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Landlords of the internet: Big data and big real estate

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Abstract

Who owns the internet? It depends where you look. The physical assets at the core of the internet, the warehouses that store the cloud's data and interlink global networks, are owned not by technology firms like Google and Facebook but by commercial real estate barons who compete with malls and property storage empires. Granted an empire by the US at the moment of the internet's commercialization, these internet landlords shaped how the network of networks that we call the internet physically connects, and how personal and business data is stored and transmitted. Under their governance, internet exchanges, colocation facilities, and data centers take on a double life as financialized real estate assets that circle the globe even as their servers and cables are firmly rooted in place. The history of internet landlords forces a fundamental reconsideration of the business model at the base of the internet. This history makes clear that the internet was never an exogenous shock to capitalist social relations, but rather a touchstone example of an economic system increasingly ruled by asset owners like landlords.

Keywords

internet history, infrastructure, real estate, big data, asset, finance

The first four floors of One Summer Street in downtown Boston are occupied by Macy's. Above, another 400,000 square feet house the internet. There, the Markley Group controls the Boston Internet Exchange Point (IXP), where major traffic purveyors interlink their networks. Inside, cage after cage of servers hum in climate-controlled rooms, protected by security systems that detect fire before there's smoke, backed up by diesel-powered generators sitting on the roof – ready to kick in if the power cuts. Jeff Markley must assure his powerful tenants that their servers will run no matter what. A renowned

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art collector, Markley's Jeff Koons balloon dog sits near graffiti art of Spider-Man and Iron Man guarding the Uninterruptible Power Supply machines, and commissioned Ray Turner portraits of his 100 employees and his Cavalier King Charles Spaniel, Max. Like the internet, art is a communicative medium whose physical life is determined, in the broad sense, by its double life as a durable financial asset (Taylor, 2013).

From One Summer, fiber optics belonging to consumer internet service providers (ISPs) like Comcast and commercial internet 'backbone' providers like CenturyLink travel up and down the coast. Some will end in a 24-story art deco building at 60 Hudson Street in Manhattan, once the headquarters of the Western Union telegraph company. Telephone cables followed the telegraph's cables. Buildings like 60 Hudson housed connections between carrier networks – hence the name 'carrier hotels.' Announcing their lease of 30,000 square feet on the building's ninth floor at the height of the dotcom boom, Telx called 60 Hudson 'the most important address for colocation on the East Coast of the United States' with tenants ranging from Time Warner to France Telecom (Telx, 2000). Like much of the world's most expensive real estate, the internet's key points of connection are coastal: embedded in large financial centers where cables emerge from the ocean (Starosielski, 2015).

From New York, much of the money, messages, and the fiber optics carrying them flows further south to Northern Virginia, just outside Washington, DC. Equinix has 13 data centers here, taking up almost 900,000 square feet in total and using 113 megawatts of power. This is valuable real estate. It took time for Equinix to grow this footprint. In 2003, *The Wall Street Journal* dismissed them as 'a little company that runs hubs for Internet traffic – and that has never made money' (Browning, 2003). But by 2014 the leading paper of American capitalism proclaimed Equinix 'the Internet's biggest landlord' (FitzGerald, 2014).

If the internet is a 'network of networks' then those networks must have physical points of interconnection. These points must be housed, guarded, and maintained, lest traffic be disrupted and the global economy stall. Someone – Markley, Equinix, 60 Hudson Street Owner LLC – collects rent for operating highly specialized buildings, with state-of-the art climate, security, and power systems, in which tenants make their networks available for interconnection, create private connections with strategic partners, and store digital assets. The speed of streaming and the ease of the cloud only exists because of these place-based economic relations.

Who owns the internet? As a complex stack of different technologies, protocols, and politics, there is not one answer. But if we look at the physical foundations supporting the rest of the internet, it is not software developers in control, but firms like Equinix and Digital Realty; whom I call *internet landlords*. At the core of the new economy is one of the oldest: real estate.

The physical foundations of the internet became valuable financial assets at the moment of the network's privatization. This process only accelerated over time. The financialization of internet infrastructure occurred through a partnership between the neoliberal state and the landlords who understood these cables, servers, and warehouses as real estate; an act of conversion that continues to shape the internet's growth and maintenance. This conversion of communications infrastructure into real estate capital is quite literal. Following their competitors, Equinix, "the internet's biggest landlord,"

became a real estate investment trust (REIT), in 2015. Doing so required convincing US tax authorities that their tenants were not primarily purchasing specific services or technologies but were renting out space on the internet equivalent to the space other REITs rented in malls or storefronts – real estate.

This article provides a history of internet landlords, mapping the real estate dynamics undergirding the internet's commercialization, growth, and physical maintenance. It is based on original archival research into the business strategies of internet landlords, drawing from the business press, financial statements, promotional materials, patents, and legal proceedings. For historical and political reasons that will become clear, this sector is most fully developed in the US and so US-based internet landlords – whose footprint now extends around the globe – will be the focus of my analysis.

I make two overarching interventions. First, empirically, the world-spanning technological 'stack' we call the internet is a haphazard assembly of different economic and social interests, sometimes competing, sometimes collaborating. At its base are not the software developers of Google or Facebook but landlords – some of the largest, most powerful ones in the world. Second, theoretically, this history advances STS research on financialization, by demonstrating how real estate capital shapes not just the concrete form of contemporary infrastructure development, but the abstract logic guiding its growth and maintenance, or stagnation and destruction. We build our networks and tunnels, but we do not build them as we please; we do not build them under self-selected circumstances, but through the asset classes, tax laws, and dead malls given and transmitted from the past.

I first review existing literature on the economic geography of the internet, showing how its empirical lacuna regarding who owns internet infrastructure can be resolved through STS literature on assetization and infrastructure. I then discuss the primary assets owned by internet landlords, how they interact, and how that business landscape emerged historically: internet landlords privatized state infrastructure, then grew their footprint by purchasing distressed assets with private equity cash after the dotcom bubble burst, before becoming financial instruments themselves –REITs – and thus some of the world's most profitable real estate firms. I conclude by reflecting on how contemporary infrastructure serves finance, rather than the reverse.

