

Application Enablement on Grid

Mangala N

System Software Development Group
CDAC, Bangalore.

mangala@cdacb.ernet.in

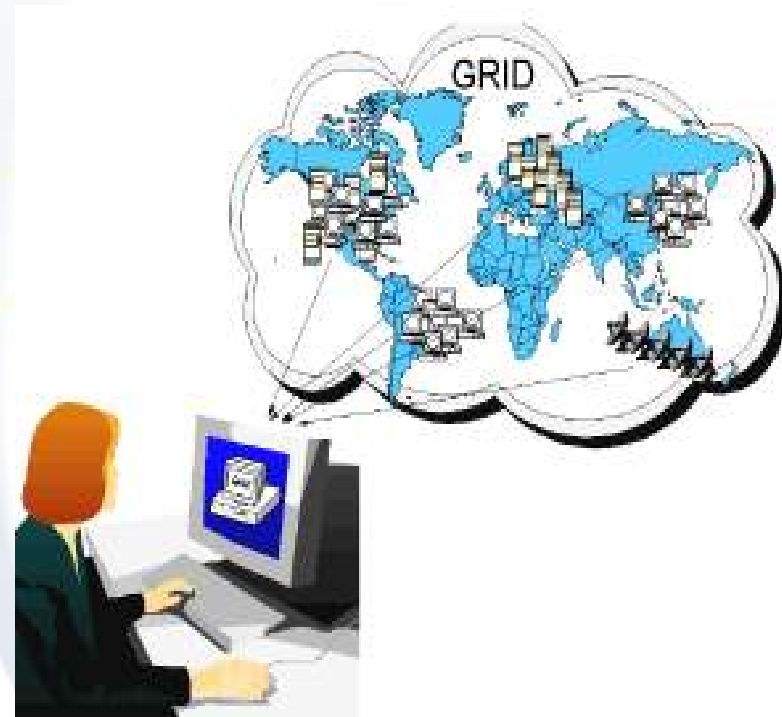


Presentation Outline

- **What is Grid Enablement?**
 - User perspective of Grid
 - Types of parallelism
- **Current Resources of GARUDA**
- **General Strategies for Grid Enablement**
- **Types of Programs on GARUDA**
- **Popular Parallel Programming Paradigms**
- **Conclusion**

What is Grid Enablement

- An application is said to be **Grid enabled** when it can run in a **Grid Environment**.
- As Grid technology matures, grid-enablement exploits the virtualized grid infrastructure to **accelerate processing time or increase collaboration**.



Exploit the Power of the Grid

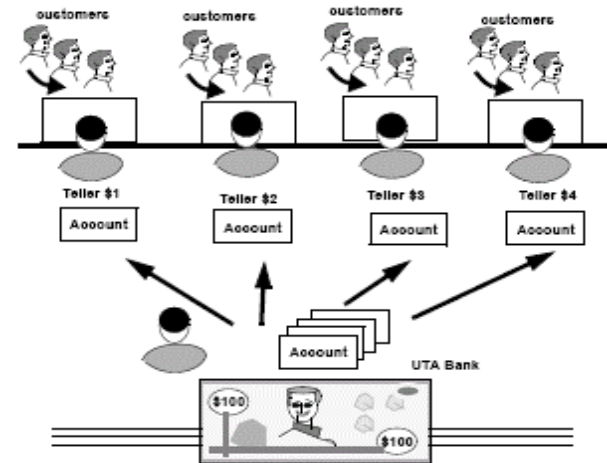
Parallel Processing - emphasizes the concurrent manipulation of data elements belonging to one or more processes solving a single problem.

Given a problem to be solved,

- Break into sub-problems.
- Solve the sub-problems simultaneously on separate processors.
- Combine results to produce an answer to the original problem.

