



## DAPNET 2.0 CONCEPT AND INTERFACE DEFINITION

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## **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

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Introduction</b>  | <b>5</b>  |
| 1.1      | Key Features   | 5         |
| 1.2      | Historic Background  | 5         |
| 1.3      | Concept presentation   | 5         |
| 1.4      | Transmitter Software   | 6         |
| 1.4.1    | Unipager   | 6         |
| 1.4.2    | Backward compatibility to XOS slave protocol                                   | 6         |
| 1.4.3    | DAPNET-Proxy for AX.25 transmitters  | 6         |
| 1.5      | DAPNET Network   | 7         |
| 1.5.1    | Overview and Concept   | 7         |
| 1.5.2    | Used third-party Software  | 7         |
| 1.5.3    | HAMCLOUD Description   | 7         |
| 1.5.4    | Transmitter Group Handling Concept   | 7         |
| 1.5.5    | Rubric Handling Concept  | 7         |
| 1.5.6    | Queuing Priority Concept   | 7         |
| <b>2</b> | <b>DAPNET Network Definition</b>   | <b>10</b> |
| 2.1      | Cluster Description  | 10        |
| 2.1.1    | Real-time Message delivery with RabbitMQ                                       | 10        |
| 2.1.2    | Distributed Database with CouchDB  | 10        |
| 2.1.3    | Authentication Concept   | 10        |
| 2.1.4    | Integration of new Nodes   | 10        |
| 2.2      | Interface Overview and Purpose   | 10        |
| 2.2.1    | RabbitMQ Exchange  | 10        |
| 2.2.2    | CouchDB Interface  | 11        |
| 2.2.3    | Core REST API  | 11        |
| 2.2.4    | Statistic, Status and Telemetry REST API                                       | 11        |
| 2.2.5    | Websocket for real-time updates on configuration, Statistics and Telemetry API | 11        |
| 2.2.6    | MQTT Fanout for third-party consumers  | 11        |
| 2.3      | Other Definitions  | 12        |
| 2.3.1    | Scheduler  | 12        |
| 2.3.2    | User Roles and Permissions   | 12        |

|          |  |           |
|----------|--|-----------|
| <b>3</b> | <b>Internal Programming Workflows</b>                    | <b>13</b> |
| 3.1      | Sent calls   | 13        |
| 3.2      | Add, edit, delete User                                   | 13        |
| 3.3      | Add, edit, delete Subscriber                             | 14        |
| 3.4      | Add, edit, delete Node (tbd)                             | 14        |
| 3.5      | Add, edit, delete Transmitter                            | 14        |
| 3.6      | Implementation of Transmitter Groups                     | 14        |
| 3.7      | Add, edit, delete Rubrics                                | 14        |
| 3.8      | Add, edit, delete Rubrics content                        | 14        |
| 3.9      | Add, edit, delete, assign Rubrics to Transmitter/-Groups | 14        |
| 3.10     | Docker integration                                       | 14        |
| 3.11     | Microservices  | 15        |
| 3.11.1   | Database Service   | 15        |
| 3.11.2   | Call Service   | 15        |
| 3.11.3   | Rubric Service   | 15        |
| 3.11.4   | Transmitter Service                                      | 15        |
| 3.11.5   | Cluster Service  | 16        |
| 3.11.6   | Telemetry Service  | 16        |
| 3.11.7   | Database Changes Service                                 | 16        |
| 3.11.8   | Status Service   | 16        |
| 3.11.9   | RabbitMQ Auth Service                                    | 16        |
| 3.11.10  | Time and Identification Service                          | 16        |
| 3.12     | Ports and Loadbalancing Concept                          | 16        |
| 3.13     | Periodic Tasks (Scheduler)                               | 16        |
| 3.14     | Plugin Interface   | 16        |
| 3.15     | Transmitter Connection                                   | 16        |
| 3.16     | Transmitter connections                                  | 17        |
| 3.16.1   | Authentication of all HTTP-Requests in this context      | 17        |
| 3.17     | DAPNET-Proxy   | 17        |
| <b>4</b> | <b>External Usage Workflows</b>                          | <b>18</b> |
| 4.1      | General Concept of REST and Websocket-Updates            | 18        |
| 4.2      | Website and App  | 18        |
| 4.2.1    | Authentication   | 18        |
| 4.2.2    | Calls  | 18        |
| 4.2.3    | Rubrics  | 18        |
| 4.2.4    | Rubrics content  | 18        |
| 4.2.5    | Transmitters and Telemetry                               | 18        |
| 4.2.6    | Nodes  | 18        |
| 4.2.7    | Users  | 18        |
| 4.2.8    | MQTT consumers   | 18        |
| 4.2.9    | Scripts and automated Software for DAPNET-Input          | 18        |

