



CENTER FOR ADVANCED AVIATION SYSTEM DEVELOPMENT (CAASD)

NextGen and SWIM Evolution in the Mid-term

Presented at ICNS 2009

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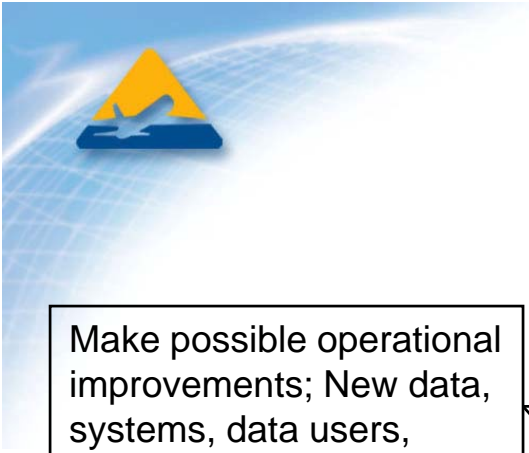
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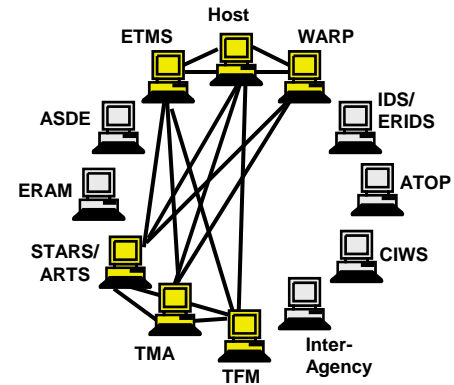
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Vision for SWIM Evolution

Make possible operational improvements; New data, systems, data users, and/or decision makers

High Cost and Complexity of Improvements



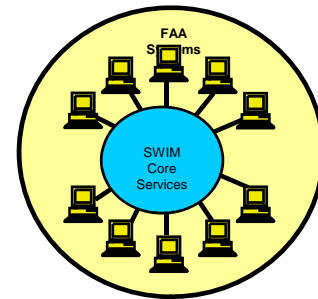
Today's NAS with hard-wired infrastructure and systems

