Tokenisation: Reducing Data Security Risk

OWASP Meeting – September 3, 2009

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Agenda

- Business Drivers for Data Protection
- Approaches to Data Security
- Tokenisation to reduce audit scope and lower risk
- Examples and Case Studies
- Questions

International Data Security Mandates

- Countries
  - United Kingdom – Companies Bill
  - Data Protection Act
  - European Union – European Union Privacy Act (EUPA)
  - Japan - Japanese Personal Information Act 2003 (JPIPA)
  - Canada – Personal Information Protection and Electronic Documents Act (PIPEDA)
- Industries
  - Payment Card Industry Data Security Standard (PCI DSS)
  - Code of Practice on Data Protection for the Insurance Sector (UK)

Many more if you do business in the U.S.

- Government
  - Sarbanes Oxley Act
  - Gramm Leach Bliley Bill
  - Healthcare Insurance Portability & Accountability Act (HIPAA)
  - Part 11 of the Title 21 Code of Federal Regulations
  - California State Bill 1386
- Industry
  - Payment Card Industry Data Security Standard (PCI DSS)
  - Healthcare Insurance Portability & Accountability Act (HIPAA)
- Company
  - Secure FTP - Bank of America, BankOne
  - AS2 - Walmart, Food Lion, McKesson

Data Security impacts a wide range of sensitive data

Payment Card Industry Data Security Standard (PCI DSS)

Credit / Debit Card Numbers

Other Personally Identifiable Information

Passport Number
Date/Place of Birth
Postal or Email Address
Telephone Numbers (home/mobile)
Mother's Maiden Name
Biometric Data
Unique Electronic Number, Address, or Routing Code
Telecommunication Id Information or Access Device

Laws

National Insurance Number
Social Security Number
Driver’s License Number
Bank Account Numbers
etc.

Healthcare

Medical related information
(Patient / Doctor, etc.)

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Approaches to Data Security

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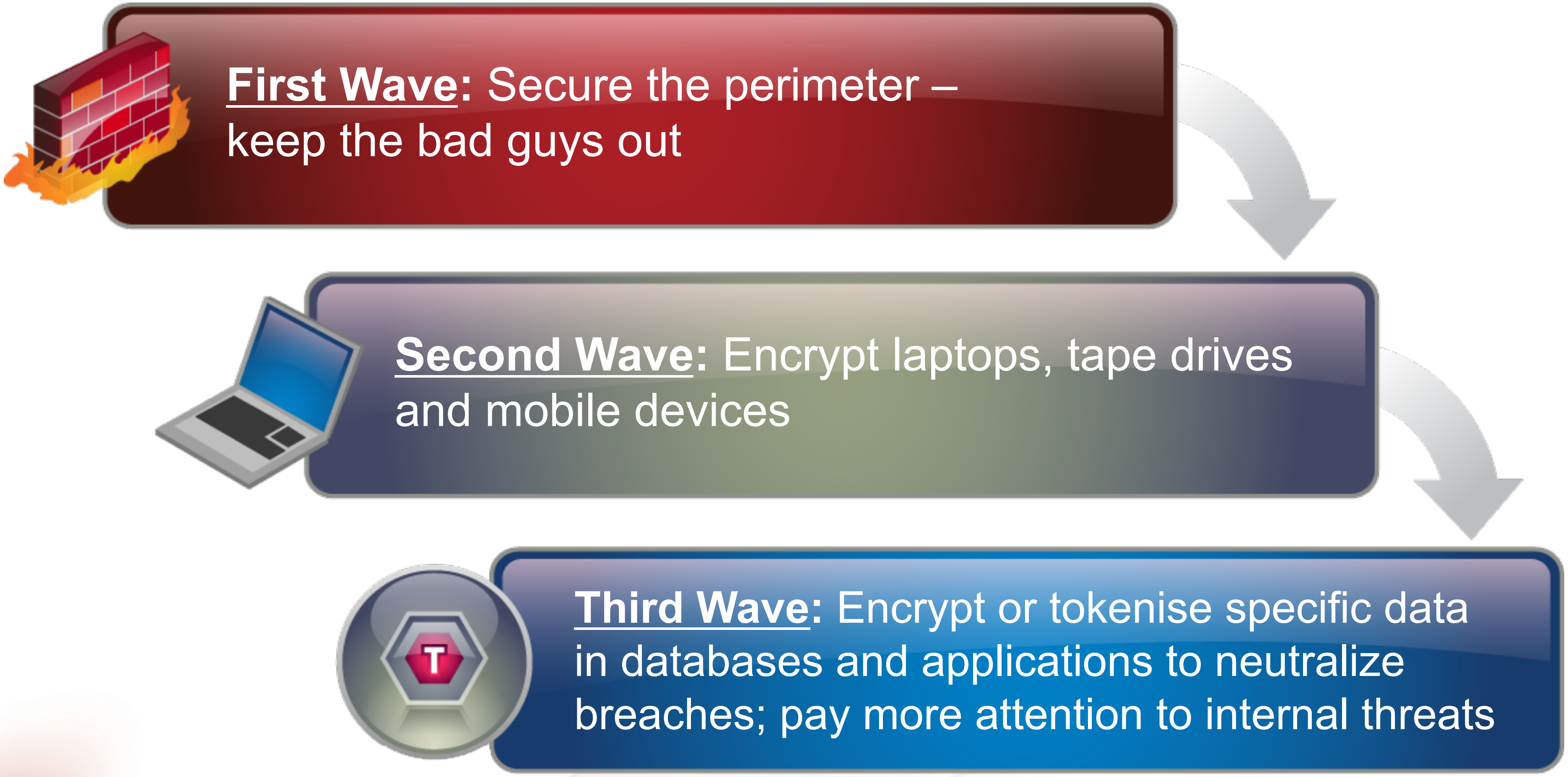
Waves of Data Protection Investment



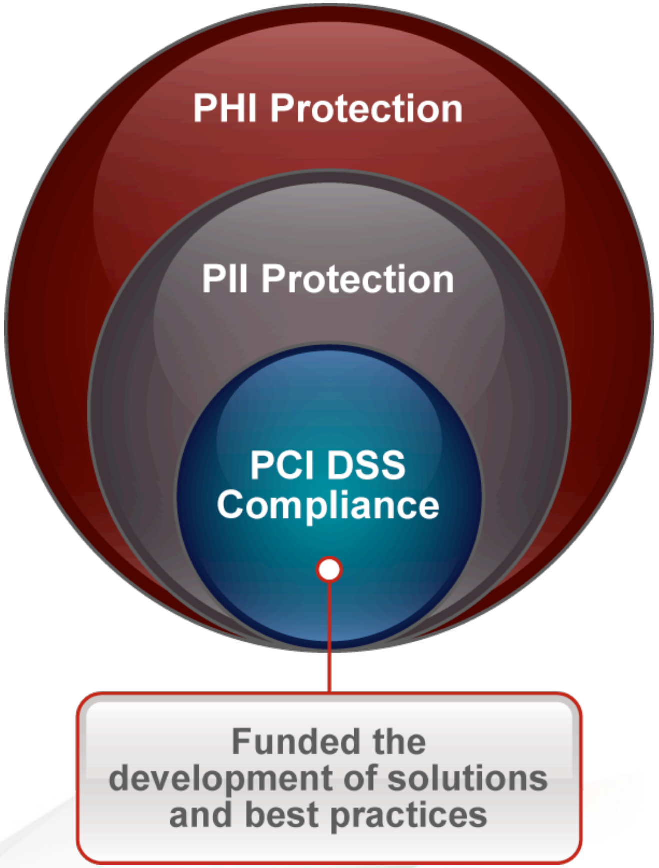
First Wave: Secure the perimeter – keep the bad guys out

Second Wave: Encrypt laptops, tape drives and mobile devices

Third Wave: Encrypt or tokenise specific data in databases and applications to neutralize breaches; pay more attention to internal threats

Trend in securing sensitive data

Boundary moving inward
to the data itself



Funded the development of solutions and best practices

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PCI DSS Driving Best Practices

