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Evolution of Net-Centric Data Services at the Air Force Weather Agency (AFWA)

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Andy Sedlacek

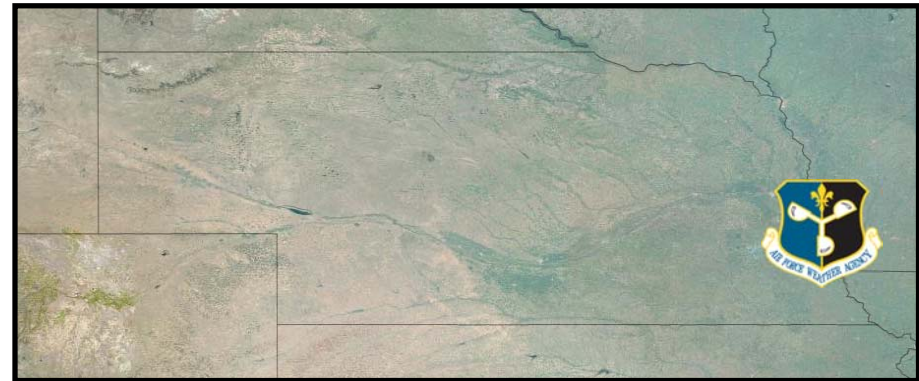Northrop Grumman Information Systems Software Project Manager

Agenda

- AFWA Mission Overview

- Background

- AFWA Evolution - First: Joint Meteorological and Oceanographic (METOC) Services

- Joint METOC Services Lessons Learned

- AFWA Evolution - Next: Enterprise Geographic Information System (e-GIS) Services

- e-GIS Services Lessons Learned

- AFWA Evolution - Current: Air Force Weather Web-Services (AFW-WEBS)

- AFW-WEBS Lessons Learned

- Conclusion

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Maximizing America's Power through the Exploitation of Timely, Accurate, and Relevant Weather Information; Anytime, Everywhere

Atlas V Evolved Expendable Launch Vehicle (EELV) Launch

Joint United States Air Force (USAF) /United States Army (USA) Patrol near Balad Air Base (AB)

C-17

F-22

AFWA Mission Overview

- AFWA Headquarters (HQ) provides centralized support for:
  - Fine scale weather modeling.
  - Global cloud analysis and forecasts.
  - Space weather observations, analysis, and forecasts.
  - Climatological products, services, and storage of USAF Climatic Data.
  - Armed Forces Network regional Long Range Forecasts/Outlooks.
  - Weather analysis and forecasting for the National Intelligence Community.
  - Global volcanic ash monitoring, modeling and prediction.
  - Host a single web portal of Air Force (AF) weather and climatology information.

- Appropriate information needed at each level of the organization's structure
  - Central HQ
  - Regional Hubs
  - Unit Support Flights

Complex, data dense, mission

Background

- Department of Defense (DoD) Net-Centric Services Strategy directive
    - Stemming from Gulf War conflict inability to share information
    - Standards based Services Oriented Architecture (SOA) to promote interoperability
    - Discoverable services
        - Reuse in multiple applications
        - Use authoritative sources

The need for Net-Centric, Sharing of Data Drove Evolution

Background

- AFWA historically produces 800,000+ products per day – primarily for human consumption
  - Data collected globally
  - Terrestrial and space based sensors
  - High amounts of time sensitive data
  - Products created often unused

- Data historically pushed via File Transfer Protocol (FTP) to end systems which had to process weather specific data formats
  - Weather Products Management Distribution System (WPMDS), Weather Secured (WS) FTP1, Multiple specialized systems
  - Minimal control and monitoring of endpoints and subscriptions

- Multiple web sites to display prebuilt imagery and text products
  - Imagery lacks geospatial references and other metadata
  - Text products require domain knowledge or decoder to interpret

- Need to modernize through netcentric approaches
  - Streamline & centralize ops
  - Focus on services
  - Machine-to-machine interoperability

