UC San Diego

Cyberinfrastructure and ARF

An overview of the IT and OT components that make up a successful 21st century, standalone research environment

Jon C. Meyer, Scripps Institution of Oceanography, UC San Diego | Cyber-Infrastructure Working Group (CIWG) | Apr 16, 2024

UC San Diego

Thanks to our sponsors and partners

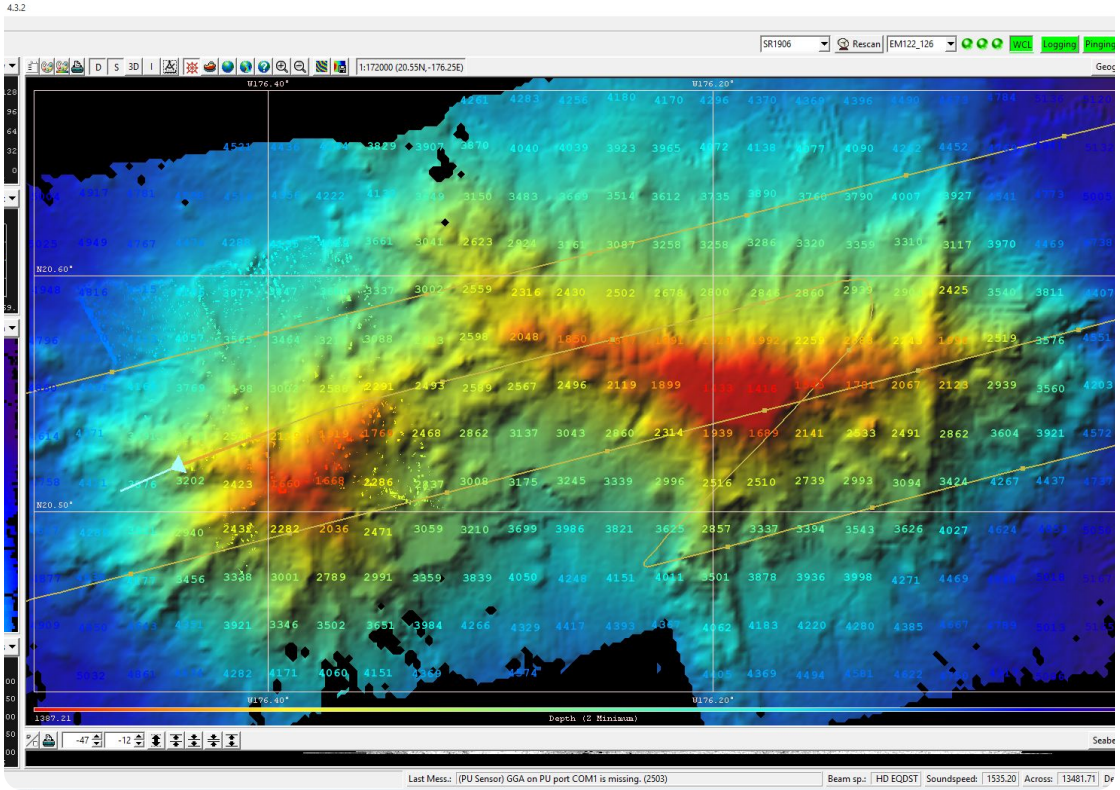
CONTENTS

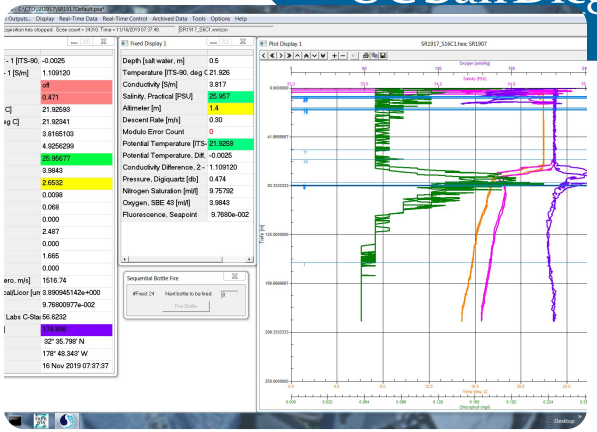
What is CI?

