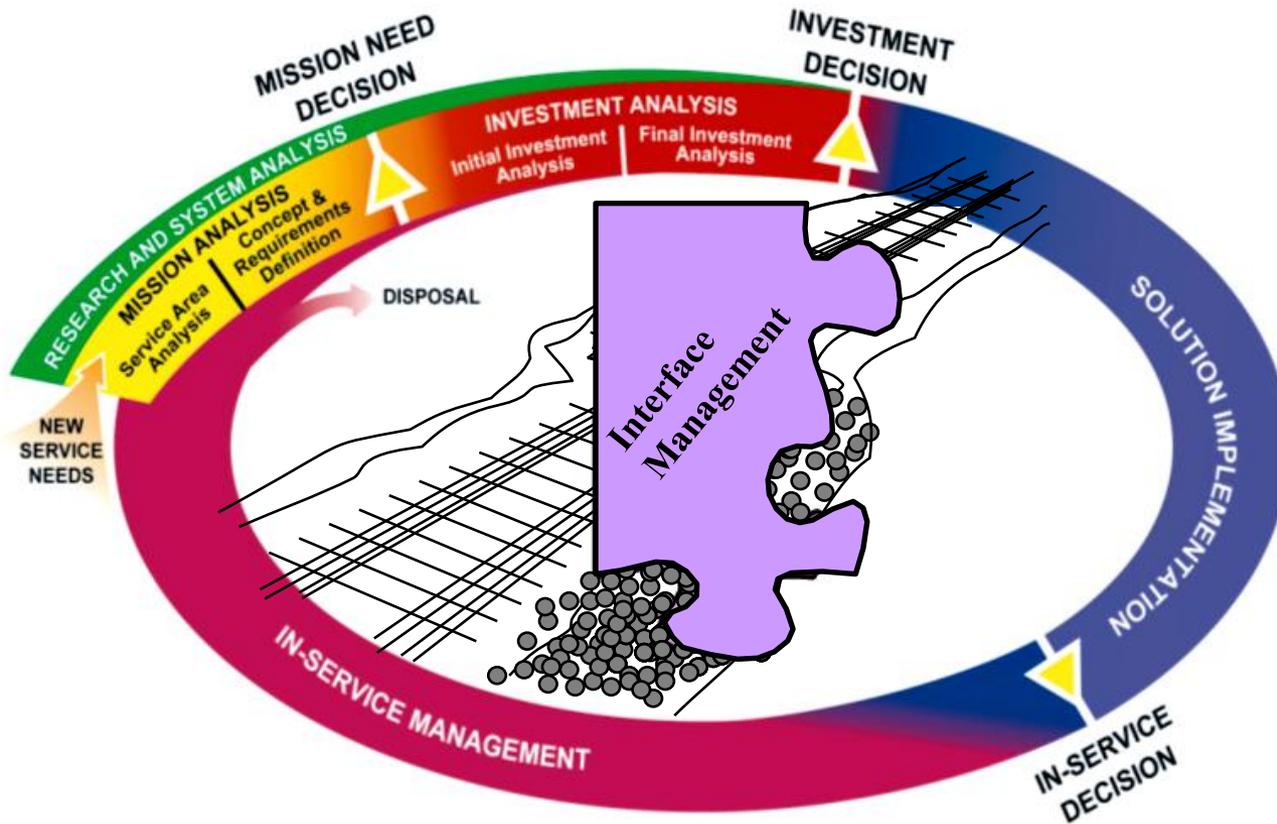


# Interface Management



Federal Aviation Administration



# FAA Interface Management

## About Your Instructor

- **Michael W. McVeigh PE (Mike)**
- **Senior System Engineer for ATM Systems, ATO Operations Planning SE**
- **Programs Terminal, Tower, NIMS, Power Systems**
- **NAS Interfaces**
- **Prior Design, Field, and Quality Engineer, Unisys**
- **Office: Portals Room 3092**
- **E-mail: Michael.McVeigh@faa.gov**
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- **Fax: (202) 385-7212**



