
Gridworks Proactor

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[[license]]

This packages provides “live actor” and “application monitored communication” infrastructure for the [GridWorks SpaceHeat SCADA](#) project. This separation allows the scada code to be more focussed on on application specific details and provides the potential to re-use the “live actor” and “application monitored” infrastructure.

FEATURES

- *Proactor*, a single threaded event loop running on asyncio, for exchanging messages between the main application object, “live actor” subobjects and MQTT clients.
- A [communication state] (“active” or not) for each external communications link is available to the proactor and sub-objects. “Active” communications is defined as ALL of the following:
 - The underlying communications mechanism (MQTT) is connected.
 - All input channels of underlying mechanism (MQTT topics) are established.
 - A application messages requiring acknowledgement have been ACKed in timely fashion (by default 5 seconds).
 - A message has been received “recently” (by default within 1 minute).
- Reliable delivery of “Events” generated locally. Generated Events are stored locally until they are acknowledged and unacknowledged Events are retransmitted when the “Active” communication state is restored.
- *gwproactor_test*, a test package for development and test environments of projects that implement a class derived from *Proactor*, allowing the derived class to be tested with the base-class tests.

REQUIREMENTS

2.1 Mosquitto

Testing requires an MQTT broker. The Mosquitto broker can be installed with:

```
brew install mosquitto  
brew services restart mosquitto
```

2.2 TLS

Testing uses TLS by default. The tests require the path to the CA certificate and private key used to sign the certificate of the MQTT broker. To set up TLS:

Install gridworks-cert (gwcert):

```
pipx install gridworks-cert
```

Create a local Certificate Authority:

```
gwcert ca create
```

Create certificate and key for the Mosquitto MQTT broker:

```
gwcert key add --dns localhost mosquitto
```

- **NOTE:** This command will generate a broker certificate that *only* allow connections to `localhost`. See [External connections](#) below to create a broker certificate which can accept connections from external devices.

Find the path to `mosquitto.conf` in the output of:

```
brew services info mosquitto -v
```

Modify `mosquitto.conf` with the TLS configuration in [example-test-mosquitto.conf](#), fixing up the paths with real absolute paths to certificate, key and CA certificate files. These paths can be found with:

```
gwcert ca info
```

Restart the Mosquitto server:

```
brew services restart mosquitto
```

Test Mosquitto 'clear' port:

```
# in one window
mosquitto_sub -h localhost -p 1883 -t foo
# in another window
mosquitto_pub -h localhost -p 1883 -t foo -m '{"bla":1}'
```

Test Mosquitto TLS port:

```
gwcert key add pubsub
# in one window
mosquitto_sub -h localhost -p 8883 -t foo \
  --cafile $HOME/.local/share/gridworks/ca/ca.crt \
  --cert $HOME/.local/share/gridworks/ca/certs/pubsub/pubsub.crt \
  --key $HOME/.local/share/gridworks/ca/certs/pubsub/private/pubsub.pem
# in another window
mosquitto_pub -h localhost -p 8883 -t foo \
  --cafile $HOME/.local/share/gridworks/ca/ca.crt \
  --cert $HOME/.local/share/gridworks/ca/certs/pubsub/pubsub.crt \
  --key $HOME/.local/share/gridworks/ca/certs/pubsub/private/pubsub.pem \
  -m '{"bar":1}'
```

2.2.1 Troubleshooting Mosquitto

Mosquitto logging can be enabled in the `mosquitto.conf` file with the lines:

```
log_dest stderr
log_type all
```

To see the console output, stop the Mosquitto service and start it explicitly on the command line:

```
brew services stop mosquitto
mosquitto -c /opt/homebrew/etc/mosquitto/mosquitto.conf
```

2.2.2 External connections

The broker certificate must be created with the *hostname* the client will use to connect to it. For example, to create a broker certificate reachable at `localhost`, `MyMac.local`, `192.168.1.10` and `foo.bar.baz` use the command:

```
gwcert key add \
  --dns localhost \
  --dns MyMac.local \
  --dns 192.168.1.10 \
  --dns foo.bar.baz \
  mosquitto
```

2.2.3 Pre-existing key files

If CA or Mosquitto certificate can key files *already* exist, their paths can be specified in `mosquitto.conf` as above and for the tests with there `GWPROACTOR_TEST_CA_CERT_PATH` and `GWPROACTOR_TEST_CA_KEY_PATH` environment variables.

2.2.4 Disabling TLS

To disable testing of TLS, modify the the file `tests/.env-gwproactor-test` with:

```
GWCHILD_PARENT_MQTT__TLS__USE_TLS=false  
GWPARENT_CHILD_MQTT__TLS__USE_TLS=false
```


INSTALLATION

You can install *Gridworks Proactor* via [pip](#) from [PyPI](#):

```
$ pip install gridworks-proactor
```


CONTRIBUTING

Contributions are very welcome. In order to develop, do this:

```
$ poetry install --all-extras
```

To learn more, see the [Contributor Guide].

LICENSE

Distributed under the terms of the [MIT license][license], *Gridworks Proactor* is free and open source software.

ISSUES

If you encounter any problems, please [file an issue](#) along with a detailed description.

This project was generated from [@cjolowicz's Hypermodern Python Cookiecutter](#) template.

7.1 Communication state

The **Proactor** maintains communication state (“active” or not active) for each external point-to-point communications link. The “active” state is intended to indicate that not only is the underlying communications channel (e.g. MQTT) healthy, but also that a valid application-level message has been recently received from the peer at the other end of the communications link. This state information is intended to allow the application derived from the Proactor to determine if it must make local decisions while the peer is disconnected, non-responsive, slow or otherwise impaired. Additionally, visibility into the history of communication is provided to (human) monitors of the system through Events generated at each transition of the the comm state.

7.1.1 “active” communication state definition

A communication link is “active” if *all* of these are true:

1. The underlying communications mechanism (MQTT) is connected.
2. All input channels of underlying mechanism (MQTT topics) are established.
3. All application messages requiring acknowledgement have been ACKed in timely fashion (by default 5 seconds).
4. A valid message has been received “recently” (by default within 1 minute) from the peer application.

Note after the underlying communication mechanism reports a connection, before communication can be considered “active”, requirements 2 and 4 above must be met. That is, all input channels must be established and at least one valid application message must be received from the peer. Requirement 2 is present because otherwise we could send a message but not hear the response to it from the peer. Requirement 4 is present because we could have good underlying communication (e.g. a connection to an MQTT broker), without the peer application actually running. Requirement 3 is not applied until after the “active” state has been reached.

