

# F/A-18 Training Systems



In 2021, CAE acquired L3Harris' Military Training business, which included Link Simulation & Training and Doss Aviation. These businesses are now integrated with CAE USA as part of CAE's Defense & Security business unit.

## Overview

CAE provides a full range of F/A-18 training systems that support the entire F/A-18 training continuum for both land and sea-based operations. Our F/A-18 Hornet/Super Hornet training systems, which have evolved and trained F/A-18 warfighters for more than 25 years, today deliver tactically relevant training on demand.

## Full range of F/A-18 training systems

Based on three tiers of commonality, our F/A-18 training systems provide customers an open and modular training system architecture that is designed to fully support aircraft concurrency, mission evolution and future technology growth.

## Common training solution architecture

The Common Training Solution Architecture (CTSA™) is the foundation of our F/A-18 training systems, providing both system hardware and software independence. The CTSA is a proven training system architecture that reduces current and future constraints to training that impact the Hornet and Super Hornet communities tactics development.

The CTSA provides:

- Standardized High Level Architecture (HLA) interoperability
- Local networking capability (U.S. Navy, NASMP)
- DMT/DMO long-haul capability (U.S. Air Force, NASMP)
- Mission management system
- Common HLA instructor operator station (IOS) interface
- HLA data recording for replay/debrief/performance measurement
- Local and long-haul debrief control interface
- Common synthetic combat environment interface
- Common device interface
- Cockpit control interface
- Image generator interface

This open and standardized architecture has been designed to be hardware and software independent, fully supporting F/A-18 training requirements today and enabling future growth requirements that are not restricted to any one vendor, platform, or trainer type.

## Common hardware architecture

Supporting the CTSA and CSA, we have incorporated a Common Hardware Architecture across our devices as a third tier of commonality. These common hardware items include:

- Commodity personal computers (PC) and components
- PC host (across devices)
- PC IOS (across devices)
- Personal computer image generator (PC-IG) (across devices)
- IOS console components
- Debrief components
- Cockpit and support components

## Common software architecture

The Common Software Architecture (CSA) is a collection of training-proven and portable hardware independent training system models that fully support migration to future hardware platforms. This open and standardized architecture has been designed to support the ever-changing landscape of personal computer-based hardware platforms that will serve F/A-18 training requirements today and in the future, unconstrained by current platform or trainer type. The CSA brings commonality across all F/A-18 training devices and includes:

- Common simulation software models
- Common instructor operator station (IOS) software
- Common photo texture database
- Common synthetic combat environment (SCE) models
- Common real-time image generation software
- Common software and database development tools

The heart of Tactical Operational Flight Trainer (TOFT) is a system and software architecture that promotes hardware independence. The continuous evolution of hardware platforms complicates simulator-to-aircraft configuration concurrency throughout the aircraft's operational life. CAE maintains a common core of software that has been delivered on range of personal computer hardware platforms, including the SimuView® image generator. This focus on software commonality enables the leveraging of development efforts from various sources, including U.S. Navy, foreign military sale and internal research and development. Software commonality facilitates updates to all F/A-18 simulation devices—from Deployable Readiness Trainers (DRT) to TOFTs—with a single investment.

## Tactical operational flight trainer

The SimuView® image generation system and scalable SimuSphere® visual display are combined to provide exceptional visual cueing realism necessary to support F/A-18 pilot training. SimuView employs off-the-shelf personal computer hardware and video cards, in addition to hardware independent image generation software. SimuSphere partial dodecahedron frame design—which is marked by seamless facet tolerances—allows for 3, 5, 7 or 9 display panels that provide pilots anywhere from 180 degree to 360 degree horizontal field of view.

## Night vision goggle stimulation

Owning the night is key to successful F/A-18 air campaigns. CAE has developed a Night Vision Training System (NVTS) that provides night vision goggle (NVG) training as an integrated product solution. The NVTS couples the image generator, NVG sensor stimulation, head tracking, user-supplied NVG goggles and correlated databases into a single integrated system.

## Distributed training networks

Our F/A-18 trainers are designed to support both local and wide area networking, enabling multiple simulators to participate in an exercise scenario. Depending on customer requirements, CAE also can provide a distributed briefing, mission observation and debriefing capability.

## Instructional systems

A modern personal computer-based Instructor Operator Station (IOS) provides a workstation designed for efficient and effective training scenario execution. The IOS provides individual control over a single device or can control multiple devices in a distributed training environment. When combined with a scalable video wall consisting of plasma displays, the IOS becomes an integral part of a mission observation facility. The IOS includes an entity station consisting of a stick, throttle and visual display.

