FAA NAS Enterprise Architecture –

Informing Future Challenges in V&V

Presented at: **2010 V&V Summit**

Date: **October 13, 2010**

Program Lifecycle

Concept
Research
Demos/Prototypes
Shortfall/Business Case
Alternatives/Analysis
Preferred Solution
Solicitation
Competition
Vendor Selection
Negotiations
Specification
SOW
Requirements/Design/Approval
Development
Integration / Test / Non-Interference
Operational Evaluations
LR Negotiations
Deployment/Installation
Training
Site Acceptance
Operational Acceptance
IOC
FOC
Benefits Realized ☺

V&V Considerations ??

Program Lifecycle AMS

- Corporate Mission Analysis
- Service Analysis
- Concept & Requirements Definition Readiness Decision
- Concept & Requirements Definition
- Investment Analysis Readiness Decision
- Investment Analysis
- Investment Decision
- Solution Implementation
- In-Service Decision
- In-Service Management

AMS Phase	Milestone	Description	FAA WBS	Average Durations (in weeks)
Mission analysis (Svc Anal & CRD)	S1	Readiness for concept and requirements definition decision	WBS 1 Mission Analysis	34
...				
Investment Analysis (Initial)	S6	Preliminary Exhibit 300 program baseline attachment 2: business case analysis report (BCAR) approved	WBS 2.1.2 : Initial Investment Decision - Analysis	41
...				
Investment Analysis (Final)	S10	System contract specification approved	WBS 2.2.2 : Final Investment Decision - Analysis	32
...				
Solution Implementation	S20	Contract Award	WBS 3.1.2 : Contract and Grant Management	
...				
Solution Implementation	S24	Critical design review (CDR) completed	WBS 3.2.3 : Solution Development - Analysis, Design, and Integration	
...				
Solution Implementation	S31	Operational test & evaluation ((OT&E) completed	WBS 3.5.1: System Development Test and Evaluation	
...				
Solution Implementation	S43	In-Service Decision	WBS 4.1.1 : Program Planning, Authorization, Management and Control	104 * to 208+ (Varies by Program)
...				
Solution Implementation	S47	First-site Commissioning	WBS 4.7 : Joint Acceptance Inspection/Commissioning/Closeout	
...				
In-Service Management	S53	Last-site commissioning	WBS 4.7 : Joint Acceptance Inspection/Commissioning/ Closeout	

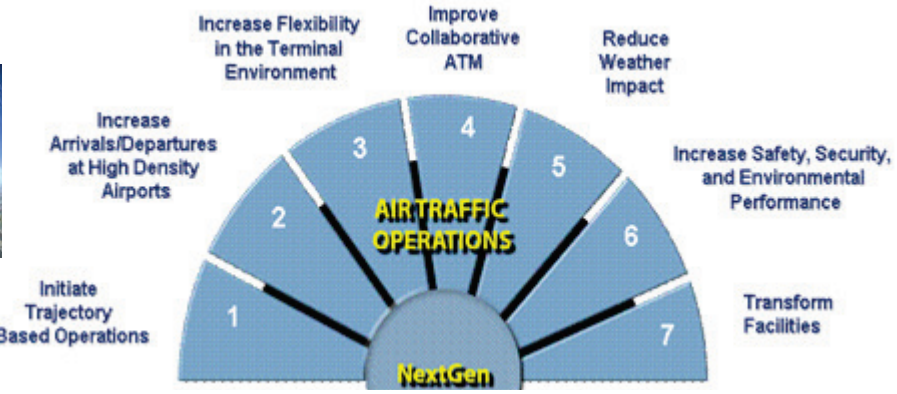
211 to 315+

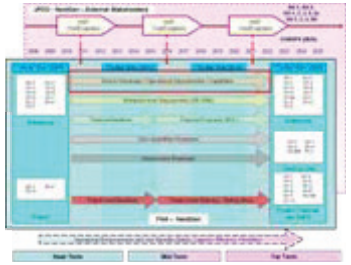
* Assumes Contract Award is sole source, rather than by competitive selection.

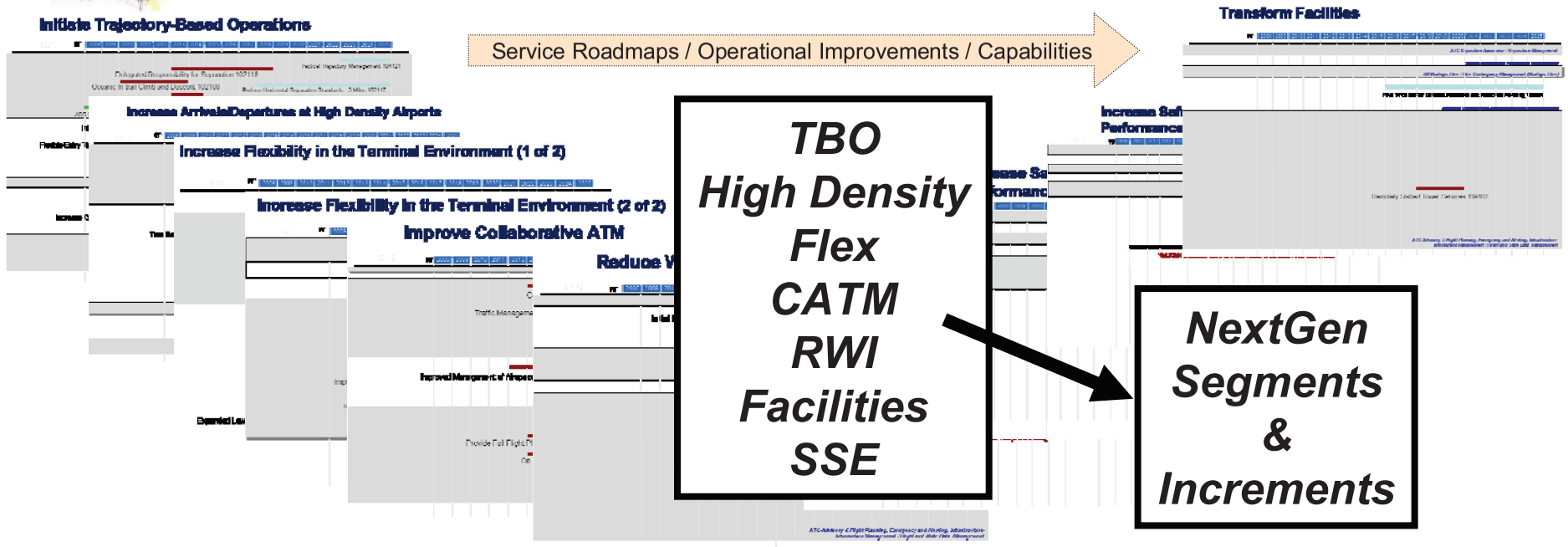
Thoughts…

- Previous charts identify complexities for a single investment…
- Now, add multiple programs together into a portfolio (or set of portfolios)…
- Movement towards enhanced interoperability between the flight deck and the ground systems…and external customers/Agencies…
- Throw in a push towards Service Oriented Architectures, Common Services, Net-Centricity…(future – cloud computing, etc…)
- Analyze the ISS and Safety Issues…
- *Now we have some real challenges for V&V…*

Service Roadmaps – Solution Sets

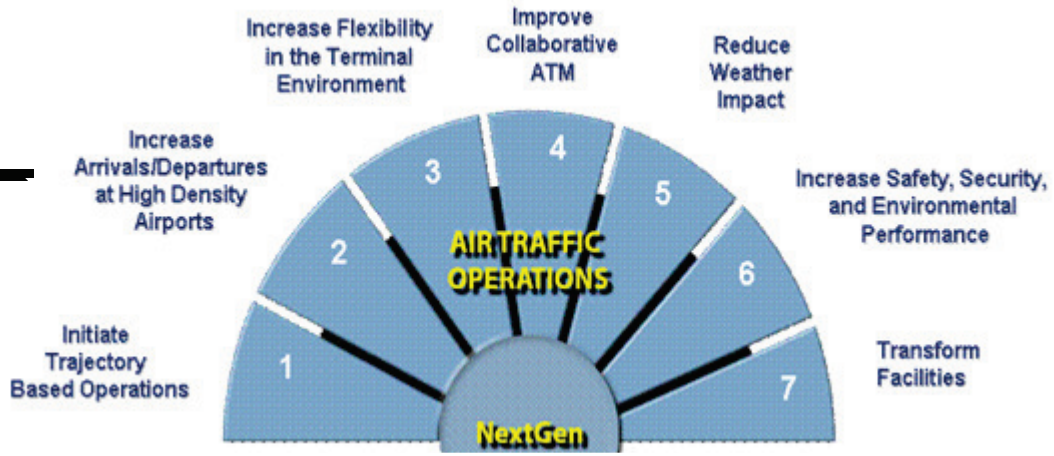




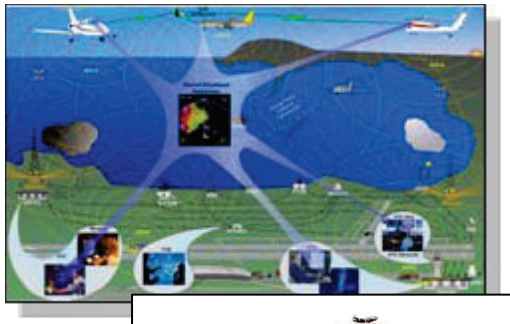


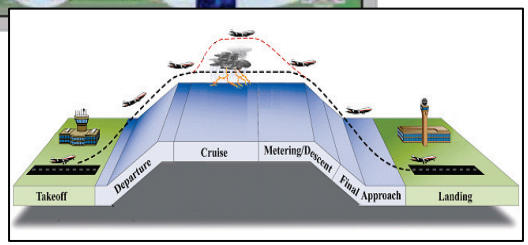
NextGen Key Capabilities

Seven (7) Solution Sets address and deliver *Capacity, Efficiency, Safety and Security* benefits for air transportation operations

