



CERES

Science Computing Facility

“It’s all about the data”

Mike Little

June 28, 2006



SCF Functions

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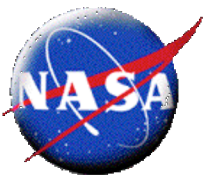
- Support Science Team
 - Algorithm and code development and testing
 - Validation and inter-calibration analysis
 - Analysis of scientific data
 - Research and Analysis Projects related to Radiation Science, Climate and Clouds
 - Production Computing environment
 - Complement to the ASDC
- Types of Operations
 - Code Development and evaluation
 - Short or proof runs of data products (non-public)
 - Experimental data products
 - Comparison of validation or inter-calibration data sets



SCF Capabilities

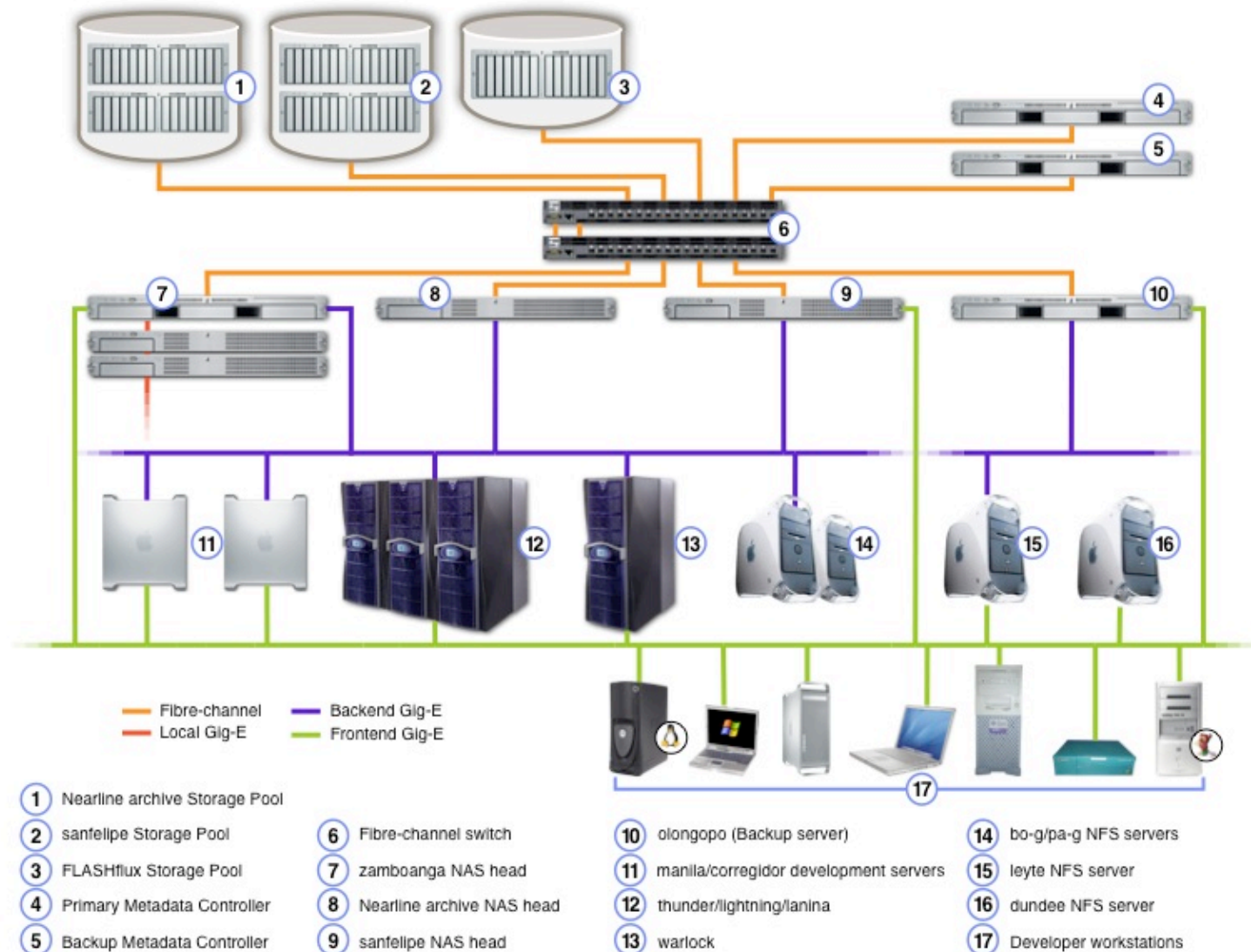
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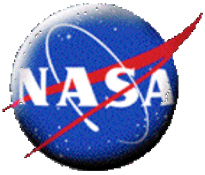
- Computation
- Storage
- Communications
- Printing
- Backup
- Web Services
- Exchange of data with external partners
- Security Services
 - Log collection and analysis
- User Services
- User Workstations



