



DAPNET 2.0 CONCEPT AND INTERFACE DEFINITION

Thomas Gatzweiler, DL2IC

Philipp Thiel, DL6PT

Marvin Menzerath

Ralf Wilke, DH3WR

LAST CHANGE: JULY 18, 2018

Abstract

This is the concept and interface description of the version 2 of the DAPNET. It's purpose in comparison to the first version released is a more robust clustering and network interaction solution to cope with the special requirements of IP connections over HAMNET which means that all network connections have to be considered with a WAN character resulting in unreliable network connectivity. In terms of consistence of the database, "eventually consistence" is considered to be the most reachable. There are "always right" database nodes inside the so called HAMCLOUD. In case of database conflicts, the version inside the HAMCLOUD cluster is always to be considered right.

Contents

1	Introduction	4
1.1	Key Features	4
1.2	Historic Background	4
1.3	Concept presentation	4
1.4	Transmitter Software	5
1.4.1	Unipager	5
1.4.2	DAPNET-Proxy	5
1.5	DAPNET Network	5
1.5.1	Overview and Concept	5
1.5.2	Used third-party Software	5
1.5.3	HAMCLOUD Description	5
1.5.4	Rubric Handling Concept	5
1.5.5	Queuing Priority Concept	5
2	DAPNET Network Definition	6
2.1	Cluster Description	6
2.1.1	Real-time Message delivery with RabbitMQ	6
2.1.2	Distributed Database with CouchDB	6
2.1.3	Authentication Concept	6
2.1.4	Integration of new Nodes	6
2.2	Interface Overview and Purpose	6
2.2.1	RabbitMQ Exchange	6
2.2.2	CouchDB Interface	7
2.2.3	Core REST API	7
2.2.4	Statistic, Status and Telemetry REST API	7
2.2.5	Websocket for real-time updates on configuration, Statistics and Telemetry API	7
2.2.6	MQTT Fanout for third-party consumers	7
2.3	Other Definitions	8
2.3.1	Scheduler	8
2.3.2	User Roles and Permissions	8

3	Internal Programming Workflows	9
3.1	Sent calls	9
3.2	Add, edit, delete User	9
3.3	Add, edit, delete Subscriber	10
3.4	Add, edit, delete Node (tbd)	10
3.5	Add, edit, delete Transmitter	10
3.6	Implementation of Transmitter Groups	10
3.7	Add, edit, delete Rubrics	10
3.8	Add, edit, delete Rubrics content	10
3.9	Add, edit, delete, assign Rubrics to Transmitter/-Groups	10
3.10	Docker integration	10
3.11	Microservices	11
3.11.1	Database Service	11
3.11.2	Call Service	11
3.11.3	Rubric Service	11
3.11.4	Transmitter Service	11
3.11.5	Cluster Service	12
3.11.6	Telemetry Service	12
3.11.7	Database Changes Service	12
3.11.8	Status Service	12
3.11.9	RabbitMQ Auth Service	12
3.11.10	Time and Identification Service	12
3.12	Ports and Loadbalacing Concept	12
3.13	Periodic Tasks (Scheduler)	12
3.14	Plugin Interface	12
3.15	Transmitter Connection	12
3.16	Transmitter connections	13
3.16.1	Authentication of all HTTP-Requests in this context	13
3.17	DAPNET-Proxy	13
4	External Usage Workflows	14
4.1	General Concept of REST and Websocket-Updates	14
4.2	Website and App	14
4.2.1	Authentication	14
4.2.2	Calls	14
4.2.3	Rubrics	14
4.2.4	Rubrics content	14
4.2.5	Transmitters and Telemetry	14
4.2.6	Nodes	14
4.2.7	Users	14
4.2.8	MQTT consumers	14
4.2.9	Scripts and automated Software for DAPNET-Input	14

5	Setup and Installation	15
5.1	Unipager	15
5.2	DAPNET-Proxy	15
5.3	DAPNET Core	15
5.4	Special issues for Core running in HAMCLOUD	15
6	Protocol Definitions	16
6.1	Microservices API	16
6.1.1	Database Service	16
6.1.2	Call Service	16
6.1.3	Rubric Service	16
6.1.4	Transmitter Service	16
6.1.5	Cluster Service	18
6.1.6	Telemetry Service	18
6.1.7	Database Changes Service	18
6.1.8	Status Service	18
6.1.9	Statistics Service	19
6.1.10	RabbitMQ Service	19
6.2	RabbitMQ	19
6.2.1	Transmitters	19
6.2.2	Telemetry	19
6.2.3	MQTT API for third-party consumers	20
6.3	Telemetry from Transmitters	21
6.4	Telemetry from Nodes	22
6.5	Statistic, Status and Telemetry REST API	23
6.5.1	Statistics	23
6.5.2	Status	24
6.5.3	Telemetry from Transmitters	24
6.5.4	Telemetry from Nodes	24
6.6	Websocket API	25
6.6.1	Telemetry from Transmitters - Summary of all TX	25
6.6.2	Telemetry from Transmitters - Details of Transmitter	26
6.6.3	Telemetry from Nodes - Summary of all Nodes	27
6.6.4	Telemetry from Transmitters - Details of Node	28
6.6.5	Database Changes	29
6.7	CouchDB Documents and Structure	31
6.7.1	Users	31
6.7.2	Nodes	32
6.7.3	Transmitters	32
6.7.4	Subscribers	33
6.7.5	Subscriber Groups	33
6.7.6	Rubrics List	33
6.7.7	Rubric's content	34
6.7.8	MQTT services and subscribers	34

Chapter 1

Introduction

more
text

1.1 Key Features

1.2 Historic Background

write
some his-
tory

1.3 Concept presentation

An overview of the DAPNET 2.0 concept is given in Fig. 1.1.

