KECK TELESCOPE CONTROL SYSTEM UPGRADE (TCSU) PROJECT STATUS

[MOCOAAB05]

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W.M. Keck Observatory

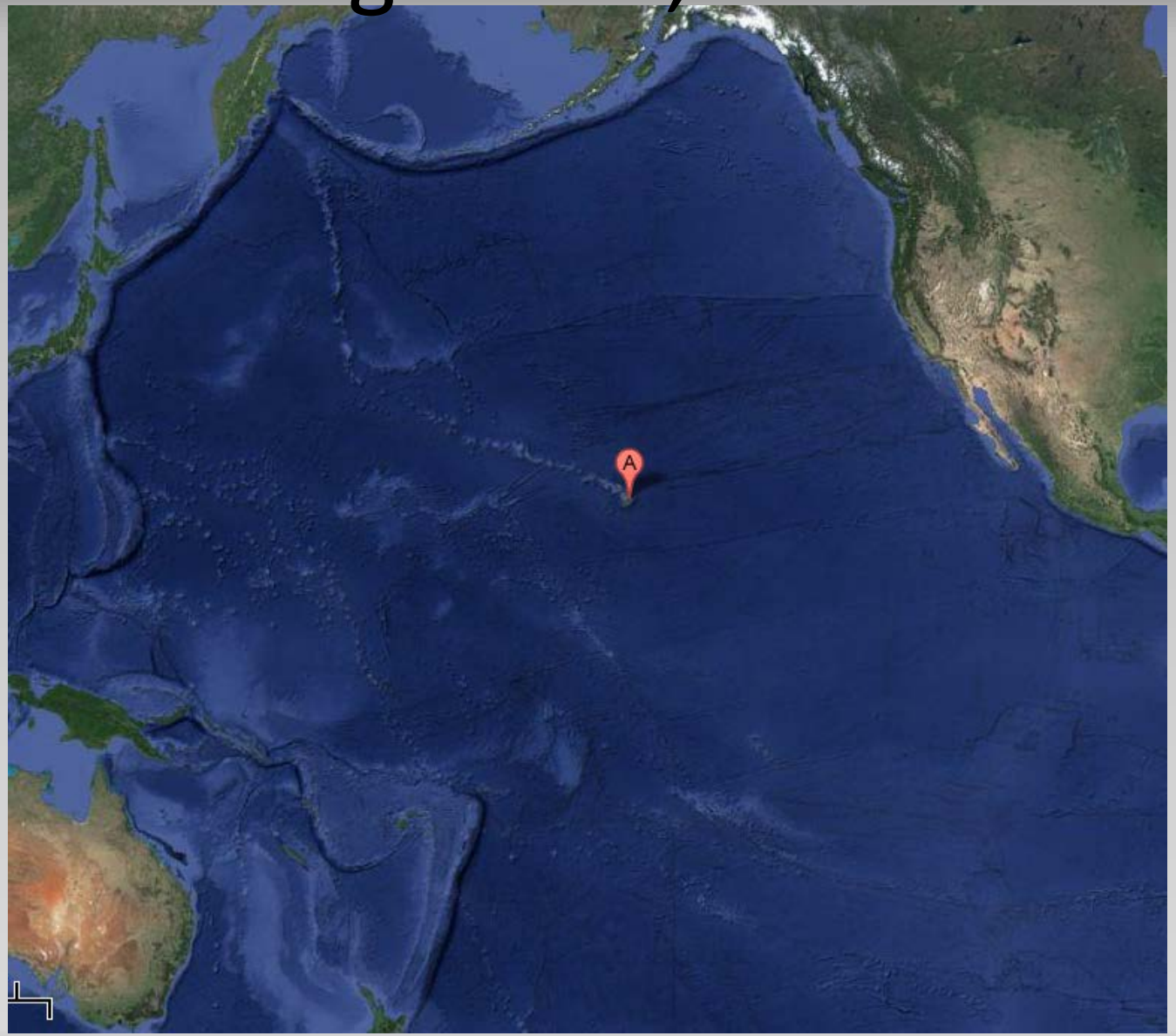
The Telescope Control System Upgrade

- The Keck telescopes, located at one of the world's premier sites for astronomy, were the first of a new generation of very large ground-based optical/infrared telescopes.
- The first Keck telescope began science operations in May of 1993, and the second in October of 1996 making the components of the telescopes and control systems more than 15 years old.
- The upgrade to the control systems of the telescopes consists of mechanical, electrical, software and network components .

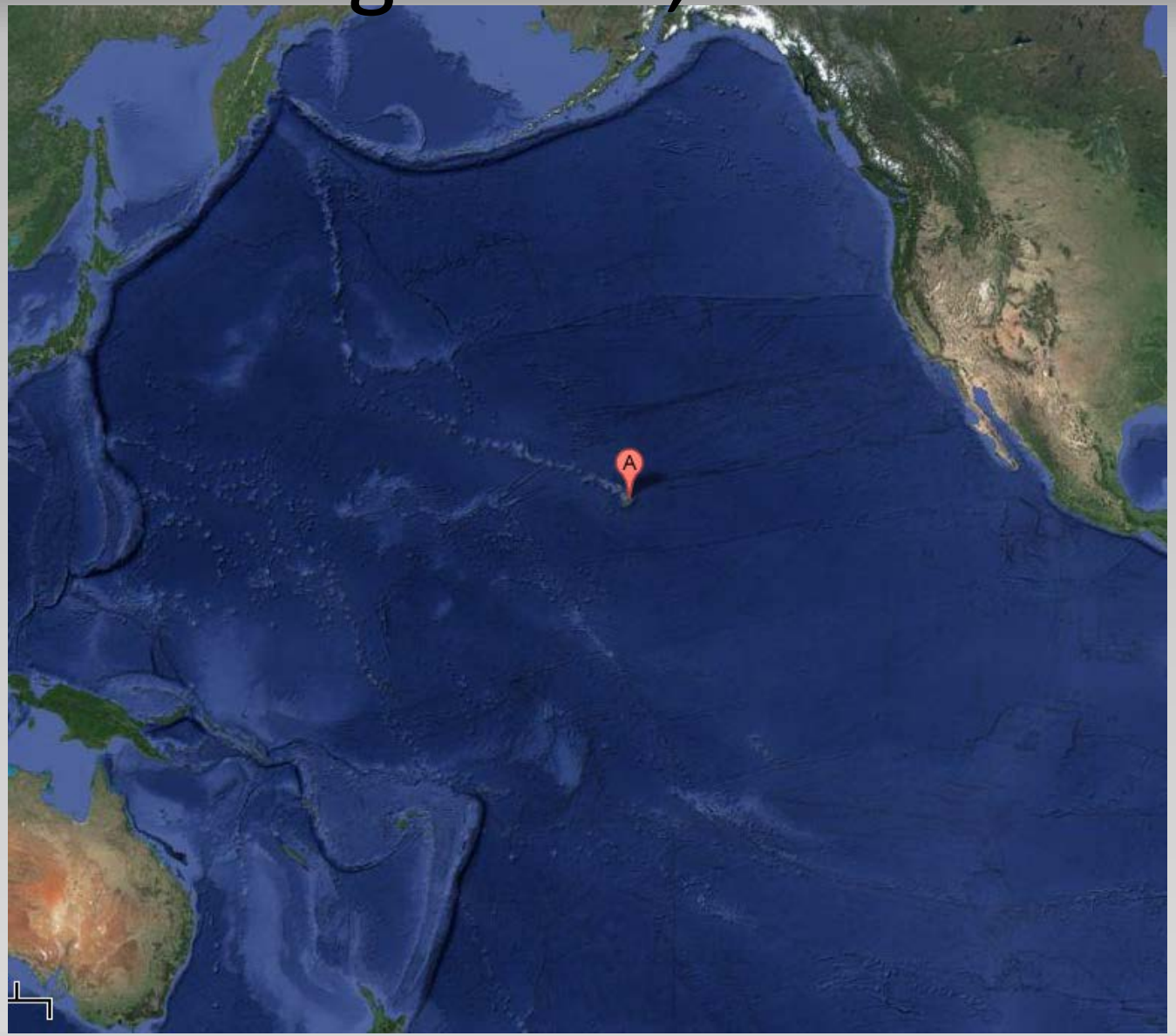
Additional Talks & Posters

- THC0BB05
  - Challenges and solutions to upgrading a running system
- THPPC067
  - New EPICS (ASYN based) device drivers for TCSU
    - National Instruments RIO, Heidenhain EIB, Symmetricom BC635PCIe, ...
- TUPPC032
  - A database-backed configuration service for IOC persistence

