

Note: 1 As stated at <https://github.com/alanxz/rabbitmq-c#threading>, you cannot share a socket, an `amqp_connection_state_t`, or a channel between threads using the `librabbitmq` library. This library is designed for use by event-driven, single-threaded applications, and does not yet meet the requirements of threaded applications. 2

To deal with this limitation, your application must open an AMQP connection (and an associated socket) per thread. If it needs to access a single AMQP connection or any of its channels from more than one thread, you must implement an appropriate locking mechanism. It is generally simpler to have a connection dedicated to each thread.

2.15.7.5 Monitor Adapter Execution 3

The AMQP protocol adapter uses the `nvds_logger` framework to generate log messages which can help you monitor execution. The adapter generates separate logs for the INFO, DEBUG, and ERROR severity levels, as described in [nvds_logger: Logging Framework](#). You can limit the log messages being generated by setting the level at which log messages are filtered in the logging setup script. 4

Note: 5 If the severity level is set to `DEBUG`, `nvds_logger` logs the entire contents of each message sent by the AMQP protocol adapter.

2.15.8 nvds_logger: Logging Framework 6

DeepStream provides a logging framework named `nvds_logger`. The Kafka protocol adapter uses this framework to generate a run time log. `nvds_logger` is based on `syslog`, and offers many related features, including: 7

- ▶ Choice of priorities (log levels) 8
- ▶ Log filtering and redirection
- ▶ Shared logging across different DeepStream instances running concurrently
- ▶ Log retirement and management using `logrotate`
- ▶ Cross-platform support

2.15.8.1 Enabling Logging 9

To enable logging, run the `setup_nvds_logger.sh` script. Note that this script must be run with `sudo`. You may have to modify the permissions associated with this script to make it executable. 10

The script accepts an optional parameter specifying the pathname of log file to be written. By default, the pathname is `/tmp/nvds/ds.log`. 11

Once logging is enabled, you can access the generated log messages by reading the log file. 12

By default, you must have `sudo` permissions to read the log file. Standard techniques for syslog-based logging configuration can eliminate this requirement. ¹

2.15.8.2 Filtering Logs ²

`nvds_logger` allows logs to be associated with a severity level similar to that which syslog offers. You can filter log messages based on severity level by modifying the setup script. By default, the script enables logging for messages at the `INFO` level (level 6) and above. You can modify this as outlined in the comments in the script: ³

```
# Modify log severity level as required and rerun this script 4
#           0      Emergency: system is unusable
#           1      Alert: action must be taken immediately
#           2      Critical: critical conditions
#           3      Error: error conditions
#           4      Warning: warning conditions
#           5      Notice: normal but significant condition
#           6      Informational: informational messages
#           7      Debug: debug-level messages
# refer https://tools.ietf.org/html/rfc5424.html for more information

echo "if (\$syslogtag contains 'DSLOG') and (\$syslogseverity <= 6) 5
then $nvdslogfilepath" >> 11-nvds.conf
```

2.15.8.3 Retiring and Managing Logs ⁶

It is recommended that you limit the size of log files by retiring them periodically. `logrotate` is a popular utility for this purpose. You can use it in cron jobs so that the log files are automatically archived periodically, and are discarded after a desired interval. ⁷

2.15.8.4 Generating Logs ⁸

You can implement modules that use the logger by including `sources/includes/nvds_logger.h` in the source code and linking to the `libnvds_logger.so` library. ⁹

Generating logs programmatically involves three steps: ¹⁰

1. Call `nvds_log_open()` before you write any log messages. ¹¹
2. Call `nvds_log()` to write log messages.
3. Call `nvds_log_close()` upon completion to flush and close the logs.

Note the `nvds_logger` is a process-based logging mechanism, so the recommended procedure is to call `nvds_log_open()` from the main application routine rather than ¹²

the individual plugins. Similarly, call `nvds_log_close()` from the main application when it shuts down the application before exit. ¹

3.0 METADATA IN THE DEEPSTREAM SDK¹

Each Gst Buffer has associated metadata. The DeepStream SDK attaches the DeepStream² metadata object, `NvDsBatchMeta`, described in the following sections.

