Lux: Enabling Ephemeral Authorization for Display-Limited IoT Devices

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Introduction

- Smart Speakers and Smart hubs – Google Home and Amazon Echo
- Uses are increasing by the day – online service access
- Widespread adoption – Hotels, conference rooms

Key Differences

Permanent Space

Temporary Space

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Long term ownership
Fully Private Space
One time authorization

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Semi Private Space
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Key Differences

Permanent Space

Issues:
1. No display – Is an issue when we want to authenticate regularly
2. Built keeping long term authorization in mind
3. Not user aware – Hotel staff misusing the authorized hub

Temporary Space

Long term ownership
Fully Private Space
One time authorization

Short Term Ownership
Semi Private Space
Temporary Authorization

Lux : Ephemeral Authorization

- System was designed to improve security in temporary environments like hotels and conference rooms.
- Requirements of such a system:

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- System was designed to improve security in temporary environments like hotels and conference rooms.
- Requirements of such a system:
  - Easy first time Authorization
  - Temporarily and Spatially bound on device Authorization
  - Enforce principle of least privilege
  - Deployable

Lux Mechanisms

- Authorization Protocols
  - First Authorization
  - Second Authorization
  - Authorization state machine

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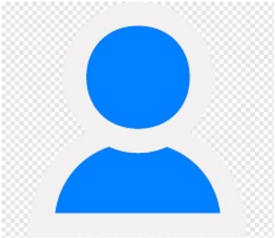
- Authorization Protocols
  - First Authorization
  - Second Authorization
  - Authorization state machine
- Automated Co presence detection
  - Creation of Initial Signature
  - Verification of test signatures

Participants



User

Smartphone

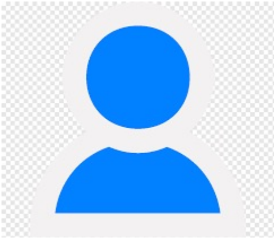
Root Service

Google Home

Online service

Participants

Usually provided by the same company => Easy deployment



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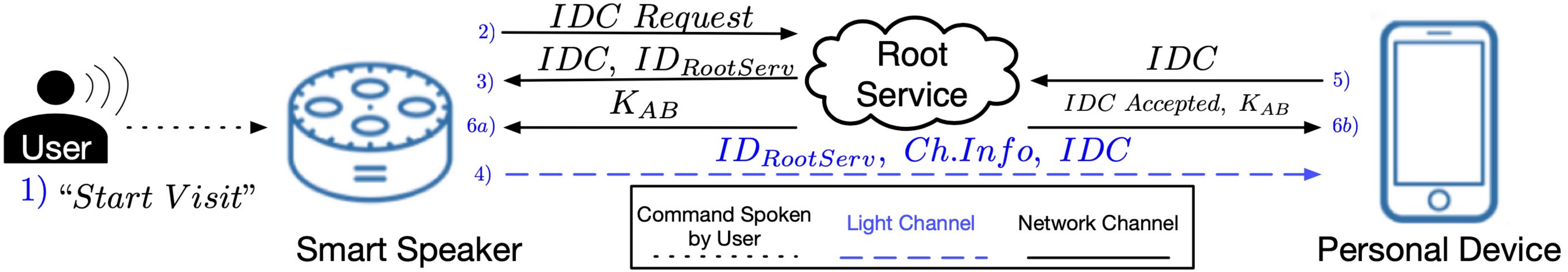
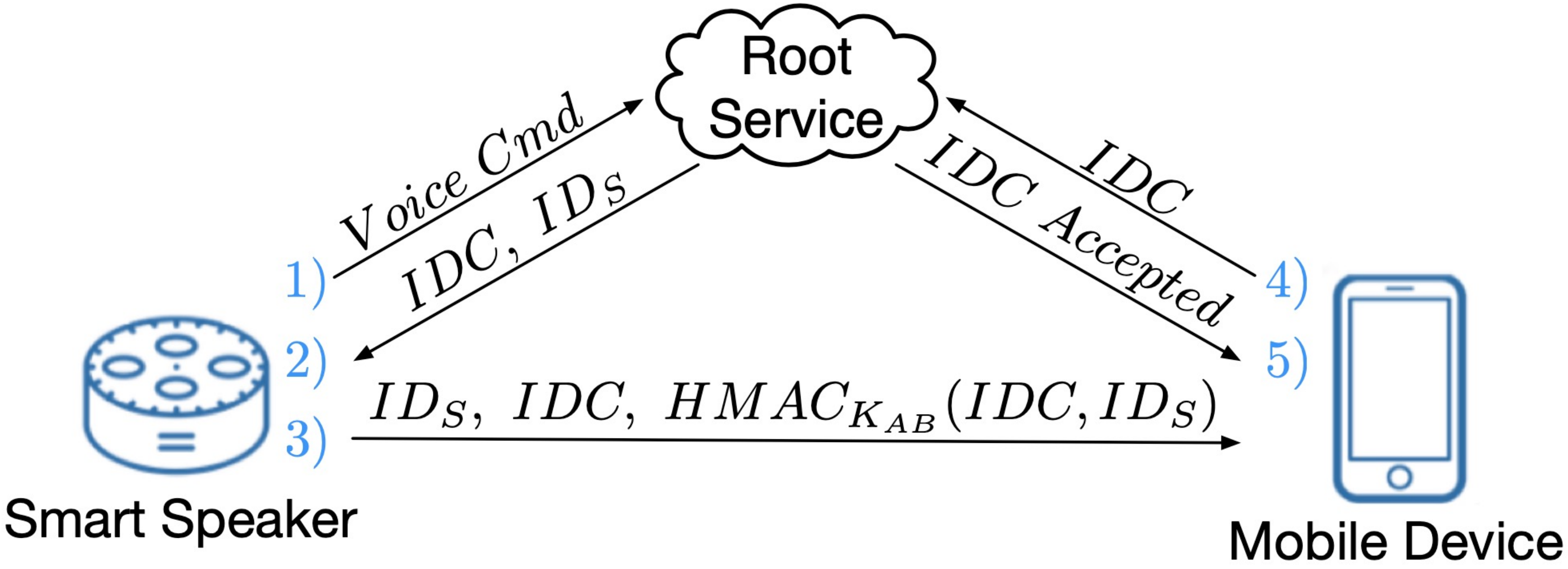


