Goby v2

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Contents

1 Goby Underwater Autonomy Project

The Goby Underwater Autonomy Project aims to create a unified framework for multiple scientific autonomous marine vehicle collaboration, seamlessly incorporating acoustic, ethernet, wifi, and serial communications. Presently the main thrust of the project is developing a set of robust acoustic networking libraries. The Goby libraries are licensed under the GNU Lesser General Public License v3 http://www.gnu.org/licenses/lgpl.-html and the applications are licensed under the GNU General Public License v3 http://www.gnu.-org/licenses/gpl.html.

1.1 Resources

- Home page, code, bug tracking, and answers: https://launchpad.net/goby.
- User Manual: (pdf).
- Developers' Manual: (html) (pdf).
- Wiki: http://gobysoft.com/wiki.

1.2 Developer manual

- goby-acomms: An overview of Acoustic Communications Library - tackle the extremely rate limited acoustic networking problem. This library was designed with four modules that can operate independently for a developer looking integrate a specific component (e.g. just encoding/decoding) without committing to the entire goby-acomms stack.
- goby-util: Overview of Utility Libraries - provide utility functions for tasks such as logging, scientific calculations, string parsing, and serial device i/o. Goby also relies on the boost libraries http://www.boost.-org/ for many utility tasks to fill in areas where the C++ Standard Library is insufficient or unelegant.
- goby-moos: An overview of the Goby/MOOS interoperability library - classes, applications (e.g. pAcomms-Handler and iFrontSeat), and functions for interoperating between Goby and the MOOS middleware.

1.3 Publications

- T. Schneider and H. Schmidt, The Dynamic Compact Control Language: A Compact Marshalling Scheme for Acoustic Communications. IEEE OCEANS'10 / Sydney.
- T. Schneider and H. Schmidt, Goby-Acomms: A modular acoustic networking framework for short-range marine vehicle communication. Unpublished working paper.
- T. Schneider and H. Schmidt, Goby-Acomms version 2: extensible marshalling, queuing, and link layer interfacing for acoustic telemetry. 9th IFAC Conference on Manoeuvring and Control of Marine Craft '12 / Arenzano, Italy.
- T. Schneider, Advances in Integrating Autonomy with Acoustic Communications for Intelligent Networks of Marine Robots. PhD Thesis, MIT/WHOI Joint Program.

1.4 Download and Install Goby

Please visit http://gobysoft.com/wiki/InstallingGoby for help on obtaining and installing Goby.

1.5 Building Examples

Please visit http://gobysoft.com/wiki/Examples to learn about the available code examples for Goby.

1.6 Authors

Goby is developed by the Goby Developers group (https://launchpad.net/~goby-dev). The lead developer is Toby Schneider (http://gobysoft.com)

2 goby-acomms: An overview of Acoustic Communications Library

Table of Contents for goby-acomms: An overview of Acoustic Communications Library.

2.1 Quick Start

To get started using the goby-acomms libraries as quickly as possible:

1. If you haven't yet, follow instructions on installing Goby: http://gobysoft.com/wiki/-InstallingGoby.
2. Identify which components you need:
   - Encoding and decoding from C++ types to bit-packed messages: dccl.
   - Queuing of DCCL messages with priority based message selection: queue.
   - A driver for interacting with the acoustic modem firmware: modemdriver.
   - Time division multiple access (TDMA) medium access control (MAC): amac.
3. Look at the "simple" code examples that accompany each component (dccl_simple.cpp, queue_simple.cpp, driver_simple.cpp, amac_simple.cpp). Then look at the example that uses all the components together: chat.cpp. The full list of examples is given in this table.
4. Refer to the rest of the documentation as needed.

Please visit https://answers.launchpad.net/goby with any questions.

2.2 Overview

2.2.1 Analogy to established networking systems

To start on some (hopefully) common ground, let's begin with an analogy to Open Systems Initiative (OSI) networking layers in this table. For a complete description of the OSI layers see http://www.itu.int/rec/T-REC-X.200-199407-I/en.

OSI Layer	Goby-Acomms library component	API class(es)	Example(s)
Application	Not yet part of Goby		MOOS Application: pAcommsHandler
Presentation	dccl: Encoding and decoding	goby::acomms::DCCL-Codec	dccl_simple.cpp two_message.cpp chat.cpp
Session	Not used, sessions are established passively.		
Transport	queue: Priority based message queuing	goby::acomms::Queue-Manager	queue_simple.cpp chat.cpp
Network	Does not yet exist. All transmissions are considered single hop, currently. Addressing routing over multiple hops is an open and pressing research problem.		
Data Link	modemdriver: Modem driver	classes derived from goby::acomms::Modem-DriverBase; e.g. goby::acomms::MM-Driver	driver_simple.cpp chat.cpp
	amac: Medium Access Control (MAC)	goby::acomms::MAC-Manager	amac_simple.cpp chat.cpp
Physical	Not part of Goby		Modem Firmware, e.g. WHOI Micro-Modem Firmware (NMEA 0183 on RS-232) (see Interface Guide)

2.2.2 Acoustic Communications are slow

Do not take the previous analogy too literally; some things we are doing here for acoustic communications (hereafter, acomms) are unconventional from the approach of networking on electromagnetic carriers (hereafter, EM networking). The difference is a vast spread in the expected throughput of a standard internet hardware carrier and acoustic communications. For example, an optical fiber can put through greater than 10 Tbps over greater than 100 km, whereas the WHOI acoustic Micro-Modem can (at best) do 5000 bps over several km. This is a difference of thirteen orders of magnitude for the bit-rate distance product!

2.2.3 Efficiency to make messages small is good

Extremely low throughput means that essentially every efficiency in bit packing messages to the smallest size possible is desirable. The traditional approach of layering (e.g. TCP/IP) creates inefficiencies as each layer wraps the message of the higher layer with its own header. See RFC3439 section 3 ("Layering Considered Harmful")

for an interesting discussion of this issue http://tools.ietf.org/html/rfc3439#page-7. Thus, the "layers" of goby-acomms are more tightly interrelated than TCP/IP, for example. Higher layers depend on lower layers to carry out functions such as error checking and do not replicate this functionality.

2.2.4 Total throughput unrealistic: prioritize data

The second major difference stemming from this bandwidth constraint is that total throughput is often an unrealistic goal. The quality of the acoustic channel varies widely from place to place, and even from hour to hour as changes in the sea affect propagation of sound. This means that it is also difficult to predict what one's throughput will be at any given time.

These two considerations manifest themselves in the goby-acomms design as a priority based queuing system for the transport layer. Messages are placed in different queues based on their priority (which is determined by the designer of the message). This means that the channel is always utilized (low priority data are sent when the channel quality is high) but important messages are not swamped by low priority data. In contrast, TCP/IP considers all packets equally. Packets made from a spam email are given the same consideration as a high priority email from the President. This is a trade-off in efficiency versus simplicity that makes sense for EM networking, but does not for acoustic communications.

2.2.5 Despite all this, simplicity is good

The "law of diminishing returns" means that at some point, if we try to optimize excessively, we will end up making the system more complex without substantial gain. Thus, goby-acomms makes some concessions for the sake of simplicity:

- Numerical message fields are bounded by powers of 10, rather than 2. Humans deal much better with decimal than binary.

- User data splitting (and subsequent stitching) is not done. This is a key component of TCP/IP, but with the number of dropped packets one can expect with acomms, at the moment this does not seem like a good idea. The user is expected to provide data that is smaller or equal to the packet size of the physical layer (e.g. 32 - 256 bytes for the WHOI Micro-Modem).

2.2.6 Component model

A relatively simple component model for the goby-acomms library showing the interface classes :

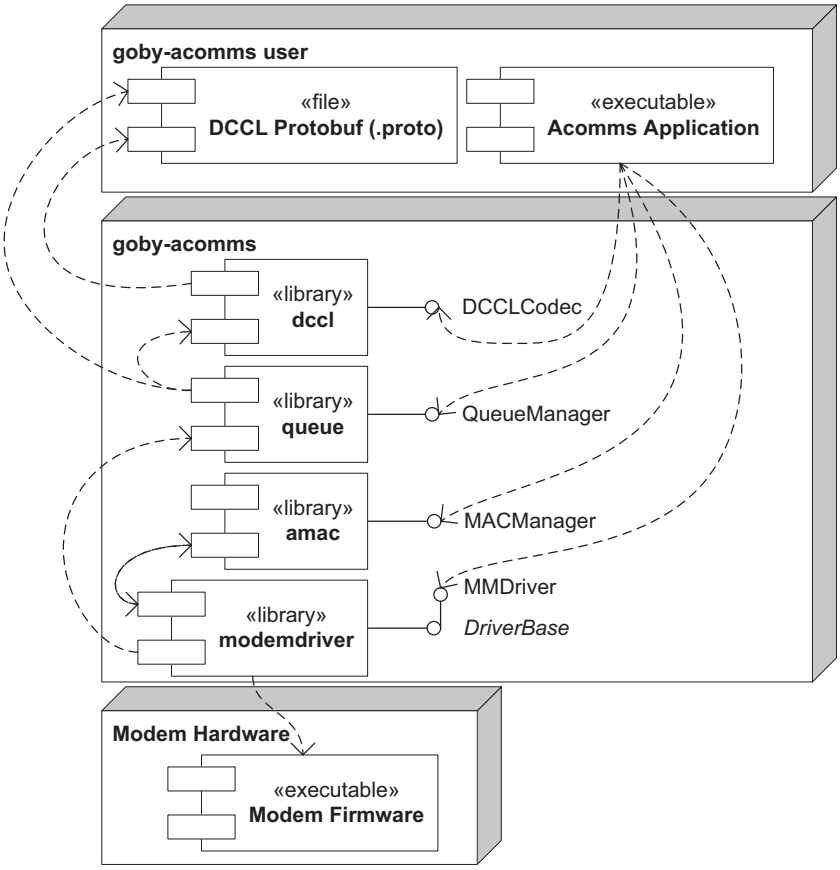

Figure 1: Basic overview of goby-acomms libraries.

For a more detailed model, see the UML models section.

2.3 dccl: Encoding and decoding

The Dynamic Compact Control Language (DCCL) provides a structure for defining messages to be sent through an acoustic modem. The messages are configured in Google Protocol Buffers and are intended to be easily reconfigurable, unlike the original CCL framework used in the REMUS vehicles and others (for information on CCL, see http://acomms.whoi.edu/ccl/.

Unlike the encoder / decoder provided with Google Protocol Buffers, each field (which could be a primitive type like double, int32, string or an user-defined embedded message like CTDMessage) of a DCCL message can be encoded using a DCCL built-in or user-defined encoder. This allows the codecs to be matched to the data's physical origins and thus make the most of the limited throughput available by making very small encoded messages.

Detailed documentation for goby-acomms: DCCL (Dynamic Compact Control Language).

2.4 queue: Priority based message queuing

The goby-acomms queuing (`queue`) component interacts with both the application level process and the modem driver process that talks directly to the modem.

On the application side, `queue` provides the ability for the application level process to push DCCL messages to various queues and receive messages from a remote sender that correspond to messages in the same queue (e.g. you have a queue for STATUS_MESSAGE that you can push messages to you and also receive other STATUS_MESSAGEs on). The push feature is called by the application level process and received messages are signaled to all previous bound slots (see Signal / Slot model for asynchronous events).

On the driver side, `queue` provides the modem driver with data upon request. It chooses the data to send based on dynamic priorities (and several other configuration parameters). It will also pack as many messages from the user into a single frame from the modem as possible using the DCCLCodec's repeated encoding functionality. Note, however, that `queue` will *not* split a user's data into frames (like TCP/IP). If this functionality is desired, it must be provided at the application layer. Acoustic communications are too unpredictable to reliably stitch together frames.

Detailed documentation for goby-acomms: queue (Message Priority Queuing).

2.5 modemdriver: Modem driver

The goby-acomms Modem driver component (`modemdriver`) of the Goby-Acomms library provides an interface from the rest of goby-acomms to the acoustic modem firmware. While currently the only driver publicly available is for the WHOI Micro-Modem (and for an example toy modem "ABCDriver"), this component is written in such a way that drivers for any acoustic modem that interfaces over a serial or TCP connection and can provide (or provide abstractions for) sending data directly to another modem on the link should be able to be written. Any one who is interested in writing a modem driver for another acoustic modem should get in touch with the goby project `https://launchpad.net/goby` and see Writing a new driver.

Detailed documentation for goby-acomms: modemdriver (Driver to interact with modem firmware).

2.6 amac: Medium Access Control (MAC)

The goby-acomms MAC component (amac) handles access to the shared medium, in our case the acoustic channel. We assume that we have a single (frequency) band for transmission so that if vehicles transmit simultaneously, collisions will occur between messaging. Therefore, we use time division multiple access (TDMA) schemes, or "slotting". Networks with multiple frequency bands will have to employ a different MAC scheme or augment amac for the frequency division multiple access (FDMA) scenario.

The Goby AMAC provides two basic types of TDMA:

- Decentralized: Each node initiates its own transaction at the appropriate time in the TDMA cycle. This requires reasonably well synchronized clocks (any skew must be included in the time of the slot as a guard, so skews of less than 0.1 seconds are generally acceptable.).
- Centralized (also called "polling"): For legacy support, "polling" is also provided. This is a TDMA enforced by a central computer (the "poller"). The "poller" sends a request for data from a list of nodes in sequential order. The advantage of polling is that synchronous clocks are not needed and the MAC scheme can be changed on short notice by the topside operator. Clearly this only works with modem hardware capable of third-party mediation of transmission (such as the WHOI Micro-Modem).

Detailed documentation for goby-acomms: amac (Medium Access Control).

2.7 Software concepts used in goby-acomms

2.7.1 Signal / Slot model for asynchronous events

The layers of goby-acomms use a signal / slot system for asynchronous events such as receipt of an acoustic message. Each signal can be connected (goby::acomms::connect()) to one or more slots, which are functions or member functions matching the signature of the signal. When the signal is emitted, the slots are called in order they were connected. To ensure synchronous behavior and thread-safety throughout goby-acomms, signals are only emitted during a call to a given component's API class do_work method (i.e. goby::acomms::ModemDriverBase-::do_work(), goby::acomms::QueueManager::do_work(), goby::acomms::MACManager::do_work()).

For example, if I want to receive data from `queue`, I need to connect to the signal QueueManager::signal_receive. Thus, I need to define a function or class method with the same signature:

```
void receive_data(const google::protobuf::Message& msg);
```

At startup, I then connect the signal to the slot:

```
goby::acomms::connect(&q_manager.signal_receive, &receive_data);
```

If instead, I was using a member function such as

```
class MyApplication
{
  public:
  void receive_data(const google::protobuf::Message& msg);

};
```

I would call connect (probably in the constructor for MyApplication) passing the pointer to the class:

```
MyApplication::MyApplication()
{
  goby::acomms::connect(&q_manager.signal_receive, this, &
      MyApplication::receive_data);
}
```

The Boost.Signals library is used without modification, so for details see http://www.boost.org/doc/libs/1_46_0/doc/html/signals.html. Member function binding is provided by Boost Bind http://www.boost.org/doc/libs/1_46_0/libs/bind/bind.html

2.7.2 Google Protocol Buffers

Google Protocol Buffers are used as a convenient way of generating data structures (basic classes with accessors, mutators). They can also be serialized efficiently, though this is not generally used within goby-acomms. Protocol buffers messages are defined in .proto files that have a C-like syntax:

```
message MyMessage
{
   optional uint32 a = 1;
   required string b = 2;
   repeated double c = 3;
}
```

The identifier "optional" means a proper MyMessage object may or may not contain that field. "required" means that a proper MyMessage always contains such a field. "repeated" means a MyMessage can contain a vector of this field (0 to n entries). The sequence number "= 1" must be unique for each field and determines the serialized format on the wire. For our purposes it is otherwise insignificant. See http://code.google.com/apis/protocolbuffers/docs/proto.html for full details.

The .proto file is pre-compiled into a C++ class that is loosely speaking (see http://code.google.com/apis/protocolbuffers/docs/reference/cpp-generated.html for precise details):

```
class MyMessage : public google::protobuf::Message
{
  public:
    MyMessage ();

    // set
    void set_a(unsigned a);
    void set_b(const std::string& b);
    void add_c(double c);

    // get
    unsigned a();
    std::string b();
    double c(int index);
    const RepeatedField<double>& c(); // RepeatedField ~= std::vector

    // has
    bool has_a();
    bool has_b();
    int c_size();
```

```
    // clear
    void clear_a();
    void clear_b();
    void clear_c();

  private:
    unsigned a_;
    std::string b_;
    RepeatedField<double> c_; // RepeatedField ~= std::vector
}
```

Clearly the .proto representation is more compact and amenable to easy modification. All the Protocol Buffers messages used in goby-acomms are placed in the goby::acomms::protobuf namespace for easy identification. This doxygen documentation does not understand Protocol Buffers language so you will need to look at the source code directly for the .proto (e.g. acomms_modem_message.proto).

2.8 UML models

Model that gives the sequence for sending a message with goby-acomms:

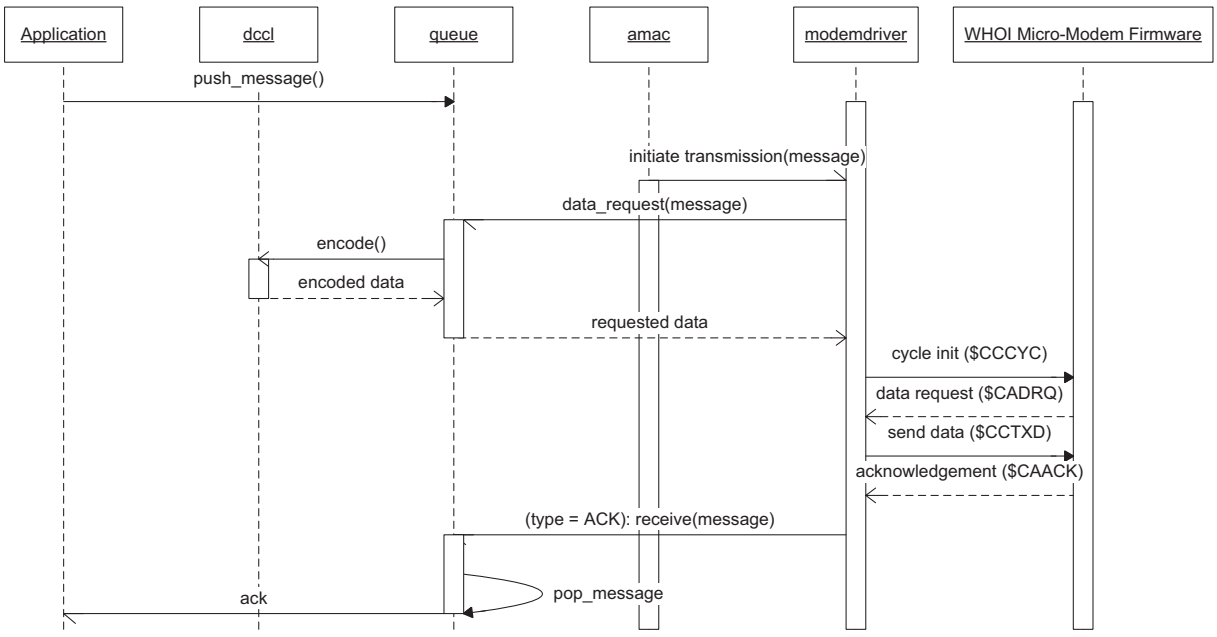

Figure 2: UML model that gives the sequence of calls required in sending a message using goby-acomms. The WHOI Micro-Modem is used as example firmware but the specific modemdriver-firmware interaction will depend on the acoustic modem used.

Model that shows the commands needed to start and keep goby-acomms running:

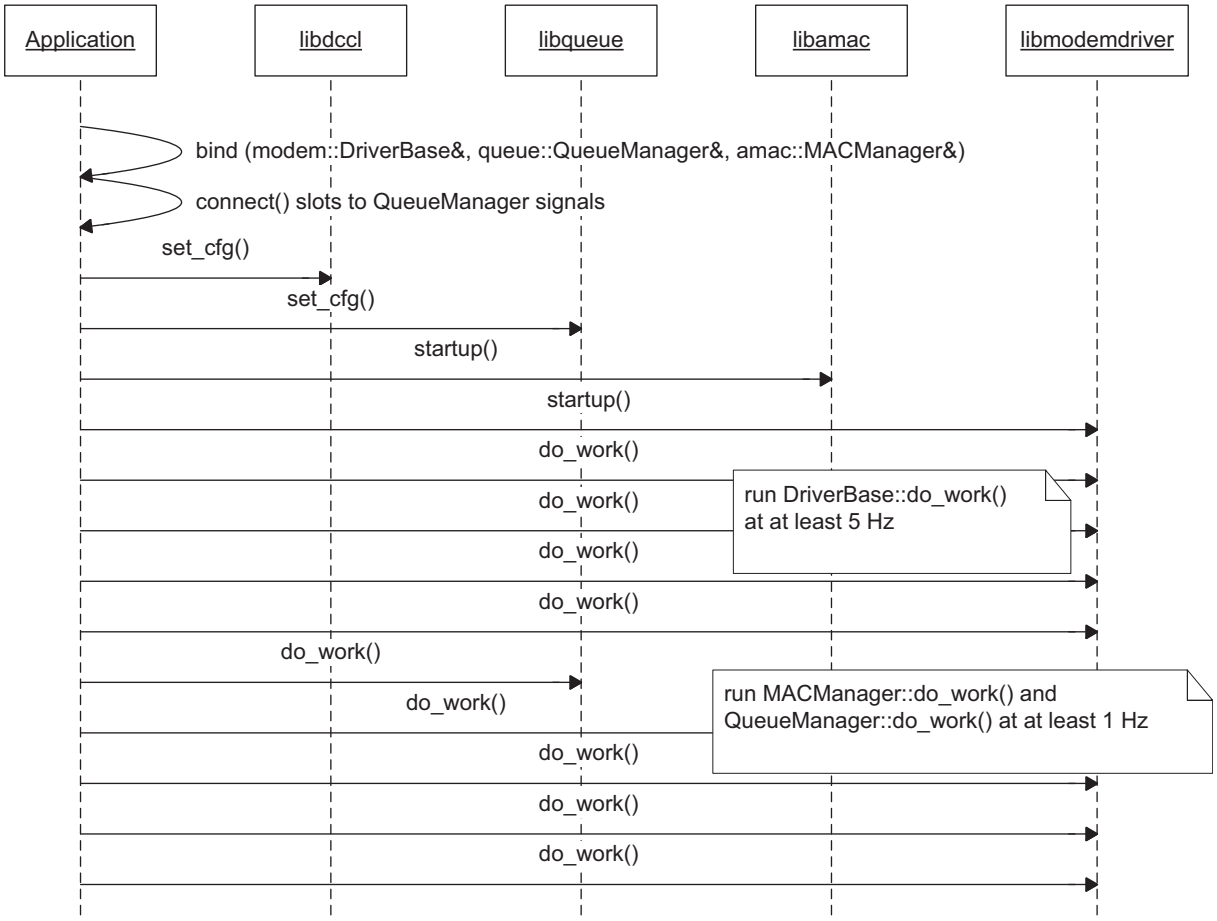

Figure 3: UML model that illustrates the set of commands needed to start up goby-acomms and keep it running.

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3 goby-acomms: DCCL (Dynamic Compact Control Language)

Table of contents for libdccl:

Return to goby-acomms: An overview of Acoustic Communications Library.

3.1 Designing a message

DCCL uses the Google Protocol Buffers (Protobuf) language to define messages. DCCL specific components are defined as extensions to the Protobuf language message and field options. You should familiarize yourself with basic Protobuf using before reading the rest of this document: see Google Protocol Buffers and `http://code.google.com/apis/protocolbuffers/docs/overview.html`.

Scenario 1: Send a string command to a vehicle:

We need to send an ASCII string command to an underwater vehicle. We thus make a Protobuf message with a single string field (let's call it "telegram") to hold our command:

```
message Simple
{
  required string telegram = 1;
}
```

The "= 1" indicates that this is the first field on the wire in our DCCL message. All fields must have a unique index, but otherwise these index values are not particularly important. "required" means a valid "Simple" message always contains something for "telegram" (could be an empty string).

To turn this Protobuf message into a DCCL message, we need to add a few options. All the options are defined in acomms_option_extensions.proto so we include that:

```
import "goby/common/protobuf/option_extensions.proto";

message Simple
{
  required string telegram = 1;
}
```

At a minimum we must give a unique ID for our DCCL message and a maximum number of bytes we allow the message to be before throwing an exception when it is loaded. This allows us to ensure that we are not creating messages larger than we can send with the physical hardware. We want to have the ability to use the lowest rate WHOI Micro-Modem message size, so we pick max_bytes to be 32. We are testing so we'll use an id of 124. See http://gobysoft.org/wiki/DcclIdTable for a list of the assigned DCCL IDs.

After these additions we have:

```
import "goby/common/protobuf/option_extensions.proto";

message Simple
{
  option (dccl.msg).id = 124;
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1;
}
```

Finally, we need to pick an encoder/decoder (codec) for each field in our message. DCCL comes with defaults for all the Protobuf types. So if we don't specifically list a codec for a given field, the default is used. The default "string" codec is goby::acomms::DCCLDefaultStringCodec and is variable length. It uses one byte to list the length of the string and then up to 255 bytes to hold the contents. To ensure we stay within our bounds for the entire message (`(goby.msg).dccl.max_bytes = 32`), we have to give a maximum allowed length for a string when using the DCCLDefaultStringCodec (`(goby.field).dccl.max_length`).

```
import "dccl/protobuf/option_extensions.proto";

message Simple
{
  // see http://gobysoft.org/wiki/DcclIdTable
  option (dccl.msg).id = 124;

  // if, for example, we want to use on the WHOI Micro-Modem rate 0
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=30];
}
```

See dccl_simple.cpp for an example of how to use this message.

Scenario 2: Send a more realistic command and receive a status message from the vehicle:

We want to be able to command our vehicle (to which we have assigned an ID number of "2") to go to a specific point on a local XY grid (meters from some known latitude / longitude), but no more than 10 kilometers from the datum. We also want to be able to turn the lights on or off, and send a short string for other new instructions. Finally, we need to be able to command a speed. Our vehicle can move no faster than 3 m/s, but its control is precise enough to handle hundredths of a m/s (wow!). It's probably easiest to make a table with our conditions:

message variable name	description	type	bounds
destination	id number of the vehicle we are commanding	int32	[0, 31]
goto_x	meters east to transit from datum	int32	[0, 10000]
goto_y	meters north to transit from datum	int32	[0, 10000]
lights_on	turn on the lights?	bool	
new_instructions	string instructions	string	no longer than 10 characters
goto_speed	transit speed (m/s)	float	[0.00, 3.00]

Taking all this into account, we form the first message (named GoToCommand) in the file two_message.proto (see Two Message example)

We choose a `dccl.id` of 125 to avoid conflicting with the message from Scenario 1 (simple.proto) and a `dccl.max_bytes` of 32 bytes to again allow sending in the WHOI Micro-Modem rate 0 packet.

Now, for the second message in two_message.proto. We want to receive the vehicle's present position and its current health, which can either be "good", "low_battery" or "abort". We make a similar table to before:

message variable name	description	type	bounds
nav_x	current vehicle position (meters east of the datum)	integer	[0, 10000]
nav_y	current vehicle position (meters north of the datum)	integer	[0, 10000]
health	vehicle state	enumeration	HEALTH_GOOD, HEALTH_LOW_BATTERY, or HEALTH_ABORT

The resulting message, can be seen under Two Message example. An example of how to use this message is given under two_message.cpp.

You can run `analyze_dccl` to view more information on your messages:

```
> analyze_dccl /path/to/two_message.proto
```

When I ran the above command I got:

```
read in: two_message.proto
=== Begin DCCLCodec ===
2 messages loaded.
= Begin GoToCommand =
Actual maximum size of message: 18 bytes / 144 bits [dccl.id head: 8, user head: 0, body: 131, padding: 5]
Allowed maximum size of message: 32 bytes / 256 bits
== Begin Header ==
== End Header ==
== Begin Body ==
GoToCommand
 required int32 destination = 1;
 :: size = 5 bit(s)
 required int32 goto_x = 3;
 :: size = 14 bit(s)
 required int32 goto_y = 4;
 :: size = 14 bit(s)
 required bool lights_on = 5;
 :: size = 1 bit(s)
 required string new_instructions = 6;
```

```
 :: min size = 8 bit(s)
 :: max size = 88 bit(s)
 required double goto_speed = 7;
 :: size = 9 bit(s)
:: min size = 51 bit(s)
:: max size = 131 bit(s)
== End Body ==
= End GoToCommand =
= Begin VehicleStatus =
Actual maximum size of message: 6 bytes / 48 bits [dccl.id head: 8, user head: 0, body: 36, padding: 4]
Allowed maximum size of message: 32 bytes / 256 bits
== Begin Header ==
== End Header ==
== Begin Body ==
VehicleStatus
 required double nav_x = 1;
 :: size = 17 bit(s)
 required double nav_y = 2;
 :: size = 17 bit(s)
 required .VehicleStatus.HealthEnum health = 3;
 :: size = 2 bit(s)
:: size = 36 bit(s)
== End Body ==
= End VehicleStatus =
=== End DCCLCodec ===
```

Besides validity checking, the most useful feature of `analyze_dccl` is the calculation of the size (in bits) of each message variable. This lets you see which fields in the message are too big. To make fields smaller, tighten up bounds.

3.2 DCCL Protobuf Options

This section gives an overview of the DCCL message and field options available for use with DCCL and the default field codecs. The full list is available in option_extensions.proto (as messages DCCLFieldOptions and DCCLMessageOptions).

DCCL message options:

name	type	default	description
id	uint32	*required*	A unique ID for each DCCL message
max_bytes	uint32	*required*	Maximum allowed size in bytes for the encoded message
codec	string	"_default"	Name of the codec to use for encoding the base message (add more codecs with goby-::acomms::DCCLFieldCodecManager::add())

DCCL field options:

name	type	default	required for codecs	description
codec	string	"_default"	optional	Name of the codec to use for encoding this field
omit	bool	false	optional	Omit this field from all DCCL encoding (has_field() will be false on receipt)

in_head	bool	false	optional	Set true for fields in the header (will *not* be encrypted, rather will be used to create the encrytion IV).
precision	int32	0	goby::acomms::DCCLDefaultNumericFieldCodec (double, float)	Number of decimal digits of precision to keep (can be negative).
min	double	0	goby::acomms::DCCLDefaultNumericFieldCodec (double, float, int32, uint32, int64, uint64, fixed32, fixed64, sfixed32, sfixed64)	Minimum value that can be encoded in this field.
max	double	0	goby::acomms::DCCLDefaultNumericFieldCodec (double, float, int32, uint32, int64, uint64, fixed32, fixed64, sfixed32, sfixed64)	Maximum value that can be encoded in this field.
static_value	string	""	goby::acomms::DCCLStaticCodec (any type)	The static value for use on decoding this placeholder field.
max_length	uint32	0	goby::acomms::DCCLDefaultStringCodec, goby::acomms::DCCLDefaultBytesCodec (string)	The maximum length of the string that can be stored in this field.
max_repeat	uint32	0	any `repeated` field	The maximum length of the `repeated` array (or vector).

3.3 Interacting with the DCCLCodec

Using the goby::acomms::DCCLCodec is a fairly straightforward endeavor (this example uses dccl_simple.cpp). First you need to get a pointer to the DCCLCodec singleton:

```
goby::acomms::DCCLCodec* codec = goby::acomms::DCCLCodec::get();
```

Validate all messages with the DCCLCodec to ensure all bounding constraints are met:

```
try
{
  dccl->validate<Simple>();
}
catch(DCCLException& e)
{
  std::cerr << "Oh no! " << e << std::endl;
  exit(1);
}
```

Then, to encode a message, create a Protobuf message, set its fields and pass it to goby::acomms::DCCLCodec::encode():

```
Simple message;
message.set_telegram("hello");
std::string bytes;
dccl->encode(&bytes, message);
```

`bytes` will now contain the encoded message in the form of a byte string (each char will contain a single byte of the message).

You may now send this message through whatever channel you would like.

To decode a message (stored in `bytes` as a byte string), simply pass bytes as a reference along with pointers to the Protobuf message to store the results.

```
message.Clear();
dccl->decode(bytes, &message);
```

For line by line interaction with the goby::acomms::DCCLCodec and for advanced use, investigate the code examples given in the Examples column of this table.

3.4 Encryption

Encryption of all messages can be enabled by providing a secret passphrase to the goby::acomms::protobuf::DCCLConfig object passed to goby::acomms::DCCLCodec::set_cfg(). All parties to the communication must have the same secret key.

DCCL provides AES (Rijndael) encryption for the body of the message. The header, which is sent in plain text, is hashed to form an initialization vector (IV), and the passphrase is hashed using SHA-256 to form the cipher key. You will want to make sure the header (designate fields for the header with `(goby.field).dccl.in_head = true`) is a nonce by including a constantly changing value such as time.

