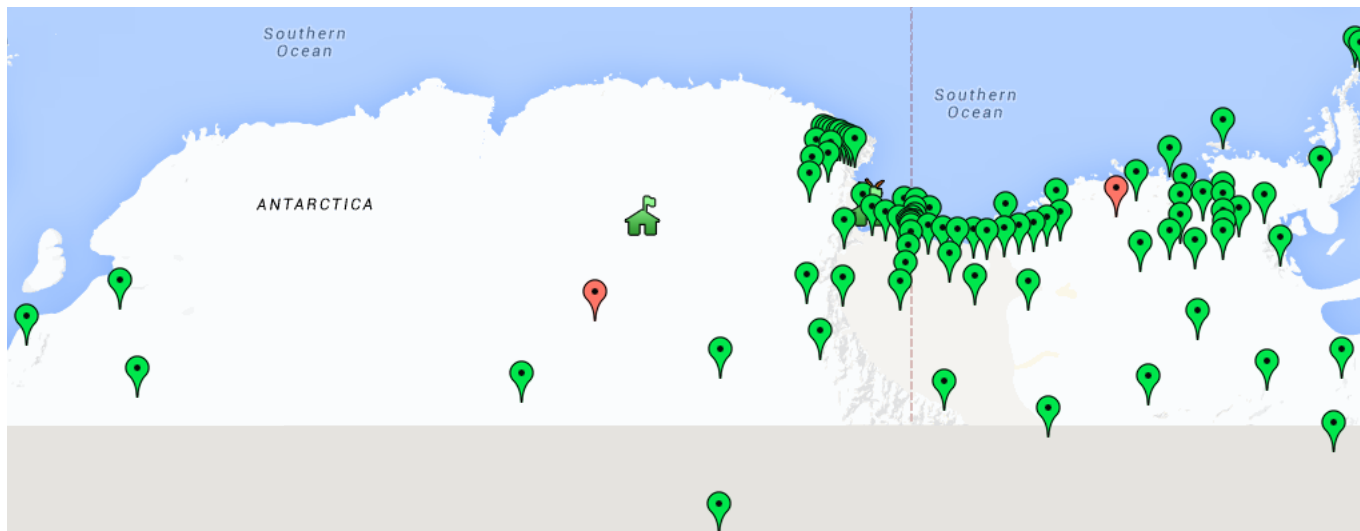


Low Power World Wide Telemetry

Paul Carpenter

4/28/2015

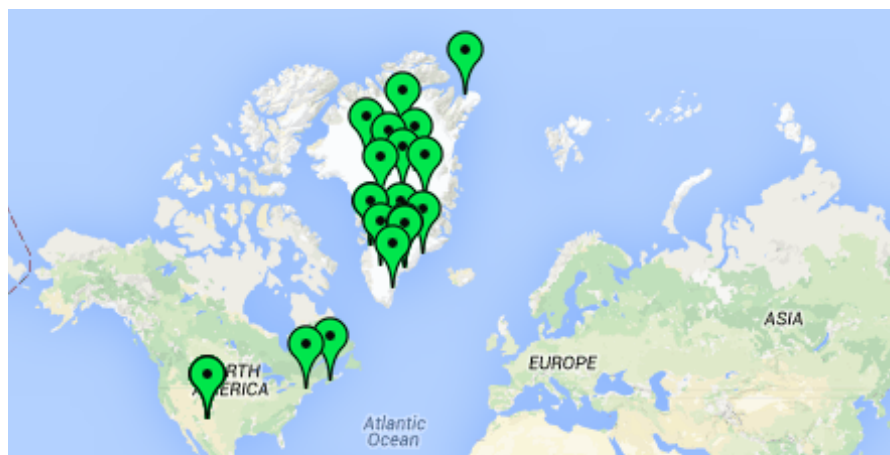
Current Polar Stations with Telemetry



133 Telemetered Stations

XI-202 - 65

XI-100(b) - 68



SOH Only Telemetry

XI-202 Iridium modem

SIM-less

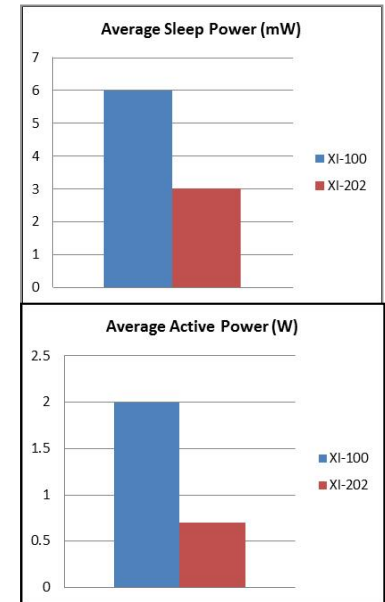
