

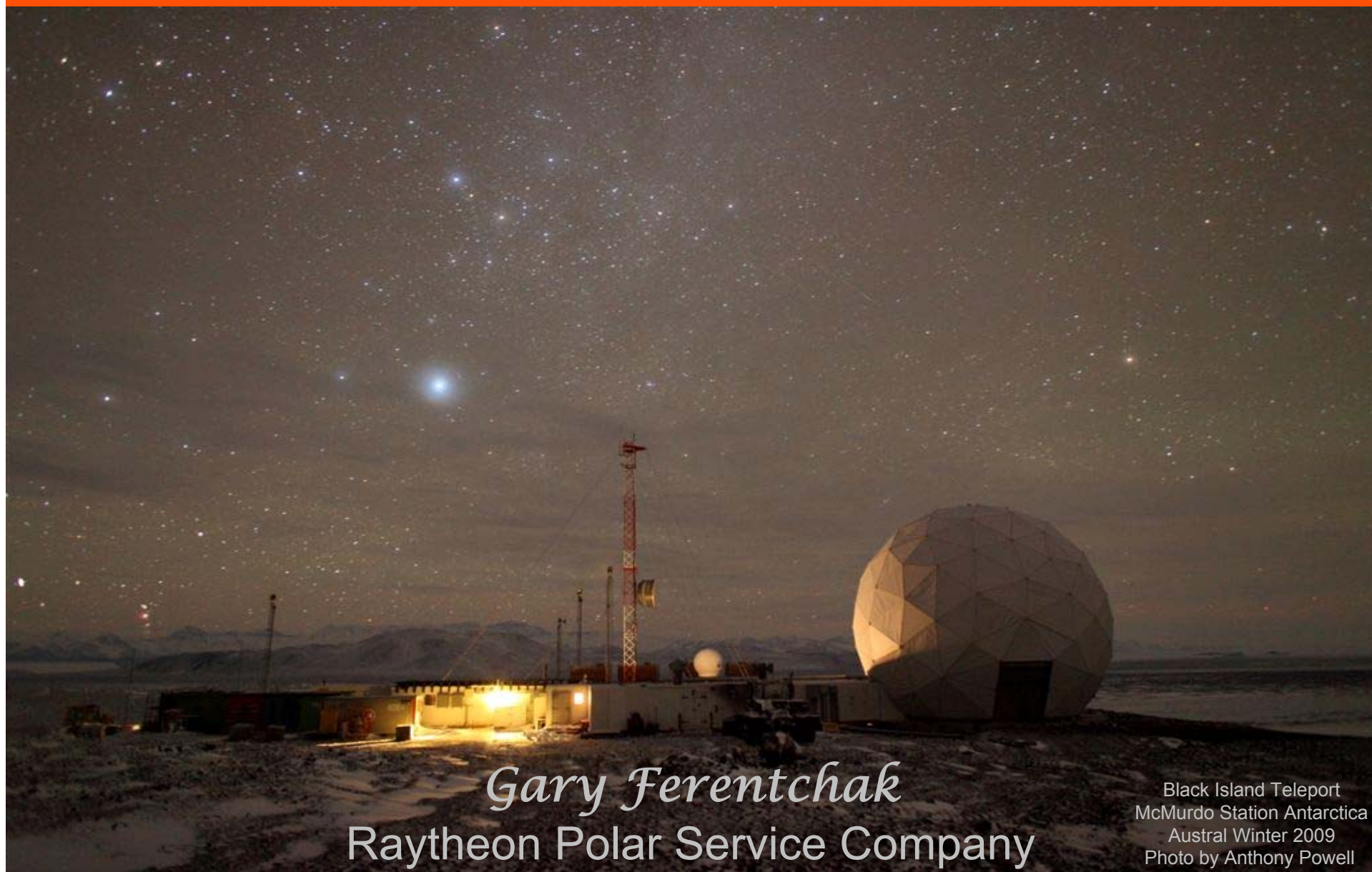


Polar Technology Conference

March 25 & 26, 2010

Raytheon

Customer Success Is Our Mission



Gary Ferentchak
Raytheon Polar Service Company

Black Island Teleport
McMurdo Station Antarctica
Austral Winter 2009
Photo by Anthony Powell



Data Transport in the Polar Regions

There are three ways to get science and operations data off-ice:

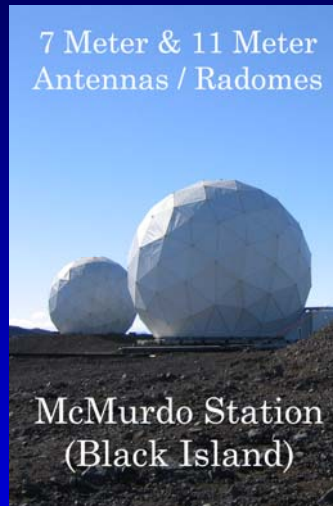
1 - Hand Carry



2 - Iridium Phones & Modems



7 Meter & 11 Meter Antennas / Radomes



McMurdo Station (Black Island)