AES is considered secure and is used for United States top secret information.

3.5 Example messages

This section provides a listing of DCCL example Protobuf messages used in the code examples and unit tests.

3.5.1 Minimal functional DCCL message

simple.proto

```
import "dccl/protobuf/option_extensions.proto";

message Simple
{
  // see http://gobysoft.org/wiki/DcclIdTable
  option (dccl.msg).id = 124;

  // if, for example, we want to use on the WHOI Micro-Modem rate 0
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=30];
}
```

See Also

dccl_simple.cpp

3.5.2 Two Message example

two_message.proto

```
import "dccl/protobuf/option_extensions.proto";
message GoToCommand
{
  option (dccl.msg).id = 125;
  option (dccl.msg).max_bytes = 32;
  required int32 destination = 1 [(dccl.field).max=31,
                                  (dccl.field).min=0,
                                  (dccl.field).precision=0];
  optional string type = 2 [(dccl.field).static_value="goto",
                            (dccl.field).codec="_static"];
  required int32 goto_x = 3 [(dccl.field).max=10000,
                             (dccl.field).min=0,
                             (dccl.field).precision=0];
  required int32 goto_y = 4 [(dccl.field).max=10000,
                             (dccl.field).min=0,
                             (dccl.field).precision=0];
  required bool lights_on = 5;
  required string new_instructions = 6 [(dccl.field).max_length=10];
  required double goto_speed = 7 [(dccl.field).max=3,
                                  (dccl.field).min=0,
                                  (dccl.field).precision=2];
}

message VehicleStatus
{
  option (dccl.msg).id = 126;
  option (dccl.msg).max_bytes = 32;
  required double nav_x = 1 [(dccl.field).max=10000,
                             (dccl.field).min=0,
                             (dccl.field).precision=1];
  required double nav_y = 2 [(dccl.field).max=10000,
                             (dccl.field).min=0,
                             (dccl.field).precision=1];
  required HealthEnum health = 3;
  enum HealthEnum {
    HEALTH_GOOD = 0;
    HEALTH_LOW_BATTERY = 1;
    HEALTH_ABORT = 2;
  }
}
```

See Also

two_message.cpp

Test1 showing all Protobuf types (using default codecs):

dccl1/test.proto

```
import "dccl/protobuf/option_extensions.proto";


enum Enum1
{
  ENUM_A = 1;
  ENUM_B = 2;
  ENUM_C = 3;
}

message EmbeddedMsg1
{
  optional double val = 1 [(dccl.field).min=0,
                           (dccl.field).max=126,
                           (dccl.field).precision=3];
  optional EmbeddedMsg2 msg = 2;
}
```

```
message EmbeddedMsg2
{
  optional double val = 1 [(dccl.field).min=0,
                           (dccl.field).max=126,
                           (dccl.field).precision=2];
  optional string sval = 2 [(dccl.field).max_length=10];
  optional Enum1 enum_default = 3;
}

message TestMsg
{
  option (dccl.msg).id = 2;
  option (dccl.msg).max_bytes = 512;

  // test default enc/dec
  optional double double_default_optional = 1 [(dccl.field).min=-100,
                                       (dccl.field).max=126,
                                       (dccl.field).precision=2,
                                       (dccl.field).in_head=true];
  optional float float_default_optional = 2 [(dccl.field).min=-20,
                                       (dccl.field).max=150,
                                       (dccl.field).precision=3];
  optional int32 int32_default_optional = 3 [(dccl.field).min=-20,
                                       (dccl.field).max=3000];
  optional int64 int64_default_optional = 4 [(dccl.field).min=-710,
                                       (dccl.field).max=3000];
  optional uint32 uint32_default_optional = 5 [(dccl.field).min=0,
                                       (dccl.field).max=3000];
  optional uint64 uint64_default_optional = 6 [(dccl.field).min=5,
                                       (dccl.field).max=3000];
  optional sint32 sint32_default_optional = 7 [(dccl.field).min=-60,
                                       (dccl.field).max=3000];
  optional sint64 sint64_default_optional = 8 [(dccl.field).min=-70,
                                       (dccl.field).max=3000];
  optional fixed32 fixed32_default_optional = 9 [(dccl.field).min=0,
                                       (dccl.field).max=400];
  optional fixed64 fixed64_default_optional = 10 [(dccl.field).min=0,
                                       (dccl.field).max=3000];
  optional sfixed32 sfixed32_default_optional = 11 [(dccl.field).min=11,
                                       (dccl.field).max=3000];
  optional sfixed64 sfixed64_default_optional = 12 [(dccl.field).min=-12,
                                       (dccl.field).max=3000];

  optional bool bool_default_optional = 13;

  optional string string_default_optional = 14 [(dccl.field).max_length=8];
  optional bytes bytes_default_optional = 15 [(dccl.field).max_length=9];

  optional Enum1 enum_default_optional = 16;

  optional EmbeddedMsg1 msg_default_optional = 17;


  required double double_default_required = 21 [(dccl.field).min=-100,
                                       (dccl.field).max=126,
                                       (dccl.field).precision=2,
                                       (dccl.field).in_head=true];
  required float float_default_required = 22 [(dccl.field).min=-20,
                                       (dccl.field).max=150,
                                       (dccl.field).precision=3];
  required int32 int32_default_required = 23 [(dccl.field).min=-20,
                                       (dccl.field).max=3000];
  required int64 int64_default_required = 24 [(dccl.field).min=-710,
                                       (dccl.field).max=3000];
  required uint32 uint32_default_required = 25 [(dccl.field).min=0,
                                       (dccl.field).max=3000];
  required uint64 uint64_default_required = 26 [(dccl.field).min=5,
                                       (dccl.field).max=3000];
  required sint32 sint32_default_required = 27 [(dccl.field).min=-60,
                                       (dccl.field).max=3000];
  required sint64 sint64_default_required = 28 [(dccl.field).min=-70,
                                       (dccl.field).max=3000];
  required fixed32 fixed32_default_required = 29 [(dccl.field).min=0,
```

```
                                    (dccl.field).max=400];
  required fixed64 fixed64_default_required = 30 [(dccl.field).min=0,
                                    (dccl.field).max=3000];
  required sfixed32 sfixed32_default_required = 31 [(dccl.field).min=11,
                                    (dccl.field).max=3000];
  required sfixed64 sfixed64_default_required = 32 [(dccl.field).min=-120,
                                    (dccl.field).max=3000];

  required bool bool_default_required = 33;

  required string string_default_required = 34 [(dccl.field).max_length=8];
  required bytes bytes_default_required = 35 [(dccl.field).max_length=9];

  required Enum1 enum_default_required = 36;

  required EmbeddedMsg1 msg_default_required = 37;

  repeated double double_default_repeat = 101 [(dccl.field).min=0,
                                               (dccl.field).max=100,
                                               (dccl.field).precision=3,
                                               (dccl.field).max_repeat=4];
  repeated float float_default_repeat = 102 [(dccl.field).min=0,
                                             (dccl.field).max=100,
                                             (dccl.field).precision=3,
                                             (dccl.field).max_repeat=4];

  repeated int32 int32_default_repeat = 103 [(dccl.field).min=0,
                                            (dccl.field).max=100,
                                            (dccl.field).max_repeat=4];
  repeated int64 int64_default_repeat = 104 [(dccl.field).min=-100,
                                            (dccl.field).max=100,
                                            (dccl.field).max_repeat=4];
  repeated uint32 uint32_default_repeat = 105 [(dccl.field).min=0,
                                              (dccl.field).max=100,
                                              (dccl.field).max_repeat=4,
                                              (dccl.field).in_head=true];
  repeated uint64 uint64_default_repeat = 106 [(dccl.field).min=0,
                                              (dccl.field).max=100,
                                              (dccl.field).max_repeat=4];
  repeated sint32 sint32_default_repeat = 107 [(dccl.field).min=-60,
                                              (dccl.field).max=100,
                                              (dccl.field).max_repeat=4];
  repeated sint64 sint64_default_repeat = 108 [(dccl.field).min=-600,
                                              (dccl.field).max=100,
                                              (dccl.field).max_repeat=4];
  repeated fixed32 fixed32_default_repeat = 109 [(dccl.field).min=0,
                                                (dccl.field).max=100,
                                                (dccl.field).max_repeat=4];
  repeated fixed64 fixed64_default_repeat = 110 [(dccl.field).min=0,
                                                (dccl.field).max=100,
                                                (dccl.field).max_repeat=4];
  repeated sfixed32 sfixed32_default_repeat = 111 [(dccl.field).min=0,
                                                  (dccl.field).max=100,
                                                  (dccl.field).max_repeat=4];
  repeated sfixed64 sfixed64_default_repeat = 112 [(dccl.field).min=-500,
                                                  (dccl.field).max=100,
                                                  (dccl.field).max_repeat=4];

  repeated bool bool_default_repeat = 113 [(dccl.field).max_repeat=4];

  repeated string string_default_repeat = 114 [(dccl.field).max_length=4, (dccl.field).max_repeat=4];
  repeated bytes bytes_default_repeat = 115 [(dccl.field).max_length=4, (dccl.field).max_repeat=4];

  repeated Enum1 enum_default_repeat = 116 [(dccl.field).max_repeat=4];

  repeated EmbeddedMsg1 msg_default_repeat = 117 [(dccl.field).max_repeat=4];
}
```

See Also

dccl1/test.cpp

3.5.3 DCCL Test2 showing an embedded message encoded by a custom (non-default) codec

dccl2/test.proto

```
import "dccl/protobuf/option_extensions.proto";


message CustomMsg
{
  option (dccl.msg).id = 3;
  option (dccl.msg).max_bytes = 256;
  option (dccl.msg).codec = "custom_codec";

  optional uint32 a = 1;
  optional bool b = 2;
}


message CustomMsg2
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 256;

  optional CustomMsg msg = 1;
  repeated int32 c = 3 [(dccl.field).max=100,
                        (dccl.field).min=0,
                        (dccl.field).max_repeat=4,
                        (dccl.field).codec="int32_test_codec"];
}
```

See Also

dccl2/test.cpp

3.5.4 DCCL Test3

dccl3/test.proto

```
import "goby/common/protobuf/option_extensions.proto";
import "dccl/protobuf/option_extensions.proto";
import "goby/test/acomms/dccl3/header.proto";

message GobyMessage
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=10];
  required Header header = 2;
}
```

protobuf/header.proto

```
import "goby/common/protobuf/option_extensions.proto";
import "dccl/protobuf/option_extensions.proto";

// required fields will be filled in for you by ApplicationBase
// if you choose not to do so yourself
message Header
{
  //
  // time
  //

  // result of goby::util::as<std::string>(goby_time())
  // e.g. "2002-01-20 23:59:59.000"
  required string time = 10 [(dccl.field).codec="_time",
```

```
                              (dccl.field).in_head=true];

  //
  // source
  //
  required string source_platform = 11 [(dccl.field).codec="_platform<->modem_id",
                                        (dccl.field).in_head=true];
  optional string source_app = 12 [(dccl.field).omit=true];

  //
  // destination
  //
  enum PublishDestination { PUBLISH_SELF = 1; PUBLISH_OTHER = 2; PUBLISH_ALL = 3; }
  optional PublishDestination dest_type = 13 [default = PUBLISH_SELF, (dccl.field).in_head=true];

  optional string dest_platform = 14 [(dccl.field).codec="_platform<->modem_id",
                                      (dccl.field).in_head=true]; // required if dest_type == other

}
```

See Also

dccl3/test.cpp

3.5.5 DCCL Test4

dccl4/test.proto

```
import "dccl/protobuf/option_extensions.proto";
import "goby/test/acomms/dccl3/header.proto";

message GobyMessage1
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 32;

  optional int32 int32_val = 1 [(dccl.field).min=0, (dccl.field).max=20];
}

message GobyMessage2
{
  option (dccl.msg).id = 5;
  option (dccl.msg).max_bytes = 32;

  optional bool bool_val = 1;
}

message GobyMessage3
{
  option (dccl.msg).id = 6;
  option (dccl.msg).max_bytes = 32;

  optional string string_val = 1 [(dccl.field).max_length=10];
}
```

See Also

dccl4/test.cpp

3.5.6 DCCL Test5

dccl5/test.proto

See Also

dccl5/test.cpp

3.5.7 DCCL Test6

dccl6/test.proto

```
import "dccl/protobuf/option_extensions.proto";

message ShortIDMsg
{
  option (dccl.msg).id = 2;
  option (dccl.msg).max_bytes = 1;
}

message ShortIDMsgWithData
{
  option (dccl.msg).id = 3;
  option (dccl.msg).max_bytes = 10;

  optional int32 in_head = 1 [(dccl.field).in_head=true, (dccl.field).min=0, (dccl.field).max=100];
  optional int32 in_body = 2 [(dccl.field).in_head=true, (dccl.field).min=0, (dccl.field).max=100];
}

message LongIDMsg
{
  option (dccl.msg).id = 10000;  option (dccl.msg).max_bytes = 2;
}

message TooLongIDMsg
{
  option (dccl.msg).id = 32768;
  option (dccl.msg).max_bytes = 32;
}

message LongIDEdgeMsg
{
  option (dccl.msg).id = 128;
  option (dccl.msg).max_bytes = 2;
}

message ShortIDEdgeMsg
{
  option (dccl.msg).id = 127;
  option (dccl.msg).max_bytes = 1;
}
```

See Also

dccl6/test.cpp

3.5.8 DCCL Test7

dccl7/test.proto

```
import "dccl/protobuf/option_extensions.proto";

message BytesMsg
{
  option (dccl.msg).id = 10;
  option (dccl.msg).max_bytes = 32;

  required bytes req_bytes = 1 [(dccl.field).max_length=8];
  optional bytes opt_bytes = 2 [(dccl.field).max_length=8];
}
```

See Also

dccl7/test.cpp

3.5.9 DCCL Test8

dccl8/test.proto

```
import "dccl/protobuf/option_extensions.proto";
import "goby/test/acomms/dccl3/header.proto";

message GobyMessage1
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 32;

  optional int32 int32_val = 1 [(dccl.field).min=0, (dccl.field).max=20];
}

message GobyMessage2
{
  option (dccl.msg).id = 5;
  option (dccl.msg).max_bytes = 32;

  optional bool bool_val = 1;
}

message GobyMessage3
{
  option (dccl.msg).id = 6;
  option (dccl.msg).max_bytes = 32;

  optional string string_val = 1 [(dccl.field).max_length=10];
}
```

See Also

dccl8/test.cpp

3.5.10 DCCL Test9

dccl9/test.proto

```
import "dccl/protobuf/option_extensions.proto";

message MiniUser
{
  option (dccl.msg).id = 1000001;
  option (dccl.msg).max_bytes = 2;

  required uint32 user = 1 [(dccl.field).min=0,
                            (dccl.field).max=0x03FF,
                            (dccl.field).in_head=true];
}

message MiniOWTT
{
  option (dccl.msg).id = 1000002;
  option (dccl.msg).max_bytes = 2;

  required uint32 clock_mode = 1 [(dccl.field).min=0,
                                  (dccl.field).max=3,
                                  (dccl.field).in_head=true];

  required uint32 tod = 2 [(dccl.field).min=0,
                           (dccl.field).max=0x0F,
                           (dccl.field).in_head=true];

  required uint32 user = 3 [(dccl.field).min=0,
                            (dccl.field).max=0x0F,
                            (dccl.field).in_head=true];
}

message MiniAbort
```

```
{
  option (dccl.msg).id = 1000003;
  option (dccl.msg).max_bytes = 2;

  required uint32 user = 1 [(dccl.field).min=0,
                            (dccl.field).max=0x03FF,
                            (dccl.field).in_head=true];
}

message NormalDCCL
{
  option (dccl.msg).id = 1;
  option (dccl.msg).max_bytes = 32;

  required int32 a = 1 [(dccl.field).min=0,
                        (dccl.field).max=0xFFFF];
  required int32 b = 2 [(dccl.field).min=0,
                        (dccl.field).max=0xFFFF];

}
```

See Also

dccl9/test.cpp

4 goby-acomms: queue (Message Priority Queuing)

Table of Contents for `queue`:

Return to goby-acomms: An overview of Acoustic Communications Library.

4.1 Understanding dynamic priority queuing

Each queue has a base value (V_{base}) and a time-to-live (ttl) that create the priority ($P(t)$) at any given time (t):

$$P(t) = V_{base} \frac{(t - t_{last})}{ttl}$$

where t_{last} is the time of the last send from this queue.

This means for every queue, the user has control over two variables (V_{base} and ttl). V_{base} is intended to capture how important the message type is in general. Higher base values mean the message is of higher importance. The ttl governs the number of seconds the message lives from creation until it is destroyed by `queue`. The ttl also factors into the priority calculation since all things being equal (same V_{base}), it is preferable to send more time sensitive messages first. So in these two parameters, the user can capture both overall value (i.e. V_{base}) and latency tolerance (ttl) of the message queue.

The following graph illustrates the priority growth over time of three queues with different ttl and V_{base}. A message is sent every 100 seconds and the queue that is chosen is marked on the graph.

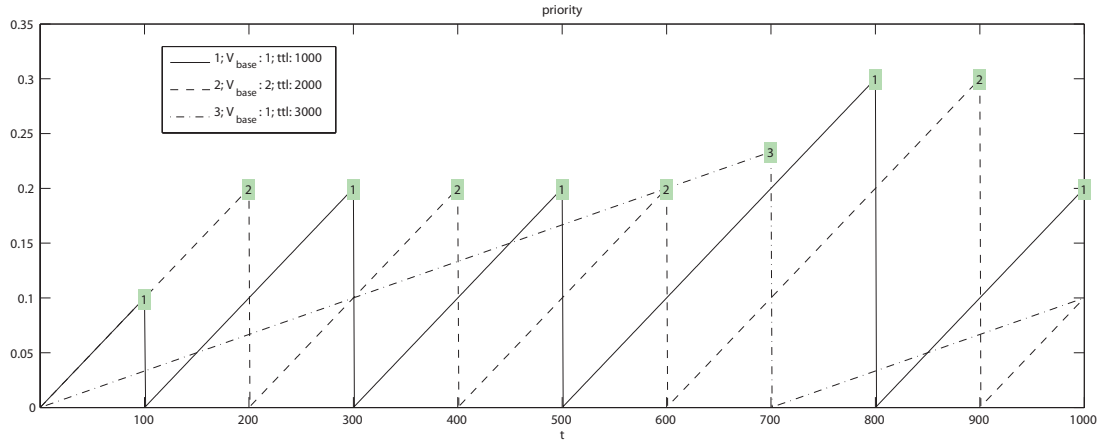


Figure 4: Graph of the growth of queueing priorities for `queue` for three different queues. A message is sent every 100 seconds from the %queue with the highest priority (numbered on the graph).

4.2 Queuing Protobuf Options

This section gives an overview of the `queue` configuration options available. The full list is available in queue.proto (as messages goby::acomms::protobuf::QueuedMessageEntry).

`Queue` message options:

name	type	default	description
ack	bool	true	Whether an acoustic acknowledgment should be requested for messages sent from this queue.
blackout_time	uint32	0	Minimum number of seconds allowed between sending messages from this queue.
max_queue	uint32	0	Allowed size of the queue before overflow. If *newest_first* is true, the oldest elements are removed upon overflow, else the newest elements are (the queue blocks). 0 is a special value signifying infinity (no maximum).

newest_first	bool	true	(true=FILO, false=FIFO) whether to send newest messages in the queue first (FILO) or not (FIFO).
ttl	int32	1800	the time in seconds a message lives after its creation before being discarded. This time-to-live also factors into the growth in priority of a queue. see value_base for the main discussion on this. 0 is a special value indicating infinite life (i.e. ttl = 0 is effectively the same as ttl = ∞)
value_base	double	1	base priority value for this message queue. priorities are calculated on a request for data by the modem (to send a message). The queue with the highest priority (and isn't in blackout) is chosen. The actual priority (P) is calculated by $P(t) = V_{base}\frac{(t-t_{last})}{ttl}$ where V_{base} is the value set here, t is the current time (in seconds), t_{last} is the time of the last send from this queue, and ttl is the ttl option. Essentially, a message with low ttl will become effective quickly again after a sent message (the priority line grows faster). See Understanding dynamic priority queuing for further discussion.

encode_on_demand	bool	false	(Advanced) enable on-demand encoding where rather than queueing data, the data request is forwarded up to the application level via the signal goby::acomms::QueueManager::signal_data_on_demand
on_demand_skew_seconds	double	1	(Advanced) if encode_on_demand == true, this sets the number of seconds before data encoded on demand are considering stale and thus must be demanded again with the signal goby::acomms::QueueManager::signal_data_on_demand. Setting this to 0 is unadvisable as it will cause many calls to goby::acomms::QueueManager::signal_data_on_demand and thus waste CPU cycles needlessly encoding.

`Queue` Role options: Queue needs to know how to address a message (the source ID and destination ID) as well as the time the message was generated. This information either read from the fields of the of the DCCL message (setting: FIELD_VALUE) or is statically configured (setting: STATIC). In the latter case, the configuration value "static_value" is set and used for every DCCL message of this type that gets queued by this QueueManager.

In the former case (the default), you can tag a given field of a DCCL message to a particular "role." This takes the place of a fixed transport layer header that protocols such as UDP use. The fields used in a given role can be anywhere within the message. The field is identified by its name (in the configuration value "field"). Submessage fields can be used by separating the field names by periods (".") until the child is a primitive type (e.g. uint32).

RoleType	**allowed field types**	**description**
SOURCE_ID	All integer types (uint32, int32, uint64, int64, ...)	The value in this field is used to represent the sending address (similar to an IP address) of the message.
DESTINATION_ID	All integer types (uint32, int32, uint64, int64, ...)	The value in this field is used to represent the destination address (similar to an IP address) of the message. 0 is reserved to indicate broadcast.
TIMESTAMP	uint64 or double	The value in this field is used as the timestamp of the message. If the type is double, it must be seconds (and fractional seconds) since the UNIX epoch (1970-01-01 midnight UTC). If it is a uint64, it must be microseconds since the UNIX epoch. This field used for expiring messages that exceed their ttl and thus must, in general, be set and correct.

4.3 Interacting with the QueueManager

4.3.1 Instantiate and configure

The goby::acomms::QueueManager is configured similarly to the goby::acomms::DCCLCodec. You need to set a unique identification number for this platform (the "modem ID") through the goby::acomms::protobuf::QueueManagerConfig .

You can configure queues by added repeated fields to the QueueManagerConfig's message_entry field, or by calling goby::acomms::QueueManager::add_queue() directly.

When using goby::acomms::QueueManager you will not likely need to use the goby::acomms::DCCLCodec directly much at all. All messages are pushed to the queues unencoded and are encoded automatically by goby::acomms::QueueManager before sending. Likewise, all messages received are decoded before being provided on the signal goby::acomms::QueueManager::signal_receive.

For example, this code configures the QueueManager with a single queue (DCCL type GobyMessage)

```
goby::acomms::protobuf::QueueManagerConfig cfg;
cfg.set_modem_id(our_id);
goby::acomms::protobuf::QueuedMessageEntry* q_entry = cfg.add_message_entry();
q_entry->set_protobuf_name("GobyMessage");
q_entry->set_newest_first(true);

goby::acomms::protobuf::QueuedMessageEntry::Role* dest_role = q_entry->add_role();
dest_role->set_type(goby::acomms::protobuf::QueuedMessageEntry::DESTINATION_ID);
dest_role->set_field("header.dest_platform");

goby::acomms::protobuf::QueuedMessageEntry::Role* time_role = q_entry->add_role();
time_role->set_type(goby::acomms::protobuf::QueuedMessageEntry::TIMESTAMP);
time_role->set_field("header.time");

goby::acomms::protobuf::QueuedMessageEntry::Role* src_role = q_entry->add_role();
src_role->set_type(goby::acomms::protobuf::QueuedMessageEntry::SOURCE_ID);
src_role->set_field("header.source_platform");
q_manager.set_cfg(cfg);
```

4.3.2 Signals and (application layer) slots

Then, you need to do a few more initialization chores:

- Connect (using goby::acomms::connect()) QueueManager signals to your application layer slots (functions or member functions that match the signal's signature). You do not need to connect a slot to a given signal if you do not need its functionality. See Signal / Slot model for asynchronous events for more on using signals and slots:
  - Received (and decoded) DCCL data: goby::acomms::QueueManager::signal_receive
  - Received acknowledgements: goby::acomms::QueueManager::signal_ack
  - Expired messages (ttl exceeded): goby::acomms::QueueManager::signal_expire
- Additional advanced features
  - Connect a slot to learn every time a queue size changes due to a new message being pushed or a message being sent: goby::acomms::QueueManager::signal_queue_size_change
  - Request that a queue be *on_demand*, that is, request data from the application layer every time the modem layer requests data (DCCL messages only). This effectively bypasses the queue and forwards the modem's data request to the application layer. Use this for sending highly time sensitive data which needs to be encoded immediately prior to sending. Set the encode_on_demand option to true for that particular Protobuf message (and if desired change the on_demand_skew_seconds). You must also connect a slot that will be executed each time data is requested to the signal goby::acomms::QueueManager::signal_data_on_demand.

4.3.3 Operation

At this point the goby::acomms::QueueManager is ready to use. At the application layer, new messages are pushed to the queues for sending using goby::acomms::QueueManager::push_message. Each queue is identified by its DCCL (Protobuf) name.

At the driver layer, messages are requested using goby::acomms::QueueManager::handle_modem_data_request and incoming messages (including acknowledgments) are published using goby::acomms::QueueManager::handle_modem_receive. If using the goby-acomms drivers (i.e. some class derived from goby::acomms::ModemDriverBase), simply call goby::acomms::bind (ModemDriverBase&, QueueManager&) and these methods (slots) will be invoked automatically from the proper driver signals.

You must run goby::acomms::QueueManager::do_work() regularly (faster than 1 Hz; 10 Hertz is good) to process expired messages (goby::acomms::QueueManager::signal_expire). All other signals are emitted in response to a driver level signal (and thus are called during a call to goby::acomms::ModemDriverBase::do_work() if using the Goby modemdriver).

See queue_simple.cpp for a basic complete example.

4.4 Example messages

This section provides a listing of `queue` example Protobuf messages used in the code examples and unit tests.

4.4.1 Minimal functional DCCL / Queue message

simple.proto

```
import "dccl/protobuf/option_extensions.proto";

message Simple
{
  // see http://gobysoft.org/wiki/DcclIdTable
  option (dccl.msg).id = 124;

  // if, for example, we want to use on the WHOI Micro-Modem rate 0
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=30];
}
```

4.4.2 Test1

queue1/test.proto

```
import "dccl/protobuf/option_extensions.proto";


message TestMsg
{
  option (dccl.msg).id = 2;
  option (dccl.msg).max_bytes = 32;

  // test default enc/dec
  optional double double_default_optional = 1 [(dccl.field).min=-100,
                                               (dccl.field).max=126,
                                               (dccl.field).precision=2,
                                               (dccl.field).in_head=true];
  optional float float_default_optional = 2 [(dccl.field).min=-20,
                                             (dccl.field).max=150,
                                             (dccl.field).precision=3];
}
```

See Also

queue1/test.cpp

4.4.3 Test2, Test3, Test4

dccl3/test.proto

```
import "goby/common/protobuf/option_extensions.proto";
import "dccl/protobuf/option_extensions.proto";
import "goby/test/acomms/dccl3/header.proto";

message GobyMessage
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=10];
  required Header header = 2;
}
```

protobuf/header.proto

```
import "goby/common/protobuf/option_extensions.proto";
import "dccl/protobuf/option_extensions.proto";

// required fields will be filled in for you by ApplicationBase
// if you choose not to do so yourself
message Header
{
  //
  // time
  //

  // result of goby::util::as<std::string>(goby_time())
  // e.g. "2002-01-20 23:59:59.000"
  required string time = 10 [(dccl.field).codec="_time",
                             (dccl.field).in_head=true];

  //
  // source
  //
  required string source_platform = 11 [(dccl.field).codec="_platform<->modem_id",
                                        (dccl.field).in_head=true];
  optional string source_app = 12 [(dccl.field).omit=true];

  //
  // destination
  //
  enum PublishDestination { PUBLISH_SELF = 1; PUBLISH_OTHER = 2; PUBLISH_ALL = 3; }
  optional PublishDestination dest_type = 13 [default = PUBLISH_SELF, (dccl.field).in_head=true];

  optional string dest_platform = 14 [(dccl.field).codec="_platform<->modem_id",
                                      (dccl.field).in_head=true]; // required if dest_type == other

}
```

See Also

queue2/test.cpp
queue3/test.cpp
queue4/test.cpp

4.4.4 Test5

queue5/test.proto

```
import "dccl/protobuf/option_extensions.proto";

message GobyMessage
{
  option (dccl.msg).id = 4;
  option (dccl.msg).max_bytes = 32;

  // one byte
  required int32 telegram = 1 [(dccl.field).min=0,
                               (dccl.field).max=255];
}
```

See Also

queue5/test.cpp

5 goby-acomms: amac (Medium Access Control)

Table of Contents for `amac`:

Return to goby-acomms: An overview of Acoustic Communications Library.

5.1 Supported MAC schemes

The Medium Access Control schemes provided by `amac` are based on Time Division Multiple Access (TDMA) where different communicators share the same bandwidth but transmit at different times to avoid conflicts. Time is divided into slots and each vehicle is given a slot to transmit on. The set of slots comprising all the vehicles is referred to here as a cycle, which repeats itself when it reaches the end. MACManager is implemented as a timer and a std::list of goby::acomms::protobuf::ModemTransmission objects. This allows you to use `amac` to create a TDMA cycle for any type of transmission (data, ping, LBL, etc.) that your modem supports.

The two variations on this scheme provided by `amac` are:

1. Decentralized: Each vehicle initiates its own transmission at the start of its slot. (goby::acomms::protobuf::MAC_FIXED_DECENTRALIZED): Slots are set at launch and can be updated using the `std::list` insert, push, pop, erase, etc. Each vehicle can have more than one slot in the cycle. The cycles must agree across all platforms; the network designer is responsible for this. Most of the time you will want to use this mode.
2. Centralized Polling (goby::acomms::protobuf::MAC_POLLED on the master, goby::acomms::protobuf::MAC_NONE on all other nodes): The TDMA cycle is set up and operated by a centralized master modem ("poller"), which is usually the modem connected to the vehicle operator's topside. The poller initiates each transmission and thus the vehicles are not required to maintain synchronous clocks. This mode requires third-party initiation of transmissions to function.

5.2 Interacting with the goby::acomms::MACManager

To use the goby::acomms::MACManager, you need to instantiate it:

```
goby::acomms::MACManager mac;
```

Then you need to provide a callback (or "slot", not to be confused with a TDMA slot) for initiated transmissions for the signal goby::acomms::MACManager::signal_initiate_transmission. This signal will be called when the goby::acomms::MACManager determines it is time to send a message. If using `modemdriver`, simply call goby::acomms::bind(goby::acomms::MACManager&, goby::acomms::ModemDriverBase&) to bind this callback to the modem driver.

Next you need to decide which type of MAC to use: decentralized fixed or centralized polling and set the type of the goby::acomms::protobuf::MACConfig with the corresponding goby::acomms::protobuf::MACType. We also need to give goby::acomms::MACManager the vehicle's modem id (like all the other components of goby-acomms):

```
using namespace goby::acomms;
protobuf::MACConfig mac_cfg;
mac_cfg.set_type(protobuf::MAC_FIXED_DECENTRALIZED);
mac_cfg.set_modem_id(1);
```

You can also provide a set of slots in the protobuf::MACConfig to initialize the MACManager with. Otherwise, you can add them later using the std::list calls.

