CBMANET
Modeling and Simulation

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MITRE
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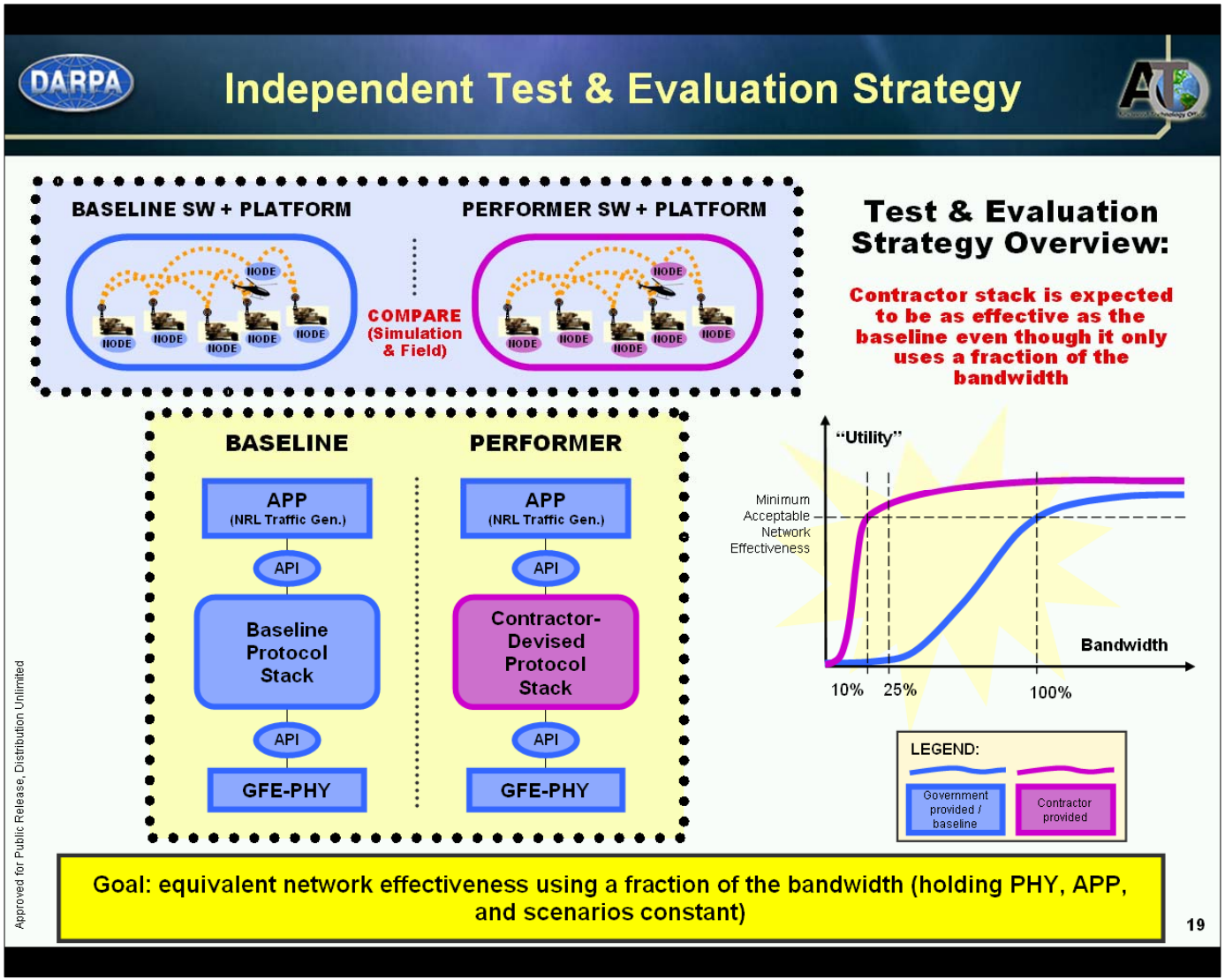
M&S Test Approach: Meet or beat the baseline with a fraction of the bandwidth



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Government M&S team responsibilities

- **Run Baseline Simulation test and compute the network utility function**
- **Run M&S IPT to refine details of the M&S approach**
  - Identify standard OPNET interfaces
  - Identify common code/procedures to be used
  - Establish a baseline for the statistics the need to be collects
- **Evaluate and confirm Contractor M&S results**
  - Conduct a code walkthrough of the contractor models and compare to the documented algorithms
  - Conduct selected runs to verify results
  - Conduct independent analysis of select results as required