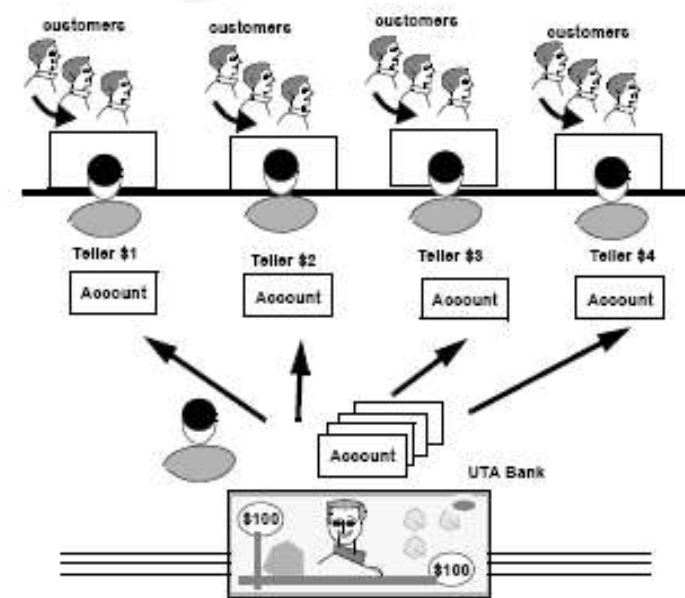
Examples of embarrassingly parallel problems:

- The [Mandelbrot set](#), where each point can be calculated independently.
- [Distributed rendering](#) of non-real-time [computer graphics](#).
 - In ray tracing, each pixel may be rendered independently. In computer animation, each frame may be rendered independently.
- Brute force searches in [cryptography](#).
- BLAST searches in [bioinformatics](#).
- Computer [simulations](#) comparing many independent scenarios, such as climate models.



Types of Parallelism

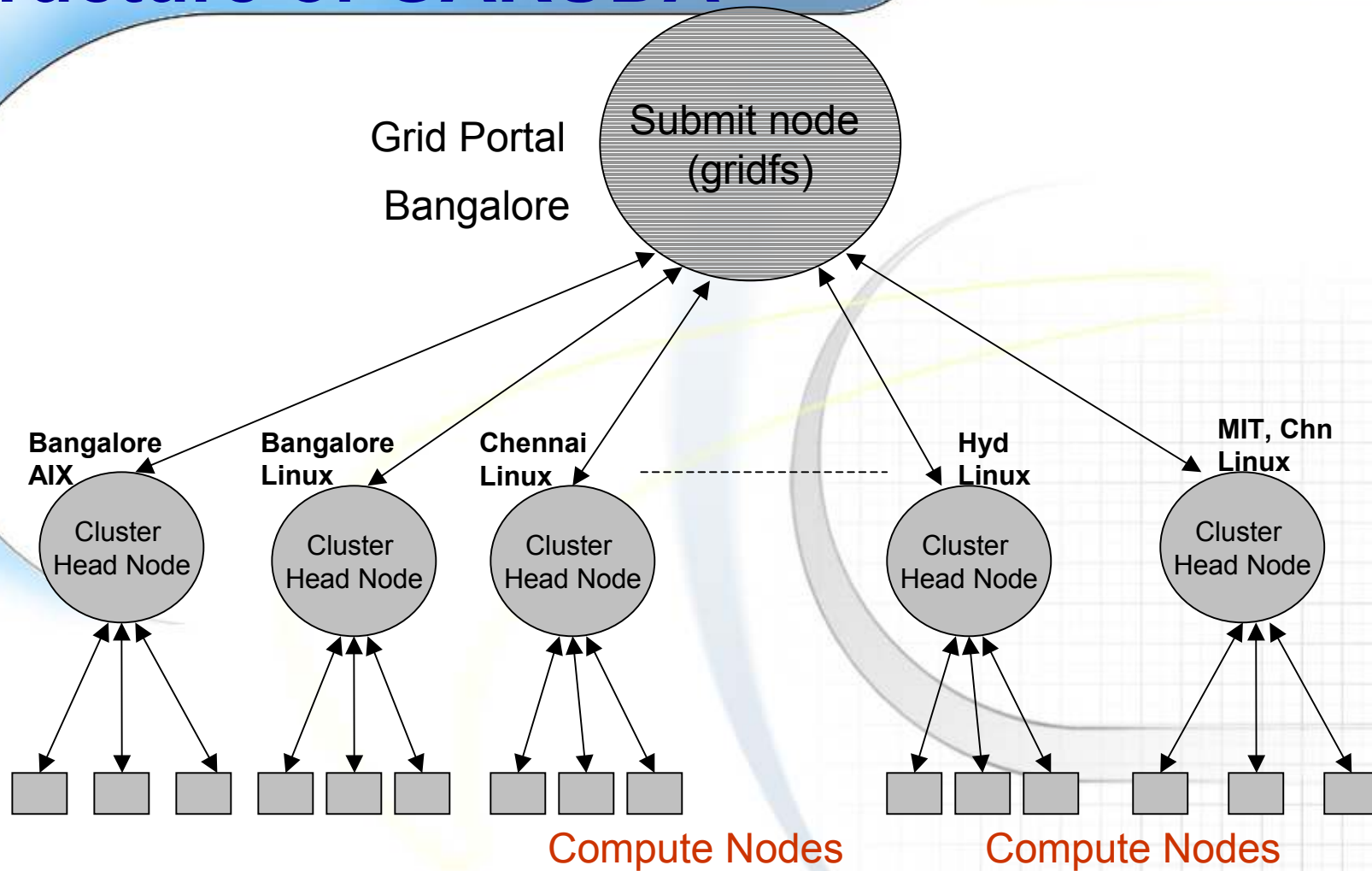
- Flynn's Taxonomy
- **SISD** - *Single-Instruction Single-Data*
- **SIMD** - *Single-Instruction Multiple-Data*
- **MISD** - *Multiple-Instruction Single-Data*
- **MIMD** - *Multiple-Instruction Multiple-Data*
 - A special case of MIMD is the *single-program multiple data* (SIMD) computation, where all the processes execute the same program, parameterized by the process index.