|          |  |           |
|----------|--|-----------|
| <b>5</b> | <b>Setup and Installation</b>                        | <b>19</b> |
| 5.0.1    | Accessible ports from HAMNET                         | 19        |
| 5.1      | Unipager   | 19        |
| 5.2      | DAPNET-Proxy   | 19        |
| 5.3      | DAPNET Core  | 19        |
| 5.4      | Special issues for Core running in HAMCLOUD          | 19        |
| 5.4.1    | Accessible ports from internet                       | 19        |
| 5.4.2    | Load balancing and high availability                 | 19        |
| <b>6</b> | <b>Protocol Definitions</b>                          | <b>20</b> |
| 6.1      | Microservices API                                    | 20        |
| 6.1.1    | Database Service                                     | 20        |
| 6.1.2    | Call Service   | 20        |
| 6.1.3    | Rubric Service                                       | 20        |
| 6.1.4    | Transmitter Service                                  | 20        |
| 6.1.5    | Cluster Service                                      | 22        |
| 6.1.6    | Telemetry Service                                    | 22        |
| 6.1.7    | Database Changes Service                             | 22        |
| 6.1.8    | Status Service                                       | 22        |
| 6.1.9    | Statistics Service                                   | 23        |
| 6.1.10   | RabbitMQ Service                                     | 23        |
| 6.2      | RabbitMQ   | 23        |
| 6.2.1    | Transmitters   | 23        |
| 6.2.2    | Telemetry  | 23        |
| 6.2.3    | MQTT API for third-party consumers                   | 24        |
| 6.3      | Telemetry from Transmitters                          | 25        |
| 6.4      | Telemetry from Nodes                                 | 26        |
| 6.5      | Statistic, Status and Telemetry REST API             | 27        |
| 6.5.1    | Statistics   | 27        |
| 6.5.2    | Status   | 28        |
| 6.5.3    | Telemetry from Transmitters                          | 28        |
| 6.5.4    | Telemetry from Nodes                                 | 28        |
| 6.6      | Websocket API  | 29        |
| 6.6.1    | Telemetry from Transmitters - Summary of all TX      | 29        |
| 6.6.2    | Telemetry from Transmitters - Details of Transmitter | 30        |
| 6.6.3    | Telemetry from Nodes - Summary of all Nodes          | 31        |
| 6.6.4    | Telemetry from Transmitters - Details of Node        | 32        |
| 6.6.5    | Database Changes                                     | 33        |
| 6.7      | CouchDB Documents and Structure                      | 35        |
| 6.7.1    | Users  | 35        |
| 6.7.2    | Nodes  | 36        |
| 6.7.3    | Transmitters   | 36        |
| 6.7.4    | Subscribers  | 37        |
| 6.7.5    | Subscriber Groups                                    | 37        |

|       |   |    |
|-------|---|----|
| 6.7.6 | Rubrics List . . . . .                  | 37 |
| 6.7.7 | Rubric's content . . . . .              | 38 |
| 6.7.8 | MQTT services and subscribers . . . . . | 38 |

# Chapter 1

## Introduction

more  
text

### 1.1 Key Features

The version 2 will please the user/operator with the following key features:

- Reliable clustering of Node instances over unreliable WAN connections like HAMNET
- Transmitter telemetry realtime display on Website and App with Websockets
- Use of microservices instead of one big application. Easier to develop, maintain and update
- Load-Balancing and fail-over for user and transmitter interfaces
- Real-time on-air display of transmitters on map
- Third-Party API for Brandmeister, APRS, etc.
- Priority Queuing for transmitters
- Send calls to individual transmitters and/or transmitter groups
- Inflexible concept of transmitter groups is replaced by group tags on transmitters
- Improved Cluster status monitoring