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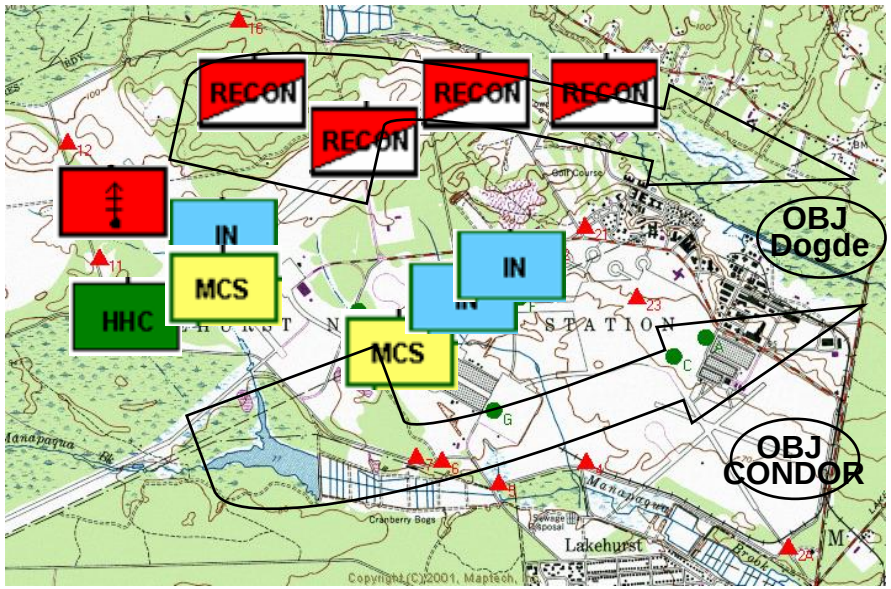
Scenario: Caspian 20.1 Based Battalion Attack

- **Operational Timeframe: 2012**

- **Mission: Seize key terrain and crossing sites to set conditions for the crossing of the river.**

- **Operational Environment:**
  - Numerous small villages
  - Complex terrain
  - Night scenario

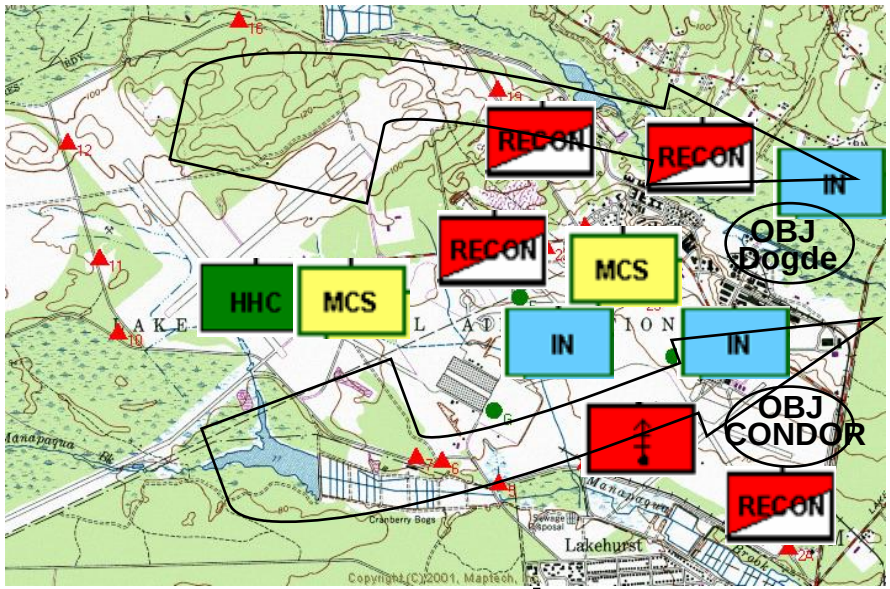


Start

Blue Forces: Offensive shaping

- **T1: Clear route Hood**
- **T2: Secure OBJ Dodge**
- **T3: Seize OBJ Condor**
- **T4: Fix and destroy with fires all long-range artillery and ADA in NAI 20**