The Big Island, Hawaii



The Big Island, Hawaii



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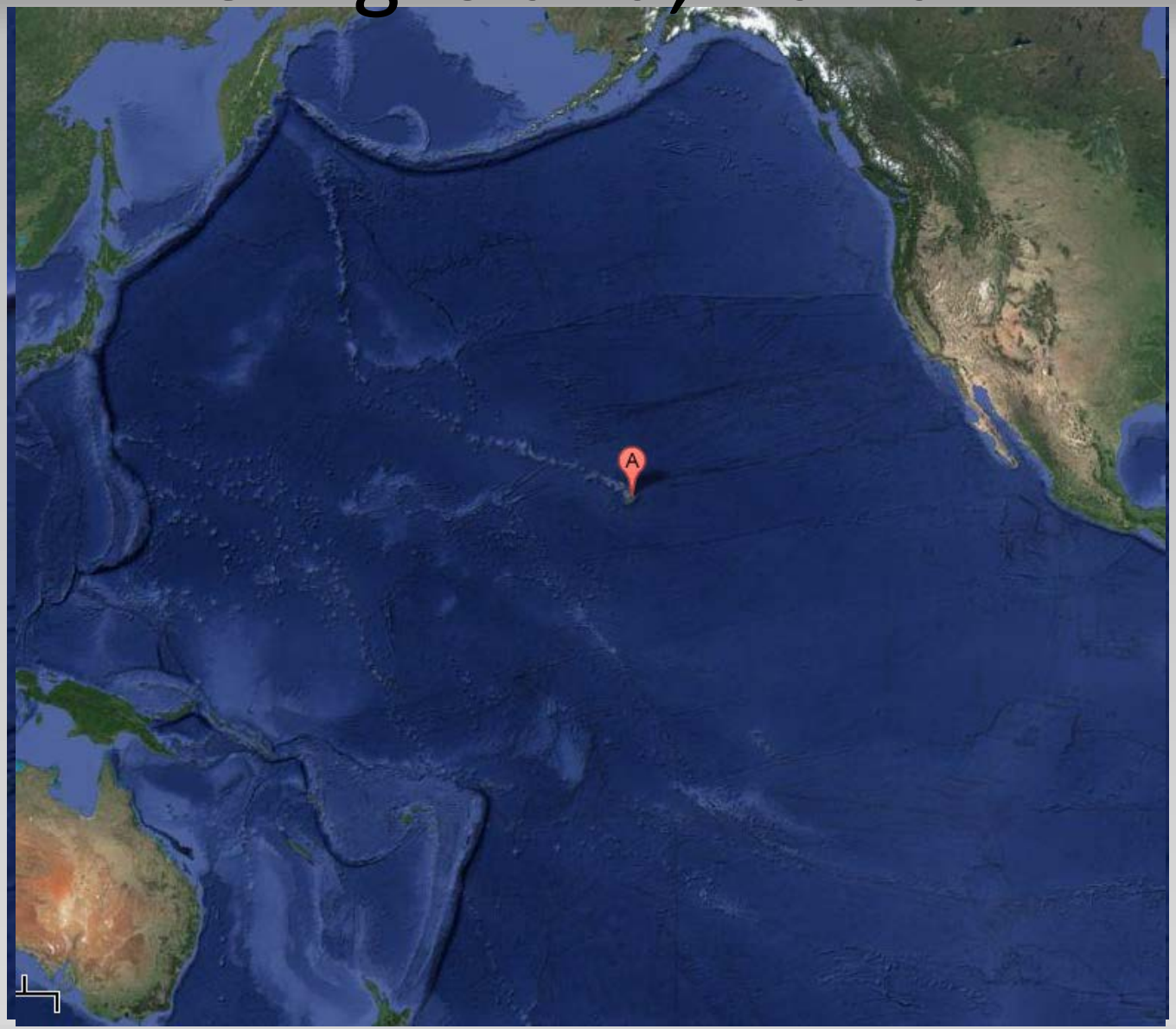

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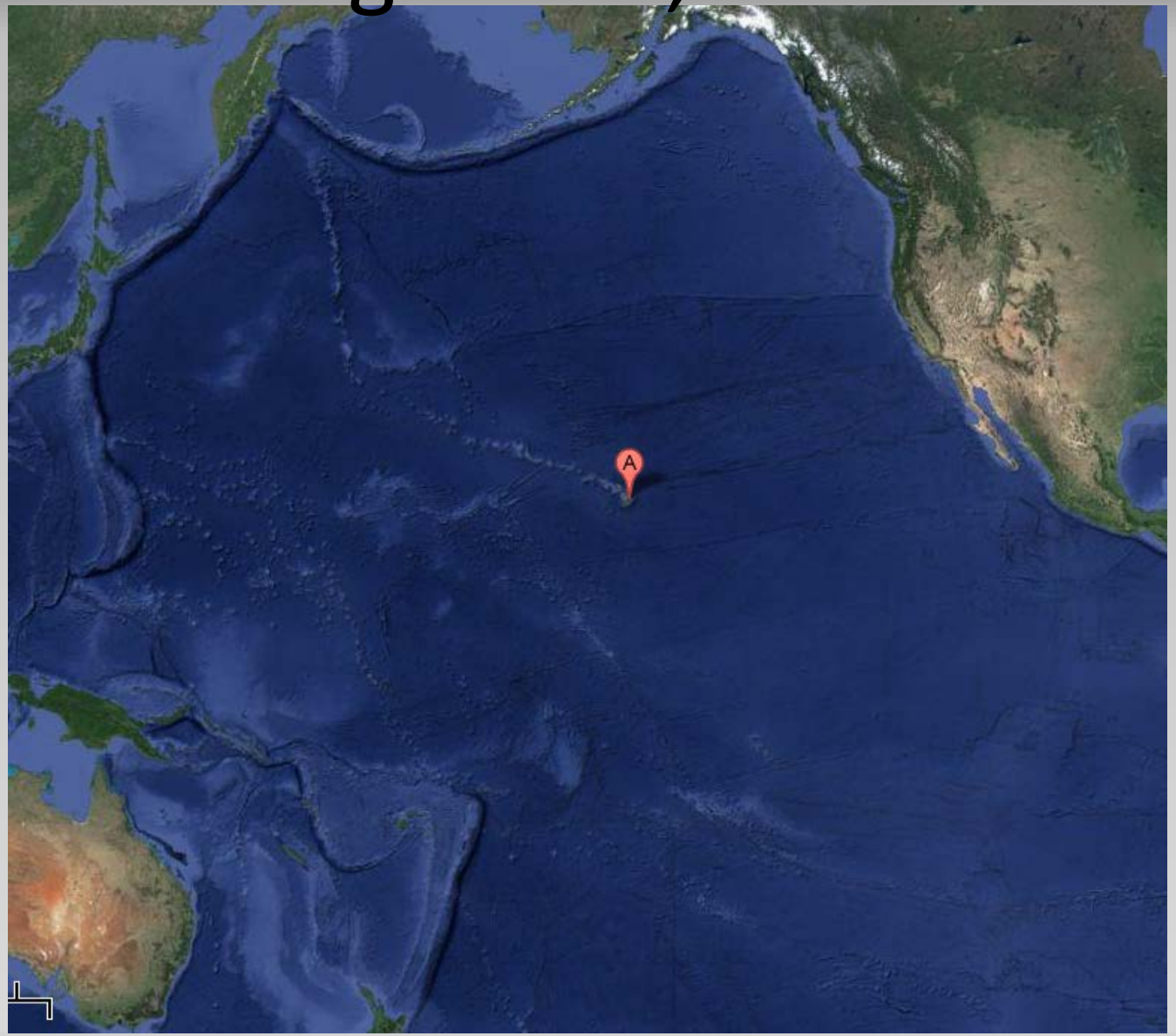

