

## A CUT ABOVE:

# BUILDING WIRELESS SPACES

*The IT staff at MIT worked with architects and construction crews to ensure that new and renovated buildings would be technologically up to speed.*

**W**hen Frank Gehry designed the Ray and Maria Stata Center for the Massachusetts Institute of Technology (MIT) in Cambridge, Mass., he envisioned a space that would spark communication among disciplines. The teaching and research center is filled with stylish, comfortable social spaces for scientists and technologists to meet in chance encounters or communicate on the go using mobile devices.

There was only one problem: When the building opened in 2004, the researchers working there in fields such as robotics, astronautics and artificial intelligence were tied to their landlines whenever they wanted to make a phone call. The building had very little cell phone reception.

“It turns out that the construction materials and, in particular, some of the coatings on the windows created a situation where cell phone signals were not able to get into the building,” says Jerry Grochow, MIT’s vice president for

Information Services and Technology (IS&T). “So now we have to go back into that building and put in some internal antennas and things like that to improve wireless reception.”

Some speed bumps on the road to a wireless world may be inevitable. But during the past few years, MIT’s information technology staff has learned a lot about how to avoid problems and maximize the effectiveness of wireless technology in new buildings.

During the planning process, IT personnel need to guide architects and construction workers in the early design stages, and alert them to potential or emerging technologies that should be incorporated during construction. “In the building trades, once they have the architectural plans, they don’t usually expect the technology to change in the middle of a building project,” says Grochow. “But in the IT business, two years can be a long time.”

For the past several years, MIT has undergone



**"SHEAR" INTELLIGENCE**

Jerry Grochow, Theresa Regan, Jack Costanza and William Mitchell (from left to right) have worked together to create inviting wireless spaces at MIT.

75%

The approximate increase in unique wireless connections per day at MIT from fall 2004 to fall 2005.

an architectural renewal involving nine major building and renovation projects. During the same time period, the popularity of wireless technologies, such as cell phones, personal digital assistants and notebook PCs, has soared.

The IT staff implemented near-total wireless fidelity coverage on the 168-acre MIT campus as of last fall. Now students commonly carry Wi-Fi-enabled notebook PCs and other devices wherever they go.

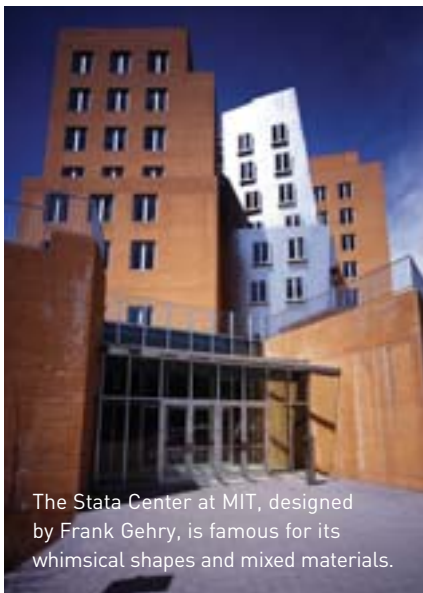
### Wi-Fi for Brainiacs

The most recent flurry of construction has been in the northeast corner of the campus, where a new Brain and Cognitive Sciences Complex (BCSC) officially opened last December, across Vassar Street from the Stata Center.

The two buildings could hardly be more different on the outside: The BCSC is sleek and subdued, while the Stata Center explodes with energy, with irregular angles jutting out in all directions. One of the few things that the buildings do have in common is that they both have complete Wi-Fi coverage inside.

More than a year before the 411,000-square-foot neuroscience center opened, while construction workers were busy bringing architect Charles Correa's vision to life, Grochow formed a committee to plan the BCSC's network services. Some of the facility's future occupants from the Brain and Cognitive Sciences department, the Picower Institute for Learning and Memory, and the McGovern Institute for Brain Research joined the committee to strategize about their technology needs.

Back when the idea for the building was first conceived, "Wi-Fi was not that big a deal," Grochow says. "Yet, by the time the building came online, there was an almost tacit assumption that everything would be wireless-enabled."



The Stata Center at MIT, designed by Frank Gehry, is famous for its whimsical shapes and mixed materials.

To meet the needs of the future tenants, the committee advocated for total wireless coverage in the complex and secured the necessary funding, says Theresa Regan, director of Operations and Infrastructure Services for IS&T.

### Material Consequences

During the construction, Regan and other technology staff members coordinated with the architect, construction employees and tenants to choose the best locations for the 150 or so wireless access points. The goal was to provide good coverage while making the APs inconspicuous.

The IT personnel also did site surveys — a process for testing Wi-Fi signal strength and quality in various locations. Grochow says that due to the construction materials, "There were some labs where we had to go in and put an access point right in the lab itself."

Obtaining good Wi-Fi coverage is part art, part science, and part trial and error. The number of walls, the amount of furniture and the types of materials in a building's construction all affect how well the signals transmit.

Porous materials like wood impede Wi-Fi signals less than denser materials such as brick and metal. Even the water in plumbing can block transmission. For IT

personnel, one advantage of getting involved early in the construction process is being able to see what the framework of a building is made of before the walls go up.

Ideally, an architect would collaborate with the IT staff to design a building in a way that maximized the effectiveness of the wireless network. In reality, tech staff members often need to compensate for architecture that's not especially wireless-friendly.

