Two Cross-Polarized Systems in the ATG Band

Presentation to FCC

Prepared by

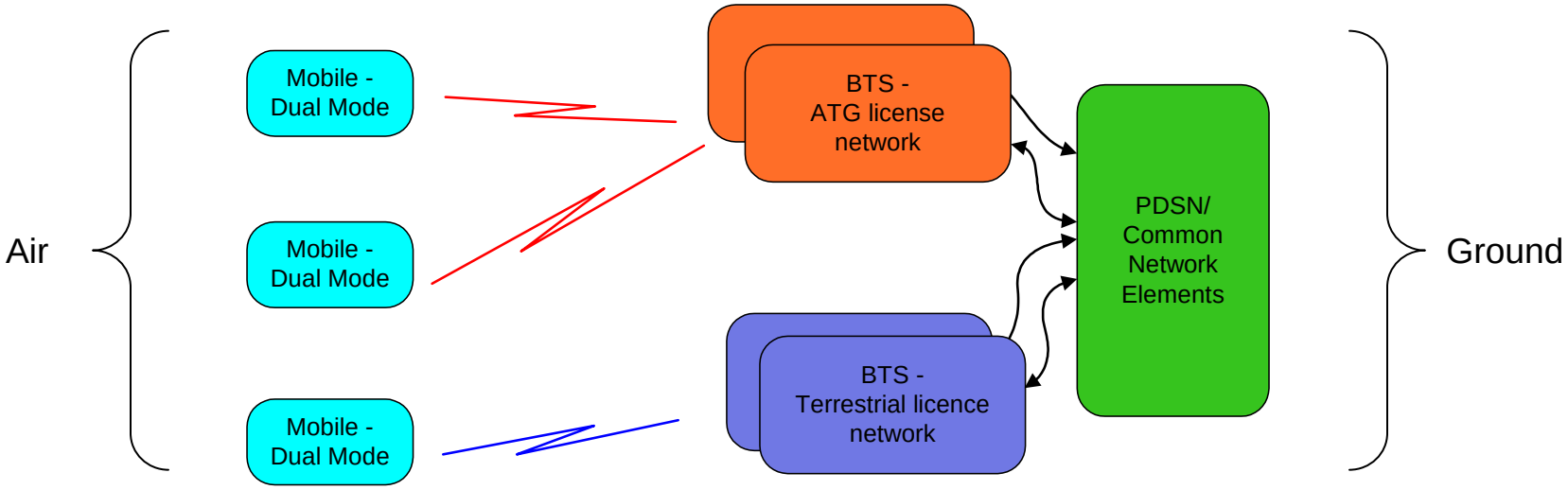
November 10, 2004

Introduction/Agenda

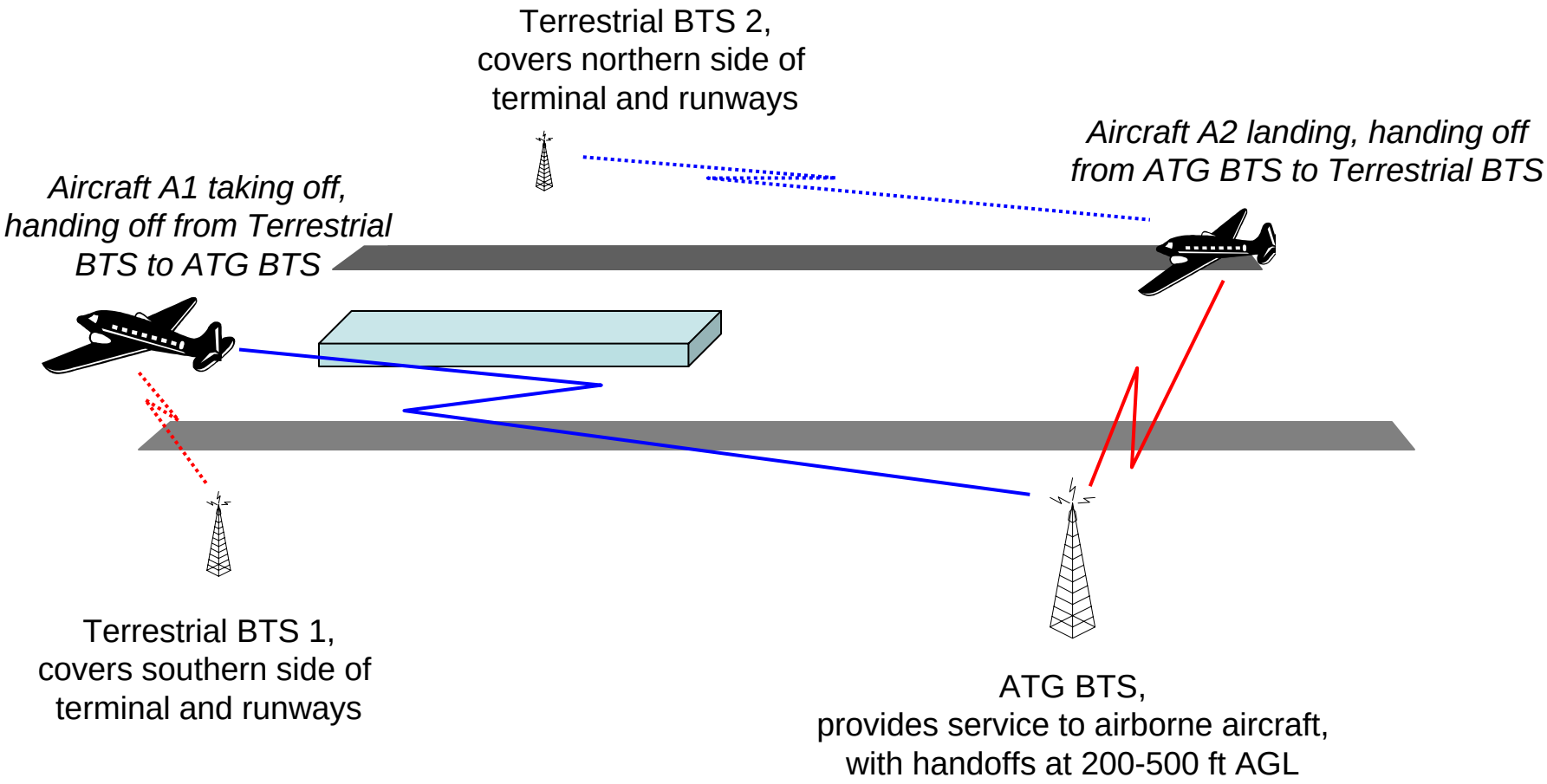
- Deck-to-deck and gate-to-gate coverage
  - Handoff to terrestrial networks for terminal coverage
  - Engineering issues
  - Denver and Salt Lake City examples
- Verizon ex parte - AirCell observations
- Out-of-Band Emissions - status of discussions
- Competition is in the public interest

