



# Workflow Integrated Network Resource Orchestration

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# Agenda



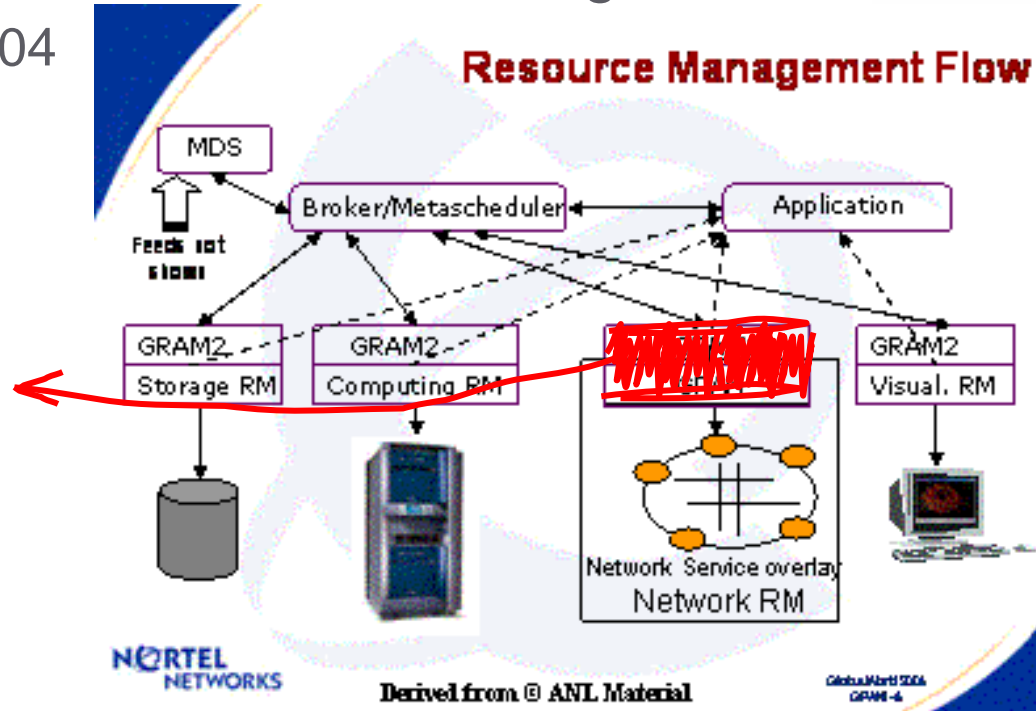
- > WS Workflows and Challenges
- > WINNER
- > Featured Solutions
- > Related Work
- > Summary

# Propel Network Resources into the Grid Universe



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

Branded as "DRAC"  
[www.nortel.com/DRAC](http://www.nortel.com/DRAC)



- > 2nd Generation: Secure Multi-Domain Brokering
  - Demo-ed at Supercomputing 2004
- > 3<sup>rd</sup> Generation: Intercept the WS Workflow Curve (Today)