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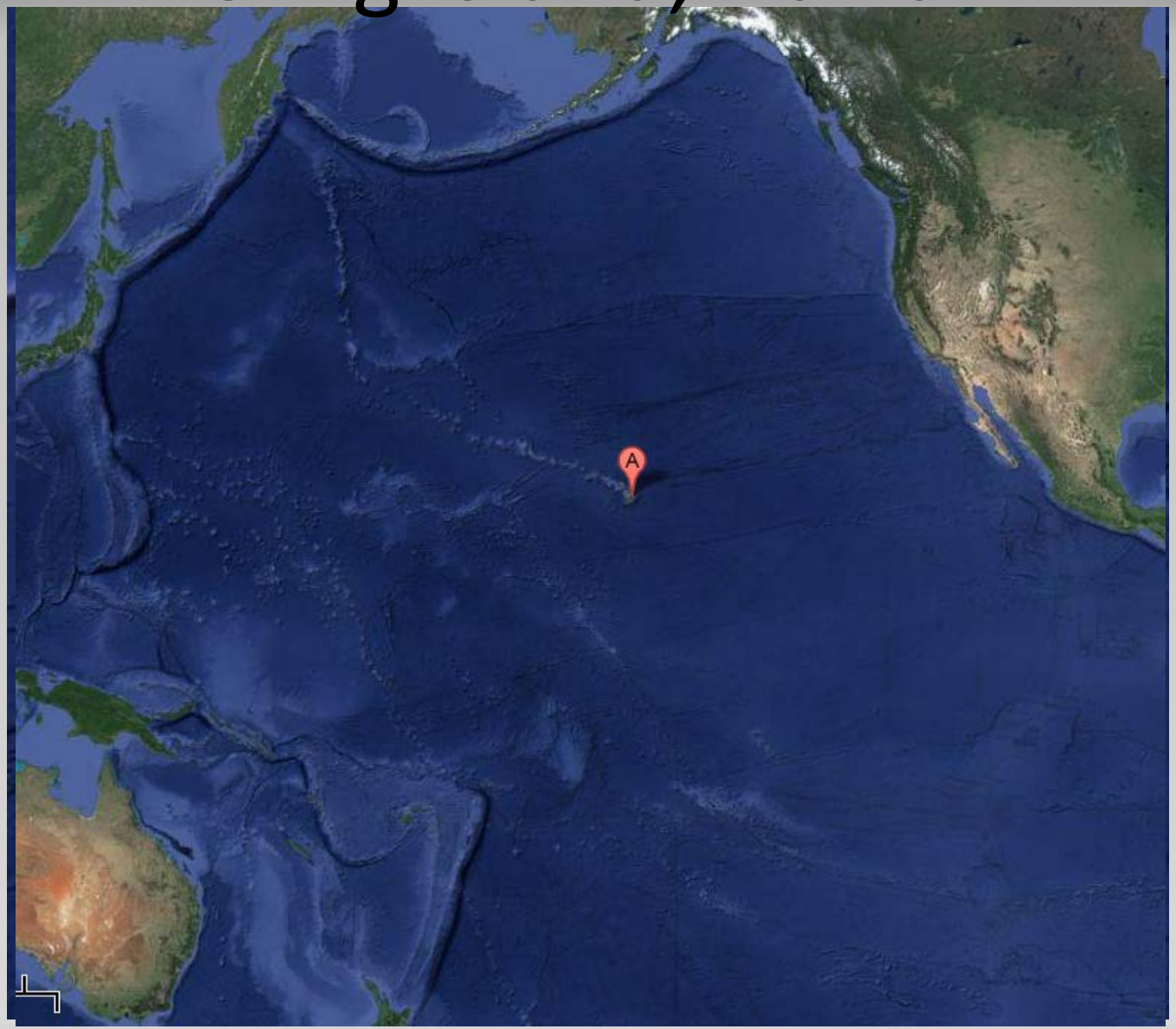

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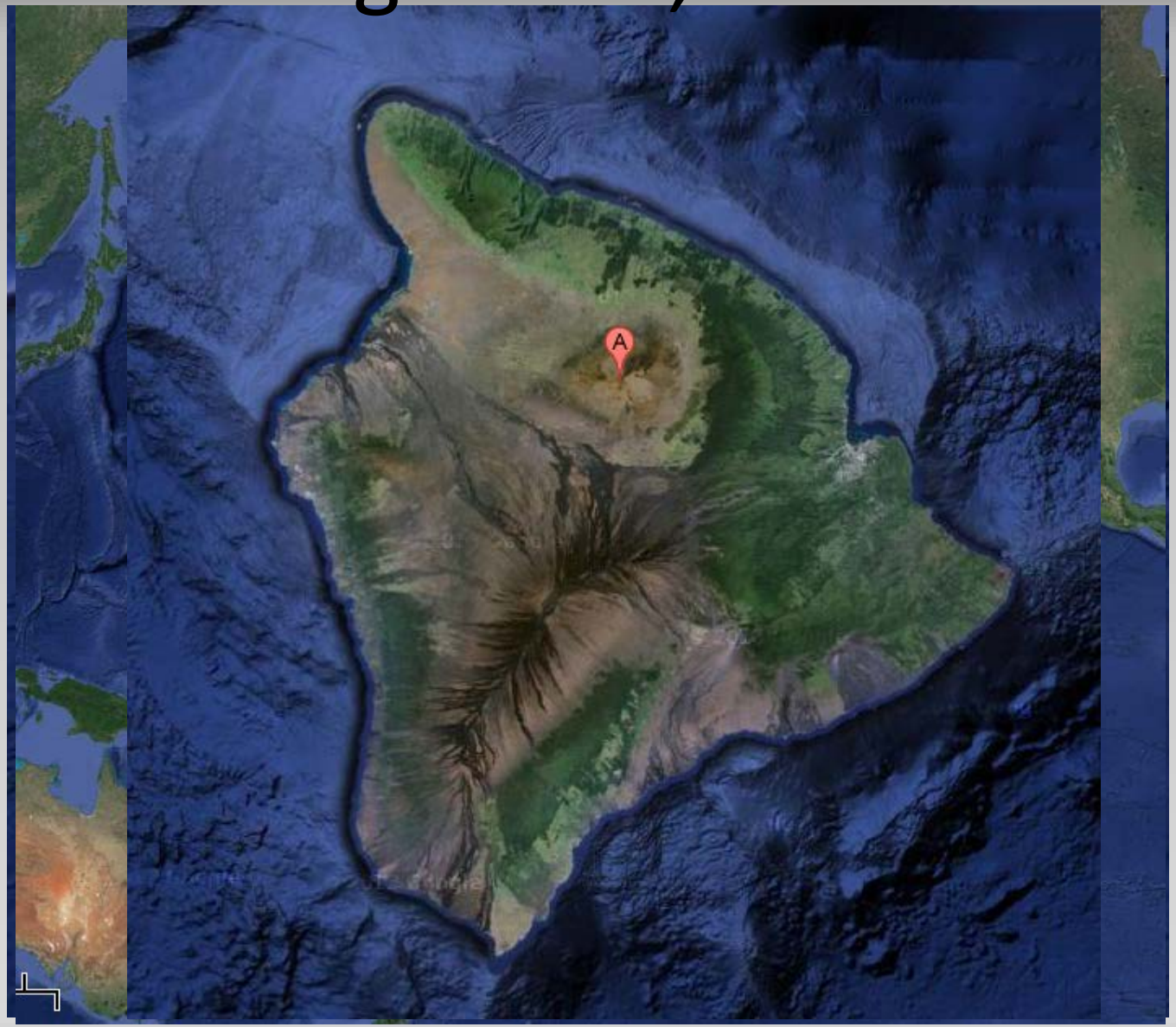

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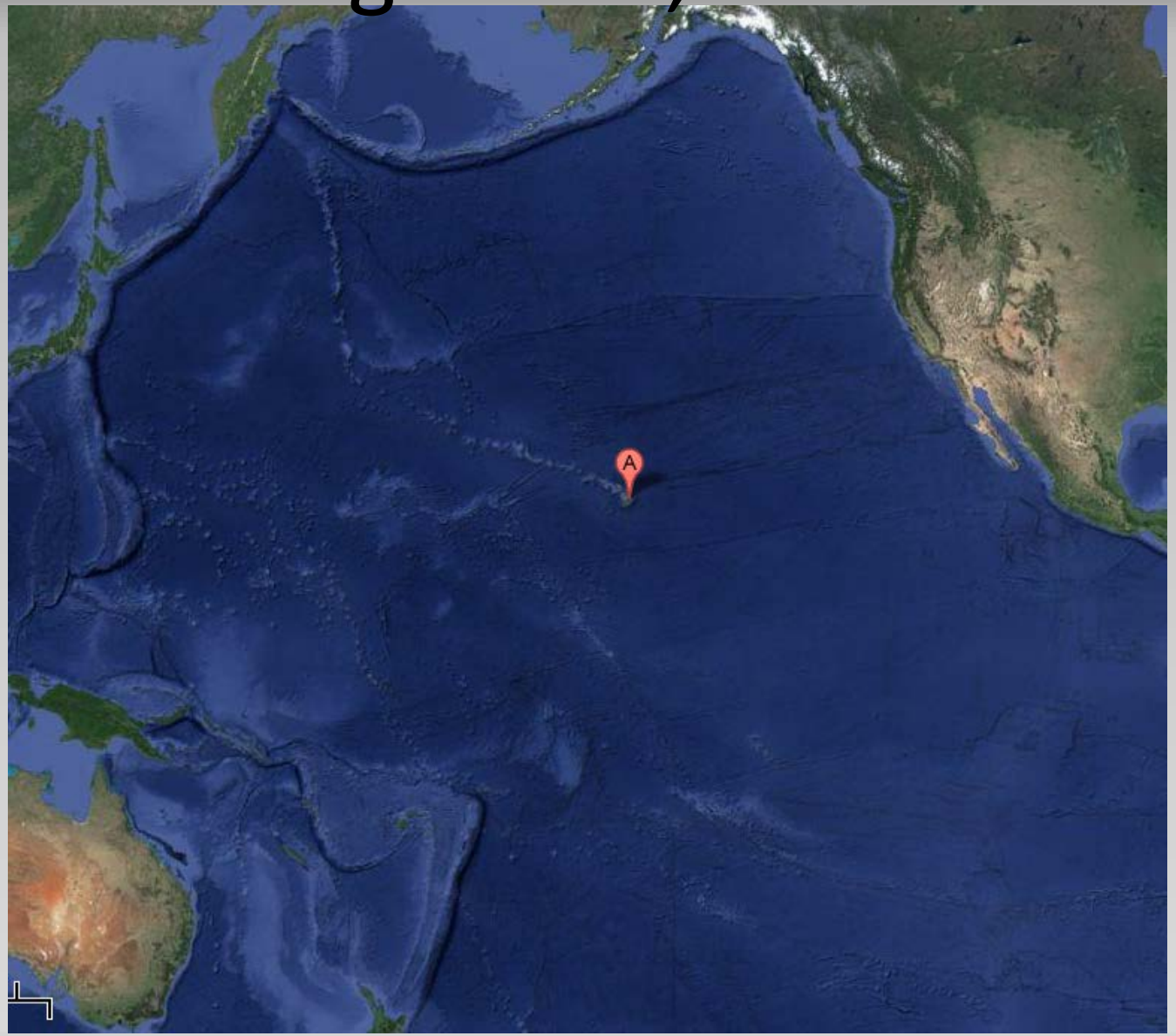

