

RelayCaster - User Manual

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November 13, 2017

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This document describes the usage of the software 'RelayCaster' of 'RelayCaster Lite'.

1. Revision History

Table 1. Revision History

Release	Comment
nmm3_relaycaster_20171113	Many feature and documentation improvements and additions for RelayCaster Encoder.
nmm3_relaycaster_20171023	First release supporting new product RelayCaster Encoder.
nmm3_relaycaster_20161026	Extended instructions for adding the dejitter filter to also support RTP input and output. See Section 10 for more information.
nmm3_relaycaster_20160826	Added option to choose a network interface for multicast streams via webinterface. See Section 12 for more information.
	Improved tool to configure network devices, so it will now configure all available network devices (see Installation Manual for further details).
	Added instructions for adding the dejitter filter. See Section 10 for more information.
nmm3_relaycaster_20151110	Added information about usage of new features: AES encryption and decryption of streams; responsive web interface; removed deprecated entries in manual.

Release	Comment
nmm3_relaycaster_20140827	Added information about restrictions of 'RelayCaster Lite' in Section 6 of user manual.
	Extended information about TTL in Section 6 of user manual.
nmm3_relaycaster_20130513	Added information that update without Internet connection is currently not available. See Section "Updating the RelayCaster without Internet Connection" for more information.
nmm3_relaycaster_20120724	Added description about how to set ttl
	Updated Section "Updating the RelayCaster without Internet Connection"
nmm3_relaycaster_20110714	Added description about download button for log files
	Added information regarding support requests
nmm3_relaycaster_20110328	Extended the RelayCaster to signalize if a stream no longer transmits data. The status sign for created streams then turns from green to yellow.
	Extended the RelayCaster to show RCSP statistics in the web interface if the RelayCaster Streaming Protocol (RCSP) is used. The status sign for created streams turns from green to yellow if a RCSP statistic exceeds its threshold.
	Updated information about API: Interfaces, examples and documentation are available as part of the NMM-Server-SDK.
	Added information about how to usage playlist files with media players.
	Added information about how to use set-top boxes with RelayCaster
nmm3_relaycaster_20110127	Added new convenience features in the web interface and extended documentation of RCSP parameters; Added example to documentation for setting the RCSP parameters for Internet connection.
	The RelayCaster provides now direct access to the received bandwidth for the GbE and the Mgmt device that is also provided in the web interface.
nmm3_relaycaster_20110120	Added support for large input and output buffer for RCSP protocol; Fixed support for sending streams via RTP protocol; Improved error handling and error messages presented to user in case of an invalid stream configuration.
	Added new RCSP specific parameters that can be configured via web interface.
nmm3_relaycaster_20101113	Initial version.

2. Accessing the Web Interface

To access the web interface of the RelayCaster, start your web browser and connect to **http://<IP_ADDRESS_OF_RELAYCASTER>** (e.g. **http://192.168.1.254**) or **https://<IP_ADDRESS_OF_RELAYCASTER>** (e.g. **https://192.168.1.254**).

When connecting using https you need to confirm the certificate.

Table 2. https certificate

Serial Number	00:B6:DB:C0:A8:A6:0D:20:22
MD5 Fingerprint	9D:69:73:36:5F:7D:86:44:9D:49:27:CA:0E:1F:81:EA

To pass the authentication, you need to provide the user name and the password, which defaults to:

Table 3. Authentication factory defaults

username	password
admin	password

The web interface consists of the following configuration pages:

- **Streams:** Add, remove, or modify streams. In addition, different system benchmarks are shown, which are also visible on the display integrated into the device itself.
- **Info:** General settings, import and export of current configuration, documentation, release information, and log files.
- **Login/Logout:** The page 'Login' is shown if you are not logged in to the RelayCaster system, otherwise 'Logout' is shown. By selecting these pages you can either login or logout from RelayCaster.

3. Adding an Encode Stream

- Access the web interface.
- Login with username and password.
- Ensure that an SDI or HDMI signal is connected to the server. Please note that only SD and HD signals up to 1.5Gbit/s are supported.
- Select the configuration page **Encode**.

- Section **Create New Encode Stream**:
 - Note: RelayCaster Encoder software allows for creating only one encode stream up to 25MBit/s.
 - **Encode name**: You may assign any encode stream identifier.
 - **Input Jack**: Either SDI or HDMI can be selected as video input.
 - **Input Format**: All supported video formats are show in this selectbox. If the selected format does not match the currently provided signal, color bars will be encoded. You may choose "Auto" for auto-detection.
 - **Output address** and **Output UDP port** specify the destination IP/port of the encoded stream. If the stream was created successfully the port will be incremented. The encoder can only send UDP streams. If you need RTP/RCSP you have to send the stream to localhost and use a RelayCaster stream to convert it.

