An Imaging Exchange Framework for Australia

A model for enabling distributed medical imaging sharing

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Executive Summary

This document proposes an **Imaging Exchange Framework (IEF)** as a national architecture for interoperable medical imaging exchange in Australia, designed to align with the Australian Digital Health Agency's **HealthConnect** strategy. The framework aims to enable safe, standards-based sharing of diagnostic imaging data between healthcare providers, patients, and systems, regardless of vendor or legacy infrastructure.

In its current form, the IEF is a discussion paper, designed to inform the direction of policy and practice. However, care has been taken to ensure that all recommendations are practical, achievable, and evidence-based. Where gaps exist in current technology, the authors have proposed new, open source solutions.

The IEF bridges **DICOM** and **FHIR** ecosystems by defining a set of roles, capabilities, and protocols that allow legacy imaging systems to participate in modern, API-driven health information exchange. It supports use cases such as referral-based imaging access, shared care imaging retrieval, and specialist second opinions, with an emphasis on **real-time discoverability and access**, rather than historical, centralised storage.

Key components of the framework include:

- A **FHIR-based discovery mechanism** for locating available imaging studies for a patient.
- A new mechanism to **retrieve bulk medical imaging**
- Integration with **HealthConnect common services**[1].

The document explicitly excludes a central archive model and image duplication. Instead, it defines a loose, federated model where images remain in their original locations and are accessed as needed. This makes the IEF adaptable, cost-efficient, and able to support both high-end PACS environments, cloud-native systems, as well as smaller providers or specialists with in-house imaging.

By aligning with national health interoperability goals, respecting privacy requirements under the APPs, and leveraging international standards, the IEF lays the groundwork for a connected imaging ecosystem in Australia that can scale with both technological and clinical expectations.

[1] To the extent that they are known at the time of writing. All references to HealthConnect are assumptions.

Introduction

This document outlines a proposal for an **Imaging Exchange Framework** to enable seamless, interoperable exchange of medical imaging data within the Australian health data ecosystem. This architecture aligns with the principles in the *Health Connect Australia Strategy*, including federated architecture, a common technology framework, and reusable interoperability patterns, while accommodating legacy and modern imaging systems.

The Framework defines an abstraction layer that bridges DICOM imaging systems with modern, HealthConnect-conformat FHIR-based record locators and appropriate, modern file exchange mechanisms, ensuring that imaging is accessible and discoverable. It enables both federated repositories and direct exchange, while ensuring pull-based discovery and retrieval of imaging and its associated metadata.

The Framework relies on HealthConnect's Common Services as well as its enabling work around FHIR and taxonomies.

The significant innovation is the inclusion of a novel bulk file exchange mechanism for medical imaging. This recognises that both DICOM and DICOMweb are not fit-for-purpose for file transfers at-scale, and introduces a modern, secure mechanism (JMIX), however DICOMweb is included as a fallback mechanism.

The architecture of the Imaging Exchange Framework supports modular deployment, allowing organisations to adopt capabilities progressively based on:

- Their technical maturity.
- Local legislative requirements.
- Specific clinical needs.

The framework recognises the reality that legacy systems, such as DICOM are not going away, and need a way to function within a new framework.

About the Authors

The IEF was created by Aurabox. Aurabox is an Australian company working at the forefront of medical imaging interoperability. Founded in 2021 by radiologist Dr Chaturica Athukorala and technologist Christopher Skene, Aurabox's mission is to solve the problem of access to medical imaging. Aurabox operates a SaaS platform for medical imaging interoperability in Australia, the UK, and Singapore.

Licence & Reuse

Background

The Australian Government, through the **Health Connect Australia** program, is establishing a national, federated health information exchange (HIE) ecosystem designed to enable secure, standards-based, and policy-aligned sharing of health information across the country. Rather than a single, centralised platform, Health Connect Australia provides a set of common capabilities, services, and architectural patterns that support information discovery, exchange, and management across diverse healthcare organisations and jurisdictions.

This national architecture is structured around several key capabilities:

- **Common Services Layer**: Provides shared, reusable national infrastructure, including identity management, authentication, authorisation, consent management, information discovery, and event notification services.

- **Digital Health Identity and Participation Services**: Ensure that healthcare providers, organisations, applications, and individuals are uniquely identified and validated within the national ecosystem.

- **Information Discovery Services**: Allow authorised participants to locate relevant health information, including clinical documents, referrals, results, and other records, across the federated environment.

- **Standards-Based Exchange**, underpinned by the **AU Core Framework for Interoperability (AU CFI)**, Sparked FHIR Implementation Guides, and internationally recognised standards such as FHIR and SNOMED CT®.

While this architecture provides a robust foundation for health information exchange, it does not yet adequately address the unique technical requirements of medical imaging. Imaging data presents distinct challenges due to:

- The large size and complex structure of imaging files (DICOM).

- The reliance of imaging systems on the legacy DICOM networking protocol, which is not designed for distributed, internet-scale exchange.

- The limitations of DICOMweb for bulk data transfer or real-time exchange of complete studies across organisational boundaries[2].

Unlike other clinical information exchange challenges, the imaging interoperability gap is primarily technical, rather than clinical or semantic. The structure, usage, and clinical interpretation of imaging data are well understood and consistent across healthcare settings. The challenge lies in providing a scalable, standards-compliant, policy-aligned technical mechanism for federated discovery and transfer of imaging studies, consistent with Health Connect Australia's architectural model.

[2] See the Appendices for a more detailed breakdown of these problems.

Overview

The **Imaging Exchange Framework (IEF)** outlines an architecture for interoperable medical imaging exchange in Australia. It defines a set of standards, roles, and obligations that govern how imaging studies can be discovered, accessed, and retrieved across organisational and jurisdictional boundaries.

The IEF does not prescribe a single system or vendor solution. Instead, it defines the rules of engagement—the patterns and responsibilities for systems wishing to participate in federated imaging exchange, whether they are PACS vendors, EHR platforms, AI tools, or public health agencies.

The IEF assumes that in order to meet the diverse needs of **Imaging Consumers**[3], two key problems must be solved. Together, resolving these two base requirements will resolve almost all imaging access issues.

1. **Discovery**
   The IEF must enable automatic and on-demand discovery of medical imaging by any requester authorised under the Privacy Act (or at minimum, via Healthconnect), in real time and without manual intervention.
2. **Retrieval**
   Imaging should be able to be retrieved on-demand, when required, at the point of care and *in the Clients system* using a pull-based retrieval model.[4]

In HealthConnect, this is the *Discovered Information Exchange*.

To facilitate real-world adoption, the IEF introduces the concept of a **Medical Data Gateway (MDG)**—a concrete reference architecture for providers who need to expose imaging systems to the HealthConnect ecosystem without major modifications to their existing infrastructure.

In short:

- The **IEF** defines *what must be done* and *under what conditions*.
- The **MDG** defines *how it can be done*, offering a technical on-ramp to meet those obligations.

Together, they enable a scalable, standards-aligned, and policy-compliant model for medical imaging interoperability—supporting modern clinical workflows, research, and secondary use across the Australian healthcare system.

[3] Imaging Consumers are any user of a digital system needing to locate, access or retrieve medical imaging and its associated metadata. The broad scope of Use Cases are detailed in Appendix 1.
[4] All imaging exchanges today use a push-based delivery model.

Policy Perspective

The Imaging Exchange Framework (IEF) has been deliberately designed to align with the **Health Connect Australia Architecture**, supporting a federated, standards-driven approach to health information exchange that reflects national digital health priorities and legislative requirements. The IEF provides a policy-compliant foundation that enables imaging systems to participate in Australia's evolving digital health ecosystem in a secure, privacy-preserving, and interoperable manner.

Rather than prescribing specific technologies, the IEF defines clear behavioural expectations, interface requirements, and conformance criteria, ensuring consistent implementation while preserving flexibility and vendor neutrality.

Central to this approach is the **Medical Data Gateway** (MDG) concept, which enables imaging systems to expose, exchange, and manage imaging information in alignment with Health Connect Australia's common services layer and interoperability patterns.

From a policy perspective, the IEF enables:

- **Federated participation**, ensuring imaging providers can retain control of their data within local systems (e.g., PACS, VNA) while supporting discoverability and secure exchange through national infrastructure such as identity, consent, and authorisation services provided by Health Connect Australia.

- **Interoperability through conformance**, allowing any IEF-compliant system, regardless of vendor or technology stack, to securely exchange imaging data across jurisdictional and organisational boundaries.

- **Privacy and security by design**, with auditability, consent integration, and alignment to national frameworks including the My Health Records Act, Australian Privacy Principles, and the Australian Signals Directorate's Information Security Manual (ISM).

- **Progressive alignment with national capabilities**, including support for FHIR-based APIs and future enhancements to My Health Record and other national infrastructure.

Providers can:

- Extend existing imaging infrastructure by integrating IEF-compliant capabilities with minimal disruption, leveraging the federated model to avoid unnecessary duplication of data.

- Engage trusted third-party vendors, such as Aurabox, as interoperability gateways, ensuring participation in the Health Connect Australia ecosystem without mandating wholesale system replacement.

- Demonstrate conformance with national policy objectives around Imaging Consumer access, care coordination, data portability, and privacy, with low operational burden.

Market Flexibility and Adoption

Any new technology proposal must acknowledge the significant, industry-wide change required for implementation. It's important to understand that this shift is driven not by the IEF itself, but by the HealthConnect project, which effectively mandates pull-based discovery and retrieval of medical imaging alongside other health data (primarily via the *Discovered Information Exchange* pattern). Traditional DICOM networking was never designed for this purpose. DICOM assumes you already know where the data is, requires manual connection management, and lacks automated discovery, consent mechanisms, or scalable retrieval suited to a federated environment.

The Federal Government has made it clear that participation in this ecosystem will be mandatory. While there is still work to be done on the practical details, it is already certain that every imaging provider and imaging consumer in Australia will need to fundamentally rethink how they approach interoperability for imaging and other medical data. The scale of change for imaging will likely exceed that required for other health data domains.

In response, the IEF adopts a minimal, practical approach. It is designed to allow organisations to retrofit existing technology with minimal complexity. Through its common capabilities, it provides simple, standardised approaches requiring only basic functionality. Its open implementation model allows organisations to engage third parties for connectivity, improving flexibility and supporting market-driven adoption.

The IEF aligns with HealthConnect Australia's goal of broad, scalable participation across the health sector. By focusing on behavioural conformance, interoperability patterns, and adherence to standards, the framework reduces barriers to entry for organisations of all sizes while promoting innovation and vendor choice.

The IEF enables:

- Best-fit implementation models, allowing healthcare organisations to build or procure IEF-compliant solutions that suit their scale, resources, and technical maturity.

- Brokered Imaging Gateway Services, enabling smaller clinics, remote providers, and equipment vendors to meet their IEF obligations by using shared services from trusted intermediaries such as Aurabox, reducing infrastructure complexity.

- Technology neutrality, with certification and participation based on standards-compliant behaviours, such as FHIR ImagingStudy discovery, asset retrieval, and HealthConnect Australia interoperability patterns — not on specific vendors, languages, or deployment models.

