Defined-trust Transport for Limited Domains

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(A secure IP transport with link-local multicast capability)

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IETF 114
RFC8520 (MUD) points out that requiring device enrollment is necessary but not sufficient to secure an IoT system.

Unfortunately, examples of real-world consequences abound:

- Compromised light bulb takes over entire IoT network
- Video surveillance company's 150,000 customer camera feeds hacked
- LoRaWan encryption can be easily hacked
RFC8520 also notes that Things have restricted roles with rigid communication constraints. Enforcing these roles and constraints could have prevented all of the listed attacks. Almost everything needed for enforcement exists.

- A topic-based pub/sub application layer is common in IoT. Topic visibility at transport-level exposes a publication’s intent.

- Securing pub/sub any-to-many transport requires per-publication signing for provenance: use enrolled identity as signing certificate.

- Chain-of-trust identities can attest to role, capabilities, attributes. Shared root-of-trust lets enrollees validate other members.

⇒ Each transport instance knows who (identity) is saying what (topic); if it knows the constraint rules it can enforce them.

This is what DeftT does!
This approach yields benefits beyond security. Communication with *topics*, not endpoints:

- is inherently broadcast-friendly, moves efficiency from $O(n^2)$ to $O(n)$
- doesn’t need brokers/hubs (eliminates single point of failure/attack)
- doesn’t use *endpoint* identities (all addresses can be link-local self-assigned, no DNS, DHCP or ARP)

Obviates traditional security approaches of firewalls, air gaps, access control lists, and end-point authentication
Two “big ideas” in DeftT

1. Trust management integrated into the transport, using trust rules specific to each deployment

2. Transport communication model embraces a broadcast physical layer with topic-based collections rather than pipes connecting endpoints

DeftT uses trust schemas for (1) and set reconciliation for (2), both relatively recent advances.

Each can be employed separately from DeftT. In particular, (1) can be deployed with application pub/sub protocols like MQTT.
Defined-trust Communications Basics

- Configuration/bootstrap (using any reasonable approach) enrolls a Thing in a trust domain with a “bundle” containing:
  
  • Trust Anchor (TA) for the trust domain
  
  • trust schema cert (*signed* by the TA) containing **rules**
  
  • *identity* (public cert *signed* by TA + private signing key)

- **Locally generated** Trust Anchors are expected (but not required)

- Identities distributed as chains-of-trust
  
  • DeftT contains validation that checks this signing chain
  
  • chain contains roles, attributes, capabilities
Schematized trust rules can be as simple as requiring that an enrolled identity signs all domain communications

- rules can evolve to finer-grained, role-, attribute-, capability-based
- *self-configuring* privacy via AEAD encryption with automatic, secure nonce key distribution via encryption using identity public keys

Trust schema updates can change run-time rules with *no* changes in code

- security for a domain can be increased; no code recompiles

Trust schemas can be reused in different deployments by changing the TA
Trust Requirements:

- Device-specific code running in Arm TrustZone
- Max Lin, CC BY-SA 3.0, via Wikimedia Commons
step1: Enroll light bulb by bootstrapping with its bundle
step 2: Enrolled light bulb joins trust domain with no use of external servers or routers

- light can listen for topics in /thisdomain/pubs with specific name, room, floor, or all lights.
- light can only report its status and not issue any commands
Notes

• Goal for this draft is an independent submission informational RFC
  - looking for feedback to improve the draft first
  - *possibly* collaborators on defined-trust communications

• Expose some ideas on transport and security that might be useful in other IETF work

• Pollere maintains an open source reference implementation on [github](https://github), along with tools and examples. Bug reports are welcome (we may be slow to respond)