

DBNet Cloud Service for Providing Low Latency Sounder Data to NWP Centers

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NOAA DB Network Overview

NOAA JPSS has funded CIMSS/SSEC to install and operate a network of polar satellite receiving stations in North America and the Pacific.

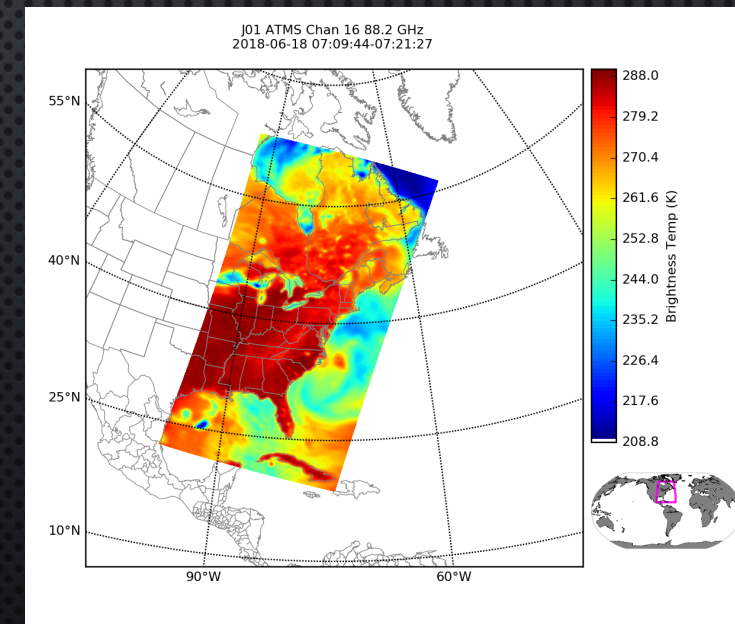
The NOAA network is part of the worldwide DBNet system coordinated by the WMO Space Program.

The goal is to deliver Infrared and Microwave sounder data (ATMS, CrIS, IASI, ATOVS) to NWP centers with low latency.

Sounder data are acquired in real-time at 16 antenna sites, processed centrally at CIMSS/SSEC to Level 1B, and delivered to NWP centers in BUFR format via GTS and EUMETCAST.

