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What Is Consolidation?
Consolidation in the Internet Economy

The Internet economy, as understood in this report, is broadly defined as the economic activities that either support the Internet or are fundamentally dependent on the Internet’s existence. This section presents an overview of current trends of consolidation in its affiliated markets, including growing forces of concentration, vertical and horizontal integration, and fewer opportunities for market entry and competition. The purpose is to give an overview of different markets, and to provide the analytical basis for the following sections that look closer at how these trends may influence the Internet’s evolution.

Organised around three separate but closely linked economic domains (Internet Applications; Access Provision; and Service Infrastructure) this section is intended to provide a snapshot of various markets, and to describe how they relate to the Internet as a whole. As such, it is not intended to provide an in-depth economic analysis, nor is it exhaustive in terms of encompassing all relevant markets and services. Rather, it provides a starting point for further discussion.

Internet Economy

The Internet economy, as understood in this report, is broadly defined as the economic activities that either support the Internet or are fundamentally dependent on the Internet’s existence.

The technology sector is different than other sectors as there are numerous relevant markets having multiple sides, each with specific competition dynamics. This makes the delineation of relevant market difficult. Further, markets are such that given market at one point in time mutates into another through the exploitation of complementarities.

—Payal Malik, Economics Adviser and Chief Economist, Competition Commission of India, Future Thinking, November 2018
Internet Applications

Applications and services shape the experience of Internet users and enable them to communicate, share, and innovate. From search to storefronts to messaging to travel and more, actors in this layer of the digital economy vie for the eyes, minds, and wallets of the Internet user. Today, a small number of companies operating some of the Internet’s most popular services dominate this market. Many of these companies act as multi-sided markets or platforms, meaning they offer a base upon which other applications, processes, or technologies can be developed. Value is created through this base by matching customers with complementary needs, examples of which include developers with users, drivers with passengers, or advertisers with consumers.¹

"One-stop shops"

The top 5 companies in the application layer today are Alphabet (parent company of Google), Amazon, Tencent, Facebook, and Alibaba:²

• Facebook and Google have been estimated to account for 84% of global digital advertising investment (excluding China).³

• In 2018, it is expected that Amazon accounted for 49.1% of all online retail spending in the US⁴. Similarly, Alibaba is estimated to have close to 60% of the e-commerce market in China.⁵

• Google alone holds 90% of the global search market⁶, over 60% of web browsers⁷, the number 1 (by far) mobile operating system (Android)⁸, the top user-generated video platform (YouTube)⁹, and has more than 1.5 billion active users of its email service (Gmail)¹⁰.

• Facebook – incorporating Facebook Messenger, WhatsApp, and Instagram – dominates social media and messaging globally¹¹; holding 4 of the world’s top 6 social media platforms.

• Tencent owns WeChat, China’s biggest social media platform, with more than 1 billion monthly active users¹². Tencent’s stable of platforms, including QQ, WeChat, and various Tencent-branded social media and content offerings, demand almost 4 times as much user attention on smartphones as Alibaba and Baidu combined¹³.

These global tech companies build digital environments that comprise multiple platforms across a diversity of spaces, and are thus often described as digital conglomerates or digital giants¹⁴. They are largely present in the application layer of the Internet, although they increasingly offer cloud services and infrastructure, as we will explore further below. They are not just the biggest companies on the Internet; they are some of the most valuable companies in the world.

Digital platforms tend to be two-sided markets, meaning they develop useful online spaces or platforms. On one side, people acquire desired products and services, and on the other side, businesses can find customers. These platforms gain market share in their respective markets due to data control and network effects (where the service’s value to the user increases with the number of other users).

Footnote References for Section 5 of the report are listed on pages 31 and 32.
54.5% of our survey respondents saw users in their region having a limited choice of applications and services.

Where data is concerned, companies use the openness and cross-border nature of the Internet, along with valuable data about their customer base, to match customers with products and services, and to continuously improve such offerings. The more customers using a service, the more data they generate for the platform. Platforms use data they collect across a range of devices and services to target advertising, generate extra revenue streams from data analytics, improve their offerings, and evolve strategies for moving into new services and markets. Platforms also increasingly use data to feed artificial intelligence (AI) processes designed to anticipate people’s purchasing and other behavioural patterns.

