T2TRG: Thing-to-Thing Research Group

Joint Meeting with ICNRG
November 13, 2016, Seoul, KR

Chairs: Carsten Bormann & Ari Keränen

WiFi

- SSID: 63_banquet-CYPRESS
- Pass: **a123456789**

Note Well

- You may be recorded

- The IPR guidelines of the IETF apply:
  see **http://irtf.org/ipr** for details.

Administrivia (I)

- Pink Sheet
- Note-Takers
- Off-site (Jabber, Hangout?)
  - **xmpp:t2trg@jabber.ietf.org?join**
- Mailing List: **t2trg@irtf.org** — subscribe at: **https://www.ietf.org/mailman/listinfo/t2trg**
- Repo: **https://github.com/t2trg/2016-11-icnrg**

Agenda

Morning

Presentations 9:00-10:15

- Research and Development of the Hyper-connected IoE Network Technology — Taewan You
- Device and Network naming structures and ICN for IoT applications — Lopez Jairo
- A RESTful, Distributed and Enhanced ICN System for IoT — GQ Wang
- I3: some thoughts towards an Industrial Information-Centric Internet of Things — Thomas Schmidt

Break 10:15-10:40 [coffee, cookies -- thanks, ETRI]

- Discussion 10:40-12:00
- Introduction to discussion - Chairs
- Discussion

Next steps, Next meeting?, etc

12:00 Lunch

Move to NMRG Workshop for the afternoon (Kensington Yoido)

T2TRG scope & goals

- Open research issues in turning a true "Internet of Things" into reality
  - Internet where low-resource nodes ("things", "constrained nodes") can communicate among themselves and with the wider Internet
- Focus on issues with opportunities for IETF standardization
  - Start at the IP adaptation layer
  - End at the application layer with architectures and APIs for communicating and making data and management functions, including security

Done so far

- Chartered in December 2015. Multiple meetings before official chartering co-located with IETF meetings and with W3C Web of Things (WoT) group
- 2016: RG meetings at Nice and Lisbon co-located with W3C WoT, at San Jose co-located with IAB IoT**SI** WS, at Buenos Aires and Berlin with the IETF meetings; participated in Dublin IAB IoT**SU** WS; RIOT summit in Berlin; Implementers' meeting in Ludwigsburg (Stuttgart)
- Three RG deliverable documents in progress on REST and security; multiple new documents on REST interaction
- Outreach (e.g., organizations like OCF and Bluetooth SIG)

Where are we going

- Work on RG deliverables and outreach continues
- Future meetings co-located with good research venues (2017)
- Meetings co-located with open source activity
    - RIOT summit in Berlin (July)
    - Eclipse IoT meeting (October)
- Benchmark/reference scenarios
    - Initial discussion in various drafts and slides
    - More elaborate documentation by end of 2016

Next meetings

- 2017 planning TBD

Thank you, ETRI!

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ICN & IoT

Dirk Kutscher

ICN & IoT

IoT one of the use cases for ICN

Several claimed benefits

- Location-independent access to named data/actuators
- Data-oriented security model
- Data availability due to caching, in-network forward strategies
- Ad-Hoc communication features
- Stack implementation simplification

Implementations

RIOT (CCNLite)

NDN-IoT

Cisco

Others?

Research Questions

- Naming in uncoordinated IoT networks
- IoT interaction semantics in ICN (push, updates)
- Security
  - Security bootstrapping (onboarding, key distribution)
  - Feasibility of ICN PK crypto
  - Other security approaches: ABE
- Semantic interoperability
  - Discovery: how to know what to ask for etc.
  - Semantics and properties of named data and dynamic computation results
- Internet picture
  - Connecting ICN IoT networks to the Internet
  - Role of gateways, translators etc.
  - Possibility of avoiding silo networks

Meeting Today

- Leverage background and new ideas in T2T and ICN communities
- Learn from current work in both groups
- Chairs' suggestion: device/data naming & semantic interoperability
  - See mailing list discussion
- Understand real-world problems and possible approaches
- Identify relevant topics for follow-up work

Endpoints

- Endpoint: you || the other party that you are talking to

- Initiator (Client):
  Server learns about it when the request hits

- Responder (Server):
  Client needs to “find” it (from URI data)

Endpoints in HTTP

- Server endpoint: Scheme/Host/Port (**Origin**)
  - Translated to Address/Port by client (**DNS**)
  - HTTPS: Client verifies DNS name of Host (**PKI**)
- Client endpoint: anonymous
  - Can use Client Address/Port (usually considered ephemeral)
  - Client certs: rare
  - Put Client identity into **Cookie** (muddled up with application state)

What's different in CoAP

- **DNS** deemphasized

- Certs (and thus **PKI**) deemphasized
  - PKI Certs need CRLs/OCSP, secure absolute time, …

- We don't have **cookies**

- **Servients**: Servers often have client component
  — how to link server and client identities?

