PREMIS PREservation Metadata Implementation Strategies

Describing Digital Object Environments in PREMIS

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Environment

- Software
- Hardware
- A format
- A document
  - A policy document
  - A manual
  - Documentation
- A cheat sheet
- A user behaviour study
- A process
- “Other representation information”

Goal

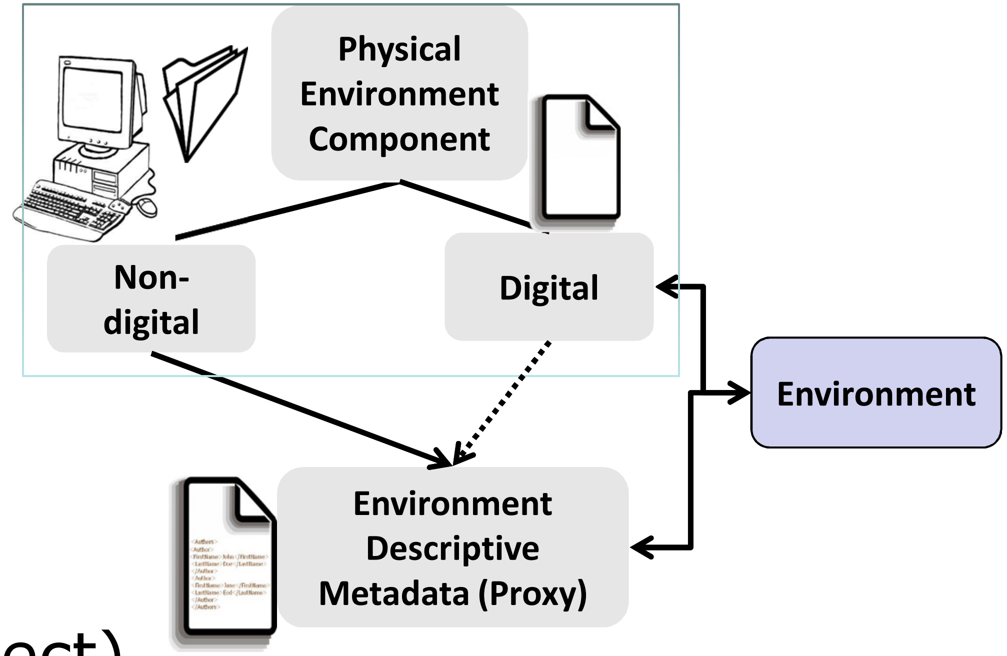
- High-level data model for Environments
- Capture the required relationships to other DP entities
- Capture desirable characteristics
- Standardized way of treating Environments
- Information sharing / exchange
- Repositories and registries

- Not:
  modelling the internals of a given
  Environment category – as e.g. TOTEM

Guidelines

- **Backward compatibility**
- **Compliance with OAIS**
- **Straightforward semantics**
  - **easy to implement**
- **Clear mapping of historic to new Environment features**
  PREMIS 2 -> PREMIS 3

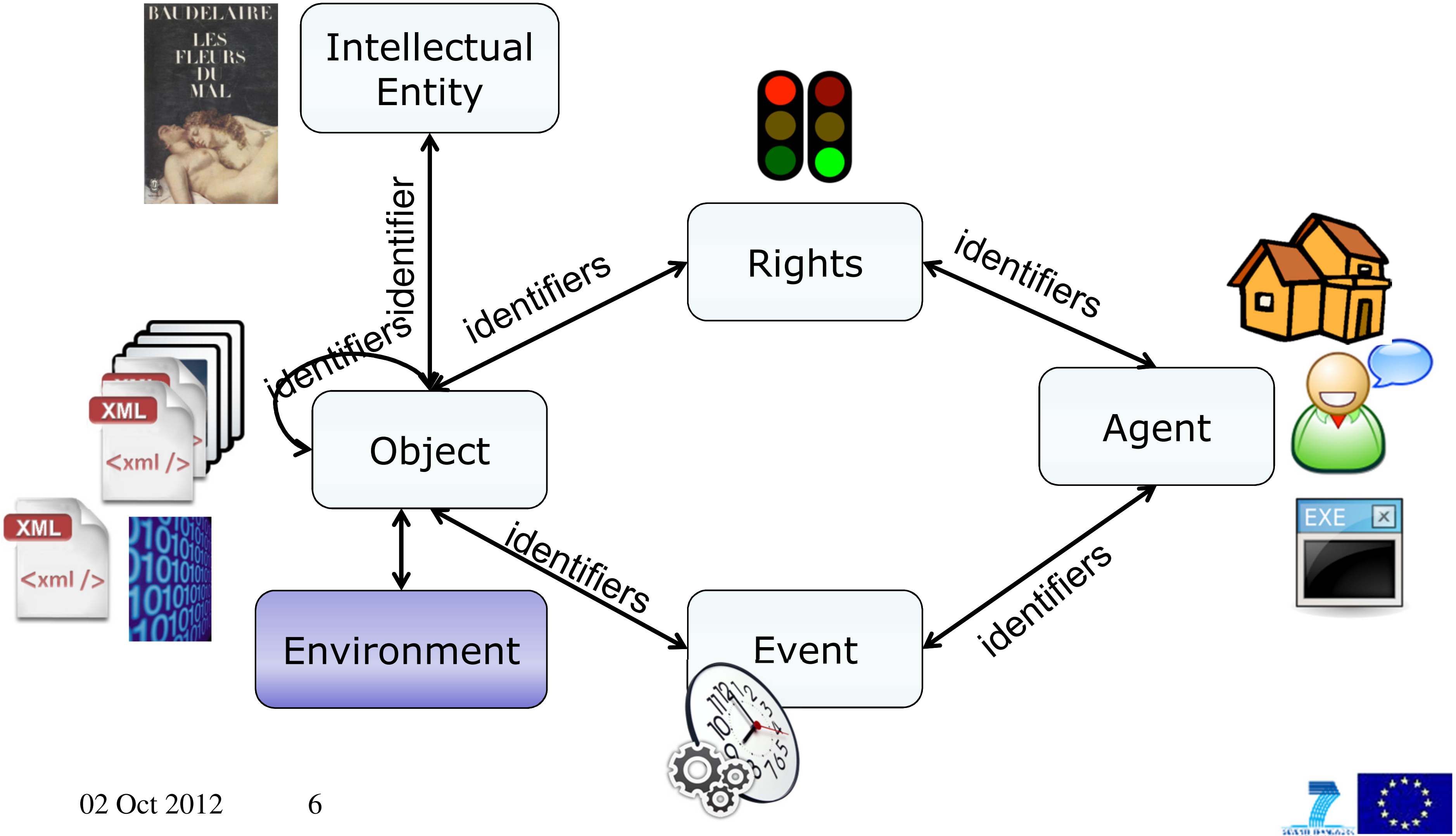
Requirements


Physical Environment Component
Non-digital
Digital
Environment
Environment Descriptive Metadata (Proxy)

- ❑ **Environments may be digital or non-digital**
- ❑ **Environments may be generic or instances** (abstract description or concrete digital object)
- ❑ **Environments may be tools or services**
- ❑ **Environments have no simple software / hardware distinction** (Virtual machines blur the distinction)

The PREMIS Data Model

Slide by S. Peyrard



Example: Object Entity

Main types of information

- identifier
- technical object characteristics
- creation information
- software and hardware environment
- digital signatures
- relationships to other objects
- links to other types of entity

