Distributed Visualization -

Building and Using HiPS in Distributed Data Storage

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Introduction

- Euclid Space Mission (ESA-M)

  - Extra galactic surveys (visible, infrared, spectroscopy)
- 10's of PB data
- Collaborators all over the world
- Multiple Science Data Centers
- Incremental Overall Progress Map - Data available, status of - processing, data release etc.

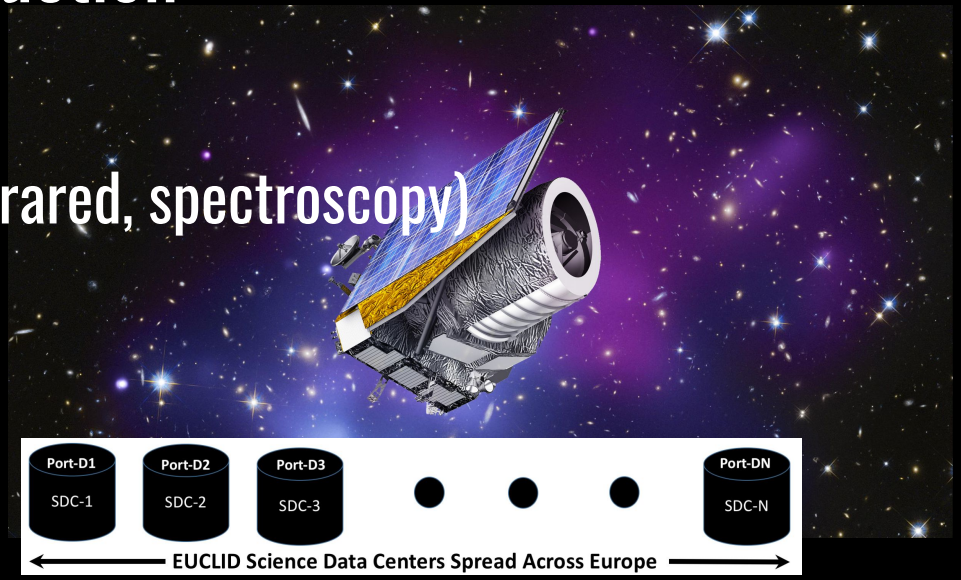

image source: ESA website

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Challenges

- Need a Distributed Visualization framework
- SDCs (heterogeneity)
- Network between SDCs - from 10s to several 100s Mbps
- Data availability/Progress according to Observation Plan
- Scalable, Flexible, Future proof framework

Two prong approach → reduce the data size (optional) &

→ enable distributed visualization

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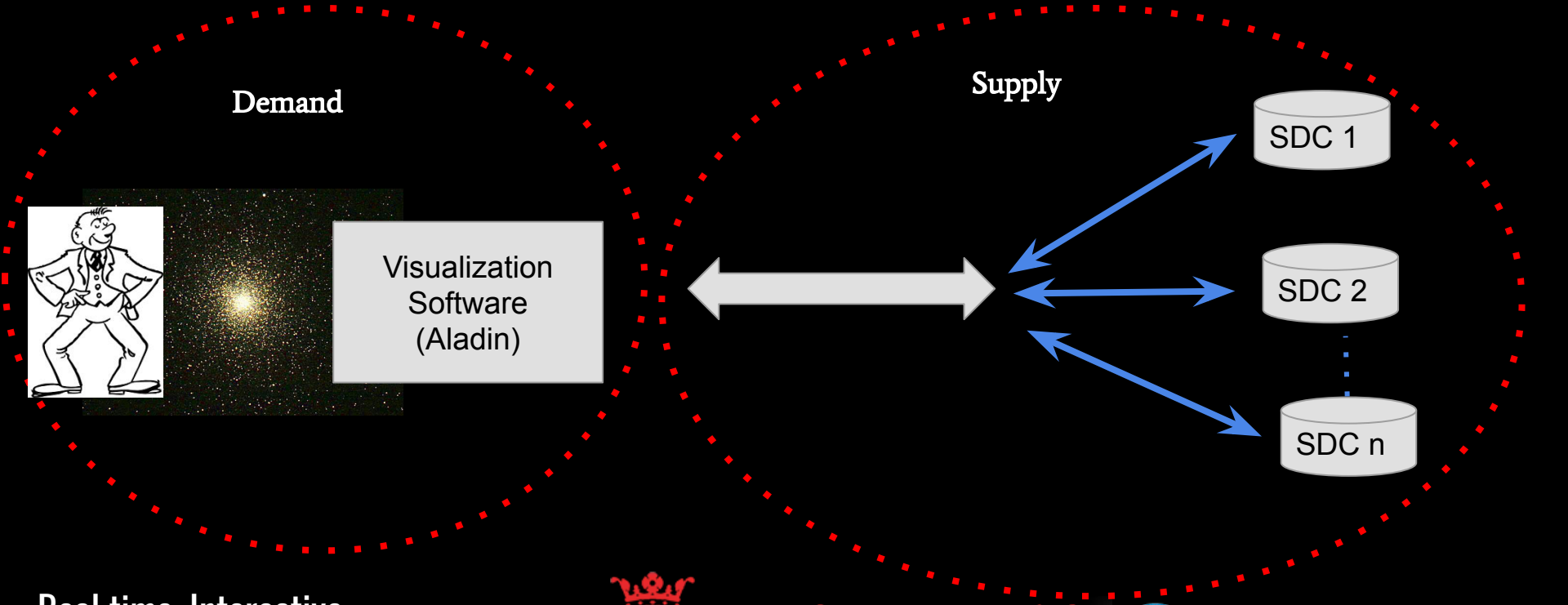
Visualization Framework



