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Ciholas Data Protocol (CDP)

Revision History

2016-03-15 - initial alpha release, describing only the position data type.

2016-03-31 - alpha release, updated to contain the current sensor data and the TWR data type.

2016-05-04

- Rename TWR Data type to Distance Data type
- Switch to little endian for integer formats.
- Change of nomenclature on distance type
- Change of RSSI from float to 2 byte signed integer in distance type
- Added user defined data type

2016-06-03

- Modified CDP overview
- Updated any places referencing CDP data that should be CDP Data Item
- Cleaned up Defined Data Types references to Type IDs
- Added Anchor Status definitions

2016-06-17

- Swapping Type and Size in the CDP Data Header
- Size in the CDP Data Header no longer includes the size of the CDP Data Header
- Changing String in the CDP Header to “CDP0002”

2016-07-15

- Deprecating types 0x0001, 0x0002, and 0x0004 in favor of 0x0008, 0x0009, and 0x000a

2016-12-08

- Deprecating type 0x0103 in favor of 0x0105
- Adding Anchor Position Status V2 (0x0105)
- Adding Anchor Health Status (0x0106)
- Created Deprecated Data Types Section
- Changing type (0x00FD) from String Message V1 to Log Message V1

2017-03-01

- Add 3 CDPs (0x0109, 0x010A, 0x010B) to support the Geofencer functionality.

Table of Contents

1 Overview

The Ciholas Data Protocol (CDP) provides a method to communicate between devices. This is implemented by having devices that are on an Ethernet network emit CDP packets, which are UDP datagrams.

CDP packets are transmitted through CDP Streams, which are identified by the Ethernet interface, IP address (both Multicast and Unicast are allowed), and port over which the packet is sent. Different CDP Streams may be defined to distinguish different categories of data.

1.1 General Data Format

All CDP numerical fields of length 2, 4, and 8 bytes are transmitted using little endian format. **Please take note that CDP does not utilize network byte order.** Very few processors in this world are big endian processors anymore. Thus, CDP utilizes little endian to reduce overhead/complexity on the transmission/reception of CDP packets. The intent is to decrease processor use as well as reduce the chances of forgetting to byte swap the data before processing.

When a CDP field is an ASCII string, the field is not byte-swapped.

A CDP Packet is made up of a CDP Header followed by any number of CDP Data Items.

2 CDP Header

Unless otherwise specified, **each field is transmitted in little endian.**

Name	Byte Length	Description
MARK	4	The 4 byte magic word (0x3230434C in little endian).
SEQUENCE	4	The sequence number of the CDP packet. The sequence number is incremented on every transmission from a given CDP Stream.
STRING	8	An ASCII string of “CDP0002” with a null terminator. **NOTE**: This is not byte swapped.
SERIAL NUMBER	4	The unique ID of the reporting device. If the reporting device does not have a serial number or it is unknown, 0 is used.

3 CDP Data Items

All CDP Data Items start with a 4 byte CDP Data Header followed by 0 to 65535 bytes of data.

3.1 CDP Data Header

Each field is transmitted in little endian.

Name	Byte Length	Description
TYPE	2	The type of the CDP Data Item.
SIZE	2	The size of the Data Item not including the Data Header

3.2 Shared Structures

Some CDP Data Items contain the following data structures.

3.2.1 Coordinates

This data structure contains the X, Y, and Z coordinates from a separately defined location.
Each field is transmitted in little endian.

Name	Byte Length	Description
X	4	The distance in millimeters from the location along the X axis. This value is a signed two's complement integer.
Y	4	The distance in millimeters from the location along the Y axis. This value is a signed two's complement integer.
Z	4	The distance in millimeters from the location along the Z axis. This value is a signed two's complement integer.

3.3 Defined Data Types

3.3.1 MPU-9250 Magnetometer V1 (TYPE = 0x0003)

This data type is used to report the magnetometer data from an onboard MPU-9250. **Each field is transmitted in little endian.**

Name	Byte Length	Description
X	2	The raw X magnetometer value. Please consult the datasheet for the MPU-9250 for more information.
Y	2	The raw Y magnetometer value. Please consult the datasheet for the MPU-9250 for more information.
Z	2	The raw Z magnetometer value. Please consult the datasheet for the MPU-9250 for more information.
GNT	4	The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.