SWIM Segment 1:
Standards-based information exchange among NAS systems

Reduced Cost and Complexity of Improvements

SWIM Segment 2:
Vision: NAS net-centric infrastructure

- SOA infrastructure
- Basic IT infrastructure
 - Security
 - Messaging

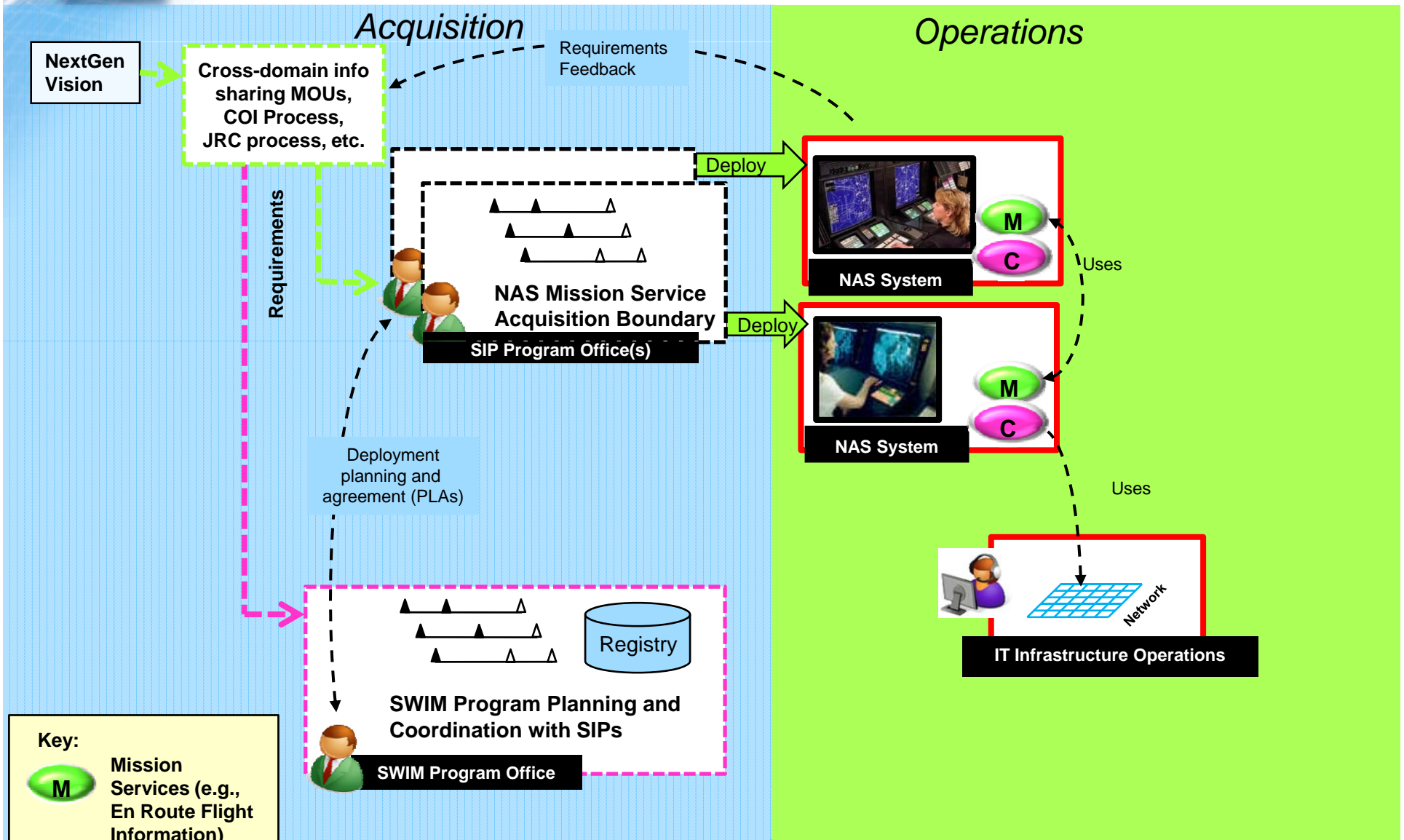


Net-Centric NAS sharing information uniformly

...SWIM Segment N

- Continued evolution of infrastructure
- New capabilities e.g., Air/ground SWIM

SWIM Acquisition and Operations Concepts (Segment 1)

