Hola Intercom Software Guide

# Revision History

* 09/01/2017: 1st draft
* 09/18/2017: Added buddy\_id to cloud api
* 10/02/2017: Added echo request and reply messages
* 10/16/2017: Added 3rd party components and updated messages
* 10/24/2017: Added manuf\_config.py. Updated message handler, messages and cloud\_api
* 10/25/2017: Added pin assignments. Added MAX17043 Particle Library
* 10/30/2017: Added restarted parameter to i\_am message
* 10/31/2017: Added battery\_lvl to cloud api. Cloud api now ticks.
* 11/21/2017: Added S1509 I/O Expander.
* 11/27/2017: Added multiple buddy support.
* 11/28/2017: Documented and applied coding convention
* 11/28/2017: Described object roles.
* 11/28/2017: Pin Assignment fixes
* 11/28/2017: Plf\_TickerBase class introduced
* 11/29/2017: Added Trace&Debug section
* 12/7/2017: Added volume control
* 12/15/2017: Added battery checker
* 1/4/2018: Added ratetune print group. Intercom\_Incoming is now a Ticker class.
* 1/9/2018: Added stuff() method to circularBuffer.
* 1/9/2018: Added COMM\_START/STOP+ACK messages
* 1/9/2018: Added recordRequest to Intercom\_Outgoing. Renamed transfer() method to run().
* 1/9/2018: Added codec patch version
* 1/11/2018: Added FSM diagrams
* 1/15/2018: Replaced BatteryChecker section with LevelChecker section. Added WifiChecker.
* 1/15/2018: Added Table of Contents
* 1/17/2018: Added getBatteryPct API
* 1/19/2018: Modified battery\_pct and wifi\_pct cloud API
* 1/21/2018: Added Intercom\_Buddy LED FSM
* 1/26/2018: Added DataDump module and expanded Registry section
* 1/26/2018: Expanded shell commands section
* 1/28/2018: Added comm state FSM to intercom\_buddy section
* 1/30/2018: Reversed relation between buddy and outgoing
* 1/30/2018: FSM updated for buddy and outgoing
* 2/1/2018: Added subsection about IDs.
* 2/2/2018: Replaced Echo mechanism with simplex keep-alive mechanism
* 2/4/2018: Added dummy intercom\_buddies\_and\_leds
* 2/4/2018: New python diagrams
* 2/12/2018: Pin assignment updates for dummy setup.
* 2/13/2018: Added Audio Amp Shutdown function.
* 2/13/2018: Replaced Enable Amp with EnableVol()
* 2/20/2018: Added longPress() method to LevelChecker and blink() method to ledBar.
* 3/7/2018: Modified pin assignments
* 3/7/2018: LedBar has now breathe() method and setExclusive/isExclusive() methods.
* 3/7/2018: BatteryChecker inherits from TickerBase and uses LedBar breathe() method and exclusive API.
* 3/7/2018: Root ticks batteryChecker
* 3/7/2018: VolumeControl uses LedBar exclusive API.
* 3/15/2018: Added PowerManagement module.
* 3/15/2018: WKP pins is Power Down/Up switch.
* 3/27/2018: Added server name to cloud API
* 4/17/2018: Major rework due to introduction of database. Affected modules: intercom\_buddy, intercom\_cloudAPI, intercom\_controller, intercom\_message\_handler intercom\_outgoing, messages
* 5/3/2018: Added Architecture section

Table of Contents

[1 Revision History 1](#_Toc513137292)

[3 Version Control 4](#_Toc513137293)

[4 Third Party Components 4](#_Toc513137294)

[5 Shell Commands 6](#_Toc513137295)

[6 Pin Assignments 6](#_Toc513137296)

[7 Firmware Coding Convention 8](#_Toc513137297)

[8 Architecture 9](#_Toc513137298)

[8.1 Manufacturing Configuration 9](#_Toc513137299)

[8.2 Device Setup using Hola App 10](#_Toc513137300)

[8.3 Intercom Server assignment using DNS 11](#_Toc513137301)

[8.4 Intercom Communication 12](#_Toc513137302)

[9 Firmware Design 13](#_Toc513137303)

[9.1 Ownership 13](#_Toc513137304)

[9.2 Intercom\_Root 13](#_Toc513137305)

[9.3 Intercom\_Incoming 15](#_Toc513137306)

