State of IWXXM

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Overview

- IWXXM Status
- Why IWXXM
- SWIM & AIXM/FIXM Linkages
- Who is ‘Working’ IWXXM
- IWXXM Issues
- Global Implementation
- US Implementation
  - OFCM Planning

ICAO Meteorological Exchange Model (IWXXM)

- ICAO Weather Exchange Model
  - Format for ***exchanging*** Wx information in XML
- Extensible* Markup Language (XML)
  - XML emphasize simplicity, generality and usability across the internet and applications
  - Is a markup language which defines a set of rules for encoding documents
- Defined by free open standards
  - International Organization for Standardization (ISO)
  - Open Geospatial Consortium (OGC)

IWXXM Status

- IWXXM version 2.1 implemented April 2017
- IWXXM version 3.0 to be implemented March 2019
  - Full version updates to align with ICAO Annex 3 amendment cycle
    - Full alignment difficult due to WMO change processes
- ICAO Annex 3
  - November 2016, Amendment 77
    - Allows the exchange of IWXXM products as ***'recommended'*** practice

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IWXXM Status

- Products include:
  - TAF
  - METAR & SPECI
  - SIGMET
  - AIRMET
  - Volcanic Ash Advisory
  - Tropical Cyclone Advisory
  - *Space Wx
  - SIGWX
  - Future – Data centric rather than Product Centric

IWXXM Status

- ICAO Annex 3
  - November 2020 Amendment 78
    - Will make the [International] exchange of IWXXM products a ***'mandatory'*** practice

Why IWXXM?

- Many ICAO SARPs and formats are based on limited technical capabilities of legacy communications systems
  - Improve ‘Business Rules” & Regulations
- XML, specifically IWXXM, overcomes these technical limitations and enables the exchange of more meaningful (weather) information
- IWXXM also utilizes the World Meteorological Organization’s (WMO) METeorological Community Exchange Model (METCE)
- Compatible with System Wide Information Management (SWIM) Concepts

Why IWXXM?

- Why would we move from a 1-2 line TAC METAR to a 5-page IWXXM METAR?
  - Enables a commonality across the aviation system domains (e.g., weather, flight, and aeronautical information)
  - Allows the geographic position and time of information to be easily integrated with multiple systems
  - Supports ‘modernization’ of MET information
    - Higher resolution met information
    - User-definable visualization and integration
    - Modern/future communications infrastructure
  - ***Separates the ***exchange*** of the information from the ***use*** of the information

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Why IWXXM

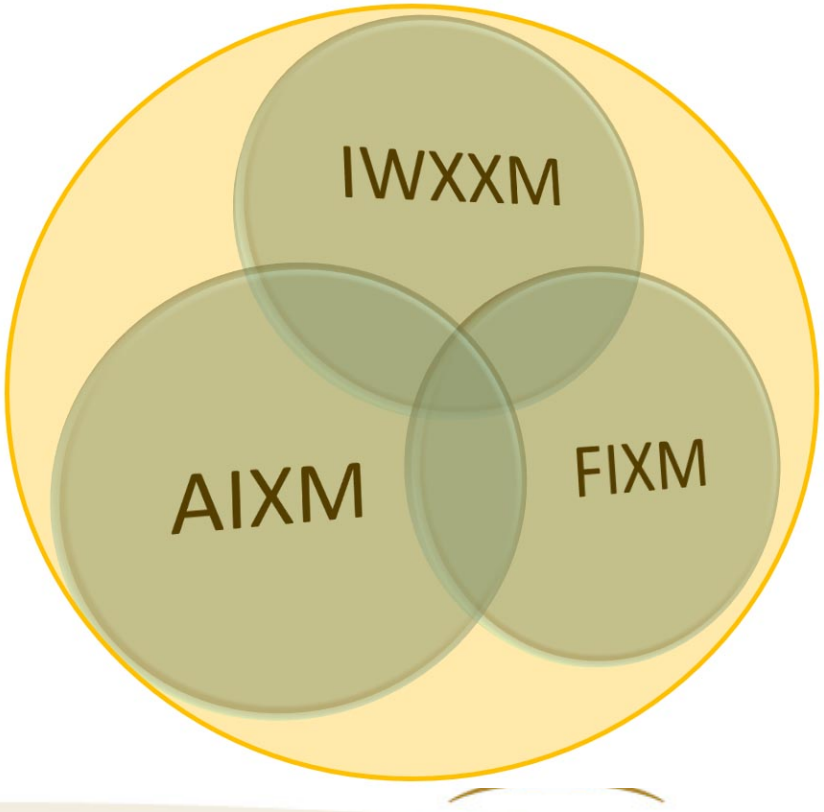
- Essentially makes information “digital”
  - Supports multiple uses, applications, and integration
    - Unlike BUFR or GRIB; follows International Standards
- TAC supports human reading only
- IWXXM supports multiple formats & uses
  - Digital (machine to machine)
    - Flight planning systems
    - Integration with AWIPS, NWP, NDFD, etc.
    - Graphical output
    - SIGWX, CCFP
  - Mapping integration
    - Google maps, GPS
  - Text output/Human consumption