The IEF includes an Implementation Roadmap that proposes a 5 year rollout of technology.

Relationship with FHIR standards

It is anticipated that the Australian Government, through programs such as **Sparked**, will continue to evolve FHIR resources and implementation guides for Diagnostic Imaging, likely including support for imaging metadata, reports, and ordering workflows. The IEF complements these efforts by focusing on the underlying technical pathways for discovery, access, and movement of complete imaging studies across the ecosystem.

The IEF remains agnostic to the specific structure of imaging metadata within FHIR, requiring only that:

- Imaging systems participating in the exchange ecosystem support the relevant national FHIR resources for imaging where mandated.

- Discovery, retrieval, and movement of full imaging studies occur through a standards-aligned, policy-compliant technical framework that addresses the size, format, and workflow requirements unique to medical imaging.

This approach ensures that imaging interoperability evolves in step with Health Connect Australia, without introducing unnecessary clinical or semantic variation, while filling the technical gaps required to achieve a fully connected, scalable, and federated imaging ecosystem.

Alignment with HealthConnect

The Imaging Exchange Framework is designed to align with the national architectural principles and technical patterns outlined in the **Health Connect Australia Architecture**.

The framework is not a single, centralised product. Rather, it defines a set of interoperable capabilities that enable imaging systems—whether public, private, or jurisdictional—to exchange information consistently, reliably, and securely within the broader Health Connect Australia ecosystem.

Consistent with Health Connect Australia, the Imaging Exchange Framework adopts a federated approach that:

- Enables local investment and innovation by private providers, jurisdictions, and health services.

- Avoids duplication of common functions by leveraging nationally provided services**,** such as identity management, authorisation, consent management, and information discovery.

- Supports bidirectional information sharing, allowing imaging providers to both contribute to and consume imaging data from the national ecosystem.

Assumptions

The IEF makes several architectural and behavioural assumptions about HealthConnect. In the event that HealthConnect does not deliver these capabilities, some parts of this proposal may need to be revised.

The key assumptions are that HealthConnect will:

1. Keep a register of the known locations of patient data, such that a querying service can determine which services it needs to access, and
    a. That this service can be queried and updated using FHIR

2. Authorise consuming services via a central authority, and that this authority can be validated by a queried Service to determine access to specific data by IHI. This is particularly important in the context of DICOM data, since this will be the primary mechanism by which Services can constrain access.

No other HealthConnect capabilities are required to allow the IEF to function.

HealthConnect Interoperability Patterns

The framework explicitly supports the five interoperability patterns described in the Health Connect Australia Architecture, as they apply to medical imaging:

Pattern	**IEF application**
Consumer-Mediated Exchange	Assumed to be handled by HealthConnect, though also possible via third-parties (Aurabox already does this, for example).
Directed Information Exchange	Supported using a combination of FHIR capabilities. Clinical systems will only retrieve imaging when actually required, using a pull model[5].
Discovered Information Exchange	Imaging data can be located and accessed based on patient identifiers and consent, regardless of where the data resides.
Information Lifecycle Management	Reduced impact of lifecycle issues by keeping imaging largely at its origin, and supporting Subscription and Notification capabilities.
Information Publish	Support for Subscription and Notification, but other publishing use cases are not supported by the IEF.

Integration with National Infrastructure

The Imaging Exchange Framework will integrate with key Health Connect Australia components, including:

- **Identity and Authorisation Services**, supporting Imaging Consumer, provider, and organisational authentication via national systems such as MyID and the Healthcare Identifiers Service.

- **Consent and Preference Management**, ensuring that imaging data is only accessed and shared in accordance with consumer preferences and applicable

[5] *Directed Information Exchange* appears superficially similar to the status quo for imaging, since imaging is usually pushed from provider to Imaging Consumer, however since imaging is never sent without a request, the status quo is actually a poor version of the *Discovered Information Exchange* model.

legislative frameworks.

- **National Information Discovery Services**, enabling providers to locate imaging records across disparate systems.

- **Registered Repository Models**, allowing imaging repositories operated by providers or third parties to expose data into environments such as My Health Record, where appropriate.

The Framework

- Policy and architecture layer.
- Technology-agnostic: defines principles and patterns, not specific products.

Purpose

The Imaging Exchange Framework defines an architecture for secure, standards-based, federated access to medical imaging in Australia. It provides a conceptual model comprising **principles**, **roles**, **exchanges**, and **governance artefacts** that enable interoperability across healthcare organisations, without requiring centralised imaging storage or shared infrastructure.

This Framework is **implementation-agnostic** but requires compliance with an approved **Implementation Profile** that expresses these concepts as real-world, testable systems. The currently recognised profile is the **Medical Data Gateway (MDG)**.

Participation in the Framework **requires** deployment of a conformant Gateway implementation—such as the MDG—that mediates access to internal imaging systems in a way that satisfies all external interface, privacy, and security obligations.

Guiding Principles

- **Federated Access**: Imaging remains within the control of its custodian organisation; no central image repository is mandated.
- **Privacy-by-Design**: Exchanges must be governed by explicit, auditable authorisation and consent.
- **Standards-Based**: FHIR and JMIX (or ZIP) are the only permitted external exchange formats.
- **Security-First**: All access must be authenticated, authorised, logged, and encrypted.
- **Modularity**: The framework supports diverse internal system architectures behind a standardised Gateway interface.
- **Decoupled Transport and Metadata**: Payloads and metadata are cleanly separated, enabling selective access, lightweight clients, and flexible processing.

Roles

The framework defines the following logical roles:

Role	Description
Service	The service that hosts imaging data (e.g. hospital, clinic, imaging centre).
Imaging Consumer	An authorised service invoking access.

Gateway	A software boundary component that implements the approved interface profile (e.g. MDG) to expose data in a conformant, secure manner.
Authorisation Authority	The system or process responsible for capturing and enforcing access (i.e. HealthConnect)
Broker / Directory	Optional intermediary that routes requests or provides service discovery and metadata resolution (e.g. HealthConnect, federated registry).

Multiple roles may be fulfilled by a single organisation or system component.

Supported Exchange Patterns

The Framework supports a set of structured exchange patterns designed to meet common interoperability needs across clinical, research, and Imaging Consumer-facing scenarios. These patterns are explicitly defined to ensure secure, policy-enforced, standards-based access to medical imaging data across organisational boundaries.

All exchanges:

- Must occur via a conformant Gateway, such as the MDG.
- Must use FHIR for orchestration and metadata, and JMIX for imaging payloads.
- Must enforce consent, identity, and access control as per the governance requirements.
- Are unidirectional, auditable, and stateless at the interface layer, unless otherwise noted.

The four patterns are:

> **Discovery** is a Imaging Consumer-initiated query to locate the existence and availability of imaging studies across federated systems. It is used when the requestor does not yet know where relevant imaging resides or whether it exists at all. Discovery operates through the Gateway using FHIR `ImagingStudy` and `DocumentReference` resources, returning metadata only—no image data or access tokens. It supports a wide range of workflows including longitudinal patient record review, referral preparation, and research cohort identification, and is governed by access control, consent policy, and identity resolution.
>
> **Retrieval** enables the secure transfer of image data following successful discovery and authorisation. It occurs through the Gateway using the JMIX (JSON Medical Imaging Exchange) format, which encapsulates both study structure and pixel data over HTTPS. Retrieval is always metadata-driven, token-bound, and logged. It is designed to support diverse clinical, Imaging Consumer, research, and AI use cases, including second opinions, MDT preparation, and inference pipelines, without exposing the complexity of legacy DICOM transport protocols.
>
> **Registration** is a provider-initiated declaration that an imaging study has been created or is expected. It allows a Data Holder to proactively publish structured metadata to a broker, peer, or shared directory, making imaging discoverable to authorised parties. Registration does not imply that an Imaging Consumer is

already subscribed to or aware of the imaging—rather, it enables downstream discovery or access. Primarily, this supports a national registry of patient data locations, however other use cases could include multi-site study publication, regional metadata sharing, and pre-upload workflows that enable early correlation between studies and clinical events.

Subscription & Notification supports event-driven workflows in which Imaging Consumers explicitly subscribe to receive notifications about imaging availability or updates. Subscriptions are configured against patient identifiers (or other data types) and when a relevant event occurs (e.g. a new study is registered), a notification is sent to the subscriber. Notifications carry metadata only and must comply with access and consent controls. This pattern is essential for asynchronous workflows such as lifecycle management, research data harvesting, and automated reporting pipelines.

Each of these patterns is optional to implement unless required by the conformance profile (e.g. MDG). However, any implemented exchange pattern **must comply with the protocol constraints** and must be routed through a Gateway interface.

Supported Access Patterns

The supported exchange patterns are intended to support a set of basic Access patterns, which are expanded upon in the individual Use Cases supplied for each Exchange Pattern.

1. An **Imaging Consumer** needs to discover all (or specific) imaging for a given Patient identified by their IHI, across the ecosystem *(Consumer Mediated, Discovered)*
2. An **Imaging Consumer** needs to retrieve any given imaging for a given Patient identified by their IHI, across the ecosystem *(Consumer Mediated, Discovered)*
3. An **Imaging Service** can provide information about the imaging it holds to a central repository *(Information Publish)*
4. An **Imaging Consumer** can be informed when updates are available for a specific Patient or Study.

Protocol and Interface Constraints

To ensure interoperability, auditability, and clear separation of responsibilities, **all external interfaces in the Framework are constrained as follows**:

- **FHIR (Fast Healthcare Interoperability Resources)** is the required standard for:
  - Metadata discovery
  - Exchange orchestration
  - Access control integration (e.g. OAuth2 scopes, consent flagging)
- **JMIX (JSON Medical Imaging Exchange)** is mandated for all **payload-level** exchanges of image data.

    - Encapsulates metadata and image parts in a structured JSON envelope
    - Supports both streaming and static delivery modes
    - Avoids the complexity and brittleness of legacy binary DICOM transport
    - Enables use of modern, cloud-native tooling and analysis

- **DICOM is prohibited for inter-organisational exchange**[6]. This protocol is tightly coupled to PACS systems, lacks modern authorisation mechanisms, and is not suitable for federated, policy-aware exchanges.

Internally, Data Holders may use any protocols (including DICOM) as long as the **Gateway interface** conforms externally to the FHIR + JMIX boundary.

*More detail on individual patterns is provided in **Appendix 1***

Participation

It is expected that all originators of medical imaging will ultimately be part of the framework. This includes all medical imaging providers, whether public or private ("General Imaging Providers"), as well as specialists performing imaging as part of their practice ("Specialist Imaging Providers").

Any organisation wishing to locate and retrieve imaging under the framework is considered an Imaging Consumer.

General Imaging Providers

This includes all imaging providers regardless of size. Actual implementation may vary widely, and may use third-parties.

Specialist Imaging Providers

Includes all medical specialists who perform in-house imaging (e.g. obstetrics, vascular). This group uses specialist or locally installed PACS software that may not be compatible with HealthConnect or the IEF. It is anticipated that most of these providers will rely on third-party providers to deliver the required capabilities, especially where a direct connection with imaging equipment is required.

