
MEMORANDUM

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TO: Catalyst Investors
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SUBJECT: 2015 Updated Tower Industry Analysis

Table of Contents

Table of Contents	1
Executive Summary	2
Wireless Tower Supply / Demand Dynamics	3
US wireless subscribers base saturated; mature growth globally	3
US smartphone penetration experiencing mature adoption; double-digit growth globally	3
Low tablet growth in short-term; potential upside exists in data plan attach rates and next-generation PC replacements	4
M2M may connections drive some upside; wireless laptops and modems offer limited upside.....	4
Total data usage has exceeded expectations; potential for further upside exists.....	5
Wireless Carrier Market Dynamics.....	6
After recent M&A (and near M&A), 4 US carriers appears status quo for the immediate future.....	6
Carrier Issues: Pricing changes (EIP, data plans), ARPU expansion, LTE capacity	6
Dish, Google and Comcast are more likely to partner with incumbent than become fifth entrant	9
Net Neutrality ruling has the potential to derail carrier capital expenditures.....	10
Voice over Wi-Fi (“VoWi-Fi”) and Voice over LTE (“VoLTE”) Considerations.....	10
3 public tower companies have continued consolidation	11
Alternative Technologies to Macrocell Towers.....	12
DAS and Small Cells	12
Other Alternative Technologies	14
Guide to Broadcast Towers.....	14
Historical Tower Industry Growth and Future Prospects.....	15
Higher than expected growth over past 5 years.....	15
Forward demand is dependent upon carrier expenditures on build-outs to handle the continued increase in data traffic.	16
Catalyst Base Case Growth and Sensitivity	17

Executive Summary

- **US wireless subscriber base saturated:** The estimated number of total US subscribers grew from 270 million in 2008 to 336 million in 2013 (2008-2013 CAGR 4.4%). The total number of US subscribers now exceeds the US population. Catalyst estimates that total subscribers will remain flat over the next 5 years.
- **Data usage has exceeded expectations, potential for further upside exists:** US mobile traffic data increased from 0.5 exabyte (“EB” – an exabyte is equal to 1 billion gigabytes) in 2010 to 6.0EB in 2013 (2010-2013 CAGR of 126%) and is expected to increase to 49.0EB by 2018 (2013-2018 CAGR of 54%). Additional demand could be driven by improved networks, subscriber handset transitions from 2G/3G to 4G and machine-to-machine (“M2M”) / internet of things (“IOT”) growth.
- **4 major carriers is current status quo:** Although the 4 major carriers have acquired all other significant carriers outside of US Cellular, the FCC / DOJ has to date thwarted proposed further consolidation to 3 major carriers. Possible new entrants (Dish, FirstNet) provide additional upside.
- **LTE capacity drives capital expenditures:** After spending the previous 4 years building-out nationwide LTE networks, carriers are focused on adding LTE capacity to support data growth. Analysts estimate this will drive annual capital expenditures of \$32+ billion through 2020.
- **Technology advances and alternative solutions represent risk:** Combination of software defined radios that can broadcast multiples frequencies and VoLTE theoretically reduces the amount of equipment broadband carriers would need on towers. Alternative solutions such as VoWi-Fi, DAS and small cells could reduce the capital expenditures spent on macrocells.
- **Catalyst growth estimates:** We expect organic lease-up growth rates to remain at historical industry averages of 6-8% for the foreseeable future. Future mergers, new industry entrants and/or partners, technology and/or alternative solutions and additional data demand are sensitivities that could affect the growth rate in either direction.
- **Broadcast towers:** Mature growth, but potential for growth following the re-pack of broadcasting caused by the 2016 600 MHz auction. Sunset risk is low for FM and television, AM sunset timeframe is 15-25 years.

Wireless Tower Supply / Demand Dynamics

US wireless subscribers base saturated; mature growth globally

- US: The estimated number of total US subscribers grew from 270 million in 2008 to 336 million in 2013 (a 2008-2013 CAGR 4.4%).¹
 - Total number of US subscribers now exceeds the US population.
 - Macro trends point to device consolidation from a voice perspective given trend toward “Bring your own device” (BYOD) in the workplace.
 - Catalyst estimates that total subscribers will remain flat over the next 5 years.
- Globally: The number of global unique subscribers grew from 2.3 billion in 2008 to 3.6 billion in 2014 (2008-2014 CAGR 7.3%) and is expected to further increase to 4.3 billion by 2020 (2014-2020 CAGR of 3.2%).²

US smartphone penetration experiencing mature adoption; double-digit growth globally

- US: The number of wireless connected smartphones increased from 78 million in 2010 to 175 million in 2013 (2010-2013 CAGR of 31%).³
 - Although estimates vary, the number of smartphones as a percentage of new handset sales has increased significantly over the past 4 years:
 - eMarketer: increased from 22% to 50% from 2010 to 2014; expects a further increase to 64% by 2017.
 - GSMA: increased from 36% to 63% from 2010 to 2014.
 - Nielsen: increased from 34% to 71% from 2010 to 2013.
 - While there is still a modest opportunity for continued smartphone penetration in the US (~5-15%), these smartphone adoption laggards are unlikely to consume the same amount of data as the “average” smartphone user.
- Globally: The number of smartphones as a percentage of new handset sales globally has increased from 12% in 2008 to an estimated 37% in 2014⁴. Catalyst estimates that global smartphone penetration rates will continue to increase and narrow the gap relative to the US market. Key drivers of global smartphone growth include (i) low cost smartphone manufacturers such as China’s Xiaomi and (ii) continued investment in 3G/4G networks by carriers in developing countries.
- Catalyst Assessment: Incremental US smartphone penetration yields minimal upside potential for tower operators. However, as explained in the data usage section below, Catalyst believes there is a significant upgrade opportunity to move existing smartphone users from 2G/3G to LTE-enabled devices with increased data consumption.

