

Software for Beamline Automation - VMXi Use-Case

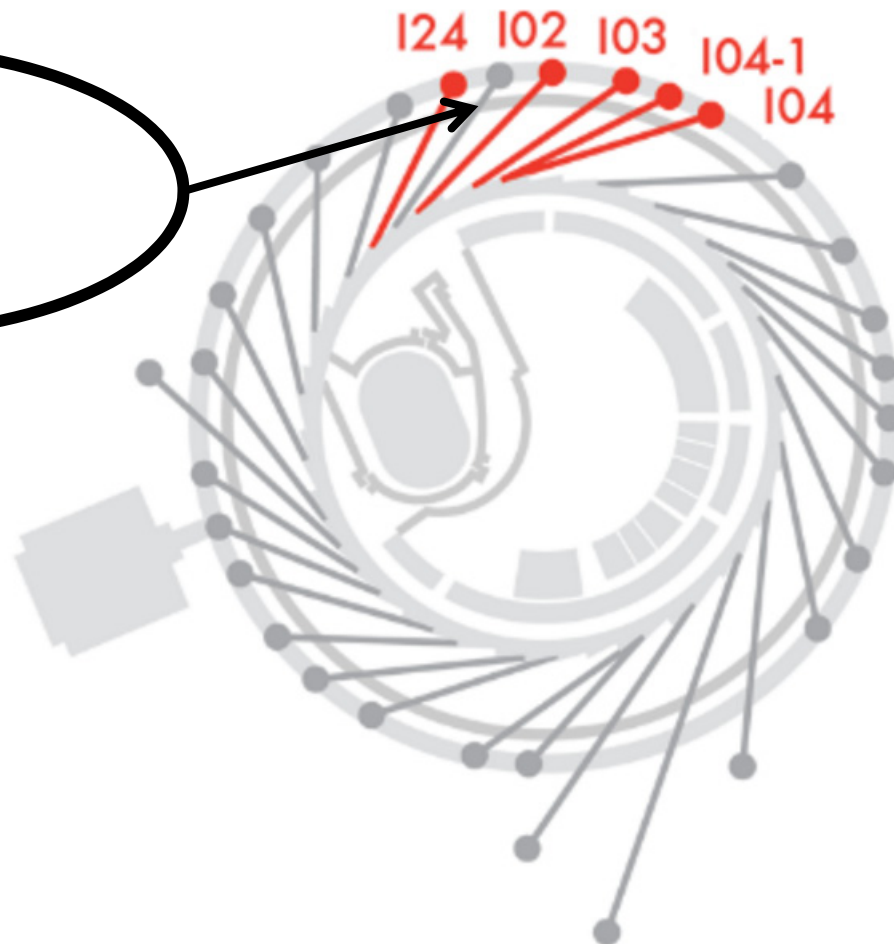
Chris Sharpe – Diamond Light Source Ltd, Oxfordshire, UK

ICALEPCS October 2017, Barcelona

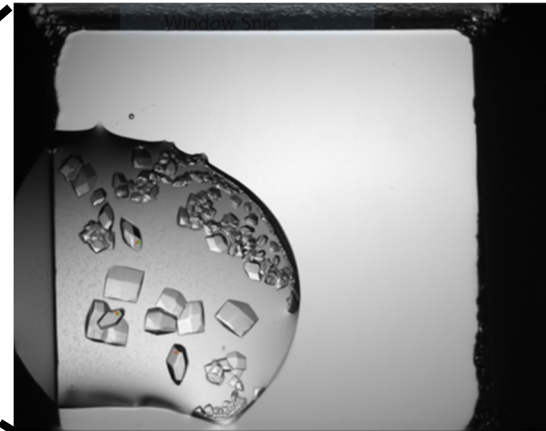
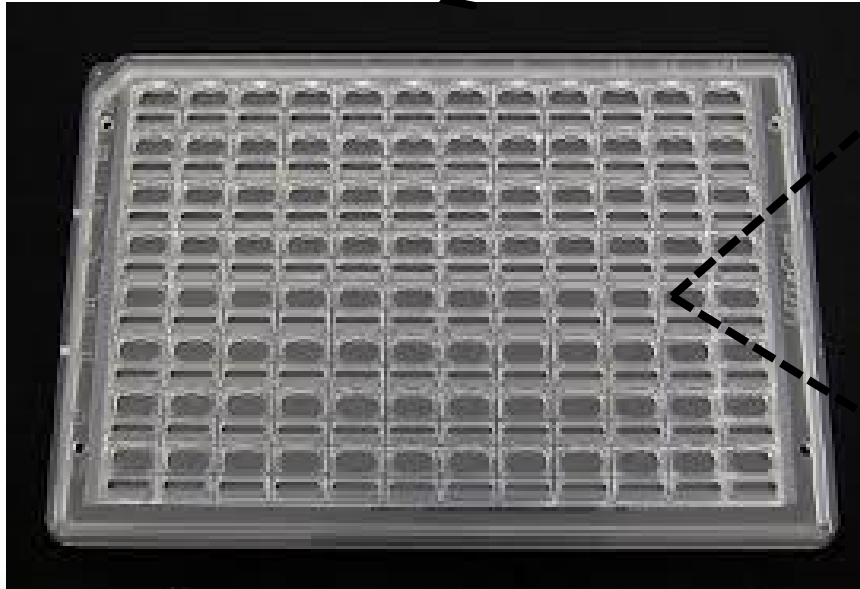


Macromolecular Crystallography (MX)

