



GPS Trackers & Iridium OpenPort

Roy Stehle

SRI International
Center for GeoSpace Studies
Menlo Park, CA 94025
roy.stehle@sri.com 650-859-2552

***Polar Technology Conference
Boulder, CO
25 & 26 March 2010***

GPS Trackers

□ Safety

- **An additional informational tool in emergencies**
- **Does not require operator activation**

□ Logistics

- **Tracking of assets (e.g., vehicles, boats)**
- **Informative of deviation from research itinerary**

GPS Trackers – Proof of Concept

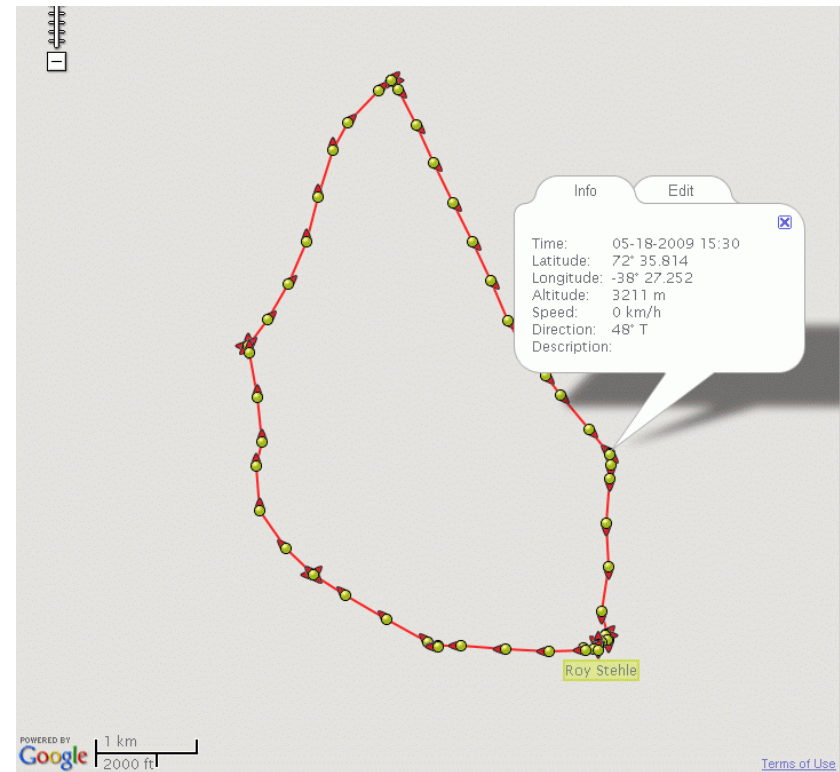
- May 2009 loaner units tested at Summit Station



IonEarth



SpiderTracks

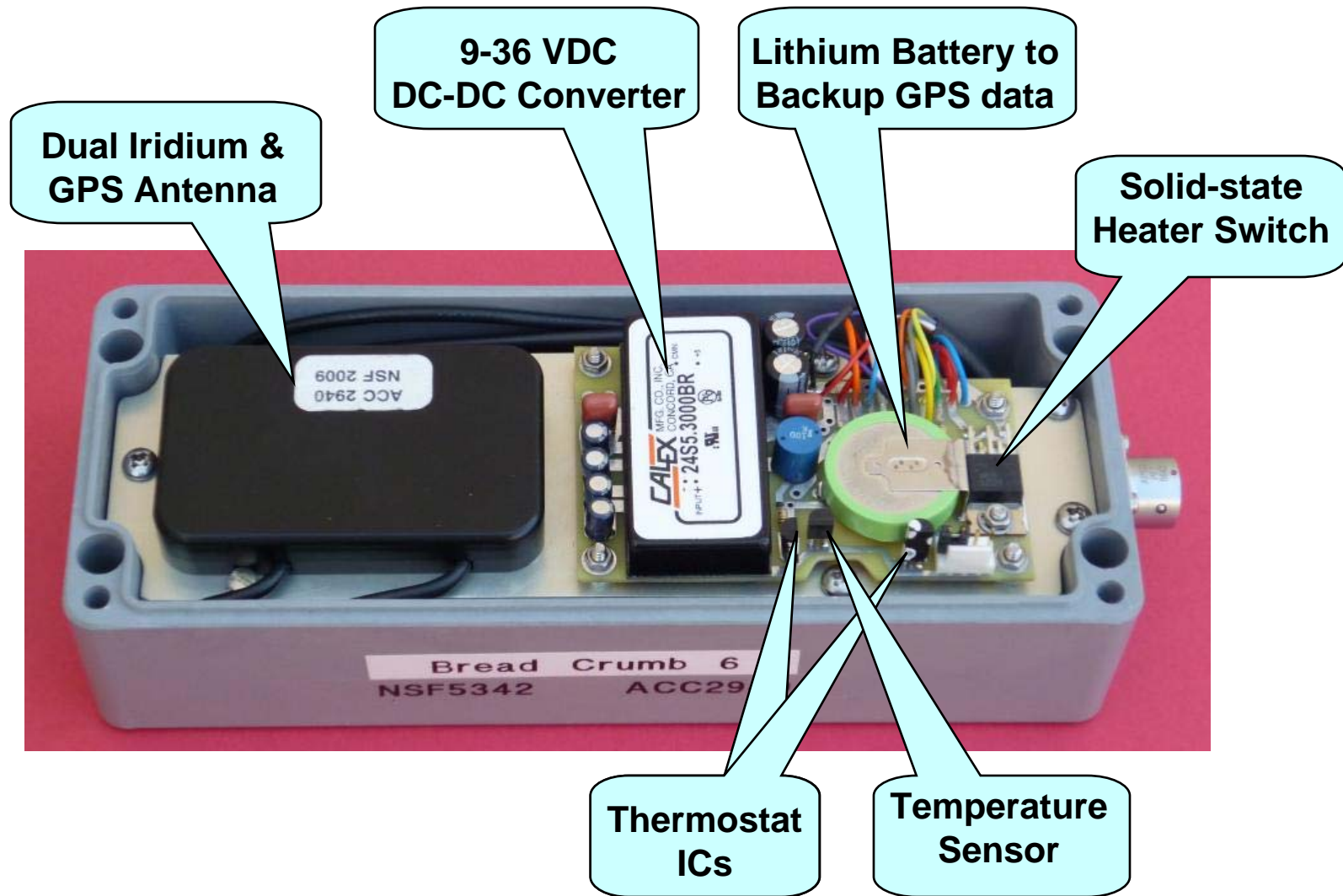


SRI's "Bread Crumb" Tracker

- ❑ **Commercial components for a quick response**
 - **NAL Research GPS Tracker and antennas**
- ❑ **Weatherproof housing for installation on snowmachines**
- ❑ **12 VDC vehicle power**



