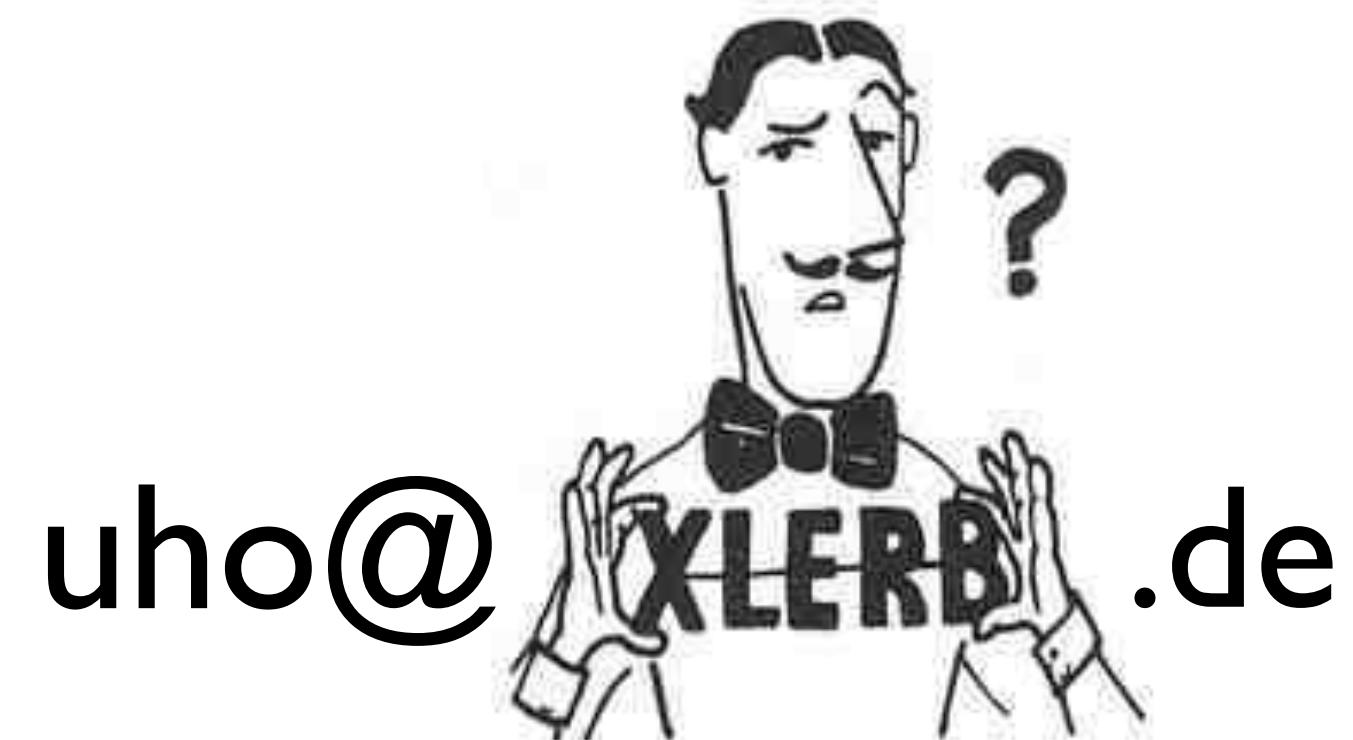


Taming the IoT

Forth's Role in the Internet of Things

EuroForth'21 conference 2021-09

Ulrich Hoffmann



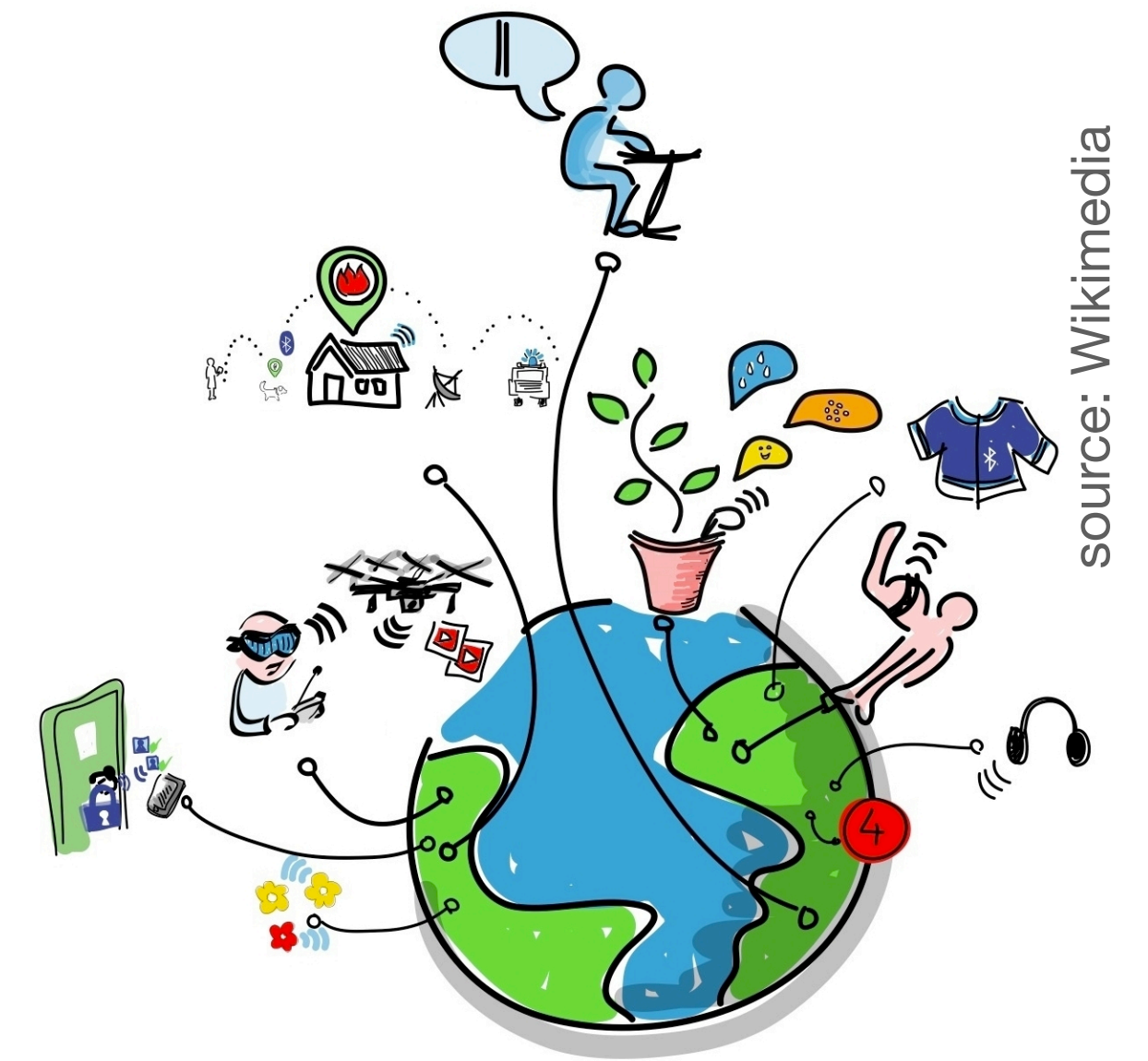
Overview

