

The logo for EaaS, featuring the text "EaaS" in white with a blue exclamation mark, set against a dark blue circular background with a thin white border.

EaaS

# Disk Images

EaaS Training Module #5

A series of five concentric white circles on a black background, located in the bottom right corner of the slide.

# During This Module

- What is a disk image?
- How do disk images relate to Software, Content, and Environment resources in EaaSI?
- What is the advantage of “copy-on-write” disk images?



I was there when floppies were  
actually floppy

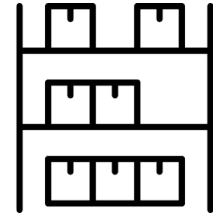
Hey cool, you 3D-printed the "Save" icon

There's a shoebox full of  
custom After Dark  
screensavers in the closet,  
I think



***But first...do you remember floppy disks?***

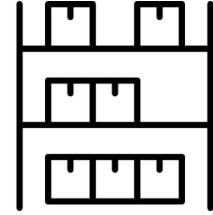
# Digital Storage Devices



- All data is stored on a physical medium
- Historically, formats have included floppy disks, optical discs (CD/DVD), hard disk drives, solid state drives, magnetic tape, and more
- Organize files according to a designated **file system** (FAT, NTFS, HFS, APFS, etc.)



# Digital Storage Devices



In addition to a user's files, storage media might have less-obvious content or file system metadata such as:

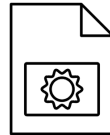
- System files



- Deleted files



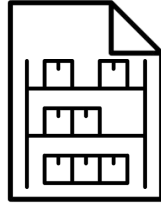
- Hidden application or configuration files



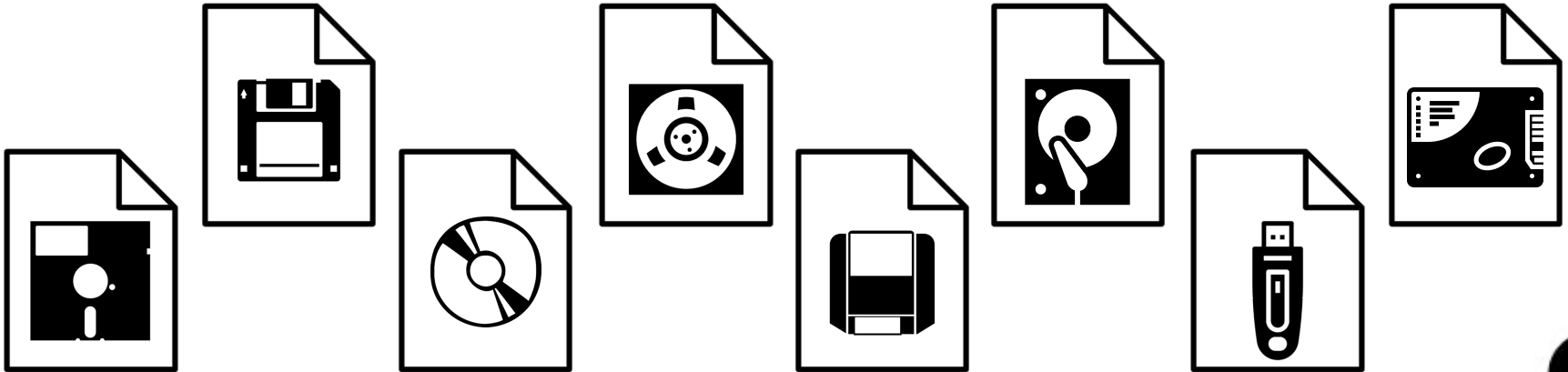
- Special permissions or attributes



# Disk Image



- A file-based copy of a storage device
- Recreates the contents and structure of that device (including file system) in agnostic blocks of data



# Emulators ❤️ Disk Images

- What emulators do for computers, disk images do for storage devices
- Translates a physical device to abstract/virtual space
- Emulators often rely on disk images to imitate floppy disks, CD-ROMs, hard drives, etc.
- Allows user to load and alter data in an emulated environment



