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Are Scientific Experiments in Security Possible?

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Experimentation is Difficult

- Difficult in any discipline
  - Time consuming, tedious
  - Expensive
- But…
  - It is a key piece of the scientific process
  - Journals in most scientific disciplines will not publish results not substantiated by analysis or by experimentation
    - Including social sciences!

Experimentation is Useful

- Many examples in CS of hypothesis validated / invalidated by experiments
- Locality of reference by programs
  - Experimentally confirmed
  - Principle used to optimize many techniques
- Independence of failure probability of multiple versions of a program
  - Experimentally disproven
  - Resulted in change in software development practices in aerospace industry

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Yet Experimentation in CS is Lacking

- Lack of training in experimentation
- Unsubstantiated claims readily published
  - 40% of ACM papers in 1993 had no empirical or theoretical backing [Tichy et al., J. of Systems and Software, Jan 1995]
  - 40-50% of software engineering papers are unvalidated [Zelkovitz, IEEE Computer, May 1998]
- Demonstrations favored over experiments
- Situation is probably worse with security research

Lack of Experimentation Shows

- No good way to evaluate return on investment in security products
  - Large numbers of products of questionable value
- Fundamental mismatch between systems' models of users and reality. Users blamed for poor security.
  - Unrealistic expectations for configuring security
    - 9 steps and six interfaces to configure permissions on a shared folder in Vista
  - Security "warnings" that are cryptic
    - Look just like other dialog boxes
    - No indication of level of risk

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Experimentation in Security is Hard

- Large number of variables (factors)
  - Need to identify key factors
- Attacker modes are hard to specify
  - Unlike dependability community that has failure modes, failure rates, etc.

Needed: Canonical Attacker Models

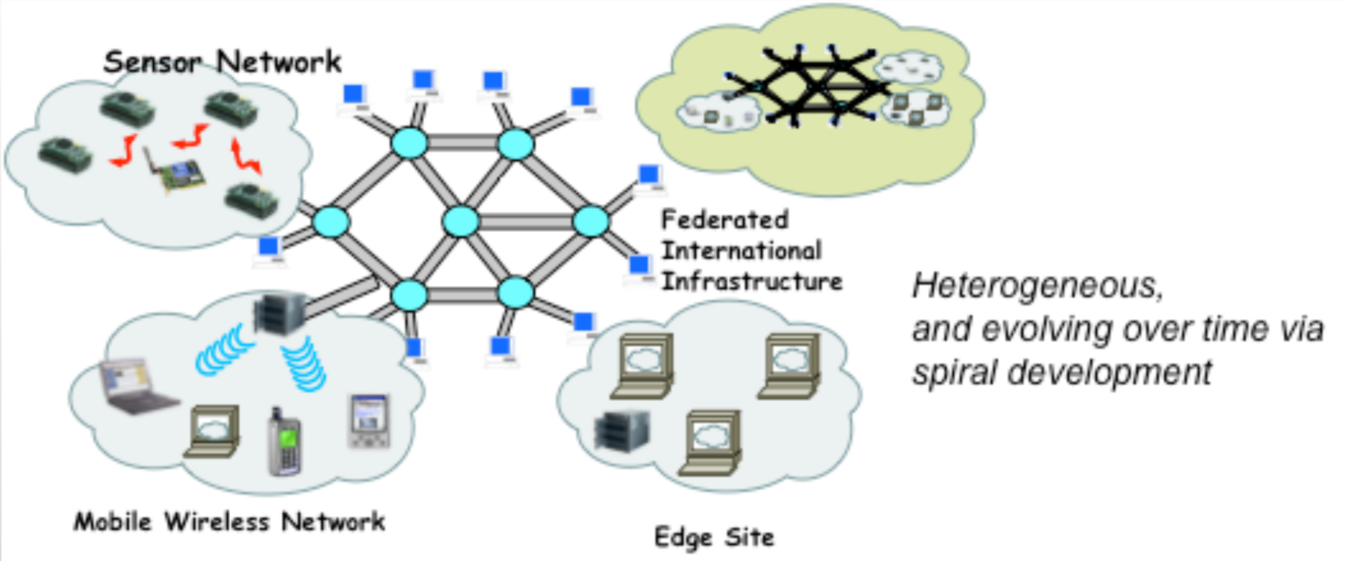
- Models that reflect capabilities of the attacker
  - Access to compute resources, network resources; physical access
- Parallel: Attacker model used secure White House differs from attacker model used to secure our homes
- Example attacker model for a jamming-resistant wireless link:
  - Attacker's max transmit energy, time to switch from listen to jamming mode, minimum distance from receiver, number of attackers

Needed: Testbeds and Data Sets

- Community accessible
- Configurable to repeat/extend experiments
- Realistic in number and type of resources

Testbeds: NSF GENI

- Infrastructure for long-running, realistic experiments in Network Science and Engineering
  - Experimentation in a controlled environment
  - Repeatability, archival
  - Community-based experimentation
- GENI needs you!
  - Solicitation 2 coming out shortly



Heterogeneous, and evolving over time via spiral development

Testbed: DARPA National Cyber Range

- For testing classified and unclassified software systems
- Ability to replicate large-scale military enclaves
- Repository for tools, recipes and architectures
- Forensic quality data collection, analysis and presentation

Future: Community Experimentation?

- Is community based experimentation the future?
  - Numbers of researchers and community members participating in experiments
    - Improve security of systems
    - Improve attacker models

Summary

- Science of Security is incomplete without experimentation
- Increased recognition of this fact
- Facilities being created to support experimentation
- Hope: We won’t have a panel discussion like this 3-5 years from now