

Evaluating Emulation and Migration: Birds of a Feather?

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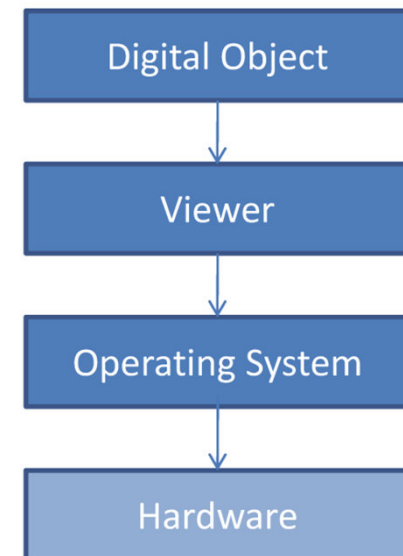
- Introduction
- View-Path
- Levels of Emulation
- Changing the View-Path using Emulation
- Changing the View-Path using Migration
- Comparison of Strategies
- An Example
- Conclusions / Future Work



- Evaluating digital preservation actions
 - as part of preservation planning
 - for verification of archived objects
 - for validation of objects retrieved from an archive
- Common method to validate migration results: Compare properties from original and migrated object
 - extract from objects using extraction language/tools
 - compare significant properties
- Emulation: no change in object, change in rendering environment -> extract from rendering
- BUT: Migration also changes rendering environment

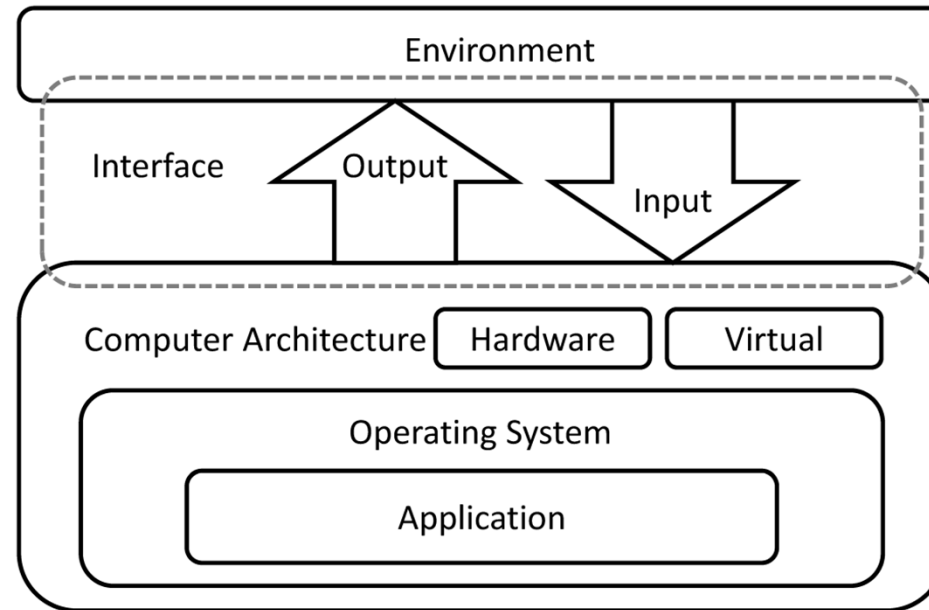
The View Path

- View Path: “full set of functionality for rendering the information contained in a digital object [Diessen et. al., 2002]“
- Contains the hardware and all secondary digital objects necessary to render a digital object
- Simple example
 - Digital Object (e.g. Microsoft Word document)
 - Viewer to render object (e.g. Microsoft Office Word 2007)
 - Operating system on which the viewer is based on (e.g. Microsoft Windows 2007)
 - Hardware (e.g. Office PC)



Levels of Emulation

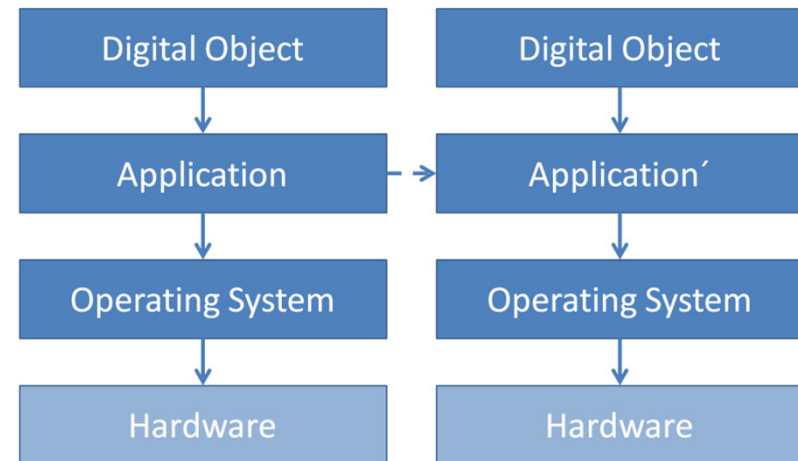
- Emulation possible on different levels