First Authorization Step

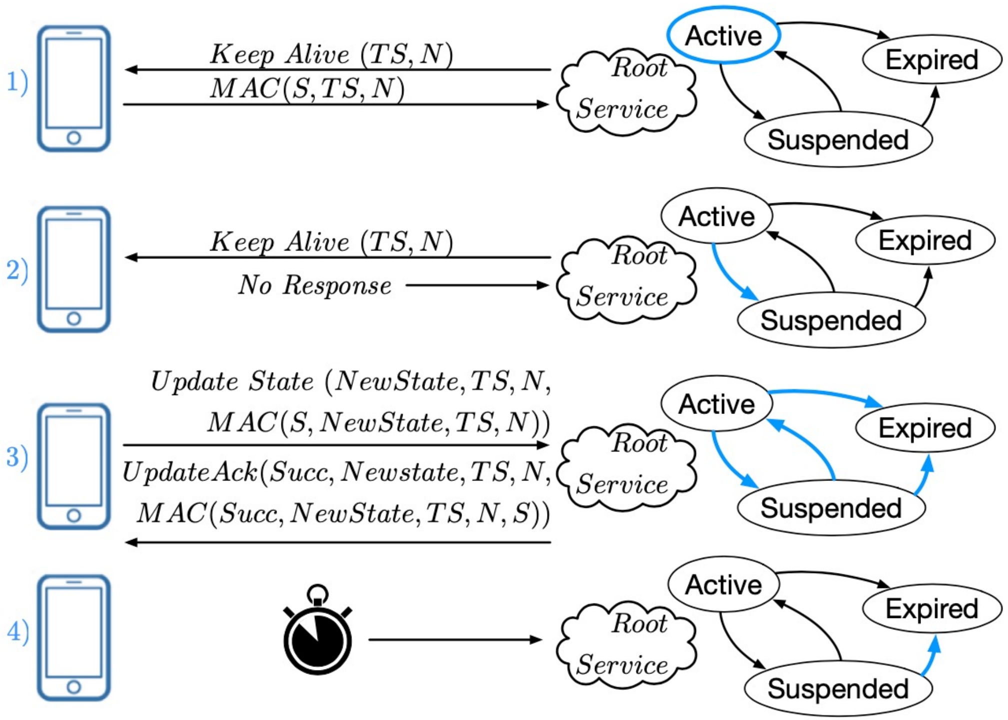
Requirements fulfilled
1. Easy setup
2. Enforce principle of least privilege – only access to user's root service account
3. Deployable – Only using software by one of the companies

