



DICOM Supplement 106: JPEG 2000 Interactive Protocol

**Lev Weisfeiler
Aware, Inc.**

**DICOM 2005 International Conference
September 26-29, 2005**



 **A W A R E**



JPEG2000 Background

- What is JPEG 2000?
 - Multi-part standard published by ISO SC29/WG1
 - Part 1: Base standard
 - Part 2: Extensions to Part 1
 - Parts 3-12: motion, compliance, wireless, security, etc.
- DICOM Supplement 61: JPEG 2000 Part 1
 - Final Text in January 2002
 - Lossless and Lossy compression
 - Progressive and embedded spatial and contrast resolution
 - Progression from lossy to lossless reconstruction
 - Regions of interest



What is JPIP?

- JPEG2000 Interactive Protocol (JPIP)
 - Part 9 of the JPEG2000 standard
 - Designated by ISO/IEC 15444-9
 - “Interactivity Tools, APIs and Protocols”

- The blueprint for the best usage of JPEG2000 functionality in a distributed application environment

- Framework for efficient communication between a client and a server
 - Partial or whole image codestreams
 - Metadata exchange



JPIP Features

- Defines a client server protocol for exchanging
 - Partial or whole JPEG2000 images
 - Metadata or other image information

- Image data is exchanged by:
 - Client making a request for a specific region of the image at a particular resolution, quality, etc.
 - Server replies by sending either:
 - Full images
 - Tiles
 - Incremental JPEG2000 data (precincts)

