SPA2007 - WS1
Strategies and Patterns for Systems Continuity
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Example System 2 - Trade Management

System Overview

This system is a "trade management" system[1] in a type of wholesale financial firm called a Futures Commission Merchant (FCM). The role of an FCM is to:

o Accept orders for exchange traded products such as derivatives (like the orange juice and pork belly futures made so famous by the film "Trading Places");

o To fulfil those orders on the appropriate exchange (such as LIFFE, CBOT or the SIMEX exchange, made famous by Nick Leason);

o To accept the resulting exchange trades (or "executions") from the exchange's clearing house and confirm that they are correct and that the FCM will take responsibility for them (the start of the "clearing" process).

Most FCMs provide this service to clients as well as trading on their own behalf (the former being known as "client" business, the latter as "proprietary" business).

The role of the trade management system (TMS) in this process is to accept inbound feeds of trading activity from the FCM's trading systems and executions from the clearing house and to match the two together, confirming the matched trades with the clearing house. The context diagram for the system is shown in Figure 1.
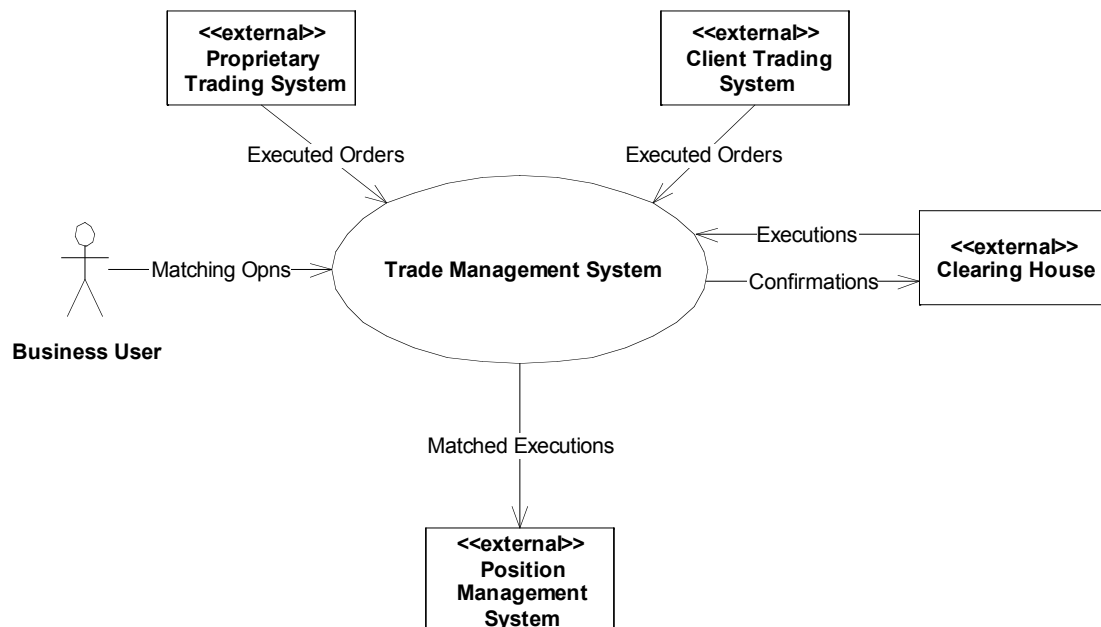

Figure 1 - Trade Management Context

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[1] If you familiar with this domain, I'm referring to a system like GL-Trade's ClearVision product.

The entities that interact with the TMS are as follows:

o *Proprietary Trading System* – the separate system used to capture proprietary trading orders and orders for clients who use the FCM to execute their trading business. This system routes the orders to exchanges for execution and feeds a copy of all of the executed orders[2] to the TMS for matching against the exchange's view of the world. This system is within the FCM.

o *Client Trading System* – systems within client organisations that perform their own execution with the exchange but use the FCM to manage ("clear") them. These systems feed copies of all of the executed orders for the client to the TMS for matching against the exchange. These systems are external to the FCM.

o *Clearing House* – the organisation that runs the clearing and settlement process for the exchange. For the purposes of this discussion, the clearing house sends a copy of the orders it believes have been executed by the FCM to the TMS and expects confirmation messages in return. The FCM will communicate with many clearing houses and typically needs to copy with proprietary hardware and software to communicate with each.