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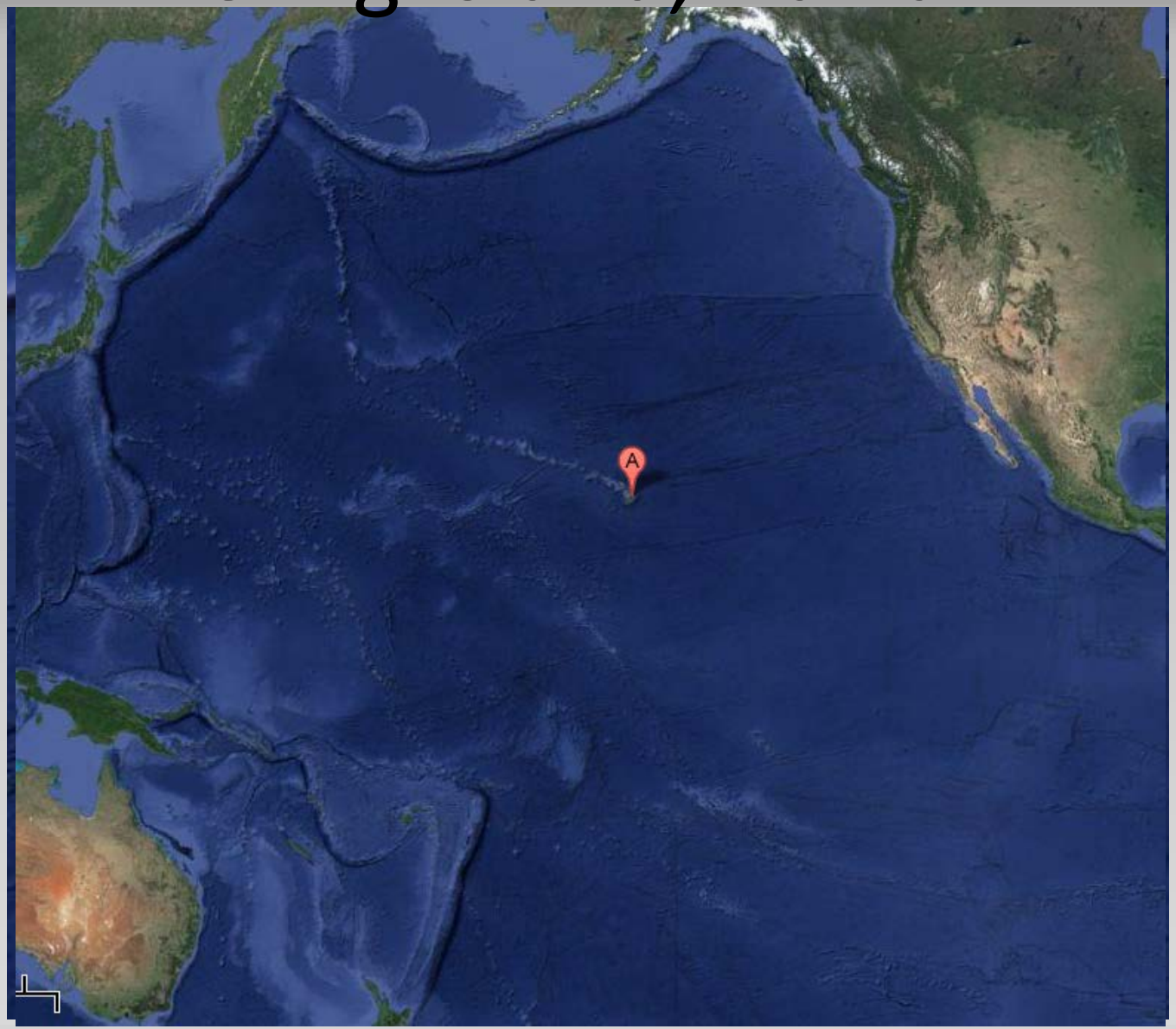

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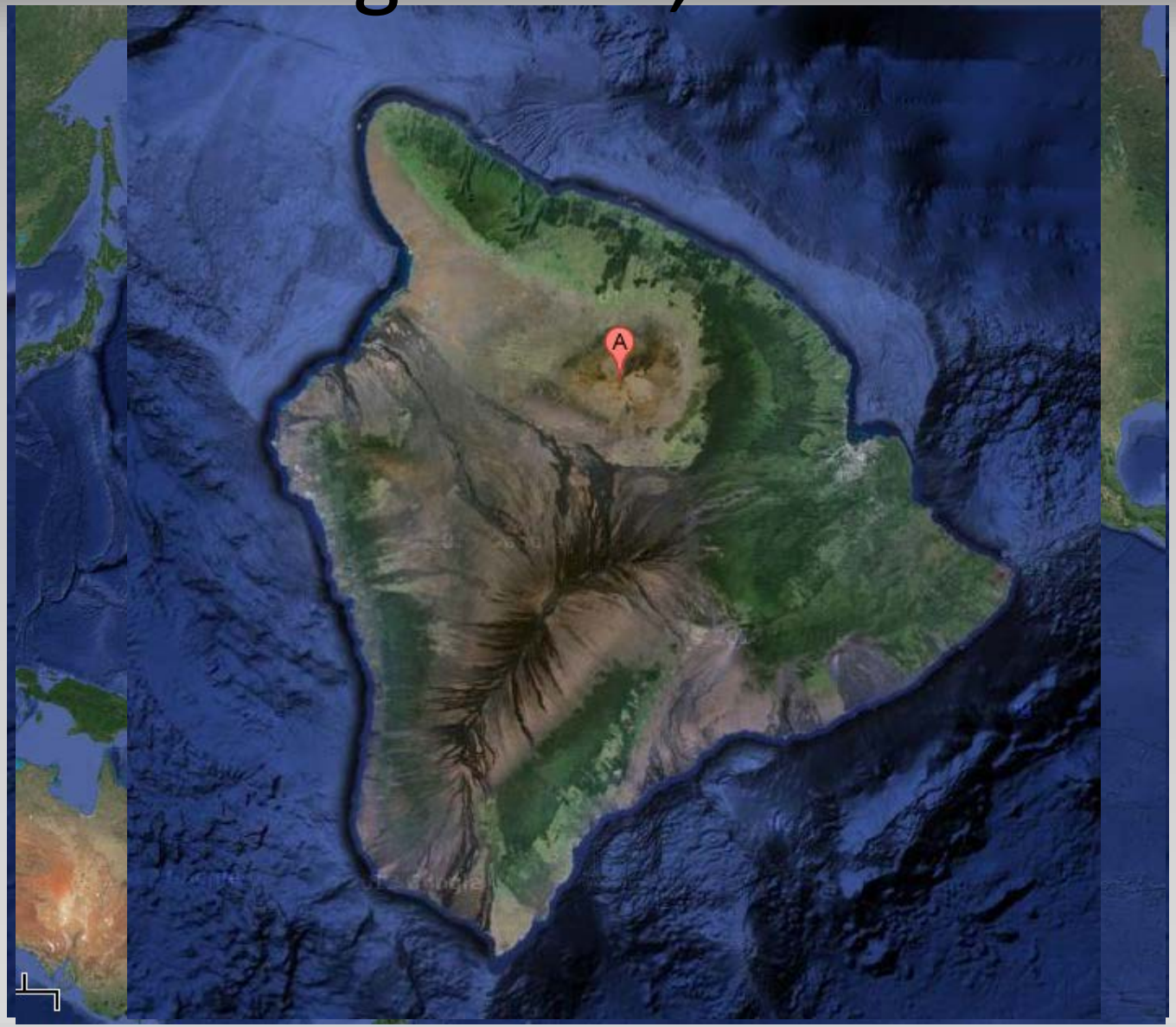
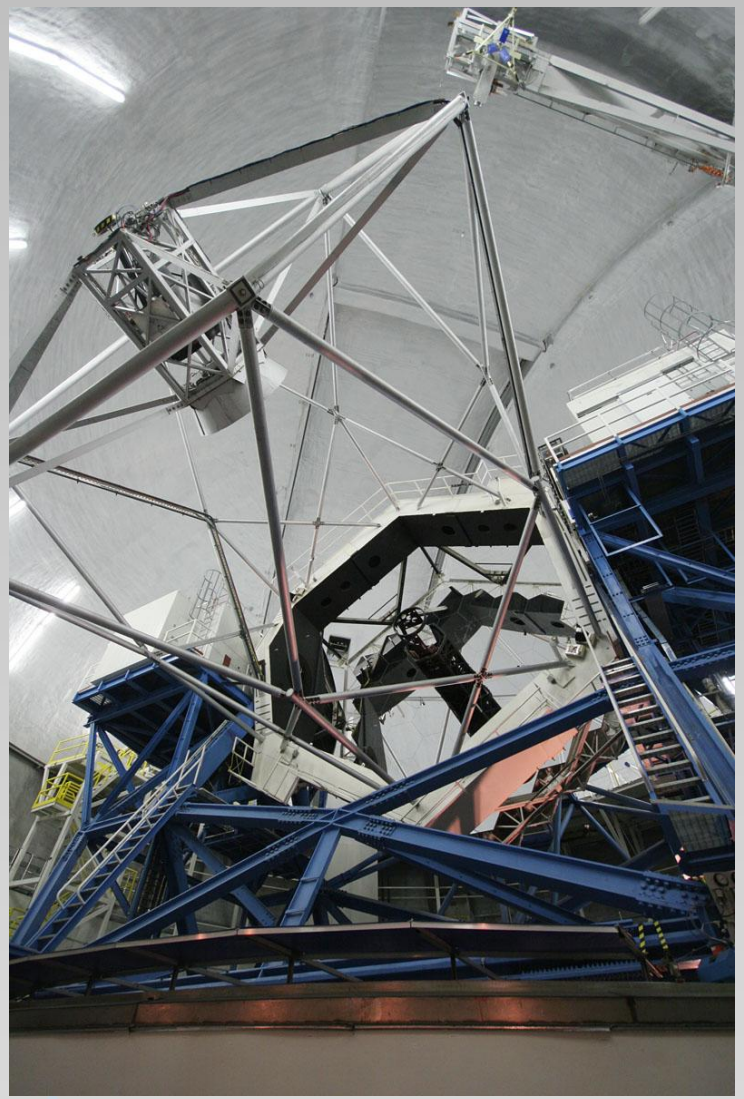
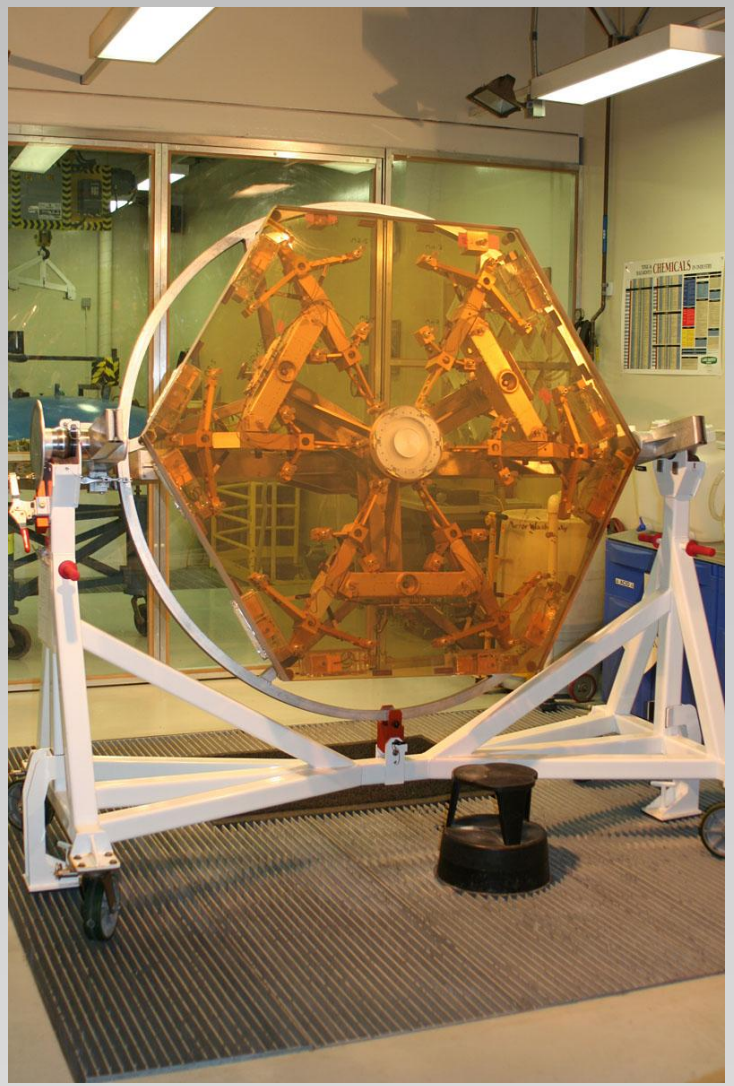