Important note: All streams that are sent to a multicast address are sent through the 'GbE' interface to the switch, independent of your network configuration. If you create a multicast stream ensure that the 'GbE' port is connected to the switch as well.

- **Video Bitrate**: Set the initial video bitrate. This setting can be updated later while the stream is running without transitional artefacts in the video. Allowed range is 300 - 25000.
- In the **Advanced** configuration dialog you can specify the following settings for **Video**
 - **Codec**: H.264 or MPEG-2
 - **Profile**: The available settings depend on the selected codec. Be aware that also the input resolution and bitrate might restrict the allowed options.
 - **Level**: The available settings depend on the selected codec. Be aware that also the input resolution and bitrate might restrict the allowed options.

In the **Advanced** configuration dialog you can specify the following settings for **Audio**

- **Codec**: Disable, MP1L2, AAC-LC, HE-AAC-v1, HE-AAC-v2
- **Channels**: Mono, Stereo, Dual Mono, Surround 5.1 (the supported channel mapping depends on the selected Codec)
- **Bitrate**: 32-640 (the supported bitrate depends on the selected codec and Channel mapping)

In the **Advanced** configuration dialog you can specify the following settings for **Muxer**

- **TS-Bitrate**: 0 currently not implemented (the actual TS-bitrate is calculated from the video bitrate and audio settings)
- Click the **Create** button to create the stream and save the configuration. If the stream is created, it is listed in Section **Modify Encode Stream** on the same page. You should see a green symbol in

the status column if the stream is started. If the stream could not be started or was stopped a red symbol will appear. If the RelayCaster Encoder recognizes a problem, the symbol turns yellow. The status will be updated every 10 seconds, if you want to manually update the information please reload the Encode page (for example, by clicking on the 'Encode' tab).

- Click the **Defaults** button to restore all default settings in this section.

4. Destroying or Stopping an Encode Stream

- Access the web interface.
- Login with username and password.
- Select the configuration page **Encode**.
 - Select the wanted stream in the table **Modify Encode Streams**.
 - To destroy the stream, click the **Destroy** button. The stream will be removed from the table after confirming the warning dialog.
 - To stop the stream, click the **Stop** button. You should see a red symbol in the status column. A stopped stream can be re-started by then clicking the **Start** button.

5. Modifying an Encode Stream

- Access the web interface.
- Login with username and password.
- Select the configuration page **Encode**.

Section **Modify Encode Stream** lists available streams.

- Select the wanted stream in the table **Modify Encode Stream**.
- **Video Bitrate** allows to change the video bitrate without interruption of the stream
- Click the **Modify** button to modify the stream and save the configuration. A green symbol signalizes that the stream could be modified whereas a red symbol will appear if this failed.

6. Adding a Stream (RelayCaster)

- Access the web interface.
- Login with username and password.
- Ensure that the stream to be recasted is streamed to the RelayCaster's address, or a multicast address.
- Select the configuration page **Streams**.
- Section **Create New Stream**:
 - Note: In general, RelayCaster software allows for creating an arbitrary number of streams. Before creating a new stream please check that the maximum number of supported streams will not be exceeded. Please refer to the technical specification of the system to see how many streams are supported in parallel. How to check the information about running streams as well as other system information is described in Section 9

RelayCaster Lite (Software-Only) is a special version of RelayCaster that allows to create only one stream with up to 15 Mbps. If more than 15 Mbps is streamed, the RelayCaster Lite version can at any time stop to process the stream.

- You may assign an stream identifier in the table **Stream name**.
- Type in the stream source the columns **Input address** and **Input port**. If the stream was created successfully the port will be incremented.

Note: The default input address is either the IP of this RelayCaster system (when receiving unicast), or the multicast address of the incoming stream.

- Type in the streaming destination in the columns **Output address** and **Output port**. If the stream was created successfully the port will be incremented.

Important note: All streams that are sent to a multicast address are sent through the 'GbE' interface to the switch, independent of your network configuration. If you create a multicast stream ensure that the 'GbE' port is connected to the switch as well. .

- Select the protocol of the incoming stream in the column **Input protocol**. The three streaming protocols supported by the RelayCaster system are:
 - Raw-UDP
 - RelayCaster Streaming Protocol (RCSP).
 - RTP
- Select the protocol the outgoing stream is to be transmitted in in the column **Output protocol**. These three streaming protocols are supported by the RelayCaster system:

- Raw-UDP
 - RelayCaster Streaming Protocol (RCSP).
 - RTP
- In the advanced configuration dialog you can specify the following settings when using UDP or RTP as output protocol:
 - Sender TTL (Optional): Specifies the time to live value for outgoing stream. The default value is 0 which uses a TTL value of 1 for multicast streams and a value of 64 for unicast streams.

