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FROST INDUSTRY QUOTIENT (IQ)

Asia-Pacific Data Center Service Providers, 2017

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1 MARKET DEFINITION AND SCOPE

1.1 DATA CENTER

A data center is critical for enterprises operating in the present borderless world globally. Whether private or public, the data center is essential for hosting mission-critical applications. These data centers help organizations streamline information while enabling easy access to users and customers from anywhere across the globe.

A data center stores computer systems and associated components commonly including a raised floor, backup power supplies, redundant data communication connections, environmental controls (such as for air conditioning and fire suppression), and security devices.

1.2 DATA CENTER OPERATING MODELS AND SERVICES

Data centers may operate on two main models. One is for an organization to build, operate, and manage its own data center for internal purposes, known as a captive data center. The other is the outsourced model, where organizations lease space and hosting services from external data center providers. These providers offer the security, power, and cooling needs for the data center and customers can use the space to deploy their servers and other equipment. This report focuses on companies providing outsourced services.

Exhibit 1 below illustrates the operating models for data centers.

Exhibit 1: Data Center Operating Models

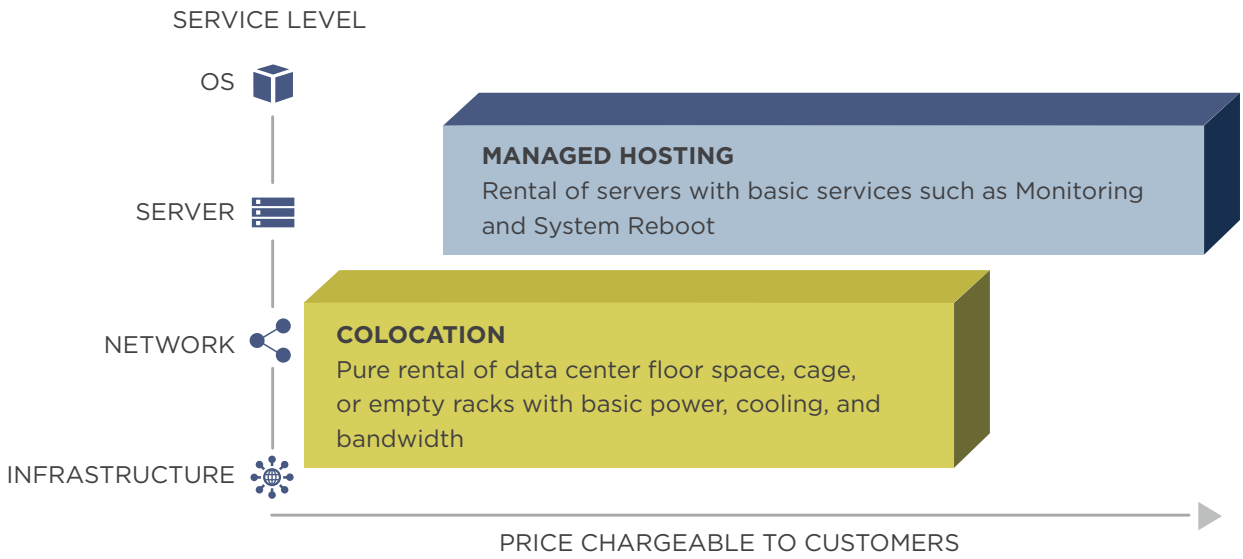
Source: Frost & Sullivan analysis

In the outsourced data center model, data center providers can offer a combination of services:

COLOCATION SERVICES	Colocation refers to pure space rental, including floor space, cages or racks in different sizes. Basic infrastructure-level support such as power, cooling, and physical security measures, as well as basic network connectivity, are provided. Customers pay a monthly or annual rental fee for the space and basic facilities, but they need to purchase their own servers and send their in-house IT resources to manage the servers.
MANAGED HOSTING SERVICES	Managed hosting services include the provision of servers. Customers do not need to purchase their own servers. Instead, they rent the servers from the data center operator together with other specified equipment. Managed hosting comes in two types – sharing the server with others or having a dedicated server. Customers can still access their servers as they wish without having to allocate their own IT resources at the data centers as the data center operator provides 24x7 system support such as monitoring and rebooting. This often includes operating system management and software security management.

Exhibit 2 below illustrates the range of services offered under the outsourced data center business model.

Exhibit 2: Data Center Services – Market Definition



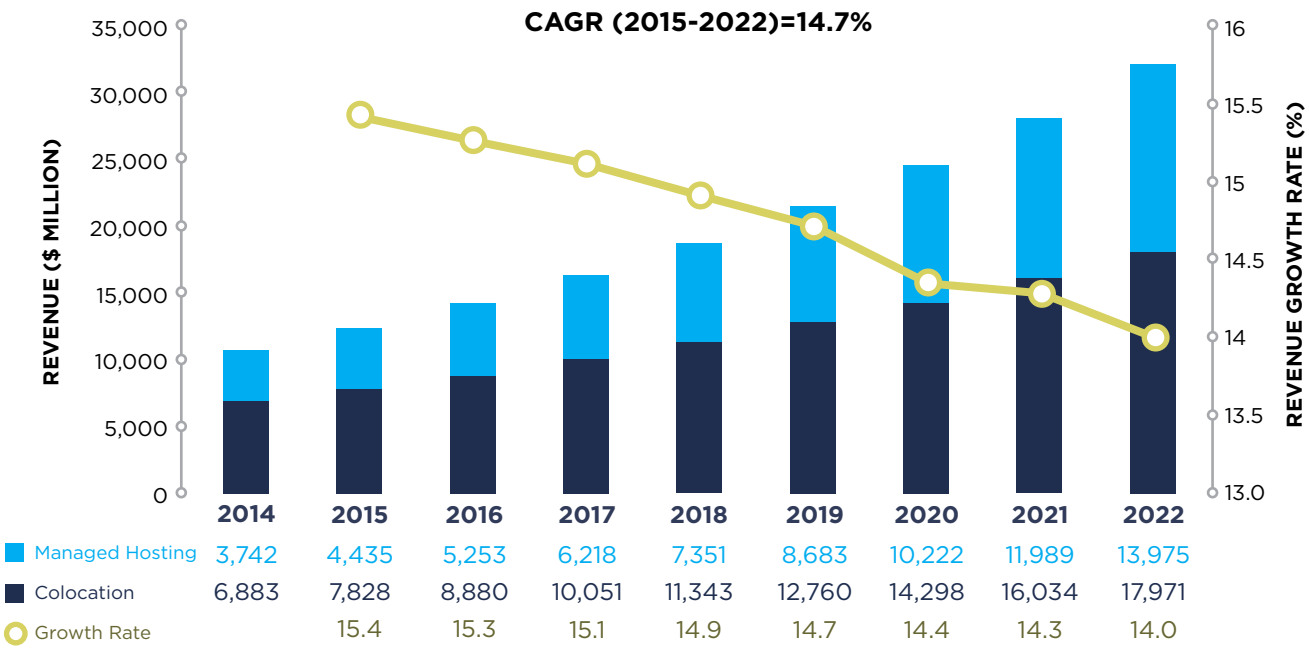
This study has not taken into consideration private/captive data centers. All the companies profiled in the Frost Industry Quotient (Frost IQ) Matrix are market participants operating in Asia-Pacific.

