Science or Security

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Caveat auditor

The opinions expressed in this talk are those of the speaker, not the U.S. government

Outline

- Anecdotes about IT security
- Observations about IT security
- Research for next generation IT security

In the beginning...

- When I broke in to this business, IT security meant keeping the machine door locked and putting the backup tapes in another building
- Timesharing on big machines and floppy disks on small ones complicated IT security, but we didn't foresee the future
- The security-free Internet and the Morris worm might have warned us

Post-1995

- At a pitac meeting in the late 1990s, a captain of industry said, "Our customers want simpler and faster networks. Security makes them more complicated and slower. The government will have to take the lead."

- In 2005, the nitrd program stood up the interagency working group, Computer Security and Information Assurance (CSIA)

- The USG as lead customer?

In CIO-land (2003-9)

- I receive assurances that NSF is prepared for a virus...

- I am required to name a senior security official, I make my best decision and we spend our best money

- Privacy joins the party and I become the senior privacy official. PII becomes the acronym of the day and CIA becomes **C**ia

Security and red faces

- Incident one: NSF-funded computers implicated in a major ddos attack. NSF grant to Educause to assist universities with security
- Incident two: Hack attack on a major NSF-supported facility. NSF grant to initiate this series of Security Summits
- Incident three: Hack attack at South Pole Station steals scientific data. NSF invests more in Polar security

Random thoughts

- Cybersecurity is a little like airport security: the first requirements are the appearance of and concern about security

- Cybersecurity is a little like the VA: just because it's underfunded is no excuse for not doing a perfect job

- The people in charge of cybersecurity should keep their necks clean

Observations about security

- Security is a *system property,* where a *system* is an interacting set of components, some of which may be (sub)systems

- It is easy to create insecure systems from secure components; it is hard to create secure systems from insecure components

- IT security (eg, CIA--confidentiality, integrity, availability) relates to a system that includes hardware, software, *human* and other components

Perfection?

- Perfect cybersecurity is as likely as zero-fatality automobile traffic
- Plan for mitigating failures as well as preventing them
- Classify failures: embarrassment, cia, financial loss, loss of life (a cps danger)

Risk Management

Likelihood * Damage

Likelihood. Damage	Low.	Medium.	High.
Low.	1.	2.	3.
Medium.	2.	4.	6.
High.	3.	6.	9.

IT insecurity sources

- Software/hardware/human error (eg, buffer overflow)
- Insider crime
- Social engineering (eg, phishing)
- Third, third, third?

Crooks and Espionage

- Botnets (spam, ddos and key-stroke capture)
- State versus commercial data theft
- Cyberwar
- Where are scientific facilities in all this?

Doing the Right Things vs doing Things Right

- A dollar spent on security is a dollar less for science?
- Is economizing on cybersecurity false economy?
- Maximal bang for the cybersecurity buck is an obvious goal
- Remember the crime novel maxim: "If you can't do the time (suffer the consequences of a particular hack), then don't do the crime (of under-investing)"

More random thoughts

- Keep the whole system in focus, not just the IT
- Increase time and attention paid to risk analysis and mitigation
- Cultivate a bad cop from afar (like OMB for the agencies)