3.3.2 LPS25H Pressure V1 (TYPE = 0x0005)

This data type is used to report the pressure measured by an onboard LPS25H. **Each field is transmitted in little endian.**

Name	Byte Length	Description
PRESSURE	4	The raw pressure value. Please consult the datasheet for the LPS25H for more information.
GNT	4	The timestamp when the LPS25H recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.

3.3.3 LPS25H Temperature V1 (TYPE = 0x0006)

This data type is used to report the temperature measured by an onboard LPS25H. **Each field is transmitted in little endian.**

Name	Byte Length	Description
TEMPERATURE	2	The raw temperature value. Please consult the datasheet for the LPS25H for more information.
GNT	4	The timestamp when the LPS25H recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.

3.3.4 User Defined V1 (TYPE = 0x0007)

This data type is used to report any user defined data bytes. Current CUWB Server software does not support this data type.

Name	Byte Length	Description
User Defined Data	X	The format of the contents are defined by the user. It is suggested that the user sends a sequence number within this data to help with detection of lost data.

3.3.4 MPU-9250 Accelerometer V2 (TYPE = 0x0008)

This data type is used to report the accelerometer data from an onboard MPU-9250. **Each field is transmitted in little endian.**

Name	Byte Length	Description
X	2	The raw X accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
Y	2	The raw Y accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
Z	2	The raw Z accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
GNT	4	The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.
Scale	1	The MPU-9250 full-scale representations in Gs. Valid values for the MPU-9250 currently are 2, 4, 8, and 16.
DLPF Rate	2	The MPU-9250 DLPF rate in Hz. Valid values for the MPU-9250 currently are 5, 10, 20, 41, 92, 184, and 460.

3.3.5 MPU-9250 Gyroscope V2 (TYPE = 0x0009)

This data type is used to report the gyroscope data from an onboard MPU-9250. **Each field is transmitted in little endian.**

Name	Byte Length	Description
X	2	The raw X gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
Y	2	The raw Y gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
Z	2	The raw Z gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.
GNT	4	The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.
Scale	2	The MPU-9250 full-scale representations in Degrees Per Second. Valid values for the MPU-9250 currently are 250, 500, 1000, and 2000.
DLPF Rate	1	The MPU-9250 DLPF rate in Hz. Valid values for the MPU-9250 currently are 5, 10, 20, 41, 92, and 184.

3.3.6 MPU-9250 Quaternion V2 (TYPE = 0x000A)

This data type is used to report quaternion data from an onboard MPU-9250.

Name	Byte Length	Description
X	4	The raw X quaternion value. Please consult the datasheet for the MPU-9250 for more information.
Y	4	The raw Y quaternion value. Please consult the datasheet for the MPU-9250 for more information.
Z	4	The raw Z quaternion value. Please consult the datasheet for the MPU-9250 for more information.
W	4	The raw W quaternion value. Please consult the datasheet for the MPU-9250 for more information.
GNT	4	The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.

3.3.7 Log Message V1 (TYPE = 0x00FD)

This data type is used to transmit debug information. The messages can originate from the firmware, cuwb_server, or some other application.

Name	Length	Description
Log Level	3 bits	Using the SysLog Severity levels of: 0 - Emergency 1 - Alert 2 - Critical 3 - Error 4 - Warning 5 - Notice 6 - Informational 7 - Debug
Identifier	13 bits	Unique message identifier. Identifiers 0-999 are reserved for use by Ciholas.
Message	X	An ASCII string. The string may or may not be NULL terminated at the discretion of the sender.

3.3.8 Position V1 (TYPE = 0x0100)

This data type is used to report the 3 dimensional position of the reporting device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
COORDINATES	12	The coordinates from the origin (0, 0, 0).
QUALITY	4	Currently unused.
SMOOTHING	2	The effective smoothing factor (the number of positions averaged minus 1)
SEQUENCE	2	The sequence number of the packet from the reporting device that was used to calculate the position. This is helpful in determining if any packets have been missed. **NOTE**: Currently the sequence number is stored as a one byte number, so this will wrap at 255. The CDP will

		represent the sequence number as two bytes for future compatibility.
GNT	4	The calculated timestamp of the transmission of the packet from the reporting device used to calculate the position. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick

3.3.9 Distance V1 (TYPE = 0x0101)

This data type is used to report the distance between the reporting device and a reflector device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
REFLECTOR SERIAL NUMBER	4	The unique ID of the reflector device.
DISTANCE	4	The distance between the 2 devices in millimeters. This value is a signed two's complement integer.
FIRST PATH	2	The first path signal quality in millibels. This value is a signed two's complement integer.
TOTAL PATH	2	The total path signal quality in millibels. This value is a signed two's complement integer.
SEQUENCE	2	The sequence number of the packet from the CUWB Server that was used to calculate the distance. This is helpful in determining if any packets have been missed. **NOTE**: Currently the sequence number is stored as a one byte number, so this will wrap at 255. The CDP will represent the sequence number as two bytes for future compatibility.
GNT	4	The timestamp when the reflector device received the final packet of the TWR process. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.

3.3.10 Infrastructure Position V1 (TYPE = 0x0102)

This data type is used to report the 3 dimensional position of a stationary device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
NODE TYPE	1	Master = 0x01 Anchor = 0x02
SERIAL NUMBER	4	The Infrastructure Node's Serial Number
COORDINATES	12	The coordinates from the origin (0, 0, 0).

3.3.11 Infrastructure Position V2 (TYPE = 0x0107)

This data type is used to report the 3 dimensional position of a stationary device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
SERIAL NUMBER	4	The Infrastructure Node's Serial Number
COORDINATES	12	The coordinates from the origin (0, 0, 0).
NODE TYPE	1	Master = 0x01 Anchor = 0x02
NODE STATUS	1	Inactive = 0x01 Active = 0x02

3.3.12 Announcement Status V1 (TYPE = 0x0104)

This data type is used to report how a device configuration request was handled. **Each field is transmitted in little endian.**

Name	Byte Length	Description
DEVICE SERIAL NUMBER	4	The serial number of the device.
STATUS	1	0 = Device configured as UWB Anchor 1 = Device configured as wired Anchor 2 = Device configured as Tag 3 = Device disabled [Note: Currently unused] 4 = Device not in configuration 5 = Not enough airtime to schedule the device 6 = The device is known to belong to another network 7 = Not enough room remaining in the Anchor reports

3.3.13 Anchor Position Status V1 (TYPE = 0x0105)

This data type is used to report the status of an anchor that provided location data about the reporting device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
ANCHOR SERIAL NUMBER	4	The serial number of the anchor.
STATUS	1	0 = Anchor data is good 1 = Anchor is unknown 2 = Anchor data does not match other anchors 3 = Anchor data is inconsistent with previous data 4 = Network Time not locked
FIRST PATH	2	The first path signal quality in millibels. This value is a signed two’s complement integer.
TOTAL PATH	2	The total path signal quality in millibels. This value is a signed two’s complement integer.
QUALITY	2	A number from 0 to 10000, with 0 being poor quality, 10000 being high quality

3.3.14 Anchor Health Information V1 (TYPE = 0x0106)

This data type is used to report the health of anchors in the network. **Each field is transmitted in little endian.**

Name	Byte Length	Description
ANCHOR SERIAL NUMBER	4	The serial number of the anchor.
BEACONS REPORTED	4	The total quantity of tag beacons that were reported by the anchor since the last Anchor Health Information.
BEACONS DISCARDED	4	The total quantity of tag beacons that were discarded from the anchor since the last Anchor Health Information.
AVERAGE QUALITY	2	The average of the quality number from 0 to 10,000; with 0 being poor quality, 10,000 being high quality for the anchor since the last Anchor Health Information.
REPORT PERIOD	1	Period of the packet in seconds.

