DELIVERING LEADING-EDGE AVIONICS SOLUTIONS TO THE AEROSPACE INDUSTRY

Intel and its ecosystem partners offer solutions with high computing performance and low system cost for size, weight, and power (SWaP) constrained environments.

Intel: Established Supplier to the Aerospace Industry

- Long-term Aerospace Supplier
  - Over 30 year history
- Large Ecosystem
  - More than 400 companies
- Real-Time Capability
  - Determinism
- Long-Term Availability
  - 7 to 15 years
- Extended Temperature
  - -40°C to 85°C[1]

Aerospace Industry Trends

The aerospace industry will forever be focused on making lighter aircraft, which generally translates into better fuel efficiency. Pursuant to this goal is reducing size, weight, and power (SWaP), yielding smaller and more energy-efficient systems, which in turn can produce overall cost savings. The importance of lowering system lifecycle cost was made clear a few years ago when cost was added to the SWaP concept, aka SWaP-C.

Another industry concern is unplanned aircraft maintenance, causing costly flight delays and cancellations. The need to improve maintenance programs is driving the industry to invest in digital technologies (e.g., machine learning and big data) to increase uptime. Similarly, investments in artificial intelligence (AI) and advanced sensors will continue to improve real-time, on-board image processing in support of more sophisticated applications, like autonomous landing, collision sensing, and object detection, recognition, and identification.[2]

With the continued emphasis on SWaP-C and digital transformation, the aerospace industry expects more from electronic system suppliers, including:

Greater computing performance

Predictive maintenance solutions using digital technologies can monitor and track an aircraft (e.g., sensors, engine temperature, and airflow rate) to alert when a failure is imminent so preemptive corrective action may be taken. AI solutions that can calculate optimal descent profiles based on aircraft weight and speed, or provide a range of alternative destinations if winds or weather change[3] also require high computing performance.

Lower system cost

The aerospace industry no longer needs to pay a premium to specialized, electronic system suppliers in order to satisfy the need for ruggedness, guaranteed long-term supply, etc. Today, these requirements are being met at lower cost by suppliers offering commercial, off-the-shelf (COTS) solutions that employ open standards, improve interoperability, and ease system upgrades.

Reduced SWaP-C

The increase in computing performance associated with the transition from single core to multi-core processors allows the consolidation of various electronic systems onto a single computing board, which decreases bill of materials (BOM) count, thus reducing size and weight, and potentially cost.

Functional/Flight Safety Requirements

The requirements for embedded aircraft systems include several embedded processor architectural areas that must be mitigated and addressed for safety-critical applications. A main concern is maximizing determinism, which is the ability to produce a predictable outcome in a specified period of time.

Intel has a long history of supplying electronic components to the aerospace industry. The following describes some of the ways Intel technologies help support the demands for higher computing performance and SWaP-C-optimized electronics systems.

High Performance Avionics Systems

Image processing, machine leaning, AI, big data analytics, and new application requirements are driving the need for avionics systems with higher levels of performance and computing headroom, which can be satisfied with Intel® processors. Some of the Intel products and features pertinent to the aerospace industry include:

- **Intel® processor families** are the foundation for electronic systems, including aircraft communications, navigation, management, and flight control. These processors support various price/performance points, execute a common set of code, and are an ideal choice for real-time, deterministic, and non-real-time applications.
- **Intel's flight safety solution efforts** include helping system developers satisfy a system's intended function, meet safety objectives, and sustain foreseeable conditions. Recognizing the complexities of flight safety certification requirements, Intel is working to enable system providers to build Intel processor-based systems with D0-254 certification to a Design Assurance Level A.
- **Extended temperature support,** from -40°C to 85°C, is available for select Intel processors. With the ability to withstand temperature extremes, Intel processors enable system suppliers to develop high performance, ruggedized avionics systems that can be deployed in the harshest field conditions.
- **Long product availability** for select Intel processors helps increase the longevity of avionics equipment. Newer processors are available for 15 years, whereas older processors are available for a minimum of seven years.

Cost-Effective Solutions

Intel ecosystem partners are delivering flexible, cost-efficient, COTS solutions based on Intel technology. These solutions can help make technology investments last longer because they incorporate next-generation computing and communications technologies.

- **Commercial, off-the-shelf (COTS) solutions** reduce development costs, increase flexibility, and shorten deployment time. When device suppliers use COTS boards and other commercially-available solutions, they can save time and development expense, and also provide hardware scalability and flexibility to their customers.
- **Competitively-priced solutions** from Intel's large ecosystem help keep costs low. With more than 400 members, this vibrant ecosystem, called the Intel® Internet of Things (IoT) Solutions Alliance, provides long lifecycle hardware and software product management.
- **Software reuse,** made possible by Intel's backward compatible instruction set, can dramatically cut down on software development costs. Intel processors, which cover a wide array of performance points, are able to execute applications written for earlier generations of processors.

SWaP-C-Optimized Solutions

Intel ecosystem partners are delivering flexible, cost-efficient, COTS solutions based on Intel technology. These solutions can help make technology investments last longer because they incorporate next-generation computing and communications technologies. Additionally, the following Intel processor features can help reduce SWaP-C.

- **Intel® Virtualization Technology (Intel® VT)**[4] enables electronic system consolidation, through which previously discrete subsystems are combined into a single system. Consolidation decreases the number of overall components, thereby eliminating their impact on SWaP-C.
- **High performance-per-watt** of Intel processor families, enabled by Intel's multi-core technology and continuous advancements in silicon manufacturing, help lower overall system power consumption.
- **Intel® System-on-Chip (SOC)** designs integrate functions (e.g., CPU, graphics, memory controller, and I/O interfaces) that previously required multiple chips, thus reducing computing board size.

Addressing Aerospace Industry Challenges

Intel and its ecosystem of hardware and software vendors offer standards-based, modular, rugged solutions for aerospace applications, backed by Intel's 30+ years of experience in delivering world-class computing and communications solutions.

System developers and integrators can benefit from this broad selection of interoperable, COTS solutions at multiple levels of integration, along with software tools designed to shorten development time and costs. Those tasked with addressing the emerging trends in the aerospace industry can satisfy their computing performance, cost, and SWaP-C requirements when they design with Intel solutions.

For more information about Intel solutions for the aerospace industry, please contact your Intel account owner or distributor partner.

1. Extended temperature of -40°C to 85°C is supported on select Intel® processor SKUs.
2. Carlos Sanchez et.al, "Image processing in airborne applications using multicore embedded computers," January 23, 2014, https://ieeexplore.ieee.org/document/6712535.
3. Darío Martínez, "Aviation revolution nears with Artificial Intelligence and Deep Learning," March 14, 2018, https://datascience.aero/aviation-revolution-ai-deep-learning.
4. Intel® Virtualization Technology requires a computer system with an enabled Intel® processor, BIOS, and virtual machine monitor (VMM). Functionality, performance, or other benefits will vary depending on hardware and software configurations. Software applications may not be compatible with all operating systems. Consult your PC manufacturer. For more information, visit http://www.intel.com/content/www/us/en/virtualization/virtualization-technology/hardware-assistvirtualization-technology.html.