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

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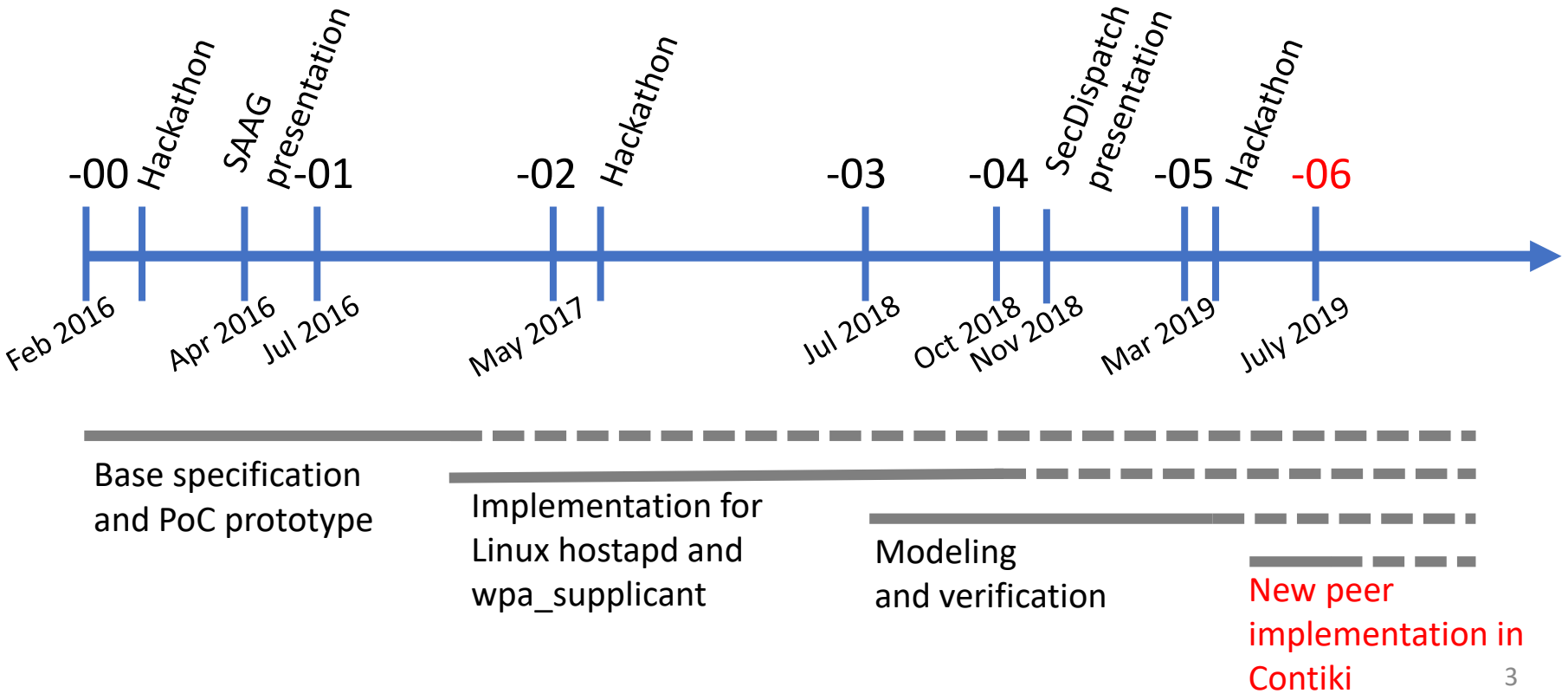
What problems EAP-NOOB solves?

- Out-of-band (OOB) = second, independent communication channel for authenticating the primary channel
  - e.g. NFC, QR
- EAP is a generic authentication framework with many methods, but currently has no OOB method
- EAP-NOOB is one solution for this: suitable for a broad range of EAP applications, stable spec, formal models and verification, open-source implementations