Internet infrastructure, assetized

Recent critical scholarship on the social life of data centers has sought to bring 'the cloud' down to earth (Hwang & Levy, 2015). Starosielski's (2015) touchstone cultural history of undersea cable networks describes the successive political-economic regimes that laid and fixed telegraph cables and fiber optics. The work of Hogan and her collaborators anchors the field, ranging from demonstrations of state and corporate control of global data through control of strategic locations (Hogan & Shepherd, 2015), to the settler-ecological thinking embedded in the tech sector's infrastructure projects (Hogan, 2018).

I build on this critical scholarship by exploring the specific economic interests of those who own internet infrastructure. As Haila (1988: 79) argues, 'it is precisely real estate markets which transmit the effects of general economic change on space'. To

understand the social space of internet infrastructure, we must investigate its production, circulation, and exchange as a real estate asset.

Work in economic geography has responded to utopian hype by showing that internet infrastructure has followed existing distributions of economic power. Zook finds this geographic concentration to be true of domain name registrations (Zook, 2000) and e-commerce (Zook, 2002). Graham and collaborators build on Zook's work to address the uneven and combined development of the internet (Graham, 2008; Graham & Mann, 2013).

Yet critical scholarship on the social life of data centers has largely not discussed their economic life – much less the difference between them and related asset classes like internet exchanges. And while economic geography has done well to map the industrial organization of data, it has not asked the same questions of the anonymous concrete buildings warehousing data.

This anonymous power is a hallmark of financialization. And it is in the STS literature on the economic life of infrastructure, specifically assetization, that we find tools for addressing the peculiar development of internet landlords. Rather than rebutting internet evangelists' stories of a weightless, seamless network, this literature allows us to approach the cables and cages of internet infrastructure as yet another 'boring thing' that, like bridges or telephone books, conceals deep social conflict (Star, 1999). Indeed, by asking the question of who owns the internet in terms of those cables and cages, rather than the content moving through them, we can understand the world-making power of the internet as one expression of a broader political economy of assetization that dominates contemporary capitalism – rather than an exogenous shock to that system. After all, the US recently had a landlord president, and today the majority of global wealth is invested in real estate (Stein, 2019).

While capitalism is often defined as a process of commodification – the transformation of things into objects produced for sale – today capitalism is marked just as much by processes of assetization: the transformation of things into resources controlled through monopoly rights, generating revenue through rents and speculation against future value. A tree's wood or an artist's CD would be a commodity, while a lumber REIT or a song's copyright is an asset (Birch, 2017). 'Assets can be bought and sold, yes. But the point is to get a durable economic rent from them, not to sell them on the market today' (Birch & Muniesa, 2020, p. 2). 'Real estate' is the name we give to assets of and on land.

Approaching the creation of the internet as a matter of assetization shifts our focus away from the struggles of inventors and entrepreneurs to the processes whereby states create and grant property rights. Real estate investors appear then not as a stagnant or parasitic branch of an otherwise dynamic capitalism, but as a class charged by the state with integrating new infrastructure into the global economy. These capitalists employ a range of experts specific to their assets – engineers, lawyers, physicists – in order to establish their current and future worth (Birch & Muniesa, 2020). Such experts have been integral to the rise of the New Public Management that transforms public goods into assets (Muniesa & Linhardt, 2011). For example, the massive Thames Tideway Tunnel sewer renovation project is funded not through public debt but through private financing secured by private utility Thames Water from institutional investors such as sovereign wealth funds (Loftus & March, 2019). In South America, developmental states are

formalizing urban transportation not through state investment and management of public bus or rail lines but by financing the construction of new bus rapid transit systems, backed through the state's credit, and auctioned off to private, often foreign, investor-operators (Paget-Seekins, 2015). It is not merely an ideological inclination to privatization that drives these moves, but the real fears of debt-averse governments and the training of administrators and experts through universities, NGOs, and trade associations that stresses this is the most effective way to build things. The internet is just one (massive) example of an infrastructure project that, under the conditions of contemporary capitalism, was always already assetized.

A brief history of internet landlords

The shape of the market

The internet's infrastructure evolved with its landlords. Relaying this history requires first outlining what's in internet landlords' portfolios. Some internet landlords own their buildings, giving them power to extend and renovate them as needed. Others lease the buildings but take charge of all essential operations within them – sacrificing some control over the physical plant to gain some flexibility in their long-term business strategy. Depending on their strategy, internet landlords will pursue different investments in different places. These investments take the form of three distinct but overlapping asset classes.

First, there are internet exchange points (IXPs): public peering locations wherein multiple large purveyors of internet traffic, such as Network Service Providers or Content Delivery Networks, physically interlink their networks. In the US, IXPs are usually privately operated, one of many services offered by large commercial colocation facilities (e.g., Equinix's Ashburn facility). Elsewhere, IXPs can be run as cooperative, nonprofit, or governmental ventures. There is usually one for each major market.

Second, there are carrier hotels or 'colo' – short for 'colocation' – facilities. Carrier hotels began with telephone companies, places to physically connect networks. Today, tenants pay for space for their servers, bandwidth to them, and connections to other networks – whether other tenants or large traffic purveyors that have laid fiber into the building. Equinix is by far the world's largest colocation provider.

Tenants of colocation facilities provide and maintain their own servers. Rentable space can be as small as a single server in a cabinet in a cage, or as large as a room of their own cages. Tenants with shared business interests (e.g., a rideshare firm and a mapping startup) will use their proximity to cross-connect via fiber-optic cable. This is 'private peering.' Typically, peers pay the landlord for the router and connection set-up, and sometimes a monthly maintenance fee. In the US, private peering through colocation facilities is more common than public peering through IXPs. In Europe, the reverse is true, though Equnix's global expansion is shifting the balance (451 Research, 2015). A roster of big clients with whom other tenants might wish to cross-connect – Amazon, Facebook, equivalent to department store 'anchor tenants' that draw foot traffic to malls – can give the landlord additional pricing power and allow them to substantially raise rent. Equinix calls these 'magnet customers.'

