# Intelligent Storage Consortium

## DISC

**University of Minnesota**

*Digital Technology Center*

*Intelligent Storage Consortium*

**Professor David DU**

Supported by

StorageTek, Veritas,
Sun, Engenio,
ETRE/Korea

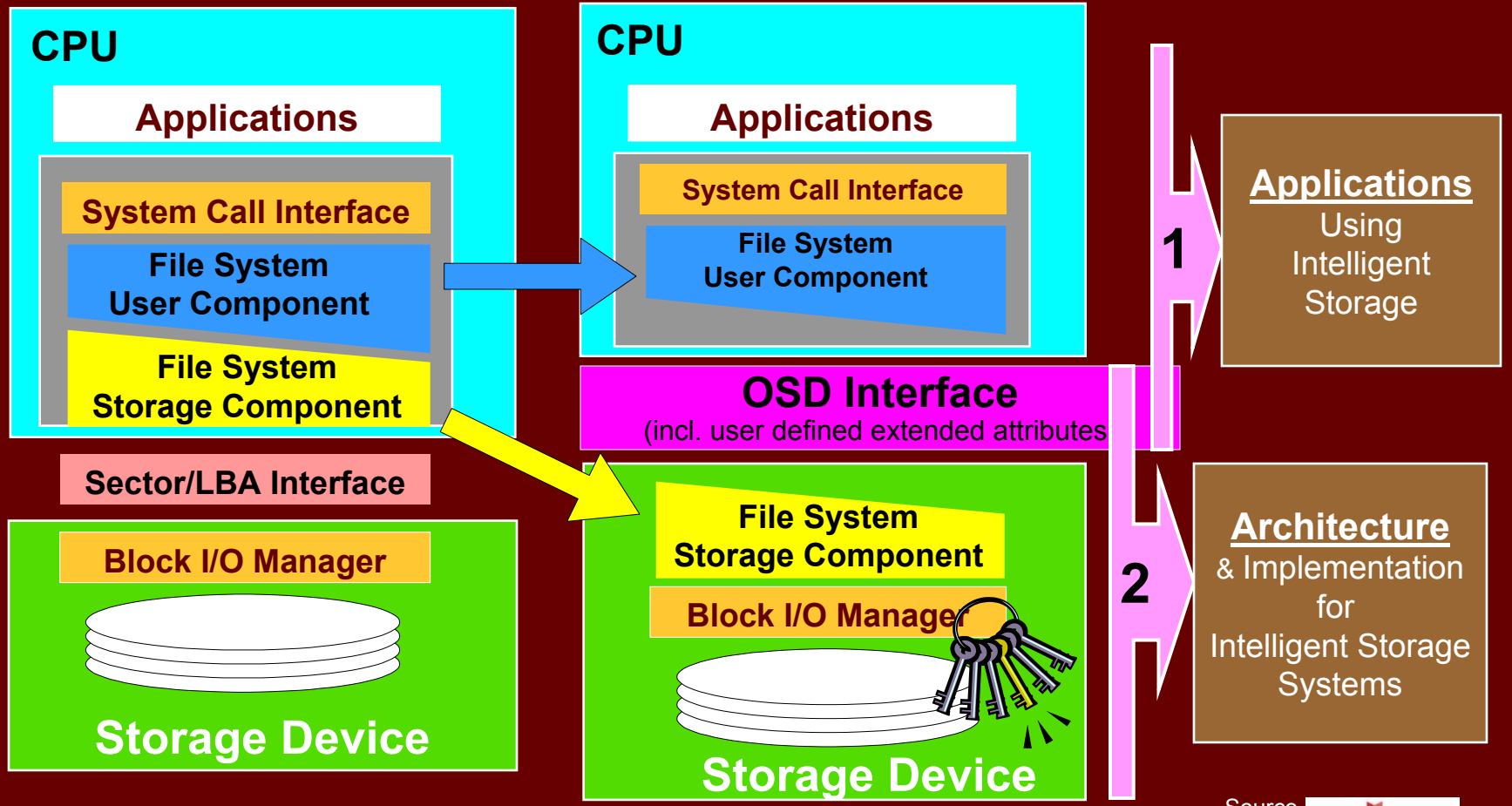
DOE, ONR, Cisco, Intel

# R&D Research Area


- To Be Emphasized
  - Archive and Restore in HEC Environment
  - I/O Middleware to Guarantee Performance
  - QoS-based Data Allocation, Migration and Accesses
- Has Been Overlooked
  - Security for Long-Term Archive
  - Applications That Can Be Benefited from OSD