Palmer Station

3 - Broadband Satellites

SMPGT – South Pole Station

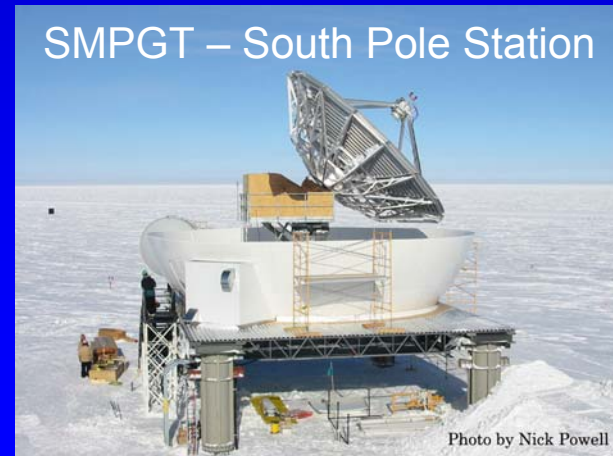


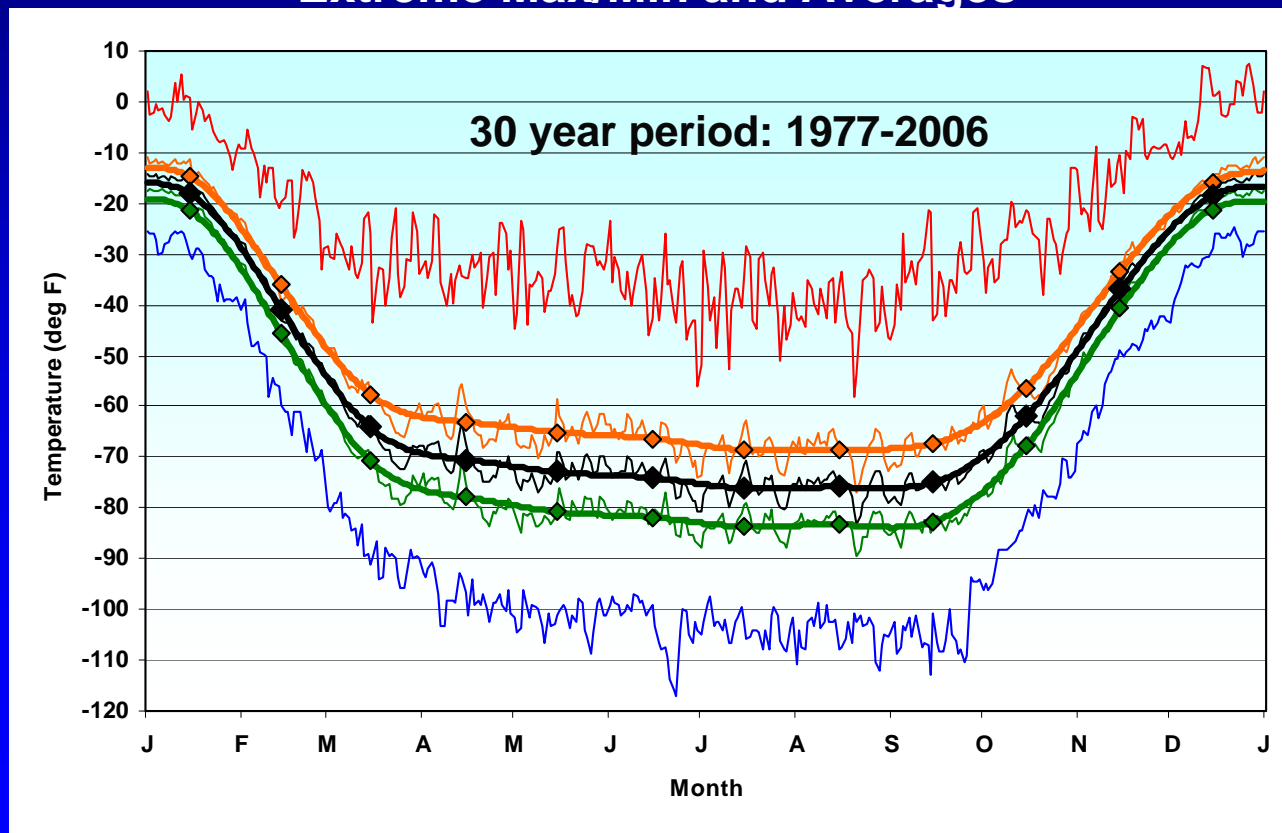
Photo by Nick Powell



Before We Start - The Big Question ???