## Tactical operational flight trainer

The TOFT, built and delivered for the F/A-18 Hornet and Super Hornet aircraft, has been designed to support the full Strike/Fighter training continuum. From Fleet Replacement Squadron (FRS) or basic flight through the most complex tactical employment training, F/A-18 TOFTs deliver highly realistic simulations that can support single ship individual, multi-ship team and combat mission rehearsal training. The TOFT provides a proven training solution for stand-alone, as well as local and long-haul networked training requirements. The TOFT is the first F/A-18 Defense Modeling and Simulation Office (DMSO) HLA-certified training device.

The F/A-18 TOFT initially leveraged the legacy F/A-18 weapons tactics trainer (WTT) high-fidelity software to provide extensive procedural and weapons system training capabilities. The TOFT has evolved to a PC-based architecture, maximizing COTS and reuse. The PC-based TOFT, along with its modular software architecture, facilitates technology insertion and simulator/aircraft concurrency. The TOFT's proven visual display systems, SimuSphere® and SimuSphere® HD, provide a very high-resolution, scalable field-of-view capability. With SimuSphere and SimuSphere HD, the TOFT footprint has been minimized, greatly reducing required facility size and power requirements. The modular TOFT can also be adapted as a deployable system for use in the field, on the road or aboard an aircraft carrier.

Since the TOFT was designed with the tenets of modularity and scalability in mind, components can be tailored to meet defined training and system requirements. These include unique avionics models, instructor and role player stations of varying fidelity and a brief/debrief system that allows students and instructors to fully reconstruct and manipulate an entire training event to maximize the effectiveness of the total learning experience. As a result, the F/A-18 TOFT presents the Hornet and Super Hornet Strike/Fighter a superior training environment, shaped in their requirements and founded on tactical relevance.

## Training capabilities

For both U.S. and international use, the TOFT supports all tactical and non-tactical training tasks associated with all variants of the F/A-18. When required, independent F/A-18 pilot and weapon sensor officer simulators that are networked can be surrounded by CAE's advanced 360 degree visual display systems. The TOFT provides proven high-fidelity crew station(s), displays, switches, validated aero, avionics systems and aircraft subsystems. Following are some of the missions and mission areas warfighters can train for in the F/A-18 TOFT:

- Individual or team training
- Single-ship and multi-ship employment
- Normal and emergency procedures
- Basic air work, formation, and local area operations
- Instruments, navigation, and all weather operations
- Night vision goggle training and employment
- Airfield takeoff and landings, carrier operations
- Air-to-air and air-to-surface weapons training
- Air-to-air and air-to-surface tactical employment training
- High Off Bore Sight weapons employment training
- Digital Close Air Support
- Precision Target Acquisition training
- Multi-functional Information Distribution
- System (MIDS) training
- Low altitude operations
- Surface-to-air threat and counter tactics training
- Mission rehearsal



## Scalable visual display technology

Delivering high performance imagery is the job of our SimuSphere and SimuSphere HD visual display systems. With excellent performance, seamless facet tolerances and flexibility, SimuSphere uses a dodecahedron frame design allowing for three, five, seven or nine display panels producing 180 degree to full 360 degree field-of-views. SimuSphere was the first small footprint system to produce constant resolution and brightness across all facets for a fully immersive visual experience. SimuSphere HD's state-of-the-art digital projectors provides industry-leading sharpness and brightness. A fully integrated visual display, SimuSphere HD supports sharp, bright heads-up-displays; high-fidelity, physics-based stimulated night vision goggle capability; and is compatible with Helmet Mounted Cueing Systems and future visual/sensor capabilities.

## Emulated mission computer and displays

We developed the first and only true emulation of the F/A-18 aircraft mission computers more than 20 years ago. This revolutionary software allows the aircraft operational flight program to be run directly by the simulator, in its native form, without preprocessing of any sort. The result is the highest fidelity cockpit presentation and facilitates ease of simulator concurrency with the aircraft at a greatly reduced cost.

The combination of the mission computer emulation and faithful simulation of aircraft displays supports all aircraft operational display modes including:

- Color digital map simulations
- Full fidelity infrared (IR) simulations
- Correlated weapons video
- Spatially correct HUD representation
- Correlated A/A and A/G radar simulations
- Distributed Training

The legacy Link Simulation & Training has provided integrated F/A-18 training since the early 1980's. In 2002, we achieved the first and only DMSO certification of HLA compliance on a four-ship of F/A-18 simulators based at Naval Air Station Lemoore, Calif. Today, F/A-18 devices are participating in multi-ship training exercises across the globe with various disparate training systems including air, land, and sea simulators.