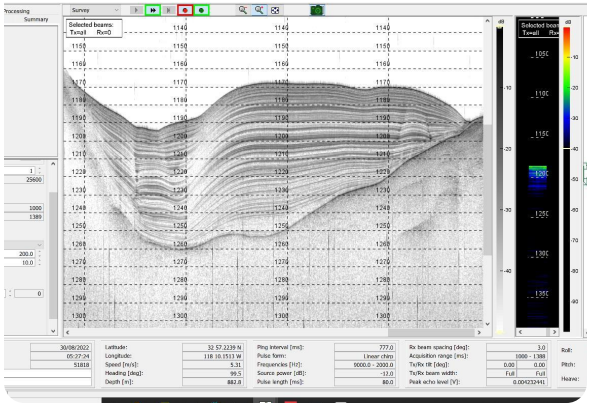
Wikipedia says:

- United States federal research funders use the term cyberinfrastructure to describe research environments that support advanced data acquisition, data storage, data management, data integration, data mining, data visualization and other computing and information processing services distributed over the Internet beyond the scope of a single institution.
- In scientific usage, cyberinfrastructure is a technological and sociological solution to the problem of efficiently connecting laboratories, data, computers, and people with the goal of enabling derivation of novel scientific theories and knowledge.
- https://en.wikipedia.org/wiki/Cyberinfrastructure for more

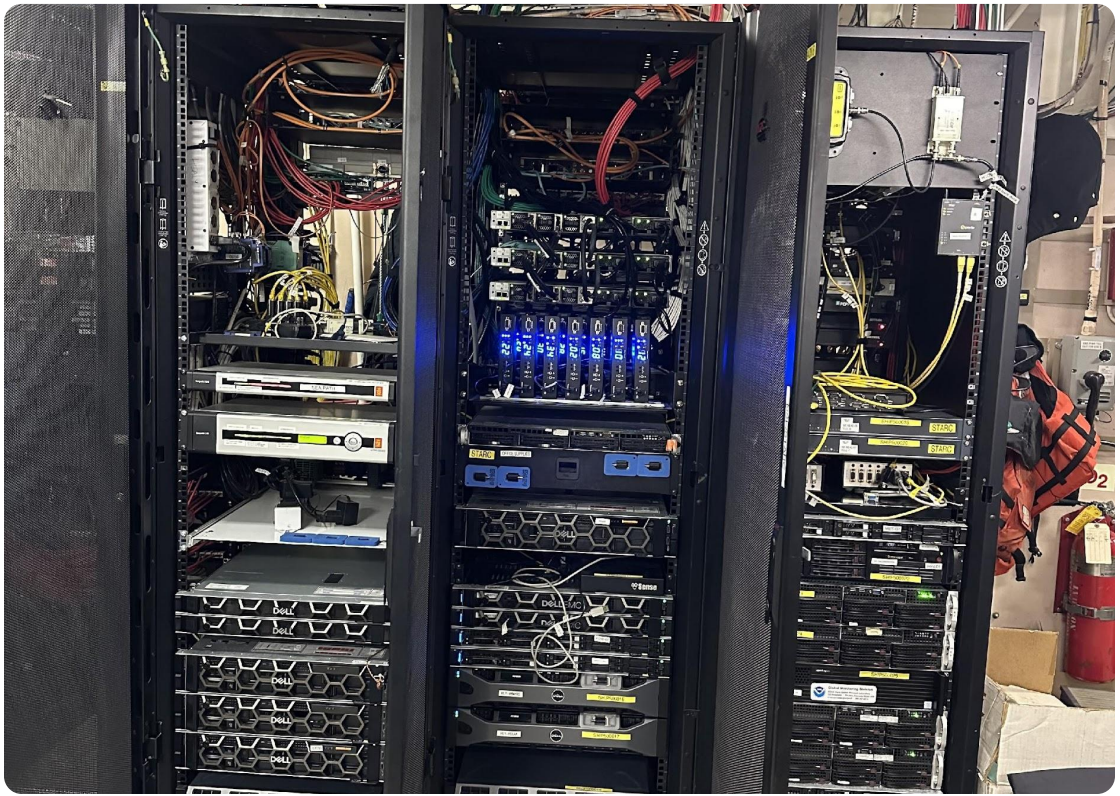
Scientific Instruments ...

