Efficient Access Control For NDN based IoT platform
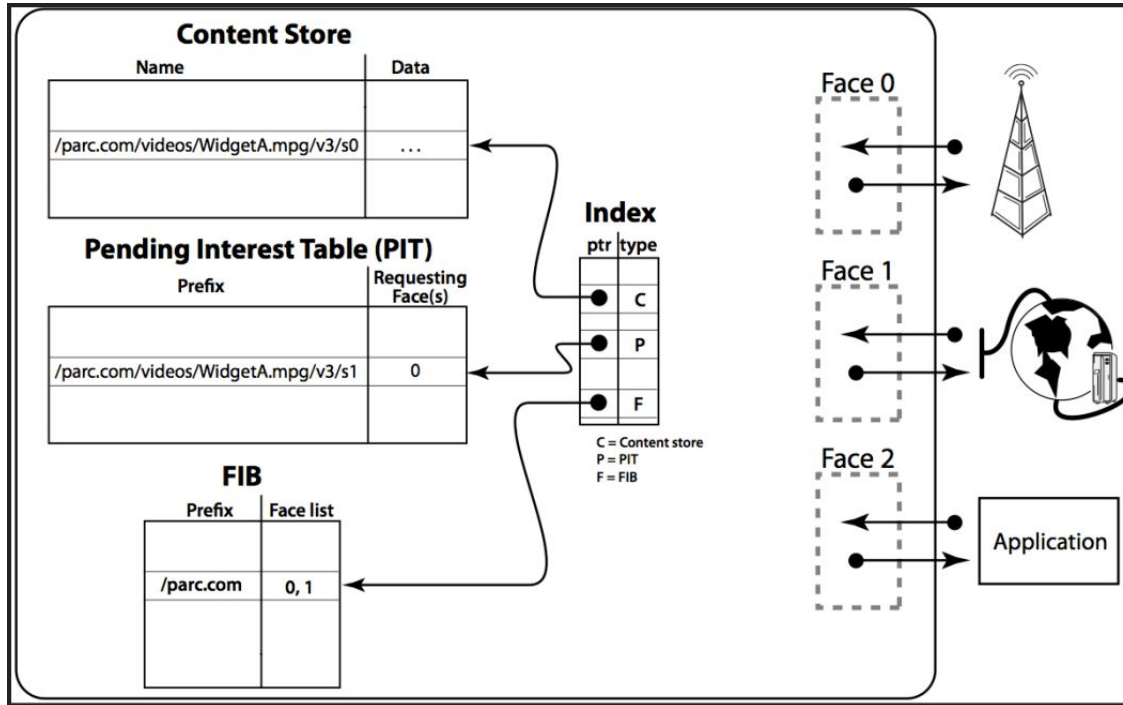
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Need Of Named Data Networking (NDN)

- Alternative to TCP/IP
  - IP address space, Speed
- Content based
- In-network caching
- Security
- Architecture

