



**QUALCOMM Incorporated**

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November 12, 2013

Ms. Marlene Dortch  
Secretary  
Federal Communications Commission  
445 12<sup>th</sup> Street, SW  
Washington, DC 20554

**Re: Expanding Access to Broadband and Encouraging Innovation through Establishment of an Air-Ground Mobile Broadband Secondary Service for Passengers Aboard Aircraft in the 14.0-14.5 GHz Band; GN Docket No. 13-114, RM-11640**

Dear Ms. Dortch:

Earlier today, Dean Brenner, Srikant Jayaraman, Len Schiff, Allen Tran and the undersigned representing QUALCOMM Incorporated (“Qualcomm”) discussed the above-referenced Notice of Proposed Rulemaking with the following staff members from the FCC’s International Bureau: James Ball, Kathleen Collins, Howard Griboff, Sean O’More, and Sci-Byung Yi.

Qualcomm discussed the FCC’s proposed rules relating to substantial service and the protection of primary operations. Qualcomm presented the attached slides and encouraged the Commission to issue a Notice of Proposed Rulemaking proposing to establish the Next Generation Air-Ground service on a secondary licensed basis in the 14.0-14.5 GHz band.

Respectfully submitted,

*John W. Kuzin*

John W. Kuzin  
Senior Director, Government Affairs – Regulatory

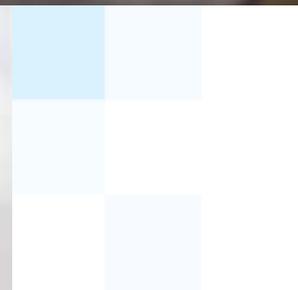
Att.

cc w/ Att.      Jim Ball  
(via email)     Kathleen Collins  
                     Howard Griboff  
                     Sean O’More  
                     Sci-Byung K. Yi



# The Air-Ground Mobile Broadband Secondary Communications Service at 14.0 - 14.5 GHz

November 12, 2013



# The Sky IS THE LIMIT!

## AIR - GROUND TECHNOLOGY

- ❑ The new Air-Ground Mobile Broadband Service will enable high-speed airborne broadband access (300 Gb/s on a combined basis) to commercial and private plane passengers
- ❑ The new service will support (via in-cabin Wi-Fi) the same broadband experience available on land – on-demand video, gaming, music, social networking, and other cloud services

# Timeline & Summary

## 14 GHz Air-Ground Mobile Broadband Service

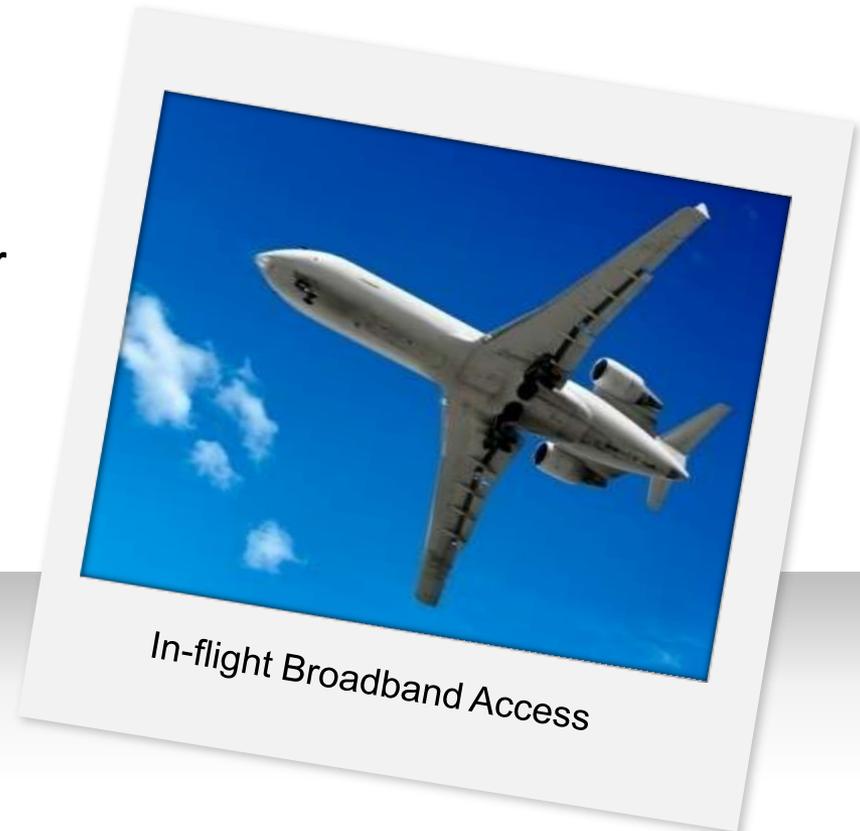
### Summary

**FCC Record demonstrates that the proposed service can operate on a secondary licensed basis in the 14.0 - 14.5 GHz band in successful coexistence with primary operations and other users of the band**

