Diamond Control Systems Status and plans for the Diamond-II upgrade

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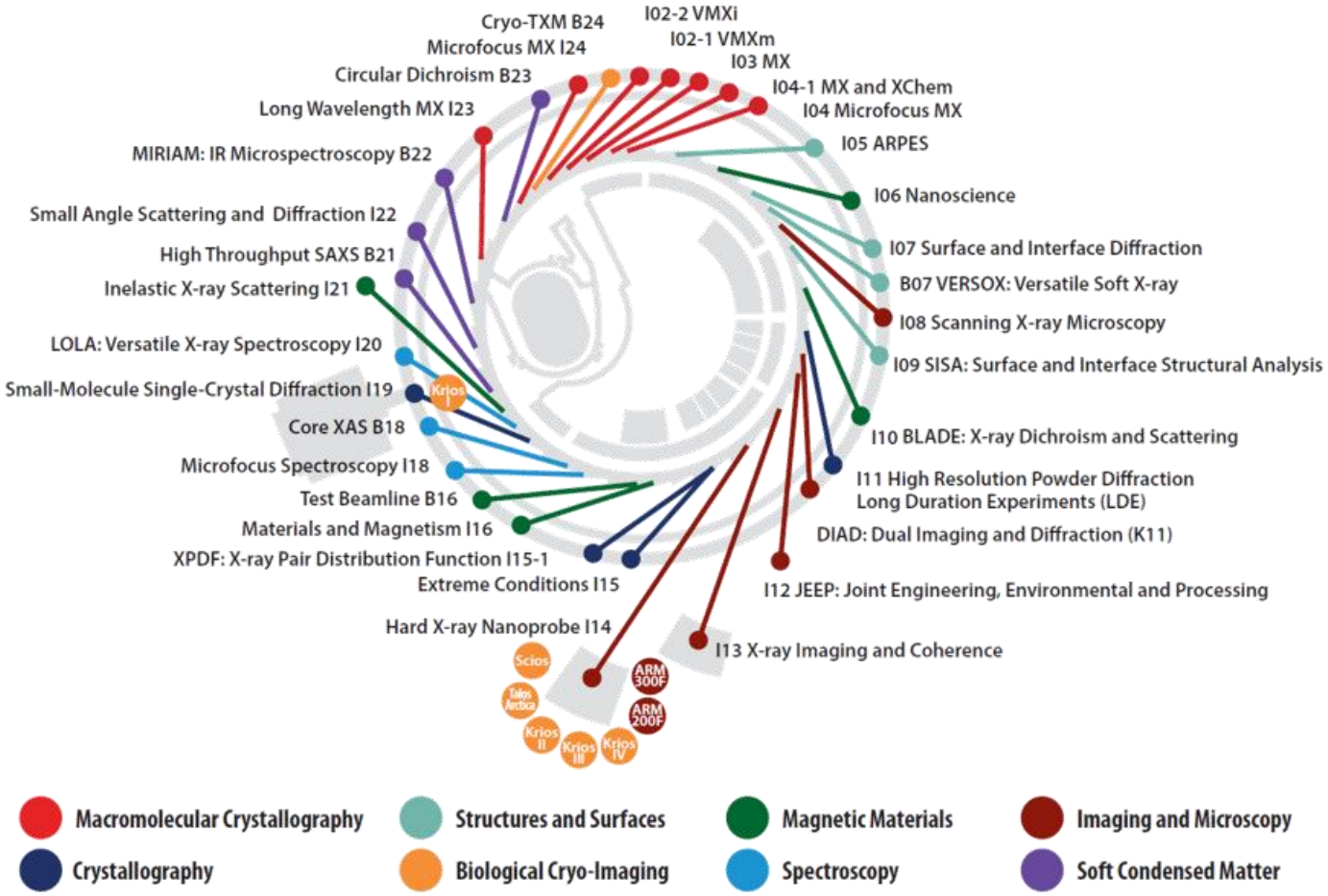
Diamond Light Source Facility

- Operational Since 2007
- 3rd Gen. Storage Ring
  - 3GeV
  - 0.8mA to 300mA
- 33 beamlines
  - >33 end-stations