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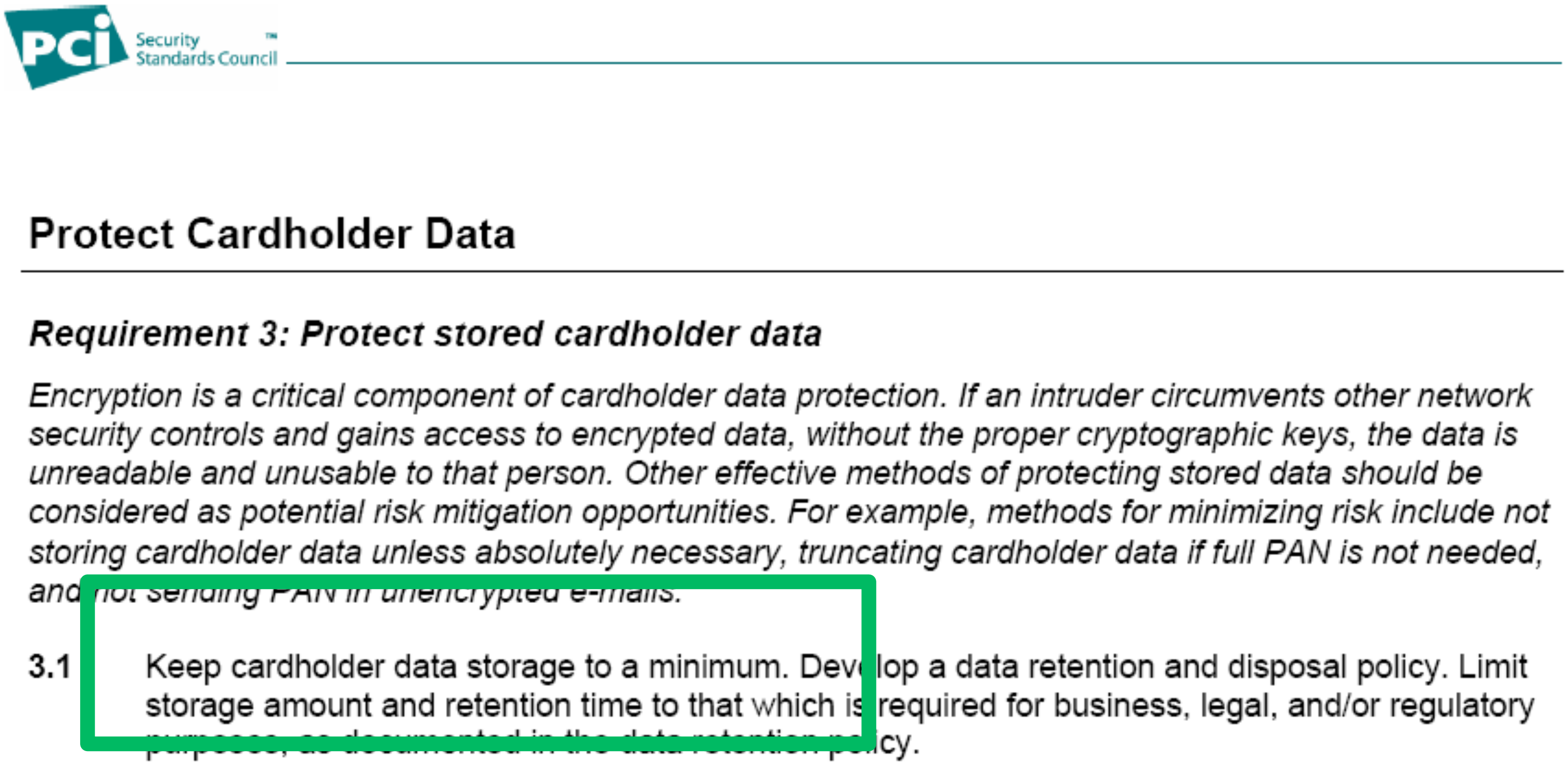
PCI DSS 3.1 – Minimise cardholder data storage



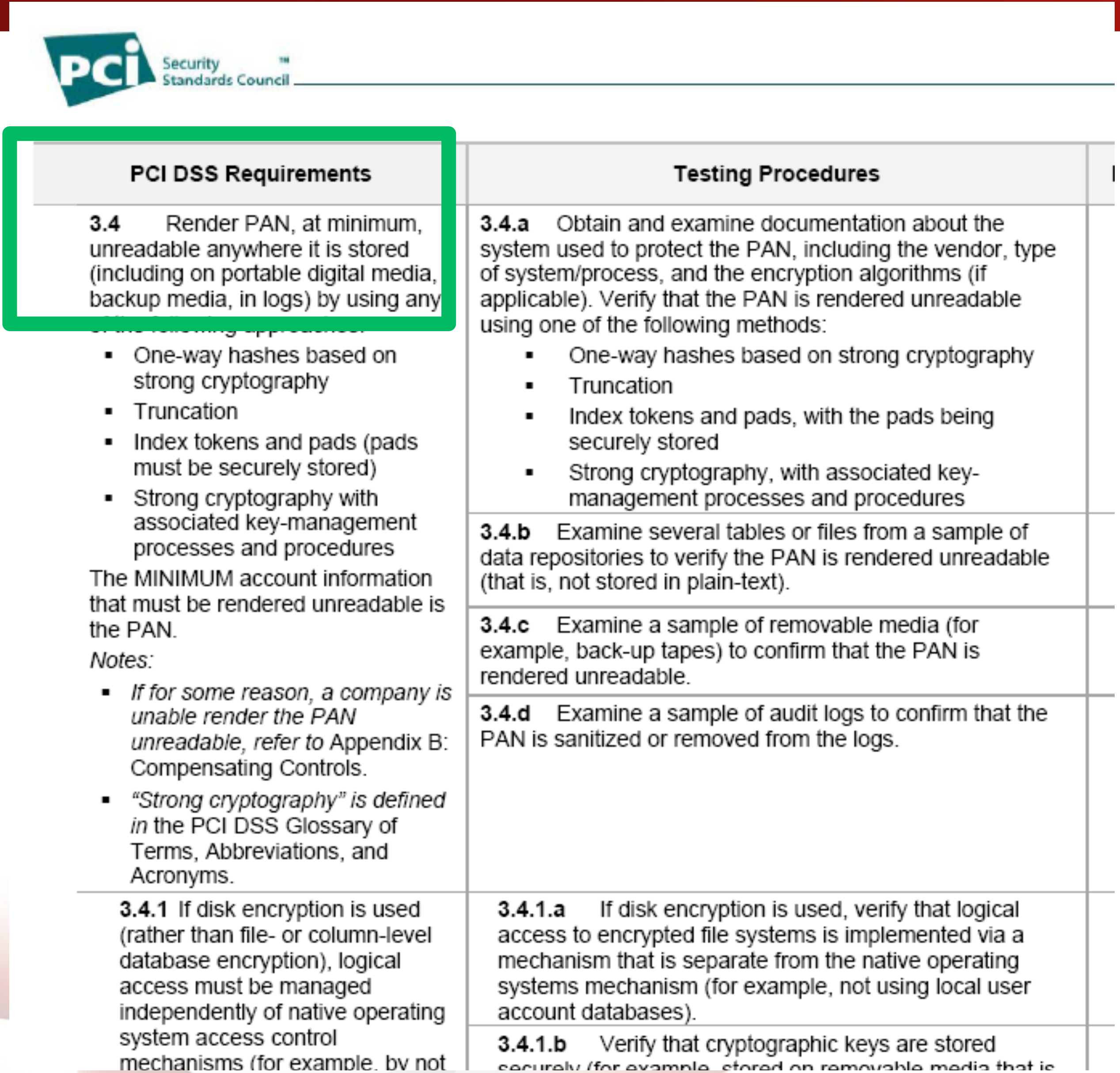
Protect Cardholder Data

Requirement 3: Protect stored cardholder data

Encryption is a critical component of cardholder data protection. If an intruder circumvents other network security controls and gains access to encrypted data, without the proper cryptographic keys, the data is unreadable and unusable to that person. Other effective methods of protecting stored data should be considered as potential risk mitigation opportunities. For example, methods for minimizing risk include not storing cardholder data unless absolutely necessary, truncating cardholder data if full PAN is not needed, and not sending PAN in unencrypted e-mails.

3.1 Keep cardholder data storage to a minimum. Develop a data retention and disposal policy. Limit storage amount and retention time to that which is required for business, legal, and/or regulatory purposes, as documented in the data retention policy.

PCI DSS 3.4 – Render PAN unreadable



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PCI DSS Requirements	Testing Procedures
3.4 Render PAN, at minimum, unreadable anywhere it is stored (including on portable digital media, backup media, in logs) by using any of the following approaches: ▪ One-way hashes based on strong cryptography ▪ Truncation ▪ Index tokens and pads (pads must be securely stored) ▪ Strong cryptography with associated key-management processes and procedures The MINIMUM account information that must be rendered unreadable is the PAN. *Notes:* ▪ *If for some reason, a company is unable render the PAN unreadable, refer to* Appendix B: Compensating Controls. ▪ *"Strong cryptography" is defined in* the PCI DSS Glossary of Terms, Abbreviations, and Acronyms.	**3.4.a** Obtain and examine documentation about the system used to protect the PAN, including the vendor, type of system/process, and the encryption algorithms (if applicable). Verify that the PAN is rendered unreadable using one of the following methods: ▪ One-way hashes based on strong cryptography ▪ Truncation ▪ Index tokens and pads, with the pads being securely stored ▪ Strong cryptography, with associated key-management processes and procedures
	3.4.b Examine several tables or files from a sample of data repositories to verify the PAN is rendered unreadable (that is, not stored in plain-text).
	3.4.c Examine a sample of removable media (for example, back-up tapes) to confirm that the PAN is rendered unreadable.
	3.4.d Examine a sample of audit logs to confirm that the PAN is sanitized or removed from the logs.
3.4.1 If disk encryption is used (rather than file- or column-level database encryption), logical access must be managed independently of native operating system access control mechanisms (for example, by not	**3.4.1.a** If disk encryption is used, verify that logical access to encrypted file systems is implemented via a mechanism that is separate from the native operating systems mechanism (for example, not using local user account databases).
	3.4.1.b Verify that cryptographic keys are stored securely (for example, stored on removable media that is