- Is Global Warming Affecting (pick one; Antarctica, Greenland, arctic)?
- **2009 - warmest year on record for South Pole Station - 54.3°F average**

South Pole Temperature Distribution Extreme Max/Min and Averages



**2009 temp –
departure
from normal
- +2.6°F**

Daily Average
Temp
w/Variation
Black = ave
Grn = low
Orn = High

Yearly
Extremes
Red = High
Blue = Low

Extreme Maximum: + 7° F

Extreme Minimum: -117° F



Iridium Administration for the Science Community

- Huge cost advantage for the NSF to use/provide EMSS SIMs to Grantees where needed – for all but special cases
- Costs for EMSS Iridium Usage:
 - Unlimited airtime for: voice, data, SMS, e-mail, RUDICS for \$256.50/month/SIM ★
 - Short Burst Data – SIM-less modems, \$80 activation fee ★ ★
 - Tier I: Unlimited usage for \$139 / month
 - Tier II: 100KB for \$ 70 / month
 - Tier II: 30KB for \$ 27 / month
 - Tier II: inactive for \$ 11 / month
 - Pager: \$80 / month
- End users responsible for managing costs
 - Use SIMs seasonally if possible – (SIMs cannot be re-activated)
 - Use Short Burst Data where appropriate
 - If systems fail hard – advise us to terminate SIMs



- ★ = small volume airtime users must check against commercial rates – could be less costly
- ★ ★ = What you wish your cell phone plan had – billed at least costly tier each month based on actual usage



Presentation Topics

- **Part 1: Iridium Multi-Channel System (IMCS)**

- What is an IMCS: Types, Flavors, Sizes, Applications
- Typical IMCS Uses: e-mail, Instant Messaging, (S)FTP File Transport, Limited Internet Access, SSH Terminal Sessions, etc.

- **Part 2: Short Burst Data (SBD)**

- Fastest growing data delivery method
- How it works & how to use it

- **Part 3: (not briefed) Iridium Administration for new Iridium Users**

- How to request SIM Cards
- Costs & who pays for Iridium Airtime
- Who can EMSS/DoD SIMS

- **Iridium Communication Choices**

- Voice and/or Data, SMS, Voice Mail
- Dial-up, Direct-IP
- Short Burst Data (SBD)
- RUDICS, Open Port



Iridium Satellite



Iridium Multi-Channel Systems

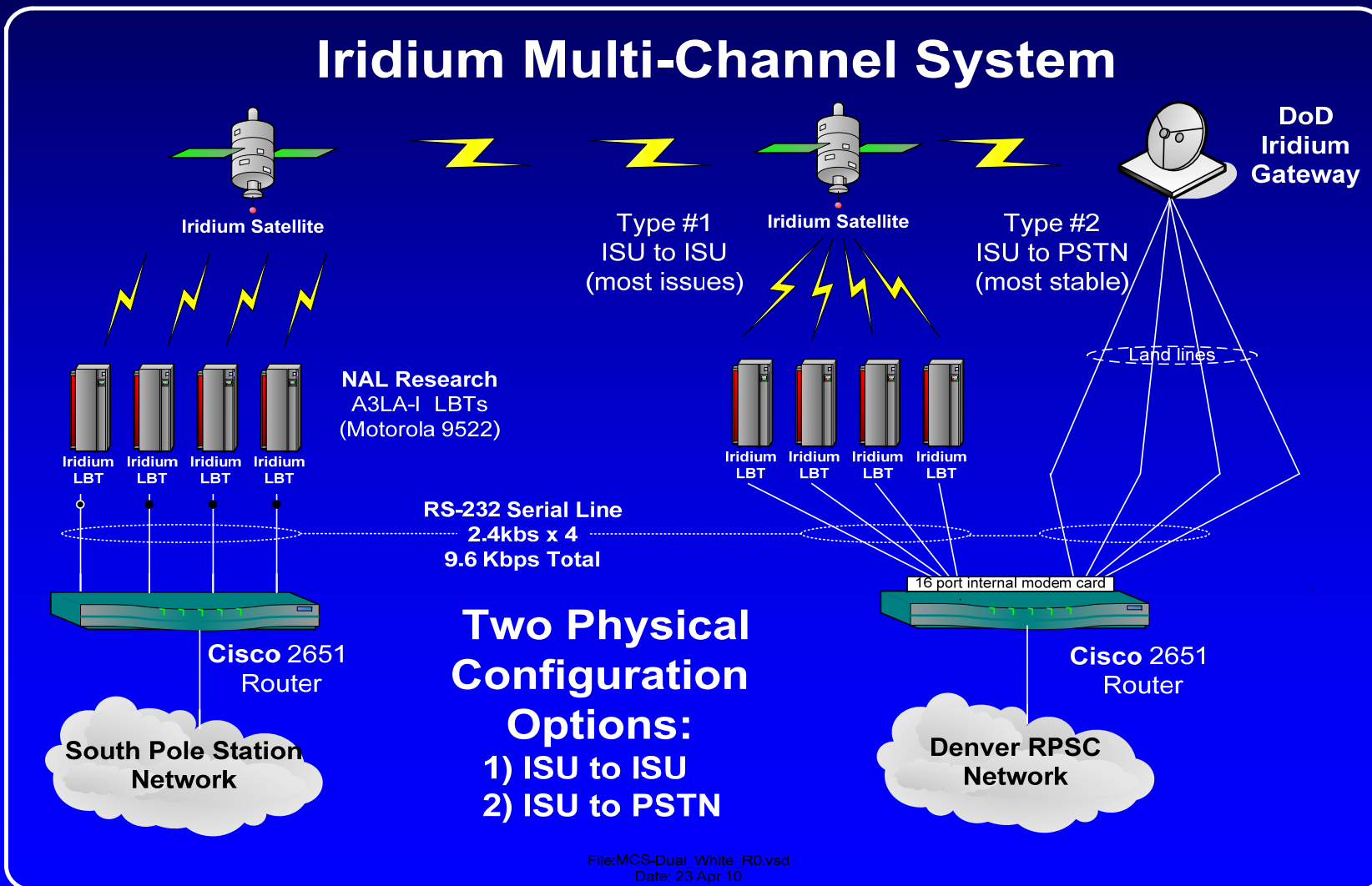
- **Iridium Multi-Channel System – What is it?**
 - Refers to technology to bond the bandwidth of individual modems into a virtual single larger pipe – i.e. 4 2400 bps Iridium modems form a single 9600 bps link.
 - Typically accomplished with the use of routers or a routing application
- **Why do it?**
 - Need more bandwidth than a single Iridium modem can deliver
 - Reliability – random call drops are a way of life, link stays up as long as one channel remains connected
 - Need to run standard TCP/ IP applications
- **How many channels are typically bundled?**
 - 2 minimum to 12+ maximum, greater than 12; overhead becomes a factor, re-dial algorithms become more critical, etc.
 - Cisco ML-PPP algorithm/overhead starts to become inefficient at 12 channels (28.8Kbps)
- **What is used to initiate and control the IMCS**
 - Cisco router
 - Linux single board computer