### 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](#).

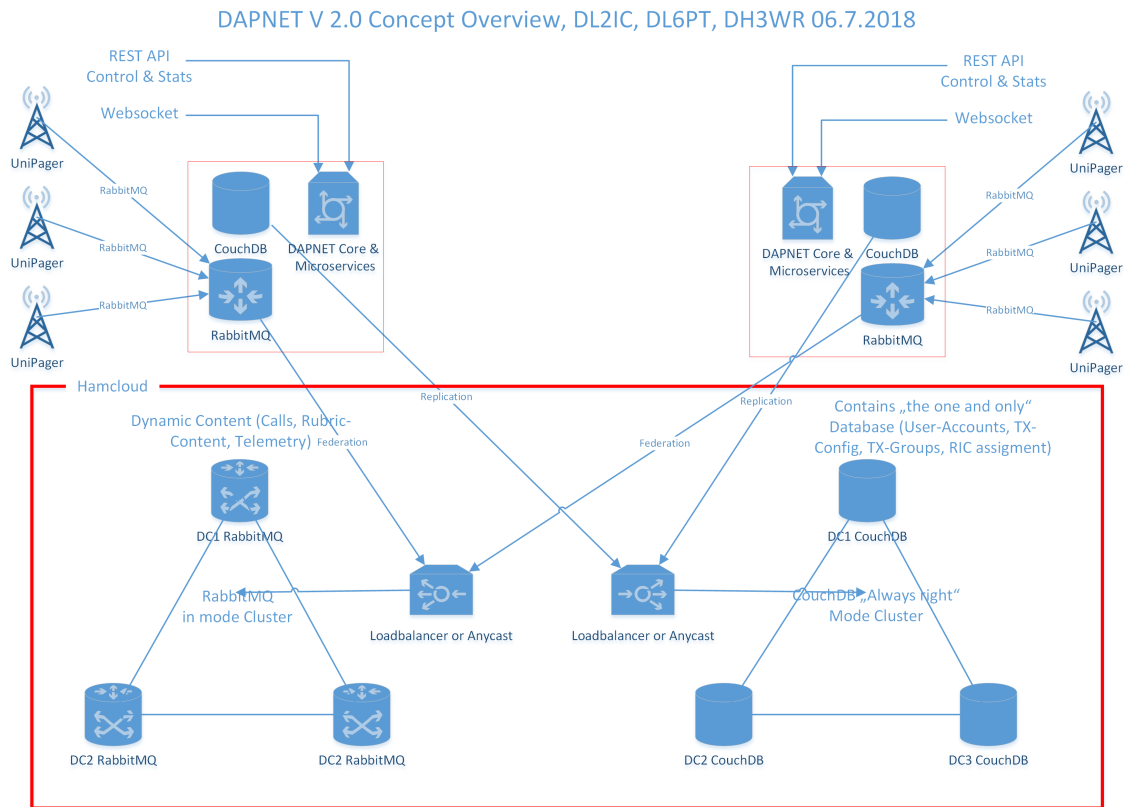


Figure 1.1: Overview of DAPNET Clutering and Network Structure

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

## 1.4 Transmitter Software

### 1.4.1 Unipager

The default software for new transmitters is [Unipager](#). It is developed and maintained by Thomas Gatzweiler, DL2IC. There is a debian based repository available. CI technology is used to assure automated compiling of new versions. Transmitters can be updated all at once if they subscribe to the [SaltStack](#) remote management program.

### 1.4.2 Backward compatibility to XOS slave protocol

The former amateur radio paging transmitters use the XOS slave protocol. It is defined [here](#). There is a NTP like time sync sequence at the beginning of each connection establishment to assure the synchronicity of the transmitters for TDMA. In times of packet-radio, this approach was necessary. Nowadays NTP is used to sync the transmitter clocks; anyway it's still supported.

As DAPNET V2 introduces RabbitMQ and REST interfaces towards transmitters, there is a need for a backward compatibility module, which is also part of the DAPNET V2 package. We hope that after some month, all IP based transmitters have switched to the new interface implementation.

### 1.4.3 DAPNET-Proxy for AX.25 transmitters

For AX.25 only transmitters like [PR430](#), there is still a demand to support thee XOS slave protocol over plain AX.25. There is a already working solution to pipe the TCP Data through a lot of intermediate programs towards a AX.25 device. The general data flow is shown [in the DAPNET DokuWiki](#). Figure 1.3 in shown for reference only.