Bread Crumb Construction



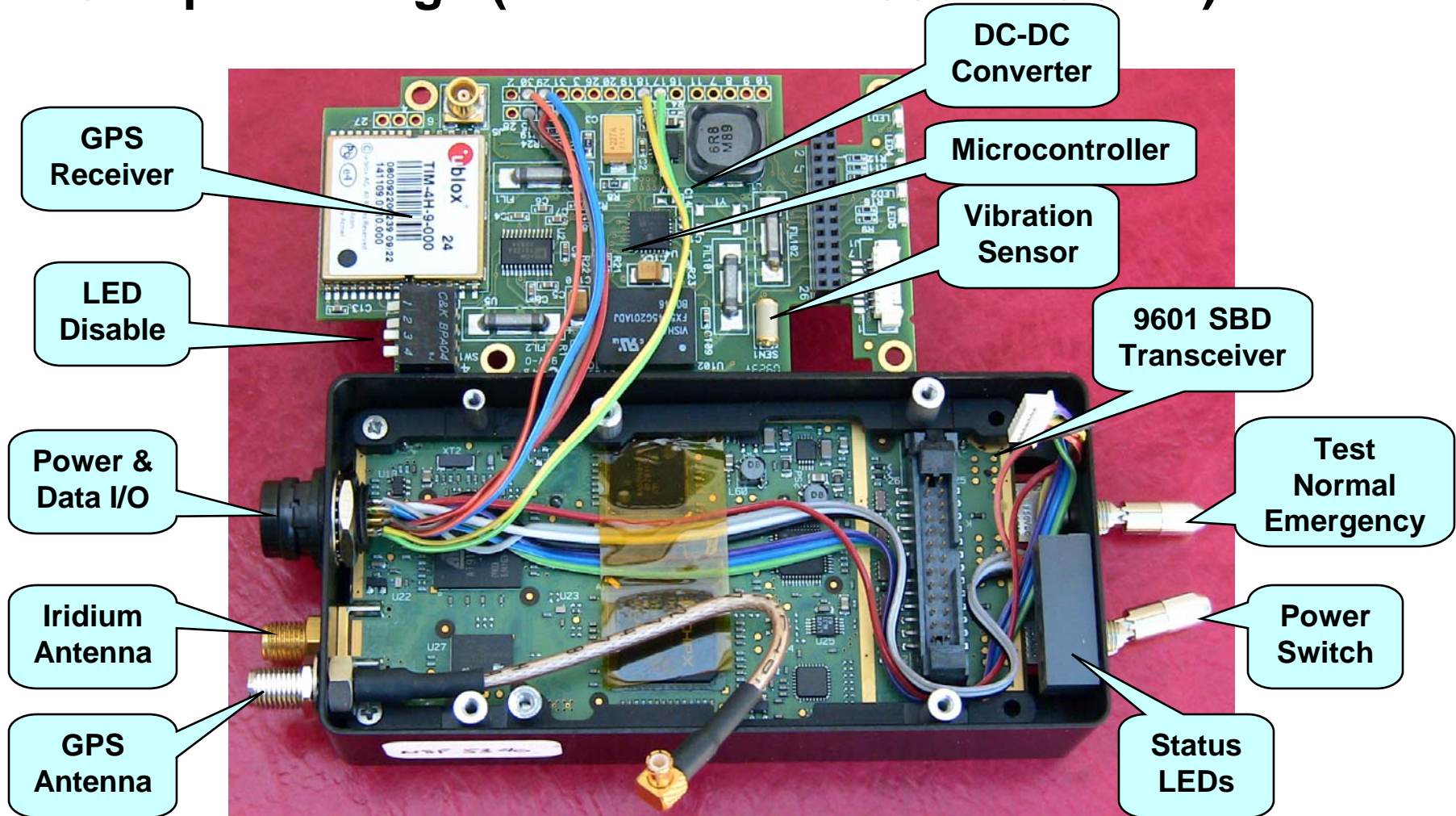
Bread Crumb Construction (cont')



GPS Receiver & Iridium Transceiver

GPS Tracker Component

Compact Design (NAL Research 9601-DGS-LP)



9601-DGS-LP Limitations



- ❑ **No clear text message option – only proprietary format**
 - Requires NDA to obtain compression formatting information
 - NAL Research provides a decoding program without an NDA, but only for Windows OS; SRI has developed a Linux decoder, but constrained by NDA
- ❑ **No backup battery for GPS ephemeris; always does a Cold Start even if programmed for “Always On”**
- ❑ **Buffering of GPS records only possible if intervals are greater than 3 minutes**
- ❑ **9601 firmware TD09003 or higher not usable with DOD allocation**
- ❑ **Potential problem in NAL microcontroller code**
 - Unit sometimes does not waken from “sleep” mode

