Internet Infrastructure and the Persistent Myth of U.S. Hegemony

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The idea that U.S.-based internet giants such as Amazon, Apple, Facebook, Google, Netflix, and Microsoft dominate the internet the world over is common—in academic writing across disciplines, the popular press, and everyday conversation. Derisory acronyms such as FAANG—Facebook, Amazon Apple, Netflix, and Google—capture the spirit of this idea. For some, this is not surprising, but rather the expected end result of neoliberal economic globalisation, and the liberalisation of global telecoms and internet policy that have been remaking the world in the U.S. image since the 1980s. Edward Snowden's disclosures about the U.S. National Security Agency-led internet surveillance programme have further galvanised claims about the extent of U.S. dominance of the internet (Carr 2016, 118–20;

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Powers and Jablonski 2015, 14–16, 109–110; Jin 2014; Kiss 2013; Fuchs 2010; Hill 2013; McChesney 2014).

This superficially persuasive conventional reading relies, however, on a partial consideration of the internet ecosystem. Expanding our frame of reference to include the internet's physical infrastructure paints a picture of internet governance that does not fit into a simple story of now-and-future U.S. hegemony. The United States certainly played a hegemonic role in the founding and early years of the internet, and U.S.-based internet giants certainly dominate much of the internet's middle and top layers, including operating systems (iOS, Windows, Android), search engines (Google), social networks (Facebook), online retailing (Amazon), over-the-top TV (Netflix), browsers (Google Chrome, Apple Safari, Microsoft Explorer), and domain names (the Internet Corporation for Assigned Names and Numbers, i.e. ICANN). However, U.S. firms and capital do not rule the hardware—or material infrastructure—of the internet. In fact, as this chapter shows, ownership and control of core elements of the global internet infrastructure such as the fibre optic submarine cables, autonomous system numbers (ASNs), and the Internet Exchange Points (IXPs) that constitute the guts of the internet, is steadily tilting towards the rest of the world, especially Europe and Brazil, Russia, India, China, and South Africa (BRICS). The relative decline of U.S. hegemony and the emergence of an ever-more multipolar world are moreover captured by the fact that the U.S. share of global internet traffic fell from half the total in 2004 to 25 per cent in 2017. So, too, as we shall see, the global distribution of internet users reveals a similar pattern (Arrighi 1994; Desai 2013; Telegeography 2018a, b).

Such trends complicate the dominant conception of hegemonic U.S. control over what the influential political economist Susan Strange (1994) refers to as the knowledge structure. Rather than American internet imperialism, what Eli Noam (2013) refers to as a "federated internet" seems increasingly realistic, as ownership, control, and power over the material foundations of the internet become more multipolar in nature, shared and contested by an increasing number of state and non-state actors. This outcome will likely erode support for the current multi-stakeholder model of internet governance. This model is supported by many commercial interests, technical experts, and non-government organisations as well as the United States and other capitalist democracies instead of a more state-centred, multilateral model promoted by those who are critical of the unaccountable power of business interests and countries such as India, China, Russia, and Brazil, which—each in their own way—seek to counter what they see as the United States and Western capitalist countries'

dominance of internet governance. Ironically, all of this is taking place just as the United States has essentially walked away from its role as a pivotal player in these affairs in light of the Trump Administration's nativist inclinations and actions—a stance that China, Russia, the European Union (EU), and others are all too eager to use to their advantage. This might not be a bad thing, however, and is exactly the kind of scenario anticipated by Noam's view of a federated internet, backstopped by multilateral agreements at the international level through the century-and-a-half-old International Telecommunications Union (ITU), for instance.

The approach of this chapter follows Strange's focus on structural power, emphasising the changing relationship between markets and states—or the "market-authority nexus" (Strange 1994, 22)—over time and how hegemonic states act both on their own *and* in concert with others to structure the conditions under which other state and non-state actors operate. It also draws on David Harvey's (2003) concept of capitalist imperialism to help highlight the changes taking place and to counteract the dominant instrumentalist view in much of the literature, which sees communications media primarily as "weapons of politics" and "tools of empire" at the expense of market, technological and other considerations.

This chapter begins by placing the current debate in its proper historical context, noting both the similarities and radical differences between the internet and its nineteenth- and twentieth-century predecessors. The next section examines the question of U.S. internet dominance and the balance between states and market forces by tracing the rise of the internet's infrastructure as it now exists. The chapter concludes with some comments on the implications for internet governance and the structure of the internet arising from the potential emergence of Noam's idea of a federated internet.

1 Theorising Global Media History[1]

News and information have followed channels of trade, migration and cultural contact for millennia, but media historians often take the second half of the nineteenth century to the turn of the twentieth century as the moment when modern global communication and media systems took shape. The dominant view in the literature tends to adopt an instrumentalist

[1] The following two sections draw extensively from Winseck and Pike (2007) and Winseck (2011).

view of communications media as "tools of empire" and "weapons of politics" (Headrick 1991), or what David Harvey (2003) calls "territorial imperialism." To be sure, control over the medium and the message did confer commercial and strategic advantages to Great Britain, the dominant power of the era, and its free trade policy in general. Submarine telegraph cables in particular were designed to attract cables and capital in a bid to maintain London as the hub of the world economy and communication. Kelley Lee also crystallises this view by emphasising how "the integration of … European imperialism … was reinforced by telegraph (and later radio and telephone) networks *whose reach was historically defined by the boundaries of empire*" (Lee 1996, 60; emphasis added). The rapid ascent of U.S. commercial, political, and military interests from World War I on is also usually cast as having allowed it to displace Britain and Europe as the centre of world communication, and more fully after World War II when Pax Americana overtook Pax Britannica. Some claim that this is where things still stand today, especially in relation to America's imperial—or at least hegemonic—hold over the global internet (Carr 2016, 118–120; Powers and Jablonski 2015, 14–16, 109–110; Jin 2014; Kiss 2013; Fuchs 2010; Hill 2013; McChesney 2014).

