Enterprise Distribution
Product Distribution and Access (PDA)

Committee for Operational Processing Centers (COPC) F2F

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Presentation Outline

- Environmental Satellite Processing Center (ESPC)
- Enterprise PG/PD
  - PDA Ingress and Egress Rates
  - High Level Data Flow Diagram
  - User Integration Status
  - Schedule Overview
  - Transition to Operations Timeline
- Summary
- Background Slides

Environmental Satellite Processing Center (ESPC)

- ESPC provides environmental satellite data to near real-time data users, international partners and other approved stakeholders supporting near real-time missions – i.e. calibration/validation activities, data quality monitoring and anomaly response
- ESPC systems also provide data to CLASS and NCEI for archive purposes and for distribution to non real-time consumers such as the science community
- ESPC is comprised of a number heterogeneous systems, often mission specific, performing the following functions
  - Data Ingestion
  - Processing
  - Distribution
- Locations: NSOF (Suitland, MD), WCDA (Wallops, VA) and CBU (Fairmont, WV)
- Backup sites
  - WCDA (Wallops CDA, VA) - ESPC CIP
  - CBU (Fairmont, WV) - PRIMARY BACKUP for JPSS

Enterprise Product Generation (PG) and Distribution (PD)

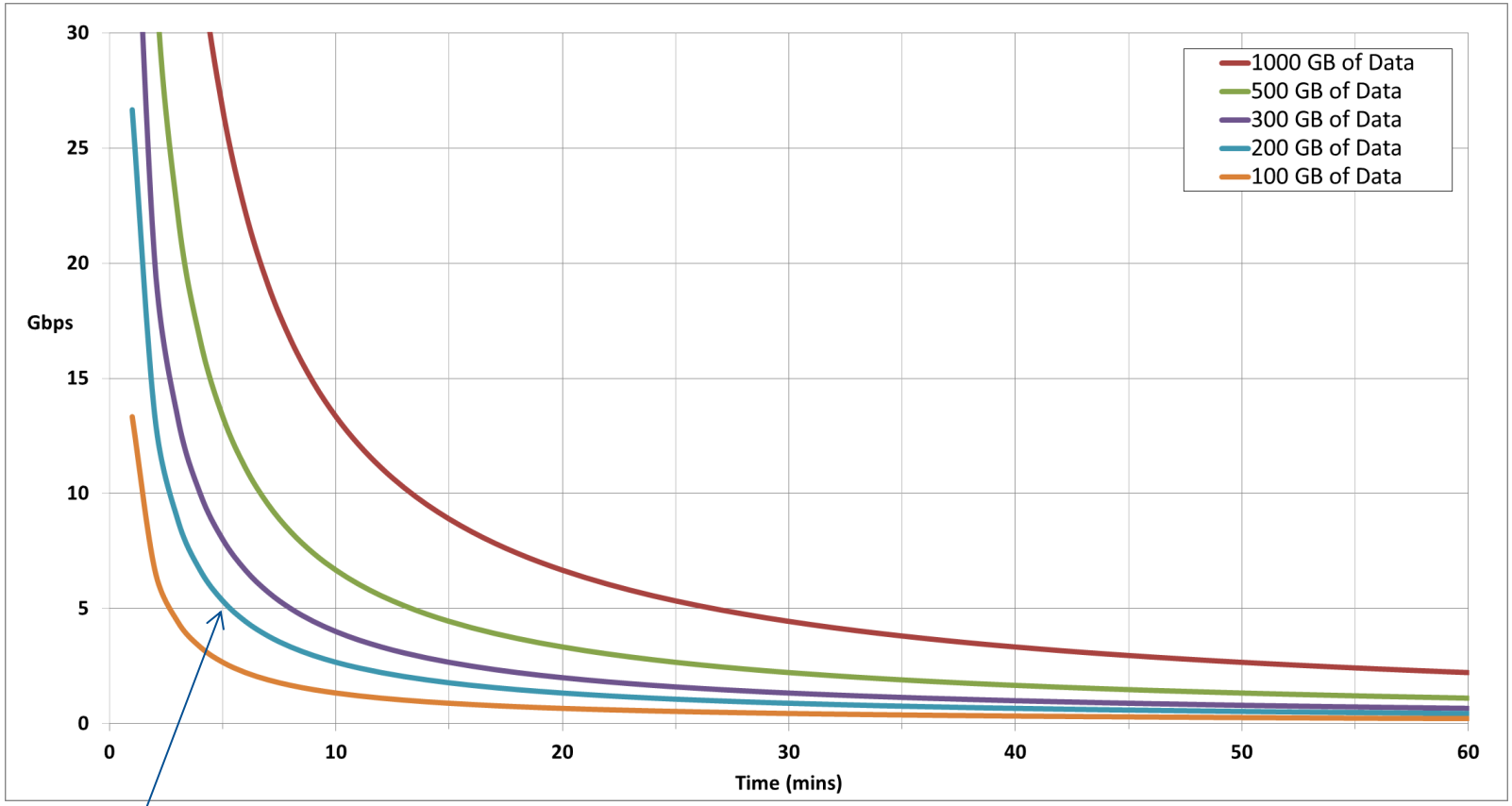
- ESPC has a new enterprise data processing and distribution system for near real-time users.
- New local area network enclave integrated within ESPC system boundary:
  - Implements greater security controls commensurate with a HIGH security system as defined by NIST FIPS 199
  - Provides far greater network capacity/performance (internal and external)
  - Includes a scalable architecture
- NDE 2.0 segment (product generation)
  - Designed as a enterprise PG system
  - NDE 1.0 has been operating since 2013 at above 99.9%
- PDA segment (product distribution)
  - Utilizes secure data transfer protocols
  - Provides multi-mission distribution for both GOES-R and JPSS missions

Product Distribution and Access (PDA) Details

PDA Ingress Capacity	14.25 TB/day
GOES-R Data Production	GOES-R will generate ~1.25 TB/day (compressed)
JPSS-1 Data Production	JPSS-1 will generate ~1.5 TB/day (compressed) or ~4 TB/day (uncompressed)
PDA Egress Capacity	35.92 TB/day
PDA to DoD	4 - 5 TB/day
Peak Throughput	23.5 Gbps (initial)
Network to Edge	Scalable to 120 Gbps
NWAVE	10 Gbps (primary & back-up)

TB – Terabyte (1 TB = 10^{12}) bytes
Gbps – Gigabit per second (1 Gigabit = 10^{9} bits per second)

