National Center for Advanced Secure Systems Research

ncassr

MITHRIL: Adaptable Security for Survivability in Collaborative Computing Sites

NCSA: Von Welch, Jim Basney, Himanshu Khurana

NRL CCS: Ken Hornstein

PNNL: TBD

NCSA

Mithril

- Mithril is a fictional material from J.R.R. Tolkien's universe, Middle-earth. It is a precious silvery metal, **stronger** than steel but much **lighter** in weight. (from Wikipedia)
- A mithril coat of mail provides **strong** protection but is **light** and **flexible**
- Our project will develop **adaptable** site security mechanisms that **maintain usability**

Mithril

- Adaptable Security for Survivability
  - Maintain high-level of openness and usability during normal operation
  - Apply security counter-measures and adjust level of service during heavy attack
- In Collaborative Computing Sites
  - Examples: NRL Center for Computational Science (CCS), NSF centers (NCSA, SDSC, PSC, NCAR), DOE Labs (NERSC, LBNL)

Problem Statement

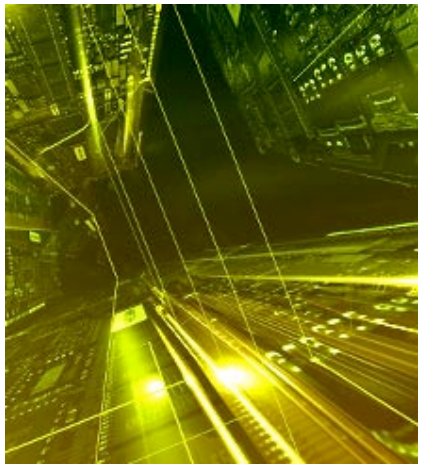
- Site security mechanisms cannot change quickly to respond to emerging threats
- Leads to service interruptions when serious attacks occur
- Need mechanisms for **adaptable** site security

Threats of Primary Concern

- Compromised accounts
  - Passwords and keys obtained from off-site compromises
  - Compromise spreads across sites
  - Large number of account compromises overwhelm manual containment practices
- Privilege escalation
- Remote exploits

