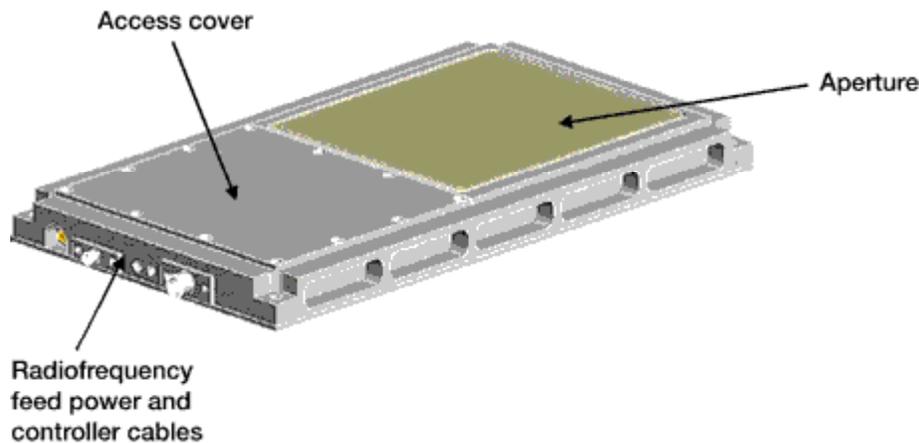


# Antennas Designed for Advanced Communications for Air Traffic Management (AC/ATM) Project

The goal of the Advanced Communications for Air Traffic Management (AC/ATM) Project at the NASA Glenn Research Center at Lewis Field is to enable a communications infrastructure that provides the capacity, efficiency, and flexibility necessary to realize a mature free-flight environment. The technical thrust of the AC/ATM Project is targeted at the design, development, integration, test, and demonstration of enabling technologies for global broadband aeronautical communications. Since Ku-band facilities and equipment are readily available, one of the near-term demonstrations involves a link through a Ku-band communications satellite.

Two conformally mounted antennas will support the initial AC/ATM communications links. Both of these are steered electronically through monolithic microwave integrated circuit (MMIC) amplifiers and phase shifters. This link will be asymmetrical with the downlink to the aircraft (mobile vehicle) at a throughput rate of >1.5 megabits per second (Mbps), whereas the throughput rate of the uplink from the aircraft will be >100 kilobits per second (kbps). The data on the downlink can be narrow-band, wide-band, or a combination of both, depending on the requirements of the experiment. The AC/ATM project is purchasing a phased-array Ku-band transmitting antenna for the uplink from the test vehicle. Many Ku-band receiving antennas have been built, and one will be borrowed for a short time to perform the initial experiments at the NASA Glenn Research Center at Lewis Field.



*Boeing 254-element Ka-band phased-array transmitting antenna.*

The Ku-band transmitting antenna is a 254-element MMIC phased-array antenna being built by Boeing Phantom Works. Each element can radiate 100 mW. The antenna is approximately 43-cm high by 24-cm wide by 3.3-cm thick. It can be steered beyond 60° from broadside. The beamwidth varies from 6° at broadside to 12° at 60°, which is typical

of phased-array antennas. When the antenna is steered to 60°, the beamwidth will illuminate approximately five satellites on the orbital arc. Spread spectrum techniques will be employed to keep the power impinging on the adjacent satellites below their noise floor so that no interference results. This antenna is power limited. If the antenna elements (currently 254) are increased by a factor of 4 (1024) or 16 (4096), the gain will increase and the beamwidth will decrease in proportion. For the latter two antenna sizes, the power must be "backed off" to prevent interference with the neighboring satellites. The receiving antenna, which is approximately 90-cm high, 60-cm wide, and 3.5-cm thick, is composed of 1500 phased-array elements.

The system phased-array controller can control both a 1500-element receiving antenna and a 500-element transmitting antenna. For ground testing, this controller will allow manual beam pointing and polarization alignment. For normal operation, the system can be connected to the receiving antenna and the navigation system for real-time autonomous track operation. This will be accomplished by first pointing both antennas at the satellite using information from the aircraft data bus. Then, the system phased-array controller will electronically adjust the antenna pointing of the receiving antenna to find the peak signal. After the peak signal has been found, the beam of the transmitting antenna will be pointed to the same steering angles as the receiving antenna. For initial ground testing without an aircraft, the ARINC 429 data bus (ARINC Inc., Annapolis, Maryland) will be simulated by a gyro system purchased for the follow-on to the Monolithic Microwave Integrated Circuit (MMIC) Arrays for Satellite Communication on the Move (MASCOM) Project. MASCOM utilized the Advanced Communications Technology Satellite (ACTS) with a pair of Ka-band experimental phased-array antennas.

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