The usage of the goby::acomms::MACManager depends now on the type:

- goby::acomms::protobuf::MAC_FIXED_DECENTRALIZED: All vehicles must be running goby::acomms::protobuf::MAC_FIXED_DECENTRALIZED and share the same cycle (set of slots). Also, since each vehicle initiates its own transaction, you can use goby::acomms::QUERY_DESTINATION_ID throughout. In this example, I used the std::list push_back instead of adding the slots to the protobuf::MACConfig (see under MAC_POLLED below). Either way, you get the same result, but you can modify the std::list after startup():

```
goby::acomms::protobuf::ModemTransmission slot;
slot.set_src(1);
slot.set_dest(goby::acomms::QUERY_DESTINATION_ID);
slot.set_rate(0);
slot.set_type(goby::acomms::protobuf::SLOT_DATA);
slot.set_seconds(10);
mac.push_back(slot); // 1->-1@0 wait 10

slot.set_src(3);
mac.push_back(slot); // 3->-1@0 wait 10

slot.set_rate(5);
mac.push_back(slot); // 3->-1@5 wait 10

slot.set_src(4);
slot.set_rate(0);
mac.push_back(slot); // 4->-1@0 wait 10
mac.update() // important - call update() after any modifying changes to the MACManager underlying
       std::list!
```

- goby::acomms::protobuf::MAC_POLLED: On the vehicles, you do not need to run the goby::acomms::MACManager at all, or simply give it the "do nothing" goby::acomms::protobuf::MAC_NONE type. All the MAC is done on the topside (the centralized poller). On the poller, you need to manually set up a list of vehicles to be polled by adding an goby::acomms::protobuf::Slot (in the initial goby::acomms::protobuf::MACConfig object or at runtime via goby::acomms::MACManager::add_slot) for each vehicle to be polled. You can poll the same vehicle multiple times, just add more goby::acomms::protobuf::Slot objects corresponding to that vehicle. Each slot has a source, destination, rate, type (data or ping [not yet implemented]), and length (in seconds). If the source is the poller, you can set the destination to goby::acomms::QUERY_DESTINATION_ID (=-1) to let `queue` determine the next destination (based on the highest priority message to send). All goby::acomms::protobuf::Slot objects for vehicles must have a specified destination (the goby::acomms::BROADCAST_ID is a good choice or the id of the poller). For example:

```
// poll ourselves (for commands, perhaps)

goby::acomms::protobuf::ModemTransmission slot;
slot.set_src(1);
slot.set_dest(goby::acomms::QUERY_DESTINATION_ID);
slot.set_rate(0);
slot.set_type(goby::acomms::protobuf::ModemTransmission::DATA);
slot.SetExtension(goby::acomms::protobuf::slot_seconds, 10);
mac_cfg.add_slot(slot); // 1->-1@0 wait 10

// reuse slot
slot.set_src(3);
slot.set_dest(goby::acomms::BROADCAST_ID);
mac_cfg.add_slot(slot); // 3->0@0 wait 10

slot.set_rate(5);
mac_cfg.add_slot(slot); // 3->0@5 wait 10

slot.set_src(4);
slot.set_rate(0);
mac_cfg.add_slot(slot); // 4->0@0 wait 10
```

You can remove vehicles by a call to goby::acomms::MACManager::remove_slot or clear out the entire cycle and start over with goby::acomms::MACManager::clear_all_slots.

Then, for either MAC scheme, start the goby::acomms::MACManager running (goby::acomms::MACManager::startup with the goby::acomms::protobuf::MACConfig object), and call goby::acomms::MACManager::do_work() periodically (5 Hz is ok, 10 Hz is better).

You can modify the MAC scheme while MACManager is running. Simply use the `std::list` insert, push, pop, erase methods to changes slots (goby::acomms::protobuf::ModemTransmission objects). After any changes that invalidate std::list iterators (insert, push, pop, erase), you **must** call goby::acomms::MACManager::update() before the next call to goby::acomms::MACManager::do_work().

See amac_simple.cpp for a basic complete example.

6 goby-acomms: modemdriver (Driver to interact with modem firmware)

Table of contents for `modemdriver`:

Return to goby-acomms: An overview of Acoustic Communications Library.

6.1 Abstract class: ModemDriverBase

goby::acomms::ModemDriverBase defines the core functionality for an acoustic modem. It provides

- **A serial or serial-like (over TCP) reader/writer**. This is an instantiation of an appropriate derivative of the goby::util::LineBasedInterface class which reads the physical interface (serial or TCP) to the acoustic modem. The data (assumed to be ASCII lines offset by a delimiter such as NMEA0183 or the Hayes command set [AT]) are read into a buffer for use by the goby::acomms::ModemDriverBase derived class (e.g. goby::acomms::MMDriver). The type of interface is configured using a goby::acomms::protobuf::DriverConfig. The modem is accessed by the derived class using goby::acomms::ModemDriverBase::modem_start, goby::acomms::ModemDriverBase::modem_read, goby::acomms::ModemDriverBase::modem_write, and goby::acomms::ModemDriverBase::modem_close.
- **Signals** to be called at the appropriate time by the derived class. At the application layer, either bind the modem driver to a goby::acomms::QueueManager (goby::acomms::bind(goby::acomms::ModemDriverBase&, goby::acomms::QueueManager&) or connect custom function pointers or objects to the driver layer signals.
- **Virtual functions** for starting the driver (goby::acomms::ModemDriverBase::startup), running the driver (goby::acomms::ModemDriverBase::do_work), and initiating the transmission of a message (goby::acomms::ModemDriverBase::handle_initiate_transmission). The handle_initiate_transmission slot is typically bound to goby::acomms::MACManager::signal_initiate_transmission.

6.1.1 Interacting with the goby::acomms::ModemDriverBase

To use the goby::acomms::ModemDriverBase, you need to create one of its implementations such as WHOI Micro-Modem Driver: MMDriver.

```
goby::acomms::ModemDriverBase* driver = new
      goby::acomms::MMDriver;
```

You will also need to configure the driver. At the very least this involves a serial port, baud, and modem ID (integer MAC address for the modem).

```
goby::acomms::protobuf::DriverConfig cfg;

cfg.set_serial_port("/dev/ttyS0");
cfg.set_modem_id(3);
```

Most modems will have specific other configuration that is required. For example the WHOI Micro-Modem NVRAM is set using three character strings followed by a number. This modem-specific configuration is stored as Protobuf extensions to goby::acomms::protobuf::DriverConfig, such as micromodem::protobuf::Config. If we were using the WHOI Micro-Modem and wanted to add an NVRAM configuration value we could write

```
cfg.AddExtension(micromodem::protobuf::Config::nvram_cfg, "DQF,1");
```

We need to connect any signals we are interested in. At a minimum this is goby::acomms::ModemDriverBase-::signal_receive:

```
goby::acomms::connect(&driver->signal_receive, &handle_data_receive);
```

where handle_data_receive has the signature:

```
void handle_data_receive(const goby::acomms::protobuf::ModemTransmission& data_msg);
```

Next, we start up the driver with our configuration:

```
driver->startup(cfg);
```

We need to call goby::acomms::ModemDriverBase::do_work() on some reasonable frequency (greater than 5 Hz; 10 Hz is probably good). Whenever we need to transmit something, we can either directly call goby::acomms::-ModemDriverBase::handle_initiate_transmission or connect goby::acomms::MACManager to do so for us on some TDMA cycle.

6.2 Protobuf Message goby::acomms::protobuf::ModemTransmission

The goby::acomms::protobuf::ModemTransmission message is used for all outgoing (sending) and incoming (receiving) messages. The message itself only contains the subset of modem functionality that every modem is expected to support (point-to-point transmission of datagrams).

All other functionality is provided by `extensions` to ModemTransmission such as those in mm_driver.proto for the WHOI Micro-Modem. These extensions provide access to additional features of the WHOI Micro-Modem (such as LBL ranging, two-way pings, and comprehensive receive statistics).

By making use of the Protobuf extensions in this way, Goby can both support unique features of a given modem while at that same time remaining general and agnostic to which modem is used when the features are shared (primarily data transfer).

6.3 Writing a new driver

All of goby-acomms is designed to be agnostic of which physical modem is used. Different modems can be supported by subclassing goby::acomms::ModemDriverBase. You should check that a driver for your modem does not yet exist before attempting to create your own.

These are the requirements of the acoustic modem:

- it communicates using a line based text duplex connection using either serial or TCP (either client or server). NMEA0183 and AT (Hayes) protocols fulfill this requirement, for example.

- it is capable of sending and verifying the accuracy (using a cyclic redundancy check or similar error checking) of fixed size datagrams (note that modems capable of variable sized datagrams also fit into this category).

Optionally, it can also support

- Acoustic acknowledgment of proper message receipt.
- Ranging to another acoustic modem or LBL beacons using time of flight measurements
- User selectable bit rates

The steps to writing a new driver include:

- Fully understand the basic usage of the new acoustic modem manually using minicom or other terminal emulator. Have a copy of the modem software interface manual handy.
- Figure out what type of configuration the modem will need. For example, the WHOI Micro-Modem is configured using string values (e.g. "SNV,1"). Extend goby::acomms::protobuf::DriverConfig to accomodate these configuration options. You will need to claim a group of extension field numbers that do not overlap with any of the drivers. The WHOI Micro-Modem driver goby::acomms::MMDriver uses extension field numbers 1000-1100 (see mm_driver.proto). You can read more about extensions in the official Google Protobuf documentation here: http://code.google.com/apis/protocolbuffers/docs/proto.-html#extensions.

  For example, if I was writing a new driver for the ABC Modem that needs to be configured using a few boolean flags, I might create a new message abc_driver.proto:

```
import "goby/acomms/protobuf/driver_base.proto"; // load up message DriverBaseConfig

message ABCDriverConfig
{
  extend goby.acomms.protobuf.DriverConfig
  {
    optional bool enable_foo = 1201 [ default = true ];
    optional bool enable_bar = 1202 [ default = false ];
  }
}
```

  make a note in driver_base.proto claiming extension numbers 1201 and 1202 (and others you may expect to need in the future). Extension field numbers can go up to 536,870,911 so don't worry about running out.

- Subclass goby::acomms::ModemDriverBase and overload the pure virtual methods (goby::acomms::ModemDriverBase::handle_initiate_ranging is optional). Your interface should look like this:

```
namespace goby
{
    namespace acomms
    {
        class ABCDriver : public ModemDriverBase
        {
          public:
            ABCDriver();
            void startup(const protobuf::DriverConfig& cfg);
            void shutdown();
            void do_work();
            void handle_initiate_transmission(const protobuf::ModemTransmission
      & m);

          private:
            protobuf::DriverConfig driver_cfg_; // configuration given to you at launch
            // rest is up to you!
        };
    }
}
```

- Fill in the methods. You are responsible for emitting the goby::acomms::ModemDriverBase signals at the appropriate times. Read on and all should be clear.

```
goby::acomms::ABCDriver::ABCDriver()
{
  // other initialization you can do before you have your goby::acomms::DriverConfig configuration object
}
```

– At startup() you get your configuration from the application (e.g. pAcommsHandler)

```
void goby::acomms::ABCDriver::startup(const protobuf::DriverConfig& cfg)
{
    driver_cfg_ = cfg;
    // check `driver_cfg_` to your satisfaction and then start the modem physical interface
    if(!driver_cfg_.has_serial_baud())
        driver_cfg_.set_serial_baud(DEFAULT_BAUD);

    glog.is(DEBUG1) && glog << group("modem_out") << "ABCDriver configuration good. Starting
       modem..." << std::endl;
    ModemDriverBase::modem_start(driver_cfg_);

    // set your local modem id (MAC address)
    {
        std::stringstream raw;
        raw << "CONF,MAC:" << driver_cfg_.modem_id() << "\r\n";
        signal_and_write(raw.str());
    }


    // now set our special configuration values
    {
        std::stringstream raw;
        raw << "CONF,FOO:" << driver_cfg_.GetExtension(ABCDriverConfig::enable_foo) << "\r\n";
        signal_and_write(raw.str());
    }
    {
        std::stringstream raw;
        raw << "CONF,BAR:" << driver_cfg_.GetExtension(ABCDriverConfig::enable_bar) << "\r\n";
        signal_and_write(raw.str());
    }
} // startup
```

– At shutdown() you should make yourself ready to startup() again if necessary and stop the modem:

```
void goby::acomms::ABCDriver::shutdown()
{
    // put the modem in a low power state?
    // ...
    ModemDriverBase::modem_close();
} // shutdown
```

– handle_initiate_transmission() is called when you are expected to initiate a transmission. It *may* contain data (in the ModemTransmission::frame field). If not, you are required to request data using the goby-::acomms::ModemDriverBase::signal_data_request signal. Once you have data, you are responsible for sending it. I think a bit of code will make this clearer:

```
void goby::acomms::ABCDriver::handle_initiate_transmission
      (const protobuf::ModemTransmission& orig_msg)
{
    // copy so we can modify
    protobuf::ModemTransmission msg = orig_msg;


        // rate() can be 0 (lowest), 1, 2, 3, 4, or 5 (lowest). Map these integers onto real bit-rates
        // in a meaningful way (on the WHOI Micro-Modem 0 ~= 80 bps, 5 ~= 5000 bps).
    glog.is(DEBUG1) && glog <<  group("modem_out") << "We were asked to transmit from "
                            << msg.src() << " to " << msg.dest()
                            << " at bitrate code " << msg.rate() << std::endl;

    // let's say ABC modem uses 500 byte packet
    msg.set_max_frame_bytes(500);

    // no data given to us, let's ask for some
    if(msg.frame_size() == 0)
        ModemDriverBase::signal_data_request(&msg);

    glog.is(DEBUG1) && glog <<  group("modem_out") << "Sending these data now: " << msg.frame(0) <<
       std::endl;

    // let's say we can send at three bitrates with ABC modem: map these onto 0-5
    const unsigned BITRATE [] = { 100, 1000, 10000, 10000, 10000, 10000};

    // I'm making up a syntax for the wire protocol...
    std::stringstream raw;
    raw << "SEND,TO:" << msg.dest()
        << ",FROM:" << msg.src()
        << ",HEX:" << hex_encode(msg.frame(0))
        << ",BITRATE:" << BITRATE[msg.rate()]
        << ",ACK:TRUE"
        << "\r\n";
```

```
    // let anyone who is interested know
    signal_and_write(raw.str());
} // handle_initiate_transmission
```

– Finally, you can use do_work() to do continuous work. You can count on it being called at 5 Hz or more (in pAcommsHandler, it is called on the MOOS AppTick). Here's where you want to read the modem incoming stream.

```
void goby::acomms::ABCDriver::do_work()
{
    std::string in;
    while(modem_read(&in))
    {
        std::map<std::string, std::string> parsed;

        // breaks 'in': "RECV,TO:3,FROM:6,HEX:ABCD015910"
        //   into 'parsed': "KEY"=>"RECV", "TO"=>"3", "FROM"=>"6", "HEX"=>"ABCD015910"
        try
        {
            boost::trim(in); // get whitespace off from either end
            parse_in(in, &parsed);

            // let others know about the raw feed
            protobuf::ModemRaw raw;
            raw.set_raw(in);
            ModemDriverBase::signal_raw_incoming(raw);

            protobuf::ModemTransmission msg;
            msg.set_src(goby::util::as<int32>(parsed["FROM"]));
            msg.set_dest(goby::util::as<int32>(parsed["TO"]));
            msg.set_time(goby::common::goby_time<uint64>());

            glog.is(DEBUG1) && glog << group("modem_in") << in << std::endl;

            if(parsed["KEY"] == "RECV")
            {
                msg.set_type(protobuf::ModemTransmission::DATA);
                msg.add_frame(hex_decode(parsed["HEX"]));
                glog.is(DEBUG1) && glog << group("modem_in") << "received: " << msg << std::endl;
            }
            else if(parsed["KEY"] == "ACKN")
            {
                msg.set_type(protobuf::ModemTransmission::ACK);
            }

            ModemDriverBase::signal_receive(msg);

        }
        catch(std::exception& e)
        {
            glog.is(WARN) && glog << "Bad line: " << in << std::endl;
            glog.is(WARN) && glog << "Exception: " << e.what() << std::endl;
        }
    }
} // do_work
```

– Add your driver header to goby/src/acomms/modem_driver.h
– Modify driver_simple.cpp to work with your new driver.
– Add your driver to the pAcommsHandler_config.proto DriverType enumeration.
– Add your driver to the pAcommsHandler.cpp driver object creation.

The full ABC Modem example driver exists in acomms/modemdriver/abc_driver.h and acomms/modemdriver/abc_driver.cpp. A simulator for the ABC Modem exists that uses TCP to mimic a very basic set of modem commands (send data and acknowledgment). To use the ABC Modem using the driver_simple example, run this set of commands (`socat` is available in most package managers or at http://www.dest-unreach.org/socat/):

```
1. run abc_modem_simulator running on same port (as TCP server)
> abc_modem_simulator 54321
2. create fake tty terminals connected to TCP as client to port 54321
> socat -d -d -v pty,raw,echo=0,link=/tmp/ttyFAKE1 TCP:localhost:54321
> socat -d -d -v pty,raw,echo=0,link=/tmp/ttyFAKE2 TCP:localhost:54321
3. start up driver_simple
> driver_simple /tmp/ttyFAKE1 1 ABCDriver
// wait a few seconds to avoid collisions
> driver_simple /tmp/ttyFAKE2 2 ABCDriver
```

Notes:

- See goby::acomms::MMDriver for an example real implementation.
- When a message is sent to goby::acomms::BROADCAST_ID (0), it should be broadcast if the modem supports such functionality. Otherwise, the driver should throw an goby::acomms::ModemDriverException indicating that it does not support broadcast allowing the user to reconfigure their MAC / addressing scheme.

6.4 WHOI Micro-Modem Driver: MMDriver

6.4.1 Supported Functionality

The goby::acomms::MMDriver extends the goby::acomms::ModemDriverBase for the WHOI Micro-Modem acoustic modem. It is tested to work with revision 0.94.0.00 of the Micro-Modem 1 and revision 2.0.16421 of the Micro--Modem 2 firmware, but is known to work with older firmware (at least 0.92.0.85). It is likely to work properly with newer firmware, and any problems while using newer Micro-Modem firmware should be filed as a bug in Goby. The following features of the WHOI Micro-Modem are implemented, which comprise the majority of the Micro--Modem functionality:

- FSK (rate 0) data transmission
- PSK (rates 1,2,3,4,5) data transmission
- Narrowband transponder LBL ping
- REMUS transponder LBL ping
- User mini-packet 13 bit data transmission
- Two way ping
- Flexible Data Protocol (Micro-Modem 2 only)

See the UML diagrams for a graphical diagram of using Goby for each of these features.

6.4.2 Micro-Modem NMEA to Goby ModemTransmission mapping

Mapping between modem_message.proto and mm_driver.proto messages and NMEA fields (see http://acomms.whoi.edu/documents/uModem%20Software%20Interface%20Guide.pdf for NMEA fields of the WHOI Micro-Modem):

Modem to Control Computer ($CA / $SN):

NMEA talker	Mapping
$CACYC	If we did not send $CCCYC, buffer data for $CADRQ by augmenting the provided ModemTransmission and calling signal_data_request: goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.src() = ADR1 goby::acomms::protobuf::ModemTransmission.dest() = ADR2 goby::acomms::protobuf::ModemTransmission.rate() = Packet Type goby::acomms::protobuf::ModemTransmission.max_frame_bytes() = 32 for Packet Type == 0, 64 for Packet Type == 2, 256 for Packet Type == 3 or 5 goby::acomms::protobuf::ModemTransmission.max_num_frames() = 1 for Packet Type == 0, 3 for Packet Type == 2, 2 for Packet Type == 3 or 8 for Packet Type == 5
$CARXD	only for the first $CARXD for a given packet (should match with the rest though): goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DATA goby::acomms::protobuf::ModemTransmission.src() = SRC goby::acomms::protobuf::ModemTransmission.dest() = DEST goby::acomms::protobuf::ModemTransmission.ack_requested() = ACK for each $CARXD: goby::acomms::protobuf::ModemTransmission.frame(F#-1) = goby::util::hex_decode(HH...HH)

$CAMSG	Used only to detect BAD_CRC frames ($CAMSG,BAD_CRC...). (in extension micromodem::protobuf::frame_with_bad_crc) micromodem::protobuf::frame_with_bad_crc(n) = Frame with BAD CRC (assumed next frame after last good frame). n is an integer 0,1,2,... indicating the nth reported BAD_CRC frame for this packet. (not the frame number)
$CAACK	goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.src() = SRC goby::acomms::protobuf::ModemTransmission.dest() = DEST (first CAACK for a given packet) goby::acomms::protobuf::ModemTransmission.acked_frame(0) = Frame#-1 (Goby starts counting at frame 0, WHOI starts with frame 1) (second CAACK for a given packet) goby::acomms::protobuf::ModemTransmission.acked_frame(1) = Frame#-1 (third CAACK for a given packet) goby::acomms::protobuf::ModemTransmission.acked_frame(2) = Frame#-1 ...
$CAMUA	goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC extension micromodem::protobuf::type = micromodem::protobuf::MICROMODEM_MINI_DATA goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.src() = SRC goby::acomms::protobuf::ModemTransmission.dest() = DEST goby::acomms::protobuf::ModemTransmission.frame(0) = goby::util::hex_decode(HHHH)

$CAMPR	goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.dest() = SRC (SRC and DEST flipped to be SRC and DEST of $CCMPC) goby::acomms::protobuf::ModemTransmission.src() = DEST goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC extension micromodem::protobuf::type = micromodem::protobuf::MICROMODEM_TWO_WAY_PING (in extension micromodem::protobuf::ranging_reply) micromodem::protobuf::RangingReply.one_way_travel_time(0) = Travel Time
$CAMPA	goby::acomms::protobuf::ModemTransmission.time() = goby::common::goby_time<uint64>() goby::acomms::protobuf::ModemTransmission.src() = SRC goby::acomms::protobuf::ModemTransmission.dest() = DEST goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC extension micromodem::protobuf::type = micromodem::protobuf::MICROMODEM_TWO_WAY_PING
$SNTTA	goby::acomms::protobuf::ModemTransmission.time() = hhmmsss.ss (converted to microseconds since 1970-01-01 00:00:00 UTC) goby::acomms::protobuf::ModemTransmission.time_source() = goby::acomms::protobuf::MODEM_TIME goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC extension micromodem::protobuf::type = micromodem::protobuf::MICROMODEM_REMUS_LBL_RANGING or micromodem::protobuf::MICROMODEM_NARROWBAND_LBL_RANGING (depending on which LBL type was last initiated) goby::acomms::protobuf::ModemTransmission.src() = modem ID (in extension micromodem::protobuf::ranging_reply) micromodem::protobuf::RangingReply.one_way_travel_time(0) = TA micromodem::protobuf::RangingReply.one_way_travel_time(1) = TB micromodem::protobuf::RangingReply.one_way_travel_time(2) = TC micromodem::protobuf::RangingReply.one_way_travel_time(3) = TD

$CAXST	maps onto extension micromodem::protobuf::transmit_stat of type micromodem::protobuf::TransmitStatistics. The two $CAXST messages (CYC and data) for a rate 0 FH-FSK transmission are grouped and reported at once.
$CACST	maps onto extension micromodem::protobuf::receive_stat of type micromodem::protobuf::ReceiveStatistics. The two $CACST messages for a rate 0 FH-FSK transmission are grouped and reported at once. Note that this message contains the one way time of flight for synchronous ranging (used instead of $CATOA). Also sets (which will *overwrite* goby_time() set previously): goby::acomms::protobuf::ModemTransmission.time() = TOA time (converted to microseconds since 1970-01-01 00:00:00 UTC) goby::acomms::protobuf::ModemTransmission.time_source() = goby::acomms::protobuf::MODEM_TIME
$CAREV	Not translated into any of the modem_message.proto messages. Monitored to detect excessive clock skew (between Micro-Modem clock and system clock) or reboot (INIT)
$CAERR	Not translated into any of the modem_message.proto messages. Reported to goby::glog.
$CACFG	NVRAM setting stored internally.
$CACLK	Checked against system clock and if skew is unacceptable another $CCCLK will be sent.
$CADRQ	Data request is anticipated from the $CCCYC or $CACYC and buffered. Thus it is not translated into any of the Protobuf messages.
$CARDP	goby::acomms::protobuf::ModemTransmission.type() = goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC extension micromodem::protobuf::type = micromodem::protobuf::MICROMODEM_FLEXIBLE_DATA goby::acomms::protobuf::ModemTransmission.src() = src goby::acomms::protobuf::ModemTransmission.dest() = dest goby::acomms::protobuf::ModemTransmission.rate() = rate goby::acomms::protobuf::ModemTransmission.frame(0) = goby::util::hex_decode(df1+df2+df3...dfN) where "+" means concatenate, unless any frame fails the CRC check, in which case this field is set to the empty string. micromodem::protobuf::frame_with_bad_crc(0) = 0 indicated that Goby frame 0 is bad, if any sub-frame in the FDP has a bad CRC

Control Computer to Modem ($CC):

$CCTXD	SRC = goby::acomms::protobuf::ModemTransmission.src() DEST = goby::acomms::protobuf::ModemTransmission.dest() A = goby::acomms::protobuf::ModemTransmission.ack_requested() HH...HH = goby::acomms::hex_encode(goby::acomms::protobuf::ModemTransmission.frame(n)), which n is an integer 0,1,2,... corresponding to the Goby frame that this $CCTXD belongs to.
$CCCYC	Augment the ModemTransmission: goby::acomms::protobuf::ModemTransmission.max_frame_bytes() = 32 for Packet Type == 0, 64 for Packet Type == 2, 256 for Packet Type == 3 or 5 goby::acomms::protobuf::ModemTransmission.max_num_frames() = 1 for Packet Type == 0, 3 for Packet Type == 2, 2 for Packet Type == 3 or 8 for Packet Type == 5 If ADR1 == modem ID and frame_size() < max_frame_size(), buffer data for later $CADRQ by passing the ModemTransmission to signal_data_request CMD = 0 (deprecated field) ADR1 = goby::acomms::protobuf::ModemTransmission.src() ADR2 = goby::acomms::protobuf::ModemTransmission.dest() Packet Type = goby::acomms::protobuf::ModemTransmission.rate() ACK = if ADR1 == modem ID then goby::acomms::protobuf::ModemTransmission.ack_requested() else 1 Nframes = goby::acomms::protobuf::ModemTransmission.max_num_frames()

$CCCLK	Not translated from any of the modem_message.proto messages. (taken from the system time using the boost::date_time library)
$CCCFG	Not translated from any of the modem_message.proto messages. (taken from values passed to the extension micromodem::protobuf::Config::nvram_cfg of goby::acomms::protobuf::DriverConfig). If the extension micromodem::protobuf::Config::reset_nvram is set to true, $CCCFG,ALL,0 will be sent before any other $CCCFG values.)
$CCCFQ	Not translated from any of the modem_message.proto messages. $CCCFQ,ALL sent at startup.
$CCMPC	micromodem::protobuf::MICROMODEM_TWO_WAY-_PING == extension micromodem::protobuf::type SRC = goby::acomms::protobuf::ModemTransmission.src() DEST = goby::acomms::protobuf::ModemTransmission.dest()
$CCPDT	micromodem::protobuf::protobuf::MICROMODEM_R-EMUS_LBL_RANGING == extension micromodem::protobuf::type micromodem::protobuf::REMUSLBLParams type used to determine the parameters of the LBL ping. The object provided with configuration (micromodem::protobuf::Config::remus_lbl) is merged with the object provided with the ModemTransmission (micromodem::protobuf::remus_lbl) with the latter taking priority on fields that a set in both objects: GRP = 1 CHANNEL = modem ID % 4 + 1 (use four consecutive modem IDs if you need multiple vehicles pinging) SF = 0 STO = 0 Timeout = micromodem::protobuf::REMUSLBL-Params::lbl_max_range() m ∗2/ 1500 m/s ∗ 1000 ms/s + micromodem::protobuf::REMUSLBLParams-::turnaround_ms() goby::acomms::protobuf::ModemRangingRequest.-enable_beacons() is a set of four bit flags where the least significant bit is AF enable, most significant bit is DF enable. Thus b1111 == 0x0F enables all beacons AF = micromodem::protobuf::REMUSLBLParams-::enable_beacons() >> 0 & 1 BF = micromodem::protobuf::REMUSLBLParams-::enable_beacons() >> 1 & 1 CF = micromodem::protobuf::REMUSLBLParams-::enable_beacons() >> 2 & 1 DF = micromodem::protobuf::REMUSLBLParams-::enable_beacons() >> 3 & 1

$CCPNT	micromodem::protobuf::protobuf::MICROMODEM_NARROWBAND_LBL_RANGING == extension micromodem::protobuf::type micromodem::protobuf::NarrowBandLBLParams type used to determine the parameters of the LBL ping. The object provided with configuration (micromodem::protobuf::Config::narrowband_lbl) is merged with the object provided with the ModemTransmission (micromodem::protobuf::narrowband_lbl) with the latter taking priority on fields that a set in both objects: Ftx = micromodem::protobuf::NarrowBandLBLParams::transmit_freq() Ttx = micromodem::protobuf::NarrowBandLBLParams::transmit_ping_ms() Trx = micromodem::protobuf::NarrowBandLBLParams::receive_ping_ms() Timeout = micromodem::protobuf::NarrowBandLBLParams::lbl_max_range() m ∗2/ 1500 m/s ∗ 1000 ms/s + micromodem::protobuf::NarrowBandLBLParams::turnaround_ms() FA = micromodem::protobuf::NarrowBandLBLParams::receive_freq(0) or 0 if receive_freq_size() < 1 FB = micromodem::protobuf::NarrowBandLBLParams::receive_freq(1) or 0 if receive_freq_size() < 2 FC = micromodem::protobuf::NarrowBandLBLParams::receive_freq(2) or 0 if receive_freq_size() < 3 FD = micromodem::protobuf::NarrowBandLBLParams::receive_freq(3) or 0 if receive_freq_size() < 4 Tflag = micromodem::protobuf::NarrowBandLBLParams::transmit_flag()

$CCMUC	SRC = goby::acomms::protobuf::ModemTransmission.src() DEST = goby::acomms::protobuf::ModemTransmission.dest() HHHH = goby::acomms::hex_encode(goby::acomms::protobuf::ModemTransmission.frame(0)) & 0x1F
$CCTDP	dest = goby::acomms::protobuf::ModemTransmission.dest() rate = goby::acomms::protobuf::ModemTransmission.rate() ack = 0 (not yet supported by the Micro-Modem 2) reserved = 0 hexdata = goby::acomms::hex_encode(goby::acomms::protobuf::ModemTransmission.frame(0))

