

ACM ICN 2020 Tutorial:

Practical NDN Application Development and Seamless Deployment

PUB/SUB IN NDN-LITE

September 29, Zoom

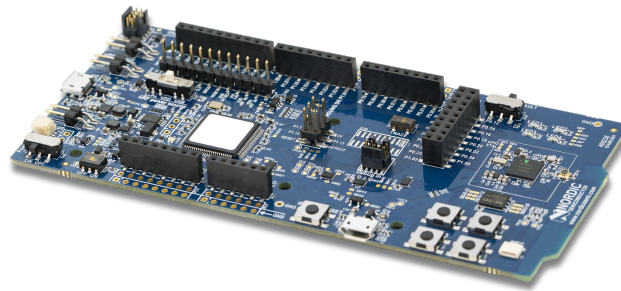
Zhiyi Zhang, **Tianyuan Yu**, Xinyu Ma, Lixia Zhang, UCLA

Introduction

- Pub/Sub is an asynchronous messaging concept
 - High-level API with decoupled publisher and subscriber
 - All about data
 - NDN's data-centric design naturally fits
 - Data itself is secured
 - Publisher make data available, don't care how many subscribers
- NDN-Lite Pub/Sub
 - Specific Pub/Sub instance for a particular use case (IoT)
 - Not a generalized solution to broader cases

NDN-Lite Overview

- An IoT framework
 - With built-in high-level system modules for security bootstrapping, service discovery, access control, [pub/sub](#) and trust management.
 - Capable to run on resource constrained devices
 - ~ 50 KiB RAM, ~ 100 KiB ROM