¹ CTIA.

² GSMA.

³ CTIA.

⁴ GSMA.

Low tablet growth in short-term; potential upside exists in data plan attach rates and next-generation PC replacements

- US:
 - The US experienced hyper growth from 2010 to 2013 as tablet shipments increased from 10 million to 70 million (2010-2013 CAGR of 89%)⁵ and estimated penetration increased from 6% in 2010 to 40%⁶ in 2013.
 - The tablet growth rate is decelerating as penetration further increased in 2014 and we expect this trend to continue in 2015.
- Globally:
 - Similar to the US, global tablet shipments exploded from 19 million in 2010 to 220 million in 2013 (2010-2013 CAGR of 126%).⁷
 - However, a single-digit CAGR of 5.4% is estimated from 2013 to 2018, with total shipments increasing to 286 million in 2018.
 - Growth from low-cost Android devices is likely higher, as iPad's sales declined from 71 million in FY2013 to 68 million in FY2014.
- Catalyst Assessment: Potential upside for tower operators in two areas:
 - Tablets that have data plans attached are increasing as US carriers reported more new postpaid subscriber plans in the first half of 2014 than they did in all of 2013.⁸
 - Tablet sales could rebound to double-digit growth if next-generation tablets can successfully integrate the mobility of smartphones with the processing power of laptops. For example, high-performance tablets such as Microsoft's Surface could compete for market share with laptops.

M2M may connections drive some upside; wireless laptops and modems offer limited upside

- M2M Connections
 - According to the GSMA, global M2M connections increased from 75 million in 2010 to 195 million in 2013 (38% CAGR).
 - Cisco⁹, which has a higher 2013 connections number than GSMA, estimates global M2M connections will increase from 300 million in 2013 to 2 billion in 2018 (46% CAGR).
 - On the consumer side, it is feasible that carriers could increase ARPU by charging subscribers \$5 to \$20 per month to connect wearables, cars, and other devices to their wireless networks.
- Laptops and Modems
 - The CTIA, which includes wireless connected tablets, laptops and modems in its statistics, reported the number of devices increased from 12 million to 25 million in 2013 (2010-2013 CAGR of 21%).
 - Given the absolute growth of tablet shipments and increased ability to use smartphones as wireless hotspots, Catalyst believes the growth didn't come from connected laptops and modems.

⁵ Nielsen.

⁶ IDC.

⁷ IDC.

⁸ Goldman.

⁹ Cisco reported 300 million global M2M connections vs. GSMA's 195 million in 2013.

- However, improved networks will allow more wireless hotspots created from smartphones to be leveraged and more data could be consumed by laptops connected to hotspots.
- **Catalyst Assessment:** The growing number of global M2M connections could yield upside for wireless tower operators as the incremental connections further tax network capacity and require additional towers and/or equipment; laptops and modems offer limited upside.

Total data usage has exceeded expectations; potential for further upside exists

- US mobile traffic data increased from 0.5 exabytes (“EB” – an exabyte is equal to 1 billion gigabytes) in 2010 to 6.0EB in 2013 (2010-2013 CAGR of 126%); global traffic data increased from 1.0EB in 2010 to 18.0EB in 2013 (2010-2013 CAGR of 162%).¹⁰
 - 3G and 4G networks have expanded data use cases beyond email and simple web surfing to video-based social media like Snapchat and streaming media services like YouTube, Spotify and Netflix.
 - Digital media consumption on mobile devices increased 80% from 2010 to 2013 and, in 2013, passed TV as the most popular consumption medium.¹¹
 - YouTube represents 17% of mobile video traffic; Netflix is currently at 5% of mobile video traffic despite 34% of traffic in wired broadband.
 - 4G-enabled phones multiply data usage over 3G-enabled phones: the chart below shows monthly data usage by device and connection compared to “feature phones.”
 - The average 4G smartphone user consumes ~4x more data than the average 3G smartphone user.¹²

	3G Smartphone	3G Tablet	4G Smartphone	4G Tablet
Usage Increase	49x	127x	184x	223x

- M2M connections shifting from 2G to 3G and 4G provide additional data usage upside as the amount of data that is extracted from each endpoint increases in volume and frequency.
 - **3G** – expected to increase as a percentage of all M2M connections from 28% in 2013 to 51% in 2018.
 - **4G** – expected to increase as a percentage of all M2M connections from 0.5% in 2013 to 14% in 2018.¹³
- US mobile traffic data expected to increase from 6EB in 2013 to 49EB in 2018 (2013-2018 CAGR of 54%); global traffic data forecasted to increase from 18EB in 2013 to 191EB in 2018 (2013-2018 CAGR of 60%).¹⁴
- **Catalyst Assessment:** Although the data volume CAGR is expected to decrease 2.3x from the previous four year period of explosive growth, US estimates remain above a 50% CAGR and Catalyst forecasts additional upside from the following:

¹⁰ Cisco, Strategy Analytics, Goldman, Catalyst. The CTIA reported that mobile traffic increased from 0.4EB in 2010 to 3.2EB in 2013 (CAGR of 102%).

¹¹ eMarketer.

¹² Cisco, Goldman.

¹³ Cisco.

¹⁴ Cisco, Strategy Analytics, Goldman, Catalyst.