PREMIS – Environment Metadata

1.5.5 creatingApplication

1.5.5.1 creatingApplicationName
1.5.5.2 creatingApplicationVersion
1.5.5.3 dateCreatedByApplication
1.5.5.4 creatingApplicationExtension

Gap Analysis

- OAIS focus on Object:
  - Creating Applications are Environments
  - Life-cycle view treating Environments uniformly

Semantic Unit: Environment

- What is needed to render or use an object
  - Operating system
  - Application software
  - Computing resources

PREMIS – Environment Metadata

1.8 **environment**

- 1.8.1 environmentCharacteristic
- 1.8.2 environmentPurpose
- 1.8.3 environmentNote

1.8.4 **dependency**

1.8.4.1 dependencyName

1.8.4.2 dependencyIdentifier

1.8.4.2.1 dependencyIdentifierType

1.8.4.2.2 dependencyIdentifierValue

1.8.5 **software**

1.8.5.1 swName

1.8.5.2 swVersion

1.8.5.3 swType

1.8.5.4 swOtherInformation

1.8.5.5 swDependency

1.8.6 **hardware**

1.8.6.1 hwName

1.8.6.2 hwType

1.8.6.3 hwOtherInformation

1.8.7 environmentExtension

Environment Example: PDF File

environmentCharacteristic = known to work

environmentPurpose = render

hardware/hwName = Intel Pentium II

hardware/hwType = processor

dependency/dependencyName= Mathematica 5.2
True Type math fonts

software/swName = Adobe Acrobat Reader

software/swVersion = 6.1

software/swType = renderer

software/swDependency = Windows NT

software/swName = Windows NT

software/swVersion = 5.0

software/swType = operatingSystem

Gap Analysis – Environment Subordinate to Object

- **Solution too specific**
  Too complex to handle in an Object repository.
- **Solution too redundant**
  Rarely specific to a single Object.
  Redundancy results in
  - Unnecessary verbosity;
  - Cumbersome management of Environment descriptions as they evolve.
- **Unable to describe stand-alone Environments**
  Independent of Objects -> Registry
  Repositories and registries need to speak the same language

➢ Solution: Environment as first class entities

Gap Analysis – Scope

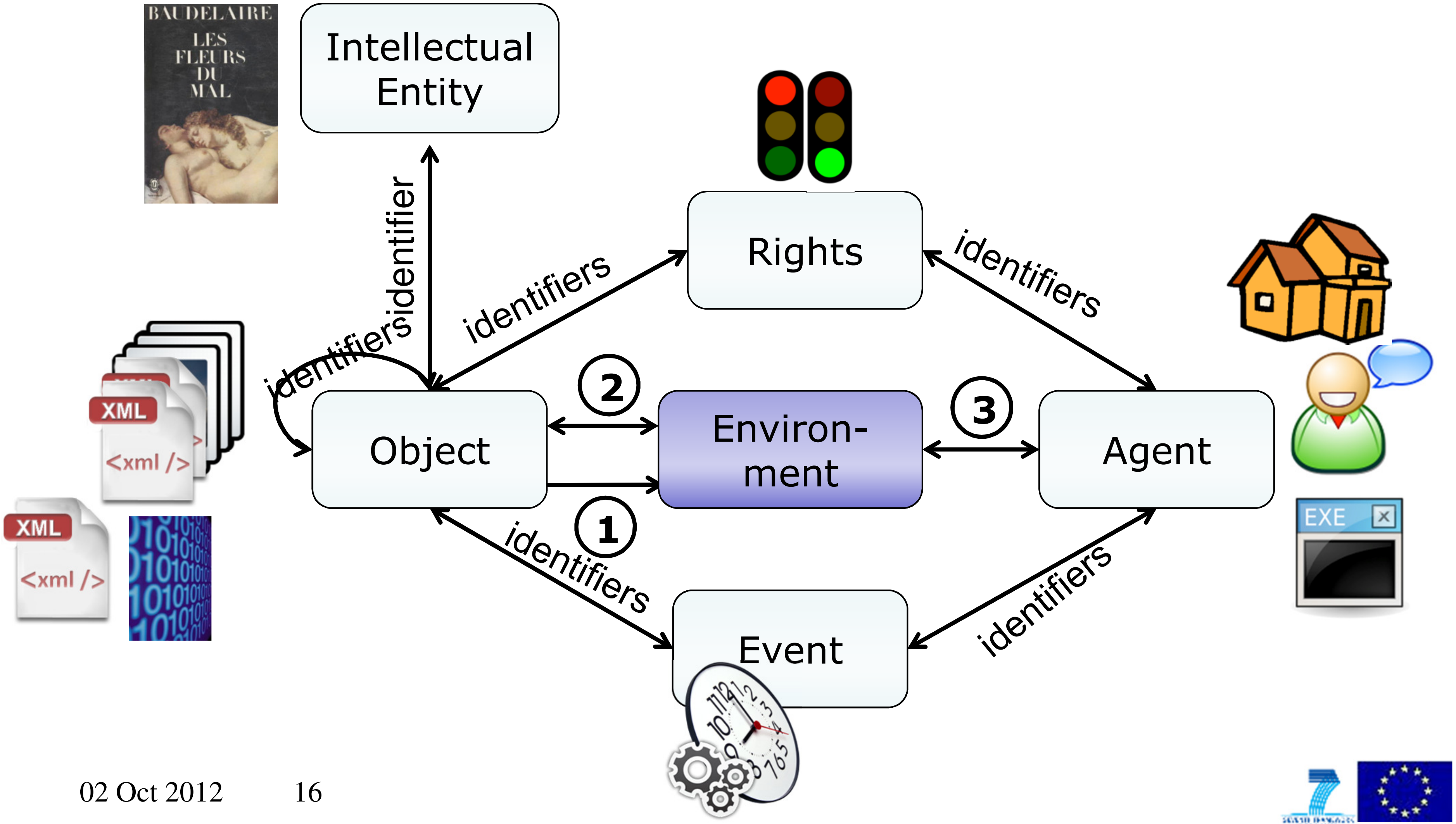
- **Primarily applicable to computing environments** (technical level).
- **No representation information in the broader sense.**
- **No explicit possibility to document the nature of dependencies**
  (e.g. operating systems to hardware).
- **No links to registry descriptions other than file formats.**
- **Specification of versions for software, but not for hardware.**

Gap Analysis - Relationships

- **Not generic enough: Environments**
  - Can be related to Objects
  - Can be Objects that need to be preserved
  - Can be software Agents in an Events object

The PREMIS Data Model

Slide adapted from S. Peyrard



Intellectual Entity

Rights

Object

Environ-ment

Agent

Event

identifier

identifiers

identifiers

identifiers

identifiers

identifiers

1

2

3

Gap Analysis - Relationships

- **Not generic enough: Environments**
  - Can be related to Objects
  - Can be Objects that need to be preserved
  - Can be software Agents in an Events object

- **Environments may link to other Environments**
  - E.g. software application linking to its hardware platform