Gate-to-gate coverage

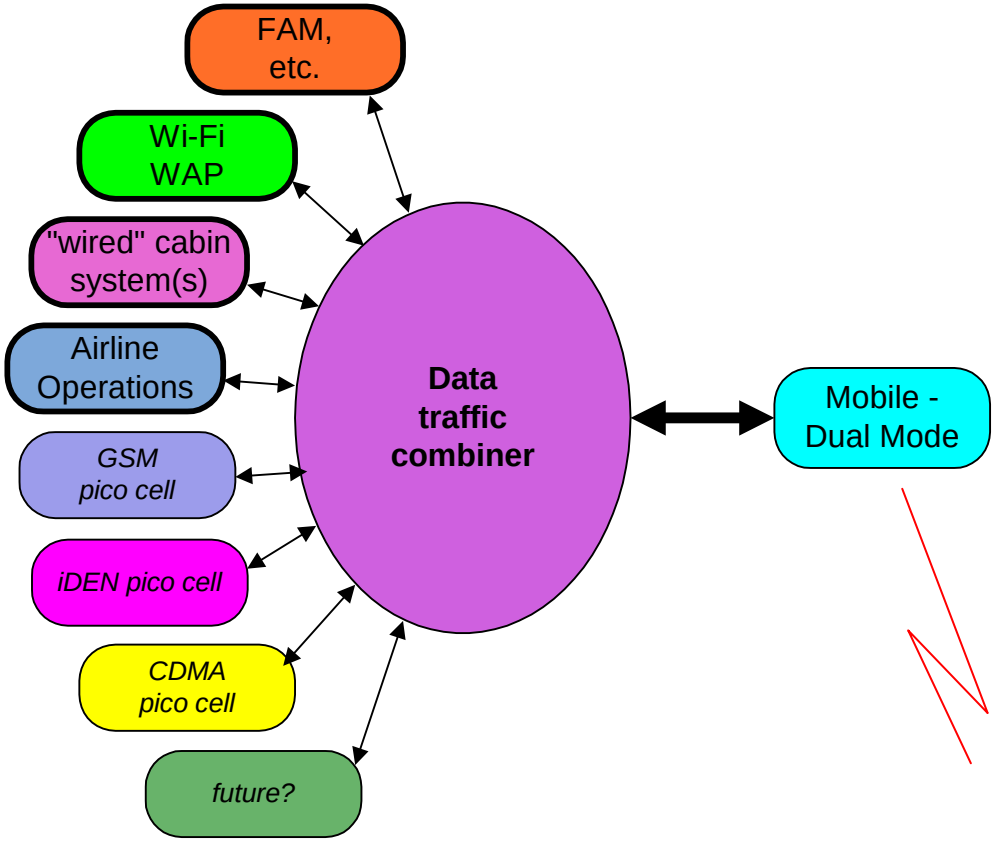
- ATG licensed systems provide deck-to-deck coverage - from takeoff to landing
- Terrestrial licensed systems provide coverage for aircraft on ground
  - Seamless handoffs between the ATG and terrestrial services as aircraft lands or takes off



Gate-to-gate coverage



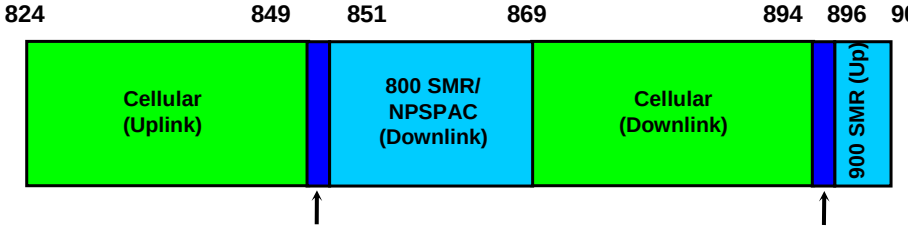
Possible aircraft systems



- On-board equipment services a variety of wireless and wired systems
- All traffic requirements combined into common data channel connecting to ground system
- Simplifies aircraft systems management
- Efficient use of ATG resources
- No individual service handoffs

Gate-to-gate coverage

- Best of both worlds
  - High bandwidth and complete coverage of airport without any compromise to ATG system performance
  - Consistent with competitive two-carrier proposal for ATG service using cross-polarization isolation
  - Minimizes possibility of cross-band interference between ATG and NPSPAC, 800 MHz SMR, Cellular and/or 900 MHz SMR services



ATG (Ground to Air)

- lower traffic density, lower path losses => lower tx levels
- uptilt antenna reduces tx power towards other services