- Real time, Interactive
- Desktop feel but no copy

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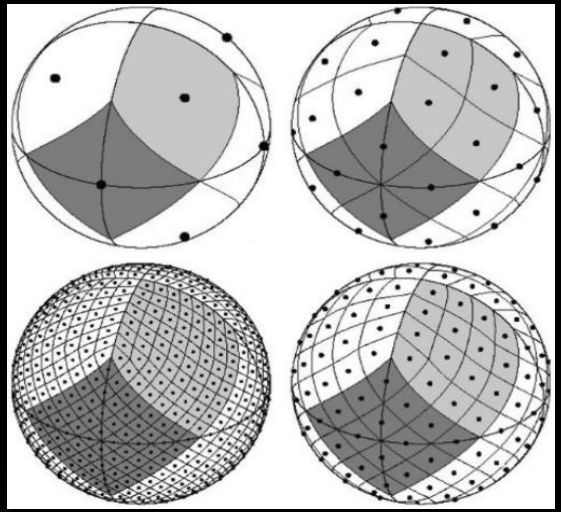
HiPS Survey

HiPS is a hierarchical tiling mechanism developed by CDS (P.Fernique et al, A&A 578, 114, 2015)

It supports multi-layer visualization

- HiPS is the defacto standard for survey maps
- HiPS is http compliant



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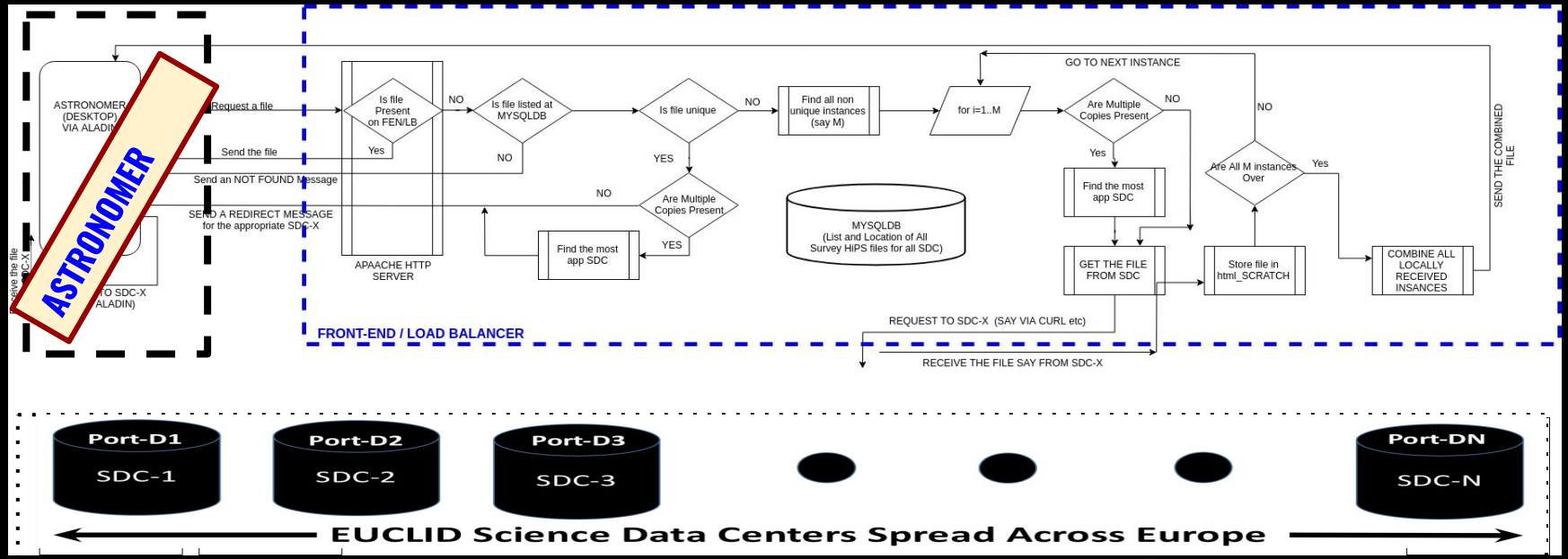
Visualization Framework with LAMP Stack