2 MARKET ASSESSMENT

2.1 MARKET SIZE AND FORECAST

Frost & Sullivan estimates the Asia-Pacific data center services market to be worth US$14.13 billion in revenue in 2016, representing a growth of 15.3% over 2015. The market will grow at a compound annual growth rate (CAGR) of 14.7% from 2015-2022 to reach US$31.95 billion at the end of 2022. The key theme driving growth across Asia-Pacific is the explosive digital needs of emerging economies with huge populations such as China, India, and Indonesia. Furthermore rising complexities within the IT infrastructure brought about by virtualization and consolidation, coupled with various cost constraints, are encouraging enterprises to look into adopting third-party data center services. This is spurring the strong growth of managed hosting, especially across emerging economies.

Exhibit 3: Data Center Services Market: Market Revenue Forecast by Segment Asia-Pacific, 2014 - 2022



	2014	2015	2016	2017	2018	2019	2020	2021	2022
Managed Hosting	3,742	4,435	5,253	6,218	7,351	8,683	10,222	11,989	13,975
Colocation	6,883	7,828	8,880	10,051	11,343	12,760	14,298	16,034	17,971
Growth Rate		15.4	15.3	15.1	14.9	14.7	14.4	14.3	14.0

Source: Frost & Sullivan analysis

While there is a greater adoption of managed hosting services, colocation services continue to dominate data center services revenue. As illustrated in Exhibit 3 above, colocation services account for the bulk of market revenue at 62.8% in 2016. This will continue to be driven by large enterprises and highly regulated verticals, such as Banking, Financial Services, and Insurance (BFSI), which require strict data confidentiality and complete management control of their operations. In addition, cloud service providers are also generating new demand for colocation as they opt for third-party facilities to host their infrastructure for providing services to customers.

It is noteworthy that some enterprises have chosen to bypass management of their IT operations and migrate straight to cloud services such as Infrastructure-as-a-Service (IaaS). The growth of cloud services thus poses a cannibalization effect to the outsourced hosting market. In response to this, many service providers have expanded data center service offerings to include cloud-based offerings as well.

2.2 COMPETITIVE LANDSCAPE

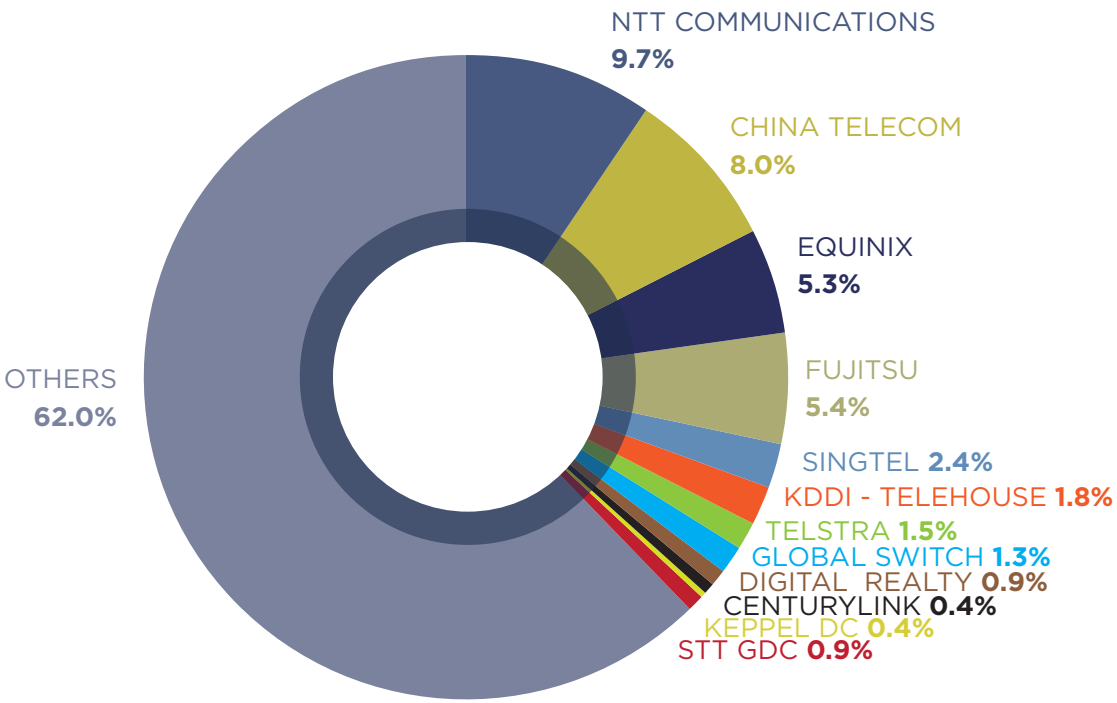
The Asia-Pacific data center services landscape is dominated by telecommunications companies/carriers such as NTT Communications (Japan), China Telecom (China), Singtel (Singapore), and Telstra (Australia). Telecom companies own the underlying network infrastructure, which allows them to have full control over their offerings – from an IT service delivery as well as from a connectivity perspective. Thus they benefit from the ability to offer an end-to-end proposition to customers comprising data center services, connectivity, cloud offerings, and value-added services such as managed security and disaster recovery, among others.

