Software Quality and Infrastructure Protection for Diffuse Computing

Principal Investigator: Andre Scedrov
Institution: University of Pennsylvania
URL: http://www.cis.upenn.edu/spyce

OPTION STARTED IN MAY 2004
The SPYCE Team

- Joan Feigenbaum (Yale)
- Joseph Y. Halpern (Cornell)
- Patrick D. Lincoln
- John C. Mitchell (Stanford)
- Andre Scedrov (U Penn)
- Jonathan M. Smith (U Penn) (until December 2003)
External Collaborators

- Cynthia Dwork (Microsoft)
- Tim Griffin (Intel)
- Vitaly Shmatikov (SRI)
- Paul Syverson (NRL)
Postdocs

- Björn Knutsson, Penn
- Ninghui Li, Stanford (until Summer 2003, now at Purdue Univ.)
- Michael Elkin, Yale (Fall 2003 - Summer 2004, now at Ben Gurion Univ., Israel)
- Gergei Bana, Penn (Fall 2004 - Summer 2005)

- 16 Ph.D. Students
URI Objective

Algorithms to model, manage and maintain a computational infrastructure, distributed among many heterogeneous nodes that do not trust each other completely and may have incentives (needs, priorities).

DoD Capabilities

Reduced cost, improved performance, and higher reliability for networked operations across untrusted networks

Scientific/Technical Approaches

Computing and networking elements diffusing into the environment need:

- Local incentive-compatibility in global distributed computing
- Scalable authorization mechanisms
- Assured communication
- Experimental evidence
Secure services through heterogeneous overlay networks
Diffuse Computing

- Paradigm developing rapidly as a result of
  - commercial computing markets
  - now-recognized potential of peer-to-peer computing and grid computing
  - the need for distributed network-centric systems

- Raises challenges for
  - system design
  - software production
  - the development of mechanisms ensuring stable equilibria of diffuse systems
Software Quality and Infrastructure Protection for Diffuse Computing
U Penn, Stanford, Cornell, Yale
URI, May 2001 Email: scedrov@cis.upenn.edu WWW: http://www.cis.upenn.edu/spyce October 22, 2004

Scientific Accomplishments
• Interdomain routing
  Path vector protocols [Penn-Yale-Intel]
  Local conditions for stable routes [Yale]
• Analysis of cryptographic protocols
  Formal methods for cryptography [Penn-Stanford]
  Kerberos 5 analysis [Penn-NRL]
• Logic for reasoning about policies [Cornell]
• SPAM reduction algorithms [Microsoft-Stanford]
• Privacy in databases [SRI-Microsoft]
• Anonymity and information hiding [Cornell-NRL]
• Content transcoding for heterogeneous clients [Penn]
• Flexible Lightweight Active Measuring Environment [Penn]

Educational Accomplishments
• Enhanced the ability to educate and train students in science and engineering and perform CIP/SW relevant research
  • 10 refereed journal publications
  • 55 refereed conference proceedings
• 5 prototypes
• 7 PhD students graduated, 16 PhD students supported
• Members of NAS Computer Science and Telecommunications Board, Defense Science Board Task Force on Science and Technology, ACM Fellows, AAAI Fellows, ...

Project Contact Information
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  Prof. Joseph Halpern,
  Dr. Patrick Lincoln, Prof. John Mitchell

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SPYCE Objective: Scalable Distributed Assurance

Develop fundamental understanding, models, algorithms, and network testbed, in order to reduce cost, improve performance, and provide higher reliability for networked operations across untrusted networks.

Incentives, Privacy, and Anonymity

Protocol Design and Analysis

Network Architecture

Trust Management
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INCENTIVES, PRIVACY, AND ANONYMITY

Protocol Design and Analysis

NETWORK ARCHITECTURE

Trust Management
Today

- Incentive-Compatibility
  - Joan Feigenbaum, Yale
- Privacy
  - Cynthia Dwork, Microsoft
- Networking
  - Vijay Ramachandran, Yale
  - Björn Knutsson, Penn