Third-party Imaging Providers

Where imaging is performed by a third party, the obligation for Participation will lie with the organisation reporting the imaging (e.g. private imaging providers that provide imaging to specialists).

Conformance

Organisations participating in the Imaging Exchange Framework must:

[6] Organisations may still use these protocols for exchange, but they are not considered conformant for an IEF implementation.

1. Deploy a Gateway that conforms to an approved Implementation Profile (e.g. the MDG)

2. Ensure all external exchange occurs via the FHIR and JMIX interfaces defined in that profile

3. Implement secure identity and access control, aligned with the Framework's governance model (i.e. HealthConnect)

4. Maintain auditable logs of all access, including metadata queries and payload downloads

5. Apply consent enforcement consistent with Australian law

At this time, the **Medical Data Gateway (MDG)** is the sole supported profile. Equivalent implementations may be recognised in future.

Deployment Models

The IEF supports three deployment models, providing flexibility to implementers to build or buy as appropriate.

In-House

Implementers may build the individual capabilities described in the IEF independently, as separate services within their environment, with reference to the MDG architecture.

In this model, implementers have full control over the implementation, only ensuring that they meet the minimum requirements for data discovery and exchange. Implementers may use the open source reference gateway (Harmony), or a build/buy a different gateway that meets the requirements.

This model is suitable for large imaging providers, State healthcare organisations, or hospitals with significant engineering resources.

Reference Gateway (MDG)

Implementers may use the open source gateway to implement the framework. This allows full flexibility to implement independently of vendors, while limiting the requirements for software development.

Implementation of the gateway may be performed internally or outsourced to a service provider.

This model will suit smaller imaging providers, organisations with limited or constrained IT environments, and Imaging Consumers.

Vendor Implementation

Implementers may partner with a vendor offering a compatible gateway and potentially interoperability layer (e.g. Aurabox) to deliver the capability. This may

entirely remove the need for custom software development and is likely the most effective solution for most implementations.

This model will suit smaller healthcare organisations who may not need complex PACS integrations, including clinics, smaller hospitals, individual specialists, allied health and sports, and other non-clinical uses including insurance.

Implementation Profile

- Operational layer.
- Recommended (but not mandatory) for providers wishing to enable discovery and sharing without deeply modifying their PACS/RIS.
- Facilitates compliance and adoption of IEF by providing a drop-in component.

The **Medical Data Gateway (MDG)** is the reference implementation profile for the Imaging Exchange Framework (IEF). It provides a formal, standards-aligned technical architecture for integrating imaging systems into Australia's federated digital health environment, consistent with Health Connect Australia principles.

The MDG serves as an interoperability broker and control point, bridging local imaging environments (e.g., PACS, RIS, VNA) with requesting systems, FHIR-based services, and Health Connect Australia's national infrastructure. It implements the core capabilities of the IEF, providing secure, policy-compliant pathways for the discovery, access, and exchange of medical imaging data.

The MDG provides a scalable, consistent pathway for imaging providers to participate in Australia's connected health ecosystem without requiring wholesale system replacement.

Although it is not defined in the IEF or MDG specifications, an MDG could function as an organisation's entire FHIR gateway, or be provided by an existing FHIR gateway, as long as it is capable of meeting the requirements of the specification. *This opens the possibility that an expanded MDG can act as the sole FHIR service connector for an organisation* – especially where the organisation is primarily concerned with medical imaging – potentially simplifying any implementation.

The MDG enables:

- Secure **Registration** of newly acquired imaging studies with national or jurisdictional record locator services.
- Standards-based **Discovery** of imaging via a FHIR interface
- Bulk **Retrieval** of imaging via JMIX.
- **Authorising and brokering access** consistent with Health Connect Australia's Common Services Layer.
- **Integrating with local imaging systems** (e.g. PACS, RIS, VNA) to retrieve studies.
- Optionally managing **event logs, consent assertions, and usage reporting**.

The MDG can be deployed in several ways:

- **Directly by imaging providers**, as an on-premises or cloud-hosted gateway;
- **Via a reference implementation** such as *Harmony*, developed by Aurabox;
- **Bundled within vendor infrastructure**, such as in PACS or RIS software offerings.

*A functional specification for the MDG is provided in the document **Medical Data Gateway Specification***

Capabilities

The MDG defines a set of technical capabilities that enable secure, scalable, and standards-based discovery, access, and transfer of medical imaging. These capabilities are designed to align with the architectural principles, interoperability patterns, and policy requirements of the IEF. Together, these capabilities deliver a modern, interoperable, and policy-aligned technical foundation for imaging exchange.

1. Imaging discovery using FHIR
2. Bulk imaging transfer using JMIX
3. Registration of patient records via FHIR
4. FHIR subscription & notification services

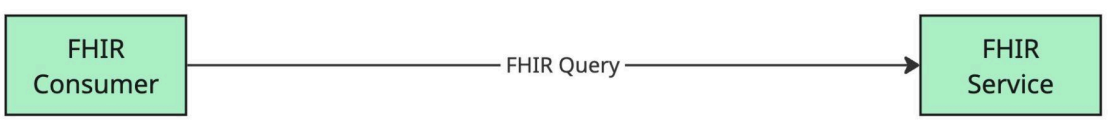
1. Imaging Discovery using FHIR

Imaging systems expose a FHIR-compliant API endpoint that enables authorised parties to discover available imaging studies for a patient. This supports standardised, privacy-aware discovery workflows using national identifiers such as the Individual Healthcare Identifier (IHI) and provides sufficient metadata to inform clinical decision-making and relevance assessment before retrieval.

a. **FHIR Services** will provide a compatible FHIR API endpoint that enables authorised parties to discover available imaging studies for a patient.

   In a practical sense, the FHIR Provider API will be expected to:
   a. Receive a compatible FHIR request from a third-party
   b. Confirm that it contains a valid HealthConnect authorisation token for the data it is requesting.
   c. Return a FHIR response listing the available ImagingStudy data containing the relevant Bulk Data URLs.

b. **FHIR Consumers** will consume the FHIR endpoints, providing imaging history back to relevant clinical systems, and providing Bulk Imaging Endpoints for the transfer service (below). FHIR Imaging Consumers are likely to be the same systems that consume other FHIR APIs in the Health Connect ecosystem.

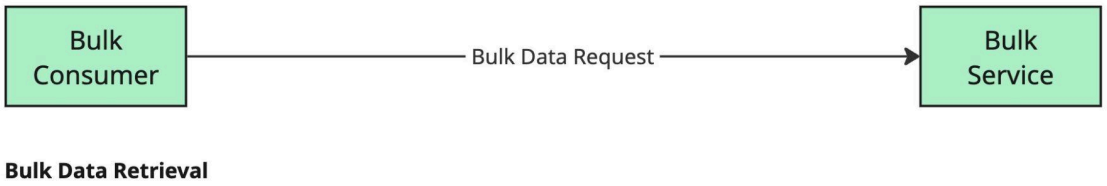


ImagingStudy Discovery via FHIR

2. Bulk Imaging Transfer using JMIX

To support high-throughput, system-to-system use cases, the MDG supports a *bulk transfer mechanism* enabling complete imaging studies to be securely packaged and delivered as compressed archives. This model simplifies both individual study transfers and the movement of large datasets for use cases such as longitudinal review, MDT preparation, research cohort assembly, or AI model training.

JMIX is the default and recommended transfer format within the Imaging Exchange Framework (IEF). It supports encrypted, policy-compliant distribution of imaging data across federated environments.



Bulk Data Retrieval

Dual-Mode Transfer Model

MDG Bulk Imaging Transfer implementations operate in a dual-mode structure:

- **Primary Endpoint (JMIX)**
  Bulk Data Services SHALL expose a JMIX-compatible endpoint that provides secure, verifiable access to full imaging studies via download URLs.

  The framework specifies either the new open specification, JMIX bulk imaging data model, which includes both secure transport format and simple retrieval API.

- **Compatibility Endpoint (DICOMweb, optional)**
  MDGs MAY expose a secondary DICOMweb-based endpoint as a *compatibility layer*. This allows for minimal integration with legacy viewers and clients that do not yet support JMIX. However, these endpoints MUST NOT be advertised as the default or preferred retrieval method and MUST be subject to the same authorisation and policy controls as JMIX endpoints.

Operational Flow – Bulk Data Service

A Bulk Data Service will:

- Receive a compatible FHIR or HTTP(S) request for an imaging dataset.
- Validate the presence and scope of a HealthConnect-compatible authorisation token.
- Return the dataset via the primary (JMIX) endpoint.
- Optionally expose a DICOMweb-compatible URL in the `ImagingStudy.endpoint` array **only when configured for compatibility**.

Operational Flow – Bulk Data Consumer

Bulk Data Consumers are systems that retrieve imaging from a Bulk Data Endpoint and forward it internally. These systems MUST:

- Extract the JMIX (or fallback) URL from the `ImagingStudy` resource.
- Revalidate or reuse a HealthConnect authorisation token.
- Retrieve the bulk data in JMIX format, unencrypt and validate it.
- Forward the dataset to relevant internal systems such as PACS, VNA, or analytical environments.

Where explicitly supported, Consumers MAY optionally use a DICOMweb endpoint, but SHOULD only do so where JMIX is not supported..

What is JMIX?

The **JSON Medical Imaging Exchange (JMIX)** format defines a secure, open, and scalable envelope for packaging and transferring complete imaging studies. It was developed to overcome limitations in legacy DICOM and DICOMweb-based transfers by supporting:

- Secure, encrypted transport
- Passive integrity verification
- Support for both clinical and secondary (e.g., research or teaching) use
- Federation across trust boundaries

JMIX is the default and recommended format within the MDG and IEF framework. Reference specifications and implementations are available at:

👉 https://github.com/aurabx/jmix

> *For more information about JMIX, see **Appendix 3**.*

Why not DICOM or DICOMweb?

While widely adopted within closed environments, **DICOM** and **DICOMweb** have significant limitations in the context of national-scale, federated health networks:

- **DICOM** cannot operate reliably over wide-area or internet-scale networks.
- **DICOMweb** is sub-optimal for large volume transfers and is rarely implemented outside vendor-controlled viewers.
- **Discovery and access control** models in DICOMweb are poorly aligned with modern identity- and consent-based architectures such as HealthConnect.
- **Endpoint variability** in DICOMweb makes interoperability brittle and non-deterministic at scale, and incapable of supporting peak traffic volumes in any real sense

Therefore, DICOMweb is not suitable as a foundational protocol for policy-enforced, standards-compliant imaging exchange across diverse providers. Where needed, DICOMweb can be made available as a compatibility bridge—but it is not considered a core part of the Imaging Exchange Framework.

*For a full discussion on these limitations, see **Appendix 4***

3. Registration via FHIR

In order to locate patient imaging within a federated system, it is assumed that HealthConnect will support some kind of patient registry, allowing Imaging Consumers to determine which Services hold patient data[7]. Services must register new patient imaging with this registry(s).

