Enabling Information Sharing thru Common Services

Trade-offs Involved when Representing Weather and/or Aviation Data in WXXM Formats (as compared with their native formats)

Presented To: Air Transportation Information Exchange Conference

Presented By: Chris MacDermaid, Glen Pankow

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Agenda

- Legacy Weather Data Formats
- Data Experience
- METAR Decoders
- METAR Example
- WXXM Features
- Addressing XML Size
- Size Comparisons
- Summary

Legacy Weather Data Formats

- Lots of aviation weather formats out there:
  - METAR
  - SIGMET
  - AIRMET
  - TAF
  - Volcanic Ash Advisory
  - Tropical Cyclone Advisory
- Desire to consolidate/standardize

Weather Data Formats (cont.)

And standardization has been ongoing and profitable

- BUFR, GRIB
  - Developed in a time where communications costs were high
  - Table-driven (governance issues)
- NetCDF
  - Self-describing
  - Hyperslabs
  - Convenient API
  - Not good with sparse data
  - CF conventions
  - Future use with OGC standards

Data Experience at ESRL/GSD

- Decoders/encoders have bugs – try to keep things as close as possible to “receipt” (original) format
- Note “missing” data
- Avoid unnecessary unit conversions
- Need metadata such as station tables.
- Applicable to long-term storage of data as well. Store data in receipt format (possibly in addition to more convenient formats) – also, store data with any headers/wrappers

Many METAR Decoders

- Aviation Digital Data Service (ADDS) METAR decoder
- NCEP METAR decoder
- AWIPS METAR decoder
- GEMPACK METAR decoder
- Many METAR decoding applications for Android and iPhone
- Google search returns 111,000 results when searching for METAR decoders