[9.4 Intercom Outgoing 16](#_Toc513137307)

[9.5 Intercom\_Controller 18](#_Toc513137308)

[9.6 Intercom\_Buddy 18](#_Toc513137309)

[9.7 Volume Control 22](#_Toc513137310)

[9.8 Level Checkers 23](#_Toc513137311)

[9.9 Power Management 25](#_Toc513137312)

[9.10 Codec 25](#_Toc513137313)

[9.11 Intercom Message Handler 26](#_Toc513137314)

[9.12 Messages 27](#_Toc513137315)

[9.12.1 Intercom IDs, Source and Destination IDs in Messages 29](#_Toc513137316)

[9.13 Intercom\_CloudAPI 29](#_Toc513137317)

[9.14 Intercom\_ButtonsAndLeds 30](#_Toc513137318)

[9.15 Trace & Debug 30](#_Toc513137319)

[9.16 Registry 31](#_Toc513137320)

[9.17 Data Dump 31](#_Toc513137321)

[10 Server Side 31](#_Toc513137322)

[11 Manuf\_config.py 33](#_Toc513137323)

# Version Control

<https://github.com/rlysens/particleIntercom/>

# Third Party Components

AWS BOTO3 (DynamoDB):

<https://aws.amazon.com/sdk-for-python/>

Draw.io:

<https://www.draw.io/>

VS1063 codec patch 2.01:

<http://www.vlsi.fi/en/support/software/vs10xxpatches.html>

SparkFun\_MAX17043\_Particle\_Library: <https://github.com/sparkfun/SparkFun_MAX17043_Particle_Library.git>

SparkFunSX1509 Library:

<https://github.com/sparkfun/SparkFun_SX1509_Arduino_Library>

LCM: <https://lcm-proj.github.io/> (in source tree)

Name-gen (in source tree)

XTEA: mbedtls-2.5.1

XTEA Python: <https://pypi.python.org/pypi/xtea/0.4.0> (in source tree)

particle.py (in source tree)

* Pytz.py
* Dateutil
* Requests
* pexpect

# Shell Commands

Enable/Disable certain print groups:

particle call Intercom1 en|dis\_prntgrp messages/ratetune/default

List available data dump modules:

particle call Intercom1 list\_ddump

Request a data dump for given module:

particle call Intercom ddump <modulename>

Serial port monitor:

particle serial monitor COM3/COM4

Build and Flash:

python build.py --device Intercom1/Intercom2/all [--flash]

Copy server-side code to Amazon EC2 server:

copypython2amazon.bat

Copy JSON files to server-side

copyjson2amazon.bat

Login to Amazon EC2 server:

ssh2amazonec3.bat

Run Manufacturing Configuration script:

python manuf\_config.py [-h,--help] [-c,--skip\_claim] [-f,--skip\_flash] [-i,--image\_filename <image\_filename>]

Finds and claims connected devices, sets up Wifi, flashes reference fw image and configures name, buddy name and secret key.

# Pin Assignments

Photon pin assignments:

A5 = SI to codec

A4 = SO to codec

A3 = SCK to codec

A2 = xDCS to codec

A1 = xRESET to codec

A0 = DREQ to codec

DAC = xCS to codec

D0 = SDA to MAX17043 fuel gauge IC and to sx1509 i/o expander

D1 = SCL to MAX17043 fuel gauge IC and to sx1509 i/o expander

D2 = xRST to sx1509 i/o expander, initially pulled high on a dummy setup, low on a real setup.

D5 = Audio Amp Shutdown

D6 = SWCLK

D7 = SWDIO

WKP = Power Down/Up

SX1509 I/O Expander pin assignments:

0 = Battery check button

1 = Buddy 0 button

2 = Buddy 1 button

3 = Buddy 2 button

4 = Buddy 0 LED

5 = Buddy 1 LED

6 = Buddy 2 LED

7 = LED Bar 1

8 = Vol.Dec.

9 = Vol.Inc.

10 = Wifi check button

11 = LED Bar 1

12 = LED Bar 2

13 = LED Bar 3

14 = LED Bar 4

15 = LED Bar 0

On Photons pins on dummy setup:

A5 = SI to codec

A4 = SO to codec

A3 = SCK to codec

A2 = xDCS to codec

A1 = xRESET to codec

A0 = DREQ to codec

DAC = xCS to codec

D0 = Buddy 0 button

D1 = Buddy 1 button

D2 = xRST to sx1509 i/o expander, initially pulled high on a dummy setup, low on a real setup.