- 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: wikipedia

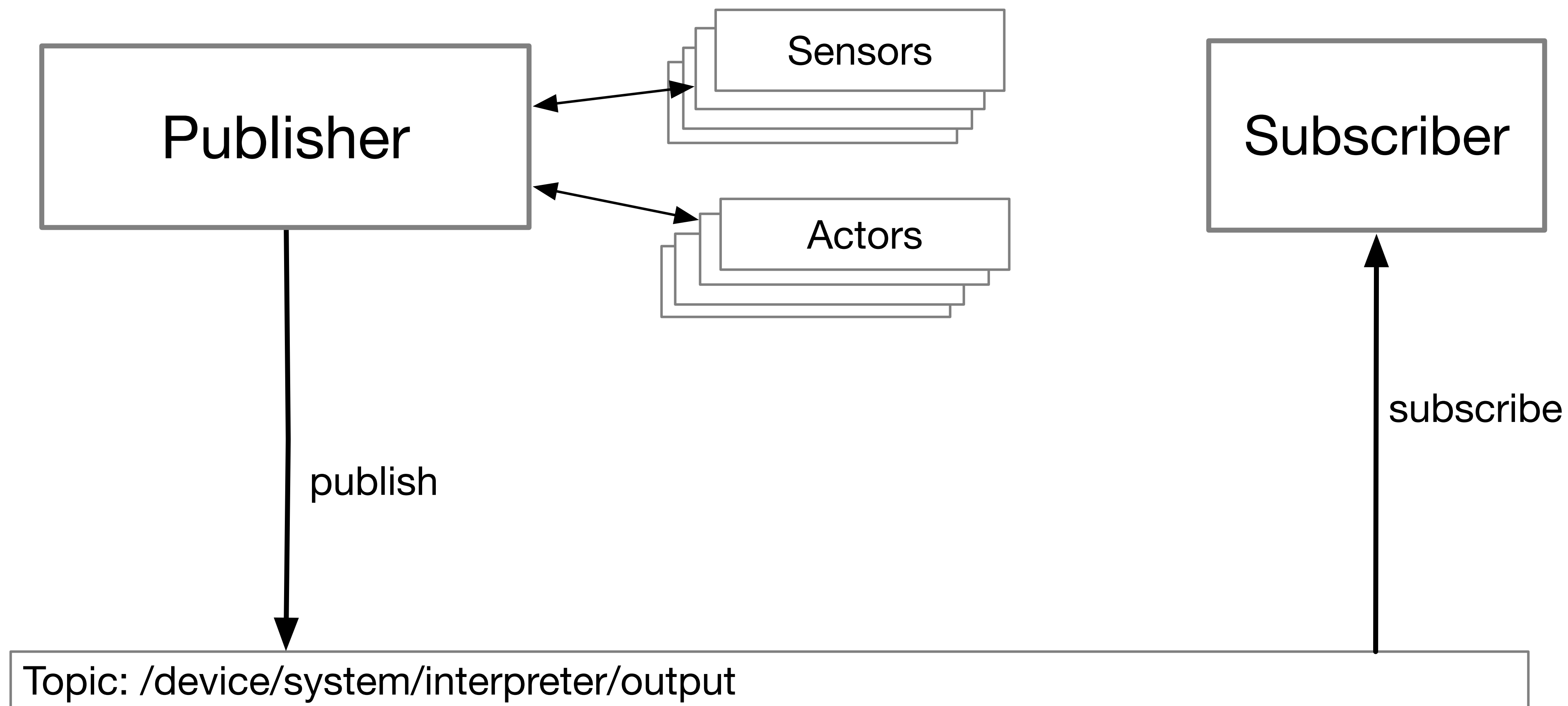


Message Queuing Telemetry Transport

- **lightweight 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, ...



