GEA Tianjin / 中国民航大学中欧航空工程师学院

SB 503 - Avionics Technologies
3-6 Integrated Modular Avionics
MMI: Man Machine Interface

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Thales Avionics

MMI (MAN-MACHINE INTERFACE)

– **Cockpit System Architecture**

- Operational needs
- Building blocks
- Airborne constraints
- Performances
- Cockpit architecture examples
- Example : ODICIS (**O**ne **DI**splay for a **C**ockpit **I**nteractive **S**olution)

What is a cockpit architecture ?

- **Operational functions**
- **Concept of cockpit**
- **Market trends**

Main actor : Customer

Operational Needs

- **Display BB :** display units, graphic generator, …
- **Control panels BB**: interactive media (CCD/KBD), existing control panels …
- **Graphic SW BB** : Plateforme SW (incl. OS), graphic server, existing operational functions, …
- **SW framework**

Main actors : Thales CKT or COTS

Building Blocks

Cockpit Architecture

Performances

- **Cost**
- **KPI** (weight, vol, Power, MTBF, nb LRU/PN, …)
- **Display Performance** (CPU, mem, latencies, …)
- **Dispatch / Maintenability**
- **Evolutivity**

Main Actor : Thales

Airborne « Constrainst »

- **Safety / certif**
- **Environmental conditions**
- **Installation** on A/C or H/C
- **Avionics I/O**

Main Actors : Certif. Authorities, Customer

Cockpit architecture is a compromise solution

Operational functions

- **Various operational needs**
  - Civil Air transport, regional transport, military operations, …
  - Single or dual pilot IFR
  - Day, night, or NVG conditions
  - Improved situation awareness
  - Mission specific needs ; ex : SAR operations
  - …

- **Large functional perimeter**
  - Primary Flight Display
  - Mission HSI: ND, DMAP, FISB, Airport Nav, Mission ND
  - A/C systems and utilities HSI (EICAS): EWD, SD
  - Crew information HSI : e-charts
  - Possible hosted functions : FMS, RMS, …

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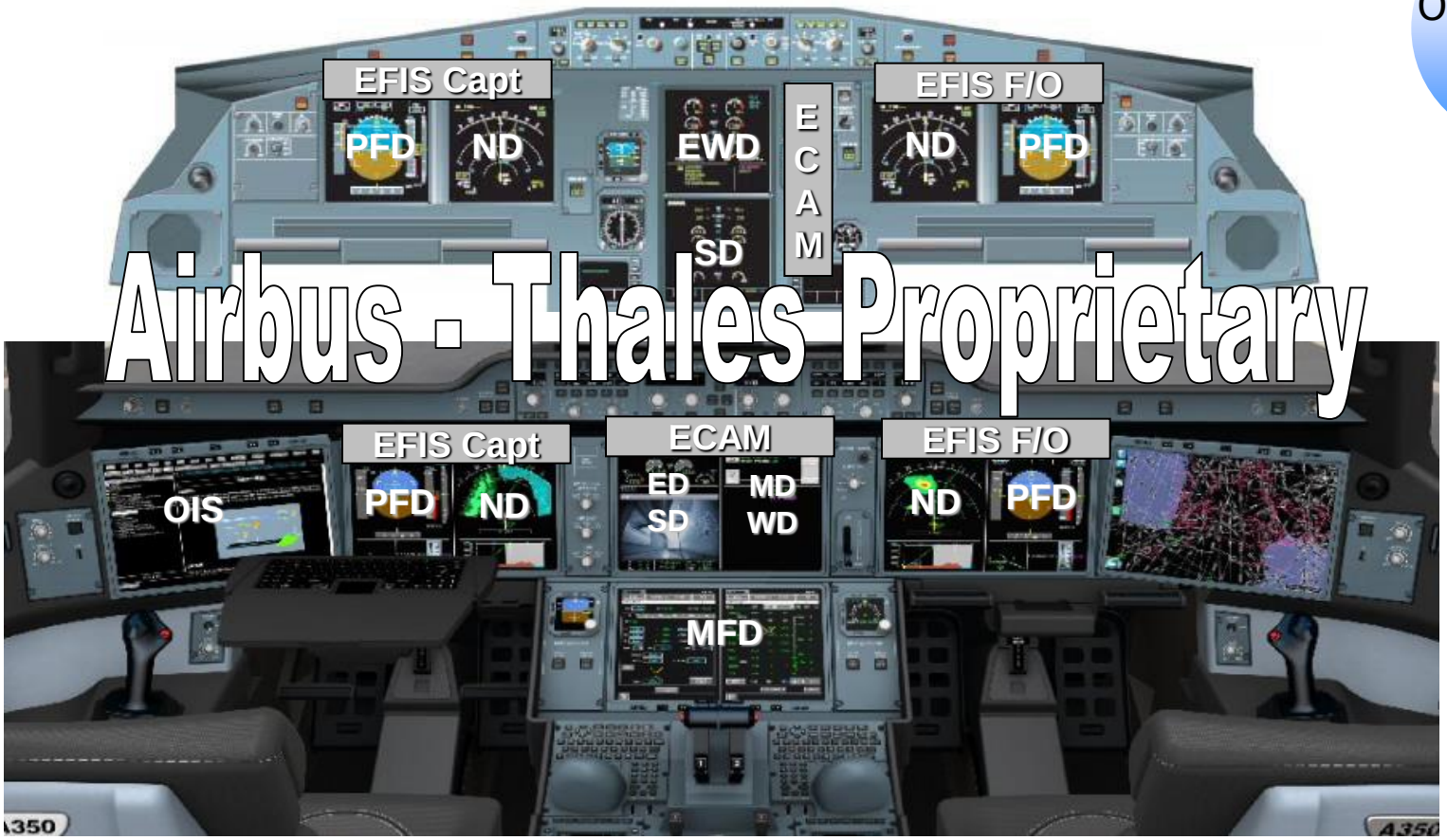
Operational Needs



