National Oceanic and Atmospheric Administration

National Weather Service

Future Needs of the Integrated Dissemination Program: An Implementation Plan

August 2020

Executive Summary

Beginning in FY 2014, the National Weather Service (NWS) replaced a collection of independent, sub-optimal and undocumented regional dissemination systems with an integrated operational common dissemination service to better support the NWS mission to protect lives and property. This effort was initiated with the congressionally appropriated Integrated Dissemination Program (IDP). For decades, the NWS relied on a non-redundant infrastructure to deliver life-saving watches and warnings. Without a centrally managed nationally supported infrastructure, NWS regional offices and National Centers developed their own networks, applications, product delivery services, and web sites to meet customer and partner needs.

When establishing IDP as an on premise private cloud, it became evident that it would take five plus years to build the infrastructure, onboard the original funded suite of mission-critical applications, and develop the expertise to support it. Phase One was resourced for around 40 percent of the total mission-critical dissemination-based applications and with those resources NWS successfully consolidated and upgraded the network bandwidth, and transitioned twenty core services to IDP. Phase One ended in FY 2018, with IDP providing primary and backup services, 24 hours a day, seven days a week for a subset of mission-critical dissemination applications.

With the initial success transitioning core delivery services of watches and warnings to IDP, NWS entered into Phase Two to initiate the onboarding of the remaining mission critical services. However, attempts to transition some of the remaining mission-critical functions, such as weather.gov and SPOT, from the old legacy systems to IDP proved problematic and transition efforts for these functions halted. Despite a few setbacks, NWS continued the effort to improve the delivery reliability and public display of model, observational, and high-resolution radar data. Phase Two is ongoing and involves specialized support, received by the one-time approved reprogramming from the IDP infrastructure vendors, as they optimize the performance and reliability of the system. Phase Two also encompasses the transition of three remaining and additional mission-critical applications to the system in FY 2021, including the All-Hazards Emergency Message Collection System (HazCollect), NWSChat, and the Advanced Hydrologic Prediction Services (AHPS) (Figure 1). While onboarding these three applications to IDP will improve the risk posture for NWS dissemination mission failure, 19 critical dissemination applications and services continue to operate on end-of-life hardware on legacy web farms and can fail at any time. To circumvent this eventual mission failure, Phase 3 could be resourced to complete the onboarding of mission-critical applications to IDP while in parallel executing the Executive Order to implement a Cloud Smart strategy transitioning appropriate NWS services to a NOAA public cloud environment.

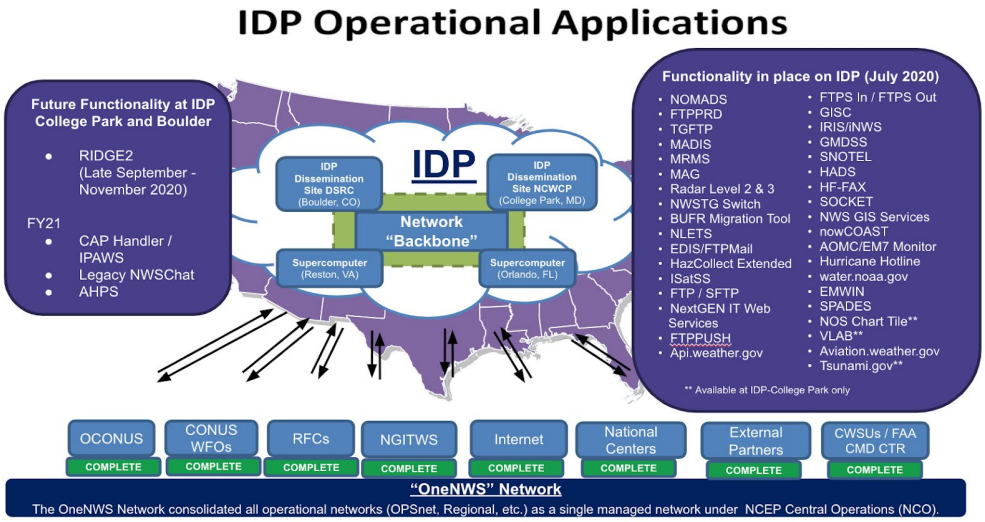

Figure 1: Depicts the success of IDP Phase 1 and 2 through July 2020. The right side lists the applications currently running operationally on IDP and the left side shows the remaining applications funded for transition.

Today, the underlying IDP infrastructure has improved bandwidth and resilience, and it provides redundant, scalable, and secure operational networks and systems; including the onboarding of the NWS Gateway with full backup capabilities for the first time in the history of the NWS. The IDP infrastructure and its applications are monitored and tracked on a 24x7 basis. However, as mentioned, 19 additional mission-critical applications and web services, such as weather.gov, NOAA Weather Wire Service, and SPOT (application that supports fire weather point forecasts) remain on legacy end-of-life servers (complete list in Appendix B). Applications, such as these, do not perform at the same level of robustness of the IDP applications due to both the age of the software and the end-of-life hardware they run on. To ensure NWS Leadership is aware of any issues with the overall operating stature, a daily "stand up" meeting occurs each morning to review and discuss any disruptions in services on all NWS systems, including both IDP and non-IDP applications (Figure 2).

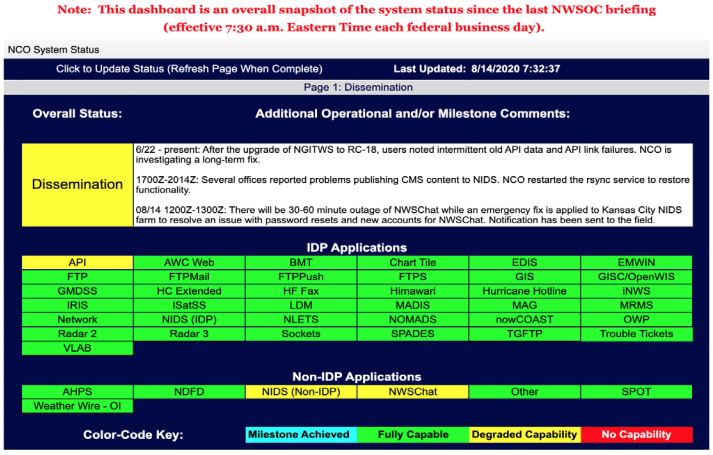

Figure 2: A snapshot of NWS monitored system status dashboard reported daily.

