

DICOM, NEMA and IHE

Activities Related to Oncology Clinical Trials

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Overview

- Images and RT Objects
- Enhanced CT and MR - new objects
- NEMA promotion of new CT/MR
- New PET activities
- IHE Teaching File and Clinical Trial Profile

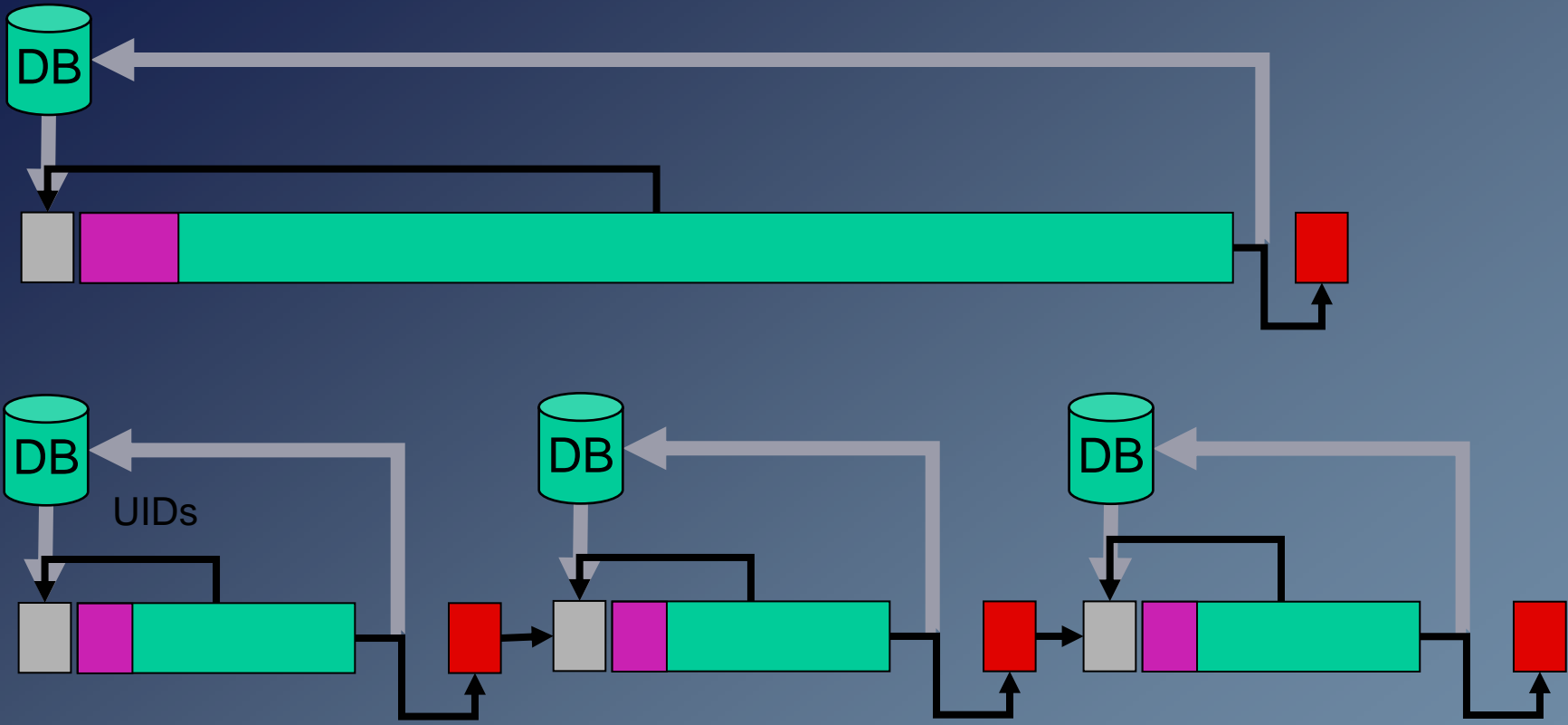
Greater Expectations

- Previously, users content with viewing + annotations
- Increasingly advanced applications
 - Hanging protocols, MPR, 3D, virtual colonoscopy
 - Perfusion, diffusion, functional MR, spectroscopy
 - Cardiac cine, CT and MR fluoroscopy
 - Lung CAD
- Such applications are often vendor-specific
 - Performed on console or same vendor's workstation
 - Depend on private attributes
- Want advanced application interoperability
- Support in multi-vendor PACS workstations
- Distributing “screen saves” on PACS insufficient

Why are new objects needed ?

- CT and MR objects more than 10 years old
 - Technology on which they are based probably more than 15 years old
- Pre-date many technological advances
 - Helical CT & fast spin echo pulse sequences
- Explosion in data set size -> performance ?
 - Multi-detector CT and functional MR
- Expectations beyond simple viewing
 - Hanging protocols & advanced applications

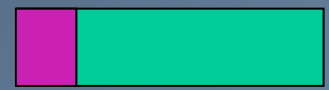
A
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Store, parse, check



