

Tabular Product Evolution in eXtensible Markup Language

Part I - Mission Connection

A. Product Description

The Selected Cities Weather Summary and Forecasts (SCS) is a tabular product first issued by NOAA's National Weather Service (NWS) in 1972 to support NWS users and partners worldwide. This product gives observed and forecast weather information for US cities in a terse, tabular format. SCS data can be found in a wide range of media outlets worldwide. The product was initially issued by the National Public Service Unit (NPSU) in Kansas City. However, in 1992 the National Oceanic and Atmospheric Administration (NOAA) NWS National Centers for Environmental Prediction (NCEP) took over production when the NPSU was discontinued.

Recently, as various National Digital Forecast Database (NDFD) weather elements became operational, ideas began to surface simultaneously from NWS regional personnel and from the Hydrometeorological Prediction Center (HPC) to streamline the product generation process for the SCS product. Several themes or objectives came to light based on those ideas, including:

- . The legacy text product (SCS) is outdated and needs to be modernized.
- . There is interest from HPC to have operational responsibility for producing the SCS text product moved to the NDFD CSS.
- . There is interest from the WFO's to eliminate the production of the CCF if operational responsibility for producing the SCS text product shifts to the NDFD CSS.

To meet these themes and objectives, four new XML products have been designed. Two Forecasts in XML (FoX) products, one Observation in XML (ObX), and a Temperature Extremes in XML (TEX) will be generated. These products can be used to generate and SCS text product using eXtensible Stylesheet Language Transformation (XSLT) style sheets. The basic function of an XSLT document is to transform an XML document(s) into a new file(s) in another format (plain text, html, or other XML documents). In time, we expect our users and partners to migrate away from the legacy text products to the new XML products. A discussion of XML and the new XML products can be found in part II – Technical Description.

All changes to NWS products and services will adhere to NWS policies as described in the NWS Directives System (NDS) NWSI 1-1002. Table 1 below shows both the current legacy text products along with the proposed new XML products:

National Public Forecast Products	Type of product	Format
Selected Cities Summary Bulletin (SCS)	Legacy	Text
Travelers Bulletin (TAV)	Legacy	Text
Coded Cities Forecast (CCF)	Legacy	Text
City Observations in XML (ObX)	New	XML
City Forecast Observations in XML (FoX)	New	XML
Temperature Extremes in XML (TEX)	New	XML

Table 1: National Public Forecast Products

B. Purpose

The purpose of the Tabular Product Evolution in eXtensible Markup Language (TPEX) plan is to **modernize** and **improve** the current tabular product suite (i.e., SCS). It also provides an opportunity to **streamline** and **automate** the generation of this product, while at the same time **maximizing** the role of the National Digital Forecast Database (NDFD) in the generation of the tabular product suite. And, by **leveraging** the success of the Digital Weather Markup Language (DWML)-based XML schema that the NDFD is enjoying, the TPEX project will move the NWS towards a more **consistent product suite**. TPEX will accomplish this by introducing a new set of XML products that deliver more value to our users and partners and use simpler

product generation processes with less human intervention.

In addition, moving to XML would also address one of NOAA’s Strategic Mission goals of serving “society’s needs for weather and water information”. "NOAA's Policy on Partnerships in the Provision of Environmental Information" also applies. It states that "To advance the environmental information enterprise, NOAA will provide information in forms accessible to the public as well as underlying data in forms convenient to additional processing, to the extent practicable and within resource constraints. NOAA will make its data and products available in internet-accessible, vendor-neutral form and will use other dissemination technologies, e.g. satellite broadcast, NOAA Weather Radio, and wireless, as appropriate. Each of the XML products will contribute to this goal, since the XML coding will make it easier for each user to access as little or as much of the information contained within each product as desired.

