DICOM Supplement 106: JPEG 2000 Interactive Protocol

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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

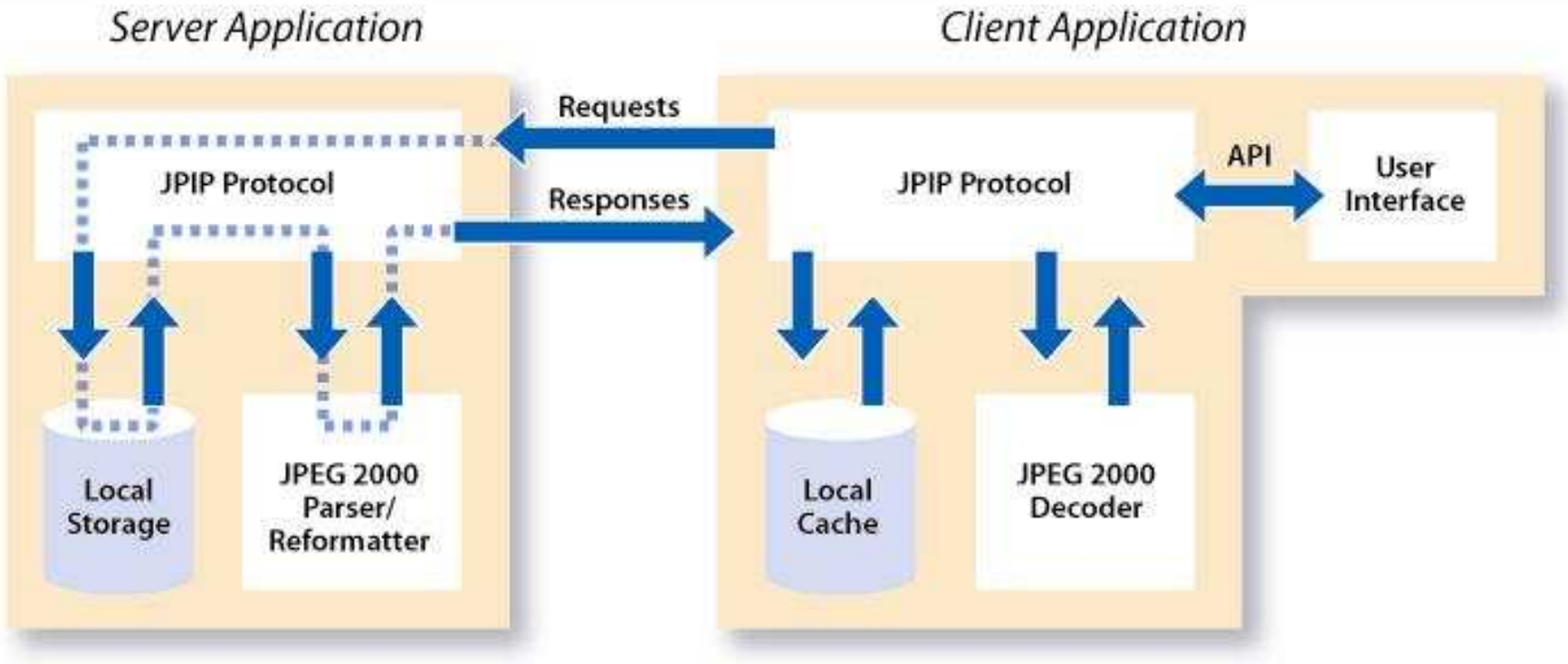
JPIP Features

- 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



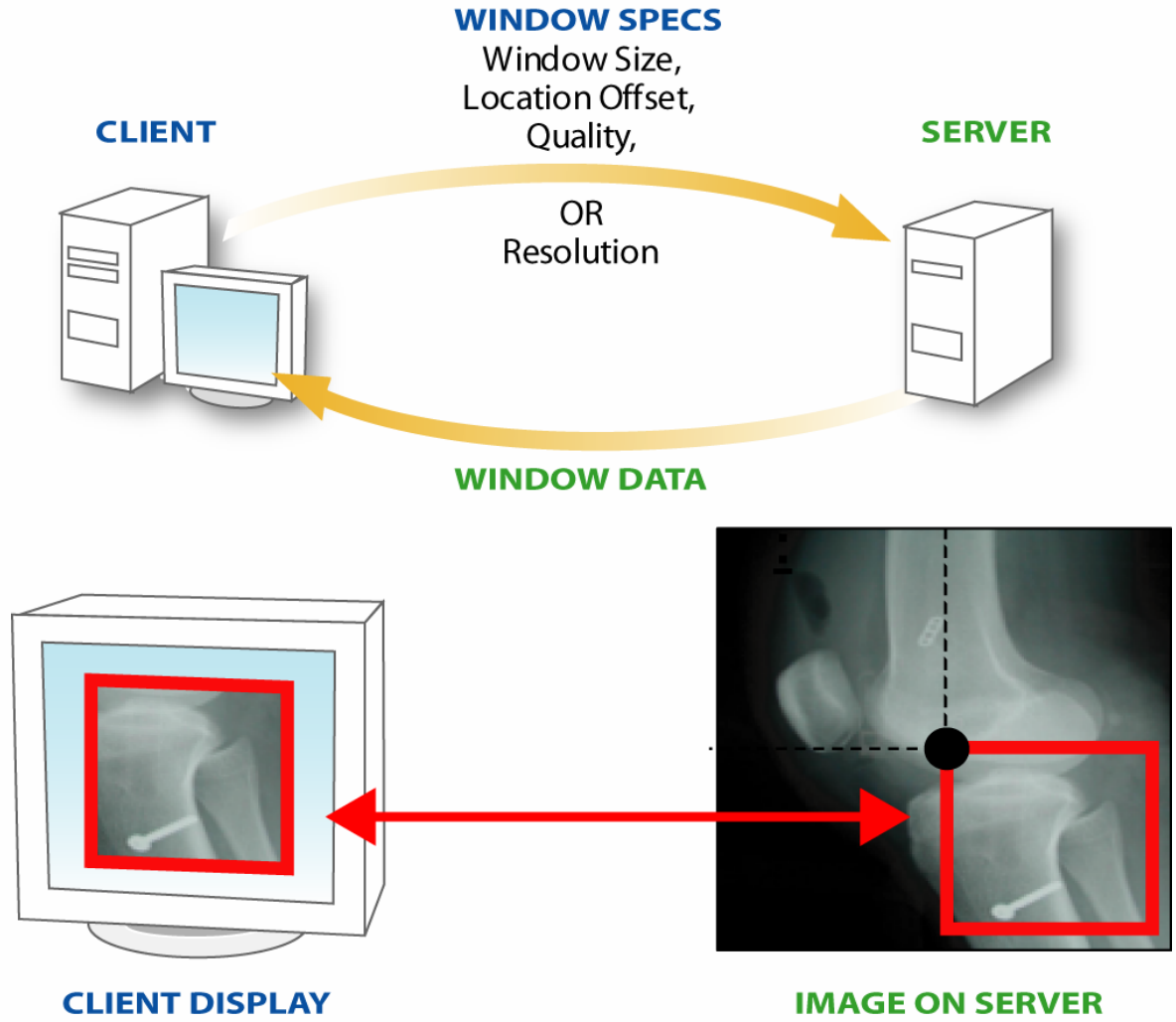
How Best To Support The Complex Codestream?

