Workflow Integrated Network Resource Orchestration

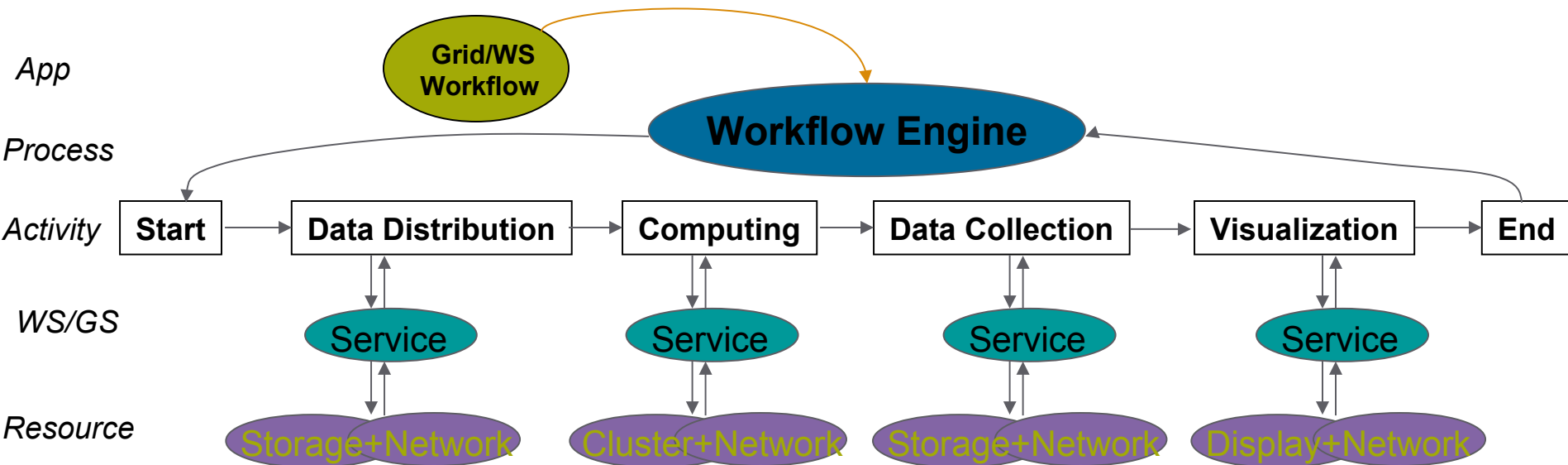# Agenda

> WS Workflows and Challenges

> WINNER

> Featured Solutions

> Related Work

> Summary

WS Workflows

> ## WS boosts up new opportunity of business development
  - Web Services (WS): service providers to customers
  - WS is interoperable and trustable among business partners
  - WS increases productivity by component service development and reduces cost by sharing services and avoiding function duplications
  - New opportunity for WS providers, publishers, applications and …
  - Globus is offering WSRF, as GT4 comes

> ## Workflow defines the automation of a business process
  - Streamlines the application job: WS and Grids
  - Evolves from object-oriented programming (OOP) to service-oriented architecture (SOA)
  - New support for WS: BPEL4WS, for Grid: GSFL