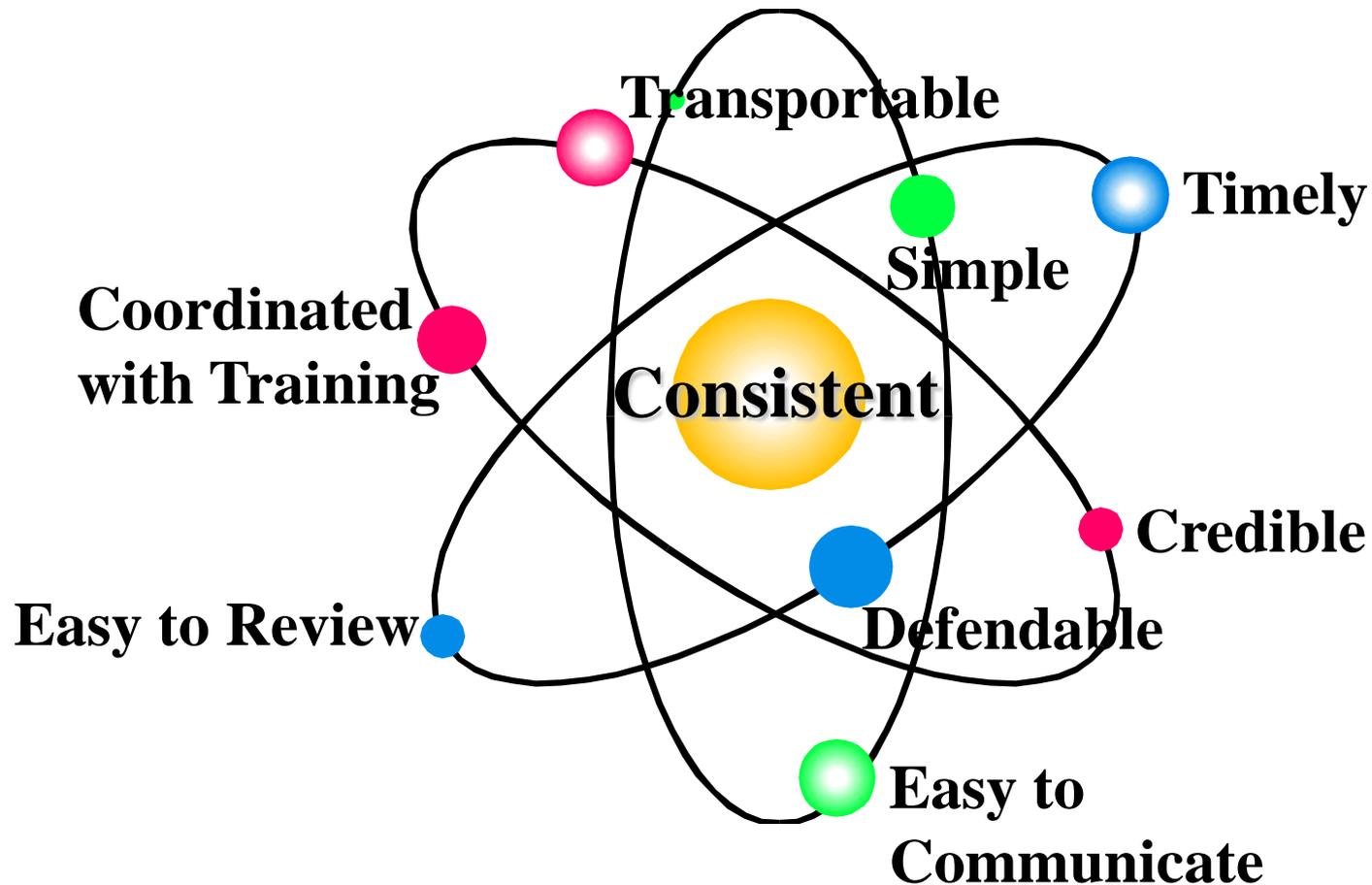
# FAA Interface Management Training Objectives

- Train *Performers* how to properly develop Interface Management work products
- Train *Program/Project Leads* how to understand and use Interface Management work products to make decisions
- Train *Senior Management* how to use the Interface Management process work products to provide oversight and Program direction



