Telecommunications: The Evolution of Connectivity

August 2022

HARBOR VIEW

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Telecommunications: A brief history

Telecommunications Infrastructure has a rich history that dates to the 1800s. The continued innovation of telecommunications technology has had a direct effect on the infrastructure that supports and sustains it. And while that technology has experienced accelerated investment as consumers long for faster data speeds and greater capabilities, like self-driving vehicles or automated machinery; the infrastructure needed to expend consumer access has historically lagged in comparison. As such, the telecommunications infrastructure space has seen increased investment in recent years as the need to keep up with emerging technologies has become a pressing issue for the carriers attempting to meet consumer need.

The Physical Infrastructure

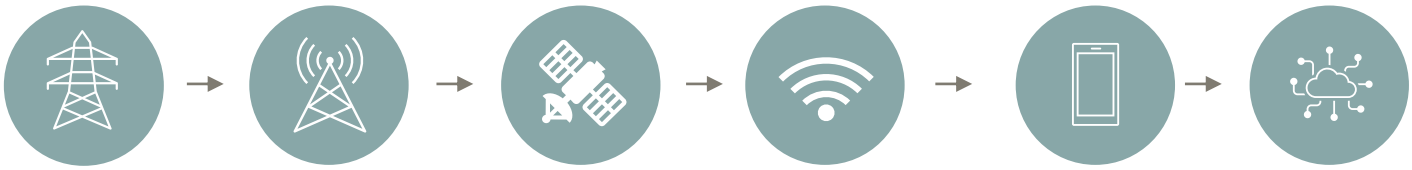
The introduction of radio waves in the 1920s further expanded innovation and made way for wireless telecommunication and the television[1]. The radio and the television both relied on physical infrastructure to be put in place so that the entire nation could gain access to such grand technology. It was during this era in history that we saw dedicated telecommunications infrastructure being built across the United States and globally[2]. The 1960s and 1970s only added to the capabilities with the first successful space launches and the ability to utilize satellite deployment. While satellites are an incredible technology on their own, they were and still are aided by physical infrastructure here, back on Earth. This included things like submarine communication cables and geostationary satellites[3]. The ability to send signals to space and bounce that signal globally allowed for greater and more reliable global communication.

The Impact of the Internet

The emergence of the internet was another important step in the evolution to the telecommunications history. The first iteration of the internet can be traced to 1969 with the invention of ARPANET[4]. And as innovation has relayed, the physical infrastructure that the internet relied on included ethernet protocols and LANS which gave way to cabling initiatives. As the internet has advanced and become more complex so have the devices that depend on it. The advancement of smart phones and computers, in terms of affordability and accessibility, has led to a society in which having several smart devices within a household is the norm. In contrast previously, access to a phone was a luxury. Before the Great Depression, fewer than 40% of households had access to a landline phone in the US and fewer than 36% had access to a radio. By the beginning of the twenty-first century about 94% of US citizens were connected through a land line and by 2019 96% of the US had access to a cellphone[5].

Moving Forward

However, like most technological advances, we outgrow and outdate technology as we move forward. That is no different in the telecommunications industry as demonstrated from the rollout of 5G and the upgrade and implementation of small cell towers to innovation of fiber optic technology. The United States is currently operating on outdated, slow broadband speeds, aging physical infrastructure components and the increased population wishing to utilize and connect to the new and next best thing[6]. Going forward, mass investment and work has already begun and will continue as the infrastructure lags what the technological advances require.



1851
20,000 miles of telegraph lines strung across the U.S.

1920s
"Golden Age of Radio"

1961
Syncom
NASA program for geosynchronous communication satellites

1969
ARPANET
First iteration of the internet

1992
First Smartphone created by IBM

2008
IoT was born

The Origin of Analog

The first generation of connectivity was analog. Created in the 1980s and based on a technology called Advanced Mobile Phone System (AMPS), 1G focused on voice services[7]. This gave way to capabilities leading to wireless cellphones. Pagers became a thing of the past and the futuristic technology of being able to call someone without a landline became a reality. The second generation can be categorized as digital voice and utilized a digital technology that was developed in the late 1980s. The capabilities included: short message services (SMS), picture messages and multimedia message services (MMS)[8]. This generation also brought the world GSM (Global System for Mobile Communication) allowing mobile phone connections in different countries with better quality and capacity. It had an approximate lifecycle of about 24 years starting in 1996 and was completely laid to rest just a few years ago in 2020[9]. Surprisingly enough, the 20-year lifecycle is about the standard when it comes to the implementing, deploying, and rolling out of the generations.

The Road to 5G

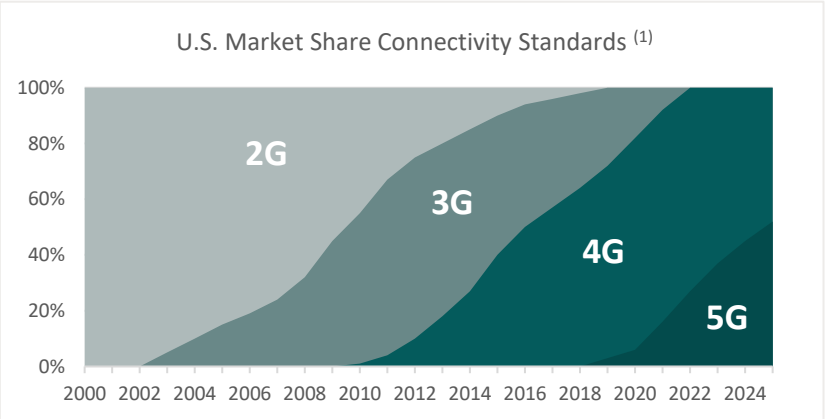
Introduced in the 2000s, 3G brought with it mobile data and the ability to access the internet from your phone. This revolutionized what people thought was possible and opened the world to the idea of smart devices. More specifically, 3G paired voice communication with data services that included web browsing, e-mail, video conferencing and navigational maps. The expanded bandwidth of this generation (15-20MHz) was utilized for high-speed internet and video chatting[10]. The main implementation of 4G, introduced in the late 2000s, was to provide high speed, high quality, high capacity, security and low-cost services for voice and data services[11]. This opened the door for broader accessibility of this technology that would soon become the norm.