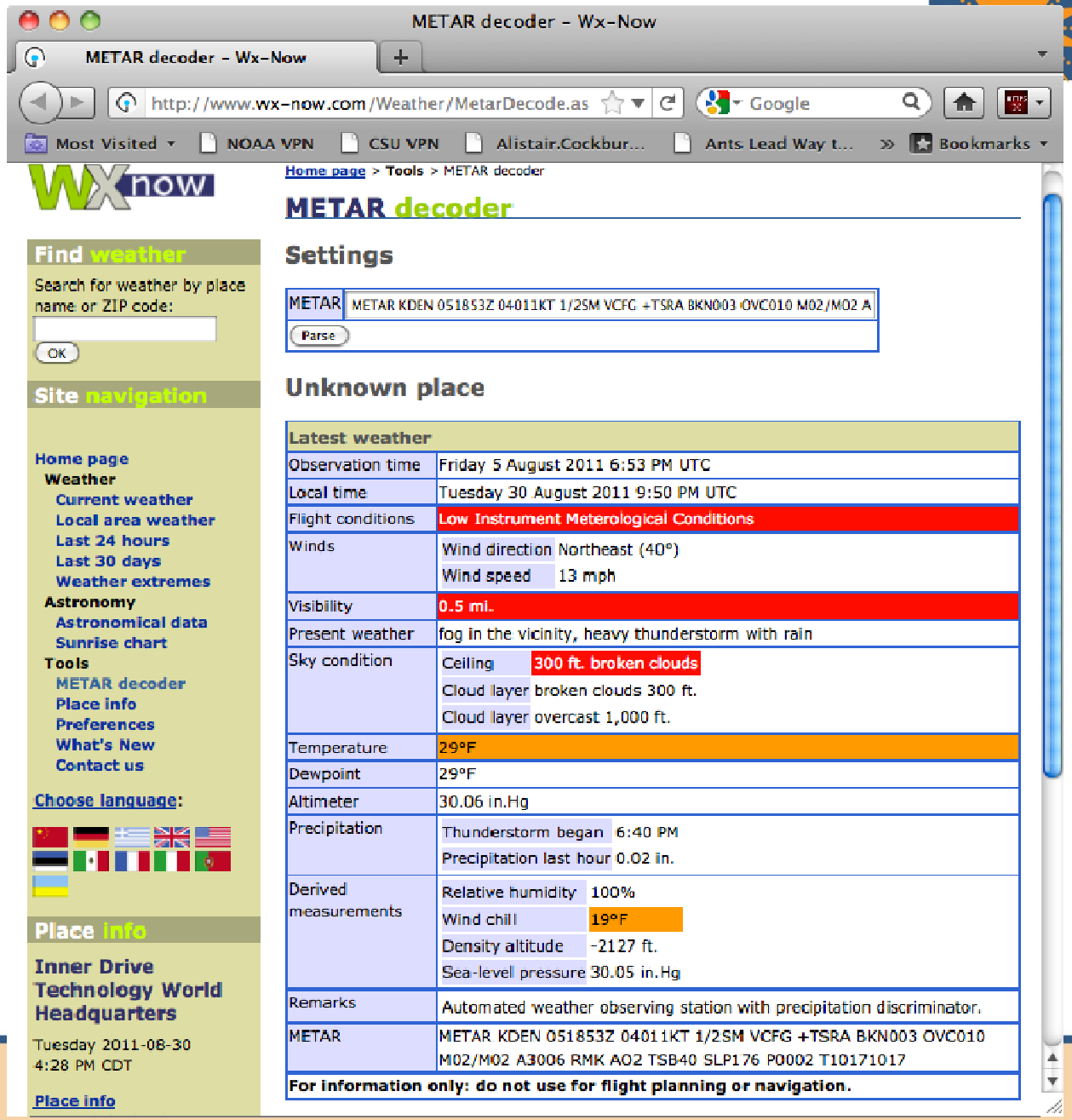
Sample METAR to WXXM Mapping

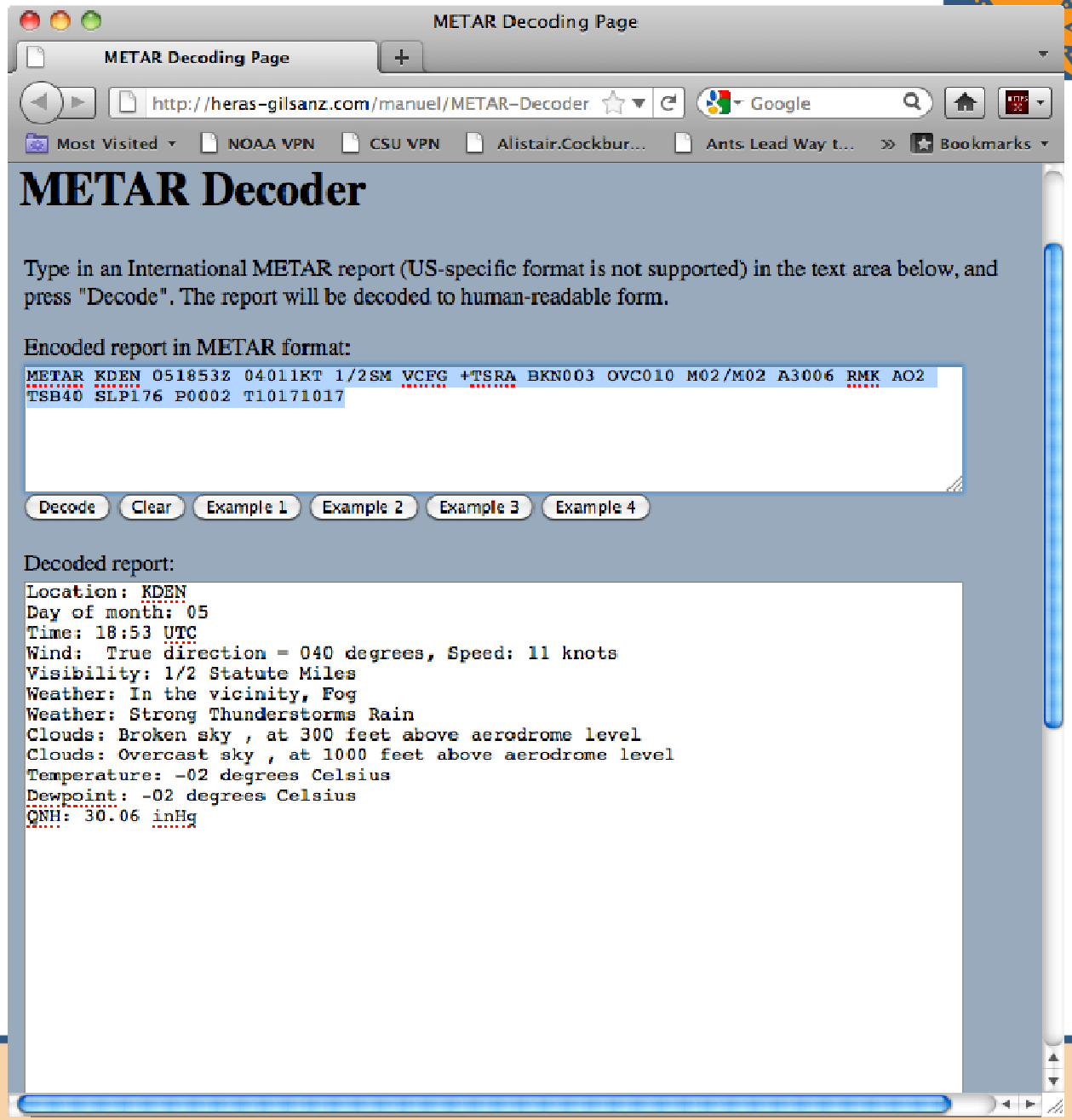
Item	Decoded Metar	WFS fragment
1	REPORT CODE NAME : METAR	<avwx:SurfaceObservation> <avwx:type>METAR</avwx:type>
2	STATION ID : KPHL	<avwx:SurfaceObservation> <avwx:stationId codeSpace="urn:icao:codes:weatherStation">KPHL</avwx:stationId>
3	RAW TEXT : KPHL 081554Z 05010KT 10SM CLR 22/16 A3009 RMK AO2 SLP189 T02170156	<avwx:SurfaceObservation> <avwx:rawText>KPHL 081554Z 05010KT 10SM CLR 22/16 A3009 RMK AO2 SLP189 T02170156</avwx:rawText>
4	OBSERVATION DAY : 04 OBSERVATION HOUR : 05 OBSERVATION MINUTE : 06	<wx:Observation gml:id="id2"> <om:samplingTime> <gml:TimeInstant gml:id="id8"> <gml:timePosition>2009-11-04T01:06:00-0400</gml:timePosition>
5 6 7	WIND DIRECTION : 280 WIND SPEED : 15 WIND UNITS : KT WIND GUST : 22	<avwx:AerodromeNx> <avwx:windSpeed uom="kt">13.0</avwx:windSpeed> <avwx:windDirection uom="deg">330</avwx:windDirection> <avwx:windGust uom="kt">22.0</avwx:windGust>
8	PREVAIL VSBY (SM) : 10.000	<avwx:prevailingVisibility uom="SM">4.000</avwx:prevailingVisibility>