Data Distribution Latency as a Function of Time and Bandwidth



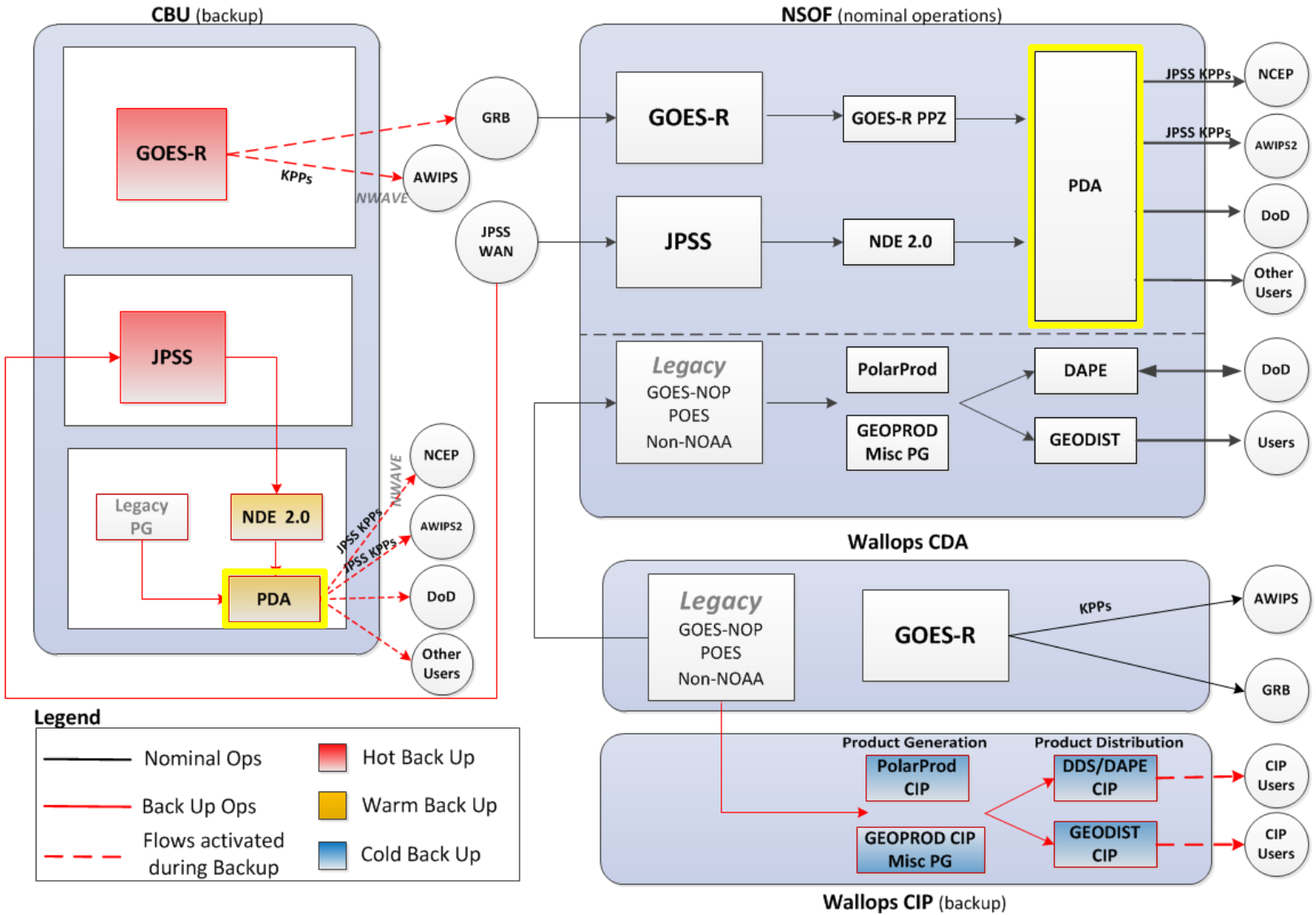
Example: Distribution of 200 GB of data from end to end in 5 minutes would require approximately 5 Gbps of dedicated bandwidth throughput.

High Level System Architecture

- **Nominal Operations from NSOF** (Suitland, MD)
  - Enterprise Infrastructure; uses NWAVE Wide Area network
  - NDE 2.0 product generation; running JPSS, GCOM and eventually GOES-R BUFR production for satellite derived winds
  - PDA distribution; providing secure push/pull data transfers to all approved users

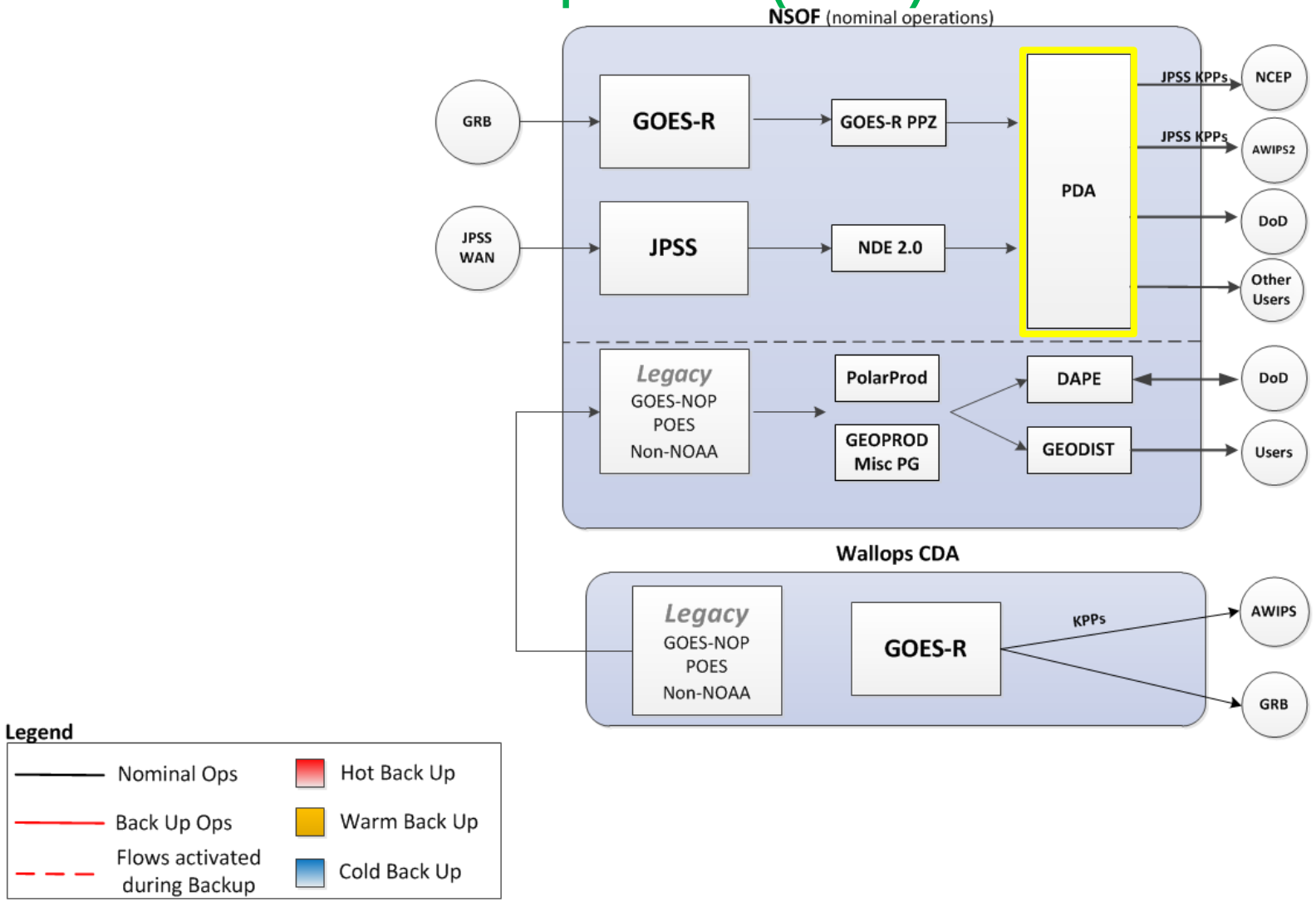
- **Backup/COOP Operations from CBU** (Fairmont, WV)
  - Enterprise Infrastructure; uses NWAVE Wide Area network
  - NDE 2.0 product generation; running JPSS (prime mission sensor only for KPPs/Critical products) and GCOM
  - PDA distribution providing only; JPSS (prime mission sensor only for KPPs/Critical products) and GCOM
  - There is no GOES-R product access from the CBU PDA.