# EaaS! Also ❤️ Disk Images

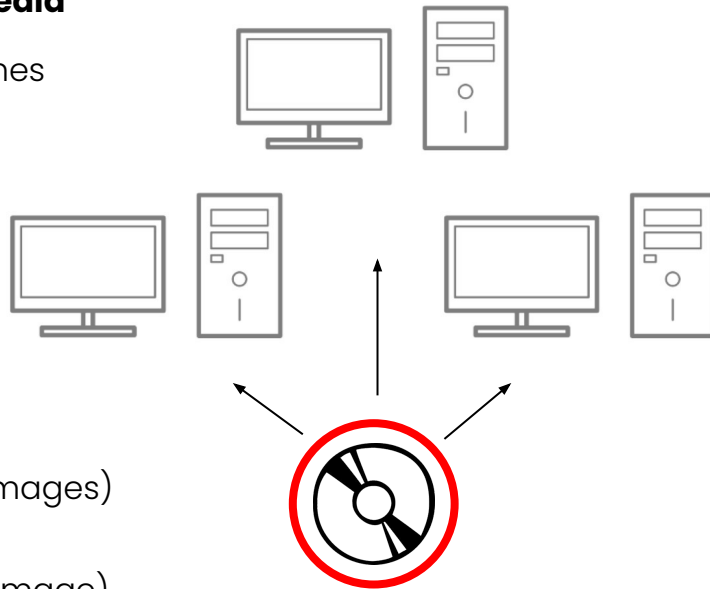
- Under the surface, *all* EaaS! resources are a combination of disk image(s) and metadata
- Disk images store data; EaaS! metadata determines how emulators and users interact with that data





# EaaS Software + Content

- Disk images recreate **external/removable storage media**
  - Devices for users to move data between machines
- Available Physical Format types for import:
  - Floppy  
(e.g. 3.5" and 5.25" floppy images)
  - ISO  
(optical media images)
  - Disks  
(external hard disk drive, flash/solid state drive images)
  - Files  
(arbitrary file set, packaged by EaaSI into a disk image)



### Import Resource

✓ METADATA

✓ FILES

3 FINISH

Finish Import

Cancel

I want to import a Software Resource

NAME  
TurboCAD 3.0 for Windows

[← Back To Metadata](#)