C. Product Availability and Transmission Schedule

The TPEX products started out as experimental NWS products. The 6-month experimental period began on September 12, 2007 and continued through approximately September 12, 2008. Table 2 below highlights each of the new products, its size, and issuance frequency. The first four products listed will be available in XML format. Details about the XML schema can be found at <http://www.weather.gov/forecasts/xml/DWMLgen/schema/DWML.xsd>. The NDFD-generated SCS product will continue to be a text product. The FOX3, FOX7, and ObX XML products will be produced hourly. The TEX product will be issued four times a day at 0000, 0600, 1200, and 1800 Coordinated Universal Time (UTC). The NDFD-generated SCS text product will be issued twice a day, at the same times the current operational SCS text product is issued by HPC. The FOX3, ObX, and TEX XML products and the NDFD-generated SCS will be issued to our users and partners as a “push” product via the Satellite Broadcast Network (SBN). The FOX7 XML product, for our more advanced users and partners, will be available via a “pull” methodology from the TOC ftp server.

Product	Size (approx)	Frequency Daily(approx)	Total Addt'l City Size (approx) Double City Size (approx)
7-day FoX (FOX7)	540 kb	24x/day	13.0 MB
3-day FoX (FOX3)	300 kb	24x/day	3.1 MB
ObX	130 kb	24x/day	3.1 MB
TEX	2-3 kb	4x/day	0.01 MB
NDFD-generated SCS	13 kb	2x/day	0.06 MB
			1040 kb
			1.7 kb
			580 kb
			0.8 kb
			260 kb
			N/A
			N/A
			0.08 kb
			26 kb

Table 2: TPEX Product Sizes D. Audience

We expect the new XML products to reach a wide range of users and partners, particularly those who capture NWS data and add value to it. These include education, media, and private meteorology interests.

E. Presentation Format

The legacy SCS product is a tabular text file suitable for transmission over the GTS. The new FoX, ObX and TEX products are issued in XML suitable for websites or to be transmitted over the internet. XSLT stylesheets can be used by our users and partners to determine the format and output the amount of data needed. Figure 1 represents a sample snippet of a FOX3 XML product. Figure 2 shows what a sample snippet of a TEX product, and what the result is if an XSLT text stylesheet is applied to the XML product.

```

(...snip...)
<parameters applicable-location="Baltimore">
  <temperature type="maximum" units="Fahrenheit" time-layout="k-p12h-n3-3">
    <name>Maximum Temperature</name>
    <value>76</value>
    <value>72</value>
    <value>58</value>
  </temperature>
  <temperature type="minimum" units="Fahrenheit" time-layout="k-p13h-n3-3">
    <name>Minimum Temperature</name>
    <value>61</value>
    <value>63</value>
    <value>45</value>
  </temperature>
  <weather time-layout="k-p12h-n6-3">
    <name>Weather Type, Coverage, and Intensity</name>
    <weather-conditions weather-summary="Sunny"/>
    <weather-conditions weather-summary="Clear"/>
    <weather-conditions weather-summary="Mostly Cloudy"/>
  </weather>
</parameters>
(...snip...)

```

Max Temp.
Values

Min Temp.
Values

Weather
Values

Fig 1: Sample snippet of FOX3 XML product

<pre> <location> <location-key>KCQT</location-key> <city state="CA" summarization = "conus">Los Angeles</city> </location> <parameters applicable-location="KCQT"> <temperature type="maximum" units= "Fahrenheit" time-layout="k-p12h-n1-1"> <name>National Maximum Temperature </name> <value>90</value> </temperature> </parameters> </pre>		<pre> US Temperature Extremes 2007-01-05T18:56:57Z National High Temperature KCQT Los Angeles 90F National Low Temperature KMSP Minneapolis 12F </pre>
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Fig 2: Sample snippet of Temperatures Extremes in XML Product with XSLT text stylesheet applied

F. Web Interface

The new XML products and NDFD-generated SCS can also be found on NOAA's web farm at <http://www.weather.gov/xml/tpex>. This site also contains additional information about each of the products, along with tools that our users and partners can use to view and work with the new products.

