

# ***2016 SPECTRUM DEVELOPMENTS***

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# Overview

- **The Intense Focus on Spectrum**
- **The Players**
- **Licensing to Address Commercial Spectrum Needs**
- **Sharing to Address Commercial Spectrum Needs**
- **Other Hot Topics**

# Spectrum Issues Front and Center

- **Increasing reliance on mobile for voice, video and data**
  - ~40% of U.S. households are now wireless-only
- **Demand will skyrocket with 5G/Internet of Things development**
  - Mobile data traffic increased 74% from 2014 to 2015
  - By 2020, traffic expected to increase more than 8x (52.6% CAGR)
    - 30.6 exabytes/month v. 3.7 exabytes/month (Note: one exabyte = 1 billion GBs)
  - 70% of global population will be mobile users by 2020
- **Both licensed and unlicensed spectrum have enormous value**
  - Licensed spectrum generated >\$400B in U.S. economic activity in 2013
  - Unlicensed added \$222B of value to U.S. economy in 2013
- **Prevailing Goals of U.S. Spectrum Policy**
  - Make more spectrum available for mobile broadband
  - Enhance spectrum efficiency

# Addressing Future Spectrum Needs



- License more spectrum, including repurposing through “Incentive Auctions”
- Develop new ways for spectrum to be shared by multiple users

# The Current FCC



- **Chairman**
  - Tom Wheeler (D) (June 2018)
- **Commissioners**
  - Mignon Clyburn (D) (June 2017)
  - Jessica Rosenworcel (D) (June 2015 – renomination pending)
  - Ajit Pai (R) (June 2016)
  - Michael O’Rielly (R) (June 2019)

# Other Major Federal Players



## Congress

- Has power to dictate spectrum policy



## The White House

- Influential spectrum policy role when it wants
- OSTP/CTO plays a coordinating role



## NTIA

- Manages all federal government use of spectrum



## DoD and other agencies

- Mission-critical and other incumbent systems

# What Have You Done For Me Lately?

- **Advanced Wireless Service-3 (AWS-3) Auction**
  - 65 MHz of mid-band spectrum repurposed
    - 1755-1780/2155-2180 MHz paired (adjacent to AWS-1 band)
    - 1695-1710 MHz unpaired, uplink
  - 6 licenses in each market
    - 4 paired: three 5x5 MHz and one 10x10 MHz
    - 2 unpaired: 5 MHz and 10 MHz
  - Auction ended January 29, 2015

# The AWS-3 Auction: Results and Implications

- **Generated \$41.3 Billion**
  - Much more than forecast
  - High-capacity → high value
- **AT&T, Verizon, DISH, T-Mobile all won licenses**
- **Not without controversy: DISH and the DE program**
- **Culmination of years of effort by NTIA, federal agencies, CSMAC, wireless industry, policymakers**
  - Transitional sharing prior to federal relocation
  - Permanent sharing with some federal systems



**The Hottest Hot Topic Today Is ...**

***THE FCC'S  
BROADCAST INCENTIVE  
AUCTION***

# Incentive Auctions

- **2002 – FCC staff: 2-sided spectrum auction could work**
- **2010 – FCC National Broadband Plan: use IA for UHF TV**
- **2012 Spectrum Act requires FCC to conduct it by 2022**
  - Unlike any prior spectrum auction
  - Wheeler FCC determined to complete it on his watch
- **Auction design is highly complex**
- **Now in the FCC auction “quiet period”**

# What's Required for Auction Success?

- **Enough broadcasters must agree to relinquish TV spectrum usage rights**
- **Wireless providers must bid enough to cover:**
  - Payments to clearing TV stations
  - Costs to reimburse stations that are repacked (\$1.75 B)
  - FCC administrative costs
- **FCC took the first step to success in Fall 2015 ...**

# First Step to Success

- **FCC offered high opening prices for TV stations**
  - Highest Go Off-Air opening price in DMA1 (NY) = **\$900MM**
  - Highest Go Off-Air opening price in DMA100 (Ft. Smith) = **\$145MM**
  - Average Go Off-Air opening price in Top 100 DMAs = **~\$412MM**



