

Agile Logistics: Next Generation Capabilities at ORNL

Computational Sciences & Engineering Division
Oak Ridge National Laboratory

Presenter

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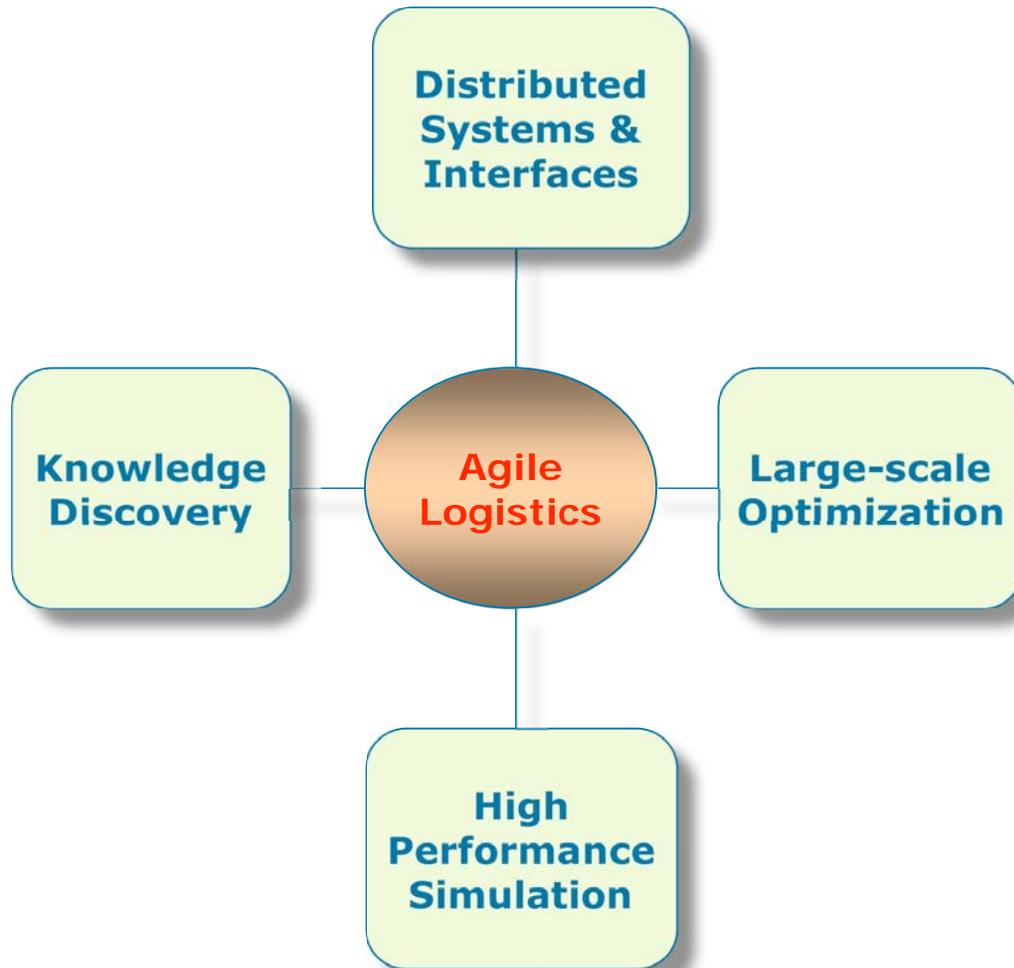