Purpose: Facilitate forward movement of 2 UE



End

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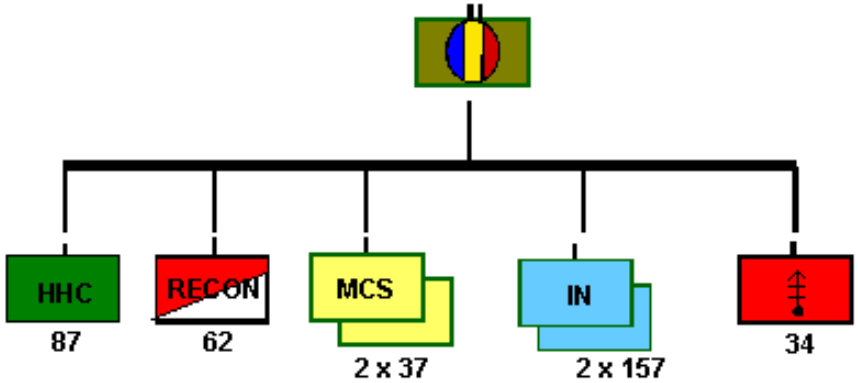
Combined Arms Battalion Force Structure for Simulation Test

Combined Arms Battalion



33	FCS Infantry Carrier (ICV)
20	FCS Mounted Combat System (MCS)
10	C2 Vehicle (C2V)
8	NLOS Mortar
10	FCS R&S V
9	ARV-RSTA
6	ARV-Assault
6	ARV-A(L)
15	FTTS-MS (Class III bulk/V)
8	FTTS-U (C2)
4	FTTS-U (SPT)
7	FCS MV (5 MV-E/2 MV-T)
15	UAV CL I L/C Units 30 Aerial Vehicles
12	UAV CL II L/C Units 12 Aerial Vehicles
3	UAV CL III L/C Units 12 Aerial Vehicles
4	81mm Mortar
18	MULE
27	Small UGV

- Includes BN HQ, 1 Recon troop, 2 MCS platoons, 2 infantry platoons and one fires platoon
- Ground robotic vehicles will not be modeled
- Total of 130 nodes to be modeled

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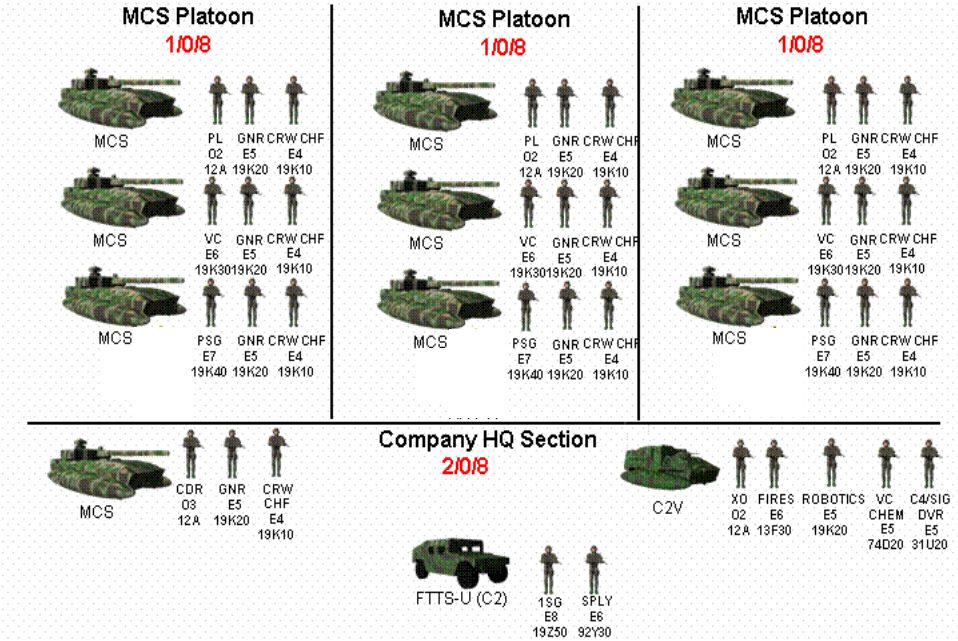
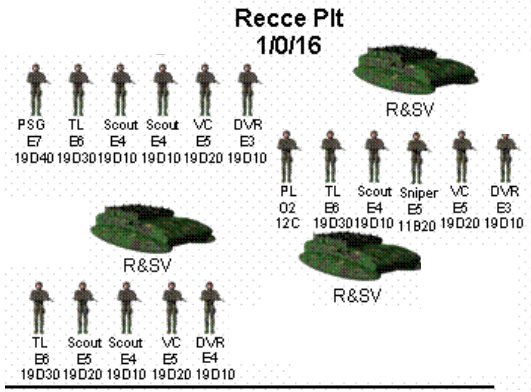
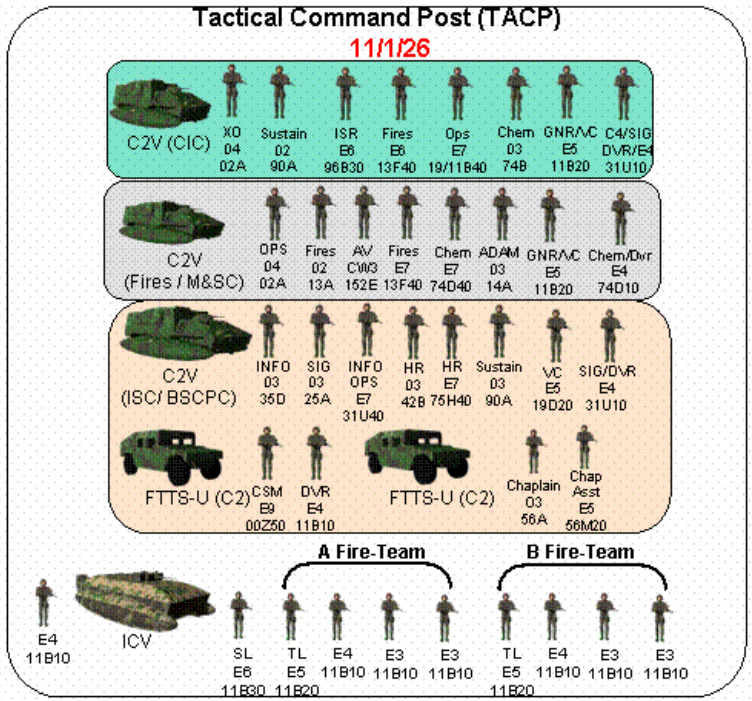
Combined Arms Battalion Elements for Field Test







