



## **Test Description Document**

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Test set, test objects, preparation and procedure

**Version** : 1.1  
**Author** : Jeffrey van der Hoeven  
**Date** : 19 July 2006  
**Project** : Emulation project

Koninklijke Bibliotheek, department HRD-DD  
Nationaal Archief of the Netherlands

# Test Description Document – Emulation Project

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## I. Revision history

Revision number	Revision date	Author	Summary of changes
0.2	17-10-2005	J.R. van der Hoeven	New Gantt chart added
0.3	18-10-2005	J.R. van der Hoeven	Modified Gantt chart
0.4	19-10-2005	J.R. van der Hoeven	Extended with test objects and descriptions
0.5	23-11-2005	J.R. van der Hoeven	Changed test procedure
0.6	09-01-2006	R. Verdegem	Added test object and testers Nationaal Archief
0.7	24-01-2006	J.R. van der Hoeven	Adjusted planning, test set description and test set preparation
1.0	24-02-2006	J.R. van der Hoeven	finalised
1.1	18-07-2006	J.R. van der Hoeven	adjusted Virtual PC to be emulation changed several sections to be more accurate

## II. Related documents

Document name	Date	Author
Micro Design Reference Workstation	22-07-2003	F. Taylor Parkins
User manual Reference Workstation	10-07-2002	F. Taylor Parkins
Digital Preservation Testbed: Research Framework	27-04-2004	Testbed
Emulation project – testbed upgrade	08-08-2005	J.R. van der Hoeven

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Date: 19-7-06  
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Author: Jeffrey van der Hoeven  
Project: Emulation project  
Page: 4

## 1 Introduction

### 1.1 General goals

This document defines the tests that have to be performed during step 2 of the emulation project: testing the existing emulators and virtualisation techniques for different types of digital objects in comparison with the Reference Workstation (RWS). The test objects will be defined by currently available emulators and virtualisation software. These applications will be tested using a test set that consists of three types of digital objects:

- PDF documents
- Database systems
- Interactive multimedia applications

### 1.2 Purpose of testing

Currently, the Koninklijke Bibliotheek (KB) and Nationaal Archief of the Netherlands are working together to develop paths to retain access to digital objects over the long-term. Because most hard- and software solutions do not consider longevity very well, other solutions have to be defined to ensure that objects will remain accessible. In the field of digital preservation, emulation is one of the possible strategies to retain long-term access to digital objects. The advantage of emulation above other strategies is that it does not require any action or changes of the original object over time. Moreover it offers a solution for the whole set of objects, including objects with functional behaviour like PDF readers, office applications and games.

To find out the requirements of the emulator that has to be developed, three steps will be carried out with subsequent deliverables:

#### **1.2.1** *Define the significant properties of the scope objects*

Each type of object has its own properties. To find out which properties are important, experienced users of PDF, multimedia publications and databases will be asked. Examples of significant properties are speed of execution, colour, keyboard interaction, copy-paste functionality, etc.

**Deliverable** : a list of significant properties for each type of digital object.

#### **1.2.2** *Test existing emulation/virtualisation tools versus RWS*

Based on the significant properties that are defined, each object executed on the RWS can be compared with the same object under emulation/virtualisation. The test criteria will be based on the significant properties. To perform these tests, various emulation and virtualisation software applications should be installed on the test machines and required disk images should be prepared.

**Deliverable** : a list of differences between the emulated / virtualised environment and the RWS for each object.

#### **1.2.3** *Evaluate emulation/virtualisation tools*

If the differences between RWS and emulation/virtualisation software are known, then the tools can be evaluated in comparison with the RWS.

**Deliverable** : a test results document describing all the test results with emulation/virtualisation versus RWS for all defined test sets (PDF, DBs and multimedia). Furthermore, it should give an overview of the capabilities and shortcomings of the existing

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tools which can be used as input for defining the requirements for the emulator that has to be developed in a later stage of the project.

## 2 Organisation

### 2.1 Test team

The test team is part of the overall emulation project team, as shown in the overview of the project organisation. The goal of the test team is to define the quality of the emulated environment compared with the RWS environment.

