



NOAA

NextGen IT/Web Services (NGITWS)

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Topics



- Origins of NGITWS
- NGITWS 101
 - What is NGITWS?
 - Why is NGITWS important?
- NGITWS Architecture
 - Data flow example
- Progress and Timelines
 - What we've accomplished and where we're headed
- Conclusions



Origins of NGITWS



The FAA Next Generation Air Transportation System needs accurate, timely, and reliable weather information

Why does NextGen care about weather?

- ~70% delays in the NAS are due to weather

Through enhanced weather products and services

- ~46% reduction in delays
- ~\$19 billion savings annually

That's where NOAA comes in

NGITWS will “...provide enhanced weather forecast information for integration into an air traffic management system.”

“Capabilities for NextGen will result in a significant increase in weather prediction and dissemination capabilities with wide ranging benefits across NOAA.”





Origins of NGITWS (cont)



- NOAA Integrated **D**issemination **P**rogram (IDP)
 - Enhance NOAA’s dissemination capabilities
 - Reliability
 - Sustainability
 - Integrated, enterprise-level capabilities
 - Core initiatives
 - NWS Ground Readiness – infrastructure improvements, network consolidation, bandwidth upgrades, etc.
 - NWS Telecommunications Gateway Re-architecture – modernizing the heart of NWS dissemination
 - NextGen IT/Web Services (NGITWS)



Origins of NGITWS (cont)

- The culmination of 5+ years of R&D efforts

4-D Data Cube

Next Generation Network
Enabled Weather (NNEW)

SE2020
prototype

- The fruit of key partnerships



FAA



National Center for
Atmospheric Research (NCAR)



MIT Lincoln Laboratory

- Leveraging key NOAA resources

- Aviation Weather Center (AWC)
- Meteorological Development Lab (MDL)
- Earth System Research Lab
- NCEP Central Operations (NCO)
- Global Systems Division (GSD)



NGITWS 101

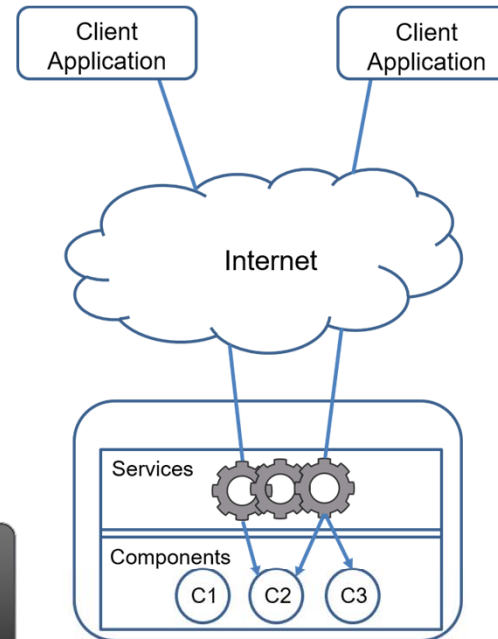
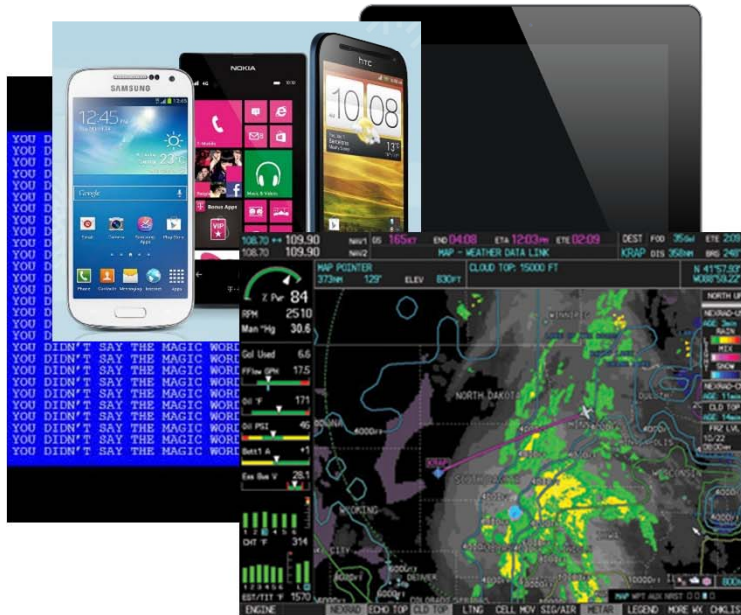


What is NGITWS?