IDP maintained an average availability time greater than 99 percent in FY 2019 and, to date, IDP is hovering around 99 percent in FY 2020 (Figure 3). It is important to note these metrics only reflect the availability of applications running operationally on the IDP in College Park, MD and Boulder, CO and do not encompass the non-IDP applications still residing on the less reliable legacy systems.

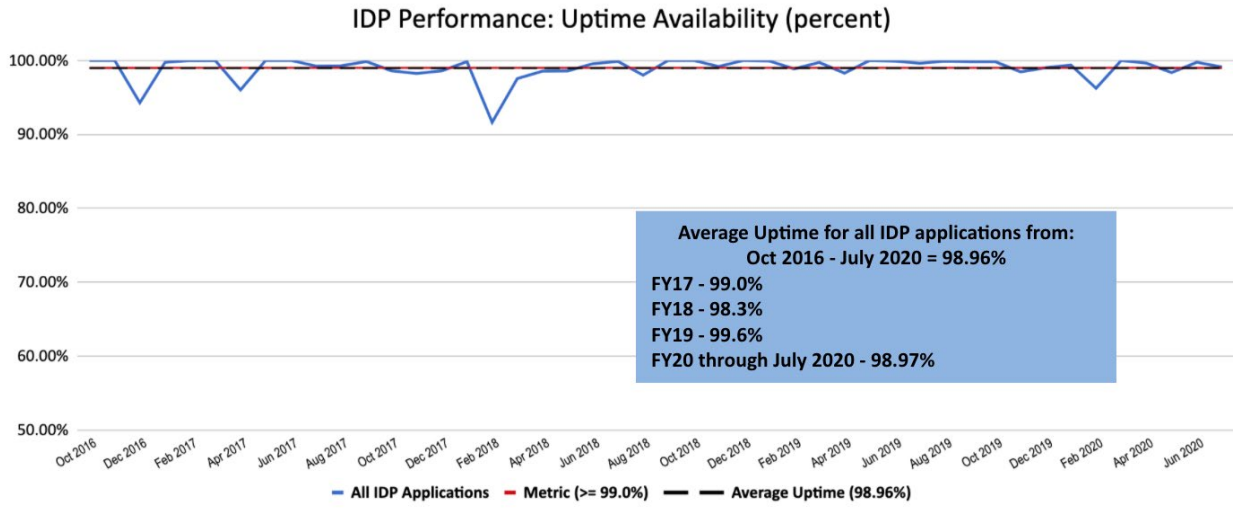

Figure 3: IDP Virtualized Private Cloud Infrastructure Current Uptime Availability

The intent of this plan is to not only complete the transition of the remaining mission-critical applications and delivery services to IDP, but also, demonstrate the viability of a public cloud platform to host and deliver non-Primary Mission Essential Functions (PMEF) through a "Cloud Smart" approach. NWS has mapped out two additional phases to accomplish this intent.

- Phase Three – a focused effort to further strengthen IDP performance and continue reengineering and migrating the remaining mission critical applications and dissemination services to IDP.
- Phase Four - currently in progress with limited scope and would continue in parallel with Phase Three. The initial step is the implementation of an economic framework to assist NWS in evaluating the benefits, risks, and strategic impact of moving to the public cloud. Pending the results of evaluations and current FY 2020 demonstrations, Phase 4 would include transitioning appropriate development environments and applications, some of which currently reside wholly on IDP, to hybrid or public cloud environments.

Phase Three has not yet been resourced. However, NWS has developed strategies to transition 19 applications onto the redundant and secure IDP platform. These 19 NWS mission-essential applications currently reside on legacy platforms with no backup and only some with 24x7 support. At the completion of Phase Three, IDP and the PMEFs it supports could more securely provide the high availability, stability and reliability of essential data required to provide

Integrated Decision Support Services on the web, directly to our core partners (Emergency Management community), the entire weather enterprise, and the American Public.

Phase Four has begun and will continue in parallel with Phase Three (see Figure 4). With a careful and deliberate approach and with the limited resources currently dedicated, NWS is able to continue evaluating applications for the cloud, and transition some services including development environments to a public cloud solution. If fully funded in a future budget, Phase Four would continue to run in parallel with Phase Three creating a hybrid cloud solution with PMEF applications running operationally in the private on premise cloud, transitioning application development environments to the public cloud, and re-architecting existing applications and web services to host on the public cloud based on the evaluation efforts.

Initiated in late FY 2018, the NWS contracted an external consulting firm to provide the NWS with an objective cloud-decision framework that aligns itself with the NOAA Cloud Strategy. The decision framework provides a financial model to evaluate the costs, benefits, and risks associated with operating within the public cloud. Also included in Phase Four is an effort to assess applications currently on IDP, as well as those identified for migration to IDP, to determine if utilizing the public cloud as a host would meet the requirement of the application with reengineering efforts, create efficiencies, and be cost effective. To date, NWS has successfully demonstrated transition of the Damage Assessment Toolkit application to the NOAA Amazon Web Services Cloud and worked closely with NOAA OAR to migrate the development environment of the Multi-Radar Multi-Sector (MRMS) application to a public cloud environment. The Gantt chart for all four phases is presented in Figure 4.