Network effects are also central to the value and power of these platforms. The more people use a marketplace like souq.com or a communications app like WhatsApp, the more valuable and attractive it is to current and prospective users. Some platforms open up a limited set of application programming interfaces (APIs) and software development kits (SDKs) to enable external developers to build on a particular functionality or sell to users via the platform (e.g., Google Maps or Apple’s App Store). These two-sided markets link innovators and customers while adding value and a stream of innovation to the platform itself.

Platform companies are also effective at attracting and retaining customers because they use their resources – and the data they continue to gather – to provide and continuously improve a one-stop shop. This means that based on what data shows about potential user preferences and needs, platform companies add features that address and test user desires. And data about projected user needs and preferences also guide their acquisition (or replication) of novel and potentially competitive services. For example, Facebook acquired WhatsApp and Instagram in order to maintain leadership in the social messaging and photo sharing markets.

Like the oil barons at the turn of the 20th century, the data barons are determined to extract as much as possible of a resource that’s central to the economy of their time. The more information they can get to feed the algorithms that power their ad-targeting machines and product-recommendation engines, the better.

— MIT Technology Review, 2018

At the core of the platform-user relationship is often the platform’s drive to keep extending user time on the platform and deepening their engagement. Platforms retain customers through a virtuous cycle: data that is generated through the use of applications and services feeds the data engine, which in turn creates a better and more tailored Internet experience. This keeps the customer engaged and on the platforms, which generates further data, and so on.

Move fast and leverage dominance

The platforms’ dominance in their original domains or markets enables them to rapidly extend into others. Amazon and Alibaba run e-commerce platforms, but also offer cloud platforms. Google’s search platform provides most of the company’s current revenue, via advertising, but its parent organisation, Alphabet, owns an ever-widening array of companies.

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Larry Page, CEO
Sergey Brin, President
Eric Schmidt, Chairman

Alphabet

Access & Energy
Craig Barret
Energy and internet access - including “fiber”, which provides low-cost broadband.

Verily
Andy Conrad
Healthcare and disease prevention research. Formerly Google Life Sciences.

Calico
Arthur Levinson
Research into longevity. Formerly Genentech’s founder.

nLab [ ]
Dan Doctoroff
Urban innovation. Solves city problems.

[Google[X]
Sundar Pichai
Chief Executive Officer of “Other Bets” products and services.

G/]
Andre Teller
Sundar’s “handpicked” and autonomy projects.

[Google capital]
[Google Self Driving Car Project]
John Krafcik
Self-driving cars. It will reportedly become an Alphabet company in 2018.

Replicant
Robots. Originally a separate Alphabet company, it is now included.

[PROJECT LOON]
[Project Wing]
[Project Titan]
[Google Self-Driving Car Project]

NOTE: The list of Google departments is non-exhaustive, as is the list of Google X projects - because they're so secretive.

Similarly, Alibaba and Tencent have diversified into new areas. 

**NOTE:** The list of Google departments is non-exhaustive, as is the list of Google’s projects, because they’re so sensitive, according to sources. As of March 2019.

*Forbes (2019).* Who Can Go the Distance in Alibaba and Tencent’s Battle For Southeast Asia And India? Available at: https://www.forbes.com/sites/traceyakovlev/2019/03/19/alibaba-and-tencent-re-for-demand-in-southeast-asia-and-india/#8c4d4f354f64.
Like Alphabet, Alibaba and Tencent have expanded well beyond their initial core service. The diagram shows merely a selection of their interests across multiple industry sectors. For example, the Alibaba group owns multiple online market places including Lazada and also Taobao, a consumer-to-consumer platform with more than 600 million active monthly users. Baidu, another large Internet company operating mainly in China, runs China’s largest search-engine, owns multiple content, advertising and app services, and also leads the Apollo Project, a leading autonomous driving and AI project.

**Streaming, mobile, and voice**

Across the platforms, content is driving online experiences, from YouTube to Amazon Prime to Twitch, Spotify, Netflix and India’s Hotstar. Gaming is growing, especially on mobile devices, and game-streaming services like Twitch respond to the 18 to 35-year-old gamer demographic, who tend to spend more time watching other people play video games than they do watching traditional sports on television. In the UK, people already spend more leisure time online than they do watching television. Streaming video and gaming on mobile devices is changing the usage and content viewing behaviours of mobile customers and is one of a number of drivers bringing about mergers in the communications, media, and content industries.

Driven by content, mobile is estimated to account for more than half of all web traffic and is still growing. Mobile apps are thriving, and expected to reach a total of 258 billion downloads valued at $157 billion (USD) in 2022. Additionally, people are increasingly using voice to interact with devices and software, especially through the use of smart assistants and devices such as Amazon’s Alexa, or Google Assistant, which powers Google Home, a smart-home Internet of Things (IoT) platform.

