Modern avionics and vetronics applications such as flight navigation and situational awareness are data-intensive and safety-critical. These applications increasingly use augmented reality and AI neural networks for machine learning and vision for vehicle autonomy. This drives the need for systems that quickly process complex data and are designed to meet unique aviation and vetronic certifications.

In defense operations, personnel need to deploy compute systems quickly wherever they’re engaged. Historically, getting computing close to where it’s needed at the edge has been a logistical challenge. Now, advances in edge computing technology are making it possible to place rugged and secure high-performance computers directly in the hands of personnel wherever missions take them—in aircraft, submarines, or a vehicle in the middle of the desert.

Modern aircraft and ground vehicles require field-ready, scalable, and high-performance mission computers to run compute-intensive, safety-critical workloads. Satisfying these needs can be challenging, and the airworthiness certification process can be difficult and costly. Mercury Systems is helping to address these challenges with a range of high-performance system building blocks, starting with the SB3515-S single-board computer.

**Challenges: Difficult certification process and the need for customization**

It is costly and time-consuming to design, build, test, and certify flight-ready mission computers. Meeting the Radio Technical Commission for Aeronautics (RTCA) DO-254 and European Organization for Civil Aviation Equipment (EUROCAE) EUROCAEED80 guidelines for design assurance level A (DAL A), the most critical for safe flight, is particularly difficult. DAL A describes hardware whose failure or malfunction would result in a catastrophic, hazardous, or severe condition that would result in death. Therefore, to achieve DAL A, high-performance electronics used in avionics and vetronics systems must be designed to stringent quality and reliability standards, only allowing at most one failure per billion hours of service. As the industry moves toward multicore processors that support multiple applications per system, this creates a high number of interference paths, making the certification process even more difficult.

The compute boards used in mission computer design combine the latest commercial processing silicon in a deterministic manner with rugged, compact, and power-efficient form factors to enable edge computing systems that are easily customizable for multiple missions. These systems must have all the features and functionality needed to enable rapid decision-making while protecting critical data. This is a challenge for system designers since seamless integration of components and architectures is required but difficult to achieve.

**Solution Brief**

**Aerospace and Defense**

**Edge Computing**

**Mercury’s Single-Board Computer Brings High Performance to Avionics**

The SBC3515-S single-board computer features an Intel® Core™ i7 processor for high performance and a streamlined path to airworthiness certification.
The solution: Mercury’s SBC3515-S for next-generation avionics design

Mercury Systems is a global commercial technology company serving the aerospace and defense industry. The company delivers solutions that power a broad range of applications in some of the most challenging and demanding environments.

Mercury engineers evaluated a range of multicore processors to create an airworthiness solution to help solve the problems affecting the industry today. Mercury chose the 11th Generation Intel® Core™ i7 processor for its performance and security features, and worked closely with Intel to obtain DO-254 artifacts that would help achieve airworthiness certification. Mercury’s SBC3515-S is the first certifiable single-board computer that uses this specific multicore processor from Intel. By employing proven design architecture, such as strong time and space segregation, Mercury eliminated design errors and maximized performance capabilities.

The SB3515-S has been designed into aviation mission computers for critical flight control and mission data processing. This single-board computer was chosen for its innovative combination of high performance, scalability, open architecture, and ease of certification.

Thorough certification process

Mercury’s SBC3515-S single-board computer helps expedite the safety certification process for avionics and vetronics systems. The solution reduces risk and lowers integration costs for systems architects and engineers. Mercury’s mature and robust design assurance checklists, guided assessments, and hardware and software artifacts help customer solutions pass airworthiness certification.

The SBC3515-S incorporates Mercury’s proven BuiltSAFE™ commercial off-the-shelf (COTS) elements and is validated with DO-254 and DO-178C artifacts. These artifacts help ensure successful certification and minimize the need for recertification during technology refresh. SBC3515-S features include:

- Safety runtime configuration
- Graphics and compute libraries
- Built-in test
- Safety monitoring
- DO-178C board packages with support for:
  - Green Hills Software same as above
  - Lynx Software Technologies
  - Wind River VxWorks
  - Other leading real-time operating systems (RTOSs)

Throughout the design process, Mercury’s qualified and experienced safety-critical engineers work with customers to help achieve their development and certification goals.

Rapid data processing

The SBC3515-S processing board can quickly process AI sensor data and incoming video streams with the 11th Gen Intel Core i7 system-on-a-chip (SoC) processor. The processor has built-in AI acceleration, an embedded GPU, and 10 GbE networking. The Intel Core i7 SoC also provides certifiable graphics with OpenGL, VULKAN, safety compute libraries, and video encode/decode features to support flight symbology for cockpit displays, signal processing, and video streaming. To minimize downtime, the SoC provides built-in health monitoring and alarm features for fault detection and reporting.

Reduced integration time and costs

The SBC3515-S module is the first certifiable Intel Core i7 processor-based single-board computer on the market. Built to align with open standards like Sensor Open Systems Architecture (SOSA™) and OpenVPX, the board helps customers avoid expensive proprietary systems architectures and vendor lock-in. It can be integrated with other 3U VPX boards from Mercury or an ecosystem of other vendors. The SBC3515-S can be used to build a low-power (80W–120W) OpenVPX processing subsystem. The SBC3515-S streamlines subsystem deployment, facilitates integration, and upgrades and accelerates safety-critical applications like AI machine learning, vision, and augmented reality. It has complete DO-254 and DO-178C artifacts that enable subsystem developers and systems integrators to develop, integrate, and certify systems with minimal risk while lowering overall cost.
Intel and Mercury: Building accessible and secure technology

Mercury and Intel work together to make innovative commercial technology more accessible to aerospace and defense organizations with trusted, secure solutions. The reliability and performance of Intel® silicon combined with Mercury’s proven BuiltSAFE™ technologies ensure that systems operate flawlessly in the field and meet the highest Design Assurance Level (DAL) objectives.

