

DISH Network Corporation (DISH)

Calling Charlie's Bluff

In our previous reports on [Globalstar](#) and [Straight Path](#), we challenged the market's complacent belief that spectrum prices can only go up and that wireless carriers have a desperate, boundless need for ever more megahertz. The most influential promoter of this bogus notion – with tens of billions of dollars riding on its veracity – is DISH Network. Since 2008, DISH has accumulated a massive portfolio of spectrum licenses and convinced investors that, any day now, it would unveil a brilliant strategy to extract value from these assets, even as evidence mounted that no major counterparty was interested in paying DISH's price.

Now, with an imminent new spectrum auction promising to drastically reduce benchmark price expectations, DISH is in the weakest position it's been in for years: sitting on a warehouse full of overpriced inventory, devoid of interested customers, and – with regulatory deadlines looming – running out of time. Meanwhile, DISH's core pay-TV business is likewise entering dire straits, with declining subscribers, strengthened competitors, and obvious secular problems only beginning to manifest. Overall, we believe that the fair value of DISH's equity is 58% lower than the current stock price – and, in a reasonable downside scenario, more than 80% lower.

Scrappy and entrepreneurial, DISH has always prided itself on its willingness to take outsized risks; as its founder, chairman, and CEO Charlie Ergen – a former [professional gambler](#) – said in 2005, “*I like to bet a few hands and bet them big.*” After achieving great success building the second-largest satellite-TV operator in the US, DISH has watched its earnings flatline for a decade, a victim of consumers' growing array of entertainment choices and the rising importance of broadband internet connections, which cable and phone companies can offer but DISH largely cannot. Casting about for a way out of this strategic morass, DISH hit upon wireless spectrum.

Initially focused on the concept of a mobile TV service, DISH's spectrum ambitions have become grander yet vaguer over time, with empty talk of “multiple options” taking the place of a concrete plan. But as DISH has continued to bet big on this single hand – culminating in its widely criticized hijacking of the previous AWS-3 spectrum auction, which earned it the ire of the FCC, Congress, and the wireless industry – it hasn't noticed that the other players have stepped away from the game. Already armed with large reserves of un- and under-utilized spectrum, combined with better options for cheap capacity enhancement in congested areas, major carriers like AT&T and Verizon now gain less and less from incremental bandwidth – a simple case of diminishing marginal returns. DISH may put on a show of confidence, but carriers are calling its bluff, and DISH shareholders will learn that sometimes, when you bet big, you lose.

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I. Investment Highlights

DISH Network: Consensus Valuation vs. Kerrisdale View			
	Market consensus	Kerrisdale	
		Base	Adverse
Pay-TV enterprise value	\$ 15,000	\$ 15,000	\$ 15,000
Less: net debt*	11,381	11,381	11,381
Pay-TV equity value	\$ 3,619	\$ 3,619	\$ 3,619
Spectrum value†	18,497	5,646	118
Total equity fair value	\$ 22,117	\$ 9,266	\$ 3,737
Equity FV per share	\$ 48	\$ 20	\$ 8
Equity downside		(58)%	(83)%

Source: company filings, sell-side reports, Kerrisdale analysis
 *Long-term debt and capital lease obligations net of cash and marketable investment securities.
 †Incorporates (1) cost of AWS-3 auction penalty based on difference between DISH's original bids and our estimate of the fair value of the spectrum in question, (2) estimated minimum cost of meeting the AWS-4 performance requirements by March 7, 2020, and (3) present value of designated-entity put price.

Carriers have plenty of spectrum already. DISH bulls generally buy into the notion that spectrum is extraordinarily scarce and cellular data consumption is relentlessly skyrocketing. However, even if these beliefs were true, it would not necessarily imply that spectrum *prices* should be high and rising. After all, the revenue generated by using that spectrum to provide wireless service grew relatively slowly for years, declined in 2014 for the first time ever,¹ and declined again in 2015.² Fierce competition has kept a lid on what users pay, while better devices have increased the scope of the demands they place on networks. Thus it might take twice as much spectrum to satisfy a \$60-per-month customer today as it did a few years ago – implying that that the profitability of a fixed unit of spectrum is *falling*, not rising. It takes more input to produce the same economic output, so the input is worth less.

Moreover, the scarcity of spectrum is vastly overstated. Consider, for instance, Verizon – the largest carrier in the US and the most frequently rumored counterparty for DISH. As of the first quarter of 2016, the vast majority of Verizon's data traffic (92%³) ran over its LTE network. But though Verizon holds, on average, 114 MHz of spectrum nationwide, its LTE network uses only

¹ Source: CTIA 2014 [Annual Wireless Industry Survey](#), [FierceWireless](#).

² Source: Kerrisdale analysis of Verizon, AT&T, T-Mobile, and Sprint wireless-segment service revenues.

³ Source: Verizon [2016 Q1 earnings release](#).

half that.⁴ The rest of the spectrum is either totally unused (newly purchased AWS-3 spectrum) or still largely devoted to inefficient legacy technologies like CDMA. Over time – indeed, more quickly than previously expected given the rapid uptake of LTE-capable devices – this under-utilized spectrum will be deployed for LTE, effectively doubling the amount of traffic Verizon can handle. A similar story is unfolding for the other carriers as well. As T-Mobile’s chief technology officer put it,⁵

But probably, the biggest thing to think about is – [let me] do rough math for you. Half our network – just over half our network today is LTE, in terms of the spectrum that we own. So half our spectrum is on the LTE technology. And that covers almost 90% of our data....So when you look at the other half of the spectrum and what it's doing, it's not doing that much.

Meanwhile, AT&T, for its part, is beginning to roll out 40 MHz of virgin LTE spectrum nationwide – approximately doubling its capacity even before taking into account its large reserve of under-utilized spectrum, which it’s also gradually shifting to LTE (a process sometimes called “refarming”).

Verizon & AT&T's Spectrum Holdings: Large Stores of Untapped Potential		
	Verizon	AT&T
<i>(Pop.-weighted average bandwidth in MHz)</i>		
Major LTE bands in use:		
700 MHz	22	22
AWS-1	35	15
Subtotal	57	37
Un/under-utilized bands:		
700 MHz (D/E blocks)	-	7
Cellular	25	23
PCS	21	38
WCS	-	20
AWS-3	11	20
Subtotal	57	109
<i>As % of LTE bands</i>	<i>101%</i>	<i>296%</i>
Source: FCC 18th Mobile Wireless Competition Report , Kerrisdale analysis		

But more spectrum is certainly not the only way for mobile operators to increase capacity. New generations of technology are also more *spectrally efficient* – that is, they can transmit greater

⁴ See e.g. Verizon’s comments at the UBS Annual Global Media and Communication Conference, December 7, 2015: “And if you look at it today, we only use 40% of our spectrum for LTE.”

⁵ Source: Capital IQ transcript of T-Mobile 2016 Q1 earnings call, April 26, 2016.

quantities of data using the same exact bandwidth. (One approach, called higher-order MIMO, is to increase the number of coordinated antennas serving a given cell.) In a [report](#) prepared for Ofcom, the British equivalent of the FCC, the telecom consultancy Analysys Mason estimated that, thanks to better technology, LTE spectral efficiency would approximately double over the next five years, thereby doubling network capacity without requiring any new spectrum.

All this fails to even consider the most important way that networks have added capacity in the past: more cell sites. Indeed, American Tower, one of the nation's largest tower companies, has estimated that, over the last few years, only 20-30% of the gains in cellular capacity have come from more spectrum and higher spectral efficiency, while all the rest has come from new cell sites and more radio equipment.⁶ While putting up new, full-fledged towers is difficult in some locations, carriers today can be surgical, deploying sites only where needed to relieve local congestion and making greater use of cheap small cells. Free and low-cost spectrum in the 5GHz and 3.5GHz bands will also play a role in addressing traffic hot spots – without requiring conventional, exclusively licensed frequencies.

Spectrum bulls might contend that even quintupling effective capacity won't satisfy consumer demand, but they overestimate just how close today's networks are to their limits. According to the market-research firm NPD Group, the average smartphone user consumes about 3 gigabytes per month (though the distribution is highly skewed – median usage is only ~1 gigabyte). Three gigabytes per month [equates](#) to just 0.009 megabits per second – or, assuming that 10% of a day's usage occurs during the peak hour, just 0.02 megabits per second at peak. By contrast, average LTE [throughput](#) in the US is approximately 10 megabits per second, highlighting the large gap – on average – between what users actually do with their devices and what their networks are truly capable of. To be sure, data consumption has grown over time, but some evidence suggests that this growth is already plateauing: Verizon, for example, has seen traffic growth decelerate sharply over the past several quarters (from 75% to 40%), while NDP Group's detailed analysis (based on tracking individual users' behavior patterns) suggests that average consumption has been flat in recent months – a far cry from the facile assumption of an endless hockey stick.

Against this backdrop of underutilized spectrum, growing efficiency, improving infrastructure, and potentially plateauing demand, it's no wonder that wireless-industry insiders regard [sensationalistic claims](#) that carriers are on the verge of “running out of spectrum” as utter nonsense. But this dynamic puts DISH in a far worse bargaining position than its supporters appreciate. While they believe that DISH's spectrum portfolio is a near-term must-have for bandwidth-starved carriers, the reality is that carriers are well-equipped to simply wait DISH out and let it squirm.

Spectrum prices should reset dramatically lower. Much has been written about DISH's cunning, disruptive bidding in the AWS-3 spectrum auction that ended in 2015; FCC Chairman Tom Wheeler reportedly [said](#) from the beginning that the company's actions “didn't smell right.”

⁶ Source: [American Tower Q3 2015 earnings call](#).

Bidding against itself by way of three separate legal entities, DISH successfully drove prices far above expectations, and investors dutifully applied those distorted prices to the rest of DISH's portfolio.

