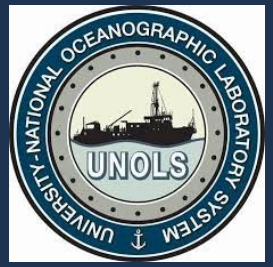


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HiSeasNet and Secondary Satellite Network Update 2020-10-21

Jon C. Meyer, Information Systems Manager, Shipboard Technical Support, Scripps Institution of Oceanography

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Telecommunications and change in the US Academic Research Fleet

Topics:

1. 2020: a year of major satcoms change for ARF
2. COVID-19 and telepresence
3. HiSeasNet website updates
4. Fleet Xpress progress and plans
5. Marlink Sealink progress and plans
6. About Leasing and Finances

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2020: a year of change for satcoms

- SIO has been managing both primary and secondary satellite systems as of January 2020
- Financial efficiencies have driven rapid adoption of systems not previously used
- The satcoms market is changing and so prices, equipment and services are changing
- COVID-19 risk mitigation is highlighting the importance of stable communications at sea
- We are in the throes of 2021 planning and acquisition

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COVID-19 and telepresence

- The fleet is not 100% ready for reliable telepresence. We have a long-term plan to engineer our way out of that, which involves full-sky views for all performance-capable systems on board either through dual radomes or top-of-ship placement. Dual radomes have a key advantage in being LEO-ready, but are also more expensive and complex to install/troubleshoot
- HiSeasNet ideally needs 90 days or more preparation time to change link performance. That said, we have been committed to trying our best to make shorter timeframes to overcome COVID-19 challenges and mostly have had success
- Where you go in the world matters for our planning; the sooner that is defined, the better the outcome
- Updating your ship's calendar at strs.unols.org helps us plan your service

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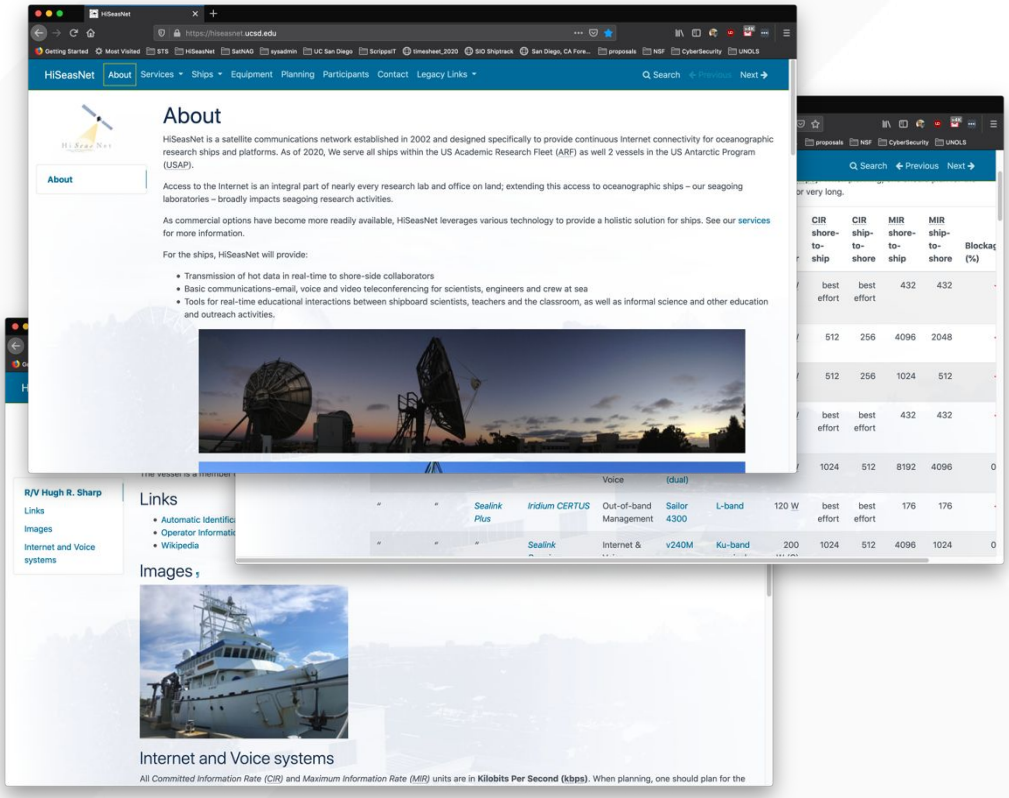
HiSeasNet website updates

