Grid and Cloud Introduction

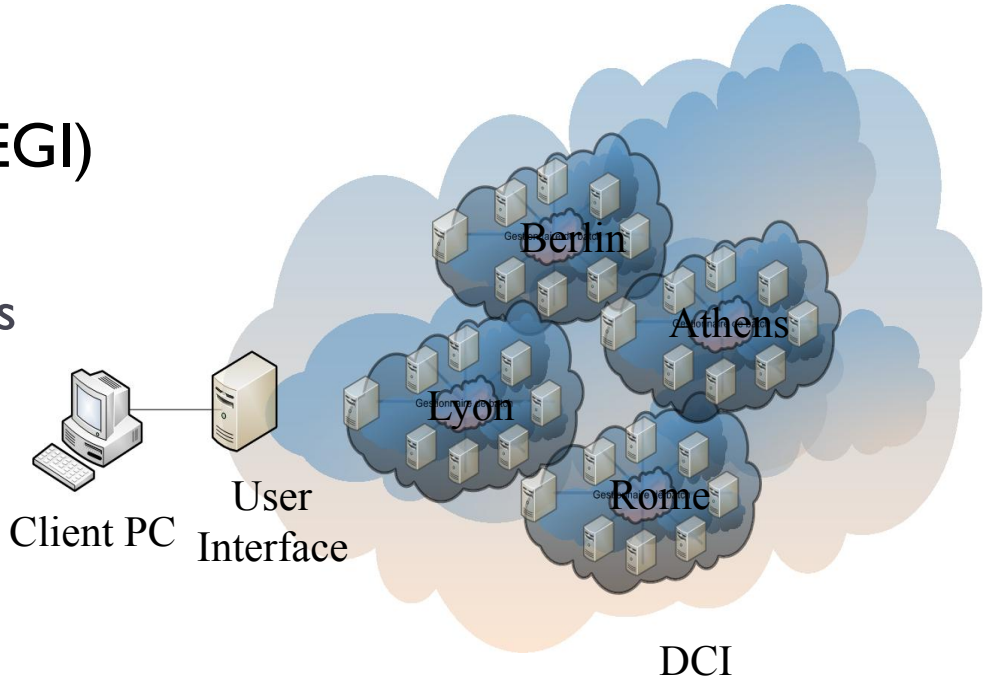
DIRAC Group

Overview

- Grid definition
- Applications of the Grid
- Related concepts
- Cloud computing
- Conclusion

Distributed Computing Infrastructures

- High Throughput Computing (HTC)
  - Several computing clusters across multiple administrative boundaries
  - Loosely coupled jobs
  - Aim to process large data volumes
- European Grid Infrastructure (EGI)
  - Approximately 500 computing centers and 315,000 physical CPUs
  - http://gstat2.grid.sinica.edu.tw
  - Virtual Organizations (VOs)



Grid definition

- Computational Grids have emerged with the aim of improving system performance availability, scalability, reliability and security through the **integration of heterogeneous and geographically distributed computational and storage resources.**

Applications of the Grid

- Any science whose needs include:
  - Dealing with large data volumes
    - E.g. LHC data, high resolution images, …
  - Capture and store information to be accessed anywhere
  - Simulate to better understand the data
  - Processing data in real time
  - Make this data available anywhere in the world
  - Share data within global scientific collaborations

e-Science

Related Concepts

- Resources
- Jobs and applications
- Middleware
- Virtual Organizations
- EGI Exemplification

Resources

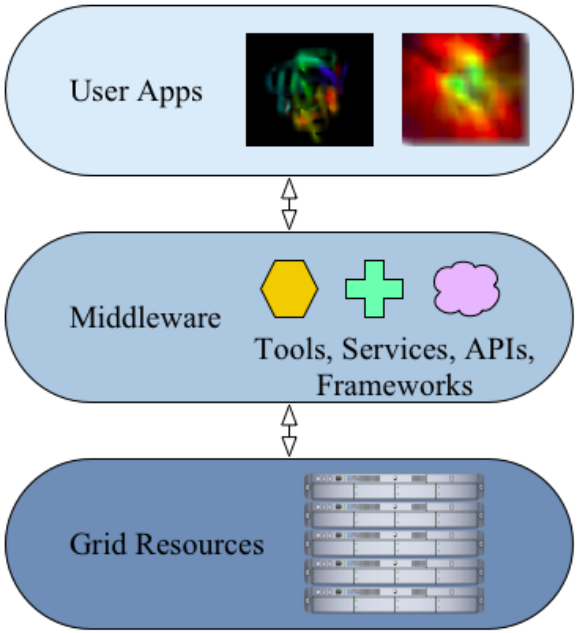
- A grid is a collection of machines, sometimes referred to as "nodes," "resources," "members," "donors," "clients," "hosts," "engines," and many other such terms.
- Computation
  - An entity that is to be shared
  - Does not have to be a physical entity (Condor pool, distributed FS)
  - Defined in terms of interfaces not devices
    - Schedulers: LSF, PBS define a compute resource
  - Open/close/read/write define access to a distributed file system
- Storage
  - Virtualization (capacity, sharing, availability)
  - Striping - speed
  - Mirrors - reliability
  - Replicas - remote access
  - Journals - transactions

Jobs and Applications

- **Application**: the highest level of a piece of work on the grid.
- **Jobs**: programs that are executed at an appropriate point on the grid. They may compute something, execute one or more system commands, move or collect data, or operate the grid machinery.
- **A Grid Application:** a collection of jobs designed to be executed in parallel on different machines in the grid.
- **Job Submission**: is the act of delegating to the Grid the search of suitable computational resources all over the world and to execute the job.

Middleware

- **Middleware** is a software system between applications and Grid resources.
  - A set of services that allows multiple processes running on one or more machines to interact.
  - Computing grids rely on middleware to allocate jobs efficiently using information about the different jobs submitted.
  - Provide services to application
    - Discovery, storage, execution, information, service integration, resource monitoring, failure detection and recovery,…
  - Hide the heterogeneity of the Grid environment.
  - Provide standard interfaces to the services.



Authentication & Authorization

- **Access policy** - What is shared? Who is allowed to share? When can sharing occur?
- **Authentication** - How do you identify a user or resource?
  - X509 PKI infrastructure
  - Personal certificate ("Grid Passport") issued by a Certification Authority
- **Authorization** - How do you determine whether a certain operation is consistent with the rules?
  - This depends on local administrators

Virtual Organizations (VOs)

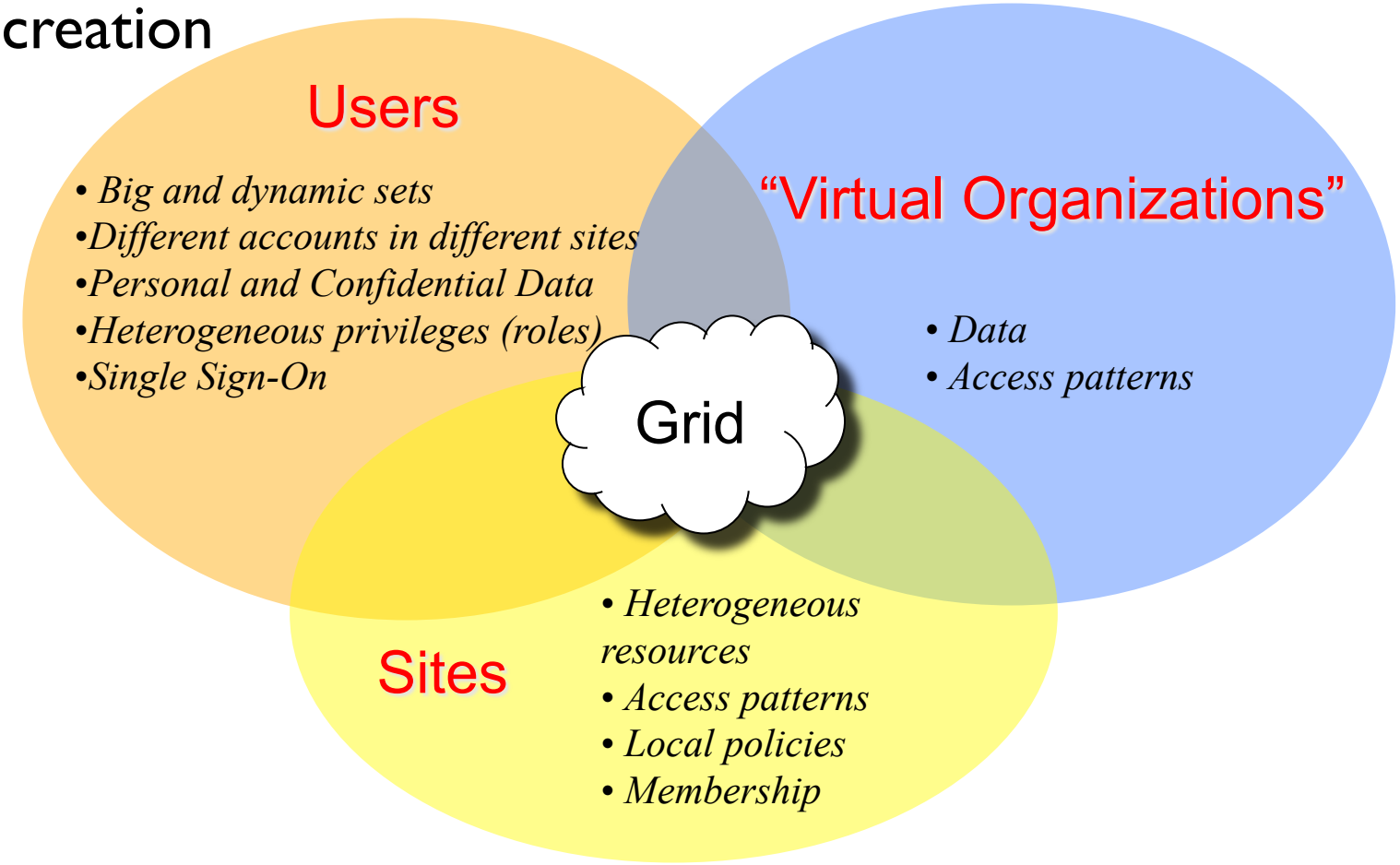
- A dynamic set of individuals or institutions defined around a set of resource-sharing rules and conditions
- A VO contributes with resources & negotiates access for users
- Users join VOs
- Effect:

Collaboration

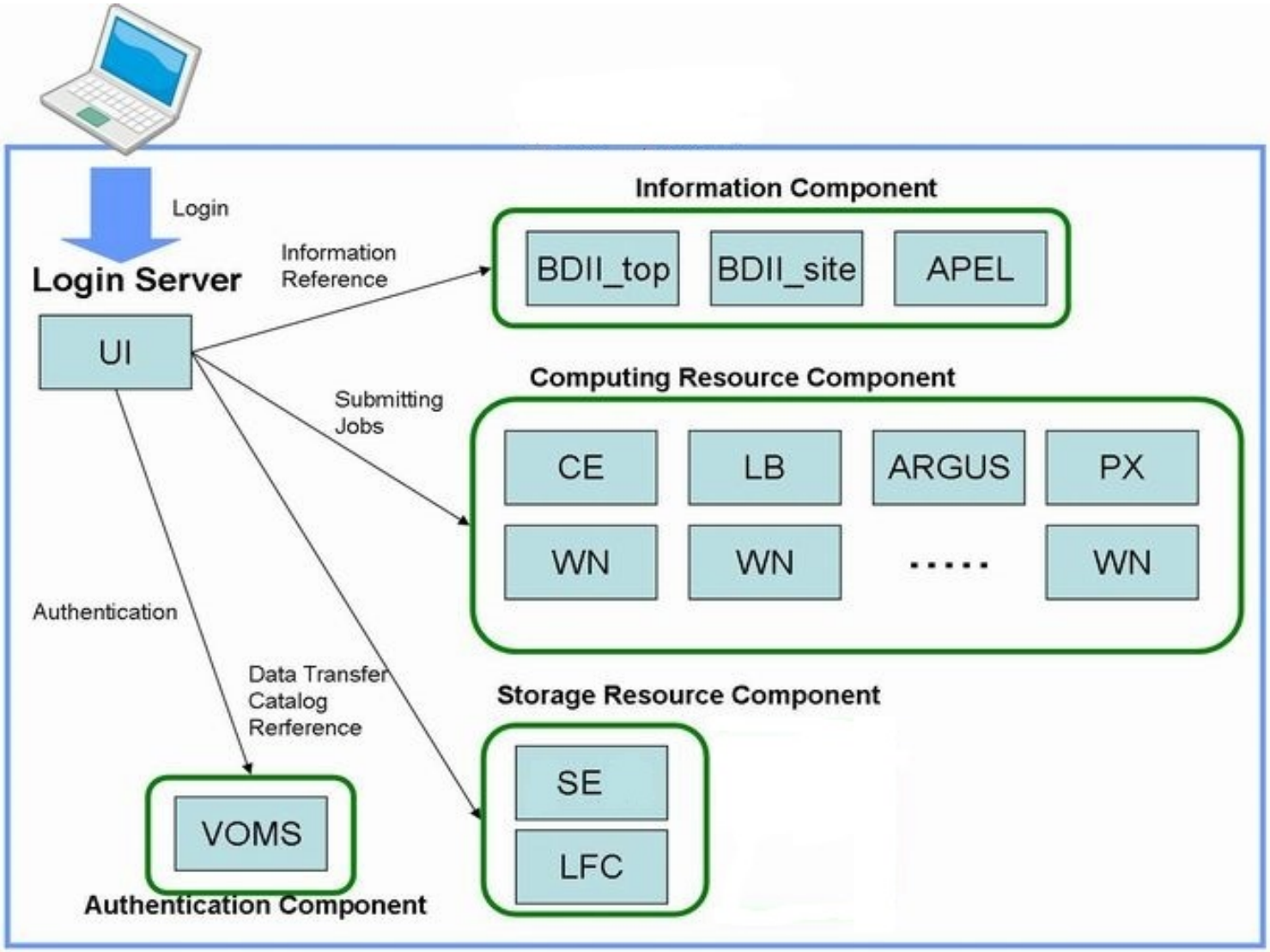
- VOs require common solutions to resource management, to manage and access data, applications and information services

Access to resources

- Personal certificate
- VO Registration
- Proxy creation

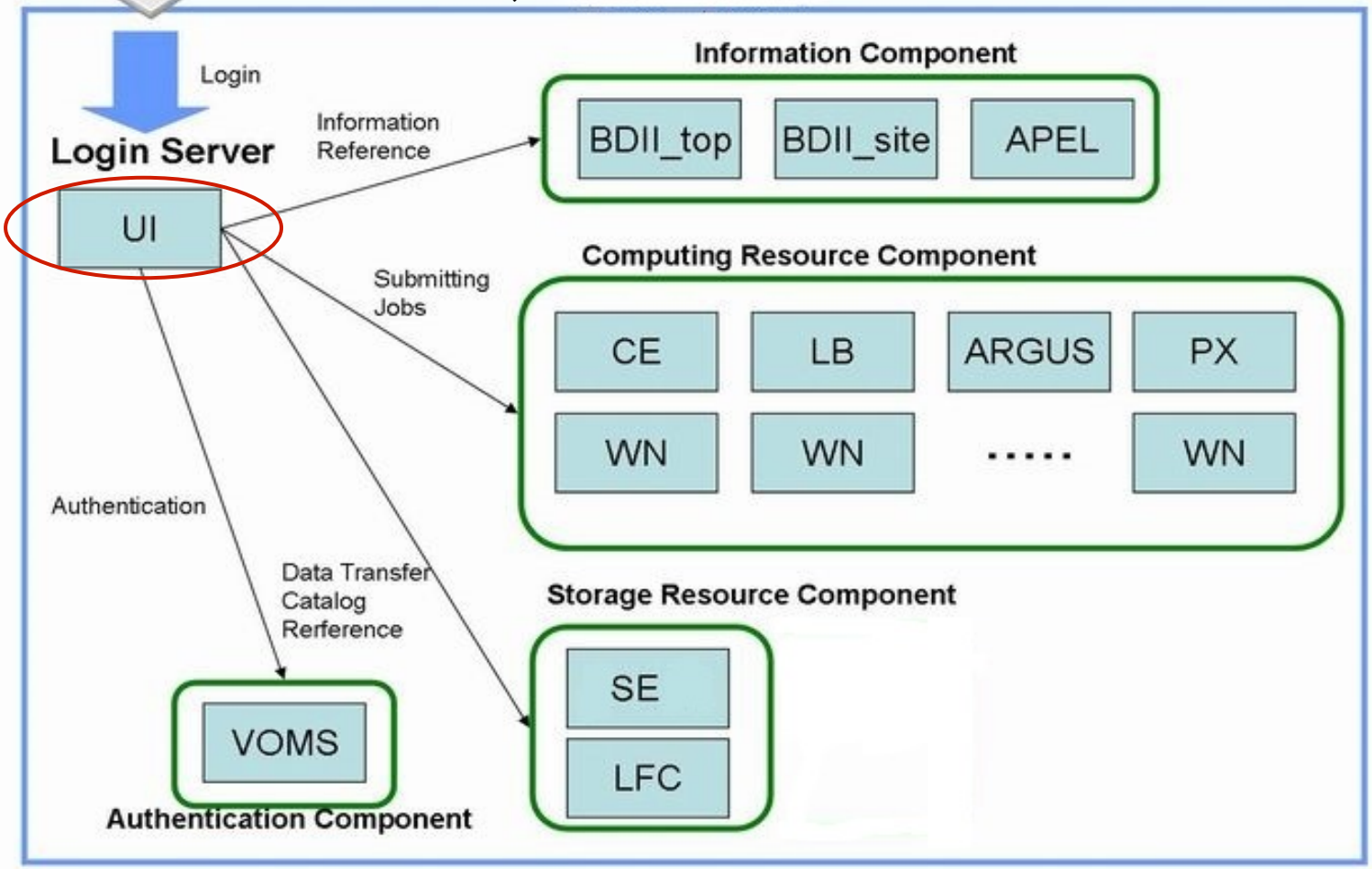


EGI Exemplification



EGI Exemplification

UI (User Interface) provides client functions such as user authentication, job submission and data transfer



