European Organization for Nuclear Research

Engineering Department

Software Testing and Deployment Using Virtualization and Cloud

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Outline

- **Part I - Background**
  - Use cases, Infrastructure
- **Part II - Concepts**
  - Virtualization, Cloud Computing, Tools and Deployment Models
- **Part III - Implementation**
  - Private cloud, Contextualization, Image Management
- **Part IV - Results**
  - Deployment Times, Wait Times

Part I

Introduction

Use Cases

- OPC Server
  - Different vendors: CAEN, Wiener, ISEG
  - Load testing to examine OPC server behaviour – high traffic, duration of execution etc.
- PLC Security
  - Process monitoring, Communication analysis
  - Security attack deployments and evaluations
- PVSS Testing and Patching
  - Developing new patches, bug fixing, pre-production deployment
- Infrastructure Development
  - Multi-Platform Deployment, Hot-Swap of production services

Common Requirement

Setup and Configure

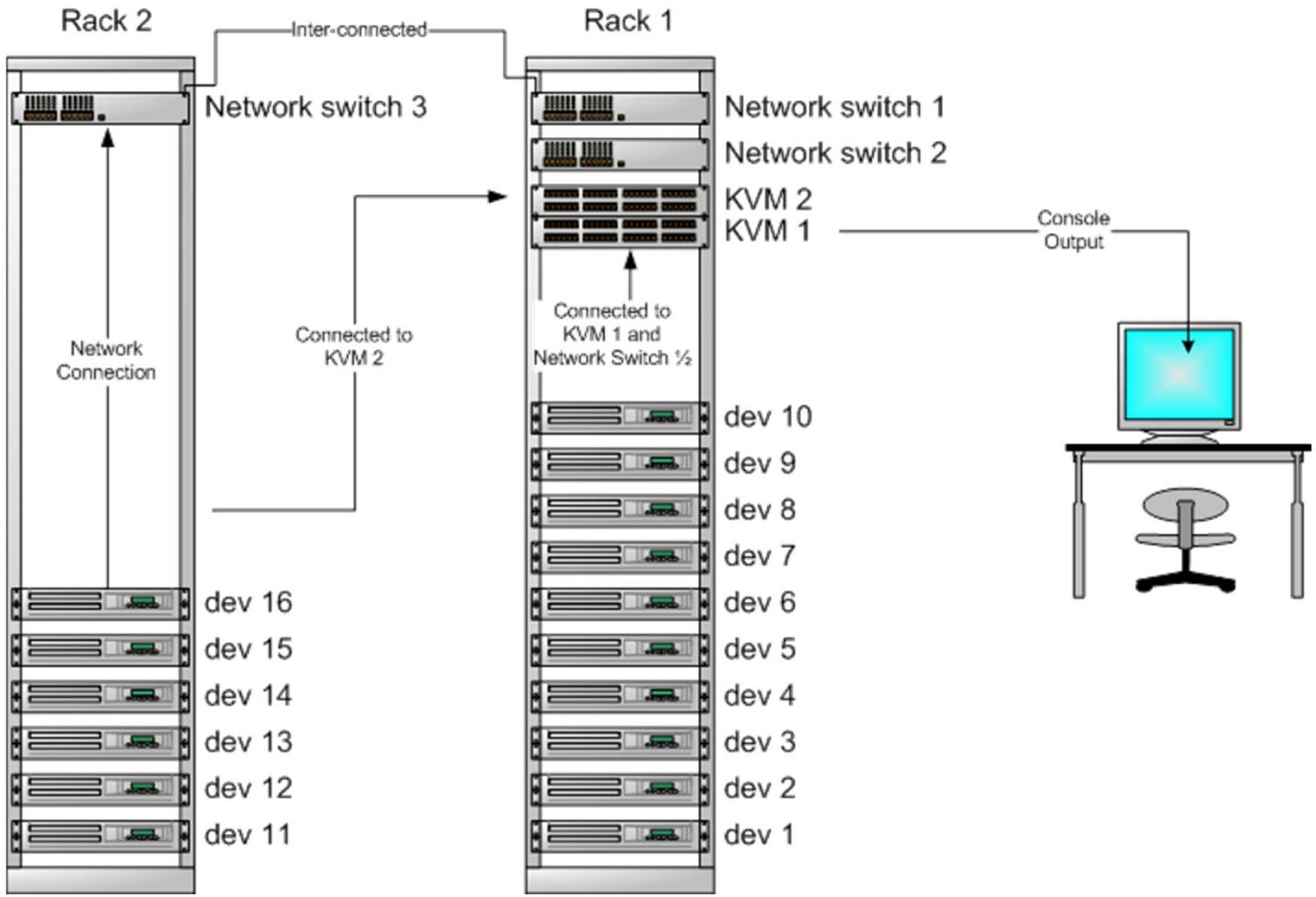
New Machines

with pre-configured software

within 30 minutes

Physical Architecture

16 HP Proliant G4 Servers: 4 TB Storage, 10 GB RAM each



Additional Constraints

- **Multiple Platforms**
  - Windows XP, Scientific Linux 5/6 (32 and 64 bit)
- **Software Dependencies**
  - OPC Server (multiple versions, multiple vendors)
  - PVSS (multiple versions/patch level)
  - PLC Environments (Step7 and Unity – multiple versions)
- **Time Constraints**
  - Each user needs a machine urgently for testing
  - Each machine must be re-installed after every test ~= 2 hrs

Additional Constraints

Multiple-Dimension Knapsack Problem

Limited Supply – More Demand

(resources vs users vs time)

How to solve?

