

# Communication Services

Observer August 2020

## Sell the News: As 5G Networks Light Up, Carrier Investment and Tower Growth Rates Won't Jump; 5G Buzz Will Be Slow to Deliver

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### 64 Executive Summary

The arrival of 5G has fueled investors' appetites for seemingly any firm they perceive will be affected by the new technology. A notable exception, which we think is correct, is the lack of exuberance for U.S. wireless carriers, especially AT&T and Verizon. In what we expect to be a repeat of the experience with 4G, wireless carriers will not be the firms to extract greater profits from these more advanced networks. Competition has restrained pricing power for them. We think investors have failed to extend this logic to the next step. If carriers aren't seeing boons to their businesses, they are unlikely to ramp up spending on their wireless towers to much higher levels than they've been recently.

Unlike the carriers, however, tower stocks' upward trajectories took a big step higher over the past year, and valuations reached unprecedented levels. We think 5G mobile networks are a primary rationale for the excitement. Usage of 5G networks is now in its infancy, but investment in towers in preparation for it has been happening for years. In many cases, carriers can now turn on their 5G networks without any further increase to their tower payments. More important, tower spending is less dependent on the wireless technology being used than the amount of mobile data traffic that the networks must handle. These are all factors that lead us to believe that spending on towers will remain robust, but it is unlikely to reach new levels.

Looking closely at the wireless carriers supports our view. AT&T, which has spent aggressively on towers in the past two years, and Verizon, which plans to spend heavily on small cells for 5G, rather than towers, have both said they expect to slow their pace of new tower spending. T-Mobile, which is now integrating Sprint's network, is likely to ramp up tower spending in the next two to three years, but it will then be able to decommission Sprint's tower sites, leading to lease cancellations on towers. Dish Network needs to build a wireless network and may pick up many of those leases, but financial restraints and specifics of its promises to the U.S. government as part of the T-Mobile/Sprint merger cause us to question whether it will do any more than make up for the loss of Sprint.

We think the best of times for U.S. tower spending have already occurred. The advent of 4G caused mobile data traffic to grow at rates that are unlikely to be repeated with 5G, as many of the "Internet of Things" functions 5G is likely to enable should take much less bandwidth than things like mobile video, which exploded with 4G. We expect traffic growth to remain high and for significant network investment by carriers to continue, but we don't expect a different environment from what we've experienced in recent years. The economic and technological realities lead us to believe continuing deployment of 5G equipment as the networks mature will look remarkably similar to what 4G has required.

With the U.S. market unlikely, in our view, to be a catalyst for tower stocks, we look to their other businesses. In that regard, American Tower is our favorite, as it has exposure to fast-growing emerging markets in India, Africa, and Latin America. SBA has less geographic diversification, while Crown Castle operates exclusively in the United States. Crown Castle is the only firm that has a prominent business apart from towers: its U.S. fiber business, where it also offers small cells. However, despite the critical factor small cells are likely to be in 5G networks, we don't think Crown Castle's fiber business will be highly profitable. Building out the fiber and small cell network is extremely expensive, and we think the carriers have too many alternative providers--including the ability to do it themselves, in many cases--for the investment to earn sufficient returns.

Against the backdrop of the current environment, valuations for all the tower companies have moved to extreme heights, but we don't expect revenue growth to materially accelerate from already high levels. We believe the stocks have risk to the downside if interest rates rise or if the market is disappointed with steady to decelerating rates of revenue growth. We believe all tower companies are expensive and at risk of seeing material stock price declines, but we continue to favor American Tower on a relative basis. If we had to own a tower company, it would undoubtedly be American Tower, and that's the one we'd enthusiastically recommend on a pullback in what remains a great albeit seemingly overheated industry.

# Communication Services Observer

Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

Michael Hodel, CFA  
Director, Communication Services  
+1 312-696-6578  
michael.hodel@morningstar.com

## Companies Mentioned

Name/Ticker	Economic Moat	Moat Trend	Currency	Fair Value Estimate	Current Price	Uncertainty Rating	Morningstar Rating	Market Cap(Bil)
American Tower AMT	Narrow	Stable	USD	190.00	257.61	High	★★	114.27
SBA Communications SBAC	Narrow	Stable	USD	190.00	311.28	High	★	34.83
Crown Castle CCI	None	Stable	USD	94.00	168.19	High	★	70.58
AT&T T	Narrow	Stable	USD	37.00	30.02	Medium	★★★★★	213.89
Verizon VZ	Narrow	Stable	USD	59.00	58.53	Medium	★★★★	242.20
T-Mobile TMUS	None	Positive	USD	89.00	115.09	High	★★	144.85
Dish Network DISH	None	Negative	USD	35.00	34.17	Very High	★★★	17.91

## Key Takeaways

- ▶ The arrival of 5G in the U.S. has fueled enthusiasm for many firms with a feasible tie to the technology. Investors seem to expect 5G to cause a revolution that requires wholesale upgrade cycles and a resulting spike in revenue. In some cases, this may make sense, but in others it doesn't.
- ▶ Investors have (rightly, in our view) perceived that telecom carriers will suffer the same fate with 5G as they did with 4G, seeing only a relatively modest uptick in profit after years of heavy investment. We suspect a lack of significant incremental profit potential will restrain network and tower spending habits, which are already robust.
- ▶ On the other hand, we hypothesize that 5G is propelling investor expectations for the tower firms that we cover on the belief that growth will continue to accelerate from the stellar business performance seen recently. We think that's unlikely for two reasons: carriers won't increase spending at significantly higher rates than historically, and 5G won't require radical changes to how networks are built.
- ▶ The optimal scenario for tower firms would emerge if 5G unfailingly required tower densification (meaning, wireless carriers were forced to deploy their equipment on a greater number of towers). We don't believe this is the case. Carriers have a variety of options to increase capacity, including through the use of small cells. Only Crown Castle is aggressively pursuing small cells, but we don't believe Crown Castle's small cell business is positioned to thrive.
- ▶ We expect carriers to continue adding new spectrum to existing towers, which is certainly lucrative for tower firms. However, we believe this is merely a continuation of what towers have been doing the past several years.
- ▶ In preparation for 5G in recent years, T-Mobile has blanketed the U.S. with 600 MHz spectrum, and AT&T and Verizon have bulked up midband deployments on towers. AT&T has also been widely deploying spectrum for the FirstNet government project. These carriers have already begun turning on 5G networks with simple software updates or radio upgrades that are mostly independent from tower spending.
- ▶ In the near term, we expect U.S. tower spending from T-Mobile to accelerate as it works feverishly to integrate Sprint's network into its own, but we think Verizon and AT&T will lull following their more aggressive recent deployments (AT&T) and heavy emphasis on fiber deployment (Verizon).
- ▶ We think the CBRS and C-Band spectrum auctions will propel Verizon and AT&T to pick up tower spending again in a couple of years, but we don't think that will result in any greater tailwind for tower companies than they've had recently.

- ▶ Eventually T-Mobile will be able to cut tower spending significantly as it realizes synergies with Sprint. Spending by Dish Network should mitigate that headwind, but Dish remains a wild card, with unconventional network ambitions and a weak financial position.
- ▶ Ultimately, tower spending is likely to remain capped by the financial motivation and resources of wireless carriers, and we don't expect more pressure or ability to further expedite network enhancements.
- ▶ With U.S. towers a less likely catalyst for future growth, the other components of each tower company's business drive our opinions on the firms. Crown Castle operates only in the U.S., but has a significant focus on its fiber and small cells while American Tower and SBA have remained committed to the tower business, expanding outside the U.S.
- ▶ We are highly skeptical of Crown Castle's fiber segment. It requires a tremendous amount of capital investment today and faces major questions concerning future demand. We think it will be difficult for Crown Castle to see a payoff on that investment, especially because potential customers such as Verizon and AT&T should be able to meet a significant portion of their small-cell needs internally.
- ▶ American Tower is our favorite tower company. We like the opportunities it has in several emerging markets, where 4G has not been fully built and many residents rely on mobile networks as their primary means of accessing the Internet.
- ▶ The tower companies are overvalued. On virtually any metric, tower companies are trading at historically high valuations. A sensitivity analysis that considers a very low-interest-rate environment, a continuation of growth near record levels in the near term, and valuation multiples permanently higher than historical averages shows the extreme assumptions one must make for tower stocks to look attractive at today's stock prices.

## 5G Excitement in the U.S. Is Building, but We Expect Investors Looking for a Network Infrastructure Revolution to Be Disappointed

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Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

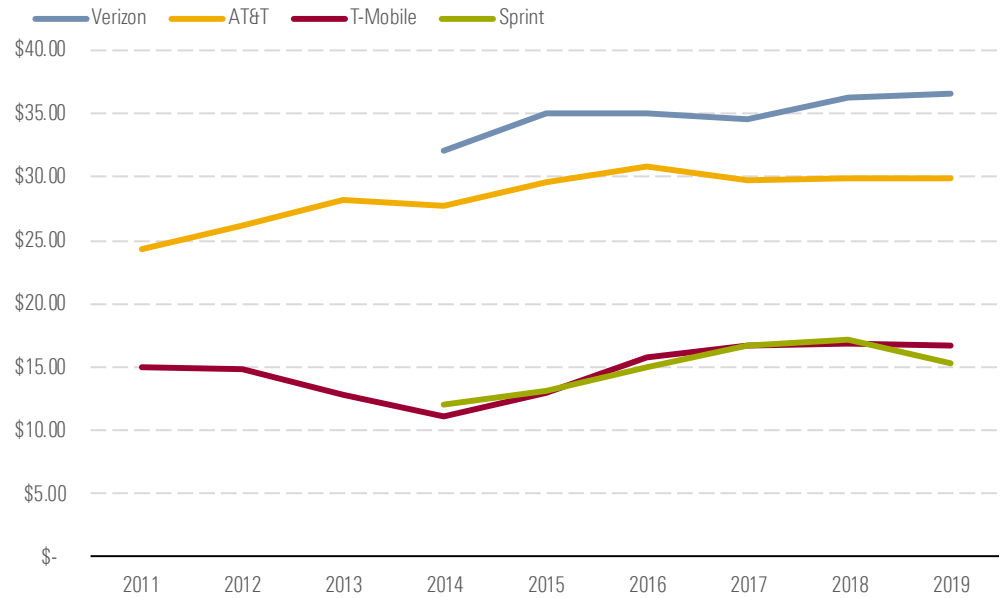
Michael Hodel, CFA  
Director, Communication Services  
+1 312-696-6578  
michael.hodel@morningstar.com

Investor enthusiasm surrounding all things 5G, with its promises of superfast speeds and millions of Internet of Things-connected devices, has steadily built over the past couple of years. While we understand the excitement around some of the technologies that enable 5G (for more, see "[Filtering the 5G Radio Frequency Landscape](#)," published in October 2018), we don't look at 5G networks as being so simply defined or universal. We believe the infrastructure side of the story--the wireless carriers and tower firms involved in physically building out networks--requires more circumspection. We don't expect 5G networks to live up to the hype anytime soon across much of the U.S.

We don't question that 5G technology has the capability to bring all the things that have been promised: gigabit speeds (meaning, over 1,000 megabits per second for downloads, versus the 4G U.S. average of less than 50 Mbps, according to multiple network testers), the ability for consumers to download movies to their phones in seconds, and so on. However, it's important to remember: 5G technology alone will not make networks fast; it needs to be applied in conjunction with sufficient spectrum bandwidth to reach its potential, and carriers need sufficient financial motivation to expand their deployment of spectrum, which benefits tower companies.

We believe there's rightly agreement among investors that the wireless carriers won't significantly benefit from 5G. The argument here is based on the carrier experience with 4G/LTE networks: After years of heavy network and spectrum investment, overall carrier profitability hasn't changed all that much. Exhibit 1 outlines EBITDA per retail postpaid and prepaid phone customer per month--growth in this metric has only marginally outpaced inflation. We use phone customers where possible, rather than total devices in service, because this figure most closely approximates total individual customers.

**Exhibit 1** U.S. Wireless Carriers Haven't Radically Increased Profits Following 4G Investments  
EBITDA per retail wireless customer per month.



Source: Morningstar, company reports.

Note: Retail phone customers include postpaid phone customers and total prepaid customers; 2018 and 2019 figures estimated based on pre-ASC 606 accounting for comparability; Verizon and Sprint began disclosing postpaid phone customers only in 2013. Sprint EBITDA deducts leased device depreciation.

In other words, even with smartphone adoption, the addition of tablets, smartwatches, and other data devices to many customers' wireless plans, and the initial wave of Internet-of-Things adoption (smart meters, connected cars, and so on), the industry isn't extracting wildly more profit per individual than a decade ago. Competition among carriers has kept a lid on prices even as network capabilities have steadily improved. Meanwhile, the apps that these networks have enabled have accrued significant value.

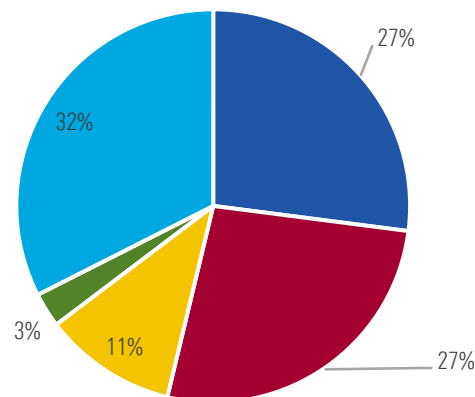
Wireless carriers face a similar conundrum today. Network connectivity isn't uniform across wireless carriers, but it is commodity-like for many, if not most, consumers today. The biggest carriers can carve out scale-based cost advantages that enable them to deploy new technologies efficiently to gain an edge, but with the T-Mobile/Sprint merger, the difference in size among the big three U.S. carriers has contracted. As a result, we expect the U.S. carriers will steadily, but incrementally, invest in their networks--much as they have in recent years--with each taking an approach that plays to its strengths. We explore these approaches in more detail later in this report.

On the other hand, we suspect that investor enthusiasm for the tower firms that now control the lion's share of the physical infrastructure used in the carriers' traditional macro wireless networks has steadily ratcheted higher over the past couple of years. In the absence of sufficient carrier motivation to propel spending to new levels, however, we're skeptical that the 5G landscape in the next few years will materially differ from the environment tower companies have operated in over the past few years.

American Tower, SBA Communications, and Crown Castle all generate the majority of their revenue from towers in the United States, which is on the verge of 5G networks. According to [wirelessestimator.com](http://wirelessestimator.com), only seven companies owned more than 1,000 towers in the U.S. at the beginning of 2020, and according to CTIA, there are about 150,000 macro towers (the big cell towers that cover large areas, are referred to simply as "towers," and make up nearly all revenue for tower companies) in the country. Exhibit 2 shows the share held by the biggest owners.

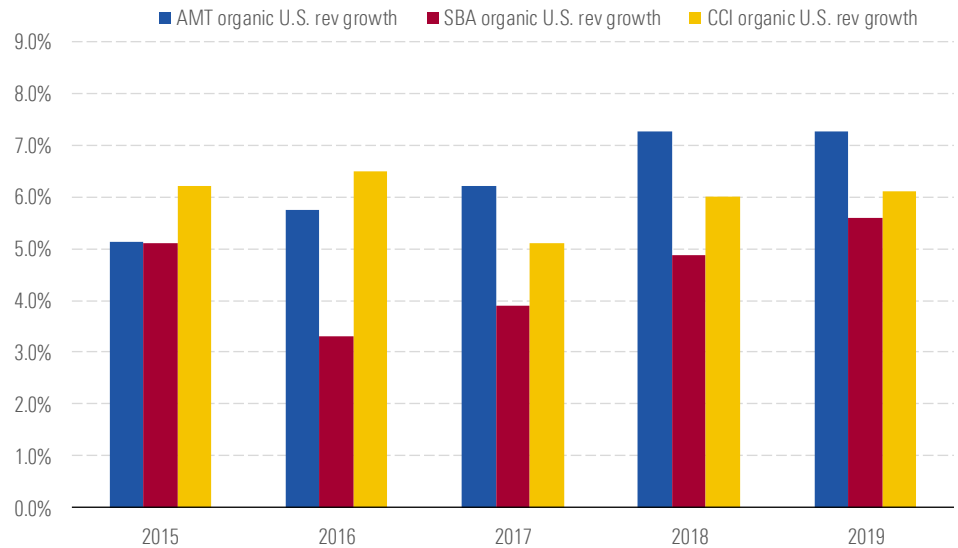
**Exhibit 2** American Tower, Crown Castle, and SBA Own Most of the United States' Cell Towers

■ American Tower ■ Crown Castle ■ SBA Communications ■ U.S. Cellular ■ Other



Source: Morningstar, company filings, CTIA. Data as of Dec. 31, 2019.

As outlined in the appendix, which explains the tower business model, towers are virtually assured of generating at least mid-single-digit revenue growth each year, but tower revenue growth in the U.S. has been especially strong over the past couple of years, which we believe has been the biggest fundamental factor driving the tower stocks higher. More specifically, we think the excitement about the prospects for 5G in the United States and the belief that we're merely at the dawn of a whole new level of network spending by carriers has brought tower valuations to unprecedented levels. We instead believe that the past few years have already shown what tower growth will be in a 5G environment, and we don't expect further acceleration.

**Exhibit 3** Organic Tower Revenue Growth Has Generally Been Accelerating the Past Three Years

Source: Morningstar, company filings.

**For Tower Firms, the Arrival of 5G Won't Change Fundamentals**

Nearly all U.S. consumers are currently still on 4G networks--most consumers do not have phones yet that are 5G-capable, and most carriers don't have broad 5G networks deployed yet. However, carriers have been smart and have been preparing, so although 5G network usage is not yet ubiquitous, tower companies have already been operating in a 5G environment for the past couple of years.

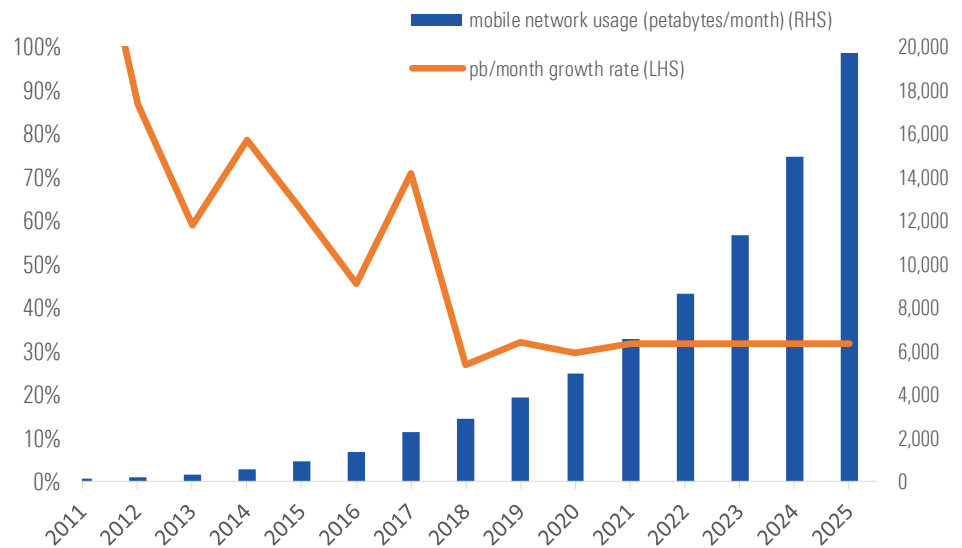
More important, it largely does not matter to tower owners which network technology tenants are using. For the most part, tower owners simply and exclusively charge rent for space taken up on a tower. The amount of space, height location on the tower, and weight are the critical factors that determine rental amounts, and those can be network-technology agnostic. Often, a carrier may change radios at base stations (computer rooms off the towers) or, for example, upgrade software to enable 5G, with few to no modifications to the antennas or other equipment on the towers, resulting in no change in rents to the tower companies. Rent amendments primarily occur when new spectrum is deployed on towers or carriers make other modifications to enhance network capacity.

Tower companies' biggest potential windfall from a 5G upgrade would be from carriers' need to deploy new spectrum on new towers, requiring new antennas and resulting in tower densification (increasing the number of towers used within a given geographic area). We see the upgrade to 5G and the potential need to deploy new spectrum on towers as separate things that could be, but are not necessarily, related to each other. Ultimately, additional spectrum being deployed is dependent on the amount of mobile data traffic. According to data from Cisco and Ericsson, as shared by American Tower, the rate of mobile data growth in the U.S. has slowed in the past few years--to about 30% annually. While the



growth rate will still be high and require carrier investment, even those companies that are promoting the need for more network equipment don't say they expect it to accelerate over the next five years (see Exhibit 4).

**Exhibit 4** Mobile Network Usage Is Quickly Growing, but the Rate of Growth Has Slowed



Source: Morningstar, American Tower, Cisco, Ericsson.

We don't expect additional spectrum to be deployed to macro towers at a significantly different pace than it has historically, so we don't believe that wide adoption of 5G in the U.S. will be a catalyst that brings tower companies to new levels of U.S. revenue growth. Instead, we think network investment by carriers will continue at a more similar pace to recent years, resulting in strong tower business, but no acceleration to recent growth rates. We expect carrier spending to align more with network usage, as it always has, rather than being dependent on which network technology is being deployed.

### **Spectrum Characteristics Determine the Best Solution to Build a Network**

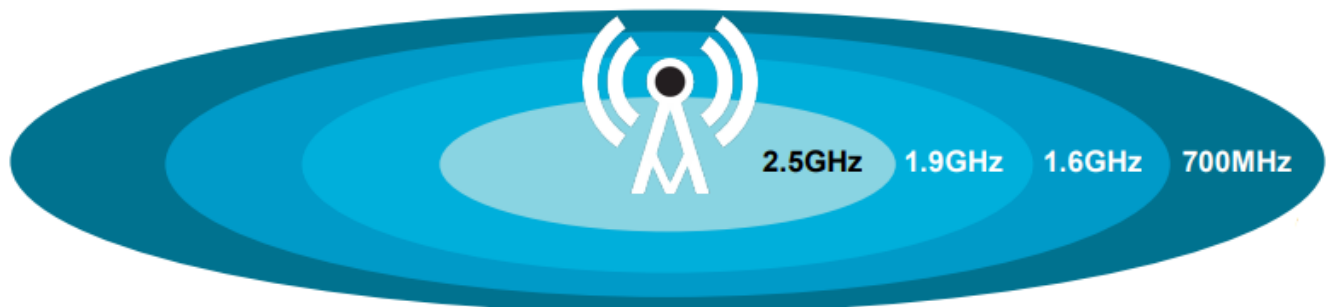
The need for densification is a popular theory of why 5G will be such a boon for tower companies. We believe that view oversimplifies network dynamics and tower spending. Densification through small cells, which are different from towers, is likely. American Tower and SBA generally don't offer small cells in the United States. Crown Castle has a large small cell business, and we will explore the small cell impact on Crown Castle's business later in this paper.

Understanding whether densification is likely and how lucrative it would be for tower companies requires an understanding of the attributes of wireless spectrum, which the government licenses in specified bands at auctions for wireless carriers. Licenses apply to specific geographic areas of the country, so carriers must bid on licenses in each region throughout the country if they want nationwide

coverage, and their rights end up not necessarily being consistent in each area. The right mix of spectrum bands is crucial to building the most economically efficient mobile network.

In some ways, a carrier's choice on which spectrum frequencies it should deploy to build its network requires a tradeoff. Lower-band spectrum, which the three major U.S. carriers hold at varying frequencies between 600 MHz and 900 MHz, has the best propagation qualities: it can travel farthest, allowing equipment on a single macro tower to reach wide geographic ranges, and it has the best ability to penetrate things like buildings, natural barriers, and inclement weather. The drawback to this low-band spectrum is that it is, by definition, in limited supply, resulting in less capacity to handle the needs of robust mobile network use over the huge ranges it can cover. Carriers typically have only 5 MHz-20 MHz blocks of bandwidth within given low-band spectrum bands.

**Exhibit 5** The Higher the Spectrum Band, the Less Distance It Propagates, All Else Equal



Source: American Tower.

From a tower company's point of view, low-band spectrum deployment is the most lucrative. It requires the biggest and heaviest antennas, and its ability to reach wider geographic ranges is maximized by being higher up on the tower. These are all the attributes that lead to the highest rents. If carriers had to densify their networks by using low-band spectrum (so that it is used for only a smaller geographic cell than its physical properties would allow, in order to mitigate the congestion) and replicating the rents per tower they are currently paying, it would lead to huge increases in tower spending, but that will not happen. The number of sites carriers would need because of the limited bandwidth combined with the high cost to deploy make it economically inefficient to use low-band spectrum to meet capacity needs.

High-band spectrum, which typically refers to millimeter-wave spectrum (generally between 30 GHz and 300 GHz, or 30,000 MHz-300,000 MHz), is the opposite of low band in every way. With the large range of frequencies, it is in much greater supply than spectrum in the 500 MHz-1,000 MHz range, and carriers can obtain large chunks of it. With such large bands, it can handle significant capacity, but the characteristics of high-band spectrum results in it being able to travel only over short distances (commonly 100-300 meters) and lead to difficulty penetrating walls or any other type of obstruction,

including rain. It is often thought of as a "line-of-sight" solution, meaning, it works best with no obstacles between the structure where the spectrum is deployed and the end point.

Use of millimeter-wave spectrum requires small cells. Functionally, small cells are essentially mini towers. Whereas towers are large, can house multiple tenants, cover a wide geographic area, are universally used by carriers as the foundations of their networks, and are unique structures that the carriers generally don't own, small cells are composed of boxes that are attached to structures like street poles in population-dense areas to serve narrow areas where carriers need to increase mobile network capacity. Given the extremely high number that would be required to cover a wide area, they would be very economically inefficient (and actually economically unfeasible) to rely on for broad coverage. We do expect 5G buildouts to require densification through small cells, with carriers using them in pockets to enhance network capacity, but that will spark little upside for macro towers. As we said, the only major U.S. tower firm that could materially benefit from small cell densification is Crown Castle, and we are skeptical of the financial wisdom of Crown Castle's small cell strategy, which has led us to disfavor the firm relative to its peers.

Midband spectrum, which is deployed on towers, sits in the middle in every way. It can, in practice, cover an area up to a mile; it is in greater supply than low band, but not nearly as much as millimeter wave; and it has better ability to penetrate obstacles than millimeter wave but is far inferior to low band in that regard. Carriers' midband spectrum holdings generally range from about 1,500 MHz to 4,000 MHz. Because of its higher frequency, midband spectrum requires smaller antennas than low-band spectrum and therefore results in less costly tower leases for carriers, all else equal. Incremental spectrum that carriers deploy on towers as they continue building their 5G networks will be midband spectrum.

**Exhibit 6** Each Carrier Has a Mix of Low-, Mid-, and High-Band Spectrum

	Company	Avg. Bandwidth < 6000 MHz										
Name of Spectrum Band			600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
Spectrum Range (MHz)			617-652; 652-653	698-757; 776-787	817-845; 862-890	1850-1920; 1930-2000	1710-1755; 2110-2155	2000-2020; 2180-2200	1695-1710; 1755-1780; 2155-2180	2305-2320; 2345-2360	2496-2690	24000- 39000
Total Available Bandwidth (MHz)			70 MHz	70 MHz	64 MHz	140 MHz	90 MHz	40 MHz	65 MHz	30 MHz		
	VZ	116 MHz										
	T	160 MHz										
	TMUS	291 MHz										
	DISH											

Source: Morningstar, public filings.