As demand for data center services in Asia-Pacific grows, facility pure-play vendors (e.g., Digital Realty, US; Equinix, US; Global Switch, UK) and carrier-neutral data center providers (e.g., Fujitsu, Japan) have also tapped on the growth trajectory by building new data center facilities or by expanding existing ones.

Frost & Sullivan considers pure-play public cloud providers such as Amazon Web Services, Microsoft Azure, and Google as Infrastructure-as-a-Service (IaaS) service providers. Thus these vendors are not considered in the competitive landscape for the purpose of this report.

Market shares held by key data center market participants in Asia-Pacific are shown below in Exhibit 4.

Exhibit 4: Data Center Services Market: Market Shares by Revenue of Key Data Center Providers, Asia-Pacific, 2016



Source: Frost & Sullivan analysis

The top 12 market participants account for 38.0% of the market revenue in 2016. NTT Communications leads the Asia-Pacific data center service providers with a market share of 9.7%. It also emerges as the vendor with the highest revenue realisation per square meter of raised floor space. China Telecom holds the second largest market share at 8.0% and also has the largest raised floor space presence in Asia-Pacific. This is followed by Fujitsu and Equinix, with market shares of 5.4% and 5.3% respectively.

The Asia-Pacific data center landscape is highly fragmented, as increasing data sovereignty concerns have given rise to dominating vendors in the respective countries. These vendors include PCCW Global (Greater China), Telkomsigma (Indonesia), AIMS (Malaysia), VADS (Malaysia), and Telin (Indonesia). As such, while these market participants are not plotted in the Frost IQ Matrix because they fall short of meeting the selection criteria, they are notable vendors in their respective countries. More details of key country-specific vendors to watch out for can be found in Section 6: Other Data Center Service Providers to Watch.

3 MARKET ASSESSMENT

In this section, Frost & Sullivan examines the key trends shaping the data center industry in Asia-Pacific.

3.1 REGULATION

Data center regulations run the gamut from pro-business (e.g., in Singapore, Hong Kong), to those that involve stringent censorship and rigid regulations favoring local participants (e.g., in China, Indonesia). In pro-business territories such as in Singapore, the government has been proactive in its efforts to offer tax incentives to attract multinational corporations (MNCs) and service providers to expand their data center capabilities in the country.

On the other hand, stringent censorship regulations continue to pose the biggest hurdle for foreign investors entering the Chinese market. The Chinese regulator, Ministry of Industry and Information Technology (MIIT), has also largely favored the issuance of Internet data centre (IDC) licenses to local vendors to date. Meanwhile in Indonesia, government Regulation No. 82 mandates Indonesian businesses conducting electronic transactions to store personal data in data centers in the country. Official compliance with Regulation No. 82 is expected to kick in with effect from the second half of 2017, posing an additional barrier of entry for foreign data center market participants.

3.2 ECONOMIC

The International Monetary Fund estimates that gross domestic product (GDP) growth among the Asia-Pacific economies is expected to slow down to about 5.3% during 2016 – 2017. Nevertheless the Asia-Pacific region remains the key pillar of growth for the global economy. In turn, governments of many Asia-Pacific countries have been able to commit to massive investments to develop the data center industry. For instance, the Thai government has introduced its digital economy plan, aimed to shift Thailand's economy towards the IT industries, with a focus on the development of data centers and cloud computing. Separately, the Singapore government has invested in the establishment of a Data Center Park (DCP) with an estimated rackable space of 105,000 square meters, to attract enterprises to set up their data center operations in Singapore.

However, rising GDP brings about higher operating costs in the form of labor, power, and connectivity costs. In recent years, data center providers in Hong Kong have reported diminishing margins as operating costs increase. Additionally, spatial constraints in Hong Kong and Singapore result in high property prices, further increasing financial burdens of service providers.

3.3 TECHNOLOGY

Broadband access speeds vary drastically across countries in Asia-Pacific, which could either drive or inhibit the adoption of IT services such as cloud computing. According to the ICT Development Index 2016, a global index published by the United Nations measuring Information and Communication Technologies (ICT) performance across various countries, South Korea is ranked first among 175 countries. Meanwhile, Indonesia and India are ranked 115th and 138th place respectively. Nevertheless this will improve given investments by many governments to improve the ICT infrastructure of their respective countries. For instance the Indonesian government has committed US$23.2 billion under the "2014-2019 Indonesia Broadband Plan" to improve broadband speeds and connectivity in the country.

As the data center ecosystem becomes more complex, demand for data center infrastructure management (DCIM) tools also increases. This is especially prevalent in more technologically-advanced countries such as Japan. DCIM tools allow data center managers to optimize data center infrastructure and operations with increasing visibilities, by understanding usage patterns of resources, and optimizing the use of power and cooling.

3.4 COMPETITION

The Asia-Pacific data center market is highly competitive, with significant build-outs giving rise to concerns of supply gluts in countries such as Australia and Singapore. Data center providers are enhancing their core propositions by diversifying their service offerings into cloud services and other managed services, in order to provide an end-to-end solution for users.

