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. Why focus on EKM?

It is the law

- Massachusetts 201 CMR 17.00 (Mar 01, 2010)
  - http://www.mass.gov/Eoca/docs/idtheft/201CMR1700reg.pdf
- Nevada Senate Bill 227 (Jan 01, 2010)
  - http://www.leg.state.nv.us/75th2009/Bills/SB/SB227_EN.pdf
- Washington House Bill 1149 (Jul 01, 2010)
  - http://apps.leg.wa.gov/documents/billdocs/2009-10/Pdf/Bills/Session%20Law%202010/1149-S2.SL.pdf
- UK RIPA Part III (Oct 01, 2007)
  - http://www.opsi.gov.uk/acts/acts2000/ukpga_20000023_en_8#pt3

It is regulated by contract

- Payment Card Industry Data Security Standard (PCI-DSS):
  - Section 3.4 – Render PAN unreadable
  - Section 3.5 – Protect cryptographic keys
  - Section 3.6 – Implement key-management
  - Section 4.1 – Use strong cryptography
  - Section 4.2 – Never send unencrypted PANs

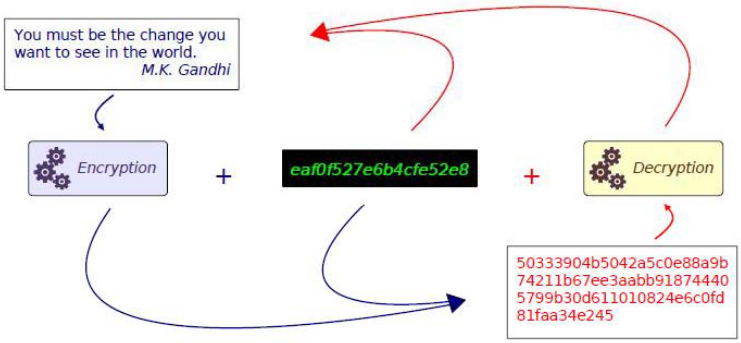
III. Some Definitions

Terms & 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

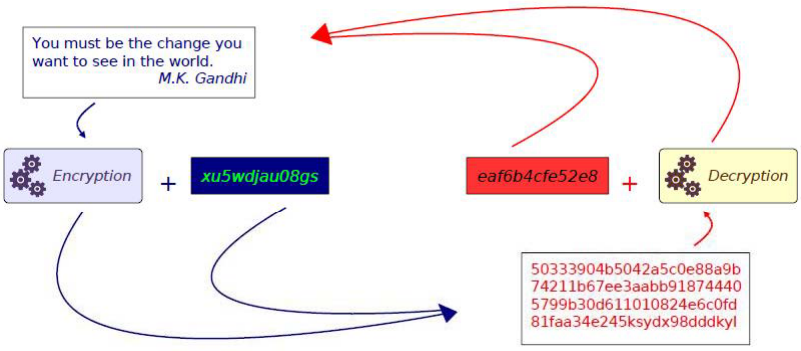


Symmetric Encryption

- **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 <u>without</u> the use of cryptography

1234 5678 9012 3456
→ 9999 0000 0000 5678

123-45-6789
→ 800-00-0123

123456789 98765432
→ 100000000 00001234

IV. 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

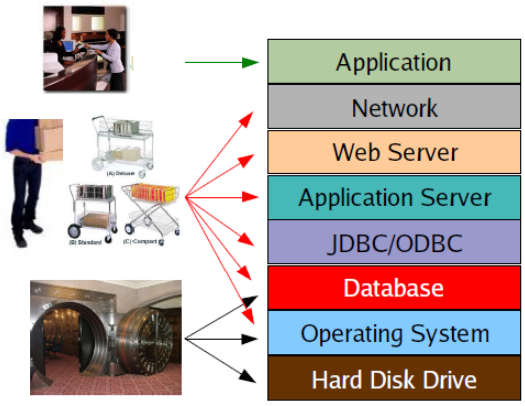
Real-world analogy

Precious cargo
Is protected all
the time!

