PANEDA KEY FEATURES

DAB Multiplexing System version 2024-04-02

Summary

Paneda develops DAB head-end systems and is today a world leader in the area. The flexible generic system is developed with the most modern technology and has several unique features, such as state-of- art redundancy mechanisms using the unique Paneda SMART content switching. Another important area is security, which means that all connections internally and externally are encrypted using TLS/HTTPS. The security has been tested by third party security companies and is graded as A+, the highest possible security level. Easy integration with third party products for contribution, meta data and distribution are also in focus. Paneda uses open API's v3 JSON based RESTful API.

Subject for changes without further notice

ABOUT THE PANEDA DAB MULTIPLEXING SYSTEM

General

Paneda has developed a completely new head end system from scratch, based on almost 20 years' experience and based on customer's feedback from over 200 installations worldwide. The system is using the most modern architecture and using restful API's with highest security in focus. The system was released in its first version during 2015 and have been further developed according to new requirements in the DAB standard and input from customer needs.

The Paneda DAB software solution has many advantages vs. a hardware solution, such as generic, further development and expansion of the system with possibility to install on any hardware platform, OS independent, which means a non-vendor lock-up.

The Paneda DAB Head-End solution is mainly realised as a software and based on docker containers for most flexible setup and easy maintenance, also enables easy expansion with adding multiplexer systems at any point without hardware investments. System upgrades managed in an easy way.

This setup offers a future proof solution where you easily can add more stations and new multiplexers at any time, using the same hardware!

For redundancy, we encourage this by providing high discounts.

SERVER version (recommended)

The Paneda system installed in a standard server, provided by Paneda or in **your** existing environment. Benefits is that it is a standard hardware and easy to migrate to any new server in the future. The system uses a Docker containerized system with Linux operating system for the multiplexing system. The very same server can host **several** multiplexers and many encoders.

FOCUS AREAS

SECURITY

The system supports:
Encrypted connections where applicable, for example when using metadata. It will not be possible for unauthorized party to manipulate metadata such as text or pictures.

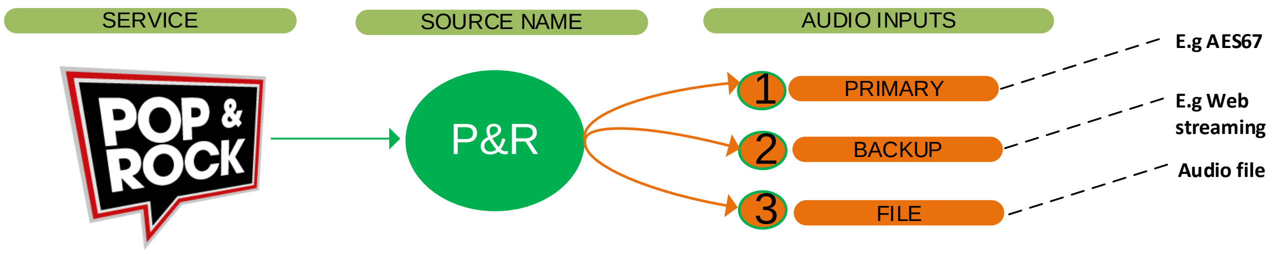
- Usage of a secure user database, all registered users must use real email addresses with a password selected by themselves. The passwords are individually salted and hashed for storage according to best practice.
- Defined custom user rights and different roles in the system, no limitations to number of users
- 2 factor authentications
- Web interface for management support HTTPS/SSL with valid certificates
- Security level A+ ranked

REDUNDANCY

Broadcast systems requires a very high availability and much focus has been on redundancy and back-up. Paneda has developed new features that offers a new and higher level of redundancy.

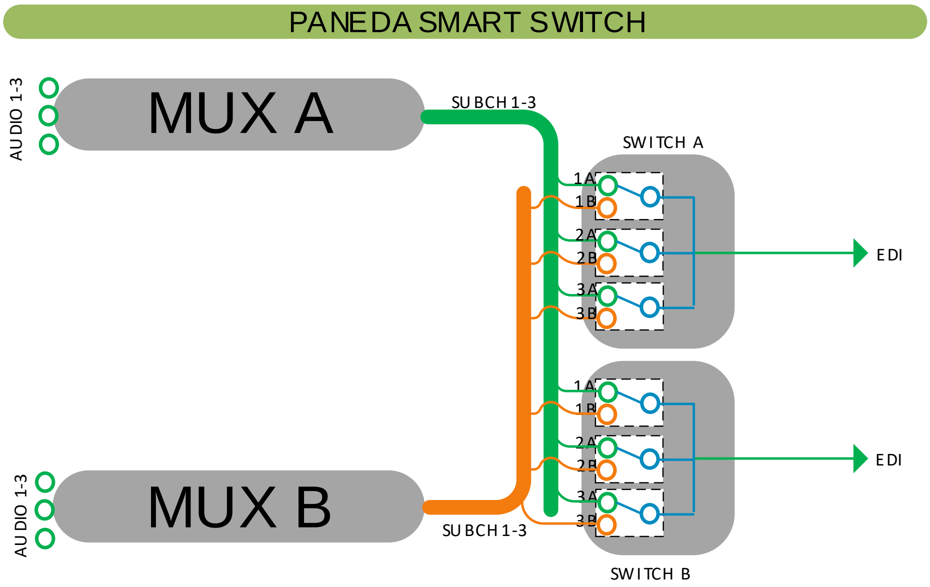
AUDIO:
The Paneda audio handling is service oriented where a service refers to a matrix of selectable audio sources, and in combination with redundant audio sources this ensures a more fault tolerant audio handling.

- A service points to an audio source rather than an audio encoder, providing best flexibility without changing encoder when changing audio source
- Each audio input can be defined with multiple audio sources, as web streams, as fallback or playing an audio file
- All defined audio inputs are “hot” and monitored. An audio switch-over will not be performed to a non-working audio.
- A service can at any point referring to any available audio source.

