Kommunikationsstandards im Gesundheitswesen

OWASP Stammtisch - 24/07/17
Chaospott Essen

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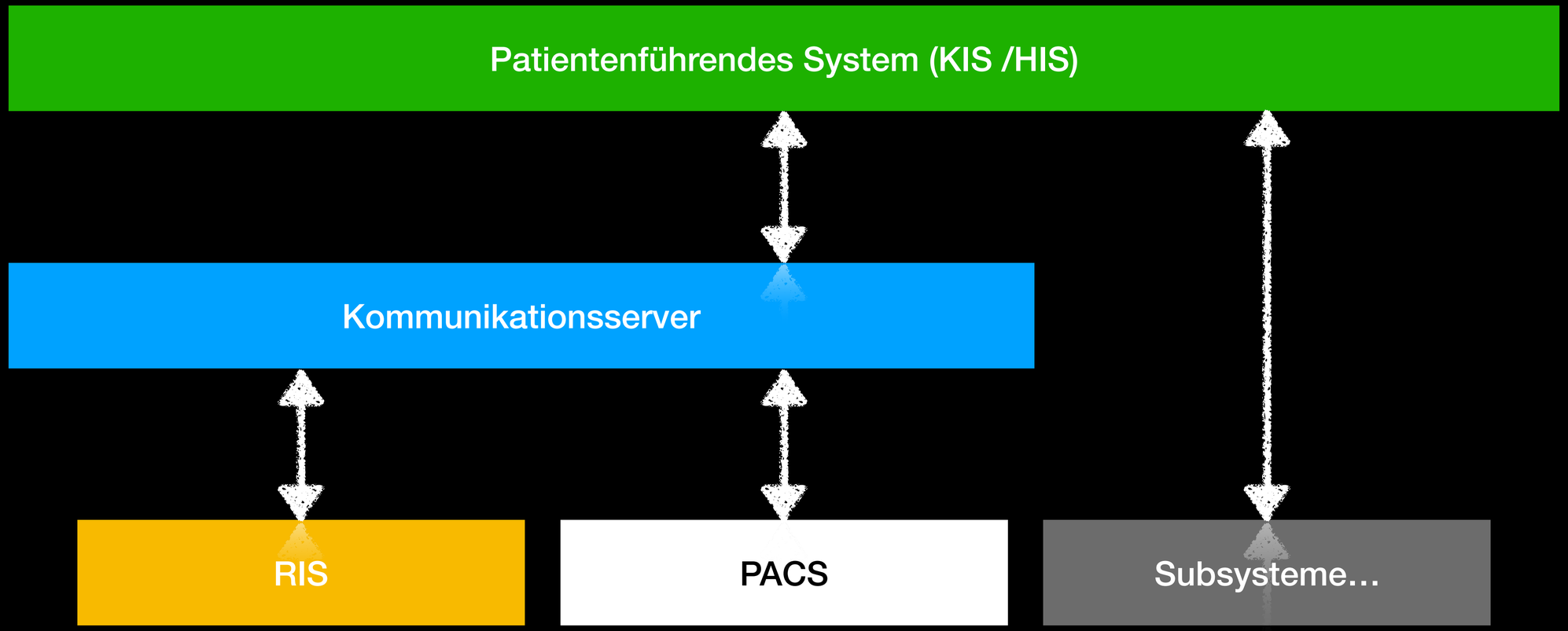
Agenda

- Big Picture - IT- Infrastrukturen in Kliniken
- Workflows
- HL7v2 / Ausblick auf HL7 FHIR / IHE
- DICOM