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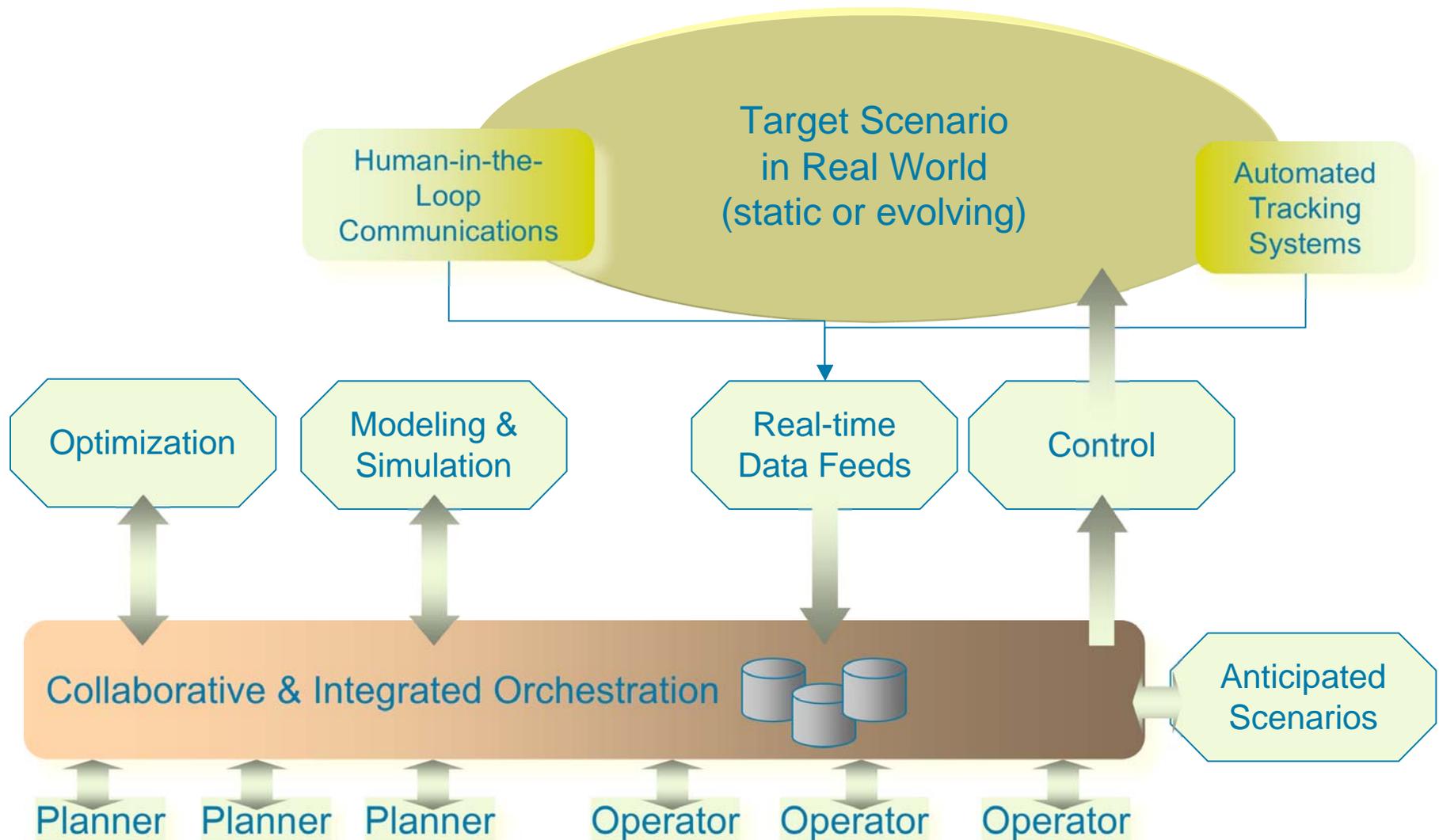
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Enablers for Next-Gen Logistics



