

# Aeronautical Systems Center

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*Dominant Air Power: Design For Tomorrow...Deliver Today*



**Real-time, Emulative,  
Terminal Model Applications  
of Legacy and Advanced  
Tactical Data Links for Use in  
LVC Assessments**

**ITEA LVC Conference Jan 2009**

**U.S. AIR FORCE**

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# Report Documentation Page

Form Approved  
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>JAN 2009</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2009 to 00-00-2009</b>	
4. TITLE AND SUBTITLE <b>Real-time, Emulative, Terminal Model Applications of Legacy and Advanced Tactical Data Links for Use in LVC Assessments</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>ASC/RA (SIMAF), Wright Patterson AFB, OH, 45433</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# Outline



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- **Why High Fidelity, Real-Time Data Link Modeling?**
- **Terminal Model Application Discussion**
  - Link 16
  - Tactical Targeting Network Technologies (TTNT)
  - Flexible Access Secure Transfer (FAST)
- **Analyses**
  - Objective Gateway, Increment 1 Study
  - Persistent Fires 09-01



# SIMAF Mission/Vision



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**Mission: SIMAF provides a real-time, high-fidelity, virtual and constructive synthetic battlespace analysis capability to evaluate:**

**Human System Interfaces**



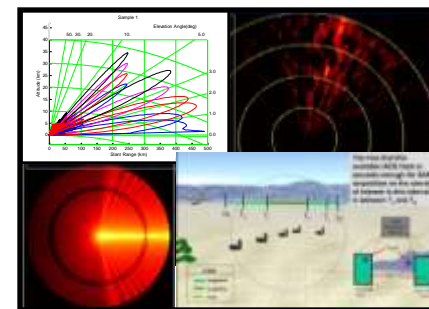
**Strategies, CONOPS & TTPs**



**Network-Enabled War-fighting Capabilities**



**Emerging Technologies**



**Current & Future Weapon Systems**

**Vision: To be a preferred DOD center for independent assessment using modeling, simulation and analysis throughout the acquisition life cycle**

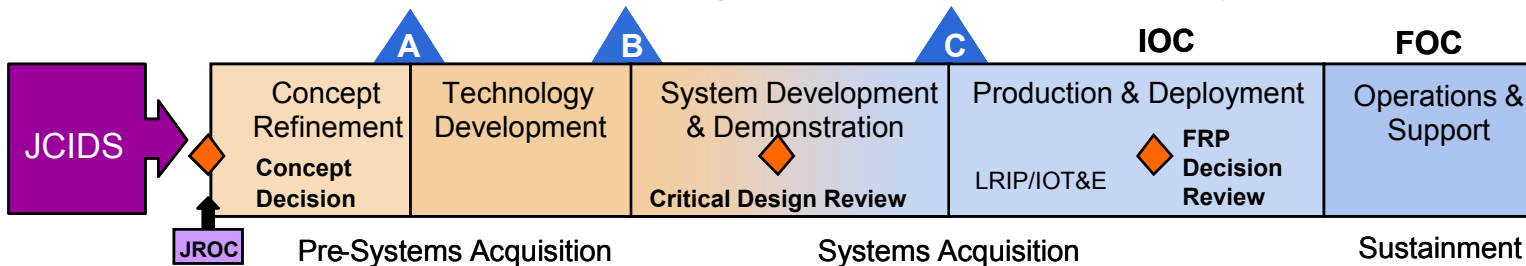


# Goal:



## Seamless, Continuous Application of LVC Throughout Acquisition

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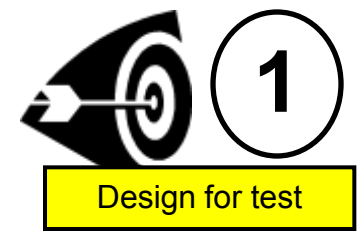
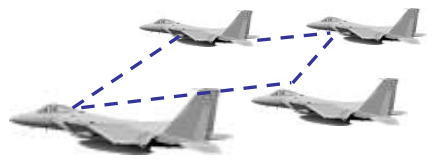
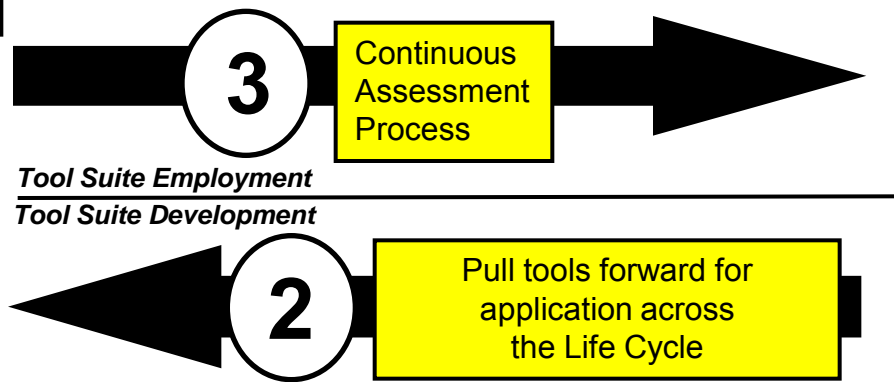
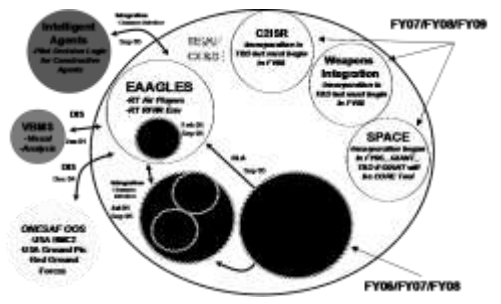


