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## **DiCOS Software Stack**





## **DiCOS resource and users**

#### •Resources:

- •5 sites available.
- Two sites under deployment.
- •20K CPU cores, ~20 PB disk, 2x10Gb international links
- •Able to be extended to large commercial clouds such as Google, Amazon, etc.
- •User/Application Projects
  - Alpha Magnetic Spectrometer (AMS) production: dynamic VMs; integrate with Google Cloud
  - Bioinformatics RNA Sequence Data Analysis: Docker container in DiCOS; customised WebUI
  - ATLAS Experiment: For local user analysis job, and also integrating with Atlas workflow as opportunistic resources
  - Superconducting: O(1000) cores MPI

#### **DiCOS Is Improved by Application Experiences**

- Alpha Magnetic Spectrometer (AMS) is the first user
- ASGC acts as one of the primary analysis & data production centers of AMS since 2012
- 600K+ CPU-Day running time and Petabyte data In/Out served by DiCOS





BDC = Open Commons Consortium (OCC) Biomedical Data Commons



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#### Web User Interface

- Single Sign-On & GSI Proxy Management Integrated
- Job Management and Monitoring Mangement
- DDM: Drag & Drop; Request; Catalog, Submission Register; Transfer; Upload/Download
- Visualization: ROOT Viewer Integration
- Future Plan
  - On demand build environment
  - Web-based CLI environment









#### Software repository (CVMFS)

- Persistent Replication of Software Environment everywhere within hours and with less efforts
- Software Distribution as a Global Service
- VM images, Executable, Library, Database



#### **System Efficiency**

- Increasing both performance and reliability
  - Auto tuning, anomaly detection and failure process: based on identified key metrics and monitoring system
  - Throughput analysis from daily operations and understanding bottlenecks
- Growing the system intelligence based on system efficiency optimization and auto-control
- Data Center: power, thermal
- Scientific computing and HPC

IOB

file transfer

performance

worker node

disk server

data management

- Networking
- Computing

disk serve

– Storage

data management



- Failure Rate
- Maximize Memory Usage
- Kernel Parameter Tuning
  Cache Strategy by Access Patterns
  - Make Best Use of Resources





Cluster CPU last hour



job management

#### **Efficiency: Jobs Analysis**



#### **Monitoring & Control**

#### Anomaly Detection, Failure Job analysis, Usage Pattern Exploration Supporting Efficiency Optimization

**By Distributed Analytics Engine for Everyday Large Logs** 



## **Release Management**

- Product team vs Release Management Team
- Component testing vs Integration Testing
- Jenkins Serves as CI server(Master) and run test project on Docker(Slave)



# Dicos API (I)

- Authentication
  - Token-based, need to obtain a credential from any IGTF authorities
- VOMS Information:
  - List all VOMS and retrieve a VOMS information
- Proxy Management:
  - Get the proxy information; upload proxy file; destroy a proxy
- Distributed Job Management:
  - Job submission; cancellation; Job information; Task information
- Reference: <u>http://docs.dicos.apiary.io</u>

F (Interoperable Global Trust Federation): <u>https://www.igtf.net</u>

## **DiCOS API (II)**

- Distributed Data Management: file data set container hierarchy
  - Authentication: Retrieve auth token
  - RSE Storage Element
    - List all keys of RSE
    - Get value of RSE attribute/key
    - Create/Update/Remove an RSE key
  - Scope:
    - Create/List/Query/Delete a scope
    - List available scopes of an account
  - Data Identifier (DID):
    - Search/Create/List Content(or metadata, rules)/Obsolete/Get status a DID
    - List all DIDs of a scope
    - Retrieve selected key-value pair by DID
    - List Replicas of DID
  - Replication Rules: Create/Get/Delete a rule associate to a DID
  - Subscriptions: Register/Delete/Get Information/List a subscription
  - Reference: https://dicos.grid.sinica.edu.tw/wiki/rucio\_rest\_api/

#### **Network Virtualisation by SDN**

- SDN Routers had been deployed at Taipei, Chicago, Amsterdam and Hong Kong, and SDN controllers are in pilot stage
- Testbed Established
  - Testbed between Taiwan and U. Chicago through StarLight is in operation for bioinformatics cloud
  - Lab Environment at ASGC
- Collaboration
  - SDX: iCAIR (Northwestern University):
  - Cross domain connections: ESNet and Internet2(also on OESS), APAN, and others
  - Network resource efficiency: CCU
  - OpenDaylight and Router solutions for multi-domain applications: Brocade:
- Embedding analytics with SDN —> efficiency and security enhancement, intelligent control
  - Objectives:
    - Routing optimisation
    - dynamic network control
    - intelligent network provisioning
    - Quality of Service/Performance Assurance
  - Approaches
    - packet loss; latency; delay variation; CRC error; utilisation;

#### **Application Advantages with DiCOS**

- Application efficiency is improved by workflow optimisation
- Sharing of common data, tools, services and knowledge is straightforward
- Able to make use of all federated resources and enjoy the scalability and availability
- Web User Interface could be customised for VO
- API is provided for flexible integration
- Data and resource protection could be achieved as a Private Cloud
- Seamless integration with existing storage/file servers

#### **Collaborations and Future Perspectives**

- Distributed DB (NoSQL) for DJM and DDM
- API & Web as the primary interfaces
- Automatic Deployment at any site and commercial resources
- System Efficiency Optimization
  - Monitoring and Intelligent Control
  - Take advantage of SDN
- Advanced DDM: smart cache and coordination of network, storage and caches
- Automatic Testing Framework: Independent Testing & Verification before Production
- Analytics Based Enhanced Security and support required data privacy protection
- Virtualisation of Storage and Network