Advanced Gtk+ Sequencer

Developer's Book

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Dedication

This book is dedicated to my friend.

Foreword

I began to code with C in spring 2002 and hadn't much programming skills, yet. You may ask me why the C programming language? Well, my friend who was already a convient free software user and hacker recomended me it. He told me that C is a standard on Unix like operating systems so it would be a good choice.

After started with language basics and several discussions with my friend about pointers he advised me of Gtk+. While I was doing my first steps in GUI programming with C, I was sure to extensively use it and became a persuaded free software user and programmer.

A year later I really understood the object orientated matter of GObject and how to write objects and widgets myself. C wasn't like Java where you just couldn't implement no classes just everything was a class or at least a method.

First output with AGS happend via Open Sound System device drivers but the entire application lacked of a thread safe concept. But for now you may write tasks.

Be part of the fun.

Chapter 1

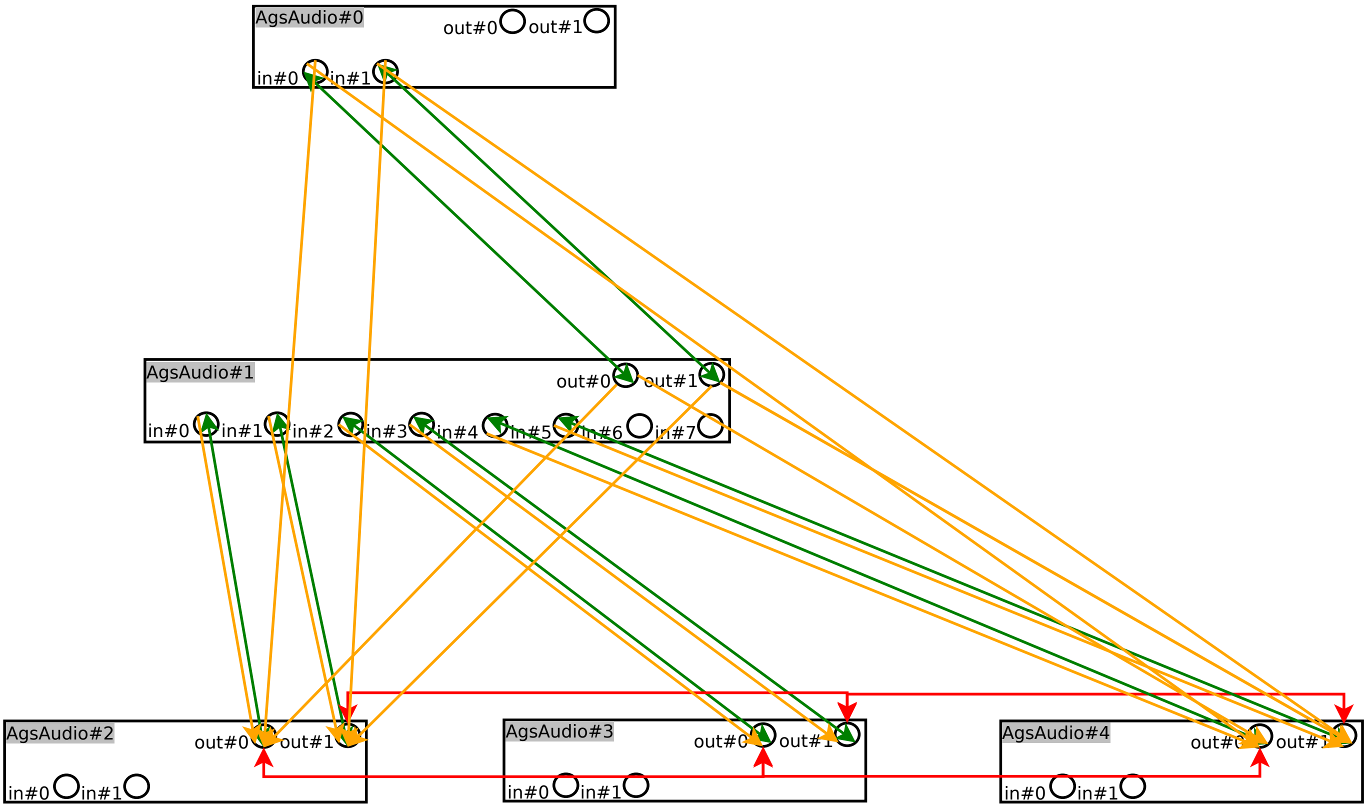
Linking

In this section you get some knowledge about ags internals. Here you get an overview of the audio layer. All code related to it is located in subdirectory <ags/audio>. Linking AgsChannel is a quiet complex thing but If you wish to do so you can just call ags_channel_link() and this will the especially covered here.

1.1 Overview

AgsAudio, AgsChannel and AgsRecycling are involved in linking. When talking about linking we should view AgsChannel objects as networked and therefore exists an additional nested network of AgsRecycling objects.

The AgsAudio object gives clarification about how AgsChannel has to be accessed either synchronously or asynchronously. Further it tells us whether AgsOutput or AgsInput has a new audio stream which causes in conjunction a dedicated AgsRecycling associated with the appropriate AgsChannel.



- green:

object	flags
Audio#0	AGS_AUDIO_SYNC | AGS_AUDIO_OUTPUT_HAS_RECYCLING
Audio#1	AGS_AUDIO_ASYNC
Audio#2	AGS_AUDIO_ASYNC | AGS_AUDIO_OUTPUT_HAS_RECYCLING
Audio#3	AGS_AUDIO_ASYNC | AGS_AUDIO_OUTPUT_HAS_RECYCLING
Audio#4	AGS_AUDIO_ASYNC | AGS_AUDIO_OUTPUT_HAS_RECYCLING

Table 1.1: AGS network layer table

  - Bidirectional linked AgsChannel to an other AgsChannel.
  - Generally you link an AgsOutput to an AgsInput.

- red:
  - Bidirectional linked AgsRecycling to an other AgsRecycling on the same level.
  - They are linked across AgsAudio objects.
  - Same level means the linked AgsRecycling are all child nodes of a parent AgsRecycling.

- yellow:
  - Unidirectional linked AgsRecycling to an AgsChannel.
  - First AgsRecycling of an AgsOutput and last AgsRecycling of an (other) AgsOutput are linked to an AgsChannel.