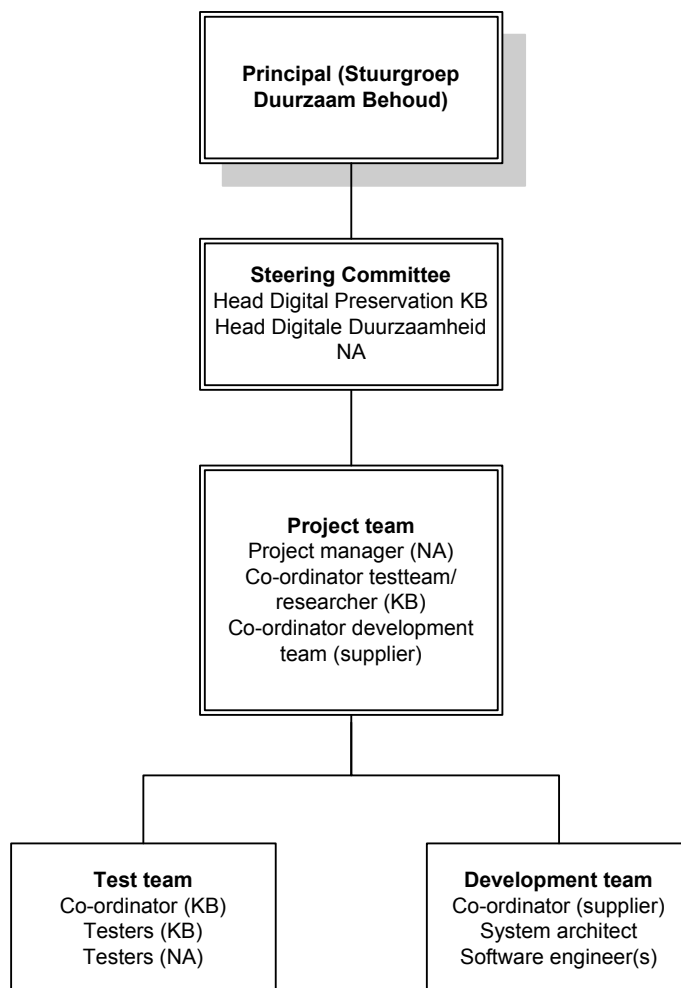


Figure 1.1: project organisation

The principal of the project is the so-called ‘Stuurgroep Duurzaam Behoud’ in which representatives of the KB and the Nationaal Archief are seated. The project will be managed by a project manager from the Nationaal Archief, who is responsible for the day to day directing of the project.

There will be two working groups: the test team and the development team. For this step in the project only the test team is of relevance. The test team is responsible for testing the existing hardware emulators versus the RWS. During later steps in the project, the test team is also responsible for testing the functionality of the developed emulator (black box testing). The test team will consist of a co-ordinator from the KB and two testers at minimum: one PDF / multimedia application tester from the KB and one database system tester from the Nationaal Archief. If necessary, more testers can be consulted from both institutions.

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The co-ordinator of the development team, together with the co-ordinator of the test team and the project manager form the project team.

### 2.1.1 Test team members

Co-ordinator Test team : Jeffrey van der Hoeven

KB tester (for experiments with PDF and interactive multimedia applications):

- Angelique Tempels – Department: HVP catal. & metadatabeh.  
Room: 3287 - Telephone: 070-3140443  
E-mail: [angelique.tempels@kb.nl](mailto:angelique.tempels@kb.nl)

Management:

- Tom Pols – (Teamleader Team 2) – Department HVP catal. & metadatabeh.  
Room: 3287/3318 - Telephone: 070-3140643  
E-mail: [tom.pols@kb.nl](mailto:tom.pols@kb.nl)
- Maarten van Schie – (Specialist Functioneel Beheer & Ontwikkeling) –  
Department HVP catal. & metadatabeh.  
Room: 3287 - Telephone: 070-3140532  
E-mail: [maarten.vanschie@kb.nl](mailto:maarten.vanschie@kb.nl)

Nationaal Archief testers (for experiments with database systems):

- Liesbeth Keijser – Department Restauratie en Conservering  
Room: 702b – Telephone: 070-3315413  
E-mail: [liesbeth.keijser@nationaalarchief.nl](mailto:liesbeth.keijser@nationaalarchief.nl)
- Henny van Schie – Department Toegangen en Gegevensbeheer  
Room: 315 – Telephone 070-3315548  
E-mail: [henny.van.schie@nationaalarchief.nl](mailto:henny.van.schie@nationaalarchief.nl)

## 2.2 Test environment

To carry out the tests, a certain test environment must be available. As the Nationaal Archief is the owner of the Digital Preservation Testbed, which was used from 2000 until 2005 to perform extensive preservation tests for the Dutch government, the emulation project can take advantage of this environment. Currently, the testbed is not in use anymore and can therefore be used for other purposes. Although the soft- and hardware needs to be upgraded, the test procedures of the Testbed can be used for emulation tests without major changes.

The Testbed consists of the following hardware:

- Test/developmentPC : Intel Pentium 3.85 GHz test & development PC
- Test/developmentPC : Intel Pentium 3.85 GHz test & development PC
- TestbedPC : standard PC of Nationaal Archief
- TestbedPC : standard PC of Nationaal Archief

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## 2.3 Planning

The following Gantt chart shows the planning for the test period.

