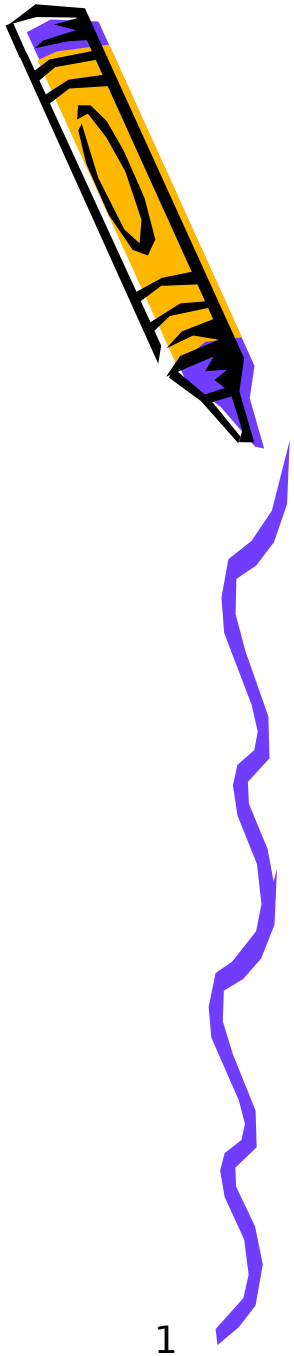
Evolution of Service Oriented Architectures



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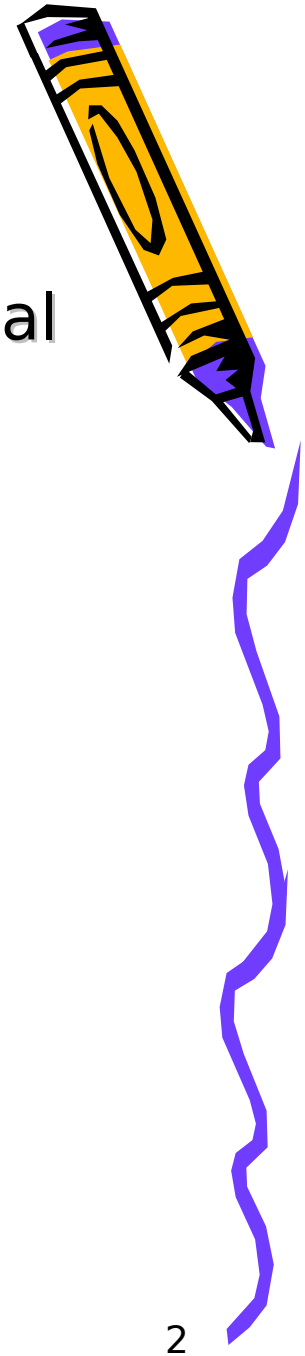
The Plan



What changes have taken place in typical application architectures?

What is service orientation?

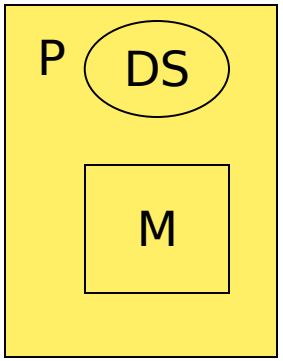
Where did it originate?

How did it evolve?

How does it connect to web services?

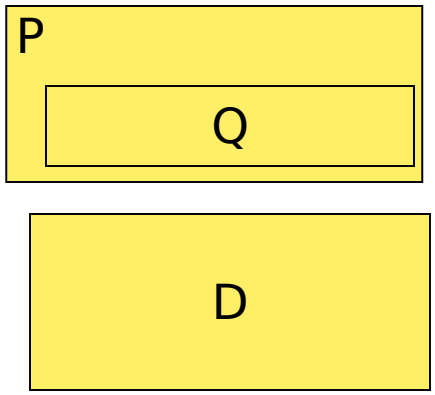
What new technologies are needed?

Architecture of Your Data-structures Assignment



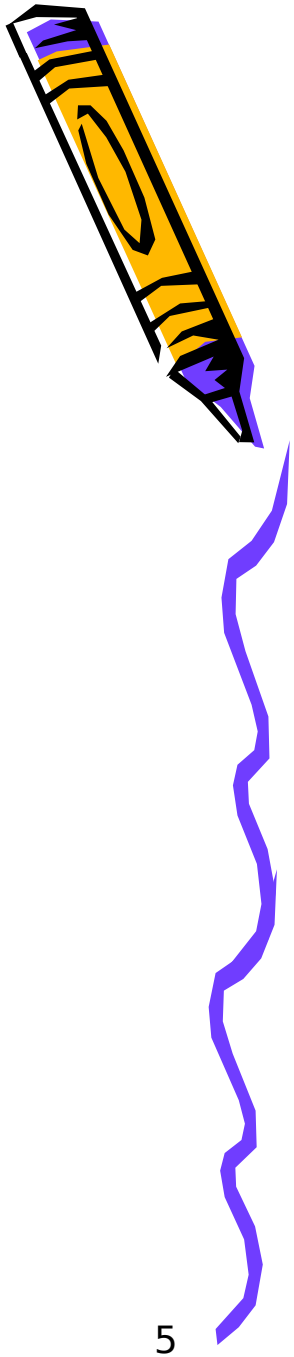
- A single process
- One main
- Manipulate data structure
- Data is live till execution
- Next run is fresh execution

A Database Assignment

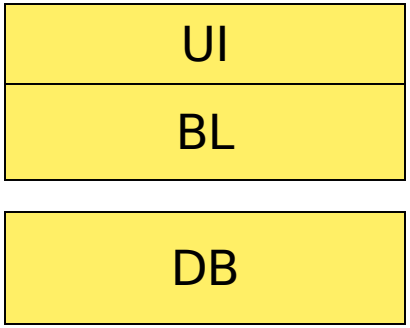


- Create Tables
- Manipulate them
- Use a query language
- Data is live across queries

Processes + Data +Interfaces

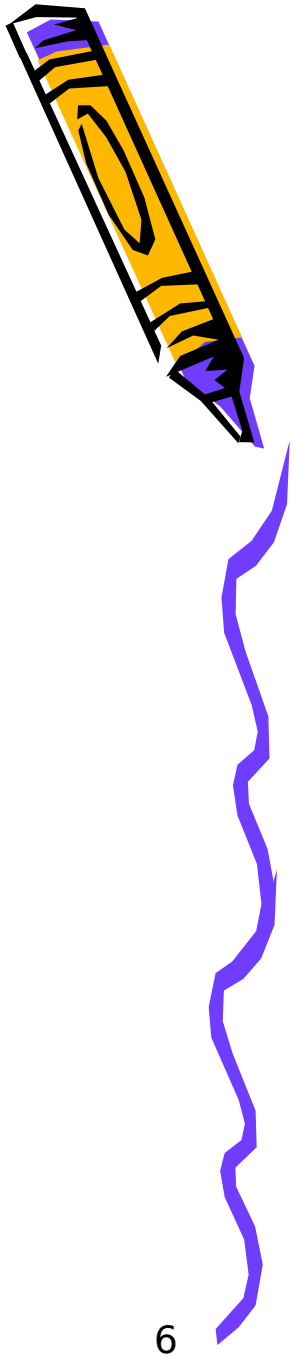


- Three tired application
  - GUI
  - Business Logic
  - Database

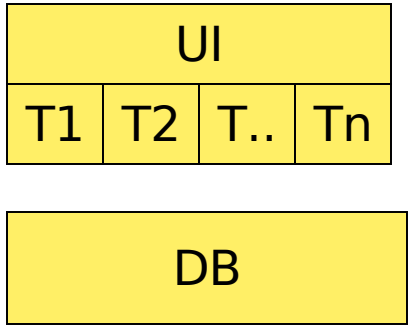


A Single user application based on persistence

Processes + Data +Interfaces + Concurrency



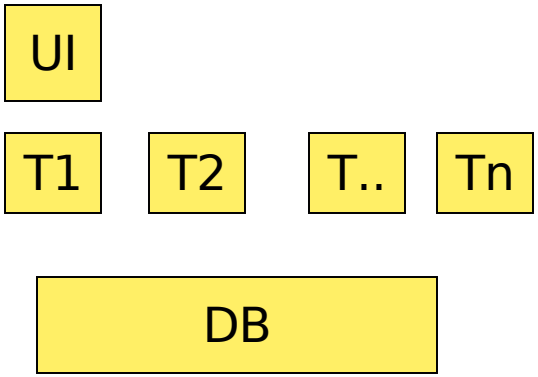
- A GUI
- Tasks: Concurrent Activities
- Shared Database
- Concurrency Control



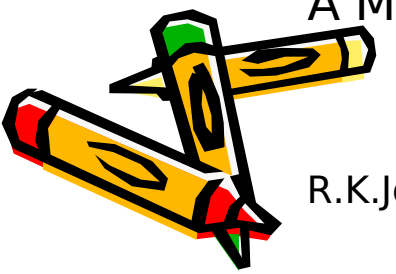
A More complex Single user application using persistence

Processes + Data +Interfaces + Parallelism → Concurrency

- A GUI
- Tasks: Concurrent and parallel Activities
- Shared Database
- Distribution of control
- Concurrency Control
- Inter-task communication