**Capability Under Development**

- Live Systems
- Virtual Representations
- Constructive Representations



### LVC Mission Environment





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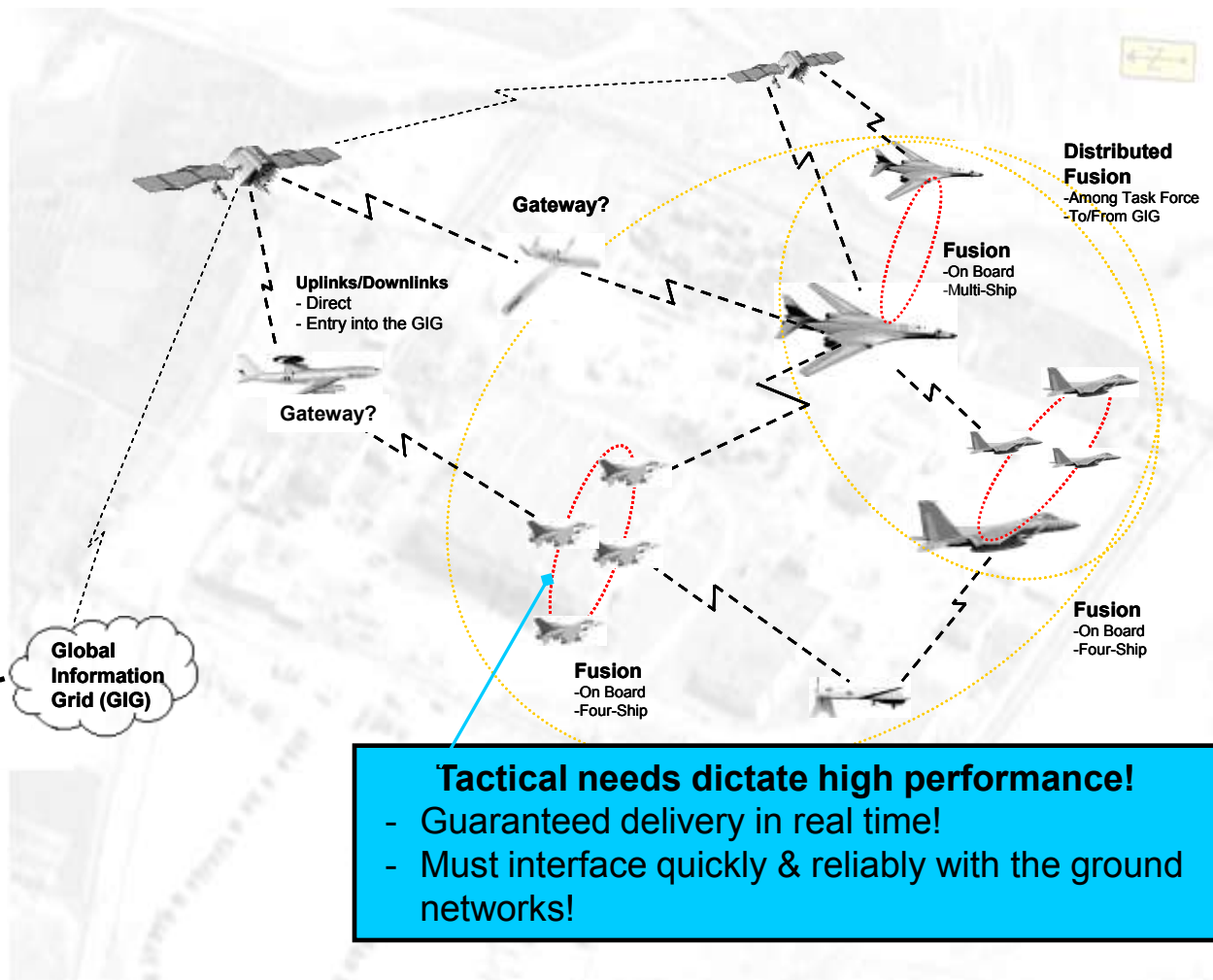
# Network Enabled Warfare

*Applied with a Capability Focus*

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AF is moving from a System focus to a Capability focus enabled by an integrated system of systems!



**Tactical needs dictate high performance!**

- Guaranteed delivery in real time!
- Must interface quickly & reliably with the ground networks!

Information is Agnostic! It doesn't care what network it resides within...and neither do we!