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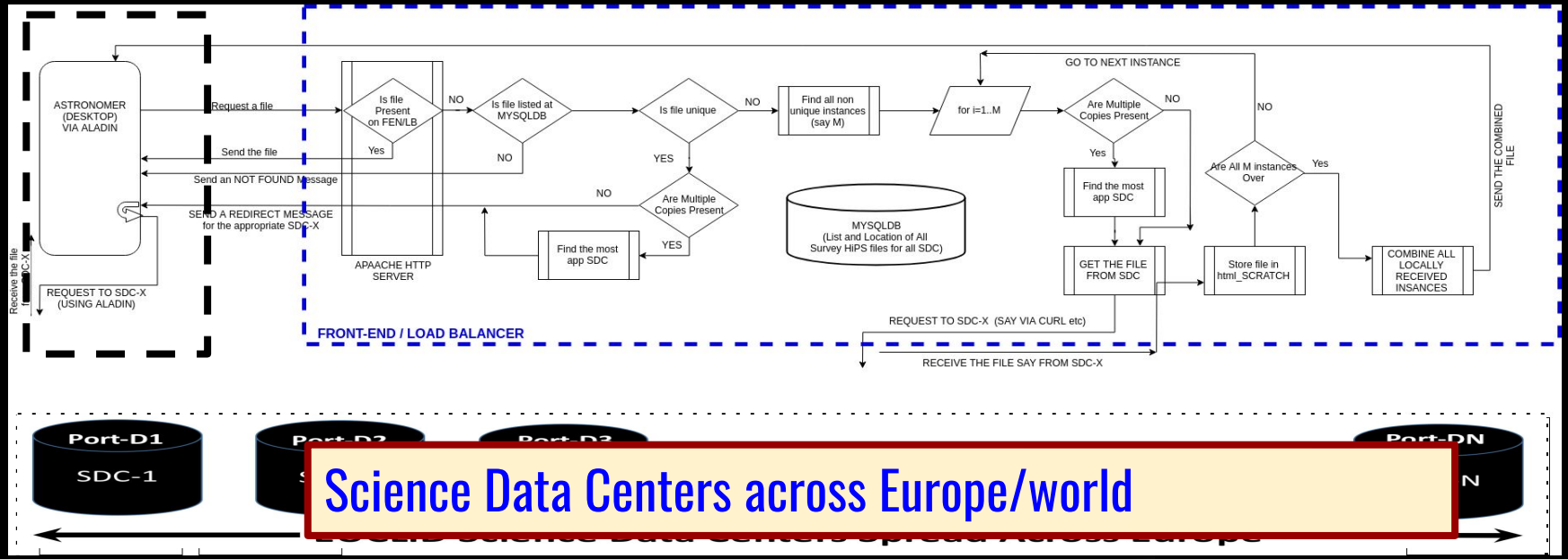
Visualization Framework with LAMP Stack



Science Data Centers across Europe/world

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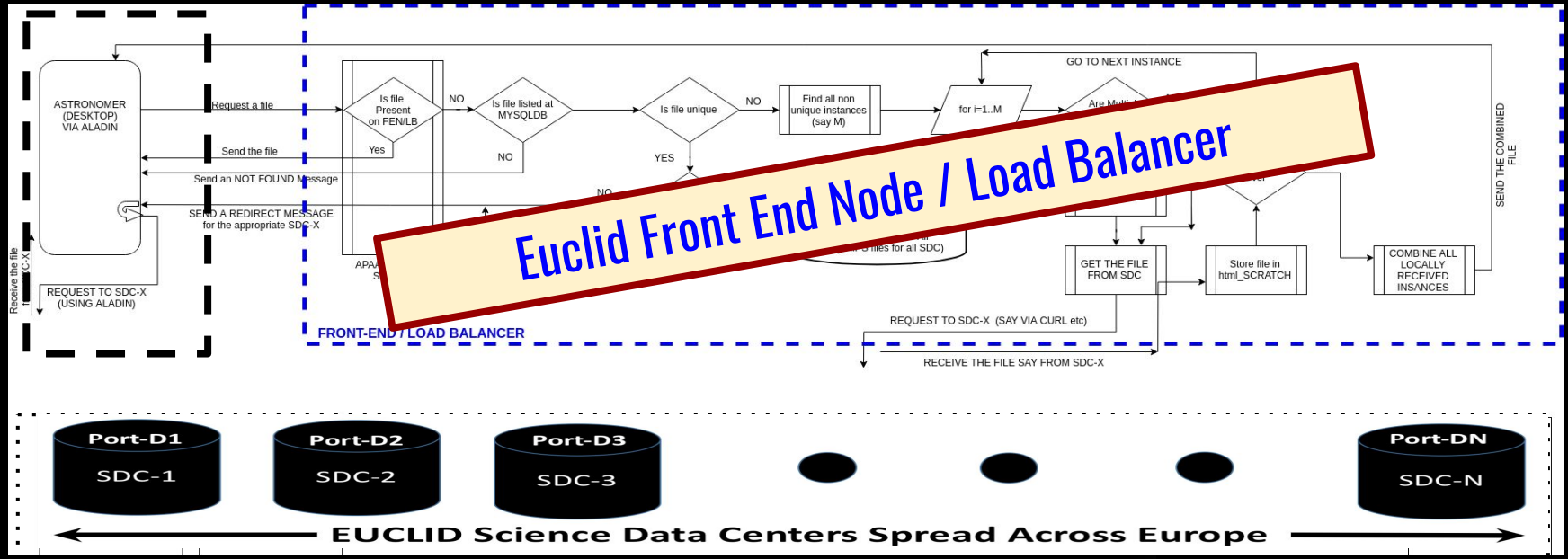
Visualization Framework with LAMP Stack