3.1 NVDSBATCHMETA: BASIC METADATA³ STRUCTURE

DeepStream uses an extensible standard structure for metadata. The basic metadata structure `NvDsBatchMeta` starts with batch level metadata, created inside the Gst-nvstreammux plugin. Subsidiary metadata structures hold frame, object, classifier, and label data. DeepStream also provides a mechanism for adding user-specific metadata at the batch, frame, or object level.⁴

DeepStream attaches metadata to a Gst Buffer by attaching an `NvDsBatchMeta` structure and setting `GstNvDsMetaType.meta_type` to `NVDS_BATCH_GST_META` in the Gst-nvstreammux plugin. When your application processes the Gst Buffer, it can iterate over the attached metadata to find `NVDS_BATCH_GST_META`.⁵

The function `gst_buffer_get_nvds_batch_meta()` extracts `NvDsBatchMeta` from the Gst Buffer. (See the declaration in `sources/include/gstnvdsmeta.h`.) See the `deepstream-test1` sample application for an example of this function's usage. For more details, see *NVIDIA DeepStream SDK API Reference*.⁶

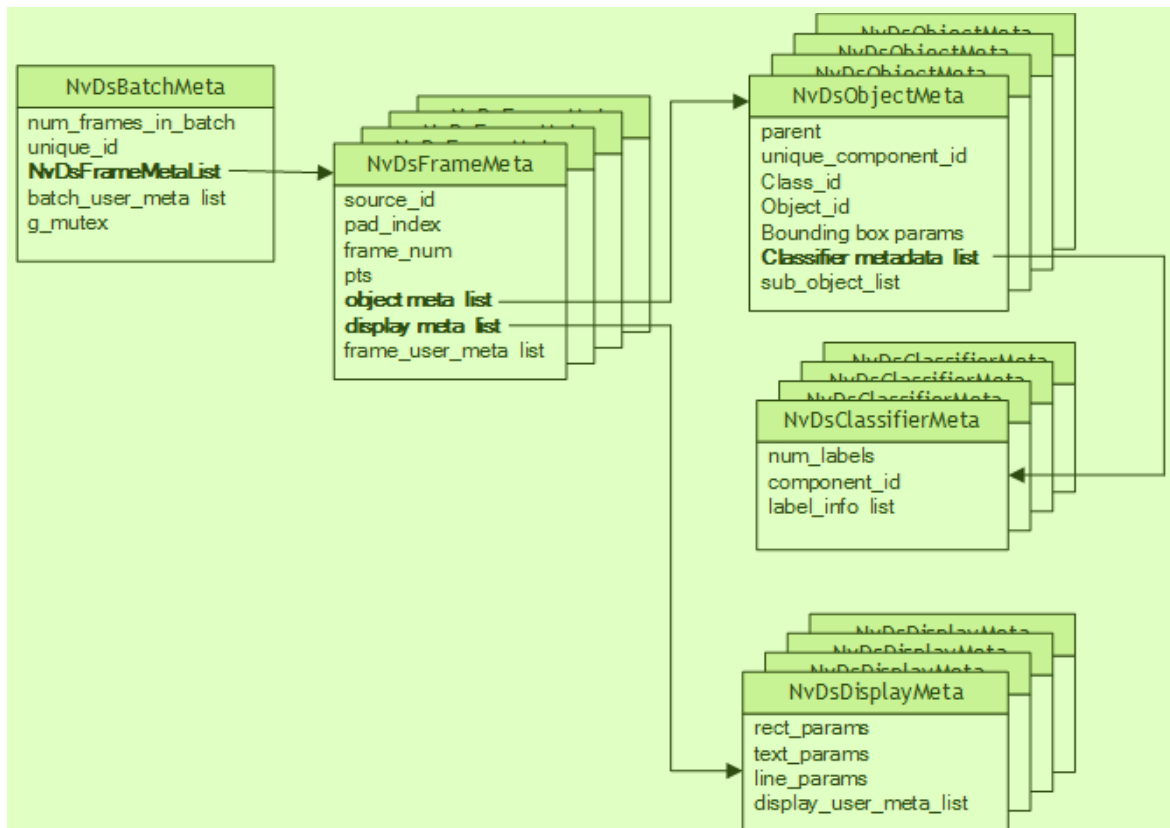


Figure 16. DeepStream metadata hierarchy

3.2 USER/CUSTOM METADATA ADDITION INSIDE NVDSBATCHMETA

To attach user-specific metadata at the batch, frame, or object level within NvDsBatchMeta, you must acquire an instance of NvDsUserMeta from the user meta pool by calling `nvds_acquire_user_meta_from_pool()`. (See `sources/includes/nvdsmeta.h` for details.) Then you must initialize NvDsUserMeta. The members you must set are `user_meta_data`, `meta_type`, `copy_func`, and `release_func`.

For more details, see the sample application source code in `sources/apps/sample_apps/deepstream-user-metadata-test/deepstream_user_metadata_app.c`.

3.3 ADDING CUSTOM META IN GST PLUGINS¹ UPSTREAM FROM GST-NVSTREAMMUX

The DeepStream SDK creates batch level metadata in the Gst-nvstreammux plugin. It holds `NvDsBatchMeta` metadata in a hierarchy of batches, frames within batches, and objects within frames.²

To add metadata to the plugin before Gst-nvstreammux³

*This procedure introduces metadata to the DeepStream pipeline at a plugin before Gst-nvstreammux.*⁴

1. Set the plugin's following members of the plugin's `NvDsUserMeta` structure:⁵

- `copy_func`
 - `free_func`
 - `meta_type`
