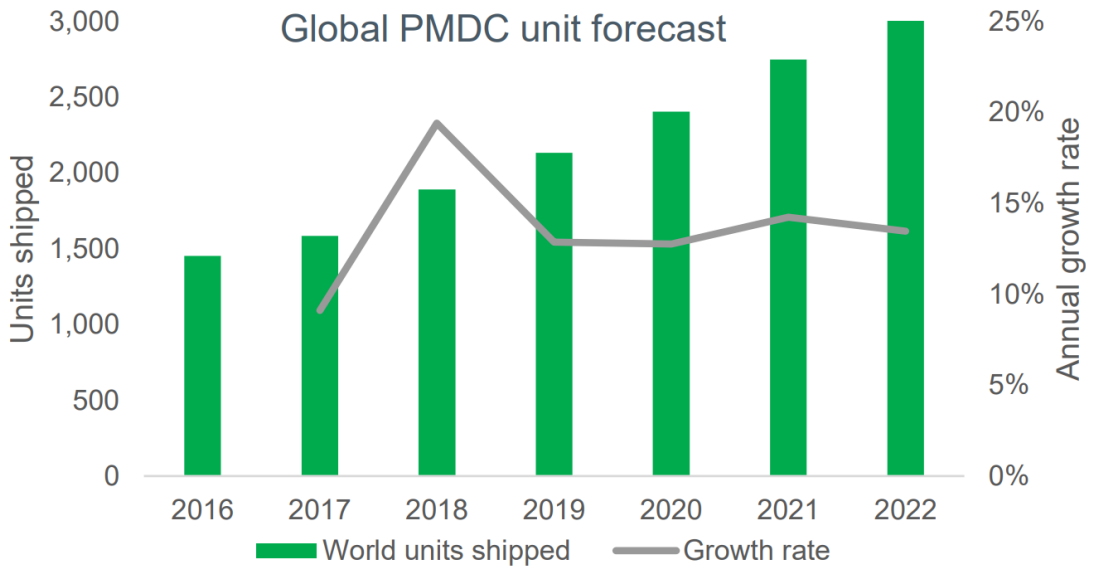


	2015	2017	2022
IT module shipment (k)	8.8	10.2	17.8
Total DC IT rack shipment (k)	1267	1288	1572
IT module penetration	0.70%	0.80%	1.10%

Source: Omdia

For the new modular data center deployment, it is estimated that more than 2,400 modular data center computer rooms were deployed globally in 2020, while this number was less than 1,500 in 2016 (see Figure 2). At present, the Americas, together with Europe, the Middle East, and Africa (EMEA) are the main markets for modular data centers, with the Asia Pacific market achieving the highest growth rate, especially in China. This is due to the need for rapid deployment and scalability from cloud, co-location, telco, as well as government and enterprise business, which makes the modular solution an attractive one with double-digit CAGR.

Figure 2: Global prefabricated modular data center (PMDC) shipments forecast and YoY growth



Source: Omdia

In general, operators' preference for modular data centers is driven by a range of factors. However, the growth of this market also faces some inhibitors. The main reason is that, for most traditional data center users, the shortage of successful use cases of emerging technology solutions weakens their cognition or confidence to transform with the changing demands. However, this situation has changed to some extent in recent years – the fundamental driver is the continued movement toward standardization. As the market gradually matured in the past 5–10 years, successful modular deployments intensified the trend of product/interface standardization and helped more customer groups become familiar with prefabricated modular data center products. Meanwhile, the standardization process is gradually transitioning the customized modular market to a fully standardized modular market. For the edge data center market, due to its large number and small scale, adoption of standardized data center modules enables players to conduct a unified construction, management, and operation of their edge data centers, which makes this market another key growth driver for the modular data center.

Appendix

Author

Shen Wang
Senior Consultant
askananalyst@omdia.com

Get in touch

www.omdia.com
askananalyst@omdia.com

Omdia consulting

Omdia is a market-leading data, research, and consulting business focused on helping digital service providers, technology companies, and enterprise decision-makers thrive in the connected digital economy. Through our global base of analysts, we offer expert analysis and strategic insight across the IT, telecoms, and media industries.

We create business advantage for our customers by providing actionable insight to support business planning, product development, and go-to-market initiatives.

Our unique combination of authoritative data, market analysis, and vertical industry expertise is designed to empower decision-making, helping our clients profit from new technologies and capitalize on evolving business models.

Omdia is part of Informa Tech, a B2B information services business serving the technology, media, and telecoms sector. The Informa group is listed on the London Stock Exchange.

We hope that this analysis will help you make informed and imaginative business decisions. If you have further requirements, Omdia's consulting team may be able to help your company identify future trends and opportunities.

Copyright notice and disclaimer