- Carriers are still upgrading networks to 4G, so average usage could continue to increase as network reliability and ubiquity improve.
- Approximately 50% of Verizon postpaid customers have yet to transition to 4G enabled devices; other carriers have similar stats.¹⁵
- Use cases that leverage the power of 3G/4G networks to transmit additional data more frequently, which creates ROI for M2M customers that switch from lower cost per connection 2G to higher cost per connection 3G/4G.

Wireless Carrier Market Dynamics

After recent M&A (and near M&A), 4 US carriers appears status quo for the immediate future

- 3 recent deals: More subscribers for “Big 4”:
 - July 2013: AT&T acquired Leap Wireless (added 4.5-5.0 million subscribers).
 - December 2012: Sprint acquired Clearwire (added 9.5-10.0 million subscribers).
 - October 2012: T-Mobile acquired MetroPCS (added 9.0 million subscribers).
- 4 carriers for now: Further consolidation thwarted by FCC / antitrust action (or fear of it)
 - August 2014: Sprint / Softbank announced publicly they declined to bid on T-Mobile due to fears that antitrust regulators would block the deal.
 - December 2011: AT&T withdraws pursuit of T-Mobile after FCC opposed the deal.
- US Landscape:¹⁶ Two dominant powers, two challengers willing to try unconventional methods and US Cellular as a distant fifth player:
 - Verizon – 125 million subscribers
 - AT&T – 119 million subscribers
 - Sprint – 55 million subscribers
 - T-Mobile – 53 million subscribers
 - U.S. Cellular – 5 million subscribers
 - Ntelos – 0.5 million subscribers
 - Cincinnati Bell – 0.2 million subscribers

Carrier Issues: Pricing changes (EIP, data plans), ARPU expansion, LTE capacity

- Pricing plans based on voice and text tiers have shifted to data usage tiers and equipment installment plans (“EIP”).
 - Data Plans: Data usage tiers and faster speeds have boosted broadband ARPU and made up for declines in voice and text revenue.¹⁷
 - According to the CTIA, new monthly ARPU declined from \$52.54 in 2004 to \$46.11 in 2011 before increasing to \$48.79 in 2013.
 - EIP: Subscribers pay for phones over time (24-30 months instead of paying upfront), which allows them to upgrade devices more often and receive a discount on their monthly service plan.
 - In return, the carrier maintains ownership of the phone.
 - This makes churning more difficult as a customer must pay off the remaining balance on the phone in addition to service breakage fee.

¹⁵ Goldman.

¹⁶ As of Q3 2014.

- It also allows carriers the opportunity to recycle the phone, either by selling the phone (often internationally) or reusing with prepaid subscribers.
 - After talking to equity analysts that cover the space, Catalyst's view is:
 - The net of EIP vs. traditional phone subsidies is neutral although it changes working capital and creates revenue and earnings recognition issues that need to be accounted for.
 - Concerns about decline in reported ARPU is overblown as EIP revenue is generally not included in the reported ARPU but the discount on the service plan received by EIP subscribers is included.
 - Percentage of customer base on EIP plans (Verizon ~15-25%, AT&T ~50%, Sprint ~75%, T-Mobile ~85-90%).
- Given wireless leadership position and broadband assets, Verizon and AT&T are able to think about their long-term value creation through ARPU expansion from the convergence of wireless, wired, content distribution and advertising.
 - However, it is important to note that even after the recent AWS-3 auction, Verizon and AT&T increased their collective share of spectrum capacity by just 2% to 38%. This compares to their joint market share of 73%. If capacity utilization of spectrum approaches 100%, these carriers either have to find more spectrum or relinquish a great deal of revenue.¹⁸
- All 4 carriers have largely built their nationwide LTE networks and are focused on increasing capacity and reliability.
- Verizon: Strong customer base, LTE capacity increases, likely building an OTT video service.
 - Strong Subscriber Base: Reputation for network quality has allowed Verizon to build the best brand and attract the highest quality subscriber base.
 - This has largely allowed it to avoid pricing wars and promotions until recently
 - Days after originally announcing it wouldn't match T-Mobile and AT&T data rollover plans, Verizon announced it was cutting data prices \$10 a month on most plans.
 - Current Initiatives: LTE capacity and long-term ARPU expansion.
 - Focused on adding capacity around LTE and expanding XLTE (branding for its 4.5G network) to additional markets.
 - Increasing ARPU through a FiOS branded OTT video service and/or delivery network.
 - Recently acquired Intel's streaming TV unit and EdgeCast (content delivery network).
 - Future: Strong growth prospects in the near-term, biggest challenges long-term are not in its control (e.g., net neutrality); positioning against AT&T in the coverage of wired, wireless and content; and running out of spectrum capacity.
- AT&T: Strong #2 behind Verizon, LTE capacity increases, early leader in convergence of wired, wireless and content.
 - Subscriber Base: Stronger than Sprint and T-Mobile but some weaknesses apparent.
 - Postpaid customers are more value-oriented than Verizon, so it needs to monitor Sprint and T-Mobile pricing carefully.
 - Continues to lose prepaid subscribers acquired from Leap Wireless.

¹⁸ New Street analyst Jonathan Chaplin.