This diagram approximates how the “active” state is achieved, maintained and lost:

Much of the complexity in this diagram results from asynchronously accumulating input channel establishments and a message from the peer upon restore of the underlying connection. After restoring communication to the underlying communication mechanism (e.g. an MQTT broker), we must get acknowledgements of all our subscriptions and a message from the peer before the link is considered “active”. There could be more than one subscription acknowledgement message, and these and the message from the peer could arrive in any order. This complexity could be reduced by serializing the accumulation of these results, at the cost of longer time to re-activate after restore of the underlying communication mechanism.

7.1.2 LinkManager

The *gwproactor.links* package implements most of the Proactor’s communication infrastructure. *LinkManager* is the interface to this package used by *Proactor*. The interaction between them can be seen by searching the code for `_links`. This search should produce approximately the following entry points in the message processing loop:

1. Start on user request.
2. Stop on user request (omitted from the diagram for clarity).
3. Handle connect of underlying comm mechanism (e.g. broker connect of MQTT).
4. Handle disconnect of underlying comm mechanism.
5. Handle intermediate connection establishment events from underlying comm mechanism (e.g. subscription ack of MQTT).
6. Send acks for incoming messages that require ack.
7. Receive acks for outgoing messages that require acks.
8. Handle timeouts for ack receipt.
9. Update “heard from recently” on message receipt.
10. Handle timeouts for “heard from recently”.

LinkManager helpers

The *LinkManager* uses these helpers:

- `,` to manage Paho MQTT clients.
- a dict of *MQTTCodec*, to contain a message coder/decoder for each MQTT client.
- *LinkStates*, to manage the communications state machine for each link.
- *MessageTimes*, to track the times of last send and receive for each link.
- *TimerManagerInterface*, to start and cancel timers for acknowledgement timeout.
- *AckManager*, to start, track, handle and cancel timers for pending acknowledgements.
- *PersisterInterface*, to persist unacknowledged Events on loss of “active” communication and re-upload them when “active” state is restored.
- *ProactorLogger*, to log communications state transitions.
- *ProactorStats*, to update various statistics about communications.

7.2 Reference

- *gwroactor*, the package interface.
 - *gwproactor.links*, an internal package used to manage communication state.
- *gwroactor_test*, a development package, used to test classes inheriting from *Proactor*

7.2.1 gwproactor

This packages provides infrastructure for running a proactor on top of asyncio with support multiple MQTT clients and sub-objects which support their own threads for synchronous operations.

This packages is not GridWorks-aware (except that it links actors with multiple mqtt clients). This separation between communication / action infrastructure and GridWorks semantics is intended to allow the latter to be more focussed.

This package is not polished and the separation is up for debate.

Particular questions:

- Is the programming model still clean after more concrete actors are implemented and more infrastructure are added.
- Does the separation add value or just complicate analysis.
- MQTTClients should be made async.
- Semantics of building message type namespaces should be spelled out / further worked out.
- Test support should be implemented / cleaner.

class gwproactor.AsyncQueueWriter

Allow synchronous code to write to an asyncio Queue.

It is assumed the asynchronous reader has access to the asyncio Queue “await get()” from directly from it.

put(*item*)

Write to asyncio queue in a threadsafe way.

Parameters

item (*Any*) –

Return type

None

set_async_loop(*loop*, *async_queue*)

Parameters

• **loop** (*AbstractEventLoop*) –

• **async_queue** (*Queue*) –

Return type

None

class gwproactor.Communicator(*name*, *services*)

A partial implementation of CommunicatorInterface which supplies the trivial implementations

Parameters

• **name** (*str*) –

• **services** (*ServicesInterface*) –

property monitored_names: Sequence[*MonitoredName*]

property name: str

class gwproactor.CommunicatorInterface

Pure interface necessary for interaction between a sub-object and the system services proactor

abstract property monitored_names: Sequence[*MonitoredName*]

abstract property name: str

abstract process_message(*message*)

Parameters

message (*Message*) –

Return type

Ok[bool] | *Err*[BaseException]

class gwproactor.ExternalWatchdogCommandBuilder

Create arguments which will be passed to subprocess.run() to pat the external watchdog.

If the returned list is empty, pat process will be run.

By default an empty list is returned if the environment variable named by service_variable_name() is not set to 1 or true.

classmethod default_pat_args(*pid=None*)

Parameters

pid (*int* | *None*) –

Return type

list[str]

classmethod pat_args(*service_name, args=None, pid=None*)

Return arguments to be passed to subprocess.run() to pat the external watchdog.

Parameters

- **service_name** (*str*) –
- **args** (*list*[str] | *None*) –
- **pid** (*int* | *None*) –

Return type

list[str]

classmethod running_as_service(*service_name*)

Parameters

service_name (*str*) –

Return type

bool

classmethod service_variable_name(*service_name*)

Parameters

service_name (*str*) –

Return type

str

class gwproactor.MQTTClientWrapper(*name, client_config, receive_queue*)

Parameters

- **name** (*str*) –
- **client_config** (*MQTTClient*) –

- **receive_queue** (*AsyncQueueWriter*) –

connected()

Return type
bool

disable_logger()

enable_logger(*logger=None*)

Parameters
logger (*Logger | LoggerAdapter | None*) –

handle_suback(*suback*)

Parameters
suback (*MQTTSubackPayload*) –

Return type
int

num_pending_subscriptions()

Return type
int

num_subscriptions()

Return type
int

on_connect(*_, userdata, flags, rc*)

on_connect_fail(*_, userdata*)

on_disconnect(*_, userdata, rc*)

on_message(*_, userdata, message*)

on_subscribe(*_, userdata, mid, granted_qos*)

publish(*topic, payload, qos*)

Parameters

- **topic** (*str*) –
- **payload** (*bytes*) –
- **qos** (*int*) –

Return type
MQTTMessageInfo

start()

stop()

subscribe(*topic, qos*)

Parameters

- **topic** (*str*) –

- **qos** (*int*) –

Return type
Tuple[int, int | None]

subscribe_all()

Return type
Tuple[int, int | None]

subscribed()

Return type
bool

subscription_items()

Return type
list[*Tuple*[str, int]]

unsubscribe(topic)

Parameters
topic (*str*) –

Return type
Tuple[int, int | None]

class gwproactor.MQTTClients

add_client(name, client_config, upstream=False, primary_peer=False)

Parameters

- **name** (*str*) –
- **client_config** (*MQTTClient*) –
- **upstream** (*bool*) –
- **primary_peer** (*bool*) –

client_wrapper(client)

Parameters
client (*str*) –

Return type
MQTTClientWrapper

clients: Dict[str, *MQTTClientWrapper*]

connected(client)