9	WX/OBSTRUCT VISION : TSRA	<om:observedProperty> <swe:Phenomenon> <wx:weatherDescriptor>THUNDERSTORMS</wx:weatherDescriptor> <wx:weatherPhenomenon>RAIN</wx:weatherPhenomenon> </swe:Phenomenon> </om:observedProperty> <om:observedProperty> <swe:Phenomenon> <wx:intensity>LIGHT</wx:intensity> <wx:weatherPhenomenon>DRIZZLE</wx:weatherPhenomenon> </swe:Phenomenon> </om:observedProperty>
10 11	OBSCURATION AMOUNT : FEW// OBSCURATION PHENOM : FG	
12	AUTO INDICATOR : AO2	<avwx:SurfaceObservation> <avwx:automated>true</avwx:automated> <avwx:SurfaceObservation> <avwx:missing>false</avwx:missing>
13	TEMP. (CELSIUS) : 12	<avwx:AerodromeNx> <avwx:airTemperature uom="C">12</avwx:airTemperature>
14	D.P. TEMP. (CELSIUS) : 11	<avwx:AerodromeNx> <avwx:dewpointTemperature uom="C">11</avwx:dewpointTemperature> <wx:Observation> <om:procedure xlink:href="urn:fdc:faa.gov:Sensor:WeatherStation:01234"/>
15	ALTIMETER (INCHES) : 29.78	<avwx:airPressure uom="bar">1.0080122</avwx:airPressure>
16	CLOUD COVER : BKN CLOUD HGT (CHARAC.) : 018 CLOUD HGT (METERS) : 540 OTHER CLOUD PHENOM : CB	<avwx:cloudConditions> <wx:CloudCondition> <wx:base uom="ft">1800.0</wx:base> <wx:amount>BROKEN</wx:amount> <wx:type>COMULONIMBUS</wx:type>
17	HOUR OF WIND SHIFT : 23 MINUTE OF WIND SHIFT: 38	
	FREQUENT LIGHTNING : TRUE CLOUD-GROUND LTG : TRUE CLD-CLD LIGHTNING : TRUE OCCASSIONAL LTG CONTINUOUS LTG IN-CLOUD LIGHTNING CLOUD-AIR LIGHTNING LIGHTNING AT AIRPORT LIGHTNING OVERHEAD DISTANT LIGHTNING	