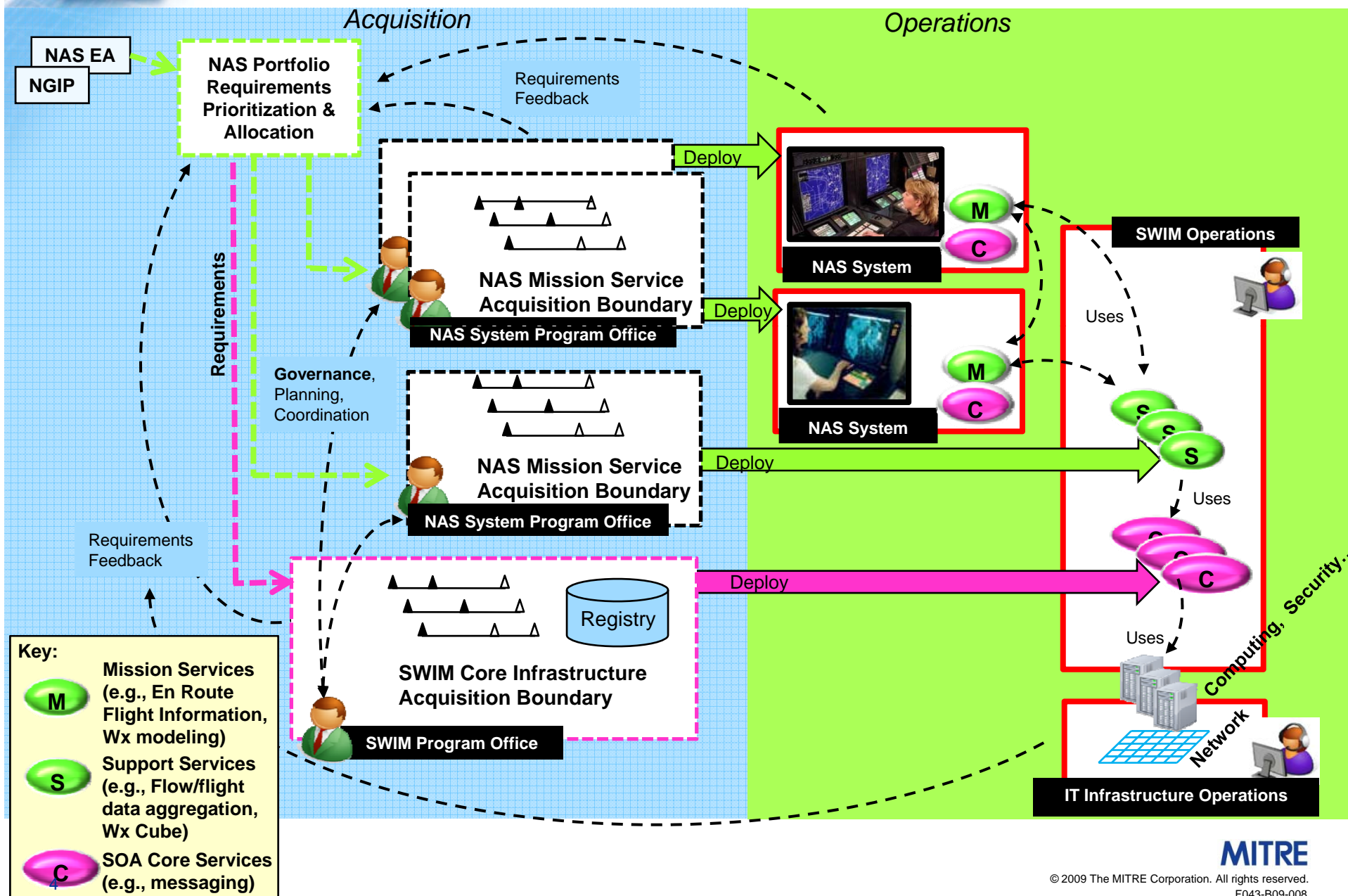


Key:

- M** Mission Services (e.g., En Route Flight Information)
- C** SOA Core Services (e.g., messaging)

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SWIM Acquisition and Operations Concepts (Notional - Segment 2 and Beyond)





NextGen Implementation Plan (NGIP) Solution Sets



NGIP Solution Set	Capabilities with SWIM Need
Initiate Trajectory Based Operations	3
Increase Arrivals/Departures at High Density Airports	2
Increase Flexibility in the Terminal Environment	2
Improve Collaborative ATM	5
Reduce Weather Impact	1
Increase Safety, Security, and Environmental Performance	3
Transform Facilities	TBD



Sample Data and Mission Logic – from Hi-Density Solution Set



Capability: High-Density - Initial Surface Traffic Management (NAS EA OI: 104209)						
Data/Service Provided	Likely Producer	Mission Logic	Possible Contributing Systems	Information Received/ Service Utilized	Receiver/ Consumer	Notes
Aircraft surface position data	ASDE-X	Aircraft surface position data is combined with flight ETAs and STAs to develop collaborative departure schedule to accommodate flight operator preferences.	SDSS, SWIM: Notionally, STBO logic could be implemented using SWIM core ESB capabilities	Aircraft surface position data	Gates and Ramps	SDSS is a functional capability which is planned for implementation without new automation. SWIM core may be an option for some mission logic.
Departure schedule data	EFS			Departure schedule data	ATC: TFM automation, ERAM TRACONS, etc.	
Flight data	ERAM			Flight data		
Departure flow management capabilities	TFM automation (TBD)			Departure flow management capabilities (?)		
ETAs and scheduled times of arrival (STAs)	TMA			ETAs and scheduled times of arrival (STAs)		
Flight operator preferences	Flight operators			Updated pushback times, parking gate assignments, predicted arrival times, etc.	FOCs Aircraft	
Departure schedules	STBO capability			Request for departure sequences and slot swaps	FOC	
Runway assignments	STBO capability					