Parameters
client (*str*) –

Return type
bool

disable_loggers()

enable_loggers(*logger=None*)

Parameters

logger (*Logger* | *LoggerAdapter* | *None*) –

handle_suback(*suback*)

Parameters

suback (*MQTTSubackPayload*) –

Return type

int

num_pending_subscriptions(*client*)

Parameters

client (*str*) –

Return type

int

num_subscriptions(*client*)

Parameters

client (*str*) –

Return type

int

primary_peer()

Return type

MQTTClientWrapper

primary_peer_client: *str* = ''

publish(*client, topic, payload, qos*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –
- **payload** (*bytes*) –
- **qos** (*int*) –

Return type

MQTTMessageInfo

start(*loop, async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

stop()

subscribe(*client*, *topic*, *qos*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –
- **qos** (*int*) –

Return type

Tuple[int, int | None]

subscribe_all(*client*)

Parameters

client (*str*) –

Return type

Tuple[int, int | None]

subscribed(*client*)

Parameters

client (*str*) –

Return type

bool

unsubscribe(*client*, *topic*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –

Return type

Tuple[int, int | None]

upstream()

Return type

[MQTTClientWrapper](#)

upstream_client: **str** = ''

class gwproactor.**MonitoredName**(*name: str*, *timeout_seconds: float*)

Parameters

- **name** (*str*) –
- **timeout_seconds** (*float*) –

name: **str**

timeout_seconds: **float**

class gwproactor.**Proactor**(*name*, *settings*)

Parameters

- **name** (*str*) –
- **settings** ([ProactorSettings](#)) –

```

add_communicator(communicator)

    Parameters
        communicator (CommunicatorInterface) –

property async_receive_queue: Queue | None

property event_loop: AbstractEventLoop | None

generate_event(event)

    Parameters
        event (EventT) –

    Return type
        Ok[bool] | Err[BaseException]

get_communicator(name)

    Parameters
        name (str) –

    Return type
        CommunicatorInterface

get_external_watchdog_builder_class()

    Return type
        type[gwproactor.external_watchdog.ExternalWatchdogCommandBuilder]

async join()

property logger: ProactorLogger

classmethod make_event_persister(settings)

    Parameters
        settings (ProactorSettings) –

    Return type
        PersisterInterface

classmethod make_stats()

    Return type
        ProactorStats

property monitored_names: Sequence[MonitoredName]

property name: str

property primary_peer_client: str

async process_message(message)

    Parameters
        message (Message) –

async process_messages()

property publication_name: str

```

async run_forever()

send(*message*)

Parameters

message (*Message*) –

send_threadsafe(*message*)

Parameters

message (*Message*) –

Return type

None

property settings: *ProactorSettings*

start()

start_tasks()

property stats: *ProactorStats*

stop()

property upstream_client: *str*

class gwproactor.ProactorLogger(*base, message_summary, lifecycle, comm_event, extra=None*)

Parameters

- **base** (*str*) –
- **message_summary** (*str*) –
- **lifecycle** (*str*) –
- **comm_event** (*str*) –
- **extra** (*dict* | *None*) –

MESSAGE_DELIMITER_WIDTH = 88

MESSAGE_ENTRY_DELIMITER =

'++++++'

MESSAGE_EXIT_DELIMITER =

'-----'

comm_event(*msg, *args, **kwargs*)

Parameters

msg (*str*) –

Return type

None

property comm_event_enabled: *bool*

comm_event_logger: *Logger*

property general_enabled: *bool*

lifecycle(*msg*, **args*, ***kwargs*)

Parameters

msg (*str*) –

Return type

None

property lifecycle_enabled: bool

lifecycle_logger: Logger

message_enter(*msg*, **args*, ***kwargs*)

Parameters

msg (*str*) –

Return type

None

message_exit(*msg*, **args*, ***kwargs*)

Parameters

msg (*str*) –

Return type

None

message_summary(*direction*, *actor_alias*, *topic*, *payload_object*=None, *broker_flag*='', *timestamp*=None, *message_id*='')

Parameters

- **direction** (*str*) –
- **actor_alias** (*str*) –
- **topic** (*str*) –
- **payload_object** (*Any*) –
- **broker_flag** (*str*) –
- **timestamp** (*datetime* | *None*) –
- **message_id** (*str*) –

Return type

None

property message_summary_enabled: bool

message_summary_logger: Logger

path(*msg*, **args*, ***kwargs*)

Parameters

msg (*str*) –

Return type

None

property path_enabled: bool

```
class gwproactor.ProactorSettings(_env_file='<object object>', _env_file_encoding=None,
                                  _env_nested_delimiter=None, _secrets_dir=None, *, paths=None,
                                  logging=LoggingSettings(base_log_name='gridworks',
                                                          base_log_level=30, levels=LoggerLevels(message_summary=30,
                                                                 lifecycle=20, comm_event=20),
                                                          formatter=FormatterSettings(fmt='%(%asctime)s %(message)s',
                                                                 datefmt='%', default_msec_format='%s.%03d'),
                                                          file_handler=RotatingFileHandlerSettings(filename='proactor.log',
                                                                 bytes_per_log_file=2097152, num_log_files=10, level=0)),
                                  mqtt_link_poll_seconds=60.0, ack_timeout_seconds=5.0,
                                  num_initial_event_reuploads=5)
```

Parameters

- **_env_file** (str | PathLike | List[str | PathLike] | Tuple[str | PathLike, ...] | None) –
- **_env_file_encoding** (str | None) –
- **_env_nested_delimiter** (str | None) –
- **_secrets_dir** (str | PathLike | None) –
- **paths** (Paths) –
- **logging** (LoggingSettings) –
- **mqtt_link_poll_seconds** (float) –
- **ack_timeout_seconds** (float) –
- **num_initial_event_reuploads** (int) –

class Config

```
env_nested_delimiter = '__'
```

```
env_prefix = 'PROACTOR_'
```

```
ack_timeout_seconds: float
```

```
classmethod get_paths(v)
```

Parameters

v (Paths) –

Return type

Paths

```
logging: LoggingSettings
```

```
mqtt_link_poll_seconds: float
```

```
num_initial_event_reuploads: int
```

```
paths: Paths
```

```
classmethod post_root_validator(values)
```

Update unset paths of any member MQTTClient's TLS paths based on ProactorSettings 'paths' member.

Parameters

values (dict) –

Return type

dict

classmethod `update_paths_name(values, name)`

Update paths member with a new 'name' attribute, e.g., a name known by a derived class.

This is meant to be called in a 'pre=True' root validator of a derived class.

