

Multi-level Resource Management: Making the Entire System Work Together

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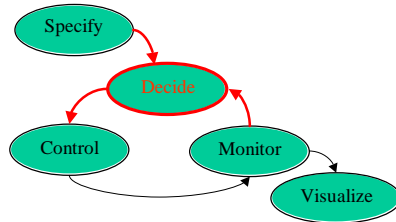
Multi-Level Resource Management

Outline

- ❑ **An Overview of the Model**
- ❑ A Reduction to Practice
 - w/ Example Applications
- ❑ Technical Challenges

Resource Management

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- QoS management part of existing organizational structures and processes
 - Set service levels
 - Monitor for compliance
 - Take action to correct variance
- QoS automation mirrors human structures/processes
 - Faster response
 - Increased scale

Purpose of a Resource Manager

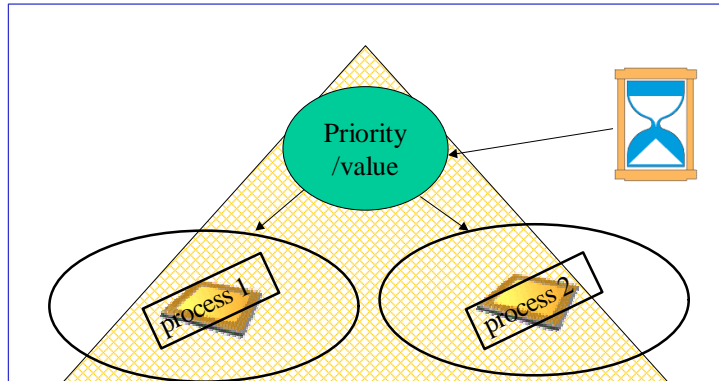
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- Allocate available resources to—
 - Achieve system objectives
 - Maximize benefit
 - Minimize costs
- Reconfigure system based on—
 - Changes in environment
 - Changes in system objectives

RM Example #1

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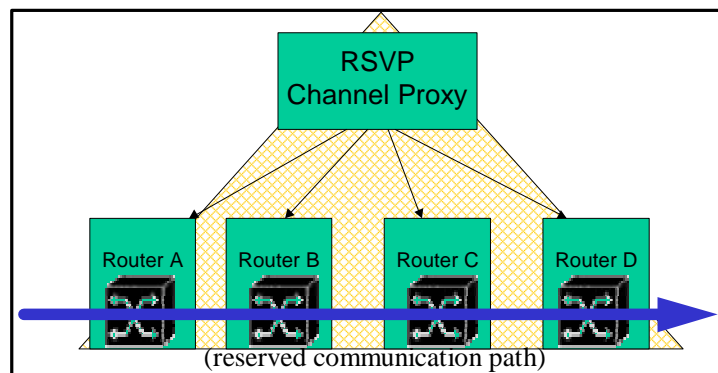
Operating System CPU Scheduler



RM Example #2

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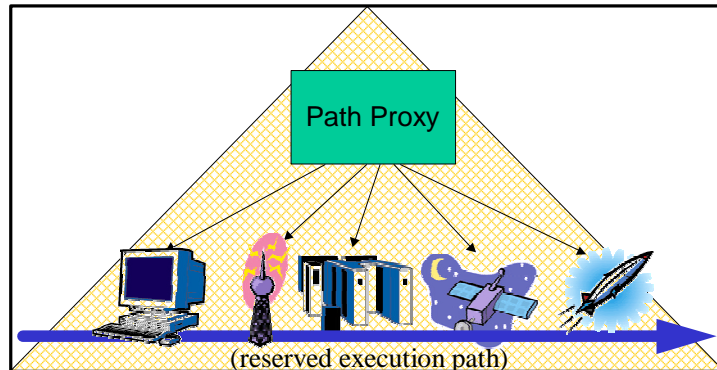
RSVP Internet Link



RM Example #3

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End-to-End Execution Path



Resource Management Model

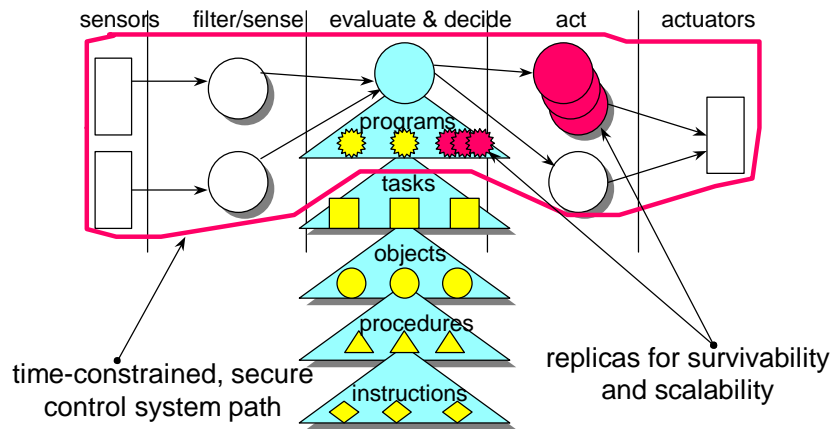
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Goals