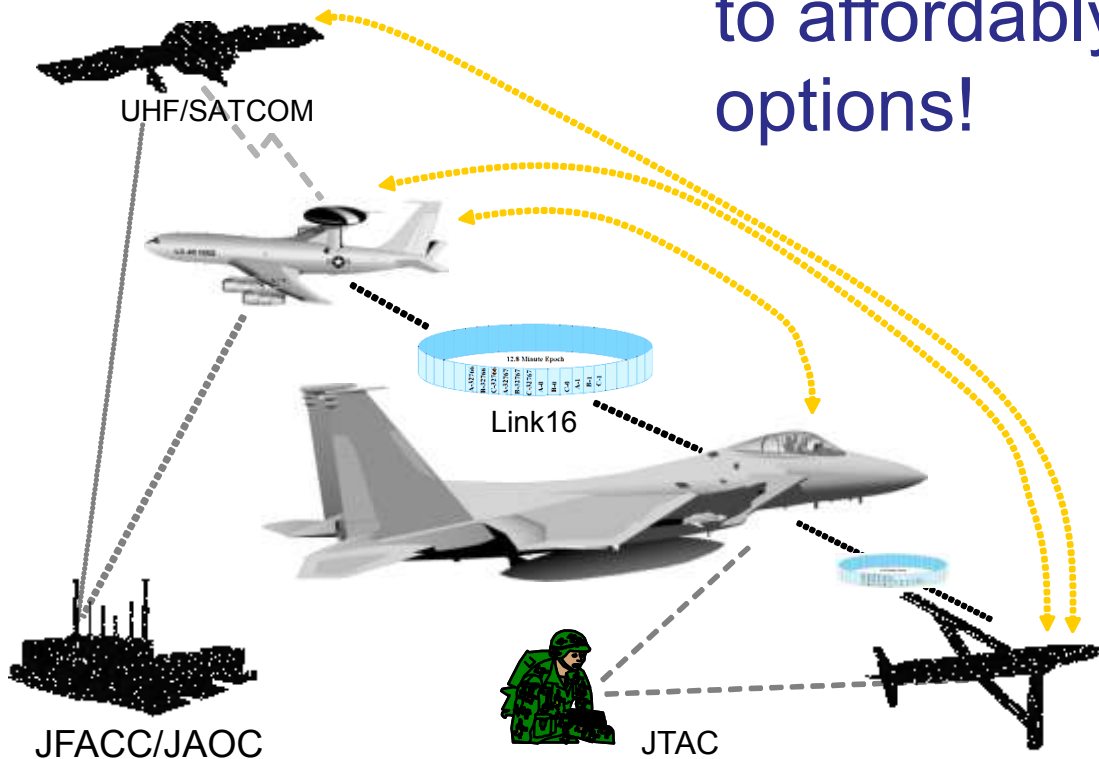


# What's the Solution?



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## Use of Distributed Simulation to affordably assess capability options!



- Scale & Repeatability
- Testing Limitations
- Operational Issues
- Range Limitations
- Cost

A Good Business Case!

**The cross domain nature of the problem lends itself to teaming to address the many “sensor to C2 to shooter to weapon” permutations!**

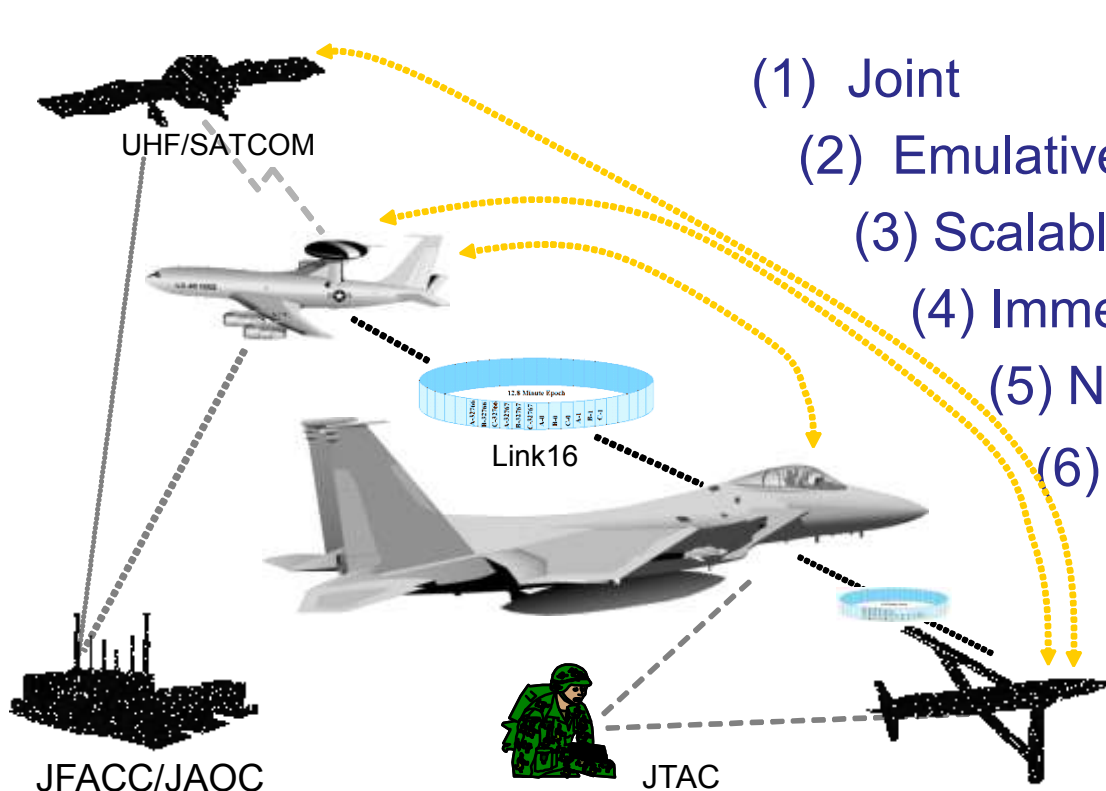


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# Environment Requirements

## Requirement Definition

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- (1) Joint
- (2) Emulative
- (3) Scalable
- (4) Immersive
- (5) Non-Proprietary
- (6) Interoperable with Test tools
- (7) Reusable

Environment must include electronic warfare and emulative quality nets!