Finally, there are data centers. While it has become something of a catch-all term, I use 'data centers' to describe facilities whose primary use is storage, not networking. Data center landlords install, manage, maintain, and optimize tenants' servers; taking over tasks that carrier hotels leave to clients. This is the physical business arrangement for the cloud. Equinix's chief competitor Digital Realty focuses on data centers.

These agglomerations harden over time. New York's 60 Hudson Street could not simply be dropped in North Dakota and hold its value. Its network connections were built on the paths laid by previous telecommunications regimes. And it is next-door to both the center of a data-hungry industry – finance – and transatlantic internet backbone. In any location, the fixed capital investments made by existing landlords and the density of interconnections made by their tenants discourage new entrants.

While the details differ between business models, operating budgets are broadly similar. Some of the most important expenses are relatively stable: staffing, maintenance, and rent – especially for those landlords – like Equinix – that do not own their own buildings. Other expenses vary. Chief among these is electricity, 40% of the typical data center operating budget (Pham & Donovan, 2017). The largest providers benefit from an economy of scale that discourages new entrants (Sverdlik, 2016). Utility expenses encourage consolidation, but so do construction costs. Like most real estate ventures, the biggest investments are paid upfront during construction: 73% of a typical data center's initial capital expenditure (12 times their annual operating costs), is spent on the equipment within the data center facility (Pham & Donovan, 2017). Larger landlords have more cash on hand and can take on more debt to fund construction.

How did this business model for the construction and maintenance of internet infrastructure emerge? As a class, internet landlords were birthed by the US property state, which tasked private actors with housing the commercializing internet's network connections in the 1990s. Telecommunications executives and more traditional real estate investors poured into the industry during the dotcom boom. The latter came to dominate after the bubble burst, as private equity cash poured into the market. As Web 2.0 drove up the demand for data storage, the market consolidated, and internet landlords transformed their firm and its cables, servers, and warehouses into financial assets themselves – REITs.

The Property State and the First Landlords

Nature grants no mortgages. The creation and circulation of real estate assets requires state intervention. As children of the 1990s, internet landlords owe their existence as a class to the privatization of existing state assets and the state's creation of a private market for internet infrastructure.

This is the work of what Haila (2000) calls the 'property state': a set of political institutions that create markets for land and property so as to integrate them into the broader economy, and that intervene in those markets so as to expand the type and amount of rents available to landlords, the parties with exclusive control over that land and property. The property state transforms fixed, local real estate into liquid capital, enmeshing those localities in global capital flows and thereby providing funds for local development. Viewed this way, internet landlords – especially large, heavily capitalized ones

– are not private parasites on public goods but deputies of the property state, turning internet infrastructure into financial assets and integrating that technology into global capital markets.

Throughout the late 1960s and into the 1970s, several publicly funded research-focused digital communication networks emerged around the world. The TCP/IP communication protocol standardized communication across these networks in 1984. But just because these networks spoke the same language did not mean they could converse. That demanded physical interconnection. While alternatives were available, the US property state pursued interconnection through the privatization of these assets and the creation of new ones.

Network providers PSINET, UUNET and CEFRNET built the first commercial internet exchange – CIX – in Washington, DC in 1991 (Greenstein, 2017). CIX charged networks a flat fee for connection to its router. Every subscriber, big or small, promised to connect to each other for free. Other CIX routers were soon added in Santa Clara and Chicago. Their model worked so well that in 1992 some of its founders came together to pledge their traffic to the first regional Internet Exchange Point, which would be built in an unassuming office building in Tysons Corner, Virginia. The Metropolitan Area Exchange – MAE East, with 'East' hinting at plans for expansion – was operated by MFS Datanet. Its switch coordinated the movement of traffic between every network that connected to it. MAE East was soon 'the crossroads for fully half of all the world's internet traffic' (Blum, 2012, p. 61) and MFS Datanet the first internet landlord.

Senator Al Gore had long envisioned a commercialized internet as an 'information superhighway', a logistical network to support 21st century US capitalism, as the interstate system did for postwar US capitalism (Greene, 2016). His 1991 High Performance Computing Act apportioned $1.547 billion to the NSF to upgrade ARPANET's civilian successor NSFNET in support of this mission.[1] Some of this money went to backbone upgrades and some went to funding new regional ISPs, but much went to creating 'on-ramps' to the superhighway: Network Access Points (NAPs) that linked networks together (Frazer, 1996). These were the first IXPs. MAE East had been so successful that the NSF used it as a model, contracting large telecommunication providers like Sprint and Pacific Bell to build and operate four new NAPs across the country (Blum, 2012, p. 64).

The NAPs followed regional concentrations of wealth in New Jersey, San Francisco, Chicago, and Northern Virginia (Townsend, 2001). Gore and the NSF created valuable private real estate from previously public goods. But not all prospective tenants and landlords were happy. In the NAPs, tenants connected through one central router – owned and operated by a landlord who levied charges based on metered traffic. This created a chokepoint, controlled by the landlord. Networks were literally running out of spaces to put their wires. Smaller players struggled to afford the rates required for entry.

In Palo Alto, Jay Adelson and Brian Reid created a different business model: a neutral landlord that would help tenants connect directly with each other, rather than through a central router. Leases were based not on variable traffic but simply the space for tenants' servers (Blum, 2012). In 1996, they opened the Palo Alto Internet Exchange (PAIX) in an old telephone switching office. Located in the heart of the dotcom boom, and near landing sites for transpacific cable, PAIX quickly become an important hub. Adelson left

his job and started a new company with the same carrier-neutral, rent-by-the-cage model in Northern Virginia, where fiber and land were more readily available (Equinix, 1999). This was Equinix, which would become 'the internet's biggest landlord'. In 2010, as part of a $683.4 million acquisition of competitor Switch & Data and their 34 properties, PAIX was returned to the company Adelson founded (Equinix, 2010).