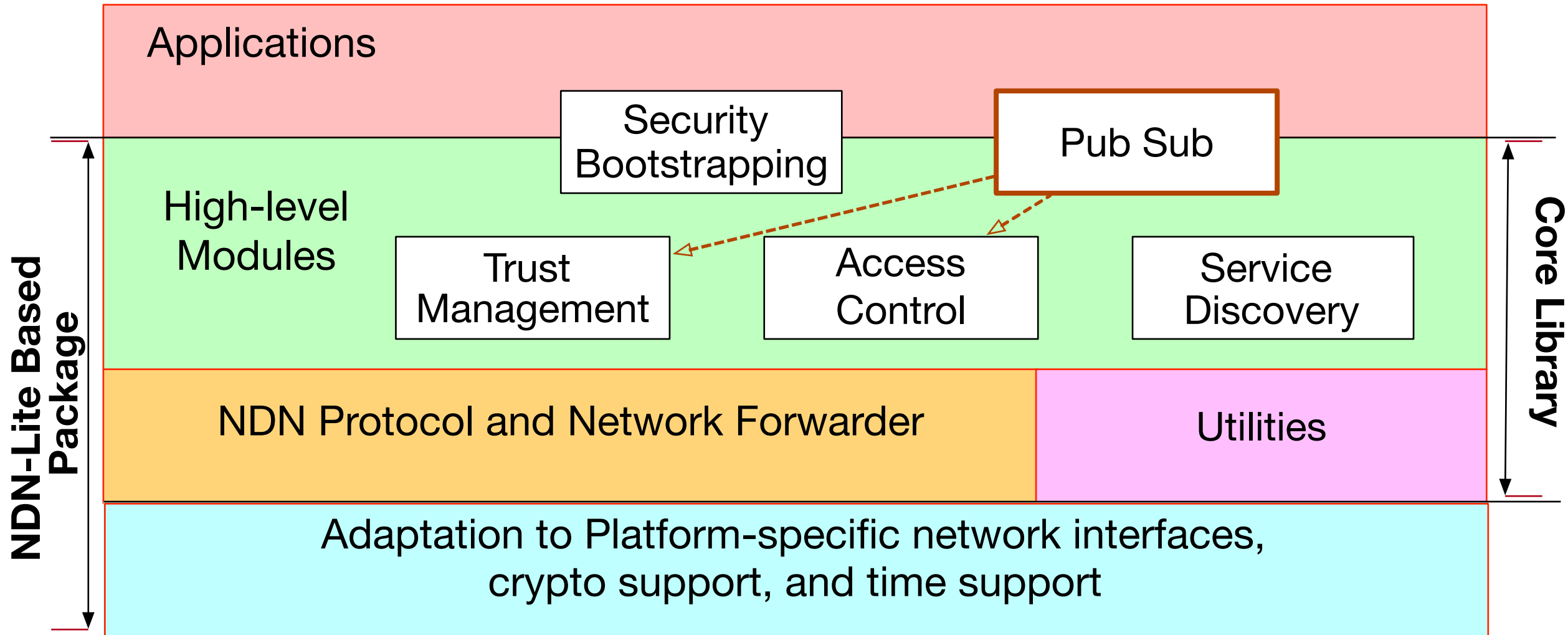


Design Decisions

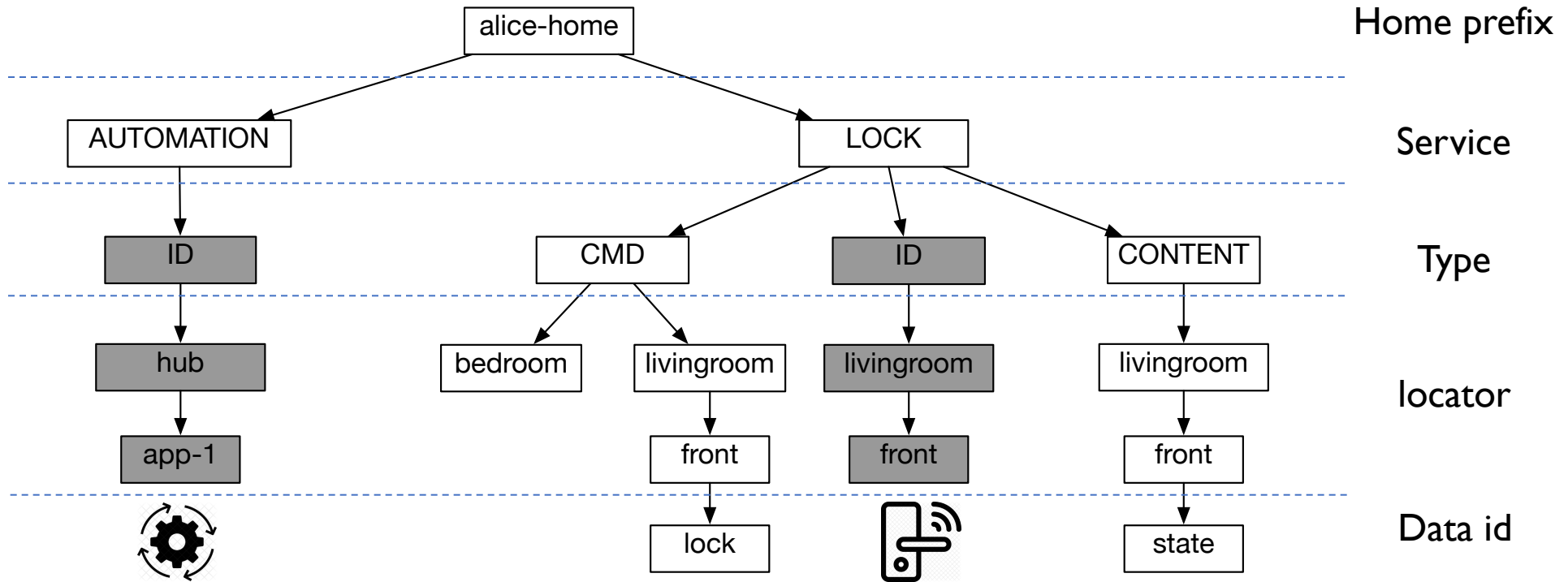
- Home IoT system functions
 - Collect data
 - Actuate commands
- Provide IoT functions via **Pub/Sub**
 - Straightforward when collecting data: subscribe to data publishing
 - Actuate commands: publish commands as data*

* Nichols, Kathleen. "Lessons Learned Building a Secure Network Measurement Framework Using Basic NDN." ACM ICN 2019.