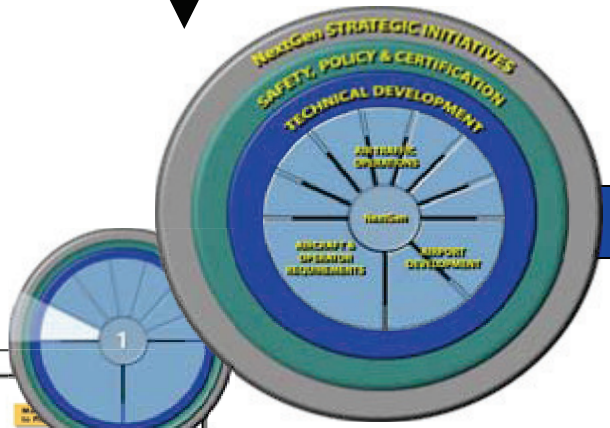


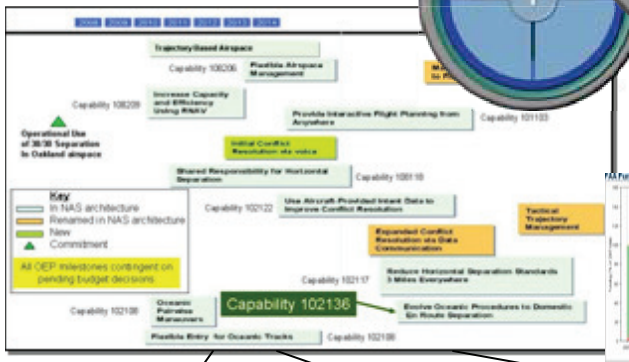
NASEA

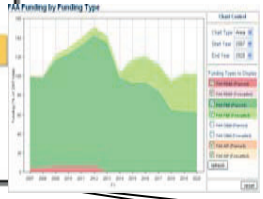




Service Roadmaps





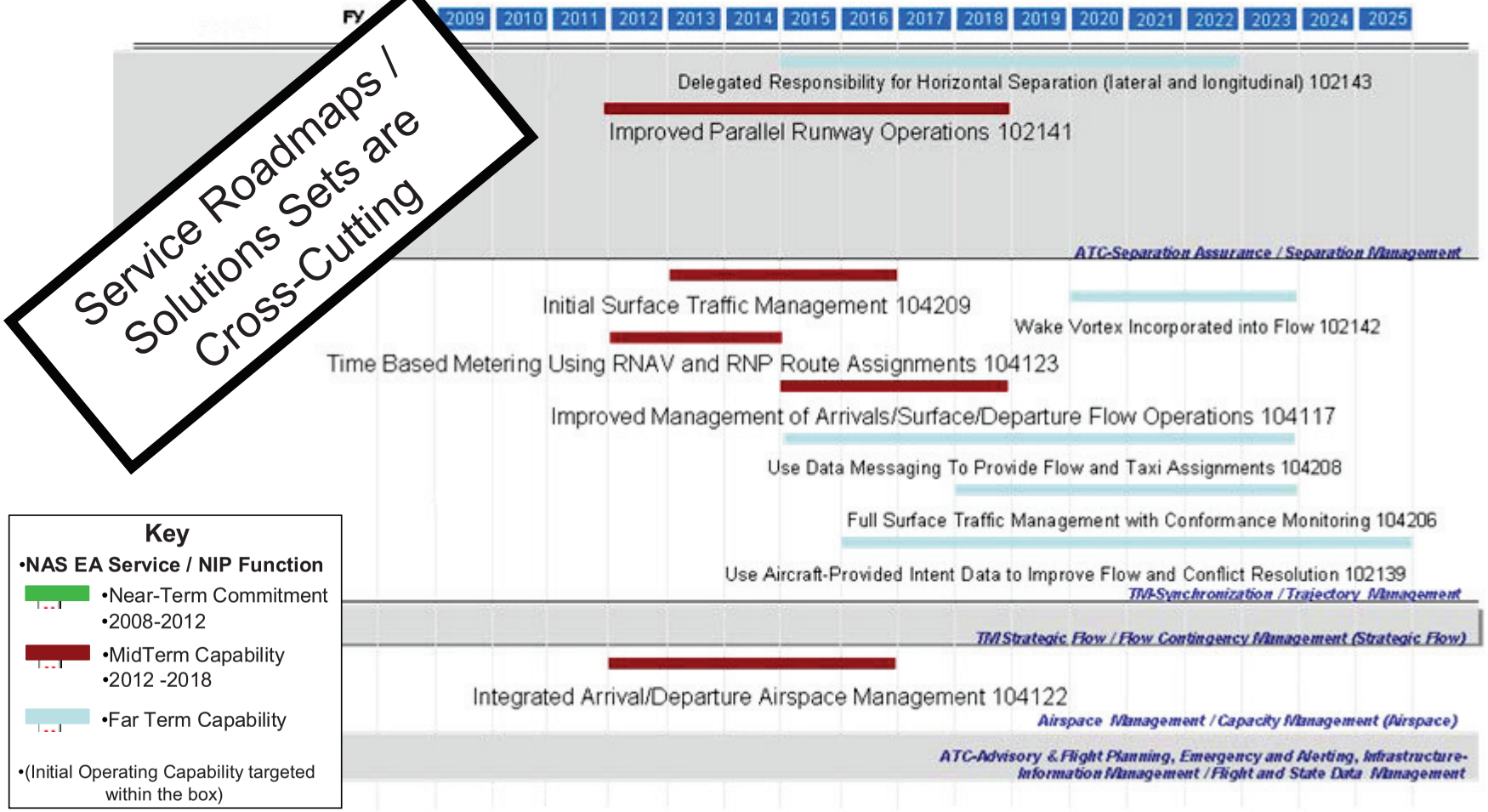


Programs

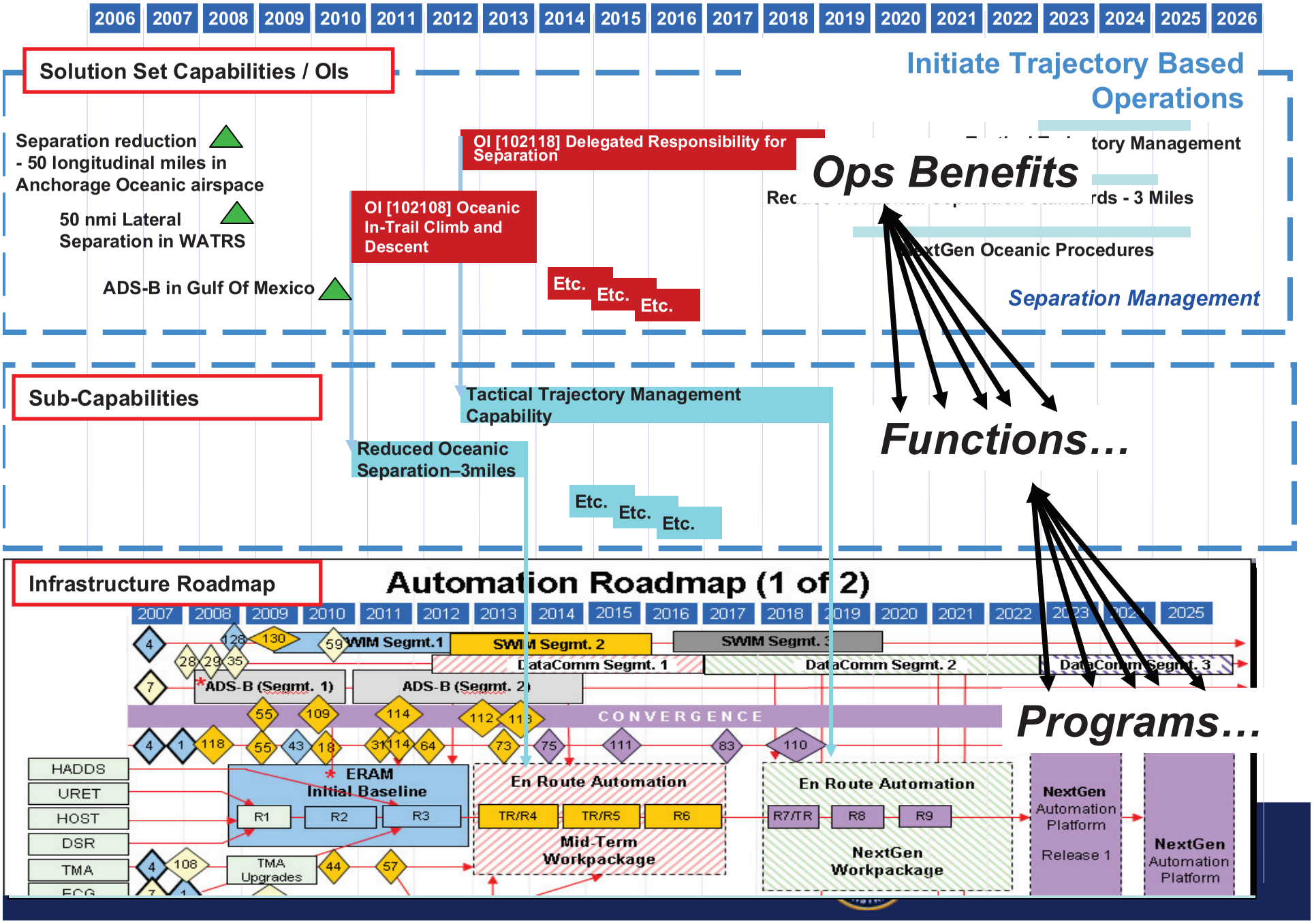
En Route Automation Modernization (ERAM)	*NextGen Collision Avoidance System*	*NextGen Traffic Flow Management*	*SWIM*	*Aeronautical Data Link*

Service Roadmaps / Operational Improvements / Capabilities

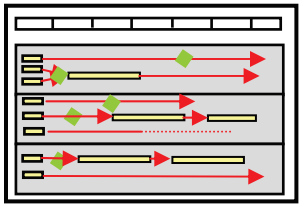
Increase Arrivals/Departures at High Density Airports