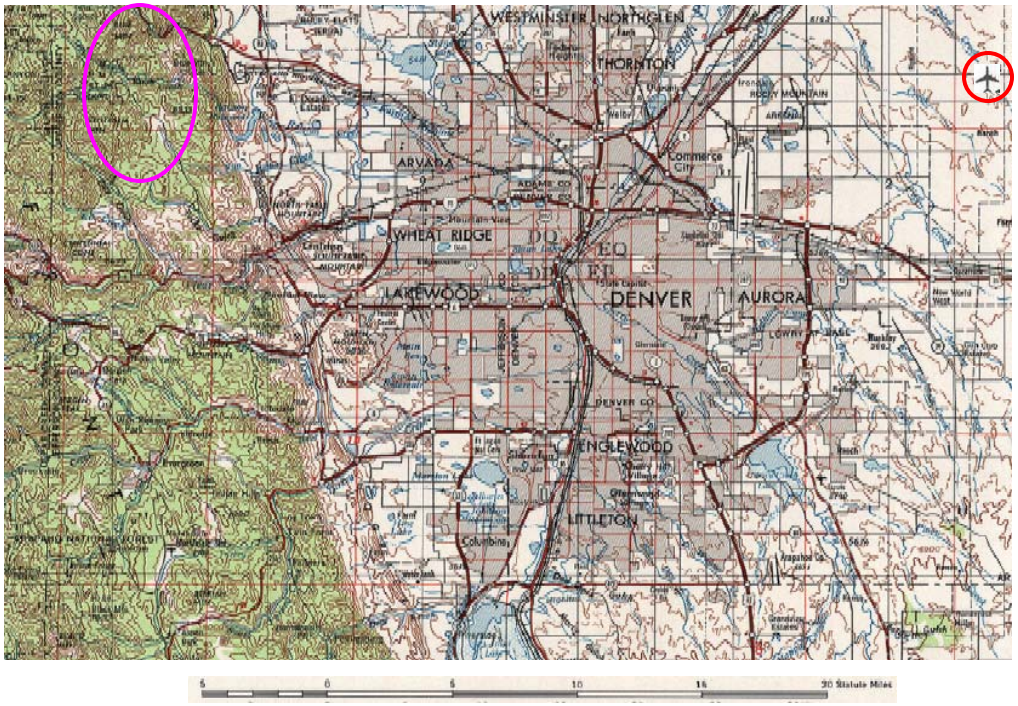
ATG (Air to Ground)

- all LOS paths - lower tx power/mobile
- not used in proximity to other services
- lower service levels, less impact

Site engineering issues

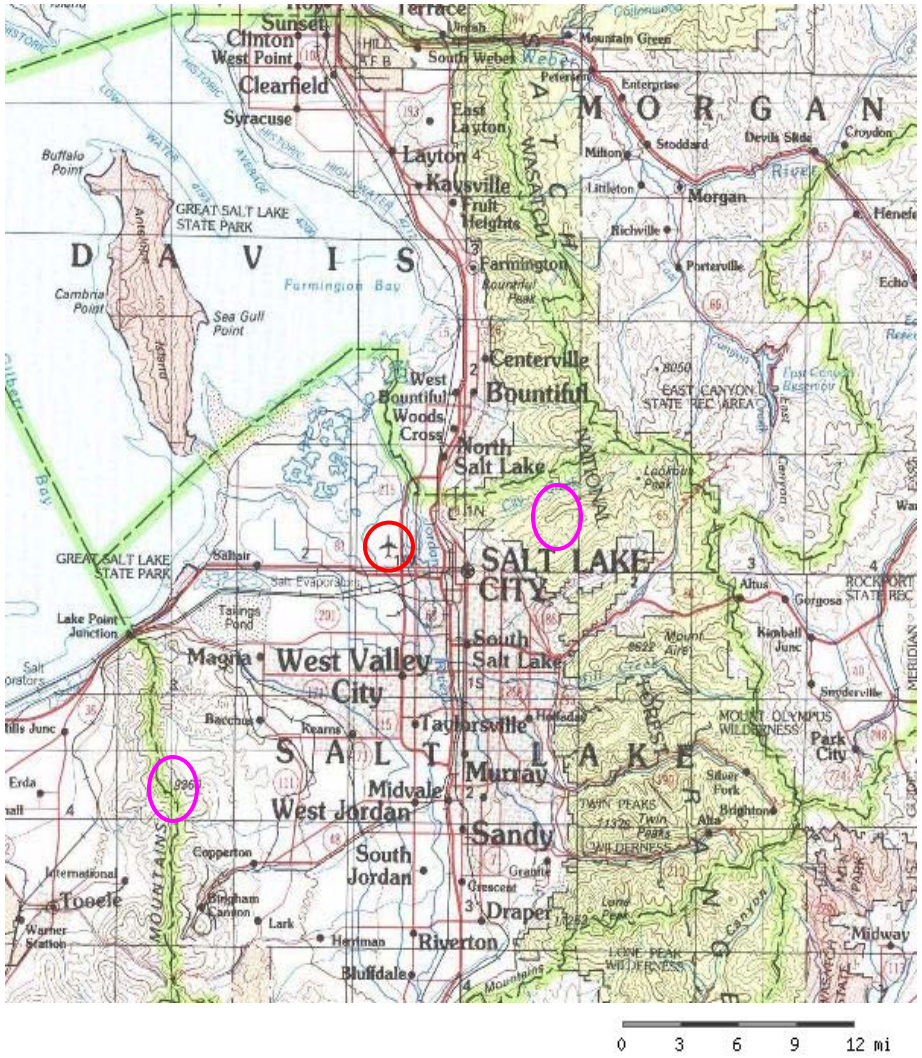
- System engineering requirements for X-Pol systems are consistent with good engineering practices for any single system
- Deck-to-deck services *do not* create problems
  - RF environment above 200-500 feet is dominated by LOS and fundamentally no different than environment at altitude
  - Below 200-500 feet system handoff to terrestrial network
  - In addition, for foreseeable future, FAA regulations and airline practices will continue to prohibit the use of Personal Electronic Devices (PEDs) during takeoff and landing, altitudes below 10,000'
- AirCell assessed likelihood of engineering difficulties due to terrain in vicinity of Denver and Salt Lake City airports