> ## Workflow has a bandwagon of applications
  - E-commercial: B2B, financial brokerage, travel planning
  - Enterprise: concurrent design, data center, human resources
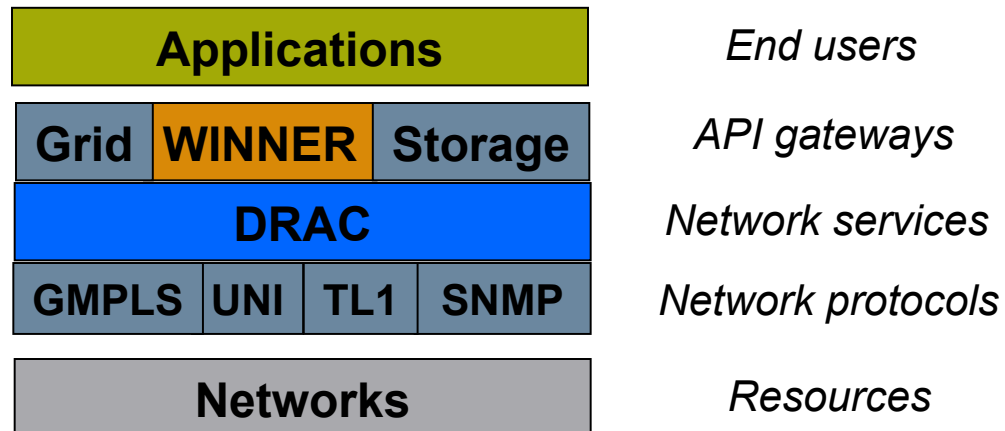 - E-Science: Grid computing, hi-energy computation

Challenges

> WS Workflows brings many new challenges
  - Business workflows streamline to network-wide collaboration
  - Grids/WS services and resources become workflow-aware

> Challenges on Network resources → our target
  - Pervasive resources share with service collaborations
  - Supply of services and resources may vary
  - Workflows may demand different levels of resources
  - Resource requirements move up or down as the workflow goes

App

Grid/WS Workflow

Process

Workflow Engine

Activity   Start → Data Distribution → Computing → Data Collection → Visualization → End

WS/GS   Service   Service   Service   Service

Resource   Storage+Network   Cluster+Network   Storage+Network   Display+Network

WINNER

Workflow INtegrated NEtwork Resource orchestration

> Orchestrates network resources to serve workflows
  - Introduces new workflow process to applications
  - Provides workflow process services
  - Employs resource services to obtain network resources
  - Resource allocations and updates in time

> Extend the workflow arm of DRAC
  - DRAC is the Nortel product "Dynamic Resource Allocation Controller" in networks
  - WINNER is the workflow gateway between apps and DRAC

Applications			End users
Grid	WINNER	Storage	API gateways
DRAC			Network services
GMPLS / UNI / TL1 / SNMP			Network protocols
Networks			Resources

# WINNER Components

> ## WINNER Process
  - Defines the business activities specific on network resources
  - Is used by app, with associated business processes

> ## WINNER Process services
  - Realize the resource operations of the WINNER process
  - Support the workflow processing of network resources

> ## WINNER Resource services
  - Perform the allocation of network resources
  - Update the status of network resources
 - Work closely with DRAC
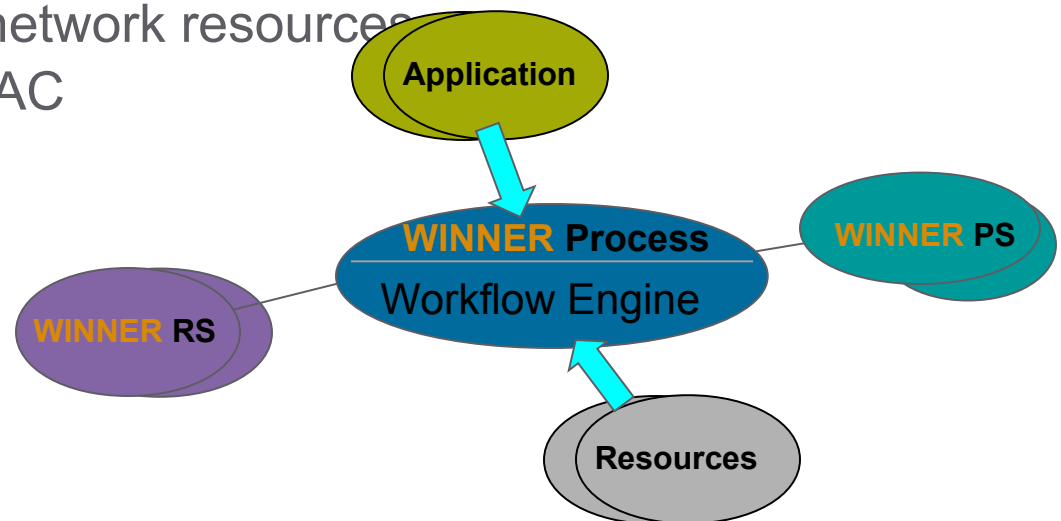
WINNER Process: activity samples

