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Piloting a Secure System Design Competition

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Origins of a Secure System Design Competition for Students

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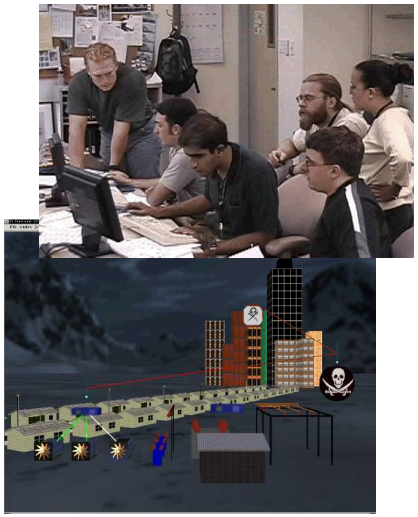
- April 2010 at Carl Landwehr's Designing a Secure Systems Engineering Competition (DESSEC) Workshop
- DESSEC's Workforce Development track identified needs and potential competition "specifications"
  - Considered how to attract, motivate, inform, and educate students in cyber security
  - Acknowledged significant gap in secure design education
  - Highlighted importance of adversarial mindset, understanding of "lore", ability to convert attack knowledge to robust defense, and confidence to take on real-world system engineering problems
  - Produced several loosely developed competition ideas: *Cyber Cup*, *Cyber Village*, *Cyber Scouts*, *Weakest Link*
- In late 2010 Doug Maughan at DHS S&T endorsed CCD pilot

The Competition Setting: Sandia's Center for Cyber Defenders (CCD)

- CCD is a highly selective, applied research internship institute at Sandia's New Mexico and California sites
  - Hosted 30 undergraduate and graduate students in summer 2012 from about 20 universities (selected from over 300 applicants)
  - Offers collaborative, threat-informed, project-based internships in cyber security
  - Contributes enabling solutions to real national security R&D projects in cyber security: examples include control system modeling, network situational awareness, protocol analysis, digital forensics, and red teaming



The Competition Specification: A Stylized Electronic Voting System

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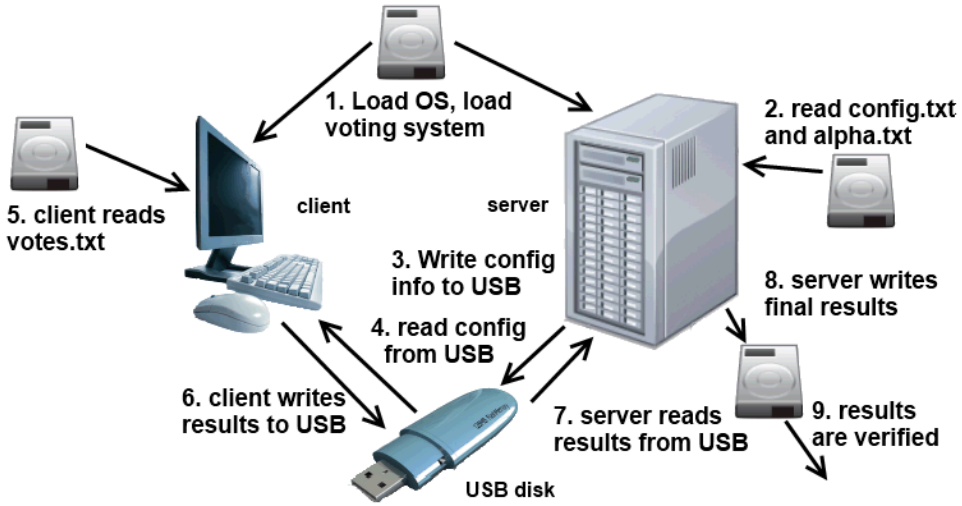
- Designed to help students identify and internalize security principles
- Assumed realistic but limited threat model
- Clearly (or so we thought) spelled out specification including requirements, rules, and evaluation and scoring procedure



EVS consisted of a server (election management system) and client (voting station) with sneakernet USB for data transfer

Competition Structure and Results

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- Competition structured into multiple rounds each having a distinct *design* and then *red team* phase
  - "Design and red team" iterative structure was chosen to cultivate and integrate adversarial mindset into an evolutionary design process
  - Pilot included two, three-person student teams and white team for oversight
  - Constrained red teaming to predefined attack scenarios with either user- or root-level access
- Students produced two substantially different designs
  - NM team focused on customizing the kernel and produced very small, highly restricted OS, while CA team implemented limited user shell and "red pill"
  - Teams choose different development platforms, tools, and crypto libraries

Observations

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- Students improved their understanding of and ability to articulate secure design principles
  - Reduce attack surface
  - Use existing tools
  - Enforce policies at lowest level
  - Defense in depth
  - Prevent easy access
- Specification is nontrivial: despite extensive pre-work, numerous ambiguities surfaced and unanticipated issues arose
- Competitions are great motivator… this was billed as research project but students were quick to forget

What's Ahead?

- Scale and sustain competition
  - Need to automate evaluation and find partners
- Experiment with different formats and themes, e.g.,
  - Could competition be used to familiarize students with new technologies and accelerate adoption?
  - What are realistic expectations with respect to innovation verses education?

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and

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More info…

DESSEC Workshop Report produced by I3P

www.thei3p.org/docs/publications/410.pdf

ACSAC Poster Session next week

Upcoming CSIIRW presentation and paper,

FIREAXE: The DHS Secure Design Competition Pilot

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