The Big Island, Hawaii

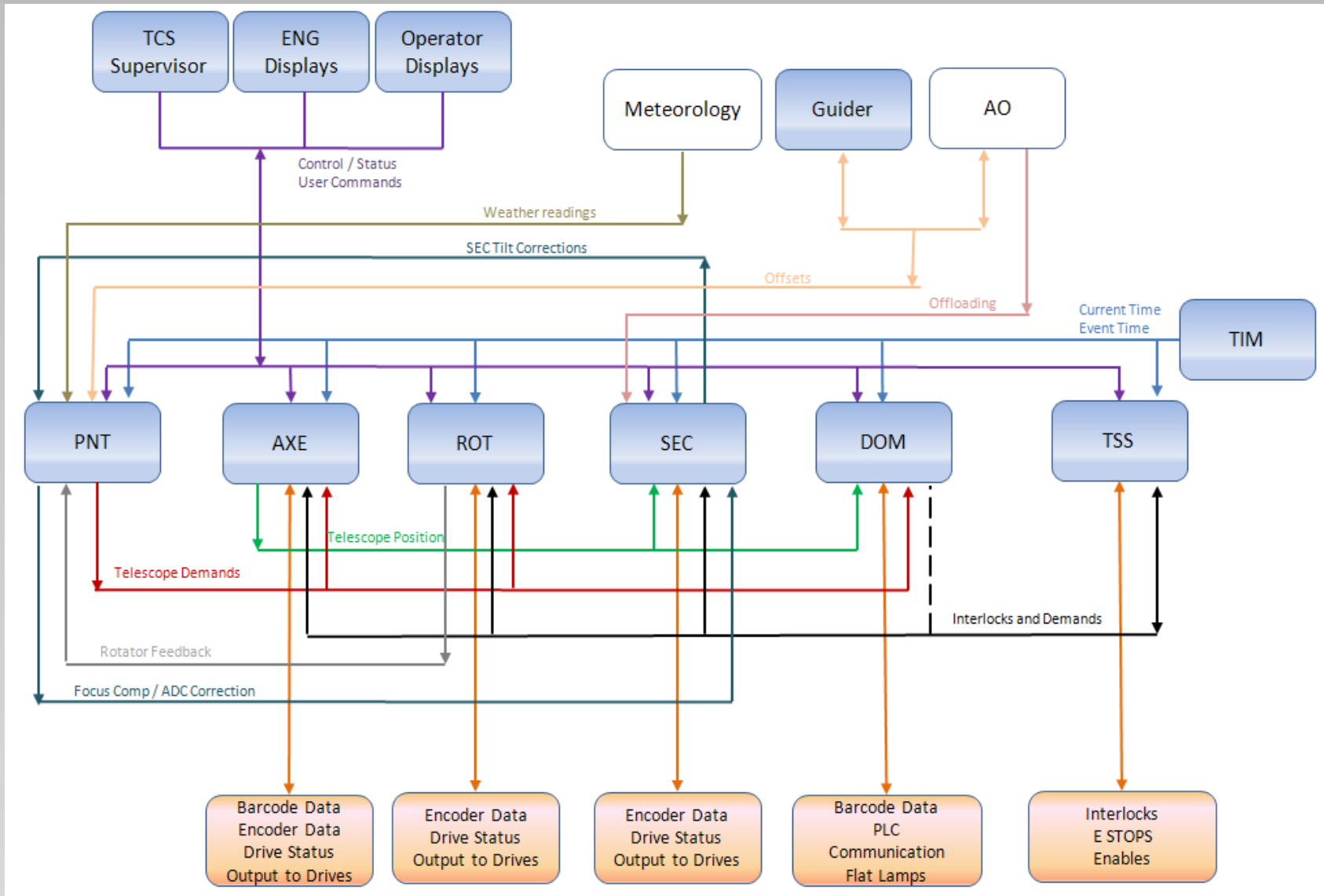
Headquarters at Kamuela, HI

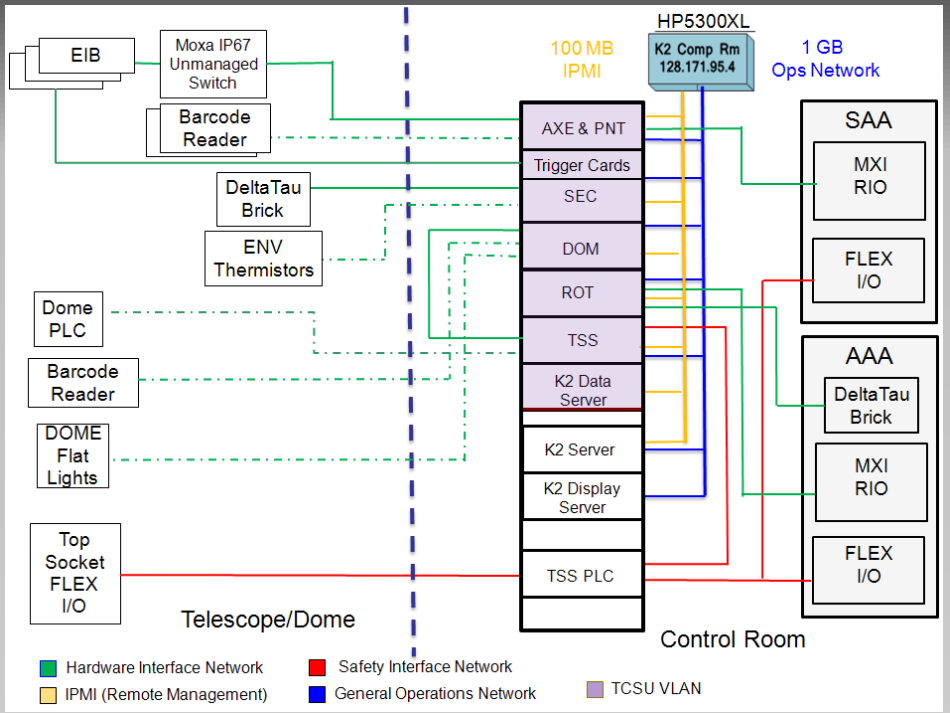
Telescope, Dome and Mirror(s)



