UW-APL PROJECT V4.0.1

This document describes update to SWIFT project by Sutron, Corp., for UW-APL.

Requirements

Changes to be made in this update. Hours quotes are estimates. Actual hours will be tracked and invoiced. Requirements are prioritized as follows, highest to lowest:

- Add new feature to send AQD/AQH configurations to sensor on recording start, from file on flash disk.
  - 6 hrs
- Add new block to support Aanderaa O2 Optode, .5 Hz sampling
  - 3 hrs
- Add new block to support WetLabs SeaOWL, 1Hz sampling
  - 3 hrs
- Update telemetry, system test, update documentation, etc.
  - 1 hrs.

Sensor Configuration

The sensor compliment is not fixed, but is entirely determined by the blocks added to the graphical setup. Sensors using a COM port may be placed on whatever COM port is desired. For such sensors, make sure PIN9 is configured properly to control power to the sensor, where needed:

- AQ (HR), SIG: RI
  - Obtain “pcf” config file using “aquapro.exe -cu”
- PB200: SW12
- Iridium Modem: RI
- Microstrain 3GX: SW12
- Ellipse: SW12
- Camera: SW5
- Aanderaa CS 4319: SW12
- ECO Puck: SW12
- Aanderaa CS 4831 O2 Optode: SW12
- WetLabs SeaOWL: SW12

Transmissions

Iridium transmissions are expected to be hourly, over Iridium modem. Suggest setting Tx Time be set on the 10 minute mark. Transmission destination is determined by modem provisioning. UW-APL’s plan is to have DOD provision modem to send to custom email address. Transmissions from units will be received as attachments to emails. The modem’s IMEI number (unique number assigned to modem) will appear in email subject line.

A transmission for a given hour will typically consist of 3 to 4 emails, with each associated data ***packet*** containing 340 bytes or less. The Iridium system does not guarantee packets arrive in order at destination. The email body specifies a time-stamp for the message, which can be used to determine when the message originated.

Packet Header

Each packet (email attachment) begins with an ***ASCII header and optional sub-header*** describing where the message "fits" within the set of messages for the hour:

- The header uses a single byte in the ASCII printable range to make it easy for humans to interpret the content, identifying the packet type.
    - "0" means self-timed contained in single packet
    - "1" means self-timed spread across multiple packets, or "extended"
- The self-timed extended packet type includes a comma-delimited sub-header to describe the subset of data being sent. The first sub-header differs from all subsequent sub-headers, in that it includes the total size of the data being sent
- In the following tables, bracketed text, e.g. "<packet-type>", denotes a field replaced in an actual transmission by real data. All chars outside of bracketed text are literals

Packet Structure

<packet-type>	<sub-header>	<data>

Sub-header 0:

,<id>,<start-byte>,<total-bytes>:

Sub-header 1 thru N:

,<id>,<start-byte>:

Where…

<packet-type>	:=	Numeric ASCII character defining packet type. Types for UW-APL: 0 := Self-timed (single packet) 1 := Self-timed extended (multiple packets)
<id>	:=	Numeric ASCII text defining the message id. Starts at "0". Rolls over after "99"
<total-bytes>	:=	Numeric ASCII text defining the total number of data bytes to be sent (data only, does not include overhead bytes)
<start-byte>	:=	Numeric ASCII text defining which byte of total-bytes is the start byte of the current packet. Starts at 0

Example

Example showing two packet transmission where the total size is 512 bytes (note, total size is of the data payload, and does not include the overhead of the header). The example uses a message id of 42	
Packet 1:	1,42,0,512:<payload bytes 0 thru 319>
Packet 2:	1,42,320:<payload bytes 320 thru 511>

Packet Payload

The data spread across the packets of a transmission also has a structure:

- The payload data is binary, transmitted Least Significant Byte (LSB) first
- Floats are single precision stored per IEEE 754 32-bit spec (4 bytes)
- Each section begins with an integer specifying the sensor type, followed by another integer specifying the number of bytes in the section

Payload Structure

The following table defines the structure of the data payload for SWIFT v3.3. Use the tool, "SBDCvt" provided by Sutron, to decode the payload. Note: input file to SBDCvt should contain only the payload, not the Iridium header.

