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ADP010304

TITLE: Mirage 2000 Combat Aircraft Upgrade in
Dassault Aviation. Solution for NWDS System Open
and Affordable

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MIRAGE 2000 COMBAT AIRCRAFT UPGRADE
IN DASSAULT AVIATION
Solution for NWDS System open and affordable

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MIRAGE 2000 are in operational service within several Air Forces since 1983. The outstanding structural sturdiness of the Mirage allowing them to fly over 2015-2020, allow Dassault Aviation to consider mid-life update.

MIRAGE 2000 mid-life update shall comply with the following criteria :

- Multirole aircraft, able to carry a wide variety of Air to Air and Air to Surface missions,
- Affordable costs,
- Replacement of current sensors (for example : RDM radar) by state of the art modern sensors with up to date operational performances (for example : multi shoot fire control),
- Replacement of the current WNDS core system by an open system based on modular avionics architecture allowing, in particular, to separate application software and hardware,
- Replacement of the current cockpit lay out by a modern glass cockpit taking benefit of the numerous advantages of the Man - Machine - Interface fitted on the MIRAGE 2000-5,
- Implementation of new functions, by the customer's national industry, thanks to a modern software workshop installed at the customer's facilities.

The target of this mid-life update is to obtain a new version of MIRAGE 2000 with a fly away price for new aircraft of 80% of the one of MIRAGE 2000-5 but with attractive operational characteristics.

1. CHOICE OF OPERATIONAL FUNCTIONS

Marketing approach followed in the market of new modern aircrafts, or updated versions of existing airframes, indicates that operational potentials of these airplanes are high.

In this context Dassault Aviation has decided :

- To fit the basic version of the future MIRAGE 2000 with :
  - an air to ground firing control with standard bombs, guns and rockets,
  - an air to air firing control with IR combat missile.

- To size the complete system to be able to add options on customer's request without modification of the core system :
  - Air to Air mode : BVR missiles with at least double shoots fire control.
  - Laser Guided weaponry
  - Data link
  - etc...

Dealing with updated versions, the basic solution has to be tailored to fit the customers' specific needs ; three levels of upgrades have been identified :

- Level 1 : full mission system upgrade.

- Level 2 : the existing system is maintained in the present state, new functions and new equipments are integrated into an additional core system.

- Level 3 : new functions and new equipment are integrated in the existing system with minor modifications.

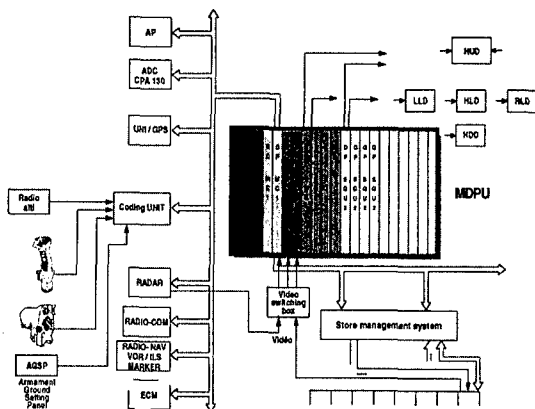Level 2 and level 3 upgrades are made up level 1 subsets.

2. TECHNICAL DEFINITION OF THE WNDS

Technical definition of the airframe, engine and weapon system was reviewed in order to find a compromise between cost and efficiency, while reducing impacts on recurring and no recurring costs :

- by simplifying actual functions (reduction of number of components)
- by using already engaged developments, showing cost reduction potentialities
- by using dual new technologies, decreasing the cost and able to cope with obsolescence problems.

2.1 - Architecture

The effort on cost reduction is mainly visible on the weapon system. A new architecture of data processing, developed around a core system with modular avionics, provides a significant reduction of development cycle and offers to the customer a potentially more evolutive system with growable capabilities, as shown below.

2.2 - Core System

The targets of the avionics core system new approach are :

- to reduce development cycles and recurring cost of the WNDS

- to have an important growth capability of the core system,
- to have a better obsolescence management and best use of current technology at any time,
- to be able to reuse already developed software with no regression.

This approach is based on :

- a standardised core data processing, the Modular Data Processing Unit (MDPU : Dassault Aviation - Dassault Electronique - Sextant),
- a new system and software environment based on an objet oriented system workshop (ODILE)
- an encapsulation of existing software with adequate interfacing with new software.

2.2.1 - MDPU generic architecture

In order to meet the important growth capability objective assigned to the new core system, the proposed core data processing has been conceived as a modular, scalable, open and evolutive platform (see fig. below) : inside a rack, power supply function and standard functional modules (up to 18) communicate through a backplane. The standard functional modules are :

- a Data Processing module (DP)
- a Graphic Processing module (GP)
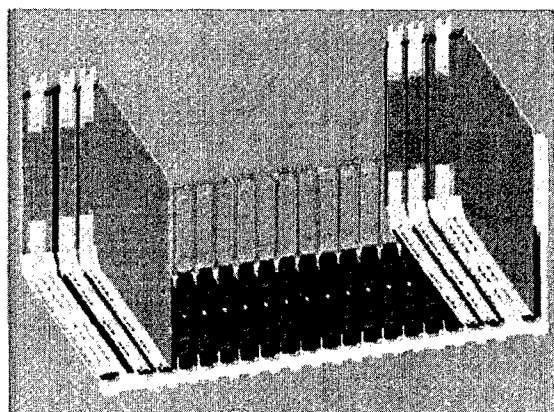- a Mass Memory module (MM)
- a Bus Coupler module (BC)

Each of the standard modules has been designed making the best use of COTS and current technology. As an example, the new processing power of one Data Processing module is 50 times higher than the one of the present M.2000 Mission Computer.

