# Rapid Simulation, Analysis, and Visualization for Navy Integrated Fire Control - Counter Air (NIFC-CA)

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*Note: All performance values are notional and used only for purposes of simulation development.*

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# Project Overview

- **Develop rapid simulation, analysis, and visualization capability to gain understanding of fighter aircraft integration in the From-the-Sea kill chain for integrated fire control operations in counter air engagements.**
  - **Employ integrated engagement concepts**
  - **Examine engagement outcomes**
  - **Quantify benefits of military utility and effectiveness**

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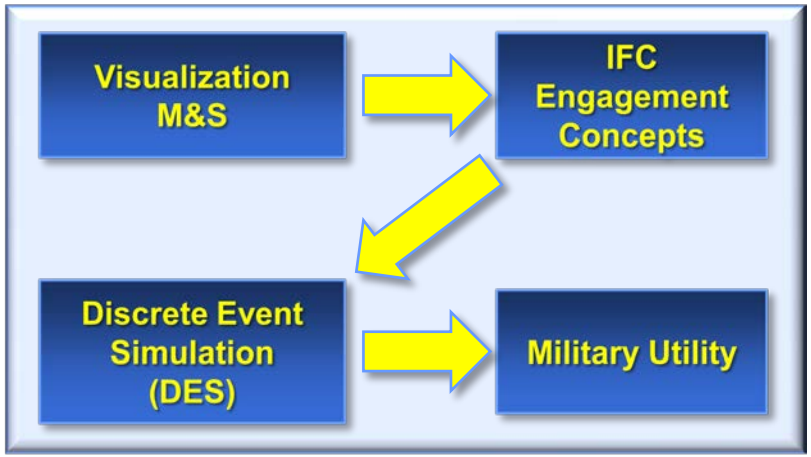
# Approach

**Approach:**

- **Utilize visualization techniques to develop integrated engagement concepts**
- **Develop Discrete Event Simulation (DES) environment**
- **Simulate effects-based modeling of:**
  - **Defensive fighter operations**
  - **Sea based missile defense**
  - **Communications / data link network**
  - **Threat attacks**
- **Generate military utility results**
  - **Rapid analysis of integrated engagement capabilities**
  - **Understanding of top-level interactions and outcomes**
  - **Measures of Outcome, Effectiveness, and Performance**

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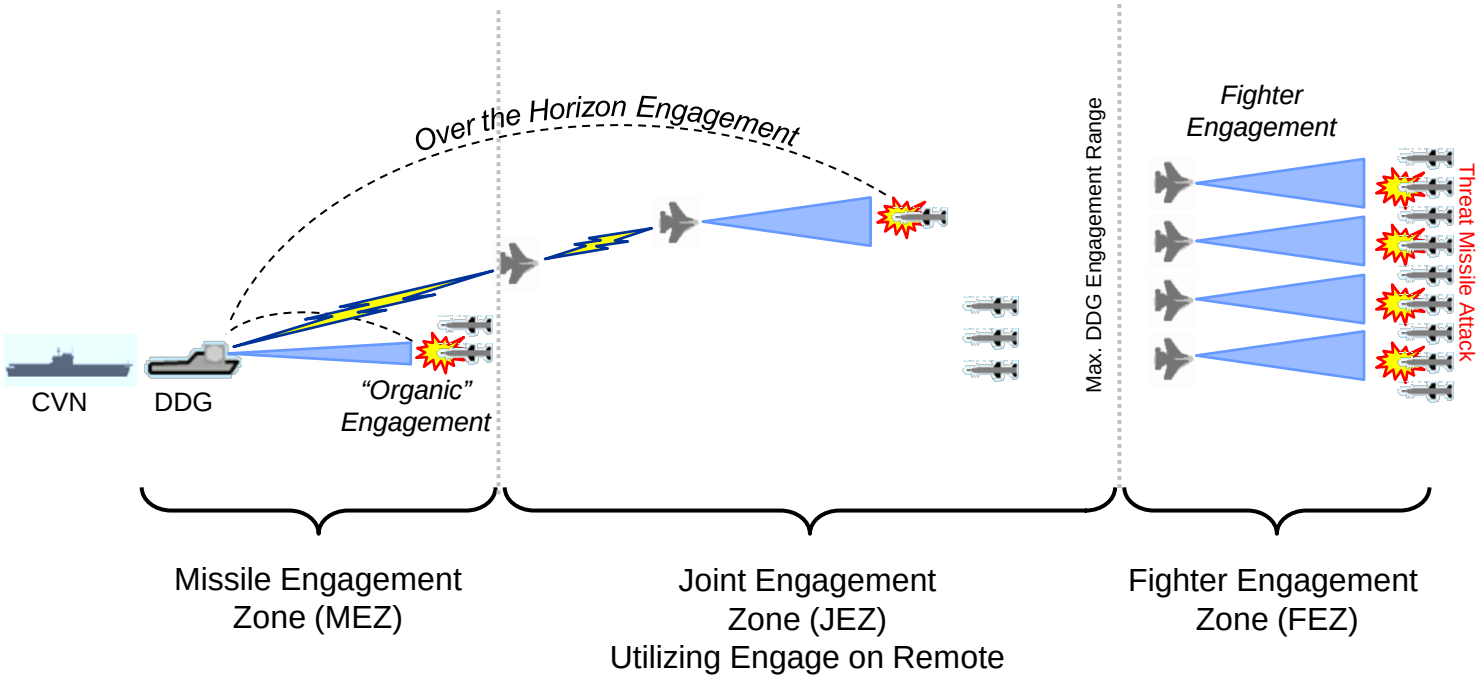
# Engagement Scenario*

