Digital Dividend

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Asunción, Paraguay

Alison Greenwald Neplokh
Chief Engineer
FCC Media Bureau
Agenda

- DTV Transition
- 700 MHz Band
- 600 Mhz and Beyond
  - Incentive Auctions
Timeline of US DTV Transition

- 1987 – FCC began “advanced television” proceeding
- 1996 – “Grand Alliance” adopts Advanced Television Systems Committee (ATSC) as standard for DTV
- 1997 – FCC adopted service rules and created Table of Allotments for additional channels
- 1998 – First DTV station on air
- 2006 – Congress establishes “hard deadline” for transition on February 17, 2009 and creates subsidy program for DTV converter boxes
- 2004-07 – Tuner mandate effective
- 2008 – NTIA begins distributing subsidy coupons for DTV converter boxes, Commission requires broadcasters, cable and satellite providers, manufacturers and others to provide DTV consumer education
- 2008-09 – Focus on consumer outreach activities by Commission staff, partners and contractors
- 2009 – Congress changes transition deadline to June 12, 2009
- 2015 – Digital conversion deadline for low-power, class-A, translator stations
US Regulatory Regime for Broadcasters

• **Second 6 MHz channel loaned to all incumbent broadcasters to build their transitional digital transmission facility.**
  – TV broadcasters would transmit in analog on one channel and in digital on the other channel during the transition.
  – The second channel would be returned at the end of the transition.

• **Flexible TV Broadcast Service Rules**
  – Each TV station is licensed for a 6 MHz channel that provides 19.4 Mbps.
  – One standard-definition broadcast video stream is required.
  – In addition, high-definition (HD), multicasting (multiple simultaneous streams), datacasting, mobile DTV, and other uses are permitted.
  – If a station uses part of its licensed channel for a subscription service, it must pay the government 5% of its gross revenues from the service.
Equipment / Consumer Programs

• **DTV receivers required to be built into TV sets**
  – phased-in basis, beginning with sets 36” and above, starting July 2004 and finishing with all sets and TV devices in July 2007.
  – Labeling required for sets and devices without a DTV tuner

• **Subsidy Program for DTV converter boxes**
  – Administered by NTIA
  – Two $40 coupons made available to any household to use toward the purchase of two converter boxes
  – Eligible boxes had to meet performance and feature standards set by NTIA and tested by FCC

• **Massive Consumer Outreach Program**
  – Government focused on the consumers likely to need the most attention.
  – TV stations required to air PSAs and educational programming
1,800 full power television stations broadcasting in analog that had to transition to digital.

- Includes nearly 400 that are non-commercial stations.
- Approximately 1,700 had both analog and digital channels (about 100 had no digital channel before the transition and 20 were digital only).
- Almost 800 terminated analog service before June 12, 2009 (many on February 17, 2009).
- Approximately 1,000 transitioned on June 12, 2009.
- Fewer than 10 stations did not transition and ceased broadcasting.
Scale of Transition (Consumers)

- Nearly 115 million households have one or more televisions in the US.
  - 98.9% of total 116,170,000 million households, over 300 million people overall.
- 11%, or 12.5 million households, rely exclusively on over-the-air (free) broadcasting for their access to television; that is, they do not subscribe to cable, satellite or any other pay service.
- Estimate that 40 million households have at least one TV set that relies on over-the-air (free) broadcasting, even though they have other TV sets in the household that are connected to a subscription service.
- By June 12, 2009, 97.8% of households were ready for the transition because they had a DTV set, a converter box, or subscribed to cable, satellite or another pay service.
Consumer Outreach

• Outreach efforts began in 2007.

• Focused on the consumers likely to need the most attention.
  – Targeted all TV viewers, in particular those who rely on over-the-air (terrestrial) broadcasting and do not subscribe to a pay service.
  – Also concentrated on reaching and helping senior citizens, minorities, non-English speakers, those with disabilities, low income consumers, and those living in rural areas or on tribal lands.

• Used FCC’s existing toll-free call center, 1-888-CALL-FCC.

• Created a DTV website, www.dtv.gov, containing publications, frequently asked questions, explanatory charts for installing converter boxes, troubleshooting guides, antenna information and mapping tools.
  – All publications were available in English and Spanish.
  – Key publications were translated into 29 languages.
Consumer Outreach

- Trained a team of 200 Commission staff who traveled throughout the country providing direct outreach to consumers and developing partnerships with local governmental agencies and non-governmental organizations.

- Established national partnerships with government agencies, such as the National Telecommunications and Information Administration, and industry groups representing broadcasters, television manufacturers, cable television, and retailers; as well as national consumer groups.