Denver airport



- Mountains are approximately 30 miles to west - any reflections likely to be very low power
- Horizon to west is at 1.1º above horizontal, will be below the main lobe of any antenna with modest uptilt
- Special site engineering requirement - ***none***

Salt Lake City airport

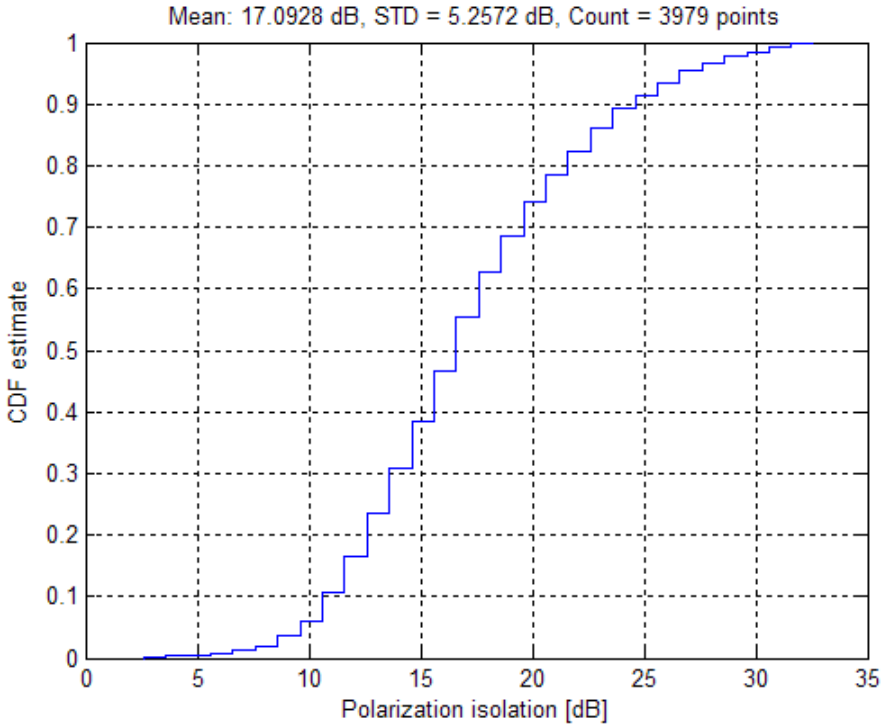


- Air traffic largely N-S on runways 16/34, 17/35; air traffic is routed on N-S routes to avoid mountains
- "Horizon" from airport to mountains is 4.5º above horizontal to the east, 3.5 º to the southwest
- Can use additional up-tilt or directional antennas to avoid any possibility of mountain reflections
- Special site engineering effort - ***modest***

Contrary to Verizon Ex Parte comments...