- **Carrier Defense:**
  - **Airborne fighter defense**
  - **Surface destroyer defense**
  - **Integrated operations against low-altitude targets**




*Notional Data

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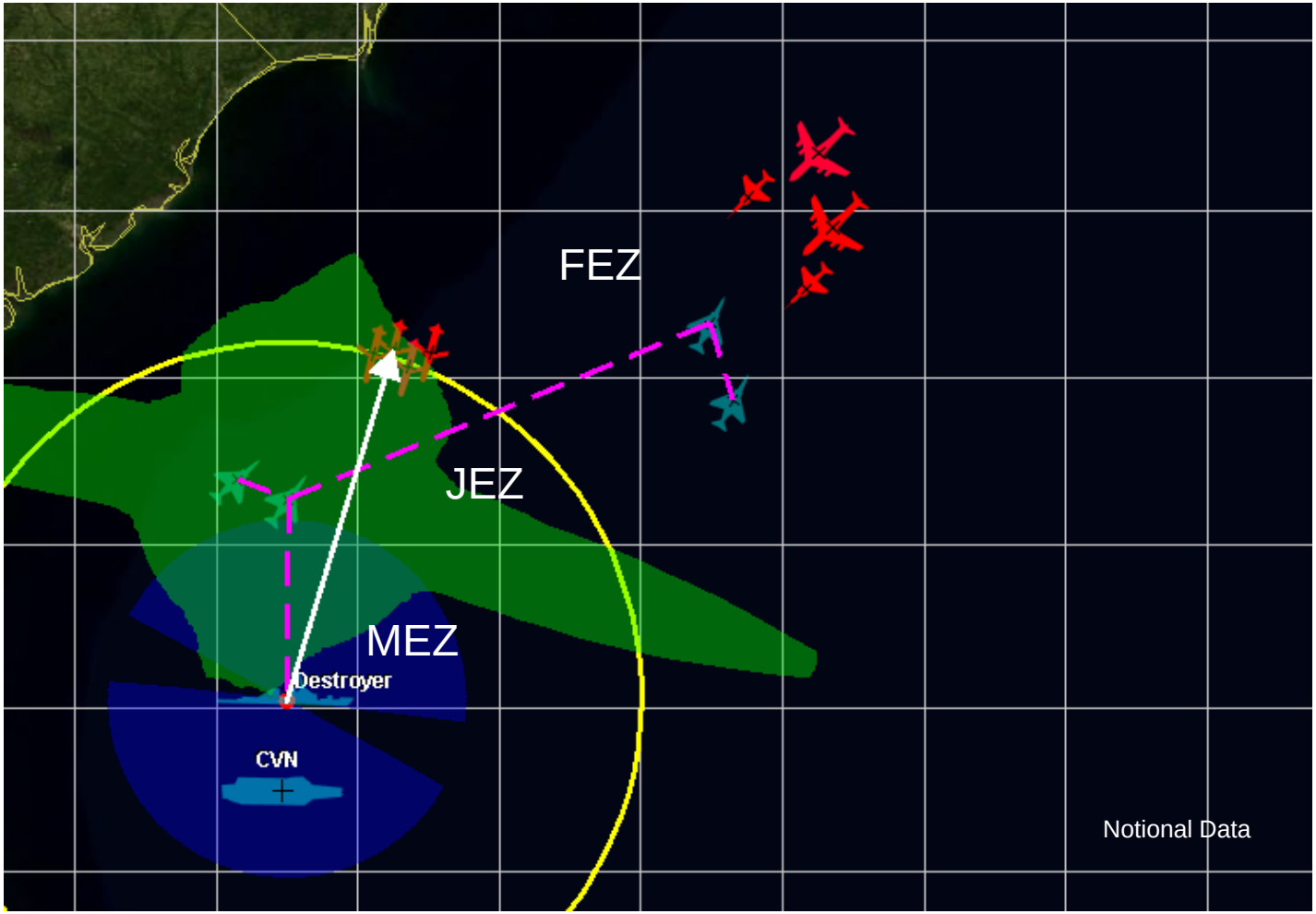
# Carrier Defense Visualization