However, as the 600MHz auction, beginning at the end of the month, approaches, DISH faces a very different situation. Already highly levered, it lacks the financial firepower to have a large impact on prices, and, after [getting into hot water](#) for its complex bidding by proxy, it's unlikely to try a similar approach again. Meanwhile, carriers' balance sheets also show the strain of the previous auction, and Sprint – the fourth-largest carrier and arguably the one most in need of low-band spectrum like the 600MHz band – is not even participating. As a result, the 30 MHz of spectrum reserved exclusively for bidding by carriers with modest low-band holdings will likely go in large part to T-Mobile, leaving the rest of the auctioned-off spectrum for AT&T and Verizon. While the total amount of available spectrum is uncertain (subject to participation by TV broadcasters opting to cash out), AT&T has expressed interest in only 20 MHz. If Verizon seeks a similar quantity, then that amounts to around 60 MHz of baseline spectrum demand among the three major carriers – compared to expected supply of 100 MHz from the broadcasters. Thus competition is likely to be subdued, with enough wiggle room to accommodate new entrants as well. No one has a good reason to bid aggressively.⁷ Therefore we expect the average auction clearing price to end up close to the reserve level of \$1.25 per MHz-pop. Here we assume \$1.50 – a 45% decline from the inflated AWS-3 results.⁸

This type of outcome has rapidly become the consensus expectation. Recently Bloomberg [reported](#) that the 600MHz auction “may yield a lot less than anticipated,” summarizing analysts' views that carriers “simply don't have the war chests to bid up” for bandwidth. *Wireless Week* [echoed](#) these comments. But few have fully considered the ugly consequences for DISH. Not only is the 600MHz auction going to reset all spectrum prices downward; the fallout is also likely to cost DISH billions of dollars in regulatory penalties.

Why? If 600MHz spectrum goes for ~\$1.50/MHz-pop, then DISH's most commercially viable holdings – the AWS-3 licenses purchased in the previous auction – must be worth far less, given their ~3x higher frequency and attendant weaker propagation. While the superior coverage provided by low-band spectrum has become less important over time, especially for carriers like Verizon and AT&T who have already achieved strong coverage, the fact remains that low-band is still more valuable, and recent precedent transactions point to 2-3x higher prices for low-band relative to mid-band (like AWS). But, after partially [defaulting](#) on auction-related payments and walking away from many spectrum licenses for which it was the winning bidder, DISH is now on the hook to the FCC for the difference between the pumped-up prices it bid and the proceeds of a future repeat auction. If average prices step down from an inflated ~\$2.70 to a more reasonable ~\$0.75, DISH's make-whole liability will balloon.

⁷ Of course, DISH might choose to bid irrationally, perhaps hoping to drop out at the last minute and thus conserve its cash, but in so doing it would just be digging itself a deeper hole.

⁸ Based on paired spectrum.

Meanwhile, DISH's more "boutique" spectrum holdings have their own problems. Not used by any carrier, they lack an ecosystem of handsets and equipment to give them value – something that likely only Verizon or AT&T have the clout to provide. But when the carrier holds the cards, the carrier extracts most of the value, resulting in very low prices for unusual bands (like the ~\$0.30/MHz-pop that AT&T paid for NextWave's WCS spectrum and Sprint paid for Clearwire's EBS/BRS spectrum). To varying degrees, DISH's AWS-4, AWS-3 unpaired uplink, H Block, and 700MHz E Block holdings all suffer from this crucial problem. Even if DISH can ultimately entice a carrier or carriers to buy or lease *all* of its spectrum, we estimate that its intrinsic value is a small fraction of what the market currently believes it is.

Breakdown of DISH's Spectrum Portfolio by Band and Kerrisdale-Estimated Value			
	MHz-pops (B)	Price (\$/MHz-pop)	Total value (\$B)
AWS-3 paired	2.6	\$ 0.83	\$ 2.2
Upper AWS-4	6.3	0.64	4.0
AWS-3 unpaired, lower AWS-4, lower H Block	11.8	0.40	4.7
Upper H Block	1.6	-	-
700MHz E Block	1.4	0.40	0.6
Total	23.7	\$ 0.48	\$ 11.5
Less: AWS-3 penalty/put			2.5
Less: AWS-4 build cost			3.2
Net spectrum value			\$ 5.8

Source: company filings, Kerrisdale analysis

Time is not on DISH's side. Making matters worse, DISH can't simply wait around for carriers to some day exhaust their existing spectral resources; it faces strict build-out deadlines imposed by the FCC. For instance, within four years DISH needs to demonstrate AWS-4 signal coverage and service for 70% of the US population; otherwise, it automatically loses its licenses.⁹ With no network of cell sites to provide such service, and with the major carriers busy for the foreseeable future deploying the spectrum they already have (and will win in the 600MHz auction), DISH does not have the luxury of playing "hard to get." It needs a partner as soon as possible – a fact that every plausible partner is well aware of and won't hesitate to use against DISH.

Indeed, while we do expect a deal to ultimately materialize, investors must take seriously the risk that DISH can't find a partner in time and simply loses its non-standard spectrum. After all, while all the carriers will be deploying AWS-3, no one but DISH has any stake in the success of, say, the H Block, and altering existing plans to incorporate such a band takes time, money, and

⁹ See [AWS-4 Report & Order](#), p. 72 ("Where a licensee fails to meet the AWS-4 Final Build-out Requirement in any EA [economic area], its authorization for each EA in which it fails to meet the requirement shall terminate automatically without Commission action").

effort. Why not just wait for DISH to lose the spectrum, then pick it up as needed down the road when the FCC puts it back on the market?

DISH's core TV business also faces grave threats. For years, satellite TV has been a reliable, if stagnant, source of cash for DISH, funding its great spectrum adventure. But with over-the-top entertainment ascendant and satellite-market leader DirecTV gaining strength from its merger with AT&T, DISH is beginning to shed core subscribers. As content costs continue to rise and DISH's already lean structure makes it difficult to cut expenses, we estimate that a further 10% subscriber loss could reduce EBITDA by 26%, potentially jeopardizing the solvency of DISH's satellite subsidiary. While some pin their hopes on DISH's own over-the-top offering, Sling TV, early indications suggest that the product is riddled with [bugs](#) and [already losing steam](#), leading to recent headlines like "[Is Sling TV a Failure?](#)" In short, DISH's weak TV business can't make up for its disastrous spectrum gamble.

II. Company Overview

DISH Network: Capitalization and Financial Results						
<i>(in millions except per-share data and ratios)</i>						
Capitalization		Financial results				
Share price	\$ 47.54					
Diluted shares	465		2013	2014	2015	2016 ¹
Market cap	\$ 22,117	Revenue	\$ 13,905	\$ 14,643	\$ 15,069	\$ 15,250
Net debt:		EBITDA ²	2,851	2,908	2,980	3,061
Long-term debt	\$ 12,091	Diluted EPS	\$ 1.76	\$ 2.04	\$ 1.61	\$ 2.84
Capital leases	160					
Total debt	\$ 12,251	Spectrum at cost ³	\$ 2,661	\$ 4,332	\$ 14,223	
Cash & cash equiv's	(709)	Net debt	3,892	5,228	12,145	
Marketable investments	(162)	To EBITDA	1.4x	1.8x	4.1x	
Net debt	\$ 11,381					
Total enterprise value	\$ 33,497	TV subscribers	14.1	14.0	13.9	

Source: Capital IQ, company filings, Kerrisdale analysis

1. Consensus estimates per Capital IQ.

2. EBITDA as defined by Capital IQ.

2. Cellular spectrum only (excludes DBS and MVDDS).

In business school they tell you not to put all your eggs in one basket. But I say put every damn egg you've got into it.

—Charlie Ergen¹⁰

Founded in 1980, DISH Network is the second-largest satellite-TV operator in the US, with 13.9 million subscribers paying ~\$88 a month. Unlike Comcast, Verizon, or AT&T, which can offer

¹⁰ Quoted in Stephen Keating, *Cutthroat: High Stakes and Killer Moves on the Electronic Frontier* (Boulder: Johnson Books, 1999).

integrated bundles of TV and other higher-margin services like broadband internet access, DISH is largely limited to TV. (Its expensive satellite-delivered broadband service is a niche business aimed at those with no better alternatives; as the company itself [says](#), “If you live in an area where cable or fiber Internet is already available, then satellite Internet service may not be your best option.”) In recent years, it has become clear that satellite TV is a mature business, with no meaningful growth in subscribers or earnings power; the modest revenue growth that DISH has achieved via price hikes has been overwhelmed by margin contraction.