« Cross Crew Qualification » ever in mind

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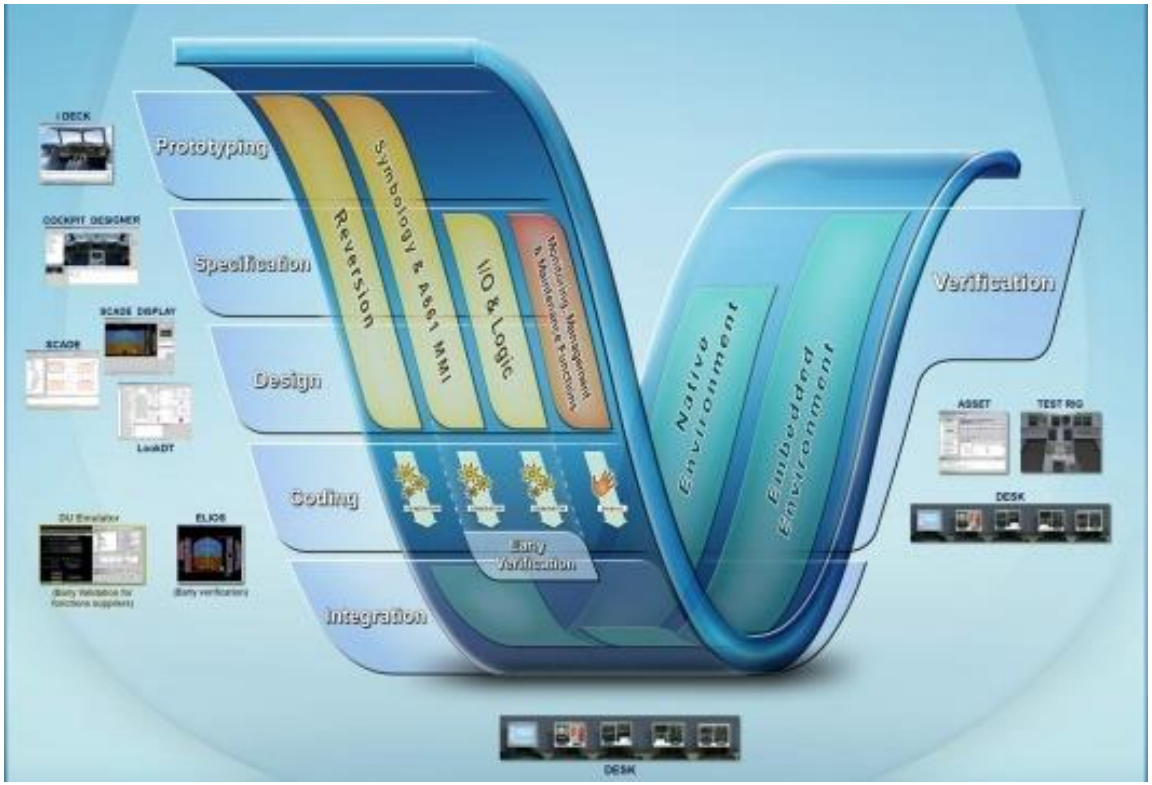
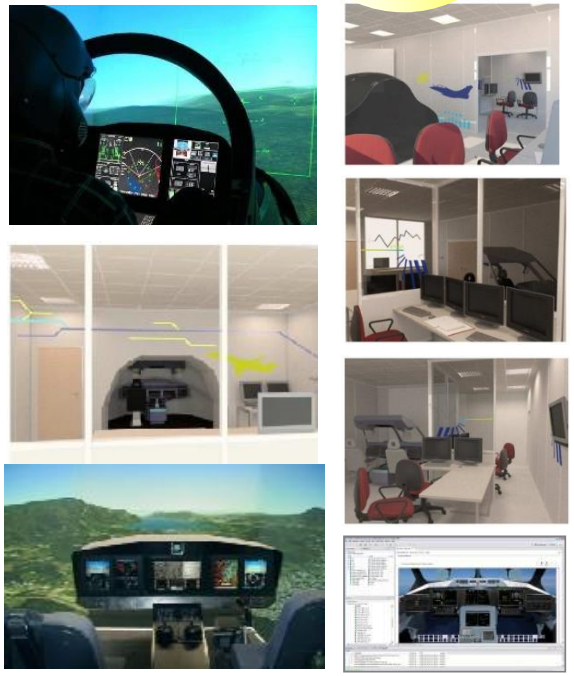
Processus & Tools