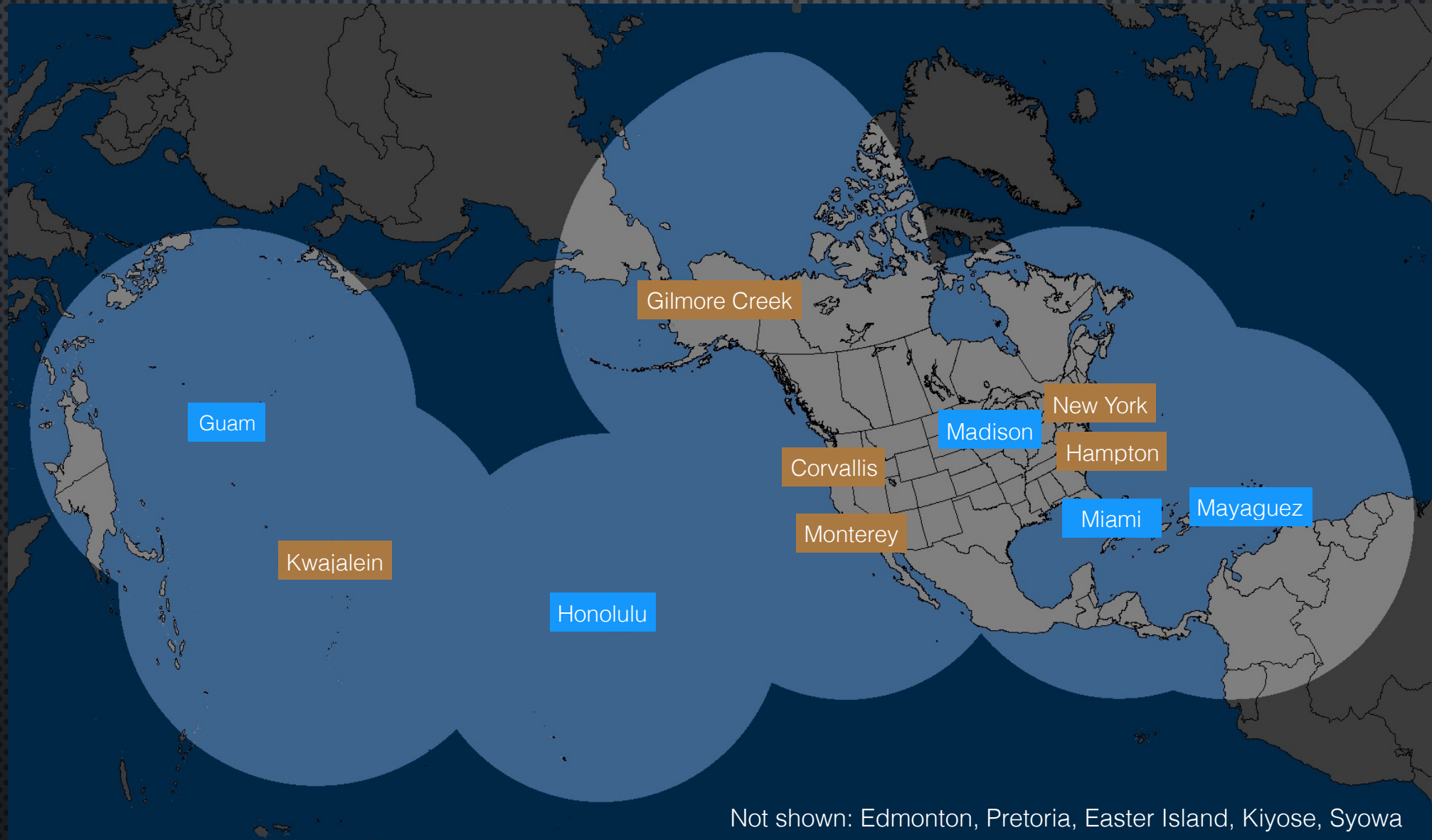


Honolulu DB Antenna



NOAA-20 ATMS DB Data

NOAA DB Network Stations and Coverage



