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Home

This page last changed on May 03, 2012 by chma.

This is the home page for the 901224_DelayTolerantNetworking space. The goal of this project is to provide a concise report detailing the feasibility of extending traditional shore based Ethernet networking to the operating environment of ocean platforms. A unique class of network protocols known as Delay Tolerant Networks (DTN) have been developed and distributed by the Delay Tolerant Networking Research Group. These protocols have been successfully applied to communicating with multiple platforms in the ocean (AUV's, buoys, etc.) by the Faculty of Engineering at the University of Porto. Referring to specific use cases derived from the CANON initiative and the Autonomy project this study will describe the utility of installing DTN technology on MBARI's ocean platforms and estimate the effort and cost required.

Important Documents
Current draft copy of DTN Feasibility Study

Meeting Notes
2012_01_04_MeetingNotes.doc
2012_01_20_DTN_BrainstormingMeeting.ppt

Field Test
The current DTN Zephyr cruise plan and network drawing is in the attachments section.

Preliminary DTN tests using Porto Manta Gateway

This page last changed on Jan 20, 2012 by oreilly.

These tests utilize the Manta A300 Gateway (on-loan from University of Porto). For these tests, I also compiled and installed DTN version 2.8.0 on my MacBook Pro laptop.

See attached PowerPoint slides that illustrate the test scenarios.

Test 1: Send and receive from stand-alone Manta host
In this test, all DTN routing and caching is isolated to the Manta host, without the use of any external network interfaces. Thus there are no network "disruptions" to deal with in this test.
Expected result: The dtnrecv utility should receive every DTN bundle send by dtnsend

Test 2: Exchange messages between Manta and MacBook via intermittent Ethernet link
, and then configured the Manta and MacBook to forward packets to one another via Ethernet. During these tests, I unplugged the Ethernet cable before issuing dtnsend commands from the Manta. After a specific interval, I reconnected the Ethernet cable.
Expected result: When the Ethernet cable is reconnected, dtnrecv on the MacBook should receive the bundle sent from the Manta

Test 3: Similar to Test 2, but using Ubiquiti radio link instead of Ethernet. During the test, power off one or both radios before issuing dtnsend commands from the Manta. After a specific interval, restore radio power and observe that message sent from Manta is subsequently received by dtnrecv client on laptop.

1/20/2012: Tests 1, 2, and 3 are complete.

Test notes:

1. Use Ubiquiti 15V (12 W) "Carrier POE Adapter".
2. Do not power on Ubiquiti radio without attached antenna!
3. While testing radios in lab, set radio power to minimum level
4. Refer to Ubiquiti AirOS users guide for radio configuration. One radio should be configured as "access point", other radio as "station".
5. Client machine's dtnrecv client should be always running during the test, since if nothing is listening for DTN messages on a given "end point" when a DTN bundle arrives, DTN discards the bundle.
6. Ricardo Martens provided DTN configuration files for use both on the Manta and the MacBook Pro (see attached ricardo-dtn.config); modify file to reflect our Manta and laptop IP addresses

Manta-Dorado tests

This page last changed on May 08, 2012 by oreilly.