Part II

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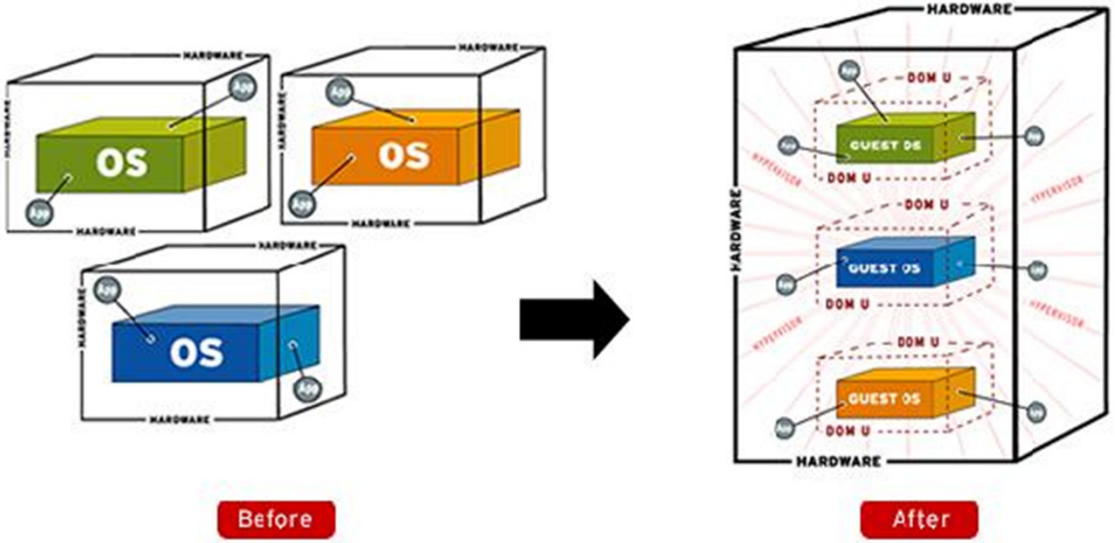
Virtualization

And

Cloud Computing

Virtualization?

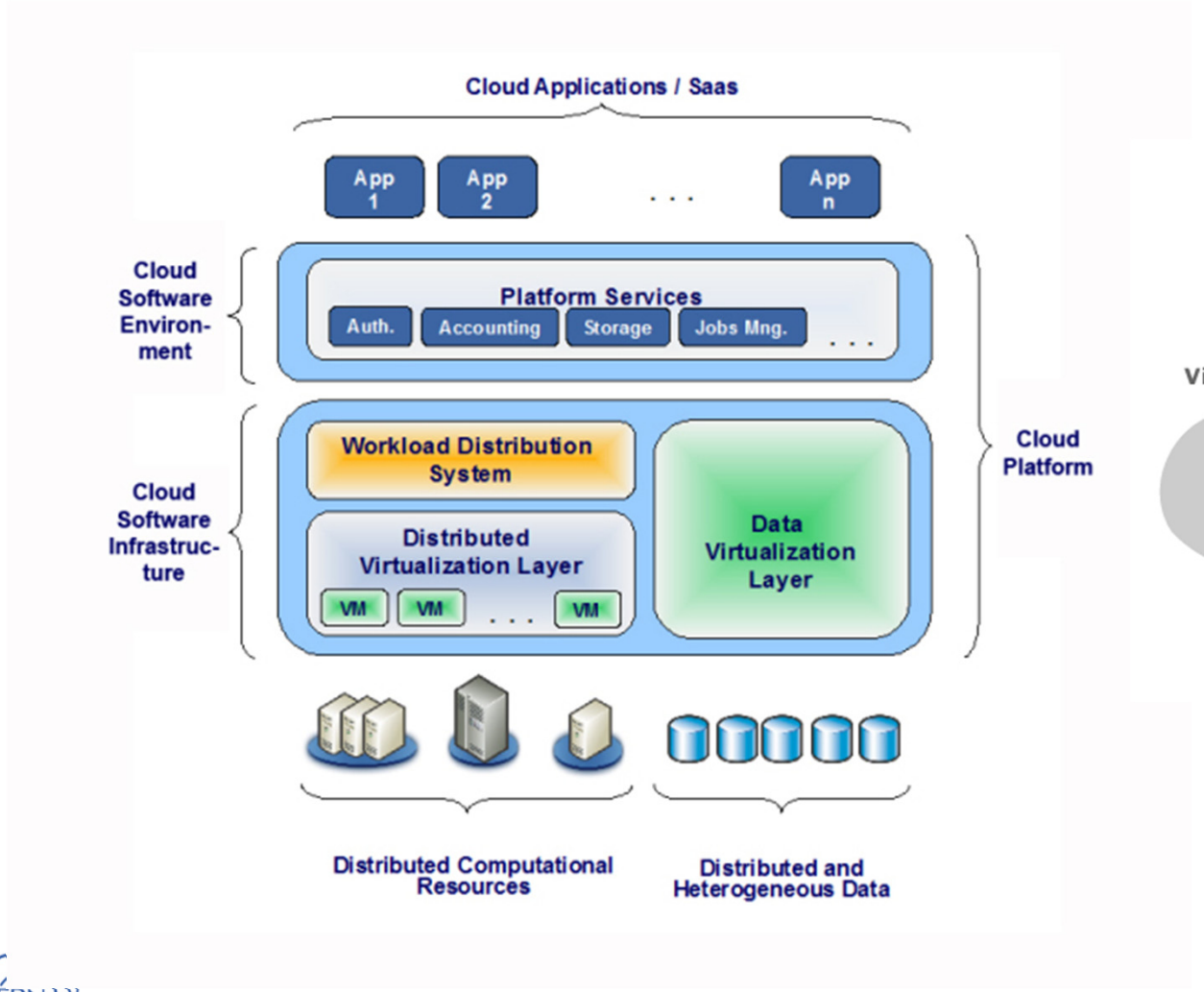
Virtualization, in computing, is the creation of a virtual version of something such as hardware platform, operating system, storage device or network resources

