

The **DETER** Project

Beyond Disk Imaging for Preserving User State in Network Testbeds

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Disk Images In Testbeds

- Testbed experimentation takes a long time
  - Setup, running, analysis
  - Weeks to months
- Testbeds encourage release of resources if they are not actively used (idle swap, emails)
- Users need a way to preserve state
  - OS configuration
  - Applications installed and data

⇒Solution: disk images

  - Base and custom images



What's the Downside?

- Images use a lot of space
  - 340 GB on Deterlab = 1/3 of shared storage
- Older images are not updated
  - Vulnerabilities
  - Swap-in problems
- Older images reduce experiment's chance of swap in
  - Not supported on new hardware – testbeds and their user base grow
  - Users do not understand this limitation

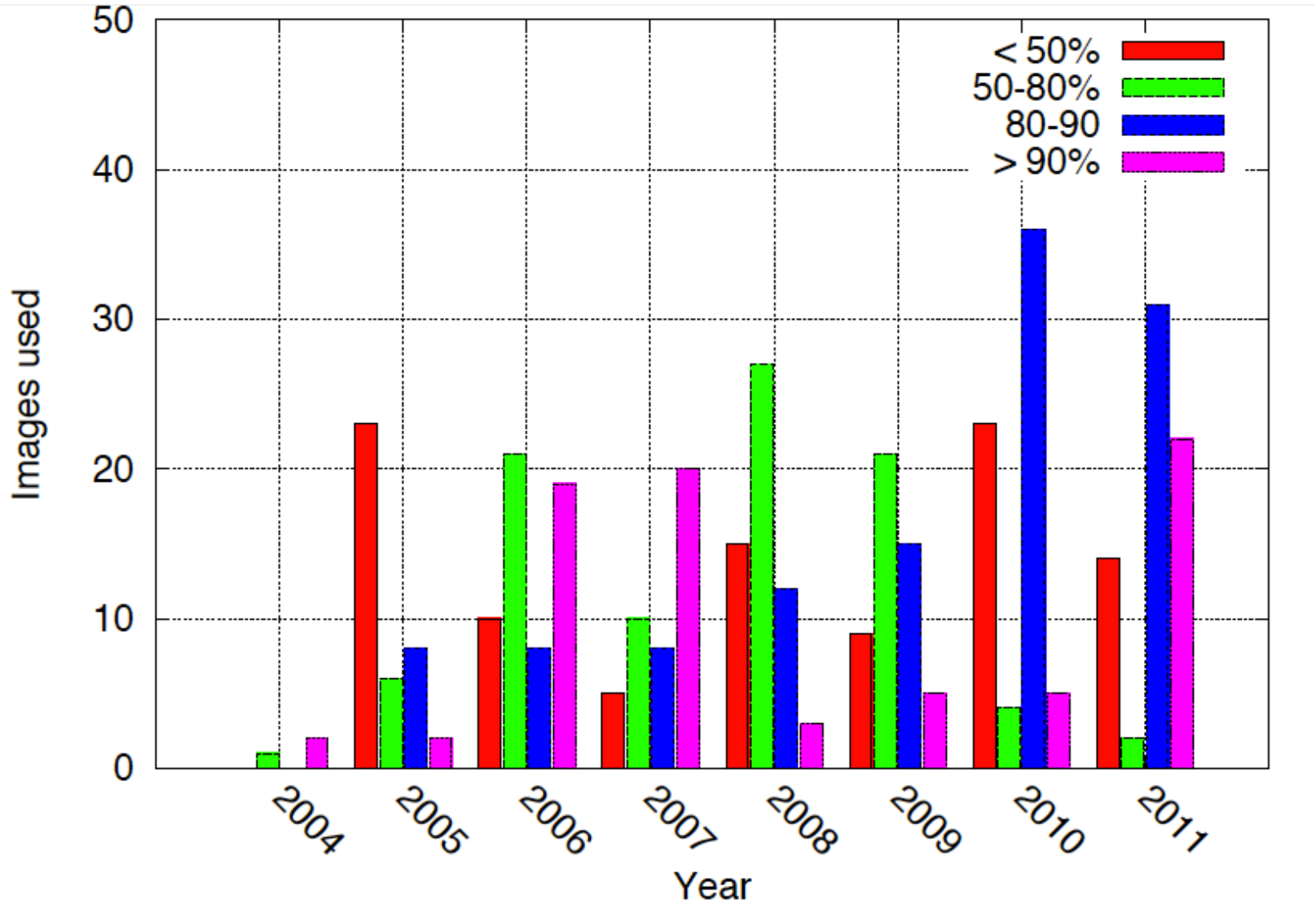


Image Usage on DeterLab

- Mined from DB/disk and usage logs
- 1,128 images
  - 645 in DB/disk (22% never used)
  - 483 used and deleted
- 47% projects and 14.4% allocations use custom images
  - 48% of research projects = 735 images/77 projects
  - 44% of class projects = 124 images/19 projects
  - 47% allocations use images older than 1 year

⇒Disk images are popular and numerous

Custom Image Use/Support

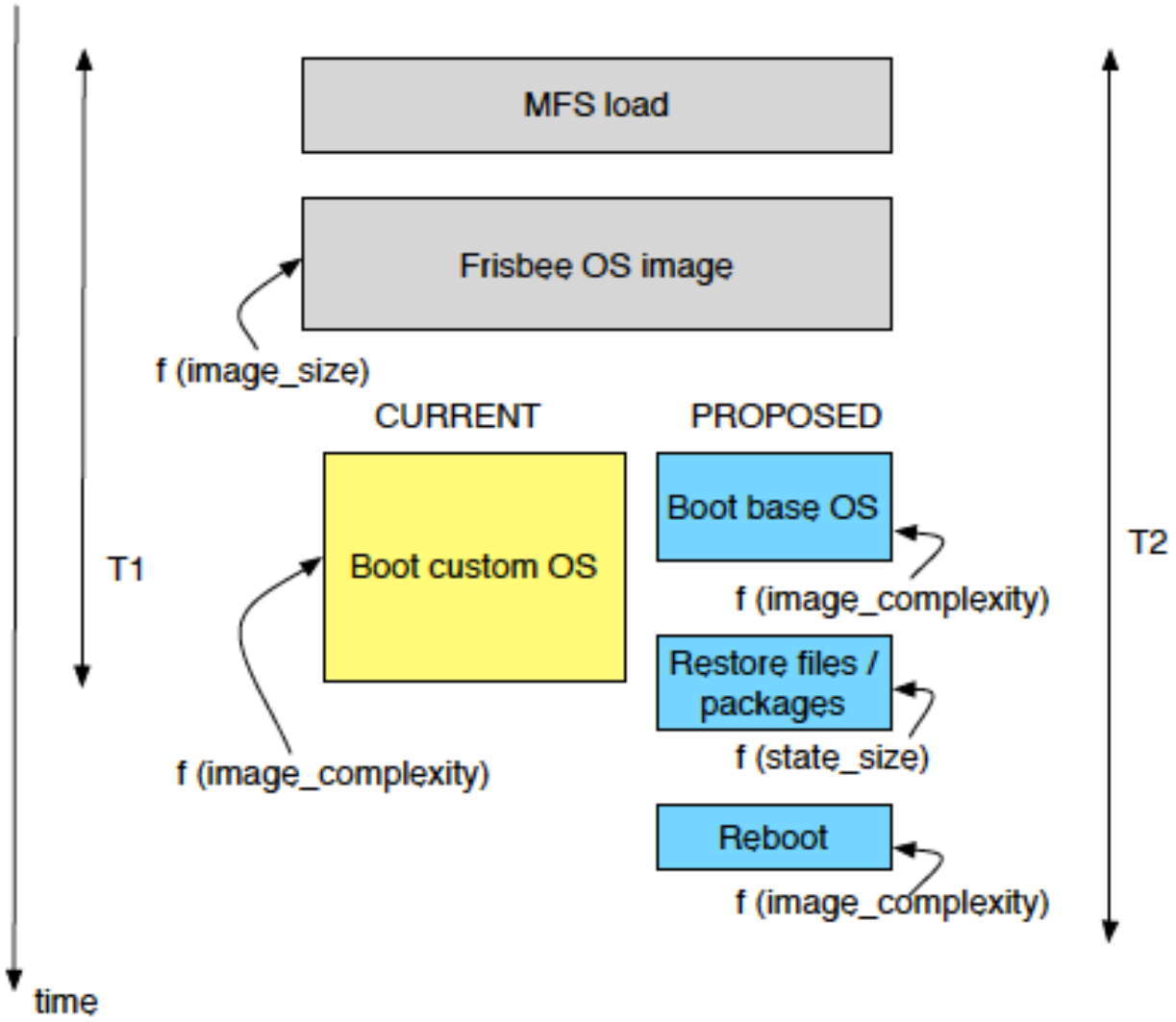




Alternatives to Disk Imaging

- Goals:
  - reduce storage requirements
  - facilitate easier update/upgrade
- Catalogue and reapply image customizations at file level
  - DiffBase
  - DiffCustom
  - AppStore
- Help users script/reapply installations + store large data locally (dedicated disk/network)