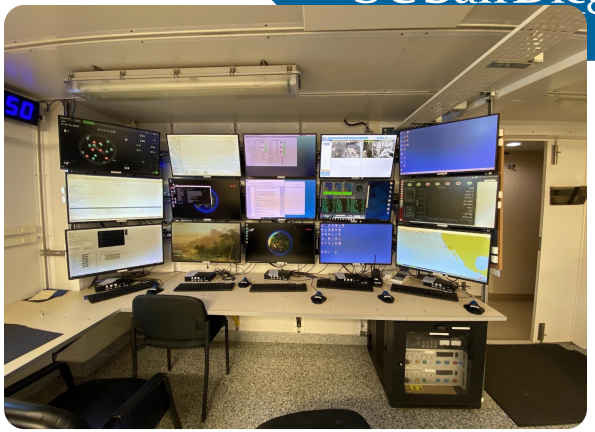






...need underlying IT to work

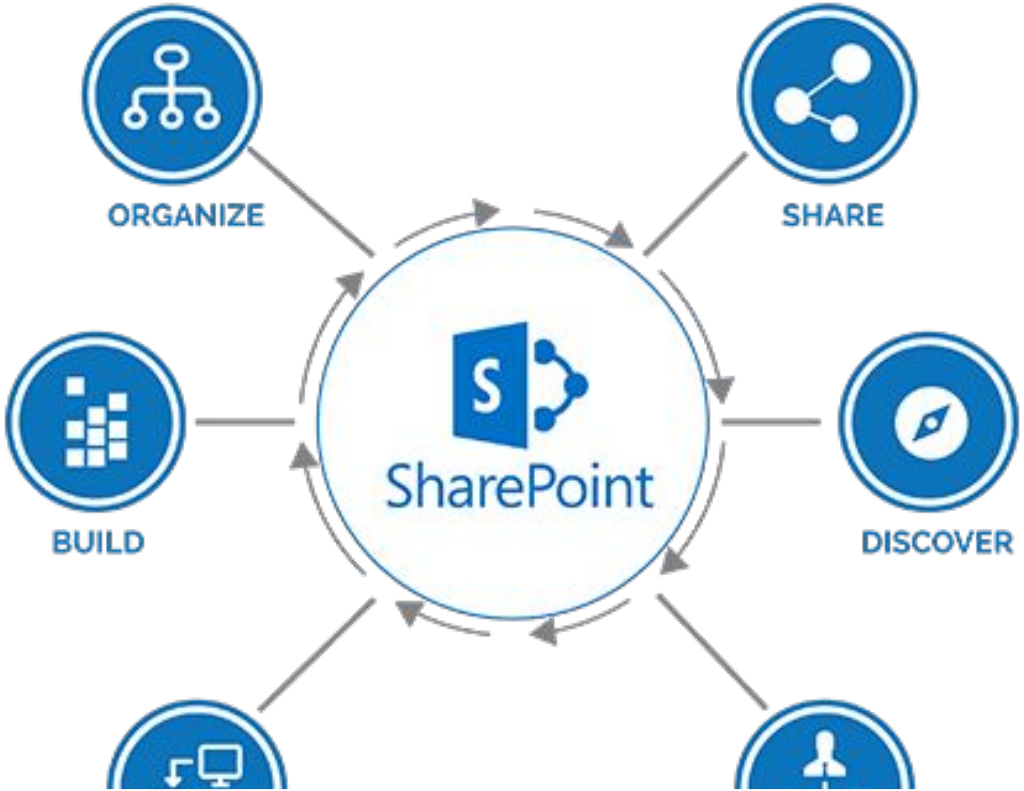




CI can involve connectivity...

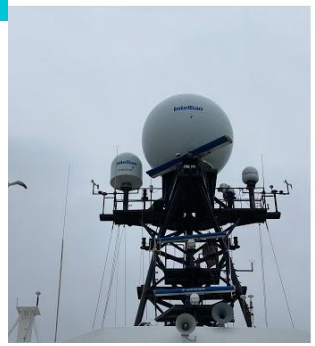
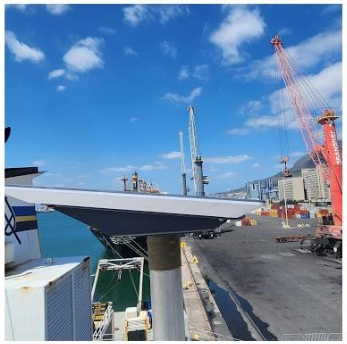
...as well as "invisible" gear...

...even cloud computing.