5G Capabilities

5G is said to be the fuel for the real wireless world or Worldwide Wireless Web (WWW) as it is set to connect not only phones and computers to the internet, but also things, like cars and machinery, from anywhere without any barriers[12]. More specifically, 5G promises to use the same LTE packetization technology with significant improvements in the radio and packet core to connect the internet to things, enabling for smarter factories, hospitals, cities, roads, etc[13].

The Rollout

However, 5G has only just begun its extensive rollout. Unlike the previous generations, 5G relies heavily on the utilization of small cell and mid band cell towers[14]. These towers have a greater broadband width, but their frequencies span fewer miles then the large cell towers which span wider ranges, but don't have as much broadband width. And unlike the previous rollouts, small cells are a new technology that will need to be built, not just updated. The investment has just begun, and the 5G available today is mainly commercialized. The 5G needed for IoT will need a larger infrastructure buildout before it can be fully implemented. Currently, only 25% of mobile connections worldwide will be 5G by 2025 (68% in the US), meaning 10 years from now, providers will still be rolling out 5G[15].



[1] American Tower

The origins of telecommunications regulation can be traced to the middle of the 19th century and the battle to establish railroad regulation. The Mann-Elkins Act of 1910 enabled the Interstate Commerce Commission (ICC) to regulate the interstate portion of telecommunications[16]. However, this business was so inconsequential that the ICC ignored its new responsibility. The important effect of this extension of the statute was that it legalized state regulation of interstate telecommunications. While this law initially did not have a grand effect on the regulation of the telecommunications space, it set the foundation for a federal, state and local level of governance on this industry.

National policy on infrastructure has been regulated on a national and state level since the Bell System. At the center of policy debate has been the importance of nationwide interexchange traffic to the welfare of consumers and the long-term economic growth of the nation. Policy has also been impacted by the presence of an elaborate regulatory superstructure that requires deals to be monitored on both the state and national levels. The main governing agency of the telecommunications industry is the Federal Communications Commission (FCC). This organization was created after the 1934 Communications Act, with the initial intent to control government monopolies in radio and telephone[17]. The FCC eventually evolved into the special-interest vehicle of telecom companies.

The 1996 Telecommunications Act implemented some key elements meant to "contain the FCC and establish fair deregulation of the telecom industry[18]." As such, the FCC, with the passing of the 1996 Telecommunications Act, "overturned a state agency's decision to contract with a single supplier to provide telecommunications services along its state highway rights-of way[19]." However, this act did not establish "the means or provide substantive legal authority to enforce its intentions of removing government-protected monopoly franchises in local phone services[20]." And so, while the initial intent of the FCC was to prevent monopolies, the lack of enforcement led to few major players attaining the majority of market share.

Realizing their mistake, the FCC created "more than 10,000 new pages of rules and regulations," but its failure to fully overturn the 1934 Communications Act and the 1996 Telecommunications Act only served to create a contradictory regulatory system where market share was dominated by leading providers[21]. As the system stands currently, wireless operators must secure the rights to the airwaves that carry the signals (3G, 4G, 5G); these radio waves are also known as spectrum, and it is typically a federal government obligation to determine and distribute the amount. The FCC utilizes an auction system to sell the rights to transmit signals over specific bands of spectrum, but this is just a portion of the process to deploy new generations of connectivity. The complexity of the system has created room for local governments to also get involved.

Municipalities and local governments have taken steps to be involved with managing telecommunication infrastructure even amongst all the regulation set forth by the federal government[22]. These items include managing right-of-way issues, cable franchising issues, wireless zoning issues, among rollout agreements on the local levels. Furthermore, local governments are often the ones making agreements with telecommunications providers to decide on the locations of cell towers, fiber infrastructure and the timeline for these projects.

All in all, as the telecommunications space continues to innovate and progress, more regulation is likely on the horizon and should be considered. Ex: open internet, things becoming more connected, how do we regulate and enforce laws on things like self-driving cars (who gets the ticket, liable during accidents) and privacy issues as the internet becomes more connected and data more available.

Recent Litigation

Mobile Now Act[23] (Passed on March 6, 2018)

- "Boosts the development of next-generation gigabit wireless broadband services including 5G, by ensuring more spectrum is identified for private sector use and by reducing the red tape associated with building broadband networks."
- 225MHz of spectrum MUST be identified for fixed and mobile wireless broadband use by 2022.
- Carves out specific amendments that address spectrum buildout and deployment for rural and tribal lands in the US

Spectrum Innovation Act[24] (Passed on July 27, 2022)

- Like the Mobile Now Act of 2018, this bill was introduced to free up spectrum for wireless broadband.
- Up to 200 MHz of spectrum would be auctioned for mobile broadband. If passed, it would provide faster speeds and more responsive consumer networks.

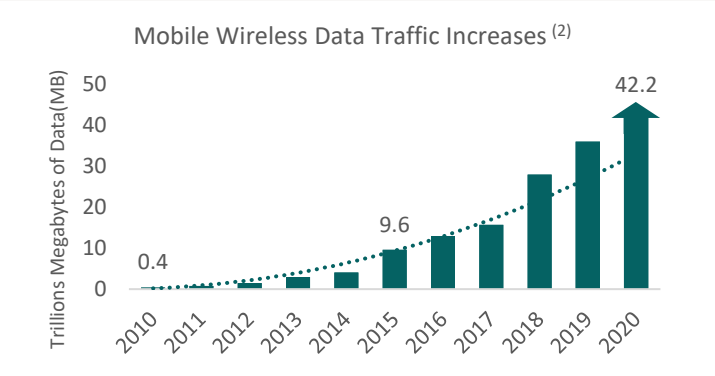
Data centers are needed to store and maintain the increased data output that devices connected to the cloud output. This increased need has pushed this division of the telecommunications space to expand and as such, experience heightened investment activity. This has also been aided by the push out of 5G and the soon to be implemented IoT. With even more mobile devices, vehicles, manufacturing devices and technology; storing data has become a top priority.