- Includes BN HQ Tactical Command Post (TACP), 1 Recon platoon and one MCS platoon
- Scenario will focus on networked fires mission to include threads starting from sensor video and imagery from the recon platoon, via the BN HQ assigning effectors to the MCS company
- Some dismounts and unattended sensors may be included
- Minimum of 22 nodes to be modeled

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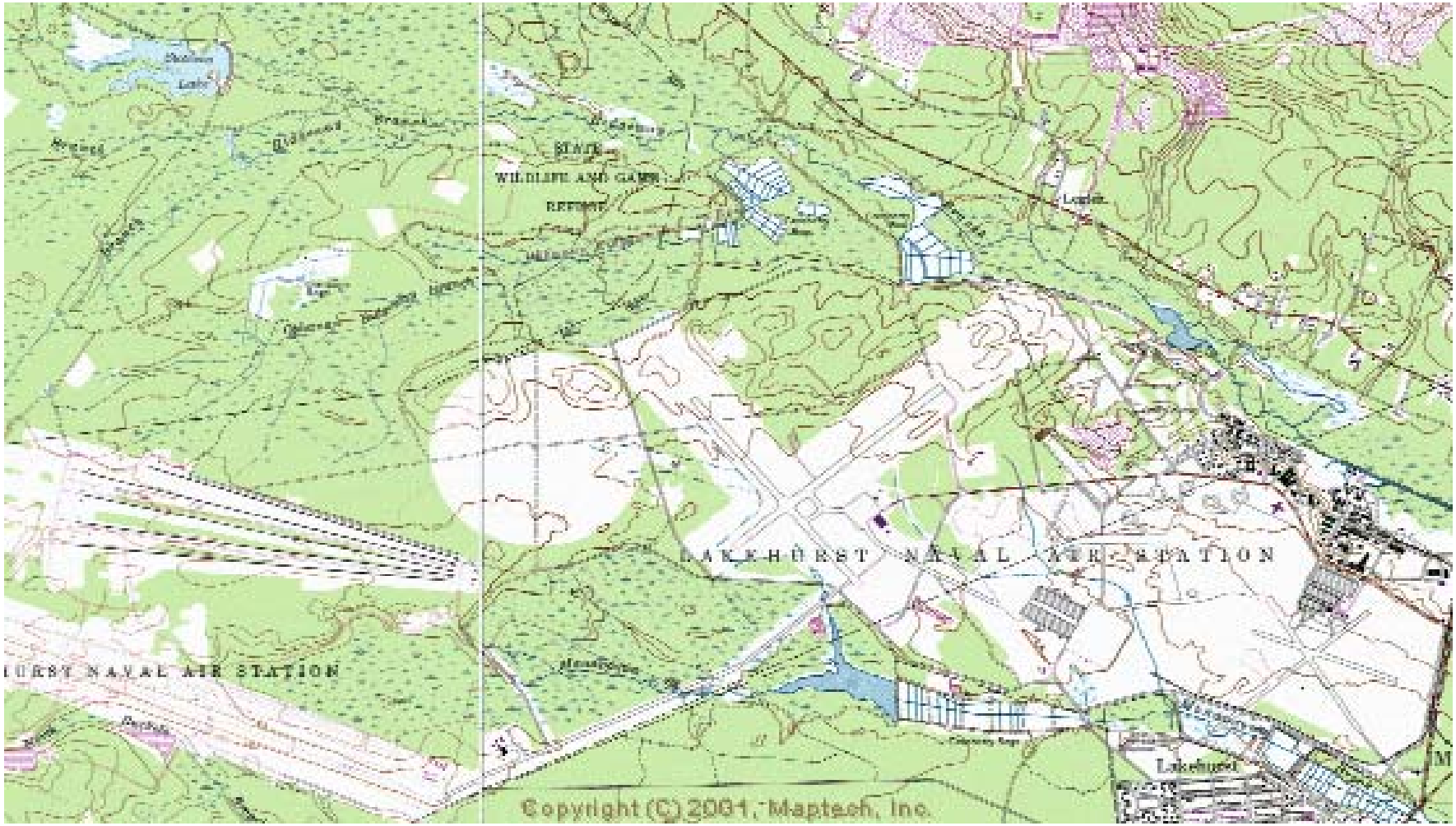
Lakehurst Environment



