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A COMPETITION ANALYSIS OF THE INDIAN CLOUD COMPUTING MARKET

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Authors

Payal Malik

Bhargavee Das

Harishankar Thayyil Jagadeesh

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Abstract

Cloud computing is the engine powering the Artificial Intelligence (AI) revolution and several other emerging technologies. While current demand and expected market growth have enabled the entry of new players, the market remains highly concentrated, with a few large cloud service providers who enjoy first-mover advantage and leverage certain common characteristics of digital markets such as economies of scale, network effects and conglomerate effects. This report examines these economic characteristics in the context of cloud computing and provides a comprehensive analysis of the competitive landscape of the market in India and worldwide. A key focus of the report is on the competition concerns that have been highlighted by competition authorities across jurisdictions, such as egress fees, committed spending discounts, tying and bundling, limited interoperability, and application portability. This report undertakes a discussion of these technical and financial market barriers within the Indian context through secondary research and stakeholder consultations. It highlights the ways in which the Indian market follows global trends. Finally, the report explores possible options for enhancing competition.

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Authors' email: *pmalik@icrier.res.in, bdas@icrier.res.in, hjagadeesh@icrier.res.in*

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1. Introduction

Cloud computing is the engine that powers disruptive innovations such as Artificial Intelligence (AI), which rely on extensive databases and computational resources. Factors such as scalability and flexibility, cost optimisation, enhanced collaboration, and security are incentivising widespread enterprise cloud adoption.[1] Increasing enterprise adoption and growing demand due to technological developments like AI are enabling Big Tech companies that made early entry into cloud service to expand their ecosystem of products and services in the cloud services market.[2] Cloud computing has also enabled large global technology companies—which entered the cloud market by leveraging their market power in adjacent digital markets such as productivity software, search engine, and e-commerce—to expand their ecosystems further.[3]

While these broad trends in the cloud landscape are attracting new business opportunities and creating value for consumers, they have also given rise to competition concerns in several jurisdictions.[4] This report documents the fundamental concepts in the cloud computing market and analyses competition dynamics in the current structure of the cloud computing market in both the global and Indian contexts.

The National Institute of Standards and Technology (NIST) defines cloud computing as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."[5] Descriptions of key terms in the definition are as follows:

- on-demand: Enterprises can avail cloud computing services and terminate these services at will
- network access: Services are accessed over the internet
- shared pool: Cloud computing service providers run large computing facilities which serve multiple customers and whose capacity is dynamically allocated among different customers

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1 Google Cloud. (n.d.). *Advantages of cloud computing*. https://cloud.google.com/learn/advantages-of-cloud-computing

2 McCord, D. (2024, April 23). *Convergence: AI's impact on competition and regulation in the cloud market.* Peterson Technology Partners. https://www.ptechpartners.com/2024/04/23/convergence-ais-impact-on-competition-and-regulation-in-the-cloud-market/

3 Australian Competition and Consumer Commission. (2023, November 27). *Digital platform services inquiry - September 2023 interim report.* https://www.accc.gov.au/about-us/publications/serial-publications/digital-platform-services-inquiry-2020-25-reports/digital-platform-services-inquiry-september-2023-interim-report

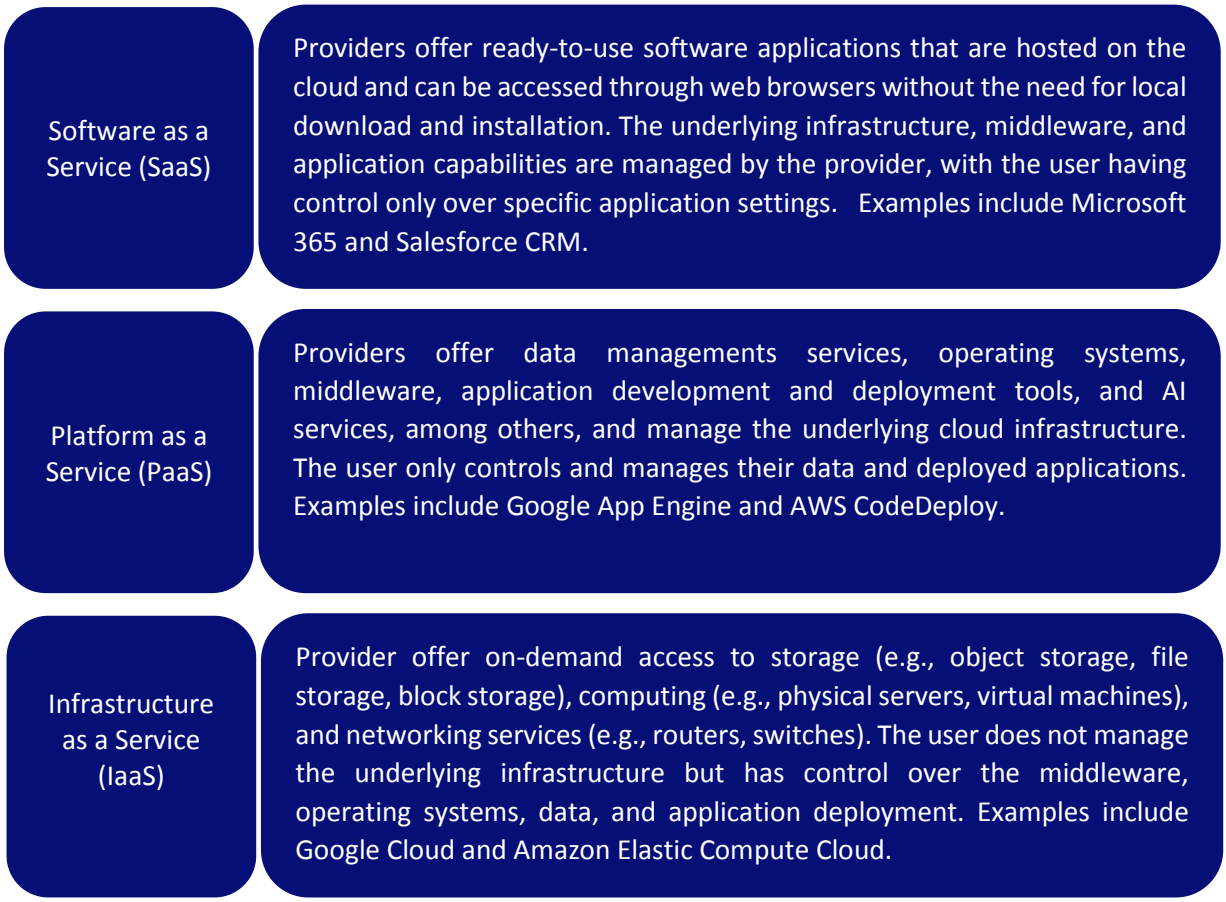
4 Mugunthan, S. (2024, January). *Competition issues in the cloud service sector.* CUTS International. https://cuts-ccier.org/pdf/bp-competition-issues-in-cloud-service-sector.pdf

5 Mell, P., & Grance, T. (2011, September). *The NIST definition of cloud computing*. National Institute of Standards and Technology, U.S. Department of Commerce. https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-145.pdf

- rapidly provisioned: As the provider already has computing facilities, enterprises can sign up and access the services with minimal delay
- minimal management effort: The upkeep of computing facilities and the concomitant software services such as the operating system (OS) and middleware are the responsibility of the cloud provider and do not require any management effort from the enterprise user

Understanding the cloud computing stack and cloud deployment models is critical to gain insights into the market characteristics that shape the cloud computing market and associated competition issues. The gamut of cloud services is sometimes conceptualised as a cloud computing stack, which comprises three delivery models that are layered over one another: Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS).[6] Most cloud computing firms operate in the SaaS layer due to lower upfront investments and larger potential user base.

Figure 1: Cloud computing service delivery models



Source: NIST[7] and IDC[8]

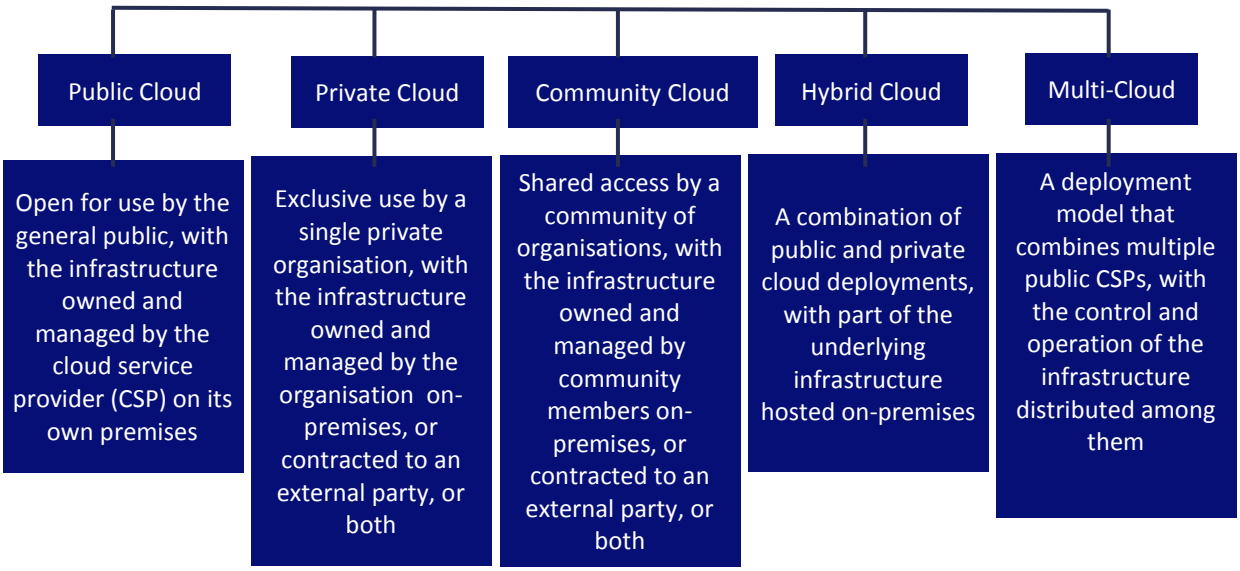
[6] This is the common classification developed by NIST, although there are certain other evolving segments, such as Business Process as a Service (BPaaS), whose place in this traditional stack is still being discussed in the literature. Source: https://cs.emis.de/LNI/Proceedings/Proceedings234/145.pdf

[7] Mell, P., & Grance, T. (2011, September). *The NIST definition of cloud computing*. National Institute of Standards and Technology, U.S. Department of Commerce. https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-145.pdf

[8] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

The cloud market is also differentiated by deployment models, which are determined by factors such as level of access and ownership of infrastructure. On the basis of access, cloud infrastructure can be categorised into public, private, and community. On the basis of ownership of infrastructure, cloud infrastructure can be categorised into provider-owned, self-owned, and hybrid. These categories are not mutually exclusive. Further, users could also use more than one cloud service provider (i.e., multi-cloud) to enable optimal cloud usage based on factors such as workload requirements and costs. Hybrid multi-cloud—which is a combination of on-premises private cloud infrastructure and multiple public cloud service providers—is another deployment model that is gaining traction.

Figure 2: Key Concepts in Cloud Deployment



Source: NIST[9] and Spacelift[10]

2. The Economics of the Cloud Services Market

An analysis of the competitive landscape of the cloud services market requires an understanding of its key economic characteristics. The combined impact of the inherent characteristics of the market and barriers to entry entrench the dominant position of cloud service providers (CSPs) known as hyperscalers. The dominance of hyperscalers is further reinforced by certain key characteristics of the cloud services market, such as economies of scale, network effects, vertical integration, and conglomerate effects.

[9] Mell, P., & Grance, T. (2011, September). *The NIST definition of cloud computing*. National Institute of Standards and Technology, U.S. Department of Commerce. https://nvlpubs.nist.gov/nistpubs/legacy/sp/nistspecialpublication800-145.pdf

[10] Roper, J. (2024, June 17). *Cloud deployment models – Types, comparison & examples*. Spacelift. https://spacelift.io/blog/cloud-deployment-models#hybrid-cloud-model

Economies of scale

Large providers are able to leverage their scale to achieve cost efficiency in operations and undertake strategic investments in innovations. Credits[11] and acquisitions[12] are important pathways through which hyperscalers are expanding their ecosystem both in India and abroad.