Sample OI/Capability to Sub-capability to Infrastructure Roadmaps Mapping

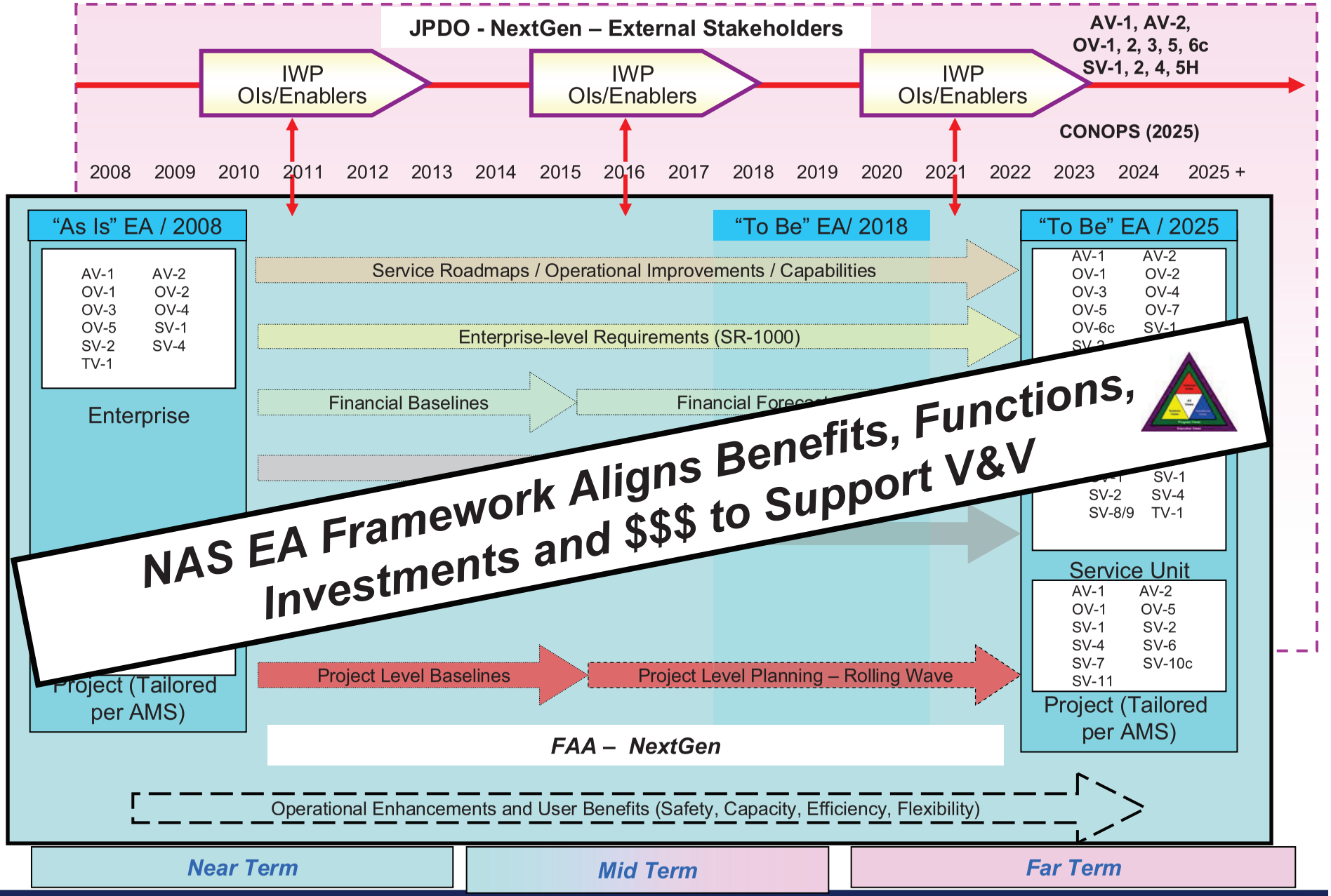


Infrastructure Roadmaps Refresher



- **Infrastructure Roadmaps are…**
  - Used to define the FAA's plan for enterprise level system, sub-capabilities, and project evolution over time – they are updated annually
  - It provides the integrated decisions and synchronized investments needed to deliver NextGen and evolve the NAS (technology, policy, strategy, training, procedures, research, etc.)
- **NAS EA Roadmaps:**
  - **Aircraft**, **Automation**, **Air-to-Ground**, **Airspace & Procedures**, **Communications**, **Facilities**, **Navigation**, **Surveillance**, **Weather**, **Enterprise Services**, **Human Systems Integration**, **Security**, **Safety**, **Airports**
  - Roadmaps capture decision points (and major milestones), assumptions, and depe
  - Infrastructure Roadmap NextGen Solution Set C
  - The EA Roadmaps cap AVS, etc. – all stakeholders are involved

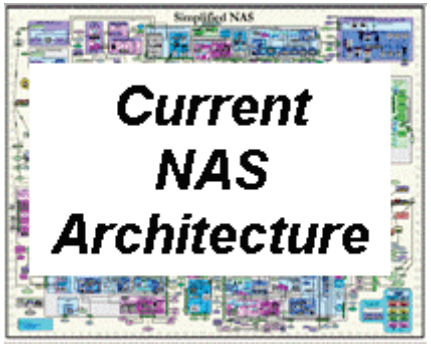
Roadmaps Organized by Function - Identify Cross Organization and System Complexities

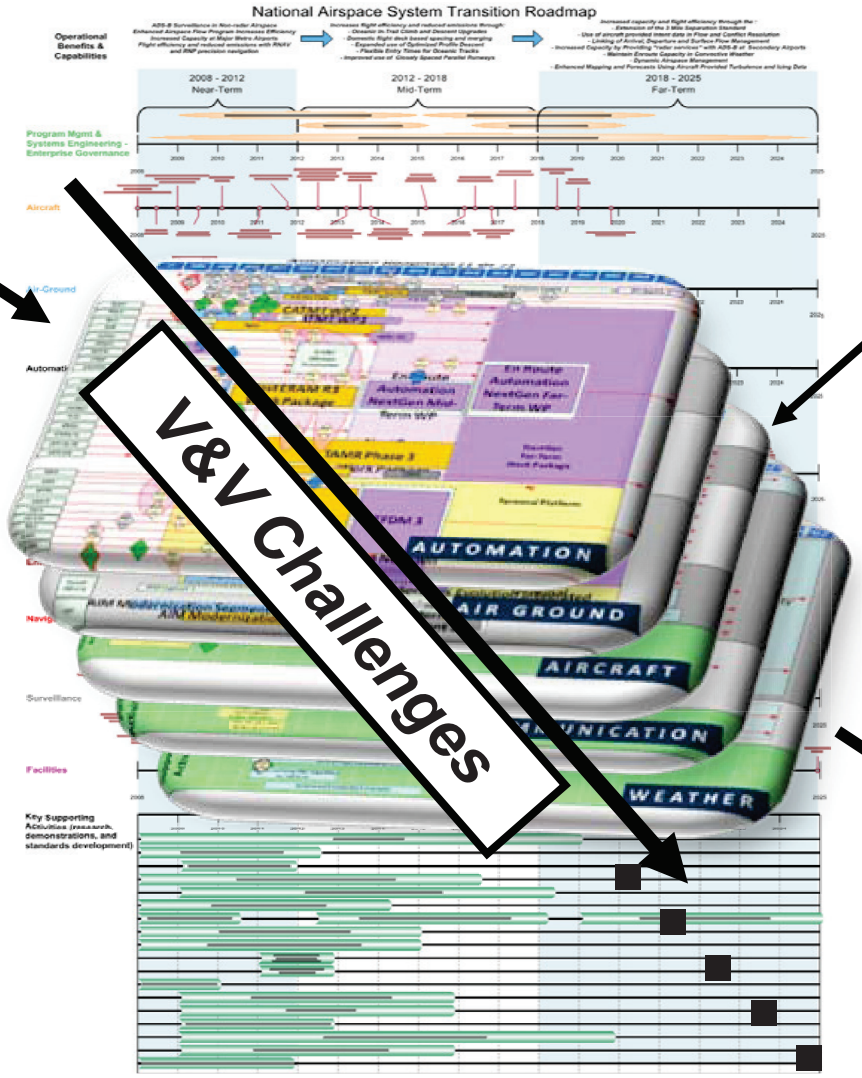


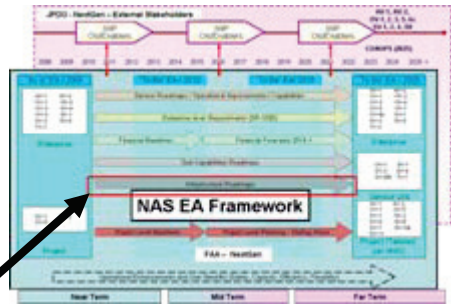
NAS EA Framework Aligns Benefits, Functions, Investments and $$$ to Support V&V