- 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

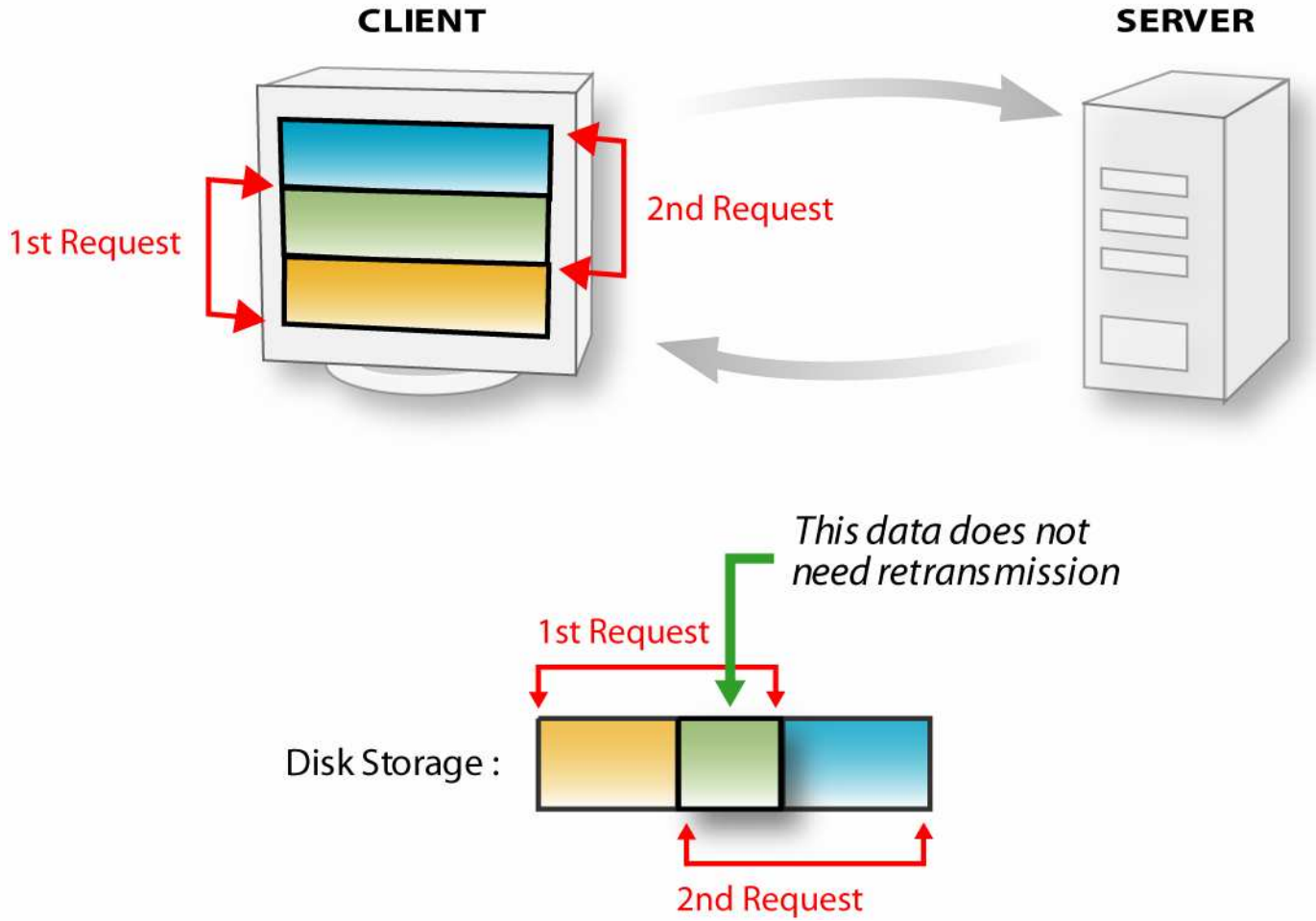
JPIP Requests: View-Window



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