Collaborative Computing Sites

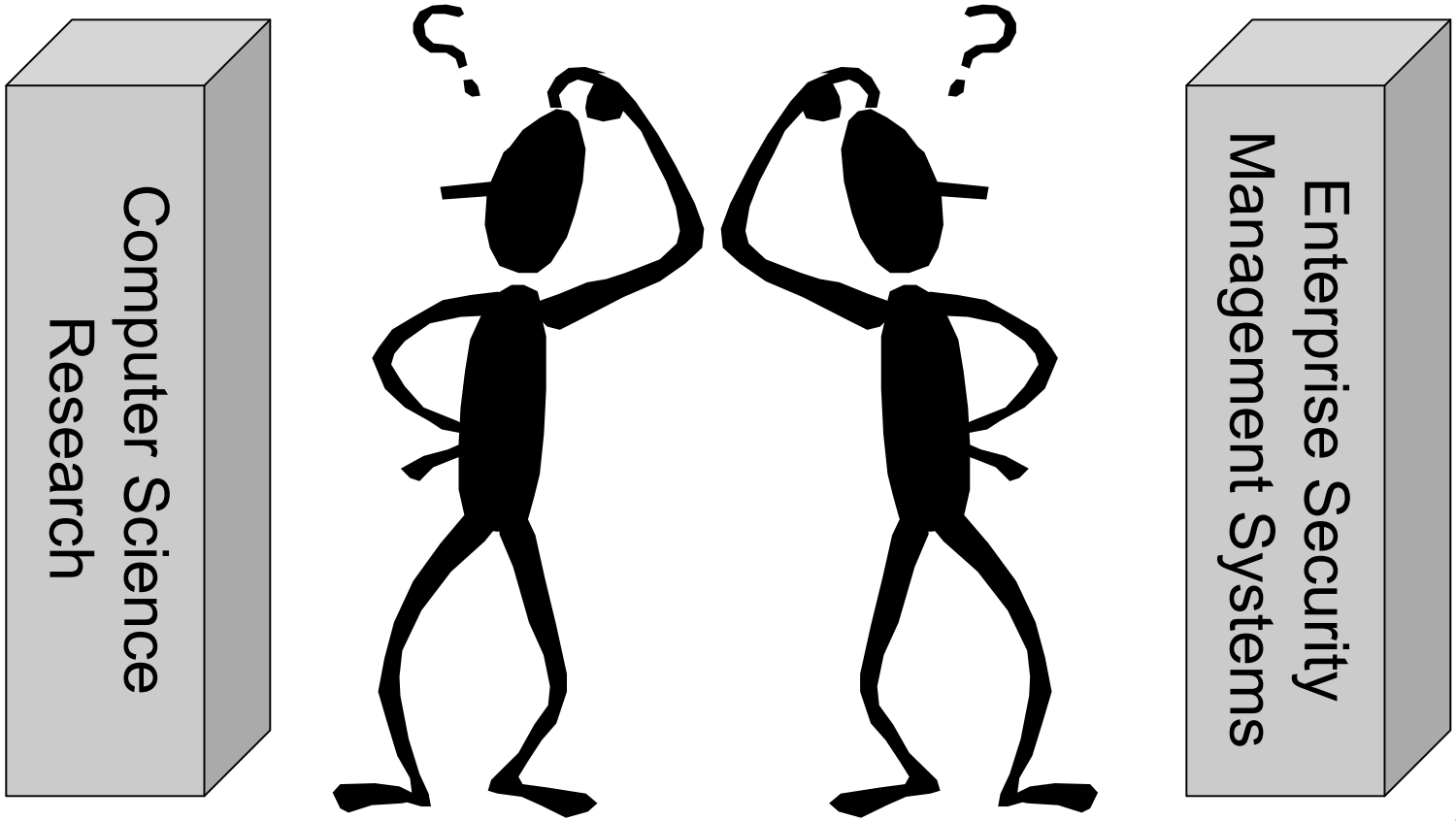
- Support large, geographically distributed user communities
- Enable pooling of distributed resources
  - Single sign-on
  - Open networks
- Provide a variety of general-purpose and specialized computing services