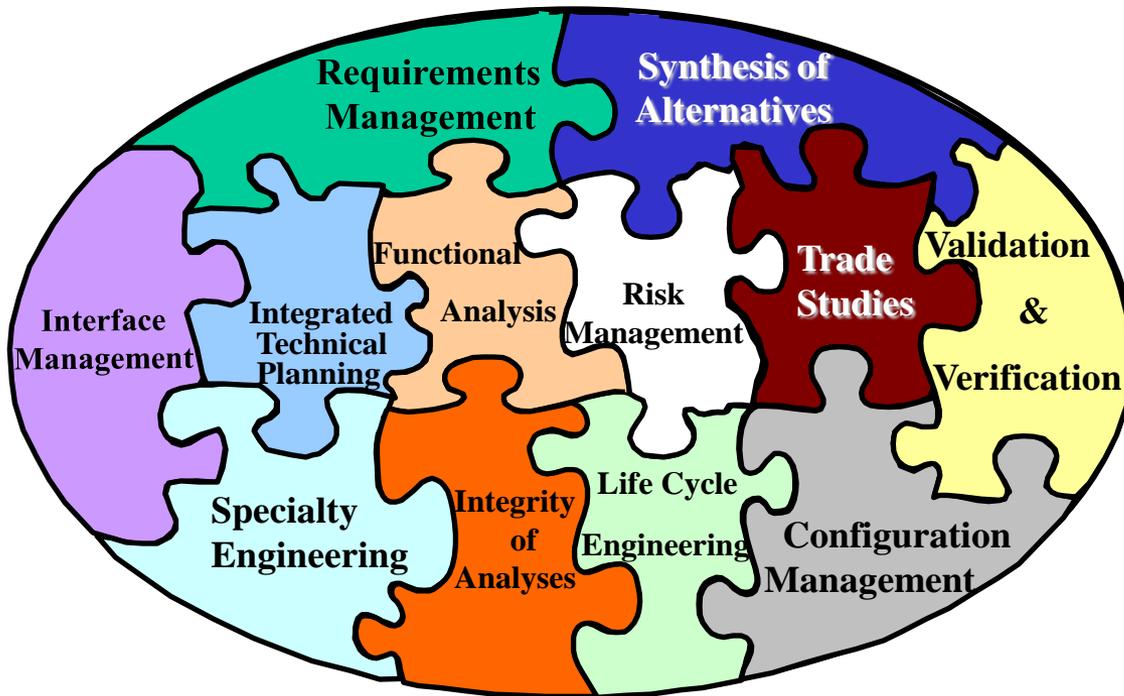
# FAA System Engineering Overview

## Process Objectives & Expectations



# Interface Management in System Engineering

**Interface Management:** An organized, systematic process for achieving functional and physical compatibility between all interrelated product elements.



The FAA partitions interface management into three significant pieces: Identify, Define, and Control.