**Visualization Used to Generate IFC Conops (engagement logic, timing, etc.)**

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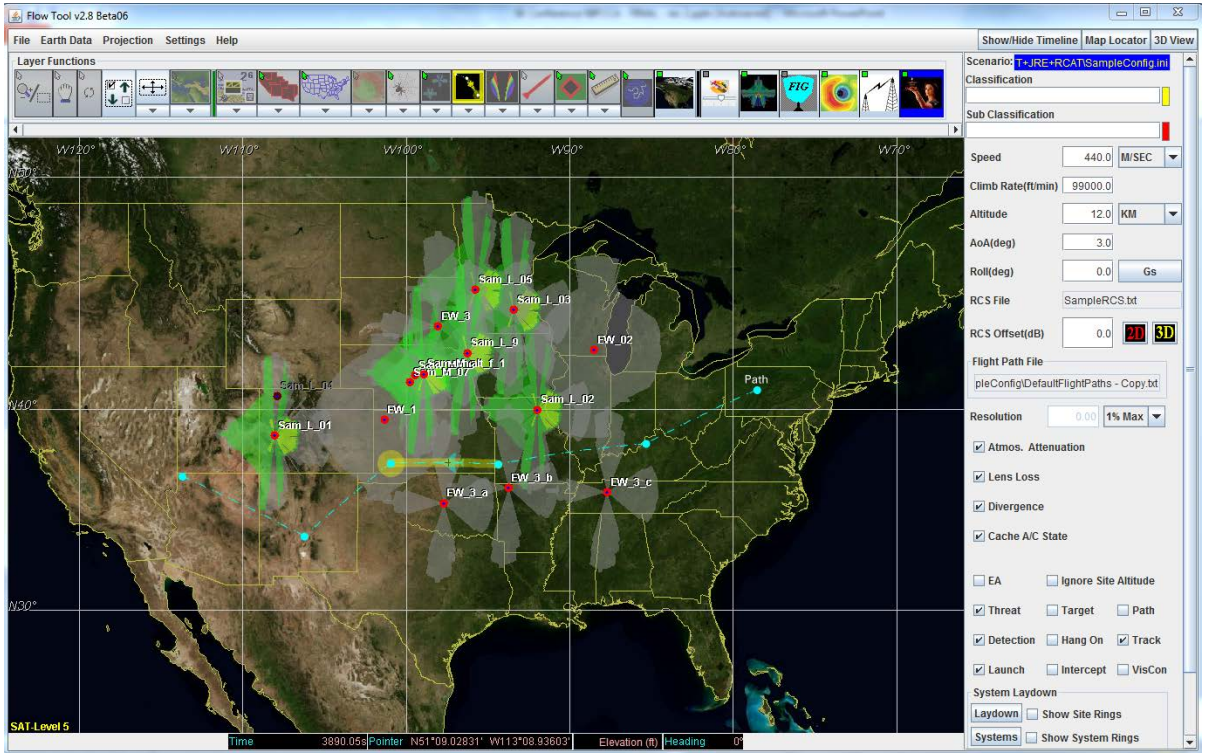
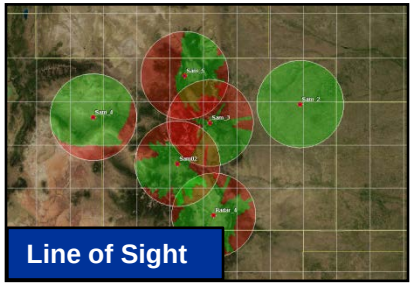
# Additional Visualization Capabilities*

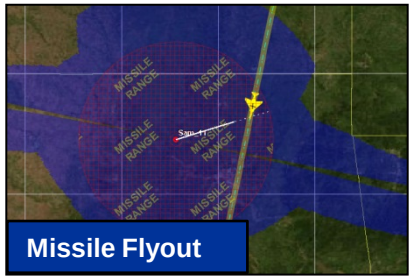


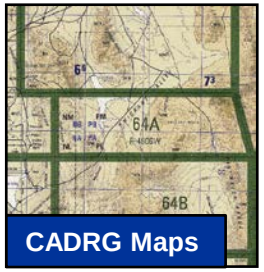

- **Investigate the susceptibility of aircraft flying through a threat laydown**
- **Visualize the interdependent effects of flight conditions, terrain effects, threat system capabilities, etc.**

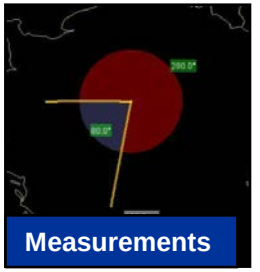
*Notional Data

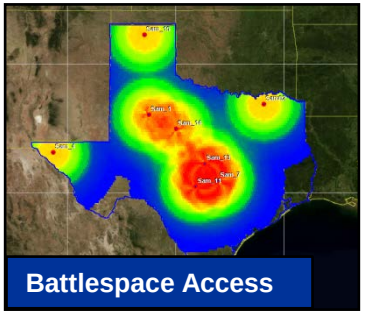
Analysis layers that can be turned on/off