6.4.3 Sequence diagrams for various Micro-Modem features using Goby

FSK (rate 0) data transmission

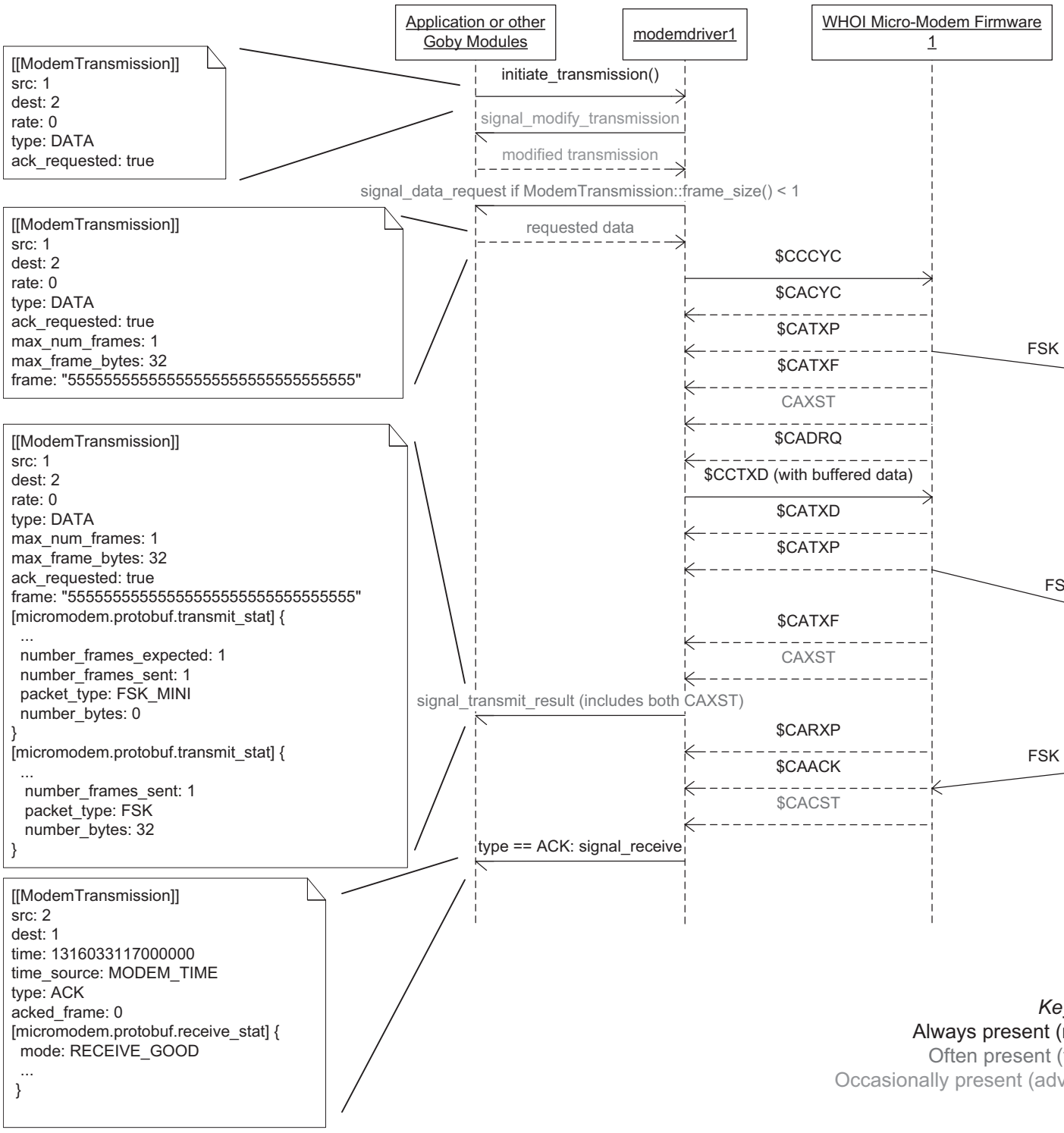


Figure 5: FSK (rate 0) data transmission

PSK (rate 2 shown, others are similar) data transmission

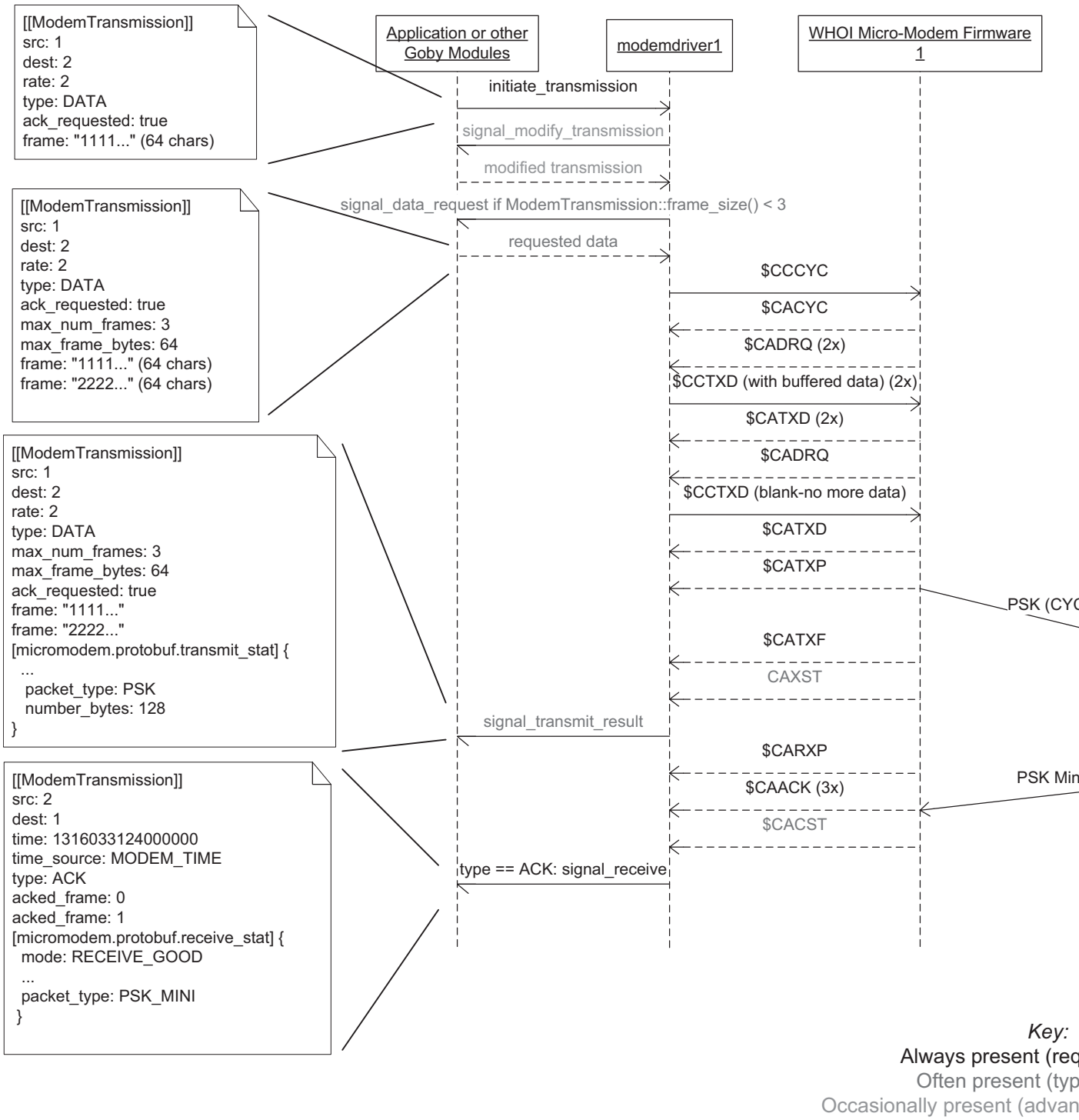


Figure 6: PSK (rate 2 shown, others are similar) data transmission

Narrowband transponder LBL ping

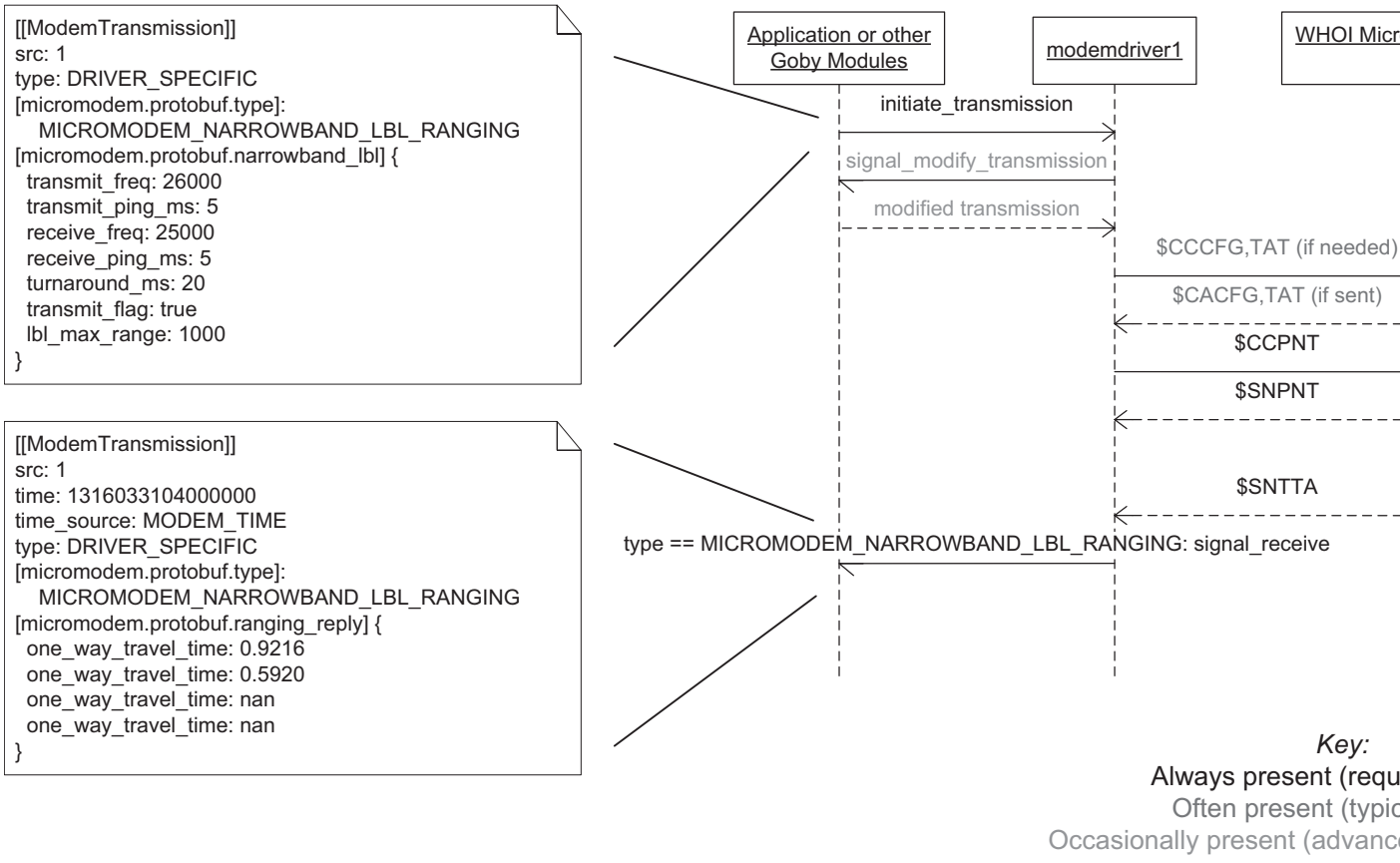


Figure 7: Narrowband transponder LBL ping

REMUS transponder LBL ping

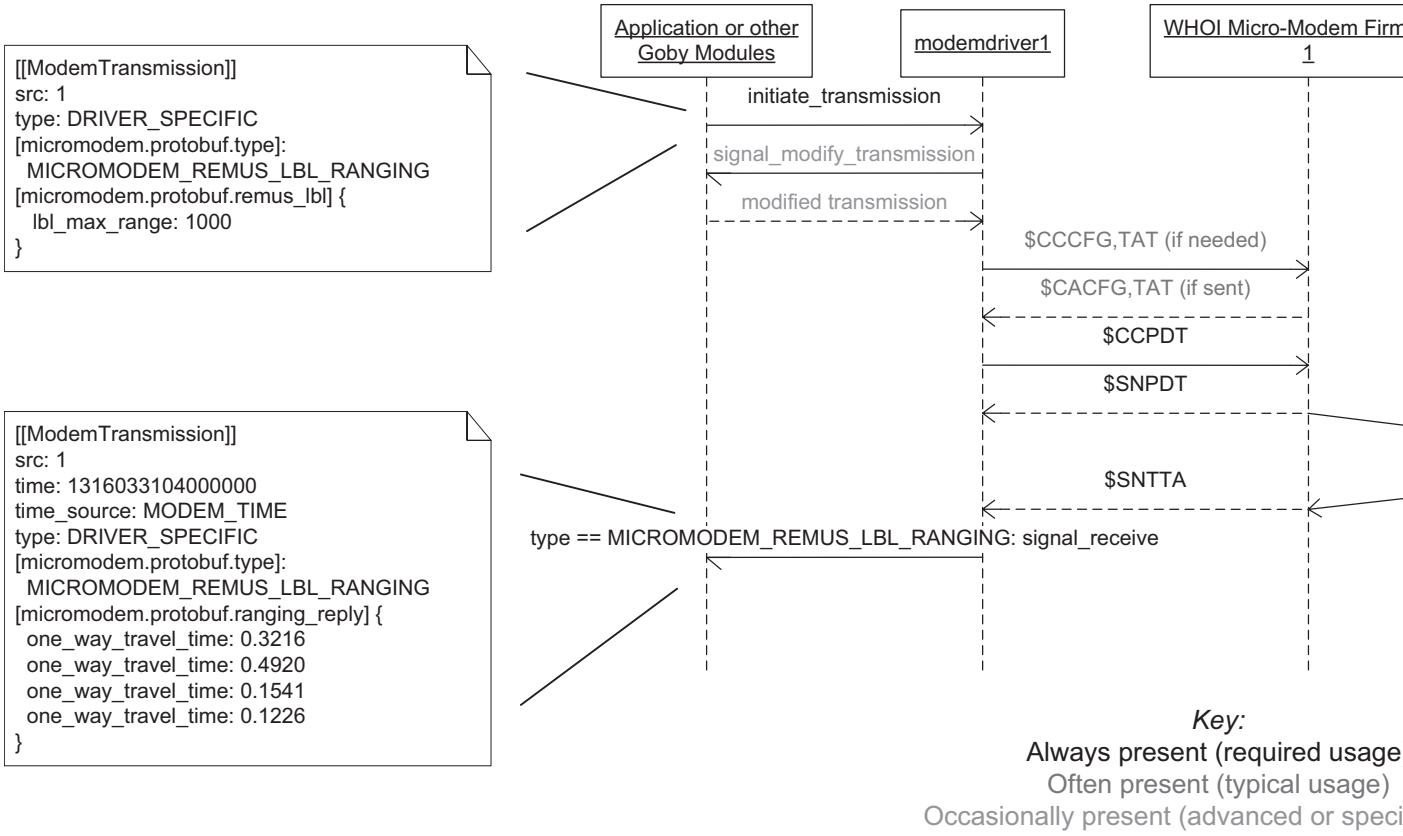


Figure 8: REMUS transponder LBL ping

User mini-packet 13 bit data transmission

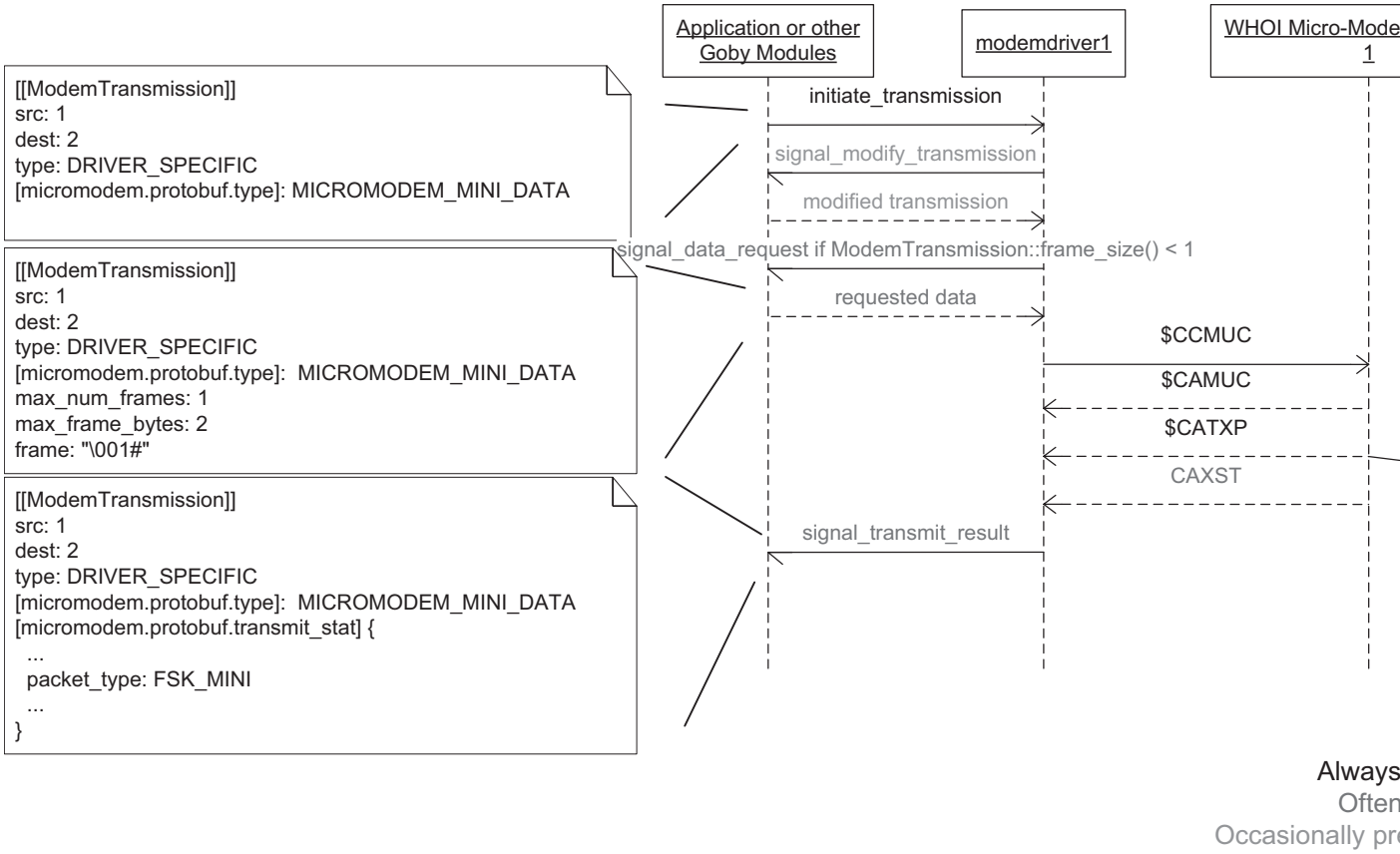


Figure 9: User mini-packet 13 bit data transmission

Two way ping

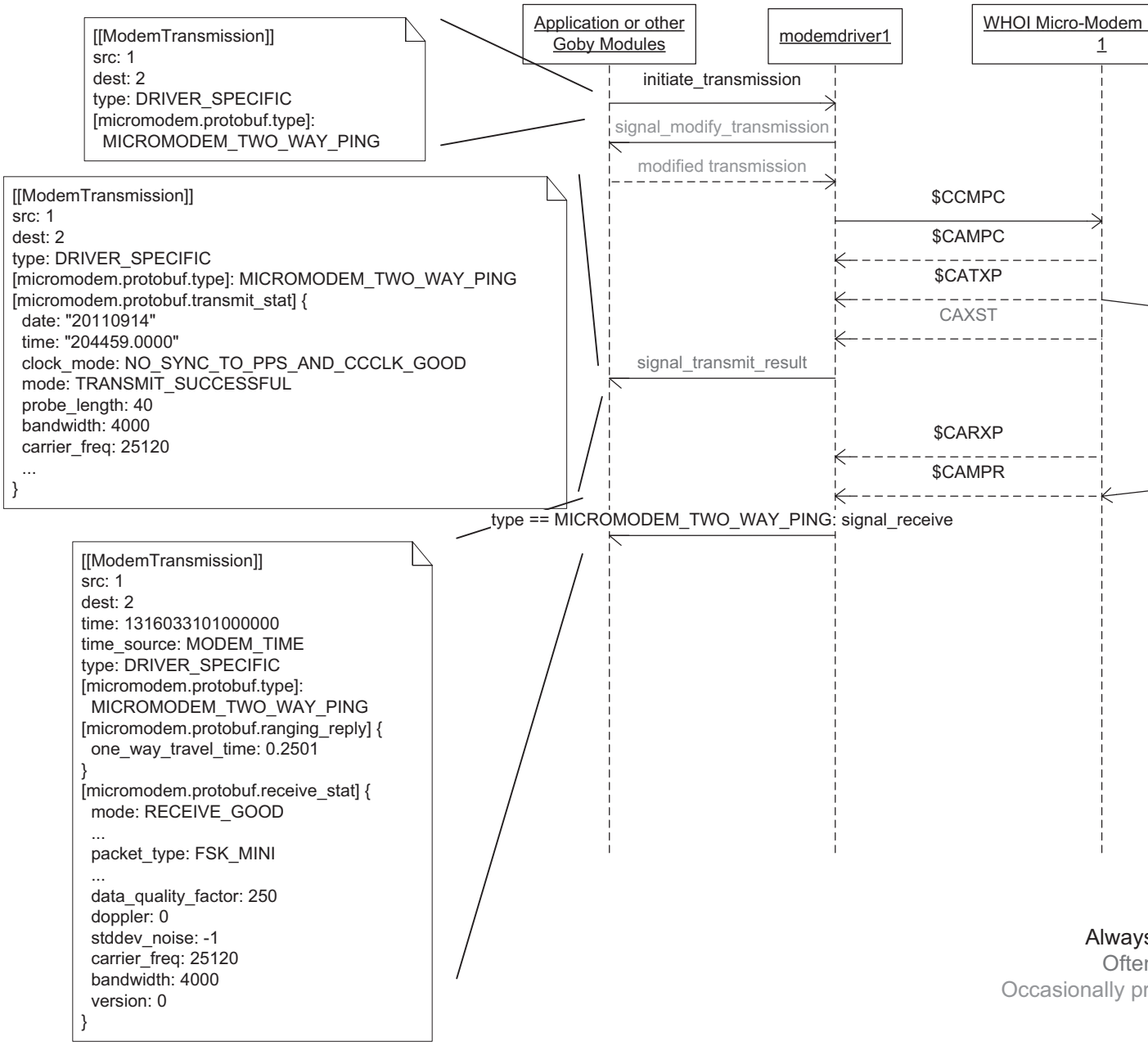


Figure 10: Two way ping

Flexible Data Protocol (Micro-Modem 2)

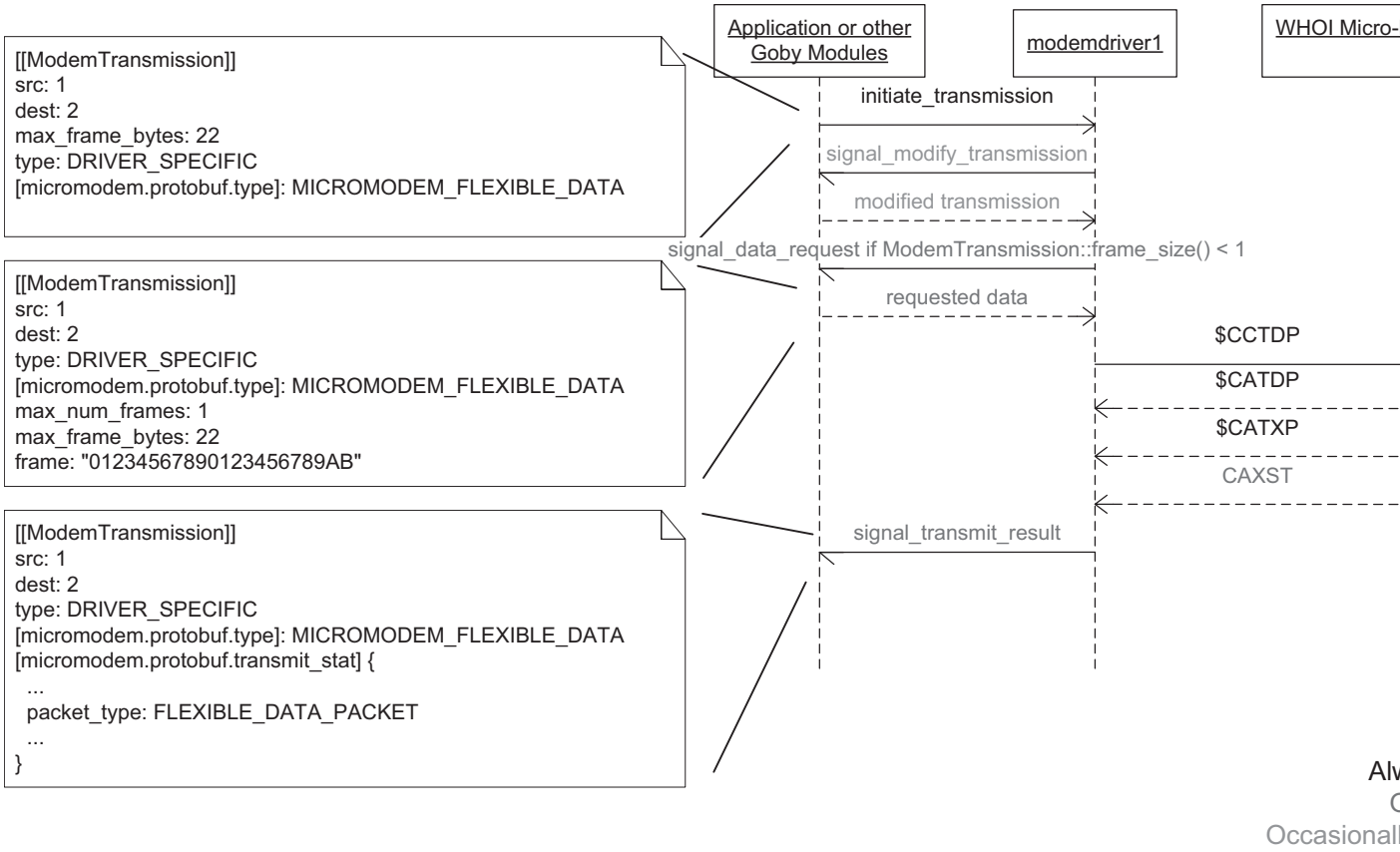


Figure 11: Flexible Data Protocol

7 goby-util: Overview of Utility Libraries

Table of Contents for goby-util: Overview of Utility Libraries.

7.1 Overview

```
The goby-util libraries are intended to provide functions and classes for handling "utility" tasks, such as lo
```

7.2 Logging

```
Because Goby is designed first and foremost as an engineering testbed and scientific research architecture, co
The \link acomms_api goby-acomms\endlink API classes all have a constructor which can take a pointer to std::o
```

```
goby::acomms::DCCLCodec dccl(&std::cout);
```

In which case you get output (to std::cout, aka the terminal window) that looks like:

```
[ 2011-Mar-01 04:06:35.169817 ]              {dccl_enc}: cryptography enabled with given passphrase
[ 2011-Mar-01 04:06:35.170610 ]              {dccl_enc}: starting encode for TEST
[ 2011-Mar-01 04:06:35.170683 ]              {dccl_enc}:  B: bool: true
...
```

The timestamp (in Universal Coordinated Time) is given, with a group name (dccl_enc = DCCL Encoder) and finally the message. These groups are provided by using the manipulator "group". Text in the stream is a member of the given group until the next flush (std::endl or std::flush). For example:

```
// prints [ 2011-Mar-01 04:06:35.169817 ]               {my_group}: my message
std::cout << group("my_group") << "my message" << std::endl; // endl flushes my_group
```

Several other manipulators are provided:

- "debug" indicates that the buffer output is insignificant except for debugging (not useful for normal runtime)
- "warn" prints the buffer until the next flush as a warning.
- "die" is a fatal warning that calls "exit" with a non-zero code (indicating a fatal error). "die" should be used very sparingly.

7.2.1 Configurable extension of std::ostream - liblogger

goby::util::FlexOstream extends std::ostream to provide a number of extra logging features. This is generally the preferred logger (instead of std::cout, etc.) for goby applications. Use goby::util::glogger() in the same way you would use std::cout or a std::ofstream object. These features include:

- Often it is desirable to log simultaneously to a text file (std::ofstream) and the terminal window (std::cout). goby::util::FlexOstream allows you to attach any number of streams to it, which are all written to with a single call to operator<< on the goby::util::FlexOstream object.
- Color support for ANSI terminals (std::cout and std::cerr stream objects only)
- Multiple verbosity settings for each attached stream: QUIET (display nothing to this stream), WARN (display only warnings), VERBOSE (display warnings and normal text, but not debug text), DEBUG (display warnings, normal text, and debug messages), GUI (display all messages in an NCurses terminal GUI window, splitting groups into different displays)
- Optional thread safe access using a simple lock / unlock syntax.

The best way to get used to goby:util::glogger() is to compile and play with the flexostream_simple.cpp example.

A handful of examples:

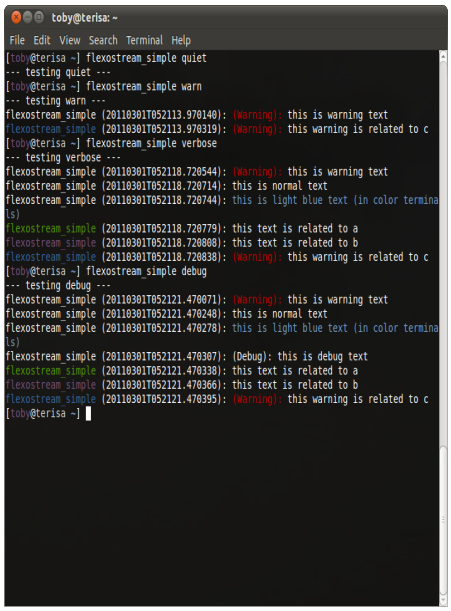


Figure 12: Example of the goby::util::glogger() output at different verbosity settings to the terminal window

Graphical user interface logger mode:

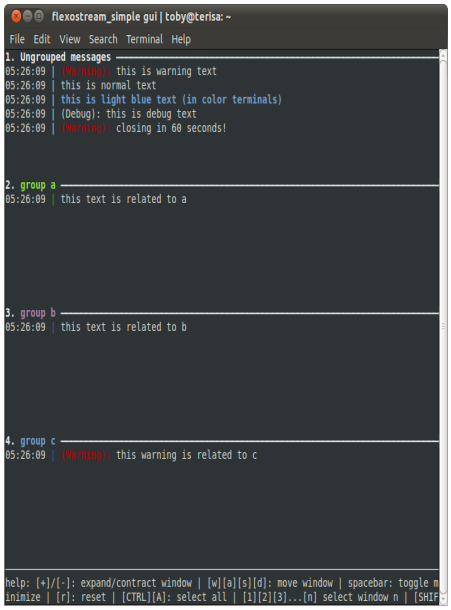


Figure 13: Example of the goby::util::glogger() in NCurses GUI mode

Simultaneous terminal window and file logging:

```
flexostream_simple quiet|warn|verbose|debug|gui test.txt
```

test.txt:

```
[ 2011-Mar-01 05:33:26.224050 ]              {}: (Warning): this is warning text
[ 2011-Mar-01 05:33:26.224277 ]              {}: this is normal text
[ 2011-Mar-01 05:33:26.224320 ]              {}: this is light blue text (in color terminals)
[ 2011-Mar-01 05:33:26.224362 ]              {}: (Debug): this is debug text
[ 2011-Mar-01 05:33:26.224388 ]              {a}: this text is related to a
[ 2011-Mar-01 05:33:26.224429 ]              {b}: this text is related to b
[ 2011-Mar-01 05:33:26.224471 ]              {c}: (Warning): this warning is related to c
```

7.3 TCP and Serial port communications - liblinebasedcomms

libutil_linebasedcomms.provides a common interface (goby::util::LineBasedInterface) for line-based (defined as

You should create the proper subclass for your needs:

- Serial communications: goby::util::SerialClient
- TCP Client: goby::util::TCPClient
- TCP Server: goby::util::TCPServer - all incoming messages (as read by goby::util::LineBasedInterface-::readline) are interleaved in the order they are received from all connected clients. Outgoing messages are sent to all connected clients unless using goby::util::LineBasedInterface::write (const protobuf::Datagram &msg) and msg.dest() is set to a specific endpoint (ip:port, e.g. "192.168.1.101:5123").

8 goby-moos: An overview of the Goby/MOOS interoperability library

Table of Contents for goby-moos: An overview of the Goby/MOOS interoperability library.

8.1 iFrontSeat

iFrontSeat is a MOOS application used to interface a Goby/MOOS community (the "backseat") running pHelmIv-P with a given manufacturer's vehicle (the "frontseat"). The usage of iFrontSeat and the existing driver suite is explained in the Goby user manual (see Resources).

8.1.1 Writing a new driver for iFrontSeat

8.1.1.1 Overview

iFrontSeat is intended to interface to a wide range of vehicles using any interface (e.g. proprietary extensions of NMEA-0183). The purpose of the driver is to implement the Goby FrontSeatInterfaceBase in the language of the particular frontseat vehicle system. Minimally, these are the requirements of the frontseat:

- it can provide a navigation solution for the vehicle (minimally latitude, longitude, depth, and speed), and typically also the geo-referenced pose of the vehicle (heading, pitch, yaw).
- it can accept a desired heading, speed, and depth (at around 1 Hz) for the vehicle and carry out these commands as quickly as reasonably possible given the vehicle's dynamics.

Additionally, the frontseat may provide or consume:

- arbitrary sensor data (e.g. CTD samples, acoustic modem datagrams)
- additional special commands (e.g. buoyancy adjustment, activate/deactivate sensors, low power mode) that the backseat can command of the frontseat.

8.1.1.2 State charts

The state of iFrontSeat (as shown in the following diagram) is determined by a combination of the state of the frontseat and the state of pHelmIvP. Only the state of the frontseat must be determined by each new driver, as the state of pHelmIvP is determined by code shared by all the drivers.

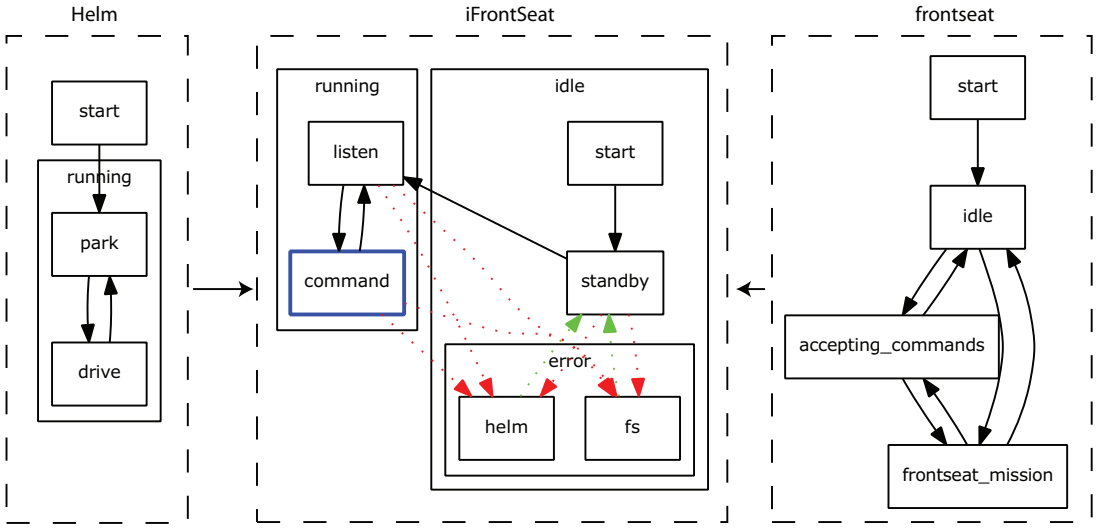


Figure 14: State charts of the iFrontSeat interface and connected ends (pHelmIvP and frontseat)

The **state of the frontseat** consists of two parallel state charts (command and data):

- Command state
  - FRONTSEAT_IDLE (required): The frontseat computer is alive and well, but is not running any mission (the vehicle is a standby mode).
  - FRONTSEAT_ACCEPTING_COMMANDS (required): The frontseat is accepting the backseat commands.
  - FRONTSEAT_NOT_CONNECTED (optional): No communication with the frontseat computer has been established (or a connection has been lost). If there is no way to tell whether the frontseat is alive at any given time, this state may not be implemented.
  - FRONTSEAT_IN_CONTROL (optional): The frontseat is running a mission and driving the vehicle but not accepting commands from the backseat. If the frontseat never runs missions without backseat control, this state may not be implemented.
- Data state (not diagrammed above)
  - frontseat_providing_data == true: The frontseat is providing all required data. What is required is determined by the specific driver, but at a minimum is the navigation solution.
  - frontseat_providing_data == false: The frontseat is not providing all required data.