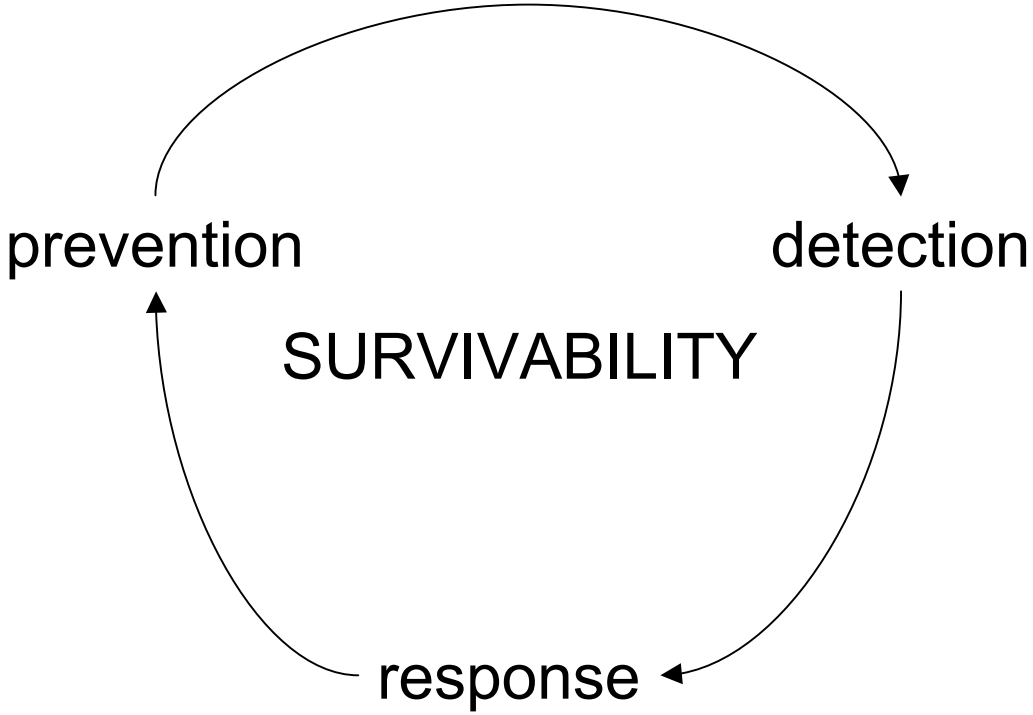
Challenges

- Must maintain usability and openness
- Off-site users
  - Vulnerabilities outside local site control
- Research systems
  - Heterogeneity
  - Special-purpose platforms
  - Obstacles to software roll-out

Bridging the Gap



Approach



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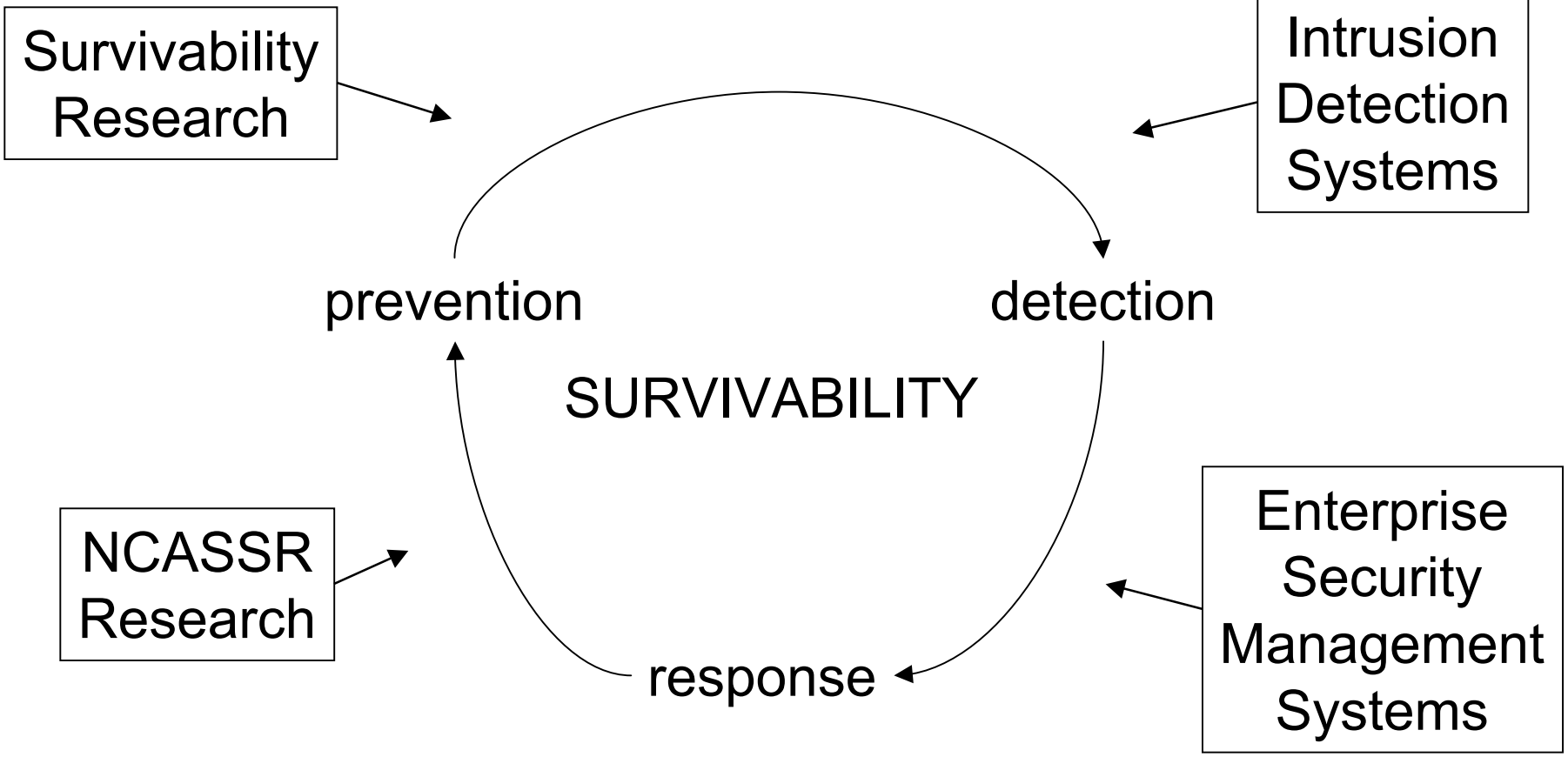