C-Store request

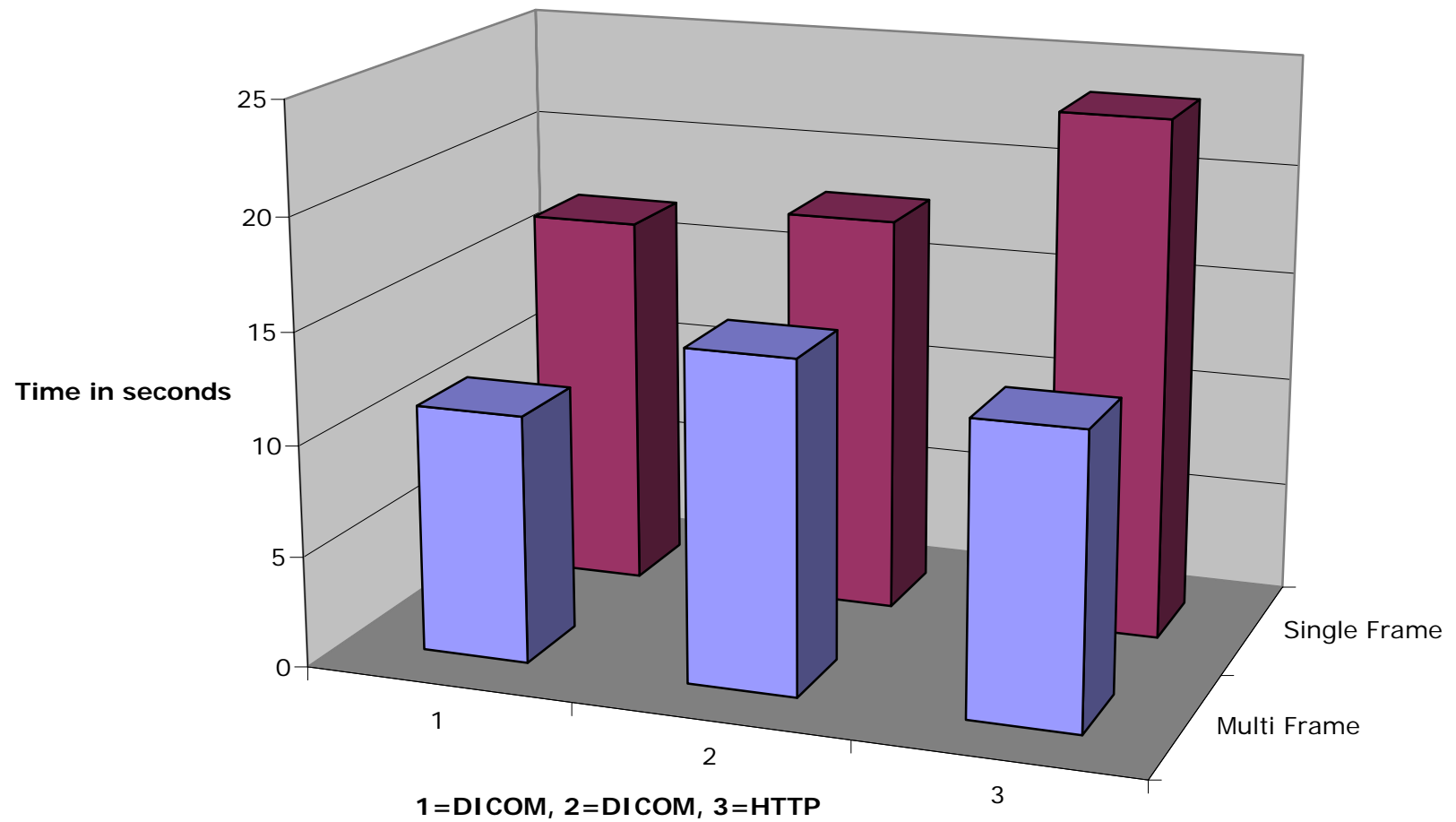


Dataset (attributes+pixels)



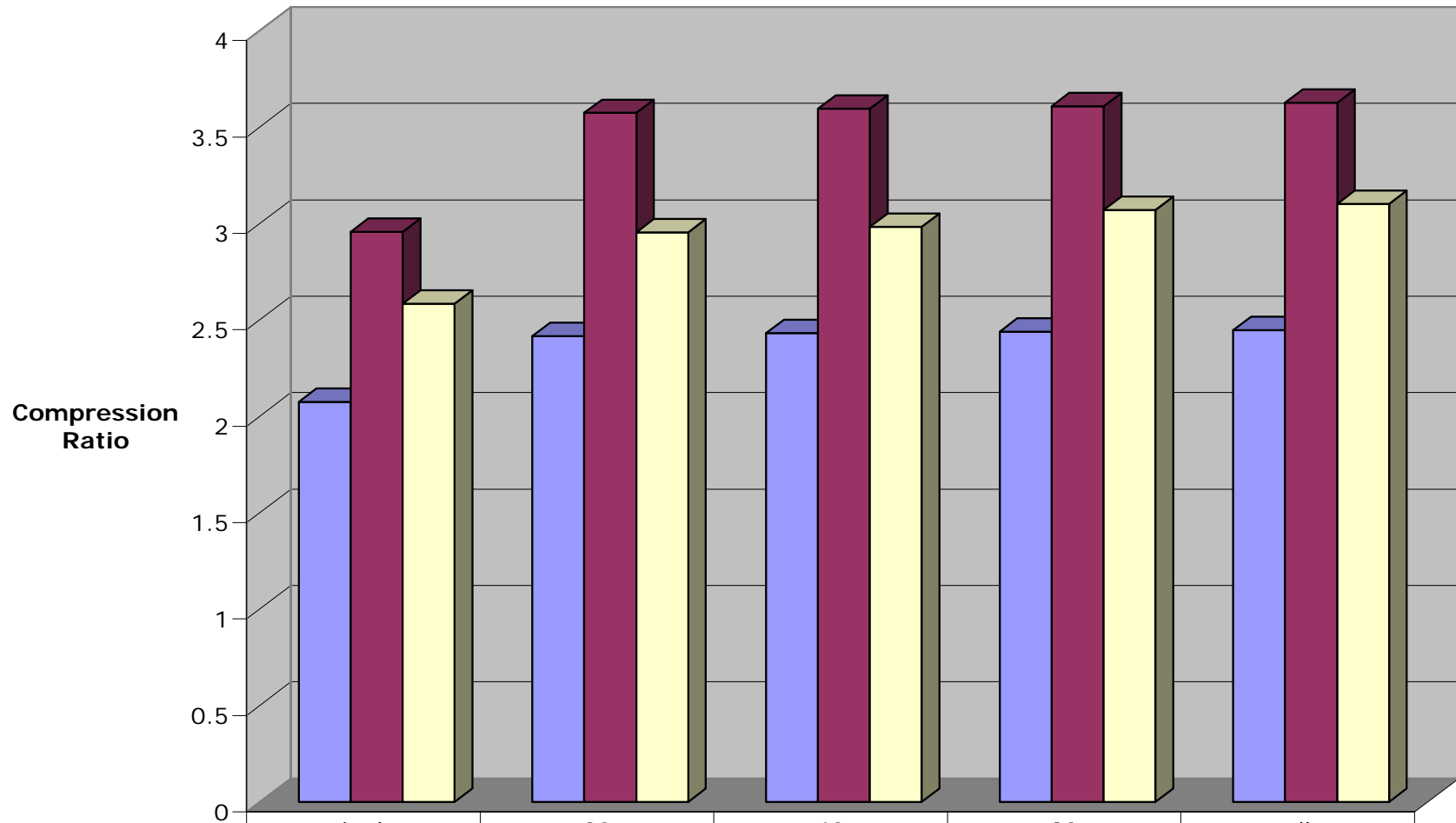
C-Store response (acknowledgement)

CTA - 548x512x512 (275MB) File read/transfer/save (GB Ethernet)



	1	2	3
Multi Frame	11.14111111	14.86703704	13.07333333
Single Frame	16.905	17.97	23.42666667

