Federally Funded (and Other) Internetworking Testbeds

David B. Nelson, Ph.D., CISSP
Director
National Coordination Office for Information Technology Research and Development

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Federal Networking and Information Technology Research and Development (NITRD) Program

- Coordinates and focuses interagency IT R&D:
  - Identify common research needs
  - Plan inter-agency research programs
  - Coordinate and collaborate on research announcements and funding
  - Review research results and adjust accordingly

- Evolved from the Federal High Performance Computing and Communications Initiative (HPCC), Computing Information and Communications Program (CIC), and Next Generation Internet Program (NGI)

- Includes 14 federal agencies, about $2B budget

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Participating Agencies and Departments

- Department of Defense
  - Defense Advanced Research Projects Agency (DARPA)
  - Defense Information Systems Agency (DISA)
  - National Security Agency (NSA)
  - Office of the Director of Defense Research and Engineering (ODDR&E)
- Department of Energy
  - Office of Science (DOE/SC)
  - National Nuclear Security Administration (DOE/NNSA)
- Department of Health and Human Services
  - National Institutes of Health (NIH)
  - Agency for Health Research and Quality (AHRQ)
- Department of Commerce
  - National Institute of Standards and Technology (NIST)
  - National Oceanic and Atmospheric Administration (NOAA)
- National Science Foundation (NSF)
- National Aeronautics and Space Administration (NASA)
- Environmental Protection Agency (EPA)
- Observer: Federal Aviation Administration (FAA)
Several organizations have set up network research testbeds

- NSF: Experimental Infrastructure Network (EIN)
- DOE/SC: Science UltraNet
- Internet2: Abilene upgrade
- National LambdaRail
- Corporation for Education Network Initiative in California (CENIC): CalREN-XD
- High Performance Wireless Research and Education Network (HPWREN)
- Others …
Major Focus of Network Testbeds is on High Bandwidth Performance

- **Issues include**
  - Improving effective bandwidth
  - Improving reliability and predictability
  - Improving end-to-end performance

- **Researching new technologies, topologies, protocols**

- **Some research networks are intended to be “broken” by research activities**

- **Security issues are not major concerns of most testbeds**

- **Some testbeds could be used for research to improve security**
Roles of Testbeds in Security R&D

- Access, analyze, respond to network traffic data
  - Real data
  - Sanitized data
  - Synthetic data
- Try new technologies in breakable environment
- Test interoperability of subsystems
- Provide nationwide infrastructure for organizations to work together on “dangerous” projects
- Allow tests of security features in broader network research context
  - “Do things securely” rather than “Do security”
Examples of Network Testbeds

- Most of the following material is quoted from testbed descriptions
End to End Provisioned Optical Network Testbed for Large –Scale eScience Applications
  – (ORNL, NCSU, UVa, CUNY plus others)

Dynamic Resource Allocation via GMPLS (Generalized MultiProtocol Label Switching) Optical Networks (DRAGON)
  – (GMU, UMd, USC)
DOE/SC: Science UltraNet

- Currently taking proposals
- Major focus on research for reliable, high-bandwidth networks
DOE/SC: Science UltraNet

High-End Science Applications

High-Performance Middleware

TCP
UDP-Like Based
Os-Bypass over WAN
Others

Logical Network Layer

Packet Switched Links
Circuit-Switched Links
Hybrid-Switched Links

Optical Layer

Dynamic Provisioning

Control and Signaling Plane
Abilene Upgrade – Current
Internet2 - Abilene

Abilene Focus Areas: 2003-2004

- High performance, native advanced services
  - Multicast
  - IPv6
  - Large Flows End-to-End
- Abilene Observatory
  - Supporting Network Research Community
  - Open Measurement & Experimentation Platform
- Dedicated Capability Experimentation
  - QoS-Enabled MPLS tunnels, for example
- Network Security
  - Role of the REN-ISAC
- Advanced Restoration Techniques
NLR Distinguishing Features

- Largest higher-ed owned/managed optical networking & research facility in the world
  - ~10,000 route-miles of dark fiber
  - Four 10-Gbps λ’s provisioned at outset
- First & foremost, an experimental platform for research
  - Optical, switching & network layers
  - Research committee (with 2 board seats)
  - Advance reservation of λ capacity for research
  - Experimental support center
Corporation for Education Network Initiative in California (CENIC)

NETWORK DEVELOPMENT AND EVOLUTION
FOR CALIFORNIA RESEARCH AND EDUCATION COMMUNITY

Responsible Entities

CENIC: CalREN-XD
CENIC: CalIREN-HPR
CENIC: CalIREN-DC

Network Type/Capabilities

Experimental/Developmental Network
High Performance Research Network
Digital California Network

Tier 1
Tier 2
Tier 3

Bleeding Edge Services
Leading Edge Services
High Quality Services

Users

Network Researchers
Large Applications Users
All K–20 California Research/Education Users

Commercial Companies
Commodity Internet
Services to General Public
● “One Gigabit or Bust” Initiative to deliver one Gb broadband to all Californians by 2010
High Performance Wireless Research and Education Network (HPWREN)
Summary

- Several network research testbeds are appearing
- Research agendas not fully determined
- Opportunities to use some of these for security research
- Bring money
For Further Information

Please contact us at:

nco@itrd.gov

Or visit us on the Web:

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