There are several types of data centers. These include, hyperscalers, enterprise data centers, colocation data centers, retail colocation data centers and carrier hotels[25]. These all have various functionality and services applied, but at their core, they have some overlying elements. The infrastructure of a data center is mainly comprised of a server and communication cabling enclosed in an often-windowless building that can have one or more floors. A stable power source, solid construction, cooling equipment and electrical wiring are also components that make up most data centers[26]. Big picture, the servers that store and process the data input require power and expel heat for their work. Cooling systems are often required elements that are built into a design of a newly constructed data center or outfitted if the data center is being placed in an existing building. These, depending on the extent and sophistication of the data center, can be quite complex. Some may include, built-in cooling fans, large air conditioners and even, on occasion, cold water pipes running throughout the facility. This can account for about 15% of the new site construction costs[27].

Furthermore, the different types of data centers and data center operators provide varying degrees of services, including security, cleaning and emergency services. A colocation data center is a facility that is sub-leased and typically shared by multiple tenants[28]. The provider usually offers turnkey solutions, including leased space, power, and connectivity. On the other hand, a retail data center, suited for small to medium sized businesses, that use less than 10 colocation racks would offer either blended internet access or connections to a preferred telecom carrier while also providing managed services[29]. These spaces are charged on a monthly bundled flat rate with installation charges being extra.

Even more extensive are the carrier hotels. These are typically found in major cities and are built into a building. They typically have multiple floors with different carriers being serviced inside. One unique quality about these carrier hotels is that they are often built into say an office building, where some floors are office spaces and others are designated for the servers. Carrier hotels offer "physical cross-connections between different customer-designated carrier networks[30]." Tenants of these data centers have access to "blended internet access or to the carrier networks of their choice[31]." The varying services and ability to connect to a specific carrier of choice contribute to the pricing model and cost associated. As such carrier hotels have been a rare, but sought-after asset as their customers tend to be "extremely sticky" and often attract valuation multiples in the "high 20s to low 30s[31]."

With the push towards ESG, data center companies need to consider the environmental impact caused by the upkeep of these assets. The environmental impact of operating and sustaining a data center can be great as the power needed and the energy required to cool and maintain the center is quite high. As such, many companies have taken steps to reduce their carbon footprint by "replacing led-acid batteries with lithium-ion batteries and augmenting power consumed from the electric grid with solar power along with recycling of air and water used[32]" all to reduce the reliance on greenhouse gases. This push creates a more sustainable model for operating data centers, as we are likely to see an increase in them as me move towards a more data-centric future. All in all, the maintenance of a data center is considerably minimum, and the revenue generated can be significant considering the number of tenants that can be managed under one asset. Because of this, valuation multiples have been quite high for these types of assets. Several acquisitions in the public space (Switch, CoreSite, CyprusOne) have been in the range of 20x-30x EBITDA[33]. The high multiples are driven by strong market positions and significantly owned real estate assets[34].



Retail colocation operators that focus more on the service offerings surrounding IT and the cloud tend to trade in the "low to mid-teen EBITDA multiples[34]." That said, assets with more of a service aspect are still seeing increased multiples during this spike in investment. All-in-all, it is not surprising that data centers are being seen as an attractive investment. The increase in data traffic has substantially increased in recent years leading to a demand and need for reliable data storage and maintenance across almost all industries.

[2] CTIA

There are several different types of towers that are used for wireless telecommunication. These include lattice towers, guyed towers, monopole towers, self-support towers, and even mobile cell towers[35]. Environmental conditions typically determine the type of tower that will be found in any particular location. Monopoles are ideal for situations where limited space, zoning difficulties or harsh weather conditions need to be factored into the build, while self-support towers account for the limited space white also being sturdy enough to carry heavy loads and withstand strong wind conditions[36]. Even so, mobile cell towers are portable, small, and typically used for temporary or emergency situations.

Lattice Towers

Guyed Tower

Monopole Tower

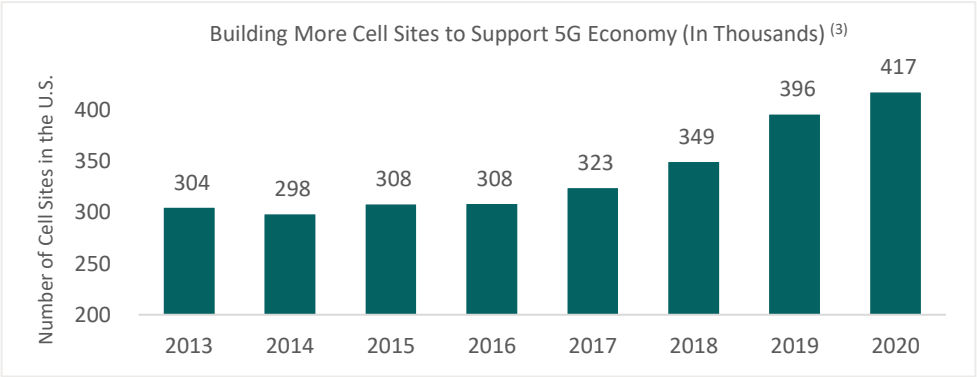
Self-Support Tower

Mobile Cell Tower

With the buildout of 5G, existing towers are being upgraded and new towers are being built to support the increased demand. Alongside those operations that have been implemented with each introduction of a new connectivity generation, small cell technology is driving the 5G roll out. A small cell is a "miniature radio access point or wireless network base station with a low radio frequency power output, footprint and range[37]." Each cell is about the size of a pizza box and can cover about the length of a football field[38]. What it lacks in range, it makes up in frequency output. These small devices can handle the frequency needed to rollout 5G at full capacity. However, the lack of coverage range means that many of them will need to be outfitted before full-fledged 5G capabilities can be reached. Once fully deployed, the US will have 5 to 10 times more small cells than macrocell towers built out[39].