1.2 Limitations

- You may not create any kind of loops.
- You may not set AGS_AUDIO_INPUT_HAS_RECYCLING without setting AGS_AUDIO_OUTPUT_HAS_RECYCLING flag.

1.3 Hands-On

There may be two ways how you can link AgsChannel objects.

Example 1.1 Prerequisites

```
AgsTaskThread *task_thread;
AgsDevout *devout;
AgsAudio *master_audio, *slave_audio;
AgsLinkChannel *linkChannel;
GError *error;

/* some pseudo code */
devout = AGS_WINDOW(gtk_widget_get_toblevel(widget))->devout;
task_thread = AGS_AUDIO_LOOP(AGS_MAIN(devout->ags_main)->main_loop)->task_thread;

/* create AgsAudio objects */
master_audio = (AgsAudio *) g_object_new(AGS_TYPE_AUDIO,
           "devout", devout,
           NULL);
```

```
slave_audio = (AgsAudio *) g_object_new(AGS_TYPE_AUDIO,
          "devout", devout,
          NULL);

/* assign AgsAudioSignal objects to master_audio and slave_audio */
ags_audio_set_flags(master_audio,
        AGS_AUDIO_OUTPUT_HAS_RECYCLING);
ags_audio_set_flags(slave_audio,
        (AGS_AUDIO_ASYNC | AGS_AUDIO_OUTPUT_HAS_RECYCLING | AGS_AUDIO_INPUT_HAS_RECYCLING)) ↩
            ;

/* create AgsChannel objects within master_audio and slave_audio */
ags_audio_set_audio_channels(master_audio, 2);
ags_audio_set_pads(master_audio, AGS_TYPE_OUTPUT, 1);
ags_audio_set_pads(master_audio, AGS_TYPE_INPUT, 1);

ags_audio_set_audio_channels(slave_audio, 2);
ags_audio_set_pads(slave_audio, AGS_TYPE_OUTPUT, 1);
ags_audio_set_pads(slave_audio, AGS_TYPE_INPUT, 8);
```

Assumed you know really what you do, you may be interested in following code.

Example 1.2 Thread-Unsafe way

```
/* link master_audio's input with slave_audio's output */
ags_channel_set_link(ags_channel_nth(master_audio->input, 0),
         ags_channel_nth(slave_audio->output, 0),
         &error);


ags_channel_set_link(ags_channel_nth(master_audio->input, 1),
         ags_channel_nth(slave_audio->output, 1),
         &error);
```

But generally you wish to create an AgsTask object and let it to link the AgsChannel for you.

Example 1.3 Multithread-Safe way

```
/* creating AgsLink task and add it to AgsDevout */
link_channel = ags_link_channel_new(ags_channel_nth(master_audio->input, 0),
            ags_channel_nth(slave_audio->output, 0));
ags_task_thread_append_task(task_thread, link_channel);

link_channel = ags_link_channel_new(ags_channel_nth(master_audio->input, 1),
            ags_channel_nth(slave_audio->output, 1));
ags_task_thread_append_task(task_thread, link_channel);
```

Chapter 2

Effects

You may directly inherit by <ags/audio/ags_recall.h> to do some wicked stuff. But generally you should inherit by these subclasses of AgsRecall:

- <ags/audio/ags_recall_audio.h>
- <ags/audio/ags_recall_audio_run.h>
- <ags/audio/ags_recall_channel.h>
- <ags/audio/ags_recall_channel_run.h>
- <ags/audio/ags_recall_recycling.h>
- <ags/audio/ags_recall_audio_signal.h>

You probably wish to have different context for fields of an effect, that's what these objects take on. But before we cover them in detail, we take a look at the lifecycle an effect must accomplish.

2.1 Play/recall context

Don't mix this context up with static/runtime context we talked before. The AgsRecall may have two faces or may be just one for play context.

The play context will be called in case the higher level of AgsRecycling will output to a device e.g. the soundcard and no further processing will be done.

The recall context means that the AgsRecall will pass one or more cycles of copying or sequencing. This design is intended to make ags as modular and reusable over different use cases as possible. Practically it should be possible to chain up several sequencers.

2.2 Hands-On instantiating an effect

After you got an overview of the basic lifecycle of an effect it's time to create an effect. In this guide we will cover instatiating an effect by using the echo effect. In the following chapter we'll take a look inside the echo effect.

2.2.1 AgsRecallContainer

AgsRecallContainer isn't a recall itself but you can use it to retrieve a different context.

Example 2.1 Creating AgsRecallContainer

```
AgsMachine *machine;
AgsDevout *devout;
AgsAudio *audio;
AgsChannel *channel;
AgsRecallContainer *echo_container;

/* some pseudo code */
machine = (AgsMachine *) gtk_widget_get_ancestor(widget,
             AGS_TYPE_MACHINE);

/* retrieve some essencial objects */
audio = machine->audio;
devout = audio->devout;

/* create the container */
recall_container = (AgsRecallContainer *) g_object_new(AGS_TYPE_RECALL_CONTAINER,
                   NULL);
```

2.2.2 AgsRecallAudio context

This is a context you want to use for fields applicable to the entire AgsAudio object.

Example 2.2 Creating AgsEchoAudio

```
AgsEchoAudio *echo_audio;

echo_audio = (AgsEchoAudio *) g_object_new(AGS_TYPE_ECHO_AUDIO,
             "audio", audio,
             "container", echo_container,
             NULL);

AGS_RECALL(echo_audio)->flags = AGS_RECALL_TEMPLATE;
```

2.2.3 AgsRecallChannel context

This context you can use for fields applicable to the AgsChannel you want to modify.

Example 2.3 Creating AgsEchoChannel

```
AgsEchoChannel *echo_channel;

echo_channel = (AgsEchoChannel *) g_object_new(AGS_TYPE_ECHO_CHANNEL,
                 "channel", channel,
                 "container", echo_container,
                 "recall_audio", echo_audio,
                 "delay", (devout->frequency * (60 / devout->bpm) / 4),
                 "repeat", 3,
                 "fade", -0.25,
                 "dry", 0.5,
                 NULL);

AGS_RECALL(echo_channel)->flags = AGS_RECALL_TEMPLATE;
```

2.2.4 AgsRecallAudioRun context

The AgsRecallAudioRun class will be duplicated for a parental running AgsChannel. There may be several AgsChannel objects as parental owning a run.