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

draft-aura-eap-noob

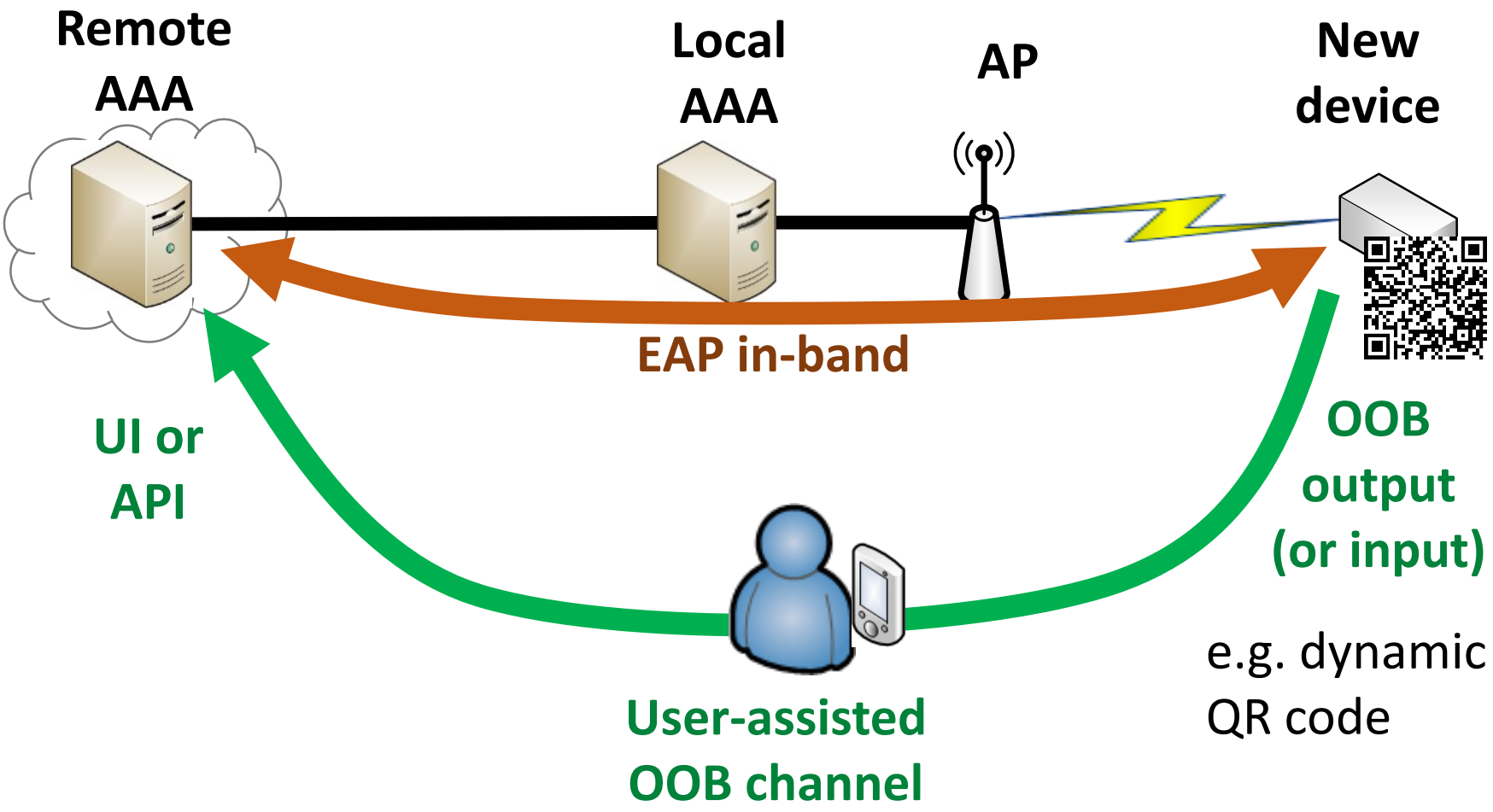


EAP-NOOB overview

- 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 authenticated devices to AAA
  - Create persistent association between AAA and device and authorize network connectivity at the same time
  - Application-level bootstrapping: assign an owner to the device and redirect to application server
- Fast reauthentication of previously registered devices without further user interaction

EAP-NOOB architecture

Trick: in-band communication over EAP between peer and server before device is registered - idea now copied by others!



New in draft version -06

Changes based on feedback from implementation and verification

- Stop overloading NAI with peer id and state, at the cost of an extra roundtrip to each exchange
  - Complies better with RFC 3748 section 5.1 guidance
  - Simpler peer implementation in wpa_supplicant

"It is RECOMMENDED that the Identity Response be used primarily for routing purposes and selecting which EAP method to use."

- Better support for identifier randomization extensions
  - Removed key identifier that may leak peer identity

Editorial changes:

- New subsection for the common handshake part in all exchanges
  - Text corresponds more closely to implementations
  - Avoids repetition of text
- Clarified when to peer starts using server-assigned Realm
  - Use Realm early for more seamless roaming support

Analysis of misbinding and mitigation

SAAG presentation in Mar 2009,
full report presented at ASIA CCS,
now available at https://arxiv.org/abs/1902.07550

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

TODO list

- Update message examples and implementation to draft -06
- Timeouts in the protocol need modeling and user testing
- Recovery from lost last messages: formally verified but should be written up into a report
- Possibly leave hooks for future extensions:
  - Device registration while roaming
  - Identifier randomization
  - Application configuration, e.g. service URL (currently only creating shared key for application layer)
  - Manufacturer certificates and other credentials

EAP-NOOB Summary

- EAP method with user-assisted OOB authentication for bootstrapping security of smart appliances
- Current version: draft-aura-eap-noob-06, no major changes expected
- Implementations:
  - wpa_supplicant and hostapd https://github.com/tuomaura/eap-noob
  - New implementation on Contiki
- Formal models in mCRL2 (protocol and DoS-resistance) and ProVerif (authentication)

There seems to be interest. This could be a candidate work item when EMU WG is rechartered

Backup slides

Roaming story

Two roaming scenarios:

1. Register device at home, then roam
   - Server assigns a Realm to the peer in Initial Exchange
   - Roaming just works
   - EAP-NOOB supports this scenario out of the box
2. Register device while roaming
   - Requires user interaction with foreign AAA to route the Initial Exchange (one EAP conversation) to home AAA
   - Server assigns a Realm to the peer in Initial Exchange
   - From then on, the roaming just works
   - EAP-NOOB is designed to not prevent this scenario

- To avoid problems, peer should start using the server-assigned Realm at the earliest possible time

Formal models and verification

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