# Intelligent Storage Research Areas

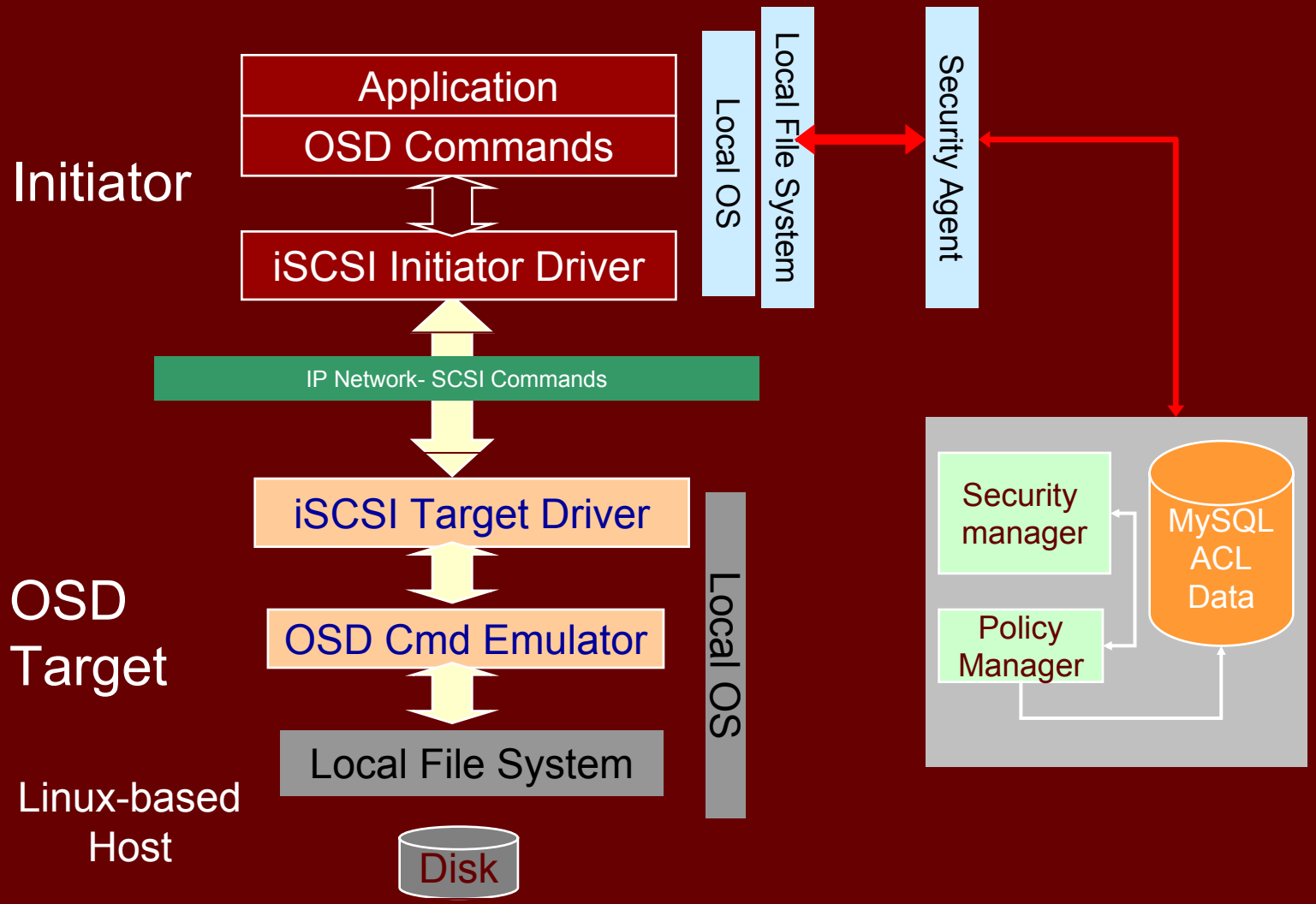
## Users & Implementers of OSD



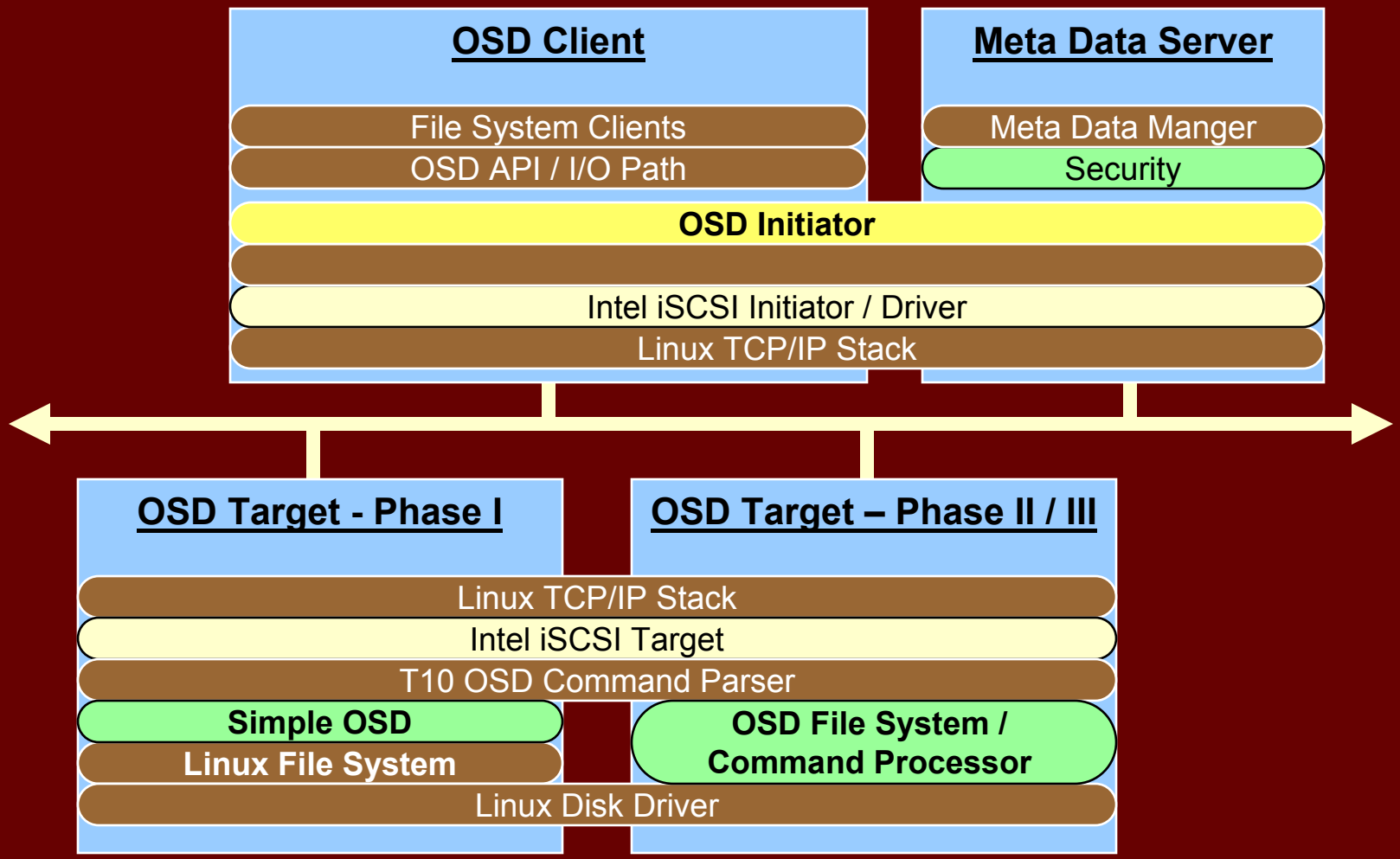

Source SNIA

# DISC – OSD Reference Implementation

## Phase I Architecture



# DISC - OSD Reference