Iridium Multi-Channel Systems

- IMCS Logical Diagram; Type #1 and Type #2

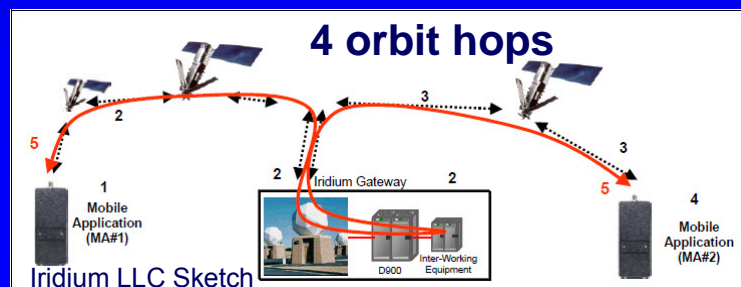
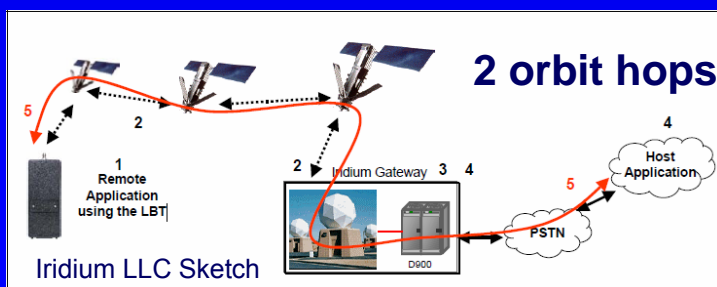


File:MCS-Dual_White_R0.vsd
Date: 23 Apr 10



Iridium Multi-Channel Systems

- Dialup – Everyone knows dialup, right? Not Iridium style !!!
 - EMSS SIMs or Commercial SIMs – but not a mix of both
 - Iridium to Iridium:
 - Standard dialup (non-DAV) and DAV dialup
 - Most costly – need two SIMs, Most call drops
 - Must consider latency (time in ms):
 - » DAV or PSTN * : Low = 0.9ms, Ave=1.3ms, High=4.8ms
 - » Non-DAV * * : Low = 1.9ms, Ave=2.8ms, High=10+ms
 - Iridium to PSTN, (no DAV)
 - PSTN to Iridium, not allowed unless from a government operated phone switch (prevent DOS attacks)
 - This is big deal: must initiate call from field equipment for most users



- ★ Most Windows app will work
- ★ ★ Most Windows apps will NOT work



Iridium Multi-Channel Systems

- Iridium behavior that Dialup must be programmed to handle:
 - First attempt call connection rate varies – 80% is a good day
 - There is no such thing as a nailed-up connection – call drops are to be expected
- Typical Iridium call drop behavior
 - Denver to Denver: Nights & Weekends 122 min
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 - South Pole to Denver (2005): 50-70 min
 - South Pole to Denver(today): Lo=48 min, Ave = 71 min, Hi=120min

This system alone uses 4.2 million airtime minutes per year

South Pole Station to Denver call drop/recoveries by modem for 16 hour period

South Pole Station	Modems 1-4	Modems 5-8	Modems 9-12	System Average
23 Mar 2010	14	15	17	
12 channel IMCS	12	10	11	
Call Recoveries	13	8	11	
16 hour period	17	20	14	
Bank Average:	14	13.25	13.25	13.5/106.6min



Iridium Multi-Channel Systems

- **Where is the NSF Using Iridium Multi-Channel Systems Today**
 - #1: South Pole Station – extends coverage to 24x7x365 for critical communications services
 - 12 channel system - 28.8kbps, operates 16+ hours / day
 - Supports population: Summer = 250, Winter = 55
 - Mission: off-ice WAN link when broadband satellites are not visible / available

IMCS Router >

IMCS Traffic Shaping >

Each 2U shelf has 4 modems.

