Incentive Auction

What Did We Learn?

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The Incentive Auction Worked!

**Objective:** Transition spectrum to its highest and best use. The Broadband Plan had identified a looming spectrum crisis and earmarked 600MHz Broadcast spectrum as one of the bands that could be reallocated. The problem was that it was being used by the broadcasters. The FCC adopted a novel auction mechanism that enabled buyers and sellers to transact and allowed for the discovery of the market clearing price.

<table>
<thead>
<tr>
<th>Initial Forecast</th>
<th>Revised Forecast</th>
<th>Final Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>0MHz Cleared</td>
<td>40-60MHz Cleared</td>
<td>70MHz Cleared</td>
</tr>
</tbody>
</table>

Source: Company data, FCC, New Street Research estimates
Only One Major Complaint: Price Broadcasters Received Was Low

• **Primary Objective Achieved:** 70MHz of licensed spectrum acquired by carriers and others that will eventually put it to work; 14MHz available for unlicensed; $7BN raised for the treasury; most of the Broadcasters that vacated spectrum remain on the air.

• **Broadcasters may be less enthusiastic about the benefits to the wireless industry.** Materials circulated by the FCC raised hopes that proceeds could be as high as $45BN. Actual proceeds to the broadcasters of $10BN fell well short of this. For many this was a windfall...just not the windfall that perhaps they had hoped for when they decided to participate.

• **Potential long-term cost:** Broadcasters may be less inclined to participate in voluntary auctions like this in future (and they are still sitting on a large amount of spectrum that the wireless industry may need). In addition, others that have valuable spectrum that might be repurposed may be less willing to engage in auctions of this nature because of the experience of broadcasters.

Source: Company data, FCC, New Street Research estimates
By The Time Auction Started, The Incumbents Lost Interest

AT&T

“The timing of [the auction] is it fits in that post 2020 era. Its characteristics for us are dramatically different than the AWS auction, because of the timing where you get the spectrum into use, the complexity of clearing, and all those sorts of things. And so the footprint characteristic of it being low band is less valuable to the industry than any low band prior to this, because for all the reasons we just discussed, the density of the networks are going to, over the next four years, move so far that 600 AWS is going to be -- it will help in more rural areas to get the propagation.”

-Randall Stephenson, CEO (UBS Conf. Dec. ‘15)

Verizon

“...600 is good spectrum. But there are places I could use it but there’s a lot of places I can’t. I would never deploy 600 in the city of New York, it just wouldn’t make engineering sense or financial sense to do that.

We can gather capacity much more efficiently through small cell and densification rather than 600.”

-Fran Shammo, CFO (UBS Conf. Dec. ‘15)

Source: Company data, FCC, New Street Research estimates
Price Was Low Due To Timing...

The timing of the auction likely hampered proceeds, as the FCC was attempting to increase carrier spectrum by nearly 40% over the course of ~2 years between Auction 97 (AWS-3) and Auction 1001 (600MHz). This resulted in over $61BN in proceeds across the auctions, more than the amount raised in nearly all major auctions previously.¹

![MHz Owned By Carriers](chart1)

![$ Invested By Carriers](chart2)

1) Only includes FCC auctions for PCS, 700MHz, and AWS bands. Assumes $500MM in lottery spend for cellular / SMR licenses in 1989 (and prior).

Source: Company data, FCC, New Street Research estimates
...And Due To “Shadow Supply”...

Alternatives to 600MHz accounted for ~140MHz, double what was auctioned. This shadow supply was more than 20% of all the spectrum in the hands of carriers at the time of the auction (more than one third if you exclude 2.5GHz). The alternatives may have been better spectrum for the larger carriers’ current needs than the spectrum that was being auctioned.

Source: Company data, FCC, New Street Research estimates
...And Because Of The Kind Of Spectrum It Was...

Proceeds in spectrum auctions are largely determined by VZ and AT&T bidding behavior - they control ~75% of industry subscribers and generate ~95% of industry FCF\(^1\). VZ and AT&T already had significant low-band spectrum holdings. There was no prospect of foreclosure. What they need most is mid and high-band.

**Low Band Spectrum Holdings**

- **MHz**
- VZ: 47
- AT&T: 57
- TMUS: 10
- Sprint: 14

**2016 FCF\(^1\)**

- **$ in millions**
- VZ: 13,908
- AT&T: 16,936
- TMUS: 484
- Sprint: 324

1) VZ FCF adds back a $3BN tax hit from the sale of wireline properties, and $5BN from ABS sales that did not benefit reported FCF. TMUS includes $1BN in drag from financed capex.

Source: Company data, FCC, New Street Research estimates
The industry generates less than $11BN annually in true FCF after dividends with which to invest in spectrum and other assets. Their balance sheets are stretched: VZ, AT&T and Sprint are all at or close to their leverage thresholds. All three have made a stated commitment to de-lever.
Carriers are investing in or contemplating investments in a number of areas, including:

- **Fiber** (VZ’s Corning deal; XO acquisition; AT&T’s FTTH expansion)
- **Millimeter Wave Spectrum** (XO acquisition; Straight Path acquisition)
- **Pay-TV Distribution Scale** (DTV; potentially DISH)
- **Content** (TWX acquisition; potentially Disney or CBS)
- **Digital Media & Platforms** (AOL; Yahoo)
- **IOT** (Telematics acquisitions)

Source: Company data, FCC, New Street Research estimates
Policy Has A Tough Time keeping Pace With Technology

The auction was conceived in a 2G / 3G world. By the time the auction happened, the carriers had completed their 4G network deployments and were already starting to look ahead to 5G. By the time the spectrum becomes available, we will be firmly in a 5G world.