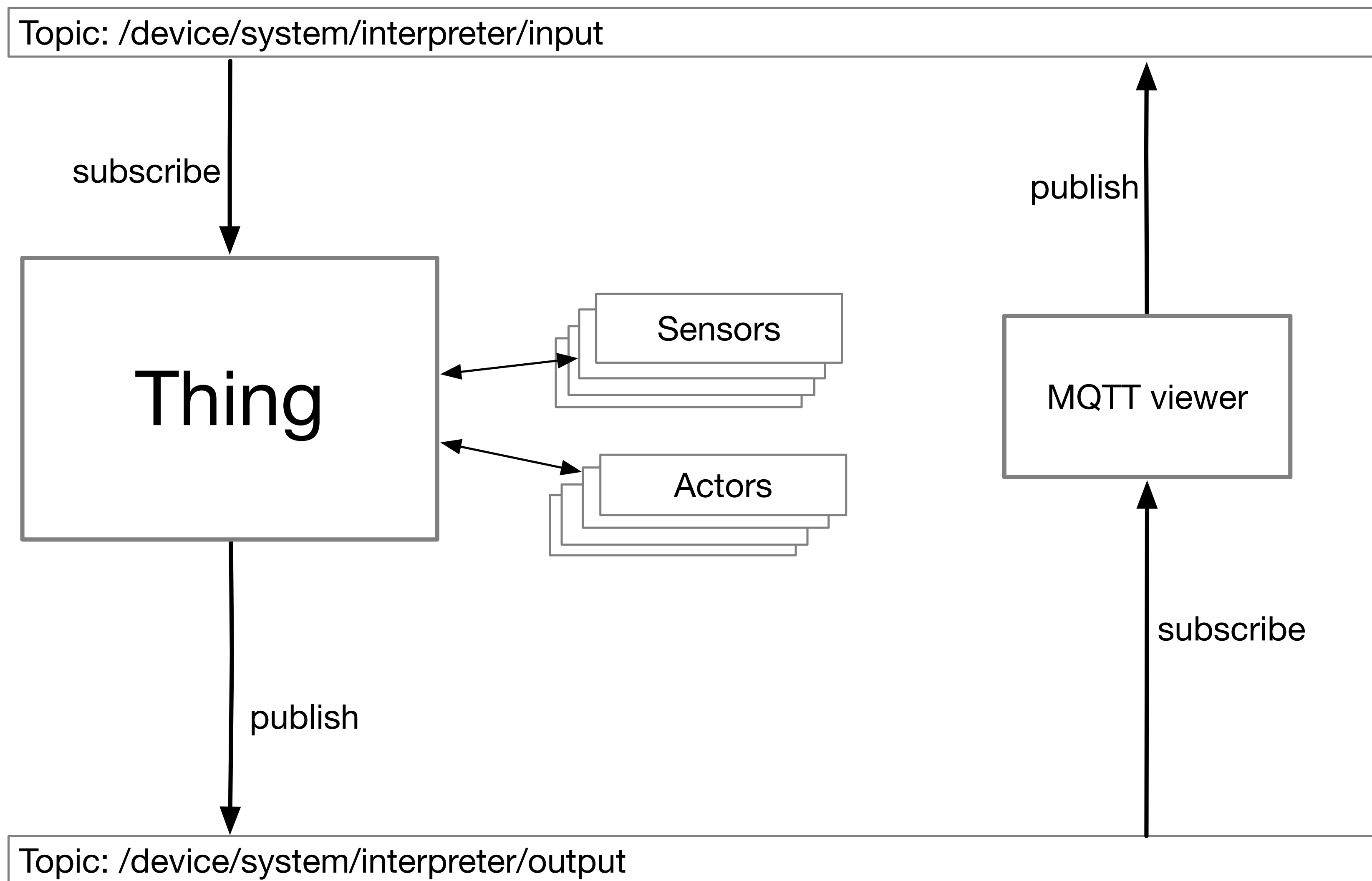
Message Queuing Telemetry Transport



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