Options

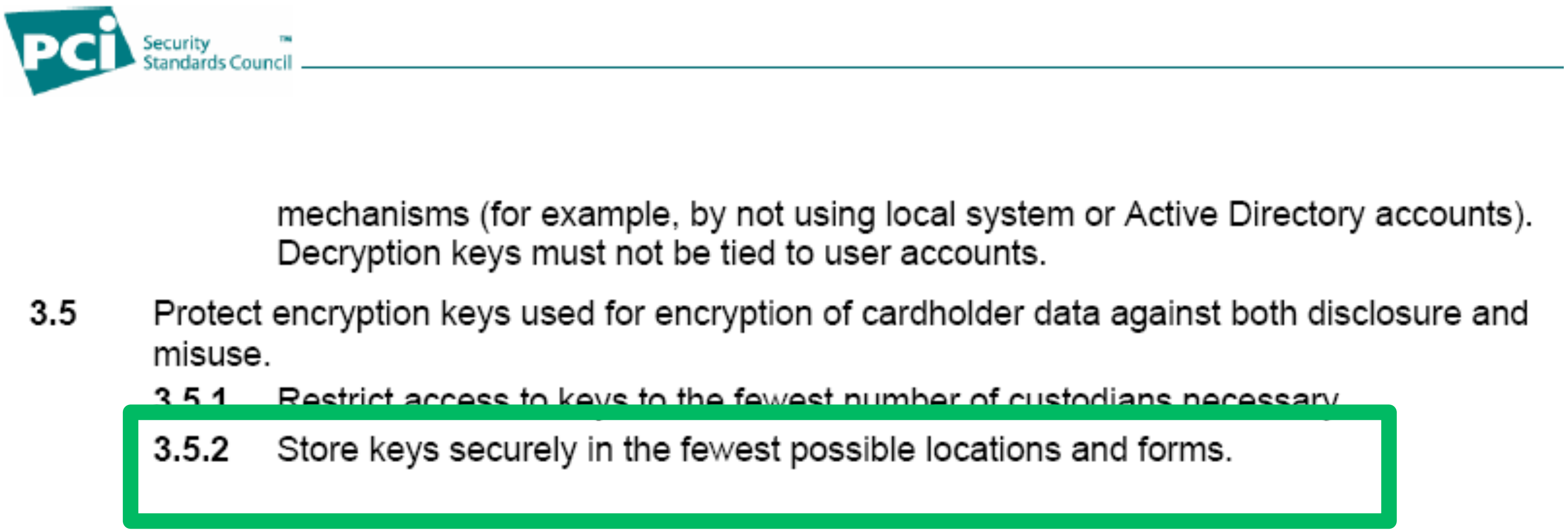
Hashing

Truncation

Tokens

Strong cryptography

PCI DSS 3.5 – Minimize key locations



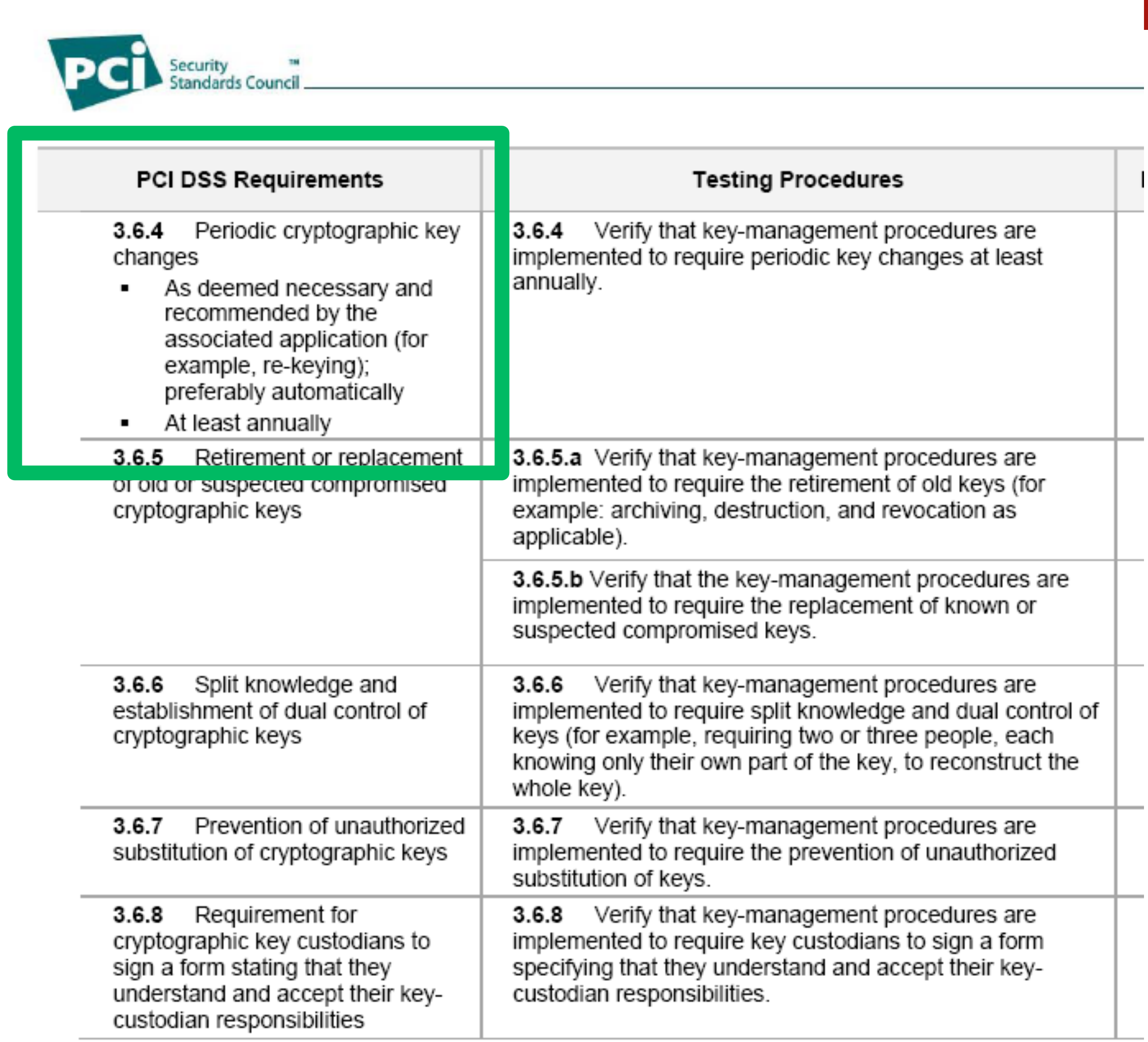
mechanisms (for example, by not using local system or Active Directory accounts). Decryption keys must not be tied to user accounts.

3.5 Protect encryption keys used for encryption of cardholder data against both disclosure and misuse.

3.5.1 Restrict access to keys to the fewest number of custodians necessary

3.5.2 Store keys securely in the fewest possible locations and forms.

PCI DSS 3.6 – Rotate Keys Annually



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PCI DSS Requirements	Testing Procedures
3.6.4 Periodic cryptographic key changes ▪ As deemed necessary and recommended by the associated application (for example, re-keying); preferably automatically ▪ At least annually	**3.6.4** Verify that key-management procedures are implemented to require periodic key changes at least annually.
3.6.5 Retirement or replacement of old or suspected compromised cryptographic keys	**3.6.5.a** Verify that key-management procedures are implemented to require the retirement of old keys (for example: archiving, destruction, and revocation as applicable).
	3.6.5.b Verify that the key-management procedures are implemented to require the replacement of known or suspected compromised keys.
3.6.6 Split knowledge and establishment of dual control of cryptographic keys	**3.6.6** Verify that key-management procedures are implemented to require split knowledge and dual control of keys (for example, requiring two or three people, each knowing only their own part of the key, to reconstruct the whole key).
3.6.7 Prevention of unauthorized substitution of cryptographic keys	**3.6.7** Verify that key-management procedures are implemented to require the prevention of unauthorized substitution of keys.
3.6.8 Requirement for cryptographic key custodians to sign a form stating that they understand and accept their key-custodian responsibilities	**3.6.8** Verify that key-management procedures are implemented to require key custodians to sign a form specifying that they understand and accept their key-custodian responsibilities.

and …

- **secure the keys,**
- **know which keys are used for which data,**
- **run your business,**

….

