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The SDP scripting library is a high-level interface for writing processing scripts. Its goal is to provide abstractions to enable the developer to express the high-level organisation of a processing script without needing to interact directly with the low-level interfaces such as the SDP configuration library.

CHAPTER

ONE

DEVELOPMENT

1.1 Installation

The library can be installed using `pip` but you need to make sure to use the SKA artefact repository as the index:

```
pip install \
  --index-url https://artefact.skao.int/repository/pypi-all/simple \
  ska-sdp-scripting
```

To install it using a `requirements.txt` file, the `pip` options can be added to the top of the file like this:

```
--index-url https://artefact.skao.int/repository/pypi-all/simple
ska-sdp-scripting
```

1.2 Usage

Once the SDP scripting library has been installed, use:

```
import ska_sdp_scripting
```

1.3 Develop a new script

The steps to develop and test an SDP processing script can be found at Script Development.

CHAPTER

TWO

FUNCTIONALITY

The required functionality of the scripting library is as follows.

2.1 Starting, monitoring and ending a script

2.1.1 At the start

- Claim the processing block.
- Get the parameters defined in the processing block. They should be checked against the parameter schema defined for the script.

2.1.2 Resource requests

- Make requests for input and output buffer space. The script will calculate the resources it needs based on the parameters, then request them from the processing controller. This is currently a placeholder.

2.1.3 Declare script phases

- Scripts will be divided into phases such as preparation, processing, and clean-up. In the current implementation, only one phase can be declared, which we refer to as the 'work' phase.

2.1.4 Execute the work phase

- On entry to the work phase, it waits until the resources are available. Meanwhile it monitors the processing block to see it has been cancelled. For real-time scripts, it also checks if the execution block has been cancelled.
- Deploys execution engines to execute a script/function.
- Monitors the execution engines and processing block state. Waits until the execution is finished, or the processing block is cancelled.
- Continuously updates the processing block state with the status of execution engine deployments. It provides aggregate information about these statuses to inform other components about the readiness of deployments.

2.1.5 At the end

- Remove the execution engines to release the resources.
- Update processing block state with information about the success or failure of the script.

2.2 Receive scripts

- Get IP and MAC addresses for the receive processes.
- Monitor receive processes. If any get restarted, then the addresses may need to be updated.
- Write the addresses in the appropriate format into the processing block state.

2.3 Compatibility with the telescope model library

We keep the scripting library compatible with the latest version of the telescope model library. If you use a configuration string that is based on an older version of the telescope model, you may experience errors or unexpected behaviour.

CHAPTER

THREE

RECEIVE PROCESS AND PORT CONFIGURATION

3.1 Multiple Port Configuration

The scripting library has the capability to configure multiple ports. This allows to deploy a single receiver with multiple ports. In another word, this will allow a single receiver to receive data for a single SPEAD stream coming from multiple processes.

Now, assuming each sender sends data for 1 channel and all baselines, then we'll want to have as many ports as channels on the receiver side. For cbf-receive, a single receiver process can receive on multiple ports already, and this is configurable via `reception.receiver_port_start` and `reception.num_ports`.

To make sense of multiple ports, the port map was required to be updated from a three-value list (ADR-10) to a four-value list. The four value defines the increment of the port number.

For example, if we set `reception.receiver_port_start = 9000` and `reception.num_ports = 3` , `count= 3`, and `max_channels=1` then the resulting port_map would look like:

```
"port": [[0, 9000, 1, 0], [1, 9001, 1, 1], [2, 9002, 1, 2]]
```

CHAPTER

FOUR

API

4.1 Processing block

class ska_sdp_scripting.processing_block.**ProcessingBlock**(*pb_id: str = None*)

Claim the processing block.

Parameters

pb_id (*str, optional*) – processing block ID

configure_recv_processes_ports(*scan_types*, *max_channels_per_process*, *port_start*, *channels_per_port*)

Calculate how many receive process(es) and ports are required, And configure a dictionary to be fed back into the receive_addresses attribute.

Parameters

- **scan_types** – scan types from EB
- **max_channels_per_process** – maximum number of channels per process
- **port_start** – starting port the receiver will be listening in
- **channels_per_port** – number of channels to be sent to each port

Returns

tuple(configured receive dict, number of processes)

Return type

tuple

create_phase(*name: str*, *requests: List[*BufferRequest*]*) → *Phase*

Create a script phase for deploying execution engines.

The phase is created with a list of resource requests which must be satisfied before the phase can start executing. For the time being the only resource requests are (placeholder) buffer reservations, but eventually this will include compute requests too.

Parameters

- **name** (*str*) – name of the phase
- **requests** (list of BufferRequest) – resource requests

Returns

the phase

Return type

Phase

exit()

Perform clean-up.

get_dependencies()

Get the list of processing block dependencies.

Returns
processing block dependencies

Return type
list

get_parameters(*schema=None*)

Get script parameters from processing block.

