HiSeasNet: Bringing the Internet to the High Seas for 4 Years and Counting

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Overview

- What is HiSeasNet? Why was it started? How does it do what it does?
- Where are we at now?
- How has it changed life at sea?
- What problems have we learned from?
- Where to from here?

Why did we dream up HiSeasNet?

- Significant bandwidth to/from platforms at sea for real-time data transfer home
  - 96 kbps ship-to-shore, 32kbps shore-to-ship (shared)
  - Possible services: Email, Web access, real-time data sent home, videoconferencing, VoIP, shore command of instruments, collaboration, etc.
- Always-on connection, flat monthly cost
  - No per-bit or per-minute charges like Iridium, Inmarsat, F77 MPDS, etc.)
- Pacific and Atlantic ocean coverage for large vessels

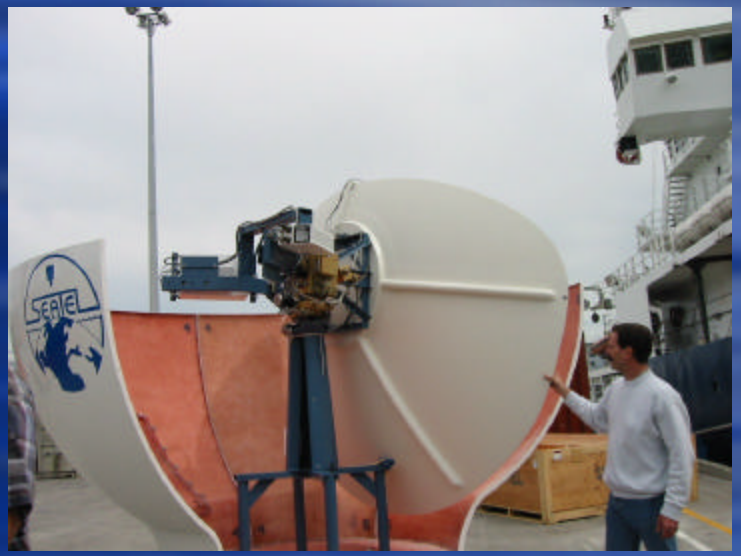
Needs determine design...

- Goals dictated C-Band antenna:
  - 2.4m dish is smallest size, SeaTel makes best marine stabilized antenna around
  - Small bandwidth on Intelsat POR and AOR satellites
- Smaller ships need smaller antennas, must go Ku-Band
  - 1.2m and now 1m SeaTel antennas
  - Ku-Band satellite coverage for Gulf of Mexico and coastal regions
- Networking layer is all IP, Cisco based on ships and shore

Brief History

- Started with one ship and commercial teleport
- Added two ships and our own earth station
- Added more C-Band ships
- Added Ku-Band coastal and Gulf of Mexico coverage
- Now at 10 ships and 1 fixed station, 3 antennas at earth station (7m POR C-Band, 7m AOR C-Band, and 3.8m N. Amer Ku-Band)
- RF gear is Codan, networking is Cisco, antennas are SeaTel, Prodelin, and Vertex

What does it look like now?