## 1.5 DAPNET Network

### 1.5.1 Overview and Concept

### 1.5.2 Used third-party Software

Used third-party Software is:

- RabbitMQ for Message delivery to transmitters and between nodes
- CouchDB as distributed database backend working on unreliable WAN connections
- NGINX as low resource high performance load balancing server for default Interface endpoints
- Docker for easy deployment and update purposes
- SaltStack for easy distributed updates and maintenance

### 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](#) and [here](#).

### 1.5.4 Transmitter Group Handling Concept

In the first Version of DAPNET, transmitters had to be member of one or more logical transmitter groups. Personal calls and rubric content could only be send to a transmitter group, which afterwards sent the data to be member transmitters. Changes in membership required the assigned owner of the group to do so.

In DAPNET V2, there will be just *virtual* transmitter groups by assigning one of more *tags* to a transmitter by its owner himself. Messages can be sent to either a single or group of individual transmitters and/or a single or group of tags. Each transmitter containing the tag will send out the message.

### 1.5.5 Rubric Handling Concept

### 1.5.6 Queuing Priority Concept

A main drawback of the original DAPNET implementation was the lack of priorities in the message queuing on a transmitter. With increasing popularity the load on the transmitters increased and the FIFO working principle led to personal calls being sent out several 10 minutes later than submitted.

To overcome this, a 5 class priority scheme is implemented in DAPNET. Messages to send out are queued

Define if uni- or anycast entry points will exist

Define if all 3 ham-cloud sites will have the same internet incoming ports, and what is the Internet DNS concept