SWIM Functions Supporting *Initial Surface Traffic Management Capability*

Possible SWIM Contributions (from NGIP ConOps Analysis)	Possible SWIM Functions with Examples
<ul style="list-style-type: none">• Notionally, Surface Trajectory Based Operations (STBO) logic could be implemented using SWIM core ESB capabilities	<p>Basic Messaging:</p> <ul style="list-style-type: none">• Transfer surface position messages, departure schedule data, flight data, flight operator preferences, etc. to STBO service engine (potentially implemented in SWIM core) <p>Message Transformation:</p> <ul style="list-style-type: none">• Transform data from formats (and protocols) provided by disparate legacy surface systems into common message formats and SWIM standard protocols <p>Service Orchestration/Composition:</p> <ul style="list-style-type: none">• Service Components implemented in SWIM ESB provide logic to combine aircraft surface position data with flight ETAs and STAs to develop collaborative departure schedule to accommodate flight operator preferences. <p>Routing:</p> <ul style="list-style-type: none">• Route aircraft gate assignments, etc. to appropriate FOCs based on aircraft identity <p>Security:</p> <ul style="list-style-type: none">• Identify and authorize external systems (FOC) submitting preferences and requesting subscription to surface information updates• Provide boundary protection (gateway) for airspace users connecting to surface information services



Summary of SWIM Core Functions Supporting NGIP Capabilities

NGIP Capability	Basic Messaging (Reliable Messaging Request/Response Publish/Subscribe)	Content Based Routing	Message Transformation	Orchestration/Composition	Web Application Hosting	Collaboration Tools	Security (I&A, Boundary Protection, other)
Flexible Airspace Management	N	P	P			P	N
Initial Conflict Resolution Advisories	N	P	P				N
Point in Space Metering	N	P	P				N
Initial Surface Traffic Management	N	P	P				N
Time Based Metering using RNP and RNAV Route Assignments	N	P	P				N
Improved Management of Airspace for Special Use	N	P	P		P		N
On-Demand NAS Information	N	P	P	P	N		N
SSA & ISS Integrated Incident Detection and Response	N	P	P	P		P	N



