Web Services for the Next Generation Air Transportation System

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Background: Web Services for NextGen

- 4+ years of collaboration between NWS and FAA to make NextGen a reality
- Many partners, including NCAR, MIT/LL, NOAA/ESRL, MDL, AWC, AFWA, and FAA Hughes Tech. Ctr.
- Current effort has a clear path to operations between NWS and FAA
Web Services
Next Generation Air Transportation System (NextGen)
Next Generation Air Transportation System (NextGen)
Stage One: Prototypes

FAA Tech Center
Egg Harbor, New Jersey

Data-consuming Applications
Enhanced WINS Dissemination (EWD)

NWS Meteorological Development Lab
Silver Spring, Maryland

Web Services
(WCS, WMS, WFS, RegRep)

NWS OPSnet MPLS
Stage Two: Migration towards operations
FAA Operational Networks

Data-consuming Applications (pub/sub)

NWS OPSnet MPLS

National Climate and Weather Prediction Center
College Park, Maryland

Web Services (WCS, WMS, WFS, RegRep)

Stage Three: Operations
Feature? Coverage? Map?

- Reg/Rep, WFS, WCS, WMS

- *Feature, coverage, and map* are all concepts from Geospatial Information Systems...

- ...with useful applications in meteorology
What's a feature?
What’s a feature?
Features in GIS

- Generally, anything you can see
- E.g., stop signs, roads, houses
- Often represented as points, polylines, and polygons
Features in meteorology

- Point observations or forecasts (e.g., METAR, TAF, PIREP)
- Geographic region where a weather forecast or warning is valid (e.g., Forecast Zone, County Warning Area, valid area of a Tornado Watch)
- Airspace volume where a weather forecast or warning is valid (e.g., SIGMET)
What’s a coverage?
Coverage in GIS

- Geographic feature that conveys different values at different locations
- Note: Regular spacing not required
Coverage in meteorology

- Grids!
- Gridded analyses, Numerical Weather Prediction (NWP) output
- National Digital Forecast Database (NDFD)
- Radar data
- Satellite data
Others...

- Maps: Images that convey interpretations of data.
- Metadata: Information about the data. (E.g., Coordinate Reference System, location, beginning/end of record)
- Methods for data discovery, including Registry/Repository (Reg/Rep)
Web Feature Service (WFS)

- Client sends a query
- Server accesses database
- Server encodes response (often multiple data points) in XML
- Server sends response to client
- Subscription also supported
Example WFS in action

- CustomWeather’s MyForecast
- Background map is served by Web Mapping Service (WMS)
- Station data are served by WFS
Web Coverage Service (WCS)

- Client sends a query
- Server accesses data store
- Server encodes response. GRIB2 and NetCDF are common response formats.
- Server sends response to client
- Subscription also supported
Example WCS in action

NCAR Flight Path Tool
Web Mapping Service (WMS)

- Client sends a query
- Server accesses data store
- Server encodes response as a bitmapped graphic
Example WMS in action

NDFD Map Viewer
WCS vs. WMS

- Important point the images don’t show:
  - WCS: Server sends data to client
  - WMS: Server sends image to client
Web Services, Old and New

• WCS, WMS Reference Implementation by NCAR
  o Implemented at FAA Tech Center, NCAR, LL/MIT, NOAA/ESRL, AWC and MDL

• WFS Reference Implementation by MIT/LL
  o Implemented at FAA Tech Center, NCAR, LL/MIT, NOAA/ESRL, AWC and MDL

• EbXML Registry/Repository by Wellfleet
  o Implemented at FAA Tech Center, LL/MIT, GSD, and MDL

• WCS, WMS, WFS prototype by ITT/Excellis
  o Implemented and being evaluated at MDL
  o Installing at NCWCP
Migrating Legacy Products

Input for FAA’s Common Support Services--Weather (CSS-Wx)

- ~1000 grids (model, satellite)
- ~130 images (various aviation charts)
- METAR, SPECI, TAF, SIGMET
- Other Traditional Alphanumeric Codes (TAC). A small number, but many headaches
  - Requires considerable xml schema extension and development
Data transport vs. contents

- **WFS**
  - XML documents

- **WCS**
  - Generally, grids encoded in NetCDF, HDF5, or GRIB2

- **WFS**
  - Bitmap images (JPEG, PNG, GIF)

- **Reg/Rep**
  - Metadata encoded in XML
METAR and SPECI: Weather observation at an aerodrome
Legacy Aviation Products

TAF: Weather forecast at an aerodrome
Legacy Aviation Products

SIGMET: Weather hazards for pilots en route
# Traditional Alphanumeric Codes (TAC)

<table>
<thead>
<tr>
<th>METAR/SPECI</th>
<th>METAR KBWI 181254Z 00000KT 10SM FEW250 14/09 A3034 RMK A02 SLP272 T01390089</th>
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<td>TAF</td>
<td>KGTF 181140Z 1812/1912 23012KT P6SM BKN100 FM181800 25015G22KT P6SM VCSH SCT050 BKN080 FM190100 30010KT P6SM VCSH BKN060 FM190800 26007KT P6SM BKN120</td>
</tr>
<tr>
<td>SIGMET</td>
<td>CONVECTIVE SIGMET 19E VALID UNTIL 1455Z FL GA AND FL CSTL WTRS FROM 30NW CRG-60E OMN LINE TS 25 NM WIDE MOV LTL. TOPS TO FL430.</td>
</tr>
</tbody>
</table>
From TAC to XML

- Traditional Alphanumeric Codes for aviation are regulated internationally
  - International Civil Aviation Organization (ICAO)
  - World Meteorological Organization (WMO)
  - Strict 3-year update cycle

- WMO Task Team for Aviation XML (TT_AvXML) developing data models and XML schemas

- Will enable “states in a position to do so” to exchange XML data.
New Data Models

- **WMO**: Modèle pour l'Échange des informations sur le Temps, le Climat et l'Eau (METCE)
  - In English, it may also be known as the ‘METeorological Community Exchange’ model

- **ICAO**: ICAO Meteorological Information Exchange Model (IWXXM)
  - Possible point of confusion: NCAR and EUROCONTROL have developed another model named WXXM