**Build for Test Range Application!**

**A large number of diverse blue force systems (including EW) integrated with diverse networks operating over multiple domains (tactical edge, C2, munitions) in real-time within a hostile environment!**



# What is High Fidelity, Real-Time Data Link Modeling?



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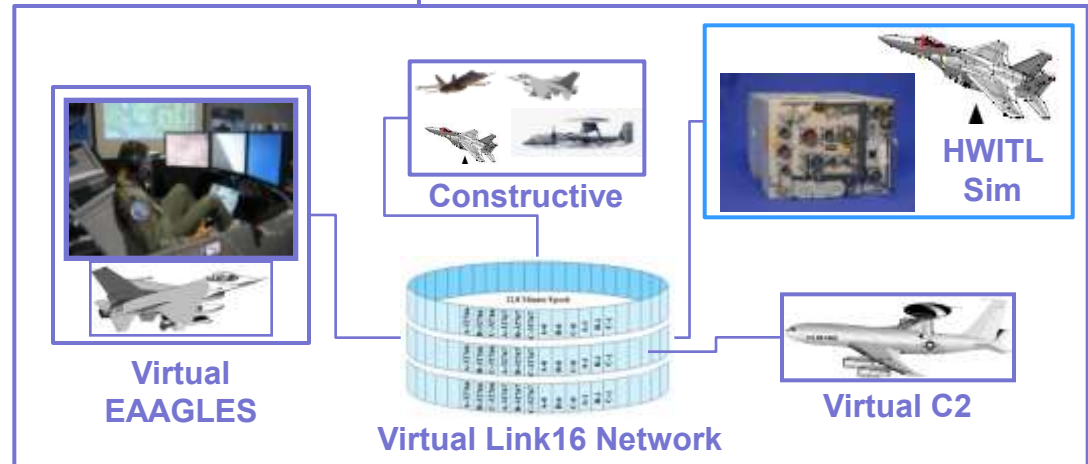
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**Real Time:** Simulation Time = Wall Clock  
(Example: 1 second sim time = 1 sec wall clock time)  
Allows interoperability with live hardware and human-in-the-loop

**Emulative:** A model that can interoperate seamlessly with live hardware through the use of actual systems' protocols or inputs and the capability to operate in the simulated system's actual environment

**Terminal Model Application:** A stand-alone executable, C++ (EAAGLES-based) software application designed to provide interfaces analogous to data link terminal hardware. Explicitly limits simulation-induced assumptions

## **Real-Time, Emulative, Terminal Model Applications of Tactical Data Links for Use in LVC Assessments**





# EAAGLES



Extensible Architecture for Analysis and Generation of Linked Simulations

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- Capability-Based Design
- Electronic combat environment
- Robust air-to-air *and* air-to-ground
- Designed for hundreds of players
  
- Proven real-time architecture (FY03-FY06)
- Optimized for the PC, yet platform independent
- Variable and Scalable Fidelity, Object Oriented
- Hardware: Dual to Networked PC “clusters”
- Hardware-in-the-Loop
- Distributed simulation via DIS and HLA
- Government owned and managed software