ID	Task Name	Start	Finish	Duration	okt 2005		nov 2005					dec 2005					jan 2006				feb 2006		
					23-10	30-10	6-11	13-11	20-11	27-11	4-12	11-12	18-12	25-12	1-1	8-1	15-1	22-1	29-1	5-2	12-2		
1	Upgrade Testbed	17-10-2005	21-12-2005	9,6w																			
2	Replace hardware	17-10-2005	30-11-2005	6,6w																			
3	Install Reference Workstation (RWS)	14-11-2005	17-11-2005	,8w																			
4	Install software	1-12-2005	21-12-2005	3w																			
5	Test Preparation	17-10-2005	13-1-2006	13w																			
6	Define test objects (emulators/virt.)	17-10-2005	21-10-2005	1w																			
7	Define test set (PDF, DB, int. Appl.)	17-10-2005	28-10-2005	2w																			
8	Define testbed procedures	28-10-2005	9-12-2005	6,2w																			
9	Prepare test objects and test set	12-12-2005	13-1-2006	5w																			
10	Introduction testers into project	10-1-2006	10-1-2006	,2w																			
11	Step 1: significant properties	2-1-2006	16-1-2006	2,2w																			
12	Define test set characteristics	2-1-2006	16-1-2006	2,2w																			
13	Step 2: Testing	17-1-2006	23-1-2006	1w																			
14	Process 13: Virt – PDF	17-1-2006	23-1-2006	1w																			
15	Process 14: Virt – CD-ROMs	17-1-2006	23-1-2006	1w																			
16	Process 15: Virt – DB systems	17-1-2006	23-1-2006	1w																			
17	Process 16: Emu – PDF	17-1-2006	23-1-2006	1w																			
18	Process 17: Emu – CD-ROMs	17-1-2006	23-1-2006	1w																			
19	Process 18: Emu – DB systems	17-1-2006	23-1-2006	1w																			
20	Step 3: evaluation	23-1-2006	10-2-2006	3w																			
21	Evaluate test results	23-1-2006	27-1-2006	1w																			
22	Write report test results	30-1-2006	3-2-2006	1w																			
23	Insert results in Testbed system	6-2-2006	10-2-2006	1w																			

Table 2.1: Gantt chart of test process

### 3 Test object description

The primary goal of the tests is to give an overview of the capabilities and shortcomings of the existing tools and to define a list of minimum requirements for the emulator that has to be developed in a later stage of the project. The following objects will be tested:

#### 3.1 Reference Workstation (RWS)

The Reference Workstation (RWS) is a normal computer platform. The RWS is used by the National Library of the Netherlands for ingest preparation of interactive multimedia publications. This computer platform will be used during the tests as original platform. All emulation and virtualisation processes will be compared to the RWS. See appendix A for the configuration of the RWS.

#### 3.2 Emulation software

##### 3.2.1 *MS Virtual PC*

The MS Virtual PC emulator is a fast and all-round emulator developed by Microsoft. The emulator was initially developed by Connectix that offered an x86 emulator especially for the Macintosh. In this way, Macintosh users were able to run a Microsoft operating system with full functionality under a Macintosh environment. Today, the Virtual PC solution is property of Microsoft and allows emulation under MacOS or MS Windows itself so that multiple Microsoft operating systems can run side by side or even on top of each other (layered emulation). It offers a great performance, but uses specific disk images that are not interchangeable. Another disadvantage is that the implementation is bound to an MS Windows environment, which lacks support for other host and target platforms (except for MacOS).

##### 3.2.2 *QEMU*

QEMU is a fast and open source cross-platform emulator. It can support x86, PPC, ARM and SPARC computer platforms on many different host platforms. The QEMU emulator uses dynamic translation (Just-In-Time compilation) of the code, which offers a good performance level. Some parts of the emulator are based on the Bochs emulator implementation. The advantage is that Bochs and QEMU use compatible 'raw' disk images.

##### 3.2.3 *Bochs*

The Bochs x86 emulator is quite similar with the QEMU emulator, but only enables emulation of an x86 as target platform. It is also slightly slower than QEMU, but can support more peripheral devices and is better configurable. As said before, it can interchange disk images with QEMU based on a 'raw' data image format.

#### 3.3 Virtualisation software

##### 3.3.1 *VMware*

VMware is a virtual machine (VM) suite for Intel x86-compatible architectures which allows the creation and running of multiple virtual x86 computers simultaneously. VMware can run a number of guest operating systems (OS), including (but not limited to) Windows, Linux, and BSD variants. Conventional emulators emulate the entire PC hardware including the CPU. VMware takes a different approach, adding a thin layer of code to virtualise the real PC

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hardware and CPU, so that multiple operating systems can run at the same time without clashing with each other.