Based on the 11th Gen Intel Core SoC with an integrated graphics processing unit (GPU), the SBC3515-S is enabling a new generation of avionics and vitronics technology. 11th Gen Intel Core processors deliver high-performance CPU/GPU compute with integrated AI acceleration, plus capabilities for applications that demand high-speed processing, computer vision, and low-latency deterministic computing. 11th Gen Intel Core processors deliver a balance of performance and responsiveness in a low-power platform.

The SoCs redefine Intel® CPU performance with high-speed wireless and wired connectivity and advanced tuning features that support advanced technical solutions with low power usage. This combination provides scalability for multicore processing in safety-critical applications. In these applications, it is important to implement multiple cores while still meeting the requirements for DAL A safety certification for safety- and mission-critical systems. 11th Gen Intel Core SoCs also provide a compelling SWaP advantage over legacy single-core CPUs with a separate GPU.

Other benefits of 11th Gen Intel Core processors include:

Performance raised across the board
Built on third-generation Intel® 10 nm process technology, 11th Gen Intel Core processors post significant gains vs. 8th Gen Intel® Core™ processors.

- Up to a 23% gain in single-thread performance\(^1\)
- Up to a 19% gain in multithread performance\(^1\)
- Up to 2.95x the graphics performance\(^1\)

Handle multiple real-time workloads with minimal jitter
The combination of the 11th Gen Intel Core processor and Intel Iris® Xe graphics performance is complemented by hardware-based acceleration and virtualization to handle multiple compute-heavy tasks simultaneously. The system maximizes hardware resources efficiently for real-time, multi-workload performance with minimal jitter.

Put accelerated AI inferencing and computer vision to work
11th Gen Intel Core processors deliver accelerated AI inferencing and computer vision in parallel with other core functions. AI and deep learning inferencing can run on up to 96 graphic execution units or run on the CPU with VNNI condensing three Advanced Vector Extensions (AVX) instructions into one.

Built-in hardware-based security
Intel provides security at the platform boot level, security for data at rest on the platform, and security for data in flight. New security features like Intel® Total Memory Encryption (Intel® TME) complement capabilities like Intel® Boot Guard.

For workloads and configurations, visit intel.com/PerformanceIndex. Results may vary.
Conclusion

Modern avionics and vetronics platforms require computers that are safe, field-ready, and scalable with flexible features built in to facilitate a range of missions reliably. These platforms are typically space-constrained and harsh environments, making it essential to ruggedize and minimize the SWaP of the computing systems. With all these requirements and necessary features, building a solution can be extremely challenging, especially when factoring in the airworthiness certification process that adds difficulty, cost, and time, potentially causing deployment delays.

Mercury Systems has created the SBC3515-S as part of a range of open-architecture safety-certifiable compute modules to address these challenges. Mercury engineers chose the multicore 11th Gen Intel Core i7 processor for its high performance, low power, and hardware-based security features.

The SBC3515-S incorporates Mercury’s flight-proven BuiltSAFE technologies with certified DO-254 and DO-178C artifacts. This design can help reduce certification time while minimizing the need for recertification during technology refreshes. The single-board computer streamlines system deployment, integration, and upgrades, helping reduce time to market. And due to its innovative combination of performance, scalability, and ease of certification, it is a popular processing choice for aviation mission computer system architects. Mercury’s safety-critical engineers and consultants partner with customers to achieve their development and certification goals.

About Mercury Systems

For 40 years, Mercury Systems has delivered military-proven commercial innovations for industrial and aviation applications. Products include safety-critical mission computing for both piloted and autonomous commercial airborne systems. Mercury’s trusted portfolio of product solutions and subsystems are purpose-built to meet or exceed the most-pressing high-tech needs for these and other edge computing use cases.

Learn more

Get more details about SBC3515-S

11th Generation Intel Core i7 processors

Compared to 8th Gen Intel® Core™ processors, 11th Gen Intel Core processors deliver higher levels of performance for computing, new core and graphics architectures, AI-based performance boosts, faster wireless and wired connectivity, and advanced tuning features.

Get the details


Testing configuration

Processor: Intel® Core™ i7 1185G7E PL1=15W TDP, 4C8T turbo up to 4.4 GHz
Graphics: Intel® Graphics Gen 12 gfx
Memory: 16 GB DDR4-3200
Storage: Intel® SSDPEKKW512GB (512 GB, PCIe 3.0 x4)
BIOS: Intel Corporation TGLSFWI1.R00.3333.A00.202008122041_oneBKC: tgl_b2b0_up3_pv_up4_qps_ifwi_2020_vwx32_4_01

Processor: Intel® Core™ i7 1185G7E PL1=15W TDP, 4C8T turbo up to 4.4 GHz
Graphics: Intel® Graphics Gen 12 gfx
Memory: 16 GB DDR4-3200
Storage: Intel® SSDPEKKW512GB (512 GB)
OS: Windows 10 Enterprise (x64) Build 18362.175 (1903/May 2019 update). Power policy set to AC/balanced mode for all benchmarks. All benchmarks run in admin mode and Tamper Protection disabled/Defender disabled.
BIOS: CNLSPFWI1.R00.X208.B00.900530139

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Performance results are based on testing as of dates shown in configurations and may not reflect all publicly available updates.

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