Research Vessels: Seagoing Datacenters

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Introduction

Scripps Institution of Oceanography (SIO) is a graduate school of UC San Diego and is a world leader in oceanographic field research. SIO supports the operation and/or scientific research of 3 research vessels, a research platform, and is in the primary role in a multi-institution partnership that works with the US Coast Guard to conduct arctic oceanographic research. SIO also manages a cost-saving satellite-based Internet project for research vessels at sea, serving the network-based needs of the majority of University-National Oceanographic Laboratory System (UNOLS) participants.

Key Products/Services

The Ship Operations & Marine Technical Support (SOMTS) department within SIO offers basic and specialized services.

Our most basic (and obvious) service is that of functional and fully equipped seagoing platforms for oceangoing research. These platforms range from a regional research vessel (R/V Robert Gordon Sproul), and Ocean Class research vessel (R/V Sally Ride -- America's newest research vessel) and a Global Class vessel (R/V Roger Revelle -- our flagship). We also support a specialized platform, R/P Flip, which is a platform designed to stably study ocean currents by inverting itself 90 degrees in the water. All platforms come equipped with instrumentation and information systems to acquire commonly useful information about the environment: from seawater temperature and salinity, ocean floor, ocean currents, wind and weather, etc. These systems often operate with other devices as a system of systems, providing cohesive information about a vessel's movement in order to better understand the environment around that vessel.

We also support a number of specialized projects: repeat hydrography, arctic research aboard the USCGC Healy (in partnership with other academic institutions and the US Coast Guard), and support a multi-dish satellite earth station through the HiSeasNet project which has provided affordable Internet to the UNOLS community for the better part of a decade.

Finally, we are in the process of exploring the data delivery mechanism(s) upon completion of scientific missions. At present, data is delivered via “sneakernet” to a data archive/curation project, but as Internet connectivity improves, standardized realtime delivery of data from oceanographic ships at sea should to. Further, modern instrumentation data needs are growing. Newer vessels are installing instruments that produce 100 times more data than other systems; a cohesive, modern data management plan is being sought for these standalone environments.

Deployment

We are in the process of upgrading SIO’s mobile platforms to datacenter-grade computing to provide the redundancy, resiliency and the graceful degradation of equipment that only a no-single-point-of-failure system can provide. Despite redundancies, severe weather and rough seas can make off-ship communication difficult at times; as such a ship needs to be somewhat self-contained when communications go awry.

Working oceanographic equipment (along with the attached computing systems) tend to have a slow upgrade path. Many ships work the majority of the year; an idle ship is expensive. As such, equipment upgrades and maintenance have to be targeted to be as non-disruptive as possible. As such, we are constantly seeking opportunities to proactively deploy and maintain equipment. That said, some of the equipment on-hand does not have clear upgrade paths and it is not rare to find a 10+ year old computer system aboard a ship. Getting such systems to behave reliably can be a losing battle.

Internet connectivity at sea remains challenging to engineer consistently and keep ships online. After a decade of successes, HiSeasNet is looking to the future to re-equip all of UNOLS with modern, maintained satellite communications. Older installations in the fleet are showing signs of wear, and proactivity is needed to keep the fleet communicating well.

Summary

Oceanographic field research is fraught with challenges of being both self-sufficient where it matters, available via network in locations with little infrastructure. SIO is looking to meet these challenges with 21st century solutions, and help lead the charge to produce excellent data from its seagoing research that will be useful and have impact for many years.