- Cross Polarization isolation is readily achievable
  - ATG paths are line-of-sight, are comparable to microwave paths (rather than NLOS mobile services with extensive multipath)
  - GE Corporate Research labs performed testing in 1993, concluded that isolation was greater than 15 dB for ATG links at cellular frequencies
  - Verizon/Telcordia have produced no contrary evidence, only speculation…
  - New AirCell flight tests confirm that 12 dB is conservative value to use for isolation
- Altitude differences do not cause loss of polarization isolation
  - Telcordia analysis is incorrect; vertical and horizontal polarization components maintain orthoganality relative to the propagation path between antennas
- Reflections will not cause cross coupling between polarizations
  - Reflections weak, and can only reduce isolation if they cause rotation of signal
- Omnidirectional horizontally polarized antennas are available
  - AirCell has used omni base station and aircraft antennas for years
  - Magnetic dipoles gives omni h-pol analogous to v-pol generated from electric dipoles

AirCell flight test results - Nov 2004



- Tests conducted on Wichita Falls, TX site
- Mean isolation >17 dB
- 90th percentile for isolation = 12 dB
- Tests conducted with single antennas - no diversity effects

Contrary to Verizon Ex Parte comments...

- Airports will not suffer high interference
  - Telcordia misinterprets an analysis of intersystem isolation - even under extremely large network loads, there was negligible inter-system impact
  - Each system will be engineered for demand placed upon that carrier's network; sharing spectrum (with effective isolation) does not change system capacity characteristics for either carrier
- Intersystem isolation will be sufficient
  - AirCell performance analysis shows that it is adequate
  - Comparison to out of band emission requirements in unshared bands is not pertinent
- Polarization integrity can be "managed"
  - Polarization isolation is primarily a function of physical orientation of antenna elements, which can be easily monitored

Contrary to Verizon Ex Parte comments...

- 200 mw mobile transmit power is adequate
  - A single mobile with +23 dBm transmit power is adequate to drive base station radio to 75% pole point at 100 mile separation
    - Additional power will not increase data rate, other cell interference and multiple aircraft will lower maximum usable power
- Path loss margins are not required
  - Telcordia misunderstands AirCell's 1997 flight test results
    - AirCell air-air tests clearly had aircraft body shielding based upon stated geometry between aircraft
    - Telcordia interpreted receive signal variations as path loss fluctuations when they were the result of antenna nulls encountered in flight on radial path directly over the serving base station
  - Common path engineering techniques used in LOS systems for several decades will minimize any path issues
    - Space diversity (vertical spacing of antennas)
    - Angle diversity (pattern diversity)
    - Engineer for unobstructed paths

Use of cross-polarization isolation is not complicated, is an accepted practice, and can be implemented with minimal effort

Out-Of-Band Emissions

- AirCell and Nextel recently met to jointly examine out-of-band emission issue
- Preliminary conclusions are that interference impact of AirCell's two system ATG plan will be consistent with recent rulings
  - 20 dB C/I for -104 (mobile) and -101 (portable) signals, per *800 MHz Report and Order*
  - No harmful interference
- AirCell also in discussions with APCO

Licensing / Competitive Bidding Rules

- **Two Licenses Needed to Ensure Competition**
  - Single license does not address the single provider concern noted in the NPRM
  - Without competition, the needs of smaller air carriers and general aviation may be ignored
  - To be effective, rules must prevent licenses from being acquired by the same provider

- **Bidding Credits Should Be Available, Consistent with Precedent**
  - 15% for bidders under $40 million in revenue; 25% for bidders under $15 million in revenue (47 C.F.R. 1.2110(f)(2))
  - Same credits as provided in the recent nationwide auction of 1670-75 MHz

FCC Precedent Supports Spectrum Auction License Caps to Ensure Competitive Entry

- ***Examples Include*:**
- **SDARS –** Bidders could win only one of two available digital audio radio licenses
- **700 MHz –** No single entity could win both of the two 700 MHz guardband licenses in any market
- **DBS (Auction No. 8) –** One-time intra-DBS spectrum cap imposed
- **PCS (initial auctions) –** No single entity could win more than 10% or 98 C and F Block licenses
- **LMS** – Multilateration licensees not permitted to hold both a Block A and a Block B or C license in the same market

