The Australian Imaging Service as the National Imaging Facility's Foundational Digital Research Infrastructure

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What is the Australian Imaging Service?

Our mission is to increase research reproducibility and drive the adoption of innovative but trusted analysis techniques.

- NCRIS invested national platform for collaborative imaging research.
- Integration with imaging facilities and clinical sites
- Secure, audited data management, access, and deidentification
- Browser accessible viewing, annotation, & analysis
- One-click reproducible pipeline library, curated collection and custom developed

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AIS Federation View

13 Nodes

570+ Users

150,000+ Sessions

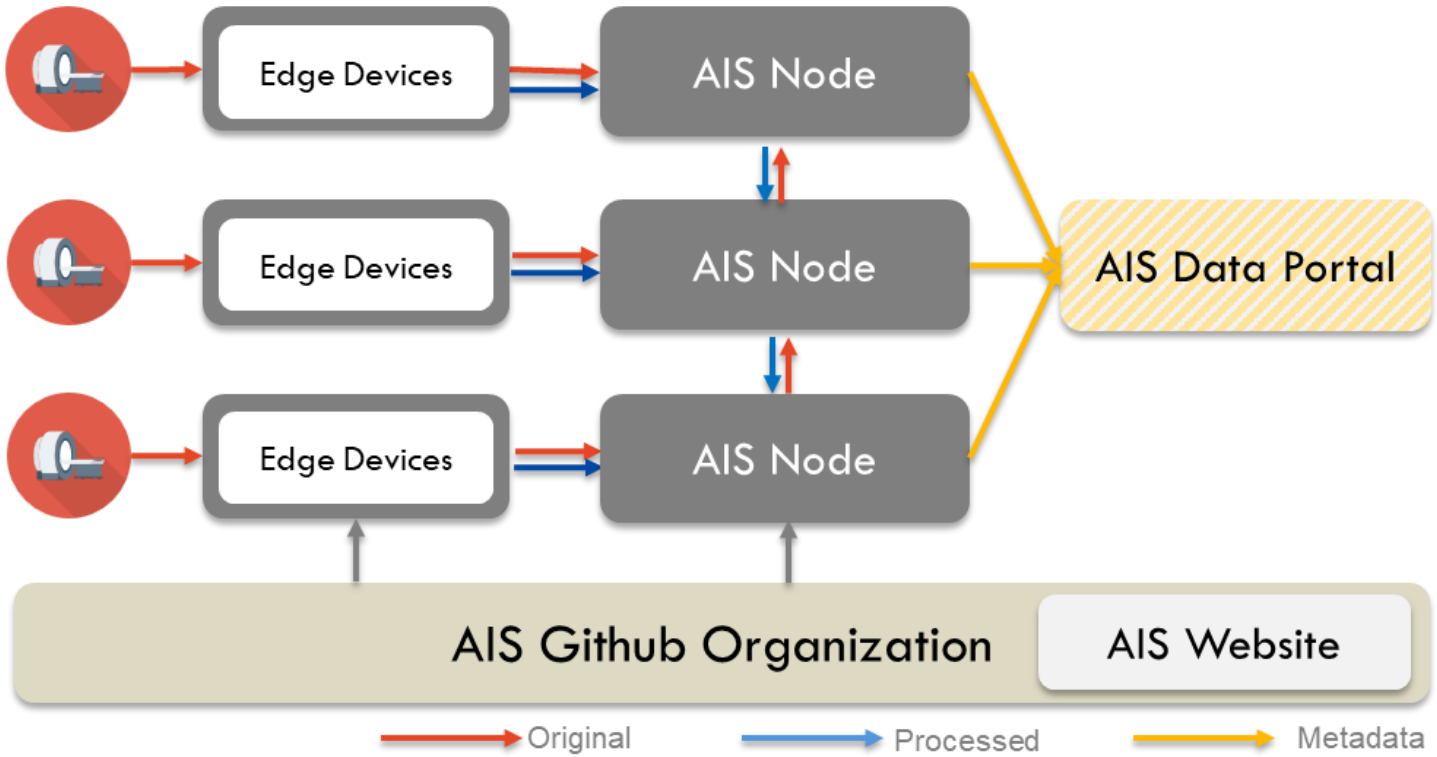
Edge Devices: Upload & process data from clinical sites and imaging facilities

AIS Nodes: Linked data repositories with shared library of containerized pipelines and analysis tools deployed on Kubernetes

AIS Data Portal (Planned): Open frontend for findable metadata (opt-in)

