

# Increasing Interoperability, what is the Impact on Reliability? Illustrated with Health care examples

by *Gerrit Muller* University of South-Eastern Norway-NISE

e-mail: `gaudisite@gmail.com`

`www.gaudisite.nl`

## Abstract

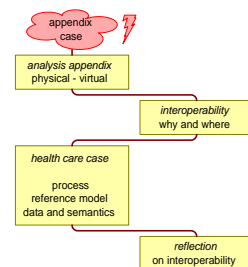
In all domains the amount of interoperability between systems is increasing. The individual systems tend to be developed and evolve independently. The consequence is that the end-to-end reliability depends on the quality of interoperation of the involved systems.

We will discuss the relationship between interoperability and reliability. This will be illustrated by examples from the health care domain.

## Distribution

This article or presentation is written as part of the Gaudí project. The Gaudí project philosophy is to improve by obtaining frequent feedback. Frequent feedback is pursued by an open creation process. This document is published as intermediate or nearly mature version to get feedback. Further distribution is allowed as long as the document remains complete and unchanged.

September 9, 2018  
status: planned  
version: 0



## *Dominican fined \$25,000 for removing wrong person's appendix*

<...snip...>

The mistake occurred Nov. 14 when two female patients were scheduled for computed tomography, or CT scans, according to the state report. The first patient underwent an appendectomy that very evening because of the CT results. But the surgery was unnecessary. The next day, a radiologist discovered the patient's CT scan was actually that of a second patient.

Hospital staff told state inspectors that the technologist had trouble starting the required intravenous line for the first patient and took her out of the CT scan room to complete that task.

However, the patient's information had already been entered into the computer system for the CT scan. After the second patient's scan was completed, a radiology technician noted the error, removed the first patient's information and entered information on the second patient.

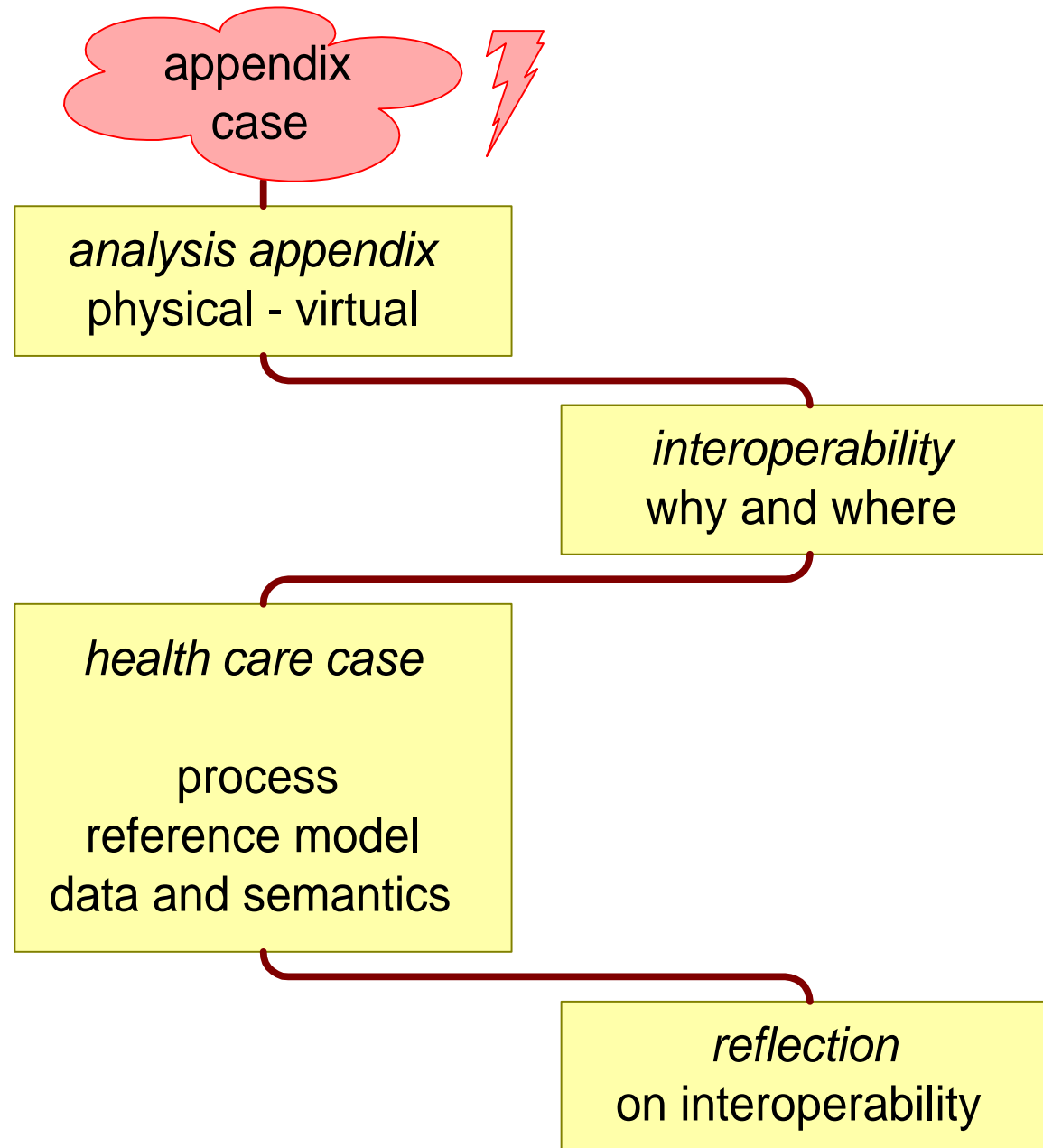
When the first patient's information was deleted from the computer in the scan room, it was not deleted from the computer system used by the radiologist.

"This was due to an incompatibility of the software between the two systems," the state report said.