The state transitions for the iFrontSeat interface states are (using the names as defined in the enumerations in moos/protobuf/frontseat.proto)

From	To	Action
Start	INTERFACE_STANDBY	Configuration Read
INTERFACE_STANDBY	INTERFACE_LISTEN	frontseat_providing_data == true
INTERFACE_LISTEN	INTERFACE_COMMAND	FRONTSEAT_ACCEPTING_COMMANDS && HELM_DRIVE
INTERFACE_COMMAND	INTERFACE_LISTEN	(FRONTSEAT_IN_CONTROL || FRONTSEAT_IDLE) && HELM_DRIVE
INTERFACE_COMMAND	INTERFACE_HELM_ERROR	HELM_NOT_RUNNING || HELM_PARK
INTERFACE_LISTEN || INTERFACE_COMMAND	INTERFACE_HELM_ERROR	HELM_PARK || if (helm_enabled) HELM_NOT_RUNNING (after timeout)
INTERFACE_LISTEN || INTERFACE_COMMAND	INTERFACE_FS_ERROR	FRONTSEAT_NOT_CONNECTED || frontseat_providing_data == false
INTERFACE_STANDBY	INTERFACE_FS_ERROR	FRONTSEAT_NOT_CONNECTED (after timeout)
INTERFACE_HELM_ERROR	INTERFACE_STANDBY	HELM_DRIVE
INTERFACE_FRONTSEAT_ERROR	INTERFACE_STANDBY	(if(ERROR_FRONTSEAT_NOT_CONNECTED) !FRONTSEAT_NOT_CONNECTED) || (if(ERROR_FRONTSEAT_NOT_PROVIDING_DATA) frontseat_providing_data == true)

8.1.1.3 Example "ABC" driver

We will show you how to a write a new driver by example. To do so, we have created a simple frontseat simulator ("abc_frontseat_simulator") that is intended to represent the real vehicle frontseat control system. The full source code for this example is given at:

- examples/moos/abc_frontseat_driver/abc_frontseat_driver.h
- examples/moos/abc_frontseat_driver/abc_frontseat_driver.cpp
- examples/moos/abc_frontseat_driver/abc_frontseat_driver_config.proto

A complete production driver is provided by BluefinFrontSeat for the Bluefin Robotics AUVs that conform to the Bluefin Standard Payload Interface version 1.8 and newer.

The transport for the ABC frontseat is TCP: the simulator (frontseat) listens on a given port and the driver connects to that machine and port. The wire protocol is a simple ascii line-based protocol where lines are terminated by carriage-return and newline (<CR><NL> or "\r\n"). Each message has a name (key), followed by a number of comma-delimited, colon-separated fields:

Key	Description	Direction (relative to frontseat)	Format	Example
START	Simulator initialization message	Receive	START,LAT-:{latitude decimal degrees},LON-:{longitude decimal degrees},DURAT-ION:{simulation duration seconds}	START,LAT:42.-1234,LON:-72,D-URATION:600
CTRL	Frontseat state message	Transmit	CTRL,STATE:{P-AYLOAD (if backseat control) or IDLE}	CTRL,STATE:PA-YLOAD
NAV	Navigation message generated from very primitive dynamics model (depth & heading changes are instantaneous)	Transmit	NAV,LAT:{latitude decimal degrees},LON-:{longitude decimal degrees},DEPTH-:{depth in meters},HEADIN-G:{heading in degrees},SPEED-:{speed in m/s}	NAV,LAT:42.-1234,LON:-72.-5435,DEPTH-:200,HEADING-:223,SPEED:1.4
CMD	Desired course command from backseat	Receive	CMD,HEADING-:{desired heading in degrees},SPE-ED:{desired speed in m/s},DE-PTH:{desired depth in m}	CMD,HEADING-:260,SPEED:1.-5,DEPTH:100
CMD	Reponse to last CMD	Transmit	CMD,RESULT:{O-K or ERROR}	CMD,RESULT:OK

Your driver will be (at a minimum) a C linkage function "frontseat_driver_load" and a subclass of FrontSeat-InterfaceBase. It should be compiled into a shared library (.so on Linux).

The C function is used by iFrontSeat to load your driver:

```
extern "C"
{
    FrontSeatInterfaceBase* frontseat_driver_load(iFrontSeatConfig* cfg)
    {
        return new AbcFrontSeat(*cfg);
    }
}
```

First you should decide what configuration your driver will accept. Your configuration object is an extension to the Google Protobuf message "iFrontSeatConfig". For the ABC frontseat driver, we use the abc_frontseat_-driver_config.proto file to define the configuration:

```
import "goby/moos/protobuf/frontseat_config.proto";
import "goby/common/protobuf/option_extensions.proto";

message ABCFrontSeatConfig
{
  required string tcp_address = 1;
  optional uint32 tcp_port = 2 [default = 54321];
  message StartParams
  {
    required double lat = 1;
    required double lon = 2;
```

```
    required int32 duration = 3;
  }
  required StartParams start = 3;
}

extend iFrontSeatConfig
{
  optional ABCFrontSeatConfig abc_config = 1001;
}
```

In this case, we need to know what IP address and TCP port the abc_frontseat_simulator is listening on, and the starting position of the simulator.

Next, you should fill out the virtual methods of FrontSeatInterfaceBase:

- The method "frontseat_state" reports the driver's belief of the frontseat command state (see State charts).

  ```
  goby::moos::protobuf::FrontSeatState AbcFrontSeat::frontseat_state() const
  {
      return frontseat_state_;
  } // frontseat_state
  ```

  In this case, we set the value of frontseat_status_ based on the received "CTRL" messages:

  ```
      if(parsed["KEY"] == "CTRL")
      {
          if(parsed["STATE"] == "PAYLOAD")
              frontseat_state_ = gpb::FRONTSEAT_ACCEPTING_COMMANDS;
          else if(parsed["STATE"] == "AUV")
              frontseat_state_ = gpb::FRONTSEAT_IN_CONTROL;
          else
              frontseat_state_ = gpb::FRONTSEAT_IDLE;
      }
  ```

- The method "frontseat_providing_data" reports the frontseat's data state (see State charts). It must return true if the frontseat is providing data to the driver reasonably often (where reasonable is defined by the driver). Here we set the class member variable "frontseat_providing_data_" to true each time we get a "NAV" message, and then false if we have had no "NAV" messages in the last 10 seconds.

  ```
  bool AbcFrontSeat::frontseat_providing_data() const
  {
      return frontseat_providing_data_;
  } // frontseat_providing_data
  ```

- The method "send_command_to_frontseat" is called whenever iFrontSeat needs to send a command to the frontseat. This command typically contains a desired heading, speed, and depth, but could alternatively contain a special command defined via an extension to the goby::moos::protobuf::CommandRequest message.

  ```
  void AbcFrontSeat::send_command_to_frontseat(const gpb::CommandRequest& command)
  {
      if(command.has_desired_course())
      {
          std::stringstream cmd_ss;
          const goby::moos::protobuf::DesiredCourse& desired_course = command.desired_course();
          cmd_ss << "CMD,"
                 << "HEADING:" << desired_course.heading() << ","
                 << "SPEED:" << desired_course.speed() << ","
                 << "DEPTH:" << desired_course.depth();

          write(cmd_ss.str());
          last_request_ = command;
      }
      else
      {
          glog.is(VERBOSE) && glog << "Unhandled command: " << command.ShortDebugString() <<
        std::endl;
      }

  } // send_command_to_frontseat
  ```

- The method "send_data_to_frontseat" is called whenever iFrontSeat needs to send data to the frontseat. These data could include sensor readings from instruments that are directly connected to the backseat, such as a CTD or acoustic modem. Our bare-bones example frontseat doesn't require any data from the backseat, so we just leave an empty implementation here.

```
void AbcFrontSeat::send_data_to_frontseat(const gpb::FrontSeatInterfaceData& data)
{
    // ABC driver doesn't have any data to sent to the frontseat
} // send_data_to_frontseat
```

- The method "send_raw_to_frontseat" is called whenever an external application wants to directly control the frontseat. This can be left blank (or post a warning to the glog) if there is no need (or desire) to allow for direct control of the frontseat from external applications.
- The method "loop" is called regularly (at the AppTick of iFrontSeat) and is where you can read data from the frontseat and do other regular work.

```
void AbcFrontSeat::loop()
{
    check_connection_state();
    try_receive();

    // if we haven't gotten data for a while, set this boolean so that the
    // FrontSeatInterfaceBase class knows
    if(goby_time<double>() > last_frontseat_data_time_ + allowed_skew)
        frontseat_providing_data_ = false;
} // loop
```

Now, the final task is to call the appropriate signals in FrontSeatInterfaceBase upon receipt of data and responses to commands. The signals are called just like normal functions with the corresponding signatures. These signals (except signal_raw_to_frontseat) are typically called in response to data received in the loop() method.

- signal_data_from_frontseat: Call when a navigation solution is received from the frontseat. This may have to be merged from several messages, which is why goby::moos::protobuf::NodeStatus has the *_time_lag fields. These fields can be used to indicate the offset of certain fields from the timestamp on the message. You can use the FrontSeatInterfaceBase::compute_missing to compute the loocal fix (X, Y, Z) from the global fix (latitude, longitude, depth) or vice-versa.
- signal_command_response: Call when the frontseat acknowledges a command, if the command request includes response_requested == true. Include the success or failure of the command, and an error code (with description) if applicable.
- signal_raw_from_frontseat: Call when a raw message (e.g. "CMD,RESULT:OK") is received from the frontseat. This is for logging and debug purposes.
- signal_raw_to_frontseat: Call when a raw message (e.g. "CMD,HEADING:260,SPEED:1.5,DEPTH:100") is send to the frontseat. This is for logging and debug purposes.

For testing the ABC driver to see how it functions, you will need to run

```
abc_frontseat_simulator 54321
```

where 54321 is the port for the simulator to listen on.

Then, run iFrontSeat in a MOOS community with pHelmIvP with the following configuration:

```
ProcessConfig = iFrontSeat_bluefin
{
    common {
        verbosity: DEBUG1
    }
    [abc_config] {  #  (optional)
      tcp_address: "localhost"  #  (required)
      tcp_port: 54321  #  (optional) (default=54321)
      start { lat: 44.0888889 lon: 9.84861111 duration: 600 }
    }
}
```

You can change the start position as desired.

9 Module Index

9.1 Modules

Here is a list of all modules:

10 Namespace Index

10.1 Namespace List

Here is a list of all documented namespaces with brief descriptions:

11 Hierarchical Index

11.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

12 Class Index

12.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

13 File Index

13.1 File List

Here is a list of all documented files with brief descriptions:

14 Module Documentation

14.1 API classes for the Dynamic Compact Control Language (includes writing custom encoders).

14.2 API classes for the major components of the Goby-Acomms acoustic communications library (DCCL, Queue, AMAC, ModemDriver).

Classes

- class goby::acomms::ABCDriver

  provides an API to the imaginary ABC modem (as an example how to write drivers)
- class goby::moos::BluefinCommsDriver

  provides a driver for the Bluefin Huxley communications infrastructure (initially uses SonarDyne as underlying hardware)
- class goby::moos::UFldDriver

  provides an simulator driver to the uFldNodeComms MOOS module: http://oceanai.mit.edu/moos-ivp/pmwiki/pmwiki.php?n=Modules.UFldNodeComms
- class goby::acomms::MACManager

  provides an API to the goby-acomms MAC library. MACManager is essentially a std::list<protobuf::ModemTransmission> plus a timer.
- class goby::acomms::ModemDriverBase

  provides an abstract base class for acoustic modem drivers. This is subclassed by the various drivers for different manufacturers' modems.
- class goby::acomms::MMDriver

  provides an API to the WHOI Micro-Modem driver
- class goby::acomms::QueueManager

  provides an API to the goby-acomms Queuing Library.
- class goby::transitional::DCCLTransitionalCodec

  provides an API to the Transitional Dynamic CCL Codec (looks like DCCLv1, but calls DCCLv2). Warning: this class is for legacy support only, new applications should use DCCLCodec directly.

14.2.1 Detailed Description

15 Namespace Documentation

15.1 goby Namespace Reference

The global namespace for the Goby project.

Namespaces

- acomms

  Objects pertaining to acoustic communications (acomms)
- common

  Utility objects for performing functions such as logging, non-acoustic communication (ethernet / serial), time, scientific, string manipulation, etc.

- pb

  Contains objects relating to the core publish / subscribe architecture provided by Goby.

- transitional

  Objects pertaining to transitioning from DCCLv1 to DCCLv2.

Classes

- class Exception

  simple exception class for goby applications

Typedefs

- typedef google::protobuf::uint32 uint32

  an unsigned 32 bit integer

- typedef google::protobuf::int32 int32

  a signed 32 bit integer

- typedef google::protobuf::uint64 uint64

  an unsigned 64 bit integer

- typedef google::protobuf::int64 int64

  a signed 64 bit integer

Enumerations

- enum **GobyFieldOptions_ConfigurationOptions_ConfigAction** { **GobyFieldOptions_ConfigurationOptions_ConfigAction_ALWAYS** = 1, **GobyFieldOptions_ConfigurationOptions_ConfigAction_NEVER** = 2, **GobyFieldOptions_ConfigurationOptions_ConfigAction_ADVANCED** = 3 }

Functions

- template<typename App , typename Config >
  int run (int argc, char *argv[], Config *cfg)

  Run a Goby application derived from MinimalApplicationBase. blocks caller until MinimalApplicationBase::__run() returns.

- void **protobuf_AddDesc_goby_2fcommon_2fprotobuf_2foption_5fextensions_2eproto** ()
- void **protobuf_AssignDesc_goby_2fcommon_2fprotobuf_2foption_5fextensions_2eproto** ()
- void **protobuf_ShutdownFile_goby_2fcommon_2fprotobuf_2foption_5fextensions_2eproto** ()
- bool **GobyFieldOptions_ConfigurationOptions_ConfigAction_IsValid** (int value)
- const ::google::protobuf::EnumDescriptor * **GobyFieldOptions_ConfigurationOptions_ConfigAction_descriptor** ()
- const ::std::string & **GobyFieldOptions_ConfigurationOptions_ConfigAction_Name** (GobyFieldOptions_ConfigurationOptions_ConfigAction value)
- bool **GobyFieldOptions_ConfigurationOptions_ConfigAction_Parse** (const ::std::string &name, GobyFieldOptions_ConfigurationOptions_ConfigAction *value)
- std::string **version_message** ()

Variables

- const GobyFieldOptions_ConfigurationOptions_ConfigAction **GobyFieldOptions_ConfigurationOptions_ConfigAction_ConfigAction_MIN** = GobyFieldOptions_ConfigurationOptions_ConfigAction_ALWAYS
- const GobyFieldOptions_ConfigurationOptions_ConfigAction **GobyFieldOptions_ConfigurationOptions_ConfigAction_ConfigAction_MAX** = GobyFieldOptions_ConfigurationOptions_ConfigAction_ADVANCED
- const int **GobyFieldOptions_ConfigurationOptions_ConfigAction_ConfigAction_ARRAYSIZE** = GobyFieldOptions_ConfigurationOptions_ConfigAction_ConfigAction_MAX + 1
- extern::google::protobuf::internal::ExtensionIdentifier < ::google::protobuf::FieldOptions,::google::protobuf::internal::MessageTypeTraits < ::goby::GobyFieldOptions > , 11, false > **field**
- extern::google::protobuf::internal::ExtensionIdentifier < ::google::protobuf::MessageOptions,::google::protobuf::internal::MessageTypeTraits < ::goby::GobyMessageOptions > , 11, false > **msg**
- const std::string **VERSION_STRING** = "2.1.4"
- const std::string **VERSION_DATE** = "2016.09.26"

Logger

- common::FlexOstream glog
  Access the Goby logger through this object.

15.1.1 Detailed Description

The global namespace for the Goby project. Converts the Google Protocol Buffers message `msg` into a suitable (human readable) string `out` for sending via MOOS.

All objects related to the Goby Underwater Autonomy Project.

Parameters

out	pointer to std::string to store serialized result
msg	Google Protocol buffers message to serialize

15.1.2 Function Documentation

15.1.2.1 template<typename App , typename Config > int goby::run (int *argc*, char * *argv[]*, Config * *cfg*)

Run a Goby application derived from MinimalApplicationBase. blocks caller until MinimalApplicationBase::__run() returns.

Parameters

argc	same as int main(int argc, char* argv)
argv	same as int main(int argc, char* argv)

Returns

same as int main(int argc, char* argv)

Definition at line 109 of file application_base.h.

15.2 goby::acomms Namespace Reference

Objects pertaining to acoustic communications (acomms)

Classes

- class MACManager

  provides an API to the goby-acomms MAC library. MACManager is essentially a std::list<protobuf::ModemTransmission> plus a timer.
- class ABCDriver

  provides an API to the imaginary ABC modem (as an example how to write drivers)
- class ModemDriverBase

  provides an abstract base class for acoustic modem drivers. This is subclassed by the various drivers for different manufacturers' modems.
- class MMDriver

  provides an API to the WHOI Micro-Modem driver
- class QueueException

  Exception class for libdccl.
- class QueueManager

  provides an API to the goby-acomms Queuing Library.

Typedefs

- typedef dccl::Exception **DCCLException**
- typedef dccl::NullValueException **DCCLNullValueException**
- typedef dccl::DefaultIdentifierCodec **DCCLDefaultIdentifierCodec**
- typedef dccl::v2::DefaultBoolCodec **DCCLDefaultBoolCodec**
- typedef dccl::v2::DefaultStringCodec **DCCLDefaultStringCodec**
- typedef dccl::v2::DefaultBytesCodec **DCCLDefaultBytesCodec**
- typedef dccl::v2::DefaultEnumCodec **DCCLDefaultEnumCodec**
- typedef dccl::v2::DefaultMessageCodec **DCCLDefaultMessageCodec**
- typedef dccl::FieldCodecBase **DCCLFieldCodecBase**
- typedef dccl::FieldCodecManager **DCCLFieldCodecManager**
- typedef dccl::internal::FromProtoCppTypeBase **FromProtoCppTypeBase**
- typedef dccl::Bitset **Bitset**
- typedef dccl::internal::TypeHelper **DCCLTypeHelper**
- typedef std::list < QueuedMessage >::iterator **messages_it**
- typedef std::multimap < unsigned, messages_it > ::iterator **waiting_for_ack_it**

Enumerations

- enum { **RATE_RUDICS** = 1, **RATE_SBD** = 0 }

Functions

- std::ostream & **operator**<< (std::ostream &out, const google::protobuf::Message &msg)
- void bind (ModemDriverBase &driver, QueueManager &queue_manager)

  binds the driver link-layer callbacks to the QueueManager
- void bind (MACManager &mac, ModemDriverBase &driver)

  binds the MAC initiate transmission callback to the driver and the driver parsed message callback to the MAC

- void bind (QueueManager &queue_manager, RouteManager &route_manager)

  creates bindings for a RouteManager to control a particular queue (QueueManager)
- void bind (ModemDriverBase &driver, QueueManager &queue_manager, MACManager &mac)

  bind all three (shortcut to calling the other three bind functions)
- void unbind (ModemDriverBase &driver, QueueManager &queue_manager)

  unbinds the driver link-layer callbacks to the QueueManager
- void unbind (MACManager &mac, ModemDriverBase &driver)

  unbinds the MAC initiate transmission callback to the driver and the driver parsed message callback to the MAC
- void unbind (QueueManager &queue_manager, RouteManager &route_manager)

  creates unbindings for a RouteManager to control a particular queue (QueueManager)
- void unbind (ModemDriverBase &driver, QueueManager &queue_manager, MACManager &mac)

  unbind all three (shortcut to calling the other three unbind functions)
- template<typename Signal , typename Slot >
  void connect (Signal *signal, Slot slot)

  connect a signal to a slot (e.g. function pointer)
- template<typename Signal , typename Obj , typename A1 >
  void connect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1))

  connect a signal to a member function with one argument
- template<typename Signal , typename Obj , typename A1 , typename A2 >
  void connect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1, A2))

  connect a signal to a member function with two arguments
- template<typename Signal , typename Obj , typename A1 , typename A2 , typename A3 >
  void connect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1, A2, A3))

  connect a signal to a member function with three arguments
- template<typename Signal , typename Slot >
  void disconnect (Signal *signal, Slot slot)

  disconnect a signal to a slot (e.g. function pointer)
- template<typename Signal , typename Obj , typename A1 >
  void disconnect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1))

  disconnect a signal to a member function with one argument
- template<typename Signal , typename Obj , typename A1 , typename A2 >
  void disconnect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1, A2))

  disconnect a signal to a member function with two arguments
- template<typename Signal , typename Obj , typename A1 , typename A2 , typename A3 >
  void disconnect (Signal *signal, Obj *obj, void(Obj::*mem_func)(A1, A2, A3))

  disconnect a signal to a member function with three arguments
- std::ostream & **operator<<** (std::ostream &os, const DCCLCodec &codec)
- uint16_t **net_checksum** (const std::string &data)
- unsigned **sbd_csum** (const std::string &data)
- void **serialize_rudics_packet** (std::string bytes, std::string *rudics_pkt)
- void **parse_rudics_packet** (std::string *bytes, std::string rudics_pkt)
- std::string **uint32_to_byte_string** (uint32_t i)
- uint32_t **byte_string_to_uint32** (std::string s)
- std::ostream & **operator<<** (std::ostream &os, const Queue &oq)
- std::ostream & operator<< (std::ostream &out, const QueueManager &d)

  outputs information about all available messages (same as info_all)

Acoustic MAC Library callback function type definitions

- std::ostream & **operator<<** (std::ostream &os, const MACManager &mac)

Variables

- const unsigned **BITS_IN_BYTE** = 8
- const unsigned **NIBS_IN_BYTE** = 2
- const int BROADCAST_ID = 0

  special modem id for the broadcast destination - no one is assigned this address. Analogous to 192.168.1.255 on a 192.168.1.0 subnet
- const int QUERY_DESTINATION_ID = -1

  special modem id used internally to goby-acomms for indicating that the MAC layer (`amac`) is agnostic to the next destination. The next destination is thus set by the data provider (typically `queue`).
- const int **QUERY_SOURCE_ID** = -1
- const unsigned char **DCCL_CCL_HEADER** = 32
- const unsigned **MULTIMESSAGE_MASK** = 1 << 7
- const unsigned **BROADCAST_MASK** = 1 << 6
- const unsigned **VAR_ID_MASK** = 0xFF ^ MULTIMESSAGE_MASK ^ BROADCAST_MASK
- const unsigned **USER_FRAME_NEXT_SIZE_BYTES** = 1
- const boost::posix_time::time_duration **ON_DEMAND_SKEW** = boost::posix_time::seconds(1)

15.2.1 Detailed Description

Objects pertaining to acoustic communications (acomms)

15.3 goby::common Namespace Reference

Utility objects for performing functions such as logging, non-acoustic communication (ethernet / serial), time, scientific, string manipulation, etc.

Namespaces

- tcolor

  Contains functions for adding color to Terminal window streams.

Classes

- class ConfigException

  indicates a problem with the runtime command line or .cfg file configuration (or –help was given)
- class FlexNCurses

  Enables the Verbosity == gui mode of the Goby logger and displays an NCurses gui for the logger content.
- class FlexOstream

  Forms the basis of the Goby logger: std::ostream derived class for holding the FlexOStreamBuf.
- struct Colors

  Represents the eight available terminal colors (and bold variants)
- class TermColor

  Converts between string, escape code, and enumeration representations of the terminal colors.

Enumerations

- enum **MarshallingScheme** {
  MARSHALLING_UNKNOWN = 0, **MARSHALLING_CSTR** = 1, **MARSHALLING_PROTOBUF** = 2, **MARSHALLING_CCL** = 3,
  MARSHALLING_MOOS = 4, **MARSHALLING_DCCL** = 5, **MARSHALLING_LCM** = 6, **MARSHALLING_MAX** = 6 }
- enum { **LIAISON_INTERNAL_PUBLISH_SOCKET** = 1, **LIAISON_INTERNAL_SUBSCRIBE_SOCKET** = 2 }

Functions

- std::ostream & operator<< (std::ostream &out, const google::protobuf::Message &msg)

  provides stream output operator for Google Protocol Buffers Message
- void **merge_app_base_cfg** (AppBaseConfig *base_cfg, const boost::program_options::variables_map &var_map)
- std::ostream & **operator**<< (std::ostream &os, const HDF5ProtobufEntry &entry)
- const Wt::WColor **goby_blue** (28, 159, 203)
- const Wt::WColor **goby_orange** (227, 96, 52)
- std::string **liaison_internal_publish_socket_name** ()
- std::string **liaison_internal_subscribe_socket_name** ()
- std::ostream & **operator**<< (FlexOstream &out, char c)
- std::ostream & **operator**<< (FlexOstream &out, signed char c)
- std::ostream & **operator**<< (FlexOstream &out, unsigned char c)
- std::ostream & **operator**<< (FlexOstream &out, const char *s)
- std::ostream & **operator**<< (FlexOstream &out, const signed char *s)
- std::ostream & **operator**<< (FlexOstream &out, const unsigned char *s)
- template<typename _CharT , typename _Traits , typename _Alloc >
  std::ostream & **operator**<< (FlexOstream &out, const std::basic_string< _CharT, _Traits, _Alloc > &s)
- double ptime2unix_double (boost::posix_time::ptime given_time)

  convert from boost date_time ptime to the number of seconds (including fractional) since 1/1/1970 0:00 UTC ("UNIX Time")
- boost::posix_time::ptime unix_double2ptime (double given_time)

  convert to boost date_time ptime from the number of seconds (including fractional) since 1/1/1970 0:00 UTC ("UNIX Time"): good to the microsecond
- uint64 ptime2unix_microsec (boost::posix_time::ptime given_time)

  convert from boost date_time ptime to the number of microseconds since 1/1/1970 0:00 UTC ("UNIX Time")
- boost::posix_time::ptime unix_microsec2ptime (uint64 given_time)

  convert to boost date_time ptime from the number of microseconds since 1/1/1970 0:00 UTC ("UNIX Time"): good to the microsecond
- boost::posix_time::ptime **nmea_time2ptime** (const std::string &mt)
- std::string **zeromq_packet_make_header** (MarshallingScheme marshalling_scheme, const std::string &identifier)
- void zeromq_packet_encode (std::string *raw, MarshallingScheme marshalling_scheme, const std::string &identifier, const std::string &body)

  Encodes a packet for Goby over ZeroMQ.
- void zeromq_packet_decode (const std::string &raw, MarshallingScheme *marshalling_scheme, std::string *identifier, std::string *body)

  Decodes a packet for Goby over ZeroMQ.

Variables

- const int **BITS_IN_UINT32** = 32
- const int **BITS_IN_BYTE** = 8
- const std::string **esc_red** = "\33[31m"
- const std::string **esc_lt_red** = "\33[91m"
- const std::string **esc_green** = "\33[32m"
- const std::string **esc_lt_green** = "\33[92m"
- const std::string **esc_yellow** = "\33[33m"
- const std::string **esc_lt_yellow** = "\33[93m"
- const std::string **esc_blue** = "\33[34m"
- const std::string **esc_lt_blue** ="\33[94m"
- const std::string **esc_magenta** = "\33[35m"
- const std::string **esc_lt_magenta** = "\33[95m"
- const std::string **esc_cyan** = "\33[36m"
- const std::string **esc_lt_cyan** = "\33[96m"
- const std::string **esc_white** = "\33[37m"
- const std::string **esc_lt_white** = "\33[97m"
- const std::string **esc_nocolor** = "\33[0m"

Time

- boost::function0< uint64 > **goby_time_function**
- int **goby_time_warp_factor** = 1
- template<typename ReturnType >
  ReturnType goby_time ()

  Returns current UTC time as a boost::posix_time::ptime.
- template<>
  uint64 goby_time< uint64 > ()

  Returns current UTC time as integer microseconds since 1970-01-01 00:00:00.
- template<>
  double goby_time< double > ()

  Returns current UTC time as seconds and fractional seconds since 1970-01-01 00:00:00.
- template<>
  boost::posix_time::ptime **goby_time**< **boost::posix_time::ptime** > ()
- template<>
  std::string goby_time< std::string > ()

  Returns current UTC time as a human-readable string.
- std::string goby_time_as_string (const boost::posix_time::ptime &t=goby_time())

  Simple string representation of goby_time()
- std::string goby_file_timestamp ()

  ISO string representation of goby_time()
- boost::posix_time::ptime time_t2ptime (std::time_t t)

  convert to ptime from time_t from time.h (whole seconds since UNIX)
- std::time_t ptime2time_t (boost::posix_time::ptime t)

  convert from ptime to time_t from time.h (whole seconds since UNIX)
- double time_duration2double (boost::posix_time::time_duration time_of_day)

  time duration to double number of seconds: good to the microsecond

15.3.1 Detailed Description

Utility objects for performing functions such as logging, non-acoustic communication (ethernet / serial), time, scientific, string manipulation, etc.

15.4 goby::common::tcolor Namespace Reference

Contains functions for adding color to Terminal window streams.

Functions

- std::ostream & add_escape_code (std::ostream &os, const std::string &esc_code)
- std::ostream & red (std::ostream &os)

  All text following this manipulator is red. (e.g. std::cout << red << "text";)
- std::ostream & lt_red (std::ostream &os)

  All text following this manipulator is light red (e.g. std::cout << lt_red << "text";)
- std::ostream & green (std::ostream &os)

  All text following this manipulator is green (e.g. std::cout << green << "text";)
- std::ostream & lt_green (std::ostream &os)

  All text following this manipulator is light green (e.g. std::cout << lt_green << "text";)
- std::ostream & yellow (std::ostream &os)

  All text following this manipulator is yellow (e.g. std::cout << yellow << "text";)
- std::ostream & lt_yellow (std::ostream &os)

  All text following this manipulator is light yellow (e.g. std::cout << lt_yellow << "text";)
- std::ostream & blue (std::ostream &os)

  All text following this manipulator is blue (e.g. std::cout << blue << "text";)
- std::ostream & lt_blue (std::ostream &os)

  All text following this manipulator is light blue (e.g. std::cout << lt_blue << "text";)
- std::ostream & magenta (std::ostream &os)

  All text following this manipulator is magenta (e.g. std::cout << magenta << "text";)
- std::ostream & lt_magenta (std::ostream &os)

  All text following this manipulator is light magenta (e.g. std::cout << lt_magenta << "text";)
- std::ostream & cyan (std::ostream &os)

  All text following this manipulator is cyan (e.g. std::cout << cyan << "text";)
- std::ostream & lt_cyan (std::ostream &os)

  All text following this manipulator is light cyan (e.g. std::cout << lt_cyan << "text";)
- std::ostream & white (std::ostream &os)

  All text following this manipulator is white (e.g. std::cout << white << "text";)
- std::ostream & lt_white (std::ostream &os)

  All text following this manipulator is bright white (e.g. std::cout << lt_white << "text";)
- std::ostream & nocolor (std::ostream &os)

  All text following this manipulator is uncolored (e.g. std::cout << green << "green" << nocolor << "uncolored";)

15.4.1 Detailed Description

Contains functions for adding color to Terminal window streams.

15.4.2 Function Documentation

15.4.2.1 std::ostream & goby::common::tcolor::add_escape_code (std::ostream & *os*, const std::string & *esc_code*)

Append the given escape code to the stream os

Parameters

os	ostream to append to
esc_code	escape code to append (e.g. "\33[31m")

Definition at line 27 of file term_color.cpp.

15.5 goby::pb Namespace Reference

Contains objects relating to the core publish / subscribe architecture provided by Goby.

Classes

- class Application

  Base class provided for users to generate applications that participate in the Goby publish/subscribe architecture.

15.5.1 Detailed Description

Contains objects relating to the core publish / subscribe architecture provided by Goby.

15.6 goby::transitional Namespace Reference

Objects pertaining to transitioning from DCCLv1 to DCCLv2.

