Encryption and Key Management

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I. Introduction

Who is StrongAuth?

- Cupertino CA-based private company
- Founded in 2001
- Focused on Architecture, Design, Development & Support of:
  - Enterprise Key Management
    - Public Key Infrastructure (PKI)
    - Symmetric Key Management System (SKMS)
- Customers in many sectors
  - Finance, Pharmaceutical, Medical Devices, e-Commerce, Entertainment, Retail, BPO Services, Manufacturing

Why bother listening to me?

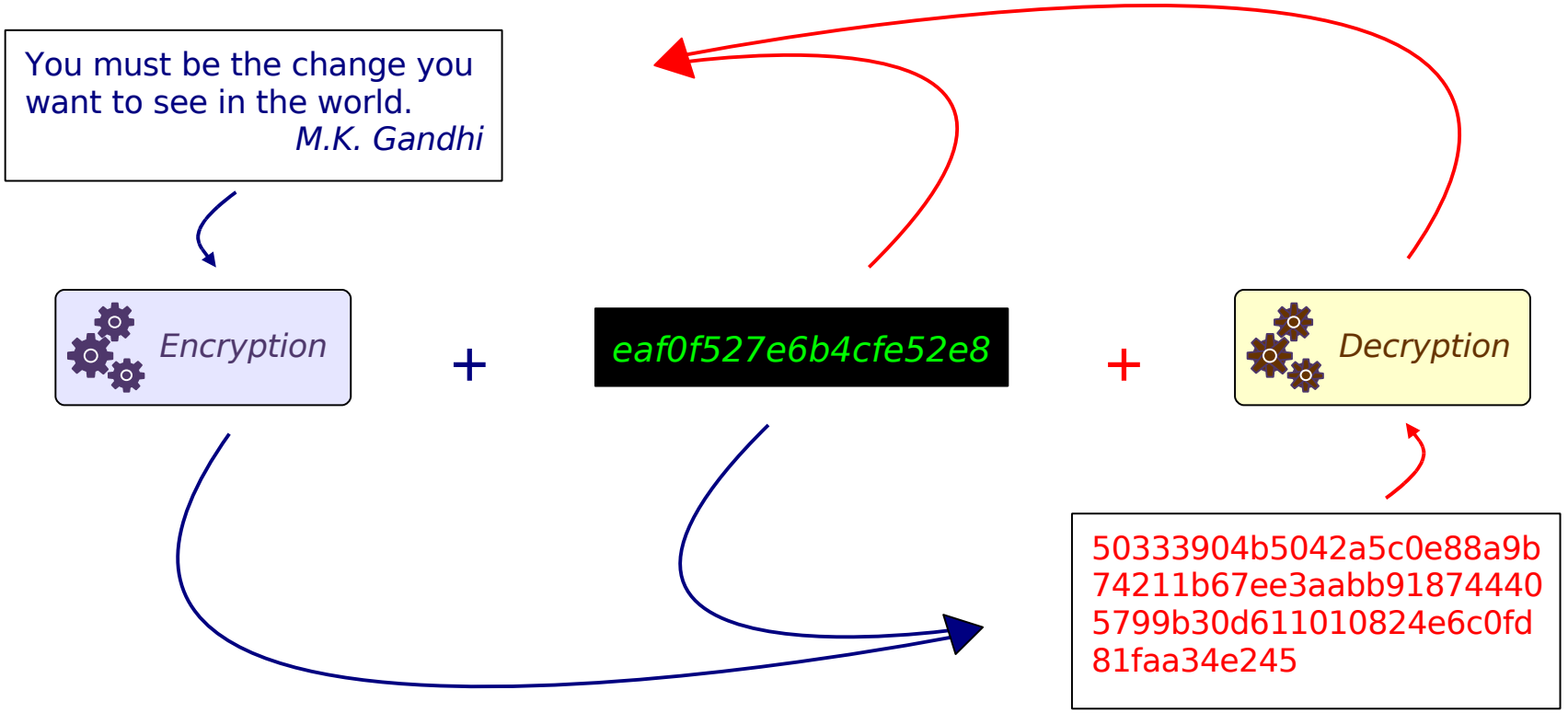
- 30+ years of work-experience
  - 6 years on the Business side
  - 24+ in Information Technology
    - 10+ in Cryptographic Key Management
- Designer, lead-developer of StrongKey – the industry's first, open-source, Symmetric Key Management System (2006)
- Designer, lead-developer of the StrongKey Lite Encryption System – the industry's lowest cost encryption & KM appliance (2010)

