EAP-NOOB : Nimble Out-of-Band Authentication for EAP

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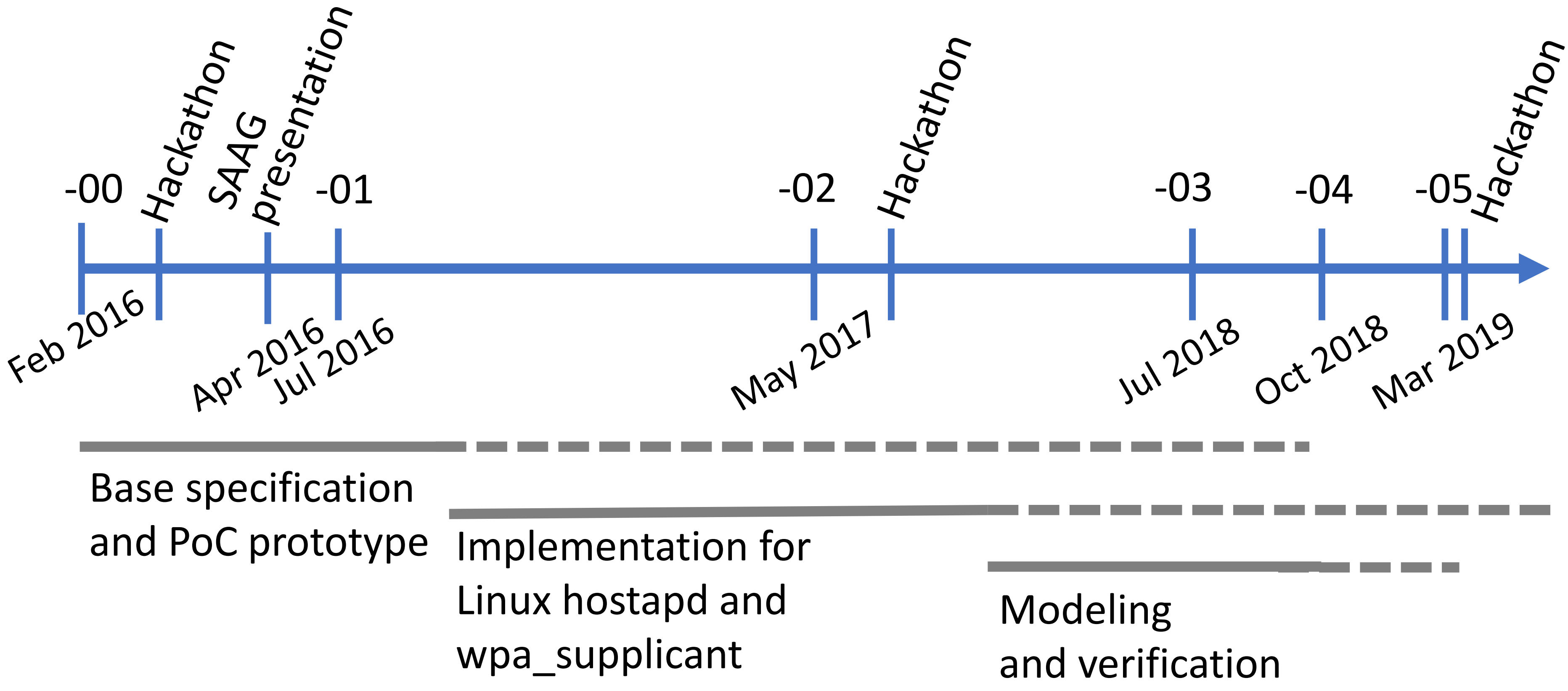
EAP-NOOB: Nimble Out-of-Band Authentication for EAP