### Timeline

- **Petition for Rulemaking filed - July 2011**
- **1<sup>st</sup> Rnd Comments/Replies filed - Sept/Oct 2011**
- **Second Request for Comments – May 2012**
- **2<sup>nd</sup> Rnd Comments/Replies filed - July 2012**
- **NPRM Released – May 2013**
- **Comments/Replies filed – Aug/Sept 2013**

**Broad support from airlines, cloud service and technology providers, equipment makers, key industry trade associations, and today's air-ground service provider**





# FCC's Key Policy Objectives

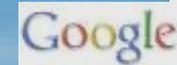
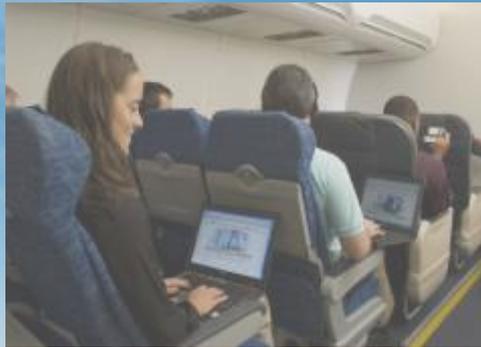
## 14 GHz Air-Ground Mobile Broadband Service

The Air-Ground Mobile Broadband Service will advance several key FCC policy initiatives:

- **Successful spectrum sharing.** FCC Record demonstrates that the 14.0 - 14.5 GHz band can be shared with primary operations without any harmful interference. Authorizing the proposed service on a secondary basis will enable far more efficient use of under-utilized spectrum
- **In-flight broadband connectivity.** Furthers FCC objective to enable increased support of mobile broadband devices on-board aircraft. The FAA has endorsed greater use of electronic devices on planes during all phases of flight
- **In-flight broadband service competition.** The FCC recently adopted rules for satellite-based air-ground systems in the 14 GHz band. The proposed air-ground mobile broadband system would cost much less than a satellite-based system and deliver superior performance with far less latency

# Air-Ground Mobile Broadband Service

Airline passengers today expect the same level of service in the air that is available on the ground



## 24/7 Connectivity

Increasing need for airline travelers to stay connected 24/7 for cloud computing, social networking, and entertainment



## High Speed Broadband

Fast connections are key to enabling music and video cloud offerings, content download, gaming and HD video streaming

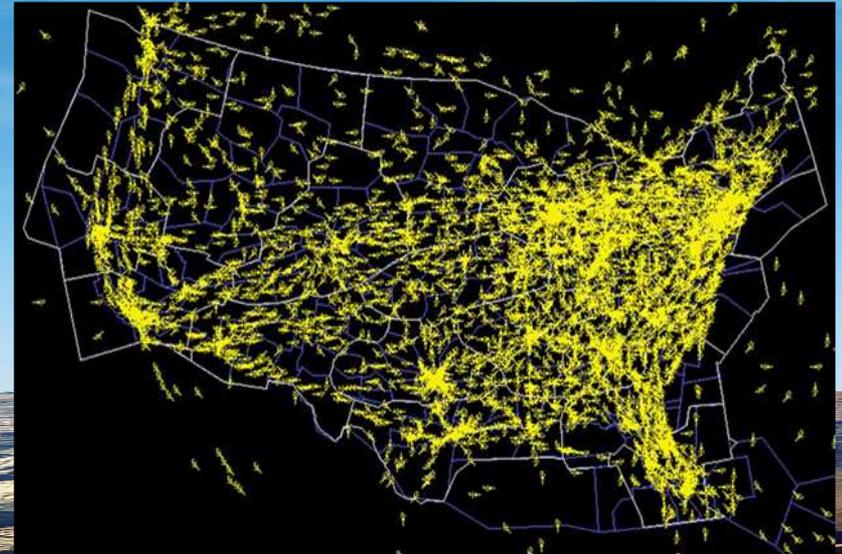
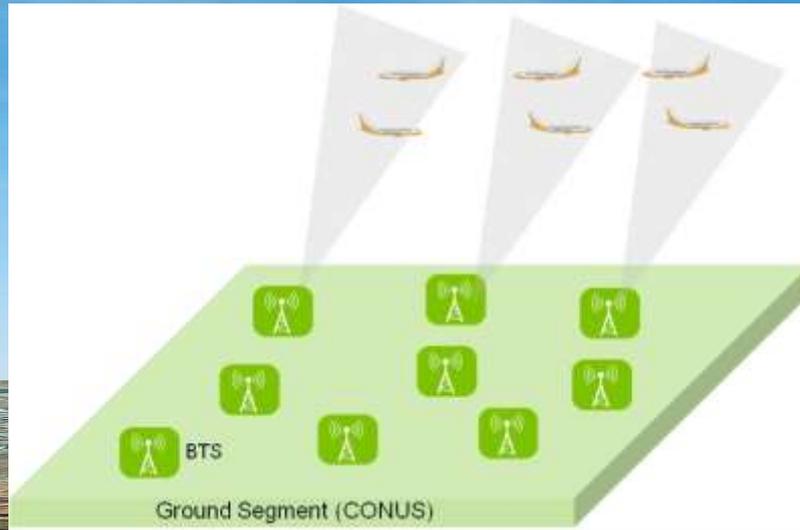