Figure 3: Pathways of Economies of Scale

Data Centres	Credits	Innovation
• Discounts: Large operators with higher purchasing power are able to obtain bigger discounts on the bulk purchase of hardware. • Efficiency in Overhead Costs: Large providers are able to invest in bigger data centres, which cuts down average operational and energy costs while enhancing security and reliability. • Efficiency from broader user base: Large providers are able to reduce relative variance in demand by serving a variety of customers across industries and geographies, thereby ensuring efficient utilisation of their data centres.	• Cloud credits are funds provided to startups to cover their initial infrastructure costs and to enable experimentation with a range of advanced cloud services. Large providers that have a bigger existing customer base are able to both provide higher credits and discounts as well as spread their risk in credit investments across a broader range of startup users of their services.	• Internal R&D: For improving existing services as well as developing new cloud services, large cloud providers are in a better position to incur significant fixed and sunk costs, as they are able to spread the high research and development (R&D) costs across a large user base and awide range of cloud and non-cloud product offerings. • Acquisitions: Large cloud providers are better placed to spend significant sums in acquiring innovative small businesses with offerings that can be integrated into their platform, thus enabling the provider to enhance their product differentiation. For instance, during 2018-20, large cloud providers invested over 42.5 billion euros in over 35 acquisitions.

Source: ACM[13] and Ofcom[14]

[11] For instance, the 'Google for Startups Cloud Program' offers cloud credits in the range of USD 200,000-350,000 for AI and Web3 startups, in addition to technical guidance and other business support. Source: https://cloud.google.com/startup?hl=en

[12] In 2022, Microsoft acquired Nuance Communications, a speech recognition and AI software, for USD 19.7 billion, which is its latest strategic investment in a string of acquisitions in the healthcare space aimed at offering a suite of cloud services such as 'Microsoft Cloud for Healthcare'. Source: https://news.microsoft.com/2021/04/12/microsoft-accelerates-industry-cloud-strategy-for-healthcare-with-the-acquisition-of-nuance/

[13] ACM. (2022, September 20). *Market study into cloud services*. ACM.nl. https://www.acm.nl/en/publications/market-study-cloud-services

[14] Ofcom. (2023, October 5). *Cloud services market study, final report.* Ofcom. https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

Network Effects

Network effects encompass the idea of the value of a product increasing for each user with an increase in its user base. In the cloud, such effects work mainly through two channels: independent software vendors (ISVs) that build SaaS applications on the underlying cloud infrastructure and end-users of the cloud (i.e., enterprises and individuals).

For ISVs, there are significant time and monetary costs involved in developing software services that are compatible with multiple cloud providers. Therefore, it makes more business sense for ISVs to deploy their services only on hyperscalers, which already have a large user base that can be tapped for maximum potential revenue. Conversely, end customers prefer complementarity between a diverse range of SaaS services with the storage and compute services of their main cloud provider, as limited technical interoperability restricts their ability to pick and choose SaaS services hosted on different clouds.

To a lesser degree, network effects work through differences in developer knowledge across clouds. As there is a cost of acquisition for specialised knowledge, the larger pool of developers is likely to train for proficiency in systems used by hyperscalers, which already enjoy large enterprise adoption. Conversely, the familiarity of the talent pool to specific cloud platforms may determine the choice of provider for enterprises migrating to the cloud. All these network effects serve to further entrench the market position of hyperscalers, whose first-mover advantage has already enabled them to capture a large share of end-users.[15]

Vertical Integration and Conglomerate Effects

Hyperscalers also enjoy an advantage in the market through two other avenues: vertical integration across the cloud computing stack and economies of scope stemming from being a part of tech conglomerates, both of which limit the scope of competitive entry and expansion for new players. Vertically integrated offerings from hyperscalers and other large providers are attractive to end-users, who value technically seamless integration of services across the stack and the possibility of higher discounts on a larger spend across the stack.

A common competitive concern for smaller operators that offer services in a single layer is the economies of scale enjoyed by integrated providers, which also allows them a price advantage; this is particularly relevant for IaaS services, which are largely homogenous. For PaaS and SaaS services, integrated large operators enjoy two main advantages: savings on underlying infrastructure costs (as integrated providers already own the infrastructure) and the use of data from third-party services deployed on their infrastructure, which enable the

[15] As well as considerable experience in the provision of a broad range of PaaS tools to attract developers. For instance, Azure and AWS are estimated to have twice the number of third-party services on their marketplaces as Google, while marketplaces of smaller cloud providers have significantly fewer services. Sources: https://www.acm.nl/system/files/documents/market-study-def-public.pdf; https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

development of competing in-house products.[16] Thus, the cost and technical efficiency afforded by vertical integration offer competitive advantages to integrated players, even on layers that otherwise have ample scope for differentiation for new entrants.

The hyperscalers are also part of large tech conglomerates that have a significant presence in other digital markets, which offers economies of scope and other advantages. Economies of scope work through spreading human capital costs and fixed investments on R&D across a range of non-cloud digital services and the cost savings associated with hosting such services on own's own cloud. Thus, Amazon's e-commerce (Amazon.com) and video streaming (Amazon Prime Video) businesses use the AWS infrastructure; parts of YouTube were moved to the Google Cloud Platform (GCP); and Microsoft's search engine, Bing, is powered by the tech giant's own cloud, Azure. Being part of the larger digital ecosystem also has other advantages such as large customer-data generation, which enables the quicker launch of new and better targeted services. For example, Google used its search and location services to offer the cloud-based Google Maps platform, which is integrated with other GCP services.[17] Microsoft has used its dominant position in the market for OSs to integrate its OneDrive platform with Windows and also offers differentiated bundles of its Microsoft 365 cloud services for various segments of users (i.e., personal, family, enterprises, and education).[18] Finally, being a part of conglomerates enables hyperscalers to leverage existing brand awareness and established relationships with long-time customers in adjacent markets.[19]

These characteristics of the cloud computing market, in combination with the technical nature of cloud computing, give rise to a number of competition concerns. Consequently, several anti-trust authorities have undertaken market studies of the cloud computing market to identify and understand specific concerns that need to be addressed.

3. The Competitive Landscape of Global Cloud Services

Market studies on the competitive landscape of the cloud computing market across geographies have largely focused on the public cloud, which contains the largest number and broadest spectrum of users. The global public cloud market is estimated to have grown at a CAGR of 24%, from USD 351.45 billion in 2020 to USD 669.23 billion in 2023.[20,21] Within the

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16 These advantages are further complemented with lock-in measures by these integrated providers with various technical switching barriers (such as closed standards and restrictions on software licensing), which are discussed in detail later.

17 Litsur, A. (2018, May 17). Google Maps platform now integrated with the GCP console. *Google Cloud Blog*. https://cloud.google.com/blog/products/gcp/google-maps-platform-now-integrated-with-the-gcp-console

18 Australian Competition and Consumer Commission. (2023, November 27). *Digital platform services inquiry - September 2023 interim report.* https://www.accc.gov.au/about-us/publications/serial-publications/digital-platform-services-inquiry-2020-25-reports/digital-platform-services-inquiry-september-2023-interim-report

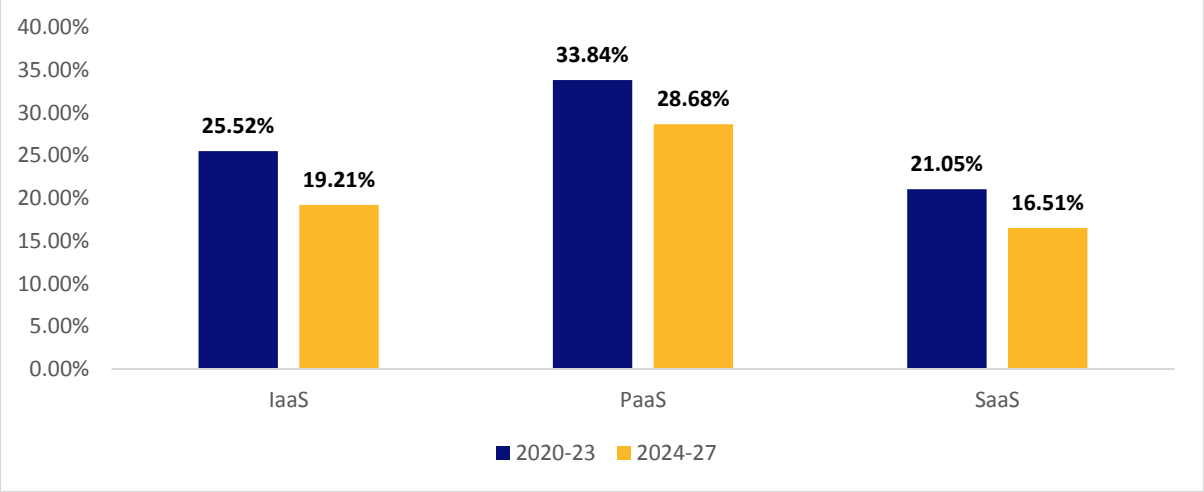
19 In Ofcom's market survey, for instance, around 23% of cloud users reported a historical relationship as an important factor in their choice of cloud provider. This competitive advantage was found to be particularly relevant for Microsoft (with around 29% of users reporting a pre-existing relationship with Microsoft as the reason for their choice for Azure), which also provides cross-market discounts for joint usage of its cloud and other products, such as Windows Server.

20 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

21 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

global public cloud market, SaaS accounted for nearly 62% of revenue, followed by IaaS (20%) and PaaS (18%).[22] The need for business continuity and hybrid workplaces were the primary drivers of migration to the public cloud in 2020 and 2021.[23] Several applications were deployed in the IaaS model during this period, largely motivated by the need to reduce large capital expenditures associated with managing on-premises storage and compute resources. In 2022 and 2023, there was increasing adoption of PaaS services to further cut down on the need for managing the underlying infrastructure as well as to take advantage of specific cloud native capabilities that are not available on IaaS.[24] The global public cloud market is expected to grow at a CAGR of 20% in the 2024-27 period to reach USD 1373.5 billion by the end of 2027, as dominant software application categories such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM) transition to the cloud to eliminate the complexities of in-house management and to leverage the capabilities of AI and Machine Learning (ML) for better user experience. However, the growth is expected to be slower in 2024-27 compared to the previous four-year period, partly due to the maturity of the market and partly due to macroeconomic trends.