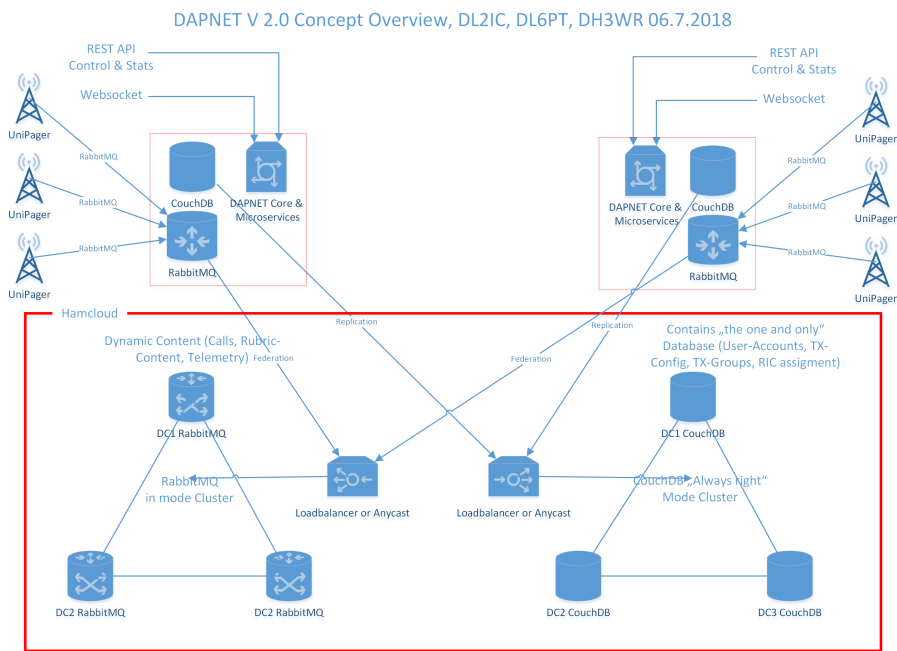


Figure 1.1: Overview of DAPNET Clutering and Network Structure

The details of a single node implementation are shown in Fig. 1.2.

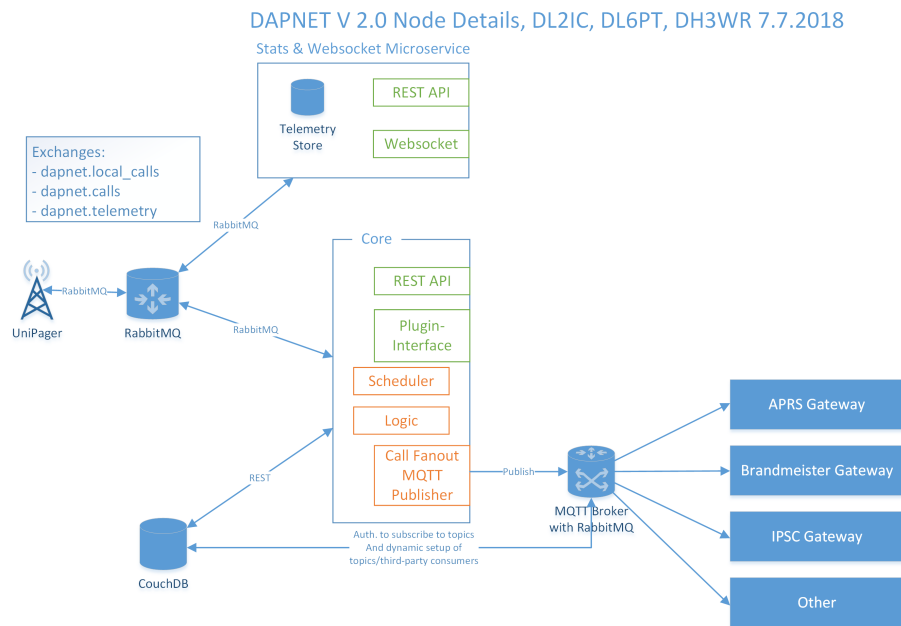


Figure 1.2: Node Details

1.4 Transmitter Software

1.4.1 Unipager

1.4.2 DAPNET-Proxy

1.5 DAPNET Network

1.5.1 Overview and Concept

1.5.2 Used third-party Software

1.5.3 HAMCLOUD Description

The HAMCLOUD is a virtual server combination of server central services on the HAMNET and provide short hop connectivity to deployed service on HAMNET towards the Internet. There are three data centers at Essen, Nürnberg and Aachen, which have high bandwidth interlinks over the DFN. There are address spaces for uni- and anycast services. How this concept is deployed is still tbd. More information is here https://www.swiss-artg.ch/fileadmin/Dokumente/HAMNET/HamCloud_-_Angebotene_Dienste_in_der_HamCloud.pdf and here <http://hamnetdb.net/?m=as&q=hamcloud>.

Define if uni- or anycast entry points will exist

1.5.4 Rubric Handling Concept

1.5.5 Queuing Priority Concept

Chapter 2

DAPNET Network Definition

2.1 Cluster Description

2.1.1 Real-time Message delivery with RabbitMQ

2.1.2 Distributed Database with CouchDB

2.1.3 Authentication Concept

2.1.4 Integration of new Nodes

2.2 Interface Overview and Purpose

2.2.1 RabbitMQ Exchange

There are 3 exchanges on each RabbitMQ instance available:

dapnet.calls Messages that are distributed to all nodes

dapnet.local_calls Messages coming only from the local node instance

dapnet.telemetry Messages containing telemetry from transmitters

Transmitters publish their telemetry data to the **dapnet.telemetry** exchange, while consume the data to be transmitted from a queue that is bound to the **dapnet.calls** and **dapnet.local_calls** exchanges.

The idea is to distinguish between *local* data coming from the local Core instance and data coming from the DAPNET network. This is necessary, as for example the calls to set the time on the pagers are generated by the local Core and not shall not distributed to other Cores and their connected transmitter to avoid duplicates.

dapnet.calls

This federated exchange receives calls from all Core instances. Personal calls are always published to this exchange, as they are unique and only published by the Core that receives the call via the [Core REST API](#). Rubric content is also emitted here. The transmitter to receive the call is defined via the routing key.

dapnet.local_calls

The the local Core publishes special calls to this exchange, like the time set calls, the rubric names and repetitions of rubric content for the local connected transmitters.

In short, all calls that are generated by the [Scheduler](#) on a Core instance are published to this exchange. As the scheduler runs on every node, otherwise the calls would be transmitted several times by the same transmitter. This exchange is not federated with other RabbitMQ instances on other Cores.

dapnet.telemetry

On each Core instance, the [Statistic, Status and Telemetry](#) microservice described in section [2.2.4](#) is consuming the telemetry of all transmitters. The received data is stored and delivered via the [Core REST API](#) and the [Websocket API](#) in section [2.2.5](#) to connected websites or apps.