Legacy data silos



Platform-specific



Web-based, service-oriented architecture (SOA)

Platform-agnostic



Closed systems



NGITWS 101 (cont)



What is NGITWS?

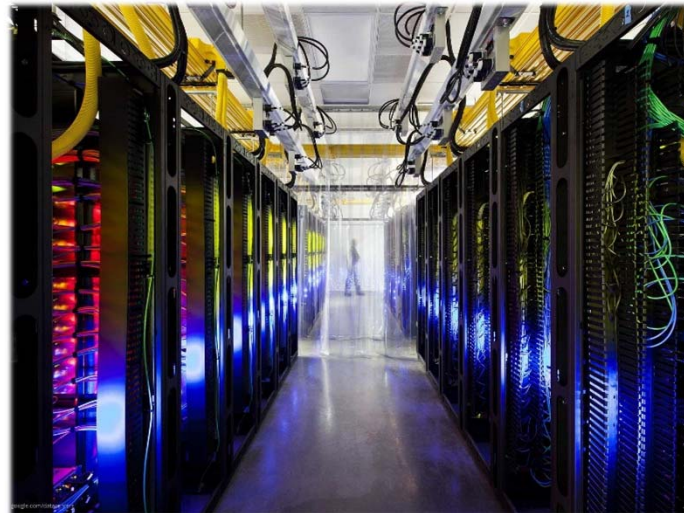
NetCDF
IWXXM

Standard data formats



OGC compliant services

State of
the art
data
centers

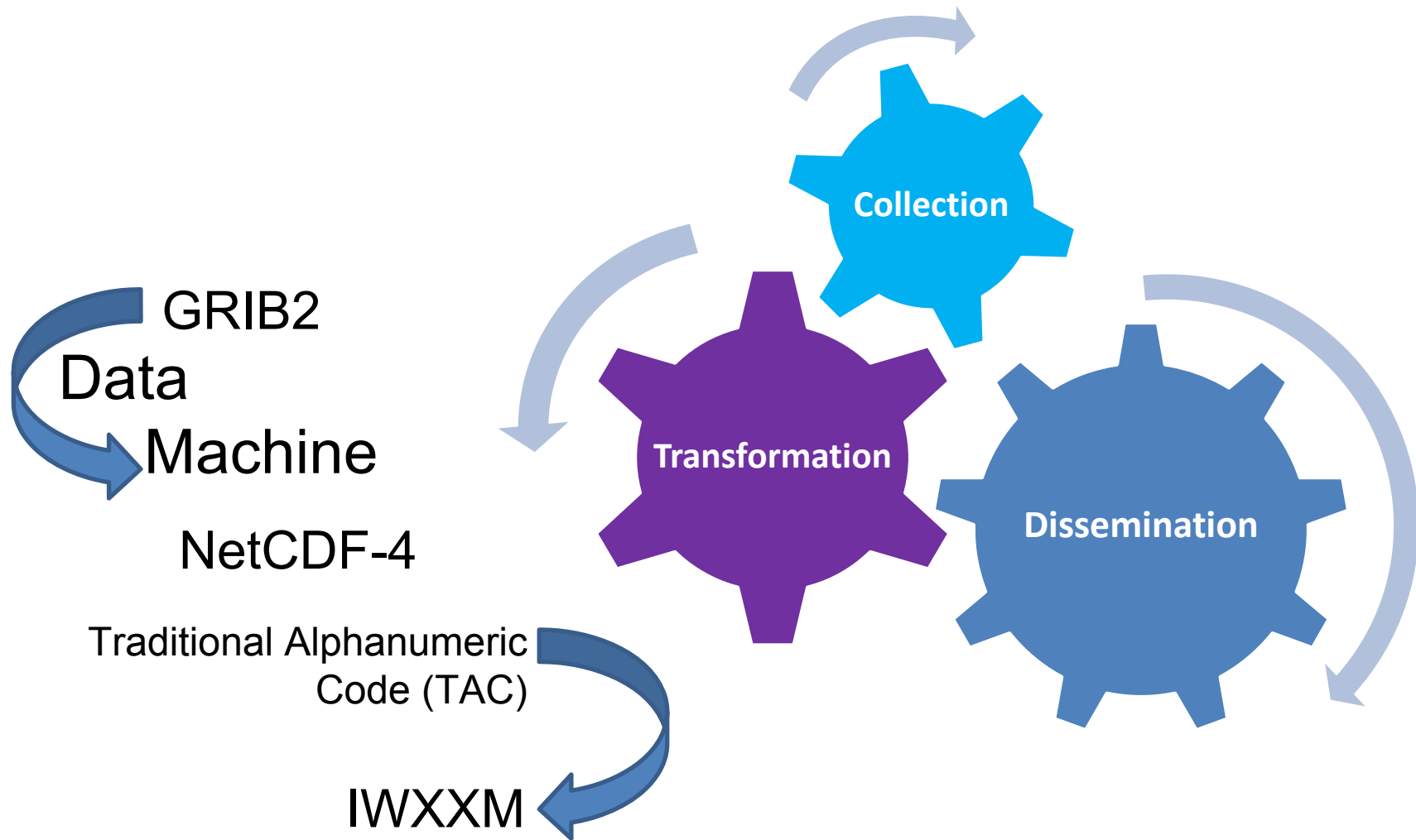




NGITWS 101 (cont)



What is NGITWS?