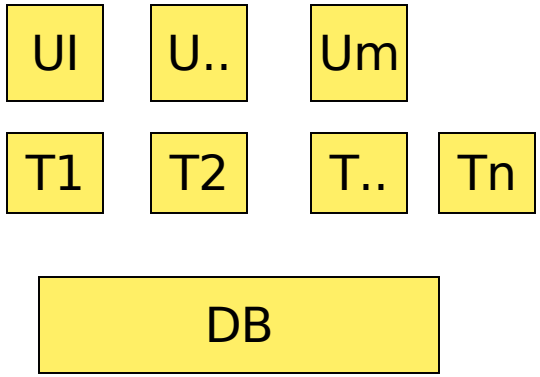


A More complex Single user parallel application using persistence



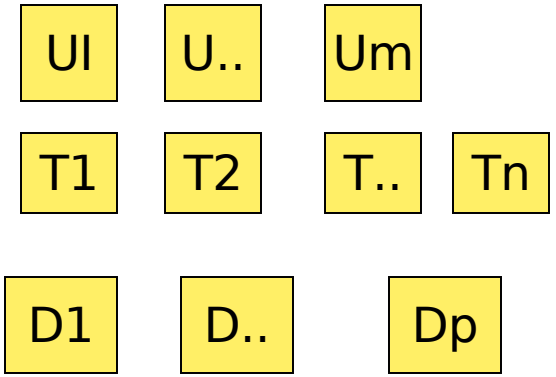
Add more user roles

- Views
- Viewers are located at different places



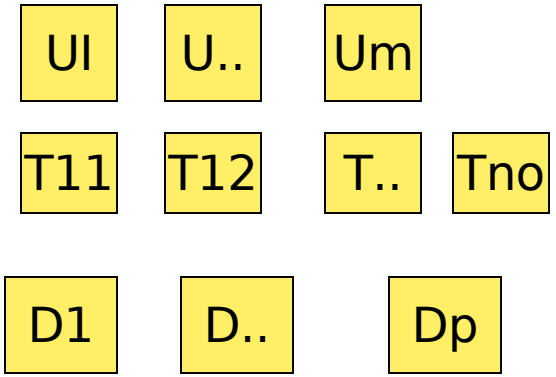
Add more data sites

- Views
- Viewers are located at different places
- Data is distributed
- Tasks are parallel



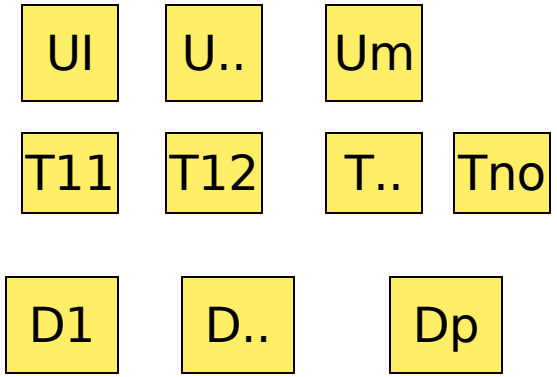
Add control replication

- Views
- Viewers are located at different places
- Data is distributed
- Tasks are parallel
  - Possible Control replication



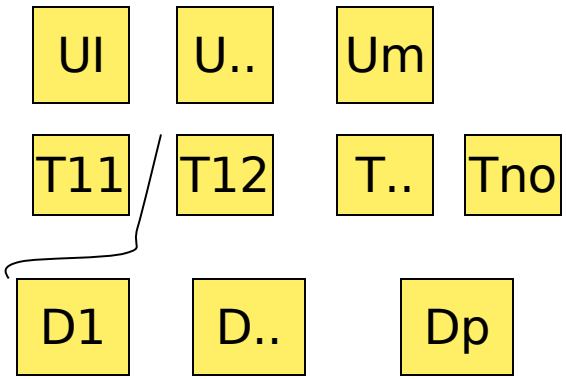
Add data replication

- Views
- Viewers are located at different places
- Data is distributed
  - And replicated
    - Multiple copy consistency
- Tasks are parallel
  - Control replication



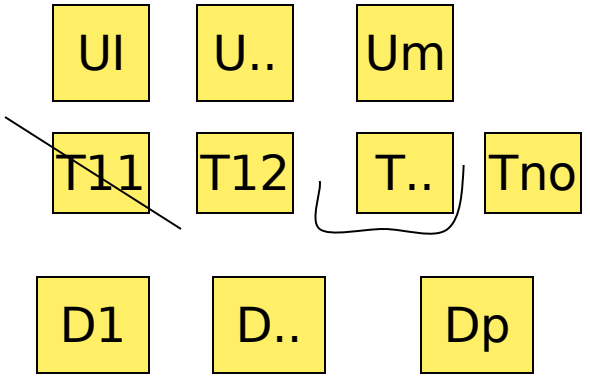
Links may fail !

- Alternate routes?

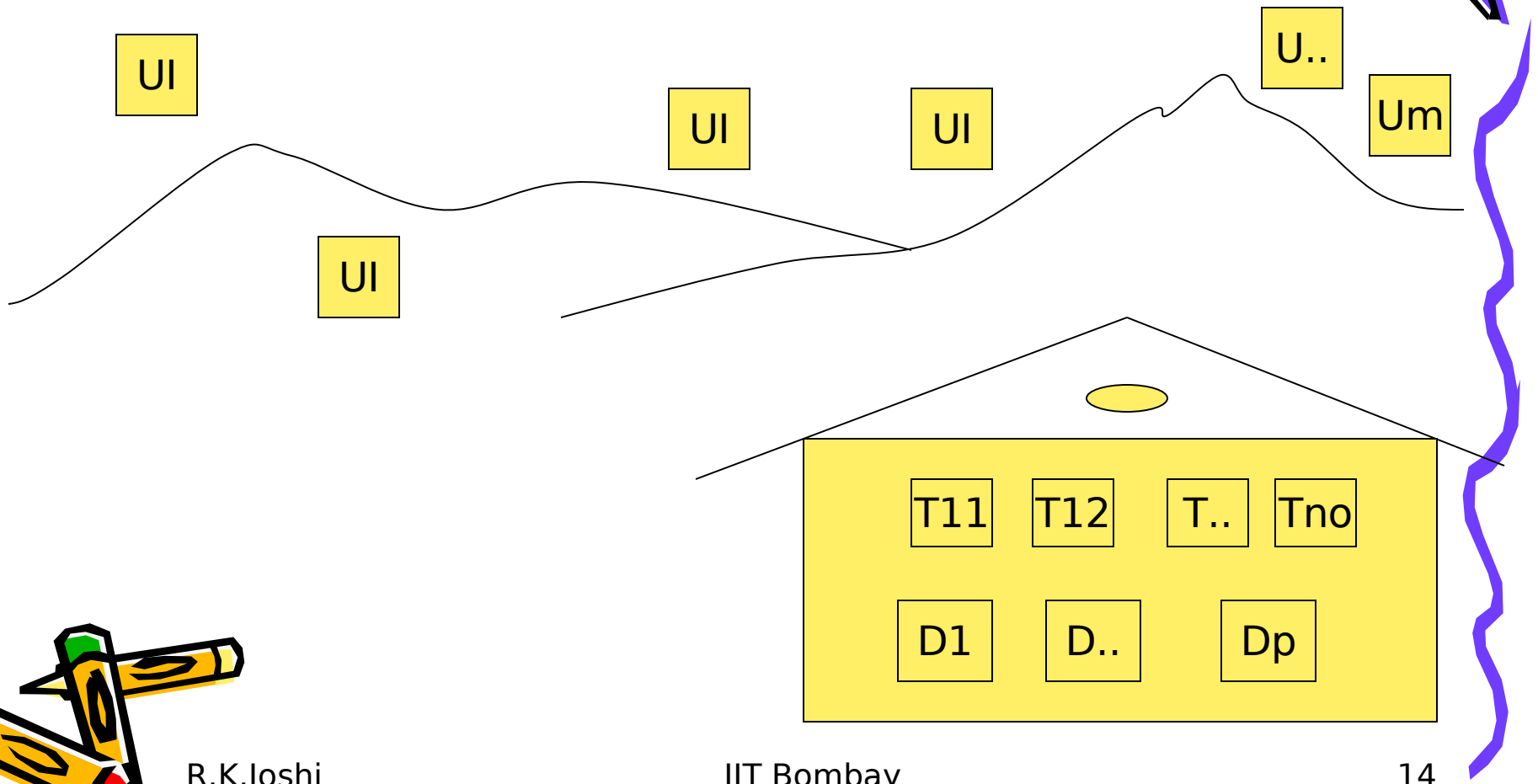


Tasks may fail !

