

DTN Zephyr Cruise Plan

Rev. 1.0 – 04APR12 mrc
1.5 – 30APR12 mrc Incorporated KR comments, added waypoints, detailed plan.
2.0 – 07MAY12
2.5 – 16MAY12mrc Minor revisions.

1.0 **Cruise objectives.**

- 1.1 Demonstrate the utility of Delay Tolerant Networking services for data and command file delivery in a real-world MBARI operational AUV environment.

2.0 **Cruise dates:**

- 2.1 Monday, May 21, 2012 – Test day.
- 2.2 Thursday, May 24, 2012 – Test day.

3.0 **Cruise navigation waypoints:**

- 3.1 Vessel rendezvous location (waypoint DTN1): **36°49'0.00"N, 121°54'0.00"W** (near former M0 position).
- 3.2 AUV rendezvous point (waypoint DTN2) : **36°49'15.00"N, 121°54'0.00"W** (about 460 meters S of DTN1)
- 3.3 AUV turn around point (waypoint DTN3) : tbd, should be about 30 minutes AUV flight west from DTN2 (Fredrick)

4.0 **AUV mission profile summary (see individual runs below for more detail):**

- 4.1 Fly west from DTN2 on a yo-yo mission between 5 and 50 meters depth.
- 4.2 Surface at DTN3 and synchronize navigation with GPS.
- 4.3 Fly east from DTN3 to DTN 2 on a yo-yo mission between 5 and 50 meters depth.
- 4.4 Surface at DTN 2 for 10 minutes to make FreeWave IP connection and synchronize navigation with GPS.
- 4.5 Repeat for each of four (4) test runs.

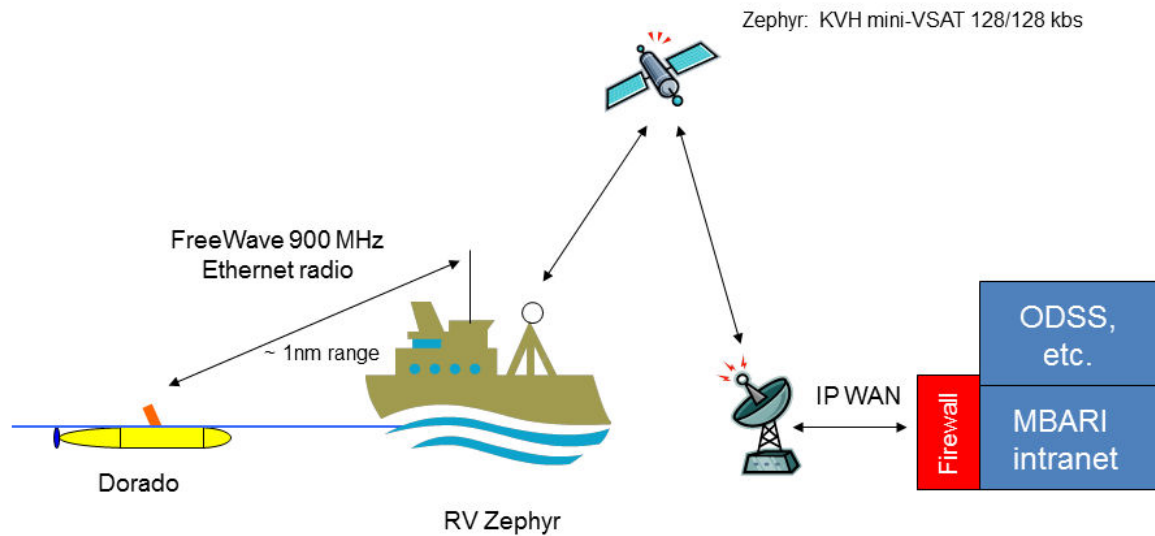
5.0 **Personnel:**

- 5.1 On Zephyr: Fredrick Py, Tom O'Reilly, Mark Chaffey
- 5.2 On shore: Kanna Rajan