Important note: This value can have impact on how the streams are forwarded in your network environment. So you should be familiar with the meaning of this value before changing the default value.

- And the following For AES Encryption when using UDP or RCSP as output protocol:
 - Encryption Key (Optional): Specifies the key which should be used for the encryption. The encryption will be enabled if and only if this field is not empty. Note: You have to insert a Key with at least as many bits mentioned in the Encryption Strength Box.
 - Encryption IV (Required if Encryption Key is not empty): Specifies the initial vector which should be used for the encryption. Note: You have to insert an IV with at least as many bits mentioned in the Encryption Strength Box. The IV is a security parameter for data-encryption. It prevents the user for dictionary attacks, for example if two messages contain the same text, than the hacker could assume, that both ciphertexts are the same and this is indeed the fact if you wouldn't use an iv. However different iv's on each message will have the result, that each ciphertext will be different, even if the message and the key are the same.
 - Encryption Strength: Specifies the Cipher strength of the encryption that means if you select 128 then a 128 bit encryption will be used.
 - Important note: AES encryption is not supported if you use RTP as output protocol

Important note 2: The Key will be masked with with the Relaycaster, so it is only possible to decrypt this stream with another RelayCaster

Important note 3: It is only allowed to have one decrypting stream for a specific input adress (and port). If you want to have decrypt the stream within an internal loop and then create multiple normal streams.

Important note 4: It is not allowed to have both: one decrypting stream and a normal (non decrypting) stream for a specific input adress (and port)

The following is an example of such an internal loop for multiple decryption: Assuming to have an incomming encrypted stream on adress A, your RelayCaster may have adress R and you will send this stream to adress B and C. Then you have to to the following: First create a decryption stream with input adress A and output adress R, then create a normal stream with input adress

R and output address B and last create a second normal stream with input address R and output address C

- And the following For AES Encryption when using UDP or RCSP as input protocol:
 - Decryption Key (Optional): Specifies the key which should be used for the decryption. The decryption will be enabled if and only if this field is not empty. Note: You have to insert a Key with at least as many bits mentioned in the Decryption Strength Box
 - Decryption IV (Required if Decryption Key is not empty): Specifies the initial vector which should be used for the decryption. Note: You have to insert an iv with at least as many bits mentioned in the decryption Strength Box
 - Decryption Strength: Specifies the Cipher strength of the decryption that means if you select 128 then a 128 bit will be used.
 - Important note: AES decryption is not supported if you use RTP as input protocol

Important note 2: The Key will be masked with with the Relaycaster, so it is only possible to decrypt incoming Streams from another RelayCaster

Important note 3: It is only allowed to have one encrypting Stream for a specific input address (and port). If you want to have multiple encrypting streams you have to build a internal loop.

Important note 4: It is not allowed to have both: one encrypting stream and a normal (non encrypting) stream for a specific input address (and port)

The following is an example of such an internal loop for multiple encryption: Assuming to have an incoming stream on address A, your RelayCaster may have address R and you will send this stream to address B and C (but encrypted) Then you have to do the following: First create a stream with input address A and output address R1 (with R1 as address R with random port) then create an encrypted stream with input address R and output address B secondly create another stream with input address A and output address R2 (with R2 as address with random port, different from R1) and last create a second encrypted stream with input address R and output address C

- The RelayCaster Streaming Protocol requires additional information. Click the image in the column **Adv** to open the advanced configuration dialog. In this dialog you can specify the following settings when using RCSP as input protocol:
 - RCSP sender address: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), enter the IP address of the host that sends the RCSP stream here.
 - RCSP input port: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), enter the RCSP port of the sender here. Note: This port has to be identical with the RCSP output port of the sender of this RCSP stream.
 - RCSP input buffer: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), specify the time in ms to cache incoming data before forwarding them. The default value is

100ms. In case of a connection with a high delay you should increase this value. Note: The RCSP input buffer must be smaller than the RCSP output buffer of the sender.

- RCSP ping interval: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), this value should be set to the round trip time (RTT) between client and server + 20%. The RTT can be measured using the 'ping' command. The default value is 10ms. It is usually OK to specify values which are more than 20% above the RTT. However, the RCSP ping interval must be less than the RCSP input buffer.
- RCSP max new missing packets: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), this value specifies the maximum number of new missing packets after which the RCSP protocol takes immediate action to prevent data loss. The default value is 20 packets. Lower numbers reduce the chance of loss of data at the cost of increased traffic.
- RCSP receive timeout: When receiving a stream via the RelayCaster Streaming Protocol (RCSP), this value specifies the time after which the RCSP protocol takes special action if it has not received any new data from the sender. The default value is 50ms. Lower numbers reduce the chance of loss of data at the cost of increased traffic.
- TTL (Optional): Specifies the time to live value for outgoing stream. The default value in web interface is 0 which means that RelayCaster automatically sets following values for TTL:

1: If outgoing stream is a multicast stream.

