Satellite Industry Update
New Systems and Regulatory Issues

Presented to
National Spectrum Management Association

Spectrum Management 2013

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Agenda

• Update on Some Existing Systems
• Broadband FSS Systems
• FSS Mobility
• Regulatory Update
Update on Some Existing Systems

- DARS
- LightSquared
- Big LEOS
- Little LEOS
DARS

- SiriusXM merger of Sirius Satellite and XM Radio completed in July 2008
- Services now operate over 2320-2345 MHz band
- Satellite Fleet:
  - Sirius originally employed a three (3) satellite HEO constellation
  - XM utilized GEO satellite operating at orbital slots 85° and 115° W.L.
  - Sirius migrating to all GEOs and will retire the HEOs within 2 years time, est.
- Currently there are nine Sirius XM satellites in orbit:
  - XM Band  XM1 though XM5 (one is retired),
  - Sirius HIEO S1 through S3, and
  - Sirius Band GEO FM5. FM6 is awaiting launch
- SiriusXM in process of integrating technologies at their terrestrial repeater sites
Lightsquared – Brief Recap

- Lightsquared predecessor companies begin development of an ATC to combat urban canyon effects and improve performance
- Circa 2004 FCC essentially approved the ATC plan
- 2005 FCC even lessened restrictions on ATC buildout requirements
- 2009 GPS community voiced concerns over interference
- In 2011 various technical analyses indicate harmful interference may indeed occur
- February 2012 FCC withdraws approval of ATC plan
- Fall 2012 Lightsquared files new frequency plan
Lightsquared - Regulatory Status of New Plan

• LightSquared submitted 3 filings to FCC in late 2012 to begin process of modifying its terrestrial authorization
  – Application for License Modification to allow use of 1670-1680 with L-band uplinks, replacing L-band downlinks in upper 10 MHz
  – Petition for Rulemaking to add terrestrial service allocation to 1675-1680
  – Petition for Rulemaking to reexamine service rules for L-band downlinks in lower 10 MHz

• LightSquared’s plan was placed on public notice by the FCC, with public comments received through early-January 2013

• In December 2012, the FCC confirmed that LightSquared’s terrestrial buildout milestones were no longer applicable while the issues surrounding GPS were still pending

• On April 29, the FCC granted LightSquared temporary authority necessary to begin feasibility assessment of critical elements of its proposed solution, working with NOAA
  – Similar to sharing studies being conducted by Verizon and T-Mobile with DoD
Lightsquared

Petition for Rulemaking
Filed 9/28/2012

RNSS
1559 – 1610 MHz

GPS

No Terrestrial Use

Application for License Modification
Filed 9/28/2012

Downlink:
Cell Site to User Device

Uplink:
User Device to Cell Site
Big LEOS & Little LEOS

• Orbcomm
  – Continues to offer M2M global asset monitoring and messaging services from constellation of 29 LEO satellites
  – Recently, Oct. 7, 2012, the first SpaceX Falcon 9 launch of a prototype OG2 ORBCOMM satellite from Cape Canaveral failed to achieve proper orbit

• Big LEOs – Iridium
  – Sept 2009 Iridium Satellite LLC merged with a special purpose acquisition company
  – System extensively used by the DOD

• Big LEOs – Globalstar
  – In 2007 Globalstar launched eight additional first-generation spare satellites into space
  – Between 2010 and 2013, Globalstar launched 24 second-generation satellites in an effort to restore their system to full service
  – Plans for ATC component
Broadband FSS Systems

- O3b Networks
- ViaSat – Exede
- Intelsat EPIC
- Hughes - Jupiter
- Inmarsat – Global Xpress
O3b Networks, Ltd.

- Serving Other 3 Billion People in emerging and less developed economies
- MEO constellation
- Bent-pipe
  - No on-board processing or crosslinks
- Services
  - Expand cellular backhaul
  - Provide broadband IP connectivity
O3b Networks, Ltd

- Launching June 24, 2013
- Backed by SES World Skies, Google, HSBC, Liberty Global, Allen and Company, Northbridge Venture Partners
- The initial launch of O3b includes eight satellites
  - Four ready to be launch as soon as this June, with second four in September
  - 16 additional satellite to be launch within 18 months of initial launch
- MEO orbit at 8000 km
- The coverage zone is between +/- 45 degrees of equator
ViaSat-1 Exede

- Exede Internet service from ViaSat, introduced Jan 2012 using ViaSat-1
- Located at 115.1° W.L.
- 72 Ka-band Spot Beams, 63 in U.S. and 9 in Canada
- ViaSat is launching in-flight connectivity on JetBlue this year, delivering more than 12 Mbps to the passenger.
Exede coverage map
Epic$^{NG}$

