A Novel Grid Resource Broker Cum Meta Scheduler
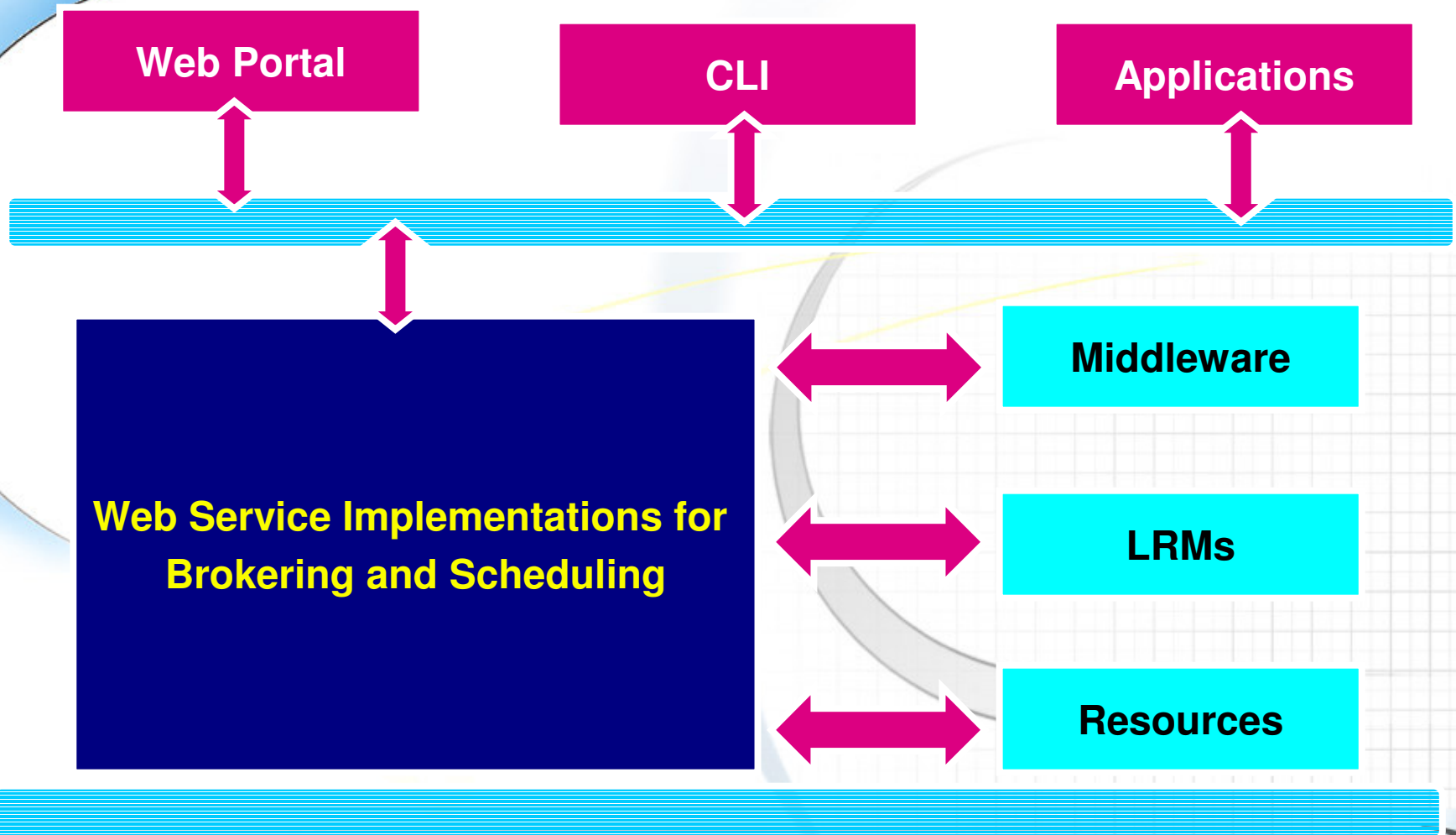
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Basic Expectations

- To aggregate the heterogeneous resources and manage the workload at a global level.

- To provide unattended, reliable, and efficient execution of jobs on heterogeneous and dynamic resources in a grid.

- To offer a unified interface for managing these loosely coupled resources, maintaining scalability and autonomy.

The Top level Architecture

Web Portal

CLI

Applications

Web Service Implementations for Brokering and Scheduling

Middleware

LRMs

Resources

International Symposium on Grid Computing (ISGC-07), Taipei - March 26-29, 2007

A Unified Suite

- Brokering Services

- Scheduling Framework

- Policy Engine

- Work Flow Engine

- Job Description Language Engine

Security Features

- **Integrates with the GSI**

- **Fine grained authorization scheme to define the privileges to Users and Administrators at these levels:**
    - Grid
    - Site
    - Resource

- **Uses the DN for authorization at the Grid Level**

- **Employs XACML for role based authorization at individual site and resource levels.**

Policy Management Engine

- Valid users / user groups

- Resource priorities

- Scheduling classes

- Job-preemption policies

- Usage Quotas on number of Jobs, Nodes, Processors, Wall clock time

- Limits on on CPU, Physical Memory, Virtual Memory, Disk utilizations

Job Description Language Engine

Operating System, Processor Architecture, Speed, Memory

Temporal, Data dependencies…

Job Priorities, Job Policy Classes

State notifications, Actions and Triggers …

Job dependencies, Interface definitions …

Job Description

Resource Requirements

Scheduling Requirements

Job Policy Requirements

Job Lifetime Management

Workflow

Job Submission and Status Tracking

- Job Submission to Middleware（Globus Toolkit）- Supporting both WS and Pre – WS components

- Notifications on Status changes with WSN support

- Transparent Co-allocation and Co-reservation of resources through a layered, flexible architecture.