The benefit of this approach is that an OS running inside VMware can run at almost the same speed as it would if it was the only OS on the system. For businesses VMware is an attractive solution, because it allows better utilization of the hardware infrastructure. The drawback is that the OS has to be compatible with the underlying physical hardware. So unlike with an emulator, you cannot use VMware to run Macintosh software on a PC, or vice versa. That is because VMware is very close to the x86 platform and does not support any other architecture. Moreover, VMware is a corporate product that is not developed for digital preservation purposes or cross platform compatibility. This makes it less reliable for a long-term solution.

## 4 Test set description

To test the various test objects a test set is required. The test set should be chosen carefully, so that most (if not all) aspects of the objects will be tested. The test set for this project will be based on three types of digital objects: PDF files, multimedia applications and databases.

### 4.1 Portable Document Format (PDF) files

The PDF test set consists of eleven PDF-documents, differing in publisher, creation and modification date, version, creator tool and operating platform.

The following files were selected:

Nr	Ver	Mod. date	Publisher	Creation tool	OS	Additional
1	1.0	27-10-2005	-	Gnostice 2.02	Windows	Tweaked file
2	1.1	09-02-2001	Biomed	Distiller 3.01	Windows	
3	1.2	21-02-2002	Biomed	Distiller 4.05	Windows	
4	1.3	23-12-2003	Elsevier	Distiller 4.05	Windows	
5	1.3	06-06-2005	Elsevier	-	-	
6	1.4	02-03-2005	Springer	Distiller 3.01	Windows	Converted 1.3
7	1.4	09-05-2005	EU/DARE	Openoffice-1.1.4	Windows	
8	1.5	28-09-2004	NTVG	Distiller 4.0	Mac	Converted 1.3
9	1.5	28-09-2004	NTVG	Distiller 4.0	Mac	Converted 1.3
10	1.5	30-09-2005	UT/DARE	Dvipdfm-0.13.2c	-	
11	1.5	11-11-2005	TU Delft/DARE	Miktex_pdfTeX-1.20a	-	

Table 4.1: test set of PDF documents

### 4.2 Multimedia applications

The following multimedia applications on CD-ROM were selected:

#### 1. Polycation-based gene delivery

Type of publication : thesis of Daniel T. Klink  
Publisher : Erasmus University Rotterdam  
Author : Daniel T. Klink  
Year of publication : 2004  
ISBN : 90-9018570-4  
Brinkman prod. nr. : B 04 39 463  
Number of CD's : 1  
Type of creation : burned  
Type of content : thesis report (PDF), movie animations, executable  
System requirements : Pentium 200 Mhz, Windows 95 or higher, 16MB RAM, SVGA graphics card, sound card, 4x CD-ROM drive, mouse, Quicktime

#### 2. Turnen in beweging

Type of publication : exercise program for gym-, diplomacy- and game gymnastics  
Publisher : Royal Dutch Gymnastics Union / Univé  
Author : -  
Year of publication : -  
ISBN : -  
Brinkman prod. nr. : B 04 39 489

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Number of CD's : 2  
Type of creation : pressed  
Type of content : movie animations, executable  
System requirements : Pentium, Windows 95 or higher, 32MB RAM

### 3. Topografie trainer

Type of publication : a training program for primary school in the field of topography  
Publisher : VanDorp Educatief  
Author : -  
Year of publication : 2004  
ISBN : 90-7769-805-1  
Brinkman prod. nr. : B 04 36 092  
Number of CD's : 1  
Type of creation : burned  
Type of content : installable, animation, executable  
System requirements : Windows, 800x600 pixels screen resolution, CD-ROM drive

### 4. Deelsommen

Type of publication : mathematics for primary education (group 7,8)  
Publisher : A.W. Bruna  
Author : Remco de Korte  
Year of publication : 2004  
ISBN : 90-229-4955-9  
Brinkman prod. nr. : B 04 19 429  
Number of CD's : 1  
Type of creation : pressed  
Type of content : installable, animation, executable  
System requirements : Windows 95 or higher, 50 MB hard disk space, high colours, mouse, CD-ROM drive

### 5. Spellingcorrector

Type of publication : grammar correction software for MS Word 97/2000  
Publisher : Van Dale Lexicografie B.V. and TNO  
Author : -  
Year of publication : 2000  
ISBN : 90-6648-902-2  
Brinkman prod. nr. : B 04 40 002  
Number of CD's : 1  
Type of creation : pressed  
Type of content : installable, text, executable  
System requirements : Pentium 133 MHz, Windows 95 or higher, 32 MB RAM (64 MB RAM for Windows 98 or higher), 60MB harddisk space, 4x CD-ROM drive

With “installable” as type of content is meant that the CD-ROM publication first has to be installed on a computer before it can be used.