o *Business User* – an end user of the system in the Business Operations (or "Back Office") area of the FCM. These users wish to monitor the flow of business through the TMS, the matching performed and to intervene in the matching process when required (typically to force a match that the TMS fails to recognise due to static data mismatch, erroneous input to the trading systems or similar). These users all work for the FCM.

o *Position Management System* – a "down stream" system within the FCM that acts as the record keeping system[3] for the FCMs current trading activity both proprietary and client. The TMS must send copies of all matched executions[4] to this system so that they can be added to the appropriate financial records held within it.

The responsibilities of the TMS are:

o Accept inbound feeds of trading activity from internal and external trading systems.

o Accept inbound feeds of execution activity from exchange clearing houses.

o Match the feeds from the trading systems and the clearing houses, confirming those entries that match with the clearing houses.

o Send a feed of matched executions to the Position Management System.

o Provide an end-user interface to allow monitoring and intervention in the matching process.

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[2] Again, if you know about this area, you'll spot that these are actually allocations for booking in the PMS, but we can ignore this detail for the purposes of this discussion.

[3] This would be Rolfe and Nolan RANsys or Sungard GMI in most FCMs.

[4] Again, this is really allocations, but it's not important from a DR or HA point of view.

Functional View

The functional view of the TMS main processing elements is shown by the UML component diagram in Figure 2. Some of the optional aspects of this diagram (in particular the component interfaces) have been suppressed in this view to simplify it and because they aren't important for the purposes of this discussion.
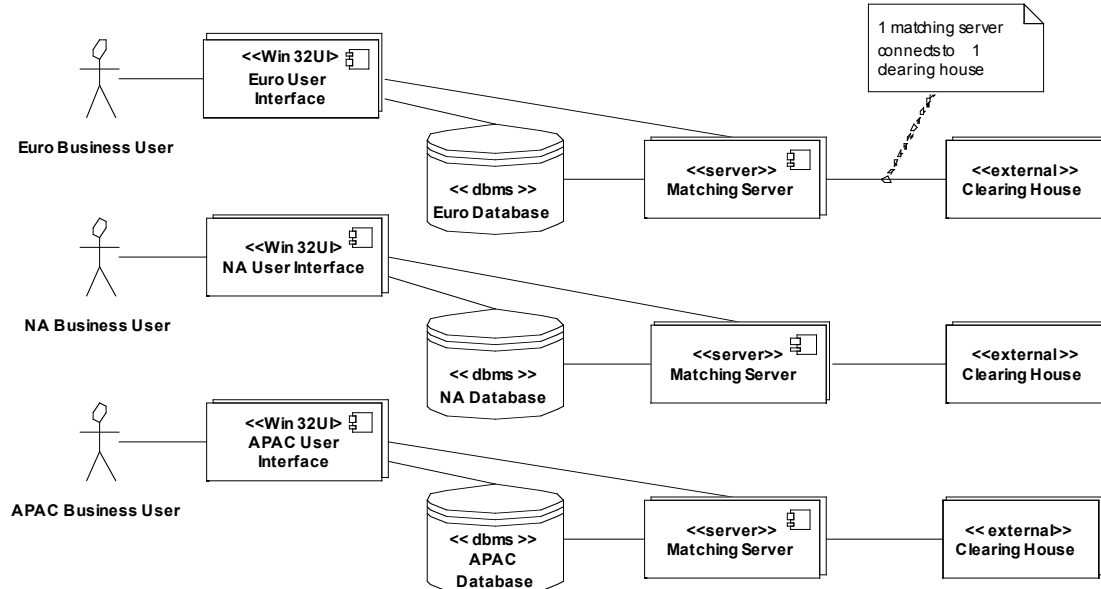

Figure 2 – Functional Processing Model

As can be seen from the diagram the functional components of this system are replicated three times, once for each operational region of the world (Europe, North America and Asia-Pacific). It is important to note that this isn't just a deployment detail involving replication of software (which could be relegated to the Deployment view) but while the underlying binaries are common globally, the configuration and usage of the components in different regions varies.[5] This means that, it is clearer to consider them as separate components, albeit ones that use the same binaries.

