Workflow Integrated Network Resource Orchestration

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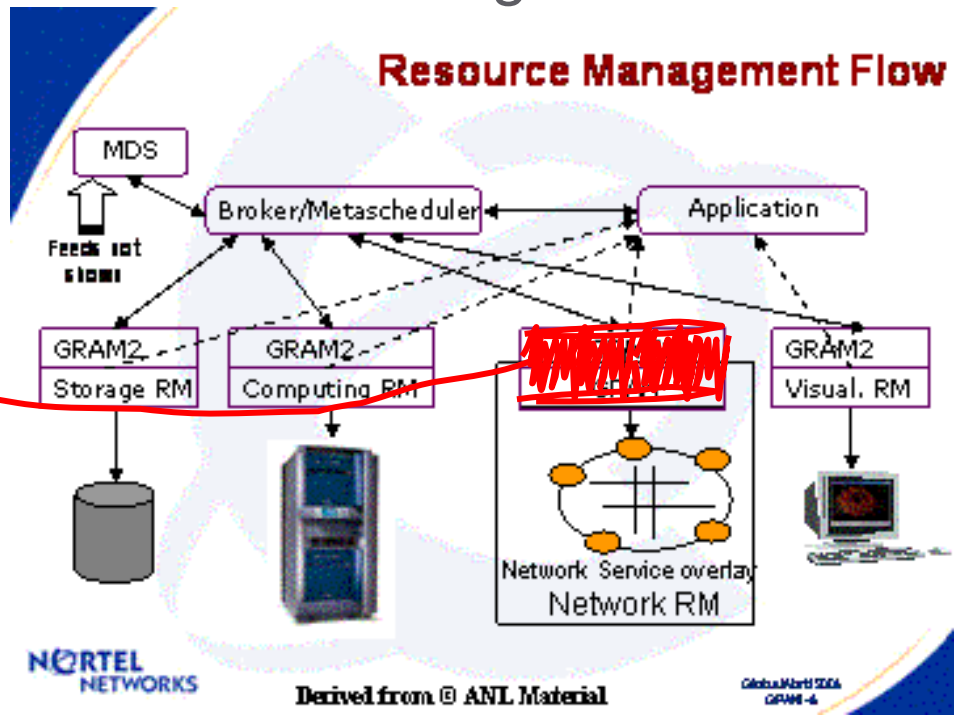
Agenda

- WS Workflows and Challenges
- WINNER
- Featured Solutions
- Related Work
- Summary

Propel Network Resources into the Grid Universe

> 1st Generation: Network Resources Mgmt for Grids
  - Demo-ed at GW04



Branded as "DRAC"
www.nortel.com/DRAC

> 2nd Generation: Secure Multi-Domain Brokering
  - Demo-ed at Supercomputing 2004

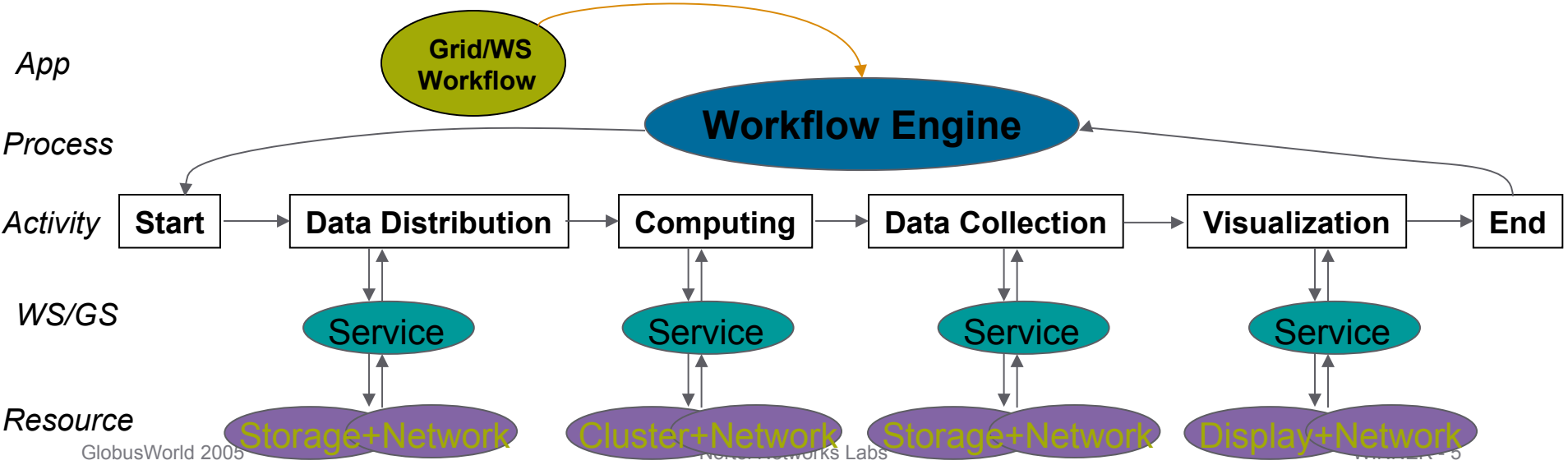
> 3rd Generation: Intercept the WS Workflow Curve (Today)

