AIRBORNE TELEMETRY AND THE ADVANCED MEDIUM RANGE AIR-TO-AIR MISSILE

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ABSTRACT

The Advanced Range Instrumentation Aircraft (ARIA) is an airborne platform to receive, record, process and retransmit telemetry data. This paper presents a summary of ARIA’s capabilities with emphasis on airborne testing of the Advanced Medium Range Air to Air Missile (AMRAAM) program. The unique test scenarios, as well as current and future telemetry requirements of the AMRAAM test program are discussed.

BACKGROUND

The Advanced Range Instrumentation Aircraft (ARIA) are modified EC-135 and EC-18B aircraft. These aircraft provide airborne worldwide telemetry coverage for Department of Defense (DOD) and National Aeronautical and Space Administration (NASA) space and missile launches. The aircraft were first developed in 1968 to support the Apollo program. A fleet of seven ARIA are now operated and maintained by the 4950th Test Wing at Wright-Patterson Air Force Base Ohio.

The ARIA have had extensive external and internal modifications made to a standard C-135 airframe. The most apparent of these modifications is the addition of a large bulbous nose which houses an eighty-three inch steerable parabolic dish antenna. Internal modifications include the addition of instrumentation subsystems known as Prime Mission Electronic Equipment (PMEE). See Figure 1. The PMEE is made up of five general systems. These include a Data Separation Console (DSC), receiver (RF), antenna console, HF voice communication (HF), and record-timing section. Recently upgraded systems include receivers, recorders, and the antenna system.

ARIA MISSION

The primary function of ARIA is to receive, record, and process telemetry data. The capabilities of ARIA also include on-board data processing, observation and verbal reports of critical events known as mark events. A further capacity of ARIA is the capability to relay data via UHF satellite or L-band links air-to-ground. An on-board computer can be used to resolve data and print out multiple events. A program called Data Separation and Storage Buffer (DSSB) is available to reformat high bit rate digital data into low bit rate data.

ARIA missions are divided into four general categories: reentry, orbital, cruise missile, and AMRAAM. Reentry tests are usually requested by the Air Force, Army, or Navy and normally require receive and record coverage only. Orbital missions for DOD and NASA launches frequently require real time transmission of data, via satellite, voice reports of mark events via HF radio, and recording of the data. Cruise missile missions include support of Air Launched Cruise Missile and Ground Launch Cruise Missile (ALCM/GLCM) testing. These missions task ARIA with three extra functions: 1) realtime retransmission of missile data using L-band telemetry links, 2) voice relay via UHF for all support aircraft, including ARIA, involved in the test scenario, and 3) control of the missile using an on-board Remote Command and Control/Flight Termination System (RCC/FTS).

AMRAAM MISSIONS

ARIA has been tasked with telemetry support of low altitude AMRAAM launches The specific requirements of ARIA support for these tests includes receiving and recording S-band telemetry links from the missile and relaying this data realtime via L-bands. Providing backup RCC/FTS for the missile, receiving and recording S-band telemetry links from the missiles’ target drones are secondary functions that ARIA is to perform.

Presently three ARIA can be configured with a required L-band pallet to support these tests. Each pallet consists of three L-band transmitters and a multiplexer to combine the three outputs to a common antenna. These transmitters have a passband bandwidth of 5 MHz to handle the 2.2 MHz data rate. Other modifications that have been performed and are required for AMRAAM support include the new ARIA AN/AKR-4 receivers to handle increased data bandwidth and data rates, the RCC/FTS equipment and the L-band antennas. The new receivers will handle up to a 20 MHz bandwidth. The 1.8 MBPS data from the AMRAAM tests has been no problem for the receivers.

AMRAAM TEST SCENARIOS

The test is designed to study the AMRAAM in an air-to-air environment. The scenario includes the launching of one to four missiles, from an F-14, F-15, F-16, or an F-18, against two to four drones in an air-to-air theatre. The drones contain an on-board computer to score missile accuracy. The scoring information is received by ARIA and then evaluated by the AMRAAM testing office. ARIA is to relay the S-band data from the missile to the ground via L-bands. The AMRAAM tests are normally completed in less than five minutes. Missile launch will not occur without first achieving a good solid decommutator lock on the ground. This makes problems such as shielding of the missile antenna by the launching aircraft mission critical.

AMRAAM test scenarios have presented new challenges to ARIA. These include tracking a rapidly moving vehicle and acquiring a second S-band link which is moving in a perpendicular direction away from the ARIA. This problem also contained other variables such as optimal positioning based on the missile antenna pattern and remaining clear of the hazard area. This problem was solved by placing ARIA perpendicular to the missiles' intended path on the side closest to the L-band receivers. ARIA was then moved two thirds of t h e way down the flight path of the missile and skewed slighty towards the drones. These moves minimized antenna slew rates, put ARIA in the optimal position to receive the S-band links from both the missile and the drone, and took into consideration L-band link margin analysis factors.