- Unclear if this is intentional or not as they have instituted a number of policies that angered Leap subscribers.
 - Network Developments: LTE capacity in dense markets.
 - Acquired most spectrum in recent AWS-3 auction including New York, Chicago, Orange County, Dallas, D.C., San Francisco, Boston, Houston, etc.
 - Current Initiatives: Adding content and advertising to wired and wireless assets.
 - DIRECTV acquisition will accelerate AT&T U-verse's plan to compete with cable providers.
 - Joint venture with the Chermin Group will continue to invest in OTT based advertising, video and supporting services.
- Sprint: Network upgrades, price cuts and a new CEO.
 - Network Developments: Improvement, deployment and decision point on 2.5 GHz.
 - Over past 2 years, Sprint has largely finished "rip and replace" of 3G network, added LTE for ~120 million POPs and sunset its 2G iDEN network.
 - Will either ramp development or sell / lease 2.5 GHz.
 - Softbank's property in Japan (Vodafone K.K.) uses 2.5 GHz and network speeds are several times faster than Verizon and AT&T.
 - Softbank has imported 200 engineers from Japan to help Sprint design the new network.
 - Post AWS-3 auction, reports surfaced that Sprint is considering selling or lease its 2.5 GHz spectrum to Verizon.
 - New Low-Cost Leader: Aggressive prices and promotions have made Sprint the low cost leader over T-Mobile.
 - Initiatives will hurt ARPU throughout 2015, it's unclear if it will help add new subscribers or just re-price the existing customer base.
 - Subscriber Base: It has the highest smartphone penetration, which limits upgrade potential.
 - New CEO: Marcelo Claure joined as part of Softbank's acquisition of BrightStar, a phone distributor in emerging countries.
 - It's believed that Sprint will leverage his experience and BrightStar to profit from returned phones from EIP plans.
 - Future: Unclear given debt load and cash burn although Softbank and Masayoshi Son's ambitions make it unlikely that it will fail in the near-term.
- T-Mobile: Momentum in subscriber adds, network improvement, seen as most likely partner for new entrants.
 - Subscriber Adds: Added 6.2 million subscribers over first 3 quarters of 2014 (3.6m postpaid, 1.0m prepaid and 1.6m through resellers / wholesale).
 - However, growth of postpaid primarily from Sprint and converting prepaid to postpaid customers, not through taking subscribers from Verizon or AT&T.
 - Net postpaid additions expected to be slow in 2015 as Sprint has fought back with price cuts of its own.
 - Network Development: Modernized network and covered 250 POPs with LTE availability over past 2 years.
 - Currently adding additional LTE capacity through "widebands" and 700 MHz.
 - Partner: Seen as most likely partner for new industry participants due to Deutsche Telekom's desire to exit stake.
 - Besides abandoned AT&T and Sprint mergers, also received low-ball offer from French carrier Lliad.

- Future: Has to make decision if it wants to be a standalone carrier. If so, it must decide whether to focus on its niche of price sensitive customers or attack leaders Verizon and AT&T directly.

Dish, Google and Comcast are more likely to partner with incumbent than become fifth entrant

- Dish: Spectrum holdings¹⁹ present wide range of opportunities; build requirements on previously acquired spectrum indicates fulcrum is near.
 - Sell: Combination of spectrum, video subscriber base and new OTT service make Dish an attractive acquisition target to Verizon.
 - Middle: Lease spectrum to Verizon, AT&T or T-Mobile.
 - Offensive: Partner with T-Mobile and/or Google to build out spectrum and effectively become an independent carrier.
 - Catalyst Assessment: Unless Verizon puts forth an attractive offer or Deutsche Telekom or Softbank offer a sweetheart deal, we see Dish most likely pursuing the middle route whereby they lease spectrum to the large incumbents.
- Google: MVNO, Google Fiber offers opportunity to disrupt status quo and test waters
 - Recently announced plans to operate as a Mobile Virtual Network Operator (“**MVNO**”) referred to as Novo that switches between Sprint and T-Mobile based on which connectivity is stronger.
 - Implications are potentially that Sprint and T-Mobile would “real-time bid” for service and Google could drive down prices.
 - Google could also subsidize beyond phones and into service, making up the difference on search and advertising.
 - Google Fiber, which is 10-20 times faster than average cable broadband, is currently in Kansas City, Austin and Provo with recently announced plans to add Atlanta, Charlotte, Raleigh-Durham and Nashville.
 - Besides wired broadband service, Google is also testing a TV package.
 - Catalyst Assessment: While Novo and Google Fiber have potential on their own, these initiatives are aimed at protecting search, YouTube and Android’s place in the internet and mobile ecosystems.
- Comcast: Unlikely to build network or buy a carrier, but holds leverage with broadband network assets, MVNO optionality and in cable Wi-Fi alliance.
 - If approved, Comcast and Time Warner Cable (after required divestitures) would have 32% of the US wired broadband subscribers, which is more than AT&T (18%) and Verizon (10%) combined.²⁰
 - Comcast has installed more than eight million wireless Internet routers in private homes that could serve as public hotspots.²¹
 - Launched a program in 2013 to “create millions of Wi-Fi access points” by adding an “xfinityWi-Fi” service set identifier (“**SSID**”) to each Xfinity router.
 - This allows any Comcast customer to get online by logging into a hotspot with their Comcast username and password.
 - Comcast has access to additional public Wi-Fi spots through Cable Wi-Fi alliance with Brighthouse, Cox and Optimum.
 - Total public Wi-Fi hotspots available are ~300,000 (and growing).
 - Until August 2016, Comcast has the option to buy wholesale data and minutes from Verizon stemming from the terms of its spectrum sale to Verizon in 2012.

¹⁹ Including those held and controlled by partners SNR and NorthStar.

²⁰ FCC, ReCode

²¹ Goldman

- Catalyst Assessment: Most likely will use assets above to protect wired broadband, cable TV and video content properties, not build a wireless network or buy a carrier.
- FirstNet: Should be funded shortly, impact on tower operators positive but not game-changing.
 - Funded: Will have \$7 billion to spend once cash is collected from the AWS-3 auction as well as 20 MHz of 700 GHz band spectrum.
 - Process to build-out: Complicated and allows states to (i) opt-in fully, (ii) opt-in partially and build their RAN based on FirstNet core, or (iii) opt-out entirely.
 - Timeline appears to be further complicated by bureaucratic management structure (e.g., 15 members on the board of directors).
 - Impact: Total spend is to be determined based on whether individual states contribute, but even at \$15 billion (which is \$8 billion more than initial funding plan) over 5 years, this is an attractive program for the tower industry but not game-changing.