NAS EA Roadmaps Capture the Evolution Strategy

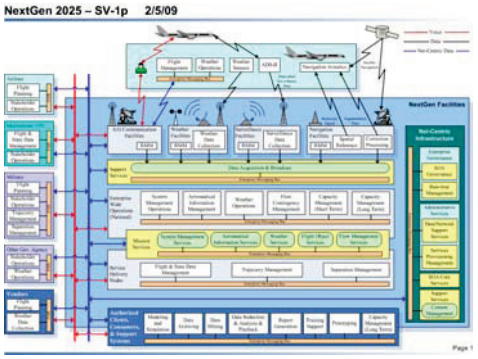
Current
2009

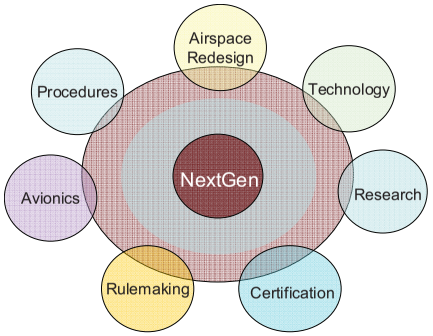




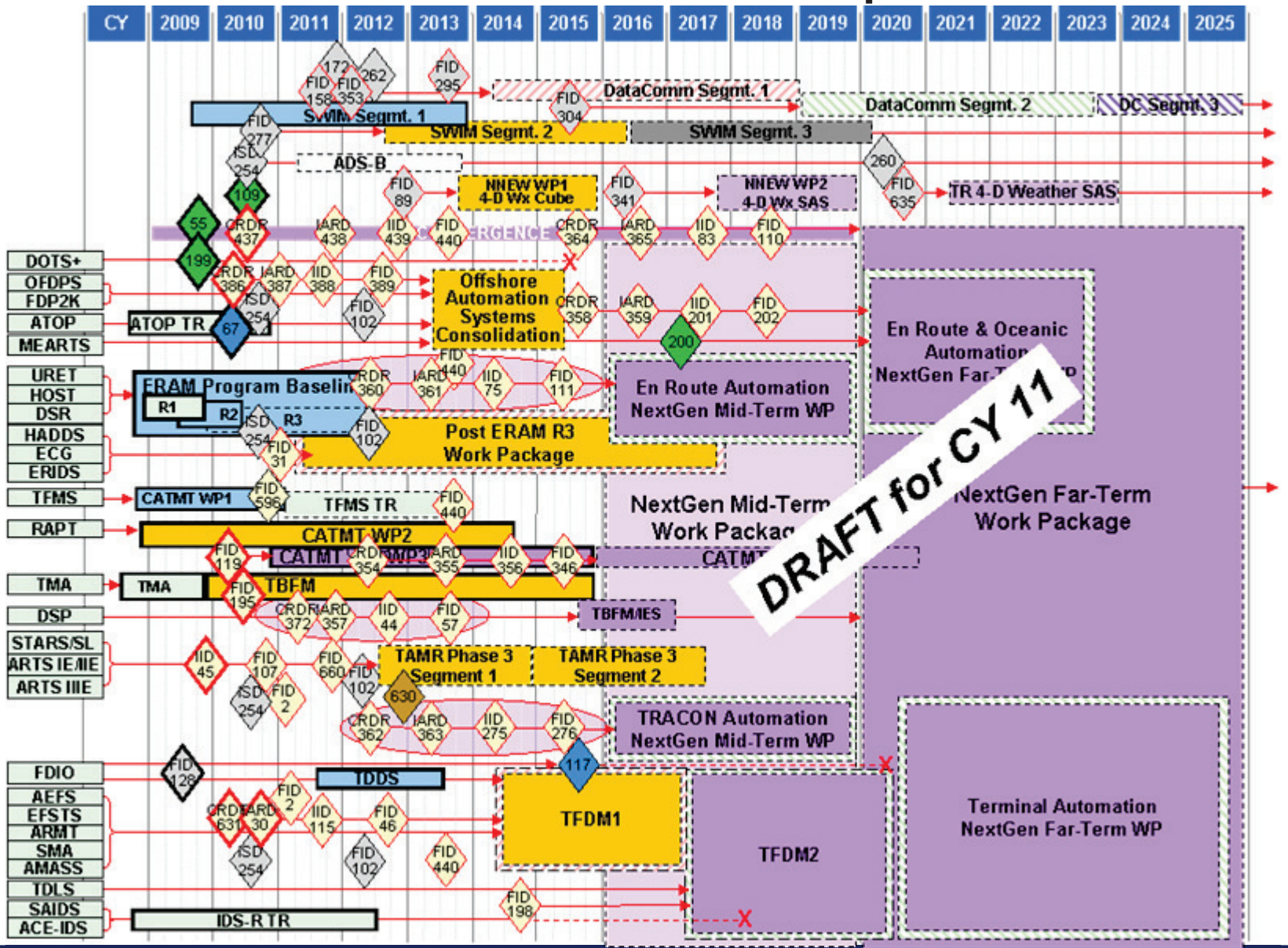


NextGen
2025+

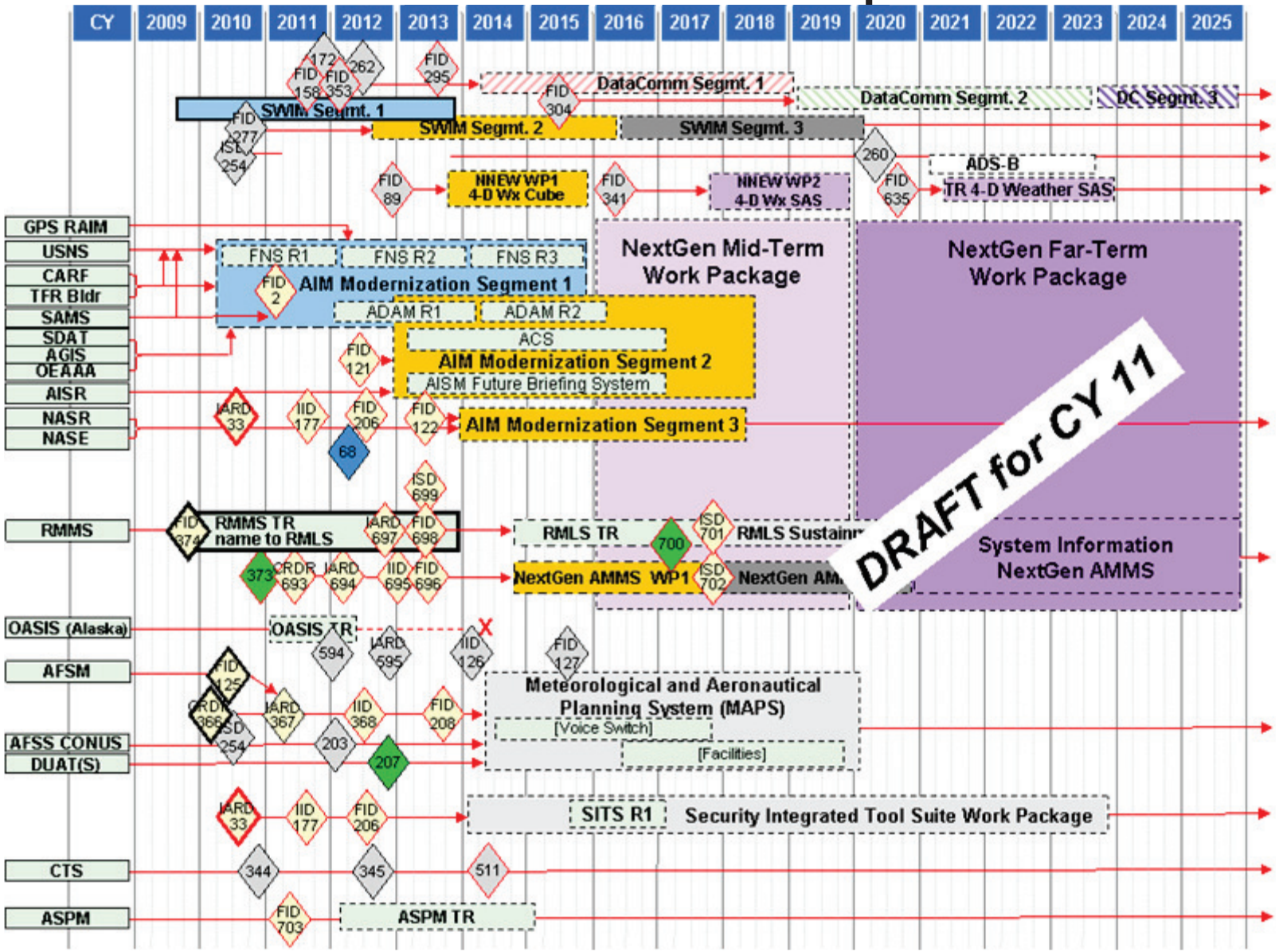




Automation Roadmap

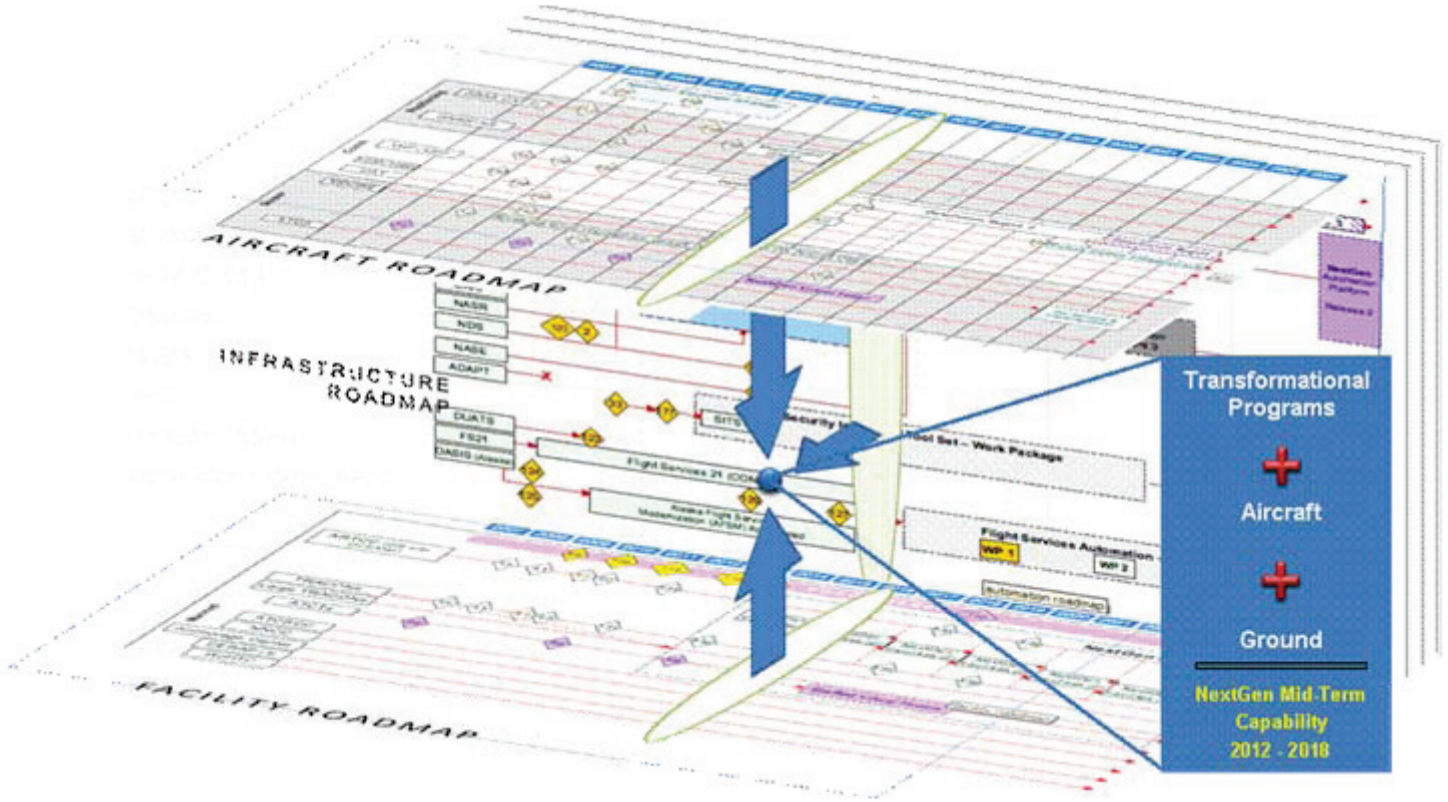


Automation Roadmap

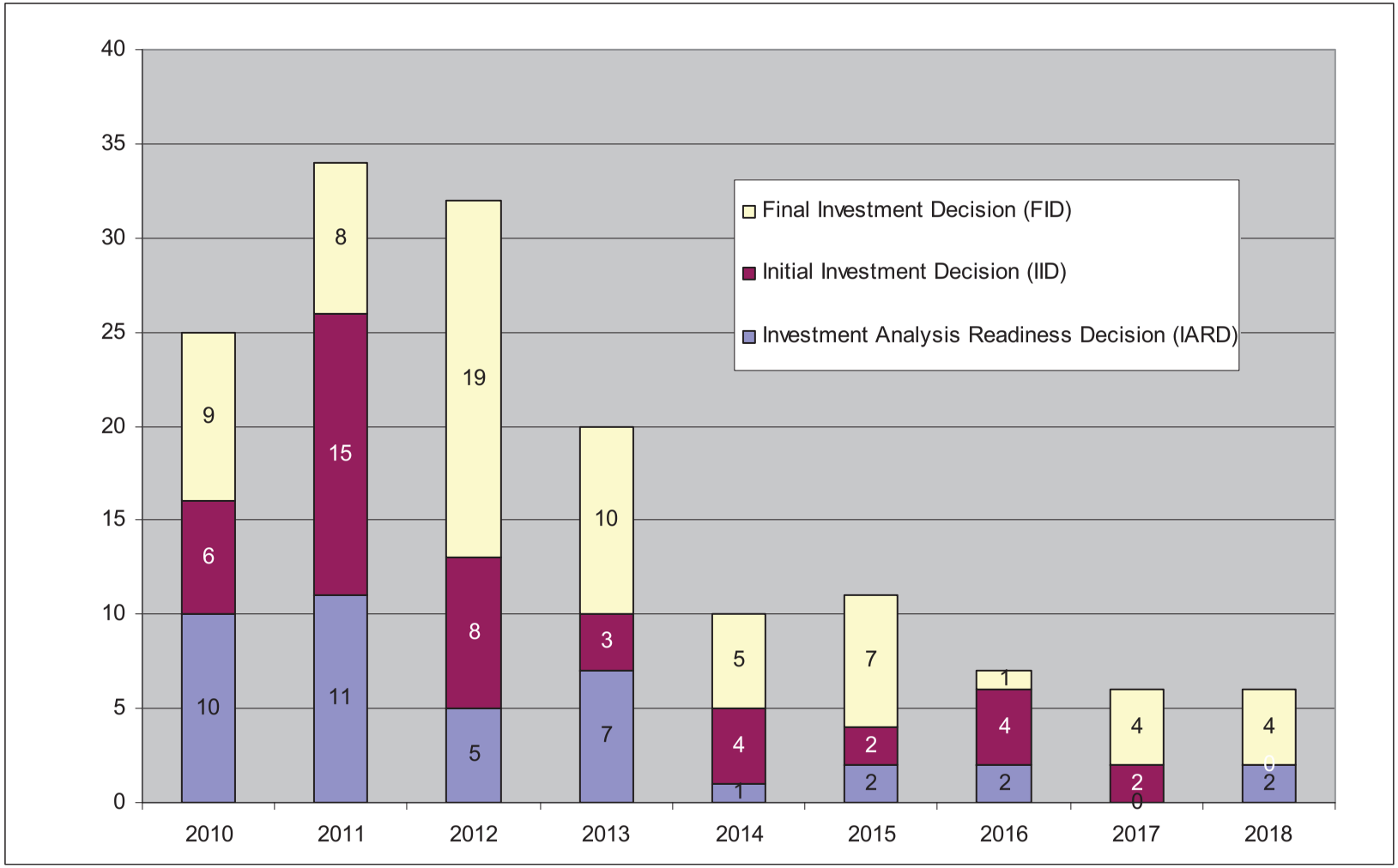


Cross Roadmap Complexity

- **NAS EA Database has *448 DPs* that are shared across roadmaps**

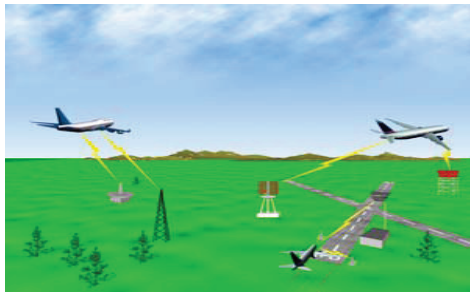


AMS Bandwidth Challenges



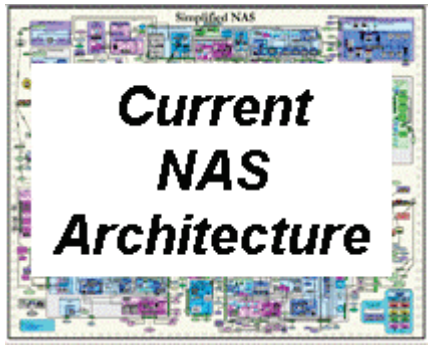
Architecture Views Frame the Evolution of the NAS

