

A400M: INSTRUMENTATION ARCHITECTURE FOR FLIGHT TEST

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ABSTRACT

The Airbus A400M military transport plane carried out its first flight on December 2009 in Sevilla (Spain).

This paper presents the flight and ground architecture designed to perform the flights tests campaign in Spain and in France.

The core of the onboard flight test instrumentation is based on distributed network architecture already developed for A380 program. Airbus adapted civilian tests equipment for the A400M military program and various specific items have been designed specifically for this program.

Two interconnected flight tests centres located in Sevilla (Spain) and Toulouse (France) are used for the flight tests campaign to ensure interoperability during the tests.

INTRODUCTION

Airbus designed for the A380 commercial aircraft a very innovative test architecture using Ethernet switched network topology. These new test technologies have been developed to acquire new avionics buses derived from commercial standards and analog parameters. The very famous IRIG 106 PCM that has been the standard of acquisition & recording within the flight test community for nearly 40 years couldn't answer to those new applications.

As avionics architecture of the A400M and A380 are close (AFDX buses), the architecture of the onboard flight test instrumentation is the same for these two aircraft.

On military aircraft we have to acquire the military bus 1553 and various new needs not used on commercial aircraft, but the network architecture can easily integrate these new applications showing the adaptability of this technology.

OVERVIEW OF THE ONBOARD SYSTEM

The architecture of the A400M onboard flight test instrumentation is divided into 3 sub installations:

- Basic Flight Test Installation performs the data acquisition of all buses (Arinc 429, CAN, RSXXX, AFDX, 1553,...) and analog parameters up to 2KHz.

- Wide band Flight Test Installation developed for the analog parameters from 2KHz up to 20KHz. These parameters are mainly vibro acoustics measurements.
- Safety Flight test installation designed for the parameters recorded on specific safety recorders (black box)

The flight test instrumentation is split into 4 levels:

- Level 1 : sensors and tapping of aircraft parameters
- Level 2 : Data acquisition units (DAU) to acquire analog (temperature, pressure, acceleration, voltage, etc) and data from avionic buses.
- Level 3 : Data merging from the DAU using Ethernet switches.
- Level 4 : User devices like Recorders, Telemetry transmitter, Real time data processing.