DISH Network: A Long History of Financial Stagnation

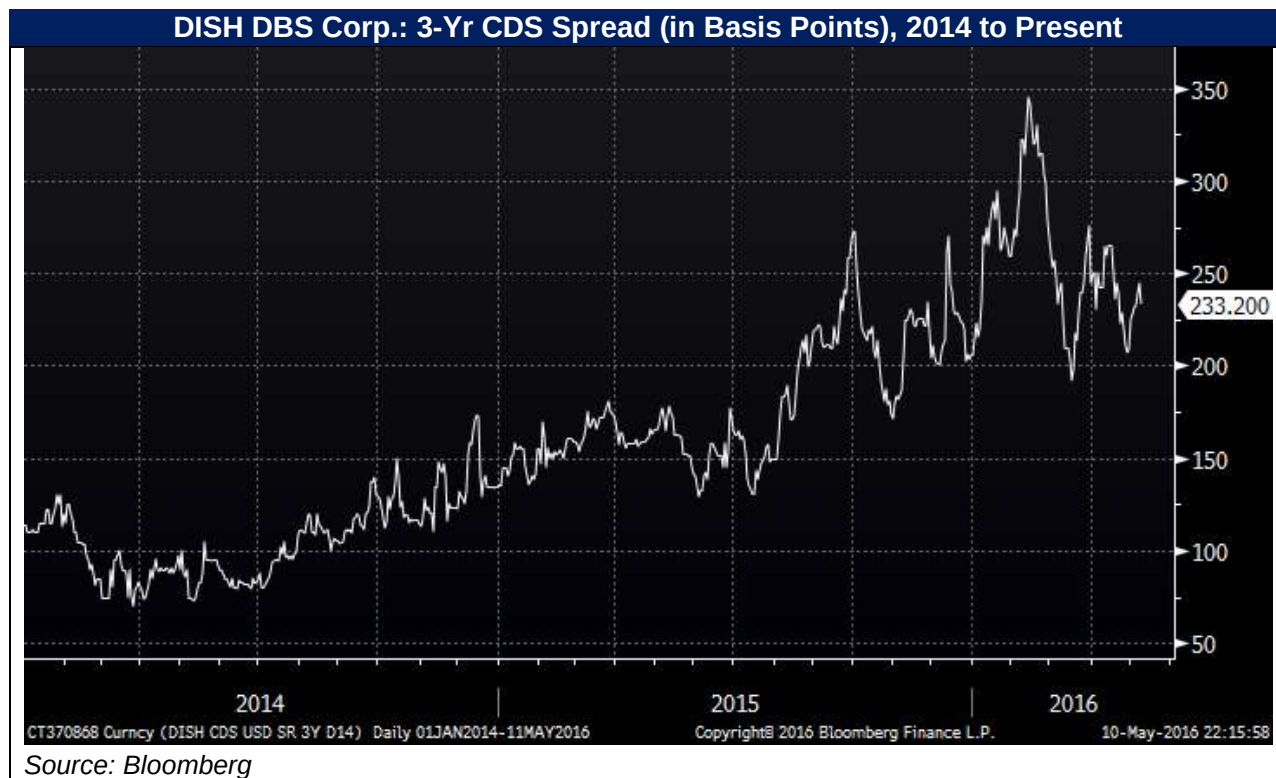
(in millions except ARPU)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	CAGR, 2007-15
Pay-TV ARPU	\$ 65.83	\$ 69.27	\$ 70.04	\$ 73.32	\$ 76.43	\$ 76.98	\$ 80.37	\$ 83.77	\$ 86.79	4%
Pay-TV subs	13.8	13.7	14.1	14.1	14.0	14.1	14.1	14.0	13.9	0%
EBITDA	\$ 2,959	\$ 3,056	\$ 2,688	\$ 3,150	\$ 3,532	\$ 2,971	\$ 2,851	\$ 2,908	\$ 2,980	0%
Free cash flow	1,172	1,058	1,157	924	1,859	1,058	1,056	1,192	1,322	2%

Source: company filings, Kerrisdale analysis

Note: EBITDA as defined by Capital IQ. (DISH-defined EBITDA includes non-operating items.)

In light of this performance – and the ongoing competitive pressures discussed further below – it’s no wonder that even bullish sell-side firms (including Deutsche Bank and Jefferies) value DISH’s pay-TV business at modest EV/EBITDA multiples of 4-5x. The fixed-income market has also become more pessimistic about the health of the business (which DISH has heavily borrowed against to fund its spectrum purchases): in recent months, the CDS spreads for DISH’s satellite subsidiary have blown out, signaling deteriorating credit.



DISH management, well aware that the days of rapid satellite-TV growth were over, made its first major terrestrial spectrum purchase in 2008, spending \$712 million at auction on 700MHz E Block licenses across much of the country. Qualcomm used similar spectrum to offer a mobile TV service called [MediaFLO](#) (a flop that it abandoned in 2010), and DISH originally indicated that its own “mobile video product” was on its way.¹¹ Instead, the spectrum has lain fallow for years. In 2012 DISH went on to purchase the assets of the bankrupt satellite firms TerreStar and DBSD and gained FCC approval to convert their nationwide spectrum from satellite to terrestrial usage; this spectrum is now known as the AWS-4 band. In 2013, DISH tried to purchase both [Sprint](#) and [Clearwire but failed](#) – perhaps a lucky break, since Sprint, having itself absorbed Clearwire, now trades for 50% less than what DISH was willing to pay three years ago. In 2014, DISH [bought up](#) a chunk of mid-band spectrum called the H Block in an FCC auction (at exactly the minimum price it guaranteed it would pay in exchange for certain regulatory favors – thus implying that the undistorted intrinsic value was less than it paid).

DISH’s first three cellular spectrum purchases – 700MHz E Block, AWS-4, and H Block – had at least the appearance of value investments: non-standard “fixer-upper” bands purchased at optically low prices. For all DISH’s posturing about possibly entering the wireless market itself as a fifth major carrier, its far more attractive option has long been to sell or lease its spectrum to the incumbents – cashing in, or so the theory went, on the difference between its “bargain” purchase prices and the prevailing market level. In 2014, however, according to the [Financial Times](#), DISH discovered that it didn’t see eye to eye with its would-be counterparties:

¹¹ Source: Bloomberg transcript of DISH 2Q 2009 earnings call.

Bankers say Verizon tried to buy spectrum from Mr Ergen last year, but balked at the \$1.50 per MHz/pop he was asking for. “They thought it was ridiculously expensive and let it get away from them...” says a person familiar with the deal. Nor is there any certainty that the regulator [the FCC] would let Dish sell to Verizon.¹²

Having already sunk more than \$4 billion into spectrum, only to be told that its price expectations were “ridiculously” excessive, DISH shifted its investment style from value to momentum. In the AWS-3 auction, it chased rising spectrum prices to unprecedented new heights, ultimately spending another \$10 billion while straining the carriers’ capital budgets. DISH’s approach mirrored the strategy it used some 20 years earlier in the auction of a broadcast-satellite orbital slot, for which DISH, MCI, and TCI (John Malone’s cable company) were the only bidders. There, too, the price rapidly rose to seemingly irrational levels, but Ergen kept bidding higher. He later explained:

If we got the slot, we had a satellite under construction that we could have used it for. If we didn’t, we raised the price of poker for somebody else and made our spectrum that much more valuable.¹³

In the AWS-3 auction, like the earlier slot auction, DISH’s bidding did indeed “raise the price of poker” for its rivals, but the other elements of the analogy didn’t apply. DISH lacks the equivalent of “a satellite under construction”: it has no wireless network to actually allow it to use all the spectrum it has accumulated and thus has no choice but to partner. Moreover, while the AWS-3 auction generated a lot of analyst notes slapping higher prices on DISH’s previous spectrum holdings, it didn’t actually make them more valuable. If anything, it made them *less* valuable: post-auction, the carriers had more spectrum and less money, reducing their need for incremental bandwidth as well as their ability to pay. (When you stretch your finances to buy an expensive house, it doesn’t make you *more* likely to pay a higher price for another one; for one thing, you already have a house, and, for another, you’re out of cash.)

Now, highly levered and sitting on a mountain of unused spectrum, DISH still has no clear plan for monetizing its investments. Rumors of an imminent transaction have come and gone, but the carriers have continued to prove unwilling to meet the company’s terms. For those who have bought into the narrative of an ongoing spectrum crunch, this deadlock ought to inspire confusion. With spectrum values endlessly rising, with bandwidth in such short supply, why will no one cut a deal? In reality, though, the absence of a deal is just one of a number of data points demonstrating that the much vaunted spectrum crunch is far less than advertised – deeply undermining the foundations of DISH’s all-in bet.

¹² The same “person familiar with the deal” also contended that Verizon would come to regret its balking, though whether that is true remains to be seen.

¹³ From Keating, *Cutthroat* (1999).

III. Carriers Already Have Plenty of Spectrum

What's so great about spectrum? Licensed spectrum, along with towers, antennas, and specialized computers, are key components of cellular networks. But what's so great about cellular networks? From a financial perspective, network operators have historically achieved only modest returns on all the capital they need to meet user demands. In 2015, for instance, carriers achieved a weighted-average return on invested capital of just 9%, with especially anemic results from T-Mobile and Sprint.

US Wireless Carriers: Returns on Capital, 2015	
	Return on capital
Verizon	16%
AT&T	8%
T-Mobile	3%
Sprint	1%
Weighted avg	9%

Source: Capital IQ, Kerrisdale analysis

The industry's mediocre profitability not only makes it foolhardy for a new player to aggressively enter the market; it also calls into question the rationality of paying ever higher prices for spectrum. When an entire network can only generate a single-digit return on capital, there is a limit to how valuable a single input to that network can be, especially at the margin. Verizon's existing spectrum portfolio is indeed very valuable because it enables Verizon to support its massive customer base, but *incremental* spectrum is naturally far less valuable, especially when the network is already in good working order.

In the wake of the AWS-3 auction, all the carriers stated repeatedly that their existing spectrum portfolios, combined with improving technology and the deployment of additional infrastructure, were well-equipped to handle growing data traffic for years to come. That would imply relatively little interest in investing even more in additional spectrum – bad news for a spectrum speculator like DISH, especially given the practical difficulties of using its non-standard bands. Spectrum bulls, of course, discount the notion that existing spectrum supply is adequate as self-serving deception: the carriers don't want the world to know how badly they need more spectrum and how much they'd be willing to pay for DISH's, so they need to insist that all is well. It's just an act – or so the bulls have argued.

But this conspiracy theory doesn't hold up to scrutiny. In a world where carriers were rapidly exhausting their spectrum resources, there would be clear evidence of mounting trouble on many fronts:

- Network performance would rapidly deteriorate as traffic overwhelmed the available capacity. Dissatisfied users would leave in droves.
- Not only would carriers buy all the spectrum they could; they'd also ramp up spending on new cell sites and network equipment to increase capacity.
- To tamp down demand, carriers would discourage data-intensive use cases like streaming video.

But this is not the world we live in:

- On average, network performance is getting *better*. According to OpenSignal, every major carrier has improved its LTE download speeds over the past year, in some cases substantially. (Ookla, the maker of Speedtest.net, [reports](#) average overall speeds that are ~50-75% higher, suggesting that OpenSignal's figure might be conservative.)