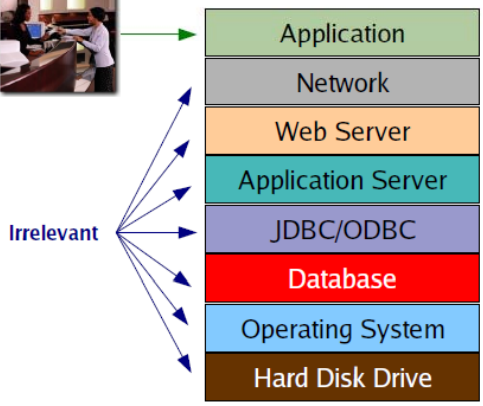
Real-world analogy

Cryptography pitfalls-3

- Encrypting at the wrong layer of the stack



The right way

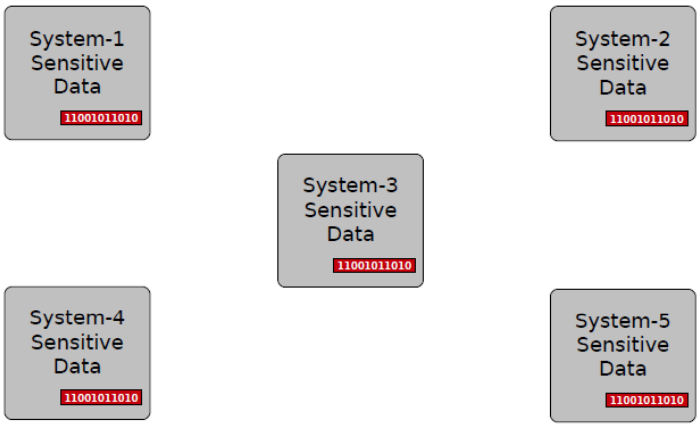


V. Solution

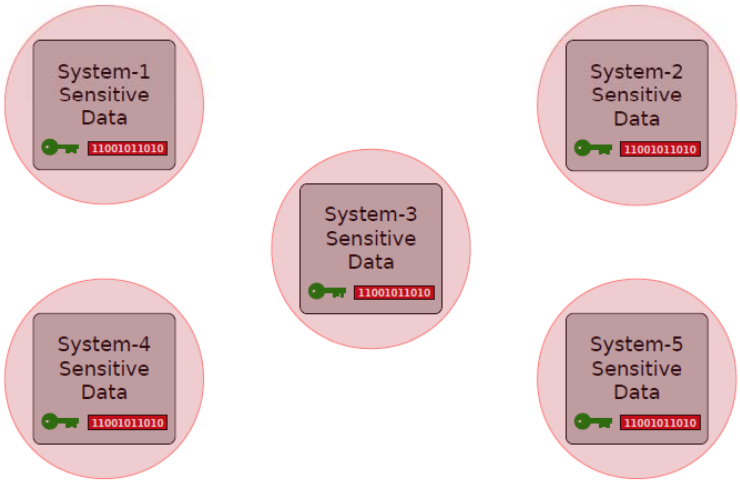
So, what do you do?

- 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 “homebrewed”
- encryption
- Follow NIST guidelines for algorithms, key-sizes

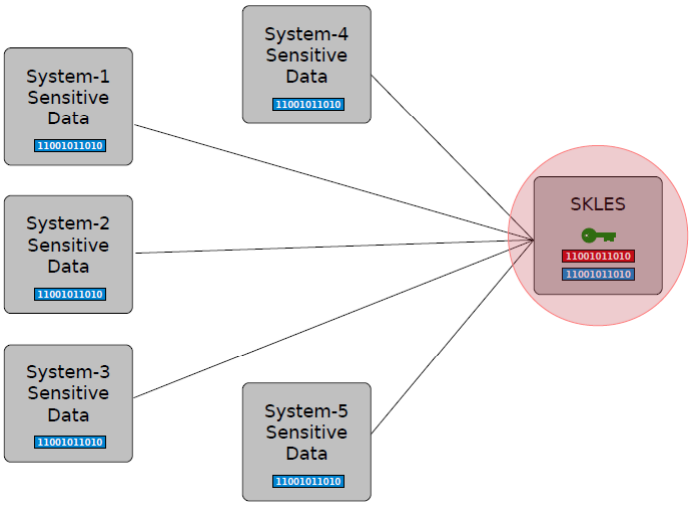
Reduce the exposure - 1



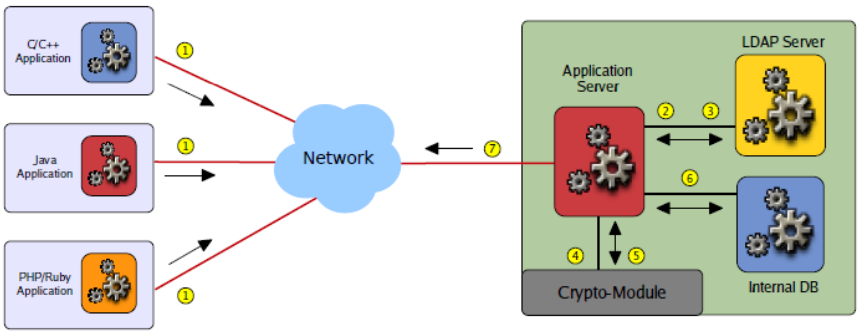
Reduce the exposure - 2



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

- Copyright © StrongAuth, Inc 2001- 2010 32
- Version 1.3
- 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 knowledgeable 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, Nevada, Washington
- Education and a long-term strategy is key to preventing crypto-chaos

Thank you.

- Questions?
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