AIS Website: Single landing page and documentation

AIS Repository: Shared cloud native codebase on Github



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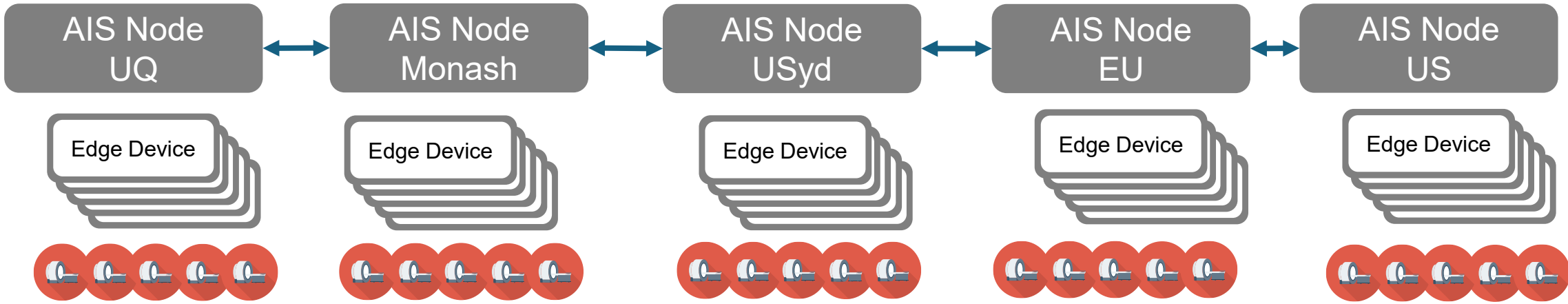
Building Research Programs on AIS

AUSTRALIAN MUSEUM EUREKA PRIZES 2024 WINNER

Excellence in Interdisciplinary Scientific Research

MSBase Imaging Repository

ACRF ACEMID Research Repository



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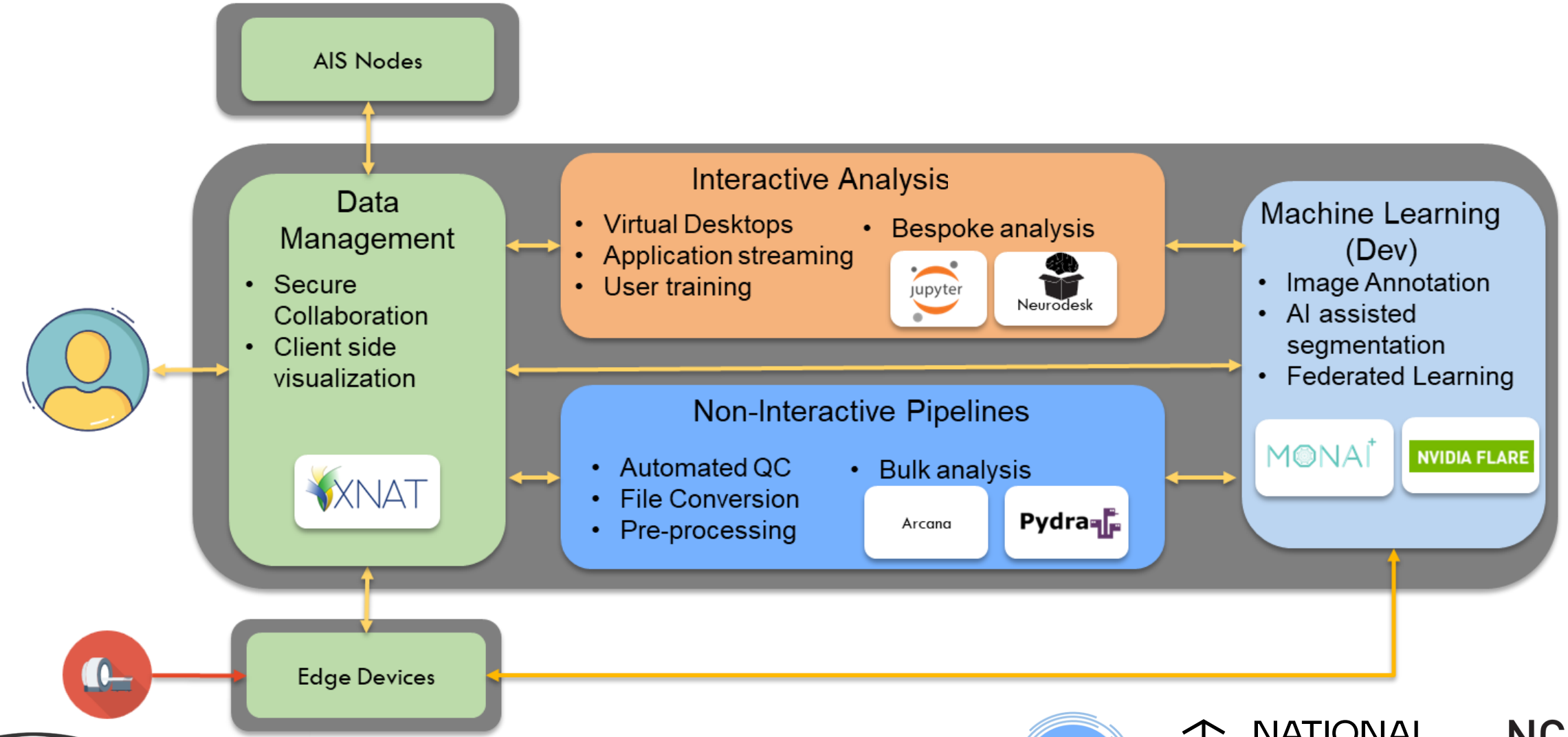
AIS Secure Data Centric Computing – 4 Capability Areas