D3 = Buddy 0 LED

D4 = Buddy 1 LED

# Firmware Coding Convention

* CamelCase
* Types start with capital
* Functions and variables start with lowercase, e.g. topIndex
* Typedefs end with \_t, e.g. RegisterEntry\_t
* Pointers end with p, e.g. registry
* Private members have leading underscore, e.g. \_registryp
* #defines are all caps and underscores, e.g. MAX\_KEY\_VAL
* ‘Namespace’-like prefixes are separated with an underscore, e.g. Intercom\_Outgoing, intercom\_outgoing
* Filenames are lowercase with underscores
* \_s may be used as string postfix
* When interacting with 3rd party code, the 3rd party coding convention may be used.

# Architecture

## Manufacturing Configuration



## Device Setup using Hola App



## Intercom Server assignment using DNS

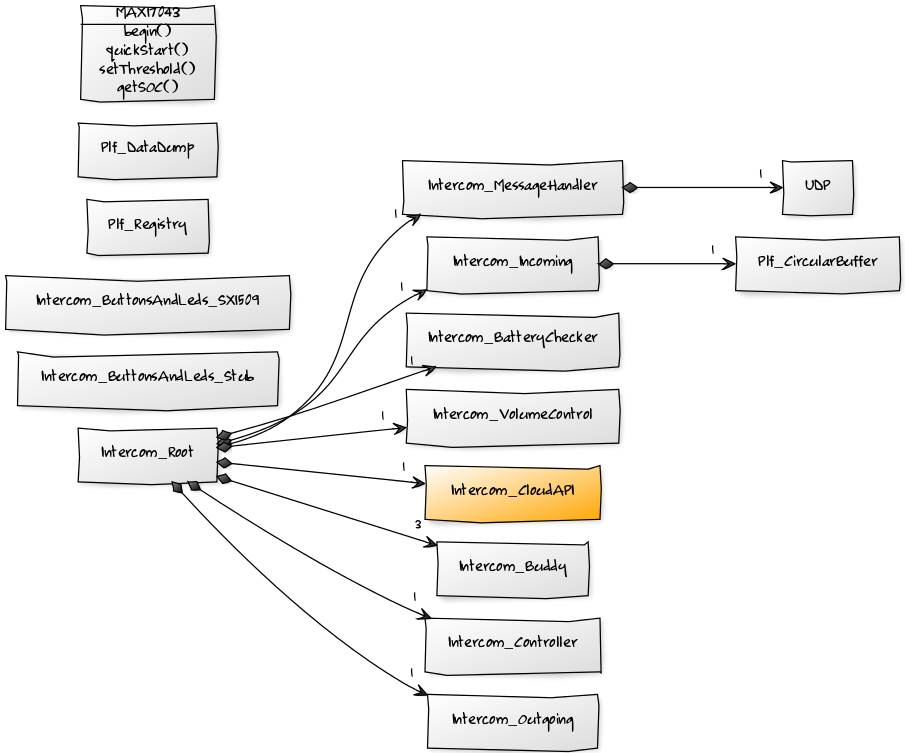


## Intercom Communication



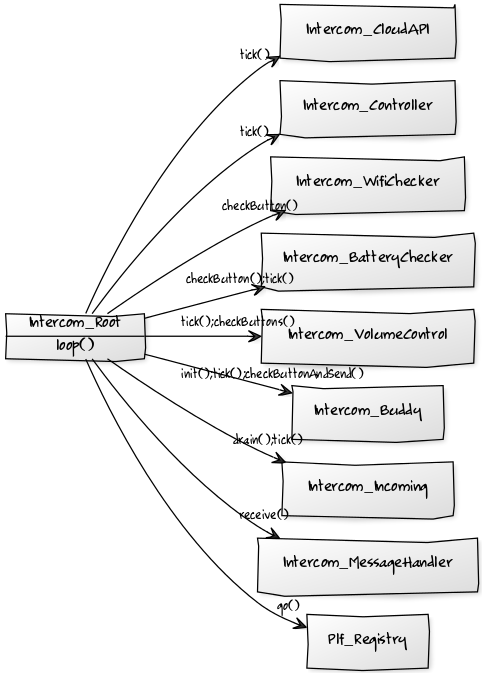
# Firmware Design

## Ownership



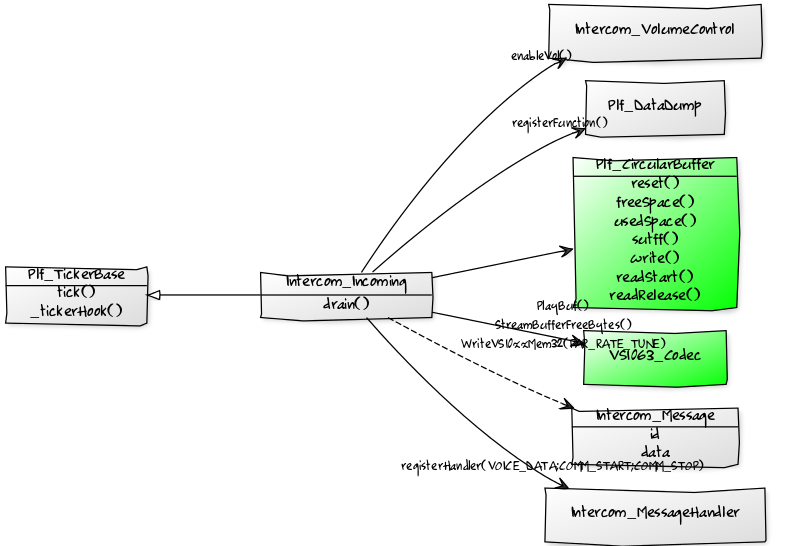
## Intercom\_Root

Intercom\_Root is the root of the Intercom object tree.



## Intercom\_Incoming

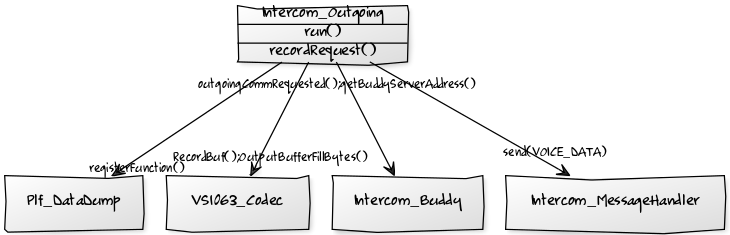
Intercom\_Incoming is in charge of the incoming datapath logic.





## Intercom Outgoing

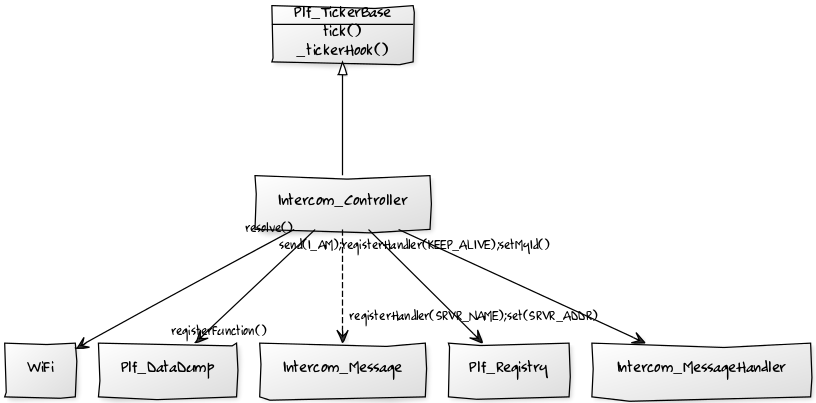
Intercom\_Outgoing is in charge of the outgoing datapath logic.