Architecture



# DISC – OSD Intelligence in the Stack
## Active Storage Objects (ASO)

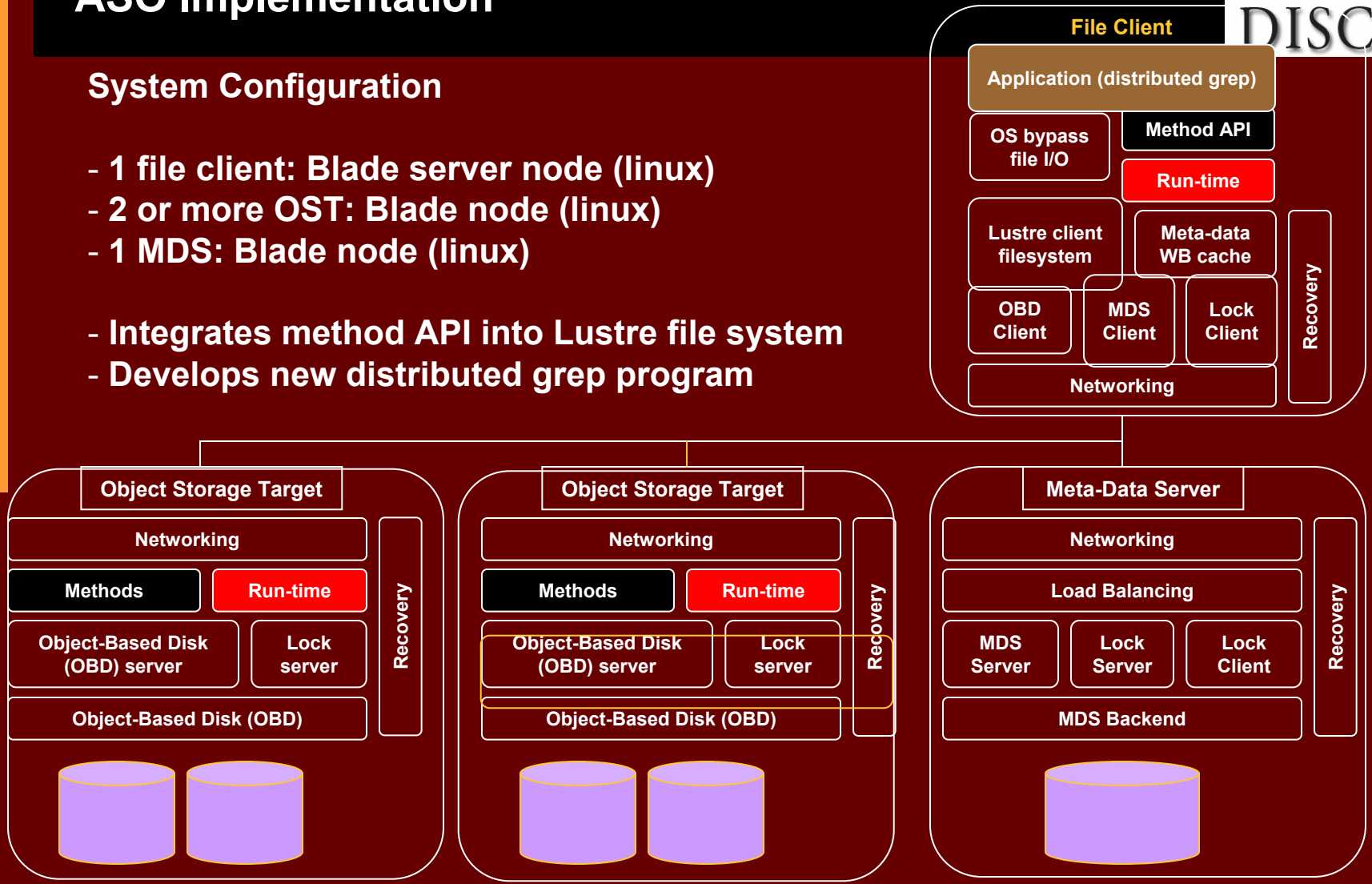

- Problem:  How can the OSD environment be extended to be even more flexible?
- Approach:  Allow objects to include executable methods in addition to the data, attributes and metadata. These methods can be invoked when a pre-set condition is met.
- Uniqueness: Data objects are truly autonomic. Intelligent storage devices have to designed to provide such a capability.