System Diagram

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Current Shortcomings

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- Cost is too high for future programs
- Cannot perform 10x re-processing
- Insufficient storage as CERES data grows
 - Studies now require access to larger quantities of data
 - Currently, restaging is time consuming
 - Storage is used inefficiently
 - Much duplication
 - Files no longer needed clogging system
 - Allocation of space to working groups is inflexible and broken up
 - Clouds needs to be segmented into separate groups
- Current computation platforms are slow and lack capacity
- Some codes need clean up of improper coding practices
- Disk space on web server needs restructuring



SCF Evolution Objectives

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- Modernize Computing Environment
 - Storage-centric model
 - Modernize computing hardware
 - Cluster computing
 - Resource Management
 - Production Scheduling
- Convert Code to run on multiple Platform-types
 - Clean up codes
 - Proof of Scientific Equivalence
 - Process for certifying codes on a given platform/OS
- Restructure Relationship with ASDC Production
 - Run interim or experimental data products DAAC-like
 - Validation and testing data
- Improve effectiveness of web services
 - Reduce dependence upon single platform
 - Improve security of individual site files



Modernize Computing Environment

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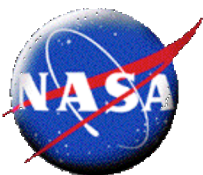
- Transition to a multi-platform environment
 - Run jobs on any available platform with same results
 - SGI IRIX
 - Mac G5 workstations and servers
 - IBM PowerPC cluster
 - Sun Solaris
 - Intel-based LINUX (bit-ordering is a compatibility issue)
 - Include user workstations in ability to run jobs
 - When in direct use by assignee, their jobs
 - “After-hours” use by resource scheduler to run job
- Access to data is the key
 - Each instrument team makes data available in their format
 - Access by users through logical file system
 - Replace copying of files with remote access on demand
 - Improve scientists ability to use all the data that is available



Storage Centric Model

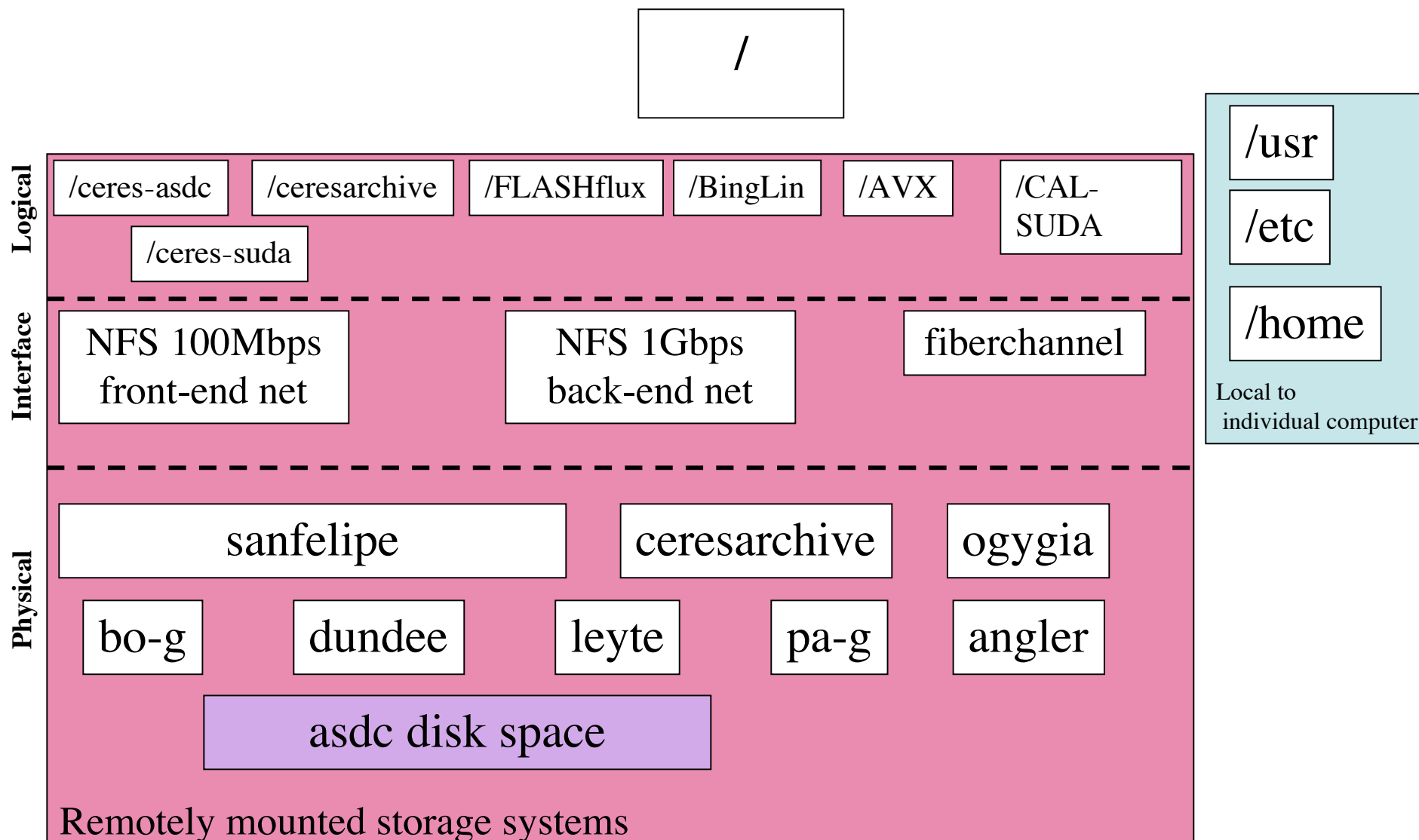
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- Logical file structure
 - Common across computational platforms
 - Independent of physical attachment mechanism and location
 - Accessible to workstations
- Physical storage structure
 - High performance storage directly attached to computer
 - High performance disk system connected via Gbps network
 - Medium performance disk system
- Storage Tsar monitors disk utilization and allocations of disk to working groups
 - Priority established by PI disk owners



Logical File Architecture

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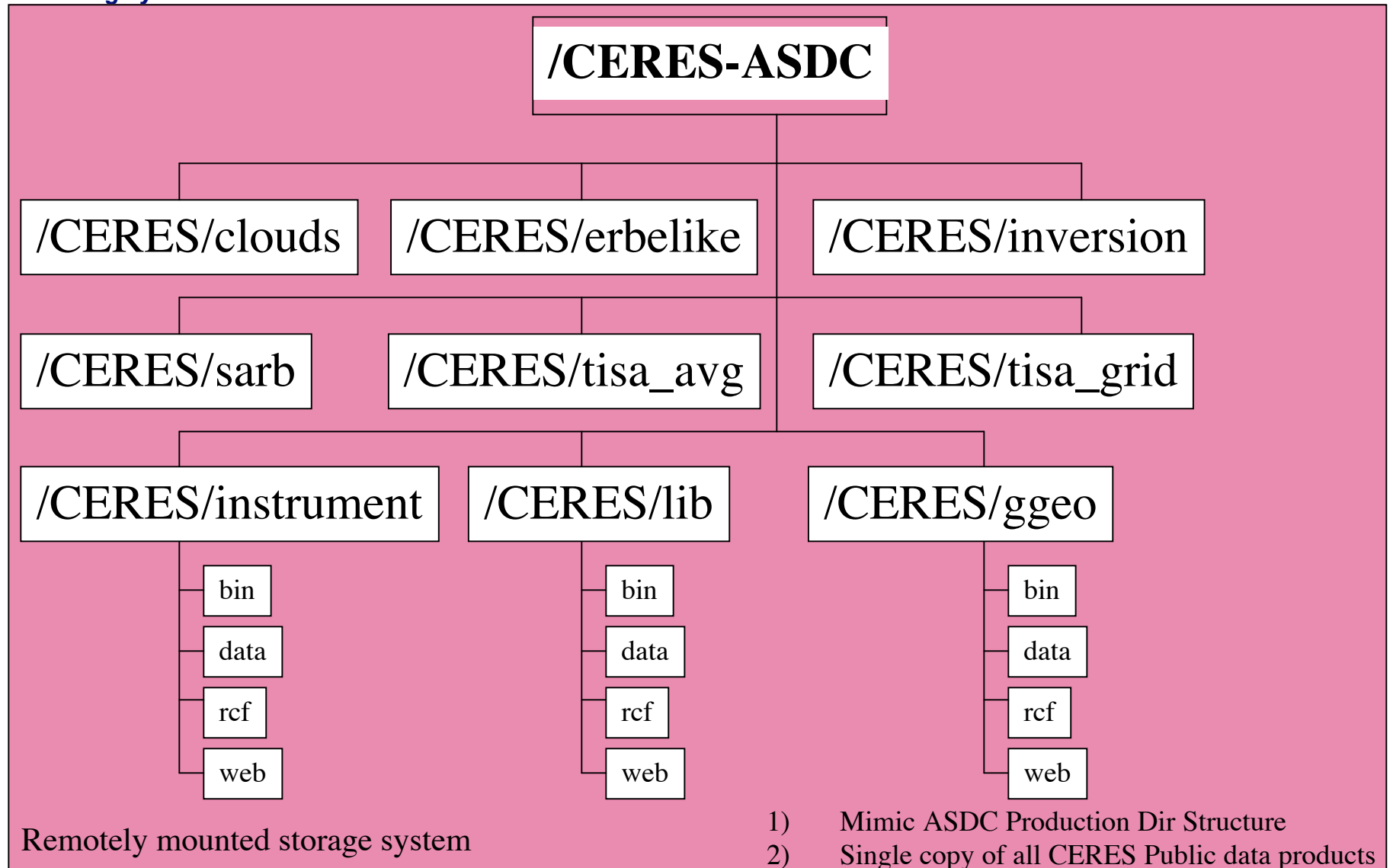