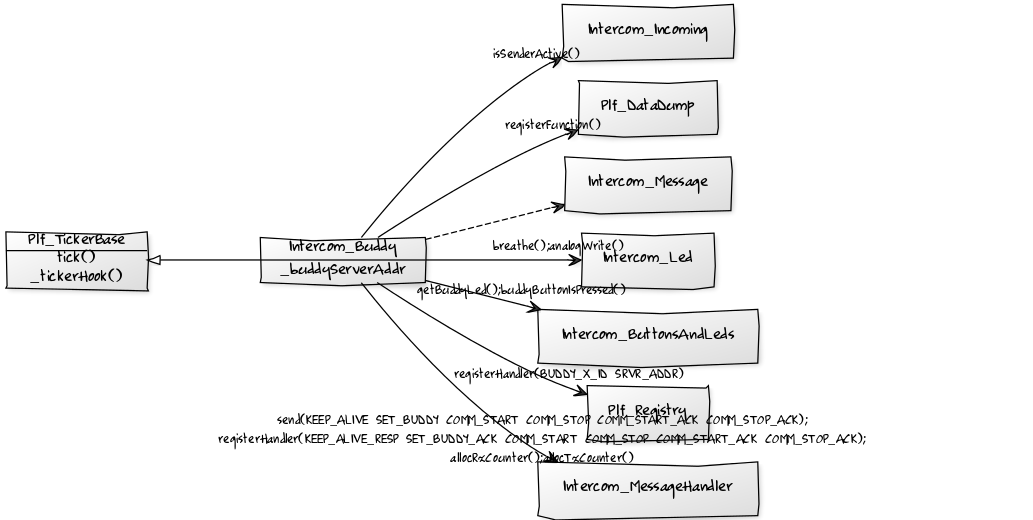
## Intercom\_Controller

Intercom\_Controller handles the control plane logic that is not Buddy specific.



## Intercom\_Buddy

Intercom\_Buddy handles all buddy related control plane logic and user I/O.







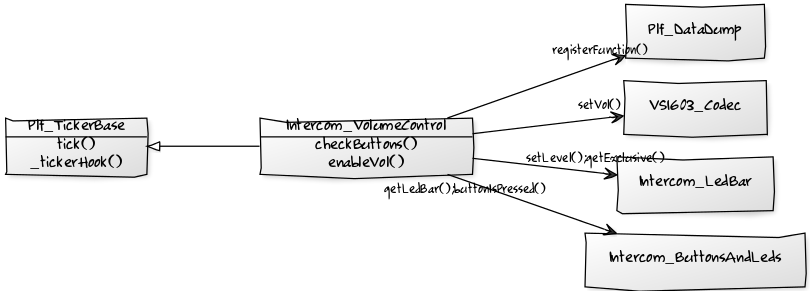




****

## Volume Control

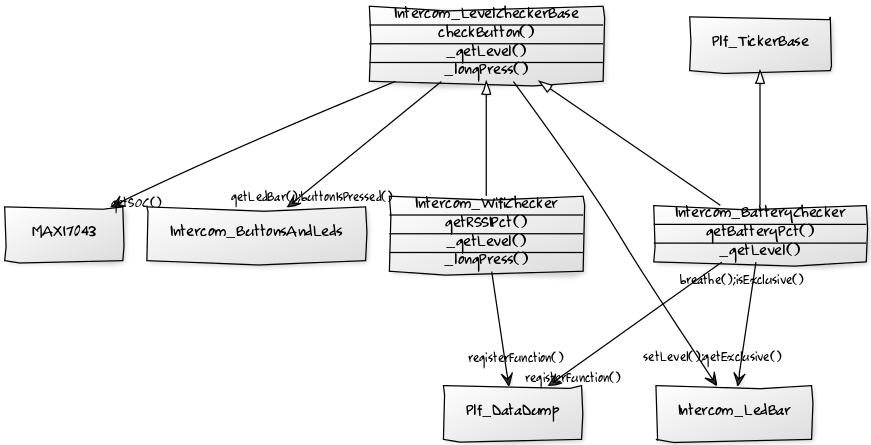
Manages volume control buttons and led bar.





## Level Checkers

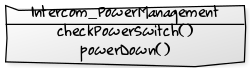
Base class Intercom\_LevelCheckerBase manages check button and led bar. Intercom\_WifiChecker and Intercom\_BatteryChecker derive from this base class and implement respectively Wifi Level checking and Battery Level checking.





## Power Management

Currently the power management class’s reponsbility is limited to putting the intercom in deep sleep when the power down switch is engaged.



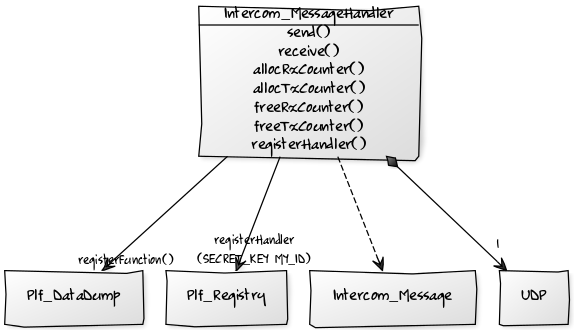
## Codec

Voice codec logic with back-end SPI interaction factored out into a separate module.



