

Middleware

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Overview

- What is middleware, anyway?
- Grid services architecture and status
- Grid Services and Access Grid

What is Middleware?

- It's the stuff that everyone wants someone else to be responsible for
- Or: Broadly deployed services that enhance the usability and capability of a network environment
 - ◆ The services themselves
 - ◆ Well-defined protocols, APIs, SDKs
- We use the term "Grid Services"

The Grid Service Space Includes ...

- Fundamentals, e.g.
 - ◆ Security: authentication, authorization, confidentiality, etc.
 - ◆ Policy: who is allowed to do what when
 - ◆ Resource discovery and characterization
 - ◆ Events and instrumentation
 - ◆ Resource allocation and co-allocation: space, network, computing; reservation
- Domain-specific
 - ◆ Data replication, intelligent multicast, ...

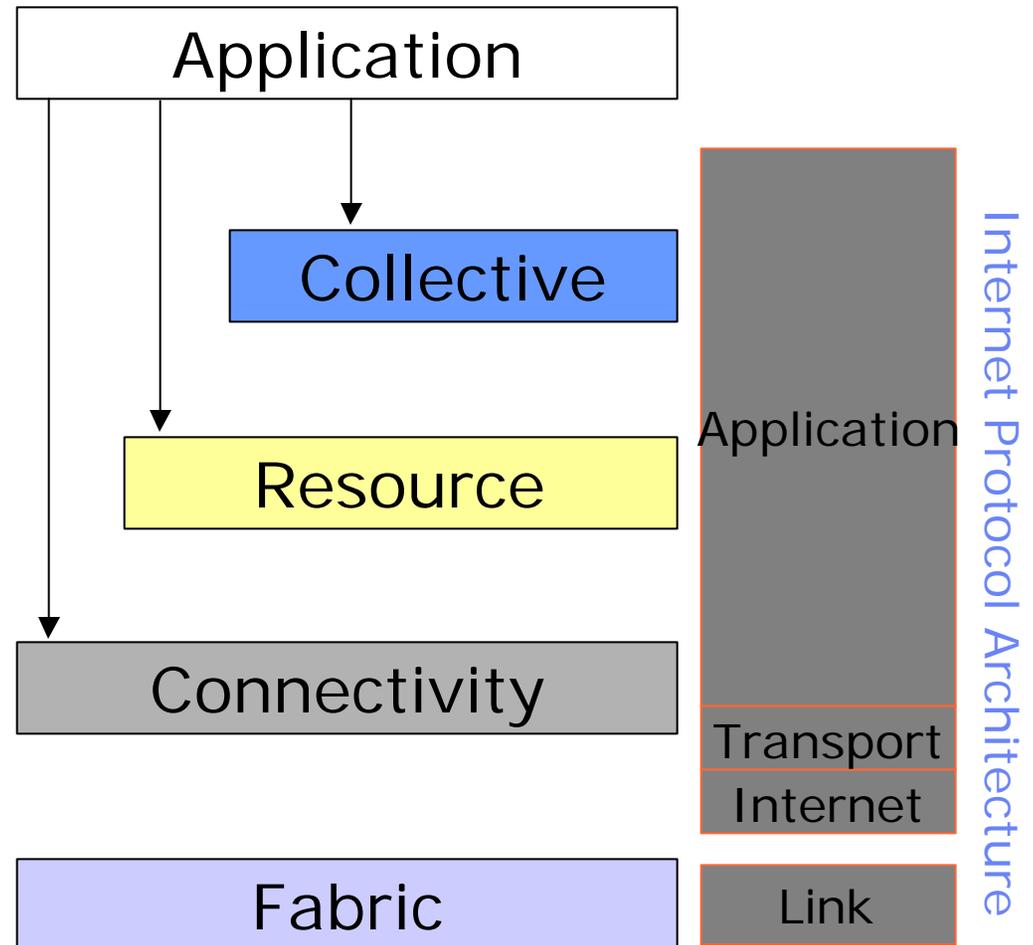
Layered Grid Architecture (By Analogy to Internet Architecture)

“Managing multiple resources”:
ubiquitous infrastructure services

“Sharing single resources”:
negotiating access, controlling use

“Talking to things”:
communication (Internet protocols) & security

“Controlling things locally”:
Access to, & control of, resources



Grid Services Architecture: Fabric Layer Protocols & Services

- Just what you would expect: the diverse mix of resources that may be shared
 - ◆ Individual computers, Condor pools, file systems, archives, metadata catalogs, networks, sensors, etc., etc.
- Few constraints on low-level technology: connectivity and resource level protocols form the “neck in the hourglass”
- Defined by interfaces not physical characteristics

Grid Services Architecture: Connectivity Layer Protocols & Services

- Communication
 - ◆ Internet protocols: IP, DNS, routing, etc.
- Security: Grid Security Infrastructure (GSI)
 - ◆ Uniform authentication & authorization mechanisms in multi-institutional setting
 - ◆ Single sign-on, delegation, identity mapping
 - ◆ Public key technology, SSL, X.509, GSS-API
 - ◆ Supporting infrastructure: Certificate Authorities, key management, etc.

Grid Services Architecture: Resource Layer Protocols & Services

- Grid Resource Allocation Mgmt (GRAM)
 - ◆ Remote allocation, reservation, monitoring, control of compute resources
 - GridFTP protocol (FTP extensions)
 - ◆ High-performance data access & transport
 - Grid Resource Information Service (GRIS)
 - ◆ Access to structure & state information
 - Network reservation, monitoring, control
 - All integrated with GSI: authentication, authorization, policy, delegation
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Grid Services Architecture: Collective Layer Protocols & Services

- Index servers aka metadirectory services
 - ◆ Custom views on dynamic resource collections assembled by a community
- Resource brokers (e.g., Condor Matchmaker)
 - ◆ Resource discovery and allocation
- Replica catalogs
- Co-reservation and co-allocation services
- Etc., etc.

Grid Services: Status

- Broad adoption of Grid technologies
 - ◆ E.g., physics (PPDG, European Data Grid, GriPhyN), climate (ESG), NASA (IPG), NSF (PACIs), earthquake engineering (NEESgrid)
- Major deployment activities
- Active community and standards effort
 - ◆ Global Grid Forum 1 (=GF6): March 2001
 - ◆ www.gridforum.org
- Application evolution: computation, data, instrumentation: next collaboration?

Grid Services and Access Grid: Opportunities at Multiple Levels

- Exploit existing services to enhance current AG framework, e.g. for
 - ◆ Authentication, authorization, confidentiality
 - ◆ Resource discovery and characterization
- Develop entirely new applications, e.g.
 - ◆ Collaborative viz of large datasets, using online storage accessed via Grid protocols
- Develop entirely new functionality based on new AG-specific services
 - ◆ E.g., domain-specific multicast