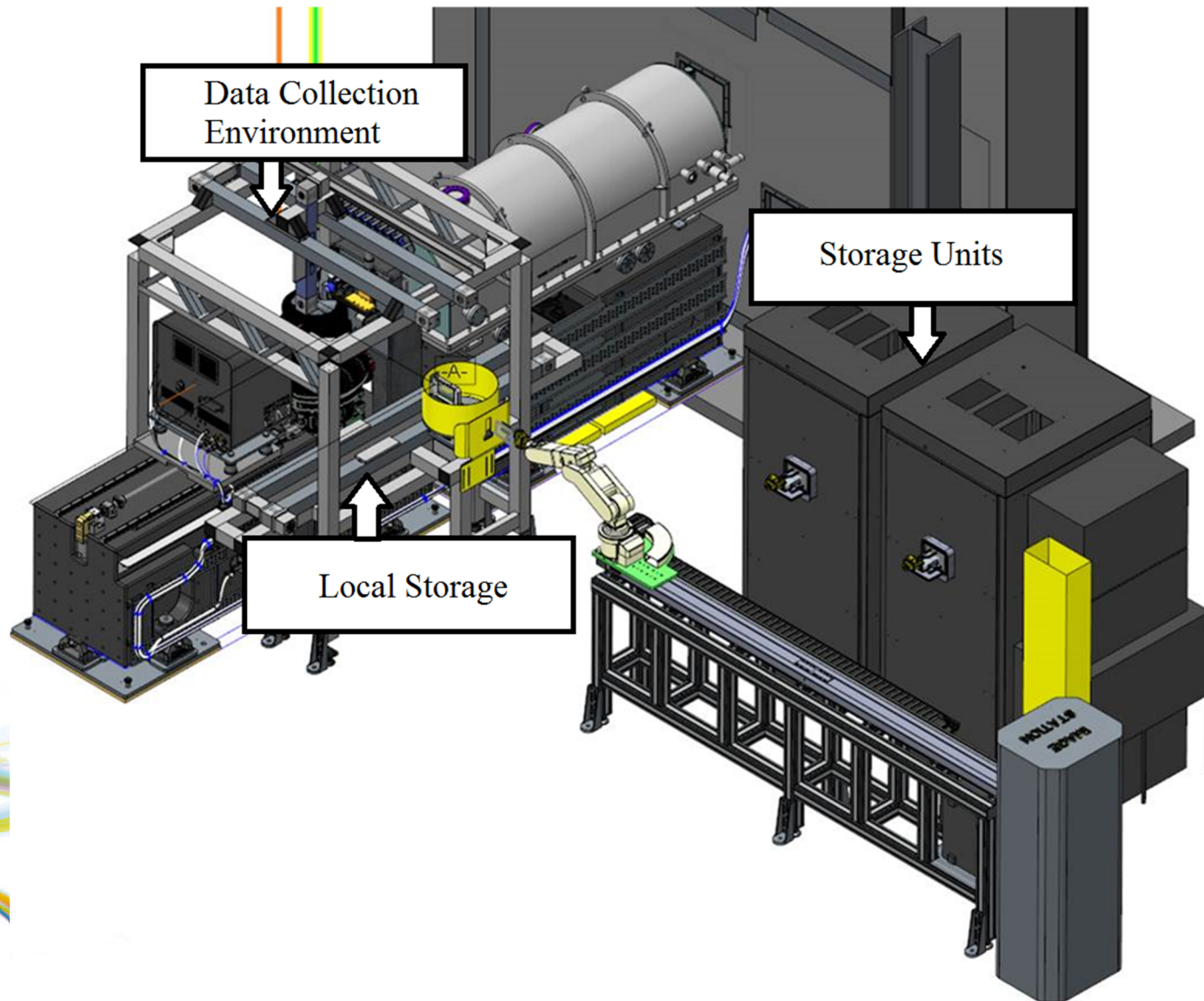
**August 2013:
I02 Selected
Phase III Upgrade**