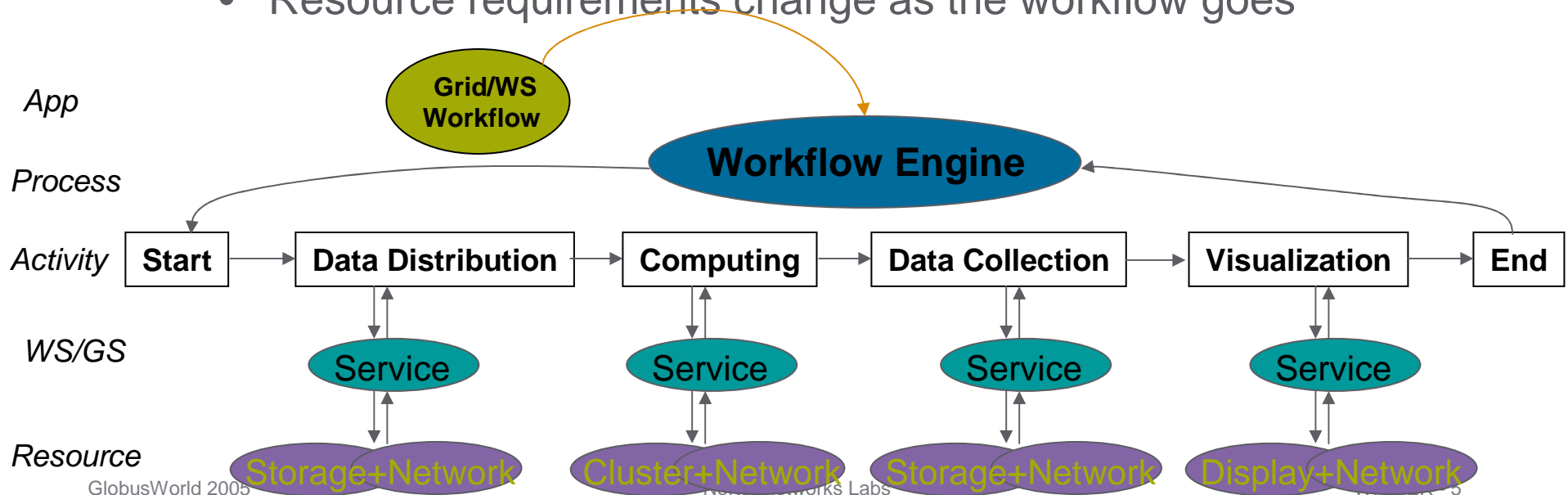
# WS Workflows

- > 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

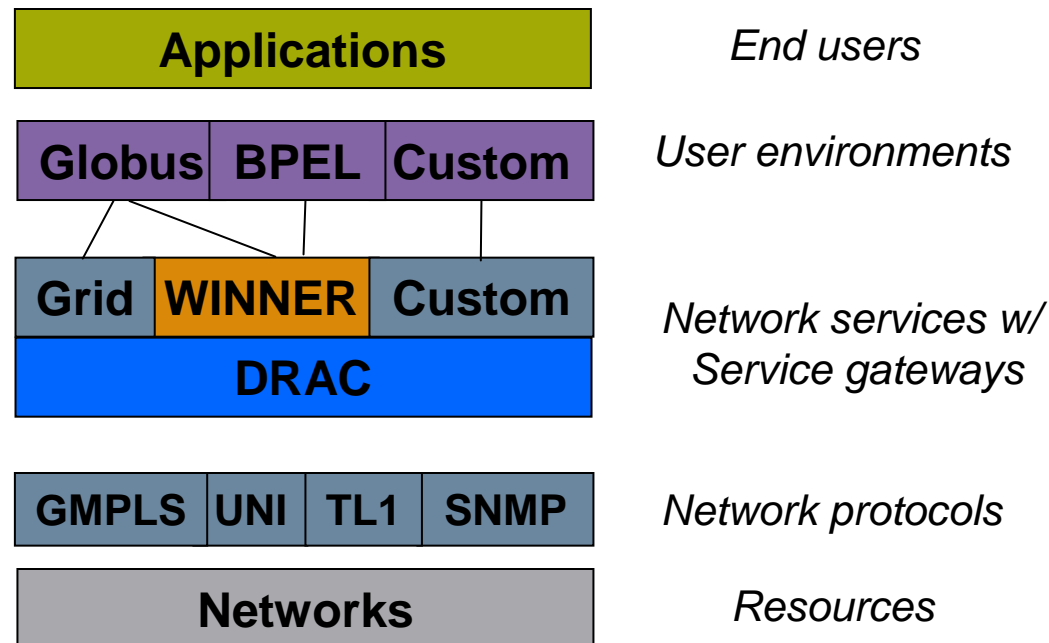




# WINNER

## 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

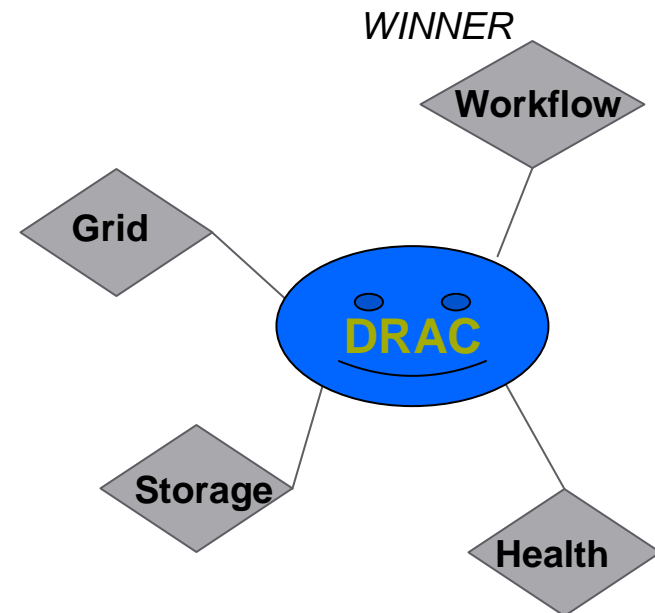




# DRAC: Dynamic Resource Allocation Controller

## 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

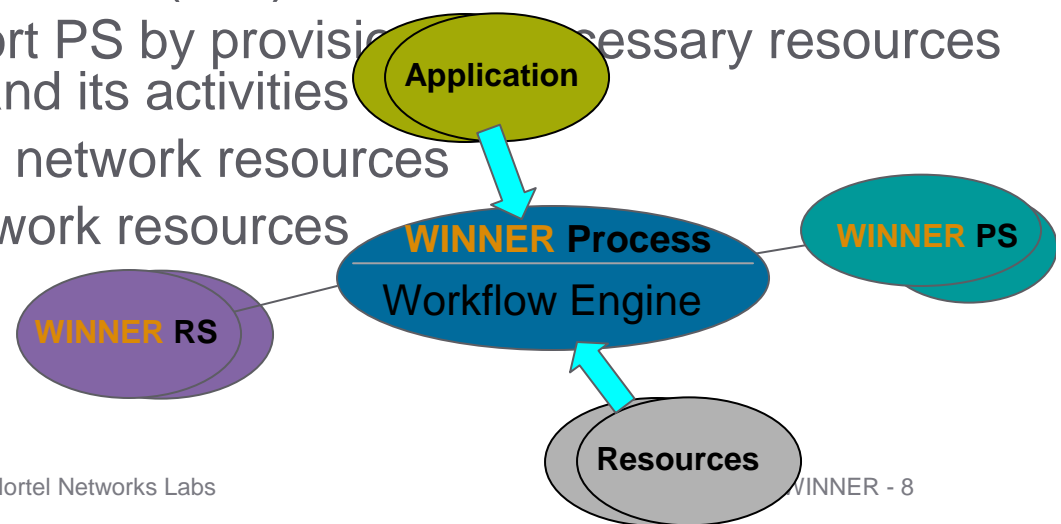
- Defines the workflow activities specific on network resources
- Acts in either standalone or extension to a legacy process
- Invocated from apps, and related business services

## > 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 providing necessary resources to conduct the process and its activities
- Perform the allocation of network resources
- Update the status of network resources
- Work closely with DRAC







