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Diagnostic Reporting and Post-Processing Workflows

Kinson Ho, Architect

Agfa HealthCare

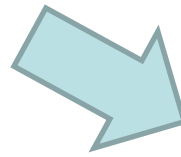
IHE Radiology Technical Committee Co-Chair



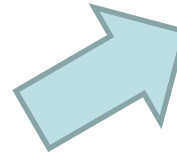
A Typical Day



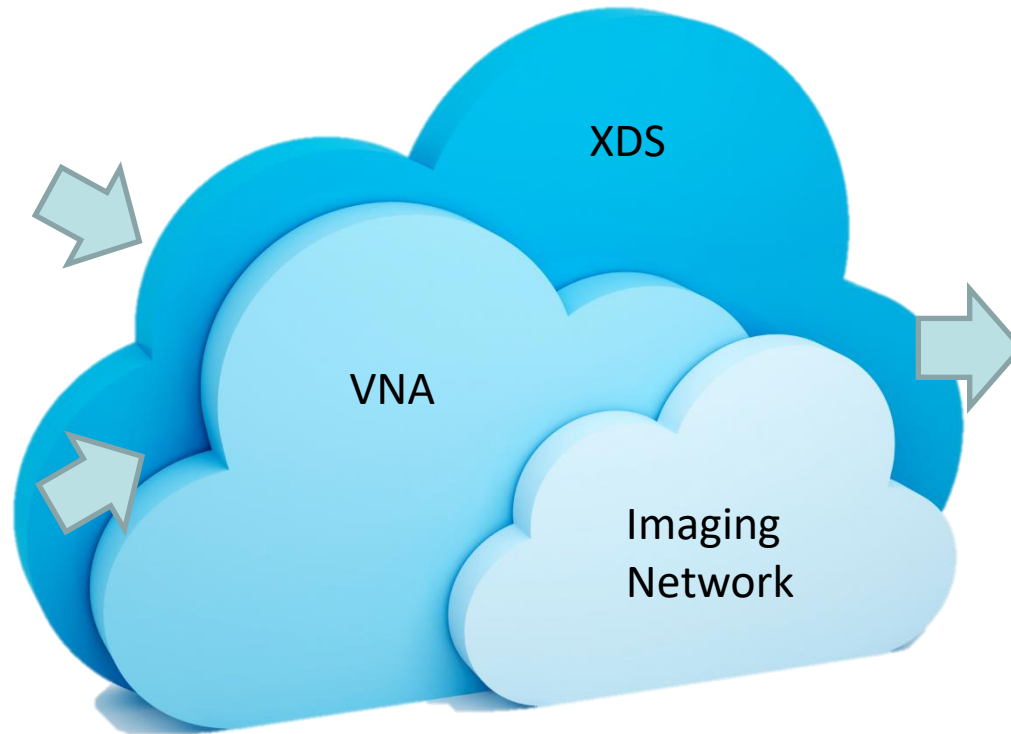
Clinical Data



Imaging Data



A Real Day



What is Workflow?

WORK

- What needs to be done?
- What are the inputs?
- What are the expected outputs?
- Who can perform the work?
- What are the additional constraints? E.g. expected completion time

FLOW

- What are the sequence of steps to complete the work?
- How to handle normal cases as well as exception cases?
- How to handle notification about state changes?

- **Work required is implied when input data exists (e.g. study shows up in worklist)**
 - Well understood if it is the normal case
 - Less well defined otherwise (e.g. foreign studies pushed to your PACS or prefetched)
- **Business logic is in the user's mind**

