operator in a KC-135 tanker flight simulator in Florida and a boom operator in the Boom Operator Weapons Systems Trainer (BOWST) simulator in Oklahoma. This was performed with all three simulators operating simultaneously via the MAF DMO UCN test network. Northrop Grumman led interoperability analysis, network integration and simulator-upgrade efforts by working with an industry team of simulator platform providers.

**Way Forward**
This distributed VAR training is transferrable to other programs. The same processes, tools, and architecture used to provide MAF with a VAR capability can also be used for integrating new tanker, receiver and boom simulator platforms. The initial steps for integrating new platforms will include:

- Examination of training program benefits in areas to include flying hour savings, increased distributed training opportunities and improved training for exercise participation.
- Evaluation of the current capabilities of simulators using the VAR tools and framework already in-place to identify and examine the VAR interoperability gaps.
- Utilization of established network connections with existing VAR test bench capabilities to minimize system integration timelines and risks, with significant cost savings.

The end result is a high-fidelity VAR training capability that is certified to established standards.

VAR is a breakthrough technology that allows aircrews to train in a way never before possible, enhancing readiness while providing significant cost-savings in a resource-constrained environment. Mastering this fundamental and critical capability at a fraction of the cost of live training, helps the Air Force do what the Air Force does best – deliver global vigilance, global reach and global power for America every day.

For more information, please contact:
Northrop Grumman
Mission Systems
Orlando Central Florida Research Park
2721 Discovery Drive, Suite 100
Orlando, Florida 32826
(321) 235-3800
http://www.northropgrumman.com

**Virtual Air Refueling (VAR)**
An Innovative Training Capability
Virtual Air Refueling (VAR) has the ability to save millions annually in flying hour dollars targeted for air refueling training in the aircraft. Northrop Grumman has overcome the challenges of distributed VAR to provide realistic training capability for maintaining aircrew readiness and increasing training opportunities.

Distributed VAR provides a training capability enabling the Air Force to reduce flying hours by shifting air refueling training to the simulator. To overcome the challenges and develop a high-fidelity VAR capability, Northrop Grumman has led a team of tanker, boom operator, and receiver simulator providers in defining system requirements, implementing a distributed test and integration framework and developing tools to enable VAR. These capabilities have allowed the team to address the distributed environment challenges including the jitter caused by network latency.

Northrop Grumman has supported Air Mobility Command (AMC) as the Mobility Air Forces (MAF) Distributed Mission Operations (DMO) Operations and Integration (O&I) contractor since 2011. Through this support Northrop Grumman has enabled the AMC vision to enhance global reach through a network of live, virtual, and constructive training capabilities; and to meet the AMC mission to train in a secure, realistic networked environment while reducing risk and operating cost. MAF DMO capabilities enable live, virtual and constructive participation in a wide range of MAF, U.S. Air Force, joint, and combined exercises.

Key Enablers and Concepts
Northrop Grumman defined more than 70 “physics based” virtual aerial refueling standards for simulators and implemented them on a distributed integration framework. Key enablers and concepts were:

- A set of standards defining the technical requirements for a VAR capability
- Unclassified Commercial Network (UCN) linking the MAF DMO O&I contractor (Northrop Grumman) and the MAF DMO Simulator Platform Developers
- Utilization of innovative test tools to enable near real-time data visualization and analysis
- Adoption of a spiral development process to build up capability in increments
- Formulation of a coherent team, made up of the various contractors
- Ensuring the timing and quality of the simulation data placed on the network
- Development of a conceptual model to ensure all the standards and their implementation support the same model

VAR Test Tools
Northrop Grumman has identified VAR challenges and prioritized the highest risk items to be addressed. These high-risk items were tackled during the spiral development process utilizing specifically designed VAR test tools. This included the enhancement of the Certification, Evaluation, Regression Test (CERT) tool to evaluate and test all of the criteria related to VAR.

A reference simulation called “EZ-Fly” was developed that could represent any and all of the tanker, boom and receiver with full on-the-wire fidelity. This provided several important capabilities: (1) a reference to bounce the CERT tests off of, allowing CERT and EZ-Fly to check each other and improve confidence in the implementations of the standards, (2) it allowed substitution for one or more of the other simulators so that issues could be resolved on one simulator without requiring another simulator for testing.

Test Architecture / Network
Northrop Grumman has developed and maintains the MAF DMO UCN. The UCN is a secure, robust, scalable, highly reliable network service to the Aircrew Training Systems; which provides significant risk reduction and schedule recovery capability by connecting development sites and training sites, whereby significant integration and test events are accomplished.

An on-demand DMO training capability is provided on the Distributed Training Center Network (DTCN). An integral part of achieving these characteristics has been the establishment of a DMO product line and remote management capability for all of the DTCN assets from the Network Operations Center (NOC) at Scott AFB. The DMO product line consists of the DTCN Gateway software, MAF DMO Standards Certification tools, and various network configurations that can be rapidly configured and deployed to meet the evolving needs of the MAF DMO training systems.

For example, the UCN capability that was used to demonstrate distributed Virtual Aerial Refueling is also used for interoperability testing performed between simulator platforms, like the KC-135 and C-17, to resolve issues prior to training. This testing and integration environment helps reduce testing timelines needed to bring the systems onto the DTCN for training.

Real-Time Virtual Air Refueling Capability
In October 2013, Northrop Grumman successfully conducted a high-fidelity virtual aerial refueling demonstration. By networking geographically dispersed flight simulators and providing a realistic simulation of an air-to-air refueling mission, Northrop Grumman connected a pilot in a C-17 transport flight simulator in Texas, an