

NORTHROP GRUMMAN

DEFINING THE FUTURE™

Time-Tested Architecture for Live-Virtual-Constructive Training

Combat Air Forces Distributed Mission Operations



Standards-based, live-virtual-constructive (LVC) training architectures are recognized as significant enablers for maximizing modeling and simulation training effectiveness and efficiency.

As the operations and integration contractor for Combat Air Forces Distributed Mission Operations (CAF DMO), Northrop Grumman is the master architect and systems integrator for CAF DMO training systems. In this role, the company provides a complete, globally distributed, interoperable, daily training capability.

CAF DMO training systems include high-fidelity, man-in-the-loop, virtual cockpits for pilots, weapon systems officers, and command control intelligence surveillance and reconnaissance crew stations.

Northrop Grumman has successfully expanded the CAF DMO training architecture to include live training for Pacific Air Forces and Air Combat Command ranges, coalition and inter-service forces.

Northrop Grumman's global training capability is achieved through five components:

- Global CAF DMO Network (DMON)
- Portal system interface
- Interoperability standards
- Mission Training Centers (MTCs)
- Cross-domain solutions

Distributed Mission Operations Network

The DMON enables persistent, on-demand, daily training for CAF DMO systems. The DMON is secure, robust, scalable and highly reliable, with high bandwidth, low latency, and high availability of commercial data services.

DMON supports multiple independent exercises at different security domains and manages the network of Type-1 encryptors and associated keying material.

The DMON uses a virtual private network that allows connectivity between sites and serves as the means for continuous monitoring and control by the Network Operations Center (NOC) and Distributed Mission Training Operations Center (DOC). Both operations centers are located at Northrop Grumman's Orlando, Fla. facility.

The NOC's resources help CAF DMO operations and integration personnel conduct day-to-day operations of the CAF DMO help desk and administer, monitor, and maintain the private network.

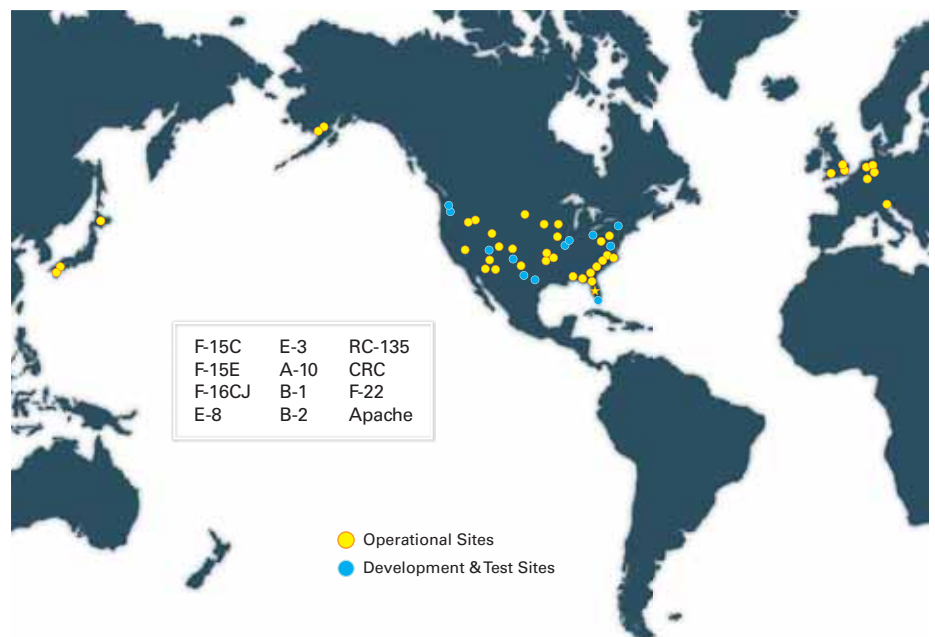
The DOC operates in a secure facility within the NOC. It is capable of conducting and coordinating classified details of CAF DMO events.

DMON Reliability

Northrop Grumman can provide connections to DMON in the most remote locations. Northrop Grumman uses an integrated array of commercial-off-the-shelf and custom network management tools that reveal real-time status of the operational DMON environment. These tools perform critical functions:

- Real-time visual fault management, performance monitor and alarm and notification message display
- Configuration management
- Full-mesh real-time delay measurements

Together, these tools allow Northrop Grumman to maintain the highest reliability and enable proactive solutions to potential network failures, contributing to maintaining DMON's availability well beyond what is required.



The Distributed Mission Operations Network (DMON) offers training resources worldwide

Interoperability Standards

Northrop Grumman facilitates a routine, daily training capability through an inter-site interoperability solution in the form of standards. These standards apply to all federate systems and MTCs participating in events executed on the DMON. Standards are derived when Air Combat Command (ACC) identifies new platforms or requirements for training. When all CAF DMO systems implement these standards, new training capabilities are available in the CAF DMO training federation.