Figure 4: Current and Expected CAGR of the Global Public Cloud Market



Source: IDC[25]

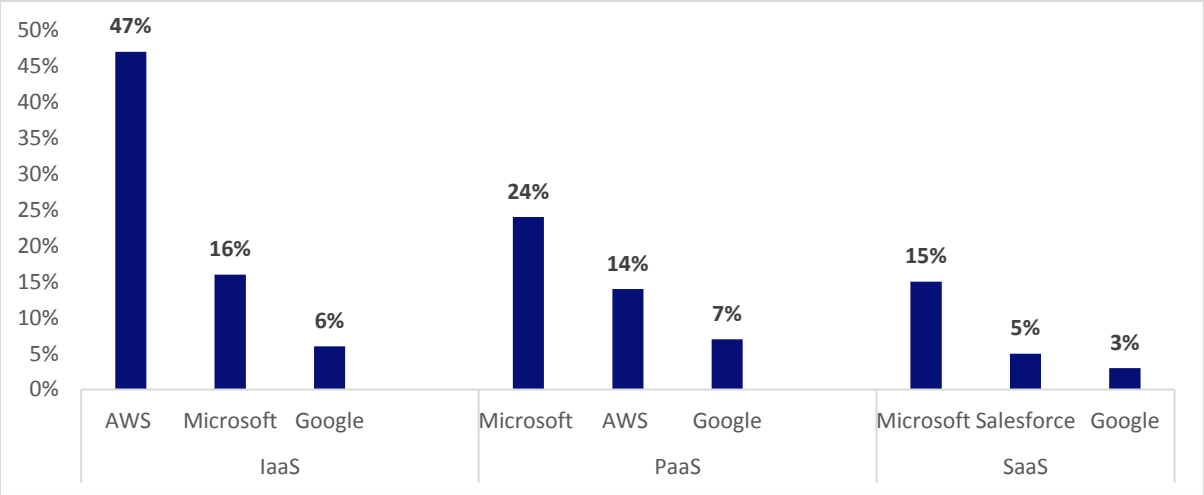
As of 2023, the top ten public cloud vendors together captured around 45% of the market share, with the three hyperscalers[26]—Amazon Web Services (AWS), Microsoft Azure, and Google Cloud—accounting for approximately 33% of the total public cloud revenue worldwide.[27]

[22] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[23] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[24] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[25] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[26] Hyperscalers are large public cloud infrastructure service providers, providing compute and storage services to a large share of enterprise customers. Source: https://www.redhat.com/en/topics/cloud/what-is-a-hyperscaler
[27] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

The IaaS model has high financial and temporal entry barriers and limited scope for differentiation. The IaaS model is the most concentrated, with around 82 companies operating globally, of which hyperscalers capture a 69% share.[28] AWS, which has data centres across regions and offers over 200 services, is the leading player in this segment. IaaS revenue contributed to around 75% of Amazon Web Services's overall public cloud services (PCS) revenue in 2023.[29] Microsoft and Google, with a YoY growth of 28% and 27%, respectively, in 2023, are also making rapid inroads into this segment. Additionally, a number of Chinese cloud providers such as Alibaba Group, Huawei, Tencent, and China Telecom are close competitors.

The PaaS and SaaS markets have relatively higher product differentiation, with a presence of over 310 and 890 companies, respectively. The growth of the PaaS market is driven mainly by data management software, middleware applications, and application development platforms, while the growth of the SaaS segment can be attributed to security and ERM applications. Microsoft is a leading player in both segments, with PaaS contributing to around 26.15% of the company's PCS revenue and SaaS contributing around 54.89%.[30]

Figure 5: Market Shares of Top 3 Vendors by Service Delivery Models (2023)

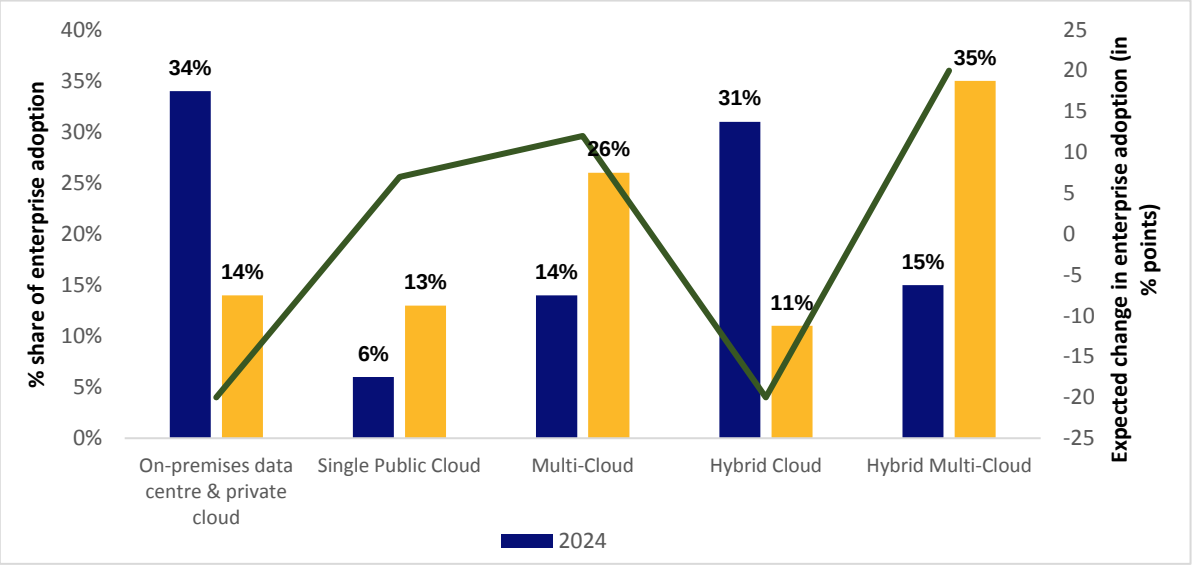


Source: IDC[31]

In terms of deployment models, although on-premises and private cloud are popular, multi-cloud and hybrid multi-cloud models are expected to increase. The choice of hybrid multi-cloud deployment is driven by the need to flexibly run solutions across clouds and on-premises, optimise costs, and improve application performance.

[28] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[29] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[30] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[31] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

Figure 6: Current and Planned IT Deployment Models (2024-27)



Source: Nutanix[32]

Given the increasing importance of multi-cloud, market studies in the cloud services market have attempted to understand barriers to the multi-cloud strategy. These studies have identified some benefits of multi-cloud deployment, as follows:

- **Flexibility:** Users can take advantage of the best features offered by different providers for various workload needs. For instance:
  - Godfrey Philips uses the Oracle cloud for certain applications (such as for streamlining of business processes and improving employee productivity through Oracle BPEL Process Manager and Oracle E-Business Suite)[33] and a data lake solution from the Cloudera enterprise platform hosted on AWS for consolidation of data, leveraging new insights, real-time monitoring of sales, etc.[34,35]
  - Uber uses AWS, GCP, and Oracle for various needs. With solutions such as Amazon Athena and Amazon Simple Storage Service (Amazon S3), the company integrated its on-premises operations with the cloud and also improved operational security and reduced costs. It also moved some of its batch data analytics and ML stack to GCP[36]

[32] Nutanix. (n.d.). *2024 enterprise cloud index: The need for infrastructure agility*. https://www.nutanix.com/enterprise-cloud-index

[33] Tata Consultancy Services. (n.d.). *Godfrey Phillips Picks Oracle, TCS.* Newsroom, Tata Consultancy Services. https://www.tcs.com/who-we-are/newsroom/tcs-in-the-news/godfrey-phillips-picks-oracle-tcs

[34] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

[35] Cloudera. (n.d.) *Eye on the Cloud for Sales Automation with Insights Driving Better Decision Making.* Cloudera. https://www.cloudera.com/content/dam/www/marketing/resources/case-studies/godfrey-phillips-customer-success-story-.pdf?daqp=true

[36] Uber Blog (2024, May 30). *Modernizing Uber's Batch Data Infrastructure with Google Cloud Platform.* Uber. https://www.uber.com/en-IN/blog/modernizing-ubers-data-infrastructure-with-gcp/

and integrated Uber Freight with Oracle Transportation Management for visibility into real-time pricing and managing changing capacity demand.[37]

- Panasonic India uses Oracle for their production applications and AWS for other secondary applications.[38]

- **Disaster Recovery and Reliability:** Users can back up their data and applications in multiple clouds and thereby avoid a single point of failure from natural calamities or cyberattacks.
- **Bargaining power:** Users can avoid vendor lock-in and have greater bargaining power in price negotiations.[39]

4. Global Regulatory Inquiries

The importance of the cloud computing industry in the global economy and its fundamental characteristics have given rise to competition concerns. Anti-trust regulators in several jurisdictions, including the United States (US), United Kingdom (UK), and European Union (EU), have undertaken market studies on the cloud service market to understand potential concerns and evaluate the need for action.

In the US, the Federal Trade Commission (FTC) initiated an inquiry into the business practices of cloud computing providers in March 2023.[40] The FTC highlighted the following competition concerns: licensing practices limiting the ability to use the software of other cloud infrastructure providers, egress fees affecting the ability to switch or use multiple cloud providers, and minimum spend contracts acting as a lock-in mechanism by incentivising customers to consolidate their needs to avail of discounts. While it did not prescribe specific remedies, it culled related issues.[41]

Ofcom, the UK's communications regulator, initiated a similar market research study on cloud services in October 2022. In March 2023, it concluded that customers were concerned about vendor lock-in and barriers of switching (particularly from Microsoft and AWS).[42] In October 2023, it referred the public cloud infrastructure services market to UK's Competition and Markets Authority (CMA) for investigation. The investigation is ongoing.[43]

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37 Gittoes, D. (2020, May 14). *Oracle teams up with Uber Freight to bring real-time information into shipping operations.* Oracle. https://www.oracle.com/corporate/blog/oracle-uber-freight-051420.html#:~:text=By%20directly%20integrating%20Uber%20Freight,reliable%20capacity%2C%2024%2F7.

38 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

39 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

40 FTC Office of Technology. (2023, March 22). *An inquiry into cloud computing business practices: The Federal Trade Commission is seeking public comments.* https://www.ftc.gov/policy/advocacy-research/tech-at-ftc/2023/03/inquiry-cloud-computing-business-practices-federal-trade-commission-seeking-public-comments

41 Jones, N. (2023, November 16). *Cloud computing RFI: What we heard and learned.* Federal Trade Commission. https://www.ftc.gov/policy/advocacy-research/tech-at-ftc/2023/11/cloud-computing-rfi-what-we-heard-learned

42 Context Consulting & Ofcom. (2023, March). *Cloud services market research, summary of findings.* Ofcom. https://www.ofcom.org.uk/__data/assets/pdf_file/0031/256459/context-consulting-cloud-services-market-research-summary-of-findings.pdf

43 Competition and Markets Authority. (2023, October 5). *Cloud services market investigation*. https://www.gov.uk/cma-cases/cloud-services-market-investigation

The French competition authority is of the view that a regulatory approach is better suited for addressing market failures in cloud services that have already been identified and which share commonalities with other digital markets.[44,45] To meet the challenges of the cloud sector and ensure faster compliance, it proposed considering a broader view of abuses (beyond those that require defining relevant market and demonstrating dominant position) and taking measures (such as administrative injunction) against companies that engage in "restrictive competition practices".

The competition concerns highlighted by these anti-trust authorities are detailed in the following section.

5. Competition Concerns in Cloud Services Market

Cloud services have common characteristics with other digital markets, such as network effects, which naturally lead to an oligopolistic competition landscape. Like in digital markets, the competitive landscape of cloud computing services may not entirely be shaped by the market dynamics, the technical limitations of the product, and the regulatory regime. Indeed, several competition authorities around the world are now looking into the artificial barriers to market entry erected by large players to preserve their dominance. This section attempts to enable a better understanding of competition concerns identified across jurisdictions, notably egress fess, committed spend discounts, licensing restrictions, tying and bundling, technical restrictions, and hyperscaler-owned cloud marketplaces.

Egress Fees

Egress fees are defined as charges for moving data out of the cloud.[46] The quantum of the fee depends on various factors such as the volume of data transferred, originating region, distance between source and destination, customer tier, and subscription type.[47] A common concern for regulators has been the substantial egress fees charged by hyperscalers, which could disincentivise switching to another provider or adopting a multi-cloud strategy.[48] There are also significant differences across providers; hyperscalers' and IBM's egress fees are estimated to be 5-10 times that of relatively smaller providers like Oracle and OVHcloud. Their

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[44] Autorité de la concurrence. (2023, June 29). *Cloud computing: The Autorité de la concurrence issues its market study on competition in the cloud sector.* https://www.autoritedelaconcurrence.fr/en/press-release/cloud-computing-autorite-de-la-concurrence-issues-its-market-study-competition-cloud

[45] The Autorité noted that antitrust law pertaining to cartels in particular may be relevant in view of the emergence of a number of cloud provider associations as well as partnerships between cloud providers and ISVs, as they may sometimes operate with anti-competitive purposes such as price collusion and the imposition of standardisation aimed at favouring the technical standards of market leaders and preventing the emergence of alternative solutions. Source: https://www.autoritedelaconcurrence.fr/sites/default/files/2023-06/Resume_Avis_Cloud%20EN_final_2023_2906.pdf

[46] Ingress, i.e., moving data into cloud infrastructure, is generally free.