 - `gst_to_nvds_meta_transform_func`
 - `gst_to_nvds_meta_release_func`
- ⁶

2. Attach the metadata by calling `gst_buffer_add_nvds_meta()` and set the `meta_type` in the `NvDsMeta` instance returned by `gst_buffer_add_nvds_meta()`.⁷

3. The Gst-nvstreammux plugin transforms the input gst-meta created in step 2 from the Gst Buffer into an `NvDsUserMeta` object associated with the corresponding `NvDsFrameMeta` object. It adds this object to the `frame_user_data` list.⁸

4. Search the `frame_user_meta` list in the `NvDsFrameMeta` object for the `meta_type` that was set in step 2, and access the attached metadata.⁹

See the sample application source code in `sources/apps/sample_apps/deepstream-gst-metadata-test/deepstream_gst_metadata.c` for more details. If gst meta is not attached with `gst_buffer_add_nvds_meta()`, it is not transformed into DeepStream metadata. It is still be available in the Gst Buffer, though.¹⁰

4.0 IPLUGIN INTERFACE¹

DeepStream 4.0 supports TensorRT™ plugins for custom layers. The `Gst-nvinfer` plugin now has support for the `IPluginV2` and `IPluginCreator` interface, introduced in TensorRT 5.0. For `caffemodels` and for backward compatibility with existing plugins, it also supports the following interfaces:

- ▶ `nvinfer1::IPluginFactory`
- ▶ `nvuffparser::IPluginFactory`
- ▶ `nvuffparser::IPluginFactoryExt`
- ▶ `nvcaffeparser1::IPluginFactory`
- ▶ `nvcaffeparser1::IPluginFactoryExt`
- ▶ `nvcaffeparser1::IPluginFactoryV2`

See the [TensorRT documentation](#) for details on new and deprecated plugin interfaces.

4.1 HOW TO USE IPLUGINCREATOR⁵

To use the new `IPluginCreator` interface you must implement the interface in an independent custom library. This library must be passed to the `Gst-nvinfer` plugin through its configuration file by specifying the library's pathname with the `custom-lib-path` key.

`Gst-nvinfer` opens the library with `dlopen()`, which causes the plugin to be registered with TensorRT. There is no further direct interaction between the custom library and `Gst-nvinfer`. TensorRT calls the custom plugin functions as required.

The SSD sample provided with the SDK provides an example of using the `IPluginV2` and `IPluginCreator` interface. This sample has been adapted from TensorRT.

