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Australian Synchrotron Control Systems

Presented by: Alan Ng - Control Systems Manager

Date: 30th October, 2020

Science. Ingenuity. Sustainability.

Overview

- The Control systems group
- BRIGHT Program
- Controls functional organisation
- Beamline team structures
- Controls development process
- Standardized solutions for BRIGHT programme
- COVID-19 Impact for BRIGHT programme
- BRIGHT beamlines updates – MEX and MCT projects
- Q&A

Control Systems

Control Systems Group

- Team Manager: Alan Ng
- Team Members:

Maxwell Smart
Honorary Agent of Control

Ben Baldwinson
Mark Clift
Adam Michalczyk
Nader Afshar
Pierfranco Valitutti
Tom Fiala
Vesna Samardic-Boban
Ross Hogan
Danny Wong
Stephen Oelofse
Noel Basten (Tech)
Simon Humphrey (Tech)

- Provide expertise support and experience in areas related to Beamline equipment control
- Support priority to BRIGHT projects
- Support and provide a point of contact for existing Beamlines

BRIGHT Program

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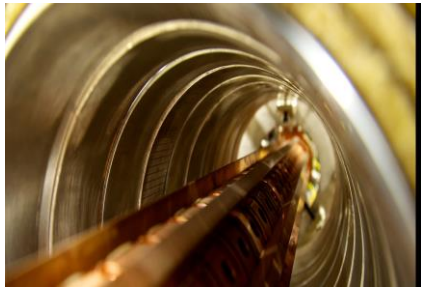
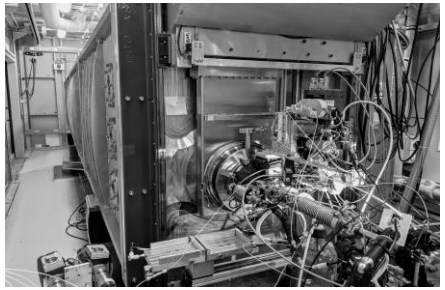
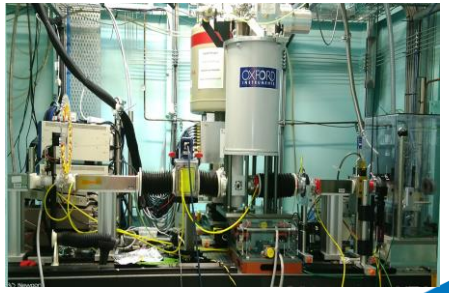
New BRIGHT Beamlines

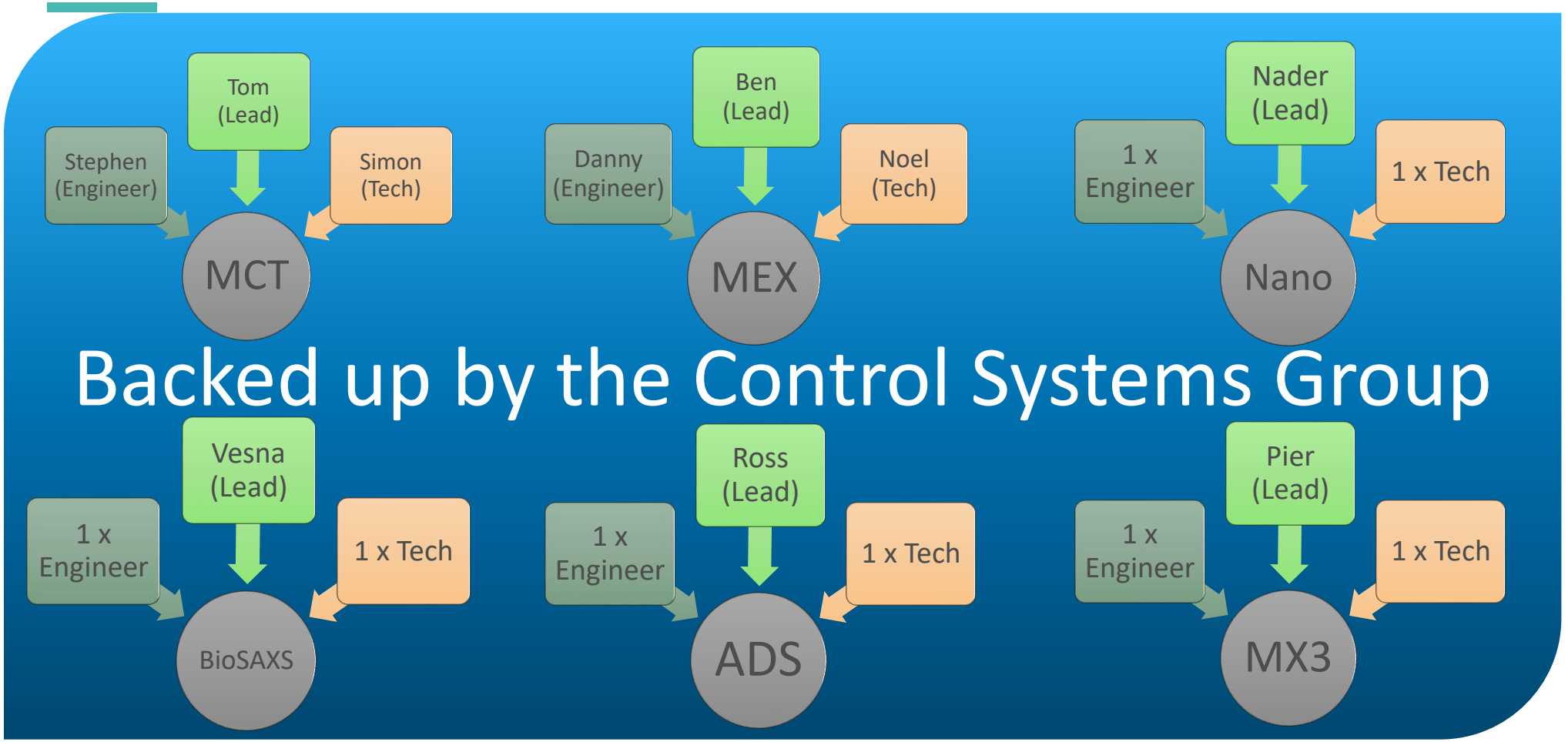
1. Micro-Computed Tomography beamline (MCT)
2. Medium Energy X-ray Absorption Spectroscopy Beamline (MEX1 & MEX2)
3. X-ray Fluorescence Nanoprobe beamline (Nanoprobe)
4. High Performance Macromolecular Crystallography Beamline (MX3)
5. Biological small angle X-ray scattering beamline (BioSAXS)
6. Advanced Diffraction & Scattering Beamlines (ADS-1 and ADS-2)







BRIGHT - Beamline Team Lead + Task Force



* The *Lead Control Systems Engineer* coordinates all controls related activity for the Beamline, following the Controls Development Process.