## Multimedia Content

Access to the full library of Internet content: TV channels, movies, games, educational content and social media

# Air-Ground Mobile Broadband System Design

Operating at 14.0 - 14.5 GHz On Secondary Licensed Basis



## Key Technology Attributes

- Enables high throughput, low latency services such as video streaming, gaming, and other rich multimedia access
- Air-Ground architecture will use several hundred cell sites covering CONUS
- Can support approximately 2 Gb/s throughput per site in existing Ku band 14.0 – 14.5 GHz FSS uplink spectrum

## Co-existence

- Designed to avoid interference with incumbent GSO satellite operations and possible future NGSO satellite services
- Designed to successfully co-exist with other services, including ESAA, TDRSS and radio astronomy

- **Two 250 MHz Nationwide Licenses.** A maximum of two separate systems can be deployed successfully in the band due to necessary coordination with TDRSS and RAS at both ends of the 14.0 - 14.5 GHz band; however, a single entity should be permitted to secure both licenses given the operational efficiencies and cost savings that a single provider can offer. Air-ground mobile broadband provider(s) will face competition from satellite providers
- **License Term and Construction Requirement.** A 10-year license term and a 5 year build out requirement are appropriate. To dissuade spectrum speculators, license transfers should be allowed only after the licensee has built out its system

# FCC Technical Operating Rules – GSO satellites



## 14 GHz Air-Ground Mobile Broadband Service

- **Conservative Interference Analysis.** Qualcomm’s analysis assumed that each base station site was serving the maximum number of aircraft on a given swath of spectrum, which will not occur in actual operation. Where cell splitting is used to service high traffic areas, per-site and per-aircraft EIRP will be reduced, ensuring total emissions into the geo arc is less than or the same as before
- **Protection of FSS Operations.** The technical parameters in Table 1 of the FCC NPRM will ensure that the actual  $\Delta T/T$  remains well below 1% during typical operation. FCC proposed rules that specify the power spectral density (“PSD”) into the geo-arc will protect primary FSS operations and provide necessary system design flexibility
- **Average G/T over CONUS does not exceed 4.5 dB.** Qualcomm showed, based upon very conservative assumptions, that the limit for the average G/T over the CONUS is less than 4.5 dB even with a high performing antenna and low-noise amplifiers (“LNAs”)
  - Where G/T exceeds 4 dB/K, the satellite beam is very likely a regional beam that does not evenly cover all of CONUS and does not see all the Air-Ground Mobile Broadband Service base stations or aircraft at the same G/T
  - The FCC should apply an average G/T of 4 dB for the emissions limits for CONUS beams into GEO arc or ask the satellite industry to provide a G/T map of high performing satellites so that one may determine an appropriate value by averaging the G/T map



## 14 GHz Air-Ground Mobile Broadband Service

- The FCC should use a 6% aggregate  $\Delta T/T$  for NGSO satellites rather than set an off-axis EIRP density in directions other than along the GSO arc. A 6% limit will not impose any actual burden on a NGSO system and will benefit the Air-Ground system. On the other hand, a 1% limit would impose severe constraints on the Air-Ground system with no corresponding benefit to any future NGSO system
- Future NGSO satellite systems can be designed to accept 6% aggregate  $\Delta T/T$  with a negligible performance or cost impact on the NGSO system
- An Air-Ground base station beam will turn its power down (or off) if it is in line with an NGSO beam and causes RoT of the NGSO satellite beam to exceed 6%
  - By using the NGSO G/T and antenna pattern parameters, the Air-Ground service operator can compute the RoT when it is in line with the NGSO system
  - If powering down the Air-Ground service beam does not lower NGSO  $\Delta T/T$ , the aircraft can be handed off to another base station

# Update on Antenna Designs

## 14 GHz Air-Ground Mobile Broadband Service

Recently prototyped aircraft antennas perform better than the antenna in Qualcomm's September 2011 filing. Figures 2 and 3 from Qualcomm's NPRM Reply Comments appear below:

