Infosec Research Council
Hard Problems List

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Homeland Security

Background

- **INFOSEC Research Council (IRC)**
  - ◆ Roundtable of major government investors in Information Security Research

- http://www.infosec-research.org/

- In existence since 1996

IRC Participating "Agencies"

- ARDA - Advanced Research and Development Activity
- CIA - Central Intelligence Agency
- DOD - Department of Defense (including the Air Force, Army, Defense Advanced Research Projects Agency, National Reconnaissance Office, National Security Agency, Navy, and Office of the Secretary of Defense)
- DOE - Department of Energy
- DHS - Department of Homeland Security
- FAA - Federal Aviation Administration
- NASA - National Aeronautics and Space Administration
- NIH - National Institutes of Health
- NIST - National Institute of Standards and Technology
- NSF - National Science Foundation
- TSWG - Technical Support Working Group.

- In addition, the IRC is regularly attended by partner organizations from Canada and the United Kingdom.

Hard Problems List (HPL)

- Original Version
  - Composed in 1997-98 based on several government sponsored workshops; Published in 1999

- Topics
  - 1. Intrusion and Misuse Detection
  - 2. Intrusion and Misuse Response
  - 3. Security of Foreign and Mobile Code
  - 4. Controlled Sharing of Sensitive Information
  - 5. Application Security
  - 6. Denial of Service
  - 7. Communications Security
  - 8. Security Management Infrastructure
  - 9. Information Security for Mobile Warfare
  - A. Secure System Composition
  - B. High Assurance Development
  - C. Metrics for Security

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Hard Problems List (HPL)

- **2005 Version**
  - ◆ In the works since Summer 2003
  - ◆ First attempt in over 6 years to identify at Federal level the hardest and most important scientific challenges facing the US in Information Security research
  - ◆ External Review Board
    - ■ Steve Bellovin
    - ■ Marc Donner
    - ■ Joan Feigenbaum
    - ■ James R Gosler
    - ■ Steve Kent
    - ■ Peter G. Neumann
    - ■ Fred Schneider
  - ◆ Document Structure

IRC HPL 2005 Topics

1. GLOBAL SCALE IDENTITY MANAGEMENT

2. INSIDER THREAT

3. AVAILABILITY OF TIME-CRITICAL SYSTEMS

4. BUILDING SCALABLE SECURE SYSTEMS

5. ATTACK ATTRIBUTION AND SITUATIONAL UNDERSTANDING

6. INFORMATION PROVENANCE

7. SECURITY WITH PRIVACY

8. ENTERPRISE LEVEL SECURITY METRICS

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1. GLOBAL SCALE IDENTITY MANAGEMENT

- Scope: Identification, authentication, authorization, requisite key infrastructure

- Motivation: Need for seamless IAA across many systems, costs of divergent IAA systems, limits of current PKI, quantum.

- Challenges: Scale, churn, anonymity, federation.

- Metrics: Scale and adversary work factor.

2. INSIDER THREAT

- Motivation: Frequency and severity of incidents historically, increasing potential.

- Challenges: Not unauthorized access, Inside knowledge of defenses, "help" from outsiders with substantial resources.

- Approaches: Connections to HP #1, pervasive auditing, and redundancy.

- Goal: Mitigate the insider threat in cyber space so far as it is in physical space.

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3. AVAILABILITY OF TIME-CRITICAL SYSTEMS

- Motivation: SCADA, military, home-land security first responders often
  - Value availability over secrecy.
  - Work in lossy, ad hoc wireless environments.

- Challenges: limited resources
  - Computational processing power.
  - Service quality guarantees given dynamics.
  - Distributed systems compound problem.

- Metric: Range of circumstances over which results can be guaranteed.

4. BUILDING SCALABLE SECURE SYSTEMS

- **Motivation: High Consequence Systems**
- **Challenges: Today's systems are huge.**
  - ◆ Catastrophic bugs can be tiny.
  - ◆ Some developers may be working against us.
  - ◆ Components, subsystems, architectures.
- **Approaches: Help formal verification scale.**
  - ◆ Development and formal V&V environments.
  - ◆ Means of correctly composing formal models.
- **Goal: Fully verified truly trustworthy TCB.**

5. ATTACK ATTRIBUTION AND SITUATIONAL UNDERSTANDING

- **Motivation: Respond to the unpreventable.**

- **Challenges:**
  - ◆ Some attacks may be acts of war, others the work of teens, others nations posing as teens.
  - ◆ Hostile networks, anonymizers, recordless public access such as wi-fi and internet cafes.
  - ◆ Big picture and appropriate response

- **Metrics:**
  - ◆ Response selection: Degradation of mission.
  - ◆ Attribution: ID of adversaries in exercises.

6. INFORMATION PROVENANCE

- Motivation: Life-critical and releasability decisions both require pedigree of data.

- Challenges: Volume, degree of automated processing and transformation. Connections to HP #7.

- Goal: Track pedigree for every byte of information in exabyte scale systems transforming terabytes of data per day.

7. SECURITY WITH PRIVACY

- Motivation: More of our interactions and transactions are occurring in cyberspace. Data mining poses risks to privacy and identity theft poses risks to security.

- Challenges: Current strategies for security often involve surveillance at cost of privacy

- Scope: IRC NOT defining privacy policy.

- Approach:
  - Tools to help users keep private info private.
  - Privacy sensitive data mining techniques.

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8. ENTERPRISE LEVEL SECURITY METRICS

- Motivation: Without means to measure progress, we're not likely to see much…

- Challenges: Inability to quantify security leaves us with systems that we can't describe
  - Impacts on deployment of security technology

- Goal: IRC supports CRA challenge that within 10 years, quantitative information-systems risk management should be at least as good as quantitative financial risk management.

Summary

- "Stake in the ground" from the front-line
- Topics selected because of their importance to Government missions and the lack of solutions
- Not the only challenges in the IT security space
- Information security is not only about technology
- Several non-technical issues impact the protection of information and systems
  - Policy issues,
  - Legal issues,
  - Technology transition challenges,,
  - Economics and market forces
  - Academic education and training

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