Current 2008



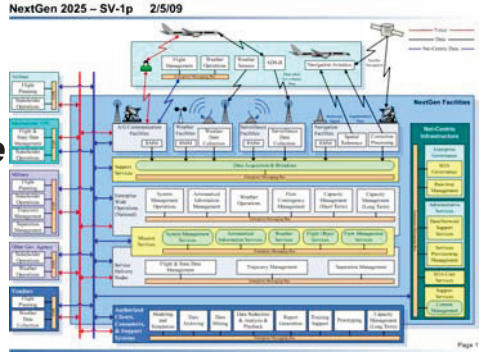
Ops Concepts

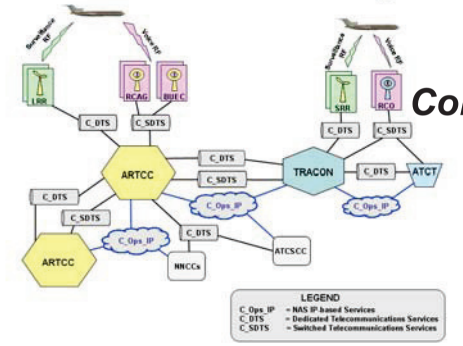
OV-1



System Architecture

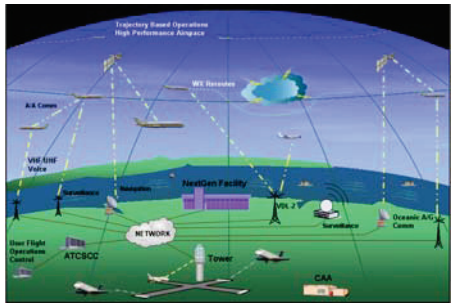
SV-1



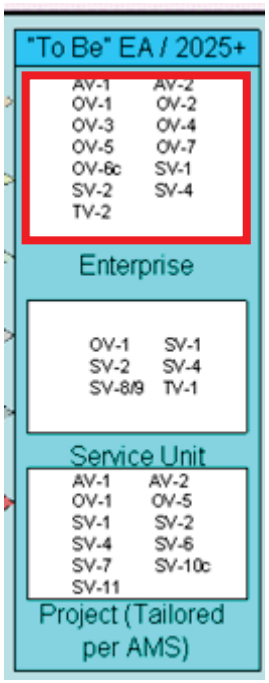


Communications Systems

SV-2



