Lawrence Livermore National Laboratory

Introduction to ns3

October 27, 2011

Peter D. Barnes, Jr.
Staff Scientist

Lawrence Livermore National Laboratory, P. O. Box 808, Livermore, CA 94551

This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344

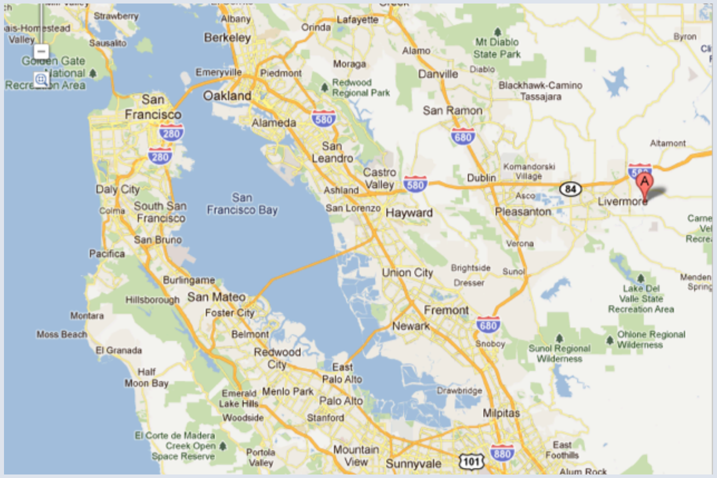
LLNL-PRES-xxxxxx

Lawrence Livermore National Laboratory

- Founded: second US nuclear weapons design laboratory
- Now: applied science laboratory, focused on (inter)national security
- Core competencies
  - High performance computing
  - High power lasers
  - Multi-disciplinary teams

Vital Stats

- **Founded: 1952**
- **Employees: 6,700**
- **Budget: US$1.6B**
- **Ph.D.s: ~2K**
- **Postdocs: ~150**
- **Students: ~100**