System Component



Naming Conventions



Both content and commands are Data packets

Application Needs

Turn on all ACs at home: 
 /alice-home /**AIRCON** /CMD /ON

Turn on all ACs at bedroom: 
 /alice-home /**AIRCON** /CMD /**bedroom** /ON

Turn on a specific AC at bedroom: 
 /alice-home /**AIRCON** /CMD /**bedroom** /**ac-1** /ON

- Home service

- E.g., /alice-home/AIRCON

- Home service + data type + locator + content id

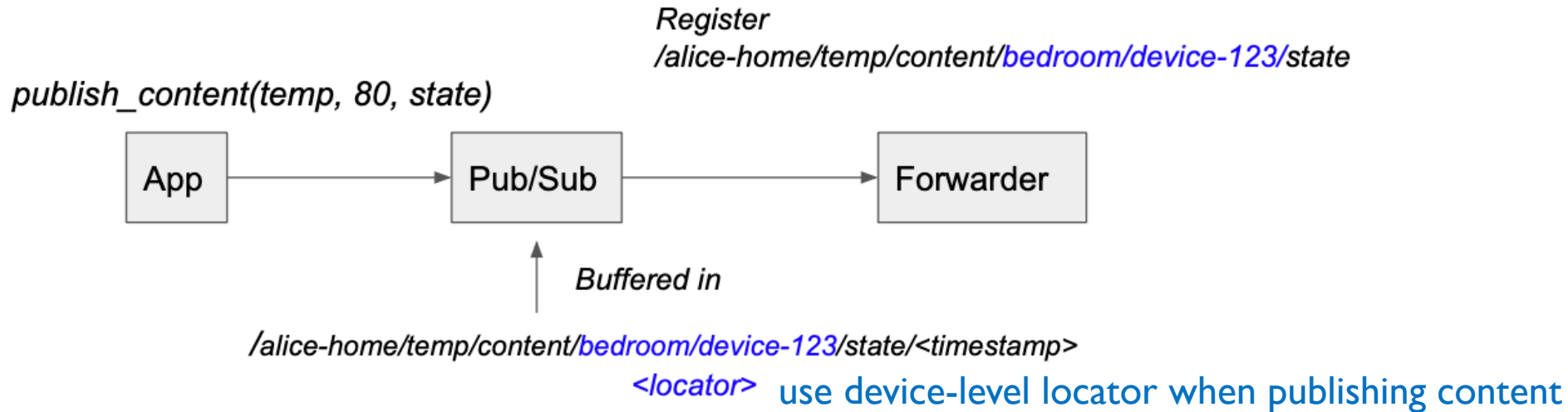
- E.g., /alice-home/TEMP/CONTENT/bedroom/sensor-a/state/<timestamp>

