Taking White Hats to the Laundry: How to Strengthen Testing in Common Criteria

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- **Problem**: the testing methodology defined in CC is underspecified
  - results are difficult to reproduce
  - affects the public's perception of the value of evaluations

Outline

- Introduction
  - Current situation with product testing in CC
  - Recent advancements in testing and their potential use in CC
- Proposal
  - Modular assurance packages based on interface-specific attacks
  - Benefits from using such packages
- Conclusions and future work

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  - re-running a subset of developer's test cases
- CEM suggests alternate approaches only when it is impractical to test directly specific functionality
  - such as source code analysis

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- Traditionally, emphasis is given to “functional testing” of security features
  - deterministic positive and negative testing prevails in the software industry
  - accepted by CEM and prioritized by relevance to SFRs:
    - SFR-enforcing TSFIs are covered
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- The deterministic functional testing is good for confirming the overall security architecture and design of the product.

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- Recent advances in testing technology have shown that deterministic functional testing is not sufficient for gaining assurance in the security features of a product
  - hackers pioneered random fuzzing of interfaces intended to penetrate them
  - fuzz testing is becoming more and more accepted by major software vendors and incorporated in product development
  - introduces the concept of probabilistic assurance

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  - Can we map Fuzz testing results to EAL levels?

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  - system crashes
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  - dangling threads
  - dangling pointers

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- Open questions:
  - What is the proper cost/benefit ratio for this type of testing?
    - Hackers, developers have different perspectives
    - Where do evaluators stand?
  - Can we incorporate this type of testing in CC?
    - Can we map Fuzz testing results to EAL levels?

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- Observation:
  - TSFIs cannot be reliably prioritized for CC testing as
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  - This issue is particularly relevant for low (<4) EAL evaluations

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- Observation:
  - Fuzzing and interface-specific tests provide a good framework for this

Interface-specific testing

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- Why Interface-specific testing?
  - Interface-specific classes of attacks have emerged
    - e.g., XSS for Web interfaces
  - As software technology standardizes, so do the attacks
    - Just recently hackers pulled off a major break-in using a classic SQL injection

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- Well-known classes of interface-specific attacks lead to standard frameworks of tests that are
  - naturally adapted to the type of interface
  - allow for state-of-the-art coupling with fuzzing for testing multilayered interfaces/protocols

Example: Well-known attacks/testing techniques for Web Interfaces

- Cross-Site Scripting (reflected, Stored, DOM based XSS)
- Session Hijacking (session fixation, session side-jacking)
- Cross-site Request Forgery (also known as session-riding)
- Path Reversal
- Code Injection (PHP, HTML, SQL Injection)
- Command injection (LDAP, XPath, XSLT, HTML, XML, OS)
- File inclusions
- Use of poor encoding practice (base 64)/ Insecure cryptographic storage
- Insecure direct object reference
- Information Leakage and Improper Error Handling

Combining Fuzzing w/ Well-Known Tests for Discovering Input-Based Vulnerabilities

- (Pseudo-)Randomly choose an input from the entire input space
- Invoke the application with that input
- Observe the resulting output
- Look for 'odd' behavior
- Exploit odd behavior

Example: HTTP Header Fuzzing

7K:>6]"=:&X<ZE`,`)7?:0=/'53#.DMO:/_2`RZN6QB9

GET M?40G);>@!5#/>L5P_`+\@V3WB+_2_ HTTP/1.0

GET http://www.foobar.com/M?40G);>@!5#/>L5P HTTP/1.0

GET http://www.foobar.com/so6gyhsiwgic.html HTTP/1.0

GET http://www.foobar.com/so6gyhsiwgic.pl HTTP/1.0

GET http://www.foobar.com/so6gyhsiwgic.ado HTTP/1.0

GET http://www.foobar.com/so6gyhsiwgic.jsp HTTP/1.0

GET http://www.foobar.com/so6gyhsiwgic.hs HTTP/

Our Goal

- Promote the development of an interface-based testing methodology for CC that
  - complements the general interface-independent testing methodology of CEM
  - maps easily to EAL levels
  - improves reproducibility of test results
  - enhances the value of the evaluation

Approaches to Adopting Interface-Based Testing in CC

- Develop testing-related assurance packages
  - combining fuzzing with interface-specific knowledge-based tests

- Modular assurance packages tailored to specific product types
  - e.g., Web product test package
    - Cross-Site Scripting (reflected, Stored, DOM based XSS)
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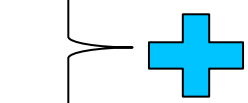

Fuzzing on interface parameters

Modular assurance packages and EAL

Some Interfaces Tested by **Some** Interface-Specific Tests With **Some** Fuzzing

Most Interfaces Tested by **Some** Interface-Specific Tests With **Some** Fuzzing

Most Interfaces Tested by **Most** Interface-Specific Tests With **Some** Fuzzing

Most Interfaces Tested by **Most** Interface-Specific Tests With **More** Fuzzing

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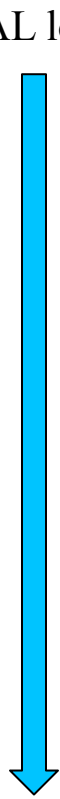

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- For consumers
  - Increases the security assurances provided by the product
  - Increases the value of certification

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- Evaluators can reliably identify more security flaws and systematically increase the rigor of CC testing
- The definition of modular test packages can be formalized to integrate in CC