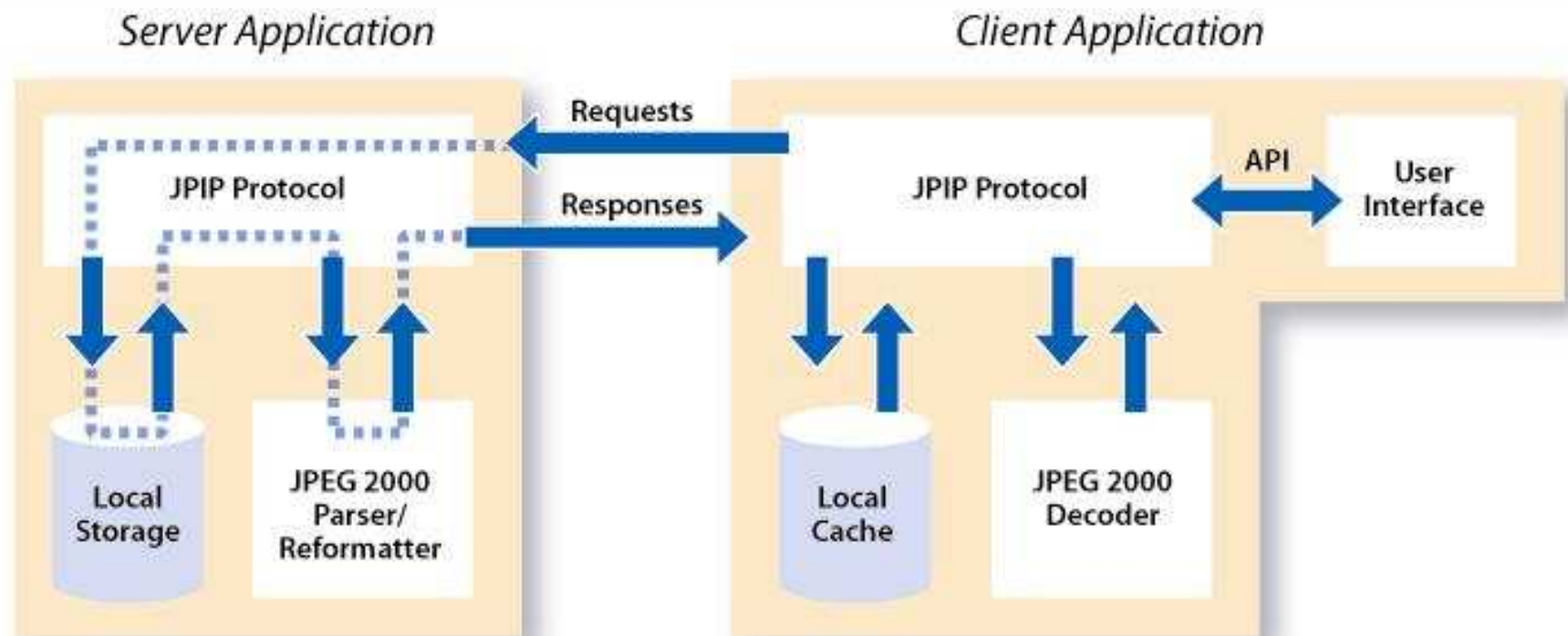


Why is JPIP Useful?

- It provides standard-based image streaming for medical systems
- Can provide interoperability between standard-compliant systems from different vendors
- Standards based systems are
 - Less expensive
 - Easier to maintain
 - Promote data sharing and system level data exchange



JPIP Application Block Diagram





How Best To Support The Complex Codestream?

- Can be Layered on HTTP, HTTPS or UDP
- Protocol features negotiated between the client and the server during handshake
- Image Data is Streamed from the Server
- Image Data is Cached on the Client
- Partial image decoding and “View Window” support