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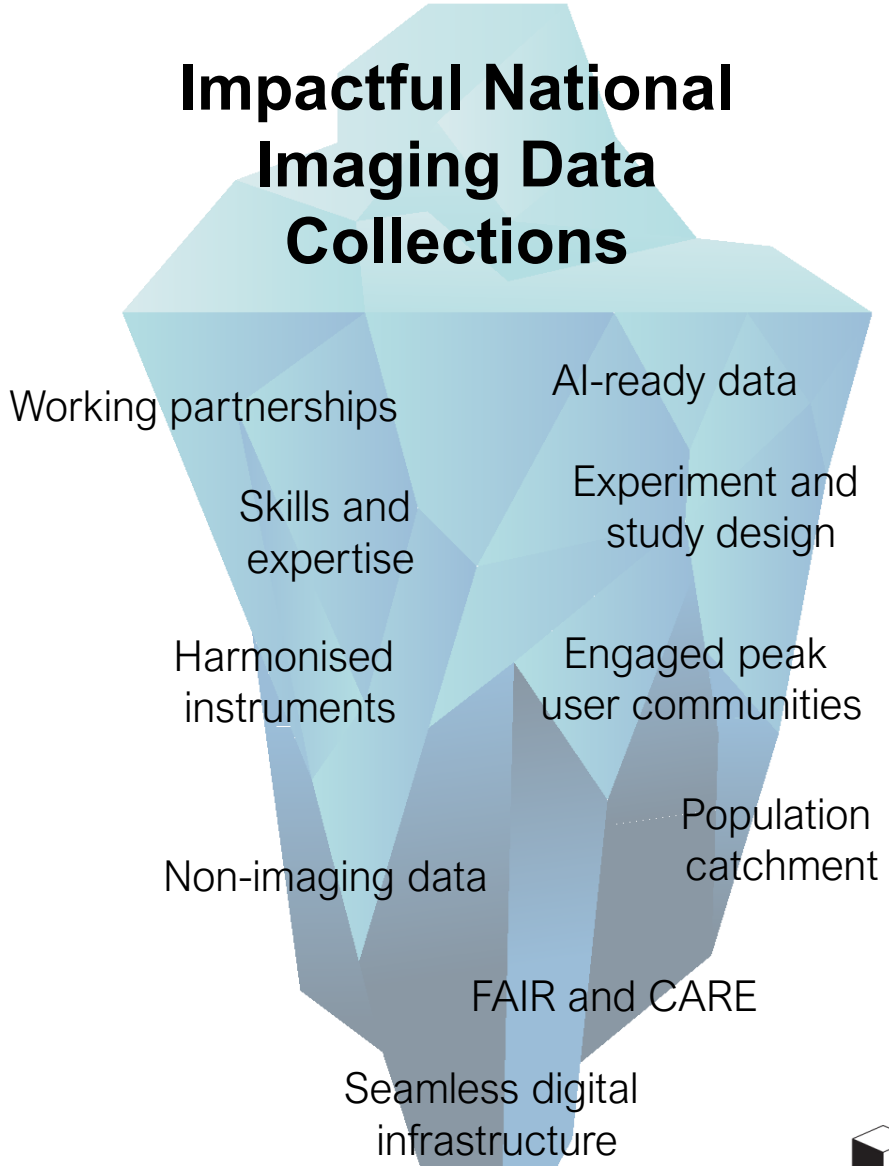
NIF Data Collections and Partnerships Program

"NIF is uniquely positioned to generate **impactful national data collections** that can be used to solve big questions in medical research"

- 100+ peak imaging equipment and specialised expertise
- Clinical-research-industry partnerships
- Spanning Australia's population and innovation precincts



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Foundational Digital Research Infrastructure

A consistent data management environment that could support all NIF nodes and partners

A technical roadmap that helps plan for the future

A support model for node partners, national-scale projects, data partners and users

A funding model that supports continuous improvement and expansion

An effective infrastructure governance model

$11M project + $2.2M in infrastructure

$10M NIF Foundational Digital Research Infrastructure

Increasing Adoption:
- 13 → ~18 Nodes
- 500 → >1,000+ users

Data Capture
- Unified instrument data uploader
- DICOM or proprietary
- University or Hospital

Data Management & National Support
- National self-service portal
- Data & Metadata Expansion

Automated & Interactive Analysis
- Software catalogues
- Cost Controls and Management
- Automated software testing
- Streamlined community contributions

Community of Practice & User Engagement
- Drive user requirements
- Drive community adoption
- Lead national training workshops