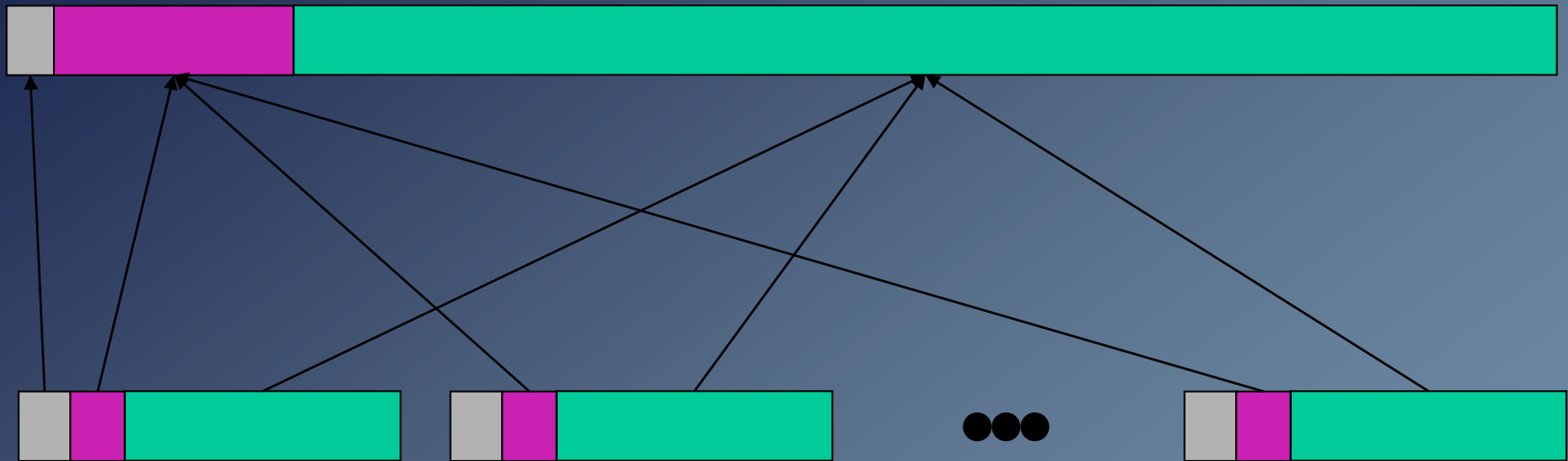
Lossless JPEG 2000 Compression (Alexis Tzannes, Aware, 2003)



	single	20	40	80	all
127x256x8 7.9MB	2.073490814	2.415902141	2.430769231	2.438271605	2.445820433
449x512x16 224MB	2.955145119	3.572567783	3.595505618	3.607085346	3.624595469
620x512x16 310MB	2.583333333	2.952380952	2.980769231	3.069306931	3.1

Slices in 3rd dimension

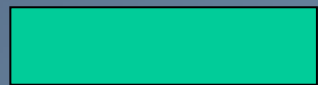
Multi-frame Functional Groups



Shared attributes



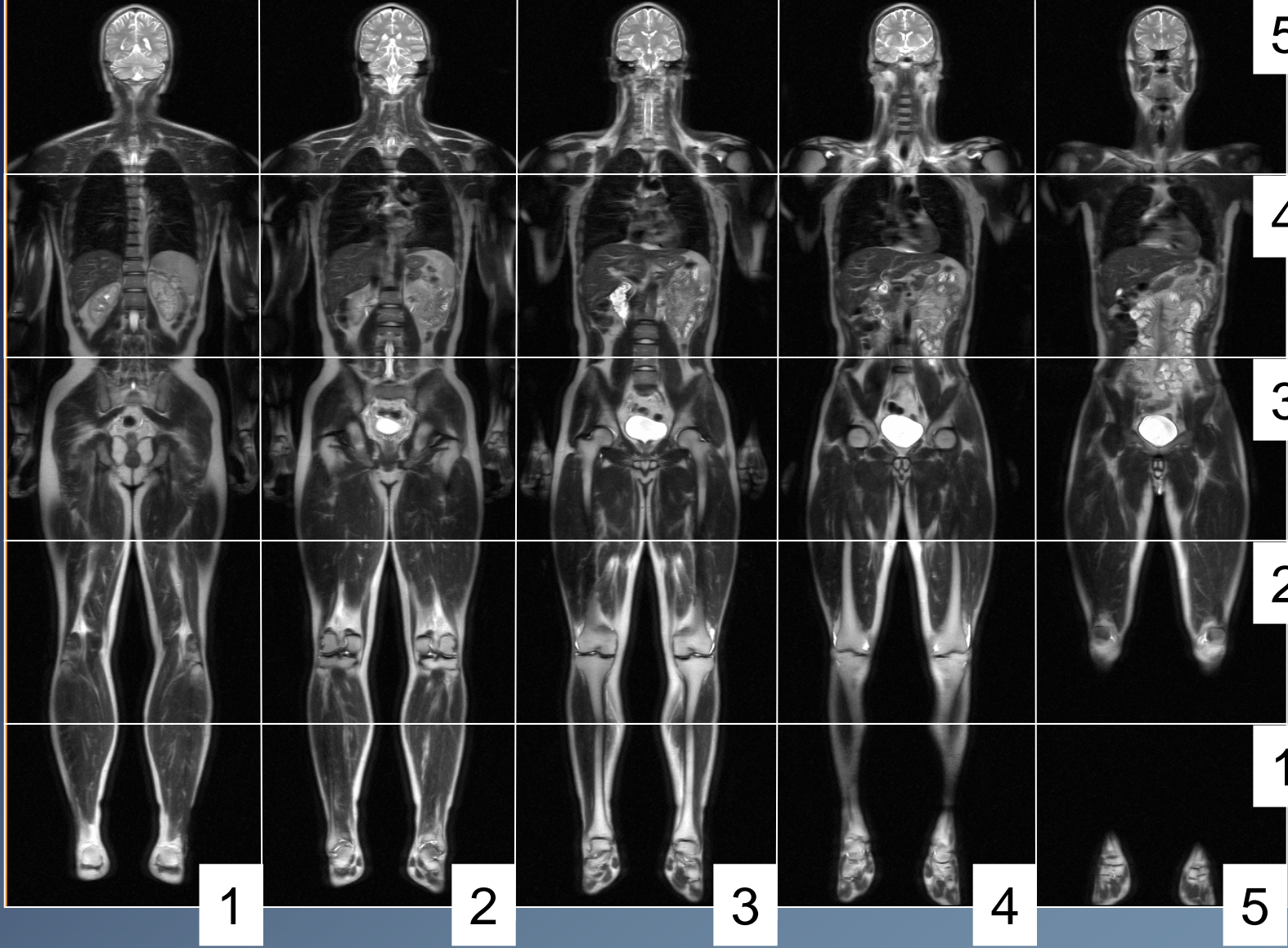
Per-frame attributes



Pixel data

Technique Attributes & Terms

	CT		MR	
SOP Class	Original	Enhanced	Original	Enhanced
Attributes (Mandatory)	18 (0)	41 (39)	44 (2)	103 (94)
Terms (Enumerated)	4 (2)	86 (18)	38 (9)	228 (47)