The capability only needs to support a notification when data is first added, however there may be other requirements based on a final HealthConnect implementation.

4. Subscription & Notification

Finally, a Service should be able to handle FHIR Subscription and Notifications for a given patient, identified by IHI. This assists with a range of lifecycle issues defined in the Use Cases section for this capability.

5. Capability Statement Publishing

In order to simplify the transition to this new system, organisations that are General or Specialist Imaging Providers must publish a Capability Statement on their website within the first 12 months of the transition period.

The capability statement should be available at a common URL `https://<domain>/ief-capability-statement` (or some similar URL to be agreed).

This capability statement should include:

1. The current mechanism by which authorised users can discover imaging held by the organisation
2. The current mechanism by which authorised users can retrieve imaging held by the organisation
3. The estimated date by which automated discovery using HealthConnect will be available
4. The estimated date by which automated retrieval using HealthConnect will be available
5. Whether the organisation currently registers patient data with HealthConnect, and by what date it will commence.

Practical Applications

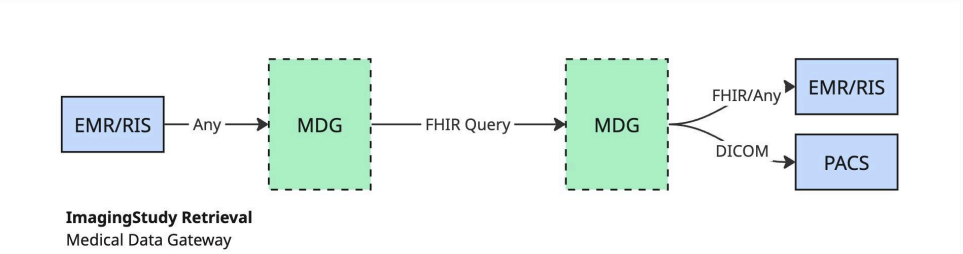
FHIR Query Gateway

As a FHIR query gateway, the MDG can convert or pass through FHIR requests to peer Services. The logical MDG is optional in this exchange, as the Service itself may already be able to parse the FHIR queries appropriately. However, an MDG may still be desirable

[7] In the event that this is not the case, the Registration model enables falling back on federated indexes.

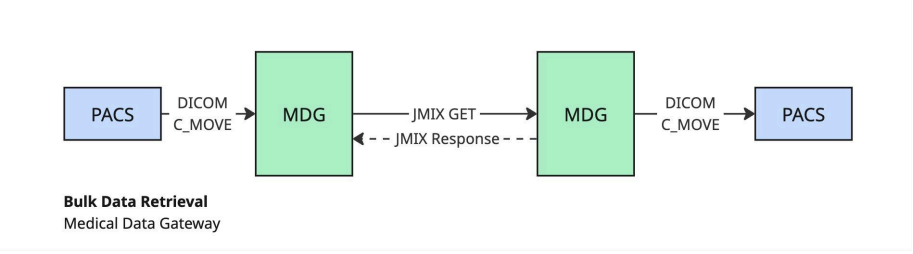
to gate internal systems, hand-off HealthConnect authorisation, or perform other proxy-related tasks (e.g. logging external queries).

This application applies for any FHIR queries, not just queries for imaging metadata.



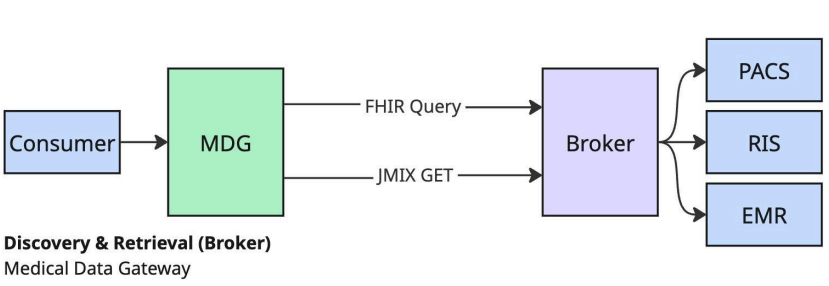
Bulk Data Service

As a Bulk Data Consumer and Service, the MDG can receive requests from a PACS, convert these to JMIX requests, then convert these back to DICOM requests at the Service end. This mitigates the need to retrofit or replace existing PACS systems, and ensures modern, secure networking when outside the organisation's network.

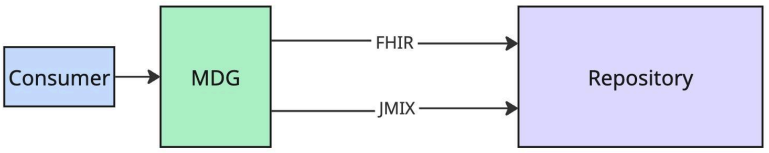


As a Broker or Repository

An MDG may function as a Broker for other services. This could be simply aggregating data with an organisation, or by acting as an indexing and proxying layer between the Imaging Consumer and third-parties. This may be particularly useful for individual specialists, who can connect their basic PACS systems to the broker using DICOM and avoid implementing the MDG altogether. From the perspective of the Imaging Consumer, this acts like any other MDG service.



An MDG may also function as a Repository, storing the data on behalf of third-parties. From an Imaging Consumer's perspective, this is functionally equivalent to a Broker.



Discovery & Retrieval (Repository)
Medical Data Gateway

A Reference Architecture: The Harmony Project

Harmony is an open-source reference implementation of the **Medical Data Gateway (MDG)** concept defined by the Imaging Exchange Framework (IEF). Developed by Aurabox, Harmony provides a practical, standards-aligned, and vendor-neutral pathway for healthcare organisations to participate in federated imaging exchange, consistent with the requirements of HealthConnect Australia.

Harmony acts as an interoperability broker between local imaging environments (e.g. PACS, RIS, VNA) and national infrastructure such as HealthConnect's discovery, identity, and consent services. It enables organisations to meet their IEF obligations with minimal disruption to existing workflows or technology investments.

Harmony is currently under active development with an initial release in late 2025.

Key Features

Harmony will provide the following core capabilities out of the box:

- **FHIR-Based Imaging Discovery:** Implements the IEF's ImagingStudy discovery endpoint, allowing authorised parties to locate imaging studies via standards-compliant FHIR APIs.
- **Bulk Imaging Transfer via JMIX:** Supports secure, efficient retrieval of complete imaging studies using the open JMIX standard, simplifying large dataset movement for clinical care, research, and secondary use.
- **Registration** of new studies with a Registry service based on HL7v2 messaging or internal webhook
- **FHIR pass-through** for other FHIR use cases.
- **DICOM Integration:** Connects to backend DICOM systems behind the firewall, enabling them to work with HealthConnect
- **Secure Identity, Consent, and Access Control:** Integrates with HealthConnect Australia's identity, consent, and authorisation services, with robust enforcement of privacy, security, and audit requirements.
- **Vendor Neutrality and Extensibility:** Designed to interface with any standards-compliant PACS, VNA, or imaging source, Harmony can be deployed as a stand-alone MDG or integrated with third-party solutions.
- **Internal job queue** supporting structured retry, logging, and other internal event management.

Federated Capabilities through Networks

While Harmony can be deployed independently by any organisation, when paired with a network like **Aurabox**, it extends its functionality to support:

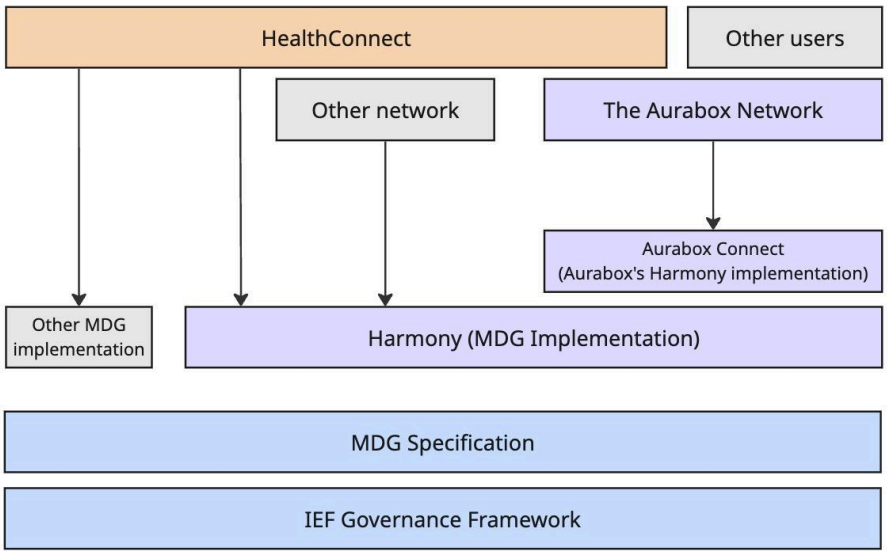
- **Network-wide Imaging Discovery**, including from remote PACS systems.
- **Peer-to-Peer Imaging Transfers** powered by encrypted WireGuard connections, enabling secure, direct exchange between trusted parties without centralised infrastructure.
- **Declarative Usage Control**, Consent Management, and Identity Assurance aligned with the Australian Privacy Principles and HealthConnect policies.

This approach provides organisations with flexibility to adopt Harmony on their own terms, while offering a seamless pathway to participate in broader imaging networks such as the Aurabox platform.

Open Source

Harmony will be released under an open-source licence, with source code, documentation, and deployment resources available via a github repository.

Organisations are encouraged to adopt or extend Harmony as a practical, standards-aligned solution for imaging exchange, whether as a fully independent deployment or in conjunction with trusted service providers.



Relationship between the IEF, MDG, Harmony, Aurabox and Health Connect

Data Considerations

Patient ID collisions

The IEF acknowledges that **DICOM identifiers are locally scoped** and MUST be treated accordingly. Implementers must use structured identifiers (e.g. IHI in OtherPatientIDsSequence, fully qualified patient references) and robust federation logic to ensure safe and accurate patient resolution across institutions.

The Patient Identifier in DICOM data should not be used to uniquely identify a patient (in fact, generally it should be ignored), unless it is properly scoped into a FHIR identifier, JMIX envelope manifest, or OtherPatientIds sequence in DICOM.

Rules for managing locally scoped Patient IDs are included in the MDG Specification document

IHI's in DICOM

To support reliable patient matching and interoperability across Australian healthcare systems, implementers of the Imaging Exchange Framework (IEF) **MUST** include the **Individual Healthcare Identifier (IHI)** in DICOM metadata using a standards-compliant, non-destructive method. IHIs are essential for patient discovery, linkage with FHIR-based registries, and integration with HealthConnect services.

The IHI should be recorded in the OtherPatientIdentifiers sequence in DICOM, FHIR data, and the JMIX manifest.

Rules for managing IHIs in DICOM are included in the MDG Specification document

Registries

> This part of the IEF is a draft proposal. It is included for completeness but may be superseded by HealthConnect implementations at a later date.