The ‘Other’ XMs

- One of three information sets used by aviation
  - Aeronautical Information (AIXM)
    - Routes, Aerodromes, FIRs
    - Traffic, Traffic Management
    - NOTAM
    - Airspace Restrictions
  - Flight Information (FIXM)
    - Flight Plan
    - Aircraft type/performance
    - Route preferences
  - Weather Information (IWXXM)

Interdependences of Information Exchange

- IWXXM is a key enabler of SWIM concepts
  - Improved Met information with IWXXM in SWIM
  - SWIM core services will enable systems
    - Request and receive information when needed
    - Subscriptions for automatic receipt
    - Publishing information & services as appropriate



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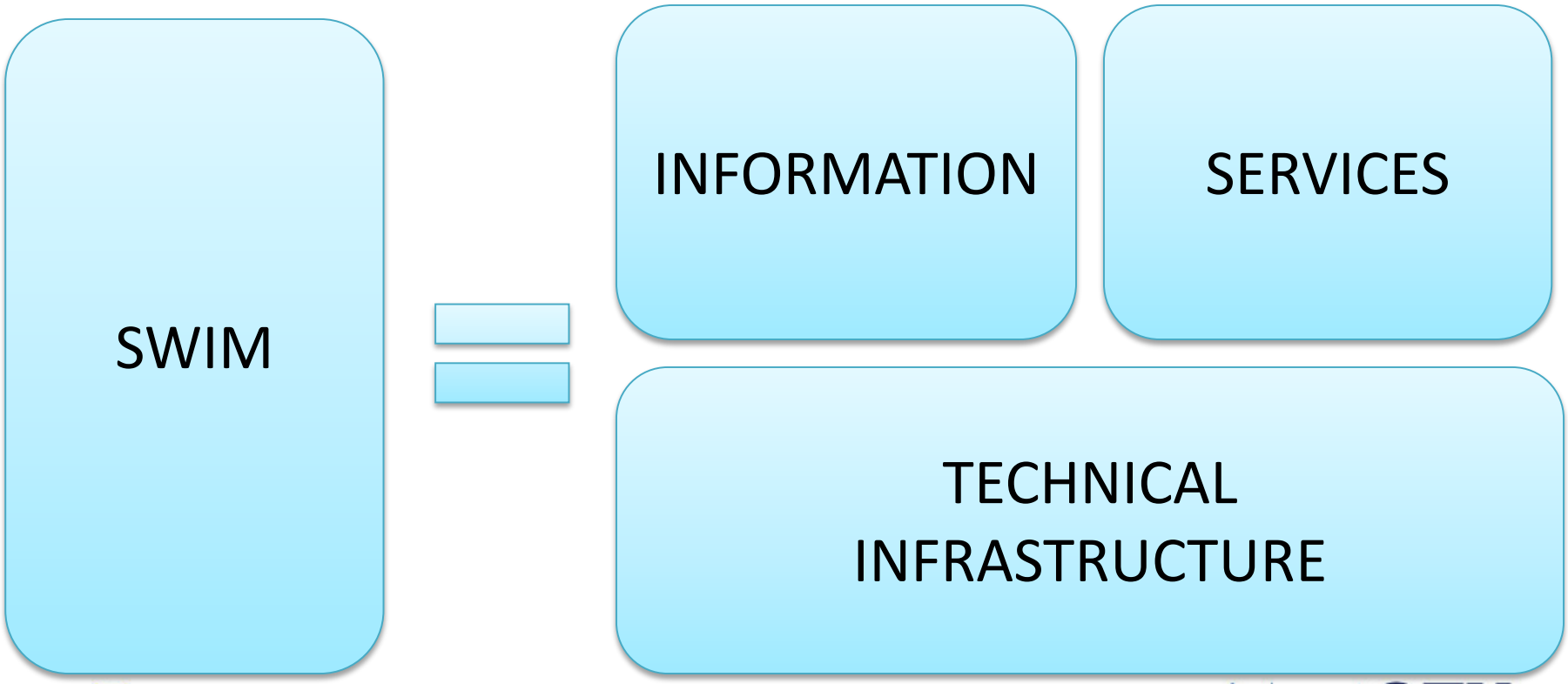
System Wide Information Management