LTE Download Speeds (Mbps)					
	2014 Q4	2015 Q1	2015 Q2	2015 Q3	2015 Q4
Verizon	6.5	8.6	11	12	12
AT&T	6.5	7.6	8	8	8
T-Mobile	10.0	10.1	11	12	12
Sprint	4.0	4.8	5	6	7

Source: OpenSignal State of LTE reports ([March 2015](#), [June 2015](#), [September 2015](#), [February 2016](#)), Kerrisdale analysis

- Despite their intense competition, carriers boast low and fairly stable churn rates. If anything, churn is trending *down*, not up. There is no sign of any mass exodus driven by a shortage of spectrum.

Monthly Churn Rates (Postpaid Users)									
	3/31/14	6/30/14	9/30/14	12/31/14	3/31/15	6/30/15	9/30/15	12/31/15	3/31/16
Verizon	1.1%	0.9%	1.0%	1.1%	1.0%	0.9%	0.9%	1.0%	1.0%
AT&T	1.3%	1.0%	1.2%	1.4%	1.2%	1.2%	1.3%	1.3%	1.2%
T-Mobile	1.5%	1.5%	1.6%	1.7%	1.3%	1.3%	1.5%	1.5%	1.3%
Sprint	2.1%	2.1%	2.2%	2.3%	1.8%	1.6%	1.5%	1.6%	1.7%
Average	1.5%	1.4%	1.5%	1.7%	1.3%	1.2%	1.3%	1.3%	1.3%

Source: company filings, Kerrisdale analysis
Note: values reflect Verizon Wireless retail postpaid, AT&T Consumer Mobility postpaid, T-Mobile branded postpaid phone, and Sprint platform postpaid.

- Carriers have *not* chosen to buy all the spectrum they can.
- Sprint, for one, isn't even participating in the upcoming 600MHz auction.

- Meanwhile, according to our estimates, Verizon, from 2012 to the time of the AWS-3 auction in 2015, was actually a net *seller* of spectrum.¹⁴
- The H Block auction, which DISH easily won, attracted no interest from the carriers.
- In the AWS-3 auction, the very fact that DISH was able to outbid the carriers for so many licenses points to real price sensitivity: Verizon and AT&T could have paid as much as DISH but opted not to.
- Even DISH chose to forfeit a host of AWS-3 licenses rather than pay full price once it learned that its “very small business” bidding credits were being revoked. Evidently it does not believe there is much margin of safety in spectrum at auction prices.
- Spending on new cell sites and equipment is *not* exploding; it’s business as usual.
- For instance, Crown Castle, essentially tied for largest tower operator in the country, has seen its tower count go from 39,697 at the [end of 2014](#) to 39,749 at [3/31/16](#), and the average number of tenants per tower has actually dipped slightly from 2.3 to 2.2. American Tower, Crown Castle’s major competitor, has increased its tower count recently, but almost entirely through acquisition; its organic rate of new builds is only ~0.3%, and its average number of tenants per tower has been flat.¹⁵ There is no frenzied race to build more sites, contrary to the predictions of the “spectrum crunch” theory.
- Major telecom vendors like Ericsson and Nokia are actually suffering from *sluggish* revenues in the US, as carriers “focus on cash flow optimization”¹⁶ after the completion of major LTE roll-outs. Spending is restrained, not booming.
- Similarly, carrier capital expenditures, though large in absolute terms, are only growing modestly, not rapidly:

Carrier Capital Expenditures (\$mm)				
	2013	2014	2015	2013-15 CAGR
AT&T	\$ 21,228	\$ 21,433	\$ 20,015	-3%
Verizon	16,604	17,191	17,775	3%
T-Mobile	4,025	4,317	4,724	8%
Sprint	6,987	4,303	7,729	5%
Total	\$ 48,844	\$ 47,244	\$ 50,243	1%

Source: Capital IQ, Kerrisdale analysis¹⁷

¹⁴ We estimate that Verizon sold 0.5B MHz-pops to AT&T in 2013 and 1.3B MHz-pops (net) to T-Mobile in 2014, partially offset by the purchase of 0.2B MHz-pops from Cincinnati Bell in 2014. See Moelis’s 2/3/15 expert report in the [LightSquared bankruptcy](#) (Appendix A, slide 17) and T-Mobile’s [January 2014 investor presentation](#) (appendix, slide 25).

¹⁵ See American Tower [2016 Q1 supplemental financial and operating data](#). 2015 US new builds totaled 85, as compared to a starting tower count of 28,566. For tenancy data, see American Tower’s [12/15 regional metrics](#). In the US, average tenancy was depressed by the Verizon tower purchase. Before, tenancy averaged 2.5 for four consecutive quarters; after, it averaged 2.2 for three consecutive quarters.

¹⁶ Source: Ericsson 2015 Q3 [earnings report](#), p. 5.

¹⁷ These figures reflect firm-level capex. AT&T does not disclose wireless-specific capex, making a clean wireless-only analysis across the industry impossible. However, if we assume, consistent with

- Far from discouraging data-intensive video consumption, several major carriers have recently begun to promote it. T-Mobile's "Binge On" feature allows subscribers to stream unlimited amounts of video (at 480p+ quality) without touching their data allocations. Verizon has rolled out its own over-the-top streaming video service, Go90. AT&T has reintroduced unlimited data plans for mobile users who also subscribe to DirecTV and has hinted at a future OTT product. If these carriers were running out of spectrum and network capacity, why would they possibly roll out these sorts of offers? It would be suicide. Yet there they are.

In sum, the notion of an impending spectrum crunch that would put carriers urgently in need of DISH's spectrum is belied by the evidence. Network performance is improving, customers are satisfied, infrastructure deployment is slow and steady, and carriers have not been shy about encouraging increased user traffic – a signal of confidence in their networks. Because there is no crisis, carriers can easily afford to let DISH twist in the wind – as indeed they have done for years.

Spectrum bulls, however, tend to ignore all these indications that networks are doing a good job accommodating growing traffic; instead, they focus on the sheer magnitude of that traffic growth and assume it must ultimately overwhelm the carriers' spectrum supplies. To be sure, cellular data consumption has increased tremendously as smartphones, LTE, and streaming video have become almost universal. But most observers fail to appreciate just how little the average user consumes relative to available throughput. Different sources provide different figures, but the [NPD Group](#), based on a panel of smartphone users with specialized metering software installed on their devices, estimates median and average cellular data consumption of ~1 and ~3 gigabytes per month, respectively. (The large difference between the median and average highlights the outsized impact of a small group of heavy users.) Those monthly consumption numbers translate to just 0.003 and 0.009 megabits per second – a tiny fraction of the >10 megabits per second that many users achieve in speed tests. Consumption has grown, but existing networks are capable of much more.

One important factor in allowing for all this spare capacity is the relatively low population density of most parts of the country. As [American Tower](#) has pointed out, 84% of the US population lives in suburban and rural areas with typical population densities in the hundreds per square kilometer. Consider a stylized example. [Business Insider](#) has ranked New Albany, Ohio, as the best suburb in America; its [population density](#) is 258 per square kilometer. (The average for the [contiguous United States](#) is 40.) Assuming a typical tower coverage radius of 2.5km, a single cell tower could cover ~20 km² containing ~5,000 people; further assuming that a single carrier has 35% market share in the area (similar to what Verizon and AT&T boast nationwide), it would

management comments from AT&T's 2015 Q4 earnings calls, that wireless capex accounts for about half of AT&T's total, then wireless-specific capex for the four carriers totaled ~\$30.4 billion, ~\$30.2 billion, and ~\$31.5 billion in 2013, 2014, and 2015, respectively, for a 2013-15 CAGR of 2%.

have to handle only ~1,800 users.¹⁸ At a usage range of 3 GB/month/user, the tower would see 177 GB of average daily traffic.

How does that stack up against the site's *capacity*? Assuming only 10 MHz of downlink bandwidth, three sectors, and 1.5 bps/Hz/sector of average spectral efficiency, the site's capacity would be 45 Mbps or 486 GB per day. *In other words, even with a small amount of spectrum, the site would use only 36% of its capacity.* Traffic could almost triple without requiring a major overhaul. With 25 MHz of downlink spectrum – more typical of metro-area LTE networks – traffic could grow almost seven-fold without exhausting *existing* resources. The table below summarizes this calculation.

Illustrative Analysis of Cell-Site Capacity Utilization				
	Value		Symbol	Notes
Aggregate traffic				
Population per km ²	258.0		<i>d</i>	New Albany, Ohio
Tower coverage radius (km)	2.5		<i>r</i>	
Tower coverage area (km ²)	19.6		<i>A</i>	$A = \pi r^2$
Tower-covered pops	5,066		$P = A \times d$	
Carrier market share	35%		<i>s</i>	
Tower-covered subscribers	1,773		$S = P \times s$	
Per-subscriber traffic (MB/mo)	3,000		<i>t</i>	
Per-subscriber traffic (MB/day)	100		$t / 30$	
Aggregate traffic at tower (MB/day)	177,304		$T = S \times t$	
Aggregate capacity				
	<u>Low</u>	<u>High</u>		
Downlink spectrum (MHz)	10	25	<i>b</i>	
Sectors per site	3	3	<i>n</i>	
Spectral efficiency (bps/Hz/sector)	1.5	1.5	<i>e</i>	
Capacity per site (Mbps)	45	113	$c = b \times n \times e$	
Capacity per site (MB/day)	486,000	1,215,000	$C = c \times 60 \times 60 \times 24 / 8$	bits/sec → bytes/day
Capacity utilization	36%	15%	T / C	
Source: Kerrisdale analysis				

Of course, all of these parameter settings will differ from market to market and carrier to carrier, but this simplified example helps to explain why carriers are not behaving like their spectrum is running out any time soon: it's not. In large swaths of the country in which most customers live, even small amounts of spectrum can go a long way.

¹⁸ At 3/31/16, Verizon had ~90 million retail postpaid smartphones and ~40-60k cell sites (depending in part on how one counts DAS nodes and small cells), for an average of 1,500 to 2,200 smartphones per site, roughly consistent with the calculation above. Other carriers serve fewer devices but operate a similar number of sites.