✓ Select All

✕ Select None

🗑 Remove Selected Files

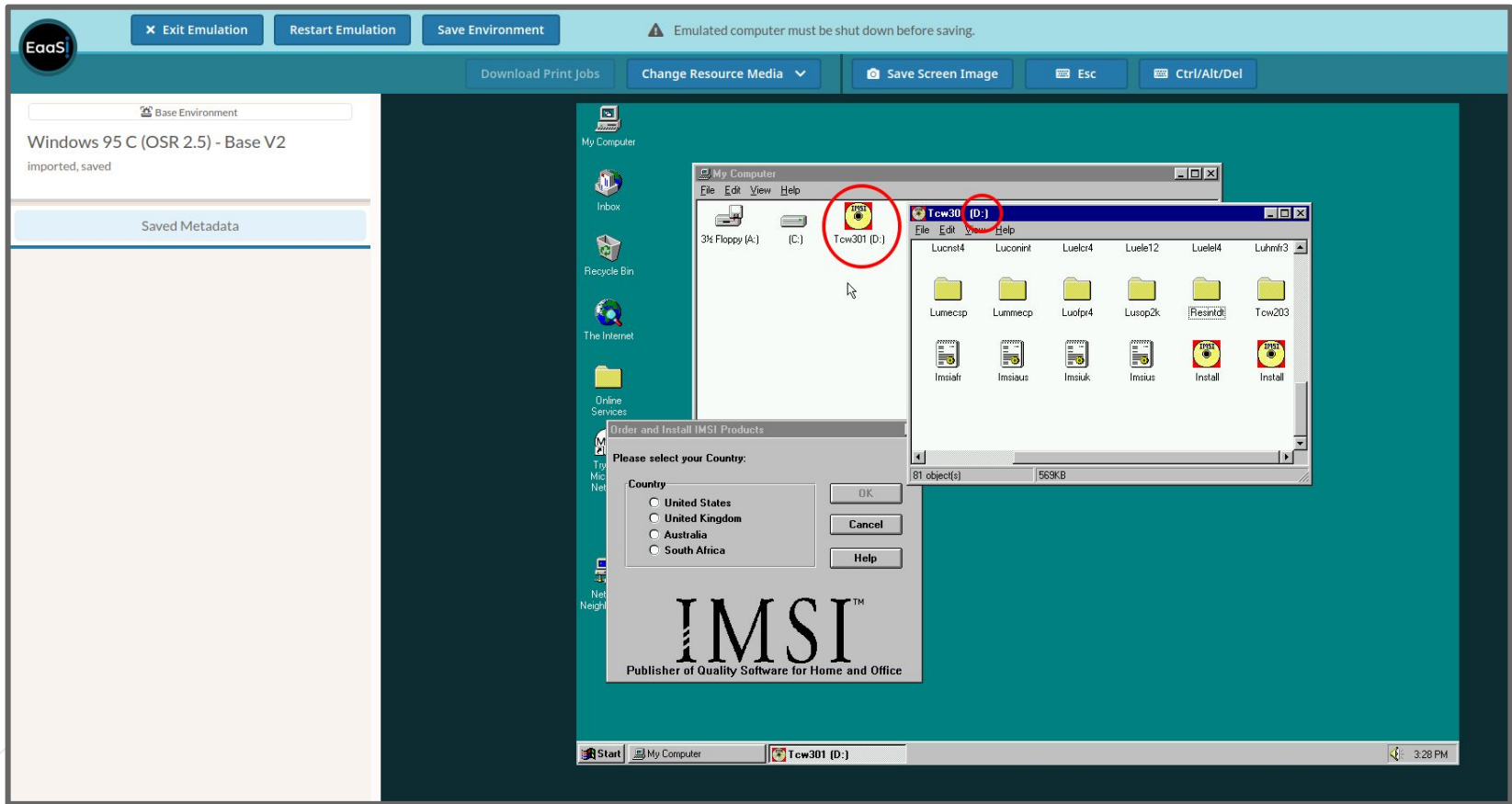
2 files attached to this resource.  
Drag and drop files using the handle on the right-hand side to change their order.

+

 Add More Files

<input type="radio"/>	TurboCAD v3.0 for Windows.iso	<div>ORDER optional 1</div>	<div>PHYSICAL FORMAT ISO</div>	<div>FILE LABEL — optional TurboCAD v3.0 for Windows.iso</div>	≡
<input type="radio"/>	TurboCAD v3.0 Symbol Libraries.iso	<div>ORDER optional 2</div>	<div>PHYSICAL FORMAT ISO</div>	<div>FILE LABEL — optional TurboCAD v3.0 Symbol Libraries.iso</div>	≡

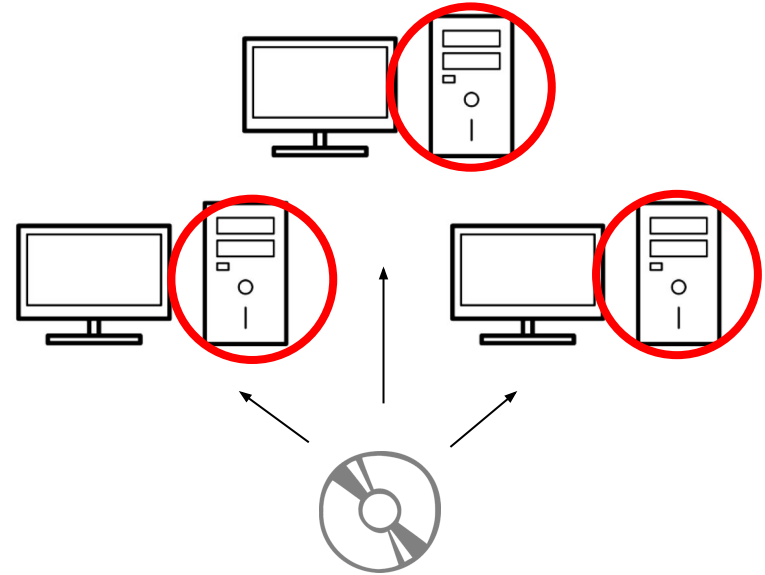
***Importing two CD-ROM disk images as an ISO-type Software resource through the EaaSI interface***