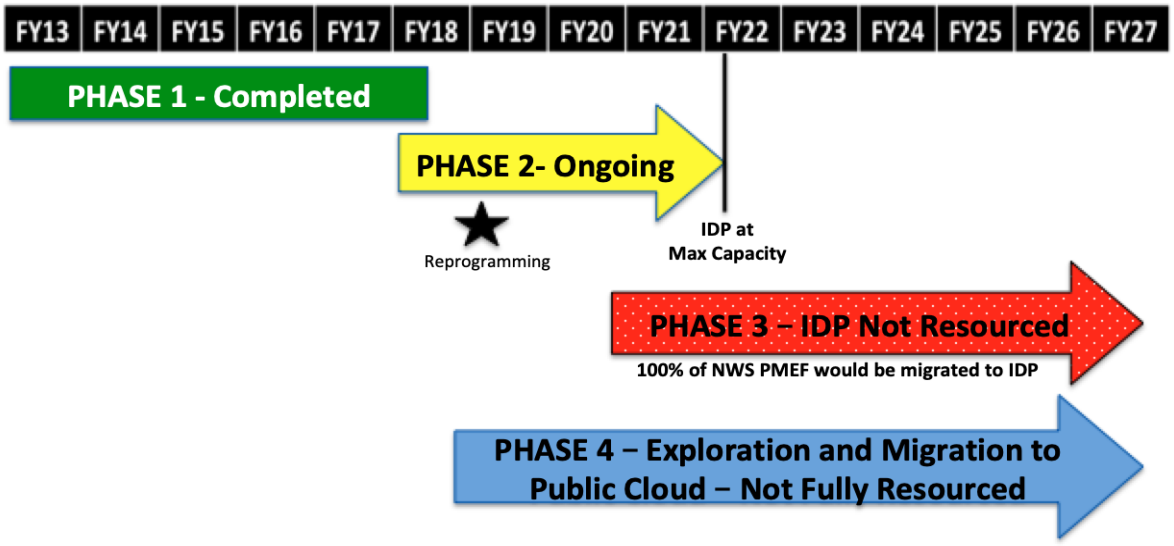

Figure 4: High Level Gantt chart of IDP Phase 1 - Phase 4

Background

The NWS mission depends on the delivery of critical data to forecasters within NWS, as well as the public, and the Weather Enterprise to meet its mission to protect lives and property and enhance the national economy. The NWS mission is at risk of degradation if information is not delivered in a reliable and timely manner.

In FY 2014, in response to a series of significant infrastructure outages that affected the ability of the NWS to execute its mission, including the issuing of warnings during severe weather events, the NWS established the Integrated Dissemination Program. The goal was to transform the organization's dissemination capabilities from a collection of independent dissemination stovepipes to an integrated operational common dissemination service in an on premise private cloud.

Although the vision of IDP was to address all mission essential applications, NWS defined the scope of IDP Phase One, focusing on a subset of the most critical systems needed to deliver NWS watches and warnings. The goals for IDP included:

- Demonstrate the operational viability of using an on premise private cloud for NWS enterprise dissemination services
- Provide fully redundant primary and backup dissemination services with a geographically diverse infrastructure for a targeted subset of NWS critical systems
- Improve bandwidth, resilience, scalability, and secure operational networks and systems
- Increase access to environmental data using diverse methods and data formats

NWS has met and exceeded this original scope. During the completion of Phase One, many mission-essential applications were discovered running on unsupported equipment with no backup. In order to continue to provide reliable weather-based services, the off-premise public cloud solution offers the potential to host more applications with high reliability.

Introduction

Phase One - Complete

The IDP was a multi-year response to ensure reliable and secure information dissemination to support the NWS mission and to help build a Weather-Ready Nation (WRN). NWS confined the scope of Phase One to:

- Transitioning a subset of applications and services related to NWS watches and warnings to IDP
- Consolidating and upgrading the network bandwidth
- Standing up GOES Re-Broadcast Antennas at eight locations to support Himawari-8, GOES-East, and GOES-West

NWS achieved the original scope of the program, and Full Operating Capability (FOC), in FY 2018, transitioning an initial 20 applications to the platform, and subsequently transitioning 16 additional mission-critical applications. The technology infrastructure created through the IDP is an on premise private cloud infrastructure and deployed at two geographically diverse locations. This effort resulted in a 100 percent backup capability for the delivery of NWS reliable and timely critical observations, model guidance, forecast, and watches and warning information for the first time in history. The OneNWS Network is operationally used at all NWS Forecast Offices, River Forecast Centers, Regional Headquarters, and National Centers to support mission-critical coordination. Data delivery services were upgraded and the bandwidth was increased by tenfold. The original scope of IDP also included the move of the "singular" gateway in Silver Spring to a fully backed up system in College Park, MD and Boulder, CO, representing the first time ever that the NWS Gateway could operate as a fully backed up system. The design, procurement, and installation of eight NWS Geostationary Weather Satellite Antenna Systems (GWSAS) were also accomplished at CONUS NWS locations, and two Himawari-8 Satellite Antenna Systems (Himawari-CAST) at OCONUS NWS locations. These enabled the receipt, processing, and display of data from the GOES-East, GOES-West, and Himawari-8 satellites. This new satellite imagery allows the NWS to forecast with more precision due to the enhanced resolution and timely receipt of the data at the critical National Centers.

Since reaching FOC, at the end of Phase One, the IDP has proven to be a powerful resource for the NWS. This was evident during the historic 2017 hurricane season when the IDP infrastructure, upgraded OneNWS Network, and a newly implemented video-enabled hurricane hotline communication system performed flawlessly during the most critical time as multiple storms affected the U.S. and Caribbean countries. However, the level of demand the NWS anticipated on the system, based on outside evaluation, far exceeded expectations. The IDP infrastructure is reaching its maximum capacity and demand continues to grow, forcing NWS to re-evaluate which applications are most critical to host on the system.

