ONTObOLOGY-DRIVEN DEVICE DESCRIPTIONS FOR IOT NETWORK MANAGEMENT

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INTRODUCTION
CHALLENGES OF THE INTERNET OF THINGS (IOT)

- Heterogeneity of network devices
- Facilitate automatized network management
  - ability to discover device capabilities
  - notifications about changes
MQTT AS A COMMON IOT PROTOCOL

Source: http://www.hivemq.com

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WHAT IS MISSING IN THIS APPROACH?

• MQTT is only a transport protocol
• IoT needs self-descriptive device configurations
• Semantics to avoid vendor lock-in
• Automatized network management

Idea: use standard network management approach for the IoT
NETCONF: NETWORK CONFIGURATION PROTOCOL

- version 1.1 by RFC 6241 in 2011
- mechanisms to install, manipulate, and delete the configuration of network devices
- operations are realized as remote procedure calls (RPCs)

NETCONF SERVER ON IOT DEVICE?


YANG: A DATA MODELING LANGUAGE FOR NETCONF

• RFC 6020 published in 2010

• YANG model defines a hierarchy of data for NETCONF-based operations
  • configurations
  • state data
  • Remote Procedure Calls (RPCs)
  • notifications

• balance between high-level data modeling and low-level encoding
WHAT IS MISSING IN YANG?

- Semantic expression is restricted
- XPath expressions are not that powerful as semantic web technologies
- YANG is a data modeling language

Idea: use an IoT ontology for device descriptions
USED PART OF THE ONEM2M BASE ONTOLOGY
AN ONTOLOGY-BASED NETCONF-MQTT BRIDGE

Microcontroller Board with LED and brightness sensor

MQTT Broker

MQTT Client/NETCONF Server

NETCONF-MQTT bridge

NETCONF Client Web-Interface

User
SYSTEM-ARCHITECTURE
PUBLISH DEVICE DESCRIPTIONS

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SYSTEM-ARCHITECTURE
CONTROL THE ACTUATOR

Device Description: oneM2M Ontology

Microcontroller Board with LED and brightness sensor

Topic for Control: led/UUID#

7. MQTT Publish Action

6. MQTT Publish Control

5. Call RPC

NETCONF-MQTT bridge

MQTT Broker

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NETCONF Client Web-Interface

User
HARDWARE: CC2538 DEVELOPMENT KIT FROM TEXAS INSTRUMENTS

- 32 kiB RAM
- 512 kiB Flash Memory
- Low Power RF ARM Cortex M3-based System 32-bit processor
- IEEE 802.15.4 compliant (6LoWPAN)
• oneM2M ontology uses RDF/XML syntax
• we use JSON-LD
• CBOR achieved compressing rate about only 87.45% comparing to the optimized JSON-LD file
CONCLUSION
CONCLUSION

• Results
  • Development of the NETCONF-MQTT Bridge
  • Ontology parser and YANG data models generator
  • Using oneM2M ontology on constrained devices
  • Evaluation on ontology file size optimization for constrained devices
THANK YOU!
ANY QUESTIONS?

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