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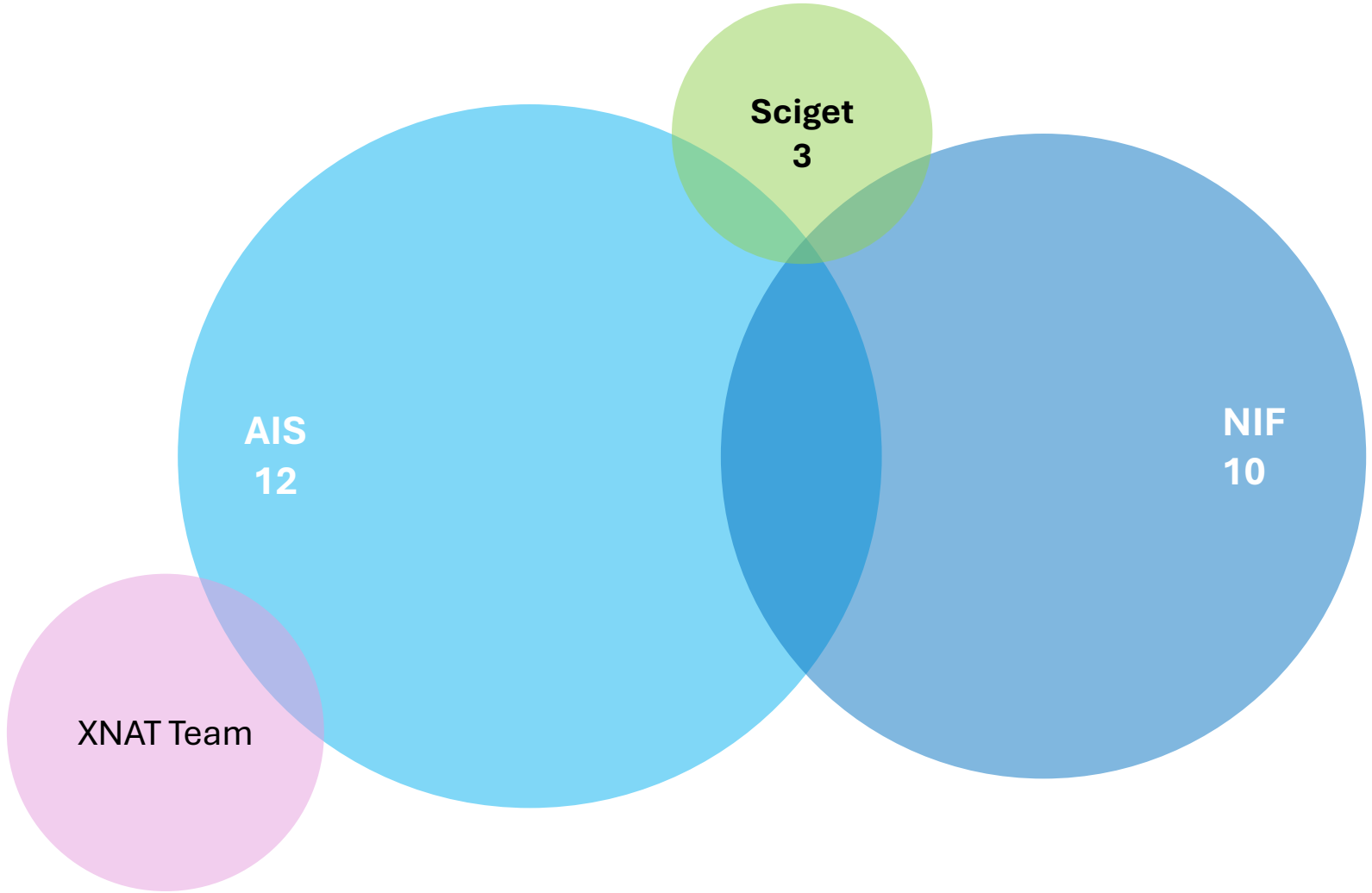
Teams Before FDRI



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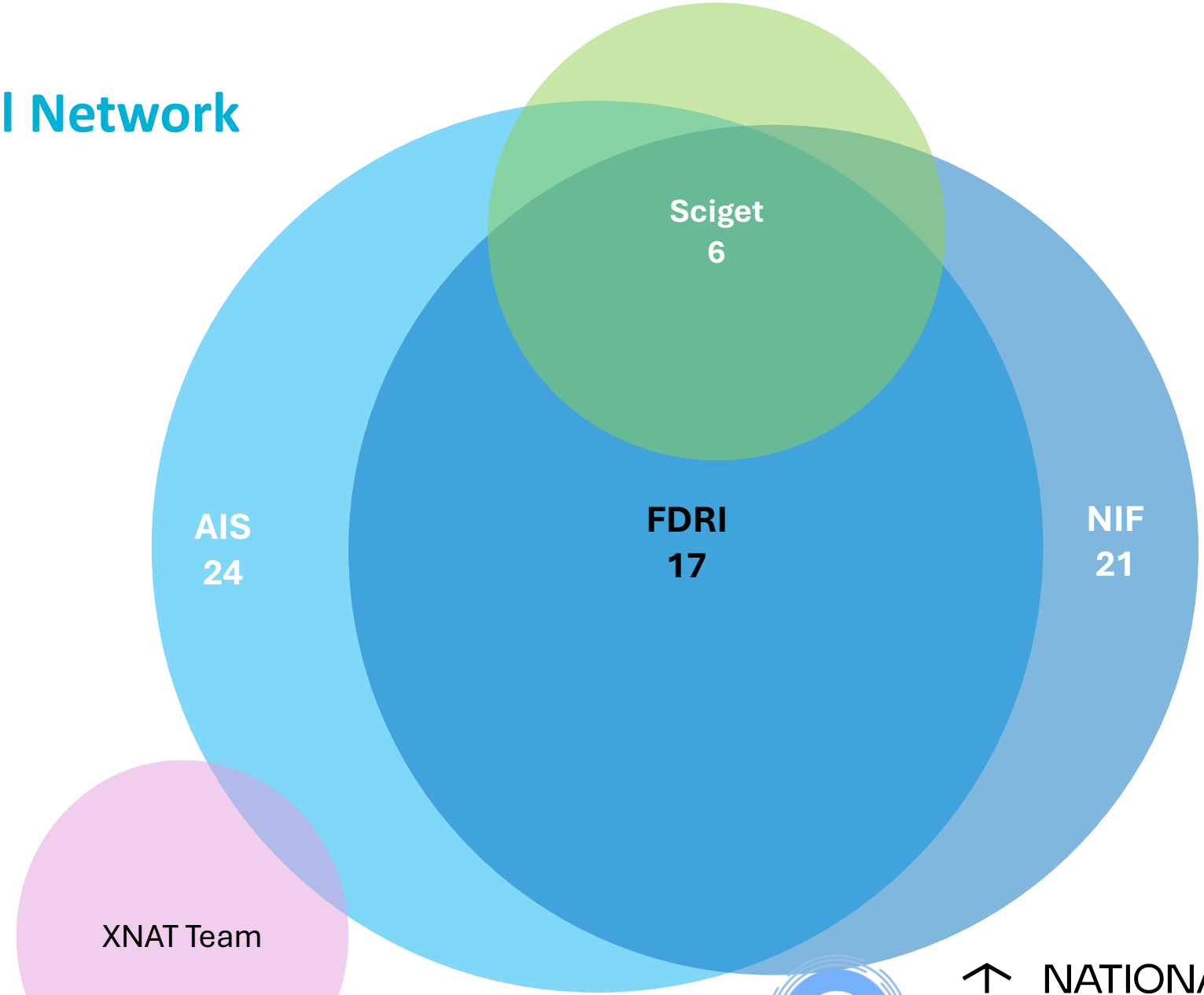
Our Digital Network