Resources on GARUDA

Institution	Location	Resource
Indian Institute of Science	Bangalore	64 cpu POWER5, Linux
Raman Research Institute	Bangalore	32 cpu Opteron, Linux
Institute of Math. Sc.	Chennai	24 cpu Opteron cluster (Cray XD1)
Madras Institute of Tech	Chennai	60 cpu P4, Linux
IIT-Delhi	Delhi	32 cpu Opteron, Linux
Jawaharlal Nehru Univ	Delhi	48 cpu AMD Opteron, Linux 16 cpu Intel Itanium, Linux
Institute of Genomics and Integrative Biology	Delhi	64 cpu Xeon, Linux
IIT-Guwahati	Guwahati	128 cpu Opteron, Linux
University of Hyderabad	Hyderabad	32 way SMP, POWER4, AIX
IIT-Kharagpur	Kharagpur	16 cpu Xeon, Linux 16 cpu PowerPC2, AIX
Space Application Centre	Ahmedabad	VSAT Terminal - 2 Nos

Structure of GARUDA

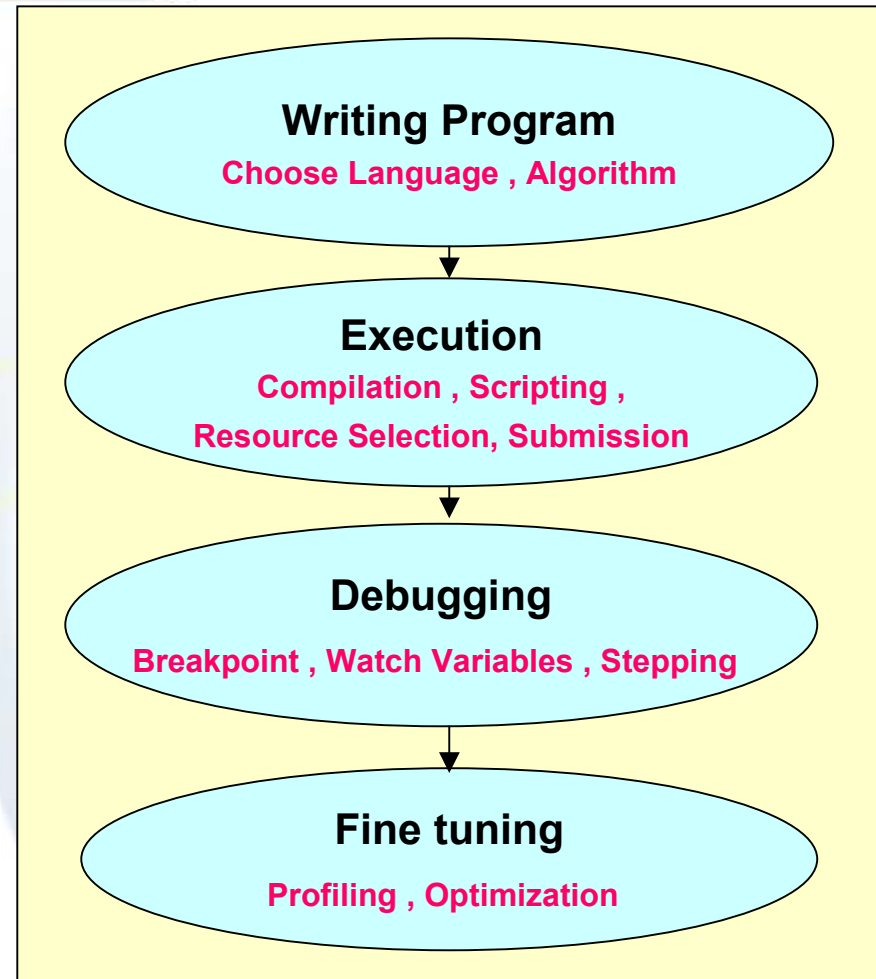
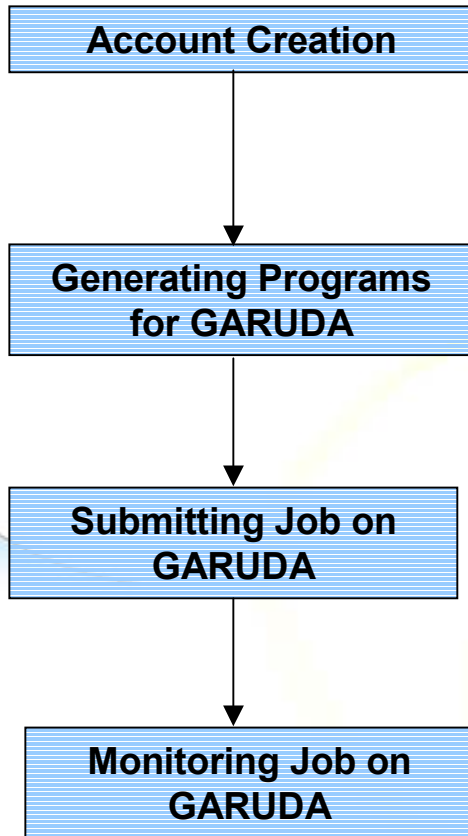