Survivability Research
Intrusion Detection Systems
prevention
detection
SURVIVABILITY
NCASSR Research
Enterprise Security Management Systems
response

Existing Work

- Survivable systems research:
  SABER, Willow, SITAR, APOD
  - How can we bring survivability research into production?
- Enterprise Security Management Systems
  - SSH Tectia: Enterprise management of SSH services
    - Doesn't support unique site platforms (ex. IA64 Linux)
    - Can we replicate this functionality for OpenSSH?
  - ArcSight ESM, Symantec ESM, Lightning Console, etc.
    - Are these systems applicable to our environments?
- Intrusion Detection Systems: Prelude, Snort, Tripwire, etc.
  - Mithril should integrate with these as possible

Leveraging NCASSR Y2

- Credential Management Services
- Policy and Key Management for Secure Group Communication
- SDR Policy Enforcement System
- Cluster Security (NVisionCC)
- PKI Testbed

Focus on Site Needs

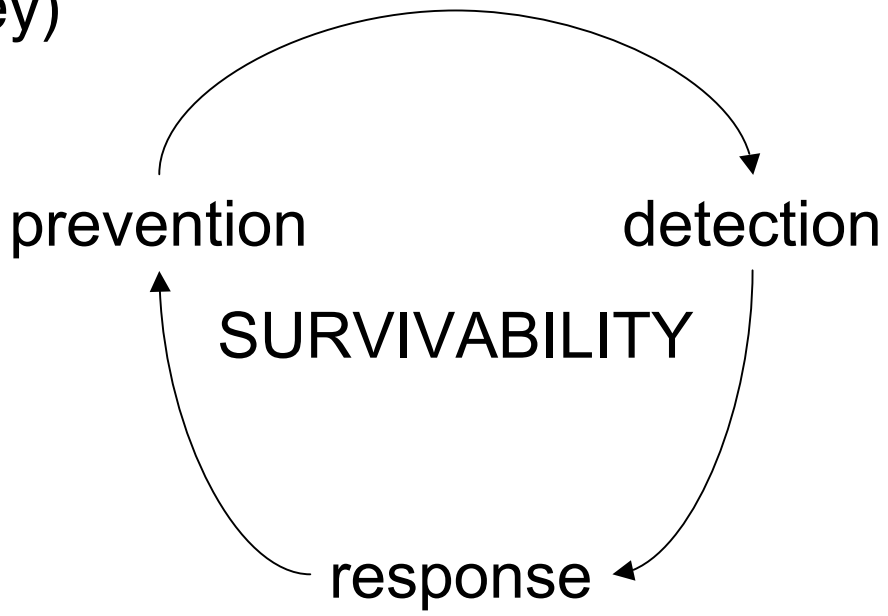
- TeraGrid sites need to maintain open environment in face of targeted attacks
- NCSA is committed to an adaptable security infrastructure
- Partnership with NRL CCS