G. Feedback Method

We are always seeking to improve our products based on user feedback. Comments regarding the new XML and NDFD-generated SCS text product can be submitted by completing the short on-line survey at:

<http://www.weather.gov/survey/nws-survey.php?code=tpex>

Part II – Technical Section

A. New Products

There will be two FoX (FOX3 and FOX7) products that will be generated and issued hourly on the NDFD CSS as part of the TPEX plan. The first FoX product (FOX3) will contain forecasts of weather and high/low temperatures for days 1 through 3 for the same stations and cities as in the current SCS and TAV text products. The second FoX product (FOX7) will contain forecasts of weather and high/low temperatures for days 1 through 7 and will provide considerably more information than the legacy three day SCS product. It could also be used as a tool for advanced planning that is not available within the current text SCS product. .

The ObX product will be generated and issued hourly by the NCEP NCO. The ObX will contain observed maximum/minimum temperatures and observed precipitation for the same cities as in the legacy SCS text product. At the appropriate times of day, the ObX will also contain high and low temperatures “so far today/tonight” in addition to the high and low temperatures for the most recent complete day/night periods. The following observing period definitions have been created for the ObX product. For maximum and minimum temperatures, the periods have been defined as 7:00 a.m. to 7:00 p.m. and 7:00 p.m. to 8:00 a.m. Local Standard Time (LST) respectively. Precipitation observations are defined as the last four 6-h synoptic times (cumulative). Maximum Temperature “so far today” is defined as the period between 7:00 a.m. to the current hour (not to exceed 6:59 p.m.). Minimum Temperature “so far tonight” is defined as the period between 7:00 p.m. to the current hour (not to exceed 7:59 a.m. the following day). The maximum/minimum temperatures “so far” time periods are based on essentially the same time periods used for maximum and minimum temperature.

The TEX product will be generated and issued four times each day at the standard synoptic times (0000, 0600, 1200, 1800 UTC) by the HPC. It will contain the so-called National High/Low Temperatures using the same criteria currently used in the SCS. Due to the flexibility of XML, the TEX could be readily expanded to include extreme values for Outside CONUS (OCONUS) areas as well (e. g., Alaska high and low).

The NWS plans to continue issuing the SCS text product twice daily. Doing so will ease the transition for our users and partners.

B. Methodology

1. FoX Product Production

There is a three step process used for generating the FoX products. Grids are processed at the NDFD Central Server System (CSS) as they arrive from WFOs, grids are summarized and geodata are assessed, and products are generated according to a time schedule. For more information about NDFD, please see Glahn and Ruth (BAMS, 2003) or visit <http://www.weather.gov/ndfd>.

Grid Arrival and Processing

As each of the WFOs send their grid information to the NDFD CSS, NDFD software records metadata associated with each grid into relational database tables. These tables contain information about the weather elements contained in the grids, their WFO of origin, valid date/time, grid arrival time, and the grid characteristics (grid size and spatial resolution).

Grid Summarization and Categorization of Geodata

Point data for the TPEX Digital Forecast Matrices (DFMs) are queried from each grid. In general terms, DFMs describe the evolution in time of a set of weather elements at a geographic point. More specifically, the TPEX DFMs contain several self-describing components to them at hourly resolution. The actual DFM data are in flat files, located by file pointers stored in a relational database table.

The first field in the CPG DFM is the ID of the WFO responsible for this area's forecast, the station or zone represented by the DFM, and the DFM type (e.g., station, public, etc.)

The second field in the CPG DFM is the year, month, date, hour, and epoch time (seconds since 00:00 1/1/1970) of the first value in the matrix.

The remaining fields provide the data for each of the weather elements. Each different field begins with the element name, and then includes the hourly values. Missing values are indicated with '9999'. The Weather (Wx) values are the “ugly string” values directly from the grids. These Wx values are themselves summarized and included as a CPG DFM element (CoP = Character of the Period).The weather elements are also summarized over a 12-h time period to yield the Character of the Period (CoP).

When creating the station DFMs, the grid point closest to a station's latitude/longitude is used. A land-sea mask is applied to ensure that only land values are used. In addition, each DFM contains information about the

originating WFO, the station ID, the valid date/time, the element names, and the actual data.

Product Generation

The FoX generation application creates the header and temporal definition sections using pre-defined configuration data and the current date and time. The application then extracts the appropriate weather information from the station DFMs and completes the formatting of the FoX.

