

# User Controlled Lightpaths Architecture, Design, Progress

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## Project Team

### University of Waterloo

- ❑ Raouf Boutaba: Project Leader
- ❑ Youssef Iraqi: Project Organiser
- ❑ Adel Ghlamallah: Consultant Architect
- ❑ Mohamed Dadi: Consultant DB Administrator
- ❑ Acila Derbal: Consultant Interface Designer
- ❑ Basem Shihada: Research Assistant (Grid Services)
- ❑ Wojciech Golab: Research Assistant (Resource Agent)
- ❑ Boris Jabes: Co-op Student (Hardware Interface)
- ❑ Iban Touchet: Co-op Student (Service Provisioning)

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# Project Team

## Canarie Technical Liaisons

- ❑ Darcy Quesnel: (Grid Services)
- ❑ TBD (Hardware, Routing)
- ❑ TBD (Java Developer?)

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# Outline

- ❑ Definitions
- ❑ High-level architecture
- ❑ Architecture details
- ❑ Lightpath objects and operations
- ❑ Software development plan

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# Definitions

## Management Domain

- set of logical resources
- under the control of a single entity

### Legend

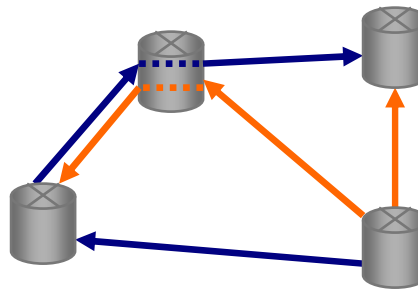
CA\*net 4 Lightpath  
Cross-Connect Device



Lightpath  
Cross-Connection



Management Domain 1  
Management Domain 2



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# Definitions (cont.)

## Lightpath Object (LPO)

- abstract representation of an LP
- under the control of a single entity

## Root LPO

- provisioned and registered in system by human user

## Partitioned LPO

- represents subset of parent LPO's bandwidth



## Compound (end-to-end) LPO

- represents concatenation of LPOs

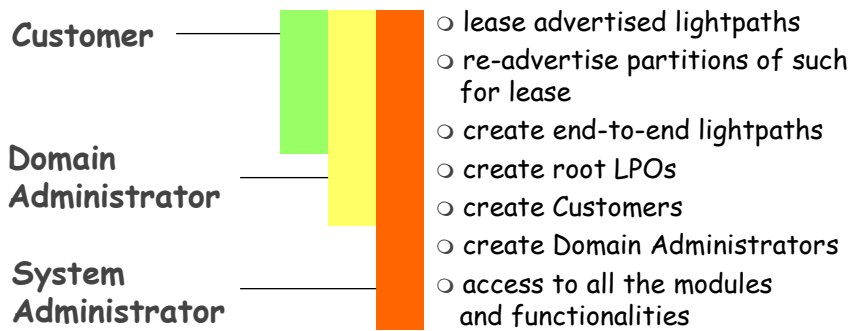


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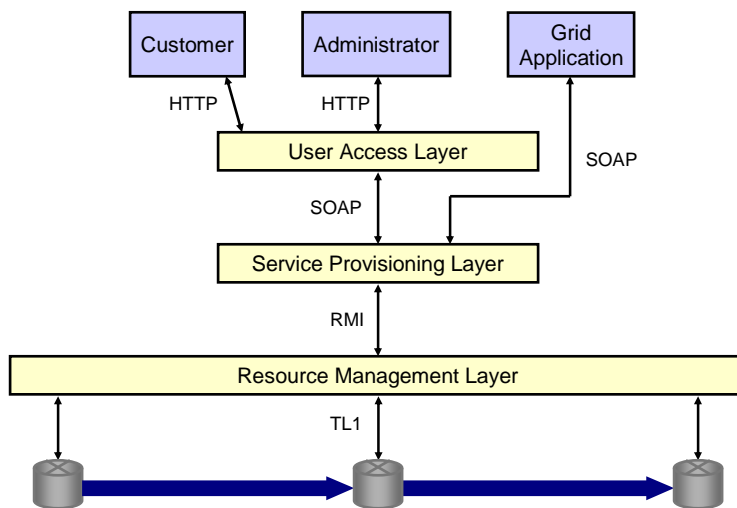
# Definitions (cont.)