Another problem that has to be solved is the potential shielding of the missile antenna by the launch aircraft. The missile is to be attached to the underbelly of the launch aircraft which may not allow ARIA to support from its intended 28,000 foot altitude. ARIA may have to support from an altitude of 5000-7000 feet. There is currently a test scheduled for August 1986 that will test these possible problems and their solutions. Supporting at a low altitude will cause ARIA to shorten the amount of loiter time that is available. The loiter time in these tests could be constrained by equipment cooling. The PMEE equipment needs to be kept below 29 C and operating in a warm climate at low altitudes gives ARIA a maximum of approximately 30 minutes loiter time.

AMRAAM testing may require the installation of a relay platform on the ARIA to relay drone commands from the ground. This platform would eliminate the need for other relay aircraft and is another example of how ARIA adapts to meet specific test requirements.

CONCLUSION

The ARIA continually faces new telemetry and engineering challenges. These challenges have been met by innovative techniques as well as constant upgrades in the equipment. The AMRAAM test scenario is an example of how ARIA adapts to unique requirements to provide telemetry coverage for space missile, and Space Shuttle testing. ARIA's adaptation for AMRAAM testing will provide increased flexibility for new tests in the future.

ACKNOWLEDGEMENT

The author wishes to acknowledge contributions made to this paper by Capt Kathryn L. Gauthier in the ARIA Programs Division.

This paper is dedicated to my wife Kathleen C. Plecity who has inspired me to do the best I possibly can.

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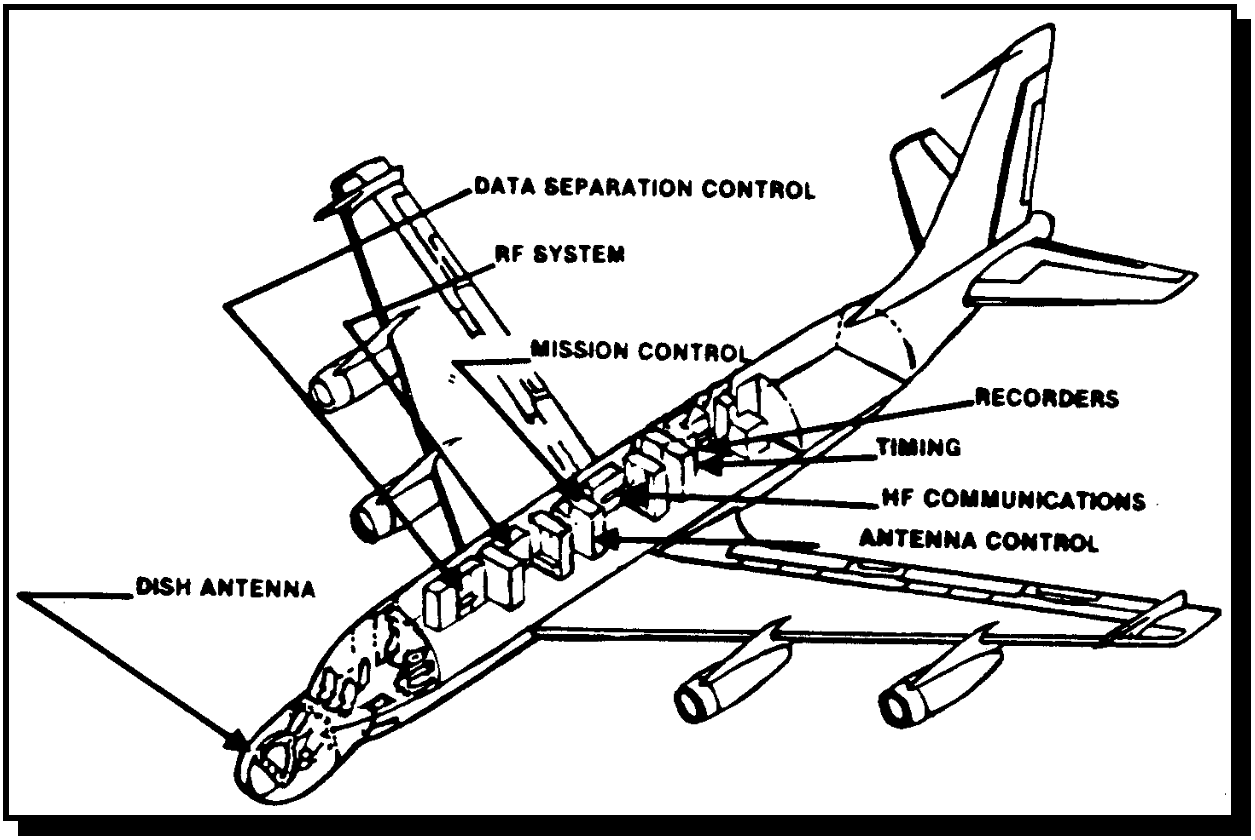

FIGURE 1 - ARIA PMEE SUBSYSTEMS