Solution dimensions
for agility in logistics
(over view)

A Generic Functional View of Defense and/or Emergency Logistics



Planner
Perumalla 6-Mar-07

Operator
ORNL/LMCO Workshop

Our Focus: Outlook

- Cannot and will not compete with industry
 - E.g., *sequential* optimization
- Can and should explore areas that industry can't or won't
 - Large-scale (limited scope for mass market)
 - High-performance (few companies have high-end capability or infrastructure)
 - Optimization plus M&S
 - Futuristic: Manage-by-wire

Our Focus: Aspects

1. Distributed Systems & Interfaces
2. Fast, Large-scale Optimization
3. High-end Modeling and Simulation
4. Knowledge Discovery

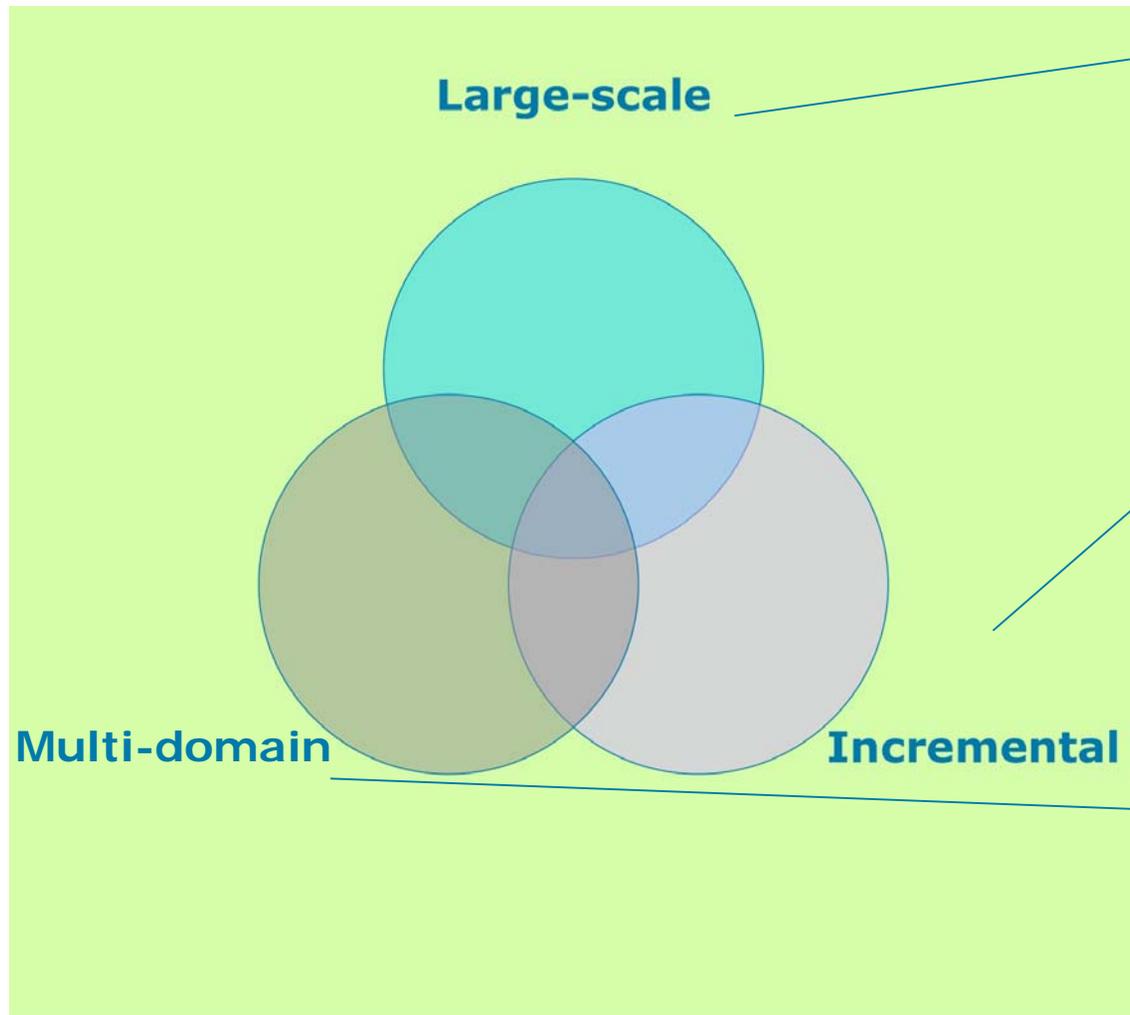
Distributed Systems & Interfaces

- Efficient/automated tracking
 - RFIDs, wireless communications, sensor networks, ...
- Collaborative systems
 - Networked, open applications, ...
- Information sharing
 - Web services, service discovery, interoperability, ...