WS Workflows

- Web Services (WS) boost opportunities for business development
- Workflow defines the automation of a business process
  - With new SOA solutions, for WS: BPEL4WS, for Grid: GSFL
  - Streamlines application jobs in terms of WS and Grids activities
- Workflow has a host of applications
  - eCommerce: B2B, financial brokerage, travel planning
  - Enterprise: concurrent design, data center, human resources
  - eScience: computing, data, visualization, sensor Grids

Challenges

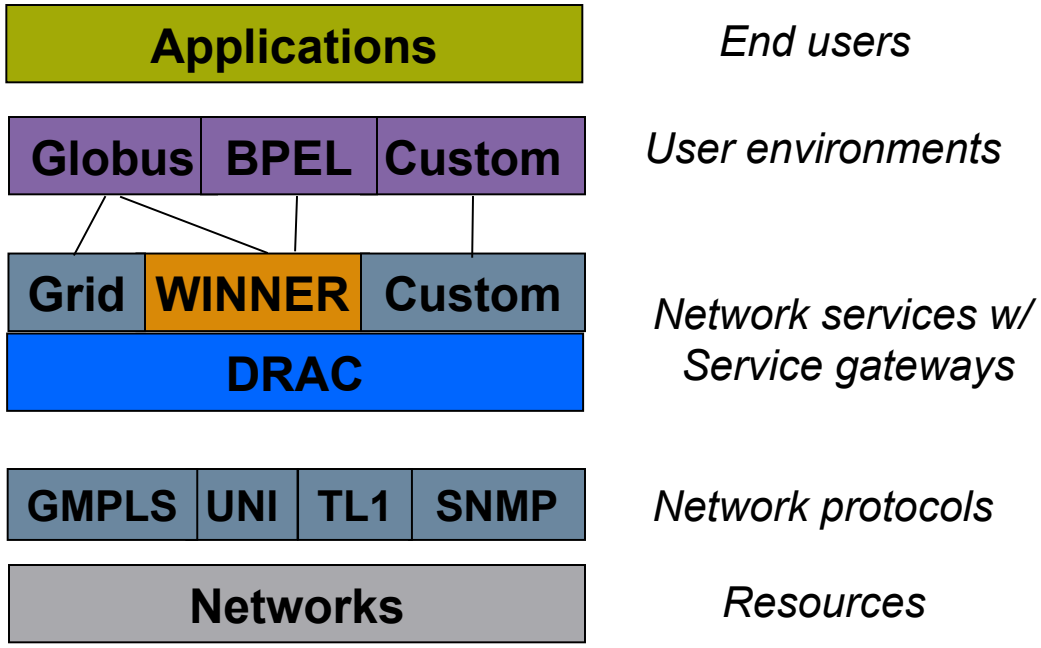
- > WS Workflows bring new challenges
  - Business workflows streamline to network-wide collaboration
  - Grids/WS services and resources become workflow-aware
- > Challenges on Network resources → our target
  - Pervasive resources sharing
  - Supply of services and resources may vary on conditions
  - Each workflow may demand a different level of resources
  - Resource requirements change as the workflow goes