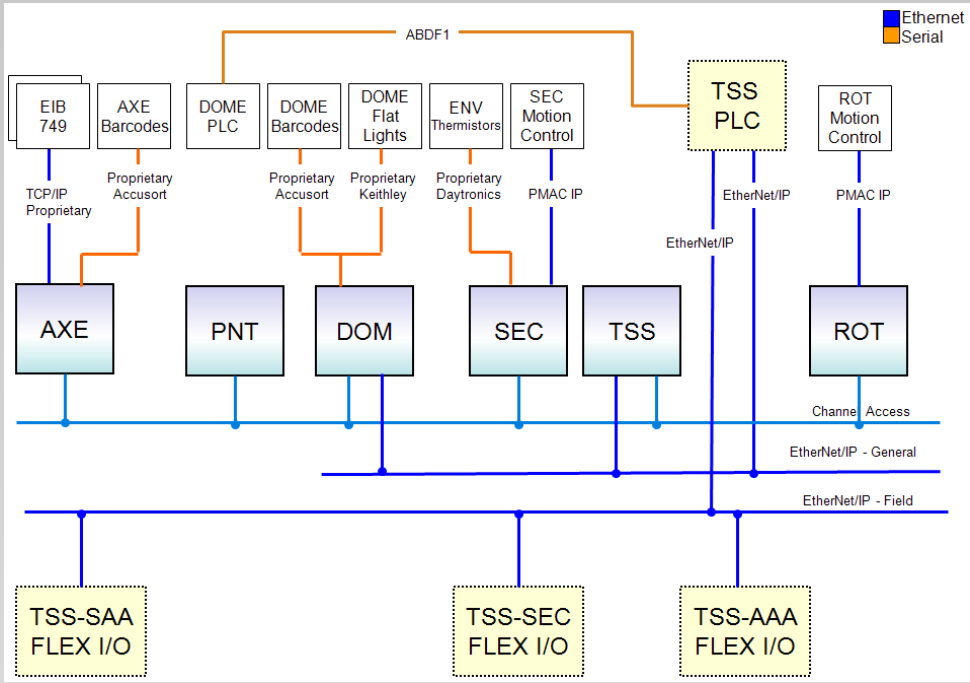


TCS Subsystems



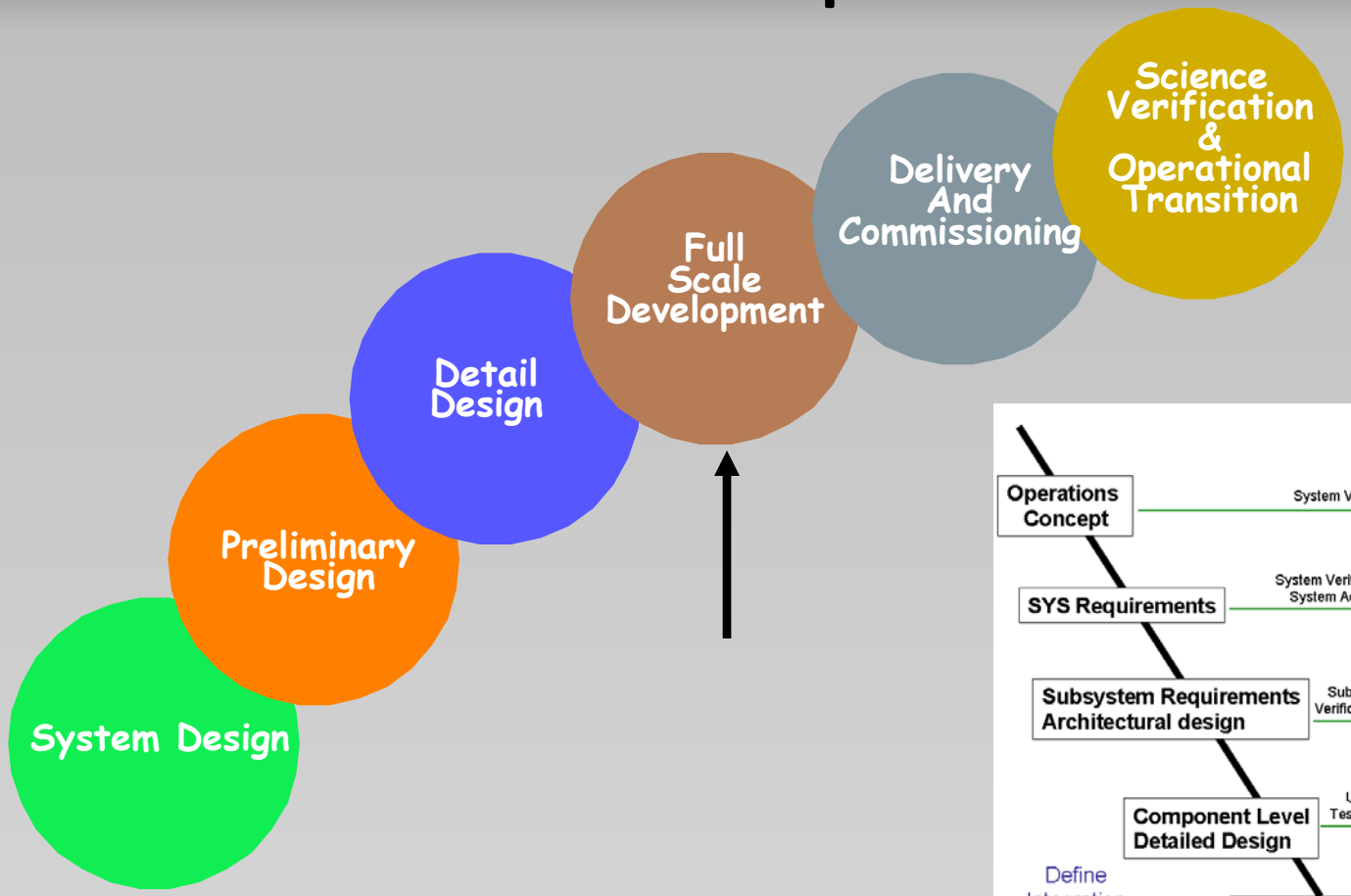


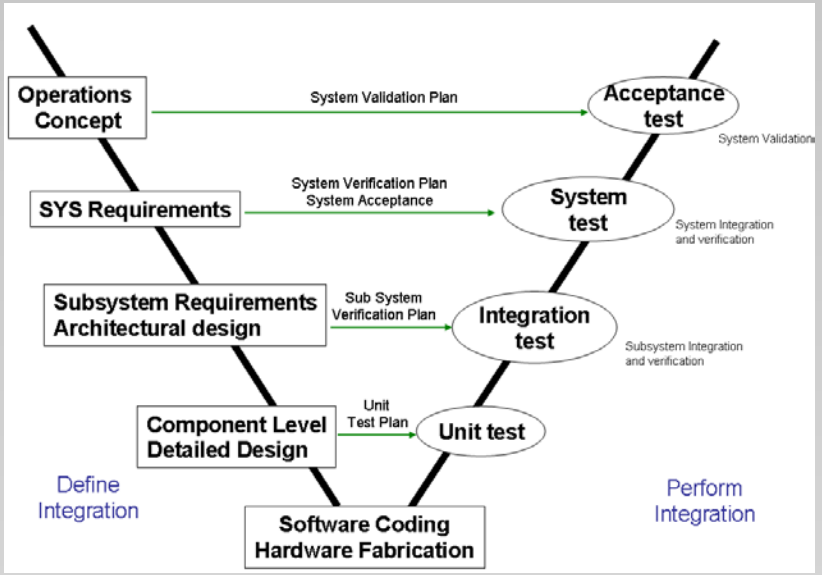
Subsystem Physical View



Subsystem Protocols

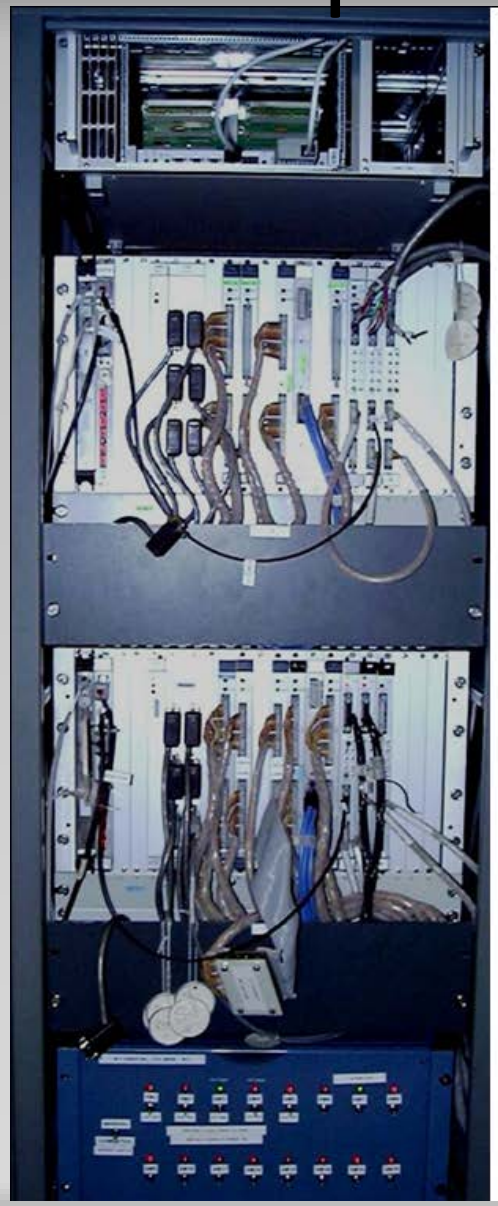
The Development Process

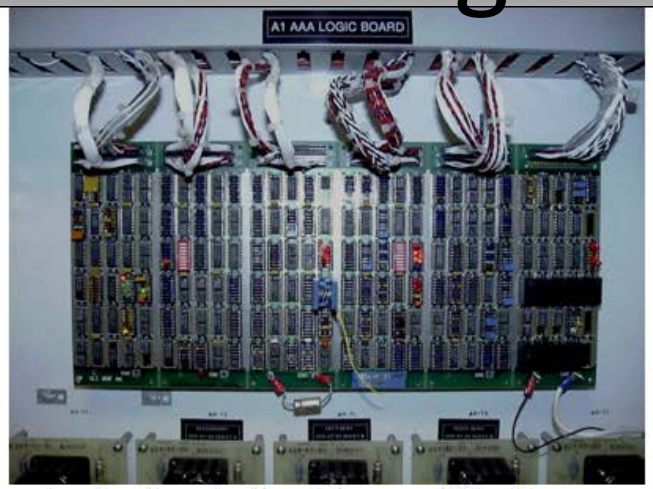




JAMA Suite (formerly Contour) for requirements management
Six Sigma "Failure Modes and Effects Analysis (FMEA) for risk analysis
Microsoft Project for schedule and tracking

Examples of Existing Hardware





Logic Boards for drive amplification

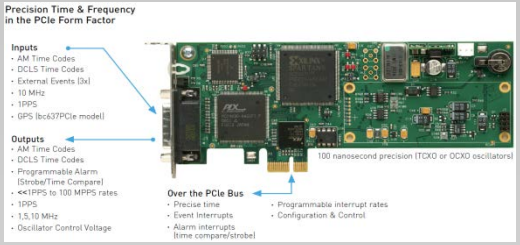