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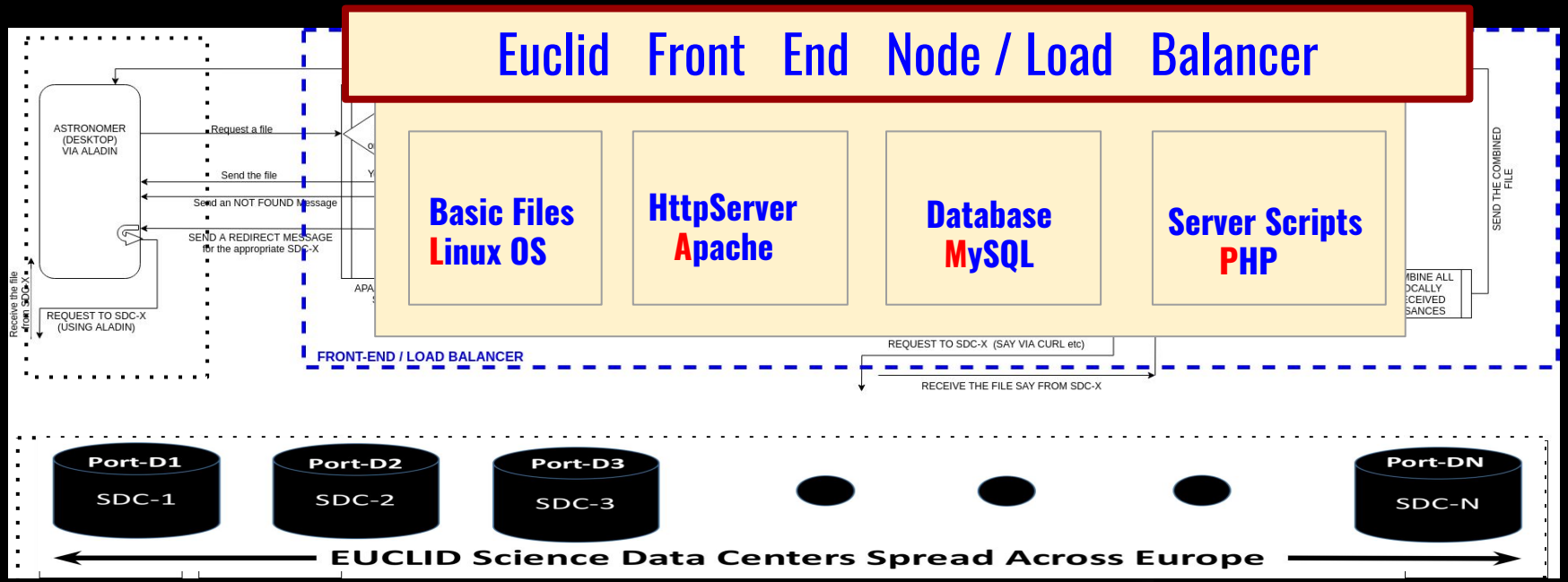
Visualization Framework with LAMP Stack