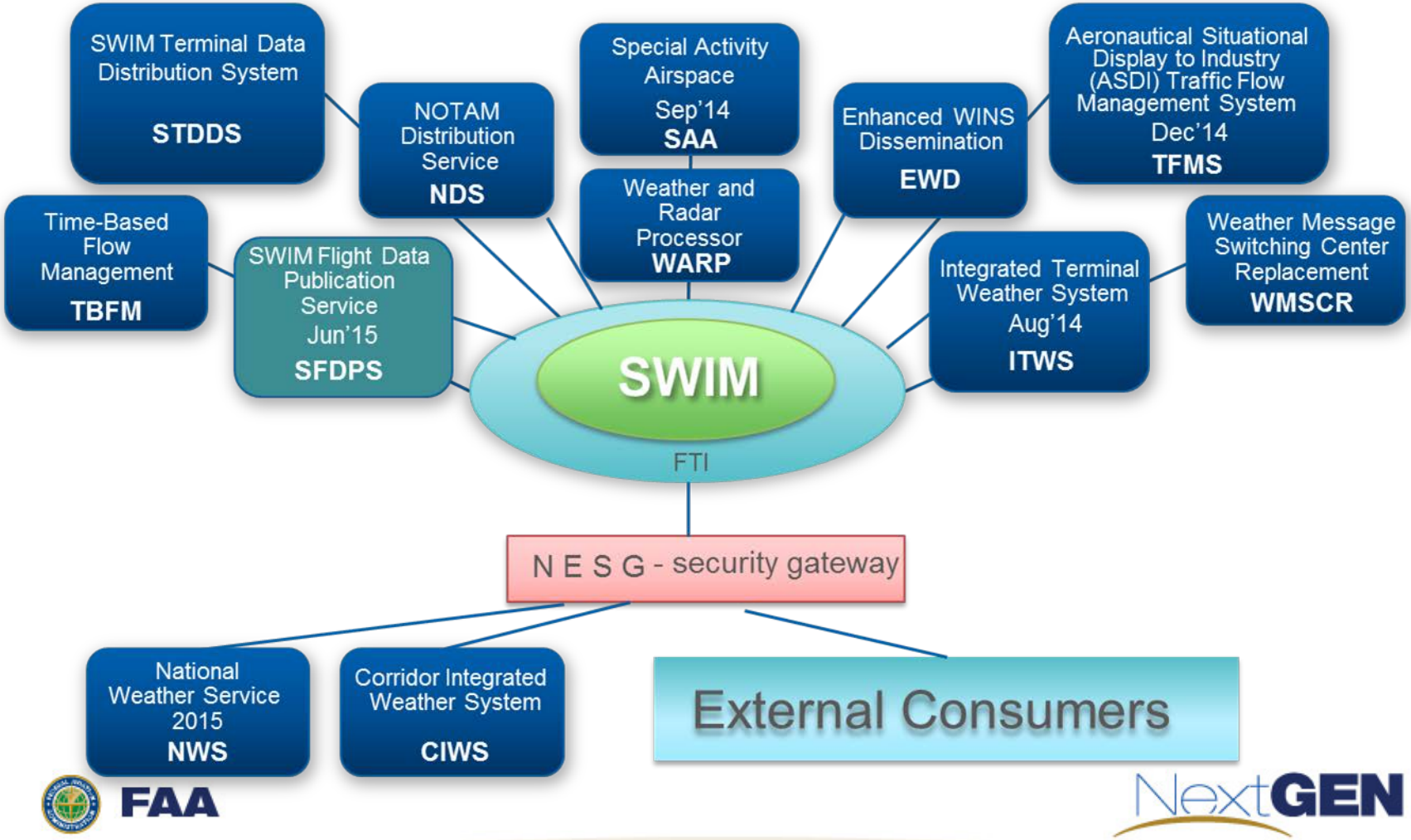
Definition



SWIM

- SWIM
  - One standard “connection” that uses universal programming language across all data
  - In the past, a new connection was created every time someone wanted to access a set of data
- SWIM allows more efficient data sharing among aviation stakeholders
  - Streamlines connections among different systems; can access multiple systems through one connection
  - SWIM utilizes standard data formats nationally and globally

SWIM consists of standards, infrastructure and governance making available a wide range of capabilities through a common infrastructure of reusable and shared services



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Who is 'Working' IWXXM Issues?

- ICAO Meteorology Panel
  - Working Groups – MRI & MISD
    - Defines MET informational needs and requirements for aviation
  - Working Group – Meteorological Information Exchange (WG-MIE)
    - Defines & implements the exchange of MET info
    - Manages the MET component of SWIM
- World Meteorological Organization
  - 'Owns' Meteorological codes (BUFR, METAR, etc)
  - TT-AvXML develops the schema

METP WG-MIE

- Good NWS-FAA collaboration & participation
- Operational Issues
  - How to handle missing information elements
  - Enabling high resolution information
  - Re-thinking the “airport observation”
    - Hourly, single point METAR outdated
  - Third party “translation”
- Policy and Governance Issues
  - How & When QA occurs
  - Security, Authorized users,
  - AMHS or skip to IP

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Who is 'Working' IWXXM Issues?

- ICAO Information Management Panel
  - Developing 'Information Services Concept of Operations'
    - Defines SWIM Information Services
      - 'Products' go away
      - Information Services and Data Centric
- ICAO Aeronautical Communications Panel
  - IWXXM messages won't transmit over the Aeronautical Fixed Telecommunications Network (AFTN)
  - IWXXM Messages will be exchanged over Aeronautical Message Handling System (AMHS)

ICAO IMP

- A global approach on information management (IM) is essential to ensure global interoperability and standardization across all data domains and to support activities such as
  - Flight and flow - information for a collaborative environment (FF-ICE)
  - Trajectory Based Operations (TBO)
  - NOTAM system review
- Overall ICAO SWIM development
  - Integrating AIXM, FIXM, and IWXXM

ICAO IMP

- Services Working Group
  - “Information Services” Concept Development
  - “Information Services” Requirements
  - SWIM Concept Development
- Architecture Working Group
  - SARP development
  - SWIM Manual
  - Change Configuration Board (AIXM)
- Governance Working Group
  - Authorization/Access/Security
  - Validation
  - Interoperability

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IWXXM Issues Being Addressed