Interface to the Workflow Applications

> Application registration
  - Unique identification of each application
  - Classification of resource workflows

> Resource Job
  - Resource specification
  - Resource allocation
  - Resource re-allocation
  - Resource release

> Query
  - Network resources: available, status
  - Resource workflows
  - Resource negotiation, when applicable

> Misc
  - Account billing
  - authorization, and security enhancement

DRAC: Dynamic Resource Allocation Controller
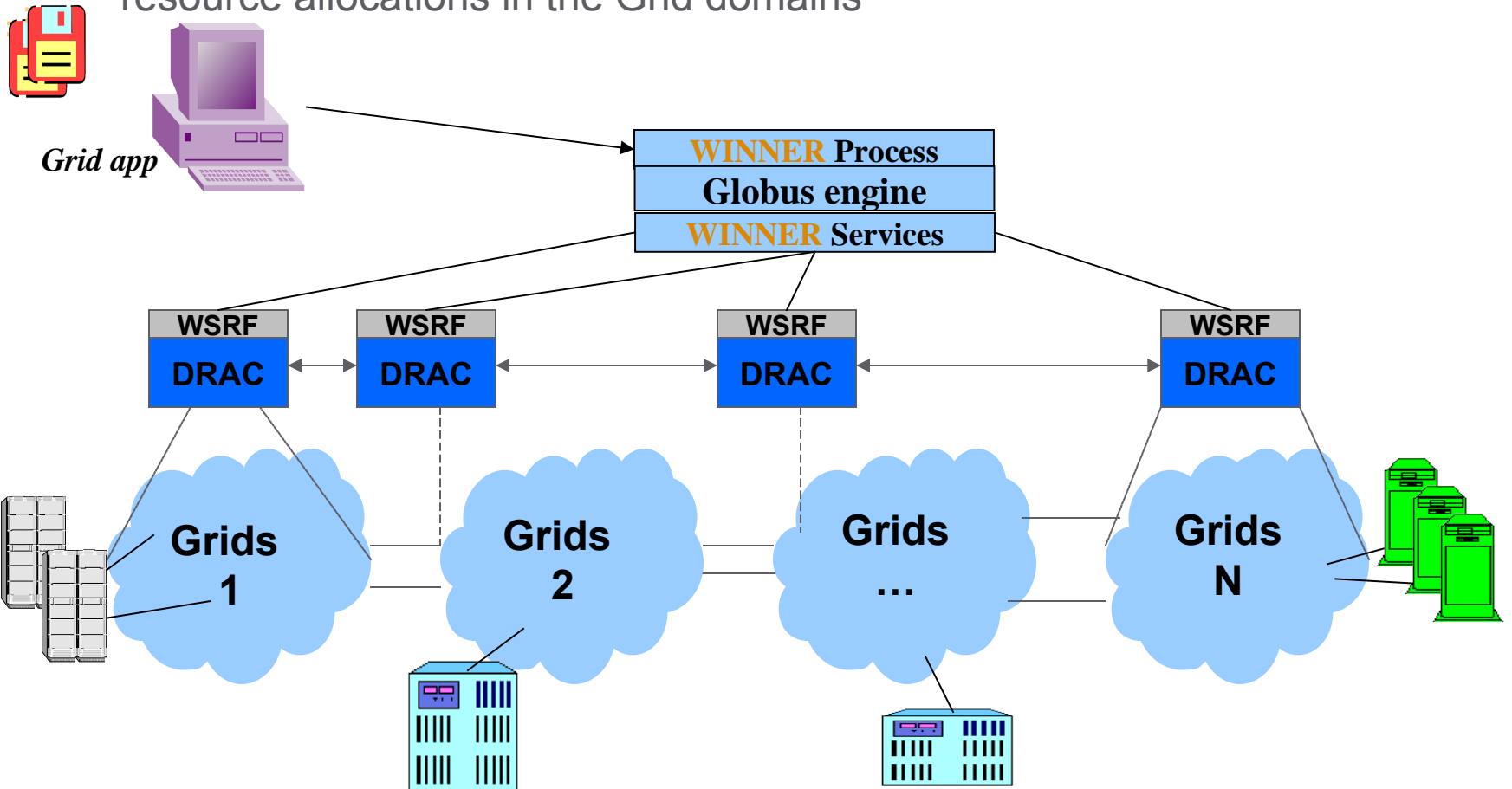## WINNER is the Workflow Arm of DRAC

