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Organizing MRI Data by using Enhanced Multi-Frame objects

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Introduction

Multi Volume

New “Dimensions”

Increasing numbers

Enhanced Multi-Frame objects

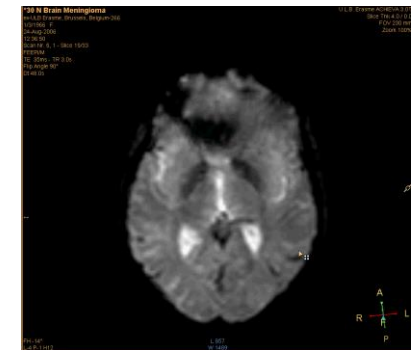
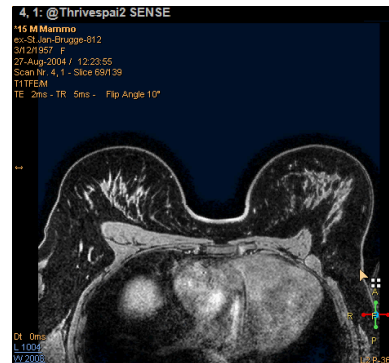
Conclusions

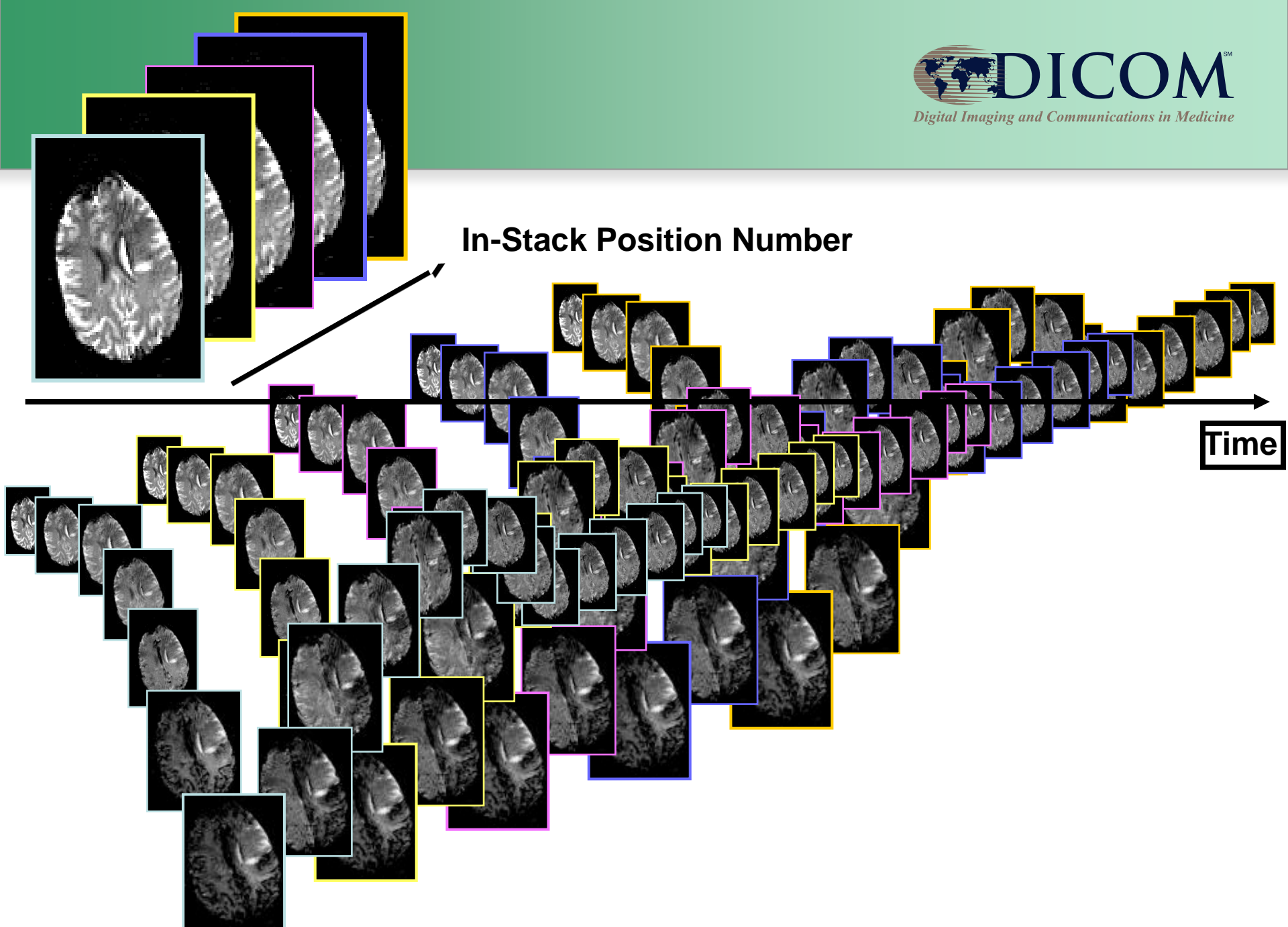
MRI DICOM data

- **Is complex due to the number of dimensions**
- **Gets more complex through Innovations in Acquisition techniques adding dimensions**
- **Increasing number of images makes it more difficult for viewing stations**
- **Synchronous Network protocol too slow to handle the increasing numbers**

One Volume acquired more than once.

- Time studies like Cardiac
- Multi Echo
- Perfusion
- Diffusion
- Arterial Spin Labeling
- Functional





MR is still developing new Techniques

→ Often adding extra Dimensions

- **Arterial Spin Labeling**
Standardized in 2009
- **Dixon images same volume different contrast**
NOT yet part of standard

1980:

- **Single image took 5 minutes to acquire and 15 minutes to reconstruct, 128^2**
- **No network export available at that time**

1986:

- **64 Slices acquired within 2 minutes, reconstruction of a 256^2 slice in 5 seconds**
- **Local Storage, no networks yet**

2013:

- **350 slices acquired in 1 minute, reconstruction of 256^2 total set in 8 seconds**
- **Central storage, transfer time 35 sec**

Numbers for different Studies

- **10.000 to 64.000 images 128^2 in a scan for functional MRI**
- **> 1 Gb of DICOM data in a Mammography study**

How to keep this manageable

- **Communication 64K takes ≥ 3 hours**
- **Processing is needed before viewing**

Structure:

- **Generic Header**
 - Patient, Study, Series information
- **Image, Frame information**
 - Shared Frame sequence containing information applicable for all frames
 - Per-Frame sequence containing specific information for each frame