Devils in the Details

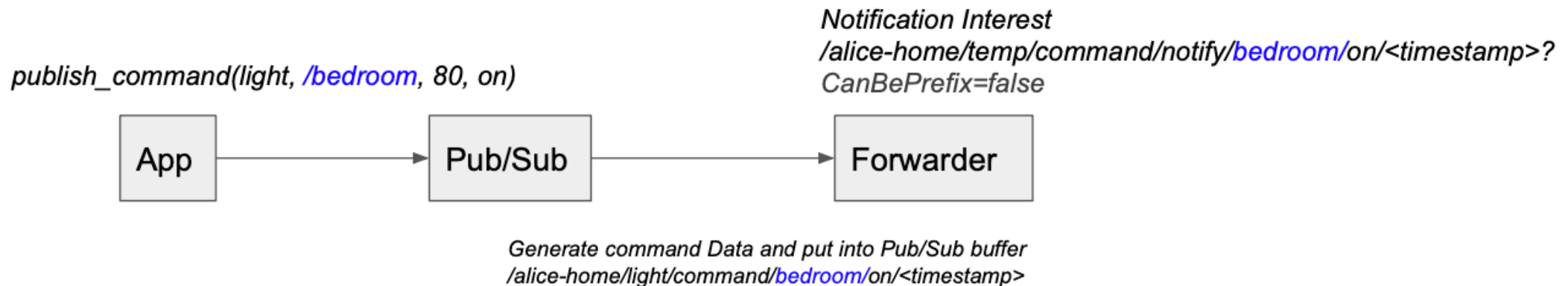
- Publish whenever data becomes available
- When to subscribe?
- NDN-Lite's two answers
 - Data published periodically, subscribers send Interests periodically
 - No perfect timing between different parties, PIT will buffer Interests
 - Data published at unpredictable times, publisher notify subscribers to fetch

Publish

`publish_content(service, content, content-id)`



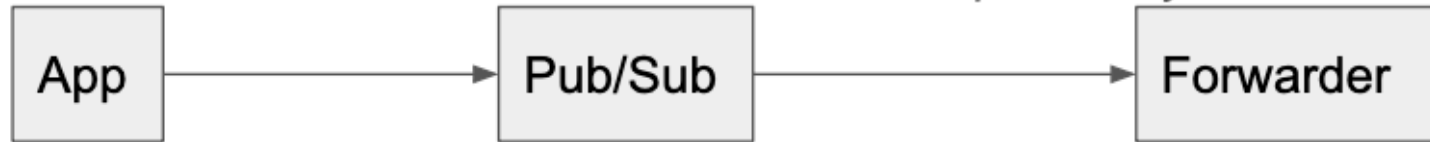
`publish_command(service, locator, command, command-id)`



Subscribe

`subscribe_to_content(service, locator, interval, callback)`

`subscribe_to_content(temp, /bedroom, 1000, cb)`



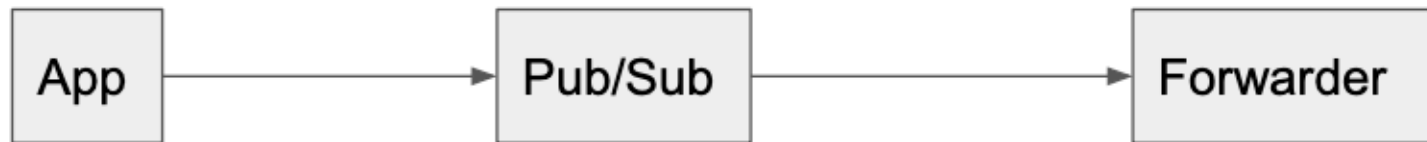
Interest

`/alice-home/temp/content/bedroom?CanBePrefix=true`

Repeat every 1000ms

`subscribe_to_command(service, locator, callback)`

`subscribe_to_command(light, /bedroom, cb)`



Register notification prefix

`/alice-home/light/command/notify/bedroom`

.....

