COL/CE/16

Enabling Communication of WDSS-II Dynamic Severe Storm Grid Data over a Network

FY 2004 Proposal to the NOAA HPCC Program

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Proposal Theme: **Technologies for Collaboration, Visualization, or Analysis**

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Enabling Communication of WDSS-II Dynamic Severe Storm Grid Data over a Network

Proposal for FY 2004 HPCC Funding

Prepared by: Russell Schneider and Jason Levit

Executive Summary:

The National Severe Storms Laboratory and the University of Oklahoma have developed an integrated software package for the analysis of real-time radar, satellite, and numerical weather prediction model data, known as the Warning Decision Support System – Integrated Information (WDSS-II). The NOAA Storm Prediction Center (SPC) seeks to integrate the WDSS-II software into experimental operations for improving convective watch lead time (severe thunderstorm and tornado), analysis of on-going severe convection, and interrogation of historical case studies by the operational forecast and research staff. The WDSS-II system contains the ability to generate "severe storm domains", or data grids on the order of 1000km x 1000km x 20km, that merge real-time data together into a quality controlled framework for data analysis and 4-D visualization. The SPC wishes to evaluate data from these pre-configured domains using the WDSS-II graphical user interface environment, to provide a high resolution and very detailed analysis of real-time weather data over a portion of the United States. Central to this analysis is NEXRAD Level II data, transmitted via the HPCC funded Collaborative Radar Acquisition Field Test (CRAFT) project, and this proposal seeks to move that data, and metadata generated via WDSS-II analysis products, over a network to a WDSS-II visualization machine located in SPC operations. However, the configuration of multiple severe storm domains and the WDSS-II system, along with the generation of metadata, is a complex process that requires detailed knowledge of the system and multiple software packages. We propose to create a simple and flexible quasi-operational framework for SPC forecasters to configure the entire WDSS-II system using a single HTML page located on a remote machine. This proposed software will dynamically transmit configuration data over a network to a server, execute scripts to re-configure that server, and begin transmitting data to a visualization system at SPC. Thus, we will create a communications management system for WDSS-II software, and develop the necessary data management software for efficient communication of large and complex amounts of WDSS-II data over the network.

Problem Statement:

Currently, a mechanism does not exist for the simple and flexible remote configuration of a "severe storm" domain (a WDSS-II data grid volume) and transmission of that data back and forth over a network. This limits the use of the WDSS-II system to those who are very knowledgeable about the configuration of all components of the software. This paradigm also limits users to configuring a severe storm domain only for a local computer, rather than remotely, which is why transmitting this data over a network is needed and important.

The current WDSS-II system, from end-to-end, contains several configuration files (both in text and XML format) and scripts (both Perl and csh) that need to be hand-edited to create a domain, as well as dozens of programs that need to be re-executed when those files are changed. If a user wishes to completely reconfigure the system for a new domain and receive different information over the network, these files and scripts must be edited, and appropriate programs executed, to create the new domain and begin transmitting the data across the network to the visualization machine. The time spent and detailed knowledge needed to perform such a task is lengthy and complex, prohibiting a national center such as the Storm Prediction Center from fully utilizing the software system. Since the mission of the SPC is to provide guidance and watches for severe convective weather, WDSS-II products (4-D data visualization, plus a myriad of data from a suite of algorithms) would provide a unique distributed data integration environment that would enhance SPC products and potentially provide for increased convective watch lead time. This proposed quasi-operational software will create an easy to use HTML graphical user interface, to re-configure the data transmission of the severe storms domain information server to the visualization system. The research proposed will involve developing new software ideas for the management of this data on the server, in the context that the data will need to be well organized for transmission and maximum flexibility. This will allow the SPC to experiment with the analysis of fine-scale, multi-radar domains to diagnose the strength, severity, and maturity of large scale mesoscale convective weather systems, in addition to smaller scale phenomena such as mini-supercells and boundaries. This multi-radar, multi-product diagnosis capability currently does not exist at the SPC within a single software package.

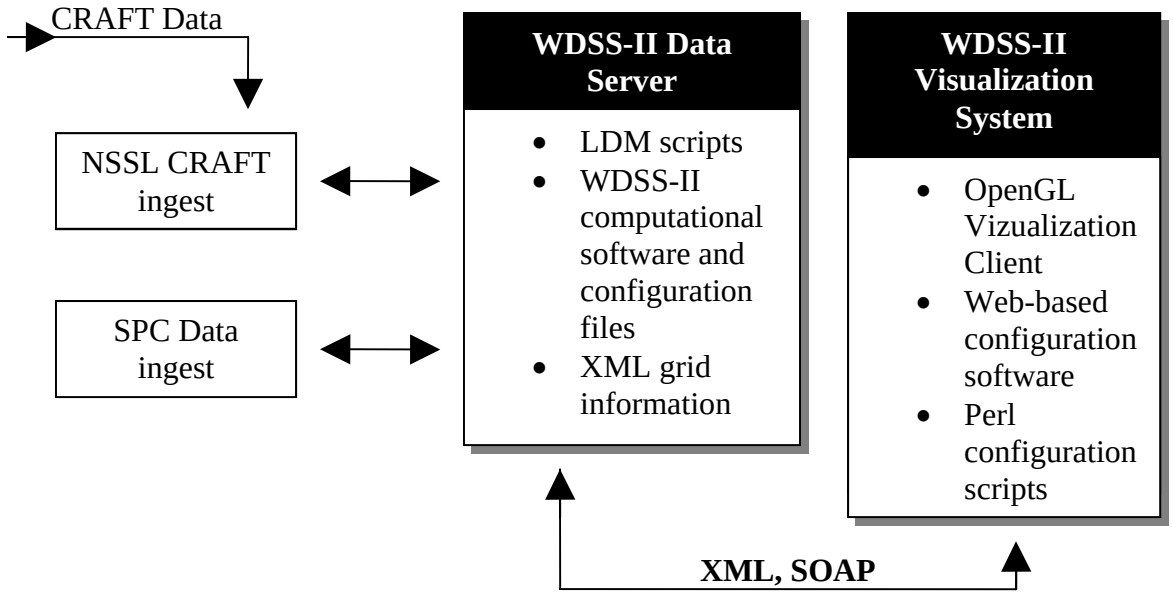
Proposed Solution:

To enable greater access to the wealth of information generated by WDSS-II, we propose to create an integrated software solution for the configuration of severe storm data domains, and transmission of the data objects contained in a domain over a network. Using emerging technologies such as XML and SOAP, along with proven technologies (Perl, web-based HTML forms) we will create the infrastructure to completely configure the transmission of multiple data sources through a simple, one-page web-based form that offers maximum flexibility but complete simplicity. This configuration system will act as the front-end to several Perl scripts that will, dynamically, completely reconfigure the entire data transmission on-the-fly. The data transmitted from the web forms will utilize XML and SOAP to organize the information.

The initial web interface will contain pre-configured domains, on a map of the United States, which are clickable by a user. The user will have a choice of what WDSS-II algorithms (over fifty algorithm choices exist) and which radars to use within a domain. Once a user has selected a particular domain, the local Perl scripts will then transmit the XML configuration data for that domain to a data server located at the SPC, via SOAP messages. This data server will then stop and restart Unidata's Local Data Manager (LDM) software (the real-time WDSS-II data ingest system), change LDM configuration scripts, and begin receiving chosen radars from the CRAFT network server at the National Severe Storms Laboratory (nearly all 120 NEXRAD radars should be available by 2004, provided through a server at the Center for Analysis and Prediction of Storms). The data server will then re-configure all necessary WDSS-II XML configuration files, through a combination of Perl scripts, and will launch correct executables for the chosen algorithms. The user will then be able to launch the visualization software on a separate

computer that retrieves data from the product server. Thus, our software will create the necessary "behind the scenes" technology for a very flexible WDSS-II environment, as it will ensure proper and organized communication of both the real-time weather data and all WDSS-II configuration data. Our overall goal is to make communication management of this data completely configurable from a single HTML page (please refer to Figure 1 for a descriptive picture of the software system organization).

Figure 1: Organization of Proposed Software System



Analysis:

The software created with this project will directly impact the mission of the National Weather Service – to protect the lives and property of the people of the United States – through improved severe weather forecasts. *The most direct benefit will lie in the ability of forecasters at the Storm Prediction Center to integrate, in a 4-D environment, NEXRAD Level II data and other real-time weather data together in a single visualization system. Such a software platform does not exist at SPC, and our proposed software creates a vehicle for improved data analysis, mining, and interrogation of real-time weather data.*

This software solution will be designed for easy transfer to other NCEP National Centers or research institutions. Given success at the SPC, other Centers such as the National Hurricane Center, Aviation Weather Center, and the Hydrological Prediction Center could use domain-based interrogation of NEXRAD data as a risk reduction activity, as this software will enable forecasters or other users in those centers to re-configure network transmission of the real-time data and WDSS-II products on-the-fly – without needing the knowledge of the complex configuration scripts and files used by the existing software. All that is needed is a high performance network capable of receiving the real-time data, and appropriate PC computers for

data analysis and visualization. The software developed will integrate seamlessly into such a hardware framework.

Performance Measures:

The performance of this project will be measured by the use of the software system, by SPC forecasters, during critical severe weather days. We believe that the previously unavailable WDSS-II products will provide the forecasters with increased knowledge of the dynamic severe weather environment. Potential long-term impacts of using the proposed software include increased convective watch lead time, and enhanced mesoscale discussions from the analysis of the severe storm grid information communicated to the visualization machine.

Milestones

- Receive award notification (tentative) – February 1, 2004
- Preliminary GUI development – March 15, 2004
- Initial data domains created – April 15, 2004
- Test during severe weather season – May 1 – June 15, 2004
- Continue to refine interface and grids – August 1, 2004

Deliverables

The proposed software package will contain several deliverable items. HTML files will be generated for the web-based GUI configuration interface. Several Perl scripts will be developed for automating the startup, shutdown, and reconfiguration of LDM and WDSS-II, as well as for developing customized severe storm grids. XML documents will be used to describe the grid data as well as the entire configuration of WDSS-II. Additionaly, SOAP messages will interact between the WDSS-II server and the HTML configuration interface to ensure efficient, organized, and flexible communication of all needed information over the network. Therefore, we will deliver a platform-independent software system that is state-of-the-art, and that takes advantage of the latest IT infrastructure and technology.