> Resource discovery
- Available physical resources in network domains
- Available network services in network domains
- Resource property, status and updates

> Resource Utilization
- Resource reservation and scheduling
- Resource allocation and release
- Job status and feedback

> Resource management
- Resource collection and abstraction
- Network configuration and control
- Security and AAA

> Application-aware smarts on resources
- Multiple API gateways: Grid, workflow, storage
- Resource policy, SLA
- Resource optimization
- Resource monitor and performance

WINNER

Workflow

GPAN

Grid

DRAC

Storage

EvaQ8

Health

WEN
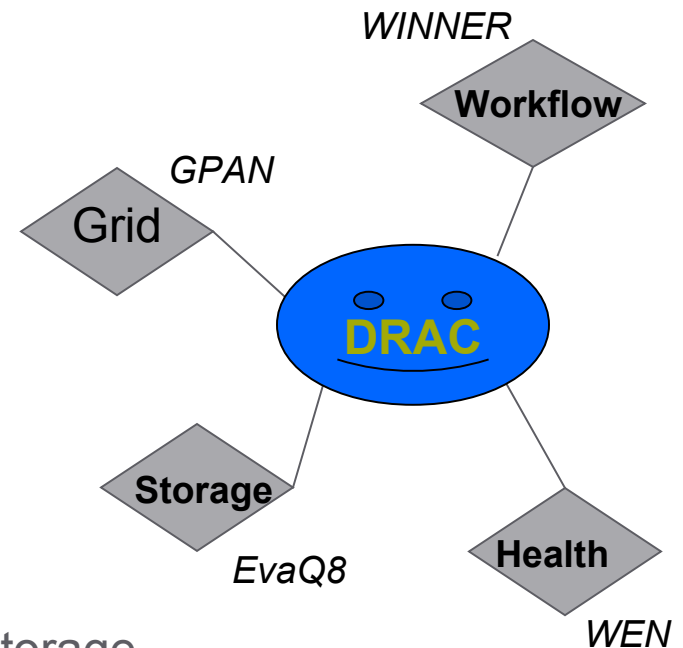
WINNER and Grids Workflows

> WINNER supports Grid apps with Grid workflow engine
- WINNER Process provides the workflow interface to Grids apps
- WINNER service (PS) provides workflow processing of network resources
- WINNER service (RS) works with the DRAC Grid (GPAN) to perform network resource allocations in the Grid domains