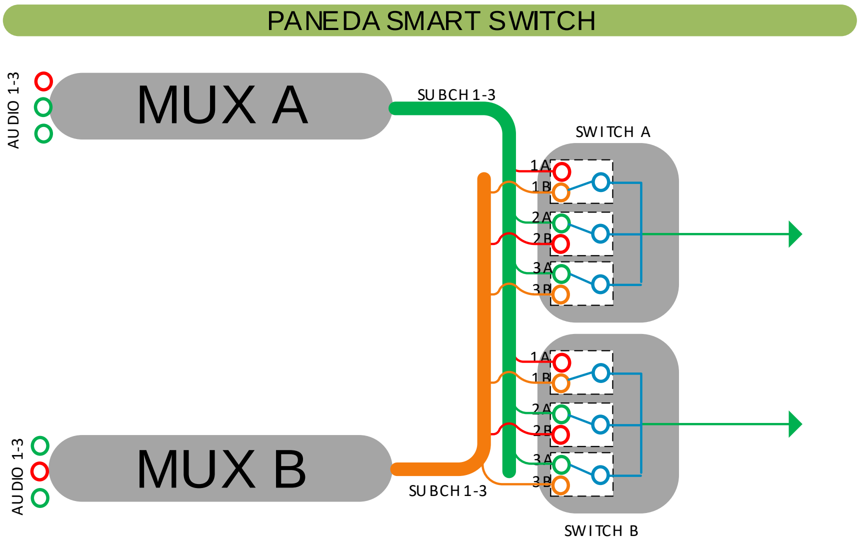


SMART CONTENT SWITCH

The unique Paneda system has a smart content switching using “patching” of two faulty signals. One audio error in one mux, another audio error in the redundant mux, generates an error free output.



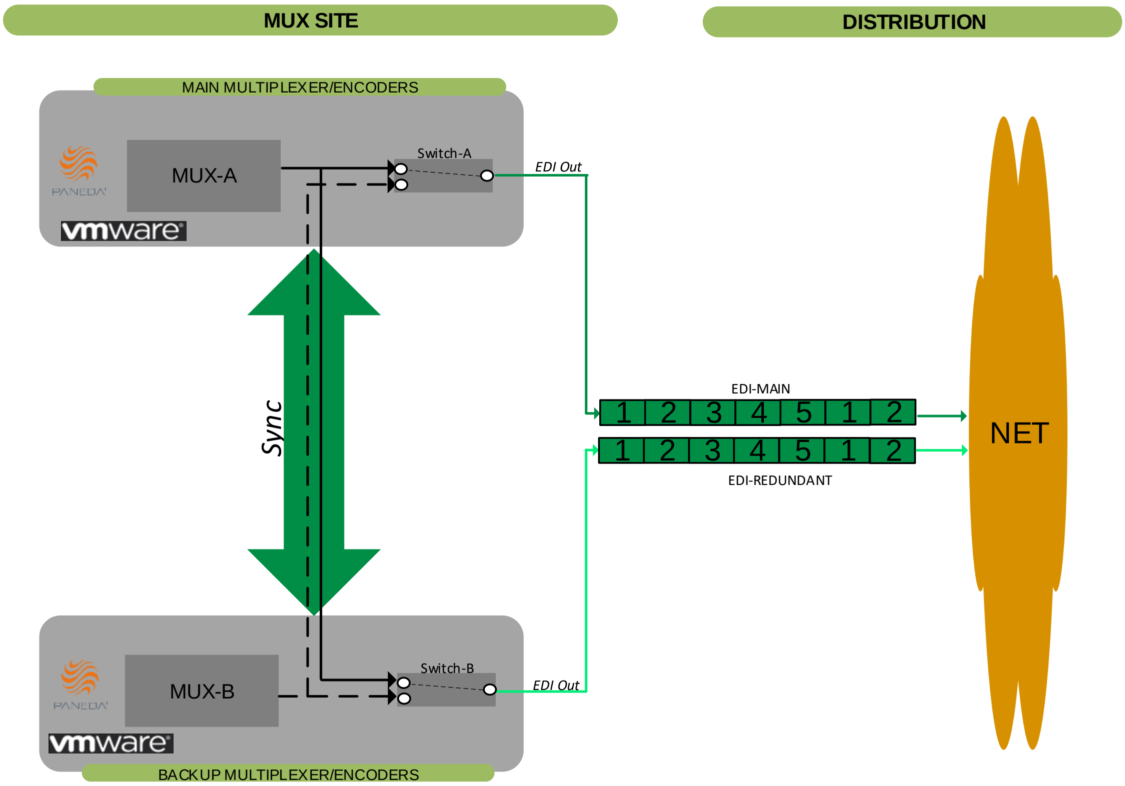
Paneda subchannel switch, example with 3 subchannels.



Picture showing multiple errors, service 1 has failed in the main system, service 2 has failed in the redundant system. Both services OK on output of both systems

SYNCHRONIZATION with PFT (Protection, Fragmentation and Transport)

Multiplexer redundancy including PFT synchronization of configuration AND multiplexer output frame synchronization. Multiplexers in redundant mode are 100% synchronized to enable seamless switching on EDI level in the transmitters or in the IP network.

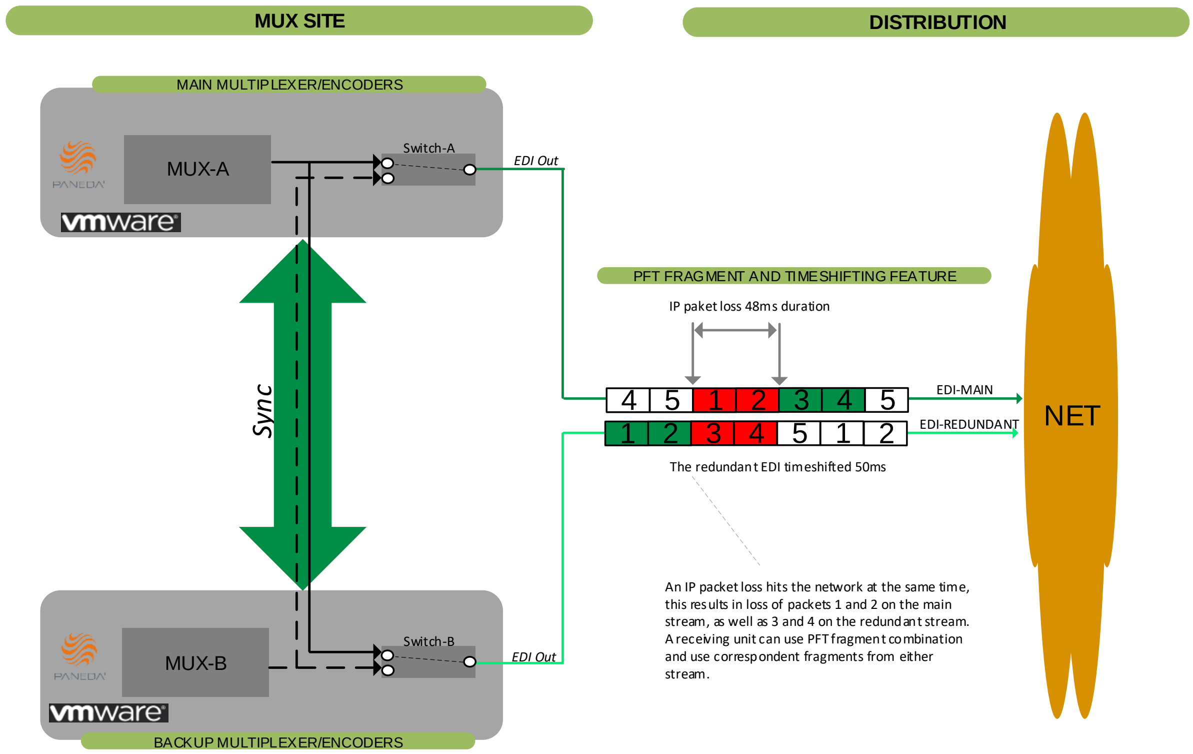


Paneda output are synchronized and PFT aligned, means that each PFT fragment contains the ***exact*** *same data.*

