

## J8.10 DEVELOPMENT AND IMPLEMENTATION OF THE NWS WARNING EVENT SIMULATOR VERSION 1.0

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### 1. INTRODUCTION

Over the last two years, the National Weather Service (NWS) Training Division has been exploring interim solutions for AWIPS (Advanced Weather Interactive Processing System) warning simulation capability until this capability is officially integrated into the AWIPS software (Page *et al* 2001). With the emergence of the Linux version of AWIPS (Davis and Grote 2001) and strong support from NWS Headquarters, a cost effective interim solution for warning simulation capability was developed in the spring and summer of 2001. In August 2001 the Warning Event Simulator (WES) version 1.0 (Figure 1) was shipped to National Weather Service forecast offices, Regional Headquarters, and the National Centers for Environmental Prediction (NCEP). The WES distribution software included data feed simulation software from the Warning Decision Training Branch (WDTB) and a Linux version of Build 5.1.1 AWIPS software from the Systems Engineering Center and the Forecast Systems Laboratory (FSL). A copy of local archiving software from Ron Miller in the Spokane NWS Forecast Office was also included with the simulation software. The development and implementation of WES version 1.0 is a first step toward addressing the critical need for warning simulation capabilities in NWS forecast offices.

### 2. WARNING SIMULATION HISTORY

Development and implementation of the Warning Decision Training Branch's NWS Warning Event Simulator (WES) represents a collaboration between NWS training centers, AWIPS developers, Regional and National Headquarters, and NWS forecast offices. Warning simulations using WSR-88D radar



Figure 1. WES user interface.

hardware and software had been an important part of radar residence training at the WDTB (formerly known as the Operational Support Facility Operations Training Branch OSF/OTB) dating back to the early-to-middle 1990s in Norman, OK. In the AWIPS era, the need for warning simulation capabilities continued, particularly for WDTB's Warning Decision Making (WDM) and Distance Learning Operations Course (DLOC) workshops held at the Cooperative Program for Operational Meteorology, Education and Training (COMET) in Boulder, CO. Because there was no simulation capabilities in AWIPS, WDTB worked with FSL and COMET to develop a simulator for practicing warning operations in the WDM and DLOC workshops that used a HP (Hewlett Packard) training copy of AWIPS. Additional warning functionality was incorporated into the simulations, including the System for Convective Analysis and Nowcasting (SCAN) (Smith *et al* 1998), with assistance from the Meteorological Development Laboratory (MDL) and FSL. Transferring workshop functionality to forecast offices early in the simulator development was prohibitive due to the complexity of AWIPS configuration management issues and the high cost of duplicating the workshop environment.

With the availability of a relatively inexpensive version of Informix for Linux (needed for the warning generation software, WarnGen), a more cost

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effective opportunity existed to transfer the simulator to forecast offices. Southern Region Headquarters and forecast offices in Norman, OK and Fort Worth, TX played an important role in raising awareness of the need for warning simulation capabilities in an operational environment, and they assisted in exploring ways to implement the simulator at a forecast office. WDTB worked with these offices to develop a low-risk technique to run the simulator on an AWIPS HP workstation by pulling an operational AWIPS HP display workstation offline and connecting it to a Linux PC running Informix.

While WDTB was investigating simplifying the complex operational HP solution, COMET was working with FSL to distribute FSL's Linux version of D2D (Display in Two Dimensions; the display side of AWIPS), and local archiving techniques began to mature at forecast offices. With strong support from the Field Requirements Group (FRG; the management team that helps organize training priorities for the NWS) and NWS Headquarters, a decision was made to combine WDTB's simulator with the Linux version of AWIPS and the local archiving technique developed by Ron Miller at the Spokane, WA forecast office. A version of Build 5.1.1 AWIPS was obtained from the Systems Engineering Center and FSL for use with the WES. While Build 5.1.1 of AWIPS does not include all the major components used in the warning process (e.g. SCAN), its timely implementation made it the most desirable option to pursue.

In the spring and summer of 2001 WDTB developed a simplified graphical user interface for the simulator (Figure 1) and an installation CD. Installation testing was completed at NWS Regional Headquarters offices. The final version of the software was delivered to NWS offices in August of 2001 along with a COMET case study, tips on effective use of the simulator, a set of instructions for testing installation, and other documents. In addition to the printed materials shipped with the simulator, the help menu within the interface contains documentation of how the simulator works as well as a step by step tutorial on how to run a simulation.