Net Neutrality ruling has the potential to derail carrier capital expenditures

- Situation: Upcoming decision on Net Neutrality will include wireless broadband providers and hamper the industry.
 - The rules are expected to limit flexibility of carriers through increased regulation and resulting “red tape.”
 - Ultimately, Furchtgott-Roth believes this would be a negative for the industry as it would likely prompt price increases to consumers and lower appetite for carriers to invest in innovation.
- Capital Expenditures Impact: Carriers will continue to invest, but at a much slower pace.
 - Instead of increasing LTE capacity and developing new technologies, carriers will shift focus to optimizing existing network with software.
 - End-result is instead of upgrading equipment on cell towers every 3 years, carriers will upgrade every 5-6 years.
- Timeline: March or April 2015 unveiling of the new rules, followed by 2+ year court process
 - Harold Furchtgott-Roth believes there is a 50/50 chance of the new rules being accepted by the courts.

Voice over Wi-Fi (“VoWi-Fi”) and Voice over LTE (“VoLTE”) Considerations

- VoWi-Fi: Potential to alleviate capacity, but challenges will prevent carriers from relying on it to replace macrocell²² capital expenditures.
 - Gartner estimates worldwide carrier-sponsored Wi-Fi hotspots shipments:
 - Grew from 1,102,500 in 2011 to 4,075,054 in 2014 (2011-2014 CAGR of 55%)
 - Estimated to grow from 4,075,054 in 2014 to 4,997,038 in 2017 (2014-2017 CAGR of 7%)
 - Strength: In buildings, homes and other areas where the subscriber is static; however, carriers are leery of being dependent on Wi-Fi signals because they sometimes don’t have control of the connection and the subscribers will blame them if there are performance issues.
 - Weakness: When the subscriber is moving, handoff between the initial Wi-Fi network and 3G / LTE or another Wi-Fi network is likely to result in service interruptions for the customer.

²² Macrocell is used interchangeably with towers for the rest of the report.

- Catalyst Assessment: While VoWi-Fi will help alleviate network congestion in some instances, it will not replace macrocells as the backbone of coverage in cities or rural areas due to problems around reliability and scalability.
- VoLTE: Concerns about an eventual shift to a single antenna for LTE are warranted, but the process is long and ultimately assumes that 5G will work on 4G equipment.
 - Current Challenge: While VoLTE is operable, the current challenge for carriers currently is getting enough smartphones that have the usage capacity to make it feasible / cost effective.
 - Future Challenges
 - Sun-setting the 2G/3G networks will be a long and drawn-out process.
 - LTE capacity and reliability will have to increase significantly because customers expect fast voice service and ubiquitous coverage.
 - Carriers will need to gradually transition subscribers so as to mitigate churn risk from forcing an upgrade.
 - Example: AT&T with M2M customers and acquired Leap subscribers.
 - LTE on different frequencies can be combined onto one antenna but according to Crown Castle CEO Ben Moreland, *"it typically has been sub-optimal, depending upon which frequency you are talking about."*²³
 - Recently acquired AWS-3 spectrum will likely need new equipment, even on towers that currently have LTE.
 - Whenever 5G arrives, it would ultimately have to work with the same equipment as LTE.
 - Catalyst Assessment: Given the numerous challenges, it's hard to envision VoLTE enabling a single antenna of LTE coverage that would materially impact tower lease-up rates over the next 5 years²⁴. However, there is moderate risk over the next 5-10 year period.

3 public tower companies have continued consolidation

- American Tower: Active M&A domestically and internationally, highest organic growth.
 - Recent M&A: Verizon (11,489 towers), Global Tower (5,400), TIM Cellular (6,480, Brazil) and Bharti Airtel tower portfolios (4,800, Nigeria and Brazil).
 - \$4.8 billion Global Tower portfolio acquisition in September 2013 added 5,400 towers and \$5.0 billion Verizon deal in February 2015 increased domestic portfolio to ~40,000 towers.
 - Global Tower portfolio averaged 2 tenants per site, while the rest of the domestic towers average 2.6 tenants per site, so lease-up opportunities exist.
- Crown Castle: Carrier-driven M&A, lowest international concentration, largest DAS business.
 - Recent M&A: T-Mobile (7,100) and AT&T (9,700) tower portfolios push domestic tower count to ~40,000 towers.
 - Significant lease-up opportunity exists given only 1.6 tenants per site.
 - DAS, which represents 6% of site rental revenue or ~\$220 million, is growing 25% YOY.
 - Only 5% of revenue is international
- SBA Communications: Less frequent and significant²⁵ M&A, aggressive capital structure.
 - Recent M&A: Focused on Brazil and Panama.

²³ FierceWireless.

²⁴ However, we still ran a sensitivity case around it.

²⁵ Defined as greater than \$500 million.