System can grow to 24 modems



Services Carried:

- E-mail – 48% SP
- United Nations Data via VPN Tunnel
- Live Weather
- **SSH Terminal Sessions**
- **Instant Messaging**
- Red = new this year**

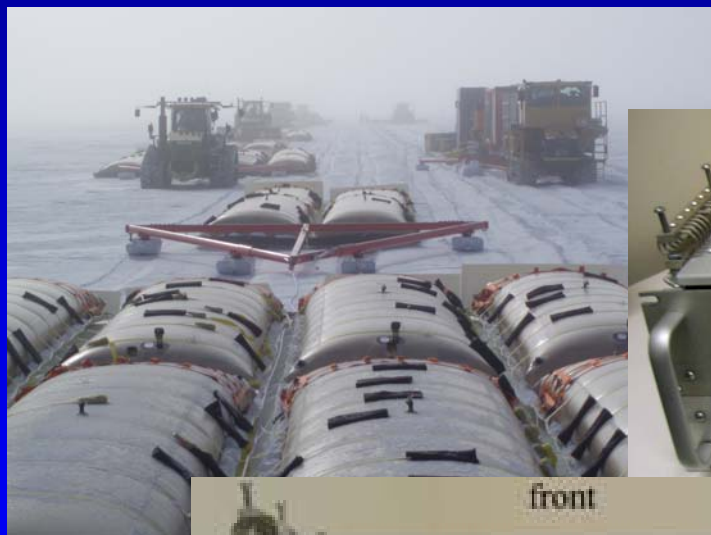
Iridium Hi-Density Antenna Array services phones & modems



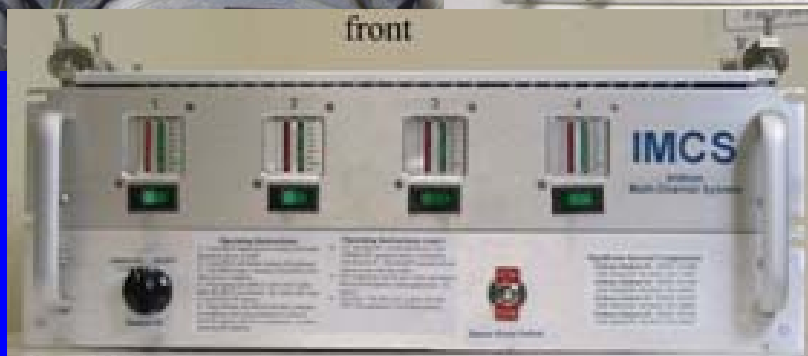


Iridium Multi-Channel Systems

- Where is the NSF using Iridium Multi-Channel Systems Today
 - #2 South Pole Traverse #1 (& Traverse #2 next season)
 - 4 channel system, operates 4-6 hours / day
 - Supports population of 8-10
 - On the road WAN connectivity – e-mail, radar imagery, etc.



Traverse IMCS
Antennas



110 VAC power
distribution



Iridium Multi-Channel Systems

- This austral summer saw the first of the new large field camps with populations of 50-95 personnel – will run for several seasons
 - Byrd Field Camp – New this season – no IT support staff once setup
 - 850 miles from McMurdo Station, □ 700 miles from the South Pole Station
 - 10,000 miles from home
 - What do you need for communications in today's remote research environment that brings hi-tech instrumentation, aviation missions, etc.



The Answer - we need it all: phones, e-mail, wireless networking, Instant Messaging, Store & Forward data transmission, etc.

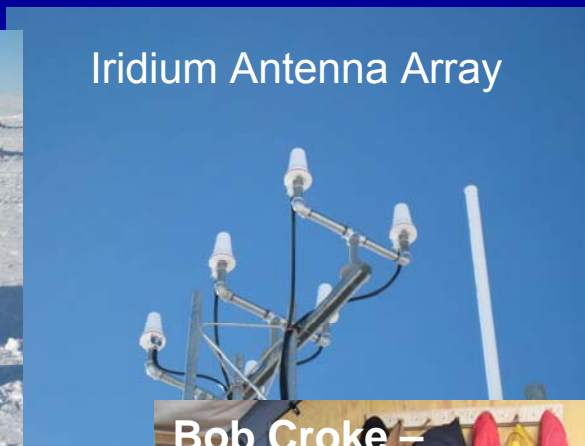


Iridium Multi-Channel Systems

- Where is the NSF using Iridium Multi-Channel Systems Today
 - #3 Byrd Field Camp
 - 4 channel comms system, operates 24 hours / day, Linux based services
 - Supports population of 55+, High reliability: no IT support staff after put-in
 - Mission: off-ice WAN link
 - Services: e-mail, Instant Messaging, Store & Forward File Transfer, Camp Wide Wireless, Printers, Computer Work Stations.