# DISC – OSD Intelligence in the Stack
## ASO Implementation

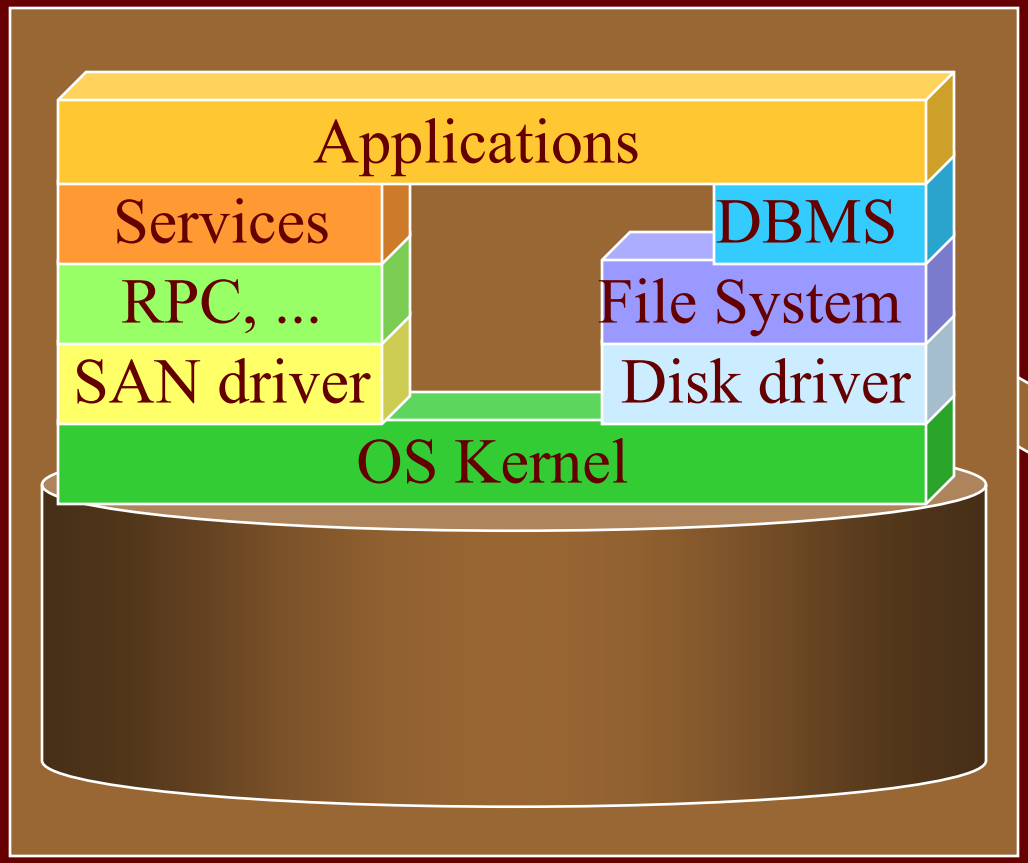
### System Configuration

- 1 file client: Blade server node (linux)
- 2 or more OST: Blade node (linux)
- 1 MDS: Blade node (linux)

- Integrates method API into Lustre file system
- Develops new distributed grep program

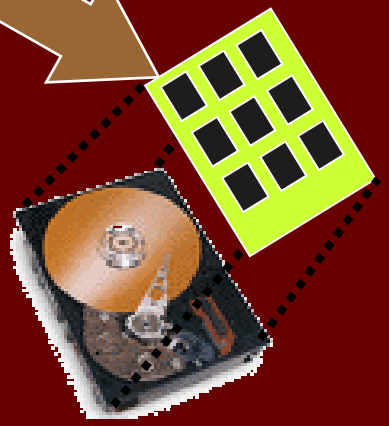


# DISC - OSD Intelligence on the Drives




**Object storage device**

- Magnetic storage (1TB?)
- Processor & DRAM
- SAN/IP attachment
- Execution environment
- Semantic-aware
- Application-aware