Parameters

- **values** (*dict*) –
- **name** (*str*) –

Return type

dict

exception `gwproactor.Problems(msg="", warnings=None, errors=None, max_problems=10)`**Parameters**

- **msg** (*str*) –
- **warnings** (*list[BaseException]*) –
- **errors** (*list[BaseException]*) –
- **max_problems** (*int | None*) –

MAX_PROBLEMS = 10**add_error**(*error*)**Parameters****error** (*BaseException*) –**Return type**`Problems`**add_problems**(*other*)**Parameters****other** (`Problems`) –**Return type**`Problems`**add_warning**(*warning*)**Parameters****warning** (*BaseException*) –**Return type**`Problems`**error_traceback_str**()**Return type**

str

errors: `list[BaseException]`**max_problems:** `int | None = 10`

problem_event(*summary*, *src*="")

Parameters

- **summary** (*str*) –
- **src** (*str*) –

Return type

ProblemEvent

warnings: `list[BaseException]`

class gwproactor.QOS(*value*, *names*=None, *, *module*=None, *qualname*=None, *type*=None, *start*=1, *boundary*=None)

AtLeastOnce = 1

AtMostOnce = 0

ExactlyOnce = 2

class gwproactor.Runnable

Pure interface to an object which is expected to support starting, stopping and joining.

abstract **async** **join**()

abstract **start**()

abstract **stop**()

async **stop_and_join**()

class gwproactor.ServicesInterface

Interface to system services (the proactor)

abstract **property** **async_receive_queue:** `Queue | None`

abstract **property** **event_loop:** `AbstractEventLoop | None`

abstract **generate_event**(*event*)

Parameters

event (*EventT*) –

Return type

`None`

abstract **get_communicator**(*name*)

Parameters

name (*str*) –

Return type

`CommunicatorInterface`

abstract **get_external_watchdog_builder_class**()

Return type

`type[gwproactor.external_watchdog.ExternalWatchdogCommandBuilder]`

abstract **property** **logger:** `ProactorLogger`

```

abstract property publication_name:  str

abstract send(message)

    Parameters
        message (Message) –

abstract send_threadsafe(message)

    Parameters
        message (Message) –

    Return type
        None

abstract property settings:  ProactorSettings

abstract property stats:  ProactorStats

class gwproactor.Subscription(Topic, Qos)

    Parameters
        • Topic (str) –
        • Qos (QOS) –

    Qos:  QOS
        Alias for field number 1

    Topic:  str
        Alias for field number 0

class gwproactor.SyncAsyncInteractionThread(channel=None, name=None, iterate_sleep_seconds=None,
                                             responsive_sleep_step_seconds=0.1, pat_timeout=20,
                                             daemon=True)

    A thread wrapper providing an async-sync communication channel and simple “iterate, sleep, read message”
    semantics.

    Parameters
        • channel (SyncAsyncQueueWriter | None) –
        • name (str | None) –
        • iterate_sleep_seconds (float | None) –
        • responsive_sleep_step_seconds (float) –
        • pat_timeout (float | None) –
        • daemon (bool) –

    PAT_TIMEOUT = 20

    SLEEP_STEP_SECONDS = 0.1

    async async_join(timeout=None)

        Parameters
            timeout (float) –

        Return type
            None

```

pat_timeout: float | None

pat_watchdog()

put_to_sync_queue(*message*, *block=True*, *timeout=None*)

Parameters

- **message** (*Any*) –
- **block** (*bool*) –
- **timeout** (*float* | *None*) –

Return type

None

request_stop()

Return type

None

run()

Method representing the thread's activity.

You may override this method in a subclass. The standard `run()` method invokes the callable object passed to the object's constructor as the target argument, if any, with sequential and keyword arguments taken from the `args` and `kwargs` arguments, respectively.

running: bool | None

set_async_loop(*loop*, *async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

Return type

None

set_async_loop_and_start(*loop*, *async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

Return type

None

time_to_pat()

Return type

bool

class gwproactor.**SyncAsyncQueueWriter**(*sync_queue=None*)

Provide a full duplex communication “channel” between synchronous and asynchronous code.

It is assumed the asynchronous reader has access to the `asyncio Queue` “`await get()`” from directly from it.

Parameters

- **sync_queue** (*Queue* | *None*) –

get_from_sync_queue(*block=True, timeout=None*)

Read from synchronous queue in a threadsafe way.

Parameters

- **block** (*bool*) –
- **timeout** (*float | None*) –

Return type

Any

put_to_async_queue(*item*)

Write to asynchronous queue in a threadsafe way.

Parameters

- **item** (*Any*) –

put_to_sync_queue(*item, block=True, timeout=None*)

Write to synchronous queue in a threadsafe way.

Parameters

- **item** (*Any*) –
- **block** (*bool*) –
- **timeout** (*float | None*) –

set_async_loop(*loop, async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

Return type

None

sync_queue: *Queue | None*

gwproactor.format_exceptions(*exceptions*)

Parameters

- **exceptions** (*list[BaseException]*) –

Return type

str

gwproactor.responsive_sleep(*obj, seconds, step_duration=0.1, running_field_name='_main_loop_running', running_field=True*)

Sleep in way that is more responsive to thread termination: sleep in *step_duration* increments up to specified *seconds*, at after each step checking *obj._main_loop_running*. If the designated *running_field_name* actually indicates that a stop has been requested (e.g. what you would expect from a field named *'_stop_requested'*), set *running_field* parameter to *False*.

Parameters

- **seconds** (*float*) –
- **step_duration** (*float*) –
- **running_field_name** (*str*) –

- **running_field** (*bool*) –

Return type

bool

gwproactor.setup_logging(*args, settings, errors=None, add_screen_handler=True, root_gets_handlers=True*)

Get python logging config based on parsed command line args, defaults, environment variables and logging config file.