Ski-Doo Installation



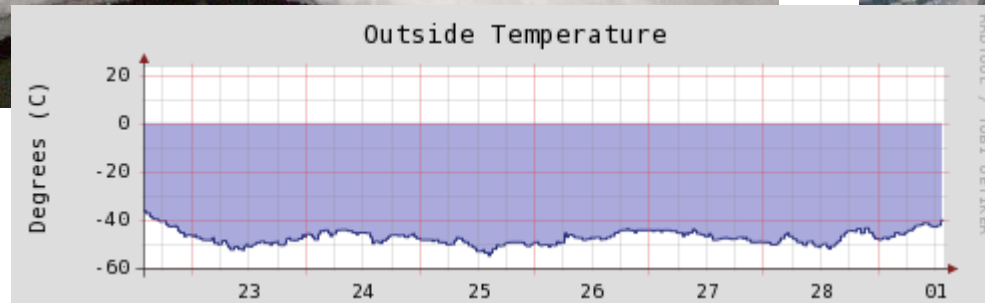
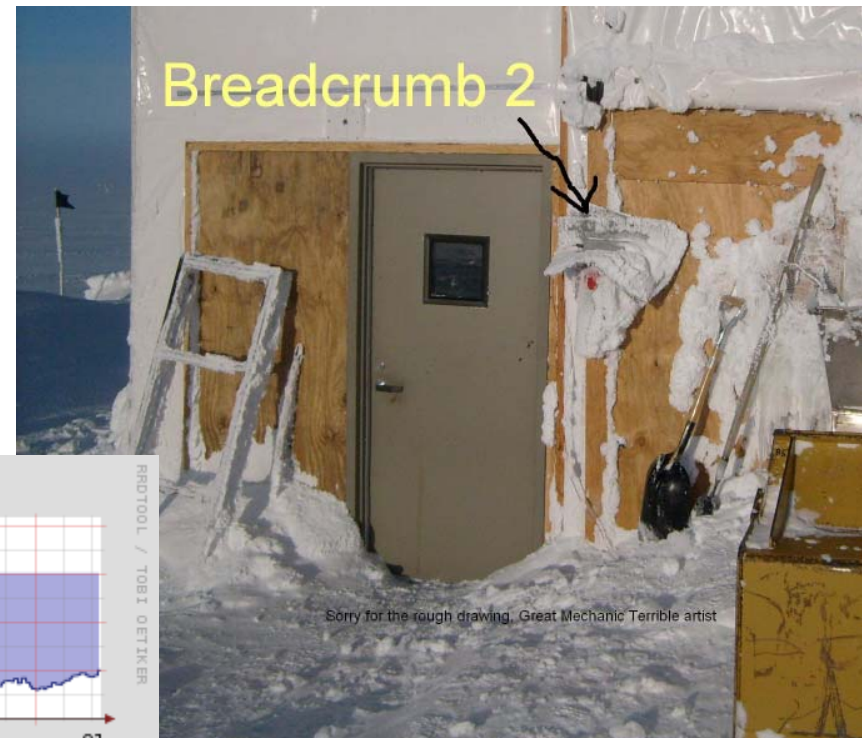
Summit Station, Greenland

Greenland Inland Traverse

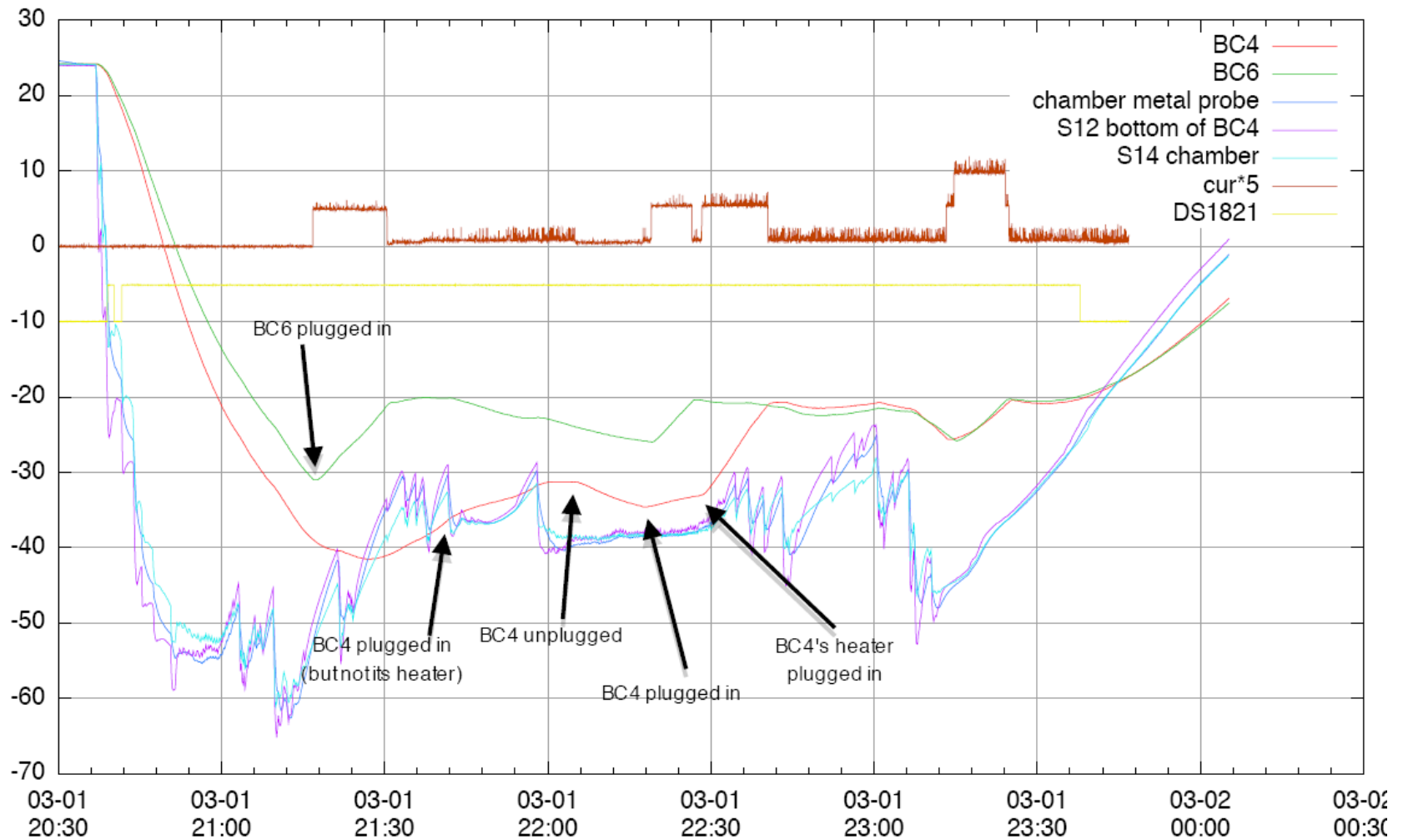


Prototype Units at Summit Station

- ❑ Operational performance testing while snowmachines were not in use
- ❑ Power dissipation causes 5° C internal temperature rise over ambient