Example 2.4 Creating AgsEchoAudioRun

```
echo_audio_run = (AgsEchoAudioRun *) g_object_new(AGS_TYPE_ECHO_AUDIO_RUN,
              "audio", audio,
              "container", echo_container,
              "recall_audio", echo_audio,
              NULL);

AGS_RECALL(echo_audio_run)->flags = AGS_RECALL_TEMPLATE;
```

2.2.5 AgsRecallChannelRun context

The AgsRecallChannelRun behaves like an AgsRecallAudioRun but is designated to an AgsChannel object.

Example 2.5 Creating AgsEchoChannelRun

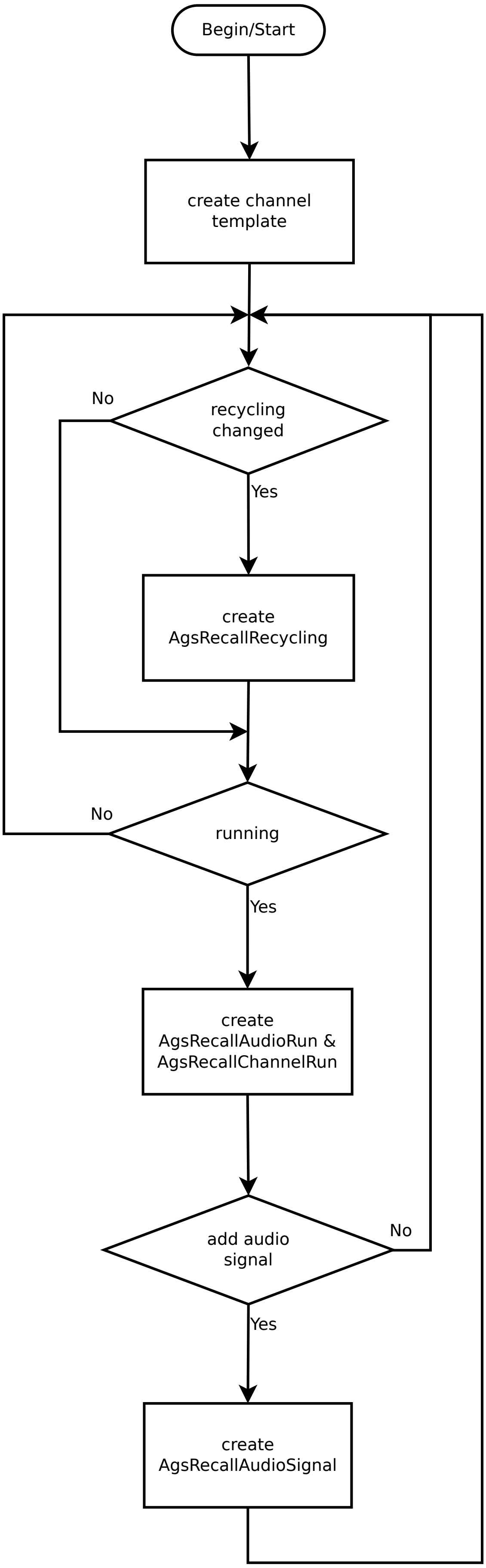
```
AgsEchoChannelRun *echo_channel_run;

echo_channel_run = (AgsEchoChannelRun *) g_object_new(AGS_TYPE_ECHO_CHANNEL_RUN,
                  "channel", channel
                  "container", echo_container,
                  "recall_audio", echo_audio,
                  "recall_channel", echo_channel,
                  "recall_audio_run", echo_audio_run,
                  NULL);

AGS_RECALL(echo_channel_run)->flags = AGS_RECALL_TEMPLATE;
```

2.3 The basic lifecycle of an effect

In this section I'll introduce the keyword run which can be understood as a playing instance. But I rather talk about run because it's not guaranted that the recall outputs directly to a device.


Begin/Start
create channel template
recycling changed
No
Yes
create AgsRecallRecycling
running
No
Yes
create AgsRecallAudioRun & AgsRecallChannelRun
add audio signal
No
Yes
create AgsRecallAudioSignal

The implemented effect as a subclass of AgsRecall resides as template on the appropriate AgsAudio or AgsChannel.

When recycling changes on input, new AgsRecallRecycling will be added. This class function may be of relevancy:

- channel_class->recycling_changed

As a new run occures the AgsRecallAudioRun and AgsRecallChannelRun will be duplicated, dependencies resolved, state initialized and enter the play loop hierarchy. These class functions will be called on the recall:

- channel_class->duplicate
  - This function will be called on the template object to instantiate the the object which will pass further processing.

Further processing:

- recall_class->resolve_dependencies
  - The recall may want to depend on a other recall (eg. a counter) and may ignore following calls while rather do processing on an event of the dependency.
- recall_class->run_init_pre, recall_class->run_init_inter & recall_class->run_init_post
  - Will be called only once for the run reffering to dedicated AgsGroupId.
- recall_class->run_pre, recall_class->run_inter & recall_class->run_post
  - Will be called for each cycle of a run reffering to AgsGroupId.
  - There may be more than one AgsGroupId for a template i.e. there can exist more than one run at the very same time.

As soon as an add_audio_signal event will be emitted on an AgsRecycling, the AgsRecallAudioSignal subclass will be instantiated which performs audio stream manipulation. These class functions will be called on the recall:

- recall_class->run_init_pre, recall_class->run_init_inter & recall_class->run_init_post
- recall_class->run_pre, recall_class->run_inter & recall_class->run_post

When you're done with processing call:

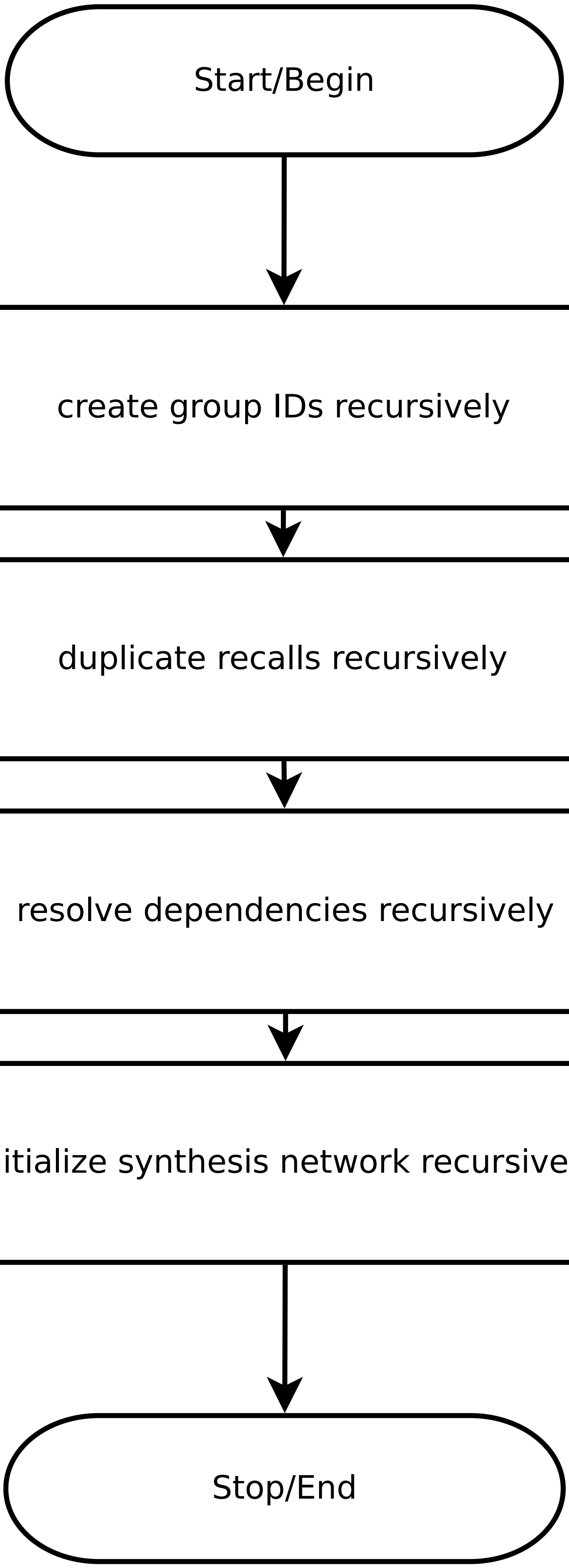
- recall_class->done

2.4 A closer look at effects

First we look at recall initialization and afterwards at processing audio data with run etapes.

2.4.1 Recursive initialization

Initilization recusivly is done by calling ags_channel_recursive_play_init().


Start/Begin
create group IDs recursively
duplicate recalls recursively
resolve dependencies recursively
initialize synthesis network recursively
Stop/End

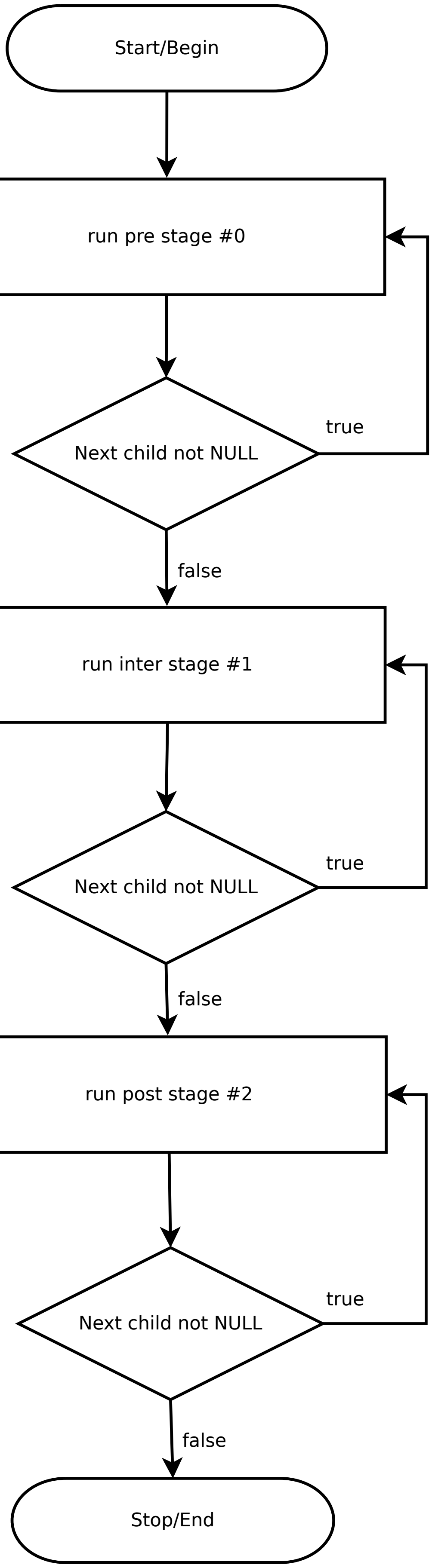
The initialization occurs in one part.

The following procedures needs to be passed:

- Allocating group id and recall countainer.
  - Acts as a unique identifier for runtime.
- Duplicating recalls and pass default properties.
  - Set up functional runtime objects.
- Resolve dependencies and inject.
  - Dynamic connect of objects.
- Initialized tree recursivly as entire initialization stage.
  - The created context is now ready to be processed ...

2.4.2 The different run stages

As mentioned before audio processing will be done within an AgsRecallAudioSignal subclass.


Start/Begin
run pre stage #0
Next child not NULL
true
false
run inter stage #1
Next child not NULL
true
false
run post stage #2
Next child not NULL
true
false
Stop/End

This object is running the stages as illustrated and you may have noticed it's recursive. The run phase is divided in 3 stages with dedicated pass within tree.

run_pre() is the very first etape. Its purpose is mainly of allocating or preparing buffers.

run_inter() is the second phase and acts as effect processor.

run_post() is the third phase and is usually used for doing clean-up.

These recalls implementing those functions generally inherit by AGS_TYPE_RECALL_AUDIO_RUN, AGS_TYPE_RECALL_CHAN or AGS_TYPE_RECALL_AUDIO_SIGNAL.

Run time values are written in real time using atomic operations. This is done by AgsPort and inherit by AGS_TYPE_RECALL_AUDIO or AGS_TYPE_RECALL_CHANNEL.