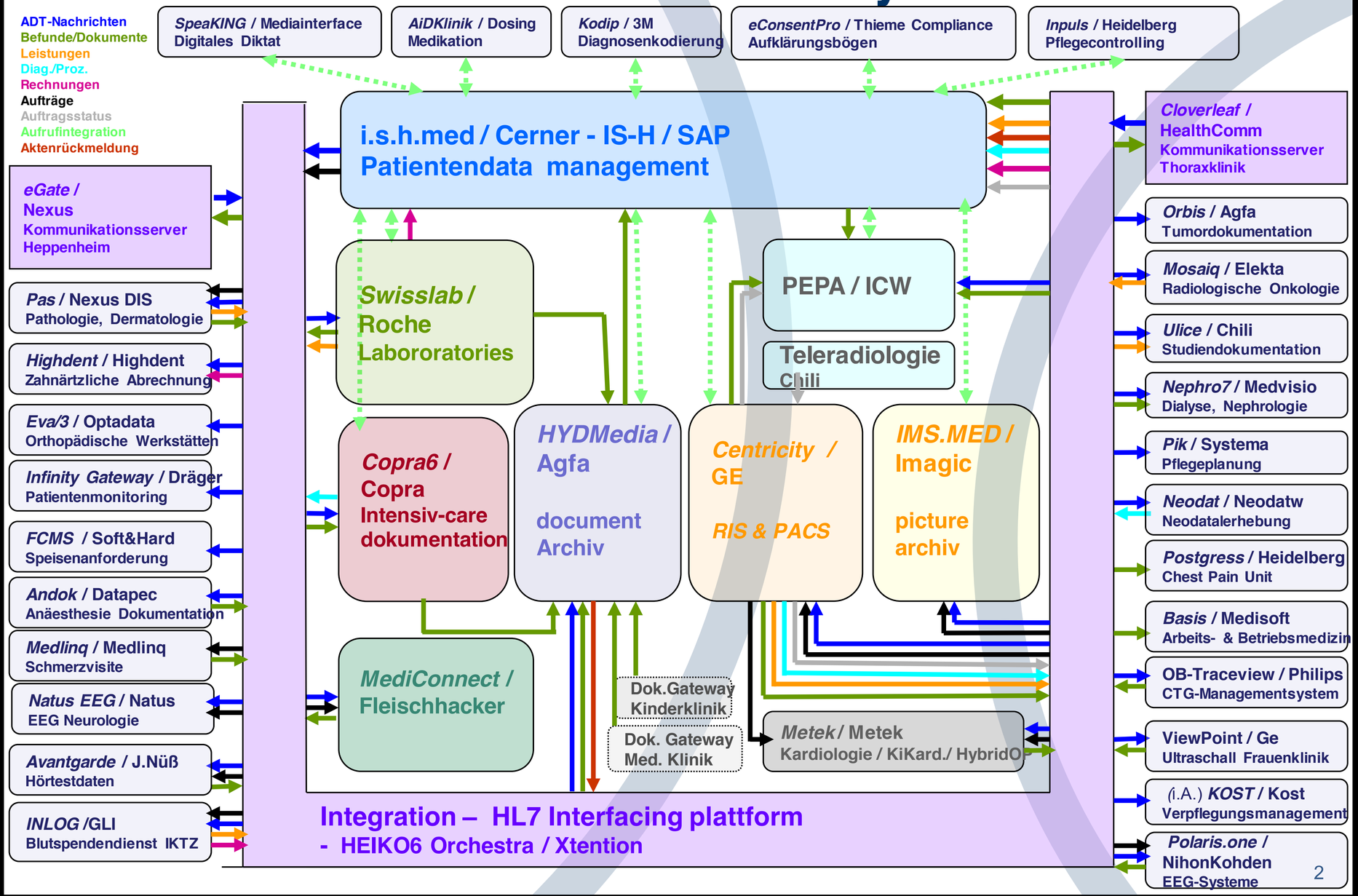
Status Quo

- heterogene IT- Systeme
  - Spezialsysteme in jeweiligen Fachabteilung
- tief integriert / Workflows Unterstützung
- regulatorischen Vorgaben
  - MDD (EG-Richtlinie 93/42/EWG) / Medizinproduktegesetz
- Anpassung an jeweiliges Gesundheitssystem notwendig

High- Level Kommunikation

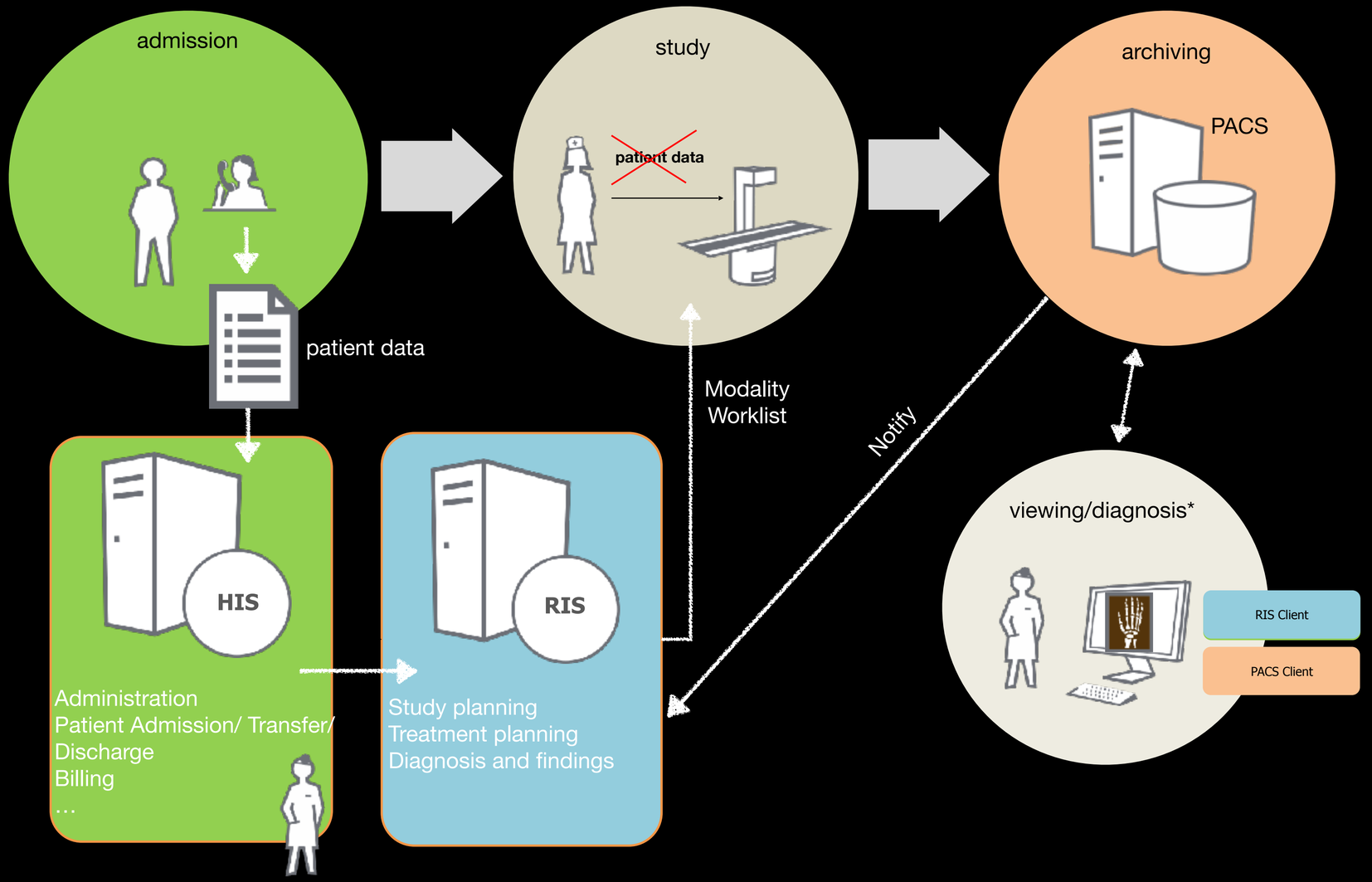


Overview software - systems



- Quelle: http://www.guig.org/sites/default/files/_fileserver/documents/2017/US-Amerikaner-inD/2017.05.10_UHHD_EHR_A.Buchauer.pdf

workflow radiology



Standard: xDT

- Formats for billing („Abrechnungsdaten“ ADT), treatment data („ Behandlungsdaten “ BDT), modality data („ Gerätedaten“ GDT), lab data („ Labordaten“ LDT),…
- Defined by „Kassenärztlichen Bundesvereinigung
- For data exchange on storage media

	Field length	ID	Data
01380000000	013	8000	0000
0128100273	012	8100	273
0153101Hittel	015	3101	Hittel
0183102Alexander	018	3102	Alexander
017310302061938	017	3103	02061938
0273104Prof. Dr. med. von	027	3104	Prof. Dr. med. von
019300019380602/1	019	3000	19380602/1
0103110M	010	3110	M
0208402Gesichts-CT	020	8402	Gesichts-CT
0117000CT	011	7000	CT
01370011636	013	7001	1636
017700227052004	017	7002	27052004
014700410768	014	7004	10768
0217005Dr. Hoffmann	021	7005	Dr. Hoffmann
0317006Kontrastmittelallergie	031	7006	Kontrastmittelallergie
0158887Asmuth	015	8887	Asmuth

Standard: Health Level 7

- Worldwide standard for all data used for hospital administration: patient data, material data , billing
- Examples:
  - patient demographic data, documents, treatment plan, study planning, lab findings…
- Defines data formats and messages

```
MSH|^~\&|RIS|RIS|PACS|PACS|20071129101630||ORM^O01|2276|P|2.3|||NE|NE
PID|1|10127|10127||Demo^Marta~Test^Marta||19580202|F|||||||O|OA
PV1|1|O|Stat1^Stat1 CHI^^CHI|S||||100068^Birgit Doctor||||||100068^Birgit Doctor|||||
4012292|||||||||||||||||||||||20071129100342
ORC|NW|6786||RAD|SC||^^^^^M||20071128162024|||Stat1^Stat1 CHI^^CHI
OBR|1|6786|10737|thap&Thorax a.-p.^RIS|||20071129100800||||||Thorax
```

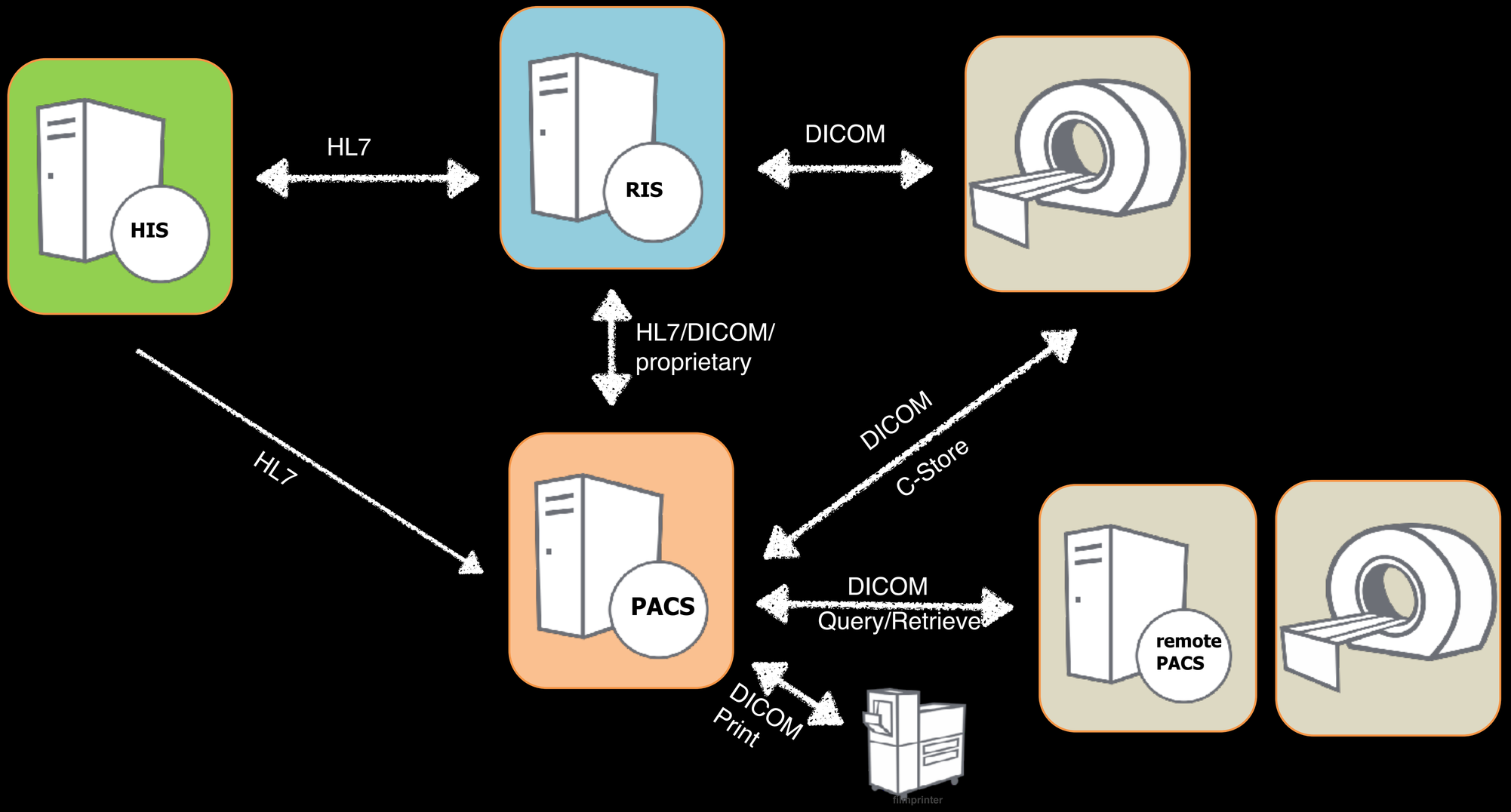
Standard: DICOM

- Worldwide standard for handling, storing, printing, and transmitting information in medical (radiological) imaging.
- Originately for sharing radiological images, nuclear therapy planning….
- Also for sharing other medical study data (ECG, ultrasound, videos,…)
- Defines data formats and protocols for data exchange
- Detailed definition of interface specifications (DICOM Conformance Statement)

Standard Applying Initiative: IHE

- **Integrating the Healthcare Enterprise:**
  - Initiated by users and manufacturers to enhance interoperability
  - Defines workflows and Use Cases
  - Develops guidelines (Frameworks), identifying the standards and methods to be used.
  - Tests example implementations
  - Stages "connectathons" and "interoperability showcases" in which vendors assemble to demonstrate the interoperability of their products.

Überblick - Standards - Radiologie



HL7

HL7 - history

- 1987 start of the development
- 1990’s rollout
- 1993 German user group
- 1995 start of the development of HL7 v3
- 1997 OSI standard (version 2.3)
- 2005 first release of HL7v3
- 2014 Release v2.8.1
- 2017 STU HL7 FHIR (HL7v4?)

HL7 - Versionen

Version 2

- compact message format, complicated to read
- robust against message failures
- offline workflow supported (outdated)

Version 3

- XML notation, easier development and easier to read
- Service Oriented Architecture (SOA), e.g.: Patient demographic query / Clinical Document Architecture (CDA)
- Usage of existing vocabularies & codes
- HL7v3 rarely used in Germany

- Newer sub-versions (2.5, 2.6, 3…??) include additional / more specific messages, more data types and error corrections.

HL7 - Versionen

HL7 - FHIR

- **F**ast **H**ealthcare **I**nteroperability **R**esources
- open-source
- web-based suite of API
  - HTTP-based, RESTful protocol, HTML and Cascading Style Sheets for user integration
- JSON, XML for data and results
- allows interactive querys, document sharing, etc.

HL7 conceptual Approach

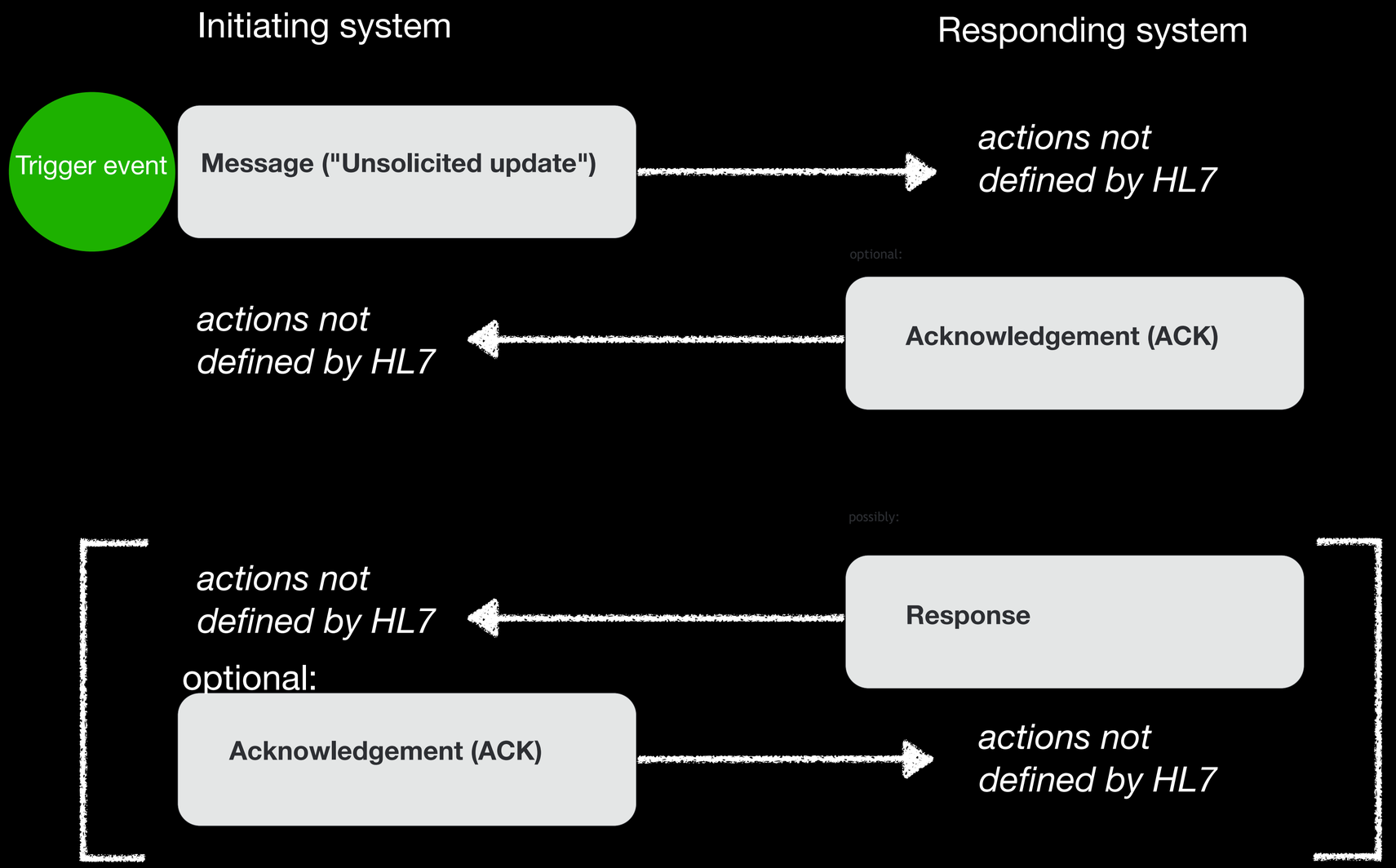
- **Trigger Event**
  - Standard is written from the assumption that an event in the real world of healthcare creates the need for data to flow among systems.
  - The real-world event is called the Trigger Event.
    - Examples:
      - A patient is admitted.
      - An item is used from floor stock on behalf of a patient.
      - A schedule has been updated with a new appointment.

- **Transaction Sets**
  - Trigger Events are grouped into fields of activity, called "Transaction Sets“.
    - Examples:
      - Patient Management
      - Materials Management
      - Scheduling

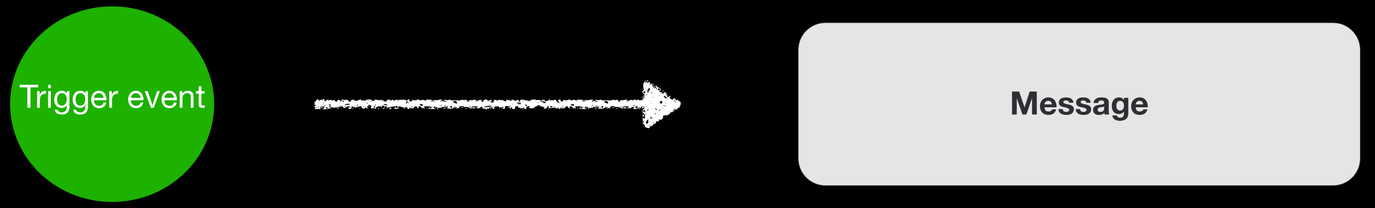
HL7 conceptual Approach

Transaction Set	Purpose
Patient Administration	Transmission of new or updated demographic and visit information about patients
Order Entry	Transmission of orders or information about orders (i.e. the request for material or services for a specific patient)
Observation Reporting	Sending structured patient-oriented clinical data like observations and results of diagnostic studies
Scheduling	Communication for the scheduling of appointments for services or for the use of resources
Medical Records / Information Management	Document management (currently). Shall be extended in the future for the exchange of other medical records.
Financial Management	Patient accounting transactions
Materials Management	Communication within the supply chain management
…	…

HL7 Transactions



HL7 Messages



- **Trigger events** are uniquely identified by a letter and two digits:
  - A08, O01, R21,…
- Trigger events determine which Message is to be sent.
- Messages dealing with similar topics are grouped into Message Types **ADT, ORM, SIU,…**
- **Message format** and contents are defined by the combination of **Message Type** and **Trigger event**

HL7 Transaction Sets

- Each Transaction Set is described in a chapter of the Standard document.

Transaction Set: Patient Administration

Transaction Set: Order Entry

HL7 Message Format - Segment

```
MSH|^~\&|RIS|ris|PACS|pacs|20151129101630||ORM^O01|2276|P|2.3|||NE|NE
PID|1|10127|10127||Demo^Marta||19580202|F|||||||O|OA
PV1|1|O|Stat1^Stat1 CHI^^CHI|S||||100068^Birgit Doctor||||||100068^Birgit Doctor|||||4012292|||||||||||||||||||||20071129100342
ORC|NW|6786||RAD|SC||^^^^^M||20071128162024|||Stat1^Stat1 CHI^^CHI
OBR|1|6786|10737|^medizinische Fragestellung^RIS^thap^Thora a.-p.^RIS|||20071129100800||||||Thorax
```

- Every line is a Segment. Segments have a defined sequence.
- Segments may be repeated.
- Segments are separated by **<CR>.**
- Every Segment starts with the Segment ID which specifies the meaning of the Segment.
    - Example: "PID" – Patient Identification
- Every Message starts with the Message Header Segment (Segment ID "MSH")

HL7 message format - data fields

```
MSH|^~\&|RIS|ris|PACS|pacs|20151129101630||ORM^O01|2276|P|2.3|||NE|NE
PID|1|10127|10127||Demo^Marta~Test^Marta||19580202|F|||||||O|OA
PV1|1|O|Stat1^Stat1 CHI^^CHI|S||||100068^Birgit Doctor||||||100068^Birgit Doctor|||||4012292|||||||||||||||||||||20071129100342
ORC|NW|6786||RAD|SC||^^^^^M||20071128162024|||Stat1^Stat1 CHI^^CHI
OBR|1|6786|10737|^medizinische Fragestellung^RIS^thap^Thora a.p.^RIS|||20071129100800||||||Thorax
```

- A Segment consists of Data Fields.
- Data Fields are separated by the symbol "|".
- Data Fields have a defined position behind the Segment ID.
  - Notation: PID.5 = field 5 of Segment "PID": Patient Name
- A Data Field has a defined data type and may be repeated. Repetitions are separated by the symbol "~".
  - Components are separated by the symbol "^", subcomponents are separated by the symbol "&".

HL7 Message Header (MSH)

```
MSH|^~\&|RIS|ris|PACS|pacs|20151129101630||ORM^O01|2276|P|2.3|||NE|NE
1   |2    |3  |4  |5    |...
```

- instead of the (recommended) symbols "|", "^", "~", "\", "&" other symbols may be used. Therefore, symbols must be defined in every message (after MSH ID

  - 3, 4 - Sending Application & Facility
  - 5, 6 - Receiving Application & Facility
  - 7 - Date / Time of Message
  - 9 - Message Type
  - 10 - Message Control ID (unique)
  - 12 - Version ID
  - 15, 16 - Acknowledgement control
  - 17-19 - Country Code, Char Set, Language

HL7 Message Transport

- (s)FTP / CIFS Shares / SOAP / SMTP
- TCP/IP (Minimal) Lower Layer Protocol (LLP aka MLLP)

Header	HL7 Message	Trailer	Carriage

Vertical tab character (0x0B)	`MSH|^~\&||.|||199908180016||ADT^A04|ADT.1.1698593|P|2.5<CR>`
	
	`PID|1||000395122||LEVERKUHN^ADRIAN^C^^^||19880517180606|M|`
		Field separator character (0x1C)	Carriage return (0x0D)

1. **Öffnen einer Netzwerkverbindung (IP, Port)**
2. **Schreiben der Nachricht incl. Framing (<SB>dddd<EB><CR>)**
3. **Lesen der ACK Nachricht incl. Framing**
4. **Schließen der Netzwerkverbindung**

- wichtigste Nachrichten:
  - ADT^A08 / A40
  - ORM: ORM^O01
- typischerweise:
  - keine Transport Verschlüsselung
  - keine auth. an Schnittstellen (Sender /Empfänger)
  - loggen HL7 Datenstrom an verschieden Stellen

DICOM

Digital Imaging and Communications in Medicine

DICOM

- weltweiter Standard für die medizinische Bildkommunikation

- Spezifikation von Datenstrukturen und Diensten
  - Netzwerkdienste: Bildübertragung, Drucken, Workflow-Unterstützung, RIS/PACS-Kopplung
  - Anwendungsprofile für den Austausch per Datenträger
  - Strukturierte Befundung

- **DICONDE**
  - modifikation des DICOM- Standards für Industrie

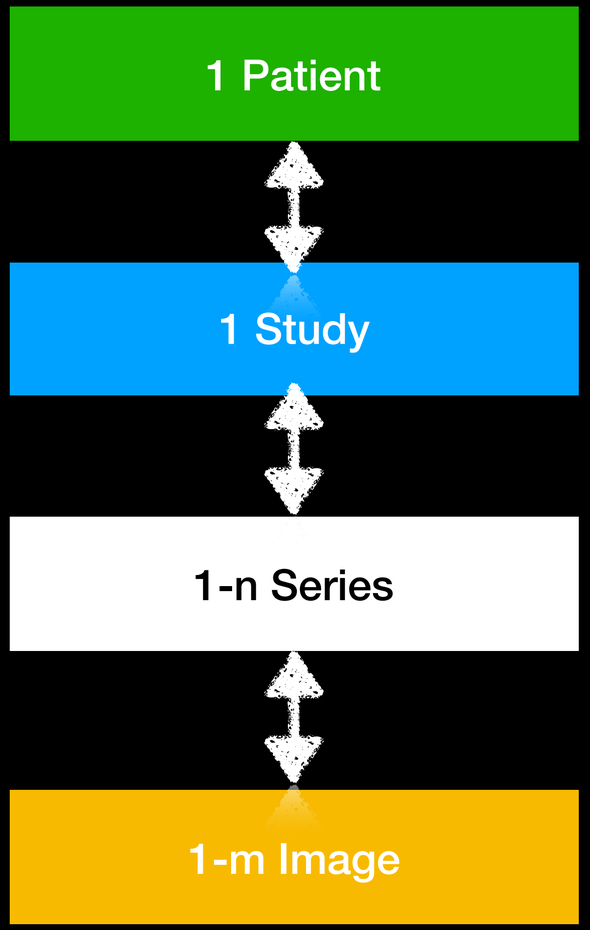
Entstehung

- **1982 - ACR und NEMA gründen ein gemeinsames Komitee**
  - 1985 - Veröffentlichung der Version 1.0
  - 1988 - Kompression- und Magnetband-Standards
  - 1989 - Angefangen mit der Netzwerkversion
- **DICOM - Digital Imaging and Communications in Medicine**
  - **Neuer Name: „DICOM Version 3.0“**
  - 1991 - Freigabe der Teile 1 und 8
  - 1993 - Teile 1-9 verabschiedet, Demonstration im Rahmen der RSNA
  - 1995 - Teile 10, 11 und 12 (Dateiformat und Speichermedien)
- **MEDICOM - Medical Image Communication**
  - EN 12052 macht aus DICOM eine offizielle Europäische Norm (verweist lediglich auf DICOM)
  - ISO IS 12052: seit Anfang 2006 auch Internationaler Standard

DICOM

- radiologische Daten unterliegen RöV -> bis 30 Jahre Archivierung
- je nach Klinik fallen bis 100 zu GB DICOM pro Tag an / Unikliniken deutlich mehr.
- typischer Archivgröße in 2017 - 50 - 100 TB. (DICOM Objekte)
- CT / MRT Studien 2-10GB (3k-9k Bilder)
- Tomographie Studien 2-5GB (2-3 Bilder).

DICOM Data Model



DICOM Data Model

- jedes DICOM Objekt ist durch UID’s weltweit eindeutig identifiezierbar
    - Studie, Serie, Instanz
- DICOM ist eine Art „Container“ für Bildeten, Information, Dokumente
        - Header enthält Metadaten, Patient, Studien Datum etc.

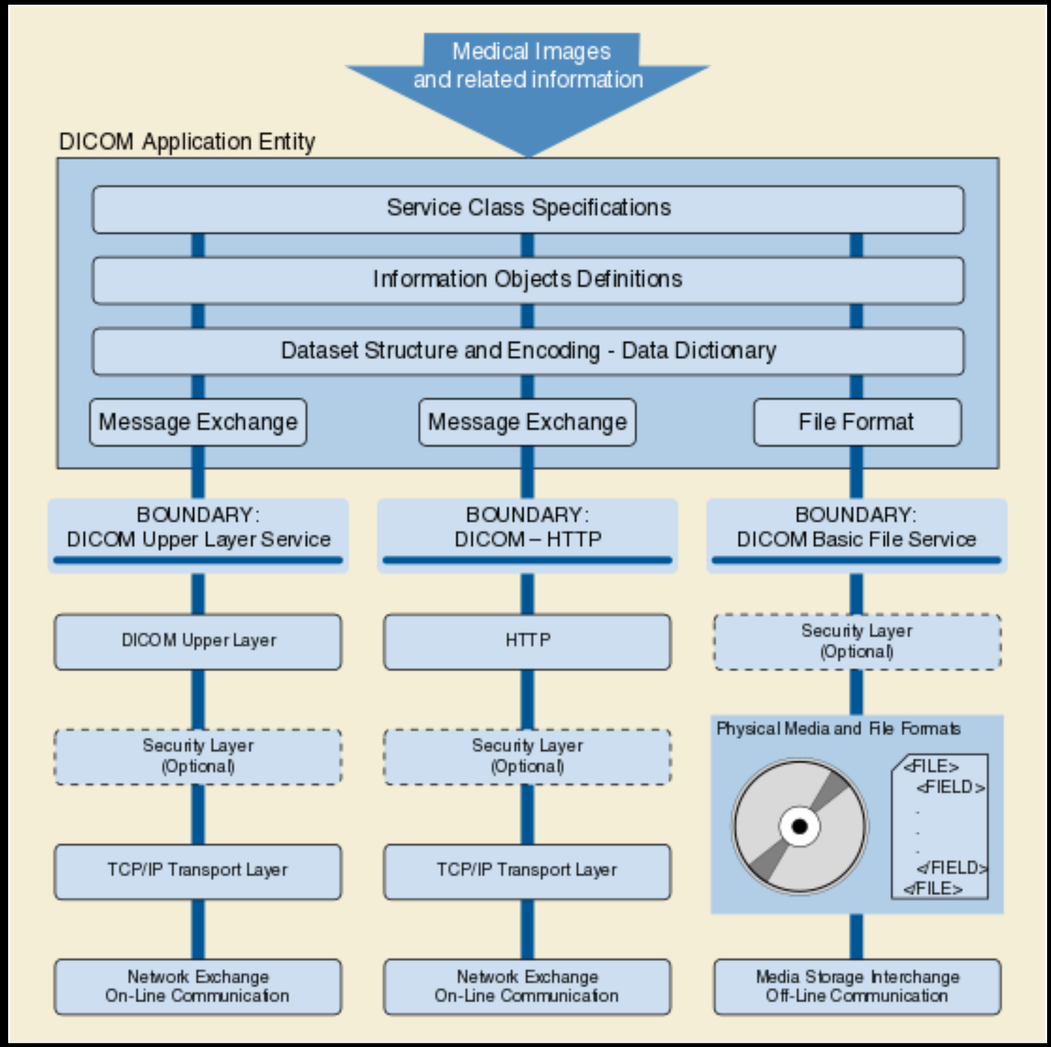
Konzept

DICOM Service Class Definitions

This part of the Standard makes use of the following terms defined in PS3.4:

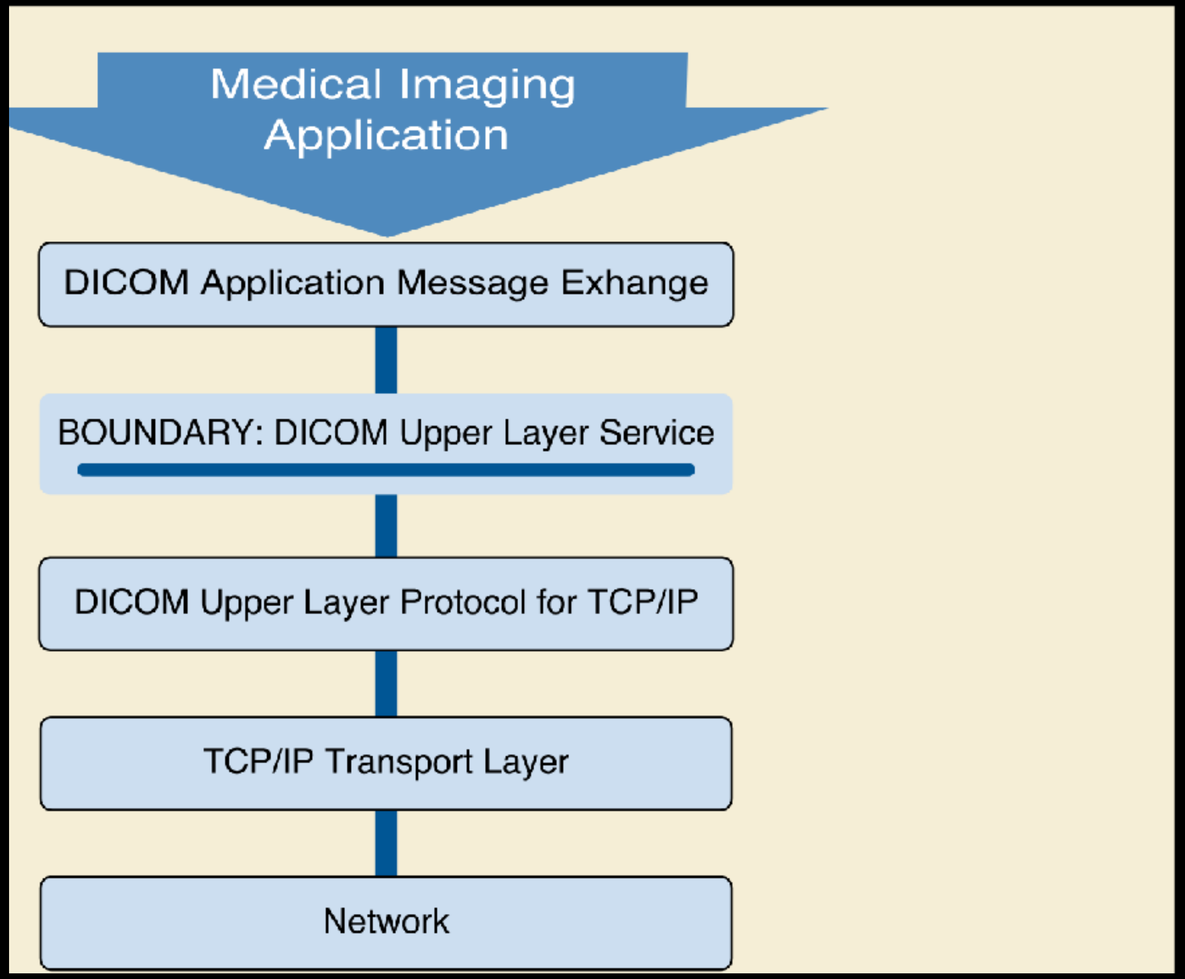
> […]
>
> b **Service Class User (SCU)**
>
> c **Service Class Provider (SCP)**
>
> d Service-Object Pair (SOP) Class
>
> e Service-Object Pair (SOP) Instance
>
> […]

- vgl. Absender auf Briefumschlag.
  - auth basiert auf AE-T / CAE-T



DICOM Standard 2017c

Figure 5-1. General Communication Model



DICOM Standard 2017c

Figure 6.1-1. DICOM Network Protocol Architecture

7.5 DIMSE Composite Services

Name	Group	Type
C-STORE	DIMSE-C	operation
C-GET	DIMSE-C	operation
C-MOVE	DIMSE-C	operation
C-FIND	DIMSE-C	operation
C-ECHO	DIMSE-C	operation

DICOM Query /Retrieve

- C-FIND + C-MOVE = DICOM Query / Retrieve
  - anfordern von Daten einer Entität
- DDoS Mode:
  - anfragen von Daten bei System A und diese zu System B senden lassen
    - System B ist nicht involviert

Demo Viewer
dcmdump (dcmtk)

http://dcmtk.org

weiterführende Links

HL7

- www.hl7.org
  - Standard: http://www.vico.org/HL7_V2_5/v251/std251/hl7.html
  - FHIR: http://www.hl7.org/fhir/
- https://wiki.hl7.de/
- http://www.ihe.net/technical_frameworks/#IT

Tooling

- http://hl7api.sourceforge.net
- http://hapifhir.io
- https://www.mirth.com
- http://dcmtk.org (-> apt-get install dcmtk)
- http://www.dcm4che.org
- http://dicom.nema.org

conformance statements:

- HL7 / DICOM Schnittstellenbeschreibungen sind öffentlich:
  - http://global.agfahealthcare.com/us/miscellaneous/interoperability/
  - http://www.usa.philips.com/healthcare/resources/support-documentation
  - https://www.healthcare.siemens.com/services/it-standards
  - https://medical.toshiba.com/service-and-support/enterprise-integration/
  - …