64: If outgoing stream is a unicast stream.

Important note: Valid values, except of 0, are 1-255. Please note that this value can have impact on how the streams are forwarded in your network environment. So you should be familiar with the meaning of these values before changing the default value.

In the advanced configuration dialog you can specify the following settings when using RCSP as output protocol:

- RCSP output port: When sending a stream via the RelayCaster Streaming Protocol (RCSP), choose a free port that can be used by all RCSP receiving clients. Note: All clients that receive this stream have to configure their RCSP input port to the this value.
- RCSP output buffer: When sending a stream via the RelayCaster Streaming Protocol (RCSP), specify the time in ms to cache outgoing data for receiving clients. The default value is 100ms. In case of a connection with a high delay you should increase this value. Note: The RCSP input buffer of receiving clients must be smaller than the RCSP output buffer.
- Sender TTL (Optional): Specifies the time to live value for outgoing stream. The default value is 0 which uses a TTL value of 1 for multicast streams and a value of 64 for unicast streams.

Important note: This value can have impact on how the streams are forwarded in your network environment. So you should be familiar with the meaning of this value before changing the default value.

Following is an example for setting the RCSP parameters of real-world set-up consisting of two RelayCaster servers, RelayCaster A and RelayCaster B located on different continents of the world. RelayCaster A and B are connected with a lossy long-distance link using the public Internet infrastructure. RelayCaster A receives a stream as Raw-UDP from the local area network it is connected to and sends the stream to RelayCaster B over the Internet using RCSP. RelayCaster B received the stream using RCSP and forwards it by using Raw-UDP to the local area network it is connected to.

- Within the web interface of RelayCaster A we create a new stream, and set RCSP as output protocol. Within the advanced configuration dialog, we set 12845 as RCSP output port. The RCSP output buffer is set to 1200 msec.
- Log in to RelayCaster B using ssh and run 'ping A' with A being the IP address of RelayCaster A. The value shown is between 60 and 80 msec. Therefore, the RCSP ping interval will be set to 120 msec.
- Within the web interface of RelayCaster B, we create a new stream, and set RCSP as input protocol. Within the advanced configuration dialog, we set the IP of RelayCaster A as RCSP sender address, and 12845 as RCSP input port. The RCSP input buffer has to be smaller than the output buffer by at least the value of the chosen RCSP ping interval of 120 msec. Therefore, we set the RCSP input buffer to 800 msec and the RCSP ping interval to 120 msec. Since the stream has a bandwidth of approximately 1 Mbps, RCSP max new missing packets is set to 400 which roughly corresponds to 400 msec of missing data. The value of RCSP receive timeout is set to 50% of the RCSP input buffer, i.e. 400 msec.
- Click the **Create** button to create the stream and save the configuration. If the stream is created, it is listed in Section **Modify Streams** on the same page. You should see a green symbol in the status column if the stream is started. If the stream could not be started or was stopped a red symbol will appear. If the RelayCaster recognizes a problem, the symbol turns yellow. Please see Section Section 9.1 for more information. To update the status of the system and the symbol please reload the streams.php page (for example, by clicking on the 'Streams' tab).

Important note: If a stream from a specific input address should be send to multiple receivers, you can create additional streams with the same input address but different output addresses. In this case the input protocol and the output protocol for all streams that use the same input address must be identical.

- Click the **Defaults** button to restore all default settings in this section.

Note: For convenience in case of the creation of several streams the tool **test_relaycaster** described in Section 20.1 is recommended.

7. Destroying or Stopping a Stream

- Access the web interface.
- Login with username and password.
- Select the configuration page **Streams**.
 - Select the wanted stream in the table **Modify Streams**.
 - To destroy the stream, click the **Destroy** button. The stream will be removed from the table.
 - To stop the stream, click the **Stop** button. You should see a red symbol in the status column. A stopped stream can be re-started by then clicking the **Start** button.

Note: For convenience in case of the deletion/stopping of several streams the tool **test_relaycaster** described in Section 20.1 is recommended.

8. Modifying a Stream

- Access the web interface.
- Login with username and password.
- Select the configuration page **Streams**.

Section **Modify Stream** lists available streams.