Grid app

| WINNER Process |
| Globus engine |
| WINNER Services |

| WSRF | | WSRF | | WSRF | | WSRF |
| DRAC | ↔ | DRAC | ↔ | DRAC | ↔ | DRAC |

Grids 1   **Grids 2**   **Grids …**   **Grids N**
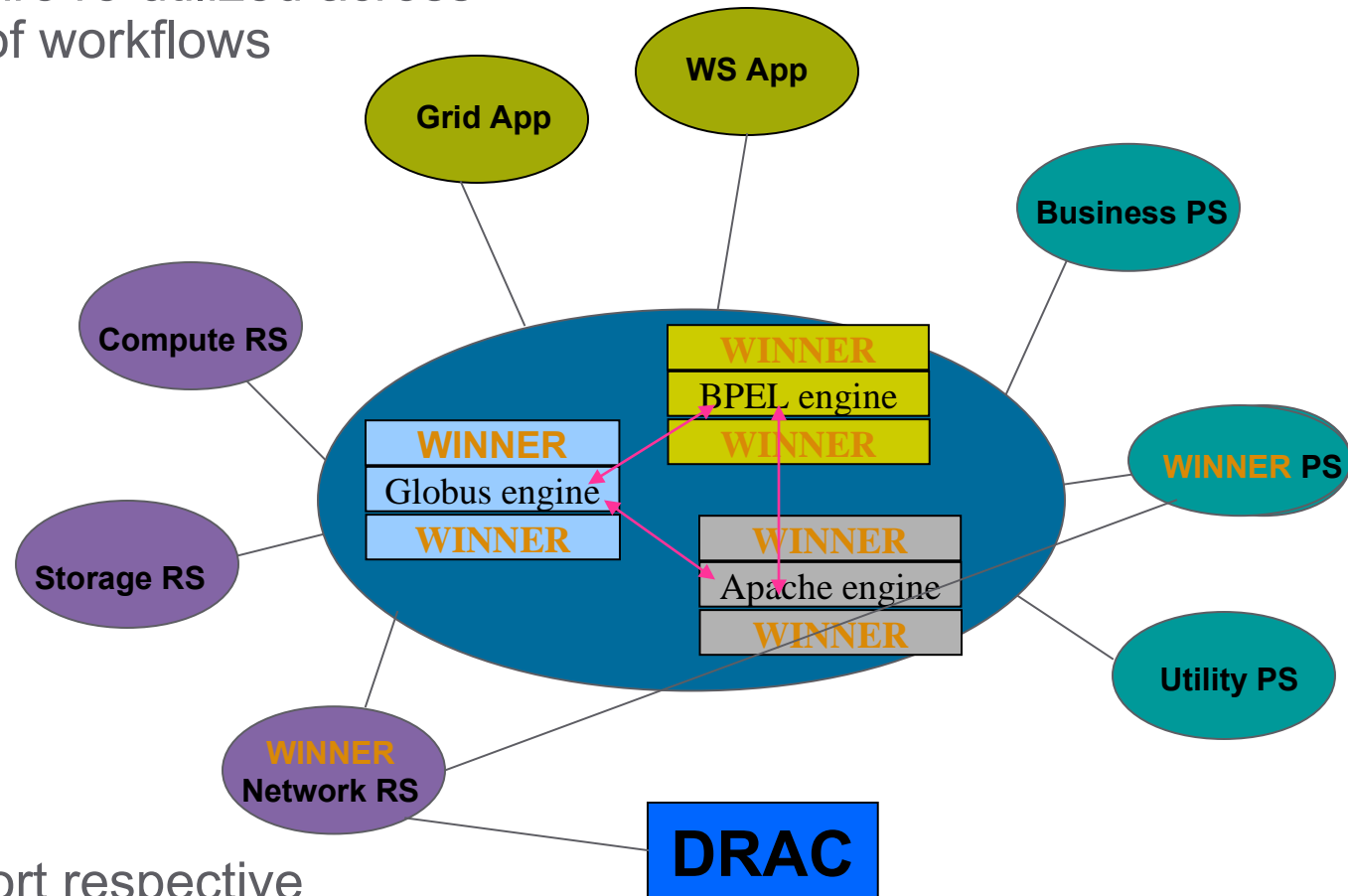
WINNER, Grids and WS Workflows