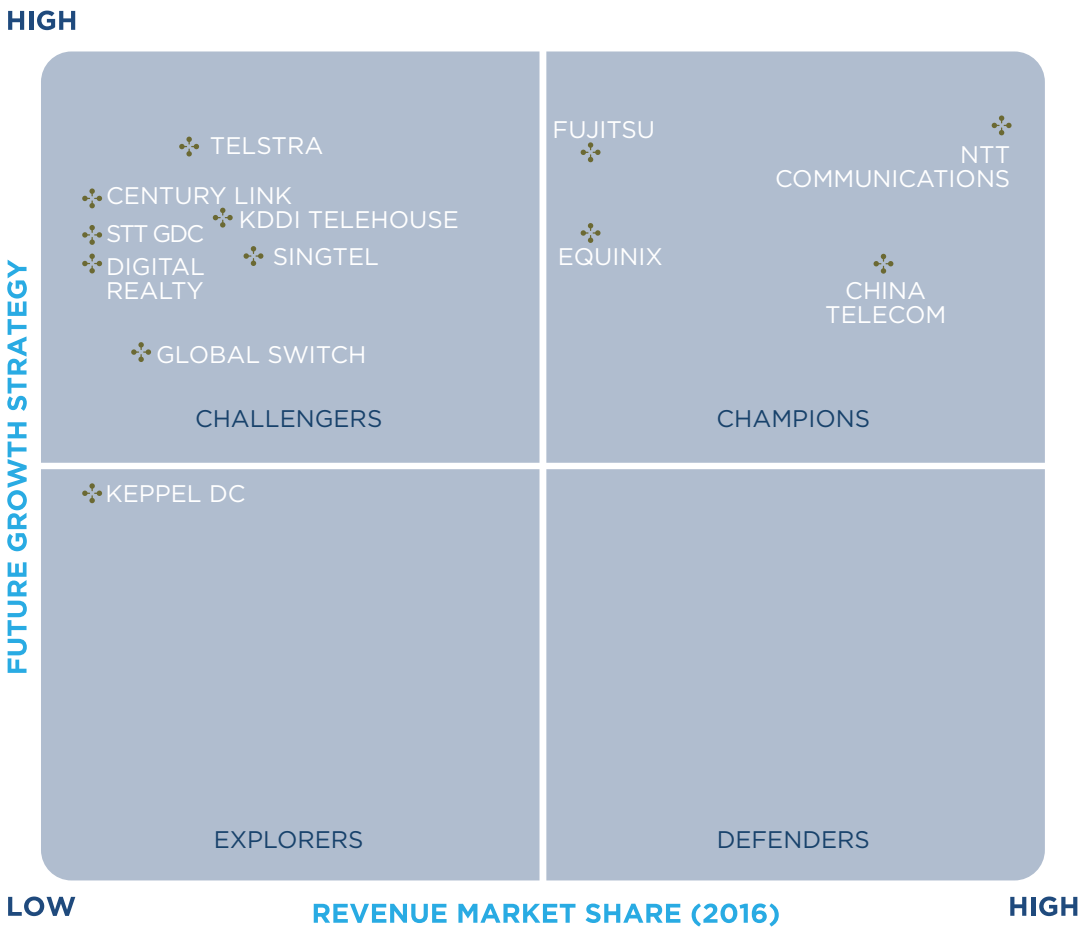
Green data center offerings have become a necessity, with an increasing focus on water consumption and refrigerant use alongside energy efficiency. The continuous evolution of intelligent thermal controls has given rise to the emergence of data centers with Power Usage Effectiveness (PUE) of below 1.2 in Japan. This is significantly lower than the average PUE rating of around 1.8 recorded by data centers globally.

4 FROST IQ MATRIX: ASIA-PACIFIC DATA CENTER SERVICE PROVIDERS, 2017

Data center service providers selected for evaluation in the Frost IQ benchmarking exercise fulfil the following two criteria: (1) Operate data centers in at least two countries in Asia-Pacific, and (2) generated revenue from Asia-Pacific data centers of more than US$60 million in 2016. Based on these, Frost & Sullivan plotted the respective vendors on the Frost IQ Matrix. The key criteria evaluated in positioning companies on the matrix are:

- REVENUE MARKET SHARE;
- PRODUCT/SERVICE STRATEGY;
- PEOPLE AND SKILLS STRATEGY;
- ECOSYSTEM STRATEGY; AND
- BUSINESS STRATEGY

Exhibit 5: Frost IQ Matrix of Data Center Providers in Asia-Pacific



Source: Frost & Sullivan analysis

Twelve major data center service providers in Asia-Pacific fulfil the selection criteria and are plotted on the Frost IQ Matrix. Four data center providers, NTT Communications, China Telecom, Fujitsu, and Equinix, are in the Champions' quadrant. NTT Communications leads the industry with the highest revenue market share as well as growth strategy in Asia-Pacific. It is well-positioned as the leading vendor, notably for its comprehensive portfolio of offerings, presence in the region, as well as maturity of channel partner ecosystem.

Seven other data center providers are in the Challengers' quadrant. They are Singtel (Singapore), KDDI Telehouse (Japan), Telstra (Australia), STT Global Data Centres (Singapore), Global Switch (Australia), Digital Realty (US), and CenturyLink (US). Singtel leads these seven service providers in terms of revenue market share. However Telstra emerges as the vendor within the quadrant with the strongest future growth strategy, driven by its integrated data center portfolio bundled with value-added services, as well as future expansion plans in Asia-Pacific.

Keppel Data Centres is a relative newcomer in the industry and is plotted in the Explorers' quadrant. Frost & Sullivan expects the vendor to grow strongly in the near future, given its aggressive growth strategy and expansion plans in recent years.

5 PROFILES OF MAIN DATA CENTER SERVICE PROVIDERS

The respective profiles of the data center service providers benchmarked in the Frost IQ Matrix are detailed below. The analyst strategy score represents the service providers' growth strategy, out of a 100-point scale. More details of the strategy score can be found in Section 8: Frost IQ Methodology – Growth Strategy.

5.1 NTT COMMUNICATIONS

NTT Communications (Japan), together with Netmagic Solutions in India, operates an extensive network of 109 data centers across 11 countries in Asia-Pacific. The vendor occupies around 200,000 square meters of floor space in Asia-Pacific, of which an estimated 62% is located in Japan.

In 2016, NTT Communications contributed 9.7% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Robust end-to-end service capabilities offerings:** NTT Communications distinguishes itself from other participants through its ability to offer comprehensive value-added services alongside colocation and managed hosting services. These include cloud solutions, managed security, network/VoIP (Voice over Internet Protocol), SDN (Software-defined Networking) and NFV (Network Functions Virtualization)-integrated web, and cloud-based VPNs (Virtual Private Networks), among others. By bringing value-added services to its data center customers, NTT has attained one of the highest "revenue realization per square meters" among market participants in Asia-Pacific in 2016.

- **Concrete plans for further expansion across Asia-Pacific:** NTT Communications increased its presence in Indonesia following the acquisition of Indonesian data center service provider Cyber CSF in October 2015. It continues to have concrete plans for further expansion to build a resilient network of data centers across Asia-Pacific. For instance, under Netmagic Solutions, there are plans to establish two more data centers in India in the next three years to serve the eCommerce, financial services, and media sectors.