- Select the wanted stream in the table **Modify Streams**.
- If you want to change the stream identifier, enter the wanted values in the column **Stream name**
- If you want to change the stream source, enter the wanted values in the columns **Input address** and **input port**.
- If you want to change the streaming destination enter the wanted values in the columns **Input address** and **input port**.
- If you want to change the advanced settings of the stream, click the image in the column **Adv** to open the advanced configuration dialog. Please refer to Section 6 for available settings:
- Click the **Modify** button to modify the stream and save the configuration. A green symbol signalizes that the stream could be modified whereas a red symbol will appear if this failed. If the RelayCaster recognizes a problem, the symbol turns yellow. Please see Section Section 9.1 for more information. To update the status of the system and the symbol please reload the streams.php page (for example, by clicking on the 'Streams' tab).

9. Displaying System Benchmarks and Status

- Access the web interface.
- Login with username and password.
- Select the configuration page **Streams**. To update the status of the system and the streams please reload the streams.php page (for example, by clicking on the 'Streams' tab) or wait some seconds (currently, after 10 seconds the status is updated).
- This section provides the following status information which are also visible on the display integrated into the device itself:

Total Streams: Shows the amount of currently allocated RelayCaster streams that are send to clients.

Bandwidth GbE: Shows the used incoming and outgoing network bandwidth in Mbps on network connector with label GbE.

Bandwidth Mgmt: Shows the used incoming and outgoing network bandwidth in Mbps on network connector with label Mgmt.

Disk usage /: Shows used disk space of root partition.

Disk usage /home: Shows used disk space of /home partition.

Disk usage /home/nmm/video: Shows used disk space of /home/nmm/video partition. Since the LCD display is limited to 16 characters the synonym 'ftp' is used as well.

CPU load: Shows the current system load in percent.

Memory usage: Shows the current memory usage in percent.

- If a warning or error is shown, you need to change the configuration of the system.

9.1. Stream Monitoring

The 'Modify Streams' section provides a status sign for each stream. To update the status of the system and the streams please reload the streams.php page (for example, by clicking on the 'Streams' tab) or wait some seconds (currently, after 10 seconds the status is updated). You should see a green symbol if the

stream can be viewed. If the stream could not be started or was stopped a red symbol will appear. A yellow button indicates a problem that occurred during run-time. In this case you can get more information by selecting this button. The information in the appearing box indicates the following problems:

- Field 'Status' shows: No data is transmitted. In this case no data is received or could be sent. Please check the network configuration and ensure that the incoming stream is still available.
- Field 'TS packet loss rate' shows a value of more than 1%. In this case the incoming stream is not correctly received and includes a lot of missing packets. Please check the network connection and ensure that system load of RelayCaster is not too high.

For RCSP streams also the following problems can occur:

- Field 'Forwarded packets' shows a value less than 99.9%. With RCSP no packets should be lost. However, this indicates that the used connection is too lossy.
- Field 'Received packets' shows a value of more than 110.0%. Too much duplicate packets were received because of too much retransmissions. This can be produced by Timeout NACK Packets or poor RCSP parameters.
- Field 'Sent packets : ..., lost %' shows a value of more than 10%. The packet loss rate strongly depends on the used connection. If it exceeds 10% the connection seems to be so bad that the provider should be informed.
- Field 'Unknown receivers' and the addresses of unknown receivers are shown. Unknown receivers mean addresses to whom no stream was created on this RCSP sender. This indicates that a RCSP receiver is not configured correctly, for example, that the 'RCSP sender address' was not set correctly.

The following issues do not lead to a yellow button but should be regarded as well wherefore a warning is shown:

- Field 'Timeout NACK packets' shows a value of more than 5%. Timeout NACKs should only be sent if for a longer period no data is received. If this happens the connection is very lossy or the RCSP parameters described in Section 6 are not set correctly (e.g. the receive timeout is too small).
- Field 'Urgent NACK packets' shows a value of more than 30%. Ideally, only regular NACKs should be sent. Otherwise RCSP is not configured optimally (then please refer to the description in Section 6 to see how this is done).

10. Dejitter Filter

RelayCaster offers an advanced feature for dejittering the stream. This allows for providing a dejittered stream on the receiving side, which might be required for forwarding streams to traditional broadcast equipment that is not able to compensate for jittering of incoming IP streams.

Dejittering is only available for the combination of UDP-to-RCSP, RCSP-to-UDP, RTP-to-RCSP, and RCSP-to-RTP. Enabling the dejitter filter requires to set up NTP correctly. Please refer to installation manual for this step. Please make sure that NTP is set up correctly by running following command.

```
ssh root@<IP_ADDRESS_OF_RELAYCASTER>
(e.g. ssh root@192.168.1.254)
```

```
ntpq -p
```

As result you should see that the system time of your server is aligned with very little offset to an NTP server that provides accurate time.