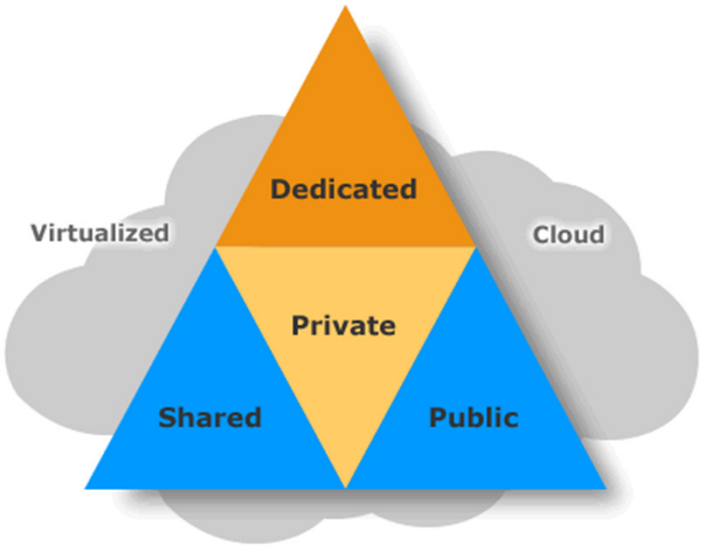


Source: Wikipedia

Cloud Computing?

Delivery of computing (CPU, Storage, Memory) as utility-service over a network





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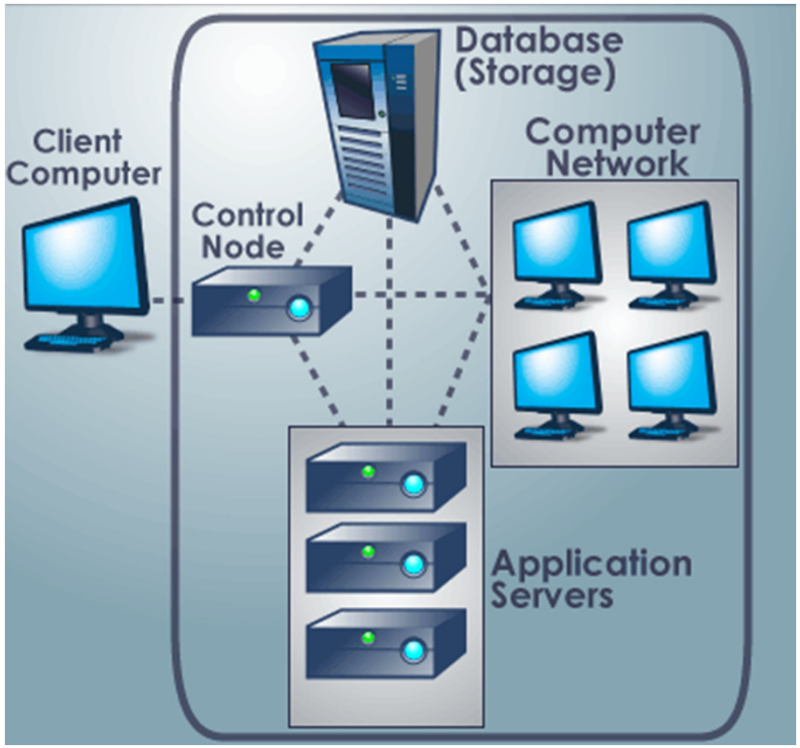

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Part III

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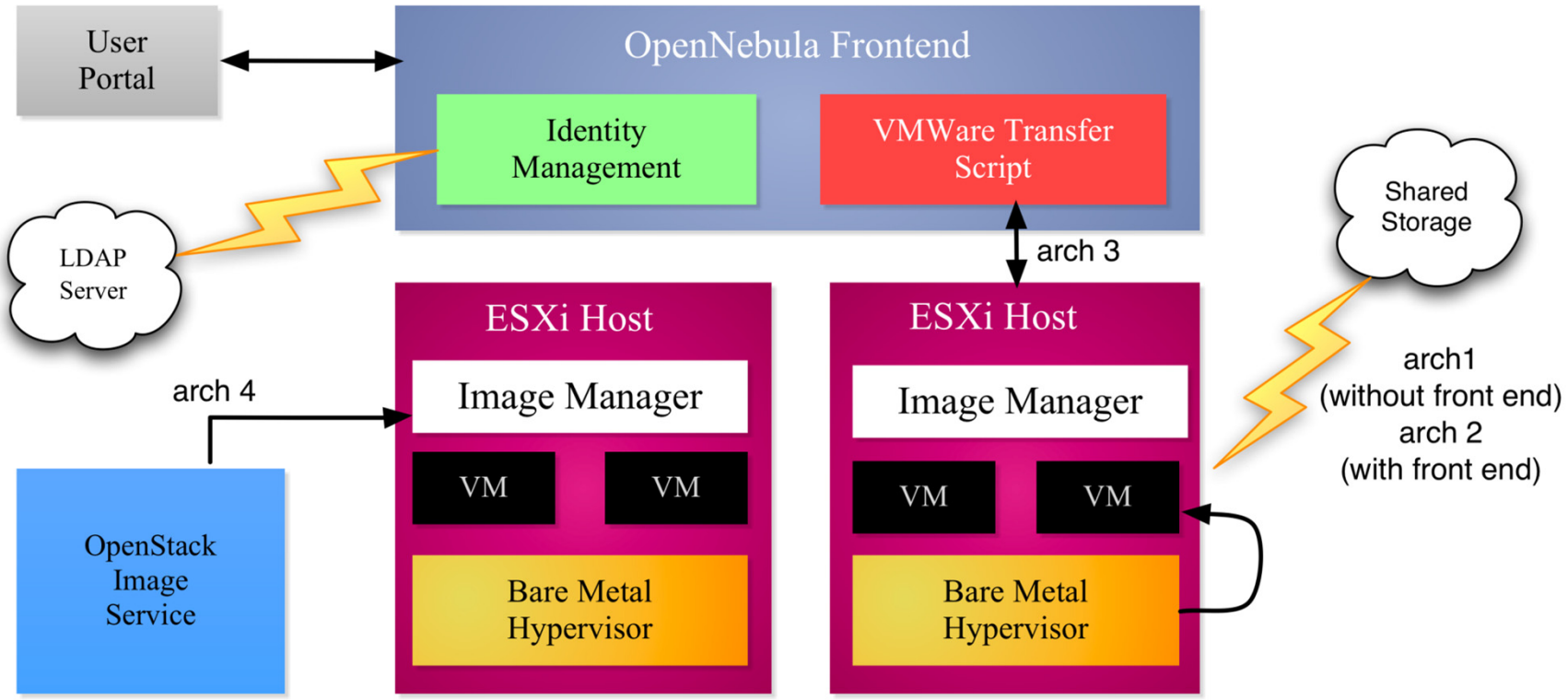
Implementation