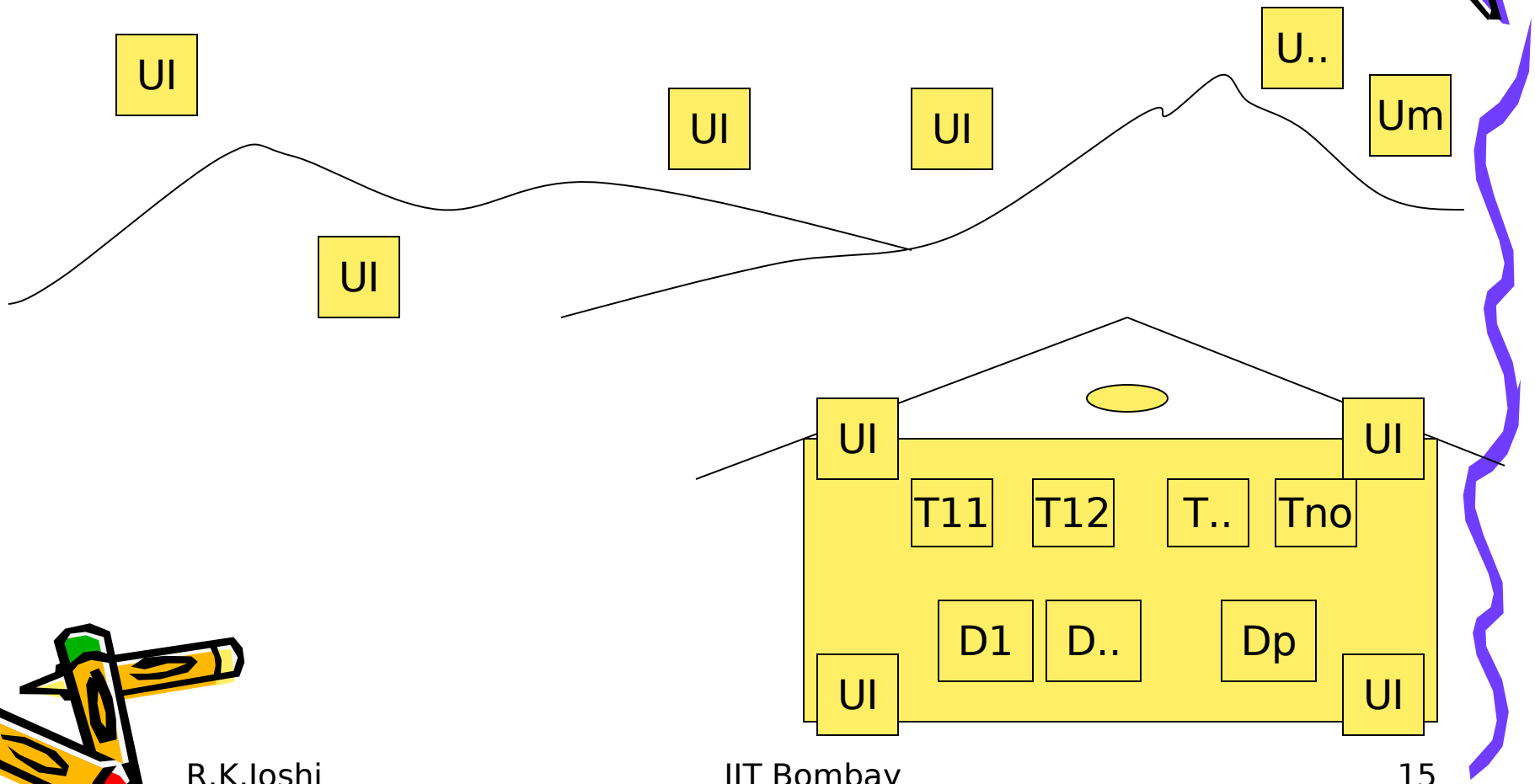
- Failure Semantics
- Recovery possible?