Classes

- class DCCLTransitionalCodec

  provides an API to the Transitional Dynamic CCL Codec (looks like DCCLv1, but calls DCCLv2). Warning: this class is for legacy support only, new applications should use DCCLCodec directly.
- class DCCLMessageVal

  defines a DCCL value

Typedefs

- typedef boost::function< void(DCCLMessageVal &)> AlgFunction1

  boost::function for a function taking a single DCCLMessageVal reference. Used for algorithm callbacks.
- typedef boost::function< void(DCCLMessageVal &, const std::vector < DCCLMessageVal > &)> AlgFunction2

  boost::function for a function taking a dccl::MessageVal reference, and the MessageVal of a second part of the message. Used for algorithm callbacks.

Enumerations

- enum DCCLType { dccl_static, dccl_bool, dccl_int, dccl_float, dccl_enum, dccl_string, dccl_hex }

  Enumeration of DCCL types used for sending messages. dccl_enum and dccl_string primarily map to cpp_string, dccl_bool to cpp_bool, dccl_int to cpp_long, dccl_float to cpp_double.
- enum DCCLCppType { cpp_notype, cpp_bool, cpp_string, cpp_long, cpp_double }

Enumeration of C++ types used in DCCL.

- enum { **POWER2_BITS_IN_BYTE** = 3 }
- enum { **POWER2_NIBS_IN_BYTE** = 1 }
- enum **DCCLHeaderPart** {
  HEAD_CCL_ID = 0, **HEAD_DCCL_ID** = 1, **HEAD_TIME** = 2, **HEAD_SRC_ID** = 3,
  HEAD_DEST_ID = 4, **HEAD_MULTIMESSAGE_FLAG** = 5, **HEAD_BROADCAST_FLAG** = 6, **HEAD_UNUSED** = 7 }
- enum **DCCLHeaderBits** {
  HEAD_CCL_ID_SIZE = 8, **HEAD_DCCL_ID_SIZE** = 9, **HEAD_TIME_SIZE** = 17, **HEAD_SRC_ID_SIZE** = 5,
  HEAD_DEST_ID_SIZE = 5, **HEAD_FLAG_SIZE** = 1, **HEAD_UNUSED_SIZE** = 2 }

Functions

- unsigned **bits2bytes** (unsigned bits)
- unsigned **bytes2bits** (unsigned bytes)
- unsigned **bytes2nibs** (unsigned bytes)
- unsigned **nibs2bytes** (unsigned nibs)
- std::string **type_to_string** (DCCLType type)
- std::string **type_to_protobuf_type** (DCCLType type)
- std::string **type_to_string** (DCCLCppType type)
- std::string **to_str** (DCCLHeaderPart p)
- template<typename Value >
  std::ostream & operator<< (std::ostream &out, const std::map< std::string, Value > &m)

  use this for displaying a human readable version
- template<typename Value >
  std::ostream & **operator**<< (std::ostream &out, const std::multimap< std::string, Value > &m)
- std::ostream & operator<< (std::ostream &out, const std::set< unsigned > &s)

  use this for displaying a human readable version of this STL object
- std::ostream & operator<< (std::ostream &out, const std::set< std::string > &s)

  use this for displaying a human readable version of this STL object
- std::ostream & **operator**<< (std::ostream &os, const DCCLMessageVal &mv)
- std::ostream & **operator**<< (std::ostream &os, const std::vector< DCCLMessageVal > &vm)

Binary encoding

- bool char_array2hex_string (const unsigned char *c, std::string &s, const unsigned int n)

  converts a char (byte) array into a hex string
- bool hex_string2char_array (unsigned char *c, const std::string &s, const unsigned int n)

  turns a string of hex chars ABCDEF into a character array reading each byte 0xAB,0xCD, 0xEF, etc.
- std::string long2binary_string (unsigned long l, unsigned short bits)

  return a string represented the binary value of `l` for `bits` number of bits which reads MSB -> LSB
- std::string binary_string2hex_string (const std::string &bs)

  converts a binary string ("1000101010101010") into a hex string ("8AAA")
- std::string hex_string2binary_string (const std::string &bs)

  converts a boost::dynamic_bitset (similar to std::bitset but without compile time size requirements) into a hex string
- template<typename T >
  bool hex_string2number (const std::string &s, T &t)

  converts a hex string ("8AAA") into a dynamic_bitset
- template<typename T >
  bool number2hex_string (std::string &s, const T &t, unsigned int width=2)

  converts a decimal number of type T into a hex string
- template<typename T >
  std::string number2hex_string (const T &t, unsigned int width=2)

  converts a decimal number of type T into a hex string assuming success

Variables

- const unsigned **DCCL_NUM_HEADER_BYTES** = 6
- const unsigned **DCCL_NUM_HEADER_PARTS** = 8
- const std::string **DCCL_HEADER_NAMES** []

15.6.1 Detailed Description

Objects pertaining to transitioning from DCCLv1 to DCCLv2.

15.6.2 Typedef Documentation

15.6.2.1 typedef boost::function<void (DCCLMessageVal&)> goby::transitional::AlgFunction1

boost::function for a function taking a single DCCLMessageVal reference. Used for algorithm callbacks.

Think of this as a generalized version of a function pointer (void (*)(DCCLMessageVal&)). See http://www.boost.org/doc/libs/1_34_0/doc/html/function.html for more on boost:function.

Definition at line 39 of file message_algorithms.h.

15.6.2.2 typedef boost::function<void (DCCLMessageVal&, const std::vector<DCCLMessageVal>&)> goby::transitional::AlgFunction2

boost::function for a function taking a dccl::MessageVal reference, and the MessageVal of a second part of the message. Used for algorithm callbacks.

Think of this as a generalized version of a function pointer (void (*)(DCCLMessageVal&, const DCCLMessageVal&). See http://www.boost.org/doc/libs/1_34_0/doc/html/function.html for more on boost:function.

Definition at line 48 of file message_algorithms.h.

15.6.3 Enumeration Type Documentation

15.6.3.1 enum goby::transitional::DCCLCppType

Enumeration of C++ types used in DCCL.

Enumerator

cpp_notype not one of the C++ types used in DCCL

cpp_bool C++ bool

cpp_string C++ std::string

cpp_long C++ long

cpp_double C++ double

Definition at line 57 of file dccl_constants.h.

15.6.3.2 enum goby::transitional::DCCLType

Enumeration of DCCL types used for sending messages. dccl_enum and dccl_string primarily map to cpp_string, dccl_bool to cpp_bool, dccl_int to cpp_long, dccl_float to cpp_double.

Enumerator

dccl_static tag_static

dccl_bool tag_bool

dccl_int tag_int

dccl_float tag_float

dccl_enum tag_enum

dccl_string tag_string

dccl_hex tag_hex

Definition at line 48 of file dccl_constants.h.

15.6.4 Function Documentation

15.6.4.1 bool goby::transitional::char_array2hex_string (const unsigned char * *c*, std::string & *s*, const unsigned int *n*) [inline]

converts a char (byte) array into a hex string

Parameters

c	pointer to array of char
s	reference to string to put char into as hex
n	length of c the first two hex chars in s are the 0 index in c

Definition at line 171 of file dccl_constants.h.

15.6.4.2 std::string goby::transitional::hex_string2binary_string (const std::string & *bs*) [inline]

converts a boost::dynamic_bitset (similar to std::bitset but without compile time size requirements) into a hex string

converts a hex string ("8AAA") into a binary string ("1000101010101010")

only works on whole byte string (even number of nibbles)

Definition at line 242 of file dccl_constants.h.

15.6.4.3 template<typename T > bool goby::transitional::hex_string2number (const std::string & *s*, T & *t*)

converts a hex string ("8AAA") into a dynamic_bitset

attempts to convert a hex string into a numerical representation (of type T)

Returns

true if conversion succeeds, false otherwise

Definition at line 273 of file dccl_constants.h.

15.6.4.4 template<typename T > bool goby::transitional::number2hex_string (std::string & *s*, const T & *t*, unsigned int *width* = 2)

converts a decimal number of type T into a hex string

Parameters

s	string reference to store result in
t	decimal number to convert
width	desired width (in characters) of return string. Width should be twice the number of bytes

Returns

true if successful, false otherwise

Definition at line 288 of file dccl_constants.h.

15.6.4.5 template<typename T > std::string goby::transitional::number2hex_string (const T & *t,* unsigned int *width* = 2)

converts a decimal number of type T into a hex string assuming success

Parameters

t	decimal number to convert
width	desired width (in characters) of return string. Width should be twice the number of bytes

Returns

hex string

Definition at line 301 of file dccl_constants.h.

15.6.5 Variable Documentation

15.6.5.1 const std::string goby::transitional::DCCL_HEADER_NAMES[ ]

Initial value:

```
= { "_ccl_id",
                                                    "_id",
                                                    "_time",
                                                    "_src_id",
                                                    "_dest_id",
                                                    "_multimessage_flag",
                                                    "_broadcast_flag",
                                                    "_unused",
        }
```

Definition at line 135 of file dccl_constants.h.

16 Class Documentation

16.1 boost::asio::time_traits< goby::common::GobyTime > Struct Template Reference

Time traits specialised for GobyTime.

`#include <goby/common/time.h>`

Public Types

- typedef boost::posix_time::ptime time_type
  The time type.
- typedef boost::posix_time::time_duration duration_type
  The duration type.

Static Public Member Functions

- static time_type now ()
  Get the current time.
- static time_type add (const time_type &t, const duration_type &d)
  Add a duration to a time.
- static duration_type subtract (const time_type &t1, const time_type &t2)
  Subtract one time from another.
- static bool less_than (const time_type &t1, const time_type &t2)
  Test whether one time is less than another.
- static boost::posix_time::time_duration to_posix_duration (const duration_type &d)
  Convert to POSIX duration type.

16.1.1 Detailed Description

template<>struct boost::asio::time_traits< goby::common::GobyTime >

Time traits specialised for GobyTime.

Definition at line 229 of file time.h.

The documentation for this struct was generated from the following file:

- goby/common/time.h

16.2 ChatCurses Class Reference

provides a terminal GUI for a chat window (lower box to type and upper box to receive messages). Part of the chat.cpp example.

`#include </build/goby2-gRCrru/goby2-2.1.5+DAILYDEB+640/share/examples/acomms/chat/chat_curses.h>`

Public Member Functions

- void set_modem_id (unsigned id)

  give the modem_id so we know how to label our messages
- void startup ()

  start the display
- void run_input (std::string &line)

  grab a character and if there's a line to return it will be returned in `line`
- void cleanup ()

  end the display
- void post_message (unsigned id, const std::string &line)

  add a message to the upper window (the chat log)
- void **post_message** (const std::string &line)

Constructors/Destructor

- **ChatCurses** ()
- ~**ChatCurses** ()

16.2.1 Detailed Description

provides a terminal GUI for a chat window (lower box to type and upper box to receive messages). Part of the chat.cpp example.

Examples:

acomms/chat/chat.cpp.

Definition at line 29 of file chat_curses.h.

The documentation for this class was generated from the following files:

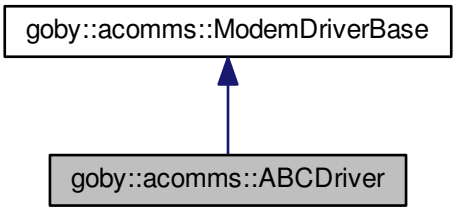
- share/examples/acomms/chat/chat_curses.h
- share/examples/acomms/chat/chat_curses.cpp

16.3 goby::acomms::ABCDriver Class Reference

provides an API to the imaginary ABC modem (as an example how to write drivers)

`#include <goby/acomms/modemdriver/abc_driver.h>`

Inheritance diagram for goby::acomms::ABCDriver:



Public Member Functions

- void startup (const protobuf::DriverConfig &cfg)

  Starts the modem driver. Must be called before poll().
- void shutdown ()

  Shuts down the modem driver.
- void do_work ()

  Allows the modem driver to do its work.
- void handle_initiate_transmission (const protobuf::ModemTransmission &m)

  Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Additional Inherited Members

16.3.1 Detailed Description

provides an API to the imaginary ABC modem (as an example how to write drivers)

Examples:

acomms/modemdriver/driver_simple/driver_simple.cpp.

Definition at line 39 of file abc_driver.h.

16.3.2 Member Function Documentation

16.3.2.1 void goby::acomms::ABCDriver::do_work ( ) [virtual]

Allows the modem driver to do its work.

Should be called regularly to perform the work of the driver as the driver *does not* run in its own thread. This allows us to guarantee that no signals are called except inside this method. Does not block.

Implements goby::acomms::ModemDriverBase.

Definition at line 114 of file abc_driver.cpp.

16.3.2.2 void goby::acomms::ABCDriver::handle_initiate_transmission (const protobuf::ModemTransmission & *m*) [virtual]

Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Parameters

m	ModemTransmission (defined in acomms_modem_message.proto) containing the details of the transmission to be started. This may contain data frames. If not, data will be requested when the driver calls the data request signal (ModemDriverBase::signal_data_request)

Implements goby::acomms::ModemDriverBase.

Definition at line 77 of file abc_driver.cpp.

16.3.2.3 void goby::acomms::ABCDriver::startup (const protobuf::DriverConfig & *cfg*) [virtual]

Starts the modem driver. Must be called before poll().

Parameters

cfg	Startup configuration for the driver and modem. DriverConfig is defined in acomms_driver_base.proto. Derived classes can define extensions (see http://code.google.com/apis/protocolbuffers/docs/proto.html#extensions) to DriverConfig to handle modem specific configuration.

Implements goby::acomms::ModemDriverBase.

Definition at line 39 of file abc_driver.cpp.

The documentation for this class was generated from the following files:

- goby/acomms/modemdriver/abc_driver.h
- src/acomms/modemdriver/abc_driver.cpp

16.4 goby::acomms::MACManager Class Reference

provides an API to the goby-acomms MAC library. MACManager is essentially a std::list<protobuf::ModemTransmission> plus a timer.

`#include <goby/acomms/amac.h>`

Inherits std::list< T >.

Public Member Functions

Constructors/Destructor

- MACManager ()
  Default constructor.
- ~**MACManager** ()

Control

- void startup (const protobuf::MACConfig &cfg)
  Starts the MAC with given configuration.
- void restart ()
  Restarts the MAC with original configuration.
- void shutdown ()
  Shutdown the MAC.
- void do_work ()
  Allows the MAC timer to do its work. Does not block. If you prefer more control you can directly control the underlying boost::asio::io_service (get_io_service()) instead of using this function. This function is equivalent to get_io_service().poll();.
- void update ()
  You must call this after any change to the underlying list that would invalidate iterators or change the size (insert, push_back, erase, etc.).
- bool **running** ()

Modem Signals

- boost::signals2::signal< void(const protobuf::ModemTransmission &m)> signal_initiate_transmission

  Signals when it is time for this platform to begin transmission of an acoustic message at the start of its TDMA slot. Typically connected to ModemDriverBase::handle_initiate_transmission() using bind().
- boost::signals2::signal< void(const protobuf::ModemTransmission &m)> signal_slot_start

  Signals the start of all transmissions (even when we don't transmit)
- unsigned **cycle_count** ()
- double **cycle_duration** ()
- boost::asio::io_service & **get_io_service** ()
- const std::string & **glog_mac_group** () const

16.4.1 Detailed Description

provides an API to the goby-acomms MAC library. MACManager is essentially a std::list<protobuf::ModemTransmission> plus a timer.

See Also

acomms_amac.proto and acomms_modem_message.proto for definition of Google Protocol Buffers messages (namespace goby::acomms::protobuf).

Examples:

acomms/amac/amac_simple/amac_simple.cpp, and acomms/chat/chat.cpp.

Definition at line 54 of file mac_manager.h.

16.4.2 Member Function Documentation

16.4.2.1 void goby::acomms::MACManager::startup (const protobuf::MACConfig & *cfg*)

Starts the MAC with given configuration.

Parameters

cfg	Initial configuration values (protobuf::MACConfig defined in acomms_amac.proto)

Examples:

acomms/amac/amac_simple/amac_simple.cpp, and acomms/chat/chat.cpp.

Definition at line 71 of file mac_manager.cpp.

16.4.3 Member Data Documentation

16.4.3.1 boost::signals2::signal<void (const protobuf::ModemTransmission& m)> goby::acomms::MACManager::signal_initiate_transmission

Signals when it is time for this platform to begin transmission of an acoustic message at the start of its TDMA slot. Typically connected to ModemDriverBase::handle_initiate_transmission() using bind().

Parameters

m	a message containing details of the transmission to be initated. (protobuf::ModemMsgBase defined in acomms_modem_message.proto)

Examples:

acomms/amac/amac_simple/amac_simple.cpp, and acomms/chat/chat.cpp.

Definition at line 96 of file mac_manager.h.

16.4.3.2 boost::signals2::signal<void (const protobuf::ModemTransmission& m)> goby::acomms::MACManager::signal_slot_start

Signals the start of all transmissions (even when we don't transmit)

Parameters

m	a message containing details of the transmission to be initated. (protobuf::ModemMsgBase defined in acomms_modem_message.proto)

Definition at line 102 of file mac_manager.h.

The documentation for this class was generated from the following files:

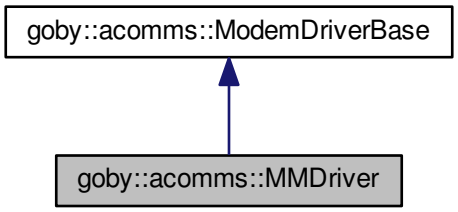
- goby/acomms/amac/mac_manager.h
- src/acomms/amac/mac_manager.cpp

16.5 goby::acomms::MMDriver Class Reference

provides an API to the WHOI Micro-Modem driver

`#include <goby/acomms/modem_driver.h>`

Inheritance diagram for goby::acomms::MMDriver:



Public Member Functions

- MMDriver ()

  Default constructor.
- ~MMDriver ()

  Destructor.
- void startup (const protobuf::DriverConfig &cfg)

  Starts the driver.

- void update_cfg (const protobuf::DriverConfig &cfg)

  Update configuration while running (not required to be implemented)
- void shutdown ()

  Stops the driver.
- void do_work ()

  See ModemDriverBase::do_work()
- void handle_initiate_transmission (const protobuf::ModemTransmission &m)

  See ModemDriverBase::handle_initiate_transmission()
- int clk_mode ()

  Current clock mode of the modem, necessary for synchronous navigation.
- bool **is_started** () const
- void **set_silent** (bool silent)
- void **write_single_cfg** (const std::string &s)

Static Public Member Functions

- static unsigned **packet_frame_count** (int rate)
- static unsigned **packet_size** (int rate)

Additional Inherited Members

16.5.1 Detailed Description

provides an API to the WHOI Micro-Modem driver

Examples:

acomms/chat/chat.cpp, and acomms/modemdriver/driver_simple/driver_simple.cpp.

Definition at line 42 of file mm_driver.h.

16.5.2 Member Function Documentation

16.5.2.1 void goby::acomms::MMDriver::startup (const protobuf::DriverConfig & *cfg*) [virtual]

Starts the driver.

Parameters

cfg	Configuration for the Micro-Modem driver. DriverConfig is defined in acomms_driver_base.proto, and various extensions specific to the WHOI Micro-Modem are defined in acomms_mm_driver.proto.

Implements goby::acomms::ModemDriverBase.

Examples:

acomms/chat/chat.cpp.

Definition at line 85 of file mm_driver.cpp.

The documentation for this class was generated from the following files:

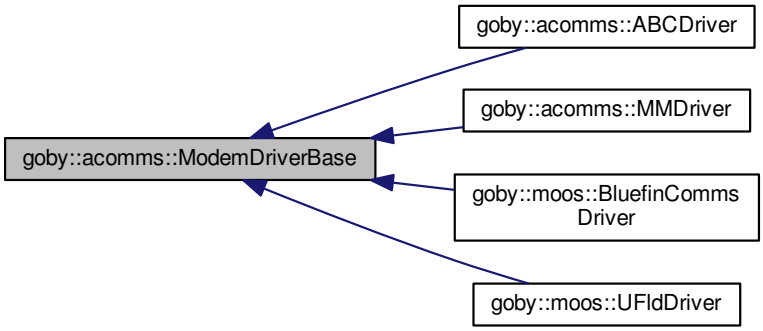
- goby/acomms/modemdriver/mm_driver.h
- src/acomms/modemdriver/mm_driver.cpp

16.6 goby::acomms::ModemDriverBase Class Reference

provides an abstract base class for acoustic modem drivers. This is subclassed by the various drivers for different manufacturers' modems.

`#include <goby/acomms/modem_driver.h>`

Inheritance diagram for goby::acomms::ModemDriverBase:



Public Member Functions

- virtual ~ModemDriverBase ()
  Public Destructor.
- int **driver_order** ()

Control

- virtual void startup (const protobuf::DriverConfig &cfg)=0
  Starts the modem driver. Must be called before poll().
- virtual void update_cfg (const protobuf::DriverConfig &cfg)
  Update configuration while running (not required to be implemented)
- virtual void shutdown ()=0
  Shuts down the modem driver.
- virtual void do_work ()=0
  Allows the modem driver to do its work.

MAC Slots

- virtual void handle_initiate_transmission (const protobuf::ModemTransmission &m)=0
  Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Public Attributes

MAC / Queue Signals

- boost::signals2::signal< void(const protobuf::ModemTransmission &message)> signal_receive
  Called when a binary data transmission is received from the modem.

- boost::signals2::signal< void(const protobuf::ModemTransmission &message)> signal_transmit_result

  Called when a transmission is completed.
- boost::signals2::signal< void(protobuf::ModemTransmission *msg)> signal_data_request

  Called when the modem or modem driver needs data to send. The returned data should be stored in ModemTransmission::frame.
- boost::signals2::signal< void(protobuf::ModemTransmission *msg_request)> signal_modify_transmission

  Called before the modem driver begins processing a transmission. This allows a third party to modify the parameters of the transmission (such as destination or rate) on the fly.
- boost::signals2::signal< void(const protobuf::ModemRaw &msg)> signal_raw_incoming

  Called after any message is received from the modem by the driver. Used by the MACManager for auto-discovery of vehicles. Also useful for higher level analysis and debugging of the transactions between the driver and the modem.
- boost::signals2::signal< void(const protobuf::ModemRaw &msg)> signal_raw_outgoing

  Called after any message is sent from the driver to the modem. Useful for higher level analysis and debugging of the transactions between the driver and the modem.

Protected Member Functions

Constructors/Destructor

- ModemDriverBase ()

  Constructor.

Write/read from the line-based interface to the modem

- void modem_write (const std::string &out)

  write a line to the serial port.
- bool modem_read (std::string *in)

  read a line from the serial port, including end-of-line character(s)
- void modem_start (const protobuf::DriverConfig &cfg)

  start the physical connection to the modem (serial port, TCP, etc.). must be called before ModemDriverBase::modem_read() or ModemDriverBase::modem_write()
- void modem_close ()

  closes the serial port. Use modem_start to reopen the port.
- const std::string & **glog_out_group** () const
- const std::string & **glog_in_group** () const
- util::LineBasedInterface & modem ()

  use for direct access to the modem

Static Protected Attributes

- static int **count_** = 0

16.6.1 Detailed Description

provides an abstract base class for acoustic modem drivers. This is subclassed by the various drivers for different manufacturers' modems.

See Also

acomms_driver_base.proto and acomms_modem_message.proto for definition of Google Protocol Buffers messages (namespace goby::acomms::protobuf).

Examples:

acomms/modemdriver/driver_simple/driver_simple.cpp.

Definition at line 44 of file driver_base.h.

16.6.2 Member Function Documentation

16.6.2.1 virtual void goby::acomms::ModemDriverBase::do_work ( ) [pure virtual]

Allows the modem driver to do its work.

Should be called regularly to perform the work of the driver as the driver *does not* run in its own thread. This allows us to guarantee that no signals are called except inside this method. Does not block.

Implemented in goby::acomms::MMDriver, goby::moos::BluefinCommsDriver, goby::moos::UFldDriver, and goby::acomms::ABCDriver.

Examples:

acomms/modemdriver/driver_simple/driver_simple.cpp.

16.6.2.2 virtual void goby::acomms::ModemDriverBase::handle_initiate_transmission (const protobuf::ModemTransmission & *m*) [pure virtual]

Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Parameters

m	ModemTransmission (defined in acomms_modem_message.proto) containing the details of the transmission to be started. This may contain data frames. If not, data will be requested when the driver calls the data request signal (ModemDriverBase::signal_data_request)

Implemented in goby::acomms::MMDriver, goby::moos::BluefinCommsDriver, goby::moos::UFldDriver, and goby::acomms::ABCDriver.

Examples:

acomms/modemdriver/driver_simple/driver_simple.cpp.

16.6.2.3 bool goby::acomms::ModemDriverBase::modem_read (std::string * *in*) [protected]

read a line from the serial port, including end-of-line character(s)

Parameters

in	pointer to string to store line

Returns

true if a line was available, false if no line available

Definition at line 66 of file driver_base.cpp.

16.6.2.4 void goby::acomms::ModemDriverBase::modem_start (const protobuf::DriverConfig & *cfg*) [protected]

start the physical connection to the modem (serial port, TCP, etc.). must be called before ModemDriverBase::modem_read() or ModemDriverBase::modem_write()

Parameters

cfg	Configuration including the parameters for the physical connection. (protobuf::DriverConfig is defined in acomms_driver_base.proto).

Exceptions

ModemDriverException	Problem opening the physical connection.

Definition at line 81 of file driver_base.cpp.

16.6.2.5 void goby::acomms::ModemDriverBase::modem_write (const std::string & *out*) [protected]

write a line to the serial port.

Parameters

out	reference to string to write. Must already include any end-of-line character(s).

Definition at line 58 of file driver_base.cpp.

16.6.2.6 virtual void goby::acomms::ModemDriverBase::startup (const protobuf::DriverConfig & *cfg*) [pure virtual]

Starts the modem driver. Must be called before poll().

Parameters

cfg	Startup configuration for the driver and modem. DriverConfig is defined in acomms_driver_base.proto. Derived classes can define extensions (see http://code.google.com/apis/protocolbuffers/docs/proto.html#extensions) to DriverConfig to handle modem specific configuration.

Implemented in goby::acomms::MMDriver, goby::moos::BluefinCommsDriver, goby::moos::UFldDriver, and goby::acomms::ABCDriver.

Examples:

acomms/modemdriver/driver_simple/driver_simple.cpp.

16.6.3 Member Data Documentation

16.6.3.1 boost::signals2::signal<void (protobuf::ModemTransmission* msg)> goby::acomms::ModemDriverBase::signal_data_request

Called when the modem or modem driver needs data to send. The returned data should be stored in ModemTransmission::frame.

You should connect one or more slots (a function or member function) to this signal to handle data requests. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemTransmission is defined in acomms_modem_message.proto.

Definition at line 96 of file driver_base.h.

16.6.3.2 boost::signals2::signal<void (protobuf::ModemTransmission* msg_request)> goby::acomms::ModemDriverBase::signal_modify_transmission

Called before the modem driver begins processing a transmission. This allows a third party to modify the parameters of the transmission (such as destination or rate) on the fly.

You may connect one or more slots (a function or member function) to this signal to handle data requests. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemTransmission is defined in acomms_modem_message.proto.

Definition at line 102 of file driver_base.h.

16.6.3.3 boost::signals2::signal<void (const protobuf::ModemRaw& msg)> goby::acomms::ModemDriverBase::signal_raw_incoming

Called after any message is received from the modem by the driver. Used by the MACManager for auto-discovery of vehicles. Also useful for higher level analysis and debugging of the transactions between the driver and the modem.

If desired, you should connect one or more slots (a function or member function) to this signal to listen on incoming transactions. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemRaw is defined in acomms_modem_message.proto.

Definition at line 109 of file driver_base.h.

16.6.3.4 boost::signals2::signal<void (const protobuf::ModemRaw& msg)> goby::acomms::ModemDriverBase::signal_raw_outgoing

Called after any message is sent from the driver to the modem. Useful for higher level analysis and debugging of the transactions between the driver and the modem.

If desired, you should connect one or more slots (a function or member function) to this signal to listen on outgoing transactions. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemRaw is defined in acomms_modem_message.proto.

Definition at line 115 of file driver_base.h.

16.6.3.5 boost::signals2::signal<void (const protobuf::ModemTransmission& message)> goby::acomms::ModemDriverBase::signal_receive

Called when a binary data transmission is received from the modem.

You should connect one or more slots (a function or member function) to this signal to receive incoming messages. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemDataTransmission is defined in acomms_modem_message.proto.

Examples:

acomms/chat/chat.cpp, and acomms/modemdriver/driver_simple/driver_simple.cpp.

Definition at line 83 of file driver_base.h.

16.6.3.6 boost::signals2::signal<void (const protobuf::ModemTransmission& message)> goby::acomms::ModemDriverBase::signal_transmit_result

Called when a transmission is completed.

You should connect one or more slots (a function or member function) to this signal to receive incoming messages. Use the goby::acomms::connect family of functions to do this. This signal will only be called during a call to poll. ModemDataTransmission is defined in acomms_modem_message.proto.

Definition at line 90 of file driver_base.h.

The documentation for this class was generated from the following files:

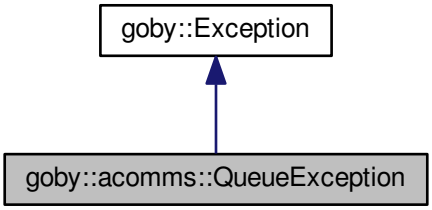
- goby/acomms/modemdriver/driver_base.h
- src/acomms/modemdriver/driver_base.cpp

16.7 goby::acomms::QueueException Class Reference

Exception class for libdccl.

`#include <goby/acomms/queue/queue_exception.h>`

Inheritance diagram for goby::acomms::QueueException:



Public Member Functions

- **QueueException** (const std::string &s)

16.7.1 Detailed Description

Exception class for libdccl.

Definition at line 34 of file queue_exception.h.

The documentation for this class was generated from the following file:

- goby/acomms/queue/queue_exception.h

16.8 goby::acomms::QueueManager Class Reference

provides an API to the goby-acomms Queuing Library.

`#include <goby/acomms/queue.h>`

Public Member Functions

- QueueManager ()
  constructor
- ~QueueManager ()
  destructor

Initialization Methods

These methods are intended to be called before doing any work with the class.

- void set_cfg (const protobuf::QueueManagerConfig &cfg)
  Set (and overwrite completely if present) the current configuration. (protobuf::QueueManagerConfig defined in acomms_queue.proto)
- void merge_cfg (const protobuf::QueueManagerConfig &cfg)
  Set (and merge "repeat" fields) the current configuration. (protobuf::QueueManagerConfig defined in acomms_queue.proto)
- template<typename ProtobufMessage >
  void add_queue (const protobuf::QueuedMessageEntry &queue_cfg)

Add a DCCL queue for use with QueueManager. Note that the queue must be added before receiving messages with QueueManager.

- void add_queue (const google::protobuf::Descriptor *desc, const protobuf::QueuedMessageEntry &queue_cfg)

  Alternative method for adding Queues when using Dynamic Protobuf Messages.

Application level Push/Receive Methods

These methods are the primary higher level interface to the QueueManager. From here you can push messages and set the callbacks to use on received messages.

- void push_message (const google::protobuf::Message &new_message)

  Push a message (and add the queue if it does not exist)
- void **push_message** (const google::protobuf::Message &new_message, const protobuf::QueuedMessageMeta *meta)
- void flush_queue (const protobuf::QueueFlush &flush)

  Flush (delete all messages in) a queue.

Modem Slots

These methods are the interface to the QueueManager from the modem driver.

- void handle_modem_data_request (protobuf::ModemTransmission *msg)

  Finds data to send to the modem.
- void handle_modem_receive (const protobuf::ModemTransmission &message)

  Receive incoming data from the modem.

Control

Call these methods when you want the QueueManager to perform time sensitive tasks (such as expiring old messages)

- void do_work ()

  Calculates which messages have expired and emits the goby::acomms::QueueManager::signal_expire as necessary.

Informational Methods

- void info_all (std::ostream *os) const

  Writes a human readable summary (including DCCLCodec info) of all loaded queues.
- template<typename ProtobufMessage >
  void info (std::ostream *os) const

  Writes a human readable summary (including DCCLCodec info) of the queue for the provided DCCL type to the stream provided.
- void info (const google::protobuf::Descriptor *desc, std::ostream *os) const

  An alterative form for getting information for Queues for message types not known at compile-time ("dynamic").
- const std::string & **glog_push_group** ()
- const std::string & **glog_pop_group** ()
- const std::string & **glog_priority_group** ()
- const std::string & **glog_out_group** ()
- const std::string & **glog_in_group** ()
- std::string **msg_string** (const google::protobuf::Descriptor *desc)
- int modem_id ()

  The current modem ID (MAC address) of this node.
- protobuf::QueuedMessageMeta **meta_from_msg** (const google::protobuf::Message &msg)

Public Attributes

- boost::signals2::signal< void(protobuf::QueuedMessageMeta *meta, const google::protobuf::Message &data_msg, int modem_id)> signal_out_route

  Used by a router to change next-hop destination (in meta)
- boost::signals2::signal< void(const protobuf::QueuedMessageMeta &meta, const google::protobuf::Message &data_msg, int modem_id)> signal_in_route

  Used by a router to intercept messages and requeue them if desired.