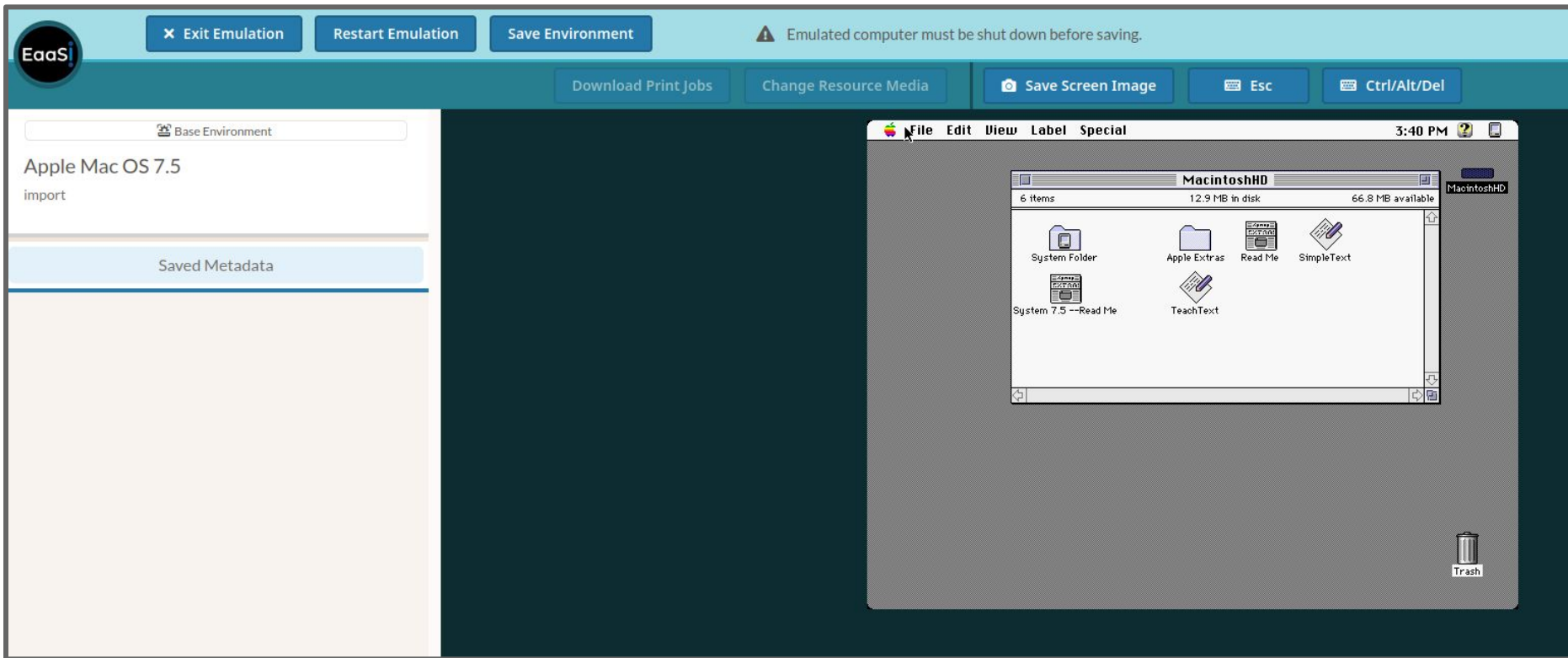


***Imported ISO-type Software resource mounted in the CD-ROM (D:) drive of a Windows 95 Environment***

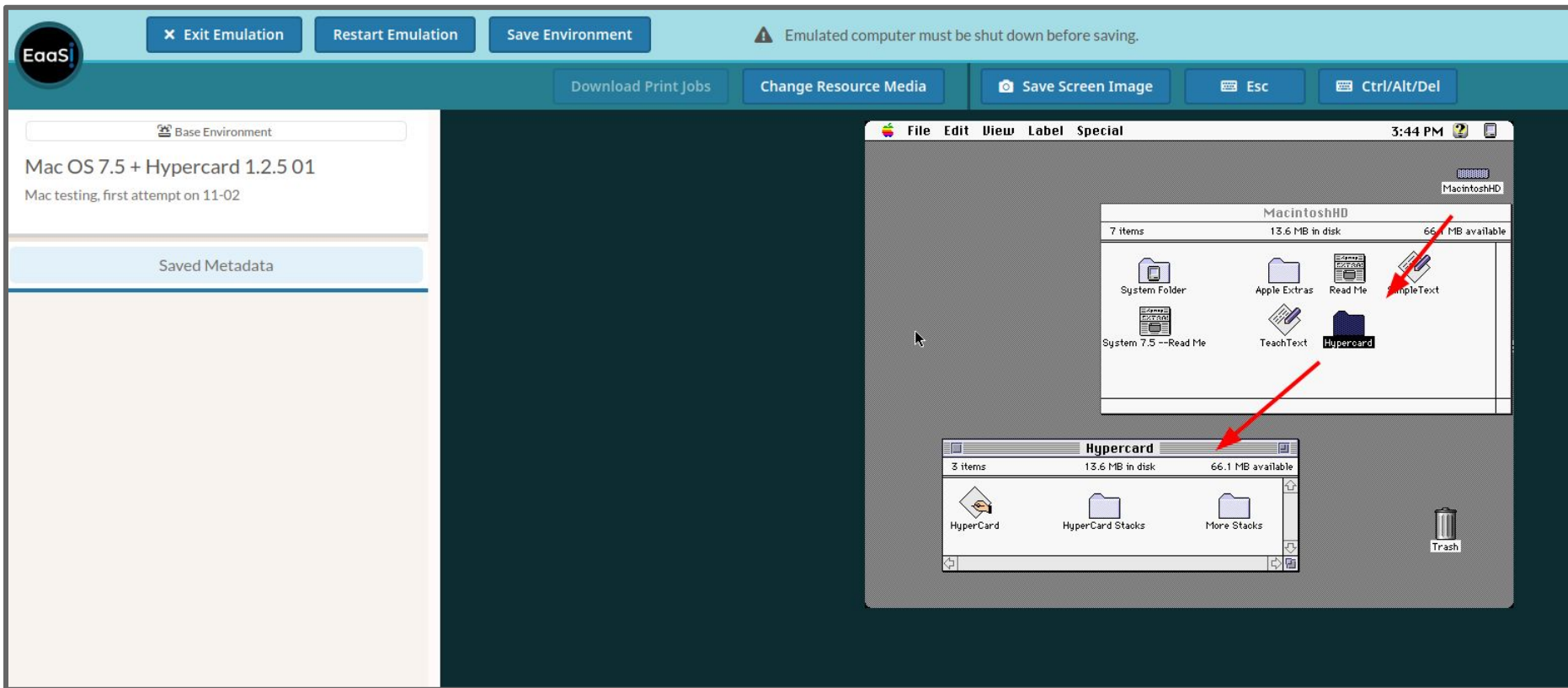
# EaaS Environments

- Disk images recreate **system drives**
  - Devices where users install operating system and application data
- Historically would be a hard disk drive, solid state drive, or possibly floppy disk
  - However, it is not necessary to specify a Physical Format type for the disk images that constitute Environments





***Contents of a system drive (“MacintoshHD”) on a Mac OS 7.5 Environment***



***System drive of a derivative Mac OS 7.5 Environment - the disk image has been altered by adding HyperCard***

# EaaS Disk Image Formats



## Software and Content:

- Resources are file-format-agnostic
- Provided metadata (e.g. Physical Format type) determines what emulated drive on an Environment EaaSI should use to attempt to attach the disk image
- Successful access to the disk image in emulation depends on:
  - Accurate metadata
  - Compatibility with the Environment's hardware and operating system

## Environments:

- Prefer the QCOW2 disk image format
  - **Q**EMU **copy-on-write** (**2**nd version)