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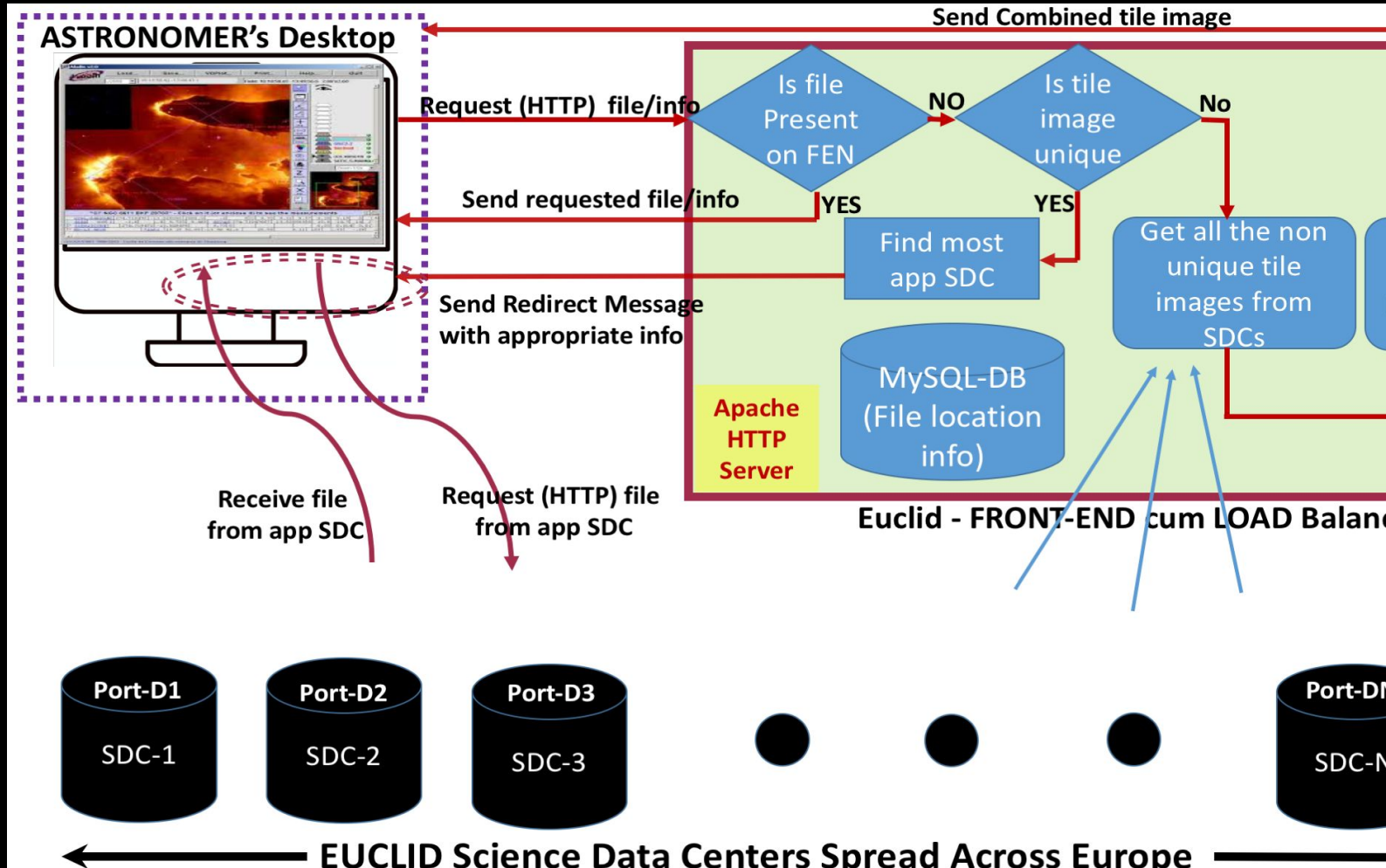
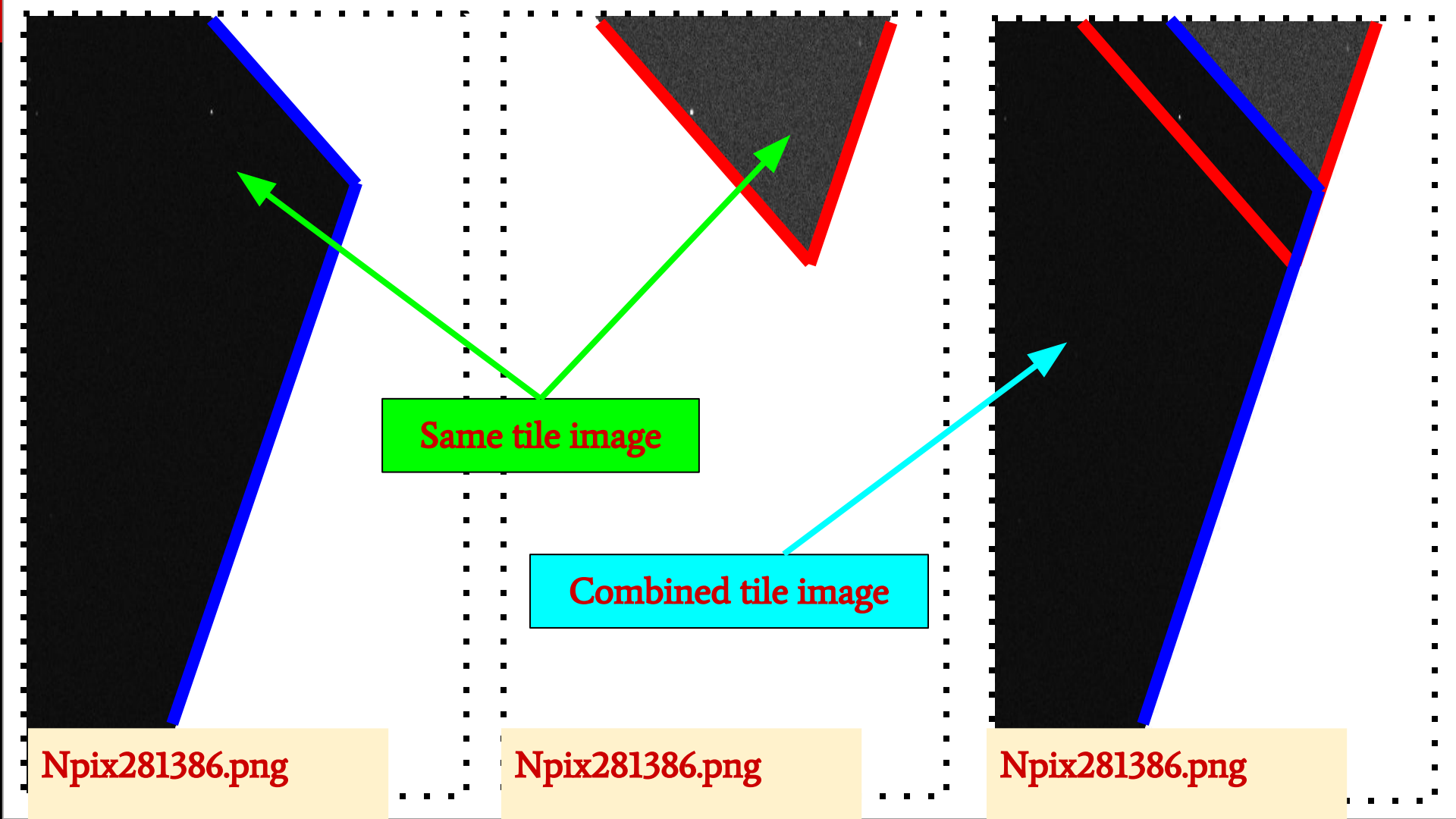
Fully Distributed Visualization