- Use & standards for the inclusion of ‘extensions’
  - Enabling ‘State’ Extensions
    - Key concept of ‘XML’
    - Agreed to by METP Oct 2016
  - Users have stated IWXXM must provide added value over Traditional Alphanumeric Characters (TAC)
- “Freezing” TAC
  - METP agreed no further development of Annex 3 TAC product templates
    - Only for clear safety of flight issues

IWXXM Issues Being Addressed

- Guidance to ICAO Regions on transitioning to IWXXM
  - When and where translation from TAC to IWXXM occurs
    - Only translate once
    - How to deal with both TAC and IWXXM messages in the global communications system
    - Where and who ‘translates’
    - Partially translated messages
  - Validation of IWXXM messages
  - Roles of Regional OPMET Databanks and Centers
  - Developing Regional transition plans and training workshops

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IWXXM Issues Being Addressed

- Information Resolution Improvements
  - IWXXM has potential for more detail than TAC messages
  - ‘Better’ information in IWXXM vs TAC
    - Will encourage adoption and transition to IWXXM
  - Example:
    - METAR uses rounded values
      - Measured overcast cloud height of 990 feet reported as OVC009
      - IWXXM can report both the METAR rounded value, as well as the actual measured value for better precision in support of Trajectory Based Operations (TBO)

Global Implementation

- International exchange of IWXXM messages expected by 2020
  - Full implementation of SWIM much later than this
- ICAO Regions Planning and Implementation Regional Groups (PIRG)
  - Guidance on transition from TAC to IWXXM
  - How does the world work with both IWXXM and TAC messages?

Assimilation & Adoption

- Yes, Many States will not be able to transition to IWXXM by November 2020.
- Two lanes:
  - In the foreseeable future, some users will remain with TAC, i.e., the slow lane
  - Other, high-end users will be in the fast lane
- Best equipped, best served
  - Those who adopt will reap benefits

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U.S. Implementation

- Office of Federal Coordinator for Meteorology (OFCM)
  - Multi-agency group focused on MET
    - NOAA/NWS
    - FAA
    - DOD
    - USGS, NASA, etc
  - Developing U.S. Implementation Strategy and joint agency transition plan
    - Key issues/needs initially identified
    - Plan development expected over 2017-2018

IWXXM Efforts In The U.S.

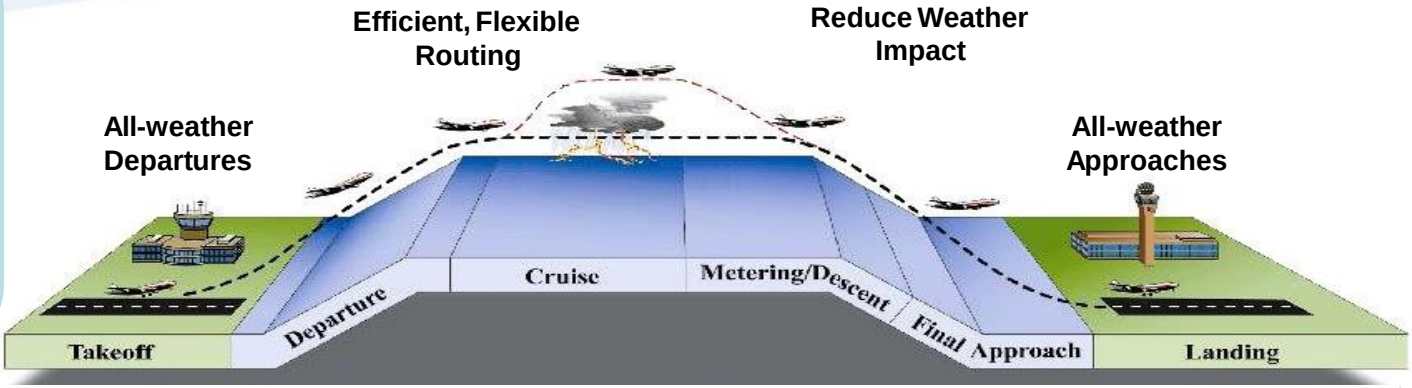
- OFCM
  - OFCM group developing U.S. IWXXM Transition Plan
  - NWS, NOAA, DoD, FAA, USGS
- FAA
  - CSS-Wx
    - Will distribute Weather information within FAA
  - May fulfill SWIM role, or conduit to SWIM for WX information internationally
  - Enterprise Information Protocol & Exchange Standards PLA
- NWS
  - ICAO OPMET Data Bank
  - Dual Product Generation in IWXXM & TAC or Translate TAC to IWXXM

IWXXM Efforts In The U.S.

- Things to consider:
  - Do we change automated observing systems
  - Does IWXXM impact U.S. ICAO compliance
  - How does IWXXM integrate with AWIPS, NDFD, NWP, etc.
  - How does this impact the transition from product-centric to data-centric weather information