AgsRecallContainer matches related recalls. This means you pack recalls of same XML type eg. ags-echo to be grouped, litteraly:

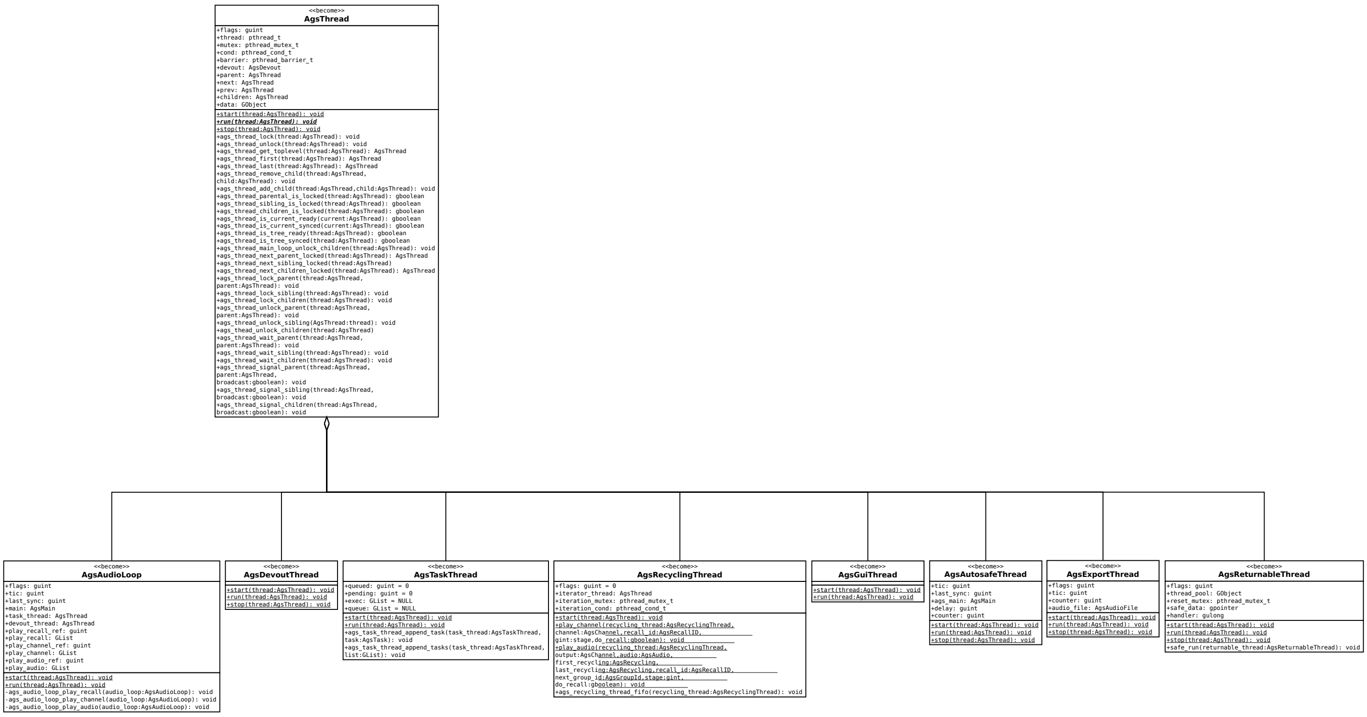
- ags-echo-channel
- ags-echo-channel-run
- ags-echo-recycling
- ags-echo-audio-signal

Chapter 3

Multi-Threaded Tree

Ags is a able to run in a super threaded fashion. AgsThread object is therefore the most basic thread which will let run your very own thread within the tree. For locking the tree you must wait until every mutex is acquired.

3.1 Well-Known Threads


<<become>>
AgsThread
+flags: guint
+thread: pthread_t
+mutex: pthread_mutex_t
+cond: pthread_cond_t
+barrier: pthread_barrier_t
+devout: AgsDevout
+parent: AgsThread
+next: AgsThread
+prev: AgsThread
+children: AgsThread
+data: GObject
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+stop(thread:AgsThread): void
+ags_thread_lock(thread:AgsThread): void
+ags_thread_unlock(thread:AgsThread): void
+ags_thread_get_toplevel(thread:AgsThread): AgsThread
+ags_thread_first(thread:AgsThread): AgsThread
+ags_thread_last(thread:AgsThread): AgsThread
+ags_thread_remove_child(thread:AgsThread,
child:AgsThread): void
+ags_thread_add_child(thread:AgsThread,child:AgsThread): void
+ags_thread_parental_is_locked(thread:AgsThread): gboolean
+ags_thread_sibling_is_locked(thread:AgsThread): gboolean
+ags_thread_children_is_locked(thread:AgsThread): gboolean
+ags_thread_is_current_ready(current:AgsThread): gboolean
+ags_thread_is_current_synced(current:AgsThread): gboolean
+ags_thread_is_tree_ready(thread:AgsThread): gboolean
+ags_thread_is_tree_synced(thread:AgsThread): gboolean
+ags_thread_main_loop_unlock_children(thread:AgsThread): void
+ags_thread_next_parent_locked(thread:AgsThread): AgsThread
+ags_thread_next_sibling_locked(thread:AgsThread)
+ags_thread_next_children_locked(thread:AgsThread): AgsThread
+ags_thread_lock_parent(thread:AgsThread,
parent:AgsThread): void
+ags_thread_lock_sibling(thread:AgsThread): void
+ags_thread_lock_children(thread:AgsThread): void
+ags_thread_unlock_parent(thread:AgsThread,
parent:AgsThread): void
+ags_thread_unlock_sibling(AgsThread:thread): void
+ags_thead_unlock_children(thread:AgsThread)
+ags_thread_wait_parent(thread:AgsThread,
parent:AgsThread): void
+ags_thread_wait_sibling(thread:AgsThread): void
+ags_thread_wait_children(thread:AgsThread): void
+ags_thread_signal_parent(thread:AgsThread,
parent:AgsThread,
broadcast:gboolean): void
+ags_thread_signal_sibling(thread:AgsThread,
broadcast:gboolean): void
+ags_thread_signal_children(thread:AgsThread,
broadcast:gboolean): void
<<become>>
AgsAudioLoop
+flags: guint
+tic: guint
+last_sync: guint
+main: AgsMain
+task_thread: AgsThread
+devout_thread: AgsThread
+play_recall_ref: guint
+play_recall: GList
+play_channel_ref: guint
+play_channel: GList
+play_audio_ref: guint
+play_audio: GList
+start(thread:AgsThread): void
+run(thread:AgsThread): void
-ags_audio_loop_play_recall(audio_loop:AgsAudioLoop): void
-ags_audio_loop_play_channel(audio_loop:AgsAudioLoop): void
-ags_audio_loop_play_audio(audio_loop:AgsAudioLoop): void
<<become>>
AgsDevoutThread
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+stop(thread:AgsThread): void
<<become>>
AgsTaskThread
+queued: guint = 0
+pending: guint = 0
+exec: GList = NULL
+queue: GList = NULL
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+ags_task_thread_append_task(task_thread:AgsTaskThread,
task:AgsTask): void
+ags_task_thread_append_tasks(task_thread:AgsTaskThread,
list:GList): void
<<become>>
AgsRecyclingThread
+flags: guint = 0
+iterator_thread: AgsThread
+iteration_mutex: pthread_mutex_t
+iteration_cond: pthread_cond_t
+start(thread:AgsThread): void
+play_channel(recycling_thread:AgsRecyclingThread,
channel:AgsChannel,recall_id:AgsRecallID,
gint:stage,do_recall:gboolean): void
+play_audio(recycling_thread:AgsRecyclingThread,
output:AgsChannel,audio:AgsAudio,
first_recycling:AgsRecycling,
last_recycling:AgsRecycling,recall_id:AgsRecallID,
next_group_id:AgsGroupId,stage:gint,
do_recall:gboolean): void
+ags_recycling_thread_fifo(recycling_thread:AgsRecyclingThread): void
<<become>>
AgsGuiThread
+start(thread:AgsThread): void
+run(thread:AgsThread): void
<<become>>
AgsAutosafeThread
+tic: guint
+last_sync: guint
+ags_main: AgsMain
+delay: guint
+counter: guint
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+stop(thread:AgsThread): void
<<become>>
AgsExportThread
+flags: guint
+tic: guint
+counter: guint
+audio_file: AgsAudioFile
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+stop(thread:AgsThread): void
<<become>>
AgsReturnableThread
+flags: guint
+thread_pool: GObject
+reset_mutex: pthread_mutex_t
+safe_data: gpointer
+handler: gulong
+start(thread:AgsThread): void
+run(thread:AgsThread): void
+stop(thread:AgsThread): void
+safe_run(returnable_thread:AgsReturnableThread): void