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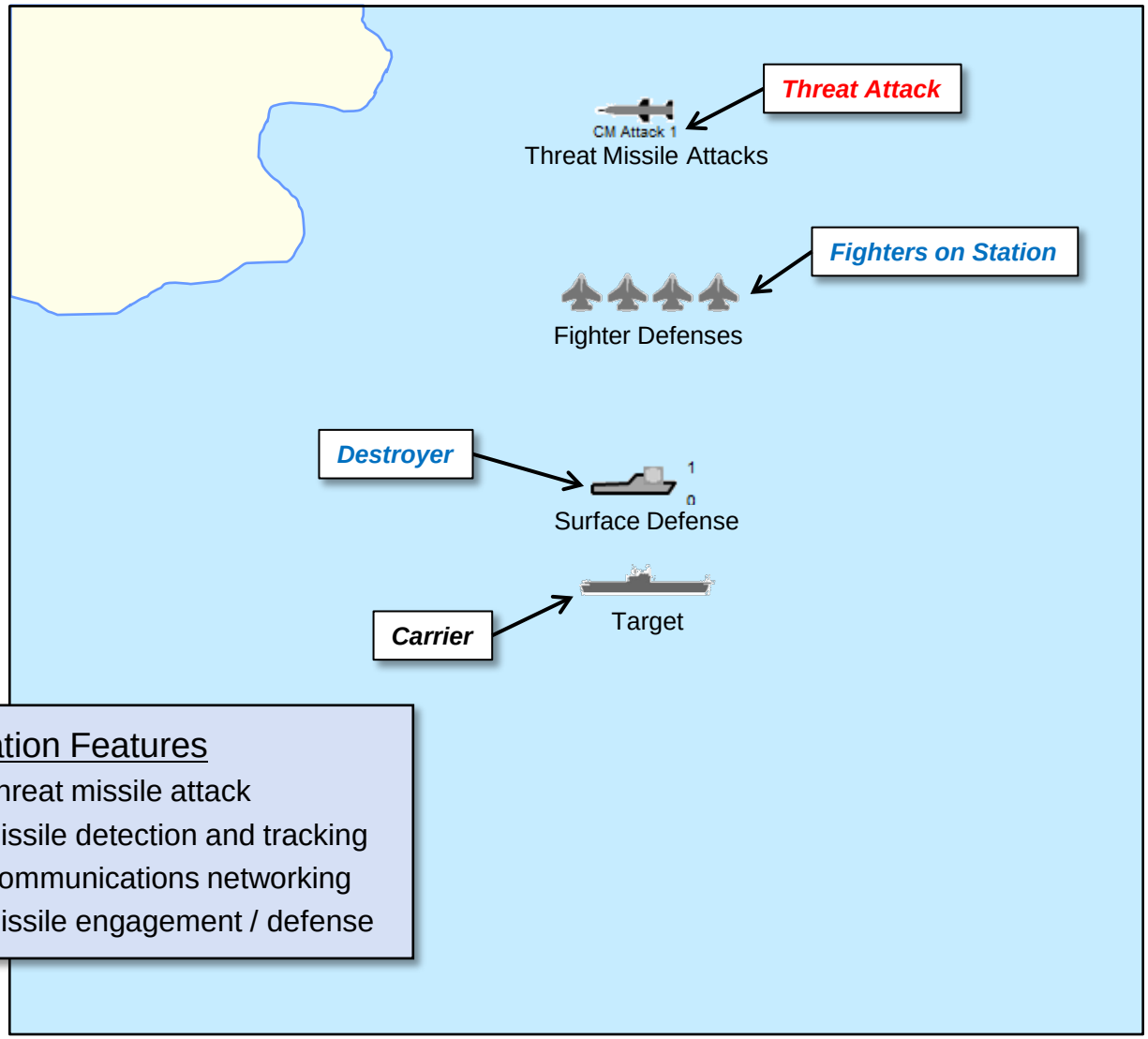
# Carrier Defense DES “Desktop” View

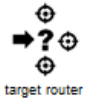





Sensor Network


Shooter Network


Comms Network






Simulation Features

- Threat missile attack
- Missile detection and tracking
- Communications networking
- Missile engagement / defense

*notional data

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# Example Attack Scenario*

- **20 threat missiles launched against carrier battle group**
- **Surface defense provided by destroyer**
- **Fighter defense options…**
  - **Case 1: No fighter defense**
  - **Case 2: Integrated fighter defense (limited bandwidth)**
  - **Case 3: Integrated fighter defense (unlimited bandwidth)**
- **25 Replications run for each option**

Threat missile speed = high subsonic
Threat missile altitude = Low
Destroyer supports up to 10 simultaneous engagements