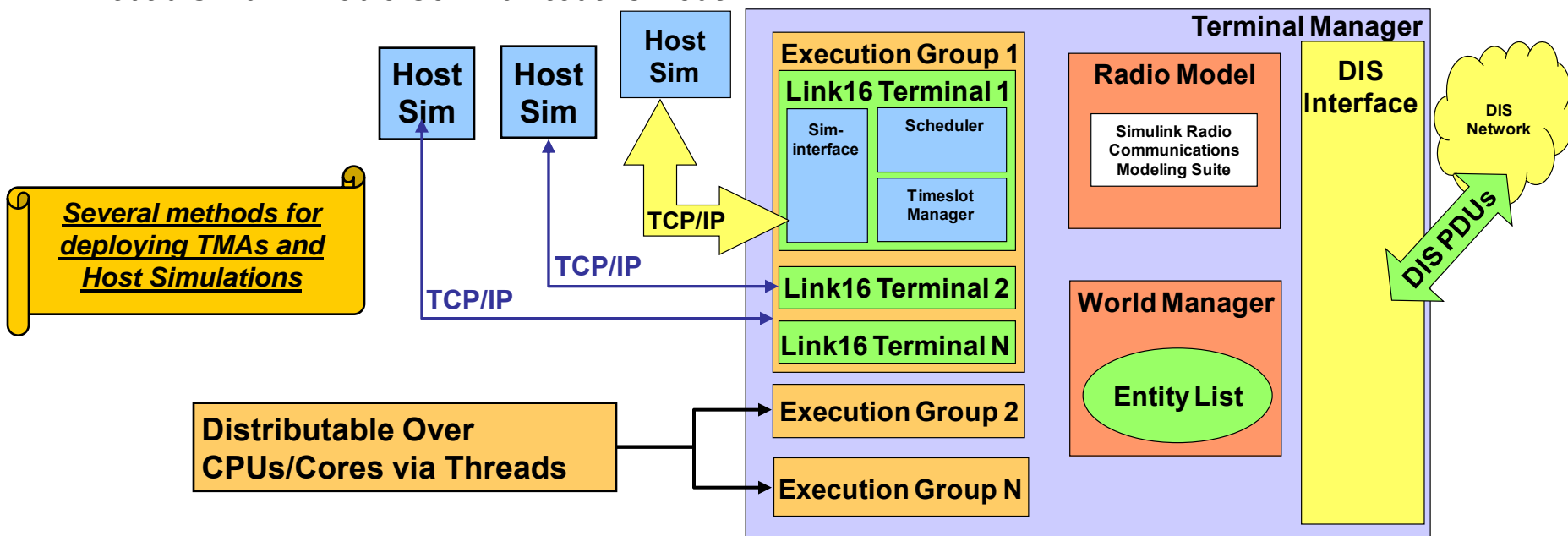
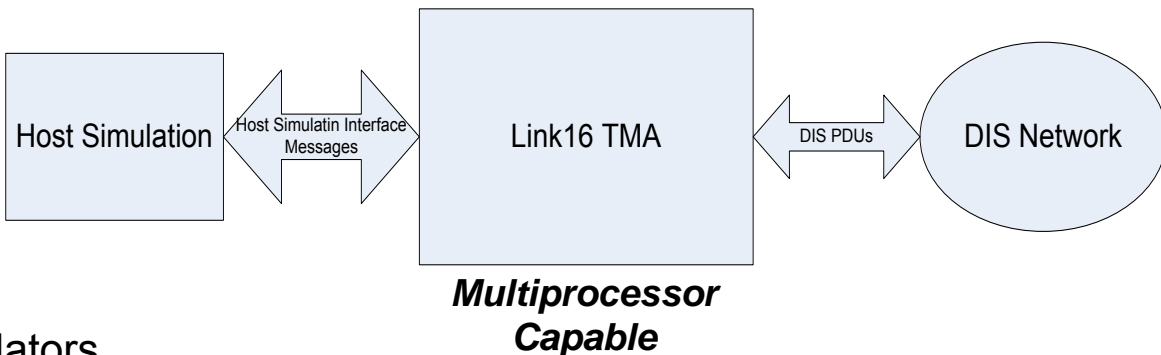
# Link16 Terminal Model Application



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- Compliant with SISO Standard 2.9.6 (TADIL-TALES)
  - Signal and Transmitter DIS PDUs which contain additional Link16 specific information
  - SISO TSA Fidelity Level 2
- Timeslot rate is very accurate
  - Timeslots are not “clumped”
- Easy to connect to via other simulators
- Realistic RF propagation characteristics
  - Matlab/Simulink Radio Communications Model