The elements in this model of the system are as follows:

o *User Interface* – A reasonably sophisticated Win32 "thick client" interface providing Business Operations users with monitoring and control capabilities over the matching process. Configured for a particular user to operate of a particular set of exchanges. *Provides* a human interface and *requires* a query interface to the DBMS for the region it operates in and a monitoring and control interface to each of the matching servers it is configured to connect to.[6]

o *Business User* – Not part of our system, but the external actor who wishes to use the user interface.

o *Database* – A relational database containing the transaction data, reference data and matching status data required for system operation. In addition to the common core (say 80% of the schema objects) extensions are installed for each

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[5] For example, each of the databases will have region specific tables, procedures, reference data and so on and the user interfaces will have different defaults, conventions and extension libraries loaded.

[6] This need for the UI to connect separately to the DBMS and each matching server isn't ideal but is exactly how one of the major commercial TMS packages works.

region to support region specific processing. Reference data is different in each regional database too. The database *provides* an SQL query interface to the schema objects it holds

o *Matching Server* – The matching servers are the functional core of the system, providing the actual matching processing and the interface to the clearing house. There is a 1:1 relationship between an execution market and a matching server (i.e. all of this FCM's business on the LIFFE exchange is matched by one matching server). There isn't any option to run multiple concurrent matching servers for one market for load balancing or high availability. Each matching server is configured to connect to a particular clearing house to match transactions for a particular execution market (that the clearing house provides clearing for). This configuration includes handling the vagaries of connection to each clearing house, sometimes involving leased lines, sometimes custom hardware devices and sometimes involving generic protocols like FTP, SFTP and HTTP over SSL. The matching servers *require* a query interface to the database and require a bi-directional interface to the clearing house. They *provide* a query and control interface to allow the matching process to be monitored and controlled if required.

o *Clearing House* – Not part of our system, but the external entity which the TMS interacts with in order to clear transactions. Each clearing house is different and exposes a proprietary interface for accepting executions and sending confirmations.

In order to keep the model diagrams readable, Figure 1 doesn't show how the allocations feed into the TMS or how the TMS feeds the PMS. These details are illustrated by the UML component diagram in Figure 3 (which again suppresses details of interfaces used and offered by components).
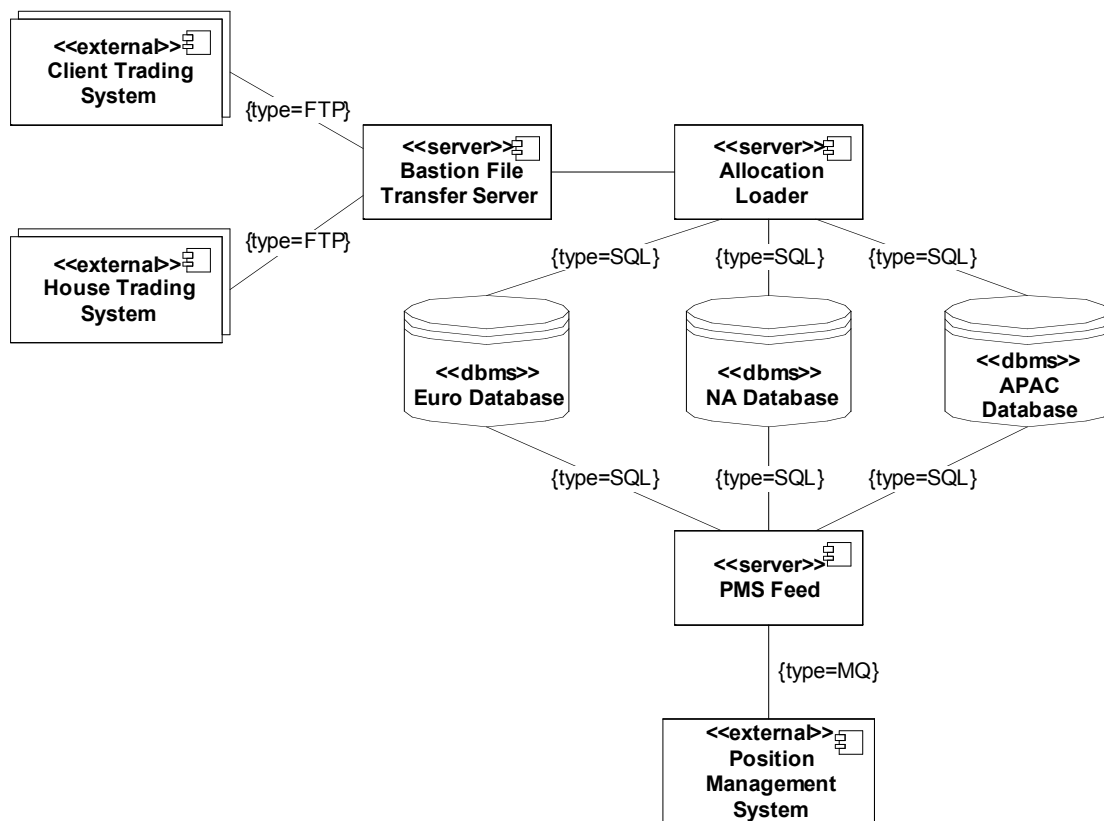