Stack ID



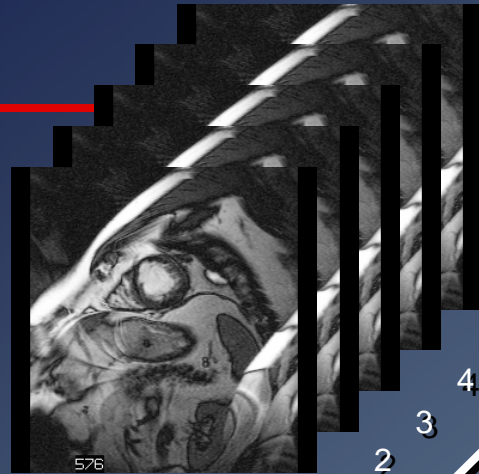
In-Stack Position

Trigger
Delay
Time

Temporal
Position
Index

48 ms

2



In-Stack Position

Stack ID = 1

1 \ 5 \ 2

Dimension
Index
Values

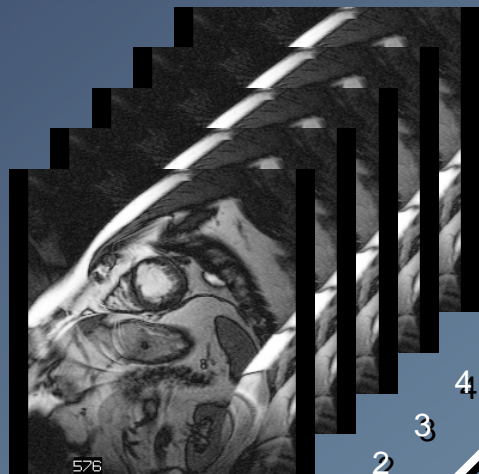
1\5\2
1\4\2
1\3\2
1\2\2
1\1\2

Dimension Index Pointers:

1. Stack ID
2. In-Stack Position
3. Temporal Position Index

0 ms

1



In-Stack Position

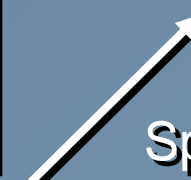
Stack ID = 1

1\5\1
1\4\1
1\3\1
1\2\1
1\1\1

Time (2)



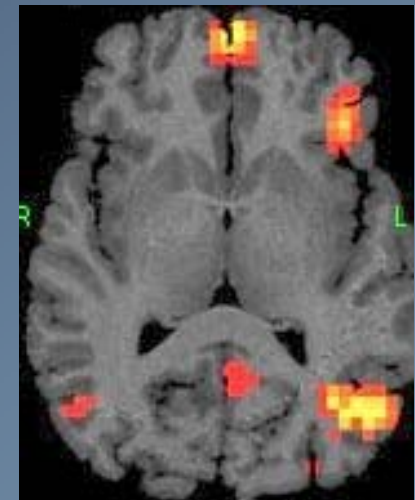
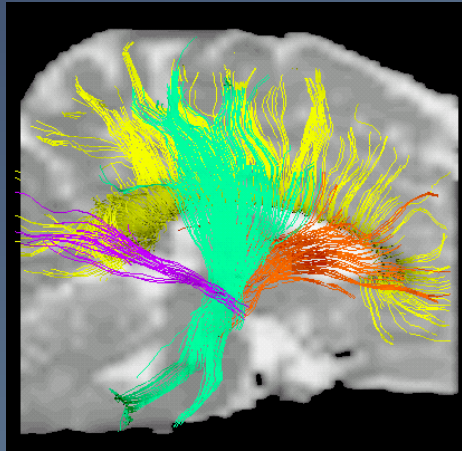
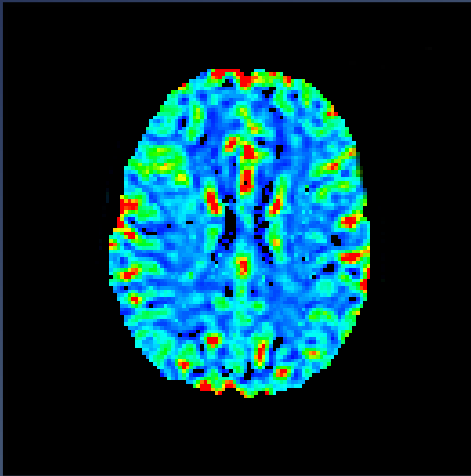
Space (1)



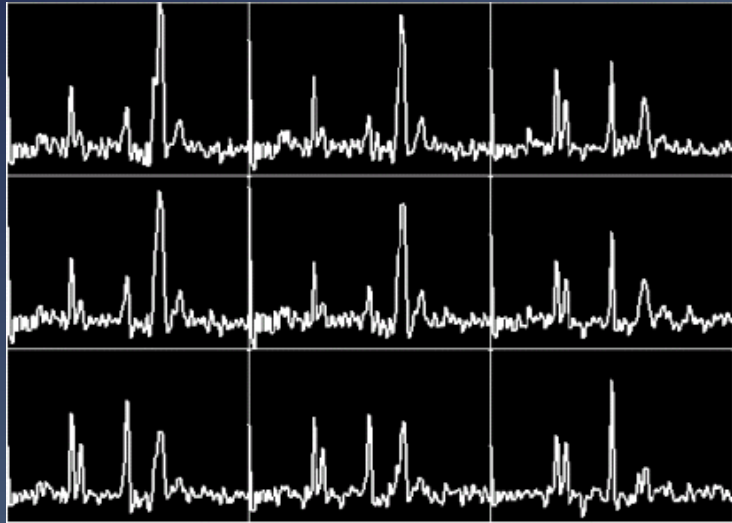
Organization of Data

- Goal is to reduce the work that the receiving application has to do to “figure out”
 - How the data is organized
 - Why it is organized that way
- Without preventing use of the data in unanticipated ways
 - E.g. 3D on a dataset not intended as a volume
- Two levels
 - The detailed shared & per-frame attributes
 - The overall dimensions, stacks and temporal positions

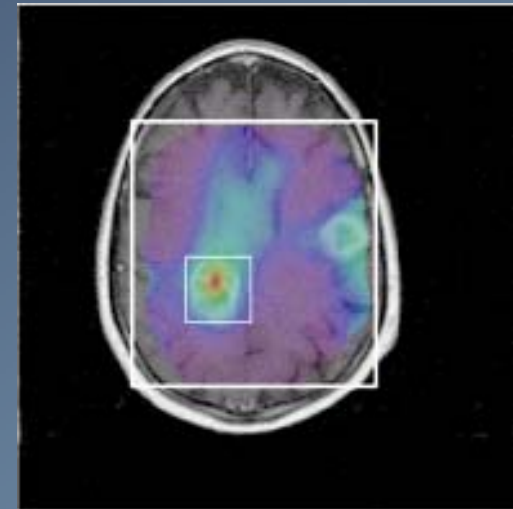
Color Information



Spectroscopy

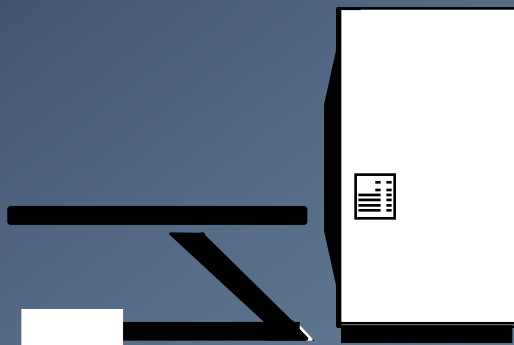


Storage of
Spectroscopy Data

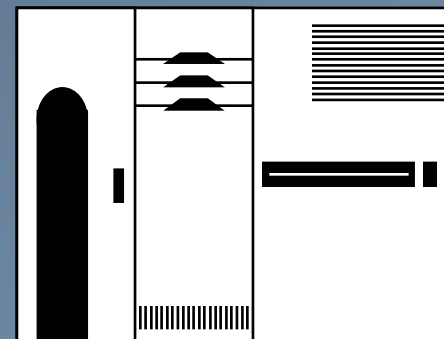


Metabolite Maps

But when ?