Low cost command & control plus SOH ~\$2000

Interfaces with the Q330 and weather stations

RT130 & Meridian integration possible

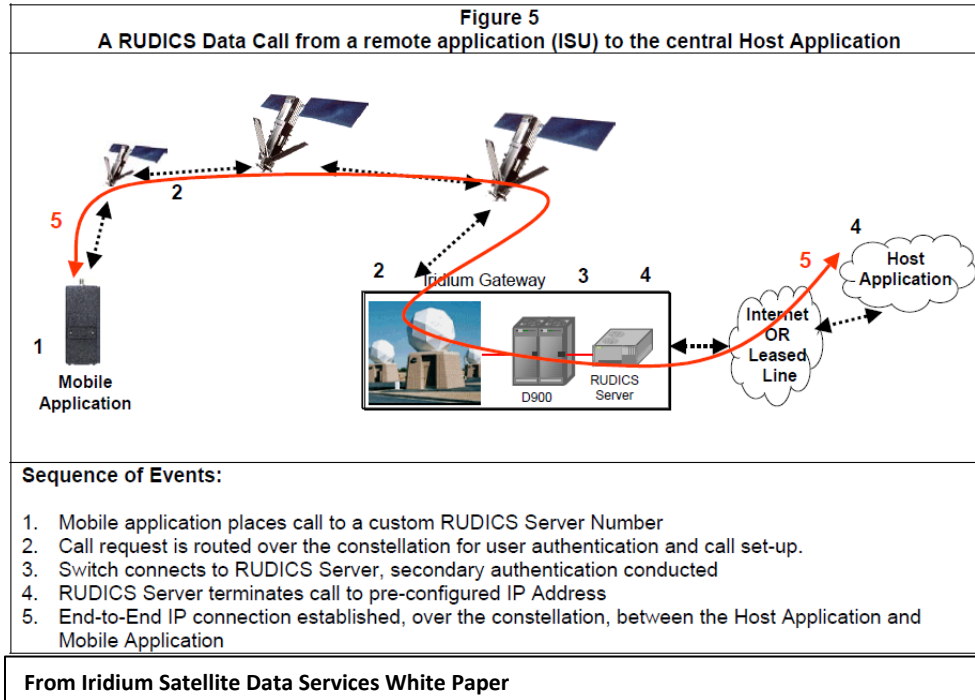
Power/logic control of external device

70 deployed in the Arctic & Antarctica



RUDICS

RUDICS – Router-Based Unrestricted Digital Internetworking Connectivity Solutions