[47] Cloudflare. (n.d.). *What are data egress fees?* https://www.cloudflare.com/en-gb/learning/cloud/what-are-data-egress-fees/?blaid=4522436

[48] For instance, market research commissioned by Ofcom found 55% respondents reporting egress fees as a concern and 45% reporting data transfer as the biggest challenge to multi-cloud.

fees are also higher than the incremental costs of providing egress.[49] Reduction or elimination of egress fees is estimated to result in savings in the range of 7.5-27% of customers' monthly bill.[50]

Table 1: Consumer Harm Due to Egress Fess

Adverse impact on medium and small enterprises	Large enterprises are in a better position to negotiate private discounts that considerably lower their egress fees. This is due to various advantages such as greater share in hyperscalers' revenue, ability to incur large upfront investments in alternative options, greater certainty over long-term expected data transfers, and better ability to understand the complex pricing schedules of cloud providers. The majority of the user base, which comprises small and medium enterprises, are unable to avail such discounts.
Limited multi-clouding	Market research has found that some customers opt for a single-cloud architecture, even though another service may offer better quality than their existing provider, in order to avoid egress costs. Even when multiple cloud providers are chosen, enterprises may maintain a siloed architecture (i.e., separating workloads in different clouds) even when a more integrated multi-cloud architecture may be more efficient,[51] partly to avoid egress fees.[52]
Barrier to integrated multi-cloud architecture	Egress fees can be unpredictable and costly for customers when making a switching decision in an integrated multi-cloud implementation. In a single-provider architecture, this cost is likely to be incurred only once, whereas in an integrated multi-cloud implementation, data is likely to be transferred repeatedly over a prolonged period of time.
Impact on innovation	Egress fees, which make external data transfer costly, can become an obstacle for the commercial viability of new cloud use cases that depend on large amounts of data egress.[53]

Source: Adapted from Ofcom[54] and Nutanix[55]

Although various competition authorities have pointed to these common harms and anti-competitive effects stemming from egress fees, there is a dearth of empirical research that isolates the effect of such fees on competition[56] and in the choice of limited data egress over factors such as network latency, problems of synchronisation, data errors, and security. Researchers have also cautioned against the blanket removal of data egress fees, citing that

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49 Ofcom. (2023, October 5). *Cloud services market study, final report*. https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

50 Rajeswaran, A. (2021, July 23). Empowering customers with the Bandwidth Alliance. *The Cloudflare Blog*. https://blog.cloudflare.com/empowering-customers-with-the-bandwidth-alliance/

51 More efficient in terms of enabling better data analytics, visibility, and management of cloud operations and reduced complexity in regulatory compliance around data protection.

52 Trouard-Riolle, M. (2023, November 16). *Multiple clouds vs. multicloud: What's the difference and why does it matter?* Nutanix. https://www.nutanix.com/blog/multiple-clouds-vs-multicloud-what-is-the-difference#:~:text=Multiple%2C%20unintegrated%20clouds%20also%20lead,if%20not%20managed%20very%20closely.

53 Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

54 Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

55 Trouard-Riolle, M. (2023, November 16). *Multiple clouds vs. multicloud: What's the difference and why does it matter?* Nutanix. https://www.nutanix.com/blog/multiple-clouds-vs-multicloud-what-is-the-difference#:~:text=Multiple%2C%20unintegrated%20clouds%20also%20lead,if%20not%20managed%20very%20closely.

56 Biglaiser, G., Crémer, J., & Mantovani, A. (2024, March). *The economics of the cloud.* (TSE Working Paper, n. 24-1520). https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2024/wp_tse_1520.pdf

this may be counterproductive for competition, with larger providers being better able to absorb the loss of revenue compared to smaller players, along with other unintended consequences such as an increase in cloud storage costs and inefficient external data transfers.[57] However, egress fees are currently being phased out[58]and several new entrants in the market are not charging it.

Committed Spend Discounts

Committed spend discounts are percentage discounts offered by cloud providers in exchange for customers committing to spend a predetermined amount across a range of cloud services over a specific period. Upon failing to meet the commitment by the end of the contract, the difference must be paid by the customer as a lump sum.[59] Although such discounts are available for all customers for certain specific cloud services, hyperscalers and other large cloud providers also offer cross-service discounts which are highly individualised agreements mainly targeted towards large, established customers.[60]

The structure of these discounts—such as the long duration of agreements, applicability toa broad range of cloud products, and high spending commitment thresholds—often incentivise enterprises to concentrate their cloud spending on a single, large provider, thus dampening the chances of smaller players with a narrower range of offerings and limited financial capacity to offer discounts to compete for new, incremental workloads.[61] The switching costs increase when such agreements are negotiated or renegotiated over a longer duration, as the existing provider may increase the thresholds for the customer to continue availing their current levels of discount.[62] The high monetary thresholds for availing larger discounts mean that customers sometimes end up transferring their workloads from other providers, thus moving away from multi-cloud, and purchasing additional services from their own cloud provider's marketplace to be eligible for meeting spending commitments, thus becoming further locked in to their primary cloud provider's ecosystem.[63]

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57 Biglaiser, G., Crémer, J., & Mantovani, A. (2024, March). *The economics of the cloud.* (TSE Working Paper, n. 24-1520). https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2024/wp_tse_1520.pdf

58 Woo, T. et al. (2024, March 13). *AWS Joins Google Cloud In Removing Egress Costs.* Forrester. https://www.forrester.com/blogs/aws-joins-google-cloud-in-removing-egress-costs/

59 Biglaiser, G., Crémer, J., & Mantovani, A. (2024, March). *The economics of the cloud.* (TSE Working Paper, n. 24-1520). https://www.tse-fr.eu/sites/default/files/TSE/documents/doc/wp/2024/wp_tse_1520.pdf

60 Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

61 Ofcom. (2023, April 5). *Cloud services market study, interim report.* https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-3-4-weeks/244808-cloud-services-market-study/associated-documents/cloud-services-market-study-interim-report.pdf?v=321879

62 Ofcom. (2023, April 5). *Cloud services market study, interim report.* https://www.ofcom.org.uk/siteassets/resources/documents/consultations/category-3-4-weeks/244808-cloud-services-market-study/associated-documents/cloud-services-market-study-interim-report.pdf?v=321879

63 Committed spend discounts may also partly impact competition in SaaS services, as hyperscalers' policies may allow marketplace spending on third-party ISV services to draw down on customer spending commitments to a lesser extent vis-à-vis spending on their own SaaS products.

Licensing Restrictions

Licensing restrictions lock in customers to specific vendor ecosystems during migration to the cloud, limiting their flexibility and options. For instance, cloud providers can leverage their dominant position in software to incorporate contractual clauses that make the deployment of their software relatively expensive in a competing cloud provider's environment, thus self-preferencing their own IaaS services.[64] Others may have terms of use that outright restrict deployment in a different provider's cloud or apply a waiting period for the reuse of their licences in a different cloud, thereby increasing the switching costs.[65]

Tying and Bundling

Software providers tie or bundle the usage of their dominant software systems with their cloud infrastructure, making other cloud providers' offerings less attractive. A 2023 study by Frederic Jenny revealed a significant decline in the market share held by independent providers, from nearly 50% in 2015 to 23% in 2021.[66] The European Commission is currently investigating Microsoft for potentially violating EU competition rules by bundling its Teams application to its Office 365 and Microsoft 365 suites. By offering Teams at close to no additional cost, Microsoft may be able to exclude competing collaboration suite providers.[67]

Technical Barriers

Technical barriers may hinder the interoperability of cloud services, impacting a user's ability to use services from multiple providers. A study by the Cloud Infrastructure Services Providers in Europe (CISPE) found the use of operating proprietary language to reduce the ease of interaction between different systems to be a major limitation on interoperability between cloud providers.[68] While interoperability is a key requirement for multi-clouding, the ease or difficulty of data and application portability are key considerations for switching.[69] The other technical barriers to multi-clouding and switching[70] are presented in Table 2.

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64 For instance, a change in Microsoft's Bring Your Own License (BYOL) policy in 2019, which forced Office 365 users to repurchase their licenses if they chose to host it on third-party cloud infrastructure, is estimated to have resulted in a cost burden of 560 million euros in Europe and additional costs of around 1 billion euros for non-Azure deployment of SQL server. Source: https://cispe.cloud/website_cispe/wp-content/uploads/2023/06/Quantification-of-Cost-of-Unfair-Software-Licensing_Prof-Jenny_-June-2023_web.pdf

65 Oracle licences, for instance, can only be deployed in approved third-party providers' clouds and is not supported on Google Compute Engine (GCE) machines, and certain other Oracle products such as Oracle RAC (Oracle Real Application Clusters) can be used exclusively in the Oracle cloud environment. Source: https://www.autoritedelaconcurrence.fr/sites/default/files/attachments/2023-09/23a08_EN.pdf

66 Jenny, Pr. Frédéric. (2023, June 21). *Unfair software licensing practices: A quantification of the cost for cloud customers.* CISPE. https://cispe.cloud/website_cispe/wp-content/uploads/2023/06/Quantification-of-Cost-of-Unfair-Software-Licensing_Prof-Jenny_-June-2023_web.pdf

67 European Commission. (2023, July 27). *Antitrust: Commission opens investigation into possible anticompetitive practices by Microsoft regarding Teams*. https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3991

68 CISPE. (2021, October 26). *New study links unfair software licences to distortion of competition in cloud infrastructure market*. https://cispe.cloud/new-study-links-unfair-software-licences-to-distortion-of-competition-in-cloud-infrastructure-market/

69 Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

70 Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

Table 2: Technical Barriers in Cloud Computing

Technical differentiation of cloud infrastructure services	Cloud providers offer different infrastructure services. Technical disparities at the interface level (i.e., proprietary APIs, protocols, and workflows) can hinder interoperability.
Technical differentiation of ancillary cloud services	Cloud providers provide different ancillary cloud services (such as observability, billing, security). Differences in these services increase complexity in managing multi-cloud environments. Customers need to use and constantly sync disparate tools or expend significant effort for a unified interface.
Asymmetry of functionalities	First-party cloud services may offer fewer functionalities when combined with services from other clouds.
Data gravity	Co-locating data and applications mitigate challenges such as latency and data governance. Therefore, data tends to be attracted to the primary cloud on which the bulk of the customer's data is hosted. Data gravity therefore discourages multi-cloud deployment and switching.
Cloud-specific skills	Customers need to develop specific technical skills for each cloud they use; lack of talent specialised in different cloud environments can hinder multi-cloud deployment.

Source: *Ofcom*[71]

Hyperscaler-Owned Cloud Marketplaces

Although the role of cloud marketplaces is at a nascent stage, competition authorities in certain jurisdictions, particularly France and Japan, have noted emerging competitive risks in the SaaS segment, arising from the growing importance of the marketplaces of hyperscalers. The Autorité de la concurrence noted that the power of large CSPs to control access to their marketplaces grants them the ability to impose several kinds of restrictions, such as those pertaining to the marketing of products, usage of technical tools, and licences, with implications for the ability of ISVs to compete with the SaaS products of the marketplace operator. Other cloud marketplaces may limit product listings based on technical characteristics, such as the Google Cloud Marketplace, which restricts permissible PaaS product types.[72]

Parity clauses imposed by providers, which require ISVs to maintain parity between the prices listed on their marketplaces and on other sales channels of the same third-party service, are of particular importance. This has implications for both the software vendors, who would then be limited in their ability to offer discounts to customers on other marketplaces that charge lower commissions, and for businesses in the software distribution market to compete on commissions and attracting a variety of product lineups.[73] Another competitive risk stems

[71] Ofcom. (2023, October 5). *Cloud services market study, final report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0027/269127/Cloud-services-market-study-final-report.pdf

[72] Autorité de la concurrence. (2023, June 29). *Opinion on competition in the cloud sector.* https://www.autoritedelaconcurrence.fr/sites/default/files/attachments/2023-09/23a08_EN.pdf

[73] Japan Fair Trade Commission. (2022, June). *Report on trade practices in cloud services sector*. https://www.jftc.go.jp/en/pressreleases/yearly-2022/June/221102EN.pdf

from privileged data access, i.e., marketplace operators being able to obtain metadata on prices, volumes, and customer information from third-party services for developing and marketing their own competing services.[74]

The following section examines the prevalence and impact of these issues in the Indian cloud computing market to determine whether there are any issues specific to the Indian context that hamper competition and growth in the Indian cloud computing market.