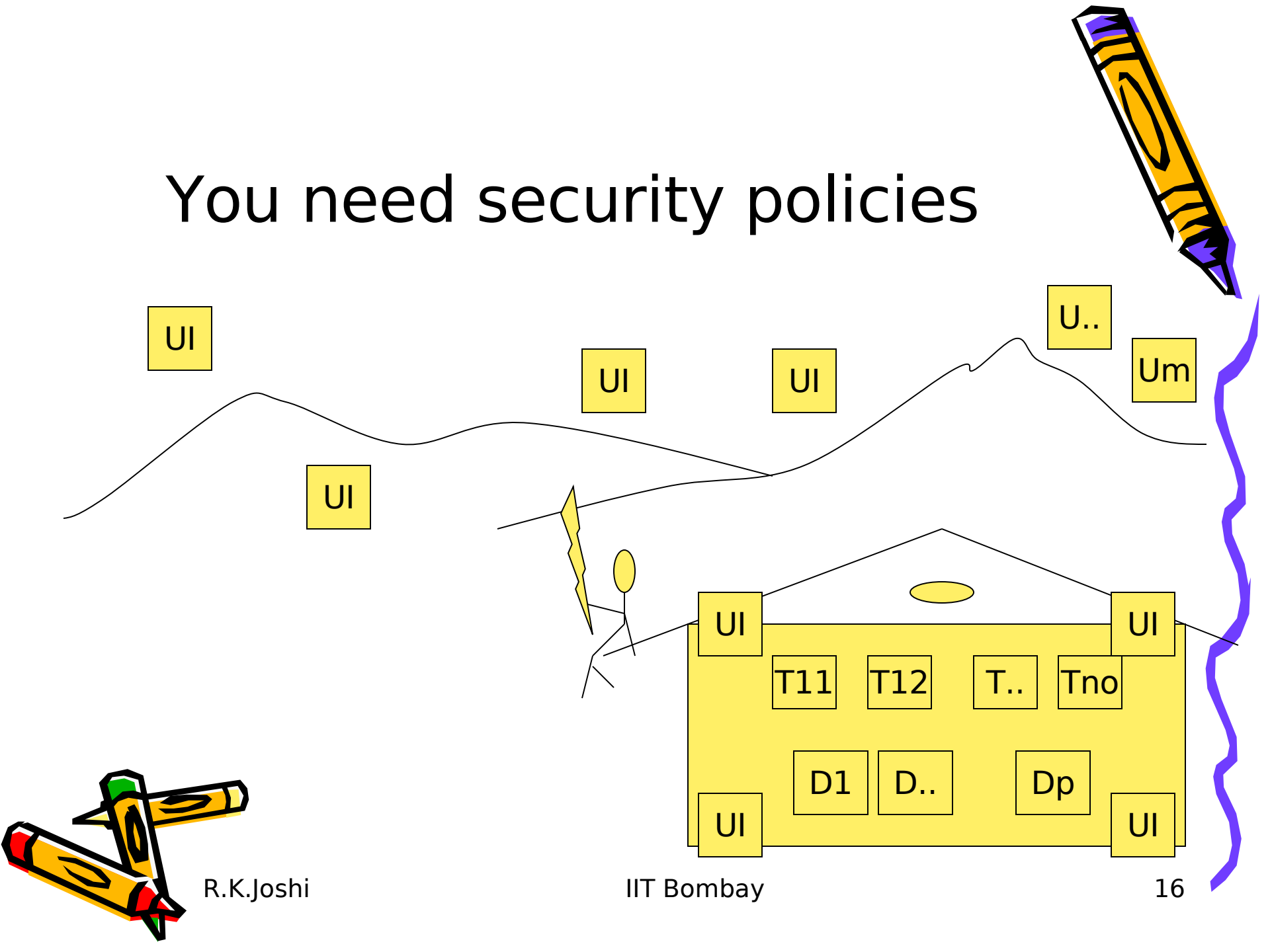
Users are scattered over the internet



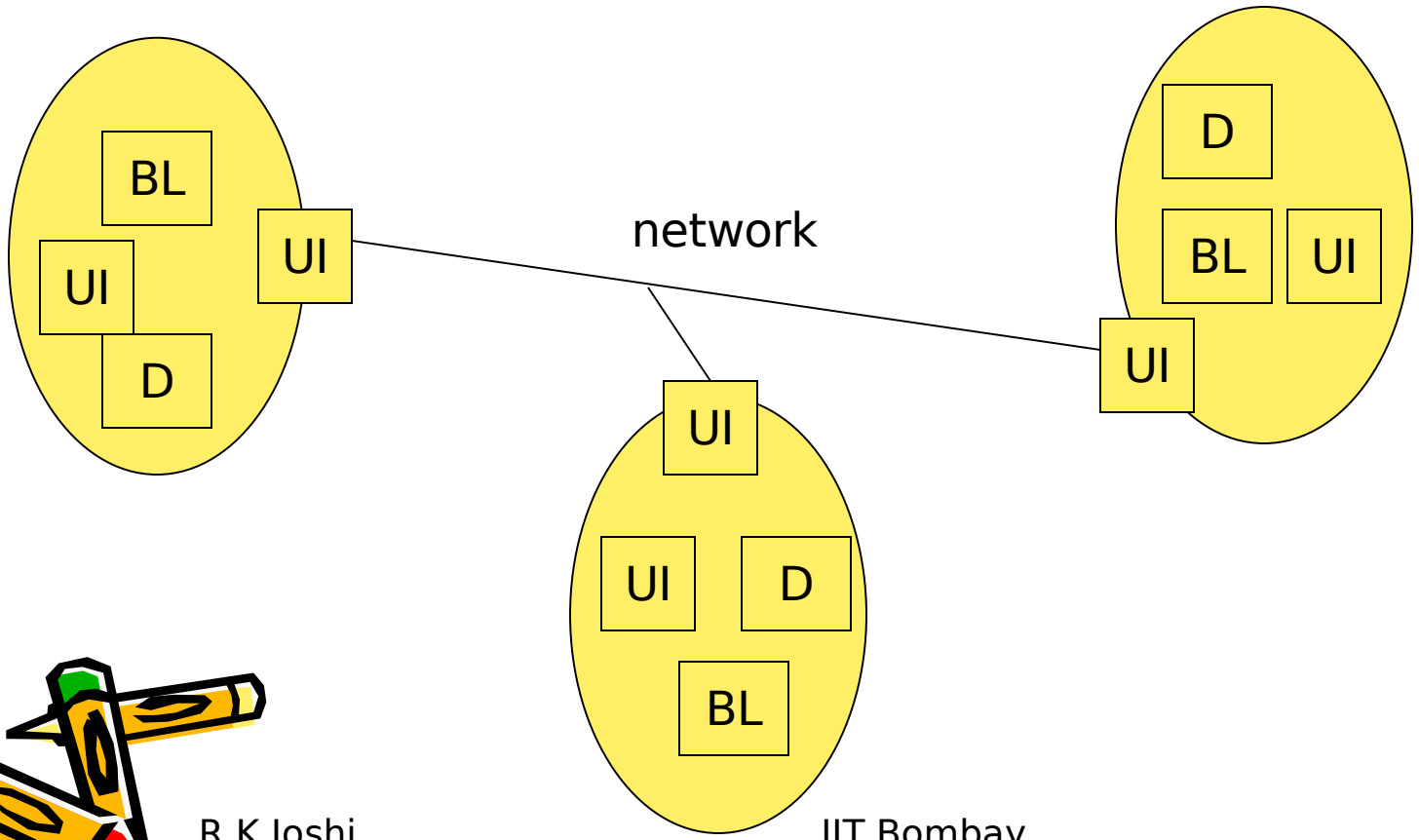
Some users are local



You need security policies



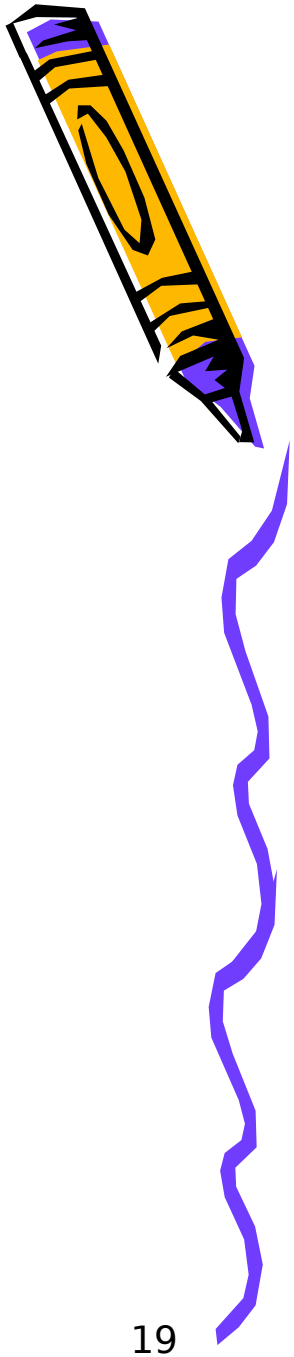
All sites have all the layers and they collaborate



Types of Applications

- Compute centric, parallel
- Data centric, huge data
- Computations and data centric
- Long vs. short transactions
- Distributed and Networked
- High volume, large users
- Event driven
- Peer-to-peer, client-server, service oriented
- Multi-concern

Service orientation



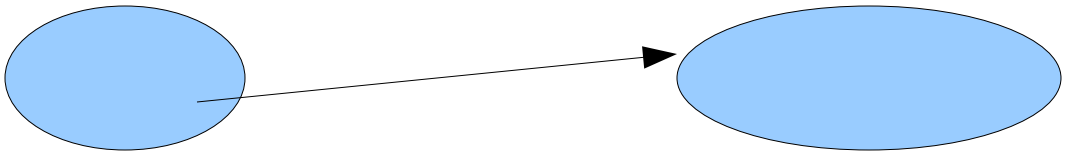
What is a service?

Service provider
and the service user

Service contracts

Origins of service orientation

- Functions and procedures
- Input parameters --> output results
- What is important is an interaction between the client and the server
- Call to the service



How do you express a service?

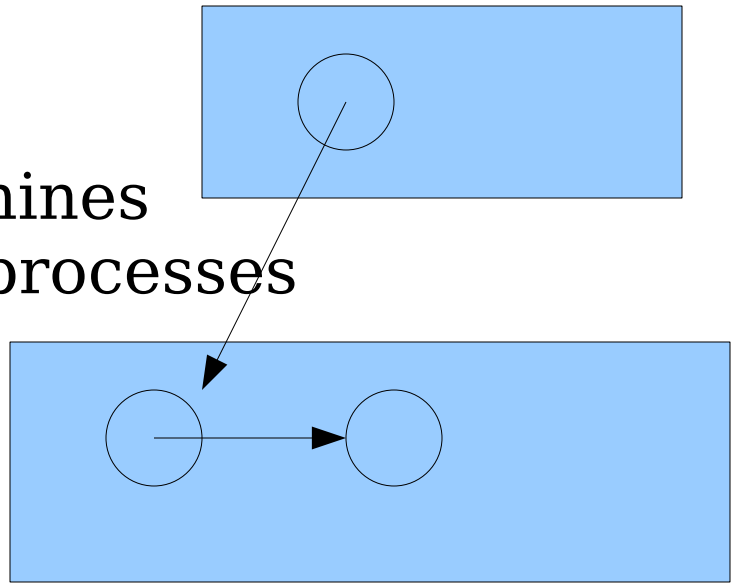
- Syntactic Contracts
- Behavioral Contracts
  - Functional behavior
  - Non-functional behavior

From local call to Remote Procedure Call

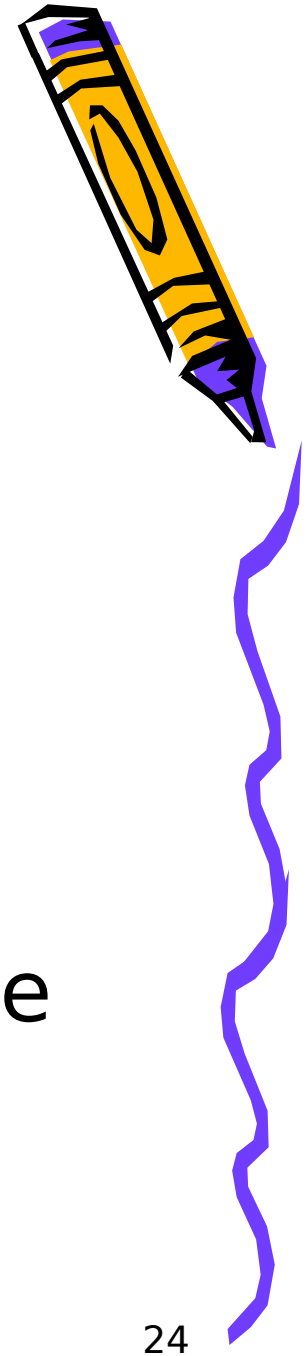
- The procedure may be located out of the calling process
- Procedure may also be located at a remote machine

RPC (early 80s)

- A very primitive service paradigm in multiprogramming systems
  - e.g. unix servers
  - Rup
  - Rusers
  - Fingerd



Issues considered in RPC



- How do you describe RPC?
- What's the process of development?
- How do you find, bind and use?
- What are the non-functional semantics such as fault tolerance semantics?

Technologies for RPC

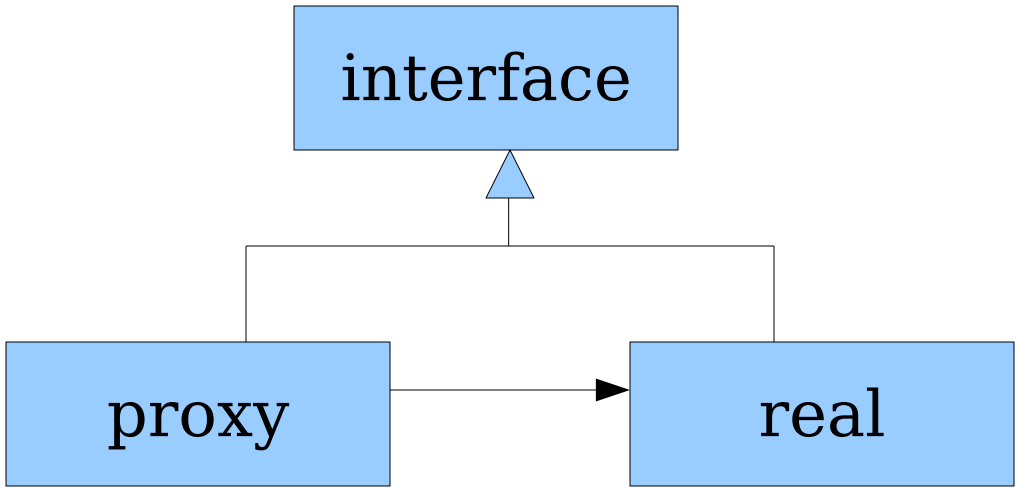
- Description: e.g. XDR format
- Marshalling and De-marshalling
- Specification Language
- Stub generator
- Portmapper (directory service)

