

Schroder Salomon Smith Barney: Citigroup **Global IP** Multicasting Network uses Cisco IOS® **Multicast** Technology to Deliver **Real-Time** Trading Data

SCHRODER SALOMON SMITH BARNEY
A member of citigroup

“Information is the key to global financial markets. To have access to timely, accurate, and critical information is essential for us to retain our position of leadership in the world of International finance.”

—Terry O’Leary, Project Director, Schroder Salomon Smith Barney

In today’s rapidly changing economy, mergers and acquisitions (M&As) is the name of the game if a company is to maintain its competitive edge. A major challenge of the M&A process is the successful merging of operations and technology infrastructures from two or more often disparate firms. By consolidation of world-class skills in financial and retail services, Citigroup leads the way with its business strategy of establishing an advanced global technology infrastructure to deliver real-time trading data from Reuters, Telerate, UPI, and other financial providers, as well as trading exchanges worldwide.

Initially, Citibank and Salomon Smith Barney (SSB) merged their operations under Citigroup and embarked on the project of building an advanced technology infrastructure and state-of-the-art trading floors in a new tower

building at its European headquarters located at the impressive financial development at Canary Wharf in London’s docklands. The critical date for this project was December 17, 1999 when the network design certification was completed and SSB committed to developing one of the

most advanced network infrastructures in the industry. Prior to this date, the network hardware and software would be assembled and tested off-site at Cisco headquarters in San Jose, California in a complete network staging, simulation, and testing—one of the largest proof-of-concepts Cisco had ever undertaken.



Citigroup's Financial Center under Development at Canary Wharf in London

In April 2000, Salomon Smith Barney purchased the Investment Banking Business of Schroder plc, which necessitated that the project be scaled up to accommodate the technical and business

integration of Schroder's operations. This merger formed the Schroder Salomon Smith Barney (SSSB) group, the European arm of Salomon Smith Barney in the U.S.

While the technology infrastructures of Citibank, Salomon Smith Barney and Schroder IT operations were broadly compatible, there was a need to standardize technology across the Citigroup companies. All three operations have been successfully integrated into a standard operating environment that forms the basis for the merged banks' European Investment Banking operations and global platform.

Citigroup Focuses on a Global Solution

The global technology infrastructure was designed to be completed in two phases, and is based on Cisco routers and switches running Cisco IOS[®] software, featuring multicast support and TIBCO trading floor applications. A key benefit to using multicast in the trading environment is the ability to ensure that all traders receive the same trading information at the same time. Citigroup selected Cisco as its partner in building this technology infrastructure based on multicast performance, raw IP forwarding speed, manageability of devices, and layer 3 enabled ATM functionality.

EXECUTIVE SUMMARY

BACKGROUND: Citigroup is the largest global financial services company providing some 100 million consumers, corporations, governments, and institutions in over 100 countries with a broad range of financial products and services, including consumer banking and credit, corporate and investment banking, insurance, securities brokerage, and asset management. Through its merged operations of Citibank, Salomon Smith Barney, and the Investment Banking Business of Schroders plc, it has successfully launched the first phase of the Citigroup Global IP multicast network.

CHALLENGE: The challenge lay in an ambitious schedule to integrate an advanced technology infrastructure into state-of-the-art trading floors of a new complex built at Citigroup's European headquarters at Canary Wharf in London. Prior to implementing Phase 1 of the Global IP multicast network, an extensive network staging and testing was completed in a record four weeks. The entire LAN network was successfully staged prior to delivering the products to Citigroup at their European Headquarters in London, which was followed by onsite installation and further testing before going live in November 2000.

CISCO IOS SOFTWARE SOLUTION: With the Cisco IOS software platform and the IP Multicast feature running on the Cisco routers and switches, Citigroup launched the first phase of its global IP multicast network. The network uses the TIBCO trading floor application and TIB/Rendezvous software uses the publish/subscribe model to distribute feeds from Reuters, Telerate and other information. This leverages the Cisco IOS multicast service on the fabric of the network to reach only clients who are interested in this data so as not to flood the entire network.

RESULTS: The result was deployment of Phase 1 of the global IP network infrastructure for the brand new Citigroup European headquarters at Canary Wharf in London's docklands. The new 16-floor building at 33 Canada Square houses 3,500 employees with over 1,200 trading positions and uses Cisco's largest IP Multicast environment to support Tibco's market data messaging application – Rendezvous. The Global IP multicast network provides selected groups of users with real-time trading data from Reuters, Telerate, and other providers, and trading exchanges from around the world. The successful implementation of Phase 1 sets the stage for an expansion of Citigroup's Global IP Multicast Network featuring large-scale multicast distribution delivering multiple, time-sensitive market data feeds across major European locations.

“Information is the key to global financial markets. To have access to timely, accurate, and critical information is essential for us to retain our position of leadership in the world of International finance,” said Terry O’Leary, Project Director for SSSB.