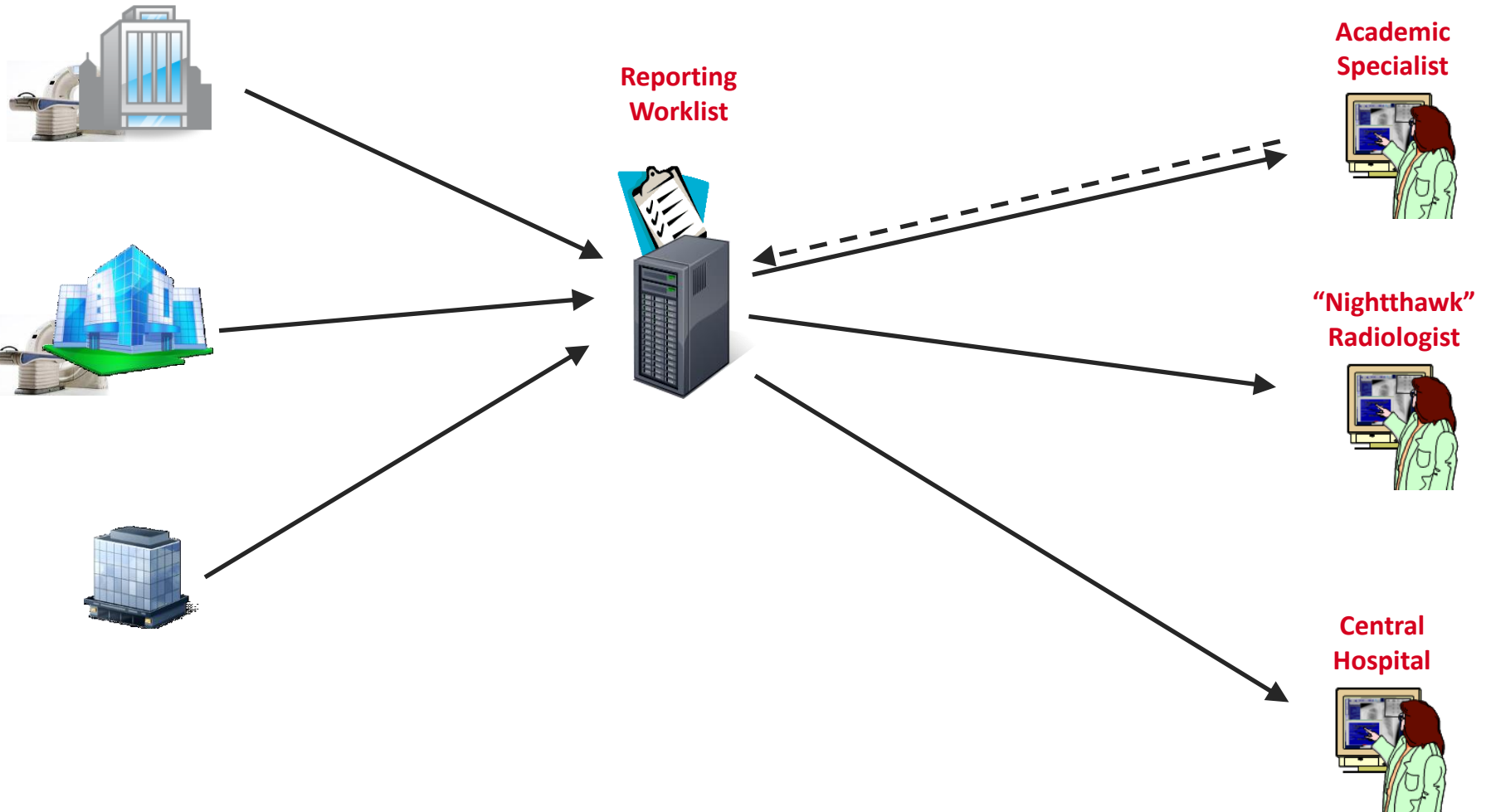
Pros	Cons
Simple	Difficult to communicate the implied context
Widely used	Difficult to integrate outside the enterprise boundary

- **UPS – Unified Procedure Steps**
 - Unified on task request, task progress and task results in one object
 - Support DIMSE and RESTful Interfaces
- **Facilitate workflow using Task**
- **Communicate Tasks among participating systems**
- **Update status of a Task to indicate progress**
- **Monitor progress of Task using notification**

Implicit vs Explicit Workflow

	Implicit Workflow	Explicit Workflow
Trigger Event	Input exists (e.g. study received)	Task exists (e.g. reading task created)
Input Readiness	Usually undefined - May be incomplete	Explicit in the Task
Message Semantics	Implicit (product specific)	Explicit in the Task
Expected Action	Implicit (integration specific)	Explicit in the Task

IHE Remote Radiology Reporting Workflow (RRR-WF)



Remote Radiology Reporting Workflow (RRR-WF)