The US property state created the first internet landlords and two of their asset classes: IXPs and carrier hotels. Privatization and legislation led directly to the creation of proto-IXPs in CIX and the NAPs. Competition with them led to Equinix's colocation model, which quickly supplanted telcom-run carrier hotels and NAPs. Indeed, some observers argue that government privatization and Equinix's success in private peering kept the European cooperative model for IXP governance from taking root in the US (Chatzis et al., 2015). This transformation of servers, cables, and warehouses into valuable financial assets paralleled the US property state's creation of and intervention into other real estate markets in the same period. While the 2008 crash brought global attention to the integration of housing markets and financial equity markets, the groundwork was laid in the 1980s and 1990s as the Departments of the Treasury and Housing and Urban Development crafted new regulations that encouraged the securitization of mortgages (Ashton, 2009).

Dotcom growth

The property state's internet wager paid off immediately. Existing infrastructure became more valuable, new infrastructure was built, and a whole new class of real estate capitalists was created. From the mid-1990s to early 2000s, internet landlords expanded their physical footprint to support the increasing digital footprint of the commercialized Web. Two broad categories of entrepreneurs entered this gold rush: traditional real estate developers and telecommunications providers. Equinix was the notable exception, founded by network operators who realized early on that networking sites were valuable real estate.

Established real estate developers realized the physical infrastructure at the core of the dotcom boom would make a good addition to their portfolios. For example, data center operator Global Switch Holdings was founded in 1998 by British real estate heir Andrew Ruhan, who sold a majority stake to developer Elliot Bernerd in 2000, whose firm owned London's famed Camden Market (Davey, 2005). The Markley Group (Leung, 2000), Switch and Data (Switch & Data, 1998), QTS Realty (*Kansas City Business Journal*, 2019), and DuPont Fabros (Haggerty, 1999) were all internet landlords whose leadership had similar origins: moving from malls, hotels, and office buildings to internet infrastructure in the years after the internet's commercialization.

Other founders came from telecommunications, largely because the carrier hotels they were already operating were quickly becoming colocation facilities for internet service providers and early content networks. These were the firms running the property state's NAPs. Other new landlords started on the fringes of the telephone business. Telx's origins lay in autodialers, digital switching, and fax-over-internet offerings, but in October 2000 the firm announced they were and would be focusing on colocation (Telx, 1998, 2000).

Beyond the founders, there was also significant overlap between telecommunications and real estate in executive personnel and corporate strategy. Switch and Data was founded by real estate entrepreneurs but, beginning in 2000, was led by a series of chief executives who came from telecommunications firms such as AT&T, Lucent, and Verizon (Switch & Data, 2000). CRGWest, later CoreSite Realty Corporation, was created specifically to manage two valuable California buildings, but their value came from their history of onsite telecommunications networking (Tucker, 2002).

Private equity and the dotcom bust

The good times did not last. The dotcom bubble soon burst. But one capitalist's loss is another's gain. Following the dotcom crash, the devalued physical infrastructure supporting Web 1.0 was redeveloped to support a more profitable landlord model. Not by internet entrepreneurs, but by real estate investors – specifically private equity. Private equity had more money and technical expertise than the telecom executives and property tycoons who had started landlord firms, and so were better equipped to realize the property state's goal of integrating internet infrastructure into global financial markets. Buying devalued properties for cheap and consolidating them into more attractive portfolios, private equity further abstracted these assets' financial value from their use as communications infrastructure.

Private equity funds are investment firms where limited partners (i.e., wealthy individuals, pension funds) invest into a portfolio targeting privately held companies. General partners manage those funds and take both a management fee and a portion of returns. Private equity approaches portfolio companies as fungible assets that can be broken apart or put back together at will; mass layoffs, debt sales, asset stripping, and deferral of pension obligations are all popular strategies for increasing a firm's value. This approach often translates to rapid cash infusions into privately held firms in the name of expansion and an eventual initial public offering (IPO) on a stock market, or the acquisition of publicly traded companies so that their assets can either be stripped off or loaded with debt that is taxed at a lower rate than other assets, debt leveraged to grow the company before a sale or support portfolio's other investments. This model grants general partners high rewards but little risk and encourages a short-term outlook on portfolio firms (Appelbaum & Batt, 2014).

By 2001, dotcoms were folding left and right and there was little demand for the glut of data centers and colocation facilities built during the boom (Joyce, 2001). 'Big data centers stand empty', the *Washington Post* declared in a 2001 headline. In Northern Virginia, developers were pulling out of deals to build new data centers or putting existing deals on hold. The story was the same for the big carrier hotels in New York like 60 Hudson, where oversupply meant many landlords were having difficulty finding tenants while overvalued startups in the sector were stripped of their assets during bankruptcy (Ryan, 2001). For example, Colocation provider Colo.com spent $400 million building out its 22 facilities across the country, but went bankrupt and had its portfolio auctioned off for $44 million (Long, 2001). The sector was overbuilt. In 2001, Gartner, Inc. estimated that there would be 50 million square feet of data center real estate in North America by 2005 − but only 20 percent of it would occupied (Swett, 2001).

This buyer's market was further buoyed by the property state's rock-bottom interest rates. Those landlords left standing after the bubble burst were, with the support of a new set of financiers, ready to acquire this devalued real estate and expand their footprints. Private equity giant Carlyle had begun financing data center construction in the late 1990s (Spinner, 2000). Its competitors warmed to these now-distressed assets in the early 2000s. They anticipated regular contracts with large tenants in tech, health, and finance; steady cash flow; and opportunities for expansion (Kang, 2018). Some of their peers had been burned by the collapse of telecommunications stocks they had bought up in the wake of the industry's deregulation by the 1996 Telecommunications Act, but others saw these assets for what they were – not phone companies, but space rented to them and their peers – and jumped in (Malik, 2003).

DuPont Fabros, an alliance between a DC-area commercial real estate investor and an heir to the du Pont family fortune able to act as his own private equity fund, made this explicit when they took the firm public in 2007. They argued their growth was based on a canny approach to 'acquiring data centers that were distressed assets between 2000 and 2003', treating them not 'as a service-based market' but 'as a new class of real estate' (DuPont Fabros Technology, 2007, p. 82).