Originals and disk images of CD-ROM's can be found in room 4.13 of Nationaal Archief.

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### 4.3 Database systems

The following database applications were selected:

#### 1. Restrap

Type of database: Restrap is an application being used by the department ‘Restoration and conservation’ to keep track of the paper records they are restoring (renovating). The application was built by an employee of the Nationaal Archief.

Developer: Employee of Nationaal Archief (Ted Indewey Gerlings)

Year of release: unknown

Original OS: MS Windows XP (in 2005 migrated from MS Windows NT4)

Original software: MS Access 2003 (in 2005 migrated from MS Access 97)

Storage: 1 file: Restrap5.mdb

Person in charge: Liesbeth Keijser

#### 2. Retrieve

Type of database: Retrieve is an application that exists of three parts: the digital images of the “Karteikarten” in TIFF; the database Retr1.mdb in MS Access 97 SR2 (with all the data mentioned on the “Karteikarten”, and the retrieval program Retrieve multi user version 2.0 that is used to find specific records and the image belonging to those records.

Developer: Microformat Systems b.v.

Year of release: 1999

Original OS: MS Windows 98 (in 2005 migrated from MS Windows NT4)

Original software: MS Access 97 (formerly Paradox)

Development tools: Borland Delphi version 3 and 5

Storage: 2 CD-ROM’s: Retrieve ARA Berlijn 01, Retrieve ARA Berlijn 02

CD-ROM 1: directory <01> until <09> (all TIFF files)  
directory <database> retrieve.db; retrieve.MB; Retr1.mdb  
file Autorun.inf  
file retrieve.exe  
file retrieve.ico

CD ROM 2: directory <10> until <19> (all TIFF files)

Person in charge: Henny van Schie

Originals and disk images of CD-ROM’s can be found in room 4.13 of Nationaal Archief.

### 5 Test set preparation

To use the test set for the experiments, the digital objects of the set must be available in the virtualisation / emulation process. Each type of digital object requires a different approach which is outlined in the following sections: base images, test set initiation and configuration.

#### 5.1 Base images

The first step is to create a set of base images for each environment that should be emulated or virtualised. As said earlier, both emulators Bochs and QEMU use the same disk image formats. However, to test each emulator separately, each of them should have their own image. The following base images should be created:

- VMware
  - MS Windows 2000 SP 2
  - MS Windows 98 SE
- MS Virtual PC
  - MS Windows 2000 SP 2
  - MS Windows 98 SE
- QEMU
  - MS Windows 2000 SP 2
  - MS Windows 98 SE
- Bochs
  - MS Windows 98 SE (MS Windows 2000 does not work on it)

#### 5.2 Test set initiation

Second is to create the test sets as defined in the previous section. The initiation of the sets can be done directly on the test environment. If that is not possible, then each set can be created elsewhere and copied to the test environment later on. Disk images can be created using image software like Winimage.

##### 5.2.1 *PDF*

All PDF files will be stored within an ISO disk image that is compatible with every emulator and virtual machine.

Aside from the PDF files, the original installation file of Adobe Acrobat reader version 5.01 for Windows (also used on the RWS) must be included on the disk image.

##### 5.2.2 *Multimedia applications*

An ISO disk image must be created from each interactive multimedia application.

##### 5.2.3 *Database systems*

To test desktop database systems several components are needed:

1. Database set
2. Database application
3. Database Management System

Based on the proposed testset, the database systems are created in MS Access. For each database system a copy of the set and application should be stored as ISO disk image. Also, an ISO image of the original MS Access 97 or 2003 installation CD-ROM should be created.

### 5.3 Configuration

If all test sets are created and stored on the test computer, the virtualisation and emulation software have to be installed and configured. As host platform Windows XP will be chosen as this is the standard working environment at the KB and Nationaal Archief. The hard- and software specifications of the Testbed system can be found in appendix B.

The following virtualisation software must be installed:

1. VMware Workstation 5 for Windows  
<http://www.vmware.com/>

The following emulation software must be installed:

1. Microsoft Virtual PC 2004 for Windows  
<http://www.microsoft.com/windows/virtualpc/default.mspx>
2. Bochs 2.2.5 for Windows  
<http://bochs.sourceforge.net/>
3. QEMU 0.8.0 for Windows with QEMU Manager  
<http://fabrice.bellard.free.fr/qemu/>

For installation instructions of the virtualisation and emulation tools, the above named references can be used.