Implementation Plan

Phase Two - Enhancements Currently Ongoing

Outages began to occur in FY 2018, bringing the availability of IDP below 99 percent (see Figure 3). These outages were attributed to a misconfiguration of the internal networking of the IDP infrastructure. At the time the infrastructure was built, using virtual machines with scalability to increase access to data in multiple formats, the IDP truly pushed the limits of technology. The decision to use virtual machines rather than purchasing the equivalent hardware at significantly greater cost allowed NWS to meet the requirements of the overall program at a lower cost. However, a misconfiguration became evident once the system became operational. To correct this, NWS required an infusion of expertise to strengthen the overall system stability. Beginning in FY 4Q 2019, NWS used $5 million of reprogrammed funds to contract with highly specialized subject matter experts from the IDP infrastructure vendors, and 11 highly skilled system administrators, for a period of 18 to 24 months. These contractors will document,

configure, and optimize the performance and reliability of the IDP systems and transfer knowledge to NWS IT personnel. This additional expertise reduces the risk of future outages, and will reduce the duration and impact of any outages that do occur. NWS is transitioning additional applications to IDP to improve reliability of those applications, and maintaining existing applications to meet both customer and security requirements.

While transitioning all remaining mission-critical applications and services will not be possible in Phase Two, the NWS through the Mission Delivery Council (MDC) prioritized a subset of these applications (Table 1) that require primary and backup services. Failure of this subset of applications generates the most immediate operational risk. In response, NWS is now preparing to on-board these applications through annually appropriated funds, funds reprogrammed to the Office of Dissemination during FY 2018, and hurricane supplemental funding from FY 2017. The critical applications transitioned with base and hurricane supplemental funding include the Satellite Product Analysis and Distribution Enterprise System (SPADES), the Radar Integrated Display and Geospatial Elements 2 (RIDGE2), and the Enterprise GIS National Viewer for flood inundation mapping. Mitigation measures are being explored to improve robustness in the face of demand for the most essential legacy web-based applications such as NWSChat while awaiting transition to IDP. NWSChat, for example, is a primary communication and coordination tool used by meteorologists, core partners and the media to quickly exchange rapidly changing forecasts, observations and warning information.

The remaining $3 million of $8 million of reprogrammed funds enabled the NWS to accelerate the on-boarding or enhancement of three critical applications to IDP ensuring 100 percent backup capability in the event of a primary system failure. These next-to-be on-boarded applications are the Advanced Hydrologic Prediction Service (AHPS), NWSChat, and the newly designed All-Hazards Emergency Message Collection System (HazCollect), also called CAP Handler, which works with FEMA IPAWS to disseminate life-saving alerts and warnings. Initiating in early FY2019, hiring and training contractors as well as preparing and on-boarding these three applications will take approximately two years, in total, and is expected to be completed by the end of FY2021. Once the Phase 2 applications that provide NWS PMEFs are transitioned to IDP, the storage, compute, and bandwidth to the Internet will reach full capacity by the end of FY2021 leaving 19 critical applications and services without a sustainable home.

Table 1: Phase Two – MDC Prioritized Application Enhancements and On-boarding

MDC approved sequence	**Application Name**	**Purpose of Application or Enhancement**	**Estimated Completion**
1	Satellite Product Analysis and Distribution Enterprise System (SPADES)	Initial Phase 1 implementation of GOES-16/17 space weather related satellite products	Completed Q1 FY 2020

2	aviationweather.gov	Implement secondary instance of NWS Aviation Weather Center (AWC) site on IDP	Completed Q3 FY 2020
3	Radar Integrated Display with Geospatial Elements 2 (RIDGE 2)	Improved spatial resolution, and enhanced images of radar data. Current services reside on legacy web farm	Q1 FY 2021
4	Implement updated HAZCOLLECT application, NWS Common Alerting Protocol (CAP) Handler application, to ingest and deliver Non-Weather Emergency Messages from FEMA IPAWS	The application to ingest non-weather emergency messages from FEMA IPAWS and rebroadcast over NOAA Weather Radio (NWR) is sporadic and unreliable. This will replace two legacy applications.	Q2 FY 2021
5	NWSChat	Allows for mission-critical collaboration between decision makers.	Q4 FY 2021
6	Advanced Hydrologic Prediction Services (AHPS)	Provides water-focused web-services including water heights at river gauge locations current and forecasted. These services currently reside on legacy web farm.	Q3/Q4 FY 2021
7	NWS Enterprise National GIS-based Viewer (Hybrid Cloud approach)	Supports flood forecasting and inundation mapping such as WPC and OWP GIS Products.	Q4 FY 2021 or Q1 FY 2022

Phase Three – Continued IDP Onboarding of Mission-Critical Applications (If Resourced)

Today, IDP supports 36 applications operationally (see Appendix A). By the end of Phase Two in late FY 2021 / early FY2022, seven additional applications will run operationally on IDP and at that point IDP will be at full capacity. NOAA developed plans for FY 2022 and beyond to transition up to 19 remaining mission-critical applications and web services to IDP (Appendix B). These applications, while critical to the mission, do not currently perform at the level NWS stakeholders require. The decision to further invest in these applications will depend on an assessment of stability of aging hardware, level of redundancy and/or development environments. The primary mechanisms to properly disseminate critical life and safety warnings to the public are NOAA Weather Radio (NWR), broadcast services, and phone-based emergency services. However, it is clear NWS Partners in the Emergency Management community rely on information provided by these applications and web services to support and execute their mission and warn the public.

In order to meet the increasing mission demands for the delivery of PMEFs from the IDP system, NWS will develop options for potential expansion of the IDP on premise private cloud infrastructure, increasing the compute and storage capacity in both Boulder and College Park. This could enable the NWS to transition the remaining prioritized critical applications to IDP, continue to enhance existing IDP applications, and provide a wide range of web and GIS services with an enterprise expandable design approach. The need for a Phase Three expansion will be determined as part of a NOAA-wide assessment of cloud transition opportunities, and it would require IDP hardware, software, and operational and maintenance staff in both Boulder, CO, and College Park, MD. NWS anticipates Phase Three could be completed in five years.