- The Intelsat Epic$^{NG}$ platform utilizes C-, Ku- and Ka-bands
- Two Intelsat Epic$^{NG}$-class satellites with expected in-service dates in 2015 and 2016
  - IS 29e serves the Americas and North Atlantic
  - IS33e in 2016 along with three more satellites to follow, total of 5 satellites
- Fully integrated with the Intelsat satellite and terrestrial infrastructure
- Expected throughput in the range of 25-60 Gbps
- Provides connectivity among multiple spot beams, including star and mesh, as well as loopback within the same user beam
- Open network allows for backward compatibility with existing networks
Jupiter 1

- EchoStar XVII, also known as Jupiter 1, is operated by Hughes Network Systems
- Launched in July 2012
- GEO Slot at 107.1° W.L.
- JUPITER will provide over 100 Gbps capacity at Ka-band using 60 spot beams
- Bent pipe architecture
Global Xpress

- Worldwide wireless broadband network by Inmarsat
- Constellation of three Inmarsat-5 satellites
- Full global coverage by end of 2014
- Offers high-speed inflight broadband services
- 89 small Ka-band beams capable of 60 Mbits/s download to 60 cm dish
- 6 steerable beams
- GX and VSAT Services
  - Download data rates of up to 50 Mbit/s
FSS Mobility

- AESS
- ESV
- VMES
- ESOMPS
Aeronautical Earth Station Services (AESS)

- FCC IB Docket 12-376
  - Adopted December 20, 2012
  - NPRM and R&O for Aeronautical Earth Station operating in GSO FSS Ku-band
  - Terminates 2005 proceeding IB docket 05-20
  - Placed on Federal Register on March 8, 2013
  - The R&O is effective 30 days after publication in the Federal Register except for Sections §25.132(b)(3), §25.227(b), and the notification provisions of §25.227 (c)(1)-(2), (d)(1)-(3)
  - Comments were due April 8, 2013 and replies April 29, 2013
Aeronautical Earth Station Services (AESS)

• The R&O implements Earth Stations Aboard Aircraft (ESAA) as an application of the Fixed-Satellite Service (FSS):
  – Primary in the 11.7-12.2 GHz (space-to-Earth) band
  – Unprotected in the 10.95-11.2 GHz and 11.45-11.7 GHz (space-to-Earth) bands,
  – Secondary basis in the 14.0-14.5 GHz band (Earth-to-space)
  – Requires coordination with Space Research Service and the Radio astronomy Service
  – Adopts Part 25 technical service rules, §25.227
  – Licensing and operational requirements for ESAA for both U.S.-registered aircraft and for non-U.S.-registered aircraft operating in U.S. airspace
  – Requiring ESAA licensees to operate consistently with the Communications Assistance to Law Enforcement Act (CALEA)
  – Does not extend certain requirements concerning 1.5/1.6 GHz safety services to other frequency bands, including those used by ESAA (Part 87)

• Seeks comment on proposal to make ESAA in 14.0-14.5 a primary allocation, same as ESV and VMES
Vehicle Mounted Earth Station (VMES)

- FCC VMES IB Docket 07-101
  - Initially Released July 2009

- FCC Adopted new Rule Part
  - §25.226 – Ku-Band only
  - Data Logging Required
  - Pointing Accuracy requirements modified slightly. Licensee must specify worst case non-interfering pointing accuracy
  - Coordination with NTIA NASA TDRSS and Radio Astronomy required

- VMES Order on Reconsideration Existing Issues
  - Restricts aggregate off-axis EIRP to 1 dB below FCC limit
  - Antenna pointing error requirements, essentially unchanged
  - Human Exposure to Radiofrequency Radiation, requirement for cessation of emissions upon loss of signal
  - Allows for ALSAT licensing
Earth Stations Onboard Vessels (ESV)

• FCC ESV IB Docket 02-10
  – Initially Released in January 2005
  – Reconsideration order July 2009

• FCC Adopted new Rule Parts
  – §25.221 - C-band
  – §25.222 - Ku-Band

• 2\textsuperscript{nd} Order on Reconsideration
  – Adopted July 17, 2012
  – Off-Axis EIRP restriction, same as VMES restriction
  – Antenna Pointing Error, also same as VMES
  – Also allows ESV to file ALSAT at Ku-band

• C-band ESVs continue to be coordinated at C-band
Earth Stations on Mobile Platforms (ESOMPS)

- Developed by CEPT ECC, ECC Decision 13(AA)
- Deployment of mobile earth stations operating at Ka-band
  - 27.5-29.5 GHz transmit
  - 17.3-20.2 GHz receive
- Includes Ships, Land Vehicles, and Aircraft mounted earth stations
- Classified as Fixed Satellite Services
- Harmonizes the use of the band to allow free circulation and exemption from individual licensing while ensuring no harmful interference
- Possible template for how FCC will address mobility in the Ka-band
Regulatory

- Smalls Cells NPRM
- Qualcomm ATG
- Regulatory Parity
- 5 GHz WiFi NPRM
- OET TAC Rx Performance
Small Cell NPRM

• FCC GN Docket 12-354
  – Released 12/12/2012
  – Comment 2/20/13
  – Reply Comments 3/22/13

