Abstract

The term "usable security" is on everyone's lips and there seems to be a general agreement that, first, security controls should not unnecessarily affect the usability and unfriendliness of systems. And, second, that simple to use system should be preferred as they minimize the risk of handling errors that can be the root cause of security incidents such as data leakages. But it also seems to be a general surprise (at least for security experts), why software developers always (still) make so many easy to avoid mistakes that lead to insecure software systems. In fact, many of the large security incidents of the last weeks/months/years are caused by "seemingly simple to fix" programming errors.

Bringing both observations together, it should be obvious that we need usable and developer-friendly security controls and programming frameworks that make it easy to build secure systems. Still, reality looks different: many programming languages, APIs, and frameworks provide complex interfaces that are, actually, hard to use securely. In fact, they are miles away from providing usable security for developers.

In this talk, I will discuss examples of complex and "non-usable" security for developers such as APIs that, in fact, are (nearly) impossible to use securely or that require an understanding of security topics that most security experts to not have (and, thus, that we cannot expect from software developers).

Outline

1. Security experts and developers
2. Secure programming can't be that difficult ...
3. The most common "fixes"
4. What we should do

About Me

- Security Expert/Architect at SAP SE
  - Member of the central security team, SAP SE (Germany)
  - Security Testing Strategist
  - Work areas at SAP included:
    - Defining the risk-based Security Testing Strategy
    - Evaluation of security testing tools (e.g., SAST, DAST)
    - Roll-out of security testing tools
    - Secure Software Development Life Cycle integration
  - ... Since December 2015:
    - Associate Professor, The University of Sheffield, UK
    - Head of the Software Assurance & Security Research Team
    - Available as consultancy & (research) collaborations

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https://www.brucker.ch/
Since the late 1940ies, we program, debug, and patch computer systems.

we do not use punch cards anymore ...
We build software since 70 years and still make the same old (security) mistakes.

The common “silver bullet”: The SDLC

- Central security experts (SDLC owner)
  - Organizes security trainings
  - Defines product standard “Security”
  - Defines security testing strategy
  - Validates products
  - ...

- Development teams
  - Select technologies
  - Select development model
  - Design and execute security testing plan
  - ...

Works nicely in theory – let’s move to reality.
Introducing the SDLC: View of the security experts

- The whiteboard is from the Microsoft’s security team
- I confess, I am guilty too:
  - We also had a board with "embarrassing developers quotes"

Introducing the SDLC: View of the developers

- Experience security as “The Department of No”
- Confronted with a strange & complex language
  - (there are over 1024 CWEs – and counting)
Example of unfriendly APIs: Buffer overflow

Let's travel back in time

Unix V7 (1979)
Reading strings
Gets returns a string of arbitrary length
Is there a secure use of gets?

Wait, let's check the man page on a modern Unix/Linux:

NAME
gets - get a string from standard input (DEPRECATED)

BUGS
Never use gets(). Because it is impossible to tell without knowing the data in advance how many characters gets() will read, and because gets() will continue to store characters past the end of the buffer, it is extremely dangerous to use. It has been used to break computer security. Use fgets() instead.

OK, let's sounds easy: Use fgets(buf, n, stdin) instead of gets(buf):

void f() {
    char buf[20];
    fgets(buf, 20, stdin); // NOT: gets(buf);
}

Is this now secure? No, fgets does not always null-terminate
we need to manually null terminate the buffer (and reserve space for the null character)
void f() {
    char buf[21];
    fgets(buf, 20, stdin);
    buf[20]='\0';
}

C-Programming has a lot in comming with (insurance) contracts: always read the small print

“Most OpenSSL functions will return an integer to indicate success or failure. Typically a function will return 1 on success or 0 on error. All return codes should be checked and handled as appropriate. Note that not all of the libcrypto functions return 0 for error and 1 for success. There are exceptions which can trip up the unwary. For example if you want to check a signature with some functions you get 1 if the signature is correct, 0 if it is not correct and -1 if something bad happened like a memory allocation failure.” (OpenSSL)

Recall the common C convention:
- 0 indicates success
- any non-zero value indicates failure

Example of unfriendly APIs: Error handling
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Which one is correct:

- Consider
  ```java
  if (some_verify_function())
      /* signature successful */
  ```

- Consider
  ```java
  if (1 != some_verify_function())
      /* signature successful */
  ```

- Consider
  ```java
  if (1 == some_verify_function())
      /* signature successful */
  ```

The last one is correct.

Example of unfriendly APIs: The Java 8 Crypto API

Just a nightmare:

- Many configurations to choose from
  - algorithm
  - mode of operation
  - padding scheme
  - right keys and sizes
  - ...
- Most ciphers are outdated/broken. Only two can still be recommended
  - AES (symmetric)
  - RSA (asymmetric)
- Many providers use insecure defaults (e.g., ECB mode)

Using the Java crypto API, is already hard for somebody who understands crypto …

Example of unfriendly APIs: XSS (Java)

Most Web Frameworks for Java do not provide input/output encoding as default
Developers need to include third party encoding libraries
(e.g., OWASP Java Encoder: https://github.com/OWASP/owasp-java-encoder)
and add calls to the encoder manually:

```java
PrintWriter out = ...;
out.println("<textarea >"+Encode.forHtml(userData)+" </textarea >");
```

You need to insert the right (there are many) encoder each time.

Common mitigations

- Provide training
  - Do we really expect that our developers understand all these details?
- Write (coding) guidelines
  - Guidelines without tool support are (mostly) worthless
- Use generic application security testing tools
  - without configuration, these tools are prone to both high false-positive rates and high false-negative rates
  - many tools are developed for security experts (and not for developers)
  - penetration tests

In their generality, these actions are often not very effective!
Security experts and developers need to work together to achieve the common goal: secure software!

(Disclaimer: security experts might need to learn how to code)!

Think positive: security enables developers to produce high-quality and secure software!

- Start early in the development:
  - Select frameworks and/or programming languages that are **secure by design**
  - Develop custom APIs-Wrappers that are easy to use and require only little security knowledge
  - To consider
    - Configure your DAST/IAST/SAST tool to support your custom APIs
    - In the fix recommendations of your DAST/IAST/SAST tool, point developers to the recommended frameworks
    - If you develop APIs, make your examples secure by default

If you do not support your developers, they will seek for help elsewhere!

Let’s close with a good example: Modern Rails

- Modern versions of Rails are pretty secure by default
- Input/output encoding is enabled by default and, in exceptional cases, needs to be disabled explicitly:
  ```ruby
  <%= account.balance.html_safe %>
  ```
  (one can argue, if html_safe is a good name denoting un-sanitized (non-trusted) channels)
- Suddenly, a simple `grep` becomes a powerful static analysis tool

Call for action
Let’s build framework and APIs are easy to use securely!
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Thank you for your attention!
Any questions or remarks?