



# Real-Time RF Propagation



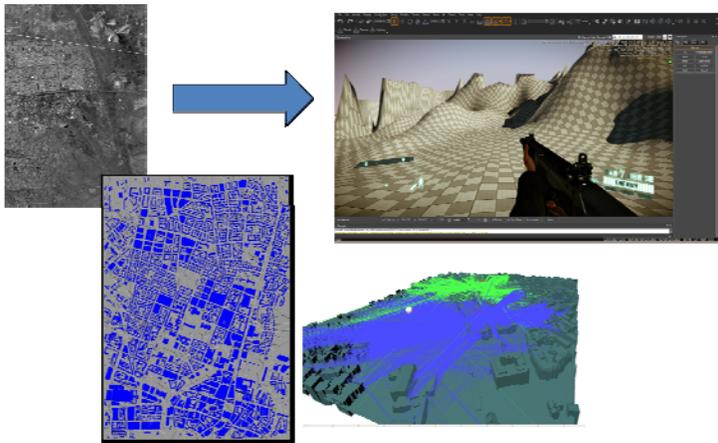
**S&T Campaign: Computational Sciences**  
*Predictive Simulation Sciences*

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## Research Objective

- Development of validated physical layer models for real time RF propagation in environments of interest
  - Pico-cell to brigade areas of operation
- New predictive capabilities for cognitive radios, intelligent jamming, waveform development



Real-Time Mobile Ad-Hoc Network (MANET) provides a platform for analysis of full applications including comparison of waveforms, routing algorithms, antennae, and other radio parameters in a controllable and repeatable laboratory environment.

## ARL Facilities and Capabilities Available to Support Collaborative Research

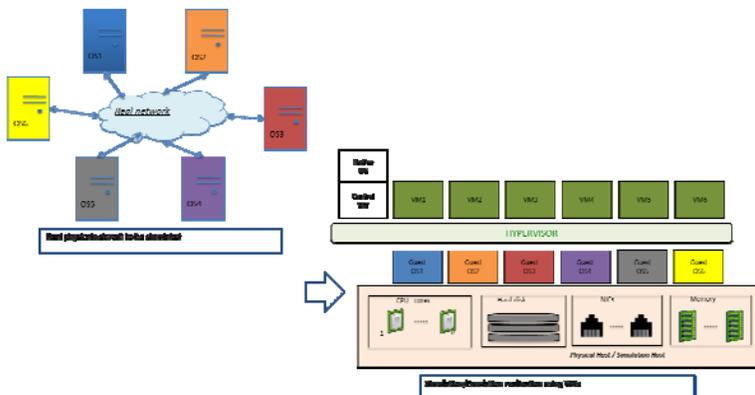
- ARL Maintains a hybrid GPU/CPU system dedicated to network simulation and emulation
- The system resides in a unique enclave allowing for simulation and code execution in a closed environment



- **SPECS**
  - 2.6Ghz 12c Interlagos – 303 TFlops Peak DP (700 SP)
  - 160 compute 2S nodes, 2.67GB Mem/core
  - 114 GPU 2S nodes, 2.67GB Mem/core
  - 6576 total compute cores
  - 456 Nvidia M2070 GPUs, 4 GPUs per node , 3 PCIe x16 Bus
- 10GbE cluster interconnect
  - Latency ~282ns min, ~546ns max
- (2) 40TB Panasas PAS12 Shelves, dedicated 1GbE Interconnect
- **Benchmarks**
  - Longley-Rice RF Propagation
  - NVIDIA C2070
    - 1288 GFLOPS
    - 275 Rados/GPU, > 65k Point-to-Point path calculations/0.5s
- **N-Body**
  - Max performance using GPUs is sustained 141 TFLOPS
  - Application becomes communication bound
- **Applications**
  - EMANE
    - 5000 node emulation
  - ns-3, network simulator
  - RF Propagation
    - ITM, TLM and Ray-Tracing
  - Secondary applications
    - Molecular Dynamics (LAMMPS and NAMD)
    - DFT
    - Etc.

## Challenges

- High fidelity RF propagation calculations for multiple use cases.
  - From pico-cell single building interiors to large areas of operation covering 1000's of square km
- Simulation of high data rate waveforms
  - Virtualization (packets/second, real time OS, etc.)



Mapping of required virtual resources to available physical resources using virtualization technologies

## Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- ARL has developed a number of RF propagation algorithms for GPUs and parallel computing systems such as Longley-Rice and Ray-Tracing
- ARL has a number of HPC systems available for development efforts and collaboration
- We are looking to collaborate on the development of full wave EM propagation algorithms for hybrid architectures
- ARL has extensive expertise in hi-fidelity mobile ad-hoc network simulation of traditional waveforms
  - We would like to begin developing advanced models for EW (Electronic Warfare) such as intelligent jammers, Software Defined Radios/GNU radio, etc.
- ARL has expertise in computing MOPs (Measures of Performance) for understanding network performance such as latency, jitter, throughput
  - We would like to develop new MOEs (Measures of Effectiveness), e.g. PESQ or POLQA for VoIP