3.2 Syncing With AgsAudioLoop

Every child thread of AgsAudioLoop will be synced as long you don't write your very own start class function of AgsThread. The thread is running as long as AGS_THREAD_RUNNING is set as flag. Put your own thread routine by overwriting class function run of AgsThreadClass.

3.3 Interfacing Audio-Layer with GUI-Layer and vice versa

At topmost there’s AgsAudioLoop whereby AgsTaskThread guarantees no concurrent memory access. To run tasks instantiate subclass of AgsTask and add to queue by calling:

- ags_task_thread_append_task()
- ags_task_thread_append_tasks()

3.4 Thread-Pool

The thread pool can be used to pull threads of AGS_TYPE_RETURNABLE_THREAD. It should return as soon as possible because of potential hang-up. It is recommended to stop thread after very first run.

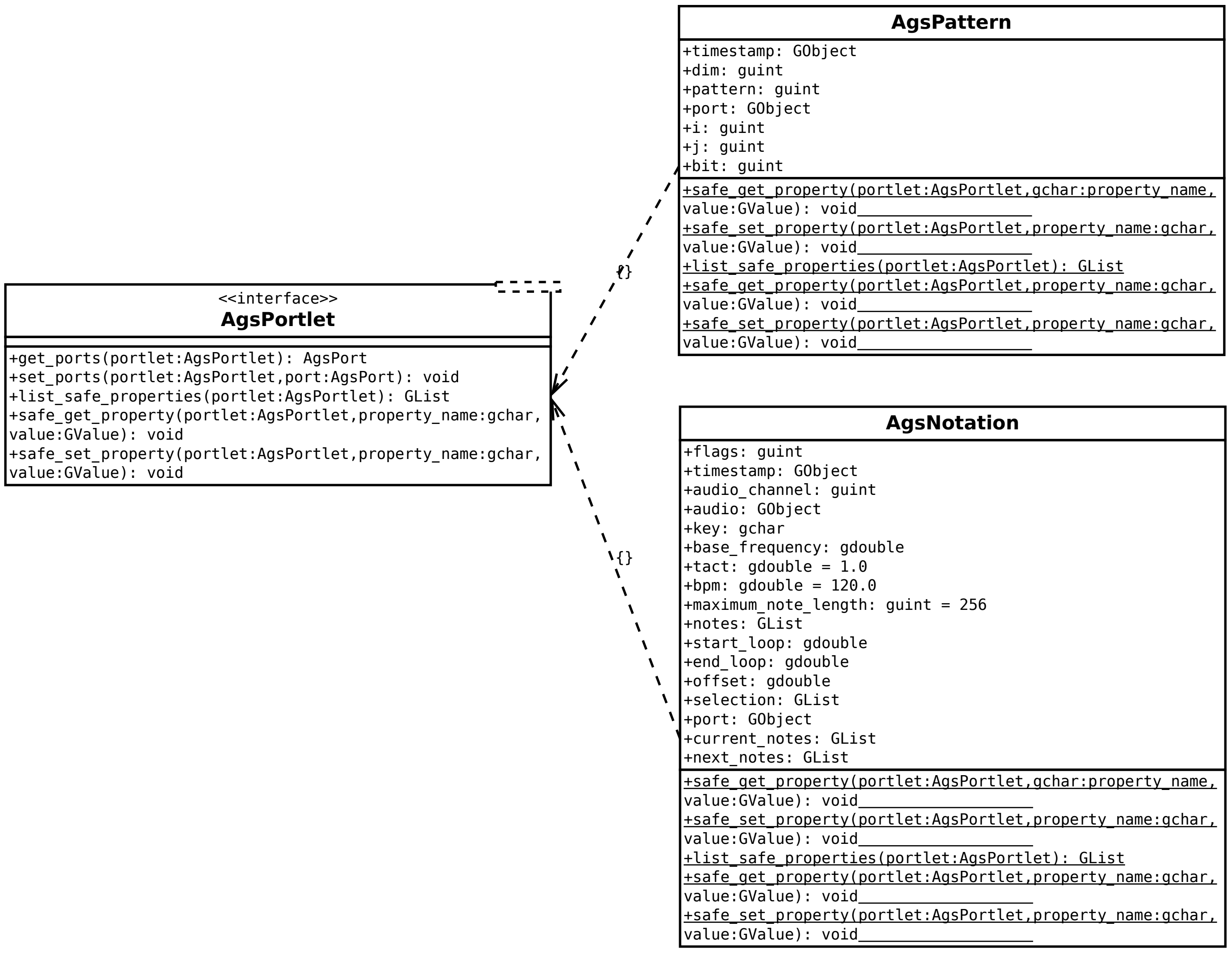
Chapter 4

Port to safe read/write

The AgsPort object may contain primitive types as well objects. The read/write operations are generally done by atomic operations. There exists interfacing AgsTaskThread functions but not used, for now. Representing objects should implement AgsPortletInterface.

4.1 Portlet interface safe read/write properties

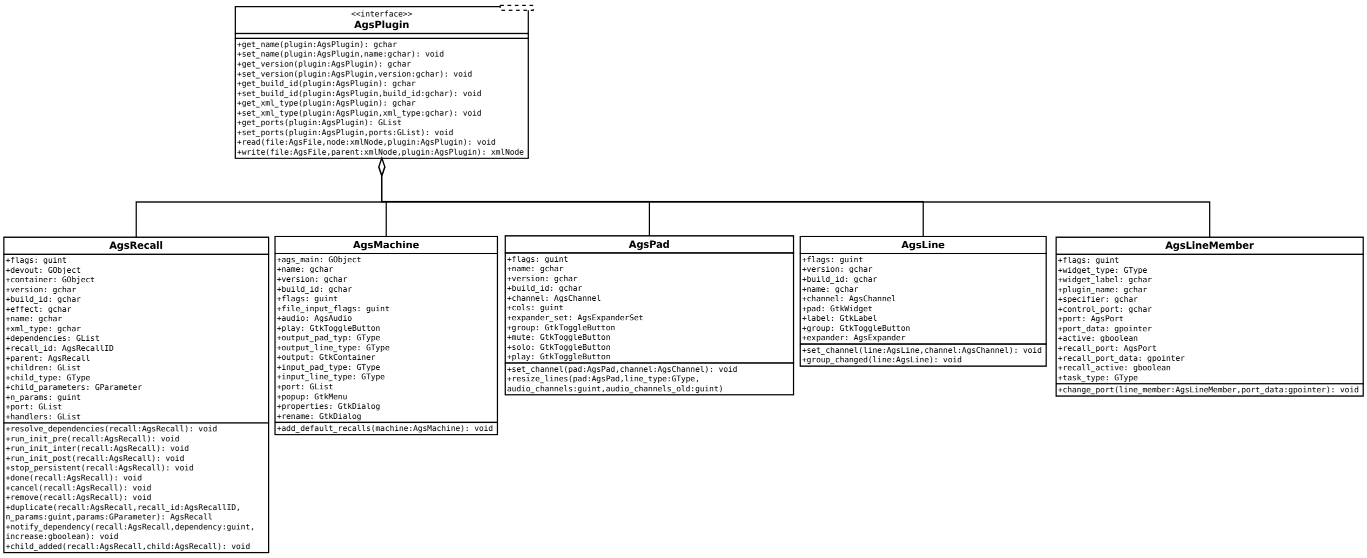
The AgsPortletInterface is used where a GObject is represented by the assigned port. The implemententing class is responsible for thread safe get/set properties. Most common way is using mutices.


AgsPattern
+timestamp: GObject
+dim: guint
+pattern: guint
+port: GObject
+i: guint
+j: guint
+bit: guint
+safe_get_property(portlet:AgsPortlet,gchar:property_name,
value:GValue): void
+safe_set_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