Brief About NDN

Incorporation of NDN in IoT

- Scalability
- Security

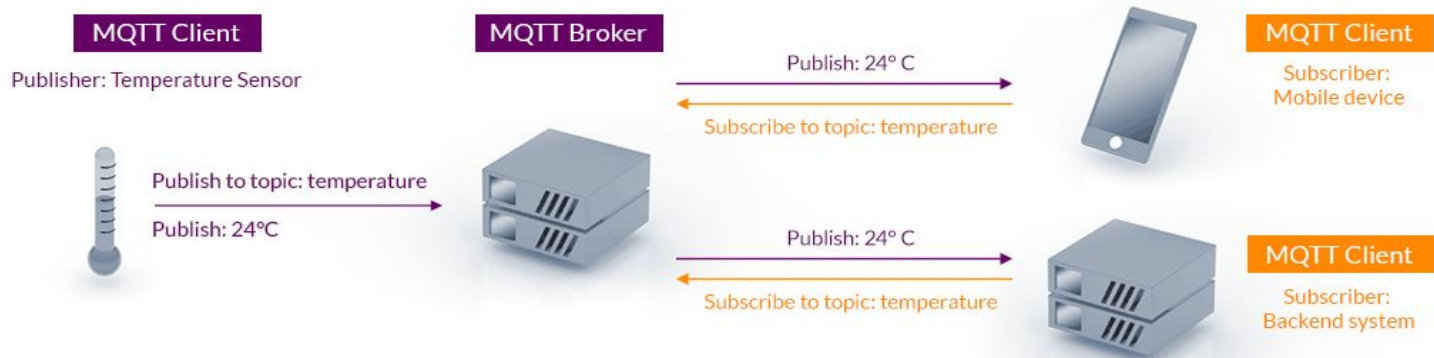# Comparative Study

- MQTT
- HoPP
- NDNIoT

MQTT: Message Queuing Telemetry Transport

- Architecture
- Feature
  - LightWeight
  - Bi-directional
  - Reliable Message Delivery (QoS)

MQTT: Architecture

- Basic Concepts:
  - Publish/Subscribe
  - Client/broker
- Basic Functionality
  - Connect
  - Publish
  - Subscribe

MQTT: Client/Broker

MQTT Client

Publisher: Temperature Sensor

Publish to topic: temperature

Publish: 24°C

MQTT Broker

Publish: 24° C

Subscribe to topic: temperature

MQTT Client

Subscriber:
Mobile device

Publish: 24° C

Subscribe to topic: temperature

MQTT Client

Subscriber:
Backend system

MQTT - Basic Functionality: Connect
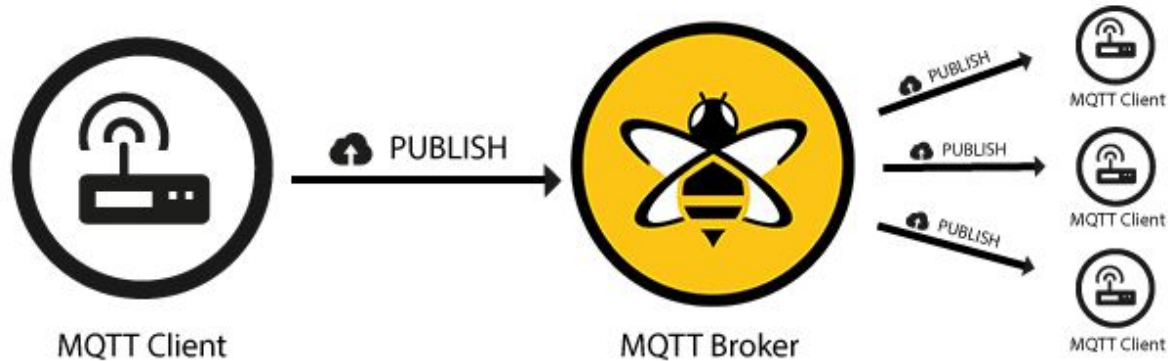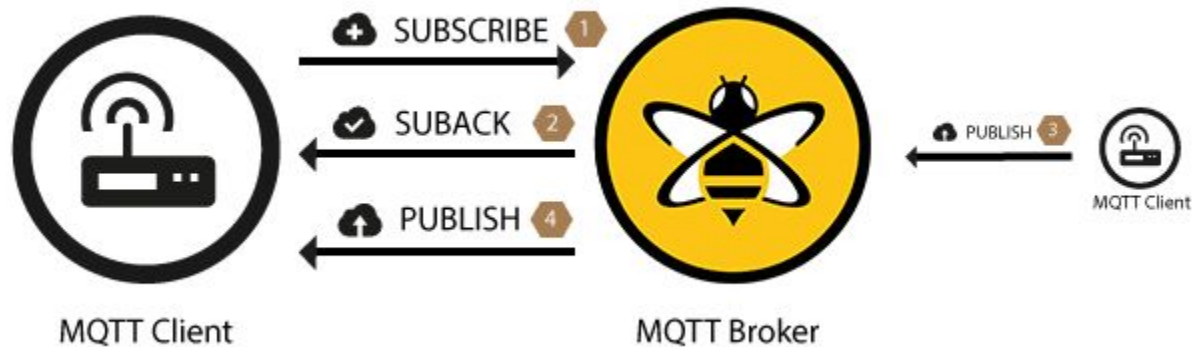