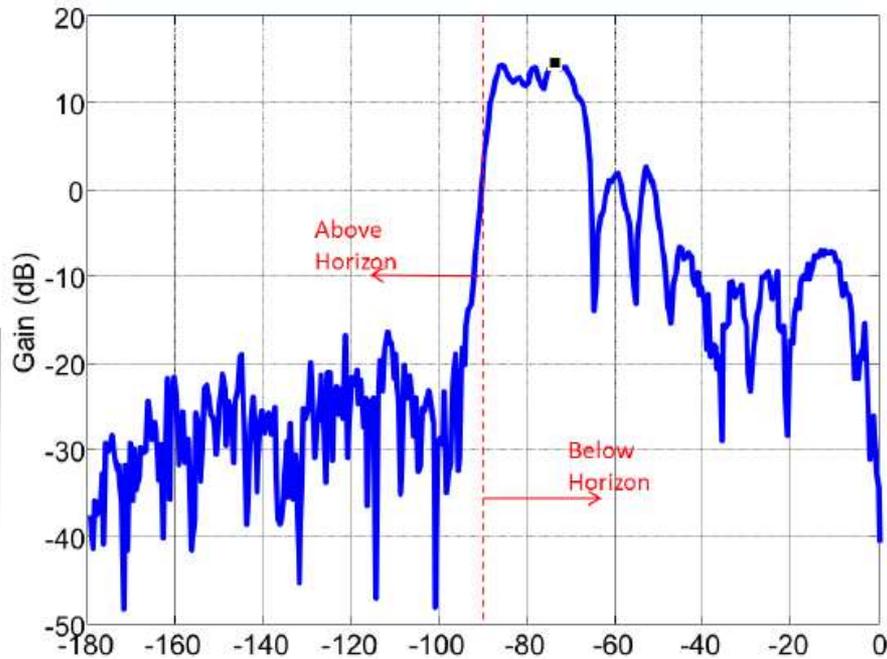


Figure 2. Aircraft antenna measurements in elevation angle for beam looking fore and aft as measured on the fuselage mockup

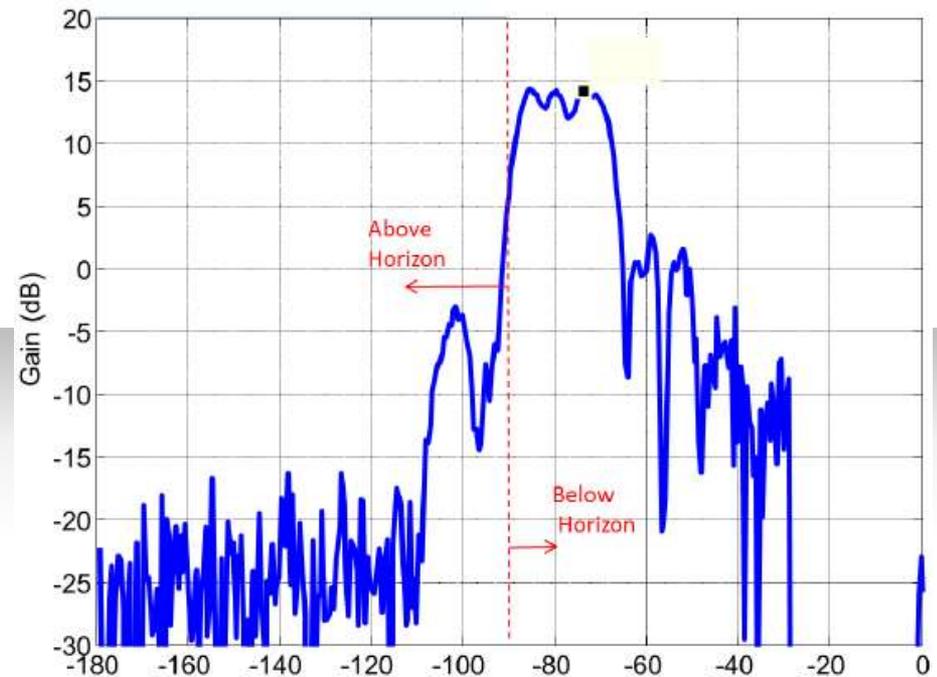


Figure 3. Aircraft antenna measurements in elevation angle for beam looking 60° away from aircraft nose as measured on the fuselage mockup

# Update on Antenna Designs

## 14 GHz Air-Ground Mobile Broadband Service

Higher gain aircraft antenna configuration (without size increase) is considered for more robust service and better user experience. Measured antenna patterns on half-cylinder fixture indicated no change in interference level as can be observed from data shown below:

