Digital Imaging and Communications in Medicine
DICOM

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Bottom- Up Approach

MR Storage SOP Class

SCU

Storage Service +
Modality Object

PACS

SCP

PACS Clients

LAN

Module

Module

Module

Attribute

Attribute
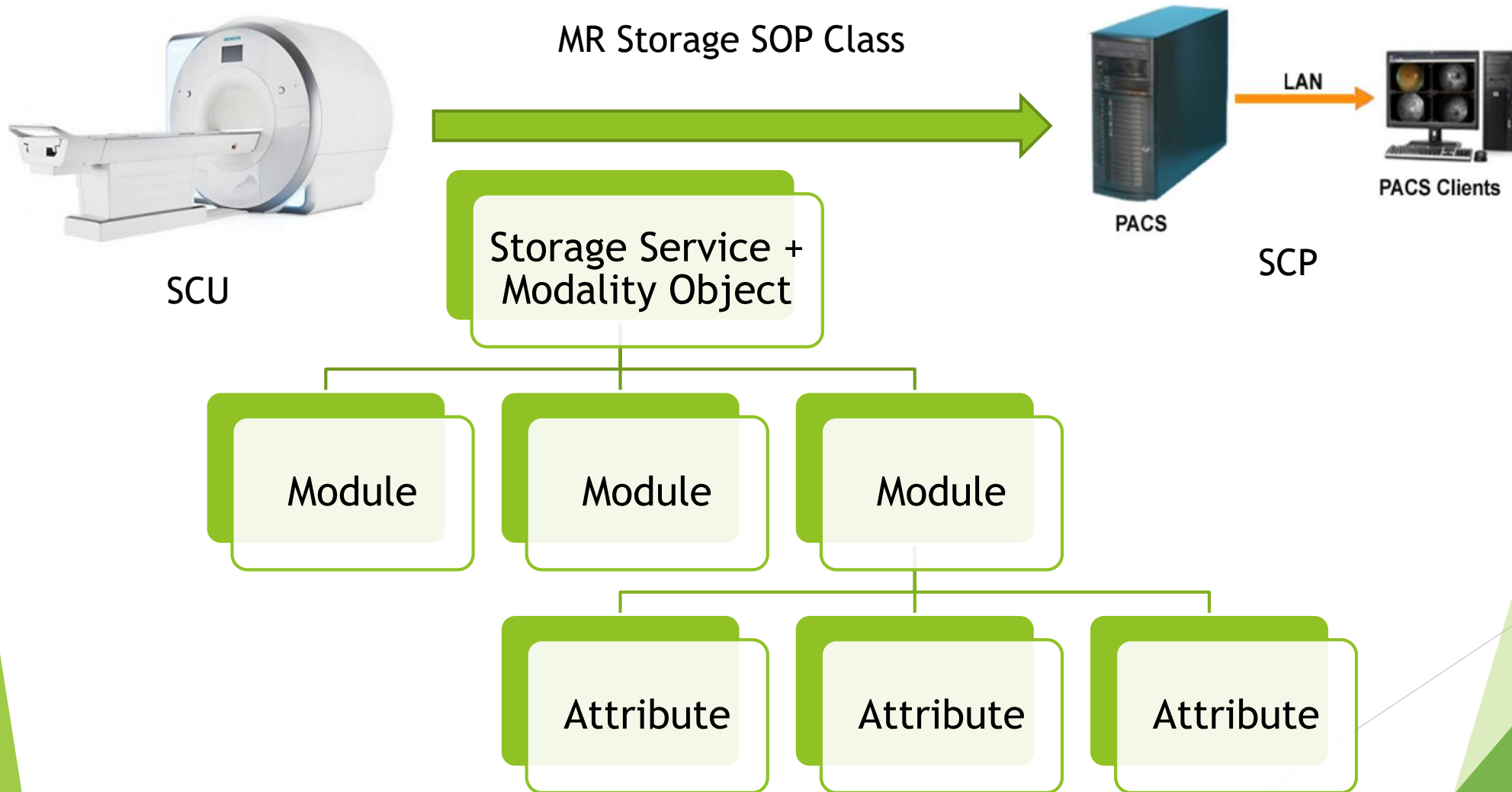
Attribute

Attribute/Elements (e.g. Patient Name)