Receive notification

`/alice-home/light/command/notify/bedroom/on/<timestamp>`

Fetch command Data by Interest

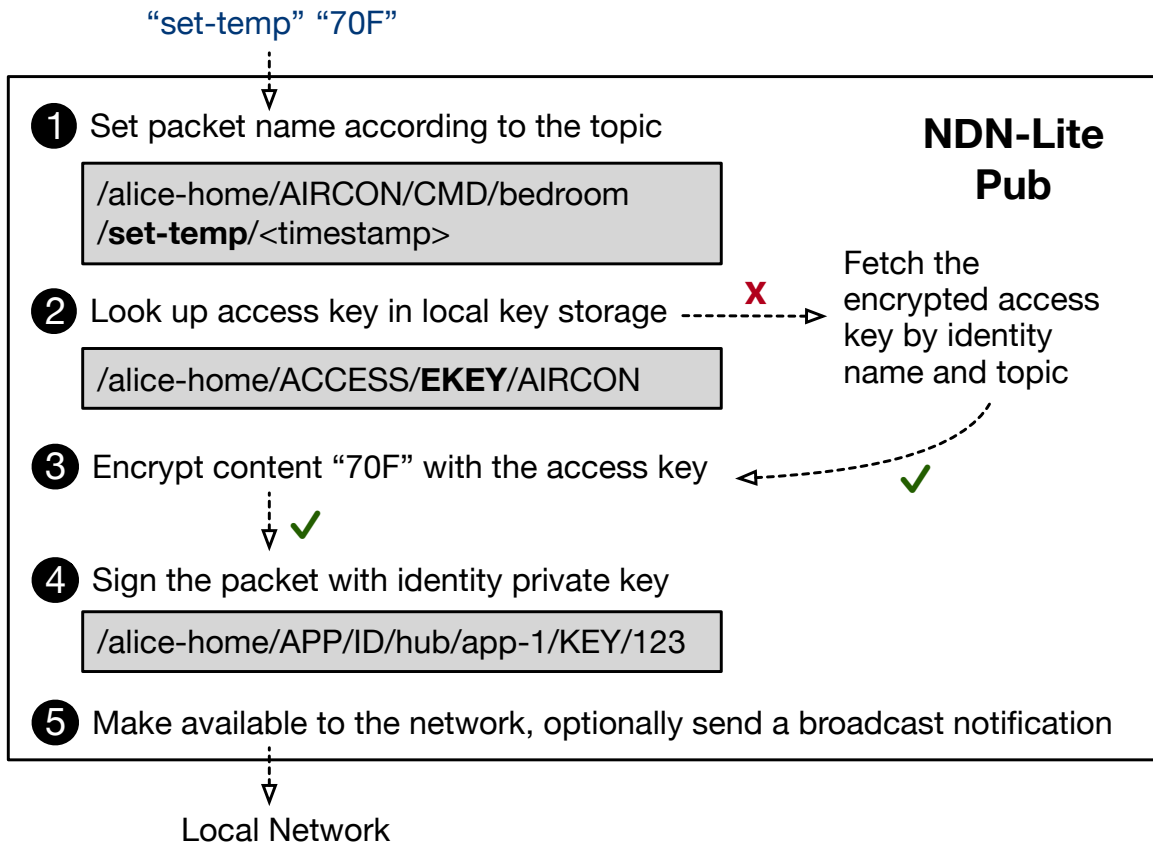
`/alice-home/light/command/bedroom/on/<timestamp>`