II. Some Definitions

- Encryption
  - A reversible cryptographic operation that transforms meaningful “plaintext” to illegible “ciphertext”
- Tokenization
  - A reversible operation that substitutes meaningful “plaintext” to meaningless “plaintext”
- Hashing
  - An irreversible cryptographic operation that transforms meaningful “plaintext” to an illegible message-digest (hash)
- Key Management
  - The life-cycle operations associated with the secure creation, use, management, distribution and destruction of cryptographic keys

Symmetric Encryption

- The process of transforming ***plaintext*** to ***ciphertext***, and vice-versa, using the **same** encryption/decryption key

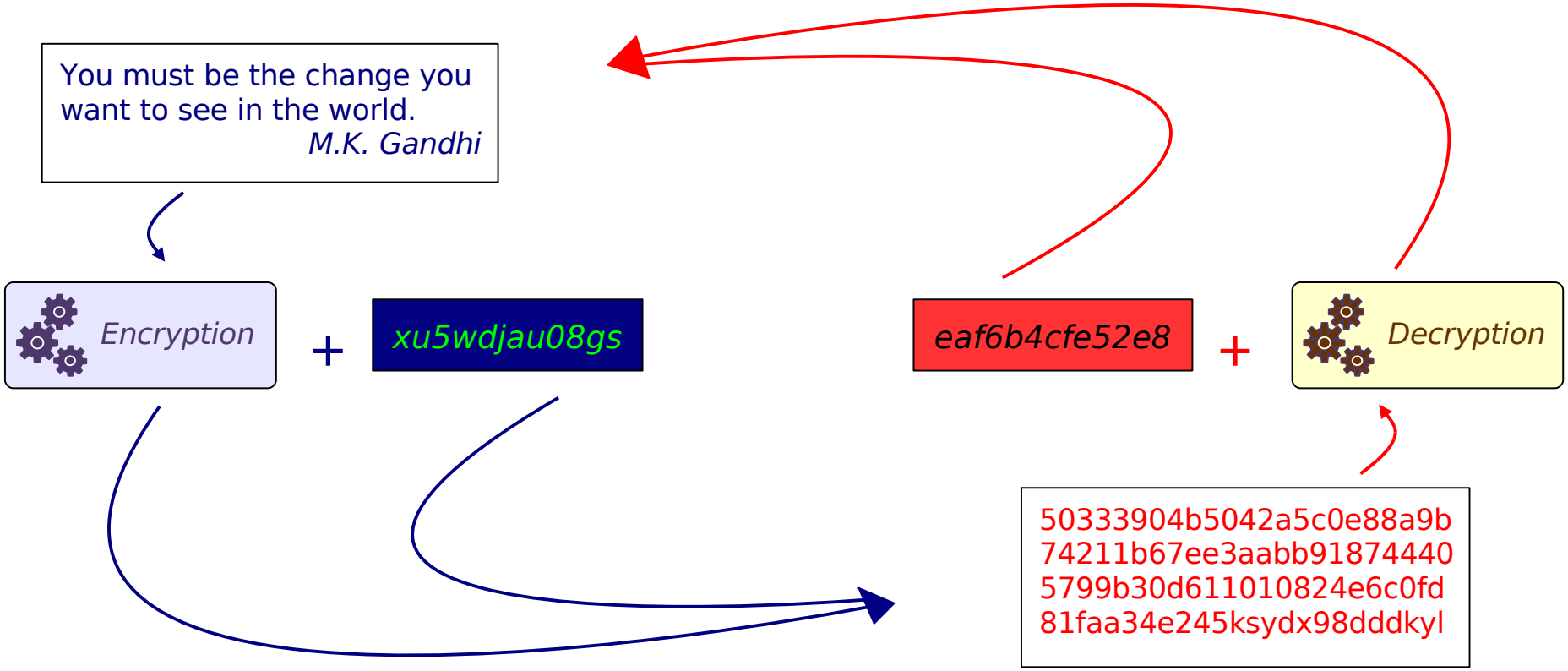


Symmetric Encryption

- **Shared key** for encryption and decryption
- Faster
- Unlimited size for plaintext
  - Typically used to encrypt bulk data
- Data Encryption Standard (DES) – 56-bit
- Triple-Data Encryption Standard (3DES)
  - 112 and 168-bit
- Advanced Encryption System (AES)
  - 128, 192 and 256-bit