Workshop on Developing Applications on Grid - GARUDA

National Grid Computing Initiative - GARUDA

Enablement of Application on GARUDA

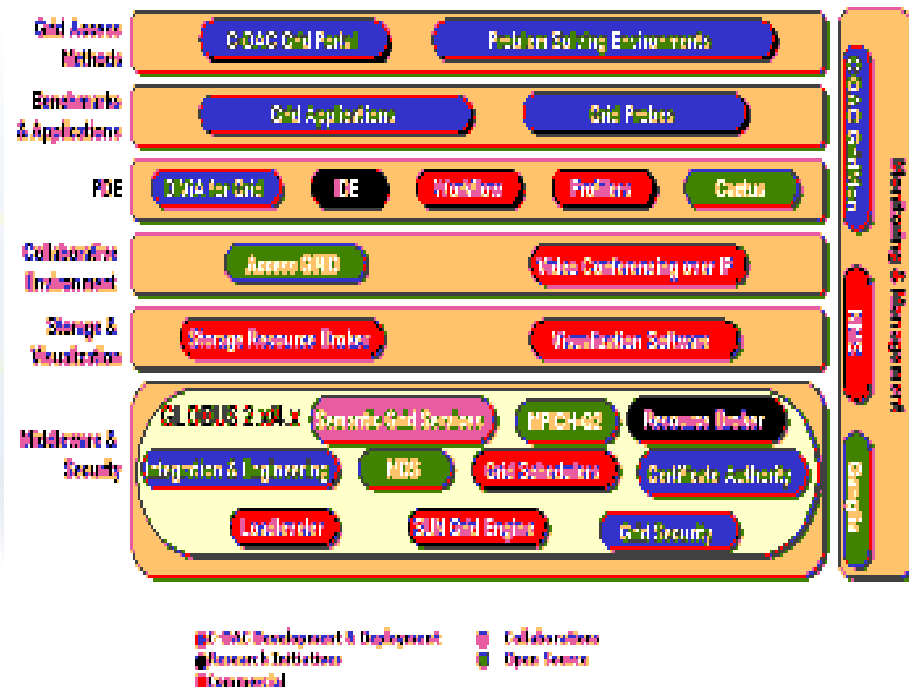
Workshop on Developing Applications on Grid - GARUDA



