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## **Building an Expanded Data Center:**

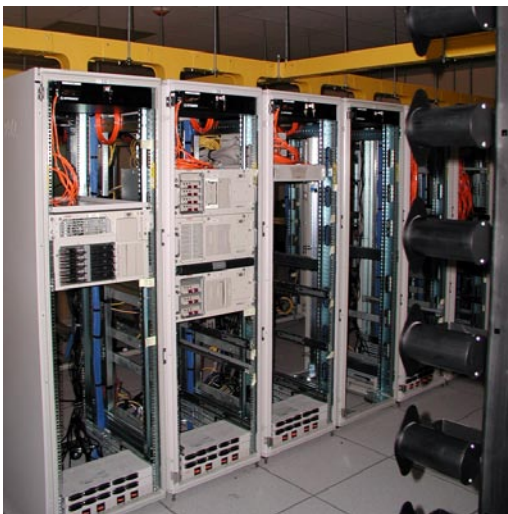
The physical design requires some construction knowledge, good consultants, and the ability to ask the right questions

By Dan Christian, MapInfo Corp.

*Dan Christian is the director of IT infrastructure for MapInfo Corp. in Troy, NY.*

In late 2002, our company headquarters in Troy, New York, was more than doubled in size. Our data center is now large enough to hold 84 racks, a network operations center, an information products lab, and our Web operations area--and still allowing plenty of room for expansion.

In the course of the 18-month, \$1.5 million expansion, the IT department learned how to plan a new data center, how to make the move from a small space to a large one, and what questions to ask along the way to make the whole process go more smoothly.



## **Getting Ready**

MapInfo is a global company that integrates software, data, and services to help organizations realize greater value from location-based information. The company's vision is to enable every business and government to "harness the power of location." More than 7,000 organizations in nearly every industry sector around the world use MapInfo technology and expertise.

We had many goals for our new data center and recognized early on that a good data center design consultant would help us to achieve these goals. We interviewed several but chose New York City-based Shen Milsom & Wilke, who did the design of the physical data center as well as the telecommunications cabling throughout the building. Bob McFarlane, a principal at the firm, has a tremendous amount of data center experience and helped us with the implementation.

We were also helped in this process by our Network Analyst, David Salamack, who had recently been through the process of building a data center at another company, and Mary Diefendorf, our Network Administrator, who did a lot of research as the project progressed. Their experience proved invaluable.

We are lucky enough to have offices close to Rensselaer Polytechnic Institute, which has a top-rate technology and computer science department. We looked at their data center, as well as those of other local companies. We traveled to Massachusetts to see Sun Microsystem's data center. And our Toronto office was simultaneously upgrading their data center, so we compared notes.

With all this help, we developed a good idea of what we wanted in our data center and how we wanted it to perform by the time we got to the design stage. The next question was to decide what the data center capacity should be. We tackled this question from both a business and a technology perspective. First, we looked at the amount of growth over the past two to three years and tried to anticipate where the company is going. To do this, we talked to product managers about upcoming projects and their IT needs. We also used storage resource manager to estimate growth. This collects information on servers and trending analysis for storage.

Then we turned around and looked at the technology, which is changing rapidly. Of course, vendors continue to develop smaller and smaller servers with more computing power. But as efficiency rises, total power consumption rises as well. Shen Milsom & Wilke apprised us of a few of the modern realities. For instance, a small cluster of physically small servers can generate as much heat as a mainframe. Put a few dozen of them together in one data center and that equals a major cooling problem.

We decided to build our facility to meet our data needs for at least the next five years. This seemed most realistic in light of the changing business and technology climates. We also wanted some extra space nearby for easy expansion.

### **Design Methodology**

One of our most pressing concerns was airflow; it's not a matter of just getting the right temperature, it's a matter of proper air distribution. Upping the thermostat on the air conditioner won't get the cooling power where it's supposed to be: inside the servers.

Our existing data center, which was more like a computer room, had five ceiling units, which we had added one by one as needed. A better approach was definitely needed. Initially we wanted under-floor cooling, but we became convinced that a top-down system is better for our purposes.

We used a depressed slab design to keep the data-center floor level with the rest of the building. Unless we excavated, we couldn't get enough height to convey the volume of under-floor air we need for a raised-floor design. As with most modern technology, our equipment generally pulls air from the front and pushes it out the back. We needed that cold air to funnel to the front of the equipment, and we needed a clear path to the air conditioners for the return air. This became a major factor in the layout.

Our reliability needs seemed to meet Tier 3 standards: redundant UPS(s) with external bypass and surge suppression; dual battery strings; dual power distribution units for each group of cabinets; and dual circuiting to properly support dual corded equipment.

We also deferred to Shen Milsom & Wilke to specify the configuration of the uninterruptible power supply. They work with realistic, measured data on power consumption and heat output, which they plug into a matrix and cross-validate to compute the correct UPS and air conditioning capacities.

What was missing from the “reliability picture” was a generator. We built the UPS so it could be readily connected to an outside mobile generator until such time as we can justify our own.

Shen Milsom & Wilke strongly suggested a permanent rack tie cable infrastructure to minimize the amount of ad hoc cabling we would need to install between servers and network switches. We took their suggestion and now simply install short patch cords at the server and data switch racks when we move or install equipment. The savings in time is enormous and we need to stock only a few lengths of patch cords. Over time, this upfront investment in infrastructure will deliver meaningful return on investment.