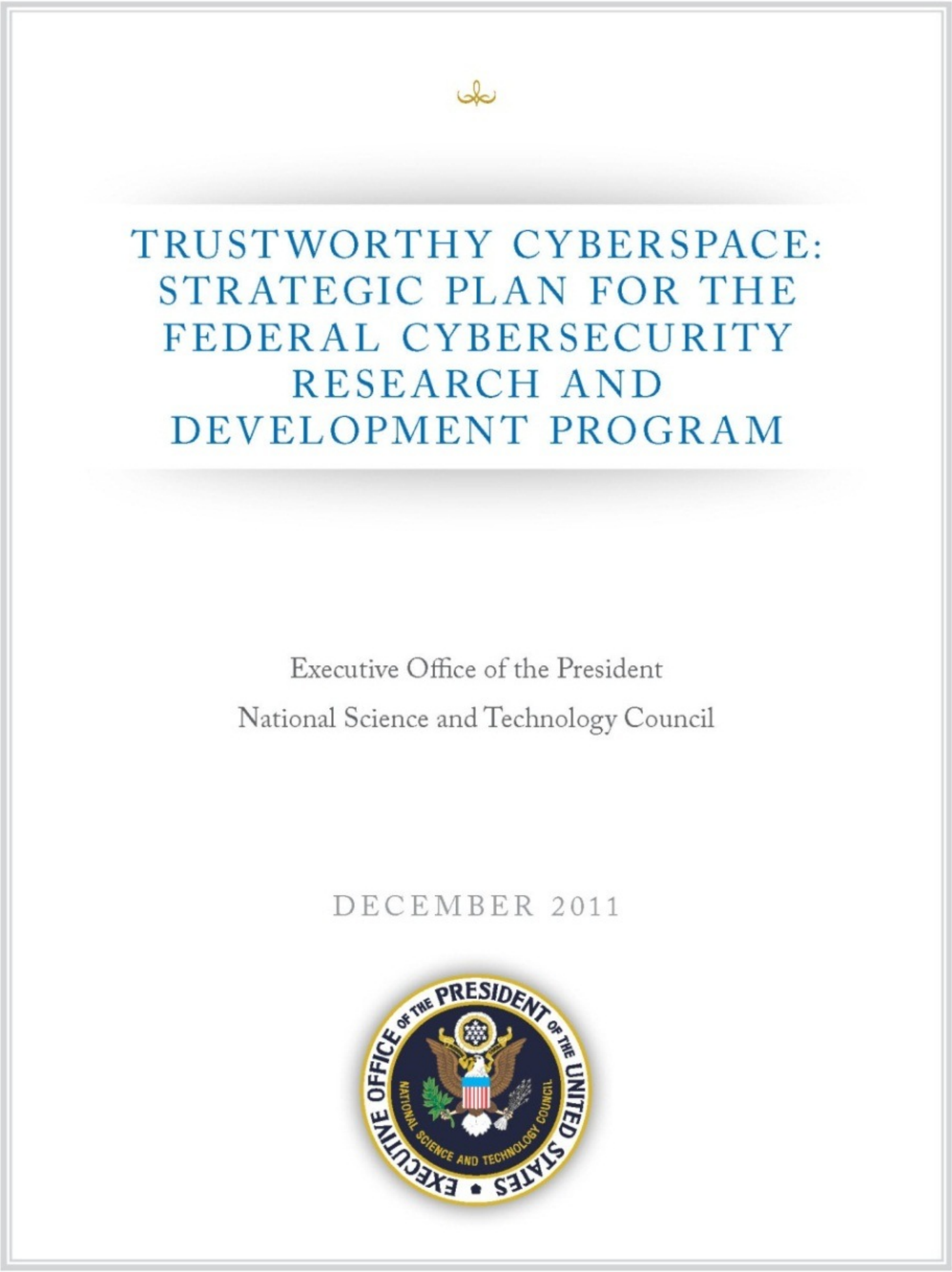
NITRD

- An interagency program under OSTP that coordinates the IT R&D programs of 20 U.S. Federal agencies (check out www.nitrd.gov)

- About $4 billion annually in agency IT R&D investments, including more than $700 million in *computer security and information assurance (CSIA)*

- NITRD has both a CSIA "Interagency Working Group" and a "Senior Steering Group"

Federal Cybersecurity R&D Strategic Plan



TRUSTWORTHY CYBERSPACE: STRATEGIC PLAN FOR THE FEDERAL CYBERSECURITY RESEARCH AND DEVELOPMENT PROGRAM

Executive Office of the President

National Science and Technology Council

DECEMBER 2011

- Research Themes
  - Tailored Trustworthy Spaces
  - Moving Target
  - Cyber Economic Incentives
  - Designed-In Security
- Science of Cyber Security
- Support for National Priorities
- Transition to Practice