The order of precedence is:

1. Command line arguments
2. Environment
3. Defaults

Parameters

- **args** (*Namespace*) –
- **settings** (*ProactorSettings*) –
- **errors** (*list[BaseException] | None*) –
- **add_screen_handler** (*bool*) –
- **root_gets_handlers** (*bool*) –

Return type

None

7.2.2 gwproactor.links

Internal package used to manage communications state. [LinkManager](#) is the interface into this package used by [Proactor](#)

class gwproactor.links.**AckManager**(*timer_mgr, callback, delay=5.0*)

Parameters

- **timer_mgr** (*TimerManagerInterface*) –
- **callback** (*Callable[[AckWaitInfo], None]*) –
- **delay** (*float | None*) –

_acks: *dict[str, dict[str, gwproactor.links.acks.AckWaitInfo]]*

_callback: *Callable[[AckWaitInfo], None]*

_default_delay_seconds: *float*

_pop_wait_info(*link_name, message_id*)

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –

Return type

AckWaitInfo | None

_timeout(*link_name*, *message_id*)

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –

Return type

None

_timer_mgr: [*TimerManagerInterface*](#)

add_link(*link_name*)

Parameters

link_name (*str*) –

Return type

None

cancel_ack_timer(*link_name*, *message_id*)

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –

Return type

[*AckWaitInfo*](#)

cancel_ack_timers(*link_name*)

Parameters

link_name (*str*) –

Return type

[*list\[*gwproactor.links.acks.AckWaitInfo*\]*](#)

num_acks(*link_name*)

Parameters

link_name (*str*) –

Return type

int

start_ack_timer(*link_name*, *message_id*, *context=None*, *delay_seconds=None*)

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –
- **context** (*Any* | *None*) –
- **delay_seconds** (*float* | *None*) –

Return type

[*AckWaitInfo*](#)

```
class gwproactor.links.AckWaitInfo(link_name: str, message_id: str, timer_handle: Any, context: Any = None)
```

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –
- **timer_handle** (*Any*) –
- **context** (*Any*) –

context: *Any* = None

link_name: *str*

message_id: *str*

timer_handle: *Any*

```
class gwproactor.links.AsyncioTimerManager
```

```
    _abc_impl = <_abc._abc_data object>
```

```
    cancel_timer(timer_handle)
```

Cancel callback associated with `_timer_handle_`.

Note that callback might still run after this call returns.

Parameters

timer_handle (*Any*) – The value returned by `start_timer()`

Return type

None

```
    start_timer(delay_seconds, callback)
```

Start a timer. Implementation is expected to call `_callback_` after approximately `_delay_sceonds_`.

The execution context (e.g. the thread) of the callback must be specified by the implementation.

The callback must have sufficient context available to it do its work as well as to detect if it is no longer relevant. Note a callback might run after cancelation if the callback was already “in-flight” at time of cancelation and it is up to the callback to tolerate this situation.

Parameters

- **delay_seconds** (*float*) – The approximate delay before the callback is called.
- **callback** (*Callable[[], None]*) – The function called after `delay_seconds`.

Returns

A timer handle which can be passed to `_cancel_timer()` to cancel the callback.

Return type

TimerHandle

```
exception gwproactor.links.CommLinkAlreadyExists(name="", current_state=StateName.none,
                                                    transition=TransitionName.none, *, msg="")
```

Parameters

- **name** (*str*) –
- **current_state** (*StateName*) –

- `transition(TransitionName)` –
- `msg(str)` –

exception `gwproactor.links.CommLinkMissing(name, *, msg=)`

Parameters

`name(str)` –

exception `gwproactor.links.InvalidCommStateInput(name=, current_state=StateName.none, transition=TransitionName.none, *, msg=)`

Parameters

- `name(str)` –
- `current_state(StateName)` –
- `transition(TransitionName)` –
- `msg(str)` –

`current_state: StateName = 'none'`

`name: str = ''`

`transition: TransitionName = 'none'`

class `gwproactor.links.LinkManager(publication_name, settings, logger, stats, event_persister, timer_manager, ack_timeout_callback)`

Parameters

- `publication_name(str)` –
- `settings(ProactorSettings)` –
- `logger(ProactorLogger)` –
- `stats(ProactorStats)` –
- `event_persister(PersisterInterface)` –
- `timer_manager(TimerManagerInterface)` –
- `ack_timeout_callback(Callable[[AckWaitInfo], None])` –

`PERSISTER_ENCODING = 'utf-8'`

`_acks: AckManager`

`_event_persister: PersisterInterface`

`_logger: ProactorLogger`

`_message_times: MessageTimes`

`_mqtt_clients: MQTTClients`

`_mqtt_codecs: dict[str, gwproto.decoders.MQTTCodec]`

`_recv_activated(transition)`

Parameters

`transition(Transition)` –

_reupload_events(*event_ids*)

Parameters

event_ids (*list[str]*) –

Return type

Ok[bool] | Err[BaseException]

_reuploads: *Reuploads*

_settings: *ProactorSettings*

_start_reupload()

Return type

None

_states: *LinkStates*

_stats: *ProactorStats*

add_mqtt_link(*name, mqtt_config, codec=None, upstream=False, primary_peer=False*)

Parameters

- **name** (*str*) –
- **mqtt_config** (*MQTTClient*) –
- **codec** (*MQTTCodec | None*) –
- **upstream** (*bool*) –
- **primary_peer** (*bool*) –

decode(*link_name, topic, payload*)

Parameters

- **link_name** (*str*) –
- **topic** (*str*) –
- **payload** (*bytes*) –

Return type

Message[Any]

decoder(*link_name*)

Parameters

link_name (*str*) –

Return type

MQTTCodec | None

disable_mqtt_loggers()

enable_mqtt_loggers(*logger=None*)

Parameters

logger (*Logger | LoggerAdapter | None*) –

generate_event(*event*)

Parameters

event (*EventT*) –

Return type

Ok[bool] | *Err*[BaseException]

get_message_times(*link_name*)

Parameters

link_name (*str*) –

Return type

[LinkMessageTimes](#)

link(*name*)

Return type

[LinkState](#) | None

link_names()

Return type

list[str]

link_state(*name*)

Return type

[StateName](#) | None

log_subscriptions(*tag=""*)

mqtt_client_wrapper(*client_name*)

Parameters

client_name (*str*) –

Return type

[MQTTClientWrapper](#)

mqtt_clients()

Return type

[MQTTClients](#)

num_acks(*link_name*)

Parameters

link_name (*str*) –

Return type

int

property num_pending: int

property num_reupload_pending: int

property num_reuploaded_unacked: int

property primary_peer_client: str

process_ack(*link_name*, *message_id*)

Parameters

- **link_name** (*str*) –
- **message_id** (*str*) –

process_ack_timeout(*wait_info*)

Parameters

wait_info ([AckWaitInfo](#)) –

Return type

[Ok](#)[[LinkManagerTransition](#)] | [Err](#)[[BaseException](#)]

process_mqtt_connect_fail(*message*)

Parameters

message ([Message](#)[[MQTTConnectFailPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_connected(*message*)

Parameters

message ([Message](#)[[MQTTConnectPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_disconnected(*message*)

Parameters

message ([Message](#)[[MQTTDisconnectPayload](#)]) –

Return type

[Ok](#)[[LinkManagerTransition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_message(*message*)