N – Needed in SWIM

P – Possibly Needed in SWIM



SWIM Segment 2 Functions Considered for NNEW

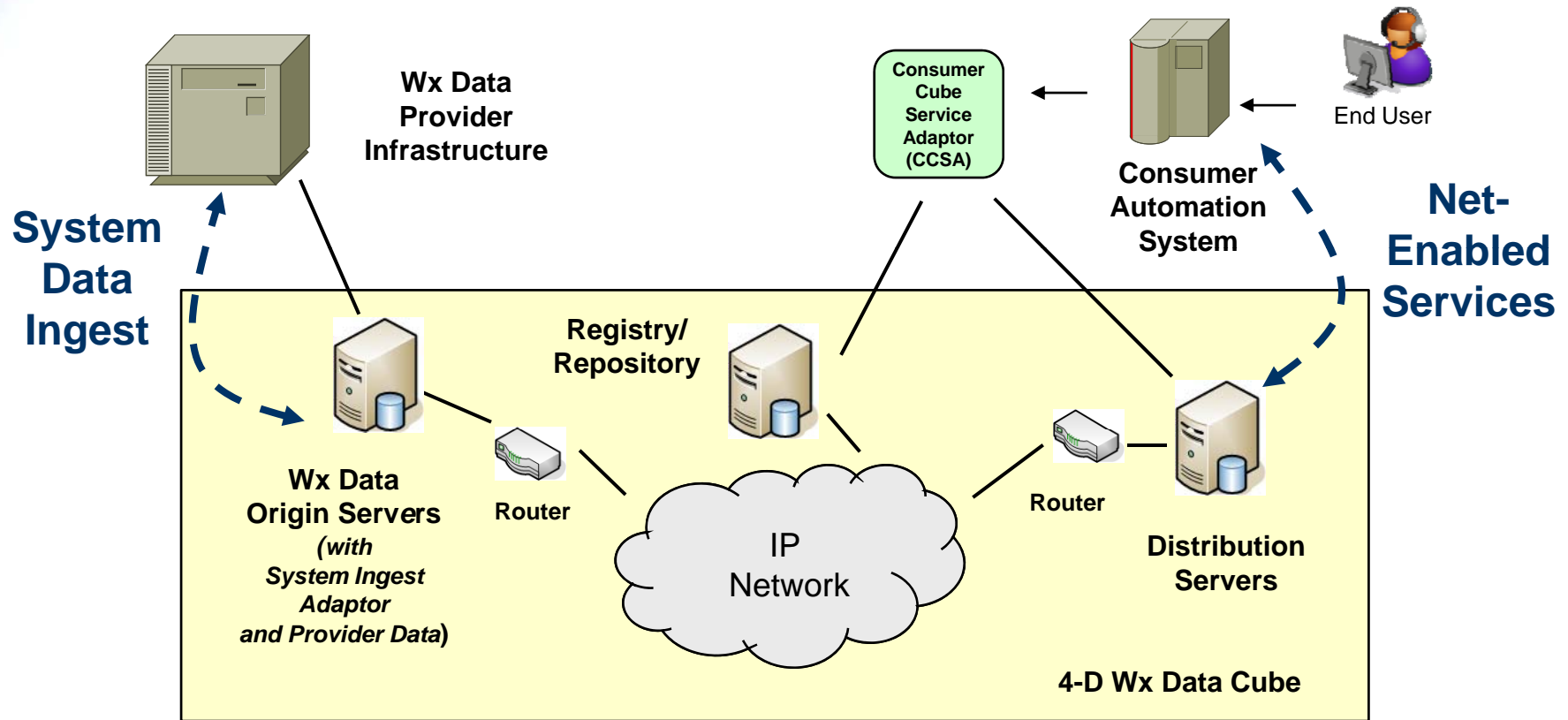
SWIM Core Functionality	NNEW Requirement
Basic Messaging	N
Content Based Routing	P
Message Transformation	P
Orchestration/ Composition	P
Web Application Hosting	N
Collaboration Tools	P
Security	N