## Users and Privileges



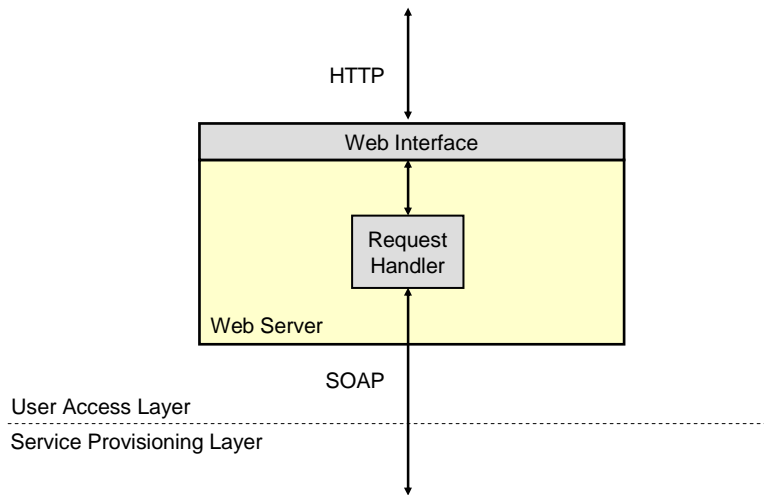
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# High-Level Architecture

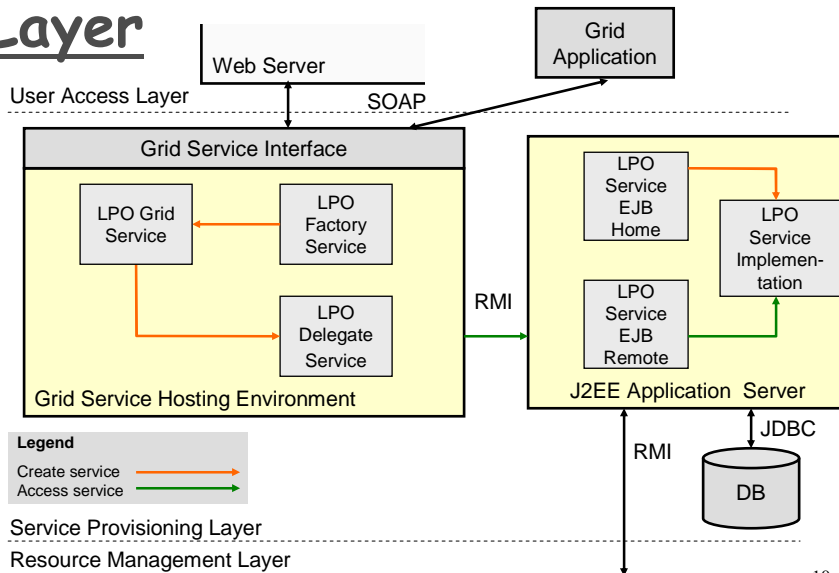


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# Details: User Access Layer