Furthermore, the 10-25 MHz of downlink spectrum deployed for LTE today will become ~50 in the years to come, creating even more headroom for traffic growth. The table below summarizes the average bandwidth held by the large carriers – but the majority of this bandwidth still supports pre-LTE technologies and voice calls. As carriers “refarm” non-LTE spectrum and convert it to LTE – a process already well underway in many areas – a tremendous amount of additional latent capacity will be unlocked.

Population-Weighted Average Megahertz by Carrier			
Verizon	AT&T	T-Mobile	Sprint
113.9	145.3	75.4	187.6

Source: FCC [18th Mobile Wireless Competition Report](#), Kerrisdale analysis
 Note: includes AWS-3 spectrum.

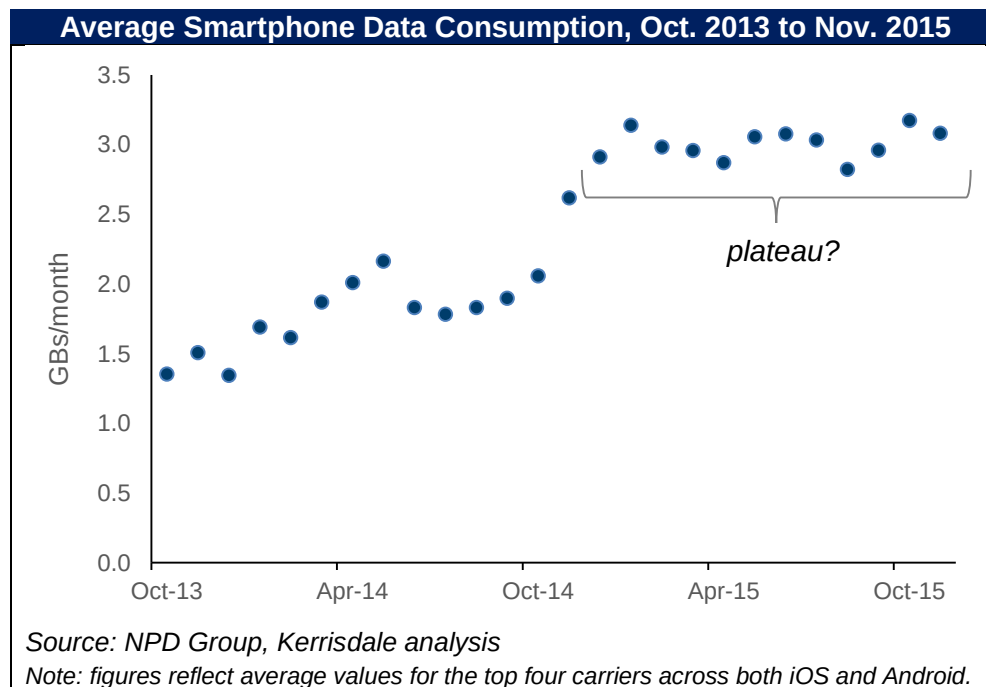
Whether all this capacity will actually be necessary any time soon is also less clear-cut than spectrum bulls believe. Consider, for instance, the CTIA’s statistics on average smartphone data consumption.¹⁹ From 2010 to 2014, it grew five-fold – a staggering amount. Yet the growth rate has steadily *declined* during that whole period, from 90% to just 18%:

Growth in Mobile Data Usage per Subscriber			
2011	2012	2013	2014
90%	51%	50%	18%

Source: CTIA, Kerrisdale analysis

Data from a different source, NPD Group, suggests, even more starkly, that growth in monthly traffic has recently stopped altogether. From January to November 2015, it has averaged ~3 GB month in and month out. While it would be no great surprise if this were only a temporary plateau, even that would be drastically at odds with the spectrum bulls’ bedrock assumption of never-ending traffic growth – a critical tenet of the DISH investment thesis.

¹⁹ Included in the FCC’s most recent [Mobile Wireless Competition Report](#), p. 95, Chart VII.B.2.



To be sure, in certain urban markets, where population density can be orders of magnitude higher than it is in the country's "best suburb," capacity is harder to come by. Power levels need to be lower, cells need to shrink, and congested "hot spots" can certainly arise. But more spectrum is not necessarily the most economically effective solution. Additional infrastructure in the form of small cells and DAS nodes (installed, for instance, on lampposts or utility poles outdoors or in the ceiling in large office buildings) can enhance spectral efficiency by putting radios closer to users, thereby increasing signal-to-noise ratios and enabling more data to flow over the same amount of spectrum. That's the strategy Verizon is now aggressively pursuing in lieu of bidding up spectrum to irrational levels. As Verizon CFO Fran Shammo said in November at an investor conference:

[W]e went into the AWS-3 auction; we spent \$10.4 billion. If I wanted more spectrum, I would have bought it in the auction. What we did was, we walked away from Chicago and New York, because we said the price got way too high. And if you look at just the math at a very simple level, in order to buy New York and Chicago and a couple other markets, it was \$6 billion additional cost for spectrum. I can build the same capacity for \$1.5 billion. The spectrum won't be launched until three years from now, so 2018. My build will be done by 2018. I'll have the exact amount of capacity I would have had if I bought that spectrum. So from our perspective, \$1.5 billion versus \$6 billion, it's a pretty simple equation.

So, why would I go out and buy spectrum and be held hostage by a third party? I mean, it makes no logical sense to do that. So, at this point, yeah, Charlie has great spectrum, but not at the price that he paid for it, because we walked away in the auction. So,

there's no reason to have this discussion, and we've talked about this before. I'm not interested in DISH.²⁰

Predictably, DISH bulls dismissed this straightforward rejection as pure hot air. But the evidence reviewed above is consistent with Shammo's argument. Today, all the carriers have large amounts of under-utilized and virgin spectrum, typical traffic demands are putting little strain on network capacity in most places, and traffic growth is decelerating. More spectrum never hurts, but carriers don't earn outsized economic returns, and spectrum, like most resources, suffers from diminishing marginal returns, so carriers have neither the ability nor the willingness to pay ever higher prices. While the skewed results of the AWS-3 auction temporarily obscured these realities, we believe that the upcoming 600MHz auction will put them on display, casting additional doubt on the sustainability of DISH's inflated valuation.

IV. Spectrum Prices Face a Major Reset Downward – Especially for DISH

The 600MHz incentive auction, already underway, will serve to put low-frequency spectrum currently used by traditional TV broadcasters into the hands of carriers. First, in the “reverse” auction, TV stations will be able to accept cash payments in exchange for going off the air and freeing up spectrum, while holdouts will be “repacked” into new frequencies. In the “forward” auction, carriers (along with would-be new entrants and speculators like DISH) will bid for cellular licenses carved out of the freed-up spectrum. Many aspects of the auction are complex, uncertain, and inter-dependent; for example, the amount of spectrum available to carriers is a function of broadcaster participation (and will vary somewhat from market to market). For our purposes, however, the most important point about the auction is the imbalance between likely supply and likely demand.

Though TV broadcasters located in major markets with major network affiliations (like CBS or ABC) may have viable business models, there are well over a thousand broadcasters in the country, many of which lack those attributes, have no clear future, and are likely to cash out. While the auction could release anywhere from 20 to 100 MHz of spectrum (in multiples of 10) for cellular use, FCC [simulations](#) suggest that, even with minimal participation from major-network and other high-value stations, 70 to 100 MHz of paired spectrum represents a likely range of outcomes; indeed, the FCC's initial clearing target is 100 MHz, the highest possible. By contrast, the AWS-3 auction offered only 50 MHz of paired spectrum. In short, given the large number of weak broadcasters for whom going off the air is financially superior to the status quo, the auction should generate a very large supply of spectrum.

²⁰ Source: Bloomberg transcript of Wells Fargo Securities Technology, Media & Telecom Conference, 11/10/15.

Meanwhile, there are only four large carriers, and the one with perhaps the worst position in low-band spectrum, Sprint, [announced](#) last year that it wouldn't even be bidding, noting, among other things, that "Sprint has the spectrum it needs." T-Mobile, notwithstanding its recent accumulation of 700MHz A Block licenses, still suffers from a coverage and building-penetration disadvantage relative to AT&T and Verizon, and the company has been vocal about its interest in buying 600MHz spectrum. But the auction will include a spectrum reserve of 30 MHz for carriers without a strong pre-existing portfolio of low-band spectrum in a given market. In some areas, AT&T and Verizon lack the threshold level of low-band spectrum and will be able to bid against T-Mobile, but in large regions T-Mobile will essentially have the reserve to itself. Since the auction reserve price is \$1.25/MHz-pop,²¹ T-Mobile won't be able to get away with an incredible bargain, and it has [stated](#) that it's "certainly not going to buy 30 MHz of spectrum at the auction." But it's plausible that it will be able to pick up ~20 MHz nationwide at ~\$1.50/MHz-pop, for total spending of approximately \$9 billion – consistent with management's remarks that it could spend "up to" \$10 billion.

If T-Mobile only buys 20 MHz, though, that leaves 50 to 80 MHz for AT&T and Verizon – large quantities relative to their current holdings. But both already have strong 700MHz portfolios, giving them good coverage; at the margin, 600MHz spectrum is less valuable to them than it is to T-Mobile. Still, 600MHz base stations operating at reduced power can, in principle, provide the same sort of capacity and cell size that mid-band spectrum can, while not foregoing the option of broader coverage where needed. Thus, even with the rising importance of mid-band spectrum, low-band spectrum is still more valuable. Yet AT&T has [said](#) that it's only looking for a 20MHz slice. If Verizon seeks the same, that would amount to just 40 MHz of demand outside the protected spectrum reserve, as compared to 50 to 80 MHz of supply. The carriers simply have no good reason to bid aggressively. Bidding near the reserve price is likely to get them what they want and still leave room for any dark-horse participants that show up. Meanwhile, even at \$1.25/MHz-pop – drastically lower than the AWS-3 paired-spectrum price of \$2.71 – the forward auction will take in some \$30+ billion. DISH, having gone all-in on the last auction, now holds just \$0.9 billion in cash and marketable investments, likely too little to significantly disrupt the bidding. With high supply flowing from the reverse auction and low demand entering the forward auction, and with DISH weakened, the final clearing price should approach the reserve price. Here we assume it winds up at \$1.50/MHz-pop – essentially in line with the recently emerging [consensus view](#).²²

What does this mean for DISH? With a more rational, less distorted benchmark price in focus, DISH will have a much harder time arguing for aggregate spectrum valuations in the many tens of billions. While management will no doubt argue that its largely mid-band portfolio is better suited to providing capacity than the 600MHz band and that it is therefore worth proportionally more, the fact remains that the self-interference that hurts low-frequency capacity can be

²¹ In the top 40 "partial economic areas." Furthermore, the \$1.25 figure is binding only for spectrum clearing levels at or below 70 MHz; above that level, the auction price is allowed to be lower as long as the aggregate proceeds exceed what a \$1.25 reserve price would have guaranteed if only 70 MHz had been cleared. For example, the reserve price could effectively step down to \$0.875 in a 100MHz auction.