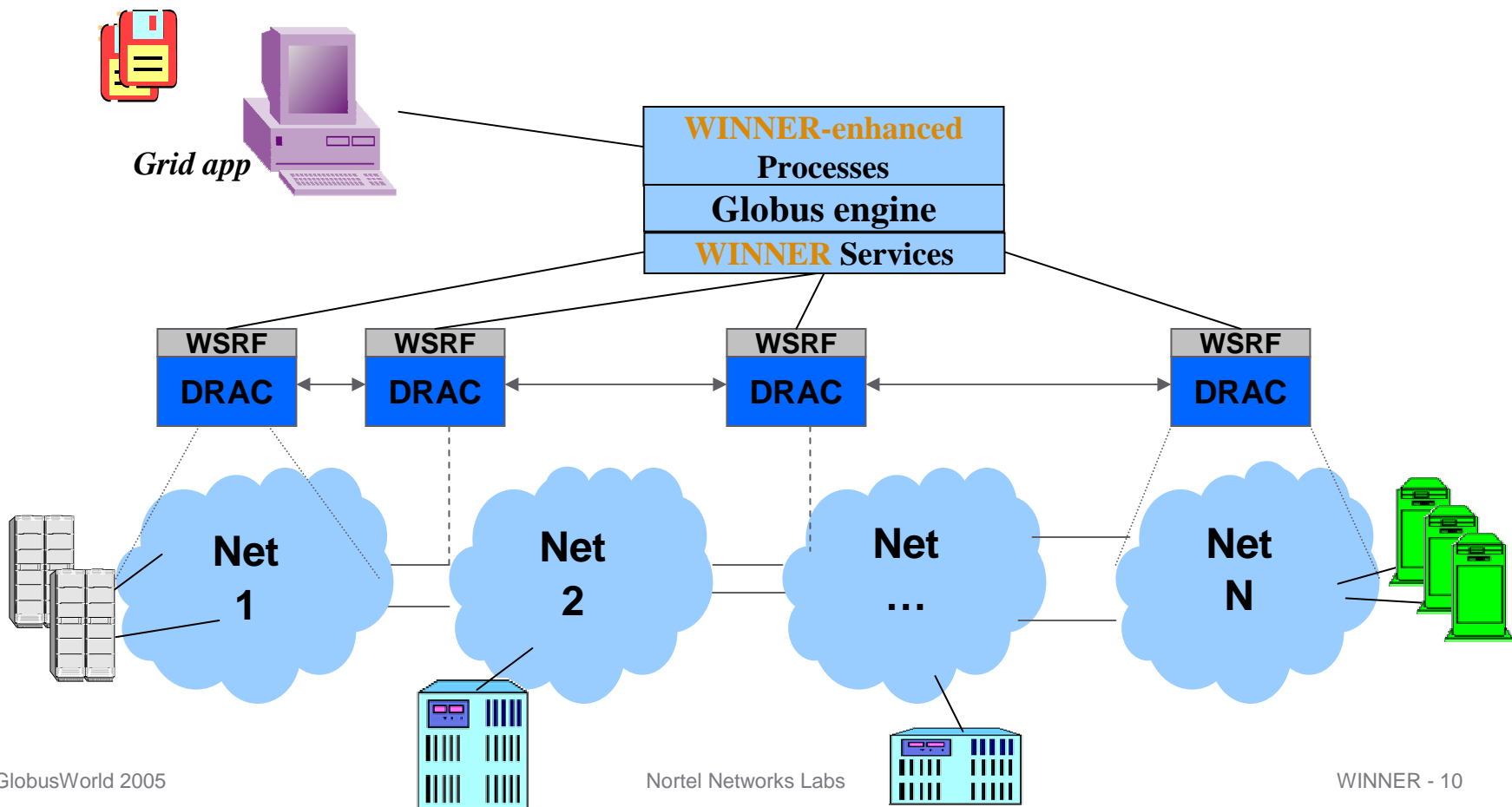
# WINNER Process: activity samples

## 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

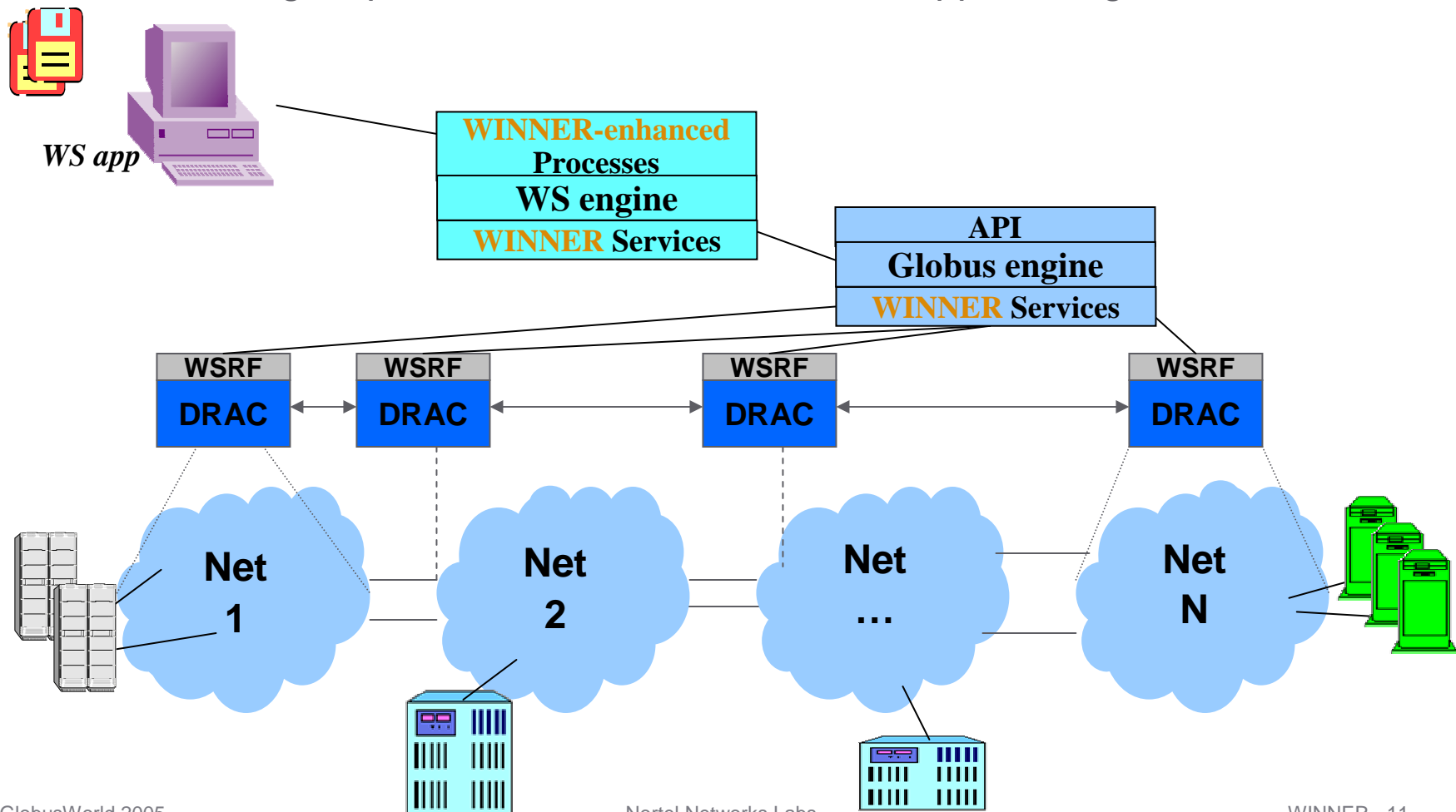
- > WINNER supports Grid infrastructures with a Grid workflow engine
  - WINNER enhances the Grid workflow processes with resource activities
  - WINNER Services interact with DRAC to perform network resource allocations in the Grid domains