SYNHRONIZATION WITH TIMESHIFT

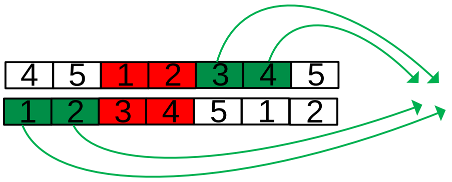
In addition to PFT synchronization, the Paneda also supports time shifting of the outputs, this provides a higher level of redundancy on the distribution network.

- On a network drop-out, a time shifted output ensures that different data is affected at the same time.
- A receiver supporting PFT handling can cherry picking fragments from either stream.


MUX SITE
DISTRIBUTION
MAIN MULTIPLEXER/ENCODERS
MUX-A
Switch-A
EDI Out
vmware
Sync
MUX-B
Switch-B
EDI Out
vmware
BACKUP MULTIPLEXER/ENCODERS
PFT FRAGMENT AND TIMESHIFTING FEATURE
IP paket loss 48ms duration
4 5 1 2 3 4 5
1 2 3 4 5 1 2
EDI-MAIN
EDI-REDUNDANT
NET
The redundant EDI timeshifted 50ms

An IP packet loss hits the network at the same time, this results in loss of packets 1 and 2 on the main stream, as well as 3 and 4 on the redundant stream. A receiving unit can use PFT fragment combination and use correspondent fragments from either stream.

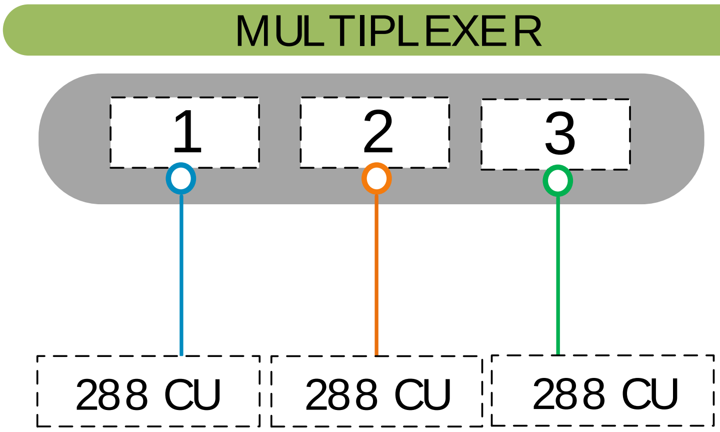
Network drop out affect different data content on the two streams.



An EDI receiver can cherry picking individual PFT fragments from either stream

PROVIDERS

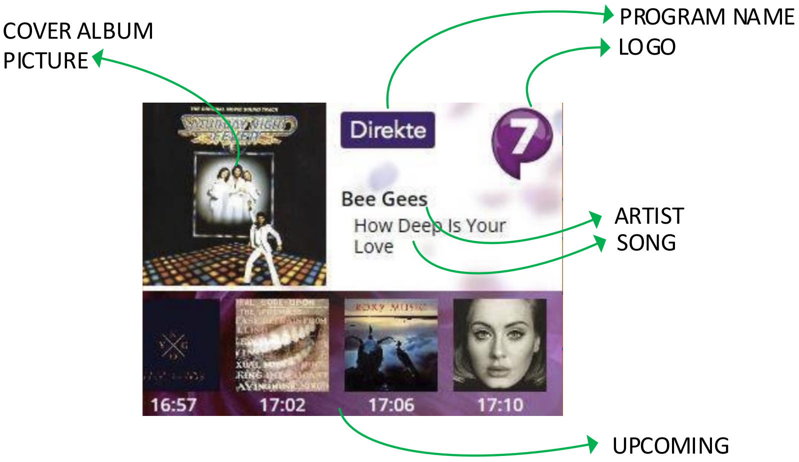
The system supports a flexible way to handle different providers. Each provider may login to the system and manage their own specified capacity range, totally isolated and independent from each other. This handling replaces the older *service multiplexer* handling and have eliminated the disadvantages of such setup.



The multiplexer can be divided into capacity slots, one for each provider. Each provider has access to their own capacity slots. Each provider uses their own web interface for managing the system. Each provider is 100% isolated from the other.