WINNER

Workflow INtegrated NEtwork Resource orchestration

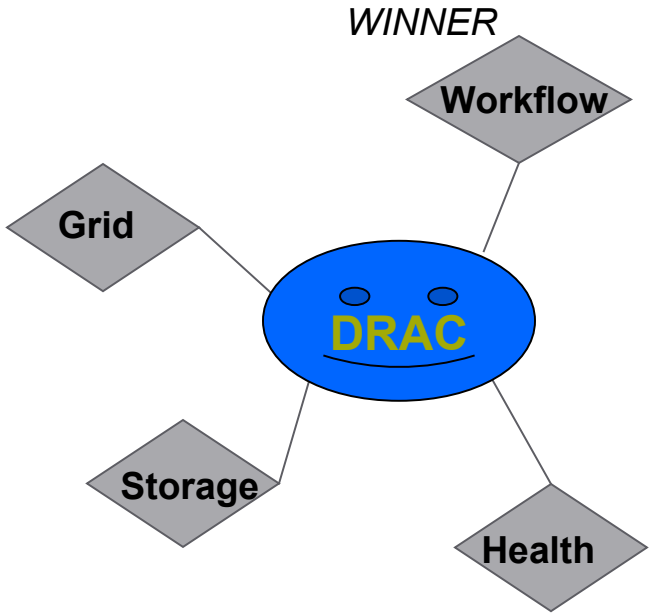
> Orchestrates network resources in harmonization with workflows
  - Enhances business processes with resource extensions
  - Employs network services to perform resource operations



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 properties, status and updates
- Resource Utilization
  - Resource collection and abstraction
  - Resource reservation and scheduling
  - Job status and feedback
- Resource management
  - Resource allocation and release
  - Network configuration and control
  - Security and AAA
- Application-aware smarts on resources
  - Multiple service gateways: Grid, workflow, storage
  - Resource policy, SLA
  - Resource optimization
  - Resource monitor and performance

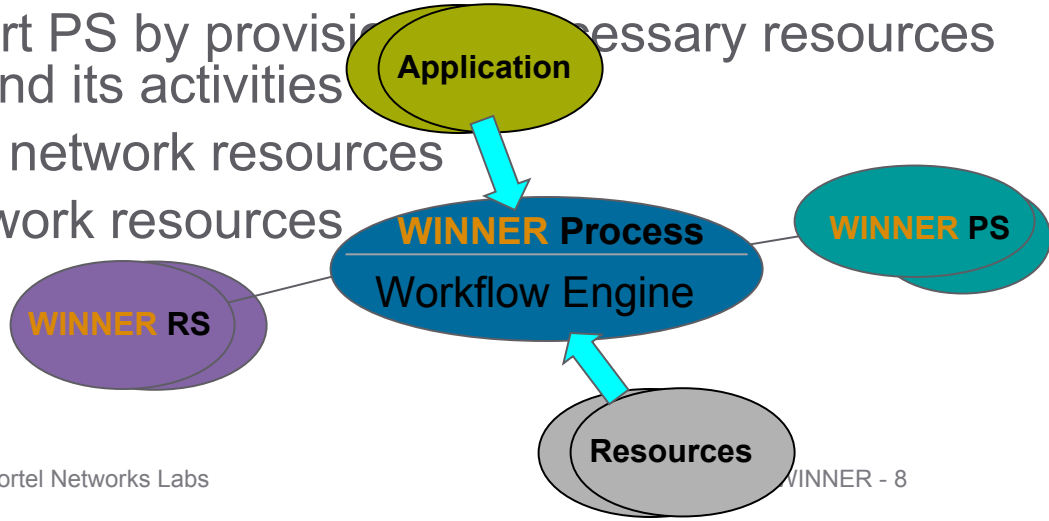


WINNER and Workflow Engine

> WINNER Process
  - Defines the workflow activities specific on network resources
  - Acts in either standalone or extension to a legacy process
  - Invocated from apps, and related business services

> WINNER Process services (PS)
  - Web services that provide the activities of the business process
  - Realize the resource operations of the WINNER process
  - Support the workflow processing of network resources

> WINNER Resource services (RS)
  - Web services that support PS by provisi[illegible]essary resources to conduct the process and its activities
  - Perform the allocation of network resources
  - Update the status of network resources
  - Work closely with DRAC