DLL Technologies

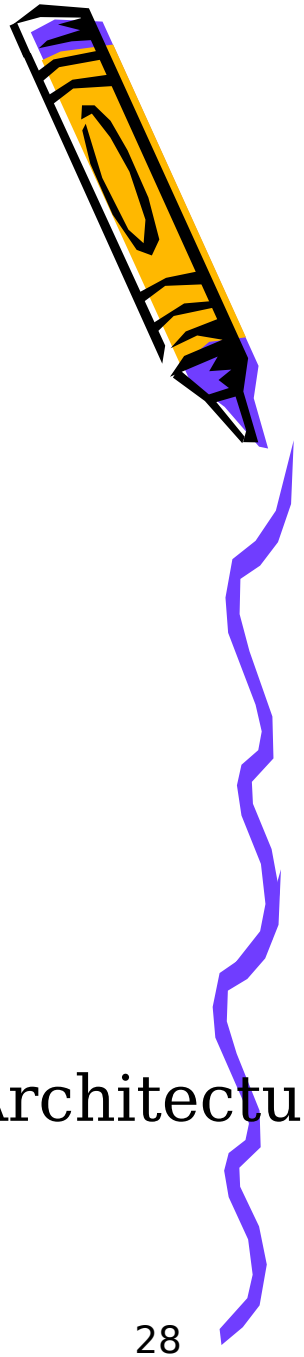
- Dynamically linked libraries
- A function or procedure may be loaded and dynamically linked
- Available on the same machine

Remote Method Invocations on Objects

- The Proxy Pattern

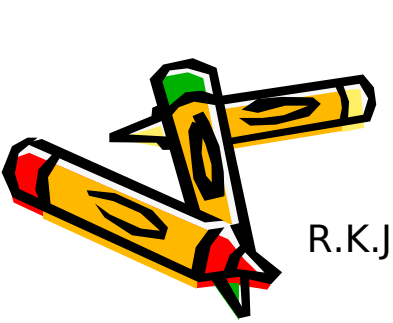


Technologies for RMI

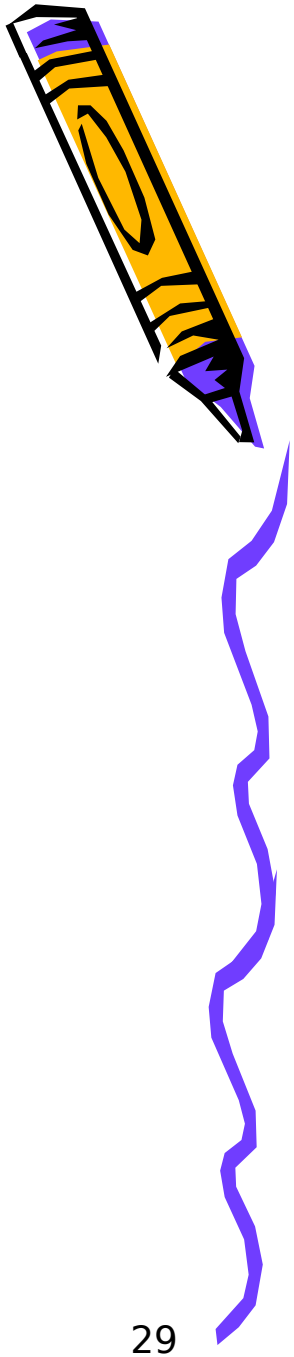


- Object specification
- Server development, Proxy generation
- Object discovery
- Object binding and use

Object Middleware Architectu

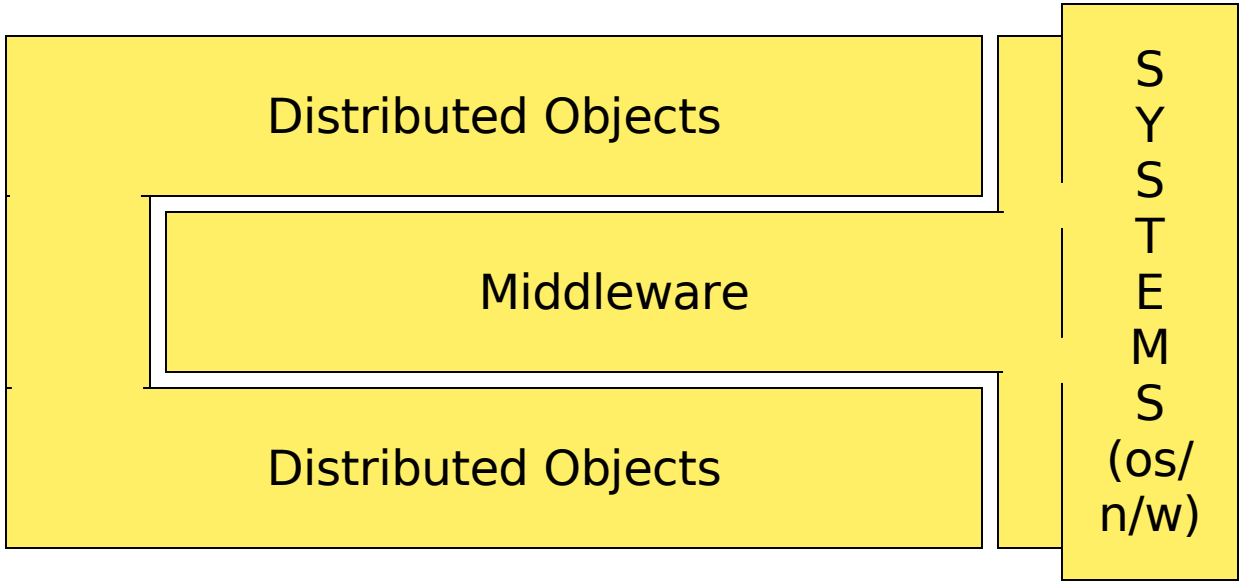


Middleware Technologies for Interoperable Networked Services



- *Typical of Applications in Lan*
- *Hide and Provide* Principle

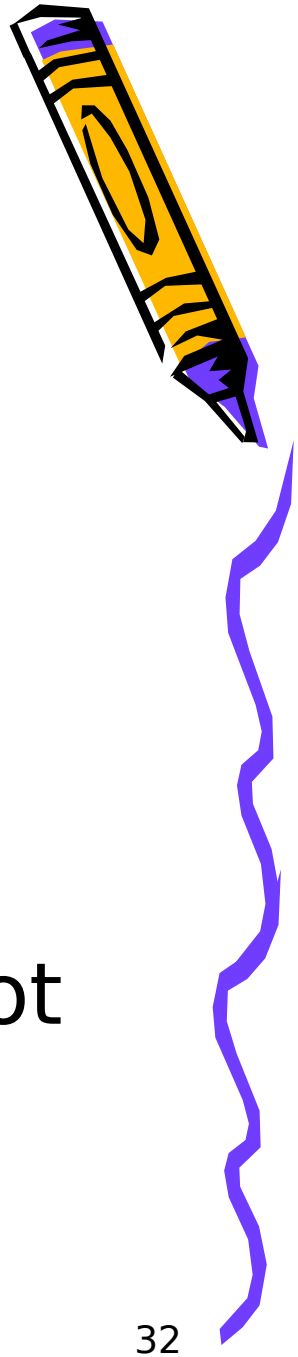
A View of CORBA-based Middleware



Concerns addressed by Middleware

- Connectivity and Communication
- Interoperability
- Repositories
- Activation
- Services
- Service Descriptions and discovery Mechanisms
- Development Process and Tools
- Standardization

Model Driven Approach



Model first

Then generate Implementation

Existence of Middleware does not make an exception to this.

Interfaces

```
Interface I {
   typeR func f (type1, type2 ..)
   ...
}
```

Interface description languages: vendor specific

Implementation in an object paradigm

Skeleton-Implementation inherits I {

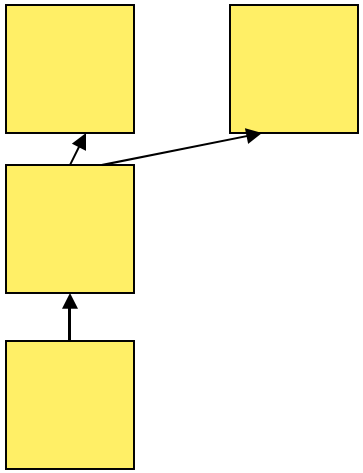
    ...

}

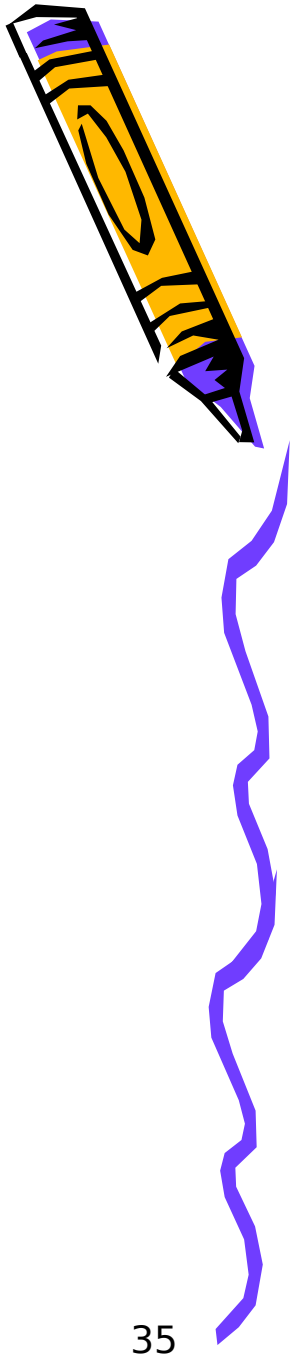
Actual-Implementation inherits Skeleton-Implementation {

....implement here...