# Details: Service Provisioning Layer



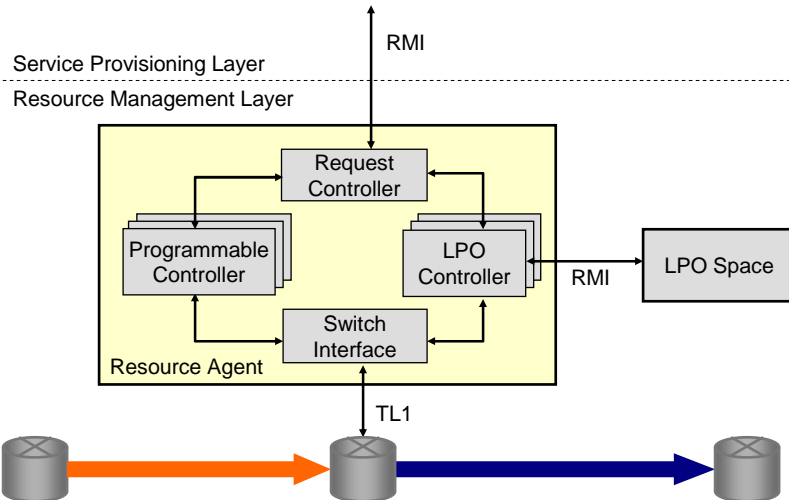
# Details: Service Provisioning Layer

## **OGSI-Conformant Services**

- Root LPO creation
- LPO query
- LPO advertisement
- LPO lease
- LPO reconfiguration
- LPO partitioning
- LPO concatenation
- End-to-end LPO establishment
- LPO termination

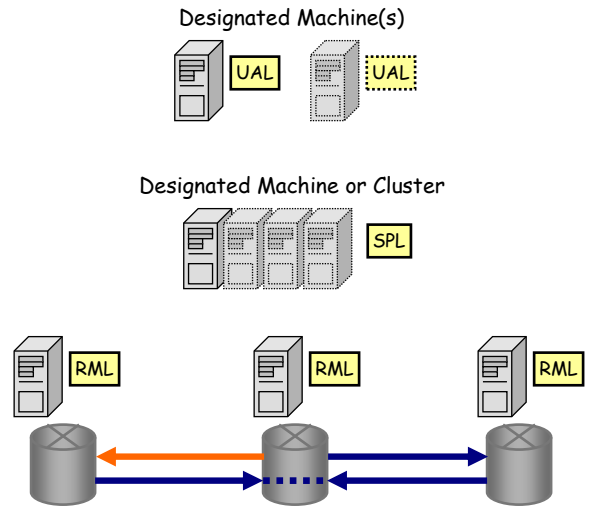
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# Details: Resource Management Layer



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# Deployment of Components

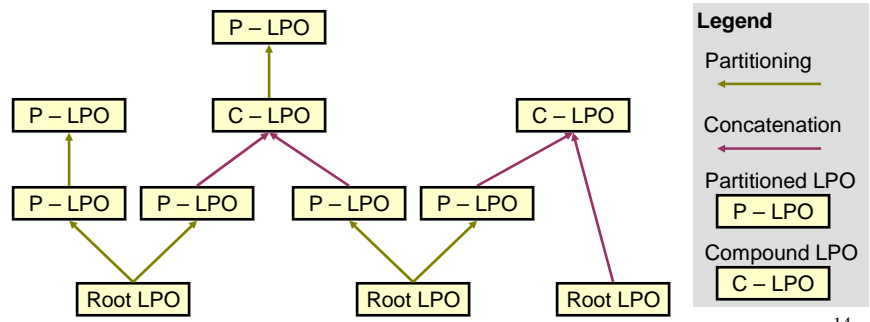


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# Lightpath Objects (LPOs)

- ❑ LPO maintained by Resource Agent corresponding to upstream switch
- ❑ all objects related to Root LPOs



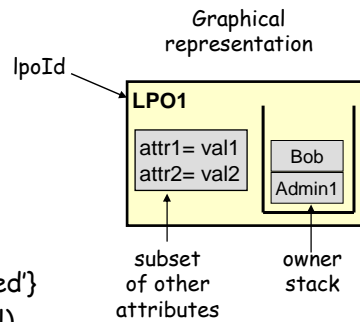
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# Lightpath Objects (LPOs)