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NIF Foundational DRI Project Plan

(1) Leadership & Governance (10% FTE)

(6) Community of Practice (7% FTE)

(2) Data Capture & Movement (25% FTE) → (3) Data Management & National Support (34% FTE) → (4) Automated Analysis (8% FTE) → (5) Interactive Analysis (16% FTE)

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Stream 1 Leadership & Governance

Goal: The purpose of this activity is to provide thought leadership, project management and governance, and operations, working with the NIF and wider biomedical imaging communities on both acute and long-term strategic planning and prioritization for the digital infrastructure delivered in this project and the projects built upon it.

Strategic Planning: Work with NIF Directors, related NCRIS capabilities, relevant international bodies, and research communities to align multiple investment streams to integrate and build upon the infrastructure.

Digital Architecture: Provide overarching technical design of the entire digital infrastructure to ensure each of the activity streams and future investments stay aligned, feasible, and sustainable. Engagement with ARDC, Pawsey, NCI, commercial, and university infrastructure teams.

Roadmapping: Rolling public roadmap consisting of a detailed breakdown of 12-month funded work along with high level plans for both funded and to be funded projects on a multi-year horizon.

Project Management & Reporting: Implement project steering committee with representatives from investment partners, meeting at a quarterly cadence.

Operations: Core operational support including onboarding, budgeting, rate-cards, and service delivery.

Stream 2 Data Capture & Movement

Goal: Develop a robust and configurable data uploader and data transfer workflow that can enable all NIF instrumentation to connect to centralized digital infrastructure at each node.

Diverse Data Support: Preclinical or clinical, DICOM or proprietary, university or hospital, the data needs of the NIF community are diverse.

Metadata Standards: Establish and implement consistent naming conventions and identifiers for projects, subjects, sessions, and scans.

Workflow Engine: to enable de-identification, injection of metadata, or conversion of data to open formats before being uploaded to the repository.

Error Handling: Robust error handling will be implemented to facilitate consist of data uploads including alerting facility staff, so issues don't go unnoticed.

Monitoring, Logging & Alerting: Services to monitor technical aspects of the infrastructure, including hardware utilization and software errors, integrating into a single national dashboard, to allow monitoring of the national fleet.

Continuous Deployment: Automation to allow remote updates of the software across the partners to ensure the fleet stays current.

Stream 3 Data Management & National Support

Deployment Classifications: Categorization of data, computation, and security capabilities and mapping across partners

Data Transfer: Integrating all nodes with standard procedures to allow researchers to seamlessly move their data.

Monitoring, Logging & Alerting: Services to monitor technical aspects of the infrastructure, including hardware utilization and software errors, integrating into a single national dashboard for technical staff.

Cost Attribution: Cost breakdown of storage and computation by research project, allowing for cost- recovery to improve the financial sustainability of the infrastructure.

Data & Metadata Expansion: Expansion of imaging and related data types and formats able to be stored along with clinical and preclinical ontologies.

Service Catalogue: Definition and rate card of core services for researchers and NIF facilities, along with Tier 0 AIS User guide and documentation.

National Portal: Tier 1 online resources with self-help user interface, access to imaging user community and facility providers.

National Technical Support: Tier 3 technical support to monitor and assist all the NIF nodes using the Monitoring, Logging, & Alerting capability.

Stream 4 Automated Analysis Foundation

Goals: enhance the automated analysis framework for efficient, reproducible research across all imaging modalities.