Furthermore, depending on the broadband that any carrier wants to output will determine the number of towers needed to achieve that type or volume of coverage. Low-band lends itself to frequencies below 1GHz, and while this bandwidth can reach large areas with minimal issues, the frequencies outputted tend to fail when it comes to high-speed data[40]. High-Band coverage bides in the opposite way, having great capacity for high-speeds, but very limited coverage areas.

As such, companies, like T-Mobile have opted for a mid-band buildout as they begin to rollout 5G. This strategy requires larger towers to be expanded on and supplemented with the small cell technology in densely populated areas as needed for true 5G coverage. For example, Verizon has committed $10 billion to build out 8,000 macro cell towers as part of their mid-band 5G strategy[41]. On the other hand, other companies have opted for more small cell deployment. Crown Castle, for one, was criticized initially for their early bet on small cell, but their deals with T-Mobile and Verizon are proven credibility for their strategy. Crown Castle currently operates around 55,000 small cells and now have executed deals ordering another 50,000 new builds[42]. Ultimately the next couple years will be very active for tower companies as the drive to get 5G fully rolled out ramps up.



This has translated to an increase in market activity surrounding all aspects of the industry. Tower construction, tower site acquisition companies, and tower operators and owners have all been on a move to consolidate and gain a leg up in the investment opportunity that is presenting itself.

[3] CTIA

Buyer Distinctions & Large Players

Buyer Type Distinctions

We have segmented the buyer universe into three types: Strategic, PE-Backed Strategic and Financial.

Strategic

- Premium due to synergies
- Industry knowledge
- Seller flexibility

Examples:

VPLS, DIGITALBRIDGE, AMERICAN TOWER

PE-Backed Strategic

- Premium due to synergies
- Equity roll / second liquidity event
- Add-On considerations

Examples:

CENTERLINE COMMUNICATIONS, PHOENIX TOWER INTERNATIONAL, AscendTek

Financial

- Investors with history of strong returns
- Equity roll / second liquidity event
- May be less familiar with industry specifics

Examples:

KKR, H.I.G. CAPITAL, GI PARTNERS

Large Players

Telecom Companies[4] as mobile or wireless network providers. These companies are typically seen as the carriers who participate in the spectrum auctions and deploy the technology to provide wireless or mobile services to the consumer. The consumer typically buys their internet/data services from these providers.

Tower Operators[5] are the "owners / landlords" of the towers. They buy and hold towers and then rent them out to carriers or telecom companies. Sometimes these operators will also provide services to the towers that they own, like maintaining and services the tech that is deployed on the towers. These are like data center operators, but typically have higher gross margins as the maintenance requirements are much lower that that of a data center.

[4] P3 Cost Analysts
[5] Wireless Estimator

Data Center Transactions

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Recently, the data center industry has seen a massive increase in investments and acquisitions. This is in part due to the increased need for data storage and maintenance as more people access the cloud. This is further emphasized with the rise of the IoT that will soon connect vehicles, machines, and even cities that will require data storage. As such, it is no surprise that data center transactions are being acquired not just by strategics, but also digital real estate investors, like DigitalBridge and American Tower, and private equity groups like GI Partners and H.I.G Capital.