This view is deeply problematic, however. For one, it gives far more attention to politics than economics. It also emphasises territorial imperialism at the expense of Harvey's second understanding of imperialism, capitalist imperialism, which he defines as a system of power that aims to allow capital accumulation and "economic power to flow across and through continuous space," and where models of development are emulated and consent is preferred to coercion. Harvey also draws on Giovanni Arrighi to suggest that while power is mainly the preserve of single hegemonic states under territorial imperialism, under capitalist imperialism the emphasis is on "the *accumulation of collective power* [amongst states and capital] as the only solid basis for hegemony within the global system" (Harvey 2003, 37; emphasis added). He also does not view corporate interests as subordinate to state interests or nation-states as the simple handmaidens of capital. This view captures the essence of the global cable systems of the nineteenth and twentieth centuries remarkably well. It is also a better, if incomplete, explanation of the global internet in the twenty-first century than the more one-dimensional views recounted a moment ago.

Communication history should start with the point that capitalism has been a globalising force since its inception, and this motive force has been inextricably tied to advances in communication (Arrighi 1994). As Karl Marx famously observed:

> Capital by its nature drives beyond every spatial barrier. Thus the creation of the physical conditions of exchange—of the means of communication and transport—*the annihilation of space by time*—becomes an extraordinary necessity for it …. [T]he production of cheap means of communication and transport is a condition for production based on capital, and promoted by it for that reason. (Marx 1867/1972, 459)

Imperialism played a crucial role in the development of these cable systems, but modernising economic forces within China, the Ottoman Empire, Persia, and the post-imperial nation-states of South America were also vital sources of demand. Moreover, while rickety telegraph cable networks had been developed in some of the imperial territories of the Caribbean and Southeast Asia in the 1860s and 1870s, they only encircled the continent of Africa a decade later, in the mid-1880s. In other words, the far-flung territories of the British, European, Japanese, and American empires—with the major exception of India—were tied into the world communication system only a decade or more later than the rest of the world. This typically happened only after large state subsidies were granted, mostly to private firms, and occasionally by several governments at once. This was the case, for example, when a subsidiary of the Eastern Telegraph Company laid, owned, and operated the cables to and around Africa after receiving substantial subsidies from Britain, France, Germany, and Portugal (Britain 1902, Appendix E). Private enterprise generally ruled the industry. Even at the height of the new imperialism (1880–1910), less than 20 per cent of cables were state-owned. Even then, however, the areas that they served were still amongst the least connected, worst served places in the world, in contrast to the conditions assumed by the "struggle for control" model of communication outlined earlier.

1.1 Foreshadowing the Future: From Copper Cables to the Global Internet Infrastructure

The massive scale of submarine telegraph cable construction in the late 1860s and the first half of the next decade, the product of a speculative financial bubble that burst in 1873, was not matched again until the turn of the twenty-first century, when a speculative flood of investment led to a 100-fold rise in telecommunications capacity before the dotcom bubble crashed in 2000–2001—a point we return to below (FCC 1999, 5). Just as submarine telegraphs were a general-purpose technology with pervasive

effects, the critical communications infrastructure underpinning the then-new world order, today fibre optic cables play a similar role with respect to the global internet. Then as now, undersea cables were regulated by governments in terms of landing licences. The monopoly landing rights that they typically gave the submarine telegraph companies in the early years of development varied considerably, as did the terms of service they demanded with respect to privileges given to local officials, interconnection with local telegraphs, as well as their need to monitor (surveillance) and block (censorship) messages perceived as threats to public morality or national security. These landing licences typically reflected the strength of the state that negotiated them. The stronger the state, the less likely it was to grant monopoly rights to a company, as was the case in Britain and the United States. The weaker the state, the longer the right to a monopoly, the more restrictive the terms-of-service obligations, and the less likely companies were to cooperate in ways other than those that advanced their business interests. In the United States, by convention, the president had the authority to grant or withhold cable landing licences before 1921, after which that authority was formalised with the passage of the *Cable Landing Licenses Act*—a measure that ensured that the use of such powers took place at the highest level of authority *and* outside Congressional oversight and, thus, steeped in secrecy—as it has remained until this day (United States 1921).

The basic geography of the internet follows that of its telegraph predecessor. Indeed, the routes laid down in the nineteenth century are still the dominant routes now, even if under very changed conditions. While the geography remains similar, the capacity of the world's information infrastructure has exploded. At the end of 2017, the global internet's backbone consisted of around 370 international submarine cables. Currently, nearly 99 per cent of all international internet traffic travels through these cables, and a single fibre pair in a cable (which typically have a dozen or so fibre pairs) can carry as much traffic as all the geosynchronous satellites orbiting the planet (Telegeography 2018c; OECD 2014, 12). Today, more than an exabyte of data transits the internet every day, which is the equivalent of 212 million DVDs or the entire contents of the British Library or U.S. Library of Congress several hundred times over (van der Berg 2012). Given all this, these international cables really are the main arteries of the internet.

While a speculative mania in the early 1870s led to the collapse of the financial bubble within a few years, it still left behind the copper cables

that really did serve the world for decades to come. So, too, in recent times did the global boom in submarine cable construction between 1998 and 2003 leave behind 16 new trans-Atlantic cables that have served as the arteries of commerce and communication between North America and Europe ever since. Cables were laid elsewhere, of course, but it was in the North Atlantic that most of the significant activity took place. During the dotcom era of the last three years of the twentieth century alone, the carrying capacity of the trans-Atlantic cables multiplied 100-fold (FCC 1999; Terabit 2018, 21). Similar patterns took place within countries as well: Some $90 billion of new investment was injected into the internet backbone and 36,000 kilometres of optical fibre laid in the United States alone at the height of the boom (Troainovski 2012).[2] The speed and magnitude of the boom—and bust—of the dotcom bubble can also be seen in the spike of capital investment in submarine cables from 1998 to 2001, and the plunge in investment thereafter (Fig. 1).