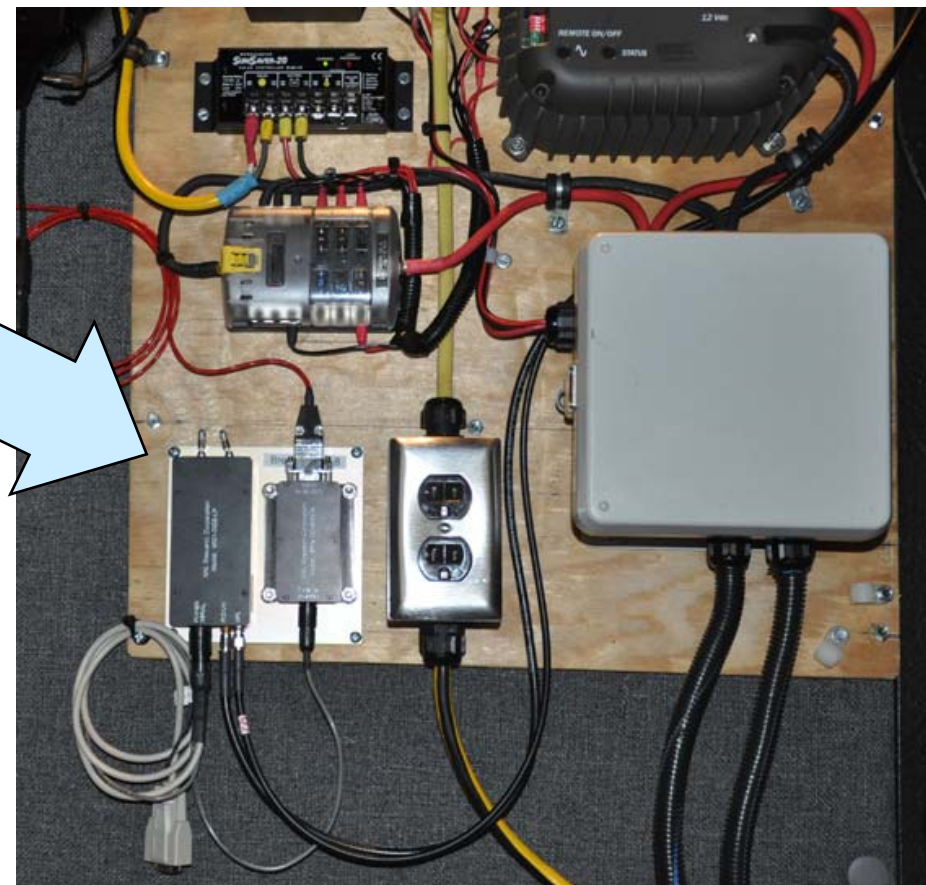
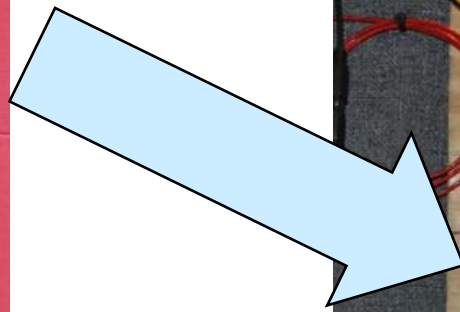
Temperature Testing w/ Thermostat