## LPO Attributes

- lpoId
- bandwidth
- ownerStack
- expireDate
- status ∈ {'available', 'reserved', 'inactive'}
- prevStatus ∈ {'available', 'reserved'}
- source (switch/slot/port/channel)
- destination (switch/slot/port/channel)
- parentLPOId
- childList
- lpoList



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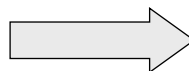
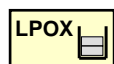
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# LPO Behaviour

## Partitioning

- can only be done by owner of parent LPO
- parent's bandwidth reduced, childList updated
- child LPO is created with link to parent and one-element owner stack

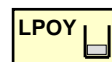
before



after



← parent



← child

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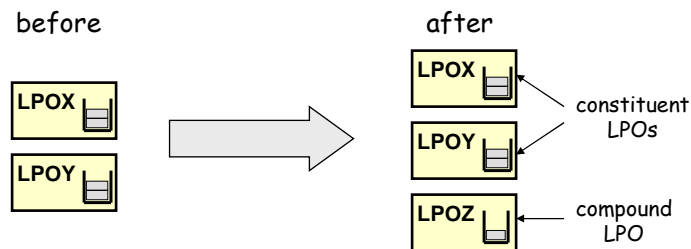
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## LPO Behaviour (cont.)

### Concatenation

- can only be done by owner of constituent LPOs
- constituent LPOs must have uniform bandwidth
- compound LPO is created with nonempty lpoList and one-element owner stack



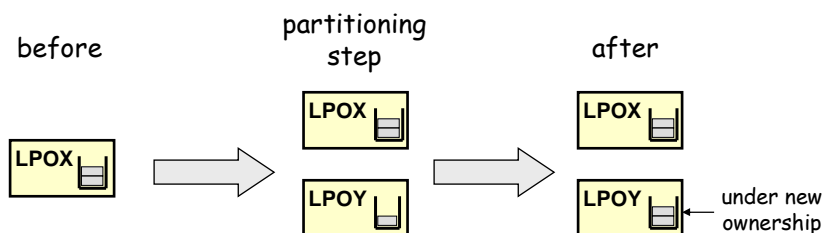
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## LPO Behaviour (cont.)

### Leasing

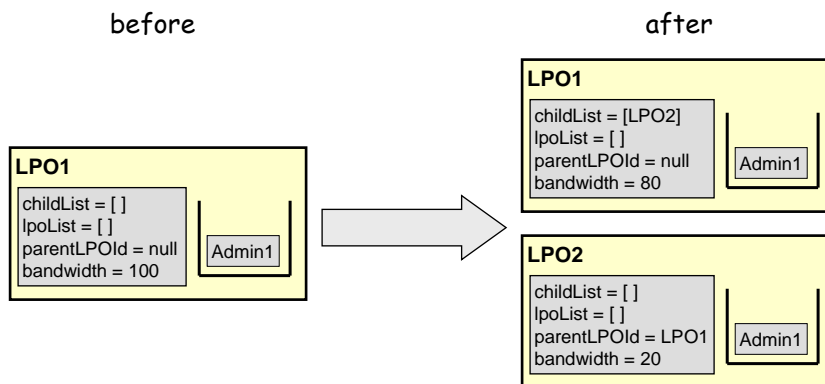
- can only be done on LPOs without children
- always create partitioned LPO for initial advertisement



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## LPO Example: Partitioning (Case 1: empty LPO list)

