Requests

- A request is a message that describes a unit of work for the system to execute.
- An application server coordinates the flow of requests between message sources (displays, applications, etc.) and application programs that run requests as transactions.

Basic control flow:
- Translate the display input (form, menu selection, etc.) into a standard format request
- Send the request to the appropriate server based on the transaction type in the request header
- Start the transaction
- Invoke the transaction type's application program
- Commit and send the transaction's output to the display

Application Server Architecture

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- An application server coordinates the flow of requests between message sources and application programs that run requests as transactions.
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Application Server Components

- Web Browser
  - A smart device, with forms, menus, input validation
  - "Calls" the web page associated with the URL, which in turn calls a workflow controller
- Workflow Controller
  - Calls Start, Commit, and Abort
  - App logic that transforms the request (automatic loan payment, money transfer) into calls on basic objects (loan, account)
  - Sometimes called business rules
- Transaction Server
  - Business objects (customer, account, loan, teller)
- Resource Manager
  - Usually a database (DB) system

Project's Process Architecture

- For the most part, Workflow Controllers and Transaction Servers are just plain old server programs.
- The features that differentiate a Workflow Controller are:
  - Brackets transactions (issues Start, Commit, and Abort), so that transaction server procedures can execute either as independent transactions or as steps in larger transactions
  - Reports Commit to the client (e.g., web server)
  - Handles Aborts and other failures (e.g., re-runs the transaction)
  - Does not access the DB system, so need not be close to the DB system (i.e., Resource Manager)
**Transaction Server**

- The features that differentiate a Transaction Server are the inverse of the Workflow Controller, namely that it:
  - Does not issue Start, Commit, and Abort (so it can be called either as an independent transaction or as a step in larger transaction)
  - Does not talk directly to the client (e.g., Web Server)
  - Can access the DB system
- In addition, it can call other transaction servers.
- Some transaction server code runs as stored procedures inside the DB system.
- So combining the transaction server and resource manager in the project isn’t really an oversimplification.

**Transaction Manager (TM)**

- The TM is the server that supports Start, Commit, and Abort.
- It implements two-phase commit (2PC).
- This is a major feature of many application servers.
  - 10 years ago, it was a major feature (TM + RPC).
  - Supports 2PC across different RMs.
- So it’s useful to have a TM in the application server even though DB products implement 2PC themselves.

**Project’s Process Architecture**

- Web Browser
- Web Server
- Workflow Controller
- Transaction Server
- Resource Manager
- Transaction Manger
- Start, Commit, Abort
- 2PC

**Remote Procedure Call (RPC)**

- Within a system or intranet, RPC is the most popular form of inter-process communication.
- A program calls a remote procedure (in another process) the same way it would call a local procedure.
  - This simplifies the message protocol. It’s always a call message followed by a return message.
  - It hides certain communications errors.
  - It automates the work of marshaling parameters into and out of the call and return messages.
- There are many implementations of the concept:
  - RMI, DCOM, CORBA/IIOP, HTTP, SOAP, ODBC, ...
- In the project, all inter-process communications is via RPC.

**Transactional RPC**

- Transactional RPC is an RPC protocol that implements the necessary plumbing to cope with a caller and/or callee that are running a transaction.
- Ideally, Start returns a transaction ID that’s hidden from the caller in a transaction context.
  - Transactional RPC passes the transaction context as a hidden parameter. It’s an easier program model and avoids errors.
  - When a transaction first arrives at a callee C, C needs to enlist with the local transaction manager (TM), so the TM knows to call C during two-phase commit.
  - A lot, C needs to execute the call in the context of the transaction that called it.

**Transactional RPC in the Project**

- You are in a project using transactional RPC in the project.
  - In steps 6 and 7
  - But the transaction context parameter is explicit (not hidden).
**Project's Process Architecture (revisited)**

- **Web Server and Client**
  - Start, Commit, Abort
  - Transaction Controller
  - Resource Manager
  - Transaction Server

**Partitioning Servers**
- To add system capacity, add server machines.
- Sometimes, you can just relocate some server processes to different machines.
- But if an individual server process overloads one machine, then you need to partition the process.
  - Rooms: flights, cars, and hotel rooms are managed by one server process. Later, you partition them into separate processes.
  - This implies the WF C has to direct its RPC calls based on resource type.
  - To facilitate such changes, the mapping of resource name to server name can be made table-driven.
  - This scenario is developed in step (7) of the project, where multiple RMs are required.

**Parameter-Based Routing**
- Sometimes, it's not enough to partition by resource type, because a resource is too popular.
  - Example: flights
  - The solution is to partition the popular resource based on value ranges.
  - Example: flight number 1-1000 on Server A, flight number 1000-2000 on Server B, etc.
  - This implies that the WF C has to direct its calls based on parameter value (e.g. flight number).
  - To facilitate such changes, the mapping of parameter range to server name can be made table-driven.
  - This is a possible project extension (not required).

**Summary of Concepts**
- Workflow controller vs. Transaction Server
- Remote Procedure Call (RPC)
- Transactional RPC
- Transaction Manager
- Partitioning Servers
- Parameter-Based Routing

There's a lot more to say about Application Servers. We'll return to the topic in a later lecture.