With its odd-shaped spaces and dense materials — including brick, concrete, stainless steel and titanium — MIT's Stata Center posed a formidable set of Wi-Fi challenges, recalls Jack Costanza, director of IT for the Computer Science and Artificial Intelligence Laboratory.

## I.T. TAKEAWAY

Here are some tips from the experts on implementing Wi-Fi in new buildings:

- Get involved early in the construction process, so you can see what the building's framework is made of and anticipate possible problems for Wi-Fi coverage.

- Beware of radio interference from technologies such as microwaves, 2.4 gigahertz cordless phones and private wireless networks. This is an especially common problem in dorms, according to Theresa Regan of MIT's Information Services and Technology (IS&T) department.

- Do site surveys in order to determine the best locations for your access points. Keep in mind that Wi-Fi signal strength and quality can vary quite a bit.

- Use a floor plan to map out preliminary locations for your access points, but be prepared to negotiate. The architect or future tenants may have other plans for certain spots.

- Creating spaces for wireless use is about more than just a well-functioning network — it's about the whole environment. To accommodate study groups of students using wireless notebook PCs, some computer rooms at MIT are equipped with comfortable armchairs, large-screen projection monitors and electronic whiteboards, says Jerry Grochow of IS&T.

## MAPPING WI-FI USAGE

Sonya Huang arrived at MIT as a freshman five years ago, when wireless hot spots were rare on campus. But things are very different today, says the grad student. "I walk around with my notebook PC and sit down anywhere I want and assume I can get on the Net," she says. "It's gotten to the point where I take it for granted."

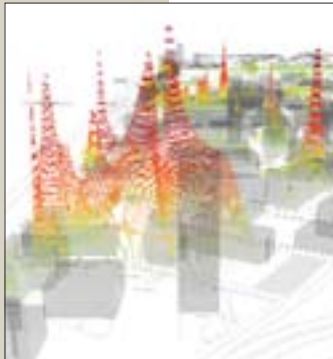
Huang is part of a research team capturing the way Wi-Fi is changing patterns of life at MIT. Their project, iSPOTS, includes online animations that show the rise and fall of Wi-Fi usage on campus during the past day or week. Users can even drill down to see Wi-Fi activity in any room with a wireless access point. The team from MIT's SENSEable City Laboratory is keeping a database so that in the future, usage patterns can be analyzed over a longer period of time.

To create the data visualizations (see art at right), the researchers use a geographic information system database and wireless local area network log files with the number of users per access point over time. The log files are anonymous, so there are no privacy concerns, says Carlo Ratti, a leader in the project.

As iSPOTS shows, today's MIT students are more likely to do their coding over coffee in a cafe than in a computer lab. Since most students have wireless notebook PCs, "Computer rooms tend to be less used," Ratti says. "Other spaces are becoming very popular: multipurpose lounges, cafes, etc." This kind of information could be used for planning future architecture and services on campus.

The project is well-timed: MIT now lays claim to being one of the largest geographic entities covered by a single wireless network.

To learn more, check out "digital\_minimal," an art exhibition at MIT's Wolk Gallery through March 29, or visit <http://ispots.mit.edu>.



Extra APs were needed, and since 802.11a didn't provide good coverage, the building uses only 802.11b/g, he says.

### Subtract Wires, Add Value

Costanza and his colleagues' work on some of MIT's newest buildings is part of the gradual push for a wireless campus. As of fall 2005, 3,000 APs provided Wi-Fi everywhere across the university, except on some playing fields. During the past few years, MIT has spent \$4 million on expanding its wireless network, including costs for APs, network equipment, contractors and staff resources, according to Regan.

With the increased coverage, student, faculty and staff usage has risen steadily. As of last November, there were around 4,000 unique wireless connections made per day in MIT's classrooms, highlighting how often students use wireless notebook PCs in class. Throughout the whole campus, there were approximately 7,000 unique connections per day, Regan says.

The wireless initiative has been an excellent investment, says William Mitchell, who served as

architectural adviser to MIT's president during much of the recent construction. In fact, he says, blanket wireless coverage is "one of the cheapest, most effective ways of adding value to your real estate."

"The coffee shop that was just a space for drinking coffee and recreation in the past now doubles as a workspace, so the duty cycle goes up," Mitchell says. "Outdoor space in a good climate now becomes workspace, and it's actually very cheap workspace and ecologically sound, too: You don't have to air condition it, and you don't have to light it."

As a professor, Mitchell has noticed that students are using

their wireless notebook PCs to engage in high-powered discourse in class. "These days, the moment I mention something, some student immediately Googles the topic and then introduces the results into the discussion," he explains. "So the discussions that go on are intense. They're very well-grounded, because the students are not just listening, they're actively engaging in a very powerful way.

"The big lesson is that you always have to think about how a physical space, a social setting and the injection of digital information all work together to create a learning environment," Mitchell says. ■

Lisa Delgado is the copy editor of EdTech magazine.



### Massachusetts Institute of Technology

**Founded:** Charter approved in 1861

**Enrollment:** 10,206

**Location:** Cambridge, Mass.

**Nobel laureates:** 61

**Motto:** "mens et manus" (mind and hand)

**Notable alumni:** George Ellery Hale, astronomer; I.M. Pei, architect; Richard Feynman, physicist