CONNECT

CONNACK

MQTT Client

MQTT Broker

MQTT - Basic Functionality: Publish

MQTT - Basic Functionality: Subscribe

MQTT: QoS

- QoS 0:
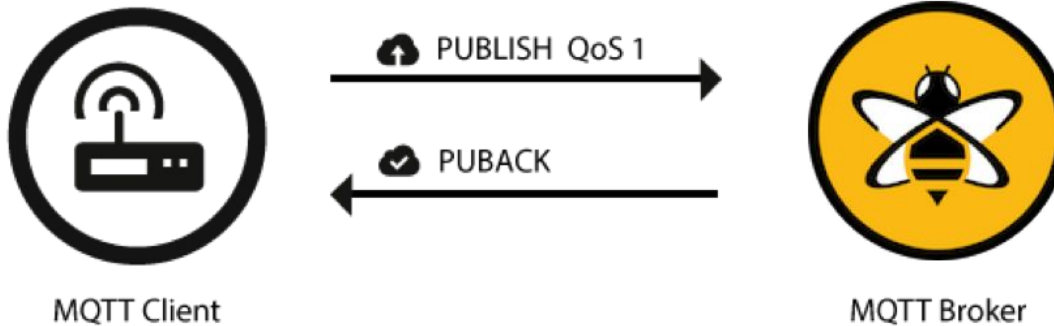 - No guarantee of delivery
  - At most once

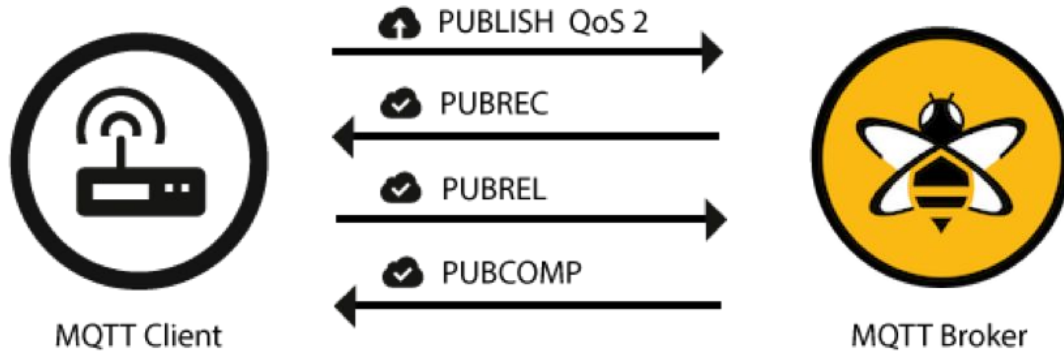MQTT Client   PUBLISH QoS 0   MQTT Broker

MQTT: QoS

- QoS 1:
  - At least once
  - Settings on broker side

PUBLISH QoS 1

PUBACK

MQTT Client

MQTT Broker

MQTT: QoS

- QoS 2:
 - Exactly once
  - Safest and slowest

HoPP: Hop based pull protocol

- Terminologies
  - Stud network
  - Content Proxies
    - Stable and powerful gateway
    - More than one CPs
    - Role: Data Caches and Persistence Access Point
- Architecture
  - Establishing and maintaining routing system
  - Publishing Content
  - Subscribing Content

HoPP: Establishing and Maintaining a routing table

- Building DODAG (Destination Oriented Directed Acyclic Graph
- A CP node announces **Prefix Advertisement Messages (PAM)** into the broadcast domain
- PAMs include a name prefix to set up default routes and a distance number starting with 0
- Nodes in the vicinity
  - Adjust their forwarding table
  - Rebroadcast PAMs with an incremented distance number until the DODAG converges