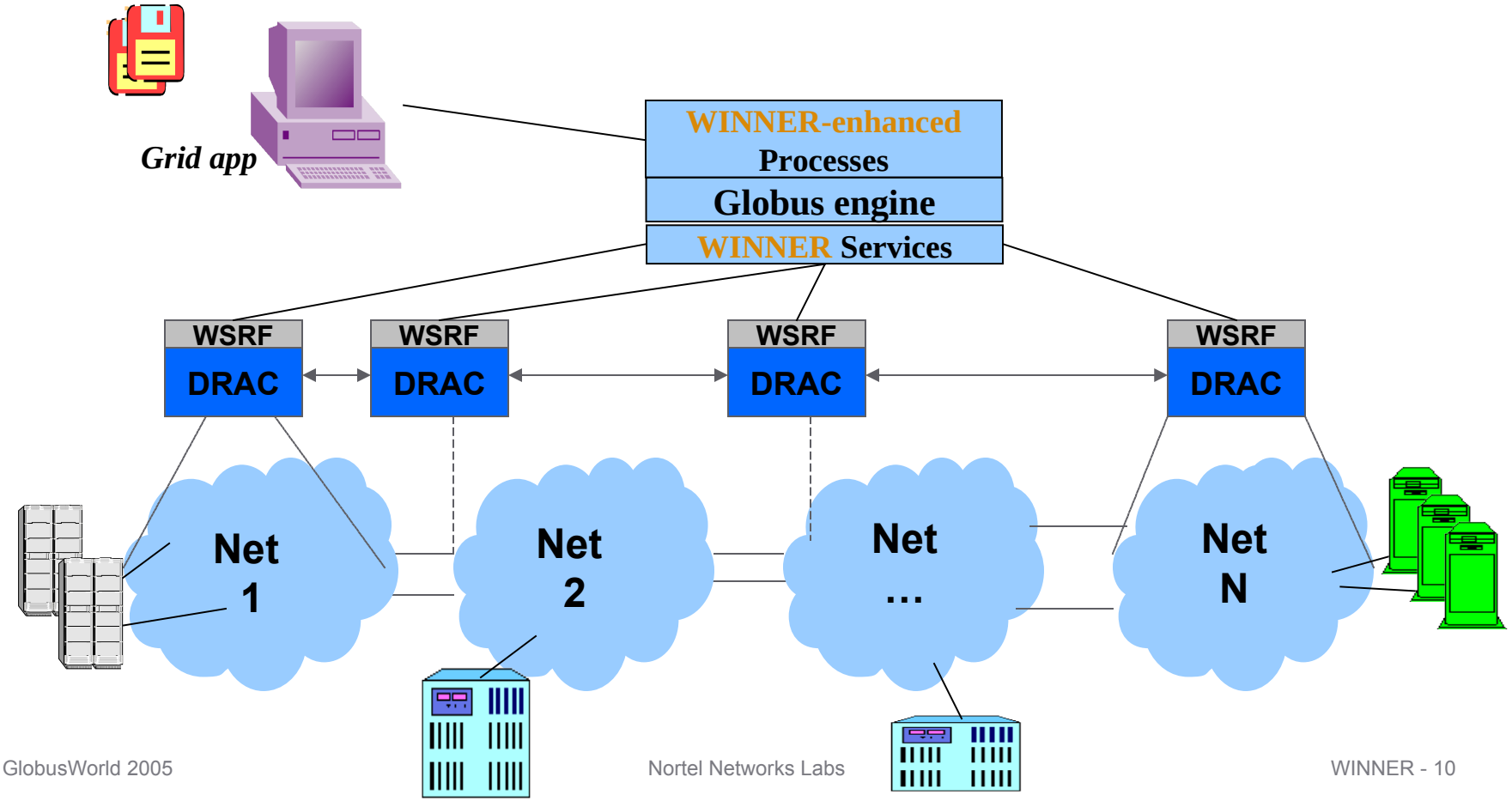
WINNER Process: activity samples

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
  - Resource workflows
  - Resource negotiation, when applicable
- Misc
  - Account billing
  - Authorization, and security enhancement
  - Exceptions, status check, and error handling