Purpose and Role

A Registry acts as a federated directory of record locations, not a repository of imaging or metadata itself. It maintains a mapping between individual patients (via IHI) and the Services or Gateways that hold or manage imaging data for them. Its role is strictly to enable:

- **Discovery routing**: Informing Imaging Consumers where they can direct queries or retrieval requests.
- **Metadata scoping**: Helping Gateways decide whether to respond to discovery queries (e.g. to reduce unnecessary lookups).
- **Audit traceability**: Logging which services have declared a relationship with a patient for governance or consent verification.

Each Registry is a **logical participant** in the framework and may operate at national, jurisdictional, network, or enterprise scope. Multiple registries can co-exist and interoperate through federation.

Registry Record Structure

Each Registry entry will contain (at minimum):

Field	Description
IHI	The patient's Individual Healthcare Identifier (or equivalent pseudonymised token if required)
Service ID	Unique identifier of the Gateway service, as a ULID or UUID.
Last Updated	Timestamp of last registration or status update
Status	A simple status determining whether the record is `active`, `removed`, or `archived`.
Type	Either `record` (default) or `registry`.

This record can be minimal and non-exhaustive, just enough to direct discovery.

How It Works

A. Registration to the Registry

1. When a Data Holder (via their MDG) acquires or becomes responsible for imaging associated with a patient, it registers the IHI + Service ID with the Registry.
2. This may be triggered by actual study registration, or proactively during patient onboarding.

B. Querying the Registry

1. When a Discovery request is initiated by an Imaging Consumer the system **queries the Registry using IHI** to determine which Gateways to contact.

C. Federation

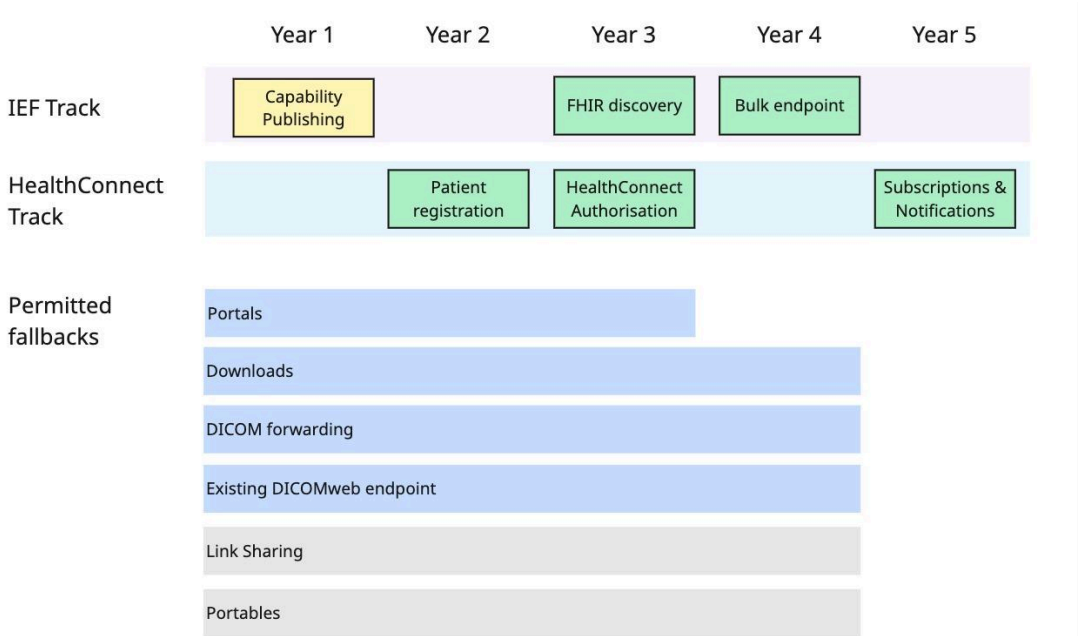
1. A Registry may also point to other known registries using the `registry` type. This will trigger an additional look up on that registry by the Imaging Consumer

Implementation Roadmap & Transition Period

To support widespread and sustainable uptake of the Framework, this document proposes a flexible, 5 year transition period in which organisations may progress through over time. During the transition period, organisations can show conformance through the use of Permitted Fallbacks that represent current practice. These Fallbacks will be replaced with a compliant implementation over time.

Progress is expected within a reasonable 5-year horizon, but timing may vary depending on resourcing, system maturity, and use case relevance.

This approach ensures interoperability can grow across a federated environment without disrupting existing workflows, while encouraging convergence toward a standards-based national imaging exchange model.



Organisations are not required to move through these phases on a fixed schedule however in order to provide certainty to consuming services, specific Capabilities should have timeframes by which they should be implemented, and an organisation considered Non-Conformant if they fail to do so.

During transition, organisations may continue to operate existing systems provided they progressively enable surrounding capabilities (e.g. discovery, metadata registration, access verification). These systems are not required to be disabled once no longer required as Fallbacks, however some will be redundant.

This phased approach allows all sectors—public, private, large, small—to participate in a federated national imaging exchange network without requiring immediate technology replacement, while maintaining clear direction toward full interoperability.

Year 1	The initial year of the transition phase will be available for organisations to plan their 4 year transition and publish their Capability Statement.

Year 2	Organisations should start sending patient registration information to HealthConnect, to enable existing Consumers to start using it to locate information. Some organisations should be ready to enable FHIR-based discovery of data.
Year 3	Most organisations should have implemented HealthConnect-authenticated requests for Imaging records using FHIR. They may still be providing fallback services to actually retrieve that data, which should be noted in the ImagingStudy record. By the end of this year, Portals are no longer an acceptable Discovery fallback mechanism.
Year 4	By the end of Year 4, Organisations should have a Bulk Transfer mechanism in place, authenticated via HealthConnect. By the end of this year, Organisations should no longer be providing other, manual mechanisms as the default transfer mechanism (though they may still persist for emergency or ad hoc usage).
Year 5	In the final Year, organisations will implement Subscription and Notification services to connect to HealthConnect.

Summary

The **Imaging Exchange Framework (IEF)** defines an architecture and patterns needed for imaging systems to participate in Australia's federated digital health ecosystem, consistent with the Health Connect Australia Architecture.

It supports:

- Federated imaging repositories that remain locally hosted but are discoverable via national standards.
- A reference gateway that translates IEF architectural principles into a practical implementation
- Standards-based discovery using Health Connect services.
- Consent-aware, policy-compliant exchange, aligned with the *Privacy Act*, *My Health Records Act*, and Health Connect's identity, access, and audit layers.

By adopting the IEF, providers and vendors can:

- Participate in national information exchange models (e.g. Discovered, Directed, Consumer-Mediated).
- Expose imaging securely in line with national repository expectations.
- Ensure compliance while supporting timely, coordinated, patient-centred care.

The IEF enables innovation without duplicating infrastructure, supports autonomy while ensuring interoperability, and advances Australia's digital health goals by making imaging more accessible, secure, and shareable across the system.

Appendix 1: Framework Patterns

1. Discovery

Locate relevant imaging studies, documents, or series based on patient identifiers, clinical context, or request metadata.

Standards:

- FHIR `ImagingStudy`, `DocumentReference`, `Patient`, `ServiceRequest`

Mechanism:

- The Imaging Consumer submits a structured query to one or more Gateways or to a broker service.
- The Gateway evaluates the query under policy and consent constraints.
- If permitted, the Gateway responds with structured metadata about matching studies, **excluding payloads or access tokens**.

Use Cases:

- A clinician preparing for a patient consultation initiates a discovery query to identify any recent CT or MRI studies conducted at other providers.
- A broker service queries all participating Gateways to populate a unified patient imaging timeline in a regional record viewer.
- A researcher performing a retrospective cohort analysis searches for patients with available imaging metadata meeting study criteria.
- An emergency department registrar checks for any recent chest imaging performed at nearby facilities for a patient presenting with respiratory distress.
- An administrative staff member in a medical imaging department uses discovery to determine whether a newly referred patient has had prior imaging elsewhere to avoid unnecessary duplication.
- A general practitioner uses a practice management system to locate any patient imaging performed externally that has not yet been received or reported locally.
- A digital health platform queries for available obstetric ultrasounds conducted across public and private sites to assist a midwife in compiling a shared antenatal record.
- A telehealth oncologist queries for historical PET scans related to a new patient referral to understand disease history and current disease burden, in order to prepare for initial virtual consultation.
- A breast screening coordinator runs a discovery query across multiple data holders to locate prior mammography metadata for interval cancer tracking.

- A public health surveillance unit queries available imaging metadata to monitor modality usage trends during an equipment outage or major event.
- A tertiary hospital's referral intake system performs pre-consult discovery queries to identify which studies need to be explicitly requested from external providers.
- A health information exchange platform passively discovers imaging studies as part of compiling a federated health record view for authorised clinicians.

Key Characteristics:

- **Discovery is not imaging access**. It returns metadata only (e.g. study date, modality, identifiers, site), sufficient to initiate a future access request.
- It can be **asynchronous or distributed**, depending on the presence of brokers or federated query orchestrators.
- **Identity resolution** (via patient identifiers or linkage service) is a critical component of discovery and must comply with the Framework's privacy and matching policies.

Constraints:

- The Imaging Consumer must be authorised to perform discovery for the subject of care.
- Responses must include no pixel data

2. Retrieval

Securely obtain imaging data once appropriate authorisation and metadata resolution is complete.

Standards:

- JMIX (JSON Medical Imaging Exchange) envelope over HTTPS

Mechanism:

- Requestor uses the `studyDownloadUrl` or `instanceAccessUrl` returned from the Discovery phase.
- Gateway emits the JMIX envelope (or multipart stream) containing structure and pixel data.

Use Cases:

- A specialist providing a second opinion retrieves historical MRI and PET scans performed at a hospital to compare findings with current imaging.
- A remote radiologist accesses studies performed at a regional site to report on overnight imaging without requiring VPN or PACS integration.
- A multidisciplinary team coordinator retrieves multiple prior studies from external providers to prepare for review in an MDT meeting.

- A trauma centre retrieves a full CT trauma series performed at a referring hospital immediately after a patient is transferred via ambulance.
- A patient uses a secure Imaging Consumer portal to retrieve their own imaging history from multiple providers and forwards it to an international specialist.
- An AI-enabled diagnostic platform retrieves a JMIX-encoded chest CT to perform automated lung segmentation as part of clinical workflow.
- A research registry harvests de-identified imaging from several locations for a longitudinal cohort study in stroke imaging outcomes.
- A cloud-native archive retrieves legacy imaging from multiple on-prem MDGs to populate a new zero-footprint PACS deployment.
- A private surgeon views prior angiographic imaging performed at two public hospitals to assist in surgical planning.
- A prosthetics technician retrieves recent and historical CT scans of a patient's lower limb from two imaging providers to assist in 3D modelling for a custom implant.
- An oncology pharmacist retrieves baseline and follow-up PET-CT imaging to validate tumour volume changes before preparing an adjusted chemotherapy dosing schedule.

Constraints:

- Only authorised users may access a retrieval URL.
- URLs must be short-lived, signed, and require token-based access.
- Partial or streaming delivery is permitted via JMIX segmentation.

3. Registration

Advertise or declare that a new imaging study is available for potential access or routing.