Kevin's castle
Kevin Bliss –
Server/Apps



Iridium Antenna Array



Installing the Iridium Antenna Array



Bob Croke –
IMCS Engineer



Iridium Multi-Channel Systems

- **#3 Byrd Field Camp – Lessons learned from 1st Operational Season**
 - Sparing was not sufficient – we spared one modem – needed two
 - High infant mortality rate with new generation A3LA-X modems. spare equipment should be wired-in where possible, no IT support staff to change out parts – UNAVCO field personnel changed modem out for us
 - Need remote reboot/power cycle capability – network accessible PDU
 - Add modem to voice conversion kit for one modem – backup to other communications systems
 - Biggest time consumer – getting personnel provisioned for e-mail – next season will use webmail front end, no contact needed with user laptop
 - Camp user request #1: Local file sharing, Solution: Wiki?
 - Camp user request #2: Larger e-mail capability for special circumstances, Solution: change from Send Mail to POSTFIX
 - Operations request – remote alert/paging capability – notify camp mgr to phone McMurdo Operations – flight ops changes etc. Solution: TBD



Iridium Multi-Channel Systems

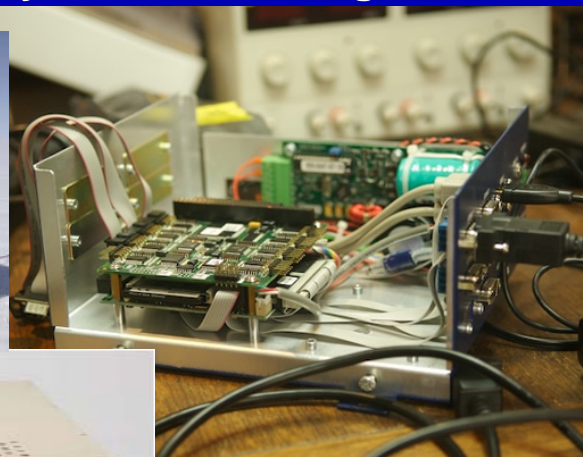
- Where is the NSF using Iridium Multi-Channel Systems - Future
 - On the books for Field Seasons: FY10/11-FY14/15
 - Pine Island Glacier Traverse - 4 channel system, man portable
 - WISSARD – 12 channel mobile system w/ live video outreach
 - McMurdo Operational Mobile Support – 4 channel System
 - Pine Island Glacier Field Camp - 8 channel system w/ helo flight following
 - CTAM (Beardmore Glacier) – 8 channel system w/ helo flight following
 - Other IMCS Systems



Kansas University (KU),
Linux, 4-8 Channels,
Greenland & WAIS,
Dr. Victor Frost



General Dynamics
"Reachback"



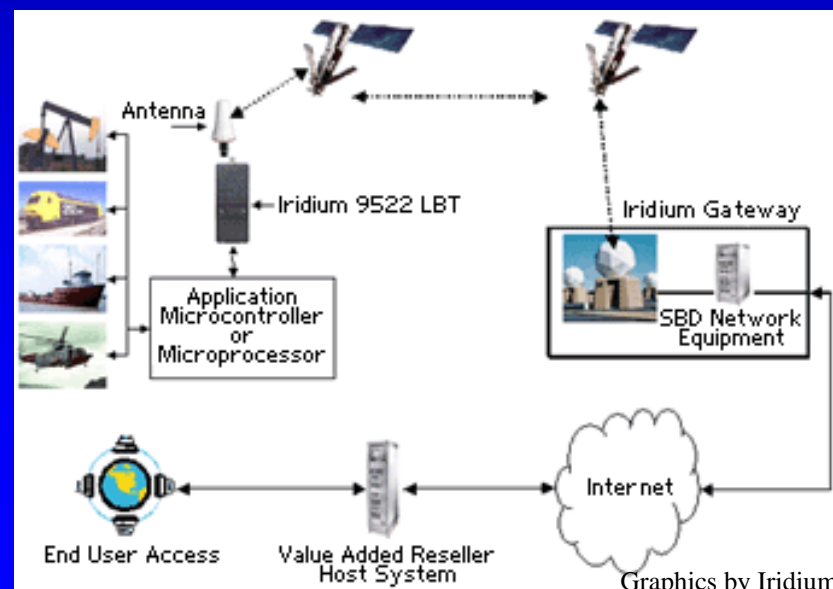
United Kingdom,
Linux, 6 Channels,
2009 Arctic Survey,
Dr. Andrew Jackson



Short Burst Data

- **Short Burst Data**
 - Rapid Growth, Cost Effective, Easy to Use, Service incl w/SIM
 - Dedicated SBD modem available, integration with GPS & more
- **Usage Growth**
 - NSF Science Usage in 2005: MO = ~ 0/day
 - NSF Science Usage on 13 Apr 2008: MO = 7380/day MT = 8/day
 - NSF Science Usage on 23 Mar 2010: (EMSS Web Site Broken)
- **Data Delivery Options**
 - E-mail, body or attachment
 - Direct IP
 - FTP
 - ISU

SBD sweet-spot is where the datagram is small – like weather station hourly reading - typically 130 bytes.