What did we do?

- Infrastructure as a Service (IaaS):
  - Virtualization and Cloud Platform
    - Private/Shared: Users tests running in virtual machines + Library of images
  - Mash-up using:
    - Commercial, Open Source, and custom developed tools
    - Evaluated tools:
      - VMWare vCenter/Lab Manager, Citrix XenServer/Lab Manager
      - OpenStack (Compute/Glance), Eucalyptus (with Xen Source), OpenNebula (open-source/commerical)
      - >> Deployed: VMWare ESXi + OpenNebula + OpenStack (Glance)
  - Performance Testing:
    - Different deployment models – incremental requests vs. burst requests (10 VM's)
    - Different storage models – shared storage (NFS) vs. distributed storage (each server)

Objective: Minimize VM Deployment Time

What did we do?

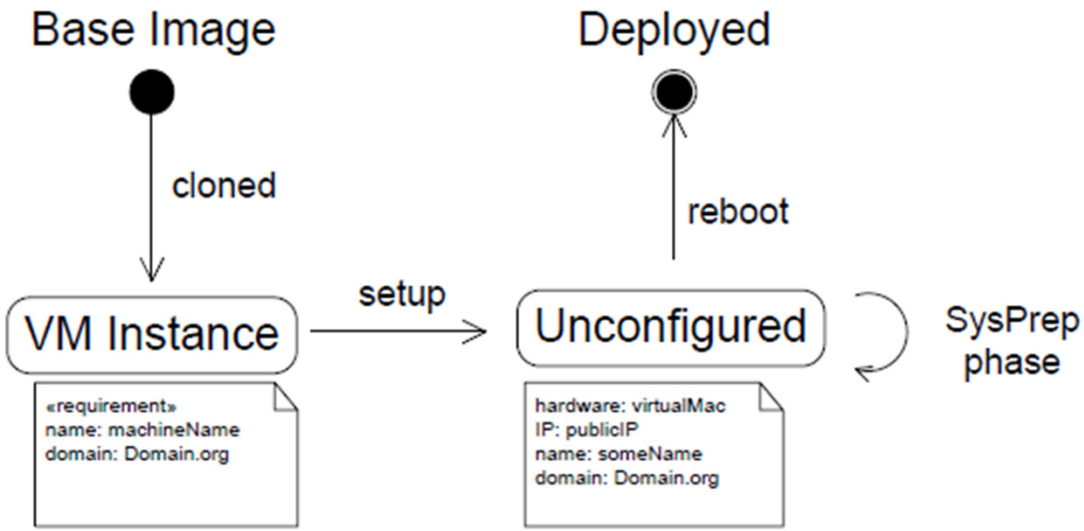


10 Server, 3 TB of Storage, 100 GB Ram = 90 Virtual Machines

Image Service and Configuration

- Image Management
  - Python service – runs on every server, standalone component
  - Updates and download images every hour from the OpenStack image service
  - Modified version of Open Nebula – deploys VM's using locally cached image