Automated Analysis Catalogue: Create an accessible catalogue outlining which pipelines are available, their intended uses, and how to run them.

Documentation and training: Produce user and developer documentation and conduct initial user and developer workshops to support adoption and gather feedback

Streamline user experience: Make it easier for the research community to implement and run their own analysis workflows as pipelines, including backend engine enhancements, simplification of the technical syntax to define a workflow, and adding easy to use interactive debugging tools.

Resource Controls and Cost Management: Develop logging to quantify the resources used by scientific workflows and allow research project to restrict their computational budget (no post-docs accidently blowing budget).

Automated Software Testing Framework: Implement regression testing framework and approval procedures for validating accuracy and reproducibility of scientific software as it is updated, including developing procedures to support prototyping software as a medical device.

Stream 5 Interactive Analysis Foundation

Goal: foundational enhancements that can underpin software for any imaging modality and improved tooling for the better user community experience.

Interactive Analysis Catalogue: Create an accessible cataloguing system for users to find the growing list of available imaging and scientific software, their intended uses, and how to run them.

Streamline scientific community experience: Make it easier for the research community to integrate new scientific applications through enhancements in the framework for application integration, streamlined technical workflows, easy to use interactive debugging tools. Uplifting and hardening of scientific application container building and testing framework

Streamline user experience: Improvements to the platform backend, user interface, and core toolkit to facilitate better management of scientific applications. Creating a robust framework for creating interactive analysis pipelines, improved support for container versioning, publishing and better support for software attribution and license management

Monitoring, Logging & Alerting: Services to monitor interactive analysis instances, including hardware utilization and software errors, integrating into a single national dashboard for technical staff.

User Training: Adding user tutorials and training material, workflows for contributing interactive analysis pipelines, and support for workshop use-cases

Stream 6 NIF Community of Practice, User Engagement and Training

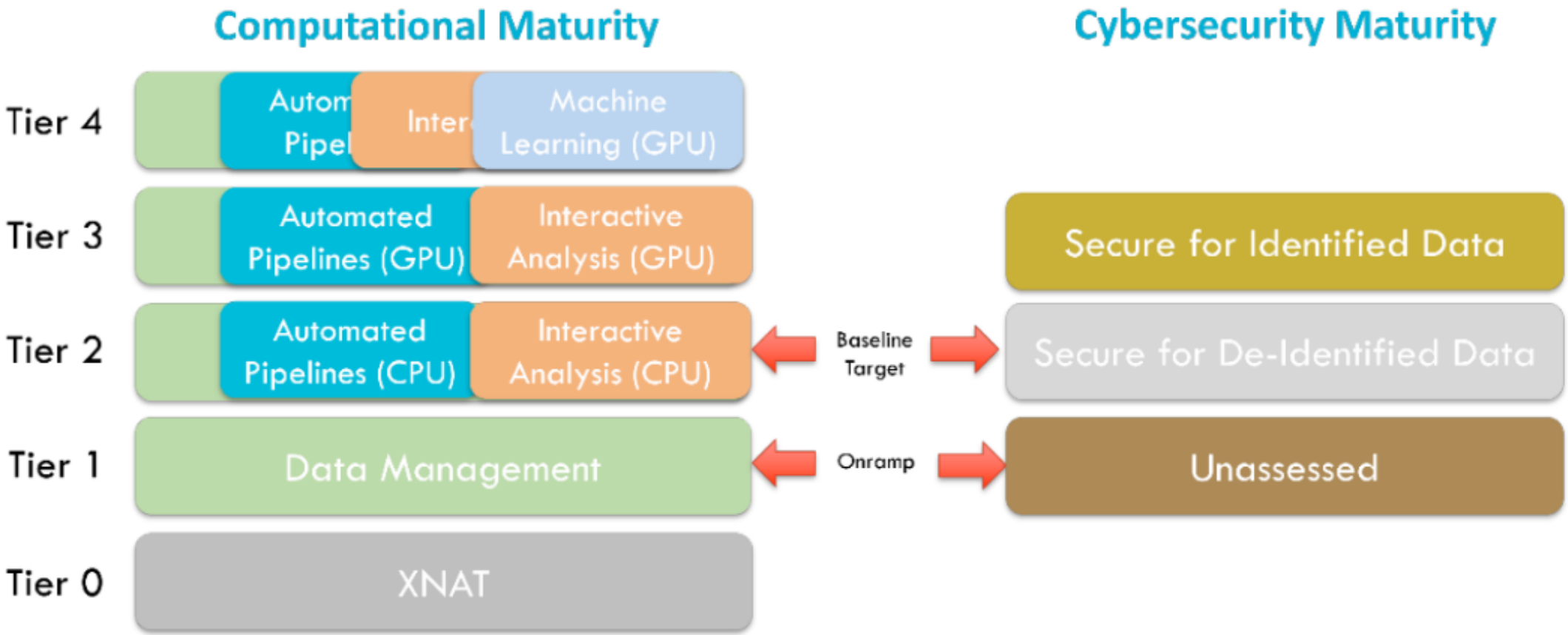
Goal: Standard approach to engaging with NIF Fellows for informing requirements, onboarding projects, and user training.