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M&S Philosophy

- The main goal of the modeling process is verifiability and consistency of the results
- The models created for the above purpose must have certain essential properties in order to make the analysis meaningful and efficient:
  - Common Simulation Environment
  - Identical Network Layout and Loading
  - Common RF propagation modeling
  - Computational Efficiency/Scalability
  - Periodic updates of models and modeling results for government independent analysis

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Simulation Environment

- **Simulation environment to be used is OPNET 11.x**
- **Connectivity (Path Loss matrices) for each of the scenario snapshots will be provided, but for reference the following propagation models will be used:**
  - Terrain Integrated Rough Earth Model (TIREM) to be used for terrain propagation effects
  - Weissberger Model added for foliage effects with parameters TBP
  - Wireless InSite by REMCOM to be used for Urban propagation effects
- **Physical layer parameters to be provided**
- **Terrain database including buildings and foliage information to be provided**

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Simulation Environment: Model Requirements

- **Expectation is that Models developed will be of adequate fidelity to evaluate all protocols proposed**
  - If abstractions are to be made to meet scalability requirements, a full description of the abstraction, rationale, and an estimate of the impact on the results is required
- **Target scalability of the model is 130 nodes**
- **All nodes modeled at same fidelity**
  - To meet scalability requirements it is suggested that propagation effects are calculated off-line

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Simulation Environment: Model Requirements

- **OPNET Model of the Application Layer traffic Sources will be provided along with the interface description and fields available plus the collected statistics and description of how they are collected**
  - It is expected that the application model will be designed to interface with the standard Transport Protocol Adaptation Layer (TPAL) with some additional fields implemented
  - It will provide information about what current transport protocols will be used in the baseline case, but additional fields will provide Speed of Service and message Perishability information for the designer to choose how to handle the transaction
- **It is expected that models will be able to complete required runs within 48 hours on standard high end single processor Windows based PC**

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Baseline Experiment

- **A Baseline experiment with 30 nodes will be conducted with a model based on the standard OPNET 802.11 model with modifications to include Ad-Hoc routing**
- **Airborne relays will be included**
- **Following cases will be examined**
  - 5 different increasing levels of traffic
  - Degraded network with 5, 10 and 20% of the nodes removed for 5 different traffic levels
  - All runs repeated with and without airborne relays

Contractor protocol stack will have to meet the baseline performance in M&S with less bandwidth

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Scalability Scenario

- A mixed open terrain and urban scenario will be used
- The scenario will be based on a Combined Arms Battalion (CAB) of 130 nodes (excluding ground robotic vehicles)
- The runs will be conducted at 30, 50, 75, 100, 130 nodes which will be subsets of the CAB

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Deliverables

- **Delivery of a modeling and simulation plan is expected, identifying what is will be modeled, at what fidelity, what additional modeling tools will be used and what analysis tools will be used for the analysis**
  - M&S plan should be updated periodically throughout the life of the program at every design review
- **Full model delivery is expected for evaluation purposes with unlocked source code**
- **All input parameter files needed to run the models**
- **Documentation describing the model and its associated modules, parameter settings, and statistics collected**
- **Documentation describing the analysis tools and the results of the runs, comparison to the baseline results, and any insights available as to the observed results**

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