Sample METAR WXXM


```
<avwx:METAR xmlns:avwx=
    "http://www.eurocontrol.int/avwx/1.1"
...
 <avwx:wxCondition>
   <wx:WxCondition gml:id="id20">
     <wx:weatherModifier>
       <wx:WeatherProximity>VICINITY</...>
     </wx:weatherModifier>
     <wx:wxPhenomenon>
       <wx:Hydrometeor gml:id="id21">
         <wx:intensity>MODERATE</...>
         <wx:type>FOG</wx:type>
       </wx:Hydrometeor>
     </wx:wxPhenomenon>
     <wx:wxCode>VCFG</wx:wxCode>
   </wx:WxCondition>
 </avwx:wxCondition>
 <avwx:wxCondition>
   <wx:WxCondition gml:id="id24">
     <wx:wxPhenomenon>
       <wx:Precipitation gml:id="id26">
         <wx:intensity>HEAVY</wx:intensity
         <wx:type>RAIN</wx:type>
       </wx:Precipitation>
     </wx:wxPhenomenon>
     <wx:wxCode>+TSRA</wx:wxCode>
     <wx:weatherDescriptor>THUNDERSTORMS..
   </wx:WxCondition>
 </avwx:wxCondition>
...
```

```
<avwx:SurfaceObservation xmlns:avwx=
    "http://www.eurocontrol.int/wxxs/1.1"
...
 <avwx:wxConditions>
   <wx:WxCondition gml:id="id20">
     <wx:intensity>MODERATE</wx:intensity>
     <wx:weatherModifier>VICINITY</...>
     <wx:weatherPhenomenon>FOG</...>
     <wx:wxCode>VCFG</wx:wxCode>
   </wx:WxCondition>
   <wx:WxCondition gml:id="id24">
     <wx:intensity>HEAVY</wx:intensity>
     <wx:weatherDescriptor>THUNDERSTORMS..
     <wx:weatherPhenomenon>RAIN</...>
     <wx:wxCode>+TSRA</wx:wxCode>
   </wx:WxCondition>
 </avwx:wxConditions>
...
```