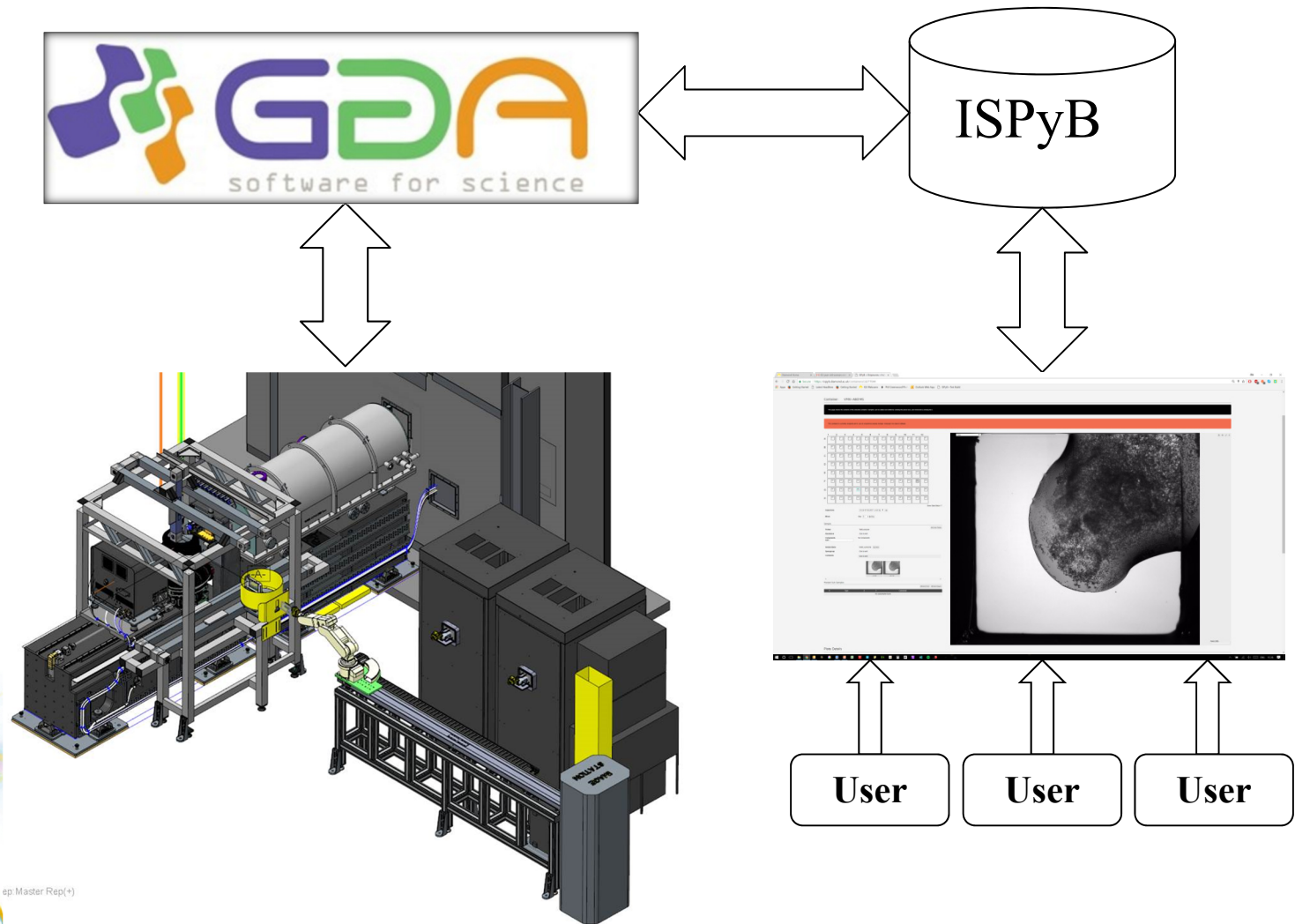
VMXi – Versatile MX *in situ*



VMXi Endstation Schematic



Beamline Automation



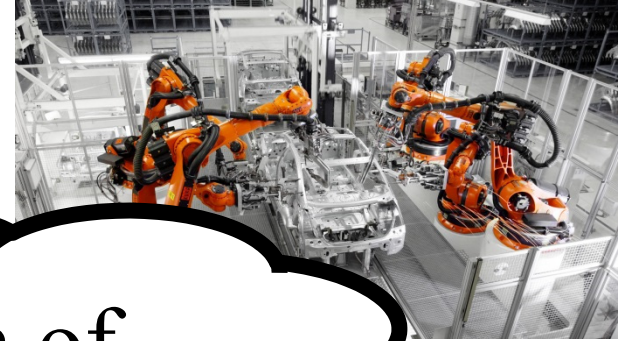
Automation Requirements

Continual processing of plates...

- Repeatedly
- Indefinitely
- Robust to faults

GDA to become a Plate Processing Machine

Software Design for Automation



This *is* the domain of
AI.



AI Models – Sense, Plan, Act.

Sense

Excitation of a sensor attuned to sense the state of some artefact in the environment. Feed sensed state data in to an agent

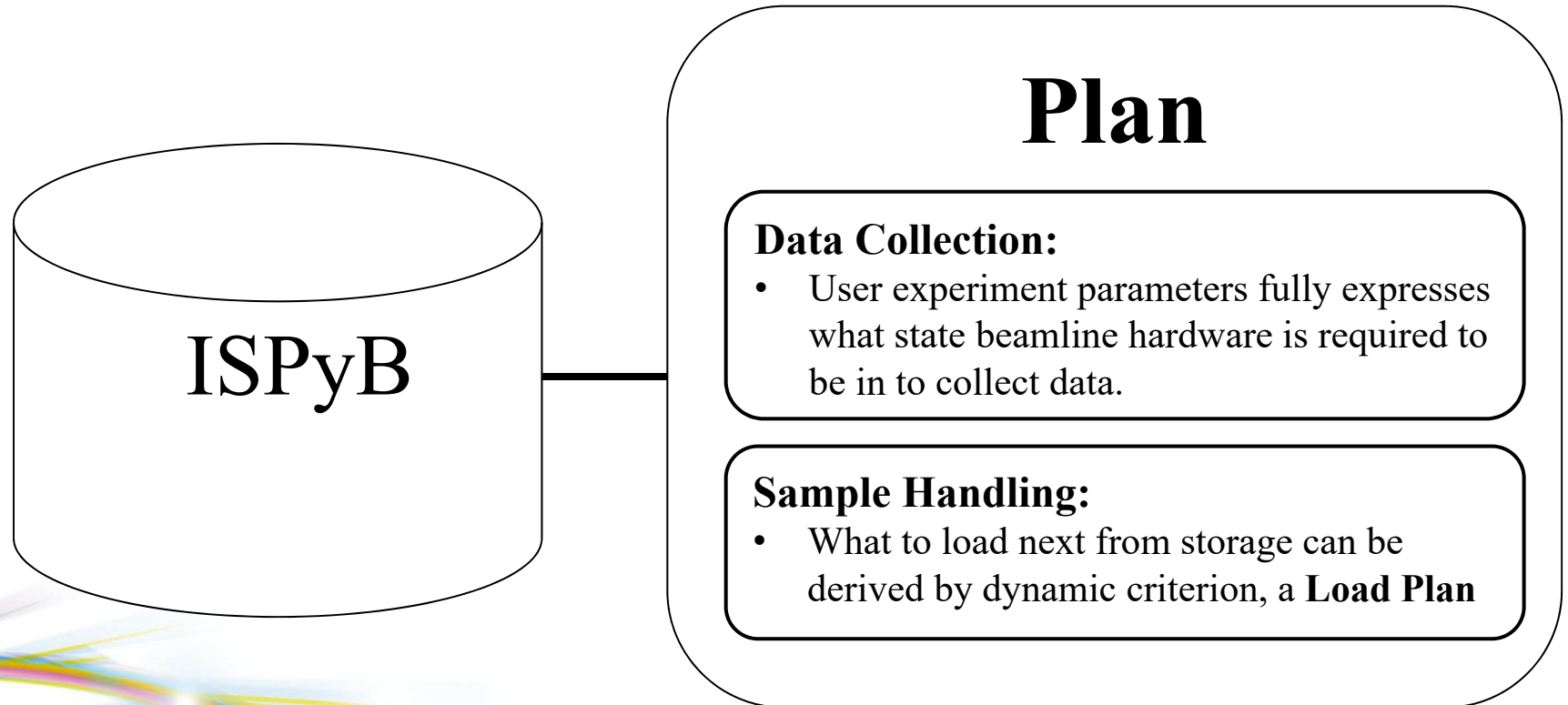
Plan

Updating global plan with the sensed data, and use plan to generate a control action.