Challenges of PCI DSS Compliance

- Store Card Holder Data (CHD) in fewest number of places
- Protect CHD wherever it is stored
- Store cryptographic keys in fewest number of places
- Rotate cryptographic keys at least annually

Tokenisation to reduce audit scope and lower risk

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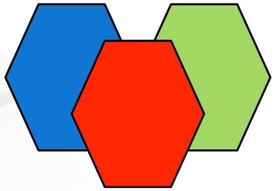
What kind of token are we talking about?

- It's not the same as the 'token' used for two-factor authentication
- It's not the 'token' used for lexical analysis in a programming language

- In data security, it's a **surrogate value** which is substituted for the actual data (e.g. credit card) while the **actual data is encrypted** and stored elsewhere.



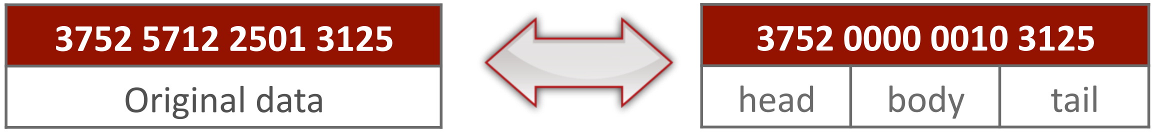
Tokens act as data surrogates

- Tokens maintain the length and format of the original data
- After tokenisation - tokens now reside where sensitive data previously resided in the application infrastructure
  - Input: sensitive data Output: token
  - Input: token Output: sensitive data
- **Limits or eliminates modifications to applications.**

Format Preserving Tokenisation

Tokens can be formatted to:

- Preserve the format (length and data type), and leading/trailing



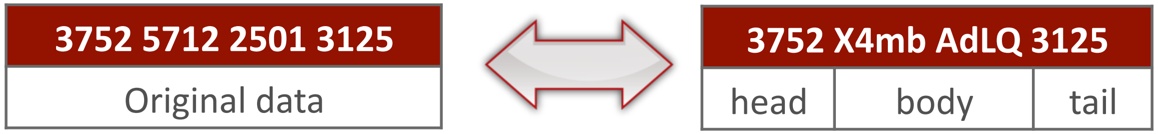
3752 5712 2501 3125

Original data

3752 0000 0010 3125

head | body | tail

- Preserve length but not data type, and leading/trailing



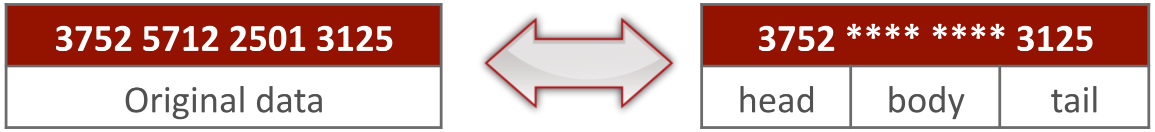
3752 5712 2501 3125

Original data

3752 X4mb AdLQ 3125

head | body | tail

- Mask a portion of the token when a full value is not needed or desirable (can't be subsequently translated back)



3752 5712 2501 3125

Original data

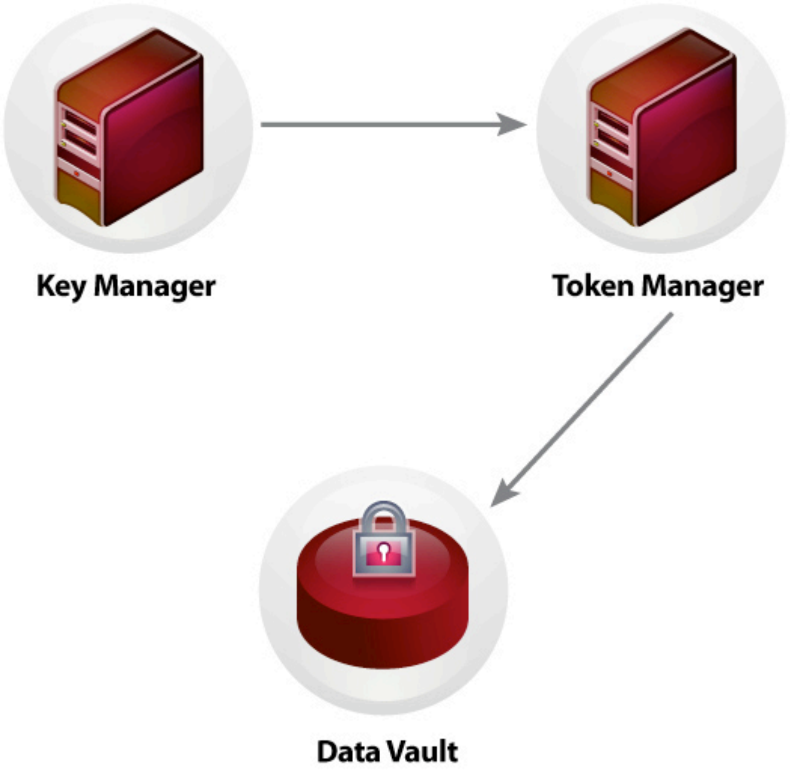
3752 **** **** 3125

head | body | tail

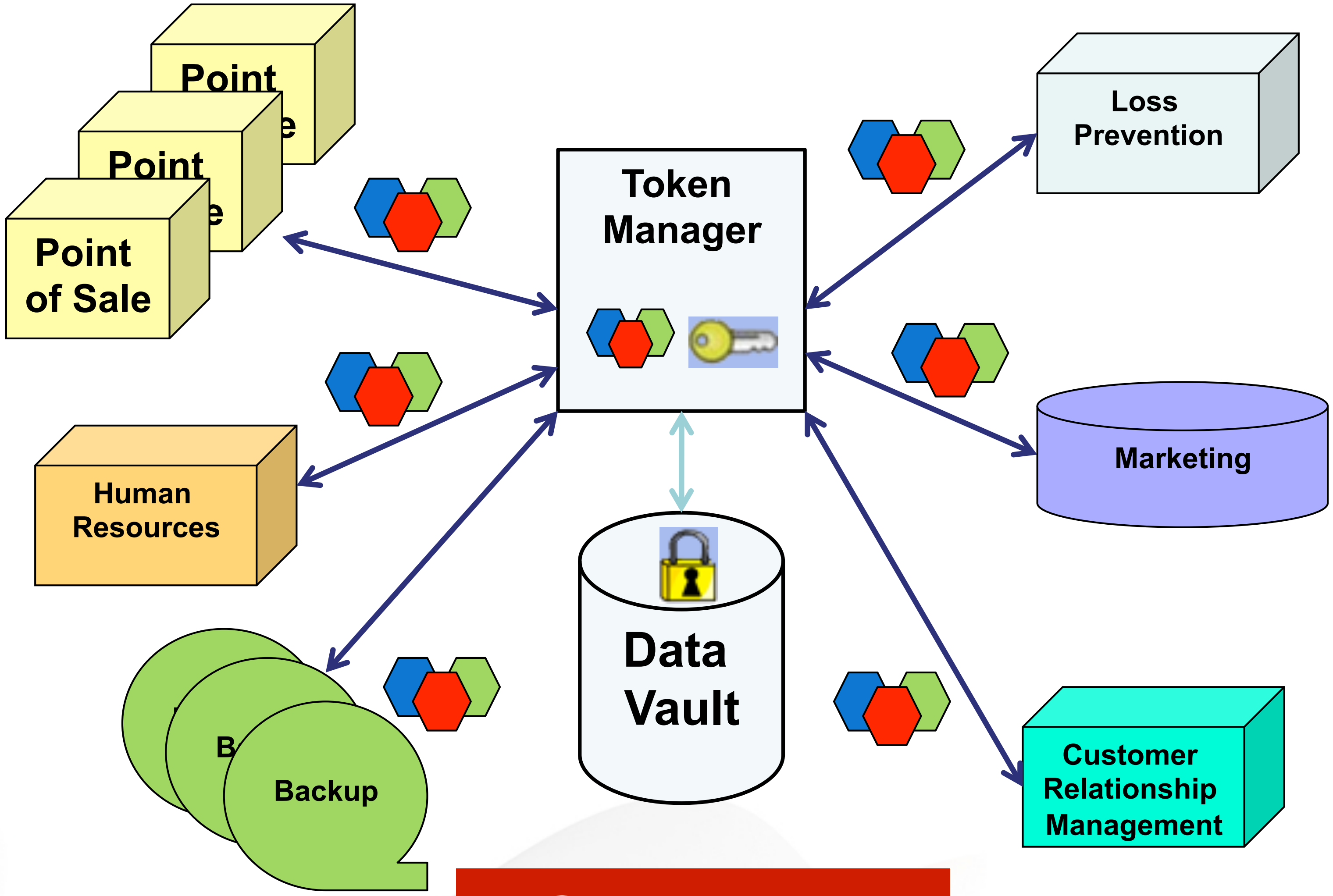
- Tokens generally maintain the length and format of the original data so that applications require little or no modification.

Centralised Data Vault

- Protected Data Vault where sensitive data is encrypted and stored
  - Reduces the footprint where sensitive data is located
  - Eliminates points of risk
  - Simplifies security management



Tokenisation Model



Tokens
Keys
Ciphertext

worldwide.