- Application (e.g., FreePDF instead of Acrobat Reader)
- Operating System (e.g., Wine instead of Windows OS)
- Computer Architecture
 - Hardware
 - Virtualization

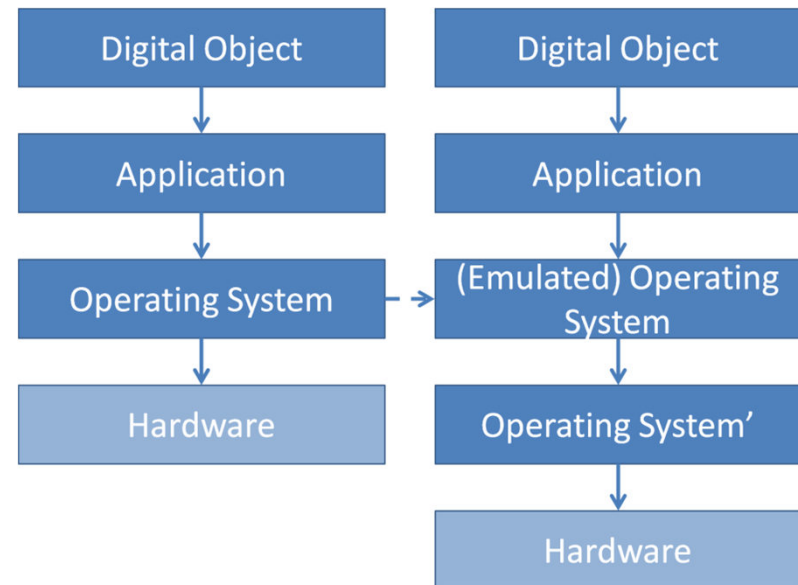
Changing View-Path using Emulation: Application

- E.g., use FreePDF instead of Adobe Acrobat Reader to render a PDF document
- Not a long term strategy (hardware/operating system stay the same)
- Application gets obsolete and needs to be replaced by a different one



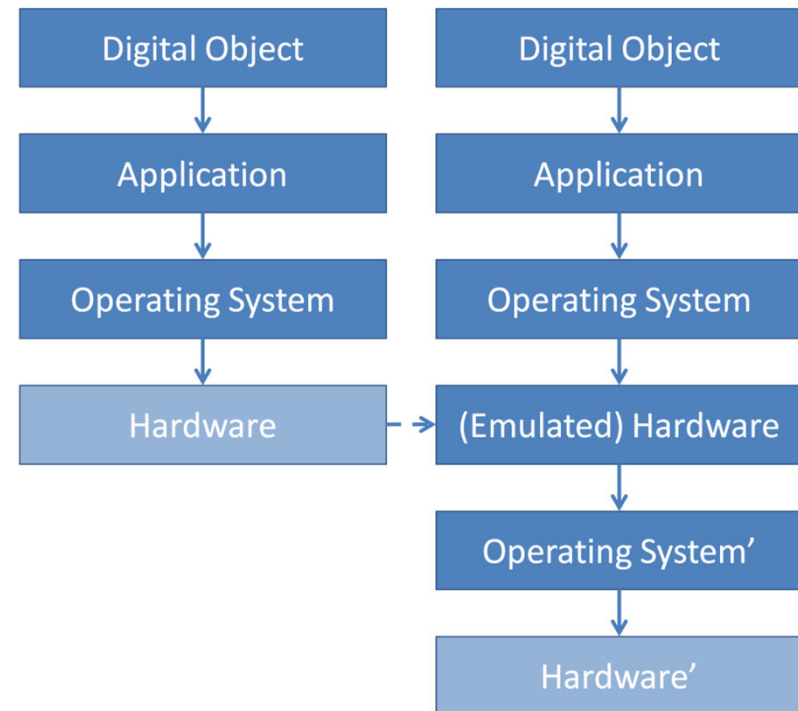
Changing View-Path using Emulation: Operating System

- E.g., use Wine to run Windows OS applications
- Use translation layer emulating the originally used operating system
- Used if operating system gets obsolete and is replaced by one running on a compatible physical hardware.