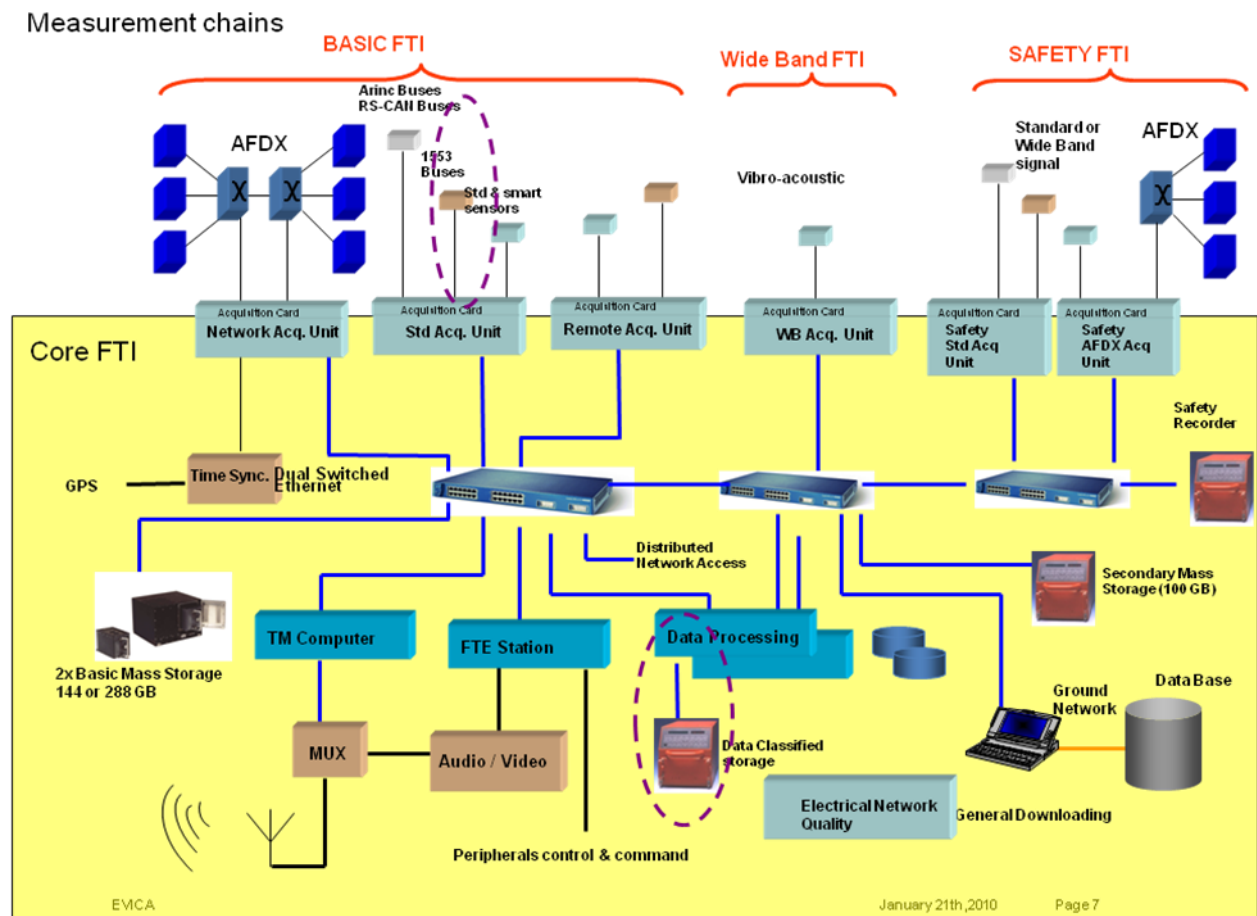


Figure 1

SPECIFIC ADAPTATION FOR A400M

Many discussions took place at Airbus to choose the type of test instrumentation to be used for the A400M military plane. Some experts wanted to use test equipment developed and certified for the military market, others believed they could adapt the equipment already developed for the A380 commercial airliner.

The environmental constraints (mainly vibration) are much more severe for the A400M. To make the right decision we decided to test the A380 equipment in order to determine if they were A400M compatible and the improvement that would be required to work on a military plane.

To sum up the results of those tests:

- Most A380 sensors didn't need any modification.
- We ruggedized some data acquisition systems designed to work inside the A380 cabin, video equipment, Ethernet switches, computers and various devices which came from the commercial market. We added shock mounts on most of them without too big difficulties.

NEW DEVELOPMENT

Among the various development performed for the A400M, two of them was really new:

Video systems

We developed many video systems for the A400M program :

- Head Up Display monitoring system
- Specific acquisition & recorder for the Enhanced Video System
- High speed cameras to visualize flares



Figure 2

Removable Flight test installation:

In order to modify quickly the test aircraft configuration we designed a clever installation of the instrumentation using pallets concept. The flight test installation is fully removable.

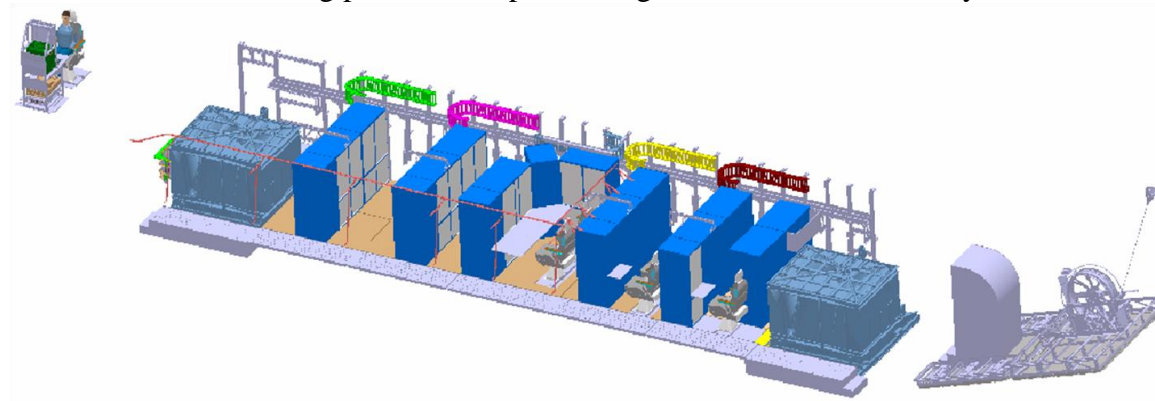


Figure 3

OVERVIEW OF THE TELEMETRY GROUND SYSTEM

The flights tests of the A400M are carried out in two major test centres located in two different countries Spain (Sevilla) and France (Toulouse), a distance of over 1000 km. To enable to design office specialists and testers to follow in real-time the flight tests of various aircraft whatever their geographical location a real time high-speed network links the two centres.