This approach allows efficient evolution of the CAF DMO training federation to meet ACC training objectives:

- SISO and IEEE-based
- Non-proprietary
- High-fidelity focus
- Comprehensive
- Live-virtual-constructive interoperability
- Multi-service

Standards Category	Standards
Interface Standards	<ul style="list-style-type: none"> • ITSEC_Network (Including Portal) • DMT-Tailored DIS-Standard • Reference Federation Object Model
Integration Process Standards	<ul style="list-style-type: none"> • Event Control • Security • Conformance Testing • Data Sharing
Federate System Performance Standards	<ul style="list-style-type: none"> • Technical Performance • Synthetic Natural Environment • Threat Representation and Computer Generated Forces • Common Models • Visualization

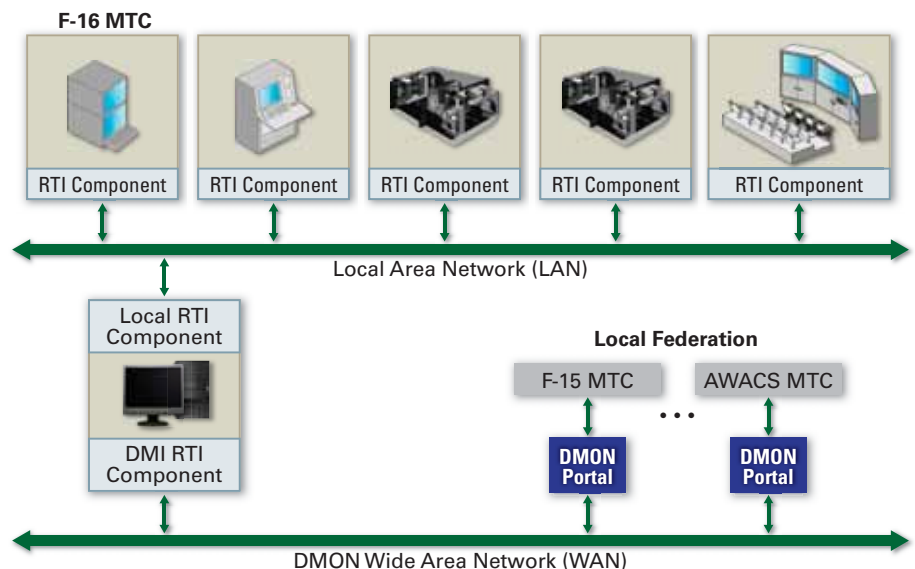
CAF DMO interoperability standards ensure effective collaboration among federate systems

Standard-Based Training Architectures

Northrop Grumman leverages its expertise with standards-based LVC solutions to integrate coalition, live, and platforms of other services including the U.S. Army's Apache trainer.

Northrop Grumman has implemented a standards-based DMO LVC solution in the DMON portal that is compatible across ACC and Pacific Air Forces (PACAF) instrumented training ranges. To achieve this objective, the portal is interoperable among TENA, HLA, and DIS implementations. The products of this effort are an initial DMO LVC capability and an associated set of candidate standards to govern a routine DMO LVC training environment. Northrop Grumman was recently awarded a contract by PACAF to leverage the ACC LVC effort to implement a distributed, standards-based LVC solution for PACAF Alaska ranges.

Further, Northrop Grumman successfully developed and implemented a multi-national security solution to facilitate a DMON connection to Royal Air Force - Waddington in support of a U.S.-UK proof-of-concept demonstration. Communication among the training systems was facilitated through DMON portals.



Northrop Grumman portal architecture supports individual and collective MTC communication

