APEX DIGITAL SYSTEMS

1010 Wayne Avenue, Suite 800, Silver Spring MD 20910 www.apexdigitalsystems.com

301-588-9767 fax: 301-588-9766

HydroXC-compliant FLDWAV – to – FLDVIEW Data Interface

Design for a HydroXC-compliant FLDWAV – to – FLDVIEW data interface, based upon current implementations of the FLDWAV and FLDVIEW applications

Stephanie Liu-Barnes, Director of Consulting and Design
Andrey Ignatov, Data Architect

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Summary

The National Weather Service's Office of Hydrologic Development and Apex Digital Systems have worked together for over a year on establishing and growing the Hydrologic XML Consortium (HydroXC) for the purpose of creating a common, self-documenting method for exchanging hydrologic data among the many organizations that use such data both operationally and for research.

In order for Consortium members and others to begin to see the benefits and reality of a HydroXC XML standard, the Consortium needs to begin producing examples of how the HydroXC data schema can apply to existing applications in use in the hydrologic community today. During this activity, Apex was tasked with designing a HydroXC-compliant data interface between the FLDWAV and FLDVIEW applications, in use at the National Weather Service (NWS) today.

This document contains a summary description of the modeling approach applied to the existing FLDWAV output data files and FLDVIEW input data files and the resulting data model.

Background

The National Weather Service currently uses two applications, FLDWAV and FLDVIEW, to generate flood forecast data and to produce maps of the forecasted floods, respectively.

Flood forecast data is generated in the FLDWAV application. FLDWAV may be used to generate data for one flood forecast across various cross-sectional mappings of a river. The output of the application is a set of flat files that describe the specifications for any number of mapping scenarios with geographical parameters and forecasted hydrologic data at each cross section.

The flood forecast map is produced by the FLDVIEW application. Preloaded GIS (Geographic Information System) data and images are used together with the hydrologic data from FLDWAV to generate a corresponding map file. FLDVIEW reads only one set of forecast data from FLDWAV at a time and applies it to the map image as specified in the defined flood scenario.

Limitations of Current Data Exchange

The current data exchange between the FLDWAV and FLDVIEW applications uses a series of comma separated flat files. Due to an evolving design and various data sources, the output of FLDWAV includes three different files and the input of FLDVIEW includes two different files. While these files are relatively compact, the comma separated format and multi-file design has several limitations.

First, the comma separated file is not self-describing and the contents and message, therefore, are not understandable to outside applications and sources. Since the forecast data in the comma separated files is not accompanied by any description or specification, it also makes it difficult to understand when read by a human. Applying the HydroXC XML format would allow for standard metadata and specifications within every forecast data file. This "built-in" specification would make the data more understandable for systems and more human readable. It would also allow the forecast data files to be shared with any outside system or application.

Secondly, the current multi-file design is complicated to maintain and introduces multiple sources for error. The files can be confused and improperly updated or stored. With the HydroXC-compliant design, all of the data is contained in one XML file that can be easily stored directly in a database, as well as in a file system.

Modeling Approach

As a first step in modeling the FLDWAV and FLDVIEW data into the HydroXC-compliant format, we studied the current specifications of both applications. We created HydroXC-compliant data diagrams for each application individually to ensure we were supporting the data needs of both applications.

Next, we compared the differences and commonalities of data points in each set. This allowed us to design one data structure to support both applications.

The Hydrologic XML Schema developed in the first phase of the HydroXC project was used to model the FLDWAV and FLDVIEW data structures into an XML format. It was found during our discovery and modeling that the flood forecast data from both of these applications could be applied to the Version One schema. However, these applications manage multiple cross sections in a scenario of mapping hydrologic flood forecast data, which caused a high level of redundancy in the resulting XML file.

In order to improve the data design, Version One of the HydroXC XML Schema was updated to support these multiple data points without increasing redundancy and overall size of the XML data file. These changes will be reflected in Version Two of the HydroXC XML Schema.

Description of Data Diagram

The HydroXC-compliant FLDWAV and FLDVIEW data structure is divided into three main areas:

1. Flood Mapping Scenario Data
2. Geographic Information for Cross Sections
3. Hydrologic Forecast Data

<u>1. Flood Mapping Scenario Data</u> contains the definition for every flood mapping scenario, including its numeric identification, the river system, and the town name. The "Segment Location Set" node in the Report section of the XML file identifies the Segment ID, the River System Name, and the Number of

Flood Mapping Scenarios for this dataset. The Town Name is specified in the header of the "XY Data Array" node for every Mapping Scenario.

2. Geographic Information for Cross Sections is defined by the Mapping Order for each cross section, the River Location, Latitude and Longitude of the River Center Line at the cross section and the Channel Bottom Invert Elevation. This data is stored in the separate "XY Data Array" nodes for each Mapping Scenario. The header for each of these nodes contains the Mapping Scenario ID, Town Name and number of Cross Sections used in this Scenario.

Metadata for the Geographical Information is stored in the "XY Data Array Definition" node in the "XY Location Data Element Set" node. All data array nodes within one "XY Location Data Element Set" are defined by one metadata node.

3. Hydrologic Forecast Data contains the hydrological forecast data for each cross section. The "Forecast Data Element Set" node specifies both the hydraulic forecast data and its metadata. This structure is able to accept multiple forecasts or time series if needed.

Each scenario is described in the "Forecast Data Array" node, which contains header data for the Forecast Scenario ID and Number of Cross Sections. Each Cross Section contains data for River Location, Water Surface Elevation, Channel Top Width and Water Elevation of the Town Side of the Levee, in the body of "Forecast Data Array" node.

Metadata for the hydrologic forecast data is stored in the "Forecast Data Array Definition" node. This single metadata node describes the data definitions for all hydrologic "Forecast Data Arrays" in the "Forecast Data Element Set".

Conclusion

Creating a design for a HydroXC-compliant data interface between the FLDWAV and FLDVIEW applications is an important step in the evolution of the Hydrologic XML schema. This work proves the concept of being able to map existing hydrologic data into the HydroXC-compliant schema. This is an essential step in showing how current applications existing in the active hydrologic community can evolve to some kind of hydrologic XML standard. It is one of the first steps of the HydroXC work that begins to bring the conceptual design thinking from phase one into a more practical implementation approach. We hope this will encourage other Consortium members to attempt this same activity with hydrology applications of their own, thus spreading the proposed standard and providing guidance for its growth.

Finally, this exercise validated and improved the Version One hydrologic XML schema defined in phase one of the HydroXC project. While the data could be mapped to the Version One schema, it allowed us to expand and improve the schema to better support this kind of hydrologic data. These changes improve the schema flexibility and ability to accommodate complex data sets.