Trust Management: A Few Examples

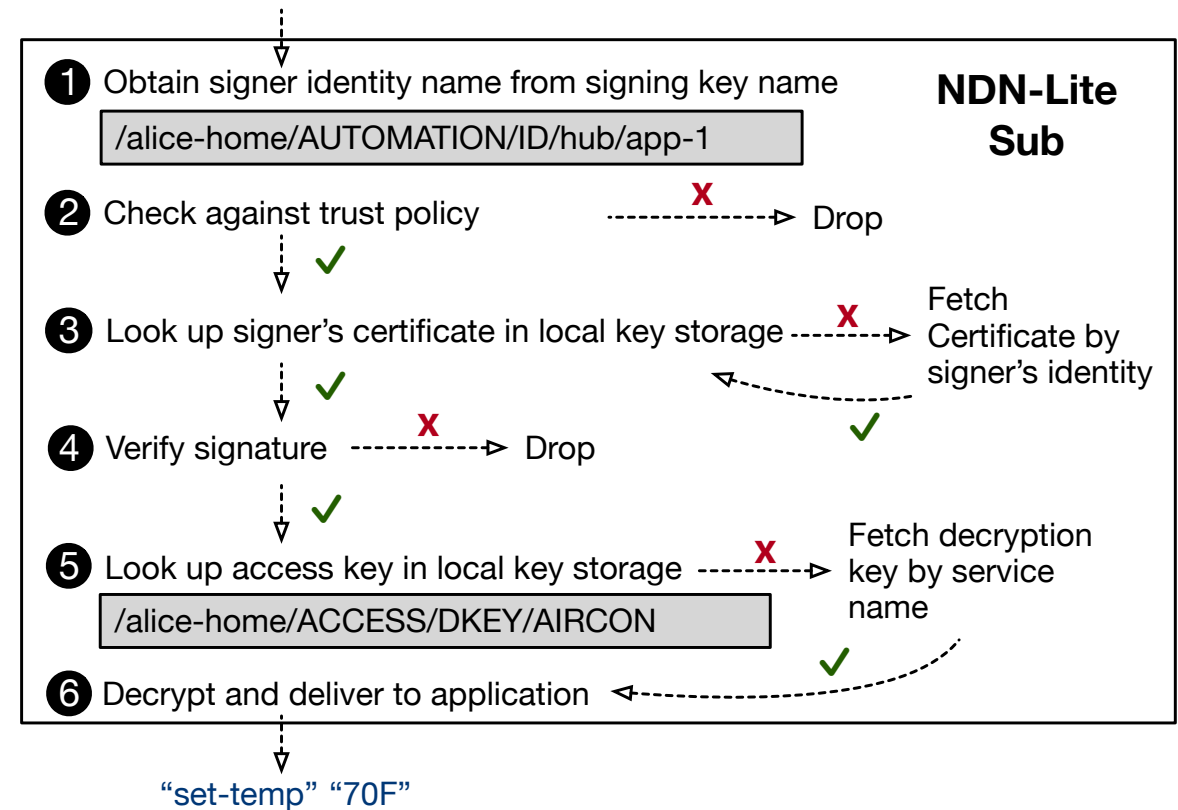
- To control who can sign
- Home automation app can control same-room ACs
 - Cmd Data Name: <alice-home><AIRCON><CMD>(<>)<>*
 - Signing Key Name: <alice-home><AUTOMATION><ID><\0><><KEY>
 - Trust Anchor: <alice-home><KEY><123><ANCHOR><456>

Pub/Sub Security Workflow

publish_command(AIRCON, /bedroom, "70F", "set-temp")



subscribe_to_command(AIRCON, /bedroom, cb)



NDN-Lite Config

- Bootstrapping through out-of-band exchange
 - Get <trust anchor, identity, certificate, trust schema>

NDN Lite


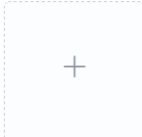
NDN IoT Controller

Search ...

- System Overview
- Device Bootstrapping
- Device List
- Service List
- Invoke Service
- Access Control
- Send Interest
- Manage Policy

BootStrap

Upload shared secrets

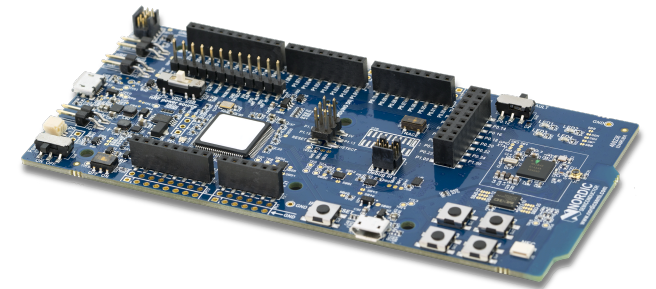
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Start bootstrapping

[Bootstrap](#)