Significant amounts of midband spectrum are deployed on towers already, however, as carriers currently use it to complement low-band spectrum and meet capacity needs, so in many cases we think the density of carriers' networks is already set up to handle further midband spectrum deployments. We therefore don't expect a big step up in macro tower densification. We believe tower companies' 5G revenue growth will come mostly from carriers' amendments to towers where they already reside, which

won't produce the same secular uptrend that densification would. To the extent densification is required, new midband leases will require less spending per tower than carriers currently have, because low band is such a prominent piece of their current footprints. ■■■

# The U.S. Carriers Are Taking a Variety of Approaches to 5G; None Promises Radical Changes in Tower Strategy

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Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

Michael Hodel, CFA  
Director, Communication Services  
+1 312-696-6578  
michael.hodel@morningstar.com

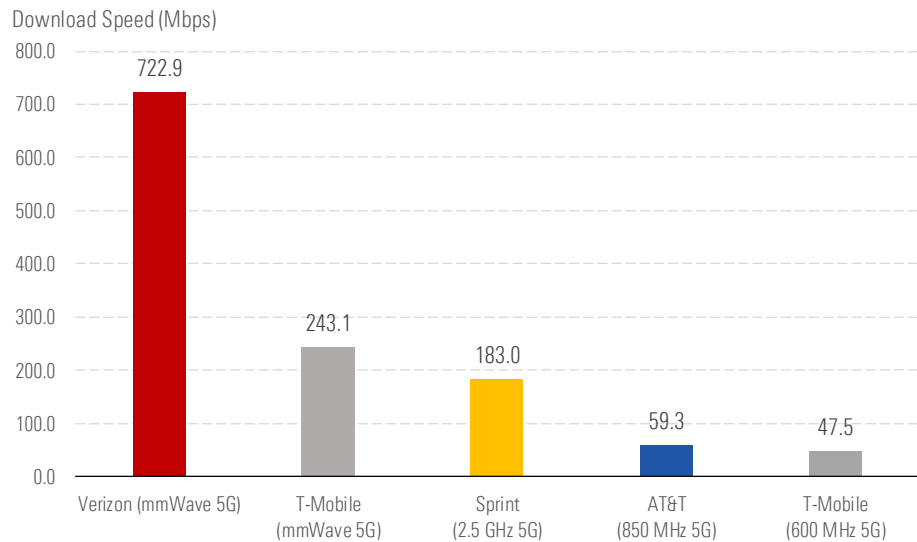
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## 5G Won't Result in Major Changes to How Carriers Build Macro Tower Networks

Practically, carriers will use a variety of architectures to build their 5G networks. Each major U.S. carrier has already been spending on towers to enable 5G, and each will apply its own strategy. Carriers can launch nationwide 5G networks without necessarily significantly amending their tower agreements by simply upgrading radios without altering their presence on towers. We expect the further buildout of network infrastructure that benefits towers and enables the types of speeds and capacity that 5G promises to be a steady process that takes place over much of the next decade. We think the pace will be consistent with historical spending, rather than accelerating as soon as 5G becomes widely available. The emergence of 5G doesn't change the reality that the speed and quality of a wireless network are functions of the equipment and spectrum that carriers deploy, and those are limited by the carriers' abilities to undertake additional spending. Financial constraints are not drastically changing with the arrival of 5G, meaning, we don't expect a dramatic rise in carriers' network spending, especially when it is unnecessary to drive additional revenue.

As carriers do spend on their 5G wireless networks, we expect a slightly lower proportion to go to towers than in the past, as small cells, on which carriers will deploy millimeter-wave as well as more traditional spectrum, will be used more. Testing conducted by Opensignal on 5G networks in downtown U.S. cities at the beginning of 2020 (before the T-Mobile/Sprint merger closed) demonstrates the difference the type of spectrum makes when building a 5G network, as shown in Exhibit 7. Again, we don't believe deployment of millimeter spectrum will meaningfully benefit U.S. tower companies.

**Exhibit 7** Opensignal Testing Shows the Superiority of mmWave Spectrum ...

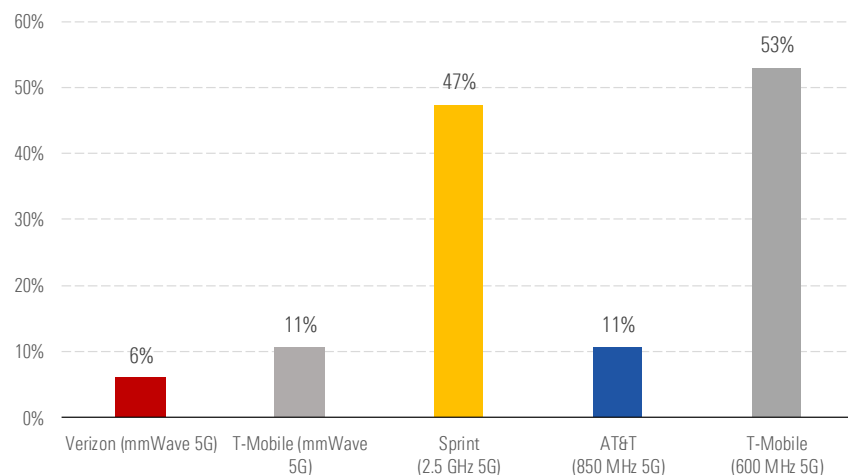


Source: Morningstar, Opensignal.

In practice, we believe universal use of millimeter-wave spectrum across the country for 5G networks would be required to broadly achieve the promises of 5G, but we see no way for that to be economically feasible. In the same trial, Opensignal tested the percentage of time the 5G signals were available in those downtown urban areas, and it showed the challenges of relying on millimeter wave, a result of the relatively tiny coverage areas of small cells (Exhibit 8). It's also important to remember that relatively few consumers are yet on 5G networks. As 5G networks get more congested, those that rely on lower and midband spectrum to cover wider areas will suffer without further improvements.

**Exhibit 8** ... But It Will Take a Lot of Time and Money Before Consumers Can Count on mmWave Signals

This is evidenced by the percentage of time consumers remain connected to these 5G networks.



Source: Morningstar, Opensignal.

Our expectation is that 5G networks will be able to meet the lofty expectations in some pockets within cities, where millimeter-wave spectrum is deployed, but in many other areas 5G will give mobile users, at least initially, a similar experience to what they get with 4G, albeit with incrementally faster speeds. Consumers' potential disappointment with the 5G experience may dampen how quickly they upgrade to 5G devices, and take pressure off carriers to upgrade quickly.

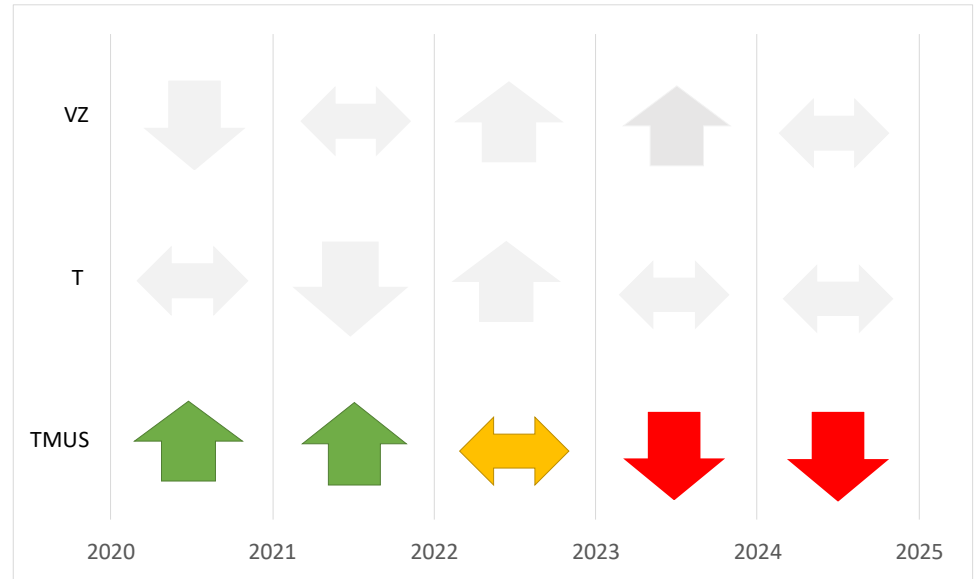
With millimeter wave being only a part of the 5G solution, in our view, we expect low-band and, especially, midband spectrum to be the 5G workhorses, and we conclude that the 5G network architecture will look similar to the 4G architecture that currently exists. We are not denying the 5G upgrade cycle; we are instead doubting that it will lead to a much different environment for tower companies. Equipment certainly needs to be upgraded to be 5G-compatible and spectrum must be available on towers for 5G, but that spending has been underway for some time, as the carriers were preparing well in advance of turning on their 5G networks, and not all of this work leads to tower amendments.

As the 5G network upgrades are completed and all carriers have nationwide coverage, we believe targeted capacity enhancements, largely based on growth in mobile network usage and consumer 5G adoption, will prompt further tower spending. We therefore have no doubt that carriers will need to constantly upgrade their networks and increase spending on towers, but we think it will merely stay on the strong trend it has been on. We don't think carriers will have the demand pressure or financial motivation to spur even faster upgrades or densification. A closer look at the major carriers' plans supports our belief that growth in tower spending is not on the cusp of taking a big step higher.

### **T-Mobile's 5G Network Is Already Live Nationwide, and It Will Rely on All Types of Spectrum**

We expect T-Mobile to be the big spender and catalyst for tower revenue growth in the U.S. for the next few years. Our view is not founded solely on an organic 5G buildout, although the result will be a high-quality, nationwide 5G network. Rather, the pace with which T-Mobile upgrades its network will be based on the integration of its network with Sprint's and the commitments it made to the federal government to get the merger with Sprint approved. The regulatory conditions seemed most designed to ensure that rural areas throughout the country will finally get access to high-quality broadband service. Exhibit 9 shows the directional impact we expect T-Mobile to have on tower revenue growth rates over the next five years.

**Exhibit 9** T-Mobile Will Ramp Up Tower Spending in the Near Term Before Realizing Savings From Sprint Synergies



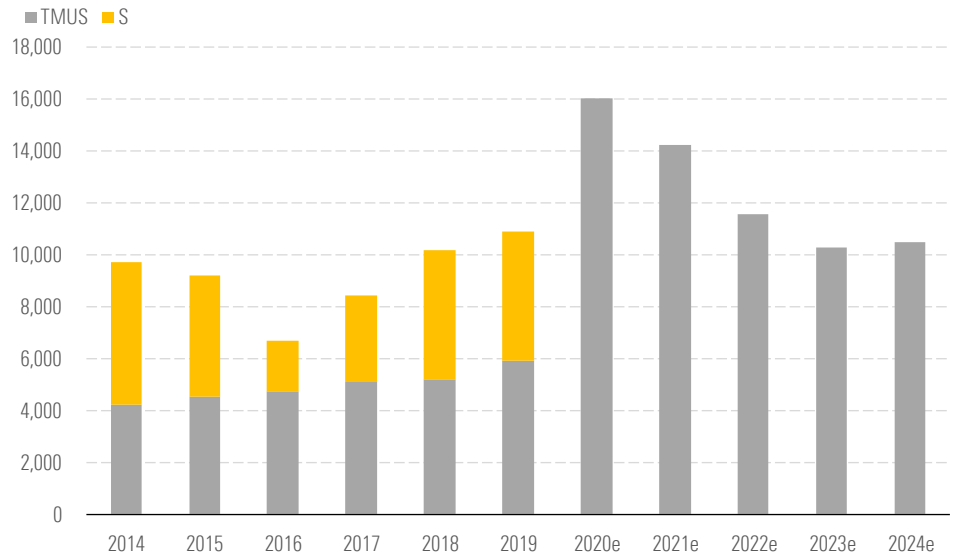
Source: Morningstar.

As part of the approval for its merger with Sprint, T-Mobile committed to cover 97% of the U.S. population with 5G service within three years of the merger's completion (April 1, 2020), with 75% receiving download speeds of at least 50 Mbps and 63% receiving at least 100 Mbps. Within six years, it must offer 5G download speeds of at least 50 Mbps to 99% of the U.S. population (and 100 Mbps to 90%). To meet its buildout requirements, T-Mobile plans to deploy midband spectrum (between 1 GHz and 6 GHz) to meet most of its coverage requirements.

T-Mobile made a lot of progress toward meeting these benchmarks even before the merger closed. T-Mobile is currently operating a 5G network that covers 225 million people in the U.S., or over two thirds of the population, across 1 million square miles, about one third of the continental U.S. landmass (or 40%-50% of the area T-Mobile will likely cover long term). However, so far, its 5G network has been built primarily with 600 MHz, low-band spectrum, as it couldn't deploy any of Sprint's 2.5 GHz spectrum it is depending on for 5G network capacity until the merger closed. Sprint had deployed 2.5 GHz capacity on all of its 45,000 macro sites over the past few years, with many of those sites deployed in 2018 or 2019 with radios capable of offering 5G service through a software upgrade. For its part, Sprint's live 5G network covered around 20 million people when the merger closed.

T-Mobile has said it plans to spend \$40 billion on its network over the next three years and \$60 billion over the next six. Those levels compare favorably with the combined capital spending of T-Mobile and Sprint over the past several years (Exhibit 10).



**Exhibit 10** T-Mobile's Capital Spending the Next Few Years Will Be More Than It and Sprint Combined Recently

Source: Morningstar, company filings.

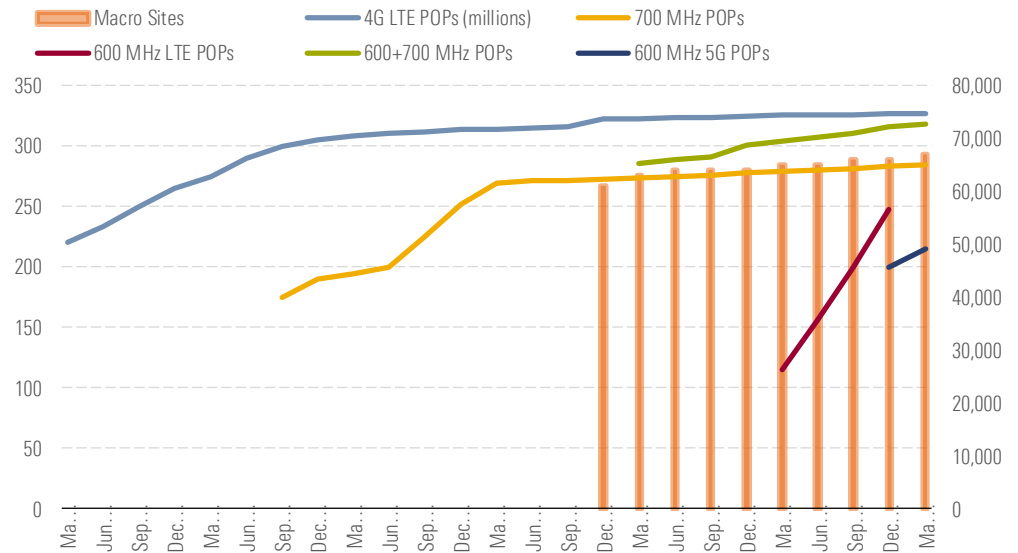
We expect four major components of T-Mobile's plan for the next five years to boost tower spending: deploy 600 MHz spectrum on towers to cover the roughly one third of the U.S. population that is not yet covered by its 5G network; migrate Sprint customers to the T-Mobile 4G network, which is likely to entail deploying additional midband spectrum, including spectrum in the 1.7-2.2 GHz range it acquired from Sprint; roll out the 2.5 GHz spectrum it got from Sprint on its towers to be used for 5G; and increase its tower portfolio from 65,000 towers (excluding Sprint's towers) to 85,000 towers over the next five years, to be accomplished by keeping 10,000 Sprint towers and adding 10,000 new towers.

The network unification and 5G deployment not only provides an example for why tower revenue growth should remain strong, but it also reveals why we aren't forecasting new levels of tower revenue growth rates. When looking at T-Mobile in the context of the whole industry, which doesn't have the additional task of consolidating two pre-existing wireless networks, it doesn't appear future spending will need to be dramatically different relative to the past couple of years, as carriers have been preparing for 5G.

From T-Mobile, we see a pace in 600 MHz deployment that doesn't seem to deviate much from what it has been. In 2017, T-Mobile won the rights to a nationwide average of 31 MHz in the 600 MHz band across the U.S. The firm has since blanketed two thirds of the country's population with 600 MHz spectrum, using 5G-capable radios and dedicating about 10 MHz to its 4G network, with the remainder reserved for 5G. T-Mobile still needs to upgrade thousands of more sites with 600 MHz spectrum, but we don't expect a faster pace or higher tower revenue growth than the 600 MHz deployment has caused recently. Management has said the further buildout will entail adding equipment to existing sites rather than adding new sites, meaning, further network densification will not be required, which makes sense given its low-band coverage grid already reaches the vast majority of the U.S. population. Exhibit 11

illustrates T-Mobile's total 4G LTE population coverage (across all spectrum bands) and the portion of its footprint served by low-frequency spectrum today (700 MHz, 600 MHz, or both).

**Exhibit 11** T-Mobile Has Aggressively Deployed New Spectrum as It Has Become Available  
 POPs = U.S. population covered.



Source: Morningstar, company filings.  
 Note: 700 MHz coverage estimated based on T-Mobile's disclosed license coverage and assumed population growth.

We expect the addition of 2.5 GHz spectrum for 5G to be the biggest source of higher spending on towers. T-Mobile acquired about 150 MHz of 2.5 GHz spectrum from Sprint that it will now deploy on its own towers. T-Mobile expects the 2.5 GHz spectrum to be the key component for realizing major 5G performance advances on its network, relying on it especially in dense urban areas.

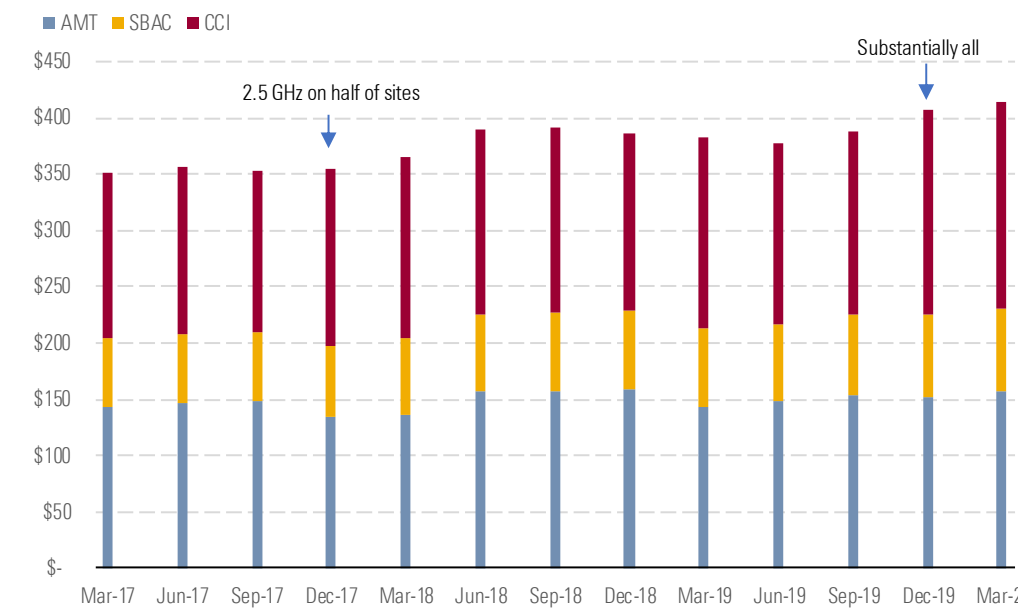
As T-Mobile redeploys the 2.5 GHz spectrum, it will also continue to deploy its other midband spectrum on the towers it is updating. Including the midband spectrum that it got from Sprint, T-Mobile has about 100 MHz of spectrum collectively between about 1.7 GHz and 2.2 GHz. While this provides further opportunities for tower revenue growth in the next couple of years, it is indicative of a firm with a well-stocked spectrum portfolio that will be in use, which will dampen the need for significant spectrum deployment in the future.

Even the heightened midband deployment in the next few years faces factors that mitigate T-Mobile's tower spending growth.

First, it does not consist largely of densification. Of an eventual tower portfolio of 85,000 towers where the 2.5 GHz spectrum potentially will be deployed, 75,000 are currently active towers where T-Mobile has leases, meaning, even new deployments are likely to consist of amendments to existing antennas, a less lucrative addition for tower companies. Based on disclosures from American Tower, we suspect

adding antennas for 2.5 GHz spectrum on existing towers adds only a couple hundred dollars per month to the tower rent. The experience with Sprint lends credence that 2.5 GHz spectrum doesn't radically alter lease payments. As Sprint deployed 2.5 GHz across its network, its combined lease payments to the three tower firms grew at only a moderate pace--about 6% annually over the past three years, including spending with Crown Castle's small cell business. Mid-single-digit organic growth rates have been the norm on towers for much of the past decade.

**Exhibit 12** Sprint's Quarterly Tower Lease Spending Has Increased at a Steady, Not Exceptional Pace  
\$ Millions



Source: Morningstar, company filings.

T-Mobile has said it expects to touch about 1,000 towers per month over the next two years. At that rate, 2.5 GHz spectrum deployment would result in an additional \$29 million per year in T-Mobile tower rents, or less than 1% of the combined U.S. tower revenue of SBA, American Tower, and Crown Castle. T-Mobile expects the 10,000 new towers to come on line more toward the end of its current five-year plan.

**Exhibit 13** TMUS' Decommissioning of Most Sprint Towers Would Cut a Substantial Chunk of Tower Revenue

	<b>AMT</b>	<b>SBAC</b>	<b>CCI</b>
Total 2019 Property Revenue (\$mm)	\$7,465	\$1,861	\$5,098
Proportion from TMUS	9%	18%	18%
Proportion from Sprint	8%	17%	14%
Revenue from S and TMUS (\$mm)	\$1,269	\$651	\$1,631
3/4 of Sprint revenue	6%	13%	11%
<b>3/4 of Sprint revenue (\$mm)</b>	<b>\$448</b>	<b>\$236</b>	<b>\$535</b>

Source: Morningstar, company filings.

Second, while T-Mobile will certainly have to spend much more on towers than it had been as a stand-alone company, it plans to eventually shut down, or decommission, 35,000 Sprint towers. The reduction will happen gradually and shouldn't have a near-term impact on tower company revenue because T-Mobile needs this currently less efficient network until it can optimize its own towers by migrating Sprint's customers, and contractual obligations will dictate the earliest that lease payments can stop. However, T-Mobile expects \$4 billion in cost savings once it's decommissioned the excess towers, and we expect much of that savings will be in the form of tower rents.

Relative to the combined network that exists today with towers from both Sprint and T-Mobile, T-Mobile's eventual network will be less dense. Exhibit 13 shows the percentage of revenue each of the three tower firms received from Sprint and T-Mobile in 2019 and how much would be at risk if T-Mobile eventually cut three quarters of that revenue (based on T-Mobile's plan to keep 10,000 Sprint towers while decommissioning 35,000). That churn would happen over time and would be offset by the additional towers that T-Mobile plans to add and potential other sources, such as Dish Network's planned buildout, which includes options to assume decommissioned Sprint sites.

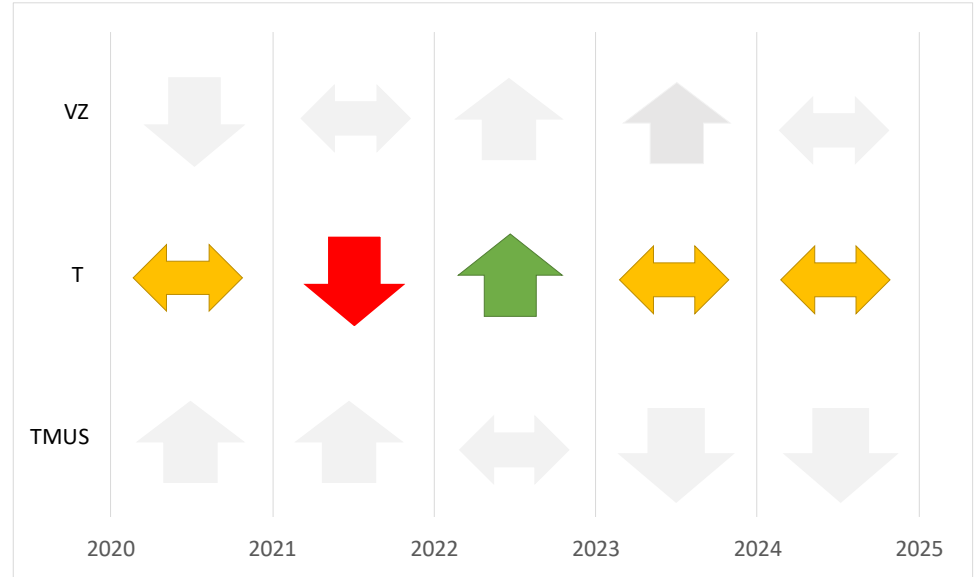
T-Mobile has said that its 5G strategy will result in nationwide average speeds of more than 400 Mbps on its network. We don't see an urgent need to improve upon that, so we expect a normalized pace of tower spending growth after the next few years. In all, we expect T-Mobile's plans to lead to a bump in tower spending growth in the next few years, but not enough to contribute to a material acceleration in the industry or at a pace that will be sustained.

**AT&T's 5G Strategy, Like T-Mobile's, Is Well-Established**

We don't expect AT&T to cause any acceleration in U.S. tower revenue growth over the next few years. If anything, we think the firm is likely to spend less on upgrading towers, thereby leading to lower colocation and amendment growth relative to the past couple of years. AT&T's tower spending will still grow, as it has contractual annual escalators and is always engaging in some amendments to enhance its network performance even when it doesn't have new spectrum to deploy, but Exhibit 14 reflects our expectation for the changes in the rate of growth each year.

**Exhibit 14** AT&T Is in the Last Stages of Its Recent Spectrum Rollout

Growth in tower spending will then slow until it has more midband spectrum to deploy.



Source: Morningstar.

AT&T's 5G strategy is somewhat similar to T-Mobile's. Its 5G network will primarily use sub-6 GHz spectrum, and it will use millimeter-wave only in very dense areas where it needs the capacity. Unlike T-Mobile, at this point AT&T is not dedicating any of its sub-6 GHz spectrum bands specifically to 5G, and it has not declared how much of its spectrum will be initially dedicated to 5G. It will use spectrum across its holdings to build its 5G network but will rely primarily on midband. AT&T holds around 160 MHz of spectrum on average across the U.S. within bands traditionally used to offer wireless service (sub-2.5 GHz). It also has over 600 MHz of millimeter-wave spectrum in the 24 GHz and 37-39 GHz bands.

**Exhibit 15** AT&T Trails T-Mobile in Average Nationwide Sub-6 GHz Spectrum, but Is Better-Positioned Than Verizon

	Company	Avg. Bandwidth < 6000 MHz	600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
<b>Name of Spectrum Band</b>			600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
<b>Spectrum Range (MHz)</b>			617-652; 652-653	698-757; 776-787	817-845; 862-890	1850-1920; 1930-2000	1710-1755; 2110-2155	2000-2020; 2180-2200	1695-1710; 1755-1780; 2155-2180	2305-2320; 2345-2360	2496-2690	24000- 39000
<b>Total Available Bandwidth (MHz)</b>			70 MHz	70 MHz	64 MHz	140 MHz	90 MHz	40 MHz	65 MHz	30 MHz		
	VZ	116 MHz										
	T	160 MHz										
	TMUS	291 MHz										
	DISH											

Source: Morningstar, public filings.

AT&T is just now broadly turning on its 5G network throughout the U.S., but the firm had already been spending substantially on upgrading towers in recent years and says it has enhanced its network capacity by 70% as a result. We think the firm has already completed most of the 5G spending it has to

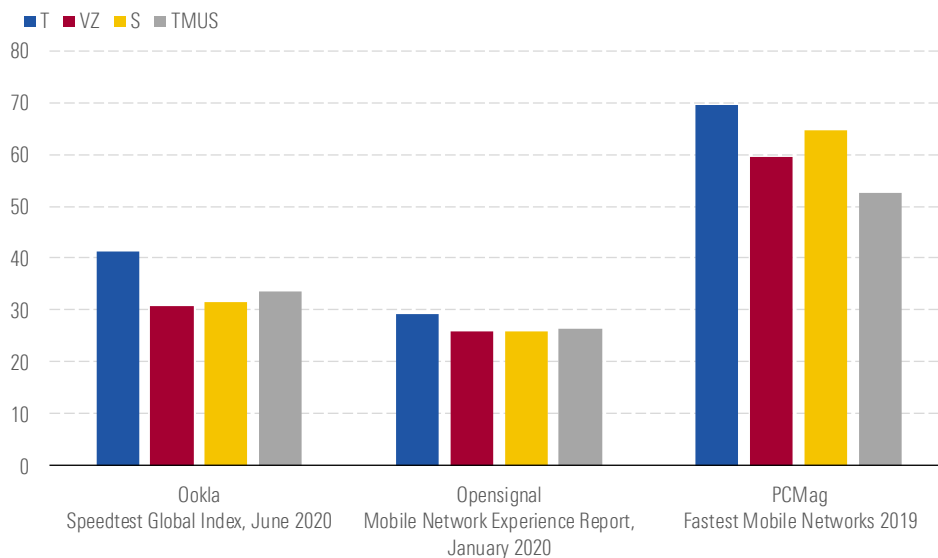
do on macro towers in the near term and has deployed the spectrum on towers necessary to underpin its 5G network.