Single host application interfacing with many field devices

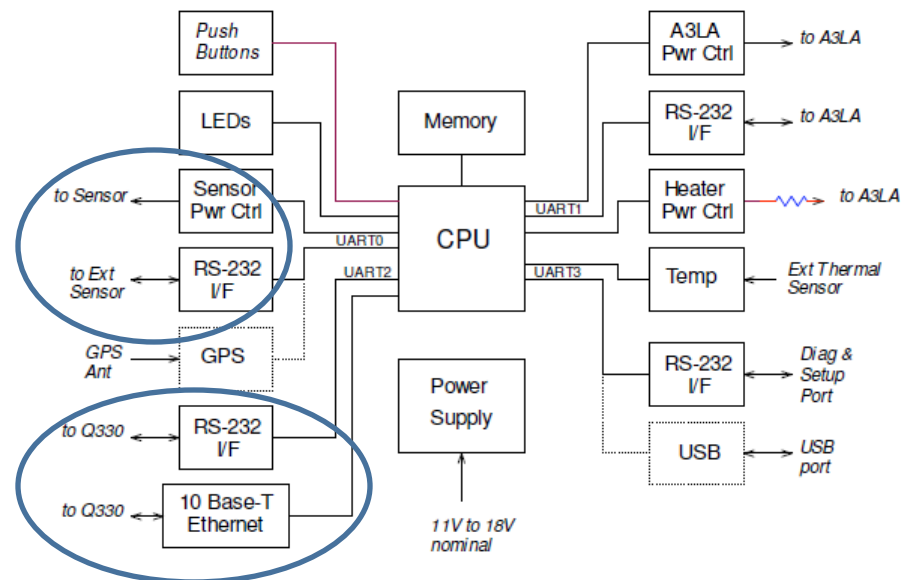
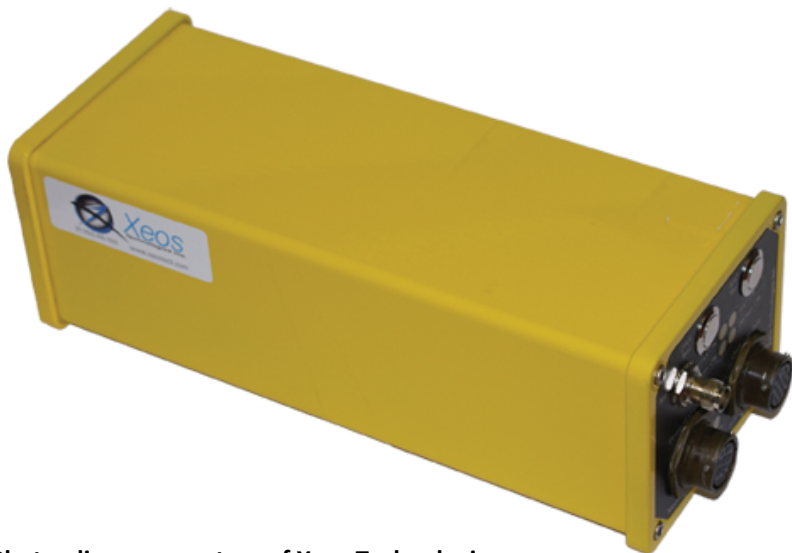
Data calls to and from a specific IP Address

Full two way communications (full duplex)

300 Bytes/s data rate allows for 1MB/hour of real time data

RUDICS - Hardware

XI-100 Iridium terminal manufactured by Xeos Technologies Inc – IRIDIUM VAR



Photo, diagram courtesy of Xeos Technologies

- Optimized for polar operation – very low standby current (450uA), integrated heater allows for transmission of data down to -55°C.
- Can interface with datalogger via Ethernet or Serial RS-232
 - Can interface with an additional “External Sensor”
 - Provides power and transmission of data, currently supporting WX520 weather station

RUDICS - Hardware

Xeos tunnel application – provides interface between host application and field devices. Turns a remote, complex network into a LAN. Tunnel can run user scripts allowing automated data acquisition.

rudics.passcal.nmtedu:8888

Xeos
Technologies Inc.