METADATA

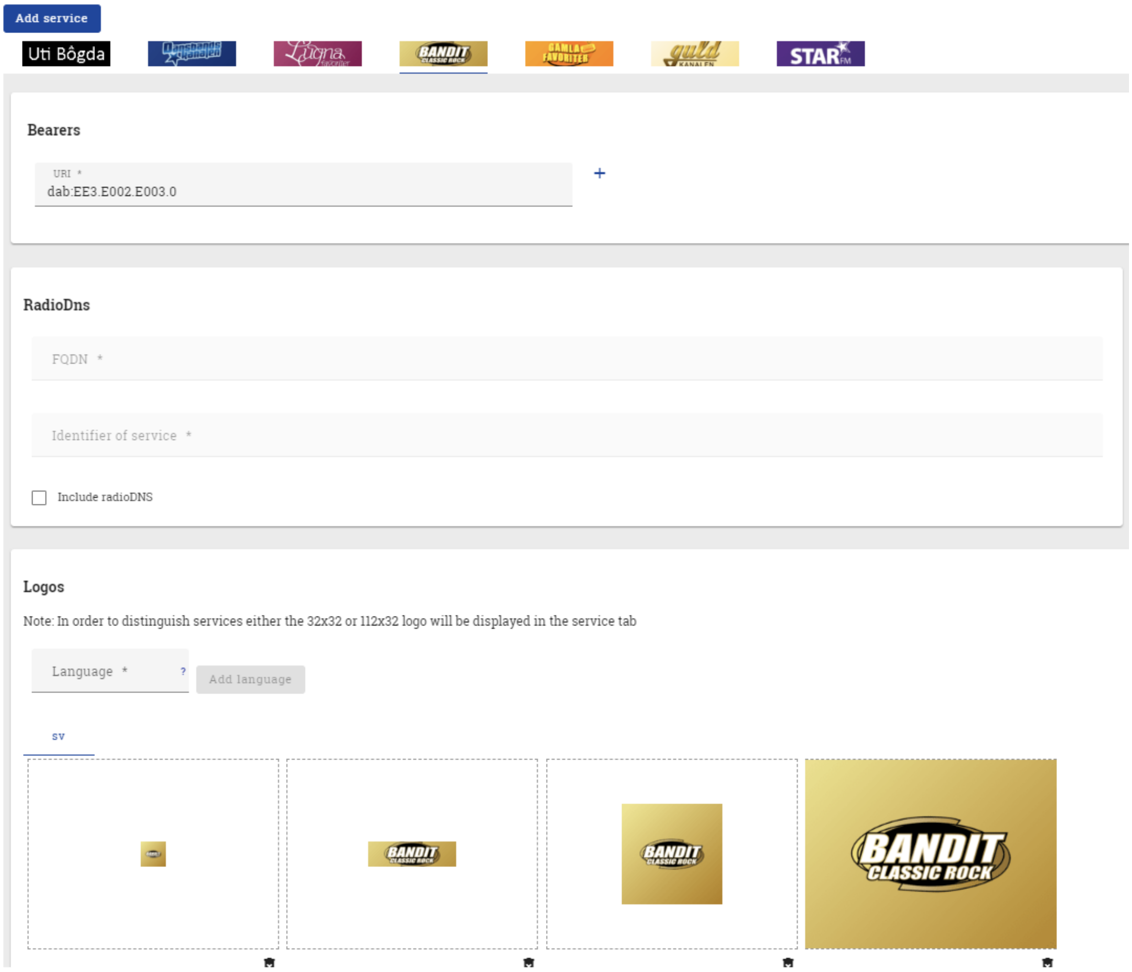
- The system supports adding text/pictures directly in the web interface
- Insertion of metadata as text and picture easy integrated, using web-based API as JSON
- Insertion of metadata is encrypted and requires an access code to prevent manipulating of metadata



SLS Example showing a dynamic information of artist, song and more.

SPI STATION LOGO

The Paneda system includes a full handling of SPI Station Logo where each radio station simply adds their stations logos directly in the web interface (or via the API) and the multiplexer compose an complete SPI service for all radio stations in the multiplexer.



Bearers

URI *
dab:EE3.E002.E003.0

RadioDns

FQDN *

Identifier of service *

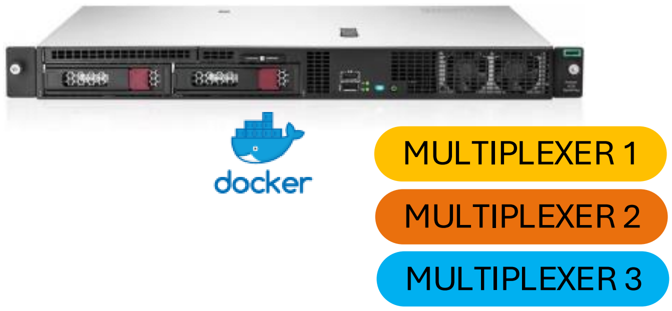
□ Include radioDNS

Logos

Note: In order to distinguish services either the 32x32 or 112x32 logo will be displayed in the service tab

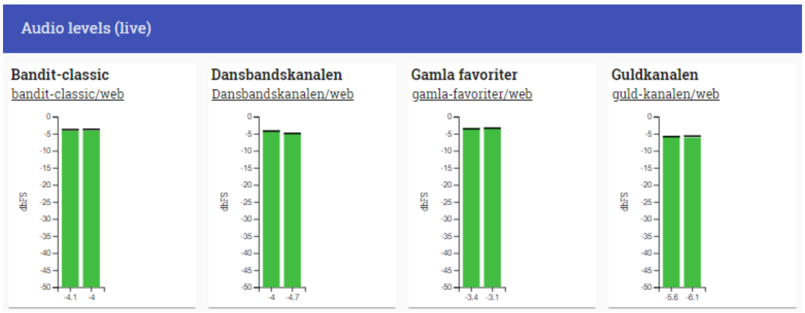
VIRTUALIZATION

The Paneda system is designed to be installed as a container-based systems, as docker. Using a server with a minimalistic operating system as Fedora core OS it's possible to install several DAB multiplexer systems and encoders in the very same hardware. Each system is independent and installed in its own isolated container system.

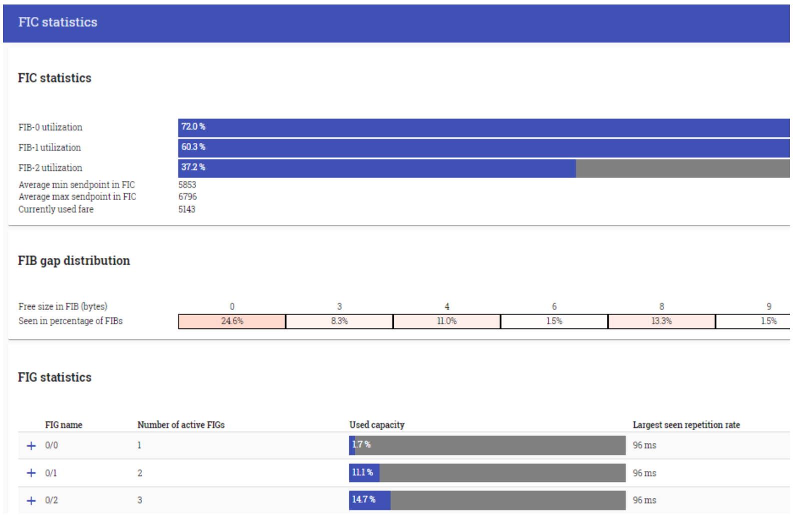


STATUS CONTROL

In the Paneda system you can be sure that you have full overview of different statistics, for example the performance of the audio input, FIG repetition rate, server hardware performance and much more.



Audio Levels, included fallback audio inputs.