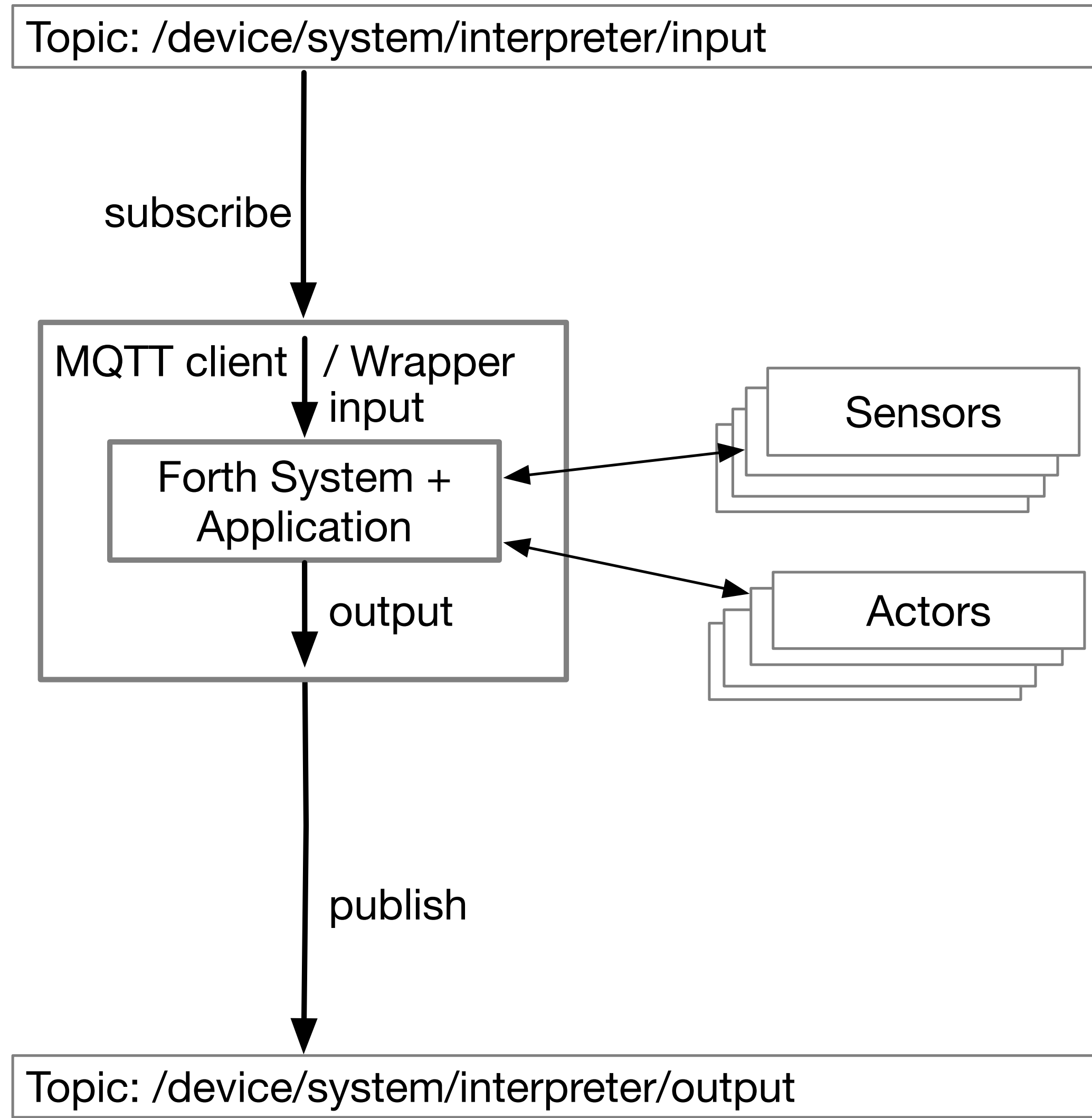
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Of course a single thing can be publisher and subscriber at the same time.