OS Loading Process

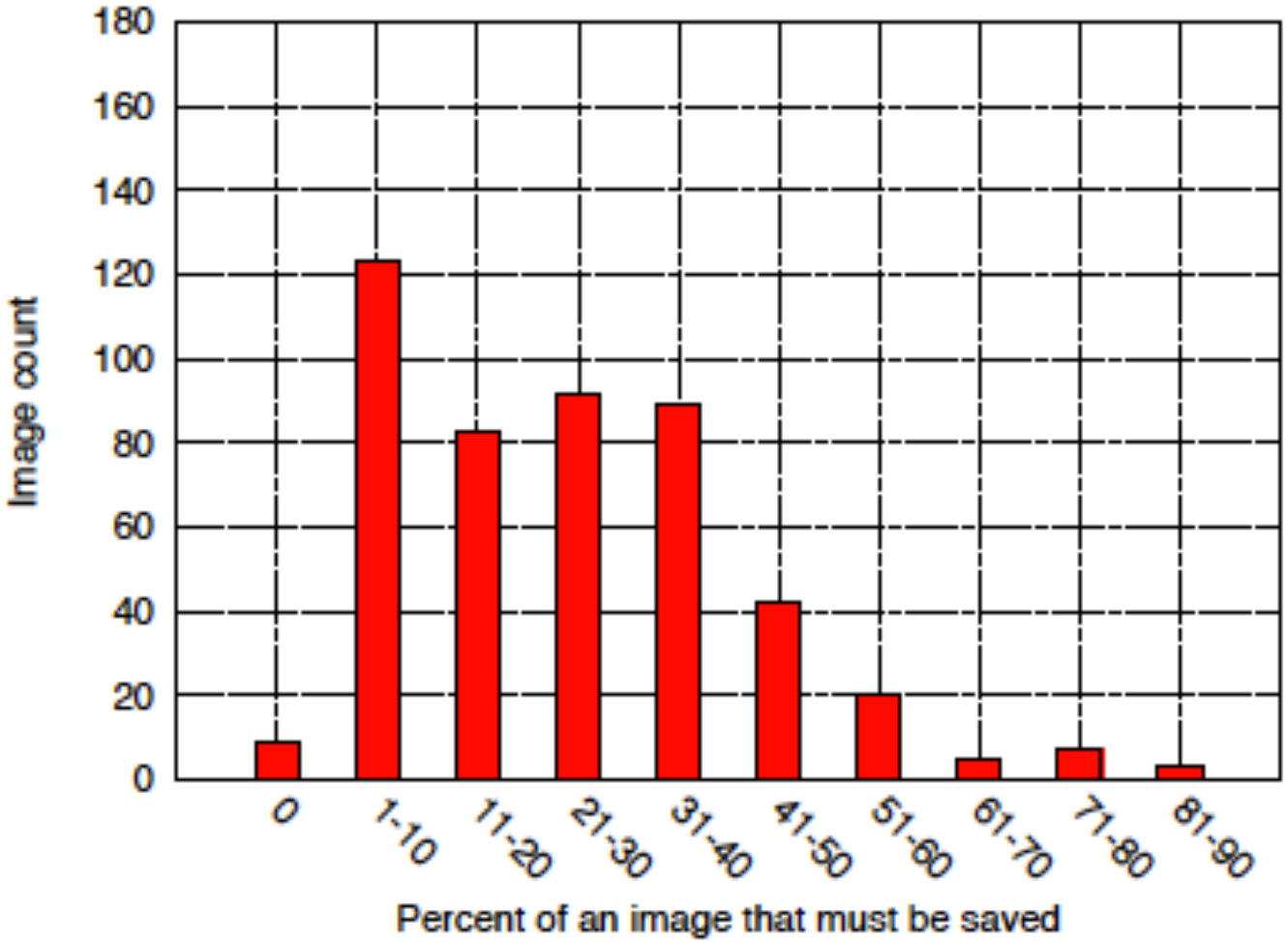




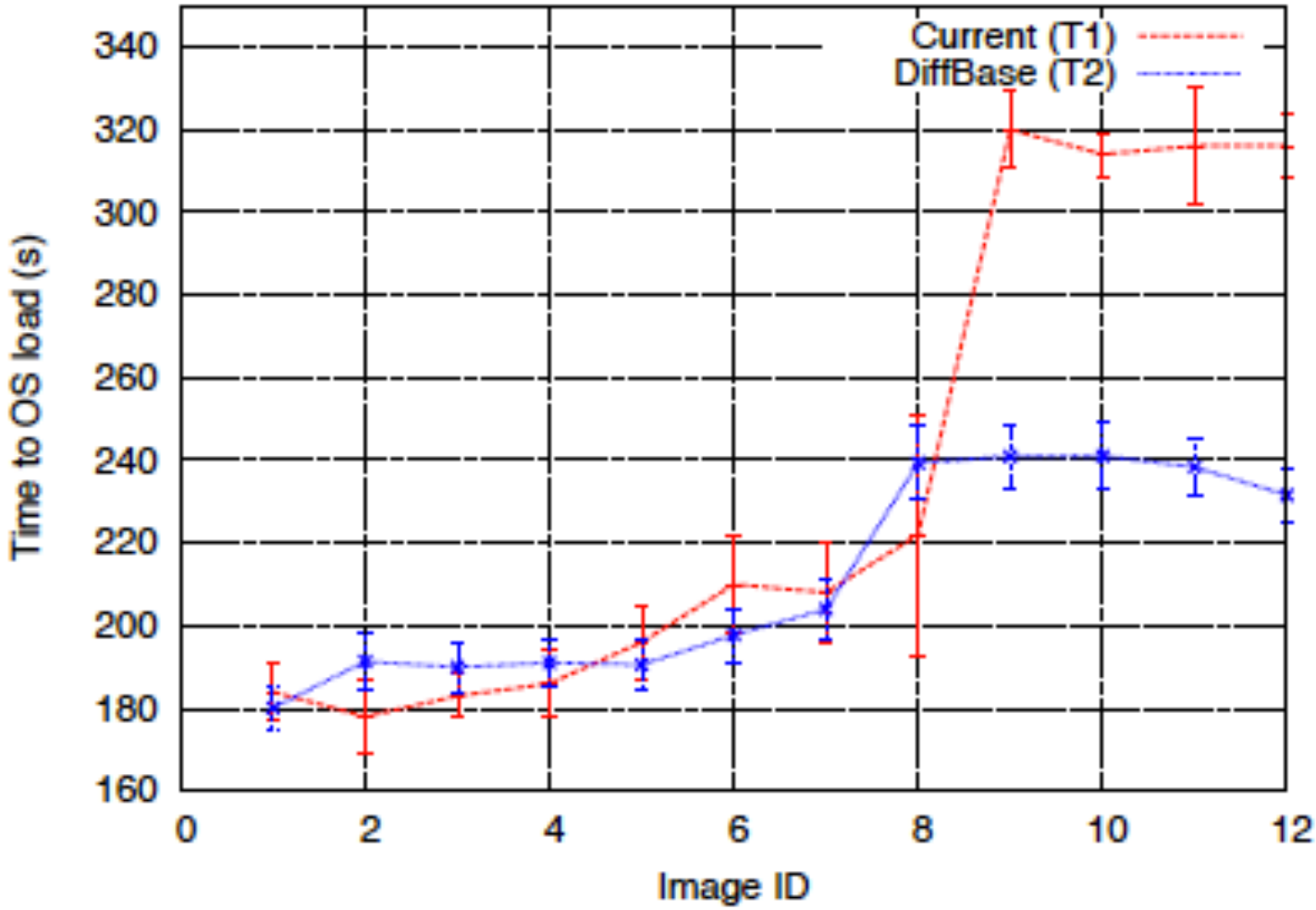
DiffBase

- Compare custom image with base during creation, file by file
  - Store only differences
  - Added/modified files, list of deleted files, catalogue of sparse files and their contents
- Saves 75% disk space
- Larger images load faster!
- Helps a little with OS update/upgrade