Of the $7 trillion lost when the market crashed between 2000 and 2002, $2 trillion could be laid at the feet of telecoms companies (Starr 2002). Repeating the events of more than a century earlier, when many of the new operators collapsed, their assets were acquired cheaply by

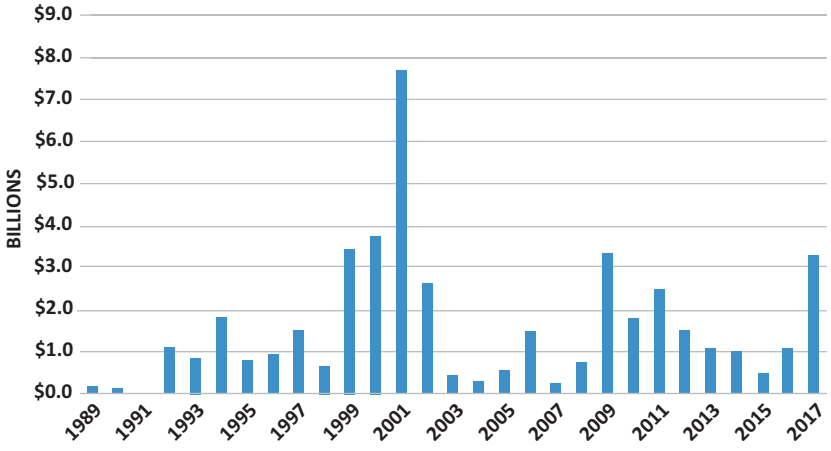

Fig. 1 Construction costs of submarine cables, 1989–2017. Source: Terabit (2018), Submarine Telecoms Industry Report, Figure 25

[2] All dollar values are in USD.

well-established telecoms carriers while a new class of more resilient rivals such as Level 3, Cogent, XO, Reliant, Zayo, and Content Distribution Networks (CDNs) also emerged. As a result, bandwidth was "dumped" onto the market and prices plummeted.

So much new fibre optic cable was laid at the time that 90 per cent or more of the capacity across the Atlantic was never "lit up" during the next decade. Instead, cable capacity was stockpiled as "dark fibre" that was not outfitted with the electronics needed to transmit traffic to avoid compounding the glut of bandwidth already in the market. No new trans-Atlantic cables, consequently, were laid for a decade and a half after the "Great Crash" (Telegeography 2016). As result, during this time, "the transatlantic market [was] served exclusively by the cable systems that were deployed between 1999 and 2003" (Terabit 2018, 21–22).

This reliance for more than a decade and a half on cables laid during the dotcom era has changed in the past two years with the construction of three new trans-Atlantic cables—two in the North (MAREA and Greenland) and another in the South (South Atlantic Inter Link or SAIL)—as well as a new cable between North and South America (Monet), and two smaller links between cities in the latter region (the Tannat and Junior Cables), with more currently on the drawing board. Indeed, there is once again talk of a renewed boom in submarine cable building in the region, and in many areas of the world—as the following paragraphs discuss.[3]

2 The Internet Outgrows Its U.S. Cradle

The real resurgence of capital investment in new submarine cables since 2008, however, initially took hold in the Asia-Pacific region before spreading to Africa, South America, and the Middle East in recent years. Total worldwide investment between 2008 and 2017 was an estimated $18 billion. Most of the investment involved the BRICS ($10.7 billion, or 60 per cent), largely due to six ambitious Asia-Pacific region cable proj-

[3] The MAREA cable is jointly owned by Telefonica, Facebook and Microsoft; the Greenland Cable by a resurrected Canadian company from the dotcom era, Hibernia Networks; the Monet Cable is jointly owned by Angola cables, Antel Uruguay, Algar Telecom and Google; the Tannat Cable by Google and Antel Uruguay; the Junior cable by Google; while the SAIL cable is jointly owned by Cameroon Tel and China Unicom, and links the west coast of Africa to the east coast of South America (Telegeography 2018c). Dates cited are for when the cables began service, unless stated otherwise, and from this source.

ects: UNITY (2010); the South-East Asia Japan Cable (2013), the Asia Pacific Gateway (2016), FASTER (2016), the Pacific Cable Light Network (2018), and the New Cross Pacific Cable (2018).

As in the past, Africa and some of the most downtrodden economies of the world have been the last to be tied into the world's internet infrastructure and have been among the least competitive, worst served, most expensive places for internet bandwidth on the planet. This too, however, is changing fast. In fact, a quarter of the investment since 2008 ($3.8 billion) has been in new cables to and around sub-Saharan Africa, with at least four new cables laid along the west coast and four along the east. In the process, South Africa, Nigeria, Kenya, and Ghana have emerged as internet hubs for the region and these links, in turn, are driving fibre optic cables to be built more widely within more African cities than has ever been the case, even into townships outside the big cities that have been badly underserved historically. As of late 2018, there were eight new cables linking India together with the Middle East and Europe in various stages of development ($2.9 billion) as well (Song 2018; Telegeography 2018c; Weller and Woodcock 2012; OECD 2014).

Government ownership and development bank financing of fibre optic submarine cables remains modest, but is on the upswing, rising from just 1 per cent of cable investment in the early twenty-first century to 11 times that amount in 2017. Now, however, it is not the "new imperialists" making the capital investments, but nation-states in the Global South, especially in Asia, sometimes in tandem with international development banks, but typically with capital from national and regional telecoms carriers, many of which are government-owned, but also with sizeable investment and ownership stakes from Google, Facebook, and Microsoft in several instances (Telegeography 2018c; Terabit 2016, 14–22; Terabit 2018, 28–31). This can be seen by examining the key players in cable system ownership, content delivery networks and Internet Exchange Points.

2.1 Changing Players and the Rise of the Post-American Internet

The number and type of submarine cable system owners and operators has expanded and diversified greatly over time. As mentioned earlier, by the end of 2017, there were 370 international undersea cables in operation. Roughly a quarter of these cables (85 in total) are owned and operated by the consortia of legacy national telecoms carriers and about that many

again are owned individually by these carriers. Over the last two decades, however, a new roster of competitors and Content Distribution Networks (CDNs) such as Amazon Web Services, Akamai, Level 3, and China Cache have emerged as significant rivals to the legacy telecoms operators. Google, Facebook, Amazon, and Microsoft have also recently entered the fray to become significant owners and operators of cables systems, sometimes by working in tandem with one or another of the aforementioned carrier groups but at other times on their own and in direct competition with the legacy telecoms-operators consortia, the new competitors and CDN operators *en masse*. The upshot overall, however, is that geographically, structurally, in terms of the composition of the consortia that own and operate the overwhelming majority of undersea cables, and in terms of national origins, the world's internet infrastructure has become vastly more complex, heterogeneous and "post-American" than ever.