The PREMIS Data Model

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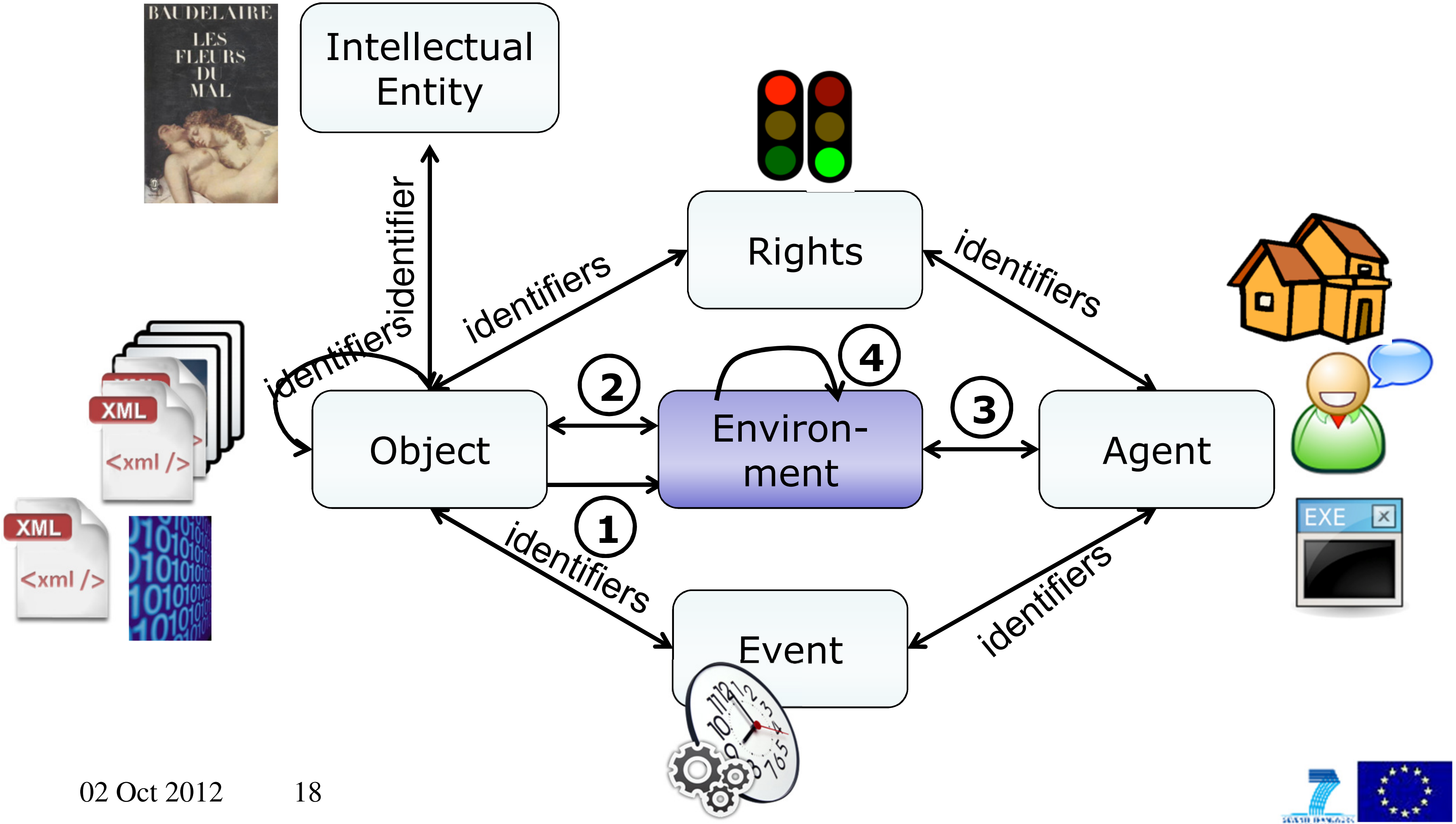
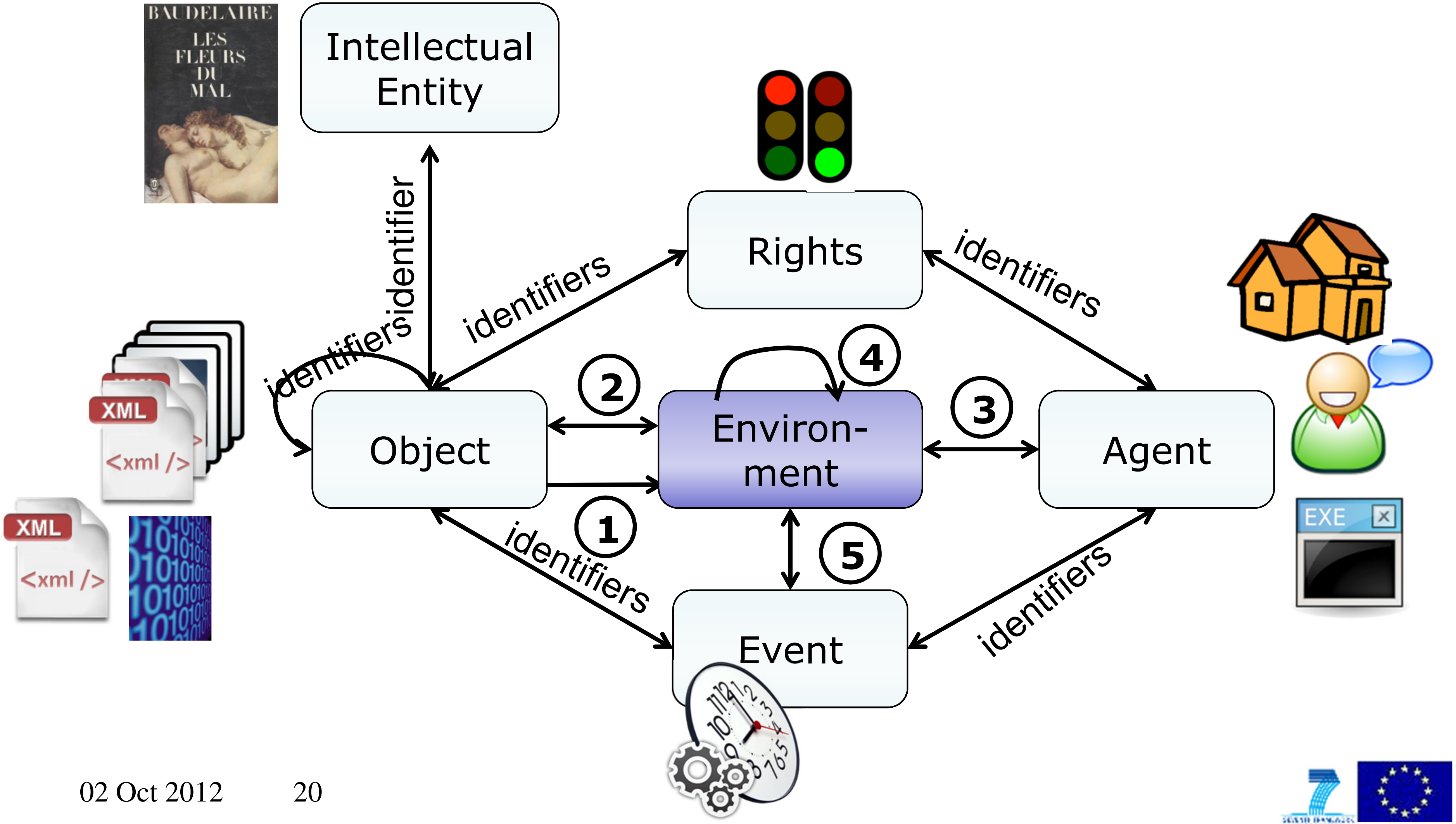


Gap Analysis - Relationships

- **Not generic enough: Environments**
  - Can be related to Objects
  - Can be Objects that need to be preserved
  - Can be software Agents in an Events object
- **Environments may link to other Environments**
  - E.g. software application linking to its hardware platform
- **Environments may link to Events**
  - Creation, adding memory, …
  - Environments may need to be versioned

The PREMIS Data Model

Slide adapted from S. Peyrard



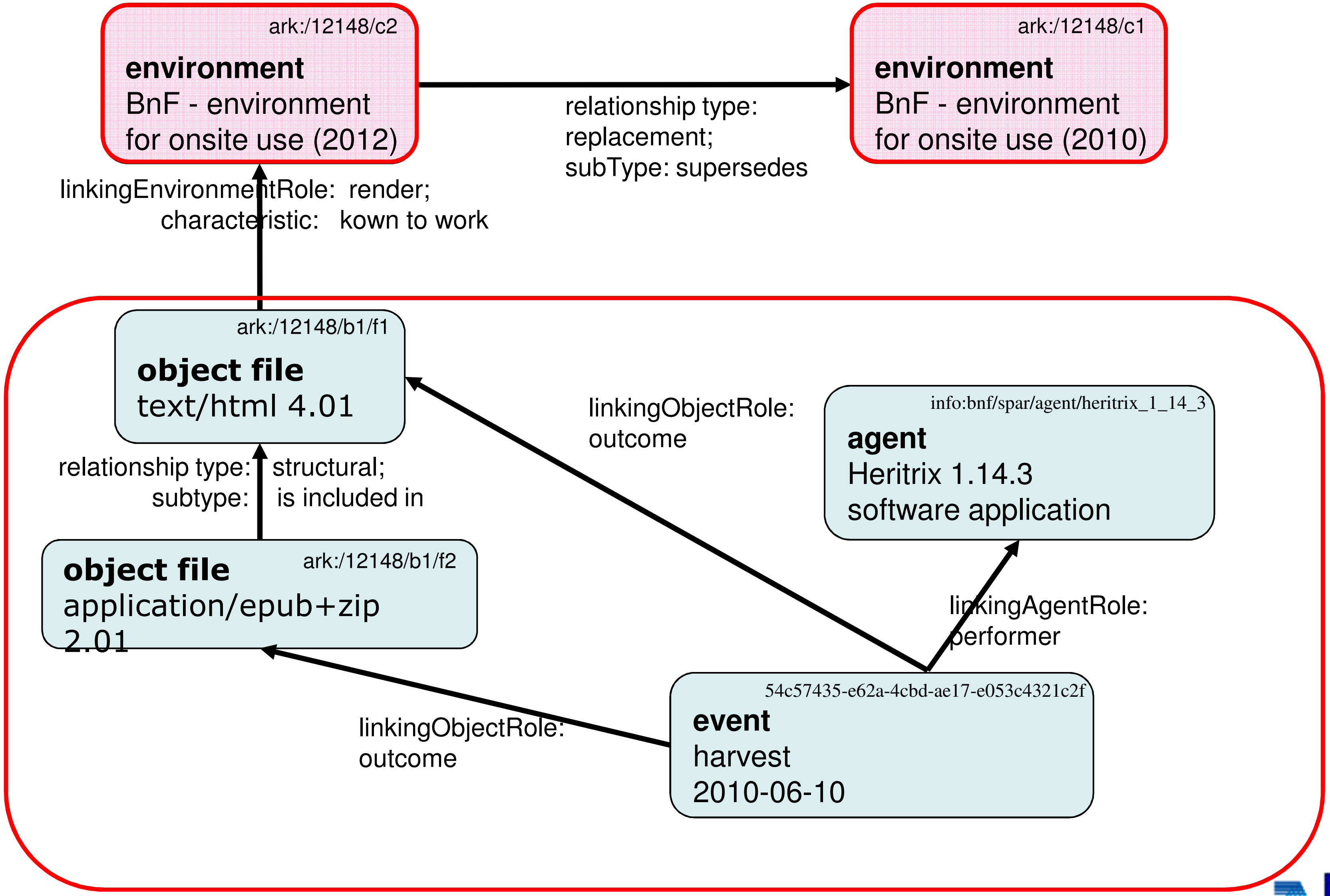
PREMIS Environments in action

3 use cases

Use case 1: Web archives rendering environment

- The national Library of France uses an environment to render its Web archives
- This environment will need periodical updates
- E.g. the browser used (Firefox 2) does not manage ePubs
    - need to update the environment so that it can render the ePub directly with an EPUBReader plugin

Macro view



ark:/12148/c2
environment
BnF - environment
for onsite use (2012)

relationship type:
replacement;
subType: supersedes

ark:/12148/c1
environment
BnF - environment
for onsite use (2010)

linkingEnvironmentRole: render;
characteristic: kown to work

ark:/12148/b1/f1
object file
text/html 4.01

relationship type: structural;
subtype: is included in

object file
ark:/12148/b1/f2
application/epub+zip
2.01

linkingObjectRole:
outcome

info:bnf/spar/agent/heritrix_1_14_3
agent
Heritrix 1.14.3
software application

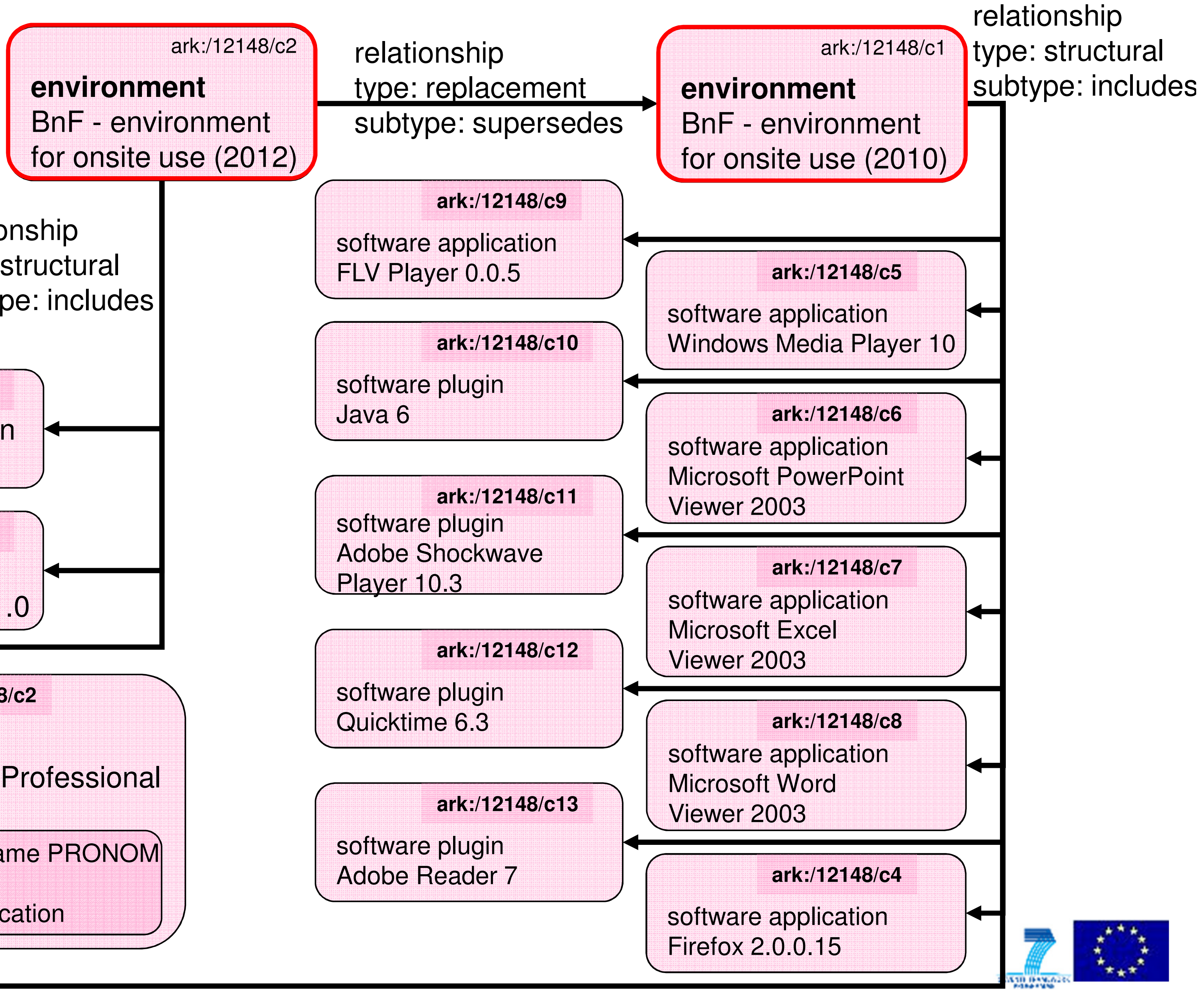
linkingAgentRole:
performer

linkingObjectRole:
outcome

54c57435-e62a-4cbd-ae17-e053c4321c2f
event
harvest
2010-06-10

PREMIS PREservation Metadata Implementation Strategies

Inclusion links



ark:/12148/c2
environment
BnF - environment
for onsite use (2012)

relationship
type: replacement
subtype: supersedes

ark:/12148/c1
environment
BnF - environment
for onsite use (2010)

relationship
type: structural
subtype: includes

relationship
type: structural
subtype: includes

ark:/12148/c14
software application
Firefox 10.0

ark:/12148/c15
software plugin
EPUBReader 1.4.1.0

ark:/12148/c2
operating system
Windows NT / XP Professional
Service pack 2

prototype:registryName PRONOM
registryKey: x-sfw-8
registryRole: specification

ark:/12148/c9
software application
FLV Player 0.0.5

ark:/12148/c10
software plugin
Java 6

ark:/12148/c11
software plugin
Adobe Shockwave
Player 10.3

ark:/12148/c12
software plugin
Quicktime 6.3

ark:/12148/c13
software plugin
Adobe Reader 7

ark:/12148/c5
software application
Windows Media Player 10

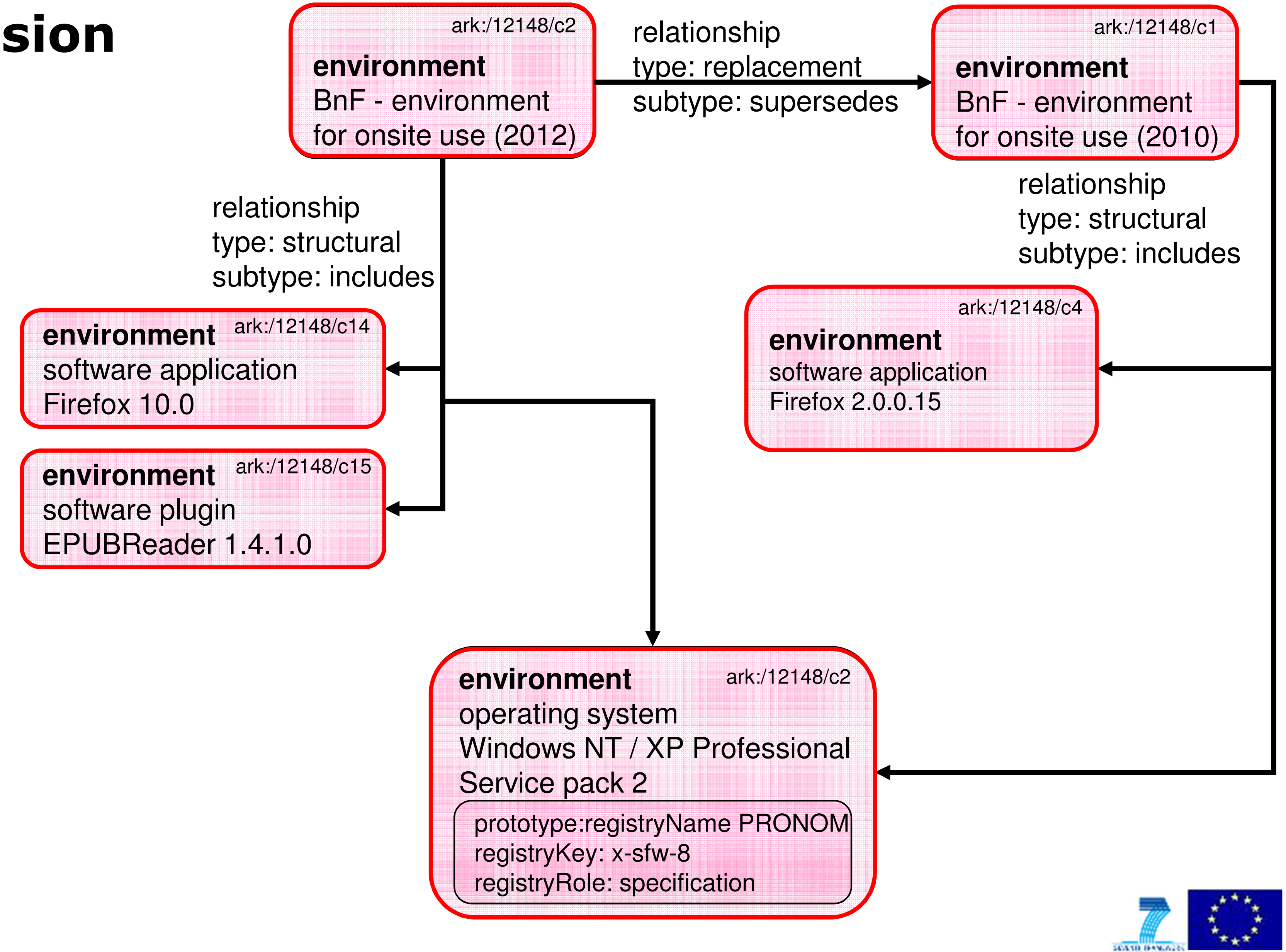
ark:/12148/c6
software application
Microsoft PowerPoint
Viewer 2003

ark:/12148/c7
software application
Microsoft Excel
Viewer 2003

ark:/12148/c8
software application
Microsoft Word
Viewer 2003

ark:/12148/c4
software application
Firefox 2.0.0.15

Inclusion links



ark:/12148/c2
environment
BnF - environment for onsite use (2012)

relationship
type: replacement
subtype: supersedes

ark:/12148/c1
environment
BnF - environment for onsite use (2010)

relationship
type: structural
subtype: includes

environment ark:/12148/c14
software application
Firefox 10.0

environment ark:/12148/c15
software plugin
EPUBReader 1.4.1.0

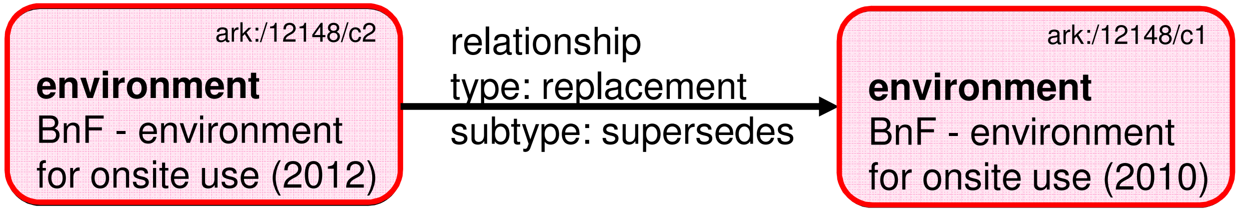
relationship
type: structural
subtype: includes

