

NASA Glenn Research Center

AeroMACS Investigation and Development



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Initial Airport Surface Communications Research



NASA GRC Space Based Technologies (SBT) Project (2004)

- Initiate the transition of Communications, Navigation and Surveillance (CNS) systems into a **high-performance network-centric digital infrastructure** to support the future development of the National Airspace System
- Research and Development Subprojects:
 - Integrated CNS Infrastructure
 - Airport Surface and Terminal Airspace Communications**
 - Satellite-based CNS
 - CNS Technologies
 - CNS Test Bed Development**
 - Future Communications System



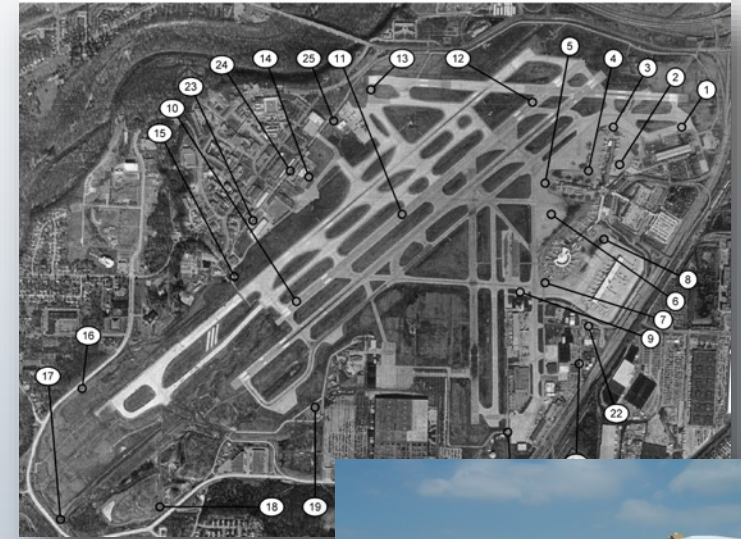
SBT Project halted in 2006 by NASA

Airport Surface Communications Project (2004-2006)



In 2004 NASA GRC started researching and developing an airport surface wireless communications network prototype to transfer mission critical voice and data communications

- Characterized performance of C-band for airport use
- Supported WRC-07 and ICAO band (5091–5150 MHz) deliberations
- Developed airport wireless basic concept definition
- Developed initial functional system architectures
- Developed concepts for future architectures
- Initiated wireless technology investigations
 - Technology assessment WiFi, WiMAX and others...
 - 802.16e investigation: Intel “Rosendale” chip, Fujitsu, SEQUANS, TeleCIS ...
 - Team recommendation to use 802.16e for airport surface (2005)
- Requirements development and airport survey (DFW)



