Variability Modeling of Cryptographic Components

Sarah Nadi

FOSD 2015 Meeting — May 14, 2015

Joint work with: Karim Ali, Steven Arzt, Eric Bodden,
Sebastian Erdweg, Steffan Krüger, and Mira Mezini

CROSSING

TECHNISCHE UNIVERSITÄT DARMSTADT

Data is Valuable

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Sony Pictures, 2014
(passwords, emails, SSNs leaked due to lacking encryption)

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TJX Companies Inc., 2006
(94 million credit cards exposed because of weak encryption)

Not everyone who needs to protect data knows how to!

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Step 1: Generate salt

Do not re-use the salt

Generate random salt for each new user or password change

Do not hard-code the salt

Do not use short salts

```
// Generate a random salt
SecureRandom random = new SecureRandom();
byte[] salt = new byte[SALT_BYTE_SIZE];
random.nextBytes(salt);
```

Step 2: Hashing

Use a secure hash function

Can optionally use a key derivation algorithm

Use a minimum of 1,000 iterations

```
PBEKeySpec spec = new PBEKeySpec(password,
                                 salt,
                                 NUM_OF_ITERATIONS,
                                 LENGTH_OF_HASH);

SecretKeyFactory skf = SecretKeyFactory.getInstance(HASHING_ALGORITHM);
byte[] hashedPassword = skf.generateSecret(spec).getEncoded();
```

Different Levels of “Variability”

- Algorithm(s) to use?
- Sequence and parameters for API calls?

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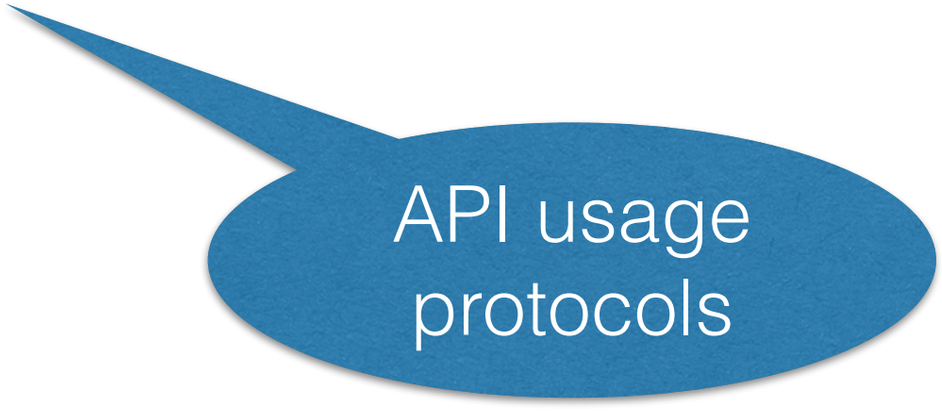


Different Levels of "Variability"

- Algorithm(s) to use?