Within each hard disk image the applications Adobe PDF Reader en MS Access 97 / 2003 should be installed. Installation of the CD-ROM publications will take place during the tests.

Aside from that, a Reference Workstation (RWS) must be available in the test room. It is preferred to have the RWS situated right next to the test computer, so that the experiments can be compared with each other quite easily.

## 6 Test procedure

In the following sections the test procedure will be described. Hereby is assumed that all required actions defined in the previous sections have been carried out. As outlined in the introduction, the following phases have to be accomplished:

1. Define the significant properties of the scope objects
2. Test existing emulation/virtualisation tools versus RWS
3. Evaluate emulation/virtualisation tools

### 6.1 Define the significant properties

Before testing the test objects (emulators/virtualisation software), it is necessary to define which properties of a digital object are characteristic for an authentic representation of it. These aspects are called the significant properties.

Based on the three types of scope objects, PDF files, interactive multimedia applications and database systems, each of them has their own significant properties. A list of significant properties should be created for each type of scope object. This will result in three lists of properties that can be used during the test sequence.

### 6.2 Test existing emulation/virtualisation tools versus RWS

When the test objects and set are initiated and the lists of properties have been created, the test sequence can be started.

First, the Testbed research framework must be configured. This should be done as described in the document “Digital Preservation Testbed: Research Framework”, version 0.2 (27 April 2004).

The tests are organized in six processes, as described hereafter:

Process	Virtualisation			Emulation		
	PDF	CD-ROM	DB	PDF	CD-ROM	DB
<b>Experiment</b>	<i>For each:</i> PDF	<i>For each:</i> CD-ROM	<i>For each:</i> DB	<i>For each:</i> PDF	<i>For each:</i> CD-ROM	<i>For each:</i> DB
	<i>Using:</i> VMware	<i>Using:</i> VMware	<i>Using:</i> VMware	<i>Using:</i> VirtualPC QEMU Bochs	<i>Using:</i> VirtualPC QEMU Bochs	<i>Using:</i> VirtualPC QEMU Bochs
<b>Processnumber</b>	<b>13</b>	<b>14</b>	<b>15</b>	<b>16</b>	<b>17</b>	<b>18</b>

Table 6.1: processes and experiments

Schematically, the test sequence can be depicted as in figure 6.1:

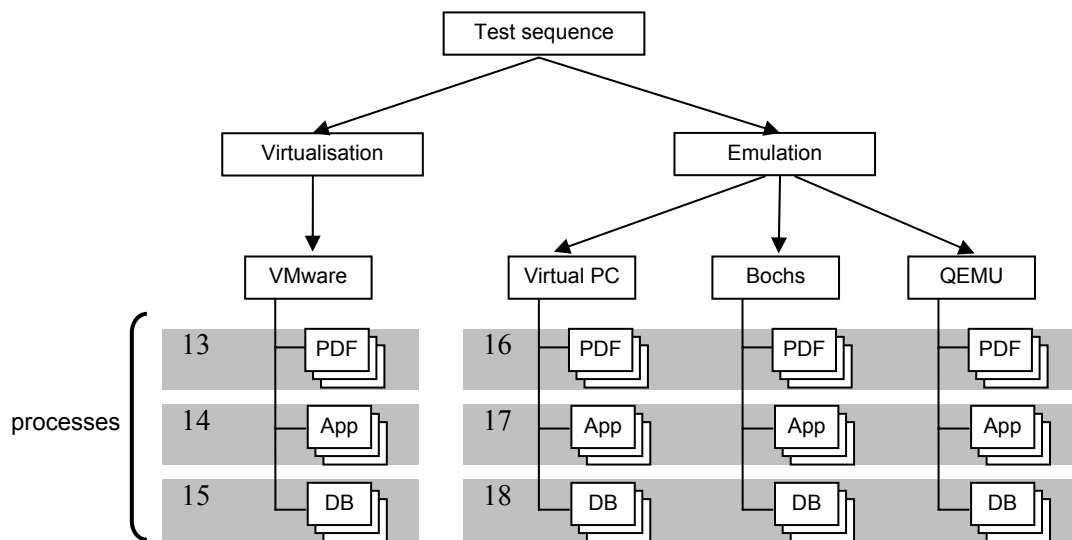


Figure 6.1: experiment sequence in processes

### 6.2.1 *Process 13: PDF with virtualisation*

Process 13 consists of experiments with virtualisation software VMware for PDF documents. For these experiments a new process should be created: “PDF with virtualisation”. During this process every PDF document needs to be tested in combination with VMware, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