DiffBase – Storage



DiffBase – OS load

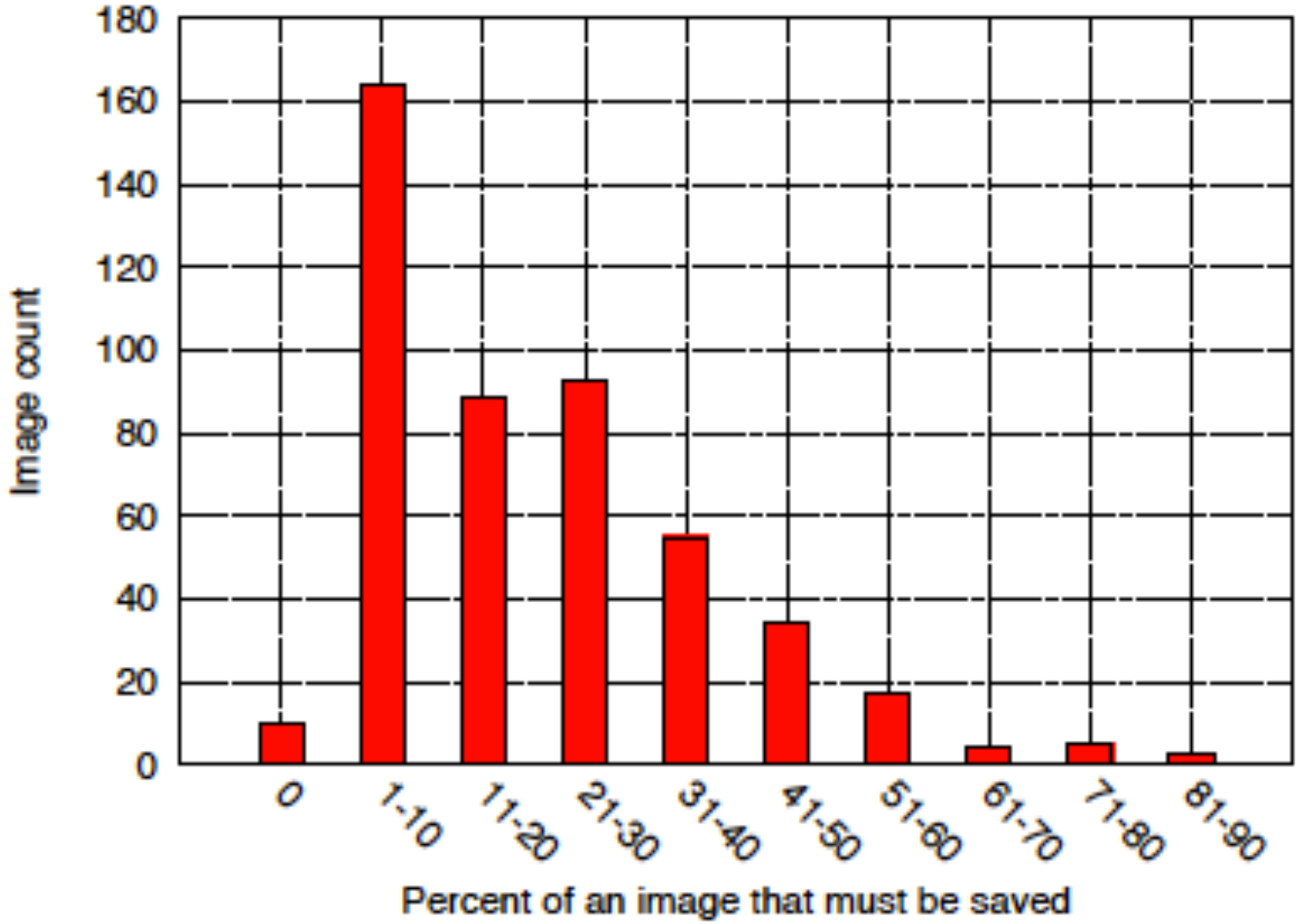




DiffCustom

- Compare custom images within one project with each other
  - Store one using DiffBase
  - For others store file differences between each and that first custom image
- Saves 78% disk space
- Helps as much as DiffBase with OS update/ upgrade