Figure 3 - Functional Data Feed Model

The elements in this model of the system are as follows:

o *House Trading Systems* – Not part of the TMS, these are the in-house front office systems that feed the TMS the executed orders for matching for the house (proprietary) business.

o *Client Trading Systems* – Not part of the TMS and outside the FCM's organisation, these are the systems within client organisations that feed the TMS the executed orders for each client for matching.

o *Bastion File Transfer Server* – A secure file transfer server, whose responsibility is to accept incoming files and store them securely, allowing them to be retrieved by other authorised system elements. *Provides* an incoming file transfer interface and an outgoing file retrieval interface for suitable authorised client elements.

o *Allocation Loader* – A server resident element, running on a regular batch schedule that reads incoming files of executed orders from the Bastion File Transfer Server and loads them into one of the TMS databases, the database being derived from the execution market that the executed orders relate to. *Requires* a file access interface to retrieve incoming files from and an SQL database interface to allow data to be inserted into the target database.

o PMS Feed – A server resident element, running continually (as a daemon style process), which reads newly matched executions from the regional databases and sends these to the PMS via a message queuing interface. *Requires* an SQL database interface in order to retrieve the matched executions and a message queue interface that accepts matched executions.

o *Position Management System* – Not part of the TMS, the Position Management System is the external system to which the TMS must send all matched executions so that they can be booked into the appropriate accounts.