Need to modernize and streamline through netcentric approaches

AFWA Evolution
First: Joint METOC Services

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- First AFW effort at discoverable web based services
  - Joint METOC Broker Language (JMBL) services
    - Simple Object Access Protocol (SOAP)-based web services
    - Very complex for ad hoc data pulls
    - Implementation required significant integration efforts
    - Extensible Markup Language (XML) schema very verbose
  - Consolidated Dissemination Capability (CDC)
    - Data push
    - End user management of data subscriptions
    - Improved organizational control of endpoints/subscriptions

Joint METOC Services Lessons Learned

- **Service complexity has costs**
  - Difficult adoption and integration
  - Higher costs to maintain complex systems
  - Higher costs to support user base
  - Lower performance/throughput

- **No universal standard**
  - Limited interoperability between applications and services

- **Legacy systems have challenges**
  - Not service capable
  - Avoid service adaptors
    - Increased coupling and complexity

- **DoD services registry and discovery incomplete**
  - Goal of easy search and addition of services not yet achievable

AFWA Evolution
Next: e-GIS Services

- Technology Overview
  - Implementation based on Commercial Off-the-shelf (COTS) GIS tools and services
  - Focus on implementing Web Mapping Service(WMS)
    - Imagery service gives information above raw data
    - Common Operational Picture integration
    - Discoverable using getCapabilities
    - Compliant with Open Geospatial Consortium (OGC) standards
      - WMS
      - Keyhole Markup Language (KML)

e-GIS Services Lessons Learned

- COTS solution required a lot of tuning to support high data volumes and highly-perishable data

- Initial frameworks and standards not well positioned for weather services
  - For example, time, elevation, and other dimensions not defined

- AFWA saw quick adoption
  - WMS and KML integration much easier
  - Simple Universal Resource Locator (URL) request vs. SOAP envelope
  - Loose coupling – no adaptors needed

- Generated interest in additional services
  - Expanded imagery services
  - Data services

- Demonstrated benefits to enterprise architecture of on-demand services
  - Reduced processing
  - Less file routing
  - Reduced latency of information to users

AFWA Evolution:
Current: AFW-WEBS

- ## Technology Overview
  - OGC Services based solution
    - Utilized COTS weather solution designed for services
  - Refreshed front end web presence
    - Modern interfaces exploiting services
    - Replacing web sites and legacy imagery production
  - Services
    - WMS and KML
    - Web Feature Service (WFS) for point information
    - Evaluating Web Coverage Service (WCS) for data exposure
  - Caching
    - Image tile caching
    - Performance and scalability needed for services to be relevant

AFW-WEBS Lessons Learned

- COTS weather service solution was successful
  - Easier to increase service offerings
  - Performance and scalability tuning still important

- Evolving OGC standards
  - WCS standard lacking
  - Extensible standards flexible, but at the cost of interoperability

- Legacy applications need to be phased out
  - Gradual transition allows for user adoption
  - Training, documentation, and communication
    - Collaboration tools help organization and users stay in sync

- Need to move some business logic into the services
  - Web Processing Services (WPS)
    - Reduced application complexity
    - Improved customization of services
    - Move from information to impacts

Conclusion

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- AFWA is continuing to work on evolving net-centric data services
  - Improving and expanding existing services
  - Data services using WCS
  - Investigating WPS

- Challenges
  - Ability of legacy systems to adapt
    - User community and organization need to evolve together
    - Coordination and communication are musts
    - Organization needs commitment to change
      - Upgrade or replace legacy systems
  - High data volumes, highly-perishable data
    - Performance and scalability require constant improvement
    - Improved data density and latency will always be desirable
  - Evolving Standards
    - Extensions and improvements to standards can help expand capabilities
    - Keeping up with standards while minimizing service impacts a challenge

Services need to continue to evolve to stay relevant

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BACKUPS

AFWA Mission Overview

- Provide regional scale analysis and forecast products, data and services through subordinate Operational Weather Squadrons and Weather Squadrons.
  - Operational Weather Squadrons provide regional support
    - Issue site forecasts
    - Mission planning weather analyses
  - Weather Flights provide unit level support
    - Flight briefings
    - Observations
  - Special Operations Weather and Army Weather Units support isolated deployments
    - Direct mission support
  - Space Weather Operations
    - Space weather analyses, forecasts and alert notifications