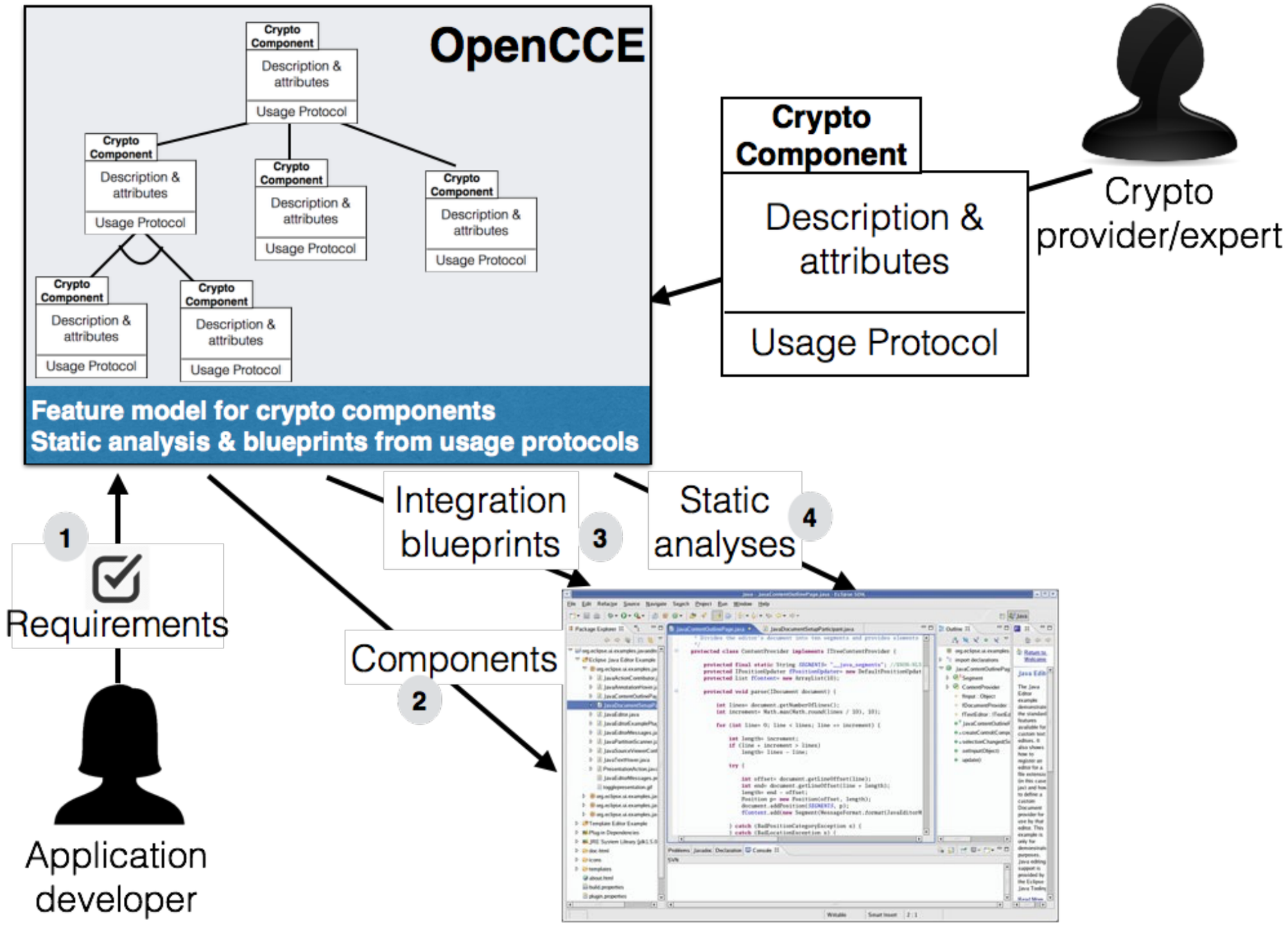
Variability model

Domain knowledge

- Sequence and parameters for API calls?

API usage protocols

Proposed Solution: OpenCCE



Using Clafer for Feature Modeling

- Clafer: class, feature, reference
- General purpose modeling language
- Can be used to define feature models
- Unifies concepts of classes, associations, and properties, and defines a main concept — a clafer.
- Clafers represent properties, types, or references depending on their nesting and syntactic modifiers
- Has an extensive tool suite for instance generation and objective optimization

Password Storing in Clafer

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```
abstract Algorithm
    name -> string
    performance -> integer ?
    xor status
        secure
        insecure

abstract Digest : Algorithm
    outputSize -> integer
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    md5: Digest
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    sha_224: Digest
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```
PasswordStoring : Task
    [name = "Password Storing"]
    digestToUse -> Digest ?
    kdaToUse -> KeyDerivAlgm ?
        [kdaToUse = pbkdf => digestToUse]
        [kdaToUse != pbkdf => no digestToUse]
    [kdaToUse || digestToUse]
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```
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digestToUse = sha_512
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        [kdaToUse != pbkdf => no digestToUse]
    [kdaToUse || digestToUse]
    [no digestToUse.status.insecure]
    [digestToUse => digestToUse.outputSize > 224]
```