National Grid Computing Initiative - GARUDA

SW Utilities on GARUDA

- Garuda Grid Portal
- Problem Solving Environments (PSE)
- Program Development Environment
- Workflow
- IDE, Debugger
- Monitoring & Management Tool (Paryavekshanam)
- Storage Resource Broker (SRB) for Data Management

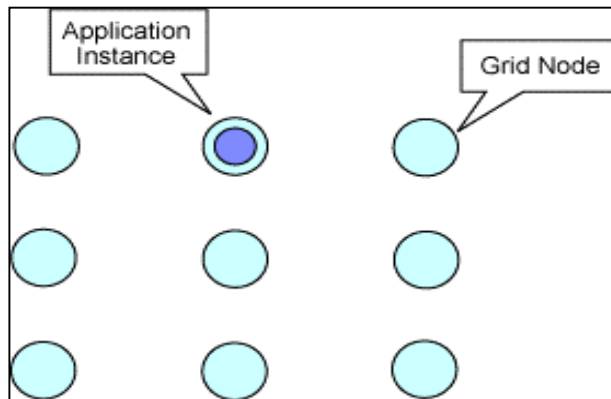


Strategies for Grid Enablement of Applications

- **Batch Anywhere** : The grid returns the correct results to the submitter after completing the execution.
- **Independent Concurrent Batch** : multiple independent instances of the same application running concurrently
- **Parallel Batch** : Parallel Batch takes each user's batch work, subdivides it, disperses it out to multiple nodes, collects it, and then aggregates the results.
- **Service** : Service Oriented Architecture
- **Parallel Services** (provides multiple service instances)
- **Tightly Coupled Parallel Programs** : Intense communications and synchronization like MPI

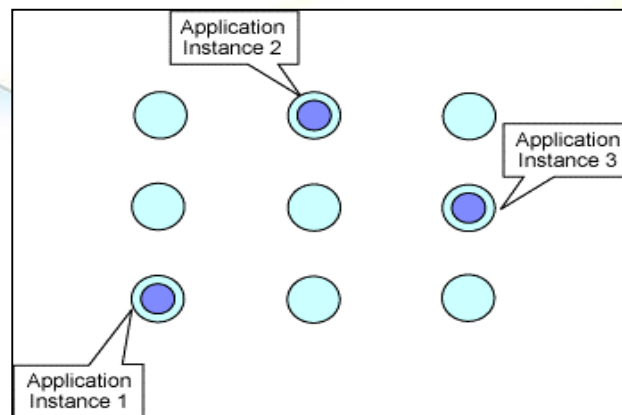
Strategies for Grid Enablement of Applications

Workshop on Developing Applications on Grid - GARUDA



Batch Anywhere

Location independence with a single instance of a job running on any one of several nodes.

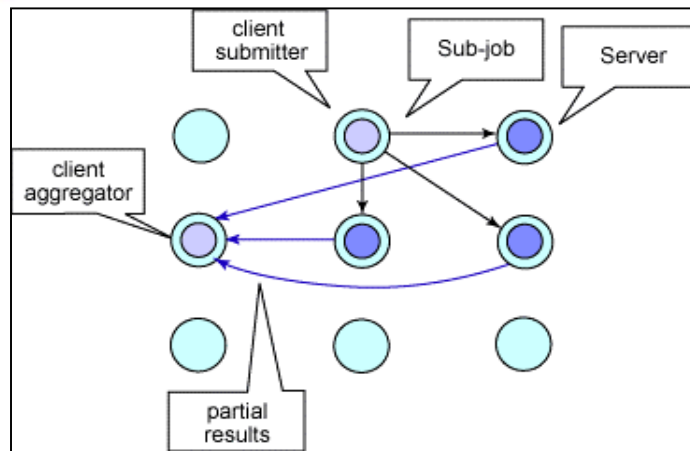


Independent Concurrent Batch

Several instances run independently without interference.