On the West coast, private equity firm GI Partners was initially financed by the California Public Employee Retirement System (CalPERS). They founded data center giant Digital Realty in 2004 through the purchase of bargain-priced data centers: 'Buying data centers post dot-com crash, which is really what happened, allowed GI and CalPERS to buy at very attractive cap rates [the ratio of net property income to property value], double-digit cap rates', said Digital Realty CEO Bill Stein in 2017 (Data Center Knowledge, 2017).

The nature of internet landlords' business means their buildings often physically consolidate competitors' holdings – i.e., Equinix and Digital Realty rent significant space from each other – but private equity also proved to be a force for concentration in three other ways.

First, private equity created new firms to run buildings that were previously independently operated. Digital Realty was born from 21 distressed carrier hotels and data centers purchased at a 20-40% discount. It went public in 2004, drastically increasing the value of GI's shares and allowing them to sell for a massive profit by 2007 (GI Partners, n.d.). In 2001, the Carlyle Group similarly consolidated its portfolio into a single firm named CRG West, later CoreSite Realty, which 'was formed to focus on data centers as a commercial real estate niche expected to grow again once the economy recovered' (Conrad, 2007).

Second, individual private equity funds invested in multiple competing firms in the sector, centralizing the financing of internet infrastructure. Besides Digital Realty, GI Partners also purchased Telx Group in 2006, owner of major colocation facilities in New York and Atlanta (Miller, 2006).

Finally, private equity consolidated corporate governance of internet infrastructure. Michael Foust, founder of GI Partners, was Digital Realty's CEO from its founding until 2014, keeping the fund's hand on the company long after it sold off its last shares in 2007 (Miller, 2014). Seaport Capital's co-founder, William Luby, was chairman of Switch and Data's board from 1999 until 2010, when the company was acquired by Equinix. Luby

joined Equinix's board and remained a member until 2021. If landlords own the internet, then private equity owns them in turn – at least until they're ready to sell.

The cloud boom

By 2006, rents were rising, slack in the market had disappeared, and internet landlords were reaping the rewards of a new boom in internet advertising revenue. 'The demand right now is such that anybody who has a data center has a very valuable piece of property. Whereas 3 years ago, you couldn't give them away', Ron Hughes, president of the California Data Center Design Group, said in 2006 (Bednarz, 2006). Private equity's bet on internet landlords had paid off.

At this time, communication was supposedly being democratized through Web 2.0; the 2006 TIME Person of the Year was 'You'. But the infrastructure undergirding this boom was increasingly under the control of a few large landlords. User-generated content was key to this surge in demand for internet landlords' space. Selfies need a physical home, even if users never saw it. After September 11th 2001, large firms also increasingly sought secure back-up locations for their data. Enterprise demand concentrated even as it grew. In 2006, 57.5% of The Markley Group's rent revenue from their One Summer Street facility in Boston – mixing IXP, collocation, and data center in one space – came from just two clients: WillTel and Qwest (CWCapital Commercial Funding Corp, 2007). Right before their IPO, 70% of DuPont Fabros' revenue came from Microsoft and Yahoo! alone (DuPont Fabros Technology, 2007).

For landlords that had survived the recent downturn and reaped private equity investment, this was a period of intensive growth. It was a seller's market. In November 2005, Equinix had a waiting list for its space 20 companies long. Since 2003, they had increased their physical footprint by 50%, expanding existing facilities, buying six new ones, and seeing 30% year-over-year revenue increases. Landlords were shortening the length of their deals – from four or five years to one or two – and doubling rents (Marsan, 2005). Growth continued through these boom years. And landlords sought to secure these gains by restructuring their companies as a specific kind of investment vehicle, making clear in the process that to them the internet was just another piece of commercial real estate. Here, the assetization of internet infrastructure reached its climax.

REITification

Besides Equinix, the largest US-based wholesale data center or colocation providers – CoreSite, CyrusOne, QTS Realty, and Digital Realty – are all incorporated in the mid-Atlantic US state of Maryland. The region is an important market, but the real reason for their common corporate home has more to do with the property state and the process of assetization that swept through this sector following the Web 2.0 boom. These firms, including Equinix, are all structured as Real Estate Investment Trusts (REITs), basically a mutual fund for specific classes of rent-collecting properties. Because of friendly regulations, two-thirds of all REITs are registered in Maryland – though the real count is likely closer to eighty percent because subsidiary REITs often share a parent company – and they make up about half of all publicly-traded companies incorporated in Maryland

(Sherman, 2015). If most REITs lead to Maryland, what led internet landlords to becoming REITs?

REITs allow internet landlords to legally structure their assets as tax-advantaged real estate investments open to global financial markets; investors from Germany or Japan can then trade in shares of apartments, nursing homes, or data centers in Virginia or Brazil. Restructuring the corporation as a REIT was the sector's preferred method for securing the gains of the Web 2.0 boom. Doing so required regulators to agree that, yes, the internet was a rentable piece of real estate, that landlords weren't servicing tenants' equipment but carving up pieces of the internet for them to lease. This became clear when Equinix ran into regulatory trouble with its REIT conversion in 2012.

During this period, internet infrastructure gains a clear double life as a liquid financial asset. A 2016 Digital Realty earnings presentation argued that their historic growth rate exceeded that of other REITs like Public Storage, Simon Property Group, and AvalonBay Communities because, compared to storage units or malls, data centers were 'sticky': Tenants invested a great deal of fixed capital in the site and so were loath to leave (Digital Realty, 2016).[2] Thus it is not just private equity investment that makes the wires and cages at the internet's heart a part of finance's airy heights, it is the transformation of that space into a specific kind of financial asset. No simple process of abstraction, this financial restructuring required a head-on confrontation with the corporality of our networks: To secure their status as REITs, internet landlords had to prove that the internet was a physical place you could own, manage, and lease, like an apartment building or a storage unit. It became a legal and financial fact that internet landlords lease (and leverage) internet real estate, and that those physical pieces of their network also circulate the globe as bundled securities.