Telescope Drive Analog Logic

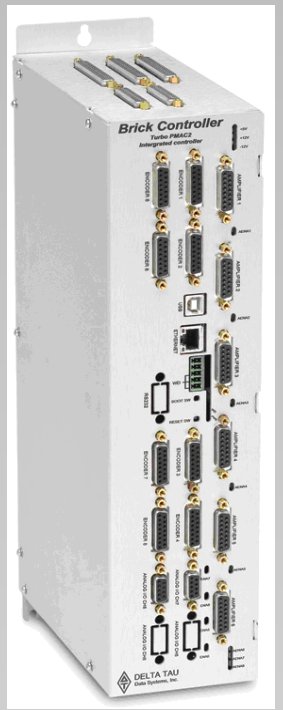
Azimuth Manual Control Panel

IO Racks for auxiliary control

VME Crates for the K1 telescope control system

New TCSU COTS Hardware

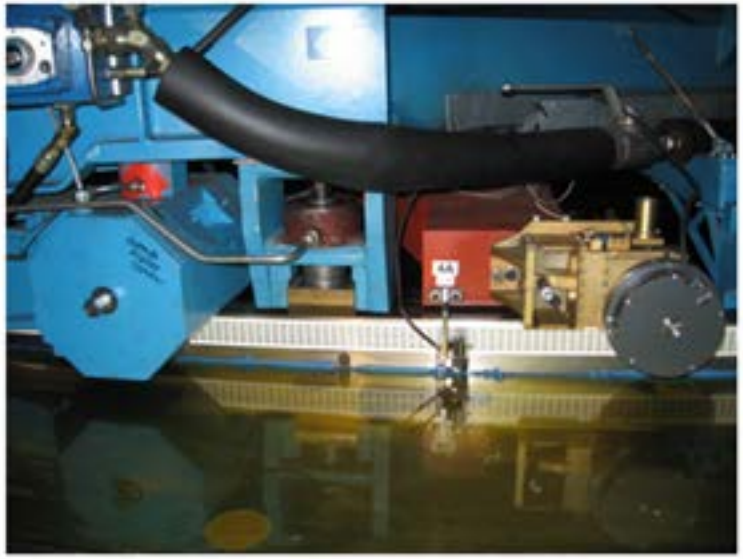




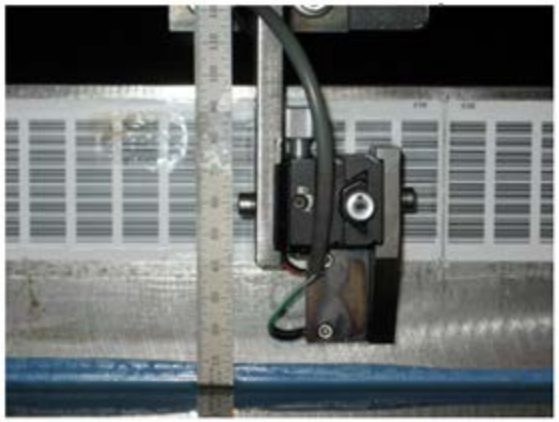
What	Principal Subsystem
IPMI	ALL
Multi Port Ethernet	ALL
bc635PCIe	ALL
RocketPort Express	AXE, DOM, SEC
MXI	AXE, ROT
Brick	ROT, SEC

Hardware components mapped to subsystem

Existing Encoder Solution



K2 Azimuth – Encoder, barcode and Precision Reference Mark (PRM)