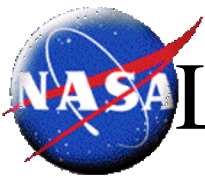


Logical File Architecture /CERES-ASDC

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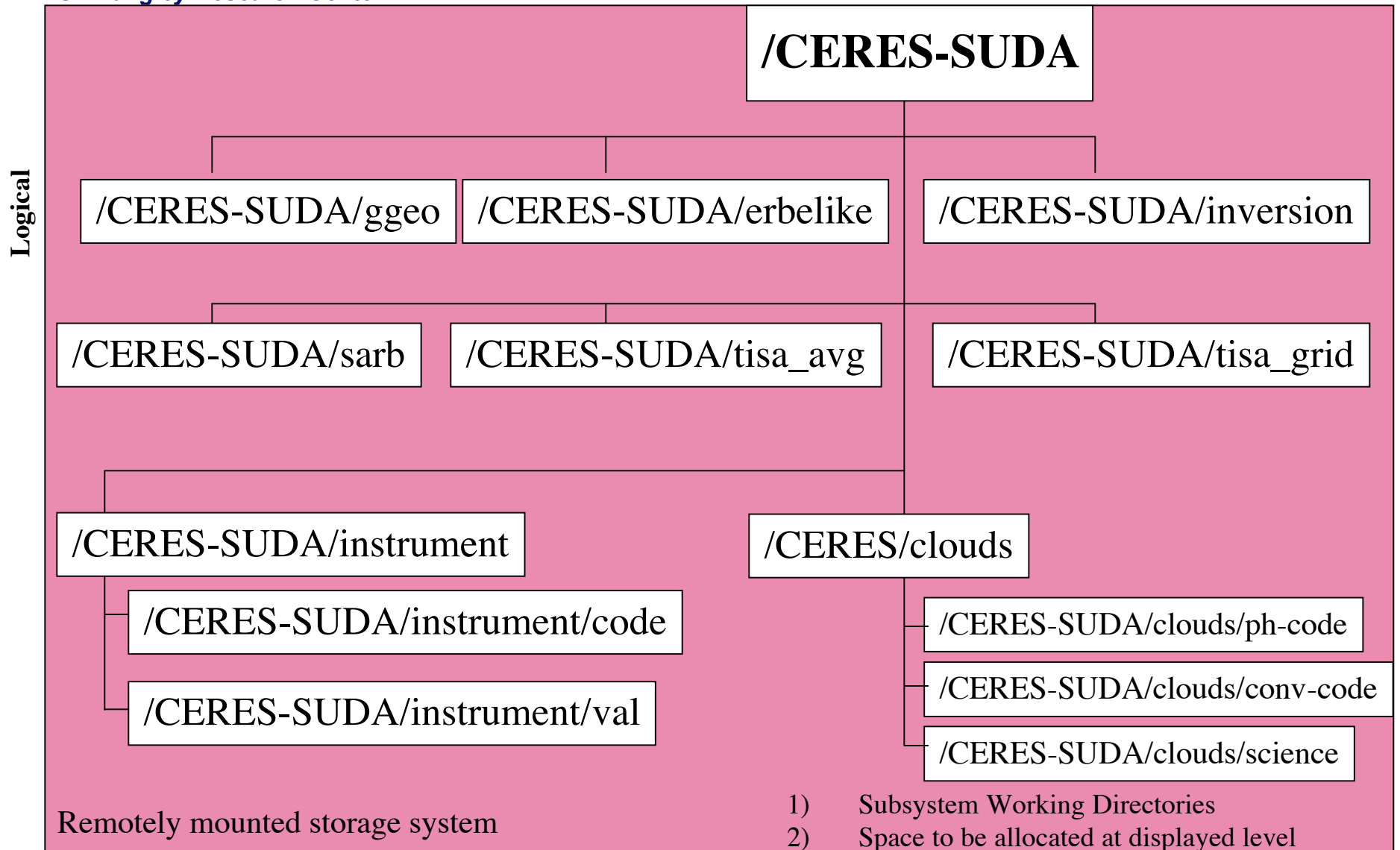
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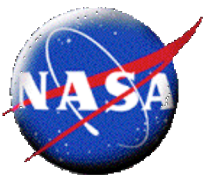