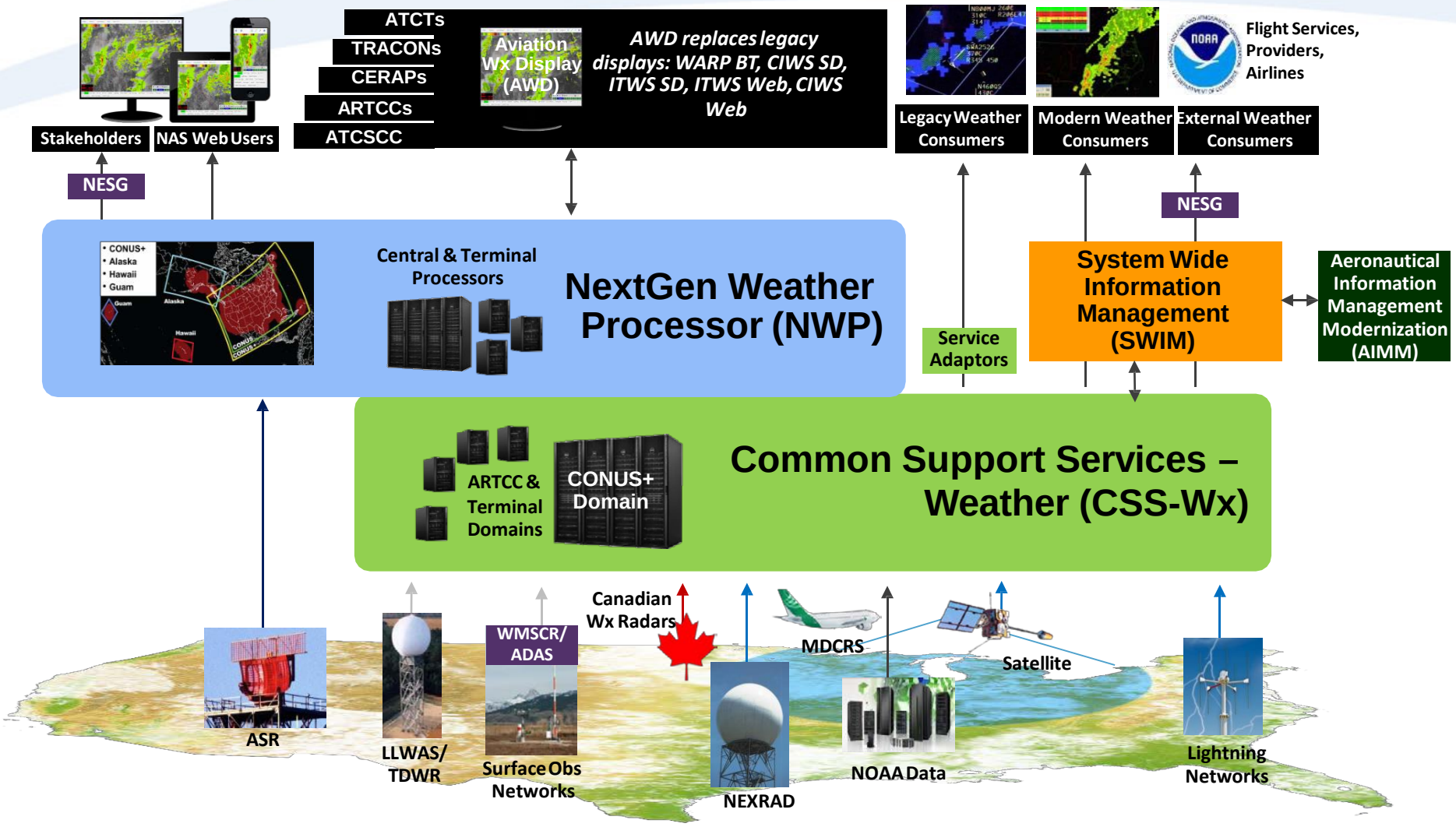
FAA Weather Programs Portfolio

- Establish common weather data standards
- Consolidate FAA legacy weather systems
- Improve aviation weather prediction capabilities
- Publish weather information for all users across the NAS



Today's Observation	• ASWON • LLWAS • TDWR • WSP • JAWS	• NEXRAD • TDWR • WSP	• NEXRAD	• NEXRAD • TDWR • WSP	• ASWON • LLWAS • TDWR • WSP • JAWS
Future Observation	• NSWOC • WSDS • JAWS • NSWRC	• NEXRAD • NSWRC	• NEXRAD • NSWRC	• NEXRAD • NSWRC	• NSWOC • WSDS • JAWS • NSWRC
Today's Processing	• **ITWS**	• **ITWS** • **WARP**	• **CIWS** • **WARP**	• **ITWS** • **WARP**	• **ITWS**
Future Processing	**NWP**				
Today's Dissemination	• **ITWS NFU, ITWS VOLPE**	• **ITWS NFU, ITWS VOLPE** • **WARP WINS, FBWTG**	• **CIWS CDDS** • **WARP WINS, FBWTG**	• **ITWS NFU, ITWS VOLPE** • **WARP WINS, FBWTG**	• **ITWS NFU, ITWS VOLPE**
Future Dissemination			**CSS-Wx**		