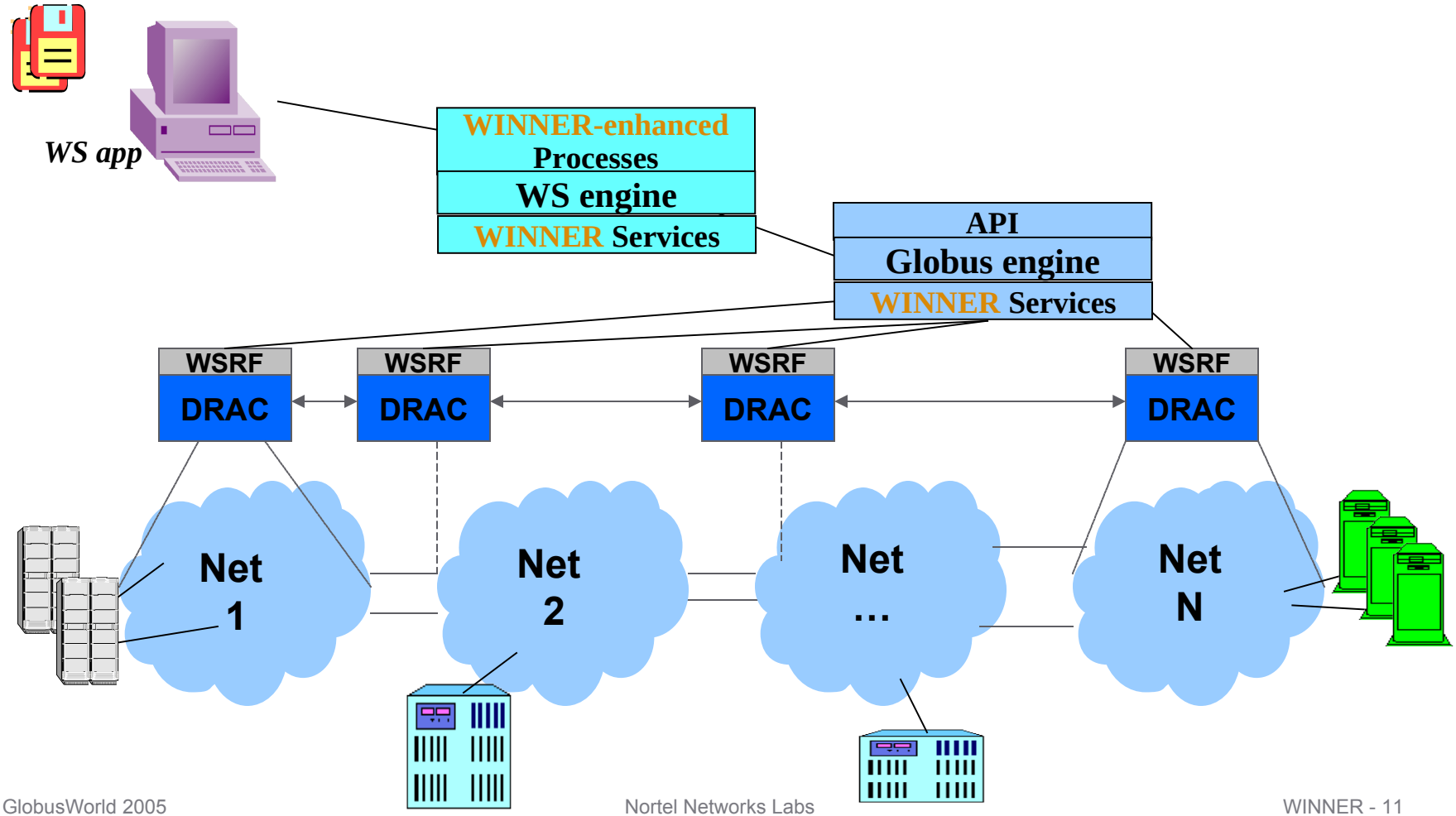
WINNER and Grids Workflows

> WINNER supports Grid infrastructures with a Grid workflow engine
  - WINNER enhances the Grid workflow processes with resource activities
  - WINNER Services interact with DRAC to perform network resource allocations in the Grid domains