Image Service and Configuration



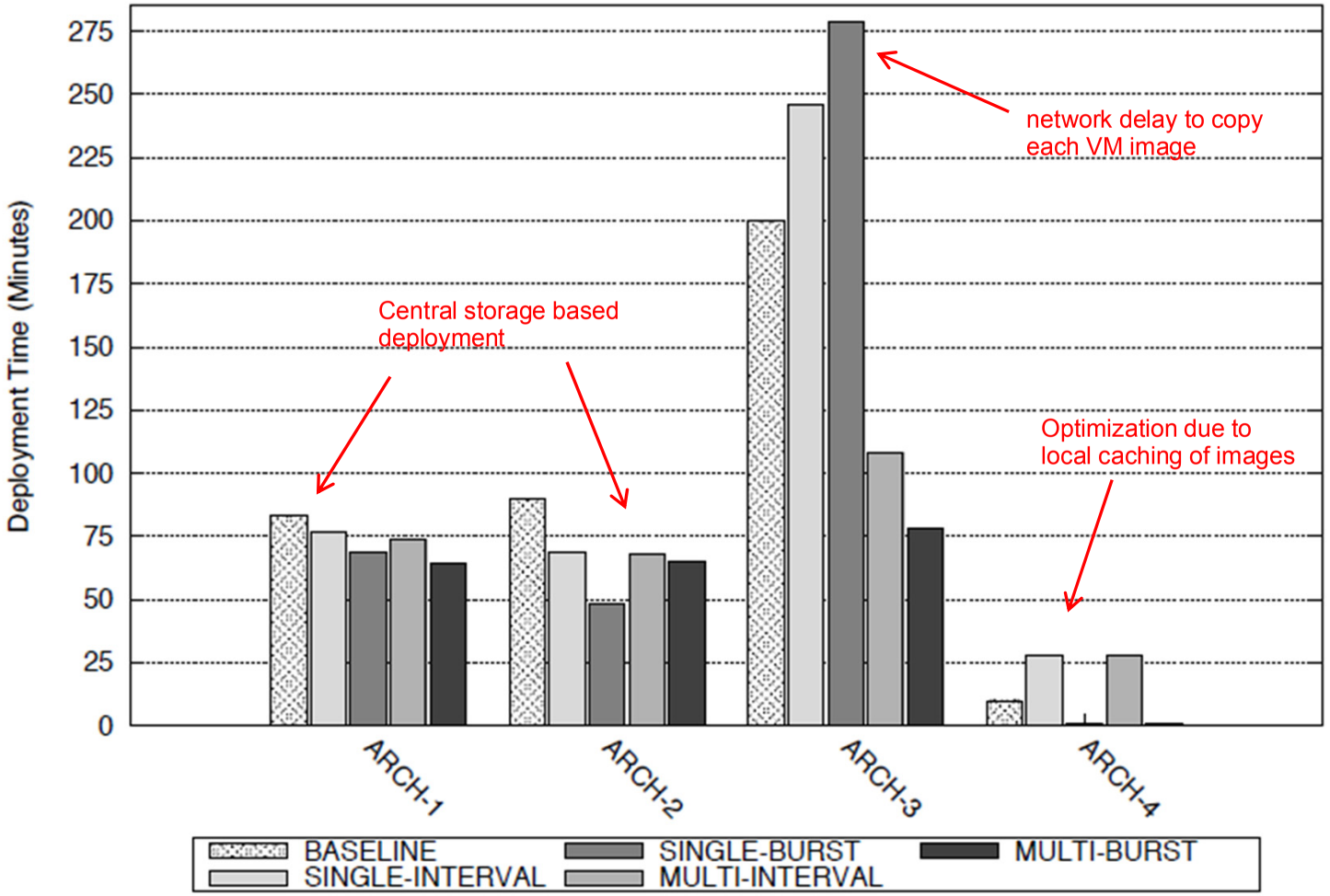
- Contextualization (Windows specific)
  - Registering MAC address in the CERN network database
  - Regenerating system security ID using System Preparation (sysprep) Tool
    - Uses a special configuration for each organization wide settings
  - Adding the machine in the CERN Domain -> Reboot

Part IV

Results

Aggregated Results

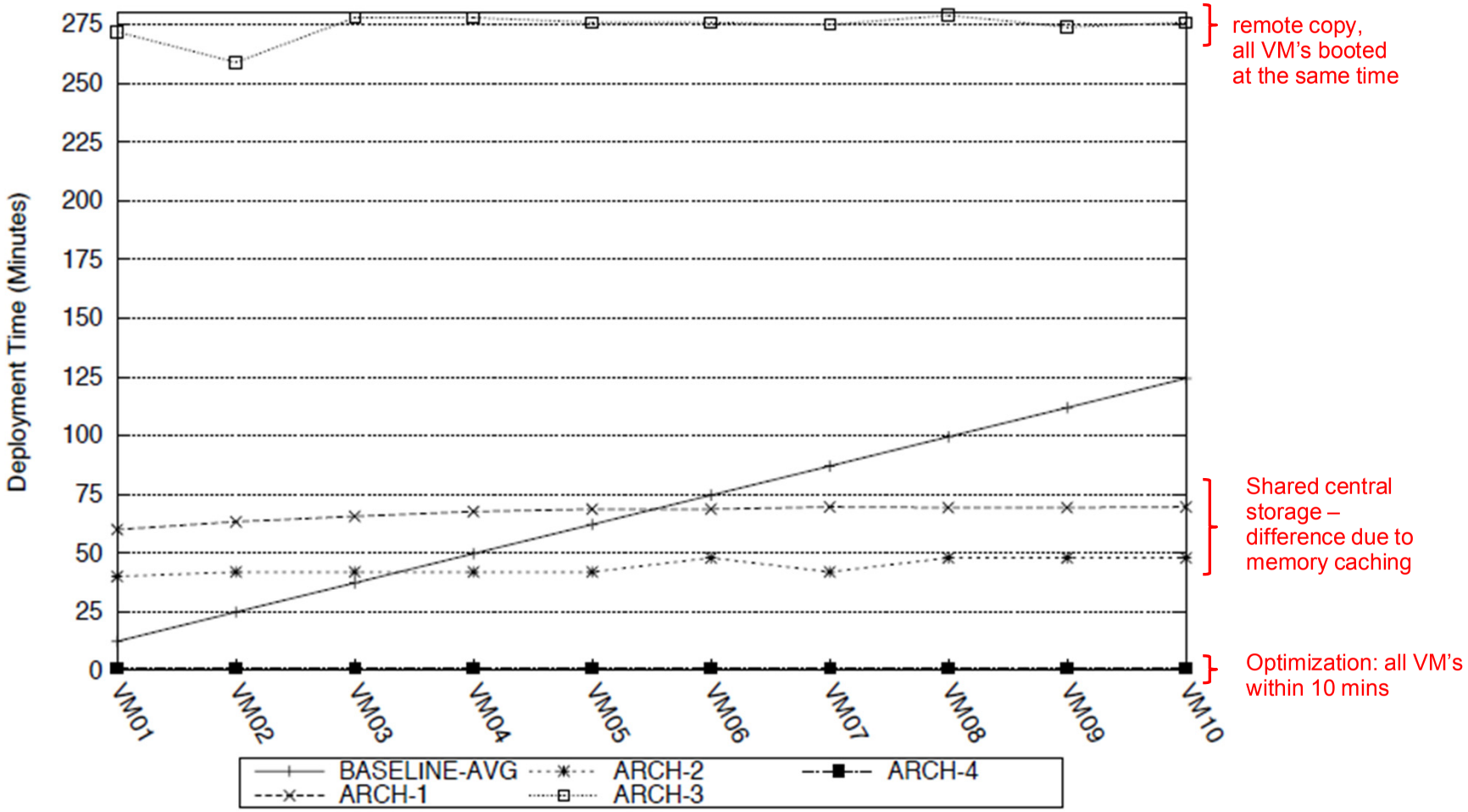
Aggregated deployment times for all configurations