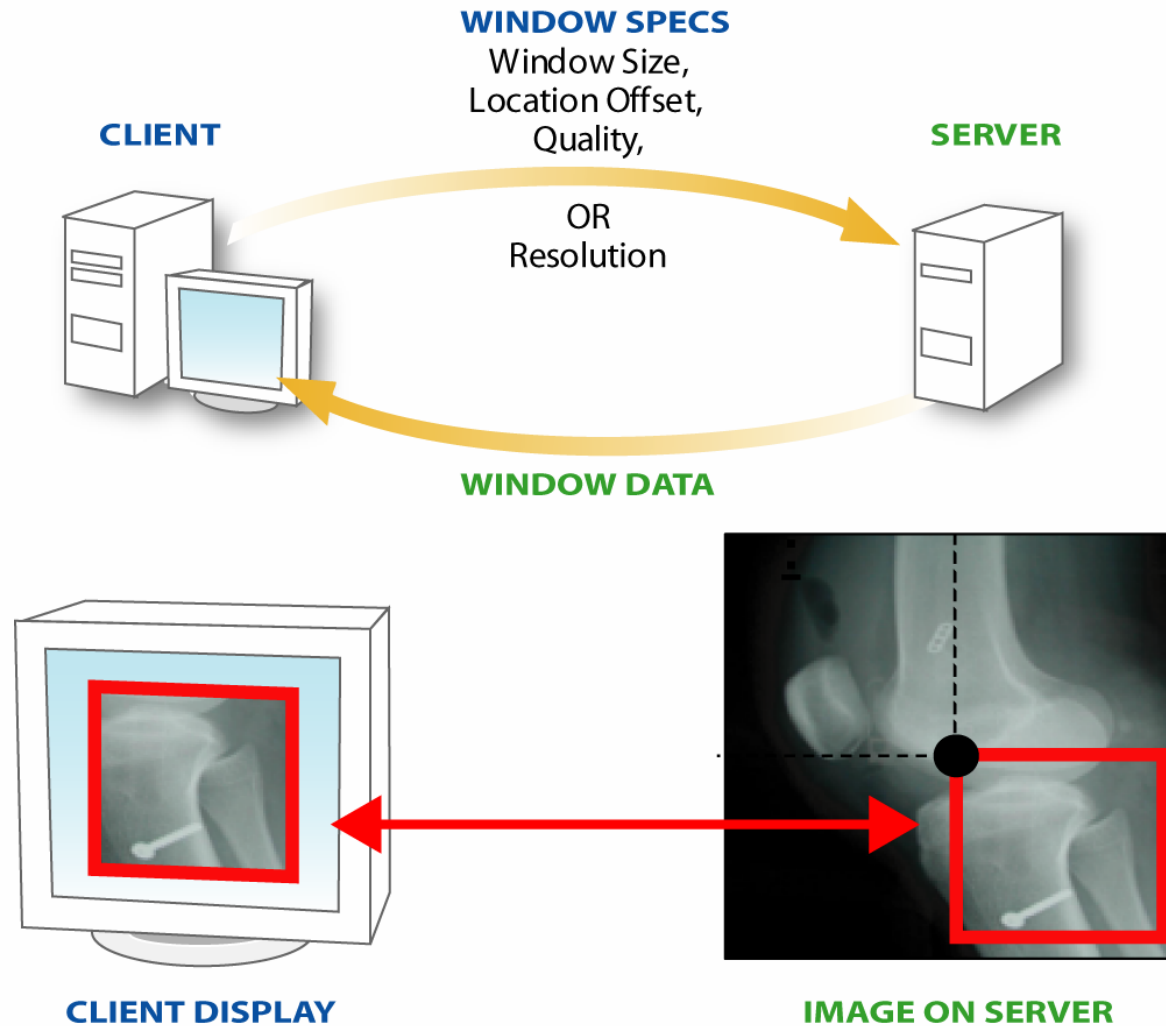


JPIP Streams

- Based on a JPIP-specific structure called “data bins”
- Two types of data bins
 - Tile: “JPT” Stream
 - Precincts: “JPP” Stream
- Tiles: A single image is treated as a collection of images