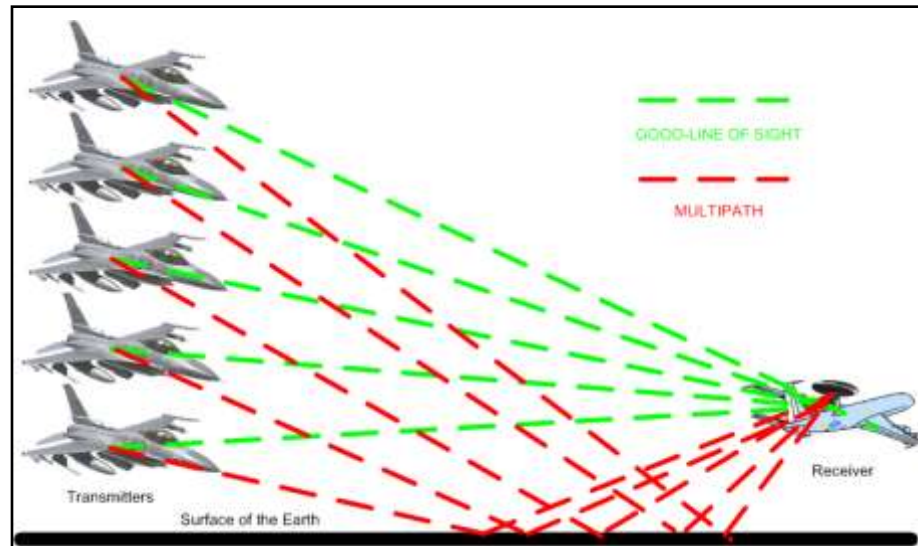
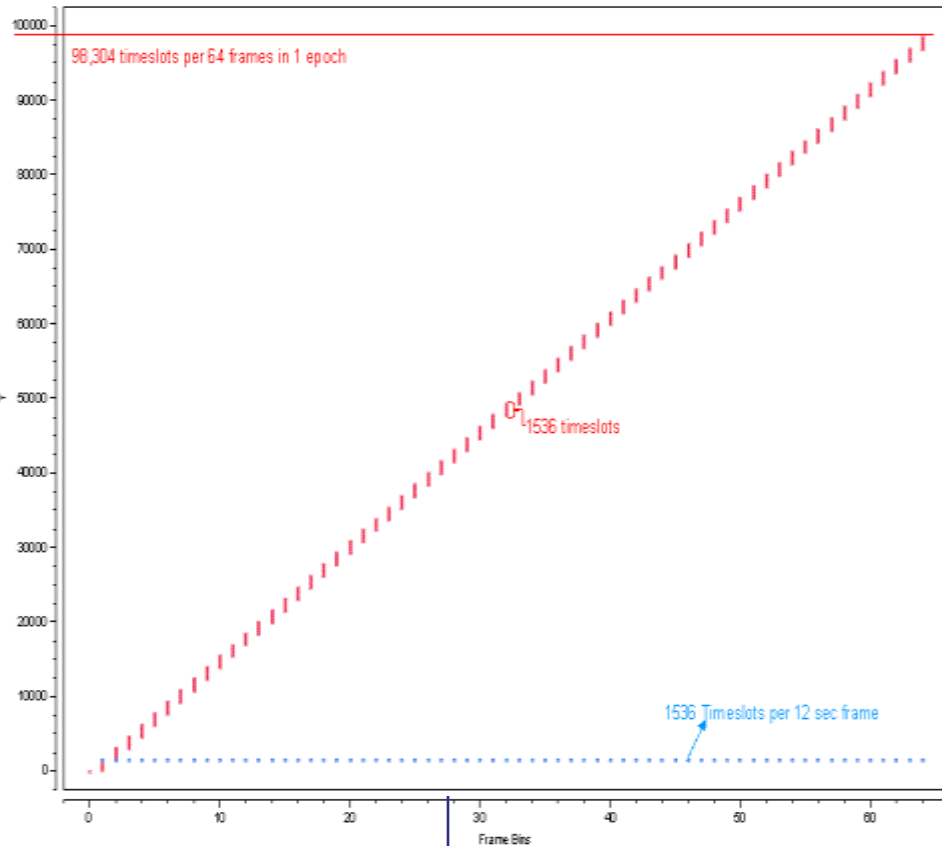
# Link16 Terminal Model Application

## Distributed V&V



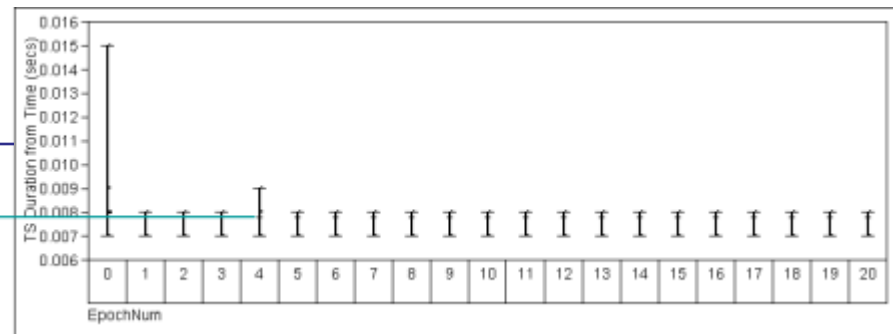
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RF Propagation

Link16 Timing Maintained Across a Physical Network  
 \* **Subject to Network Latency Limitations**