> WS Workflow applications take advantages of Grids
- WS engine provides the WINNER process to WS apps
- Grids engine provides Grids services to WS app through WINNER services
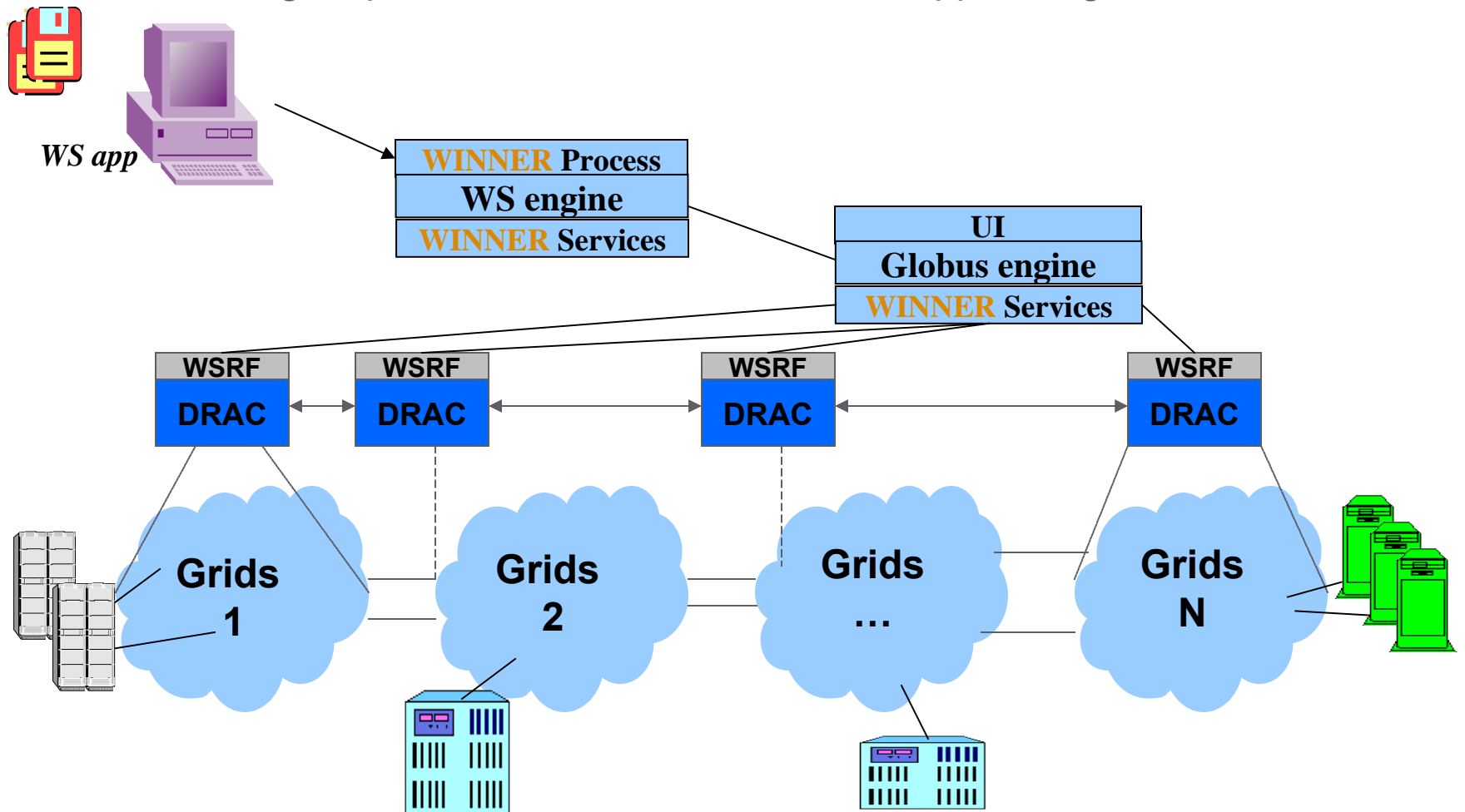
WINNER and Multiple Workflows