For enabling the dejitter filter, you need to change following entry on all participating systems, meaning all senders and all receivers that communicate with each other need to either enable or disable this option; by default this option is disabled.

```
ssh nmm@<IP_ADDRESS_OF_RELAYCASTER>
(e.g. ssh root@192.168.1.254)
```

```
cp /home/nmm/nmm3_relaycaster/bin/relaycaster_wrapper.sh \
  /home/nmm/nmm3_relaycaster/bin/relaycaster_wrapper.sh__BACKUP
vi /home/nmm/nmm3_relaycaster/bin/relaycaster_wrapper.sh
```

Then change following line

```
#start relaycaster
cd $HOME
$SCRIPTPATH/$NMM_BINARY $RELAYCASTER_OPTION $@ 2>&1 | logger -p local1.warn -t "[relayca
```

and add the -T option

```
#start relaycaster
cd $HOME
$SCRIPTPATH/$NMM_BINARY $RELAYCASTER_OPTION -T $@ 2>&1 | logger -p local1.warn -t "[rela
```

When you have changed this file on all participating servers, you need to restart the RelayCaster on all servers by running following script.

```
ssh root@<IP_ADDRESS_OF_RELAYCASTER>
(e.g. ssh root@192.168.1.254)
```

```
/home/nmm/nmm3_relaycaster/bin/start_all_relaycaster_services.sh
```

For disabling the dejitter filter on all participating systems again, please run following commands.

```
ssh nmm@<IP_ADDRESS_OF_RELAYCASTER>
(e.g. ssh root@192.168.1.254)
```

```
cp /home/nmm/nmm3_relaycaster/bin/relaycaster_wrapper.sh__BACKUP \  
  /home/nmm/nmm3_relaycaster/bin/relaycaster_wrapper.sh  
  
/home/nmm/nmm3_relaycaster/bin/start_all_relaycaster_services.sh
```

11. Changing the Password

- Access the web interface.
- Login with username and password.
- Select the configuration page **Info**.
 - Enter a username and password and click the **Save** button

12. Changing Network Interfaces for Multicast Streams

The factory setting for outgoing multicast streams is GbE and for incoming multicast streams Mgmt. Changing these settings in the RelayCaster works as follows:

- Access the web interface.
- Login with username and password.
- Select the configuration page **Info**.
 - Choose network devices for **Multicast Input** and **Multicast Output**.

Note: The 'Default' option for multicast input will usually default to Mgmt, unless explicitly specified otherwise in the routing table of the system.

- Click the **Save** button to apply the new settings.

These settings are stored in the config file.

13. Importing and Exporting the Configuration

Importing and exporting the configuration of the RelayCaster works as follows:

- Access the web interface.
- Login with username and password.
- Select the configuration page **Info**.
 - Click the **Export** or **Import** button and select a location and file name on the local host.

Warning: don't import a configuration from a different (older or newer) 'RelayCaster' version.

RelayCaster Lite (Software-Only) is a special version of RelayCaster that allows to create only one stream with up to 15 Mbps. If more than 15 Mbps is streamed, the RelayCaster Lite version can at any time stop to process the stream. If a configuration with more than one stream is imported, only the first stream is created.

Note: The tool **test_relaycaster** described in Section 20.1 can also be used to importing or exporting a configuration.

14. Resetting the Configuration

Resetting the configuration of the RelayCaster works as follows:

- Access the web interface.
- Login with username and password.
- Select the configuration page **Info**.
 - Click the **Reset** button and confirm the dialog with OK.
 - Wait at least 60 seconds before using the RelayCaster web interface again.

15. Accessing Logfiles

The log files are saved in the directory **/home/nmm/.nmm**.

You can download the log files as an .tgz archive using the web interface:

- Access the web interface.
- Login with username and password.
- Select the configuration page **Info**.
 - Press button 'Download all log files'.

Important Note: This operation could take several minutes until the save dialog appears for downloading all log files.

Important Note: This operation can cause a high system load until the archive of all log files is created.

You can view the log files by using the web interface:

- Access the web interface .
- Login with username and password.
- Select the configuration page **Info**.
 - Access the last entries of the wanted log files by clicking on **last entries** or the full log file by clicking on **full log**.

16. Updating the RelayCaster

16.1. Updating the RelayCaster Connected to the Internet

Important Note: Before updating the RelayCaster ensure that you logout from the web interface of the RelayCaster as described in Section Section 2.