To assist in capturing the relevant training points of these complex, large scale exercises, we have a fully developed distributed briefing, mission observation and debriefing capability to round out the suite of services that provide F/A-18 operators with the most complete training system in the world.

## Synthetic combat environment

Our open and modular CTSA supports the use of the best synthetic combat environment (SCE) or multiple SCEs, including commercial-off-the-shelf products for the training mission.

There are many SCEs available on the commercial market that will continue to evolve over time, which is why our CTSA is designed to provide the flexibility and modularity needed to support future training requirements and technology growth. For stand-alone and networked training, our F/A-18 SCE provides the ideal tactical and virtual environment to support the entire F/A-18 training continuum.

Our sophisticated F/A-18 SCE includes aircraft, missiles, ground vehicles, electronic warfare effects, weather and time-of-day controls. Performance and effects of tactical threats and environmental effects are user definable and menu driven, enabling rapid integration of current threat, Order of Battle and environment information into the simulation.

## Deployable readiness trainer

The DRT can be thought of as a repackaged F/A-18 TOFT, providing reduced footprint and focused, tactically-relevant physical cockpit fidelity at a significantly reduced cost. The DRT uses the same computational system and software as the TOFT, so it provides the identical, accurate, high-fidelity OFP/SCS and systems replication provided by its higher physical fidelity relative. The system was designed to support deployed operations, with a fidelity focused on tactical employment and tactical procedures-based training associated with advanced training requirements.

Using the same HLA architecture found in the TOFT, the DRT can be fully integrated into a distributed network to provide a fully interoperable force multiplier. The DRT has two visual systems options, including a flat panel display that can be used for a forward out-the-window visual when a wide field-of-view is not needed. If a greater field-of-view or field-of-regard is required to support more complex and dynamic training, we can provide a high-fidelity, 360 degree visual environment for both day and night operations.

## Instructor operator station

The new F/A-18 IOS has been human factors and F/A-18 instructor-engineered to provide a workstation designed for efficient and effective training scenario execution. The F/A-18 IOS is a PC-based and HLA-connected component of our F/A-18 training systems.

The IOS provides individual control over a device or can control multiple devices in a distributed training environment. The Microsoft Windows® -based IOS provides the capability to initialize, support, control and monitor all aspects of a training exercise. When combined with a scalable video wall consisting of plasma displays, the IOS provides a state-of-the-art mission observation facility.

The IOS also includes an entity station or instructor flown target (IFT) with a stick, throttle, and visual display. With this component, instructors, operators, or other event participants can take control over any threat aircraft or simulated blue aircraft to provide dynamic interactive control. Following are some of the roles this component can fill:

- Lead for wingman training
- Wingman for lead training
- Two-ship lead for four-ship lead training
- Tailoring threat air presentation

The entity station or IFT can be integrated with either an IOS stealth view, or it can be integrated with low-cost goggles providing a simple 360 degree field-of-view, to provide the entity pilot with a dynamic, interactive capability.

## Debriefing system

The debrief system was born out of a cooperative effort between current and qualified FA-18 tactical aircrew, systems design engineers and training psychologists. The debrief system captures all mission event data. This data is stored and available for later use during mission analysis and debrief.

To effectively present this information to maximize teaching and learning. We use a state-of-the-art video wall. The video wall is a scalable debrief system, comprised of multiple wall-mounted flat screen color displays and interactive whiteboard technology.

These displays provide crew station display repeater function, a God's-eye view of the mission replay over associated tactical maps or geographic terrain representations and a variety of images, including a stealth viewer, an event timeline, 3D or 2D displays and pair data displays that fully support multi-ship tactical debriefing.

During a mission debrief, the mission commander may use the map to take the trainees through the planned mission prior to an event replay as well as annotating comments, flow and other points of interest using the interactive whiteboard technology. Central to the debrief system capability is the video playback system, integrated into the debrief event controls. Variable forward and reverse rates of playback speed are supported.

In addition, the system captures and displays instructor-selected performance and execution data on an event timeline, as well as supporting manual event marking by an instructor or operator. In short, the debrief system provides the instructor and trainee alike a Strike/Fighter pilot-designed teaching and learning aid that will maximize the effectiveness of a training event.

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