Logical File Architecture /CERES-SUDA

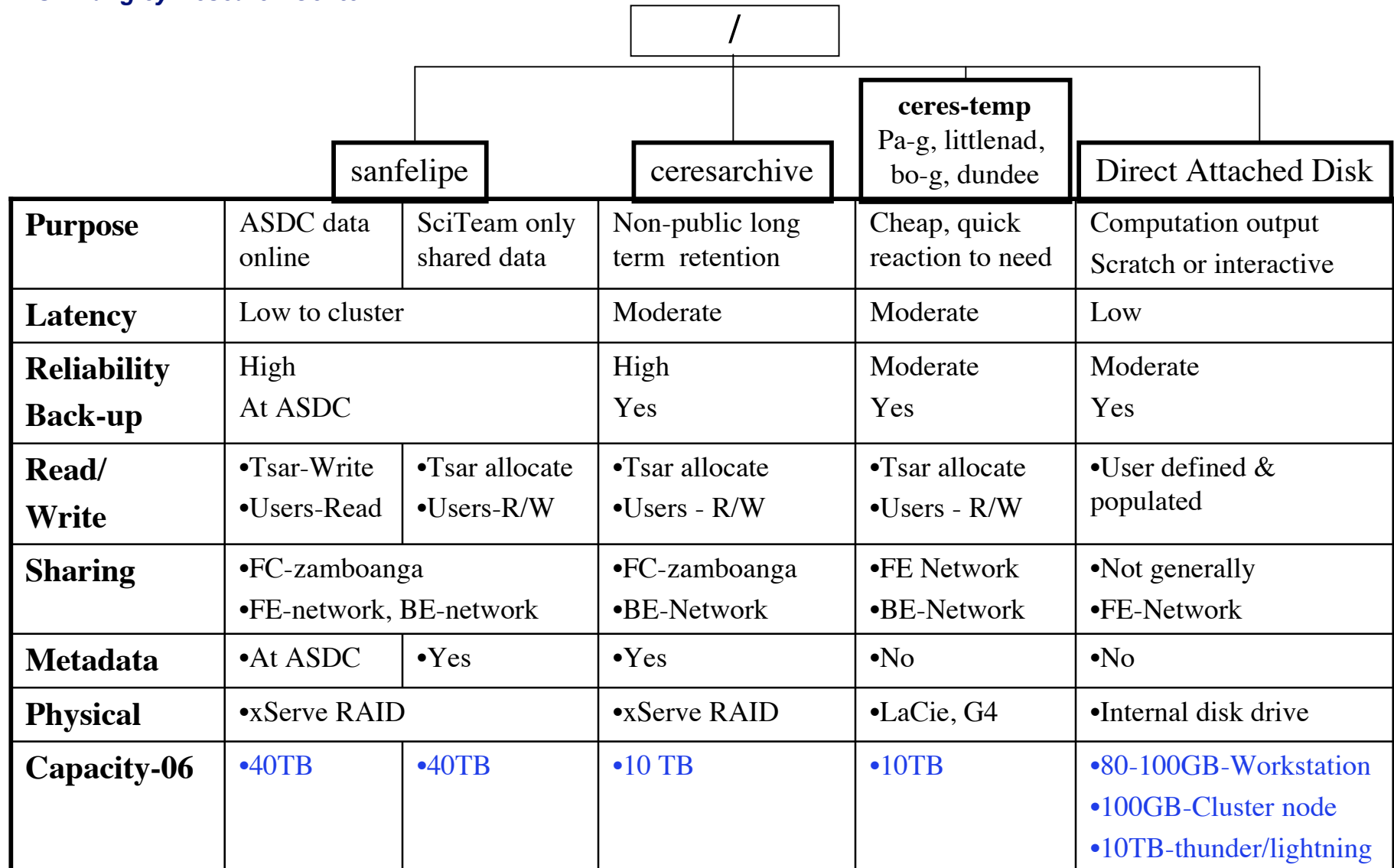
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CERES Physical Storage Architecture