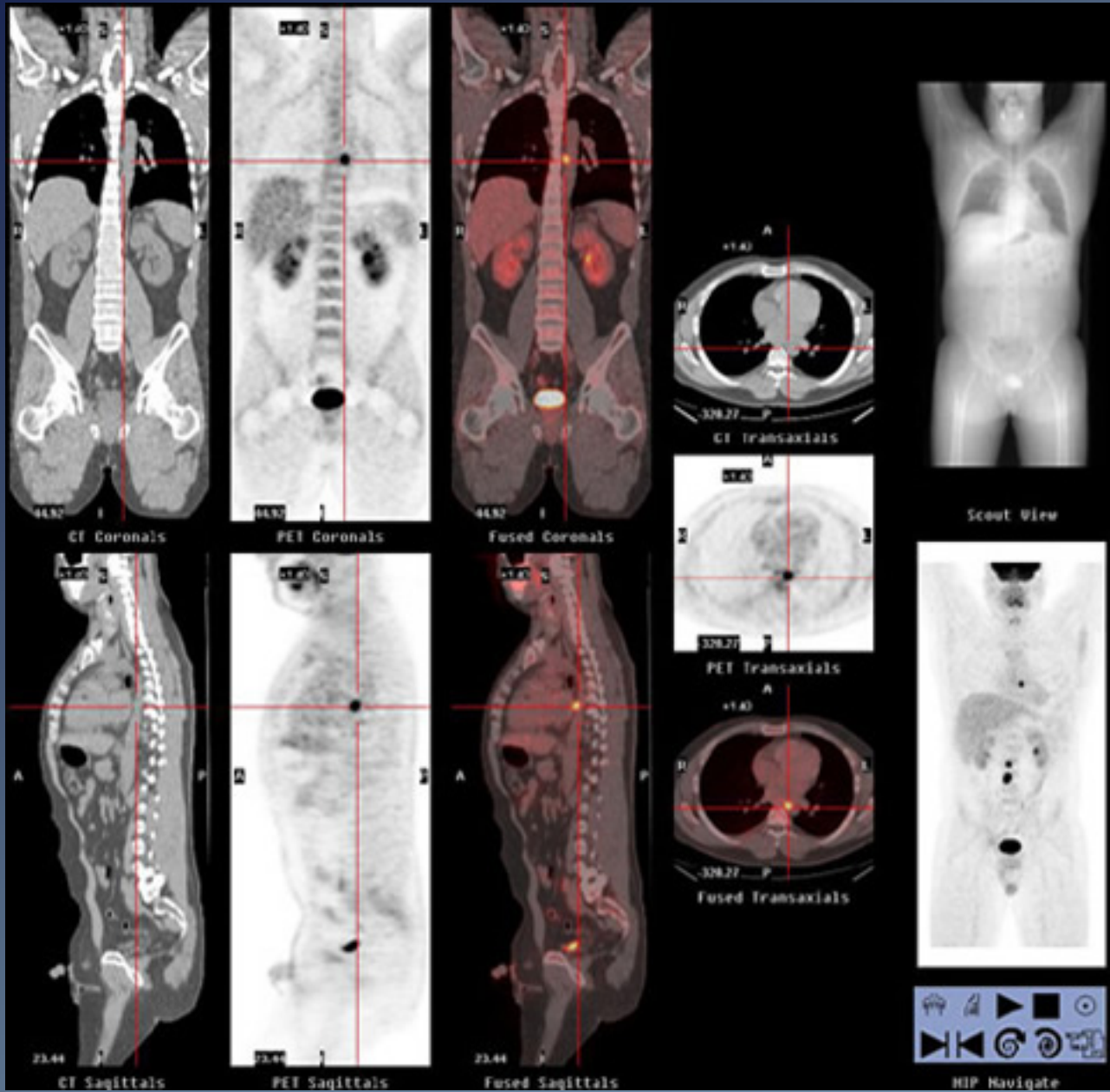
Modality



PACS

NEMA Initiatives

- MR test tools, images and spectra available
- CT test tools and images in development
- Open Source Java + DICOM images
- Includes validator - ensure object correctness
- Implementation testing & demonstration
 - Jun 2005 - SCAR demonstration (Orlando)



Not Just MR & CT ?

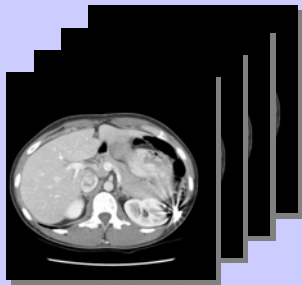
- Need for new multi-frame PET object
 - Currently single slice
 - Much renewed interest in PET-CT fusion
 - Decision to develop new multiframe PET IOD
- X-ray angiography work in progress
 - Support for digital detectors
 - New acquisition types
 - Tomosynthesis

CT-PET Enhancements

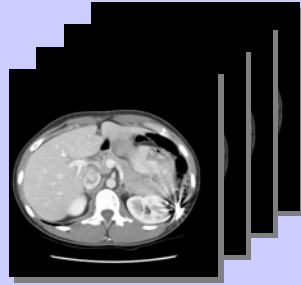
- Registration
 - Spatial Registration object
 - Fiducials objects
- Fusion
 - Blended Color Presentation State object