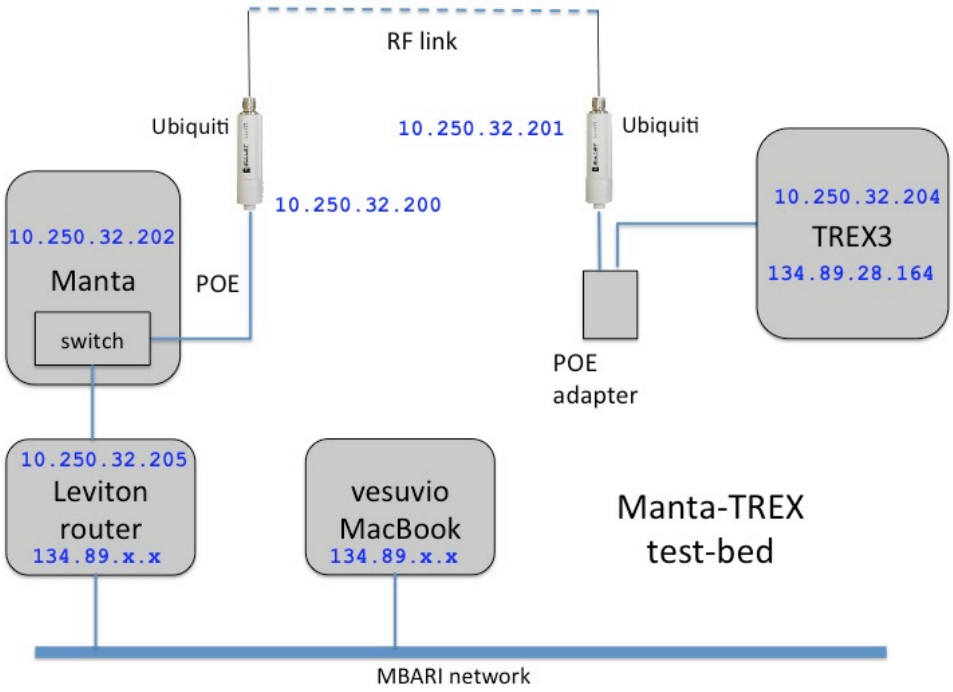
In-Lab Configuration

We first wanted to test installation and networking procedures before working with the actual Dorado vehicle. To this end we set up a Manta-Dorado test-bed in Building G, using computer "trex3" as a stand-in for the Dorado vehicle TREX computer (which is "trex2"). trex3 hardware, operating system, and installed applications are nearly identical to those of trex2. Equipment included the following:

- Manta gateway
- Ubiquiti radios (2)
- trex3 linux machine
- Leviton router
- POE adapter

For safety reasons, we set the radio output power to 12 dBm for these indoor tests.

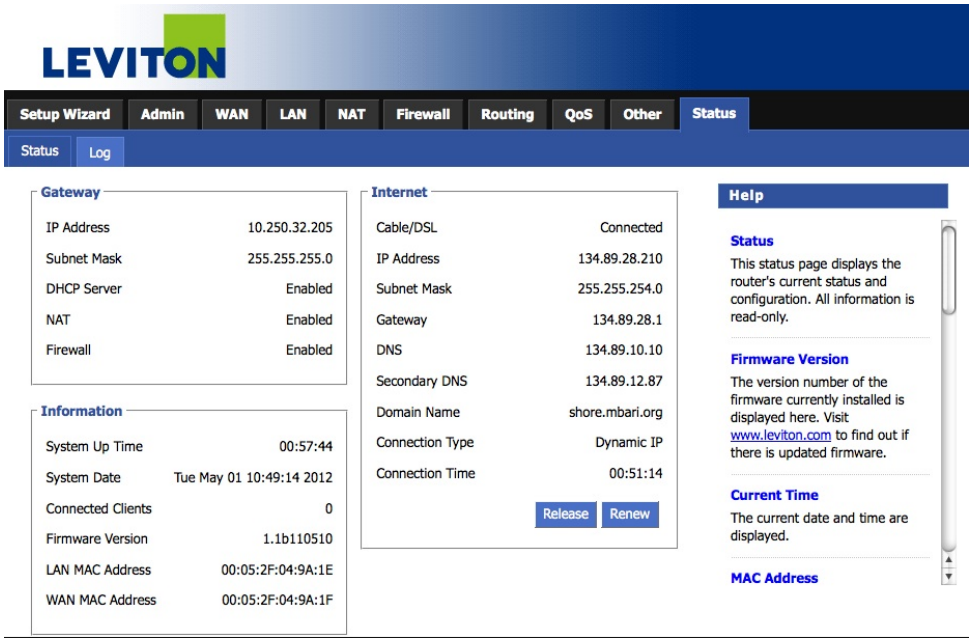
Our intent was to build a network similar to what we plan for at-sea tests. The components were connected as shown below. We assigned static addresses throughout, except for the Leviton router 134.89.x.x address, which was assigned by DHCP.