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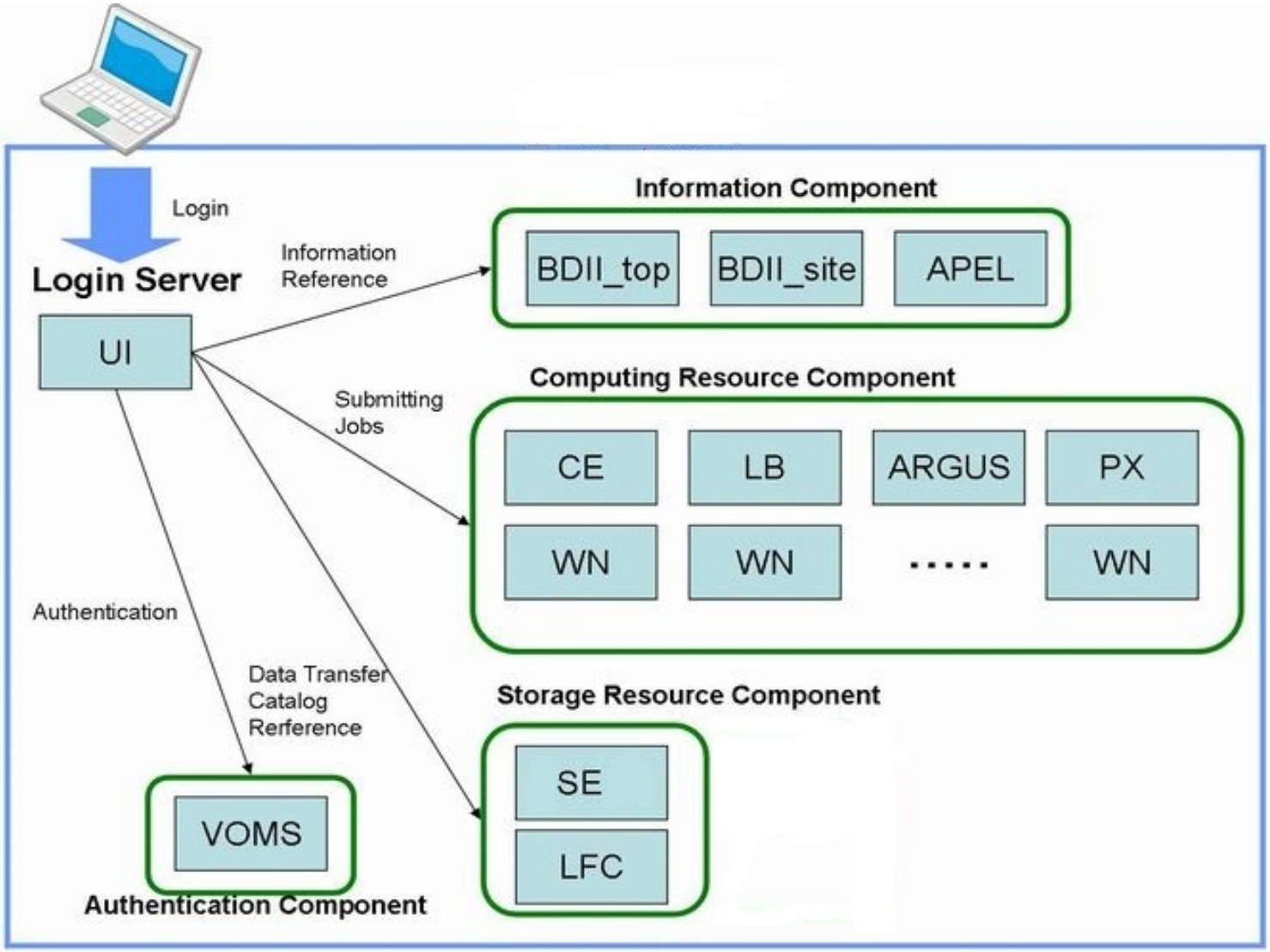
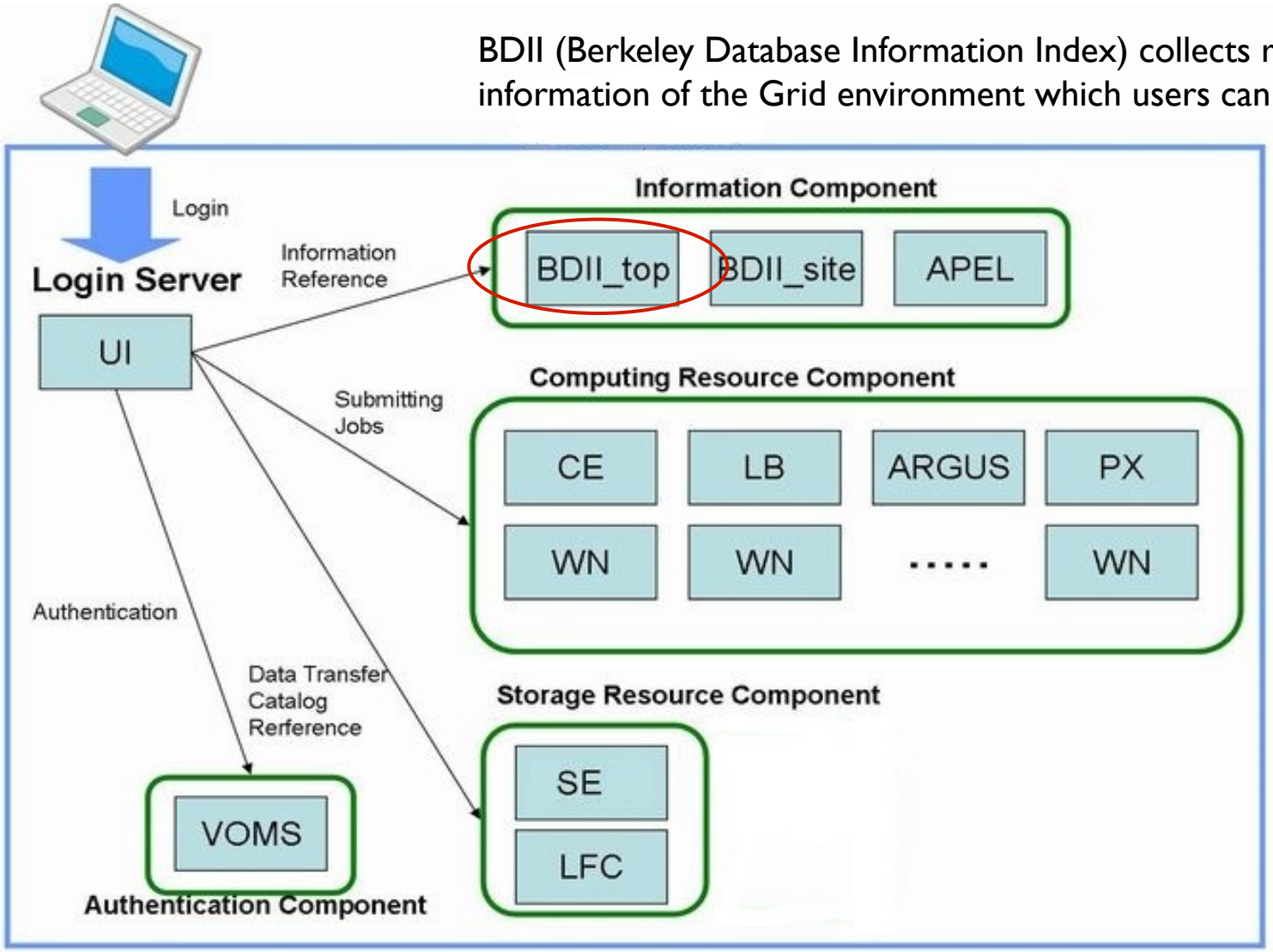


EGI Exemplification

BDII (Berkeley Database Information Index) collects resource information of the Grid environment which users can refer to