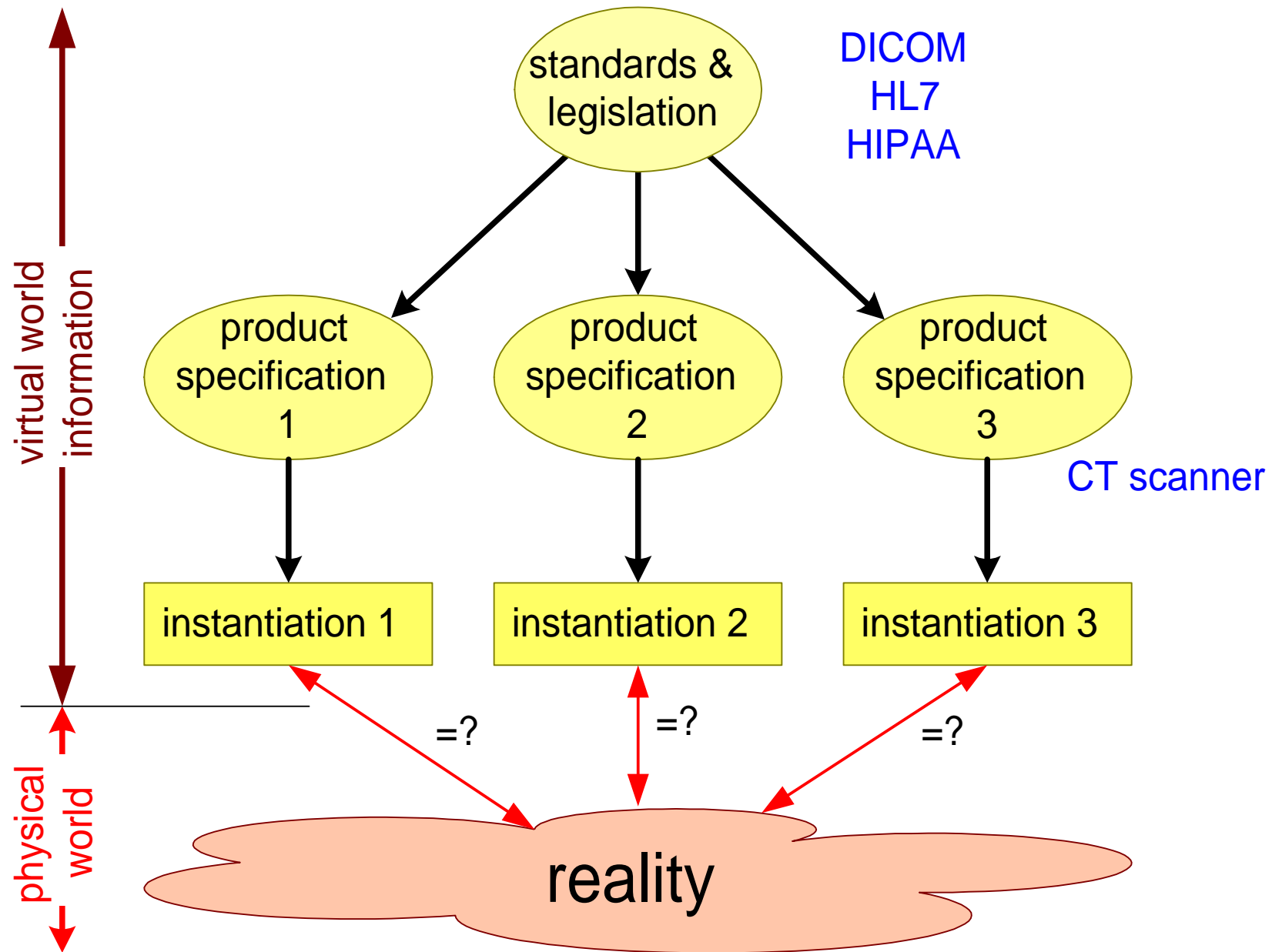
<...snip...>

from Santa Cruz Sentinel [http://www.santacruzsentinel.com/ci\\_9356389](http://www.santacruzsentinel.com/ci_9356389)