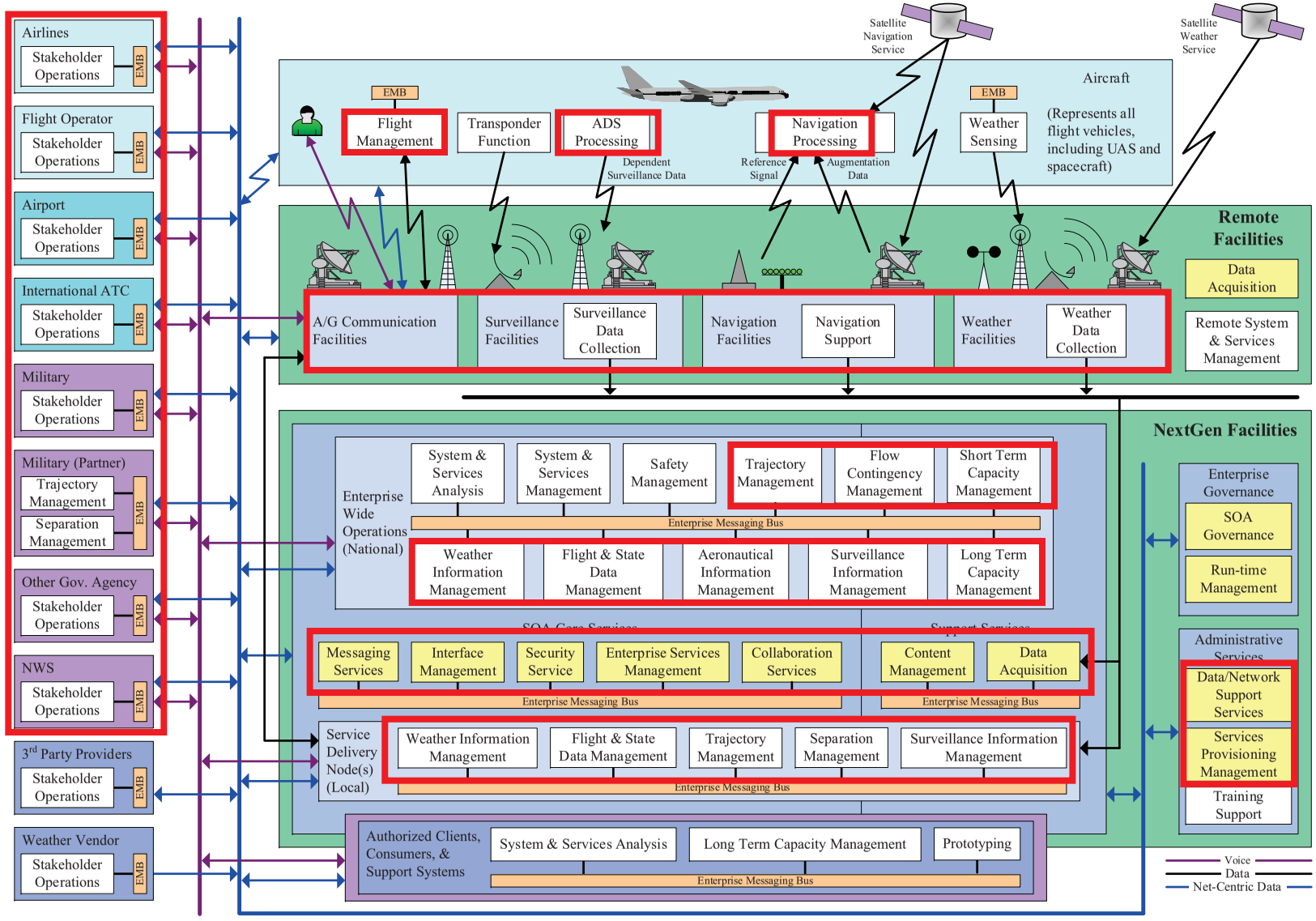
NextGen 2025+



other EA views too…

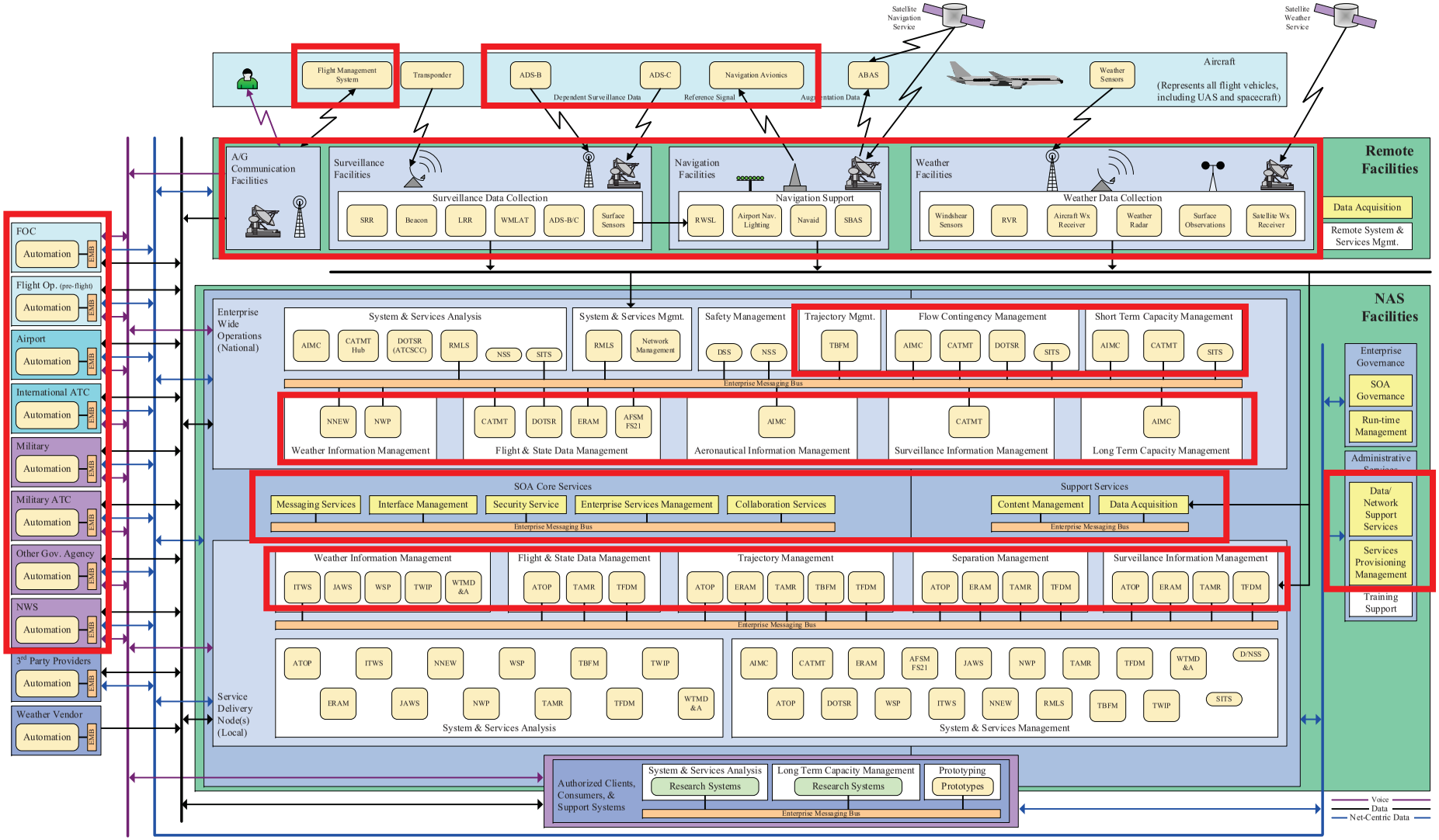
NextGen System Context Diagram (SV-1) for 2025

TBO

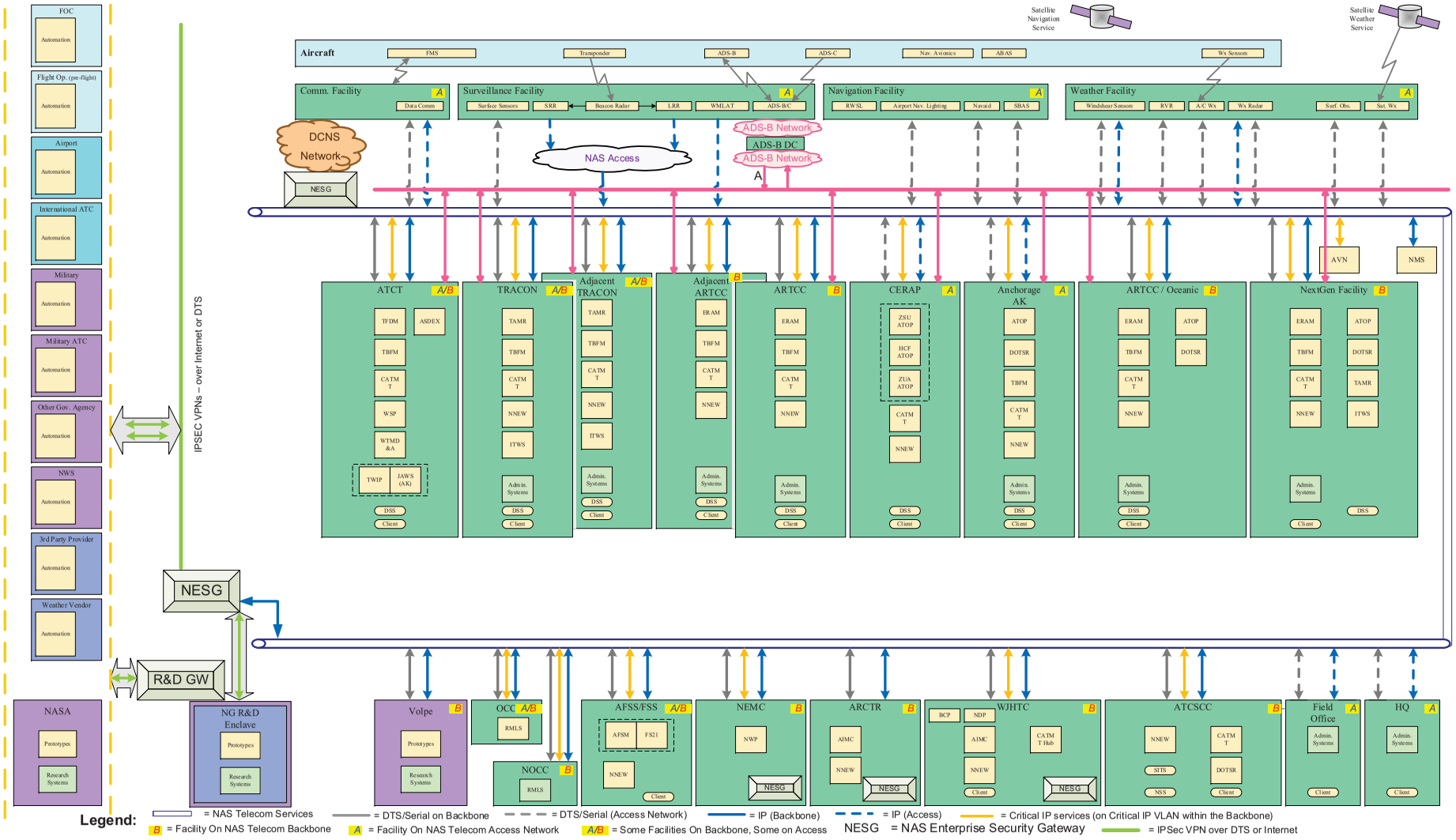


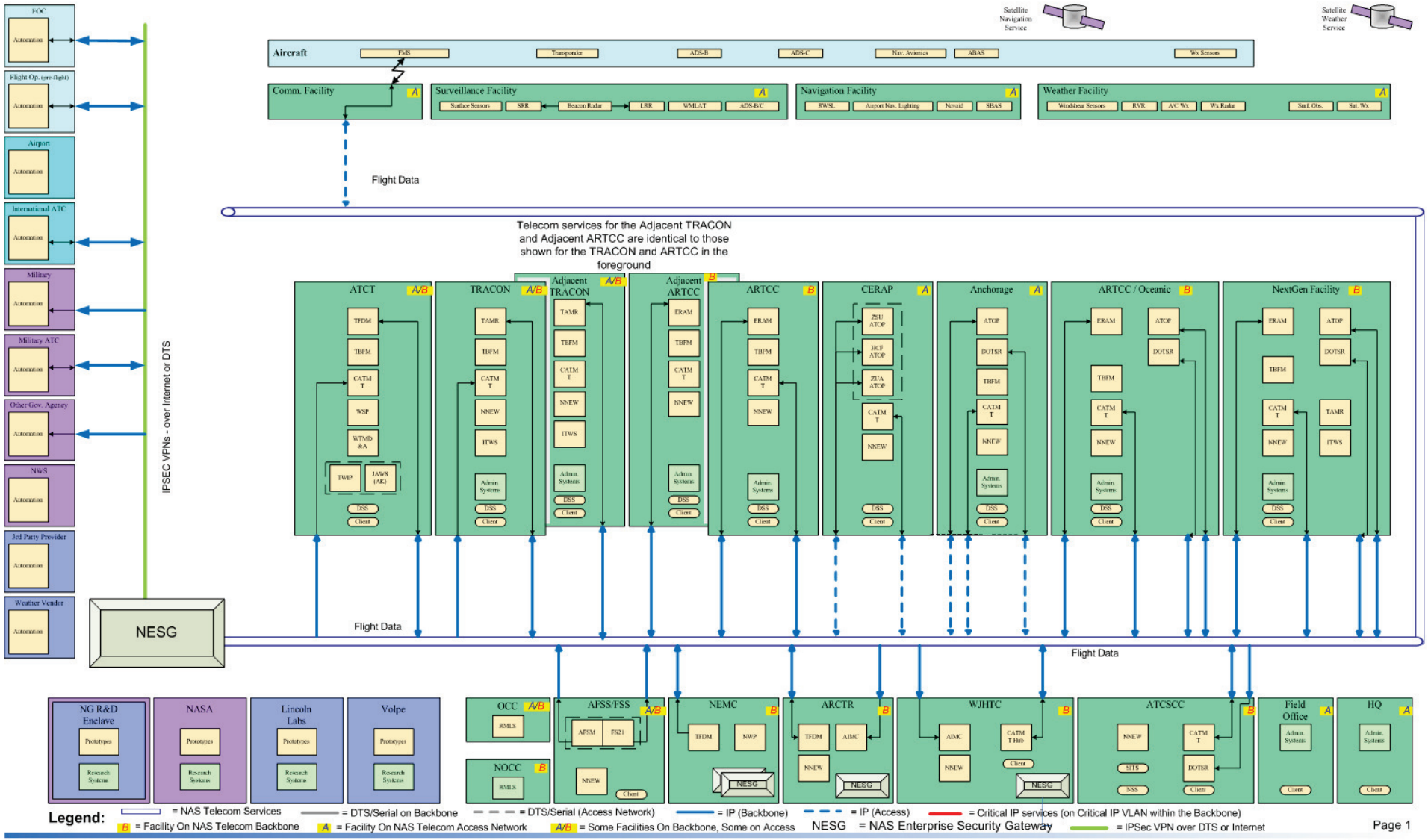
NextGen System Context Diagram (SV-1) for 2018