The obsolescence management has been taken into account by using standard interfaces between the various components of the MDPU in order to be able to change hardware and software components without any impact on the application software. Furtherone, this makes the associated

evolutions easier by allowing a component to be changed with minimum impact on its environment. The standard interfaces concern the hardware as well as the middleware components. The Operating Software can be changed without any modification of the application software. In the same way, the CPU of the Data Processing module can be changed independently of the others functions implemented in the module.

The modular configuration of the MDPU also contributes to simplify maintenance procedures, the LRU concept being replaced by a LRM concept.

This core system will be installed on all present Dassault Miltary programmes (M.2000-9, Rafale, ATL3).

2.2.2 - *MIRAGE 2000 Configuration*

The proposed configuration for the MIRAGE 2000 includes the functions implemented in the two Mission Computers and the two Symbol Generator Units in the previous architecture : mission management including operational moding management, display and control management, maintenance management. The Data Processing Module containing mission computer software is totally redundant so that then one fails, all the operational capabilities are kept (no degradation in back up mode).

2.3 - Radar

2.3.1 - The basic radar is the Thomson-CSF RC 400, with an emitting power of 400 W, allowing a firing capability of two simultaneous targets in Air to Air mode, with a range slightly lower than the one of RDY radar. Signal processing functions are directly derived from the algorithms of the RDY, and therefore must provide a very

similar quality and sturdiness of the fire control, but with a significant price reduction.

This radar is presently under development.

2.3.2 - The multitarget RDY, radar of the M.2000-5/-9 is obviously available upon customer's requirement.
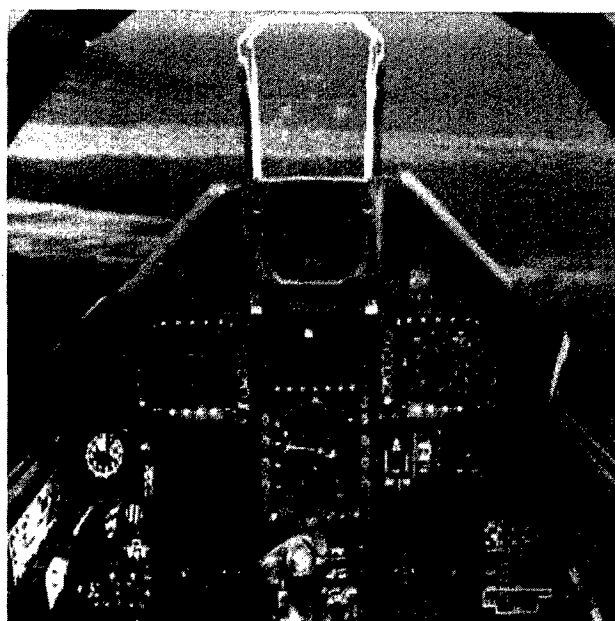
2.4 - Cockpit lay out

In service experience has shown that the M.2000-5 cockpit concept with five displays was very much appreciated by combat pilots.

This is mainly due to :

− the concept Head up - Head level displays collimated at infinity, giving without accommodation by pilot's eye both the immediate situation (HUD) and the main sensor display,

− a peculiar display dedicated to the long term, ie tactical situation (HDD)

− two interactive lateral displays and a mode selector panel, last three displays will be LCD.

It was stated that such a cockpit gives to the pilot a good and clear situation awareness, even in heavy workload phases.

2.5 - Others functions

- The inertial platform is a Sextant TOTEM 3000 Gyrolaser with GPS hybridisation.

- The radiocom system could be provided by the customer national industry as the ECM and Stores Management Systems.

3. CUSTOMER'S ON SITE DEVELOPMENT ENVIRONMENT : ODILE

- The objectives of the on site environment are mainly to give to the customer the ability to modify the MDPU software which has been initially developed by French Industry : same environment based on ODILE is used in France to develop oriented objet part of software functions. This is provided in order to :

- give to the customer ability to make system level modifications (by opposition to going directly at very detailed local software level),

- with the shortest modification cycle : ability to show prototyped functions to pilots and to complete development and validation up to flight test in short time,

- so that the modification has no impact on the existing object oriented and encapsulated part of the software. No regression test on this part is necessary after reuse of already developed software.

This workshop incorporates some new tools and relies on the same new methodology (Dassault Aviation System Development Methodology - DSDM - based on RTOOSA) as those used in France by Dassault Aviation to develop software in object oriented technology for new functions.

It is composed of :

- an OASIS rapid prototyping facility for pilot in the loop Man Machine Interface (MMI) simulation

- a DSDM development environment with :

  Δ analysis tool-sets for system requirements analysis

  Δ system design tool set

  Δ software development tool set for software design, coding and testing

- a MDPU Hybrid Simulator for integration (validation of MDPU software)

This workshop will be supplied with appropriate training and assistance.

The development process is described in figure below.