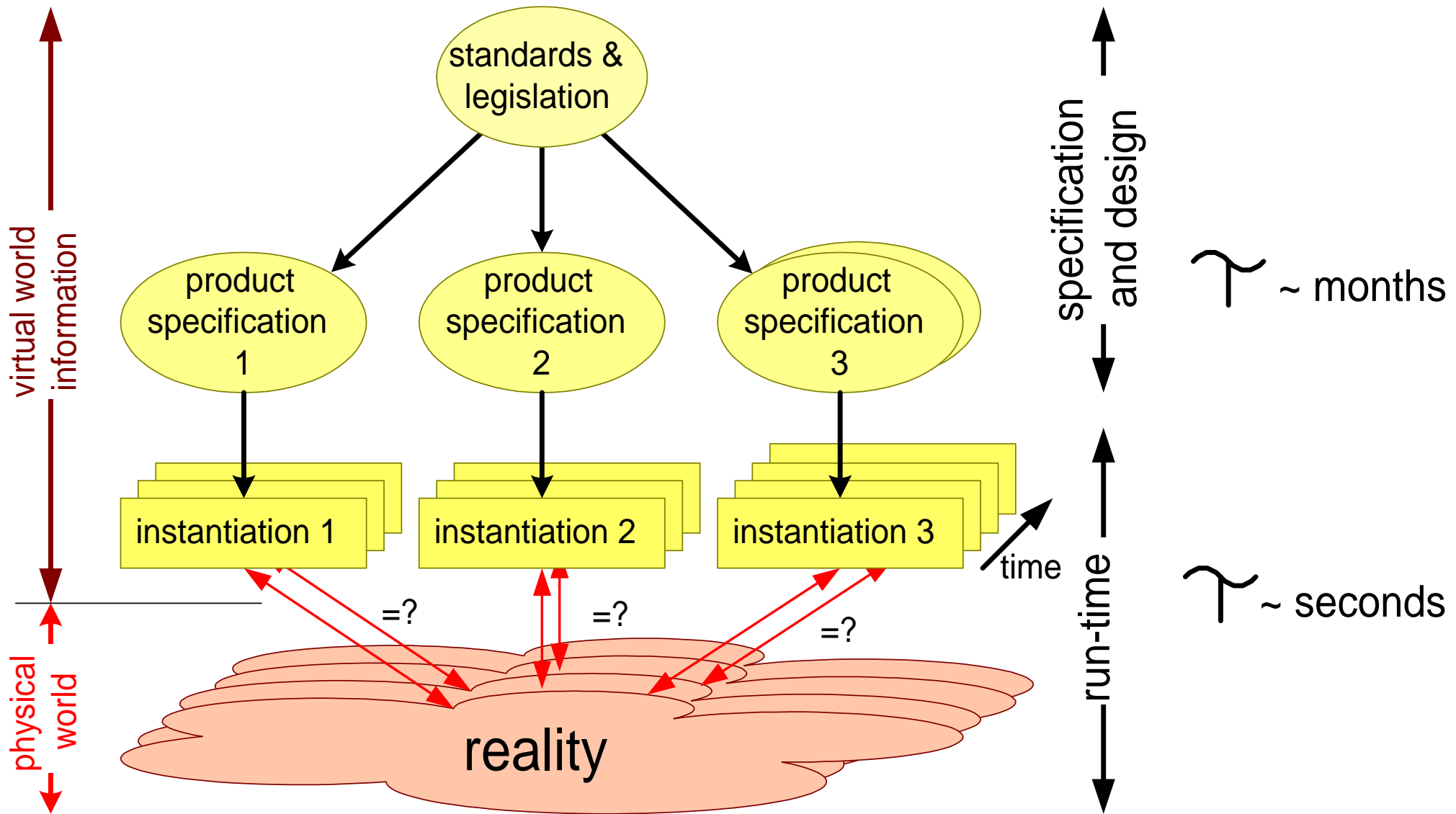
# Figure Of Contents™



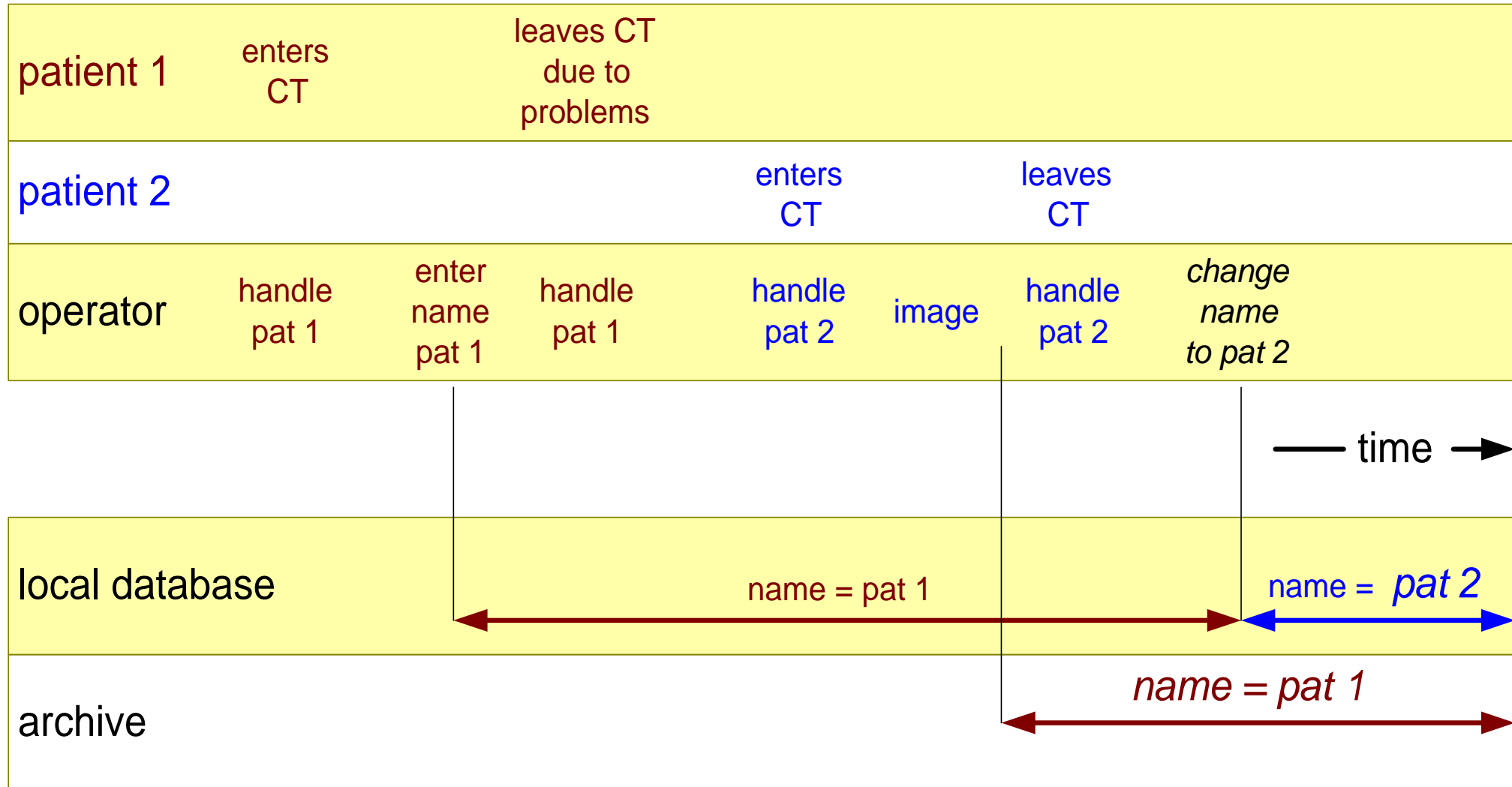
# Physical and Virtual World Views



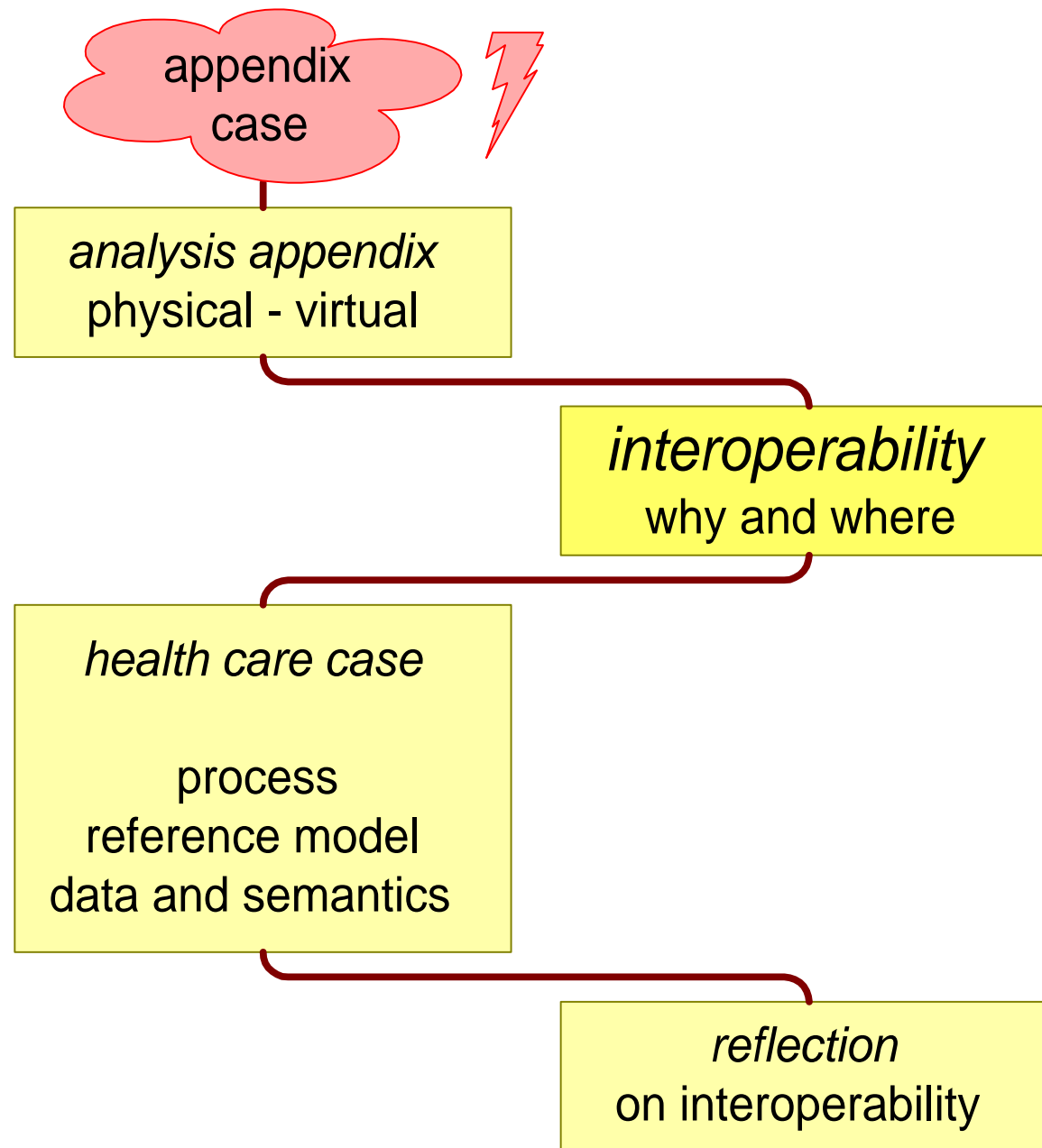
# Adding Dynamics; the Time Dimension



# Example: the Appendix Case



# Figure Of Contents™



# Interoperability is happening everywhere

defense

#ships, #tanks, #planes,  
#weapons, #soldiers, ...