Tailored Trustworthy Spaces

- Paradigm
  - Supporting context-specific trust decisions
  - Basing trust decisions on verifiable assertions
- R&D Program Examples
  - Trusted foundation for cyberspace operations [OSD and Service Labs]
  - High assurance security architectures [NSA, ONR, AFRL, NIST]
  - Content and Context Aware Trusted Router (C2TR) [AFRL]
  - Information Security Automation Program [NIST, NSA, DHS]
  - Security Content Automation Protocol (SCAP) and Access Control Policy Machine [NIST]
  - Military Networking Protocol (MNP) program [DARPA]
  - High-Level Language Support for Trustworthy Networks [NSF]

Moving Target

- Paradigm
  - Providing resilience through agility
  - Continue safe operation in a compromised environment
- R&D Program Examples
  - Polymorphic Enclaves and Polymorphic Machines [AFRL]
  - Self Regenerative, Incorruptible Enterprise that Dynamically Recovers with Immunity [AFRL]
  - Clean-slate design of Resilient, Adaptive, Secure Hosts (CRASH) [DARPA]
  - Mission-Oriented Resilient Clouds [DARPA]
  - Cyber Camouflage, Concealment, and Deception [DARPA]
  - Morphing Network Assets to Restrict Adversarial Reconnaissance (Morphinator) [Army]
  - Defensive Enhancements for Information Assurance Technologies (DEFIANT) [Army]
  - Robust Autonomic Computing Systems [ONR]

Cyber Economic Incentives

- Paradigm
  - Developing understanding of what impacts cyber economics
  - Providing incentives to good security
- R&D Program Example
  - NSF Secure and Trustworthy Cyberspace (SaTC) Program
    - NSF Computer & Information Science & Engineering Directorate + NSF Social, Behavioral & Economic Sciences Directorate

Designed-In Security

- Paradigm
  - Developing SW systems that are resistant to attacks
  - Generating assurance artifacts to attest to the system's capabilities to withstand attacks

- R&D Program Examples
  - Survivable Systems Engineering [OSD/SEI CERT]
  - Trusted Computing [DARPA, NSA, OSD, NIST]
  - Software Development Environment for Secure System Software & Applications [ONR]
  - META (flows, tools, and processes for correct-by-construction system design) [DARPA]
  - Software Assurance Metrics And Tool Evaluation (SAMATE) [DHS, NIST]

Supporting National Initiatives

- Health IT
- Smart Grid
- Transportation
- Trusted identities
- Cybersecurity education

Science of Security

- Paradigm
  - – Developing scientific foundations to inform the field of cybersecurity
- R&D Program Examples
  - – AFOSR 2011 Science of Security MURI
    - Stanford, Berkeley, Cornell, CMU, U of Penn
  - – NSA Science of Security Lablets
    - UIUC, NC State, CMU
  - – NSF TRUST Program components
    - Berkeley, CMU, Cornell, San Jose SU, Stanford, Vanderbilt

Accelerating Transition to Practice

- Currently, a chasm exists between the research community and the operations community
- Bridging that chasm, commonly referred to as the "valley of death," requires cooperative efforts and investments by both the R&D and operations communities
- CSRI: Computer Security Research Institute

More random thoughts

- The "science" of cybersecurity is harder than previous successes like compilers, operating systems, database systems, networking, etc

- The escalating war between the good guys and the bad guys will continue. Cyber science should help the good guys

- Bad publicity helps, but God forbid a cyber disaster

Finally

- Because cybersecurity is still an immature (and ever-changing) discipline, we see through the glass darkly

- Cloud computing has been called the industrialization of IT. To what extent might it be the industrialization of cybersecurity, too?