600MHz Auction Timeline

FCC National Broadband Plan released
600MHz Reverse Auction begins
Spectrum NPRM released
Auction rules issued for public notice
600MHz Forward Auction Begins
600MHz Forward Auction Ends
Majority of 600MHz expected to be available for deployment

Wireless Technology Deployment Cycles

3G
4G LTE
Preparation For 5G

Source: Company data, FCC, New Street Research estimates
Spectrum Needs And Values Are Changing

Prior to 2013, low-band routinely fetched 2x the amount of mid-band. The perceived value of mid-band vs low-band started to shift after VZ deployed LTE on 700MHz. By the AWS-3 auction in 2015, mid-band sold for more than 2x the last significant low-band transaction. The incentive auction was conceived in an era when low-band was the most valuable spectrum, and executed in an era when focus had shifted to higher bands.

1) Indexes reported values to national auction prices for all transactions, save VZ-SpectrumCo and auctions themselves. Source: Company data, FCC, New Street Research estimates
Delaying The Auction Would Have Had a Cost

Traffic growth has been accelerating as competition heats up, nearing 50% per user in 1Q17. We believe growth accelerated even further following the launch of unlimited mid-way through the quarter. T-Mobile is driving innovation and lower prices across the industry; without more spectrum they would run out of capacity and would have to pull back on competition at some point.

Source: Company data, FCC, New Street Research estimates
And (Controversially) Timing May Have Been Pro-Competitive

The timing of the auction was not ideal for Verizon and AT&T; however, this allowed T-Mobile to acquire ~30MHz of spectrum at an attractive price. T-Mobile now has as much spectrum as Verizon with less than half the subs.

Source: Company data, FCC, New Street Research estimates
Excess Capacity At Challengers Good For Prices & Innovation

The fact that TMUS and Sprint now have ~2x the capacity per subscriber compared to VZ and AT&T should be good for consumer pricing as additional capacity should translate into lower marginal costs for the challengers. In addition, it has allowed for innovation in consumer offerings.

Source: Company data, FCC, New Street Research estimates
The Scorecard: Not A Bad Outcome...

Bands Identified In National Broadband Plan (<3.5GHz)

<table>
<thead>
<tr>
<th>Band</th>
<th>Planned MHz</th>
<th>Actual MHZ</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>WCS</td>
<td>20</td>
<td>30</td>
<td>+10</td>
</tr>
<tr>
<td>AWS-2/3</td>
<td>60</td>
<td>75</td>
<td>+15</td>
</tr>
<tr>
<td>D Block</td>
<td>10</td>
<td>20</td>
<td>+10</td>
</tr>
<tr>
<td>MSS</td>
<td>90</td>
<td>40</td>
<td>-50</td>
</tr>
<tr>
<td>Broadcast TV</td>
<td>120</td>
<td>70</td>
<td>-50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>300</strong></td>
<td><strong>235</strong></td>
<td><strong>-65</strong></td>
</tr>
</tbody>
</table>

Source: Company data, FCC, New Street Research estimates
## Summary

<table>
<thead>
<tr>
<th>Holder</th>
<th>MHz</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ligado</td>
<td>~40</td>
<td>Ligado is currently seeking terrestrial authorization for ~30MHz of MSS spectrum, with only Iridium and DOT opposing. We suspect that the outcome of the proceeding will be known over the next 6-12 months. In addition, they are petitioning the FCC to auction another 5MHz currently held by NOAA, a process which is likely to stretch beyond 2017.</td>
</tr>
<tr>
<td>Globalstar</td>
<td>~11.5</td>
<td>Globalstar has 11.5 MHz of 2.4GHz spectrum covering entire United States that has been approved by the FCC for terrestrial use with power limitations.</td>
</tr>
<tr>
<td>Others</td>
<td>?</td>
<td>There are other smaller bands, like Pacific Datavision’s 900MHz SMR licenses. And others. And at some point, the Broadcasters may be back...</td>
</tr>
</tbody>
</table>

Source: Company data, FCC, New Street Research estimates
Things to Reconsider

- Reserves
- DE Discounts
- Channel size

Source: Company data, FCC, New Street Research estimates
A Challenge: Two Pieces Of Analysis to Consider

Our analysis of wireless markets globally suggests that the distribution of share of rather than the number of carriers determines pricing behavior. In addition, given high fixed costs, it is highly unlikely that four carriers could earn their cost of capital simultaneously (we haven’t seen it occur in over a decade, even with Sprint massively under-investing). A four carrier market may be both fundamentally unsustainable and unnecessary.

R-Squared Between Pricing And Indicators Of Market Concentration

Industry ROIC

Source: Company data, FCC, New Street Research estimates
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