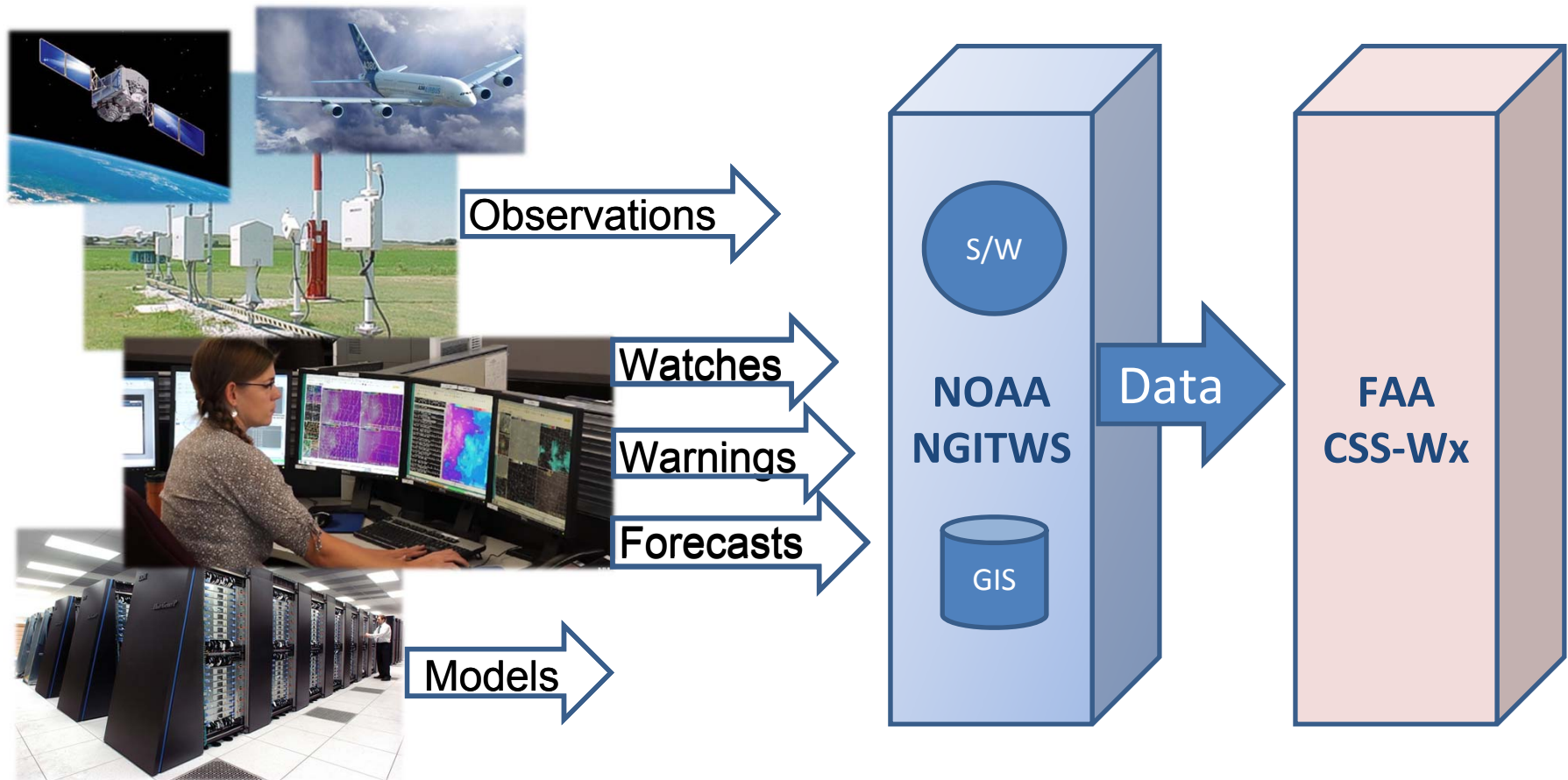




NGITWS 101 (cont)



What is NGITWS?





NGITWS 101 (cont)



Why is NGITWS important?

Reliability

Performance

Interoperability



NGITWS 101



Why is NGITWS important?

Reliability

Performance

Interoperability

College Park, Maryland



Two state-of-the-art,
geographically-diverse data centers



Boulder, Colorado



NGITWS 101 (cont)



Why is NGITWS important?

Reliability

Performance

Interoperability

Private high-speed network

100-200 Mbps

Redundant high-speed network

- ❑ One-to-many capability -
College Park and/or Boulder
can feed Atlantic City, Salt
Lake City, and Atlanta
- ❑ Quality of service (QoS) -
ability to prioritize certain
types of traffic over others



NGITWS 101 (cont)



Why is NGITWS important?

Reliability

Performance

Interoperability

Standards-driven

- OGC Web Coverage Service (WCS)
- OGC Web Feature Service (WFS)
- OGC Web Map Service (WMS)