The Communications Act Requires the FCC to Promote Competition

- **If Auction Authority Is Used, the Commission Must Seek to Promote the Section 309(j)(3) Objectives of:**
  - The development and rapid deployment of new technologies, products and services for the benefit of the public . . .
  - Promoting economic opportunity and competition and ensuring that new and innovative technologies are readily accessible to the American people by avoiding excessive concentration of licenses and by disseminating licenses among a wide variety of applicants, including small businesses . . .
  - Efficient and intensive use of the electromagnetic spectrum

ATG Services Are CMRS Services, Subject to a "Heightened Scrutiny" on Competition

- "Congress established the promotion of competition as a fundamental goal of CMRS policy formulation and regulation." (*Ninth Competition Report* at para. 6)

- Section 332(c)(1)(C) requires the FCC to analyze and report annually:
  - whether there is effective ATG competition
  - whether any provider has a dominant share of the ATG market
  - whether additional ATG providers would likely enhance competition

- FCC stopped reporting on ATG after the *Second Competition Report*

- Section 332(c)(1)(C) establishes that promoting competition alone is a sufficient basis for a public interest finding

FCC Recently Confirmed that Spectrum Sharing "Should be Implemented, and Improved, Wherever Possible"

- **The July 16, 2004 *Big LEO Order* (FCC 04-134) Implemented Sharing Among MSS Operators in a 3 MHz Portion of L-Band**
  - "Sharing this spectrum should promote spectral efficiency by increasing the number of MSS licensees that will use this spectrum, particularly at a time when the demand for spectrum has increased. In fact, we believe that promoting efficient spectrum use through sharing spectrum is consistent with our overall spectrum policy." (para. 45)
  - Requiring "spectrum users to share is consistent with the" Spectrum Policy Task Force Report. (fn. 131)
  - Sharing "would be more beneficial than granting MSS operators exclusive access." (para. 47)

The false premise ... *Satellite Solutions Offer A Competitive Alternative to Terrestrial Air-to-Ground Telecom*

Today's facts, including Airfone's own statements, clearly indicate that satellite solutions are not a competitive domestic option

- No U.S. airline has installed satellite communications aboard its narrow-body domestic aircraft
- Satcom weight, drag and cost have only been defendable for transcontinental widebody aircraft
- Verizon Airfone today charges $4/min + $4 setup for a terrestrial ATG call, but needs to charge $10/min + $10 setup for an Inmarsat satcom call
- Iridium & Globalstar – Low cost voice and narrow band data, not able to support broadband telecom features.

Majority of U.S. carriers have elected to not provide Airfone or satellite passenger telecom services