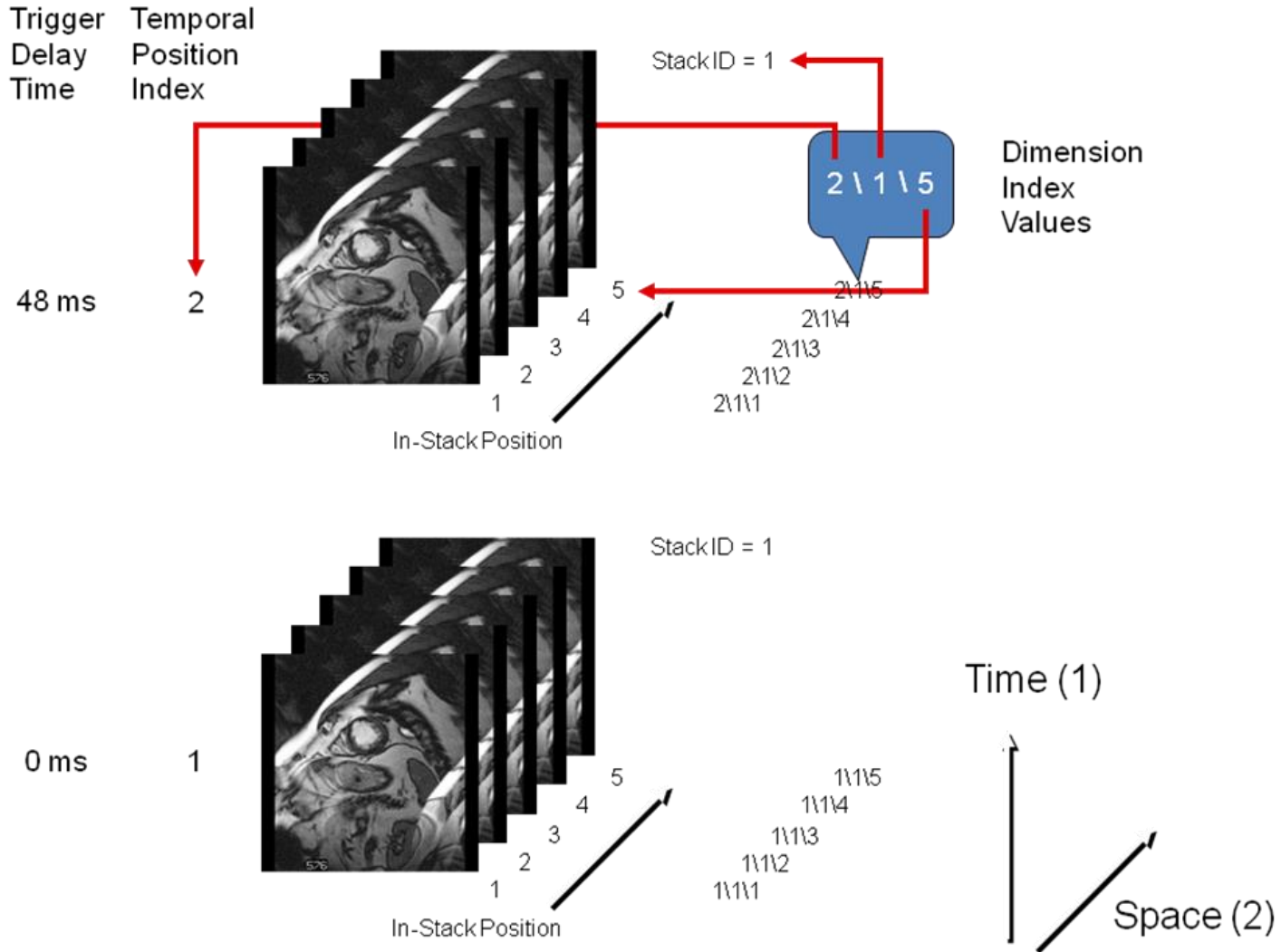
Be aware most Functional Groups are NOT fixed to the Shared or Per-Frame Sequence !

Dimension Organization:

- **At series level the Dimension Index Sequence (0020,9222) defines which Attributes are used for indexing the frames**

- **At frame level the Dimension Index Values (0020,9157) specifies the index values per Frame**