Asymmetric Encryption

- The process of transforming ***plaintext*** to ***ciphertext***, and vice-versa, using **two different** keys

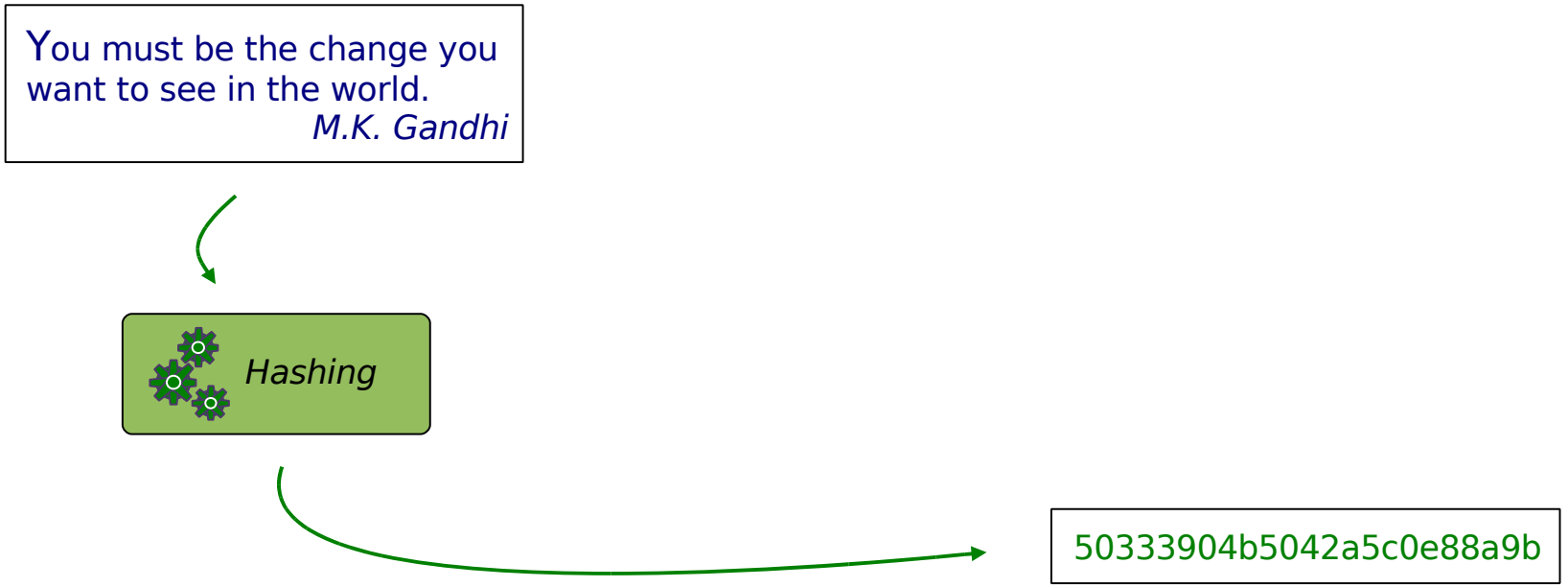


Asymmetric Encryption

- **Different** keys for encryption & decryption
- Slower
- Limited size for plaintext
  - Less than the size of the key
  - Used to encrypt symmetric keys & hashes
- Rivest-Shamir-Adelman (RSA)
  - 512 to 8192-bits
  - 2048-bits recommended for 2010 deployments

Message Digest (Hash)

- The object created by the process of transforming data to a **fixed-size** cryptographic value using a **one-way** transformation process