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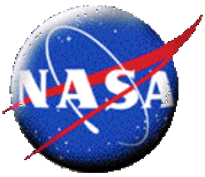




CERES SCF Cluster Computing

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- Resource Management using Sun Grid Engine
 - Client Running on each Compute-server
 - Multiple Queues reflect prioritization of processors
 - CERES (N nodes)
 - CERES Instrument Re-validation (2 nodes)
 - NEWS Processing (4 nodes)
 - AVX (4 nodes)
 - Execute and status jobs
- Multiple Job Scheduling Tools
 - S4PM
 - Individual Processing File



CERES SCF Cluster Concept of Ops

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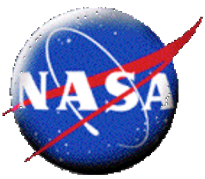
- User develops and tests code on individual workstation
- User does final testing and interactive production on manila, corregidor, (+2)
- To perform larger test, use zamboanga (G5 cluster)
 - Is it a short, simple run with data already staged?
 - Prepare job request file and put in scheduler in-box
 - Is it a complex or production-like run?
 - Is this SS already configured for S4PM
 - Prepare an S4PM job request (looks like a PR)
 - If not, work with Scott Zentz to create S4PM infrastructure
- Production Runs (NEWS, AVX)
 - Standing PRs using S4PM to test for data availability and then run jobs in proper order



CERES Code Conversion

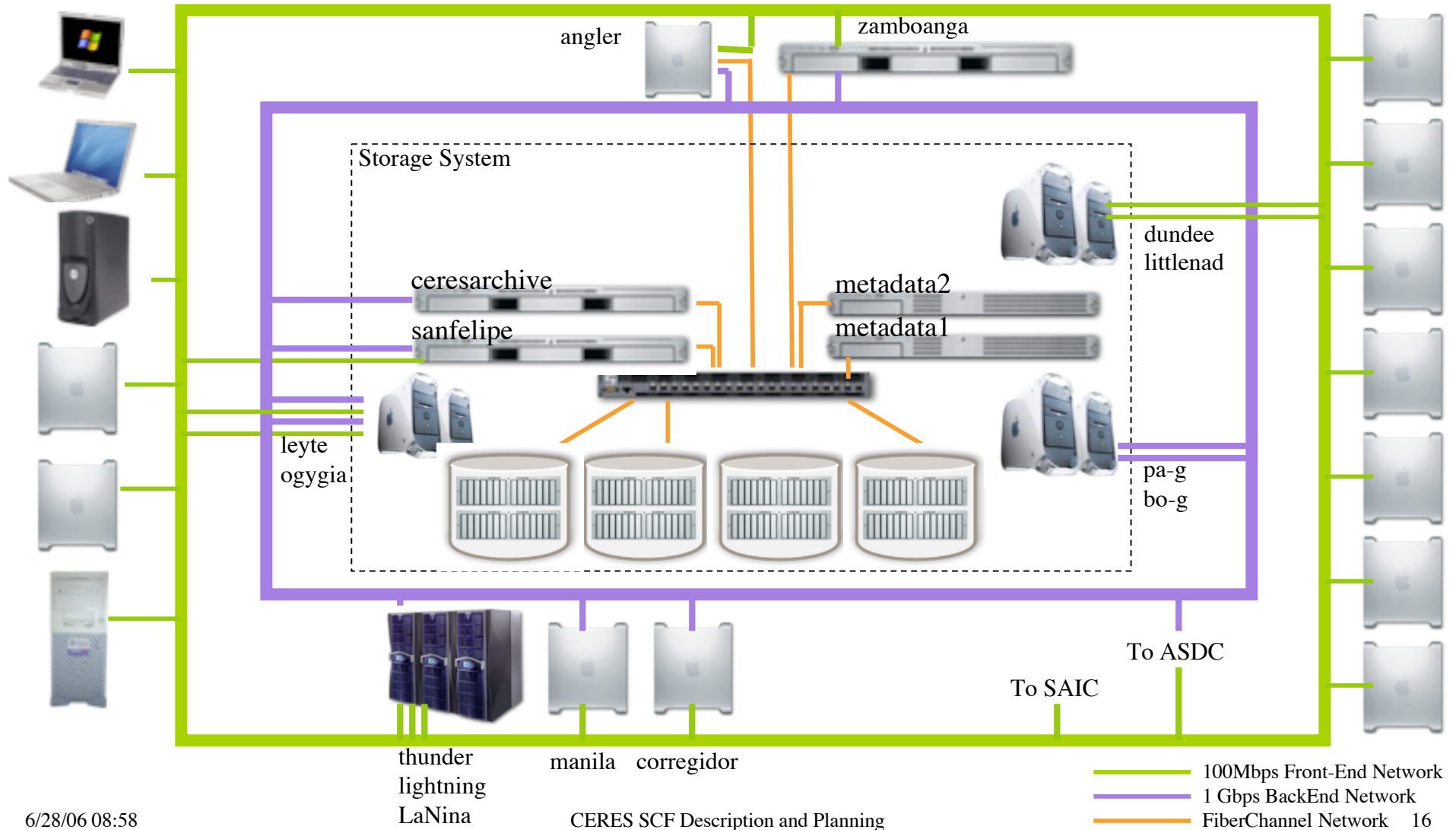
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- Based on running on a single processor
 - Multi-processing issues handled by cluster effort
- Code Clean-up
 - Lessons Learned from Donaldson experience
 - Coding practices (common block, data, mixed-mode arithmetic)
 - Documentation and CM to track what is certified
 - Re-examine granularization of data to be processed
 - Eventually address bit-ordering to permit use of Intel processors
- Code Certification
 - Develop code certification process for each SS
 - Automate code certification testing
 - Use for all code changes as part of delivery
 - CM of code versions, not just data product versions