arch-1: shared storage without front end
arch-2: shared storage with front end
arch-3: distributed storage, remote copy
arch-4: distributed storage with local cache

Wait Times – Burst mode

Single-Burst: 10 VM's on one server



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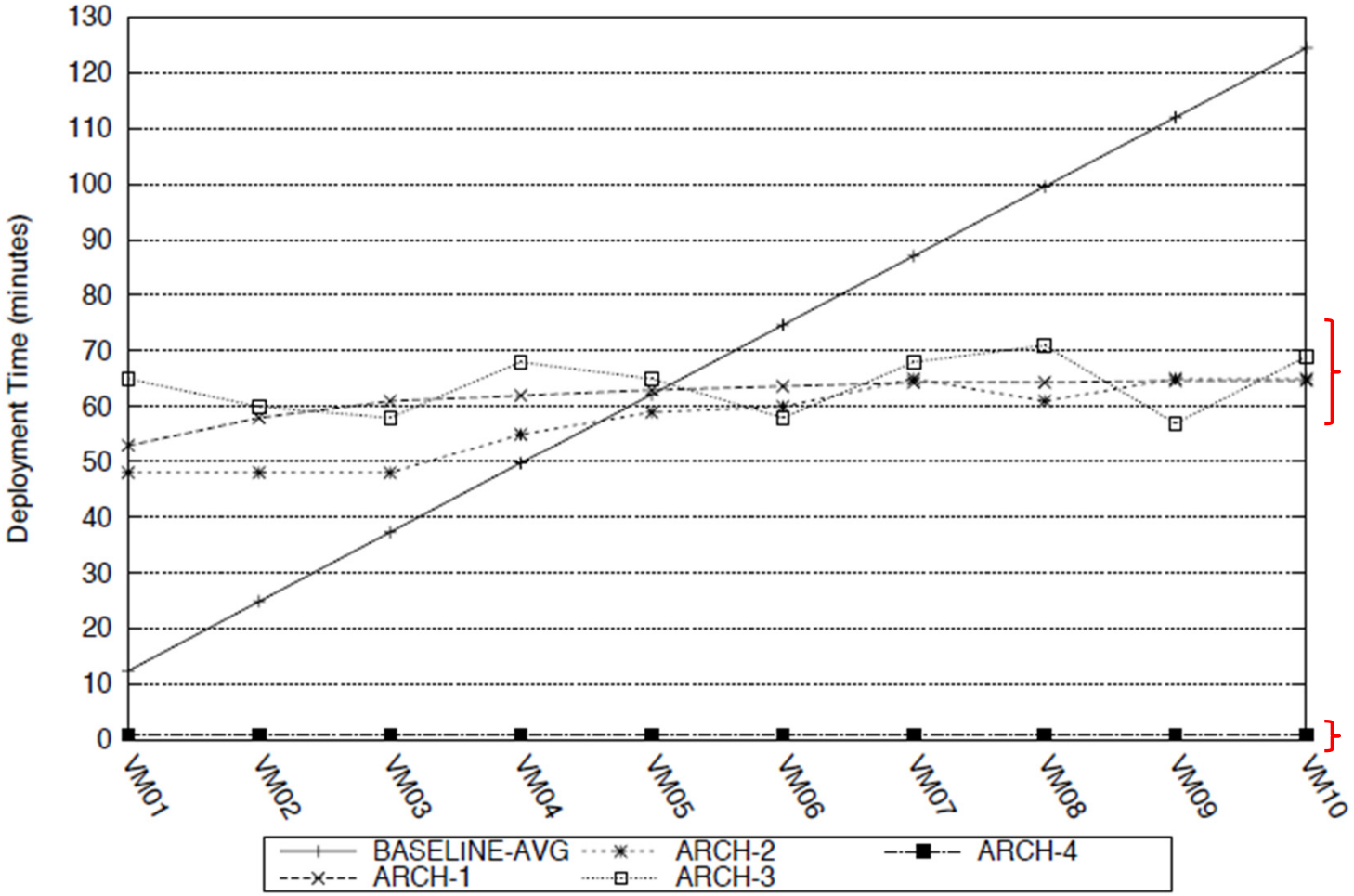
Wait Times – Burst mode