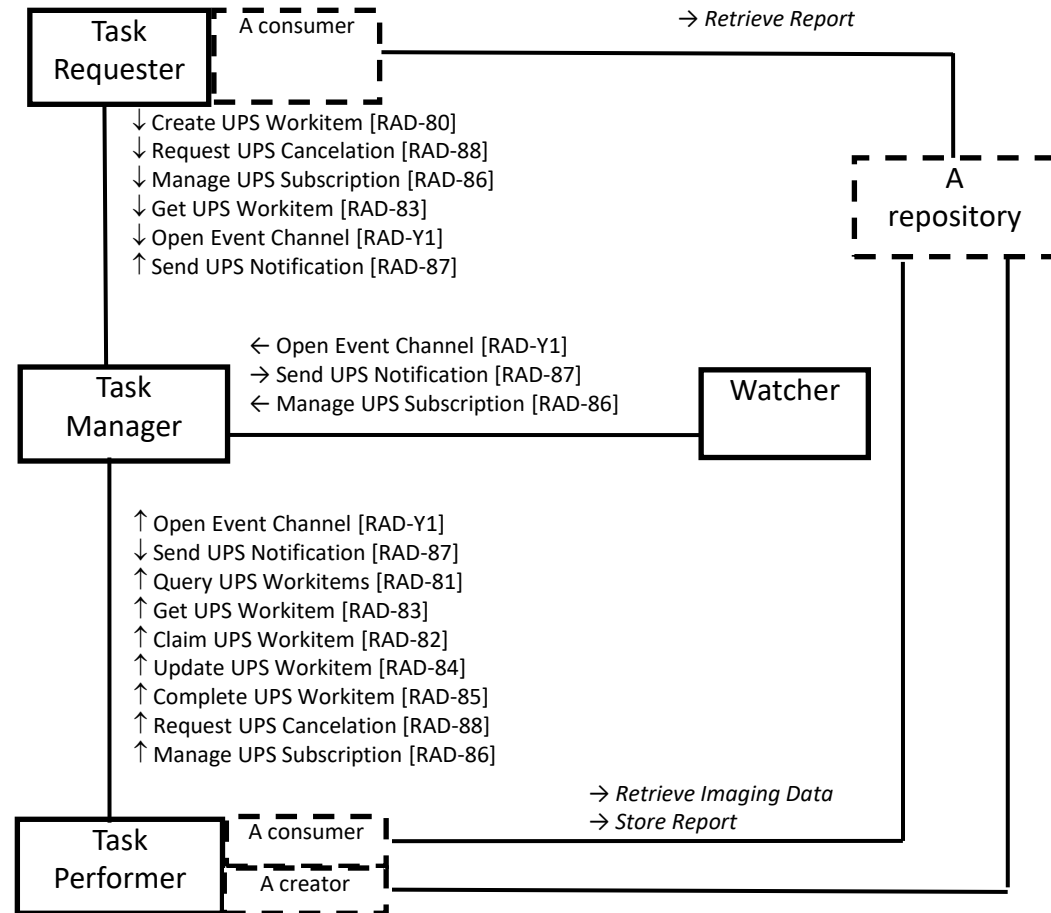


Worklist model

- Scheduled tasks
- Relationship to Patient, Order, Workflow
- Lists of inputs and outputs
- Notification of Progress/completion

Data flow can use:

- XDS, XDS-I
- DICOMweb WADO, STOW
- DICOM C-STORE, C-MOVE



Key Concept: Task

Task Identification

Patient Identification

Service Request

Scheduled Task Details

Input References

Progress Information

Performed Task Details

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
Task Identifier	SOP Class UID (0008,0016) SOP Instance UID (0008,0018)
Transaction Identifier	Transaction UID (0008,1195)

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
Patient Demographics	Patient's Name (0010,0010) Patient ID (0010,0020) Issuer of Patient ID (0010,0021) Other Patient IDs Sequence (0010,1002) Patient's Birth Date (0010,0030) Patient's Sex (0010,0040)

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
Accession	Accession Number (0008,0050) Issuer of Accession Number Sequence (0008,0051)
Admitting Diagnoses	Admitting Diagnoses Description (0008,1080) Admitting Diagnoses Code Sequence (0008,1084)
Reason for Exam	Reason for Requested Procedure (0040,1002) Reason for Requested Procedure Code Sequence (0040,100A)
Referring Physician	Requesting Physician (0032,1032)
Ordering Department	Requesting Service (0032,1033)

Key Concept: Task

- Task Identification
- Patient Identification
- Service Request
- Scheduled Task Details**
- Input References
- Progress Information
- Performed Task Details

Details	Corresponding UPS Attribute
Require Preliminary Report, Final Report or both	Scheduled Processing Parameters Sequence (0074,1210)
Scan Procedure (including body system)	Scheduled Workitem Code Sequence (0040,4018)
Sub-specialty required (e.g. NM, Neuro, etc.)	Scheduled Workitem Code Sequence (0040,4018)
Expected Completion Date/Time	Expected Completion Date and Time (0040,4011)
Priority / Urgency	Scheduled Procedure Step Priority (0074,1200)
Assigned Reader or Organization	Scheduled Human Performers Seq (0040,4034) Scheduled Station Name Code Seq (0040,4025) Scheduled Station Class Code Seq (0040,4026) Scheduled Station Geographic Location Code Seq (0040,4027)
Tasks labels	Procedure Step Label (0074,1204) Worklist Label (0074,1202)
Study UID to be used for created instances	Study Instance UID (0020,000D)

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
References to acquired images and locations <ul style="list-style-type: none">- XDS Retrieve- WADO-RS Retrieve- DICOM Retrieve- Media Retrieve	Input Information Sequence (0040,4021)
EMR Portal Address	Pertinent Resource Sequence (0038,0101)
References to other relevant input documents	Input Information Sequence (0040,4021)
Input Readiness	Input Readiness State (0040,4041)

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
Status	Procedure Step State (0074,1000)
Progress Information <ul style="list-style-type: none">- Numeric indicator- Description (e.g. Annealing Complete)- Performer Contact info- Cancellation info	Progress Information Sequence (0074,1002)

Key Concept: Task

Task Identification
Patient Identification
Service Request
Scheduled Task Details
Input References
Progress Information
Performed Task Details