FIC statistics

FIC statistics

FIB-0 utilization	72.0 %
FIB-1 utilization	60.3 %
FIB-2 utilization	37.2 %
Average min sendpoint in FIC	5853
Average max sendpoint in FIC	6796
Currently used fare	5143

FIB gap distribution

Free size in FIB (bytes)	0	3	4	6	8	9
Seen in percentage of FIBs	24.6%	8.3%	11.0%	1.5%	13.3%	1.5%

FIG statistics

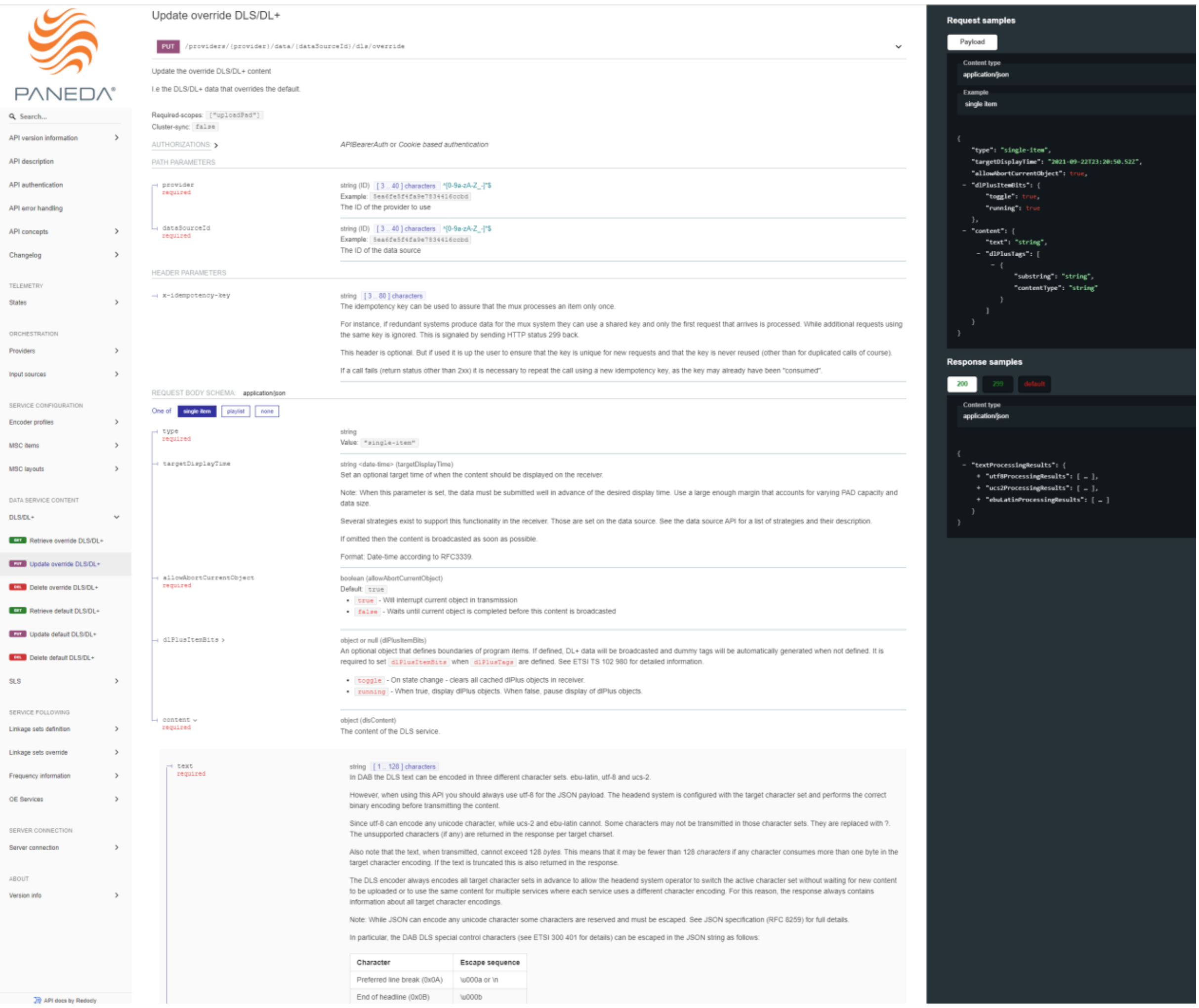
	FIG name	Number of active FIGs	Used capacity	Largest seen repetition rate
+	0/0	1	1.7 %	96 ms
+	0/1	2	11.1 %	96 ms
+	0/2	3	14.7 %	96 ms

FIG statistics with repetition rate per FIG. .

OPEN API v3

The API is a state-of-the-art JSON based RESTful API running over https with a token-based authentication schema. The API is well documented using open-api 3.0 syntax providing easy to read documentation. The API is built on the same technologies that we all expect to see in modern software, and it is what all the major tech giants offer today. Such as APIs provided by Facebook, Google, Twitter, etc.

The API covers everything, from settings to service configurations, scheduler, monitoring, PAD data etc.



Update override DLS/DL+

PUT /providers/{provider}/data/{dataSourceId}/dls/override

Update the override DLS/DL+ content

I.e the DLS/DL+ data that overrides the default.

Required-scopes: ["uploadPad"]
Cluster-sync: false

AUTHORIZATIONS: *APIBearerAuth* or *Cookie based authentication*

PATH PARAMETERS

provider required
string (ID) [3 .. 40] characters ^[0-9a-zA-Z_-]*$
Example: 5ea6fe5f4fa9e7834416ccbd
The ID of the provider to use

dataSourceId required
string (ID) [3 .. 40] characters ^[0-9a-zA-Z_-]*$
Example: 5ea6fe5f4fa9e7834416ccbd
The ID of the data source

HEADER PARAMETERS

x-idempotency-key
string [3 .. 80] characters
The idempotency key can be used to assure that the mux processes an item only once.

For instance, if redundant systems produce data for the mux system they can use a shared key and only the first request that arrives is processed. While additional requests using the same key is ignored. This is signaled by sending HTTP status 299 back.

This header is optional. But if used it is up the user to ensure that the key is unique for new requests and that the key is never reused (other than for duplicated calls of course).

If a call fails (return status other than 2xx) it is necessary to repeat the call using a new idempotency key, as the key may already have been "consumed".

REQUEST BODY SCHEMA: application/json

One of single item playlist none

type required
string
Value: "single-item"

targetDisplayTime
string <date-time> (targetDisplayTime)
Set an optional target time of when the content should be displayed on the receiver.

Note: When this parameter is set, the data must be submitted well in advance of the desired display time. Use a large enough margin that accounts for varying PAD capacity and data size.

Several strategies exist to support this functionality in the receiver. Those are set on the data source. See the data source API for a list of strategies and their description.

If omitted then the content is broadcasted as soon as possible.