Ciphertext in data vault

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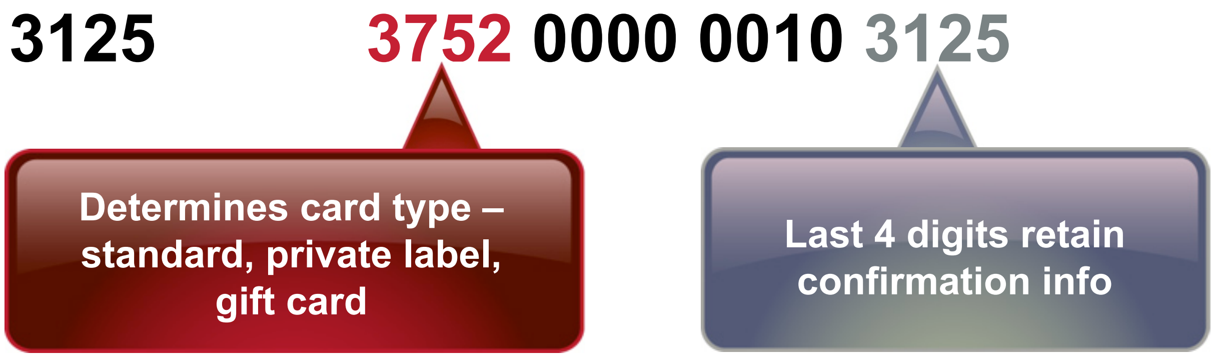
Tokens are surrogates for masked data

- Formatted tokens can be used wherever masked credit card information is required

USING CREDIT CARD NUMBER

3752 5712 2501 3125

USING TOKEN



3752 0000 0010 3125

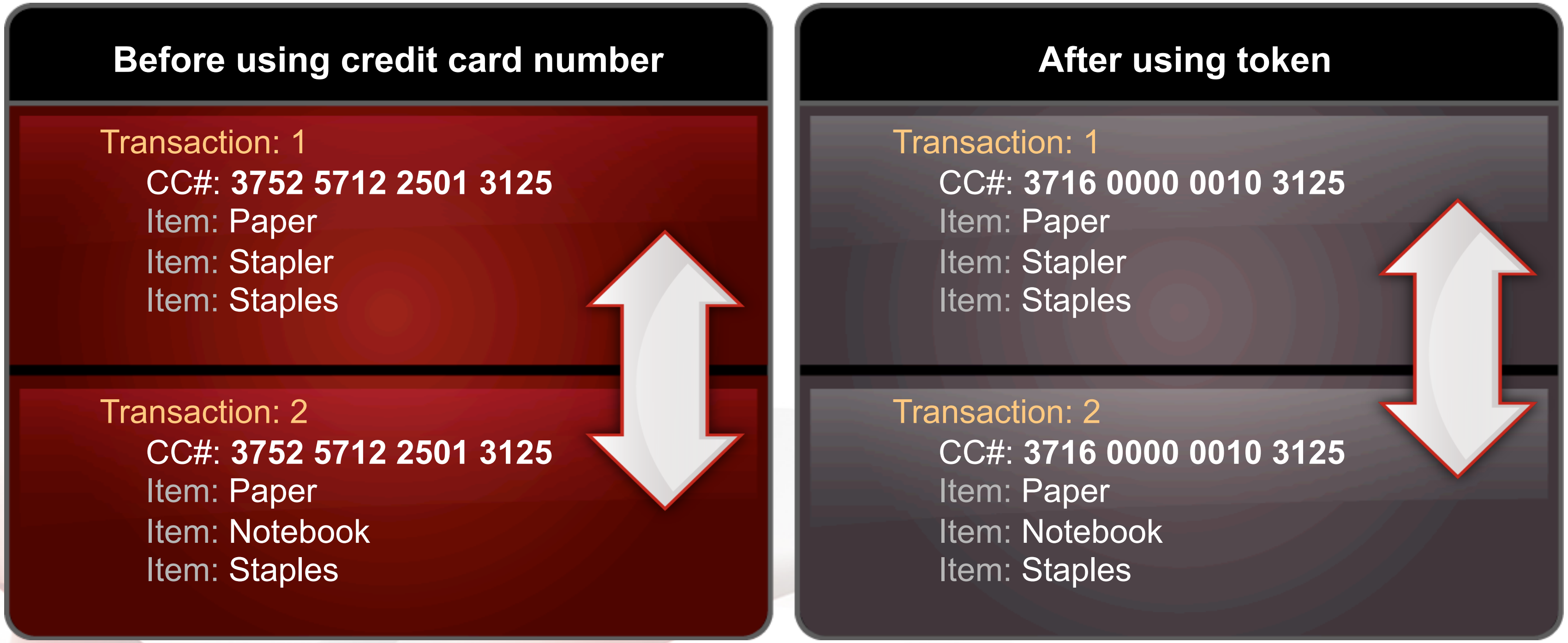
Determines card type – standard, private label, gift card

Last 4 digits retain confirmation info

- Therefore wherever tokenised data suffices, risk is reduced

1:1 Token / Data Relationship

- Same token value is consistent for same data across entire enterprise; maintains **referential integrity** across applications
- Data analysis can be performed using token – e.g. data warehouse



Before using credit card number

Transaction: 1
CC#: **3752 5712 2501 3125**
Item: Paper
Item: Stapler
Item: Staples

Transaction: 2
CC#: **3752 5712 2501 3125**
Item: Paper
Item: Notebook
Item: Staples

After using token

Transaction: 1
CC#: **3716 0000 0010 3125**
Item: Paper
Item: Stapler
Item: Staples

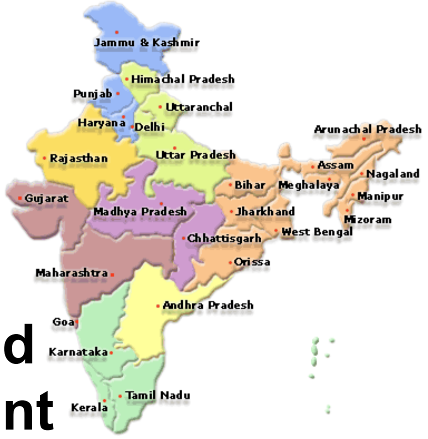
Transaction: 2
CC#: **3716 0000 0010 3125**
Item: Paper
Item: Notebook
Item: Staples

Tokens Not Derived from Data

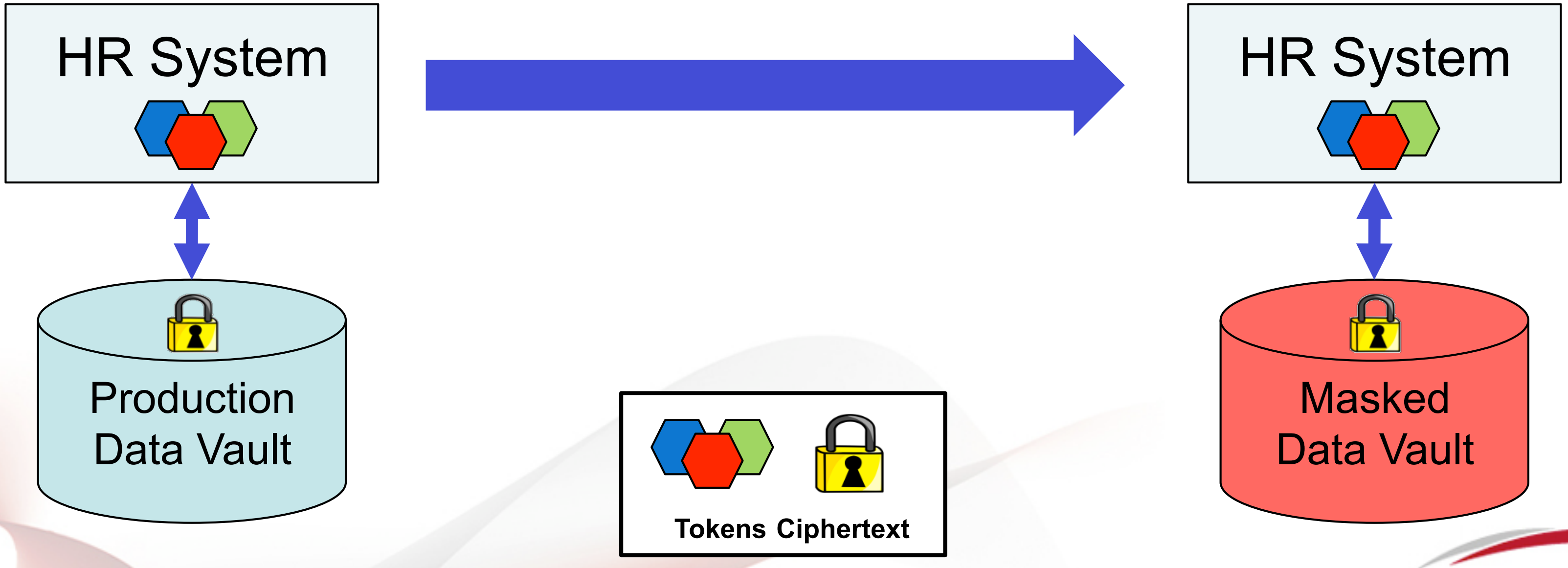
- Original data values cannot be mathematically derived from tokens
  - Tokens can be safely passed to databases, applications, mobile devices, etc.
- Token has no intrinsic value
- Solves the age-old problem of data for development and testing – it can be the same as production!