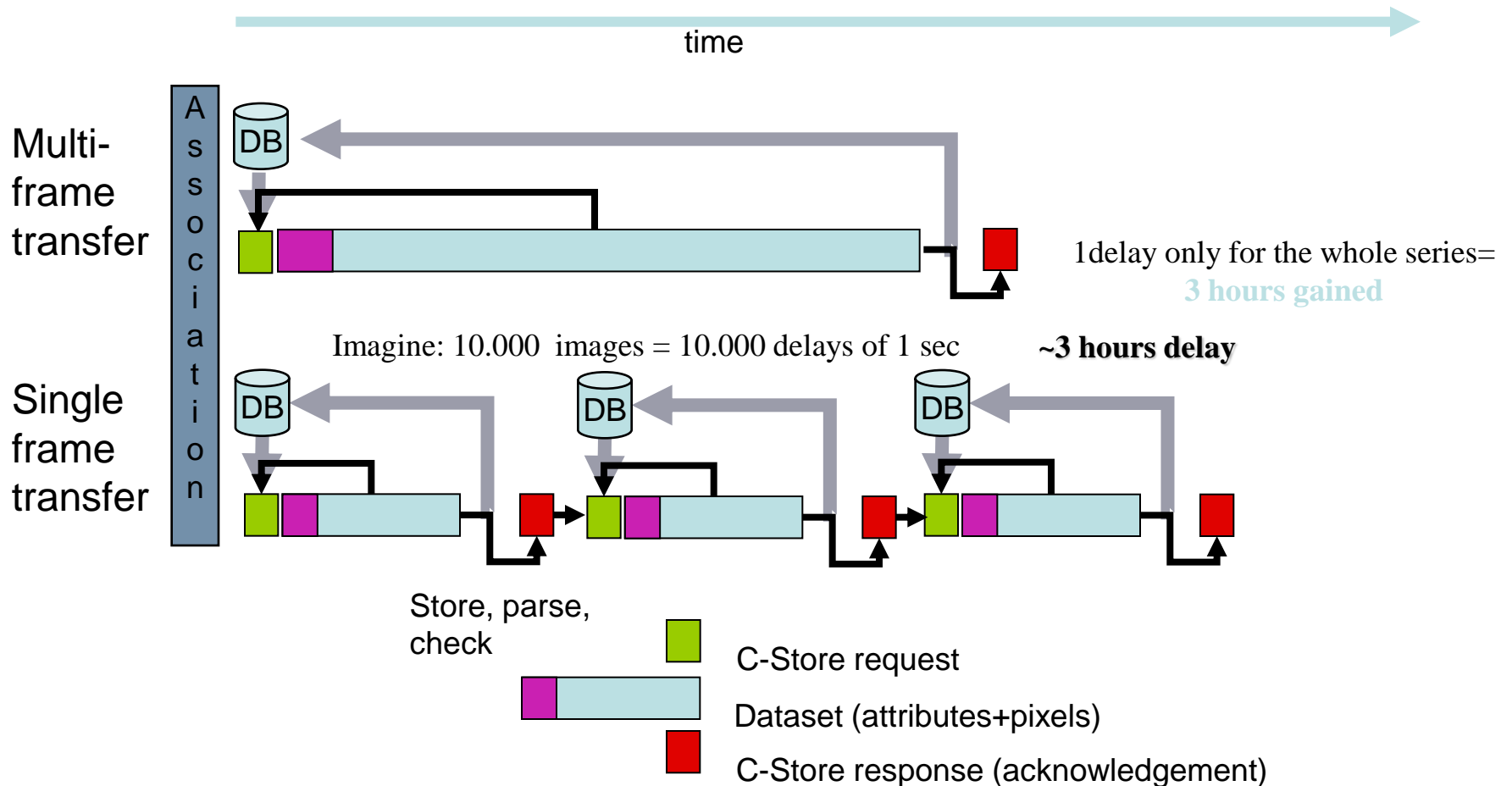
Enhanced Multi-Frame object



Dimension Index Sequence supports new information through private tags

- Dimension Index pointer (0020,9165)
- **Dimension Index Private Creator (0020,9213)**
- Functional Group Pointer (0020,9167)
- **Functional Group Private Creator (0020,9238)**
- Dimension Description Label (0020,9421)

Enhanced Multi-Frame object



* Slide Courtesy: David A.Clunie

Dimension module

- Gives you insight into the organization of the series
- Helps to display the frames consistently

Multi-Frame technique

- Reduces the overhead during transfer
- Keeps increasing numbers manageable

K. Verduin, B Haworth:

SPIE Medical Imaging 2003, All day workshop

SPIE 2003

<http://medical.nema.org/dicom/spie2003/enhancedmriworkshop>

B. Erickson, D. Clunie:

The New CT and MR DICOM Objects: Why All the Fuss?

SCAR 2005

<ftp://medical.nema.org/medical/dicom/Multiframe/Presentations/SCAR-2005/>

K. Verduin:

Enhanced MR addresses Multi-Vendor Interoperability issues in clinical radiology
DICOM Conference China 2008

ftp://medical.nema.org/MEDICAL/Private/Dicom/Conferences/2008_China/Day_2/

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Thank you for your attention !