The initial project focused on Phase 1, which is based on a Cisco local area network (LAN) and a multicast-based TIBCO application installed in the Canada Square tower at Canary Wharf. However, the complete scope of the project including Phase 2 will link up all Citigroup sites in the London Metropolitan area with distributed multicast operating throughout a metropolitan area network (MAN), and other operations through a wide area network (WAN).

Phase 1—Network Staging and Testing

The first step in developing the network came in June 1999, when the team ran a pilot test in London to evaluate equipment from Cisco and another vendor. In this phase the SSSB Technology team looked at performance, reliability, functionality, multicast capability, and frame to cell integration. Extensive troubleshooting was performed using state-of-the-art testing tools, and Cisco's switches and routers proved to be far superior in all tests.



In the summer of 1999, the Cisco team began staging the entire network and simulating real-time production quality operations on this LAN. The entire LAN was constructed on site at Cisco headquarters in just four weeks, and the Cisco team working on this project numbered between 20 and 30 people. Set up and testing of the network involved configuring thirty Cisco 8500 switches and eighty-two Cisco Catalyst 6500 switches, and multicasting data and video from hundreds of sources to 1500 front office traders and 2500 back office analysts using TIBCO applications over this network. Richard Barclay, Alexander Rawlinson and Chris Welland, SSSB technical project leaders were on hand for the onsite network build out along with the Siemens Network Systems team, a Cisco Gold Partner and the systems integrator selected for the project. The network was switched on and the live test was a success. Phase 1 of the project was signed off by SSSB.

“Typically, to debug a network installation of this size from London with early code to support Multicast functionality in a relatively new set of products would take about three to six months,” said Richard Barclay, 1st vice president at SSSB. “Since we were working with a California manufacturer, it made sense to send our Network and Market Data team to San Jose and work with Cisco in their labs on our Multicast network. The result was that we ended up with a robust and solid solution, and by working in close partnership with Cisco, Siemens, and TIBCO we were able to accomplish this in a record four weeks.”

The hardware used in the network testing in San Jose was shipped to London where it was reconstructed on an empty floor in the new building for a further 12 weeks of rigorous testing. This was done to eliminate any outstanding issues that didn't surface during the testing in California. With the contacts already established with Cisco development engineers who understood the network design and who had a vertical slice of the

network back in their labs, any of the tests could be repeated. When the data center was ready, the LAN was installed and tested again.

Phase 1 was completed in November 2000, with the Citigroup Global IP multicast network delivering live data feeds to 1200 front office traders and back office operations on the two trading floors of the new tower building. The SSSB IT team ranged in size from 5 to 15 engineering specialists during the design, testing, and implementation phases. SSSB treated this as a global project that involved network engineering teams on both sides of the Atlantic working together throughout the design and implementation phases to successfully deliver the London network. Parts of the knowledge and architecture gained from the Citigroup Centre (CGC) project in London were replicated in other major Citigroup infrastructure build outs including New York, Singapore, and Sydney.

In recognition of the successful completion of Phase 1 of the Citigroup Global IP Network project, SSSB received the prestigious IT Team of the Year at the European Banking Technology Awards 2000. This award is given to the IT Team in the industry who successfully implements a technology strategy in a retail or wholesale arena.

Cisco IOS Multicast Software and TIBCO's TIB/Rendezvous Software Speeds Delivery of Real-Time Data

The Citigroup Global IP Multicast Network uses the TIBCO trading floor application with TIB/Rendezvous software that enables diverse applications to share data across LANs and WANs. Programs on heterogeneous platforms communicate transparently with self-describing data messages and subject-based addressing. It uses the publish/subscribe model that allows clients to take feeds from Reuters, Telerate, and other information providers. This leverages the Cisco IOS Multicast service on the fabric of the network to reach only the clients who are interested in this data and not the entire trading floor. In this way, the flow of information into the network can be

controlled without flooding the entire network. Users or clients can also publish data out to other interested subscribers. So a client can be both a publisher and subscriber hence this maps onto the different multicast relationships maintained by the multicast Rendezvous Points (RPs) few-to-many (servers to clients), many-to-few (clients back to the servers), many-to-many (client to other clients or servers). This relationship between the TIBCO application and the network minimizes the amount of Source, Group (S,G) state within the network thus keeping the network as clean as possible by reducing the number of network resources consumed by the Multicast application.

“When we embarked on this mission, the primary challenge we faced was to find a scalable efficient mechanism to distribute real time data from multiple sources to all our traders with constantly low latency,” said Richard Barclay. “Given the scale of our network and the number of sources and receivers we have, this was impossible using conventional delivery mechanisms. Cisco’s IP Multicast solutions enabled us to achieve this goal without any compromises.”