Details	Corresponding UPS Attribute
References to performer <ul style="list-style-type: none"> - Human Performer Code - Performer's Name - Performer's Organization 	UPS Performed Procedure Sequence (0074,1216) Actual Human Performers Sequence (0040,4035)
Information about Performed Procedure <ul style="list-style-type: none"> - Station Name - Station Class - Station Geographic Location - PPS Start/End Date & Time - PPS Description - Comment - Workitem Code - Processing Parameters 	UPS Performed Procedure Sequence (0074,1216)
References to task output	UPS Performed Procedure Sequence (0074,1216) Output Information Sequence (0040,4033)

Key Concept: Actors and Their Responsibilities

Task Requester

- Create Task
- Assign Task
- Request cancellation
- Retrieve task output
- Subscribe to notification
- Receive notification

Task Manager

- Manage tasks (including assignment)
- Manage subscription
- Send notification

Task Performer

- Query task
- Retrieve task
- Claim task
- Perform task
- Retrieve task input
- Update task with progress and output
- Request cancellation

Watcher

- Subscribe to notification
- Receive notification
- Assign Task

Key Concept: Task Notification and Subscription

Use Cases

- **Attending Physician may want to be notified when a report is available or if critical finding is discovered**
- **Task Requester may want to monitor progress of its own tasks**
- **Task Manager sends notification and details of tasks for task management and distribution**
- **Task Performer may want to be notified of task assignment or cancellation**
- **Watcher receives notification of tasks for dashboard or analytics (e.g. performance, study mix, turnaround time, compliance to SLA, etc.)**

Subscription

- **Global subscription**
- **Filtered subscription (e.g. based on assignment, type, etc.)**
- **'Gift subscription'**

Key Concept: Claim, Assignment or Open Worklist

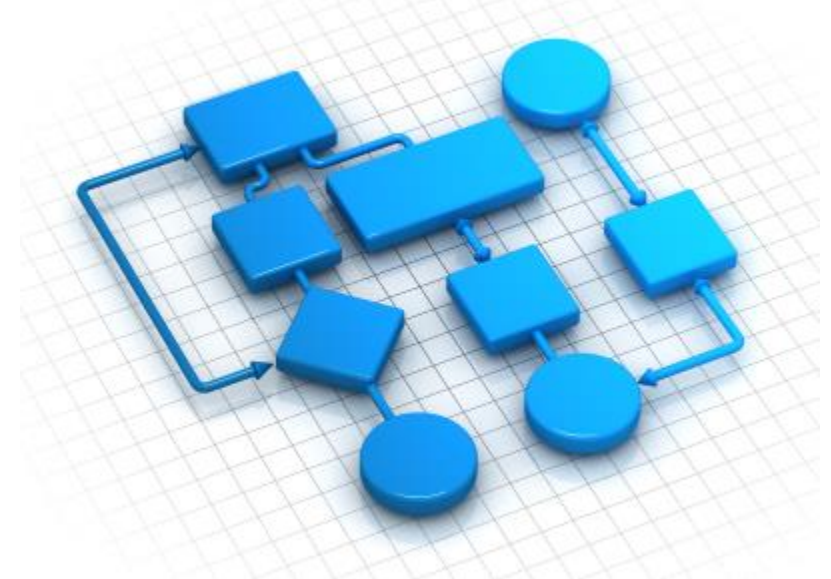
- **Tasks can be assigned to a particular Performer or Organization**
- **Tasks can be discovered via query or subscription**
- **For Open Worklist, it is possible for the Task Manager to over-filter the results by injecting additional query constraints**
- **Performer accepts and takes control of a task by claiming it**
 - **i.e. Assignment is still a request**
 - **Performer can cancel the request explicitly**
 - **Performer can ignore the assignment**
 - **Claiming a task does not mean that it is actually being worked on yet**
 - **Progress information is used to actually indicate progress**