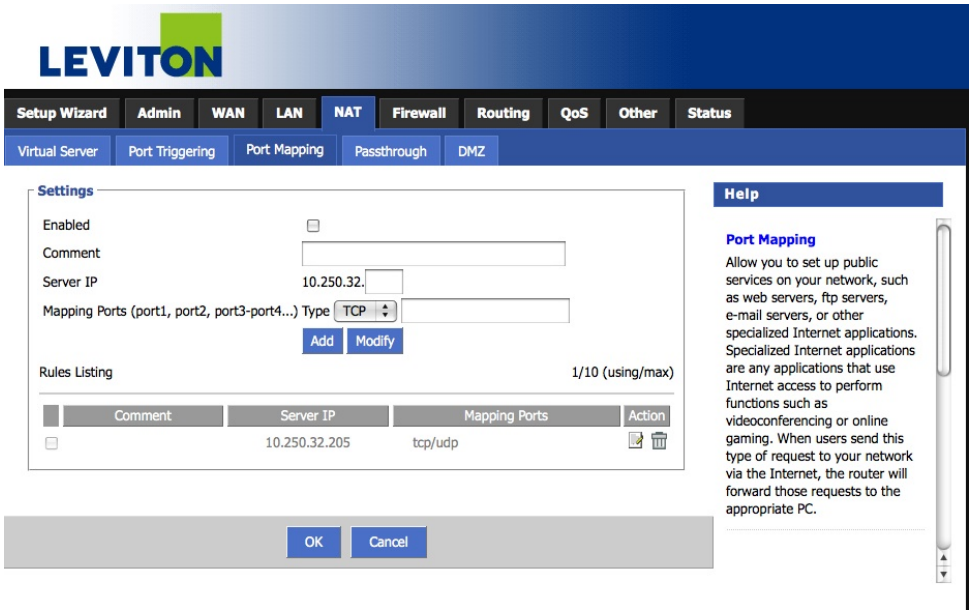
Note that trex3 has two addresses; a 134.89.x.x address (per current operations) and a 192.168.2.5 address, for connection to the Ubiquiti radio. The 192.168.2.5 address was assigned as an "IP alias" with the Linux ifconfig command:

```
/sbin/ifconfig eth0:1 192.168.2.5
```

Below are setup configuration parameters of the Leviton router:



Leviton router status



Leviton NAT configuration; allows WAN to connect to Manta
In addition, we registered the Leviton router with dyndns.org to enable DDNS look-up of its IP address. The router's name is mbari-dtn0.dyndns.org.
NOTE: However the VSAT IP address is apparently not routable to incoming traffic, unless a static IP address is purchased - thus shore cannot "push" data to the ship. Instead, we'll "pull" data from shore to ship with rsync over DTN.

At-Sea Test Configuration

The at-sea test configuration diagram is available at https://oceana.mbari.org/confluence/download/attachments/18579458/10020806-E_+DTNFieldTest.pdf

Computers in the above diagram play roles as described below.

trex (onboard Dorado):

- Sends log files to shore (odss-staging) via dtncp

- Runs dtncpd to receive files from vesuvio

Setup: Start dtnd, dtncpd at boot

vesuvio (onboard ship)

- Periodically runs DTN-proxied rsync client to exchange files with shore (odss-staging) in uplink/ and downlink/ directories
- Routes trex packets sent to shore via dtncp

odss-staging (on shore)

- Runs dtncpd to receive files from trex
- Hosts uplink/ and downlink/ directories for synchronization with vesuvio via DTN-proxied rsync

Setup: Start dtnd, dtncpd at boot

DTN at-sea test checklist

This page last changed on May 15, 2012 by oreilly.