We put fiber overhead in bright yellow “Fiber Duct” for maximum protection and identification, and installed the copper beneath the floor where it will be undisturbed. Keeping the data network and telecom on separate paths meant added protection for fiber. Salamack and Diefendorf were adamant about using patch panels in the racks—a feature that has already saved time and money. Adding a rack used to take two weeks and visits from the electrician and the cabling contractor.



Now, thanks to the upfront investment, we simply pull up a floor tile and plug the new rack in.

The most difficult decision at the time was whether to use Category 5e or 6 cabling. TIA/EIA was just in the midst of ratifying the CAT 6 cabling standard and it took some research to convince us that the CAT 6 cable on the market at that time would actually meet the standard when it was published. Ultimately, we chose CAT 6 as a hedge against the future, chose a handful of vendors and interviewed installation companies. Shen Milsom & Wilke wrote the bid specification, with language protecting our interests in this important matter. Somewhere in middle of this process, CAT 6 became a standard.

We debated for some time about the dimensions of the raised floor. We’d all heard nightmare stories about floors that didn’t allow for expansion or, and this was a really scary prospect, were too shallow for future cable. The idea that we could build such a

costly facility only to find it inadequate or outgrown in a few years was something we would not want to explain to management. infrastructure. We also wanted to incorporate our Web operations area. Outsourcing our Web site--because we didn't have room to house it--was costing upwards of \$250,000 per year.

However, these functions run autonomously and needed to be physically separate from the main data center equipment. Shen Milsom & Wilke suggested the use of security screens rather than hard walls to separate these functions. This serves a two-fold purpose: airflow is maintained throughout the space so all air conditioners contribute to the redundancy of the design, and security screens can be unbolted and moved without the dirt or disruption of demolishing building walls if space requirements change.

We also wanted a network operations center to monitor our network around the world. We have three worldwide offices and close to 30 field offices. We wanted seats for at least three people with network displays on large screens so we could troubleshoot any problems. We also wanted a standard office environment for their comfort; no one wants to spend eight hours sitting in a space with enough air conditioning for 84 equipment racks.

### **Building the Data Center**

The data center had to stay fully operational during construction. We were concerned about how construction would affect our equipment. The hard drives are sensitive to vibration. We had about two gigabytes of storage on our storage area network and stand-alone drives. However, the expansion meant the new building would be built immediately adjacent to our existing space, with a fair amount of demolition just outside our walls for the four-story addition. Ultimately, the data center would seem like one large space; you could walk from one structure to the next and not realize they weren't original. But achieving this meant heavy work right next to us that could put us out of business.

Shen Milsom & Wilke has vibration design expertise and they recommended several ways to mitigate disturbance to the data center during construction. The initial slab demolition would cause the building to move and shake. So the first step was to isolate the slab from vibration. The company specified certain slab cuts and demolition techniques to minimize these disturbances. They also calculated the potential effects on our disc drives, and further specified construction techniques for the building that would avoid potentially hazardous shock conditions. This included prohibiting pile driving and demolition with a wrecking ball, as well as safety precautions when delivering heavy materials and hoisting steel. We also monitored vibration to ensure it was not affecting our equipment.

We managed the installation ourselves. We had particularly strong feelings about the installation of the cable. The quality of the network really depends on the installation and no one wants to mess with there cable after it is installed.

As project manager, I had three to four meetings each week with the different members of the construction team. By the time the job concluded, I had worked with almost a dozen different trades—including concrete, tile, and electrical contractors.

### **Making the Move**

Timing was, of course, an issue. We were scheduled to move into the data center two

months before the rest of the company moved into the new structure. We relied on Mary Diefendorf to develop a moving plan. We scheduled a 48-hour move figuring the data center would be shut down from a Friday evening until Sunday evening. In fact, things went so smoothly we were up and running within 24 hours. The pre-planning and cable infrastructure were big contributors to this achievement.

### **Two Years Later**

Our new data center regularly saves us time and money. Going from five ceiling-mounted air conditioners to one central system saves us an estimated \$96,000 per year. We have five computer room air conditioners (CRACs) that cycle once a week. This way, if one unit fails, the system automatically switches to keep four running so there is enough cooling to sustain the center. We also have piping in place for the installation of two more CRACs whenever loads require them, as well as the wiring infrastructure to install a generator at a future date.

The network operations center, information products lab, and Web operations area were formerly in three different places, each with its own sets of problems. Combining these into one large space—though each area is separated from the main space with security screens—makes it easier to function and leverage the raised floor, cable system, and air conditioning. The uninterruptible power supply is also caged off in the data center.

While we've set aside space for the network operations center, we won't put it to full use until the company grows to a certain level. The space includes two projectors and three KVM-connected workstations. With this equipment, we can light up the console on any machine in the data center and, via video switch, project the images on wall. In the interim we're using the space to do installations of software or upgrades. That way we don't have to huddle over a terminal screen. It also provides a locked room where we keep software, documentation, and tools.

Best of all, the data center is at only half of its capacity. For every row built, we added a vacant rack. We've organized the racks so they are functionally contiguous; all the like systems—which share similar software platforms—are together in the same row. That way it is easier for us to do maintenance.

We got through without major disasters. The closest we came is when we were unable to test the emergency power out until we had the equipment in place. This caused some gray hair, but came off smoothly in the end. At the end of the day, the inclusion of the business community, technology considerations, experienced staff, and constant involvement in the project contributed to a successful project that enabled our company to flourish without interruption to the business operation.

Architect: Woodward Connor Gillies & Seleman, Albany, NY

Data center, telecommunications: Shen Milsom & Wilke Inc. New York City, NY

Completion: October 2002

Size: 1,100 square feet