2.2.2 CouchDB Interface

The CouchDB interface is a REST interface defined in the CouchDB documentation. All communication with the CouchDB database are done by means of the interface. No user should be able to connect to the CouchDB REST interface, only the Core software components should be able to do so. The local node can access CouchDB with randomly created credentials which are automatically generated on the first startup of the node. For database replication, the other nodes are authenticated by their authentication key in the nodes database.

2.2.3 Core REST API

The Core REST API is the main interface for user interactions with the DAPNET network.

2.2.4 Statistic, Status and Telemetry REST API

2.2.5 Websocket for real-time updates on configuration, Statistics and Telemetry API

2.2.6 MQTT Fanout for third-party consumers

In order to allow third-party application to consume the data sent out by DAPNET transmitters in an easy and most generic way, there is an MQTT broker on each Core. As the [RabbitMQ](#) instance already has a plugin to act as an MQTT broker, this solution is chosen.

To dynamically manage the third-party applications attached to DAPNET, there is a [CouchDB](#)-Database containing the existing third-party descriptive names, corresponding MQTT topic names and authentication credentials to be allowed to subscribe to the that specific MQTT topic.

It is a intention to not fan out every content on DAPNET to every third-party application but let the user decide if personal calls directed to her/him will be available on other third-party applications or not. The website will display opt-in checkboxes for each subscriber to enable or disable the message delivery for each third-party application. As we have had some issues in this topic in the past, this seems the best but still generic and dynamic solution.

The fan out consists of the source and destination callsign, the destination RIC and SubRIC and an array of callsign and geographic location of the transmitters, where this specific call is supposed to be sent out by DAPNET transmitters. The type of transmitter is also given. The reason to output also the transmitter and their location is to enable third-party applications to estimate the content's distribution geographic area and take adequate action for their own delivery or further processing. (Example: Regional Rubric content to Regional DMR Group SMS.)

The third-party applications can (if access is granted) only read from the topic. All Core instances have read/write access to publish the data.

The MQTT topics are kept local on the Core instance and are never distributed between DAPNET-Cores.

2.3 Other Definitions

2.3.1 Scheduler

2.3.2 User Roles and Permissions

There are two types of users: Admins and Non-Admins. Admins are allowed to do everything. Non-Admins are just allowed to edit the entities that they own and send calls.

Make
overview
of data
displayed
to Non-
Admin
users
from
CouchDB
in
REST-
Calls (see
[6.1](#).

Chapter 3

Internal Programming Workflows

3.1 Sent calls

3.2 Add, edit, delete User

Show current users

1. Get current status via `GET /users` on Core URL
2. Handle updates via Websocket

Add and Edit User

1. If edit: Get current status via `GET /users/<username>` on Core URL
2. Show edit form and place data
3. On save button event, send `POST /users/<username>` on Core URL

The core will update the CouchDB and generate a RabbitMQ administration message to inform all other nodes. This information is transmitted by the Stats and Websocket Micro-Service to all connected websocket clients to get them updated. This will also happen for the website instance emitting the edit request, so its content is also updated.

Delete User

1. Ask "Are you sure?"
2. If yes, send `DELETE /users/<username>` on Core URL

The core will update the CouchDB and generate a RabbitMQ administration message to inform all other nodes. This information is transmitted by the Stats and Websocket Micro-Service to all connected websocket clients to get them updated. This will also happen for the website instance emitting the edit request, so its content is also updated.

3.3 Add, edit, delete Subscriber

3.4 Add, edit, delete Node (tbd)

3.5 Add, edit, delete Transmitter

3.6 Implementation of Transmitter Groups

3.7 Add, edit, delete Rubrics

Show current configuration

1. Get current status via GET /rubrics on Core URL
2. Handle updates via websocket

Add and Edit rubrics

1. If edit: Get current status via GET /rubrics/<rubricname> on Core URL
2. Show edit form and place data
3. On save button event, send POST /users/<rubricname> on Core URL

The core will update the CouchDB and generate a RabbitMQ administration message to inform all other nodes. This information is transmitted by the Stats and Websocket Micro-Service to all connected websocket clients to get them updated. This will also happen for the website instance emitting the edit request, so its content is also updated.

Delete rubric

1. Ask "Are you sure?"
2. If yes, send DELETE /users/<rubricname> on Core URL

The core will update the CouchDB and generate a RabbitMQ administration message to inform all other nodes. This information is transmitted by the Stats and Websocket Micro-Service to all connected websocket clients to get them updated. This will also happen for the website instance emitting the edit request, so its content is also updated.

3.8 Add, edit, delete Rubrics content

3.9 Add, edit, delete, assign Rubrics to Transmitter/-Groups

3.10 Docker integration

DL2IC:
Docker
Inte-
gration
beschreiben

3.11 Microservices

A DAPNET node consists of several isolated microservices with different responsibilities. Each microservice runs in container and is automatically restarted if it should crash. Some microservices can be started in multiple instances to fully utilize multiple cores. The access to the microservices is proxied by a NGINX webserver which can also provide load balancing and caching.

REST endpoint	Microservice
* /users/* * /nodes/* * /rubrics/* * /subscribers/* * /subscriber_groups/* DELETE /transmitters/:id PUT /transmitters	Database Service
* /calls/*	Call Service
* /rubrics/:id/*	Rubric Service
GET /transmitters GET /transmitters/:id POST /transmitters/bootstrap POST /transmitters/heartbeat	Transmitter Service
POST /cluster/discovery	Cluster Service
GET /telemetry/*	Telemetry Service
WS /telemetry/transmitters WS /telemetry/transmitters/<TxName> WS /telemetry/nodes WS /telemetry/nodes/<NodeName>	Summary data of all TX Details for TX <TxName> Summary data of all nodes Details for Node <NodeName>
WS /changes	Database Changes Service
GET /status/*	Status Service
GET /statistics	Statistics Service
GET /rabbitmq/*	RabbitMQ Auth Service

3.11.1 Database Service

- Proxies calls to the CouchDB database
- Controls access to different database actions
- Removes private/admin only fields from documents

3.11.2 Call Service

- Generates and publishes calls to RabbitMQ
- Receives all calls from RabbitMQ
- Maintains a database of all calls

3.11.3 Rubric Service

- Publishes rubric content as calls to RabbitMQ
- Periodically publishes rubric names as calls to RabbitMQ

