A Data Processing System Designed for the Cloud

JPSS-CGS
Raytheon IIS - NWS

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JPSS CGS IDPS – what is it?

Managed Missions
S-NPP, NOAA-20, JPSS-2+

Data Processing Missions
GCOM-Wn

Data Acquisition & Routing Missions

Space-Ground Communications Node
SLE-Capable Ground Stations: SvalSat, FCDAS, McMurdo, TrollSat, WSC

Ground Network Node
CGS WAN, Service Entry and Delivery Points

Management and Operations Node
Command/Control, Trending/Analysis, Orbit Operations, Mission Management, Security Management, Situational Awareness, Mission Data Tracking

Data Processing Node
Data Ingest, Data Processing, Data Product Dissemination

CGS Support Nodes
Factory, Development, Logistics

Support Service Providers
AGS, CARA, FDF, FTS, SDS, LSS

Data Product Consumers
ESPC, CLASS, GRAVITE

Raw Data Consumers
FNMOC, NAVOCEANO, SDS

Data Routing Consumers
557th WW, EUMETSAT, FNMOC, GSFC, NSF

Weather, Water and Climate Applications

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JPSS CGS IDPS – Products

- IDPS produces extremely high quality products from the Suomi-NPP and NOAA20 Spacecraft as part of the JPSS Common Ground System.

- First Light Image from S-NPP VIIRS

- First Light Image from NOAA-20 VIIRS Captures Thomas Fire in California

Source: https://earthobservatory.nasa.gov

Source: https://www.nesdis.noaa.gov/JPSS-1
JPSS CGS IDPS – Details

- **Interface Data Processing Segment**
  - IDPS is the Joint Polar Satellite System - Common Ground System segment responsible for providing the ground data processing capability to create the S-NPP and JPSS data products from raw sensor data. The IDPS receives Application Packets (APs) from the Command, Control & Communications Segment (C3S), generates and stores Raw Data Records (RDRs), converts RDRs into Sensor DRs (SDRs), Temperature DRs (TDRs) and Environmental DRs (EDRs), then pushes all required data into the Central’s computers.
  - All of this has to occur with extremely low latency and high quality
  - IDPS receives ~400 Gigabytes of data from 3 spacecraft and delivers over 7 Terabytes of data out to the Mission Partners every day
**JPSS CGS IDPS – History**

- IDPS was first worked as a concept starting in the early 2000’s
- Original Design was for a large mainframe computer
  - Fun Fact: The building that these computers would go in was not completed at the time and once completed the Server room could not support the weight of the mainframe!
- As Hardware options matured IDPS was able to move to a blade architecture that began to allow significant flexibility
- The Software followed along nicely with a very configurable setup allowing you to easily change HW resource utilizations
- Configuration changes now can be made to select how many different virtual servers are available for each portion of IDPS
JPSS CGS IDPS – Current Design

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IDPS Cloud Technical Demo

- Technical demonstration of IDPS to a Cloud Env.
- Live S-NPP & JPSS-1 SMD Contacts
- Continuous Flow with a controlled Ops-Like Demonstration

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Moving IDPS Ops into the Cloud

- Working with the JPSS Ground Project IDPS team we were able to obtain access to a NASA managed portion of Amazon Web Service’s “Pub Cloud” (Public Access Cloud)
- This allowed us to install IDPS into the Amazon Web Services (AWS) environment with a live data flow from the JPSS System
  - The initial estimate was roughly 1 month to get IDPS running once the instance was setup (COTS ready)
  - It ended up being much more straight forward then thought and only took 4 days!
- We delivered to a Mission Partner within the same cloud without any issues
- We then successfully migrated into an AWS GovCloud instance to prove additional Security Capabilities
  - This included a demonstration of Failover between two AWS Availability Zones
How did IDPS do going into the Cloud?

- **Advantages**
  - **Scalability**
    - Near instant interchange of Resources (e.g. VM with CPU/Memory via Machine Images). Ideal for scenarios such as “Meltdown / Spectre Case Study” & Tech Refresh.
    - Storage easily added/reduced based on processing plans
  - **Agility/Efficiency**
    - Initial/Manual IDPS cloud infrastructure setup and software deployment & integration extremely fast
    - Cloudformation templates showed automated/rapid deployment of cloud infrastructure
    - Ability to stop/terminate resources that are not used
  - **Accessibility**
    - Secure Console & VM access established (Expand/Control Anywhere, good for COOP options and overall access to any string)
The Future of IDPS in the Cloud

Current

Future
Changes to IDPS are minimal for cloud migration

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IDPS – Designed for the Cloud

- As demonstrated in the initial efforts IDPS does not require significant modifications to execute in a cloud environment.
- The Key Areas that require SW Architecture modifications in the Ingress and Egress portions of IDPS
  - Data Delivery - Data out (and in)
  - Ingest - Data In
- Other modifications are for optimization to better utilize cloud architecture
  - Dynamic Algorithm Resource Allocation
- ATO in the Cloud
  - Help to define the processes and tools that are necessary to reach the correct security levels
- Currently working with the JPSS Program Representatives to the NOAA NESDIS Cloud Initiative
IDPS – Benefits: Failovers and COOPs

- Currently the JPSS CGS primary facility is located at the NSOF in Suitland, Md, and the backup facility is located at the CBU in Fairmont, WV.
  - The backup facility is unmanned by any program personnel
  - The operations teams have 12 hours to get to the site and get the system nominal

- Data Processing in the Cloud COOP
  - With replicated data between two geographically separated Zones we can be ready to process data within minutes instead of hours
    - No travel time
    - Replicated Data
    - Can be either a Warm or Hot backup
IDPS: Benefits - Faster to Operations

- Currently there is a 12 week cycle once a software release is ready to proceed to operations before it goes operational
  - This includes 4 weeks within the Factory
  - 2 Weeks for Operational Board Approvals
  - 6 Weeks on Site Strings

- Our estimates for a software release in a Cloud instance is around 6 weeks (with potential to decrease)
  - Factory Time will be cut down with automation updates
  - Board Approvals can be concurrent with Parallel OPS activities
IDPS - Other Cloud Benefits

- Moving IDPS into the cloud will allow even more flexibility with resource allocations allowing:
  - Faster modifications to algorithms (Significant decrease in durations for Science Modification to Operations)
  - Simple capabilities to add new Polar Missions
    - Spin up a few more Nodes
  - Capability to handle Non-Polar Missions
  - Flexible Testing
    - Ability to setup a new instance for tailored test data flows to partners on demand
Notional Timeline for IDPS in the Cloud

Migration Phases

- Initial
- Prototypes
- Initial Implementation
- Optimization
- Future Modernization

Security

- IATT
- IATO
- ATO

System Engineering and Operations Milestones

- Design Review
- ORR

AWS Pub/Gov Cloud Demos
AZURE Pub Cloud Demos
Parallel OPS
TTO

Q4CY18  Q2CY19  Q4CY19  Q2CY20  Q4CY20  Q2CY21

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Summary

- IDPS requires only minor modifications to begin taking advantage of many features available only in a cloud environment

- IDPS is a perfect demonstration of a flexible and modular system that fits beautifully into a cloud environment

*IDPS was designed for the Cloud long ago on a sunny day!*