### 3. CONVERTING A CASE FOR WES

In an operational AWIPS, raw data is processed by its Data Server (DS) into AWIPS format files with filenames containing the time of the product (e.g. 19980408\_2300 for a 2300 UTC product on May 8<sup>th</sup> of 1998). The AWIPS display workstations access the processed data for display. The WES uses these processed AWIPS format files to simulate a real-time data feed.

When an AWIPS case is created and is

displayable by D2D, it is ready to be processed by the simulator. The WES conversion tool (selected through the tools button in the interface) prepares data for simulation by renaming all data files in the "Grid", "sat", "radar", and "point" directories. Renaming the files to include an "a" in front of the filename hides the data from the D2D display. When the files are renamed, the paths to the directories containing data are saved to a file to help optimize subsequent processing. The simulator eventually makes the "a" files visible by creating symbolic links that point to the data at appropriate times.

For some data such as radar, the filename does not adequately represent the time the data was collected. Although radar scans in a single volume coverage pattern (VCP) are collected within a five or ten minute period, they are all given the same filename which is the start of the volume scan. In order to simulate the actual tilt sequence of the radar, the convert tool creates symbolic links with a "b" in front of the filename to assist processing files at the correct time. The "b" links are created using the standard tilt sequence timing of the radar and the VCP number taken from the radar product header. Other data sets such as LAPS (Local Analysis and Prediction System) (Albers *et al* 1996) and MSAS (MAPS Surface Assimilation System) (Miller and Barth 1999) also have "b" links created to simulate the creation of the products at 20 minutes after the hour because the filename convention for these products is only given at the top of the hour (e.g. 2300 UTC).

### 4. RUN SIMULATION IN WES

The "Run Simulation" button in the interface prepares the case for the time of the simulation, and it starts the AWIPS decoders needed for product notification and creating warnings. Following the user input start time, the simulator creates symbolic links that point to the hidden "a" data files to make all data before the start time visible to D2D. Data after the start time are made invisible by deleting symbolic links. After the data has been prepared for the simulation start time, AWIPS processes are started using variables input by the user.

A summary of the input variables is provided as the final step before the simulation is started to allow the user to catch any input mistakes. After the user clicks on the final "Run Simulation" button and is prompted to restart D2D, the Informix database is purged of all warnings to prevent "future warnings" from corrupting WarnGen. After the database is purged, a copy of the "date" executable is used to reset the system clock. Each minute the simulator recursively searches subdirectories known to contain

data files. Symbolic links are created each minute relative to the system time, and notification is triggered for radar, satellite, LAPS, and MSAS files, causing data loops to automatically update. Point data such as lightning and surface observations are more difficult to notify for because the data for a given hour are stored in a single file. This will have to be addressed in a future version of the simulator.

Once the simulation is started, the main simulator window is made inaccessible. At this time the summary window is the active window to interface with the simulator. A pause feature is included to allow the simulation to be paused and restarted without having to start a new simulation. This feature may be used to allow detailed discussion of the warning decision making process in the middle of a simulation. Some AWIPS processes are killed and restarted in pausing/resuming, and the date is reset to time the simulation was paused. The "Stop Simulation" button stops the simulation, kills the AWIPS decoders, and resets the system time using the BIOS.

## 5. FUTURE PLANS

The NWS Warning Event Simulator was designed as a first step toward simulation capability at NWS forecast offices using operational software and data sets. Future versions of WES are planned to contain other convective and winter weather warning AWIPS tools such as SCAN, FFMP (Flash Flood Monitoring and Prediction System) (Smith *et al* 2000), and WWA (Watch Warning Advisory) (Sperow *et al* 2000). As future AWIPS builds are released, the WES will also need to be re-released to keep the simulation functionality relevant to current operations.

In order to solve the current problem of notifying for point data, such as lightning data, the paradigm for simulating the data processing on already processed data will have to be changed. This will likely require processing raw data files just like the operational AWIPS Data Server. Although there is a greater computational overhead with processing raw data files, the small size of the point files may not result in a significant load on the system. The biggest ramification for this change will be that forecast offices will likely not have the capability to locally archive the raw point data to be used in a simulation. With a small investment, much of the point data could be archived at a regional or national level, though important local data sources such as mesonet data would likely not be able to be archived at a higher level.

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