Phase Four - Exploring and Demonstrating the Use of the Public Cloud

In FY 2018, the NWS Office of Dissemination initiated an independent analysis of the applications running on the IDP on premise private cloud, awarding the contract to Forrester in September 2018. The evaluation was meant to explore three cases: 1) Evaluate mission-critical applications currently running on IDP to determine if migration to the public cloud would be beneficial and cost-effective, 2) evaluate non mission-critical applications running on aging non-IDP to determine if the public cloud is a viable and secure option, and 3) determine if the development environments for applications currently running on IDP can or should be migrated to the public cloud. The results from Forrester stated: "Forrester has found that the use of an internal cloud at NWS has created an environment where both applications and infrastructure have been optimized for the way NWS needs to deploy and manage their workloads. Key aspects of the analysis included: the requirement to have predictable / consistent costs, requirement to have predictable response and availability of mission essential watches, warnings, observations, data services etc., and the ability to size their infrastructure to their workloads." These results pre-date the NOAA Cloud Utility and Big Data Project contracts and were based on the premise for NWS to continue data access and delivery at the same availability and uptime as done today on IDP. Forrester assumed public cloud IaaS/PaaS instances were aligned to match or exceed current or projected on-premises infrastructure requirements and cost estimates were based off Amazon Web Services (AWS) GovCloud pricing.

Not all of the applications currently running on IDP have yet been evaluated to determine if a public cloud could provide the correct amount of support while also providing an acceptable Return on Investment (ROI). Many of the applications currently on the private cloud infrastructure (IDP) require high availability on a 24 x 7 x 365 basis with low latency processing and services to provide real time data. With the applications reviewed to date, it would appear that in order to provide this level of service, with the appropriate security levels, these applications are better run on an internal on premise private cloud. The Forrester study also made it clear that the NWS applications are very highly customized and current configurations of the NWS applications are not designed to fully benefit from the public cloud. Forrester suggested the

need for greater adoption of more modern object-oriented programming languages that are more conducive to scaling-out architectures to better utilize cloud resources. Therefore, in addition to the cost to shift to the public cloud, and possible egress costs to share data with our partners, NWS would also need to consider the cost to refactor the applications.

Having stated the above, more positive opportunities are emerging. The recently awarded NOAA Cloud Utility and Big Data Project contracts provide a new vehicle to conduct low-risk demonstrations in FY 2020. For example, NWS and OAR are working collaboratively to run the Multi-Radar Multi Spectrum (MRMS) development environment in the public cloud space. By removing the MRMS development environment on the IDP infrastructure, one-third of the compute and storage allotted for that application would be made available to support the critical upgrades required by forecasters to support the weather and water mission. Also in FY 2020, with the NOAA Cloud Utility contract, NWS plans to transition the Damage Assessment Toolkit (DAT) application and potentially the Local Climate Analysis Tool (LCAT) to public cloud with a dedicated 8 x 5-support team. Furthermore, these NOAA contracts enable NWS to explore the viability to re-architect applications that provide raw and graphical numerical weather prediction model guidance to run in a public cloud environment. If data egress costs to NWS can be avoided, these applications could provide benefit to NOAA and the weather enterprise, where data could be co-located with private industry data processing.

The Phase 3 investments in contract software engineering services would also begin to build the expertise NWS needs to ensure all applications are coded efficiently and flexible enough to take advantage of cloud technology. This would make future migration from internal cloud to public cloud for appropriate types of applications much more straightforward. As Phase Four continues, it will be through the FY 2020 demonstration projects, a transition roadmap that Forrester is tasked to deliver by the end of FY 2020, and the tool Forrester built for the NWS to evaluate which systems are the best candidates for the public cloud, much like what is being considered for supporting our modeling suite. In FY 2020, NWS and OAR completed a demonstration to move the IDP development environment of the Multi-Radar Multi-Spectrum (MRMS) to the public cloud environment using the new NOAA Cloud Utility Contract. If this demonstration is successful, other development organizations can do the same allowing up to 15 percent of the overall computational virtual machines available for other PMEF applications to be re-engineered and migrated to IDP allowing compute and storage to become available for production. In this approach, the development organization for each of the IDP applications will need to assume costs to transition their respective development environment to the public cloud.

As NOAA codifies its enterprise cloud concept of operations, it is possible that some of these constraints, such as egress costs and application refactoring, could be mitigated and options for some types of applications reassessed this includes applications and services such as VLab and NOMADS. In alignment with the 2019 Federal Cloud Computing Strategy - Cloud Smart, many

factors will need to be taken into consideration when evaluating what remains on premise and what is better suited for the public cloud. As with any new technical approach, investment in both time and resources will be required. Table 2 provides an initial analysis of application candidates for the public cloud and the PMEF applications required to remain on the on premise private cloud infrastructure.

Table 2: Possible Future Cloud Platforms for Current and New NWS Applications
Note: If a Public Cloud platform is selected, resources would be required to re-engineer the service from its current onsite infrastructure to the public cloud. Furthermore, data egress costs must be considered and analyzed prior to any transition to the public cloud environment.

List includes current IDP applications and other NWS applications included in the IDP Plan. * Application currently running on IDP **Application Name**	Recommended Dissemination Infrastructure: **Private Cloud** **Hybrid Cloud** **Public Cloud** **TBD**	Level of resourced activity: **Resourced** **Partially -Resourced** **Non-Resourced**
MRMS Development Environment*	Public Cloud	Resourced – Phase 4
Damage Assessment Toolkit	Public Cloud	Resourced – Phase 4
Local Climate Analysis Tool	Public Cloud	Resourced – Phase 4
VLAB*	Public Cloud	Partially –Resourced – Phase 4
The Development Environment for most IDP Apps	Public Cloud	Partially –Resourced – Phase 4
NOMADS*	Public Cloud	Partially –Resourced – Phase 4
National GIS Viewer – Operations	Hybrid Cloud	Partially –Resourced – Phase 4
NOS Chart Tile*	TBD	Non-Resourced
WPC Ensemble Situational Awareness Table	TBD	Non-Resourced
CONDUIT	TBD	Non-Resourced
NWS Climate Website	TBD	Non-Resourced
nowCOAST GIS and web Services*	TBD	Non-Resourced
MAG*	TBD	Non-Resourced
OWP Data Processing and website water.noaa.gov*	TBD	Non-Resourced
Ocean Prediction Center Website	TBD	Non-Resourced
Climate Prediction Center Website	TBD	Non-Resourced
River Forecast Centers Websites	TBD	Non-Resourced
Aviation Forecast Verification Tool	TBD	Non-Resourced
Verification Service for Aviation Forecast Evaluation Tool	TBD	Non-Resourced
Mobile.weather.gov	Hybrid Cloud	Non-Resourced – Phase 3