2. ObX Product Production

The methodology for generating the ObX product is to screen hourly observations via automated procedures. Only the subset of stations transmitting Meteorological Aerodrome Report (METAR) data currently used in the SCS text product is kept. Second, automated procedures are used to quality control the integrity of the remaining data.

Quality control checks for the ObX products attempt to correct data problems that can be readily recognized. Temperature values that are too cold or too hot are replaced with missing values. Six-hour accumulated precipitation values of 0.01 inches are considered suspect. If precipitation is reported in the observations during that 6-h period, then the accumulated precipitation value of 0.01 is accepted. Otherwise, it is replaced with a value of zero. These criteria are based on methods used by the NWS Verification Program.

Values for maximum and minimum temperature, precipitation, and maximum and minimum temperatures “so far” in the ObX product are updated hourly as described above. As the ObX products are issued each hour, valid times for a number of the weather elements change. For example, at 7:00 p.m. LST the current day's Maximum Temperature “so far today” becomes a complete period Maximum Temperature. At that point, the previous Maximum Temperature “so far today” becomes the Maximum Temperature, and the Maximum Temperature “so far today” becomes undefined until 12:00 p.m. Local Time (LT) the following day.

3. TEX Product Production

Generation of the TEX products requires the collaboration of HPC and NCO. First, the two organizations need to maintain and periodically update a filter list of stations or cities that will be considered for the National High/Low Temperature. This filter list will generally reflect the station criteria currently used in the SCS.

Then NCO software searches through the appropriate surface observations, identifies the National High/Low stations, generates a draft version of the TEX and makes it available to HPC forecasters. HPC forecasters then review the TEX, and make any limited adjustments if needed and issue the product.

4. SCS Product Production

The methodology for generating the SCS text product will be to use an XSLT stylesheet to transform the FoX, ObX, and TEX products into the SCS. This stylesheet will be made available to our users and partners. Our users and partners could develop their own stylesheets to create the SCS or other similar text products at hourly intervals. The resulting SCS text will have the exact same format as the HPC-produced SCS product, meaning no immediate software changes are required by the SCS users.

C. TPEX Process

Figure 3 shows the proposed process for generating the new XML and NDFD-generated SCS products. The FOX3, FOX7 and SCS products will be generated on the NDFD CSS, the TEX product will be generated by the NWS's HPC and the ObX product will be produced by the NCO. The NWS Telecommunications Gateway (TG) will route products between NWS centers and our users and partners.