Short Burst Data

- **Short Burst Data hardware comes in several flavors w/different capabilities, w/specific integration, some models are SIM-less**
- **SBD Transport capability by hardware type**
 - SBD w/std modem: send 1 to 1960 bytes, receive 1 to 1890 bytes
 - SBD 9601 modem: send 1 to 340 bytes, receive 1 to 270 bytes
 - SBD 9602 modem: new – specifications not released yet
- **Typical integration**
 - GPS: trackers, beacons, fleet vehicle & aircraft tracking
 - Auxiliary processors to add functionality
- **Backup to dial-up or Direct IP (always use redundant comms)**





Short Burst Data

- SBD session controlled by expended “AT” command set – has binary and ASCII methods, a session goes something like this:

To ISU (from DTE)	To DTE (from ISU)	Description
AT+SBDWB=351␣		The FA instructs the ISU that it will write a 351 byte message into the ISU.
	READY␣	The ISU informs the FA that it is ready to receive the message
Binary transfer		The FA sends the 351 byte message followed by the two byte checksum to the ISU. This transfer is not echoed.
	0␣	The ISU will send a zero result code to the FA indicating that the message was loaded without error.
AT+SBDI␣		The FA instructs the ISU to initiate an SBD transfer.
	+SBDI: 1, 23, 0, -1, 0, 0␣	The ISU informs the FA that the message was sent successfully using MOMSN 23. No MT message was received and no MT messages are queued.
AT+SBDD0␣		The FA instructs the ISU to clear the message from the Mobile Originated buffer.
	0␣	The ISU informs the FA that the message buffer was cleared successfully.

Max daily transport from an A3LA Modem, sending back-to-back SBD messages: ~ 1 Mbyte (Dialup w/stable connection – 18+ Mb/day)



Short Burst Data

- **Typical/current uses of SBD**
 - Remote weather stations and NOAA drifting buoys
 - Tracking hazardous waste cargo – US Coast Guard
 - In-transit visibility for high value military cargo transport
 - Tracking driver/sled location during Annual Iditarod Sled Race
 - Tracking snowmobiles in Greenland – SRI accomplishment
 - DARPA – tracking autonomous vehicle position – NAL Research accomplishment & other blue force tracking
 - Tracking position of annual McMurdo to South Pole Traverse – RPSC – in progress
 - Daily data and system health checks – Dome A, Antarctica



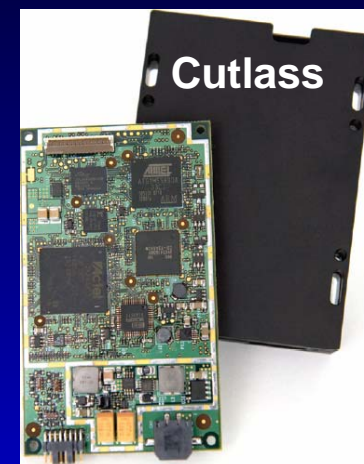
Dr. Michael Ashley - UNSW
PLATO is a joint China-
Australia-UK-US collaboration

Combo of SBD and Direct IP
data transfer – Linux SBC



New OEM Equipment for Science Developers

- **ITT – Cutlass OEM Module**
 - Complete redesign of 9601 SBD modem
 - All current SBD features + Integrated GPS
 - Size of a business card
 - Single antenna for all RF
 - Downside – pricy, box of 10 = \$15K, Eval kit = \$8K
- **Iridium 9602 – Available June 2010**
 - Little known – development on schedule
 - Built-in GPS interface
 - Claim less power/cost/weight
- **Beam Communications – SBD Offering**
 - RST425 Developers Kit – cost = \$2K
- **Iridium 9601 & 9601-DG**



Beam RST425 Developers Kit





Presentation Topics – Part 3

- Part 3: (not briefed) Iridium
Administration for new Iridium Users
Supporting the Science Community
 - How request SIM Cards
 - Costs for Iridium Usage
 - Who pays for Iridium Airtime
 - Who can EMSS/DoD SIMS
- Iridium Communication Choices
 - Voice and/or Data, SMS, Voice Mail
 - Dial-up: ISU<>ISU or PSTN, Direct-IP
 - Short Burst Data (SBD)
 - RUDICS
 - Open Port



Iridium Satellite



Iridium Administration for the Science Community

- Types of SIM cards: EMSS/DoD and Commercial
 - Largest difference – cost, minor capability differences
 - Who can request/use EMSS SIMs: USA, Canada, UK, Australia, New Zealand, others must check
 - Commercial from any Iridium VAR or VAM
- How to be authorized to use EMSS SIM Cards
 - Propose during Grant process – work with your NSF science manager
 - Request through the SIP process after Grant approved
 - Issued by DISA, process managed by Raytheon for the NSF
 - SIM card is physically sent/delivered to you by Raytheon
 - We need to know: quantity, start date, stop date
 - We need to know: non-std services like RUDICS and SBD
 - SIMs must be activated and sometimes special provision is needed

RPSC contact for requesting SIMs: Dan Wagster



Iridium Administration for the Science Community

- Who pays for EMSS Iridium airtime?
 - The NSF via an interagency agreement
 - Funding by NSF department managing your science grantNote: Commercial SIMs – paid by you (can be allowable grant expense)
- Who can be issued EMSS/DoD SIMs (for all voice/data)?
 - US Government – encrypted and non-encrypted use
 - Big users are the military & Homeland Security
 - Small users – most other government agencies
 - NSF – uses slightly more than 1% of all EMSS airtime
 - US Government designees for non-encrypted use
 - Antarctic Support Contractor – currently Raytheon Polar Service Co.
 - US National grantees funded by a NSF science grant
 - Some foreign nationals whose science is funded by the NSF – Canada, UK, Australia, New Zealand, all other foreign nationals must check