Message Digest (Hash)

- No key is involved – just an algorithm
- Unlimited size data
- Typically used to verify the integrity of a file
- Message Digest 5 (MD5) – Broken!!
  - 128-bit fixed size
- Secure Hashing Algorithm – (SHA)
  - SHA1: 160-bit (Avoid, if possible)
  - SHA-256, SHA-384 and SHA-512

Tokenization

- The process of **substituting** a like-value for plaintext without the use of cryptography

1234 5678 9012 3456

9999 0000 0000 5678

123-45-6789

800-00-0123

123456789 98765432

100000000 00001234

III. Cryptography Pitfalls

Cryptography pitfalls-1

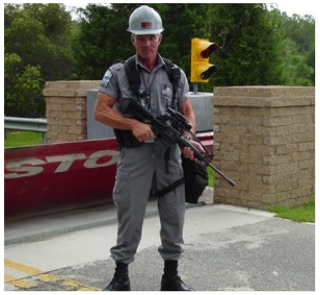
- Storing symmetric key in a file, registry-entry, database record – *somewhere on the system*
- Encrypting symmetric key with public key, but storing private key in a file
- Using Password-Based-Encryption (PBE), but storing the password in a file
- Compiling symmetric key into the program
- Encrypting symmetric key with another symmetric key
- Backing up the key with the ciphertext

Cryptography pitfalls-2

- Using a single key to encrypt all data
- Not verifying the integrity of decrypted data
- Not thinking through key-rotation issues
  - Single rotation per year
  - Rotating DEK-ciphertext - not data-ciphertext
- Not thinking through split-key knowledge issues
- Not planning for rapid changes in cryptography
- Encrypting at the wrong layer of the stack

Real-world analogy

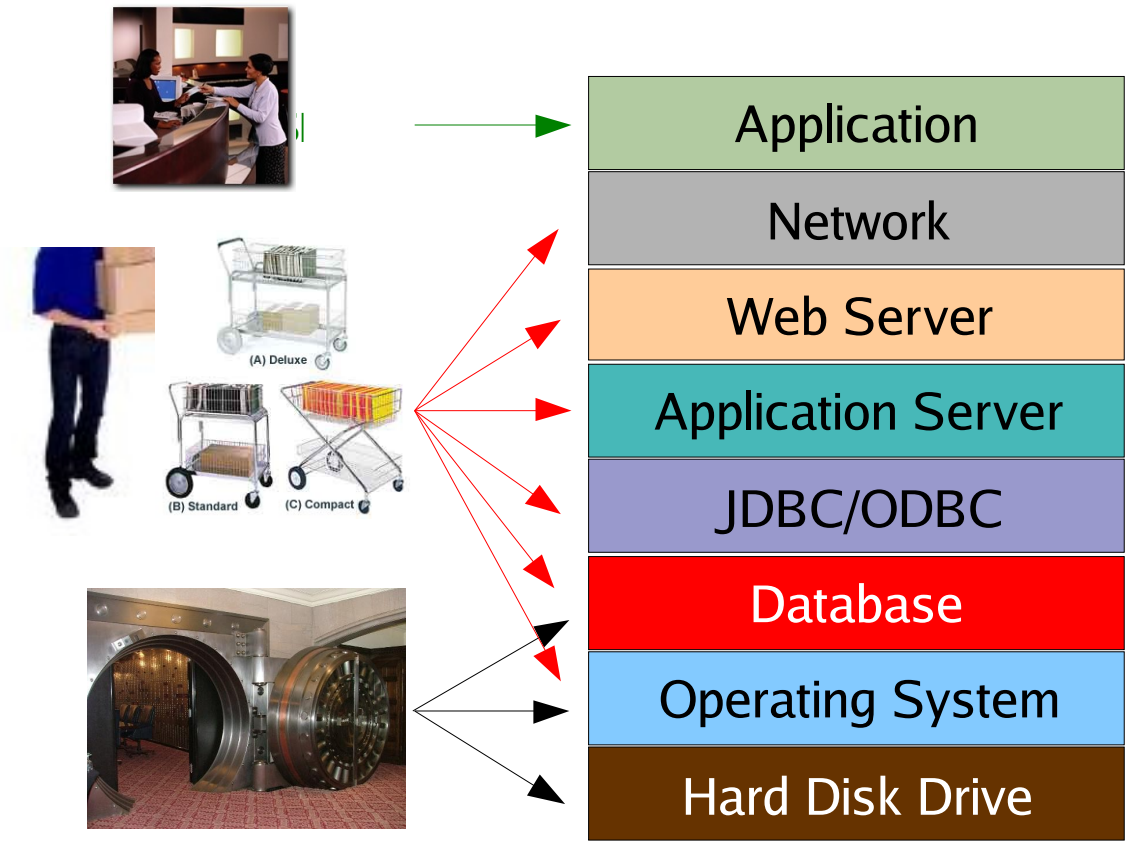
Precious cargo
Is protected all
the time!