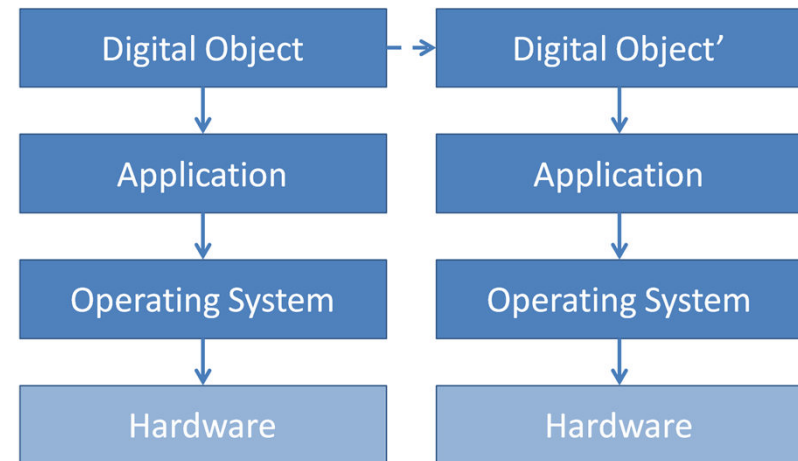
Changing View-Path using Emulation: Hardware

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- Use translation layer emulating the originally used operating system
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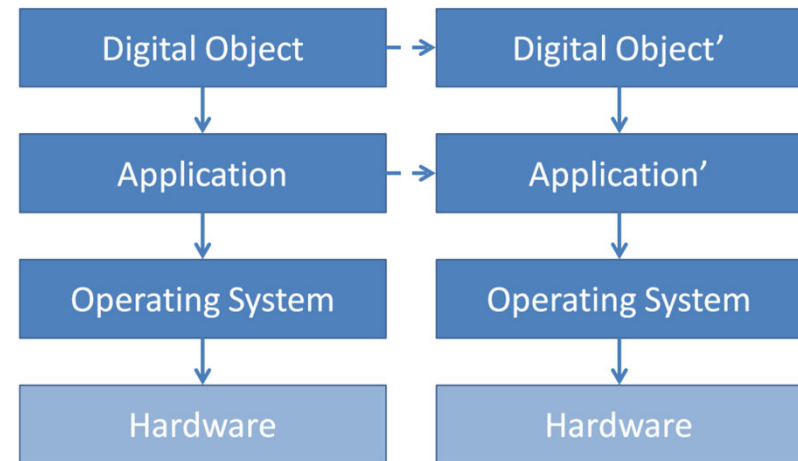
Changing View-Path using Migration: Object

- Change digital object, use the same application to render
- E.g., migrate image in BMP format to PNG, use the same tool to view the image
- Limited use, as usual motivation is that application gets obsolete, not just the format of the digital object
- (strictly speaking, application changes too, as other decoding algorithms are used)



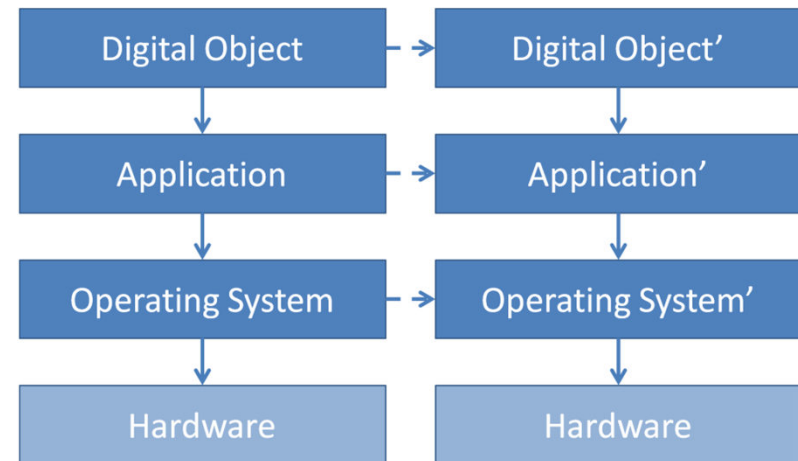
Changing View-Path using Migration: Application

- Change digital object and application used to render it
- E.g., migrate documents from a Microsoft Word DOC-format to PDF-A, use Adobe Acrobat Reader instead of Microsoft Word to render objects.
- operating system and hardware are still unchanged
- (strictly speaking, new version of an application constitutes a new application that needs to be verified)