## Intercom Message Handler

Sends, receives and dispatches Intercom messages.

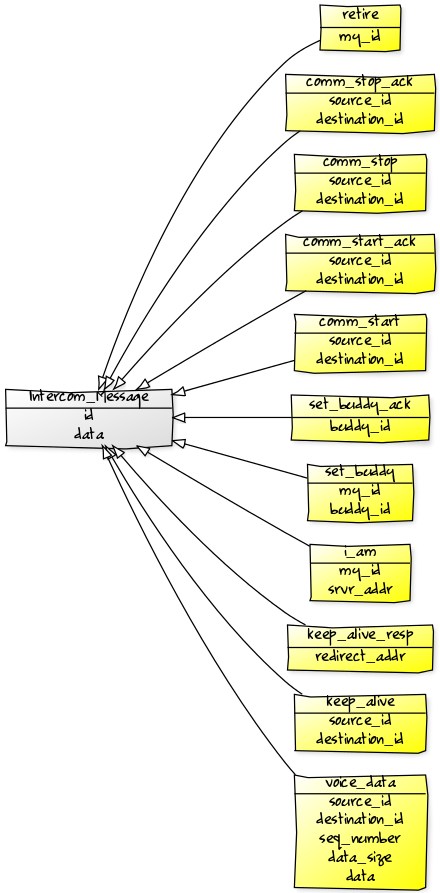


## Messages

Note that the message channel is not considered reliable. Messages can get lost and the message protocols must be robust against occasional message loss. All messages except i\_am are encrypted using XTEA block cipher. The secret key is configured into the device at manufacturing time.

Encryption modes CBC and ECB are supported (selected at compile time).

The retire message is only used between servers, not by firmware.



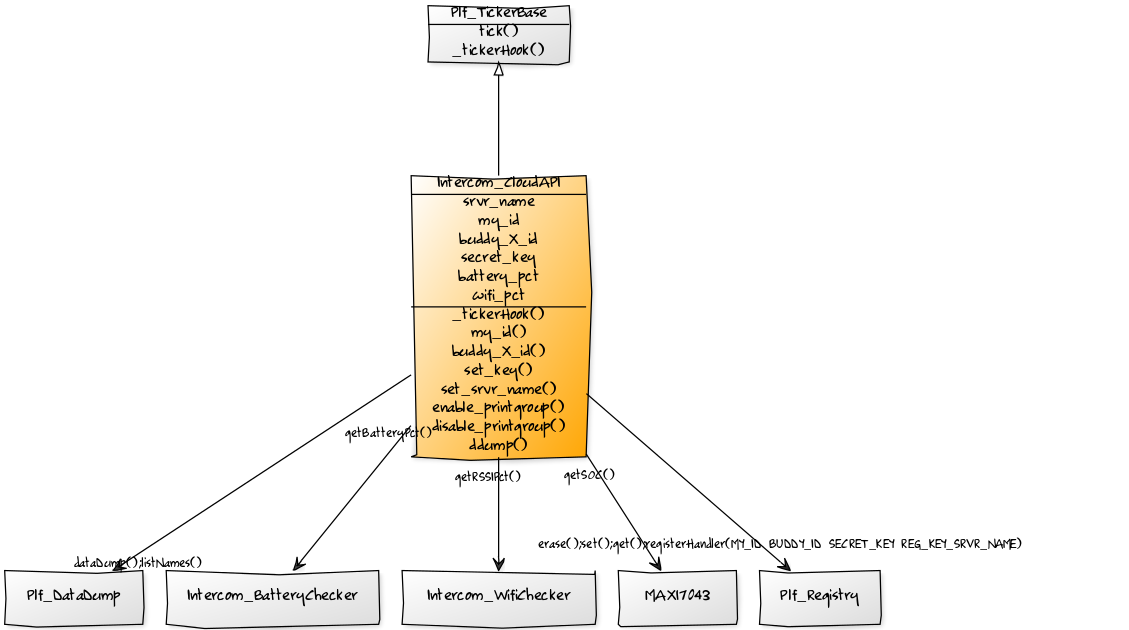
### Intercom IDs, Source and Destination IDs in Messages

The Intercom Server assigns IDs to intercoms, starting from 1 upwards. The Intercom Server itself has a ID of 0. The value -1/0xffffffff means ID\_UNKNOWN. These IDs are used as source\_id and destination\_id in message communication.