Amongst the group of new competitors, three companies stand apart and typify the trends being analysed here: the U.S.-based Level 3 and two others with headquarters in Mumbai, India—Global Cloud Xchange and Tata (Telegeography 2018c). There are several other second-tier companies of this type, with several that are non-U.S.-centric as well. They include Cogent (U.S.), PCCW (Hong Kong), XO (U.S.), Global Transit (Malaysia) and Hurricane Electric (U.S.) (Zmijewski 2014). A second type of operator consists of CDNs. They are specialised niche players that carry internet traffic for large corporate and government users, media, and entertainment companies such as Netflix, Google, Amazon, Facebook, Baidu, and so on. Seven CDN operators stand out amongst the rest: Amazon, Akamai, Level 3, Edgecast (Verizon),[4] China Cache, Limelight, and Highwinds (Rayburn 2015). The first four entities on the list control roughly three-quarters of all revenue in this niche area and are U.S.-based, as are the latter two. The only non-U.S. CDN operator among the group is China Cache. While this would seem to cut against the grain of the argument of this chapter, it must be kept in mind that the CDNs compete in a wider market of much bigger players that include the incumbent carriers, competitive bandwidth wholesalers and, increasingly, the global internet giants such as Google, Facebook, Amazon and Microsoft, who are building their own networks, sometimes single-handedly but often by joining other consortia to do so as well. Overall, the consortia approach,

[4] Verizon is not a new company but entered the CDN business after acquiring Edgecast in 2013.

with its deep historical roots in the cartels of the nineteenth and twentieth centuries, continues to be a mainstay of the universe, but they now consist of a much more heterogeneous mix of private and state actors. This complex reality helps to explain why the former national monopoly carriers see international markets as being highly competitive, but given the interplay of national, state, and corporate interests in most consortia, it is also why we should be cautious about being too quick to pin a national identity on these actors—at least the corporate ones—as if private capital and the complex technological systems they command are merely "tools of empire" and handmaidens of their respective governments.

Beyond the undersea cables, there are approximately 2000 Internet Exchange Points (IXPs) around the world. They are essential elements of the internet infrastructure where traffic is handed off between all the networks that make up the internet system. Indeed, 99 per cent of internet traffic is handled by peering arrangements at IXPs and occurs without any money changing hands or a formal contract (van der Berg 2012; Weller and Woodcock 2012). The biggest IXPs are in New York, London, Amsterdam, Frankfurt, Seattle, Chicago, Moscow, Sao Paulo, Tokyo and Hong Kong. These are the "switching centres," where international internet backbone providers, internet content companies, and the CDNs interconnect with one another, and local internet service providers (ISPs), media and entertainment companies, and other big "content service" providers. In developed markets, internet companies such as Google, Baidu, Facebook, Netflix, Youku, and Yandex use these IXPs to interconnect with local ISPs such as Deutsche Telekom in Germany, BT or Virgin Media in the United Kingdom or Comcast in the United States to gain last-mile access to their customers—and vice versa back up the chain.

Crucially, IXPs help to establish accessible, affordable, fast, and secure internet service. Where they do not exist or are rare, as in Africa, or run poorly, as in India, the cost of bandwidth is astronomically more expensive. This is a major factor that helps to explain why internet service is so expensive in areas of the world that can least afford it. It is also why developing countries are being encouraged to make IXPs a cornerstone of their economic development and telecoms policy work (Song 2018; Telegeography 2018c; van der Berg 2012; Weller and Woodcock 2012).

In addition to the undersea cables and IXPs underpinning the internet, there are also thousands of local, national, and regional networks of a wide variety of kinds and sizes that interconnect with one another to form "the internet." Every network that connects to the internet is given a num-

ber—autonomous systems number (ASN)—and you can count the number of such networks by the number of ASNs that have been assigned. In 1997, there were 3,212 ASNs that comprised the entire internet; by early this year, that number had soared to 84,414 (OECD 2015; Maigron 2018; Hawkinson and Bates 1996). Crucially, the geography of where these networks are located has changed dramatically over the past two decades. Thus, in 1997, for instance, 56 per cent of ASNs were located in the United States. Adding Europe and Japan raised the total share of these core regions of the global economy at the time to 79 per cent, while the BRICS accounted for just 5 per cent. A decade later, the U.S. share of ASNs had dropped to 39 per cent while that of the transnational core countries fell to two-thirds. The BRICS share, in contrast, was double what it had been ten years earlier. Fast forward to early 2018, and the trend towards a post-American internet continues. By this time, the United States' share of ASNs had continued to slide to 31 per cent, and the "transnational core" countries had fallen to 57 per cent. Taken on its own, in contrast, the EU's share rose significantly to 25 per cent, while the BRICS' share had soared to 18 per cent—almost four times what it had been, despite under-representing the true scope of the changes, given that the number of ASNs in China is not well-captured because they are hidden behind the country's "great firewall" (Fig. 2).

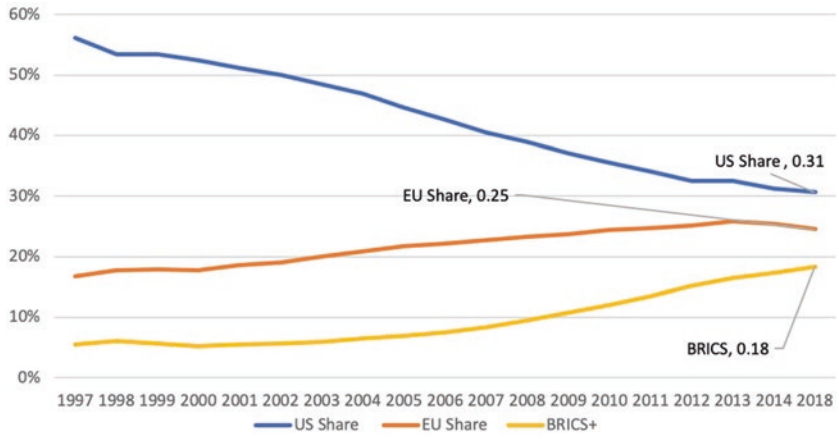

Fig. 2 Country and region share of autonomous system numbers, 1997–2018. Sources: OECD 2015, Table 2.44; Maigron 2018

Who uses the internet from where and for what purposes has also changed dramatically over time. Fibre optic cables, and the mobile wireless and internet system that they gird, are no longer the "rich man's post" as during the days of international telegraphy and telephony. Indeed, the cost of internet transit has plunged in recent years to "about $0.0000008 per minute—or 100,000 times lower than typical voice rates" (van der Berg 2012). As prices have plunged, internet and mobile phone use has exploded. Thus, while the number of people who used the international telegraph could be counted in the thousands in the late nineteenth century, there were already 400 million regular internet users and 800 million mobile wireless subscriptions by the end of the twentieth century (i.e., roughly 5 per cent and 10 per cent of the world population, respectively). Fast forward to 2017, and there were 5 billion unique mobile wireless subscribers and 3.6 billion regular internet users (Broadband Commission 2017, 10; ITU 2018).