Standards:

- FHIR

Mechanism:

- The Data Holder (or their MDG) actively registers the presence of a new study with a known Imaging Consumer or broker service.
- Registration may include minimal metadata and link to a discovery endpoint.

Use Cases:

- An imaging provider registers with HealthConnect that it holds data for a given patient.
- A hospital PACS registers newly finalised studies with a regional broker, making them discoverable across multiple participating providers

Unsupported by potential use cases:

- A private specialist pre-registers an upcoming imaging study with a peer Gateway, allowing the receiving system to associate the study when it arrives and avoid delayed reconciliation.

- A mobile imaging service uploads a `DocumentReference` entry to a shared Gateway directory, registering portable X-rays as soon as they are exported from the modality.

- A multi-site clinic publishes a study metadata stub (`ImagingStudy` with minimal fields) in advance of DICOM transmission, enabling early correlation with upcoming clinical workflows.

- A regional research repository registers new de-identified study metadata to a central access broker, flagging that imaging contributions for approved protocols are now available.

- A public hospital updates its local MDG to register that a patient's emergency CT series has been finalised and is available for downstream retrieval by authorised trauma centres.

Constraints:

- Registration must include sufficient identifiers for resolution and access control.
- It must not include pixel data or bypass consent verification mechanisms.

4. Subscription & Notification

Purpose: Enable event-driven workflows by notifying subscribers of changes to study availability or status.

Standards:

- FHIR `Subscription`

Mechanism:

- An authorised Imaging Consumer registers interest in events (e.g. "study available", "series uploaded", "review complete").
- The Gateway or broker emits a notification to the subscriber's endpoint upon relevant triggers.

Supported Use Cases:

- A multidisciplinary team system subscribes to notifications for imaging updates for a panel of patients scheduled for review, receiving alerts when new studies are registered at participating sites.
- A hospital emergency department subscribes to imaging updates for recently transferred trauma patients, receiving alerts when remote providers complete imaging.

- A regional broker service maintains subscriptions for enrolled patients, updating a Federal registry when new information is available.
- A research data custodian subscribes to imaging availability events for participants in an ethics-approved study, receiving structured metadata for each new study that meets the inclusion criteria.
- A national cancer registry subscribes to imaging updates for enrolled patients across multiple public hospitals, allowing longitudinal imaging data to be captured as studies are performed.
- A consumer-facing health app subscribes to imaging availability for authenticated users who have linked their identity to one or more participating providers, receiving metadata notifications when new imaging is added to their record.

Not currently supported:

- A referring GP's clinical system subscribes to notifications for completed Reports for requests they initiated, allowing the practice to follow up when reports are delayed or missing. It is suggested that this is covered by a separate Results profile or as part of eRequesting.
- A teleradiology platform subscribes to specific provider MDGs for availability events, allowing new urgent studies to be routed into the reporting queue in near real-time. The profile doesn't currently support per MDG subscriptions (only per patient). This is also considered an internal (i.e. non IEF) transfer. The profile does not preclude using an extended MDG to fulfill this function, but it is not part of the profile.

Constraints:

- Subscribers must be pre-authorised, with delivery endpoints whitelisted and secure.
- Payloads in notifications must be limited to metadata or references.

Appendix 2: JMIX – Technical Overview

Overview

The JSON Medical Imaging Exchange (JMIX) standard provides a modern, implementation-neutral format for packaging, securing, and transferring complete medical imaging studies. It is designed to meet the requirements of federated, large-scale health information exchange environments, such as those defined by HealthConnect Australia.

JMIX complements, rather than replaces, existing standards like DICOM and FHIR by addressing critical gaps in secure, bulk data movement between systems and organisations.

Key Features

- **Full Study Packaging:** Entire imaging studies, including all relevant DICOM files and associated metadata, are encapsulated into a single, portable archive for simplified transfer.
- **Cryptographic Integrity and Signing:** JMIX packages include robust digital signatures and hash-based verification to ensure authenticity, integrity, and tamper resistance of transferred imaging data.
- **End-to-End Encryption:** All packages are encrypted using industry-standard cryptography (AES-256 with optional perfect forward secrecy) to safeguard patient data in transit, even over secure channels such as HTTPS.
- **Requester and Sender Assertions:** Embedded signed metadata provides verifiable information about both the sender and the intended recipient, supporting regulatory compliance, auditability, and access control enforcement.
- **Extensibility:** The JMIX container format is designed to accommodate additional content types beyond DICOM files, including reports, AI outputs, annotations, or structured metadata, ensuring future-proof adaptability.

Integration with the Imaging Exchange Framework (IEF)

Within the IEF, JMIX operates as the preferred standard for bulk imaging data transfer, supporting:

- The **Bulk Data API Endpoint**, allowing authorised clients to retrieve complete imaging studies in JMIX format.
- **FHIR ImagingStudy Integration**, where references to JMIX packages are embedded in discovery responses to facilitate secure access.
- **Peer-to-Peer Transfer Workflows**, including support for encrypted network paths such as WireGuard, enabling direct, secure exchange between trusted parties.

Fallback to standards-compliant ZIP archives containing DICOM Part 10 file sets is permitted for environments unable to adopt JMIX immediately, ensuring broad compatibility.

Availability

JMIX is published as an open standard with a permissive open-source reference implementation available at: https://github.com/aurabx/jmix

Organisations are encouraged to adopt JMIX to enable secure, scalable imaging exchange in alignment with national policy, technical requirements, and the principles of the Imaging Exchange Framework.

Appendix 3: Practical limitations of DICOM/DICOMweb

It is anticipated that integration gateways based on the MDG model will communicate directly with DICOM services within organisations, however the Framework does not support these for inter-organisational communication.

DICOM is an unusual format, in that it allows a file to be reconstructed from its metadata, of which the image (pixel data) is one field. In a regular DICOM transaction, the metadata is streamed *in any order* and reconstructed at the destination. In fact, it is not until it is exported that the file has structure. While the DICOM file and protocol formats appear similar, they are actually quite different under the hood. Both DICOM and DICOMweb are not file retrieval or transmission protocols, but data transmission protocols. They are designed for accessing and sending the underlying data using a specific protocol and format. Unlike in FHIR, where this is desirable, this creates a number of issues when attempting to move an entire study

DICOM limitations

This proposal deliberately excludes support for classic **DICOM** network services (DIMSE). There are several key reasons for this:

- *Network Model Incompatibility:* DIMSE assumes persistent, stateful TCP/IP connections, static AETitles, and does not support modern routing such as DNS. HealthConnect's peer-to-peer exchange model would require every service to VPN to every other service – clearly an unrealistic model.

- *Security & Auditing Limitations:* Traditional DICOM lacks native support for modern authentication standards such as OAuth2, OpenID Connect, or mutual TLS. Mapping access control, consent, and audit requirements into DIMSE is brittle and non-standardised. Every connection would require an additional, DICOM-enabled authentication proxy, *within* the VPN layer.

- *Poor Fit with HealthConnect and FHIR:* The national HealthConnect ecosystem is predicated on FHIR and RESTful access patterns that DICOM does not support.

- *Interoperability Complexity:* Supporting DIMSE at scale would imply the need to register and resolve separate AE Titles for every PACS, manage legacy PACS configurations, and maintain backwards compatibility across heterogeneous vendor environments. This would significantly increase complexity without meaningfully improving clinical interoperability.

Fundamentally, DICOM is incapable of providing any of the core capabilities that would be required for a distributed, scalable, secure imaging exchange network.

In summary, while traditional DICOM remains relevant within internal hospital networks and local PACS environments, its inclusion in this framework would constrain scalability, interoperability, and security. Instead, the framework promotes progressive, standards-aligned mechanisms that can support both modern and transitional imaging workflows.

DICOMweb limitations

The case to limit the use of **DICOMweb** is more nuanced. As a RESTful, web-based architecture, DICOMweb appears – at first glance – to be a good fit for data exchange. It suffers from several key limitations, however, which make it unsuitable for bulk data exchange[8].

DICOMweb is the wrong type of protocol

DICOMweb is designed to provide high level JSON metadata and granular, per-frame access to imaging. This is good for web-based applications that need to access specific studies for incremental viewing. This same strength is a weakness *when retrieving an entire study*, as each frame must be retrieved with at least two requests, one for metadata and another for pixel data.

- This adds considerable overhead to the total request time as well as bandwidth. Retrieving imaging in this way is much slower than a single request for a package, *by several orders of magnitude (see example below)*.
- The request cannot be compressed and response compression is reduced
- DICOMweb endpoints generally limit the number of concurrent requests to prevent overloading the service, slowing the transfer further. The bottleneck for DICOMweb is not bandwidth, but concurrency.
- Servers often impose pagination limits (e.g., max 100–1000 instances per response). Large studies require multiple paginated requests and careful client-side assembly.
- Robust reconstruction requires pagination handling, retry logic, and reliable bulk data access. This requires extensive tracking and error checking on the retrieval side. A single failed request will invalidate an entire Series.

Example:

A PET CT may require over 1200 separate requests (or more) to retrieve an entire study. Each instance must be tracked separately by the receiving system, and the failure of any given request will invalidate the Series it belongs to. If multiframe objects (e.g., Enhanced CT, Enhanced PET) are used and accessed per-frame, the number of frame requests could exceed 1500, as each frame may be retrieved via its own URL.

Speed is further restricted by concurrency limitations, paginations, bandwidth, and the capacity of the requesting service to make multiple requests.

In contrast, JMIX requires 1 request for the same study (and even DICOM does not have this problem, as it moves data in a single stream, despite its other issues).

[8] In fact, this is a problem that the DICOM community has been trying to solve (unsuccessfully) for some time. The MINT project in the late 2010s introduced some mechanisms in DICOMweb to address this, but was ultimately scrapped, while the later DICOM Supplement 211 was meant to add a single download endpoint. Neither were ultimately successful, as the bulk transfer model is incompatible with the way DICOMweb has been implemented.

Other issues

There are further issues with DICOMweb:

- DICOMweb implementations are inconsistent. BulkDataURI access may be restricted on some services, and is required to retrieve pixel data; not all servers support or expose this. Full WADO-RS instance retrieval (application/dicom) may be unsupported on some servers.
- Authentication constraints (e.g., token expiry) can disrupt multi-request reconstruction workflows
- Filtering limitations (e.g., incorrect handling of query parameters) may yield incomplete results
- It is not possible to retrieve all data for a study using a single DICOMweb request. DICOM Sup 211[9] attempted to provide a ZIP package from a DICOMweb request, but was withdrawn in 2023 for this reason[10].

DICOMweb has been proposed as a solution to a kind of “national imaging viewer”. However, again, practical limitations will severely hinder a successful outcome:

- Web-based viewers require extremely fast, JPEG transcoded imaging to work effectively. While any organisation could, in theory, provide a DICOMweb endpoint, delivering imaging at the speeds necessary to meet user expectations is technically challenging, and well beyond the capabilities of most organisations[11].
- The DICOMweb endpoints of common platforms like Intelerad’s Inteleviewer are not designed for this use case[12] and are unlikely to be able to serve imaging at scale, as designed.
- Transcoding has only patchy implementation, and some implementations do not currently work correctly[13].