# Baseline the System

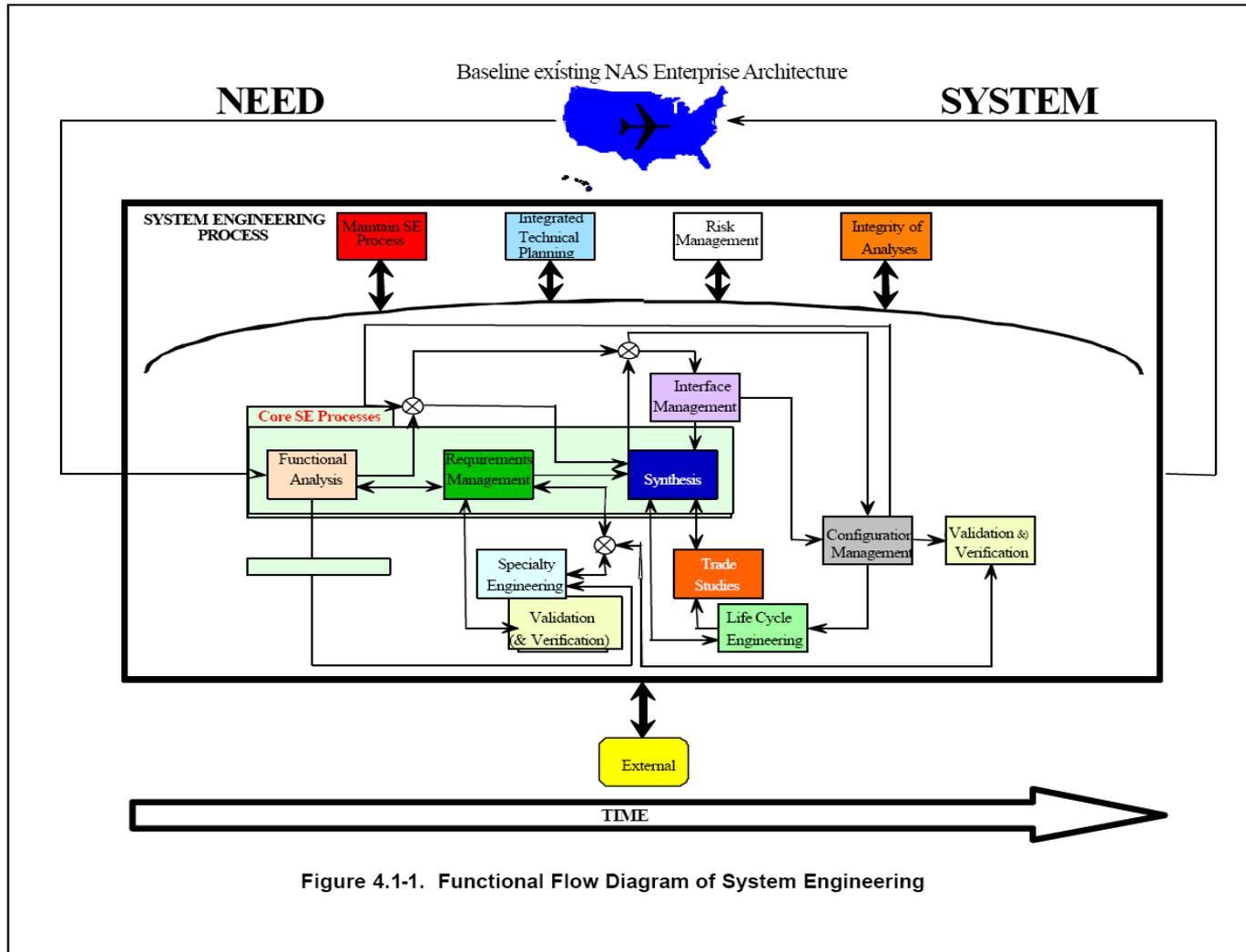
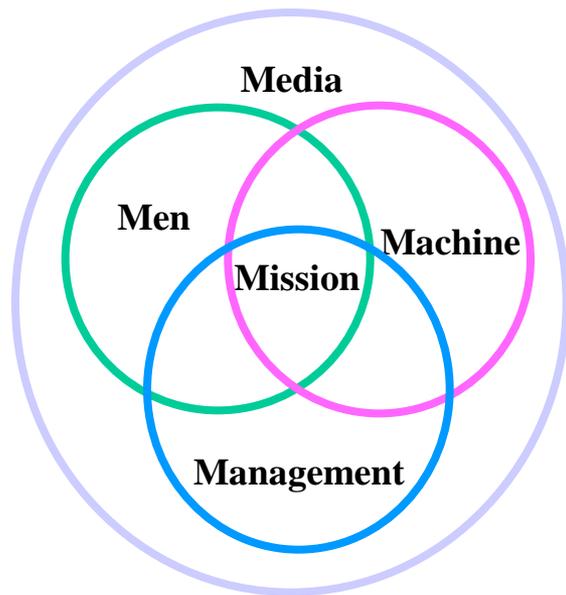