- **Enough interest from broadcasters generated for FCC to set a target to clear 126 MHz for mobile broadband**

# 600 MHz Band Plan

- New mobile broadband licenses (in blue) will be 5x5 MHz paired
- Band plan will change if auction needs multiple stages

| MHz to be Cleared | UHF TV Channels |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |   |   |            |            |            |            |            |            |
|-------------------|-----------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|---|---|------------|------------|------------|------------|------------|------------|
| 42                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 11 | A  | B  | 11 | A | B | 700 MHz UL |            |            |            |            |            |
| 48                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 7  | A  | B  | C  | 11 | A | B | C          | 700 MHz UL |            |            |            |            |
| 60                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 9  | A  | B  | C  | D  | 11 | A  | B | C | D          | 700 MHz UL |            |            |            |            |
| 72                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 11 | A  | B  | C  | D  | E  | 11 | A  | B  | C | D | E          | 700 MHz UL |            |            |            |            |
| 78                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 7  | A  | B  | C  | D  | E  | F  | 11 | A  | B  | C | D | E          | F          | 700 MHz UL |            |            |            |
| 84                | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 3  | A  | B  | C  | D  | E  | F  | G  | 11 | A  | B  | C | D | E          | F          | G          | 700 MHz UL |            |            |
| 108               | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 11 | A  | B  | 3  | 37 | 3  | C  | D  | F  | F  | G  | H  | 11 | A  | B  | C  | D | E | F          | G          | H          | 700 MHz UL |            |            |
| 114               | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 7  | A  | B  | C  | D  | 3  | 37 | 3  | E  | F  | G  | H  | I  | 11 | A  | B  | C  | D | E | F          | G          | H          | I          | 700 MHz UL |            |
| 126               | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 9  | A  | B  | C  | D  | E  | F  | 3  | 37 | 3  | G  | H  | I  | J  | 11 | A  | B  | C  | D  | E | F | G          | H          | I          | J          | 700 MHz UL |            |
| 138               | 21              | 22 | 23 | 24 | 25 | 26 | 27 | 11 | A  | B  | C  | D  | E  | F  | G  | H  | 3  | 37 | 3  | I  | J  | K  | 11 | A  | B  | C  | D  | E  | F | G | H          | I          | J          | K          | 700 MHz UL |            |
| 144               | 21              | 22 | 23 | 24 | 25 | 26 | 7  | A  | B  | C  | D  | E  | F  | G  | H  | I  | J  | 3  | 37 | 3  | K  | L  | 11 | A  | B  | C  | D  | E  | F | G | H          | I          | J          | K          | L          | 700 MHz UL |

Key: Blue = New 600 MHz Band licenses  
 Grey = Duplex Gap/Guard Bands  
 White = Post-Auction UHF TV Band  
 Orange = Channel 37 (protected)

# Incentive Auction – The Basics

- **Three interdependent elements:**
  - **Reverse Auction** – descending clock auction determines which TV stations will be paid to clear, and how much they will receive
    - “Repacking feasibility” check every round – determines prices paid to stations
  - **Forward Auction** – ascending clock auction (plus assignment phase) determines which wireless bidders get new licenses, and for how much
    - Bidders express demand in clock rounds at prices specified by the FCC
  - **Repacking** – remaining stations rearranged with a smaller TV band
- **Options for full-power and Class A TV stations:**
  - Relinquish spectrum and exit over-the-air broadcast business
  - Relinquish spectrum and share a channel with another station
  - Move from UHF to VHF or from High-VHF to Low-VHF
  - Sit out / drop out and be relocated

# Incentive Auction – Unlicensed

- **Spectrum Act allows unlicensed use of guard bands, which were required to be “no larger than is technically reasonable to prevent harmful interference”**
- **Low-band unlicensed opportunities after the auction:**
  - Guard Bands
  - Duplex gap
  - Channel 37
  - Continued use of remaining TV White Spaces