In addition, Airbus teams located in Germany (Hamburg and Bremen) and United Kingdom (Filton) can also follow the tests using a remote telemetry network (see Figure 4).

A central database located in Toulouse is used to manage the configuration of all A400M flight test installation.

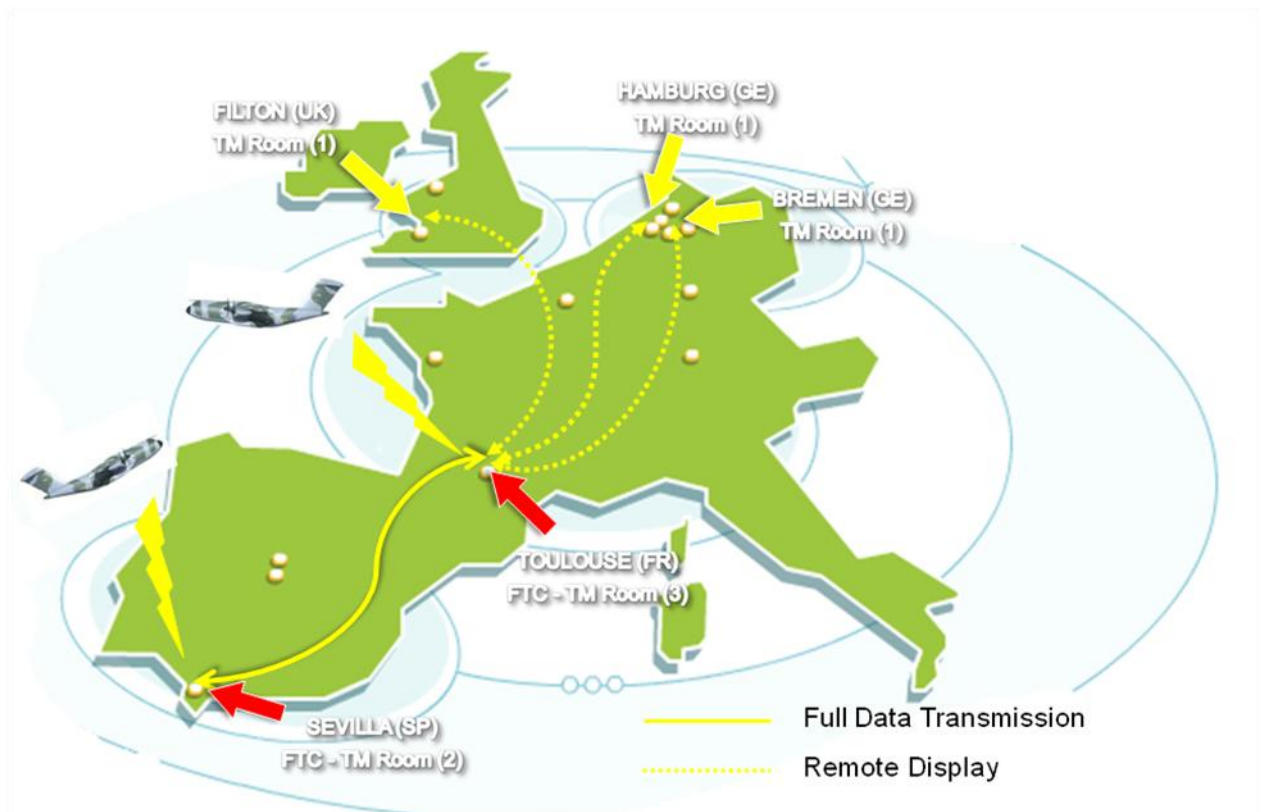


Figure 4

CONCLUSION

We have developed for 10 years a scalable and modular Ethernet switched architecture able to acquire new needs (1553, new specific sensors,...). This technology used on A380 and A400M will gradually replaces our old PCM installations on legacy test aircraft. For the A400M the option of reusing A380 test systems was the good one. After several months of flight test with several aircraft in service the onboard test instrumentation works well. The two main test centres are fully interoperable and the remote telemetry facilities allow to specialists located in different countries to follow the flight tests in real time.