## Intercom\_CloudAPI

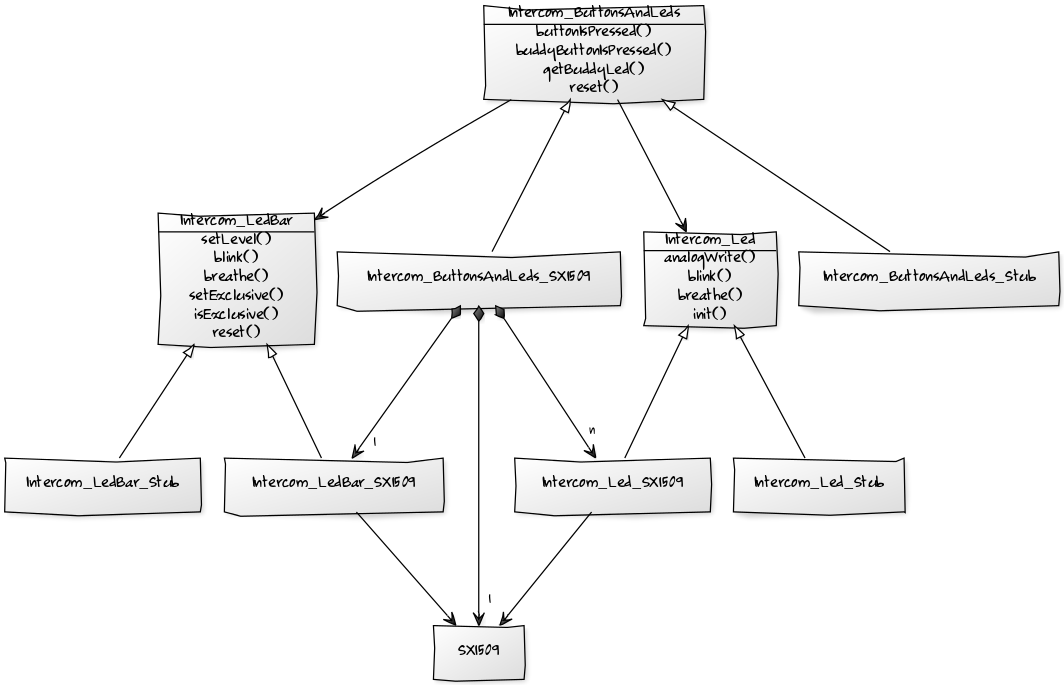
Intercom\_CloudAPI represents the API toward the cloud/Hola App.

X=0, 1 or 2



## Intercom\_ButtonsAndLeds

Intercom\_ButtonsAndLeds encapsulates interaction with buttons and leds. Uses the SX1509 I/O extender library.



## Trace & Debug

* Tracing: plf\_utils.h has a Trace print API (PLF\_PRINT) with printgroups that can be enabled/disabled via the cloudAPI.
* Asserts: plf\_assert in plf\_utils.h
* Error return codes: Each module has a unique MODULE\_ID to be used as a base for error return codes (e.g. return –(MODULE\_ID+1)).
* Event Counting: See plf\_even\_counter.h. Counters can be displayed by datadumping the stats module.
* Data Dumping: See Data Dump section below.

## Registry

The Registry keeps track of a number of Registry elements (strings) identified by a registry key. Registry elements can be set, retrieved and removed (made invalid). Certain registry elements are persistent (i.e stored in non-volatile memory), others are volatile. See list below.