High Level Architecture



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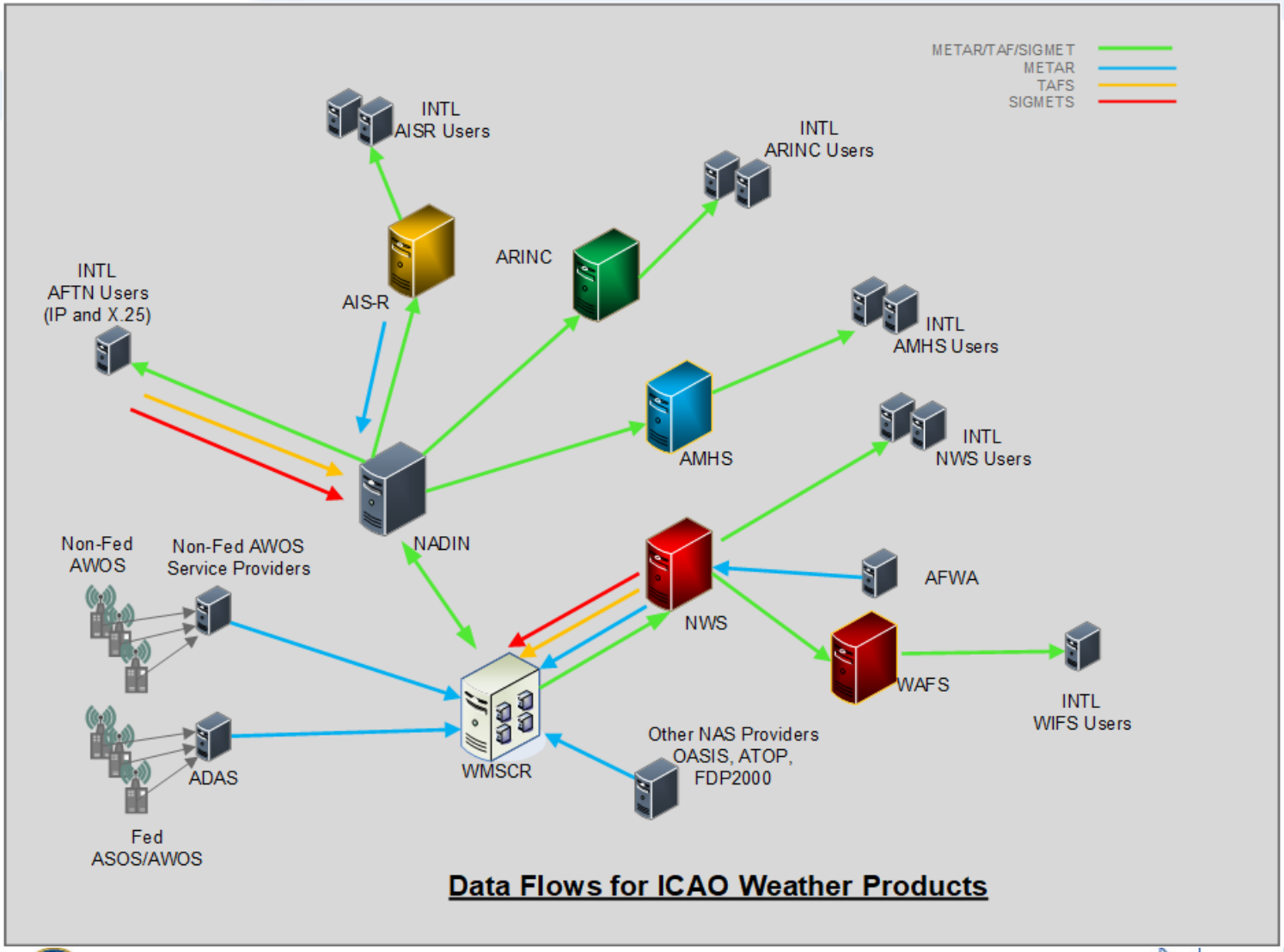
WMSCR's View of ICAO Wx Products Flow



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ICAO Products in WXXM

WXXM has previously implemented ICAO products before they were officially represented in IWXXM

WXXM 1.x – a number of ICAO Annex 3 products

WXXM 2.0 – AIRMET, VA Advisory, SigWx

Products in WXXM should be considered deprecated and should no longer be used when they become available in an official form in IWXXM


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TAC vs IWXXM

- Traditional Alphanumeric Code (TAC)