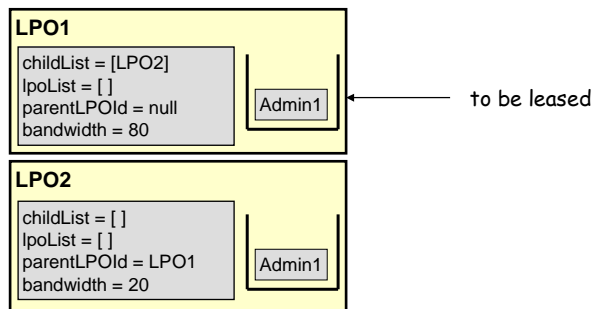


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## LPO Example: Leasing

before

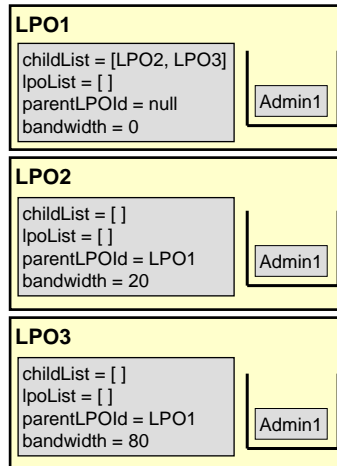


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# LPO Example: Leasing

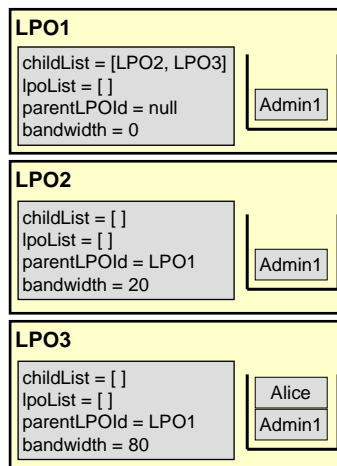
intermediate step (spawning and advertising)



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# LPO Example: Leasing

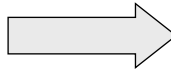
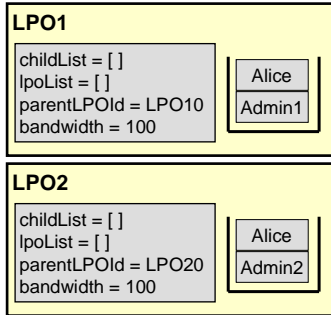
after



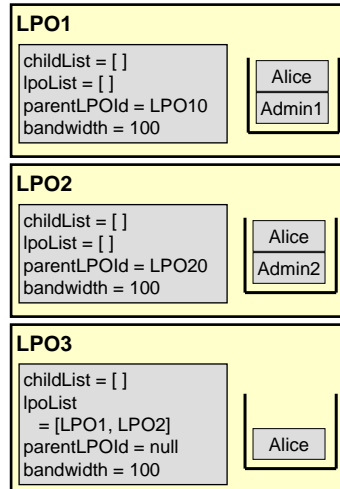
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# LPO Example: Concatenation

before



after

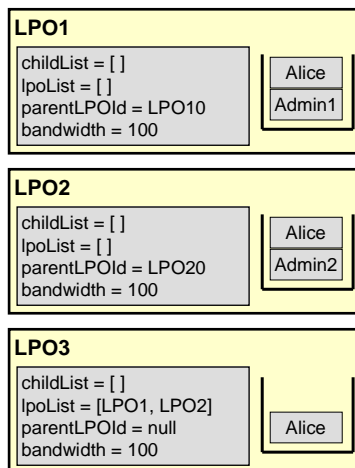


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# LPO Example: Partitioning (Case 2: non-empty LPO list)

before



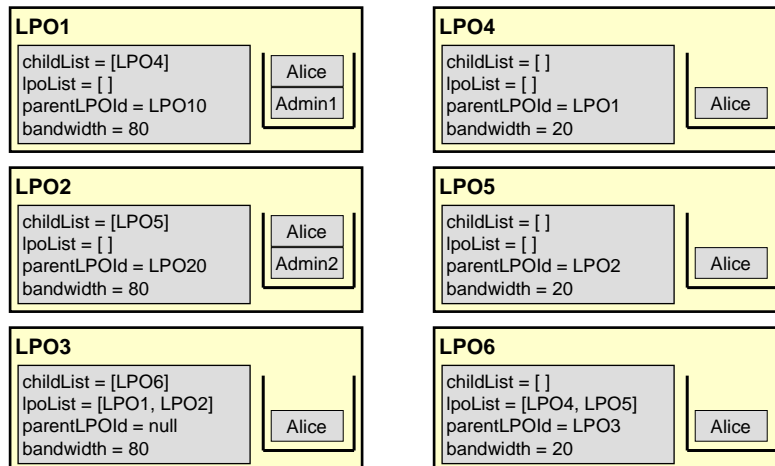
to be partitioned

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## LPO Example: Partitioning (Case 2: non-empty LPO list)

after



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## Software Development Plan