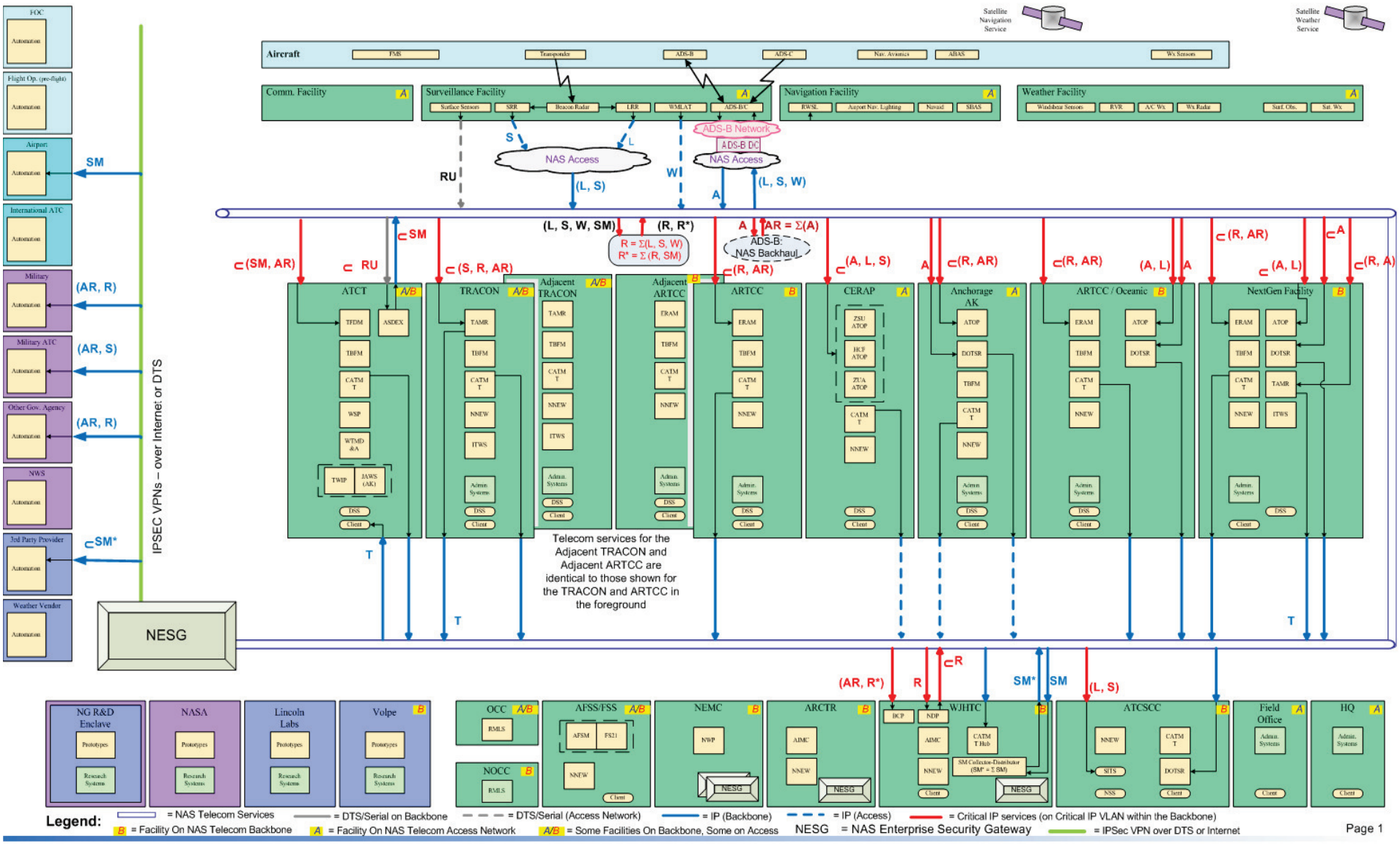
TBO



NextGen Overall Information Flow Communications Diagram (SV-2) for 2018




FOC
Flight Op. (pre-flight)
Airport
International ATC
Military
Military ATC
Other Gov. Agency
NWS
3rd Party Provider
Weather Vendor
Automation
IPSEC VPNs - over Internet or DTS
NESG
Satellite Navigation Service
Satellite Weather Service
Aircraft
FMS
Transponder
ADS-B
ADS-C
Nav. Avionics
ABAS
Wx Sensors
Comm. Facility
Surveillance Facility
Surface Sensors
SRR
Beacon Radar
LRR
WMLAT
ADS-B/C
Navigation Facility
RWSL
Airport Nav. Lighting
Navaid
SBAS
Weather Facility
Windshear Sensors
RVR
A/C Wx
Wx Radar
Surf. Obs.
Sat. Wx
Flight Data
Telecom services for the Adjacent TRACON and Adjacent ARTCC are identical to those shown for the TRACON and ARTCC in the foreground
ATCT A/B
TRACON A/B
Adjacent TRACON A/B
Adjacent ARTCC B
ARTCC B
CERAP A
Anchorage A
ARTCC / Oceanic B
NextGen Facility B
TFDM
TBFM
CATM T
WSP
WTMD &A
TWIP
JAWS (AK)
TAMR
NNEW
ITWS
ERAM
ATOP
DOTSR
ZSU ATOP
HCF ATOP
ZUA ATOP
Admin. Systems
DSS
Client
Flight Data
Flight Data
NG R&D Enclave
NASA
Lincoln Labs
Volpe
Prototypes
Research Systems
OCC A/B
NOCC B
RMLS
AFSS/FSS A/B
AFSM
FS21
NNEW
NEMC B
NWP
NESG
ARCTR B
AIMC
WJHTC B
CATM T Hub
ATCSCC B
SITS
NSS
Field Office A
HQ A
Legend:
= NAS Telecom Services
= DTS/Serial on Backbone
= DTS/Serial (Access Network)
= IP (Backbone)
= IP (Access)
= Critical IP services (on Critical IP VLAN within the Backbone)
B = Facility On NAS Telecom Backbone
A = Facility On NAS Telecom Access Network
A/B = Some Facilities On Backbone, Some on Access
NESG = NAS Enterprise Security Gateway
= IPSec VPN over DTS or Internet
Page 1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SM
(AR, R)
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SM*
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RVR
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Wx Radar
Surf. Obs.
Sat. Wx
ADS-B Network
ADS-B DC
NAS Access
NAS Access
S
L
W
A
RU
(L, S)
(L, S, W)
(L, S, W, SM)
(R, R*)
R = Σ(L, S, W)
R* = Σ(R, SM)
A
A = Σ(A)
ADS-B NAS Backhaul
⊂(SM, AR)
⊂ RU
⊂SM
⊂(S, R, AR)
⊂(R, AR)
⊂(A, L, S)
A
⊂(R, AR)
⊂(R, AR)
(A, L)
A
⊂(R, AR)
⊂A
⊂(A, L)
⊂(R, A)
ATCT
TRACON
Adjacent TRACON
Adjacent ARTCC
ARTCC
CERAP
Anchorage AK
ARTCC / Oceanic
NextGen Facility
TFDM
ASDE-X
TBFM
CATM T
WSP
WTMD &A
TWIP
JAWS (AK)
TAMR
NNEW
ITWS
Admin. Systems
DSS
Client
ERAM
ZSU ATOP
HCF ATOP
ZUA ATOP
ATOP
DOTSR
T
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(AR, R*)
R
⊂R
SM*
SM
(L, S)
NG R&D Enclave
NASA
Lincoln Labs
Volpe
Prototypes
Research Systems
OCC
NOCC
RMLS
AFSS/FSS
AFSM
FS21
NEMC
NWP
ARCTR
AIMC
WJHTC
BCP
NDP
CATM T Hub
SM Collection-Distributor (SM* = Σ SM)
ATCSCC
SFTS
NSS
Field Office
HQ
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= DTS/Serial (Access Network)
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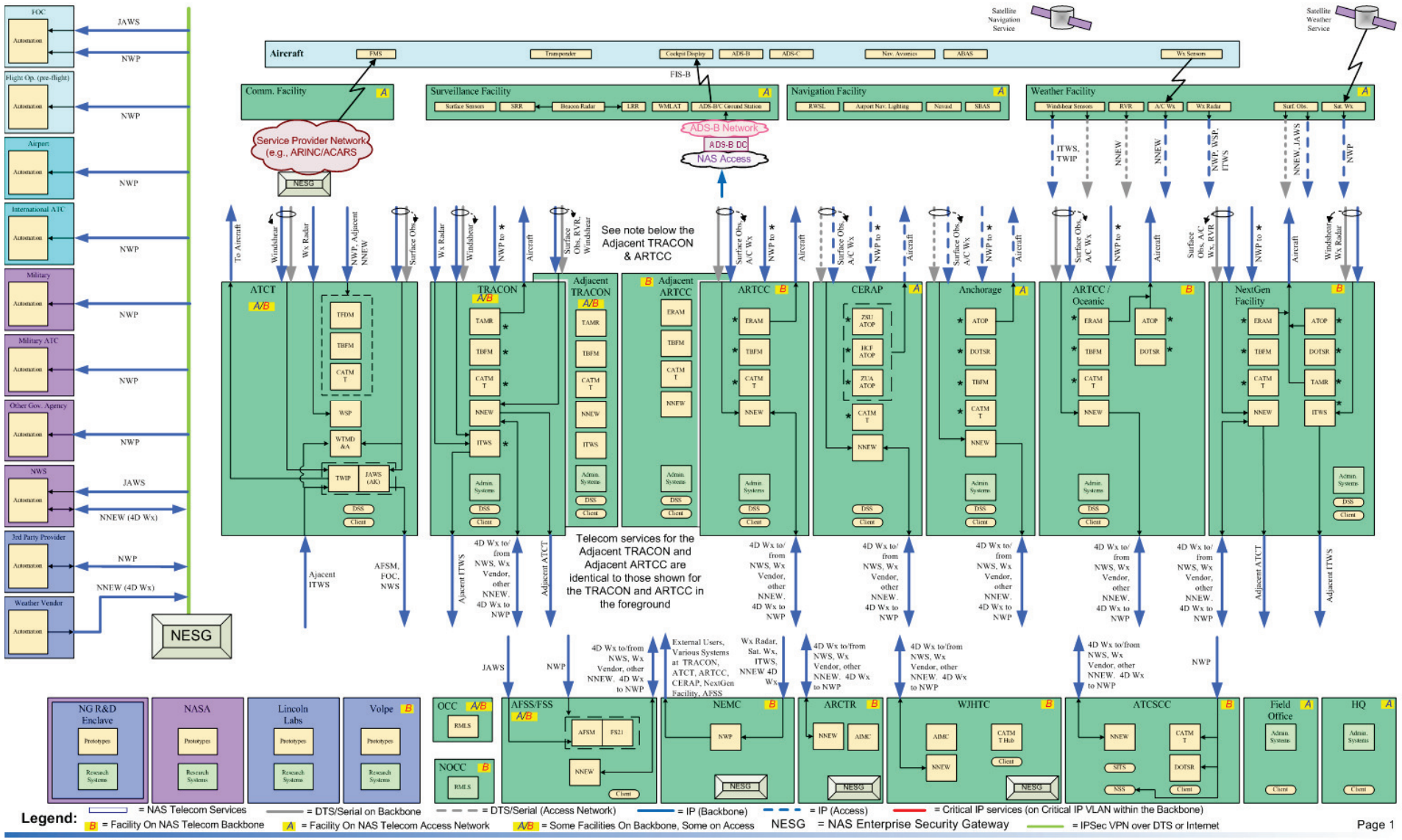
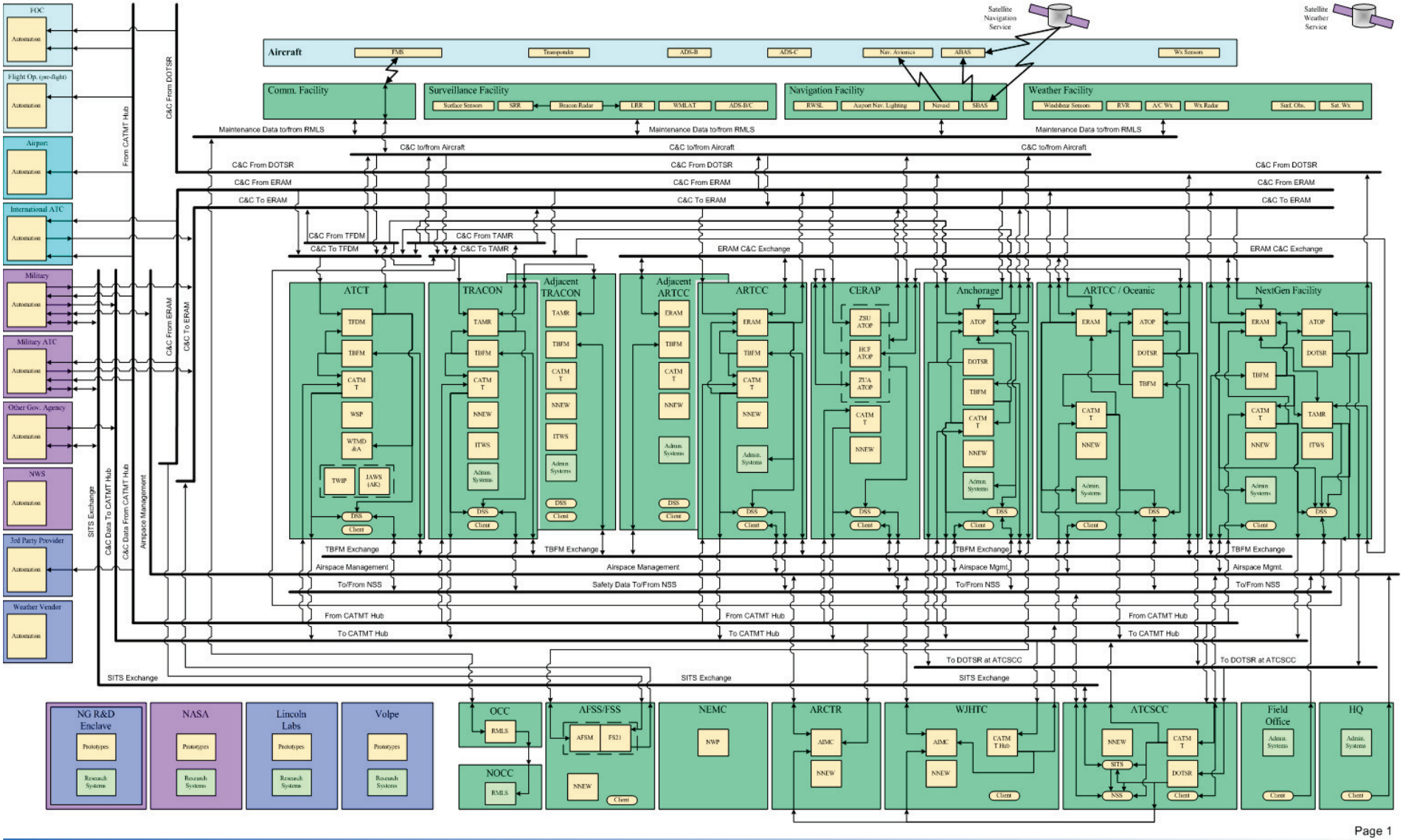
Page 1