6.0 **Test architecture.**

- 6.1 In order to provide network communications with wet assets such as the AUV which have limited line-of-site radio capabilities of about 1nm or less, the network architecture requires a “gateway” communications hop between the AUV and the shore based network. This gateway can reside on a buoy or other surface platform, or in the case of this test, a ship. The gateway consists of radio communications hardware and application software for passing files between the AUV and shore.
- 6.2 Simplified view of the architecture for the test:

DTN Engineering Test



7.0 Dorado AUV requirements:

- 7.1 AUV sys logging disabled or minimized (to reduce radio overhead).
- 7.2 DTN stack running on T-rex computer.
- 7.3 Configured routing table on MVC computer to allow T-rex IPO access to Zephyr though MVC FreeWave radio link.
- 7.4 Software routine on T-rex for placing test files in DTN send directory (FP). Note see next section for file details.
 - 7.4.1 Test files in the following formats.
 - 7.4.1.1 AUV to shore files: Data files from the AUV mission (or simulated files). These files are binary (FP) Note: initial assumption is 20% IP and radio overhead, may be revised in shoreside testing.
 - 7.4.1.2 Shore to AUV files: Pseudo mission tasking files (non-executable) corresponding to an XML file length of approximately 200 mission "behaviors".
- 7.5 Working FreeWave Ethernet radio and antenna (approx. 96kbs max.)
- 7.6 AUV GPS position logged and available post-mission.

8.0 Zephyr requirements:

- 8.1 Working KVH mini-VSat and network connection for our equipment (ship provided).
 - 8.1.1 Static routable IP address on Zephyr (Doug).
- 8.2 Working FreeWave Ethernet radio and antenna (AUV team provided).
- 8.3 Manta 2000 box and power supply (science party).
- 8.4 Laptop computer (science party).
- 8.5 Leviton router and all cabling (science party).

8.5.1 Router configured for KVH static address and NAT port translation for shipboard routing.

8.6 Ship position logged on Winfrog and available post-mission.

9.0 **Shoreside requirements:**

9.1 Host file server on odss-staging.shore.mbari.org at IP address: 134.89.12.34 running DTN application and containing directory [??] for location of test files. The monitoring and verification of files will be done from at sea via the satellite network with Kanna available on shore for backup.

9.2 Re-configuration of MBARI firewall to allow traffic originating on Zephyr to reach odss-staging.

10.0 **Data logging**

10.1 For each test mission the following data is logged or recorded:

10.1.1 Zephyr time and position (Winfrog).

10.1.2 AUV time and position.

10.1.3 FreeWave connect and disconnect times (from ping routine or manual recording of link status).

10.1.4 DTN connect and disconnect events (I don't know how to do this, manually? Logged?).

10.1.5 DTN data transfer rates. Record names of files transferred during a timed session.

11.0 **Test missions.**

11.1 Mission 1.

11.2 Objective: Test the ability of the AUV to establish a network connection through the FreeWave radio link and automatically transfer files through the DTN application. The test is run on the network connection between the AUV and the ODSS shore side server via the Manta box or PC on the Zephyr. The file sizes have been estimated to provide about 25% radio channel fill during an 4¹ minute transfer window, including TCP overhead.

11.3 File names and sizes for transfer:

11.3.1 From odss-staging.shore.mbari.org to AUV:

11.3.1.1	File name	File Size	File Type
	DTN_cmd_test1	200 behaviors	XML

11.3.2 From AUV to odss-staging.shore.mbari.org:

11.3.2.1	File name	File Size	File Type
	DTN_n.txt	580kB ²	binary (n = sequential file designator.

Each subsequent file number will approximately double in size)

¹ Reduced from 8 minutes – just seemed too long and generated large file sizes.

² File size calculated as radio link = 96kb/10 for byte count x .8 for IP overhead x .25 for 25% fill x 60 seconds x 4 minutes. May increase or decrease file size based on lab testing results.