3.3.15 Node Status Change V1 (TYPE = 0x0108)

This data type is used to report when the status for a node has changed. **Each field is transmitted in little endian.**

Name	Byte Length	Description
NODE SERIAL NUMBER	4	The serial number of the node.
NODE STATUS	1	Inactive = 0x01

3.3.16 Zone Status V1 (TYPE = 0x0109)

This data type is published periodically by the Geofencer to report the status of the different zones and the tags that entered/exited them. **Each field is transmitted in little endian.**

Name	Byte Length	Description
ZONE ID	2	Zone identifying number.
ZONE LABEL	16	String alias to ZONE ID.
TAG TRACKER	X*9	An array of TAG TRACKER Structures identifying the tags that entered/exited the zone.
TAG TRACKER Structure		
TAG SERIAL NUMBER	4	Tag serial number.
TIME STAMP	4	GNT of the tag's last change of status (entered/exited this zone) event.
Flag	1	0 - TAG_ENTERED_ZONE 1 - TAG_EXITED_ZONE

3.3.17 Zone Status Change V1 (TYPE = 0x010A)

This data type is used to by the Geofencer to report a tag/zone change of status event (when a tag entered or exited one or more zones). It is transmitted when the geofencer receives a position packet and detects a change of status event for a specific tag at a specific time**. Each field is transmitted in little endian.**

Name	Byte Length	Description
TAG ID	4	Tag serial number.
TIME STAMP	4	GNT from the tag's position packet.
ZONE TRACKER	X*19	An array of ZONE TRACKER Structures identifying the zones that this tag entered/exited.

ZONE TRACKER Structure		
ZONE ID	2	Zone identifying number.
Zone Label	16	String alias to ZONE ID.
Time of Change	4	The time when the change happened (interpolated)
Flag	1	0 - TAG_ENTERED_ZONE 1 - TAG_EXITED_ZONE

3.3.18 Zone Definition V1 (TYPE = 0x010B)

This data type is published periodically by the Geofencer to report the structure of each zone**.** The bodies that make each zone are listed in an array of Unity Standard Definitions.
*** Please note that these definitions are different from the body creation definitions stored in the Geofencer's definition SQLite file. **Each field is transmitted in little endian.**

Name	**Byte Length**	**Description**
ZONE ID	2	Zone identifying number.
ZONE LABEL	4	Human readable alias to ZONE ID.
BODY	X*37	An array of Body structures that make up the zone.
BODY Structure (Conforms with Unity's standards)		
BODY TYPE	1	0 - GEOFENCER_BODY_SPHERE 1 - GEOFENCER_BODY_CYLINDER 2 - GEOFENCER_BODY_BOX
POSITION	12	The coordinates from the origin (0, 0, 0) to the center of the body (in millimeters).
SCALE	12	The "size" of the body as a triplet of half "lengths" of the body measured from the center of the body in the y,x, and z directions respectively (in millimeters).
ORIENTATION	12	Rotation parameters of the body around the x,y, and z

		axes respectively (in degrees). Currently only z-coordinates rotation is implemented for the box type.

3.3.19 User Data Fronthaul V1 (TYPE = 0x010C)

This data type is used to forward any user data that is sent to the server on to the DW devices on the network.

Name	Byte Length	Description
Serial Number	4	The serial number of the device that should receive the message.
User Defined Data	X	The format of the contents are defined by the user. It is suggested that the user sends a sequence number within this data to help with detection of lost data.

3.3.20 Node Status Change V2 (TYPE = 0x010D)

This data type is used to report when the status for a node has changed. **Each field is transmitted in little endian.**

Name	Byte Length	Description
NODE SERIAL NUMBER	4	The serial number of the node.
NODE INTERFACE IDENTIFIER	1	The interface identifier of the node.
NODE STATUS	1	Inactive = 0x01

3.3.21 Anchor Position Status V2 (TYPE = 0x010E)

This data type is used to report the status of an anchor that provided location data about the reporting device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
ANCHOR SERIAL NUMBER	4	The serial number of the anchor.
ANCHOR INTERFACE IDENTIFIER	1	The interface identifier of the anchor.
STATUS	1	0 = Anchor data is good 1 = Anchor is unknown 2 = Anchor data does not match other anchors 3 = Anchor data is inconsistent with previous data 4 = Network Time not locked
FIRST PATH	2	The first path signal quality in millibels. This value is a signed two's complement integer.
TOTAL PATH	2	The total path signal quality in millibels. This value is a signed two's complement integer.
QUALITY	2	A number from 0 to 10000, with 0 being poor quality, 10000 being high quality

3.3.22 Anchor Health Information V2 (TYPE = 0x010F)

This data type is used to report the health of anchors in the network. **Each field is transmitted in little endian.**

Name	Byte Length	Description
ANCHOR SERIAL NUMBER	4	The serial number of the anchor.
ANCHOR INTERFACE IDENTIFIER	1	The interface identifier of the anchor.
BEACONS REPORTED	4	The total quantity of tag beacons that were reported by the anchor since the last Anchor Health Information.
BEACONS DISCARDED	4	The total quantity of tag beacons that were discarded from the anchor since the last Anchor Health Information.
AVERAGE QUALITY	2	The average of the quality number from 0 to 10,000; with

		0 being poor quality, 10,000 being high quality for the anchor since the last Anchor Health Information.
REPORT PERIOD	1	Period of the packet in seconds.