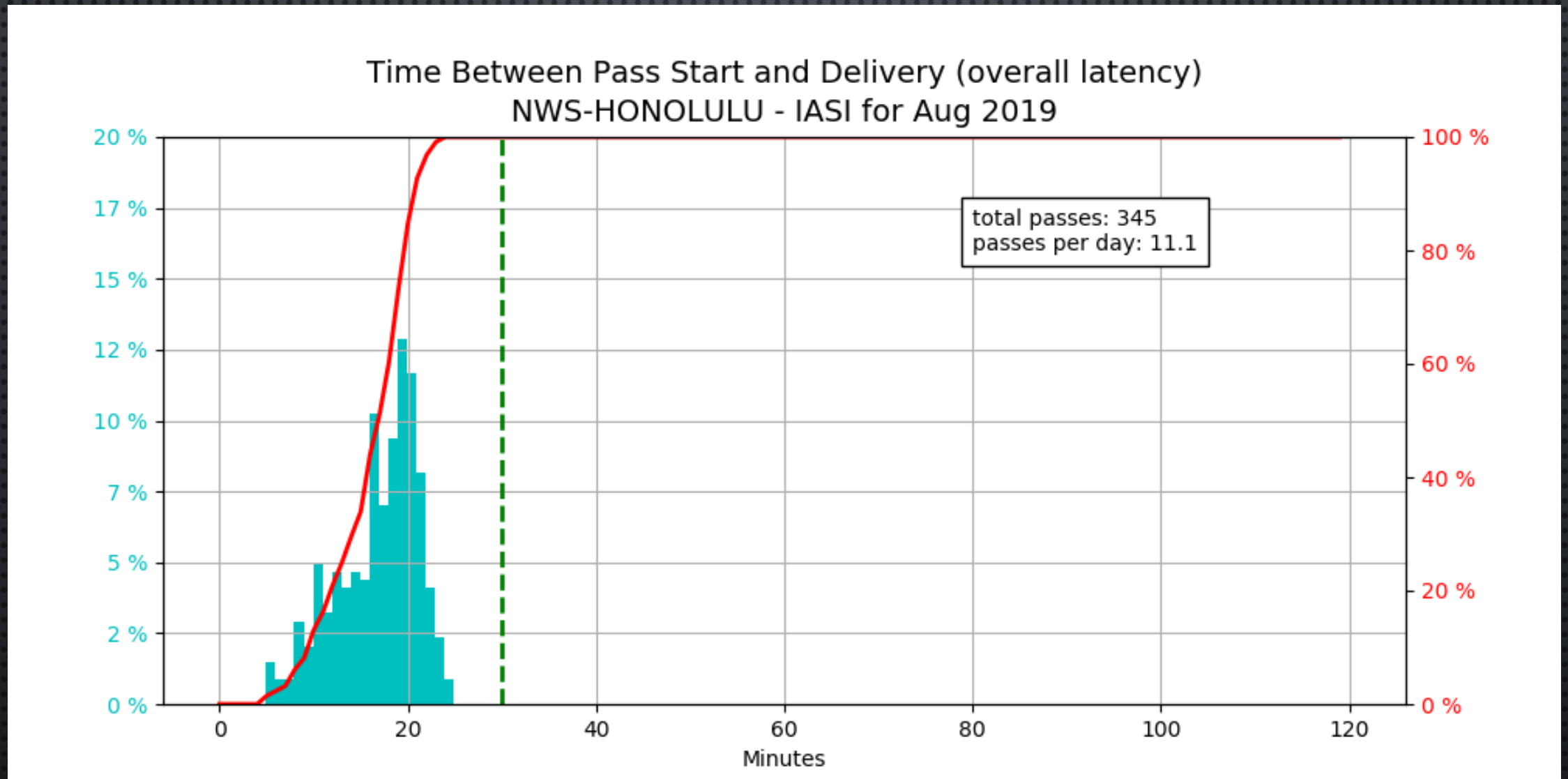
Antenna owned and operated by CIMSS/SSEC

Antenna owned and operated by network partner

NOAA DB Network Status (Sept 2019)