Key Concept: Orchestration, Task Management and Data Flow

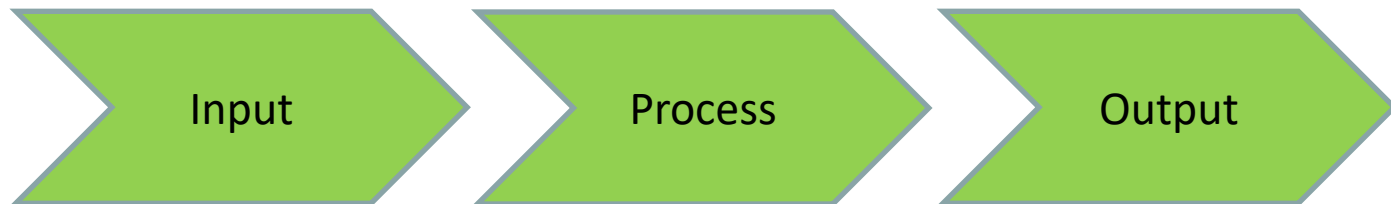
Task Management



Workflow Orchestration

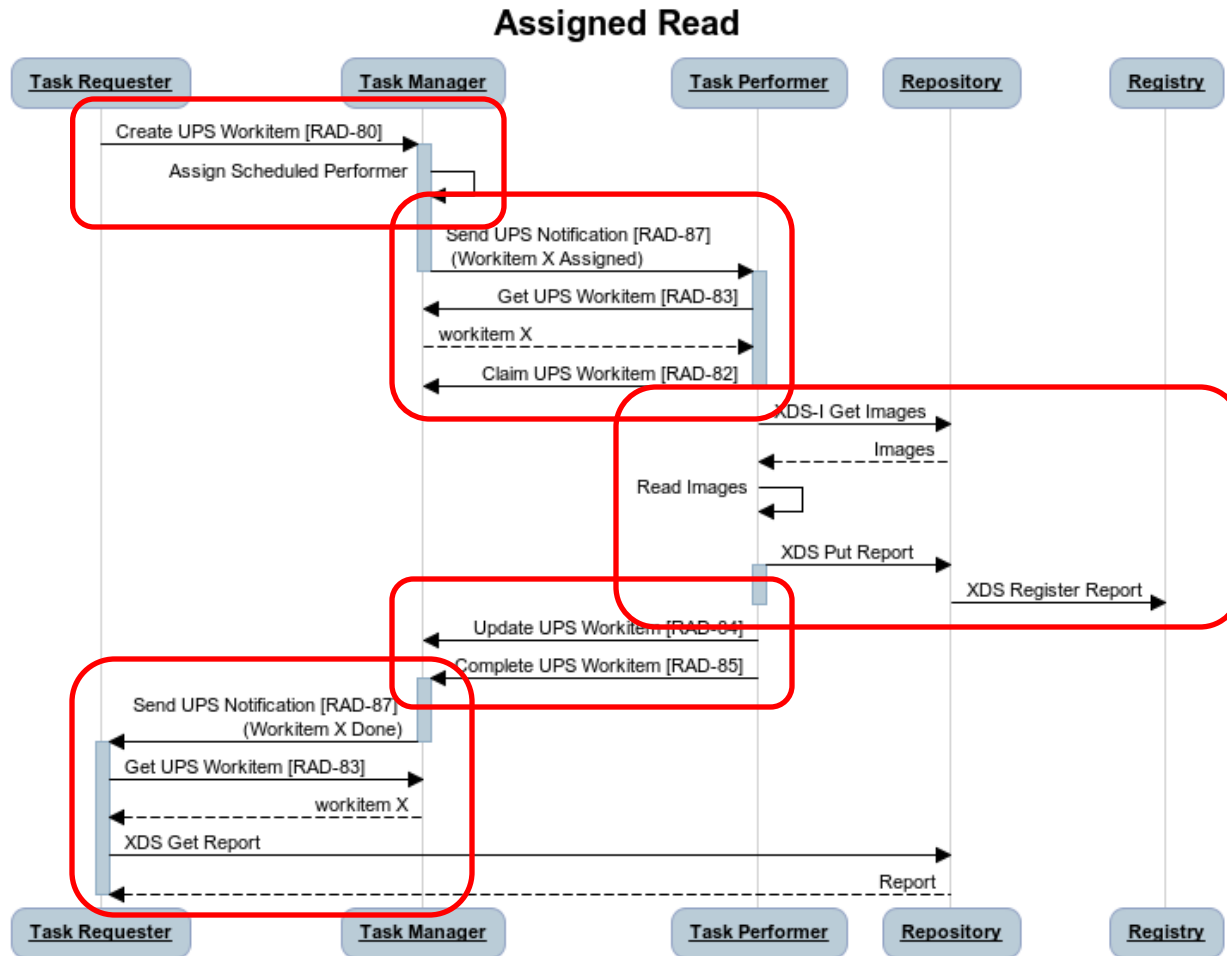


Data Management

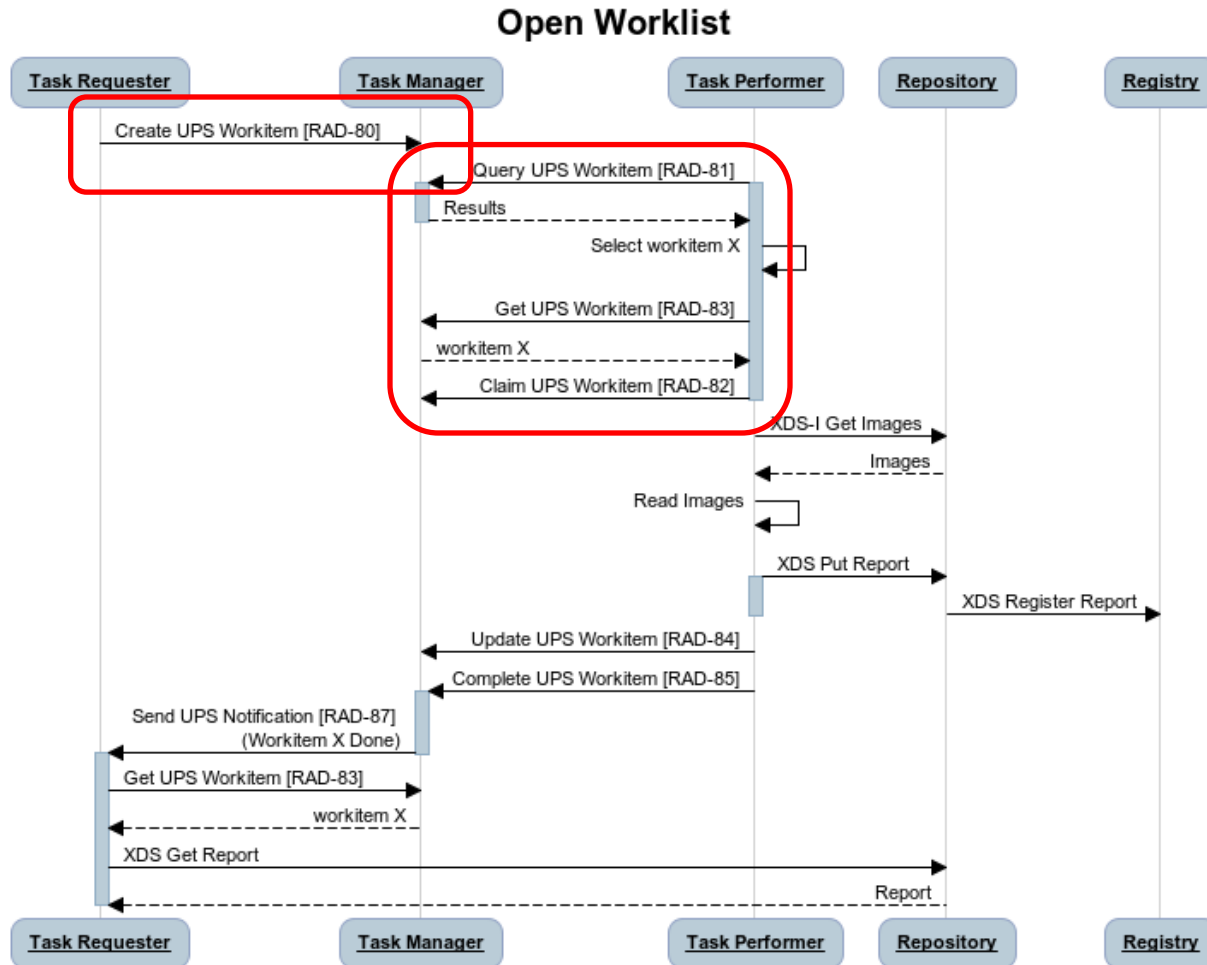


- **Task Requester and Task Performer may operate at different facilities or even different organizations**
- **Key identifiers such as Patient ID or Accession Number may be different between the Requester and the Performer**
- **Task scheduled information must be recognizable by the Performer**
 - **Common codes (Scheduled Workitem Code Seq)**