 - Each tile can be randomly accessed and decoded
- Precincts: Small rectangular sub-regions within each resolution level
 - Provides rectangular Region-of-interest decode



JPIP Requests: View-Window



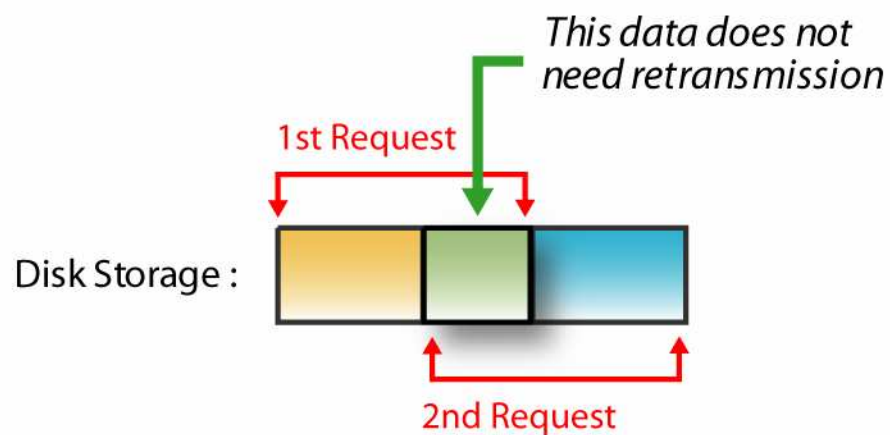
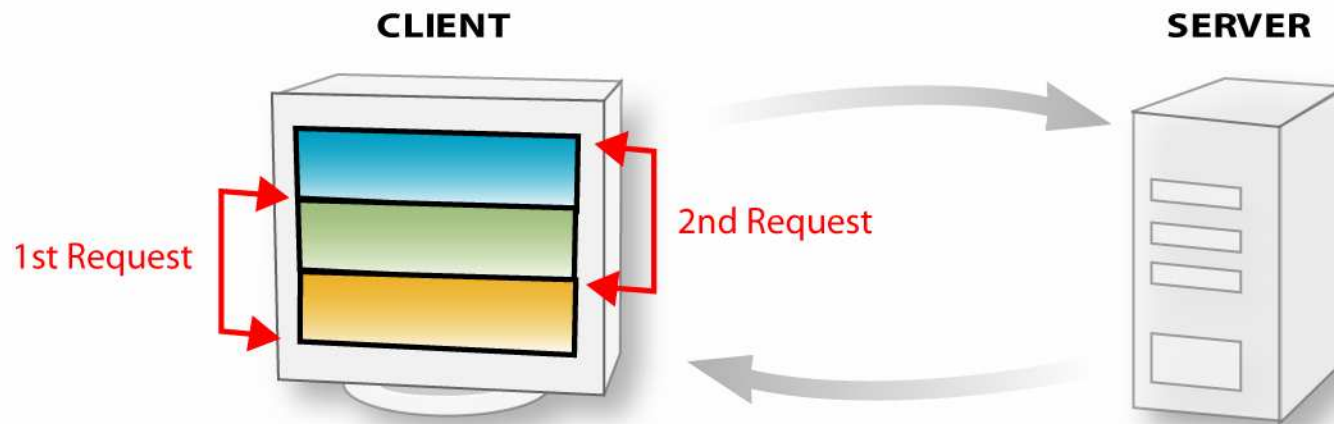