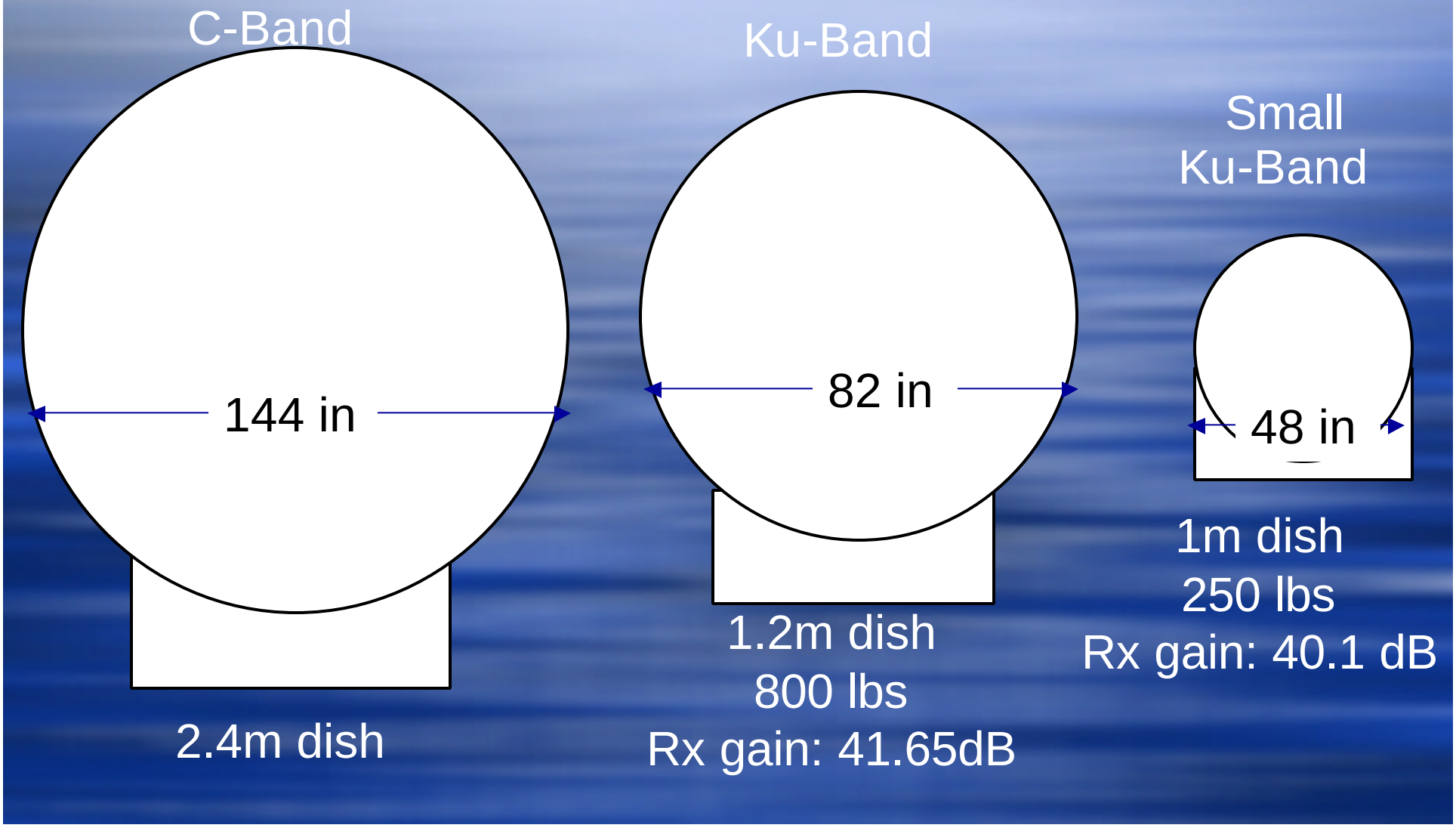
HiSeasNet Services

- Installation & commissioning for new ships
- Ship and shore equipment maintenance 2x/yr
- Satellite bandwidth
  - Ship-to-shore: 96kbps (C-Band), 64kbps (Ku)
  - Shore-to-ship: 180kbps for 3 slots on AOR C-Band, 160kbps for 5 slots on POR C-Band, 192kbps for 3 slots on Ku-Band
  - Per ship slice of shore carrier: ~32/64 (C/Ku) kbps
- Hub station connection to Internet
  - Direct routing through to home institution
  - Voice over IP through to home institution
  - Email
  - Web browsing
  - Video teleconferencing