1. hiseasnet.ucsd.edu has been updated with information mostly about:
   1. The vessels we are supporting
   2. The equipment we use/will use
   3. The service plans we are/will purchase
2. We are in the process of setting up a FAQ section to address some repeated questions we are getting
3. We are in the process of creating a login-required section where reports and private URLs can be shared
4. Feedback welcome via our web form at the site



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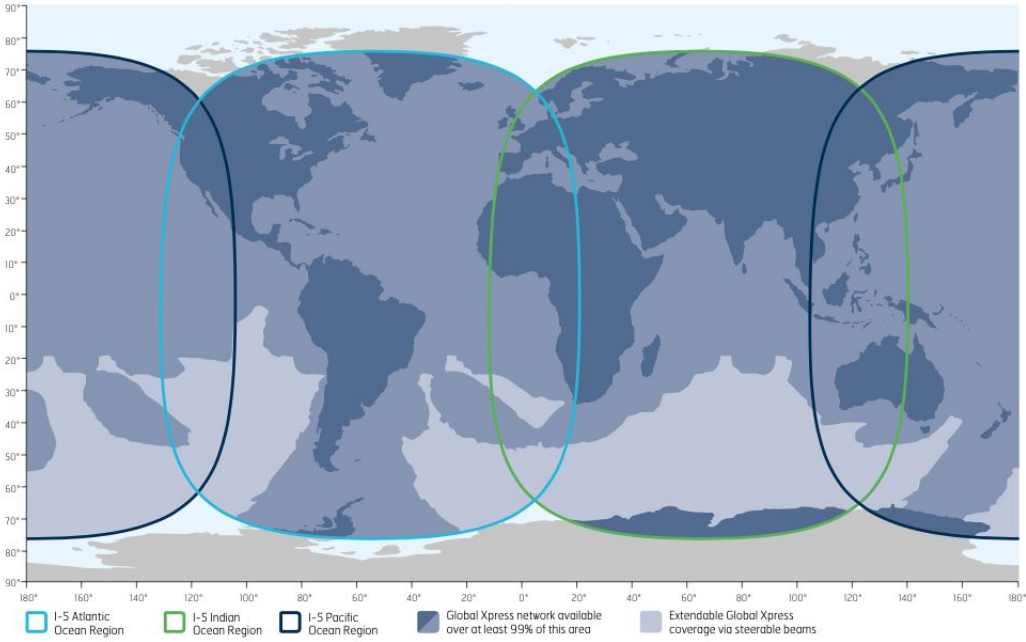
About Fleet Xpress

- *Fleet Xpress* is 2 systems: *Global Xpress* (Ka-band, primary) + *FleetBroadband* (L-band, backup)
- All ARF vessels have (save 1 pending) have Fleet Xpress, now
- 1m radomes for Ka-band, 30cm L-band: easier to fit on smaller vessels than Ku-band or C-band options, but Ka-band is more subject to weather
- Performance capability of up to 10Mbps
- Global Xpress Coverage map does **NOT** guarantee service
- Internet and Voice
- New radome model for 2021: Intellian GX100NX HP, which is LEO-compatible



This map depicts Inmarsat's expectations of coverage, but does not represent a guarantee of service. The availability of service at the edge of coverage areas fluctuates depending on various conditions. The first satellite was successfully launched in 2013, providing coverage over Europe, Middle East, Africa and Asia.

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Fleet Xpress early 2021 Plans

1. R/V Atlantis to receive dual GX100NX HP radomes -- on order
2. R/V Sikuliaq to receive dual GX100NX HP radomes -- on order
3. A FleetBroadband radome bulk purchase is on order -- 83% of the fleet will receive a lifecycle replacement system, soon
4. R/V Sally Ride to relocate GX100HP radome, commissioned in Feb 2020, to top-of-mast (à la R/V Neil Armstrong) in Q2-Q3 2021 shipyard
5. Complications with installation of Fleet Xpress aboard R/V Rachel Carson have caused delay. Working toward resolution with UW in 2021 and using pay-by-the-byte FleetBroadband in the meantime
6. Ocean/Global class vessels will generally be receiving leased radomes, going forward. Smaller vessels are likely to own for the foreseeable future
7. Working on 2021 budget for other vessel upgrades