DAPNET V 2.0 Node Details, DL2IC, DL6PT, DH3WR 19.7.2018

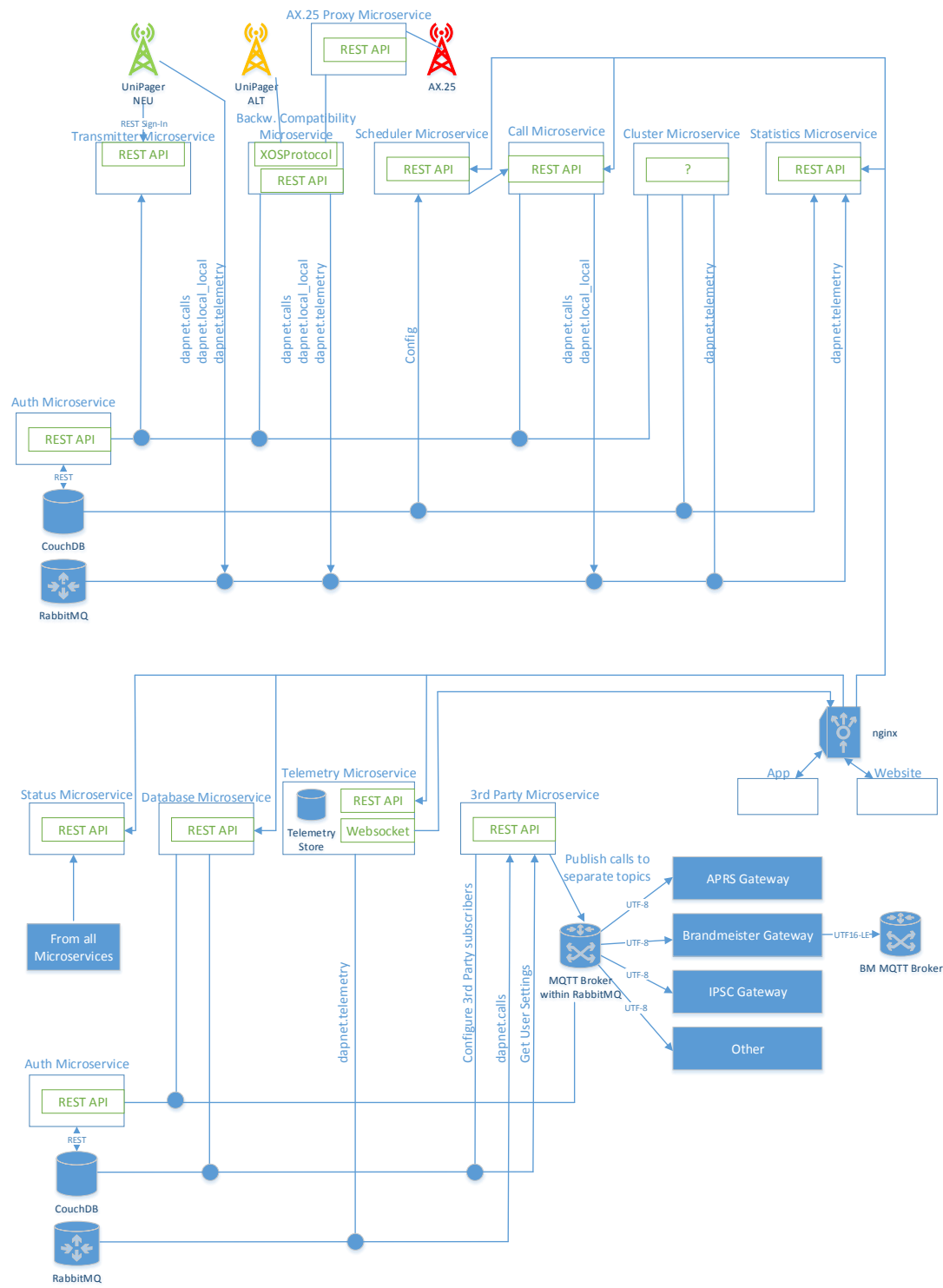


Figure 1.2: Node Details

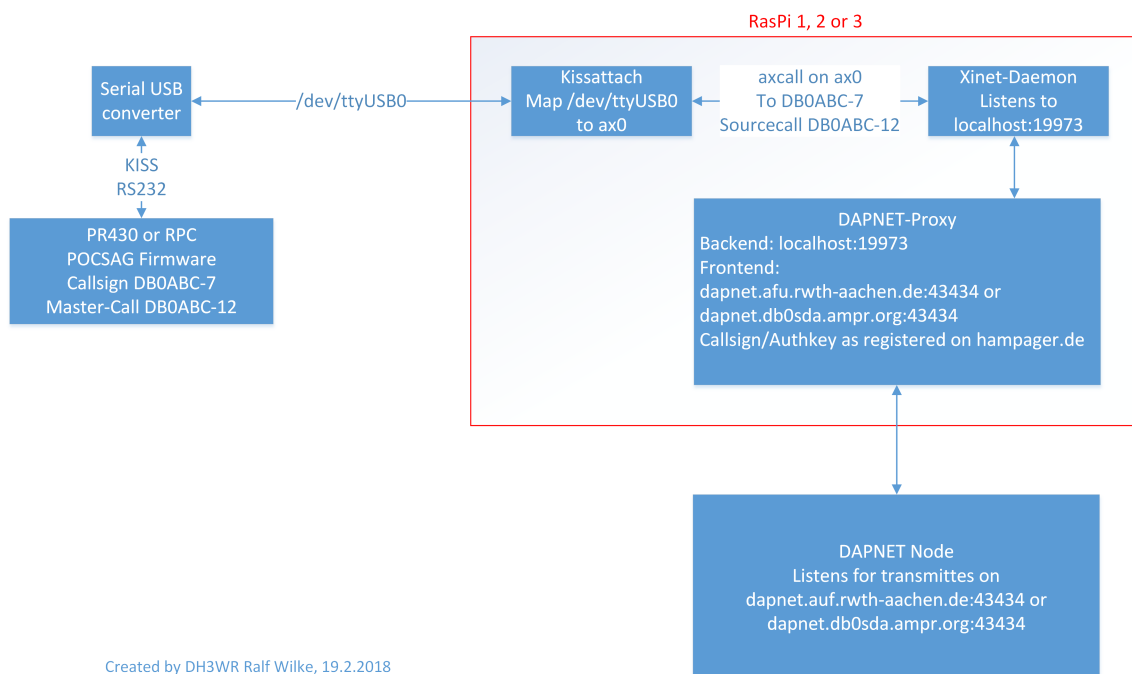


Figure 1.3: Data flow for AX.25 connections from DAPNET

## 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 instaces 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/*<br>* /nodes/*<br>* /rubrics/*<br>* /subscribers/*<br>* /subscriber_groups/*<br>DELETE /transmitters/:id<br>PUT /transmitters | Database Service  |
| * /calls/*  | Call Service  |
| * /rubrics/:id/*  | Rubric Service  |
| GET /transmitters<br>GET /transmitters/:id<br>POST /transmitters/bootstrap<br>POST /transmitters/heartbeat                              | Transmitter Service   |
| POST /cluster/discovery   | Cluster Service   |
| GET /telemetry/*  | Telemetry Service   |
| WS /telemetry/transmitters<br>WS /telemetry/transmitter/<TxName><br>WS /telemetry/nodes<br>WS /telemetry/node/<NodeName>                | Summary data of all TX<br>Details for TX <TxName><br>Summary data of all nodes<br>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

### 5.0.1 Accessible ports from HAMNET

## 5.1 Unipager

## 5.2 DAPNET-Proxy

## 5.3 DAPNET Core

## 5.4 Special issues for Core running in Hamcloud

### 5.4.1 Accessible ports from internet

To offer the endpoints to internet-based transmitters and users, the following port have to be accessible:

| Type | Port | Application                      |
|------|------|----------------------------------|
| TCP  | 80   | HTTP Webinterface and Websocket  |
| TCP  | 443  | HTTPS Webinterface and Websocket |
| TCP  | 5672 | RabbitMQ Client connection       |

### 5.4.2 Load balancing and high availability

#### Internet-based

To offer load balancing and high availability, the internet-based DNS record *hampager.de* would use DNS round-robin with the static internet IPs of the Hamcloud instances.

#### HAMNET/Hamcloud-based

The Hamcloud instances would offer an anycast IP to for transmitter and user connections. There is a special subnet of 44.0.0.0/8 IPs designated for this anycast approach. Besides, the Hamcloud DAPNET instances will have unicast IPs for administration and their inter-node-synchronization. To connect other nodes besides from the three hamcloud instances, the endpoint to be attached will also be distributed via anycast for maximal fail-over capability.

# 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, (max 21 Bits)
    "type": "alphanum", | "numeric"
