

The Utah Network Emulation Facility

The Utah Testbed aims to become the premier network and distributed systems research platform.

Today there exist three environments in which to perform experimental network and distributed systems research: live networks, network simulators, and static small-scale testbeds. Although each environment has benefits, each also has many limitations. Here at the University of Utah, we are building a new and unique type of experimental environment: a universally-available "Internet in a room" which will provide a new, much anticipated balance between control and realism.

Based on generous equipment grants from Cisco and Compaq, with additional support from DARPA, the University of Utah, Novell, and Nortel, we have built a first-generation facility.



The University of Utah Network Emulation Facility is completely reconfigurable by remote researchers around the world.

This prototype features high-speed Cisco switches connecting, with over 2 miles of cabling, 160 end nodes and 40 core nodes. The core nodes can be used as end nodes, simulated routers or traffic-shaping nodes, or traffic generators. Fueled

by a recently awarded multi-million dollar NSF grant, we are now working to fully realize our unique design goals: penalty-free remote accessibility, maximum configurability and large scale. We are developing secure, user-friendly web-based tools to remotely reserve, configure and control machines and links remotely down to the hardware level: error models, latency, bandwidth, packet ordering, buffer space—all can be user-defined. Even the operating system disk contents can be securely and fully replaced with custom images. We are also expanding our hardware base to include high speed bleeding edge programmable network processor chips, such as the Intel IXP1200, as well as hundreds of wireless nodes distributed throughout the building.

While our end product will target most areas of distributed systems and network research—from active networks to traditional protocol observation—one of its most compelling attributes is that building the emulation facility is a research project in and of itself. The many challenges include development of algorithms and software that will optimally map from virtual to physical topology, protecting researchers from others' traffic as well as sandboxing generated traffic so as to prevent denial of service launches, non-intrusive instrumentation, arbitrary topology construction and discovery, and architecture of router simulation nodes. The list goes on. We have found that each day brings a new, interesting design challenge regardless of the arena: from web-based tools to physical hardware configuration.

The Utah Network Emulation Facility provides both a new platform for research and infrastructure research opportunities. The prototype has already been used by a number of external researchers; resulting in two papers at the OSDI conference in October 2000. Please contact us to learn more about how to get involved or use this facility.

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