**Overall trends**

Consolidation in markets at the application layer currently appears to be centred around a relatively small number of firms, predominantly from the US and China. Users and businesses benefit from this trend because they enjoy the convenience and markets that these platforms provide. The same companies are also expanding their operations into new markets through acquisitions and new product developments, further expanding their ownership to an even broader set of services that will shape users’ Internet experience.

The Internet is growing and shrinking at the same time: users and traffic are both increasing, but most of the interactions are with a smaller number of dominant one-stop-shop players. This raises a question: How will the increase in time spent online, combined with the extension of the application layer into domestic and public life (e.g., smart homes), impact the Internet and its users?

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Facebook was one of four companies (along with Google, Amazon, and Apple) that dominated the Internet; the combined value of their stock is larger than the G.D.P. of France.

— The New Yorker, September 2018

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I think the world we live in now is too often one in which investment in start-up companies is geared towards reaching the point where they can be sold to one of the existing big players rather than grow into a big and independent enterprise itself. This is a challenge for me and for others because we grew up with an Internet where today’s big company is going to be tomorrow’s second tier.

— Chris Riley, Director, Public Policy, Mozilla, Future Thinking, August 2018
Access Provision

Access to the Internet enables users to connect to information and communication technologies (ICTs) across the globe. **Physical access** is measured using metrics like availability, quality, and price of connectivity and services. Access and Internet adoption are both influenced by factors that are less easily measured and often deeply entrenched in societies, including levels of education (which tend to impact digital literacy skills), income levels (which impact the cost and affordability of broadband and devices), infrastructure development (especially in rural areas), the availability of relevant content (which impacts whether people want to gain access), and various cultural and structural factors which may impact adoption.

Supply side consolidation

To gain access to the Internet, users interact with providers on the supply side of access provision, chiefly mobile Internet or fixed broadband operators. National and regional circumstances vary greatly and have a significant impact on consolidation trends in the access layer in a specific region, making it difficult to identify a widespread trend of consolidation in the access market. But in certain markets, the access market is dominated by a small number of suppliers. Where this is the case, such dominance tends to be driven by certain structural factors like high fixed costs and significant barriers to entry (often for regulatory reasons), which often means that providers need significant scale to become and remain commercially viable. This need for economy of scale, encapsulating the ability to offer a lower price than that of most competitors, can naturally lead to consolidation. There is also evidence that some markets that were liberalised from historic governmental monopolies are again becoming consolidated, sometimes leading to higher prices.

**Trends:** Developed markets are experiencing a trend towards consolidation by dominant operators, with several instances of markets with 4 mobile operators moving to 3, via mergers. Access providers face lower prices for data transport, a maturing subscriber base, competition between fixed and mobile that is driving down prices, and the erosion of voice and SMS revenues by Voice over IP (VoIP) or IP-based instant messaging (IM) services. In response, some large access providers are moving into other layers by purchasing or allying with media, IT services, or software companies, and merging with other operators.

Some access providers are responding to the challenges of lower prices, infrastructure investment, and the erosion of revenues by sharing infrastructure. Sharing towers, masts, and ducts can reduce costs, ensure coverage, and still promote competition. This has proven successful in the highly regulated markets of the UK, Poland, and Romania. Other responses include ventures into other businesses and layers, such as operators purchasing digital media, IT services, or software players with an eye toward vertically or horizontally expanding into sectors that could, over time, become parts of their core business.

"With the mobile market in developed economies nearing saturation point, technology giants such as Google, Facebook and Amazon are turning to large and fast-growing markets in Asia and Africa..."We think the future of the internet looks like the next billion users,” says Josh Woodward, a product manager at Google, whose team looks at future trends in smartphone use.

— The Guardian, September 2018

Spectrum – cash cow or country enabler?

Mobile providers need allocations of radio spectrum to give users wireless access to the Internet. Access to affordable spectrum is therefore a foundational principle for ensuring access to ICTs and future network development; however, wireless access networks could be hampered, especially in...
developing countries, by the lack of optimal and affordable spectrum.42

When governments decide to use spectrum auctions to generate revenue, incumbents tend to prevail over potential new entrants.43 This is at least partly because auctions often fail to attract new entrants into the market when reserve prices are set too high or when the amount of spectrum on offer is too limited.44 In Ghana and Brazil, auctioned spectrum for 4G has gone to incumbents and market concentration has increased.45 Governments, however, may deliberately incentivise the creation of new market entrants. In some cases, those new entrants may be purchased by incumbents further down the line.