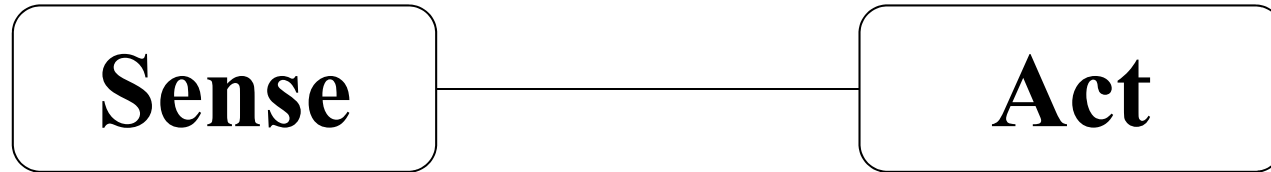
Act

Present the control action to the agent actuators and do the action.

Planning and Decision Making

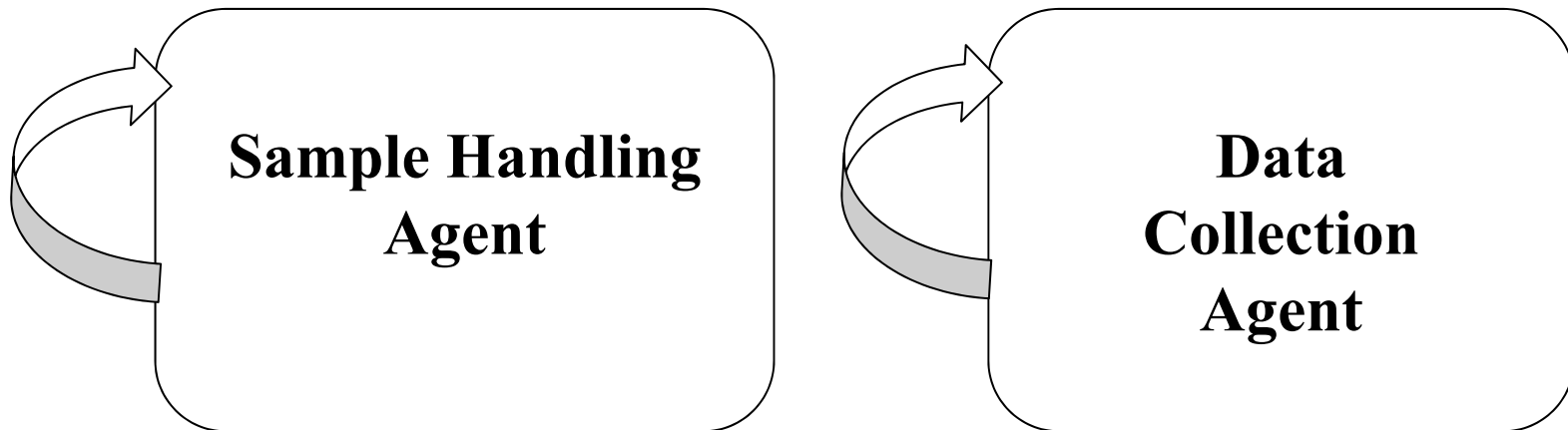


Reactive Controller

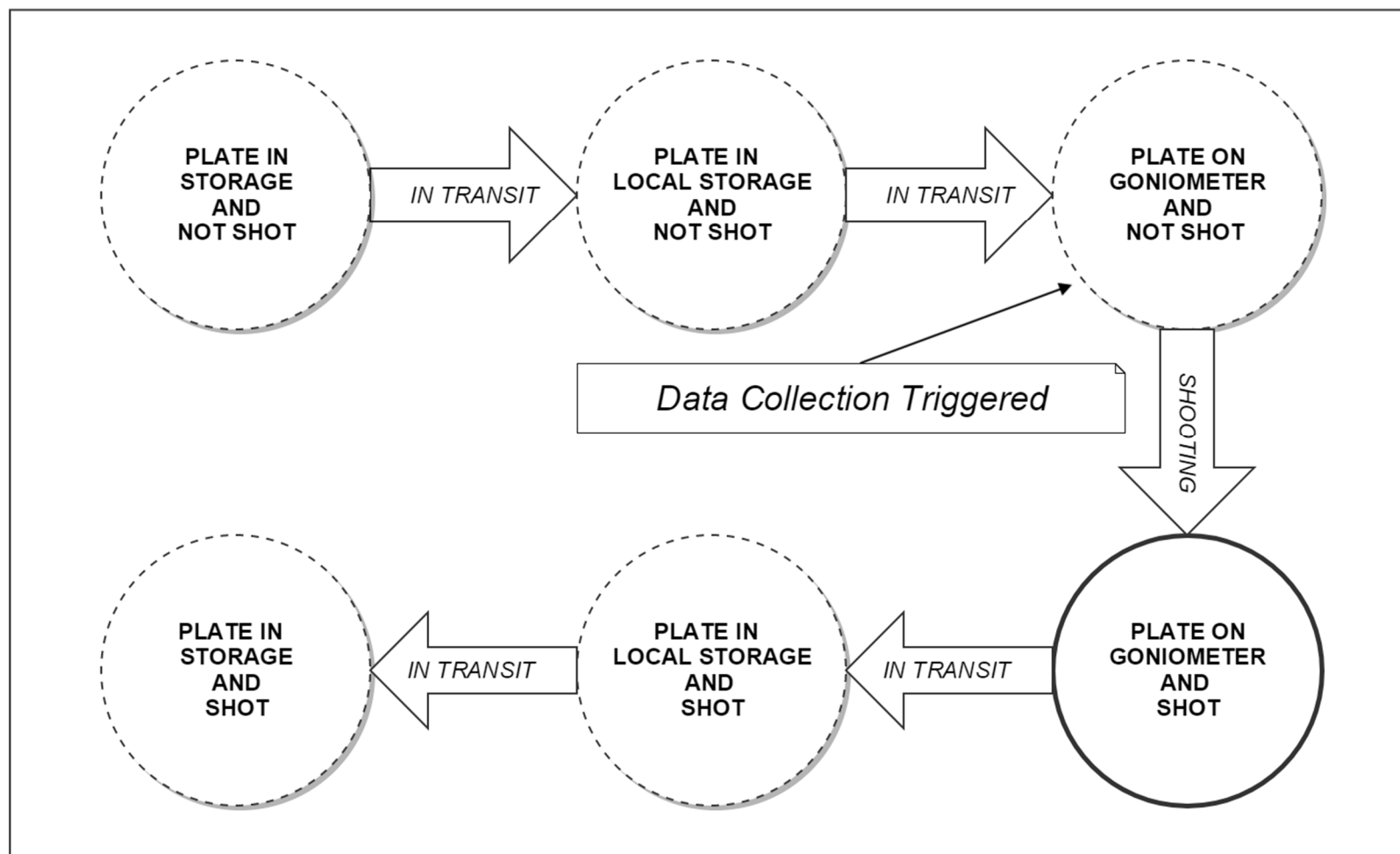