}



Register your implementation



Create an instance and register

- obj = new Actual

- register it with a registry

- start accepting requests

Alternative Registration Mechanism

Do not Create instance directly

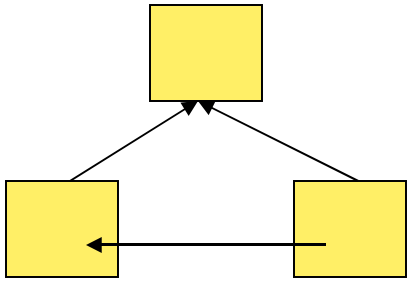
Register only the implementation

The middleware will create an instance when needed

Find, Bind and Invoke

- Find your component
- Create a placeholder for it
- Invoke as if it is a local component

Proxy Design Pattern

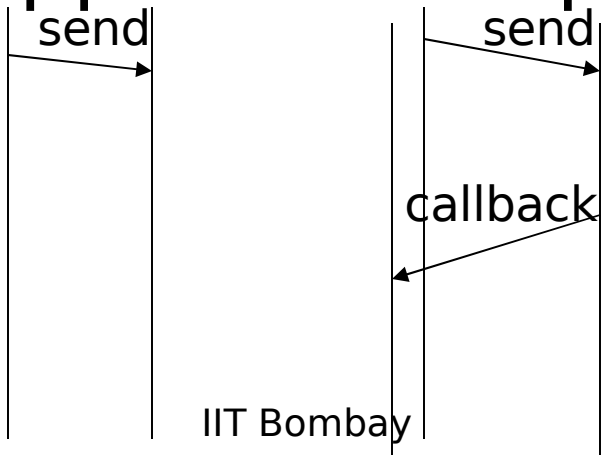


Dynamic Invocation

- Unlike procedure/function calls in your day to day programming
- Make a request as a message and send it to remote component

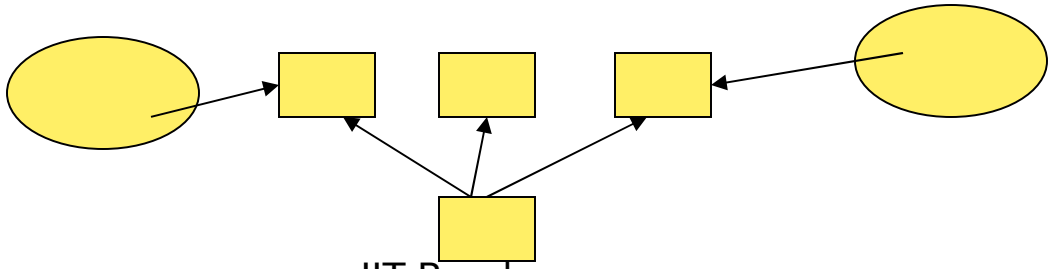
One way calls and callbacks

- One way calls do not block the caller
- Callbacks from server needs that the caller supports an exportable interface



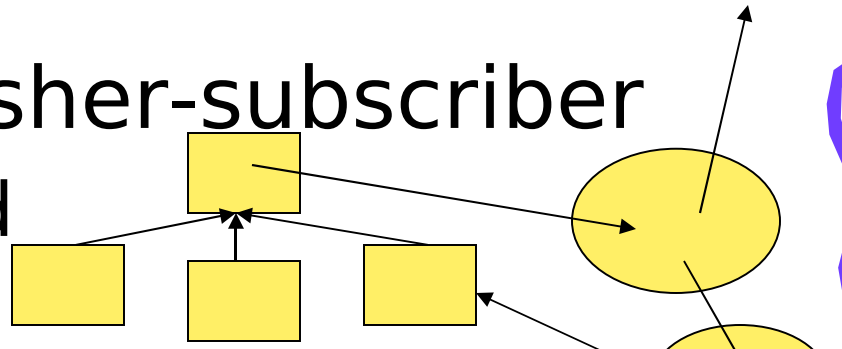
Multiple interfaces sharing an implementation

- Different users may use different interfaces
- Roles can be associated with interfaces
- Single implementation realizes all
- Interface navigability

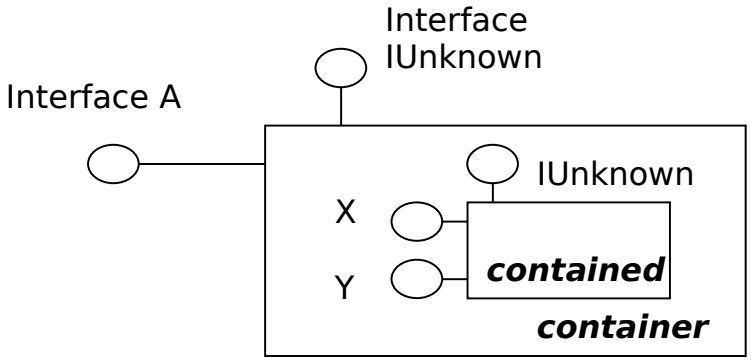


Generic Services

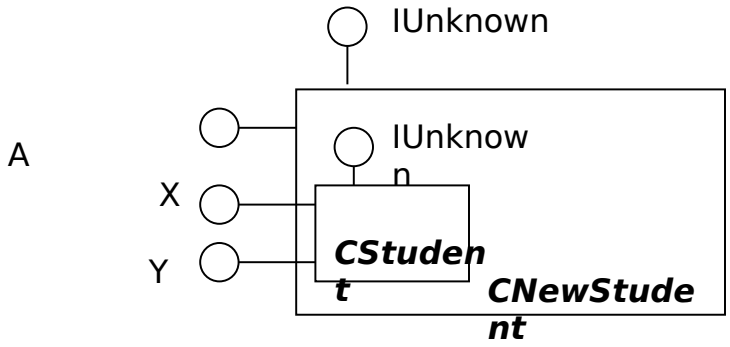
- Type independent services
- Based on object orientation (polymorphism)
- E.g. Naming: name→object mappings
- E.g. events: publisher-subscriber
  - Events of any kind