Deal Date	Target Company	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Revenue	EV / LTM EBITDA
Jun-22	451 D Street (Related Fund Management)	GI Partners	n/a	n/a	n/a
Jun-22	Riverstone Technology	Charlesbank Capital Partners	n/a	n/a	n/a
Jun-22	Lynn	NSI Industries	n/a	n/a	n/a
Jun-22	Capalon Communications	Voxology Group	n/a	n/a	n/a
Jun-22	Novva Data Centers	CIM Group	$355	n/a	n/a
May-22	Switch*	DigitalBridge and IFM	$11,000	n/a	n/a
May-22	22262 Cloud Plaza	GI Partners	n/a	n/a	n/a
May-22	Quantum Loophole	Aligned Data Centers	n/a	n/a	n/a
May-22	iConnect Montana	VPLS	n/a	n/a	n/a
Apr-22	Carrier-1 Data Centers	VPLS	n/a	n/a	n/a
Apr-22	Unitas Global	Digital Alpha Advisors	n/a	n/a	n/a
Apr-22	Connectivity Source	Clarus Communications	n/a	n/a	n/a
Apr-22	Triton DataCenter	MNX Solutions	n/a	n/a	n/a
Apr-22	Cologix	Stonepeak Infrastructure	$3,000	n/a	n/a
Mar-22	Cyrus One	KKR & Global Infrastructure Partners	$15,000	n/a	n/a
Mar-22	NFINIT	GI Partners, LightEdge Solutions	n/a	n/a	n/a
Mar-22	Cyrus One	DataBank	$670	n/a	n/a
Feb-22	Transformyx	Lockstep Technology Group	n/a	n/a	n/a
Feb-22	Veristor Systems	Anexinet	n/a	n/a	n/a
Jan-22	vXchnge	H5 Data Centers	n/a	n/a	n/a
Jan-22	Teraco	Digital Realty	$1,700	n/a	n/a
Jan-22	ITRenew	Iron Mountain	$925	n/a	n/a
Jan-22	Grand Power Systems	Roman Manufacturing	$2	n/a	n/a
Jan-22	Fusion Connect	Morgan Stanley Private Credit	$81	n/a	n/a
Jan-22	Just Analytics	Rackspace Technology	n/a	n/a	n/a
Jan-22	Bracknell U.K. Data Center	Keppel DC Reit	n/a	n/a	n/a
Jan-22	Hudson Interxchange	Cordiant Digital Infrastructure	$74	n/a	n/a
Jan-22	XS telecom	MKD Electric	n/a	n/a	n/a
Jan-22	General Datatech	H.I.G Capital	n/a	n/a	n/a
Dec-21	M247 Limited - (Manchester)	Pulsant	n/a	n/a	n/a
Dec-21	Core Site Realty	American Tower	$9,440	n/a	n/a
Dec-21	Mosys	Peraso	n/a	n/a	n/a
Dec-21	Sirius Computer Solutions	CDW	$2,400	n/a	n/a
Nov-21	Global Cloud Xchange	3i Infrastructure	$512	n/a	n/a
Nov-21	340 Progress Circle	Fifteenfortyseven Critical Systems Realty	n/a	n/a	n/a
Nov-21	EmconIT	Evernex (3i Group)	n/a	n/a	n/a
Oct-21	Switch Electric	BrightMark Partners	n/a	n/a	n/a
Oct-21	Glbal Communication Networks	Berkshire Partners (UpStack)	n/a	n/a	n/a
Oct-21	Quantum Park Property	Landmark Dividend (Digital Bridge)	n/a	n/a	n/a
Oct-21	DataSite	American Tower	$201	n/a	n/a
Oct-21	Innovium	Marvel International	$1,000	n/a	n/a
Oct-21	HVR Software	Fivetran	$700	n/a	n/a
Aug-21	QTS Realty	Blackstone Infrastructure Partners	$10,000	n/a	29.7
Nov-20	Vantage Data Center (CA22)	DigitalBridge	$539	n/a	n/a
Jun-20	VNET	Blackstone	$150	n/a	n/a
Jan-19	Evoque Data Center Solutions	Brookfield Infrastructure Partners	$1,100	n/a	n/a
Jan-18	IO Data Centers (U.S. Operations)	Iron Mountain	$1,347	n/a	n/a
Aug-17	ViaWest	Peak 10	$1,820	n/a	n/a

Source: Pitchbook

Telecom Service Transactions

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Telecom Service Transactions, include companies that conduct site acquisition, design and engineering services, as well as internet and telecom service providers that deliver internet and telecom connectivity on a consumer level. During the first half of 2022, Telecom Service Transactions have seen an increase in M&A activity. The buyers included Strategics, PE-Backed Strategics as well as a few Financial buyers. This activity is consistent with what we are seeing throughout the entirety of the industry as infrastructure buildout and the progression of increased global connectivity continues to rise.

Deal Date	Target Company	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Reveue	EV / LTM EBITDA
Jun-22	Eastern Oregon Net*	Ziply Fiber	n/a	n/a	n/a
Jun-22	Visionary Broadband	GTCR LLC	n/a	n/a	n/a
May-22	J. Lee Associates	Calera Capital	n/a	n/a	n/a
May-22	KeyCom Technologies	CPT Netowork Solutions	n/a	n/a	n/a
Apr-22	Moundridge Communications Network*	Rural Telephone Service Company	n/a	n/a	n/a
Apr-22	Tehnology Associates EC	Phoenix Tower International (Blackstone)	n/a	n/a	n/a
Apr-22	Nextgen Connected Communities	Summit Broadband	n/a	n/a	n/a
Mar-22	BullsEye Telecom, Inc	Lingo Communications	n/a	n/a	n/a
Mar-22	STC Netcom (Saratoga Partners)	Centerline Communication LLC (Audax)	n/a	n/a	n/a
Feb-22	Leaf Communications	Centerline Communication LLC (Audax)	n/a	n/a	n/a
Jan-22	ITG Communications	Oaktree Capital Management	n/a	n/a	n/a
Jan-22	QOS Networks	Zayo Group	n/a	n/a	n/a
Jan-22	J&S Communications	National OnDemand (Blue Point Capital)	n/a	n/a	n/a
Dec-21	The Harlequin Group	Telent	n/a	n/a	n/a
Oct-21	Digicel Pacific*	Telstra	$1,850	n/a	n/a
Oct-21	Superloop*	Digital Bridge	$104	n/a	n/a
Sep-21	CitySwitch	CBRE Caledon	n/a	n/a	n/a
Aug-21	Centerline Communications	Audax Group	n/a	n/a	n/a
Jul-21	A&M Communications	Congruex (Crestview Partners)	n/a	n/a	n/a
Jul-21	Spectrum Services (Las Vegas)	NextEdge Networks (Bow River Capital Partners)	n/a	n/a	n/a
Jun-21	Clarus Communications	Telecom Decision Makers	n/a	n/a	n/a
Feb-20	Vertiv	GS Acquisition Holdings	$1,240	n/a	n/a
Jan-20	TeleWorld Solutions	Samsung Electronics America	n/a	n/a	n/a
Oct-19	Vinculums Services	QualTek USA (Brightstar Capital Partners & CDIB Capital International)	n/a	n/a	n/a
Aug-18	NTP Wireless	Mountain (Maine)	n/a	n/a	n/a
Jan-18	Synergy Engineering Services	Advantage Engineers (Partriot Capital & First Capital Partners	n/a	n/a	n/a
Sep-21	Cincinnati Bell	Macquarie Infrasturcture	$2,900	$1.8	$7.3

Source: Pitchbook

Tower Transactions

Tower construction, while historically not a highlighted space of transaction activity, has seen an increase in investment since the announcement of 5G. The push by carriers to build out their 5G infrastructure has been significant as they rush to meet the coverage expectations that have already started to market to consumers. This market has been historically fragmented and PE groups, who typically tend to stay away from this space due to the customer concentration expected in this industry, have begun roll up strategies to capitalize on the carrier investment in the space and the prolonged nature of an infrastructure rollout. This is specific to 5G as small cell and macro towers will need to be increased significantly in order to provide true 5G coverage.