# Copy-on-write



- QCOW2 files can use another disk image as a **backing** file
- Data blocks in the two images are overlaid when an emulator is run, appearing as one system drive
- Any new changes or alterations to an Environment are written to a new copy-on-write file; the backing file(s) remains untouched
- Allows for chains of derivative Environments and storage savings (copy-on-write files only describe *changed* data blocks, making them usually significantly smaller than the backing file)



[← Back to All Results](#)

## Windows 3.0 + Aldus PageMaker 4.0 Details

[Actions Menu](#)

Metadata

History

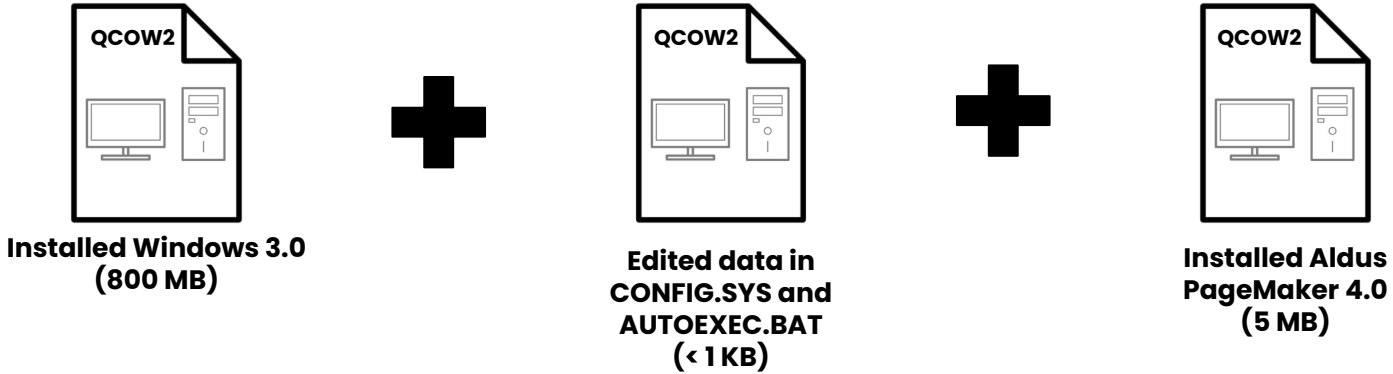
Resource Details

DATE

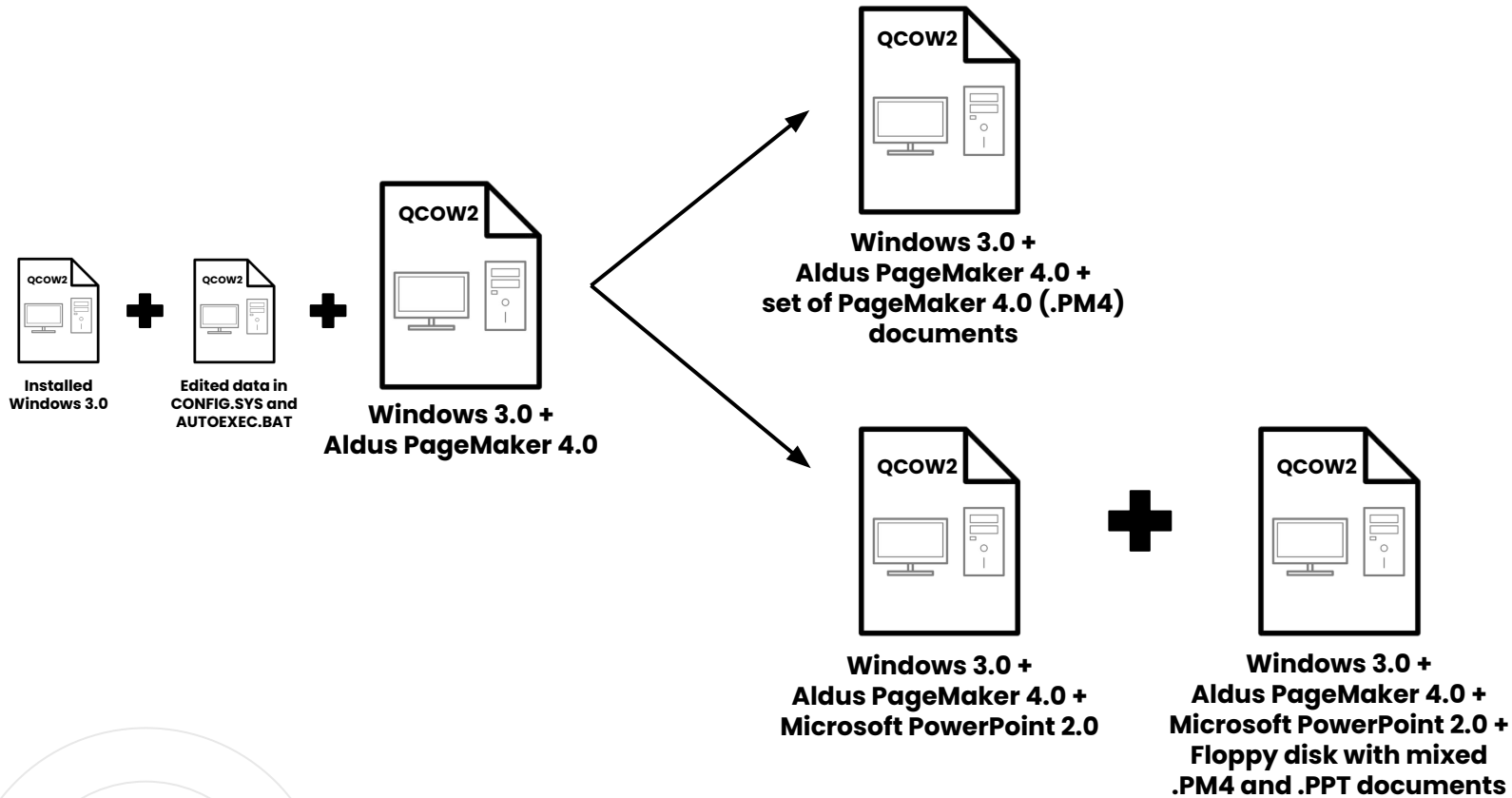
CHANGES

N/A	installed, saved, 3/19/2020	FORK
N/A	3/15/2019 - edited config.sys and autoexec.bat to allow for to run Windows in enhanced mode instead of real mode	FORK
N/A	3/15/2019 - imported and saved	FORK

***Environment resource “History” shows the chain of copy-on-write derivatives, along with the option to fork a new chain off any particular backing file***



***A visualization of the copy-on-write disk image chain of the  
“Windows 3.0 + Aldus PageMaker 4.0” Environment in previous screenshot***

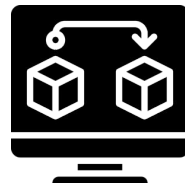