health care

#hospitals, #clinical departments,  
#physicians, #pathologies, #patients, ...

traffic control

*et cetera*

entertainment

*et cetera*

telecommunication

administration

manufacturing

*et cetera*



# Interoperability Requires Standards

interoperability

*"extremely  
challenging"*

human factors

data semantics

application protocols

connectivity

*"only  
engineering"*

data syntax

formats, tags

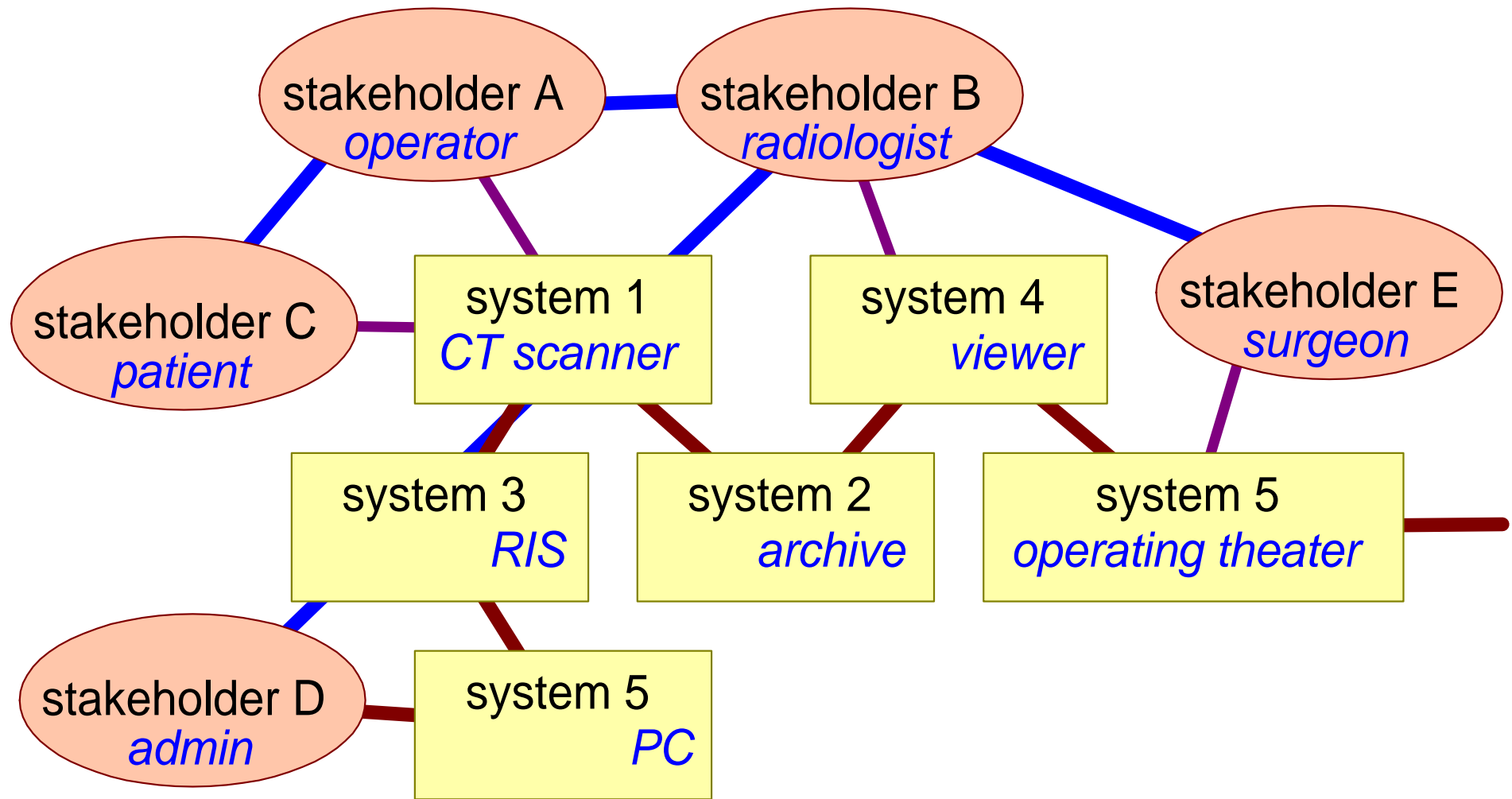
protocols

e.g. TCP/IP

physical

media, interfaces  
cables, connectors, ...

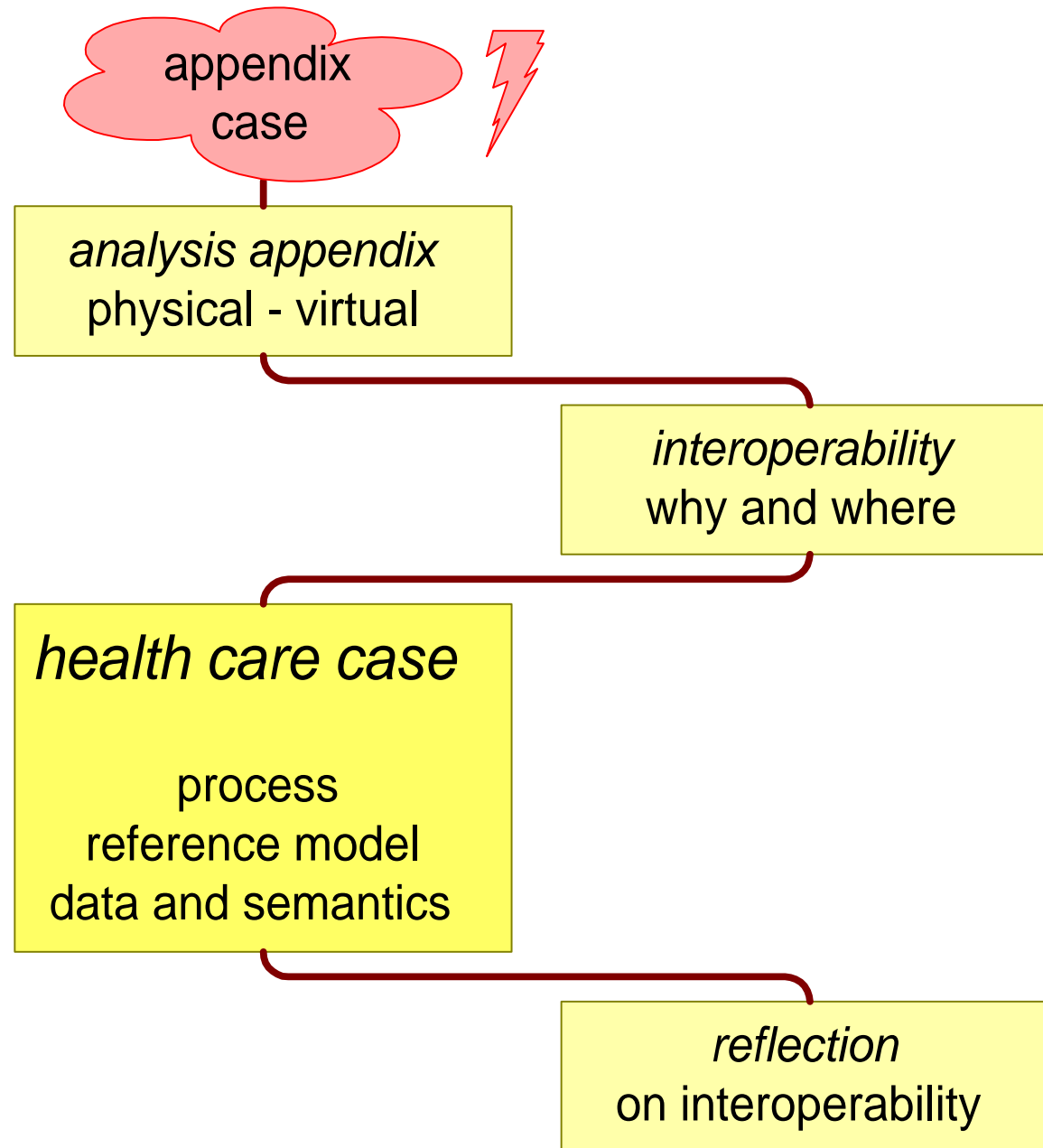
# Challenge....



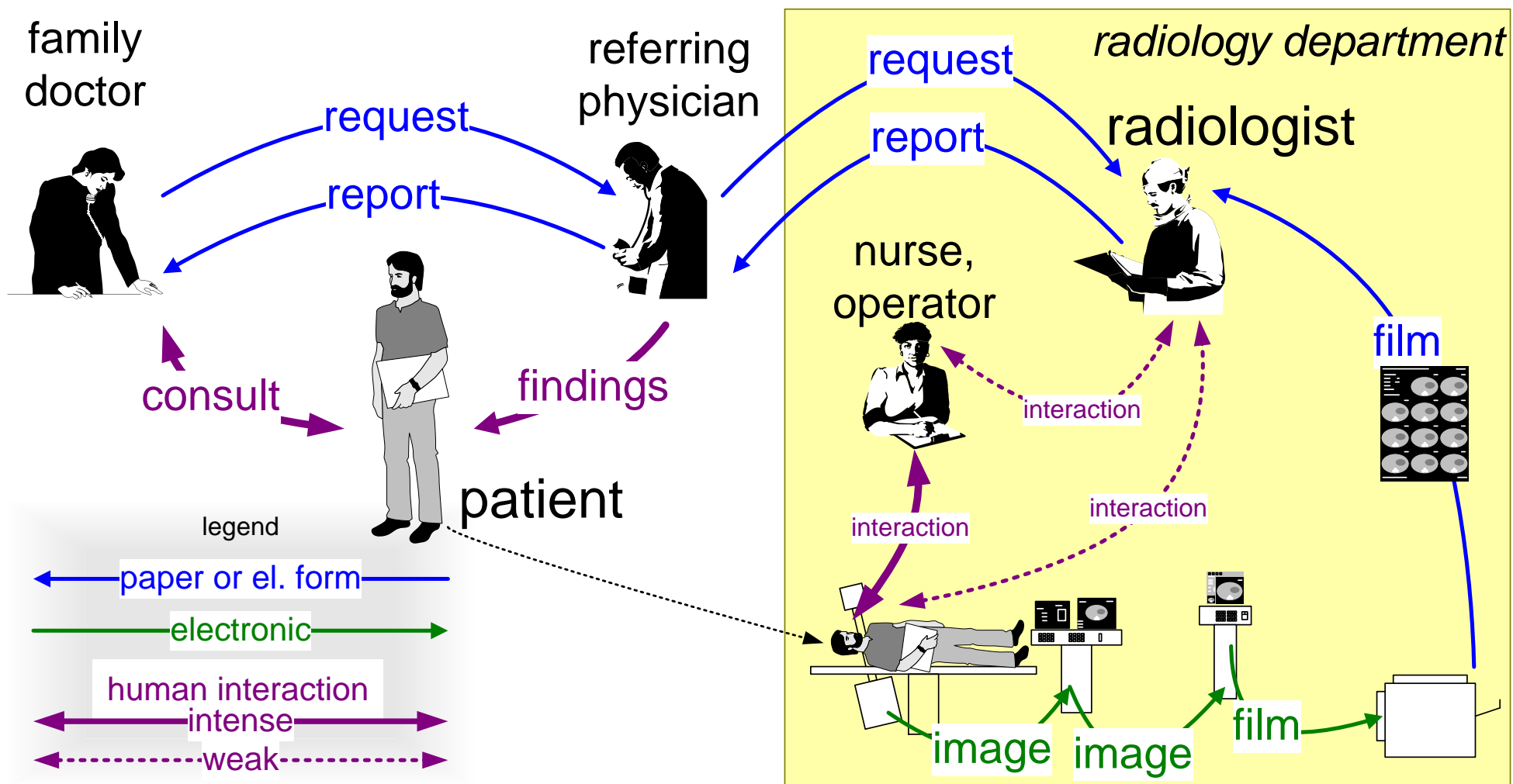
End-to-end performance "emerges" from performance of interoperating systems and humans

Any mismatch in  
connectivity or *interoperability*  
shows up first as  
*functionality* or *performance* problem  
and then as  
intermittent *reliability*  
(or safety, security, availability) problem