Deal Date	Target Company	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Revenue	EV / LTM EBITDA
May-22	Signal Point Systems	Mobilitie (BAI Communications)	n/a	n/a	n/a
May-22	Tower Engineering Solutions	Congruex	n/a	n/a	n/a
Mar-22	Modern Link Communications	Pfingsten Partners	n/a	n/a	n/a
Dec-21	J5 Infrastructure Partners	Centerline Communications	n/a	n/a	n/a
Nov-21	Tower Technologies	Nsight	n/a	n/a	n/a
Sep-21	CellSite Solutions	Fort Point Capital	n/a	n/a	n/a
Aug-21	East River Tower	Murphy Tower Service	n/a	n/a	n/a
Jul-21	IMMCO, Inc.	Gibson Technical Services	$19	n/a	n/a
Apr-21	Gibson Technical Services	Orbital Energy Group	$39	$1.2	n/a
Nov-20	True North Management Services	Congruex	n/a	n/a	n/a
Aug-19	AscendTek	Borgman Capital	n/a	n/a	n/a
Aug-19	Virginia Tower Construction	Borgman Capital	n/a	n/a	n/a
Jan-19	Fulton Technologies	ADDvantage Technologies Group	n/a	n/a	n/a

Like that of Data Center owners and operators, the deal activity surrounding towers owners and operators has recently experienced a significant increase. Major players in the tower owner/operator space includes all 3 buyer types with PE buyers picking up investments in the space at a much rapid pace than historically. As more towers are being built, so does the amount of tower real estate looking to be picked up by these tower owners and operators. The acquisition of a piece of tower real estate is an attractive market as carriers will pay rent to use and maintain tech on the tower.

Deal Date	Target Company	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Revenue	EV / LTM EBITDA
Jul-22	Deutsche Telekom AG (GD Towers)*	Digital Bridge and Brookfield Infrastructure Partners	$17,500	n/a	n/a
May-22	Mobile towers and rooftop portfolio from TPG Telecom Limited	OMERS Infrastructure	$950	n/a	n/a
Apr-22	Telenet (TowerCo)*	DigitalBridge	$820	n/a	n/a
Apr-22	TowerCom, LLC (Tower Portfolio)	Fengate Asset Management	n/a	n/a	n/a
Mar-22	Cellnex Telecom (1,226 Telecom Sites)	Phoenix Tower	n/a	n/a	n/a
Dec-21	Syn & Nova (Tower Portfolios)	Digital Bridge	$100	n/a	n/a
Nov-21	MTN Group (5,709 Towers)	IHS Holdings Limited (IHS Towers)	$6,400	n/a	n/a
Oct-21	Vertical Bridge	Digital Bridge	$700	n/a	n/a
Mar-21	Cellnex Telecom (2,000 Telecom Sites)	Phoenix Tower, Bouyguess Telecom	n/a	n/a	n/a
Jan-19	TowerCo	Peppertree Capital Management	$300	n/a	n/a

Source: Pitchbook

Telecom Infrastructure Transactions

All other infrastructure needs have also been experiencing a ramp up in deal activity, specifically in 2022, as they begin to see increased investment to upgrade the existing tech and buildout systems to handle the rapid expansion and rollout of 5G technology. Fiber construction companies, utility services and electric/wireless companies have begun to see investment by both financial buyers and strategics, as companies try to concentrate their service offerings and financial buyers try to capitalize on the investments in all aspects of wireless and cellular ahead of the 5G rollout and tech investments that are likely ahead in the near future.

Deal Date	Target Company	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Revenue	EV / LTM EBITDA
Jun-22	Unity Group	Everstream Solutinos	$135	n/a	n/a
Jun-22	Summit Utility Structures	Nucor Corporation	n/a	n/a	n/a
May-22	J. Lee Associates, Inc.	Thayer Infrastructure Services (Calera Capital)	n/a	n/a	n/a
May-22	Signal Point System	Mobilitie	n/a	n/a	n/a
May-22	Sorensen Companies	Congruex (Crestview Partners)	n/a	n/a	n/a
Apr-22	Unified Utility Alliance	National OnDemand (Blue Point Capital)	n/a	n/a	n/a
Apr-22	Atlantic Electric	Comfort Systems USA (FIX)	n/a	n/a	n/a
Mar-22	Empire Access	Antin Infrastructure	n/a	n/a	n/a
Mar-22	Greenlight Networks*	Oak Hill Capital	$300	n/a	n/a
Mar-22	Consolidated Communications	Alinda	$90	n/a	n/a
Feb-22	Cohere Technologies	Koch Industries Inc.	n/a	n/a	n/a
Feb-22	Federated Wireless	Cerberus Capital Management	n/a	n/a	n/a
Feb-22	ImOn Communications*	Goldman Sachs Asset Management	n/a	n/a	n/a
Feb-22	Dobson Fiber	ICON Infrastructure	n/a	n/a	n/a
Feb-22	Public Safety Towers	InfraRed Capital	$50	n/a	n/a
Jan-22	Blue Danube Systems	NEC Corporation	n/a	n/a	n/a
Jan-22	Mobileum Inc.	H.I.G. Technology Partners	n/a	n/a	n/a
Jan-22	Clearwave Fiber	Stephens Capital, GTCR, TPO, Sparklight	n/a	n/a	n/a
Jan-22	Metronet	Vexus	n/a	n/a	n/a
Dec-21	Wood River Network	Great Plains Communications	n/a	n/a	n/a
Dec-21	Henkels and McCoy	MasTec	$600	n/a	n/a
Sep-21	FibreStream	Beanfield Metroconnect	n/a	n/a	n/a
Jul-21	Harmonic Ltd.	KBR	$19	n/a	n/a
Feb-22	Gap Wireless	Network Wireless Solutions, LLC (Grain Mangement LLC)	n/a	n/a	n/a
Dec-20	ADB Companies	Warren Equity Partners	n/a	n/a	n/a
Feb-20	Zayo Group	EQT Infrastructure and Digital Colony Partners	$8,400	$3.2	$7.2

Source: Pitchbook

Telecom Manufacturing Transactions

The manufacturing industry has also begun to gain traction as the increased need for materials to build and upgrade telecom infrastructure has been on the rise. This is mainly being done by Strategics and PE groups looking to add capabilities to existing portfolio companies. 2021 was a historical year for deal making in general, but really stood out as a year for acquiring in this market as well.