In order to operate any kind of national viewer capability, the ADHA will need to retrieve imaging into a central cache first, transcode it, then provide it at scale. This neutralises any practical benefits of the DICOMweb format, leaving only the downsides.

[9] DICOM Standards Committee, Working Group 27; 2020; *Supplement 211: DICOMweb Support for the application/zip Payload;* https://www.dicomstandard.org/News-dir/ftsup/docs/sups/sup211.pdf
[10] See https://comp.protocols.dicom.narkive.com/nvNDGXjW/zip-over-DICOMweb
[11] Aurabox operates a platform which does this, and manages clusters of serverless DICOMweb endpoints with authentication. This is a complex and expensive technical challenge.
[12] Nor are they designed for the bulk retrieval or HealthConnect use case. It may be a Terms of Service breach in some cases.
[13] Including Google Healthcare.

Comparison of technologies within a HealthConnect ecosystem

	DICOM	DICOMweb	FHIR + DICOMweb	IHE (Base framework)	IHE (MDG/Harmony)
Capabilities					
Patient discovery	Requires a central DICOM router and manual handling. Per AE searching only. VPN required.	Per server search.	Federated search through HealthConnect	Federated search through HealthConnect	Federated search through HealthConnect and/or Aurabox/third party
Metadata search efficiency	Poor due to manual requirement	Acceptable but very slow for some query types[14]	Good (FHIR)	Good (FHIR)	
Search scaling	Terrible	Acceptable	Good (FHIR)	Good (FHIR)	
Retrieve imaging	Requires a direct VPN (or central router).	Yes, inefficient, multiple requests per image		Yes, in a single package	
Retrieval efficiency	Fast	Very Slow		Fast	
Scaling model	None. Limited to capacity of DICOM node	Mixed, partly limited by DICOM node, but may include caching layers		Mixed, partly limited by DICOM source. Supports caching, federation, and other scaling.	
Security features					
HealthConnect auth	No	Likely to require dedicated auth proxy			Explicitly supported
Transport encryption	Point-to-point VPNs only.	HTTPS transport layer (no VPN)			P2P, per transaction wireguard VPN with ephemeral keys

[14] Many DICOMweb services run full file system searches for queries that are not supported by local indexes. This can take 10s of seconds for large studies.

	DICOM	DICOMweb	FHIR + DICOMweb	IHE (Base framework)	IHE (MDG/Harmony)
Data encryption	No	No, except for HTTPS wrapper		Fully encrypted with perfect forward secrecy, even within a HTTPS transaction, when using JMIX.	
Sender & Requester signing	No			Signed requester & sender assertions	
Extensible	No			Yes	
Package verification and signing	No			Yes	
Implementation					
Connectivity Complexity	High. Requires VPN connections and a central DICOM router. Difficult to configure.	Moderat, requires implementing new, custom DICOMweb, FHIR and authentication proxy layers		Moderate, requires new FHIR, JMIX and auth proxy layers, but may be able to share implementations	Relatively easy, drop-in solution
Industry use	Ubiquitous	Almost none[15]		Not yet implemented	
Open Source	No, but free to use	No, but free to use		Yes	Yes, except for Aurabox specific connectors

[15] Outside of proprietary imaging viewers (e.g. Inteleviewer), there is almost no uptake of DICOMweb technology.

Appendix 4: Valid requests for data

The IEF makes a number of assumptions about what constitutes a valid request for medical imaging or imaging metadata. These assumptions are based on the requirements outlined in the Australian Privacy Act, Australian Privacy Principles, State legislation, and advice given by the OAIC[16].

In all cases, automated release of data using machine readable policies should be achievable when the following criteria is met:

Requirement	***Action***	***IEF implementation***
The patient can be identified	The Imaging Service must be certain that they are providing imaging for the right patient	The IEF assumes that all requests for patient data are attached to a valid IHI. In addition, services may perform their own data matching to locate the correct imaging.
The identity of the patient is verified	The Imaging Service must be certain that the imaging is being provided for a patient that is properly identified.	The Service needs to trust that the Imaging Consumer has validated identity correctly. This is not part of the IEF.
The identity of the requester is verified	The Imaging Service must verify the identity of the requester	It is assumed that HealthConnect will perform this function centrally.
The purpose for the request is known	The Imaging Service must apply different rules based on the purpose of the request.	How this is implemented depends on the way the HealthConnect Authorisation service functions. The MDG should be able to validate access based on Requirement 3.
A valid consent is available	The Imaging Service must have a valid consent under the Privacy Act	For clinical use, an implied consent is the current status quo. This is the expected minimum baseline on which HealthConnect will function In other cases, where a valid consent can be established electronically, the information should be released electronically, otherwise it should fall back to a manual process.

[16] This model is based on the implementation currently active in Aurabox, which has trialed it with over 50 medical imaging providers, hospitals, and imaging specialists.

Appendix 5: FAQs

1. What is the Imaging Exchange Framework (IEF)?

The Imaging Exchange Framework is a proposed national architecture that enables secure, standards-based medical imaging exchange across Australia. It is designed to bridge existing gaps in interoperability by allowing healthcare organisations to discover and retrieve diagnostic imaging in real-time—without requiring centralised storage or extensive re-engineering of legacy systems.

By using modern APIs and established standards like FHIR and DICOM, the IEF ensures that providers, patients, and systems can participate regardless of their technical capabilities. The framework is explicitly aligned with the Australian Government's *HealthConnect* strategy and broader goals for federated health data sharing.

2. Why is this framework necessary?

Australia's current imaging landscape is fragmented and inefficient. Clinicians routinely rely on manual processes such as CDs, USB drives, faxes, and siloed portals to obtain imaging. Imaging is often duplicated because the original study cannot be found or accessed, leading to unnecessary radiation exposure, delays in care, and increased costs.

The IEF addresses these issues by introducing a standards-aligned, decentralised method of image discovery and retrieval. It shifts the model from a reliance on data warehouses or local PACS integrations to a federated, policy-enforced architecture that supports real-time access—on demand, and without duplication.

3. Does this mean images are stored in a central repository?

No. The IEF *intentionally avoids* the creation of a central image archive. Instead, it defines a **federated exchange model**, where images are stored at their original source and accessed only when necessary. This approach ensures:

- Greater scalability
- Lower infrastructure overhead
- Better alignment with privacy principles
- Continued control by the originating provider

Images remain with the organisation that created them, and are shared through secure, authorised workflows when requested by an authorised party.

4. What technologies does the IEF use?

The framework integrates several key standards and components:

- **DICOM** for clinical imaging formats (but not transport)
- **FHIR** (specifically, the *ImagingStudy* resource) for study-level discovery and metadata exchange

- **JMIX**, a JSON-based wrapper that enables secure packaging and transfer of imaging datasets
- **RESTful APIs** for modern application-level integration
- Optional **subscription and notification models** for asynchronous workflows

Together, these components provide a flexible and modular architecture that works across existing systems while enabling future innovation.

5. What is JMIX and how does it fit into the IEF?

JMIX stands for **JSON Medical Imaging Exchange**, and it's a critical technical enabler for the framework. JMIX packages DICOM studies into a secure, verifiable envelope that can be transmitted using standard web infrastructure—such as HTTP(S), email, USB, or cloud storage—without compromising security or auditability.

Each JMIX envelope contains cryptographically signed metadata, consent information, and access conditions, making it particularly suited for federated environments where traditional DICOM transport is impractical.

6. How does the framework ensure patient privacy and consent?

Privacy and consent are central to the IEF's design. The framework defines a **Basis for Access** model that incorporates:

- Verified clinician and organisation identities
- Explicit purpose-of-use declarations (e.g. treatment, second opinion)
- Consent capture and enforcement, aligned with the **Australian Privacy Principles (APPs)**
- Auditable request/release logs
- Local policy enforcement by each participating provider

Importantly, privacy controls are not centralised—they are enforced at the edge, allowing each provider to retain full control over access decisions.

7. Can smaller providers or non-hospital environments participate?

Yes. The IEF is explicitly designed to accommodate a **multi-speed ecosystem**, where not all participants have the same infrastructure or technical capabilities. For instance:

- Hospitals with mature PACS and DICOMWeb implementations can integrate directly
- Regional clinics or specialists without PACS can participate using lightweight upload/download portals
- Cloud-native providers can exchange using API-based workflows
- All participants can use JMIX for packaging and delivery

This flexibility ensures national coverage without penalising smaller organisations or delaying adoption due to technical complexity.

8. What use cases does the IEF support?

The framework supports a wide range of real-world clinical and operational use cases, including:

- Access to imaging for referrals or shared care
- Cross-organisational retrieval for second opinions or multidisciplinary team (MDT) meetings
- Patient access and consented sharing of imaging with new providers
- Secure, auditable exchange for clinical trials and research
- Integration into national programs such as the **Lung Cancer Screening Program**

These workflows are designed to work seamlessly across public, private, and mixed settings.

9. How does the IEF relate to HealthConnect and other national strategies?

The Imaging Exchange Framework aligns closely with the **HealthConnect** vision and the *National Digital Health Strategy (2023–2028)*, which emphasise:

- Person-centred data sharing
- Federated health networks
- Interoperable, standards-based exchange

IEF provides the imaging-specific architecture and policy framework needed to achieve these goals, while ensuring compatibility with HealthConnect registries, identity services, and other infrastructure as it evolves.

10. What are the next steps for the IEF?

The framework is currently being validated through pilot implementations involving hospital systems and regional imaging providers. These pilots aim to:

- Test technical interoperability
- Refine the JMIX specification
- Evaluate consent and policy models in practice
- Generate clinical and economic evidence for national rollout

In parallel, stakeholder engagement is underway with government agencies, industry partners, and standards bodies to ensure alignment with national objectives and long-term sustainability.

11. Can we leverage cloud providers for managing DICOMWeb services

As far as this proposal goes, no. The major cloud providers all advertise DICOM storage services, however none of these are fit-for-purpose as high-availability clinical repositories, without considerable additional engineering.

Of these, the following limitations apply:

- The Google HealthCare API can store large volumes of data, and has a DICOMweb API. Its transcoding functions are currently. broken.
- Azure's DICOM store also has a DICOMweb API, but no transcoding, and its functions are more limited
- AWS DICOM store only supports ingress/egress via storage buckets (no DICOMweb API).

In all cases, to serve images over DICOMweb at scale for any of these services requires implementation of a scalable authentication and proxying layer, a significant undertaking.

12. How would a National Imaging Viewer fit in?

One of the proposals for HealthConnect is a National Imaging Viewer. There is very little detail on this currently, however as the Government does not plan to build a central archival facility for imaging, a Viewer will probably operate more like a proxy service. Apart from the consideration of which viewer to choose (a complex question in itself), the delivery of imaging to the viewer is a critical concern.

