NDN-BMS Security: Requirements and Solution

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Application scenario

- NDN-BMS collects sensor data from UCLA campus and publishes the data into an NDN repo.
- Multiple users have access to the data.
- Different users have different access privileges.
Security requirements

• Authenticity & Integrity: each data packet is verifiable

• Confidentiality: only authorized user can access BMS data

• Scalability: security mechanism need to scale to a large number of users
Current solution

- Authenticity & Integrity:
  - Every data packet is signed by the data publisher (a gateway connected to sensors)
  - Gateway’s public key is certified by some higher-level authority (e.g., building manager), which is certified by the top manager (using the root key)
  - Every entity in the system trusts the root key
Current solution

- Confidentiality: encryption-based access control
  - All BMS data is encrypted with a symmetric key
  - Users gain access to the data by acquiring the encryption key
Encryption key distribution

- Users are identified by their public keys
- The data encryption key (DEK) is encrypted by the authorized user’s public key and published as normal NDN data
- DEK is updated periodically, or whenever a user changes privilege (e.g., adding or dropping access to some data)
Scalability issue in DEK management

- The first prototype publishes DEK for each user as a separate data packet
  - $O(n)$ RSA encryption and $O(n)$ RSA signing
- A simple optimization: pack all encrypted DEKs into a single data packet
  - $O(n)$ RSA encryption and $O(1)$ RSA signing
A better(?) solution

- Recommended by RFC 2627: hierarchical key management (designed for secure multicast)
Scalable user deletion

- $O(\log(n))$ updates vs. $O(n)$ updates in old scheme
- Cost: more keys to manage & transmit

![Key Management Diagram]

- $E(K1, DEK')$
- $E(K2', DEK')$
- $E(K3, K1)$
- $E(K4, K1)$
- $E(K5', K2')$
- $E(K6', K2')$
- $E(U6, K5')$
Other issues

- Selection of cryptography
  - Symmetric vs. asymmetric encryption
  - HMAC vs. RSA signing
- Hierarchical access control
Summary

- Encryption is the most effective access control for NDN applications
- Multicast security may be a useful reference
- Hierarchical access control is a new challenge