Format: Date-time according to RFC3339.

allowAbortCurrentObject required
boolean (allowAbortCurrentObject)
Default: true
- true - Will interrupt current object in transmission
- false - Waits until current object is completed before this content is broadcasted

dlPlusItemBits
object or null (dlPlusItemBits)
An optional object that defines boundaries of program items. If defined, DL+ data will be broadcasted and dummy tags will be automatically generated when not defined. It is required to set dlPlusItemBits when dlPlusTags are defined. See ETSI TS 102 980 for detailed information.

- toggle - On state change - clears all cached dlPlus objects in receiver.
- running - When true, display dlPlus objects. When false, pause display of dlPlus objects.

content required
object (dlsContent)
The content of the DLS service.

text required
string [1 .. 128] characters
In DAB the DLS text can be encoded in three different character sets. ebu-latin, utf-8 and ucs-2.

However, when using this API you should always use utf-8 for the JSON payload. The headend system is configured with the target character set and performs the correct binary encoding before transmitting the content.

Since utf-8 can encode any unicode character, while ucs-2 and ebu-latin cannot. Some characters may not be transmitted in those character sets. They are replaced with ?. The unsupported characters (if any) are returned in the response per target charset.

Also note that the text, when transmitted, cannot exceed 128 *bytes*. This means that it may be fewer than 128 *characters* if any character consumes more than one byte in the target character encoding. If the text is truncated this is also returned in the response.

The DLS encoder always encodes all target character sets in advance to allow the headend system operator to switch the active character set without waiting for new content to be uploaded or to use the same content for multiple services where each service uses a different character encoding. For this reason, the response always contains information about all target character encodings.

Note: While JSON can encode any unicode character some characters are reserved and must be escaped. See JSON specification (RFC 8259) for full details.

In particular, the DAB DLS special control characters (see ETSI 300 401 for details) can be escaped in the JSON string as follows:

Character	Escape sequence
Preferred line break (0x0A)	\u000a or \n
End of headline (0x0B)	\u000b

Request samples

Payload

Content type
application/json

Example
single item

```
{
    "type": "single-item",
    "targetDisplayTime": "2021-09-22T23:20:50.52Z",
    "allowAbortCurrentObject": true,
  - "dlPlusItemBits": {
        "toggle": true,
        "running": true
    },
  - "content": {
        "text": "string",
      - "dlPlusTags": [
          - {
                "substring": "string",
                "contentType": "string"
            }
        ]
    }
}
```

Response samples

200 299 default

Content type
application/json

```
{
  - "textProcessingResults": {
      + "utf8ProcessingResults": [ … ],
      + "ucs2ProcessingResults": [ … ],
      + "ebuLatinProcessingResults": [ … ]
    }
}
```

Supported features

Audio/Metadata

- The system supports 64kbps with PS+SBR (only Fraunhofer codec supports this feature)
- A service points to an audio source rather than an audio encoder providing best flexibility without changing encoder when changing audio source.
- Each audio input can be defined with multiple audio sources, as web streams as fallback or even playing an audio file.
- Supports an easy way to insert audio from remote sites
- Insertion of metadata as text and picture easy integrated, using web-based API as JSON.
- Supports adding text/pictures directly in the web interface
- Alarms if no metadata is present

Monitoring

- Custom defined SNMP channels
- Monitoring via the Paneda API, support for major monitoring systems like DataMiner and more.
- The web interface supports real-time status overview of the system, including real-time VU meters
- All activities in the system logged in an audit log

General system support and functions

- Only web-based interface is required for settings/controlling and monitoring no config files or other methods required
- The system (web interface) uses and support TLS (SSL) for highest security including 2factor authentication.
- Supports multiple languages
- Support for local language in the web interface
- Remote support in an easy way
- The complete system is built to be realized in a Docker container setup, or VMware.
- The system uses Linux as operating system (non-Windows OS)
- The system is scalable in the way that a new service/new provider or even a new complete system can be started without hardware investments
- Supports service following between DAB-FM, and supporting the latest standard “linkage actuator”
- Support for measurement of audio levels (VU meters) in the web interface
- Custom FIG signalling supported
- Support for other codecs (as Open source codec)
- Seamless changing of bitrate of a service as well as changing codec
- Support for using Web radio streams as audio source like shoutcast/icecast and other commonly used formats for web radio
- EDI input support including support for “re-multiplexing” and subchannel based extraction.
- Support for using mobile phone for controlling/monitoring in such way that the web interface is developed to be scalable for mobile devices.
- Support for the All-In media “RAPID” content system
- 1+1 redundancy including synchronization of configuration AND multiplexer output frame synchronization
  (Multiplexers in redundant mode 100% bit synchronized to enable seamless switching on EDI level in the transmitters or in the IP network)

TECHNICAL FEATURES

AUDIO ENCODER	INCLUDED	OPTION
Open source codec MP I/II & AAC	●	
Support for AES67/Livewire	●	
Support for AES/EBU		○
Support for streaming formats, Icecast/Shoutcast e.tc	●	
Audio input redundancy, multiple sources		○
Support for Fraunhofer PRO AAC codec	●	
Support for external encoders	●	
Audio input as file, mp3 or wav	●	
Drift compensation for web streams	●	
Silence detector	●	
Gain control	●	
VU meter real-time	●	
Seamless changes of audio parameters	●	
Hardware external encoder		○

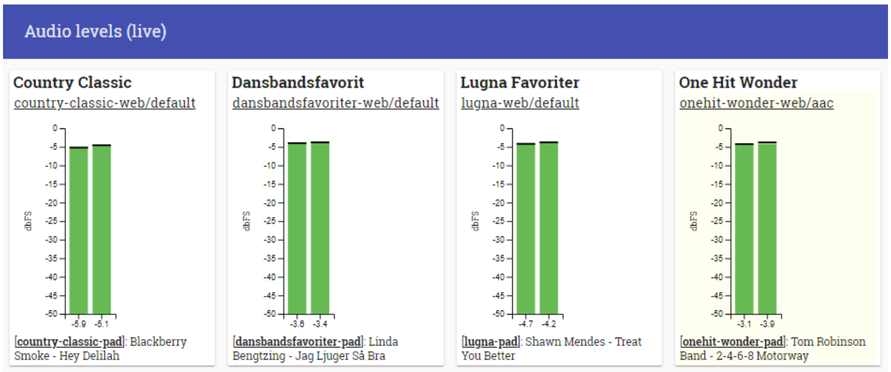
MULTIPLEXER	INCLUDED	OPTION
EDI Input re-multiplexing	●	
Full EDI standard implementation	●	
Multiple EDI outputs	●	
Individual settings of EDI outputs	●	
EDI PFT synchronization	●	
EDI PFT address field support	●	
Advanced Configuration Scheduler	●	
Service following FIG 0/6	●	
Linkage actuator	●	
Frequency Information FIG 0/21	●	
Other Ensemble FIG 0/24	●	
FIG editor	●	
ETI recording at output		○
Virtual Service Provider	●	
SMART Content Switch		○
Seamless built in EDI switch		○
Graphical performance monitor	●	
Announcement support	●	
Extended Label support FIG2 type	●	