3.11.4 Transmitter Service

- Maintains a list of all transmitters and their current status

3.11.5 Cluster Service

- Maintains a list of known nodes and their current status
- Manages federation between RabbitMQ queues
- Manages replication between CouchDB databases

3.11.6 Telemetry Service

- Maintains the telemetry state of all transmitters
- Forwards telemetry updates via websocket

3.11.7 Database Changes Service

- Forwards database changes via websocket

3.11.8 Status Service

- Periodically checks all other services and connections

3.11.9 RabbitMQ Auth Service

- Provides authentication for RabbitMQ against the CouchDB users database

3.11.10 Time and Identification Service

- Sends periodic time and identification messages to RabbitMQ

3.12 Ports and Loadbalancing Concept

3.13 Periodic Tasks (Scheduler)

3.14 Plugin Interface

3.15 Transmitter Connection

Transmitter connections consist of two connections to a Node. A REST connection for initial announcement of a new transmitter, heartbeat messages and transmitter configuration and a RabbitMQ connection to receive the data to be transmitted.

The workflow for a transmitter connection is the following:

1. Announce new connecting transmitter via Core REST Interface ([6.1.4](#)).
2. Get as response the transmitter configuration or an error message ([6.1.4](#)).
3. Initiate RabbitMQ connection to get the data to be transmitted ([6.2.1](#)).

The authentication of the transmitter's REST calls consist of the transmitter name and its AuthKey, which is checked against the value in the CouchDB for this transmitter.

3.16 Transmitter connections

If a transmitter wants to connect to DAPNET, the first step is to sign-in and show its presence via the Core REST interface. This interface is also used for transmitter configuration like enabled timeslots and keep-alive polling.

3.16.1 Authentication of all HTTP-Requests in this context

All HTTP-requests issued from a transmitter have to send a valid HTTP authentication, which is checked against the CouchDB. It consists of the transmitter name and its AuthKey.

3.17 DAPNET-Proxy

Da es sich bei den Anfragen um POST-Requests mit JSON Body handelt, wäre es einfacher da den AuthKey mit dazu zu packen, so wie es auch schon in der Protokoll-Definition umgesetzt ist.

Chapter 4

External Usage Workflows

4.1 General Concept of REST and Websocket-Updates

4.2 Website and App

4.2.1 Authentication

4.2.2 Calls

4.2.3 Rubrics

4.2.4 Rubrics content

4.2.5 Transmitters and Telemetry

4.2.6 Nodes

4.2.7 Users

4.2.8 MQTT consumers

4.2.9 Scripts and automated Software for DAPNET-Input

Chapter 5

Setup and Installation

5.1 Unipager

5.2 DAPNET-Proxy

5.3 DAPNET Core

5.4 Special issues for Core running in HAMCLOUD

Chapter 6

Protocol Definitions

6.1 Microservices API

See [Microservices definition](#).

define
all the
REST /
WS In-
terfaces

6.1.1 Database Service

* /users/*

* /nodes/*

* /rubrics/*

* /subscribers/*

* /subscriber_groups/*

DELETE /transmitters/:id

PUT /transmitters

6.1.2 Call Service

* /calls/*

6.1.3 Rubric Service

* /rubrics/:id/*

6.1.4 Transmitter Service

GET /transmitters

GET /transmitters/:id

GET /transmitters/:id

POST /transmitters/bootstrap

POST /transmitter/bootstrap

```
{
  "callsign": "db0avr",
  "auth_key": "<secret>",
  "software": {
    "name": "UniPager",
    "version": "1.0.2"
  }
}
```

Answers to the bootstrap REST call

200 OK

```
{
  "timeslots": [true, true, false, true, ...],
  "nodes": [
    {
      "host": "node1.ampr.org",
      "port": 4000,
      "reachable": true,
      "last_seen": "2018-07-03T07:43:52.783611Z",
      "response_time": 42
    }
  ]
}
```

423 Locked

```
{
  "error": "Transmitter temporarily disabled by config."
}
```

423 Locked

```
{
  "error": "Transmitter software type not allowed due to serious bug."
}
```

POST /transmitters/heartbeat

POST /transmitter/heartbeat

```
{
  "callsign": "db0avr",
  "auth_key": "<secret>",
  "ntp_synced": true
}
```

Answers to the heartbeat REST call 200 OK

```
{
  "status": "ok"
}
```

If network wants to assign new timeslots without disconnecting (for dynamic timeslots)

200 OK

```
{
  "status": "ok",
  "timeslots": [true, true, false, ...],
  "valid_from": "2018-07-03T08:00:52.786458Z"
}
```

If network wants to initiate handover to other node

503 Service unavailable

```
{
  "error": "Node not available, switch to other node."
}
```

6.1.5 Cluster Service

POST /cluster/discovery

6.1.6 Telemetry Service

GET /telemetry/*

WS /telemetry

6.1.7 Database Changes Service

WS /changes

6.1.8 Status Service

The purpose of the status service is to provide a short overview of the DAPNET network and the microservices.

GET /status

200 OK

```
{
  "good_health" : true,
  "version" : "1.2.3"
  "microservices\_running" : {
    "database" : true,
    "call" : true,
    "rubric" : true,
    "transmitter" : true,
    "cluster" : true,
    "telemetry" : true,
    "database-changes" : true,
    "statistics" : true,
    "rabbitmq" : true,
    "thirdparty" : true
  }
}
```

GET /status/<service_name>

List of valid values for *service_name*:

database-service
call-service
rubric-service
transmitter-service
cluster-service
telemetry-service
database-changes-service
statistics-service
rabbitmq-service

200 OK

<Status output from service itself>

6.1.9 Statistics Service

GET /statistics

6.1.10 RabbitMQ Service

GET /rabbitmq/*

6.2 RabbitMQ

There are 3 exchanges available on each RabbitMQ instance:

dapnet.calls Messages shared between all nodes

dapnet.local_calls Messages coming from the local node instance

dapnet.telemetry Messages containing telemetry from transmitters

6.2.1 Transmitters

Valid Messages are:

dapnet.calls

The messages to transfer data to be transmitted by the transmitter have the following format.