METAR YUDO 221630Z 24004MPS 0600 R12/1000U DZ FG SCT010 OVC020 17/16 Q1018 BECMG TL1700 0800 FG BECMG AT1800 9999 NSW

- IWXXM

```
<iwxxm:METAR xmlns:iwxxm="http://icao.int/iwxxm/1.0" mlns:xlink="http://www.w3.org/1999/xlink"
   xmlns:gml="http://www.opengis.net/gml/3.2" xmlns:om="http://www.opengis.net/om/2.0"
   xmlns:metce="http://def.wmo.int/metce/2013"
   xmlns:sams="http://www.opengis.net/samplingSpatial/2.0"
   xmlns:sf="http://www.opengis.net/sampling/2.0"
   xmlns:saf="http://icao.int/saf/1.0"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="http://icao.int/iwxxm/1.0 http://schemas.wmo.int/iwxxm/1.0/iwxxm.xsd
   http://def.wmo.int/metce/2013 http://schemas.wmo.int/metce/1.0/metce.xsd"
   gml:id="metar-YUDO-20120822163000Z"
   status="NORMAL"
   automatedStation="false">
   <iwxxm:observation>
      <om:OM_Observation gml:id="obs-03839-20120824T12Z">
         <om:type xlink:href="http://codes.wmo.int/49-2/observation-type/IWXXM/1.0/MeteorologicalAerodromeObservation" xlink:title="Aerodrome
Observation"/>
         <!-- time at which the observation actually occured -->
         <om:phenomenonTime>
            <gml:TimeInstant gml:id="ti-201208221630Z">
               <gml:timePosition>2012-08-22T16:30:00Z</gml:timePosition>
            </gml:TimeInstant>
         </om:phenomenonTime>
         <!-- time at which the results of the observation were made available (10-minutes later) -->
         <om:resultTime>
            <gml:TimeInstant gml:id="ti-201208221640Z">
               <gml:timePosition>2012-08-22T16:40:00Z</gml:timePosition>
            </gml:TimeInstant>
         </om:resultTime>
         <om:procedure>
            <metce:Process gml:id="p-49-2-metar">
               <gml:description>WMO No. 49 Volume 2 Meteorological Service for International Air Navigation APPENDIX 3 TECHNICAL SPECIFICATIONS
RELATED TO METEOROLOGICAL OBSERVATIONS AND REPORTS</gml:description>
```

```
</metce:Process>
        </om:procedure>
        <om:observedProperty xlink:href="http://codes.wmo.int/49-2/observable-property/MeteorologicalAerodromeObservation" xlink:title="Observed
properties for METAR and SPECI (Meteorological Aerodrome Reports)"/>
        <om:featureOfInterest>
          <!-- featureOfInterest type and shape must refer to a point -->
          <sams:SF_SpatialSamplingFeature gml:id="sampling-point-03839">
            <sf:type xlink:href="http://www.opengis.net/def/samplingFeatureType/OGC-OM/2.0/SF_SamplingPoint" xlink:title="SF_SamplingPoint"/>
            <sf:sampledFeature>
              <!-- The aerodrome at which this observation took place -->
              <saf:Aerodrome gml:id="uuid.dd062d88-3e64-4a5d-bebd-89476db9ebea">
                <gml:identifier codeSpace="urn:uuid:">dd062d88-3e64-4a5d-bebd-89476db9ebea</gml:identifier>
                <saf:designator>YUDO</saf:designator>
                <saf:name>DONLON/INTERNATIONAL</saf:name>
                <saf:locationIndicatorICAO>YUDO</saf:locationIndicatorICAO>
                <saf:ARP>
                  <gml:Point gml:id="pt52284-32035" srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
                    <gml:pos>12.34 -12.34</gml:pos>
                  </gml:Point>
                </saf:ARP>
              </saf:Aerodrome>
</sf:sampledFeature>
            <sams:shape>
              <!-- This is where the observation took place, assumed to be representative of the entire aerodrome -->
              <gml:Point gml:id="point-5225-3201" srsDimension="2" srsName="http://www.opengis.net/def/crs/EPSG/0/4326">
                <gml:pos>12.34 -12.34</gml:pos>
              </gml:Point>
            </sams:shape>
          </sams:SF_SpatialSamplingFeature>
        </om:featureOfInterest>
        <!-- The result of the observation -->
        <om:result>
          <iwxxm:MeteorologicalAerodromeObservationRecord gml:id="or1" cloudAndVisibilityOK="false">
            <iwxxm:airTemperature uom="Cel">17.0</iwxxm:airTemperature>
            <iwxxm:dewpointTemperature uom="Cel">16.0</iwxxm:dewpointTemperature>
            <iwxxm:qnh uom="hPa">1018</iwxxm:qnh>
            <iwxxm:surfaceWind>
              <iwxxm:AerodromeSurfaceWind variableDirection="false">
                <iwxxm:meanWindDirection uom="deg">240</iwxxm:meanWindDirection>
                <iwxxm:meanWindSpeed uom="m/s">4.0</iwxxm:meanWindSpeed>
```

```
</iwxxm:AerodromeSurfaceWind>
            </iwxxm:surfaceWind>
            <iwxxm:visibility>
               <iwxxm:AerodromeHorizontalVisibility>
                  <iwxxm:prevailingVisibility uom="m">600</iwxxm:prevailingVisibility>
               </iwxxm:AerodromeHorizontalVisibility>
            </iwxxm:visibility>
            <iwxxm:rvr>
               <iwxxm:AerodromeRunwayVisualRange pastTendency="UPWARD">
                  <iwxxm:runway>
                     <saf:RunwayDirection gml:id="uuid.b1947d80-b7f7-11e2-9e96-0800200c9a66">
                        <gml:identifier codeSpace="urn:uuid:">b1947d80-b7f7-11e2-9e96-0800200c9a66</gml:identifier>
                        <saf:designator>12</saf:designator>
                        <saf:trueBearing uom="deg">118.23</saf:trueBearing>