Parameters

message ([Message](#)[[MQTTReceiptPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_suback(*message*)

Parameters

message ([Message](#)[[MQTTSubackPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

publication_name: **str**

publish_message(*client*, *message*, *qos=0*, *context=None*)

Parameters

- **message** ([Message](#)) –
- **qos** (*int*) –

- **context** (*Any*) –

Return type

MQTTMessageInfo

publish_upstream(*payload*, *qos*=*QOS.AtMostOnce*, ***message_args*)

Parameters

- **qos** (*QOS*) –
- **message_args** (*Any*) –

Return type

MQTTMessageInfo

reuploading()

Return type

bool

send_ack(*link_name*, *message*)

Parameters

- **link_name** (*str*) –
- **message** (*Message[Any]*) –

Return type

None

async send_ping(*link_name*)

Parameters

link_name (*str*) –

start(*loop*, *async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

Return type

None

start_ping_tasks()

Return type

list[_asyncio.Task]

stop()

Return type

Ok[bool] | *Err*[*Problems*]

stopped(*name*)

Parameters

name (*str*) –

Return type

bool

subscribe(*client*, *topic*, *qos*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –
- **qos** (*int*) –

Return type

Tuple[*int*, *int* | *None*]

subscribed(*link_name*)

Parameters

link_name (*str*) –

Return type

bool

update_recv_time(*link_name*)

Parameters

link_name (*str*) –

Return type

None

property upstream_client: *str*

```
class gwproactor.links.LinkManagerTransition(link_name: str = "", transition_name:  
    gwproactor.links.link_state.TransitionName =  
    <TransitionName.none: 'none'>, old_state:  
    gwproactor.links.link_state.StateName =  
    <StateName.not_started: 'not_started'>, new_state:  
    gwproactor.links.link_state.StateName =  
    <StateName.not_started: 'not_started'>, canceled_acks:  
    list[gwproactor.links.acks.AckWaitInfo] = <factory>)
```

Parameters

- **link_name** (*str*) –
- **transition_name** (*TransitionName*) –
- **old_state** (*StateName*) –
- **new_state** (*StateName*) –
- **canceled_acks** (*list*[*gwproactor.links.acks.AckWaitInfo*]) –

canceled_acks: *list*[*gwproactor.links.acks.AckWaitInfo*]

```
class gwproactor.links.LinkMessageTimes(last_send: float = <factory>, last_recv: float = <factory>)
```

Parameters

- **last_send** (*float*) –
- **last_recv** (*float*) –

```
get_str(link_poll_seconds=60.0, relative=True)
```

Parameters

- **link_poll_seconds** (*float*) –
- **relative** (*bool*) –

Return type

str

```
last_recv: float
```

```
last_send: float
```

```
next_ping_second(link_poll_seconds)
```

Parameters

link_poll_seconds (*float*) –

Return type

float

```
seconds_until_next_ping(link_poll_seconds)
```

Parameters

link_poll_seconds (*float*) –

Return type

float

```
time_to_send_ping(link_poll_seconds)
```

Parameters

link_poll_seconds (*float*) –

Return type

bool

```
class gwproactor.links.LinkState(name, curr_state=StateName.not_started)
```

Parameters

- **name** (*str*) –
- **curr_state** (*State*) –

```
_handle(result)
```

Return type

Ok[[Transition](#)] | *Err*[[InvalidCommStateInput](#)]

```
active()
```

```
active_for_recv()
```

```
active_for_send()
```

```
curr_state: State
```

```
in_state(state)

    Parameters
        state (StateName) –

    Return type
        bool

name: str

process_ack_timeout()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

process_mqtt_connect_fail()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

process_mqtt_connected()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

process_mqtt_disconnected()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

process_mqtt_message()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

process_mqtt_suback(num_pending_subscriptions)

    Parameters
        num_pending_subscriptions (int) –

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

start()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

property state: StateName

states: dict[gwproactor.links.link_state.StateName,
gwproactor.links.link_state.State]

stop()

    Return type
        Ok[Transition] | Err[InvalidCommStateInput]

class gwproactor.links.LinkStates(names=None)

    Parameters
        names (Sequence[str] | None) –
```


_links: dict[str, [gwproactor.links.link_state.LinkState](#)]

add(name, state=[StateName.not_started](#))

Parameters

- **name** ([str](#)) –
- **state** ([StateName](#)) –

Return type

[LinkState](#)

link(name)

Parameters

name ([str](#)) –

Return type

[LinkState](#) | None

link_names()

Return type

list[str]

link_state(name)

Parameters

name ([str](#)) –

Return type

[StateName](#) | None

process_ack_timeout(name)

Parameters

name ([str](#)) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_connect_fail(message)

Parameters

message ([Message](#)[[MQTTConnectFailPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_connected(message)

Parameters

message ([Message](#)[[MQTTConnectPayload](#)]) –

Return type

[Ok](#)[[Transition](#)] | [Err](#)[[InvalidCommStateInput](#)]

process_mqtt_disconnected(message)

Parameters

message ([Message](#)[[MQTTDisconnectPayload](#)]) –

Return type*Ok*[*Transition*] | *Err*[*InvalidCommStateInput*]**process_mqtt_message**(*message*)**Parameters****message** (*Message*[*MQTTReceiptPayload*]) –**Return type***Ok*[*Transition*] | *Err*[*InvalidCommStateInput*]**process_mqtt_suback**(*name*, *num_pending_subscriptions*)**Parameters**

- **name** (*str*) –
- **num_pending_subscriptions** (*int*) –

Return type*Ok*[*Transition*] | *Err*[*InvalidCommStateInput*]**start**(*name*)**Parameters****name** (*str*) –**Return type***Ok*[*Transition*] | *Err*[*InvalidCommStateInput*]**start_all**()**Return type***Ok*[*bool*] | *Err*[*Sequence*[*BaseException*]]**stop**(*name*)**Parameters****name** (*str*) –**Return type***Ok*[*Transition*] | *Err*[*InvalidCommStateInput*]**stopped**(*name*)**Parameters****name** (*str*) –**Return type***bool***class** gwproactor.links.**MQTTClientWrapper**(*name*, *client_config*, *receive_queue*)**Parameters**

- **name** (*str*) –
- **client_config** (*MQTTClient*) –
- **receive_queue** (*AsyncQueueWriter*) –