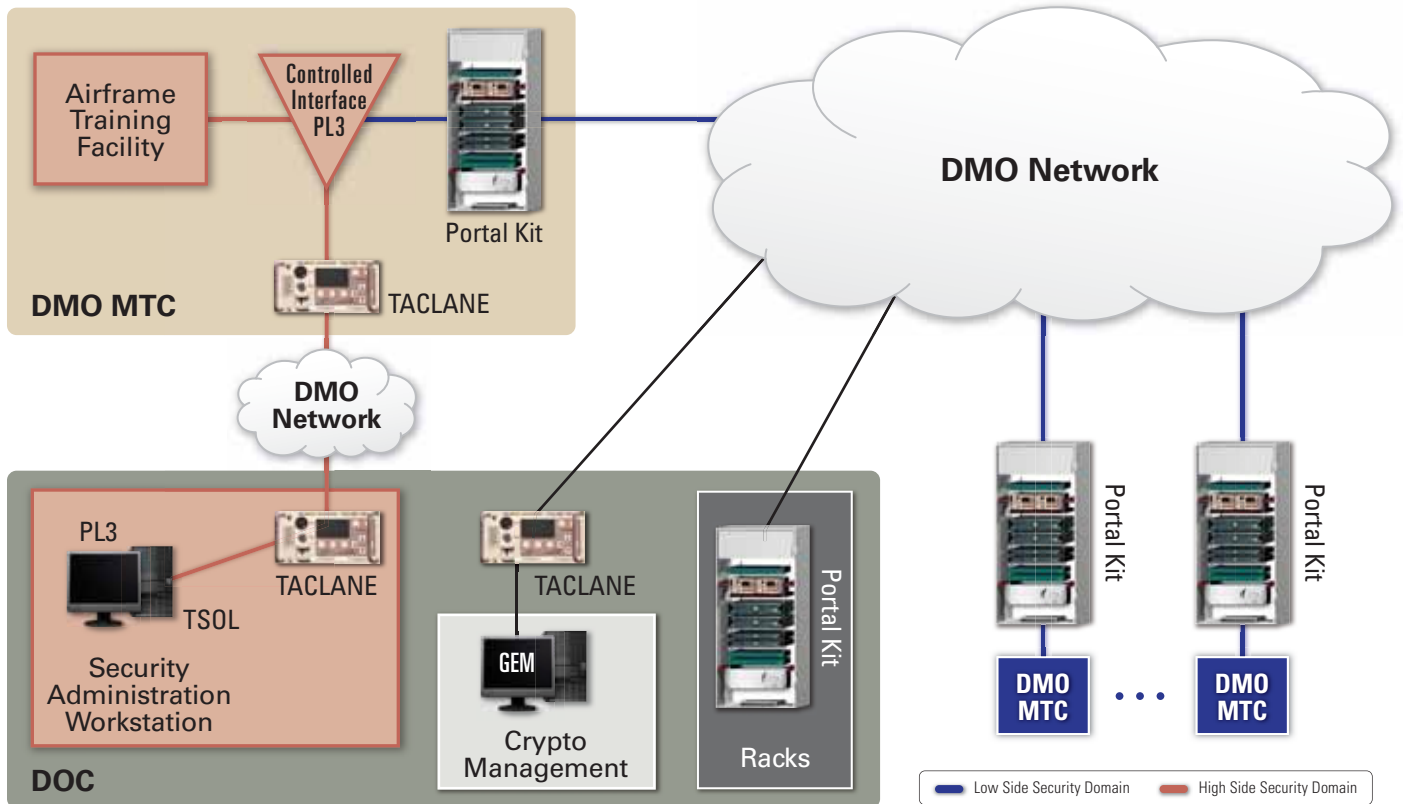
demonstrated the potential for coalition training in the standards-based, daily training environment of CAF DMO.

Portal

The DMON portal supports the CAF DMO training environment by isolating each MTC's version of the simulated world. The portal allows communication between MTCs across a wide area network and using different simulation protocols. Further benefits include traffic management, filtering invalid or unnecessary data, routing traffic based on simulation data values or needs and transforming data on-the-fly-between participants.

The portal's features meet the challenges of today's highly dynamic virtual and live environments while supporting the evolution and expansion of CAF DMO standards:

- State database correlate entities and effects
- Compliant dead reckoning support for multiple local area networks (LAN)
- LAN endpoints supporting similar or disparate protocols (DIS, HLA, NATO EX, TENA)
- Loop back onto the same LAN
- Interest management over the wide area network



DCDS architecture enables secure, cross-domain training

DMON Cross Domain Solution

Northrop Grumman's DMON Cross Domain Solution (DCDS) provides an effective, evolvable security solution for persistent team training across CAF DMO security domains.

The DCDS is the first security implementation to enable daily, cross-domain team training.

The DCDS allows training between participants operating under different security policies to train together in the DMON's closed simulation environment. Its protection level three supports the CAF DMO vision to allow warfighters to train with full operational capabilities.

Further, the DCDS supports coalition exercises on a case-by-case basis, as part of a multi-national security solution for U.S. participant DMON sites.

Remote management from the DOC allows for the security expertise of the operations and management team to be centrally located with DMON event managers.

Northrop Grumman's operations and integration team manages rule set deployment, controlled interface

start up and shutdown, and controlled interface auditing from Orlando, Fla. Because the controlled interface is not located with its management system, a dedicated cryptonet is established over the DMON, allowing secure communication between the two devices.

The operations and integration team implemented the DCDS at five MTC sites in 2008. Four more are planned for 2009, with new platforms and rule sets.

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