2022
Celebrating Diamond's 20th anniversary and 15 years of research and innovation

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DLS Control Systems Today

- Currently based on EPICS R3.14.12
  - PVAccess adopted in a few areas – primarily to transfer area detector data
- IOC target platforms
  - VME/VxWorks: 430
  - RHEL7 Linux soft-iocs: 1568
  - Windows soft-iocs: 55
- Display managers:
  - EDM: initially deployed everywhere
  - CSS: Machine operator screens have been transferred from EDM + around 5 beamlines
- Build System anno. 2006
  - A dedicated build server and build user
    - Production file system (NFS) is read-only to all except the build server/user
  - Gitlab DVCS – tags used to identify releases
  - Homegrown Bash scripts automate the build processes
  - Engineer in-the-loop to deploy new versions on the machine/beamline

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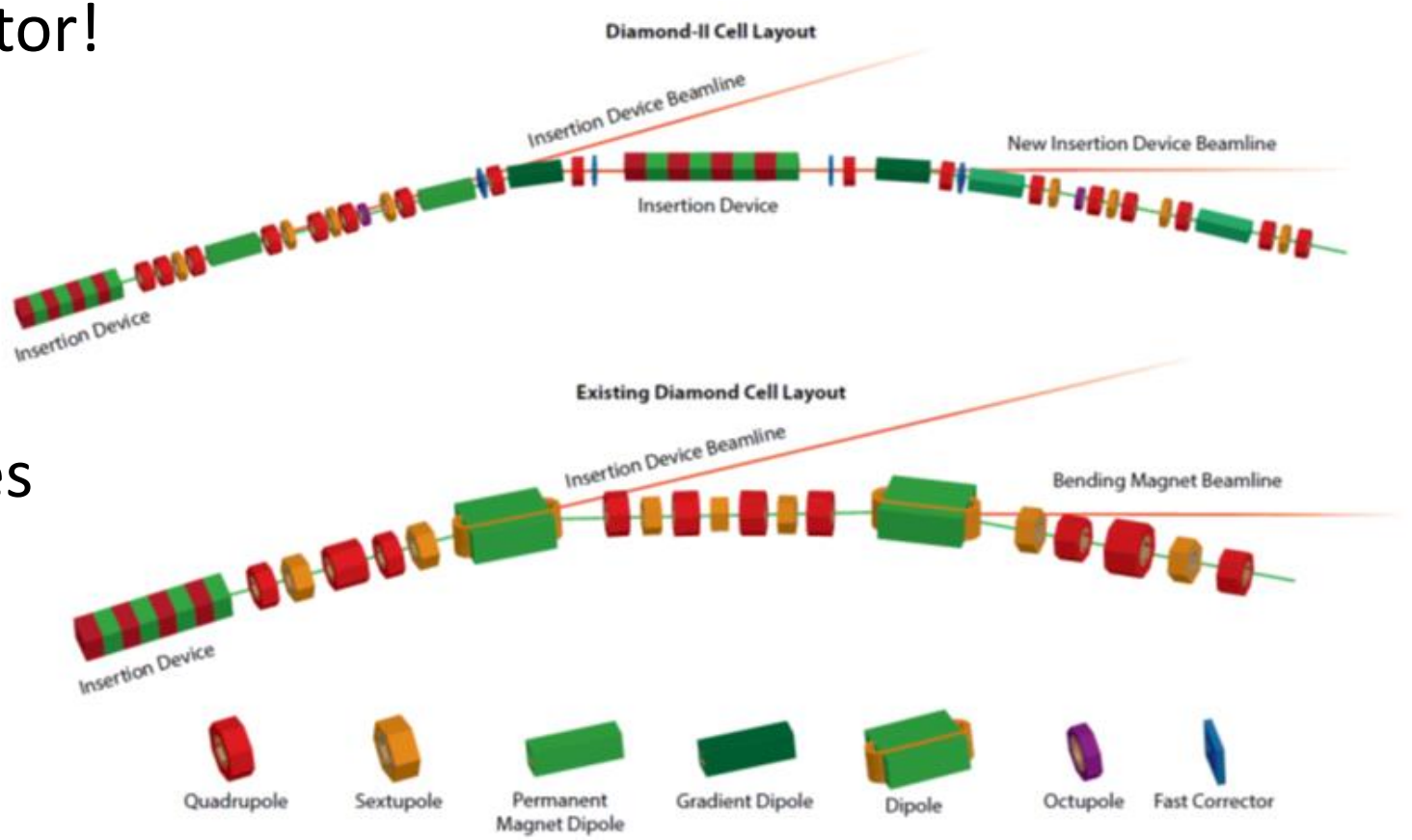
Diamond-II Facility Upgrade Project

- Replacing the entire accelerator!
- Benefits
  - Low Emittance
  - Increased Capacity
  - Higher Energy
- All bending magnet beamlines turn into insertion device beamlines