6. Indian Cloud Market: Trends and Issues

Transformation of India's PCS Market

India's PCS market accounted for 1.1-1.2% of the global PCS market in the 2020-23 period and is estimated to have grown at a CAGR of 29.01% to reach USD 8.3 billion during the same time.[75] The need for business continuity and rapid digitisation during the COVID-19 pandemic (2021 onwards) led to rapid growth of the Indian public cloud services market. With the increasing adoption of AI by businesses for various purposes such as streamlining operations, enhancing productivity, improving customer experience, and launching new services, the Indian PCS market is expected to grow at a CAGR of 24% over the 2024-27 period to reach USD 20.3 billion by the end of 2027.

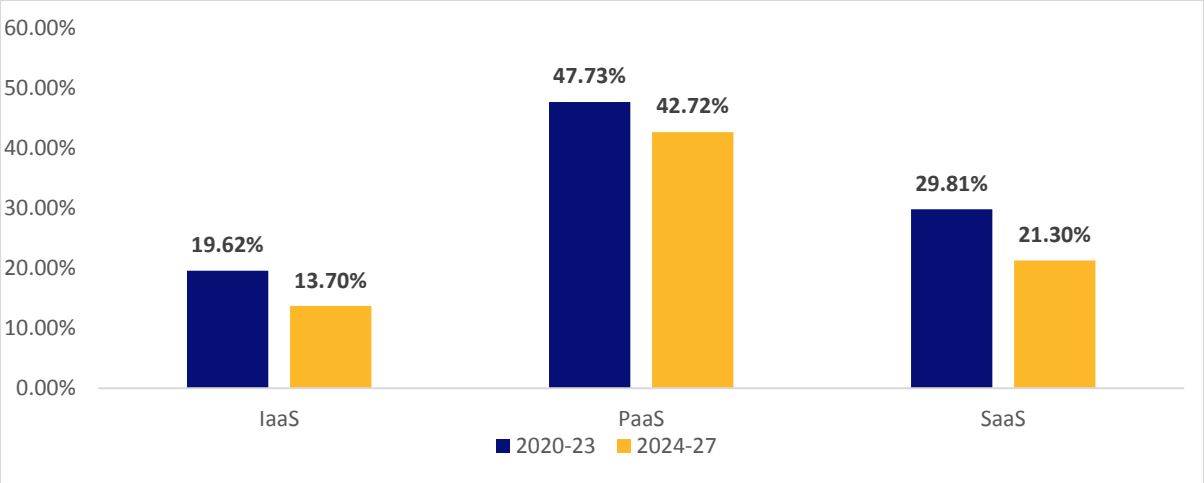
In line with global trends, SaaS accounted for the highest share of revenue, at around 65-66% in 2020-23, driven largely by collaborative, CRM, and ERM applications. However, the PaaS segment is expected to experience the highest growth rates in the future due to the growing demand for database management, application development, and analytics services. The IaaS segment initially registered strong demand from enterprises shifting the bulk of their applications to the cloud to optimise capital expenditure as well as from the proliferation of cloud-native startups (i.e., startups whose operations reside in their cloud). However, growth has subsequently tapered due to the selective deployment of applications to the cloud and the shift to serverless technologies offered as PaaS.[76]

[74] Japan Fair Trade Commission. (2022, June). *Report on trade practices in cloud services sector*. https://www.jftc.go.jp/en/pressreleases/yearly-2022/June/221102EN.pdf

[75] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

[76] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

Figure 7: Current and Expected CAGR of the Indian Public Cloud Market

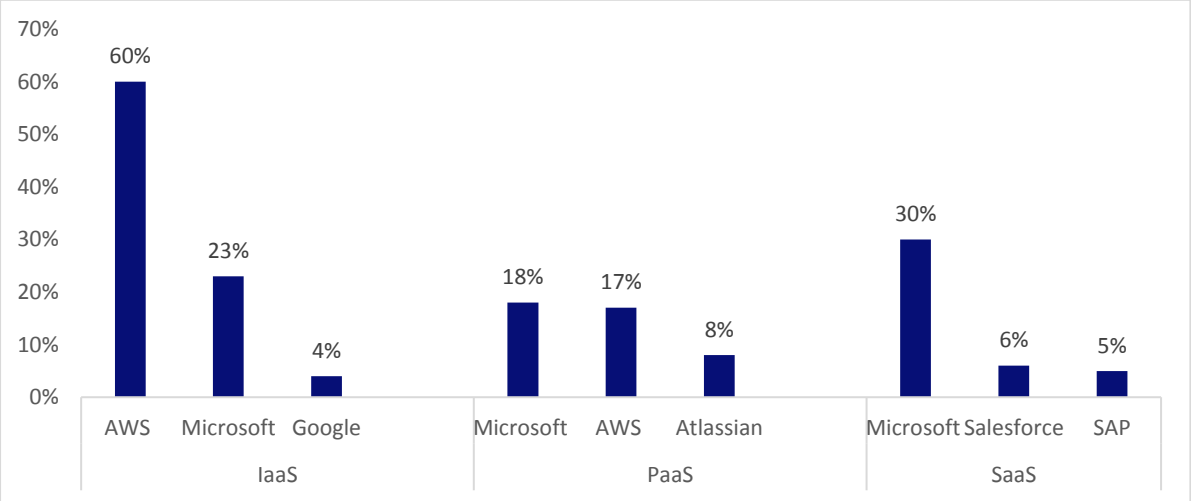


Source: IDC[77]

Competitive Landscape of the Indian PCS Market

Similar to the global PCS landscape, the Indian PCS market is characterised by the dominance of a few international vendors. The cumulative market share (by revenue) of the top ten vendors accounts for close to 60% of the overall Indian PCS market, with the two leading vendors—Microsoft (27%) and AWS (15%)—together capturing a little over 40% while others account for less than 5% each. A segmentation by the layers of the computing stack indicates the highest concentration in the IaaS layer, with the top three providers accounting for as much as 87%, while the PaaS and SaaS markets are relatively less concentrated,[78] with the top three vendors accounting for less than 43% and 41% market share, respectively.

Figure 8: Market Shares of the Top Three Vendors by Segment



Source: IDC[79]

[77] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[78] This is due to the presence of a larger number of companies (over 165 in PaaS and over 500 in SaaS).
[79] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

Major players in the Indian IaaS market

Microsoft

Microsoft is the leader in the Indian PCS market, with significant presence across all three layers of the Indian PCS market, particularly in PaaS and SaaS, and an overall revenue of USD 2.2 billion in 2023. Microsoft's strong presence in the OS and on-premise productivity software markets has helped maintain its mindshare among enterprise customers.[80] Its PaaS revenue experienced the highest annual growth in 2023 at 50%, mainly from the sale of managed database services, AI platforms, and application development tools.[81] Some of its close competitors in PaaS subcategories are presented in Table 3.

Table 3: Microsoft Competitors in Select PaaS Categories

PaaS category	Microsoft service	Competitor services
Data management	Azure Data Factory	AWS Glue, Google Cloud BigQuery, IBM InfoSphere DataStage
Application development	Azure App Service	Google App Engine, AWS Elastic Beanstalk
DevOps	Azure DevOps	AWS DevOps, Jira (Atlassian service), Google Cloud Build

Source: IDC[82], Statista[83], Gartner[84], G2[85]

Microsoft's SaaS revenue registered 40% YoY growth in 2023 and contributed 72.7% to its overall PCS revenue for the year. Its major offerings within this segment include its productivity services, particularly collaboration solutions such as Teams and its office suite Office 365. Its closest productivity suite competitor in India is Google, but new entrants such as Zoho, which was estimated to have around 6% market share in office software in 2022, are also present.[86] Microsoft increased its market share in Indian SaaS by 3% in 2023.

Table 4: Microsoft Competitors in Select SaaS Categories

SaaS category	Microsoft service	Competitor services
Collaboration	Conferencing: Teams	Google Meet, Zoom, Skype
	E-mail: Microsoft Outlook	Gmail, Amazon WorkMail, ZohoMail
	File sharing: OneDrive	Google Drive, Dropbox
Office	Word processing: Microsoft Word	Google Docs, ZohoWriter
	Spreadsheets: Microsoft Excel	Google Sheets, Zoho Sheets

Source: IDC[87], Statista[88]

[80] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[81] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[82] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[83] Statista. (n.d.). *Platform as a service - India*. https://www.statista.com/outlook/tmo/public-cloud/platform-as-a-service/india
[84] Gartner Peer Insights. (n.d.). *Microsoft alternatives in DevOps platforms.* https://www.gartner.com/reviews/market/devops-platforms/vendor/microsoft/alternatives
[85] G2. *Top 10 Azure data factory alternatives & competitors.* https://www.g2.com/products/azure-data-factory/competitors/alternatives
[86] Statista. (n.d.). *Platform as a service - India*. https://www.statista.com/outlook/tmo/public-cloud/platform-as-a-service/india
[87] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[88] Statista. (n.d.). *Software as a service - India*. https://www.statista.com/outlook/tmo/public-cloud/software-as-a-service/india#key-players

In other key enterprise SaaS offerings such as ERP and CRM, Microsoft's share is relatively lower than its competitors such as Oracle, SAP, and Salesforce. SAP's SaaS revenue from the public cloud edition of its ERP product S/4HANA registered 16% YoY growth in 2023, contributing around 92.69% to its overall PCS revenue. The company hosts its workloads in its own data centres as well as in AWS. Oracle's SaaS revenue grew at 27% YoY in 2023, contributing around 84.34% to its total public cloud revenue in India. It recently embedded generative AI capabilities in its cloud-based ERP software, Oracle Cloud HCM.[89] Salesforce, with its dominance in CRM, also witnessed 27% YoY growth in its SaaS revenue in 2023, which contributed around 94.11% to its total public cloud revenue in India.

Microsoft is also a top competitor in the IaaS segment. In 2015, it was the first public cloud provider to open a local data centre.[90] Its IaaS revenue, which mostly comes from its Azure Storage service, grew by 20% YoY in 2023 and contributed to around 18.4% of its total public cloud revenue that year.

AWS

AWS's dominance in the IaaS layer is supported by consulting and migration services, a robust security framework, and a large partner network and has enabled it to become the second leading player in the overall Indian PCS market, with a revenue of USD 1.3 billion, and the IaaS services registering 8% YoY growth in 2023, contributing 84.6% to its overall revenue.[91] Its top product categories in this segment are its computing service, Amazon Elastic Cloud Compute (Amazon EC2), and its object storage service, Amazon Simple Storage (Amazon S3). The company is estimated to have invested USD 3.7 billion during 2016-22 and is expected to further invest USD 12.7 billion in cloud infrastructure in India by 2030. It launched its first data-centre infrastructure region in Mumbai in 2016, followed by one in Hyderabad in 2022. AWS also established local zones in cities like Delhi and Kolkata to support greater availability and resiliency and lower latency for end-users.[92] Its partner network has also enabled the uptake of its IaaS services across industries and among top players. Notable AWS deals in 2023 are presented in Table 5.