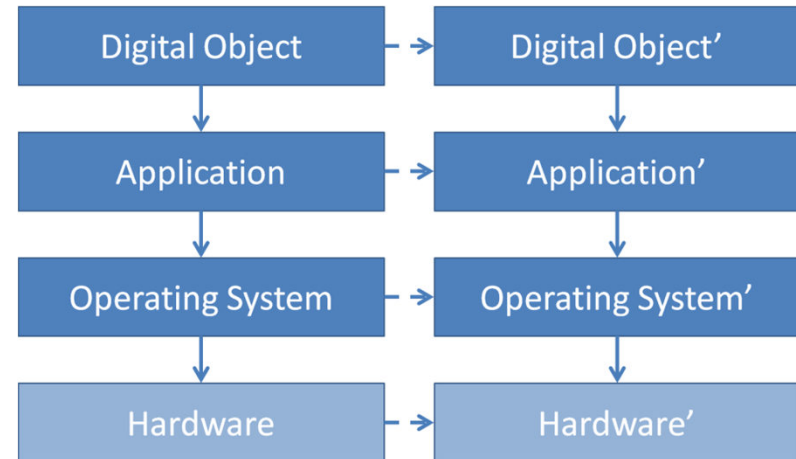
Changing View-Path using Migration: Operating System

- Operating system gets obsolete and has to be replaced, replacing also the application
- Three layers in the view-path changed if possible to run on the same hardware.
- E.g., migrate object from MS Word 95 format to MS Word 2007 format, change application from MS Word 95 to MS Word 2007, change OS from MS Windows 95 to MS Windows 7.



Changing View-Path using Migration: Hardware

- Hardware gets obsolete -> replace physical hardware by different one
- Upgrade usually involves operating system upgrade and application upgrade as well
- Changes all (!) layers in view-path -> even if same version of operating system is installed, drivers for components change



Comparison of Strategies: Emulation

- Replace one layer in the view-path or add additional layer as an interface between emulated view-path and new underlying layers.
- Complexity increases as side-effects of introduction of new layers have to be considered
- Evaluation: comparison between rendering in original view-path and in new view-path
- Change in the view-path due to layer getting obsolete -> re-evaluation of the rendering.

Comparison of Strategies: Migration

- View-path of digital object only stays the same if the same application on the same system is used (even then: different code is used, e.g. a PNG library instead of a JPG library), every other case changes the view-path
- Every change of lower layer in the view-path leads to all layers above being changed
- Potential side-effect thus bigger than when using emulation of the original rendering environment
- Evaluate by comparing new rendering to original rendering (just as in emulation).



An Example



- Microsoft Word for Windows 97-2003 (doc) format
- Rendered using Microsoft Word 2010

Standard Form 15 (Rev. 2/90) (EG)
U.S. Office of Personnel Management
FPM Supplement 296-33
FPM Chapter 211

**APPLICATION FOR 10-POINT
VETERAN PREFERENCE
(TO BE USED BY VETERANS & RELATIVES OF VETERANS)**

Form Approved:
O.M.B. Nn 3206-0001

PERSON APPLYING FOR PREFERENCE			
1. Name (Last, First, Middle)		2. Name and Announcement Number of Civil Service or Postal Service Exam You Have Applied For or Position Which You Currently Occupy	
3. Home Address (Street Number, City, State and ZIP Code)		4. Social Security Number	5. Date Exam Was Held or Application Submitted
VETERAN INFORMATION (to be provided by person applying for preference)			
6. Veteran's Name (Last, First, Middle) Exactly As It Appears on Service Records			
7. Veteran's Periods of Service		8. Veteran's Social Security Number	
Branch of Service	From	To	Service Number
			9. VA Claim Number, If Any
<p>INSTRUCTIONS: Check the block which indicates the type of preference you are claiming. Answer all questions associated with that block. The "DOCUMENTATION REQUIRED" column refers you to the back of this form for the documents you must submit to support your application. (PLEASE NOTE: Eligibility for veterans' preference is governed by 5 U.S.C. s 2108, 5 CFR Part 21 1, and FPM chapter 211. All conditions are not fully described in this form because of space restrictions. The office to which you apply can provide additional information. Instructions on how to apply for five point preference are on SF 171, Application for Federal Employment, or PS Form 2591, Application for Employment (U.S. Postal Service Application).</p>			
10. <input type="checkbox"/> VETERAN'S CLAIM FOR PREFERENCE based on non-compensable service-connected disability; award of the Purple Heart; or receipt of disability pension under public laws administered by the VA			DOCUMENTATION REQUIRED (See reverse of this form.) A and B



An Example

- Microsoft Word for Windows 97-2003 (doc) format
- Rendered using OpenOffice 3.41

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An Example



- migrated to Microsoft Word for Windows 2007 (docx) format
- Rendered using Microsoft Word 2010

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- Not enough to compare migrated object to original in current environment and assume that rendering will be the same in a future environment
- Take the target rendering environment after migration into account.
- Preservation Planning when Environment changes
 - Any change in target rendering environment has to lead to new preservation planning iterations evaluating the changed environment (even if format of the digital object stays unchanged)
 - Re-evaluate your collections rendering whenever you change the tools to render it





Thank you for your attention.

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