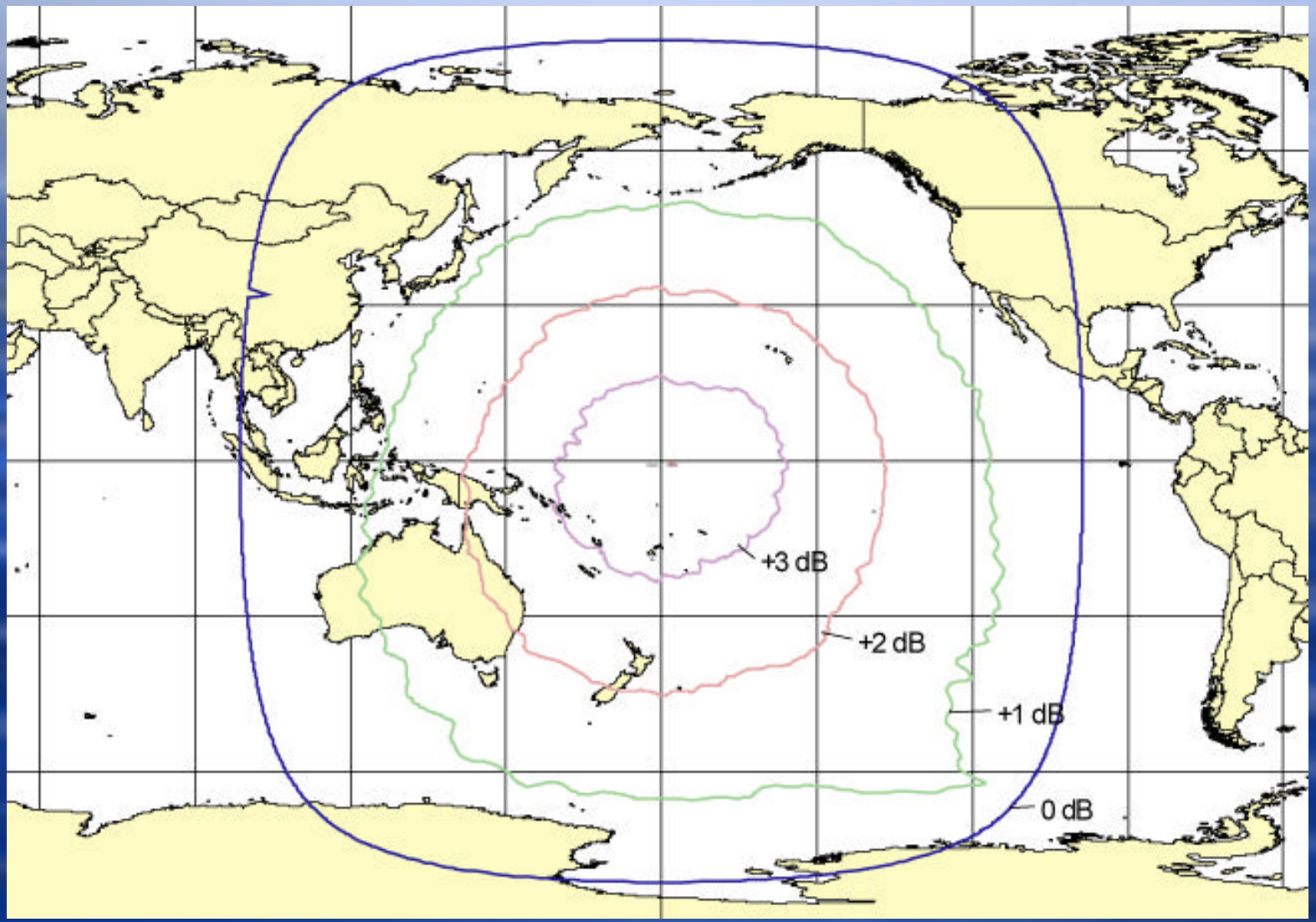
HiSeasNet Fleet

- C-Band (2.4m dish, Global coverage)
  - R/V Atlantis
  - R/V Kilo Moana
  - R/V Knorr
  - R/V Melville
  - R/V Revelle
  - R/V Seward Johnson
  - R/V Thompson
  - IDA HOPE Station (BAS Antarctica)
  - R/V Langseth (future)
- Ku-Band (1.2m dish, North America coastal coverage)
  - R/V Endeavor
  - R/V New Horizon
  - R/V Pelican (1m dish)