Several years ago, AT&T won a government contract to build out FirstNet, a nationwide network for first responders. The federal government gave AT&T 20 MHz of 700 MHz spectrum and cash support, and AT&T was required to then deploy the spectrum on towers throughout the U.S. to create the network. Because one of the biggest expenses in upgrading a network is the cost involved in climbing the towers, AT&T leveraged the climbing it was required to do for FirstNet and took the opportunity to upgrade the equipment on the towers it touched for FirstNet to get ready for 5G and deploy a significant amount of spectrum to which it had the rights but had been dormant to that point.

As a result, on all the towers AT&T has touched for FirstNet, AT&T has all its spectrum deployed (it added an average of 40 MHz of AWS-3 and WCS spectrum to towers) and all its equipment ready for 5G. To turn on its 5G network, AT&T simply has to update software; it will not have to spend more on the towers it has already touched.

The FirstNet buildout is now 80% complete. We expect AT&T to proceed with a similar tactic on the remaining towers through most of 2021, but the pace of its macro tower amendments will slow down. When the FirstNet rollout is finished, AT&T will have deployed the 700 MHz spectrum for FirstNet on the majority of its roughly 70,000 towers, meaning, those towers will also all be 5G enabled, house all of the midband spectrum AT&T currently needs for its initial 5G network, and have their technology upgraded to enhance the efficiency of the spectrum. About 200 million people in the U.S. are already covered by AT&T's 5G-enabled network.

With a live 5G network, a 4G network significantly enhanced by the recent upgrades, and spectrum that can be transferred to 5G use with mere software adjustments, we expect AT&T's tower spending to slow down. As we've said, we believe sufficient network capacity throughout the country is the most important factor in determining how much investment carriers need to make in their networks, and AT&T seems to be currently well positioned in that regard. We don't expect consumers to notice significant speed differences between AT&T's 4G network and the initial 5G network. On the other hand, AT&T's 4G network is now widely regarded as the fastest in the U.S., so we expect consumers to remain satisfied on it, especially given a methodical upgrade cycle to 5G phones and the extended process for competitors to offer superior networks, 5G or otherwise. As Exhibit 16 exemplifies, AT&T's 4G network has been universally recognized as the fastest in recent national speed tests.

**Exhibit 16** In Multiple Network Tests, AT&T Currently Has the Fastest 4G Download Speeds Nationwide (Mbps)

Source: Morningstar, PCMag, Opensignal, Ookla.

Note: Ookla speed score is composed of 90% download and 10% upload mix. The others reflect download speeds.

AT&T's next step will be to bring 5G speeds closer to levels that will meet the hype, and AT&T will have to spend significantly to do that, but we expect the next phase of buildout to be less speedy and less focused on macro towers. The firm doesn't have the amount of midband spectrum holdings that T-Mobile does, so to bring about meaningful difference in consumer experience between 4G and 5G, it plans to deploy millimeter-wave spectrum in dense urban areas. Given the economic inefficiencies of a broad network built on millimeter wave, we also suspect AT&T will choose to selectively acquire and deploy more midband spectrum.

The initial priority for AT&T to enhance the 5G network will be to deploy more millimeter-wave spectrum, and the firm is shifting capital spending more toward fiber and small cells than towers. AT&T says it already has millimeter-wave offerings in 35 U.S. cities. Again, this component of a 5G strategy is largely independent from tower spending and will have little effect on the tower segments of the U.S. firms. The extent to which small cell buildouts will have an impact on Crown Castle's small cell business is explored later in this paper.

AT&T acknowledges that its millimeter-wave strategy is designed for little pockets within cities and venues and that lower-band spectrum is the key to nationwide 5G coverage. If and when AT&T needs more midband spectrum deployed on macro towers to enhance its 5G network, we expect the firm to accomplish it with purchases of additional spectrum rights in future auctions and through dynamic spectrum sharing, or DSS, which essentially enables carriers to simultaneously use spectrum for 4G and 5G, rather than having to dedicate bands to one or the other.

The United States has two midband spectrum auctions on the horizon. The government intends to begin an auction for about 70 MHz of spectrum in the 3,550 MHz-3,650 MHz band (CBRS band) in July 2020 and 280 MHz of spectrum in the 3,700 MHz-3,980 MHz range (the C-Band) in December 2020. Because AT&T has said that it doesn't expect its current midband holdings alone to yield significant 5G performance differences relative to 4G, we expect the firm to be a player in one or both of those auctions.

The eventual deployment of additional midband spectrum will certainly boost tower revenue growth, but the timing and the amount that AT&T may win are speculative. In speaking about additional midband spectrum, management has taken the long view and emphasized that building a 5G network will be a process that takes a decade. More important, we don't expect any deployment to match the 60 MHz of spectrum deployment and equipment upgrades that AT&T has undertaken on towers over the past couple of years, which will leave colocation and amendment spending short of what AT&T has done to boost towers in that time frame.

**Verizon's Current 5G Focus Is on Small Cells, Leaving Towers out of a Spending Ramp**

Verizon has the fewest spectrum resources under 6 GHz available for broad 5G deployment, but it was early to begin building a large portfolio of millimeter-wave spectrum. As a result, it has fewer options for spending on towers and is currently focusing on its small cell deployment. Verizon has an average of around 116 MHz of spectrum below 6 GHz--the least of the three big carriers (Exhibit 17). It has hundreds of megahertz' worth of millimeter-wave spectrum.

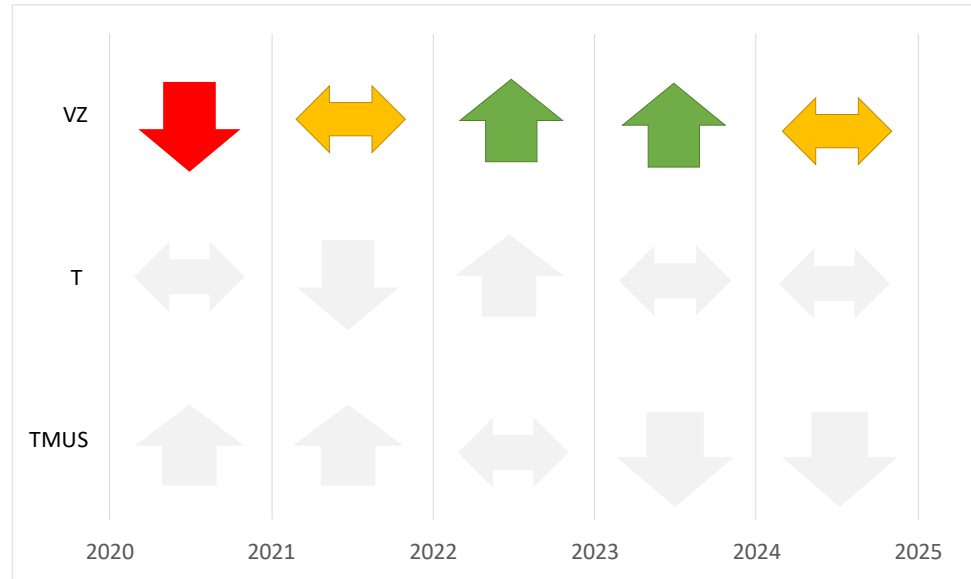
**Exhibit 17** Relative to Its Competitors, Verizon Has Lower Nationwide Holdings of Sub-6 GHz Spectrum

	Company	Avg. Bandwidth < 6000 MHz	600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
<b>Name of Spectrum Band</b>			600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
<b>Spectrum Range (MHz)</b>			617-652; 652-653	698-757; 776-787	817-845; 862-890	1850-1920; 1930-2000	1710-1755; 2110-2155	2000-2020; 2180-2200	1695-1710; 1755-1780; 2155-2180	2305-2320; 2345-2360	2496-2690	24000- 39000
<b>Total Available Bandwidth (MHz)</b>			70 MHz	70 MHz	64 MHz	140 MHz	90 MHz	40 MHz	65 MHz	30 MHz		
	VZ	116 MHz										
	T	160 MHz										
	TMUS	291 MHz										
	DISH											

Source: Morningstar, public filings.

Verizon currently has a two-pronged strategy to build its 5G network: it will rely heavily on millimeter wave and on dynamic spectrum sharing, or DSS, to more efficiently use its lower-band spectrum. At present, Verizon is prioritizing capital spending toward its fiber buildout rather than towers. As we said for AT&T, Verizon's tower spending will continue to grow through escalators and the constant amendment activity that carriers engage in, but with less new spectrum to deploy, we expect the rate of growth to decelerate in the near term (Exhibit 18).



**Exhibit 18** Until Verizon Has More Midband Spectrum to Deploy, We Expect Tower Spending Growth to Slow Down

Source: Morningstar.

Because millimeter-wave spectrum is not conducive to providing broad 5G coverage, Verizon will, like its competitors, use lower-band spectrum on towers to accomplish blanket coverage across the U.S. However, because Verizon has a relative dearth of lower-band spectrum to allocate to 5G without impairing its 4G network, it plans to rely heavily on DSS, which essentially enables a network to allocate bands of spectrum simultaneously to 4G and 5G technologies.

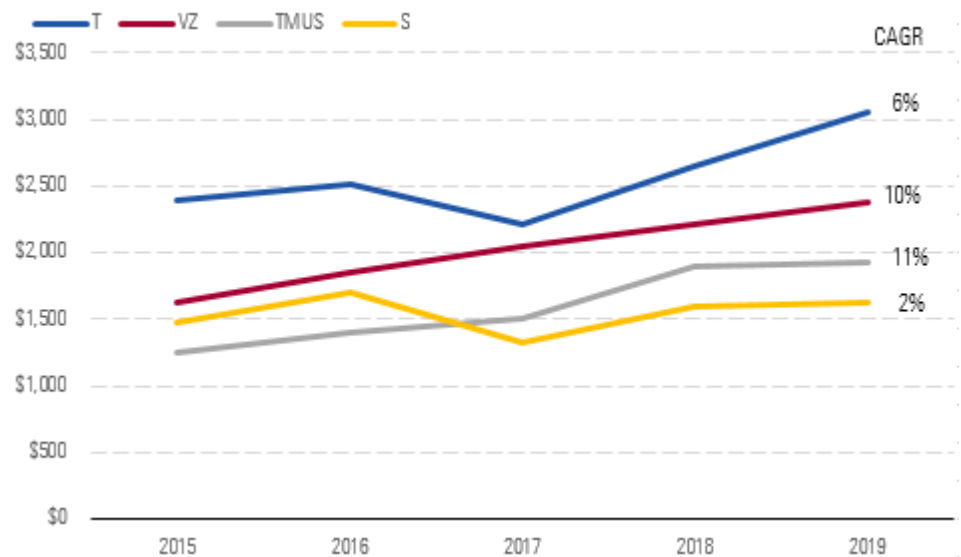
With DSS, Verizon will not have to choose which bands are for which network generations. Instead, the same spectrum will automatically be used for whichever network a consumer should be accessing, allowing Verizon to be much more efficient with its spectrum holdings. A consumer with a 5G device and network plan can use the exact same network as the person next door who has only a 4G device. Verizon has been deploying DSS into its network and expects to turn it on in 2020.

DSS means little in the way of tower amendments and colocations. Because the spectrum is already in use, it doesn't have to get further deployed on towers, and antennas can remain the same. While Verizon has to spend to update its radios and employ the new technology, the presence on the tower--the only thing that really matters to tower company revenue--does not necessarily need to be materially altered.

Like its competitors, nearly all the spending Verizon has done on towers the past few years has been with an eye toward 5G, meaning, the equipment it deployed is 5G compatible and will simply require a software upgrade to turn on the 5G network. Management has frequently said that the bulk of its tower spending for 5G took place over the past few years. Based on disclosures from the tower companies, Exhibit 19 shows Verizon's tower spending has steadily grown over the past five years, compounding at

a rate only less than T-Mobile, which deployed new 600 MHz spectrum nationwide within that time frame. After a period with a focus on towers, Verizon's management has said the majority of its network investment will shift to small cells. We expect Verizon's current strategy to result in little incremental tower spending for 5G--the firm expects to keep its activity on macro towers in 2020 at a similar level to what it was in 2019.

**Exhibit 19** Verizon's Tower Spending Has Steadily Grown Each of the Past Five Years (\$ Millions)



Source: Morningstar, company filings of AMT, SBAC, and CCI.

However, we expect Verizon to be a major player in the CBRS and C-Band spectrum auctions, because in our view, the company needs more midband spectrum to deploy on towers for 5G. While DSS might be a sufficient near-term step to turn on a 5G network, we don't think Verizon has enough sub-6 GHz spectrum to efficiently meet growing capacity needs and match the capabilities of AT&T and T-Mobile. Again, regardless of network technology, having insufficient spectrum to meet usage demand is what drives further spectrum deployment, and we think Verizon needs more spectrum.

However, we don't expect new midband spectrum to be a material tower catalyst soon. First, it can take over a year from the time a spectrum auction concludes until the spectrum is available to be deployed, so, we don't think an aggressive deployment would come before 2022, irrespective of other circumstances. We also think the additional midband spectrum rollout will be slow to start because Verizon is currently prioritizing and putting significant spending resources behind its fiber buildout and small cell deployment. Verizon is currently building fiber in 60 cities, including cities outside its legacy wireline footprint, which is primarily in the Northeast. The firm expects to deploy 5 times as many small cells in 2020 as it did in 2019, and it says it has another two to three years left on that endeavor, after which it will assess whether it will build fiber in additional markets. With that priority, we don't expect aggressive midband deployment on towers in the near term. And if Verizon follows through on an

extensive small cell network, future midband deployment is likely to skew more toward additions to existing towers rather than densifying to new towers.

Considering that Verizon has been deploying AWS-3 spectrum on towers the past couple of years, and, according to the firm, adding about 2,000 net new towers each year recently (to about 66,000), we think it likely Verizon's incremental tower spending will dip in the near term. When Verizon does undertake new midband spectrum deployments, we doubt it will be at a materially higher spending level compared with the recent past. Overall, we see Verizon as a good balance to T-Mobile--T-Mobile will increase spending more in the next couple of years but then pull back as it can shut down Sprint towers, while Verizon will slow tower spending growth in the near term before picking back up with new spectrum acquisitions. Together, they support our belief that the pace of tower revenue growth will remain steadily high, but will be unlikely to make a material advance.

**Dish Network Is a Wild Card for Spending on Towers**

Dish Network has been reluctant to discuss its plans for its network buildout and tower deployment, leaving it as a potential source of high variability for future tower revenue streams.

Dish has licenses to midband spectrum in the AWS-3, AWS-4, and PCS H blocks as well as low-band licenses in the 600 MHz and 700 MHz bands, and thus far deployed almost none of it. As part of the Sprint/T-Mobile merger gaining regulatory approval, Dish acquired Sprint's prepaid wireless business and committed to build its own 5G network, which ensures it will broadly deploy much of its spectrum on towers.

**Exhibit 20** Dish Has Substantial Amounts of Spectrum That It Is Obligated to Deploy

	Company	Avg. Bandwidth < 6000 MHz										
Name of Spectrum Band			600 MHz	700 MHz	800 MHz	PCS	AWS-1	AWS-4	AWS-3	WCS	2.5 GHz	mmWave
Spectrum Range (MHz)			617-652; 652-653	698-757; 776-787	817-845; 862-890	1850-1920; 1930-2000	1710-1755; 2110-2155	2000-2020; 2180-2200	1695-1710; 1755-1780; 2155-2180	2305-2320; 2345-2360	2496-2690	24000- 39000
Total Available Bandwidth (MHz)			70 MHz	70 MHz	64 MHz	140 MHz	90 MHz	40 MHz	65 MHz	30 MHz		
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	TMUS	291 MHz										
	DISH											

Source: Morningstar, public filings.

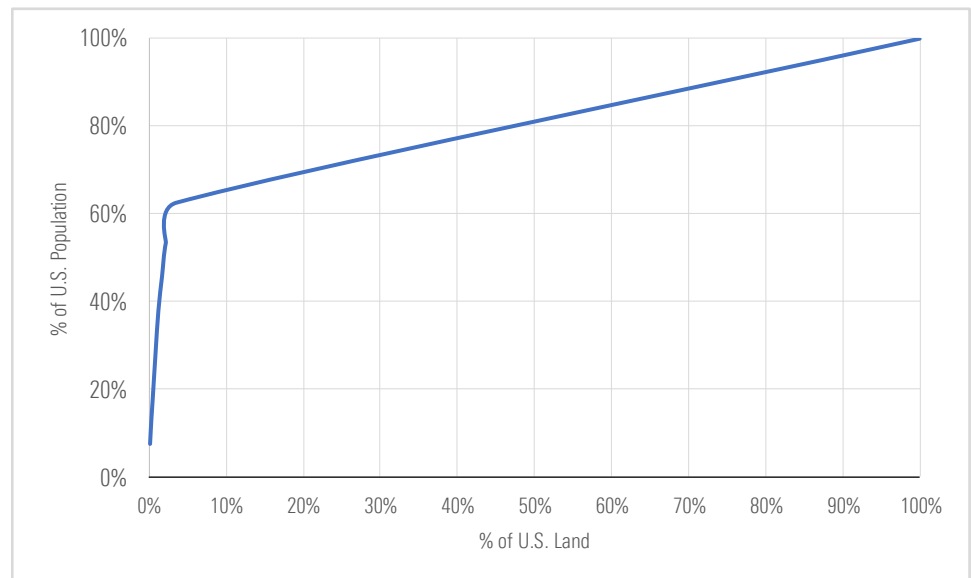
Dish's 5G network must provide service to 20% of the population by June 2022 and 70% by June 2023 with its AWS-4, PCS H, and 700 MHz spectrum. The agreement requires the spectrum to be deployed on at least 15,000 sites. By June 2023 Dish also must offer 5G broadband service to at least 70% of the U.S. population with its 600 MHz spectrum. Additionally, Dish committed not to sell its AWS-4 or 600 MHz licenses for six years and will face substantial cash penalties and potentially the loss of its spectrum if it fails to meet the buildout timelines. These provisions would seem to ensure new tower business, and we

believe Dish will be an incremental tenant, but we don't think tower companies can count on Dish to be a growth catalyst yet.

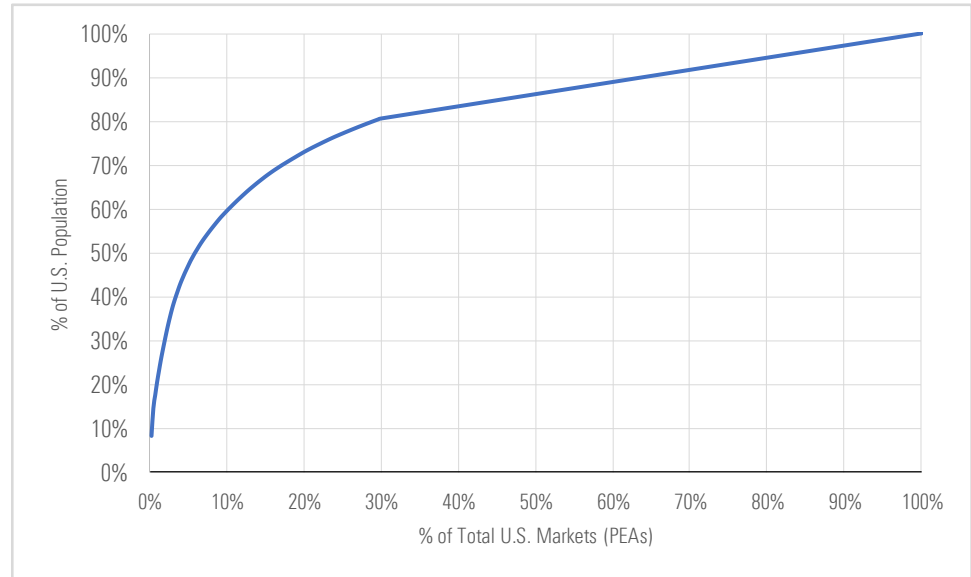
Dish has implied that it is not in a hurry to deploy spectrum on towers--meaning any tower leases may come only shortly before the deadlines--and it has the luxury of being content to meet the bare minimum requirements without near-term concern on what that means for network quality. As part of the merger approval, Dish is entitled to use T-Mobile's network nationwide for seven years, so during that time frame, its ability to offer a high-quality network to its mobile customers (who were also acquired as part of the merger) is independent of the level to which it builds its own network. With that being the case, it may be content to meet its mandates in the least costly way. For example, Dish must provide download speeds of at least 35 Mbps to at least 70% of the U.S. population by June 2023, but we think it would be able to accomplish that in a fairly narrow geographic area.

According to U.S. Census Bureau estimates, in 2013, 63% of the U.S. population lived in cities that collectively made up only 3.5% of the country's land area (see Exhibit 21). After the last U.S. census, in 2010, over 70% of the country's population resided in the top 71 of 415 U.S. markets as defined by the Federal Communications Commission (deemed partial economic areas, or PEAs, in FCC parlance). Given trends toward cities that were evident after the 2000 and 2010 censuses, we expect the 2020 census to show even more concentration in cities. For Dish, meeting its obligations while taking advantage of that population pattern would reduce the benefit to the tower companies. Not until 2025 does Dish have to provide service to at least 75% of the population in every PEA.

**Exhibit 21** Dish Could Provide Service to Over 60% of Population by Deploying Spectrum on Only 3% of U.S. Land



Source: Morningstar, U.S. Census, data as of 2013.

**Exhibit 22** Half of the U.S. Population Lives in the 25 Biggest Markets

Source: Morningstar, U.S. Census, FCC; Data as of 2010 census.

One reason for the slower rollout may be that Dish has the option to assume the leases on at least 20,000 cell sites from T-Mobile as the sites are decommissioned, which it would likely be able to leverage to reduce its own building costs. For tower companies, Dish taking over these sites would in large part serve to merely offset Sprint churn rather than lead to revenue growth acceleration.

Assuming Dish proceeds with its network buildout, the network will eventually need to be self-sufficient, as the initial agreement to use T-Mobile's network will lapse in 2027. We see a wide range of potential outcomes for Dish, but it appears unlikely that it will have the ability or desire to build an entire nationwide network that rivals the three bigger players. It may ultimately choose to continue buying capacity from an existing carrier and targeting niche geographies or customer types, while selling some of its spectrum assets. Regardless, it's likely Dish will do some building, but the most likely case we see is that it picks up spending within the next couple of years, but ends up effectively just being a replacement for the Sprint headwind that will arise in a few years.

### **The CBRS and C-Band Spectrum Auctions Will Not Lead to a More Robust Environment**

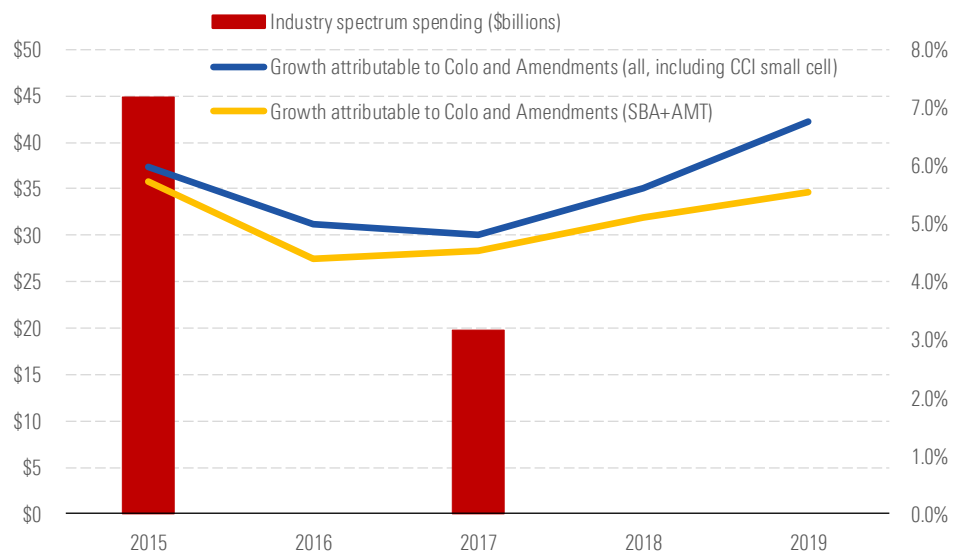
The Federal Communications Commission is scheduled to auction CBRS licenses--around the 3.6 GHz band--beginning in July 2020. It intends to make 70 MHz available, but several characteristics seem to make it unlikely to be widely deployed by carriers: licenses will be sold on a county-by-county basis, resulting in narrow coverage areas for each license, and there are power limitations that curb propagation and may make the band impractical for rural areas. We don't expect CBRS deployment to be a major tower catalyst, and it may be more amenable to small cell deployments.

The auction with more potential to boost tower spending is the C-Band auction, currently scheduled for December 2020, which consists of 280 MHz of spectrum between 3.7 GHz and 4.2 GHz. We expect this spectrum to be widely deployed on towers. Because of its higher frequency compared with other spectrum deployed on towers, its propagation will be worse and it likely will have to be used on a greater number of sites, although we expect it to be used only in areas that need enhanced capacity rather than for broad coverage. Like CBRS, C-Band spectrum will likely also find extensive use on small cells.

The higher frequency also translates to smaller antennas that are less expensive to deploy on towers. Based on our conversations with industry professionals, we don't think there's a typical economic difference for tower companies between tenants deploying larger antennas on fewer towers or smaller antennas on more towers. In addition, it might take a bit longer before C-Band spectrum is available for deployment, as it needs to be moved from the satellite services for which it had been assigned previously, which contributes to our conclusion that significant deployment for this spectrum is unlikely before 2022.

Despite the many different characteristics between spectrum bands, we still find it worthwhile to look at tower revenue growth following past auctions to check whether they resulted in noticeable spikes. We only have tower colocation and amendment figures since 2014, but as Exhibit 23 shows, spending at spectrum auctions doesn't necessarily lead to big spikes in tower industry revenue growth in the immediate aftermath of the auctions.

**Exhibit 23** Tower Revenue Growth Did Not Spike in the Immediate Aftermath of Recent Spectrum Auctions

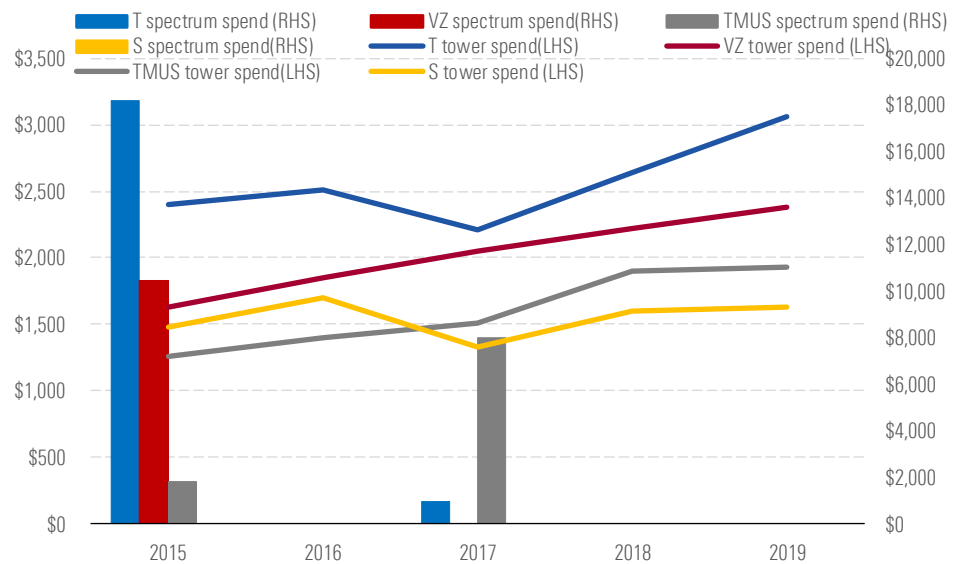


Source: Morningstar, FCC, company filings.

The AWS-3 auction closed in January 2015, and the 600 MHz broadcast incentive auction closed in the first half of 2017. AWS-3 included 65 MHz of spectrum around 1.7 GHz and 2.1 GHz. In the auction, 1,600 licenses were sold, with AT&T winning the lion's share. The 600 MHz auction provided 70 MHz of spectrum, and T-Mobile, which won the most, was the only major existing carrier to win a significant amount. Dish Network also won large chunks of spectrum in both auctions.