METAR decoder - Wx-Now
METAR decoder - Wx-Now
http://www.wx-now.com/Weather/MetarDecode.as
Google
Most Visited
NOAA VPN
CSU VPN
Alistair.Cockbur...
Ants Lead Way t...
Bookmarks
WXnow
Home page > Tools > METAR decoder
METAR decoder
Find weather
Search for weather by place name or ZIP code:
OK
Site navigation
Home page
Weather
Current weather
Local area weather
Last 24 hours
Last 30 days
Weather extremes
Astronomy
Astronomical data
Sunrise chart
Tools
METAR decoder
Place info
Preferences
What's New
Contact us
Choose language:
Place info
Inner Drive Technology World Headquarters
Tuesday 2011-08-30
4:28 PM CDT
Place info
Settings
METAR
METAR KDEN 051853Z 04011KT 1/2SM VCFG +TSRA BKN003 OVC010 M02/M02 A
Parse
Unknown place
Latest weather
Observation time
Friday 5 August 2011 6:53 PM UTC
Local time
Tuesday 30 August 2011 9:50 PM UTC
Flight conditions
Low Instrument Meterological Conditions
Winds
Wind direction Northeast (40°)
Wind speed 13 mph
Visibility
0.5 mi.
Present weather
fog in the vicinity, heavy thunderstorm with rain
Sky condition
Ceiling 300 ft. broken clouds
Cloud layer broken clouds 300 ft.
Cloud layer overcast 1,000 ft.
Temperature
29°F
Dewpoint
29°F
Altimeter
30.06 in.Hg
Precipitation
Thunderstorm began 6:40 PM
Precipitation last hour 0.02 in.
Derived measurements
Relative humidity 100%
Wind chill 19°F
Density altitude -2127 ft.
Sea-level pressure 30.05 in.Hg
Remarks
Automated weather observing station with precipitation discriminator.
METAR
METAR KDEN 051853Z 04011KT 1/2SM VCFG +TSRA BKN003 OVC010 M02/M02 A3006 RMK AO2 TSB40 SLP176 P0002 T10171017
For information only: do not use for flight planning or navigation.


METAR Decoding Page
METAR Decoding Page
http://heras-gilsanz.com/manuel/METAR-Decoder
Google
Most Visited
NOAA VPN
CSU VPN
Alistair.Cockbur...
Ants Lead Way t...
Bookmarks
METAR Decoder
Type in an International METAR report (US-specific format is not supported) in the text area below, and press "Decode". The report will be decoded to human-readable form.
Encoded report in METAR format:
METAR KDEN 051853Z 04011KT 1/2SM VCFG +TSRA BKN003 OVC010 M02/M02 A3006 RMK AO2 TSB40 SLP176 P0002 T10171017
Decode
Clear
Example 1
Example 2
Example 3
Example 4
Decoded report:
Location: KDEN
Day of month: 05
Time: 18:53 UTC
Wind: True direction = 040 degrees, Speed: 11 knots
Visibility: 1/2 Statute Miles
Weather: In the vicinity, Fog
Weather: Strong Thunderstorms Rain
Clouds: Broken sky , at 300 feet above aerodrome level
Clouds: Overcast sky , at 1000 feet above aerodrome level
Temperature: -02 degrees Celsius
Dewpoint: -02 degrees Celsius
QNH: 30.06 inHg

Example: 2 METAR Decoders

- METAR Text → NetCDF decoder for ESRL modelers
  - Subset of METAR fields (for meteorological requirements)
  - Common unit of measure
- METAR Text → MADIS project
  - Value-added quality control flags
  - Subset of METAR fields
  - Common unit of measure

WXXM Features

- Descriptions being completed
- Human- (as well as computer-) readable XML
- Standards-compliant
- Value-added information
- Leverage XML support in databases