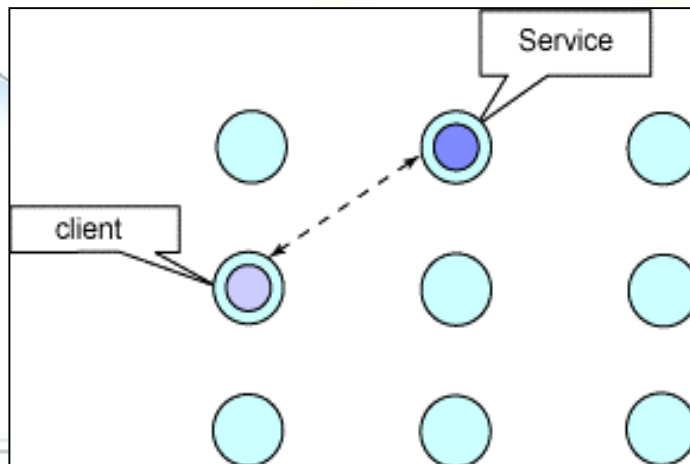
National Grid Computing Initiative - GARUDA

Strategies for Grid Enablement of Applications



Parallel Batch

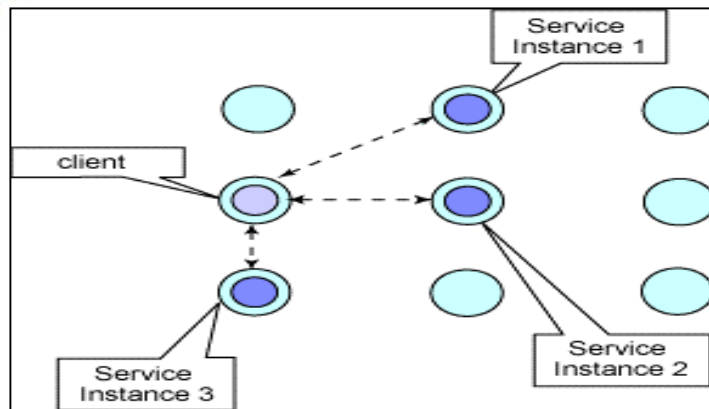
Parallel support subdivides and spreads work among nodes.