• Creates new Citizens Broadband Service (CBS) operating in 3550-3650 MHz Band
  – Promotes use of small cell technology
  – Promotes use of agile spectrum sharing technologies

• SIA and other satellite users concerned about the proliferation of devices in adjacent band
Qualcomm ATG – FCC NPRM

• Qualcomm proposes Air-Ground communications service on secondary base in 14.0-14.5 GHz Band.
• Qualcomm Filed RM-11640
• FCC Releases NPRM on May 9, 2013
  – GN Docket 13-114
  – Adopted May 9, 2013
• Operation would be on secondary basis in 14 GHz band
• Coordination requirements similar to VMES, ESV, AESS
• Interference Issues mitigated using spatial diversity
  – Base Station pointed to the north
  – Aircraft stations oriented below the horizon of aircraft
  – Qualcomm provided analysis of non-interference operation with NGSO systems
Regulatory Parity

- FCC Newly released NPRM and NOI
- NPRM Seeks Amendment of Part 2 of the Commission’s Rules for Federal Earth Stations Communicating with Non-Federal Fixed Satellite Service Space Stations
- NTIA requests that Federal Earth Stations it authorizes be allowed the same regulatory status as non-Federal earth stations in the same frequency bands (see next slide)
- NPRM has Four Key Objectives:
  - Parity between Federal and non-Federal earth stations
  - FCC maintains oversight of the FSS
  - Ensure any new rules would not hinder or delay licensing and coordination
  - Establish procedures that ensure Federal and non-Federal earth station comply with FCC rules
- Frequency coordination issues are of concern
## Regulatory Parity

### Table 1: NTIA Requests Primary Status in 13.275 MHz of Non-Federal Spectrum

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Frequency Band</th>
<th>Amount of Spectrum</th>
<th>Directional Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-band</td>
<td>3600-4200 MHz</td>
<td>600 MHz</td>
<td>space-to-Earth</td>
</tr>
<tr>
<td></td>
<td>5850-6725 MHz</td>
<td>875 MHz</td>
<td>Earth-to-space</td>
</tr>
<tr>
<td>Ku-band</td>
<td>10.7-12.2 GHz</td>
<td>1,500 MHz</td>
<td>space-to-Earth</td>
</tr>
<tr>
<td></td>
<td>12.7-13.25 GHz</td>
<td>550 MHz</td>
<td>Earth-to-space</td>
</tr>
<tr>
<td></td>
<td>13.75-14.5 GHz</td>
<td>750 MHz</td>
<td>Earth-to-space</td>
</tr>
<tr>
<td>Ka-band</td>
<td>18.3-19.3 GHz</td>
<td>1,000 MHz</td>
<td>space-to-Earth</td>
</tr>
<tr>
<td></td>
<td>19.7-20.2 GHz</td>
<td>500 MHz</td>
<td>space-to-Earth</td>
</tr>
<tr>
<td></td>
<td>27.5-30.0 GHz</td>
<td>2,500 MHz</td>
<td>Earth-to-space</td>
</tr>
<tr>
<td>V-band</td>
<td>37.5-39.5 GHz</td>
<td>2,000 MHz</td>
<td>space-to-Earth</td>
</tr>
<tr>
<td></td>
<td>47.2-50.2 GHz</td>
<td>3,000 MHz</td>
<td>Earth-to-space</td>
</tr>
</tbody>
</table>
5 GHz WiFi NPRM

- FCC NPRM allowing use of unlicensed WiFi devices at 5 GHz
- In the Matter of Revision of Part 15 of the Commission’s Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band
  - ET Docket No. 13-49
  - Adopted: February 20, 2013, Released: February 20, 2013
  - Comment Date: 45 days after publication in the Federal Register
  - Reply Comment Date: 75 days after publication in the Federal Register
- Satellite users have interference concerns regarding interference at 5.9 GHz
5 GHz WiFi NPRM

Channels proposed for 5 GHz bands (new U.S. regulations), showing 20, 40, 80 and 160 MHz channels (tentative conclusions from public announcement by Julius Genachowski, FCC Chairman, at CES 9 January 2013)
OET TAC Receiver Performance

- FCC Office of Engineering and Technology
- Technology Advisory Council (TAC) White Paper Comments request on Recommendations for Improving Receiver Performance
  - ET Docket No. 13-101, DA 13-801
  - April 22, 2013
- Paper entitled “Interference Limits Policy – The use of harm claims thresholds to improve the interference tolerance of wireless systems”
  - Interference Limits Policy Approach
  - Specifies “harm claims thresholds”
  - In-band and out-of-band limits must be exceeded before claims of harmful interference can be made
Conclusions

• Several new items just released:
  – Regulatory Parity NPRM
  – 14 GHz Air Ground NPRM
  – AESS service rules, expect to see more licenses granted

• Several new broadband systems continue to roll out and will provide enterprise and consumers with access to broadband satellite services

• Items to keep your eye on
  – Small Cells at 3.5 GHz
  – WiFi at 5.9 GHz
  – OET Receiver Requirements