TAG	VR	VL	Value
(0010, 0010)	PN	10	Smith^Joe^

▶ Tag: (Group #, Element #) to identify the attribute/data element (more than 2000 available)

▶ Value Representation (VR): data type to encode the value(s) e.g. PN = Patient Name up to 64 characters

▶ Value Length (VL): The length of the Value stored (always even-pad with space if needed)

Byte#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Decimal	16	0	16	0	'P'	'N'	10	0	S	m	i	t	h	^	J	o	e	(space)
Binary	10	00	10	00	50	4E	0A	00	53	6D	69	74	68	5E	4A	6F	65	20
	$g=0010$		$e=0010$		VR type		VR length $L=10=0x000A$		VR value = Smith^Joe (with trailing space)									

Module (e.g. Patient Module)

Attribute	Tag	Type	Attribute Description
Patient Name	(0010,0010)	2	Patient's Full Name
Patient ID	(0010,0020)	1	Primary hospital identification number
Issuer of Patient ID	(0010,0021)	3	Identifier of the Assigning Authority that issued Patient ID
…	…	…	

▶ Module is a logical group of attributes about a common topic

▶ Type: (1) Required (2) May be empty if unknown (3) Optional (C) Conditional

IOD – Information Object Definition (e.g. Enhanced CT Object)

IE	Module	Reference	Usage
Patient	Patient	C.7.1.1	M
…	…	…	…
Equipment	General Equipment	C.7.5.1	M
Image	General Image	C.7.6.1	M
	Contrast/Bolus	C.7.6.4	C-Required if contrast media was used in this image
	CT Image	C.8.2.1	M

▶ Information Entity (IE): A group of modules representing a real-world object

▶ An IOD is a collection of Modules

▶ A Module is a collection of attributes from one IE

▶ Usage: (M) Mandatory, (C) Conditional, (U) Optional

DICOM Real World Models

- A <u>Patient</u> can have (0-n) <u>Visits</u> to a hospital/clinic

- Physicians order (0-n) <u>Imaging Service Request</u> for each patient

- Radiology plans (1-n) <u>Requested Procedures</u> which are reported and billed to satisfy each ISR

- Radiology Information System (RIS) schedules (1-n) <u>Scheduled Procedure Steps</u> for each RP

- Equipment executes (1-n) <u>Performed Procedure Steps</u> for each SPS

DICOM Information Model

- A <u>Patient</u> may have many studies

  - A <u>Study</u> is a group of Series for a given Requested Procedure

    - A <u>Series</u> may group closely related Images from same PPS, same protocol & same piece of equipment

      - An <u>Image</u> holds the acquired data

- <u>Instances</u> are actual data created based on an IOD

- DICOM uses unique identifier (<u>UIDs)</u> to identify

  - Specific Instances

  - Specific SOP Classes

  - Specific Study/Series

  - … and many other things

DICOM Services

- Print – Printing IODs to a DICOM Printed

- Storage – Storing Objects, e.g. to Pacs

- Query/Retrieve – Getting Objects, e.g. from a PACS

- MWM – Getting Scheduled Patients, e.g. from RIS (Modality Worklist Management)

- MPPS – Status (Started, Completed) back to RIS (Modality Performed Procedure Step)