# HoPP: Establishing and Maintaining a routing table
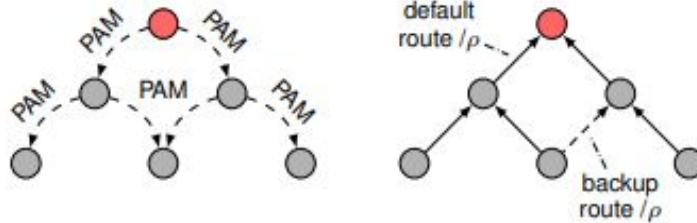
(a) Establishing a routing DODAG by prefix advertisements

HoPP: Publishing the content

- A node with new data
  - Select the name (from predefined scheme accessible by local controller)
  - Advertise the content name to the upstream router via Name Advertisement message (NAM)
- Connection is established
- Data is transferred.

HoPP: Subscribing the content

- Names follows the application-specific logic
- Names can be learned by issuing interest on topic
- Corresponding CP will respond to the interest
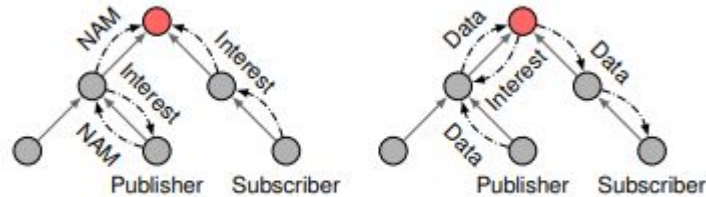
(b) Pubish and Subscribe operations

NDNIoT: NDN based IoT protocol

- Architecture
- Advantages over other protocol

NDNIoT: NDNIoT provides simple solution. How?

- **data-centric security** directly in a local network system instead of relying on secured sessions and trusted cloud servers
- Naming conventions provide an open environment for applications and services

NDNIoT: NDNIoT provides simple solution. How?

- Support different communication interfaces e.g. Bluetooth, Wi-Fi, Ethernet, 802.15.4 (low-rate wireless personal area networks (LR-WPANs))

- **Supports content multicast and in-network caching**

- Developers focus on the data itself without worrying about DNS or IP config

NDNIoT: Advantage

- Auto configuration
- Service Discovery
- Data-centric security
- Content Delivery

NDNIoT: Architecture
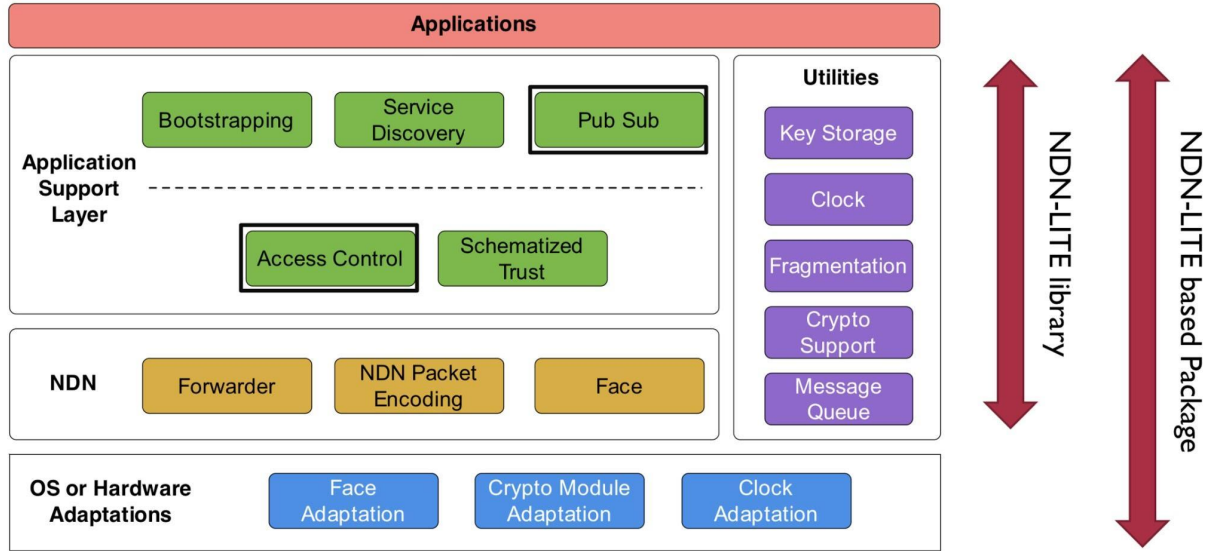
NDNIoT: Architecture