+list_safe_properties(portlet:AgsPortlet): GList
+safe_get_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
+safe_set_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
{}
<<interface>>
AgsPortlet
+get_ports(portlet:AgsPortlet): AgsPort
+set_ports(portlet:AgsPortlet,port:AgsPort): void
+list_safe_properties(portlet:AgsPortlet): GList
+safe_get_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
+safe_set_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
{}
AgsNotation
+flags: guint
+timestamp: GObject
+audio_channel: guint
+audio: GObject
+key: gchar
+base_frequency: gdouble
+tact: gdouble = 1.0
+bpm: gdouble = 120.0
+maximum_note_length: guint = 256
+notes: GList
+start_loop: gdouble
+end_loop: gdouble
+offset: gdouble
+selection: GList
+port: GObject
+current_notes: GList
+next_notes: GList
+safe_get_property(portlet:AgsPortlet,gchar:property_name,
value:GValue): void
+safe_set_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
+list_safe_properties(portlet:AgsPortlet): GList
+safe_get_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void
+safe_set_property(portlet:AgsPortlet,property_name:gchar,
value:GValue): void

Chapter 5

Plugin interface to do abstraction

The AgsPlugin interface defines some elementary functions like get_name() or set_name() and therefor get_version(), set_version(), get_build_id() and set_build_id(). Further it contains functions used to persist it using XML. This would be get_xml_type(), set_xml_type(), read() and write(). And get_ports() and set_ports() to allow thread safe communication between the different layers of Advanced Gtk+ Sequencer but to be said those functions accomplish for persisting and restoring.



