

Breakout Report on Protocols and Architectures

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General Questions for Group

- What are the interesting and important research topics in the area of architectures and protocols?
- [How] will GENI help?
- What GENI requirements are implied?

Policy Aspects of GENI-based Research

- GENI Science Board (GSB) may be more transformative than GENI itself.
 - GSB can favor collaborative experiments and experiments that build on others' work.
 - Requests to GSB for GENI access will presumably include experiment justification, including "how will I know when I have succeeded"?
 - Adult supervision is a fine thing, BUT there are dangers.
 - Need some mechanism to provide a low entry bar to a class of modest-resource experiments.
 - Lottery?

GENI Code Base

- Develop/catalog/maintain useful software components for GENI researchers
 - Modularity, high-standard of coding
 - GENI role?
 - Library with maturity framework
- E.g., XORP as GENI resource
 - Open-source code for control plane (routing, etc.) for Internet Slice.
 - Readily extensible for new architectures and new routing protocols.

Technical Issues for GENI

- Important GENI facilities: composition of services/protocols, and interconnection of slices.
- GENI Emulation capability:
 - A researcher may need to create a local clone of GENI, for running small versions of experiments that may eventually grow large enough to justify using the public GENI.
- User interface to create slice must be very general
 - Eg ask for N nodes, or ask for N nodes with particular characteristics.
 - Possibilities and complexity almost endless; should start with simple policies and extend as needed

Technical Issues (2)

- How does an experimenter implement a modified router algorithm in GENI?
 - Easy: PC router (EG CLICK), or
 - Much harder: Programmable switch: meta-router.
- Experimenters' issues with security experiments
 - University blocks traffic
 - May have to explicitly red-team to inject attacks
 - Move IP addresses under attack into GENI?

Technical Issues (3)

- High precision synchronized realtime clocks
 - Highly secure, resilient time system
- Tools for resolving scheduling conflicts
 - GENI pick conference deadlines
- Strong characterization of loss of fidelity
 - Load, slicing, ...
 - Effect if allow over-subscription

Members' Interesting Research Areas (1)

- New schemes for network addressing and identity
- Better reliable transport protocol
 - Handle very large $BD \cdot \text{delay}$ products
 - Exploit assist code in routers
- Robustness to DDoS attacks
- Architectures for trust-modulated transparency
- Diffusion routing
 - Avoids traffic engineering; link DDoS is impossible.

Interesting Research Areas (2)

- Protocol knobs are often wrong (link costs in OSPF)
 - Need a general strategy for building tunable protocols
- Operations and network management of large systems
 - Hard problem; need architecture to simplify it.
 - (See more detailed discussion later)

Net Management Research Discussion

- **Input to discussion: One person's list of research issues:**
 - Implement Knowledge Plane architecture
 - Self-adaptive and self-configuring networks
 - Balance between manual and automatic configuration
 - Distinct management channel?
 - Centralized vs. decentralized
 - Better low-level abstraction than the MIB?
 - Event-based rather than polled?
 - Cross-domain management

Network Mgt Research Topics

- Need high-level abstraction to express network health/status, for diagnosis, control, configuration ...
 1. MIBs are poor ontologies
 2. Need network-level abstraction; MIB is device-level
- Need strategies for cross-region diagnosis
- Need cross-layer management abstraction
 - Interactions between management at different layer
 - Network management in presence of overlays
- Consider fault isolation techniques from other fields

Final Thoughts

Demonstration at scale will inspire people to think more about many scale-related architectural issues.

GENI application to large-scale disaster recovery simulations

- o Lots of CPU, distributed communication, non-disruptive.
- o Implications for GSB composition?