Blending for CT-PET

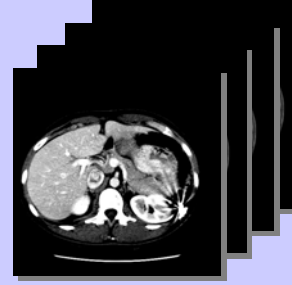
select
underlying



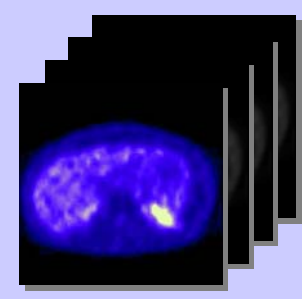
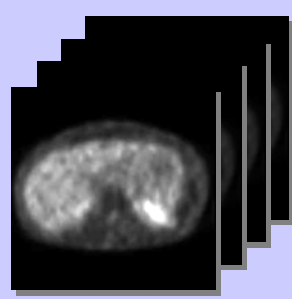
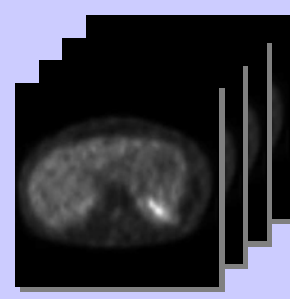
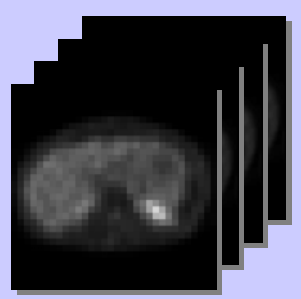
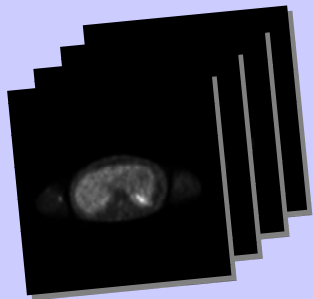
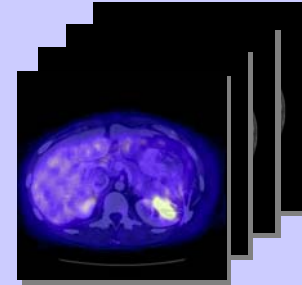
[register]



rescale and
window



blend



select
superimposed

resample

within slices

[between slices]