Test systems use ‘production tokens’

Production HR System Germany



Outsourced Development India



HR System

HR System

Production Data Vault

Masked Data Vault

Tokens Ciphertext

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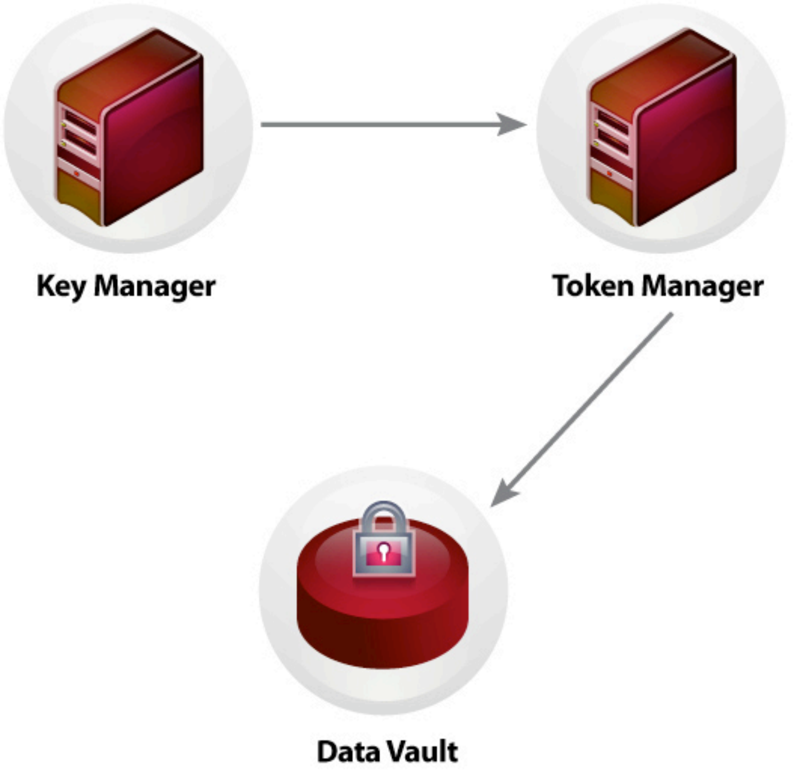
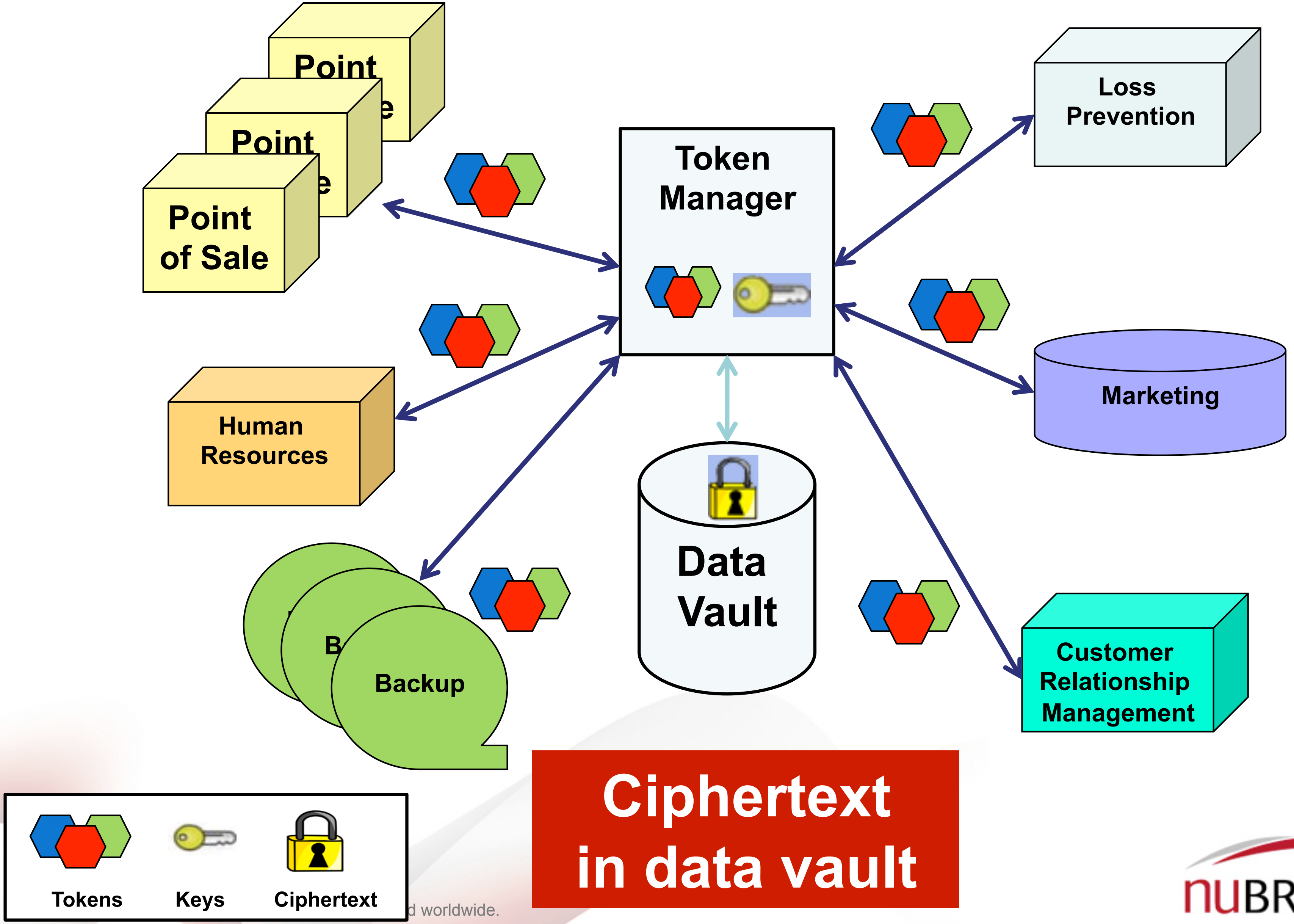
Centralised Key Management

- Control over who accesses sensitive data
- Rotate keys without having to decrypt and re-encrypt old data, and no system downtime
- Keys are distributed to token server, not throughout enterprise



