Feedback on IMA certification and on-going regulatory work in Europe

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International IMA Conference – Moscou 2012
Life of a System Certification Manager before IMA ...

Life of a System Certification Manager with IMA ...

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IMA perimeter in Avionics System

Certification Process

Incremental Certification

Lessons Learned

On-going Regulatory work in Europe
Avionics System
IMA perimeter

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Avionics System Perimeter

A trend: from Equipment, to Subsystem and Open Avionics System Package
Integrated Modular Avionics (IMA)

Before

Platform composed by a set of non system specific and highly configurable computers

1 function = 1 computer

ARINC 429

Now with IMA

Multiple systems applications are executed on the same platform and network

Allowing highly integrated architecture, IMA permits recurrent, development and maintenance cost savings optimizing industrial business model
Platform / Module supplier:

- Production, Supply chain, component obsolescence management and capacity to F3 design in the future
- In Service Experience on COTS hardware component (Certification constraint)
- RT Operating System (such as A653) skills
- Robust Partitioning demonstration (Partitioning) skills

Sub-System Designers / Application Suppliers

- Functional domain (Flight Management, Fuel, Cabin...) skills
- Functional oriented Software engineering skills

IMA system integrator

- Complex integration (mixing software and functional aspects) skills
- Incremental Integration & Acceptance

IMA objective: Select the best supplier for each task taking into each specificity
Integrated Modular Avionics
Certification Process

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System Development & Type Certification Contribution

Avionics System Supplier (Thales)

Suppliers Sub-contractors

Aircraft Manufacturer

Contract
System Development & Type Certification Contribution

TSO Equipment

Type Certification
TSO installation

TC Validation

Agreements Arrangements between AAs

Airworthiness Authority Country A (IAC-AR)

Airworthiness Authority Country C (ex: FAA)

Technical Standard Order (TSO) Authorization

Airworthiness Authority Country B (EASA)
Aircraft Certification Basis:
- CS 25/AP25/FAR 25
- Special Conditions, Exemptions, ESF

AMC (generic)
IM (specific CRI / IP)

Determination of Certification Basis

System Supplier

Equipment Supplier

Standards

System
ARP4761
ARP4754

IMA
DO-297

HW
DO-254

SW
DO-178B

Environmental
DO-160

Certification basis flow-down

AUTHORITY

Aircraft Certification Basis

System “Qualification” Basis

Equipment “Qualification” Basis

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FAA :

◆ 2002 : TSO C153 « IMA hardware elements »
◆ 2003 : AC20-145 about TSO C153 (obsolete with AC20-170)
◆ 2004 : AC20-148 about « reusable software component (RSC) »
◆ 2010 : AC20-170 making the link between TSO C153, AC20-148 "reusable software component" and DO-297
◆ 2012 : PS-ANM-25-08 provides criteria to determine if the guidance in AC 20 170 is applicable (Am I an IMA ?)

EASA :

◆ CRI-Fxx : Interpretative Materials for Integrated Modular Avionics System
◆ CRI-Fxx : Interpretative Materials for Incremental Certification

These regulatory materials are calling on industrial standards as means of compliance
ARP4754 (+ARP4761) and more recently DO297 are structuring IMA system development and certification processes.
According to DO-297:

DO297 shall be used to structure IMA definitions in order to avoid misleading interpretation at the beginning of the certification program.
Which kind of authority involvement and audit reviews with IMA?
Integrated Modular Avionics
Incremental Certification

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In the frame of each TC, specific CRI/IP (IM) are published considering IMA architecture as a system. But a system whose certification shall be handled via an incremental process (see DO297)

(*) DO297/ED124 definition
What was at stake?

- 2 ways are identified to manage resources sharing issues at system level:
  - IMA conventional way (API ARINC 653):
    - Multi system integration on platform
  - IMA Incremental way (API ARINC 653 + Incremental process):
    - Replacement of multi-system integration by qualification credit based on Usage Domain qualified at platform level

« AA warned about potential difficulties during the compliance demonstration in case of Incremental approach is not followed. This is derived from the complexity of IMA systems »
What is at stake regarding IMA certification?

