CRYPTOGRAPHIC VALIDATION CHALLENGES WITH BRITTLE ALGORITHMS

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Brittle (Dictionary.com):

1) having hardness and rigidity but little tensile strength; breaking readily with a comparatively smooth fracture, as glass.

2) easily damaged or destroyed; fragile; frail.

Brittleness of a cryptographic algorithm

- modern cryptographic algorithms (e.g., block ciphers) are public

  - depend on strong keys and keeping them secret

- characterizes not just the theoretical security properties of the algorithm;

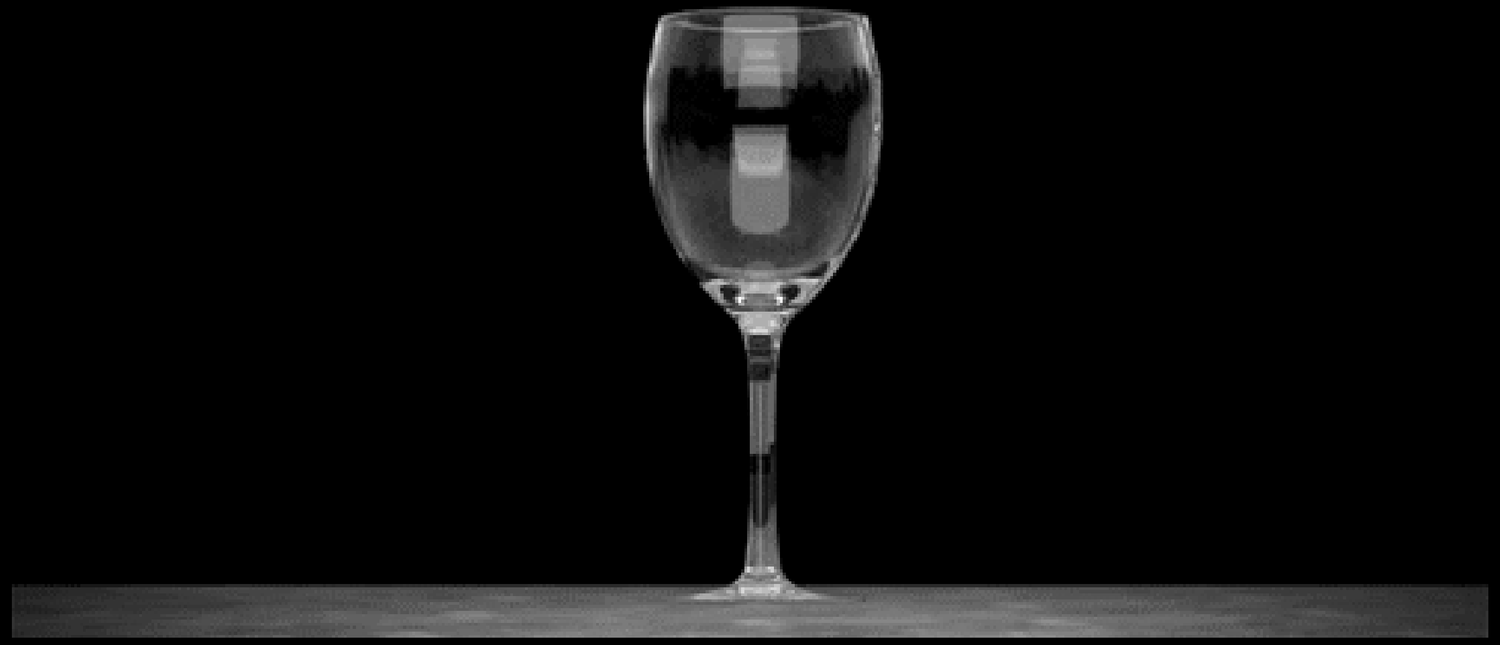
- but also the opportunities an algorithm offers for robust implementations in a variety of environments

EXAMPLE : AES-GCM

- Very efficient and universally liked symmetric cipher
- A NIST standard – SP 800-38D (2007)
  - mandates uniqueness of key/IV pair for security
  - sets specific requirements for acceptable IV construction

Example: AES-GCM (continued)

What happens when the key/IV uniqueness is compromised ?