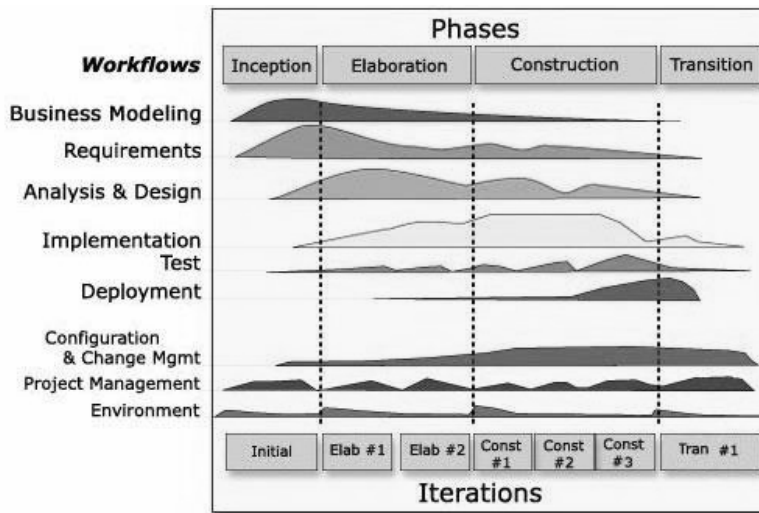
### Phase-Based Approach

- development cycle conducted in phases
- each phase consists of one or more iterations in which a subset of the system is analysed, designed, developed, and tested

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# Software Development Plan



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# Software Development Plan

## Advantages of Phase-Based Approach

- highly dynamic and adaptive
- accommodates changes to requirements, technologies, and goals
- development in iterations provides:
  - reduced technical risk
  - maximum flexibility in planning features for each release
  - early versions of a partially working system

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## Phases: Inception

- ❑ purpose
  - develop product requirements
  - establish scope for system
  - define major use cases
- ❑ number of iterations: 1
- ❑ milestone
  - Business Case Review

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## Phases: Elaboration

- ❑ purpose
  - analyze requirements
  - analyze, design, and implement high-risk use cases
  - develop architecture
- ❑ number of iterations: 2
- ❑ milestones
  - Architectural Prototype
  - Use Case Model
  - Design Document

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## Phases: Construction

- ❑ purpose
  - analyze and design remaining use cases
  - develop fully functional version of software
  - test software
- ❑ number of iterations: 3
- ❑ milestone
  - Pre-release Version

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## Phases: Transition

- ❑ purpose
  - prepare pre-release version for deployment
  - ensure smooth installation
  - test software
  - train users
- ❑ number of iterations: 1
- ❑ milestone
  - Release Version

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## Phases: Maintenance

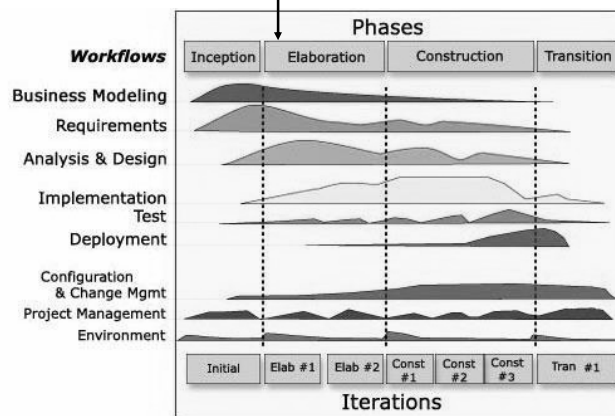
- purpose
  - fine-tune system
  - improve reliability of system
- number of iterations: several
- milestone
  - Maintenance Version(s)