- ❑ Simplify reconfiguration of resources
- ❑ Simplify reassignment of tasks
- ❑ Allow composition of separate subsystems
- ❑ Manage wide range of resources
- ❑ Manage wide range of applications
 - Multiple applications
 - Competing
 - Cooperating
- ❑ Standardization and certification

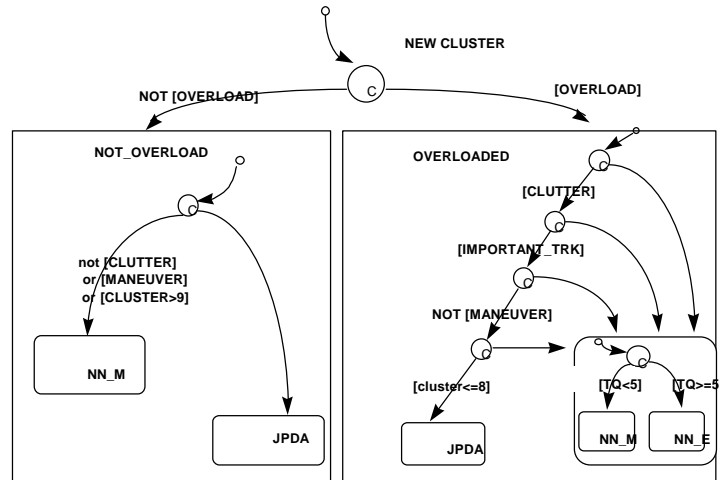


Application & QoS Models (DeSiDeRaTa)



Slide courtesy of Lonnie Welch, Ohio U.

Radar Algorithm Selection (AWACS Surveillance Tracking)



Slide courtesy of Thomas Wheeler/E. Douglas Jensen, MITRE

Resource Management Model

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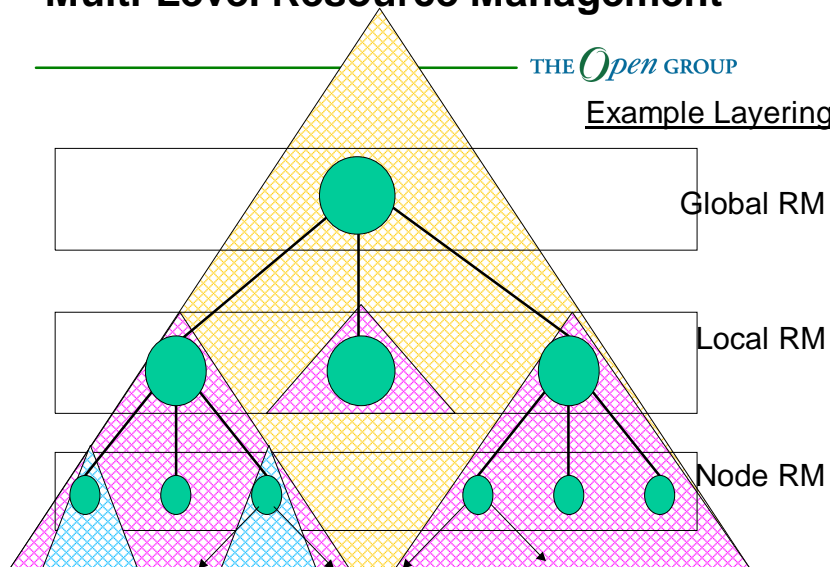
Abstract Architecture

- Composable
 - Common interfaces
- Separation of policy and mechanism
 - Policy—application/mission specific
 - Mechanism—implementation specific
- Modeled on practical computer configurations augmented by human organization principles

Multi-Level Resource Management

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Example Layering



Resource Domain

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A Resource Domain is—

- —a natural set of resources
- —organized together in a
- —hierarchical fashion to
- —perform a common function
- —under the control of
- —a single resource manager.