- Developed and implemented government-financed contracts with businesses for in-home installation services and walk-in help centers throughout the nation.
Lessons Learned

• Setting a hard date for switch-off is important (but OK to change it if necessary)

• Consistent Message is Important

• Early transition for a few markets

• “Soft tests”
  – Coordinate across all stations in a market
  – Combine with a local “call-in” center

• Pay attention to receiving antennas

• Low VHF (channels 2-6) subject to reception problems (more than anticipated)

• “Night light” service after switch-off date
Agenda

- DTV Transition
- 700 MHz Band
- 600 Mhz and Beyond
  - Incentive Auctions
The US “Digital Dividend”

- 108 MHz of UHF spectrum reclaimed in the 700 MHz band
- 74 MHz commercial use (assigned by auction) 34 MHz public safety (no auction)
  - 24 MHz pursuant to 1997 Congressional legislation
  - 10 MHz to be assigned pursuant to February 2012 Congressional legislation
- Additional value likely resides in “white space” within the remaining spectrum assigned for television service
TV SPECTRUM ALLOCATION

Before Transition: Analog and Digital TV stations allocated to Ch. 2 – 69 (each channel is 6 MHz)
After Transition: Digital TV stations allocated to Ch. 2 – 51 (i.e. “core” DTV spectrum)
  - Ch. 52 – 69 – Reclaimed for advanced wireless uses
  - Ch. 63, 64, 68 and 69 – Reallocated for public safety

Key:
- In core”/“Low VHF” channel
- “In core”/“High VHF” channel
- “In core” UHF channel
- “Out of core” channel (also referred to as “700 MHz Band”)
- Spectrum allocated for Public Safety
- Spectrum allocated to Radio Astronomy and Medical Telemetry
US Auction Results for 700 MHz Band

• Revenue
  – Net auction proceeds $19.6 billion
  – 2008 700 MHz auction (Auction 73) yielded $1.287/MHz-pop

• Timing: Auction completed prior to June, 2009 analog switch-off date

• Auction winners include
  – Major telephone companies (Verizon, ATT); wireless broadband use
  – ATT, via a secondary market transaction, acquired spectrum purchased at auction by Qualcomm
    • Qualcomm’s mobile video service (separate from ATSC DTV) operated for several years but ultimately was not profitable
  – Other
Spectrum Reallocated From Television Broadcast to Commercial Wireless and Public Safety Use

- The 698-806 MHz band ("700 MHz Band") had been occupied by television broadcasters using TV channels 52 through 69.
  - Excellent propagation characteristics for mobile use
    - Signals penetrate buildings and walls
    - Cover large geographic areas with less infrastructure than higher bands

- As a result of the DTV transition, the 700 MHz band has been made available for new commercial and public safety services.
  - 24 MHz for public safety uses
  - Remainder for commercial uses
  - In 2008, the Commission offered at auction ten megahertz of the commercial spectrum (the "D Block") with conditions designed to facilitate deployment of a nationwide, interoperable broadband public safety communications network on the adjacent public safety spectrum. Because the highest bid did not meet the reserve price, the D Block was not sold and remains with the FCC.
  - The Public Safety chapter of the National Broadband Plan describes an alternative proposal for moving forward on a public safety broadband network.
US 700 MHz Band Plan

Revised 700 MHz Band Plan for Commercial Services

<table>
<thead>
<tr>
<th>Block</th>
<th>Frequencies (MHz)</th>
<th>Bandwidth</th>
<th>Pairing</th>
<th>Area Type</th>
<th>Licenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>698-704, 728-734</td>
<td>12 MHz</td>
<td>2 x 6 MHz</td>
<td>EA</td>
<td>176</td>
</tr>
<tr>
<td>B</td>
<td>704-710, 734-740</td>
<td>12 MHz</td>
<td>2 x 6 MHz</td>
<td>CMA</td>
<td>734</td>
</tr>
<tr>
<td>C</td>
<td>710-716, 740-746</td>
<td>12 MHz</td>
<td>2 x 6 MHz</td>
<td>CMA</td>
<td>734</td>
</tr>
<tr>
<td>D</td>
<td>716-722</td>
<td>6 MHz</td>
<td>unpaired</td>
<td>EAG</td>
<td>6</td>
</tr>
<tr>
<td>E</td>
<td>722-728</td>
<td>6 MHz</td>
<td>unpaired</td>
<td>EA</td>
<td>176</td>
</tr>
<tr>
<td>C</td>
<td>746-757, 776-787</td>
<td>22 MHz</td>
<td>2 x 11 MHz</td>
<td>REAG</td>
<td>12</td>
</tr>
<tr>
<td>A</td>
<td>757-758, 787-788</td>
<td>2 MHz</td>
<td>2 x 1 MHz</td>
<td>MEA</td>
<td>52</td>
</tr>
<tr>
<td>D</td>
<td>758-763, 788-793</td>
<td>10 MHz</td>
<td>2 x 5 MHz</td>
<td>Nationwide</td>
<td>1*</td>
</tr>
<tr>
<td>B</td>
<td>775-776, 805-806</td>
<td>2 MHz</td>
<td>2 x 1 MHz</td>
<td>MEA</td>
<td>52</td>
</tr>
</tbody>
</table>

* Subject to conditions respecting a public/private partnership.

The blocks shaded above in gray (Lower 700 MHz Band C and D Blocks and Upper 700 MHz Band A and B Blocks) were auctioned prior to Auction 73.

