Kubernetes for EPICS IOCs

EPICS Deployment and Packaging Workshop

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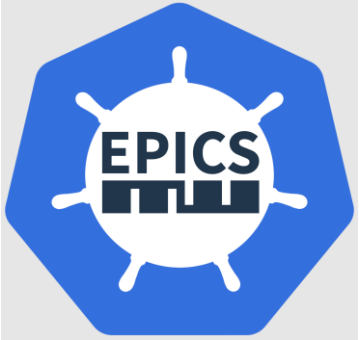
Kubernetes for EPICS IOCs

- Applying modern industry standards to manage EPICS IOCs
  - Containers
    - Package IOC software and execute it in a lightweight virtual environment
  - Kubernetes
    - Centrally orchestrate all IOCs at a facility
  - Helm Charts
    - Deploy IOCs into Kubernetes with version management
  - Repositories
    - Source, container and helm repositories manage all the above assets. No shared filesystems required.
  - Continuous Integration / Delivery
    - Source repositories automatically build assets from source when updated.

Benefits



- Containers are decoupled from the host OS and each other.
  - Upgrade of Host Operating System becomes trivial
  - VERY good news for collaboration:
    - All BL45P IOCs dependencies are vanilla EPICS Community versions
  - Isolation protects against most security vulnerabilities
  - Run anywhere: develop, test, demo on a laptop or home machine.
- Kubernetes provides economy of scale through centralized:
  - Software deployment and management
  - Logging and Monitoring
  - Resource management: Disk, CPU, Memory
- Remove maintenance of internal management tools
- Reusable skills for controls engineers

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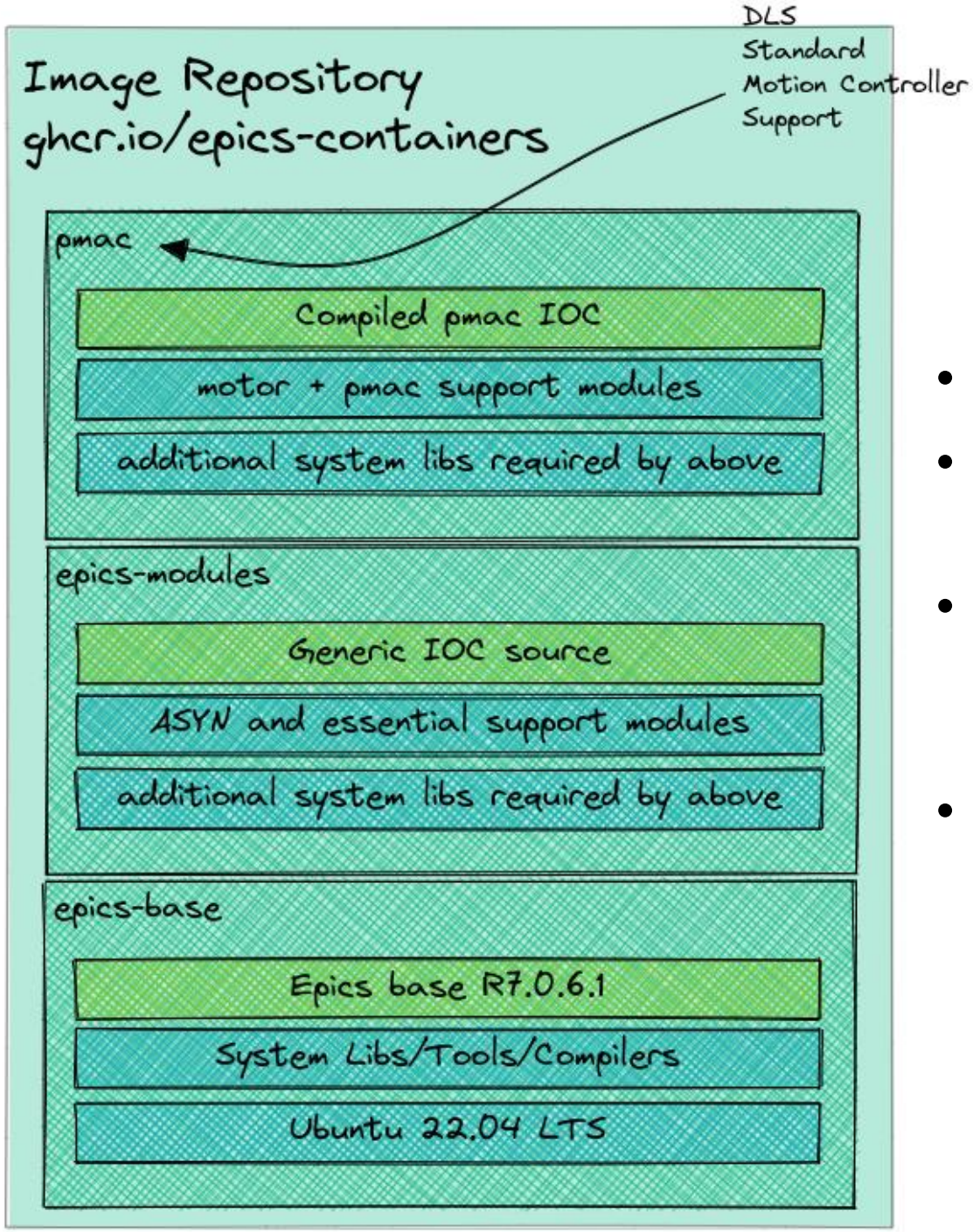