3.3.23 Infrastructure Position V3 (TYPE = 0x0110)

This data type is used to report the 3 dimensional position of a stationary device. **Each field is transmitted in little endian.**

Name	Byte Length	Description
SERIAL NUMBER	4	The Infrastructure Node's Serial Number
INTERFACE IDENTIFIER	1	The infrastructure node's interface identifier.
COORDINATES	12	The coordinates from the origin (0, 0, 0).
NODE TYPE	1	Master = 0x01 Anchor = 0x02
NODE STATUS	1	Inactive = 0x01 Active = 0x02

3.4 Deprecated Data Types

3.4.1 MPU-9250 Accelerometer V1 (TYPE = 0x0001)

This data type has been replaced with MPU-9250 Accelerometer V2 (Type = 0x0008)

~~This data type is used to report the accelerometer data from an onboard MPU-9250.~~ **~~Each field is transmitted in little endian.~~**

~~Name~~	~~Byte Length~~	~~Description~~
~~X~~	~~2~~	~~The raw X accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~
~~Y~~	~~2~~	~~The raw Y accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~

~~Z~~	~~2~~	~~The raw Z accelerometer value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~
~~GNT~~	~~4~~	~~The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.~~

3.4.2 MPU-9250 Gyroscope V1 (TYPE = 0x0002)

This data type has been replaced with MPU-9250 Gyroscope V2 (Type = 0x0009)

~~This data type is used to report the gyroscope data from an onboard MPU-9250.~~ **~~Each field is transmitted in little endian.~~**

~~Name~~	**~~Byte Length~~**	**~~Description~~**
~~X~~	~~2~~	~~The raw X gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~
~~Y~~	~~2~~	~~The raw Y gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~
~~Z~~	~~2~~	~~The raw Z gyroscope value (per network configured scale). Please consult the datasheet for the MPU-9250 for more information.~~
~~GNT~~	~~4~~	~~The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.~~

3.4.3 MPU-9250 Quaternion V1 (TYPE = 0x0004)

This data type has been replaced with MPU-9250 Quaternion V2 (Type = 0x000A)

~~This data type is used to report quaternion data from an onboard MPU-9250.~~

~~Name~~	~~Byte Length~~	~~Description~~
~~X~~	~~4~~	~~The raw X quaternion value. Please consult the datasheet for the MPU-9250 for more information. This field is formatted in big endian.~~
~~Y~~	~~4~~	~~The raw Y quaternion value. Please consult the datasheet for the MPU-9250 for more information. This field is formatted in big endian.~~
~~Z~~	~~4~~	~~The raw Z quaternion value. Please consult the datasheet for the MPU-9250 for more information. This field is formatted in big endian.~~
~~W~~	~~4~~	~~The raw W quaternion value. Please consult the datasheet for the MPU-9250 for more information. This field is formatted in big endian.~~
~~GNT~~	~~4~~	~~The timestamp when the MPU-9250 recorded the data. This value is represented in Global Network Time, which is roughly 1.026 microseconds per tick.~~

3.4.4 Anchor Position Status V1 (TYPE = 0x0103)

This data type has been replaced with Anchor Position Status V2 (Type = 0x0105)

~~This data type is used to report the status of an anchor that provided location data about the reporting device.~~ **~~Each field is transmitted in little endian.~~**

~~Name~~	**~~Byte Length~~**	**~~Description~~**
~~ANCHOR SERIAL NUMBER~~	~~4~~	~~The serial number of the anchor.~~
~~STATUS~~	~~1~~	~~0 = Anchor data is good~~ ~~1 = Anchor is unknown~~ ~~2 = Anchor data does not match other anchors~~ ~~3 = Anchor data is inconsistent with previous data~~