Wed 9 Apr 14 :: 8:36:03 pm

Status View Logs Q330 Shutdown

id	Name	Status	Last Connected	Last Disconnected	Rx/Tx	V/I/RSSI	
8	UPPA.modem.150	Active	09-04-2014 07:14:27 PM	09-04-2014 07:35:10 PM	74 KB / 2431 KB	13.17 V / 32 C / 5	Details Restart
9	SOEG.modem.151	Active	09-04-2014 08:32:31 PM	09-04-2014 08:31:30 PM	190 KB / 6711 KB	13.84 V / 19 C / 4	Details Restart
10	HEL1.modem.181	Active	09-04-2014 07:40:42 PM	09-04-2014 07:42:46 PM	7 KB / 1087 KB	10.71 V / 17 C / 5	Details Restart
11	NE2.149	Active	n/a	n/a	0 KB / 0 KB	13.52 V / -17 C / 5	Details Restart
12	ICESG.modem.192	Active	09-04-2014 07:06:32 PM	09-04-2014 07:01:06 PM	4 KB / 0 KB	14.4 V / -11 C / 5	Details Restart
13	DY2G.modem.143	Active	09-04-2014 07:41:43 PM	09-04-2014 07:40:46 PM	6 KB / 1346 KB	14.47 V / -3 C / 5	Details Restart
14	NEEM.modem.144	Active	09-04-2014 07:40:59 PM	09-04-2014 07:43:01 PM	5 KB / 1179 KB	14.05 V / -18 C / 5	Details Restart
15	JAK.modem.180	Inactive	n/a	n/a	0 KB / 0 KB	0.0 V / 12 C / 0	Details Restart
16	RIS3.modem.117	Inactive	n/a	n/a	0 KB / 0 KB	0.0 V / -8 C / 0	Details Restart
17	PIC1.modem.135.POKER.FLAT	Active	09-04-2014 08:05:18 PM	09-04-2014 08:03:39 PM	164 KB / 5520 KB	13.84 V / 24 C / 5	Details Restart
18	RUDI.modem.179	Active	09-04-2014 08:35:44 PM	09-04-2014 08:34:10 PM	258 KB / 10414 KB	13.2 V / 41 C / 5	Details Restart
19	ICES2.modem.206	Active	n/a	n/a	0 KB / 0 KB	12.83 V / -21 C / 5	Details Restart
20	BRRP.modem.145	Active	n/a	n/a	0 KB / 0 KB	12.88 V / 25 C / 5	Details Restart
21	NOR.modem.178	Active	09-04-2014 08:03:36 PM	09-04-2014 08:02:11 PM	256 KB / 6755 KB	13.31 V / -5 C / 5	Details Restart
22	ICES1.modem.205	Active	n/a	n/a	0 KB / 0 KB	12.78 V / -24 C / 5	Details Restart
23	B44.access.new.rudics.cfg	Inactive	n/a	n/a	0 KB / 0 KB	0.0 V / 28 C / 0	Details Restart
24	DBG.modem.142	Active	09-04-2014 08:13:15 PM	09-04-2014 08:11:37 PM	164 KB / 6075 KB	13.44 V / 7 C / 5	Details Restart
25	NE1.207	Active	n/a	n/a	0 KB / 0 KB	13.39 V / -33 C / 5	Details Restart
26	modem.208	Inactive	n/a	n/a	0 KB / 0 KB	0.0 V / 25 C / 0	Details Restart
27	NE3.209	Active	n/a	n/a	0 KB / 0 KB	13.6 V / -19 C / 5	Details Restart
31	NE4.210	Active	n/a	n/a	0 KB / 0 KB	13.65 V / -18 C / 5	Details Restart
32	NE5.211	Active	n/a	n/a	0 KB / 0 KB	13.68 V / -18 C / 5	Details Restart
33	NE6.212	Active	n/a	n/a	0 KB / 0 KB	12.88 V / -12 C / 5	Details Restart
34	SE1.213	Active	n/a	n/a	0 KB / 0 KB	13.55 V / -34 C / 5	Details Restart

[Add New Site](#) [Restart All](#)