Common open-source apps

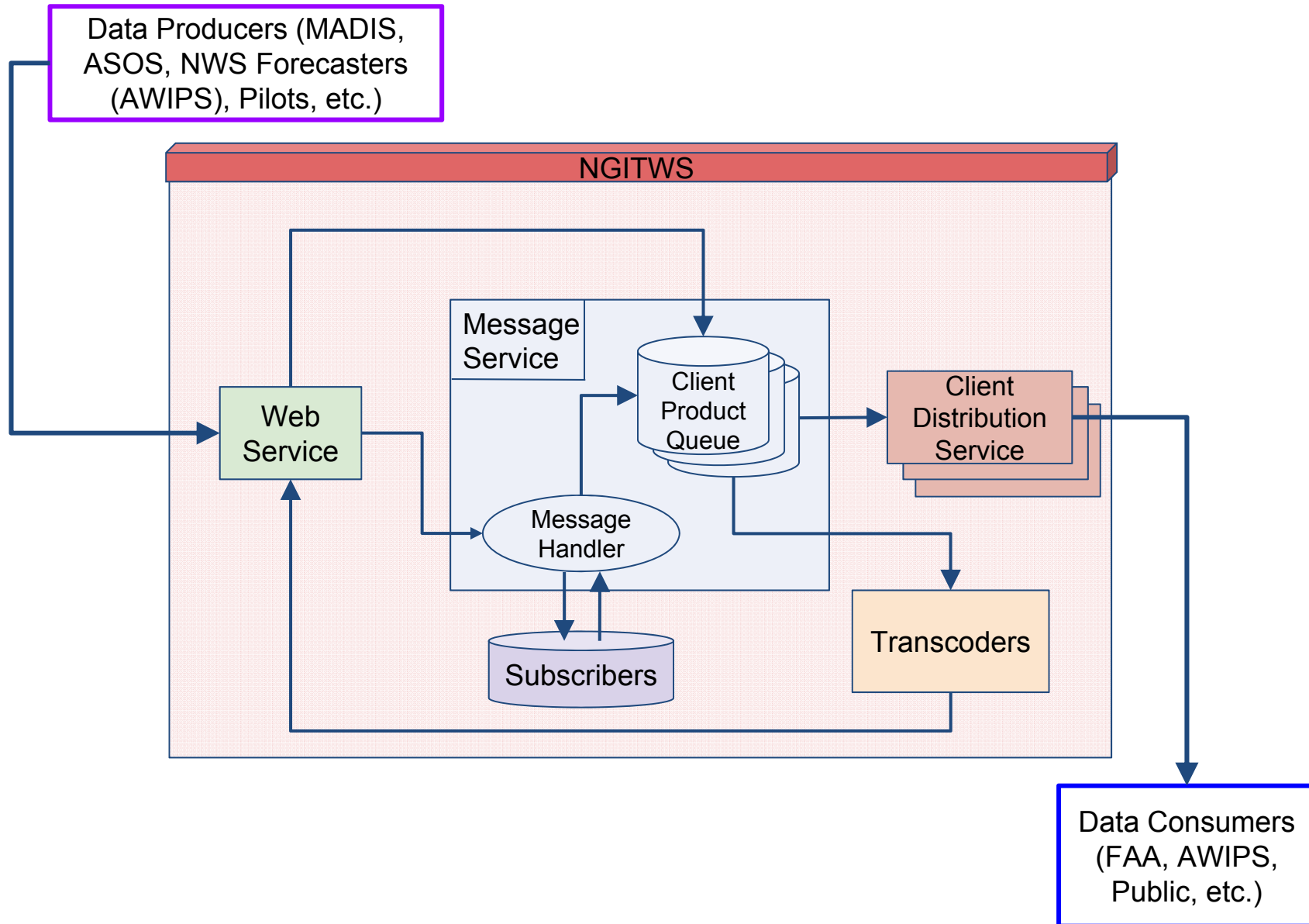
- GeoServer
- RabbitMQ
- MongoDB

International standard data formats

- NetCDF-4
- XML - IWXXM, IWXXM-US, USWX

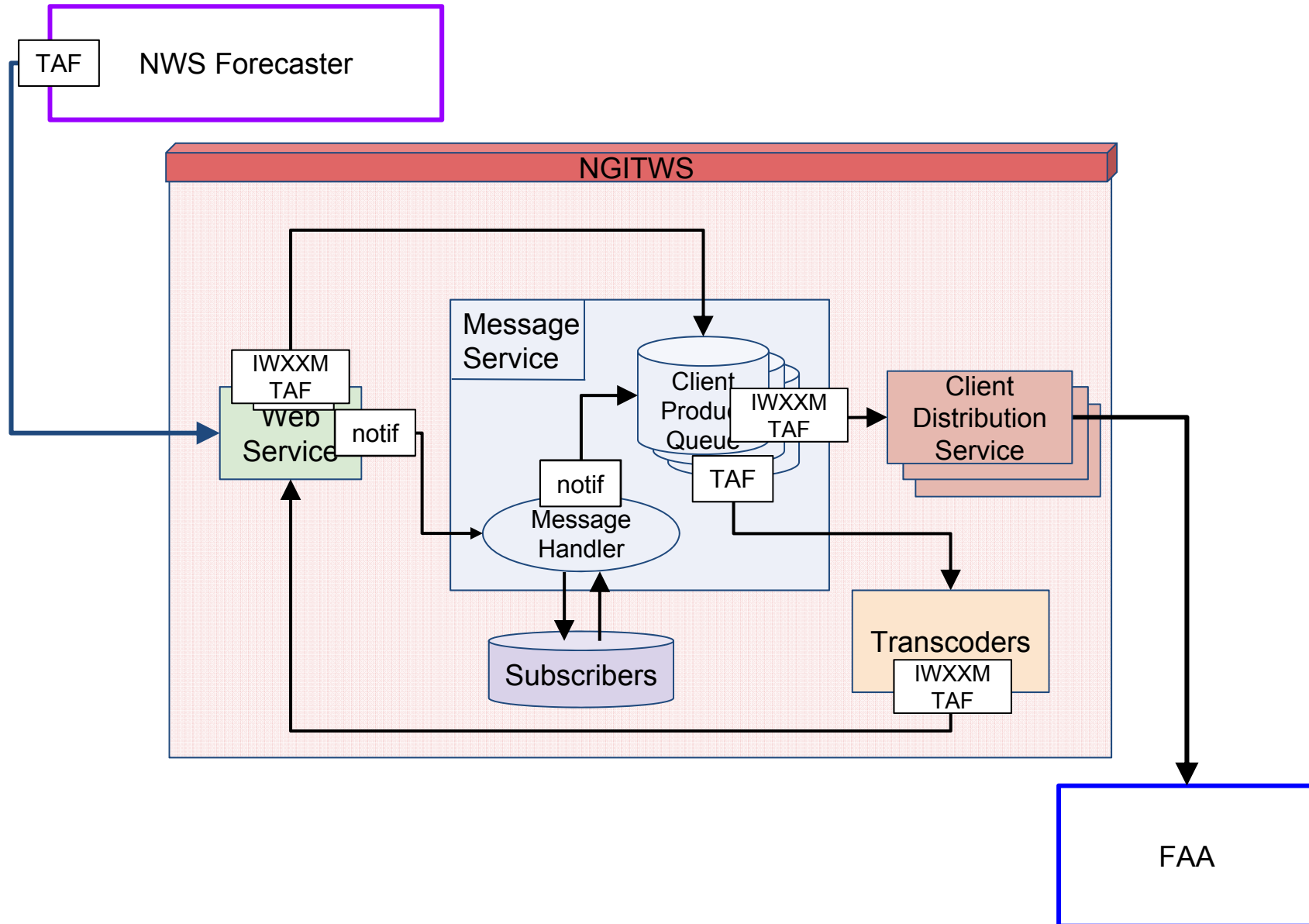


NGITWS Architecture





NGITWS Architecture – data flow example





Progress and Timelines



Data Exchange: Phase 1 - in place now



- Source:
 - NextGen IT/Web Services system on the NOAA IDP Development Tier in College Park, MD
- Destination:
 - FAA SWIM/NEMS Research and Development, FAA William J. Hughes Technical Center, Atlantic City, NJ
- Network:
 - VPN over the Internet