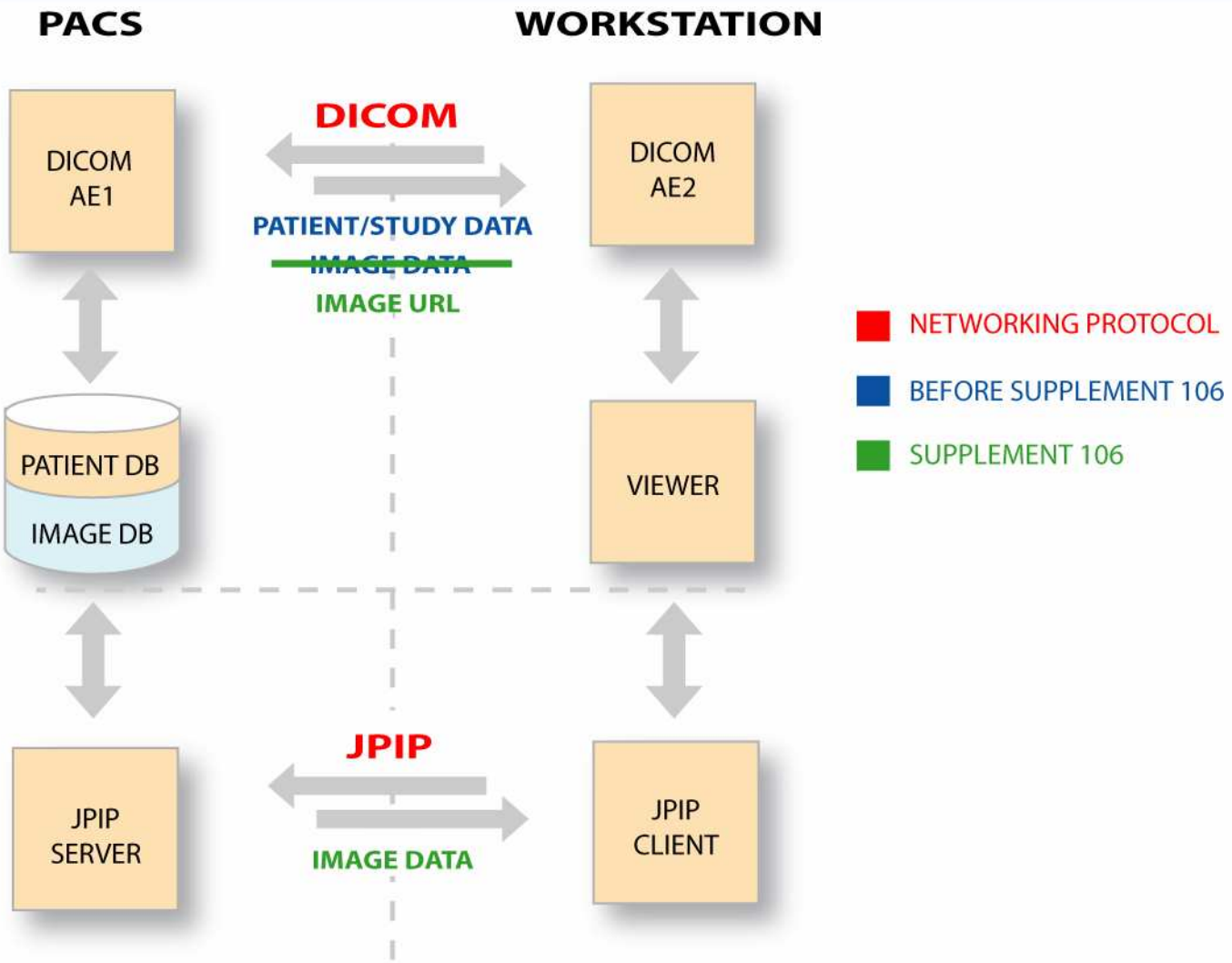
DICOM and JPIP

- 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

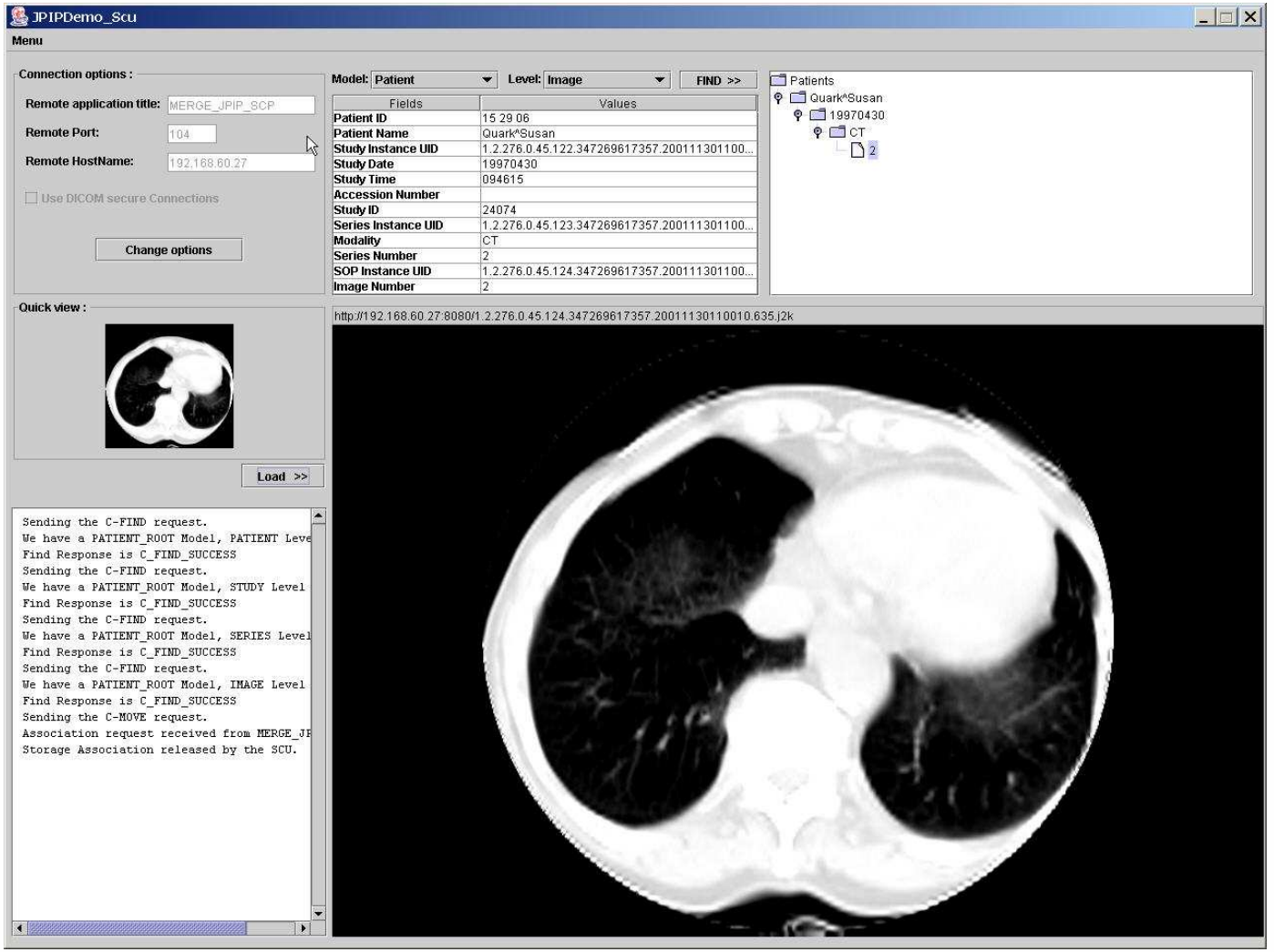
DICOM with JPIP: Supplement 106

- 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



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