Examples and Case Studies

Tokenisation Model



Point of Sale

Token Manager

Loss Prevention

Marketing

Human Resources

Data Vault

Backup

Customer Relationship Management

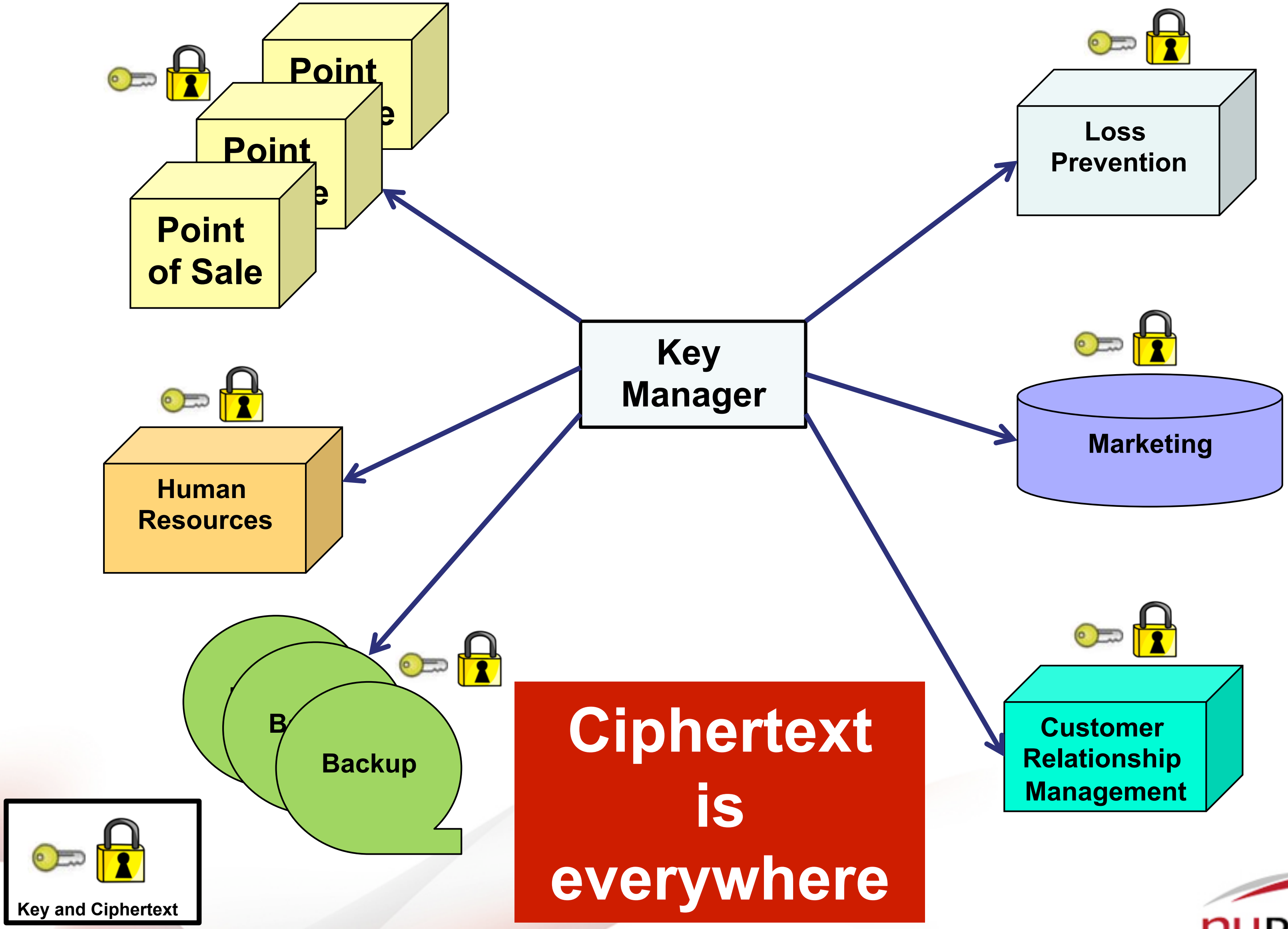
Tokens

Keys

Ciphertext

Ciphertext in data vault

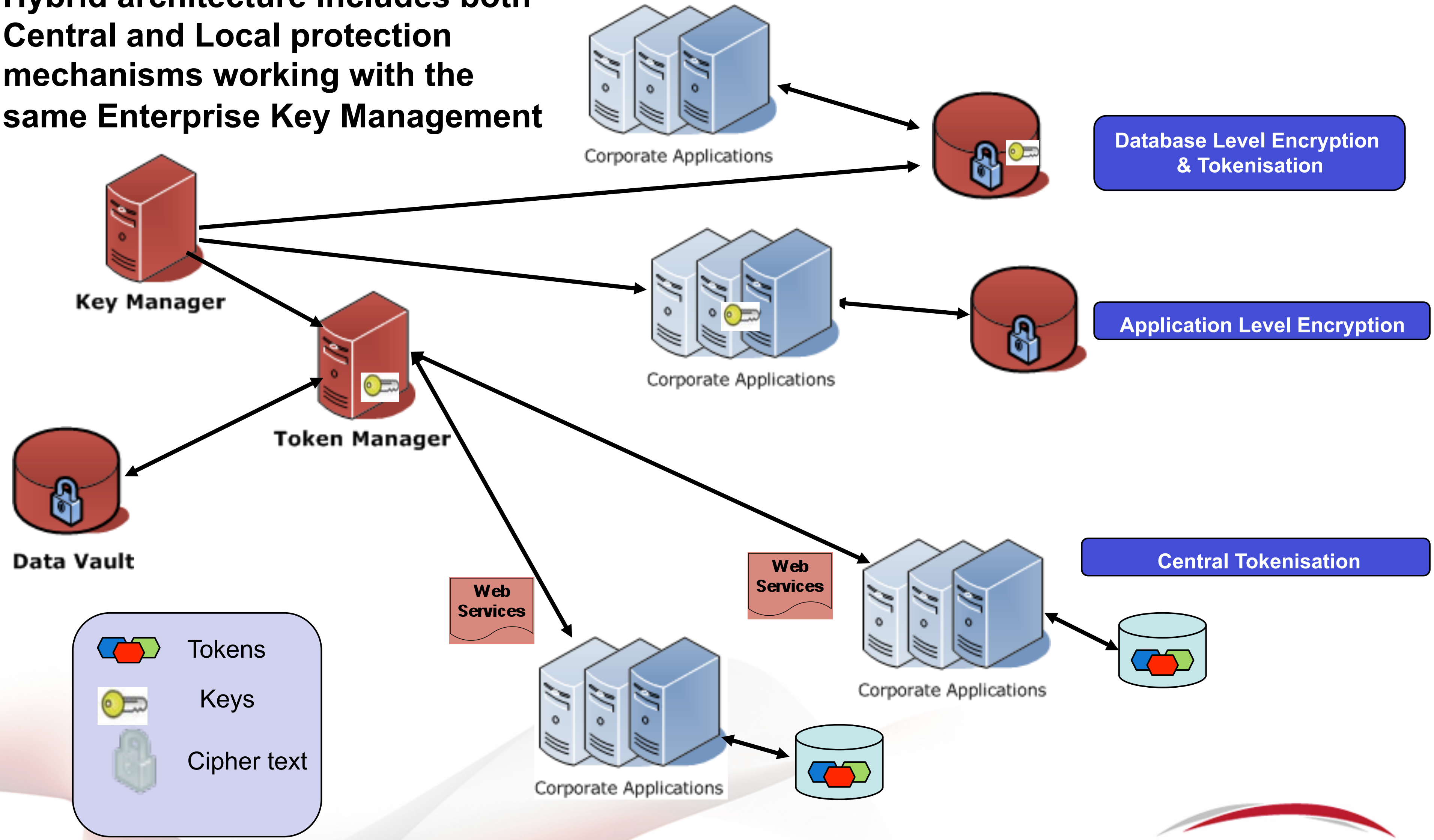
Localised Encryption Model



Ciphertext is everywhere

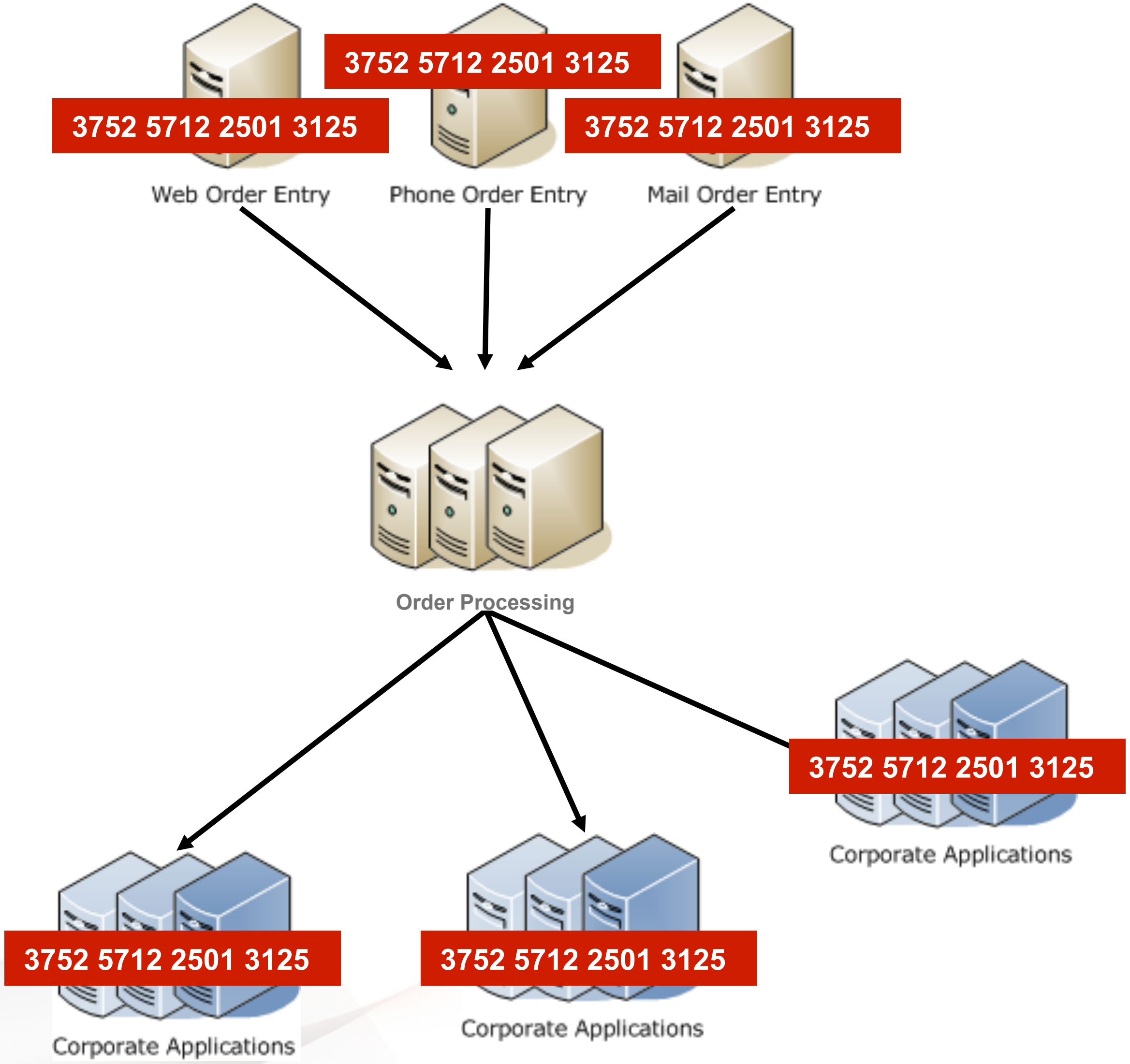
Hybrid Model – Tokenization and Localised Encryption