### 6.2.2 *Process 14: CD-ROM with virtualisation*

Process 14 consists of experiments with virtualisation software VMware for CD-ROM publications. For these experiments a new process should be created: “CD-ROM with virtualisation”. During this process every CD-ROM publication needs to be tested with VMware, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

### 6.2.3 *Process 15: DB with virtualisation*

Process 15 consists of experiments with virtualisation software VMware for database systems. For these experiments a new test process should be created: “DB with virtualisation”. During this process every database needs to be tested with VMware, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

### 6.2.4 *Process 16: PDF with emulation*

Process 16 consists of experiments with emulation software Virtual PC, QEMU and Bochs for PDF documents. For these experiments a new process should be created: “PDF with emulation”. During this process every PDF document needs to be tested with Virtual PC, QEMU and Bochs, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

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### 6.2.5 *Process 17: CD-ROM with emulation*

Process 17 consists of experiments with emulation software Virtual PC, QEMU and Bochs for CD-ROM publications. For these experiments a new process should be created: “CD-ROM with emulation”. During this process every CD-ROM publication needs to be tested with Virtual PC, QEMU and Bochs, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

### 6.2.6 *Process 18: DB with emulation*

Process 18 consists of experiments with emulation software Virtual PC, QEMU and Bochs for databases. For these experiments a new process should be created: “DB with emulation”. During this process every database needs to be tested with Virtual PC, QEMU and Bochs, which will be the experiments. The same test set objects should be tested on the RWS and compared with the results on the test computer.

## 6.3 Evaluate emulation / virtualisation tools

When all tests have been carried out, the results should be evaluated. First, the different techniques (virtualisation/emulation) should be evaluated. Second, the tools virtualisation tools and emulation tools should be compared with each other.

All findings should be well documented using the document *Testbed Research Framework* and written down in a final report, called *Test Results Document*. This report will serve as input for the development team of the emulation project, on which they can decide which aspects of virtualisation and emulation should be considered for design. Furthermore, the characteristics (significant properties) of the test set objects (PDF, multimedia and databases) can be taken into account to develop an emulator that is suitable for rendering these kind of objects.

### Appendix A: Reference Workstation (RWS) PLATFORM-10

<b>Software</b>		
<i>Application</i>	<i>Version</i>	<i>Files</i>
MS Windows 2000 Professional	Service Pack 3	w2ksp3.exe
MS Direct X for NT	8	DX80NTeng.exe
Display Drivers (Compaq nVidia LP AGP GeForce2MX-400)	6.13.10.4103	41.03_win2kxp.exe
Intel Chipset		SP22545.exe
Intel Ide		SP21356.exe
Intel pro 1000T		pro2kxpm.exe
Keyboard		SP21795.exe (not used because it only enables the function keys on the top of keyboard)
Mouse		SP21424.exe
Sound		SP22286.exe
<b>Additional Software</b>		
<i>Application</i>	<i>Version</i>	<i>Files</i>
MS Internet Explorer	5.50.4134.0600	ie552000 directory, setup is started via ie5setup.exe
MS Windows Media Player	7.1	mp71.exe
MS SysPrep (in deploy.cab)	1.1	W2KCD:\support\tools\deploy.cab and Windows 2000 System Preparation Tool (version 1.1) from Microsoft (sysprep update)
Power Quest Drive Image Pro	4.0	Drive Image Pro 4.0 directory, subdirectory dp40en, subdir setup, contains setup.exe
Adobe Acrobat Reader	5.01	Acrobat Reader 5.01 directory, rp501enu.exe (only used on development to read the documentation)
Java Plug-in for the browser [=IE]	1.3.1_02 Standard Edition International	j2re-1_3_1_02-win-i.exe
InterVideo WinDVD	2000	Install CD delivered with DVD-ROM Drive (COMPAQ JLMS DVD-ROM LTD-1665)
Paragon CD-ROM emulator	2.5 Personal Edition	Install cd : iso 'paragon cd.iso'
<b>Hardware</b>		
<i>Component</i>	<i>Specification</i>	
Main board	Compaq EVO D510 CMT	
Processor	Intel Pentium 4 system running at 2,4GHz	
Internal memory	1 GB RAM	
Hard disk devices	2 internal disks: 40 GB Maxtor 6E040L0 40 GB WDC WD400BB-60CJA0	
Display adapter	nVidia GeForce4 MX 420 display adapter	
	Fill Rate	: 1 Billion Texels/Sec.