pseudo-color

Getting Images from PACS

Standard Boundary

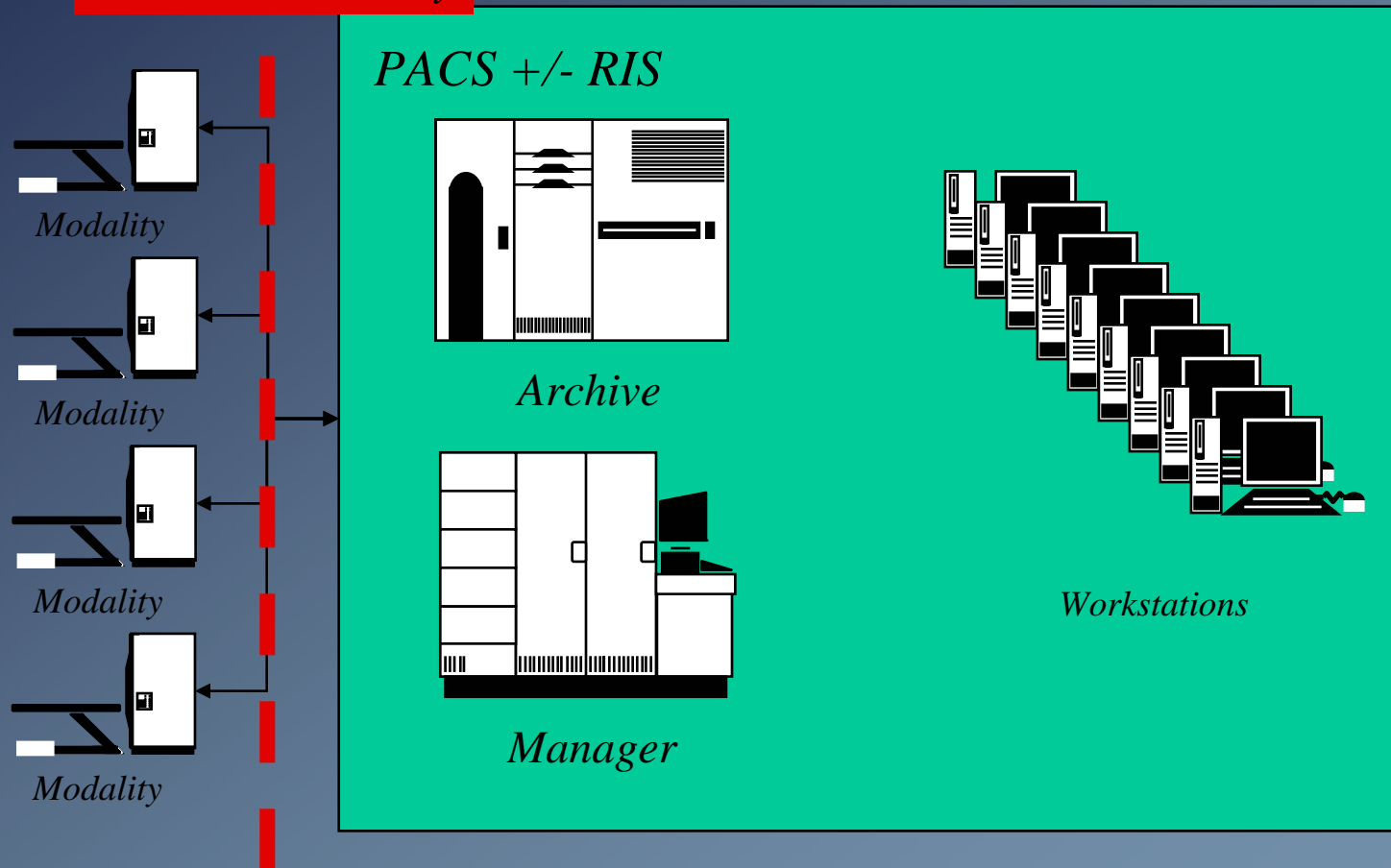
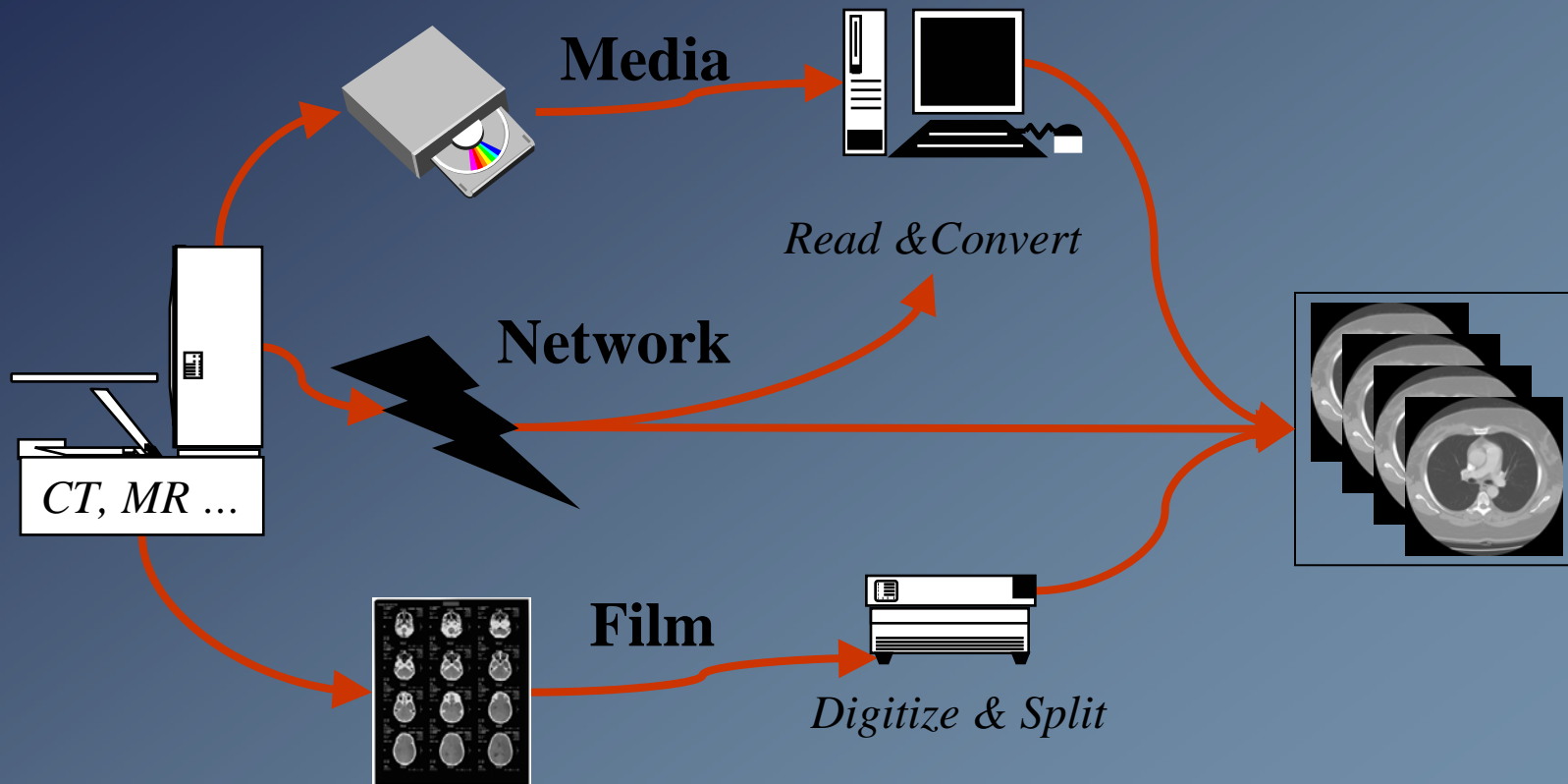
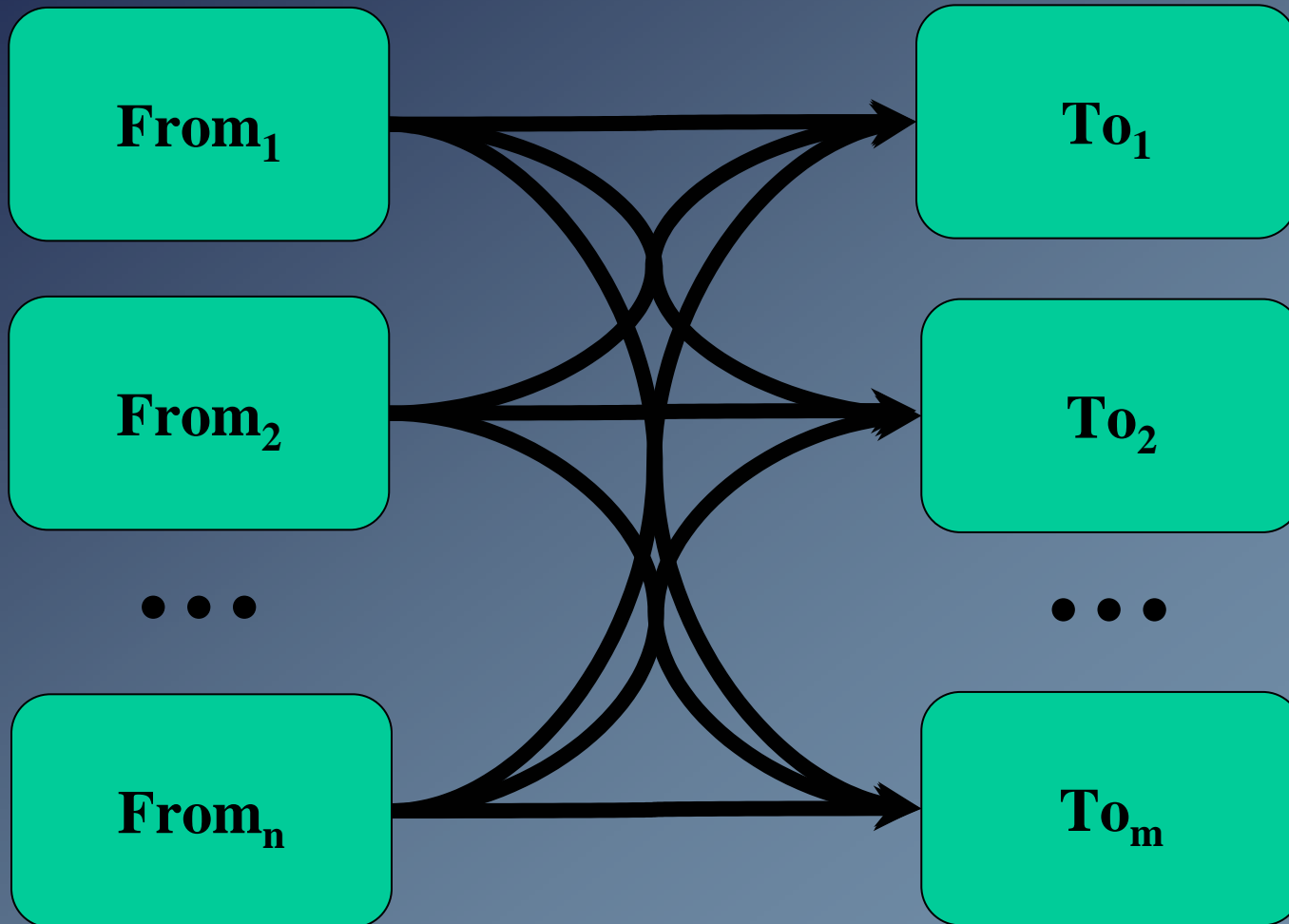