- A tight coupling between what is sensed and the action generated.
- It is stateless.
- It should not execute any computationally difficult or intensive task.

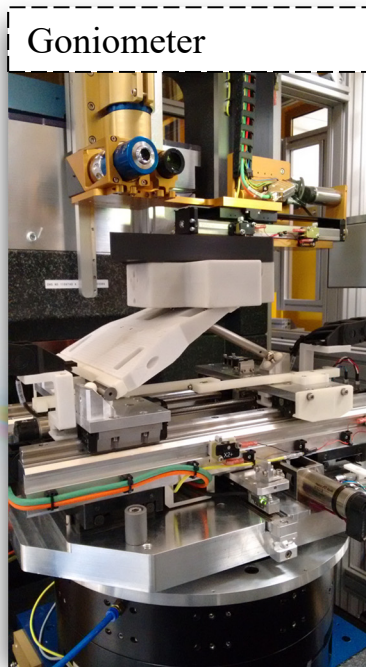
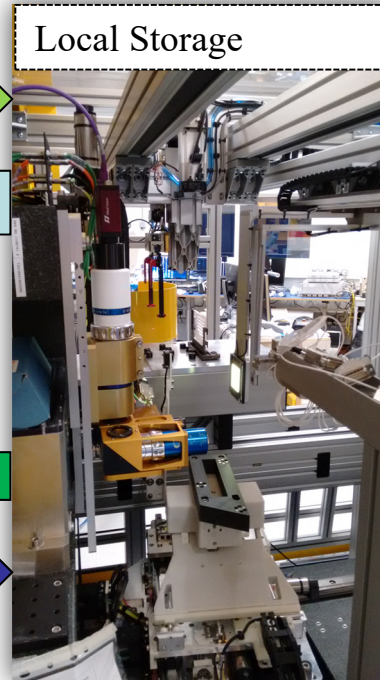
Reactive Controllers