- 16% percent of revenue outside of US.
- 16,000 domestic tower portfolio, which represents only 40% of American Tower and 40% of Crown Castle's total portfolio size, respectively.
- High leverage (8.0x debt / EBITDA) and no dividend

Alternative Technologies to Macrocell Towers

DAS and Small Cells

- Distributed Antenna Systems ("DAS"): Collections of spatially separated antennas connected to a base source via a transport medium (i.e. wire) that provides wireless voice and data in an events center, hotel or stadium.
 - Strengths:
 - Provides voice coverage in areas that have weak macrocell connections.
 - Can distribute multiple cellular frequencies to serve more than one carrier.
 - Weaknesses:
 - Expensive (\$25,000+ per system) and time consuming to install.
 - Doesn't enhance network capacity as well as small cells.
 - Only ~2% of buildings are structured to be able to support them due to requirements around cooling, power and internet connection.
- Small Cells: Encompasses femtocells, picocells, and microcells, which are low-powered base stations that have a range of 10 meters to 2 kilometers compared to macrocells, which have a range of a few hundred kilometers.
 - Types of Small Cells:
 - Femtocells: Used in homes, small businesses or retail locations; range of 10 meters.
 - Picocells: Used in buildings such as offices, shopping centers or train stations; range of 200 meters.
 - Microcells: similar use case to Picocells; range of 2 kilometers.
 - Strengths:
 - Better at supporting network capacity than DAS.
 - Can be deployed without special HVAC, power facilities or T1 internet connection.
 - Lower cost (\$500-4,000) base stations than DAS.
 - Weaknesses:
 - Provides weaker voice coverage as compared to DAS.
 - Larger buildings or coverage areas that require more than one small cell as interference between the small cells is common.
 - Each cell only distributes one frequency, meaning 4 cells are needed to serve each carrier (which also creates interference).
- Historical and Future Growth Estimates:
 - DAS
 - Today:
 - Crown Castle DAS²⁶ revenue grew 25% YOY in 2014 to ~\$220 million.
 - Revenue from equipment and deployments was \$4.3 billion globally and \$2.8 billion in North America in 2014.

²⁶ Crown Castle DAS business was formed from acquiring NG Networks in 2012 for \$1 billion.

- Forecast: Revenue for equipment and deployments is expected to increase to \$8.2 billion in 2019 (2014-2019 CAGR of 14%).²⁷
 - North American CAGR expected to be ~9-10% (balanced by Asia's expected 25% CAGR).
 - Small Cells
 - Today:
 - Gartner estimated that annual worldwide 3G and LTE shipments of equipment from 2011 to 2014 increased from 170,000 to 590,000 (2011-2014 CAGR of 51%).²⁸
 - PCIA estimated the number of femtocells deployed in 2013 was 2.5 million.
 - Enterprise small cell revenue (assumed to be equipment and deployment) was \$432 million in 2014.²⁹
 - Forecasts:
 - Gartner estimated that annual worldwide 3G and LTE shipments of equipment from 2014 to 2017 will increase from 590,000 to 2,350,000 (2014-2017 CAGR of 51%).
 - PCIA estimates that the number of femtocells will increase to 54 million by 2018 (2013-2018 CAGR of 85%).
 - Enterprise small cell revenue expected to increase to \$3 billion in 2019 (2014-2019 42% CAGR).³⁰
- Catalyst Assessment: A combination of DAS and small cells will continue to supplement macrocell coverage and capacity in buildings, but technology and/or economics have to improve to replace macrocells for outdoor coverage.
 - Indoor: The combination of LTE, which runs on higher frequencies, and the increase of LED certified buildings has increased the challenges of delivering quality coverage and capacity service in buildings by macrocells. We expect DAS and small cells to continue to be leveraged to increase capabilities in these structures.
 - This is important to carriers because the vast majority of data traffic (70-90%) is indoors and 30% of in-office employee calls are made on mobile devices.³¹
 - Outdoor: Performance to cost ratio doesn't equal macrocells.
 - DAS: Cost-prohibitive and difficult to install as a solution beyond stadiums or fairgrounds.
 - Small Cells: Combination of limited range and interference issues make its use as an alternative to macrocells difficult.
 - Outdoor small cells work best in dense locations with high traffic concentration; however, rents in Long Island and Orange County are nearly \$400 a month for a coverage area that is 10-20x smaller than a macrocell.³²

²⁷ ABI Research.

²⁸ At the end of 2014, the estimated total worldwide installed base was 1,274,000.

²⁹ ABI Research, AGL Magazine.

³⁰ ABI Research, AGL Magazine.

³¹ Gartner.

³² AGL Magazine. This doesn't include other costs like power, backhaul and propagation.

Other Alternative Technologies

- Satellite: Even with technology advances (both over the past 5 years and expected over the next 5-10 years), latency and coverage issues still make it hard to envision satellite being a real alternative to macrocells.
- Mesh Networks: Scalability and security concerns, along with subscriber dynamics around sharing capacity, limit ability to be nationwide alternative to current system.
- Google/SpaceX Balloons: Too early to project both technology execution and commercial viability of project.