- Message pattern:
 - Publish-Subscribe
- Data:
 - 183 unique gridded numerical model products in NetCDF-4
 - 15 unique XML (IWXXM, IWXXM-US, USWX) products



Data Exchange: Phase 2 - Q3 FY17



- Source:
 - NextGen IT/Web Services system on the NOAA IDP Development Tier in College Park, MD
- Destination:
 - FAA SWIM/NEMS Research and Development, FAA William J. Hughes Technical Center, Atlantic City, NJ
- Network:
 - **Private high-speed network**
- Message pattern:
 - Publish-Subscribe
- Data:
 - **236** unique gridded numerical model products in NetCDF-4
 - **39** unique XML (IWXXM, IWXXM-US, USWX) products
 - **66 unique image products**



Data Exchange: Phase 3 - Q2/Q3 FY18



- Source:
 - NextGen IT/Web Services system, NOAA IDP **Operational** Tiers in College Park, MD, **and Boulder, CO**
- Destination:
 - FAA SWIM/NEMS Research and Development, FAA William J. Hughes Technical Center, Atlantic City, NJ, **and FAA SWIM/NEMS Operational Centers in Salt Lake City, UT, and Atlanta, GA**
- Network:
 - Private high-speed network
- Message pattern:
 - Publish-Subscribe
- Data:
 - 236 unique gridded numerical model products in NetCDF-4
 - 39 unique XML (IWXXM, IWXXM-US, USWX) products
 - 66 unique image products