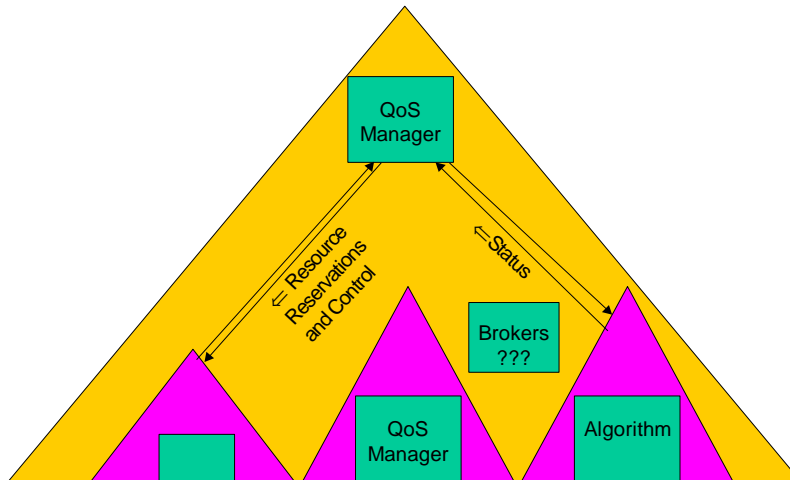
Resource Management Roles

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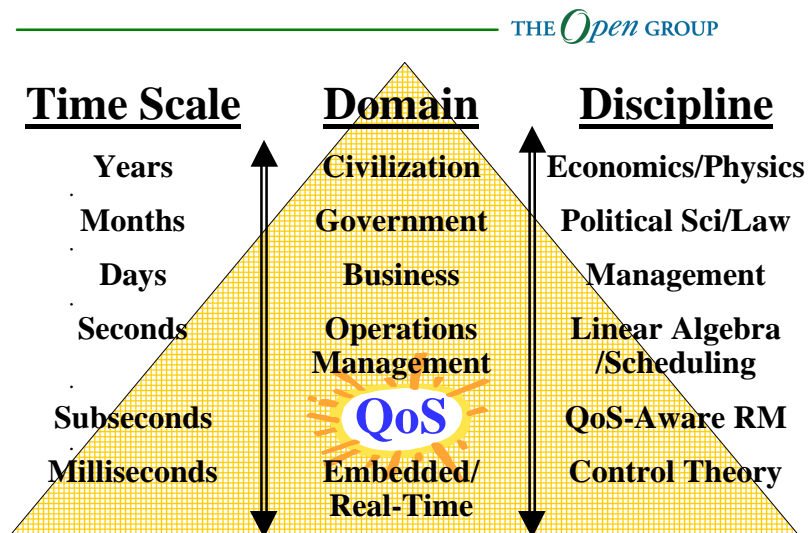
- Application
- Resource controller
- Resource arbitrator
- QoS manager
- Resource broker/trader
- Metrics system
- Communication infrastructure

Composable Resource Management Architecture

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Some (Over-)Generalizations



Multi-Level Resource Management

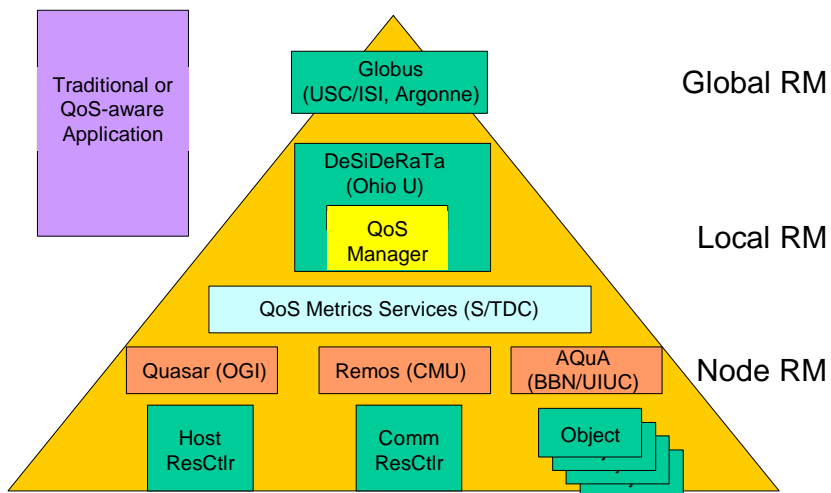
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Outline

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—w/ Example Applications
- Technical Challenges