Who uses the internet has also shifted decisively to the BRICS countries and the Global South. Whereas two-thirds of internet users lived in the United States in 1996, by 2017 Americans constituted less than 5 per cent of the world's internet users, while China alone now accounts for nearly 20 per cent of the total. In sum, the vast majority of growth in terms of internet and mobile phone use has been in the Global South, and this is changing how the internet is used, is being developed, and the policy responses that will shape its future. None of this should obscure the fact, however, that there is an estimated four billion people, or 52 per cent of the world's population, that still lack internet access, and the gender divide continues to be stubbornly difficult to bridge (Broadband Commission 2017).

Given these developments, it is unsurprising that the United States' share of internet traffic has declined. The United States undoubtedly dominated global internet traffic during the first decade of the commercial internet—which also put it at the nexus of a powerful system of mass internet surveillance—but its position has declined steadily since. In 2004, half of all internet traffic globally flowed through the United States, but by 2017, that number had fallen to less than one-quarter (Telegeography 2018a, b). Figure 3 illustrates the point.

2.2 United States Still Dominates Internet-Based Audiovisual Media and Gaming Applications

The idea of an underlying shift to a post-American internet based on the changes just described should not be overblown, however. Take, for

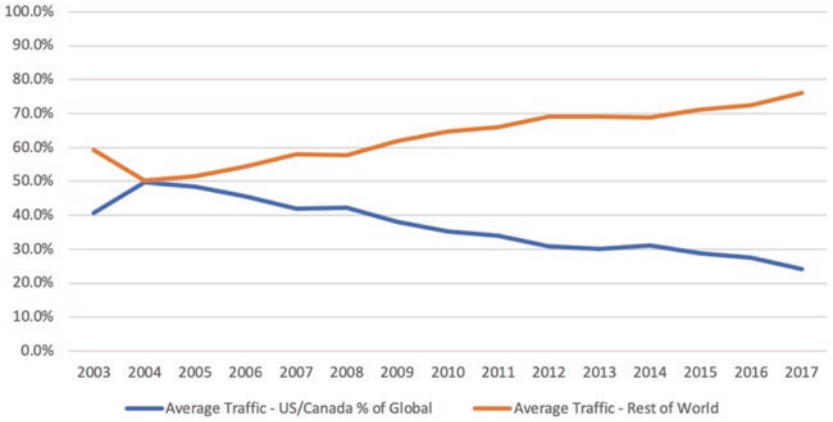

Fig. 3 U.S. share of international internet traffic, 2003–2017. Sources: Telegeography, Global Internet Geography (Figure 8): Global International Internet Traffic, 2013–2017 (Gbps), 2018a; Telegeography, Global Internet Geography (Country Profiles: U.S.), 2018b

example, the fact that while billions of people use the internet for many reasons, the most popular uses are to watch television and movies, listen to music and to play games. Consequently, audio/video-based media and gaming made up nearly three-quarters of internet traffic worldwide in 2016 and are expected to surpass 80 per cent within five years, with U.S. firms leading the way (Cisco n.d.). Indeed, Netflix accounts for a third of all internet traffic. YouTube is the second largest source of traffic on fixed and mobile networks worldwide. Combined, the big five internet giants—Google, Amazon, Facebook, Netflix and Microsoft—currently account for nearly 60 per cent of all "prime-time" internet traffic, a phrasing that deliberately reflects the fact that internet usage swells and peaks at exactly the same time as the classic prime-time television period, that is, 7 pm to 11 pm (Table 1).

2.3 Two Approaches to Building Internet Infrastructure

The idea that the internet has become an entertainment distribution system during "prime-time" is fundamentally influencing the current phase of internet infrastructure development. Such realities are driving, for

Table 1 Prime-time internet traffic composition, North America, 2016

Upstream		Downstream		Aggregate	
BitTorrent	18.37%	Netflix	35.15%	Netflix	32.72%
YouTube	13.13%	YouTube	17.53%	YouTube	17.31%
Netflix	10.33%	Amazon Video	4.26%	HTTP - OTHER	4.14%
SSL - OTHER	8.55%	HTTP - OTHER	4.19%	Amazon Video	3.96%
Google Cloud	6.98%	iTunes	2.91%	SSL - OTHER	3.12%
iCloud	5.98%	Hulu	2.68%	BitTorrent	2.85%
HTTP - OTHER	3.70%	SSL - OTHER	2.53%	iTunes	2.67%
Facebook	3.04%	Xbox One Games Download	2.18%	Hulu	2.47%
FaceTime	2.50%	Facebook	1.89%	Xbox One Games Download	2.15%
Skype	1.75%	BitTorrent	1.73%	Facebook	2.01%
	69.32%		74.33%		72.72%

Source: Sandvine *Global Internet Phenomena*, 2017, 4

instance, the emergence of specialised CDNs and the internet giants' efforts to build undersea cable systems and data centres around the world—sometimes jointly with the legacy telecoms operators; at other times, with the new competitive carriers; and other times, all on their own in stiff competition with both of those groups.

Worldwide, the public internet is also being eclipsed by private internets built, owned and operated by the world's largest internet companies, traditional telecoms carriers and a relatively new class of CDNs and internet bandwidth wholesalers such as Level 3, Tata, Global Cloud Xchange, Cogent, XO, Hurricane Electric, and CDNs. These trends may also be altering these large American internet companies' such as Google, Facebook, and Netflix stance on network neutrality/common carriage and other internet and public policy issues as well, given that once they own their own networks or contract heavily with CDN providers, they rely less on the transit services of either the incumbent or the relatively new generation of competitive carriers. As a result, the internet giants achieve their aims through competition and contracts rather than regulation and public policy. This appears to be the case with Google since 2010, for example, when its support for network neutrality/common carriage wilted relative to what it once was, while Netflix has toned down its support for such measures in recent years as well (Stevenson 2014). In essence, parallel private internets have been developed outside the orbit of the public internet in order to bring the services of Google, Baidu, Facebook, Netflix, Youku, and so forth as close to the doorsteps, desktops, and devices of their users as possible.

