Limitations and Vulnerabilities of Real-time Data Systems for Hazards Warning Activities

Limitations

One of the major limiting factors in our near real-time data collection operations is time. This is an inherent problem of the satellite based data collection/transmission systems. The system was designed to operate on a 4-hour 100-baud or 1-hour 300-baud transmission sequence. This pattern works well for scientific data collection, but is not well suited for hazard warning systems. By manipulating threshold levels in the instrumentation, data can be transmitted via forced random transmissions and refreshed on about a 5 to 7 minute cycle. Processing time for the LRGS is 2-3 minutes and another 2 to 3 minutes to pull and display data in the web system. David Briar says we have reached this turn-around time, but we have not been able to test this successfully. Even 5 to seven minutes is a long time when critical decisions need to be made about evacuation orders or hazard warnings. An option like channel 154 (established as an emergency contingency for last year's California fires) may be an improvement, but we do not have this as a permanent arrangement with NESDIS. We need to look at developing new systems of data transmission that are faster and more robust. Proponents of radio and telephone linked systems tout their capability of instantaneous data delivery. These systems, however, only work in certain terrains and have proven to be vulnerable to lightning, high winds, and other storm conditions.

Timely access to GOES satellite transmission windows proves to be another problem. Immediate assignment of one or two windows can be accomplished in a relatively short period of time. Assignment of large blocks of windows (10 or more) required for major flood events or forest fires can take considerably longer. The Channel 154 random transmission option allowed as many as 100 windows to be immediately assigned to cover last season's fires in California. This was a stopgap measure and may not be available again without an open GOES channel and a dedicated demodulator. A program to cache window assignments and equipment needs to be established.

Data delivery/dissemination to emergency management personnel (EMS) and the National Weather Service (NWS) can be a serious limitation. We currently have only two options of data delivery to these critical personnel. The most widely used method is the Internet. Currently all NESDIS data is received via LRGS and processed by District NWIS before being ported to Reston for inclusion into NWISWEB. If Reston goes down nobody will get data. The distribution system NATWeb has 4 servers including the one at EROS. Data updates to only one of these servers which serves the data to the other three. If the key server goes down nobody gets data. NATweb is also where most public web pages in the USGS reside including; project data pages, most district web pages, job announcements and general information web pages. We were told that the agency was evaluating reverse proxy to help the system and it was discovered that NATweb is too unstable to be used for hazard warning applications. Using the Internet also leaves data delivery open to the vagaries of web reliability and speed. When a major event happens, millions of users flood the Internet and slow its response time, affecting emergency data delivery. Redundancy is a key element in the delivery system. The USGS has made advances in the area by dual-homing district offices, but the South Dakota District remains without dual-home linkage. The other option is to disseminate data through the National Weather Service, Advanced Weather Interactive Processing System (AWIPS-HADS). This requires NWS staff sufficiently knowledgeable in the system to effect data delivery and a cooperative agreement to deliver

the data. Processing by the AWIPS-HADS system also adds another measure of time to the process.

Vulnerabilities

Using the Internet for data dissemination exposes the process to the vulnerabilities of a publicly accessible system. This includes hackers, webmasters, users, and systems maintenance personnel, any one of which can bring the system down. There is some debate as to whether a dedicated system for processing hazard warning data is necessary, but a robust and fast alternative needs to be developed.

The current organizational structure of the USGS, Water Resources Division is not designed to cope with the demands of true real-time data dissemination for hazards applications. We are not staffed or set up for 24-hour-a-day, long-term operations. We do not have the manpower or financial resources to compensate employees for standby time, required shift work, or dedicated space to accommodate this type of operation. We have worked around these difficulties using operational agreements with the National Weather Service through a cooperative Memorandum of Understanding that assigns the 24-hour response activities to their agency. This provides a workable arrangement in many areas, but may not work in all regions. The arrangement is obviously vulnerable to agreement with the NWS, budgetary restrictions of either agency, and cooperator agreement.

Current infrastructure in most USGS offices leaves the system vulnerable to power outages, vandalism, earthquakes, and storm damage. Most USGS offices do not have facilities hardened to any of these effects. This is especially true for flood warning systems where the office providing the storm warnings is adversely affected by the same storm. USGS offices are not normally equipped with automatic power backup systems or self-contained generators nor are they in a financial position to acquire such equipment. Unfortunately the USGS entered the real-time data business from a scientific vantage point and has only recently begun to address the costs and responsibilities inherent with hazard warning work.