²² \$1.50/MHz-pops x 70 MHz x 320mm pops = \$33.6 billion.

reduced by simply operating at lower power. Whatever 600MHz is worth, DISH's AWS-3 spectrum must be worth less.

How much less? At their original FCC auctions, "clean" 700MHz licenses sold for 6.7x the price per MHz-pop of comparable AWS-1 licenses.²³ On this basis, if 600MHz spectrum now sells for \$1.50, then DISH's AWS-3 spectrum is only worth \$0.22. But we adopt a less extreme view.²⁴ The declining value of incremental coverage has in fact caused the difference in value between low- and high-band spectrum to compress. Triangulating across a number of relatively recent spectrum trades, however, we estimate that the ratio is still 2-3x:

- When T-Mobile [purchased](#) 700MHz A Block spectrum from Verizon in January 2014 in exchange for cash and a mixture of AWS and PCS mid-band spectrum, it valued the 700MHz at \$1.85/MHz-pop. However, the licenses purchased were disproportionately in high-value markets; we estimate that \$1.85 in those markets translates to a \$1.45 nationwide average. However, the A Block suffers from interference challenges. Assuming the same ratio of A to B Block values that prevailed in the 700MHz auction, a \$1.45 price for the A Block implies \$3.35 for the unimpaired B Block. Meanwhile, T-Mobile valued the mid-band spectrum it gave to Verizon at \$1.72/MHz-pop, but, again, this spectrum came disproportionately from high-value markets, implying a ~\$1.55 nationwide price. $\$3.35 \text{ for 700MHz B} / \$1.55 \text{ for mid-band} = \mathbf{2.2x}$.
- When AT&T [purchased](#) 700MHz B Block spectrum from AT&T in September 2013 in exchange for cash and AWS-1 spectrum, the implied nationwide B Block price, by our estimates, was \$2.78/MHz-pop. Moelis has estimated that the nationwide AWS-1 price was \$0.81.²⁵ The ratio of low- to mid-band was **3.4x**.
- In two separate transactions in 2013, Grain Management [purchased](#) 700MHz B Block spectrum for an implied national price of \$3.20, while T-Mobile [purchased](#) AWS-1 spectrum for an implied national price of \$1.57. The ratio of low- to mid-band was **2.0x**.

Thus a \$1.50/MHz-pop nationwide average price for 600MHz spectrum points to, at best, a \$0.75/MHz-pop nationwide average price for standard mid-band spectrum like AWS-3. At auction, however, driven by DISH's aggressive bidding, this spectrum sold for \$2.71/MHz-pop, implying a drastic 72% markdown from 2015 to 2016.

²³ See [Exhibit 1](#) from former FCC Chairman Kevin Martin's [4/25/08 statement](#) to Congress regarding the 700MHz auction. We regard the 700MHz B Block as the only "clean" one. (The A Block suffers from interference from TV Channel 51, the C Block is subject to "open access" requirements initially viewed as burdensome, and the E Block is unpaired.) Since the B Block is licensed by Cellular Market Area (CMA), we compare it to the AWS-1 A Block, the only AWS-1 block licensed the same way. $\$2.67/\text{MHz-pop for the 700MHz B Block} / \$0.40/\text{MHz-pop for the AWS-1 A Block} = 6.7x$.

²⁴ It's interesting to note that the 6.7x price ratio is very close to what a simple theoretical model would predict. Based on propagation, we might expect spectrum value to go as the inverse square of the frequency (a point discussed in our [Globalstar report](#)). Using a 700 B center frequency of 722 MHz and an AWS-1 A center frequency of 1915 MHz, the ratio is 2.65, the square of which is 7.0 – close to the 6.7x empirical value from the auctions.

²⁵ See Moelis's 2/3/15 [expert report](#) in the LightSquared bankruptcy (Appendix A, slide 17, note 7).

Is this assumption too draconian? Note that the 72% figure is highly consistent with the comments from Verizon's CFO quoted above. He asserted that AWS-3 licenses that sold for \$6 billion really had intrinsic value of only \$1.5 billion since that level of capex could generate the same amount of incremental capacity as additional spectrum could. Dropping from a \$6 billion purchase price to \$1.5 billion of intrinsic value is a 75% decline.

Moreover, \$0.75/MHz-pop is in line with the expectations that T-Mobile [laid out](#) (slide 7) to the FCC prior to the AWS-3 auction in January 2014. It estimated that the H Block auction would clear at \$0.50-\$0.75/MHz-pop, while the AWS-3 auction would clear at \$0.80-\$1.20. However, DISH was the [only serious bidder](#) in the H Block auction – none of the carriers participated – and it won every license available at an average of exactly \$0.50/MHz-pop, the minimum price it had promised the FCC it would bid. Therefore, in the absence of such a promise, the price would have been below \$0.50 and thus worse than T-Mobile expected. The natural inference would be that the AWS-3 auction price would likewise fall below T-Mobile's \$0.80/MHz-pop lower bound – consistent with our \$0.75/MHz-pop estimate. (Because DISH's AWS-3 licenses are disproportionately drawn from high-value markets, we adjust the nationwide \$0.75 up to \$0.83 for DISH, based on the assumption that all AWS-3 licenses drop in price by the same percentage.)

Whatever its market value, the AWS-3 band is at least standard spectrum.²⁶ Verizon, AT&T, and T-Mobile are all incorporating it into their networks, guaranteeing that an ecosystem of handsets and equipment will support it. Because of these economies of scale, standard spectrum used by multiple carriers is always far more valuable than peculiar one-off bands. Unfortunately for DISH, the bulk of its spectrum portfolio consists of the latter:

- **Upper AWS-4 (2180-2200 MHz):** While [officially](#) included in the industry standards body 3GPP's Band 66 – the extended AWS band – DISH's 20 MHz of nationwide upper AWS-4 spectrum has a unique limitation: only Band 66 devices *capable of carrier aggregation* are required to support it.²⁷ Carrier aggregation – an LTE-Advanced feature that allows two separate units of spectrum to work in concert – is common in high-end phones but far less common in cheaper ones (which, in the aggregate, account for a high volume of unit sales). Indeed, the entire motivation behind giving DISH's upper AWS-4 spectrum

²⁶ Note, however, that DISH's AWS-3 spectrum, held by the designated entities SNR and Northstar, is now encumbered: any future buyer of the underlying licenses must assume a pro-rata share of DISH's deficiency payment, discussed below. (See e.g. the "special conditions" listed for [one of Northstar's licenses](#) in Virginia.) Since the amount of the deficiency payment won't be determined until the unknown future date when the FCC re-auctions the licenses that DISH's entities defaulted on, these encumbrances will likely impede monetization.

²⁷ See 3GPP TSG-RAN Working Group 4 document R4-155921, "Text Proposal for TR 36.869: Section 7.2 Interoperability by Means of CA": "there may be some concerns that mandating intra-band CA precludes low cost (i.e. non-CA) UEs and MTC devices from being supported in the band. Therefore, a compromise solution to address both interoperability and low cost UE concerns in the band is proposed, which is to mandate intra-band CA to CA-capable UEs only."

second-class status within Band 66 was to enable “low cost” user devices to support Band 66 *without* supporting DISH’s spectrum.

Today, according to Sprint, only 21% of postpaid phones support carrier aggregation.²⁸ While this figure will likely grow over time – Sprint also disclosed that 76% of *new* phones sold support it – it’s unlikely to become 100% any time soon, especially given the [trend](#) toward lower phone turnover. Furthermore, certain carrier-aggregation-capable devices²⁹ only support a maximum combined downlink bandwidth of 20 MHz. Such a device, if already enjoying 10 or 20 MHz of downlink bandwidth on its primary band, would only be able to use 0 to 10 MHz of DISH’s upper AWS-4 – *not* the full 20 MHz.

Furthermore, while Band 66 is a superset of the widely used AWS-1 band (Band 4), carriers are unlikely to deploy Band 66 equipment unless they have AWS-3 spectrum in a given market. But Verizon, for instance, owns no AWS-3 spectrum in New York or Chicago; T-Mobile owns no AWS-3 spectrum in any of the top nine metro areas. If Verizon later acquires or leases DISH’s upper AWS-4 spectrum in these areas, it would likely need to rip out its Band 4 equipment and replace it with Band 66 – a far more grueling and costly undertaking than DISH bulls seem to appreciate. Meanwhile, Sprint doesn’t use AWS spectrum, making it incapable of benefiting from DISH’s upper AWS-4 at all,³⁰ further shrinking the pool of interested parties.

In short, though DISH glosses over these inconvenient details, the carrier-aggregation-related limits on DISH’s upper AWS-4 spectrum make it materially less valuable than the core AWS-3 portion of Band 66, with permanently lower device support and reduced usability even for a subset of devices that *will* support it. As a result, we believe it is generous to value upper AWS-4 at a 15% haircut to our assumed nationwide paired AWS-3 price of \$0.75/MHz-pop.