Deal Date	Target Company	Description	Acquirer / Investor	Enterprise Value ($M)	EV / LTM Revenue	EV / LTM EBITDA
Jun-22	Lynn (North Wales)	Manufacturer of cable assemblies intended for the data center and broadband markets	NSI Industries	$20	n/a	n/a
Nov-21	Loral Space & Communications	Loral Space & Communications Inc is a provider of satellite-based communications services	Telesat Canada	n/a	n/a	n/a
Nov-21	Allied Wire & Cable	Manufacturer of wire and cable products	Audax Group, Genuine Cable Group	n/a	n/a	n/a
Aug-21	East River Tower	Manufacturer of wireless telecommunication tower	Murphy Tower Service	n/a	n/a	n/a
Aug-21	Silhouette Enclosures	Manufacturer and designer of custom industrial enclosure and control room	Creō-Tech Industrial Group	n/a	n/a	n/a
Jul-21	RF Engineering & Energy Resource	Manufacturer and supplier of telecommunications products and services catering to the wireless and wireline industries	ComSovereign	$3	n/a	n/a
Jul-21	Meglab	Designer and manufacturer of electrical equipment and telecommunications infrastructure	Epiroc	n/a	n/a	n/a
Jun-21	Color Resource Concentrates	Manufacturer of color concentrates for the telecommunications, fiber, building, electronics and specialty wire markets	Chroma Color	n/a	n/a	n/a
Jan-21	Comprod	Manufacturer and supplier of radio frequency telecommunication products	Kairos Capital Management	n/a	n/a	n/a
Dec-20	Zoom Telephonics	Designing, producing, marketing, selling internet access and other communication-related products	Minim	n/a	n/a	n/a
Nov-20	Copperhead Industries	Manufacturer of copper-clad steel tracer wire systems	Copperweld Bimetallics, Kinderhook Industries	n/a	n/a	n/a
Jul-20	Buse Industries	Manufacturer of wire and cable harness assemblies and related products	Brenneman and Associates	n/a	n/a	n/a
Jan-20	Apelio Innovative Industries	Manufacturer of telecommunication network accessories and electrical switchgear	Globalturk Capital, Raycap	n/a	n/a	n/a
Apr-19	Wanho Manufacturing	Manufacturer and distributor of telecommunication infrastructure components	J.H. Whitney Capital Partners	n/a	n/a	n/a
Jun-18	Spectrum Communications	Manufacturer and provider of wireless telecommunications equipment and services	BearCom, LKCM Headwater Investments	n/a	n/a	n/a
May-17	Radio Waves	Manufacturer and distributor of microwave antennas designed to maximize telecommunications system performance	Genstar Capital, Infinite Electronics	n/a	n/a	n/a
Apr-17	Lynn (North Wales)	Manufacturer of cable assemblies intended for the data center and broadband markets	NewSpring Capital	n/a	n/a	n/a