It doesn't look to us like the AWS-3 auction caused any change in spending patterns, with carriers mostly continuing a steady march higher. As Exhibit 24 shows, we do see a spike in spending for T-Mobile and AT&T after 2017, and T-Mobile's was a direct result of the spectrum auction, but that was for low-band spectrum (the most expensive to deploy on towers) at a time when T-Mobile had limited low-band capacity and likely felt the need to deploy quickly. AT&T's spike coincides with the beginning of the FirstNet spectrum deployment, which had to be completed under government timelines. Through smart planning, AT&T waited to deploy much of its AWS-3 winnings, later piggybacking on its FirstNet efforts.

**Exhibit 24** Post-Auction Spending Spikes From Individual Carriers Were Due to Unique Circumstances (\$ Millions)



Source: Morningstar, FCC, company filings of AMT, SBAC, and CCI.

We expect future midband auctions to result in a spending pattern like Verizon's after its 2015 midband winnings--it gradually deployed the spectrum over a period of several years. We expect future spectrum deployments to similarly contribute to a stable growth environment, with spending coming over a period of many years. We continually come back to our belief that carriers' network expansion plans are largely dictated by their annual budgets, and we don't see any network necessities in the next few years that will supersede that priority, leading to a continuation of steady growth. ■■

## Technological Advancements Make Carriers' Spectrum Deployments More Efficient, and We Think 5G Tower Spending Will Mimic That of 4G

Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

Michael Hodel, CFA  
Director, Communication Services  
+1 312-696-6578  
michael.hodel@morningstar.com

The three ways carriers add capacity to their networks are by deploying new spectrum on existing sites, densifying their footprints by adding the same spectrum to a greater number of sites, or by using technology and software to make their spectrum deployments more efficient. Adding spectrum and densifying tower footprints are undisputedly positive catalysts to tower revenue growth. Improved spectral efficiency, on the other hand, reduces the amount of spectrum otherwise needed to achieve a desired level of network capacity and quality and thus can reduce the need for additional tower spending. New technologies are constantly developed, and we expect them to be a prominent part of 5G networks.

However, not all technological advancements are detrimental to tower companies--if a carrier can deploy less spectrum or use fewer towers but needs a bigger antenna presence on existing deployments to do it, the tower company could do just as well. Exhibit 25 summarizes our view on the effect three prominent technologies have on tower companies. Many other technologies exist, and undoubtedly others will continue to emerge.

**Exhibit 25** Technologies That Are Implemented on the Tower Can Benefit Tower Companies; Software and Radio Technologies Generally Don't

Technology	How It Makes Carrier's Spectral Holdings More Efficient	Effect on Tower Companies
Dynamic Spectrum Sharing (DSS)	Allows carriers to use the same spectrum band for both 4G and 5G network.	Carriers can avoid adding as much new spectrum to towers that would be dedicated for 5G.
Carrier Aggregation	Allows carriers to piece together non-contiguous spectrum blocks into a single block, increasing bandwidth and	Carriers can maximize utilization of spectrum on towers, allowing them to slow additional deployments
Massive MIMO	Carriers add more antennas to towers to increase capacity for carrier and speed for consumer	Carriers add antennas to towers, resulting in higher tower rents due to extra space and weight

Source: Morningstar.

On balance, we believe these developments will allow carriers to take a more strategic approach to their tower spending than in the past. Dynamic spectrum sharing technology should enable carriers to more gracefully shift from 4G to 5G than prior network transitions allowed, reducing the need to put new equipment on towers by extending the life of existing deployments. As network upgrades mature, the technologies we expect to be most useful within 5G are carrier aggregation and massive MIMO, with both evolving from technologies already deployed in 4G LTE networks.

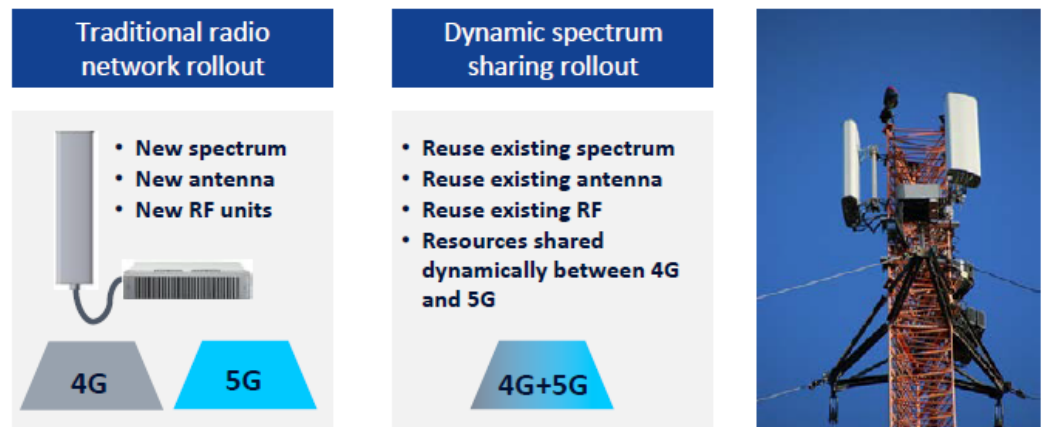


### Dynamic Spectrum Sharing Fosters a Smoother Transition to 5G

We expect dynamic spectrum sharing to result in lower tower spending growth relative to the traditional alternative--deploying new networks on a stand-alone basis and running them side by side with legacy technologies. DSS has never been used before, but the perceived need to provide a graceful transition path prompted the 3GPP, the industry's standards setting body, to build DSS functionality into its standards setting process. Verizon has especially staked its network strategy on DSS and expects it to be live in its network by the end of 2020. Each of the carriers have said they will use it, although T-Mobile seems likely to only use it sparingly.

DSS allows carriers to use a given block of spectrum for both 4G and 5G. Traditionally, carriers had to allocate fallow spectrum to new network technologies. They accomplished this through a combination of new spectrum licenses and "refarming" existing spectrum holdings that had been used for older networks (meaning they would take it away from an older network technology, like 2G or 3G). Of course, carriers can't shut down or significantly reduce capacity on old network technologies until the carriers' newer-generation networks have enough capacity and customers' devices are sufficiently equipped for the more advanced network. Verizon does not have enough spectrum capacity to broadly refarm traditional spectrum and use it for 5G, nor does it have an abundance of new spectrum to dedicate to 5G, which is why DSS will be so important for the carrier.

#### Exhibit 26 Dynamic Spectrum Sharing Allows Carriers to Reuse Core Network Elements



Source: Nokia, Dynamic Spectrum Sharing for Rapid 5G Coverage Rollout White Paper.

Broad use of DSS rather than the greenfield deployment of new spectrum will weigh on tower company revenue growth because it will enable carriers to more efficiently use spectrum as they transition to new network technologies. Nokia claims that more than 5 million of its AirScale and Flexi radio units, which can utilize DSS and support 5G through a software upgrade, have been deployed by nearly 360 carriers globally. Ericsson and Samsung, also major equipment suppliers to the U.S. wireless carriers, have likewise highlighted their DSS technology offerings recently, and vendors and carriers universally say the new technologies will save site expenses. With DSS, both 4G and 5G networks can share the same

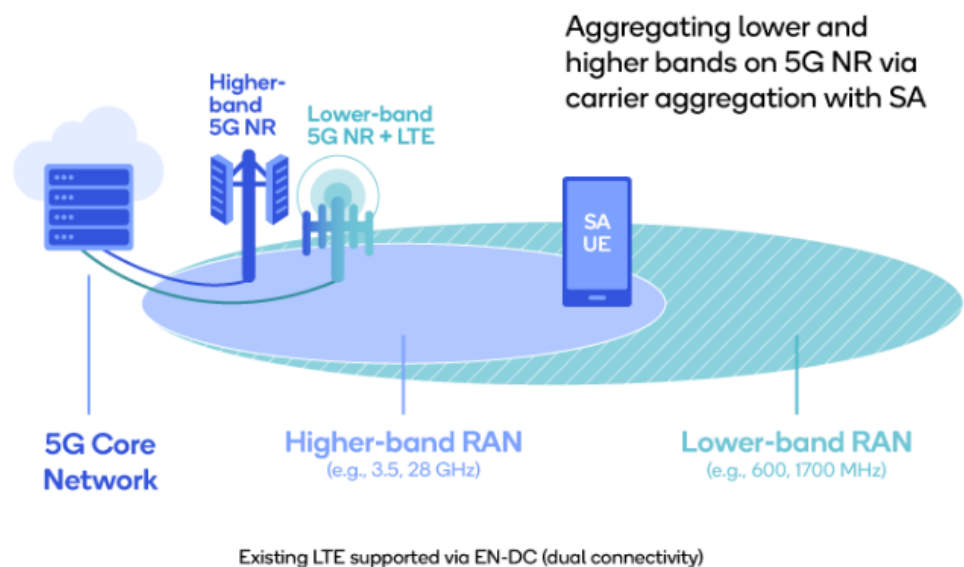
spectrum, including antenna structures, reducing the waste or congestion that might otherwise result. DSS should enable carriers to reduce the spectrum bandwidth they need to deploy without making their networks more congested--a positive for them but leaving less opportunity for tower companies.

### Carrier Aggregation Continues to Evolve, Bringing More Spectrum On Board

Carrier aggregation is another tool that enables carriers to maximize the utilization of their spectrum holdings and provide better speeds for customers. Carrier aggregation is a key technology within the 4G LTE standard. For example, T-Mobile began deploying LTE carrier aggregation around 2015 and had hit most of its network a couple years later. The technology allows carriers to use noncontiguous spectrum blocks as if they were one. For example, if a carrier has only 10 MHz of spectrum in the 800 MHz band and 20 MHz at 2.1 GHz, the carrier could use them together as a 30 MHz block of bandwidth. The larger block enables faster speeds for consumers and may allow the carrier to delay further spectrum deployments it might have otherwise needed to increase its speeds.

As carriers deployed carrier aggregation for 4G, firms upgraded radios but didn't necessarily need to significantly change their antennas. As a result, the use of the technology generally led to fewer tower amendments, all else equal. With 5G, the main promise of carrier aggregation is that it will enable wireless firms to bring together spectrum resources from an extremely wide range of frequencies, deployed on both macro sites and small cells. Carrier aggregation will also pair with DSS to provide 5G users simultaneously with access to both low-frequency spectrum for broad coverage and other bands for capacity.

**Exhibit 27** Carrier Aggregation Enables Multiple New Spectrum Bands to Enter the Fold and Support One Another



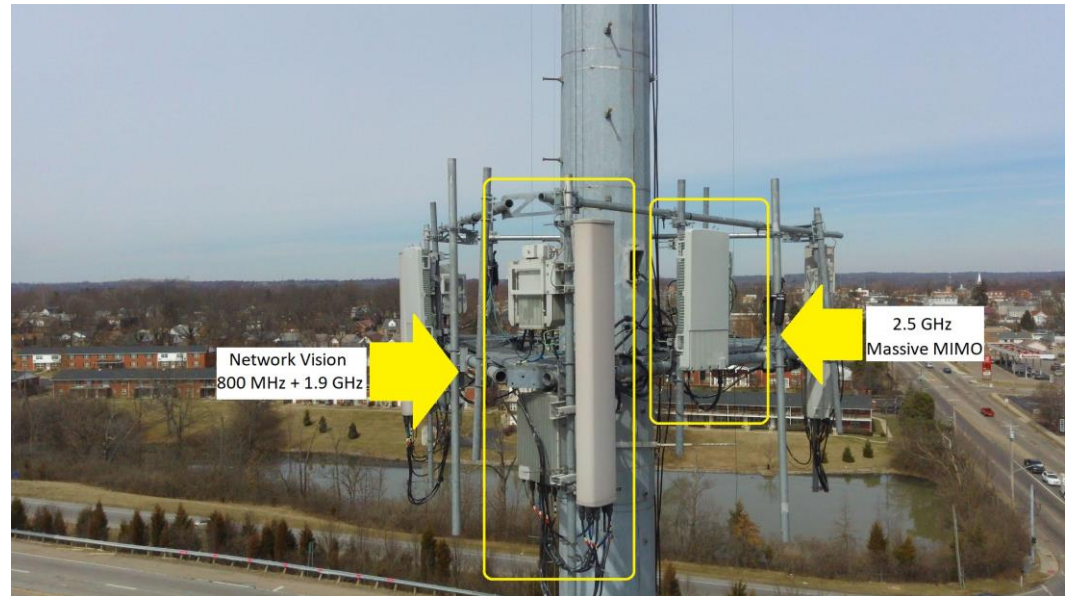
Dynamic Spectrum Sharing directly migrates to 5G core and standalone mode for full 5G capabilities.

As shown in Exhibit 27 from Qualcomm above, the impact of 5G carrier aggregation will depend on how carriers choose to deploy new spectrum bands. The exhibit depicts an existing cell site (lower band 5G NR + LTE) and a new 5G-only site. If the new 5G site is using millimeter wave spectrum, it will likely reside on a small cell located on a utility pole or similar structure. On the other hand, midband spectrum could be utilized on the existing macro site itself (an amendment) or a new adjacent macro site (colocation). On balance, however, we expect the bulk of 5G carrier aggregation will utilize small cells to augment capacity radiating from an existing macro site overlay, thus reducing demand for tower space, all else equal.

### **Massive MIMO: New Antennas Aren't Always Massive but Still Create Tower Demand**

Unlike DSS and carrier aggregation, MIMO, which stands for multiple input multiple output, is an antenna technology and can lead to expensive tower amendments, benefitting the tower companies. Like carrier aggregation, MIMO technology was introduced in 4G LTE and should take another leap forward with 5G. MIMO enables carriers to increase network capacity not by adding more spectrum, but rather by making spectrum use more efficient within a given geography. The technology sends multiple signals from the same tower by using multiple antennas (often housed in a single antenna panel), with each signal delivering its own data load. In addition, large antenna arrays allow wireless operators to use beamforming and beam steering technologies, which concentrate a signal in a tight location to service a specific user and reduce interference with signals operating on the same frequency nearby, another way to make spectrum more efficient.

As carriers deploy MIMO antennas, one antenna panel on a tower might go from having about a dozen antennas embedded in it to 100 or more. Massive MIMO (a term often used to describe 8x8 MIMO or greater) antennas also often integrate radios and other electronics. According to American Tower, these panels are often extremely large and heavy and are comparable in size and weight to an antenna that would be deployed for 600 MHz spectrum. But again, the frequency used by the carrier is critical: lower frequencies require larger antenna structures. Exhibit 28 shows a legacy Sprint "Network Vision" site (the name given to its initial LTE build around 2011) upgraded with a new MIMO panel. The MIMO panel looks small by comparison, despite housing far more antenna elements, because the dual-band Network Vision panel was built to accommodate Sprint's 800 MHz spectrum.

**Exhibit 28** New Antenna Technologies Like Massive MIMO Could Expand Tower Demand

Source: s4gru.com

Still, the net result of MIMO technology is that a midband spectrum deployment that would historically require a smaller antenna--and thus provide tower companies less opportunity to collect increased rents--becomes akin to the pricier low-band deployments. According to the tower companies, amendments to add massive MIMO antennas can add as much as \$1,500 per tower per month in site rental revenue.

Both T-Mobile and Sprint have historically been vocal in their use of advanced antenna technologies in 4G. As of the end of 2019, T-Mobile claimed to have deployed 4x4 MIMO, the current mainstream technology allowing a user to receive four signals from four antenna elements on a tower, in at least parts of about 70% of markets across the U.S. Similarly, Sprint was an early adopter of MIMO technology, as MIMO is well-suited for use with 2.5 GHz spectrum. We expect that to continue following the firms' merger, but the massive amount of spectrum now at T-Mobile's disposal may make the efforts less urgent.

While use of MIMO should certainly be a boost to tower companies, the increased cost to the carrier can be partially offset to the extent that it lets carriers scale back on the number of towers they need or the amount of spectrum deployed. Also, if carriers primarily deploy MIMO on high-frequency spectrum, many (if not most) of these sites could end up as small cells.

Ultimately, we don't expect technological advancements to affect tower companies differently than in the past. Carriers are constantly attempting to reduce their network costs while simultaneously keeping up with the steady growth in network usage. And while MIMO antennas will be a tailwind, the other offsetting factors should keep them from bringing tower revenue growth to new levels.

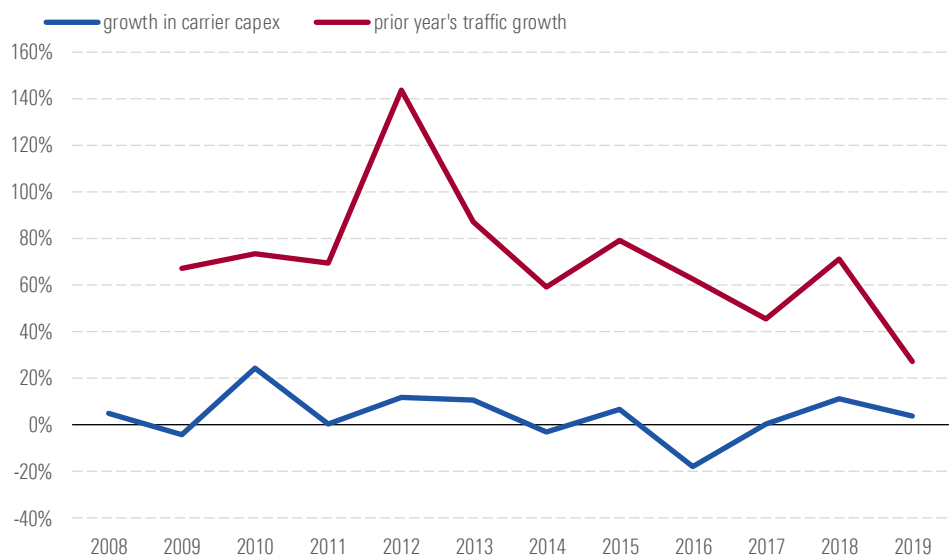
### 5G Spending Will Not Lead to a Greater Boost for Tower Companies Than 4G

Overall, nothing leads us to believe that 5G will be any more lucrative for tower companies than 4G, which has led to a decade of impressive revenue growth.

The evolution to 4G brought video to mobile phones and made smart phones ubiquitous, literally putting computers in everyone's pockets, leading to the sharing/gig economy, and making mobile phones a primary means to social media and connection. These developments have led to mobile data use growth averaging almost 50% per year in the U.S. over the last five years. According to Ericsson, video now makes up 63% of mobile data traffic. Carriers have had to build out their networks--almost exclusively with low-band and midband spectrum--to accommodate it.

According to data from American Tower, carrier capital spending in the U.S. between 2010, when 4G launched, and 2019 averaged \$29 billion per year. The period encompassed two major spectrum auctions--AWS-3 and 600 MHz--and both the coverage and capacity phases of the 4G buildout. It also included the transition from 3G to 4G and now the beginning of the transition from 4G to 5G. During the transition periods, carriers are spending on both network generations simultaneously. As Exhibit 29 shows, regardless of technology transitions or spectrum auctions, the change in carrier capital spending from year to year is highly correlated to the prior year's network traffic growth. In other words, when traffic growth accelerates, carriers follow with greater capital spending. When traffic growth decelerates, carrier spending has fallen. Our view remains that the level of mobile data usage, coupled with the level of competitive intensity in a given market, ultimately dictates the level of tower spending.

**Exhibit 29** Carrier Capital Spending Tends to Follow Mobile Data Traffic Growth



Source: Morningstar, American Tower.

We don't expect 5G to lead to another massive shift in consumer usage patterns that would cause mobile data consumption to accelerate sharply from the 30% annual growth rates of recent years. In the U.S., the merger of Sprint and T-Mobile should reduce competitive intensity for market share, but we expect each of the three national carriers will continue to prioritize network quality as they have in the past, for fear of falling hopelessly behind. Even as 5G leads to greater IoT connectivity and connected cities, we don't see these use cases causing the same data usage spike as those that are smartphone enabled. American Tower estimates that even by 2025, IoT, which it defines as machine to machine connections, will make up only about 3% of total U.S. data traffic, up from just over 1.5% in 2019. IoT relies largely on sensors, which don't take up much bandwidth.

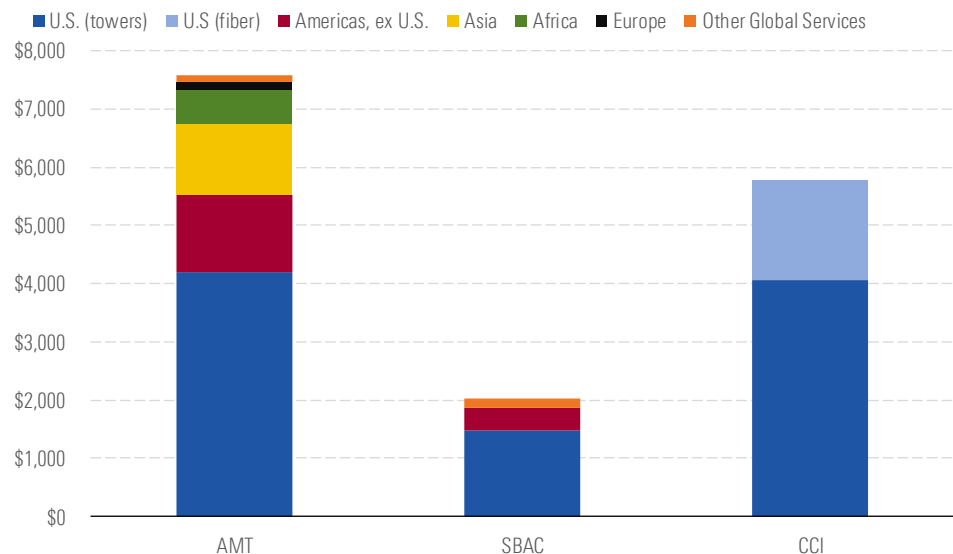
Other use cases, like augmented or virtual reality, may become more prominent in the future, but in the near term, we believe the main attraction of 5G is the ability to handle the growing usage around existing use cases in a more efficient way. We don't see a development like mobile video and the resulting jump in data usage being a part of 5G in the near term. When layering on top of that reality with the increased use of small cells, which will be a major way to add capacity in urban areas without relying on towers, and continuing technological efficiencies, we don't see catalysts that will prompt an even better environment for towers in the U.S. In short, we don't expect a materially different carrier spending pattern on towers to emerge over the next few years. ■■

## Differences Exist Among the Major Tower Companies' Businesses, and American Tower Is Our Favorite

Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

Though we don't expect 5G to lead to a cycle of higher levels of macro tower revenue growth rates in the U.S., we forecast organic revenue growth to remain at historically high levels over the next few years, as carriers keep up with the continued expansion of mobile network use and the potential new sources of tower spending emerge. But as the U.S. tower business continues on its current trajectory, we believe the other segments of tower companies' businesses will come more in focus. American Tower and SBA have focused their non-U.S. tower efforts on international expansion, while Crown Castle's focus has been on building small cells in the U.S. Exhibit 30 shows the percentage of revenue each company gleaned from its various segments in 2019. Outperformance in these ancillary areas will be necessary for continued stock appreciation, in our view. In the sections that follow, we analyze the components and prospects for these businesses. We believe tower opportunities in several emerging markets are much more appealing than pursuing small cells in the U.S.

**Exhibit 30** American Tower Is the Most Geographically Diversified, While Crown Castle Pursues Fiber (\$ Millions)



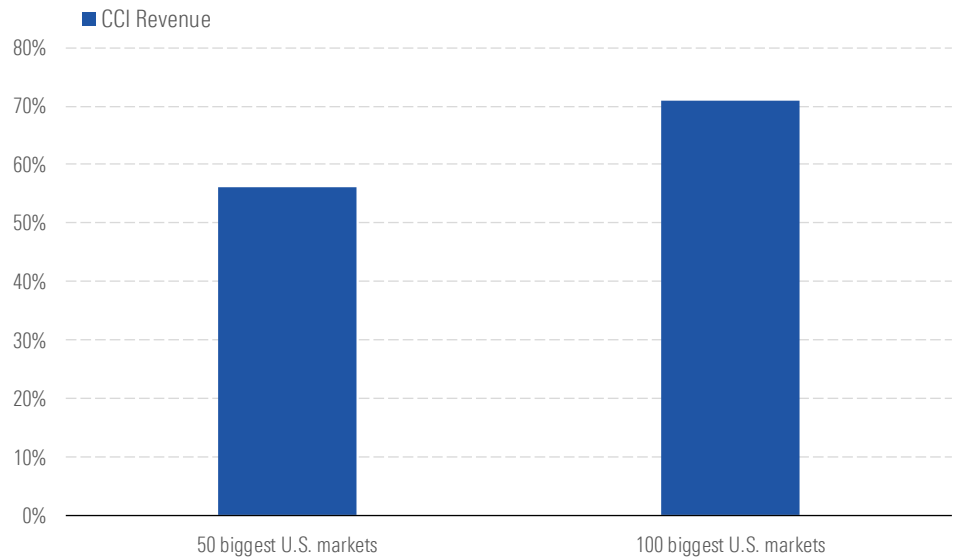
Source: Morningstar, company filings.

### We Dislike Crown Castle's Aggressive Pursuit of Small Cells

Of the three major U.S. tower companies, Crown Castle's business is the one that is the outlier. It is the only one that operates exclusively in the United States, but more significantly, it is the only one that isn't primarily focused on the traditional macro tower business. Within the U.S., its presence is more heavily

weighted toward the biggest cities, different from its peers that skew toward suburban and rural areas or smaller markets. As Exhibit 31 shows, most of its revenue comes from the biggest U.S. markets.

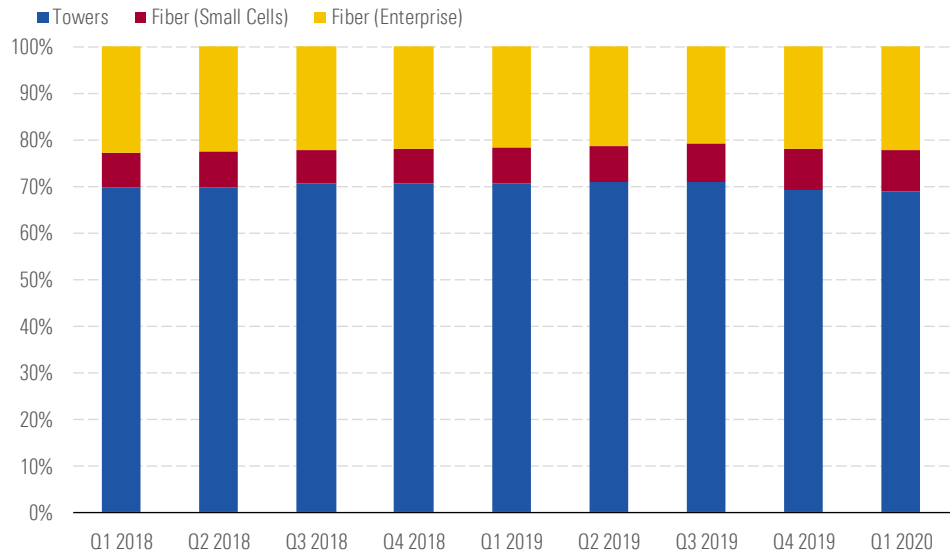
**Exhibit 31** Most of Crown Castle's Revenue Comes From the Biggest U.S. Markets



Source: Morningstar, Crown Castle earnings presentation.

A major part of Crown Castle's urban strategy has been its heavy investment to support carriers' small cell buildouts, including the acquisition and construction of extensive fiber infrastructure, which is happening primarily in the 30 biggest U.S. cities. Although 70% of Crown Castle's total revenue still came from towers in 2019, the firm's spending and focus has shifted sharply to building small cells, which are part of its fiber segment. Despite the spending, however, the fiber business has not yet grown any faster than its tower segment. In fact, tower revenue has remained steady as a percentage of the total since Crown Castle acquired Lighttower at the end of 2017 to double its fiber footprint (see Exhibit 32).



**Exhibit 32** Towers' Contribution to CCI Revenue Has Remained Constant Since the 2017 Lighttower Acquisition

Source: Morningstar, company filings.

We dislike Crown Castle's fiber business, and it is the reason why we don't assign a moat to the company. Although we think its tower business is fantastic and certainly worthy of a moat, the firm has been sinking enormous sums of money into building out fiber and small cells, and we think Crown Castle will have difficulty realizing worthwhile returns on this investment.