Process Flow: Assigned Read

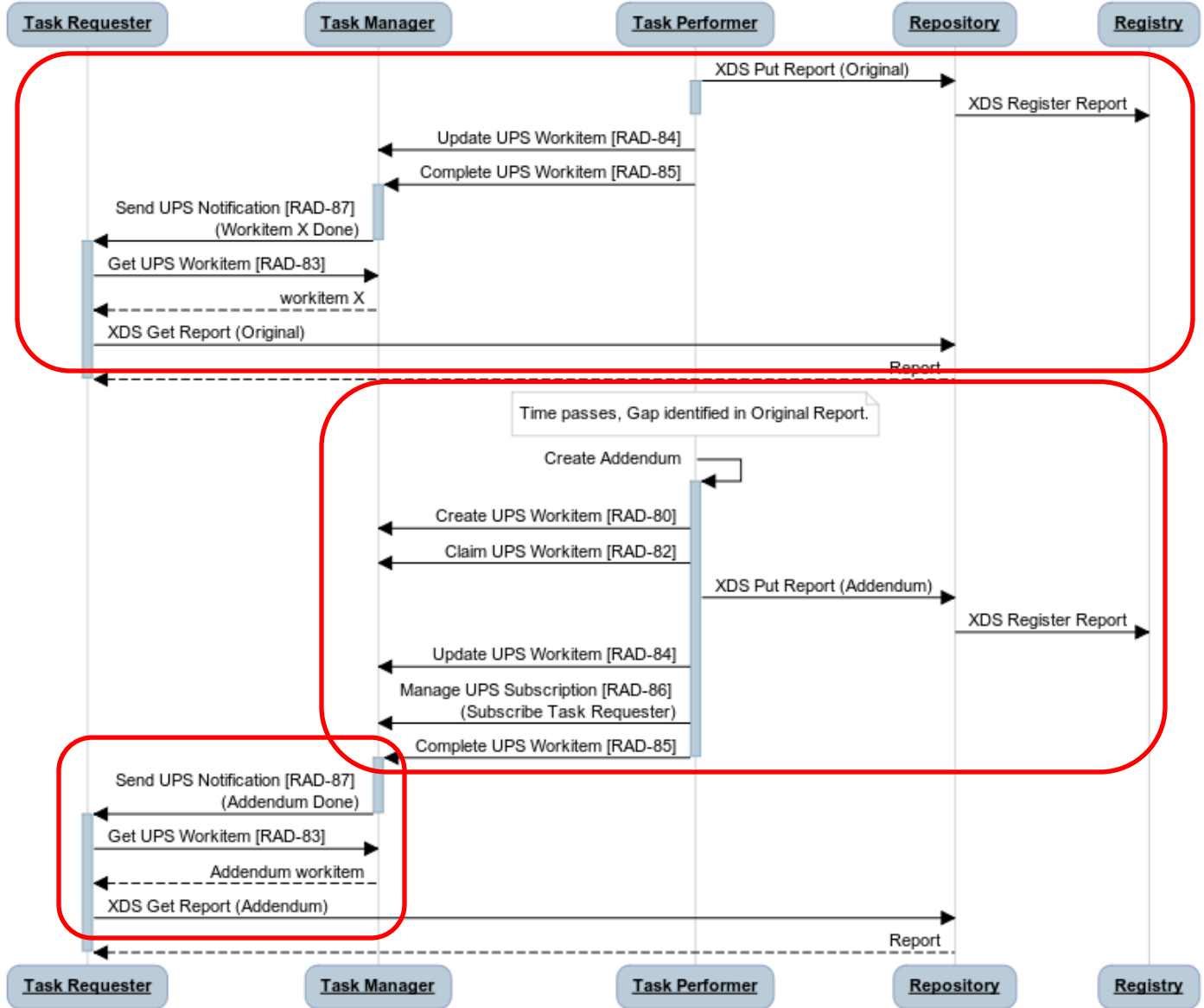


Process Flow: Open Worklist



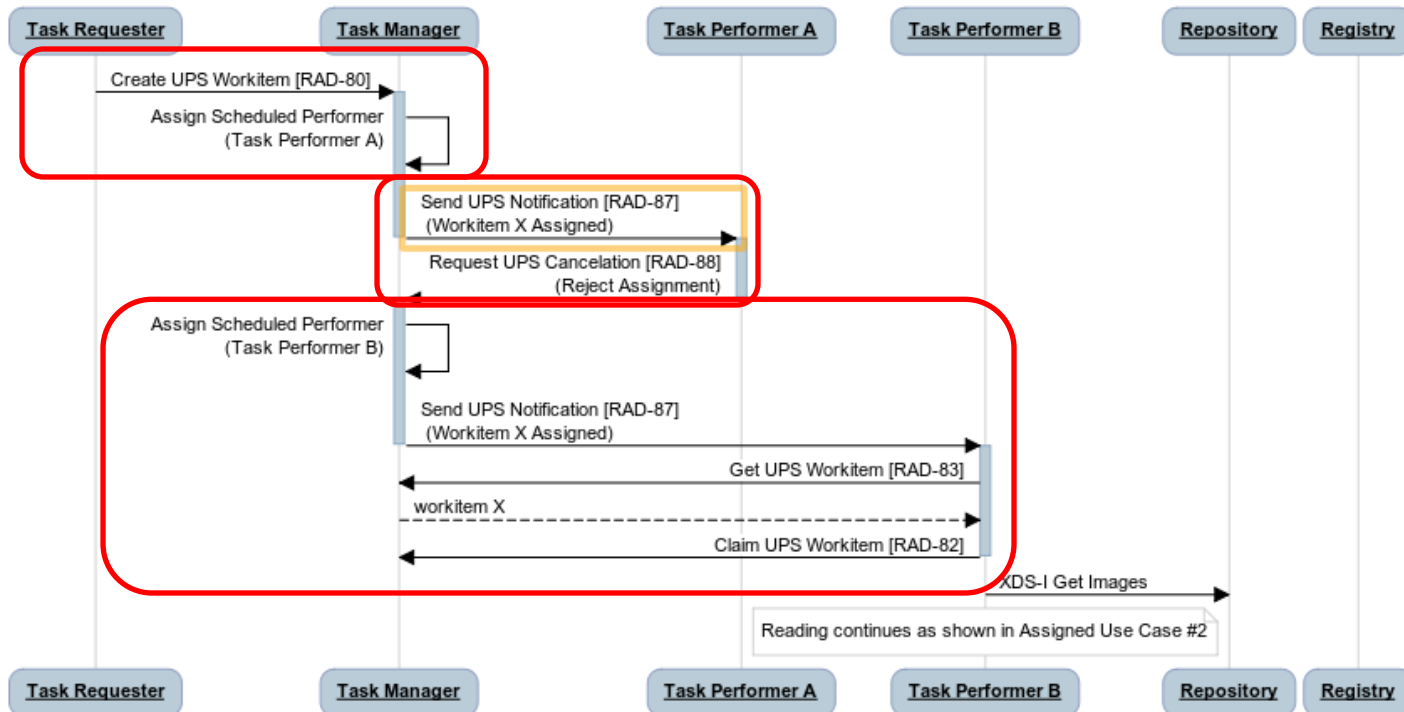
Process Flow: Report Addendum

Report Addendum



Process Flow: Re-assignment

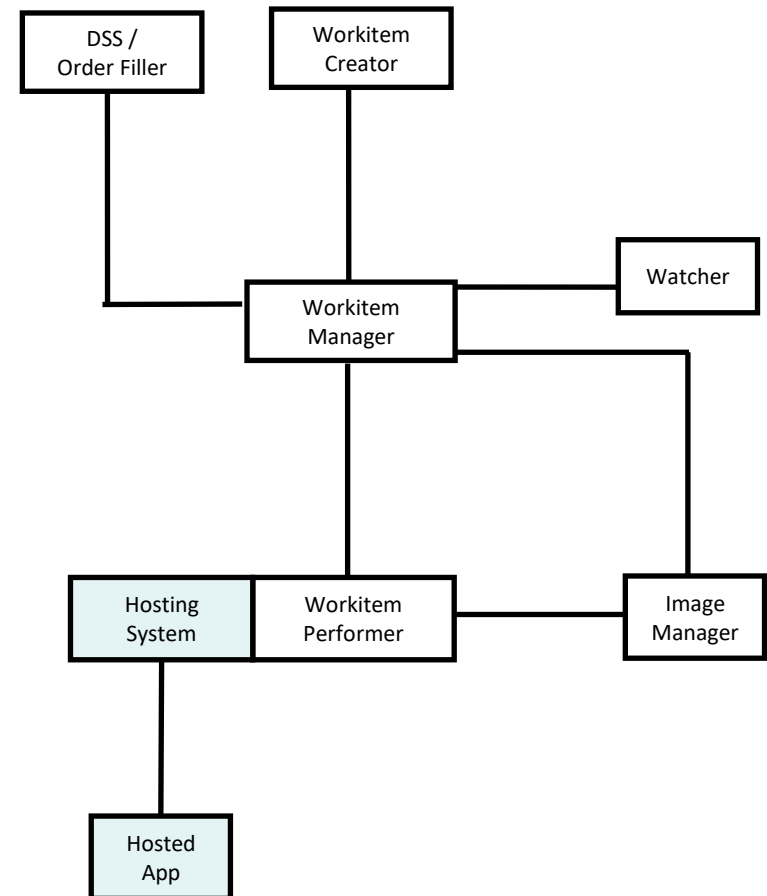
Re-assignment



- **IHE PAWF builds on DICOM UPS**

- **Essential Profile Features:**

- **Worklist managed processing**
 - Automated & manual
- **Progress notifications**
 - Any interested system (RIS, Billing, Reading Worklist, Dashboard, Analytics)
 - Subscription-based
- **Cancellation requests**
 - With reason & contact
- **Hosted applications (“DICOM plugins”)**



- **DICOM UPS and UPS-RS supports task-oriented workflow**
- **Focus on task management**
- **Can be integrated with different data management infrastructure**
- **Can be used for various reporting or post-processing workflows**
- **Support both assignment based workflow or open worklist**

What's
next



UPS-RS Summary

<u>Action Type</u>	<u>Section</u>	<u>Method & Resource</u>
<u>CreateUPS</u>	6.9.1	POST {+SERVICE}/workitems{?AffectedSOPInstanceUID}