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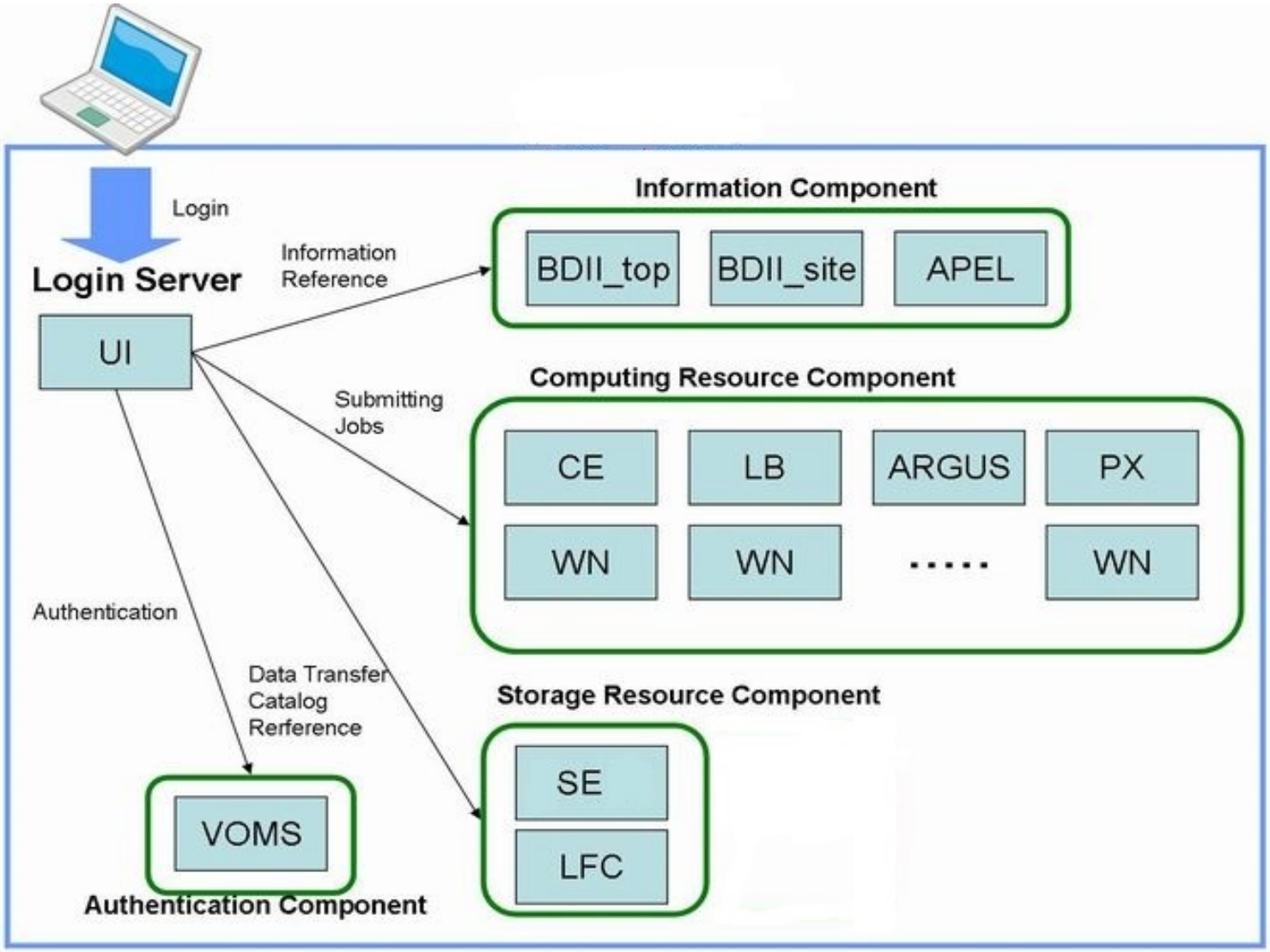

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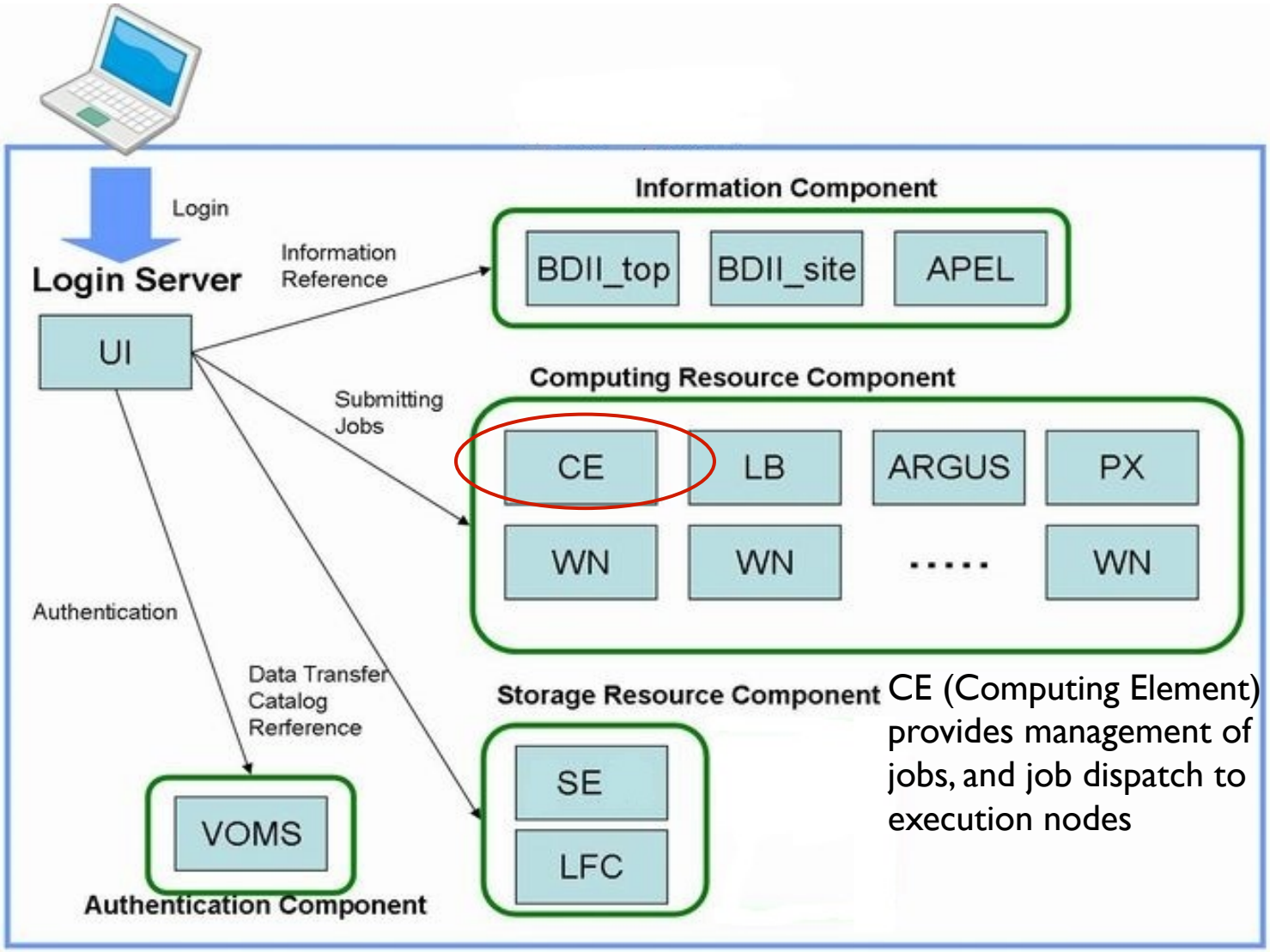
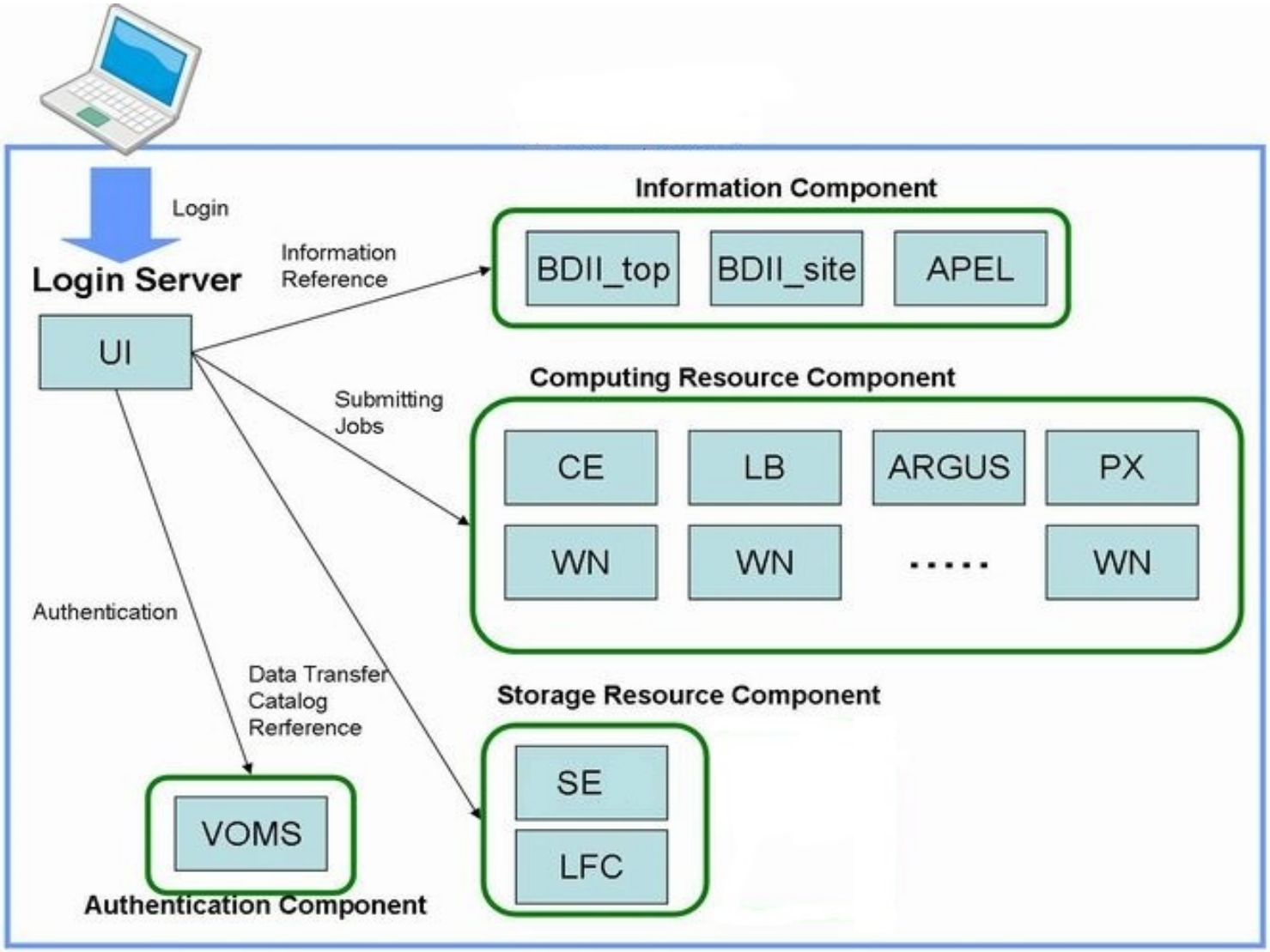