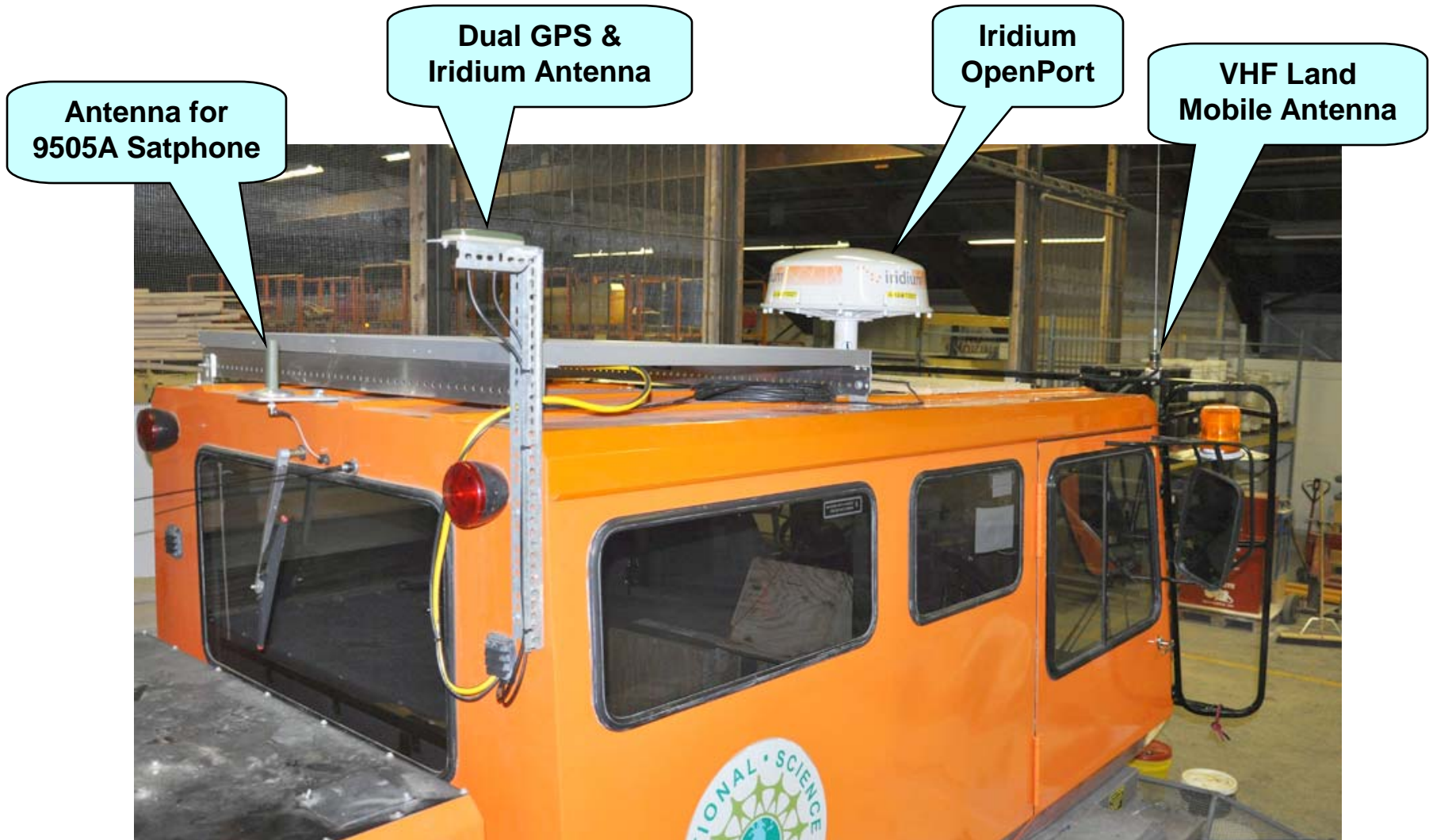
GPS Tracker Mounted in Tucker



- Mounted on interior side wall



Installation on Tucker Sno-Cat



Web Display (under development)

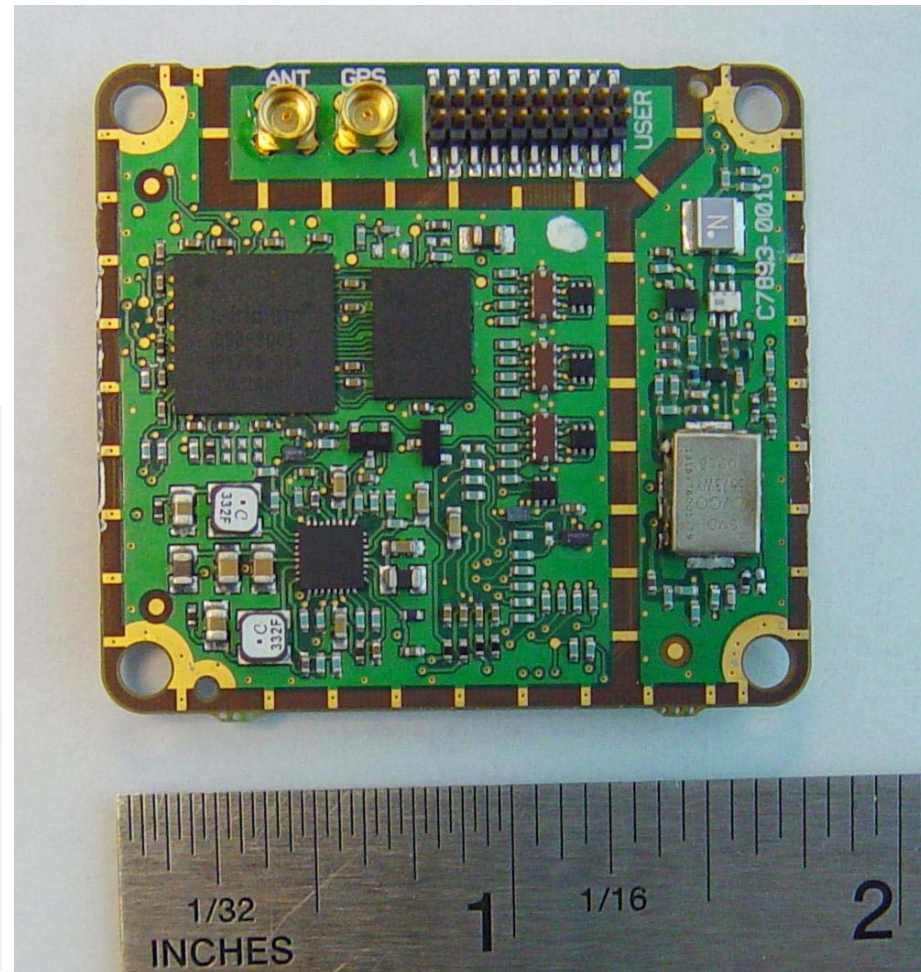
- ❑ Present location
- ❑ Bread crumb trails
- ❑ Retrieval of past tracks
- ❑ Waypoints & registered satellite photos