[89] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[90] Microsoft. (2015, September 29). *Microsoft launches commercial cloud services from local datacenters in India.* https://news.microsoft.com/en-in/microsoft-launches-commercial-cloud-services-from-local-datacenters-in-india/
[91] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[92] https://press.aboutamazon.in/news-releases/news-release-details/aws-invest-inr-105600-crores-us-127-billion-cloud-infrastructure

Table 5: Major AWS Deals Across Industries (2023)

Industry	Description
Sports	Strategic collaboration between Tech Mahindra and AWS to build a sports cloud platform powered by AI/ML, real-time analytics, and AR/VR for delivering immersive and personalised experiences for sports fans, efficient management of sports stadiums, better audience segmentation, advanced data-driven insights into player performance, etc.[93]
Finance	HDFC Securities Ltd. launched its mobile trading platform HDFC Sky on AWS cloud to provide secure and low-latency trading service to over 75 million customers and to reduce its own annul IT infrastructure and management expenses by 50%.[94]
Health	Collaboration between AWS and the government on storage of digital health records and creation of Unified Health Interface (UHI) as an interoperable network for health applications. Previously, AWS has been the cloud infrastructure partner for other India Stack applications such as DigiLocker and CoWIN.[95]
Space	AWS strategic partnership with ISRO and IN-SPACe to support space tech innovation through cloud computing. Its Space Accelerator programme recently shortlisted 24 Indian space startups across a range of space segments such as spacecraft propulsion, orbital and launch vehicles and satellite imagery.[96]

Source: IDC Insights[97] and media reports

GCP

Google, through its Google Cloud Platform (GCP), is the third largest player in the Indian IaaS segment, although its market share is relatively lower at 4%. IaaS contributed around 30.83% of Google's overall PCS revenue in 2023. The top product category in IaaS is storage services, followed by computing. Its first cloud region went live in Mumbai in 2017, followed by Delhi-NCR in 2021.[98] In collaboration with a wide network of channel partners, Google has rapidly acquired customers across the banking and financial services industry (BFSI), manufacturing, and retail sectors and attracted startups through its Google for Startups Cloud Program.[99,100] Although a relatively late entrant, GCP doubled its market share in the past five years, and its AI push has contributed to attracting customers for its cloud services. Some of GCP's notable deals are detailed in Table 6.[101]

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93 Tech Mahindra. (2023, November 27). *Tech Mahindra launches a sports cloud platform built on AWS to provide an immersive fan experience globally, powered by AI, ML, analytics, and AR/VR.* https://www.techmahindra.com/insights/press-releases/tech-mahindra-launches-sports-cloud-platform-built-aws-provide-immersive/#:~:text=Built%20on%20AWS%2C%20the%20world's,technologies%2C%20enabling%20high%20volumes%20of

94 BFSI Network. (2023, November 27). *HDFC Securities launches HDFC SKY, a new trading app on AWS.* https://bfsi.eletsonline.com/hdfc-securities-launches-hdfc-sky-a-new-trading-app-on-aws/

95 Lele, S. (2023, October 11). AWS, govt join hands to advance healthcare with UHI, integrated records. *Business Standard*. https://www.business-standard.com/technology/tech-news/aws-govt-join-hands-to-advance-healthcare-with-uhi-integrated-records-123101100680_1.html

96 Amazon. (2024, June 28). *AWS India announces first-ever space accelerator to support 24 space-tech startups*. https://www.aboutamazon.in/news/aws/aws-indias-first-ever-space-accelerator

97 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

98 IBEF. (2021, July 16). *Google Cloud adds second cloud region in India in Delhi-NCR.* https://www.ibef.org/news/google-cloud-adds-second-cloud-region-in-india-in-delhincr

99 Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

100 Google Cloud. (n.d.). *Start and scale with the Google for Startups Cloud Program.* https://cloud.google.com/startup/apply?hl=en

101 Agarwal, H., & Lohchab, S. (2024, June 25). Google Cloud's AI push is winning clients: Thomas Kurian. *The Economic Times*. https://economictimes.indiatimes.com/tech/artificial-intelligence/google-clouds-ai-push-is-winning-clients-thomas%20kurian/articleshow/111246125.cms?from=mdr

Table 6: Major GCP Deals Across Industries (2022-23)

Industry	Description
BFSI	Google Cloud partnered with HDFC ERGO General Insurance to launch two superapps that leverage GCP's AI/ML capabilities for making personalised recommendations to customers.[102]
Retail	The National Cooperative Union of India (NCUI) collaborated with Google Cloud in 2023 to launch a dedicated e-commerce application.[103]
Health	GCP partnered with the eGov Foundation and state health departments to provide a cloud-based patient management platform for the establishment of Tele-ICUs in districts of Karnataka and Nagaland.[104]

Source: IDC[105] and media reports

Market Trends

Partnership Between Telcos and Hyperscalers

Another factor shaping the competitive dynamics of the Indian cloud services market is partnerships between Indian telecom giants and hyperscalers. In 2019, Microsoft entered a ten-year strategic partnership with Reliance Jio Infocomm for the co-development of customised, affordable cloud-based solutions particularly targeted towards SMEs and startups.[106] Key aspects of the partnership included Jio setting up data centres to deploy Azure platform, providing Microsoft Office 356 tools to its internal staff, migrating its applications to the Azure cloud, providing a tailored productivity and collaboration suite to SMEs, as well as other advanced technological offerings such as data analytics, AI, blockchain, Internet of Things (IoT), and edge computing.[107,108] A year later, Bharti Airtel announced a strategic collaboration with AWS to develop differentiated Airtel Cloud products and capabilities leveraging AWS services for its large enterprise and SME customers.[109] It also entered a partnership with Google Cloud the same year to offer G-Suite services (e.g., Gmail, Google Docs, Google Drive, Calendar) to SMEs as part of its integrated Information and Communication Technology (ICT) portfolio for businesses;[110] more recently, it deepened this

[102] Google Cloud. (n.d.). *HDFC ERGO case study.* https://cloud.google.com/customers/hdfc-ergo

[103] Bagchi, S. (2023, July 1). *NCUI taps Google Cloud to launch an e-commerce application for cooperatives.* Techcircle. https://www.techcircle.in/2023/07/01/ncui-taps-google-cloud-to-launch-an-e-commerce-application-for-cooperatives/

[104] Das, S. (2022, November 28). Karnataka govt launches remote ICU services in 41 state-run hospitals. *Mint*. https://www.livemint.com/technology/tech-news/karnataka-govt-launches-remote-icu-services-in-41-state-run-hospitals-11669642464966.html

[105] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

[106] Soni, Y. (2019, August 12). Reliance-Microsoft Azure to offer Jio-Azure cloud services for SMEs. *Inc42 Media*. https://inc42.com/buzz/reliance-microsoft-azure-to-offer-free-cloud-services-for-smes-startups/

[107] Microsoft. (2019, August 12). *Jio and Microsoft announce alliance to accelerate digital transformation in India.* https://news.microsoft.com/en-in/jio-and-microsoft-announce-alliance-to-accelerate-digital-transformation-in-india/#:~:text=The%20initial%20two%20datacenters%2C%20which,in%20calendar%20year%202020.

[108] Maheshwari, A. (2019, August 19). Microsoft and Jio: Accelerating India's digital progress. *Microsoft Blog*. https://blogs.microsoft.com/blog/2019/08/12/microsoft-and-jio-accelerating-indias-digital-progress/

[109] Airtel. (2020, August 5). *Airtel and AWS join hands to accelerate digital transformation of business in India.* https://www.airtel.in/press-release/08-2020/airtel-and-aws-join-hands-to-accelerate-digital-transformation-of-business-in-india

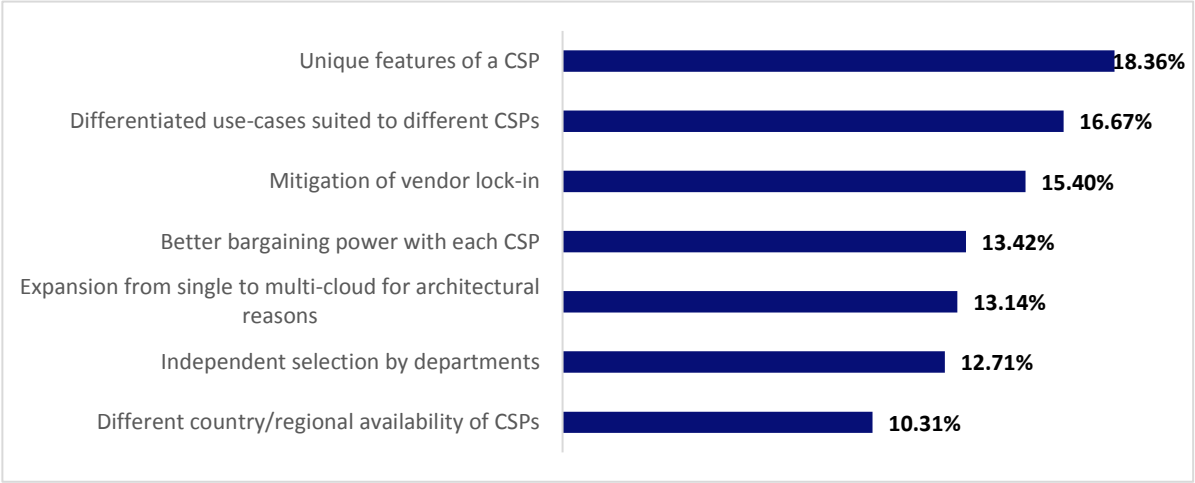
[110] Bharti Enterprises. (2020, January 20). *Airtel and Google cloud partner to boost collaboration.* https://www.bharti.com/press-release-2019-2020-airtel-and-google-cloud-partner-to-boost-collaboration.html

collaboration to leverage GCP's generative AI capabilities.[111] Thus, by harnessing synergies with dominant connectivity players, the hyperscalers have been able to gain direct access to their partners' enterprise customers, enabling them to rapidly expand their footprint in the Indian cloud market.

Increasing Multi-Cloud Adoption

Multi-cloud adoption has been gaining traction in India. As per an IDC survey of 160 enterprises, 42% reported deployment of multi-cloud strategy.[112] An estimated 80% of public cloud users have distributed their workloads over multiple cloud providers, with 33% using two cloud providers (organisations with 50-249 employees), 19% using three cloud providers (organisations with 500-999 employees), and 27% using four or more cloud providers (organisations with 5000+ employees).[113] This deployment strategy is driven largely by product differentiation, i.e., the need for organisations to leverage the unique features of different providers and their suitability for different use cases, followed by other key considerations such as the desire to mitigate vendor lock-in and gain greater bargaining power in price negotiations (see Figure 8).

Figure 9: Drivers of Multi-Cloud Adoption in India



Note: n=150

Source: IDC[114]

However, enterprises in India largely deploy a siloed multi-cloud architecture, hosting different customer datasets and applications on different clouds with minimal integration, as opposed to an integrated multi-cloud deployment, which involves mixing and matching of

[111] Airtel. (2024, May 13). *Airtel and Google Cloud enter into a long-term strategic collaboration accelerate cloud adoption and deploy generative AI solutions.* https://www.airtel.in/press-release/05-2024/airtel-and-google-cloud-enter-into-a-long-term-strategic-collaboration-to-accelerate-cloud-adoption-and-deploy-generative-ai-solutions#:~:text=May%202024-,Airtel%20and%20Google%20Cloud%20Enter%20into%20a%20Long%2DTerm%20Strategic,Google%20Cloud's%20AI%20technologies

[112] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

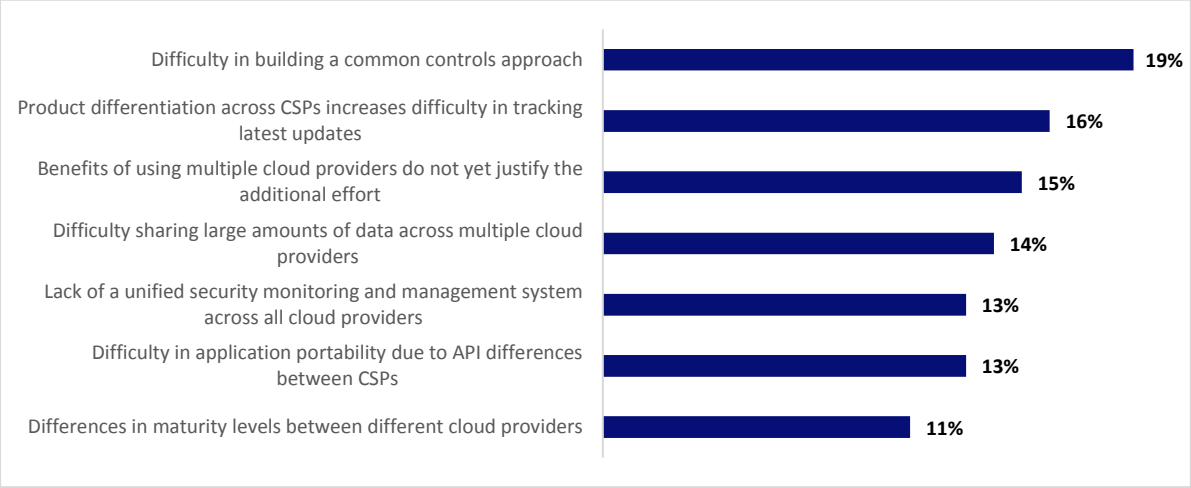
[113] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

[114] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

services across providers in a consolidated architecture. While this is partly due to technical challenges, it is also driven by the phenomenon of shadow IT, i.e., the independent procurement of cloud and other IT services by individual departments or business units within an organisation, based on their needs.[115] More importantly, lack of interoperability and other technical challenges limit enterprises' ability to seamlessly integrate the services of various CSPs which, in turn, reduces the scope for new players to compete for incremental workloads.