The schema checking is not currently implemented.

Parameters
schema – schema to validate the parameters

Returns
processing block parameters

Return type
dict

get_scan_types() → List[str]

Get scan types from the execution block.

Updates the scan types with the default parameters and channels.

This is only supported for real-time scripts

Returns
scan types

Return type
list

nested_parameters(*parameters: dict*)

Convert flattened dictionary to nested dictionary.

Parameters
parameters – parameters to be converted

Returns
nested parameters

receive_addresses(*configured_host_port*, *chart_name=None*, *service_name=None*, *namespace=None*, *script='vis-receive'*)

Generate receive addresses and update the processing block state.

Parameters

- **configured_host_port** – constructed host and port
- **chart_name** – Name of the statefulset
- **service_name** – Name of the headless service
- **namespace** – namespace where it's going to be deployed
- **script** – processing script that is configuring receive addresses options: vis-receive, pointing-offset; default: vis-receive

static request_buffer(*size: float*, *tags: List[str]*) → *BufferRequest*

Request a buffer reservation.

This returns a buffer reservation request that is used to create a script phase. These are currently only placeholders.

Parameters

- **size** (*float*) – size of the buffer
- **tags** (*list of str*) – tags describing the type of buffer required

Returns
buffer reservation request

Return type
BufferRequest

update_parameters(*default_parameters: dict*, *parameters: dict | Mapping*)

Nested overwrite of default_parameter values with ones in parameters.

Parameters

- **default_parameters** –

  dict
  default parameter values

- **parameters** –

  dict
  script specific parameters

Returns
processing block additional parameters

Return type
dict

4.2 Buffer request

class ska_sdp_scripting.buffer_request.**BufferRequest**(*size: float*, *tags: List[str]*)

Request a buffer reservation.

This is currently just a placeholder.

Parameters

- **size** (*float*) – size of the buffer
- **tags** (*list of str*) – tags describing the type of buffer required

size: float

tags: List[str]

4.3 Script phase

class ska_sdp_scripting.phase.**Phase**(*name: str, list_requests: List, config: ska_sdp_config.Config, pb_id: str, eb_id: str, script_kind: str, qc_config: str*)

Script phase.

This should not be created directly, use the `ProcessingBlock.create_phase()` method instead.

Parameters

- **name** (*str*) – name of the phase
- **list_requests** (*list*) – list of requests
- **config** (*ska_sdp_config.Config*) – SDP configuration client
- **pb_id** (*str*) – processing block ID
- **eb_id** (*str*) – execution block ID
- **script_kind** (*str*) – script kind
- **qc_config** (*str*) – Queue Connector config string

check_state(*txn: ska_sdp_config.config.Transaction, check_realtime: bool = True*) → None

Check the state of the processing block.

Check if the PB is finished or cancelled, and for real-time scripts check if the EB is finished or cancelled.

Parameters

- **txn** (*ska_sdp_config.Transaction*) – SDP configuration transaction
- **check_realtime** (*bool*) – Whether to check execution block state if the processing block is realtime (i.e. cancel processing script for FINISHED/CANCELLED)

ee_deploy_dask(*name: str, n_workers: int, func: Callable, f_args: Tuple[Any]*)

Deploy a Dask execution engine.

Parameters

- **name** (*str*) – deployment name
- **n_workers** (*int*) – number of Dask workers
- **func** (*function*) – function to execute
- **f_args** (*tuple*) – function arguments

Returns

Dask execution engine deployment

Return type

`DaskDeploy`

ee_deploy_helm(*deploy_name: str, values: dict | None = None*)

Deploy a Helm execution engine.

This can be used to deploy any Helm chart.

Parameters

- **deploy_name** (*str*) – name of Helm chart
- **values** (*dict, optional*) – values to pass to Helm chart

Returns
Helm execution engine deployment

Return type
`HelmDeploy`

ee_deploy_test(*deploy_name: str, func: Callable = None, f_args: List[Any] = None*) → *EEDeploy*

Deploy a fake execution engine.

This is used for testing and example purposes.

Parameters

- **deploy_name** (*str*) – deployment name
- **func** (*function*) – function to execute
- **f_args** (*tuple*) – function arguments

Returns
fake execution engine deployment

Return type
`FakeDeploy`

ee_remove() → None

Remove execution engines deployments.

is_eb_finished(*txn: ska_sdp_config.config.Transaction*) → bool

Check if the EB is finished or cancelled.

Parameters
txn (*ska_sdp_config.Transaction*) – config db transaction

Return type
bool

monitor_deployments(*txn: ska_sdp_config.config.Transaction, iteration: int = 0*)

Monitor deployments, update the deployment status in the processing block state based on the deployments' pods' state.

Also update the deployments_ready pb state key.

At the moment deployments_ready = True only if all deployments are RUNNING. Else, it is False.