Optimization – Research

Areas

Benefits



Optimize for regional, national or world-scale scenarios; accommodate higher modeling resolution

Rapidly respond to unfolding / evolving scenarios; achieve better agility and effectiveness

Optimize across proprietary, legacy or non-sharable entity boundaries; realize globally optimal operation

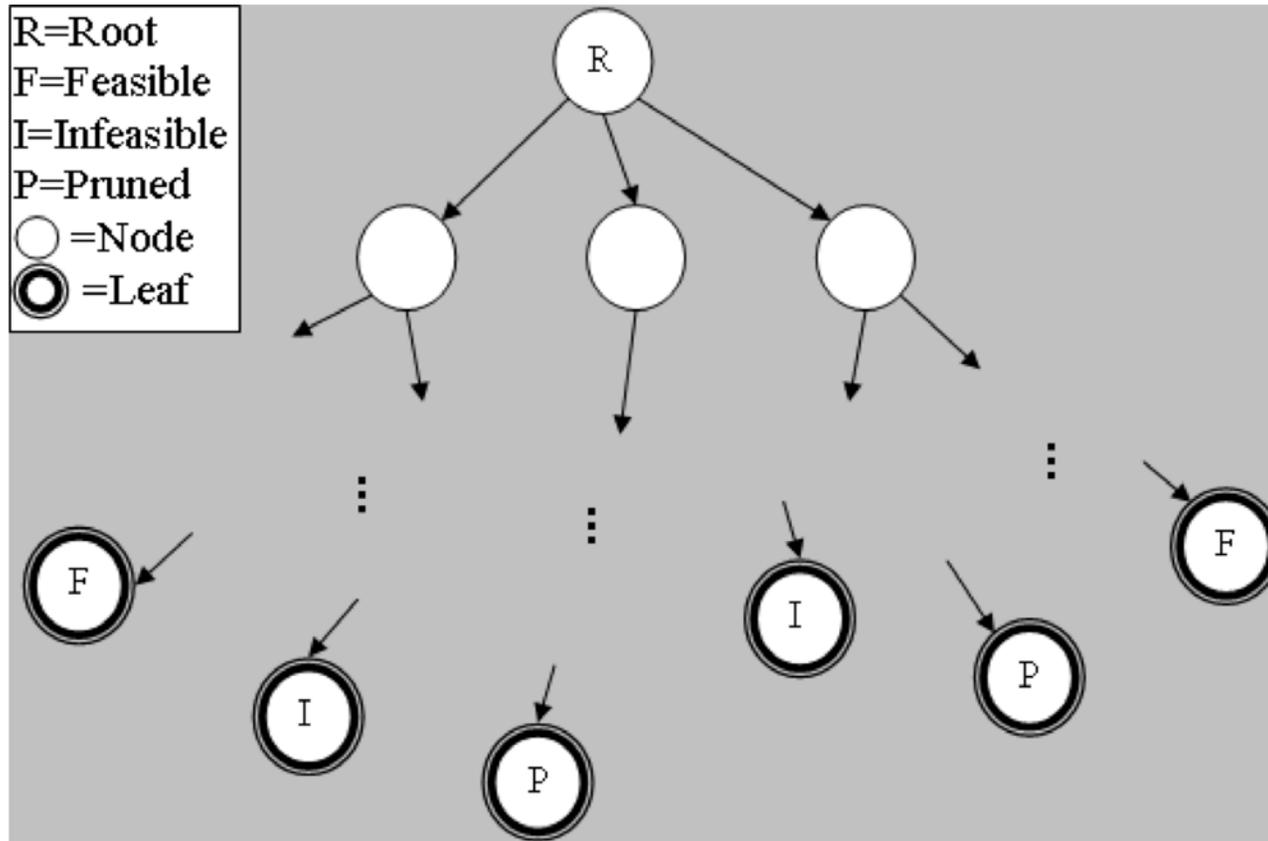
Technical – Formulations

Maximize $c^T x$
such that $Ax \leq b$

$x \geq 0$, and some subset of x are integral

- Large-scale: Size of x and/or x' is large
- Incremental: (a) variables are added to x
(b) variables are deleted from x (c) A , b or c are changed
- Multi-Domain: A is mostly block structured. Values across blocks are not sharable

Core: Parallel Branch-and-Cut



- By far the most commonly used method.
- Sequential processing well-studied.
- Large-scale, parallel processing (harder problems, faster solutions, hundreds of processors) remains very challenging.