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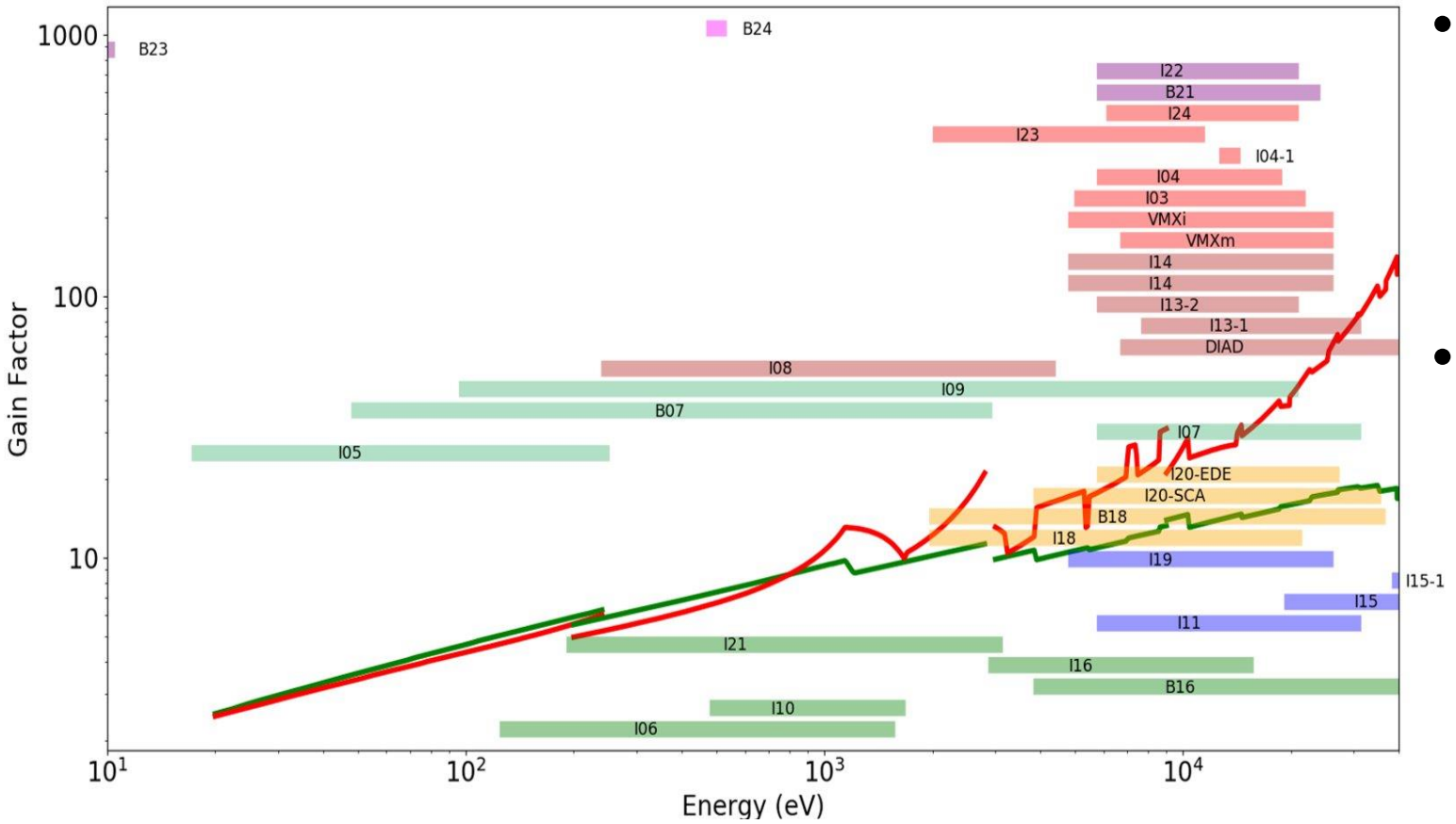
Diamond-II Brightness Gain



- Exploit the improvements in photon-beam properties
  - Coherence
  - Brightness
- Increased brightness means
  - Lower exposure time, higher detector framerate
  - Faster scans
  - Higher degree of scan synchronization

Diamond-II Programme

- New Accelerator
  - But re-use many Controls components: VME I/O
- Beamline Programme:
  - Critical Beamline Upgrades
    - Necessary changes to just work with the new machine (more Pb!)
  - 5 new “Flagship Beamlines”
    - New world-class beamlines, taking full advantage of the new machine
  - Competitive Beamline Upgrades
    - Upgrades to exploit the improvement to the beam