11.4 Test protocol:

- 11.4.1 AUV is programmed to perform a 30 minute transit yo-yo mission and return to a rendezvous point DTN2, 460 meters south from the Zephyr location. The file named [DTN_data_test1] is placed in the AUV DTN send directory for transfer prior to the rendezvous. When a network connection has been established between the AUV and the Zephyr the file is transferred to the Zephyr and back to odss-staging.shore.mbari.org. The elapsed time between the network connection being established and the completion of the file transfer is measured.
- 11.4.2 Fly west from DTN2 on a yo-yo mission between 5 and 50 meters depth.
- 11.4.3 Surface at DTN3 and synchronize navigation with GPS.
- 11.4.4 Fly east from DTN3 to DTN 2 on a yo-yo mission between 5 and 50 meters depth. Prior to surfacing place the test file in the DTN send directory.
- 11.4.5 Surface at DTN 2 for 10 minutes maximum to make FreeWave IP connection with the radio terminal on the Zephyr (loitering at waypoint DTN1) and synchronize navigation with GPS.

12.0 **Mission 2.**

12.1 Objective: Same as mission 1 with larger file size (or multiple files) for 50% fill.

12.2 File names and sizes for transfer:

12.2.1 From odss-staging.shore.mbari.org to AUV:

12.2.1.1	File name	File Size	File Type
	DTN_cmd_test2	200 behaviors	XML

12.2.2 From AUV to odss-staging.shore.mbari.org:

12.2.2.1	File names	File Size	File Type
	DTN_n+1.txt	1160kB	binary

12.3 Test protocol: Identical to mission 1 with new file name and size.

13.0 **Mission 3.**

13.1 Objective: Same as mission 1 with larger file size (or multiple files) for 100% fill.

13.2 File names and sizes for transfer:

13.2.1 From odss-staging.shore.mbari.org to AUV:

13.2.1.1	File name	File Size	File Type
	DTN_cmd_test3	200 behaviors	XML

13.2.2 From AUV to odss-staging.shore.mbari.org:

13.2.2.1	File name	File Size	File Type
	DTN_n+2.txt	2320kB	binary

13.3 Test protocol: Identical to mission 1 with new file name and size.

14.0 **Mission 4.**

- 14.1 Objective: Same as mission 1 with larger file size (or multiple files) for 200% fill. Test is to see if DTN continues uncompleted file transfer when re-connection is made on subsequent vehicle run.
- 14.2 File names and sizes for transfer:
- 14.2.1 From odss-staging.shore.mbari.org to AUV:
- | 14.2.1.1 | File name | File Size | File Type |
|----------|---------------|---------------|-----------|
| | DTN_cmd_test4 | 200 behaviors | XML |
- 14.2.2 From AUV to odss-staging.shore.mbari.org:
- | 14.2.2.1 | File name | File Size | File Type |
|----------|-------------|-----------|-----------|
| | DTN_n+3.txt | 4640kB | binary |
- 14.3 Test protocol: AUV is programmed to perform a 30 minute yo-yo mission and return to a rendezvous point DTN2, 460 meters south from the Zephyr location. The files named [DTN_data_test4A to H] are placed in the AUV DTN send directory for transfer prior to the rendezvous. When a network connection has been established between the AUV and the Zephyr the file is transfer begins to the Zephyr and back to odss-staging.shore.mbari.org. At the end of the 10 minute maximum surface window the vehicle dives and continues the mission. The number of files transferred is logged.
- 14.4 Fly west from DTN2 on a yo-yo mission between 5 and 50 meters depth.
- 14.5 Surface at DTN3 and synchronize navigation with GPS.
- 14.6 Fly east from DTN3 to DTN 2 on a yo-yo mission between 5 and 50 meters depth. Prior to surfacing place the test files in the DTN send directory.
- 14.7 Surface at DTN 2 for 10 minutes maximum to make FreeWave IP connection with the radio terminal on the Zephyr (loitering at waypoint DTN1) and synchronize navigation with GPS.
- 14.8 After 10 minutes execute a second mission, fly west from DTN2 on a yo-yo mission. Surface at DTN3 and synchronize navigation with GPS.
- 14.9 Fly east from DTN3 to DTN 2 on a yo-yo mission between 5 and 50 meters depth. Do not place any additional test files in the DTN send directory.
- 14.10 Surface at DTN 2 and make a FreeWave IP connection with the radio terminal on the Zephyr (loitering at waypoint DTN1) and synchronize navigation with GPS.
- 14.11 After 10 minutes on the surface, log files transferred and end mission. Recover AUV.