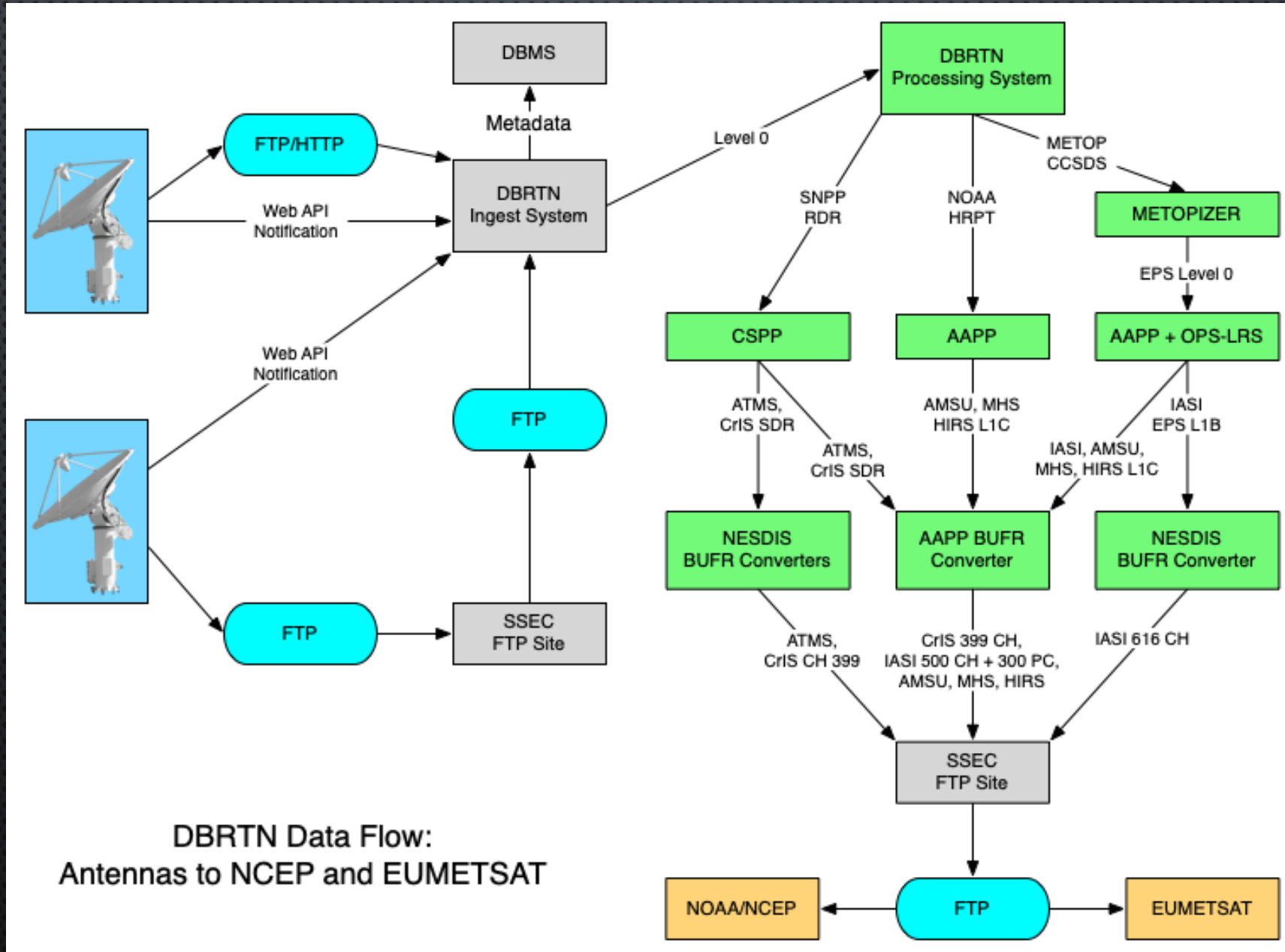
Site	SNPP/N20 ATMS	SNPP/N20 CrIS	Metop-A/B/C IASI	Metop-A/B/C ATOVS	NOAA-18/19 ATOVS	Notes
Madison	✓	✓	✓	✓	✓	
Honolulu	✓	✓	✓	✓	✓	
Miami	✓	✓	✓	✓	✓	
Mayaguez	✓	✓	✓	✓	✓	
Guam	✓	✓	✓	✓	✓	
Kwajalein	✓	✓	✓	✓	✓	No Metop-C
Monterey	✓	✓	✓	✓	✓	
Gilmore	✓	✓	✓	✓	✓	No Metop-A
New York City	✓	✓	✓	✓	✓	
Hampton	✓	✓	✓	✓	✓	
Easter Island	✓			✓	✓	Bandwidth limited
Edmonton	✓	✓				SNPP only
Pretoria	✓	✓				SNPP/NOAA-20
Kiyose	✓	✓				SNPP/NOAA-20
Syowa	✓					Bandwidth limited
Corvallis						Offline for upgrade

Honolulu IASI latency: August 2019



Relative to start of the overpass, average latency is < 20 minutes.
100 percent of files are delivered in < 25 minutes.

NOAA DB Network Centralized Processing Workflow



DBNet Receiving and Processing: Traditional Model

DBNet comprises more than 70 physical antenna sites scattered across all continents. At many antenna sites, reception and processing are done onsite.