Multi-Burst: 10 VM's on all servers



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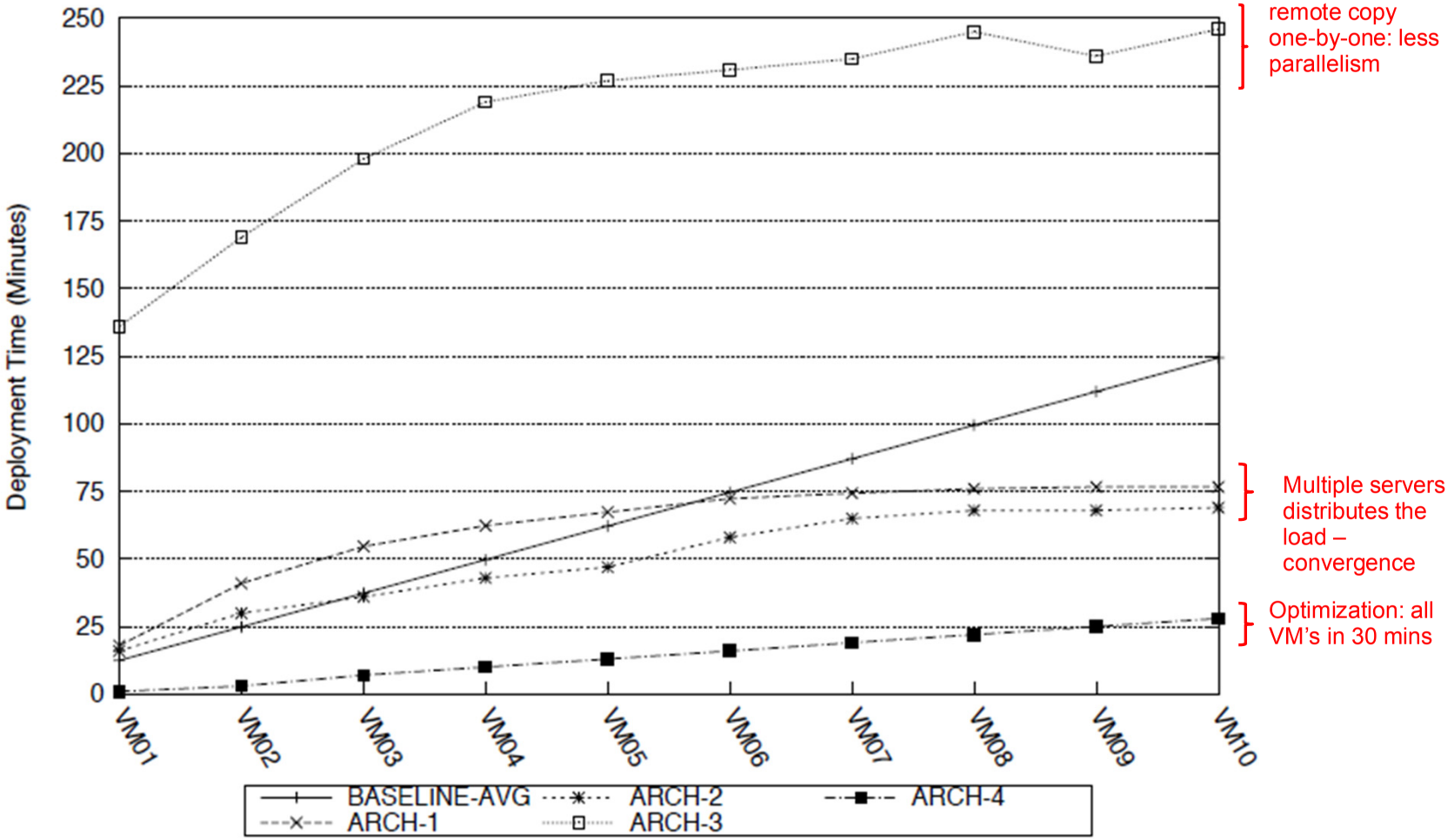
Wait Times – Interval mode

Single-Interval: 10 VM's on one server every 3 mins



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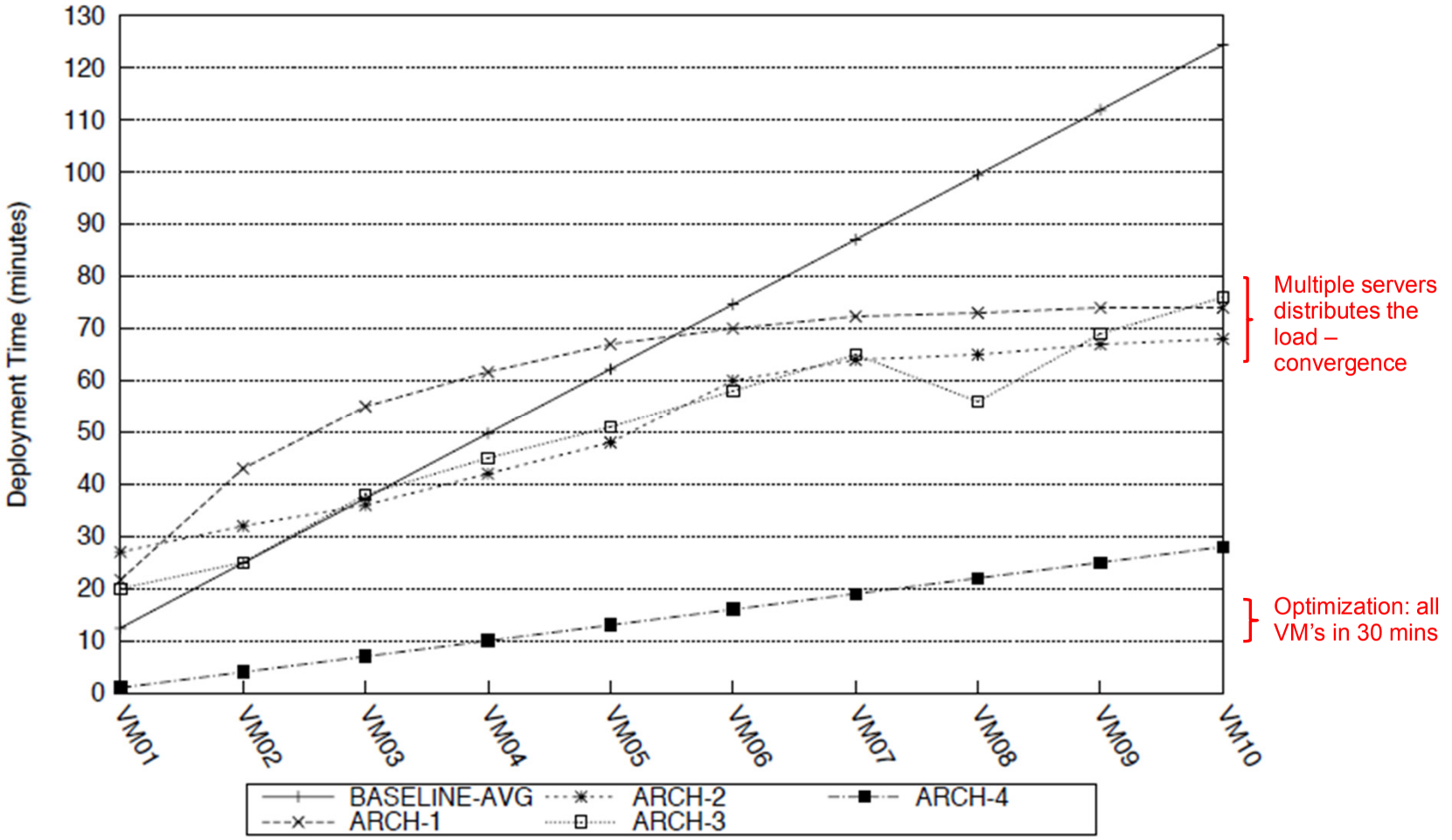