                        <saf:elevationTDZ uom="m">20.5</saf:elevationTDZ>
                        <saf:usedRunway>
                           <saf:Runway gml:id="uuid.2f864fc0-b7f8-11e2-9e96-0800200c9a66">
                              <gml:identifier codeSpace="urn:uuid:">2f864fc0-b7f8-11e2-9e96-0800200c9a66</gml:identifier>
                              <saf:designator>12/30</saf:designator>
                              <saf:associatedAirportHeliport xlink:href="#uuid.dd062d88-3e64-4a5d-bebd-89476db9ebea"/>
                           </saf:Runway>
                        </saf:usedRunway>
                     </saf:RunwayDirection>
                  </iwxxm:runway>
                  <iwxxm:meanRVR uom="m">1000</iwxxm:meanRVR>
               </iwxxm:AerodromeRunwayVisualRange>
            </iwxxm:rvr>
            <iwxxm:presentWeather xlink:href="http://codes.wmo.int/306/4678/DZ" xlink:title="Moderate Drizzle"/>
            <iwxxm:presentWeather xlink:href="http://codes.wmo.int/306/4678/FG" xlink:title="Fog"/>
            <iwxxm:cloud>
               <iwxxm:AerodromeObservedClouds>
                  <iwxxm:layer>
                     <iwxxm:CloudLayer>
                        <iwxxm:amount xlink:href="http://codes.wmo.int/bufr4/codeflag/0-20-008/2" xlink:title="Scattered"/>
                        <iwxxm:base uom="ft">1000</iwxxm:base>
                     </iwxxm:CloudLayer>
                  </iwxxm:layer>
                  <iwxxm:layer>
                     <iwxxm:CloudLayer>
```

```
<iwxxm:amount xlink:href="http://codes.wmo.int/bufr4/codeflag/0-20-008/4" xlink:title="Overcast"/>
                        <iwxxm:base uom="ft">2000</iwxxm:base>
                    </iwxxm:CloudLayer>
                </iwxxm:layer>
            </iwxxm:AerodromeObservedClouds>
        </iwxxm:cloud>
    </iwxxm:MeteorologicalAerodromeObservationRecord>
  </om:result>
 </om:OM_Observation>
</iwxxm:observation>
<iwxxm:trendForecast>
 <om:OM_Observation gml:id="trend-fcst-1">
  <om:type xlink:href="http://codes.wmo.int/49-2/observation-type/IWXXM/1.0/MeteorologicalAerodromeTrendForecast" xlink:title="Aerodrome Trend
Forecast"/>
  <!-- time at which the forecast conditions actually occur -->
  <om:phenomenonTime>
   <gml:TimePeriod gml:id="tp-201208221630Z-201208221700Z">
    <gml:beginPosition>2012-08-22T16:30:00Z</gml:beginPosition>
    <gml:endPosition>2012-08-22T17:00:00Z</gml:endPosition>
   </gml:TimePeriod>
  </om:phenomenonTime>
  <!-- time at which the results of the observation were made available -->
  <om:resultTime xlink:href="#ti-201208221640Z"/>
  <om:procedure xlink:href="#p-49-2-metar" xlink:title="WMO 49-2 METAR procedure"/>
  <om:observedProperty xlink:href="http://codes.wmo.int/49-2/observable-property/MeteorologicalAerodromeTrendForecast" xlink:title="METAR trend
forecast properties"/>
  <om:featureOfInterest xlink:href="#sampling-point-03839"/>
  <om:result>
   <iwxxm:MeteorologicalAerodromeTrendForecastRecord gml:id="trend-fcst-record-03839-201208221630Z-201208221700Z"
changeIndicator="BECOMING" cloudAndVisibilityOK="false">
    <iwxxm:prevailingVisibility uom="m">800</iwxxm:prevailingVisibility>
    <iwxxm:forecastWeather xlink:href="http://codes.wmo.int/306/4678/FG" xlink:title="Fog"/>
   </iwxxm:MeteorologicalAerodromeTrendForecastRecord>
  </om:result>
 </om:OM_Observation>
</iwxxm:trendForecast>
<iwxxm:trendForecast>
<om:OM_Observation gml:id="trend-fcst-2">
  <om:type xlink:href="http://codes.wmo.int/49-2/observation-type/IWXXM/1.0/MeteorologicalAerodromeTrendForecast" xlink:title="Aerodrome Trend
Forecast"/>
  <!-- time at which the forecast conditions actually occur -->
```

```
<om:phenomenonTime>
            <gml:TimePeriod gml:id="tp-201208221800Z-201208221900Z">
               <gml:beginPosition>2012-08-22T18:00:00Z</gml:beginPosition>
               <gml:endPosition>2012-08-22T19:00:00Z</gml:endPosition>
            </gml:TimePeriod>
         </om:phenomenonTime>
         <!-- time at which the results of the observation were made available -->
         <om:resultTime xlink:href="#ti-201208221640Z"/>
         <om:procedure xlink:href="#p-49-2-metar" xlink:title="WMO 49-2 METAR procedure"/>
         <om:observedProperty xlink:href="http://codes.wmo.int/49-2/observable-property/MeteorologicalAerodromeTrendForecast" xlink:title="METAR trend
forecast properties"/>
         <om:featureOfInterest xlink:href="#sampling-point-03839"/>
         <om:result>
            <iwxxm:MeteorologicalAerodromeTrendForecastRecord gml:id="trend-fcst-record-03839-201208221800Z-201208221900Z"
changeIndicator="BECOMING" cloudAndVisibilityOK="false">
               <iwxxm:prevailingVisibility uom="km">10</iwxxm:prevailingVisibility>
               <iwxxm:prevailingVisibilityOperator>ABOVE</iwxxm:prevailingVisibilityOperator>
               <iwxxm:forecastWeather nilReason="http://codes.wmo.int/common/nil/nothingOfOperationalSignificance"/>
            </iwxxm:MeteorologicalAerodromeTrendForecastRecord>
         </om:result>
      </om:OM_Observation>
   </iwxxm:trendForecast>
</iwxxm:METAR>
```