**Trends:** Incumbent operators already had first-mover advantage by occupying the optimal parts of existing spectrum allocations. Instead of attracting new entrants to diversify markets, spectrum auctions may be helping dominant players gain even more market share by only making it feasible or attractive for them, and not for new entrants, to participate in competitive bids.

**For many users,**

**Facebook is the Internet**

Three billion people are currently unconnected to the Internet, a little less than half of the world’s population.46 There are still significant gaps between developed and developing regions, urban and rural, men and women, wealthy and poor, young and elderly, and literate and illiterate people.47 Quality, price and availability of both fixed and mobile broadband services vary greatly between countries and regions.48 That said, some approaches to connecting the unconnected may risk locking users into current application platforms and exposing users only to a limited version of the Internet.49

Developed country users largely enjoy higher bandwidth, faster connections, and lower latency, thanks to peering between networks and locally hosted content.50 While most developed countries have near-universal fixed networks to support the widespread introduction of broadband, in Africa, for instance, fixed line networks reach barely 1% of the population.51 Although the total number of mobile phone subscriptions globally is greater than the number of people on Earth, many people in developing countries still do not use a mobile phone.52 And when the unconnected do gain access, such access may not be of adequate quality or low enough cost to be meaningful to them.53

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This phenomenon is particularly evident, considering data recently released by the Brazilian Institute for Geography and Statistics (IBGE 2018), showing that the most popular activity among Brazilians Internet users is the utilisation of applications aimed at exchanging messages, such as WhatsApp and Facebook, with 94.5% of Brazilians stating that they use the Internet primarily for this purpose.

— Regional panel input - FGV Brazil

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78% of our survey respondents identifying as belonging to the “Business” stakeholder group agree that there is a trend of consolidation in the Internet Economy.

Providing access via a walled gardens of content gets users online and could drive demand for a wider range of what the Internet offers (i.e., outside walled gardens). For example, Facebook’s Free Basics – a partnership with mobile network operators – gives users in more than 60 developing countries free access to content curated by Facebook, including news, employment, health, and local information.54 But while these services are technically free, as no money is exchanged, users could be confined to one company’s platform, as many users cannot afford the costs of accessing data from other services or are simply unaware that other services are available.55 On the other hand, zero-rated initiatives can offer
useful ways of serving areas and populations that have traditionally been underserved for profitability reasons. A study conducted in Ghana, Kenya, Nigeria, and South Africa found that zero-rating cannot only provide a gateway to the Internet for first-time and price-sensitive users, but when the practice is adopted by non-dominant mobile network operators, zero-rating can enhance competition.\(^{56}\)

**Overall trends**

To summarise, different market maturity levels, regulations, and institutions in each country significantly impact competitive market structures for access provision and how open they are to new entrants. These factors make it difficult to discern overall global trends of consolidation. Although national conditions vary, traditional access providers face pressure, particularly with the continued growth of mobile, a rising demand for data, and decreasing profit margins. In response, some operators share infrastructure, find ways to better use available spectrum, form strategic alliances and mergers and acquisitions, and seek higher returns in adjacent markets such as content and services. Examples of these actions include operators purchasing digital media, IT services or software players, with an eye toward vertically or horizontally expanding into sectors that could, over time, become parts of their core business.

At the same time, while platform-driven efforts to connect the unconnected are being driven by narrower interests than may be compatible with the porous and collaborative nature of the open Internet, the impact on local innovation and opportunity is unclear.

This raises questions about whether the access provision domain almost intrinsically tends to dominance due to the impact of economies of scale and other operating factors, and whether the entry of digital actors traditionally operating in other Internet domains (e.g., the app layer) might improve competition within 1 layer, while only entrenching their overall dominance cross-domain.

While the access markets differ considerably across the globe, to what degree will evolving access technologies bring the unconnected online faster? And, to what degree will the Internet platforms seek to gain a foothold in the access markets?

As the demand for streaming content grows around the globe, how will the networks that provide such services meet the bandwidth demands, particularly in those countries in which there are significant connectivity challenges?
Service Infrastructure

The Internet is a worldwide interconnection of computers in tens of thousands of networks run by diverse organisations. Its fundamental properties of collaboration, interoperability, permissionless Innovation, mutual agreement, and global reach make it possible for anyone who wants to be part of a network to simultaneously be part of the Internet as a whole. The open and decentralised nature of the Internet means that, in principle, anyone can set up a service at the edge of the network, which includes both the networks and devices within homes and enterprises, as well as the Internet service provider networks that connect those homes and enterprises to the global Internet.