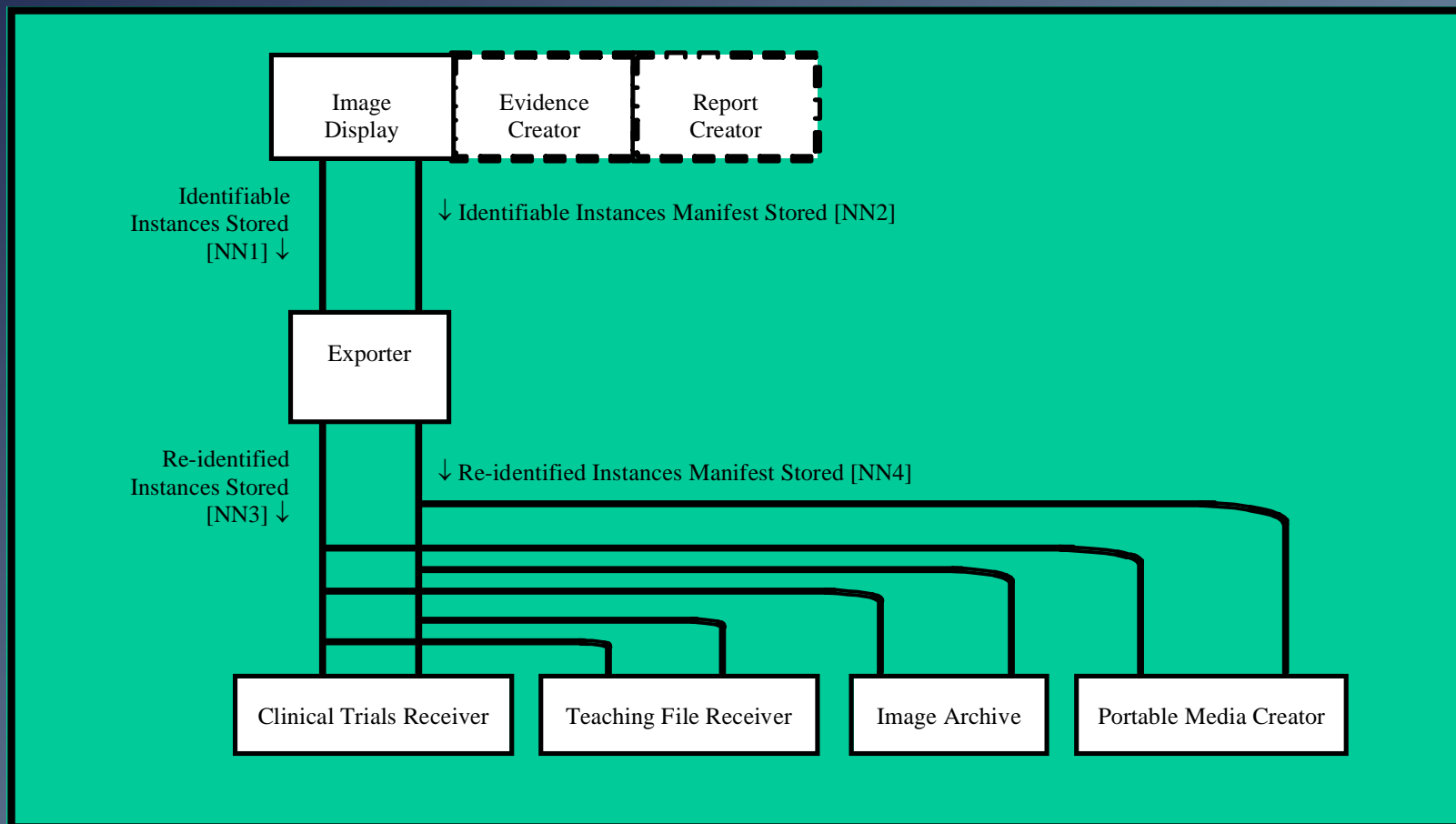
Image Transfer from Sites



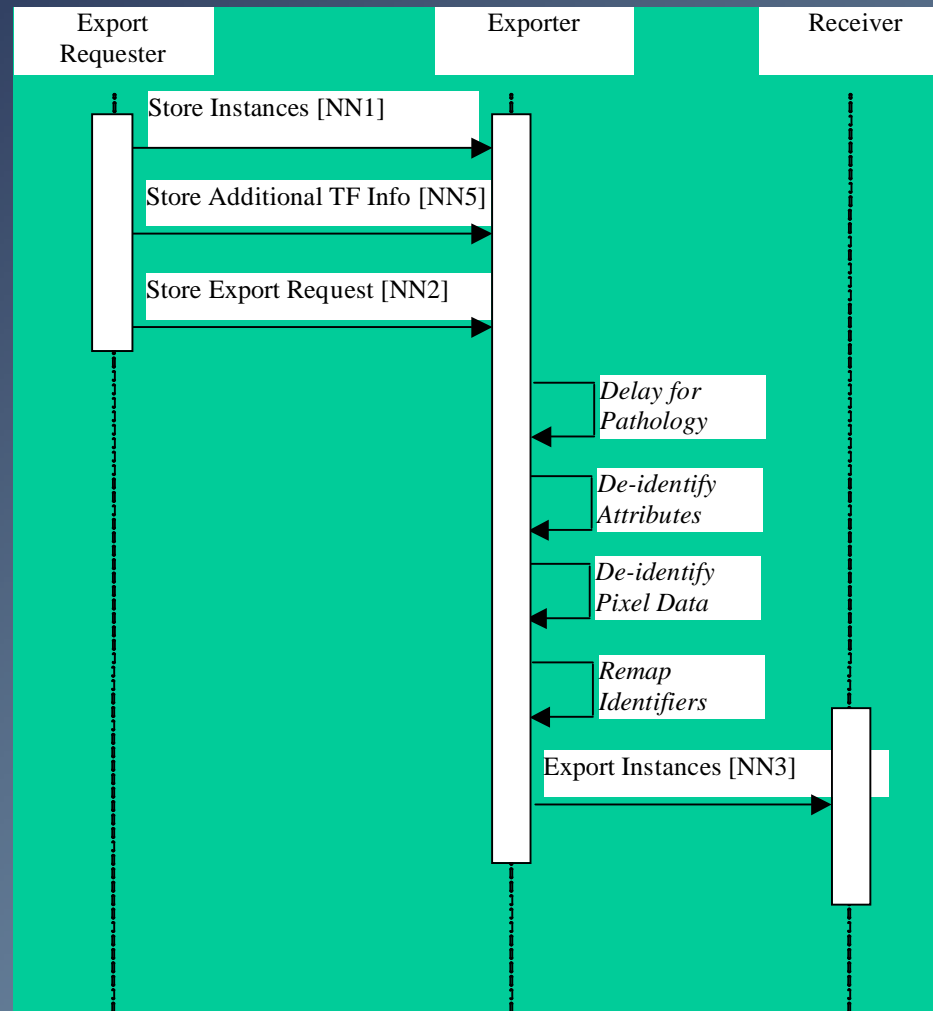
n:m problem ... sites & trials



IHE Teaching File and Clinical Trial Export Profile



IHE Teaching File and Clinical Trial Export Profile



IHE Teaching File and Clinical Trial Export Profile

- Selection (export request)
 - De-identification (header +/- pixel data)
 - Remapping to replacement identifiers
 - Algorithmic or with enrollment list
-
- Key goal is to encourage PACS vendors to support research/clinical trials/teaching
 - Avoid need for trial-specific “boxes” in sites