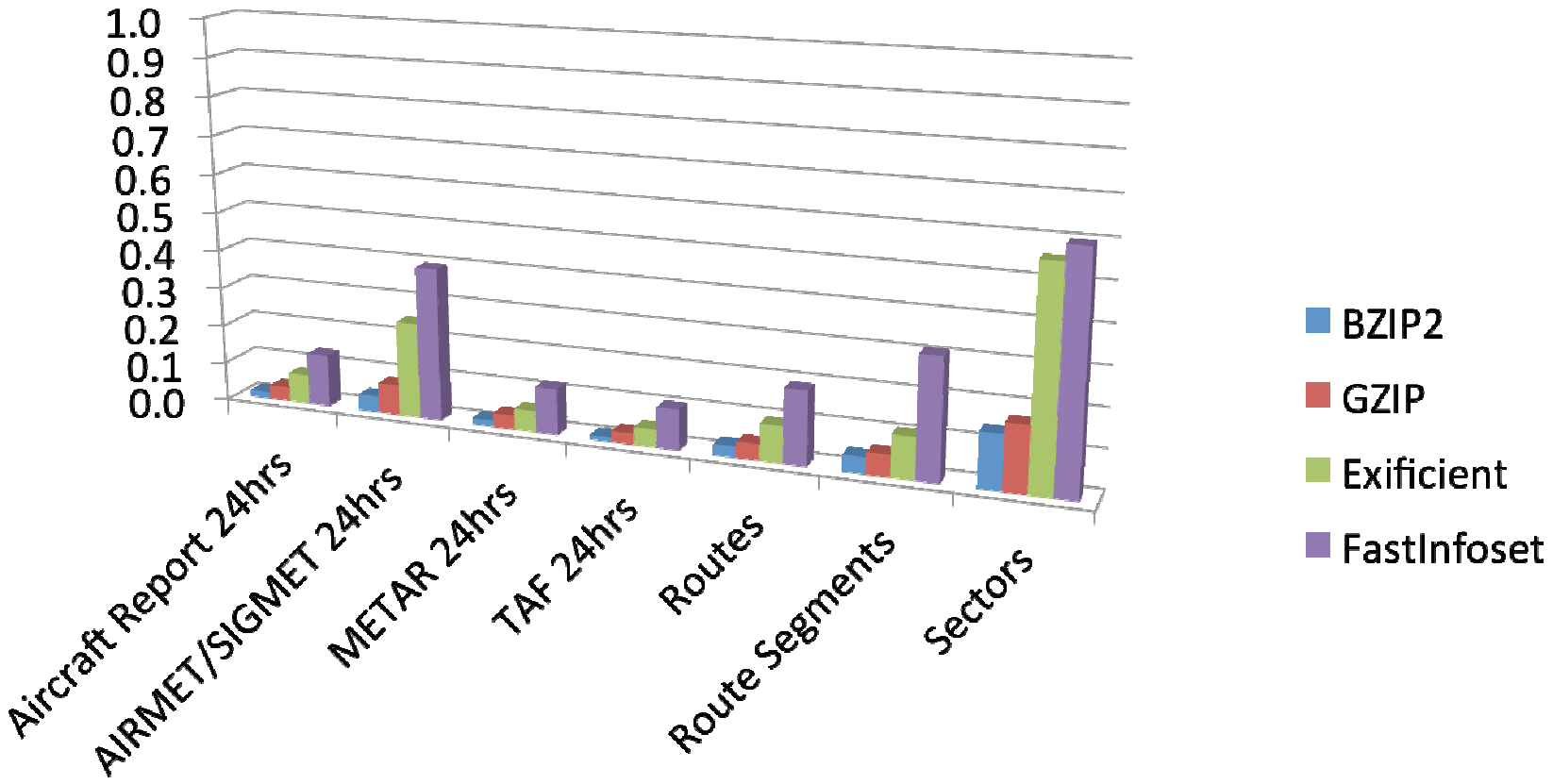
Addressing XML Size

- Text compression techniques
- Binary XML (EXI)
- Protocol buffers, etc.

Size Comparisions

- WXXM: 2100KB (per 1000 records (80KB raw text))
- METAR NetCDF: 500KB
  - 11 ID/location/time/type vars (stationName, latitude, timeObs, autoStationType)
  - 10 weather observation vars (temperature, windDir)
  - 2 x 6 cloud condition vars
  - 10 remarks vars (tempFromTenths, precip1Hour)
  - 1 rawMETAR var
- MADIS METAR NetCDF: 1400KB
  - Similar to above, but add in 4-6 QC vars for 14 obs vars
  - Plus 15 misc vars (firstOverflow, firstInBin)

AIXM and WXXM



Exificient and FastInfoset were run schema-less

From Aaron Braeckel NCAR/RAL

Summary

- Many decoders
- Need to maintain mapping legacy format to WXXM
- NOAA responsible for putting NOAA provided weather data in the 4-D Data Cube
- Need FAA/NOAA governance of mapping

Questions & Answers / Feedback

More Information / Contacts

- Glen Pankow <Glen.F.Pankow@noaa.gov>, 303-497-7028
- Chris MacDermaid <Chris.MacDermaid@noaa.gov>, 303-497-6987