<u>UpdateUPS</u>	6.9.2	POST {+SERVICE}/workitems/{UPSInstanceUID}{?transaction}
<u>SearchForUPS</u>	6.9.3	GET {+SERVICE}/workitems{?query*}
<u>RetrieveUPS</u>	6.9.4	GET {+SERVICE}/workitems/{UPSInstanceUID}
<u>ChangeUPSState</u>	6.9.5	PUT {+SERVICE}/workitems/{UPSInstanceUID}/state
<u>RequestUPSCancellation</u>	6.9.6	POST {+SERVICE}/workitems/{UPSInstanceUID}/cancelrequest
<u>CreateSubscription</u>	6.9.7	POST {+SERVICE}/workitems/{UPSInstanceUID}/subscribers/{AETitle}{?deletionlock} {additional methods omitted for brevity}
<u>SuspendGlobalSubscription</u>	6.9.8	POST {+SERVICE}/workitems/1.2.840.10008.5.1.4.34.5/ {additional methods omitted for brevity}
<u>DeleteSubscription</u>	6.9.9	DELETE {+SERVICE}/workitems/{UPSInstanceUID}/ subscribers/{AETitle}
<u>OpenEventChannel</u>	6.9.10	GET {+WSSERVICE}/subscribers/{AETitle}
<u>SendEventReport</u>	6.9.11	N/A

See DICOM PS3.18 for details

Kinson Ho, Architect - Agfa HealthCare
IHE Radiology Technical Committee Co-Chair
kinson.ho@agfa.com

Thank you for your attention!