For each transmission, there is a separate RabbitMQ message, as different receivers might need different text encoding. All encoding is already done, when this message is created. The transmitter does no character encoding at all. Both personal pagings and rubric related messages are transmitted with this protocol.

```
{
  "id": "016c25fd-70e0-56fe-9d1a-56e80fa20b82",
  "protocol": "POCSAG",
  "priority": 3,
  "expires": "2018-07-03T08:00:52.786458Z",
  "message": {
    "ric": 12342,
    "subric": 0 to 3,
    "type": "ALPHANUM",
    "speed": 1200,
    "function": 3,
    "data": "Lorem ipsum dolor sit amet"
  }
}
```

The selection of the transmitter is done by means of the routing key. Besides, the priority is also used in the RabbitMQ queuing to deliver higher priority messages first.

dapnet.local_calls

Same as for the the network originated calls in section [6.2.1](#).

6.2.2 Telemetry

On the telemetry exchange, all transmitters and nodes publish their telemetry messages. The format the same as in section [6.3](#) and [6.4](#).

6.2.3 MQTT API for third-party consumers

In order to allow third-party instances like , or others to get the emitted calls and rubric contents in a real time event driven way, there is an MQTT API. It is not implemented via a dedicated MQTT broker, but uses the existing RabbitMQ instance (<https://www.rabbitmq.com/mqtt.html>). There is no distribution of the messages via this MQTT broker; it is local only. So every node publishes the messages locally on its own. Each subscriber has an array of enabled third-party applications. This allow to define the user, if call directed to her/his subscriber shall be also sent to third-party services (see 6.7.4).

check
with
DL2IC

The currently existing MQTT topics are defined in the CouchDB (see section 6.7.8). This makes it possible to add more third-party services and authorized users during runtime without the need to update the software. The valid users to subscribe to the topic are also listed in the same CouchDB database.

The only permitted access for third-party consumers is read. So the subscribe request from a third-party MQTT-Client must use authentication which is checks against the CouchDB data. If correct, read access is granted. Core software has always write access to publish the calls group messages.

The transmitters who are supposed to send out the personal call or the rubric content are published with callsign, geographic location and type of transmitter (widerange or personal). With this generic concept, every third-party application can decide what to do with the content received.

The encoding of the data is UTF-8.

The format of the data published for **personal paging calls** is

```
{
  "pagingcall" : {
    "srccallsign" : "dl2ic",
    "dstcallsign" : "dh3wr",
    "dstric" : 12344,
    "dstsubric" : 0 ... 3,
    "priority" : 3,
    "message" : "DAPNET 2.0 rocks dear YL/OM"
    "transmitted_by" : [
      {
        "callsign" : "db0abc",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "PERONAL" | "WIDERANGE"
      },
      {
        "callsign" : "db0def",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "PERONAL" | "WIDERANGE"
      }
    ],
    "timestamp" : <TIMESTAMP>
  }
}
```

The format of the data published for **rubric_content paging calls** is

```
{
  "rubricmessage" : {
    "message" : ""
    "transmitted_by" : [
      {
        "callsign" : "db0abc",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "PERONAL" | "WIDERANGE"
      },
      {
        "callsign" : "db0def",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "PERONAL" | "WIDERANGE"
      }
    ]
  }
}
```

```

    }
  ],
  "timestamp" : <TIMESTAMP>
}
}

```

6.3 Telemetry from Transmitters

Telemetry is sent from transmitters to the RabbitMQ exchange **dapnet.telemetry** as defined in section 6.2. It is also used in the same way on the websocket API to inform the website and the app about the telemetry in real-time in section 6.6.1 and 6.6.2.

This is sent every minute in complete. If there are changes, just a subset is sent. The name of the transmitter is used as routing key for the message.

```

{
  "onair": true,
  "node": {
    "name": "db0xyz",
    "ip": "44.42.23.8",
    "port": 1234,
    "connected": true,
    "connected_since": "<timestamp-format>"
  },
  "ntp": {
    "synced": true,
    "offset": 124,
    "server": ["134.130.4.1", "12.2.3.2"],
  },
  "messages": {
    "queued": [123, 123, 123, 123, 123, 123],
    "sent": [123, 123, 123, 123, 123, 123]
  },
  "temperatures": {
    "unit": "C" | "F" | "K",
    "air_inlet": 12.2,
    "air_outlet": 14.2,
    "transmitter": 42.2,
    "power_amplifier": 45.2,
    "cpu": 93.2,
    "power_supply": 32.4,
    "custom": [
      {"value": 12.2, "description": "Aircon Inlet"},
      {"value": 16.2, "description": "Aircon Outlet"},
      {"value": 12.3, "description": "Fridge Next to Programmer"}
    ]
  },
  "power_supply": {
    "on_battery": false,
    "on_emergency_power": false,
    "dc_input_voltage": 12.4,
    "dc_input_current": 3.23
  },
  "rf_output" : {
    "fwd": 12.2,
    "refl": 12.2,
    "vswr": 1.2
  },
  "config": {
    "ip": "123.4.3.2",
    "timeslots": [true, false, ..., false],
    "software": {
      name: "Unipager" | "MMDVM" | "DAPNET-Proxy",
      version: "v1.2.3", | "20180504" | "v2.3.4",
    },
  },
  "hardware": {
    "platform": "Raspberry Pi 3B+"
  },
  "rf_hardware": {

```

```

    "c9000": {
      "name" : "C9000 Compact",
      "<pa_dummy>" : {
        "output_power" : 123,
        "port" : "/dev/ttyUSB0"
      }
      "<rpc>": {
        "version" : "XOS/2.23pre"
      }
    },
    "rasp pager": {
      "name": "Rasp pager",
      "modulation": 13,
      "power": 63,
      "external_pa": false,
      "version": "V2"
    },
    "audio": {
      "name" = "Audio",
      "transmitter": "GM1200" | "T7F" | "GM340" | "FREITEXT",
      "audio_level": 83,
      "tx_delay": 3
    },
    "rfm69": {
      "name" : "RFM69",
      "port": "/dev/ttyUSB0"
    },
    "mmdvm": {
      "name" : "MMDVM",
      "dapnet_exclusive": true
    }
  },
  "proxy" : {
    "status": "connected" | "connecting" | "disconnected"
  }
}

```

6.4 Telemetry from Nodes

Telemetry is sent from nodes to the RabbitMQ exchange **dapnet.telemetry** as defined in section 6.2. It is also used in the same way on the websocket API to inform the website and the app about the telemetry in real-time in section 6.6.3 and 6.6.4.