Endpoints in CoAP/UDP

- Client uses **URI data** to look up server transport address
  - lookup mechanism intentionally not defined in RFC 7252
- Server uses **request transport address** to reply and send notifications

CoAP/UDP: Issues

- Endpoint transport addresses might not be stable
  - IP addresses change due to renumbering
  - Transport addresses change due to NAT timeouts
- Transport address change loses endpoint identity

CoAP/UDP: Issues

- Server address change:
  - New requests:
    Lookup mechanism likely to use cache ➔ stale info
  - Observe, other long-running requests:
    Client cannot relate Notification from new address to the right server
- Client address change:
  - Observe, other long-running requests:
    Server cannot send Notification to the right client

Endpoints in CoAP/DTLS

- Client uses **URI data** to look up server transport address
- Client states (**SNI**) and verifies server identity
  (and server possibly verifies client identity)
- Endpoint is the peer in the resulting **connection**
  - Ephemeral: endpoint dies with connection
  - (but long-term endpoint “identity” doesn’t)

“Identity”

- Most misunderstood word in security
- Identity = set of claims
  - But that’s not how we use the term intuitively
- Need another word for the “real-world identity” of a Thing
  - But what is that? Owner change, role change, repairs (replace board/chip)…
- Where authorization is entirely identity-based: need “revocation”

Endpoint claims in HTTPS

- server: DNS name
  (tied into Authority and thus Origin)
  - Cert can actually have other claims,
    but those are rarely visible to application

- client: (could have cert, but usually:)
  established in-band, then reified into cookies

Endpoint claims in COAPS

- PSK mode: mutual verification
  - needs out of band channel; cf. DCAF
    - source, scope specified by those OOB mechanisms
- RPK mode: implicit server identity claim
  - OOB channel can be used (e.g., with directed identity)
- Cert mode: less well-defined (could use HTTPS model)

Implicit vs. Explicit Claims

- PSK: Implicit claim of existing security association
- RPK: Implicit claim of server possession of private key
  - Both can be augmented by OOB information

- Cert: Explicit claim of SNI possession (time-bounded)

- With CWT, have more fine-grained, explicit claims:
  - Issuer, Audience, Scope, …

Identity confusion in APIs

- Very little of this makes it into APIs
- E.g., IoTivity uses the transport address as endpoint identity — even with DTLS
  - Application may send data via new, unrelated DTLS connection that happens to have the same transport address
- Issue: How to represent endpoints in APIs?

CoAP/DTLS: Issues

- DTLS connection tied to transport address pair
  - dies when either pair changes
- Current request/response matching includes “epoch”
  - does not even extend Observe across session resumption

Naming data

- (on an endpoint = server)
- resources, collections
- structured data: reach inside?
  - e.g., YANG data resource identifiers? COMI FETCH payloads?
- Names vs. semantics

Schemas

- Describe the possible structures (descriptive)

- Augment structures with semantics (

Securing data

- within a context (communication security)
- as a freestanding object (object security)
- Where are the trust anchors coming from?
- What is the relationship between resource discovery and setting up security associations?

ABE for ICN IoT

Börje Ohlman

Security requirements for IoT in an ICN context

- An IoT security solution should ***not rely on e2e connectivity***, i.e. it should provide secure communication with disconnected or sleeping devices
- After the information object leaves the sensor it should be ***secured without having to trust any intermediate device*** which it might be stored on.
- ***Access control*** to information object ***should be done off-sensor*** to avoid DoS attacks through illegitimate requests that will drain the sensor battery

