6. Application Server Issues for the Project

CSEP 545 Transaction Processing for E-Commerce

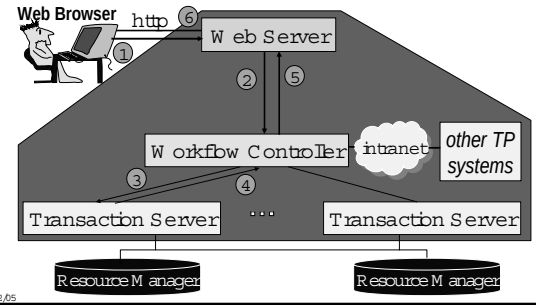
Philip A. Bernstein

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-form at 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

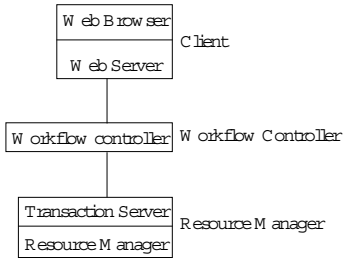
- App server should make the previous control flow scale up
- Bold lines carry request messages



Application Server Components

- Web Browser
  - A smart device, with forms, menus, input validation
- Web server
  - Performs front-end work, e.g., security, data caching, ...
  - "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 1



Workflow Controller

- For the most part, Workflow Controllers and Transaction Servers are just plain old server programs
- The features that differentiate a Workflow Controller are that it
  - 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 Commits 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 it need not be close to the DB system (i.e. Resource Manager)

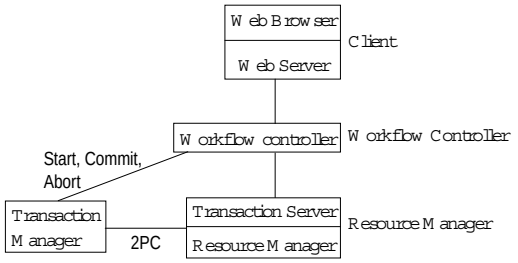
Transaction Server

- 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.
- Often, 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 the major feature (TM + T-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 2



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.

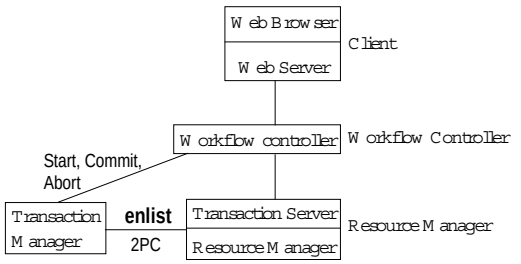
Transactional RPC

- 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 that transaction context as a hidden parameter. It's an easier programming 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.
  - Also, C needs to execute the call in the context of the transaction that called it.

Transactional RPC in the Project

- You are implementing transactional RPC in the project.
  - In steps 6 and 7
  - But the transaction context parameter is explicit (not hidden).

Project's Process Architecture (revisited)



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.
  - Example – flights, cars, and hotel rooms are managed by one server process. Later, you partition them in separate processes.
  - This implies the WFC 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 a WFC 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.