Controls – Area of Contribution:

- Supporting Synchrotron & BRIGHT via:
  - Direct BRIGHT BL engagement via embedded Lead Control Engineers
  - Utilities & Controls Integration project (BRIGHT+)
  - Beamline Control Systems Platform (BCSP)
- BL CS architecture, BL CS HW and EPICS layer SW for
  - Data Acquisition, electronics and BL components/instrumentation/devices
- Interface definitions and implementation between EPICS layer and Scientific SW (Sci Computing/BL Sci)
  - Interface between EPICS layer and Engineering GUI's
  - SW testing and Integration for BL systems

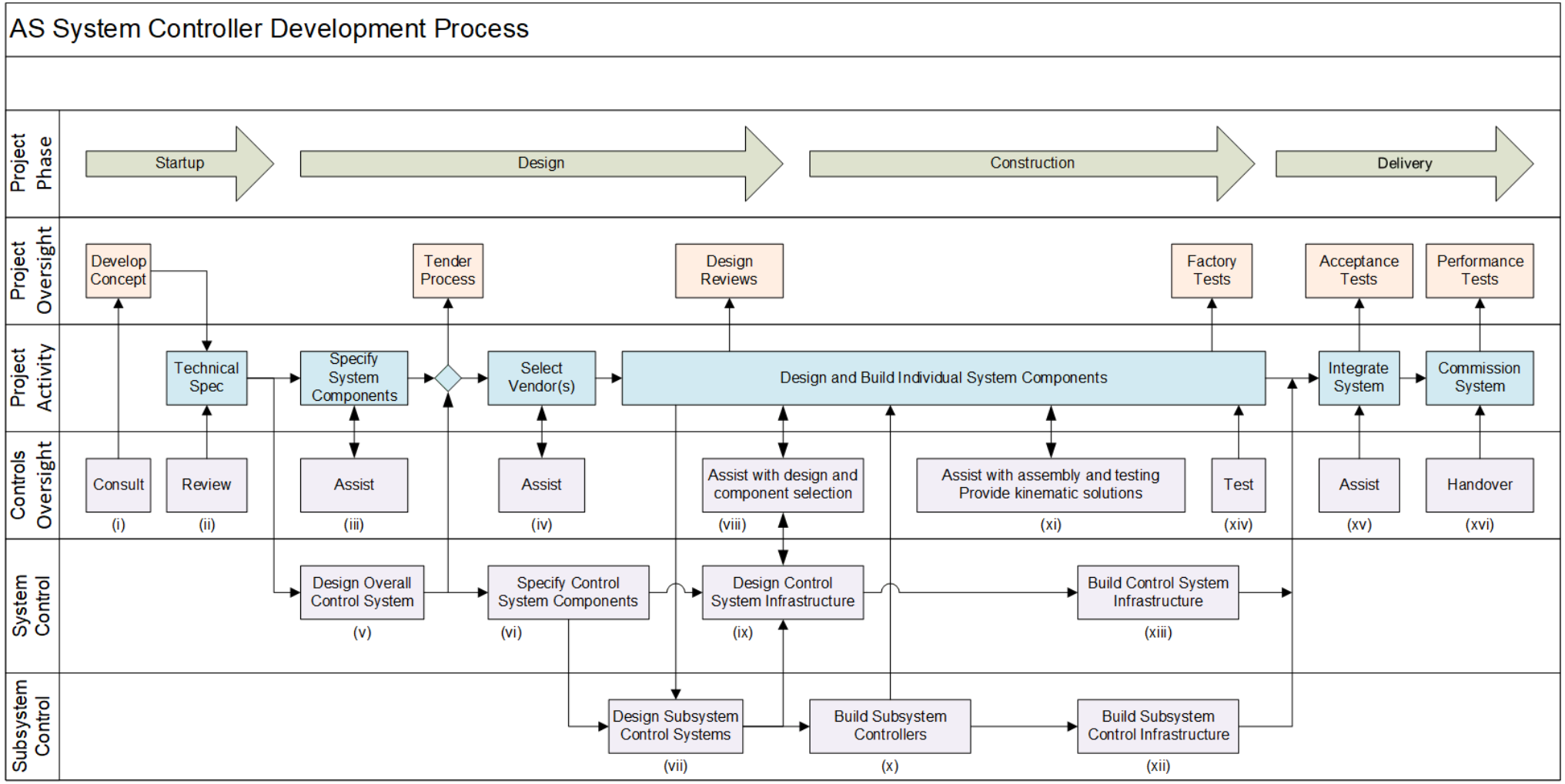
Controls – Area of Contribution:

- for the controls system as a whole:
  - applying systems perspective to beamline controls system design
  - understanding science requirements and translating them to controls/software design inputs and test criteria
- for Motion controls:
  - translating requirements to design, specification, configuration, and test-plans
  - advanced loop tuning and coordinated motion
- for implementation of motion axes using standardised PowerBrickLV HW:
  - backbone and platform development
  - complex system solutions
  - test and validation

Controls – Area of Contribution:

- for Detectors controls:
  - Detectors integration from design, specification, configuration, and test-plans
  - test and validation
- for Robotics controls:
  - Robotics integration from design, specification, configuration, and test-plans
  - Service, test and validation
- for maintenance and service for existing Beamlines:
  - **Refurbishment program** for aging and EoL equipment
  - Repair and replacement of controls related systems
  - Development/deployment of common standardized controls software platform

Controls Development Process



Control Systems Standardized Solutions:

- where possible standardized HW & SW solutions are applied to BL projects
- for Motion controls:
  - translating requirements to design, specification, configuration, and test-plans
  - advanced loop tuning and coordinated motion
  - stepper motors and brushless motors, with encoder feedback
- for implementation of motion axes using PowerBrickLV :
  - backbone and platform development
  - PowerBrick configuration tool - psych
  - PowerBrick IOC
- for implementation of Beam Cameras using Flir Grasshopper:
  - Centos 8 Area Detector IOC with Configurable ROI
  - 4.4um pixel size, Maximum frame rate: 1179fps, PoE GigE

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COVID-19 impact

COVID-19 impact is wide ranging for the BRIGHT program:

- Delivery method – Prolonged timing with uncertainty
- Tendering and Procurement – Vendors delay for quotation
- Schedule – FAT, SAT, Commissioning delays
- Resource – Manpower, Contractors (Timing for hire)
- Shipment – Timing vs cost
- Cost – Overall increase of costs
- Risk – Higher risks for delivery (vendor delays)
- Quality – Maintaining quality at a higher cost
- Expectation – Lower expectation for on time delivery

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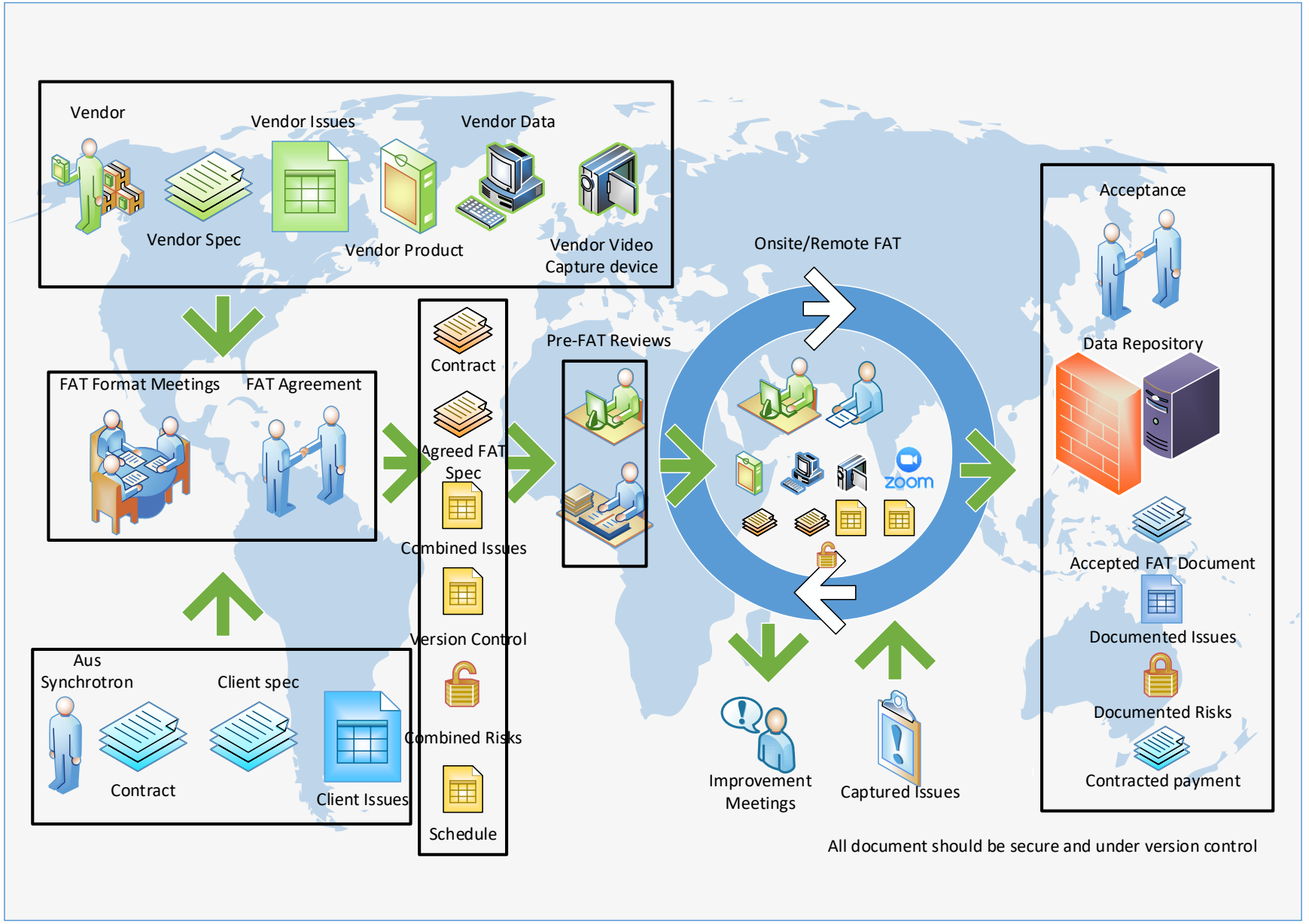
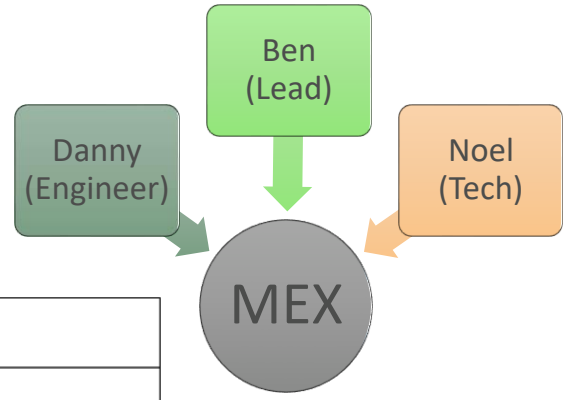
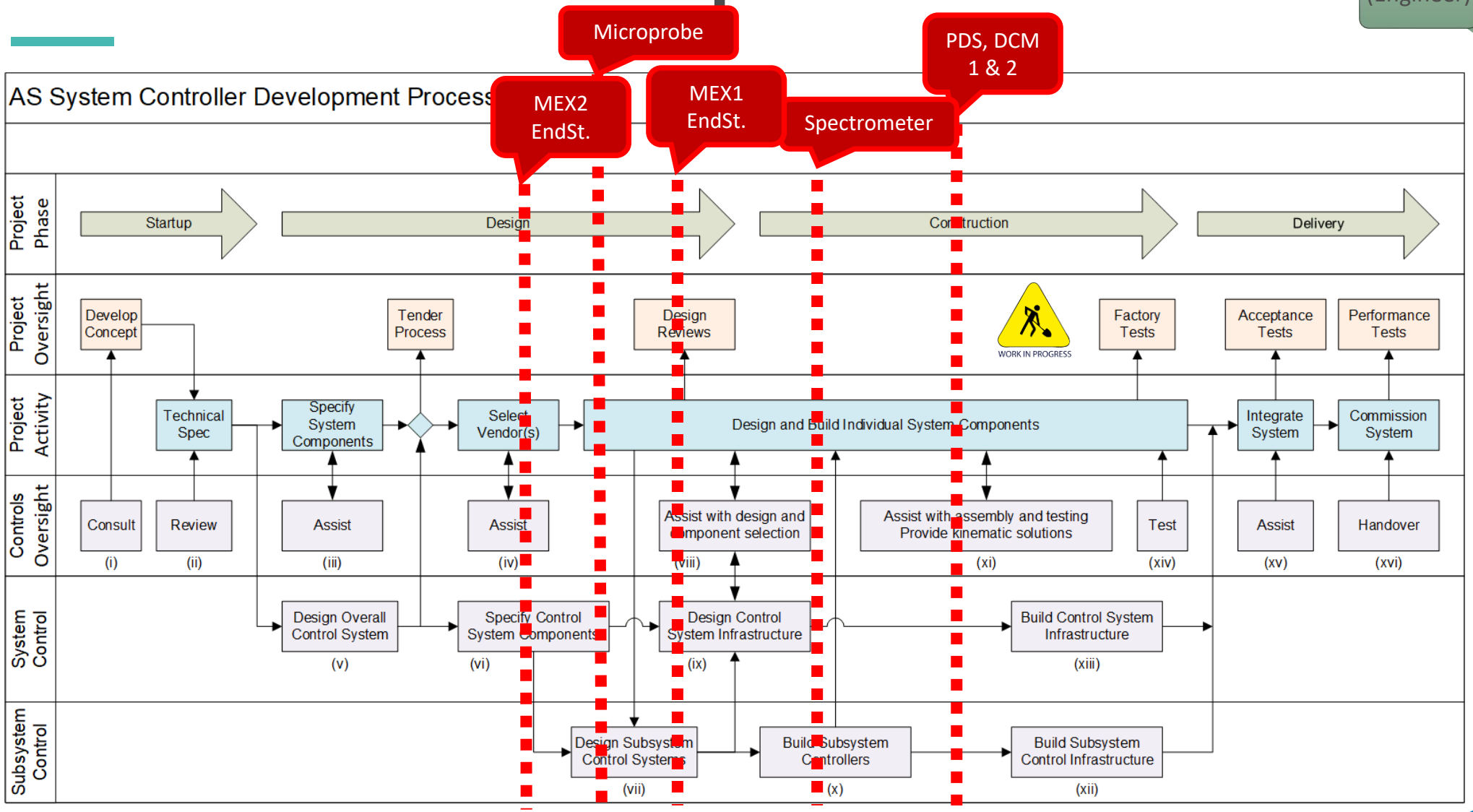
Remote Factory Acceptance Test (RFAT)