Same tile image
Combined tile image
Npix281386.png
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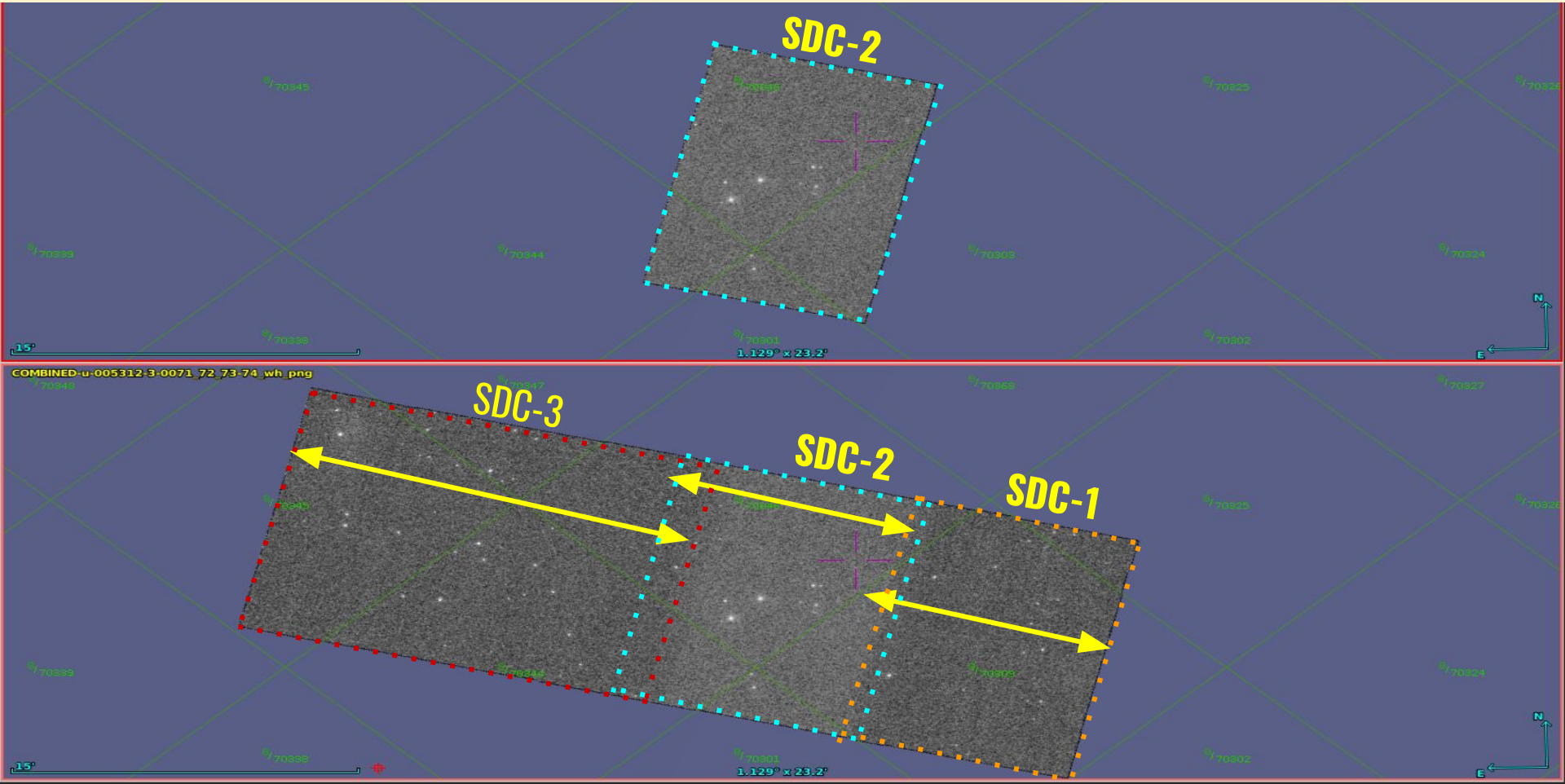
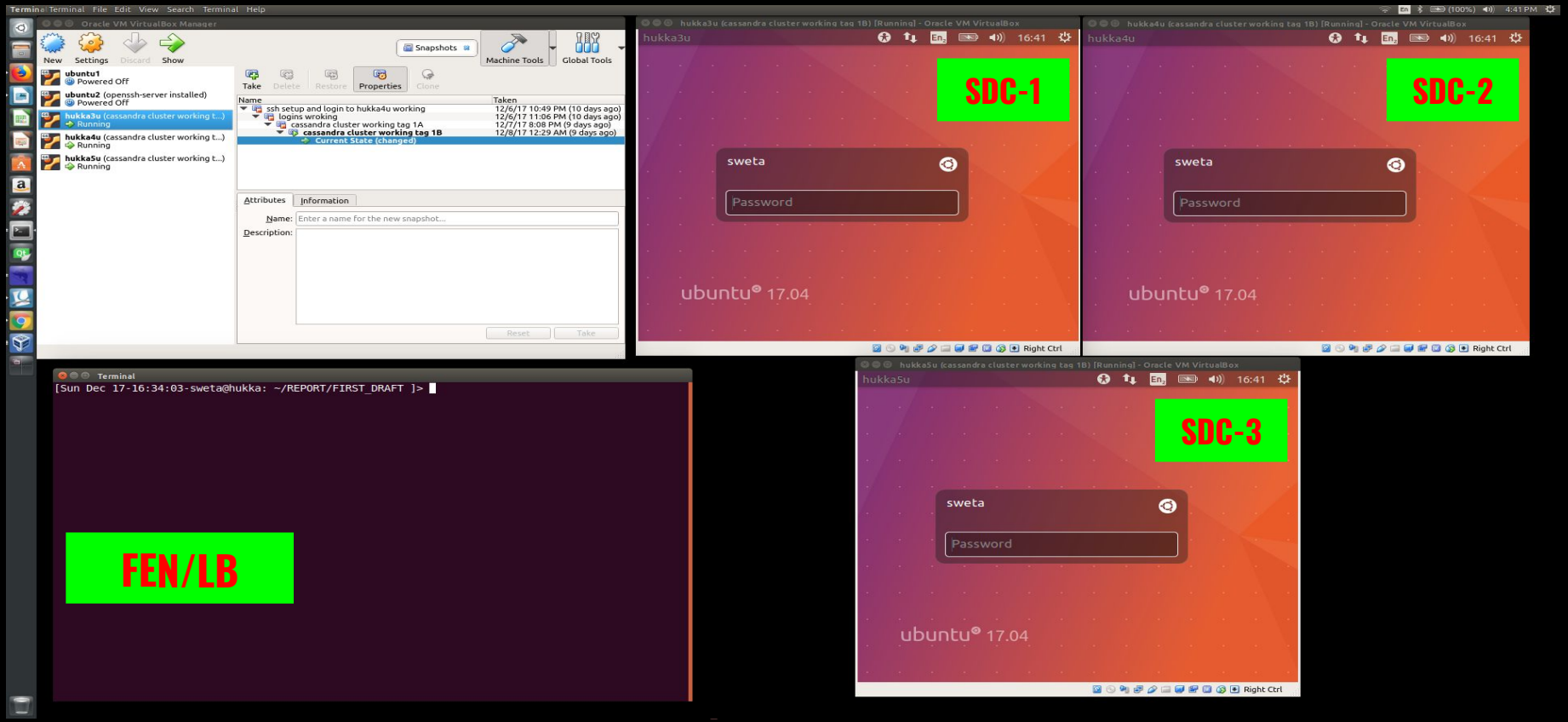
Visualization in practice