Source Origination Efforts



- Project to produce IWXXM from original source
 - AWIPS/TAF
 - Kick Off planning Q4 FY16
 - Start Requirements, Statement of Work
 - Initial Work Phase Q1 FY17
 - Complete Requirements, Initiate Prototyping, Design Reviews
 - Beta Testing Q4 FY17
 - Deploy Software Q1 FY18



Other Internal NWS Efforts



- Review and updating of internal NWS directives and policies that involve IWXXM
- Identify additional Dissemination channels for IWXXM products
- Continued involvement of development of additional schemas (Volcanic Ash and Tropical Cyclone Advisories)



Other Internal NWS Efforts (Cont'd)



- Continued work with UK Met Office on the Met Ocean Application Profile, a newly proposed Open Geospatial Consortium (OGC) standard for Web Coverage Service
- Potential benefits to future IDP Web Services include:
 - New trajectory and getCorridor capabilities
 - Reduction in number of getCoverage requests required over current WCS 2.0 core
 - DescribeCoverage that establishes framework for describing multi-dimensional data cubes with a single identifier
 - Mechanism for quality control using a data mask using the O&M result quality element
 - A rangetype property of the coverage with MetOcean metadata linking to the WMO registries

Bottom Line: New proposed standard better aligns with 4D weather data!



Conclusion



- ❖ This work is extremely important!
- ❖ Through healthy partnerships and leadership support we've made tremendous progress

Continue to focus on

- ✓ Reliability
- ✓ Performance
- ✓ Interoperability



NextGen IT/Web Services = the foundational capability for providing the critical aviation weather information necessary for decision making in the National Airspace System.





Backup




Architecture - technologies

Goals: Open-source, Proven, Industry-hardened

- GeoServer
 - Java-based open-source geospatial software suite
 - Commercial support provided by NOAA-funded contract with  Boundless
 - Leverages open standards
 - OGC-compliant implementation of Web Feature Service (WFS), Web Coverage Service (WCS), and Web Map Service (WMS)
 - Global user community
- RabbitMQ  RabbitMQ™
 - Open-source message broker that implements the Advanced Message Queuing Protocol (AMQP)
 - Commercial support provided by NOAA-funded contract with Pivotal Software, Inc.



Architecture - technologies (cont)

- MongoDB 
 - Open-source "Big Data" database
 - Used by industry heavyweights like Facebook, Craigslist, eBay, MetLife, and Adobe
 - Also used by the United Kingdom Meteorology Office (UK Met)
- Java
 - Java 2 Platform, Enterprise Edition (J2EEs) Web Services built on Oracle Java 1.8
 - Java Messaging Service (JMS) API
 - Pivotal Spring API - allows for rapid development and prototyping
- WebHooks
 - Event/Data Server Push notification system using HTTP technologies
 - Currently being evaluated by the NWS to replace the Family of Services (FoS) system