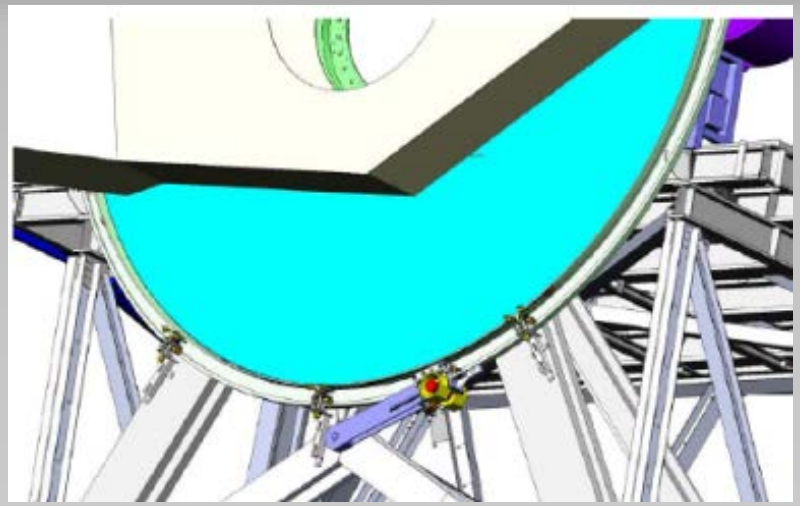


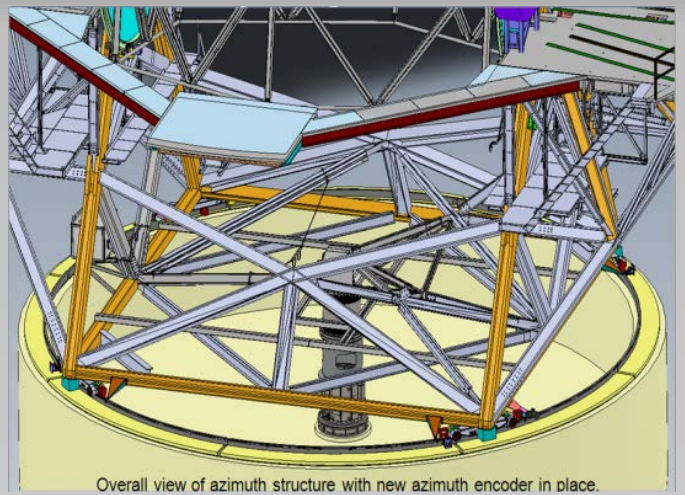
K2 Azimuth - PRM close up

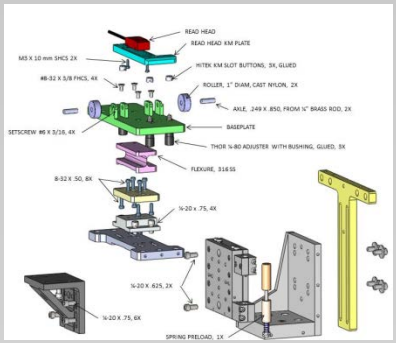
K2 Encoder Interface

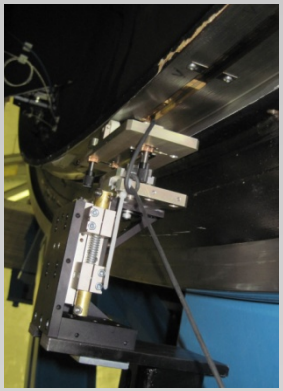
Heidenhain ROD 800 - Sealed Incremental Angle Encoders with Solid Shaft
Barcode solution for absolute positioning to 1 degree
Precision Reference Marks (PRMs) for absolute positioning to 0.1 degree
Custom Electronics and VME Counter Cards

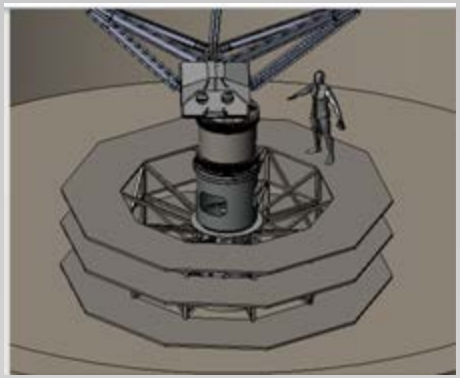
New Encoder Solution

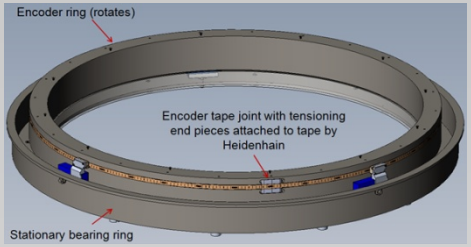












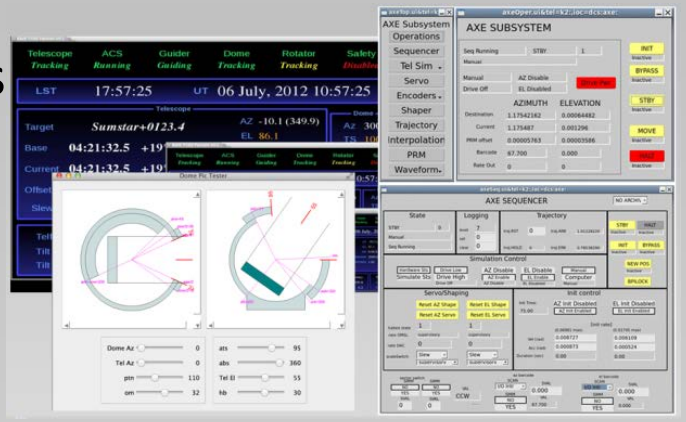
Heidenhain ERA 8480 Read Heads
Heidenhain ERA 8400 C/I Tape (with Distance Coded Reference Marks)
Heidenhain EIB 749 – Encoder Interface Box

Full Scale Development To Date

- Build Environment complete with full configuration management and tools (TDCT, make, debuggers, release scripts etc.)
- All COTS hardware has been purchased and integrated with EPICS
- The HQ Lab has Linux servers with MRG real time running EPICS IOCs and functioning implementations for:
  - All necessary drivers
  - TIM subsystem
  - Infrastructure and tools
  - PLC communication and basic programming
  - FPGA communication and basic programming
  - IOC monitoring
  - AXE, ROT, SEC, DOM and PNT software

Full Scale Development To Date

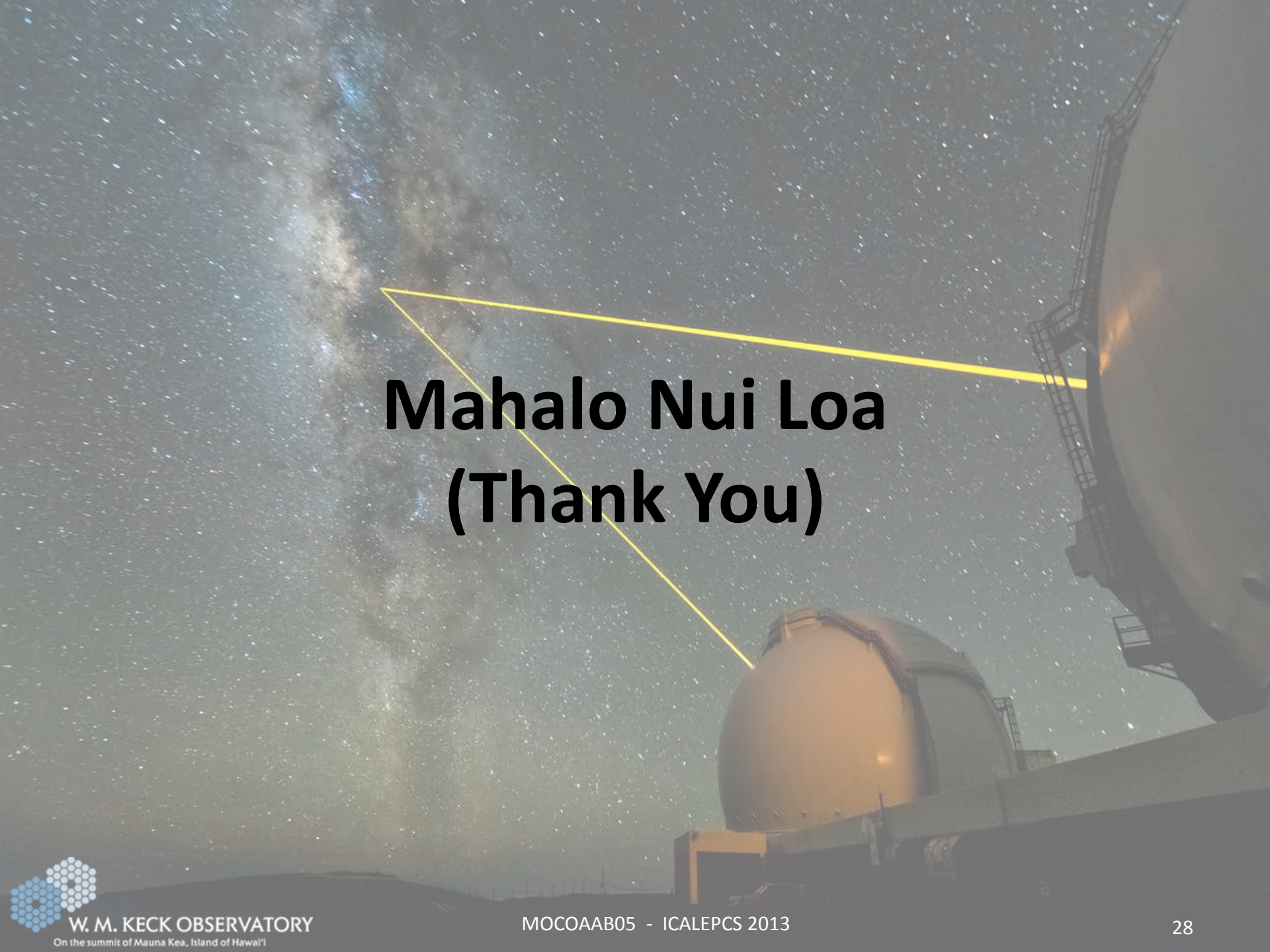
- All existing engineering user interfaces have been ported (painlessly) from DM to caQtDM
- QT based prototypes completed for ops displays
- Elevation Encoder Prototype Complete
  - More engineering nights planned
- Azimuth Encoder Prototype work has started
  - Basic collocation and vibration analysis complete
  - Expect summit installation January 2014



- New feed-forward and revised structural filter for servo solution has been tested
- Secondary load-side encoder installation will start in October
- Kinematic programming for secondary coordinated moves are finished
- Telescope testing has begun with aspects of the new DOM subsystem

What is Next?

- Complete full scale development
- Complete azimuth encoder prototype
- Perform headquarters integration and test
- Perform summit preparations
  - Install switch boxes, pull cables, cable the switching solution and field I/O
- Start KII Deployment, commissioning and operational hand over
  - Goal completion date: December 2014
- Start KI Deployment, commissioning and operational hand over
  - Goal completion date: September 2015


Mahalo Nui Loa
(Thank You)