Future ESPC Data Operations (To-Be State)



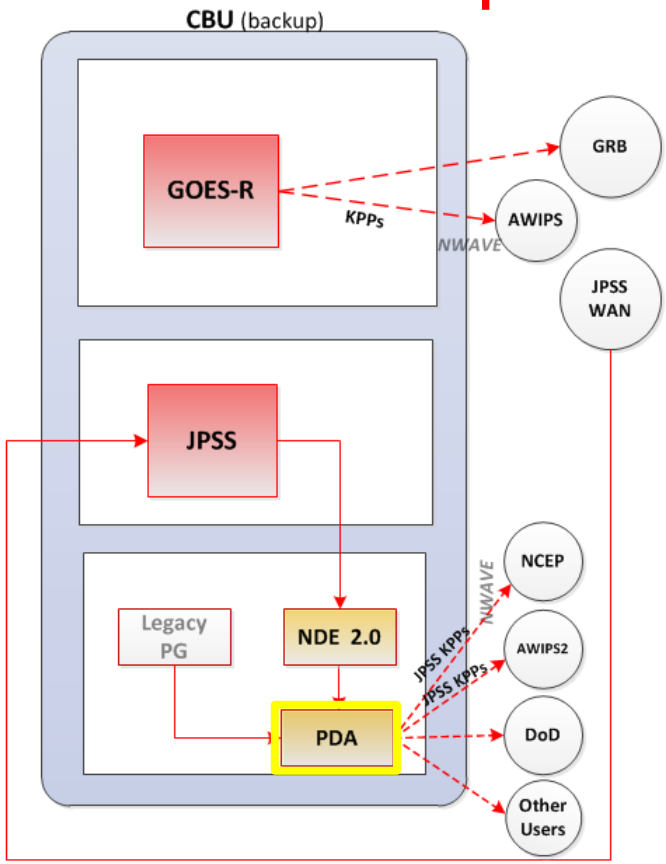
Future ESPC Data Operations (To-Be State)

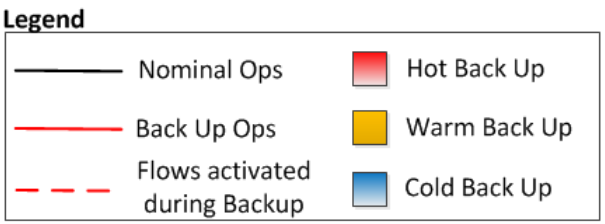
Nominal Operations (NSOF)

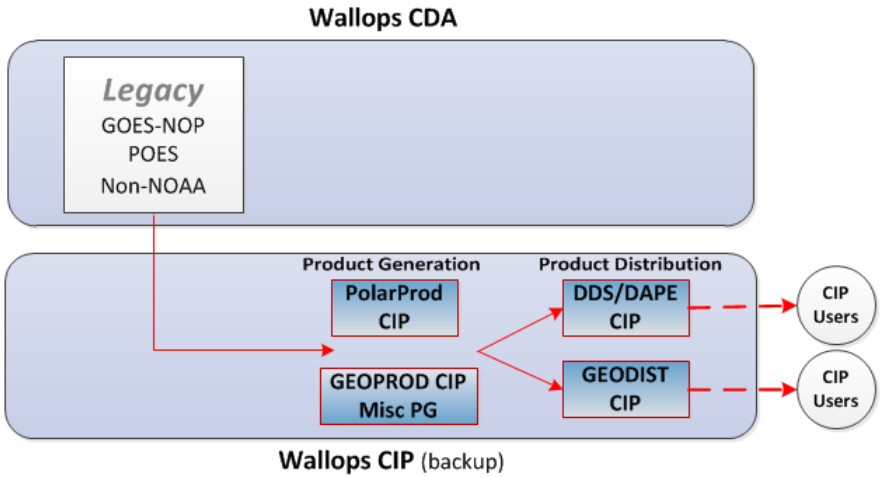


Future ESPC Data Operations (To-Be State)

Backup/COOP Operations (CBU/APC)







Integration Status

- PDA status from end user perspective:
- Integrated and tested to date are:
  - USAF 557th
  - USN FNMOC
  - USN NAVO
- Ongoing integration efforts:
  - USN JTWC

Interface	Integration Status	Ops Priority
FNMOC		1
NAVO		1
557th		1
JTWC		1

Integration Status	
	Active Data Flow (Fully Integrated)
	Flow Not Active (Fully Integrated)

Operational Prioritization on PDA:

[1 – 5] where 1 is the highest priority given on the system and is primarily used to shed lower priority users in the event system resources become limited due to system or some other capacity limitation.

Operational Tier / Prioritization	
1	Life & Property / National Interest Missions
2	Int'l Agreement Missions / NRT NOAA-NASA Environmental Missions/ Launch Support-Cal Val
3	External Mission Support (i.e. AR) / Data Preservation /Archive
4	Ops Test Support
5	Mission (Dev) Test Support / Long Term Approved RT Request
6	Prototype / Temporary Approved Dataflows or Tests / R2O

Current User Status – DoD and Others

Interfaces			Integration Status			Ops Priority
			NSOF Ops	CBU	NSOF I&T	
OAR	OAR	AOML			N/A	2
DoD	USN	FNMOC			N/A	1
		NAVO			N/A	1
		JTWC			N/A	1
	USAF	557th WW			TBD	1
International	EUMETSAT – OISFTP				TBD	2
	EUMETSAT – IDS/MMDS (new)				TBD	2
	CMC				N/A	2
	UKMET		TBD	N/A	N/A	2
	JMA			N/A	N/A	2
	Mexico Nat'l Met Service		TBD	N/A	N/A	2
	France (CLS/CNES)		TBD	N/A	N/A	2
	India NCMRF			N/A	N/A	2
NASA/NOAA/NSF	NSIDC		TBD	N/A	N/A	2
NASA	JPL/DAAC			N/A	N/A	3
	GPM			N/A	N/A	2

Integration Status	
	Active Data Flow (Fully Integrated)
	Flow Not Active (Fully Integrated)
Gray	Not Yet Fully Integrated
N/A	Not Applicable

Operational Tier / Prioritization	
1	Life & Property / National Interest Missions
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Current User Status - NWS