CERES SCF Target Architecture

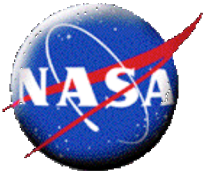
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CERES SCF Description and Planning

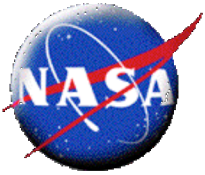
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Improving CERES Relationship with ASDC

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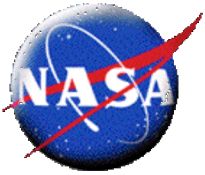
- Common Production Model based on S4P
 - ASDC does all production for public release
 - SCF performs short or non-public runs
 - Jointly Develop S4P implementation that both facilities can use
 - Ensure that adhoc runs can be made at SCF with confidence that they are run with the same results as the ASDC
- Improve Process for Data Production
 - Delivery Process
 - Reduce time required to update code by reducing testing and rework
 - Production Request Process
 - Improve efficiency of production request submission to support CERES Automation
 - Improve accuracy of implementation of production requests
 - Production Process
 - Increase automation of data production
 - Reduce adhoc runs at ASDC



CERES Automation via S4P

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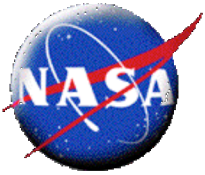
- Development and Modification of Software
 - ASDC S4PM implementation for CERES based on MISR
 - Production model reflecting CERES approach with re-processing
 - CERES PGEs and Scripts
 - Convert scripts to Perl for portability
 - PCF Generator needs to be a standardized with input data as delivery
 - Exception handling without operator intervention
- Modify Processes to Support CERES Automation
 - Configuration Management of Codes and Scripts (TBD)
 - Delivery Process (TBD)
 - Production Request Process with no Operator Attention
 - PR is ingested and used as input to S4PM
 - Special cases handled by Operator on limited basis
 - Production Process
 - Operators during Day Shift
 - Lights out during all other shifts using S4PM



Communications Upgrades

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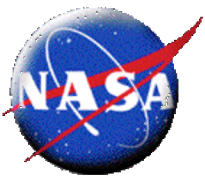
- Upgrade back-end network to 10Gbps
 - Expand reach to upstairs computer room
 - Coordinate acquisition, interoperability and schedule with ASDC
- Foreign-national firewall
 - Isolate SD assets from remainder of LaRCNet
 - Needs coordination with LaRC OCIO