SECURITY	INCLUDED	OPTION
HTTPS (SSL) encryption	●	
Certificate handling	●	
2 factor authentications	●	
Internal and external connections encrypted	●	
User database with custom user rights	●	
User audit log	●	

DATA	INCLUDED	OPTION
DLS	●	
DL+	●	
SLS	●	
EPG		○
TPEG		○
Support for external content systems as Rapid	●	
Alarm on no metadata	●	
Backup metadata on no content	●	
SPI Station Logo without external systems		●

GENERAL	INCLUDED	OPTION
All language support	●	
Mobile friendly GUI	●	
JSON web API	●	
SNMP custom defined	●	
100% web interface for setup and management	●	
Remote tunnel for support and upgrades	●	
Backup&restore from GUI	●	
Support for Docker Containers	●	
Realtime status monitoring in web interface	●	
Support for manage 3rd party system web interface	●	
Realtime status monitoring in web interface	●	
Graphical event log overview	●	
Unlimited number of users	●	

EXAMPLE PRINT SCREENS



Audio levels (live)

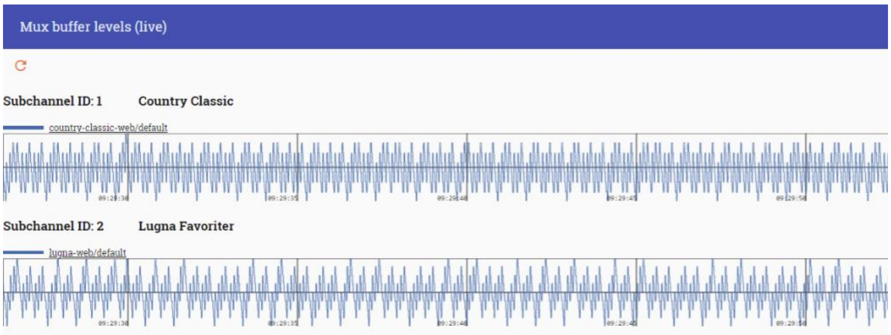
Country Classic
country-classic-web/default
[country-classic-pad]: Blackberry Smoke - Hey Delilah

Dansbandsfavorit
dansbandsfavoriter-web/default
[dansbandsfavoriter-pad]: Linda Bengtzing - Jag Ljuger Så Bra

Lugna Favoriter
lugna-web/default
[lugna-pad]: Shawn Mendes - Treat You Better

One Hit Wonder
onehit-wonder-web/aac
[onehit-wonder-pad]: Tom Robinson Band - 2-4-6-8 Motorway

AUDIO STATUS OVERVIEW WITH PAD DATA.

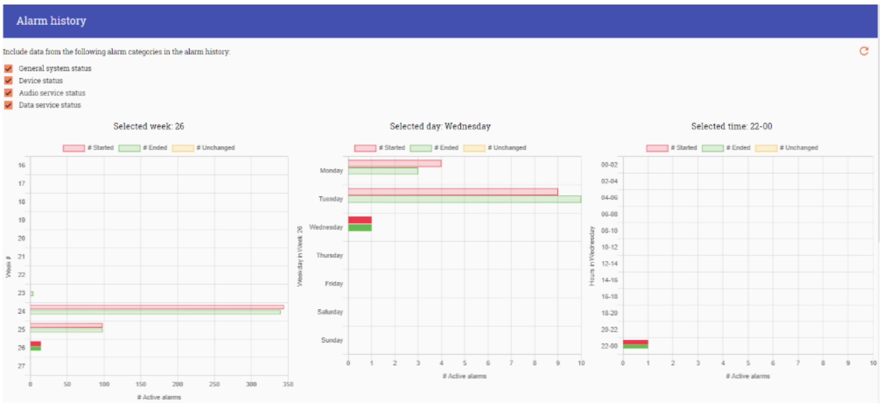


Mux buffer levels (live)

Subchannel ID: 1 Country Classic
country-classic-web/default

Subchannel ID: 2 Lugna Favoriter
lugna-web/default

REAL TIIME BUFFER LEVEL STATUS



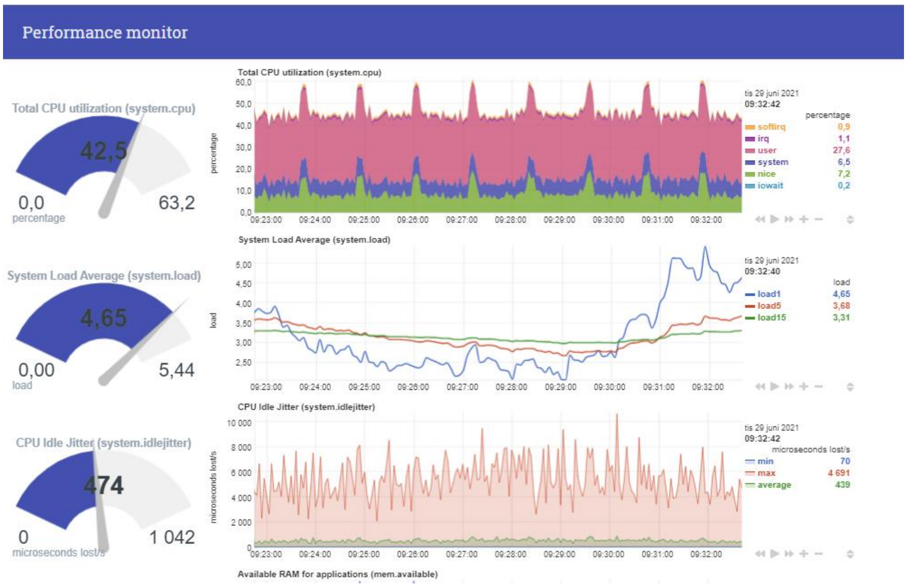
Alarm history

Include data from the following alarm categories in the alarm history:

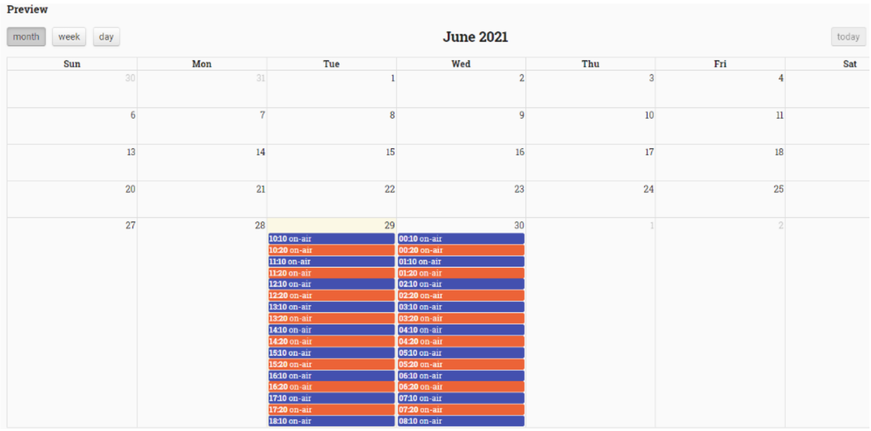
- ☑ General system status
- ☑ Device status
- ☑ Audio service status
- ☑ Data service status

GRAPHICAL ALARM HISTORY LOG

PERFORMANCE MONITOR



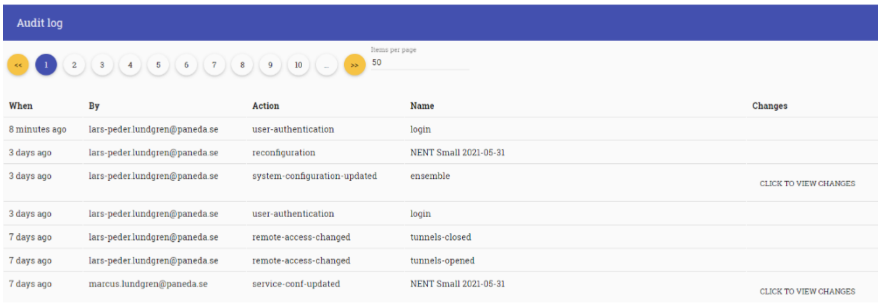
CALENDER BASED SCHEDULER



June 2021

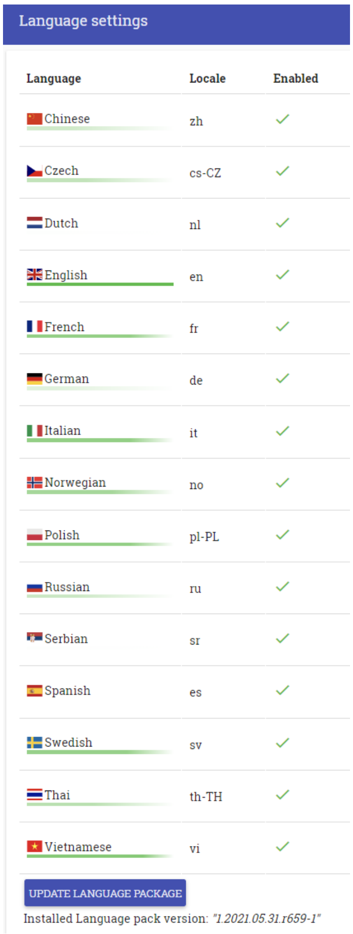
Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	31	1	2	3	4	
6	7	8	9	10	11	
13	14	15	16	17	18	
20	21	22	23	24	25	
27	28	29 10:10 on-air 10:20 on-air 11:10 on-air 11:20 on-air 12:10 on-air 12:20 on-air 13:10 on-air 13:20 on-air 14:10 on-air 14:20 on-air 15:10 on-air 15:20 on-air 16:10 on-air 16:20 on-air 17:10 on-air 17:20 on-air 18:10 on-air	30 00:10 on-air 00:20 on-air 01:10 on-air 01:20 on-air 02:10 on-air 02:20 on-air 03:10 on-air 03:20 on-air 04:10 on-air 04:20 on-air 05:10 on-air 05:20 on-air 06:10 on-air 06:20 on-air 07:10 on-air 07:20 on-air 08:10 on-air	1	2	

AUDIT LOG PER USER



When	By	Action	Name	Changes
8 minutes ago	lars-peder.lundgren@paneda.se	user-authentication	login	
3 days ago	lars-peder.lundgren@paneda.se	reconfiguration	NENT Small 2021-05-31	
3 days ago	lars-peder.lundgren@paneda.se	system-configuration-updated	ensemble	CLICK TO VIEW CHANGES
3 days ago	lars-peder.lundgren@paneda.se	user-authentication	login	
7 days ago	lars-peder.lundgren@paneda.se	remote-access-changed	tunnels-closed	
7 days ago	lars-peder.lundgren@paneda.se	remote-access-changed	tunnels-opened	
7 days ago	marcus.lundgren@paneda.se	service-conf-updated	NENT Small 2021-05-31	CLICK TO VIEW CHANGES

MULTI LANGUAGE SUPPORT

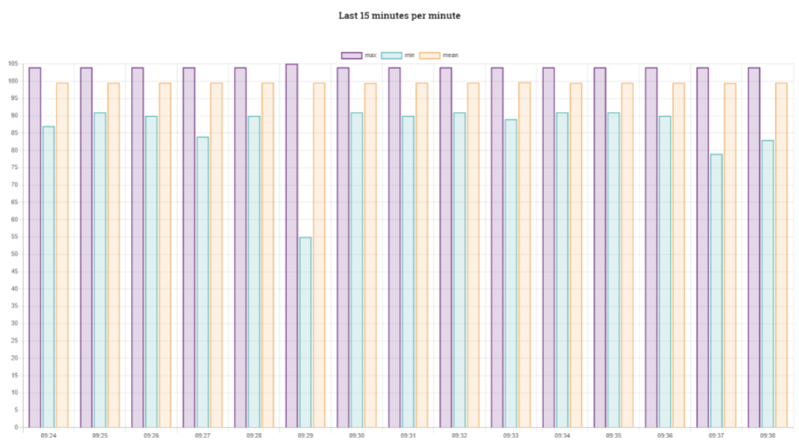


Language settings

Language	Locale	Enabled
Chinese	zh	✓
Czech	cs-CZ	✓
Dutch	nl	✓
English	en	✓
French	fr	✓
German	de	✓
Italian	it	✓
Norwegian	no	✓
Polish	pl-PL	✓
Russian	ru	✓
Serbian	sr	✓
Spanish	es	✓
Swedish	sv	✓
Thai	th-TH	✓
Vietnamese	vi	✓

Installed Language pack version: *"1.2021.05.31.r659-1"*

OUTPUT BUFFER STATUS OVERVIEW


Last 15 minutes per minute
max
min
mean
09:24
09:25
09:26
09:27
09:28
09:29
09:30
09:31
09:32
09:33
09:34
09:35
09:36
09:37
09:38