Building Blocks





Prototyping tool in order to specify and integrate on a native basis, covering the entire development Cycle for HIS functions (Model, Simulation & verification)

THALES

AIRBUS GROUP

SAFRAN

Safety / Certification

Airborne Constrainst

Failure Conditions (Integrity)	Hazard class.	DAL	Cockpit Archi. impact
Misleading display of primary flight parameters (altitude, airspeed, altitude) on both primary displays	**CAT**	**B monit. by A**	**Feedback** (dissimilar from display channel)
Misleading display of primary flight parameters (altitude, airspeed, altitude) on one primary display	**HAZ**	**B**	
Misleading display of stabilized heading on primary displays	**HAZ**	**B**	(Often feedbacked parameter)
Misleading display of flight path vector on one primary display	**MAJ**	**C**	(DAL B as part of PFD)
Misleading Display of Nav / Position information (*)	**MAJ – HAZ**	**C - B**	(ND is dev. in DAL B)
Loss of / Misleading display of crew alerting CAS messages	**MAJ**	**C**	
Misleading Display of flight crew procedures	**MAJ - CAT**	**C - A**	
Misleading display of any required engine indications for more than one engine (**)	**CAT**	**B monit. by A**	**Feedback** (dissimilar from display channel)

Integrity → Monitoring

Catastrophic → No single failure → dissimilarity

(*) In specific flight phases (approach or arrival and departures). Previous certifications have shown that, in the traditional ATC environment, this level of safety has been achieved by simultaneous display of raw radio navigation data in addition to any multi-sensor computed data.
(**) If the power setting parameter is indicating higher than actual during takeoff, this can lead directly to a catastrophe, either due to a high speed runway overrun or impacting an obstacle after takeoff.

Avionics and Cockpit I/Os

Airborne Constrainst

- Avionic Network layer
  - Recent A/C : AFDX
  - Legacy A/C or H/C config. : A429 (≈30 in)
  - Military : 1553
- Safety Net (CSFL**(*)**)
  - primary ref. (ADC, AHRS/IRS, RA) : A429
  - Other sources (GPS, AFCS, FADEC, FW) : A429
- Specific Inputs
  - WXR & TAWS : A453
  - GND/FLT discretes
  - XM or AIS receivers, FADEC : RS422
  - Video sources : Analog (Stanag 3350) or digital (A818, SMPTE)

- **Cockpit Network**
  - AFDX or Ethernet
- **Media and Control Panels network**
  - CAN
  - Legacy : A429 or discretes
- **Cockpit Video links**
  - Link between Graphic Generation and LCD Display : A818 (if external) or LVDS (if internal)

(*) CSFL : Continuous Safe Flight and Landing

Dispatch

Performances

– Dispatch considerations

- Dispatch = capability to take-off, even with an equipment failed
- Upmost importance in Air Transport and Buisiness Aviation, Important for Regional airlines.
- **Master Minimum Equipment List** (MMEL) defines number of equipments required for dispatch and any related conditions

– Impact on architecture

- Safety objectives shall be met, even under MMEL conditions
- Power supply distribution impacts MML definition
- Measurement :
  OI rate (per million T.O.)

7U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

MASTER MINIMUM EQUIPMENT LIST

AIRCRAFT: A-318, A-319, A-320, A-321	REVISION NO:21 DATE: 06/17/2009	PAGE: 31-7

SYSTEM, & SEQUENCE NUMBERS	ITEM	1.	2. NUMBER INSTALLED	3. NUMBER REQUIRED FOR DISPATCH	4. REMARKS AND EXCEPTIONS
31	INDICATING/ RECORDING SYSTEMS				
63-01	Display Units (DU)				
1)	PFDU 2	C	1	0	(O) May be inoperative provided: a) PFDU1, NDU1, E/WDU, SDU and NDU2 are operative, and b) Approach minimums do not require its use.

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ODICIS Concept launched by Thales (1/2)

ODICIS: One DIsplay for a Cockpit Interactive Solution

ODICIS Concept launched by Thales (2/2)

ODICIS: One Display for a Cockpit Interactive Solution

Thank you for your attention !