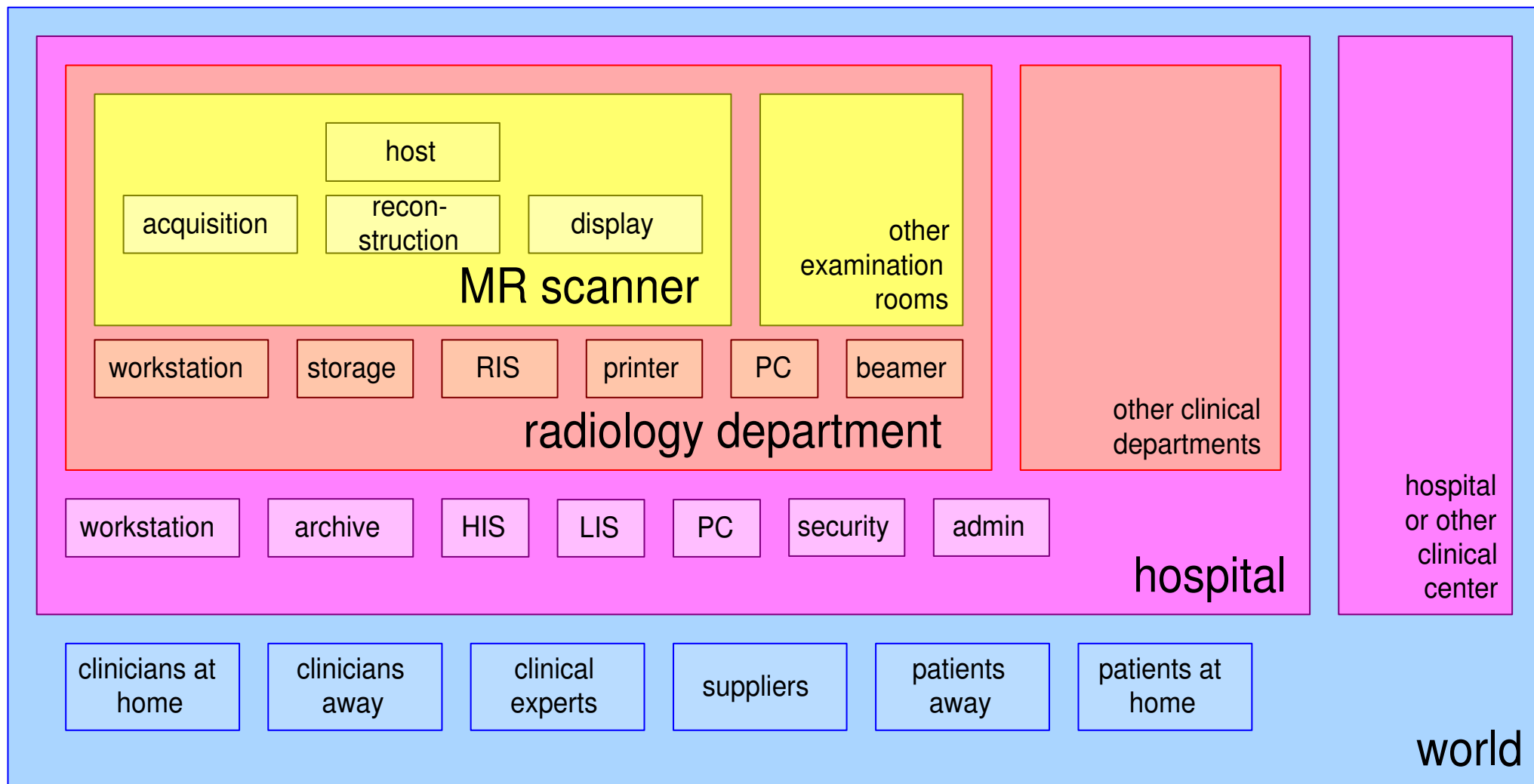
# Figure Of Contents™



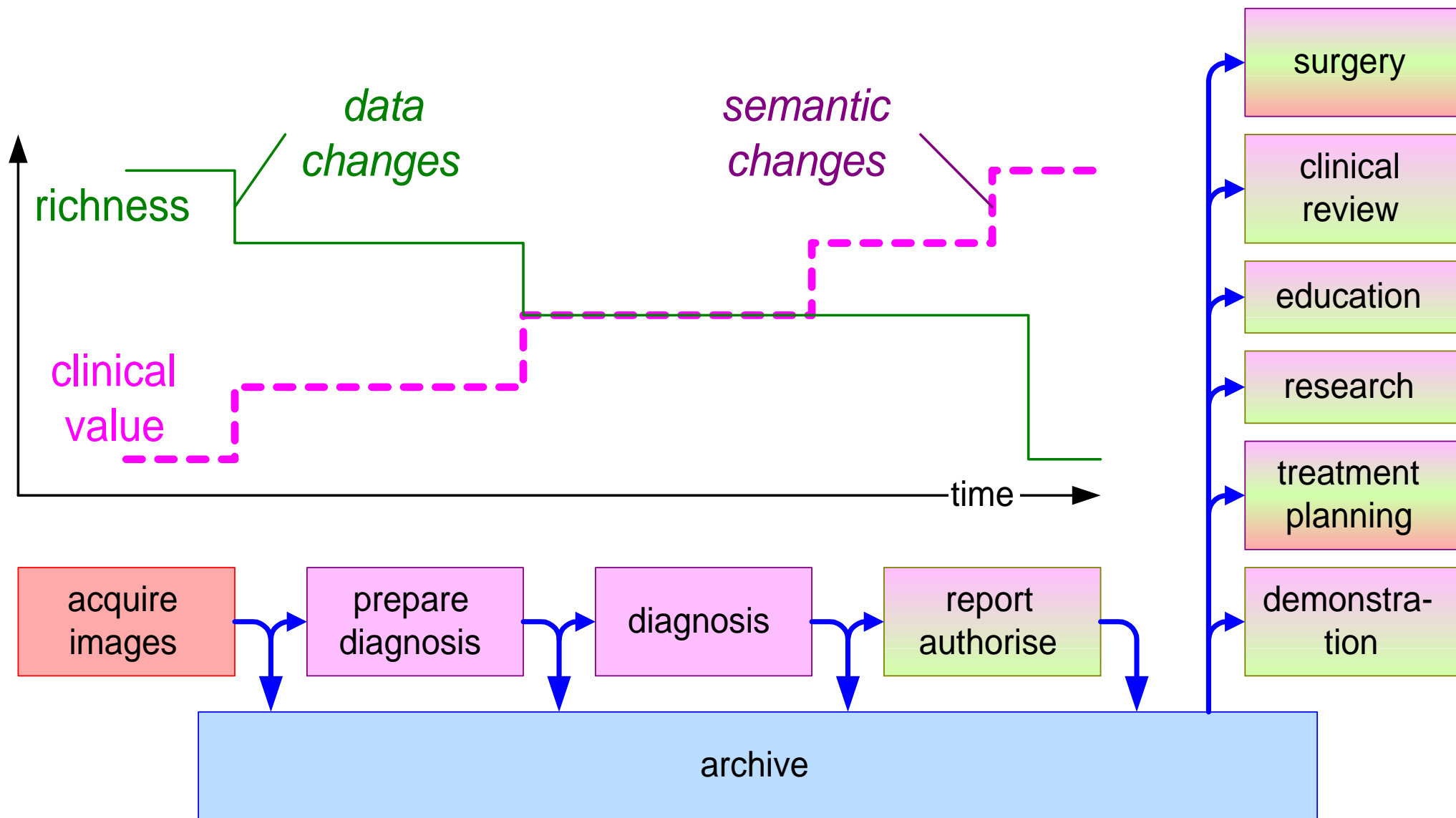
# Health Care Work Flow



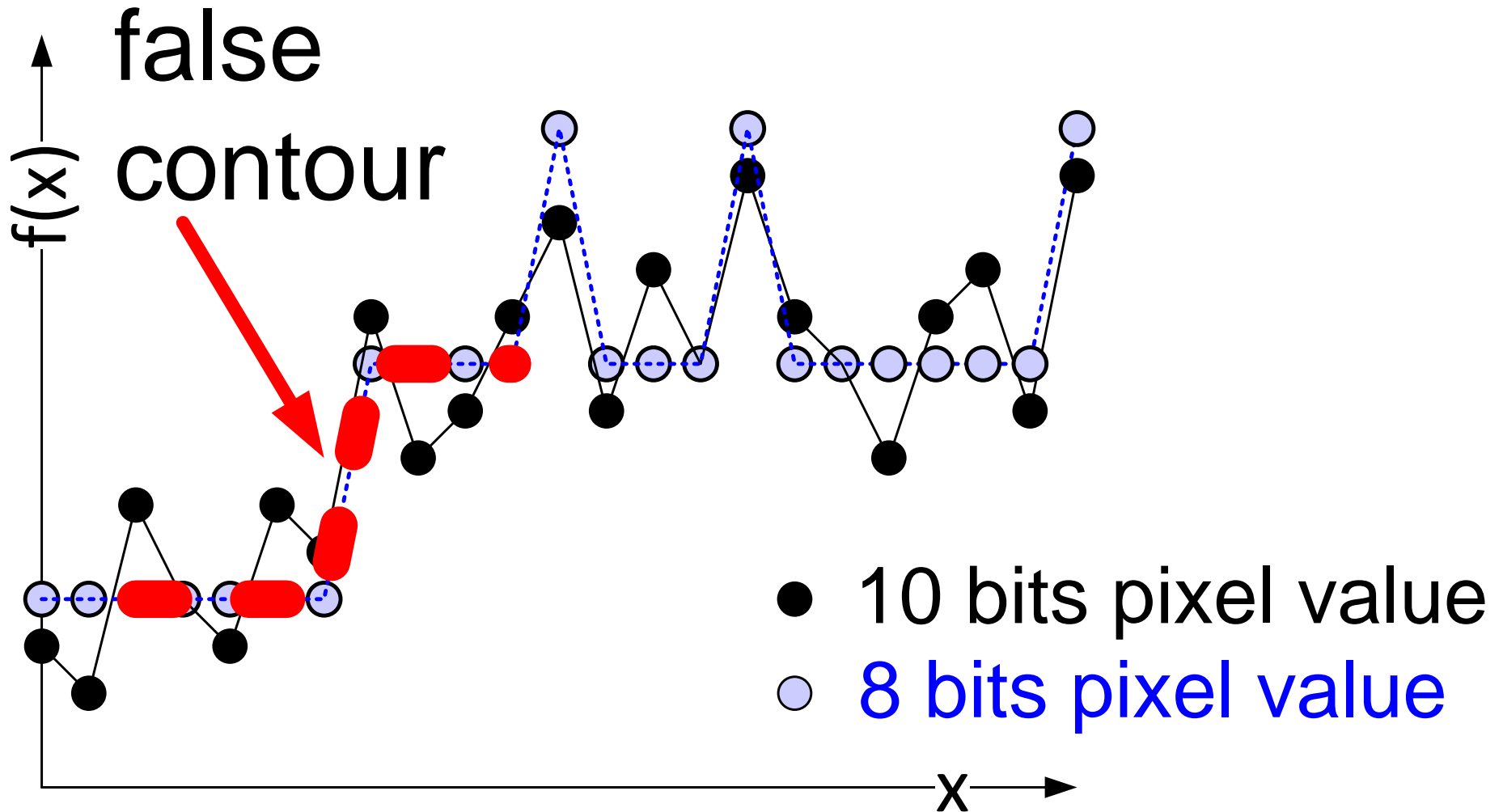
# Scopes of Interoperability



# Clinical Process Triggers Data and Semantic Changes

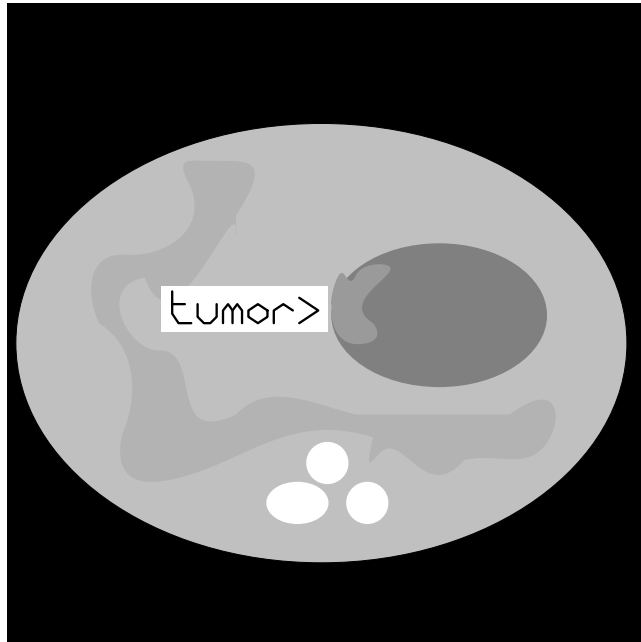


# Example of Semantic Safety Problem

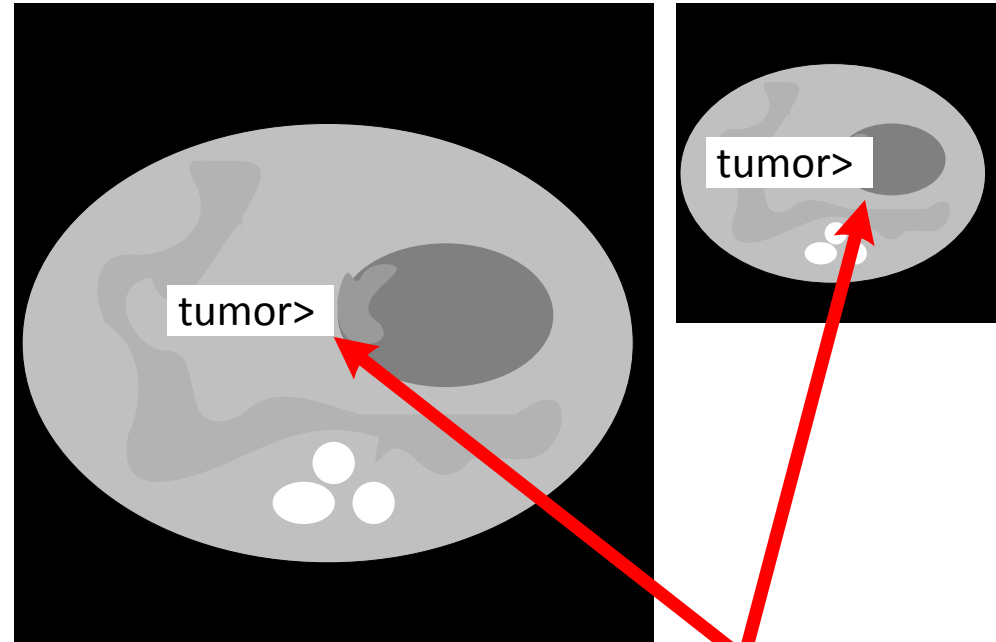




# Example of Data Processing Safety Problem



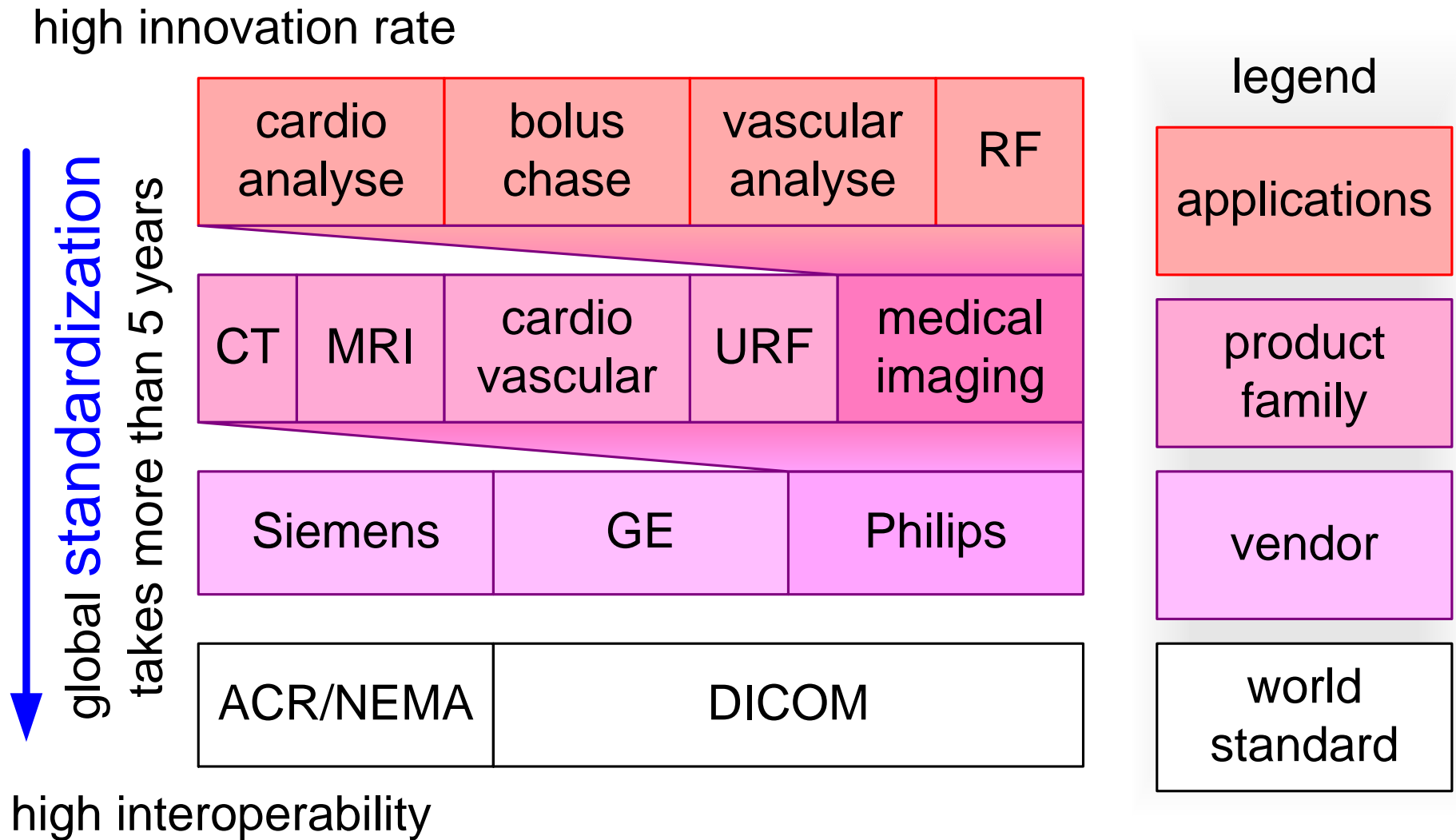
URF monitor output:  
fixed size letters at fixed grid