# WINNER, Grids and WS Workflows



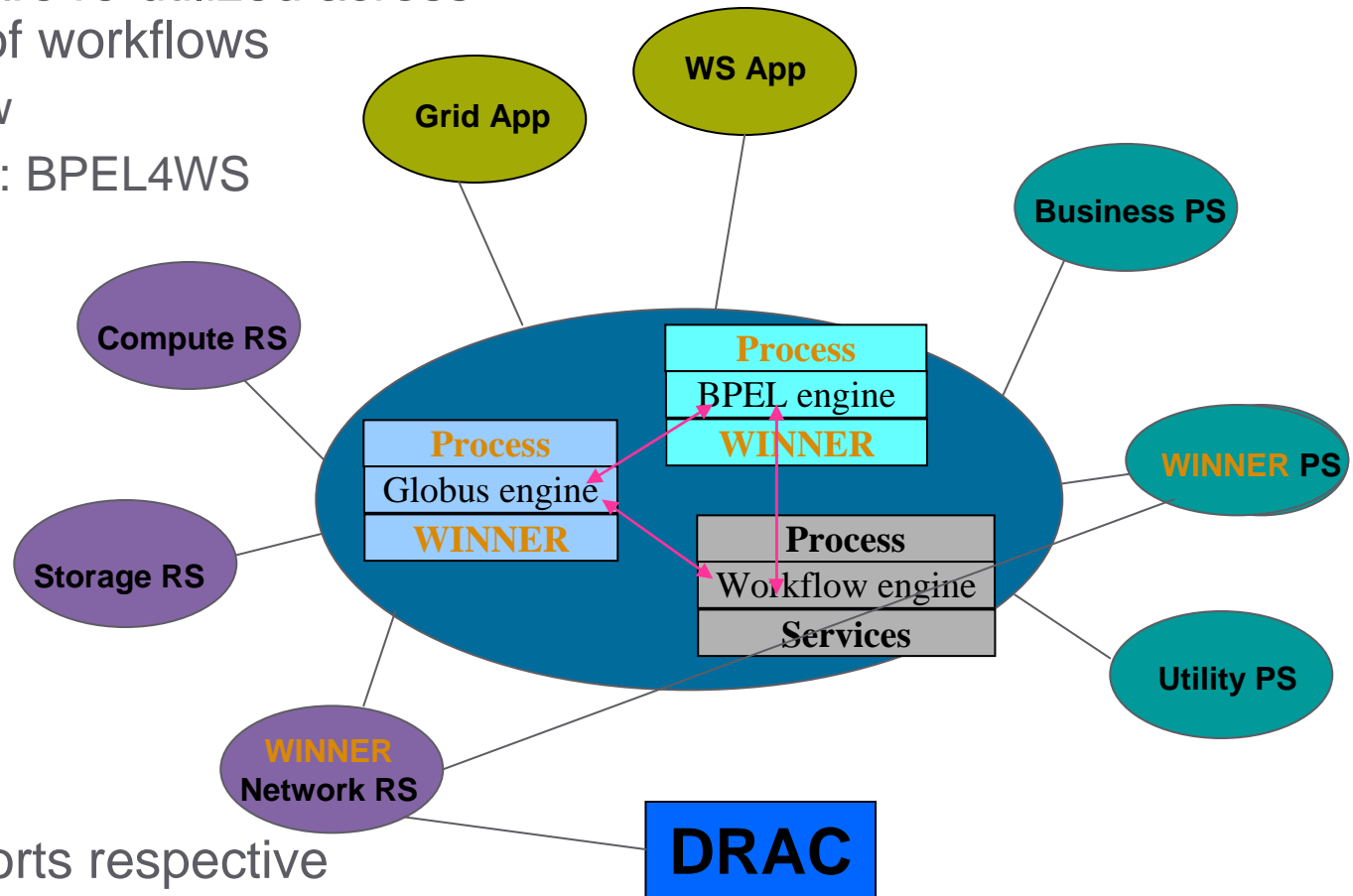
- > WS Workflow applications take advantages of Grids
  - WS engine provides the WINNER enhanced business processes to WS apps
  - Grids engine provides Grids services to WS apps through WINNER services





