Taming the IoT

Forth's Role in the Internet of Things

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Overview

- The Internet of Things
- MQTT
- Forth Things
- Demo
- Different Kind of Messages
- Domain Specific Languages
- Conclusion

The Internet of Things

- **embedded Systems**
- **interconnected by Internet technology**
- **+ specialised communication protocols**
  - **MQTT (Message Queuing Telemetry Transport) publish and subscribe via a broker**
  - ROS (robot operating system)
  - zeromq, AMQP, DDS

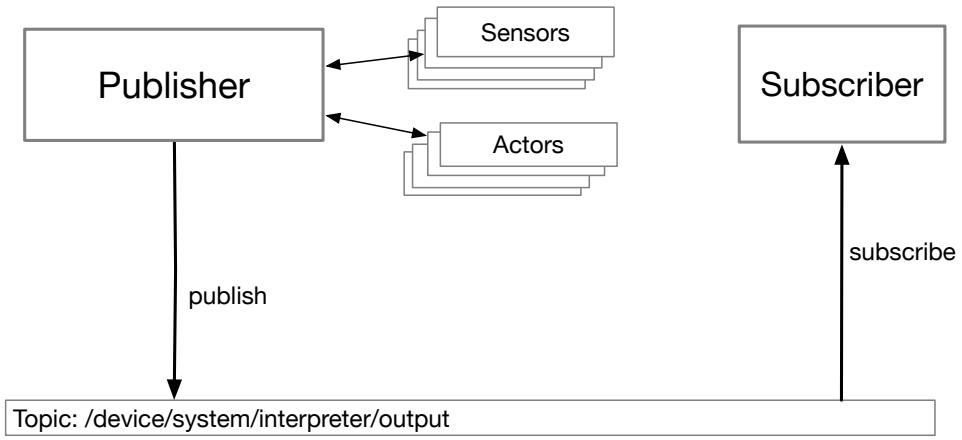
source: Wikimedia

Message Queuing Telemetry Transport

- **lightweigth IoT communication**
- ***publish* and *subscribe* 1:N communication**
- **uses a *broker* (server) usually runs over TCP/IP**
- ***topics* (communication channels)**
  - **a node (thing)**
    - **can publish a message to a topic and**
    - **all subscribers of that topic receive the message**
  - **with hierarchical names such as `/device/system/interpreter/input`**
  - **wild cards in order to subscribe to a set of topics `+` `#`**
- quality of service, last will, ...
- wide support by libraries, applications, community
  node red, mqtt explorer, mosquitto broker, ...

source: Wikimedia

Message Queuing Telemetry Transport



Of course a single thing can be publisher and subscriber at the same time.

source: Wikimedia

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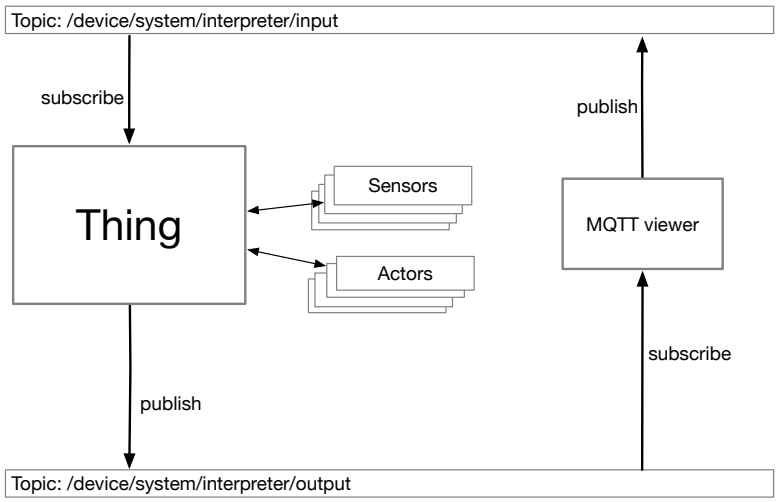