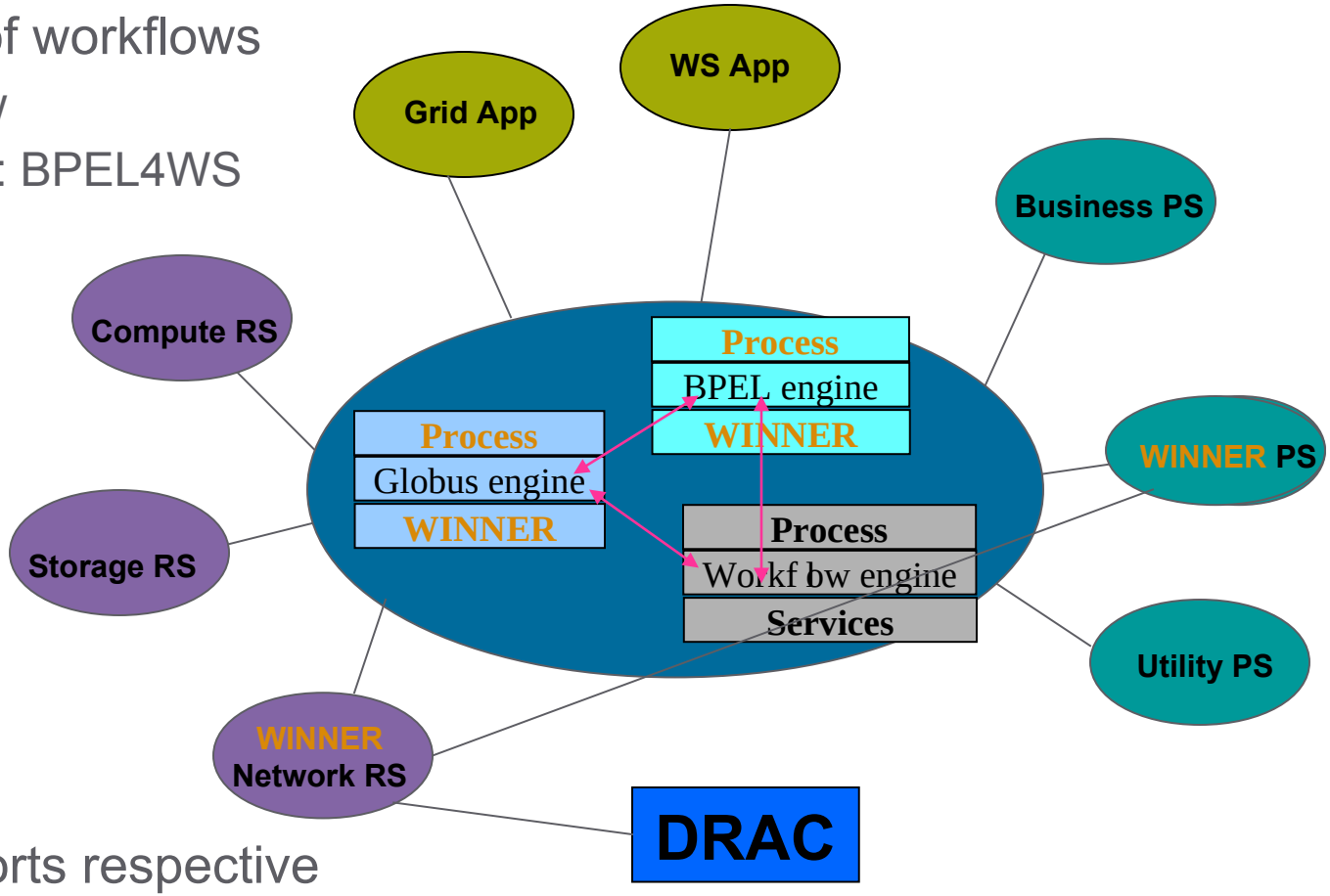
WINNER, Grids and WS Workflows

> WS Workflow applications take advantages of Grids
  - WS engine provides the WINNER enhanced business processes to WS apps
  - Grids engine provides Grids services to WS apps through WINNER services



WINNER and Multiple Workflows

> Web Services are re-utilized across multiple types of workflows
  - Grid workflow
  - WS workflow: BPEL4WS
  - Others