Real-world analogy

Cryptography pitfalls-3

- Encrypting at the wrong layer of the stack



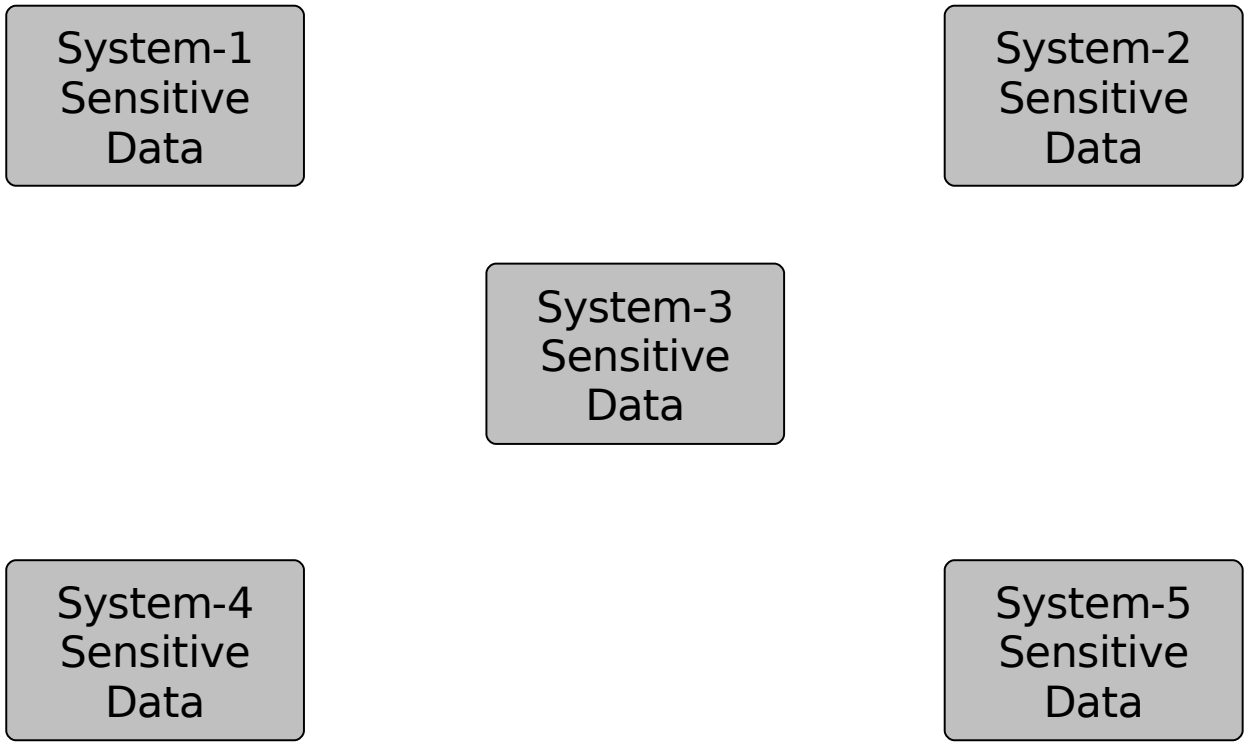
The right way

IV. Solution

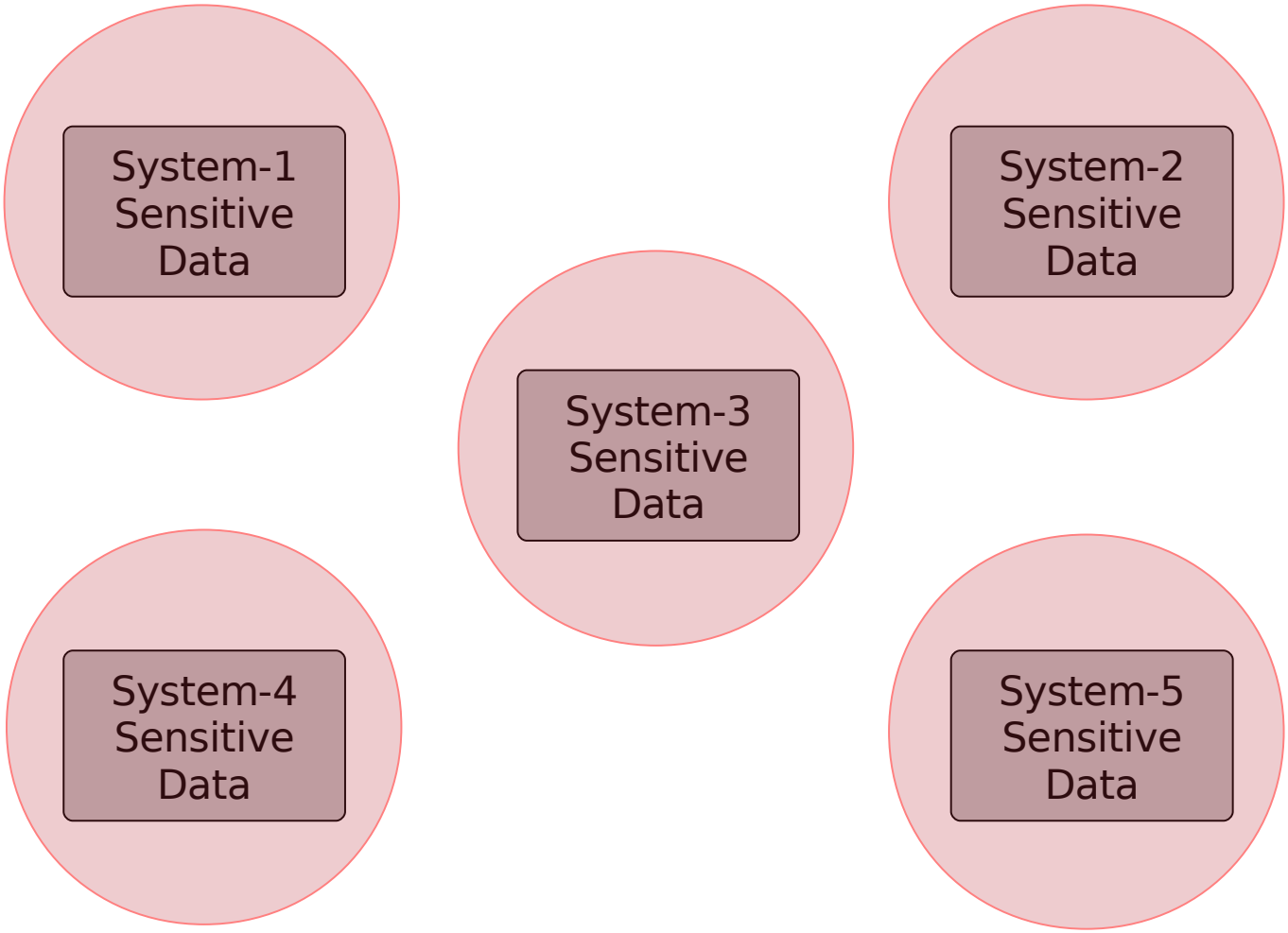
So, what do you do?