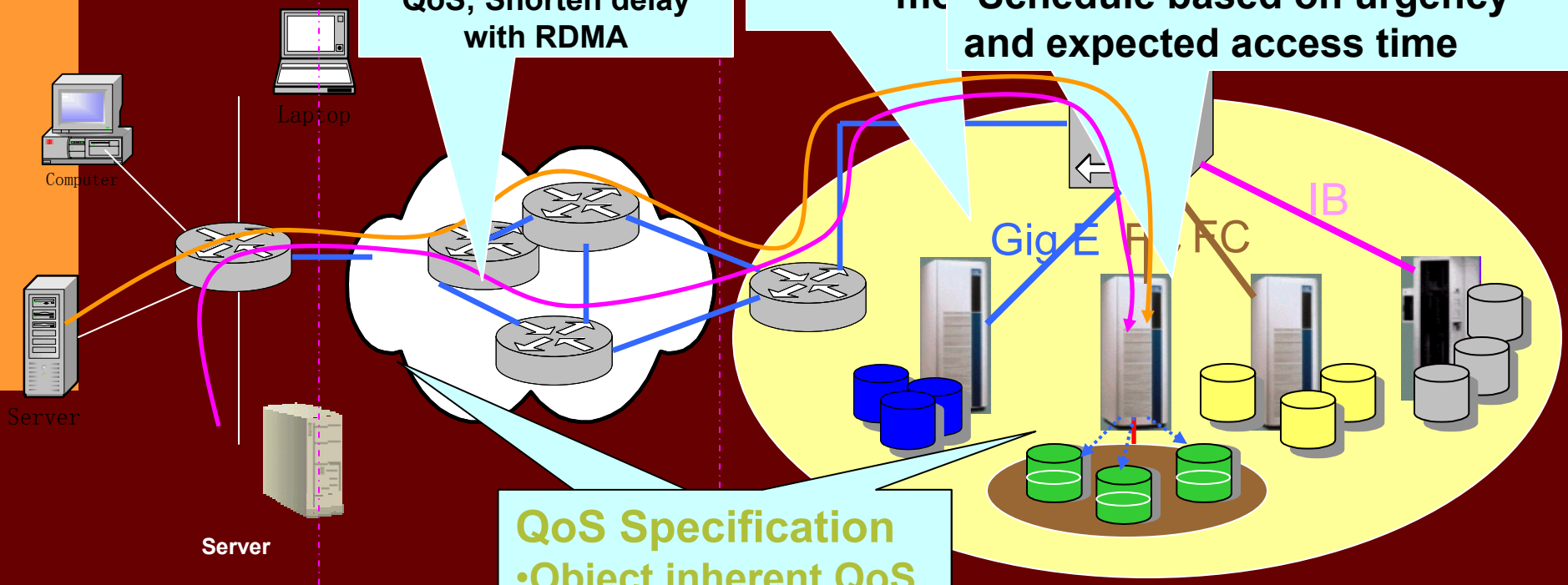


# QoS Provisioning

Integrating network QoS with Storage QoS; Shorten delay with RDMA

Assu
• dynami
• adjustab
• storage
mo

QoS-based Scheduling:
• requests breakdown based on current load, buffer space and network BW
•Schedule based on urgency and expected access time