Copyright 2009 SRI International

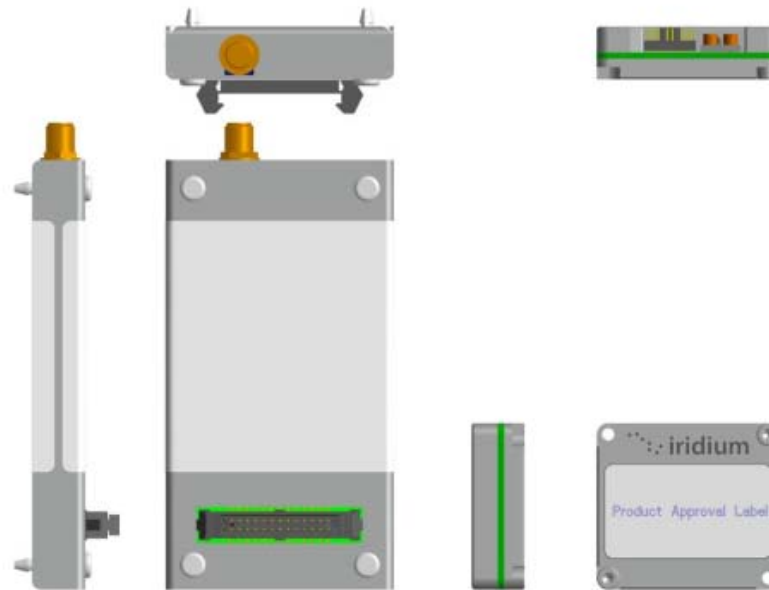
ID	Tracker	Vehicle	Timestamp (UTC)	Motion	Latitude	Longitude	Altitude (m)
2	BreadCrumb 2	Snow machine Heide	2010-03-15 18:42:31	false	72 34' 50"	-38 27' 30"	3202
3	BreadCrumb 3	Snow machine	2010-01-17 19:07:41	true	37 27' 17"	-122 10' 34"	9
4	BreadCrumb 4	Snow machine	2010-03-21 09:49:28	false	76 24' 46"	-68 18' 24"	496
5	BreadCrumb 5	Snow machine	2010-03-23 16:01:14	false	76 24' 47"	-68 18' 22"	490
6	BreadCrumb 6	Snow machine	2010-03-24 16:19:55	false	76 22' 54"	-67 49' 30"	810
7	BreadCrumb 7	Snow machine	2010-03-24 15:55:47	false	37 27' 17"	-122 10' 35"	11
8	BreadCrumb 8	Tractor (Tucker)	2010-03-24 16:20:36	false	76 22' 54"	-67 48' 50"	796
9	BreadCrumb 9	Tractor (Case)	2010-03-03 16:43:30	false	37 27' 17"	-122 10' 34"	40
10	HomeBrew 1		2010-03-24 13:27:57	false	37 27' 16"	-122 10' 33"	0

9602 GPS Tracker

- Commercial begin deliveries in June 2010



9601 to 9602 Comparison



9601

Basic Specification

Length: 106.4 mm

Width: 56.2 mm

Height: 13 mm

Weight: 117 g

Operating Temperature: -35 °C to 70 °C

Storage Temp: -40 °C to 85 °C

Main input voltage: 5.0 VDC 0.5 VDC

9602

Basic Specification

Length: 45 mm

Width: 41 mm

Height: 13 mm

Weight: ~75 g

Operating Temperature: -40 °C to 85 °C

Storage Temp: -40 °C to 85 °C

Main input voltage: 5.0 VDC 0.5 VDC

Iridium OpenPort



Above Deck Equipment (ADE)

- ❑ No moving parts
- ❑ Height: 9.1 in (230 mm)
- ❑ Diameter: 22.5 in (570 mm)
- ❑ Weight: 24.3 lb (11 kg)
- ❑ Single CAT-5 cable POE

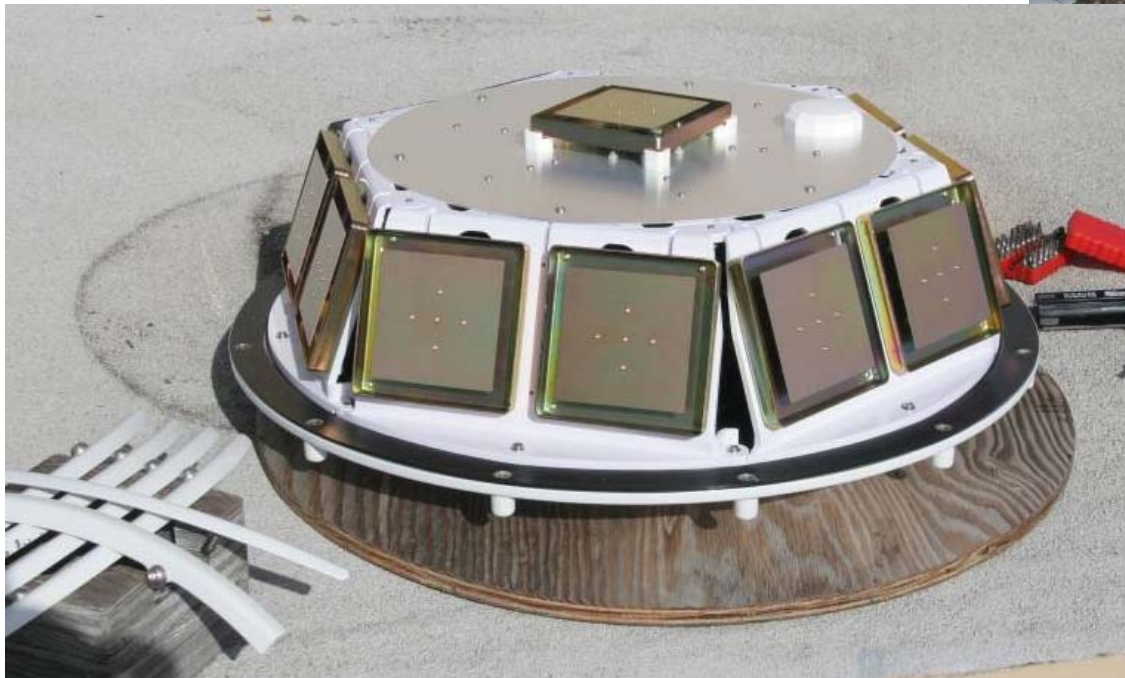


Below Deck Equipment (BDE)

- ❑ IP-based 9.6 – 128 kbps
- ❑ Per megabyte pricing
- ❑ Ethernet port
- ❑ 3 independent RJ11 phone jacks simultaneous w/ data
- ❑ 7.8 x 9.8 x 2.2 inches
- ❑ 3 lbs (1.35 kg)
- ❑ 120/220 V, 50-60 Hz