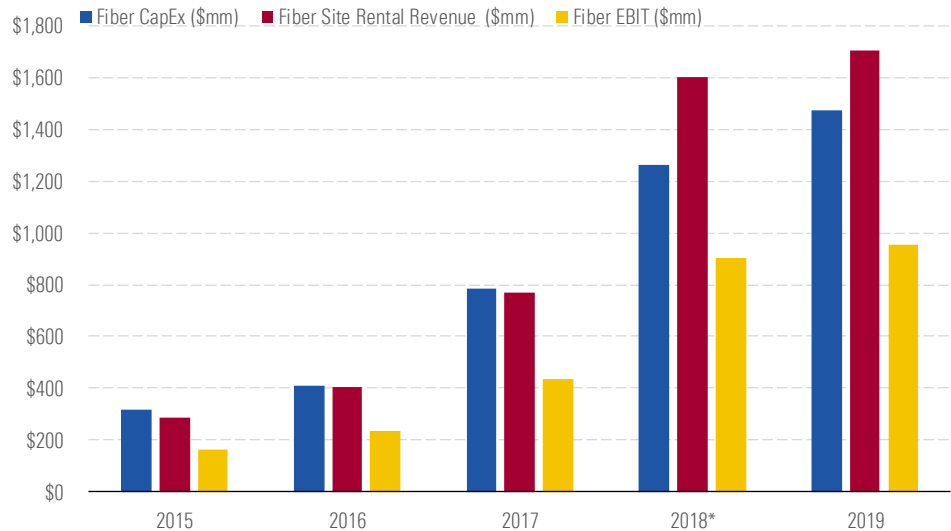
Fiber access is often the critical factor in deploying small cells. With each small cell covering a small area, an extensive fiber network is needed to transmit information from each site back to the network core. However, two of the three U.S. wireless carriers also have massive fiber holdings stemming from their traditional fixed-line telecom businesses and both are actively expanding their footprints. As a result, these firms can meet their own small cell needs in many places without having to rely on a third-party provider like Crown Castle. Conversely, none of the wireless carriers have significant tower ownership.

Carriers used to own towers, but they've gradually realized over the years that ownership is not economically efficient. Towers only have one primary use--to deploy spectrum--and the beauty of towers is the operating leverage that comes as multiple tenants deploy equipment on them. Carriers tended to not lease space to competitors, so they didn't have the multiple revenue streams that towers bring when they are in the hands of third-party providers. In short, towers were much more valuable to third-party tower companies (which also operate as real estate investment trusts to squeeze out even higher profits through tax savings) than to carriers. Carriers have therefore routinely sold tower portfolios to tower companies over the past two decades, leasing back the space they needed instead.

Fiber is different. It has multiple uses, providing multiples services to a wide variety of customers and end markets and making it more valuable. AT&T and Verizon already have hundreds of thousands of route miles of fiber that serve their business and residential wireline customers. Verizon is aggressively adding fiber to serve its small cell needs and also connect to other major points of demand, like data centers, industrial sites, and office parks. Therefore, multiservice telecom carriers can use fiber to not only deploy their own small cells, but to also serve other needs of their own businesses. Verizon management has repeatedly said it desires the "owner's economics" of fiber, meaning it can put fiber to use in as many ways as are economically feasible without relying on a third party. They can also sell capacity to customers in other industries that are not competitors.

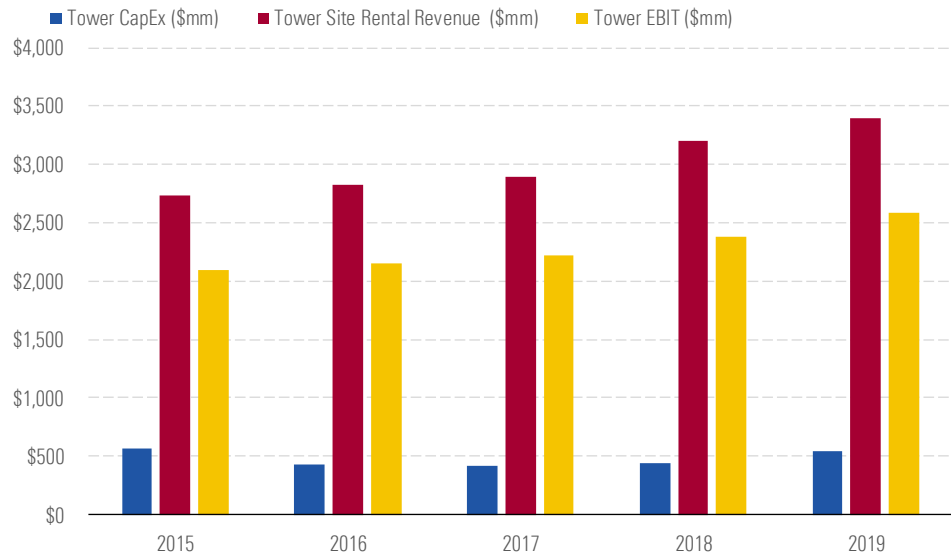
For Crown Castle, we fear this dynamic--where many of the biggest potential customers are also perennial potential competitors--means it won't have sufficient demand to earn a return on the fiber it is building. As Exhibit 33 shows, Crown Castle has been spending heavily on its fiber business but has not yet seen any leverage from that with faster sales or profit or profit growth. We don't expect that to change any time soon. (Its 2018 jump in revenue and profit is from the November 2017 acquisition of Lighttower, for which it paid over \$7 billion). Exhibit 34 shows that the return looks even worse when compared to the financial profile of the core tower business.

**Exhibit 33** Crown Castle's Capital Spending Has Grown Faster Than Revenue or Profits Excluding the 2017 Lighttower acquisition.



Source: Morningstar, company filings.

Note: Crown Castle purchased Lighttower and its 32,000 route miles of fiber in November 2017, making most 2018 growth inorganic.

**Exhibit 34** Tower Sales and Profits, on the Other Hand, Continue Growing With Minimal Investment

Source: Morningstar, company filings

**We Expect Both Components of Crown Castle's Fiber Segment to Be Challenged**

Small cells currently make up a very small percentage of Crown Castle's total revenue despite the investment to grow that business. Much of Crown Castle's fiber footprint comes from its 2017 acquisition of Lighttower, and with that acquisition the firm inherited a substantial enterprise business--about 70% of Crown Castle's fiber revenue comes from leasing fiber capacity to enterprises or government agencies. The enterprise business (which Crown Castle often refers to as its "fiber solutions" business) is slow growing (about 3% annually), and Crown Castle is not prioritizing it. In our view, the enterprise business that Crown Castle inherited through numerous fiber acquisitions was an afterthought that Crown Castle didn't desire. Crown Castle's interest was in acquiring fiber in critical markets to support its small cells, and it essentially had to take the other business with it. As the firm's CFO said about Lighttower's enterprise business around the time of the Lighttower acquisition:

*And so we were really interested in that asset base because it supported our strategic view of putting small cells in place. But when we got there and started looking into it, we weren't just buying those assets. We were buying a business that, as you say, was a fiber solutions business that we were really trying to figure out how do we think about it. And through our conversations... we've gotten pretty comfortable with aspects of the enterprise business being more of the infrastructure side of the enterprise solutions provision.*

In the time since, management has not publicly given much attention to the enterprise business and has repeatedly said that it expects it to grow by about 3% per year, consistent with past performance. In our

view, that is not sufficient for a business that makes up 70% of revenue in a fiber segment that has had an average capital intensity of 85% over the past four years. It will make realizing adequate returns difficult, even if small cells do outperform.

But we don't expect excellent small cell performance. In the context of small cells, Crown Castle has compared fiber to towers and acknowledged that it will need multiple tenants on fiber runs for the returns to be worthwhile. The initial return on a tower with a single tenant typically does not justify the cost (American Tower says that a tower with one tenant initially yields a 3% return on investment). And even though revenue from the initial tower tenant grows through escalators and as the tenant adds more equipment to the tower (two sources of growth that are relatively minimal on fiber), excess returns on towers don't become large until tower owners add additional tenants. Although there are not necessarily multiple tenants on a single small cell pole, the shared resource in the small cell business is fiber. Crown Castle has been rapidly extending its fiber footprint while espousing the view that as it can colocate tenants on the fiber, it will realize double-digit returns on capital.

Until now, we have not seen a shift in the proportion of anchor tenants versus colocated tenants that the company periodically discloses. Since acquiring Lighttower in 2017, Crown Castle has consistently disclosed that anchor tenants have made up between 70% and 80% of new small cells.

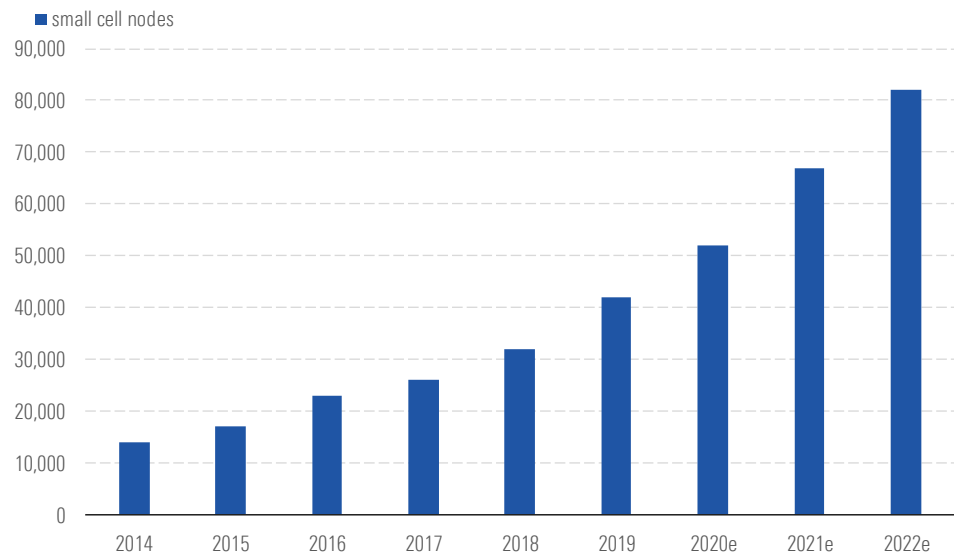
In our view, Crown Castle needs to completely flip the proportion of colocated versus anchor tenants to come even close to justifying its current valuation, and we think that is unlikely. In the near term, we see only three customers that will have meaningful small cell demand in places Crown Castle operates-- AT&T, Verizon, and T-Mobile. Their demand for Crown Castle's small cells will depend on their fiber strategy, their fiber ownership relative to Crown Castle's footprint, and the presence of competing fiber owners like Zayo or potentially a cable company.

T-Mobile does not have any material fiber holdings and has said millimeter-wave spectrum, and therefore small cells, will be one component of its multifaceted 5G strategy. It has said it will rely on third parties for the full service. Because Crown Castle's fiber and small cell offerings are almost exclusively in the biggest cities, which is where T-Mobile will be using small cells, we expect T-Mobile will be a reliable customer for Crown Castle (although Sprint's biggest small cell provider was cable partner Altice USA).

However, T-Mobile has said that the density of its macro towers allows it to rely primarily on low and midband spectrum for 5G and have less need for small cells. Judging by the company's own statements, the recent PCMag speed test cited above, and the amount of 2.5 GHz spectrum the firm is dedicating to 5G, we think it's likely T-Mobile will be able to exceed 100 Mbps 5G download speeds without significantly adding to its small cell footprint. Such a performance level would satisfy the speed requirements T-Mobile agreed to as part of the Sprint merger approval (providing two thirds of the country's population 5G service with 100 Mbps speeds within three years and three quarters with 50 Mbps by that time). In conjunction with our belief that a full consumer transition to 5G will likely be

stretched over the course of a decade and that T-Mobile won't face competitive pressure to provide faster speeds sooner, we don't think small cells will be a focus for T-Mobile in the near term. When T-Mobile does turn its focus to small cells, which we expect will be more toward the end of its five-year plan, we question how much incremental demand T-Mobile will trigger. T-Mobile expects to ultimately use about 50,000 small cells to supplement its network, and Sprint and T-Mobile collectively had about 55,000, when the merger closed. Like with towers, we expect some of the existing small cell footprint overlapped, and we expect some of Sprint's small cells will be shut down, so there will be new small cell demand. But it should not be a major need. Based on management's comments, we expect T-Mobile to add no more than 20,000 small cells, which is discouraging in light of the number of small cells Crown Castle already has running (Exhibit 35) and the pace of new deployments it needs to justify its investment, in our view. Beyond that, as we've said, we believe Crown Castle needs multiple tenants to make the investment worthwhile, meaning that no matter how much T-Mobile uses Crown Castle, AT&T and Verizon demand will be critical.

**Exhibit 35** Crown Castle Has Been Adding About 10,000 Small Cells per Year Recently



Source: Morningstar, company filings.

We expect these other two carriers to be spottier in their use of Crown Castle. We expect each to use Crown Castle small cells, but we doubt Crown Castle will be their primary provider or that they'll demand quantities great enough to make Crown Castle's broad fiber buildout lucrative.

AT&T has said that its small cell strategy will encompass a combination of "do-it-yourself," which will require no third party whatsoever; third-party reliance, which will fall directly into Crown Castle's business; and a hybrid solution, where it will lease fiber in areas where it lacks it but will take it upon itself to secure the required permits and put up the small cell poles. The hybrid solution will not be part

of Crown Castle's small cell business, which is full-service and premised on the monthly rents it charges for the small cell nodes themselves. Based on the amount of fiber AT&T has and the strategy it has articulated, we don't expect it to be a major driver for Crown Castle.

Verizon's fiber holdings are not quite as extensive as AT&T's, and at present small cells are a central solution of its small cell strategy. We expect Verizon to add more small cells than any competitor, and management has frequently discussed how its spending focus is now much more on fiber and small cells than towers. However, it has also often emphasized that it prefers to own the fiber that is required for small cells, leading us to believe that, like AT&T, it won't be a reliable customer across Crown Castle's fiber footprint. For example, at the end of 2017, Verizon acquired WideOpenWest's fiber assets in Chicago to "expedite (its) network densification with fiber and small cells." By that time, Crown Castle already had an extensive fiber footprint in Chicago through its acquisitions of Sunesys and Lightower.

Verizon is currently adding fiber in over 60 markets, a huge number considering we believe small cells are viable solutions only in very dense areas. Crown Castle has said it is focusing on the 30 biggest U.S. cities, so we expect there is a lot of overlap with Verizon. By the end of 2019, Verizon had added 30,000 route miles under its "One Fiber" initiative (which it has described as "the buildout of a next-generation fiber network capable of supporting wireless and wireline technologies and multiple products") and is now adding about 2,000 route miles of fiber to it per month. The firm expects a similar pace of fiber building for the next couple of years. But while it says that it will deploy 5 times as many small cells on 5G millimeter wave in 2020 as it did in 2019 while doubling the number of cities in which it has millimeter-wave coverage (to 60), it has also said that by the end of 2019 a significant majority of its new small sites were already going up on its own fiber, a reversal from the beginning of that year, when more small cells were deployed through third parties. We expect the portion of "self-perform" small cell deployments to only grow.

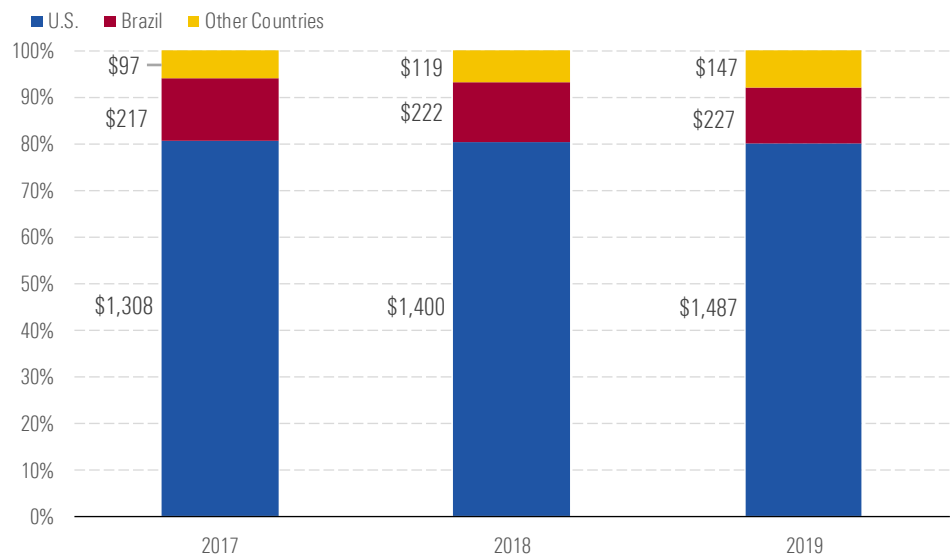
Our view is that Crown Castle will have difficulty garnering enough colocation tenants to make its small cell strategy worthwhile and justifying the enormous levels of capital spending that it has been sinking into its vast fiber buildout. It has been our least favorite of the tower companies since shortly after the Lightower merger, and we are unlikely to recommend it until it changes its fiber strategy or proves that fiber colocations begin to take hold, which would show up as a dramatic reduction in capital spending while maintaining similar revenue growth and expanding fiber margins. We've been fruitlessly awaiting the spike in fiber colocations for some time, and we are not holding our collective breath.

### **American Tower and SBA Have Similar Global Strategies Focused on Macro Towers, but We Prefer American Tower's Broader Geographic Diversity and More Conservative Financials**

We prefer the businesses of American Tower and SBA Communications to that of Crown Castle, because they are almost entirely focused on macro towers and have minimal fiber or small cell exposure in the U.S. We also think it is smart for each of them to have a presence outside the U.S., which is a mature market that is saturated with smart phones and has already seen the revolutionary update to 4G. There are a couple of factors that lead us to choose American Tower as far and away our favorite tower company.

SBA's business is only in North and South America and is still almost entirely in the U.S. and Brazil (see Exhibit 36). International revenue makes up about 25% of the company's total sales. We think SBA is well-served to have a presence outside the U.S., but the wisdom we see in geographic diversification leads us to prefer the greater international exposure and broader geographic footprint of American Tower.

**Exhibit 36** Nearly All of SBA's Site Leasing Revenue Comes From the U.S. and Brazil

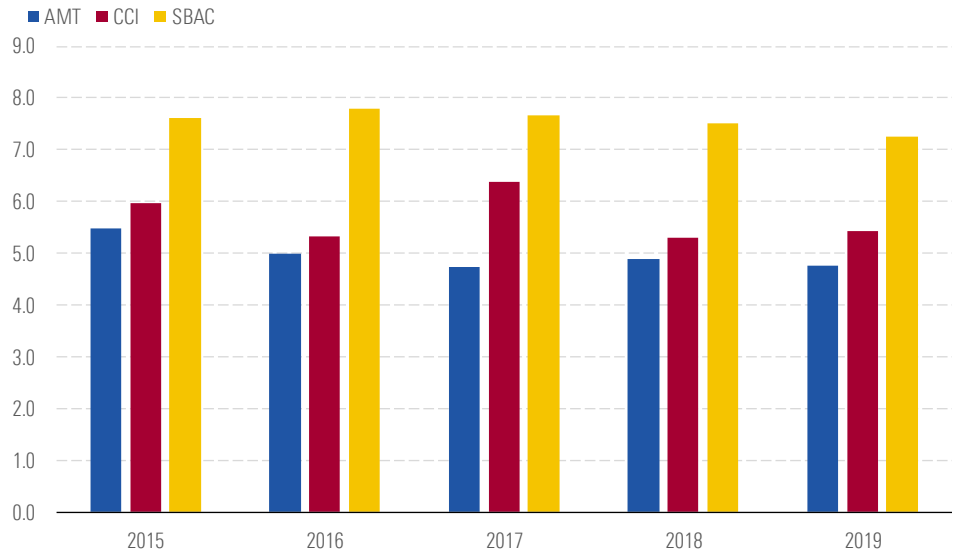


Source: Morningstar, company filings.

Note: Site leasing revenue makes up over 90% of total SBA revenue. The remainder, site development revenue, is also split among SBA's geographic markets.

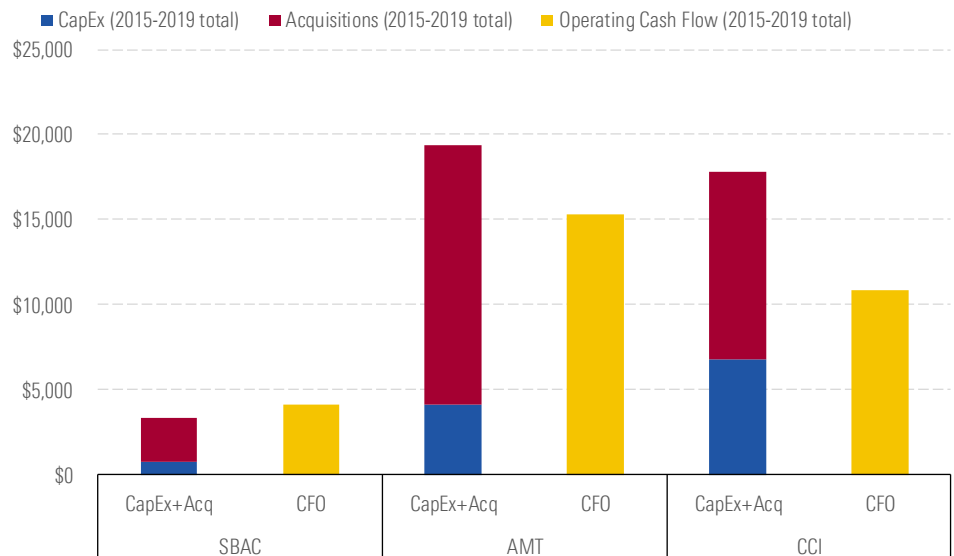
Aside from the business preference, we prefer the relative financial conservatism of American Tower versus its peers. As Exhibit 37 shows, American Tower has historically kept its debt/EBITDA ratio lower than Crown Castle and well below SBA. Crown Castle's higher financial leverage is a result of its fiber strategy. We don't agree with the strategy, but the leverage makes sense considering Crown Castle needs the capital to accomplish its small cell objectives. SBA, on the other hand, with a business that doesn't require much capital spending and, relative to its peers, hasn't made many significant acquisitions recently (Exhibit 38), could have a pristine balance sheet but has chosen to leave itself with what we see as a riskier financial profile.

**Exhibit 37** SBA Maintains a Debt/EBITDA Ratio Materially Higher Than Its Peers



Source: Morningstar, company filings.

**Exhibit 38** The Past Five Years, Relative to Operating Cash Flow, SBA Spent Less on Acquisitions, Capital Expenditures (\$ Millions)



Source: Morningstar, company filings.

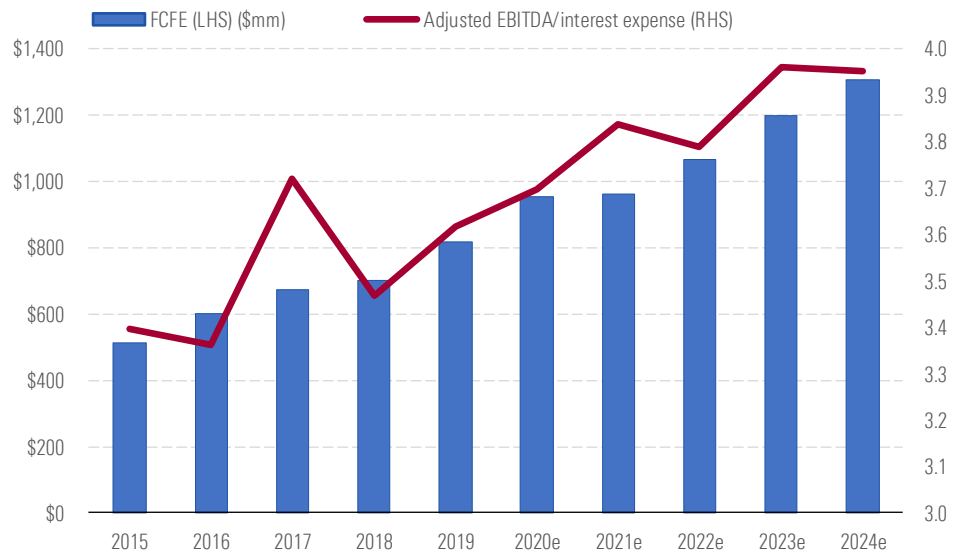
Instead, SBA has chosen to continually add debt for the sole purpose of buying back shares--shares that we think have been extraordinarily expensive the past couple of years. To be clear, the strategy has looked brilliant in recent years. Business has stayed good, borrowing costs have remained minuscule,



and the stock has moved straight upward, creating enormous value for shareholders so far. However, we think this strategy amounts to playing with fire, and at the very least, we expect it to ultimately prove to be value destructive.

We expect free cash flow to remain high well into the future, and we don't project SBA to have any difficulty in covering its interest or meeting its obligations, as shown in Exhibit 39. However, in an unpredictable world and one that will presumably one day see interest rates rise, prudence would require us to shy away from a company that maintains 7 times leverage so that it can buy back stock at historically high valuations.

**Exhibit 39** SBA's Free Cash Flow Has Been Growing, and We Project No Trouble Covering Interest Payments

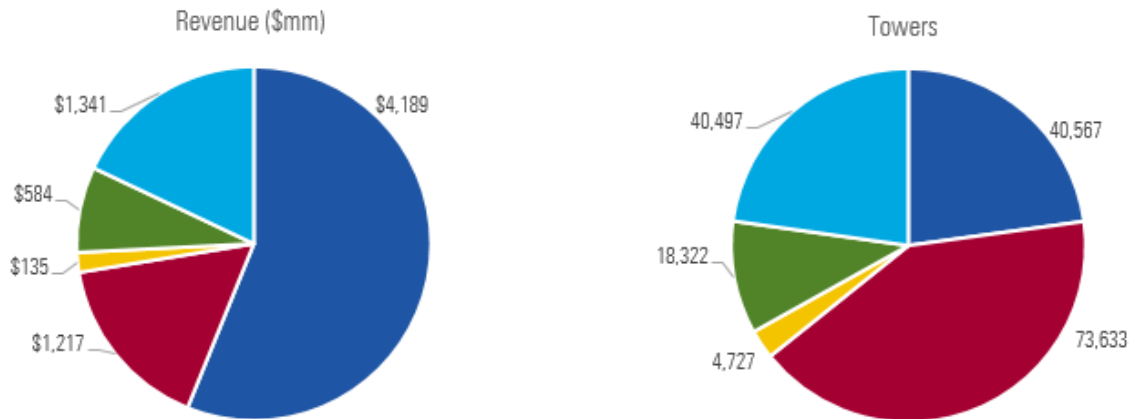


Source: Morningstar, company filings.

Not only are we more comfortable with American Tower's debt profile, but also, we think several of its Eastern Hemisphere regions have opportunities for excellent growth, leading to better opportunities than SBA has. It is also less dependent on the U.S. in case domestic market growth slows from its recent torrid pace. Exhibit 40 shows American Tower's geographic diversification in terms of both revenue and tower ownership.

**Exhibit 40** By Both Revenue and Tower Holdings, American Tower Is Geographically Well Diversified

■ U.S. ■ India ■ Europe ■ Africa ■ Latin America



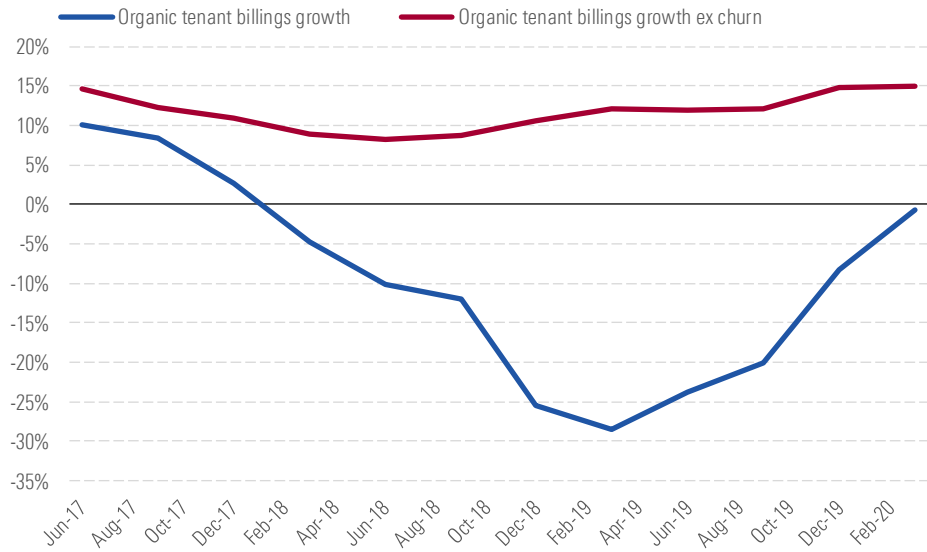
Source: Morningstar, company filings.