JPIP Caching Description

- Server-side
 - Server has a description of client cache (“cache model”)
 - Server doesn’t send data already in the client cache

- Client-side cache
 - Storage of JPIP data bins
 - Caching is client-driven: cache status updates sent to the server

JPIP Caching Diagram





Motivation for JPIP: DICOM Use Cases

- Stack Navigation of a large CT study
 - Low resolution preview
 - Full fidelity imagery available on demand
- Large Single Image Navigation
 - Pan/Zoom region of interest at display resolution
- Thumbnail Representation for a Study
 - Sub-resolution image easily extracted
- Display by Dimension
 - Random access to individual frames of a large enhanced multiframe object



DICOM and JPIP

- October 2004: Work started on drafting a supplement to include JPIP in DICOM
- January 2005: First draft of Supplement 106 “JPIP”
- March 2005: Supplement 106 approved for public comment through August 1
- Comments will be addressed after the DICOM Standards Committee meeting on September 29

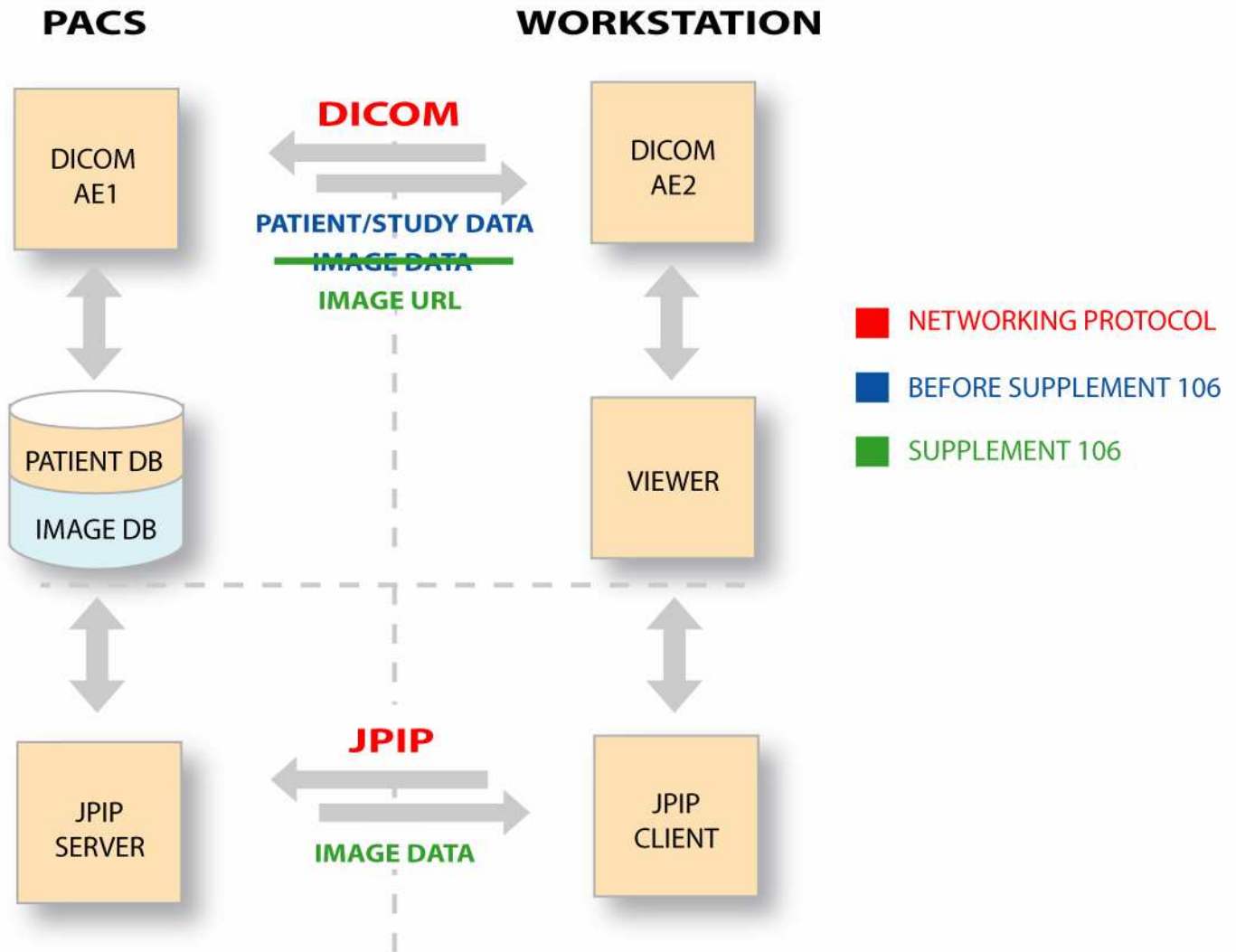


DICOM with JPIP: Supplement 106

- Pixel data is replaced with JPIP Image URL
 - New Transfer Syntax is defined
 - Pixel data is available from the JPIP server
- Image data is streamed via JPIP protocol
- Study and Patient data is transferred via DICOM



DICOM with JPIP: Diagram



DICOM with JPIP: Prototype Application

The screenshot displays the JPIPDemo_Scu application interface. The window title is "JPIPDemo_Scu".

Menu

Connection options :

- Remote application title: MERGE_JPIP_SCP
- Remote Port: 104
- Remote HostName: 192.168.60.27
- Use DICOM secure Connections
- Change options

Model: Patient Level: Image FIND >>

Fields	Values
Patient ID	15 29 06
Patient Name	Quark*Susan
Study Instance UID	1.2.276.0.45.123.347269617357.200111301100...
Study Date	19970430
Study Time	084615
Accession Number	
Study ID	24074
Series Instance UID	1.2.276.0.45.123.347269617357.200111301100...
Modality	CT
Series Number	2
SOP Instance UID	1.2.276.0.45.124.347269617357.200111301100...
Image Number	2

Patients

- Quark*Susan
 - 19970430
 - CT
 - 2

Quick view :

Load >>

http://192.168.60.27:8080/1.2.276.0.45.124.347269617357.20011130110010.635.j2k

Log:

```
Sending the C-FIND request.
We have a PATIENT_ROOT Model, PATIENT Level
Find Response is C_FIND_SUCCESS
Sending the C-FIND request.
We have a PATIENT_ROOT Model, STUDY Level
Find Response is C_FIND_SUCCESS
Sending the C-FIND request.
We have a PATIENT_ROOT Model, SERIES Level
Find Response is C_FIND_SUCCESS
Sending the C-FIND request.
We have a PATIENT_ROOT Model, IMAGE Level
Find Response is C_FIND_SUCCESS
Sending the C-MOVE request.
Association request received from MERGE_JPIP
Storage Association released by the SCU.
```




Future Directions

- Combine functionalities of Supplements 105 and 106 to use JPIP to browse volumetric data
- Sub-resolution decoding in third dimension to quickly browse volumes
- Component collections to enhance performance