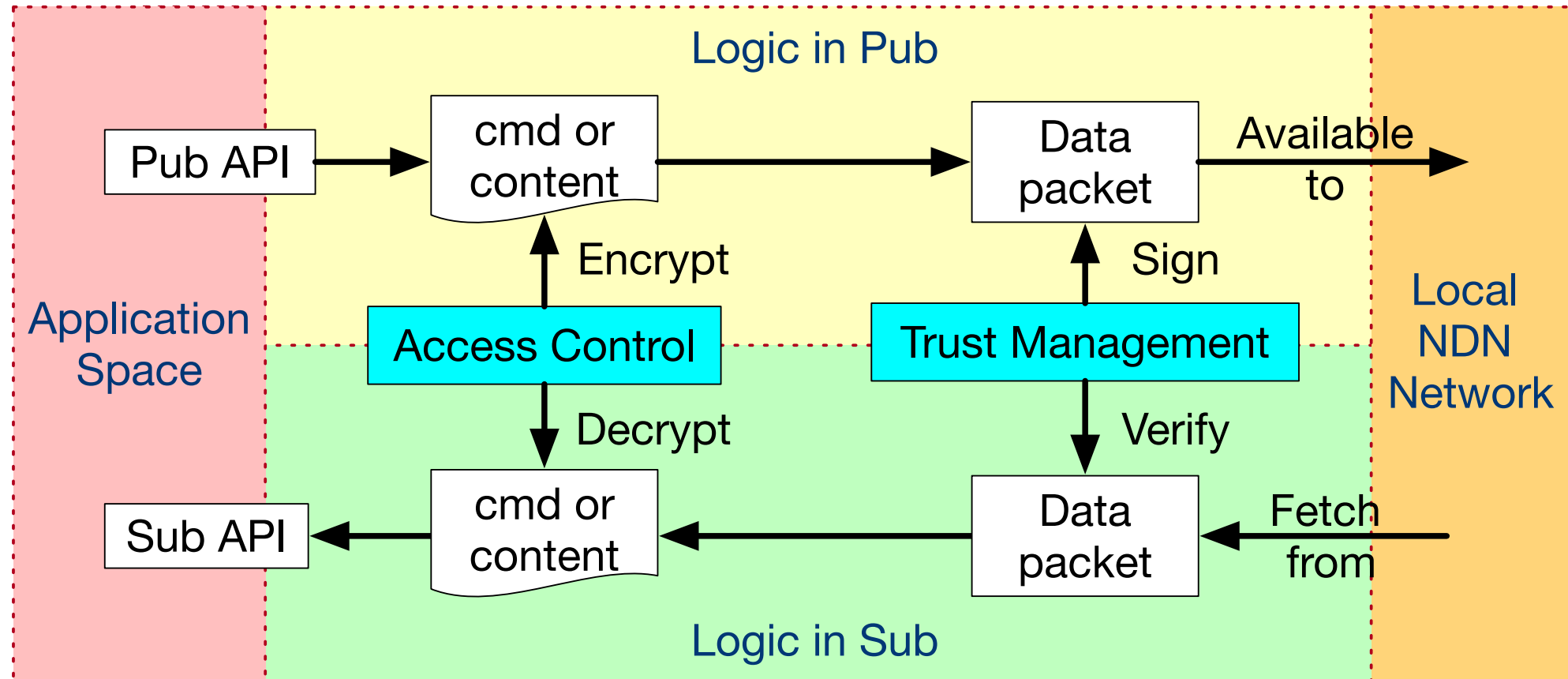
Stored shared secrets

Device Identifier	Public Key	Symmetric Key	Operation
device-398	498CCE9F87B82B6D81621758E994F4A9A2F050129 4B49AD55D4B2AED3380845CD2B5AC4EEA5820993 8E436133828ED0CCD4EA70BFACBFC14ABF4DB6D 7AB1BAC1	6154F3998F5C4C90B31E2D2466D83156	remove



Under Pub/Sub APIs

- Security are designed into the pub/sub APIs



Summary

- NDN-Lite Pub/Sub
 - Organize application with name tree
 - Provides high-level APIs for application
 - Built-in security
- Future work: reliability
- Code available: <https://ndn-lite.named-data.net>

Thank you
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