CE (Computing Element) provides management of jobs, and job dispatch to execution nodes

EGI Exemplification



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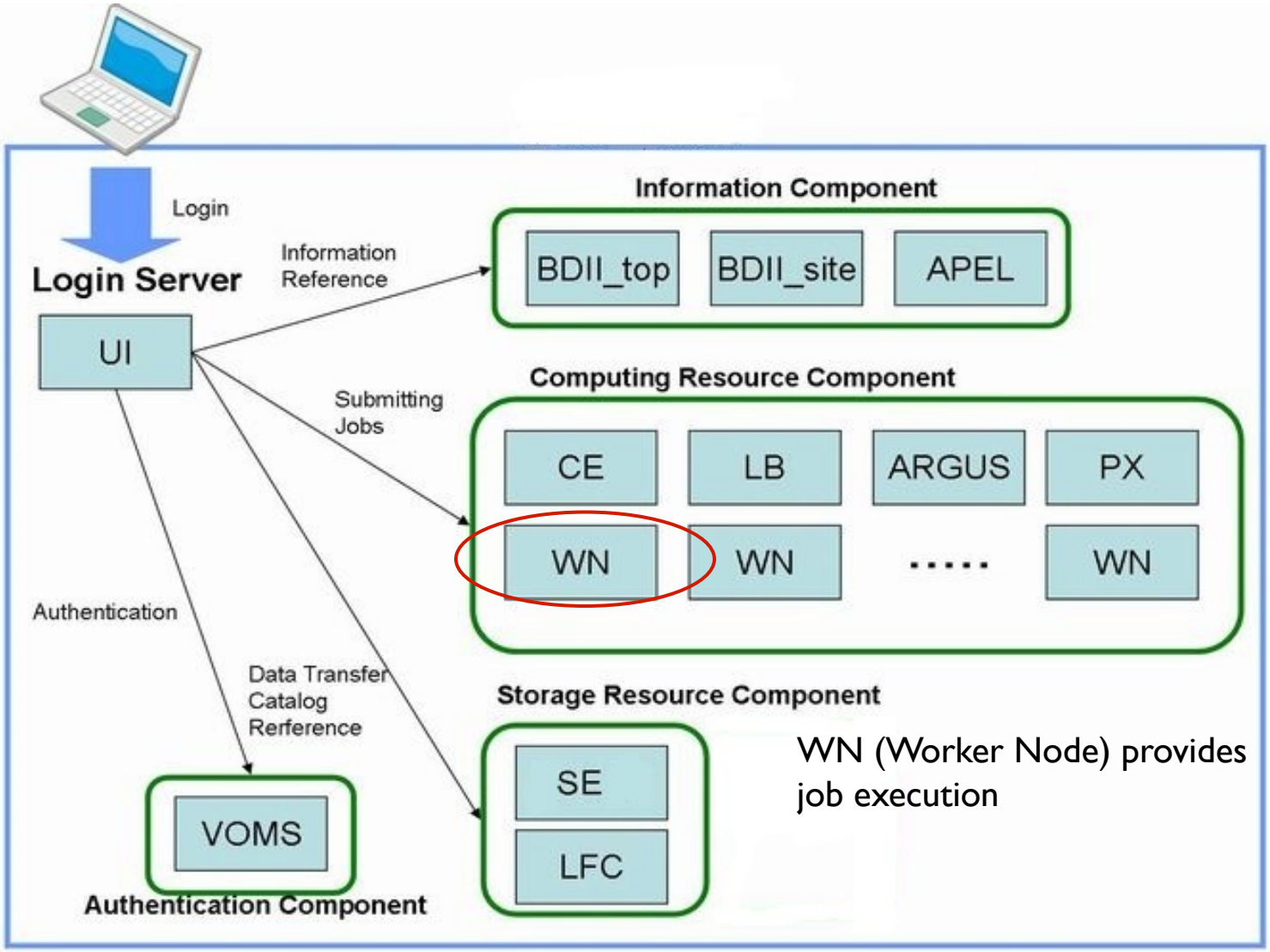
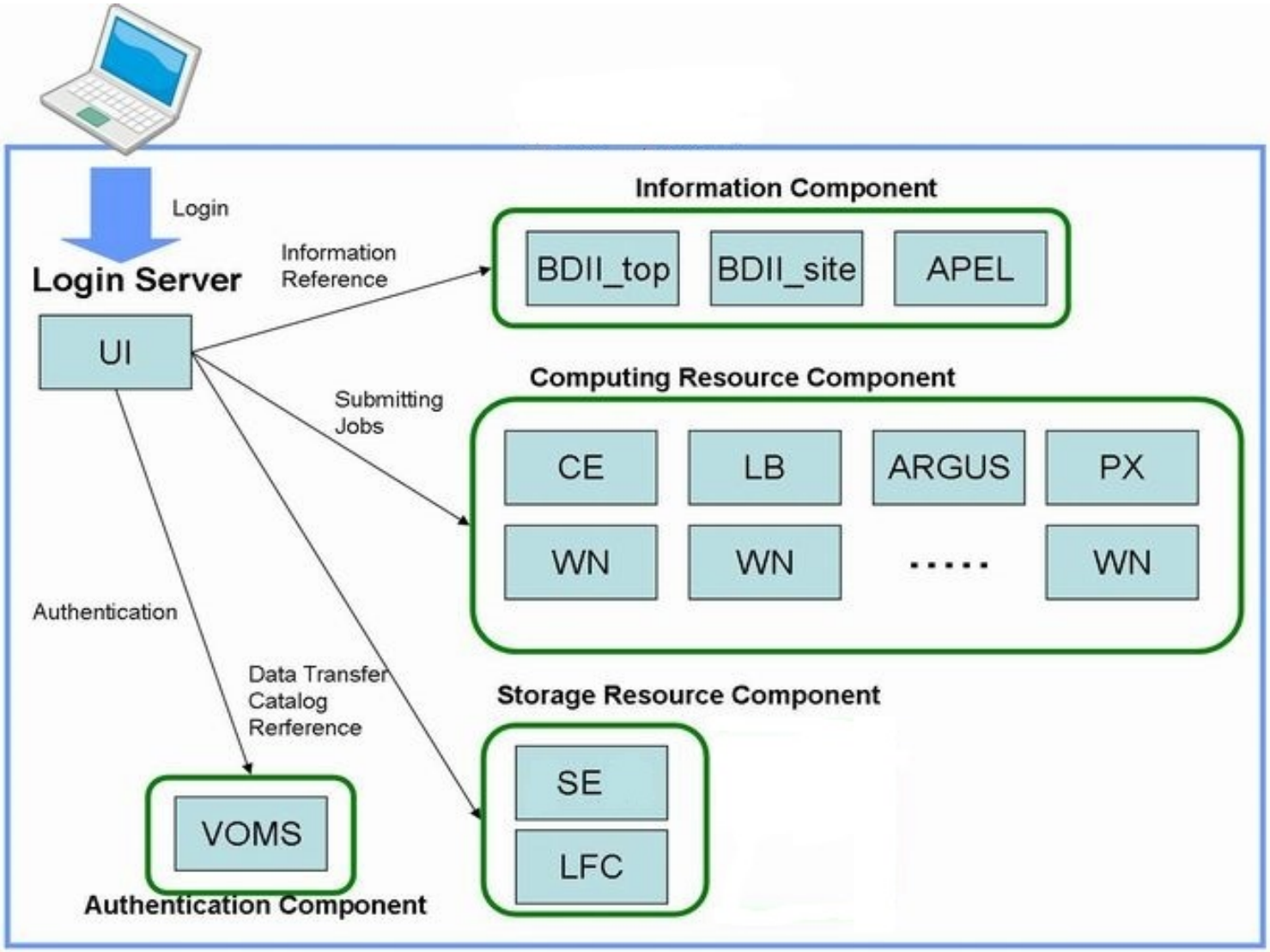