Component Reuse: e.g. Containment in COM/DCOM

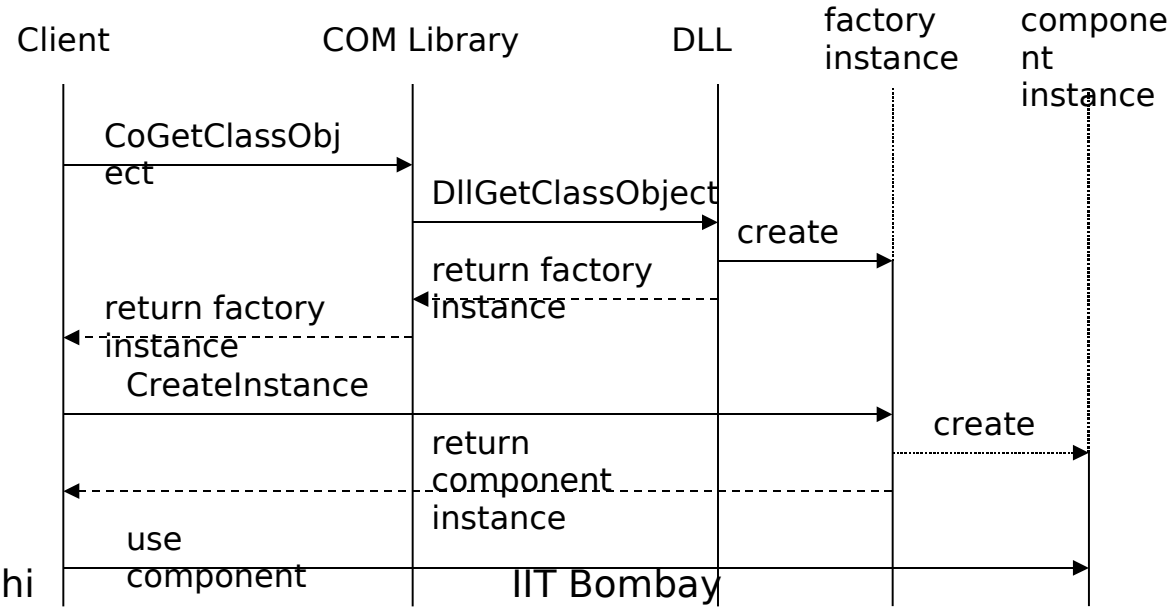


Component Reuse: Aggregation in COM/DCOM



Creation through Factory Objects

- First find and bind to factory
- Factory creates objects
- DLL based factories



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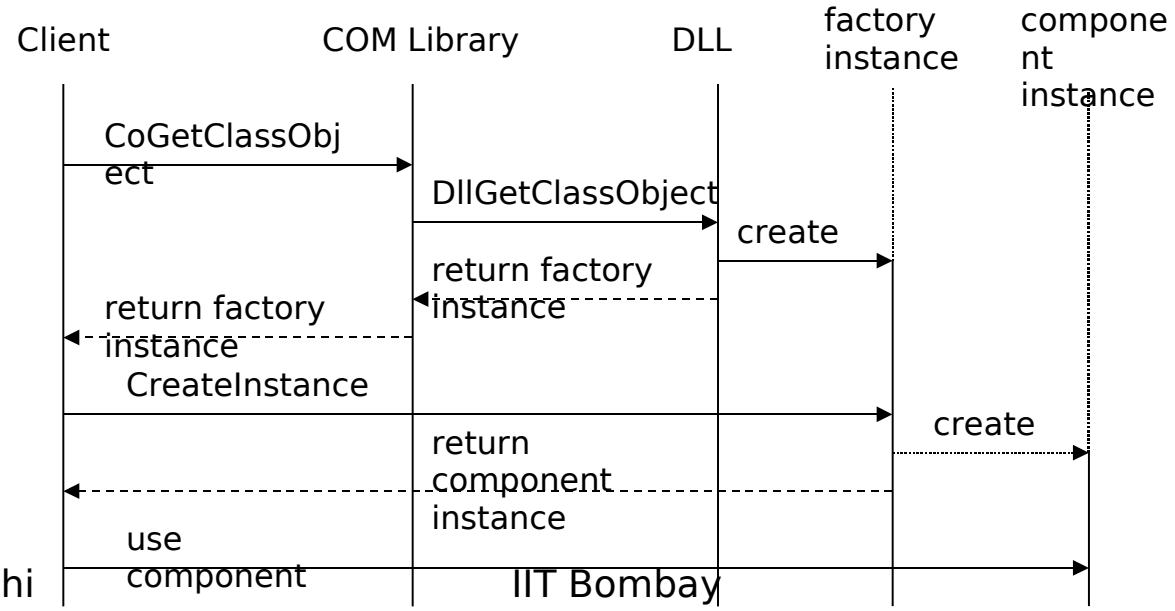


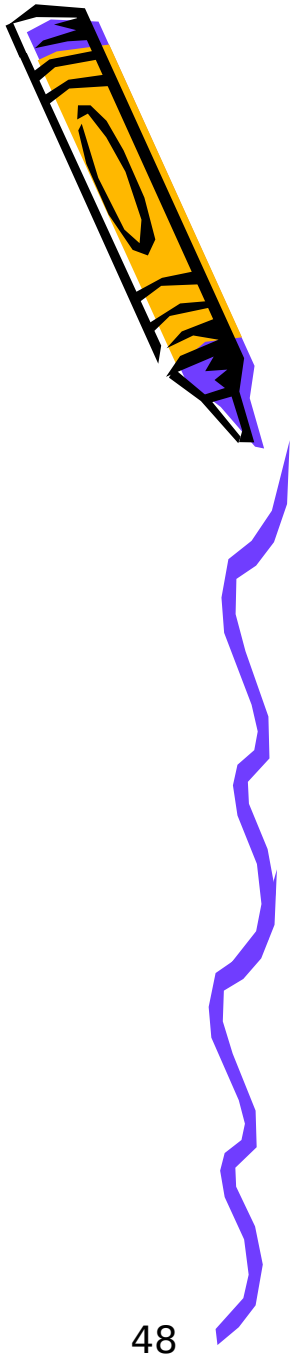
Web Services

- A service is available through http-based protocols.
- You have to cross the firewalls
- A different set of technologies, but the issues are the same
- You need to rework out all the issues of communication, typing, discovery, descriptions, security

Example Web Service Standards and Technologies

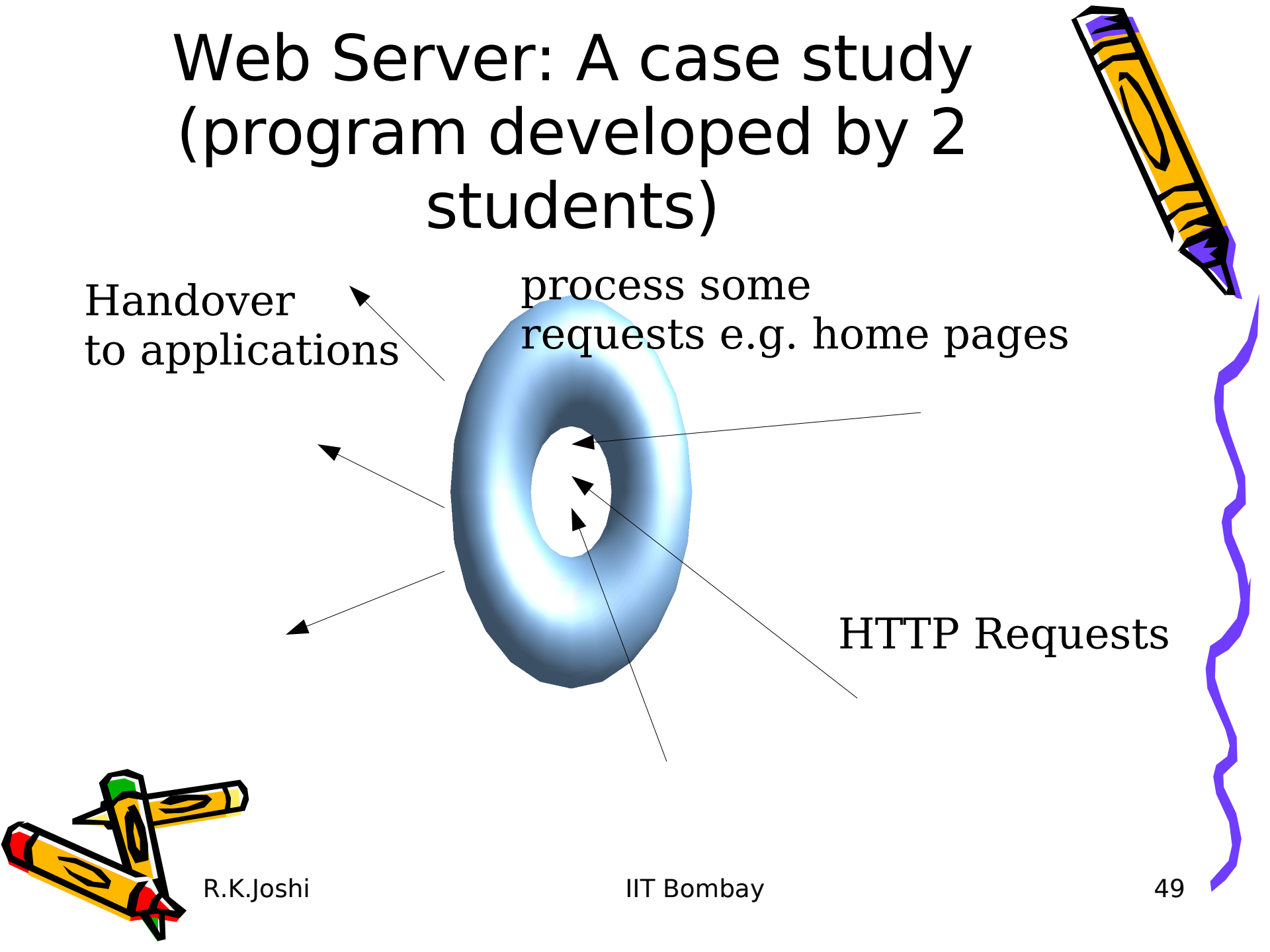
- WSDL – web service description language
- SOAP – Simple object access protocol for exchanging xml based messages
- UDDI – universal description discovery and integration

Some examples of service orientation



- Telephonic services
- Web Services
- Services for mobile devices
- Peer to peer applications
- Aggregates and Compositions

Web Server: A case study (program developed by 2 students)