Service Infrastructure describes the services and businesses that enable network participants to connect with each other to build and sustain the Internet. It includes specialised services like naming and addressing management, hosting and distribution of content, and the interconnection of the networks themselves. A number of the large platform companies are increasingly investing in cloud services and content delivery networks (Amazon Web Services) to undersea cables (Google), extending their reach from the application layer into the services and infrastructure layers.

“Do-it-yourself” transit?

Transit is how large communications providers interconnect to ensure data goes where it is needed around the world. The Internet depends on a fabric of business relationships that structure the exchange of data. For similarly sized networks, connectivity between them is often enabled via settlement-free peering, where no money is exchanged because the relationship has roughly equal value to both parties. Smaller networks must buy access to the global Internet from larger networks that market, sell, and operate transit service.

A small number of Tier 1 providers dominate the market for international transit. Every network that connects to the Internet is assigned an Autonomous System Number (ASN). Some of these Autonomous Systems (ASes) – usually very large networks – are known as Tier 1 providers. They do not need to buy transit from anyone else; rather, they sell it. A recent analysis of the interdependencies among ASes showed that a small group of Tier 1 providers play a significant role in connecting remote networks of the Internet. The largest Tier 1 provider, Level 3, is estimated to serve nearly 53% of all ASNs in their customer cone.

**Trends:** Although a small number of Tier 1 operators dominate global transit, there is a flattening of the Internet’s hierarchy, as increasingly, networks interconnect via Internet Exchange Points (IXPs) and use Content Delivery Networks, thereby relying less on transit.

IXPs reduce access costs and latency by keeping more traffic local, and have seen significant growth in recent years, with the total number of IXPs increasing to 543 from 375 in the past 12 months. Transit prices have been falling steadily, with some estimates indicating that global prices have decreased an average of 27% compounded annually between 2015 and 2018.

These market trends are reinforced by the continued growth of Content Delivery Networks (CDNs) and large content providers investing in their own infrastructure for international connectivity. Google, for example, has laid its own oceanic submarine cables.

Overall, transit providers are under pressure from several directions. As IXPs keep more traffic local, economic and performance considerations will favour peering and non-monetised arrangements over transit arrangements. The evolution of CDNs using private networks to distribute content internationally also helps drive down demand for transit. Diminishing profitability of transit service provision may drive acquisitions and mergers intended to increase scale and reduce costs.
Content Delivery Networks (CDNs) – local hosting, global brands

CDNs are specialised networks of servers designed to cache and serve content in geographically diverse locations closer to the user. They store a copy of the content (e.g., cloud storage capacity or popular films) close to the edge of the network serving the content consumer. CDNs can increase reliability, reduce latency and also reduce demand for transit.

**Trends:** CDNs are now a fundamental infrastructure component for building high-performance, reliable web services. Some big content providers even operate their own CDNs (e.g., Netflix Open Connect67). Among the top 1,000 websites globally, CDN use grew to an estimated 87.5% in August 2018 from 50% in June 2014. Of the websites in the sample that use CDNs, 27% use Amazon Cloudfront and 27% use Akamai. While some content providers make use of multiple CDN providers, the fact that 474 of the top 1,000 global websites use one of these 2 CDN providers indicates that they have significant market share.68

Beyond the top 2 players, companies such as Microsoft and Alibaba are expanding their own CDN services, both organically and through acquisitions. Similarly, Alibaba is now estimated to have one of the largest CDNs in China after acquiring the online video platform Youku in 2016.70

**Cloud computing grows; as does big players’ market share**

With the ability to access and manage servers remotely, from anywhere on the Internet, new businesses have emerged that specialise in renting out space and processing on their servers. Today, cloud computing services dominate this arena. They use large data-centres with expertise and economies of scale, offering their specialised services globally. Customers tend to access these resources as needed instead of buying and managing servers themselves.

Cloud computing essentially means the delivery of computing and storage services over the Internet, with companies offering these services called cloud providers. These providers offer functions as a service. These are functions to rent, including Infrastructure as a Service (IaaS), Platform as a
Service (PaaS), and Software as a Service (SaaS). IaaS customers outsource basic computing requirements, such as processing and storage, to cloud providers, but manage everything else themselves, from operating systems to deploying applications. PaaS providers offer additional elements of the technological stack, including operating systems and functions like development tools, database management, and analytics. Large providers may even offer AI/machine-learning capabilities such as natural language-processing and image recognition, for instance. SaaS, in turn, largely covers applications discussed in Section 1.1 on Applications and Services.