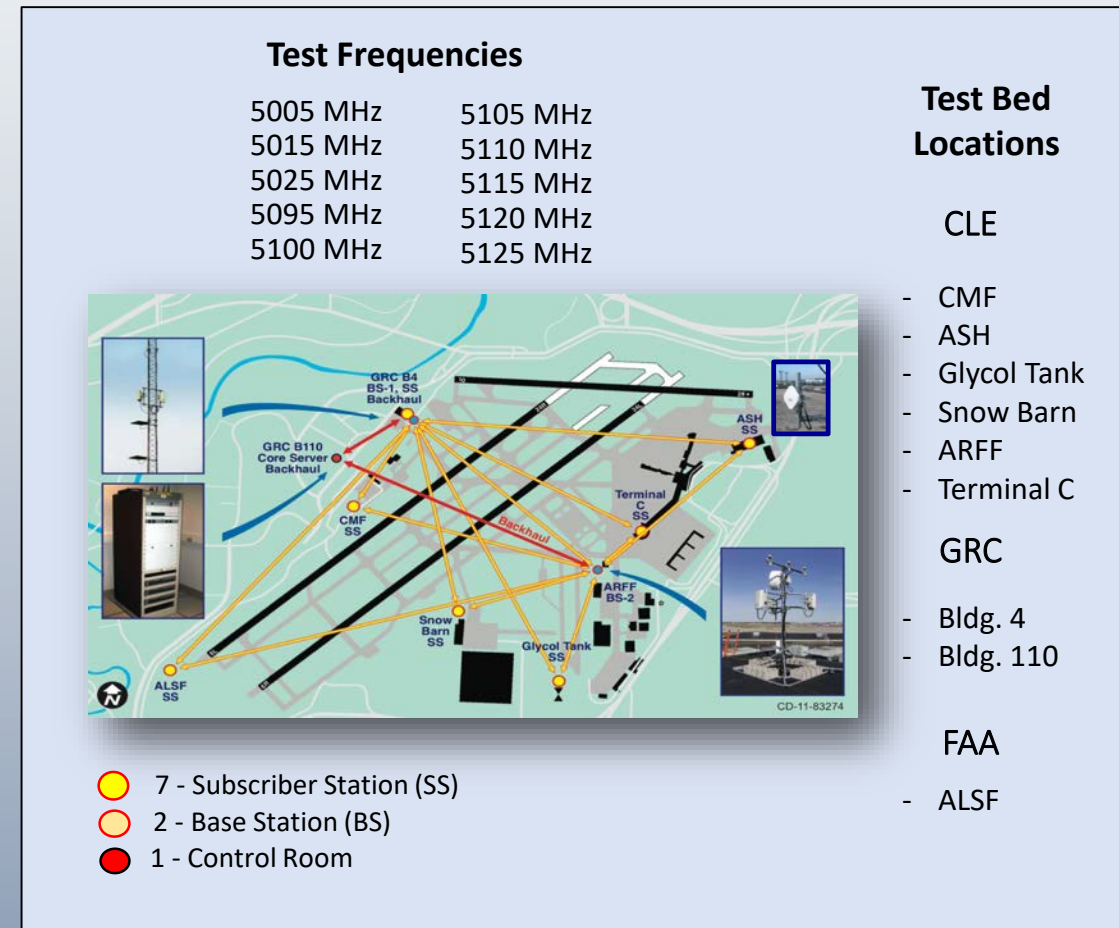
2005 Measurements, CLE, JFK, MIA

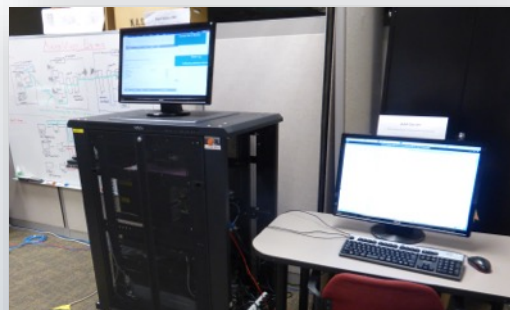
NASA Glenn Research Center CNS Test Bed



2006 - NASA GRC in partnership with industry and government established the CNS Test Bed in North East Ohio

- Originally test bed consisted of three airports (BLK, CLE and LPR) and the NASA Glenn Research Center (GRC)
- Today's configuration consists of NASA GRC and Cleveland Hopkins Airport
- Objectives:
 - Prototype
 - Evaluate
 - Measure
 - Reduce risk
- Applied Research
 - Advanced Integrated Surveillance
 - **Airport Surface Wireless Communications**
 - Secure Information Sharing
 - Staffed Virtual Tower
 - **AeroMACS**
 - SMART NAS





AeroMACS AAA Equipment



Experiment Control and Monitoring Facility



Testbed Network Equipment



Analysis & Evaluation



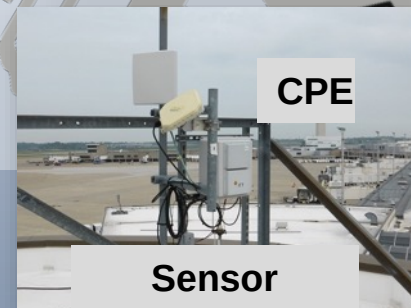
Cleveland Hopkins Airport



Aeronautical Research Vehicle (ARV)



Sensor Platform



Sensor Platform



AeroMACS Base Stations & Equipment

AeroMACS NASA Trials and Investigation - 1



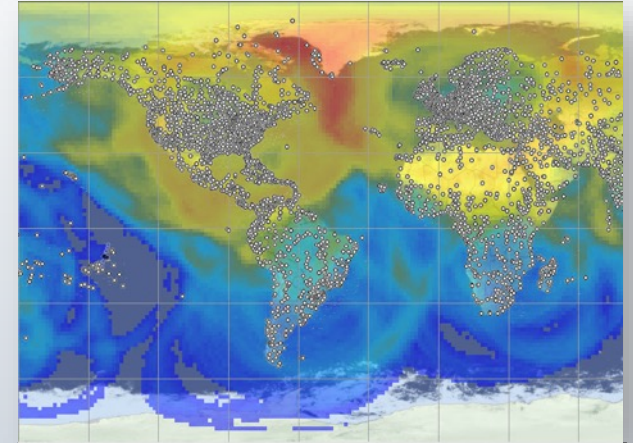
- 2010 Mobility testing – Vehicle testing
 - Link stability
 - Traffic throughput rates
 - Multi-antenna (MIMO) operations
- 2011 Aircraft Mobile Application Testing – AeroMACS testing on Boeing 737-700 corporate aircraft
 - Weather to the cockpit, Antenna performance, Throughput
 - Partners: Boeing, Continental Airlines, WSI, ITT, FAA, NASA, CLE Airport Authority
- 2012 Surveillance Video Test – Trial using terminal radar video
- 2014 Standard Compliance Trial – First compliance system test and demonstration with Hitachi Corp.
 - Network Entry
 - Traffic throughput rates
 - Quality of Service
 - Mobility
 - Long Term System Stability



AeroMACS NASA Trials and Investigation - 2



- 2015 World-Wide satellite interference analysis
 - Modeled 6270 airports impact to satellite feeder links
 - Large Airports: 35 (USA) + 50 (Europe)
 - Medium Airports: 123 (USA) + 50 (Europe)
 - Small Airports: 1366 (North America) + 1249 (Europe) + 3336 (Rest of World)
- 2015 AOSP - SMART NAS Test Bed – Utilize AeroMACS in evaluation of future ATM concepts.
 - Integration of AeroMACS system into Live, Virtual, Constructive (LVC) test environment
- 2016 AATS over AeroMACS Technology Trials – AeroMACS testing using FAA Bombardier aircraft
 - Collaboration between FAA, Hitachi, Ltd. and NASA
 - AATS data exchange
 - Mobile & Fixed data exchange



AeroMACS Satellite Interference



SMART NAS Experiments



AeroMACS AATS Trial

Standards Development Support



- RTCA
 - AeroMACS Technology Profile Development – Technology performance evaluation at NASA CNS Testbed facility
 - Minimum Operational Performance Standards (MOPS) development and working group support
 - User Services Requirements Investigation and Applications Survey
 - AeroMACS Standards Validation Testing
- International Civil Aviation Organization
 - Standards and Recommended Practices (SARPs) validation testing at NASA CNS Testbed
 - Technical manual development support
 - Mobile Satellite Service Interference Analysis for AeroMACS Base Stations

AeroMACS Horizons

- AeroMACS as backbone for millimeter wave communications – IOT devices, baggage, etc.
- Urban Air Mobility Aerodrome critical service delivery over AeroMACS
- Video/taxi support for Unmanned Vehicles on airport surface
- AeroMACS support for autonomous taxi operations