Name	Data Type	Description
Payload Type	ASCII char	"7" = SWIFT v4.0 (with Signature enhancements)

One or more sensor structures, as defined below
("Miscellaneous" structure containing battery voltage will always be included)

Aquadopp HR ("AQH")

Name	Data Type	Description
Type	1-byte int	= 0
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 64 bytes following
A(0)	Float	Value of A(0)
A(1)	Float	Value of A(1)
…	…	…
A(15)	Float	Value of A(15)

Aquadopp non-HR ("AQD")

Name	Data Type	Description
Type	1-byte int	= 1
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 160 bytes following
Mean(0)	Float	Mean(0) beam 1
Mean(1)	Float	Mean(1) beam 1
…	…	…
Mean(39)	Float	Mean(39) beam 1

PB200 ("PB2")

Name	Data Type	Description
Type	1-byte int	= 2
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 80 bytes following
WDMean	Float	Value of wind direction mean
WDSTD	Float	Value of wind direction standard deviation
WSMean	Float	Value of wind speed mean
WSSTD	Float	Value of wind speed standard deviation
PBLat	Float	PB200 Latitude

PBLon	Float	PB200 Longitude
PBYear	4-byte int	PB200 Year
PBMonth	4-byte int	PB200 Month
PBDay	4-byte int	PB200 Day
PBSeconds	4-byte int	PB200 seconds into the day (decimal digits map to hhmmss, e.g., 170859 = 17:08:59)
ATMean	Float	Value of air temperature mean
ATSTD	Float	Value of air temperature standard deviation
BPMean (new in v3.2)	Float	Mean baro pressure bars
BPSTD (new in v3.2)	Float	Standard deviation baro pressure bars
COGMean (new in v3.2)	Float	Course Over Ground, mean direction unit
COGSTD (new in v3.2)	Float	Standard deviation, COG direction unit
SOGMean (new in v3.2)	Float	Speed Over Ground, mean speed scalar
SOGSTD (new in v3.2)	Float	Standard deviation, SOG scalar

IMU

Name	**Data Type**	**Description**
Type	1-byte int	= 3
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 1796 bytes following
Hs	Float	Significant wave height
Tp	Float	Dominant period s
Dp	Float	Direction deg T
E(0)	Float	Spectral energy density m^2/Hz
…	…	…
E(41)	Float	…
f(0)	Float	Frequency Hz
…	…	…
f(41)	Float	…
a1(0)	Float	Normalized spectral moment a1
…	…	…
a1(41)	Float	…
b1(0)	Float	Normalized spectral moment b1
…	…	…
b1(41)	Float	…

a2(0)	Float	Normalized spectral moment a2
…	…	…
a2(41)	Float	…
b2(0)	Float	Normalized spectral moment b2
…	…	…
b2(41)	Float	…
IMULat	Float	Value of IMU Latitude
IMULon	Float	Value of IMU Longitude
hAz(0)	4-byte int	Histogram of vertical acceleration
…	…	…
hAz(31)	Float	…
bcAz(0)	Float	Bin centers of hAz
…	…	…
bcAz(31)	Float	…
hAh(0)	4-byte int	Histogram of magnitude of horizontal acceleration
…	…	…
hAh(31)	Float	…
bcAh(0)	Float	Bin centers of hAh
…	…	…
bcAh(31)	Float	…
hVh(0)	4-byte int	Histogram of magnitude of horizontal velocity
…	…	…
hVh(31)	Float	…
bcVh(0)	Float	Bin centers of hVh
…	…	…
bcVh(31)	Float	…

Aanderra CS 4319 ("ACS")

Name	**Data Type**	**Description**
Type	1-byte int	= 4
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 12 bytes following
ConductivityMean	Float	Conductivity mean
TempMean	Float	Temperature mean
SalinityMean	Float	Salinity mean

Aanderra CS 4831 O2 Optode ("ACO")

Name	Data Type	Description
Type	1-byte int	= 12
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 4 bytes following
O2 Concentration	Float	02 Concentration Mean

WetLabs SeaOWL ("SWL")

Name	Data Type	Description
Type	1-byte int	= 13
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 4 bytes following
FDOM Reported Mean	Float	FDOM Reported Mean (Column 14)

ECO Puck ("ECO")

Name	Data Type	Description
Type	1-byte int	= 5
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 12 bytes following
F2Mean	Float	Column 2 mean
F4Mean	Float	Column 4 mean
F6Mean	Float	Column 6 mean

Miscellaneous

Name	Data Type	Description
Type	2-byte int	= 6
Size	2-byte int	= 4 bytes following
BatteryVoltage	Float	Battery voltage