The markets we like most for American Tower are its developing markets, primarily in India and Africa, where mobile broadband penetration is lower and a mobile connection often serves as the primary means of accessing the Internet.

**We See Great Opportunity for American Tower in India, but It Is Not Without Risks**

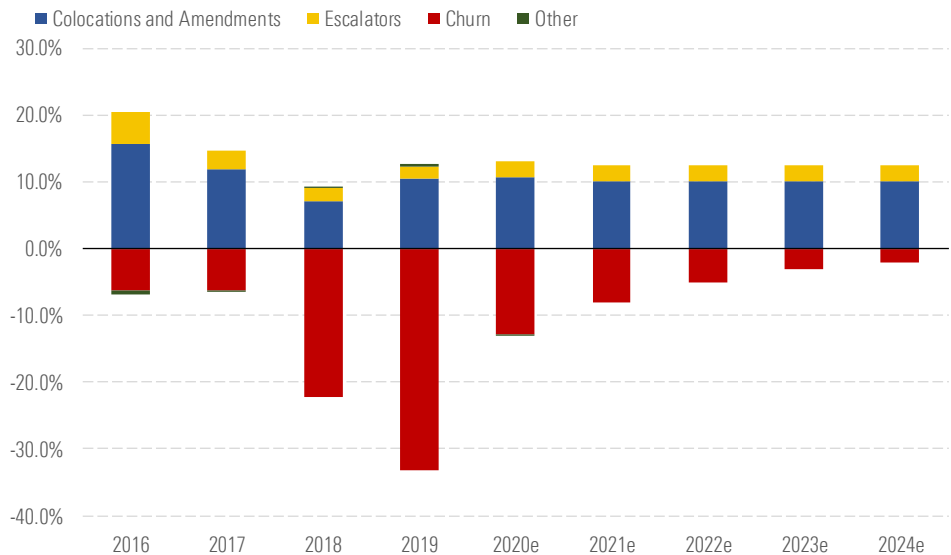
We are the most excited about American Tower's opportunity in India, which is the only country comprising American Tower's Asia segment. India is American Tower's next biggest market after the U.S., and it has suffered a series of setbacks in recent years that have weighed on its growth, most notably dramatic carrier consolidation that saw the India wireless market contract from over a dozen carriers to three main carriers that collectively have about 90% market share. Exhibits 41 and 42 show the dramatic effect the resulting churn had on tenant billings.

**Exhibit 41** On an Organic Basis, American Tower's India Revenue Has Declined the Past Two Years



Source: Morningstar, company filings.

**Exhibit 42** Churn in India Has Overshadowed Double-Digit Growth From New Leasing and Escalators



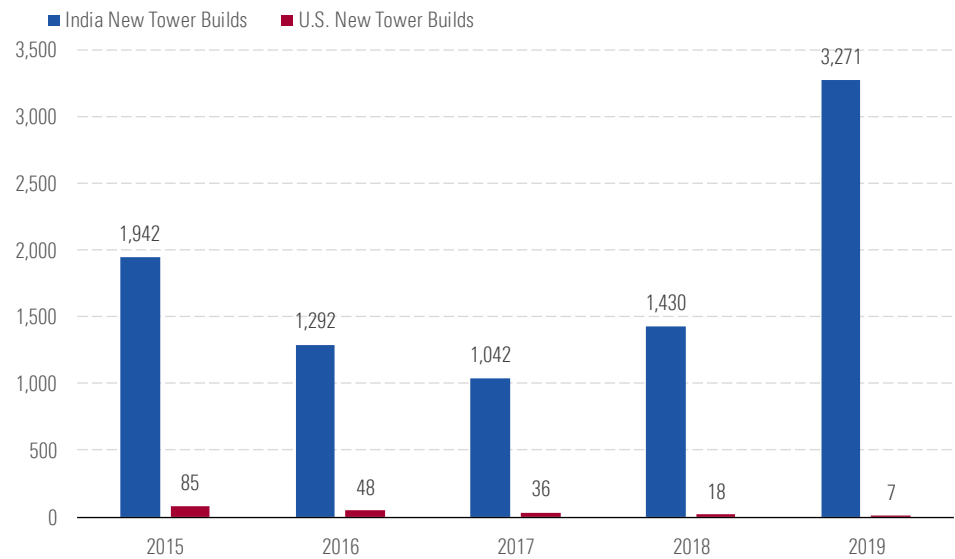
Source: Morningstar, company filings.

With the consolidation mostly in the past and churn now returning to more normalized rates, we expect organic revenue growth in India to climb toward the double digits as underlying market fundamentals take hold. Growth prospects in India look promising because mobile broadband penetration is only 40%-

50% in India (in a country with 1.3 billion people); carriers are still in the process of upgrading from 2G networks--one carrier is upgrading to 4G while the other two are upgrading to 3G; and according to American Tower, consumers who can access 4G networks use more bandwidth than U.S. consumers, because, again, it is often their only source for an Internet connection.

Each of the three major carriers in India currently holds an average of 60 MHz-80 MHz of low- and midband spectrum nationally. We expect all carriers to build to 4G networks over the next few years and that Indian consumers will be major bandwidth users, requiring increasing network density. Unlike in the U.S., where the major tower firms have not been expanding their tower footprints, American Tower has been aggressively building new towers in India in addition to continually acquiring additional towers (Exhibit 43).

**Exhibit 43** AMT Has Been Focusing Its New Tower Builds in International Markets, Especially India



Source: Morningstar, company filings.

We expect the current dynamics to lead to significant opportunity in for American Tower in India, but risk remains. We're presently awaiting the resolution of the adjusted gross revenue, or AGR, case that India's Supreme Court recently decided. In the case, which had been going through the courts for about 15 years, the Supreme Court reversed lower courts and issued a final judgment that the telecom industry collectively had underpaid their taxes and owed the government \$17 billion, roughly 75% of which is due to interest and penalties rather than the actual tax.

Two of the three major carriers in India are on the hook for part of this penalty (about \$4 billion each). Not only would cash outlays crimp their ability to invest in their networks, but one, Vodafone Idea, would also likely have difficulty surviving if it had to pay the entire balance in the near term, especially since Vodafone has committed to its shareholders that it won't invest any more capital in Vodafone Idea

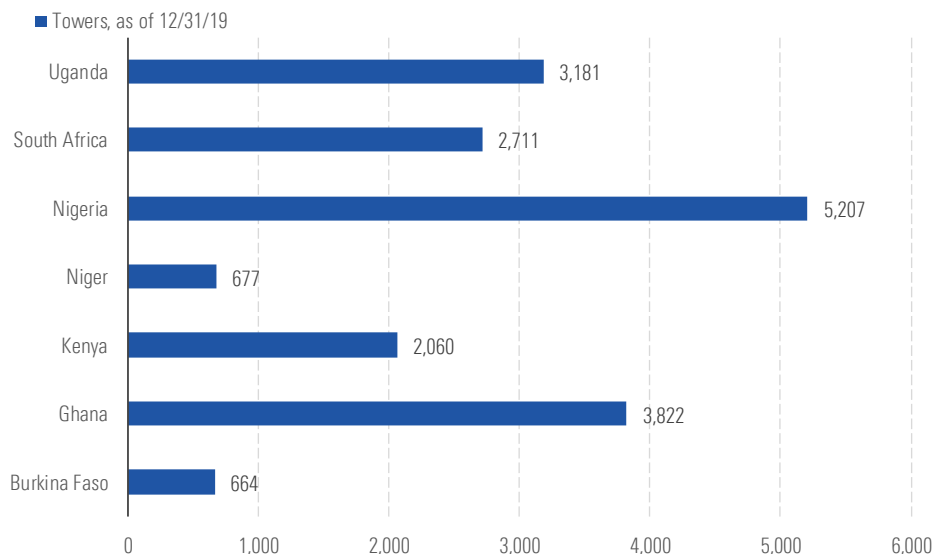
(which is a joint venture between Vodafone and India's Idea) than what it is contractually obligated to provide. The Supreme Court is now awaiting to carriers' proposals for payment plans.

We expect the carriers to be allowed flexible terms and will manage through this situation. In our view, it is in the Indian government's interests to have widespread, high-quality mobile broadband networks and robust competition. It has an explicit goal, under its Digital India initiative, to make digital infrastructure a utility accessible to every citizen. Furthermore, the current government is not the one that brought the initial AGR case. In our view, the government would hurt itself to drive a major carrier into bankruptcy or slow the progress of infrastructure buildouts by the carriers, so we expect a resolution that avoids those outcomes.

### Africa Also Has Several Developing Markets Poised for Growth

American Tower's presence in Africa has increased significantly in the past couple of years, primarily through its acquisition of Eaton Towers. In addition to acquiring 5,500 towers, the Eaton acquisition added the new markets of Burkina Faso and Niger as well as deepening American Tower's presence in other developing African countries: Ghana, Uganda, and Kenya. American Tower is also in South Africa, which is a more developed market, and Nigeria. Exhibit 44 displays the size and breadth of American Tower's tower portfolio in Africa.

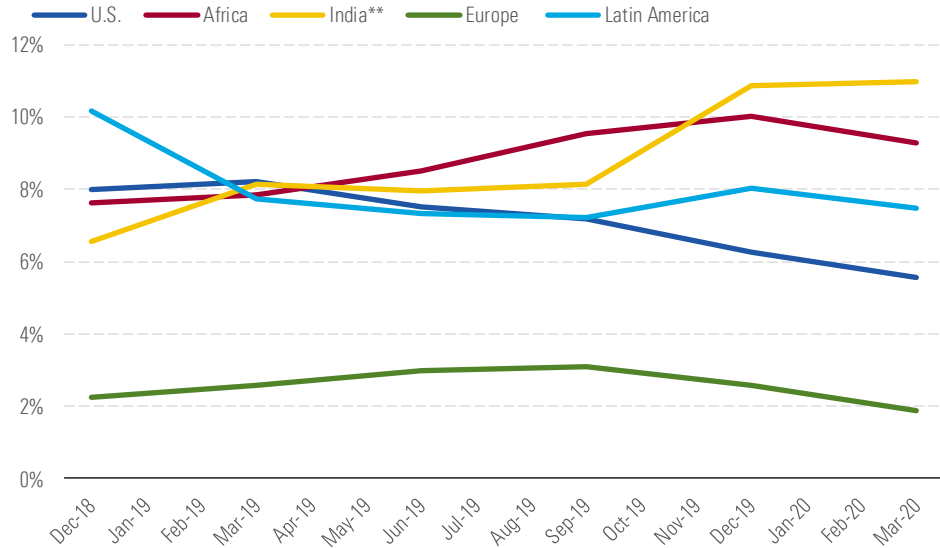
**Exhibit 44** American Tower Has a Material Presence in Multiple Africa Markets



Source: Morningstar, company filings.

Africa has been American Tower's fastest-growing market recently, and we expect similar tailwinds for most of the region as American Tower has in India (Exhibit 45 charts recent organic tenant billings growth rates by geographic segment, but uses normalized churn of 4% in India rather than actual churn rates caused by the carrier consolidation.)

**Exhibit 45** Africa Is a Fast-Growing Market for American Tower



Source: Morningstar, company filings.

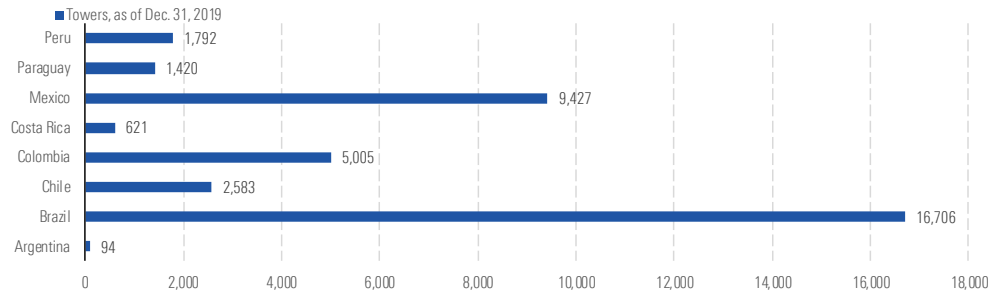
\*\*India's results are adjusted for recently heightened churn, instead using a normalized rate of 4% churn.

Niger, Nigeria, Burkina Faso, Uganda, and Kenya all have mobile broadband penetration rates of about 40% or less, according to data shared by American Tower. Although 4G coverage varies by country, it is far from universal. Several prominent carriers do not yet have 4G networks; many others have just begun to launch their 4G networks in the last year and a half. Within the last year, American Tower has said that less than 10% of its Africa markets had access to 4G and mobile data usage was a fraction of what it is in more advanced countries.

As we have already seen in developed markets and as we expect from India, we believe the drive toward 4G will be a big catalyst for tower companies. Like in India, there's limited fixed-line infrastructure in many developing African countries and the governments are recognizing the importance of wireless broadband. We see the potential for 4G connections to be the sole or primary Internet connections for residents, so we think we are in the very early stages of an explosion in mobile data traffic and the infrastructure spending that will have to follow.

**Latin America Remains a Growth Market**

Latin America generates a similar amount of revenue as India, leaving those as the next biggest regions behind the U.S., but American Tower is in eight different Latin American countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Paraguay, and Peru. Exhibit 46 displays the size and breadth of American Tower's tower portfolio in Latin America.

**Exhibit 46** By a Wide Margin, Brazil and Mexico Are American Tower's Biggest Latin America Markets

Source: Morningstar, company filings.

Most of those countries have more developed wireless networks than India and the countries in Africa, leaving us generally expecting lower Latin America growth in comparison. Paraguay and Peru are the least penetrated markets in terms of mobile broadband, with both around 60%, but their 4G networks have been widely deployed for several years, so we don't expect the same imminent upside from them as we do from India and Africa.

Brazil and Mexico are American Tower's largest Latin America markets by a wide margin. They are also countries where American Tower has seen significant network spending recently and where it is more aggressively expanding its tower footprint. Outside of India, most of the new towers that American Tower expects to build in 2020 are in Brazil and Mexico. From a technology cycle standpoint, Brazil and Mexico are closely behind the U.S., with widespread 4G coverage that is on the cusp of embarking on 5G.

We expect colocation and amendment growth in Latin America to be similar to the United States. One big difference in Latin America is that escalators are typically tied to inflation rather than a flat rate (around 3% in the U.S.). Historically, this has led to higher organic revenue growth rates in Latin America, but tamer inflation in recent years has closed the gap.

American Tower also owns fiber in a few international markets, including in Mexico and Brazil, which brings in additional revenue. American Tower doesn't own fiber for the purpose of small cell deployment in these markets. Rather, it is because a relative lack of fiber in the ground in these countries, which makes it more necessary to American Tower's tower business and makes the fiber more valuable.

**Other Revenue Sources Are Not Major Drivers for American Tower**

American Tower's fifth geographic segment is Europe, but its business there is relatively small and slow growing. We don't expect any change to the pace of tower construction or organic revenue growth over the next several years, so Europe doesn't have a major impact on our American Tower valuation.

We would not be surprised to see American Tower buy a big tower portfolio in Europe, because we think it would be helped by having more scale, but we don't think it's a priority, and we commend American

Tower for not overreaching. Across data centers and towers, we've seen private capital chasing developed real estate infrastructure in recent years and bid up multiples. American Tower has said on multiple occasions that tower valuations in Europe have simply been too high. We think a company like American Tower can bring value to tower development and expansion that financial buyers cannot. As long as American Tower can find more compelling opportunities in the high-growth, developing markets, we prefer the firm remains focused there.

American Tower also derives about 3% of its U.S. revenue from distributed antenna systems, or DAS. DAS networks are often deployed in indoor and outdoor settings like airports, shopping malls, and sports stadiums that can be densely packed with people and require more network bandwidth. They function similarly to small cells in that they boost network capacity to a small area. Unlike small cells that are deployed throughout cities, DAS networks don't require a vast fiber network because DAS is concentrated in major venues. As a result, we see DAS as a good business that can add to returns. Nonetheless, we don't see it as a likely source of major growth in our American Tower forecast. The DAS business has been around for many years, and we don't see a change in dynamic to the venues where it's deployed. In our view, American Tower's prospects will remain tied solely to the need for further tower deployments.

We think there are many things to like about American Tower's business, and we like its prospects better than its peers. But as we discuss in the next section, we cannot outright recommend it at today's prices, where we view all the tower stocks as too expensive. We do see it as the least overvalued, and it is the tower firm we'd choose on a relative basis. ■■■



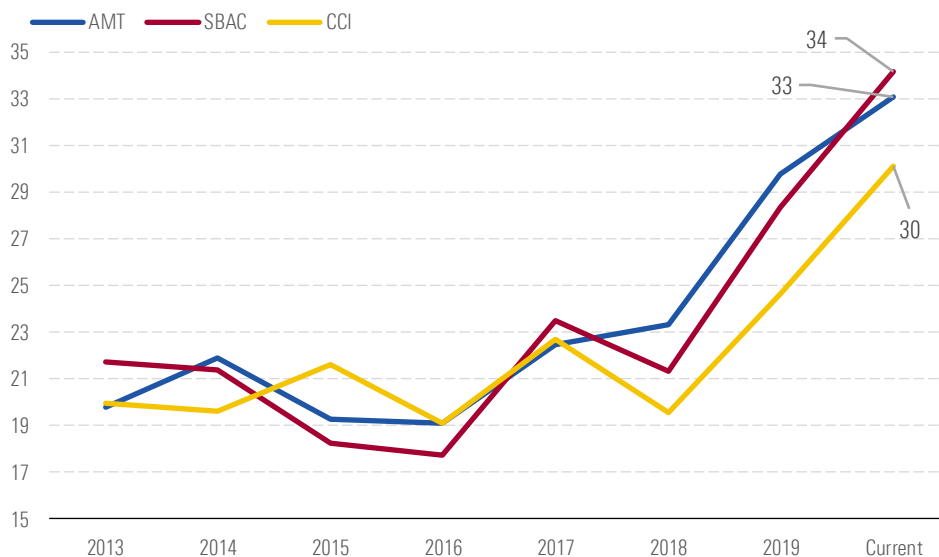
## Huge Expansion in Tower Valuation Multiples Is Unwarranted; We'd Look for a Pullback Before Considering American Tower

Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

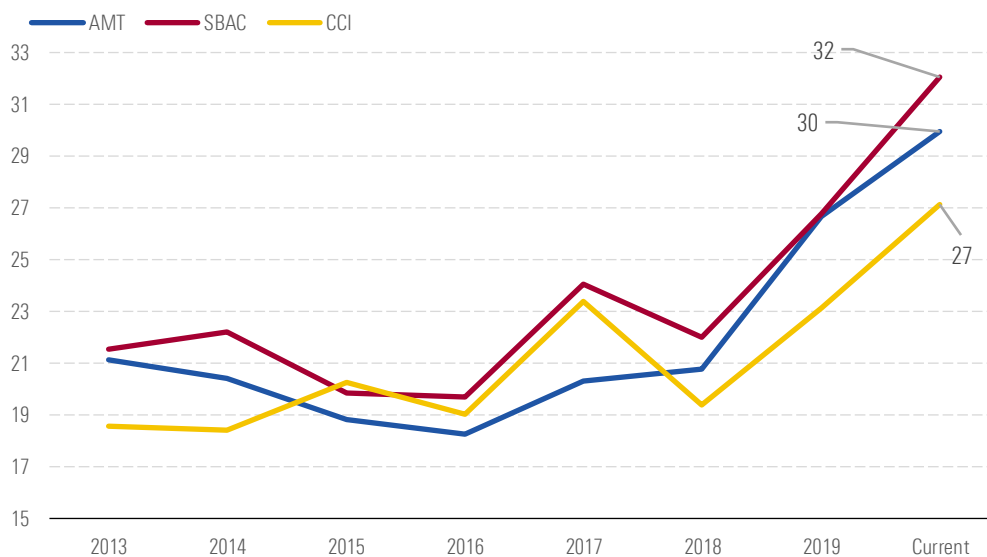
### Despite Good Prospects, All Tower Firms Look Too Expensive to Us

Across our tower company coverage, valuation multiples had trended up in recent years before skyrocketing in 2019. As Exhibits 47 and 48 show, multiples have continued expanding and are now at record levels. Although we expect the tower business to remain strong, and we particularly like American Tower's positioning, we cannot rationalize the valuations of any of these firms. We think investors counting on an explosion of growth to justify current valuations will be disappointed.

#### Exhibit 47 Current Stock Prices Imply Historically High Trailing AFFO Multiples



Source: Morningstar, company filings. Current Multiple is based on TTM AFFO and price as of July 20, 2020.

**Exhibit 48** Current Stock Prices Imply Historically High Trailing EV/EBITDA Multiples Too

Source: Morningstar, company filings. Current Multiple is based on TTM EBITDA and EV as of July 20, 2020.

To us, there are two possible explanations for the multiple expansion, but neither warrant an expectation that these new levels are sustainable long term.

First, we think the market could be expecting a new level of growth in the future, largely on the back of the 5G upgrade cycle in the U.S. and elsewhere. As we've discussed, we don't think this is likely. We find it more probable that recent strength will continue but not accelerate. Even assuming these good times continue, as our forecasts do, our current fair value estimates don't imply growth will be sufficient for the firms to justify these multiples. Instead, we find continually higher multiples for growth rates that are no different from the past.

As Exhibit 49 shows, even if the stocks remained flat through 2023, based on our forecasts, they would still at that time be trading at or above multiples of adjusted funds from operations, or AFFO, (a common metric for real estate investment trusts) that they averaged between 2016 and 2018, before valuations took a big step up in 2019. Each firm's average multiple was similar from 2013 to 2018, but we have focused on the 2016-18 period in order to exclude years when more large acquisitions occurred.

Exhibit 49 also shows the compounded AFFO growth that would be required for each firm to return to a normal multiple by 2023 (the average from 2016 to 2018), again assuming no stock appreciation. Although it appears Crown Castle does not need to exceed its recent growth trend to become fairly valued, its three-year historical growth rate is skewed by its large acquisition of Lighttower at the end of 2017. We also think Crown Castle deserves a lower multiple than American Tower and SBA because, as a percentage of sales, its capital spending has been 2 to 4 times higher than either of those firms over the past several years, and we project the pattern to continue over the next few years.

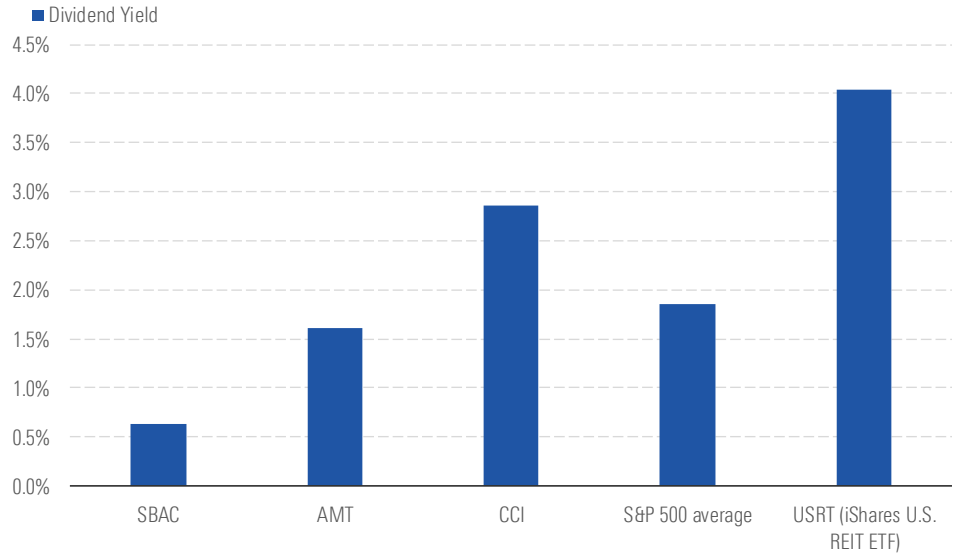
**Exhibit 49** Even if Growth Accelerates, Tower Stocks Still Will Look Expensive in 2023

	<b>AMT</b>	<b>SBAC</b>	<b>CCI</b>
Current Stock Price	\$258	\$310	\$168
Current Market Cap (\$mm)	\$114,270	\$34,830	\$70,580
2019 AFFO (\$mm)	\$3,441	\$972	\$2,600
Current Trailing AFFO Multiple	33	36	27
Average Trailing AFFO multiple, 2016-2018	20	21	20
AFFO CAGR, last 3 years	13%	9%	12%
AFFO/share CAGR, last 3 years	11%	13%	8%
<b>Our forecast</b>			
4-year AFFO CAGR	12%	10%	8%
4-year AFFO/share CAGR	14%	17%	11%
2023 AFFO (\$mm)	\$5,316	\$1,379	\$3,531
Current multiple on our 2023 AFFO forecast	21	25	20
Multiple on 2023 AFFO Implied by Our FVE	17	15	12
<b>AFFO CAGR Required to Reach Normalized Multiple by 2023; Assuming Stagnant Stock Price</b>			
Compound AFFO growth needed for next 4 years	15%	15%	9%
2023 AFFO (\$mm)	\$6,018	\$1,701	\$3,585
Current multiple on hypothetical 2023 AFFO	19	20	20

Source: Morningstar, company filings. Data as of August 7, 2020.

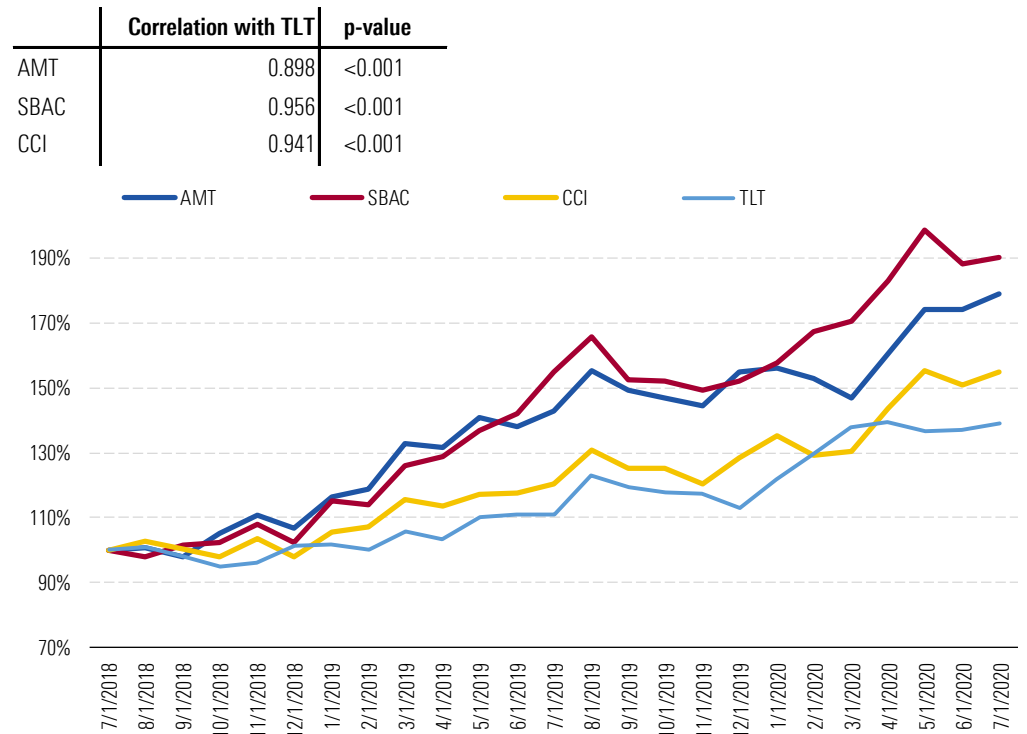
Company-specific growth potential likely isn't the only reason investors have bid up tower multiples. The current interest-rate environment has likely played a role as well. Tower stocks have a high negative correlation to interest rates--as interest rates have gone down, tower stock prices have risen. As REITs that are considered safe dividend payers, we see how investors look at them as bond proxies to find yield. But although these companies have consistent histories of dividend growth (except for SBA, which only recently initiated a dividend), they are not high yielders (see Exhibit 50). SBA yields less than 1%; American Tower yields less than 2%; and Crown Castle yields less than 3%. To us, those yields are not attractive when the S&P 500 is yielding 2%. Nonetheless, Exhibit 51 shows that the tower firms' correlations to the TLT, an ETF that tracks the 20-Year Treasury Bond, have been especially pronounced over the past two years.