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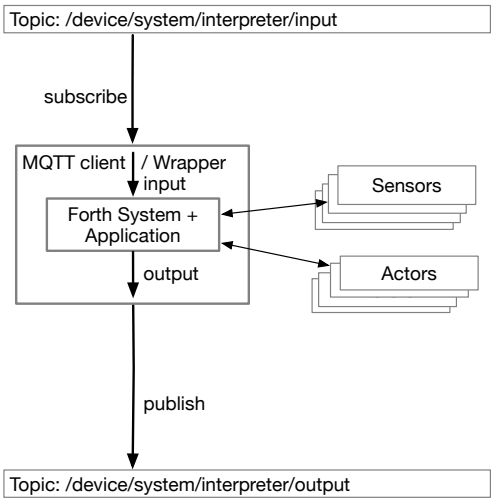
Forth things

Can we implement things in Forth? Yes



connect Forth's input and output to topics

Forth things

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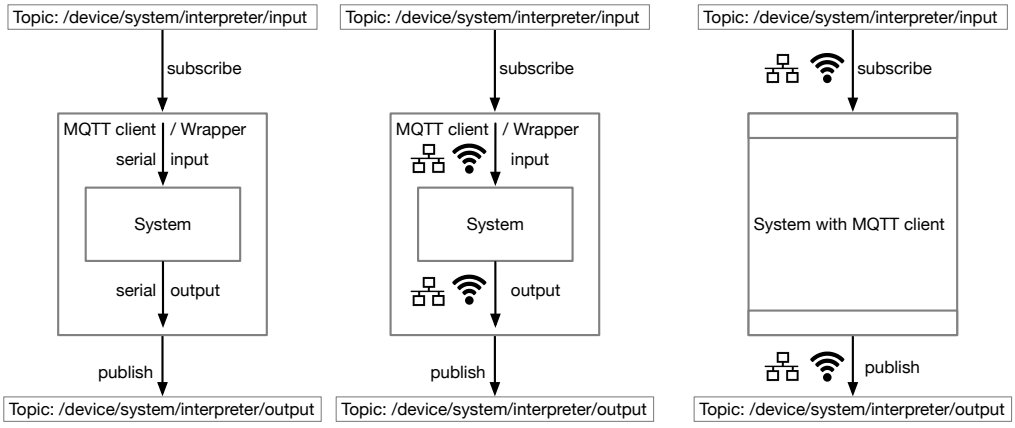
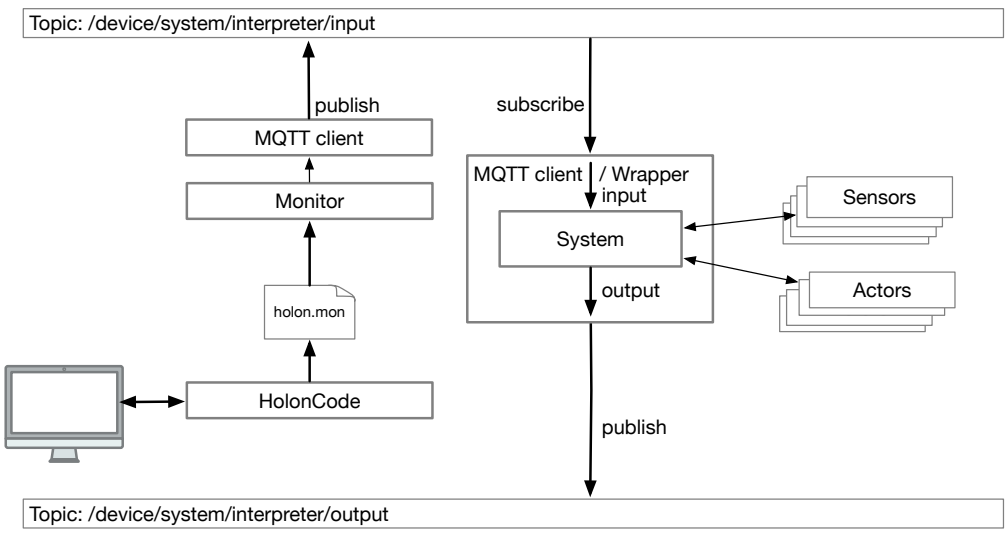


connect Forth's input and output to topics

Forth things - Interactive Development



DEMO

- MQTT broker is running
- MQTT explorer is connected to see messages
- seedForth is wrapped so that its
  - input comes from /device/system/seedForth/input
  - output goes to /device/system/seedForth/output
- MQTT explorer can send messages to seedForth
- Command line client **`connect`** can access seedForth via MQTT