Establishing technical requirements: Participating digital specialists will provide technical advice to the CoP, identify and communicate emerging practice area functional and technical requirements back to their main activity and centrally, to be classified as an epic, feature or task, as a candidate for implementation via the layered project governance processes (see 6.1).

Partner adoption: NIF facility-based participants will play an important ambassadorial role in encouraging, facilitating, and
coordinating adoption of community practices at their home partner facility and institution.

User engagement and training The CoP will assist establishing a user engagement and training plan (including in-person training opportunities), bringing together on-line training content from other activities under one umbrella, and also build a suitable training environment to run the sessions and provide the training content.

Establishing shared context



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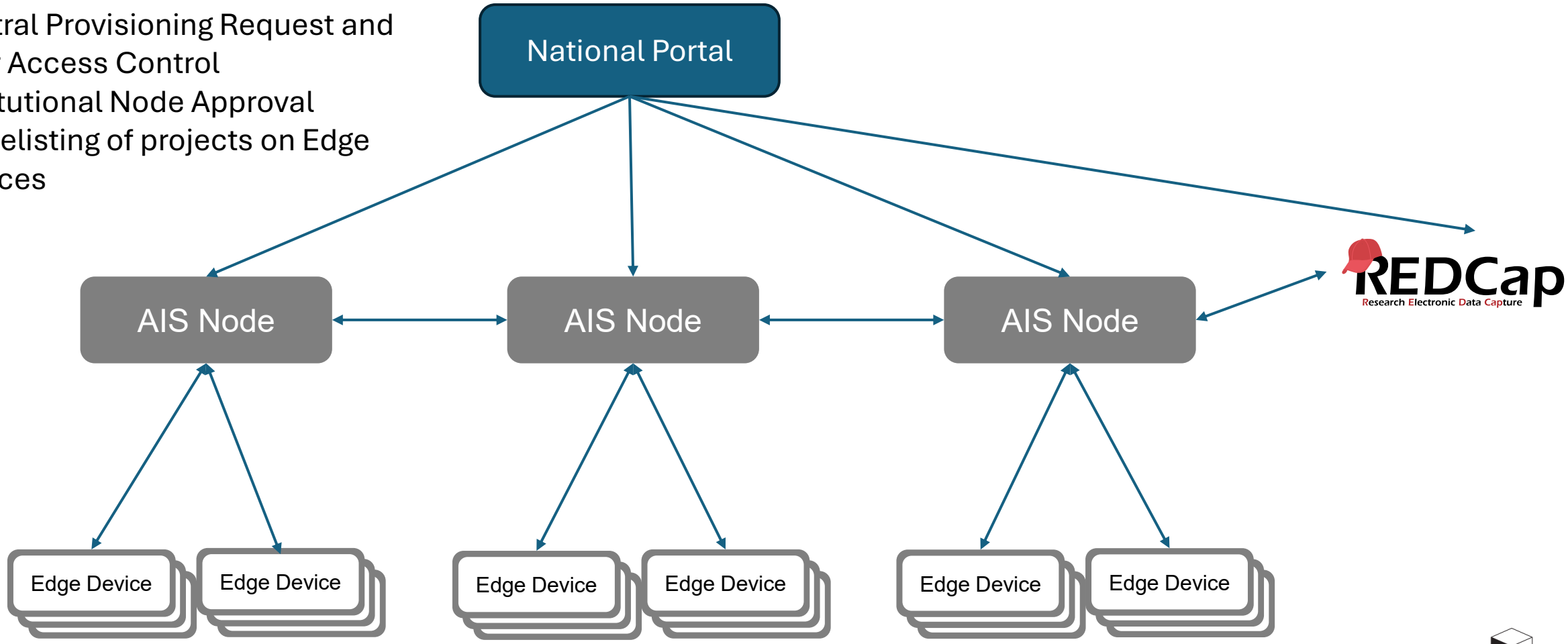
National Coordination to enable Multi-Site Studies

1) Central Provisioning Request and User Access Control
2) Institutional Node Approval
3) Whitelisting of projects on Edge Devices