The US property state created REITs in 1960 as a special tax status for real estate-owning trusts, in order to encourage small investors to take part in postwar urban renewal, and then expanded the category to include more assets like internet infrastructure in the 1980s and 1990s. Dividends from REITs have no federal corporate income tax assessed as long as: 90% are paid out annually, 75% of assets are in real estate, and 75% of income are rents from 'real property'. A good deal, but one initially only available to a small group of traditional US real estate investors. In 1972, REITs had a total market capitalization of only $1.5 billion.

The creation of a market for internet infrastructure was one part of the US property state's broader transformation of the commercial real estate market, turning it from a relatively boring, stable area of finance with low, regular returns, and into a dynamic, high-gain part of the global economy, wherein everything that was or could be landed property was potentially an asset. In this way, it is important to read something like Al Gore's High Performance Computing Act of 1991 − which created the first IXPs as 'on-ramps to the information superhighway' – alongside real estate regulations in legislation like the Tax Reform Act of 1986, the Technical and Miscellaneous Revenue Act of 1998 and the REIT Modernization Act of 1999. Collectively, these bills lowered the barrier for REIT status, made it easier to maintain that status, let REITs provide services to tenants and create taxable subsidiaries to operate properties as businesses, and, most importantly, allowed REITs to diversify into other sectors. The first timber REIT was created in 1999, followed by REITs that owned billboards, casinos, nursing homes, private prisons, self-storage

facilities, hotels, and, of course, internet infrastructure. In 2016, REITs' collective assets were worth $1.8 trillion, a thousandfold increase in forty years (Gravelle, 2016).

The expansion of REITs made it easier for global investors to put money into local malls or warehouses without owning or operating them – especially once REITs began being publicly traded. In this way, 'REITs contribute to the financial fluidity of property (fixed capital) by disembedding the process of investment from the procuring of local knowledge necessary to assess risk. In doing so, REITs help to transform real estate into a liquid commodity by enabling investors to buy and sell interests in diversified portfolios of properties on an instantaneous basis' (Gotham, 2006, p. 265). Property states in Asia and Europe expanded REIT classification following regional recessions, bringing undervalued, distressed assets back into global circulation and pouring global cash into local real estate markets after local investors had been wiped out. Similarly, internet landlords began their transformation into REITs after scooping up assets devalued through the dotcom crash.

Digital Realty was first in 2004. DuPont Fabros followed in 2007, CoreSite in 2010, CyrusOne and QTS Realty Trust in 2013, and Equinix, already public, converted itself to a REIT in 2015. In 2016, S&P Global Ratings said that REITs 'tend to outperform in low-interest rate environments and when the economy is on the up-and-up', and REITs had done better than US stocks and government bonds over the previous decade. S&P listed Equinix and Digital Realty as two of the top three performing REITs over a 10-year span (Yeatts & Juge, 2016).

But Equinix's REIT conversion, announced in 2012, was never assured. It required a philosophical confrontation with the nature of property and the internet. Tax regulators at the US Internal Revenue Service (IRS) chose the Equinix case as the point where internet landlords had to prove that the internet was a place, one that could be divided up and rented out. This was the fight Equinix had to win to transform all those concrete warehouses filled with caged servers into liquid, mobile financial assets.

Underlying the rise of REITs made up of data centers and exchanges was the assumption that these facilities fit an elastic legal definition of 'real property': land, improvements on land, permanent structures, or structural features of buildings. In 2013, the IRS temporarily halted REIT rulings as it conducted a review of eligibility standards. Equinix stock fell, their prospects unclear. After all, servers and cages were not land, permanent structures, or structural features of buildings. They were modular, regularly upgraded, reassembled, and moved. And tenants' contracts looked more like service agreements than the leases signed by a store in a mall, agreeing to standardized payments for things like security and parking and rated payments for heating, cooling, and interconnection. At the time, 'Equinix's own customer contracts expressly state[d] that they are service agreements, not leases of real property, and that space is 'licensed'' (Citrome, 2014, p. 207). Because power and climate control are at the core of landlords' value proposition, one tax analyst argued that 'these server farms and data centers operate more as unregulated utilities than as real estate landlords' (Boos, 2015).

Equinix said that none of these features were accessory to their business but central to their sector's product offerings: data storage and transmission. Essentially, they argued that while the internet was much larger than any one of their facilities, tenants would not be able to work on or through the internet without renting space from landlords and the

support that came with it. Their local properties were rentable pieces of this global, networked whole. The IRS eventually agreed, ruling that 'tenants' IT equipment is not functional unless it is connected to and exchanging data with the network existing outside the Centers' (Internal Revenue Service, 2014, p. 2).[3] Coincidentally, Equinix's lobbying expenditures in 2014-15 were greater than that of prior four years combined (Center for Responsive Politics, 2020).

Equinix was now officially a real estate investment trust, and likely saved around $150 million per year in taxes as a result of the conversion (Troianovski, 2012). On top of soaring demand, these friendly financial terms drove more investment into the sector – leading to massive sales like that for the One Wilshire Boulevard exchange, the most expensive real estate transaction in Los Angeles history when it closed in 2013 (Vincent, 2013). In 2020, the five internet landlords structured as REITs were worth a collective $110 billion – with Equinix and Digital Realty making up the vast majority, $98.7 billion (Hoya Capital Real Estate, 2020).

The internet was now, for tax purposes, officially a space you could divide, rent, and trade. And it was not software developers, or anyone building for the Web, who had made it so. It was landlords, who had transformed their organizations into financial assets, REITs, based on this principle. Everyone else online was just passing through their property lines.

Consolidation and the threat of big tech

Today the industry is marked by a consolidation of both supply and demand. The latter threatens the business model of many landlords. Some tenants in enterprise and consumer software have grown so powerful as to buy their own space, rather than renting. Despite this threat, all signs point to internet landlords remaining in control of internet infrastructure because they control the real estate market for it; where tech giants are simply adding resources to support their core business.