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Conclusion

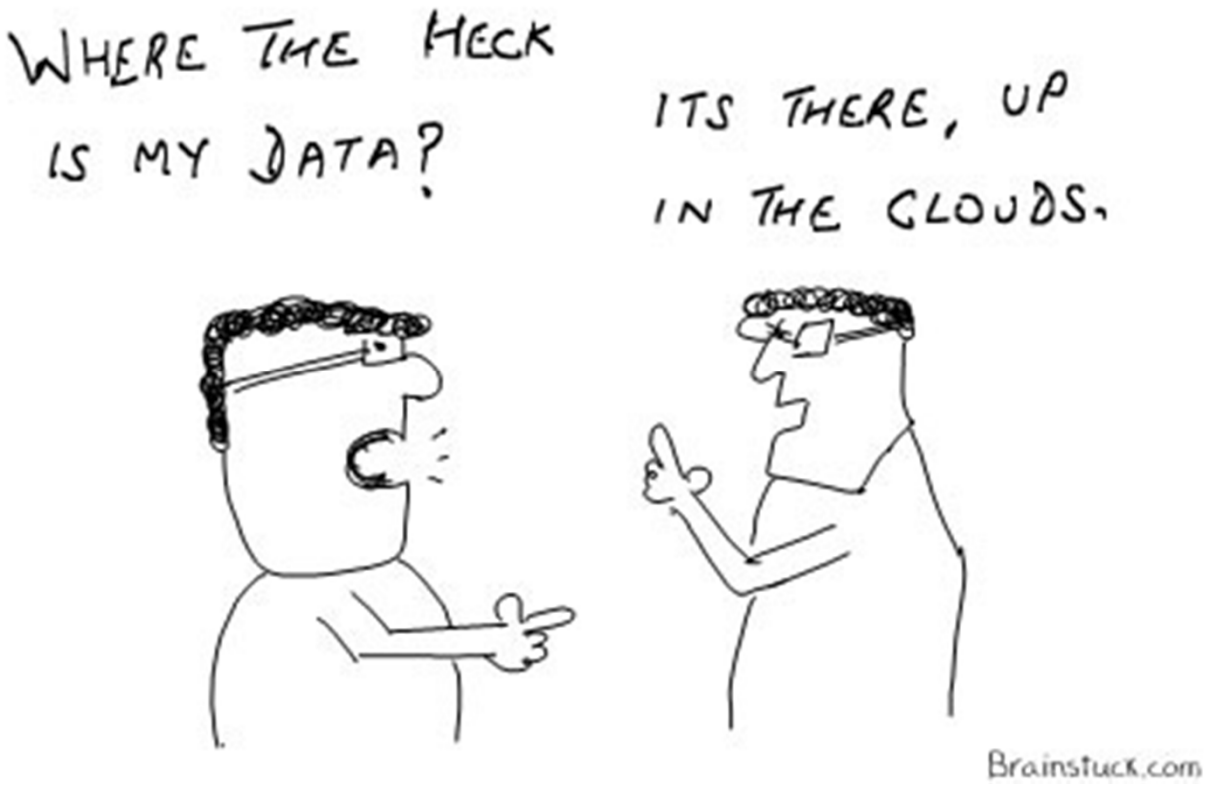
- Cloud/Virtualization
  - Useful technologies for better utilization of physical infrastructure
    - Not necessarily applicable to all scenarios, but true for some
    - Lots of tools available: Commercial and Open Source
  - Private “Local” Clouds
    - Possible to deploy with commodity hardware – reasonable cost
    - Requires some expertise to deploy/maintain

- Achievement
  - Added flexibility to the physical infrastructure : multi-tenant
  - Library of images for our users – different OS with software
  - Users can get their VM (Windows or Linux) within 30 mins
    - Run the test, shutdown the VM’s after testing.

Useful Pointers

- **Benjamin Farnham: WEPMS006, MOPMS025**
  - "Automated testing of OPC Servers"
  - "Migration from OPC-DA to OPC-UA"
- **Brice Copy: WEPKS001, WEAAULT02**
  - "Agile Development and Dependency Management for Industrial Control Systems"
  - "Model Oriented Application Generation for Industrial Control Systems"
- **Filippo Tilaro: WEPMU029**
  - "Industrial Devices Robustness Assessment and Testing against Cyber Security Attacks"
- **Paul C. Burkimsher: THBHMUST01**
  - "Multi-platform SCADA GUI Regression Testing at CERN"

Questions



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