<<interface>>
AgsPlugin
+get_name(plugin:AgsPlugin): gchar
+set_name(plugin:AgsPlugin,name:gchar): void
+get_version(plugin:AgsPlugin): gchar
+set_version(plugin:AgsPlugin,version:gchar): void
+get_build_id(plugin:AgsPlugin): gchar
+set_build_id(plugin:AgsPlugin,build_id:gchar): void
+get_xml_type(plugin:AgsPlugin): gchar
+set_xml_type(plugin:AgsPlugin,xml_type:gchar): void
+get_ports(plugin:AgsPlugin): GList
+set_ports(plugin:AgsPlugin,ports:GList): void
+read(file:AgsFile,node:xmlNode,plugin:AgsPlugin): void
+write(file:AgsFile,parent:xmlNode,plugin:AgsPlugin): xmlNode
AgsRecall
+flags: guint
+devout: GObject
+container: GObject
+version: gchar
+build_id: gchar
+effect: gchar
+name: gchar
+xml_type: gchar
+dependencies: GList
+recall_id: AgsRecallID
+parent: AgsRecall
+children: GList
+child_type: GType
+child_parameters: GParameter
+n_params: guint
+port: GList
+handlers: GList
+resolve_dependencies(recall:AgsRecall): void
+run_init_pre(recall:AgsRecall): void
+run_init_inter(recall:AgsRecall): void
+run_init_post(recall:AgsRecall): void
+stop_persistent(recall:AgsRecall): void
+done(recall:AgsRecall): void
+cancel(recall:AgsRecall): void
+remove(recall:AgsRecall): void
+duplicate(recall:AgsRecall,recall_id:AgsRecallID,
n_params:guint,params:GParameter): AgsRecall
+notify_dependency(recall:AgsRecall,dependency:guint,
increase:gboolean): void
+child_added(recall:AgsRecall,child:AgsRecall): void
AgsMachine
+ags_main: GObject
+name: gchar
+version: gchar
+build_id: gchar
+flags: guint
+file_input_flags: guint
+audio: AgsAudio
+play: GtkToggleButton
+output_pad_typ: GType
+output_line_type: GType
+output: GtkContainer
+input_pad_type: GType
+input_line_type: GType
+port: GList
+popup: GtkMenu
+properties: GtkDialog
+rename: GtkDialog
+add_default_recalls(machine:AgsMachine): void
AgsPad
+flags: guint
+name: gchar
+version: gchar
+build_id: gchar
+channel: AgsChannel
+cols: guint
+expander_set: AgsExpanderSet
+group: GtkToggleButton
+mute: GtkToggleButton
+solo: GtkToggleButton
+play: GtkToggleButton
+set_channel(pad:AgsPad,channel:AgsChannel): void
+resize_lines(pad:AgsPad,line_type:GType,
audio_channels:guint,audio_channels_old:guint)
AgsLine
+flags: guint
+version: gchar
+build_id: gchar
+name: gchar
+channel: AgsChannel
+pad: GtkWidget
+label: GtkLabel
+group: GtkToggleButton
+expander: AgsExpander
+set_channel(line:AgsLine,channel:AgsChannel): void
+group_changed(line:AgsLine): void
AgsLineMember
+flags: guint
+widget_type: GType
+widget_label: gchar
+plugin_name: gchar
+specifier: gchar
+control_port: gchar
+port: AgsPort
+port_data: gpointer
+active: gboolean
+recall_port: AgsPort
+recall_port_data: gpointer
+recall_active: gboolean
+task_type: GType
+change_port(line_member:AgsLineMember,port_data:gpointer): void

5.1 Hands-on

5.1.1 get_type()

First you need to tell object type system to use the AgsPluginInterface this is normally done in the classes get_type() function.

Example 5.1 ags_echo_channel_get_type()

```
GType
ags_echo_channel_get_type()
{
  static GType ags_type_echo_channel = 0;

  if(!ags_type_echo_channel){
    static const GTypeInfo ags_echo_channel_info = {
      sizeof (AgsEchoChannelClass),
      NULL, /* base_init */
      NULL, /* base_finalize */
      (GClassInitFunc) ags_echo_channel_class_init,
      NULL, /* class_finalize */
      NULL, /* class_channel */
      sizeof (AgsEchoChannel),
      0,    /* n_preallocs */
      (GInstanceInitFunc) ags_echo_channel_init,
    };

    static const GInterfaceInfo ags_plugin_interface_info = {
      (GInterfaceInitFunc) ags_echo_channel_plugin_interface_init,
      NULL, /* interface_finalize */
      NULL, /* interface_data */
    };

    ags_type_echo_channel = g_type_register_static(AGS_TYPE_RECALL_CHANNEL,
               "AgsEchoChannel\0",
               &ags_echo_channel_info,
               0);

    g_type_add_interface_static(ags_type_echo_channel,
                                AGS_TYPE_PLUGIN,
                                &ags_plugin_interface_info);
  }

  return(ags_type_echo_channel);
}
```

5.1.2 plugin_interface_init()

Implement its set_ports() function.

Example 5.2 ags_echo_channel_plugin_interface_init()

```
void
ags_echo_channel_plugin_interface_init(AgsPluginInterface *plugin)
{
  ags_echo_channel_parent_plugin_interface = g_type_interface_peek_parent(plugin);

  plugin->set_ports = ags_echo_channel_set_ports;
}
```

5.1.3 set_ports()

Finally load the ports restored of XML file.

Example 5.3 ags_echo_channel_set_ports()

```
ags_echo_channel_set_ports(AgsPlugin *plugin, GList *port)
{
  while(port != NULL){
    if(!strncmp(AGS_PORT(port->data)->specifier,
                "./delay[0]\0",
                10)){
      g_object_set(G_OBJECT(plugin),
                   "delay\0", AGS_PORT(port->data),
                   NULL);
    }else if(!strncmp(AGS_PORT(port->data)->specifier,
                      "./repeat[0]\0",
                      11)){
      g_object_set(G_OBJECT(plugin),
                   "repeat\0", AGS_PORT(port->data),
                   NULL);
    }else if(!strncmp(AGS_PORT(port->data)->specifier,
                      "./fade[0]\0",
                      9)){
      g_object_set(G_OBJECT(plugin),
                   "fade\0", AGS_PORT(port->data),
                   NULL);
    }else if(!strncmp(AGS_PORT(port->data)->specifier,
                      "./dry[0]\0",
                      8)){
      g_object_set(G_OBJECT(plugin),
                   "dry\0", AGS_PORT(port->data),
                   NULL);
    }

    port = port->next;
  }
}
```

Appendix A

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Related projects

Here is a brief list of Advanced Gtk+ Sequencer's direct dependencies.

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- libasound2: ALSA, http://alsa-project.org
- ladspa-sdk: LADSPA, http://www.ladspa.org
- libsndfile1: Sndfile-1, http://www.mega-nerd.com/libsndfile
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