ark:/12148/c4
environment
software application
Firefox 2.0.0.15

environment ark:/12148/c2
operating system
Windows NT / XP Professional
Service pack 2

prototype:registryName PRONOM
registryKey: x-sfw-8
registryRole: specification

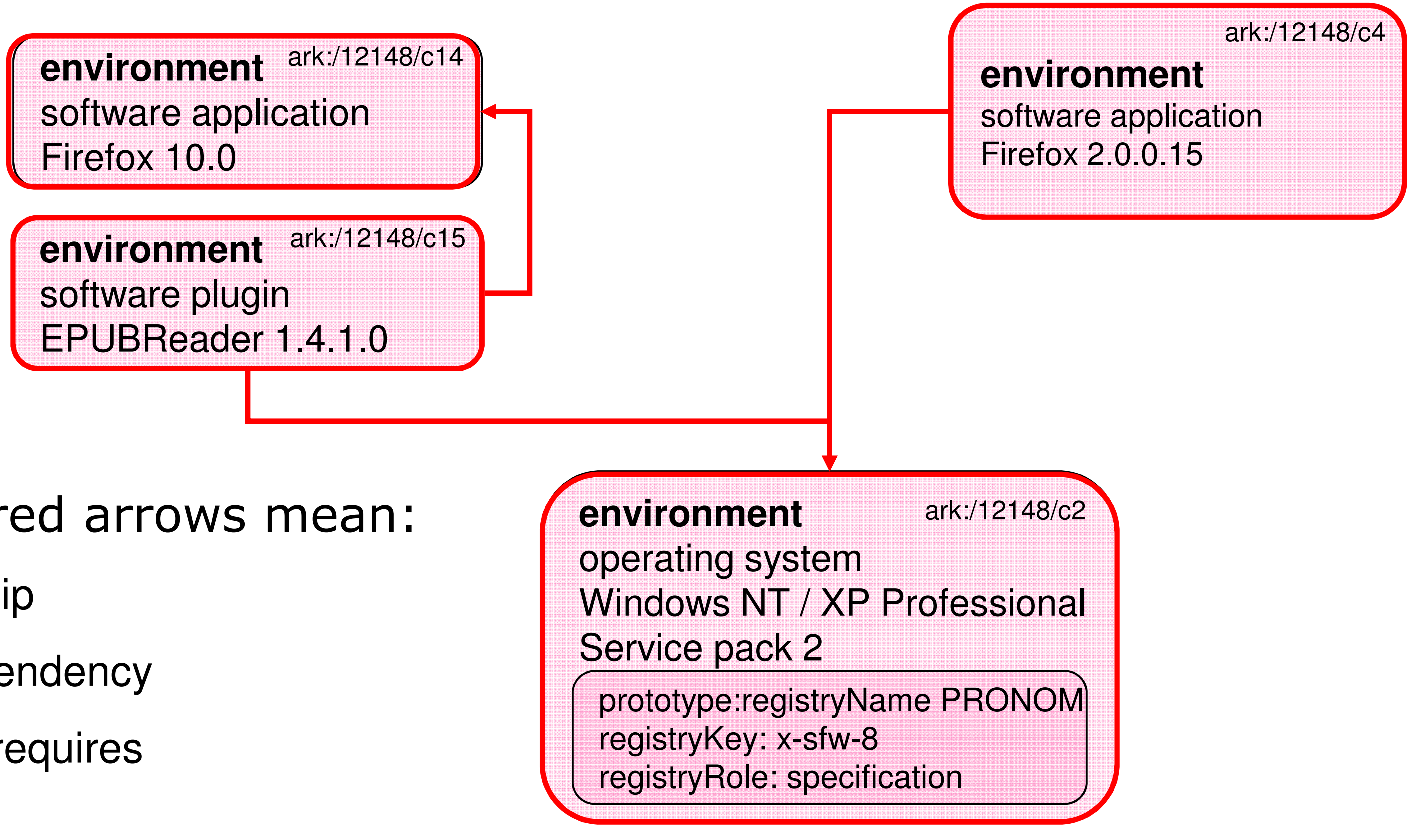
Dependency links



ark:/12148/c2
environment
BnF - environment for onsite use (2012)

relationship
type: replacement
subtype: supersedes

ark:/12148/c1
environment
BnF - environment for onsite use (2010)



environment ark:/12148/c14
software application
Firefox 10.0

environment ark:/12148/c15
software plugin
EPUBReader 1.4.1.0

ark:/12148/c4
environment
software application
Firefox 2.0.0.15

environment ark:/12148/c2
operating system
Windows NT / XP Professional
Service pack 2

prototype:registryName PRONOM
registryKey: x-sfw-8
registryRole: specification

All the red arrows mean:

relationship

type: dependency

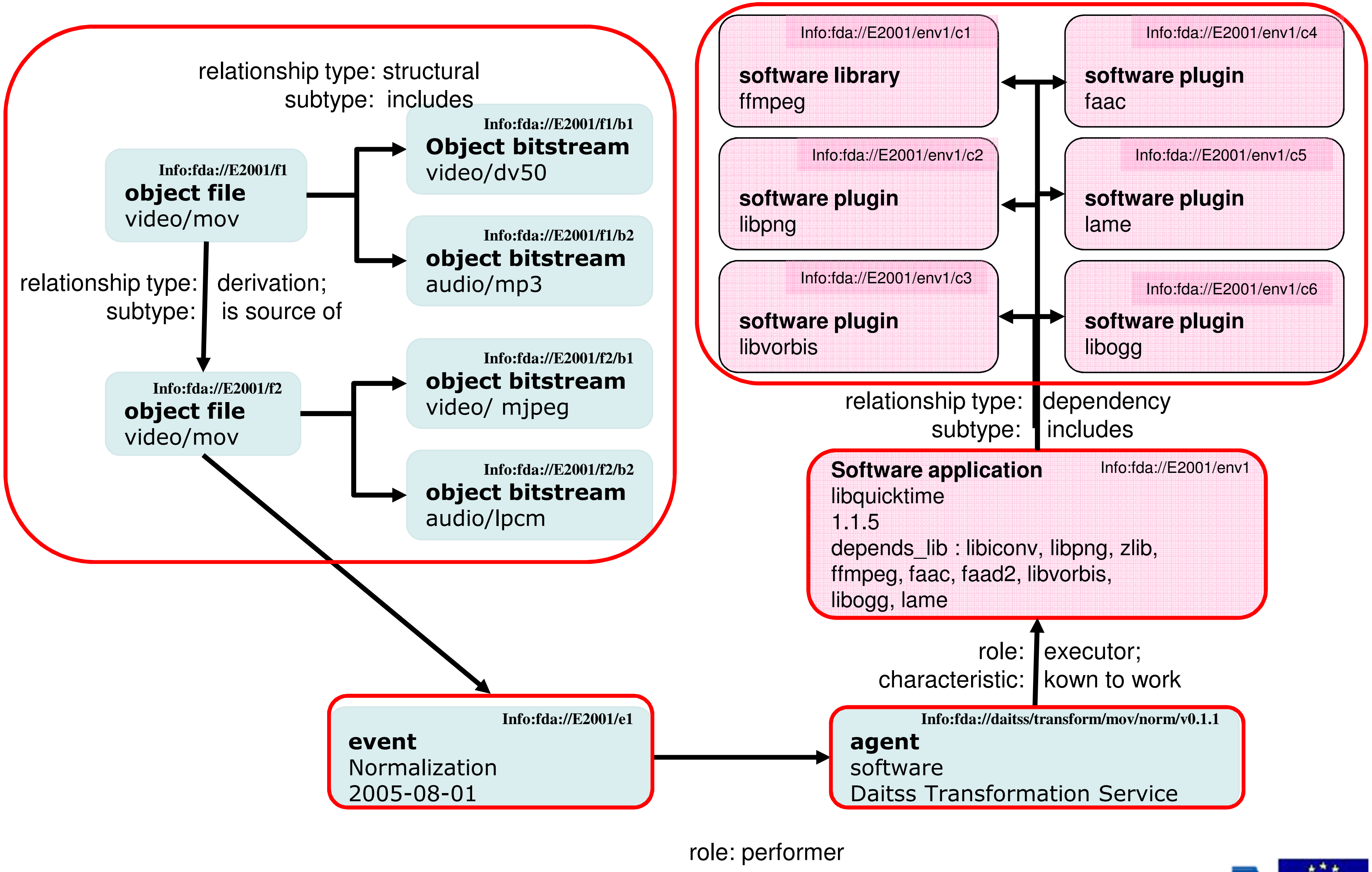
subtype: requires

Why PREMIS 3

- The environment description can be **modularized** and **shared** across different objects
- Express relationships between environments:
  - **whole/part**: environments can bundle together different pieces of environments
  - **replacement**: environments can be superseded by more recent ones
  - **dependency**: environments can be related to other environment that support their use
- Possibility to associate a **registryKey** with an environment

Use Case 2: Documenting Environment Used by a Format Transformation Service

- Upon Ingesting, Quicktime files with various video and audio encodings are normalized into Quicktime files with MJPEG video with lpcm audio.
- The software used for the Quicktime format normalization, i.e., libquicktime, has dependency on other software libraries and codec plugin.
- Need to record the environment for the format normalization tool so that it can be reproduced on a different server or institution.



relationship type: structural
subtype: includes

Info:fda://E2001/f1
object file
video/mov

Info:fda://E2001/f1/b1
Object bitstream
video/dv50

Info:fda://E2001/f1/b2
object bitstream
audio/mp3

relationship type: derivation;
subtype: is source of

Info:fda://E2001/f2
object file
video/mov

Info:fda://E2001/f2/b1
object bitstream
video/ mjpeg

Info:fda://E2001/f2/b2
object bitstream
audio/lpcm

Info:fda://E2001/env1/c1
software library
ffmpeg

Info:fda://E2001/env1/c4
software plugin
faac

Info:fda://E2001/env1/c2
software plugin
libpng

Info:fda://E2001/env1/c5
software plugin
lame

Info:fda://E2001/env1/c3
software plugin
libvorbis

Info:fda://E2001/env1/c6
software plugin
libogg

relationship type: dependency
subtype: includes

Software application Info:fda://E2001/env1
libquicktime
1.1.5
depends_lib : libiconv, libpng, zlib, ffmpeg, faac, faad2, libvorbis, libogg, lame

role: executor;
characteristic: kown to work

Info:fda://E2001/e1
event
Normalization
2005-08-01

Info:fda://daitss/transform/mov/norm/v0.1.1
agent
software
Daitss Transformation Service

role: performer

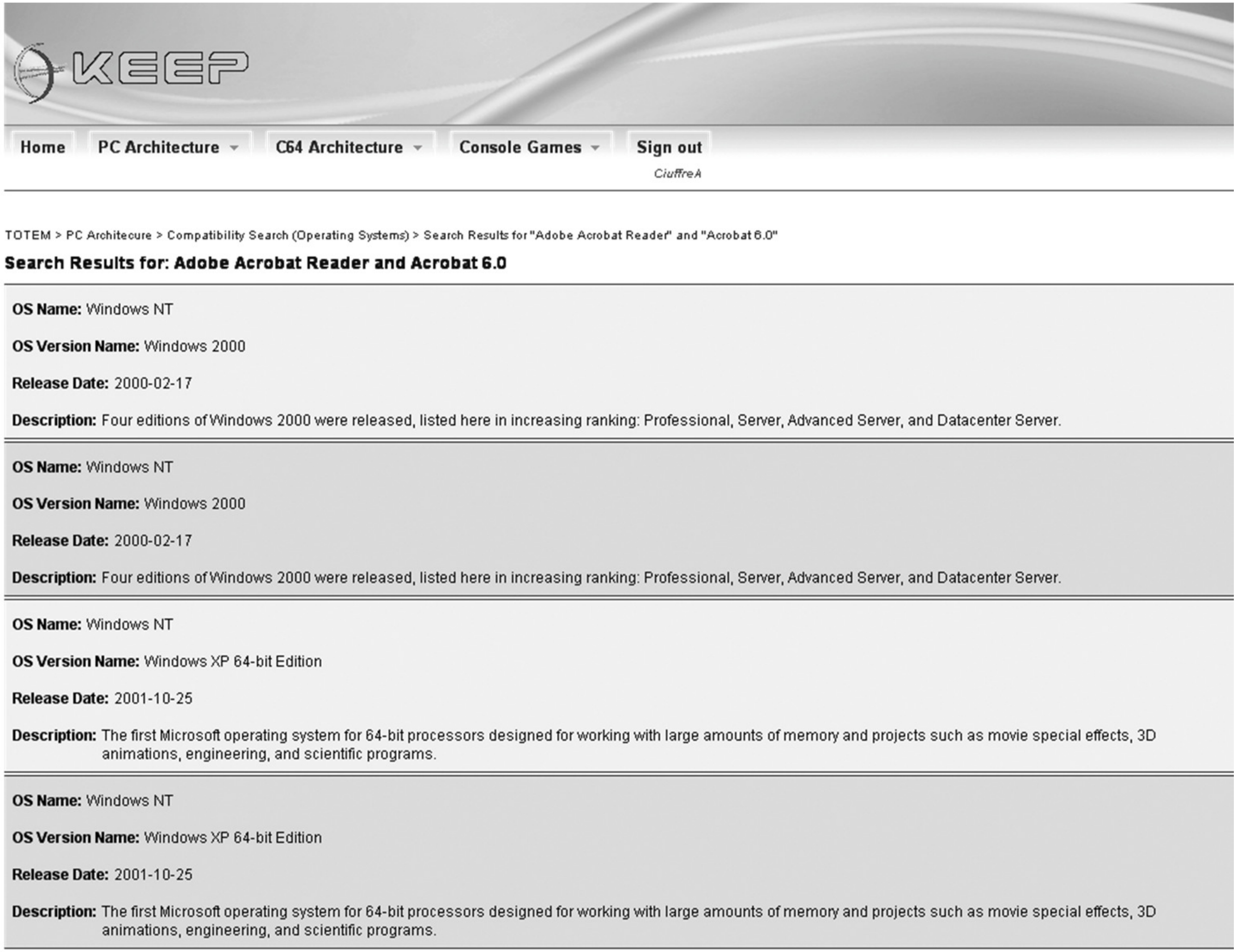
Why PREMIS 3

- In PREMIS 2, software used by Agent can only be described in AgentNote with broad granularity.
- Decouple PREMIS Agent from Environment related information.
- Environment can be versioned and maintained separately from Agent.
- Allow different granularity for recording environment information.