Modem on and transmitting data

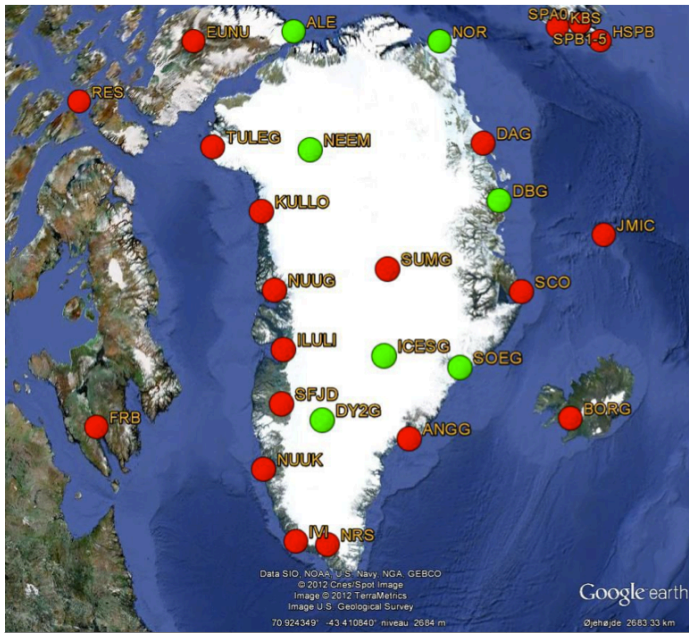
Modem standby



RUdics TUnnel Software (RUTUS)

- Web interface developed by Xeos Technologies Inc. to improve and ease the configuration, control and data throughput of Xeos modems.
 - Old tunnel developed as a prototype. Was slow to use, buggy and offered limited diagnostics.
- Template based configuration for SBD only and RUDICS enabled modems
- Improved data flow and efficiency
- Enhanced command and control of RUDICS including:
 - On/Off for temperature, voltage, data moved, and more!
- Logging of all incoming and outgoing messages and tunnel statistics. All data available for download and analysis
- RUTUS is an ongoing project. The concept and design is general and not specific to seismic data or PASSCAL. The hope is that other groups and facilities can make use of it.
- RUDICS use update:
 - Seven summer time RUDICS sites deployed in Greenland in the Summer of 2014
 - Eleven GLISN sites ran all year with RUDICS and 99% data recovery
 - All data is available to researchers in real time at the IRIS DMC
 - Duty cycled RUDICs development has led to significant power savings

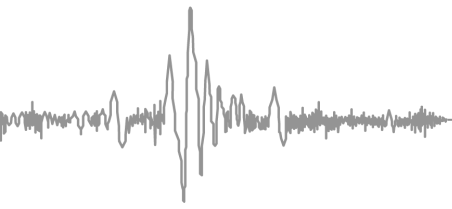
RUDICS – In Field Use



GLISN station with RUDICS

GLISN station with other telemetry system





Current Use

1. Greenland – 15 stations moving up to **20MB/day**
2. Antarctica '13-'14 – 2 stations moving **9MB/day**
3. Poker Flats, Alaska – **9MB/day**

Future Deployments

1. Phase into Antarctic more experiments – ~34 stations

Advantages

1. In depth command and control
2. Real time data acquisition
3. SOH monitoring of devices
4. RUDICS can be turned on/off to conserve power

Current Problems:

1. Complex, inaccessible network makes troubleshooting and bug fixing difficult
 1. DOD black box – networks can be brought down inexplicably.
2. Drop outs, slow link -> difficult to optimize host application

Power Consumption:

1. SOH and 1Hz data on three channels (in the field) – 1.45W
2. SOH and 20Hz on three channels using latest FW (lab testing) – 2W
3. SBD mode (in the field) – 10mW



RUDICS – You can use it!

- Iridium connectivity and real time data transmission need not be complex!
- XI-100 unit currently has great functionality, and much additional functionality that needs more development.
- Unit has been designed to interface with any networked remote device – not specific to seismic or geophysical instrumentation.
 - It is an **Ethernet bridge** of the Iridium Network
 - UNAVCO uses it with GPS receivers

New Data Telemetry

Iridium Pilot

- 134 Kbit/s listed
- Transmitting 1 to 2 hours per day to maintain 100SPS
- 18 to 31 Watts
- 3W to 4W station with power cycling telemetry
- \$6k to \$10k unit target price
- Development and integration cost, <\$20k target
- Not on DOD network
- 1,000 Mb/month - \$1,500/month commercial rate
- 400Mb/month - ~\$600/month commercial rate

Xeos is getting a unit

- Non-funded scoping study for feasibility study
- Determine what is needed for autonomous unit
- Work with PASSCAL engineers
 - Power requirements
 - Data throughput

Iridium NEXT

- ???