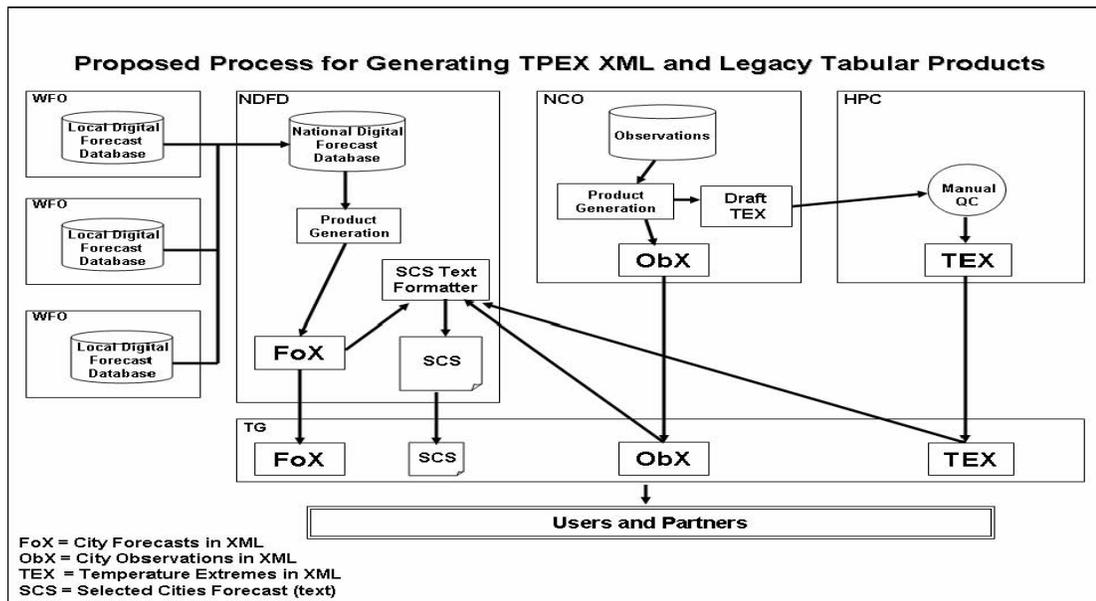


Fig 3: Proposed process for generating the 4 XML and SCS text products

D. Benefits to our Users and Partners

1. A modernized product suite. The new XML products will be superior to the current text suite in the following ways:

a. More flexibility for our users and partners. XML makes it easy for users and partners to choose the data they want from within the product. XML also makes it easier for users and partners to adjust when the NWS makes changes. Examples of how NWS would make a change include adding additional weather elements, locations, and time projections. The reason XML makes it easier for our users and partners is that it is organized by “tags”. These “tags” really represent the meteorological information contained in the product. For example, the FOX product would have separate “tags” for maximum temperature, minimum temperature and CoP or sky condition. If additional weather elements were added, it would be as an additional “tag” that our users and partners could parse out. In addition, it will be far easier for our customers and partners to manipulate the amount of data as well as format of the data using XSLT stylesheets. This represents a significant improvement to our users and partners who are use to receiving a tabular text product in all capital letters.

b. Better service to our user and partners. The TPEX Plan will generate more products, more often for our NWS users and partners, and this will provide more accurate and more useful information, particularly with observed high and low temperatures and projected forecast information. One improvement in the observational information contained in the current tabular product suite is the addition of high and low temperatures “so far today/tonight” in addition to the high and low temperatures for the most recent complete day/night periods. In addition, ObX will be issued *hourly*, providing more accurate values for maximum and minimum temperature than the current SCS product. In addition, requirements have been established that will allow for the automation the QC process for generating the ObX product.

The FoX forecast products will also have a decided advantage over the SCS text product. First, the FoX products will be issued *hourly*. This increased frequency of issuance will allow for better forecasts as synoptic weather conditions change throughout the course of a given day. Second, there will be *improvements* to the **CoP parameter**. The first improvement will be to add character of the night values. The second improvement is to assign a more precise set of weather definitions to CoP. The point-and-click codes will be used as opposed to the old CCF CoD codes, as they contain both daytime and nighttime values, whereas the CCF codes used in the current legacy product suite only have daytime weather values.

c. More consistency in the NWS product suite. Since the FoX products will be formatted directly from the NDFD, they will be consistent with the NDFD and all other products generated from the NDFD. In addition, the TEX and ObX products generated and issued by HPC and NCO respectively, will also adopt the same XML-based format schema. Having consistency for products that produce similar output results is important, and the TPEX plan is the first step in providing that consistency.

2. An improved product generation process. TPEX will introduce a number of automated quality control procedures into the production of the ObX and TEX products. Most of this quality control is provided manually by HPC forecasters today. Specific QC checks performed include:

- a. Temperature - Only values between the range -50 through 130 degrees Fahrenheit shall be accepted.
- b. Precipitation - The reported value is a 24-hour total derived by summing four consecutive 6-hour totals. The code first eliminates all "trace" (i.e. -0.1) and "missing" values and then sums any remaining values. However, if no values remain to be summed after the elimination step, then no corresponding precipitation value is reported in the ObX product. This ensures that you'll never see a precipitation value of 0.00 (i.e. no precipitation) unless one or more of the 6-hour periods actually reported as such.

3. More streamlined product generation. The current process for creating the SCS product involves a number of forecasters at WFOs and at HPC. The draft SCS product today cannot be generated successfully until NCO Central Server System (CSS) has received the latest CCF products from each WFO. This interrelationship/interdependency frequently obstructs the issuance of the operational SCS. This interdependency condition will not exist by implementing the TPEX plan. That is because the XML FoX products are generated directly from the WFO grids of weather elements sent to the NDFD Central Server System without direct human intervention.

E. Additional Information

For additional information about these products please contact:

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