Updating the 'RelayCaster' works as follows:

- Login as user root by using a ssh client:

```
ssh root@<IP_ADDRESS_OF_RELAYCASTER>  
(e.g. ssh root@192.168.1.254)
```

- Start the latest version of the script **nmm3_relaycaster_download.sh** to update the 'RelayCaster':

```
sh /home/nmm/nmm3_relaycaster/bin/nmm3_relaycaster_download.sh
```

Warning: This process removes the relaycaster configuration `~/nmm/relaycaster.conf` and encodecaster configuration `~/nmm/relaycaster_encoder.conf`

17. Downgrading the RelayCaster

Downgrading the 'RelayCaster' works as follows:

- Login as user root by using a ssh client:

```
ssh root@<IP_ADDRESS_OF_RELAYCASTER>
(e.g. ssh root@192.168.1.254)
```

- Stop the services as follows:

```
sh /home/nmm/nmm3_relaycaster/bin/stop_all_relaycaster_services.sh
```

- Remove the system link **/home/nmm/nmm3_relaycaster** which points to the current release:

```
rm /home/nmm/nmm3_relaycaster
```

- Remove the relaycaster configuration **/home/nmm/.nmm/relaycaster.conf**:

```
rm /home/nmm/.nmm/relaycaster.conf
```

- Remove the encodecaster configuration **/home/nmm/.nmm/relaycaster_encoder.conf**:

```
rm /home/nmm/.nmm/relaycaster_encoder.conf
```

- Remove the plug-in information **/home/nmm/.nmm/plugins.***:

```
rm /home/nmm/.nmm/plugins.*
```

- Create a new system link to a old release:

```
ln -s /home/nmm/nmm3_relaycaster_<RELEASE_DATE> \
/home/nmm/nmm3_relaycaster
```

Hint: You can list all available releases as follows:

```
ls -dl /home/nmm/nmm3_relaycaster_**
```

- Start the services as follows:

```
sh /home/nmm/nmm3_relaycaster/bin/start_all_relaycaster_services.sh
```

18. Streaming Clients

18.1. Receiving Streams

To receive created streams that contain MPEG data streams (see section Section 6) media players like VLC or mplayer can be used. The following sections describe the usage of the these applications.

18.1.1. VLC

- Download and install the VLC media player from <http://www.videolan.org>.
- Start the VLC media player (Linux: vlc, windows: vlc.exe).
- Select **Media** -> **Open Network** from the menu or press **Ctrl + N** and type in the following settings:
 - Protocol: UDP
 - Address: DESTINATION which has been used to create the stream (see section Section 6) (e.g. 192.168.1.22)
 - Port: PORT which has been used to create the stream (see section Section 6) (e.g. 12345)
- Click the "Play" button to receive the stream

Alternatively you can start vlc with command line arguments as follows:

```
vlc udp://@<DESTINATION>:<PORT>
(e.g. vlc udp://@192.168.1.22:12345)
```

If the received stream contains service information (SDT tables), VLC sometimes selects the wrong program. To override the selection choose the right program in the menu **Playback** -> **Program**. Alternatively you can choose the program by using command line parameters:

```
vlc udp://@<DESTINATION>:<PORT> --program "<SERVICE_ID>"
```

In this case you have to provide the SERVICE_ID of the program.

Optionally, you can also create a playlist for easily selecting available streams, e.g. for performing channel-hopping. The following example shows an .xspf file containing two streams, named 'Channel 1' and 'Channel 2', available as multicast streams.

```
<?xml version="1.0" encoding="UTF-8"?>
<playlist version="1" xmlns="http://xspf.org/ns/0/"
  xmlns:vlc="http://www.videolan.org/vlc/playlist/ns/0/">
  <title>Wiedergabeliste</title>
  <trackList>
    <track>
      <title>Channel 1</title>
      <location>udp://@239.1.1.1:12345</location>
      <extension application="http://www.videolan.org/vlc/playlist/0">
```

```

        <vlc:id>0</vlc:id>
        <vlc:option>udp-caching=300</vlc:option>
    </extension>
</track>
<track>
    <title>Channel 2</title>
    <location>udp://@239.1.1.2:12346</location>
    <extension application="http://www.videolan.org/vlc/playlist/0">
        <vlc:id>1</vlc:id>
        <vlc:option>udp-caching=300</vlc:option>
    </extension>
</track>
</trackList>
<extension application="http://www.videolan.org/vlc/playlist/0">
    <vlc:item tid="0" />
    <vlc:item tid="1" />
</extension>
</playlist>

```

When opening this .xspf file, vlc allows for jumping from one stream to another by pressing the next/last track buttons. Please also make sure that deinterlacing is enabled.

18.1.2. mplayer

- Download and install mplayer from <http://www.mplayerhq.hu>.
- Start mplayer as follows:

Linux:

```
mplayer udp://@<DESTINATION>:<PORT> -cache 1024
(e.g. mplayer udp://@192.168.1.22:12345 -cache 1024
```

Windows:

```
mplayer.exe udp://@<DESTINATION>:<PORT> -cache 1024
(e.g. mplayer.exe udp://@192.168.1.22:12345 -cache 1024
```

If the video contains artifacts increase the cache size from 1024 to a higher value.

19. Application Programming Interface

This section describes the the RelayCaster application programming interface (API), which can be used by external applications to control the RelayCaster and query its status. The API provides a superset of all functionality which is exposed in the web interface.