# Incentive Auction – Timeline

- **3/29/2016: TV stations made “initial commitments” to accept opening prices**
- **5/31/2016: Reverse auction bidding will begin**
  - Reverse auction could take ~4-6 weeks
- **Early-to-mid July: Forward auction bidding will begin**
  - Forward auction could take a couple of months
- **When will the auction end?**
  - If forward auction generates high \$\$, probably ends in September
  - If not, additional stage(s) would extend the auction into 4Q
- **Repacking to take place over the following 39 months**

# Key Issues

- **For TV Broadcasters**
  - How much am I actually going to be paid to clear?
  - How will channel sharing work in reality?
- **For Wireless Providers**
  - Some spectrum is “reserved” for bidding by all but AT&T & VZ – how much will the discount be?
  - How much mobile broadband spectrum will be “impaired” by TV assignments?
  - Interference issues with unlicensed in duplex gap and guard bands
- **For Everybody**
  - Will the FCC actually be able to pull this off?

# What Can We Watch For?



- **Very little information will be available to the public until after the auction, but some things will be known:**
  - Pace of the reverse auction
  - Total amount required for payment to broadcasters
    - FCC will announce this after the reverse auction
  - Overall duration of the forward auction
  - Has the “Final Stage Rule” been met?
    - FCC will announce this when it occurs

# New Sharing Paradigms

- **3.5 GHz – Citizens Broadband Radio Service**
- **mmW Spectrum Above 24 GHz (Spectrum Frontiers)**
- **Wi-Fi / LTE-U / LAA**
- **5 GHz**
- **New Legislative Efforts**

## 3.5 GHz (3550-3700 MHz)

- **April 2015: FCC created new “Citizens Band Radio Service”**
  - Flexibility in access model based on need for IX protection
  - Coordination between FCC, NTIA and DoD produced smaller exclusion zones
  - Small cells and sensing technology provide roadmap for nationwide commercial use
- **Three-tier access modeled after PCAST**
  - Incumbent Access: federal military radar (3550-3650 MHz) and grandfathered users
  - Priority Access Licenses (PALs): 10 MHz, census tract, 3-years (protected from GAA)
  - General Authorized Access (GAA) : up to 80 MHz + opportunistic (no IX protection)
- **Spectrum Access System (SAS) – frequency coordinator**
  - Protect higher tier users and optimize co-existence between PALs and GAA users
  - Deadline for applications to be SAS administrators was yesterday
- **May 2, 2016: FCC order finalized CBRS rules**
  - PALs must “use it or share it” – affirms preference for GAA
  - PALs may engage in some secondary market transactions

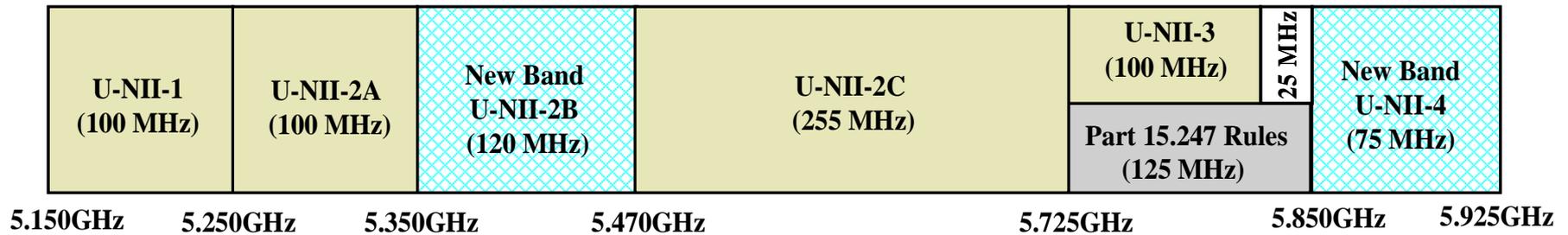
# mmW Band Rulemaking

- **Coincides with momentum toward 5G wireless**
  - High-bandwidth content with speeds in excess of 10 gigabits per second (GB/s)
  - Latency reductions to less than one-thousandth of a second
  - Lots of activity in 5G development worldwide
- **October 2014 – FCC *Notice of Inquiry***
  - Mobile services in bands above 24 GHz in context of standards for 5G services
  - Supplement to, not substitute for, lower bands; attractive for dense, high-traffic areas
- **October 2015 – FCC *Notice of Proposed Rulemaking***
  - Proposes “Upper Microwave Flexible Use Service” under a new Part 30 of FCC Rules
  - Bands: 28 GHz (incumbent LMDS), 37 GHz, 39 GHz, 60 GHz
- **FCC *Report and Order* Expected in July 2016**
  - Sharing between terrestrial and satellite users
  - Technical rules for 28 GHz sharing with grandfathered LMDS licensees
  - 37 GHz, proposals give building owners exclusive in-building use – factory implications