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## Progress

- presently in Elaboration Phase, Iteration 1



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# User Controlled Lightpaths Prototype Demonstration

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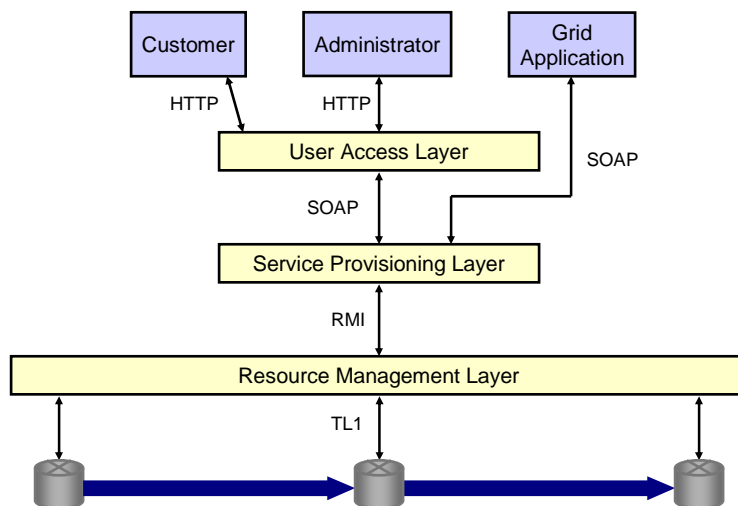
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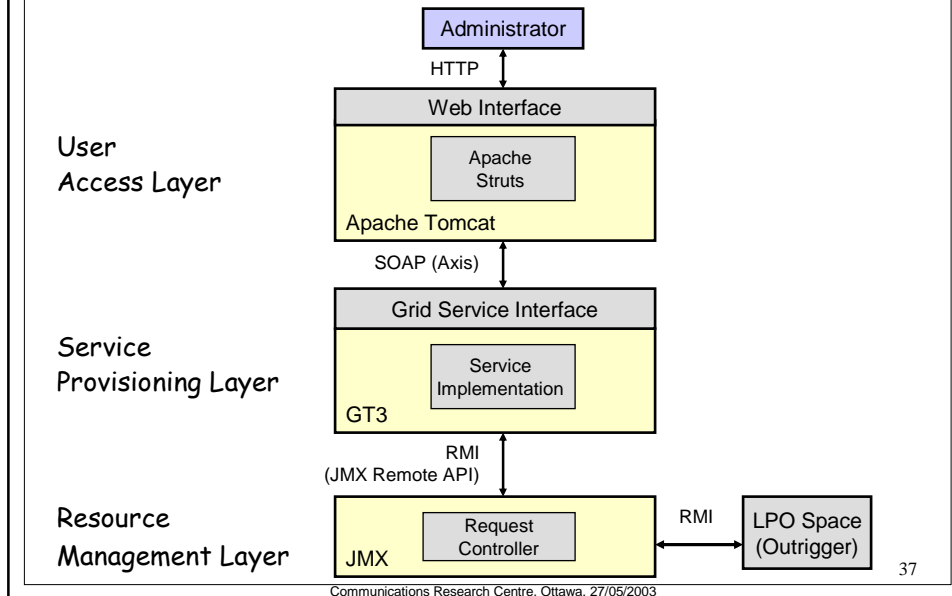
## High-Level Architecture



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## Demonstration System



## Demonstration Scenario

- Create Root LPO
- Partition an LPO
- Advertise an LPO
- Lease an LPO
- Terminate a Lease
- Terminate an LPO