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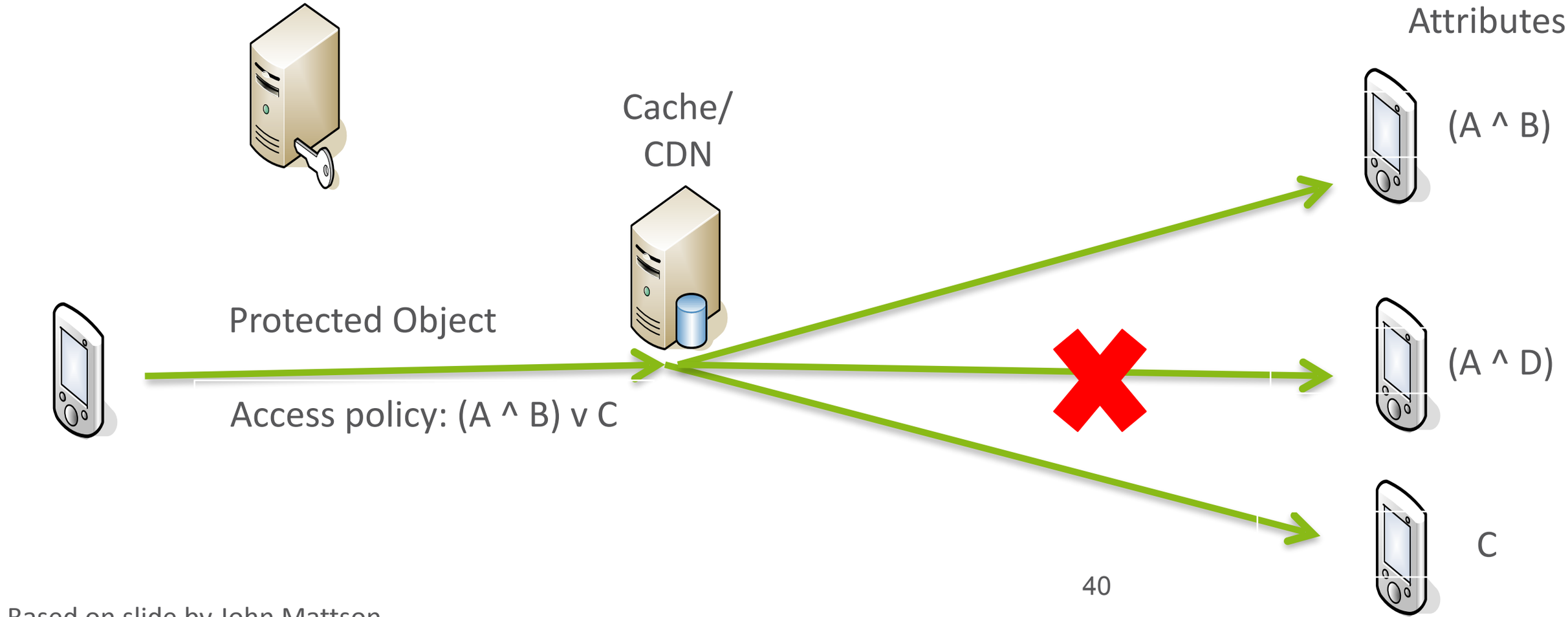
ATTRIBUTE BASED ENCRYPTION (ABE)

Main benefit: Does not require communication with the key management server. Which would be a benefit for constrained devices (how heavy are the ABE operations?). Can encrypt to several selected recipients.



Based on slide by John Mattson

ABE Key Characteristics

Pros

- Does not require communication with the key management server.
- Very good match between ICN's need for secure objects and ABE's way of securing objects
- Can provide fine grained access control for to objects while the objects still are cacheable (not different encryption for different sets of users)
- Can provide good privacy by use of decentralized attribute authorities
- Attribute authorities can be well integrated with the organizations responsible for related activities, e.g. health care authorities are issuing the health related attributes

Cons

- Computationally heavy, scalability issue
- Expands data when encrypted

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Beyond “data”

- Support for actions (actuators), events (push)
- Actions natural in IETF IoT stack
- But REST has no direct support for the state implied by publish/subscribe ➔ Rucksack design?
  - HTTP world: reverse POSTs
  - CoAP: Observe (closer to REST)

Kinds of resources

- time-varying **values** (Time series, e.g., a sensor)
  - temporal resolution can be crunched; load shed
- current vs. **desired** values (simple action)
- **actions** as separate resources (complex action)
- e**vents** (discrete, need to be preserved/cannot be merged)