CHALLENGES

- **Strong competition in existing markets, especially Japan:** NTT Communications continues to generate the bulk of its revenue from Japan, despite having data centers across key cities in Asia-Pacific. The Japan data center market is highly saturated and has strong incumbents such as Fujitsu, thereby limiting NTT's potential for revenue growth in the region.

5.2 FUJITSU

Fujitsu (Japan) is a leading systems integrator and provider of IT services globally. The vendor focuses on offering data center services as part of its bundling strategy to manage a greater share of enterprise ICT infrastructure, and provides end-to-end IT consulting and outsourcing solutions. In Asia-Pacific, Fujitsu operates/leases a network of 81 data centers primarily in Japan, Australia, and Singapore. In 2016, new annexes were constructed for the expansion of the existing Tatebayashi Data Center and Akashi Data Center in Japan, which will add 50% more data center space to Fujitsu's existing capacity in Japan.

In 2016, Fujitsu contributed 5.4% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Expertise in providing end-to-end ICT outsourcing portfolio:** Fujitsu's core strengths lie in its systems integration and end-to-end ICT outsourcing capabilities. This allows Fujitsu to offer customized offerings, comprising data center operations, ICT infrastructure management, and global delivery networks, among others.
- **Aggressive expansion strategy in Asia-Pacific:** Fujitsu is expanding aggressively in Asia-Pacific, as evident from the recent expansion of data center facilities in Japan, as well as the establishment of its third data center in the West of Singapore in 2016. There are clear expansion plans in other regions as well. For instance, as part of its 2025 roadmap, Fujitsu Australia is undergoing a nationwide strategy of expansion and refurbishing selected sites, to upgrade power infrastructure and internal capacities. These include investments in the Western Sydney data center, as well as undergoing Tier 4 Uptime certification for its Western Australian data center, in order to offer higher value secure services to support cloud, Internet of Things (IoT), and big data offerings.

CHALLENGES

- **Slow expansion plans in high-growth emerging economies:** While Fujitsu plans to expand its network of data centers in the Philippines, Malaysia, and Indonesia, it currently still has a weak coverage in these countries. For instance in 2016, 96.1% of the vendor's total raised floor space in Asia-Pacific is in Japan, Australia and China, while the rest of the emerging countries represent the remaining 3.9%. As such, Fujitsu may be slow to leverage on the growth of emerging economies such as Indonesia, which is expected to lead the Asia-Pacific data center revenue growth within the next 5 years.

5.3 TELSTRA

Telstra (Australia) has been investing significantly in its data center and network capabilities in Asia-Pacific in recent years. A noteworthy investment is the acquisition of Pacnet Limited (Hong Kong and Singapore) in April 2015, which enables Telstra to operate the largest submarine cable network in Asia-Pacific and bolster its data center presence significantly in the region. Telstra operates 58 data centers globally, of which more than 20 are located in Australia. The vendor's data center services recorded revenue growth in excess of 30% in 2016, driven mainly by managed hosting services.

ANALYST STRATEGY SCORE

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In 2016, Telstra contributed 1.5% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Integrated data center portfolio bundled with connectivity:** The Pacnet acquisition has been instrumental to Telstra's integrated data center strategy, by enabling the vendor to bundle its data center portfolio with advanced SDN capabilities.
- **Greater expansion reach into China:** The joint venture between Telstra and Pacnet Business Solutions China (PBS) in 2015 is also advantageous in serving as Telstra's springboard into mainland China. Telstra is well-positioned to tap on PBS's extensive network footprint across 23 provinces in mainland China, as well as established relationships with the Chinese government and carriers, to expand its integrated data center portfolio reach in the region.

CHALLENGES

- **Mindshare for connectivity services remains stronger than data center offerings for now:** Telstra still primarily commands mindshare as a superior connectivity and multi-cloud orchestration vendor, and less so for its data center offerings. It also faces intense competition within its major market Australia from the likes of Global Switch and Fujitsu, thereby limiting its potential for growth in the region.

5.4 CENTURYLINK

CenturyLink operates four colocation data centers in Asia-Pacific. Additionally it operates managed services and cloud pods in additional data centers across Shanghai, Bangalore and Sydney. Through a network of partners, CenturyLink is able to extend its colocation reach in Shanghai and Australia as well.

In May 2015, the vendor established its first cloud data center in Singapore. This marked the first location in Asia-Pacific for CenturyLink's cloud infrastructure which it has been consistently expanding, alongside providing other connectivity services across the Asia-Pacific region.

In 2016, CenturyLink contributed 0.4% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Comprehensive hybrid IT portfolio:** CenturyLink offers an integrated and comprehensive hybrid IT portfolio that includes colocation, managed hosting, cloud services, network, and managed services. This allows the vendor high flexibility in its offerings and to bundle multiple service offerings to manage a broad range of delivery models in supporting its customers on their digital transformation journeys.
- **Commitment to operational excellence:** CenturyLink has set a new bar in the data center industry by obtaining the Uptime Institute's Management and Operations (M&O) Stamp of Approval for 52 data centers in its global portfolio, including three in Asia-Pacific.

CHALLENGES

- **Presence in competitive markets:** CenturyLink operates solely in metro cities for now, where the landscape is relatively saturated. It also faces intense competition within its major market Australia from the likes of Global Switch and Fujitsu, thereby limiting its potential for growth in the region. There is also a risk of excessive capacities in markets like Australia and Singapore, amid increasing data center build-outs in neighbouring lower-cost countries such as Malaysia and Thailand.

5.5 KDDI TELEHOUSE

KDDI Telehouse's (Japan) clientele is predominantly made up of Japanese and European companies that are developing their business in Hong Kong and Japan. There is an increasing focus on bringing more US-based customers into the Asia-Pacific regions. The vendor operates close to 30 data centers, of which the bulk of raised floor space resides in Japan. In 2016, KDDI Telehouse launched two new facilities in Japan, specifically Tokyo (1,300 racks) and Osaka (700 racks).