Interfaces			Integration Status			Ops Priority
			NSOF Ops	CBU	NSOF I&T	
NWS	AWIPS	ANCF			N/A	1
		BNCF			N/A	1
		TNCF				4
		AWIPS DD*		N/A		1
	NWSTG	Primary	OBE	OBE	OBE	1
		Backup	OBE	OBE	OBE	1
		Dev	OBE	OBE	OBE	4
	NCEP	WCOSS - Tide			N/A	1
		WCOSS - Gyre			N/A	1
		NCO - IDP A			N/A	1
		NCO - IDP B			N/A	1
		NHC			N/A	1
		SWPC			N/A	1
		AWC			N/A	1
		SPC			N/A	1
	Pacific Region	PHFO/CPHC	TBD	TBD	TBD	1
	Southern Region	SMG (JSC)				1
	NOHSRC					2

KPP

Integration Status	
	Active Data Flow (Fully Integrated)
	Flow Not Active (Fully Integrated)
Gray	Not Yet Fully Integrated
N/A	Not Applicable

Operational Tier / Prioritization	
1	Life & Property / National Interest Missions
2	Int'l Agreement Missions / NRT NOAA-NASA Environmental Missions/ Launch Support-Cal Val
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Current User Status - NESDIS

Interfaces			Integration Status			Ops Priority
			NSOF Ops	CBU	NSOF I&T	
NESDIS	OSPO	GOES-R PPZ		N/A	TBD	1
		JPSS CGS			TBD	1
		Okeanos			N/A	2
		ESPC SFS			N/A	1
		PolarProd			N/A	1
		~~DAPE (DoD GW)~~	OBE	OBE	OBE	1
		NIC			N/A	1
		VIIRSDIST			N/A	1
		SAB			N/A	1
	Coast Watch*				N/A	2
	NCEI SS			N/A	N/A	3
	CLASS				N/A	3
	STAR	Dist Servers		N/A	N/A	3
		CIRA		N/A	N/A	5
		CIMSS		N/A	N/A	5

Integration Status	
	Active Data Flow (Fully Integrated)
	Flow Not Active (Fully Integrated)
Gray	Not Yet Fully Integrated
N/A	Not Applicable

Operational Tier / Prioritization	
1	Life & Property / National Interest Missions
2	Int'l Agreement Missions / NRT NOAA-NASA Environmental Missions/ Launch Support-Cal Val
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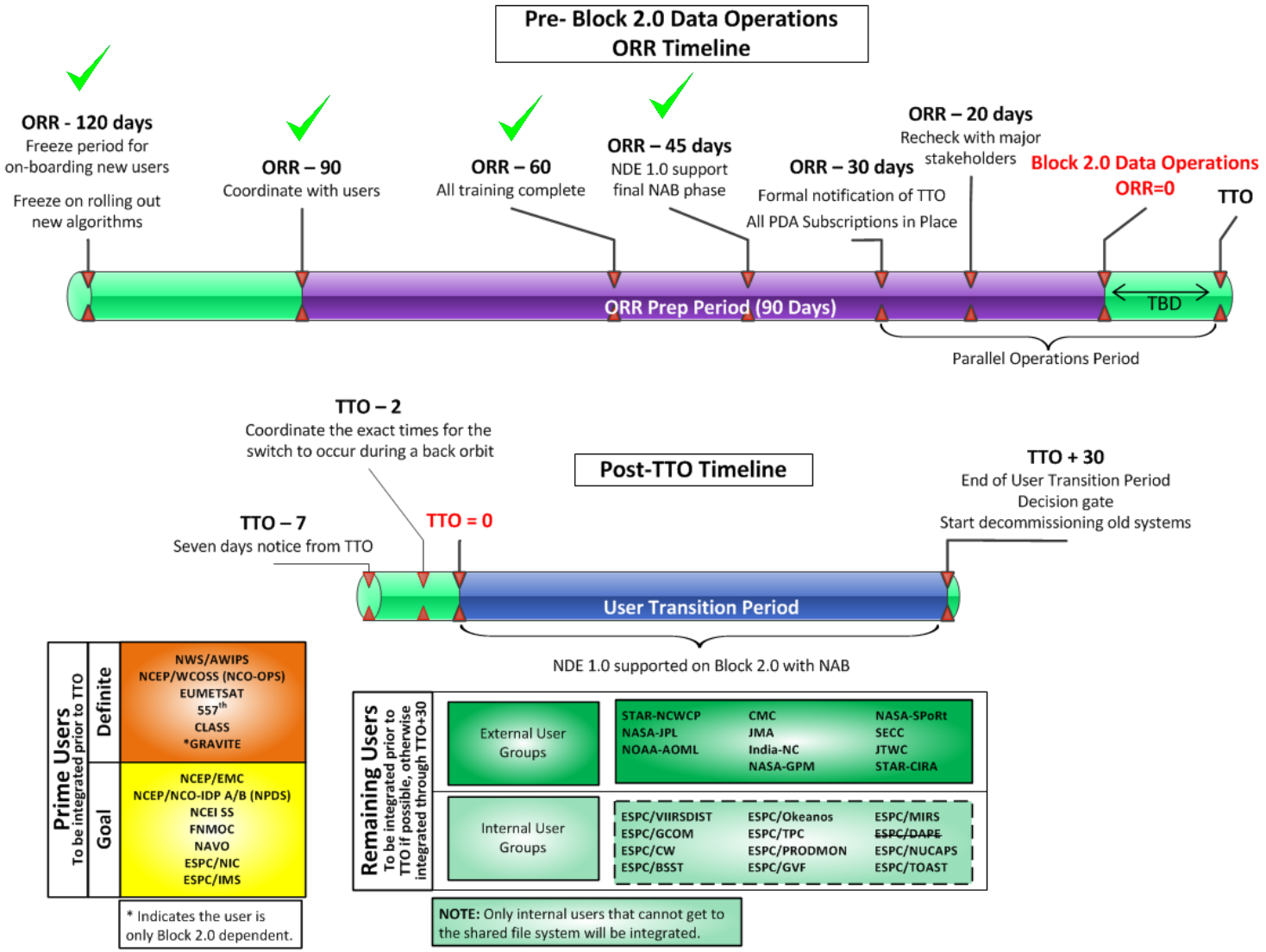
High Level Schedule Drivers

- PDA Operational Readiness Review (ORR) – Nov 15, 2016
  - Scope: PDA 2nd ORR that includes NDE 2.0 production generation
- JPSS Block 2.0 data Operations ORR – Dec 5-9, 2016
  - Scope: product generation and distribution systems; also includes data routing missions from McMurdo
- JPSS Ground Segment ORR – Dec 13, 2016 (TBC)
  - Scope: roll-up ORR of all systems
- Leads us to a transition to operations (TTO) of all the above systems no earlier than Jan 9, 2017

Ground Segment Transition: User Transition Timeline ORR – 120 to TTO + 30 (Decommission Start)