PIC

Name	Data Type	Description
Type	1-byte int	= 7
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9

Size	2-byte int	= Number of bytes in picture following (varies)
Picture (jpg)	Bytes	Bytes comprising jpg image

Vaisala 536 ("SDI-a")

Name	Data Type	Description
Type	1-byte int	= 8
Port	1-byte char	SDI-12 address char, e.g., '0', '1', etc.
Size	2-byte int	= 48 bytes following
WDMean	Float	Value of wind direction mean deg
WDSTD	Float	Value of wind direction standard deviation deg
WSMean	Float	Value of wind speed mean m/s
WSSTD	Float	Value of wind speed standard deviation m/s
ATMean	Float	Value of air temperature mean C
ATSTD	Float	Value of air temperature standard deviation C
RHMean	Float	Mean relative humidity %
RHSTD	Float	Standard deviation relative humidity %
BPMean	Float	Mean baro pressure mbars
BPSTD	Float	Standard deviation baro pressure mbars
RainAcc	Float	Rain accumulation mm
RainInt	Float	Rain intensity mm/h

Signature ("SIG")

Name	Data Type	Description
Type	1-byte int	= 9
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 4 to n bytes following
nBurstCells	2-byte int	0 min, 128 max
A(0)	Float	Value of A(0)
A(1)	Float	Value of A(1)
…	…	…
A(nBurstCells-1)	Float	Value of A(nBurstCells-1)
nAvgCells	2-byte int	0 min, 64 max
EastMeans(0)	Float	Value of EastMeans(0)
…	…	…
EastMeans(nAvgCells-1)	Float	Value of EastMeans(nAvgCells-1)

NorthMeans(0)	Float	Value of NorthMeans(0)
…	…	…
NorthMeans(nAvgCells-1)	Float	Value of NorthMeans(nAvgCells-1)

SBG Ellipse ("SBG")

Name	Data Type	Description
Type	1-byte int	= 10
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 1196 bytes following
Hs	Float	Significant wave height
Tp	Float	Dominant period s
Dp	Float	Direction deg T
E(0)	Float	Spectral energy density m^2/Hz
…	…	…
E(41)	Float	…
f(0)	Float	Frequency Hz
…	…	…
f(41)	Float	…
a1(0)	Float	Normalized spectral moment a1
…	…	…
a1(41)	Float	…
b1(0)	Float	Normalized spectral moment b1
…	…	…
b1(41)	Float	…
a2(0)	Float	Normalized spectral moment a2
…	…	…
a2(41)	Float	…
b2(0)	Float	Normalized spectral moment b2
…	…	…
b2(41)	Float	…
cf(0)	Float	
…	…	…
cf(41)	Float	…
Lat	Float	Value of IMU Latitude
Lon	Float	Value of IMU Longitude

Y81000 ("Y81")

Name	Data Type	Description
Type	1-byte int	= 11
Port	1-byte int	Com port index, i.e., 2, 3, 4, 6, 7, 8, or 9
Size	2-byte int	= 960 bytes following
Ustar	Float	Wind friction velocity
Epsilon	Float	Dissipation rate
MeanU	Float	Mean wind velocity east-west
MeanV	Float	Mean wind velocity north-south
MeanW	Float	Mean wind velocity updraft
MeanTemp	Float	Mean sonic temp
Anisotropy	Float	Metric for the inertial sub range of the spectrum
Quality	Float	Metric for ustar estimate
Freq(0)	Float	
…	…	…
Freq(115)	Float	…
TkeSpectrum(0)	Float	
…	…	…
TkeSpectrum(115)	Float	…

Network Configuration

Configure Digi radio as Access Point for shore PC, and Subscriber Unit for SWIFTs.

When using Digi radios for WiFi bridge of SBG Ellipse data, be sure to set the Default Gateway in the Xpert to the IP Address of the Digi Access Point radio. This appears to be required in order for socket clients on the Xpert to be able to succeed in making connections to the host PC (but was not required in order to accept incoming connections, e.g., Xterm).

Autopoll Setup

```
Three (3) Xpert Tasks
Task types = "Capture"
Task #1 Connection Settings
   IP Address: 0.0.0.0
   IP Port: 3001
Task #2 Connection Settings
   IP Address: 0.0.0.0
   IP Port: 3002
Task #3 Connection Settings
   IP Address: 0.0.0.0
   IP Port: 3003
```