Above Deck Equipment (ADE)

- ❑ 13 Iridium antenna
- ❑ Antenna combiner and logic under modular cover
- ❑ GPS antenna



Iridium OpenPort Deployments

- ❑ **Greenland Traverse 2008 - 2010**
 - Use on-the-move; omnidirectional
 - IP-based; easy interface; 128 kbps
- ❑ **Project Camp at Alert**
- ❑ **On-board USCGC *Healy***
- ❑ **Support for 6 units on USCGC *Healy*, *Polar Sea*, *Polar Star***
- ❑ **GoNorth! dog sled traverse**
- ❑ **Iridium has activated >1000 units**



Enhanced Bandwidth

- Utilizes adjacent channels with enhanced modem
 - 16 channels provide 128 kbps; 8 channels provide 64 kbps
 - Uses all 4 timeslots per channel
 - » Modulation efficiency of 3.33 compared to bonded modems
 - 9.6 kbps is minimum data rate

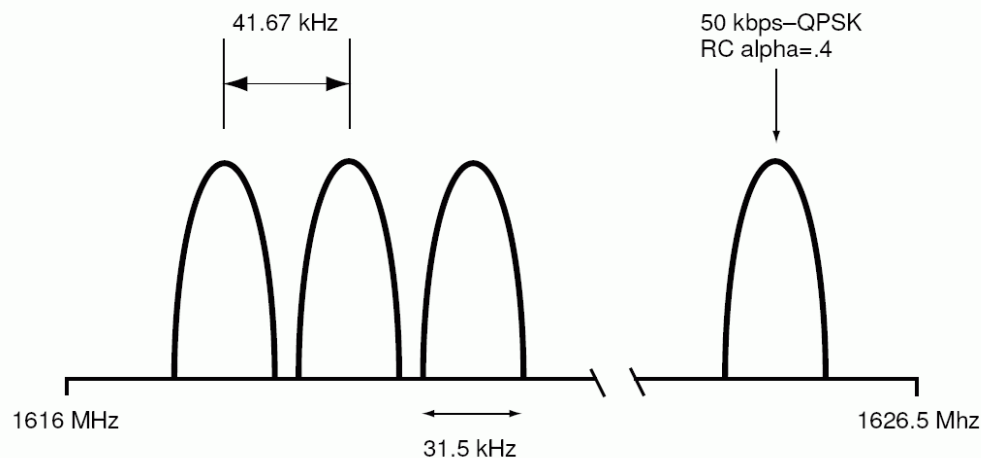


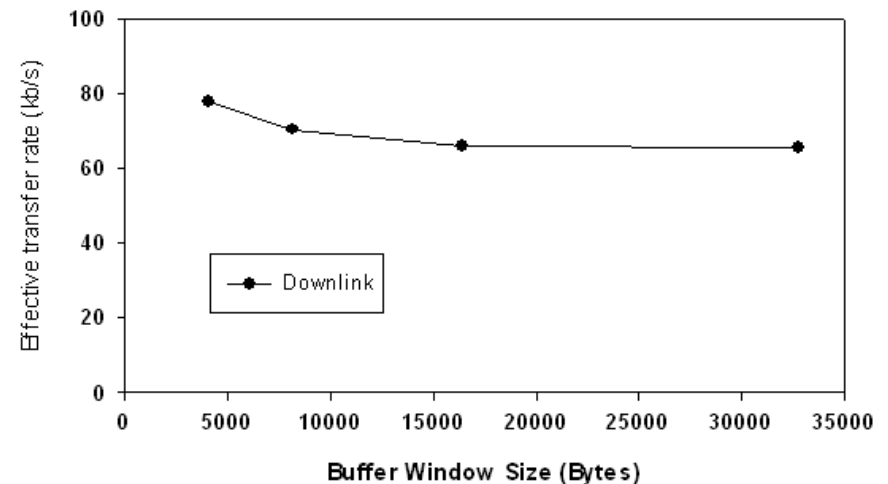
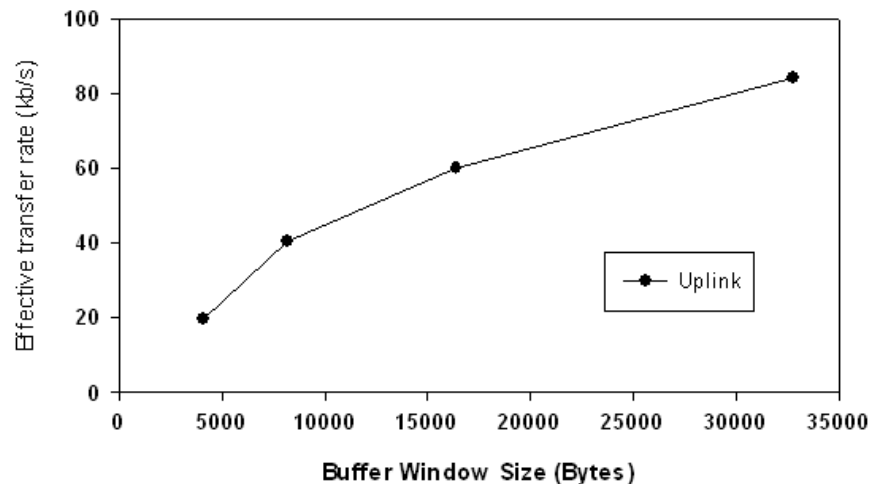
Figure 2-6 FDMA Frequency Plan