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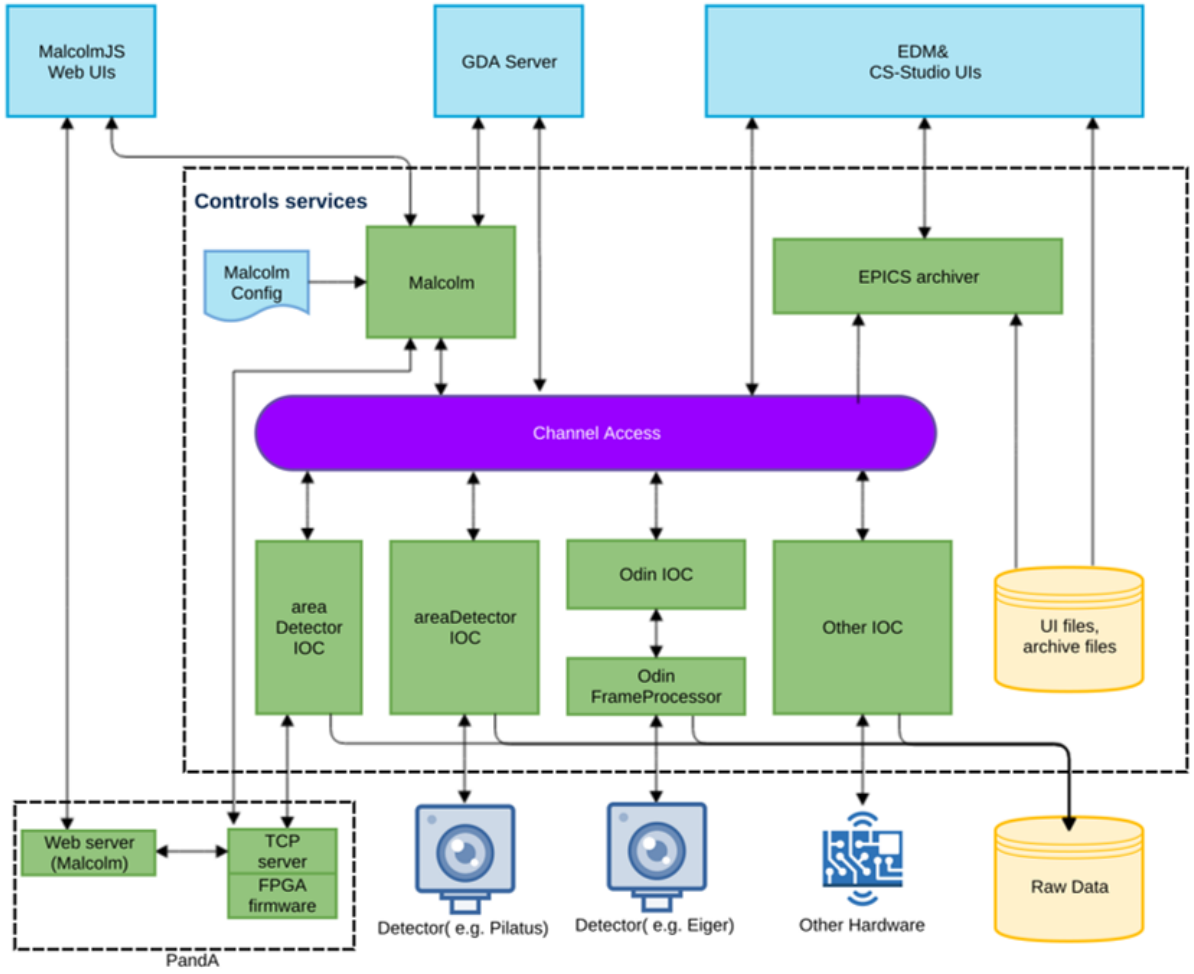
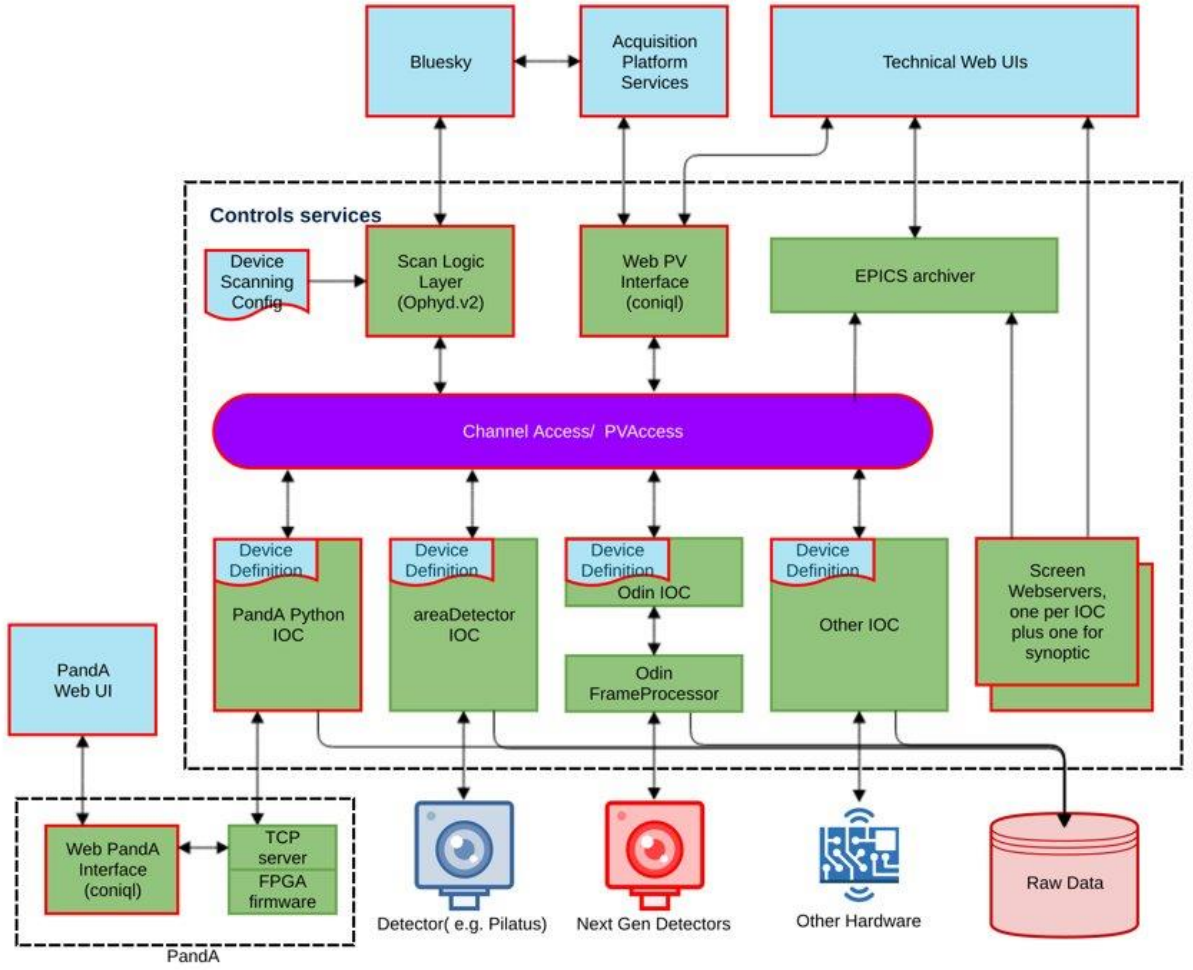
Diamond-II Control Systems Updates

- EPICS Controls Systems are a part of a deep software stack
- The entire stack is up for review and modernization
- Opportunities to address obsolescence



Diamond-II Control Systems Updates

- Service-based architecture
  - All services built and deployed in containers on Kubernetes
- Adopting BlueSky and Ophyd
  - Replacing parts of GDA
  - Extending Ophyd with Malcolm functionality (Ophyd v2)
- Adopting EPICS7
- Obsolete VxWorks systems
  - Replace VME hardware with EtherCat and soft-IOCs where possible
  - Adopt RTEMS and port existing VxWorks IOCs
- Browser-based Web UIs
  - React-based frontend
  - Runtime PV access via GraphQL
  - Screens designed in Phoebus .bob format



Diamond-II: When? How much???

- Plans and budgets…
  - Funding: approx. £500M over 8 years
  - Full Business Case (FBC) submitted to government towards end of 2022
  - Approvals expected 2023…
  - Around £81M has been approved for first phase
- Planning an 18-month downtime/dark period around 2026
  - Critical Upgrades and 3 new Flagship Beamlines before dark period
  - 2 Flagship Beamlines after dark period
  - Keep ~~all~~ most beamlines operational until dark period

Thank you for listening

Any questions?