*Notional Data

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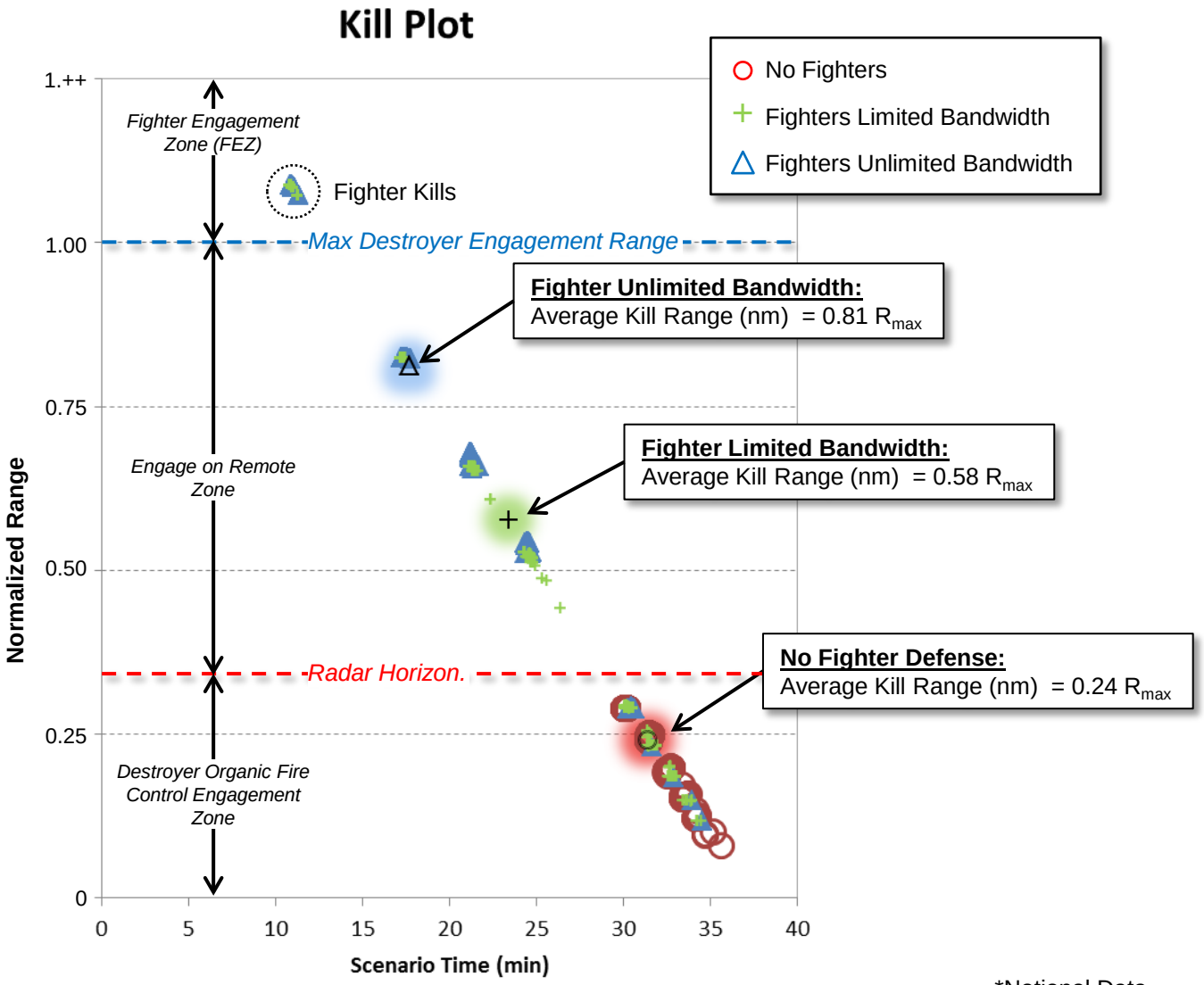
# Combined Kill Plot