DiffCustom – Storage

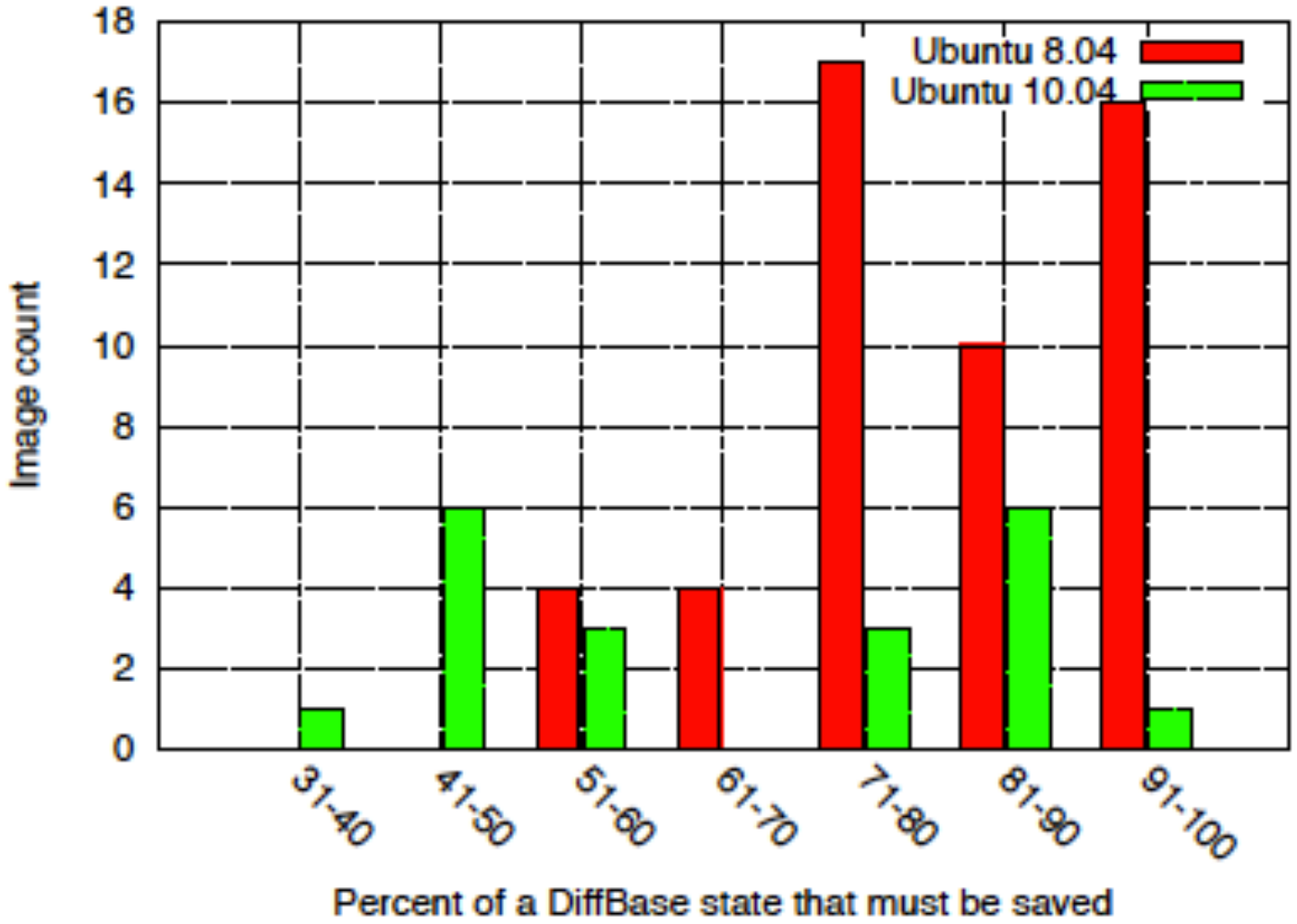




AppStore

- Run DiffBase approach
- Automatically compare files identified as added/ modified with application packages
- For matches:
  - Remove them from DiffBase state
  - Store configuration changes and package name
- Saves 81% disk space
- Facilitates easy OS update/upgrade

App Store – Storage





Conclusions and Future Work

- Testbed users need a way to save state
  - Disk images are not a good option
- Our proposed alternatives save significant amount of storage
  - But do little to help users update/upgrade images
- Future research
  - Help users catalogue changes they made to a base image and their purpose
  - Automate migration to other images / upgrade



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