ANALYST STRATEGY SCORE

In 2016, KDDI Telehouse contributed 1.8% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Strong presence in Greater China:** KDDI Telehouse has 22,860 square meters of colocation raised floor space in Beijing, Shanghai, and Hong Kong (two facilities in each city) in total, making it the largest global colocation provider in the Greater China region.
- **Comprehensive connectivity reach:** The vendor has a network reach of over 190 countries, offering fully-managed networks such as the Euro-Asia link, Pan-European network, and East Asia network. It also offers carrier-neutral access to connectivity providers for its data centers.

CHALLENGES

- **Pure-play colocation strategy outside of Japan limits monetization opportunities:** KDDI Telehouse remains a pure-play colocation service provider outside of Japan. This limits the company's monetization opportunities as colocation services occupy the lower end of the data center value chain.

5.6 EQUINIX

Equinix is a leading global interconnection and data center company, with 150 data centers in 21 countries across five continents. The company provides a dynamic environment where rich business ecosystems (8,500+ businesses), enterprises (2,250+), and cloud and IT service providers (2,500+) interconnect to each other and to more than 1,400+ available networks. The company has 29 data centers across Asia-Pacific, including Australia, China, Hong Kong, Indonesia, Japan and Singapore.

In 2016, Equinix contributed 5.3% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Strong ecosystem strategy owing to continuous investments in Platform Equinix:** Equinix has invested US$13.5 billion over 19 years to create Platform Equinix, a colocation and interconnection platform that extends across 150 global data centers in 41 markets. It enables high performance, secure, and reliable cloud access and service deliverys. Platform Equinix interconnects clouds, networks, business ecosystems and data at the edge, providing virtual control and transparency across the world's most globally interconnected data centers, within the largest cloud and network provider-neutral marketplaces. With Platform Equinix, customers implement Interconnection Oriented Architecture (IOA), a blueprint for becoming an interconnected enterprise, and achieve their global digital transformation objectives.

- **Strong expansion strategy:** Equinix practises prudent capital allocation to capture first-mover advantage in future global hubs. This has resulted in continuous expansion across the Asia-Pacific region, opening data centers in Melbourne and Singapore in 2015, as well as Tokyo and Sydney in 2016. In 2017, it has planned expansions for its Hong Kong and Singapore data centers, representing an investment of over US$104 million.

CHALLENGES

- **Strong competition in existing markets, especially Japan:** Among its network of data centers in Asia-Pacific, Equinix has the largest presence in Japan, in which about 25% of its raised floor space resides. The Japanese data center market is highly saturated and has strong incumbents such as NTT Communications, NEC, and Fujitsu. Nevertheless to improve the company's market position in Japan, Equinix acquired Bit-isle (Japan), one of the leading data center service providers in Japan, in 2015. With acquisition of Bit-isle, Equinix added five data centers in Tokyo. Upon the completion of the Tokyo data center in 2016, Equinix will now have a total of ten IBX data centers in Tokyo and one in Osaka, making the vendor the fourth largest data center operator in Japan.

5.7 STT GLOBAL DATA CENTRES

STT Global Data Centres ("STT GDC") (Singapore) is a wholly-owned subsidiary of ST Telemedia. Established in June 2014, it currently manages a portfolio of close to 50 data centers (including third-party sites) across China, India, the UK, and Singapore.

STT GDC has been aggressive in its acquisition strategies. Notable acquisition plans include a 42% stake in Chinese data center provider GDS Services in 2014, a 70-30 joint venture with StarHub, Singapore (STT MediaHub) in 2015. Other acquisitions include a 49% stake in UK data centre provider Virtus Data Centres in 2015, as well as a 74% stake in Tata Communication's (Mumbai and Singapore) data center portfolio in India and Singapore in 2016.

In 2016, STT Global Data Centres contributed 0.9% to the Asia-Pacific data center services market revenue.

ANALYST STRATEGY SCORE

75

COMPETITIVE ADVANTAGES

- **Aggressive expansion plans in Asia-Pacific, notably China and India:** STT GDC has demonstrated aggressive expansion plans in Asia-Pacific, notably in China and India. In 2014, ST GDC acquired a 42% stake in leading Chinese data center provider GDS Services in order to grow its presence in the country. Separately, the joint venture with Tata is yet another clear signal that the vendor is looking to expand aggressively into India, to become a global platform of advanced, integrated and carrier-neutral data centers in high growth markets.

CHALLENGES

- **Difficulties in establishing synergies:** With Tata Communications and GDS Services being two large conglomerates, it could be a challenge for STT GDC to integrate the data center offerings of these vendors together with ST GDC's existing network connectivity and data center assets. Difficulties in establishing operational and technical synergies could thus be a roadblock to STT GDC's expansion plans in the region.

5.8 SINGTEL

Singtel is the incumbent telecom operator in Singapore, with a strong position in managed hosting, network, hybrid cloud, and professional services, among others.

The vendor currently has 12 data centers in Singapore, Hong Kong, and Australia, occupying a combined raised floor space of more than 100,000 square meters. It also partners with other providers to operate 20 data centers in other countries in Asia-Pacific. Singtel's most recent data center investment is in Singapore's DC West data center, a US$280-million Tier 3+ facility that was completed in December 2015.

In 2016, Singtel contributed 2.4% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Comprehensive end-to-end managed ICT offerings:** In recent years, Singtel has been reinventing itself as a one-stop ICT solutions provider. It offers a robust enterprise-grade solution consisting of managed hosting, cloud-enabled network, security solutions, as well as infrastructure management, among others. As a result, Singtel has been successful in capturing market share among enterprises with regional headquarters in Singapore and other countries in Asia-Pacific. Singtel's data centers in Singapore enjoyed utilization of about 80% in 2016.

CHALLENGES

- **Risk of data center glut in major market Singapore:** Singtel generates the majority of its data center revenue from Singapore. There runs the risk that significant build-outs in Singapore could limit its potential for growth in the data center space, exacerbated by increasing competition from global providers (e.g., Digital Realty, Equinix), as well as up-and-coming local providers (e.g., Keppel Data Centres, IO, Singapore).