First, supply. The number of internet landlords has shrunk through acquisitions. The high costs of construction, the lower cost of power for large landlords, and the difficulty large tenants face in moving their customized assets between landlords has meant that the bar for new entrants was always high. But the largest internet landlords have acquired smaller rivals, their war chests stuffed with profits from Web 2.0 demand, private equity investment, IPOs, and REIT-based tax avoidance. This growth can be intensive, allowing them to offer new services to old tenants. For example, Digital Realty acquired telx for $1.89 billion in 2015 so that the datacenter giant could also provide colocation services (Dulaney, 2015).

This growth can also be extensive, expanding their geographic footprint. Because their assets are fixed in place and competitors can squat on prime real estate – especially for colocation and IXPs – acquisition is essential to landlords' growth, which is no surprise for a sector so heavily enmeshed with private equity. The acquisition frenzy has also coincided with a push from large telecommunications providers to sell off their data centers. Equinix's recent acquisitions combine these trends. The 2015 acquisition of UK-based Telecity for $3.6 billion, combined with their existing properties, made Equinix the largest datacenter and colocation provider in Europe (Zekaria, 2015). This push continued east with the acquisition of Zenium's Istanbul data center in 2017

(Equinix Inc, 2017). After opening a colocation facility in southern Florida 'to act as a bridge', Equinix began a $500 million spending spree on Latin American properties that included the $225 million purchase of ALOG in Brazil (Verge, 2014) and the $175 million purchase of three Mexican data centers (Equinix Inc, 2020). Their Latin American portfolio was rounded out by the purchase of 29 Verizon colocation facilities for $3.6 billion, a sale that included properties in Colombia and Miami and 600 new enterprise customers (Hufford, 2016).

Second, while the demand for internet landlords' properties has skyrocketed, more and more of that demand has come from has fewer and fewer tenants. Large technology firms – Netflix, Microsoft, Amazon, etc. – that have powered financial markets to new heights during an era of secular stagnation account for much of the demand. This trend began during the early 2000s but has accelerated of late. Today, Digital Realty takes in 53.2% of its revenue from its 20 largest customers, with 9.6% coming from an unnamed 'Fortune 50 Software Company'. 63 of its 225 data centers were occupied by a single customer in 2019 (Digital Realty Trust Inc, 2020). The purchasing power of these 'hyperscale' customers is so great that they now dictate the design and layout of new data centers, forcing smaller tenants to adjust their assets to fit (Fulton, 2019).

Internet landlords worry about losing significant revenue if these tech giants decide to build space instead of rent. In their annual reports for 2018, four of the five publicly traded data-center REITs – Digital Realty, CoreSite, CyrusOne, and QTS – offered similar warnings about the risk of key customers opting to build or expand their own data centers. Digital Realty cautioned that 'our customers may choose to develop new data centers or expand their own existing data centers or consolidate into data centers that we do not own or operate, which could reduce demand for our newly developed data centers or result in the loss of one or more key customers.' Equinix was alone in not offering such a warning. Their business model focuses on colocation rather than wholesale data storage, so they are less vulnerable to threats from tech giants, who have been busy building data centers for their own use but have no interest in expanding into carrier hotels.

For consumer software firms like Facebook and Apple, these new buildings are largely meant to house their own assets, or the data of users sending pictures, messages, and other media. Enterprise firms like Amazon and Microsoft build for themselves, and for the cloud infrastructure they provide to businesses. The manager of Facebook's first data center said in 2010, 'We're much more able to control our costs by doing it this way' (Letzing, 2011). Apple, Google, Amazon, and Microsoft have each announced similar multibillion-dollar facilities expansions.

Some scholars use these building sprees as evidence for big tech's control of the internet's infrastructure from top to bottom, from the consumer-facing Web to the servers and cages storing and moving our data – the 'stack' (Bratton, 2015). Hindman (2018) correctly describes Google's massive fixed-capital investments as an example of how internet-based markets tend towards concentration, because of network effects and economies of scale. But just because firms like Google and Facebook dominate the headlines and the stock market, it does not mean they are close to dominating the stack. Different pieces of the stack exist in different markets with different incentives, different restrictions, and different competitors. The bottom of the stack is run by landlords, not software developers, and will be for the foreseeable future.

Landlords' current advantage against big tech can be roughly measured in two ways: their physical footprint and the reach of their network. At the end of 2019, Google had 19 data center facilities − 11 in the US, 5 in Europe, two in Asia, one in South America' (Miller, 2019). In comparison, Digital Realty has 225 data center facilities − 147 in the US, 3 in Canada, 41 in Europe, 19 in Latin America, 10 in Asia, 5 in Australia – totaling 36.6 million rentable square feet (Digital Realty Trust Inc, 2020). Even if every Google data center is among the world's largest, totaling more than a million square feet, they still would not touch the square footage of Digital Realty, who, while the world's largest data center operator, is but one landlord.

What about the breadth of their networks? We can approximate this by the number of network connections. Equinix, the world's leader in private peering – although, again, just one landlord profiting from colocation – is perhaps the better comparison here. In July 2020, according to industry tracker PeeringDB, Google had 231 public peering points and 121 private peering points, spread across the world in various landlords' facilities. At Equinix's Ashburn, Virginia exchange alone, there are 282 peers.

A tremendous amount of money and innovation may go into Google's advertising networks, but those networks are largely housed in cages rented from a third party. Of Google's 231 public peering points, 22 are housed in Equinix facilities. Equinix similarly holds 35 of Google's 121 private peering points. As for the data centers themselves, while tech giants – especially Google and Amazon – do invest in their own data centers for their own needs – rather than leasing them out, as landlords do – their relationship with internet landlords is largely symbiotic: 'The cloud and internet giants lease more than 70 percent of their hyperscale data center footprint from commercial data center operators' (Sverdlik, 2019). The symbiosis is unsurprising since they don't directly compete. Google isn't in real estate. They're in advertising. Tech giants don't lease out physical space, though they own a tremendous amount of it. Their data centers are largely for their own use.