- Bootstrapping
  - Two types: security and network
  - Needed for newly added devices
    - To communicate with other IoT devices
    - Build the trust relationship between local IoT system
    - Sign and verify NDN data packets

NDNIoT: Architecture

- Service Discovery
  - Find services in local IoT network
  - Advertise the own services to other nodes
  - Prefix discovery and prefix registration (similar to HoPP)

Survey:

	TCP/IP based		NDN based	
	MQTT	HoPP	NDN-IoT	
Transport	TCP ✓	NA ✓	NA ✓	
Pub/Sub	✓	✗	✓	
Push	✓		✓	
Pull	✗	✓	✓	
Flow Control	✓	✓	✓	
Reliability	(Q0,Q1,Q2)	✓	✓	

Research Areas:

- Publish/Subscribe (explained(tutorial) in recent ACM ICN 2020 conference[sept 29 - oct 1])
- Access Control

Proposed Access Control:

- Access Control
  - Authentication
  - Authorisation
- Different Access Control in NDN
  - Attribute based
  - Role based

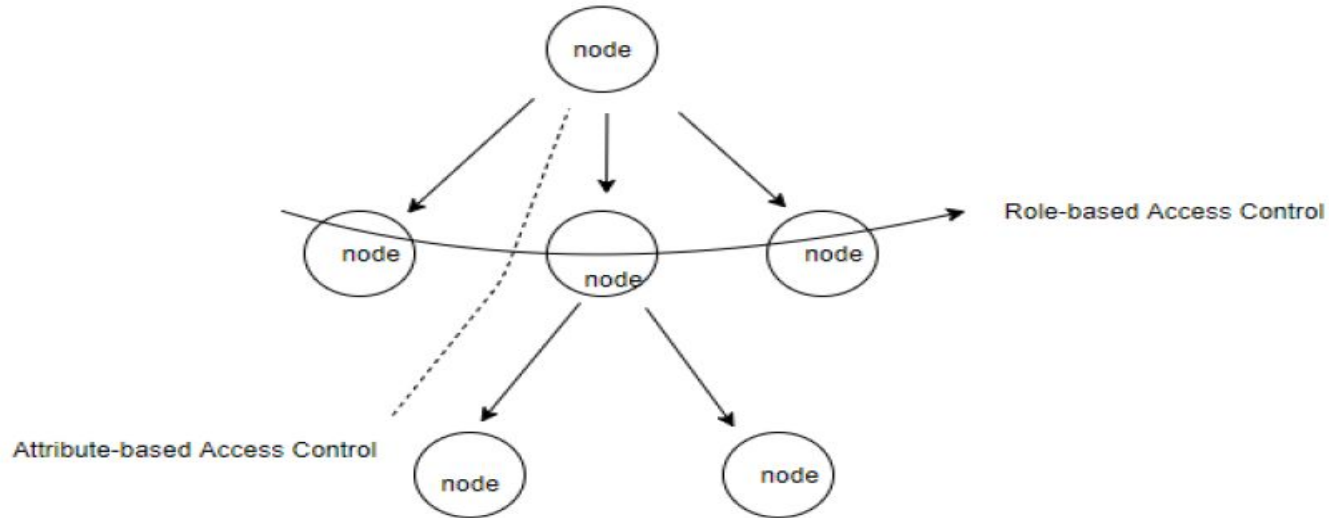# Proposed Access Control: Attribute-role based

Fig. 3.2   Flow of Access Control Policy

Plan for Future

- Validation of proposed Access control
- Implementation of proposed Access control

Conclusion

- NDNIoT can be promising alternative to TCP/IP based MQTT