This is sent every minute in complete. If there are changes, just a subset is sent. The name of the nodes is used as routing key for the message.

```

{
  "good_health" : true,
  "microservices" : {
    "database" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "call" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "rubric" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "transmitter" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "cluster" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "telemetry" : {

```



```

    "ok" : true,
    "version" : "1.2.3"
  },
  "database-changes" : {
    "ok" : true,
    "version" : "1.2.3"
  },
  "statistics" : {
    "ok" : true,
    "version" : "1.2.3"
  },
  "rabbitmq" : {
    "ok" : true,
    "version" : "1.2.3"
  },
  "thirdparty" : {
    "ok" : true,
    "version" : "1.2.3"
  },
},
"connections" : {
  "transmitters" : 123,
  "third_party" : 3
},
"system" : {
  "free_disk_space_mb": 1234
  "cpu_utilization": 0.2
  "is_hamcloud" : false
}
}

```

6.5 Statistic, Status and Telemetry REST API

The statistic and telemetry REST API provides up-to-date information regarding the transmitters and the network via REST. This can be used by e.g. grafana to draw nice graphes or nagios plugins.

6.5.1 Statistics

Statistics are given in JSON with number values only to may parsing easier.

GET /stats

No authentication required.

Answer: 200 OK

```

{
  "users" : 1234,
  "transmitters": {
    "personal": {
      "online": 13
      "total": 34
    },
    "widerage": {
      "online": 53,
      "total": 97
    }
  }
  "nodes": {
    "online": 10,
    "total": 19
  },
  "processed_calls": 1234,
  "processed_rubric_content_changes": 234
}

```

6.5.2 Status

GET /status

No authentication required.

Answer: 200 OK

```
{
  "nodes": [
    {
      "host": "node1.ampr.org",
      "port": 4000,
      "reachable": true,
      "last_seen": "2018-07-03T07:43:52.783611Z",
      "response_time": 42
    }
  ],
  "connections": {
    "rabbitmq": true,
    "couchdb": true,
    "hamcloud": true,
  },
  "hamcloud_node": false,
  "general_health": true
}
```

6.5.3 Telemetry from Transmitters

GET /telemetry/transmitter

No authentication required. Here all stored telemetry from all transmitters is provided.

Answer: 200 OK See [6.3](#)

GET /telemetry/transmitter/<transmittername>

No authentication required. Here all stored telemetry from the specified transmitter is provided.

Answer: 200 OK

See [6.3](#)

GET /telemetry/transmitter/<transmittername>/<section_of_telemetry>

No authentication required. Here all stored telemetry within the telemetry section from the specified transmitter is provided. Possible sections are 2. Level JSON groups, see [6.3](#).

Examples: onair, telemetry, transmitter_configuration

Answer: 200 OK

See [6.3](#)

6.5.4 Telemetry from Nodes

GET /telemetry/nodes

No authentication required. Here all stored telemetry from all nodes is provided.

Answer: 200 OK See [6.4](#)

GET /telemetry/nodes/<nodename>

No authentication required. Here all stored telemetry from the specified node is provided.

Answer: 200 OK

See 6.4

6.6 Websocket API

The idea is to provide an API for the website and the app to display real-time information without the need of polling. A websocket server is listing to websocket connections. Authentication is done by a custom JOSN handshake. The connection might be encrypted with SSL if using the Internet or plain if using HAMNET.

The data is taken from the **dapnet.telemetry** exchange from the RabbitMQ instance and further other sources if necessary.

There are 4 main endpoints in the websocket interface:

Endpoint	Microservice
WS /telemetry/transmitters	Summary data of all TX
WS /telemetry/transmitters/<TxName>	Details for TX <TxName>
WS /telemetry/nodes	Summary data of all Nodes
WS /telemetry/nodes/<NodeName>	Details for Node <NodeName>
WS /changes	Database changes

Define if authentication is necessary of some end-points?

6.6.1 Telemetry from Transmitters - Summary of all TX

URL: ws://FQDN/telemetry/transmitters

The data is the same as received from the **dapnet.telemetry** exchange from the RabbitMQ instance. It is defined in section 6.3.

The websocket-Server generates an array of JSON Objects which have the name of the transmitter obtained from the RabbitMQ routing key.

The current time slot is also sent in the summary and updated also by its own every time a time slot change happens.

```
{
  "transmitters": [
    "db0abc" : {
      "onair": true,
      "node": {
        "name": "db0xyz",
        "ip": "44.42.23.8",
        "port": 1234,
        "connected": true,
        "connected_since": "<timestamp-format>"
      },
      "ntp": {
        "syncd": true
      },
    },
    "messages": {
      "queued": [123, 123, 123, 123, 123, 123],
      "sent": [123, 123, 123, 123, 123, 123]
    },
    "config": {
      "ip": "123.4.3.2",
      "timeslots" : [true, false, ..., false],
      "software": {
        name: "Unipager" | "MMDVM" | "DAPNET-Proxy",
        version: "v1.2.3", | "20180504" | "v2.3.4"
      },
    },
    "proxy" : {
      "status": "connected" | "connecting" | "disconnected"
    }
  ]
}
```

```

    }
  },
  "db0xyz" : {
    "onair": true,
    "node": {
      ....
    }
  },
  "current_timeslot" : 12
}

```

6.6.2 Telemetry from Transmitters - Details of Transmitter

URL: `ws://FQDN/telemetry/transmitters/<transmittername>`

The data is the same as received from the **dapnet.telemetry** exchange from the RabbitMQ instance. It is defined in section 6.3.