BRIGHT MEX Project

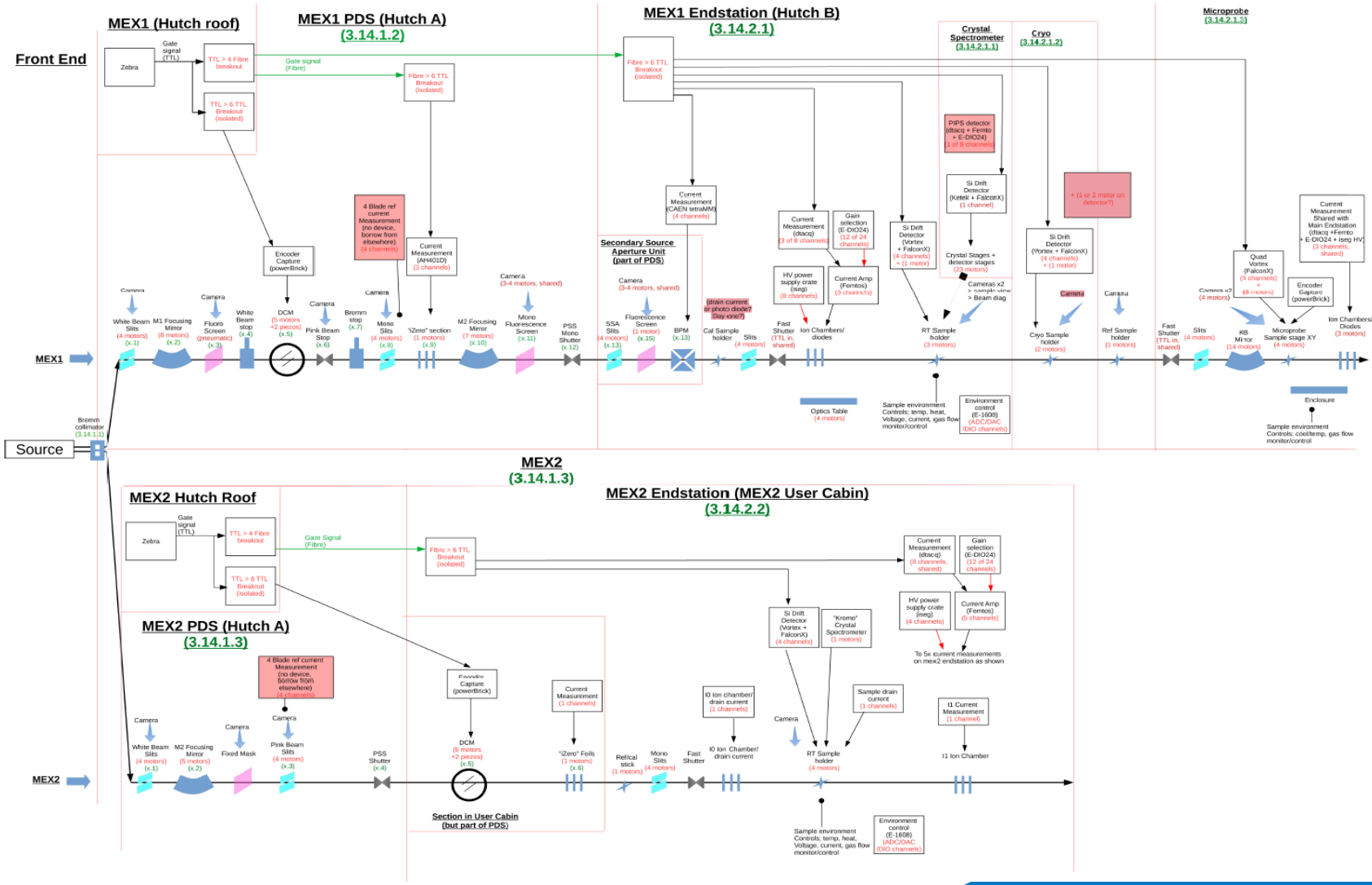
MEX Controls Development Process





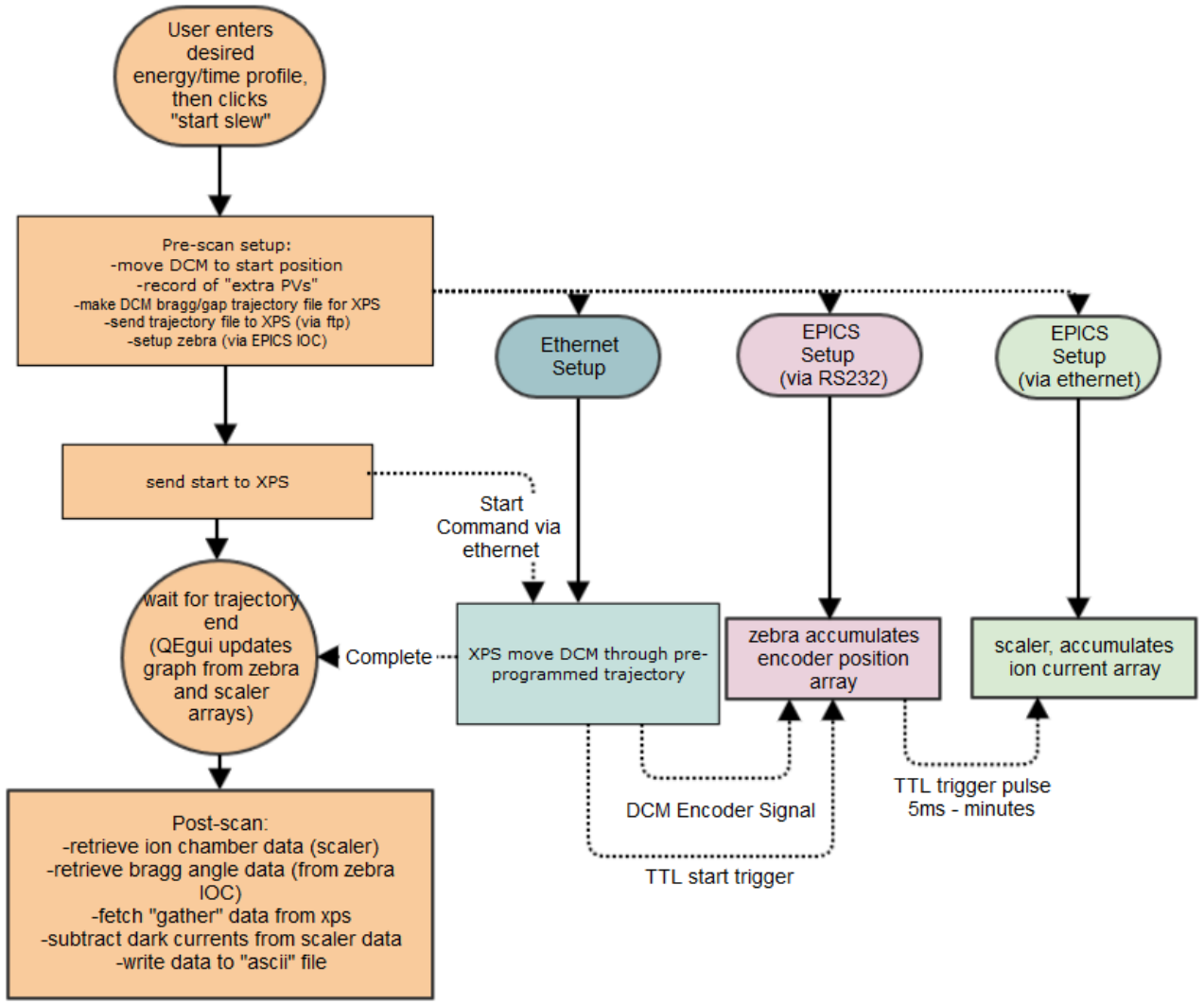
MEX Data Acquisition and Synchronisation