Adaptability: OTP Deployment

- One Time Password tokens are costly and inconvenient for routine use by NCSA users
- In case of sustained, large-scale attack, transition resources to high-security mode
  - Update SSH configurations to temporarily require OTP hardware token authentication
  - Distribute tokens to priority users via overnight mail
- Keep serving small number of high-priority users during intrusion response / clean-up

Project Organization

- SSH Management (Basney)
- Continuous Biometric Authentication (PNNL)
- Adaptable IDS (Welch)
- Secure Email for Incident Response (Khurana)
- Survivability Management System (Welch)
- NRL Requirements and Evaluation (Hornstein)



Managing Remote Login Services

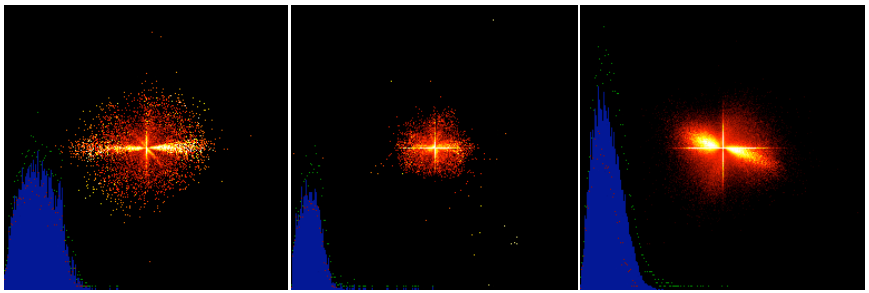
- Remote login is arguably the most essential service provided by collaborative computing sites today
- SSH is very configurable
  - Wide variety of authentication mechanisms
  - Many options for security restrictions
- SSH can be an effective site access control point
- Plans:
  - Develop an OpenSSH management subsystem
  - Develop management system for Kerberos Telnet

SSH Key Management

- SSH public key authentication provides single sign-on
- SSH keys can be difficult to manage
  - Unencrypted or encrypted with poor passwords
  - No lifetime restrictions
  - No revocation capability
- OpenSSH credential management service
  - Delivers keys to ssh-agent, not written to disk
  - Provides revocation capabilities

Continuous Biometric Authentication

- Authenticate the user throughout their session
- Monitor mouse movement and keystroke timing
- Build on existing work at PNNL for Windows
- Apply to Unix systems



Mouse velocity distributions of different users (PNNL)

Adaptable/Reactive IDS

- Match monitoring precision with current threat level
  - Host-based IDS competes for cycles with high performance computing jobs
- Detect violations of current policy
  - Activate OTP-only policy
    -> kill non-OTP processes

Secure Email Services

- Needed for intrusion detection and coordinating intrusion response
  - Monitoring and IDS processes send alerts via email
  - Need for system administrators to communicate securely (signed, encrypted) across-site when under ongoing attack
  - Need intrusion tolerant system so attackers can't eavesdrop

Himanshu Khurana, Adam Slagell, and Rafael Bonilla. SELS: A Secure E-mail List Service. In proceedings of the Security Track of the ACM Symposium on Applied Computing (SAC), March 2005.