Difficulties in data and application portability resulting from differences in data formats and APIs are a challenge for enterprises (see Figure 9). For enterprises that host their data on one CSP and their applications on another, the integration of services across platforms is generally achieved by system integrators through the development of a customised integration layer. Some of the domestic CSP entrants in the market provide direct cloud connectivity to third-party cloud providers to enable customers to experiment with their services for some workloads while continuing most of their operations with their primary cloud provider.[116] This enables them to compete without requiring a complete switch from customers. Some level of integration between different cloud environments are also being enabled by larger incumbents. For instance, the R&D teams of Oracle and Microsoft have developed native integration between Oracle Cloud Infrastructure (OCI) and Microsoft Azure.[117] With regard to data migration, besides egress fees, networking charges and the possibility of data loss are some of the other challenges for enterprises. Multi-cloud implementation is also set back by other key technical barriers such as the lack of a unified platform for visibility, management and efficient monitoring of multi-cloud operations, and the lack of standardised security monitoring and management systems across providers.

Figure 10: Technical Challenges to Multi-Cloud Adoption for Enterprises



Note: n=160

Source: IDC[118]

[115] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[116] Shakti Cloud. https://shakticloud.ai/
[117] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.
[118] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC.

Nascent CSPs and Competition

New providers in the Indian market can only afford to provide limited cloud credits in terms of volume and duration. Some domestic CSPs provide these credits to a small network of existing long-term customers in adjacent data-centre businesses to incentivise them to try their proprietary cloud platforms.[119] The inability to compete on cloud credits can be a key barrier to customer acquisition for cloud startups, especially cloud-native startups. Hyperscalers enjoy a decisive advantage in the provision of such financial incentives that are also coupled with technical and business support programmes. For instance, AWS has various accelerator programmes, such as ML Elevate, that have accelerated over 105 AI startups in India through the provision of cloud credits of USD 100,000-200,000, along with curated mentoring sessions and networking opportunities with potential investors.[120,121] Similarly, Microsoft in partnership with 13 startup accelerators rolled out its BizSpark Plus programme that provided USD 120,000 worth of Azure credits for a year to shortlisted startups, along with its full suite of software development tools and marketing visibility through connections to key industry players.[122]

However, several domestic entrants are positioning themselves as cost-efficient alternatives to the hyperscalers, which is particularly relevant for the SMB segment. Certain customers of such players have reported cost reduction in the range of 30-70% upon migration of some of their workloads from larger providers.[123] Besides the amount, accurate estimation and forecasting of cloud costs from the services of hyperscalers is also a challenge for certain enterprises. This partly stems from a lack of comprehensive visibility into all the services that have been procured and the status of usage of these services, which makes it difficult to control cloud costs and sometimes results in the user incurring unexpected expenses.[124] In view of this, certain new entrants in the market are providing customised billing support to ensure better predictability and planning of cloud costs as well as regular personalised technical support for small and mid-tier enterprises that may find it difficult to obtain such level of engagement from larger providers.

Digital Public Infrastructure and Lateral Entry for Enhancing Competition in Cloud Computing

In India, Digital Public Infrastructure (DPI) is being increasingly adopted in areas such as digital payments, e-commerce, and e-health to overcome the interoperability challenge and ensure the improved aggregation of demand and supply through the use of open-source technologies. This paradigm is now being explored in the cloud computing space through the Open Cloud Compute (OCC) project. OCC seeks to combine DPI and edge computing

[119] Stakeholder interview.
[120] Basu, I. (2023, April 5). AWS ML Elevate 2022 charts the roadmap for AI/ML startups to build and scale. *YourStory*. https://yourstory.com/2023/04/aws-ml-elevate-2022-charts-aiml-startups-roadmap
[121] ML ELevate 2023. (n.d.). *Frequently asked questions.* https://www.mlelevate.com/faq
[122] Microsoft. (2016, December 5). *Microsoft announces BizSpark Plus program for startups in India.* https://news.microsoft.com/en-in/microsoft-announces-bizspark-plus-program-for-startups-in-india/
[123] Stakeholder interview and website testimonials.
[124] Ranjan, R. (2024, June). *Indian cloud market analysis.* IDC; Stakeholder interview

paradigms to build an open and interoperable network of cloud providers of various sizes. By linking and combining underutilised storage and computing capacity at the edge and providing a set of standard interfaces for onboarding on the network, OCC could improve competition at the margins by shifting some workloads from the centralised computing model that involves mega data centres to independent micro-data-centre providers, improving the visibility of new entrants to a wider potential customer base who may looking for cheaper alternatives and ensuring the mitigation of lock-in into proprietary ecosystems of incumbents.

Competition Issues Identified Through Stakeholder Consultations

This study included a series of consultations with cloud computing stakeholders, including hyperscalers, domestic CSPs, enterprise users, cloud advocacy organisations, and cloud DPI proponents.

The major issues related to the competitive landscape that emerged from discussions with domestic CSPs is that the market is heavily tilted in favour of the incumbent hyperscalers. Market conditions are such that the demands of enterprise users, especially large ones, are almost non-contestable due to a large number of barriers to entry.

Large enterprises are afraid of data loss during migration of data from a hyperscaler to a smaller cloud provider. There are also doubts about the sufficiency of data-security protocols of smaller providers. Domestic cloud providers across the spectrum, from startups to billion-dollar enterprises, reported that it is difficult to overcome the reputational advantage and perceived reliability of hyperscalers among enterprise customers. A larger developer pool is also available for hyperscaler clouds, which makes app development and deployment easier. Large enterprises also prefer hyperscalers due to the latter's prompt and high-quality technical support, which smaller providers may not be able to match. Certain hyperscalers were also reported to provide complimentary services such as productivity and AI applications with their cloud services.

On the other hand, enterprise users pointed out that domestic CSPs are not necessarily cheaper, since large enterprises have the bargaining strength to negotiate large discounts with hyperscalers. In essence, the competition in the Indian cloud market seems to be stratified with large enterprise customers being catered to almost exclusively by hyperscalers and domestic providers targeting small and medium businesses who are not the core focus of hyperscalers. Further, small enterprises might also choose hyperscalers due to certain constraints; for example, unlike hyperscalers, a domestic cloud provider may not have the pre-built pipelines to enable a variety of services and would need to employ a dedicated engineering team.

The financial practices of hyperscalers such as cloud credits can make it difficult for competitors to challenge the entrenched dominance of hyperscalers even when it comes to a new user. From the perspective of a startup, utilising hyperscaler cloud credits reduces

infrastructure costs to zero and allows engineering teams to use tools and platforms that they are already familiar with. Nascent domestic cloud providers expressed their inability to compete with the financial incentives of hyperscalers such as cloud credits. Larger domestic providers also expressed concerns that resource-constrained small and medium enterprises enter hyperscaler clouds mainly due to cloud credits and get locked in for reasons such as egress fees, limited interoperability, and difficulty in porting applications.

The extensive on-ground partner ecosystem of hyperscalers is also a major advantage for them in gaining trust and driving adoption among enterprise users. System integrators can influence the cloud-purchasing decisions of enterprises in favour of hyperscalers. Further, by harnessing synergies with dominant telecom players Reliance Jio and Bharti Airtel, hyperscalers have been able to gain direct access to millions of enterprise customers, enabling them to rapidly expand their footprint in the Indian cloud market. Interestingly, some stakeholders pointed out that the public-sector digital transformation driven by large global consulting companies tends to promote hyperscalers.

Domestic cloud providers are pursuing a variety of strategies to counter the competitive advantages of incumbent hyperscalers. Some domestic data-centre firms[125] have transitioned to CSPs. For such firms, the barriers to entry are significantly lower as they do not have to make large investments in real estate and computing capacity to enter the market and can instead utilise the assets from the data-centre business. For the most part, domestic providers seek to counter the pain points faced by the customers and project themselves as distinct in these aspects.

Most domestic cloud providers offer lower prices than hyperscalers; some domestic providers claimed that their customers have been able to reduce cloud costs in the range of 30-70% in comparison to hyperscalers. Domestic providers use financial tools such as a billing matrix or increased transparency to differentiate themselves from hyperscalers, where users reportedly face cost shocks. Most smaller cloud providers claim to offer around-the-clock personalised support by a human support representative to small and medium customers as well, which would not be possible for hyperscalers. Therefore, the value proposition of domestic cloud providers vis-à-vis hyperscalers lies in providing more flexibility to enterprises in how they design their cloud architecture.

While most domestic cloud providers are attempting to distinguish themselves from hyperscalers, some are emulating hyperscalers. Some domestic cloud providers are attempting to acquire customers through cloud credits and committed spend discounts, although this is being done in a targeted and limited manner. Other domestic cloud providers[126] have also started their own marketplaces for third-party apps to be deployed on their cloud, similar to hyperscaler-owned cloud marketplaces. Additionally, some domestic

[125] For instance, Yotta. https://yotta.com/
[126] For instance, Yotta's Shakti Cloud marketplace. https://shakticloud.ai/marketplace.html.

cloud providers are pursuing niche markets where they have an inherent advantage or which are too small to be of concern to hyperscalers, such as connectivity for trading exchanges that require specific protocols or guaranteeing data storage within the sovereign territory of a country to meet legal and data-security requirements. Some domestic cloud providers are heavily focused on AI services, as even large enterprises are willing to try out the niche services of startups in the AI cloud where innovation is being led by startups and niche markets are yet to grab the attention of hyperscalers.

The lack of interoperability between cloud services has been cited as a major reason for limited competitive pressure on hyperscalers from other cloud providers. Currently, there are no standard APIs or specifications in cloud services to enable native interoperability between cloud providers. However, API management systems and integration middleware can be stacked on to the native interface of cloud providers to ensure interoperability and enable a multi-cloud deployment that takes advantage of the unique capabilities of each hyperscaler. Even then, all the data required for one function (e.g., data analytics or app development) needs to be maintained in the same cloud to reduce latency and data-migration costs. Even if data and applications hosted on different clouds can interact, application components would need to be reconfigured when porting an application from one cloud provider to another. Finally, although there are no technical difficulties in data migration from one CSP to another, significant data-transit fees need to be paid for lift-and-shift scenarios, where a workload is shifted from one cloud to another. Complementarities in the businesses of players like Oracle and Microsoft have enabled in-built interoperability in certain services, although most services are not interoperable across providers.

There are several other barriers to multi-clouding beyond interoperability. Multi-cloud implementation is also set back by other technical barriers such as the lack of a unified platform for visibility, the management and efficient monitoring of multi-cloud operations, and the lack of standardised security monitoring and management systems across providers. Enterprises utilising multiple services from one cloud provider are often locked into that environment due to technical factors such as the complexity of porting and losing advanced capabilities of their primary cloud provider on the portion of their workload that is hosted on another cloud. Multi-clouding would also require additional technical capabilities within the enterprise as well as developers to deploy applications across multiple environments.