Bootstrapping security for smart appliances

draft-aura-eap-noob



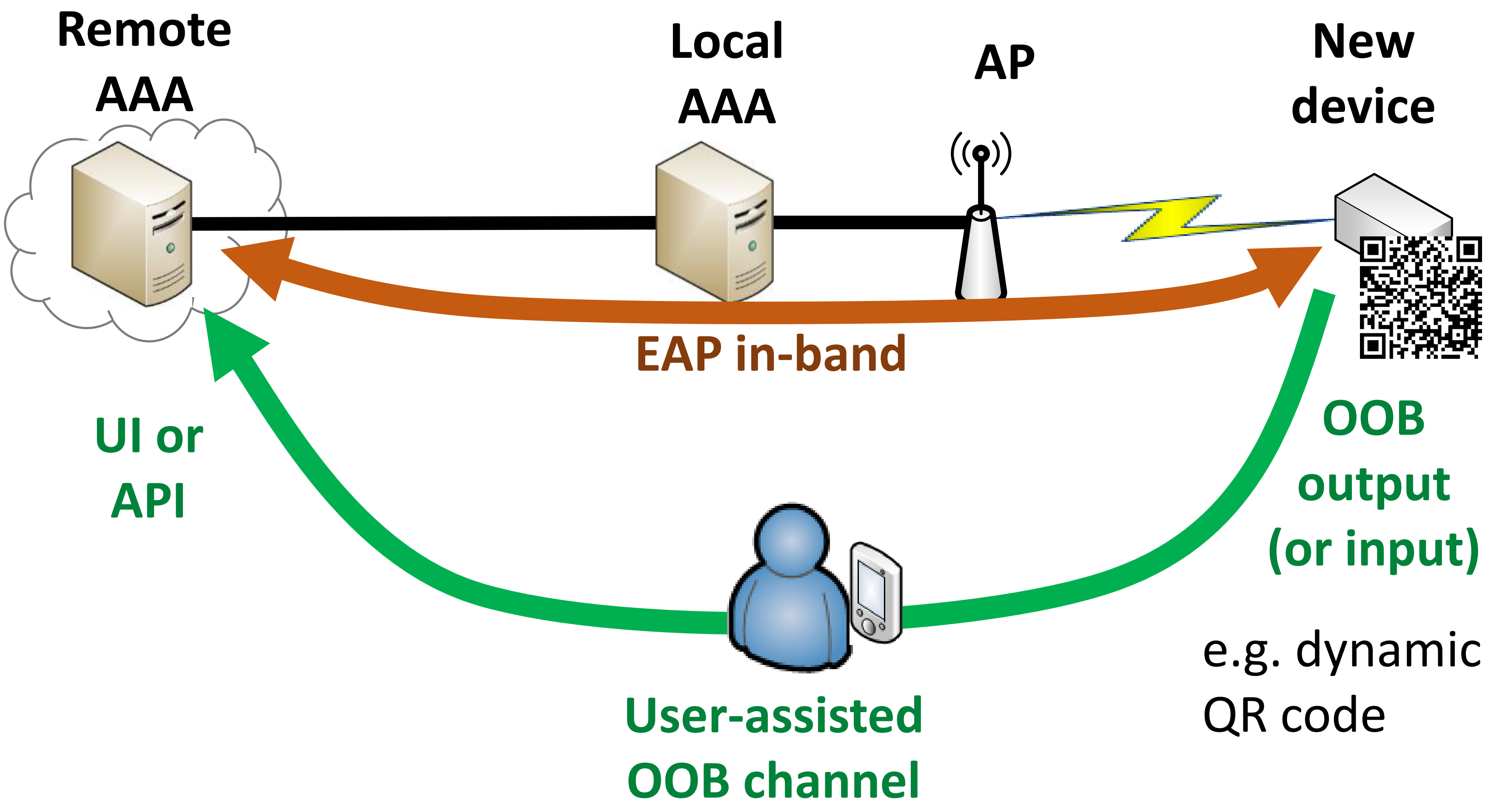
Short EAP-NOOB overview

What problems EAP-NOOB solves?

- EAP method for bootstrapping devices out-of-the-box without professional administration
- User-assisted out-of-band (OOB) authentication
  - E.g. scanning a dynamic QR code, dynamic NDEF tag
- Registration of new peer devices
  - Create persistent association between AAA and device
  - Authorize network connectivity at the same time
  - Application-level bootstrapping: assign an owner to the device and redirect to application server

EAP-NOOB architecture

Trick: in-band communication over EAP between peer and server before device is registered



e.g. dynamic QR code

Recent developments in EAP-NOOB

New in draft version -05

- Improved security considerations section
- Error message codes changed for better structure
- Easier implementation of rekeying (Reconnect Exchange)

Plan for -06:

- Add one roundtrip to each exchange. Deliver PeerId and peer state to server without updating NAI
    - Comply better with RFC 3748 section 5.1 guidance
    - Simpler peer implementation in wpa_supplicant
    - Better support for identifier randomization

Formal models and verification

Continued work on formal models:

- mCRL2 model
  - Modeling Protocol messages and state machines
  - Deadlock-freeness
  - DoS resistance for intentionally dropped messages
- ProVerif model
  - Cryptographic key-exchange properties
  - Misbinding: correspondence between user intention and protocol completion

Analysis of misbinding

- Generic attack against device-pairing protocols where devices have no verifiable identifiers and authentication is based only on physical access
- Bluetooth and others are vulnerable
- Device with compromised UI can trick user to pair another device instead

- EAP-NOOB “pairs” devices with cloud. Device authenticated by user’s physical access
  → misbinding possible
- Mitigation: channel binding, trusted path, asset tracking

More at SAAG on Thursday or in this report

Temporal identifiers?

- Path to adding identity protection
  - PeerId is a persistent identifier for the peer
    → Can it be randomized in the future?
  - Recently-added Kz identifier also identifiers peer
    → Decided to remove in -06
- Why not randomize PeerId right now?
  - Not an easy task: Identifier update must be synchronized between peer and server. Must balance anonymity, reliability and server scalability
  - Should not be vulnerable to misuse of fall-back identifier (similar to IMSI catcher)

Other issues on our TODO list

- Thorough modeling and analysis of error message handling
- Timeouts in the protocol need modeling and user testing
- Hooks for bootstrapping application configuration, e.g. service URL (currently only creating shared key)

Recovering from dropped messages

- High-level goal: after initial bootstrapping, never repeat the user-assisted OOB step
- Problem:
  - Dropped last message in bootstrapping can cause failure
  - Dropped last message in cryptosuite upgrade could cause persistent failure
- Protocol (since -05) recovers from dropped messages in cryptosuite update i.e. Reconnect Exchange
  - Avoid persistent DoS that could break existing associations
  - Formal model and verification (mCRL2)
  - To minimize complexity, decided not to add similar recovery during initial bootstrapping

Changes to EAP spec (RFC 3748)?

Possibly controversial personal opinion

- EAP should be updated to provide features commonly required by methods:
  - Method payload in EAP-Response/Identity
  - (Maybe) method payload in EAP-Success, delivered to peer
  - Fragmentation support (without wrapping in EAP-TLS)
- For channel binding required by RFC 7057, methods should have access to AAA AVPs:
  - Calling-Station-ID, Called-Station-ID

EAP-NOOB Summary

- EAP method with user-assisted OOB authentication for bootstrapping security of smart appliances
- Current version: draft-aura-eap-noob-05

There seems to be interest. If and when EMU WG is rechartered, this could be a work item