WN (Worker Node) provides job execution

EGI Exemplification



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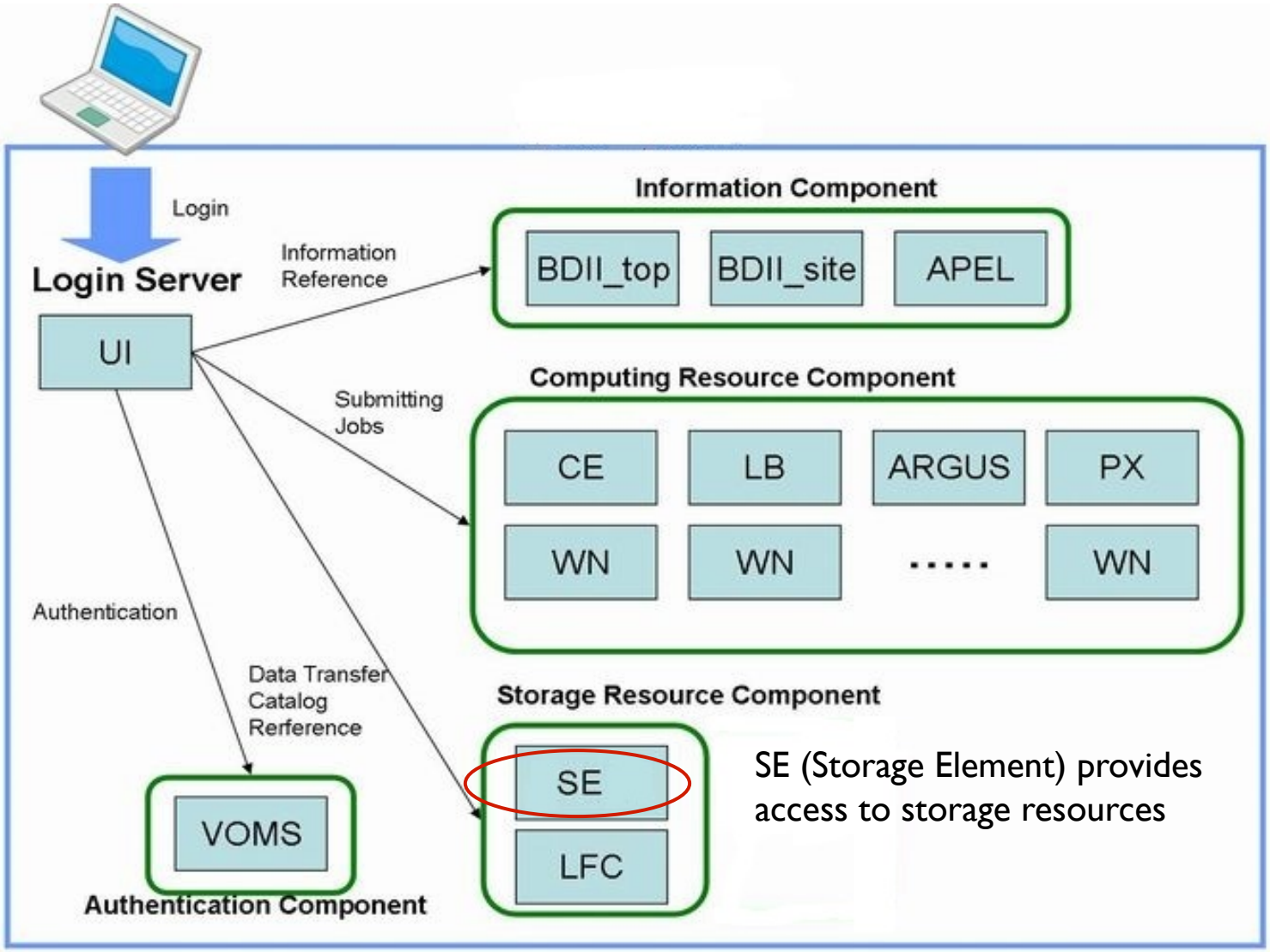
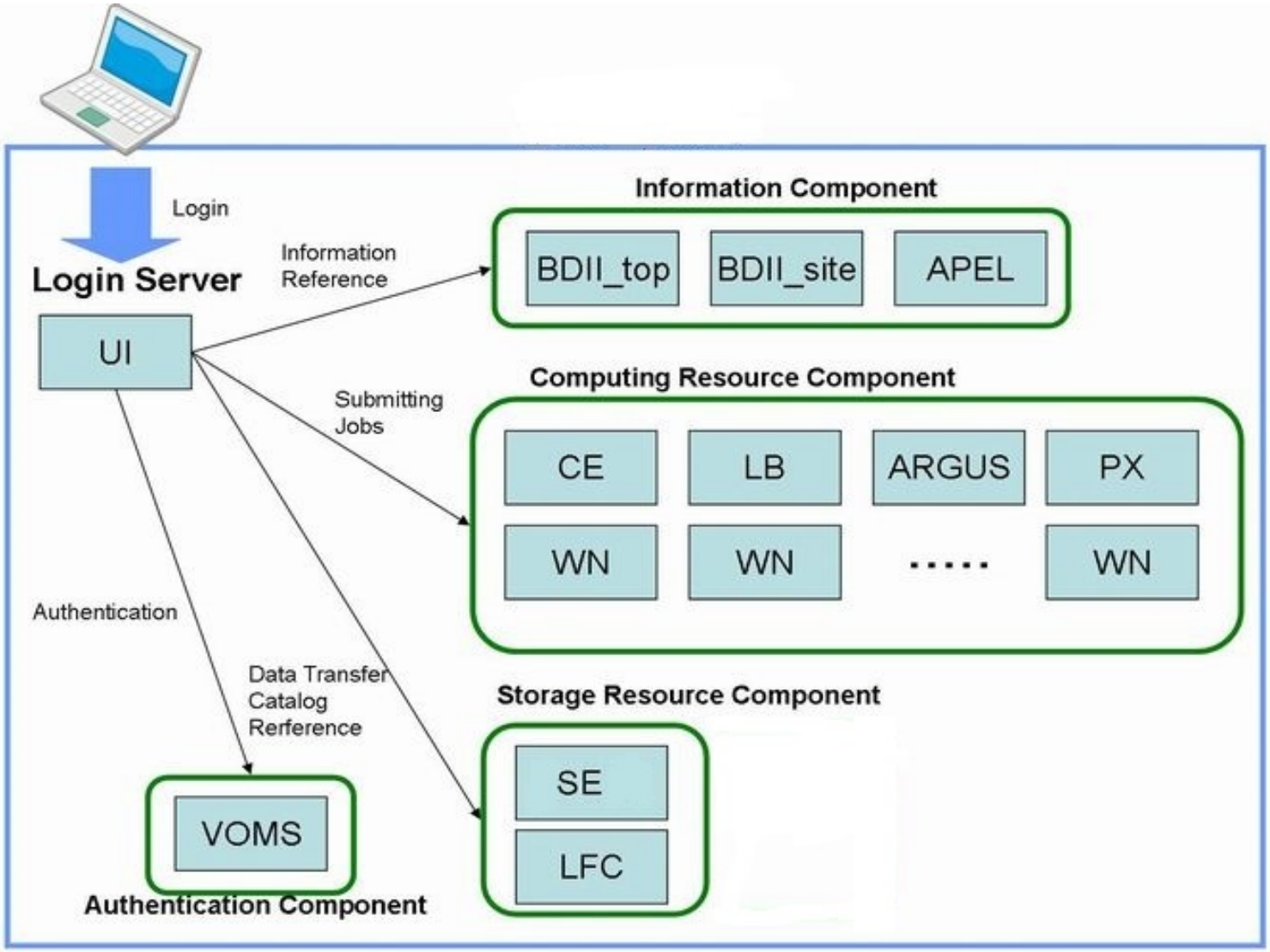