***Branching chains of backing files allow for the same software to be used in multiple use cases***

<b>Environment</b>	<b>Without copy-on-write (copying all data for every Environment)</b>	<b>With copy-on-write</b>
Windows 3.0	800 MB	800 MB
Windows 3.0 (with edited CONFIG.SYS and AUTOEXEC.BAT files)	800 MB	<1 KB
Windows 3.0 + Aldus PageMaker 4.0	805 MB	5 MB
Windows 3.0 + Aldus PageMaker 4.0 + set of PageMaker 4.0 documents	806 MB	1 MB
Windows 3.0 + Aldus PageMaker 4.0 + Microsoft PowerPoint 2.0	811 MB	6 MB
Windows 3.0 + Aldus PageMaker 4.0 + Microsoft PowerPoint 2.0 + Floppy disk with PM4/PPT files	812.44 MB	1.44 MB
<b>Total</b>	<b>4834.44 MB</b>	<b>813.44 MB</b>

***The more Environments created using such chains of backing files, the greater the storage savings compared to repeatedly copying raw data***

# “Computer Image” Import



- Allows users to essentially import a complete Environment from outside EaaS
- Applies only in two specific scenarios:
  - Converting a virtual machine from another emulation or virtualization platform into an EaaS Environment
  - Extracting, imaging, and converting a unique system drive from a physical computer into an EaaS Environment

EaaS

MY DASHBOARD

EXPLORE RESOURCES

MY RESOURCES

EMULATION PROJECT

IMPORT RESOURCE

MANAGE NODE

Q Search resources...