The websocket-Server gives out all the telemetry data from a certain transmitter. The name of the transmitter obtained from the RabbitMQ routing key.

```

{
  "onair": true,
  "node": {
    "name": "db0xyz",
    "ip": "44.42.23.8",
    "port": 1234,
    "connected": true,
    "connected_since": "<timestamp-format>"
  },
  "ntp": {
    "synced": true,
    "offset": 124,
    "server": ["134.130.4.1", "12.2.3.2"],
  },
  "messages": {
    "queued": [123, 123, 123, 123, 123, 123],
    "sent": [123, 123, 123, 123, 123, 123]
  },
  "temperatures": {
    "unit": "C" | "F" | "K",
    "air_inlet": 12.2,
    "air_outlet": 14.2,
    "transmitter": 42.2,
    "power_amplifier": 45.2,
    "cpu": 93.2,
    "power_supply": 32.4,
    "custom": [
      {"value": 12.2, "description": "Aircon Inlet"},
      {"value": 16.2, "description": "Aircon Outlet"},
      {"value": 12.3, "description": "Fridge Next to Programmer"}
    ]
  },
  "power_supply": {
    "on_battery": false,
    "on_emergency_power": false,
    "dc_input_voltage": 12.4,
    "dc_input_current": 3.23
  },
  "rf_output" : {
    "fwd": 12.2,
    "refl" : 12.2,
    "vswr" : 1.2
  },
  "config": {
    "ip": "123.4.3.2",
    "timeslots" : [true, false, ..., false],
    "software": {
      name: "Unipager" | "MMDVM" | "DAPNET-Proxy",
      version: "v1.2.3", | "20180504" | "v2.3.4",
    }
  }
}

```

```

    },
  },
  "hardware": {
    "platform": "Raspberry Pi 3B+"
  },
  "rf_hardware": {
    "c9000": {
      "name": "C9000 Compact",
      "<pa_dummy>": {
        "output_power": 123,
        "port": "/dev/ttyUSB0"
      }
    },
    "<rpc>": {
      "version": "XOS/2.23pre"
    }
  },
  "rasp pager": {
    "name": "Rasp pager",
    "modulation": 13,
    "power": 63,
    "external_pa": false,
    "version": "V2"
  },
  "audio": {
    "name": "Audio",
    "transmitter": "GM1200" | "T7F" | "GM340" | "FREITEXT",
    "audio_level": 83,
    "tx_delay": 3
  },
  "rfm69": {
    "name": "RFM69",
    "port": "/dev/ttyUSB0"
  },
  "mmdvm": {
    "name": "MMDVM",
    "dapnet_exclusive": true
  }
},
"proxy": {
  "status": "connected" | "connecting" | "disconnected"
}
}

```

6.6.3 Telemetry from Nodes - Summary of all Nodes

URL: `ws://FQDN/telemetry/nodes`

The websocket-Server generates an array of JSON Objects which have the name of the node obtained from the RabbitMQ routing key.

```

{
  "nodes": [
    "db0sda": {
      "good_health": true,
      "connections": {
        "transmitters": 123,
        "third_party": 3
      },
      "system": {
        "is_hamcloud": false
      }
    },
    "hamcloud1": {
      "good_health": true,
      "connections": {
        "transmitters": 658,
        "third_party": 25
      },
      "system": {

```

```

        "is_hamcloud" : true
    }
},
....
]
}

```

6.6.4 Telemetry from Transmitters - Details of Node

URL: `ws://FQDN/telemetry/nodess/<nodename>`

The data is the same as received from the **dapnet.telemetry** exchange from the RabbitMQ instance. It is defined in section [6.3](#).

The websocket-Server gives out all the telemetry data from a certain node. The name of the transmitter obtained from the RabbitMQ routing key.

```

{
  "good_health" : true,
  "microservices" : {
    "database" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "call" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "rubric" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "transmitter" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "cluster" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "telemetry" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "database-changes" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "statistics" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "rabbitmq" : {
      "ok" : true,
      "version" : "1.2.3"
    },
    "thirdparty" : {
      "ok" : true,
      "version" : "1.2.3"
    },
  },
  "connections" : {
    "transmitters" : 123,
    "third_party" : 3
  },
  "system" : {
    "free_disk_space_mb": 1234
    "cpu_utilization": 0.2
    "is_hamcloud" : false
  }
}

```

```
}
```

6.6.5 Database Changes

URL: `ws://FQDN/changes`

To inform the website or the app about changes in the CouchDB database, the websocket microservice keeps a connection to the local CouchDB API and receives a stream of updates to the database. As there may be data in the changes that are confidential, the stream is parsed and sent out in a reduced form to the websocket client. Further information: <http://docs.couchdb.org/en/2.0.0/api/database/changes.html>

The format of the updates is:

define/review
format

Transmitter related

New transmitter added

```
{
  "type": "transmitter",
  "action": "added",
  "name": "db0abc",
  "data": {
    (Data from CouchDB Change feed in processed way)
  }
}
```

Existing transmitter changed

```
{
  "type": "transmitter",
  "action": "changed",
  "name": "db0abc",
  "data": {
    (Data from CouchDB Change feed in processed way)
  }
}
```

Transmitter deleted

```
{
  "type": "transmitter",
  "action": "deleted",
  "name": "db0abc"
}
```

User related

New User added

```
{
  "type": "user",
  "action": "added",
  "name": "db1abc",
  "data": {
    (Data from CouchDB Change feed in processed way)
  }
}
```

Existing user changed

```
{
  "type": "user",
  "action": "changed",
  "name": "db1abc",
  "data": {

```

```

    (Data from CouchDB Change feed in processed way)
  }
}

```

User deleted

```

{
  "type": "user",
  "action" : "deleted",
  "name": "db1abc"
}

```

Rubric related

New Rubric added

```

{
  "type": "rubric",
  "action" : "added",
  "id": "...",
  "data" : {
    (Data from CouchDB Change feed in processed way)
  }
}

```

Existing rubric changed

```

{
  "type": "user",
  "action" : "changed",
  "id": "...",
  "data" : {
    (Data from CouchDB Change feed in processed way)
  }
}

```

Rubric deleted

```

{
  "type": "user",
  "action" : "deleted",
  "id": "..."
}

```

Rubric content related

New Rubric content added

```

{
  "type": "rubric_content",
  "action" : "added",
  "id": "...??",
  "data" : {
    (Complete Data dump of all ten rubric messages as stored in CouchDB)
  }
}

```

Existing rubric changed

```

{
  "type": "rubric_content",
  "action" : "changed",
  "id": "...",
  "data" : {
    (Complete Data dump of all ten rubric messages as stored in CouchDB)
  }
}

```

Rubric content deleted

Check
against
CouchDB
structure


```
{
  "type": "rubric_content",
  "action" : "deleted",
  "id": "...",
  "data" : {
    (Complete Data dump of all ten rubric messages as stored in CouchDB, some may be empty)
  }
}
```

Node related

New node added

```
{
  "type": "node",
  "action" : "added",
  "name": "db0abc",
  "data" : {
    (Data from CouchDB Change feed in processed way)
  }
}
```