- Reduce the exposure of sensitive data
- Abstract cryptography **out** of the application
- Use a cryptographic hardware module as a back-stop
- Use specialized solutions rather than “home-brewed” encryption
- Follow NIST guidelines for algorithms, key-sizes

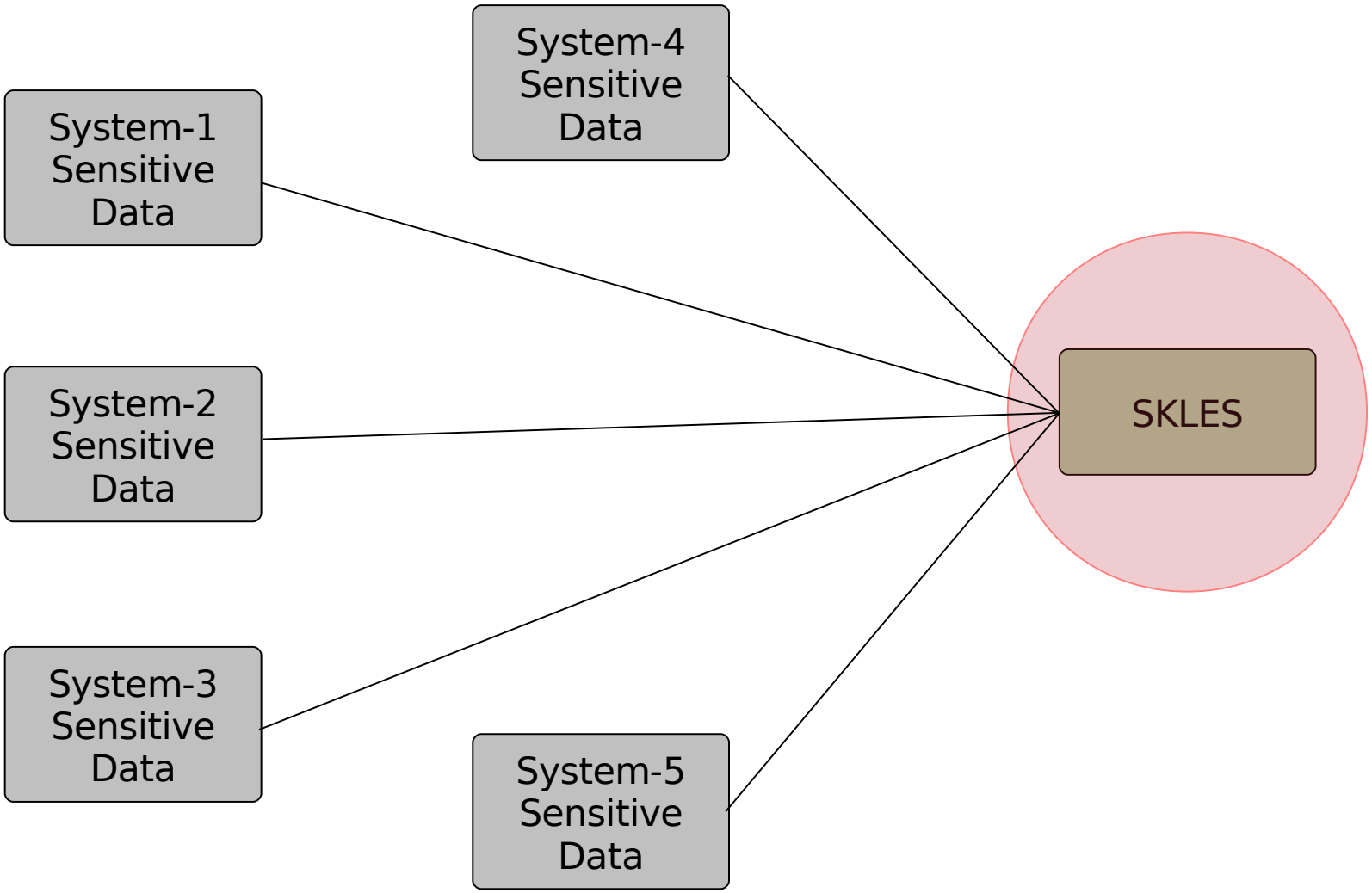
Reduce the exposure - 1



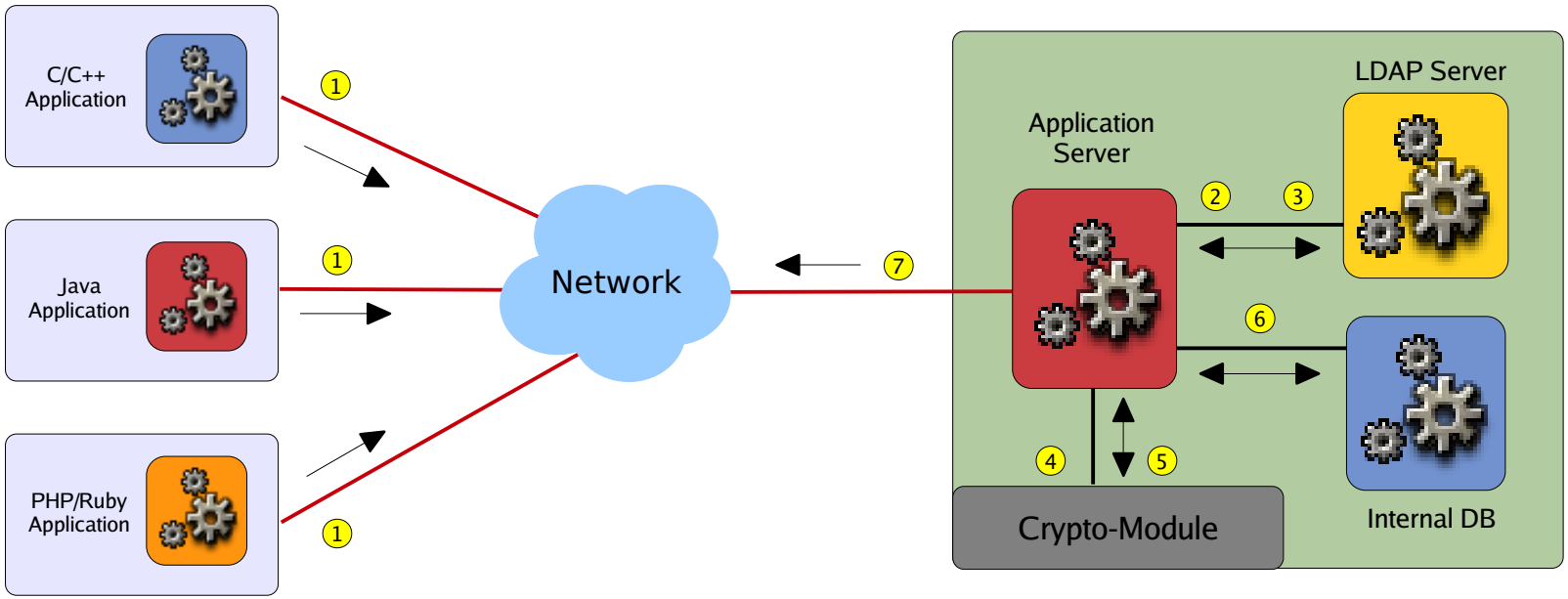
Reduce the exposure -2



Reduce the exposure - 3



Abstract cryptography out



Applications

Encryption and Key Management

Use cryptographic hardware

TPM

HSM

- Trusted Platform Module
  - CC EAL4+ certified
  - RSA 2048-bit keys that never leave the TPM
  - Embedded on computer motherboards
- Hardware Security Module
  - FIPS 140-2 certified
  - RSA and Suite-B algorithms
  - Erases on-board cryptographic material when stolen

Use specialized solutions

NIST Guidelines

- Triple-DES (112- or 168-bits) symmetric keys
- AES (128-, 192- or 256-bits) symmetric keys
- RSA (2048-bits or greater) asymmetric keys
- SHA-256, SHA-384 or SHA-512 for message-digests
- FIPS 140-2 certified cryptographic hardware modules
- Common Criteria EAL certified cryptographic hardware modules

Summary

- Cryptography has always been complex, but is getting increasingly so:
  - Attackers are knowledgable and using crypto
  - Crypto-hardware is becoming ubiquitous
  - Growing number of crypto forums and standards
  - State laws are referencing PCI-DSS or crypto directly
    - Massachusetts, Minnesota, Nevada, Washington
- Education and a long-term strategy is key to preventing crypto-chaos

- Thank You
- Questions?
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