Agent Communication and Co-ordination



Sample Handling



PVs

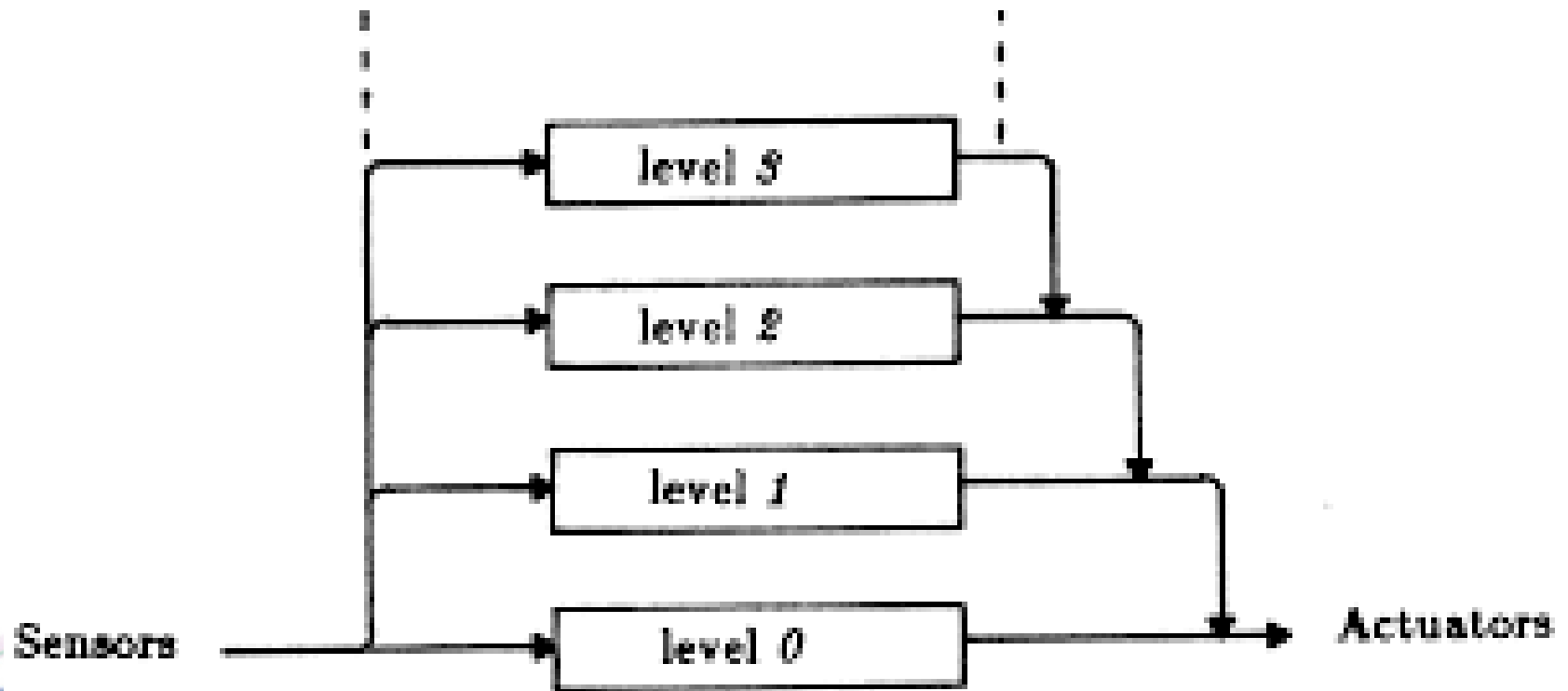
External Storage->Local Storage

Local Storage->Goniometer

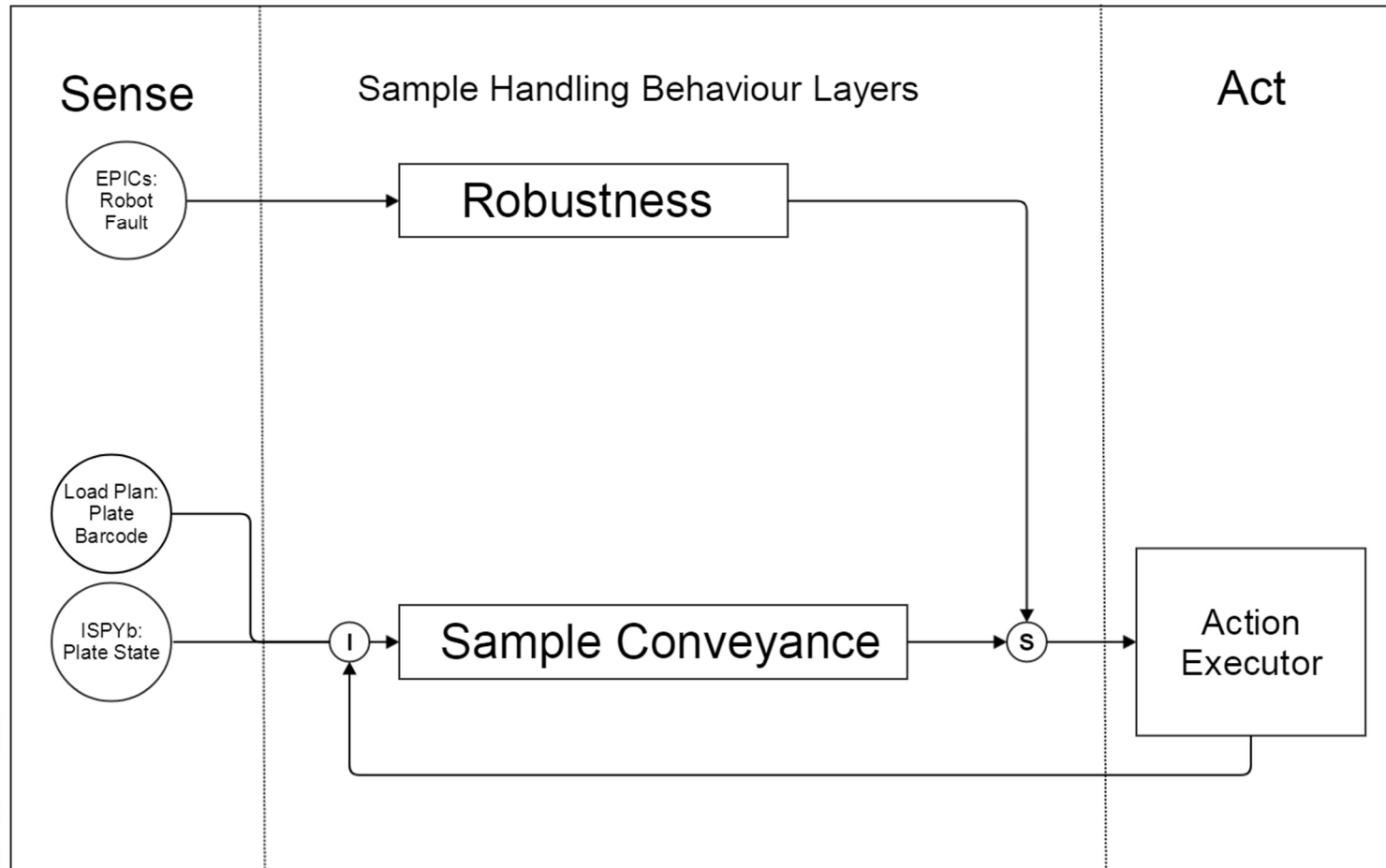
Goniometer->Local Storage

Local Storage->External Storage

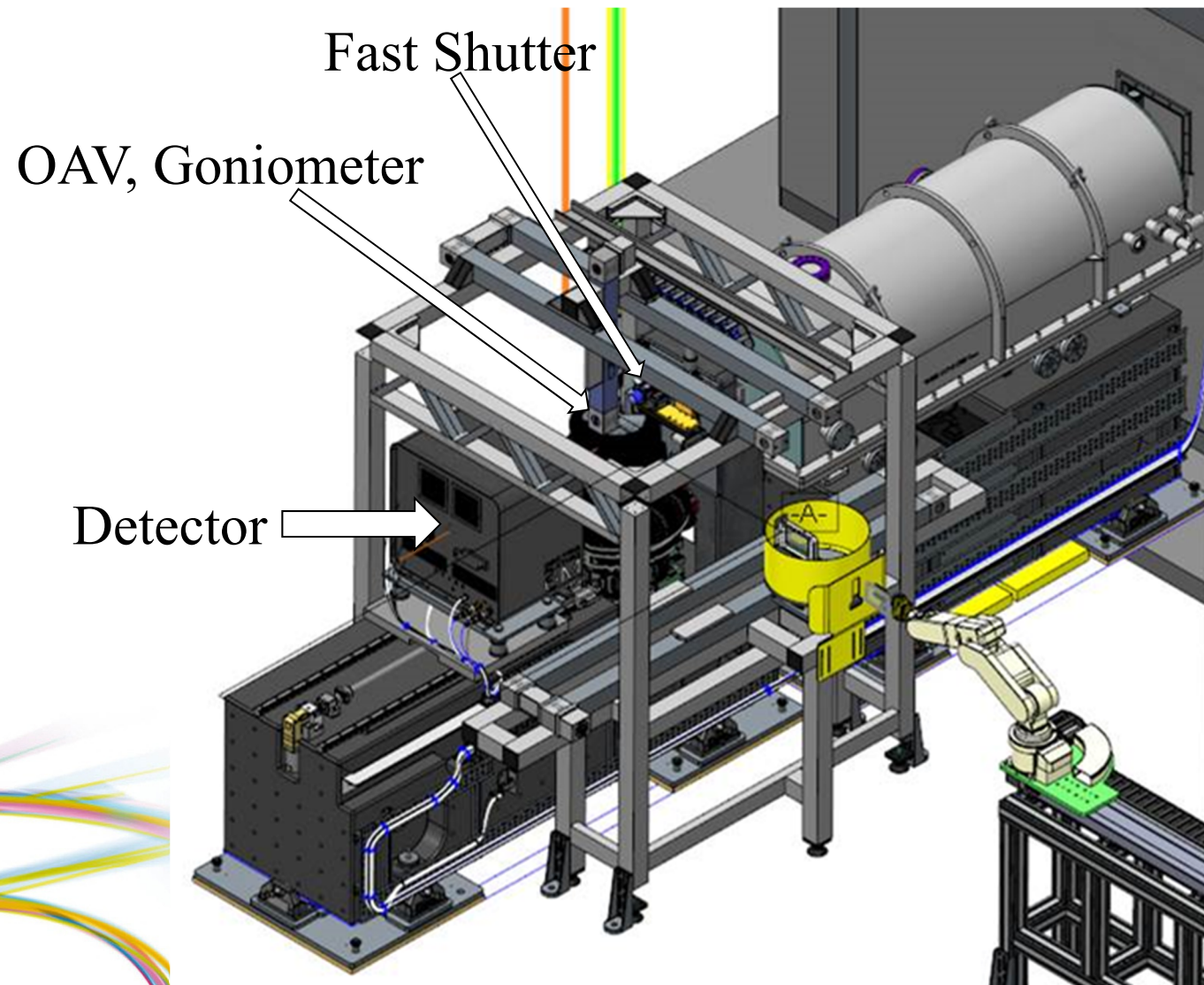
Brooks's Subsumption Architecture



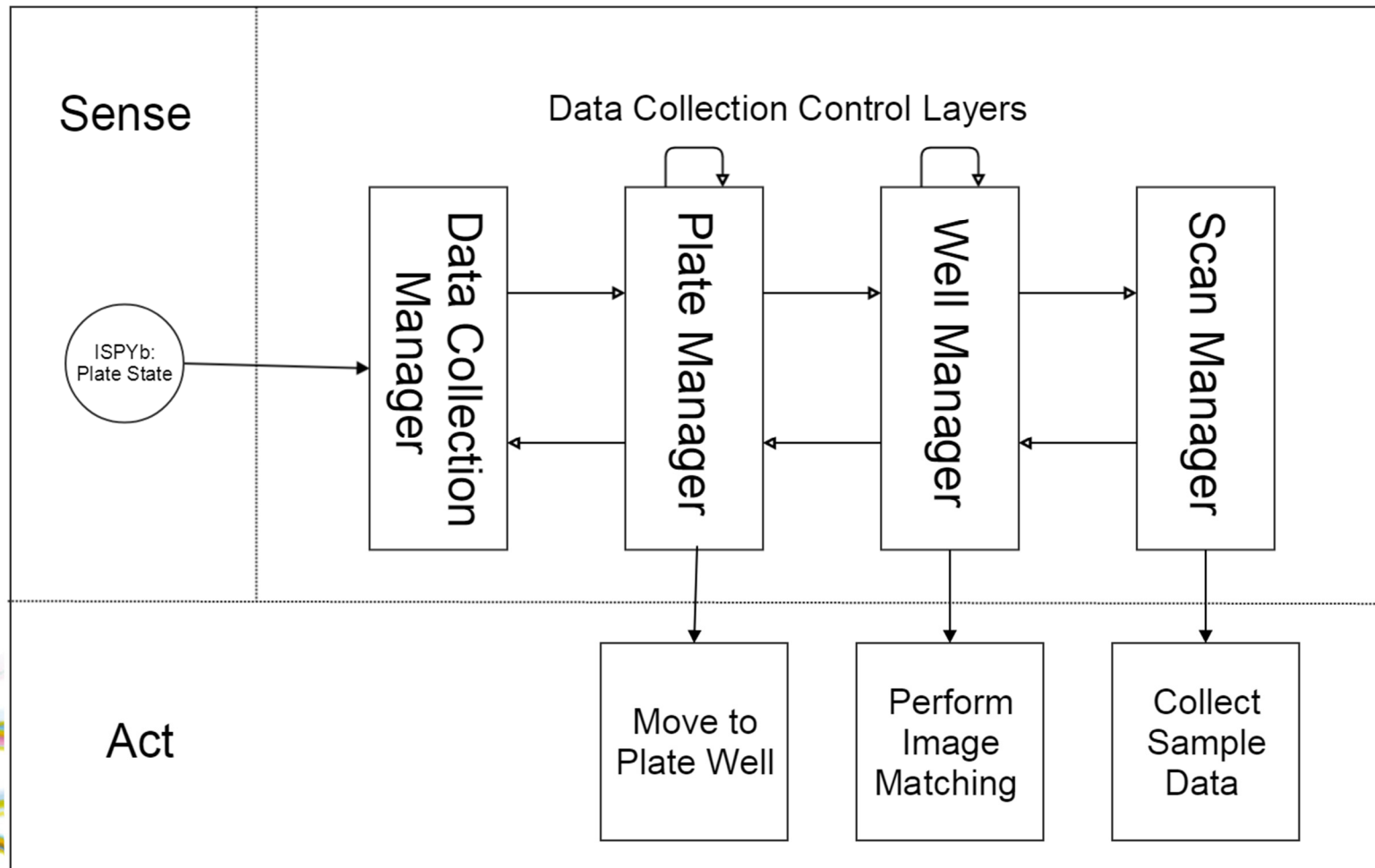
Sample Handling Reactive Controller