**What is at stake:**

- Performance and safety of integrated module in any operational situation. The IMA architecture (including networks) is considered as a complex system of the aircraft.
- Independent qualification of some components and credit from some components pre-qualification is needed to simplify final approval.

**Qualification credits:**

- Credit n°1: Bare Module & Tools pre-qualification: Modules & tool chain properties (partitionning, configurability, performances) is demonstrated and guaranteed in a frame of a Usage Domain.
- Credit n°2: A qualified tool chain guarantees that Modules are well configurated compliantly to Usage Domain
- Credit n°3: Standalone qualification of Avionic applications are expected to be granted in the context of an integrated module with several functions

**Keys Points:**

- Incremental qualification process shall be defined to master the interactions between the industrial players
- Incremental qualification taking benefit from Module & Tool properties (partitionning, configurability & usage domain)
Lesson learnt from recent IMA certification

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A/C Certification Basis understanding and good anticipation (Special Conditions, Issue Papers, etc)
- Including additional requirements from Importing Authorities.
- Including Interpretative Materials about Integration & Incremental Processes (which credit in which context ?).

Good sharing of the Certification Basis by A/C manufacturer with the IMA System Integrator, Application Suppliers and IMA Platform supplier

Joint Certification Strategy
- TSOs / ETSOs
- Incremental Certification Approach in line with business workshare.

Management of the Sub-contractors with correct cascading of certification requirements
Lessons Learned (2)

- Bilateral Agreements or Arrangements between Authorities facilitate and optimize the Certification

- Early agreement on a Certification Program structured in several audit domains
  - IMA System & Integration domain
  - Application software qualification
  - Platform qualification (hardware, Operating system and Tools)

- Early validation by AA of the HW, SW, SYS Certification Plans (SOI 1) reduce the risk
  - Simple and Complex Hardware Components classification
  - Clear roadmap for COTS components (In Service Experience, Errata...)

- Keep AA in the loop along the development process
- SOI audits in good phasing along with development reviews
- Relationship and confidence between Offices of Airworthiness is essential
IMA Rulemaking in Europe
What else?

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The IMA platforms are composed of elements/modules which are both generic and configurable.

The IMA elements/modules are designed to be reusable in order to reduce cost development and facilitate certification programs.

Nevertheless, « reuse » does not mean « certification credit » from an aircraft to another. The certification credit from the Incremental Acceptance is only granted for a dedicated Type Certificate (TC).

This credit should be granted independently of the aircraft thanks to a [European] Technical Standard Order (TSO - Equipement Certificate) and their certification data package recognised as certification credit when reused for a new aircraft.
Thales promotes an European System (ETSO, AMC) facilitating reuse and certification credit in IMA systems via an ETSO IMA platform (2C153) and Software Functional ETSO approach (AMC)
ETSO IMA and AMC will be created in EASA regulatory corpus

- ETSO 2C153 shall be developed and published enabling authorizations at IMA platform/module level, independent from aircraft.
- FAA TSO C153 cannot simply be transposed into an ETSO, because it does not contain sufficient Minimum Performance Specifications (MPS) and do not cover Core Software.
- ETSO 2C153 to be complemented by AMC 20-170 (based on ED124/DO297) to provide more guidance for integration at function and aircraft level without needing dedicated Certification Review Item (CRI)

RMT.0456 included in EASA Rulemaking Programme 2013-2016
This ETSO refers to IMA platform modules which are appliances composed of Hardware and Core Software or any embedded software module contributing to the intended function of resources sharing.

Seven basic types of IMA platform modules are identified:

- TYPE A : Rack Module (only relevant for Cabinet architecture)
- TYPE B : Processing Module.
- TYPE C : Graphical Processing Module.
- TYPE D : Mass Data Storage Module.
- TYPE E : Interface module. (Input/Output Module and/or network module)
- TYPE F : Power Supply Module (only relevant for Cabinet architecture)
- TYPE G : Display Head Module

En equipment can combine several types (e.g B+D)
Thank you for your attention
Any questions?

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