Figure 4.1-1. Functional Flow Diagram of System Engineering

# FAA Interface Management

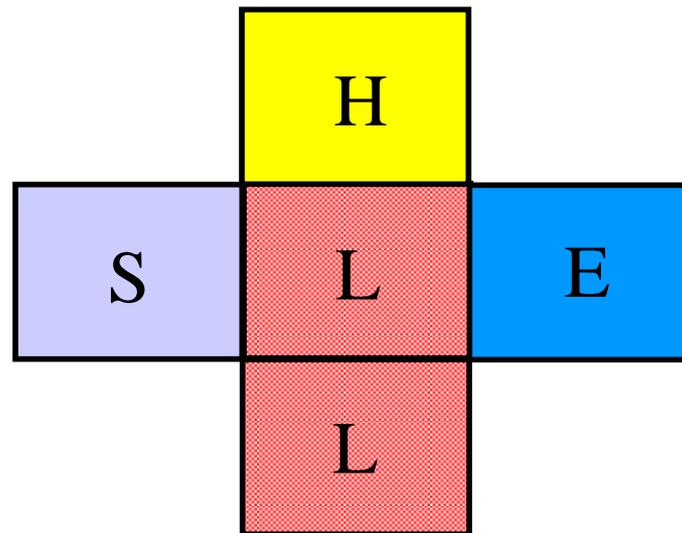
## The 5M Model of a System



- **Mission:** Central function or purpose
- **Man:** Human element
- **Machine:** Hardware and software
- **Management:** Policies, procedures, and regulations
- **Media:** Environment - ambient and operational

# FAA Interface Management

## The Shell Model of a System



S = Software

H = Hardware

E = Environment

L = Liveware (people)

# FAA Interface Management

## Interface Management Objectives

- **Define and illustrate physical and functional characteristics in sufficient detail to ensure compatibility of the interface so that this compatibility can be determined from the information in the IRD/ICD alone.**
- **Identify interface data needed and monitor submission of this data**



# FAA Interface Management Terms

- **Interface Requirements – Specify the performance, functional or physical attributes that are required to exist at a common boundary. This boundary can exist between two or more functions, system elements, configuration items, or systems.**
- **Interface Requirements Document (IRD) – Contains the FAA interface requirements between two elements, including type of interface (e.g., electrical, pneumatic, hydraulic, etc.) and the interface characteristics (performance, functional, or physical). In its final form, the IRD is primary documentation of the interface requirements.**

# FAA Interface Management Terms (Continued)

- **Interface Control Document (ICD) - The “design” document that describes the detailed “as built” implementation of the requirements contained in the IRD. The ICD is one of the two primary products of the interface process and is usually developed by the vendor.**