- A wide range of application profiles – Serial, Batch, Array, Parallel, Multi-Jobs and Workflows

Application / Domain Specific Features

- Canned, Extensible Workflows for Application Specific Scheduling.

- Plugin architecture for building customized domain specific workflows.

- Optimizations for known, pre-defined Communication and Storage Patterns.

Scheduling Features

- Best Available Heuristic Match of Heterogeneous resources can be seen as
  0-1 Knapsack Problem in Combinatorial Optimization

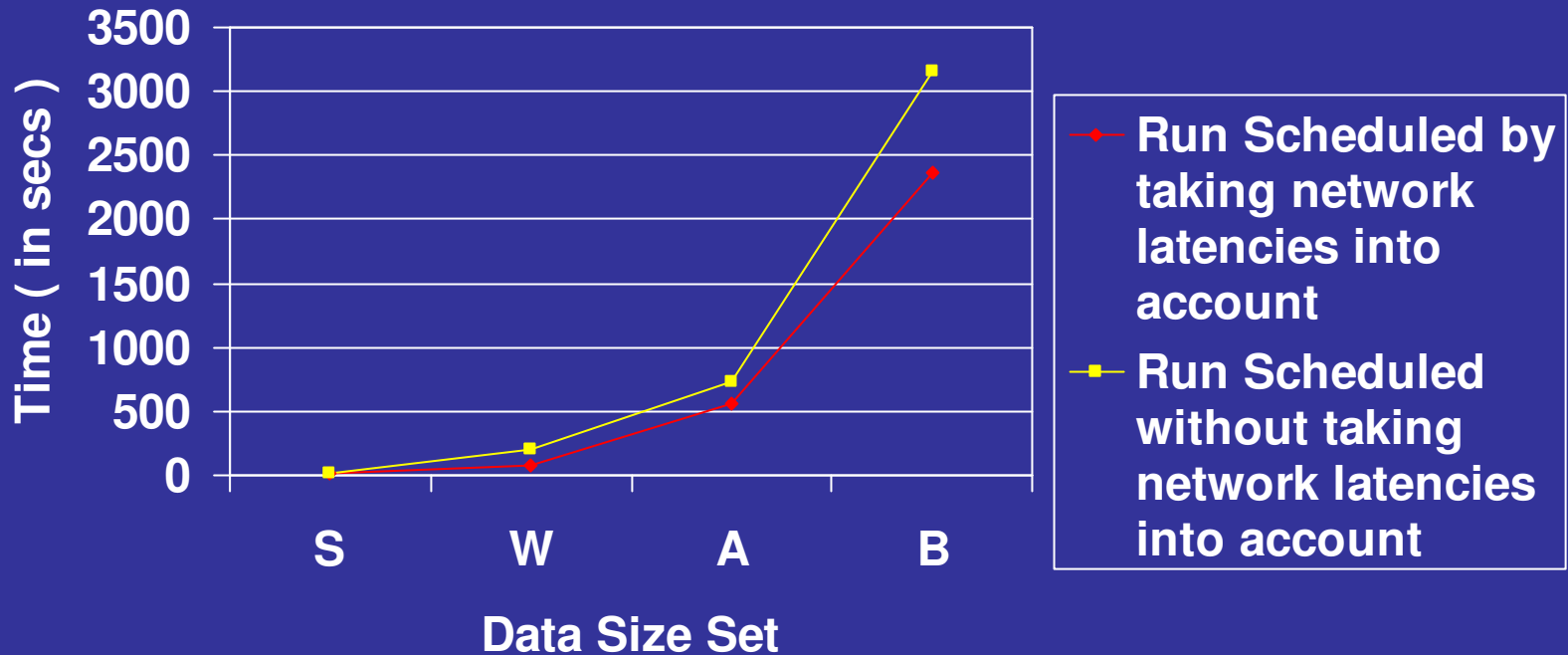 **Input description**: A set of items $S = \{1,\ldots,n\}$

  where item i has size s_i and value v_i.

  A knapsack capacity C.

  Problem description: Find the subset $S' \subset S$ that maximizes the value of $\sum_{i \in S'} v_i$ given that $\sum_{i \in S'} s_i \leq C$; i.e. all the items fit in a knapsack of size C.

Effect of including Network parameter

Turnaround time of Integer Sort Runs

Legend:
- Run Scheduled by taking network latencies into account
- Run Scheduled without taking network latencies into account

Y-axis: Time (in secs)
X-axis: Data Size Set (S, W, A, B)

Standards Compliance

- Caters to most of the GGF use cases for meta-scheduling

- Security Framework Integrates with the GSI

- Advance Reservation Services as per the GGF Recommendations

- Job description Language in line with the JSDL v1.0 specification

Other popular products in the market

- Moab – From Cluster Resources Inc.
    - Feature rich, Separate Policy Engine, Advance Reservations
    - Supports only compute resources – no network and data resources involved in making scheduling decisions

- GridWay
    - Seamless Integration with Globus, Adaptive scheduling
    - Comes only with simple greedy round robin scheduling, Trivial support for accounting/logging, Lack of Fine grained policy settings

References

- **Grid Brokers and Metaschedulers Market Overview** – Gridwisetech.com
  http://www.gridwisetech.com/content/view/110/88/lang,en/

- **Gridway – Metascheduling solutions to the grid**
  http://www.gridway.org

- **Moab – Metascheduler**
  www.clusterresources.com/products/mwm

Thank you!