Application of a Real-Time Structural Health Monitoring (SHM) System for Tall Buildings

Powerful benefits of real-time SHM:

- Enhances understanding of a building's health through continuous monitoring and analysis
- Provides a basis for rapid decision making regarding building safety and the possible need for evacuation following an extreme event
- Improves emergency response by identifying potential failure locations
- Allows more rapid identification of hidden structural damage
- Supplies building performance information needed to more rapidly return a facility to operation

Federal Building: San Francisco, CA

The 24-story, steel frame building is located in a seismically active area and had previously undergone a seismic retrofit. Additionally, the building has been designated as part of the Building Occupancy Resumption Program (BORP), an award-winning program of the San Francisco Department of Building Inspection, which allows building owners to pre-certify private post-earthquake inspection of their buildings by qualified licensed engineers (BORP 2001).

Digitexx is the pioneer in real-time structural health monitoring. The Internet-based system remotely monitors, analyzes, distributes and archives data and information in multiple locations concurrently.

The building owner needed a monitoring system that would facilitate rapid assessment of the structural health of the building and assist in making informed decisions regarding post-earthquake building occupancy. In 2002, Digitexx, in close cooperation with a government agency, city officials and a leading engineering company designed and installed a PC-based 32-channel, 24-bit RTMS-2001 system capable of complex structural health monitoring with data distributed to multiple remote locations over the Internet in real-time. The system has worked continuously since its installation and has recorded a number of small and moderate earthquakes.

For their work on the project, Digitexx and their partners received awards for engineering excellence by both the American Council of Engineering Companies (ACEC) and Consulting Engineers and Land Surveyors of California (CELSOC). The project was also featured as the cover story in the May 2004 issue of *Earthquake Spectra* (EERI).

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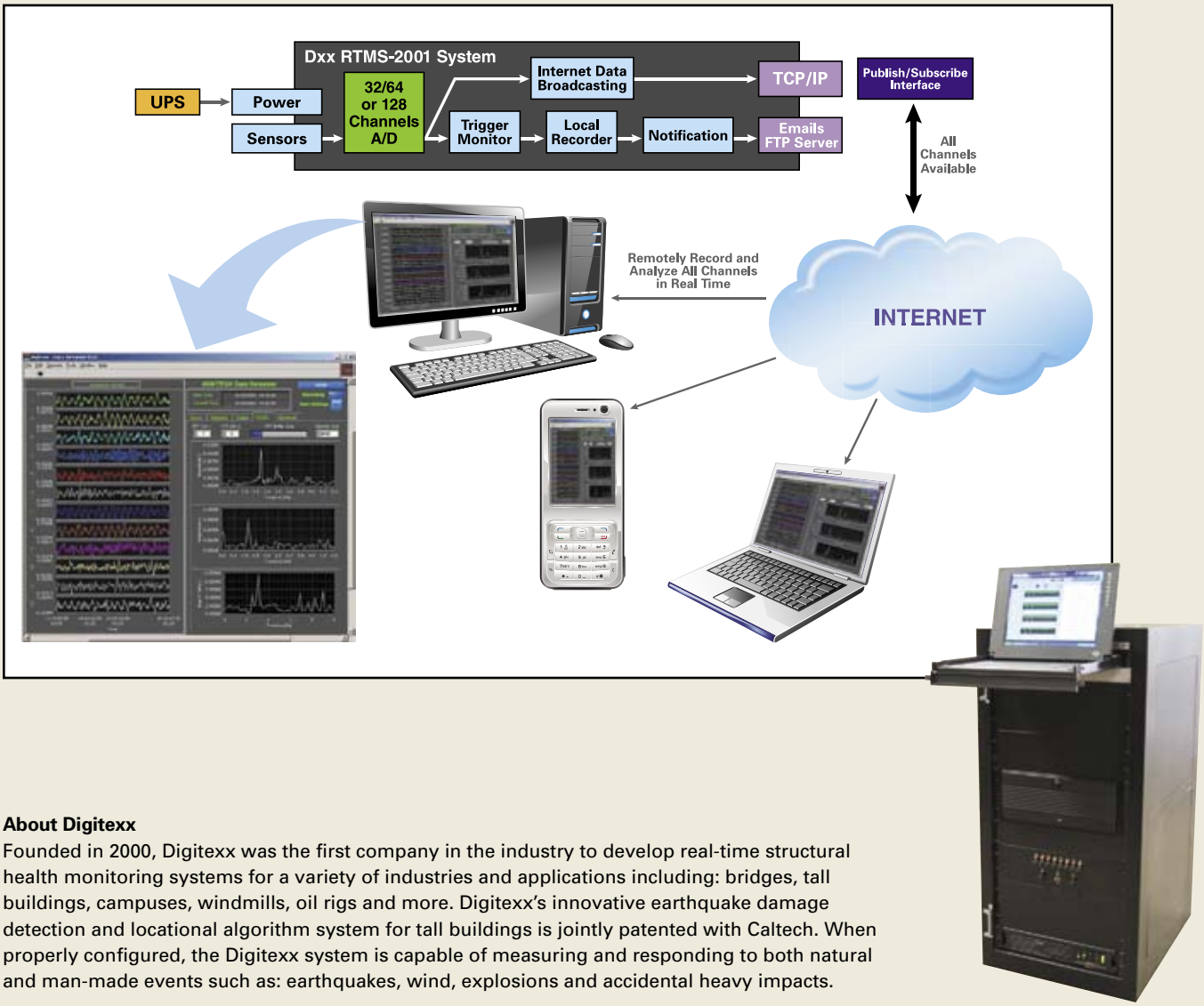
Real-Time Monitoring System Architecture

The Digitexx monitoring system is based on a highly efficient, multithreaded software design that allows the system to acquire data from a large number of channels, monitor and condition this data, and distribute it, in real-time, over the Internet to multiple remote locations.

Thirty-two accelerometers deployed throughout the building continuously send out data computing actual drift ratios at several pairs of consecutive floors, or average drift ratios over various combinations of non-adjacent floors to the system. If an event such as an earthquake occurs, pre-assigned thresholds of drift (based on FEMA recommendations for levels of displacement and inter-story drift) are exceeded in one or multiple locations, thus triggering the recording and analyzing of data (including pre-event memory). Once an event is recorded, the system notifies a list of users (via e-mail) and uploads the event via FTP to another site.

The building owner and engineers anticipate using the data provided by the system to justify an efficient, private-sector, post-earthquake inspection program than would otherwise be required by the city of San Francisco for a similar non-instrumented building in the same area.



About Digitexx

Founded in 2000, Digitexx was the first company in the industry to develop real-time structural health monitoring systems for a variety of industries and applications including: bridges, tall buildings, campuses, windmills, oil rigs and more. Digitexx's innovative earthquake damage detection and locational algorithm system for tall buildings is jointly patented with Caltech. When properly configured, the Digitexx system is capable of measuring and responding to both natural and man-made events such as: earthquakes, wind, explosions and accidental heavy impacts.

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