- Distributed data capture model; each device captures its own real-time data
- Single beamline wide gate signal; all data capture is aligned
- Simple to understand, implement, and operate. Devices are HW independent.
- Flexible; allows high level scripts to select which device is to record data for each experiment

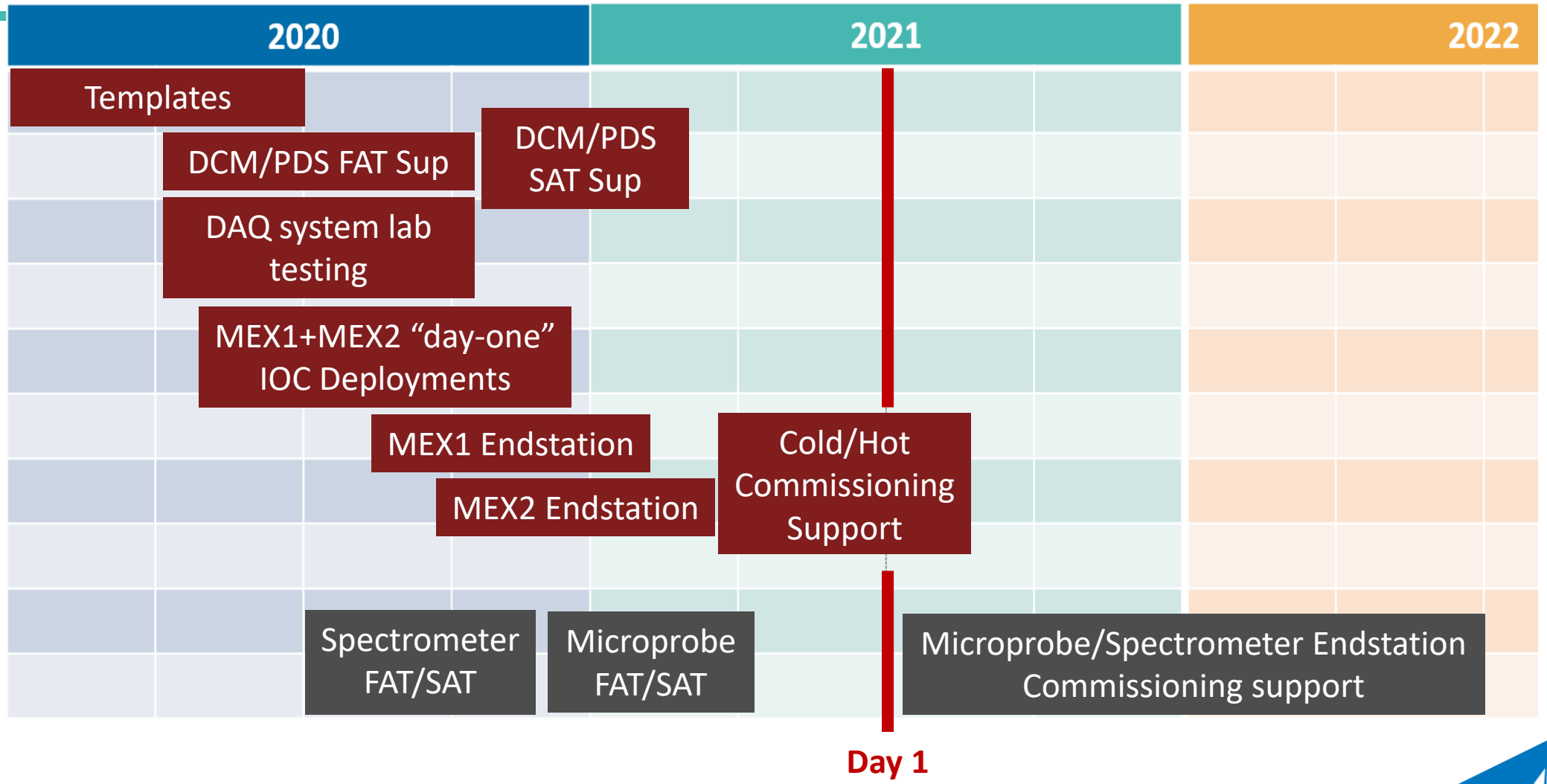


MEX/XAS DCM Slew Scan

- Bluesky/Ophyd layer generates a target path and sends to IOC via EPICS arrays e.g. [theta1, theta2, ..] & [time1, time2, ..]
- Target path is used to generate coordinate system PVT motion program
- position/time input is arbitrary & can accommodate any length
- limit checking prior to running is controlled at IOC level
- Motion file uploaded to the Newport XPS
- Currently implementing on XAS slew scan project