The NIST CMVP

MISSION:

Improve the security and technical quality of cryptographic modules employed by Federal agencies (U.S. and Canada) and industry by

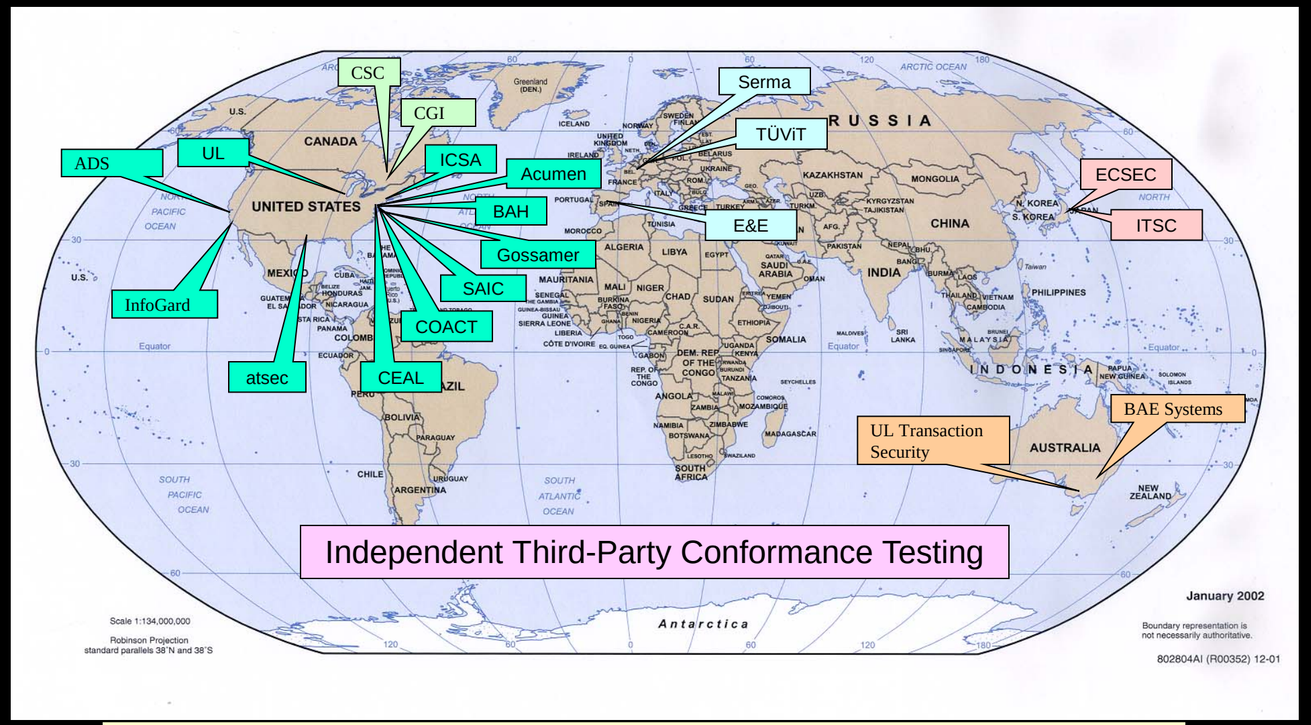
- developing standards;
- research and development of test methods & validation criteria;
- leverage accredited independent third-party testing laboratories

The international aspects of CMVP

- **Adoption of CMVP standards into ISO**
  - **ISO/IEC 19790 *Security Requirements for Cryptographic Modules***
  - **ISO/IEC 24759 *Test requirements for cryptographic modules***

- **Japanese Government Relationship**
  - **Japan Cryptographic Module Validation Program (JCMVP)**
  - **Support of dually accredited Japanese testing laboratories**