# Wi-Fi / LTE-U / LAA

- **Wi-Fi**
  - IEEE 802.11 standard; embedded base of > 1 billion devices
  - ~63% of U.S. households are equipped with Wi-Fi
  - Over 60% of mobile device traffic now offloaded to Wi-Fi
- **Carrier Alternative: LTE-Unlicensed and License Assisted Access**
  - Bonds unlicensed band to licensed band – a type of carrier aggregation
  - Would share spectrum with Wi-Fi; provides greater throughput than Wi-Fi
- **LTE-U devices submitted for Part 15 certification w/o standard**
  - Opponents (NCTA, Wi-Fi Alliance) concerned that LTE-U will interfere with Wi-Fi
  - Wi-Fi Alliance working with LTE-U on common testing parameters by August 2016
  - What if LTE-U device meets Part 15 rules but not the new testing parameters?
- **LAA was developed through 3GPP process**
  - LAA devices use listen-before-talk (LBT) contention protocol to co-exist with Wi-Fi devices
  - 3GPP determinations on LBT standards not completed

# 5 GHz Unlicensed



- 2014: FCC substantially modified use of the 5 GHz U-NII band**
  - More U-NII-1 power for outdoor hotspots; new U-NII-3 OBE limits protect FAA
  - Consolidated the rules applicable to U-NII-3 and set device certification deadline
- March 2016: FCC Recon Order**
  - Relaxed U-NII-3 OBE limits to help WISPs – automakers have asked for recon
  - Allowed more time for manufacturers to come into compliance with new rules
- Next up: Record refresh on U-NII-2B and U-NII-4 (195 MHz)**
  - Main U-NII-4 Issue: can DSRC share with Wi-Fi and other unlicensed uses?

## A Couple of Other Hot Topics

- **The MOBILE NOW Act**
- **Ligado (formerly LightSquared)**

# MOBILE NOW Act

- **Making Opportunities for Broadband Investment and Limiting Excessive and Needless Obstacles to Wireless (MOBILE NOW) Act**
  - Jointly sponsored by Sens. Thune (R-SD) and Nelson (D-FL)
  - Intent to facilitate 5G development
- **Major Components**
  - Codifies 2010 policy to free up 500 MHz for commercial use by 2020
  - Incentives for federal agencies to relinquish or share spectrum
  - Further NTIA evaluation of six bands between 24 GHz and 86 MHz
  - “Dig Once” policy for federal agencies
- **Prospects**
  - Voted out of Senate Commerce Committee on March 3, 2016
  - Very few legislative days left in this Congress, but could be “hotlined”

# Ligado (formerly LightSquared)

- **Under new control following bankruptcy**
  - Still holds L-Band satellite spectrum with ATC capability
- **Original terrestrial commercial mobile proposal**
  - Uplink at 1627.5-1637.5/1646.7-1656.7 MHz
  - Downlink at 1526-1536/1545-1555 MHz (also leasing 1670-1675 MHz)
    - GPS interests at 1559-1610 MHz objected to use of 1545-1555 MHz
    - 2012: proposed to forego 1545-1555 MHz in exchange for access to 1675-1680 MHz
- **Late 2015: reached agreement with GPS interests**
  - Agreed to limit power on all L-Band spectrum it intends to use terrestrially
- **Dec. 31, 2015: Ligado filed applications with FCC to effectuate GPS deal and gain access (per auction) to 1675-1680 MHz**
  - Comments on license modification due May 23, 2016
  - Comments on 1675-1680 MHz proposal due June 21, 2016
  - Even if successful, additional FCC rulemaking proceedings would still be needed

# Questions?

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