Contribution of Integrated Modular Avionics of Second Generation for Business Aviation

Bruno Andrillon, Dassault Aviation

Challenges for business aviation are globally similar to the ones that transport aviation is facing to. Introduction of Integrated Modular Avionics (IMA) in transport aircraft (since A380) has shown an increase in efficiency and in management of critical applications through key elements for incremental certification (from technical point of view, tools and processes). Since this kind of solutions has been helpful in transport aviation, it may be intuitively suggested that the same contribution may bring similar results in business aviation. Extension to the second generation IMA (IMA 2G) addressed by studies like SCARLETT (**S**calable and **R**econfigurab**LE** pla**T**form and **T**ools) should even contribute more to business aviation. This paper aims at examining the benefits of IMA 2G for business aviation.

Many functions in many systems

From the avionics point of view, four major evolutions are identified in business aviation:

- *'Multi-systems' / 'Multi-domains'*: interactions between avionics systems are increasing, including with critical systems, cockpit management or open-world ones. An illustrative example is the centralized maintenance system which may interact with all these systems / domains.

- *'Digital Aircraft'*: introduction of new functions and services implies increasing needs for processing power and information exchanges between embedded systems themselves or between embedded systems and ground ones.

- *'Network Centric Operations'*: aircraft becomes a network subscriber in larger systems including Air Traffic Management or operator needs (e.g. connection between embedded maintenance system and maintenance centers).

- *Security*: the increase in safety constraints and the increase in aircraft/ground systems interactions at same time imply to consider security as a key element for any future avionics systems.

These four axes drive the introduction of a new shared computation resource in business jets: IMA 2G.

Pure computation resource linked to remote I/O peripherals

IMA 2G offers a pure computation resource based on Core Processing Modules (CPM), communicating with peripheral Input/Output resources (Remote Data Concentrators – RDC) through ARINC664 part 7 network. The set of CPMs and RDCs components linked by a common network draws a generic platform. Hence the architecture design offers drastically generalized resources to improve high level of integration of numerous systems. This generic

platform allows reducing wiring, equipment number and part numbers, with positive consequences on reliability and maintainability. Mass and volume of electronics needed to embed these systems should be globally reduced through the optimization of use of shared computation resources.

Processing Cabinet

Remote Data Concentrator
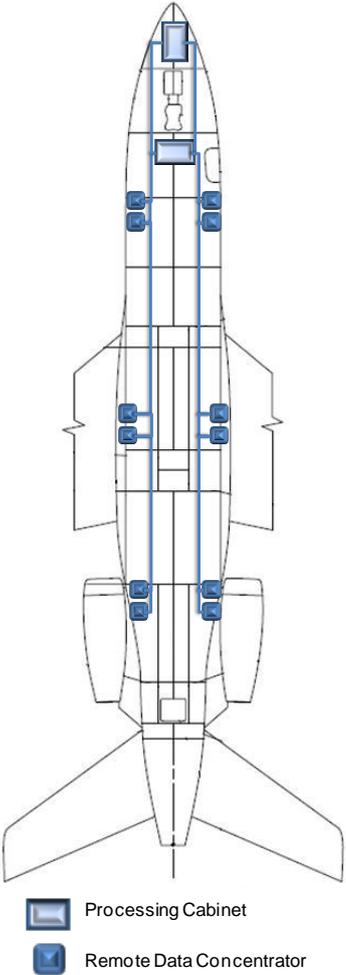
Example of generalized architecture for a business aircraft

On a strict technological viewpoint, IMA 2G brings more powerful and efficient CPU (introducing multi-core processing units) and larger bandwidth for backbone network (increasing ARINC664 part 7 network to 1Gb/s, with reduced latency).

The use of these new capabilities may allow integrating every aircraft functions in this single IMA 2G system: time critical, high performance or open world functions.

Platform API, openness and incremental certification

This IMA 2G generic platform is accessible through a standardized API. This API should be common to any aircraft type thanks to projects lead by major airframers and aeronautical suppliers, such as SCARLETT. Interest for business aviation is to draw benefit of a marketplace where function suppliers may work on various aircraft types (transport, regional, business), milking potential communalities for their specific function and increasing their experience and efficiency through product line development. Moreover, with this generalized IMA, the Function Suppliers and Equipment Suppliers can focus on their real knowledge: they do not need to supply a computer dedicated to their function, instead using the IMA platform.