The internet giants are generally taking two different approaches—depending on the availability of capacity, costs, and region—to internet infrastructure: one based on direct investment and ownership stakes in fibre optic submarine cables where capacity is low; the other based on obtaining access to bandwidth from carriers and CDN providers *and* building data centres at each end of the cable where capacity is abundant and cheap. Google and Facebook, for instance, are pursuing the first strategy mostly in relation to several new cables across the Pacific and along the Asian coastline from Korea to Thailand, a consequence of the relative scarcity of bandwidth in the Asia-Pacific (see below). In the North Atlantic region, in contrast, rich in "dark fibre" left over from the dotcom crash, capacity is abundant and cheap, and therefore the internet giants have stayed away—until recently—from laying their own cables in favour of buying capacity from either the incumbent carriers, new competitors such as Tata or CDN providers. As the same time, they are also building huge data factories on either side of the Atlantic Ocean that allow them to warehouse the vast stores of data they collect and to bypass the undersea cables as much as possible altogether.

In the last two years, however, this too has begun to change with the announcement of two new northern trans-Atlantic cables. The first of those cables—the MAREA cable between the United States and Europe, with ownership shared between Telefonica (50 per cent), Facebook (25 per cent), and Microsoft (25 per cent)—began operating last year. Google has also built three cable systems during this time between cities in Brazil and Uruguay—Junior and Tannat—with a link to Miami (the Monet cable, which is jointly owned by Google, 33.3 per cent; the Angolan-based Angola Cables, 33.3 per cent; the Uruguay-based Antel, 16.7 per cent; and the Brazil-based Algar, 16.7 per cent). It is also building a major cable system to link Los Angeles with Chile on the Pacific coast of the Americas—the Marie Curie cable system. The idea that key internet infrastructure is shifting towards the Global South can also be seen in the plans by Telefonica to bring its Brazil-USA (BRUSA) cable to life in 2018, while yet another, the Seabras cable (Seaborn Networks), is slated for development in the next year (Telegeography 2018c). In short, as demand begins to catch up to capacity, and shift from the west to the east and the north to the south, and from the "public internet" to "private internets," new investment is taking place. Obviously, the very large place that Google, in particular, has carved out for itself in many of these projects certainly requires that any claims about a wholesale shift to a "post-American internet" come with caveats.

At their core, however, most of these projects are multinational in character and criss-cross private and public lines, or between "states and markets" with relative ease. The Google-led Monet project and the MAREA joint venture between Telefonica, Facebook and Microsoft both exemplify the point.

Conditions in the Asia-Pacific region have been somewhat different because bandwidth there has been scarcer for a longer period of time. Therefore, the need for new cables has been far greater. This is reflected in the fact that the four biggest undersea optical fibre cable projects of the past decade have been in the Asia-Pacific region: UNITY (2010), the South-East Asia Japan Cable (SJC) (2013), the Asia Pacific Gateway (2016), and FASTER (2016). Two more major projects are also on the drawing board and slated to begin service soon: the New Cross Pacific Cable (NCP) and the Pacific Light Cable Network (PLCN). Once again, Google and Facebook loom large in all of these projects, reflecting their extraordinary growth in the Asia-Pacific region and their own interest in surmounting the lack of bandwidth that has characterised the region.

In many ways, these developments represent the physical emergence of a federated internet wherein many different actors—that is, legacy telecoms carriers, new competitors, mobile wireless operators, government-owned carriers and the global internet giants—coalesce across national lines to build the infrastructure of the internet. The physical existence of a federated internet is nicely illustrated by some of Google's activities in Asia. Google, for example, played a key role in such ventures in 2008 when it acquired a substantial ownership stake in the $300 million UNITY Cable, a cable that runs from California to Japan. The lead role in the UNITY consortia, however, is not played by Google, but Vodafone (40 per cent), followed by the regions' major national carriers, many of which are state-owned. Beyond Vodafone, however, how much of this venture each party owns is not known (Telegeography 2018c; Chowdhry 2014). In 2011, Google acquired an ownership stake in the South-East Asia Japan Cable, a $400 million system of spurs that run from the trans-Pacific cables to Brunei, China, Hong Kong, Japan, the Philippines, and Singapore, with a second phase of the project slated to extend the network to Thailand (Telegeography 2018c). The make-up of the ownership group behind this cable is larger than in the UNITY project but still includes many of the same players: China Telecom, China Mobile, Singtel, Singtel Optus, Chunghwa Telecom, KDDI, Google, Globe Telecom, the Telephone Organisation of Thailand, Telkom Indonesia, Brunei International

Gateway, and Airtel. Again, we have little insight into how much of this venture is owned by Google and the others involved, but state-owned telecoms operators appear to dominate the consortia, given the role of China's two biggest government-owned telecoms operators (China Telecom and China Mobile), Singtel and its affiliate Singtel Optus, and incumbent national carriers from Taiwan, Brunei, and Thailand. KDDI, Globe Telecom and Airtel are from the relatively new category of competitive telecoms and/or mobile network operators from Japan, the Philippines, and India, respectively, with ownership stakes in this system. While Google stands out in this area, both Facebook and Microsoft are engaged in a number of similar ventures.

The surge in internet-infrastructure construction activity is not confined to Asia. There has also been an explosion of bandwidth and connectivity to the coastal perimeter of Africa, with at least eight new cables laid since 2010. The recent push for new IXPs on the continent is also being met (Song 2018). Both developments have also helped to overcome the historically entrenched imperial geography of communications whereby messages first had to traverse the metropoles of empire (e.g. London, Paris) en route to other places within Africa or to locations wholly unrelated to this imperial geography. They have also contributed to a rapid drop in prices, thereby further adding to the "mobile wireless" revolution which has seen the number of mobile phone subscribers soar from 12 per 100 people to 78 per 100 between 2005 and 2017 in Africa (ITU 2018). Such developments have also underpinned the emergence of a unique kind of mobile internet on the continent, with unique applications and services—most notably, m-banking (mobile banking) taking off in Africa in ways that resemble trends in India, Southeast Asia, China, and some other developing countries, but with only poor analogues in Europe and North America (Broadband Commission 2017).