Service

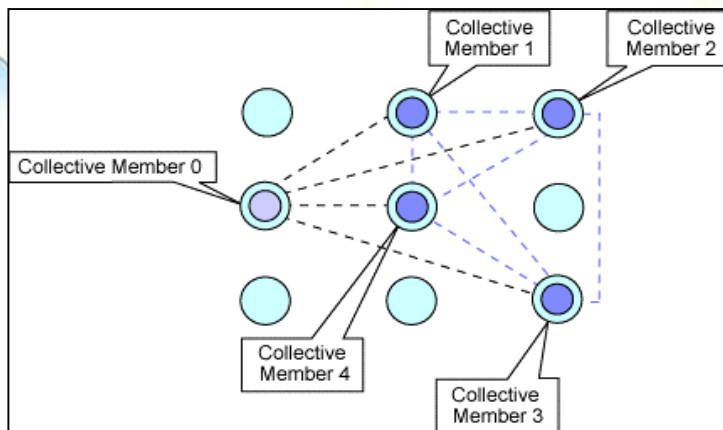
Client and Server are loosely coupled

Strategies for Grid Enablement of Applications



Parallel Service

Provides multiple service instances

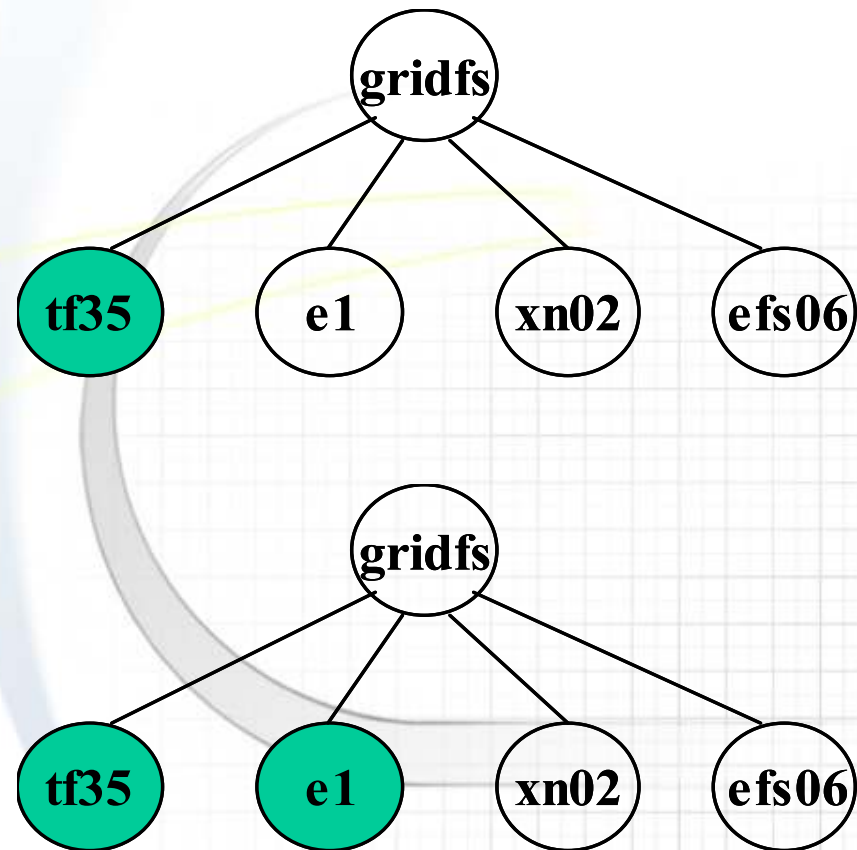


Tightly coupled Parallel Programs

Intense communication and synchronization.

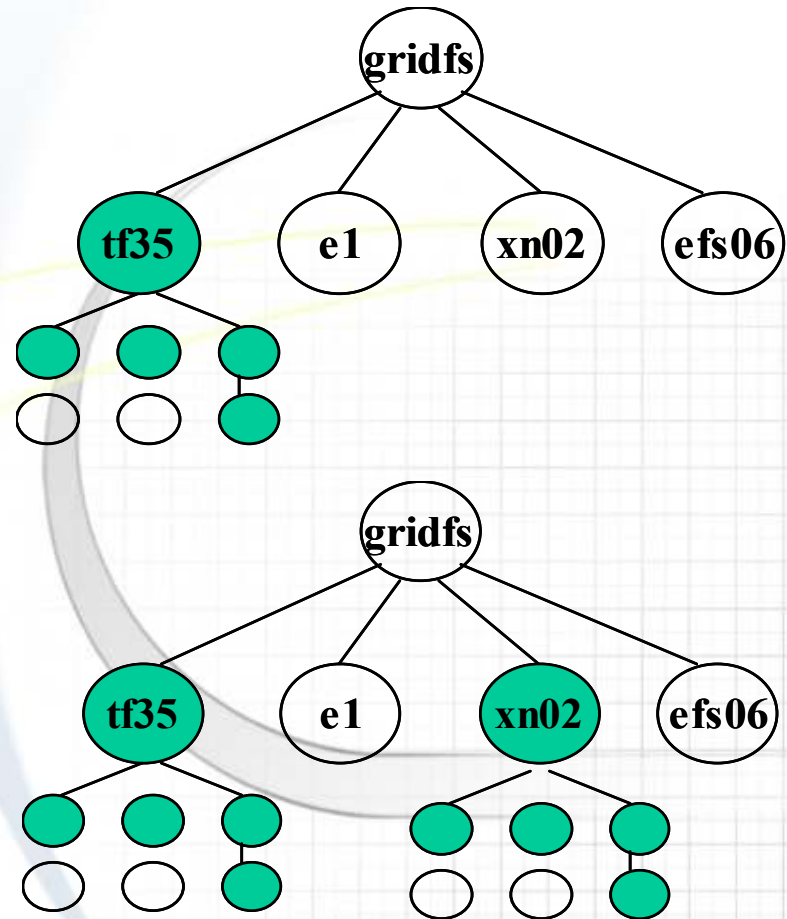
Types of Programs on GARUDA

- **Sequential Jobs** for particular platform
- **Concurrent Sequential Jobs** for different platforms



Types of Programs on GARUDA

- **Homogeneous Parallel job** for particular OS
- **Heterogeneous Parallel Jobs**



Popular Parallel Programming Paradigms

- **Web Services** with .NET or J2EE
- **Object-based programming models** using Common Object Rquest Broker Architecture (CORBA), Object Linking and Embedding (OLE) and Distributed Component Object Model (DCOM)
- **Networking computing models** like Distributed Computing Environment (DCE)
- **Parallel-Processing Models** such as Message Passing Interface (MPICH-G2)

Conclusion

Application Enablement on Grid means.....!

- Understanding the nature of applications.
- Understanding the characteristics of the Grid.
- Learn the utilities to make your applications work on the grid.

Sample Application . .

Embarrassingly Parallel Example