Equipment:

Laptop 'vesuvio'

Manta gateway

Leviton router

Freewave radio

Procedure: setup

Plug VSAT cable into Leviton WAN port

Plug ship network cable into Leviton LAN port

Plug Manta into Zephyr router

Plug vesuvio laptop into Zephyr router

On vesuvio:

open System Preferences -> Network; verify that Location is set to "DTN"Start ping-to-shore log

verify route from vesuvio to trex (aka dtn-trex)

Start ping-to-vehicle log

Start ping-to-shore log

Start dtnd

Start dtncpd

Verify satellite connection on VSAT panel; verify proper manta static address in shore.dtn.conf on odss-staging

On odss-staging:
Start dtnd
Start dtncpd

Procedure: during test

Prior to vehicle surfacing: transfer sequentially-numbered mock mission file from shore to trex via dtncp - execute as dtnuser@odss-staging:

```
dtncp --expiration 86400 ~/mydtn/outgoing/mission_n.txt dtn://trex.dtn
```

where 'n' is surfacing sequence number.

During vehicle surfacing, verify telemetry file transfer from trex to shore - execute as dtnuser@odss-staging:

```
ls ~/mydtn/incoming/trex.dtn/*.txt
```

Results of the above command should show files dtn_n.txt, where 'n' is the leg sequence number. Note that files grow in size for each leg, so there may be delay for large files.

Cheat-sheet

On trex and shore machine, DTN files are kept in directory ~/mydtn

On vesuvio laptop, DTN stuff is in O'Reilly's account. Configuration files are in ~/mbari-dtn (which is a mercurial repository). Other DTN files (logs, etc) are in ~/mydtn.

To mount Manta root filesystem as read-write:

```
mount -o remount,rw /
```

To mount Manta root filesystem as read-only:

```
mount -o remount,ro /
```

To add route from vesuvio to trex, execute this command on vesuvio:

```
sudo route add 134.89.32.39 10.250.32.1 255.255.255.255
```

Satellite static addresses:

```
187.125.171.144   65W - BRAZIL
66.178.119.209    125W - CARIBBEAN
216.245.254.64    105W - CONUS 1 & 2
216.147.147.186   37.5W - N. ATLANTIC OCEAN REGION (NAOR)
69.88.13.47       172E - N. PACIFIC OCEAN REGION
```

References

This page last changed on Jan 23, 2012 by chma.

DTN Research Group References and DTN2 implementations

http://www.dtnrg.org/docs/code/DTN2/doc/manual/ Detailed information on DTN2, the current reference implementation of DTN. The section on the DTN2 API details all of the functions needed to code an application which interfaces to the DTN2 protocol at a fairly low level.

http://www.rfc-editor.org/rfc/rfc5050.txt reference for DTN2 message (bundle) specifications.

http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5733227&tag=1 Porto Group paper on implementing DTN2 and developing Convergence Layer
Adapter (CLA) for the WHOI MicroModem.

Trinity College Dublin DTN implementation

http://www.n4c.eu/Download/n4c-tcd-007-d4_1-FINAL.pdf Description of installing and configuring a DTN node with some good examples of how to use DTN2 without modifying the underlying code.

IBR-DTN implementation

http://www.ibr.cs.tu-bs.de/projects/ibr-dtn/
Website of the German Institut für Betriebssysteme und Rechnerverbund (IBR) DTN implementation.

http://journal.ub.tu-berlin.de/eceasst/article/view/512 Detailed paper describing the IBR-DTN implementation designed for embedded systems.

http://tools.ietf.org/html/draft-irtf-dtnrg-tcp-clayer-02 This document describes the protocol for the TCP-based Convergence Layer Adapter (CLA) for Delay Tolerant Networking (DTN).

Postellation implementation

http://www.ietf.org/proceedings/79/slides/DTNRG-3.pdf

Misc.

http://www.ipnsig.org/reports/DTN_Tutorial11.pdf

.bookmarks

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