- **AWS-3 unpaired uplink/lower AWS-4/upper H Block** (1695-1710 MHz / 1995-2020 MHz): Based on DISH’s recent [press release](#) about the 3GPP standardization process, we believe that this proposed Franken-band represents its current strategy for cobbling together some value out of wholly non-standard spectrum that, in its original form, no one else wanted. The AWS-3 unpaired uplink spectrum that DISH purchased did not attract any serious carrier bids, nor did the earlier H Block auction. But if carriers were unwilling to pay \$0.50/MHz-pop for the H Block before, there’s no reason why’d they pay DISH anything more for this “mega H Block” now.

²⁸ Capital IQ transcript of Sprint FY2016 Q3 earnings call, January 26, 2016.

²⁹ LTE Cat 4 UEs.

³⁰ At least under current LTE standards. It’s possible that future standards may allow the aggregation of the upper AWS-4 portion of Band 66 with e.g. Sprint’s 850MHz spectrum, but no such carrier-aggregation cases are currently defined, let alone supported by devices.

In addition, with its unusual, asymmetric 15+25 MHz structure, it raises carrier-aggregation issues similar to those that affect the upper AWS-4 band: under current draft rules,³¹ the first iteration of the band would only allow, at most, 15+15 MHz of bandwidth, wasting a *minimum* of 10 MHz (40%) of the available downlink – more in certain locations where other licensees own a portion of the uplink band or where the need to coordinate with incumbent government users of the spectrum in 27 protection zones³² restricts operations. Future standards will likely allow intra-band carrier aggregation, enabling some hypothetical devices to access the full downlink band, but, again, only if they are high-end enough to support carrier aggregation in the first place.

Setting technical complications aside, the most important problem is that the band simply has no advocate on the planet besides DISH. While Verizon and AT&T could likely create an ecosystem around this band if they chose to, they're well aware of their own power and wouldn't leak that value to DISH by overpaying for orphan spectrum. Thus we value this band at a 20% discount to the H Block auction price: \$0.40/MHz-pop.

- **Lower H Block** (1915-1920 MHz): Left out of DISH's Franken-band is what was originally the uplink portion of the H Block, which sits adjacent to the PCS uplink band. We highly doubt that a narrow, isolated, non-standard, unpaired uplink band will garner any market interest and thus ascribe no value to it.
- **700MHz E Block** (722-728 MHz): Though it does belong to a proper 3GPP band ([Band 29](#)), this small piece of downlink-only spectrum is little used in the real world even though AT&T owns a large piece of it (as well as the entire adjacent band). Because of technical problems with using carrier aggregation to combine two different low-frequency bands, the 700MHz E Block can only be aggregated with a higher-frequency band like AWS or PCS that suffers from inferior propagation – thereby forfeiting the key advantage of 700MHz. As a result, the E Block, despite being low-band spectrum, should be valued like mid-band. We estimate that AT&T purchased 700MHz D and E Block spectrum from Qualcomm in 2010 at a 6% premium to the pricing that prevailed in the 2008 700MHz auction; applying the same premium to DISH's original purchase price would generate a price per MHz-pop of \$0.52. However, AT&T likely regrets its former purchase, given its subsequent inability to exploit the spectrum on a meaningful scale. Thus, we apply a discount and value this band at \$0.40/MHz-pop.

This band-by-band analysis is summarized below. In the aggregate, we value DISH's cellular spectrum at \$11.5 billion gross.

³¹ See 3GPP TR 36.749 V0.1.0 (2016-02).

³² These zones include portions of the Miami, Sacramento, Boulder, Kansas City, and Knoxville metro areas, among others.

Breakdown of DISH's Spectrum Portfolio by Band and Kerrisdale-Estimated Value

	MHz- pops (B)	Price (\$/MHz- pop)	Total value (\$B)
AWS-3 paired	2.6	\$ 0.83	\$ 2.2
Upper AWS-4	6.3	0.64	4.0
AWS-3 unpaired, lower AWS-4, lower H Block	11.8	0.40	4.7
Upper H Block	1.6	-	-
700MHz E Block	1.4	0.40	0.6
Total	23.7	\$ 0.48	\$ 11.5

Source: company filings, Kerrisdale analysis

However, there is one more effect to take into account. After the FCC denied DISH the “small business” discounts that it thought it had obtained by bidding through its designated entities, DISH chose to selectively default, paying for only a subset of the licenses it had won. In addition to assessing a penalty for this behavior, the FCC put DISH on the hook for any shortfall relative to its original purchase price when the agency ultimately re-auctions the forfeited licenses. Overall, DISH’s bids for these licenses totaled \$3.4 billion; assuming that their value declines 72% from the inflated auction price, DISH will therefore be liable for an additional \$2.5 billion – a pure loss.³³ Netting this cost against the \$11.5 billion in gross spectrum value, we find that the overall fair value of DISH’s portfolio is ~\$9 billion, or roughly half of what the market implies. And this estimate doesn’t even consider DISH’s costly and challenging buildout deadlines, further discussed below.

It’s been easy for investors to buy into the DISH narrative because its underpinnings – more smartphones, more data traffic, ever rising spectrum prices – seemed so unassailable. As the spectrum market reverses direction, however, the narrative has stopped lining up with reality. DISH “put every damn egg” it had into one basket; now the basket is starting to slip.

³³ Using our estimates, DISH will be entitled to a partial refund of the \$516 million interim payment made to the FCC in 2015, partially offsetting the larger deficiency payment. However, in five years DISH will also need to pay a contractually defined “put price” to the controlling minority investors in the designated entities, SNR and Northstar, that legally hold its AWS-3 licenses; we estimate this price to be \$562 million, based on a 20% annually compounded return on the \$226 million of capital contributed by those minority investors. At a 10% discount rate, the present value of this put liability is \$349 million, roughly equal to the \$373 million FCC refund that, on our numbers, DISH will eventually receive.

V. Time Is Not on DISH's Side

Some observers contend that there's no need for DISH to rush into a deal now. If Verizon wants to talk tough, let it; as traffic grows and its network struggles under the burden, it will eventually come crawling back to the negotiating table. As explained above, we dissent from this view – but even if we didn't, time is not on DISH's side, and the clock is ticking.

As part of its standard operating procedure, the FCC requires licensees to provide specified minimum levels of coverage in their markets by specific dates; the purpose is to prevent wasteful spectrum warehousing. While the agency has, in many circumstances, granted extensions and waivers – including to DISH – licensees aren't entitled to leniency, and some fairly large spectrum holders (like FiberTower³⁴) have indeed been stripped of their holdings for failing to comply with buildout requirements. Because DISH has acquired its spectrum in several different transactions, it faces a range of deadlines, summarized below:

- AWS-4
 - 40% coverage (by population) by March 2017
 - 70% coverage by March 2021
 - If the first deadline is missed, then the second one moves up to March 2020.
- 700MHz E Block
 - Same timeline as AWS-4.
- H Block
 - 40% coverage by April 2018
 - 75% coverage by April 2024
 - If the first deadline is missed, then the second moves up to April 2022.
- AWS-3
 - 40% coverage by October 2021
 - 75% coverage by October 2027
 - If the first deadline is missed, then the second one moves up to October 2025.

With no sign of any buildout underway, DISH's March 2017 and April 2018 deadlines for providing coverage and offering service to 40% of the US population are already as good as missed. There just isn't enough time to go from a standing start to covering some 125 million people – especially without any existing infrastructure. That moves the focus to March 2020, when DISH must achieve 70% coverage via AWS-4 and the 700MHz E Block, and April 2022, when it must achieve 75% coverage via the H Block. March 2020 is less than four years away. All the carriers are currently knee-deep in network engineering to make use of their existing spectrum – Verizon, for instance, has publicly [sketched out](#) its spectrum roadmap through “2019+.” Since no carrier has any particular need for DISH's non-standard spectrum, there's no compelling reason to alter current plans to accommodate strange new bands. That puts DISH in

³⁴ See e.g. Fletcher, Heald & Hildreth's summary of the FiberTower situation in [FHH Telecom Law](#), Dec. 2012 (p. 3).

a weak bargaining position, because it needs to find a deal in the next few years, while the carriers can comfortably wait. The nearer the deadline looms, the more the carriers can squeeze DISH.

Indeed, meeting the March 2020 deadline in a manner consistent with the spirit of the build-out requirements³⁵ is likely already impossible. In May 2012, DISH's vice president for wireless development said, in a sworn statement,³⁶ that, "[b]ased on an ambitious buildout schedule, DISH believes it can deploy its network to 60 million people ('POPs') within four years." But 60 million people is less than 20% of the country's population; in the next four years, DISH (*or any entity it sells its licenses to*) has to cover **3.5x** that many people. While DISH once argued that "[e]ven at four years, a 30 percent POPs coverage requirement is aggressive and likely unrealistic,"³⁷ it now faces a vastly more stringent requirement over an even shorter timeframe. Leasing or selling the spectrum doesn't fix the problem – the same 2020 deadline will apply to whoever holds the licenses.

DISH can't demand an extension from the FCC simply on the grounds that it wants to wait longer to hold out for a bigger check from Verizon or AT&T; it likely needs to claim (disingenuously, in our view) that circumstances beyond its control prevented a big enough build-out.³⁸ If it literally makes no attempt to build anything from now until 2020, it will almost certainly lose its licenses. Thus DISH's best choice is, as quickly as possible, to create what some call a "save build" – a wasteful, low-performing network that exists not to serve customers but to just barely satisfy regulatory requirements and keep licenses in good standing. But DISH needs to cover 70% of the population in *each* of 176 "Economic Areas" – a tall order. For smaller carriers, achieving near-nationwide coverage has cost ~\$30 billion.³⁹ Based on our discussions with industry experts and participants, we believe that, by cutting almost every corner, DISH *might* be able to achieve 70% coverage in four years with only 20,000 cell sites (prioritizing the tallest towers to reach the furthest at the lowest cost) and an average equipment cost per cell site of ~\$160,000, for a total investment of \$3.2 billion – a tenth of the cost of an actually functional network that any consumer would want to use.