**Exhibit 50** Tower Dividend Yields Are Not Especially Attractive Relative to REIT ETFs or the S&P 500



Source: Morningstar, Yahoo Finance, multpl.com. Data as of July 16, 2020.

**Exhibit 51** Tower Stocks Have Moved With Interest Rates and Are Highly Correlated to Treasury ETFs



Source: Morningstar.

In our opinion, it's risky to buy these stocks primarily because of the interest-rate environment. While our discounted cash flow model uses a normalized interest-rate environment, which, admittedly, we haven't seen in over a decade (and one could argue a new normal rate is lower), a sensitivity analysis around our discount rate assumptions shows there is a large margin of overvaluation that will be especially vulnerable if interest-rate expectations rise. The sensitivity analyses in Exhibits 52, 53, and 54 show the weighted average cost of capital and terminal EBITDA multiple that would be required, assuming our explicit five-year forecasts, for American Tower, SBA, and Crown Castle, respectively, to be reasonably valued. In those exhibits, only the green boxes reflect assumptions that would make the stocks undervalued at today's levels. Red boxes are below our fair value estimate, and yellow boxes are between our fair value estimate and the current market price, inclusive. Our fair value estimates are boxed at the intersection of our WACC and the implied terminal multiple on our 2024 EBITDA. We chose a 5% WACC as the lowest range of our analyses: with current average borrowing costs for these firms around 3%, any WACC below that would imply a cost of less than 7%, which we think is unrealistic for the risk of these equities.

**Exhibit 52** To Be Fairly Valued, AMT Requires a Terminal Multiple on 2024 EBITDA Above Its Historical Average

American Tower	WACC				
Terminal EBITDA Multiple	5.0%	6.0%	7.0%	8.0%	9.0%
11	\$123	\$115	\$108	\$102	\$95
15	\$174	\$164	\$155	\$147	\$138
19	\$226	\$214	\$203	\$190	\$181
23	\$277	\$263	\$250	\$237	\$224
27	\$328	\$312	\$297	\$282	\$267

	Explicit forecast 2020-2024:	2017-2019 average:	2019 EBITDA Multiple	2011-2018 Avg. Multiple
Revenue Growth	8.1%	9.6%	26.4	19.9
EBITDA Growth	9.3%	10.3%		
AFFO Growth	11.5%	12.9%		
FCF Growth	12.3%	12.0%		

Source: Morningstar, company filings. Data as of August 7, 2020.

Note: Red boxes are below our fair value estimate; yellow boxes are between our fair value estimate and the current stock price, inclusive; green boxes are above the current market price. Our fair value estimate is boxed at the intersection of our WACC and the implied terminal multiple on our 2024 EBITDA.

**Exhibit 53** To Be Fairly Valued, SBA Requires a Terminal Multiple on 2024 EBITDA Above Its Historical Average

SBA Communications	WACC					
	Terminal EBITDA Multiple	5.0%	6.0%	7.0%	8.0%	9.0%
11		\$113	\$104	\$95	\$88	\$80
15		\$174	\$162	\$151	\$141	\$131
19		\$234	\$219	\$204	\$190	\$181
23		\$293	\$275	\$260	\$247	\$231
27		\$354	\$334	\$315	\$299	\$281

	Explicit forecast 2020-2024:	2017-2019 average:	2019 EBITDA Multiple	2013-2018 Avg. Multiple
Revenue Growth	7.4%	7.3%	26.8	21.4
EBITDA Growth	8.8%	8.4%		
AFFO Growth	9.0%	9.4%		
FCF Growth	11.2%	10.7%		

Source: Morningstar, company filings. Data as of August 7, 2020.

Note: Red boxes are below our fair value estimate; yellow boxes are between our fair value estimate and the current stock price, inclusive; green boxes are above the current market price. Our fair value estimate is boxed at the intersection of our WACC and the implied terminal multiple on our 2024 EBITDA.

**Exhibit 54** To Be Fairly Valued, Crown Castle Requires a Terminal Multiple Above Even Its Current Level

Crown Castle	WACC					
	Terminal EBITDA Multiple	5.0%	6.0%	7.0%	8.0%	9.0%
11		\$77	\$72	\$67	\$62	\$58
15		\$113	\$105	\$99	\$94	\$88
19		\$148	\$139	\$131	\$125	\$117
23		\$183	\$173	\$163	\$156	\$147
27		\$219	\$207	\$196	\$187	\$177

	Explicit forecast 2020-2024:	2017-2019 average:**	2019 EBITDA Multiple	2013-2018 Avg. Multiple
Revenue Growth	6.3%	14.7%	23.1	19.3
EBITDA Growth	7.8%	15.2%		
AFFO Growth	10.0%	15.3%		
FCF Growth	31.7%	(10.9%)		

Source: Morningstar, company filings. Data as of August 7, 2020.

\*\*The November 2017 acquisition of Lighttower makes revenue, EBITDA, and AFFO growth artificially high. Excluding 2018, CCI's average 2015-19 revenue, EBITDA, and AFFO growth were 6.4%, 6.6%, and 10.6%, respectively.

Note: Red boxes are below our fair value estimate; yellow boxes are between our fair value estimate and the current stock price, inclusive; green boxes are above the current market price. Our fair value estimate is boxed at the intersection of our WACC and the implied terminal multiple on our 2024 EBITDA.

Under any basis of evaluation, the tower stocks are historically expensive. In our view, the only way for that to be warranted would be if there are catalysts in the underlying businesses that will bring fundamental financial performance to new heights as well. We suspect that excitement about what 5G will mean to tower companies is at least partially behind the multiple re-rating, and we think that is bound to lead to disappointment. Despite a strong environment for towers, we'd await a better buying opportunity before wading into any of them, and our choice would be American Tower. ■■■

# The Basics: Tower Companies Have Fantastic Business Models Poised to Benefit as Mobile Networks Require More Capacity

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Matthew Dolgin, CFA  
Equity Analyst  
+1 312-696-6783  
matthew.dolgin@morningstar.com

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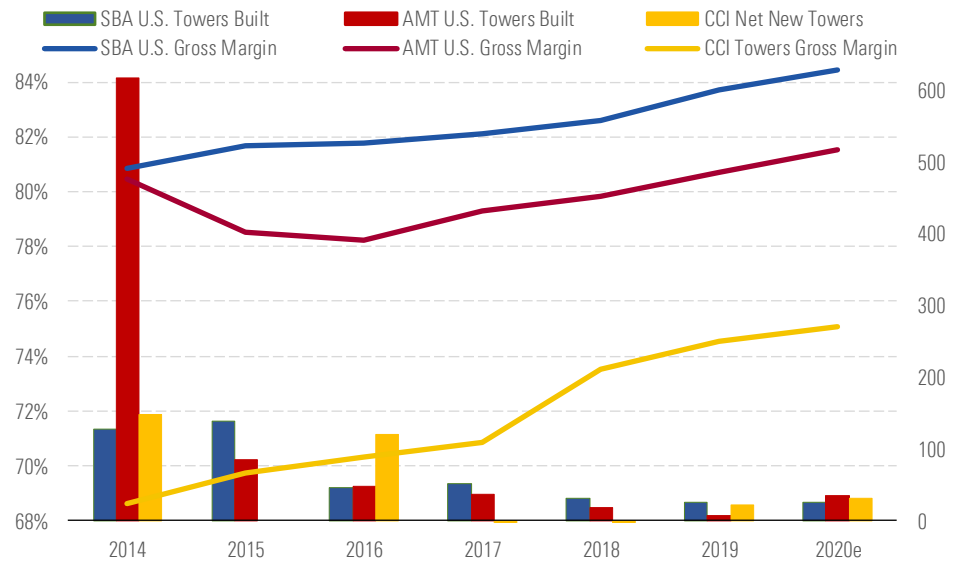
## **Towers Have Reliable Recurring Revenue Locked Into Long-Term Contracts and Few Competitors**

The tower business is a great one. Mobile phone carriers lease space on towers to hang the antennas and supporting equipment required for their wireless networks. The carriers sign long-term contracts (typically five to 10 years on the initial contracts followed by tenant renewal options) for space on the towers that include annual escalators and provisions for amendments. The escalators result in rents rising each year (typically about 3% annually in the U.S. and usually tied to inflation in foreign markets) even if the equipment is untouched. The amendment provisions lead to higher rents when carriers have to add or modify equipment on towers, things they frequently have to do to accommodate growing network traffic.

On top of escalators and amendments, revenue growth on existing towers comes from adding new tenants (deemed "colocation" revenue). Towers can accommodate multiple different antenna arrays from multiple tenants, with the U.S. average hovering just above two tenants per tower. Because adding tower sites is one of the ways for carriers to enhance their networks, carriers sometimes need to enter new towers. Colocation revenue also can come from new carriers, such as Dish Network in the U.S., entering the market, or from noncarriers, such as broadcast stations or government entities. Because the costs to operate a tower are mostly fixed, revenue from incremental tenants is almost entirely profit. As we have seen over the past several years in the U.S., which is a mature tower market where the tower companies have been building very few new towers, margins have been continually expanding (see Exhibit 55).



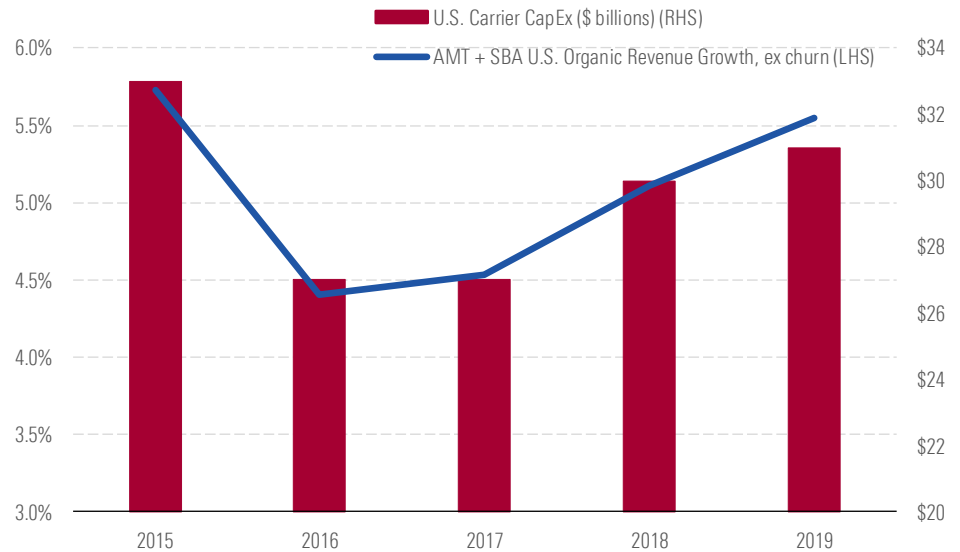
**Exhibit 55** When Firms Aren't Building Many New Towers, Margins Continually Rise



Source: Morningstar, company filings.

For a tower company's existing tower portfolio, organic cash revenue growth each period is made up of escalator, amendment, and colocation revenue and is offset by churn. Churn is typically quite low unless there is carrier consolidation or bankruptcies that lead carriers to shut down, or "decommission" their networks. When there is carrier consolidation, churn typically remains slightly elevated for an extended period of time rather than spiking dramatically, a result of the long-term contracts--even when a carrier desires to shut down a tower, it must wait until the contract on a given tower expires (an alternative is to reach a lump sum settlement to abandon towers immediately).

When carriers add to or modify the equipment on their towers, they lock themselves into incremental recurring payments for the remainder of their leases. Although payments to tower companies are operating expenses for carriers, the carriers' capital spending is a good indication of these network upgrades, as the carriers pay for the equipment and labor required to implement the upgrades (see Exhibit 56).

**Exhibit 56** As Carriers' Capital Spending Increases, So Too Do Their Recurring Rents to Tower Companies

Source: Morningstar, American Tower Presentation, company filings.

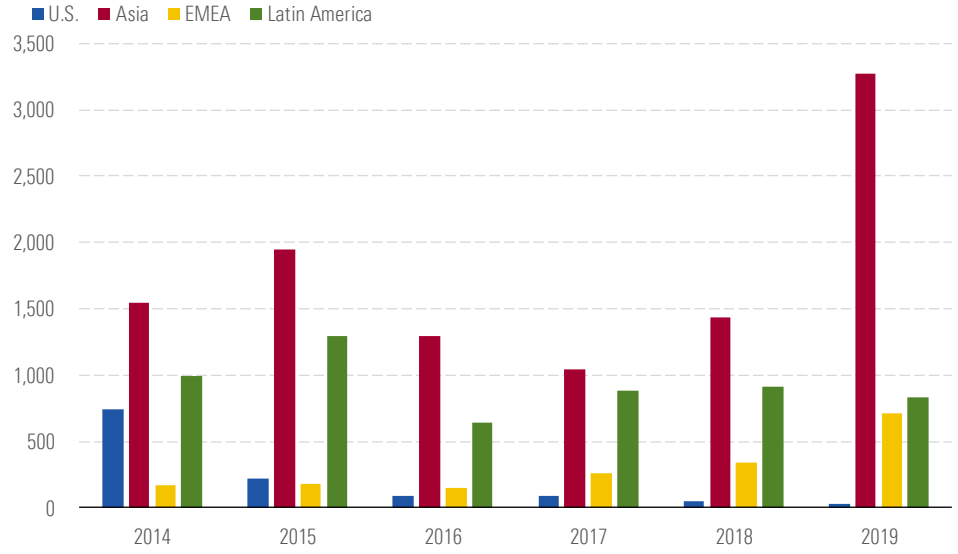
Note: Crown Castle does not break out its organic revenue growth and churn on towers, so it is excluded from the growth calculation.

Carrier spending is highly correlated to the amount of mobile network data usage, which, spurred by the advent of smartphones and video streaming, has been growing rapidly--averaging nearly 50% annually for the past five years in the U.S., according to American Tower, which was using data from Cisco and Ericsson. When networks get congested, carriers can either:

- 1) Deploy more wireless spectrum on their towers (the radio frequencies that the carriers have licensed and use to build wireless networks), which may require them to add new antennas and other equipment to towers (amendments);
- 2) Add their spectrum holdings to more locations ("densify their networks") so the spectrum that's deployed serves a smaller geographic area, or cell (tower colocations or small cell deployments); or
- 3) Use advanced technologies, like carrier aggregation or MIMO antennas, so that they gain more capacity by using their spectrum more efficiently (potentially amendments).

In addition to the revenue tower companies produce on their existing tower portfolios, they regularly report nonorganic revenue that includes towers that have been newly built or acquired in the past year. The tower companies have not been building many new towers in the U.S., but new tower construction remains high in many international markets, as shown in Exhibit 57.

**Exhibit 57** New Tower Building Has Been Most Prevalent in Asia and Latin America



Source: Morningstar, company filings.



## Appendix Valuation Summaries

Morningstar Equity Research | 7 August 2020

### American Tower Corporation (AMT)



Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
258 USD	190 USD	High	Standard	Narrow	Stable	N/A		
Analyst	Matthew Dolgin, CFA	Five-Star Price	114.00	Estimated COE	9.0%	Adjusted P / E	60.1	44.3
Phone & Email	312-696-6783	Fair Value Estimate	190.00	Pre-Tax Cost of Debt	5.3%	EV / Adjusted EBITDA	28.1	21.9
	matthew.dolgin@morningstar.com	One-Star Price	294.50	Estimated WACC	8.0%	EV / Sales	17.6	13.7
Sector	Comm. Services	Market Price	258.00	ROIC *	13.3%	Price / Book	23.9	17.6
Industry	Telecom Services	P / FVE	1.36	Adjusted ROIC *	11.7%	FCF Yield	2.4%	3.2%
				* 5-Yr Projected Average		Dividend Yield	1.8%	2.4%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Millions	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			7,580	7,811	8,468	9,234	10,093	11,039	
Gross Profit			5,364	5,530	6,047	6,688	7,416	8,224	
Operating Income			2,688	2,815	3,315	3,902	4,581	5,520	
Net Income			1,888	1,780	2,345	2,857	3,452	4,272	
Adjusted Income			1,892	1,913	2,345	2,857	3,452	4,272	
Adjusted EPS			4.25	4.29	5.28	6.54	8.07	10.18	
Adjusted EBITDA			4,743	4,898	5,371	5,950	6,609	7,342	
<b>Growth (% YoY)</b>									
Revenue	9.4%	1.9%	3.0%	8.4%	9.1%	9.3%	9.4%	7.8%	
Gross Profit	10.3%	1.9%	3.1%	9.3%	10.6%	10.9%	10.9%	8.9%	
Operating Income	13.2%	41.1%	4.7%	17.7%	17.7%	17.4%	20.5%	15.5%	
Net Income	30.5%	53.8%	-5.7%	31.7%	21.9%	20.8%	23.7%	17.7%	
Adjusted EPS	27.0%	56.1%	1.0%	23.2%	23.8%	23.3%	26.2%	19.1%	
Adjusted EBITDA	10.1%	1.6%	3.3%	9.6%	10.8%	11.1%	11.1%	9.1%	
<b>Profitability (%)</b>									
Gross Margin	70.2%	70.8%	70.8%	71.4%	72.4%	73.5%	74.5%	72.5%	
Operating Margin	30.4%	35.5%	36.0%	39.1%	42.3%	45.4%	50.0%	42.6%	
Net Margin	19.6%	24.9%	22.8%	27.7%	30.9%	34.2%	38.7%	30.9%	
Adjusted EBITDA Margin	62.2%	62.6%	62.7%	63.4%	64.4%	65.5%	66.5%	64.5%	
Return on Equity	25.1%	36.3%	36.1%	54.8%	104.1%	434.0%	-430.3%	39.7%	
Adjusted ROIC	10.3%	10.3%	10.2%	10.9%	11.6%	12.5%	13.3%	11.7%	
Adjusted RONIC	38.7%	1.6%	41.8%	21.3%	40.0%	36.9%	25.9%	33.2%	
<b>Leverage</b>									
Debt / Capital	79.6%	82.6%	82.2%	86.3%	93.5%	100.6%	106.8%	93.9%	
Debt / EBITDA	5.5	5.5	5.0	4.7	4.5	4.2	4.1	4.5	
EBITDA / Interest Expense	5.0	5.4	5.5	6.3	6.6	6.9	7.2	6.5	
FCFE / Total Debt	0.12	0.11	0.12	0.14	0.15	0.16	0.17	0.15	
<b>Cash Flow</b>									
Dividends per Share			3.78	4.54	5.44	6.53	7.84	9.41	
Free Cash Flow to the Firm			9	3,050	3,496	3,881	4,346	4,955	
FCFE (CFO-Capex)			2,761	2,721	3,370	3,803	4,315	4,887	
Dividend Franking			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Dividend Payout Ratio			89.2%	113.6%	103.0%	99.9%	97.2%	92.4%	

Source: Morningstar estimates, company filings.

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**SBA Communications Corporation (SBAC)**

Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
311.28 USD	190 USD	High	Standard	Narrow	Stable	N/A		
Analyst	Matthew Dolgin, CFA	Five-Star Price	114.00	Estimated COE	9.0%	Adjusted P / E	(2,261.0)	(1,380.1)
Phone & Email	312-696-6783 matthew.dolgin@morningstar.com	Fair Value Estimate	190.00	Pre-Tax Cost of Debt	5.3%	EV / Adjusted EBITDA	30.7	21.4
Sector	Comm. Services	One-Star Price	294.50	Estimated WACC	8.0%	EV / Sales	21.8	15.2
Industry	Telecom Services	Market Price	311.28	ROIC *	14.7%	Price / Book	(8.1)	(4.9)
		P / FVE	1.64	Adjusted ROIC *	14.7%	FCF Yield	2.8%	4.6%
				* 5-Yr Projected Average		Dividend Yield	0.5%	0.9%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Thousands	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			2,014,645	2,079,503	2,260,540	2,441,748	2,637,745	2,849,611	
Gross Profit			1,521,614	1,607,137	1,774,314	1,941,163	2,122,012	2,317,908	
Operating Income			583,488	643,761	819,277	988,189	1,173,119	1,456,782	
Net Income			146,991	3,135	356,549	498,066	665,402	920,131	
Adjusted Income			156,498	(15,507)	376,397	519,234	686,803	941,765	
Adjusted EPS			1.36	(0.14)	3.45	4.94	6.79	9.68	
Adjusted EBITDA			1,410,632	1,477,256	1,639,804	1,789,372	1,951,948	2,124,769	
<b>Growth (% YoY)</b>									
Revenue	7.2%	8.0%	3.2%	8.7%	8.0%	8.0%	8.0%	8.0%	7.2%
Gross Profit	7.9%	8.9%	5.6%	10.4%	9.4%	9.3%	9.2%	8.8%	
Operating Income	14.6%	7.2%	10.3%	27.3%	20.6%	18.7%	24.2%	20.1%	
Net Income	24.5%	209.8%	-97.9%	11274.5%	39.7%	33.6%	38.3%	44.3%	
Adjusted EPS	41.5%	-0.9%	-110.1%	-2607.3%	43.0%	37.5%	42.7%	48.0%	
Adjusted EBITDA	8.4%	8.1%	4.7%	11.0%	9.1%	9.1%	8.9%	8.5%	
<b>Profitability (%)</b>									
Gross Margin	74.9%	75.5%	77.3%	78.5%	79.5%	80.4%	81.3%	79.4%	
Operating Margin	28.2%	29.0%	31.0%	36.2%	40.5%	44.5%	51.1%	40.7%	
Net Margin	5.3%	7.3%	0.2%	15.8%	20.4%	25.2%	32.3%	18.8%	
Adjusted EBITDA Margin	69.9%	70.0%	71.0%	72.5%	73.3%	74.0%	74.6%	73.1%	
Return on Equity	-3.4%	-4.2%	-0.1%	-7.5%	-9.2%	-11.0%	-14.0%	-8.4%	
Adjusted ROIC	11.3%	11.9%	12.2%	13.5%	14.7%	16.0%	17.1%	14.7%	
Adjusted RONIC	41.9%	25.6%	103.2%	-179.6%	587.4%	237.0%	128.9%	175.4%	
<b>Leverage</b>									
Debt / Capital	148.4%	155.0%	170.8%	184.4%	197.8%	211.2%	217.8%	196.4%	
Debt / EBITDA	8.6	8.1	10.1	7.4	7.0	6.6	6.2	7.5	
EBITDA / Interest Expense	3.2	3.3	2.7	3.8	3.9	4.2	4.5	3.8	
FCFE / Total Debt	0.07	0.08	0.09	0.09	0.09	0.10	0.11	0.10	
<b>Cash Flow</b>									
Dividends per Share		0.74	1.63	1.95	2.34	2.81	3.38		
Free Cash Flow to the Firm		265,582	709,281	1,162,555	1,254,942	1,401,420	1,547,089		
FCFE (CFO-Capex)		815,809	989,854	974,903	1,098,056	1,242,662	1,374,702		
Dividend Franking		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
Dividend Payout Ratio		57.7%	5849.8%	59.7%	49.5%	42.8%	35.7%		

Source: Morningstar estimates, company filings.

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## Crown Castle International Corp (CCI)



Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
168.19 USD	94 USD	High	Standard	None	Stable	N/A		
Analyst	Matthew Dolgin, CFA	Five-Star Price	56.40	Estimated COE	9.0%	Adjusted P / E	79.5	44.4
Phone & Email	312-696-6783 matthew.dolgin@morningstar.com	Fair Value Estimate	94.00	Pre-Tax Cost of Debt	5.8%	EV / Adjusted EBITDA	25.6	16.6
Sector	Comm. Services	One-Star Price	145.70	Estimated WACC	8.0%	EV / Sales	15.1	9.7
Industry	Telecom Services	Market Price	168.19	ROIC *	11.6%	Price / Book	7.6	4.3
		P / FVE	1.79	Adjusted ROIC *	9.1%	FCF Yield	1.6%	2.8%
				* 5-Yr Projected Average		Dividend Yield	2.9%	5.1%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Thousands	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			5,763,000	5,915,355	6,288,325	6,740,696	7,212,988	7,706,435	
Gross Profit			3,777,000	3,988,177	4,325,551	4,669,783	5,032,651	5,415,320	
Operating Income			1,591,000	1,722,680	2,033,765	2,312,337	2,617,064	2,949,651	
Net Income			746,564	864,151	1,226,909	1,473,433	1,738,414	2,027,259	
Adjusted Income			778,777	894,433	1,257,289	1,503,813	1,768,794	2,057,639	
Adjusted EPS			1.86	2.12	2.97	3.55	4.17	4.89	
Adjusted EBITDA			3,305,000	3,473,913	3,789,342	4,098,399	4,425,885	4,772,957	
<b>Growth (% YoY)</b>									
Revenue	14.4%	7.2%	2.6%	6.3%	7.2%	7.0%	6.8%	6.0%	
Gross Profit	15.8%	7.0%	5.6%	8.5%	8.0%	7.8%	7.6%	7.5%	
Operating Income	18.8%	10.6%	8.3%	18.1%	13.7%	13.2%	12.7%	13.1%	
Net Income	39.9%	45.7%	15.8%	42.0%	20.1%	18.0%	16.6%	22.1%	
Adjusted EPS	18.7%	16.3%	13.6%	40.2%	19.6%	17.6%	17.2%	21.3%	
Adjusted EBITDA	14.9%	6.8%	5.1%	9.1%	8.2%	8.0%	7.8%	7.6%	
<b>Profitability (%)</b>									
Gross Margin	65.0%	65.5%	67.4%	68.8%	69.3%	69.8%	70.3%	69.1%	
Operating Margin	26.3%	27.6%	29.1%	32.3%	34.3%	36.3%	38.3%	34.1%	
Net Margin	9.9%	13.0%	14.6%	19.5%	21.9%	24.1%	26.3%	21.3%	
Adjusted EBITDA Margin	57.7%	57.3%	58.7%	60.3%	60.8%	61.4%	61.9%	60.6%	
Return on Equity	4.7%	6.8%	8.7%	13.9%	18.5%	24.5%	34.0%	19.9%	
Adjusted ROIC	7.7%	8.0%	8.2%	8.7%	9.2%	9.5%	10.0%	9.1%	
Adjusted RONIC	22.9%	13.2%	16.7%	28.3%	21.6%	19.2%	31.2%	23.4%	
<b>Leverage</b>									
Debt / Capital	59.7%	63.3%	67.2%	70.2%	73.2%	76.2%	81.1%	73.6%	
Debt / EBITDA	6.3	5.8	5.8	5.5	5.2	5.1	4.9	5.3	
EBITDA / Interest Expense	4.2	4.6	4.5	4.8	5.0	5.2	5.3	5.0	
FCFE / Total Debt	0.04	0.04	0.06	0.06	0.08	0.09	0.10	0.08	
<b>Cash Flow</b>									
Dividends per Share			4.57	4.80	5.14	5.50	6.05	6.65	
Free Cash Flow to the Firm			1,160,863	1,897,334	2,056,886	2,419,529	2,774,009	3,140,173	
FCFE (CFO-Capex)			641,000	1,120,736	1,225,619	1,599,078	1,949,163	2,300,520	
Dividend Franking			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Dividend Payout Ratio			256.1%	234.8%	177.5%	158.1%	147.4%	138.0%	

Source: Morningstar estimates, company filings.