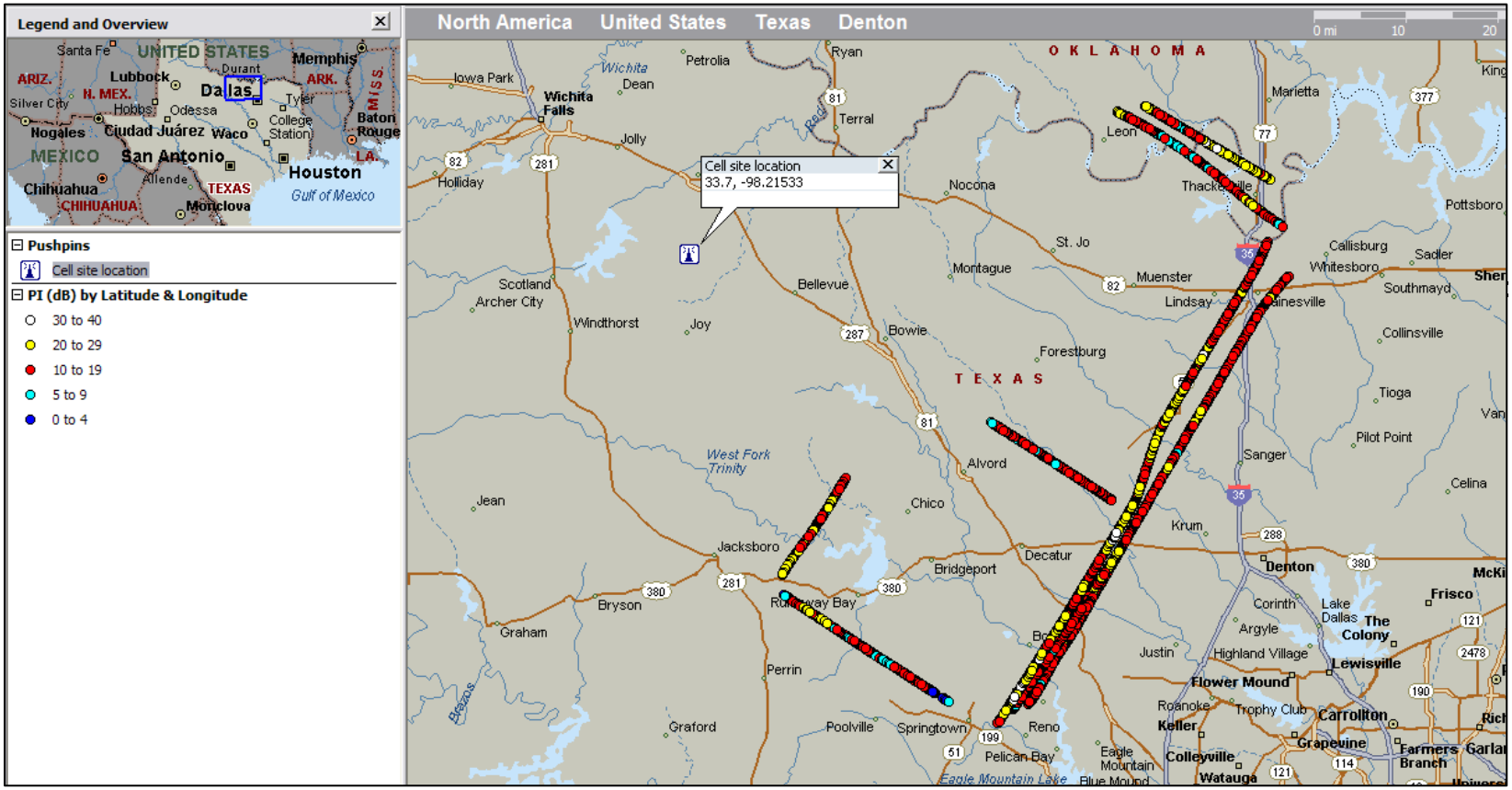
Alaska Airlines
American Airlines
America West
ATA
AirTran
Frontier Airlines
Independence Air
JetBlue Airways
Northwest Airlines
Southwest Airlines

Plus all Regional Airlines with the exception of United Express and Midwest Express

- **More than 6,400 aircraft are un-served (~79% of the U.S. fleet)[7]**
- **Airlines need competitive offerings and have made that request known to the FCC**
- **Verizon Wireless customers pay $0.10 per minute with $10 Monthly fee or $0.69 without fee. Everyone else pays $4.00/minute, plus a $4.00 set-up charge**

Backup Slides

AirCell flight test - Nov 2004



Out-of-band emissions

- Four band edges
  - 849 MHz: ATG BTS - V-pol - to cellular B band BTS (uplink)
  - 851 MHz: ATG BTS - H-pol - to NPSPAC/SMR mobile (downlink)
  - 894 MHz: ATG Mob - V-pol - to cellular B band mobile (downlink)
  - 896 MHz: ATG Mob - H-pol - to 900 SMR BTS (uplink)
- No harmful Interference
  - reasonable power limits (+23 dBm mobile, +53 dBm BTS EIRP over 1.25 MHz)
  - uptilted ATG BTS antenna provides discrimination to ground
  - per cellular/PCS OOBE requirements of 43 + 10lobP isolation and Qualcomm EVDO spectral mask for emissions, -35 dB rolloff achieved
  - additional rejection/isolation can be achieved using transmit filters
  - BTS locations and frequencies used can be coordinated to further reduce interference potential