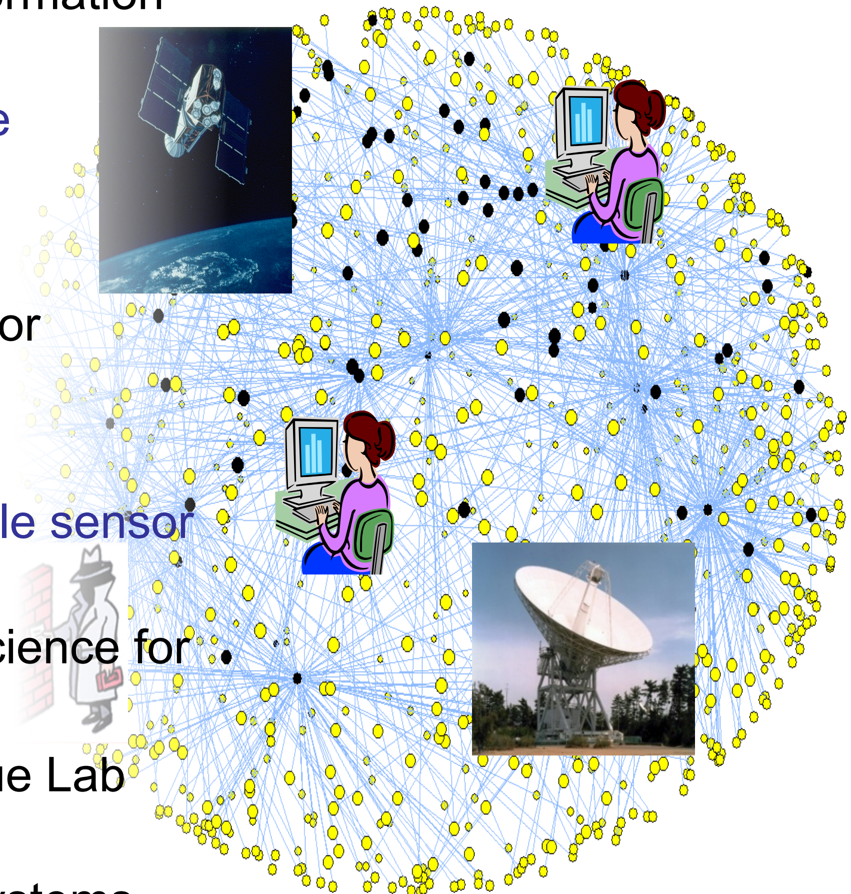


Location: 80 km east of San Francisco

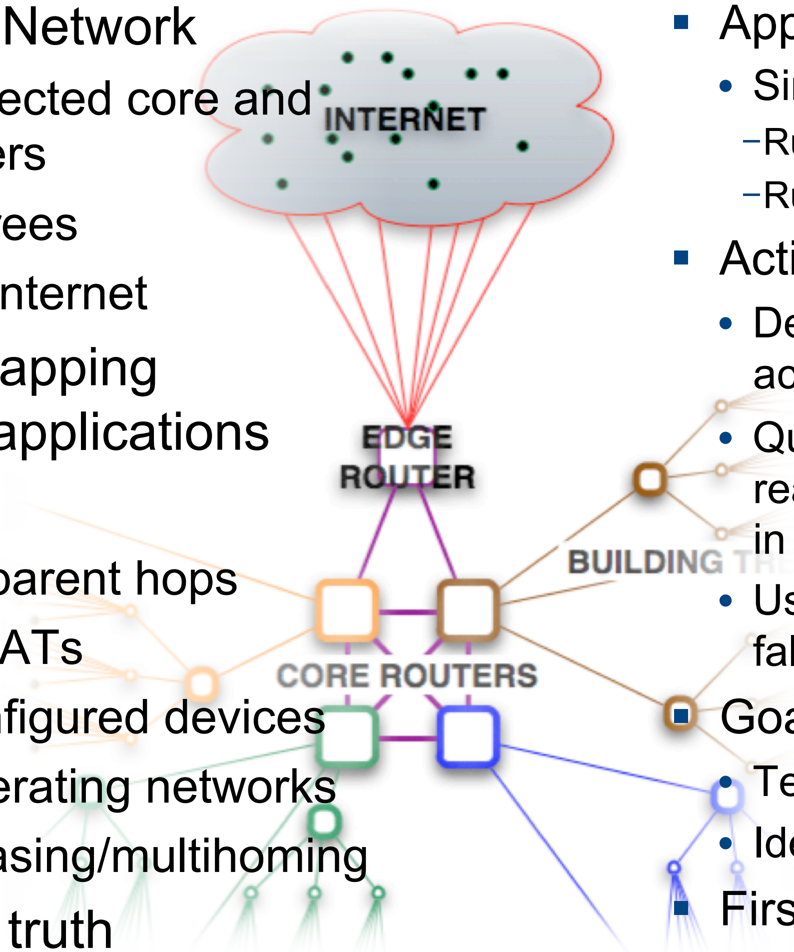
Lawrence Livermore National Laboratory

Cyber/Space/Intel: Information science, situational awareness, at scale

- Situational awareness in complex information systems at scale
  - Prototype at scale and in real time
  - Compromised environments
- Navigating massive data streams
  - Dealing with rapidly growing sensor capabilities
  - Large-scale distributed analytics
- Modeling and simulation for large-scale sensor and information networks
  - Build foundations – information science for complex systems
  - Simulation at scale requires unique Lab resources – but in a new regime
  - Enables test and evaluation for systems that do not exist today



Enterprise Network: Mapping and Analytics Validation

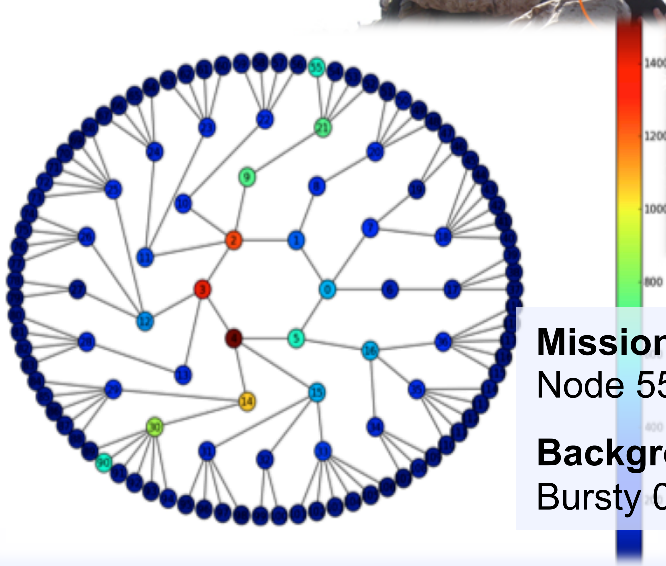


- Enterprise Network
  - Fully connected core and edge routers
  - Random trees
  - “Outside” internet
- Network mapping has many applications
- Difficulties:
  - TTL-transparent hops
  - Proxies, NATs
  - Poorly configured devices
  - Non-cooperating networks
  - Router aliasing/multihoming
- No ground truth

- Approach:
  - Simulate enterprise (20K) network
    - Run real mapping processes
    - Run real detection algorithms
- Activities
  - Develop completeness and accuracy metrics
  - Quantify range of physical realizations (ensemble) that result in same logical map
  - Use ground truth to understand false positives
- Goals
  - Test inferences through obstacles
  - Identify best places for sensors
- First steps
  - Building model from complete map

Mission Resource Usage and Interference

- UAV Reconnaissance Mission
  - Video: A→B→C→D
    Latency requirement.
  - UAV control A→E
    Different QoS requirements.
  - Globally distributed!
- Questions:
  - Given a map and background traffic, what is the data flow?
  - Do we still meet QoS requirements when link X-X' fails?
  - Need to add a second mission. How does that change the data flow, performance, and resiliency?
- First steps
  - HOTNet–realistic router configuration
  - Measure delivered packet fraction



Mission:
Node 55 to 90 at 1 Mbps

Background:
Bursty 0.1 Mbps/node

ns3 Interests

- Parallel, both MPI and threads
  - Developing simple benchmark model
  - Will propose patch for tracking critical path
  - Need to coordinate with Ken Renard
- Large model specification
  - Currently developing XML schema, based on our mapper ontology
  - Need to coordinate with `ns3xml`, others?
- Routing, especially BGP
- RF/Wireless: satellites, urban environments
- Realistic traffic simulation/generation
  - Very interested in Doreid Ammar's PPBP model
  - Will propose statistical framework for multi-type content

LLNL Team and Contacts

Member	Expertise	eMail
Peter Barnes (PI)	Cyber analysis, networks	pdbarnes@llnl.gov
Jim Brase	Networks	brase1@llnl.gov
Tom Canales	Network programming	canales1@llnl.gov
Domingo Colon	Network virtualization	colon3@llnl.gov
Matt Damante	Visualization	damante2@llnl.gov
Matt Horsley	RF/Wireless modeling	horsley1@llnl.gov
David Jefferson	Discrete Event Simulation	jefferson6@llnl.gov
Ron Soltz	HPC	soltz1@llnl.gov