The viewer will need a single endpoint it can retrieve imaging data from, and that imaging data will need to be available with extremely high levels of availability and speed, as well as being fully transcoded. This is a complex system to operate at scale, but will (at minimum) require imaging to be preloaded into a cache before being sent to the viewer. This is necessary because the client systems which hold the imaging will be unlikely to be able to support the high-availability, throughput, scaling, metadata normalisation and transcoding requirements[17]. This would add a massive, unreasonable burden on commercial and public providers, that they currently have no capacity to deliver.

The IEF supports this cached model through the Bulk Transfer mechanisms in the MDG, with fallbacks to DICOMweb if required.

13. What about patient access?

The question of whether patients have access to their own imaging as part of HealthConnect has not yet been answered, however the IEF model would make it easier for services to provide complete access to a patient for their own medical imaging, whether that is via MyHealthRecord or a third-party application such as Aurabox.

[17] Aurabox has several years experience delivering smaller, less complex high-availability imaging endpoints at scale, and can attest to the significant complexity in serving imaging fast enough and reliably enough to meet end user needs.

Appendix 6: Imaging Intensive specialties

Specialists who use medical imaging directly, not just relying on radiology reports, are typically those whose clinical decision-making or procedural work involves first-hand interpretation or intraoperative visualisation of images. These clinicians may read images themselves, use imaging to guide interventions, or review images to understand anatomy and pathology beyond what a report provides.

Specialty	Notes
Radiology	• **Primary users** of medical imaging. • Radiologists interpret and report all imaging modalities (X-ray, CT, MRI, US, nuclear medicine). • Interventional radiologists also use imaging in real-time to guide procedures.
Surgery (general & subspecs)	Use imaging for **pre-operative planning**, **evaluating disease progression, intraoperative guidance**, and **postoperative review**. Especially relevant for: • **Neurosurgeons** (MRI, CT, functional imaging) • **Orthopaedic surgeons** (X-ray, CT, MRI) • **Cardiothoracic and vascular surgeons** (CT angiograms, echocardiography, DSA) • **ENT surgeons** (CT/MRI for sinus, skull base, neck masses) • **Colorectal** • **Urology**
Cardiology	Particularly **interventional cardiologists** use: • **Echocardiography** • **Cardiac MRI** • **Coronary angiography** **CT coronary angiograms** Used during procedures (e.g. stenting, TAVI) and to monitor function.

Oncology	• **Radiation oncologists**:
	  ○ Use imaging to **plan radiation fields** (CT, MRI, PET).
	• **Medical oncologists**:
	  ○ Directly review CT/PET scans to assess **treatment response** and **disease progression**.

Emergency Medicine	• Use **point-of-care ultrasound (POCUS)** and review X-rays and CTs before reports are available. Must make time-critical decisions (e.g. pneumothorax, fractures, bleeds).
Intensive Care	Use imaging like: • **POCUS** • **Chest X-rays**

	• **CT scans** (e.g. to evaluate stroke, sepsis source) Often review without a formal report due to urgency.
Obstetricians and Gynaecologists	• Routinely perform **obstetric and gynaecological ultrasound** themselves for diagnostic purposes and procedural guidance.
General Practice	• May use **POCUS**, especially in rural/remote areas. • Some review basic imaging like **chest X-rays** or **musculoskeletal scans**.

Respiratory	• Interpret **chest imaging** (X-ray, CT) for conditions like:
	  ○ Lung cancer
	  ○ ILD
	  ○ Pulmonary embolism

Neurology	Often review **MRI/CT brain imaging** themselves to understand: • Stroke • Tumours • MS • Epilepsy-related lesions
Gastroenterology	Use imaging for: • Liver disease (CT/MRI/US) • IBD monitoring (MRI enterography) • Interventional endoscopic ultrasound
Sports Medicine	Commonly use: • **Ultrasound** to assess and guide injections • **MRI** for soft tissue injuries Read and interpret scans directly to guide rehabilitation.
Dentistry / OMFS	• Use dental X-rays, OPG, CT, and cone-beam CT directly. • Critical for dental implants, jaw surgery, and pathology.

Outstanding Issues

The following issues are unresolved at the time of publication. With the exception of (1), these issues are not critical to the implementation of the IEF or MDG model.

1. Identifying Canonical Data

There is no strategy for:

- **Determining the authoritative version** of a study (e.g. when studies are corrected, updated, or split).
- Establishing **study lineage or provenance**, which is crucial for medico-legal defensibility, teaching, or regulated use.

Without canonical tagging, there is risk of using out-of-date, incomplete, or duplicated imaging.

2. Restricting Access for Sensitive studies

The IEF assumes access is mediated by role, consent, and purpose, but doesn't explicitly support:

- Marking studies as **sensitive or restricted** (e.g. mental health, forensic cases, reproductive health, HIV)
- Applying additional access constraints (e.g. dual attestation, time gating, supervisor approval)

Some jurisdictions (e.g. state health departments) may require **granular access tiers** beyond simple role-based access.

3. De-Identification and Redaction protocols

While JMIX provides structural integrity, there is no defined:

- Standard protocol for de-identifying DICOM (beyond basic tag removal)
- Differentiation between **fully de-identified**, **redacted**, and **pseudonymised** imaging
- Mechanism for releasing different versions (e.g. raw vs teaching-ready) from the same source

This leaves ambiguity for research use, teaching packs, and cloud-based workflows where redaction must be policy-controlled and provable.

4. Real-Time Consent Revocation

The framework defines consent enforcement, but doesn't describe:

- **Propagation of consent changes** (e.g. if a patient withdraws access after imaging is shared)
- Notification or enforcement mechanisms across federated services

This creates potential for **data leakage** or **non-compliant secondary use**.

5. Partial Study Retrieval and Segmentation

Clinical use may not always require full study retrieval. Examples include:

- Retrieving just the key series or reports
- Preloading low-resolution images for triage

The framework does not yet define policies or mechanisms for **segment-level retrieval**, which could reduce bandwidth and improve responsiveness in time-critical settings.

6. Dynamic Credential Validation

While identity verification is mentioned, IEF doesn't cover:

- **Ongoing credential verification** (e.g. has the requesting doctor's AHPRA status changed?)
- Integration with national provider registries or organisational credentialing databases

In dynamic clinical environments (e.g. locums, trainees), **access revocation lag** could pose a compliance risk.

7. Study Lifecycle Governance

There is no definition of:

- How long studies are made discoverable
- Who is responsible for removing outdated or superseded studies
- What happens when source systems are decommissioned or change vendor

This is particularly important in a **federated model without central retention**, where discoverability must be lifecycle-aware.

8. Cross-Border and Cross-Jurisdictional Compliance

As imaging flows between:

- State boundaries (e.g. VIC to NSW)
- Private and public systems
- Domestic and international entities (e.g. second opinions from overseas)

Compliance with **local regulations, secondary consent models**, and **data export restrictions** becomes complex and is not yet addressed by the framework.

9. Audit Log Interoperability and Tamper Evidence

While the IEF promotes audit trails, it does not define:

- A **shared audit format** or standard (e.g. FHIR AuditEvent)
- Methods to **verify log integrity** across providers
- Integration with national digital health audit infrastructure

This is vital for regulatory inspection, breach investigations, or retrospective reviews in medicolegal cases.

Glossary

Term	Definition
APPs (Australian Privacy Principles)	A set of 13 principles in the Privacy Act 1988 (Cth) that govern standards, rights and obligations around the collection, use and disclosure of personal information, including health information.
AU CFI (AU Core Framework for Interoperability)	A national interoperability specification defining FHIR profiles, terminologies and patterns specific to Australian healthcare. It forms part of the HealthConnect reference architecture.
Aurabox	A vendor-neutral imaging platform and interoperability gateway that supports HealthConnect-aligned exchange workflows, including acting as a Medical Data Gateway.
Bulk Data Endpoint	A secure web endpoint that allows authorised systems to retrieve complete medical imaging studies (as encrypted ZIP or JMIX archives). Used in high-volume transfer workflows.
DICOM (Digital Imaging and Communications in Medicine)	A global standard for storing and transmitting medical images and related information. Designed for LAN-scale use, not modern federated networks.
DICOMweb	A RESTful web-based variant of DICOM, offering metadata and image access via HTTP. Limited adoption and poor performance in bulk retrieval use cases.
Directed Information Exchange	An interoperability pattern in HealthConnect where a system "pulls" information directly from another known source, typically in response to a referral or clinical trigger.
Discovered Information Exchange	A HealthConnect pattern enabling systems to locate and retrieve health information (e.g., imaging) based on a patient identifier, without needing prior knowledge of where the data is stored.
FHIR (Fast Healthcare Interoperability Resources)	A modern, web-based interoperability standard developed by HL7 for exchanging healthcare data. FHIR is central to the HealthConnect ecosystem.
FHIR ImagingStudy	A FHIR resource that describes an imaging study (e.g., MRI, CT) including metadata like modality, body site, and study date. Used to support discovery and linkage to bulk retrieval endpoints.
HealthConnect	The Australian Government's national federated digital health infrastructure. Provides core services including identity, consent, discovery and interoperability patterns.

Harmony	An open-source implementation of a Medical Data Gateway developed by Aurabox, designed to provide a plug-and-play solution for organisations adopting the Imaging Exchange Framework.
IHI (Individual Healthcare Identifier)	A unique 16-digit identifier issued to individuals in Australia, used for linking health information across providers and services.
Imaging Consumer (Role)	A system or application that initiates discovery or retrieval of imaging data. Examples include PACS, RIS, EHRs, FHIR clients, or AI pipelines.
Imaging Exchange Framework (IEF)	A standards-based architecture and policy framework that enables federated discovery, access, and sharing of medical imaging across Australia's health system.
Imaging Intensive Speciality	A clinical specialty that relies on medical imaging as part of their practice (as opposed to utilising reports provided by radiologists).
Imaging Specialist	Specialists who **use medical imaging directly**, not just relying on radiology reports, are typically those whose clinical decision-making or procedural work involves **first-hand interpretation or intraoperative visualisation** of images. These clinicians may read images themselves, use imaging to guide interventions, or review images to understand anatomy and pathology beyond what a report provides.
JMIX (JSON Medical Imaging Exchange)	An open standard for packaging and securely transferring medical imaging studies. Supports encryption, digital signatures, and bulk download workflows.
MDG (Medical Data Gateway)	A standards-compliant interoperability broker that connects local imaging systems to the national HealthConnect infrastructure. Implements discovery, consent, security, and transfer protocols.
MyID / Healthcare Identifiers Service	National identity services used to validate patients, providers, and organisations participating in the HealthConnect ecosystem.
PACS (Picture Archiving and Communication System)	A system used by healthcare providers to store, retrieve, distribute, and present medical images. Typically DICOM-based.
Service (Role)	Any system that makes imaging data available to authorised Imaging Consumers. This includes PACS, RIS, VNAs, EMRs or dedicated MDGs.
Sparked	A national accelerator program developing FHIR Implementation Guides for Australian clinical domains, including imaging and pathology.

TLS (Transport Layer Security)	A cryptographic protocol used to ensure secure transmission of data over a network. TLS 1.2+ is mandated for all data transfers in IEF.
VNA (Vendor Neutral Archive)	A data repository that stores medical images in a standard format and interface, allowing integration with multiple PACS or viewing systems.