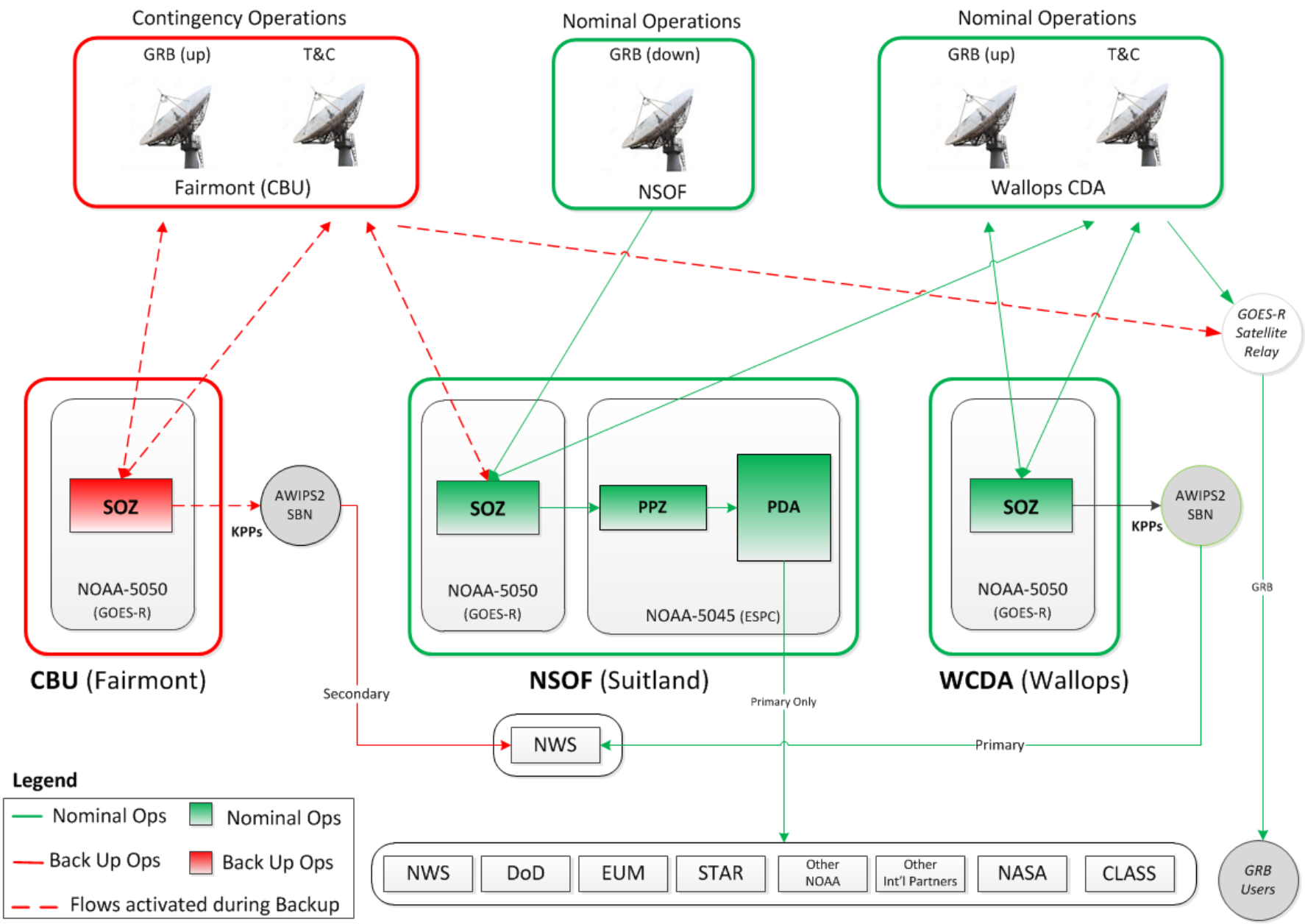
Summary

- PDA and significant network upgrades (ESPC 2.0) are integral in future mission success for SNPP, JPSS and GOES-R; those activities are on track and are going well.
- The NWAVE high speed network architecture has been used for operational data flows and it is highly scalable; segments critical for operational service are subject to Critical Weather Day freeze process.
- The NOAA-EUMETSAT Communications Roadmap initiative is crucial in terms of near term data sharing and exchanging future data – this will be critical for NOAA and DoD once it is made operational.

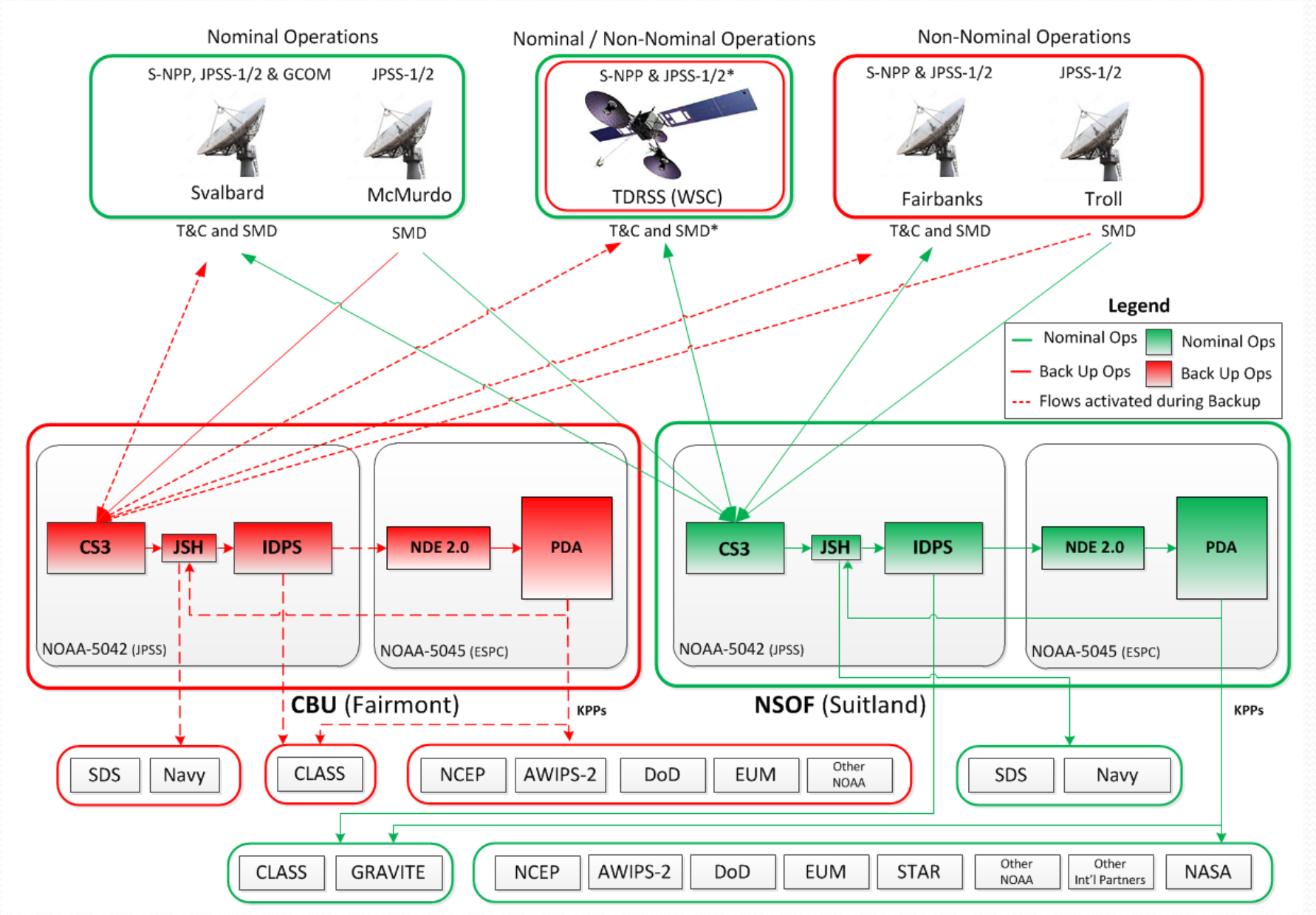
Many Thanks!