Weather.gov* including Content Management System	Hybrid Cloud	Non-Resourced – Phase 3
SPOT	Hybrid Cloud	Non-Resourced – Phase 3
Tsunami.gov	Hybrid Cloud	Non-Resourced – Phase 3
NOAA Weather Wire Service Open Interface	Private Cloud	Non-Resourced – Phase 3
Forecast.weather.gov	Hybrid Cloud	Non-Resourced – Phase 3
NDFD	Hybrid Cloud	Non-Resourced – Phase 4
Enhanced Data Display	Hybrid Cloud	Non-Resourced – Phase 4
FTPPRD*	Private Cloud	Resourced – Phase 1
TGFTP*	Private Cloud	Resourced – Phase 1
Radar Level 2*	Private Cloud	Resourced – Phase 1
Radar Level 3*	Private Cloud	Resourced – Phase 1
NWSTG Core Switch*	Private Cloud	Resourced – Phase 1
BUFR Migration Tool*	Private Cloud	Resourced – Phase 1
NLETS*	Private Cloud	Resourced – Phase 1
HazCollect Extended (CAP Handler)*	Private Cloud	Resourced – Phase 1
EDIS & FTPMail*	Private Cloud	Resourced – Phase 1
FTP / SFTP*	Private Cloud	Resourced – Phase 1
FtpPush*	Private Cloud	Resourced – Phase 1
FTPS-In*	Private Cloud	Resourced – Phase 1
FTPS-Out*	Private Cloud	Resourced – Phase 1
GISC*	Private Cloud	Resourced – Phase 1
GMDSS*	Private Cloud	Resourced – Phase 1
HF-FAX / Radiofax*	Private Cloud	Resourced – Phase 1
SOCKETS*	Private Cloud	Resourced – Phase 1
MetaData Generator for OpenWIS	Private Cloud	Resourced – Phase 1
NextGen IT Web Services*	Private Cloud	Resourced – Phase 1
The ASOS Monitoring Center*	Private Cloud	Resourced – Phase 1
Hurricane Hotline*	Private Cloud	Resourced – Phase 1
Emergency Managers Weather Information Network (EMWIN)*	Private Cloud	Resourced – Phase 2
Satellite Product Analysis and Distribution Enterprise System (SPADES)	Private Cloud	Resourced – Phase 2
Radar Integrated Display with Geospatial Elements 2 (RIDGE2)	Private Cloud	Resourced – Phase 2
NWSChat on IDP (Near-term plan)	Private Cloud	Resourced – Phase 2
AHPS (water.weather.gov)	Private Cloud	Resourced – Phase 2
Goes 16 and Goes 17 automated rapid scan scheduling	Private Cloud	Resourced – Phase 2
Api.weather.gov *	Private Cloud	Resourced – Phase 2
GTS Internet File Service	Private Cloud	Resourced – Phase 2
National Ice Center Website	Private Cloud	Resourced – Phase 2
Aviationweather.gov*	Private Cloud	Resourced – Phase 2
MADIS* (Includes HADS and SNOTEL)	Private Cloud	Resourced – Phase 2

MRMS*	Private Cloud	Resourced – Phase 2
ISatSS*	Private Cloud	Resourced – Phase 2
IRIS / iNWS*	Private Cloud	Resourced – Phase 2
Geospatial Information Services - operations* (IDP-GIS)	Private Cloud	Resourced – Phase 2

Conclusion

The NWS has built a strong and effective dissemination system that has the architectural capability to provide consistent and reliable service with 100 percent backup in two geographically diverse locations. Since its operational designation in October 2017 IDP operates at an average 98.9 percent availability for the applications it serves, and, after Phase Two is complete, should run at greater than 99 percent availability. With the additional hardware, software, and resources outlined in Phase Three, NWS can increase support to its partners by further developing the IDP to:

- expand the infrastructure to accommodate sustainment of all NWS mission-critical functions by adding existing critical applications currently running on legacy systems;
- enhance and sustain applications currently running on IDP

NWS strives to ensure the timely delivery of mission-critical data, watches, and warnings to the public and partners and NWS will determine if the use of an off-premise public cloud is a viable option for public facing mission-critical applications. This approach aligns itself with the 2019 Federal Cloud Computing Strategy: Cloud Smart operates on the principle that agencies should be equipped to evaluate their options based on their service and mission needs, technical requirements, and existing policy limitations. Computing and technology decisions should also consider customer impact balanced against cost and cyber security risk management criteria. Additionally, agencies need to weigh the long-term inefficiencies of migrating applications as-is into cloud environments against the immediate financial costs of modernizing in advance or replacing them altogether." The information gathered in Phase Four, to date, has shown the PMEF-related applications do not lend themselves to the public cloud. As Phase Four continues to progress in parallel with Phases Two and Three, NWS will also evaluate selected applications with lower mission importance, as well as the possibility of moving the IDP development environment, as possible opportunities to use public cloud environments for support.

At the present time, given the current results of the Forrester study, a hybrid cloud approach is warranted. NWS needs to continue moving forward with transitioning mission-critical applications to run on the on premise private cloud while in parallel looking for opportunities where a public cloud solution makes sense.