Upgrade Web Services

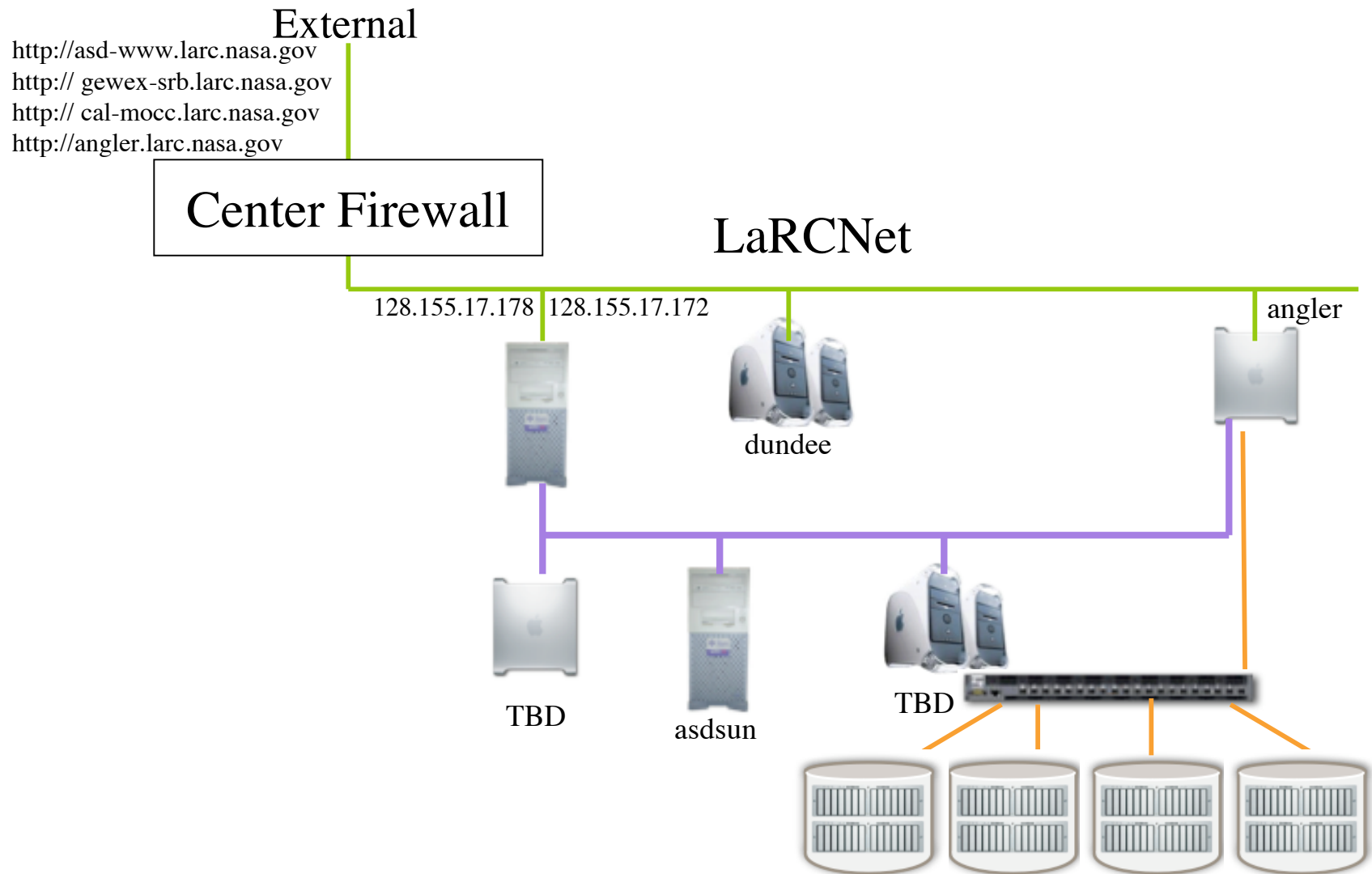
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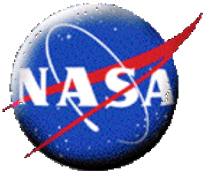
- Migrate files from cirrus to individual file servers
 - NFS mount file servers to web server read-only
 - Computer Security
 - Web server only has web server problems
 - Application servers on this machine
 - File servers control access to the files
- Increase throughput capacity of webserver
 - Replacement hardware
- Reduce the number of web servers
 - Reduce cost of support
 - Consolidate application services



Web Service Architecture

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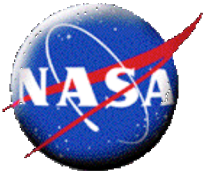




Holes WE Need to Fill

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- What are we not thinking of...
 - How would the users LIKE to use the system?
 - What makes the scientists more effective in understanding the atmosphere?
- How do users submit jobs to the cluster...
 - S4P for the big stuff
 - Web interface?
 - What does it take to submit a job to SGE
- New Delivery Process to put code into production
- Implementation of CM Process
 - Code versioning in CVS in a semi-uniform way



Specific Actions

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- CERES Code Conversion
 - Code Kitchens with Apple, etc.
- Cluster Management Support
 - S4P Implementation with the ASDC
 - Other submission models
 - SGE Implementation on all platforms
- SCF Hardware
 - Storage System
 - Computation Systems
 - How long to keep the SGI's?
 - Communications Upgrade
- Procedure Changes
 - Storage Tsar
 - Configuration Control of Converted Codes
 - Certification of codes
 - Testing of Code Changes for Delivery
 - Delivery Process
 - Document the new system for the users