Container Images: Generic IOCs

- IOC container images represent a **generic** IOC
- The same **generic** image is used for every IOC that controls a given class of device
- An IOC **instance** is a container based on a **generic** IOC image with an added startup script that makes it unique
- This example shows the filesystem layers in the **generic** IOC for the standard DLS Motion Controller

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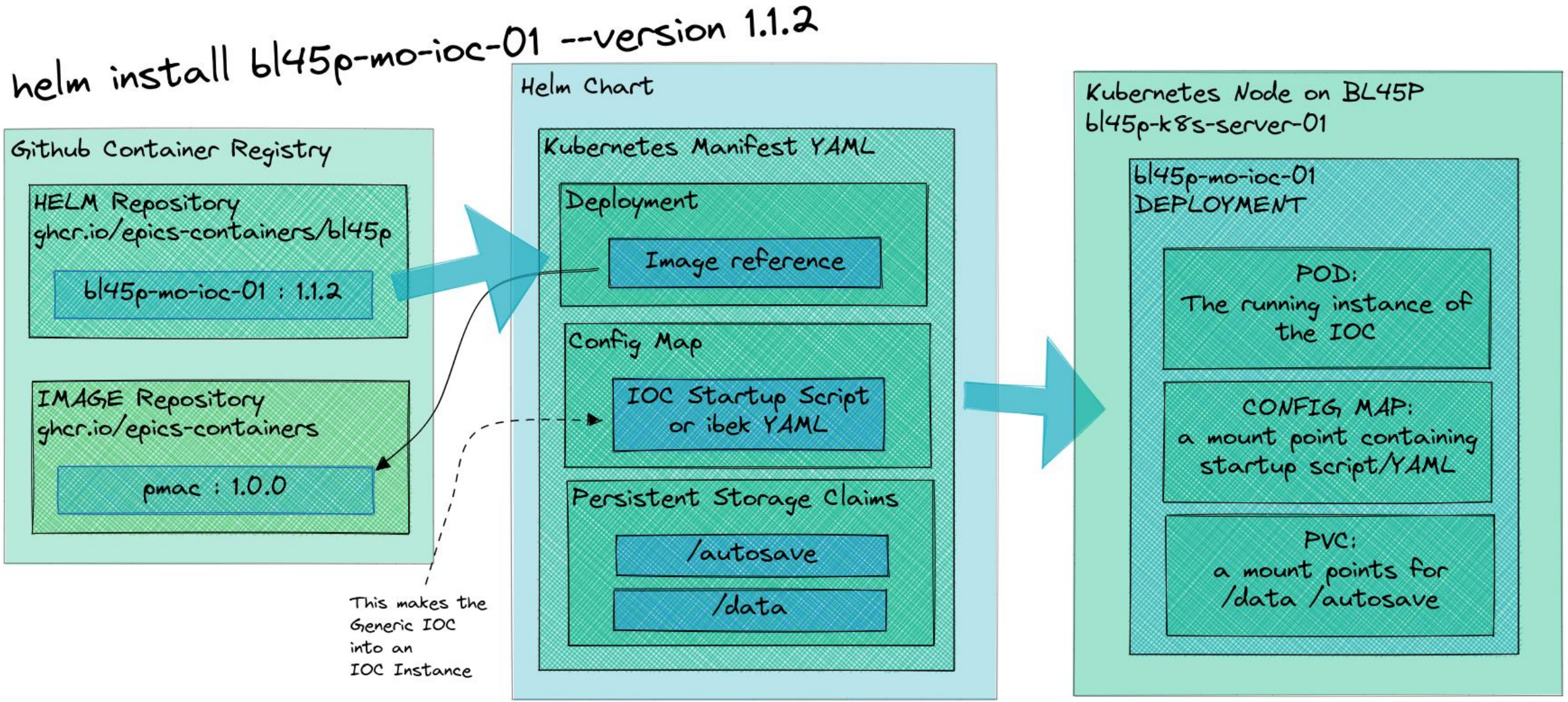
Runtime Containers: IOC Instances



Current Status

- The test DLS beamline BL45P has all its IOCs running in Kubernetes today
- The MX Bridge beamline will be deployed using Kubernetes in late 2023 (remote at Max IV in Sweden).
- All source and assets for the BL45P POC work are published at
  - https://github.com/epics-containers
- The organization includes enough documentation for others to try this approach. Including hands on TUTORIAL.
  - https://epics-containers.github.io/
- Please join the organization and contribute your own ideas!

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Thanks for listening
Any Questions?

Features Provided by Kubernetes and Helm

- Auto start IOCs when servers come up
- Restart crashed IOCs
- Manually Start and Stop IOCs
- Allocate the server which runs an IOC
- Move IOCs if a server fails
- Throttle IOCs that exceed CPU limit
- Restart IOCs that exceed Memory limit
- Monitor security vulnerabilities
- Increase IOC security via isolation

- Deploy versioned IOCs to the beamline
- Track historical IOC versions
- Rollback to a previous IOC version
- Monitor IOC status and versions
- View the current log
- View historical logs (via graylog)
- Connect to an IOC and interact with its shell

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Additional material

G Knap, T Cobb, Y Moazzam, U Pedersen and C Reynolds
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