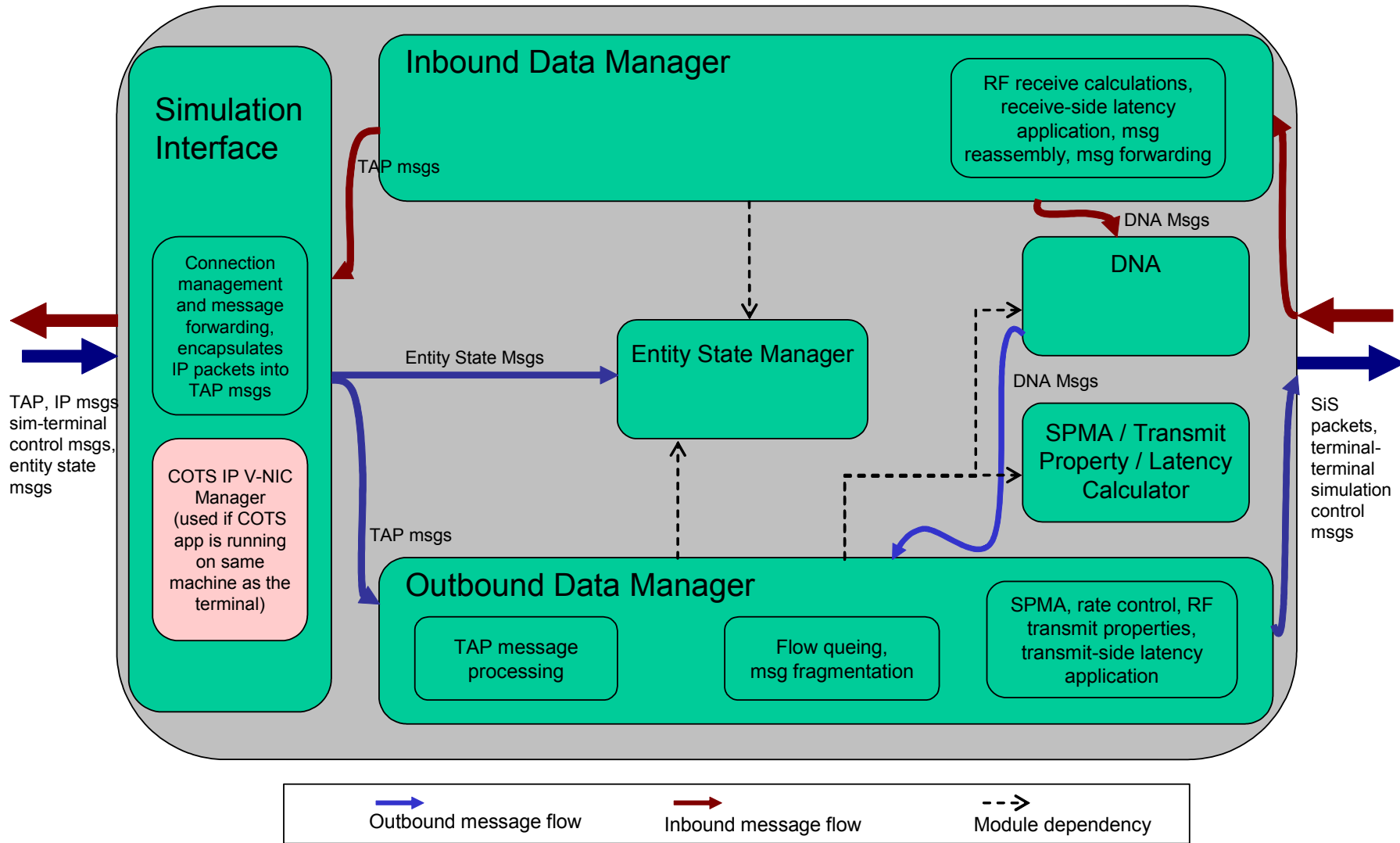


# TTNT Terminal Models

## Internal Structure



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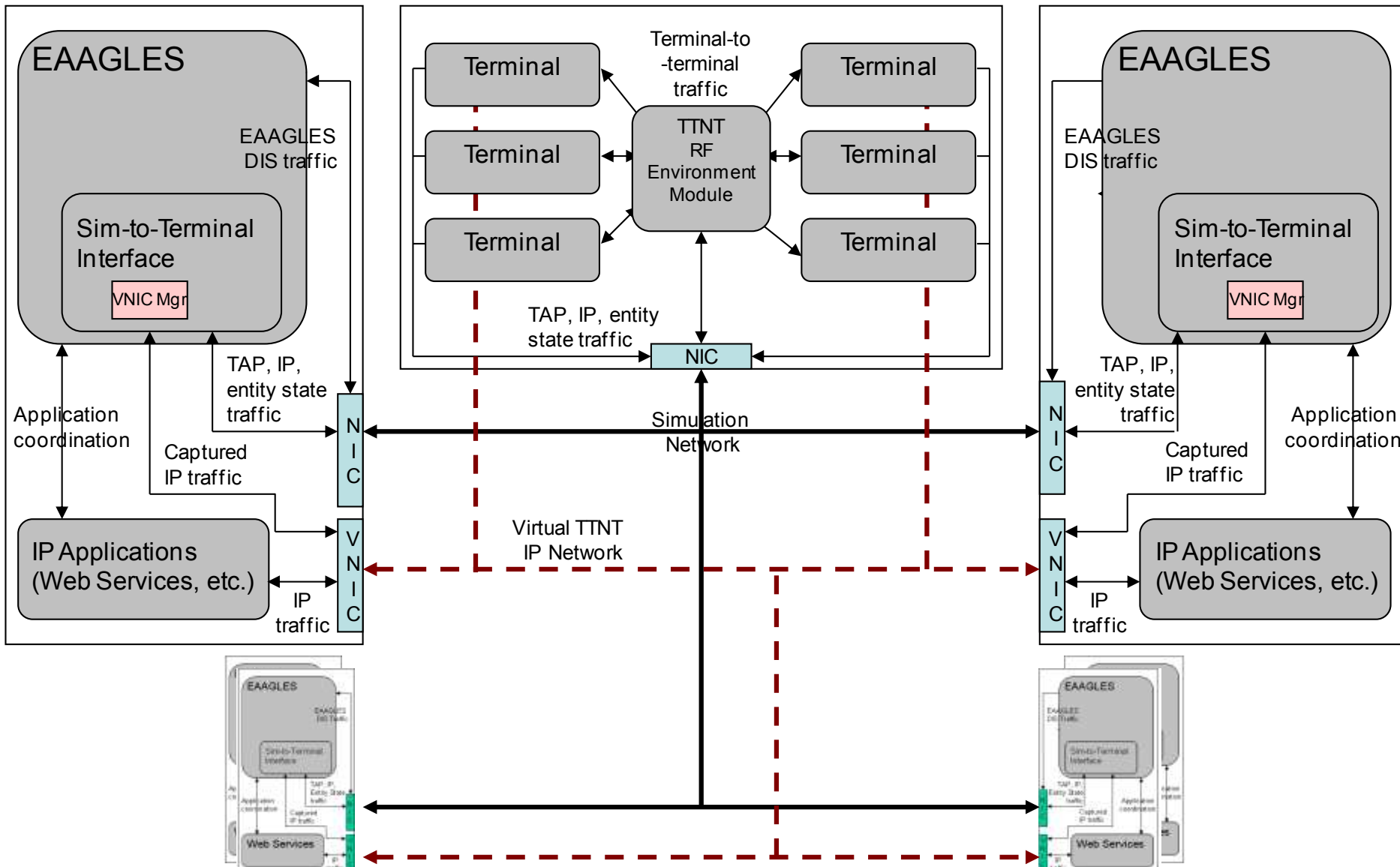