P – Possibly Needed in SWIM

N – Needed in SWIM

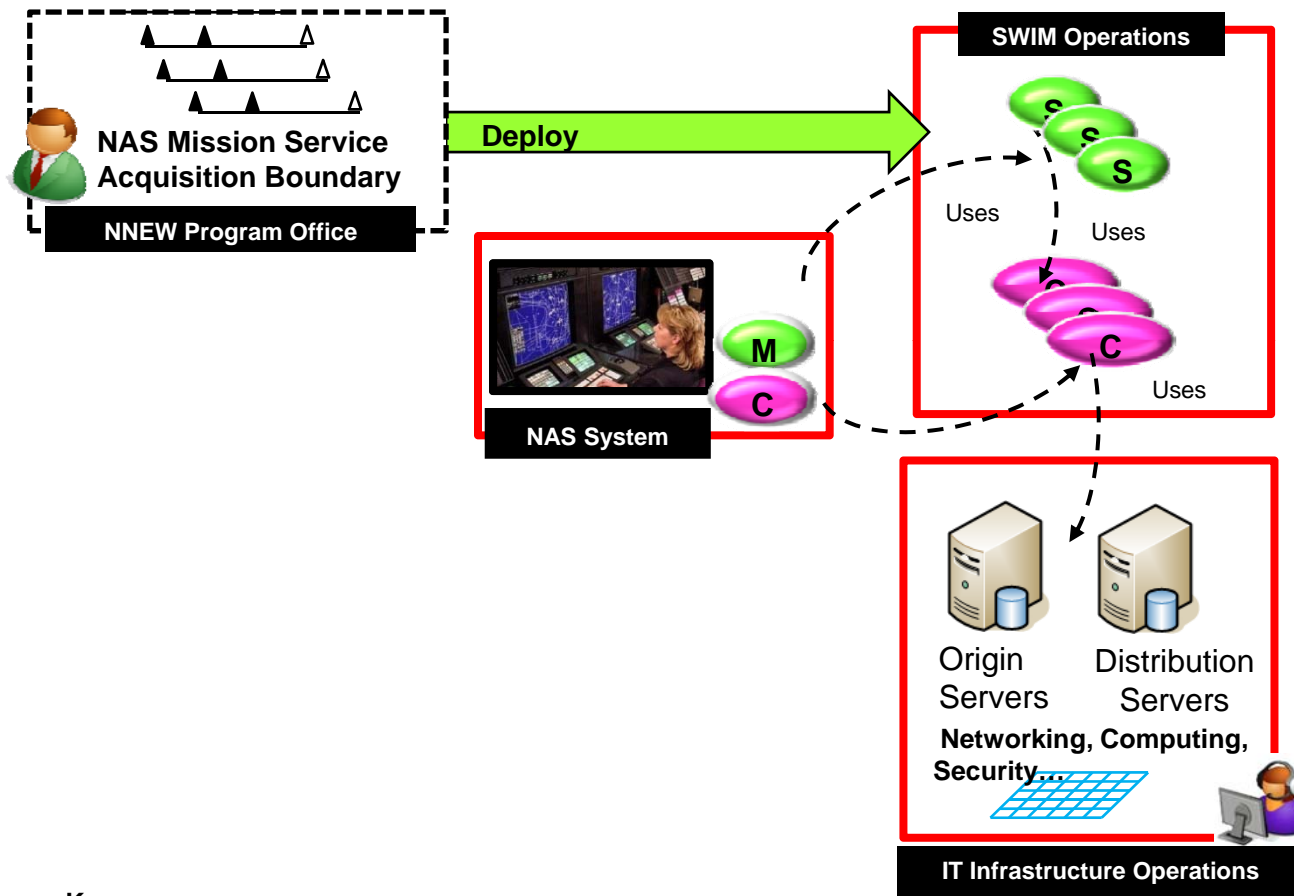


High-Level Architecture for the 4-D Wx Data Cube





Notional NNEW Allocation to the SWIM Core



Key:



M Mission Services
(e.g., En Route Flight Information, Wx modeling)



S Support Services
(e.g., Flow/flight data aggregation, Wx Cube)



C SOA Core Services
(e.g., messaging)



Backup Slides



Sample ConOps Table – from Improved Collaborative Air Traffic Management



Capability: CATM - Provide Full Flight Plan Constraint Evaluation with Feedback (NAS EA OI: 101102)						
Data/Service Provided	Likely Producer	Mission Logic	Possible Contributing Systems	Information Received/ Service Utilized	Receiver/ Consumer	Notes
User preferences (routes, altitudes, and fleet priority)	FOC	Validate and accept intent information Validate and accept flight plans (and updates) Evaluate “What if” requests against conditions that would impact flights	TFMS: Perform trajectory modeling, “what-if” analysis, determine which events affect which flights SWIM: - Identify and authenticate users requesting analyses - Deliver input information to TFMS - Distribute filed flight plans to the appropriate ATC (ERAM) facility - Determine which consumers need to be notified about an affected flight, and deliver notifications	Filed flight plans	ERAM	Most of the mission logic functionality would likely be allocated to TFMS, however some functionality could be allocated to the SWIM Core.
Intent information (and intent modification)				“What if” analysis: current and predicted information for <u>flight along path</u>	FOC	
Flight plan filing (and flight plan modifications)				Notifications of impact to filed or intended flight plans		
Weather	Wx systems	Detect changed conditions that would impact intended or filed flights and notify subscriber				
Traffic Management Initiatives	TFMS					
Airspace information SUA status	AIM	Route filed flight plans to ERAM system at departure ARTCC				
Required a/c performance characteristics	AIM					
Restrictions (LOAs, SOPs, SAA)	AIM					
Terminal status	TDDS					
NAS Status	TBD					



Criteria for Proposing Support Services to the SWIM Core

- **Consistency with NextGen Net-Centric Operations vision and goals, e.g., loose coupling between producers and consumers**
- **Best use of the technology likely to be available for SWIM Segment 2**
- **Knowledge of best practices and other government and industry efforts with goals similar to SWIM, e.g., GCSS-AF program**
- **Avoid allocation of mission logic that is**
 - **highly specific to a particular NAS domain**
 - **highly resource intensive**
 - **firmly slated for inclusion to specific NAS systems**