Appendix A: Phase One and Phase Two Functionality in place at IDP College Park and Boulder as of August 2020

*Available only on the IDP Infrastructure in College Park, MD

**Enhancements will go live in FY 2021

No.	Application Name	IDP Phase	Purpose of Application Or Enhancement
1	National Operational Model Archive & Distribution System (NOMADS)**	2	Provides NWS gridded numerical weather prediction model output for the public including the Weather Enterprise.
2	File Transfer Protocol Server (FTPPRD) (https://ftpprd.ncep.noaa.gov)	1	This FTP service provides numerical model output in GRIB and BUFR formats. Some observational data (surface, upper air, radar) that is used as input to the models are also available.
3	Telecommunications Gateway FTP (TGFTP)	1	This server provides anonymous ftp and http services. The server also fulfills international commitments for data distribution and most importantly, the migrated application provides backup capabilities for the first time for this service. (ftp://tgftp.nws.noaa.gov/)
4	Meteorological Assimilation Data Ingest System (MADIS)**	2	MADIS is a meteorological observational database and data delivery system that provides observations that cover the globe. MADIS provides several methods for users to access the data to meet their needs. Users can request data from July of 2001, which is when MADIS was first available to the public, to the present.
5	Multi-Radar/Multi-Sensor System (MRMS)	2	The MRMS system was developed to produce severe weather and precipitation products for improved decision-making capability to improve severe weather forecasts and warnings, hydrology, aviation, and numerical weather prediction.
6	Model Analysis and Guidance (MAG)**	2	The MAG website provides graphical output of model guidance (global, mesoscale, tropical, etc.) from the NOAA High Performance Supercomputing System.
7	Radar Level 2	1	Digital radial base data and Dual Polarization variables output from the signal processor in the Radar Data Acquisition unit

8	Radar Level 3	1	Output product from the Radar Product Generator, assisting forecasters and others in weather analysis, forecasts, warnings, and weather tracking.
9	NWS Telecommunications Gateway (NWSTG) Switch	1	Enables the delivery of all NWS watches, warnings, advisories, and forecasts to be routed both domestically and internationally.
10	BUFR Migration Tool (BMT)	1	The BMT transforms the legacy coded text products, such as Synop and Radiosonde observations, into the BUFR binary format for dissemination to worldwide partners.
11	National Law Enforcement Telecommunications System (NLETS)	1	NLETS provides NWS forecasts, warnings and reports to emergency responders, public safety and law enforcement personnel via NLETS, which is also used for such things as to issue All Points Bulletins, request Interpol information, or notify the police or fire department that a homeowner's security system or fire alarm has been triggered.
12	Email Data Input System (EDIS) and FTPMail	1	The NWS Email Data Input System (EDIS) Program is a legacy service providing our partners with a simplified process for delivering weather products (SYNOP, METAR, etc.) and data via email to NWS for further dissemination. The NWS FTPMail was established primarily for mariners who have limited World Wide Web access but maintain the ability to interface with NWS through e-mail services. The NWS FTPMail service allows customers to request and receive Weather Products through a simple mail transfer protocol. By using FTPMail, a user's request is automatically sent as either an attachment or content of an e-mail message on an as-needed basis.
13	Office of Water Prediction (OWP) Data Processing and Website	2	Post-processes the output from the Water Model into a format for use by NWS offices and provides via ftp access to the public, and website for public access. https://water.noaa.gov
14	IDP Satellite Subsystem (ISatSS)**	2	Takes input from various satellites and performs reformatting before transferring data to NWS operations.
15	File Transfer Protocol/Secure File Transfer Protocol	1	Allows computers to transfer data over the internet. (FTP/SFTP)

16	FTPPush	1	The application sends WMO headed products via ftp or scp. Three partners remain active, GeoNetCast, HF Fax and FAA. The application pulls data directly from the CP IDP core switch.
17	FTPS-IN	1	Provides the ability for screened customers to send data securely to the NWS
18	FTPS-OUT	1	A secure FTP site where NWS can place data where NWS-approved deep core partners can access via a username / password.
19	Global Information Center System (GISC)	1	WMO's major component to Open World Meteorological Organization WMO Information Systems (WIS), collecting and disseminating information to WIS centers and with the global WMO community
20	Inter-Regional Integrated Services (IRIS/iNWS)** and HazCollect Extended	2	IRIS (Integrated Real-time Impact Services) provides an integrated framework, which supports contact, impact, storm report, and observation management functions. IRIS stores decoded National Weather Service text products, allowing them to be used by other services it supports, including iNWS. IRIS provides a web interface for National Weather Service personnel to manage impact ("Impacts Catalog"), contact, and storm report data; it provides a situational awareness mapping display. It provides a real time observation monitor and logging of communications with core partners. The HazCollect Extended piece of the application converts NWS weather emergency messages into Common Alerting Protocol (CAP) v2.0 for delivery of Wireless Emergency Alerts (WEA) through FEMA Integrated Public Alert and Warning System (IPAWS) to cell phones via commercial wireless carriers.
21	Global Maritime Distress and Safety System (GMDSS)	1	An international system which uses improved terrestrial and satellite technology and ship-board radio systems to ensure rapid alerting of shore-based rescue and communications authorities in the event of an emergency. In addition, the system alerts vessels in the immediate vicinity and provides improved means of locating survivors.

22	Snow Telemetry (SNOTEL)	1	The SNOTEL network is composed of over 800 automated data collection sites located in remote, high-elevation mountain watersheds in the western U.S. They are used to monitor snowpack, precipitation, temperature, and other climatic conditions. The data collected at SNOTEL sites are transmitted to a central database, called the Water and Climate Information System, where they are used for water supply forecasting, maps, and reports. The processing of this data has been merged with MADIS.
23	Hydrometeorological Automated Data System (HADS)	1	HADS web pages are structured to provide necessary system information and site meta-data to National Weather Service Offices. The processing of this data has been merged with MADIS.
24	HF-FAX / Radiofax	1	Radiofax, also known as HF FAX, radiofacsimile or weatherfax, is a means of broadcasting graphic weather maps and other graphic images via HF radio.
25	SOCKET	1	The application is a two-way transmitter of WMO headed products that both send and receive data from our partners. Data is ingested into the NWSTG core switching system.
26	NWS Global Information Services (GIS) Services**	2	NWS GIS services are now running and being hosted on the IDP infrastructure with newer web mapping software and an open source database. The new geospatial web services provide users with both time-enabled services and OGC Web Mapping Services (WMS). The data can be accessed at http://idpgis.ncep.noaa.gov. Additionally the new geospatial web services provide users with both time-enabled services and OGC Web Mapping Services.
27	NOS Chart Tile*	2	In collaboration with the National Ocean Service (NOS), Marine Charts Division's (MCD), the existing Navigational Chart Data (ENCD) website is hosted and supported by NCEP Central Operations on NOAA's IDP systems. (http://www.charts.noaa.gov/)