5.9 CHINA TELECOM

China Telecom is the largest internet data center (IDC) provider in China, and hosts a majority of the domestic Internet content and services. Under its "8+2" strategy, China Telecom has 8 regional cloud data centers in China and 2 cloud campuses in Inner Mongolia (Northern China) and Guizhou (Southwestern China). The vendor has over 300 data centers distributed across China occupying around 400,000 square meters of raised floor space.

In 2016, China Telecom contributed 8.0% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Excellent in-country reach owing to dominance in network assets and longstanding relationships with the government:** China Telecom owns more than 70% of the bandwidth in China and operates a comprehensive MPLS (Multiprotocol Label Switching) VPN network that connects the majority of Chinese government departments. The vendor is able to attain market dominance in the country by leveraging its longstanding relationships with provincial and municipal governments as well as Chinese state-owned enterprises, and selling them its bundle of network assets, rack space, power, and cooling provision.
- **Robust one-stop ICT services for Chinese enterprises:** China Telecom has been "cloudifying" its data centers, so that data center services can be offered together with cloud services and disaster recovery offerings. With plans to build a third nationwide backbone network alongside the existing ChinaNet and CN2, China Telecom is cementing its position as the provider of the most complete transmission network in China.

CHALLENGES

- **Increasing competition from non-Chinese vendors:** There has been increasing competition from global vendors targeting the foreign customer base, a segment that China Telecom is seeking to grow. For instance, CenturyLink (US) partnered with Chinese data center provider GDS Holdings to launch its managed hosting and cloud services in China. Other market participants such as Equinix and Telstra are also looking to increase their data center presence in China.

5.10 DIGITAL REALTY

Digital Realty (US) is the largest wholesale colocation provider globally, and focuses on providing data center, colocation, and interconnection solutions to customers. It currently operates a network of eight data centers in Asia-Pacific spanning approximately 50,000 square meters in raised floor space across Australia, Singapore, Hong Kong, and Japan.

Key clients include enterprises in the financial services, IT services, cloud, and telecoms sectors. Other major tenants consist of other data center participants such as Equinix and Fujitsu.

In 2016, Digital Realty contributed 0.9% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Expansion of service offerings beyond space and power:** In October 2015, Digital Realty completed the US$1.89-billion acquisition of Telx (US), one of the world's largest interconnection providers. The acquisition enhances Digital Realty's strategic direction of transitioning toward a value-added participant beyond its core wholesale colocation leasing business. More importantly, it increases the vendor's attractiveness to customers seeking access to robust interconnection environments with massive wholesale data center space available for lease.
- **Strong turnkey offering:** Digital Realty focuses on facilities development, and commands strong mindshare in the turnkey data center construction business space. Its strategy to develop data centers in a modular manner with a low turnaround time of 26 weeks or less confers the vendor a significant edge over its competitors.

CHALLENGES

- **Conservative expansion strategy overly concerned with occupancy rates:** Digital Realty is currently only exploring building and expanding its data center portfolio in metro cities within Japan, Australia, Hong Kong, and Singapore. The vendor is reluctant to expand to emerging economies for now, as it feels the customers there are not mature enough to demand sufficient colocation services to meet its breakeven occupancy rate.

  It does, however, have the capability to build in any market in the region if an existing or new customer has a specific requirement for a custom data center facility in that region.

5.11 GLOBAL SWITCH

Global Switch (UK) targets the large-scale/wholesale data center services market in Asia-Pacific and Europe. It is the leading provider of colocation services in Australia, where it occupies 53,907 square meters of floor space across two data centres, designated Sydney West and Sydney East. With ongoing construction nearing completion, there is expected to be an additional 19,000 square meters added to the Sydney East facility. Global Switch is on the AGIMO (Australian Government Information Management Office) Data Center Facilities Panel, making it a preferred partner for the Commonwealth Government and its agencies.

In Singapore, Global Switch is also a leading large-scale carrier-neutral data center provider. The 26,743 square meters Tai Seng data center hosts a diverse connectivity, cloud and hosting provider ecosystem in the country.

In December 2016, a consortium of private sector Chinese corporate and institutional investors acquired a 49% stake in the Company.

In 2016, Global Switch contributed 1.3% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **Increasing expansion in Asia:** In December 2016, Global Switch announced that it signed two major pre-commitments with Daily-Tech Beijing Co., Ltd (Daily-Tech) for new data center developments in Hong Kong and Singapore. For both of these pre-commitments, China Telecom Global will, upon construction completion, become the end customer through direct service agreements with Daily-Tech. Construction of the new 45,000 square meters data center in Hong Kong is nearing completion and scheduled to open in mid-2017. Separately, the construction of the data center in Woodlands in Singapore is expected to be completed in 2018.

  Aside from the pre-commitments signed, Global Switch also announced in December 2016 that it entered into a joint venture agreement with Daily-Tech to develop a new data center in Shanghai.

CHALLENGES

- **Pure-play colocation strategy limits monetization opportunities:** Global Switch remains primarily a pure-play colocation vendor, which limits the company's monetization opportunities as colocation services occupy the lower end of the data center value chain. However it should be noted that in addition to existing services such as fit-out and remote hands services, customers of its new Hong Kong data center will have access to a range of cloud and managed services.

5.12 KEPPEL DATA CENTRES

Keppel Data Centres Holdings ("Keppel DC") is a 70-30 joint-venture company formed in 2011 by Keppel T&T and Keppel Land to consolidate their data center assets. It is also the first data center provider to introduce a data center Real Estate Investment Trust (REIT) in the Asia-Pacific region. Keppel DC currently manages and operates more than 25,000 square meters of raised floor space in Singapore, with other data centers located in Malaysia and Australia as well. Outside Asia-Pacific, Keppel DC also has data centers located in Ireland, the United Kingdom, The Netherlands, and Germany.

In 2016, Keppel Data Centres contributed 0.4% to the Asia-Pacific data center services market revenue.

COMPETITIVE ADVANTAGES

- **High portfolio occupancy rate:** Keppel DC boasts an average portfolio occupancy rate of 92%, one of the highest among data center providers. This enables Keppel DC to enjoy operational efficiencies and higher profitability, which could be channelled toward further expansion plans in the Asia-Pacific region.