Background Slides

Future Architecture/Future Geo Operations



Future Architecture/Future Polar Operations



Current S-NPP Near Real-time Data Flow from ESPC

NOAA-5045 (ESPC)

ESPC LAN

ESPC Internal Users/Systems

NDE 1.0 (PE-1) Operational System

SAN

DAPE

Internal Users

VIIRSDIST
MiRS
TCP
NUCAPS
TOAST
PRODMON
GVF

CW
NIC
GCOM
BSST
Okeanos

Systems that serve specific user communities

Receptor Sites
Svalbard
Fairbanks (Alt)

NOAA MAN (internet)

NCEP POP

NCEP POP/COPC Via DAPE

User Product Expiration Times

Up to 180 mins
Up to 5 hours
Up to 8 hours
Up to 12 hours
Up to 24 hours
24 hours or more

3rd Party Relay

EUMETcast
WMO/GTS

NOAA-5042 (JPSS CGS)

CS3
MMC/SGMMC

IDPS
Interactive Data Processing Segment

IDPS Ops Flow

USAF 557th

External Users

USN NAVO
USN FNMOC
USAF 557th

AWIPS ANCF
AWIPS BNCF
WCOSS
Tide Gyre
NCEP IDP A
NCEP IDP B
EMC

CMC
AOML
CLASS
JMA
NASA GPM
STAR-NCWCP
India-NC
NASA SPoRT
EUMETSAT
USN JTWC
NCEI
JPL DAAC
STAR-CIRA

Internal NESDIS dataflow

External NESDIS dataflow

ESPC User Overview (Today)

General near real-time data access categories

- Critical Users *[near real-time justification]*
  - Protection of Life and Property
  - National Security
  - Economic Security
    - Transportation (air, ground & marine), energy sector, etc
- Priority Users *[near real-time justification, resources permitting]*
  - International partners - mutual data sharing agreements
  - Critical user support – additional decision support information
  - Anomaly support
  - Launch support
  - Private sector
    - Weather enterprise, transportation, energy, client support purposes, etc
- Support-related Users *[near real-time justification, resources permitting]*
  - Calibration / Validation activities
  - Research to Operations (R2O) or Testbed initiatives
  - General product monitoring

Current Internal and External NDE Users

Internal Users (ESPC)	Description
CW	ESPC Coast Watch systems
VIIRSDIST	VIIRS Mcidas system - SAB
IMS	Interactive Multi-sensor Snow and Ice Mapping System – NIC/ESPC (X)
TCP	Tropical Cyclone Product systems
NIC	National/Naval Ice Center
BSST	Blended Sea Surface Temperature
MiRS	Microwave Integrated Retrieval System
NUCAPS	NOAA Unique CrIS/ATMS Processing System
TOAST	Ozone
Okeanos	Ocean Color systems
GVF	Global vegetation systems
PRODMON	NDE PG Product Monitoring
~~GCOM~~	~~GCOM -> npds~~

External Users	Description
NWS/AWIPS	National Weather Service/ Advanced Weather Interactive Processing System
NCEP/WCOSS (NCO-OPS)	NCEP Super Computers (Tide/Gyre)
557th	United States Air Force (USAF) 557th Weather Wing
NOAA-AOML	Coast Watch nodes (GOMEX & Caribbean)
NCEP/NCO-IDP A/B (NPDS)	NCEP College Park/Boulder Systems
NCEP/EMC	Environmental Modelling Center (Dev)
FNMOC	Fleet Numerical Meteorology and Oceanography Center
NAVO	Naval Oceanographic Office
JTWC	U.S. Navy – Joint Typhoon Warning Center
NASA-JPL	Jet Propulsion Laboratory – NASA DAAC (archive)
JMA	Japanese Meteorological Association
CMC	Environment Canada – Met Centre
India-NC	India Medium Range Forecast Center
NCEI	National Centers for Environmental Information
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
STAR-NCWCP	STAR – Central Distribution System
STAR-CIRA	Colorado State – Cooperative
NASA-GPM	Global Precipitation Mission
CLASS/NCEI	NOAA Archive
SSEC/CIMSS	Space Science and Engineering Center (Univ of Wisconsin) - Cooperative
~~NWSTG OPS~~	~~NWS Telecommunications Operations Center~~

Red – Critical Users

Blue – Primary Users

Black – Support-related Users

ESPC/DAPE – provides specialized data access to DoD today; however, all new mission data will be provided by PDA once operational

NDE Operational Products (Today)

Application Short Name	Application Name	Product Name	Format	Satellite
ACSPO SST	Advanced Clear Sky Processor for Oceans (NDE) - SST	SST, Clear Sky Mask	netCDF	SNPP
AOT	Aerosol Optical Thickness	VIIRS Aerosol Optical Thickness (NDE)	BUFR	SNPP
ATMS-SDR	ATMS SDR radiances	ATMS SDR radiances 22 channels (NDE)	[BUFR]	SNPP
CRIS-SDR-399	CrIS SDR radiances 399	CrIS IR sounder SDR radiances 399 channels for NWP data assimilation (NDE)	[BUFR]	SNPP
CRIS-SDR-1305	CrIS SDR radiances 1305	CrIS IR sounder SDR radiances 1305 channels for NWP data assimilation (NDE)	BUFR	SNPP
NUCAPS Level 2	NOAA Unique CrIS ATMS product System Level 2	CrIS/ATMS Atmos Temp Profile CrIS/ATMS Atmospheric Moisture Profile	[netCDF]	SNPP
MIRS ATMS	Microwave Integrated Retrieval System (NDE) - ATMS	MIRS ATMS image products MIRS ATMS SND products	[netCDF]	SNPP
OMPS-NP	OMPS nadir profile	Ozone nadir profile (NDE)	BUFR	SNPP
OMPS-TC	OMPS total column	Ozone total column (NDE)	BUFR	SNPP
VIIRS-EDR	VIIRS EDR	VIIRS EDR (NDE)	netCDF	SNPP
VIIRS-SDR	VIIRS SDR	VIIRS SDR (NDE)	netCDF	SNPP
VIIRS Binary Snow Cover	VIIRS Binary Snow Cover	VIIRS Binary Snow Map	netCDF	SNPP
VPW	VIIRS Polar Winds	VIIRS Polar Winds	[BUFR], netCDF	SNPP
GVF	Green Vegetation Fraction	VIIRS Green Vegetation Fraction	netCDF, GRIB2	SNPP
NTCP	Microwave Tropical Cyclone Products	Microwave Tropical Cyclone Products	netCDF, TXT, PNG	SNPP
VHP	Vegetation Health Products	VIIRS Vegetation Health Products	netCDF	SNPP
GAASP Day 1	GCOM-W1 AMSR2 Algorithm Software Processor	AMSR 2 Microwave Brightness Temperature (MBT), Total Precipitable Water (TPW), Cloud Liquid Water (CLW), Precipitation Type/Rate (PT/R), Sea Surface Temperature (SST), Sea Surface Wind Speed (SSW)	netCDF, BUFR	GCOM-W1
Active Fire	Active Fire	VIIRS Active Fire	netCDF	SNPP

Current NDE 1.0 Operational Summary

- NDE Operational System (PE1) is performing as expected (> 99.9%).
- NDE Operational System (PE1) is the largest single distribution system within ESPC (legacy network) – utilizes ~35-40% of the internal network resources.