Deployment View

The Deployment view captures the way in which the system's functional components are deployed into their production environment. The deployment for the TMS is shown in the UML deployment diagram in Figure 4. This model shows the deployment of all of the data centre resident elements of the system but doesn't show the deployment of clients as this is relatively straightforward – the client UI is simply installed on end-user workstations as required and connects to the required servers in the appropriate regional data centre.
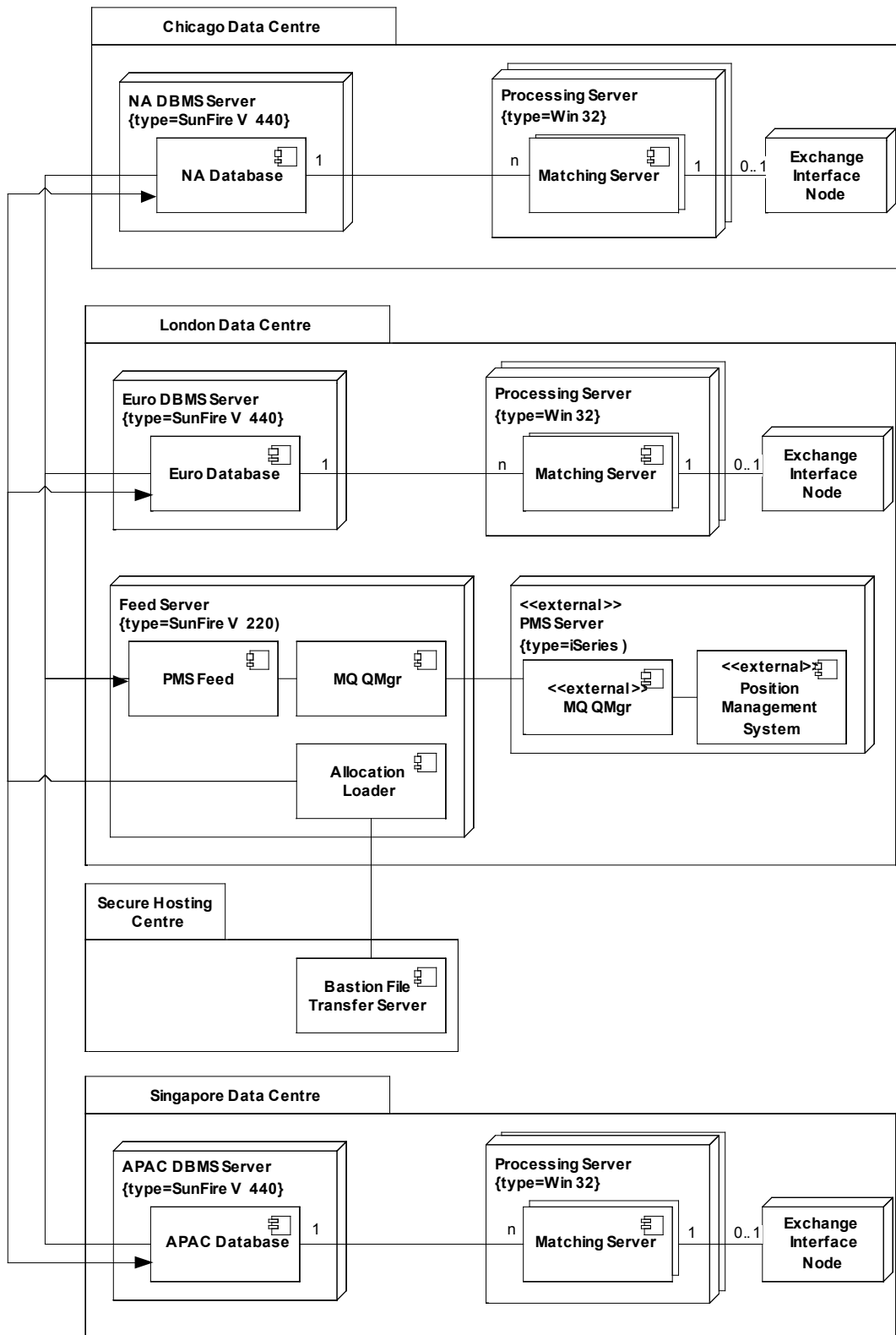
Figure 4 - Deployment Model

The elements of this deployment model are summarised below.

o The system is deployed across four data centres; there are 3 regional data centres and a secure hosting centre, run by a 3rd party, which the FCM uses to host the file transfer server.

- The Chicago, London and Singapore data centres all contain the core processing elements for their region (DBMS, matching servers and exchange interfacing hardware if required). There is one DBMS server and many Processing Server machines in each data centre. Each Processing Server hosts one Matching Server software server. Each Processing Server *may* have an associated Exchange Interface Node, if required, which provides proprietary connectivity to the clearing house. The storage required for the DBMS servers has been omitted from the diagram, but can be assumed to be part of the regional SAN infrastructure.

- The London data centre also contains a server machine that hosts the inter-component data feed software and the Position Management System, which runs on an IBM iSeries (nee AS/400) machine (although the PMS server isn't actually part of the TMS, but it does communicate with it).

- The TMS' elements run on a number of server types, with the databases and feeds running on Sun Solaris machines, while the processing servers run on Windows servers.

- For the purposes of this discussion, the Secure Hosting Centre just contains the file transfer server (along with the network hardware required to ensure that only the Allocation Loader can access the files uploaded to this server). The file transfer server is installed into this environment for security reasons to avoid a breach of this server leading to further breaches in the FCM's network.

- The PMS Feed element connects to the three regional databases in order to extract matched executions, which it feeds to the PMS. This feed uses IBM Websphere/MQ messaging and so there is an MQ Queue Manager server on both the Feed Server and the PMS Server.

- The Allocation Loader connects to the Bastion File Transfer Server to retrieve incoming files of executions, which it loads into the regional databases by connecting directly to them and running SQL statements to load the data into inbound data tables.

As it stands, the TMS has no high availability or disaster recovery provision in its deployment environment.