**AT&T (T)**

Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
30 USD	37 USD	Medium	Poor	Narrow	Stable	N/A		
Analyst	Michael Hodel, CFA	Five-Star Price	25.90	Estimated COE	9.0%	Adjusted P / E	9.8	12.1
Phone & Email	312-696-6578	Fair Value Estimate	37.00	Pre-Tax Cost of Debt	6.5%	EV / Adjusted EBITDA	6.5	7.4
	michael.hodel@morningstar.com	One-Star Price	49.95	Estimated WACC	7.5%	EV / Sales	2.1	2.4
Sector	Comm. Services	Market Price	30.00	ROIC *	9.6%	Price / Book	1.2	1.4
Industry	Telecom Services	P / FVE	0.81	Adjusted ROIC *	6.4%	FCF Yield	11.4%	9.2%
				* 5-Yr Projected Average		Dividend Yield	7.0%	5.6%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Millions	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			181,193	171,339	177,340	179,170	181,926	185,133	
Gross Profit			57,631	56,367	57,071	59,100	60,464	62,134	
Operating Income			29,413	28,480	29,883	32,284	33,826	35,196	
Net Income			13,900	16,491	17,475	19,549	21,277	22,513	
Adjusted Income			26,232	22,000	22,105	23,561	24,746	25,983	
Adjusted EPS			3.57	3.05	3.13	3.41	3.62	3.80	
Adjusted EBITDA			59,215	56,366	57,070	59,099	60,463	62,133	
<b>Growth (% YoY)</b>									
Revenue	3.4%	6.1%	-5.4%	3.5%	1.0%	1.5%	1.8%	0.4%	
Gross Profit	3.9%	2.1%	-2.2%	1.3%	3.6%	2.3%	2.8%	1.5%	
Operating Income	4.7%	5.1%	-3.2%	4.9%	8.0%	4.8%	4.0%	3.7%	
Net Income	2.3%	-28.2%	18.6%	6.0%	11.9%	8.8%	5.8%	10.1%	
Adjusted EPS	8.0%	1.4%	-14.4%	2.6%	9.0%	5.9%	5.0%	1.2%	
Adjusted EBITDA	5.3%	4.9%	-4.8%	1.3%	3.6%	2.3%	2.8%	1.0%	
<b>Profitability (%)</b>									
Gross Margin	32.1%	31.8%	32.9%	32.2%	33.0%	33.2%	33.6%	33.0%	
Operating Margin	16.2%	16.2%	16.6%	16.9%	18.0%	18.6%	19.0%	17.8%	
Net Margin	12.5%	7.7%	9.6%	9.9%	10.9%	11.7%	12.2%	10.8%	
Adjusted EBITDA Margin	32.0%	32.7%	32.9%	32.2%	33.0%	33.2%	33.6%	33.0%	
Return on Equity	13.9%	7.6%	9.1%	9.8%	11.2%	11.9%	12.2%	10.8%	
Adjusted ROIC	5.1%	5.7%	6.0%	6.1%	6.4%	6.7%	7.0%	6.4%	
Adjusted RONIC	75.3%	-25.3%	-2.9%	-4.7%	-50.3%	-13.5%	-21.8%	-18.6%	
<b>Leverage</b>									
Debt / Capital	49.9%	47.0%	46.6%	48.1%	46.2%	43.6%	40.7%	45.0%	
Debt / EBITDA	3.3	2.9	2.9	2.9	2.6	2.4	2.1	2.6	
EBITDA / Interest Expense	6.9	6.7	6.9	6.9	7.6	8.5	9.1	7.8	
FCFE / Total Debt	0.14	0.18	0.15	0.15	0.17	0.19	0.21	0.18	
<b>Cash Flow</b>									
Dividends per Share		2.05	2.09	2.13	2.17	2.21	2.25		
Free Cash Flow to the Firm		39,019	26,736	26,542	25,638	29,273	30,232		
FCFE (CFO-Capex)		29,033	24,645	25,654	25,637	27,319	28,468		
Dividend Franking		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
Dividend Payout Ratio		108.4%	91.3%	86.0%	76.6%	71.1%	68.4%		

Source: Morningstar estimates, company filings.

## Verizon Communications (VZ)

Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
57 USD	59 USD	Medium	Standard	Narrow	Stable	N/A		
Analyst	Michael Hodel, CFA	Five-Star Price		Estimated COE	9.0%	Adjusted P / E	11.8	N/A
Phone & Email	312-696-6578	Fair Value Estimate	59.00	Pre-Tax Cost of Debt	6.5%	EV / Adjusted EBITDA	7.3	7.5
	michael.hodel@morningstar.com	One-Star Price	79.65	Estimated WACC	7.7%	EV / Sales	2.7	2.7
Sector	Comm. Services	Market Price	57.00	ROIC *	11.1%	Price / Book	3.4	3.5
Industry	Telecom Services	P / FVE	0.97	Adjusted ROIC *	9.9%	FCF Yield	7.6%	7.3%
				* 5-Yr Projected Average		Dividend Yield	4.4%	4.3%
						(2020 Estimates)	(Price)	(Fair Value)

	3-Yr	Forecast						5-Yr
All values (except per share amounts) in: USD Millions	CAGR/AV G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>								
Revenue		131,868	128,222	135,146	136,501	140,082	143,787	
Gross Profit		77,142	77,137	77,620	80,072	82,408	84,811	
Operating Income		30,507	30,637	30,721	31,797	32,979	34,201	
Net Income		19,265	19,013	20,152	21,212	22,122	23,063	
Adjusted Income		19,927	19,933	20,152	21,212	22,122	23,063	
Adjusted EPS		4.81	4.82	4.87	5.13	5.35	5.58	
Adjusted EBITDA		47,189	47,162	47,416	48,962	50,364	51,806	
<b>Growth (% YoY)</b>								
Revenue	1.5%	0.8%	-2.8%	5.4%	1.0%	2.6%	2.6%	1.7%
Gross Profit	1.1%	1.8%	-0.0%	0.6%	3.2%	2.9%	2.9%	1.9%
Operating Income	0.7%	1.7%	0.4%	0.3%	3.5%	3.7%	3.7%	2.3%
Net Income	13.6%	24.1%	-1.3%	6.0%	5.3%	4.3%	4.3%	3.7%
Adjusted EPS	7.5%	2.2%	0.1%	1.1%	5.3%	4.3%	4.3%	3.0%
Adjusted EBITDA	1.0%	-0.5%	-0.1%	0.5%	3.3%	2.9%	2.9%	1.9%
<b>Profitability (%)</b>								
Gross Margin	58.5%	58.5%	60.2%	57.4%	58.7%	58.8%	59.0%	58.8%
Operating Margin	22.8%	23.1%	23.9%	22.7%	23.3%	23.5%	23.8%	23.4%
Net Margin	16.8%	14.6%	14.8%	14.9%	15.5%	15.8%	16.0%	15.4%
Adjusted EBITDA Margin	35.9%	35.8%	36.8%	35.1%	35.9%	36.0%	36.0%	35.9%
Return on Equity	52.6%	33.6%	28.9%	27.0%	25.1%	23.2%	21.6%	25.2%
Adjusted ROIC	7.8%	7.4%	9.8%	9.7%	9.8%	10.0%	10.3%	9.9%
Adjusted RONIC	-11.5%	2.5%	612.5%	-3.1%	13.2%	1625.3%	-94.1%	430.8%
<b>Leverage</b>								
Debt / Capital	68.5%	64.5%	60.2%	56.1%	52.7%	48.3%	44.5%	52.4%
Debt / EBITDA	2.6	2.4	2.3	2.1	2.0	1.9	1.7	2.0
EBITDA / Interest Expense	9.2	9.9	10.0	10.8	11.9	12.3	12.6	11.5
FCFE / Total Debt	0.13	0.16	0.17	0.19	0.19	0.21	0.23	0.20
<b>Cash Flow</b>								
Dividends per Share		2.46	2.52	2.58	2.64	2.70	2.76	
Free Cash Flow to the Firm		21,469	19,055	18,753	16,319	22,479	23,198	
FCFE (CFO-Capex)		17,807	17,898	19,750	19,047	20,207	20,926	
Dividend Franking		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
Dividend Payout Ratio		52.9%	54.8%	53.0%	51.5%	50.5%	49.5%	

Source: Morningstar estimates, company filings.



## T-Mobile US (TMUS)



Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
105 USD	89 USD	High	Standard	None	Positive	N/A		
Analyst	Michael Hodel, CFA	Five-Star Price	53.40	Estimated COE	9.0%	Adjusted P / E	37.1	31.4
Phone & Email	312-696-6578	Fair Value Estimate	89.00	Pre-Tax Cost of Debt	8.0%	EV / Adjusted EBITDA	7.6	6.8
	michael.hodel@morningstar.com	One-Star Price	137.95	Estimated WACC	8.0%	EV / Sales	2.6	2.3
Sector	Comm. Services	Market Price	105.00	ROIC *	8.8%	Price / Book	2.3	1.9
Industry	Telecom Services	P / FVE	1.18	Adjusted ROIC *	8.4%	FCF Yield	2.6%	3.1%
				* 5-Yr Projected Average		Dividend Yield	0.0%	0.0%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Millions	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			44,998	75,089	78,880	79,385	81,058	83,325	
Gross Profit			26,477	45,123	45,385	46,554	47,635	48,858	
Operating Income			5,722	7,825	8,655	13,292	16,957	18,553	
Net Income			3,468	3,571	4,241	7,719	10,538	11,743	
Adjusted Income			3,468	3,571	4,241	7,719	10,538	11,743	
Adjusted EPS			4.02	2.83	3.39	6.24	8.62	9.71	
Adjusted EBITDA			13,383	25,713	26,487	28,484	29,134	29,864	
<b>Growth (% YoY)</b>									
Revenue	6.3%	3.9%	66.9%	5.0%	0.6%	2.1%	2.8%	13.1%	
Gross Profit	8.1%	6.1%	70.4%	0.6%	2.6%	2.3%	2.6%	13.0%	
Operating Income	19.9%	7.8%	36.8%	10.6%	53.6%	27.6%	9.4%	26.5%	
Net Income	35.1%	20.1%	3.0%	18.8%	82.0%	36.5%	11.4%	27.6%	
Adjusted EPS	33.5%	19.4%	-29.5%	19.6%	84.3%	38.1%	12.6%	19.3%	
Adjusted EBITDA	7.9%	7.9%	92.1%	3.0%	7.5%	2.3%	2.5%	17.4%	
<b>Profitability (%)</b>									
Gross Margin	57.6%	58.8%	60.1%	57.5%	58.6%	58.8%	58.6%	58.7%	
Operating Margin	12.1%	12.7%	10.4%	11.0%	16.7%	20.9%	22.3%	16.3%	
Net Margin	8.5%	7.7%	4.8%	5.4%	9.7%	13.0%	14.1%	9.4%	
Adjusted EBITDA Margin	28.9%	29.7%	34.2%	33.6%	35.9%	35.9%	35.8%	35.1%	
Return on Equity	14.3%	8.8%	6.3%	7.1%	12.1%	14.7%	14.5%	10.9%	
Adjusted ROIC	6.6%	5.4%	6.4%	6.9%	8.6%	9.7%	10.4%	8.4%	
Adjusted RONIC	6.6%	0.9%	253.8%	35.9%	-373.0%	-46.1%	-571.3%	-140.1%	
<b>Leverage</b>									
Debt / Capital	55.9%	55.1%	52.8%	50.9%	47.6%	43.7%	39.8%	47.0%	
Debt / EBITDA	3.6	5.4	2.8	2.8	2.4	2.1	2.0	2.4	
EBITDA / Interest Expense	8.7	10.9	7.6	7.6	8.6	9.3	9.7	8.6	
FCFE / Total Debt	0.09	0.06	0.05	0.08	0.15	0.20	0.22	0.14	
<b>Cash Flow</b>									
Dividends per Share		0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Free Cash Flow to the Firm		3,047	4,309	3,933	10,678	16,297	14,197		
FCFE (CFO-Capex)		4,309	3,466	4,977	9,156	11,913	12,621		
Dividend Franking		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		
Dividend Payout Ratio		0.0%	0.0%	0.0%	0.0%	0.0%	0.0%		

Source: Morningstar estimates, company filings.

## DISH Network (DISH)



Last Price	Fair Value	Uncertainty	Stewardship	Economic Moat	Moat Trend	Morningstar Credit Rating		
33.5 USD	35.5 USD	Extreme	Poor	None	Negative	N/A		
Analyst	Michael Hodel, CFA	Five-Star Price		Estimated COE	11.0%	Adjusted P / E	11.8	12.5
Phone & Email	312-696-6578	Fair Value Estimate	35.50	Pre-Tax Cost of Debt	10.0%	EV / Adjusted EBITDA	10.6	11.0
	michael.hodel@morningstar.com	One-Star Price		Estimated WACC	9.6%	EV / Sales	1.8	1.9
Sector	Comm. Services	Market Price	33.50	ROIC *	7.3%	Price / Book	1.3	1.4
Industry	Pay TV	P / FVE	0.94	Adjusted ROIC *	7.3%	FCF Yield	14.4%	13.6%
				* 5-Yr Projected Average		Dividend Yield	0.0%	0.0%
						(2020 Estimates)	(Price)	(Fair Value)

All values (except per share amounts) in: USD Millions	3-Yr		Forecast					5-Yr	
	CAGR/AV	G	2019	2020	2021	2022	2023	2024	Projected CAGR/AVG
<b>Income Statement</b>									
Revenue			12,808	15,742	16,422	18,071	20,953	24,016	
Gross Profit			4,297	4,287	4,248	4,459	5,183	6,335	
Operating Income			1,879	2,022	1,981	2,127	2,852	4,046	
Net Income			1,399	1,480	1,448	785	1,332	2,233	
Adjusted Income			1,399	1,480	1,448	785	1,332	2,233	
Adjusted EPS			2.60	2.83	2.77	1.50	2.55	4.27	
Adjusted EBITDA			2,509	2,701	2,782	3,127	3,952	5,196	
<b>Growth (% YoY)</b>									
Revenue	-5.3%	-6.0%	22.9%		4.3%	10.0%	16.0%	14.6%	13.4%
Gross Profit	-7.4%	-1.3%	-0.2%		-0.9%	5.0%	16.3%	22.2%	8.1%
Operating Income	-5.3%	-12.5%	7.6%		-2.1%	7.4%	34.1%	41.9%	16.6%
Net Income	-1.8%	-11.2%	5.7%		-2.1%	-45.8%	69.8%	67.7%	9.8%
Adjusted EPS	-5.2%	-13.2%	8.8%		-2.1%	-45.8%	69.8%	67.7%	10.4%
Adjusted EBITDA	-7.4%	-12.2%	7.6%		3.0%	12.4%	26.4%	31.5%	15.7%
<b>Profitability (%)</b>									
Gross Margin	32.8%	33.6%	27.2%		25.9%	24.7%	24.7%	26.4%	25.8%
Operating Margin	14.8%	14.7%	12.8%		12.1%	11.8%	13.6%	16.8%	13.4%
Net Margin	12.4%	10.9%	9.4%		8.8%	4.3%	6.4%	9.3%	7.6%
Adjusted EBITDA Margin	20.1%	19.6%	17.2%		16.9%	17.3%	18.9%	21.6%	18.4%
Return on Equity	23.5%	13.9%	12.0%		10.5%	5.3%	8.4%	12.6%	9.8%
Adjusted ROIC	6.8%	8.5%	7.9%		5.8%	5.5%	7.2%	10.1%	7.3%
Adjusted RONIC	84.1%	42.1%	-7.9%		-58.2%	-7.1%	18.2%	396.2%	68.2%
<b>Leverage</b>									
Debt / Capital	62.9%	55.0%	61.9%		59.6%	58.0%	57.0%	53.3%	58.0%
Debt / EBITDA	5.9	5.6	7.8		7.7	6.7	5.6	4.1	6.4
EBITDA / Interest Expense	111.2	105.1	108.0		111.3	3.0	3.8	4.9	46.2
FCFE / Total Debt	0.08	0.08	0.12		0.03	0.01	0.06	0.12	0.07
<b>Cash Flow</b>									
Dividends per Share			0.00		0.00	0.00	0.00	0.00	
Free Cash Flow to the Firm			1,017		989	572	853	(1,694)	3,199
FCFE (CFO-Capex)			1,180		2,525	707	213	1,264	2,557
Dividend Franking			0.0%		0.0%	0.0%	0.0%	0.0%	0.0%
Dividend Payout Ratio			0.0%		0.0%	0.0%	0.0%	0.0%	0.0%

Source: Morningstar estimates, company filings.

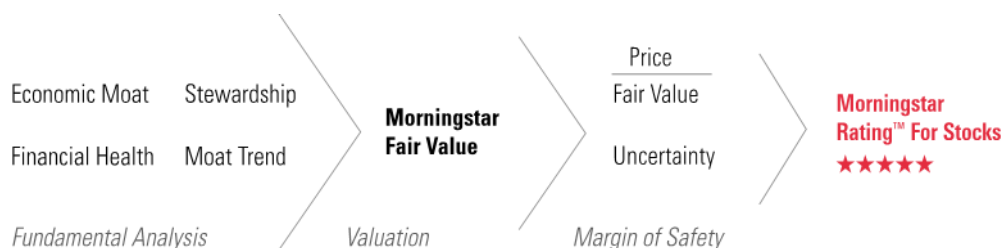
## Research Methodology for Valuing Companies

### Overview

At the heart of our valuation system is a detailed projection of a company's future cash flows, resulting from our analysts' research. Analysts create custom industry and company assumptions to feed income statement, balance sheet, and capital investment assumptions into our globally standardized, proprietary discounted cash flow, or DCF, modeling templates. We use scenario analysis, in-depth competitive advantage analysis, and a variety of other analytical tools to augment this process. Moreover, we think analyzing valuation through discounted cash flows presents a better lens for viewing cyclical companies, high-growth firms, businesses with finite lives (e.g., mines), or companies expected to generate negative earnings over the next few years. That said, we don't dismiss multiples altogether but rather use them as supporting cross-checks for our DCF-based fair value estimates. We also acknowledge that DCF models offer their own challenges (including a potential proliferation of estimated inputs and the possibility that the method may miss short-term market price movements), but we believe these negatives are mitigated by deep analysis and our long-term approach.

Morningstar's equity research group ("we," "our") believes that a company's intrinsic worth results from the future cash flows it can generate. The Morningstar Rating for stocks identifies stocks trading at a discount or premium to their intrinsic worth—or fair value estimate, in Morningstar terminology. Five-star stocks sell for the biggest risk-adjusted discount to their fair values, whereas 1-star stocks trade at premiums to their intrinsic worth.

### Morningstar Research Methodology



Source: Morningstar.

Four key components drive the Morningstar rating: (1) our assessment of the firm's economic moat, (2) our estimate of the stock's fair value, (3) our uncertainty around that fair value estimate, and (4) the current market price. This process ultimately culminates in our single-point star rating.

### Economic Moat

The concept of an economic moat plays a vital role not only in our qualitative assessment of a firm's long-term investment potential, but also in the actual calculation of our fair value estimates. An economic moat is a structural feature that allows a firm to sustain excess profits over a long period of time. We define economic profits as returns on invested capital (ROIC) over and above our estimate of a firm's cost of capital, or weighted average cost of capital (WACC). Without a moat, profits are more susceptible to competition. We have identified five sources of economic moats: intangible assets, switching costs, network effect, cost advantage, and efficient scale.

Companies with a narrow moat are those we believe are more likely than not to achieve normalized excess returns for at least the next 10 years. Wide-moat companies are those in which we have very high confidence that excess returns will remain for 10 years, with excess returns more likely than not to remain for at least 20 years. The longer a firm generates economic profits, the higher its intrinsic value. We believe low-quality, no-moat companies will see their normalized returns gravitate toward their cost of capital more quickly than companies with moats.

To assess the sustainability of excess profits, analysts perform ongoing assessments of the moat trend. A firm's moat trend is positive in cases where we think its sources of competitive advantage are growing stronger, stable where we don't anticipate changes to competitive advantages over the next several years, or negative where we see signs of deterioration.

**Estimated Fair Value**

Combining our analysts' financial forecasts with the firm's economic moat helps us assess how long returns on invested capital are likely to exceed the firm's cost of capital. Returns of firms with a wide economic moat rating are assumed to fade to the perpetuity period over a longer period of time than the returns of narrow-moat firms, and both will fade slower than no-moat firms, increasing our estimate of their intrinsic value.

Our model is divided into three distinct stages:

**Stage I: Explicit Forecast**

In this stage, which can last 5 to 10 years, analysts make full financial statement forecasts, including items such as revenue, profit margins, tax rates, changes in working capital accounts, and capital spending. Based on these projections, we calculate earnings before interest, after taxes (EBI) and net new investment (NNI) to derive our annual free cash flow forecast.

**Stage II: Fade**

The second stage of our model is the period it will take the company's return on new invested capital--the return on capital of the next dollar invested (RONIC)--to decline (or rise) to its cost of capital. During the Stage II period, we use a formula to approximate cash flows in lieu of explicitly modeling the income statement, balance sheet, and cash flow statement as we do in Stage I. The length of the second stage depends on the strength of the company's economic moat. We forecast this period to last anywhere from one year (for companies with no economic moat) to 10–15 years or more (for wide-moat companies). During this period, cash flows are forecast using four assumptions: an average growth rate for EBI over the period, a normalized investment rate, average return on new invested capital (RONIC), and the number of years until perpetuity, when excess returns cease. The investment rate and return on new invested capital decline until a perpetuity value is calculated. In the case of firms that do not earn their cost of capital, we assume marginal ROICs rise to the firm's cost of capital (usually attributable to less reinvestment), and we may truncate the second stage.

**Stage III: Perpetuity**

Once a company's marginal ROIC hits its cost of capital, we calculate a continuing value, using a standard perpetuity formula. At perpetuity, we assume that any growth or decline or investment in the business neither creates nor destroys value and that any new investment provides a return in line with estimated WACC.

Because a dollar earned today is worth more than a dollar earned tomorrow, we discount our projections of cash flows in stages I, II, and III to arrive at a total present value of expected future cash flows. Because we are modeling free cash flow to the firm--representing cash available to provide a return to all capital providers--we discount future cash flows using the WACC, which is a weighted average of the costs of equity, debt, and preferred stock (and any other funding sources), using expected future proportionate long-term, market value weights.

**Uncertainty Around That Fair Value Estimate**

Morningstar's uncertainty rating captures a range of likely potential intrinsic values for a company and uses it to assign the margin of safety required before investing, which in turn explicitly drives our stock star rating system. The uncertainty rating represents the analysts' ability to bound the estimated value of the shares in a company around the fair value estimate, based on the characteristics of the business underlying the stock, including operating and financial leverage, sales sensitivity to the overall economy, product concentration, pricing power, and other company-specific factors.

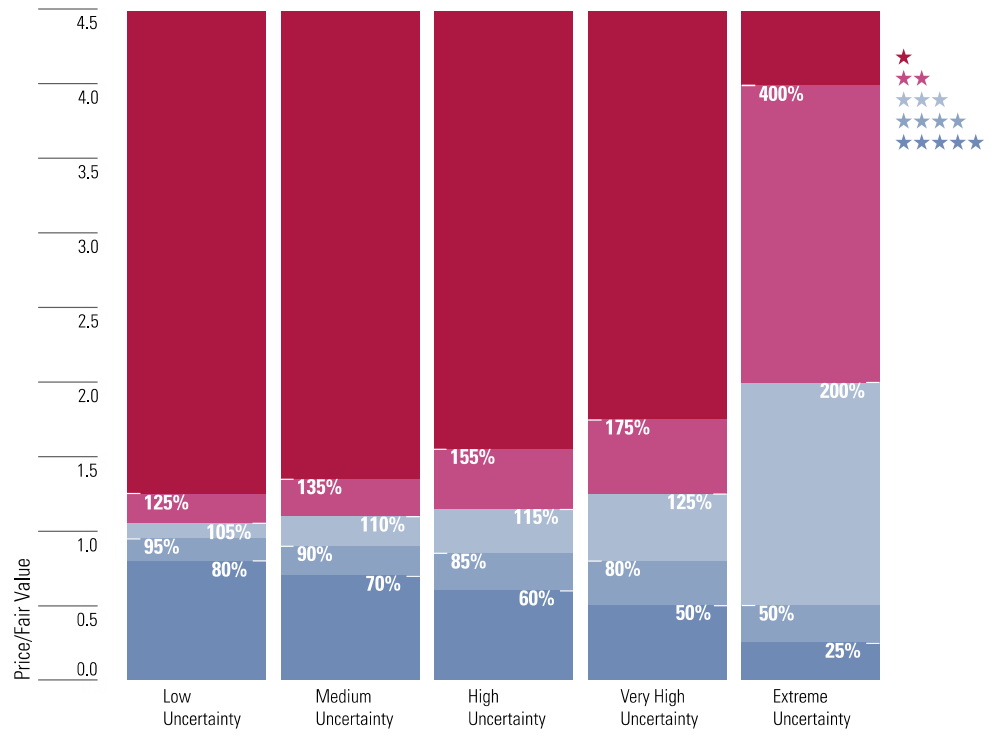
Analysts consider at least two scenarios in addition to their base case: a bull case and a bear case. Assumptions are chosen such that the analyst believes there is a 25% probability that the company will perform better than the bull case and a 25% probability that the company will perform worse than the bear case. The distance between the bull and bear cases is an important indicator of the uncertainty underlying the fair value estimate.

Our recommended margin of safety widens as our uncertainty regarding the estimated value of the equity increases. The more uncertain we are about the estimated value of the equity, the greater the discount we require relative to our estimate of the value of the firm before we would recommend the purchase of the shares. In addition, the uncertainty rating provides guidance in portfolio construction based on risk tolerance.

Our uncertainty ratings for our qualitative analysis are low, medium, high, very high, and extreme.

- ▶ Low: Margin of safety for 5-star rating is a 20% discount and for 1-star rating is a 25% premium.
- ▶ Medium: Margin of safety for 5-star rating is a 30% discount and for 1-star rating is a 35% premium.
- ▶ High: Margin of safety for 5-star rating is a 40% discount and for 1-star rating is a 55% premium.
- ▶ Very high: Margin of safety for 5-star rating is a 50% discount and for 1-star rating is a 75% premium.
- ▶ Extreme: Margin of safety for 5-star rating is a 75% discount and for 1-star rating is a 300% premium.

Morningstar Equity Research Star Rating Methodology



**Market Price**

The market prices used in this analysis and noted in the report come from the exchange on which the stock is listed, which we believe is a reliable source.

For more details about our methodology, please go to <https://shareholders.morningstar.com>.

**Morningstar Star Rating for Stocks**

Once we determine the fair value estimate of a stock, we compare it with the stock's current market price on a daily basis, and the star rating is automatically recalculated at the market close on every day the market on which the stock is listed is open. Our analysts keep close tabs on the companies they follow and, based on thorough and ongoing analysis, raise or lower their fair value estimates as warranted.

Please note, there is no predefined distribution of stars. That is, the percentage of stocks that earn 5 stars can fluctuate daily, so the star ratings, in the aggregate, can serve as a gauge of the broader market's valuation. When there are many 5-star stocks, the stock market as a whole is more undervalued, in our opinion, than when very few companies garner our highest rating.

We expect that if our base-case assumptions are true, the market price will converge on our fair value estimate over time, generally within three years (although it is impossible to predict the exact time frame in which market prices may adjust).

Our star ratings are guideposts to a broad audience, and individuals must consider their own specific investment goals, risk tolerance, tax situation, time horizon, income needs, and complete investment portfolio, among other factors.

The Morningstar Star Ratings for stocks are defined below:

★★★★★ We believe appreciation beyond a fair risk-adjusted return is highly likely over a multiyear time frame. Scenario analysis developed by our analysts indicates that the current market price represents an excessively pessimistic outlook, limiting downside risk and maximizing upside potential.

★★★★ We believe appreciation beyond a fair risk-adjusted return is likely.

★★★ Indicates our belief that investors are likely to receive a fair risk-adjusted return (approximately cost of equity).

★★ We believe investors are likely to receive a less than fair risk-adjusted return.

★ Indicates a high probability of undesirable risk-adjusted returns from the current market price over a multiyear time frame, based on our analysis. Scenario analysis by our analysts indicates that the market is pricing in an excessively optimistic outlook, limiting upside potential and leaving the investor exposed to capital loss.

### **Risk Warning**

Please note that investments in securities are subject to market and other risks, and there is no assurance or guarantee that the intended investment objectives will be achieved. Past performance of a security may or may not be sustained in the future and is no indication of future performance. A security investment return and an investor's principal value will fluctuate so that, when redeemed, an investor's shares may be worth more or less than their original cost. A security's current investment performance may be lower or higher than the investment performance noted within the report. Morningstar's uncertainty rating serves as a useful data point with respect to sensitivity analysis of the assumptions used in our determining a fair value price.

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+1 312 696-6869

equitysupport@morningstar.com



22 West Washington Street  
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