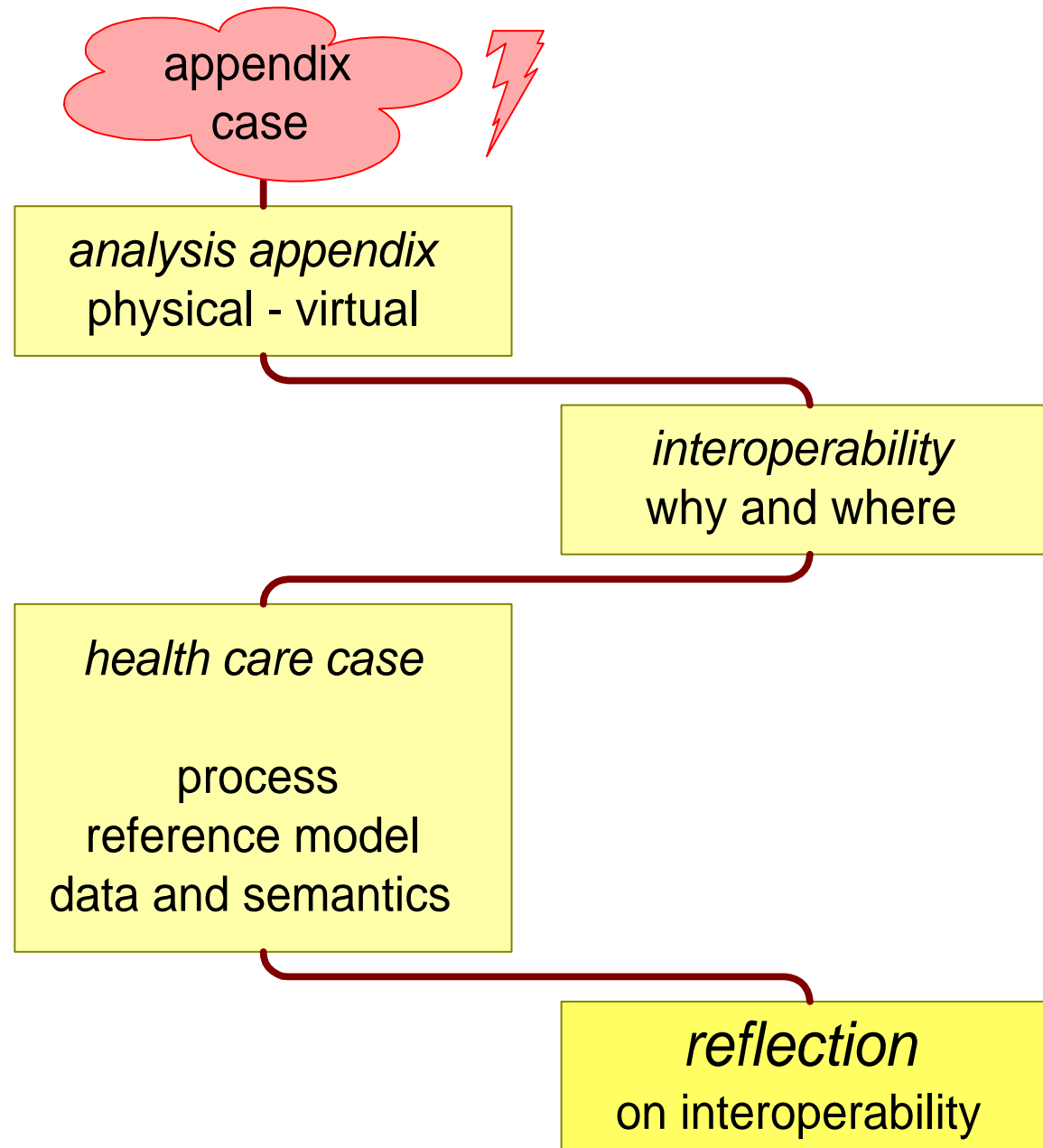
for user readability the font-size was determined "intelligently"; causing a dangerous mismatch between text and image

EV output: scaleable fonts in graphics overlay

# Innovation and Interoperability



# Figure Of Contents™



# Many Dimensions of Interoperability

integrating **multiple**

applications

clinical analysis  
clinical support  
administrative  
financial  
workflow

in **multiple**

languages

cultures

USA, UK,  
China, India,  
Japan, Korea  
France, Germany  
Italy, Mexico

delivered by **multiple**

vendors

Philips  
GE  
Siemens

based on **multiple**

media, networks

DVD+RW  
memory stick  
memory cards  
bluetooth  
11a/b/g  
UTMS

and **multiple**

standards

Dicom  
HL7  
XML

and **multiple**

releases

R5  
R6.2  
R7.1

many small *interoperability* faults

may create

huge *reliability* problems

mission accomplished.....

....but did we execute the right mission?

to create reliable end-to-end performance

we need to understand the

dynamic interoperation

of many systems and humans