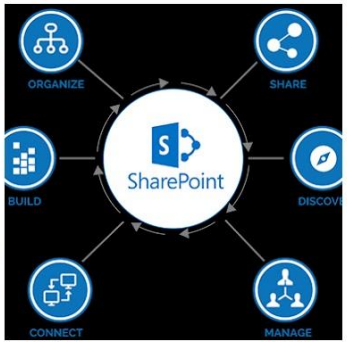


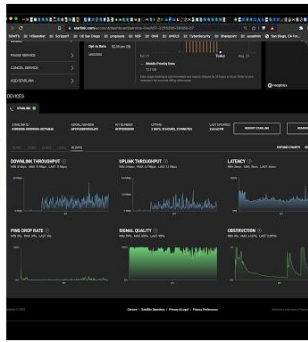
CI is everywhere!

Your day-to-day work life, whether at sea, or at home is likely very dependent on modern computing resources





Why is CI important?

CI is critical to many aspects of (work) life

Because CI is a fundamental component of both successful scientific equipment installations, as well operational infrastructure, it needs to work stably for it to be perceived as invisible

Examples of real-world, disruptive CI failures on ships

- Critical computer does not boot
- Inadequate compute power (slow)
- Slow/faulty network connection
- Internet connectivity impacted
- Difficulty communicating with SMEs off-ship
- Phone breaks, hobbling real-time comms
- Communications fault between science equipment
- Communications fault for crew equipment, causing slow response time
- Power zap, resulting in gear failure (hard disk, power supply)
- No spare parts for critical equipment

CI needs to be stable

For modern CI to be perceived as invisible, it needs to be planned

Shipboard CI installations need:

Industrial/harsh environment considerations, redundancies, and regular maintenance

CI In Action

Universities plan for Cyber Infrastructure

See https://fasterdata.es.net/nsf-docs/campusCIplanning/ for examples.

NSF's Campus Cyberinfrastructure (CC*) program sponsors universities to overcome disparities in cyber-connectivity associated with geographic location, and thereby advance the geography of innovation and enable populations based in these locales to become more nationally competitive in science, technology, engineering, and mathematics (STEM) research and education are particularly encouraged. Science-driven requirements are the primary motivation for any proposed activity.

Example: Outline of IU's 2020 plan

- IU networks
  - Physical network plant
  - Implementation of IPv6
  - Mutually Agreed Norms for Routing Security (MANRS)
- Compute and storage capacity
- InCommon implementation
- IU Cybersecurity and resilience
- Cyberinfrastructure in support of scientific research, collaboration, and scientific workflows
  - Support for general scientific workflows
  - Support for bioinformatics workflows
  - Support for cyberinfrastructure and data collaboration support.

Example: Outline of UCI's 2015 plan

- Guidance
- Infrastructure
  - Compute, Storage, Networking, Support
- The 4-Sigma target
- Seed → Sustain
- Storage
- Networking
- Bandwidth Upgrade within Campus
- Bandwidth Upgrade for UCINet External Network Connections
- Networking Performance Improvement at the OIT Data Center (OITDC)
- Support for New Technology
  - IPv6
  - Software Defined Networking (SDN)
  - InCommon Federation
- Human Resources
  - Scientific Programming
  - Storage and Archiving
  - Hardware
- Software
- Scalability
- Configuration
- Cluster-based Instruction
- Licensing

CI considerations for ARF

- Produce a CI plan for ARF. Chief goals:
  - Compatible with all participating universities' standards for cybersecurity
  - Create the least friction for researchers and staff to move between ARF vessels, in terms of their CI
- From a CI perspective, treat ships like floating buildings – adopt best practices from universities and industry where possible
- Account for regulatory requirements for ships, too (EG Safer Seas, IMO 2021)
- Treat Operational Technology (OT) like Information Technology (IT). IE, plan for systems that control engine, air conditioners, cameras, phones, etc in a manner consistent with how scientific systems are maintained and managed

Summary

Key takeaways

- CI is critical to stable operations on ships
- CI needs to be planned to be "invisible"
- Good CI is needed for all personnel on ship
- To continue to innovate in oceanographic research into the 21st century, CIWG strongly encourages an easy-to-comprehend, well-defined CI Plan for ARF to be a priority goal over the coming years

UC San Diego

Thank you!

Questions?

Jon C. Meyer, Scripps Institution of Oceanography, UC San Diego | Cyber-Infrastructure Working Group (CIWG) | Apr 16, 2024