Import Resource

1 METADATA

2 FILES

3 FINISH

Next

Cancel

I want to import a 

Computer Image

NAME

FreeDOS 1.2 Virtual Machine

< Back To Metadata

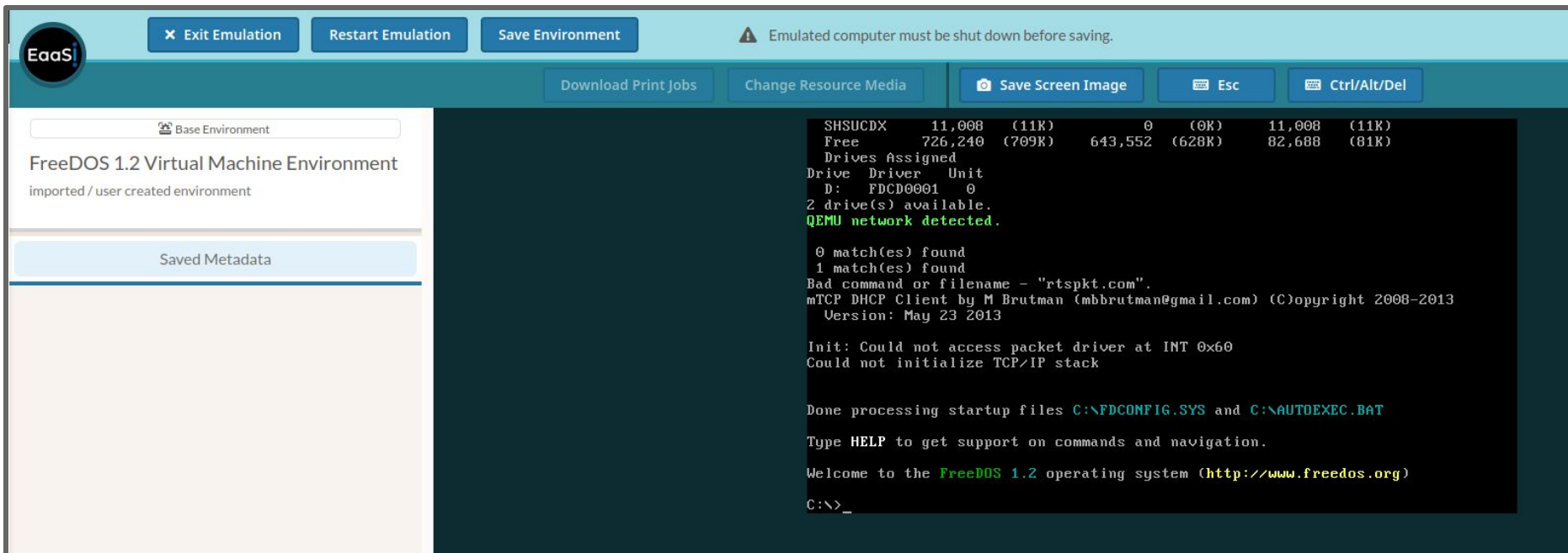
I will attach my disk image from...

FILE URL

https://s3.wasabisys.com/diskimages/FreeDOS1.2.qcow2

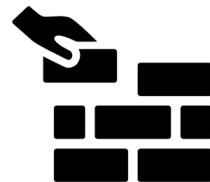
Continue >

***Importing a QEMU Virtual Machine containing  
FreeDOS 1.2 as a Computer Image***



**Imported FreeDOS 1.2 Virtual Machine running  
as an EaaS! Environment**

# Block by Data Block



- Disk images are critical to moving, combining, and interacting with data in the EaaSI platform
- Staying agnostic to specific disk image *formats* or *content* allows for technical flexibility but makes accurate metadata crucial to functional emulation



# Credits

- Training Module written and designed by Ethan Gates, Software Preservation Analyst, Yale University Library
- All photos, screenshots, and videos recorded by Ethan Gates
- Icons sourced from [The Noun Project](#)
- EaaSI program of work sponsored by the Alfred P. Sloan Foundation and the Andrew W. Mellon Foundation, hosted by Yale University Library



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