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About Sealink Plus

- Sealink uses a combination of Ku-band and C-band radio frequency. When performance is needed, these are the frequency ranges to use for geostationary orbit satellite
- The “Plus” is an out-of-band Iridium CERTUS system that allows Marlink remote troubleshooting capability
- Marlink (service provider) has field-tested 80Mbps performance on ships. R/V Roger Revelle currently testing this for Sea Trials!
- Large radome requirements make it more practicable to consider for Intermediate or bigger vessels
- Commercial version similar to what HiSeasNet has historically done
- Regional plans can be used for cheaper. **We are interested in coordinating with operators on planned work areas to reduce overall costs.**
- *R/V Sikuliaq*, *R/V Sally Ride* will be converted to Sealink Plus in 2021

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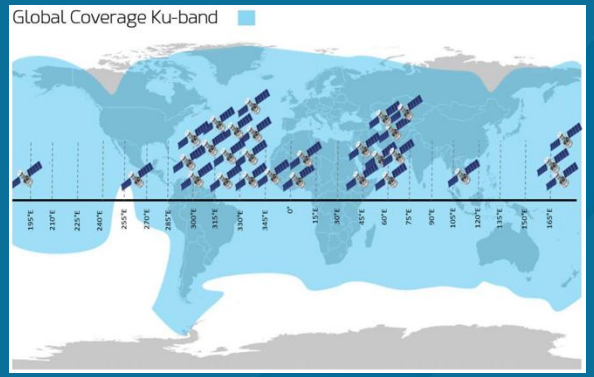
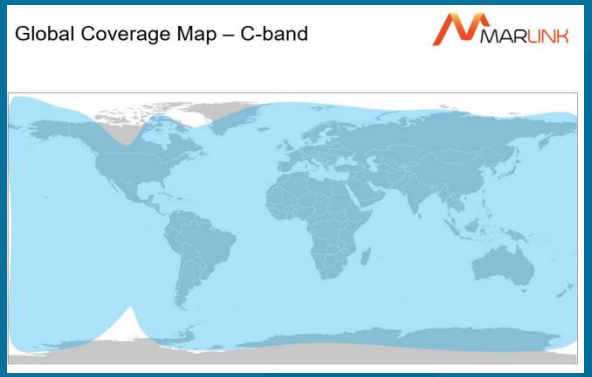
About Sealink: Coverage at a glance





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Late 2020/early 2021 Sealink Plans

- Intermediate vessels *(R/V Atlantic Explorer*, *R/V Endeavor*, *R/V Oceanus*) being upgraded, Sealink -> Sealink Plus
- *R/V Thomas G. Thompson* being converted to Sealink Plus in Q4 2020 with existing 9711 antenna. Radome move, top-of-ship
- *R/V Atlantis* to receive a new Intellian v240M system in early 2021 (on order)
- *R/V Sikuliaq* to receive a dual Intellian v240M (Gen 2) systems in early 2021 (on order). Gen 2 is very new and introduces LEO compatibility. Sikuliaq will help us test that due to the nature of where the vessel operates.
- Sealink modems being upgraded iDirect -> Newtec
- HiSeasNet Ground Station service remains operational for expansion use, but is will no longer transmitting 24/7/365 in 2021