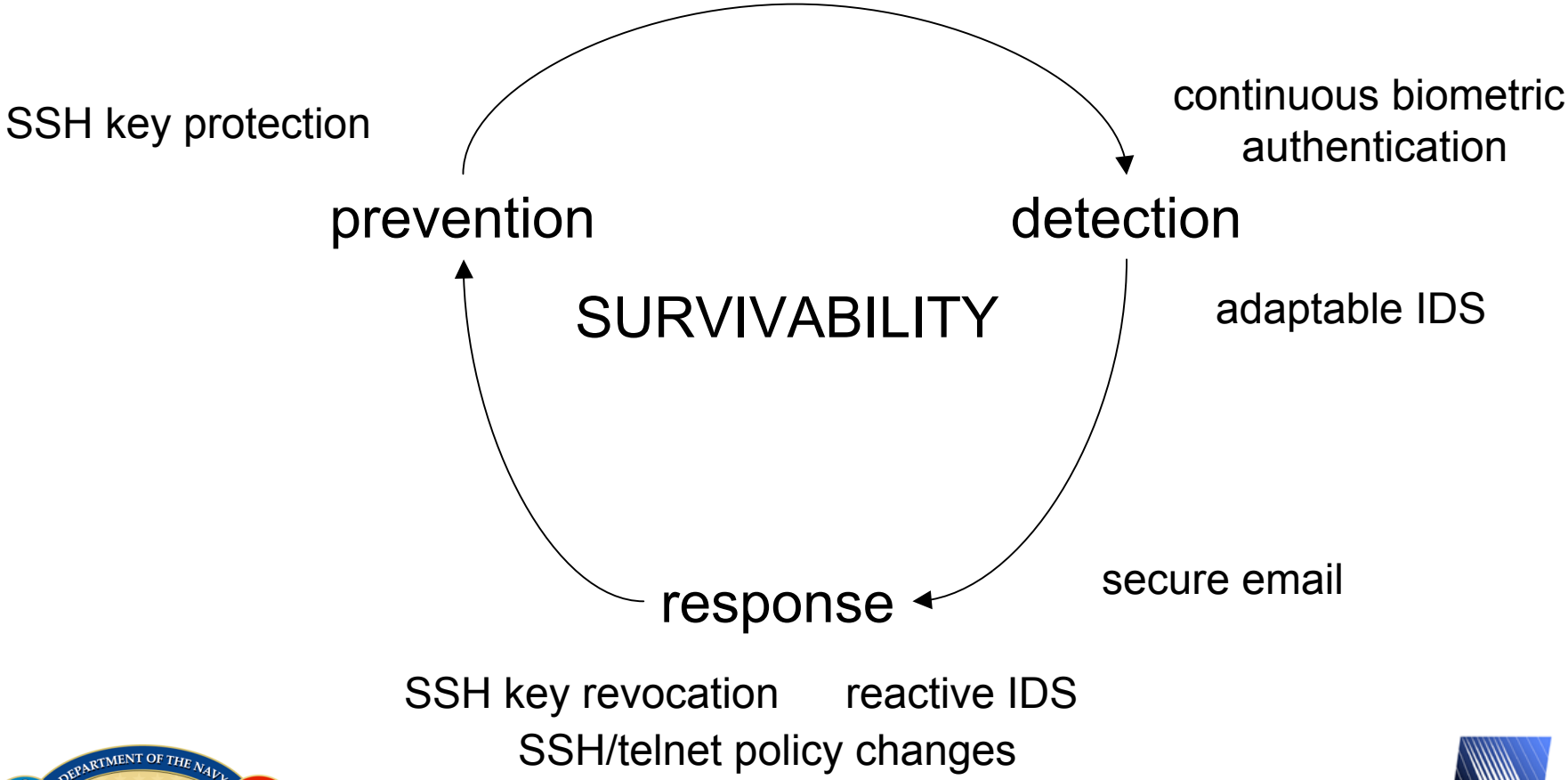
Survivability Management

- Provide a management interface to site-wide security policies
- Integrate SSH and IDS adaptation into security management console

Technology Transfer

- Design for deployment at NCSA and NRL
  - Focus on immediate needs identified by NCSA and NRL production security personnel
- Open source software distribution
- Modeling and evaluation of survivability approach for collaborative computing sites

Mithril


SSH key protection
continuous biometric authentication
prevention
detection
SURVIVABILITY
adaptable IDS
response
secure email
SSH key revocation
reactive IDS
SSH/telnet policy changes