Another key point for business aviation is to be able to offer to the clients the latest services allowing an increase in the Return on Investment for a business jet usage. It implies to keep the capability for adding continuously new functions with an improved Time to Market: openness (any third party supplier may run a software partition on the platform) and incremental certification concept (adding a new software partition does not imply re-testing the whole system) eases these additions. IMA 1G as introduced in Airbus A380 already allows incremental certification and openness; specific benefits from second generation of IMA come from the usage of a more productive toolset such as Early Validation Tool.

IMA 2G: scalability

The IMA 2G platform is designed to be scalable. It means that the same building blocks may be used for several types of aircraft, airliners or business jets. As for other avionics actors, this point offers the benefits of sharing development costs and communalizing experience.
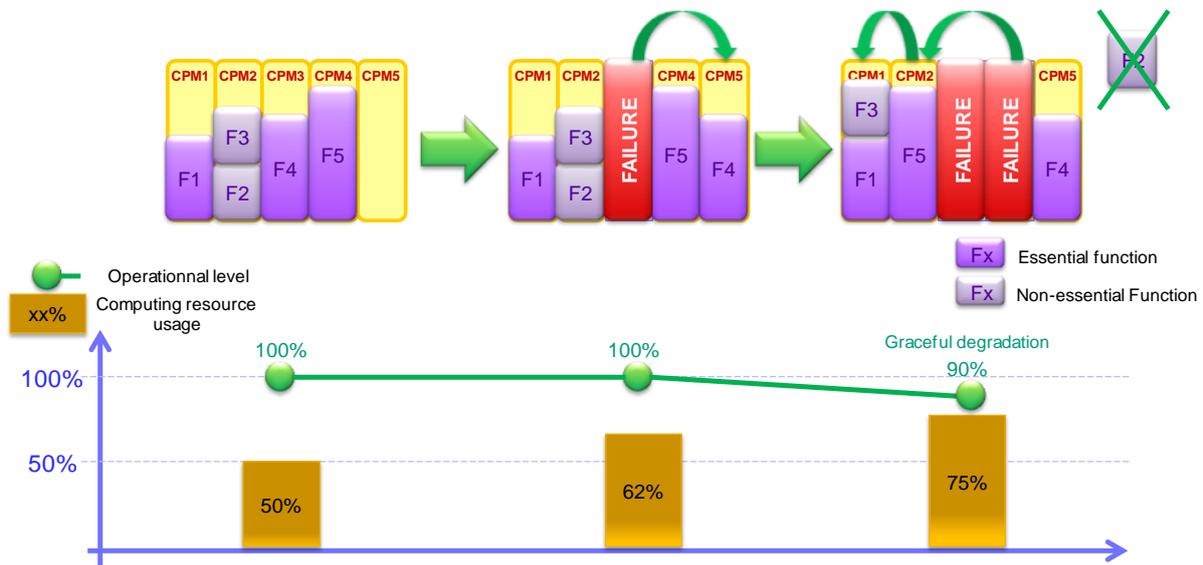
IMA 2G: reconfiguration

One of the major elements coming with IMA 2G is the capability for platform reconfiguration. As business jets are designed to land in a drastically larger set of airports in the world than it is for transport aircraft, the reconfiguration may bring a very important improvement for client satisfaction: the ability for avoiding NOGO (because of avionics issue) far away from any maintenance center. For instance (as illustrated in diagram below), in case of CPM failure, reconfiguration offers to migrate functions from the failed CPM to a spare one, or even to spare resource in already used CPM – potentially with a 'graceful degradation' – allowing not to cancel the mission.

SCARLETT objective is to reach a 100% dispatch level from avionics viewpoint, avoiding unscheduled maintenance.

Conclusion

Thanks to its new properties, Integrated Modular Avionics of Second Generation allows business aviation to meet the future challenges of continuous improvement in reliability, services and comfort for the final client. Generalized IMA comes with simpler architecture; scalability ensures re-use of building blocks from many types of aircraft; reconfiguration brings an increased apparent reliability.

Example of IMA platform reconfiguration: without operational degradation, then with graceful degradation