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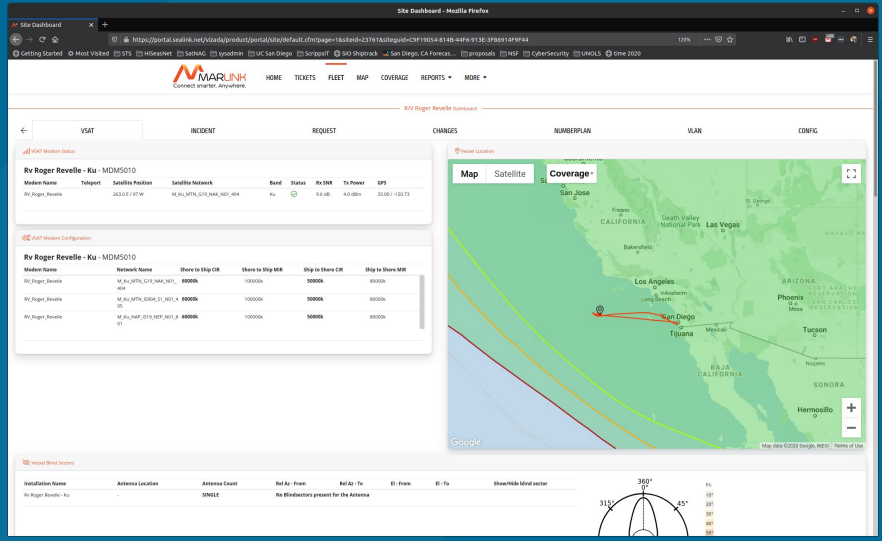
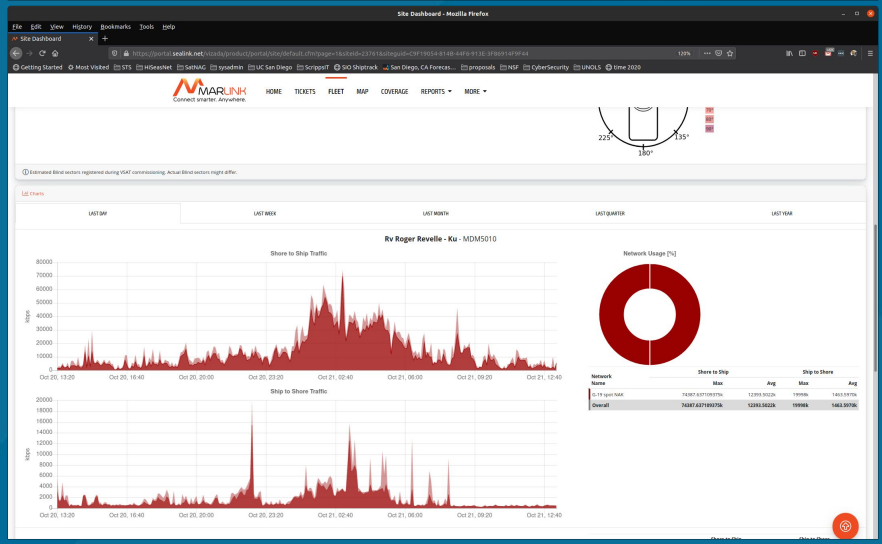
Sealink: REVELLE Maximum Test Shot

- R/V Roger Revelle has an Intellian v240M antenna
- We asked Marlink if a ~3 day test shot was possible. It was. Details:
  a. It was not feasible to do it for less than 2 weeks
  b. ship->shore 100Mbps MIR, 60Mbps CIR
  c. shore->ship 60Mbps MIR, 50Mbps CIR
  d. Using Galaxy 19 Ku
- Testing is currently underway, results are mostly positive
  a. We are troubleshooting TCP jitter, which keeps a single session at ~25Mbps
  b. The ship was asked to have everybody stream after dinner and we realized our full CIR, in aggregate
- Productivity positives (per PI Appelgate):
  a. Two-factor authentication works using DUO pushed to my cell phone.
  b. VPN (with two-factor) not a problem.
  c. Campus resources, like shared drives, not a problem.
  d. No-compromise email service, web browsing, Zoom calls -- it all "just" works.
  e. Streaming World Series Baseball





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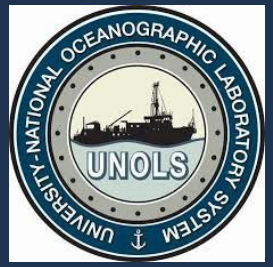
About Leasing, Finances

- In early 2020, we were approved to conduct a Pilot Program for the ARF wherein we lease satellite equipment. This has gone well
- Leasing options we are leveraging spread out hardware costs over ~5 years -- essentially 20%/year
- Aged equipment in-fleet, along with spreading budgetary commitments out over multiple years has caused us to lease more, and quickly. We now generally plan to lease all satcoms gear for Ocean/Global vessels
- Leasing enforces lifecycle maintenance due to length of the lease. 5-7 years (with renewals) is the expected maximum
- Leased equipment must contain an airtime plan (EG Marlink *Sealink Plus*/*Fleet Xpress*)
- Day Rate plan, coordinated with funding agencies, is not yet finalized. Expected:
    a. All airtime plans are expected to be incorporated in the ship's Day Rate for *Oceanographic Technical Services*
    b. All hardware leases are expected to be incorporated in the ship's Day Rate for *Ship Operations*
    c. *Day Rates will go up. Ships with two systems (Sealink Plus and Fleet Xpress) can about double the Day Rate than ships with solely Fleet Xpress*
    d. *Ocean/Global vessels can expect a hardware Day Rate (Ship Ops) and an airtime Day Rate (OTS)*

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Questions?

Thanks!