# TTNT Terminal Models Deployed on HPC



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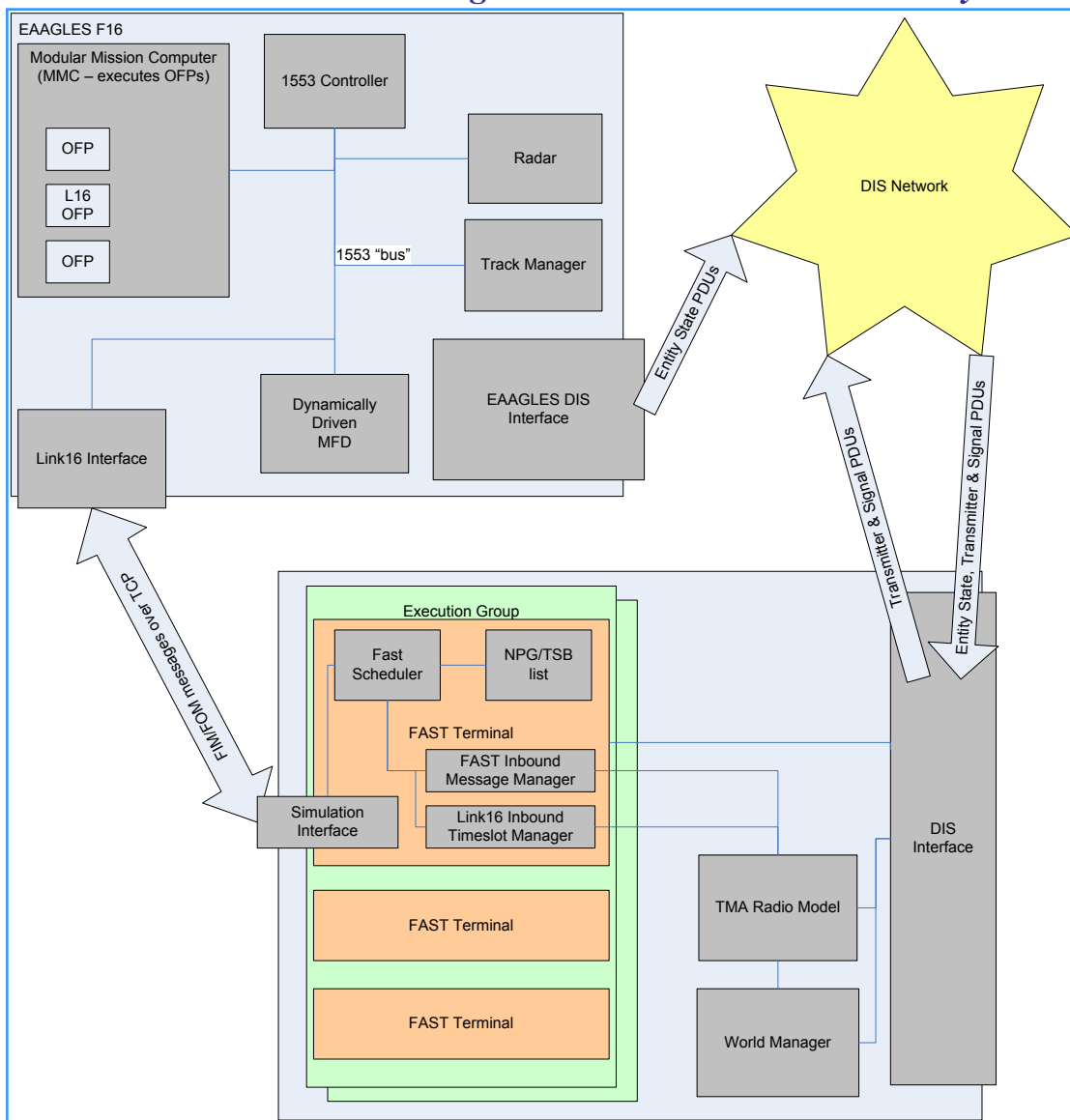


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# FAST Terminal Model Application



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Extends  
TADIL-  
TALES  
Standard for  
Link16 over  
DIS

Explicit  
Interface from  
Host Sim to  
FAST  
Terminal  
Simulation



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