CHALLENGES

- **Pure-play colocation strategy limits monetization opportunities:** Keppel DC remains primarily a colocation vendor, which limits the company's monetization opportunities as colocation services occupy the lower end of the data center value chain. Unlike telco companies, it faces challenges in fulfilling end users' increasing demand for end-to-end ICT services such as connectivity and other managed solutions.

6 OTHER DATA CENTER SERVICE PROVIDERS TO WATCH

While the following data center service providers did not meet the selection criteria to be benchmarked for the current year of study, they are key vendors to watch out for as well. The profiles vendors is as follows:

NAME OF VENDOR	DATA CENTER PRESENCE IN ASIA-PACIFIC	PROFILE AND COMPETITIVE ADVANTAGES
PCCW GLOBAL	Hong Kong, China	PCCW Global owns a network of data centers across six locations in Hong Kong, and one data center in Guangzhou, China. Besides colocation and managed hosting, PCCW's service offerings include designing and building data centers for customers. The vendor has extensive network assets in Greater China to facilitate robust cross-border data center solutions in the region.
TELKOMSIGMA	Indonesia	Telkomsigma is the largest data center provider in Indonesia, occupying approximately 20% of its raised floor space in 2016. Key verticals served include the Banking and Financial Services sector. Telkomsigma enjoys strong partnerships with vendors such as IBM, and has been transitioning to be an end-to-end service provider offering a portfolio of colocation services and virtual private cloud solutions, among others.
AIMS DATA CENTRE SDN. BHD.	Malaysia, Singapore, Thailand, Vietnam, Hong Kong	AIMS is a subsidiary of TIME dotCom Berhad (TIME), a fixed-line telecommunications provider based in Malaysia. AIMS operates data centers across five locations in Malaysia spanning more than 5,100 square meters. It has partner data centers in Singapore, Thailand, Vietnam, and Hong Kong. AIMS is able to gain a foothold in the Malaysian market owing to its ability to bundle superior connectivity solutions with its data center offerings.

NAME OF VENDOR	DATA CENTER PRESENCE IN ASIA-PACIFIC	PROFILE AND COMPETITIVE ADVANTAGES
VADS BERHAD	Malaysia, Hong Kong	As a wholly-owned subsidiary of Telekom Malaysia, VADS Berhad is the largest retail data center provider in Malaysia. It operates 14 data centers across the country, with a raised floor space of more than 10,000 square meters. VADs's advantage lies in its ability to offer an integrated portfolio of ICT services, including cloud offerings, managed security, and managed network services, among others.
TELEKOMUNIKASI INDONESIA INTERNATIONAL PTE. LTD. (TELIN SINGAPORE)	Singapore	Established in 2009, Telin Singapore is an upcoming data center provider in Singapore. It currently operates three data centers in Singapore. The latest investment is the Telin-3 Data Center located at the Singapore Data Center Park, which is Tier III and Tier IV-certified. Telin is a subsidiary of the PT Telkom group. Despite being a newcomer in the market space, the vendor has grown very rapidly, and is looking to expand aggressively in Asia-Pacific in coming years.

7 THE ANALYST WORD

Frost & Sullivan expects the lower end of the colocation market, mainly served by pure-play providers who rent space by racks or cabinets to local businesses, to cease in importance over the next few years. As the IT environment increases in complexities, many Asia-Pacific enterprises are outsourcing their applications to third-party vendors to increase operational and cost efficiencies. Further, the more advanced threat landscape has made enterprises more conscious and open to third-party services to strengthen their info-security.

Managed hosting is emerging as the foundation for most managed services, whereby organizations are increasingly turning to vendors that are able to offer a robust one-stop end-to-end ICT solution encompassing rack space, power, cooling, cloud offerings, and managed services (e.g., managed security, cloud orchestration, managed WAN (Wide-area Network) optimization). Nevertheless, high-end colocation and interconnect providers will still enjoy growth, as secure, latency-sensitive applications continue to in demand in highly-regulated verticals such as the financial services sector.

As market competition intensifies in the Asia-Pacific data center landscape, with increasing threat emerging from region-specific providers, it is imperative that market participants incorporate value-added services complementing their data center portfolio to increase their value propositions. Data center vendors competing in saturated markets such as Japan and Australia should also consider broadening their geographical reach to diversify their portfolio revenue.

Security, disaster recovery, and business continuity planning solutions will be key areas of expansion for data center service providers to minimize downtime and ensure data confidentiality. In optimizing data center operations, the emphasis will be on data center design and architecture in which technologies are deployed using hyper-converged infrastructure, modularization, software-driven systems, and consolidations.

8 FROST IQ METHODOLOGY – GROWTH STRATEGY

The focus of Frost IQ is to provide a balanced assessment of an industry. The industries analyzed are those that Frost & Sullivan analysts have tracked over a period of time. Data collected, for instance vendors' revenue, is scrutinized and forms part of the input for the Frost IQ Matrix. Additional information is collected from various sources including interviews with market participants.

The approach includes a mix of quantitative and qualitative assessment. The Frost IQ Matrix has two major axes. These are revenue market share and future growth strategy.

1. REVENUE MARKET SHARE 	• Market share information is derived from Frost & Sullivan research. This research includes market trackers and syndicated research reports. From regular research conducted at quarterly, semi-annual or annual intervals, Frost & Sullivan analysts build a revenue database for vendors in the market. • The X-axis of the Frost IQ Matrix measures the relative market share of market participants on a percentage scale. The mid-point of the axis on the matrix is set at 50% of the market share of the leading participant in that market.
2. GROWTH STRATEGY 	• Frost & Sullivan considers four main components in the growth strategy, the Y-axis of the Frost IQ Matrix. The guiding principle is that these components and their subcomponents should follow the Mutually Exclusive and Comprehensively Exhaustive (MECE) test. The components are as follows:  Product/Service strategy;  People and skills strategy;  Ecosystem strategy; and  Business strategy

There is an equal weightage to all the components, with measurement on a 100-point scale. The dividing line is at the mid-point, i.e., a weighted score of 50 on a 100-point scale. Analysts make assessments of the industry participants' strategy for the above parameters.

Details of the subcomponents are available, if required.

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NEXT STEPS

Schedule a meeting with our global team to experience our thought leadership and to integrate your ideas, opportunities and challenges into the discussion.

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