4.2 HOW TO USE IPLUGINFACTORY¹

To use the `IPluginFactory` interface, you must implement the interface in an independent custom library. Pass this library to the `Gst-nvinfer` plugin through the plugin's configuration file by specifying the library's pathname in the `custom-lib-path` key. The custom library must implement the applicable functions:

- ▶ `NvDsInferPluginFactoryCaffeGet`
- ▶ `NvDsInferPluginFactoryCaffeDestroy`
- ▶ `NvDsInferPluginFactoryUffGet`
- ▶ `NvDsInferPluginFactoryUffDestroy`
- ▶ `NvDsInferPluginFactoryRuntimeGet`
- ▶ `NvDsInferPluginFactoryRuntimeDestroy`

These structures are defined in `nvdsinfer_custom_impl.h`. The function definitions must be named as in the header file. `Gst-nvinfer` opens the custom library with `dlopen()` and looks for the names.

For Caffe Files⁵

During parsing and building of a caffe network, `Gst-nvinfer` looks for `NvDsInferPluginFactoryCaffeGet`. If found, it calls the function to get the `IPluginFactory` instance. Depending on the type of `IPluginFactory` returned, `Gst-nvinfer` sets the factory using one of the `ICaffeParser` interface's methods `setPluginFactory()`, `setPluginFactoryExt()`, or `setPluginFactoryV2()`.

After the network has been built and serialized, `Gst-nvinfer` looks for `NvDsInferPluginFactoryCaffeDestroy` and calls it to destroy the `IPluginFactory` instance.

For Uff Files⁸

During parsing and building of a caffe network, `Gst-nvinfer` looks for `NvDsInferPluginFactoryUffGet`. If found, it calls the function to get the `IPluginFactory` instance. Depending on the type of `IPluginFactory` returned, `Gst-nvinfer` sets the factory using one of the `IUffParser` interface's methods `setPluginFactory()` or `setPluginFactoryExt()`.

After the network has been built and serialized, `Gst-nvinfer` looks for `NvDsInferPluginFactoryUffDestroy` and calls it to destroy the `IPluginFactory` instance.

During Deserialization¹¹

If deserializing the models requires an instance of `NvInfer1::IPluginFactory`, the custom library must also implement `NvDsInferPluginFactoryRuntimeGet()` and optionally `NvDsInferPluginFactoryRuntimeDestroy()`. During deserialization, `Gst-nvinfer` calls the library's `NvDsInferPluginFactoryRuntimeGet()`

function to get the `IPluginFactory` instance, then calls `NvDsInferPluginFactoryRuntimeDestroy` to destroy the instance if it finds that function during `Gst-nvinfer` deinitialization.

The `FasterRCNN` sample provided with the SDK provides an example of using the `IPluginV2+nvcaffeparser1::IPluginFactoryV2` interface with `DeepStream`. This sample has been adapted from `TensorRT`. It also provides an example of using the legacy `IPlugin + nvcaffeparser1::IPluginFactory + Gst-nvinfer 1::IPluginFactory` interface for backward compatibility.

5.0 DOCKER CONTAINERS¹

DeepStream 4.0 provides Docker containers for both dGPU and Jetson platforms. These containers provide a convenient, out-of-the-box way to deploy DeepStream applications by packaging all associated dependencies within the container. The associated Docker images are hosted on the NVIDIA container registry in the NGC web portal at <https://ngc.nvidia.com>. They leverage the [nvidia-docker](#) package, which enables access to GPU resources from containers, as required by DeepStream applications. The rest of this section describes the features supported by the DeepStream Docker container for the dGPU and Jetson platforms.²

Note: The DeepStream 4.0 containers for dGPU and Jetson are distinct, so you must take care to get the right image for your platform.³

5.1 A DOCKER CONTAINER FOR DGPU⁴

The Deepstream 4.0 container for dGPU is kept in the “Inference” section of the NGC web portal. The “Container” page gives instructions for pulling and running the container, along with a description of its contents.⁵

Unlike the container in DeepStream 3.0, the dGPU DeepStream 4.0 container supports DeepStream application development within the container. It contains the same build tools and development libraries as the DeepStream 4.0 SDK.⁶

In a typical scenario, you build, execute and debug a DeepStream application within the DeepStream container. Once your application is ready, you can create your own Docker container holding your application files (binaries, libraries, models, configuration file, etc.), using the DeepStream 4.0 container as a base image and adding your application-⁷