Application Signals

- boost::signals2::signal< void(const protobuf::ModemTransmission &ack_msg, const google::protobuf::Message &orig_msg)> signal_ack

  Signals when acknowledgment of proper message receipt has been received. This is only sent for queues with queue.ack == true with an explicit destination (ModemMessageBase::dest() != 0)
- boost::signals2::signal< void(const google::protobuf::Message &msg) > signal_receive

  Signals when a DCCL message is received.
- boost::signals2::signal< void(const google::protobuf::Message &orig_msg)> signal_expire

  Signals when a message is expires (exceeds its time-to-live or ttl) before being sent (if queue.ack == false) or before being acknowledged (if queue.ack == true).
- boost::signals2::signal< void(const protobuf::ModemTransmission &request_msg, google::protobuf::Message *data_msg)> signal_data_on_demand

  Forwards the data request to the application layer. This advanced feature is used when queue.encode_on_demand == true and allows for the application to provide data immediately before it is actually sent (for highly time sensitive data)
- boost::signals2::signal< void(protobuf::QueueSize size)> signal_queue_size_change

  Signals when any queue changes size (message is popped or pushed)

Friends

- class **Queue**

16.8.1 Detailed Description

provides an API to the goby-acomms Queuing Library.

See Also

acomms_queue.proto and acomms_modem_message.proto for definition of Google Protocol Buffers messages (namespace goby::acomms::protobuf).

Examples:

acomms/chat/chat.cpp, and acomms/queue/queue_simple/queue_simple.cpp.

Definition at line 50 of file queue_manager.h.

16.8.2 Member Function Documentation

16.8.2.1 template<typename ProtobufMessage > void goby::acomms::QueueManager::add_queue (const protobuf::QueuedMessageEntry & *queue_cfg*) [inline]

Add a DCCL queue for use with QueueManager. Note that the queue must be added before receiving messages with QueueManager.

Template Parameters

ProtobufMessage	Any Google Protobuf Message generated by protoc (i.e. subclass of google::protobuf::Message)

Definition at line 74 of file queue_manager.h.

16.8.2.2 void goby::acomms::QueueManager::flush_queue (const protobuf::QueueFlush & *flush*)

Flush (delete all messages in) a queue.

Parameters

flush	QueueFlush object containing details about queue to flush

Definition at line 164 of file queue_manager.cpp.

16.8.2.3 void goby::acomms::QueueManager::handle_modem_data_request (protobuf::ModemTransmission * *msg*)

Finds data to send to the modem.

Data from the highest priority queue(s) will be combined to form a message equal or less than the size requested in ModemMessage message_in. If using one of the classes inheriting ModemDriverBase, this method should be connected to ModemDriverBase::signal_data_request.

Parameters

msg	The ModemTransmission containing information about the data request and is the place where the request data will be stored (in the repeated field ModemTransmission::frame).

Returns

true if successful in finding data to send, false if no data is available

Examples:

acomms/queue/queue_simple/queue_simple.cpp.

Definition at line 218 of file queue_manager.cpp.

16.8.2.4 void goby::acomms::QueueManager::handle_modem_receive (const protobuf::ModemTransmission & *message*)

Receive incoming data from the modem.

If using one of the classes inheriting ModemDriverBase, this method should be bound and passed to ModemDriverBase::signal_receive.

Parameters

message	The received ModemMessage.

Examples:

acomms/queue/queue_simple/queue_simple.cpp.

Definition at line 633 of file queue_manager.cpp.

16.8.2.5 template<typename ProtobufMessage > void goby::acomms::QueueManager::info (std::ostream * *os*) const [inline]

Writes a human readable summary (including DCCLCodec info) of the queue for the provided DCCL type to the stream provided.

Template Parameters

ProtobufMessage	Any Google Protobuf Message generated by protoc (i.e. subclass of google::protobuf::Message)

Parameters

os	Pointer to a stream to write this information

Definition at line 147 of file queue_manager.h.

16.8.2.6 void goby::acomms::QueueManager::info_all (std::ostream * *os*) const

Writes a human readable summary (including DCCLCodec info) of all loaded queues.

Parameters

os	Pointer to a stream to write this information

Definition at line 181 of file queue_manager.cpp.

16.8.2.7 void goby::acomms::QueueManager::push_message (const google::protobuf::Message & *new_message*)

Push a message (and add the queue if it does not exist)

Parameters

new_message	DCCL message to push.

Examples:

acomms/chat/chat.cpp, and acomms/queue/queue_simple/queue_simple.cpp.

Definition at line 137 of file queue_manager.cpp.

16.8.3 Member Data Documentation

16.8.3.1 boost::signals2::signal<void (const protobuf::ModemTransmission& ack_msg, const google::protobuf::Message& orig_msg)> goby::acomms::QueueManager::signal_ack

Signals when acknowledgment of proper message receipt has been received. This is only sent for queues with queue.ack == true with an explicit destination (ModemMessageBase::dest() != 0)

Parameters

ack_msg	a message containing details of the acknowledgment and the acknowledged transmission. (protobuf::ModemMsgAck is defined in acomms_modem_message.proto)

Examples:

acomms/chat/chat.cpp.

Definition at line 189 of file queue_manager.h.

16.8.3.2 boost::signals2::signal<void (const protobuf::ModemTransmission& request_msg, google::protobuf::Message* data_msg)> goby::acomms::QueueManager::signal_data_on_demand

Forwards the data request to the application layer. This advanced feature is used when queue.encode_on_demand == true and allows for the application to provide data immediately before it is actually sent (for highly time sensitive data)

Parameters

request_msg	the details of the requested data. (protobuf::ModemDataRequest is defined in acomms_modem_message.proto)
data_msg	pointer to store the supplied data. The message is of the type for this queue.

Definition at line 206 of file queue_manager.h.

16.8.3.3 boost::signals2::signal<void (const google::protobuf::Message& orig_msg)> goby::acomms::QueueManager::signal_expire

Signals when a message is expires (exceeds its time-to-live or ttl) before being sent (if queue.ack == false) or before being acknowledged (if queue.ack == true).

Parameters

expire_msg	the expired transmission. (protobuf::ModemDataExpire is defined in acomms_modem_message.proto)

Definition at line 199 of file queue_manager.h.

16.8.3.4 boost::signals2::signal<void (protobuf::QueueSize size)> goby::acomms::QueueManager::signal_queue_size_change

Signals when any queue changes size (message is popped or pushed)

Parameters

size	message containing the queue that changed size and its new size (protobuf::QueueSize is defined in acomms_queue.proto).

Definition at line 211 of file queue_manager.h.

16.8.3.5 boost::signals2::signal<void (const google::protobuf::Message& msg) > goby::acomms::QueueManager::signal_receive

Signals when a DCCL message is received.

Parameters

msg	the received transmission.

Examples:

acomms/chat/chat.cpp, and acomms/queue/queue_simple/queue_simple.cpp.

Definition at line 194 of file queue_manager.h.

The documentation for this class was generated from the following files:

- goby/acomms/queue/queue_manager.h
- src/acomms/queue/queue_manager.cpp

16.9 goby::common::Colors Struct Reference

Represents the eight available terminal colors (and bold variants)

`#include <goby/common/logger/term_color.h>`

Public Types

- enum Color {
  nocolor, **red**, **lt_red**, **green**,
  lt_green, **yellow**, **lt_yellow**, **blue**,
  lt_blue, **magenta**, **lt_magenta**, **cyan**,
  lt_cyan, **white**, **lt_white** }

  The eight terminal colors (and bold or "light" variants)

16.9.1 Detailed Description

Represents the eight available terminal colors (and bold variants)

Definition at line 123 of file term_color.h.

The documentation for this struct was generated from the following file:

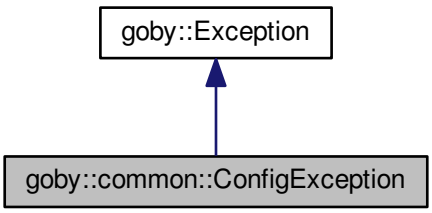
- goby/common/logger/term_color.h

16.10 goby::common::ConfigException Class Reference

indicates a problem with the runtime command line or .cfg file configuration (or –help was given)

`#include <goby/common/configuration_reader.h>`

Inheritance diagram for goby::common::ConfigException:



Public Member Functions

- **ConfigException** (const std::string &s)
- void **set_error** (bool b)
- bool **error** ()

16.10.1 Detailed Description

indicates a problem with the runtime command line or .cfg file configuration (or –help was given)

Definition at line 54 of file configuration_reader.h.

The documentation for this class was generated from the following file:

- goby/common/configuration_reader.h

16.11 goby::common::FlexNCurses Class Reference

Enables the Verbosity == gui mode of the Goby logger and displays an NCurses gui for the logger content.

`#include <goby/common/logger/flex_ncurses.h>`

Public Member Functions

Constructors / Destructor

- **FlexNCurses** ()
- ~**FlexNCurses** ()

Initialization

- void **startup** ()
- void **add_win** (const Group *title)

Use

- void insert (boost::posix_time::ptime t, const std::string &s, Group *g)

  Add a string to the gui.

Utility

- size_t **panel_from_group** (Group *g)
- void **recalculate_win** ()
- void **cleanup** ()
- void **alive** (bool alive)

User Input Thread

- void run_input ()

  run in its own thread to take input from the user

16.11.1 Detailed Description

Enables the Verbosity == gui mode of the Goby logger and displays an NCurses gui for the logger content.

Definition at line 42 of file flex_ncurses.h.

The documentation for this class was generated from the following files:

- goby/common/logger/flex_ncurses.h
- src/common/logger/flex_ncurses.cpp

16.12 goby::common::FlexOstream Class Reference

Forms the basis of the Goby logger: std::ostream derived class for holding the FlexOStreamBuf.

`#include <goby/common/logger/flex_ostream.h>`

Inherits std::ostream.

Public Member Functions

- void **refresh** ()
- void **set_group** (const std::string &s)
- void **set_unset_verbosity** ()

Initialization

- void add_group (const std::string &name, Colors::Color color=Colors::nocolor, const std::string &description="")

  Add another group to the logger. A group provides related manipulator for categorizing log messages.
- void set_name (const std::string &s)

  Set the name of the application that the logger is serving.
- void **enable_gui** ()
- bool **is** (goby::common::logger::Verbosity verbosity)
- void add_stream (logger::Verbosity verbosity=logger::VERBOSE, std::ostream *os=0)

  Attach a stream object (e.g. std::cout, std::ofstream, ...) to the logger with desired verbosity.
- void **add_stream** (goby::common::protobuf::GLogConfig::Verbosity verbosity=goby::common::protobuf::GLogConfig::VERBOSE, std::ostream *os=0)
- const FlexOStreamBuf & **buf** ()

Overloaded insert stream operator<<

- std::ostream & **operator<<** (FlexOstream &(*pf)(FlexOstream &))
- std::ostream & **operator<<** (std::ostream &(*pf)(std::ostream &))
- std::ostream & **operator<<** (bool &val)
- std::ostream & **operator<<** (const short &val)
- std::ostream & **operator<<** (const unsigned short &val)
- std::ostream & **operator<<** (const int &val)
- std::ostream & **operator<<** (const unsigned int &val)
- std::ostream & **operator<<** (const long &val)
- std::ostream & **operator<<** (const unsigned long &val)
- std::ostream & **operator<<** (const float &val)
- std::ostream & **operator<<** (const double &val)
- std::ostream & **operator<<** (const long double &val)
- std::ostream & **operator<<** (std::streambuf *sb)
- std::ostream & **operator<<** (std::ios &(*pf)(std::ios &))
- std::ostream & **operator<<** (std::ios_base &(*pf)(std::ios_base &))

Thread safety related

- boost::recursive_mutex & mutex ()

  Get a reference to the Goby logger mutex for scoped locking.
- void **set_lock_action** (logger_lock::LockAction lock_action)

Friends

- template<typename T >
  void **boost::checked_delete** (T *)
- std::ostream & **operator<<** (FlexOstream &out, char c)
- std::ostream & **operator<<** (FlexOstream &out, signed char c)
- std::ostream & **operator<<** (FlexOstream &out, unsigned char c)
- std::ostream & **operator<<** (FlexOstream &out, const char *s)
- std::ostream & **operator<<** (FlexOstream &out, const signed char *s)
- std::ostream & **operator<<** (FlexOstream &out, const unsigned char *s)

16.12.1 Detailed Description

Forms the basis of the Goby logger: std::ostream derived class for holding the FlexOStreamBuf.

Definition at line 45 of file flex_ostream.h.

The documentation for this class was generated from the following files:

- goby/common/logger/flex_ostream.h
- src/common/logger/flex_ostream.cpp

16.13 goby::common::TermColor Class Reference

Converts between string, escape code, and enumeration representations of the terminal colors.

`#include <goby/common/logger/term_color.h>`

Static Public Member Functions

- static Colors::Color from_str (const std::string &s)

  Color enumeration from string (e.g. "blue" -> blue)
- static std::string str_from_col (const Colors::Color &c)

  String from color enumeration (e,g, red -> "red")
- static Colors::Color from_esc_code (const std::string &s)

  Color enumeration from escape code (e,g, "\33[31m" -> red)
- static std::string esc_code_from_col (const Colors::Color &c)

  Escape code from color enumeration (e.g. red -> "\33[31m")
- static std::string esc_code_from_str (const std::string &s)

  Escape code from string (e.g. "red" -> "\33[31m")

Friends

- template<typename T >
  void **boost::checked_delete** (T *)

16.13.1 Detailed Description

Converts between string, escape code, and enumeration representations of the terminal colors.

Definition at line 137 of file term_color.h.

The documentation for this class was generated from the following files:

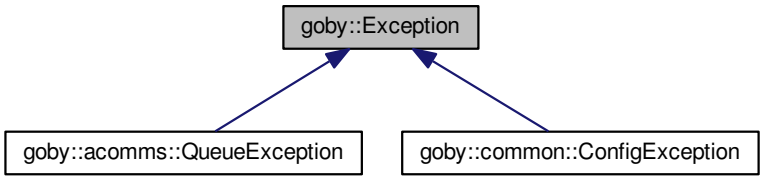
- goby/common/logger/term_color.h
- src/common/logger/term_color.cpp

16.14 goby::Exception Class Reference

simple exception class for goby applications

`#include <goby/common/exception.h>`

Inheritance diagram for goby::Exception:



Public Member Functions

- **Exception** (const std::string &s)

16.14.1 Detailed Description

simple exception class for goby applications

Definition at line 33 of file exception.h.

The documentation for this class was generated from the following file:

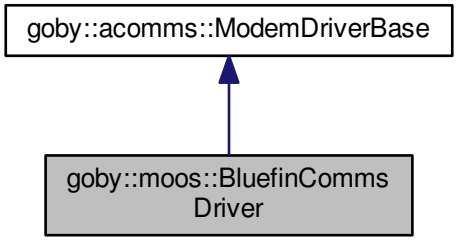
- goby/common/exception.h

16.15 goby::moos::BluefinCommsDriver Class Reference

provides a driver for the Bluefin Huxley communications infrastructure (initially uses SonarDyne as underlying hardware)

`#include <goby/moos/moos_bluefin_driver.h>`

Inheritance diagram for goby::moos::BluefinCommsDriver:



Public Member Functions

- **BluefinCommsDriver** (goby::acomms::MACManager *mac)

- void startup (const goby::acomms::protobuf::DriverConfig &cfg)

  Starts the modem driver. Must be called before poll().
- void shutdown ()

  Shuts down the modem driver.
- void do_work ()

  Allows the modem driver to do its work.
- void handle_initiate_transmission (const goby::acomms::protobuf::ModemTransmission &m)

  Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Additional Inherited Members

16.15.1 Detailed Description

provides a driver for the Bluefin Huxley communications infrastructure (initially uses SonarDyne as underlying hardware)

Definition at line 45 of file moos_bluefin_driver.h.

16.15.2 Member Function Documentation

16.15.2.1 void goby::moos::BluefinCommsDriver::do_work ( ) [virtual]

Allows the modem driver to do its work.

Should be called regularly to perform the work of the driver as the driver *does not* run in its own thread. This allows us to guarantee that no signals are called except inside this method. Does not block.

Implements goby::acomms::ModemDriverBase.

Definition at line 186 of file moos_bluefin_driver.cpp.

16.15.2.2 void goby::moos::BluefinCommsDriver::handle_initiate_transmission (const goby::acomms::protobuf::ModemTransmission & *m*) [virtual]

Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Parameters

m	ModemTransmission (defined in acomms_modem_message.proto) containing the details of the transmission to be started. This may contain data frames. If not, data will be requested when the driver calls the data request signal (ModemDriverBase::signal_data_request)

Implements goby::acomms::ModemDriverBase.

Definition at line 98 of file moos_bluefin_driver.cpp.

16.15.2.3 void goby::moos::BluefinCommsDriver::startup (const goby::acomms::protobuf::DriverConfig & *cfg*) [virtual]

Starts the modem driver. Must be called before poll().

Parameters

cfg	Startup configuration for the driver and modem. DriverConfig is defined in acomms_driver_base.proto. Derived classes can define extensions (see http://code.google.com/apis/protocolbuffers/docs/proto.html#extensions) to DriverConfig to handle modem specific configuration.

Implements goby::acomms::ModemDriverBase.

Definition at line 52 of file moos_bluefin_driver.cpp.

The documentation for this class was generated from the following files:

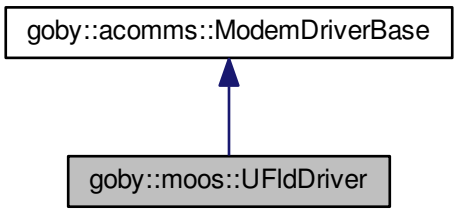
- goby/moos/moos_bluefin_driver.h
- src/moos/moos_bluefin_driver.cpp

16.16 goby::moos::UFldDriver Class Reference

provides an simulator driver to the uFldNodeComms MOOS module: http://oceanai.mit.edu/moos-ivp/pmwiki/pmwiki.php?n=Modules.UFldNodeComms

`#include <goby/moos/moos_ufield_sim_driver.h>`

Inheritance diagram for goby::moos::UFldDriver:



Public Member Functions

- void startup (const goby::acomms::protobuf::DriverConfig &cfg)

  Starts the modem driver. Must be called before poll().
- void shutdown ()

  Shuts down the modem driver.
- void do_work ()

  Allows the modem driver to do its work.
- void handle_initiate_transmission (const goby::acomms::protobuf::ModemTransmission &m)

  Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Additional Inherited Members

16.16.1 Detailed Description

provides an simulator driver to the uFldNodeComms MOOS module: http://oceanai.mit.edu/moos-ivp/pmwiki/pmwiki.php?n=Modules.UFldNodeComms

Definition at line 44 of file moos_ufield_sim_driver.h.

16.16.2 Member Function Documentation

16.16.2.1 void goby::moos::UFldDriver::do_work ( ) [virtual]

Allows the modem driver to do its work.

Should be called regularly to perform the work of the driver as the driver *does not* run in its own thread. This allows us to guarantee that no signals are called except inside this method. Does not block.

Implements goby::acomms::ModemDriverBase.

Definition at line 207 of file moos_ufield_sim_driver.cpp.

16.16.2.2 void goby::moos::UFldDriver::handle_initiate_transmission (const goby::acomms::protobuf::ModemTransmission & *m*) [virtual]

Virtual initiate_transmission method. Typically connected to MACManager::signal_initiate_transmission() using bind().

Parameters

m	ModemTransmission (defined in acomms_modem_message.proto) containing the details of the transmission to be started. This may contain data frames. If not, data will be requested when the driver calls the data request signal (ModemDriverBase::signal_data_request)

Implements goby::acomms::ModemDriverBase.

Definition at line 89 of file moos_ufield_sim_driver.cpp.

16.16.2.3 void goby::moos::UFldDriver::startup (const goby::acomms::protobuf::DriverConfig & *cfg*) [virtual]

Starts the modem driver. Must be called before poll().

Parameters

cfg	Startup configuration for the driver and modem. DriverConfig is defined in acomms_driver_base.proto. Derived classes can define extensions (see http://code.google.com/apis/protocolbuffers/docs/proto.html#extensions) to DriverConfig to handle modem specific configuration.

Implements goby::acomms::ModemDriverBase.

Definition at line 45 of file moos_ufield_sim_driver.cpp.

The documentation for this class was generated from the following files:

- goby/moos/moos_ufield_sim_driver.h
- src/moos/moos_ufield_sim_driver.cpp

16.17 goby::pb::Application Class Reference

Base class provided for users to generate applications that participate in the Goby publish/subscribe architecture.

`#include <goby/pb/application.h>`

Inherits goby::common::ZeroMQApplicationBase.

Inherited by goby::acomms::Bridge, goby::acomms::FileTransfer, goby::acomms::IPGateway, goby::acomms::ModemDriver, and goby::acomms::MoshRelay.

Protected Types

- typedef goby::common::Colors **Colors**

Protected Member Functions

- template<typename ProtoBufMessage >
  void subscribe (boost::function< void(const ProtoBufMessage &)> handler=boost::function< void(const ProtoBufMessage &)>(), const std::string &group="")

Subscribe to a message (of any type derived from google::protobuf::Message)

- template<typename ProtoBufMessage , class C >
  void subscribe (void(C::*mem_func)(const ProtoBufMessage &), C *obj, const std::string &group="")

  Subscribe for a type using a class member function as the handler.
- common::ZeroMQService & zeromq_service ()

  Fetchs the newest received message of this type.
- boost::shared_ptr
  < StaticProtobufPubSubNodeWrapper > **pubsub_node** ()

Constructors / Destructor

- Application (google::protobuf::Message *cfg=0)
- virtual ~**Application** ()

Publish / Subscribe

- void **publish** (const google::protobuf::Message &msg, const std::string &group="")

16.17.1 Detailed Description

Base class provided for users to generate applications that participate in the Goby publish/subscribe architecture.

Definition at line 45 of file application.h.

16.17.2 Constructor & Destructor Documentation

16.17.2.1 goby::pb::Application::Application (google::protobuf::Message * *cfg* = `0`) [protected]

Parameters

cfg	pointer to object derived from google::protobuf::Message that defines the configuration for this Application. This constructor will use the Description of `cfg` to read the command line parameters and configuration file (if given) and use these values to populate `cfg`. `cfg` must be a static member of the subclass or global object since member objects will be constructed *after* the Application constructor is called.

Definition at line 38 of file application.cpp.

16.17.3 Member Function Documentation

16.17.3.1 template<typename ProtoBufMessage > void goby::pb::Application::subscribe (boost::function< void(const ProtoBufMessage &)> *handler* = `boost::function<void (const ProtoBufMessage&)>()`, const std::string & *group* = `""`) [inline], [protected]

Subscribe to a message (of any type derived from google::protobuf::Message)

Parameters

handler	Function object to be called as soon as possible upon receipt of a message of this type. The signature of `handler` must match: void handler(const ProtoBufMessage& msg). if `handler` is omitted, no handler is called and only the newest message buffer is updated upon message receipt (for calls to newest<ProtoBufMessage>())

Definition at line 71 of file application.h.

16.17.3.2 template<typename ProtoBufMessage , class C > void goby::pb::Application::subscribe (void(C::*)(const ProtoBufMessage &) *mem_func*, C * *obj*, const std::string & *group* = `""`) [inline], [protected]

Subscribe for a type using a class member function as the handler.

Parameters

mem_func	Member function (method) of class C with a signature of void C::mem_func(const ProtoBuf-Message& msg)
obj	pointer to the object whose member function (mem_func) to call

Definition at line 87 of file application.h.

16.17.3.3 common::ZeroMQService& goby::pb::Application::zeromq_service ( ) [inline], [protected]

Fetchs the newest received message of this type.

You must subscribe() for this type before using this method

Definition at line 111 of file application.h.

The documentation for this class was generated from the following files:

- goby/pb/application.h
- src/pb/application.cpp

16.18 goby::transitional::DCCLMessageVal Class Reference

defines a DCCL value

`#include <goby/moos/transitional/message_val.h>`

Public Types

- enum { **MAX_DBL_PRECISION** = 15 }

Public Member Functions

Constructors/Destructor

- DCCLMessageVal ()
  empty
- DCCLMessageVal (const std::string &s)
  construct with string value
- DCCLMessageVal (const char *s)
  construct with char value*
- DCCLMessageVal (double d, int p=MAX_DBL_PRECISION)
  construct with double value, optionally givig the precision of the double (number of decimal places) which is used if a cast to std::string is required in the future.
- DCCLMessageVal (long l)
  construct with long value
- DCCLMessageVal (int i)
  construct with int value
- DCCLMessageVal (float f)
  construct with float value
- DCCLMessageVal (bool b)
  construct with bool value
- DCCLMessageVal (const std::vector< DCCLMessageVal > &vm)
  construct with vector

Setters

- void set (std::string sval)

set the value with a string (overwrites previous value regardless of type)

- void set (double dval, int precision=MAX_DBL_PRECISION)

  set the value with a double (overwrites previous value regardless of type)
- void set (long lval)

  set the value with a long (overwrites previous value regardless of type)
- void set (bool bval)

  set the value with a bool (overwrites previous value regardless of type)

Getters

- bool get (std::string &s) const

  extract as std::string (all reasonable casts are done)
- bool get (bool &b) const

  extract as bool (all reasonable casts are done)
- bool get (long &t) const

  extract as long (all reasonable casts are done)
- bool get (double &d) const

  extract as double (all reasonable casts are done)
- operator double () const

  allows statements of the form
- operator bool () const

  allows statements of the form
- operator std::string () const

  allows statements of the form
- operator long () const

  allows statements of the form
- operator int () const

  allows statements of the form
- operator unsigned () const

  allows statements of the form
- operator float () const

  allows statements of the form
- **operator std::vector**< **DCCLMessageVal** > () const
- DCCLCppType type () const

  what type is the original type of this DCCLMessageVal?
- bool empty () const

  was this just constructed with DCCLMessageVal() ?
- unsigned **precision** () const

Comparison

- bool **operator==** (const DCCLMessageVal &mv) const
- bool **operator==** (const std::string &s) const
- bool **operator==** (double d) const
- bool **operator==** (long l) const
- bool **operator==** (bool b) const

Friends

- std::ostream & **operator**<< (std::ostream &os, const DCCLMessageVal &mv)

16.18.1 Detailed Description

defines a DCCL value

Definition at line 36 of file message_val.h.

16.18.2 Member Function Documentation

16.18.2.1 bool goby::transitional::DCCLMessageVal::get (std::string & *s*) const

extract as std::string (all reasonable casts are done)

Parameters

s	std::string to store value in

Returns

successfully extracted (and if necessary successfully cast to this type)

Definition at line 127 of file message_val.cpp.

16.18.2.2 bool goby::transitional::DCCLMessageVal::get (bool & *b*) const

extract as bool (all reasonable casts are done)

Parameters

b	bool to store value in

Returns

successfully extracted (and if necessary successfully cast to this type)

Definition at line 158 of file message_val.cpp.

16.18.2.3 bool goby::transitional::DCCLMessageVal::get (long & *t*) const

extract as long (all reasonable casts are done)

Parameters

t	long to store value in

Returns

successfully extracted (and if necessary successfully cast to this type)

Definition at line 190 of file message_val.cpp.

16.18.2.4 bool goby::transitional::DCCLMessageVal::get (double & *d*) const

extract as double (all reasonable casts are done)

Parameters

d	double to store value in

Returns

successfully extracted (and if necessary successfully cast to this type)

Definition at line 229 of file message_val.cpp.

16.18.2.5 goby::transitional::DCCLMessageVal::operator bool ( ) const

allows statements of the form

```
bool b = DCCLMessageVal("1");
```

Definition at line 276 of file message_val.cpp.

16.18.2.6 goby::transitional::DCCLMessageVal::operator double ( ) const

allows statements of the form

```
double d = DCCLMessageVal("3.23");
```

Definition at line 268 of file message_val.cpp.

16.18.2.7 goby::transitional::DCCLMessageVal::operator float ( ) const

allows statements of the form

```
float f = DCCLMessageVal("3.5");
```

Definition at line 307 of file message_val.cpp.

16.18.2.8 goby::transitional::DCCLMessageVal::operator int ( ) const

allows statements of the form

```
int i = DCCLMessageVal(2);
```

Definition at line 297 of file message_val.cpp.

16.18.2.9 goby::transitional::DCCLMessageVal::operator long ( ) const

allows statements of the form

```
long l = DCCLMessageVal(5);
```

Definition at line 290 of file message_val.cpp.

16.18.2.10 goby::transitional::DCCLMessageVal::operator std::string ( ) const

allows statements of the form

```
std::string s = DCCLMessageVal(3);
```

Definition at line 283 of file message_val.cpp.

16.18.2.11 goby::transitional::DCCLMessageVal::operator unsigned ( ) const

allows statements of the form

```
unsigned u = DCCLMessageVal(2);
```

Definition at line 302 of file message_val.cpp.

16.18.2.12 void goby::transitional::DCCLMessageVal::set (double *dval*, int *precision* = MAX_DBL_PRECISION)

set the value with a double (overwrites previous value regardless of type)

Parameters

dval	values to set

precision	decimal places of precision to preserve if this is cast to a string

Definition at line 119 of file message_val.cpp.

The documentation for this class was generated from the following files:

- goby/moos/transitional/message_val.h
- src/moos/transitional/message_val.cpp

16.19 goby::transitional::DCCLTransitionalCodec Class Reference

provides an API to the Transitional Dynamic CCL Codec (looks like DCCLv1, but calls DCCLv2). Warning: this class is for legacy support only, new applications should use DCCLCodec directly.

`#include <goby/acomms/dccl.h>`

Public Member Functions

- template<typename Key >
  const
  google::protobuf::Descriptor * **descriptor** (const Key &k)
- unsigned message_count ()
- template<typename Key >
  unsigned get_repeat (const Key &k)
- std::set< unsigned > all_message_ids ()
- std::set< std::string > all_message_names ()
- template<typename Key >
  std::map< std::string,
  std::string > message_var_names (const Key &k) const
- std::string id2name (unsigned id)
- unsigned name2id (const std::string &name)
- std::vector< DCCLMessage > & **messages** ()

Constructors/Destructor

- DCCLTransitionalCodec ()
  Instantiate optionally with a ostream logger (for human readable output)
- ~DCCLTransitionalCodec ()
  destructor

Initialization Methods.

These methods are intended to be called before doing any work with the class. However, they may be called at any time as desired.

- void **convert_to_v2_representation** (pAcommsHandlerConfig *cfg)

16.19.1 Detailed Description

provides an API to the Transitional Dynamic CCL Codec (looks like DCCLv1, but calls DCCLv2). Warning: this class is for legacy support only, new applications should use DCCLCodec directly.

See Also

transitional.proto and acomms_modem_message.proto for definition of Google Protocol Buffers messages (namespace goby::transitional::protobuf).

Definition at line 96 of file dccl_transitional.h.

16.19.2 Constructor & Destructor Documentation

16.19.2.1 goby::transitional::DCCLTransitionalCodec::DCCLTransitionalCodec ( )

Instantiate optionally with a ostream logger (for human readable output)

Parameters

log	std::ostream object or FlexOstream to capture all humanly readable runtime and debug information (optional).

Definition at line 44 of file dccl_transitional.cpp.

16.19.3 Member Function Documentation

16.19.3.1 std::set<unsigned> goby::transitional::DCCLTransitionalCodec::all_message_ids ( )

Returns

set of all message ids loaded

16.19.3.2 std::set<std::string> goby::transitional::DCCLTransitionalCodec::all_message_names ( )

Returns

set of all message names loaded

16.19.3.3 template<typename Key > unsigned goby::transitional::DCCLTransitionalCodec::get_repeat (const Key & *k*) [inline]

Returns

repeat value (number of copies of the message per encode)

Definition at line 131 of file dccl_transitional.h.

16.19.3.4 std::string goby::transitional::DCCLTransitionalCodec::id2name (unsigned *id*) [inline]

Parameters

id	message id

Returns

name of message

Definition at line 145 of file dccl_transitional.h.

16.19.3.5 unsigned goby::transitional::DCCLTransitionalCodec::message_count ( ) [inline]

how many message are loaded?

Returns

number of messages loaded

Definition at line 127 of file dccl_transitional.h.

16.19.3.6 template<typename Key > std::map<std::string, std::string> goby::transitional::DCCLTransitionalCodec::message_var_names (const Key & *k*) const [inline]

Returns

map of names to DCCL types needed to encode a given message

Definition at line 140 of file dccl_transitional.h.

16.19.3.7 unsigned goby::transitional::DCCLTransitionalCodec::name2id (const std::string & *name*) [inline]

Parameters

name	message name

Returns

id of message

Definition at line 148 of file dccl_transitional.h.