> WINNER supports respective workflow engines
  - WINNER services widely shared

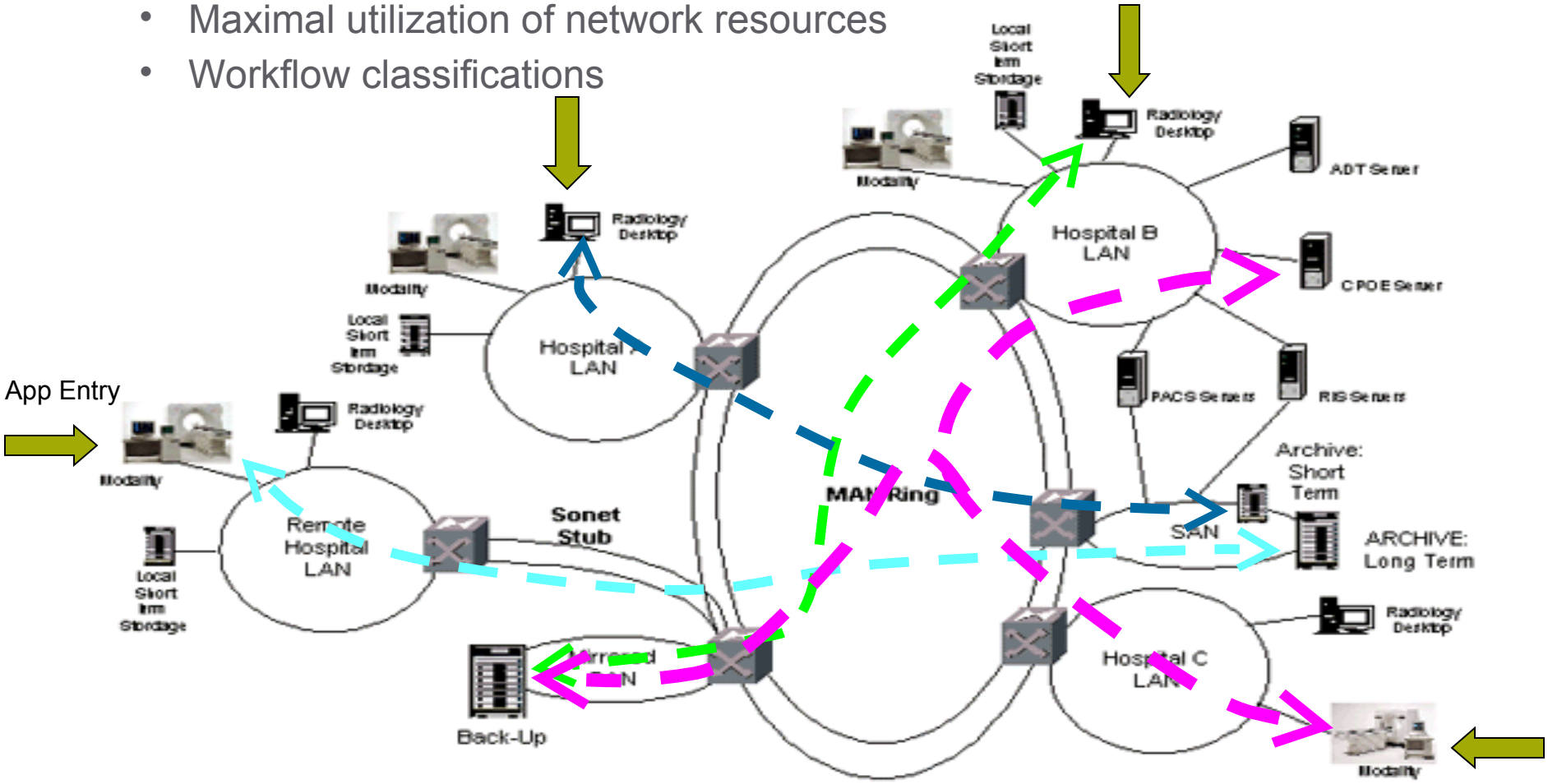
PS = Process Service
RS = Resource Service

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 for resources
- WINNER performs workflow-aware late-binding, through DRAC
  - Network resource selections or alternations according to applications
  - Resource optimization among workflows
  - Service site selections or alternations, together with service providers