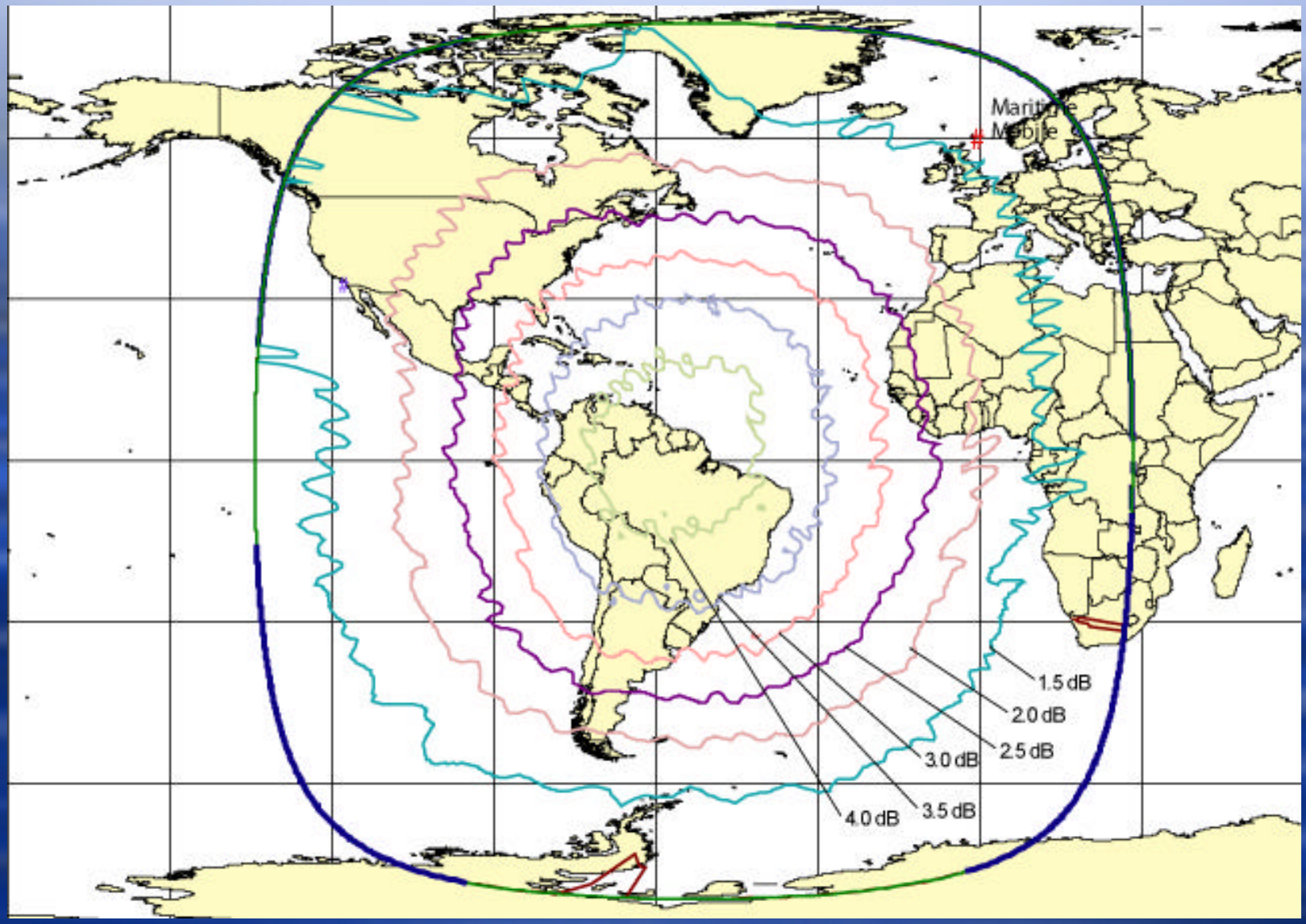
Antenna Comparisons



Pacific Coverage



Atlantic/Eastern Pacific



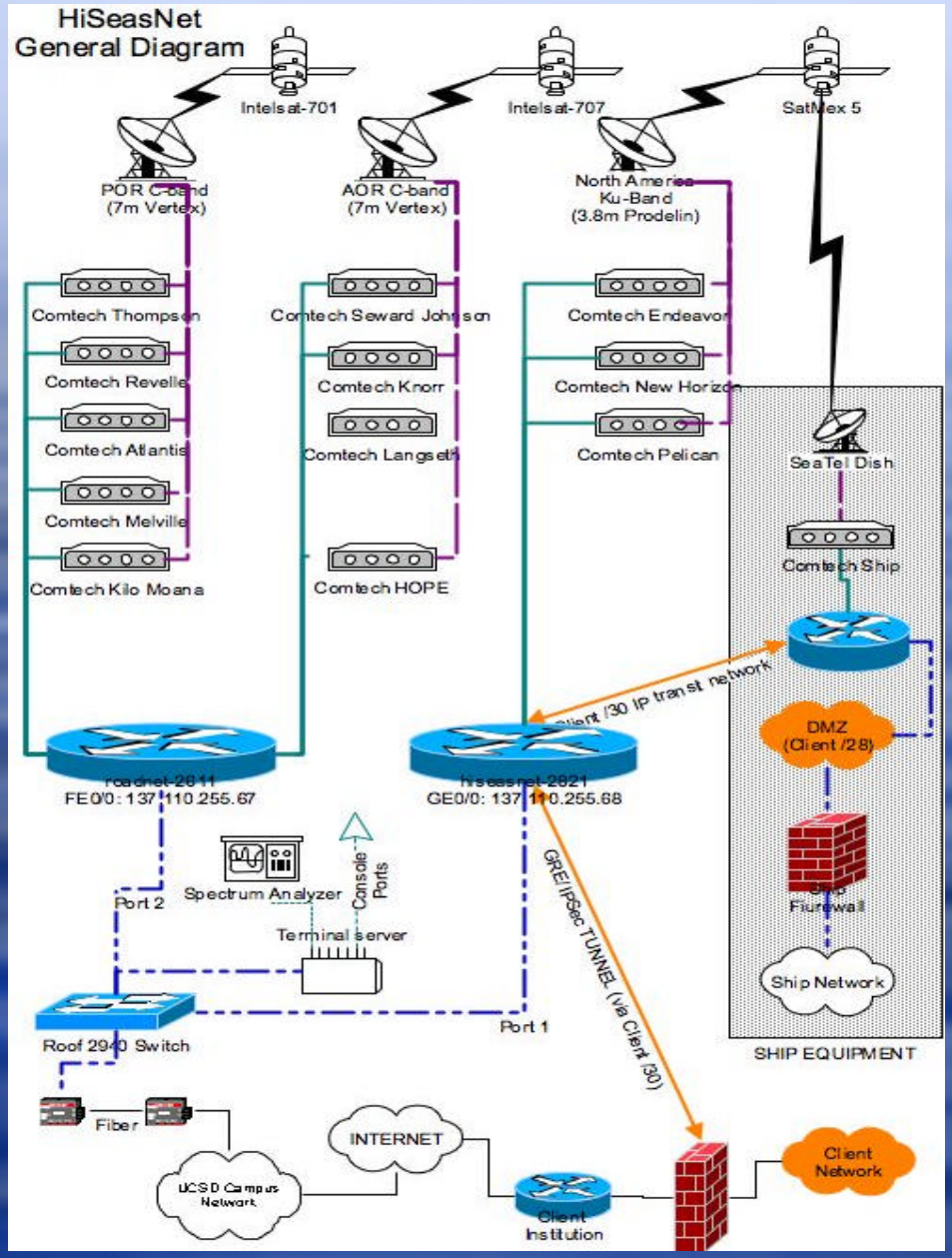
Ku-band Coverage

Earth Station in San Diego

How life is different

- Real-time email exchanges
- VoIP and instant messaging
- Photo/video exchanges in real time
- Remote control of equipment from other ships
- Scientists collaborating with shore
- Ship operations benefits
- Daily life (online banking, entertainment, photos home, etc.)
- Ask the ship operators and scientists!

Network Diagram



Downsides

- Ship structures sometimes block signal (makes for “bad headings”)...may last for days on long transits
- No IOR coverage...cannot see it from San Diego
- Some ships are not large enough for C-Band antennas, but don’t operate in Ku-Band areas
- Somewhat frequent equipment problems on small ship platforms

Failures and Spares

- Most problems are user or ship related
  - Power outage, antenna repoints, gyro failure, unfamiliarity with gear, better aiming, etc.
  - Solution: Learn gear and ship quirks via training program under development
- Antenna pointing failures occur, but usually are not catastrophic