Digital Realty CEO Bill Stein told a REIT investor forum that he expects each tech giant to go through cycles of building before returning to leasing because 'What we do for cloud providers that they can't do for themselves is that we build on a very cost-effective basis' (FD Wire, 2017). Ratings agency Moody's notes that a build/lease mix is normal for a given company in a given year: Building secures core assets for the long term, while leasing aids speedy growth (Moody's Investors Service, 2017). Given these caveats from the sector's leaders and regulators, and the entrenched landlord power, I suspect that big tech's recent building spree largely parallels landlords'. Both benefit from the booming profits of a sector that, unlike much of the global economy, is still growing and, like much of the global economy, is a prime target for financial speculation. For now, as far as the infrastructure at the bottom of the stack goes, this is still the landlord's internet. It is they, and not big tech, who are collecting rents at the internet's physical core.

Conclusion

The physical points of interconnection that knit together the network of networks we call the internet are built and maintained by landlords. They extract rents from tenants who send and store large amounts of data and understand themselves to be competing with

other real estate empires dealing in storage units, or malls, or apartments, or nursing homes. This market was created by the property state during the internet's commercialization, before growing in the dotcom boom, maturing in the bust as private equity bought up devalued assets, and expanding rapidly through Web 2.0. Their status secured through their transformation into REITs, internet landlords have today expanded across the world, to the point where the only challenge to their power comes from their most powerful tenants – and even that threat looks unlikely to materialize. Their global reach comes not just from physical networks of warehouses and cables but the IRS-approved reality that those facilities are in fact a rentable part of the internet *and* a financial asset that circulates between global investors far removed from the physical location. Real estate capital runs the internet's base, not the software developers who dominate headlines and the stock market.

The built project of the internet is thus part of a broader trend wherein contemporary capitalist infrastructure comes to life, and to the market, through a process of assetization initiated by the property state, led by real estate capital, and managed by financial and technical experts who best understand how to turn bridges, tunnels, and internet exchanges into tradeable, fungible, rentable assets. However, it is not the case that neoliberal political institutions have perverted the infrastructural visions of the postwar Keynesian state or a nobler brand of far-sighted capitalism, when things were supposedly built for common good. Capitalist infrastructure has always concretized the space-time relations specific to particular modes of production. The warehouses, cables, and cages undergirding the internet are perhaps the best example of this dynamic today, revealing as they do the world-shaping power of real estate specifically and assetization generally. It is in this sense that the internet was always already real estate: The determinate structure of capitalist social relations at the moment of its commercialization laid grooves to be followed by the property state and early landlords, who built infrastructure that further concretized this shape, which was strengthened through the state's approval of REIT status, and so on (Endnotes, 2019). Key to this very social process of determination is the double life of infrastructure under capitalism.

Observing the centrality of continent-spanning means of communication and transportation to the expansion of industrial capitalism, Marx (1993) famously remarked that 'capital by its nature drives beyond every spatial barrier' and so builds large, fixed infrastructure projects to ensure 'the annihilation of space by time' (p. 524). Industrial property states directly subsidized these railroads or ports or telegraph lines to support national development, or otherwise sanctioned the bond sales or bank loans that animated this infrastructure. Within capitalism, infrastructure always lives a double life as a financial asset, with two distinct relationships to space-time embodied in the same span of concrete. On the one hand, infrastructure speeds up the movement of workers and goods so that the circulation time between production and exchange can be brought as close to zero as possible. On the other hand, the mass of resources invested in infrastructure, its long lifetime, and the guarantee of both by the state introduces a dependable, calculable delay between investment and return 'out of which the present extracts wealth from the future' (Mitchell, 2020). Most of the money supply is created through bank credit. Transoceanic shipping lines and transcontinental railways were early, dependable vehicles for the growth of credit markets and the most common investments

on new stock exchanges. As much as they exist to accelerate commodity exchange across space, infrastructure also exists to create the temporal horizon through which financial speculation occurs. Speed hastens sales, but delays accumulate interest and rent. Infrastructure brings finance to life as much as the reverse.

Mitchell's argument that infrastructures work on time, and work more the more time they accumulate, would seem to contradict our common sense of both the political life of infrastructure – where finance seems only to support projects whose shapes are dictated by social needs – and the specific promise of the internet – which, more than any other technology, promised to end distance through speed. The US's transcontinental railways did not just move people and things; these great industrial infrastructures also 'move[d] investment paper, in the form of bonds, bank loans, and share certificates … provid[ing] the means to create them and carry them through time' (Mitchell, 2020). The same would appear to be true of the internet. Given their state-sanctioned transformation into REITs, internet landlords seem to build infrastructure as much for the creation of a durable asset, attractive to investors the world over, as they do for the creation of a local node in a communications network that can move at the speed of light.

Shortly after the famous passage wherein time annihilates space, Marx (1993) observes that 'the highest development of capital exists' not when infrastructure is 'paid out of *deductions from the social revenue*, the state's taxes … but rather out of *capital as capital.* This shows the degree to which capital has subjugated all conditions of social production to itself, on one side; and, on the other side, hence, the extent to which social reproductive wealth has been *capitalized*' (p. 532). This describes well the progressive development of internet infrastructure and internet landlords as a class. Created by the property state, internet landlords soon exceeded it through their management by finance capitalists – private equity – and then through their own transformation into a financial asset – REITs. Landlords have not captured the internet, rather, they *are* the internet. The network's instantaneous communication serves the infinite delay of assetization. The 'social reproductive wealth' of the global communicative commons only exists as it does in the present because its physical foundations will remain valuable real estate far into the future.

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Notes

1. It is in this sense, of government funding for internet privatization, that Al Gore really can be said to have created, if not 'invented', the internet. For more on this history and its intersection with broader economic policy, see Greene (2021).
2. It is important to note that ratings agencies draw the opposite conclusion from the same data: Data center REITs are a *riskier* investment than malls or storage units, because the properties cannot be quickly 'flipped' into alternative uses in the case of a downturn. Indeed, the fixity of these assets led to their sharp depreciation after the dotcom crash, allowing today's internet landlords to scoop them up on the cheap.
3. Private Letter Rulings are anonymized such that the party requesting the ruling cannot be identified. However, the contents and timing of this ruling, and the subsequent industry reporting on it, makes it almost certain it was addressing Equinix.

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