28	nowCOAST	2	nowCOAST v5.0 is a GIS-based online web mapping portal displaying near real-time observations, analyses, tide predictions, model guidance, watches/warnings, and forecasts for the coastal United States. Visual point-and-click access to 60 NOAA data products and services are available to users to assist in areas such as marine transportation, emergency management, search and rescue coordination, HAZMAT response, risk management, and U.S. military planning and operations via http://nowcoast.noaa.gov.
29	NextGen IT Web Services (NGITWS)	1	A web-based data dissemination service that will revolutionize the accessibility, discoverability, and machine-to-machine communication and processing of National Weather Service (NWS) data sets
30	The ASOS Monitoring Center (AOMC/EM7)	1	The AOMC monitors the quality of the sensors in thousands of ASOS automatic observing sites across the United States.
31	Hurricane Hotline	2	NWS video-based communication/collaboration for significant weather events
32	Application Programming Interface for weather.gov (api.weather.gov)	2	API allows developers access to critical forecasts, alerts, and observations, along with other weather data. The API is based upon of JSON-LD to promote machine data discovery.
33	Emergency Managers Weather Information Network (EMWIN)	2	Provides data over the National Environmental Satellite, Data, and Information Service (NESDIS) Geostationary Operational Environmental Satellite (GOES-16 / 17) satellites and is available through a public facing NWS web service.
34	Aviationweather.gov	2	NWS Aviation Weather Center (AWC) site
35	VLab*	2	The NOAA Virtual Lab (https://vlab.ncep.noaa.gov/) does not provide data sets, but is a set of development tools for use by software developers bringing applications to the IDP system.
36	Tsunami.gov*	2	NWS Tsunami Warning Center website

Appendix B: Phase Three and/or Phase 3 – Currently Un-resourced Prioritized Applications for IDP On-boarding or Public Cloud migration

Prioritized Number	Application Name	Purpose of Application or Enhancement
1	SPOT application in support of fire weather forecasts	Primary instance resides on the legacy web farm in Kansas City and Silver Spring.
2	NWS Primary Front-Facing Website Weather.gov including Content Management System (CMS)	Primary instance resides on the legacy web farm in Kansas City and Silver Spring.
3	Implement backup of Tsunami.gov on IDP	Existing web services without backup on IDP. Resides on the legacy web farm.
4	Point-and-click forecast by zip code-forecast.weather.gov	Provides customers with zip code specific forecasts.
5	National Digital Forecast Database (NDFD) web services	NWS field offices working in collaboration with the National Centers for Environmental Prediction (NCEP) are combined in the NDFD to create a seamless mosaic of digital forecasts. Application currently resides on the legacy web farm.
6	NWS River Forecast Centers (RFCs) Web Pages	NOAA NWS websites running on legacy system
7	NOAA Weather Wire Service Open Interface (NWWS-OI)	NWWS is the fastest delivery method to receive NWS text alerts, warnings, advisories, and weather information. Alerts and warnings are available to the NWWS user within seconds of issuance.
8	Mobile.weather.gov	Provides local forecast and current weather conditions. In addition, can look at local radar, satellite, river gage information and if appropriate marine information.
9	Aviation Forecast Verification Tool (AFVT)	Enhances capabilities for the verification of gridded aviation weather forecasts made available by NDFD.
10	Climate Prediction Center (CPC) Website	NOAA NWS website running on legacy system

11	NWS Climate website (weather.gov/climate)	NOAA NWS website running on legacy system
12	Ocean Prediction Center (OPC) Website	NOAA NWS website running on legacy system
13	Regional Area 4 (RA-IV) GIFS	The Global Telecommunications System (GTS) Internet File Service (GIFS) is provided by the NWS for World Meteorological Organization (WMO) Regional Association IV (RA-IV) Member States, and other WMO Regions that are adjacent to RA-IV, as a highly reliable Internet source of meteorological products
14	Enhanced Data Display (EDD)	Multi-purpose web-based, cross-platform GIS system that provides our partners and customers with a single comprehensive web-based interface to access both forecasts and observations of any nature (public, fire, marine, aviation, hydrologic, climate, etc.). This application would be integrated into the larger NWS GIS Enterprise Viewer. This application currently resides in experimental status on the legacy web farm.
15	VLab - Implement back up of GOES 16/17 automated rapid scan scheduling	WFOs use VLab to schedule the GOES-16 and GOES-17 rapid scan operations for targeted sectors of the U.S. during weather events. Rapid scan events enable forecasters to view high-resolution satellite imagery every minute instead of every 5 minutes. Without a backup, scheduling must be done manually through special requests when the system is down.
16	Metadata Generator for OpenWIS	WMO Information System used for the collection and sharing of information for all WMO and related international programs.
17	Verification Service for Aviation Forecast Evaluation (VSAFE) Tool	Suite of four verification tools, that provide verification and analysis capabilities to support performance monitoring of a variety of NWS aviation services and products provided to the FAA.

18	WPC Ensemble Situational Awareness Table (ESAT)	Ensemble forecast tool that will mine data and point out when there is potential for an extreme weather event, as well as the likelihood of an event.
19	Cooperative Opportunity for NCEP Data Using IDD Technology (CONDUIT)	Makes NCEP model data available to university and the US Weather Research Program (USWRP) communities