  - Solution: Upgrading older ship installations during maintenance to newer SeaTel antenna logic
- When equipment dies, it is usually RF gear, despite it being the “most reliable in the business”
  - Solution: Spare LNAs on board, encourage all ships to have on-board RF spares, depot converter and power amp spares in SD

Equipment Downtime

Date	Location	Problem	Downtime
2/2002	Revelle	Bad rotary joint on install	0 ship days
3/2002	Revelle	Router failure	~0 ship days
4/2002	Revelle	Antenna PCU failure (had spare)	0 ship days
11/11/2003	Melville	Bad PCU at install	0 ship days
4/27/2004	Revelle	Failed LNA	20 ship days
12/1/2004	Revelle	Converter failure in port	0 ship days
2/2/2005	Earth Station	Circuit breaker tripped	1 ship day
3/17/2005	Earth Station	Converter problem?	1 ship day
4/1/2005	Atlantis	Broken antenna sprocket	1 ship day
4/11/2005	Melville	Failed power amp	~30 ship days
5/20/2005	Earth Station	Blown fuse	
7/10/2005	Knorr	Broken antenna drive belt	2 ship days?
7/24/2005	Earth station	Failed power amp	12.5 ship days
7/31/2005	Earth station	Failed power amp	3.5 ship days
8/11/2005	Earth station	Noisy link to the internet	15 ship days
9/12/2005	Earth station	Ku-band converter intermittent	0 ship days