    "speed": 1200,
    "function": 0 to 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" : 12354,
    "dstfunction" : 0 .. 3,
    "priority" : 3,
    "message" : "DAPNET 2.0 rocks dear YL/OM"
    "transmitted_by" : [
      {
        "callsign" : "db0abc",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "personal" | "widerange"
      },
      {
        "callsign" : "db0def",
        "lat" : 12.123456,
        "long" : 32.123456,
        "type" : "personal" | "widerange"
      }
    ],
    "timestamp" : "2018-07-03T08:00:52.786458Z"
  }
}
```

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" : "2018-07-03T08:00:52.786458Z"
}
}

```

## 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": "2018-07-03T08:00:52.786458Z"
  },
  "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 JOSH 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": "2018-07-03T08:00:52.786458Z"
      },
      "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/transmitter/<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": {
    "ip": "44.42.23.8",
    "port": 1234,
    "connected": true,
    "connected_since": "2018-07-03T08:00:52.786458Z"
  },
  "ntp": {
    "syncd": 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" : "X0S/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/node/<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@dar.c.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@darf.de",
  "admin": true,
  "enabled": true,
  "created_on": "2018-07-03T08:00:52.786458Z",
  "created_by": "dh3wr",
  "changed_on": "2018-07-03T08:00:52.786458Z",
  "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  |
| changed_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": "2018-07-03T08:00:52.786458Z",
  "created_by": "dh3wr",
  "changed_on": "2018-07-03T08:00:52.786458Z",
  "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": "2018-07-03T08:00:52.786458Z",
  "created_by": "dh3wr",
  "changed_on": "2018-07-03T08:00:52.786458Z",
  "changed_by": "dh3wr",
  "aprs_broadcast": false,
  "antenna_pattern" : <couchDB attachment>,
  "avatar_picture" : <couchDB attachment>
}

```

#### 6.7.4 Subscribers

If type is "Skyper", function is always 3. Keep this in mind

```

{
  "_id" : "dl1abc",
  "description" : "Peter",
  "pagers" : [
    {
      "ric": 123456,
      "function": 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>"
    },
    ...
  ]
}

```