Existing node changed

```
{
  "type": "node",
  "action" : "changed",
  "name": "db0abc",
  "data" : {
    (Data from CouchDB Change feed in processed way)
  }
}
```

Node deleted

```
{
  "type": "node",
  "action" : "deleted",
  "name": "db1abc"
}
```

6.7 CouchDB Documents and Structure

als
Tabelle
darstellen

6.7.1 Users

Table 6.1: CouchDB: Users

Key	Value-Type	Valid Value Range	Example
_id	string		dl1abc
password	string	bcrypt hash	—
email	string		dl1abc@darc.de
admin	boolean		true
enabled	boolean		true
created_on	string	ISO8601	2018-07-08T11:50:02.168325Z
changed_on	string	ISO8601	2018-07-08T11:50:02.168325Z
changed_by	string	valid user name	dh3wr
email_valid	boolean		true
avatar_picture	couchdb_attachment		

```
{
  "_id": "dl1abc",
  "password": "<bcrypt hash>",
  "email": "dl1abc@darcd.de",
  "admin": true,
  "enabled": true,
  "created_on": <DATETIME>,
  "created_by": "dh3wr",
  "changed_on": <DATETIME>,
  "changed_by": "dh3wr",
  "email_valid": true
  "avatar_picture": <couchdb attachment>
}
```

Wofür
genau
braucht
man
email_valid?

6.7.2 Nodes

Table 6.2: CouchDB: Nodes

Key	Value-Type	Valid Value Range	Example
_id	STRING	N/A	db0abc
coordinates	[number; 2]	[lat, lon]	[34.123456, 6.23144]
hamcloud	boolean	true/false	true
created_on	string	ISO8601	2018-07-08T11:50:02.168325Z
created_by	string	valid user name	dh3wr
changed_on	string	ISO8601	2018-07-08T11:50:02.168325Z
changed_by	string	valid user name	dh3wr
owners	[string]	N/A	["dl1abc", "dh3wr", "dl2ic"]
avatar_picture	couchdb_attachment		

```
{
  "_id": "db0abc",
  "auth_key": "super_secret_key",
  "coordinates": [34.123456, -23.123456],
  "hamcloud": true,
  "created_on": <DATETIME>,
  "created_by": "dh3wr",
  "changed_on": <DATETIME>,
  "changed_by": "dh3wr",
  "owners": ["dl1abc", "dh3wr", "dl2ic"],
  "avatar_picture": <couchdb attachment??>
}
```

6.7.3 Transmitters

Tabelle
weiter
machen

```
{
  "_id": "db0abc",
  "auth_key": "hdjaskhdlj",
  "enabled": true,
  "usage": "PERSONAL" | "WIDERANGE",
  "coordinates": [34.123456, -23.123456],
  "power": 12.3,
  "antenna": {
    "agl": 23.4,
    "gain": 2.34,
    "type": "OMNI" | DIRECTIONAL,
    "direction": 123.2,
    "cable_loss": 4.2
  }
  "owners" : ["dl1abc", "dh3wr", "dl2ic"],
  "groups" : ["dl-hh", "dl-all"],
  "emergency_power": {
    "available": false,

```

Table 6.3: CouchDB: Transmitters

Key	Value-Type	Valid Value Range	Example
<code>_id</code>	string	N/A	db0abc
<code>auth_key</code>	string	N/A	asd2FD3q3rF
<code>enabled</code>	boolean	true/false	true
<code>usage</code>	string	PERSONAL WIDERANGE	WIDERANGE
<code>coordinates</code>	[number; 2]	[lat, lon]	[34.123456, 6.23144]
<code>power</code>	number	0.001 ...	12.3
<code>created_on</code>	string	ISO8601	2018-07-08T11:50:02.168325Z
<code>changed_by</code>	string	valid user name	dh3wr
<code>changed_on</code>	string	ISO8601	2018-07-08T11:50:02.168325Z
<code>changed_by</code>	string	valid user name	dh3wr
<code>owners</code>	ARRAY of STRING	N/A	["dl1abc", "dh3wr", "dl2ic"]
<code>avatar_picture</code>	couchdb_attachment		

```

    "infinite": false,
    "duration": 23*60*60 // seconds
  },
  "created_on": <DATETIME>,
  "created_by": "dh3wr",
  "changed_on": <DATETIME>,
  "changed_by": "dh3wr",
  "aprs_broadcast": false,
  "antenna_pattern" : <couchDB attachment>,
  "avatar_picture" : <couchDB attachment>
}

```

6.7.4 Subscribers

```

{
  "_id" : "dl1abc",
  "description" : "Peter",
  "pagers" : [
    {
      "ric": 123456,
      "subric": 0 .. 3,
      "uuid": "0023-1233-aefe-1234-3423-9812",
      "name": "Peters Alphapoc",
      "type" : "UNKNOWN" | "Skyper" | "AlphaPoc" | "QUIX" | "Swissphone" | "SCALL_XT" | "Birdy"
      "enabled" : true
    },
    ...
  ],
  "third_party_services" : ["APRS", "BM"],
  "owner": ["dh3wr", "dl1abc"]
}

```

check if
[] is valid
JSON

6.7.5 Subscriber Groups

```

{
  "_id" : "ov-G01",
  "description": "Ortverband Aachen",
  "subscribers": ["dl1abc", "dh3wr"],
  "owner": ["dh3wr", "dl1abc"],
}

```

6.7.6 Rubrics List

```

{
  "_id": "wx-dl-hh"
  "number": 14,
}

```

```

    "description": "Wetter DL-HH",
    "label": "WX DL-HH",
    "transmitter_groups": ["dl-hh", "dl-ns"],
    "transmitters": ["db0abc"],
    "cyclic_transmit": true,
    "cyclic_transmit_interval": 60*60, // seconds
    "owner" : ["dh3wr", "dl1abc"]
}

```

6.7.7 Rubric's content

<UUID> of rubric (as defined in [6.7.6](#))

```

{
  "_id" : "<UUID>",
  "rubric": "wx-dl-hh",
  "content": [
    "message1",
    ...,
    "message10"
  ],
}

```

6.7.8 MQTT services and subscribers

```

{
  "_id": "APRS",
  "topic": "aprs"
  "subscribers": [
    {
      "name": "example",
      "password": "<bcrypt hash>"
    },
    ...
  ]
}

```