Iridium Administration for the Science Community

- Where you can use EMSS SIMs?
 - So far: the arctic, Antarctica, Greenland
 - USA, Canada, United Kingdom, Australia, & New Zealand – all others must ask
 - Buoys world-wide (NOAA)
- Current use policy has recently come under scrutiny
- EMSS Gateway recently made “USE” statement that the NSF and NOAA are investigating – stay tuned!!!
 - Some use instances may be governed by ITAR
 - Use instances of commercial SIMs are covered by the Commerce Control List

Example: Request to use EMSS SIMs by US Nationals performing science in Russia. The answer is yes if US National is in control of SIMs 24x7. Science Group used commercial SIMs since they would leave science equipment unattended in the field overnight and on weekends.



NOAA Buoy



EMSS Iridium Communications Choices

- Voice: non-encrypted only for science and ops communities)
 - EMSS supported phones for non-military / non-encrypted use: 9500, 9505, 9505a, and 9555 (Note: 9555 must be white listed at the EMSS Gateway)
 - EMSS or Commercial Gateway SIM'd phones and modems cannot talk to each other, must be identical SIM source
 - Iridium to Iridium – can just dial the number, all other calls require additional information (Iridium is country code “08”)
 - Iridium to PSTN, domestic and International - must have “secret decoder ring” to place Iridium voice/data calls
 - PSTN to Iridium (voice) – must have conversion list
 - PSTN to Iridium (data) – must be from government operated PSTN, VERY IMPORTANT- calls from civilian or private PSTNs not permitted
 - Easy integration with VoIP and private PBXs
- Two EMSS Iridium dialing guides are available – DISA & RPSC



9505 &
9505A



9555

versions (the Iridium “secret decoder ring”)



EMSS Iridium Communications Choices

- Data transport comes in multiple flavors: Dialup, SMS, Short Burst Data, RUDICS, Open Port (includes voice)
 - Hardware: Iridium phone w/ data kit, modem, SBD modem
 - Modem or phone w/Data kit: 2400 bps minimum
 - SMS: 160 characters, Mobile Originated or Mobile Terminated, ISU to ISU, ISU to e-mail, e-mail to ISU, Iridium Website to ISU
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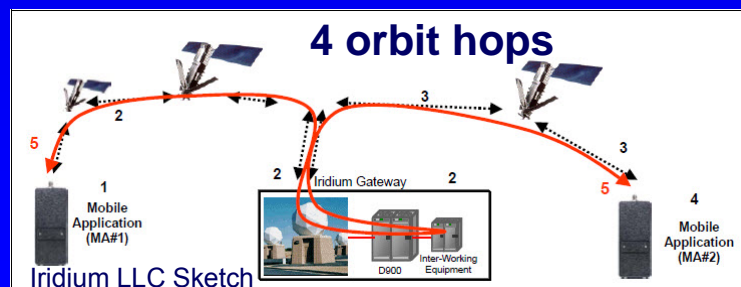
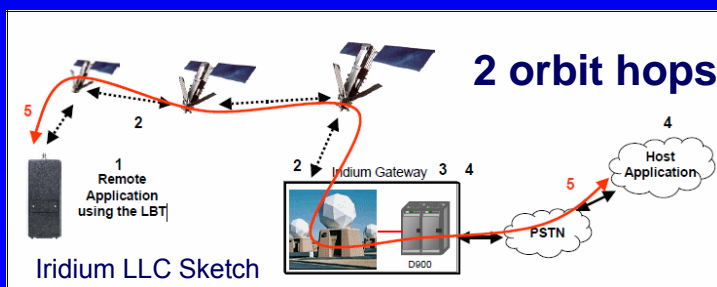


Eurocom Sailor Unit
voice & data plus
integrates Iridium
easily with VoIP or
PBX



EMSS Iridium Communications Choices

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From the Iridium School or Hard Knocks

Absolute Musts for Remote Unattended Systems Communicating via Iridium

- Disable “PIN” and “Call Forwarding” For Modem Use (Unless You Really Like Diagnostic Challenges)
- Power Cycle Modems Once / Week Or Sooner (Cures Many Evils)
- ALWAYS Dial-out Occasionally (Loss of Registration Issue – Yes in 2010 !!)
- Use More Than One Communications Mode – Devices Can Be Concurrently Provisioned For: Dial-up, SBD, RUDICS, SMS, Etc.
- DoD SIMs and Commercial SIMs Do Not Talk To Each Other !!!
- Remember the Iridium Dial Plan – There Are Different Access Codes For NADP, 800#’s, International, Etc. (Iridium Is Country Code “8”) 008-816-763-12345
- Be able To Reconfigure Remote Systems On-The-Fly (Epoch Change Example)
- Have Intelligent “Phone-Home” Algorithm – No Blind Dialing (will be interrupted as war dialing a federal facility and THEY will come for you)
- RS232 issues - when all else fails – try 2 stop bits
- Call US – we keep track of who is using Iridium technology and can likely recommend someone to who has “done it”
- Call the trouble circuit with a handset (all those tones and canned messages you never hear on a data circuit might be really helpful)



Conclusion of Part 3

Questions?