Large-scale Optimization

Current Techniques

- Limited in scale and speed
- Mostly sequential processing

Our Approach

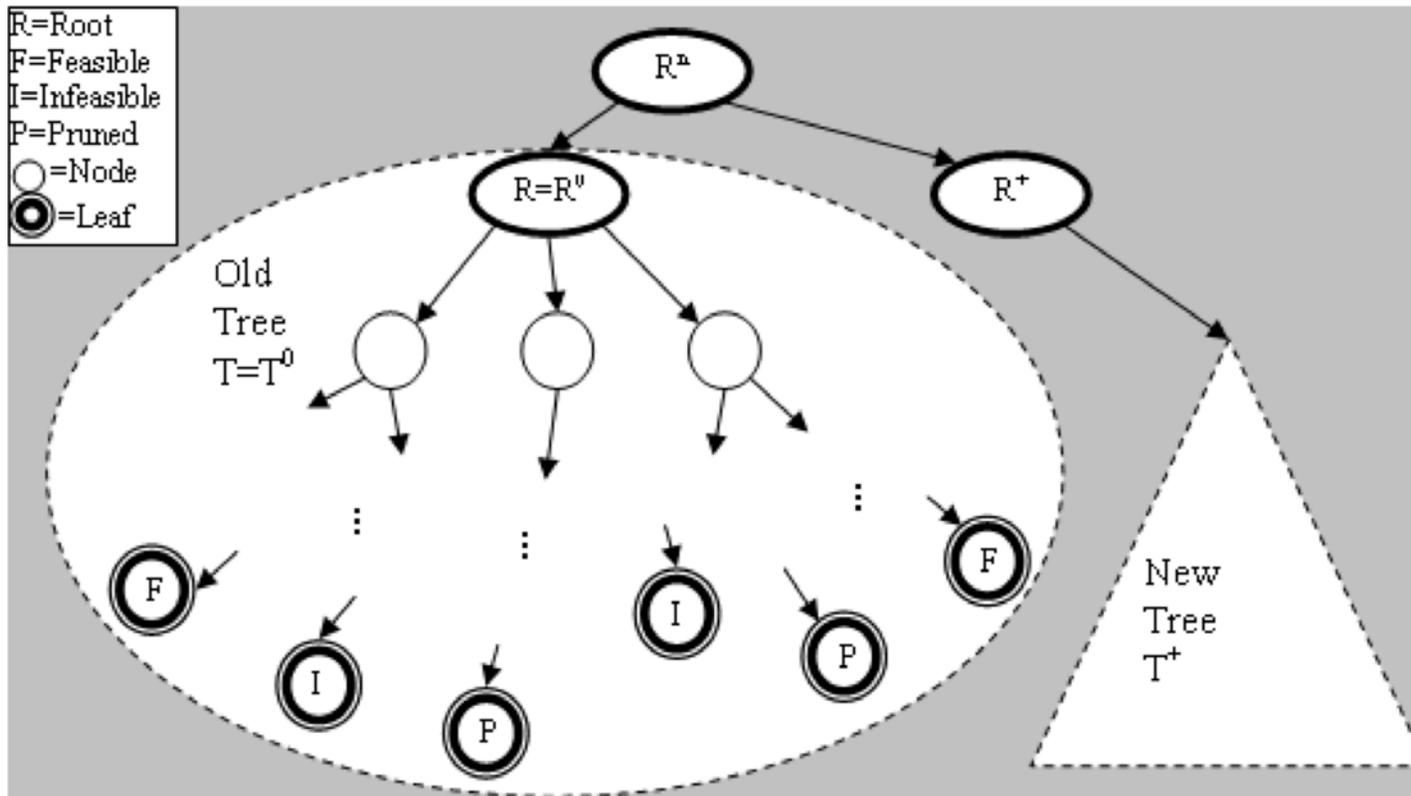
- Parallel processing
- Scalability to high-performance computing platforms
- Have prototype solver – **Axe**
 - Tested on hundreds of processors
 - Unique capability

Large-scale Logistics - Example

OSAF at Center for Army Analysis

– Switch to their presentation ...