Hybrid architecture includes both Central and Local protection mechanisms working with the same Enterprise Key Management

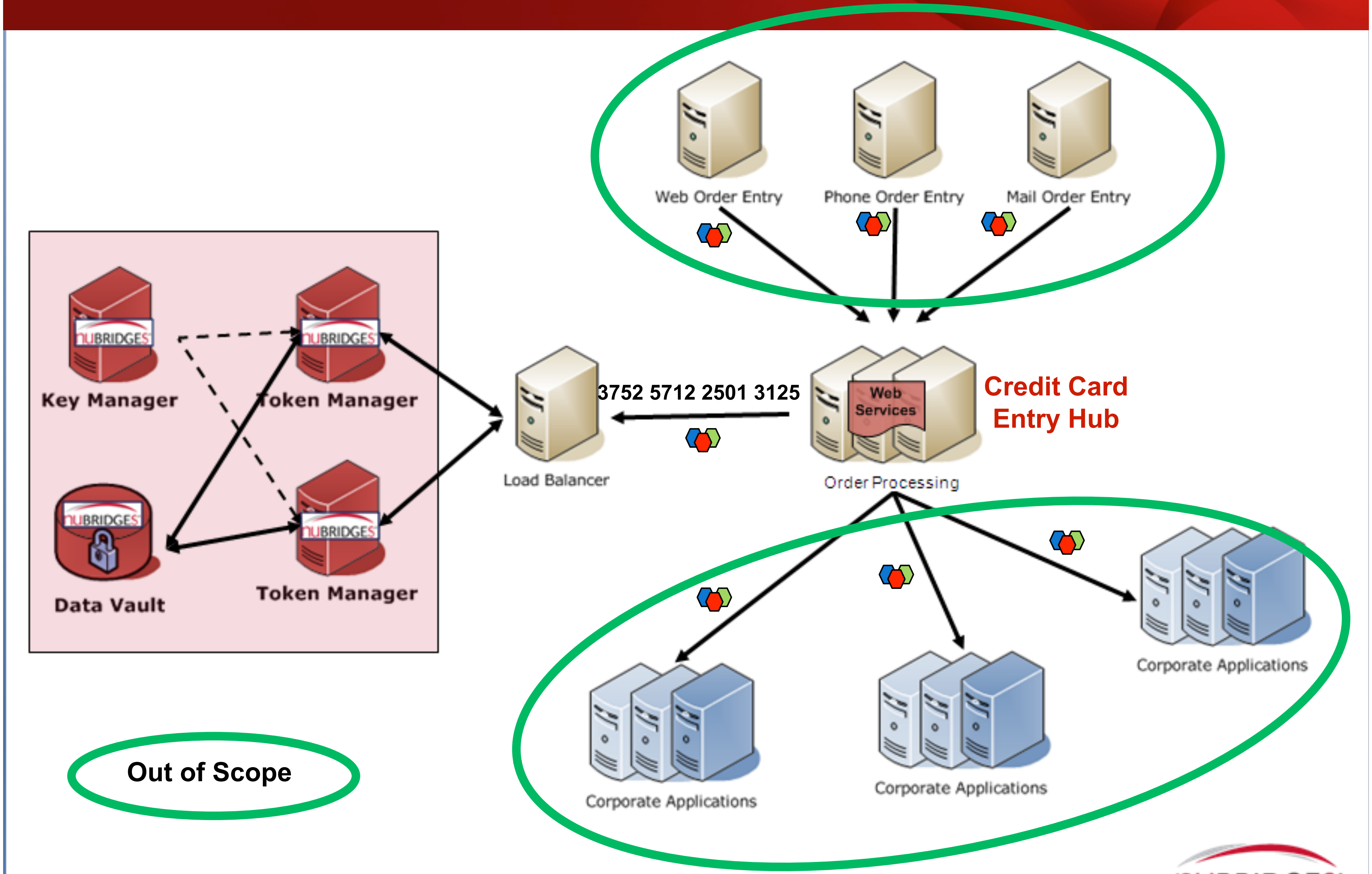


Before: Order Flow without Tokenisation

80+ systems in PCI DSS scope



After: Order Flow with Tokenisation



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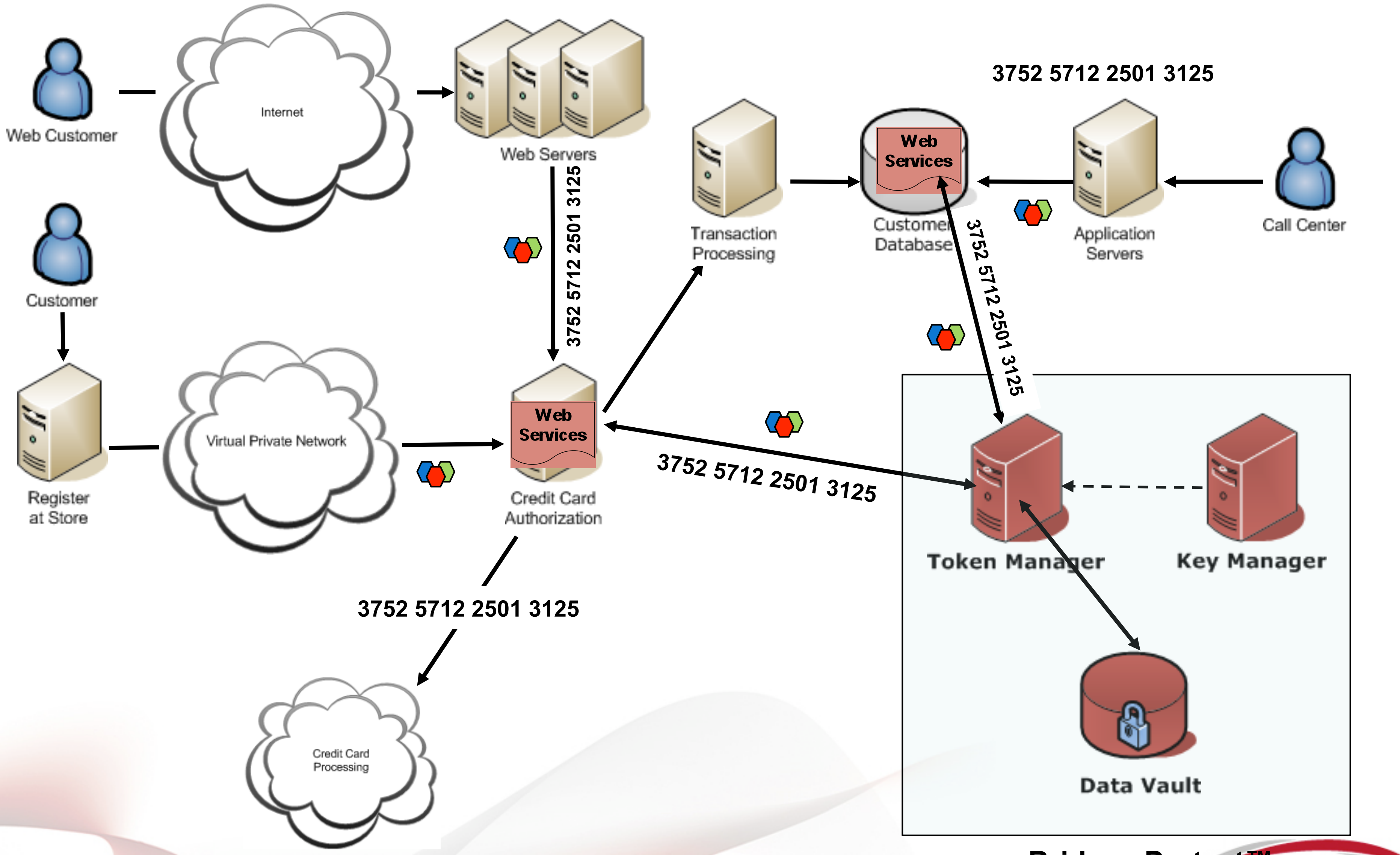
Case Study 2: Order Flow with Tokenisation



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Thank you!

Questions?

For more information, visit:
http://nubridges.com/resource-center/

White Paper: Best Practices in Data Protection: Encryption, Key Management and Tokenization

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