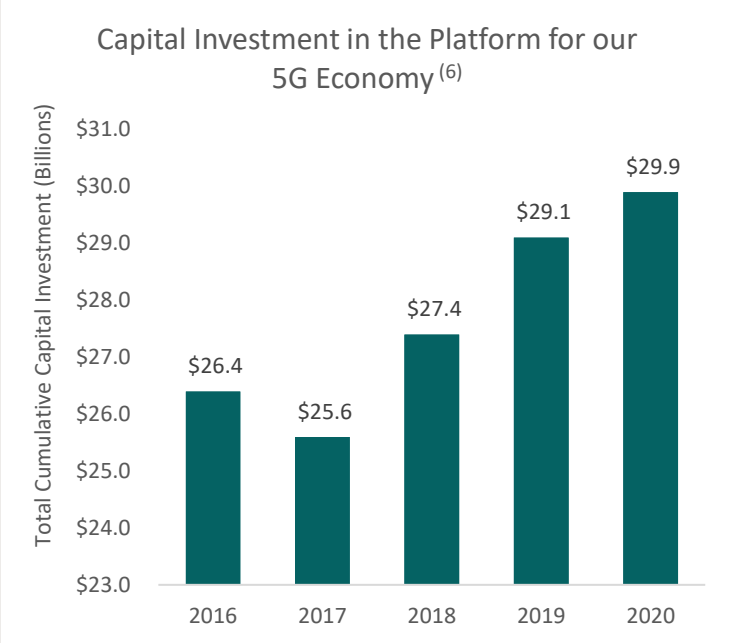
Source: Pitchbook

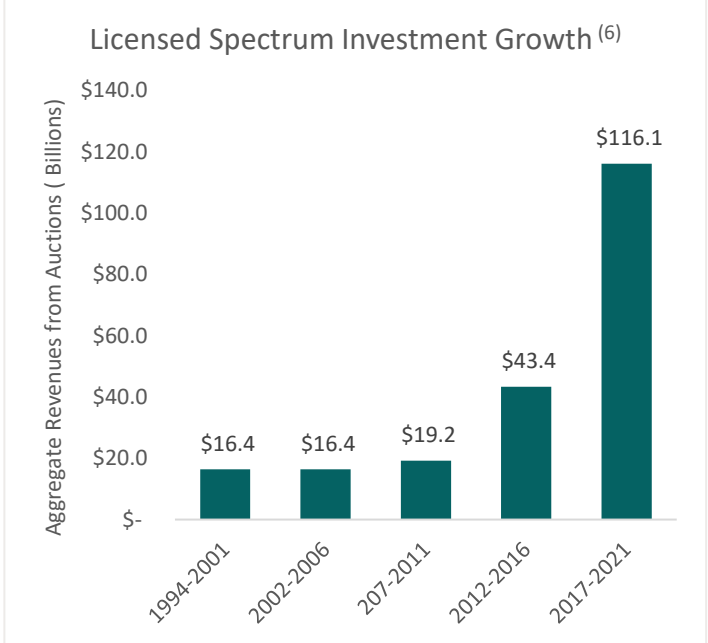
Significant investment is expected to pour into the industry as the rollout of 5G begins gaining momentum. In 2020, wireless providers invested $30 billion into the industry, marking the third straight year of increasing capital expenditures[43]. Furthermore, as discussed earlier, licensed spectrum is also increasing as Congress approves more spectrum to be auctioned by the FCC. In 2020, the two auctions held by the FCC generated approximately $85 billion[44]. This represents "the largest investment in a spectrum auction to date and brings the total to more than $200 billion in payments to the government for spectrum[45]."

The infrastructure needed to fully rollout 5G is in initial stages, and the M&A activity surrounding this space has taken notice. With the North America telecommunications market estimated at $245M in 2020 and expected to grow to $830M by 2025 at a CARG of 26.8% over the forecast period, it makes sense that there has been an increased number of deals surrounding this space[46].

More specifically, we are seeing M&A activity that addresses both the challenges and the benefits of 5G in the telecommunications industry. For one, we are seeing a shift of digital infrastructure assets, that include towers, fiber optics and data centers, from telecom players to infrastructure investors. Secondly, we are seeing investments and acquisitions of telecommunication infrastructure builders by companies trying to get ahead of the boom in carrier investment in the construction of the necessary 5G infrastructure.

M&A activity remains robust in the telecommunications industry as investors look to capitalize on this booming market. Investments have been on the rise since 2020 and have ramped up speed in 2021 and 2022. The government investment, with increased auctions of spectrum, have prompted rapid expansion to get the United States fully ramped up and connected, so things like smart cities and autonomous vehicles can become a reality sooner, rather than later. More specifically, PE groups have become more active in the space ahead of the rollout, and strategics have begun to seek acquisitions to speed up their ability to be an asset in this rollout. With the labor shortages affecting all industries, companies are looking to acquisition strategies to expand their access to available crews and gain insights into employee retention within the industry to stay ahead of the growing market.





[6] CTIA

Industrial Tech Expertise

TELECOMMUNICATIONS: EVOLUTION OF CONNECTIVITY WHITEPAPER

Telecommunications Provider **Acquired by** STRATEGIC BUYER	Metal Processor **Acquired by** FINANCIAL BUYER	Automobile Supplier **Investment from** FINANCIAL SPONSOR	Metal Fabricator **Acquired by** FINANCIAL BUYER	Fire Safety & Training Provider MANAGEMENT BUYOUT	Solar Lighting Designer & Integrator **Acquired by** STRATEGIC BUYER
Utilities Data Analysis Provider **Acquired by** STRATEGIC BUYER	Aerospace Component Testing Provider **Acquired by** STRATEGIC BUYER	Recycling Solutions Provider VALUATION ANALYSIS	Property Management Provider STRATEGIC ADVISORY SERVICES	Fluid Dynamics & Modeling Provider **Acquired by** FINANCIAL BUYER	Light Industrial Staffing Firm **Seeking acquisition** FINANCIAL BUYER

Note: Unless displayed with the Harbor View logo, the transactions documented were executed in previous roles

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Building on his nearly 25 years of Investment Banking and Private Equity experience, Nate leads Harbor View's Industrial Tech practice. In his role, Nate advises clients in the Automated Solutions, Industrial & Related Services, and Traditional Industrial sectors helping business owners navigate the company sale, acquisition, and capital raise process.

Definitions:

Data Centers: broad category involving different industries or sub-verticals.

Data Center Service Providers: typically started in colocation now offer robust managed services and cloud services.

Telecommunications infrastructure provider is any person, persons or company providing inactive elements of the telecom network including dark fibers, right of way, duct space, towers, etc. as well as those who provide end to end bandwidth to other service providers.

Traditional telecommunications infrastructure service providers: help to build, manage, and operate voice networks. Essentially, their job is to install and maintain the equipment necessary for telecommunications technology to work.

Wireless infrastructure provider is any person, persons, or company that builds or installs transmission equipment, wireless facilities, or wireless support structures, but is not a wireless services provider. These can include people who install optical fiber, construct cell tower sites, conduct radio antenna testing or provide installation services of standard phone equipment.

Wireless service providers would include satellite companies, phone companies or internet service providers.

Additional History:

https://www.ustelecom.org/120-years-of-transforming-americas-wired-infrastructure/

The origin of United States telecommunication dates to 1851, when 20,000 miles of telegraph lines were first strung throughout the United States. By 1866, the first successful transatlantic cable was laid and in the 1870s, telephone technology was born. While Alexander Graham Bell patented the telephone in 1876, it wasn't until 1894 that we saw mass innovations to the telecommunications space. This is in part due to expiring of Bell's key telephone related patents. By the end of 1894 roughly 80 new competitors had obtained about 5% of the phone market and by the early 1900s, that number of competitors had grown to more than 3,000. This mass introduction of new players into the telecommunications space not only accelerated innovation but allowed this technology to be greater utilized.

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TELECOMMUNICATIONS: EVOLUTION OF CONNECTIVITY WHITEPAPER

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