# 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**

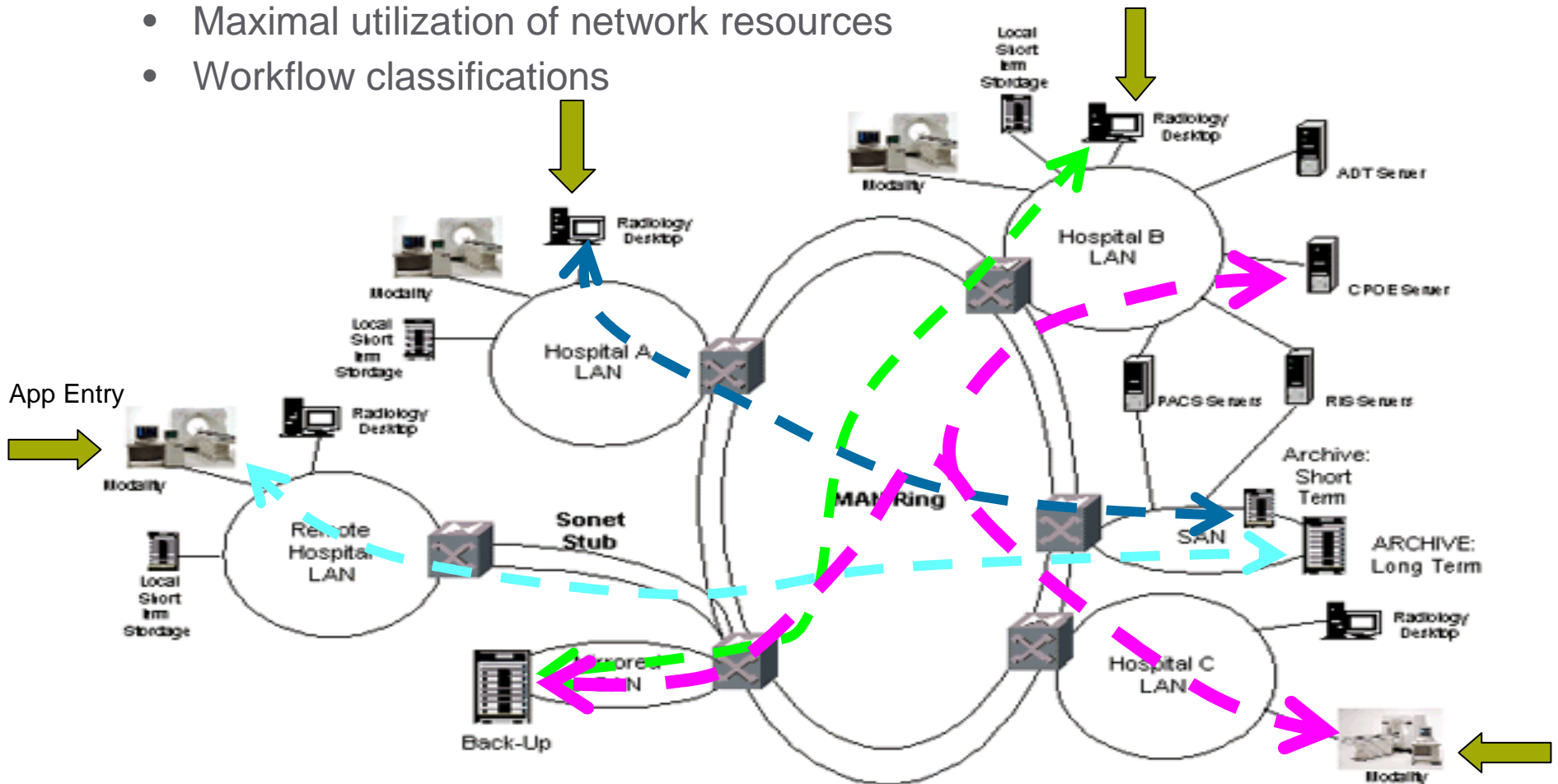
# WINNER and Late-Binding



- > 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

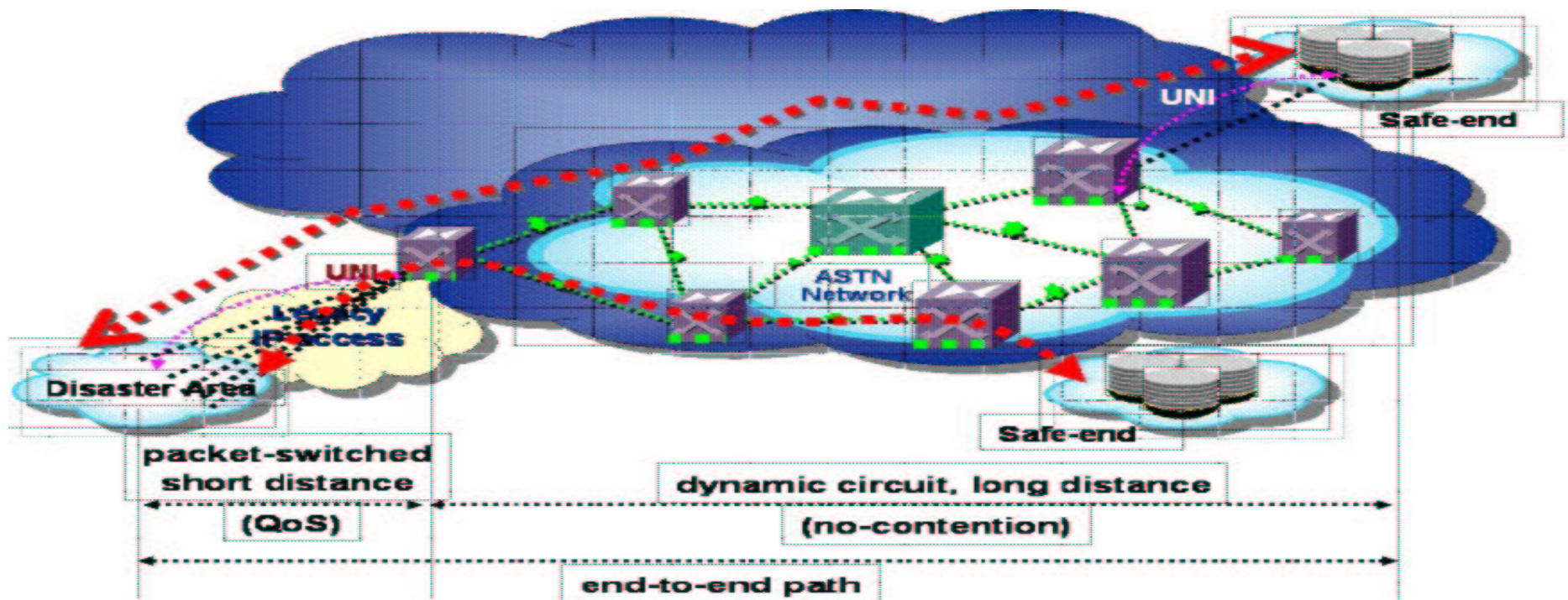
- > Workflows of radiology data transporting and medical processing
  - Application-aware network resource allocations
  - Dynamic adjustments of network resources and workflow priorities
  - Maximal utilization of network resources
  - Workflow classifications



# 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 ?