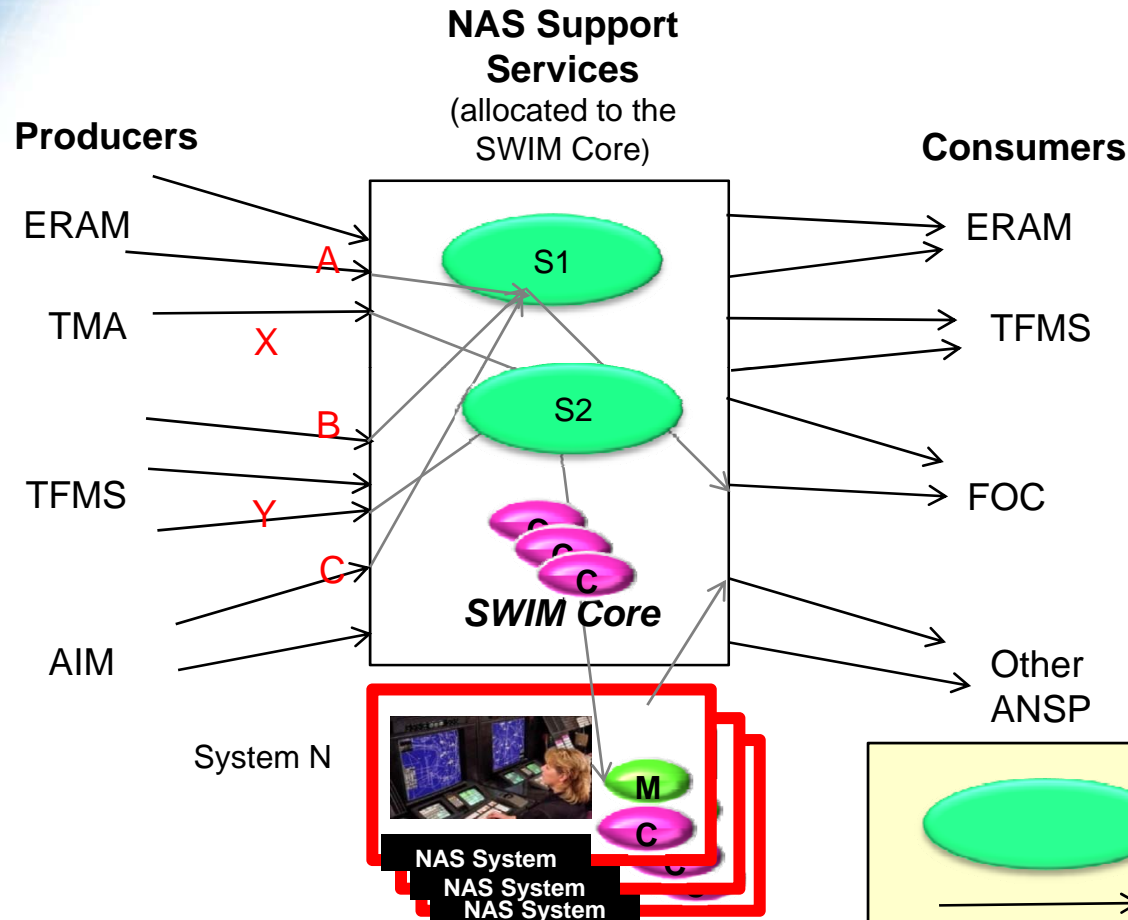


Salient Architectural Features for SWIM Core in Segment 2

- **An Enterprise Service Bus (ESB) which provides a common backbone for (at a minimum) basic messaging**
 - It also may support higher level functions such as content-based routing, transformation, and service orchestration
- **A centralized core for enterprise service management to provide an end-to-end management of services**
 - complements the SIP specific system management systems
- **Boundary protection security gateways and mechanisms to communicate with all non-NAS users**
- **Security (and other) policy enforcement mechanisms**
 - complemented by security (and other) policy enforcement within SIPs



Notional Processing in the SWIM Core



Sample Support Services In SWIM Core

1. Combine data A, B, C and notify the Flight Operations Center (FOC) upon a certain condition
2. Combine X and Y and provide to NAS end system N for further processing