Finally, the structure of businesses itself can be a barrier; different business units of an enterprise need to exchange data, and these would incur high data-migration costs in a multi-cloud scenario. Therefore, it was reported that large enterprises consider only hyperscalers when multi-clouding for generalised requirements. On the other hand, small enterprises are hesitant to distribute their workload among multiple cloud providers due to technical complexities and cost concerns. Therefore, in the current scenario, most enterprises end up choosing to multi-cloud among hyperscalers or choose a hybrid cloud deployment of a public cloud provider and a dedicated private cloud.

Another issue was cost shocks faced by hyperscaler cloud users. The unpredictable costs could stem from a lack of comprehensive visibility by the enterprise into all the services that have been procured and the status of usage of these services. While domestic providers highlighted cost shocks faced by hyperscaler customers and their value proposition of predictable costs, the views of enterprise users were mixed. Some enterprise users have experienced significant cost escalation due to various factors such as the scale up of applications, technology upgrades, and enhancements in security features. Other enterprise users expressed the contrary view that cost shocks can be avoided through cloud usage planning, forecasting future demand, incorporating cost monitoring tools into the cloud framework, and regularly monitoring costs by the cloud team of the enterprise. This implies that cost shocks can be attributed to improper planning and poor usage governance by cloud users. Meanwhile, certain policy organisations expressed the view that there is significant cost unpredictability with hyperscalers, even in regular use, especially due to egress fees when switching providers. The stakeholders also expressed diverse views regarding the future competitive landscape of the cloud computing market in India. Certain cloud providers are predicting that the competitive landscape will undergo a transformation and that the domination to the hyperscalers will be challenged when centralised cloud computing will give way to distributed computing and edge computing. Other cloud providers stated that a consultative policymaking framework, such as the one in the Indian telecommunications sector, is required for the Indian cloud computing industry. Policy organisations are also advocating for a paradigm shift based on decentralisation, such as through a DPI platform that can be used to unite numerous independent providers on a single network to enhance their discoverability and utilisation and lead to more competitive market outcomes.

7. Conclusion

Competition concerns about the cloud computing market primarily relate to the potential for incumbent global technology companies to expand their ecosystems and entrench their dominance. The three hyperscalers—Amazon, Google, and Microsoft—accounted for 33% of global public cloud revenue in 2023. The Indian public cloud services market was estimated at USD 7.51 billion in 2023. Going forward, the growth of the market is expected to have a significant impact on the Indian economy, with an expected contribution of around USD 310-380 billion by 2026 (amounting to ~8% of GDP) and 14 million new jobs. Inherent characteristics of the cloud computing market such as economies of scale, network effects, vertical integration, and conglomerate effects may reinforce the dominance of hyperscalers.

Anti-trust interventions based on a deeper understanding of the cloud market may be the first step to correct any market failures. Leading competition authorities such as the US Federal Trade Commission, UK Competition and Markets Authority, and French Autorité de la concurrence have undertaken market studies on the cloud market to identify areas of concern. Some of these market studies and academic literature have highlighted practices such as egress fees, committed spend discounts, licensing restrictions, tying, and hyperscaler-

owned cloud marketplaces to be potentially problematic. The European Commission has raised concerns that, since April 2019, Microsoft has been tying Teams with its core SaaS productivity applications, thereby restricting competition in the market for communication and collaboration products and defending its market position in productivity software and its suites-centric model from competing suppliers of individual software. It is estimated that Microsoft's policy of offering additional compute facility when the SQL Server software is hosted on the Azure cloud led to an estimated overcharge of 1 billion euros between 2019 and 2022 from SQL Server users who did not shift to Azure cloud.[127]

Several practices of incumbent CSPs identified over the course of the study pose competitive concerns and merit scrutiny by the Competition Commission of India. Committed spending discounts offered by CSPs are essentially retroactive rebates[128] which require investigation into whether they are being offered with exclusionary intent. These discounts lock in customers for a specific period and incentivise single-sourcing, thereby concentrating cloud spending and potentially reducing competition for incremental workloads. Moreover, as these discounts are, at times, also tied to spending on the marketplaces of hyperscalers, they reinforce network effects and may hinder third-party apps from moving to competing marketplaces developed by nascent domestic CSPs. This is because committed spend discounts significantly alter the competitive dynamics of incremental workloads as the user has to decide between the price benefit offered by a competitor on the marginal demand and the committed spend discount on total demand if the spend is kept with the incumbent. Similarly, the almost non-existent interoperability between different native CSPs in the absence of customised enabling digital infrastructures such as middleware and data pipelines is tantamount to a refusal to deal. CSPs do not have any incentive to provide interoperability as it will increase competitive constraints on them. In the absence of interoperability, the requirement for configuring and managing middleware and data pipelines discourages most small users from multi-clouding.

Microsoft and Amazon have captured around 42% of the Indian public cloud market, with all other competitors having market shares of less than 5% each. The IaaS layer of the Indian cloud computing stack is most concentrated with the top three vendors which, taken together, account for 87% market share in 2023. While other cloud service providers differentiate themselves from hyperscalers in terms of cost-efficiency and personalised support, certain business practices of hyperscalers create technical and financial barriers to switching and multi-clouding. On the technical side, limited interoperability and restrictions on the portability of data and applications due to the use of proprietary APIs lead to vendor

[127] Jenny, Pr. Frédéric. (2023, June 21). *Unfair software licensing practices: A quantification of the cost for cloud customers*. CISPE. https://cispe.cloud/website_cispe/wp-content/uploads/2023/06/Quantification-of-Cost-of-Unfair-Software-Licensing_Prof-Jenny_-June-2023_web.pdf

[128] Retroactive rebates typically involve a sales threshold and a discount being granted on the entire sales volume (including past sales) if the threshold is reached or exceeded. They differ from incremental rebates, which involve discounts on sales exceeding a predetermined threshold, but not on sales beneath the threshold.

lock-in. On the financial side, cloud credits and committed spend discounts have emerged as significant barriers.

The study team conducted a series of stakeholder consultations among hyperscalers, domestic CSPs, enterprise users, and cloud advocacy organisations to situate the theoretical findings within the realities of the Indian cloud computing market. The key finding was that competition in the cloud computing market is occurring in a stratified manner. Enterprise users invariably choose hyperscalers citing factors such as reliability, technical support, larger ecosystem of apps and app developers, data security, and the ability to obtain competitive prices through bargaining. Even large technological companies that are transforming themselves into full stack CSPs are facing severe challenges in convincing enterprise customers to shift workloads away from the hyperscalers. On the other hand, small startups and businesses, which are not deemed significant customers by hyperscalers, choose nascent cloud startups for their competitive pricing and personalised support, which hyperscalers do not provide to smaller customers. Therefore, domestic providers appear to be competing at the margins by targeting customers who are not prioritized by hyperscalers.

Another key insight was the divergence regarding the issue of sticker shock in relation to cloud computing costs. While this was a major problem among smaller providers and consumer organisations with hyperscalers, several large enterprises did not find this to be a major issue. This divergence could be due to the greater bargaining power as well as financial and technical prowess of larger enterprises, which allow them to understand pricing structures, ensure accurate usage planning, conduct better forecasting of future demand, and establish efficient usage governance structures to avoid superfluous consumption.

Several stakeholders pointed out that partnership ecosystems—be it in the form of a network of system integrator partners or strategic partnerships with other infrastructure providers like telecom companies—have enabled hyperscalers to rapidly expand their footprint in the Indian cloud market.

Finally, ecosystem participants cite differing visions for a more competitive Indian cloud market, including a shift away from centralised cloud computing to edge computing and the creation of a DPI for cloud computing that can enhance the discoverability and utilisation of micro data centres.

In such a competitive landscape and the absence of policy interventions that enable a more balanced and competitive outcome, it would be difficult for the Indian cloud computing ecosystem to flourish and enable domestic innovation. As markets invest in more compute capacity to meet the growing demand, it becomes increasingly important to examine and restructure the market.[129] It is also important to reiterate that the benefits of a competitive

[129] Palchaudhuri, S., Lall, T., Bhojwani, T. & Varma, P. (n.d.). *Creating open, innovative compute markets: The DPI way.* Open Cloud Compute (Concept Paper). https://docs.google.com/document/d/1ZZd3d8CDu4qcZlrr_b3WW9QGVO-IPl2Ztph_8iQKlkc/edit#heading=h.yr89xd4hjwrq

cloud ecosystem do not accrue to enterprises alone; an enterprise invariably passes on its costs to consumers through pricing, and lower cloud costs for Indian enterprises would trickle down to Indian consumers through reduced prices. Further, IT and IT-enabled services are key exports of India, and lower loud computing costs would also make these exports competitive. Cloud services have been listed as one of the core digital services for ex-ante regulation of systemically significant digital enterprises (SSDE) under India's Draft Digital Competition Bill, 2024, likely in recognition of the growing importance of cloud services and the potential for anti-competitive conduct therein to tip markets in a manner that cannot be remedied by ex-post intervention.

In addition to existing regulatory initiatives, there is a need for increased policy impetus for true interoperability among CSPs to ensure greater competition in the market. When CSPs are fully interoperable, multi-clouding becomes easy, and CSPs would pose a greater competitive constraint to each other as users would not be locked into any particular cloud ecosystem. There are several benefits to a multi-cloud approach, such as optimally combining the services of multiple providers based on cost, speed, scalability, and enabling redundancies. There has been increasing multi-cloud adoption among Indian enterprises, with 80% of firms in an IDC survey reporting that they used multiple cloud providers. However, enterprises use a siloed multi-cloud architecture with minimal integration between cloud providers. Lack of interoperability between different cloud providers was cited as the primary reason for the inability to seamlessly integrate the services of different cloud providers.

In parallel to making existing cloud computing ecosystem function better, alternatives such as decentralised cloud computing need to be supported and nurtured to create a viable alternative to hyperscaler-driven cloud computing for the developing world. The OCC project aims to decentralise and expand computing infrastructure by connecting cloud providers of various sizes through open and interoperable APIs. A decentralised network that connects smaller providers would ease entry and create incentives for improving technical synergies between providers, potentially reducing lock in to proprietary ecosystems. This could help be more cost-efficient and facilitate more customised solutions in addition to enhanced security and reliability from a distributed network vis-à-vis centralised data centres. While it cannot be said with certainty that OCC or any other decentralised network might become the preferred service provider for enterprise users, an open and decentralised architecture holds immense potential to unlock cloud computing access for individual users and small businesses.

Finally, cloud computing is important to address the needs of today as well as the future. Computing capacity, or compute, is one of the fundamental components of large AI systems, the others being algorithmic innovation and vast datasets. Computing capacity is also one of the most difficult elements for smaller businesses to set up in-house as it can take hundreds of millions of dollars' worth of compute to train an AI system. Unlike previous technological

revolutions, India has embraced the AI revolution at the same time and with the same intensity as the rest of the world. However, affordable and accessible cloud computing capacity is a prerequisite for India to emerge a leader in the next “industrial” revolution. We need creative strategies beyond digital regulation to combat the concentration of market power among hyperscalers and provide open, sustainable, and effective cloud access to Indian innovators and industry. The ability of cloud providers, particularly non-hyperscalers, to position themselves on these technological challenges could help overcome some of the identified barriers to entry and expansion. Enabling cloud computing innovation, which serves interests beyond the commercial gains of Big Tech, requires public-good investments in digital infrastructure and models that have the capability to scale and support decentralised computing power.

Our Offices:
4th Floor, Core 6A, India Habitat Centre, Lodhi Road, New Delhi-110003

The Isher Building, Plot No. 16-17, Pushp Vihar, Institutional Area, Sector 6, New Delhi-110017

O: +91 11 43112400 / 24645218, **F**: +91 11 24620180 | **W:** https://icrier.org/ipcide/ | **E:** ipcide@icrier.res.in