*Notional Data
Averages across 25 Replications

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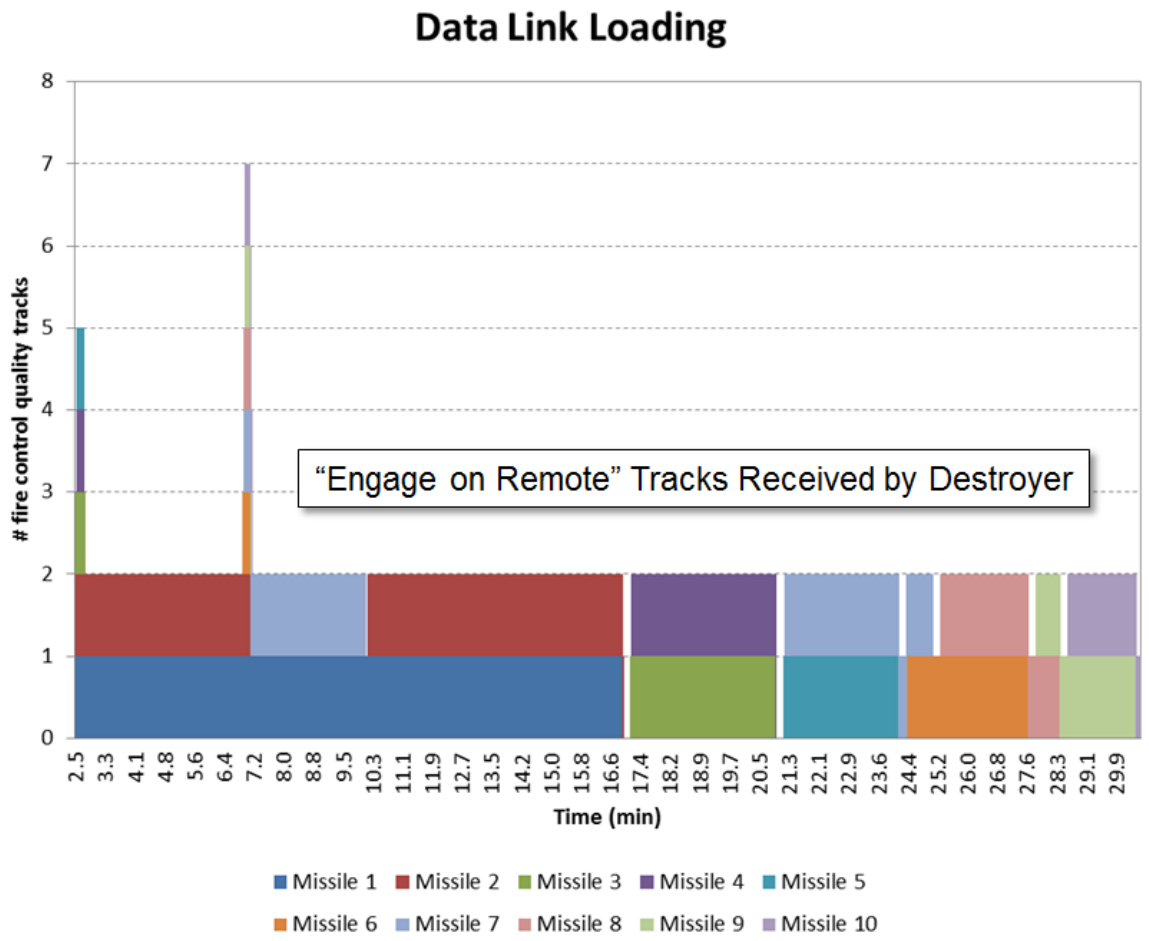
# Data Link Simulation Summary

Simple message queuing and processing model captures link “bandwidth / capacity”




*Notional Data from Single Replication

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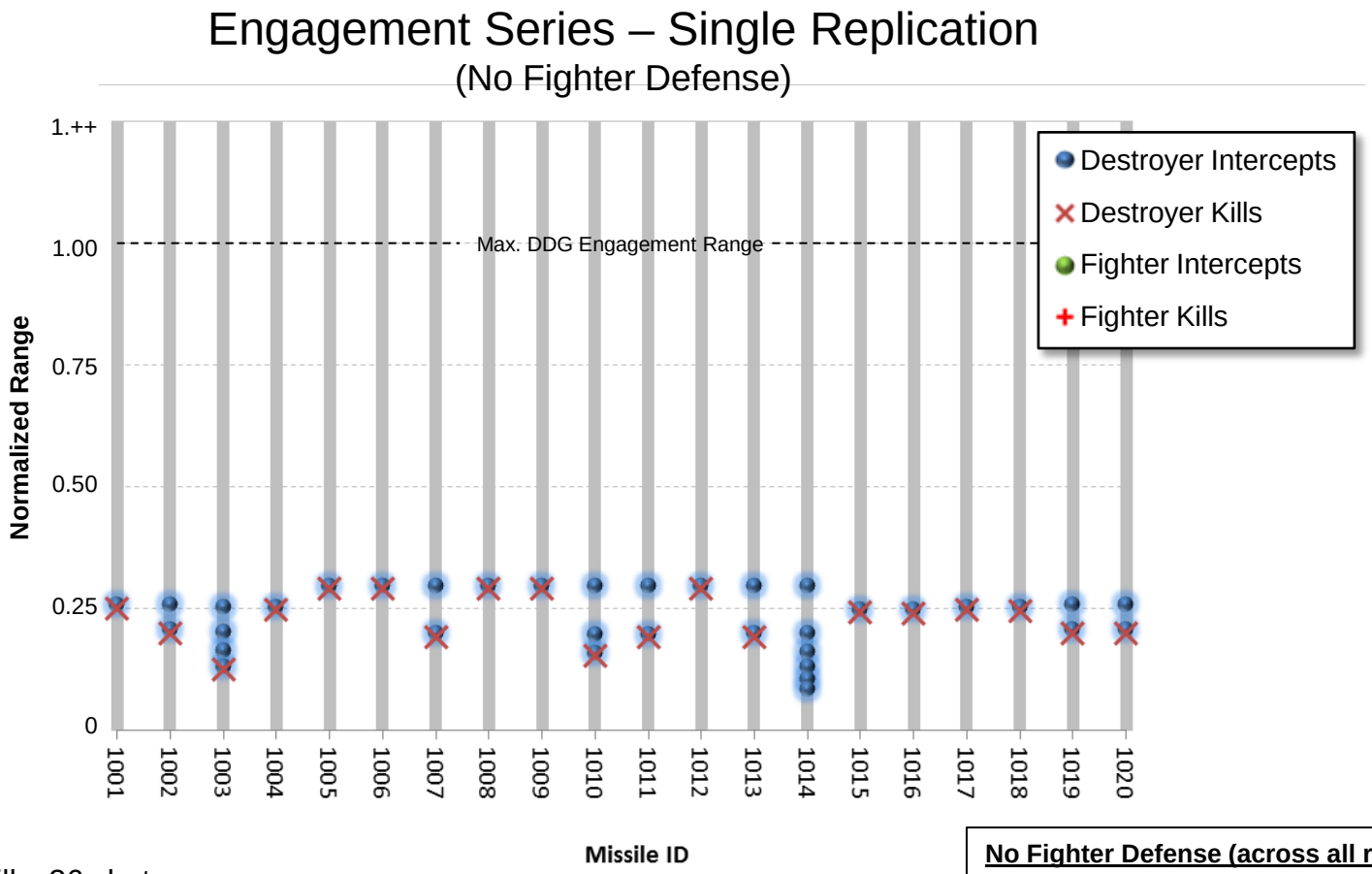
# Engagements – No Fighter Defense