	Sep 2013 (Initial operations)	**Today**
Number of users (subscriptions)	3 (12)	34 (411)
Total Data Ingest*	~70 TB	~117 TB
Production Success*	99.9%	99.9%
Distribution Success*	99.5%	99.9%
Total Distributed Data Size*	~10 TB	~35-40 TB

Statistics are based on a 30-day period.

PDA Status

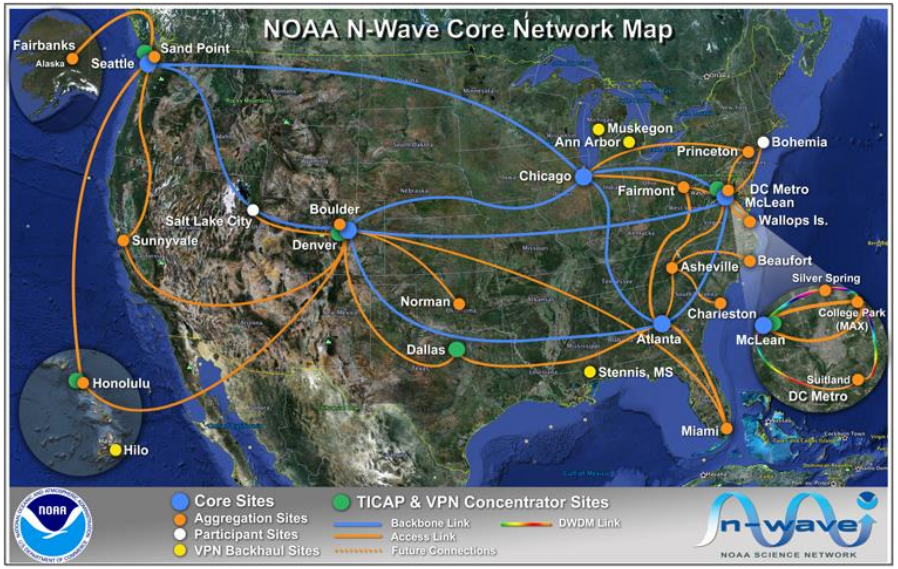
- Primary PDA interface is functioning as designed; this interface serves the vast majority of users including KPP interfaces.
- The highest priority data consumers have been integrated and are in the process of understanding the system (i.e. such as tailoring functionality, subscription usage, etc) – external user training has been provided.
- A specialized NWS web service interface (PDA OGC-like web services / AWIPS Data Delivery) is continuing to mature – this specialized service represents a paradigm shift in terms of direct distribution expansion for NWS only.
- NDE 1.0 (current system) is under freeze for new users integration, product changes or new products – waiver must be approved by senior management.
- Preparations for transitioning to new ground segment have been underway for 15+ months
- 1st PDA ORR was conducted on July 20/21, 2016; 2nd ORR scheduled for mid-Nov.

PDA Validation Testing

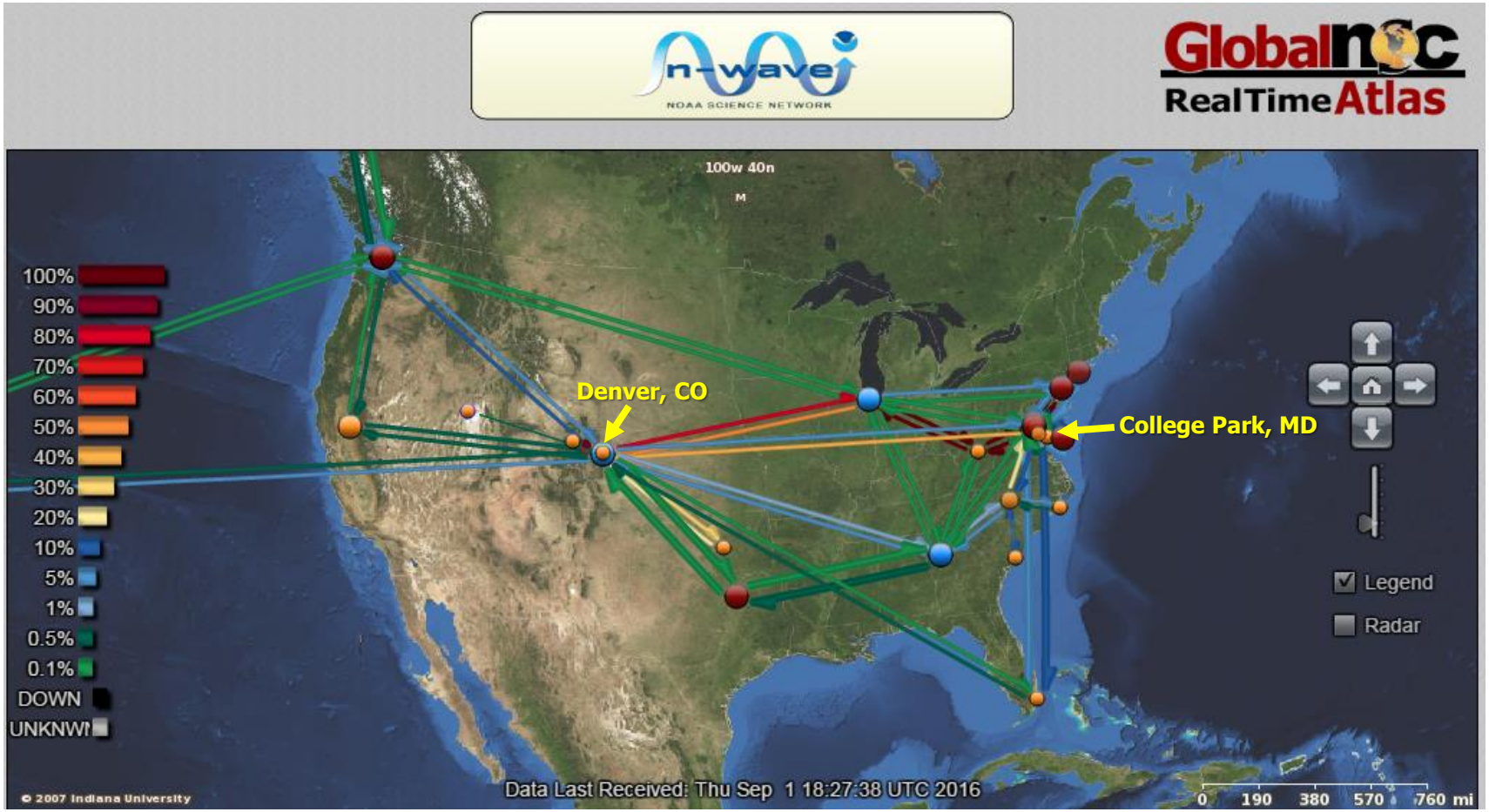
- Systems completed verification testing and 1st phase of validation testing is completed.
- 2nd phase of validation will be completed in mid-September.
- Successfully received and delivered simultaneous long duration data flows from JPSS and GOES-R programs.
  - 21 day dataflow from JPSS to PDA
    - major test objectives were executed based on 18 days of available data
  - DOE-4 dataflow from GOES-R to PDA
    - Successful delivery of simulated GOES-R data from Wallops to PDA interface.
    - Standing PDA subscriptions were successfully fulfilled.
    - A developing NWS interface called OGC/AWIPS-DD was also tested with partial success, issues are actively being worked.