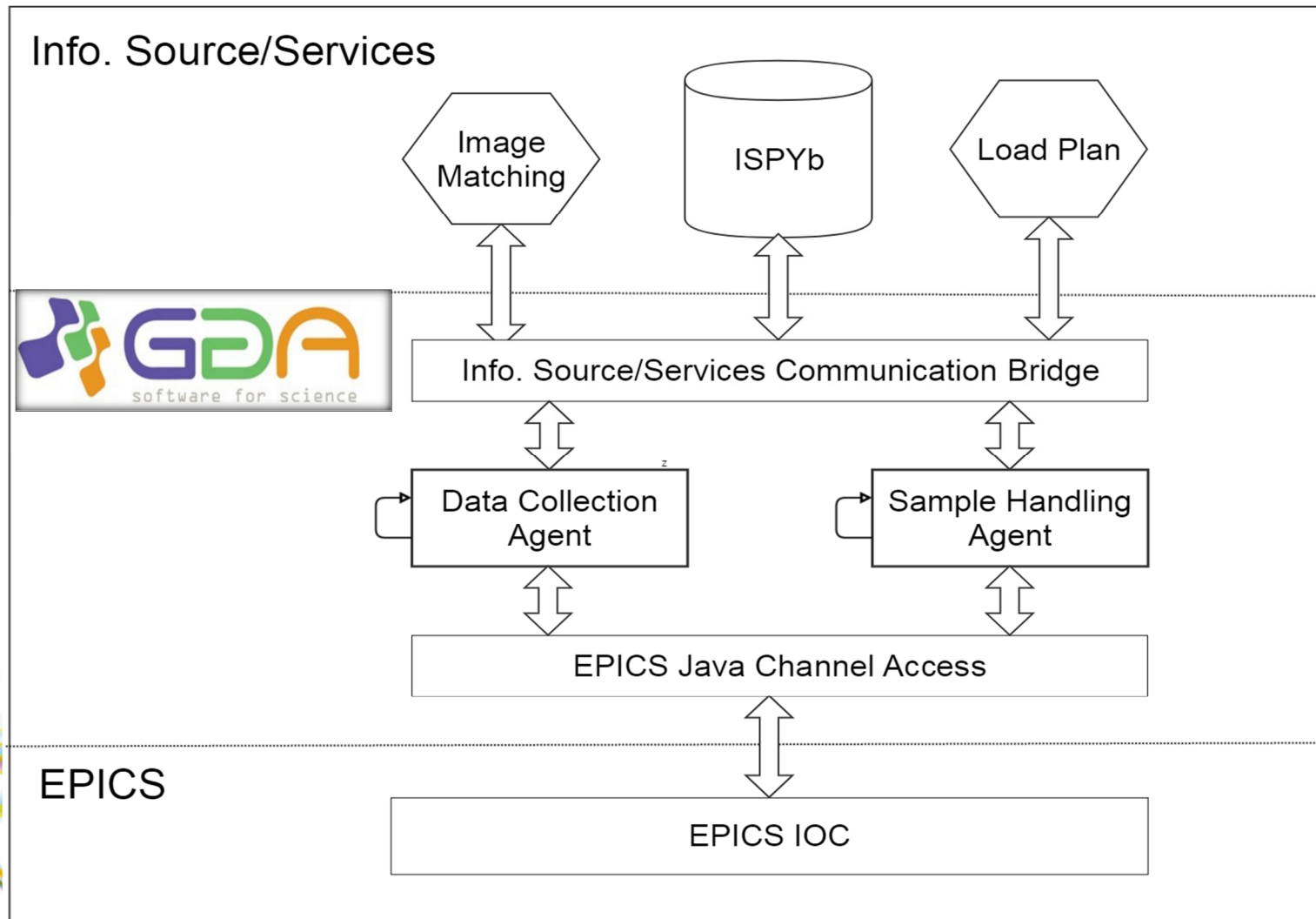
Data Collection Environment



Data Collection Reactive Controller



GDA VMXI



Summary

- Automation is possible with standard software tools
- AI is the domain for design solution
- Planning and decision making tasks are external
- Computational intensive tasks are external
- Hardware synchronisation in controls layer
- Reactive Agents initiate and monitor actions only



Thank you to.....

VMXi beamline staff: Thomas Sorenson, Juan Sanchez-Weatherby, James Sandy and Carina Lobley.

Scientific Software: Alun Ashton, Kevin Savage, Karl Levik, Stuart Fisher and Graeme Winter.

Controls: James O’Hea, Lee Hudson, Alan Greer, Kris Ward and Chris Martin.

GDA: Paul Hathaway.

And to all the mechanical, electronical engineers and technicians who built VMXi.

Thank you for your attention...Questions