These changes are also resulting in a new generation of African-based companies such as Liquid Telecom that are not only connecting the continent with the rest of the world but also laying fibre to the doorstep within cities and beyond. Of course, this is being done first in the affluent gated communities of major cities, but it is also taking place in some of the townships that have previously been neglected. Companies such as Liquid Telecom are also using the internet infrastructure they have built as a base from which to start pay-television services that are challenging the previously insurmountable dominance of sub-Saharan Africa's largest media conglomerate, Napster, and especially its pay-TV service, MultiChoice

(Kwese/Econet 2017). In short, the massive growth in bandwidth throughout the continent and between it and the rest of the world is not only increasing access to the internet but fostering changes across the media, society and economy. At the same time, however, keen observers worry that despite these changes, it is unlikely that more than half of Africans will benefit from these developments unless fundamental changes in politics, policy, justice, and how these issues are thought about take place (Song 2018).

2.4 Emerging Trends

Two major points stand out from this extensive overview. First, U.S. companies, most prominently Google but also firms such as Facebook and Microsoft, have carved out a large place for themselves in key internet infrastructure ownership initiatives. This is a relatively new trend and one that should be watched in the years ahead.

Second, while some of the ownership details are incomplete (such details are a tightly guarded secret in the industry), U.S.-based companies' control over core elements of the global internet—undersea cables, IXPs, internet traffic, and internet users—has steadily slipped over the past two decades. In general, the centre of gravity for the internet has shifted away from the United States towards the Asia-Pacific region and the BRICS countries, but also to the Global South and the European Union. Chinese interests have emerged as key players not just within the Asia-Pacific region but in many areas around the world. Two of its big three telecoms operators—China Telecom and China Mobile—are involved in several key regional projects, while the country's third major operator, China Unicom, has interests in several other key ventures (e.g. the Asia Pacific Gateway, New Cross Pacific, South Atlantic Inter Link (SAIL), amongst others). The big three Chinese telecoms operators cut the most prominent figures in the Asia-Pacific region, but their interests also extend beyond Asia to include cable links to India and the Arab world, from there to Europe, and from Africa to South America. That the Pacific Light Cable Network is also majority-owned by a Chinese real estate and investment firm bolsters the assessment that China is a dominant force in the region—and increasingly, across the world.

Neither is China the only player in this area. National telecoms operators from Japan—the incumbent carrier NTT and the competitive telecoms and internet operators, KDDI and Softbank—have sizeable ownership

stakes in several Asia-Pacific cable systems built over the last decade, as do government-owned carriers from Taiwan, South Korea, Thailand, Indonesia, Brunei, and Vietnam, and national telecoms firms from Malaysia, the Philippines and India. Their emergence is an indicator of the growing clout of a wider range of countries in the region and the rise of competition within them, and the fact that whatever divide one might imagine between "states and markets" when it comes to who owns the world's internet infrastructure, especially in this region of the world, there is far more harmony of interests than often assumed. As a matter of fact, state-owned enterprises routinely sit cheek-by-jowl with historical telecoms monopolies from the private sector, the roster of relatively new competitive operators (e.g. Tata and Level 3) and, now, the internet giants such as Google, Facebook, Amazon and Microsoft. In short, we can see the emergence of a federated internet in which entities and interests cut across national lines and the boundaries between states and markets are represented in microcosm in the many consortia that have built, own, and operate core elements of the global internet infrastructure. When these arrangements do not hold, however, the internet giants, especially Google, are also building and operating their own systems to meet their soaring demand and to bring their services as close to end users as possible, for example: the Pacific Light Cable Network and the Tannat and Junior cables.

A preliminary view based on the available information is that the U.S. internet companies are important but subordinate players within consortia that are dominated by a mix of private- and state-owned national carriers as well as some relatively new competitors. Keen to wrest control of core elements of the internet infrastructure that they perceive to have been excessively dominated by U.S. interests in the past, Asian governments and private investors have also joined forces to change things in their favour. In terms of the geopolitical economy of the internet, there is both a shift towards the Asia-Pacific region *and* an increased role for national governments. A similar phenomenon extends beyond Asia, however, insofar that state and development bank investment, while miniscule at just 1 per cent between 1987 and 2010, has soared to 11 per cent since then (Terabit 2018, 20–28). These changes in ownership and control of internet infrastructure point to much bigger geopolitical and economic changes afoot that are fundamentally reshaping how the internet will develop in the decades ahead, much along the lines that Ronald Deibert has suggested as the next billion internet users—mostly from the Global South—come online (Deibert 2013, 101).

3 From a Universal Dream to the Federated Internet?

While the preceding discussion suggests a world in which the primary competition is between what Strange would call the market and state authority, it is in Edward Snowden's disclosures of mass internet surveillance by the National Security Agency and its Five Eyes partners (i.e. the United States, Australia, Britain, Canada, and New Zealand) and European intelligence services (e.g. Germany, France, Spain and Sweden) that we can see the other tension in this story—namely, that the stature of U.S. structural power in the geopolitical economy of the internet is shrinking (European Parliament 2014). The extent of state surveillance revealed by Snowden, in fact, reveals not so much U.S. hegemony, but rather, that the erosion of the U.S.-centric model of the internet has, in essence, required the U.S. government to work in league with others to carry out its mass internet surveillance programmes. Although the United States and key American internet companies are still in command with respect to some core elements of the internet such as operating systems, internet content, social networks, and search engines, it is complex global alliances and transactions that actually underpin the global internet infrastructure.

These developments indicate an emerging new phase in internet governance and control. In the first phase, circa the 1990s, technical experts and organisations such as the Internet Engineering Task Force played a large role, while the state sat relatively passively on the sidelines. In the second phase, circa the early to mid-2000s, commercial forces surged to the fore, while global internet governance revolved around ICANN and the multi-stakeholder model. More recently, the revelations of mass internet surveillance by many states, and ongoing disputes over the multi-stakeholder/"internet freedom" agenda versus the national sovereignty, multilateral model (which would have the ITU and United Nations system play a larger role in internet governance) all indicate that significant changes are afoot where the relationship between states and markets is now in a heightened state of flux, with a wide variety of new actors on all sides assuming a more prominent role than the past (Schackelford et al. 2015; Powers and Jablonski 2015).