> Web Services are re-utilized across multiple types of workflows
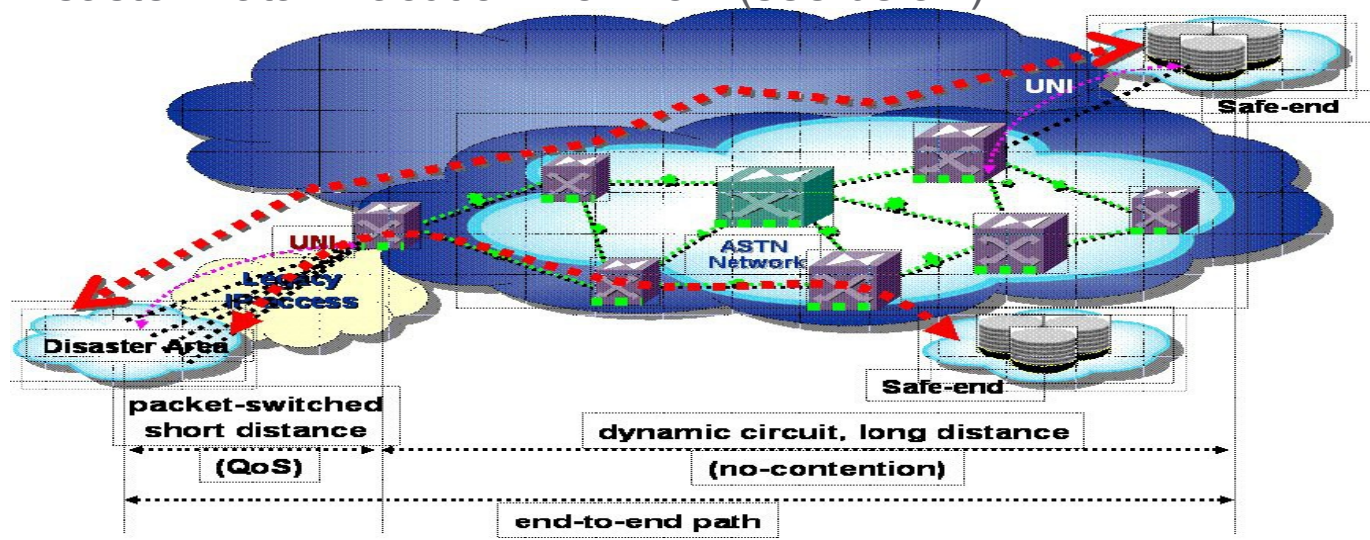 - GT4: WSRF
  - BPEL4WS
  - Apache WS

> WINNER support respective workflow service engines
  - WINNER services widely shared

Grid App

WS App

Business PS

Compute RS

WINNER
BPEL engine
WINNER

WINNER
Globus engine
WINNER

WINNER PS

WINNER
Apache engine
WINNER

Storage RS

WINNER
Network RS

Utility PS

DRAC

WINNER and Late-Binding

> Late binding resources with workflows happen when
  - Workflow services and/or resources supply change
  - Workflows compete or optimize for resources
  - Workflows have special or uncertain requirements of resources

> WINNER performs workflow-aware late-binding, through DRC
  - Network resources selections or alternations according to applications
  - Resource optimization such as switching among workflows
  - Service site selections or alternations, together with service providers

> Typical usecases
  - Workflow Engaged Networks for Radiology in Metro Regions
  - Disaster Data Evacuation workflow (see below)

Related Work

> BPEL4WS

> GridFlow: the SDRC Matrix
- http://www.npaci.edu/dice/srb/matrix/

> GSFL and GridAnt
- http://www-unix.globus.org/cog/projects/workflow/

> Pegasus and vGRADS
- http://www.globus.org/about/events/sc2004/demos.html

> GWFE
- http://www.gridbus.org/workflow/

Summary

> WINNER integrates network resources with WS workflows
- Provides WINNER processes, process services and resource services
- Workflow-aware network resource allocations

> DRAC network services are leveraged for allocation and information on network resource orchestration

> Late-binding gives the capability to supply network resources in favor of application workflows

> WINNER fits with Grids, Web Services, and other workflow applications
- WS workflows can take advantages of Grids

Workflow Integrated Network Resource Orchestration

Questions and Comments ?