Incremental Optimization

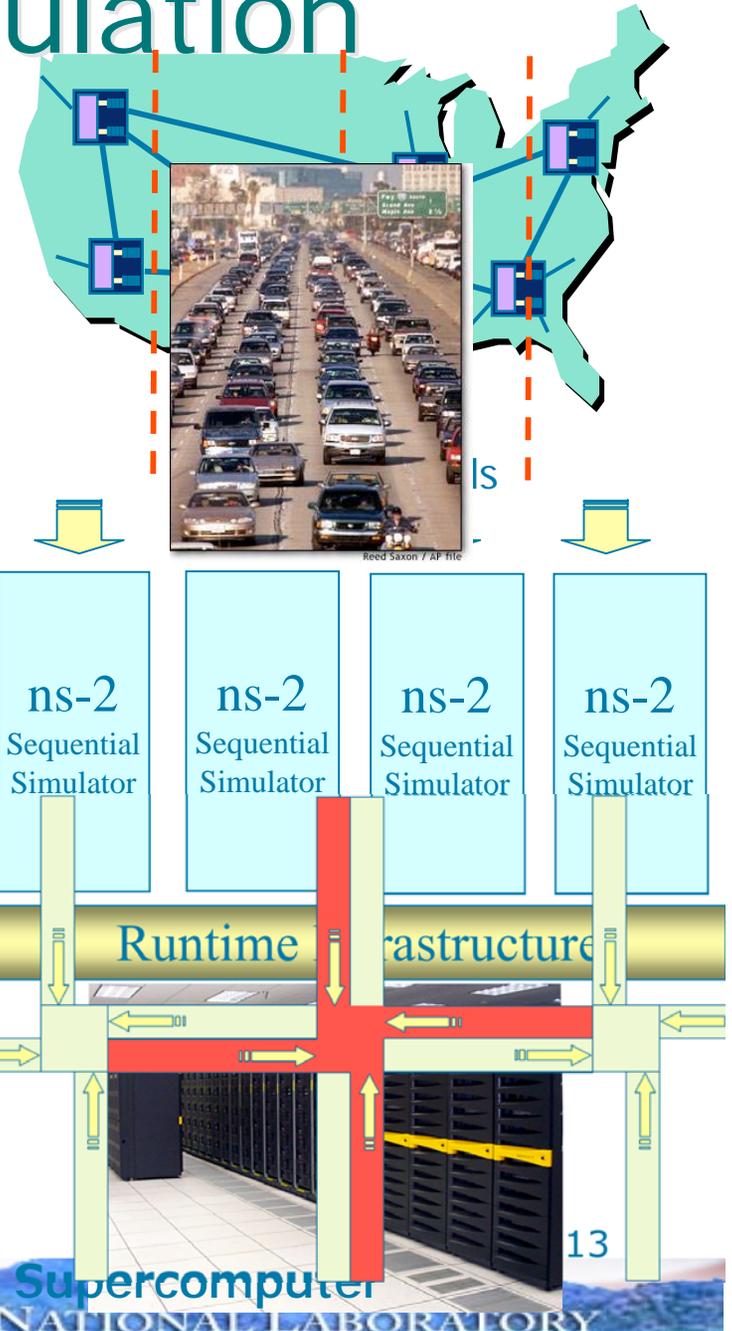


Example incremental tree modification for RHS changes and/or new variable addition

- Fast re-optimization with incremental updates
- Parallel processing for real-time response
- State-of-the-art; little known

Modeling & Simulation

- Large-scale, rapid simulation requirements
 - Planning for contingencies (e.g., weather)
 - Transportation, weather, conflict, ...
- Unique expertise
 - DoD HLA, supercomputing
 - Among the largest internet simulations to date
 - Ultra-large scale transportation simulation (work in progress)



Knowledge Discovery*

- Demand prediction, future needs assessment
- Uncertainty propagation from history
- Pattern matching for enemy characterization
- Detection of unusual behavior in logistics chain

- E.g. Detect Malfeasance...

*Ideas partly contributed by Dr. Ganguly (CSED)

KD – Example Application

- Corruption and/or misappropriation
 - Anomalous vs. normal trend correlation and detection
- E.g. incidents of slow but abnormally excessive inventory replenishments in Iraq

Questions / Comments?

Thank you