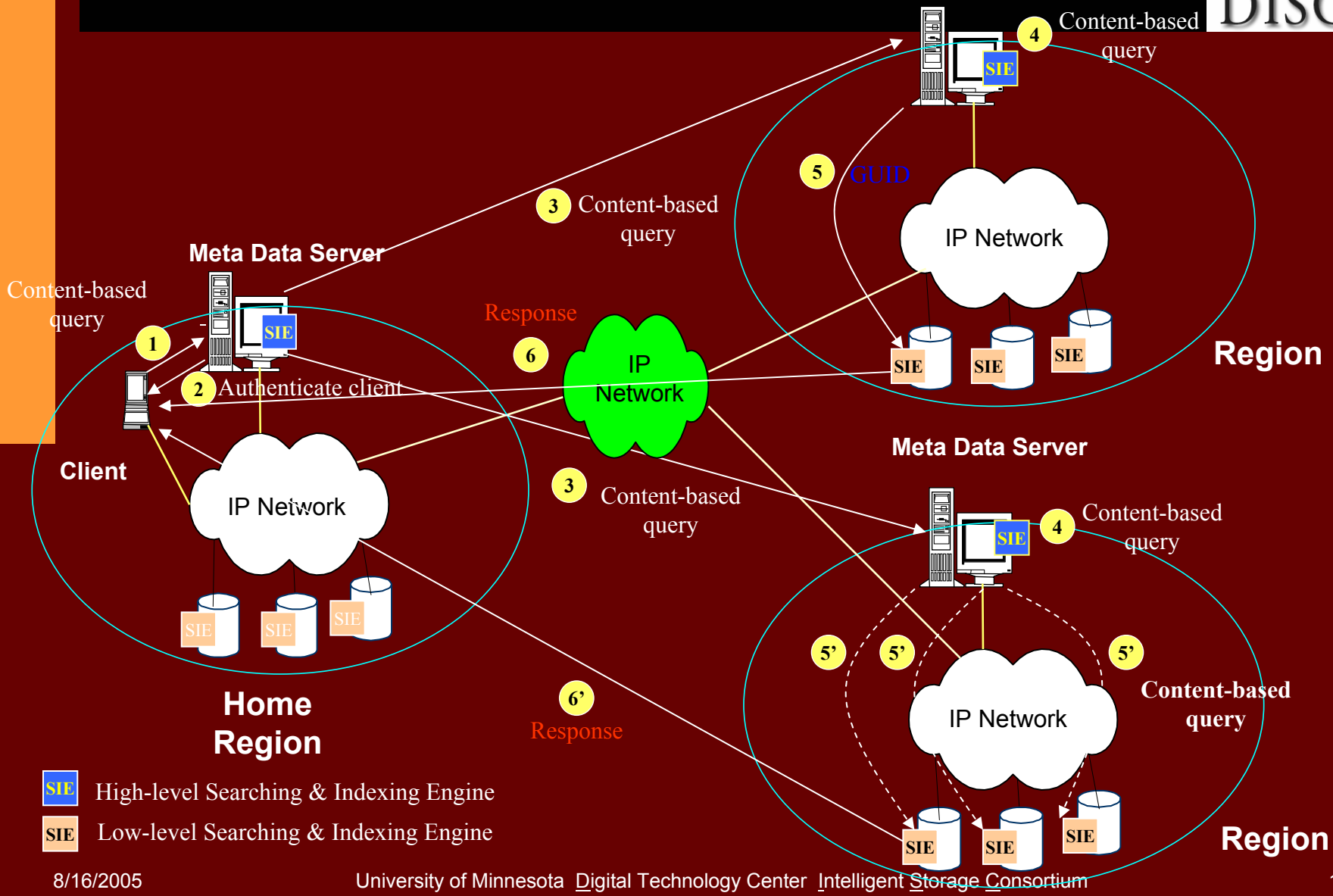

QoS Specification
•Object inherent QoS
•Operation level QoS
•Session level QoS

Clients

Network Cloud

Data Center

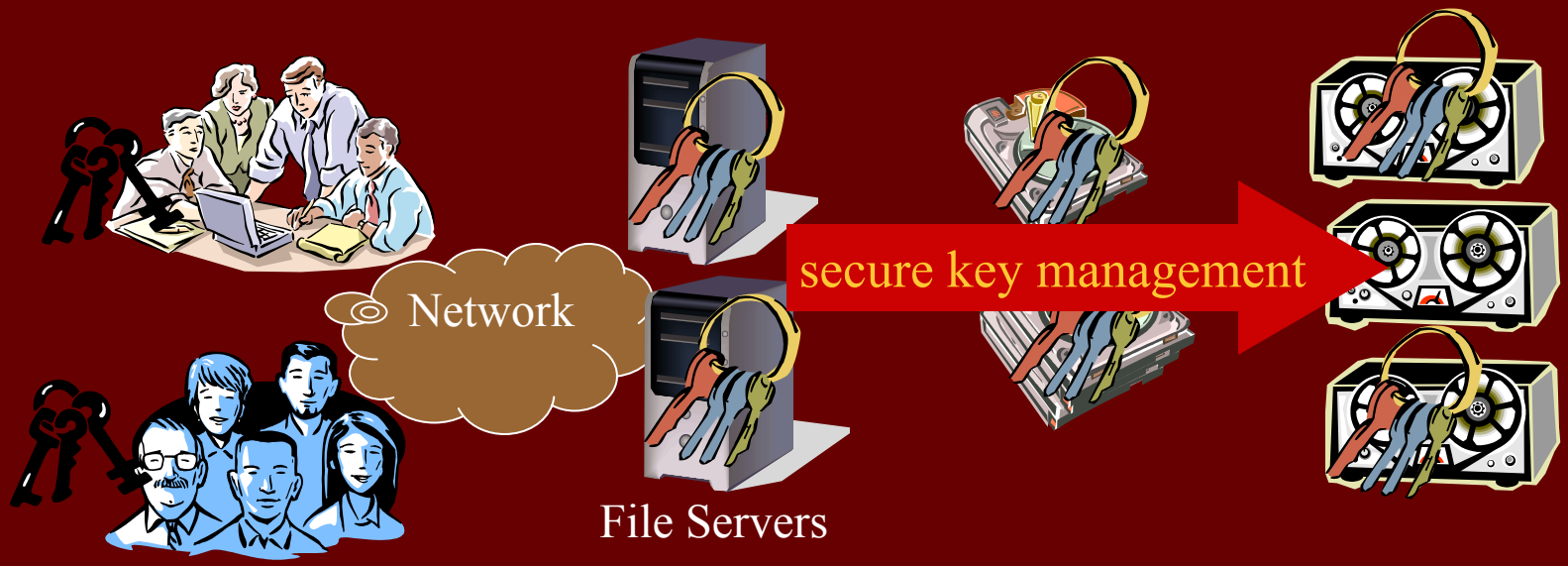
# Two-Level Search & Indexing



# Secure File Sharing With Long Term Key Management


- Secure and scalable file sharing
- End-to-end data security
  - Confidentiality
  - Integrity
- Efficient key revocation