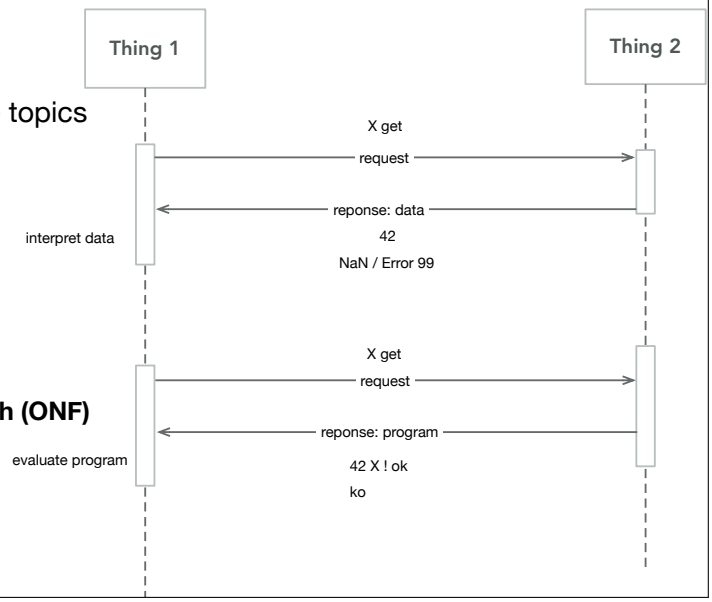
Different kind of messages

- **connect Forth's input and output to topics**

- **Forth's output must be lean. Two words**
  - **`verbose` - make system ready for interactive use**
  - **`quiet` - calm down system to do no echo or superfluous output.**

Different kind of messages

- connect Forth's input and output to topics
- **What messages to exchange?**
  - **requests (commands) and data reponses?**
  - **requests (commands) and program responses?**
- **Heinz Schnitter's Open Network Forth (ONF)**



Domain Specific Languages (DSL)

- "Forth is well suited for DSLs."
- Yes - but how?
  - sealed vocabularies
  - natural langage like syntax
  - best practice for design of Forth DSLs?
  - sandboxes?

Domain Specific Languages (DSL)

Sealed Vocabularies

- **Put all words of your DSL in word lists of their own.**
- **Only search these word lists, i.e. seal these vocabularies**

This might be helpful:

```
: evaluate-in-search-order ( c-addr u i*x wid1 ... widn n -- j*x )
   n>r  get-order
   nr>  set-order
   n>r  ['] evaluate catch
   nr> set-order
   throw ;
```

Domain Specific Languages (DSL)

Natural Language Syntax

- **Design your DSL using different kinds of words**
  - **nouns (-- i*x)**
  - **verbs (i*x --)**
  - **adjectives (i*x -- j*x)**
- **Make your commands phrases with**
  - **subject object1 object2 ... verb**

elbow 30 degrees clockwise turn

See "In Review: FORML 1984 Asilomar Conference", FD, Vol. VI, No. 5, p34ff, 1984

Domain Specific Languages (DSL)

Best practices and sandboxes?

- **Who has a systematic structured aproach to Forth DSLs?**
  - **please contact me ->** 
- **Sandboxing**
  - **We want to evaluate Forth source code.**
  - **How can this be restricted to be save?**
  - **Certainly no unrestricted `@` and `!`** 🙂
  - **Work on best practices to do sandboxes**
  - **Again: please contact me ->** 

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• Different Kind of Messages	data or program responses
• Domain Specific Languages	sealed vocabularies, nouns&verbs, sandboxes
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Questions?