Forth things

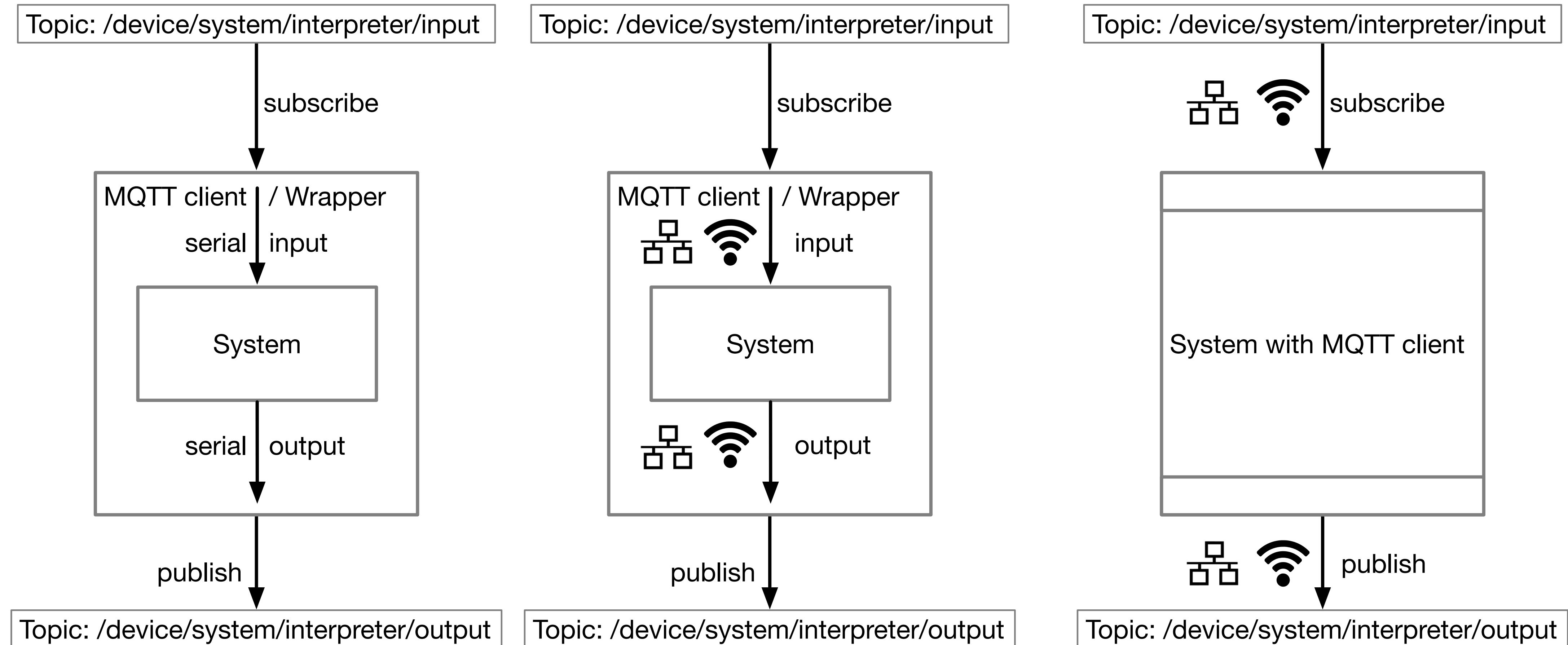
Can we implement things in Forth? Yes



connect Forth's input and output to topics

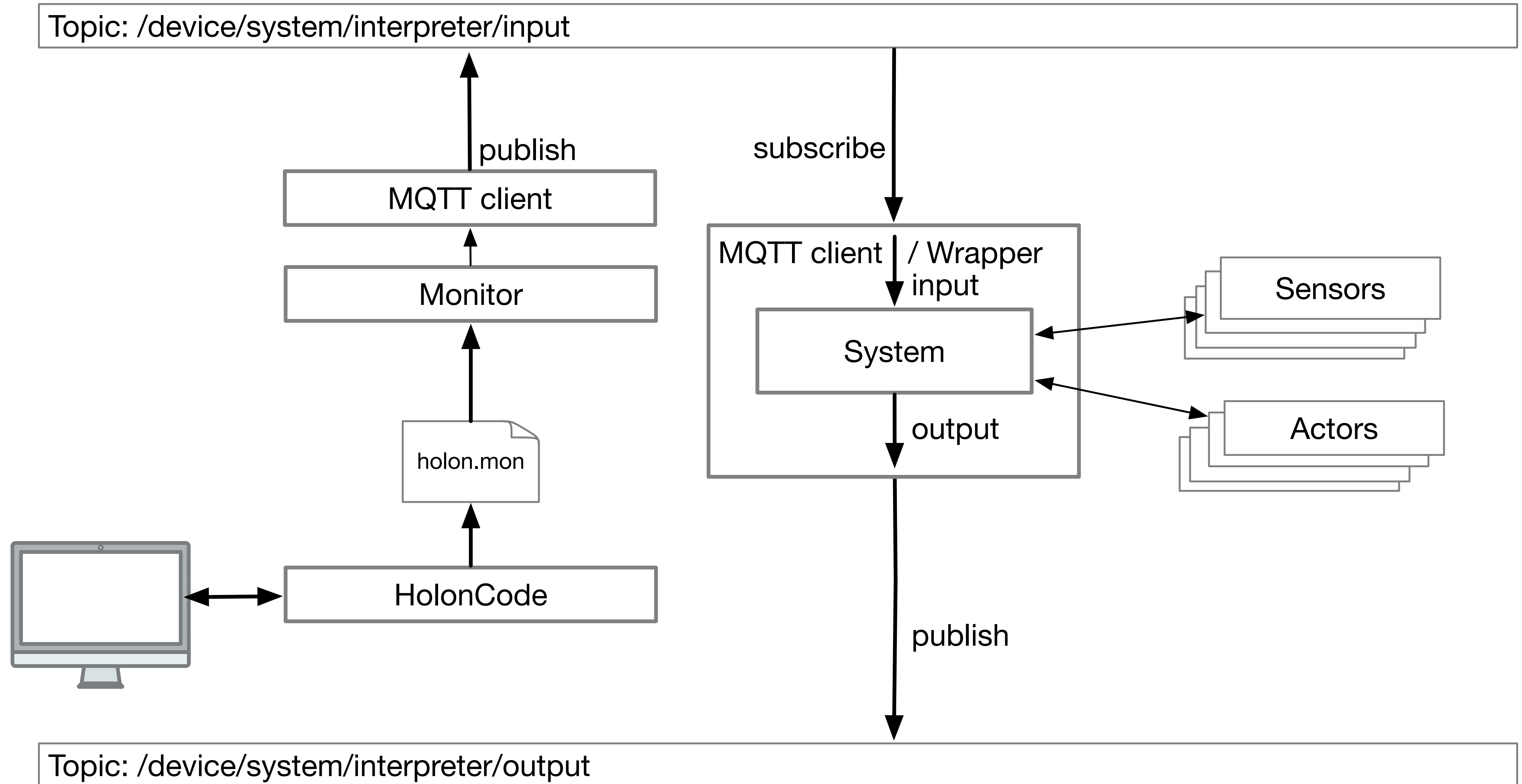
Forth things

Can we implement things in Forth? Yes



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

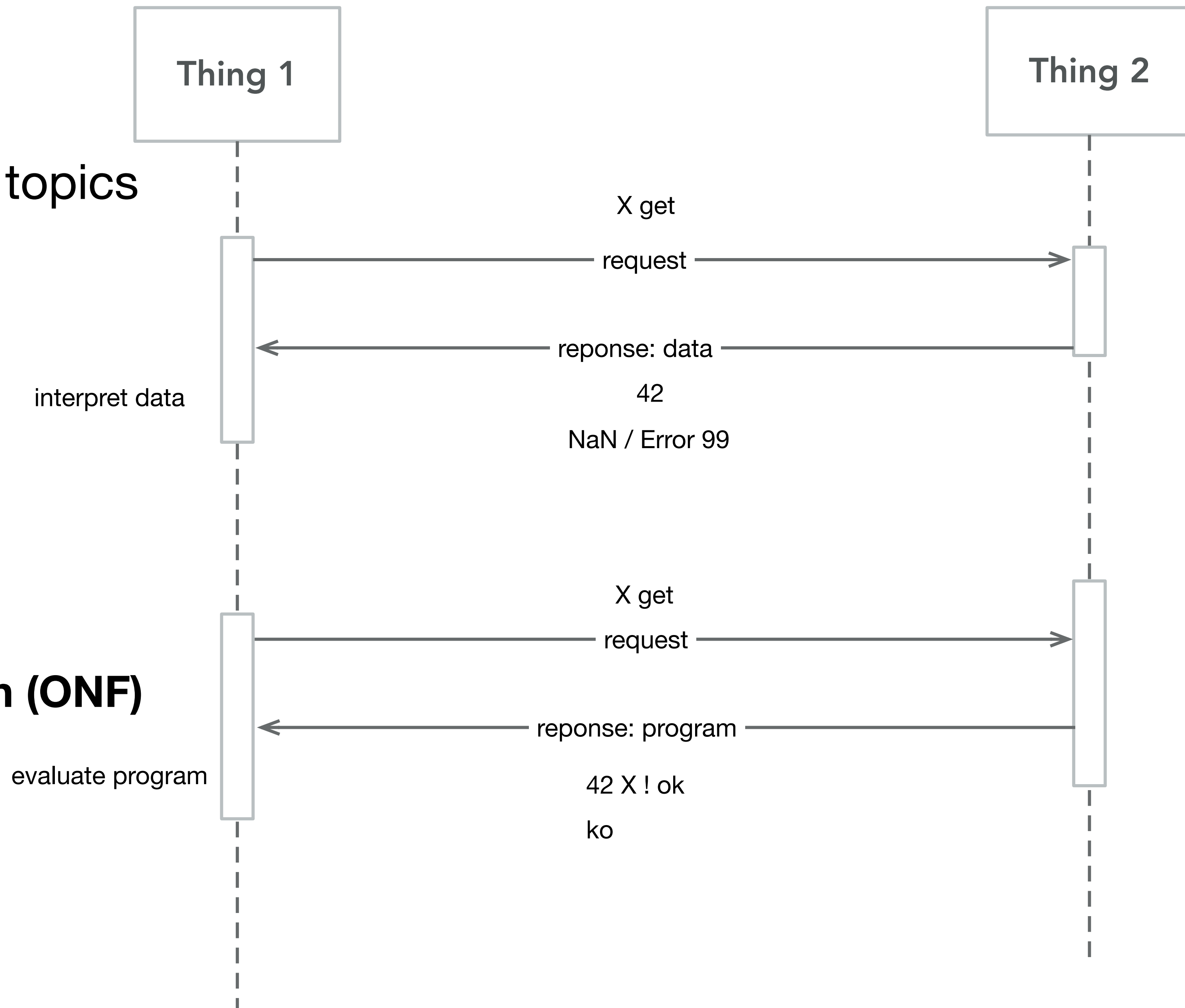
- connect Forth's input and output to topics

- **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 language 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


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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- Forth Things
 - connect input and output to topics
- Demo
 - we've seen some stuff live
- Different Kind of Messages
 - data or program responses
- Domain Specific Languages
 - sealed vocabularies, nouns&verbs, sandboxes
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 - you are here

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Questions?