# US & APT Plans

## US band plan

<table>
<thead>
<tr>
<th>Block size (MHz)</th>
<th>Lower band</th>
<th>Upper band</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A B C D E A B C</td>
<td>C D Public Safety C A D Public Safety</td>
</tr>
<tr>
<td>Frequency (MHz)</td>
<td>FDD TDD FDD</td>
<td>FDD TDD FDD</td>
</tr>
</tbody>
</table>

## APT FDD band plan

<table>
<thead>
<tr>
<th>Ancho (MHz)</th>
<th>5</th>
<th>45</th>
<th>10</th>
<th>45</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (MHz)</td>
<td>2</td>
<td>703</td>
<td>748</td>
<td>76</td>
<td>603</td>
</tr>
</tbody>
</table>

Source: Wikimedia Commons
RF Propagation

Signals do not stop where they are supposed to
Agenda

• DTV Transition

• 700 MHz Band

• 600 MHz and Beyond Incentive Auctions
Exponential Mobile Data Growth…

U.S. Mobile Data Traffic Growth Forecast

1 Petabyte (PB) = Approx. 1 Million Gigabytes = $10^{15}$ bytes

### ...Driven by New Technologies and Consumption Patterns...

<table>
<thead>
<tr>
<th>Device Type</th>
<th>2011 (MBs per Month)</th>
<th>2016 (MBs per Month)</th>
<th>CAGR(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Smartphone</td>
<td>4</td>
<td>108</td>
<td>91%</td>
</tr>
<tr>
<td>M2M</td>
<td>71</td>
<td>266</td>
<td>30%</td>
</tr>
<tr>
<td>Smartphone</td>
<td>150</td>
<td>2,576</td>
<td>77%</td>
</tr>
<tr>
<td>E-Book Reader</td>
<td>750</td>
<td>2,880</td>
<td>31%</td>
</tr>
<tr>
<td>Tablet</td>
<td>517</td>
<td>4,223</td>
<td>52%</td>
</tr>
<tr>
<td>Laptop</td>
<td>2,131</td>
<td>6,942</td>
<td>27%</td>
</tr>
</tbody>
</table>

(1) **NOTE:** CAGR – “Compound Annual Growth Rate.” Source: Cisco Visual Networking Index (VNI) Global Mobile Data Traffic Forecast, 2011–2016. Data is based on global averages.
Traffic growth outpacing efficiency gains by 2.5X

Traffic Growth

Technology Efficiencies

Network Density Efficiencies

Adjusted Demand Multiple

Growth In Addition To ~10X Increase in Data Offloading

Spectrum Demand Drivers (2012-2016)

750%

200%

30%

300%

Broadcast TV Allocation

TV Band Spectrum Post DTV Transition: 294 MHz

Diagram showing TV Channel Number, Frequency in MHz, LMR, TV Channels, Channel 37, TV Channels, and 700 MHz Uplink.
Efficient Reallocation of Spectrum Using Innovative Band Plans

TV Band Spectrum Before Auction (294 MHz)

- Flexible band plans to accommodate varying amounts of cleared spectrum
- Consistent downlink nationwide, varying uplink

"Generic" 5 MHz spectrum blocks

Key Post-Auction Band Plan Innovations

- Flexible band plans to accommodate varying amounts of cleared spectrum
- Consistent downlink nationwide, varying uplink
- “Generic” 5 MHz spectrum blocks
Incentive Auction Key Components

**Broadcasters**
- Offer to relinquish spectrum usage rights

**Mobile Broadband Providers**
- Offer to purchase spectrum licenses

**Reverse Auction**

**Forward Auction**

**Integration**
Incentive Auction Process Timeline

- NPRM issued October 2012
- Report & Order expected later this year
- Target Auction in 2014
• US Proposal to JTG on Agenda Item 1.1
• Recognizing the growing need for mobile spectrum 470-806/862 MHz frequency range and different national priorities among the member states for the UHF broadcasting, it is necessary for WRC-15 to adopt a regulatory solution that would:
  a) Enable administrations to preserve broadcasting and other services in the UHF range and,
  b) Allow administrations flexibility to address the mobile spectrum shortage consistent with their domestic requirements.
• Match Region III allocation
Thank you
WHITE SPACES
TV White Spaces

- TV channels are “allotted” to cities to serve the local area
- Other licensed and unlicensed services are also in TV bands
- “White Spaces” are the channels that are “unused” at any given location by licensed devices
TVWS Spectrum Availability

- Available spectrum varies by location
- In rural areas many channels are available
- In big cities only a few channels may be available
- Examples of availability in UHF channels 21 – 51 (Illustrative):

### New York

| 2 | 1 | 2 | 2 | 2 | 2 | 2 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |

### Washington, DC

| 2 | 1 | 2 | 2 | 2 | 2 | 2 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 3 | 4 | 5 | 6 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 |

- Full Service DTV Station
- Low Power TV Station
- Channel Open/ Adjacent to TV
- Channel Open/ Not Adjacent to TV

In less dense areas many channels are available. For example: Wilmington, NC: 25 channels = 150 MHz
• Both fixed and personal/portable devices may operate in the TV white spaces on an unlicensed basis

• Devices must:
  – 1) include a geolocation capability and
  – 2) access a database of protected radio services at that location to obtain a list of available channels

• Database(s) established & administered by third parties