As the locus of the material infrastructure of the internet tilts away from the United States and towards other countries, it stands to reason that they will gain more influence over the policies and practices that shape it.

The emergence of a federated internet therefore has the potential to reshape the internet as we currently know it, with significant consequences for the currently dominant multi-stakeholder model of internet governance. This form of governance, itself an outcome of U.S. internet hegemony (Carr 2016; Powers and Jablonski 2015), is supported by many commercial interests, technical experts, and non-government organisations as well as the United States and Western capitalist democracies. It is pitted, however, against a more state-centred, multilateral model promoted by those who are critical of the unaccountable power of business interests as well as countries such as India, China, Russia and Brazil which—each in their own way—seek to counter what they see as the United States' and Western capitalist countries' dominance of internet governance.

An even fuller response in terms of this "return of the state" idea can also be seen in the efforts being taken by some illiberal countries to build semi-autonomous, national web 3.0 spaces based on the following: (1) systematic filtering and blocking of certain kinds of internet content and websites; (2) fostering national champions (Alibaba, Baidu, and Tencent in China and Yandex and Vkontakte in Russia); and (3) turning to large internet-media-communication campaigns (propaganda and disinformation) to shape national and foreign information spaces (Deibert and Rohozinski 2010, Chap. 2; Noam 2013; Powers and Jablonski 2015). Russia and China are also trying to add international legal norms steeped in nineteenth-century views of state security that would further entrench the semi-autonomous, national web 3.0 model in a multilateral approach to international internet governance. The U.S. declaration a decade and a half ago that cyberspace is the fifth frontier of war (in addition to land, sea, air, and space) has not helped in the least in this regard (United States Department of Defense 2003).

It is also of interest that just as these structural possibilities open up for a significant remaking of the rules of engagement with respect to global internet governance, the United States has essentially walked away from its role as a decisive player in these affairs with the election and subsequent 18 months of the Trump Administration's nativist inclinations and actions. In other words, the mantle in such matters has passed from the United States to China, the EU, and other countries that are more inclined towards multilateral institutional arrangements, rather than the hegemony by proxy implicit in multi-stakeholder governance (Powers and Jablonski 2015). This result, in and of itself, is not necessarily a negative outcome.

More to the point, the logical endpoint of such trends would seem to take us to Noam's concept of a federated internet, possibly structured by multilateral agreements through established entities such as the ITU.

4 Conclusion

In seeking to understand the exercise of power, Susan Strange advocated focusing on structural power—that is, the ability to set the context within which other actors operate—and the balance between state and non-state/market actors. An examination of both issues raises questions about hegemony, and who will win and lose from a particular set of rules. In this case, by examining the development of, first, submarine cable telegraph networks, and, later, internet infrastructure, we can gain insights into the question of the extent of U.S. hegemony in this area and, critically, the scope and direction of changes over time.

The idea that the world was being remade in the image of the U.S. model of economic and technological globalisation has not panned out. Instead, like the world economy overall, the geography of the internet is tilting away from the United States and towards Europe, the BRICS, and the "rest-of-the-world" (Arrighi 1994; Desai 2013). The U.S. internet giants do dominate the "code" and "content layers" of the internet: that is, operating systems (iOS, Windows, Android), search (Google), social media (Facebook), online retailing (Amazon), and over-the-top TV services (Netflix), although in some countries, they hardly figure at all: China, Russia, Korea and Japan. The United States, however, does *not* rule the "guts and the gears"—the hardware, the material infrastructure—of the internet. These core components of the internet are becoming more plentiful outside of, and less dependent on, the United States.

Google is involved in three of the four major undersea cable projects in the Asia-Pacific region that are already up and running, and two more that will be pressed into action in short order. Facebook is also a partner with Google and a Chinese investment firm in the Pacific Light Cable Network currently in the works. Microsoft has joined the fray as well. Based on what we know, the U.S. internet giants' stakes are not dominant in any of these new ventures, however. Instead, a mixture of telecoms carriers, governments, competitive telecom and mobile network operators, and investment funds from the region loom large. The outsized role of China stands out in each case, with China Mobile, China Telecoms and China Unicom having ownership interests in five of the region's six major, recent cable

projects. The fact that there were no new north Atlantic cables laid after 2003 until two recent initiatives—the MAREA and Hibernia cable projects, respectively—also illustrates the point about how the global internet's centre of gravity is shifting to the Asia-Pacific region. The fact that much of the trans-Atlantic capacity that does exist remains to be unlit dark fibre also strikes one as an effort to hold back the extraordinary carrying capacity that already exists in the name of profit over access to affordable communications.

Lastly, parallel private internets are being built by bandwidth wholesalers (Level 3, XO, Cogent, etc.), CDNs (Amazon, Akamai, Level 3, China Cache, etc.), and others to serve the needs of the internet giants and voracious appetites of those they serve. The private internets that are being laid on top of the public internet are meant to bring the services of Google, Baidu, Facebook, Netflix, Youku, and so forth as close to the doorsteps, desktops, and devices of these services' users as possible. By 2014, these private internets were carrying more internet traffic than the public internet in the Euro-American zone, with similar results expected to take place in Asia and the rest of the world in the next few years. The internet is not only fragmenting along geopolitical and regional lines, in other words, but between public and private internets as well.

In sum, there is no longer a single, universal internet—if there ever was—but rather, a multitude of internets. The centripetal forces nudging things in this direction are also fortifying the push for national internets in China, Russia, and Iran as well, amongst others. In this light, perhaps we are at another critical juncture, equivalent to the "big bangs" of the late twentieth century that brought about the kinds of regulated telecoms-internet competition that we have seen for the last 25 years, or similar to the consolidation of the "industrial communications infrastructure" in the late nineteenth and early twentieth centuries. The question that hangs in the balance now is whether we will see the triumph of the "federated internet," as Noam (2013) suggests, or redoubled efforts to build on the two-decade-old dream of a universal, worldwide internet based on a common commercial model and the cultural values of liberal democracy. While the hegemonic vision of a universal, liberal internet may still prevail—history is always in motion—the material evidence suggests its displacement by a federated internet is not an unrealistic prospect.

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