NOAA-EUMETSAT Communications Roadmap

- Initiative is well underway to increase trans-Atlantic communications capacity between NOAA/NESDIS and EUMETSAT.
- Leads are: NESDIS/ACIO and EUMETSAT Network Team
- Objective is to use NWAVE/internet2 and GEANT (high speed R&D networks) for large data transport. Goal is to establish a 5 Gbps secure VPN tunnel to TICs in College Park and Denver.
- H/W is installed at CP-MAX and Denver
- Circuit contracts in place with GEANT
- Performance characterization tests are ongoing
- EUMETcast terrestrial multicast already flowing to test client receiver located at STAR (College Park)

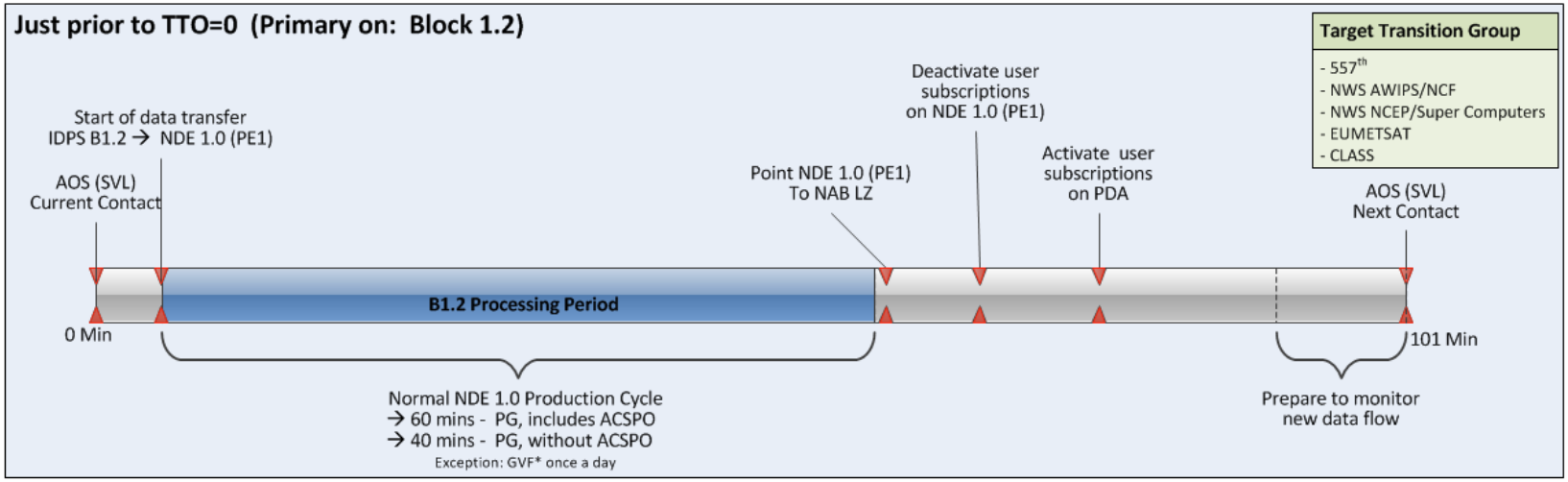


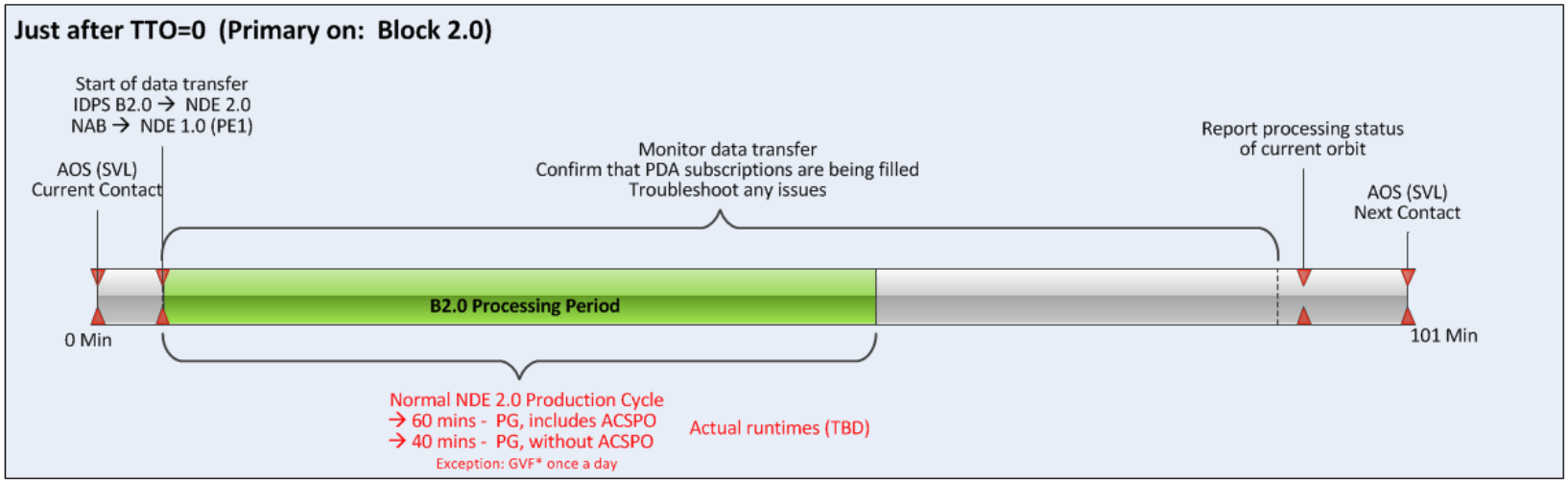
NWAVE Network – Real Time Atlas



http://carto.nwave.noaa.gov/www/atlas.cgi?map_name=Nwave%20New

Ground Segment Data Ops Transition





*Note: GVF runs once a day at approximately 02:00Z and takes 5-6 hours.