International Conference on Integrated Modular Avionics – Moscow

The EC FP7 R&D project SCARLETT

2012-10-29
An introduction to Avionics

Scarlett presentation

Conclusion
Avionics: up to 30% of Aircraft total cost

Aircraft = Structure + Engines + … ?

Avionics
Avionics

Aircraft System Architecture: many highly cooperating systems

Avionics: Core System supporting overall aircraft operations
Architecture trade-offs

**Federated architecture**
- Dedicated computers for each system
- Extensive pt-2-pt wiring

**Integrated architecture**
- Shared computers
- Less wiring

Avionics community engaged the transition end of 1990’s
Avionics Architecture evolution – a short history

In 1970’s and 1980’s, 2 major trends:

- **Increase of complexity**
  - Increase the number of equipments installed on aircraft
  - Increase the number of wires to interconnect all equipments

- **Higher level of requests and constraints**
  - Time to market (including management of obsolescence)
  - Safety
  - Performances
  - Maintenance costs
Avionics Architecture evolution – a short history

**FEDERATED ARCHITECTURE**

1 FUNCTION = Many LRU

1 FUNCTION = 1 LRU

Many FUNCTIONS = 1 LRM

**IMA ARCHITECTURE**

Modularity

Integration

**Between 1990’s and 2000’s, a new step is reached: capability to integrate several applications inside a common unit**

- IMA is identified as a concept permitting to
  - Reduce the number of equipments installed on aircraft
  - Reduce the number of types of equipments installed on aircraft
  - Reduce the number of connexions

IMA = Integrated Modular Avionics
Aircraft Certification is not only product quality insurance, but also deals with multi-actor development process enforcement.
IMA first generation

**30 years of architecture evolution to contribute**

- To bring flexibility for first design or upgrades
- To reduce aircraft life cycle cost
- To improve maintainability

**Challenges**

- Safety: prevent side effects
- Multi-role Organization and business model
- Certification costs

Reduction of « SWaP »

- Size, Weight and Power consumption
- 40% cut maintenance costs

Partitionning features
- Process and Role standardization

IMA first generation is flying → what’s next ?
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Conclusion
The consortium

- 39 Companies
- From 16 countries
- Complementary profiles
  - Large Industrial Companies
  - Public Research centers
  - Industrial Research centers
  - Universities
  - SMEs
- Broad range of expertise
  - Airframers
  - Module / Platform suppliers
  - Function suppliers
  - Modelisation
  - Simulation
  - OS
Very demanding ramp-up phases require huge improvements in system maturity at Entry Into Service

Increasing the set of functions hosted by the IMA platform reduces risk on maturity: the development effort for core electronics (HW / OS) is communalised
Next generation IMA platform will need to provide more computing power and interface capability

Volume / weight / power consumption constraints will remain
IMA 1G

Incremental certification

Common Toolset for all application development

Reduction of P/N with common processing modules

... several different types of CPIOM modules

Sharing of resources by several applications (HW, basic SW, avionics network)

... At module level

... For a selected number of application
From IMA1G/IMA1G+ to IMA2G : SCARLETT Objectives

1. Provide a scalable solution
2. Define minimal set of modules
3. Increase number of supported function
4. Develop new standards to support 2nd generation IMA
5. Provide associated process and toolset
6. Demonstrate fault tolerance and reconfiguration

- Increase operational reliability
- Avoid unscheduled maintenance
- Reduce development cycle
- Scalability to various aircraft types
- Reduce cost of spare parts
- Save weight, volume, power consumption
- Reduce Set of Part Numbers
**IMA1G**

- Is only used for selected applications
- Characterized by several types of processing Modules because of Input / Output
- Does authorize better reuse and less Part Numbers but not re-configurability

**IMA1G+**

- Performance upgrading to sustain more functions
- Upgrade Operating System with separation between Local and Global variable
- Generalization of Incremental Certification

**IMA2G**

- Will separate Input / Output from computing resource
- Will bring enhanced performance enabling a greater number of applications to be hosted on the same module
- Will provide specific platform services such as reconfiguration
- Will enable scalability
SCALABILITY

= Capability of the architecture to be adapted to…

Set of Families
(Regional / Large+small transport, bizjet)

Family of A/C

Single A/C

IMA 1G

IMA 1G+

IMA2G

Needs of various A/C types
- weight / volume
- power consumption
- environmental conditions (thermal, vibration, etc)
- Specific functions
- Specific Input / Outputs requirements

Large number and many types of applications
- high performance applications
- time critical applications
- avionics server functions

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IMA2G architecture
(Principles and building blocks)

- All target A/C needs can be met by the IMA2G architecture
- Adaptation / development cost and lead time are reduced compared to existing standards
Configuration aspects have increased a lot

Thus, defining a standard for configuring each IMA2G resources is a must to improve the overall effort required for configuring an aircraft.
Reconfiguration: a mean to enhance operational availability

Platform level services

Operational level

Resources

Optimized use of shared resources and graceful degradation
Allow for reduction of unscheduled maintenance

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The steps completed in this first project are:

- Definition and validation of new IMA2G platform architecture concepts
- Development of key basic components, like Core Processing Module or Remote Data Concentrator, and supporting tools
- Demonstration of key features:
  - Platform reconfiguration capabilities
  - Decentralized Input / Output
  - IMA new type of modules:
    - Time Critical for Flight control
    - Avionics server for crew and passengers

SCARLETT provides the pillars for IMA2G concept
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Conclusion
Imagine 2010’s – 2020’s

- IMA2G confirmation: need in scale demonstration
- Technology breakthroughs?
- Even more computing power?
- With even less Weight and Power?
- Passengers needs for connectivity

Preparing IMA2G next generation products
IMA concept: what’s next?

Enlarging IMA2G to all Information domains
IMA2G way forward

FUTURE PROGRAMS

IMA2G

IMA1G+ AIRBUS A350

AIRBUS A400M SUKHOI SJ AIRBUS A380

NEVADA VICTORIA SCARLETT

ASHLEY

FUTURE STUDIES


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