Virtual Machines as SDCs



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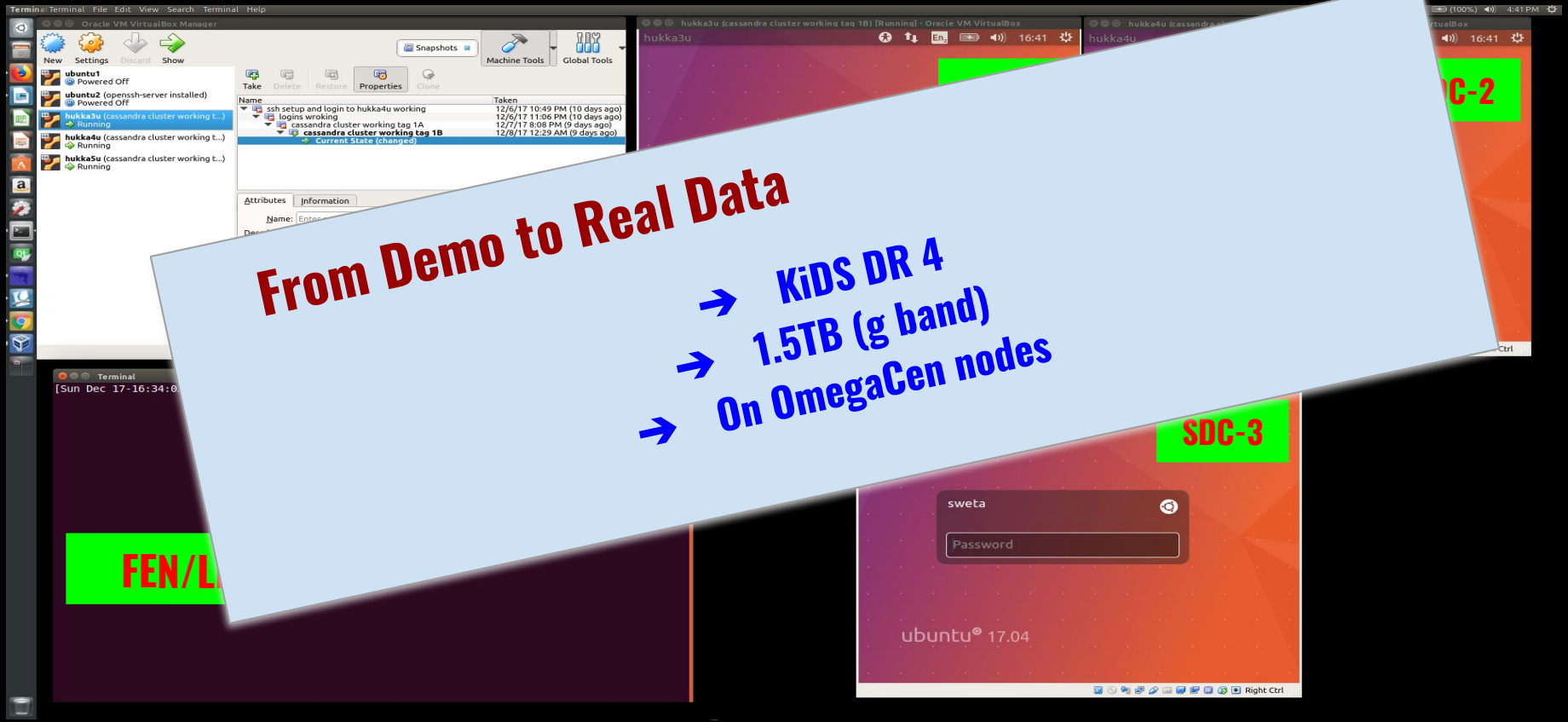

Important Aspects

- **Discussion Points**
  - Variable network Bandwidth ? - FEN/LB (optimal redirection), independent parallel transfer between SDCs & User, stateless nature of http.
  - Network failure at SDC ? - copy at other SDC used, low order hips on FEN.
  - Headers - jpeg , png
  - Data Cubes
  - All code/configuration etc. would be placed on Gitlab.
- **Multiple FEN/LB**
- **Distributed nosql databases like Apache Cassandra**
- **Nginx on SDCs for improved performance**
- **Reverse proxy configuration as an alternative topology**