Use Case 3: Environment Used for emulation preservation action

- Example from DNB for EC KEEP project. Digital Object is radar simulation for racing boat training package (1999). Vague systems requirements in catalogue metadata: **PC (hardware) and MSDOS (operating system)**
- For emulation there are two issues: we need **versions**, and they need to be **compatible**. These can be found in **TOTEM http://www.keep-totem.co.uk/ .** Several iterations?
- **Hardware emulators** and if necessary, **software emulators** can then be specified.
- We need an **emulation platform**, e.g. KEEP Emulation framework (EF) **http://emuframework.sourceforge.net/** to run these emulators.
- Finally need **reading room environment to run this EF**.

Trustworthy Online Technical Environment Metadata (TOTEM) compatibility search



TOTEM > PC Architecure > Compatibility Search (Operating Systems) > Search Results for "Adobe Acrobat Reader" and "Acrobat 6.0"

Search Results for: Adobe Acrobat Reader and Acrobat 6.0

OS Name: Windows NT

OS Version Name: Windows 2000

Release Date: 2000-02-17

Description: Four editions of Windows 2000 were released, listed here in increasing ranking: Professional, Server, Advanced Server, and Datacenter Server.

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OS Version Name: Windows 2000

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Description: Four editions of Windows 2000 were released, listed here in increasing ranking: Professional, Server, Advanced Server, and Datacenter Server.

OS Name: Windows NT

OS Version Name: Windows XP 64-bit Edition

Release Date: 2001-10-25

Description: The first Microsoft operating system for 64-bit processors designed for working with large amounts of memory and projects such as movie special effects, 3D animations, engineering, and scientific programs.

OS Name: Windows NT

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Release Date: 2001-10-25

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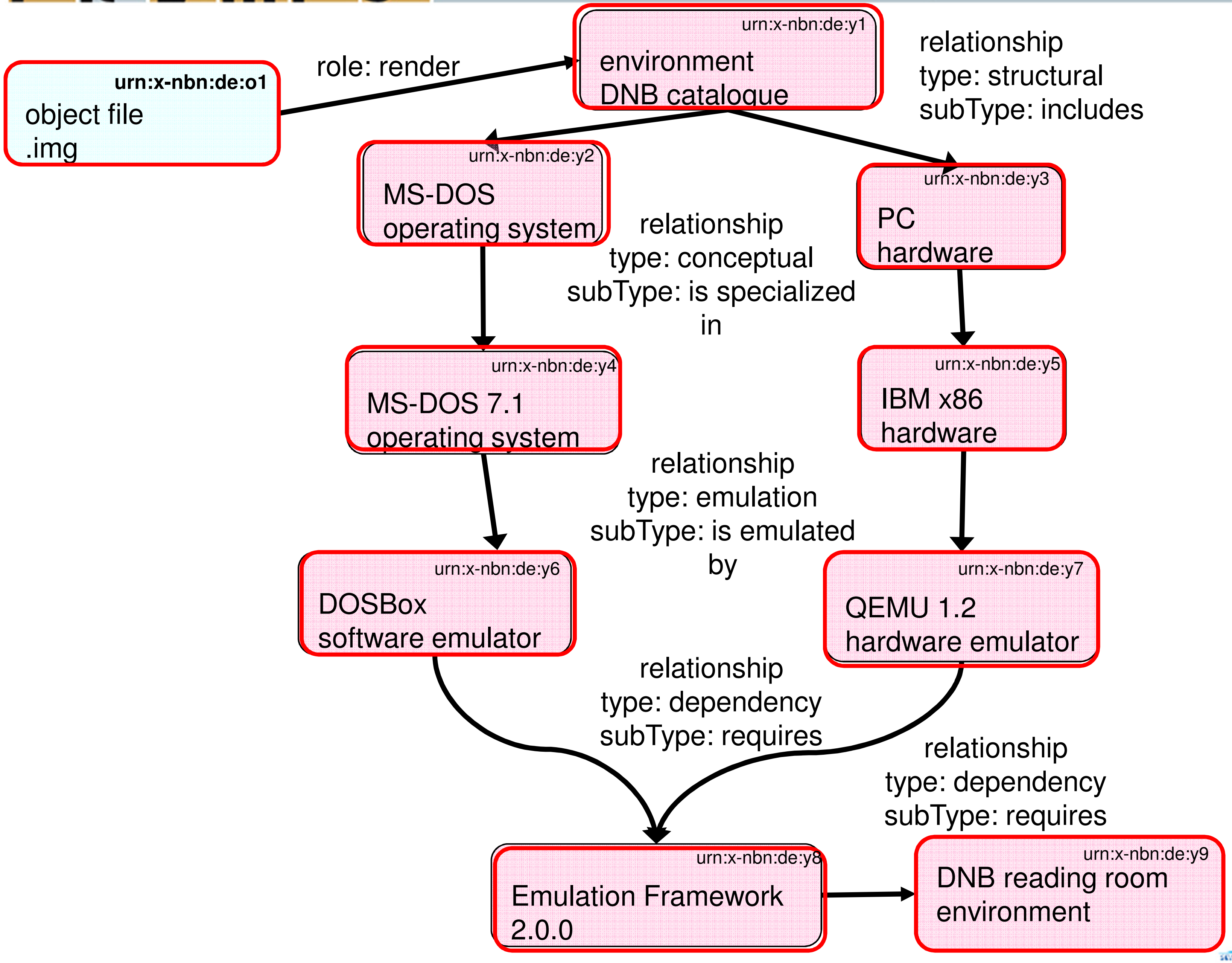

urn:x-nbn:de:o1
object file
.img

role: render

urn:x-nbn:de:y1
environment
DNB catalogue

relationship
type: structural
subType: includes

urn:x-nbn:de:y2
MS-DOS
operating system

urn:x-nbn:de:y3
PC
hardware

relationship
type: conceptual
subType: is specialized
in

urn:x-nbn:de:y4
MS-DOS 7.1
operating system

urn:x-nbn:de:y5
IBM x86
hardware

relationship
type: emulation
subType: is emulated
by

urn:x-nbn:de:y6
DOSBox
software emulator

urn:x-nbn:de:y7
QEMU 1.2
hardware emulator

relationship
type: dependency
subType: requires

relationship
type: dependency
subType: requires

urn:x-nbn:de:y8
Emulation Framework
2.0.0

urn:x-nbn:de:y9
DNB reading room
environment

Link to Technical Registry TOTEM

{version of original hardware platform as located in environment registry that is compatible with the software version chosen above}

environmentIdentifier (M, R)

environmentIdentifierType (M, NR): **URN**

environmentIdentifierValue (M, NR): **urn:x-nbn:de:y3** **(not real identifier)**

environmentDescription (O, R)

environmentName (O, NR): **PC**

environmentVersion (O, NR): **IBM x86** *{chosen as it was current in 1996 and is compatible with MSDOS 7.1}*

environmentRegistry (O, R)

environmentRegistryName (M, NR): **TOTEM** *{hardware is not in PRONOM}*

environmentRegistryKey (M, NR): **TUID-xxxx**

environmentRegistryRole (O, NR): **external**

environmentNote (O, R): **Developed 1991.**

Emulation Complexity

- Version details are vital for SW, OS, HW etc.
- There are complex interdependencies between SW/OS/HW
- We need iterative technical registry calls to determine these.
- We have stacked environments.
- Finding emulation information is not straightforward, so it is imperative we keep emulator details.
- Running Emulation Frameworks is new for memory institutions, and is complicated, so important to record reading room environment details where this happens.

Conclusion

- ❑ Design Environment stand-alone entity
- ❑ Validate on community-provided use cases: TOTEM technical registry, IIPC, DAITSS, TIMBUS project, New York University
- ❑ Propose to PREMIS Editorial Committee

Thank you!