Parameters

- **txn** – Transaction object (config.txn)
- **iteration** – number of txn iteration

update_pb_state(*status: ProcessingBlockStatus = ProcessingBlockStatus.UNSET*)

Update processing block state.

If the status is UNSET, it is marked as finished.

Parameters
status (*str, optional*) – status

wait_loop(*func: Callable[[ska_sdp_config.config.Transaction], bool], time_to_ready: int = 0*)

Wait loop to check the status of the processing block. It also updates the processing block state with deployment statuses for realtime scripts.

Parameters

- **func** – function to check condition for exiting the watcher loop
- **time_to_ready** – set deployments_ready to true after this amount of time has passed (seconds). Only for deployments deployed with phase.ee_deploy_test

4.4 Execution engine deployment

class ska_sdp_scripting.ee_base_deploy.**EEDeploy**(*pb_id: str, config: ska_sdp_config.Config*)

Base class for execution engine deployment.

Parameters

- **pb_id** (*str*) – processing block ID
- **config** (*ska_sdp_config.Client*) – SDP configuration client

get_id() → str

Get the deployment ID.

Returns
deployment ID

Return type
str

is_finished(*txn: ska_sdp_config.config.Transaction*) → bool

Check if the deployment is finished.

Parameters
txn (*ska_sdp_config.Transaction*) – configuration transaction

Return type
bool

remove(*deploy_id: str*) → None

Remove the execution engine.

Parameters
deploy_id (*str*) – deployment ID

update_deploy_status(*status: str*) → None

Update deployment status.

Parameters
status (*str*) – status

4.5 Helm EE Deployment

class ska_sdp_scripting.helm_deploy.**HelmDeploy**(*pb_id: str, config: ska_sdp_config.Config, deploy_name: str, values: dict = None*)

Deploy Helm execution engine.

This should not be created directly, use the `Phase.ee_deploy_helm()` method instead.

Parameters

- **pb_id** (*str*) – processing block ID

- **config** (*ska_sdp_config.Config*) – SDP configuration client
- **deploy_name** (*str*) – name of Helm chart to deploy
- **values** (*dict, optional*) – values to pass to Helm chart

4.6 Dask EE deployment

class ska_sdp_scripting.dask_deploy.**DaskDeploy**(*pb_id: str, config: ska_sdp_config.Config, deploy_name: str, n_workers: int, func: Callable, f_args: Tuple[Any]*)

Deploy a Dask execution engine.

The function when called with the arguments should return a Dask graph. The graph is then executed by calling the compute method:

```
result = func(*f_args)
result.compute()
```

This happens in a separate thread so the constructor can return immediately.

This should not be created directly, use the `Phase.ee_deploy_dask()` method instead.

Parameters

- **pb_id** (*str*) – processing block ID
- **config** (*ska_sdp_config.Client*) – configuration DB client
- **deploy_name** (*str*) – deployment name
- **n_workers** (*int*) – number of Dask workers
- **func** (*function*) – function to execute
- **f_args** (*tuple*) – function arguments

4.7 Fake EE deployment

class ska_sdp_scripting.fake_deploy.**FakeDeploy**(*pb_id: str, config: ska_sdp_config.Config, deploy_name: str, func: Callable = None, f_args: Tuple[Any] = None*)

Deploy a fake execution engine.

The function is called with the arguments in a separate thread so the constructor can return immediately.

This should not be created directly, use the `Phase.ee_deploy_test()` method instead.

Parameters

- **pb_id** (*str*) – processing block ID
- **config** (*ska_sdp_config.Client*) – SDP configuration client
- **deploy_name** (*str*) – deployment name
- **func** (*function*) – function to execute
- **f_args** (*tuple*) – function arguments

set_deployments_ready(*time_to_ready: int = 0*)

Set deployments_ready to True

Parameters

time_to_ready – set deployments_ready to true after this amount of time has passed (seconds)

4.8 Queue connector functions

Common functions used to configure the QueueConnector

ska_sdp_scripting.queue_connector.**configure_queue_connector**(*txn*, *qc_config*, *pb_id*, *eb_id*)

Function to configure queue connector.

Parameters

- **qc_config** – QueueConnector configuration string
- **txn** – Transaction
- **pb_id** – Processing block ID
- **eb_id** – Execution block ID

Returns

ska_sdp_scripting.queue_connector.**tear_down_queue_connector**(*config*, *qc_config_path*)

Function for tearing down the QueueConnector

Parameters

- **config** – SDP configuration client
- **qc_config_path** – QueueConnector config path

ska_sdp_scripting.queue_connector.**wait_for_queue_connector_state**(*config*, *qc_config_path*, *expected_state*, *timeout*)

Function to wait for queue connector state.

Parameters

- **config** – SDP configuration client
- **qc_config_path** – Path of the QueueConnector configuration (str)
- **expected_state** – Expected state the QueueConnector needs to reach (str)
- **timeout** – How much time to elapse before TimeoutError

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FIVE

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