Ongoing Use of Multicast

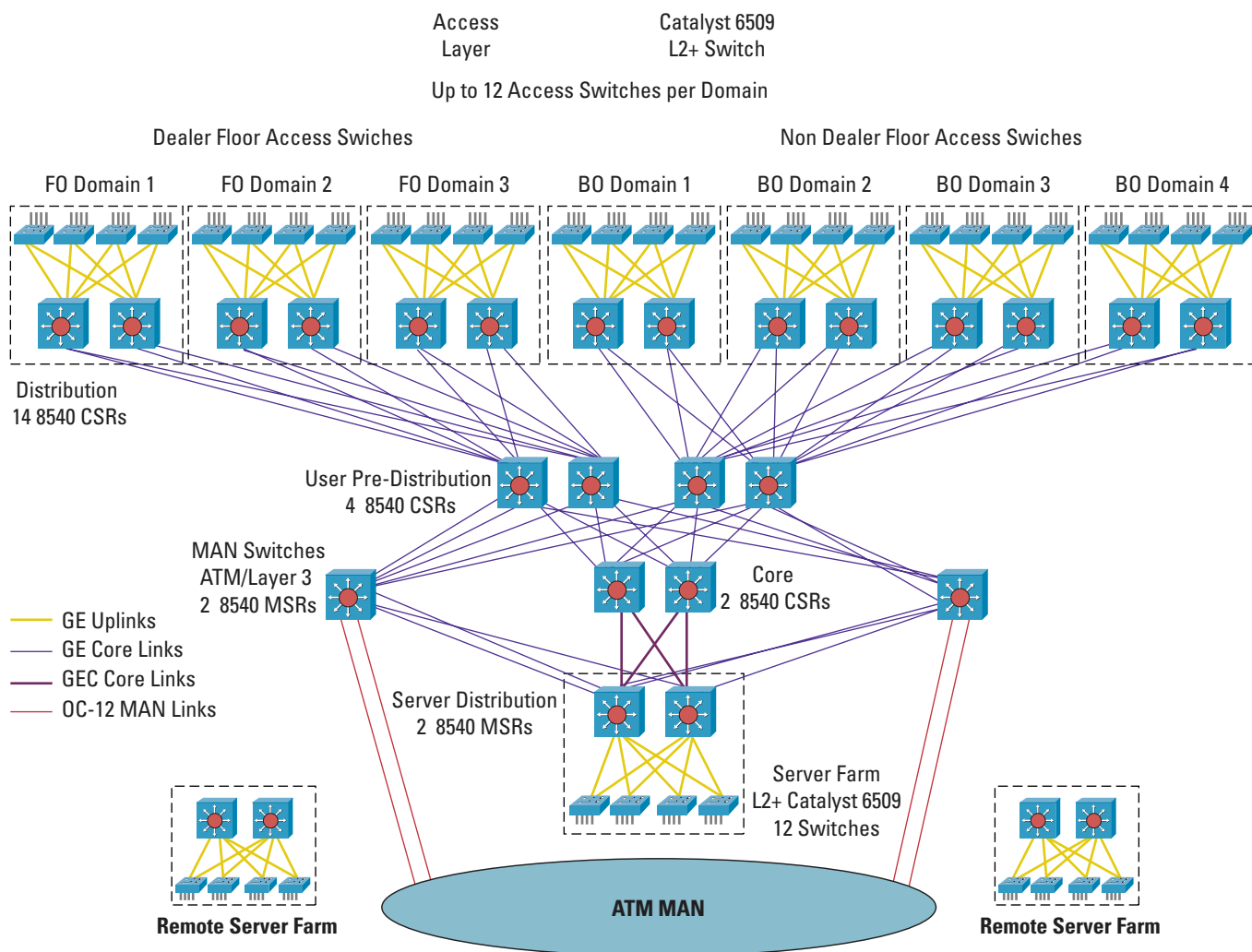
While Multicast is currently being successfully used in Phase 1 of the Citigroup Global IP network infrastructure, it will be distributed throughout several of the Citigroup sites across the London Metropolitan Area Network (MAN) when Phase 2 of the project has been completed.

“Using Multicast and layer 3 resilience, we are able to provide the quickest and most reliable information; real-time data that’s as close as we can get to a solution that’s reliable as a PABX telephone switch” said Richard Barclay. “We have proved that Multicast works and we have already taken the first leap with this technology in Phase 1 of this project. In Phase 2 we now need to partner again with Cisco to distribute the multicast on a much larger scale to multiple locations using the latest Cisco IOS functionality.”

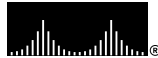
Phase 2 of the Citigroup Global IP network infrastructure in Europe consists of a major rationalization of Citigroup buildings across London, involving up to 8,000 users. An extension to the Citigroup’s headquarters is being built at 25 Canada Square, right next to the 33 Canada Square building completed in Phase 1, and a new data center is being constructed in South London. The new buildings will be ready for production use by Q2 2002, with the network rollout commencing in Q3 2001. The Phase 2 network developments include extending the multicast environment to provide a homogenous network running across four separate buildings in the London area, with multicast distribution of market data extending out to include key European trading centers as well. This will be achieved using the latest Cisco technology including Multicast Source Discovery Protocol (MSDP) and 6500 layer 3 switches. The network build out and testing will take place at Siemens Network Systems’ facility at Hemel Hempstead, near London.



Figure 1 Phase 1 of Citigroup's Global IP Network



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