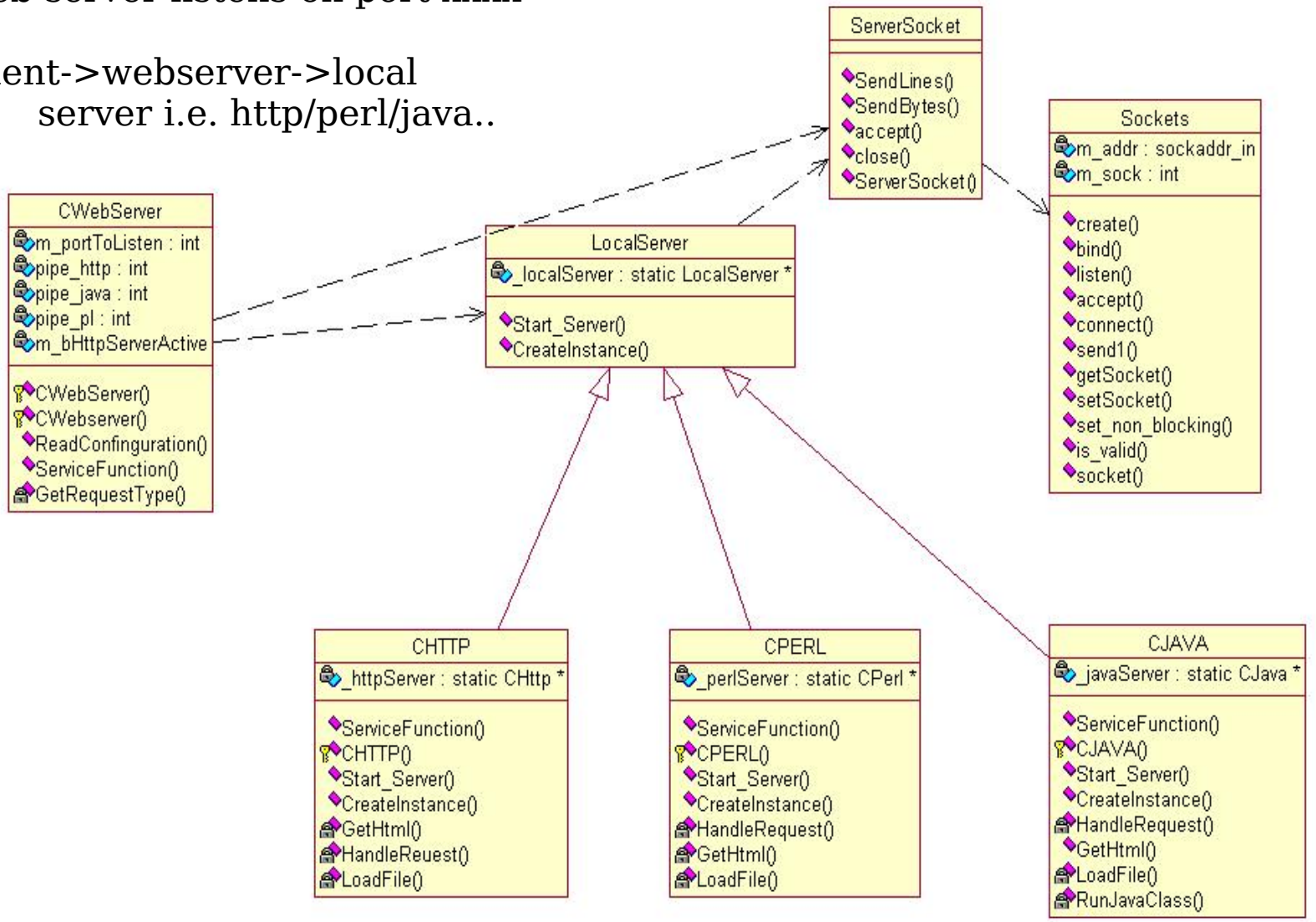
First, a Simple Socket Server An example code

- simple_server_main.cpp

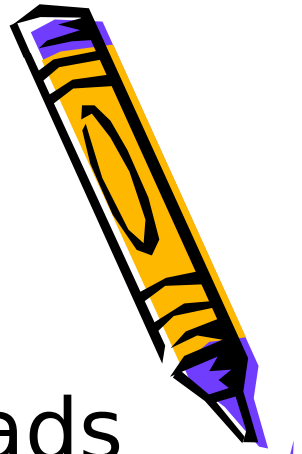
A simple webserver code how does it look like?

web server listens on port xxxx

client->webserver->local
server i.e. http/perl/java..



Implementation



- instances of local server as threads
- Another web server thread listens to incoming requests
- request type determined and the request dispatched
- communication between main thread and local threads through pipes, one per local thread

CLASS: CWebServer

CWebServer()

Input: int port, int p_http, int p_java, int p_plÂ

creates an instance of CWebServer. (this is the constructor)

Service_function()

Input: CWebServer * _webserver Output: nothing

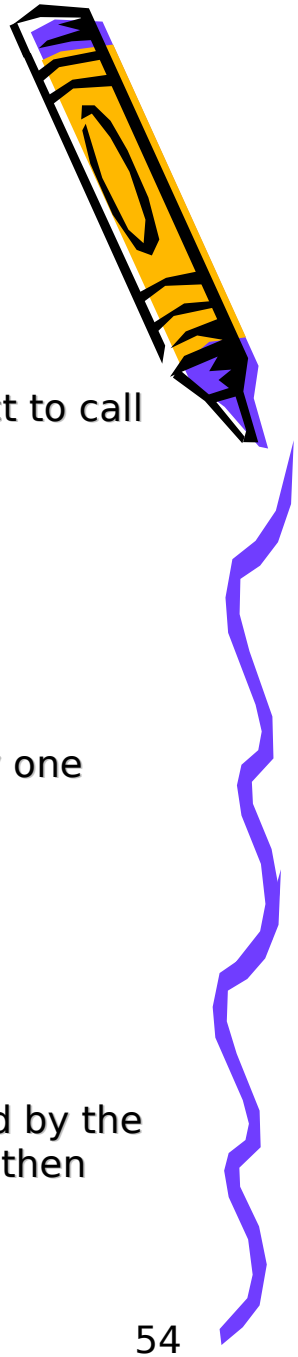
The main service loop which infinitely listens to the port for incoming requests and then classifies them and dispatches them to the appropriate LocalServer thread.

GetRequestType()

Input: std::string line Output: int request_type

Classifies the incoming request as one of the following HTTP_REQ, JAVA_REQ, PL_REQ, BAD_REQ which then helps the service loop to decide which thread to send the request to.

CLASS : LocalServer



this is an abstract class which only provides the interface to the CWEbServer object to call the functions on the appropriate LocalServer objects

CreateInstance()

Input : int pipe_d

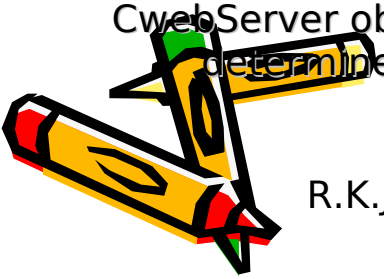
Output : static LocalServer * Â

This is the function which emulates the SINGLETON pattern to ensure that only one instance of each of the LocalServers is created.

HandleRequest()

Input : int sock, string & strFirstLineÂ

This function is supported by all the LocalServer objects. This is the function called by the CwebServer object to dispatch the request. Basically this reads the header and then determines the actions to be taken and then returns the file back to client.



CLASS : CHTTP

CLASS: CHTTPÂ

CHTTP

Input:int pipe_dÂ

Description: This is the constructor which creates a pipe for this object which communicates with the main service loop which diverts the appropriate incoming request to this object.

GetHtml ()

Input : http_request * rÂ

Description : This function searches for the requested file and then sends it to client with the help of LoadFile function.

LoadFile ()

Input : string & strFilePath, string & strFileContentsÂ

Description: This function when called by the GetHtml, gets the contents of the requestd file and then sends it to the client (bypassing the CwebServer object).

CLASS : CPerl

CPerl

Input:int pipe_dÂ

Description: This is the constructor which creates a pipe for this object which communicates with the main service loop which diverts the appropriate incoming request to this object.

GetPerl ()

Input : perl_request * rÂ

Description : This function searches for the requested file and then sends it to client with the help of LoadFile function.

LoadFile ()

Input : string & strFilePath, string & strFileContentsÂ Â

Â Description: This function when called by the GetPerl, gets the contents of the requestd file and then sends it to the client (bypassing the CwebServer object).

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CLASS : CJava

CJava

Input:int pipe_dÂ

Description: This is the constructor which creates a pipe for this object which communicates with the main service loop which diverts the appropriate incoming request to this object.

GetJava()

Input : java_request * rÂ

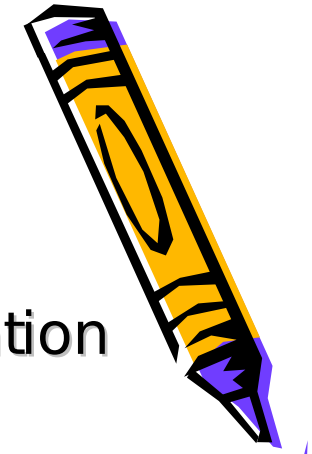
Description : This function searches for the requested file and then sends it to client with the help of LoadFile function.

LoadFile ()

Input : string & strFilePath, string & strFileContentsÂ

Description: This function when called by the GetJava, gets the contents of the requestd file and then sends it to the client (bypassing the CwebServer object).

Natural Extensions



How are logins and permissions and communication security to be handled?

How should requests be logged?

What support is assumed from the browser at client end?

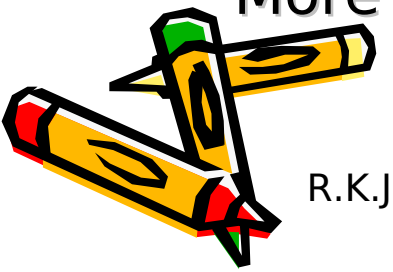
What support is available for application architectures?

Grids at the backend?

How are services themselves described?

What formats are used to exchange data, requests, results?

More meaningful or semantically rich applications designed as services



Once again, what's a service?

Agreed protocol between client and a server

Web services are provided on the web

Servers may use sophisticated available technologies, middleware, parallelism, shared spaces, shared resources

At client side, some support is provided by the browser, but stand-alone applications can also exist

So Explore and Enjoy your workshop!