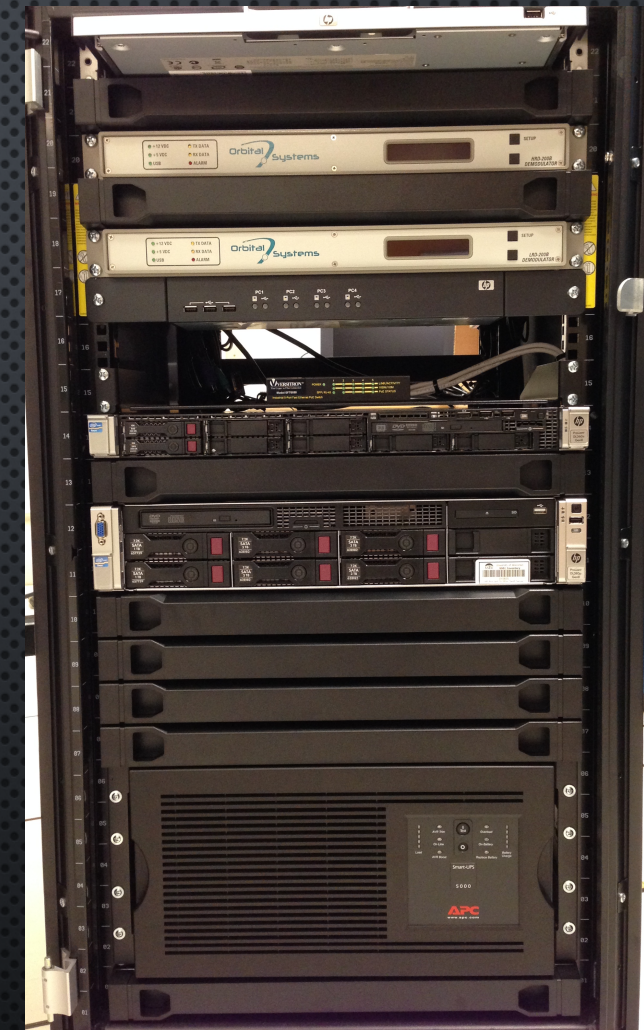
DBNet antenna sites need to install, configure, automate, and maintain software packages including:

RT-STPS, Metopizer, AAPP, OPS-LRS, CSPP SDR

Sometimes the processing system is supplied by a vendor, sometimes it is homegrown.

In order to maintain consistency between DB and global data, DBNet sites must have up-to-date versions of software, calibration lookup tables, and coefficient files.

These can be significant challenges!



Typical DB antenna site equipment for reception and processing

DBNet Cloud Service Concept

We propose a DBNet Cloud Service where we move the NOAA DB Network model to a Cloud Provider. *DBNet site operators will only need to upload their Level 0 data:* The Cloud Service converts to Level 1B and BUFR, and then disseminates via GTS.



Cloud Service Advantages:

1. Significantly reduces workload for DBNet antenna site operators;
2. DBNet product quality and consistency is guaranteed (same software version is used to process data from all antenna sites);
3. Removes the requirement for DBNet antenna site operators to upgrade processing hardware and software to support new missions (e.g., JPSS 2/3/4, Metop SG-A, FY-3 E/F/G);
4. Allows reproducible deployments worldwide.



DBNet Cloud Service Prototype

A DBNet Cloud Service prototype has been developed with the following components



File Depot(s)

Data Upload Dropbox
Data Integrity Check
Data Repository (72 hr)



Core Services

Processing API
Metadata Database
Ingest from File Depots



Processing Node(s)

Metopizer, AAPP, OPS-LRS, CSPP
SDR
BUFR conversion, GTS headers,
WMO filenames



Management

Configuration management
Infrastructure Deployment
Monitoring & Alerting

DBNet Cloud Service Prototype Deployment

AWS Cloud Services Deployment (using EC2 only; not locked in to AWS)

- 1 x core services node (US East)
- 1 x management node (SSEC)
- 2 x file depots (US East, Tokyo)
- 1 x m5a.xlarge processing node (US East)

- 6 Antenna Sites (Guam, Honolulu, Madison, Miami, Mayaguez, Hampton)
- CrIS, ATMS (SNPP, NOAA-20), IASI (Metop-A/B/C), ATOVS (NOAA-18/19, Metop-A/B/C)

Cost averaging around \$500 USD per month including compute instances, data transfers between regions, and data egress. Meets current DBNet latency goals.