```
digestToUse = sha_512
kdaToUse = pbkdf
```

Challenges

Modeling

- Identifying the best boundary between feature model and usage protocol
- Identifying constraints

Clafer

- Dealing with redundant information in generated instances
- “Querying” the model
- Configurator design

General Design

- Interfacing between feature model & usage protocol

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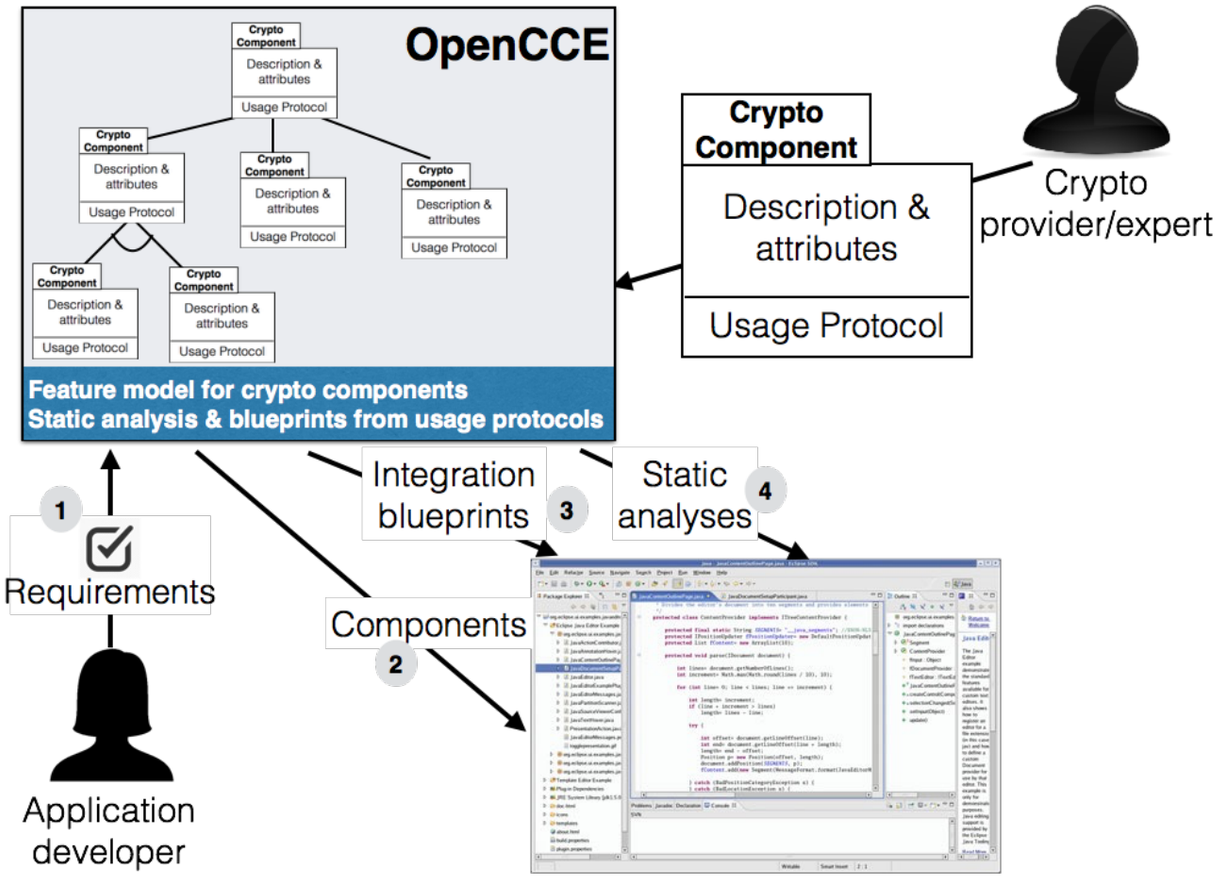


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sarahnadi.org