Guide to Broadcast Towers

- General Overview: Instead of enabling wireless broadband service, broadcast towers enable television, FM and AM radio service.
 - Large towers, more equipment: Towers are large (600-1,500 feet) and tenants have \$3-5 million of equipment on each tower.
 - Less tenants, more cash flow per tower: Compared to broadband, less tenants per site but higher cash flow as leases run from \$2,000 to \$20,000+ per month.
 - Leases structure: Generally 15 year non-cancelable contracts with no outs and structured as triple-net, meaning broadcaster pays all operating costs, taxes and insurance.
 - New tower development: Very few new broadcast towers were built after a boom during the digital conversion in the early 2000s because of the size and the need to be located close to population centers, making real estate costs prohibitive.
 - More common are retrofits to add capacity.
 - A small amount of new FM towers are still being built.
 - Lease-up prospects: Opportunities exist for television and FM.
 - Upcoming 600 MHz auction will be a catalyst for tower operators as they will be able to obtain lease amendments from broadcasters transitioning from 40-50 band to 0-40 bands.
 - Expected that very few stations will turn off completely as FCC is paying for this transition.
 - The television transition to mobile (which will require horizontal and vertical bands) will require additional equipment upgrades because signals are currently configured only on a horizontal band.
 - FM sites can support broadband offsite backhaul service.
 - Sunset and cyclical: Only concerned about AM.
 - Potential for AM sunset does not exist in 15-25 years.
 - However, AM towers are more likely to have some broadband customers as tenants.
 - For television, if stations are broadcasting, the law mandates they must be picked up by cable / satellite providers enabling content distribution.
 - Boom and bust cyclical of broadcasters doesn't affect tower operators, as paying rent to broadcast is the first expense paid (effectively debt).
- Valuation, M&A, etc.: While broadcast towers trade at a discount because they lack the growth profile of broadband towers, they still have many of the same qualities that make broadband towers attractive, and offer arbitrage and consolidation opportunities.
 - Multiples / Recent M&A:
 - American Tower / Richland Towers: 50 towers, \$385 million, \$30.5 million TCF, 12.8x EV / TCF.

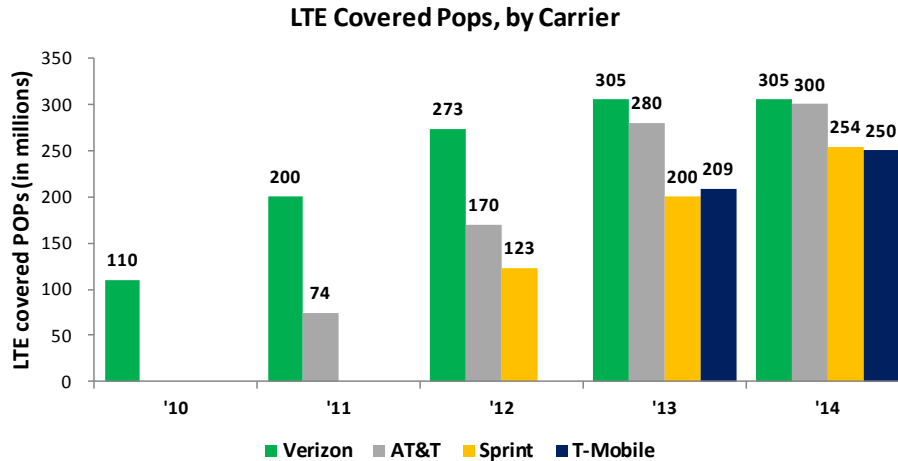
- Vertical Bridge / iHeartMedia: 411 towers, \$400 million, \$30.0 million TCF, 13.1x EV / TCF.
- Credit Rating: Credit agencies don't distinguish between broadcast and broadband towers.
- Securitization: Prior to its sale, Richland Towers was able to get 8x leverage on securitization because of the non-cancelable 15 year contracts.
- Arbitrage: Since buying Richland, American Towers has received arbitrage expansion on the broadcast towers as it has been rolled into broader portfolio.
- Consolidation: Majority of broadcast towers are still owned by broadcasters so there is potential for additional broadcast M&A.

Historical Tower Industry Growth and Future Prospects

Higher than expected growth over past 5 years

- Historical Cell Sites: According to the CTIA, commercial operational cell sites have increased from 242,130 in 2008 to 304,360 in 2013 (CAGR of 4.7%).
 - This exceeded Catalyst's 2010 "High Growth" case of a 5-year 2.5% CAGR.
 - The growth was concentrated in 2010-2012:
 - 2008-2010: 242,130 to 253,086 (1.2% CAGR).
 - 2010-2012: 253,086 to 301,779 (9.2% CAGR); the bulk of the LTE network build-outs occurred.
 - 2012-2013: 301,779 to 304,360 (0.9% YOY growth).
 - RBC, which didn't report absolute number of cell sites in its report, estimated the number of net new cell sites from 2007-2015. These numbers don't tie to the CTIA reports, but provided a different estimate of the recent growth profile.
 - New Cell Sites: 2007 (16.1K), 2008 (19.7K), 2009 (20.9K), 2010 (21.3K), 2011 (17.9K), 2012 (16.8k), 2013 (21.9k), 2014 (22.3K).
- Historical Capital Expenditures: Although sources differ slightly, 2010-2014 annual carrier capital expenditures have been above \$25 billion per year.
 - CTIA: 2010 (\$24.9B), 2011 (\$25.3B), 2012 (\$30.1B), 2013 (\$33.1B).
 - Goldman: 2010 (\$26.3B), 2011 (\$26.2B), 2012 (\$29.8B), 2013 (\$32.6B), 2014 (\$33.5B).
 - CapEx to Organic Lease-up Relationship: American Tower CEO James Taiclet, *"From 2010 to 2012, we saw aggregate spend on wireless CapEx of about \$25B to \$30B, supporting our organic core growth rates in the range of 7-8%. Beginning in 2013, we then saw wireless CapEx spending ramp-up to nearly \$35B a year and have experienced elevated levels of organic leasing growth beyond our target range in the area of 9%."*³³
- Historical Organic Lease-up Growth: Recent domestic organic same-tower growth (includes churn) revenue above historical average of 6% to 8% (inclusive of ~3% annual escalator).
- Catalyst Assessment: Carrier capital expenditures and tower lease-up growth since 2010 has been driven by the 4 carriers expanding their LTE network coverage to become nationwide, which now covers 80%-97% of the population as seen in the chart below.
 - Given propensity to upgrade and add additional equipment on existing towers, capital expenditures better tie to organic growth than net new cell sites.

³³ Goldman.