# Secure File Sharing With Long Term Key Management

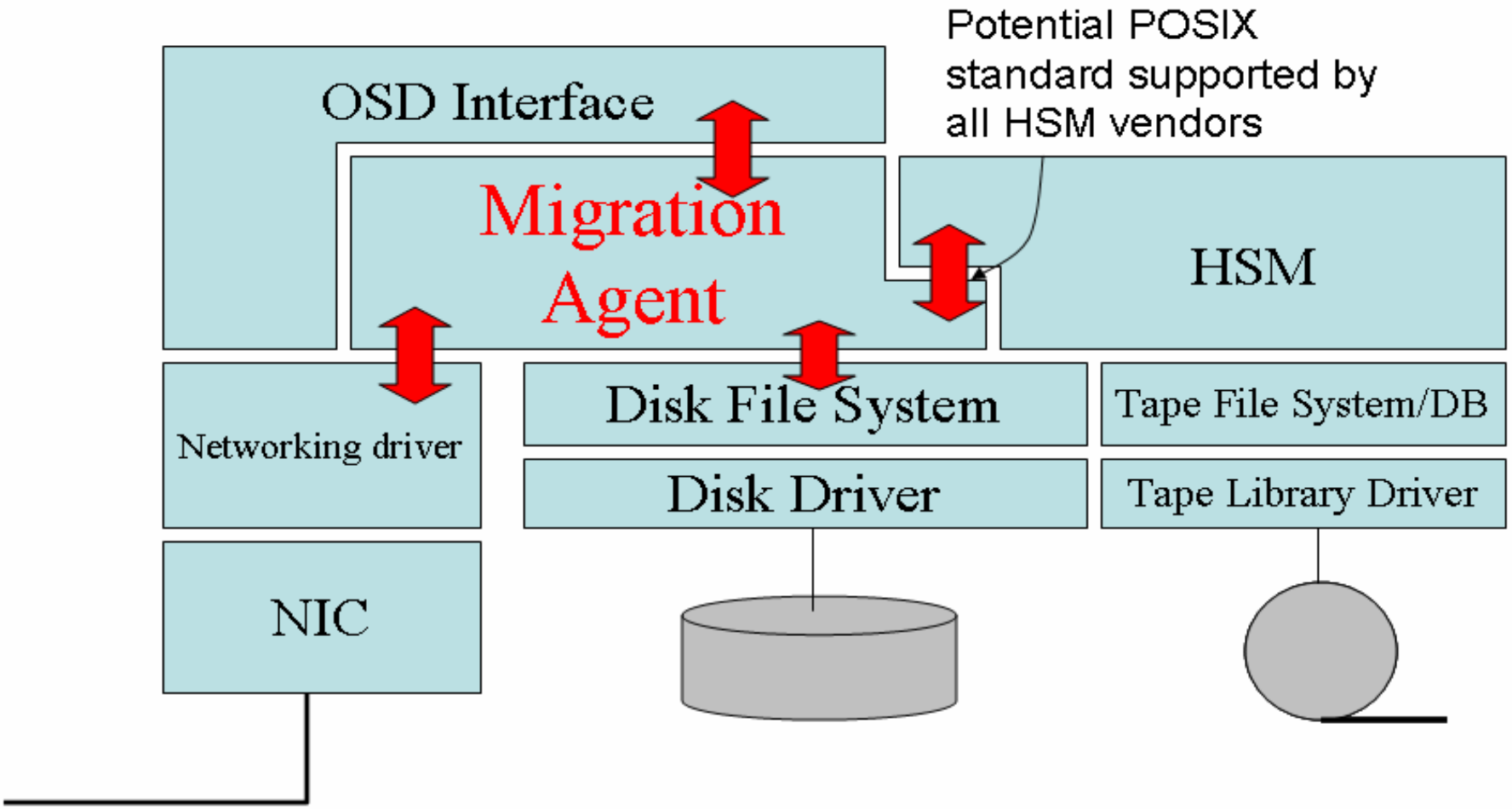



- Long term key management
  - Secure keys → secure data
- Secure key backups and retrieval
- Efficient key recovery

1. Creating OSD-Enabled Tape Library

2. High Performance File System

3. Migration Agent for Multi-Vendor HSMs



# Select DISC Faculty

**David Du** – Professor Computer Science & Engineering
Research Interests: Object-based Storage Devices, multimedia computing, high-speed and optical networks, mass storage systems

**David Lilja** – Professor & Head Electrical and Computer Engineering
Research Interests: high-performance computer architecture, parallel computing, computer systems performance analysis, nano-computing, storage systems and system performance.

**Ahmed Tewfik** – Professor Electrical and Computer Engineering
Research Interests: Wireless/wired server and storage area networks, content addressable storage, privacy protecting secure documents and media, multimedia distribution, optical tomography

**Jon Weissman** – Associate Professor Computer Science & Engineering
Research Interests: Computational Grids, Intelligent Storage, Distributed Systems, High Performance Computing

**Yongdae Kim** – Assistant Professor Computer Science & Engineering
Research Interests: Storage and Data Security, Wireless and Sensor Network Security, Distributed System Security