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Conclusion & future steps

- ➔ Successfully developed and demonstrated distributed visualization framework for very large surveys
- ➔ Our framework works on heterogenous SDCs.
- ➔ Data size reduction using png instead of pure fits for hips survey generation has been explored
- ➔ Applicable to big, collaborative project like SKA
- ➔ Extremely Important IVOA Role - especially in context of Big projects
- ➔ It is being implemented on OmegaCen server nodes as SDCs
- ➔ Performance and Monitoring using ELK stack is in progress
- ➔ Optimisation - caching, key value stores(cdb), distributed db(Apache Cassandra)
- ➔ We are on our way to implement the framework for Aladinlite, as it works on the desktop version

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Suggestions/Feedback

- Combining distributed mandatory and recommended files using Aladin
  - Mandatory: properties
  - Recommended: index.html, moc.fits, allsky
- Is it possible to specify the quality png resolution ?

Fits → HiPS(png) using Aladin/hipsgen

- Combining same tile number images
  - Linux Commands e.g. convert
  - Python libraries
  - More feedback is welcome

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Thank You !

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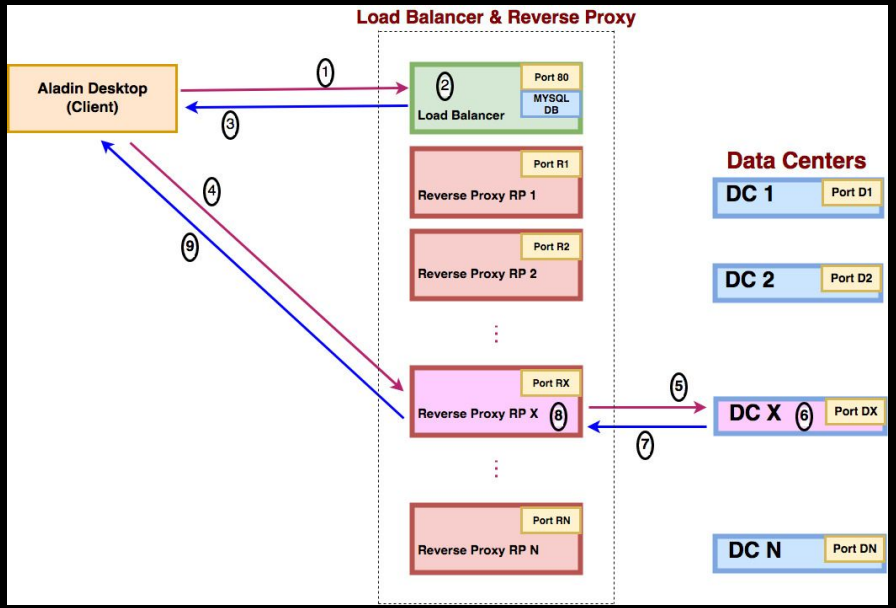
Architecture

Distributed Network Mode

Reverse Proxy Network Mode



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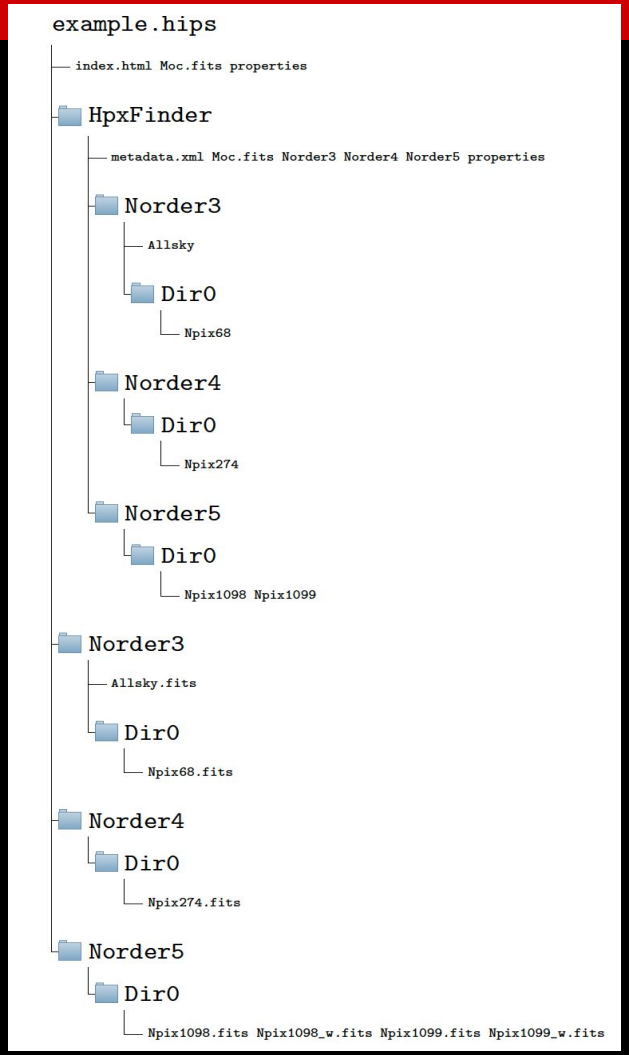

HiPS Survey

- HiPS is http compliant - allows it to be accessed via http server
- Simple Hierarchical Tree structure with directories and files

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LAMP Stack

1. Linux → open source(free), reliable(virus free)
2. Apache → most popular, open source, reliable, secure, fast, http,
3. MySQL → simple, sql, open source
4. PHP → open source, server side(code executed on server side), scripting language, communicate with MySQL

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