- … many more

# DICOM SOP Class

MR Storage SOP Class

LAN

PACS

PACS Clients

SCU

SCP
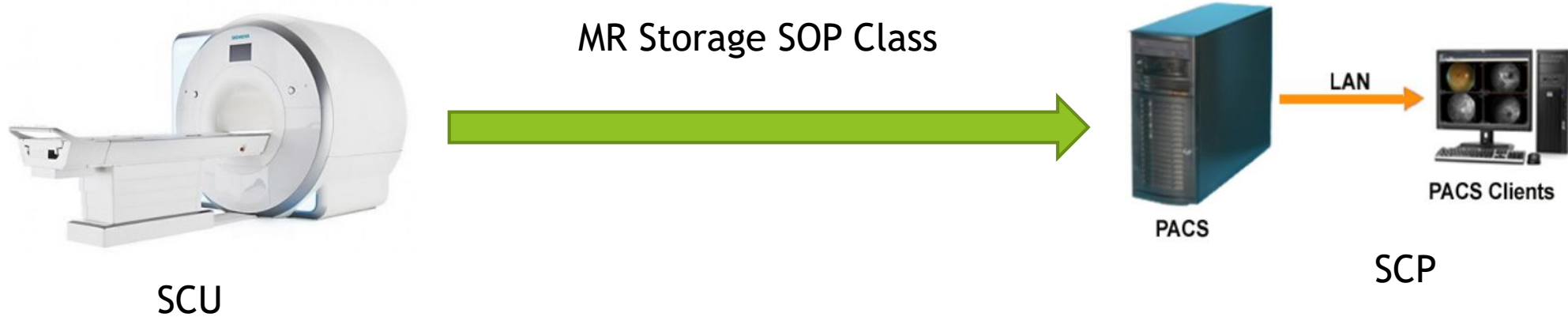
- ▶ SCP-Service Class Provider
  - ▶ The system that provides the service
- ▶ SCU-Service Class User
  - ▶ The system that uses the service

DICOM Association Negotiation

- Before two Applications Entities (AE) perform DICOM transaction they must first agree:
  - Which SOP Class will they use (e.g. MR Image Storage)
  - Who will be the SCU, who is the SCP
  - Which is the Transfer Syntax (e.g. Explicit Little Endian)
- This is the Association Negotiation
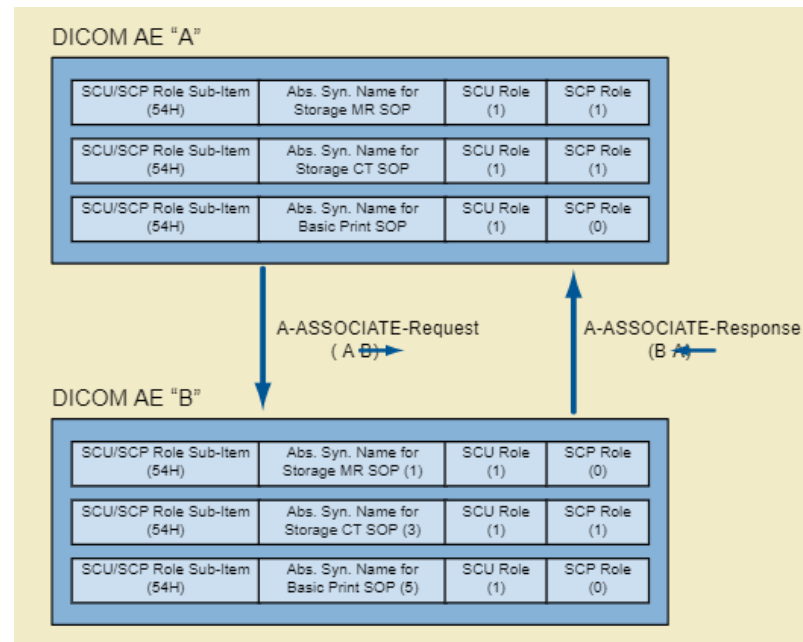
Why is it so specific?

- Complex medical image Data (e.g.)
  - MR Image
    - Single frame, 12-16 bit grayscale image
    - MR acquisition-pulse sequence parameters
    - 3D patient relative co-ordinate/vector position
  - X-Ray Angiography Image
    - Multi-frame, 8-10 bit grayscale image
    - XA acquisition – radiation/collimation/motion
    - Dynamic C-arm/table relative positioning

Product DCS

- DICOM Conformance Statement
  - Lists the SOPs supported by the product
  - Describes product implementation details and behaviors
  - Describes any proprietary attributes

Thank you for your attention!!!