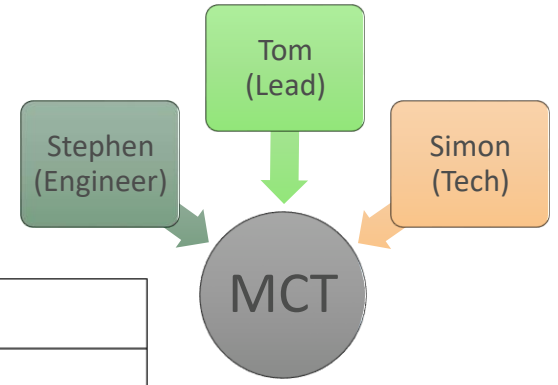


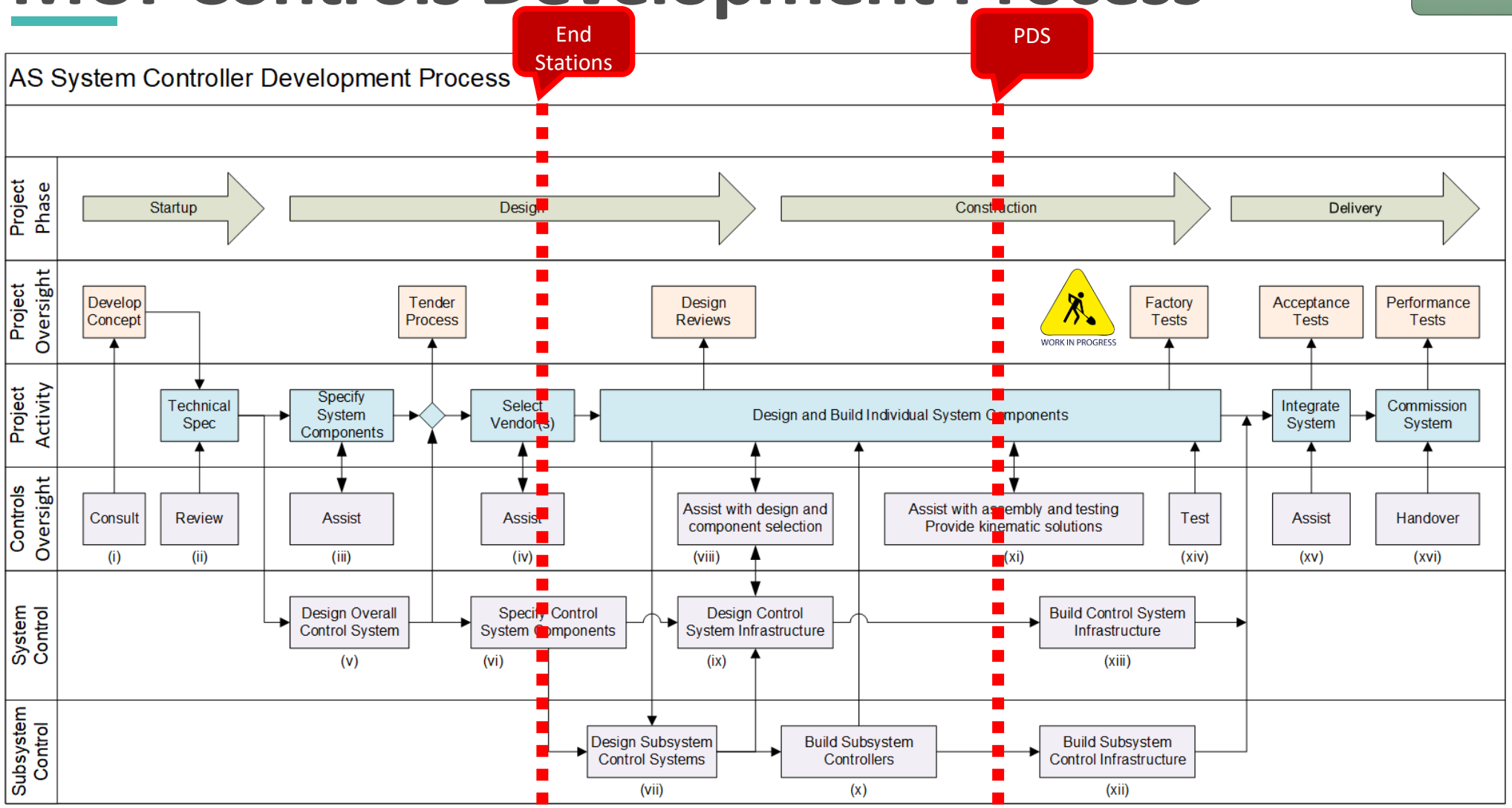
MEX Control Systems Schedule



BRIGHT MCT Project

MCT Controls Development Process

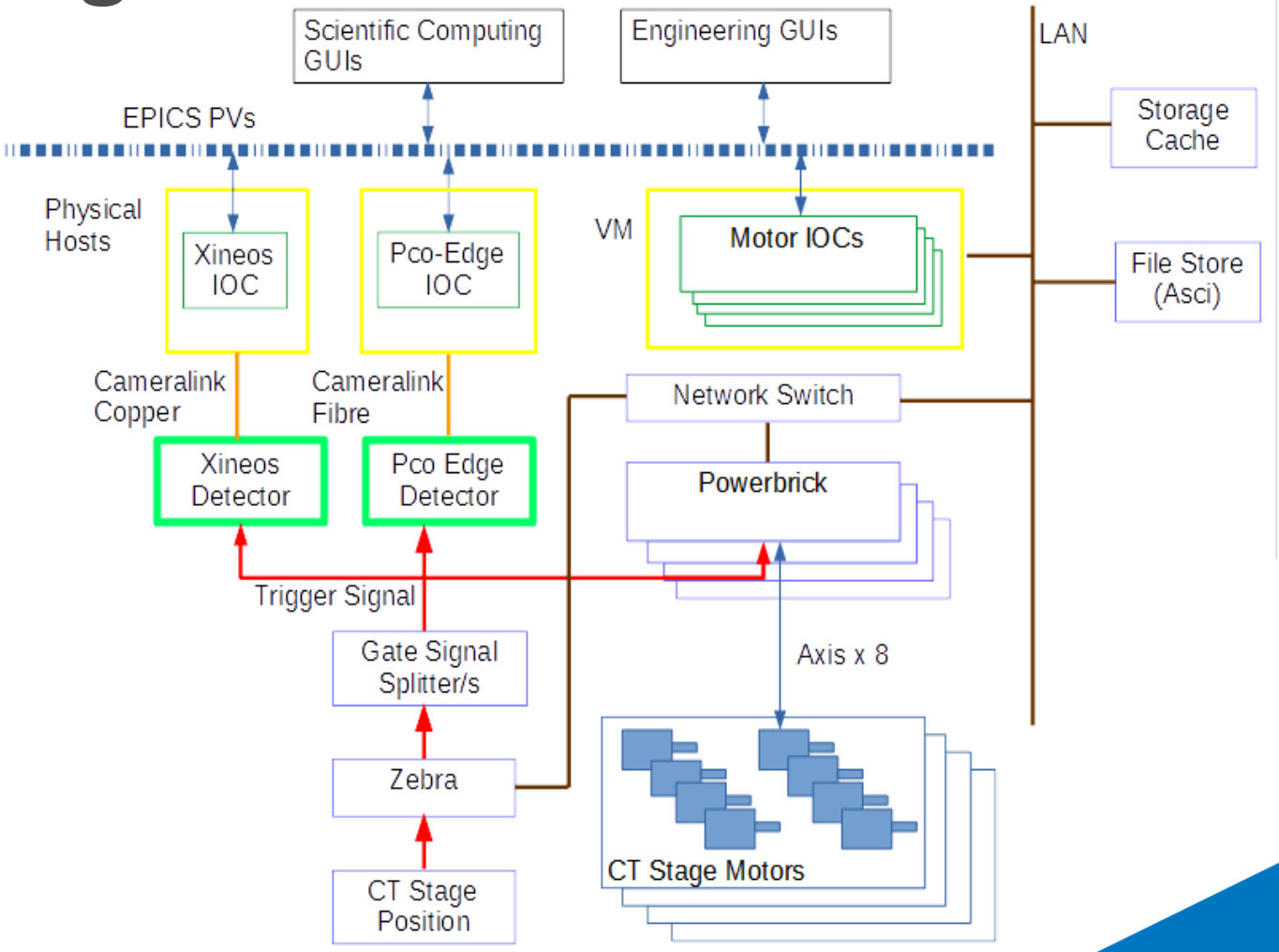




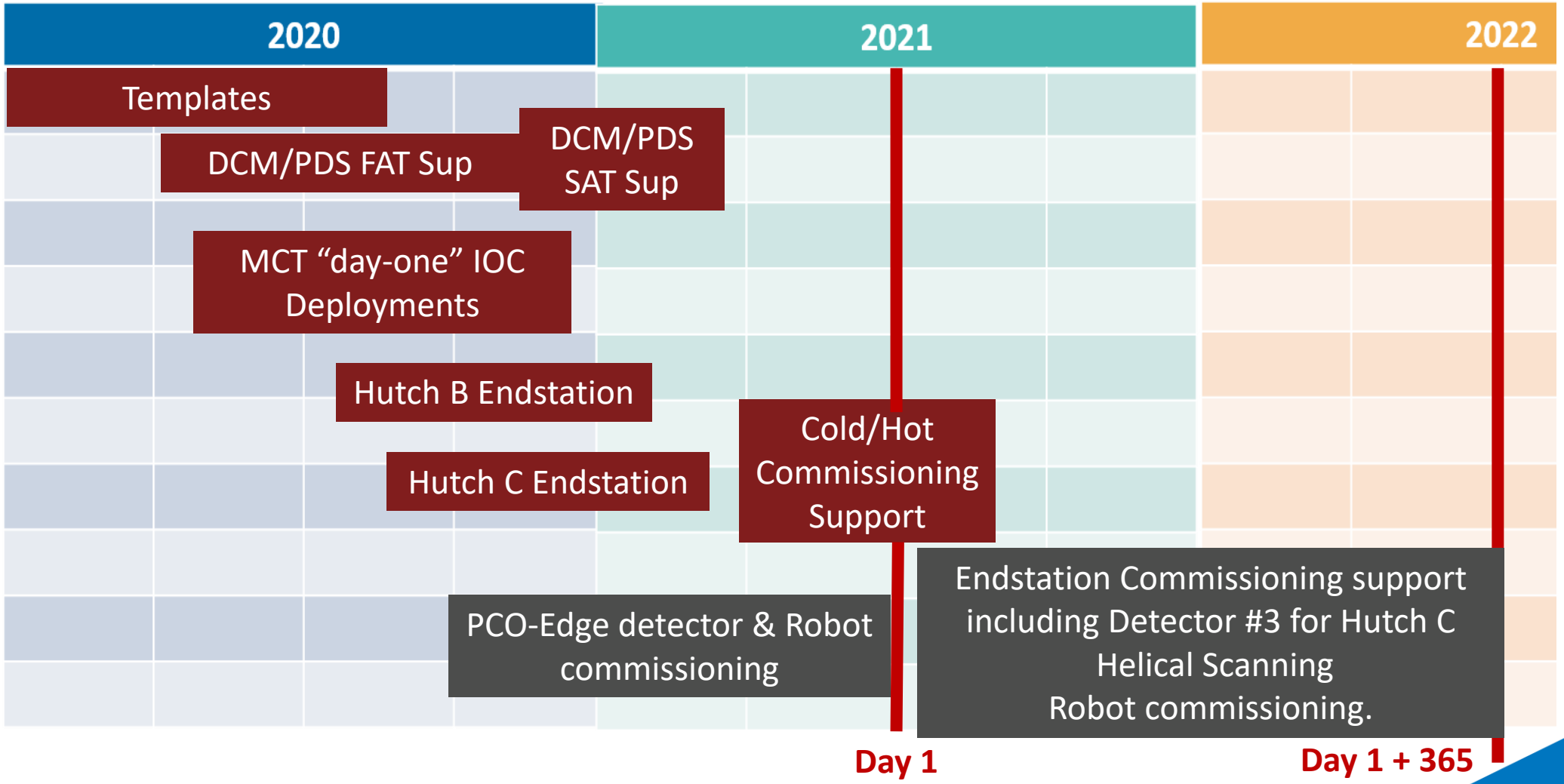
Proposed IMBL / MCT CT Stage Environment

Notes:

- The detector is selected from the user GUIs & positioned in the beam.
- Only one detector in use at any one time on any beamline.
- Common detectors across IMBL & MCT: PCO-Edge
- Image acquisition with external triggering method 1:
  - The CT Stage horizontal position is fed into the Zebra using an incremental encoder.
  - The zebra is programmed to send a trigger signal on position / angle.
- Image acquisition with external triggering method 2:
  - Used in the Controls helical scan demo.
  - The CT stage position is not used as an input to the Zebra
  - The zebra is programmed to send a pre-programmed trigger signal
- The trigger signal causes the detector to acquire an image and the Powerbricks to record the motor positions.
- Output files: Image and position data



MCT Control Systems Schedule



Q&A

Thank you