SE (Storage Element) provides access to storage resources

EGI Exemplification



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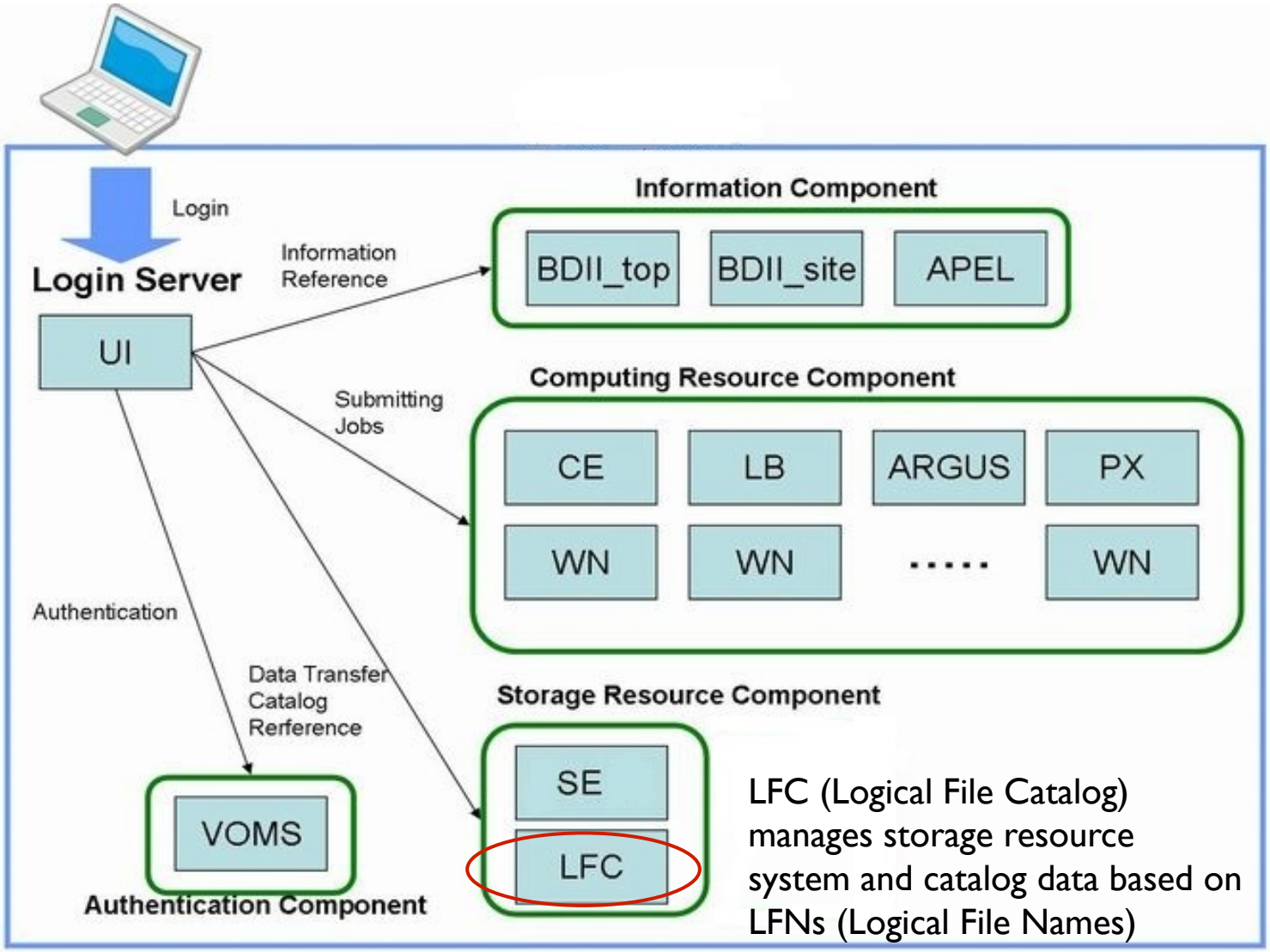
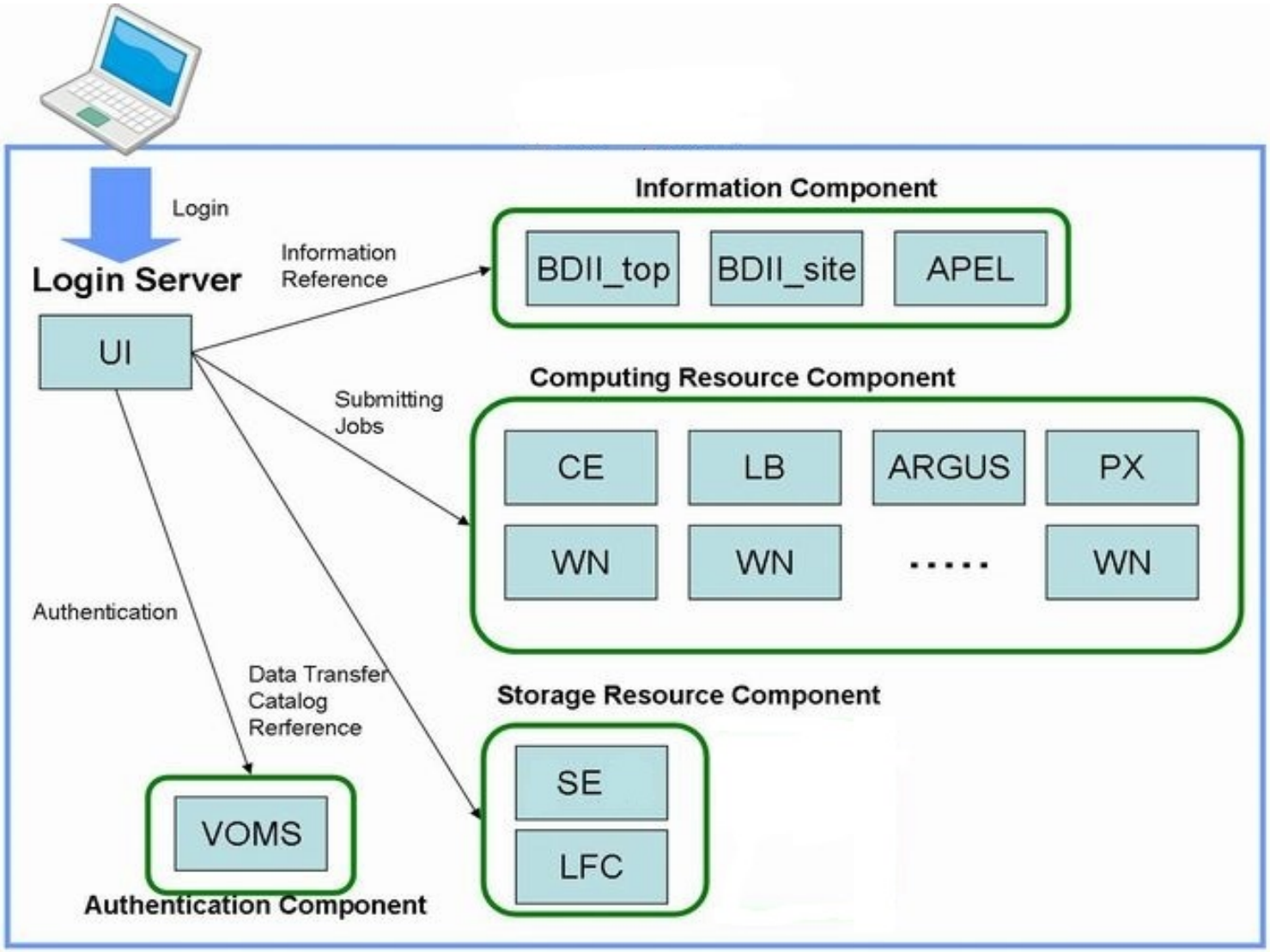


LFC (Logical File Catalog) manages storage resource system and catalog data based on LFNs (Logical File Names)