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	Triangles per Second : 31 Million Memory Bandwidth : 2.7GB/Sec. Maximum Memory : 32MB
Sound device	SoundMAX AC97 Integrated Digital Audio
Optical storage devices	DVD-ROM Drive (COMPAQ JLMS DVD-ROM LTD-1665), Region 2
Floppy disk drives	3.5" floppy drive
Ports (external)	4 Universal Serial Bus ports (USB) 2 serial communications ports (COM) 1 parallel communications port (LPT)
Network adapters	100 Megabit Ethernet network adapter 1 Gigabit Ethernet network adapter
Monitor	CTX S500B  <i>Viewing</i> Display Technology : Active Matrix TFT Panel Display Panel : 15" (Diagonal) Resolutions : 640 x 350 @ 70Hz 720 x 400 @ 70Hz 640 x 480 @ 60Hz, 72Hz, 75Hz 800 x 600 @ 60Hz, 72Hz, 75Hz 1024 x 768 @ 60Hz, 70Hz, 75Hz 1024 x 768 (Max)  Contrast Ratio : 400:1 Brightness (Typical) : 250 cd/m2 Viewing Angle (H/V) : 120/100 (degrees) Pixel pitch : 0.297 mm Scanning characteristics : 30kHz - 60kHz (Hor. Freq.), 58Hz ~ 75Hz (Vert. Freq.)  Response time : tr:13ms / tf:27ms Maximum color support : 16.7 million  <i>Bodywork</i> Cabinet Color(s) : Black VESA compliant : yes Plug & Play : yes Power usage : 35W maximum Dimensions : 14.65" W x 14.02" H x 6.77" D Weight : Net: 8.16 lbs. Gross: 14.1 lbs Inputs signals : Video= RGB Analog (0.7Vp-p) Sync= H/V Separated (TTL)  User controls : Front Panel Controls: Power Switch, LCD Indicator, ESC, Up, Down, Enter  On-screen menu controls : Contrast, Brightness, Auto Tune, Color Temp, Size, Phase, Focus, Dithering, Text/Gfx, Position, Languages, Recall  Environments : PC and Mac  <i>miscellaneous</i> Safety regulations : FCC Class B, UL, cUL, CE, TCO'99
Keyboard	Compaq US keyboard for Microsoft Windows
Mouse	Compaq PS/2 (Logitech) mouse, wheel, wired, mouse ball

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More information on the specification of the RWS:

Graphics card -> <http://www.nvidia.com/page/geforce4mx.html>

Sound card -> <http://www.digit-life.com/articles/inteld815efvac97/>

Monitor -> [http://www.ctxtec.com/products/lcd\\_s500b.htm](http://www.ctxtec.com/products/lcd_s500b.htm)

### Appendix B: Host machine configuration

<b>Hardware</b>	
Systemmodel	HP Workstation xw4200
Processor	Intel Pentium 4, 3.8 GHz, dual core
Motherboard	HP Workstation xw400, model 0914h
Graphics	NVIDIA Quadro FX 1400
Storage	Harddisk 1: 400 GB -> part1 = 20 GB (C), part2 = 380 GB (D) Harddisk 2: 400 GB -> part1 = 120 MB, part2 = 370 GB
Memory	2 GB DDR
Sound	AC'97 integrated sound device
Network	Broadcom NetXtreme Gigabit Ethernet (10/100/1000 Mbit)
Removable storage devices	3,5 inch Floppy drive CD-/DVD-ROM drive CD-/DVD-R/RW drive
Communication ports	1 serial port 1 parallel port 2 PS/2 ports 5 plug&play ports 8 USB ports 1 Ethernet port 1 SVGA port 1 Digital video port 1 TV-out port 1 infrared port
Monitor	Philips Brilliance 170P, 17 inch
Pointing device	HP PS/2 scrollwheel Mouse
Keyboard	HP USB standard keyboard
<b>Software</b>	
<i>Windows environment</i>	
Operating system	MS Windows XP, SP2, 32 bit (5.1.2600), standard NA image
Additional driver settings	Graphics driver for NVIDIA Quadro FX 1400 driver file: 81.67_forceware_winxp2k_english_whql.exe  Sound driver for SoundMAX integrated digital audio driver file: sp27792.exe
Additional software	Adobe Acrobat 7.0 Professional Bochs 2.2.1 Bochs 2.2.5 Broadcom 802.11 wireless LAN adapter Intervideo DVD check Intervideo WinDVD JDK SE 1.5.0.06 (v5 update 6) Java webstart KB888111:High Definition Audio McAfee Virusscan Enterprise MS .NET framework 1.1 MS Office Professional 2003 MS Office Project Professional 2003 MS Office Visio Professional 2003 MS Virtual PC 2004

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	Mozilla Firefox 1.5 NVIDIA Drivers QEMU 0.7.2 QEMU 0.8.0 SoundMAX UltraISO v7.65 SR-2 VMware Workstation Windows Installer 3.1 WinImage WinRAR archiver ZENworks Desktop Management Agent
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