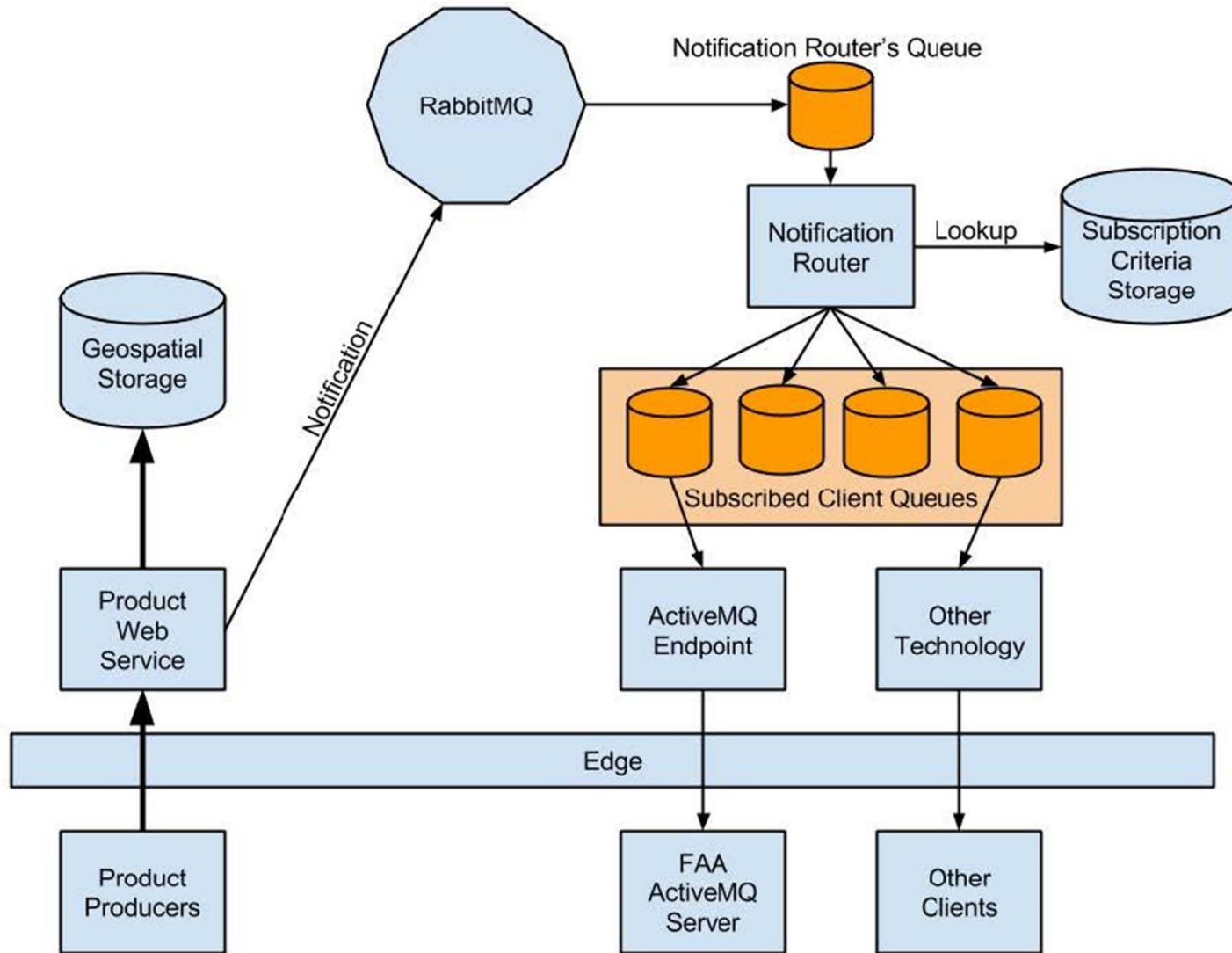
Architecture - approaches and methodologies



- Agile development approach
 - Deliver a working product frequently
 - Anticipate and embrace change
- Microservices design pattern
 - Independent, small, modular services
 - Clustered service deployment
 - Easily scalable
 - Improved fault isolation
 - Leverage the power of the virtual computing environment
- Publish-Subscribe pattern
 - Message exchange pattern
 - Publishers are decoupled from specific consumers
 - Consumers get only what they need



Architecture - illustration





Points of emphasis (cont)



Performance

- Private high-speed network
 - 100-200 Mbps
 - MPLS-based WAN
 - ❑ One-to-many capability - Either College Park or Boulder can feed all of the FAA endpoints
 - ❑ Quality of service (QoS) - improved service to select traffic



Points of emphasis (cont)



Interoperability

- Standards-driven
 - Open Geospatial Consortium (OGC) Standards
 - Web Coverage Service (WCS)
 - Web Feature Service (WFS)
 - Web Map Service (WMS)
- Commonly available open-source applications
 - GeoServer
 - RabbitMQ
 - MongoDB
- International standard data formats
 - NetCDF-4
 - XML - IWXXM, IWXXM-US, USWX





SOA

