U.S. AIR FORCE TELEMETRY IN THE 1970'S

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Summary The telemetry systems used by the U.S. Air Force in the '70's must be highly reliable, flexible, possess growth potential and meet the requirements of operational realism, An attempt must he made to provision the basic weapon system design for the required telemetry hardware in order to prevent the tested version from incurring a penalty due to its subsequent incorporation. The components associated with future U.S. Air Force telemetry systems will be lighter, smaller, consume less power, withstand more severe environments, and cost much less than those of the past.

Introduction The problems associated with U.S. Air Force telemetry systems in the '70's are many. Not only are we facing the age-old problems of weight, size, power requirements, etc., but the new weapon systems have compounded and magnified these problems many times over.

On any new weapon system, whether it be aircraft, missile, or satellite, we face the problem of operational realism. Especially on new missile systems we must flight test missiles that are representative of the operational force. Reliability in today's telemetry systems must be emphasized more, not only because of the satellite program where millions of dollars are spent for one launch and if the telemetry fails all is lost, but also from the fact that today's test programs are reduced to the bare minimum.

A means of data acquisition is also a problem with today's new weapon systems. With the advent of land, sea, and air based systems we are forced to use many different test ranges. The answer to data acquisition seems to be some type of a mobile platform. We not only have to solve these problems to produce acceptable weapon systems, but we must accomplish this with an ever decreasing budget.

U.S. Air Force telemetry in the '70's will definitely be governed by the problems we face. Many of the new weapon systems, B-1, F-15, MINUTEMAN III, are using primarily Pulse Code Modulation (PCM) telemetry systems, augmented by Frequency Modulation (FM) when vibration measurements are of prime interest.

The challenge of meeting operational realism in today's weapon systems has to be one of great importance. The definition of operational realism is similar no matter what type weapon system. In MINUTEMAN, for example, operational realism could be defined in the following manner:

1. Hardware configurations which alter the Missile Performance Parameters and Models (MPPM) are not acceptable. The MPPM used to target the operational fleet must also be used to target the test missile.

2. It is desirable that the mass properties of the test missile be the same as the tactical. In no case shall it result in a change to the targeting software program.

3. Test missile hardware configurations which alter the physical dimensions, separation characteristics and/or aerodynamic properties of the operational system are unacceptable, unless they can be incorporated without perturbing the requirements of (1.) above.

4. Missile preparation and launch procedures will be the same as used for the weapon system at operational sites. Checkout, verification, monitor, and control of the system shall be accomplished independent of the weapon system.

One can see that trying to comply with all of the above requirements is all but impossible and herein lies the challenge. A Data Bus system helps to work many of the problems but at the same time increases the requirements placed on such items as remote multiplexers and signal conditioning boxes. A good example of this would be making a number of measurements in the I-II interstage area on MINUTEMAN. The remote multiplexer would have to be sized for location in the raceway, where the physical dimensions would be a major constraint. On an aircraft you might require it to be located on a wing spar where size and vibration under heavy G loads would be of prime concern.

The aerodynamics of a weapon system must also be duplicated. On MINUTEMAN we violate this requirement by having to add an instrumentation wafer (increasing length and weight) and a higher raceway cover to accommodate the instrumentation cable.

Meeting operational realism with a given piece of hardware is not sufficient in itself. In today's environment of reduced budgeting for defense systems we must produce equipment with a very high degree of reliability. The manned space program is an excellent example. Because of limited resources, the satellite and missile programs also require many components to have high reliability.

At first glance the data acqusition area seems like it would have little or no effect on new telemetry systems. In most cases this would probably be true; but suppose you need a one megabit system and you suddenly find out the range can only record at 500 kilo bits per second. With the many different types of weapon systems being tested today, it is impossible to locate a test range where we could perform all the required testing. The cost involved in constructing new receiving sites at different locations for each new test program forces us to a mobile concept. The Apollo Range Instrumentation Aircraft (ARIA) is one used on many test programs. Coordination with the test range early in the development of any weapon system is mandatory.

Conclusion The next decade is expected to create U.S. Air Force telemetry needs which would equal the challenges of the past decade. The problems may take significantly different forms as the emphasis shifts from system performance to substantial reductions in component size, weight and cost. The U.S. Air Force expects this need to arise from an ongoing effort to develop and improve missiles, aircraft and space systems.

One of the more pressing needs is a test instrumentation concept which permits ICBM flight testing with operationally configured hardware. That is to say, that the flight test instrumentation system would be designed such that it does not alter the missile size, weight, shape, or performance. Such a system ensures that the flight test data is applicable to hardware in the operational force. The solution to this need might well be a telecommunications concept which is new functionally and physically.