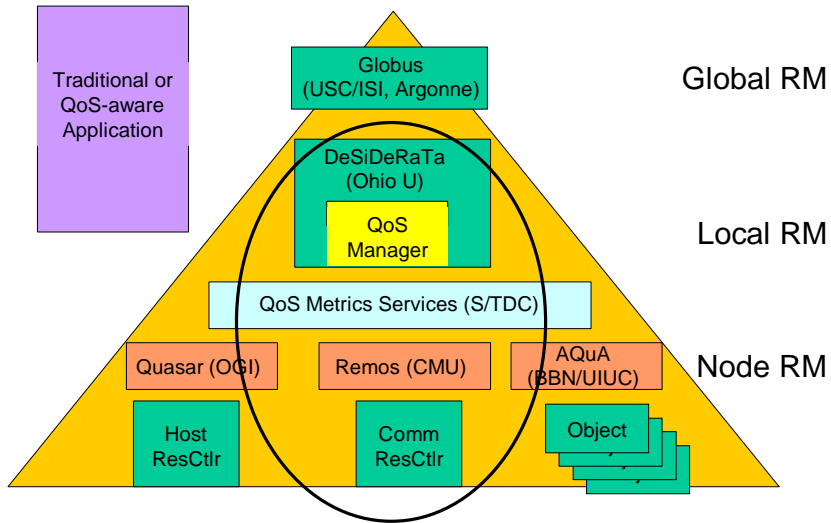
QUITE Resource Management System

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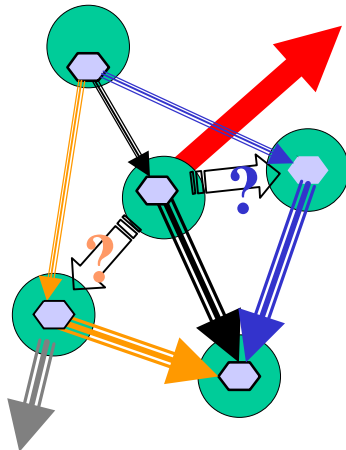
QUITE Experiment on Path-aware Process Placement (Components)

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QUITE Experiment on Path-aware Process Placement (Application)

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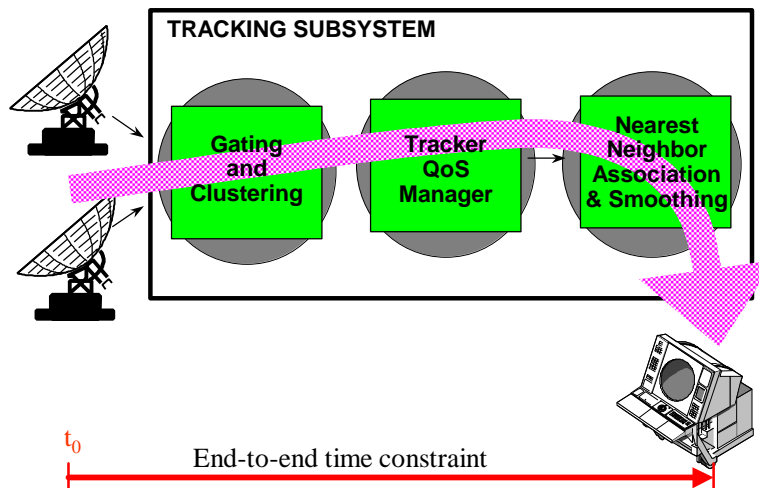
- 1) Stable operation
- 2) Disruptive event—due to unknown and unexpected communications traffic
- 3) Move process to another node
- 4) Need to select target node based on application model that incorporates comm usage
 - includes prediction of move of communications load from current to target node

AWACS Radar Tracking THE *Open* GROUP

- Advanced Warning and Control System is
 - An airborne radar system
 - For employment of tactical airpower
- AWACS surveillance missions
 - Generate aircraft tracks for Command and Control
- Too many sensor reports can overload the system
 - Causing sectors of the sky to “go blank”

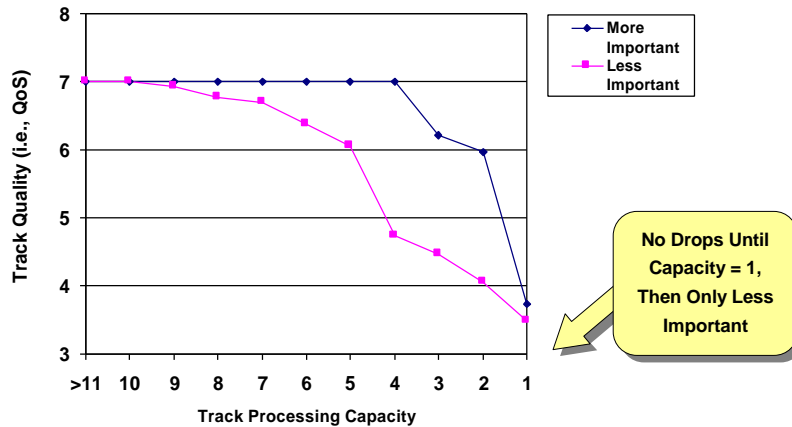
ALLOCATE RESOURCES
to the RIGHT TRACKS
for this MISSION
at this TIME

QoS-Driven Adaptive Tracking THE *Open* GROUP



Managed QoS in AWACS Surveillance Mission Tracking

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Technical Challenges

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- ❑ Identify design patterns in QoS controllers
- ❑ Identify design patterns in QoS-aware applications
- ❑ Identify common communication patterns between components and applications
- ❑ Incorporation of existing and evolving standards and practice
- ❑ Foster creation and enhancement of QoS standards and identify practical certification requirements