Without *some* Potemkin village of a network, DISH is at extreme risk of seeing its most valuable assets evaporate overnight. Even with such a ruse, however, the FCC might still have a hard time concluding that DISH was truly providing "reliable coverage" or meaningful "service"; much

³⁵ In the AWS-4 Report & Order, the FCC said, "As an initial matter, we observe that the incumbent 2 GHz MSS licensees [*owned and controlled by DISH*] generally support our seven year end-of-term build-out benchmark and have committed to '**aggressively build-out a broadband network**' if they receive terrestrial authority to operate in the AWS-4 band. **We expect this commitment to be met...**" (emphasis added).

³⁶ Exhibit 2 of DISH's [comments](#) in the AWS-4 proceeding.

³⁷ *Ibid.*

³⁸ The incorporation of the upper AWS-4 band into Band 66 (and earlier into Band 23) actually hurts DISH's ability to get an extension since it will be less able to argue that equipment was unavailable.

³⁹ Excluding intangible assets, cash, and wireless licenses, T-Mobile has ~\$29 billion of tangible assets; Sprint has ~\$30 billion.

depends on the Commission's general attitude toward the firm. If DISH *does* lose its AWS-4 licenses in 2020, then much of the rest of its spectrum portfolio will fall apart as well. Without the lower AWS-4 band, DISH's would-be Franken-band would revert to 15 MHz of unpaired uplink, which no carriers want, and the 5+5 MHz H Block, which might at best add a small amount of value to Sprint's PCS G Block – but Sprint, of course, is already long on spectrum and short on cash. With these holdings losing all realistic hopes of generating value, DISH would be left with its paired AWS-3 and 700MHz E Block spectrum, for a gross value of \$2.7 billion, largely wiped out by \$2.5 billion in AWS-3 re-auction penalties. In this scenario, DISH's equity would lose almost all of its value and decline to ~\$8 per share.

In fact, the outcome could be even worse. While we assume in our base case that DISH *does* manage to monetize almost all of its spectrum (with the minor exception of the stranded lower H Block), there's a serious risk that DISH eventually loses many of its licenses in the face of overwhelming indifference from the carriers. After all, if DISH loses its licenses, the spectrum doesn't go away; the FCC would likely re-auction it, complete with new, extended buildout deadlines. To the extent a carrier actually was interested in DISH's spectrum at some point in the future, it's not at all obvious that buying it from DISH is a better option than simply waiting for the FCC to take it back and then buying it at auction.

While some DISH bulls continue to dismiss the FCC's deadlines as toothless, DISH's envelope-pushing tactics have earned it no friends in Washington; whatever goodwill it once enjoyed as a potential disruptor of the perceived carrier oligopoly has now evaporated. The FCC has no reason to give DISH special treatment. And this suits the oligopoly just fine. With no impending spectrum crisis to further jack up prices, and with even more spectrum coming to market in the 600MHz auction and beyond, the carriers have the upper hand against DISH, and they know it.

VI. DISH's Core TV Business Is Weak

Borrowing from the sell-side consensus and valuing DISH's pay-TV business at ~5x annual EBITDA of ~\$3 billion, we find that almost all the value of that business flows to debt holders; as a result, the vast majority of DISH's equity value (84%) stems from spectrum. A keen focus on spectrum is thus appropriate. However, it's worth remembering all the difficulties that DISH's satellite operations face.

The challenges posed by the rise of “cord cutters” and “cord nevers” are widely discussed with respect to cable operators, but cable can at least supply internet connectivity to retain customers (at a higher profit margin). DISH can't. This problem has existed for years, but, as low-cost alternatives to conventional pay TV like Netflix and Hulu continue to improve and grow, DISH is particularly at risk because, based on our discussions with industry participants, its customer base is skewed heavily toward low-income and price-sensitive households. DirecTV has long boasted higher ARPU, for instance (driven in part by its expensive but exclusive and very sticky [NFL Sunday Ticket](#) product), and DISH has tended to offer steeper promotional discounts. Today, DISH is increasingly squeezed between, on the one hand, cable operators

offering internet access and video for not much more than DISH charges for TV only and, on the other hand, over-the-top services providing content in a different format but at a much lower price. As the pay TV industry moves more toward “skinny bundles” offering fewer channels for a lower monthly rate, DISH’s value-conscious customers are especially likely to be tempted away by the competition. Meanwhile, content providers have continued to hike their prices, driving relentless margin contraction for DISH (partially mitigated by the company’s unusually sharp-elbowed negotiations).

While consensus expects fairly stable earnings for as far as the eye can see, which we incorporate into our base case, we also consider an adverse scenario that simply extrapolates the two key trends just described: customer attrition and content-cost inflation. Adjusting for subscribers to DISH’s new over-the-top service, to which we will return, DISH’s pay-TV subscribers fell 4% year-over-year in 2016 Q1.⁴⁰ If this trend persist or deepens, DISH could easily lose another 5 to 10% of its subscribers over time. In addition, subscriber-related expenses have steadily increased for a long time, driven by content costs; in the past four years, those expenses have risen an average of 160 basis points per year as a percentage of revenue. Continuing on that trajectory for another year would take subscriber-related expenses to ~60% of revenue. Further, we assume that other expenses remain flat; DISH is already known for strict budgets and penny-pinching, suggesting that there’s little fat to cut. Taken together, these assumptions imply a 16 to 26% decrease in EBITDA. Using the same 5x multiple, this scenario would imply a pay-TV enterprise value of just ~\$11 to \$12.5 billion – within striking distance of DISH’s net debt. It doesn’t take much disruption to push the satellite subsidiary, on a standalone basis, into likely insolvency.

Illustrative Analysis of Pay-TV Earnings Power in Adverse Scenario			
	2015	5% sub loss	10% sub loss
Revenue	\$ 14,954	\$ 14,206	\$ 13,458
Expenses:			
Sub-related	8,783	8,524	8,075
As % of rev.	58.7%	60.0%	60.0%
Other (ex. D&A)	3,190	3,190	3,190
Total	11,973	11,714	11,265
EBITDA	\$ 2,980	\$ 2,492	\$ 2,193
%Δ from 2015		(16)%	(26)%

Source: company filings, Kerrisdale analysis

Can DISH’s over-the-top live streaming TV service, Sling, turn around the business? We doubt it. Less than a year after it debuted, industry observers are already writing it off. One recently

⁴⁰ We assume ~400,000 Sling subscribers, in line with the estimates cited by TV-industry analyst [Dan Rayburn](#).

[reported](#) that Sling “has seen decelerating signups since they launched in the market. There was a rush of sign ups when the service came out, but now, the growth has not been that impressive,” due in part to issues with video quality and user frustrations with the inability of multiple members of a household to stream different content simultaneously. Another [pundit](#) even provocatively predicted that Sling TV would be dead by the end of 2016:

The streaming service...is buggy. Since its introduction last January, it has suffered major technical failures during several highly-watched shows, such as college basketball's Final Four, episodes of *Game of Thrones* and *The Walking Dead*, and even the mid-season finale of *Pretty Little Liars*. Numerous Sling TV users report the picture either freezes or goes black during such high-profile programs, or they have difficulty logging in.

It's become undeniably clear that Sling TV is not equipped to guarantee a reliable stream when a large number of people tune in.

The technical snafus have created negative word-of-mouth for the service, which has kept subscriber totals under 500,000 according to several analysts.

...So I can't see Sling TV's service improving much over the next year, which will significantly hurt its subscription efforts. Consequently, at some point, I predict that Dish will pull the plug because it will be more trouble than it's worth.

While we expect DISH to give Sling more time to prove itself, the product's mediocrity is a reminder that competing against the likes of Netflix is easier said than done. Moreover, even if the product did take off, it would likely be a Pyrrhic victory: given the relatively low price of Sling but the high cost of some of its content, particularly ESPN, Sling is doomed to low margins, and, given its potential appeal to DISH's price-sensitive satellite subscribers, it runs the risk of cannibalizing the more lucrative core product. Even if Sling sticks around, there's no easy way for DISH to overcome the weakness of the pay TV sector and its own particularly weak position within it.

VII. Conclusion

DISH Network: Consensus Valuation vs. Kerrisdale View			
	Market	Kerrisdale	
	consensus	Base	Adverse
Pay-TV enterprise value	\$ 15,000	\$ 15,000	\$ 15,000
Less: net debt*	11,381	11,381	11,381
Pay-TV equity value	\$ 3,619	\$ 3,619	\$ 3,619
Spectrum value†	18,497	5,646	118
Total equity fair value	\$ 22,117	\$ 9,266	\$ 3,737
Equity FV per share	\$ 48	\$ 20	\$ 8
Equity downside		(58)%	(83)%

Source: company filings, sell-side reports, Kerrisdale analysis

*Long-term debt and capital lease obligations net of cash and marketable investment securities.

†Incorporates (1) cost of AWS-3 auction penalty based on difference between DISH's original bids and our estimate of the fair value of the spectrum in question, (2) estimated minimum cost of meeting the AWS-4 performance requirements by March 7, 2020, and (3) present value of designated-entity put price

Combining the consensus view of the value of DISH's TV business with our band-by-band analysis of the value of its spectrum portfolio, we arrive at an equity fair value of \$20 per share, 58% below the current stock price. In a less probable but still quite plausible adverse scenario, in which DISH loses its AWS-4 spectrum as a result of missed buildout deadlines, fair value drops down to just \$8 per share. From there, even modest additional impairment to the satellite-TV business would threaten to wipe out the equity entirely.

Such price targets may seem hard to swallow; DISH's swagger alone has convinced many that, no matter how much it seems like there's no real plan, everything will somehow work out anyway. But, considered dispassionately, DISH's current strategic direction was always a dangerous longshot: leveraging up a slowly decaying business to double and triple down on an illiquid, highly specialized, highly regulated, limited-life, non-cash-flowing asset with only two to three plausible buyers. DISH has outlived many skeptics over the years, but, in investing as in gambling, there's such a thing as pressing your luck.

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