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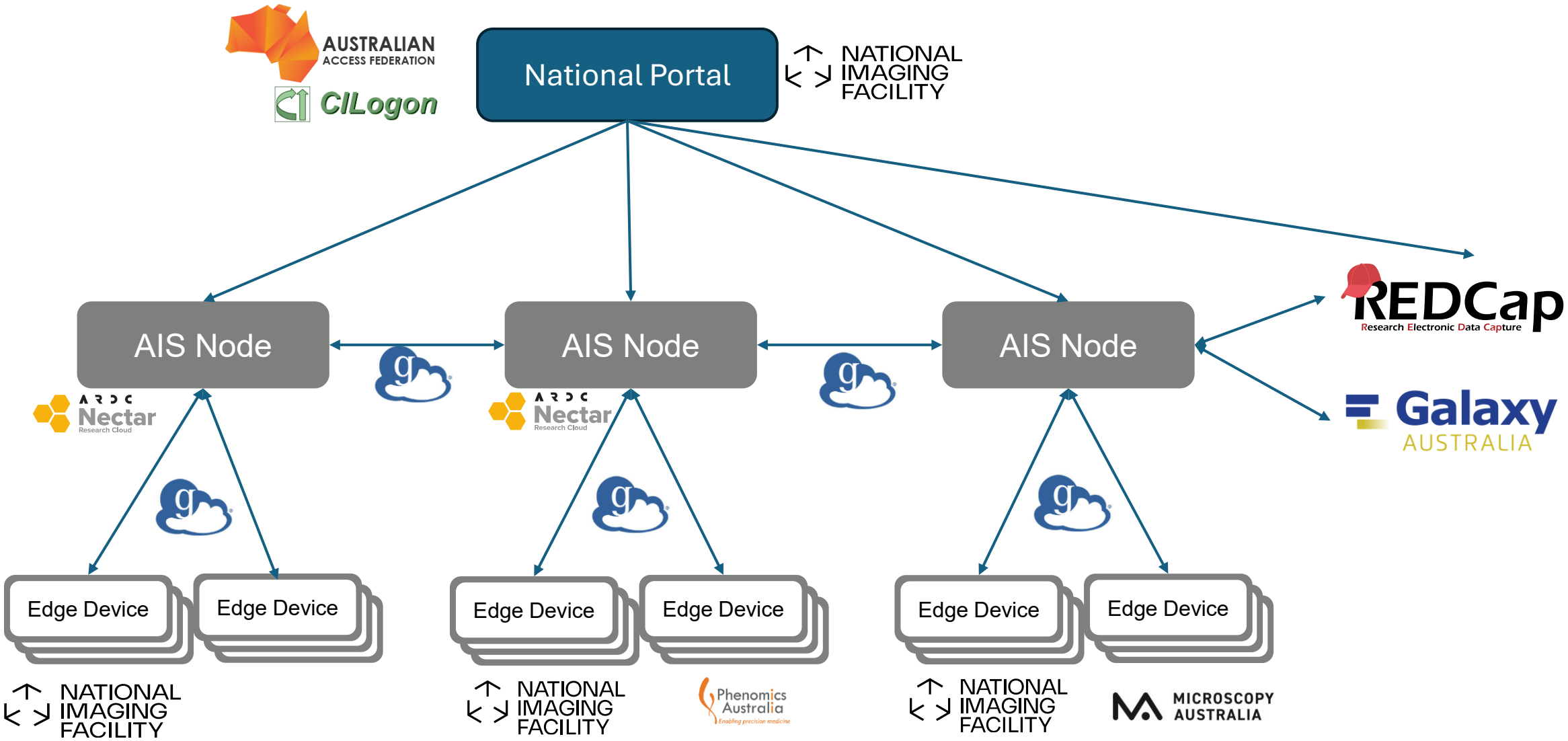
Wider NCRIS Network Support

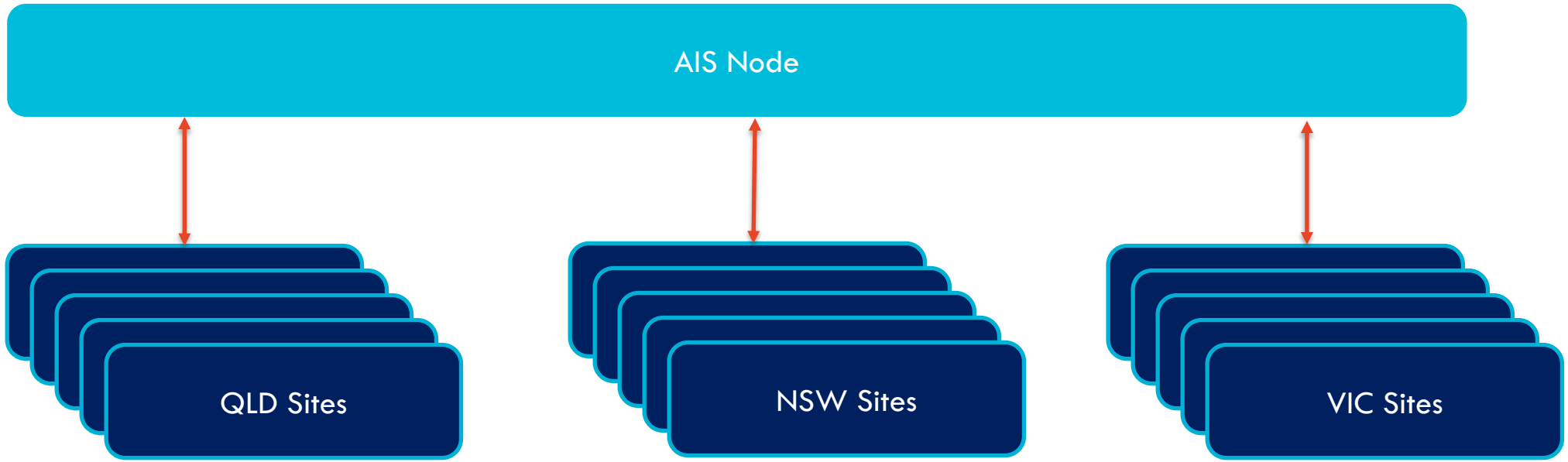


Federated Learning

FLERA

Federated Learning Ecosystem For Research In Australia

Transfer model weights between AIS edge devices and nodes. Images never leave the clinical environment



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Funding

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