Forward demand is dependent upon carrier expenditures on build-outs to handle the continued increase in data traffic.

- **Nationwide LTE Capacity:** Despite nationwide coverage, the capacity and reliability of LTE networks is constantly challenged, especially in high density areas. This will continue to require carrier expenditures and strong tower lease-up rates over the 3-4 years.
 - **Verizon:** LTE network built on low band 700 MHz; expected to increase capacity through AWS-1 bands.
 - **AT&T:** LTE network built on low band 700 MHz; expected to increase capacity through AWS-1, WCS and additional 700 MHz bands.
 - **Sprint:** Increasing capacity by upgrading network to support multiple bands (800 MHz, 1900 MHz and 2.5GHz) and adding CDMA voice over 800 MHz; long-term focus on 2.5GHz.
 - **T-Mobile:** Increasing LTE capacity by upgrading major markets with “wideband” spectrum holdings.
- **4.5G and 5G Future:** Verizon has XLTE in US; South Korea is trial testing 5G.
 - Guidance on timeline of new technologies has been unclear, but:
 - Verizon has XLTE in over 100 markets.
 - South Korea has started trial testing 5G; Japan is expected to start soon.
- **New / Unused Spectrum will require build-outs over the next 10 years:**
 - **Dish:** Portion of existing spectrum (700 MHz, AWS-2) needs to be built or returned to FCC by 2020.
 - **AWS-3:** Will require equipment upgrades at sites; AT&T, Verizon and T-Mobile (\$29.4 billion) expected to build out in relatively short order; Dish and partners³⁴ (\$13B) is a wild card.
 - **Broadcast:** Broadcasters have option to sell 600 MHz band in 2016 auction; widespread participation expected given AWS-3 prices.
 - **FirstNet:** Government initiative using 20MHz in 700 MHz band to build nationwide public safety network.
 - **Globalstar, Lightsquared:** 22 MHz of 2.4 GHz band and 20 MHz in the L band.

³⁴ SNR and Northstar control the spectrum acquired in the AWS-3 auction.

- Goldman Quote: “Deployment of unused and soon to be auctioned spectrum bands should keep carriers busy for most of the next decade.”
- New Cell Sites: Increase of 90,000 cell sites between 2013 and 2018 to 405,000 cell sites (implies a 2013-2018 CAGR of 5.5%).³⁵
 - Forward CAGR is higher than CTIA’s reported CAGR of 4.7% from 2008-2013.
 - Spread over 5 years, this implies approximately 18,000 new sites per year.
 - This CAGR doesn’t include growth from equipment upgrades at existing cell sites.
- Capital Expenditure Predictions: Goldman expects annual capital expenditures to average ~\$32.8 billion until 2020. PCIA estimates an annual average of ~\$35.2 billion for 2015-2017.
 - Goldman Estimates: 2015 (\$32.6B), 2016 (\$32.4B), 2017 (\$32.6B), 2018 (\$32.7B), 2019 (\$33.2B), 2020 (\$33.7B).
 - PCIA Estimates: 2015 (\$35.0B), 2016 (\$35.0B), 2017 (\$35.6B).

Catalyst Base Case Growth and Sensitivity

- Base Case Growth Rate: Based on the capital expenditure predictions above, Catalyst estimates that the organic lease-up growth rate will remain at historical industry averages of 6-8%. For conservatism, we are using 6% in sensitivities.
- Sensitivities:
 - Changes are calculated off of Goldman’s ~\$32.8 billion capital expenditures prediction and Catalyst’s 6% organic growth rate estimate.
 - Sprint and T-Mobile Merge: Due to overlap, projected capital expenditures for both (1/3 or ~\$11B of total capital expenditures) estimated to be cut 50% per year.³⁶
 - Results in a 1.0% decrease in growth rate to 5.0%.
 - Net Neutrality rule harsher than expected: Results in a decreased investment appetite and total projected capital expenditures to decrease 20% or ~\$6.6 billion per year.
 - Results in a 1.2% decrease in growth rate to 4.8%.
 - Small Cells take greater share than expected: Small Cells capture a greater than anticipated share of capital expenditures, resulting in a 10% decrease in total capital expenditures or ~\$3.3 billion per year.³⁷
 - Results in a 0.6% decrease in growth rate to 5.4%.
 - Single antenna VoLTE decrease requirements: All necessary steps occur for carriers to transition to single antenna LTE that broadcast multiple frequencies, equating to a 30% decrease in total capital expenditures or ~\$10.0 billion per year.
 - Results in a 1.8% decrease in growth rate to 4.2%.
 - FirstNet raises \$15 billion instead of \$7 billion: Increases carrier capital expenditures ~\$1.1 billion per year.
 - Results in 0.2% increase in growth rate or 6.2%.
 - Dish partners with T-Mobile: Due to increased resources, T-Mobile increases projected capital expenditures 50% (increase ~\$4.8 billion to ~\$7.2 billion per year).
 - Results in 0.4% increase in growth rate or 6.4%.

³⁵ Marc Ganzi, AGL Magazine December 2014.

³⁶ This assumption is probably high in the short term as they don’t have much overlapping spectrum / technologies.

³⁷ In this sensitivity, spend would actually begin shifting from macrocells to small cells. Unfortunately, we don’t have an estimate on small percent of capital expenditures for US carriers, so we have to back into the figure by decreasing total capital expenditures (which is the variable tied to our growth rate estimate).

- Data growth higher than expected: Data growth continues to exceed expectations and most carriers make additional investments to reflect demand growth. This causes a 25% increase in total capital expenditures or ~\$8.2 billion per year.
 - Results in 1.8% increase in growth rate or 7.8%.