_client: *Client***_client_config**: *MQTTClient*

```

_client_thread()

_name: str

_pending_subacks: Dict[int, List[str]]

_pending_subscriptions: Set[str]

_receive_queue: AsyncQueueWriter

_stop_requested: bool

_subscriptions: Dict[str, int]

connected()

    Return type
    bool

disable_logger()

enable_logger(logger=None)

    Parameters
    logger (Logger | LoggerAdapter | None) –

handle_suback(suback)

    Parameters
    suback (MQTTSubackPayload) –

    Return type
    int

num_pending_subscriptions()

    Return type
    int

num_subscriptions()

    Return type
    int

on_connect(_, userdata, flags, rc)

on_connect_fail(_, userdata)

on_disconnect(_, userdata, rc)

on_message(_, userdata, message)

on_subscribe(_, userdata, mid, granted_qos)

publish(topic, payload, qos)

    Parameters
    • topic (str) –
    • payload (bytes) –
    • qos (int) –

```

Return type*MQTTMessageInfo***start()****stop()****subscribe(topic, qos)****Parameters**

- **topic** (*str*) –
- **qos** (*int*) –

Return type*Tuple*[*int*, *int* | *None*]**subscribe_all()****Return type***Tuple*[*int*, *int* | *None*]**subscribed()****Return type***bool***subscription_items()****Return type***list*[*Tuple*[*str*, *int*]]**unsubscribe(topic)****Parameters****topic** (*str*) –**Return type***Tuple*[*int*, *int* | *None*]**class** gwproactor.links.MQTTClients**_send_queue:** *AsyncQueueWriter***add_client(name, client_config, upstream=False, primary_peer=False)****Parameters**

- **name** (*str*) –
- **client_config** (*MQTTClient*) –
- **upstream** (*bool*) –
- **primary_peer** (*bool*) –

client_wrapper(client)**Parameters****client** (*str*) –**Return type***MQTTClientWrapper*

```

clients: Dict[str, MQTTClientWrapper]

connected(client)

    Parameters
        client (str) –

    Return type
        bool

disable_loggers()

enable_loggers(logger=None)

    Parameters
        logger (Logger | LoggerAdapter | None) –

handle_suback(suback)

    Parameters
        suback (MQTTSubackPayload) –

    Return type
        int

num_pending_subscriptions(client)

    Parameters
        client (str) –

    Return type
        int

num_subscriptions(client)

    Parameters
        client (str) –

    Return type
        int

primary_peer()

    Return type
        MQTTClientWrapper

primary_peer_client: str = ''

publish(client, topic, payload, qos)

    Parameters
        • client (str) –
        • topic (str) –
        • payload (bytes) –
        • qos (int) –

    Return type
        MQTTMessageInfo

```

start(*loop*, *async_queue*)

Parameters

- **loop** (*AbstractEventLoop*) –
- **async_queue** (*Queue*) –

stop()

subscribe(*client*, *topic*, *qos*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –
- **qos** (*int*) –

Return type

Tuple[int, int | None]

subscribe_all(*client*)

Parameters

client (*str*) –

Return type

Tuple[int, int | None]

subscribed(*client*)

Parameters

client (*str*) –

Return type

bool

unsubscribe(*client*, *topic*)

Parameters

- **client** (*str*) –
- **topic** (*str*) –

Return type

Tuple[int, int | None]

upstream()

Return type

MQTTClientWrapper

upstream_client: *str* = ''

class gwproactor.links.**MessageTimes**

_links: dict[*str*, *gwproactor.links.message_times.LinkMessageTimes*]

add_link(*name*)

Parameters

name (*str*) –

Return type

None

get_copy(*link_name*)

Parameters

link_name (*str*) –

Return type

LinkMessageTimes

link_names()

Return type

list[str]

update_recv(*link_name*, *now=None*)

Parameters

- **link_name** (*str*) –
- **now** (*float* | *None*) –

Return type

None

update_send(*link_name*, *now=None*)

Parameters

- **link_name** (*str*) –
- **now** (*float* | *None*) –

Return type

None

class gwproactor.links.QOS(*value*, *names=None*, *, *module=None*, *qualname=None*, *type=None*, *start=1*, *boundary=None*)

AtLeastOnce = 1

AtMostOnce = 0

ExactlyOnce = 2

class gwproactor.links.Reuploads(*event_persister*, *logger*, *num_initial_events=5*)

Parameters

- **event_persister** (*PersisterInterface*) –
- **logger** (*ProactorLogger*) –
- **num_initial_events** (*int*) –

NUM_INITIAL_EVENTS: int = 5

```
_event_persister: PersisterInterface
_logger: ProactorLogger
_num_initial_events: int
_reupload_pending: dict[str, None]
_reuploaded_unacked: dict[str, None]
clear()

    Return type
    None

property num_reupload_pending: int
property num_reuploaded_unacked: int
process_ack_for_reupload(message_id)

    Parameters
    message_id (str) –

    Return type
    list[str]

reuploading()

    Return type
    bool

start_reupload()

    Return type
    list[str]

exception gwproactor.links.RuntimeLinkStateError(name="", current_state=StateName.none,
                                                transition=TransitionName.none, *, msg="")

    Parameters
    • name (str) –
    • current_state (StateName) –
    • transition (TransitionName) –
    • msg (str) –

class gwproactor.links.StateName(value, names=None, *, module=None, qualname=None, type=None,
                                start=1, boundary=None)

    active = 'active'
    awaiting_peer = 'awaiting_peer'
    awaiting_setup = 'awaiting_setup'
    awaiting_setup_and_peer = 'awaiting_setup_and_peer'
    connecting = 'connecting'
```



```

none = 'none'

not_started = 'not_started'

stopped = 'stopped'

class gwproactor.links.Subscription(Topic, Qos)

    Parameters
        • Topic (str) –
        • Qos (QOS) –

    Qos: QOS
        Alias for field number 1

    Topic: str
        Alias for field number 0

    _asdict()
        Return a new dict which maps field names to their values.

    _field_defaults = {}

    _fields = ('Topic', 'Qos')

    classmethod _make(iterable)
        Make a new Subscription object from a sequence or iterable

    _replace(**kws)
        Return a new Subscription object replacing specified fields with new values

class gwproactor.links.TimerManagerInterface
    Simple interface to infrastructure which can start timers, run callbacks on timer completion, and cancel timers.

    _abc_impl = <_abc._abc_data object>

    abstract cancel_timer(timer_handle)
        Cancel callback associated with _timer_handle_.

        Note that callback might still run after this call returns.

        Parameters
            timer_handle (Any) – The value returned by start_timer()

        Return type
            None

    abstract start_timer(delay_seconds, callback)
        Start a timer. Implementation is expected to call _callback_ after approximately _delay_sceonds_.

        The execution context (e.g. the thread) of the callback must be specified by the implemntation.

        The callback must have sufficient context available to it do its work as well as to detect if it is no longer
        relevant. Note a callback might run after cancelation if the callack was already “in-flight” at time of can-
        cellation and it is up to the callback to tolerate this situation.

        Parameters
            • delay_seconds (float) – The approximate delay before the callback is called.
            • callback (Callable[[], None]) – The function called after delay_seconds.