NMM-based applications should use the NMM API, which is described in Section 19.1. Applications which are not using NMM can use the XML-RPC API, which is described in Section 19.2.

19.1. NMM API

The NMM API consists of a number of NMM interfaces, which are provided by the NMM-Server-SDK. It can be used by applications written in C++ on Windows, Linux, Mac OS X and other supported platforms. The NMM-Server-SDK also provides build environments for Windows and Linux, as well as example programs, which can be used as a basis for custom applications. You can get the latest releases of NMM and the NMM-Server-SDK at <http://www.gmit-gmbh.de/relaycastersdk.html>.

For detailed information about NMM and the RelayCaster interfaces, please see the Doxygen documentation of the API, which can be found at <http://www.gmit-gmbh.de/relaycastersdk.html>.

The NMM-Server-SDK also provides an example program, `test_relaycaster`, which demonstrates the use of the NMM API. Its interactive and command-line-based interface can be used for controlling the RelayCaster and querying its status, such as creating and destroying streams. For detailed usage information see section Section 20.1.

19.2. XML-RPC API

The XML-RPC interface is based on open standards, such as the HTTP protocol and the XML format, so it can be used by any application, such as a web application developed in PHP, a shell script, or a custom application which does not use NMM. Furthermore, our integrated RPC server supports encrypted connections using SSL.

For more information, please see the documentation of the XML-RPC API provided with the NMM-Server-SDK, which can be found at <http://www.gmit-gmbh.de/relaycastersdk.html>.

20. Tools

This section describes RelayCaster tools, which can be used to control the RelayCaster and query its status using the RelayCaster API (see Section 19.1 for details).

20.1. test_relaycaster

The tool `test_relaycaster` is included in your RelayCaster release and can be used to efficiently set up and control streams. It can be started as follows.

```
ssh nmm@<IP of RelayCaster server>
cd /home/nmm/nmm3_relaycaster/bin/
./wrapper.sh test_relaycaster
```

For detailed usage information, run the application as follows:

```
./wrapper.sh test_relaycaster -h
```

An important use case is explained as an example how to use the tool: The creation of several streams. In the following it is assumed that your RelayCaster system has the IP address 192.168.1.10 and two incoming streams to ports 12345 and 12346 are available, which are to be forwarded to IP address 192.168.1.11 and ports 23456 and 23457.

```
ssh nmm@192.168.1.10
cd /home/nmm/nmm3_relaycaster/bin/
./wrapper.sh test_relaycaster -H 192.168.1.10
```

At that point the tool will show a list of available commands. To create several streams with consecutive port numbers, the command `tryCreateStreams` can be used. The command needs to be entered and confirmed by pressing the 'Enter' key. The tool will ask you for needed settings and provides default values in square brackets. Please enter the required settings or leave the fields empty to use the default and press the 'Enter' key again.

```
create stream for benchmark:
  streaming source (address) [127.0.0.1]: 192.168.1.10
  streaming source (port) [12345]: 12345
  input protocol (0=RAWUDP, 1=RTP, 2=RCSP) [0]: 0
  streaming destination [192.168.1.10]: 192.168.1.11
  streaming destination (port) [12345]: 23456
  output protocol (0=RAWUDP, 1=RTP, 2=RCSP) [0]: 0
  number of streams [1]: 2
```

As 'streaming source' the IP address of your RelayCaster or a multicast address has to be entered, plus the port for receiving the stream. Please ensure that at the chosen address and port a stream is available. The 'input protocol' and 'output protocol' can be chosen between Raw-UDP, RTP and RelayCaster Streaming Protocol (RCSP) (only if purchased). The parameters for 'streaming destination' specify the destination IP address and port (either unicast or multicast). When using the command `tryCreateStreams`, you are able to specify how many streams are to be created. If more than one stream is to be created, the used port numbers for incoming and outgoing streams will automatically be increased. Be careful when using this command for multicast streams: We recommend to always use a different multicast address and different port for each stream. In this example, two UDP streams to IP address 192.168.1.11 ports 23456 and 23457

will be created. If the streams with this settings could be created successfully the following output will be printed:

```
creating stream (source: 192.168.1.10:12345,  
  destination: 192.168.1.11:23456)  
created stream with stream ID 1  
creating stream (source: 192.168.1.10:12346,  
  destination: 192.168.1.11:23457)  
created stream with stream ID 2
```

The `test_relaycaster` tool can also be used with scriptable user interaction (http://www.gmit-gmbh.de/nmmdocs_scriptable-user-interaction.html) For detailed usage information, run the tool as follows (please notice that you need to provide '-' three times).

```
./wrapper.sh test_relaycaster ---help
```