Protocol



Second Authorization

Protocol



Permission States and State Machine

Implementation

- Speaker and phone
  - A nexus 6 with android 7
  - Video is offloaded for signal detection and extraction
  - Custom speaker with 18 RGB lights transmitting data over 3 channels.
  - Used a diffuser to deal with white balance

Implementation

- Co Presence detection
  - Use of WiFi access points list to detect co presence
  - A signature is used to for this purpose
    - List of mac and pi
    - Pi is RSS normalized and made positive
      - Has the property of summing up to one
  - Two types of signatures calc by personal device
    - Sigloc and Sigt
  - Pi is a probability distribution and hence we use Hellinger's distance as a measure to determine similarity
  - Threshold is used to classify it as co present.

$$p_i = \frac{RSS_i - dB_{lim} + 10}{\sum_{j=1}^{n} RSS_j - dB_{lim} + 10}$$

Consequently, *Sig* can be seen as a probability distribution:

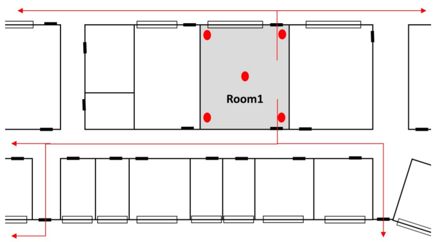
$$Sig = \{(mac_1, p_1), \cdots, (mac_n, p_n)\}, \text{ where } \sum_{i=1}^{n} p_i = 1$$

Evaluation Summary

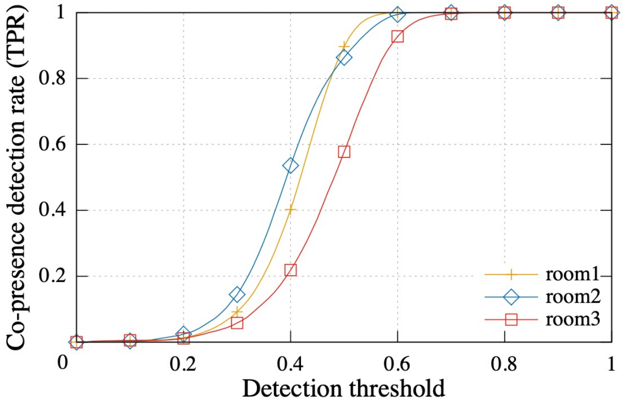
- Various Timings
  - First authorization – 4036 (del 320ms) – encoding and decoding of messages
  - Second authorization – 155ms (del 6.2)
- ProVerif – No leakage in TLS connection – K ab doesn’t leak and hence HMAC cant be forged

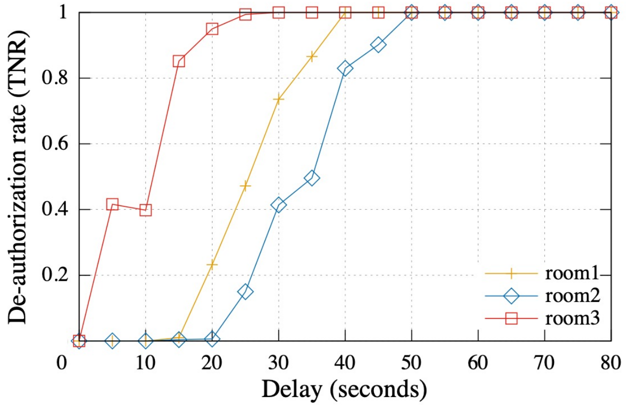
Evaluation Summary

- Deauthorization



Experimental Setup





Accuracy vs Delay Tradeoff

Hyperparameter :

1. dB lim (constant added to normalization eq)
2. Scan rate
3. Threshold for classifier

1 and 2 are found out by minimizing $(H(Sig_{loc}, Sig_t))$

3 is calculated by taking accuracy and delay into account

Can we have an adversary attack?

- It is possible if the adversary simulates 6 AP. A lot of work.
- Need to setup the AP beforehand and then try to simulate signature when the user goes out of scope – basically follow him around with wifi
- Not feasible