No Fighters
Destroyer 19 kills, 36 shots
Leakers = 1
1 Replication

**No Fighter Defense (across all replications):**
Average Kill Range (nm) = 0.24 $R_{max}$

*Notional Data

**All Engagements Occur at Close Range**

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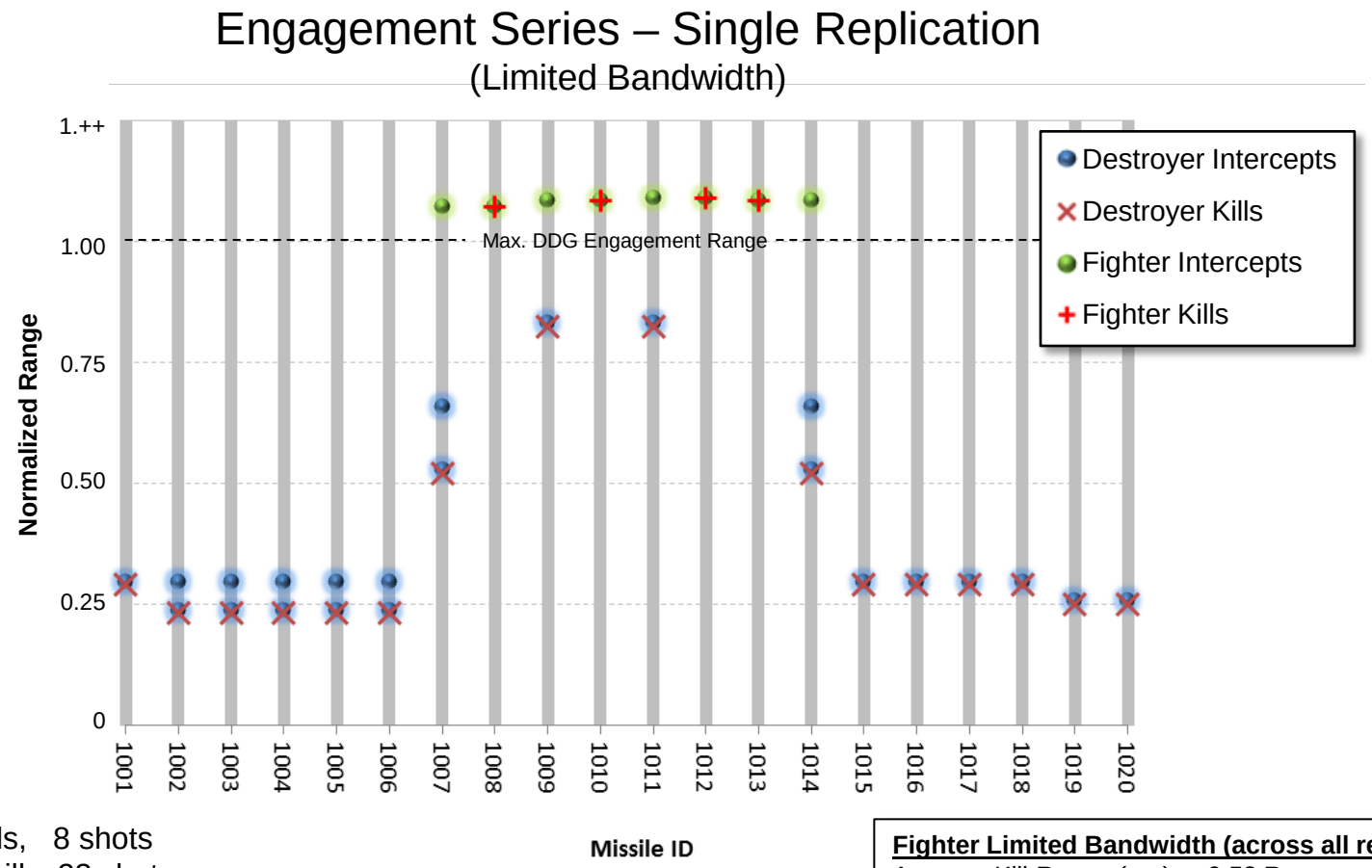
# Engagements – Limited Bandwidth