DBNet Cloud Service: File Depot (One or more)

CLIENT DATA DROPBOX

- SFTP, HTTPS, FTP UPLOADS ACCEPTED
- IP RESTRICTED
- SSH PUBLIC KEY AUTHENTICATION

DATA INTEGRITY

- CHECKSUM FOR INCOMING FILES
- VIRUS SCAN OF INCOMING FILES

ASYNCHRONOUS NOTIFICATIONS

- MAKES FILE LISTINGS UNNECESSARY
- REDUCE LATENCY



DBNet Cloud Service: Core Services

PROCESSING/FILE APIS

- JOB SELECTION FOR PROCESSING NODES
- REPORT PROCESSING STATUS/METRICS
- PROVIDE MONITORING DATA

METADATA PERSISTENCE

- POSTGRESQL
- SITE, FILE, AND PROCESSING METRICS
- PROVENANCE

MONITORING/METRICS/ALERTS

- PROMETHEUS/ALERTMANAGER, GRAFANA
- REAL-TIME
- PRODUCT AVAILABILITY AND LATENCY
- HARDWARE, SOFTWARE METRICS

MESSAGING

- RABBITMQ MESSAGE BROKER
- ASYNCHRONOUS EVENTS
- REDUCES COUPLING

DBNet Cloud Service: Processing Node (one or more)

 Interact with API

- Select jobs to run
- Report status
- Report metrics

 Run Science Software

- CSPP SDR
- AAPP
- OPS-LRS
- BUFR Conversion
- GTS Headers

 Manage Software

- Update Ancillary
- Update LUTs

Processing node is responsible for running one or more science software packages for any combination of satellite and/or sensor.

DBNet Cloud Service Technologies: Containers

DOCKER

- INFRASTRUCTURE/SERVICES
- REPRODUCIBLE
- DEPENDENCY ENCAPSULATION
- CONFIGURATION MGMT. INTEGRATION

SINGULARITY

- SCIENCE SOFTWARE
- VERY SIMPLE DEPLOYMENT OF NEW VERSIONS
- SECURITY MODEL MORE APPROPRIATE FOR SCIENCE SOFTWARE
- ENCAPSULATION
 - CAN BE CREATED BY ANYONE
 - FACILITATES DEV-OPS

DBNet Cloud Service: Next Steps

Short term:

- System deployment via Kubernetes (orchestrated container-based deployment)
- Completing monitoring displays and alerts
- Migrating the current NOAA DBRTN processing to the Cloud Service

Long term:

- Inviting new partners to contribute to the DBNet Cloud Service
- Documenting and releasing the Cloud Service system to DBNet operators
- Standing up new instances of the Cloud Service in other regions (South America, Asia Pacific)

Potential new DNBet sites

Bangkok, Thailand
Mexico City, Mexico
Ascension Island
Dammam, Saudi Arabia
Nairobi, Kenya
Yuzhno-Sakhalinsk, Russia
Orange CA, USA
Dhaka, Bangladesh
Punta Arenas, Chile
Santiago, Chile

DBNet Cloud Service Summary

DBNet Cloud Service prototype is operational

- Concept has been demonstrated from end-to-end
- ATOVS, IASI, CrIS, and ATMS are ingested, processed, and delivered from 6 antenna sites
- System is flexible in terms of configuration and deployment (different cloud providers, multiple file depots, scalable processing)

NOAA DB Network operational processing will migrate to the Cloud Service in 2020. We will invite other DBNet operators to either contribute data to the Cloud Service or to run new instances of the Cloud Service.

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