**Trends:** Cloud computing is growing fast. The market for cloud computing services like IaaS and PaaS is expected to almost triple to $110.8 billion in 2021 from $41.9 billion in 2016. The IaaS market has long been dominated by Amazon Web Services (AWS), with Gartner estimating AWS’s global market share of IaaS to be 51.8% in 2018. The IaaS market now appears to be consolidating around a small set of large providers: AWS, Microsoft, Google, IBM and Alibaba. The current top 10 providers are expected to increase their market share even further, to 70% from 50%, by 2021.

The market for PaaS features the same players – AWS, Microsoft, Google, IBM and Alibaba – but also includes established companies like Oracle and Salesforce. As large investments are required in order to provide the full range of capabilities and resources, the IaaS and PaaS markets appear to be consolidating around the major players.

**DNS services – growing concentration on all sides**

The Domain Name System (DNS) translates reader-friendly domain names (e.g., example.com) into numeric Internet Protocol (IP) addresses. The DNS comprises many actors and functions, including registries, registrars, and root zone operators, but we focus here on two functions: recursive DNS and DNS hosting services. In both areas, we see trends of concentration towards a smaller set of global providers.

**Recursive DNS services**

Recursive DNS servers perform an IP address lookup in the DNS on the user’s behalf. They have traditionally been supplied by the user’s Internet Service Provider (ISP), but now new options...
are available, with public recursive DNS servers, available to anyone, increasingly being used. ISPs and enterprise administrators can outsource recursive DNS service to one of these public servers. Tech-savvy individuals may also choose to configure their devices to make use of public DNS servers, for example, to circumvent a local DNS-based censorship regime.76

Trends: Since Google entered the market with 8.8.8.8, several other public recursive DNS providers have emerged (e.g., Cloudflare’s 1.1.1.1 and Quad9). Google’s public DNS is still considered the largest among these services, with estimates from APNIC indicating that nearly 15% of all Internet users rely on the service.77

40% of our survey respondents see consolidation being a global trend, while 26.5% see it as more visible in certain countries.

DNS hosting services

Dedicated DNS hosting services are typically used either as part of a bundle of hosting services offered to smaller websites and individuals, or as more specialised DNS hosting providers used by large content providers and businesses, as well as cloud service providers with high-traffic domains, which need to avoid costly website downtime. CDNs use the DNS to direct traffic to content instances in order to improve reliability and latency for content providers.

Trends: A study of the top 1,000 domains using .com, net and .org indicates a trend towards consolidation in the DNS space with 4 providers: Dyn, Akamai, AWS, and Cloudflare. These providers had an estimated combined market share of 50% in May 2017.78 This is being driven both by the move away from self-hosting and toward cloud-based site-hosting and management platforms, which use the DNS for traffic engineering purposes, and also by consolidation in the broader hosting market. While website owners may benefit from vertical bundling of services and access to expertise, bundling also potentially impacts DNS diversity as single points of failure can reduce overall network resilience in the event of outages or other service failures. Single points of failure can similarly be exploited in attacks, such as the 2016 DDoS attack against Dyn.79

Overall trends

Transit is changing in ways that can reduce demand for traditional Tier 1 international transit. As IXPs are more widely used, CDN use grows and data is stored closer to users, and large platforms build their own infrastructure. Price pressure in international transit may drive market consolidation amongst Tier 1 providers as they try to deal with lower margins and the ongoing need for infrastructure investment. The changes to transit are mostly driven by developments in other areas of service infrastructure, particularly CDN and cloud-computing. These, in turn, are driven largely by the growth and investment by major Internet platforms and technology companies.

A small number of players in different parts of the technology stack increasingly dominate service infrastructure. The decentralised nature of the Internet is changing, and at some levels, more concentrated arrangements are beginning to emerge, particularly in DNS services and CDNs.

This changing topology of the Internet raises a number of critical questions:

What is the benefit or impact, if any, for competition and the open and interoperable Internet when the Internet platforms secure a significant presence across the application and services layers?

Does the flattening of the Internet change the fundamental characteristics of the global infrastructure – and in particular those of global reach and integrity, and interoperability and mutual agreement?