The documentation for this class was generated from the following files:

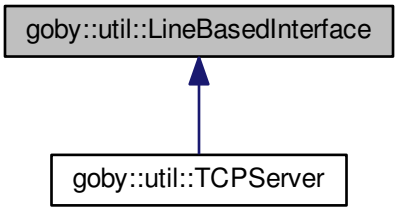
- goby/moos/transitional/dccl_transitional.h
- src/moos/transitional/dccl_transitional.cpp

16.20 goby::util::LineBasedInterface Class Reference

basic interface class for all the derived serial (and networking mimics) line-based nodes (serial, tcp, udp, etc.)

`#include <goby/util/linebasedcomms/interface.h>`

Inheritance diagram for goby::util::LineBasedInterface:



Public Types

- enum **AccessOrder** { **NEWEST_FIRST**, **OLDEST_FIRST** }

Public Member Functions

- **LineBasedInterface** (const std::string &delimiter)
- void **start** ()
- void **close** ()
- bool **active** ()
- void **sleep** (int sec)
- bool readline (std::string ∗s, AccessOrder order=OLDEST_FIRST)

returns string line (including delimiter)

- bool **readline** (protobuf::Datagram ∗msg, AccessOrder order=OLDEST_FIRST)
- void **write** (const std::string &s)
- void **write** (const protobuf::Datagram &msg)
- void **clear** ()
- void **set_delimiter** (const std::string &s)
- std::string **delimiter** () const
- boost::asio::io_service & **io_service** ()

Protected Member Functions

- virtual void **do_start** ()=0
- virtual void **do_write** (const protobuf::Datagram &line)=0
- virtual void **do_close** (const boost::system::error_code &error)=0
- void **set_active** (bool active)
- std::string & **delimiter** ()
- std::deque
  < goby::util::protobuf::Datagram > & **in** ()
- boost::mutex & **in_mutex** ()

Protected Attributes

- std::string **delimiter_**
- boost::asio::io_service **io_service_**
- std::deque< protobuf::Datagram > **in_**
- boost::mutex **in_mutex_**

Friends

- template<typename ASIOAsyncReadStream >
  class **LineBasedConnection**

16.20.1 Detailed Description

basic interface class for all the derived serial (and networking mimics) line-based nodes (serial, tcp, udp, etc.)

Definition at line 45 of file interface.h.

16.20.2 Member Function Documentation

16.20.2.1 bool goby::util::LineBasedInterface::readline (std::string ∗ *s*, AccessOrder *order* = OLDEST_FIRST)

returns string line (including delimiter)

Returns

true if data was read, false if no data to read

Definition at line 80 of file interface.cpp.

The documentation for this class was generated from the following files:

- goby/util/linebasedcomms/interface.h
- src/util/linebasedcomms/interface.cpp

16.21 goby::util::SerialClient Class Reference

provides a basic client for line by line text based communications over a 8N1 tty (such as an RS-232 serial link) without flow control

`#include <goby/util/linebasedcomms/serial_client.h>`

Inherits goby::util::LineBasedClient< ASIOAsyncReadStream >.

Public Member Functions

- SerialClient (const std::string &name="", unsigned baud=9600, const std::string &delimiter="\r\n")

  create a serial client
- void set_name (const std::string &name)

  set serial port name, e.g. "/dev/ttyS0"
- void set_baud (unsigned baud)

  baud rate, e.g. 4800
- std::string name () const

  serial port name, e.g. "/dev/ttyS0"
- unsigned baud () const

  baud rate, e.g. 4800
- boost::asio::serial_port & **socket** ()
- std::string local_endpoint ()

  our serial port, e.g. "/dev/ttyUSB1"
- std::string remote_endpoint ()

  who knows where the serial port goes?! (empty string)

16.21.1 Detailed Description

provides a basic client for line by line text based communications over a 8N1 tty (such as an RS-232 serial link) without flow control

Definition at line 35 of file serial_client.h.

16.21.2 Constructor & Destructor Documentation

16.21.2.1 goby::util::SerialClient::SerialClient (const std::string & *name* = "", unsigned *baud* = 9600, const std::string & *delimiter* = "\r\n")

create a serial client

Parameters

name	name of the serial connection (e.g. "/dev/ttyS0")
baud	baud rate of the serial connection (e.g. 9600)
delimiter	string used to split lines

Definition at line 30 of file serial_client.cpp.

The documentation for this class was generated from the following files:

- goby/util/linebasedcomms/serial_client.h
- src/util/linebasedcomms/serial_client.cpp

16.22 goby::util::TCPClient Class Reference

provides a basic TCP client for line by line text based communications to a remote TCP server

`#include <goby/util/linebasedcomms/tcp_client.h>`

Inherits goby::util::LineBasedClient< ASIOAsyncReadStream >.

Public Member Functions

- TCPClient (const std::string &server, unsigned port, const std::string &delimiter="\r\n", int retry_interval=10)

  create a TCPClient
- boost::asio::ip::tcp::socket & **socket** ()
- std::string local_endpoint ()

  string representation of the local endpoint (e.g. 192.168.1.105:54230
- std::string remote_endpoint ()

  string representation of the remote endpoint, (e.g. 192.168.1.106:50000

Friends

- class **TCPConnection**
- class **LineBasedConnection**< **boost::asio::ip::tcp::socket** >

16.22.1 Detailed Description

provides a basic TCP client for line by line text based communications to a remote TCP server

Definition at line 34 of file tcp_client.h.

16.22.2 Constructor & Destructor Documentation

16.22.2.1 goby::util::TCPClient::TCPClient (const std::string & *server*, unsigned *port*, const std::string & *delimiter* = "\r\n", int *retry_interval* = 10)

create a TCPClient

Parameters

server	domain name or IP address of the remote server
port	port of the remote server
delimiter	string used to split lines

Definition at line 28 of file tcp_client.cpp.

The documentation for this class was generated from the following files:

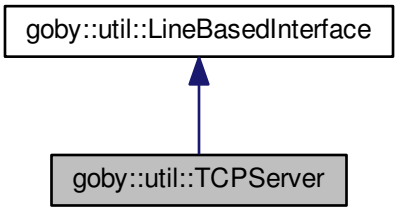
- goby/util/linebasedcomms/tcp_client.h
- src/util/linebasedcomms/tcp_client.cpp

16.23 goby::util::TCPServer Class Reference

provides a basic TCP server for line by line text based communications to a one or more remote TCP clients

`#include <goby/util/linebasedcomms/tcp_server.h>`

Inheritance diagram for goby::util::TCPServer:



Public Types

- typedef std::string **Endpoint**

Public Member Functions

- TCPServer (unsigned port, const std::string &delimiter="\r\n")
  create a TCP server
- void **close** (const Endpoint &endpoint)
- std::string local_endpoint ()
  string representation of the local endpoint (e.g. 192.168.1.105:54230
- const std::map< Endpoint, boost::shared_ptr < TCPConnection > > & **connections** ()

Friends

- class **TCPConnection**
- class **LineBasedConnection**< **boost::asio::ip::tcp::socket** >

Additional Inherited Members

16.23.1 Detailed Description

provides a basic TCP server for line by line text based communications to a one or more remote TCP clients

Definition at line 49 of file tcp_server.h.

16.23.2 Constructor & Destructor Documentation

16.23.2.1 goby::util::TCPServer::TCPServer (unsigned *port*, const std::string & *delimiter* = "\r\n") [inline]

create a TCP server

Parameters

port	port of the server (use 50000+ to avoid problems with special system ports)
delimiter	string used to split lines

Definition at line 56 of file tcp_server.h.

The documentation for this class was generated from the following files:

- goby/util/linebasedcomms/tcp_server.h
- src/util/linebasedcomms/tcp_server.cpp

16.24 Group Class Reference

Defines a group of messages to be sent to the Goby logger. For Verbosity == verbose streams, all entries appear interleaved, but each group is offset with a different color. For Verbosity == gui streams, all groups have a separate subwindow.

`#include <goby/common/logger/logger_manipulators.h>`

Public Member Functions

- **Group** (const std::string &name="", const std::string &description="", goby::common::Colors::Color color=goby::common::Colors::nocolor)

Getters

- std::string name () const

  Name of this group (used in the group manipulator)
- std::string description () const

  Human readable description of this group.
- goby::common::Colors::Color color () const

  Color to use when displaying this group (for streams that support terminal escape codes only: std::cout, std::cerr, std::clog)
- bool enabled () const

  Is this group enabled?

Setters

- void **name** (const std::string &s)
- void **description** (const std::string &s)
- void **color** (goby::common::Colors::Color c)
- void **enabled** (bool b)

16.24.1 Detailed Description

Defines a group of messages to be sent to the Goby logger. For Verbosity == verbose streams, all entries appear interleaved, but each group is offset with a different color. For Verbosity == gui streams, all groups have a separate subwindow.

Definition at line 69 of file logger_manipulators.h.

The documentation for this class was generated from the following file:

- goby/common/logger/logger_manipulators.h

16.25 GroupSetter Class Reference

Helper class for enabling the group(std::string) manipulator.

`#include <goby/common/logger/logger_manipulators.h>`

Public Member Functions

- **GroupSetter** (const std::string &s)
- void **operator()** (std::ostream &os) const
- void **operator()** (goby::common::FlexOstream &os) const

16.25.1 Detailed Description

Helper class for enabling the group(std::string) manipulator.

Definition at line 116 of file logger_manipulators.h.

The documentation for this class was generated from the following files:

- goby/common/logger/logger_manipulators.h
- src/common/logger/logger_manipulators.cpp

17 File Documentation

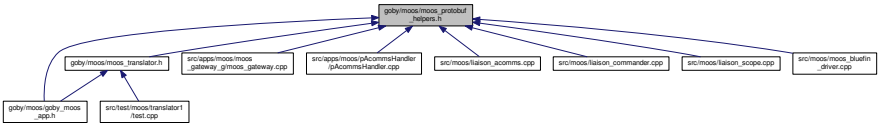
17.1 goby/moos/moos_protobuf_helpers.h File Reference

Helpers for MOOS applications for serializing and parsed Google Protocol buffers messages.

```
#include <limits>
#include <boost/format.hpp>
#include <boost/regex.hpp>
#include <google/protobuf/io/printer.h>
#include <google/protobuf/io/tokenizer.h>
#include "goby/common/logger.h"
#include "goby/util/as.h"
#include "goby/util/binary.h"
#include "goby/util/dynamic_protobuf_manager.h"
#include "goby/moos/moos_string.h"
#include "goby/util/primitive_types.h"
#include "goby/moos/transitional/message_algorithms.h"
#include "goby/moos/transitional/message_val.h"
#include "goby/moos/protobuf/translator.pb.h"
```

Include dependency graph for moos_protobuf_helpers.h:

This graph shows which files directly or indirectly include this file:



Namespaces

- goby

  The global namespace for the Goby project.

Functions

- std::map< int, std::string > **goby::moos::run_serialize_algorithms** (const google::protobuf::Message &in, const google::protobuf::RepeatedPtrField< protobuf::TranslatorEntry::PublishSerializer::Algorithm > &algorithms)
- std::string **goby::moos::strip_name_from_enum** (const std::string &enum_value, const std::string &field_name)
- std::string **goby::moos::add_name_to_enum** (const std::string &enum_value, const std::string &field_name)
- bool **serialize_for_moos** (std::string *out, const google::protobuf::Message &msg)
- void parse_for_moos (const std::string &in, google::protobuf::Message *msg)

  Parses the string `in` to Google Protocol Buffers message `msg`. All errors are written to the goby::util::glogger().
- boost::shared_ptr < google::protobuf::Message > **dynamic_parse_for_moos** (const std::string &in)

Variables

- const std::string **goby::moos::MAGIC_PROTOBUF_HEADER** = "@PB"
- goby::moos::protobuf::TranslatorEntry::ParserSerializerTechnique **goby::moos::moos_technique** = goby::moos::protobuf::TranslatorEntry::TECHNIQUE_PREFIXED_PROTOBUF_TEXT_FORMAT

17.1.1 Detailed Description

Helpers for MOOS applications for serializing and parsed Google Protocol buffers messages.

Definition in file moos_protobuf_helpers.h.

17.1.2 Function Documentation

17.1.2.1 void parse_for_moos (const std::string & *in*, google::protobuf::Message * *msg*) [inline]

Parses the string `in` to Google Protocol Buffers message `msg`. All errors are written to the goby::util::glogger().

Parameters

in	std::string to parse

msg	Google Protocol buffers message to store result

Definition at line 1352 of file moos_protobuf_helpers.h.

18 Example Documentation

18.1 acomms/amac/amac_simple/amac_simple.cpp

```
// Copyright 2009-2016 Toby Schneider (http://gobysoft.org/index.wt/people/toby)
//                     GobySoft, LLC (2013-)
//                     Massachusetts Institute of Technology (2007-2014)
//
//
// This file is part of the Goby Underwater Autonomy Project Binaries
// ("The Goby Binaries").
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//
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// along with Goby.  If not, see <http://www.gnu.org/licenses/>.

#include "goby/acomms/amac.h"
#include "goby/acomms/connect.h"
#include "goby/common/logger.h"

#include <iostream>

using goby::acomms::operator<<;

void init_transmission(const goby::acomms::protobuf::ModemTransmission& msg);

int main(int argc, char* argv[])
{
    goby::glog.set_name(argv[0]);
    goby::glog.add_stream(goby::common::logger::DEBUG1, &std::clog);

    //
    // 1. Create a MACManager
    //
    goby::acomms::MACManager mac;

    //
    // 2. Configure with a few slots
    //
    goby::acomms::protobuf::MACConfig cfg;
    cfg.set_modem_id(1);
    cfg.set_type(goby::acomms::protobuf::MAC_FIXED_DECENTRALIZED);
    goby::acomms::protobuf::ModemTransmission* slot = cfg.add_slot();
    slot->set_src(1);
    slot->set_rate(0);
    slot->set_type(goby::acomms::protobuf::ModemTransmission::DATA);
    slot->set_slot_seconds(5);


    //
    // 3. Set up the callback
    //

    // give a callback to use for actually initiating the transmission. this would be bound to
       goby::acomms::ModemDriverBase::initiate_transmission if using libmodemdriver.
    goby::acomms::connect(&mac.signal_initiate_transmission
      , &init_transmission);

    //
    // 4. Let it run for a bit alone in the world
    //
    mac.startup(cfg);
    for(unsigned i = 1; i < 150; ++i)
    {
        mac.do_work();
        usleep(100000);
    }
```

```
    //
    // 5. Add some slots (modem ids 2 & 3, and LBL ping from 1): remember MACManager is a
       std::list<goby::acomms::protobuf::ModemTransmission> at heart
    //

    // one way we can do this
    goby::acomms::protobuf::ModemTransmission new_slot;
    new_slot.set_src(2);
    new_slot.set_rate(0);
    new_slot.set_type(goby::acomms::protobuf::ModemTransmission::DATA);
    new_slot.set_slot_seconds(5);

    mac.push_back(new_slot);

    // another way
    mac.resize(mac.size()+1);
    mac.back().CopyFrom(mac.front());
    mac.back().set_src(3);

    mac.resize(mac.size()+1);
    mac.back().CopyFrom(mac.front());
    mac.back().set_type(goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC);
    mac.back().SetExtension(micromodem::protobuf::type,
                            micromodem::protobuf::MICROMODEM_REMUS_LBL_RANGING);

    // must call update after manipulating MACManager before calling do_work again.
    mac.update();


    //
    // 6. Run it
    //

    for(;;)
    {
        mac.do_work();
        usleep(100000);
    }

    return 0;
}

void init_transmission(const goby::acomms::protobuf::ModemTransmission& msg)
{
    std::cout << "starting transmission with these values: " << msg << std::endl;
}
```

18.2 acomms/chat/chat.cpp

```
// Copyright 2009-2016 Toby Schneider (http://gobysoft.org/index.wt/people/toby)
//                     GobySoft, LLC (2013-)
//                     Massachusetts Institute of Technology (2007-2014)
//
//
// This file is part of the Goby Underwater Autonomy Project Binaries
// ("The Goby Binaries").
//
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// (at your option) any later version.
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// but WITHOUT ANY WARRANTY; without even the implied warranty of
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// GNU General Public License for more details.
//
// You should have received a copy of the GNU General Public License
// along with Goby.  If not, see <http://www.gnu.org/licenses/>.

// usage: connect two modems and then run
// > chat /dev/tty_modem_A 1 2 log_file_A
// > chat /dev/tty_modem_B 2 1 log_file_B

// type into a window and hit enter to send a message. messages will be queued
// and sent on a fixed rotating cycle

#include <iostream>

#include "goby/acomms/dccl.h"
#include "goby/acomms/queue.h"
#include "goby/acomms/modem_driver.h"
#include "goby/acomms/amac.h"
#include "goby/acomms/bind.h"
```

```
#include "goby/util/as.h"
#include "goby/common/time.h"
#include "chat.pb.h"

#include <boost/lexical_cast.hpp>

#include "chat_curses.h"


// Uncomment to use the Micro-Modem 2 Flexible Data Packet instead of the traditional $CCCYC data cycle
//#define USE_FLEXIBLE_DATA_PACKET
// Uncomment to use the Micro-Modem ping $CCMPC instead of sending data
//#define USE_TWO_WAY_PING

using goby::util::as;
using goby::common::goby_time;

int startup_failure();
void received_data(const google::protobuf::Message&);
void received_ack(const goby::acomms::protobuf::ModemTransmission&,
                  const google::protobuf::Message&);
void monitor_mac(const goby::acomms::protobuf::ModemTransmission& mac_msg);
void monitor_modem_receive(const goby::acomms::protobuf::ModemTransmission& rx_msg);


std::ofstream fout_;
goby::acomms::DCCLCodec* dccl_ = goby::acomms::DCCLCodec::get();
goby::acomms::QueueManager q_manager_;
goby::acomms::MMDriver mm_driver_;
goby::acomms::MACManager mac_;
ChatCurses curses_;
int my_id_;
int buddy_id_;


int main(int argc, char* argv[])
{
    //
    // Deal with command line parameters
    //

    if(argc != 5) return startup_failure();

    std::string serial_port = argv[1];

    try
    {
        my_id_ = boost::lexical_cast<int>(argv[2]);
        buddy_id_ = boost::lexical_cast<int>(argv[3]);
    }
    catch(boost::bad_lexical_cast&)
    {
        std::cerr << "bad value for my_id: " << argv[2] << " or buddy_id: " << argv[3] << ". these must be
       unsigned integers." << std::endl;
        return startup_failure();
    }

    std::string log_file = argv[4];
    fout_.open(log_file.c_str());
    if(!fout_.is_open())
    {
        std::cerr << "bad value for log_file: " << log_file << std::endl;
        return startup_failure();
    }

    //
    //  Initialize logging
    //
    goby::glog.add_stream(goby::common::logger::DEBUG1, &fout_);
    goby::glog.set_name(argv[0]);


    // bind the signals of these libraries
    bind(mm_driver_, q_manager_, mac_);

    //
    // Initiate DCCL (libdccl)
    //
    goby::acomms::protobuf::DCCLConfig dccl_cfg;

    dccl_->validate<ChatMessage>();

    //
    // Initiate queue manager (libqueue)
    //
    goby::acomms::protobuf::QueueManagerConfig q_manager_cfg;
    q_manager_cfg.set_modem_id(my_id_);
```

```
    goby::acomms::protobuf::QueuedMessageEntry* q_entry = q_manager_cfg.add_message_entry();
    q_entry->set_protobuf_name("ChatMessage");

#ifdef USE_FLEXIBLE_DATA_PACKET
    q_entry->set_ack(false);
#endif

    goby::acomms::protobuf::QueuedMessageEntry::Role* src_role = q_entry->add_role();
    src_role->set_type(goby::acomms::protobuf::QueuedMessageEntry::SOURCE_ID);
    src_role->set_field("source");

    goby::acomms::protobuf::QueuedMessageEntry::Role* dest_role = q_entry->add_role();
    dest_role->set_type(goby::acomms::protobuf::QueuedMessageEntry::DESTINATION_ID);
    dest_role->set_field("destination");

    goby::acomms::connect(&q_manager_.signal_receive, &received_data);
    goby::acomms::connect(&q_manager_.signal_ack, &received_ack);

    //
    // Initiate modem driver (libmodemdriver)
    //
    goby::acomms::protobuf::DriverConfig driver_cfg;
    driver_cfg.set_modem_id(my_id_);
    driver_cfg.set_serial_port(serial_port);

#ifdef USE_FLEXIBLE_DATA_PACKET
    driver_cfg.AddExtension(micromodem::protobuf::Config::nvram_cfg, "psk.packet.mod_hdr_version,1");
#endif

#ifdef USE_TWO_WAY_PING
    goby::acomms::connect(&mm_driver_.signal_receive, &
      monitor_modem_receive);
#endif

    //
    // Initiate medium access control (libamac)
    //
    goby::acomms::protobuf::MACConfig mac_cfg;
    mac_cfg.set_type(goby::acomms::protobuf::MAC_FIXED_DECENTRALIZED);
    mac_cfg.set_modem_id(my_id_);
    goby::acomms::connect(&mac_.
      signal_initiate_transmission, &monitor_mac);

    goby::acomms::protobuf::ModemTransmission my_slot;
    my_slot.set_src(my_id_);
    my_slot.set_dest(buddy_id_);
#ifdef USE_FLEXIBLE_DATA_PACKET
    my_slot.set_type(goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC);
    my_slot.SetExtension(micromodem::protobuf::type, micromodem::protobuf::MICROMODEM_FLEXIBLE_DATA);
    my_slot.set_max_frame_bytes(32);
    my_slot.set_rate(1);
#elif defined(USE_TWO_WAY_PING)
    my_slot.set_type(goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC);
    my_slot.SetExtension(micromodem::protobuf::type, micromodem::protobuf::MICROMODEM_TWO_WAY_PING);
#else
    my_slot.set_type(goby::acomms::protobuf::ModemTransmission::DATA);
    my_slot.set_rate(0);
#endif
    my_slot.set_slot_seconds(12);

    goby::acomms::protobuf::ModemTransmission buddy_slot;
    buddy_slot.set_src(buddy_id_);
    buddy_slot.set_dest(my_id_);
    buddy_slot.set_slot_seconds(12);
#ifdef USE_FLEXIBLE_DATA_PACKET
    buddy_slot.set_type(goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC);
    buddy_slot.SetExtension(micromodem::protobuf::type, micromodem::protobuf::MICROMODEM_FLEXIBLE_DATA);
    buddy_slot.set_max_frame_bytes(32);
    buddy_slot.set_rate(1);
#elif defined(USE_TWO_WAY_PING)
    buddy_slot.set_type(goby::acomms::protobuf::ModemTransmission::DRIVER_SPECIFIC);
    buddy_slot.SetExtension(micromodem::protobuf::type, micromodem::protobuf::MICROMODEM_TWO_WAY_PING);
#else
    buddy_slot.set_type(goby::acomms::protobuf::ModemTransmission::DATA);
    buddy_slot.set_rate(0);
#endif

    if(my_id_ < buddy_id_)
    {
        mac_cfg.add_slot()->CopyFrom(my_slot);
        mac_cfg.add_slot()->CopyFrom(buddy_slot);
    }
    else
    {
        mac_cfg.add_slot()->CopyFrom(buddy_slot);
        mac_cfg.add_slot()->CopyFrom(my_slot);
    }
```

```
    //
    // Start up everything
    //
    try
    {
        dccl_->set_cfg(dccl_cfg);
        q_manager_.set_cfg(q_manager_cfg);
        mac_.startup(mac_cfg);
        mm_driver_.startup(driver_cfg);
    }
    catch(std::runtime_error& e)
    {
        std::cerr << "exception at startup: " << e.what() << std::endl;
        return startup_failure();
    }

    curses_.set_modem_id(my_id_);
    curses_.startup();

    //
    // Loop until terminated (CTRL-C)
    //
    for(;;)
    {
        std::string line;
        curses_.run_input(line);

        if(!line.empty())
        {
            ChatMessage message_out;
            message_out.set_telegram(line);

            // send this message to my buddy!
            message_out.set_destination(buddy_id_);
            message_out.set_source(my_id_);

            q_manager_.push_message(message_out);
        }

        try
        {
            mm_driver_.do_work();
            mac_.do_work();
            q_manager_.do_work();
        }
        catch(std::runtime_error& e)
        {
            curses_.cleanup();
            std::cerr << "exception while running: " << e.what() << std::endl;
            return 1;
        }
    }

    return 0;
}

int startup_failure()
{
    std::cerr << "usage: chat /dev/tty_modem my_id buddy_id log_file" << std::endl;
    return 1;
}

void monitor_mac(const goby::acomms::protobuf::ModemTransmission& mac_msg)
{
    if(mac_msg.src() == my_id_)
        curses_.post_message("{control} starting send to my buddy");
    else if(mac_msg.src() == buddy_id_)
        curses_.post_message("{control} my buddy might be sending to me now");
}

void monitor_modem_receive(const goby::acomms::protobuf::ModemTransmission& rx_msg)
{
    if(rx_msg.GetExtension(micromodem::protobuf::type) == micromodem::protobuf::MICROMODEM_TWO_WAY_PING &&
       rx_msg.HasExtension(micromodem::protobuf::ranging_reply))
    {
        const micromodem::protobuf::RangingReply& range_reply = rx_msg.GetExtension(
      micromodem::protobuf::ranging_reply);
        if(range_reply.one_way_travel_time_size() > 0)
        {
            double owtt = range_reply.one_way_travel_time(0);
            curses_.post_message(range_reply.ShortDebugString());
        }

    }

}
```

```
void received_data(const google::protobuf::Message& message_in)
{
    ChatMessage typed_message_in;
    typed_message_in.CopyFrom(message_in);
    curses_.post_message(typed_message_in.source(), typed_message_in.telegram());
}

void received_ack(const goby::acomms::protobuf::ModemTransmission& ack_message,
                  const google::protobuf::Message& original_message)
{
    ChatMessage typed_original_message;
    typed_original_message.CopyFrom(original_message);

    curses_.post_message(
        ack_message.src(),
        std::string("{ acknowledged receiving message starting with: "
                    + typed_original_message.telegram().substr(0,5) + " }"));
}
```

18.3 acomms/modemdriver/driver_simple/driver_simple.cpp

```
// Copyright 2009-2016 Toby Schneider (http://gobysoft.org/index.wt/people/toby)
//                     GobySoft, LLC (2013-)
//                     Massachusetts Institute of Technology (2007-2014)
//
//
// This file is part of the Goby Underwater Autonomy Project Binaries
// ("The Goby Binaries").
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//
// You should have received a copy of the GNU General Public License
// along with Goby.  If not, see <http://www.gnu.org/licenses/>.

//
// Usage (WHOI Micro-Modem): run
// > driver_simple /dev/tty_of_modem_A 1
//
// wait a few seconds
//
// > driver_simple /dev/tty_of_modem_B 2
//
// be careful of collisions if you start them at the same time (this is why libamac exists!)

// Usage (example ABCModem): run
// > driver_simple /dev/tty_of_modem_A 1 ABCDriver
// > driver_simple /dev/tty_of_modem_B 2 ABCDriver
// Also see abc_modem_simulator.cpp

#include "goby/acomms/modem_driver.h"
#include "goby/util/binary.h"
#include "goby/common/logger.h"
#include "goby/acomms/connect.h"

#include <iostream>

using goby::acomms::operator<<;


void handle_data_receive(const goby::acomms::protobuf::ModemTransmission& data_msg);

int main(int argc, char* argv[])
{
    if(argc < 3)
    {
        std::cout << "usage: driver_simple /dev/tty_of_modem modem_id [type: MMDriver (default)|ABCDriver]"
       << std::endl;
        return 1;
    }

    //
    // 1. Create and initialize the driver we want
    //
    goby::acomms::ModemDriverBase* driver = 0;
    goby::acomms::protobuf::DriverConfig cfg;
```

```
    // set the serial port given on the command line
    cfg.set_serial_port(argv[1]);
    using google::protobuf::uint32;
    // set the source id of this modem
    uint32 our_id = goby::util::as<uint32>(argv[2]);
    cfg.set_modem_id(our_id);

    goby::glog.set_name(argv[0]);
    goby::glog.add_stream(goby::common::logger::DEBUG2, &std::clog);

    if(argc == 4)
    {
        if(boost::iequals(argv[3],"ABCDriver"))
        {
            std::cout << "Starting Example driver ABCDriver" << std::endl;
            driver = new goby::acomms::ABCDriver;
        }
    }

    // default to WHOI MicroModem
    if(!driver)
    {
        std::cout << "Starting WHOI Micro-Modem MMDriver" << std::endl;
        driver = new goby::acomms::MMDriver;
        // turn data quality factor message on
        // (example of setting NVRAM configuration)
        cfg.AddExtension(micromodem::protobuf::Config::nvram_cfg, "DQF,1");
    }


    goby::acomms::connect(&driver->signal_receive, &handle_data_receive)
      ;

    //
    // 2. Startup the driver
    //
    driver->startup(cfg);

    //
    // 3. Initiate a transmission cycle with some data
    //

    goby::acomms::protobuf::ModemTransmission transmit_message;
    transmit_message.set_type(goby::acomms::protobuf::ModemTransmission::DATA);
    transmit_message.set_src(goby::util::as<unsigned>(our_id));
    transmit_message.set_dest(goby::acomms::BROADCAST_ID);
    transmit_message.set_rate(0);

    transmit_message.add_frame("Hello, world!");
    transmit_message.set_ack_requested(false);

    std::cout << transmit_message << std::endl;

    driver->handle_initiate_transmission(transmit_message);

    //
    // 4. Run the driver
    //

    // 10 hz is good
    int i = 0;
    while(1)
    {
        ++i;
        driver->do_work();

        // send another transmission every 60 seconds
        if(!(i % 600))
            driver->handle_initiate_transmission(transmit_message);

        // in here you can initiate more transmissions as you want
        usleep(100000);
    }

    delete driver;
    return 0;
}

//
// 5. Post the received data
//

void handle_data_receive(const goby::acomms::protobuf::ModemTransmission& data_msg)
{
    std::cout << "got a message: " << data_msg << std::endl;
}
```

18.4 acomms/queue/queue_simple/queue_simple.cpp

simple.proto

```
import "dccl/protobuf/option_extensions.proto";

message Simple
{
  // see http://gobysoft.org/wiki/DcclIdTable
  option (dccl.msg).id = 124;

  // if, for example, we want to use on the WHOI Micro-Modem rate 0
  option (dccl.msg).max_bytes = 32;

  required string telegram = 1 [(dccl.field).max_length=30];
}
```

queue_simple.cpp

```
// Copyright 2009-2016 Toby Schneider (http://gobysoft.org/index.wt/people/toby)
//                     GobySoft, LLC (2013-)
//                     Massachusetts Institute of Technology (2007-2014)
//
//
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// queues a single message from the DCCL library

#include "goby/acomms/queue.h"
#include "goby/acomms/connect.h"
#include "simple.pb.h"
#include "goby/util/binary.h"
#include <iostream>


using goby::acomms::operator<<;

void received_data(const google::protobuf::Message& msg);

int main()
{
    //
    //  1. Initialize the QueueManager
    //
    goby::acomms::QueueManager q_manager;

    // our modem id (arbitrary, but must be unique in the network)
    const int our_id = 1;

    goby::acomms::protobuf::QueueManagerConfig cfg;
    cfg.set_modem_id(our_id);
    cfg.add_message_entry()->set_protobuf_name("Simple");
    q_manager.set_cfg(cfg);

    // set up the callback to handle received DCCL messages
    goby::acomms::connect(&q_manager.signal_receive, &received_data);

    //
    //  2. Push a message to a queue
    //

    // let's make a message to store in the queue
    Simple msg;
    msg.set_telegram("hello all!");
    q_manager.push_message(msg);

    std::cout << "1. pushing message to queue 1: " << msg << std::endl;
```

```
    // see what our QueueManager contains
    std::cout << "2. " << q_manager << std::endl;

    //
    //  3. Create a loopback to simulate the Link Layer (libmodemdriver & modem firmware)
    //

    std::cout << "3. executing loopback (simulating sending a message to ourselves over the modem link)" <<
       std::endl;

    // pretend the modem is requesting data of up to 32 bytes

    goby::acomms::protobuf::ModemTransmission request_msg;
    request_msg.set_max_frame_bytes(32);
    request_msg.set_max_num_frames(1);

    q_manager.handle_modem_data_request(&request_msg);

    std::cout << "4. requesting data, got: " << request_msg << std::endl;
    std::cout << "\tdata as hex: " << goby::util::hex_encode(request_msg.frame(0)) << std::endl;

    //
    //  4. Pass the received message to the QueueManager (same as outgoing message)
    //
    q_manager.handle_modem_receive(request_msg);

    return 0;
}

//
//  5. Do something with the received message
//
void received_data(const google::protobuf::Message& msg)
{
    std::cout << "5. received message: " << msg << std::endl;
}
```

Index