NextGen 2018 SV-2 Weather Information Flow Communications Diagram 12/31/09

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NWS
3rd Party Provider
Weather Vendor
Automation
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ADS-B
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Navaid
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Weather Facility
Windshear Sensors
RVR
A/C Wx
Wx Radar
Surf. Obs.
Sat. Wx
Maintenance Data to/from RMLS
C&C to/from Aircraft
C&C From DOTSR
C&C From ERAM
C&C To ERAM
C&C From TFDM
C&C To TFDM
C&C From TAMR
C&C To TAMR
ERAM C&C Exchange
From CATMT Hub
C&C From DOTSR
C&C From ERAM
C&C To ERAM
SITS Exchange
C&C Data To CATMT Hub
C&C Data From CATMT Hub
Airspace Management
ATCT
TRACON
Adjacent TRACON
Adjacent ARTCC
ARTCC
CERAP
Anchorage
ARTCC / Oceanic
NextGen Facility
TFDM
TBFM
CATM T
WSP
WTMD &A
TWIP
JAWS (AK)
TAMR
NNEW
ITWS
Admin. Systems
ERAM
ATOP
DOTSR
ZSU ATOP
HCF ATOP
ZUA ATOP
DSS
Client
TBFM Exchange
Airspace Management
To/From NSS
Safety Data To/From NSS
From CATMT Hub
To CATMT Hub
To DOTSR at ATCSCC
SITS Exchange
NG R&D Enclave
Prototypes
Research Systems
NASA
Lincoln Labs
Volpe
OCC
RMLS
NOCC
AFSS/FSS
AFSM
FS21
NNEW
NEMC
NWP
ARCTR
AIMC
WJHTC
CATM T Hub
ATCSCC
SITS
NSS
Field Office
HQ

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Complexities…

- Simultaneous investments working their way through AMS will cause strain on V&V resources
- Will need to be diligent in managing interfaces and associated complexities during testing – no longer *simply* V&V of functions, IRDs & ICDs…
- Non-interference testing and focus on ISS, safety issues (i.e., failure modes, etc.), human factors, etc… will be even more important
- Need mechanisms to evaluate system threads and associated testing while systems are being developed to reduce downstream V&V risks

Summary Thoughts…

- Can we test cross cutting benefits using the same methods used in the past for individual system replacements/enhancements?
- How do you test a NextGen solution set?
- Is our existing lab environment going to support NextGen testing?
- How do we test SWIM, Datacomm, ADS-B, the Automation programs, etc… together to validate NextGen benefits?
- Considerations for field deployment and testing; what can the field handle from a test and training perspective?

Take Aways….

- **Need to think about V&V in an evolved way to support NextGen**
- **Need to get started on V&V planning for NextGen now**
- **Address any existing organizational barriers that limit our ability to V&V benefits across the NAS to support NextGen – *when you do work think about not just your piece of the NAS, but what's good for the entire system*…**
- **Leverage lessons learned / best practices from across Industry and Government for V&V strategies of enterprise solutions, net-centric technologies, and for ensuring interoperability**
- ***We can do this…start thinking now about the problem!***

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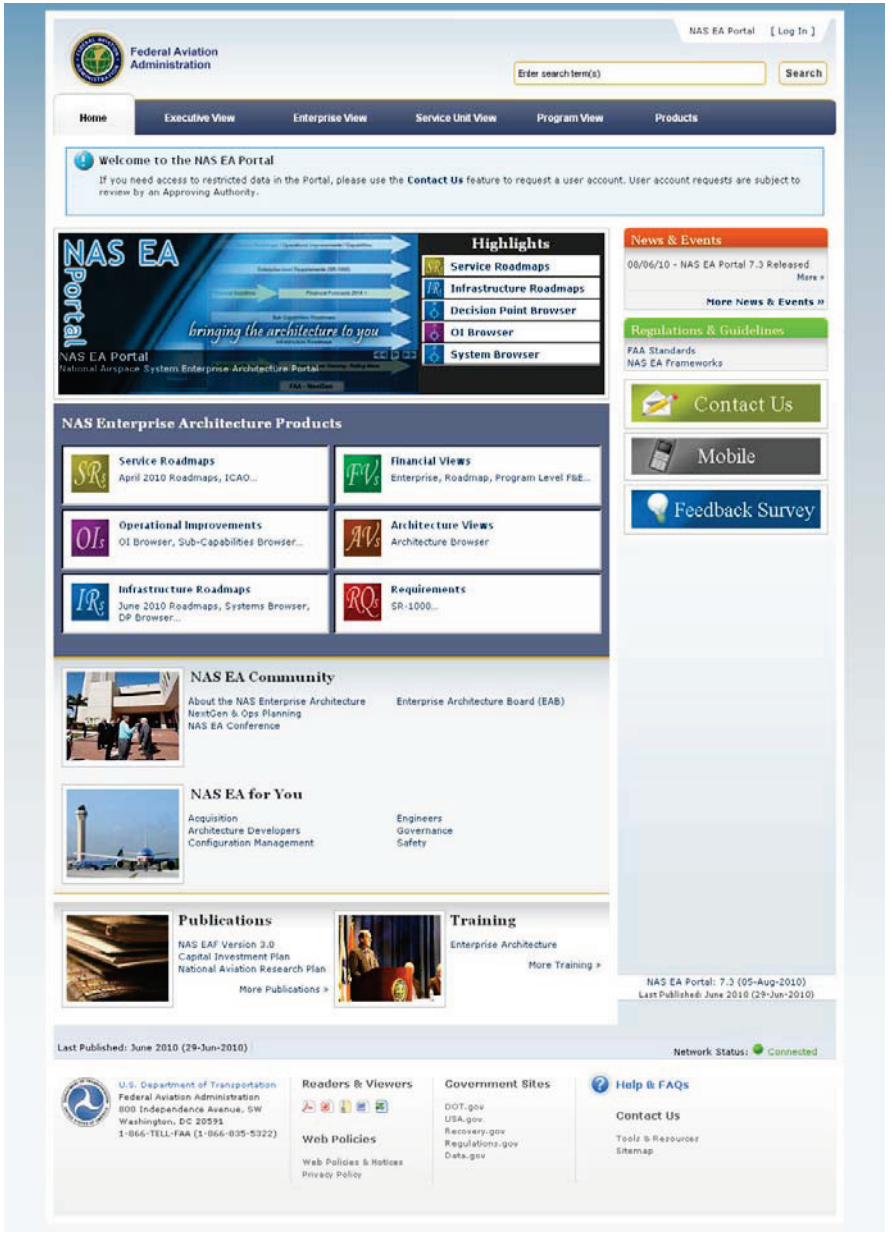
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