```

Returns

A timer handle which can be passed to `_cancel_timer()` to cancel the callback.

Return type

Any

```
class gwproactor.links.Transition(link_name: str = "", transition_name:
    gwproactor.links.link_state.TransitionName = <TransitionName.none:
    'none'>, old_state: gwproactor.links.link_state.StateName =
    <StateName.not_started: 'not_started'>, new_state:
    gwproactor.links.link_state.StateName = <StateName.not_started:
    'not_started'>)
```

Parameters

- `link_name` (*str*) –
- `transition_name` (*TransitionName*) –
- `old_state` (*StateName*) –
- `new_state` (*StateName*) –

`activated()`

`active()`

`deactivated()`

`link_name: str = ''`

`new_state: StateName = 'not_started'`

`old_state: StateName = 'not_started'`

`recv_activated()`

Return type

bool

`recv_deactivated()`

Return type

bool

`send_activated()`

Return type

bool

`send_deactivated()`

Return type

bool

`send_is_active()`

Return type

bool

`transition_name: TransitionName = 'none'`

```
class gwproactor.links.TransitionName(value, names=None, *, module=None, qualname=None,
                                     type=None, start=1, boundary=None)

    message_from_peer = 'message_from_peer'

    mqtt_connect_failed = 'mqtt_connect_failed'

    mqtt_connected = 'mqtt_connected'

    mqtt_disconnected = 'mqtt_disconnected'

    mqtt_suback = 'mqtt_suback'

    none = 'none'

    response_timeout = 'response_timeout'

    start_called = 'start_called'

    stop_called = 'stop_called'
```

7.2.3 gwproactor_test

Development package used to test classes inheriting from *gwproactor.Proactor*

7.3 Contributor Guide

Thank you for your interest in improving this project. This project is open-source under the [MIT license](#) and welcomes contributions in the form of bug reports, feature requests, and pull requests.

Here is a list of important resources for contributors:

- [Source Code](#)
- [Documentation](#)
- [Issue Tracker](#)
- [Code of Conduct](#)

7.3.1 How to report a bug

Report bugs on the [Issue Tracker](#).

When filing an issue, make sure to answer these questions:

- Which operating system and Python version are you using?
- Which version of this project are you using?
- What did you do?
- What did you expect to see?
- What did you see instead?

The best way to get your bug fixed is to provide a test case, and/or steps to reproduce the issue.

7.3.2 How to request a feature

Request features on the [Issue Tracker](#).

7.3.3 How to set up your development environment

You need Python 3.7+ and the following tools:

- [Poetry](#)
- [Nox](#)
- [nox-poetry](#)

Install the package with development requirements:

```
$ poetry install --all-extras
```

You can now run an interactive Python session, or the command-line interface:

```
$ poetry run python
$ poetry run gridworks-proactor
```

7.3.4 How to test the project

Run the full test suite:

```
$ nox
```

List the available Nox sessions:

```
$ nox --list-sessions
```

You can also run a specific Nox session. For example, invoke the unit test suite like this:

```
$ nox --session=tests
```

Unit tests are located in the `tests` directory, and are written using the [pytest](#) testing framework.

7.3.5 How to submit changes

Open a [pull request](#) to submit changes to this project.

Your pull request needs to meet the following guidelines for acceptance:

- The Nox test suite must pass without errors and warnings.
- Include unit tests. This project maintains 100% code coverage.
- If your changes add functionality, update the documentation accordingly.

Feel free to submit early, though—we can always iterate on this.

To run linting and code formatting checks before committing your change, you can install pre-commit as a Git hook by running the following command:

```
$ nox --session=pre-commit -- install
```

It is recommended to open an issue before starting work on anything. This will allow a chance to talk it over with the owners and validate your approach.

7.4 GridWorks Energy Consulting Code of Conduct

7.4.1 Basic Truth

All humans are worthy.

7.4.2 Scope

This Code of Conduct applies to moderation of comments, issues and commits within this repository to support its alignment to the above basic truth.

7.4.3 Enforcement Responsibilities

GridWorks Energy Consulting LLC (gridworks@gridworks-consulting.com) owns and administers this repository, and is ultimately responsible for enforcement of standards of behavior. They are responsible for merges to dev and main branches, and maintain the right and responsibility to remove, edit, or reject comments, commits, code, documentation edits, issues, and other contributions that are not aligned to this Code of Conduct, and will communicate reasons for moderation decisions when appropriate.

If you read something in this repo that you want GridWorks to consider moderating, please send an email to them at gridworks@gridworks-consulting.com. All complaints will be reviewed and investigated, and GridWorks will respect the privacy and security of the reporter of any incident.

7.4.4 What not to add to this repo

Ways to trigger GridWorks moderation enforcement:

- Publish others' private information, such as a physical or email address, without their explicit permission
- Use of sexualized language or imagery, or make sexual advances
- Troll

7.4.5 Suggestions

- Empathize
- Recognize you are worthy of contributing, and do so in the face of confusion and doubt; you can help clarify things for everyone
- Be interested in differing opinions, viewpoints, and experiences
- Give and accept constructive feedback
- Accept responsibility for your mistakes and learn from them
- Recognize everybody makes mistakes, and forgive

- Focus on the highest good for all

7.4.6 Enforcement Escalation

1. Correction

A private, written request from GridWorks to change or edit a comment, commit, or issue.

2. Warning

With a warning, GridWorks may remove your comments, commits or issues. They may also freeze a conversation.

3. Temporary Ban

A temporary ban from any sort of interaction or public communication within the repository for a specified period of time. No public or private interaction with the people involved, including unsolicited interaction with those enforcing the Code of Conduct, is allowed during this period. Violating these terms may lead to a permanent ban.

4. Permanent Ban

A permanent ban from any sort of interaction within the repository.

7.4.7 Attribution

This Code of Conduct is loosely adapted from the [Contributor Covenant](https://www.contributor-covenant.org/version/2/1/code_of_conduct.html), version 2.1, available at https://www.contributor-covenant.org/version/2/1/code_of_conduct.html.

Community Impact Guidelines were inspired by [Mozilla's code of conduct enforcement ladder](#).

For answers to common questions about this code of conduct, see the FAQ at <https://www.contributor-covenant.org/faq>. Translations are available at <https://www.contributor-covenant.org/translations>.

7.5 License

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