

Privacy-Preserving Protocol Based On Bluetooth Encrypted Data Sharing

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Overview

Introduction

- Background

- Requirement

Protocol

- Analysis

- Proposed Protocol

Security and Functionalities

- Security

- Functionalities

Background

The pandemic of COVID-19 is devastating, which has caused global impact.

The "health code", as a pass for returning personnel, records the individual's health and takes the form of "green code", "red code", and "yellow code" to dynamically detect data.

Requirement

- ▶ The personal information is hidden to server
- ▶ Location and time window of infected ones is possible
- ▶ Statistical data is available
- ▶ Information transferred between parties should be protected

Analysis

- ▶ Privacy should be kept on local device except for being infected
- ▶ All data transmission process should be encrypted
- ▶ The client is anonymous to other clients and servers

Protocol I

- Periodic Rolling Exposure Key(PREK)
- Interval Proximity Identifier Key(IPIK)
- Encrypted User Metadata Key(EUMK)

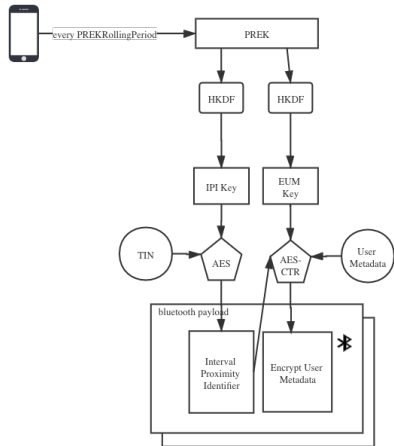


Figure: Key generation and Encryption

Protocol II

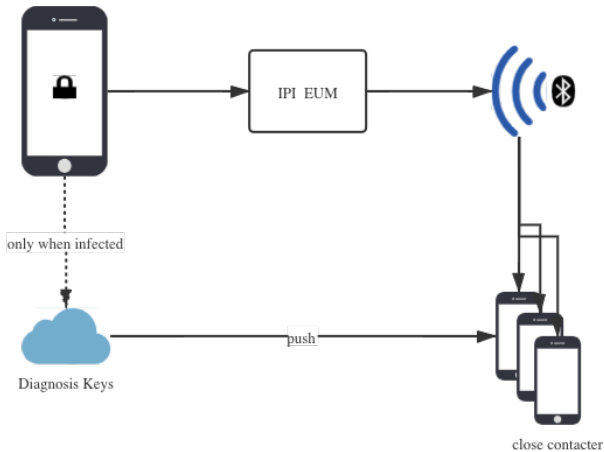
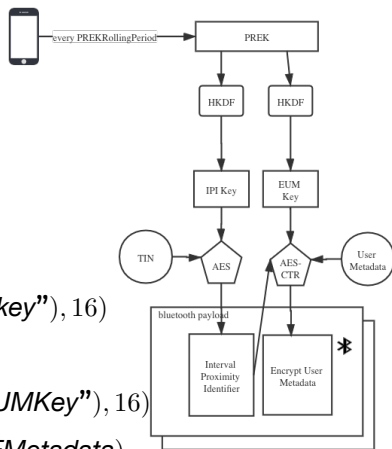


Figure: Data transmission

Mathematic Details



$$TIN(timestamp) \leftarrow timestamp / (60 \times 15)$$

$$i \leftarrow \lfloor TIN(timestamp) / PREKP \rfloor \times PREKP$$

$$PREK_i \leftarrow CRNG(16)$$

$$IPIK_i \leftarrow HKDF(PREK_i, NULL, UTF8("IPIkey"), 16)$$

$$IPI_{i,j} \leftarrow AES_{128}(IPIK_i, 0 || TIN_j)$$

$$EUMK_i \leftarrow HKDF(PREK_i, NULL, UTF8("EUMKey"), 16)$$

$$EUM_{i,j} \leftarrow AES_{128-CTR}(EUMK_i, IPI_{i,j}, BLEMetadata)$$

Figure: Key generation and Encryption

Security

- ▶ Only infector's Periodic Rolling Exposure Key will upload to the cloud server
- ▶ The encrypted metadata cannot be decrypted without PREK
- ▶ Client-to-client communication is based on authenticated Bluetooth data transmission

Functionalities

- ▶ Data statistics is possible as the register data can be collected.
- ▶ Location and time windows of infected can be tracing.

The End