Table 1-1 Sub-Band Frequency Allocation

Sub-band	Lower Edge (MHz)	Upper Edge (MHz)
1	1616.000000	1616.333333
2	1616.333333	1616.666667
3	1616.666667	1617.000000
4	1617.000000	1617.333333
5	1617.333333	1617.666667
6	1617.666667	1618.000000
7	1618.000000	1618.333333
8	1618.333333	1618.666667
9	1618.666667	1619.000000
10	1619.000000	1619.333333
11	1619.333333	1619.666667
12	1619.666667	1620.000000
13	1620.000000	1620.333333
14	1620.333333	1620.666667
15	1620.666667	1621.000000
16	1621.000000	1621.333333
17	1621.333333	1621.666667
18	1621.666667	1622.000000
19	1622.000000	1622.333333
20	1622.333333	1622.666667
21	1622.666667	1623.000000
22	1623.000000	1623.333333
23	1623.333333	1623.666667
24	1623.666667	1624.000000
25	1624.000000	1624.333333
26	1624.333333	1624.666667
27	1624.666667	1625.000000
28	1625.000000	1625.333333
29	1625.333333	1625.666667
30	1625.666667	1626.000000

OpenPort Bandwidth Testing

- ❑ Large latencies impact TCP protocols
- ❑ Data files transfer at 128 kbps, but protocol handshakes reduce the effective datarate
- ❑ Large buffer window (e.g., 32,768 bytes) improves throughput by reducing handshakes
- ❑ Large files have higher effective throughput



Port Forwarding & Redirection

- ❑ Tested with:
 - FTP
 - Telnet
 - SSH
 - VPN
- ❑ Some implementation problems remain

configuration

This page allows configuration of the unit.

LAN IP Configuration

IP address: 192 168 0 1

Subnet Mask: 255 255 255 0

Use as DHCP Server:

Starting IP address: 192 168 0 2

Update IP Configuration

Port Forwarding Configuration

Rule #	External Port	Internal Port	IP Address	Protocol
1	21	21	192.168.0.100	TCP

Add Rule Edit Rule Delete Rule

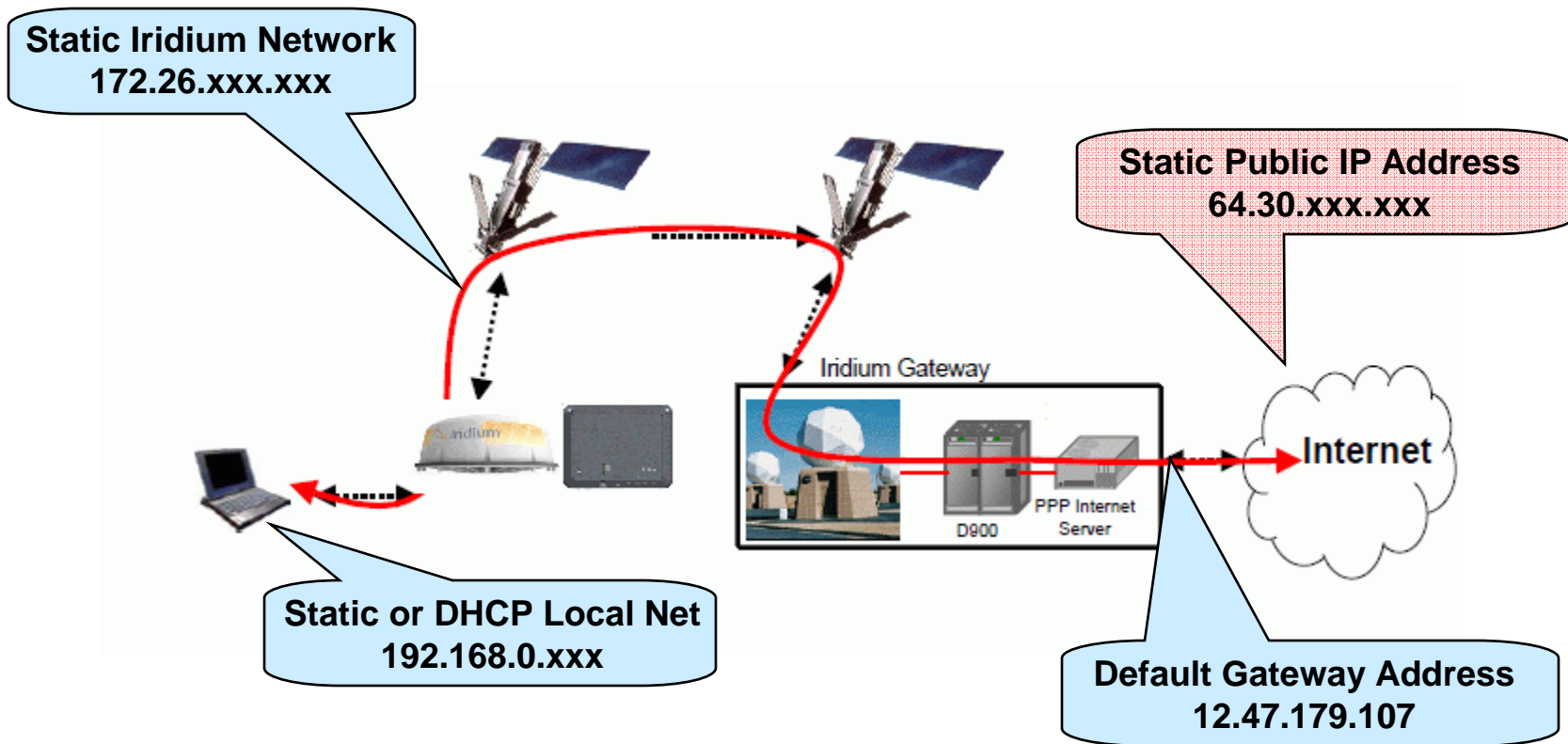
Location: USA, Canada

Update localisation settings

Copyright Iridium Satellite LLC 2008

OpenPort Static Public IP Address

- ❑ Implemented starting with firmware AO09010
- ❑ \$36 per month
- ❑ Not available from all Service Providers



Firewall at Service Provider POP

- ❑ **Implementation by SatCom Global**
- ❑ **Based on an Inmarsat implementation**
- ❑ **Flexible set of rules**
 - **Avoids Denial of Service Attacks**
 - **Stops charges from Port Scanners or undesired use (e.g., YouTube)**