9/5/05	Thompson Video gear	Ku-band power amp failure	1 ship day
10/1/05	Earth Station	Blown fuse	1 ship day?
11/8/05	Thompson	Pedestal structure failure	10 ship days
11/12/05	Earth Station	Blown fuse	1 ship day
3/22/06	Seward Johnson	Bad power amp at install	0 ship days
3/23/06	Seward Johnson	Bad spare PCU at install	0 ship days
5/11/06	Earth station	Campus ACT router failure	3.5 ship days
7/2006	Knorr	Bad level cage and PCU	1 ship day?
8/14/06	Pelican	Failed BUC shortly after install	2 ship days
8/15/06	New Horizon	Failing Amp(?) Causing shoulders affecting Endeavor signal?	1 ship day
9/29/06	Earth Station	Ku-band tripped GFCI while Geoff and Steve unavailable	4.5 ship days

Future Work

- Work on training program
  - Multi-day, hands-on and classroom training for geared at HiSeasNet techs
  - Will involved theory, troubleshooting, procedures, operations, monitoring, etc.
  - Have a rough outline now, will be soliciting feedback soon
  - Hope to generate better permanent written materials for HiSeasNet operations
- Bring Langseth online
- Continue routine operations and maintenance/upgrades of all equipment (tracked in a trouble ticket database)

Questions?