Keys:

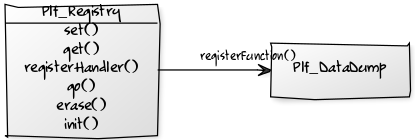
REG\_KEY\_MY\_NAME persistent

REG\_KEY\_BUDDY\_X\_NAME persistent

REG\_KEY\_BUDDY\_X\_ID volatile

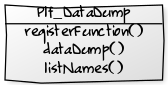
REG\_KEY\_SECRET\_KEY persistent

X=0, 1 or 2



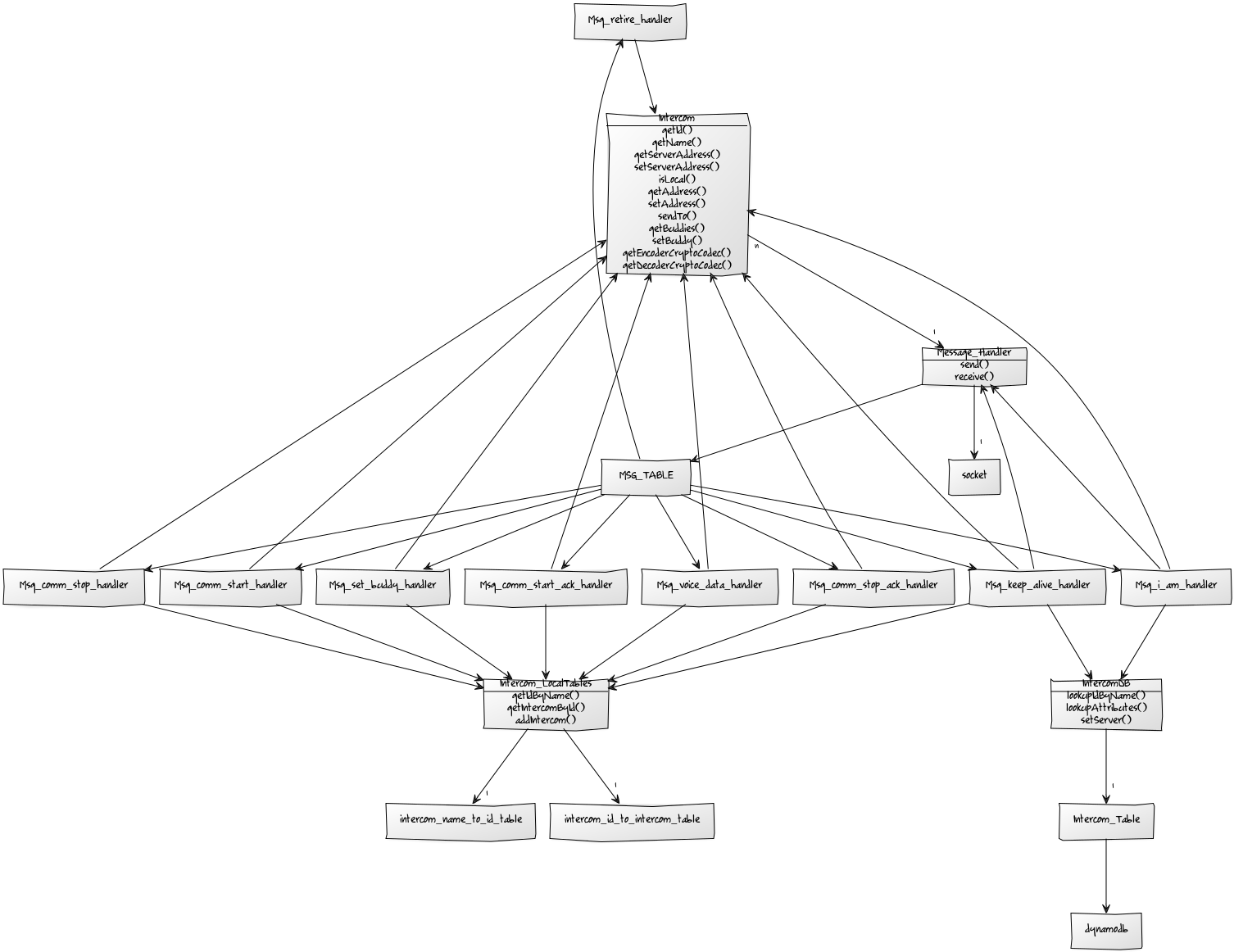
## Data Dump

Other objects can register a data dump function with the Plf\_DataDump object. A data dump function implementation prints out the object’s state. Plf\_DataDump hooks into the CloudAPI so that the user can request a data dump of any registered object.



# Server Side

Message\_Handler is the central object. Intercom\_name\_to\_id table and interom\_id\_to\_intercom table are used for Intercom name to id mapping and looking up corresponding Intercom objects.



# Manuf\_config.py