EGI Exemplification



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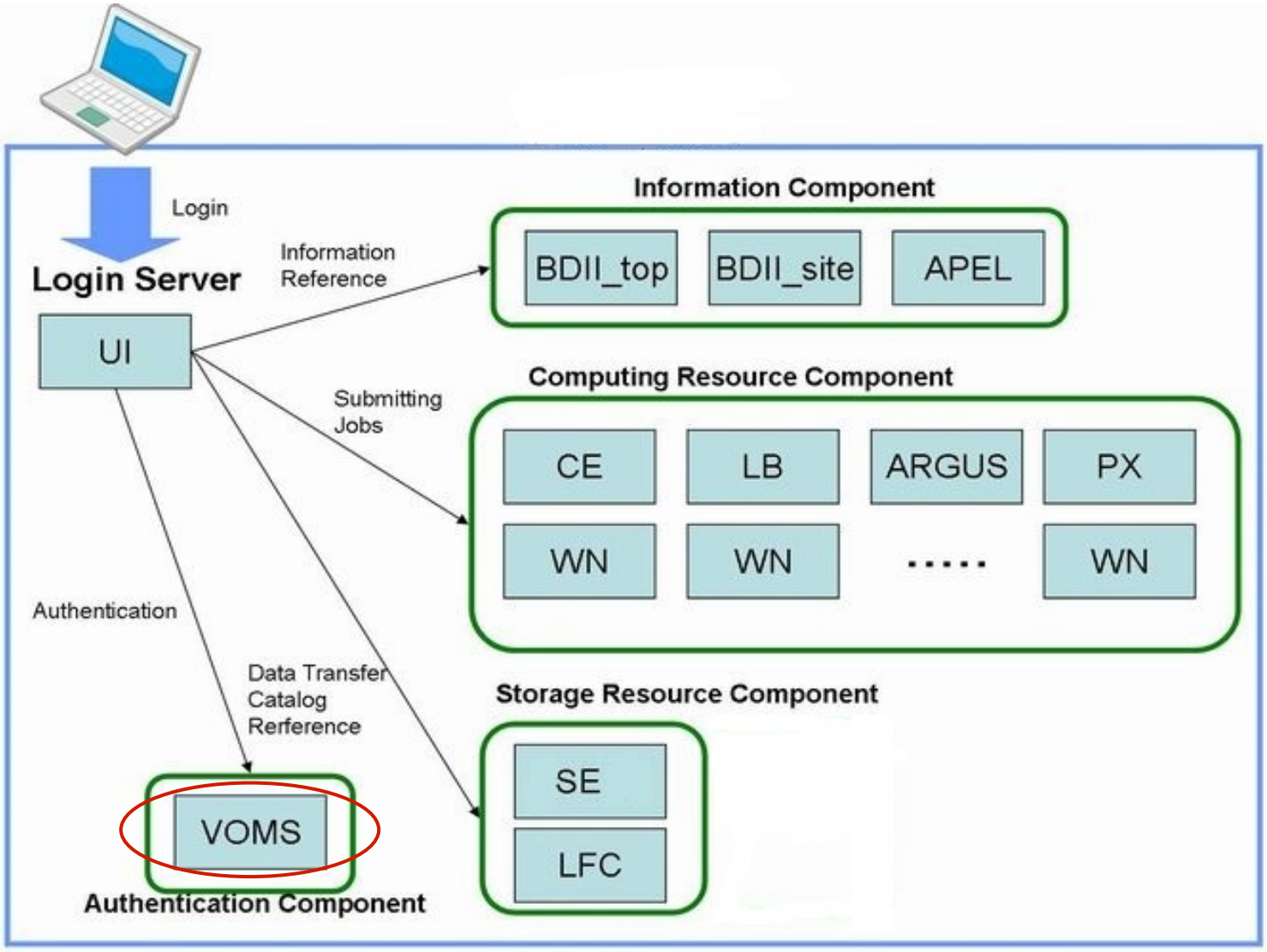
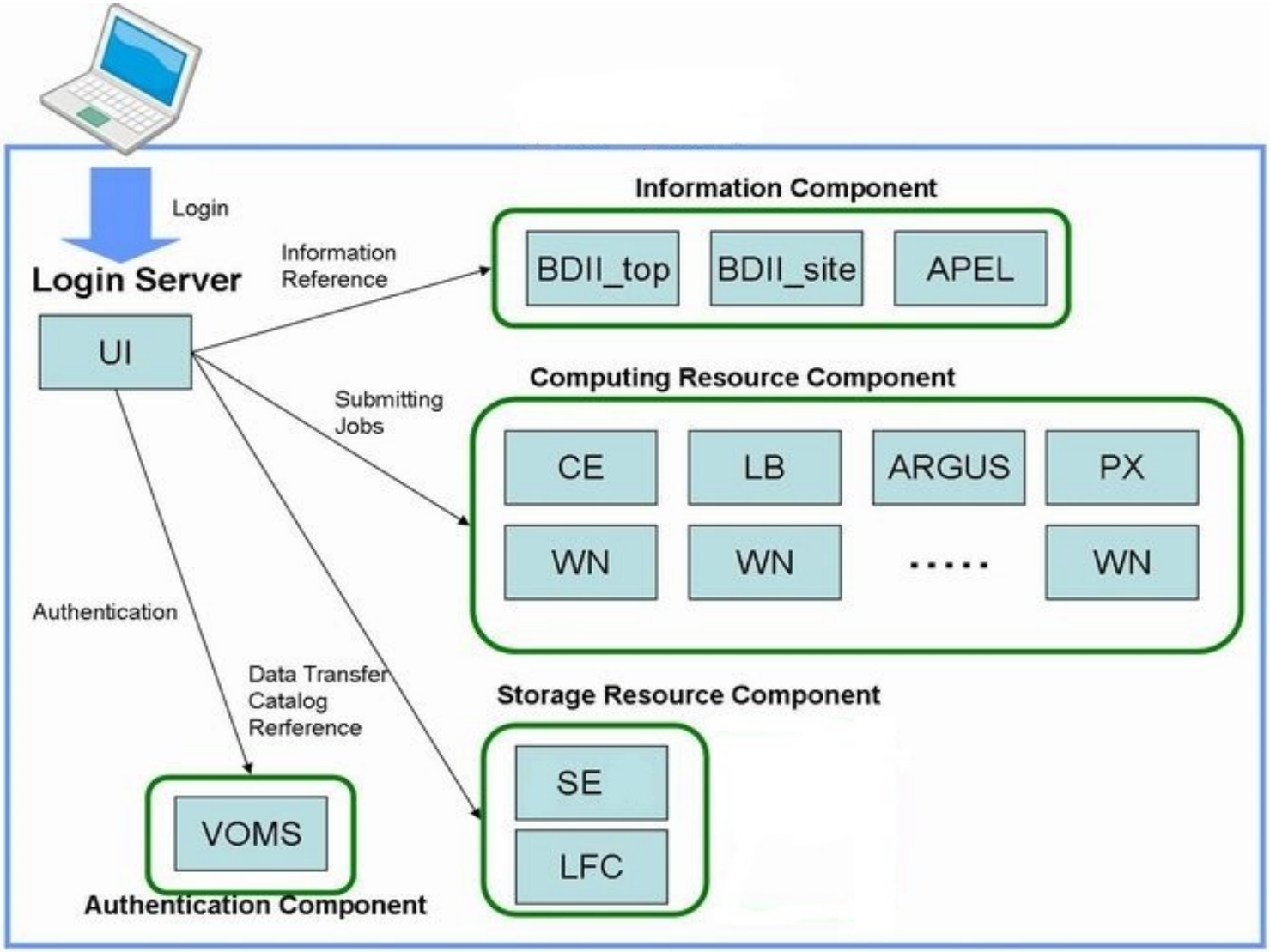


(Virtual Organization Membership Service) manages user information related to VO

EGI Exemplification



Grid Issues

- Scheduling
  - User has requirements for the jobs
  - Find appropriate resources
- Administration
  - Impact every area of Grid Usage
  - Permission to run in machines
  - User permissions
- Heterogeneity
  - A huge range of architectures and OS
- Data
  - Data ownership

Cloud Computing

- Definition
  - A model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

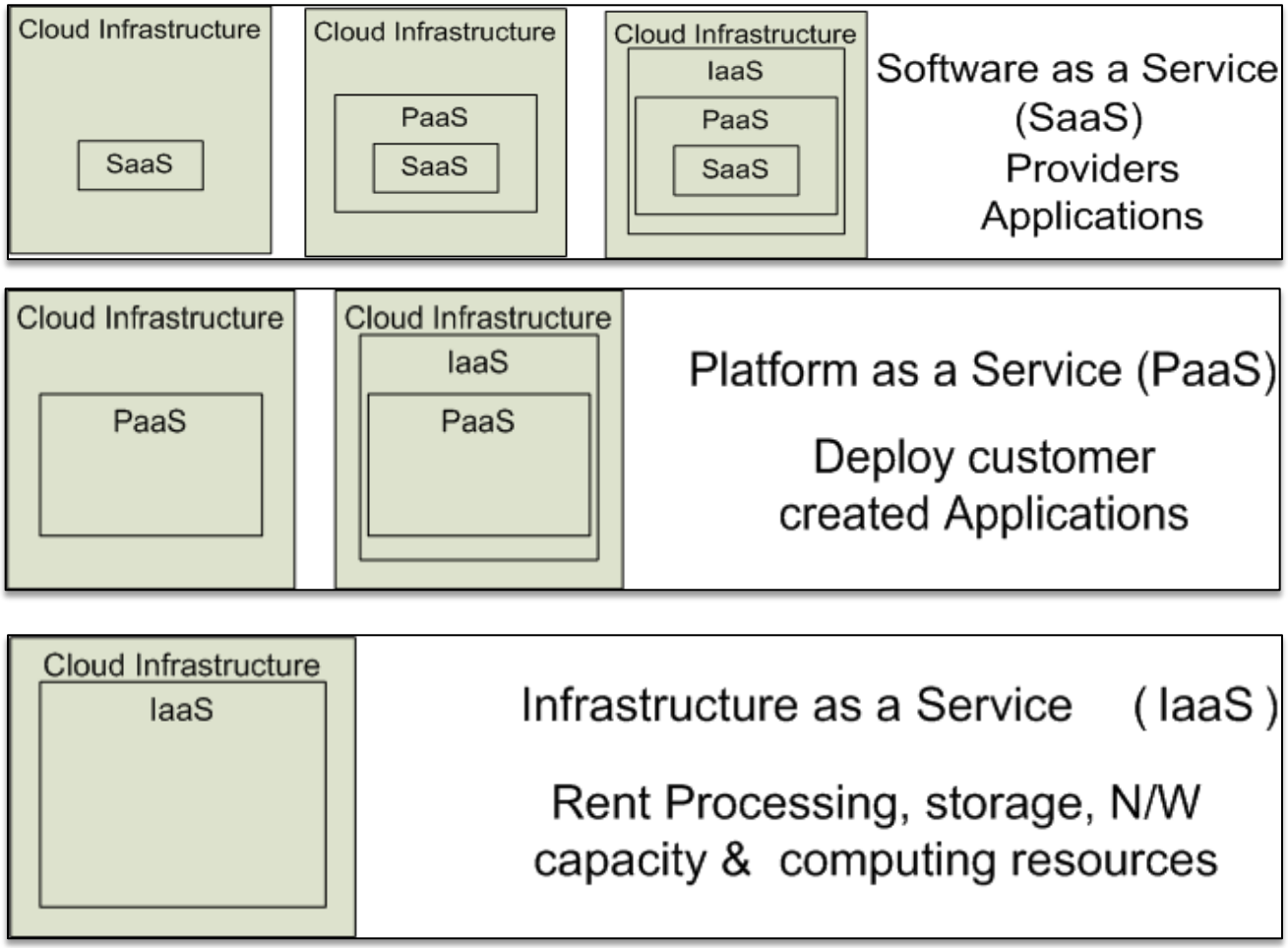
- In addition to Grids, the Cloud provides
  - On demand services, that are always on, anywhere and anytime
  - Economic model allowing to pay as much as used and needed
  - Virtualization (abstraction of a physical host machine)

Cloud service models

Software as a Service (SaaS)

Platform as a Service (PaaS)

Infrastructure as a Service (IaaS)



Conclusions

- The Grid and Cloud are becoming ubiquitous
- Their availability and stability is improving quickly
- If you have compute-intensive applications or if you are part of a large community sharing data and applications – it is time to start using Grids and/or Clouds

Questions