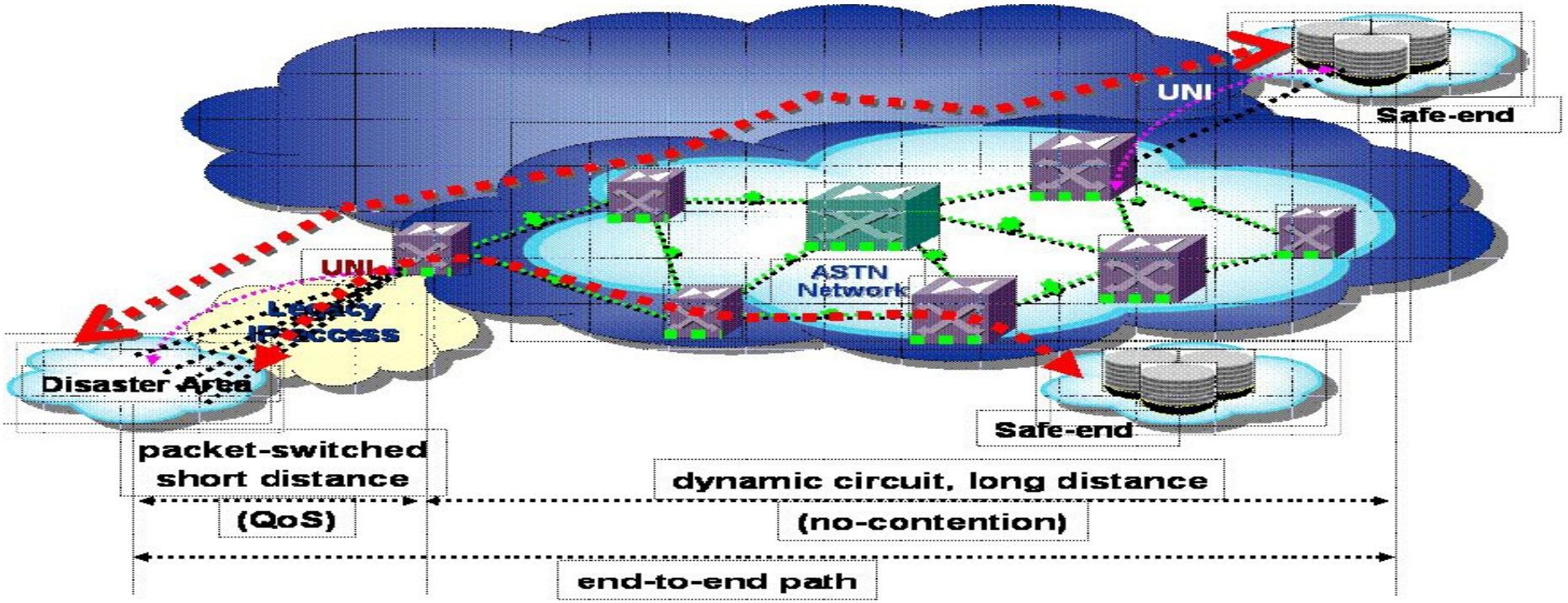
Use Case: Workflow Engaged Networks for Radiology in Metro Regions

- Workflows of radiology data transporting and medical processing
  - Application-aware network resource allocations
  - Dynamic adjustments of network resources and workflow priorities
  - Maximal utilization of network resources
  - Workflow classifications



Use Case: Disaster Recovery

- Workflows of data evacuation and restoration in a disaster area
  - Critical Live Data pointing to survivors and their whereabouts
  - Sensor data showing distress in architectural structures and environment
- Orchestrates network resources for orderly, max-yield workflows
  - Sensor-triggered workflow automation without any operator involvement
  - End-to-end, secure, across the agile network infrastructure
  - Policy-driving resource allocation and its preemptive usage



Related Work

- WSBPEL or BPEL4WS: the OASIS effort
  - http://www.oasis-open.org
- GridFlow/SDRC Matrix: a peer-to- peer infrastructure for Grid Workflow Management Systems
  - http://www.npaci.edu/dice/srb/matrix/
- GSFL and GridAnt: Globus workflow effort
  - http://www-unix.globus.org/cog/projects/workflow/
- Pegasus: mapping of complex scientific workflows onto the grid
  - http://pegasus.isi.edu/pegasus/main.htm
- GWFE: execute their workflow applications on Grids
  - http://www.gridbus.org/workflow/: Globus 2.4
- Taverna: a language and software tools for eScience
  - http://taverna.sourceforge.net/

Summary

- WINNER integrates network resources with WS workflows
  - WINNER processes, process services and resource services
  - Workflow-aware network resource orchestration
- DRAC network services are leveraged for allocation and information in network resource orchestration
- Late-binding gives the adaptability to orchestrate network resources in favor of workflows' needs
- WINNER fits with Grids, Web Services, and other workflow applications
  - Enhances business processes with resource extensions
  - WS workflows can take advantages of Grids
- Two use-cases show the workflow benefits in medical and disaster applications

Workflow Integrated Network Resource Orchestration

Questions and Comments ?