Fighters 4 kills, 8 shots
Destroyer 16 kills, 23 shots
Leakers = 0
1 Replication

**Fighter Limited Bandwidth (across all replications):**
Average Kill Range (nm) = 0.58 $R_{max}$

*Notional Data

**Few Engagements Occur at Extended Range**

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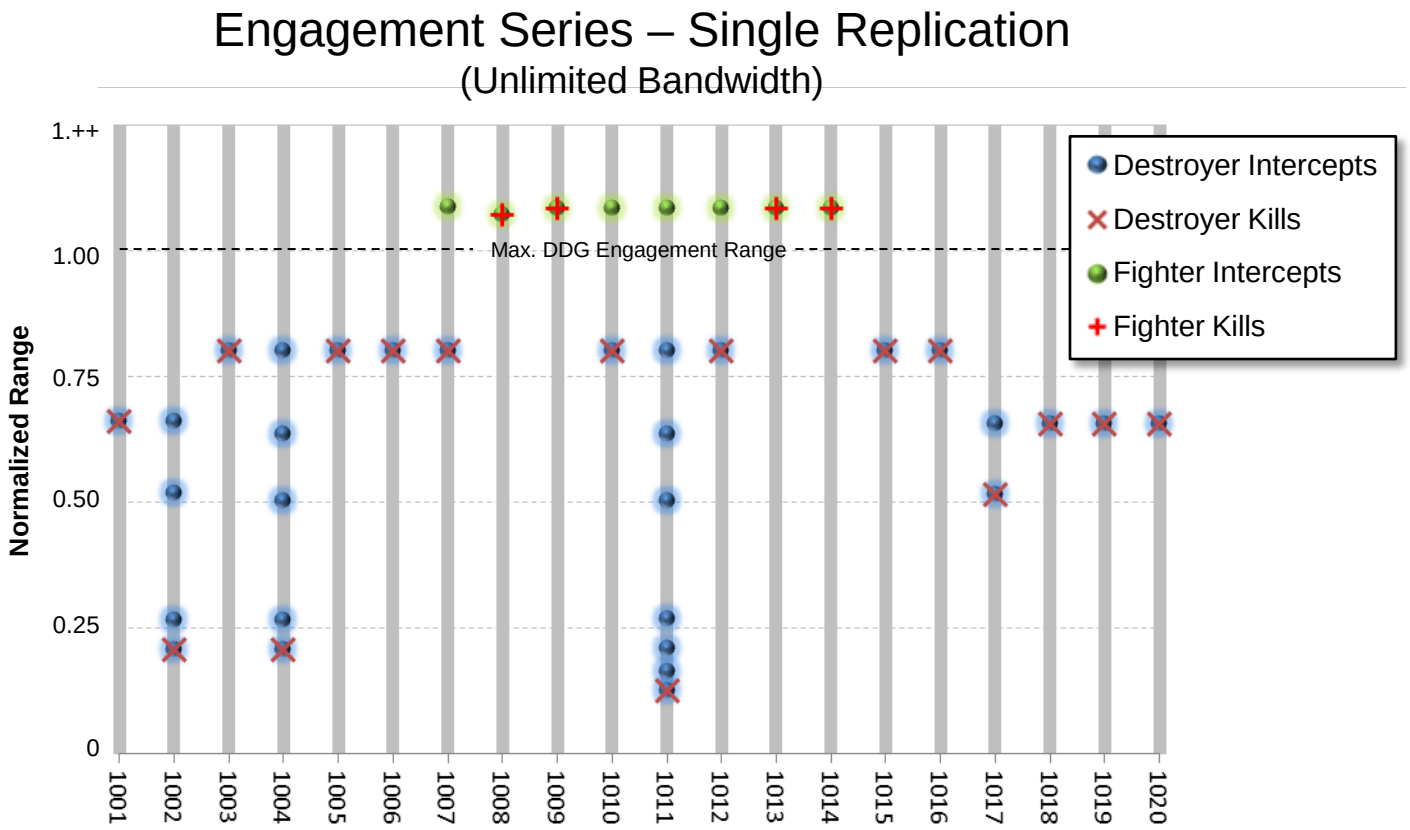
# Engagements – Unlimited Bandwidth




Fighters 4 kills, 8 shots
Destroyer 16 kills, 30 shots
Leakers = 0
1 Replication

**Fighter Unlimited Bandwidth (across all replications):**
Average Kill Range (nm) = 0.81 $R_{max}$

*Notional Data

**Many Engagements Occur at Extended Range**

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# About the Author

**Ms. Tammy McNeley is a Lockheed Martin Fellow and serves as Chief Engineer of the Lockheed Martin Aeronautics' Warfare Integration Laboratories including F-35 and Advanced Development Program facilities. She has 30+ years of experience in military Operations Analysis (OA) and human-in-the-loop simulation and is certified as an Expert Systems Engineering Professional (ESEP) by the International Council on Systems Engineering (INCOSE). She is also an active member of the National Defense Industrial Association (NDIA) Systems Engineering (SE) Modeling and Simulation (M&S) Committee.**

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