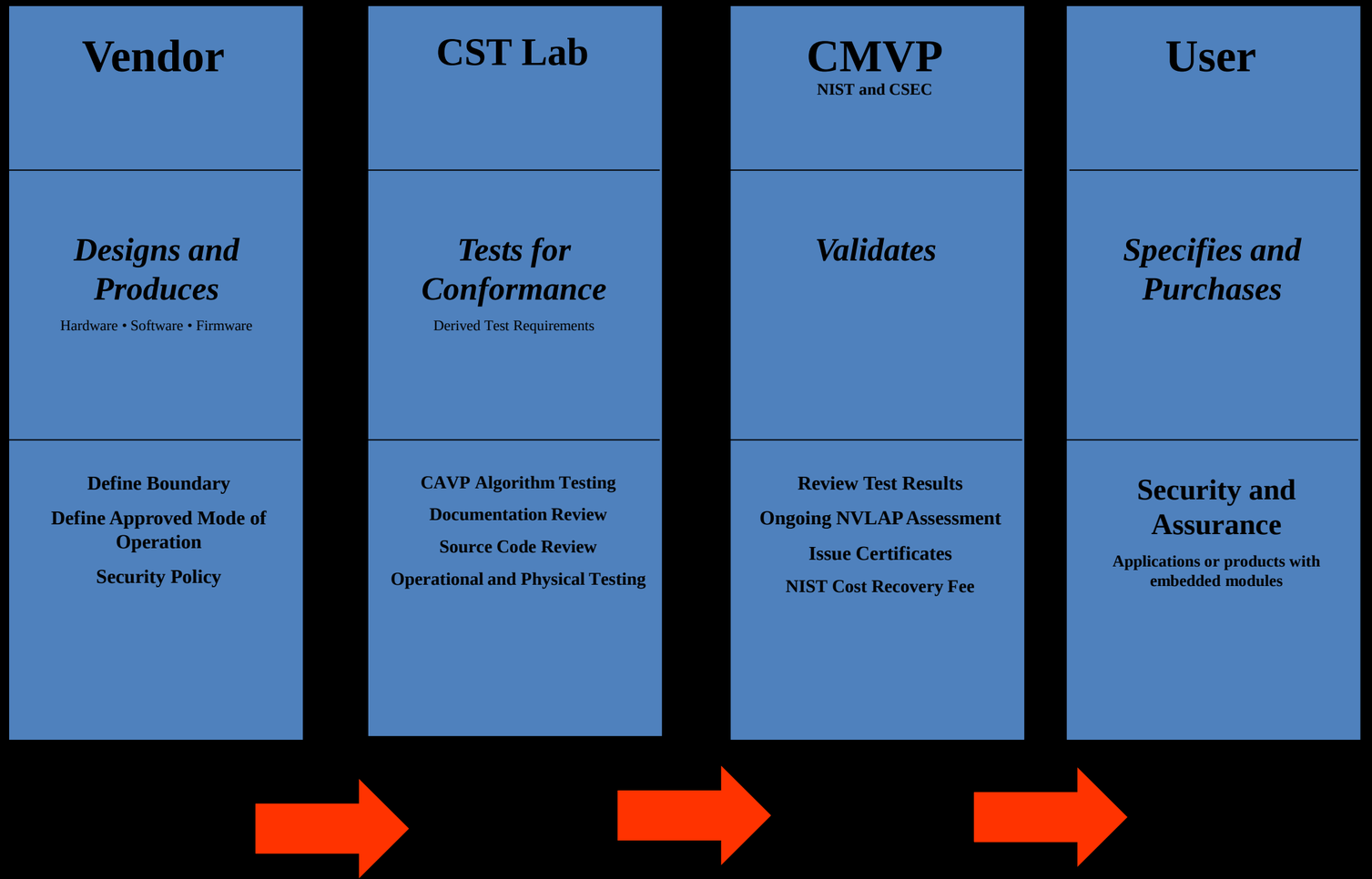
International footprint of the CMVP



Development of standards, test artifacts, proficiency exams and training

NVLAP HB 150-17: Cryptographic and Security Testing

CMVP Testing and Validation Flow



Example: AES-GCM (continued)

SP 800-38D requires IV's be constructed inside the crypto module boundary to guarantee uniqueness of key/IV pairs.

But…

- **collides with existing industry crypto standards:**
  - **CNG**
  - **PKCS#11**
  - **Protocol implementations:**
    - **TLS (RFC 5288), IPSec (RFC 5282), etc.**

A note on testing AES-GCM in the CMVP

- **The key/IV uniqueness requirement is tested by implementation inspection, not machine tested**
  - **a source of trouble for the testing laboratories and vendors**
  - **requires special attention by the NIST reviewers too**
  - **potential for confusion among federal users of cryptography**

A note on existing industry crypto standards

- **The problem discussed on the previous slide should not be taken to indicate that the architecture of these libraries is bad.**
  - **they predate AES-GCM and have proven track records of adoption**
  - **hopefully it is a matter of natural evolution and time to adopt this algorithm properly**

A SOBERING OBSERVATON:

- **AES-GCM - a good but brittle algorithm**

- **Adoption as a NIST standard has led to difficulties for all constituencies:**

  - **vendors of cryptographic technology**
  - **independent accredited third-party testing laboratories**
  - **NIST validation programs**
  - **federal users of cryptography**

CONCLUSION:

Someone once said this about standards:
“With ISO 9000 you can … certify a manufacturer that makes life jackets out of concrete”, **Richard Buetow, Motorola**

Selecting robust lightweight primitives for potential future standardization is important to avoid running into unpleasant unintended consequences

Robustness is more than just classic theoretical security analysis

Questions?