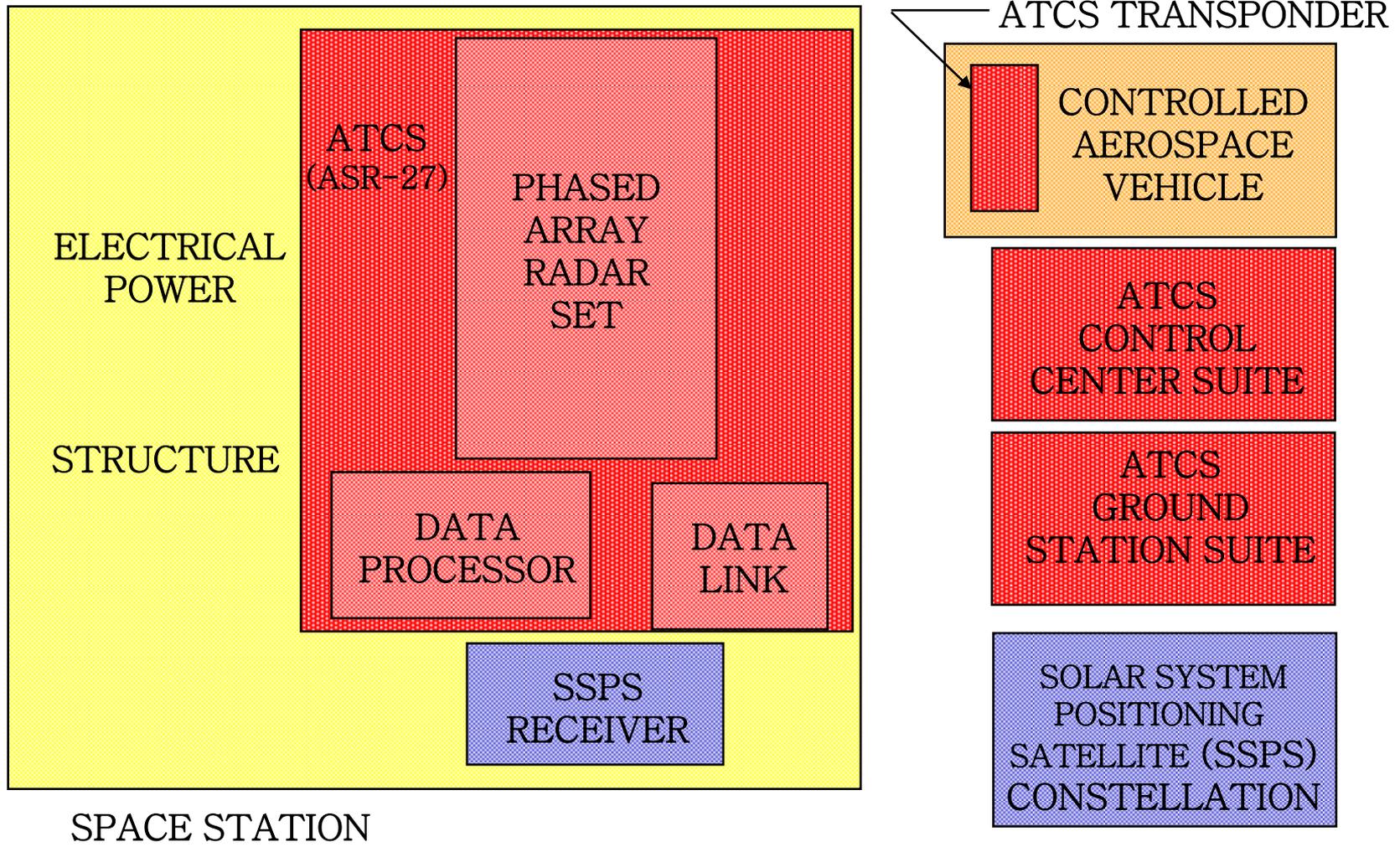
# FAA Interface Management Terms (Continued)

- **Interface Control Planning - For the AMS, this planning is contained in the functional integration section of the Implementation Strategy and Planning document, attachment 3 to the Exhibit 300. It is a summary of the planning contained in the SEMP and documents the formal management system of interface controls that ensure physical and functional compatibility between interfacing hardware, software and facilities. The interface planning section also provides the means for identifying and resolving interface incompatibilities and for determining the impact of interface design changes. It contains the templates for preparing, revising, and processing Interface Control Documents unique to the program and addresses supplier participation in the interface process. (see SEM Section 4.2)**

# FAA Interface Management Terms (Continued)

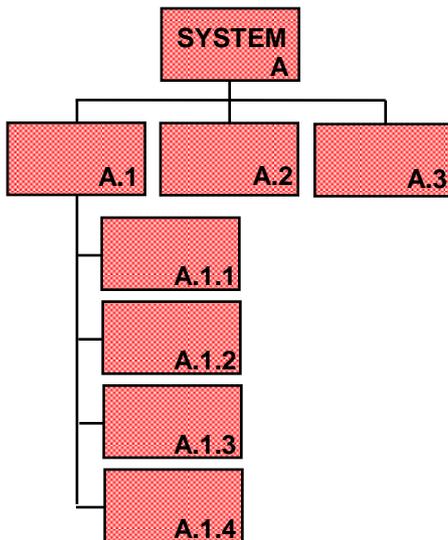
- **Interface Working Group (IWG) - The forum established through the SEMP and ISAP for discussing interface issues. IWG meetings serve two purposes: to ensure effective, detailed definition of interfaces by all cognizant parties, and to expedite the addition of initial IRDs, ICDs, and subsequent drawing changes to the baseline by encouraging resolution of interface issues. The IWG shall consist of IWG Chair, IRD/ICD Custodian, and management personnel from associated teams. (Integrated Technical Planning (Section 4.2) provides detailed instructions on this topic.)**

# FAA Interface Management Space-Based Traffic Control

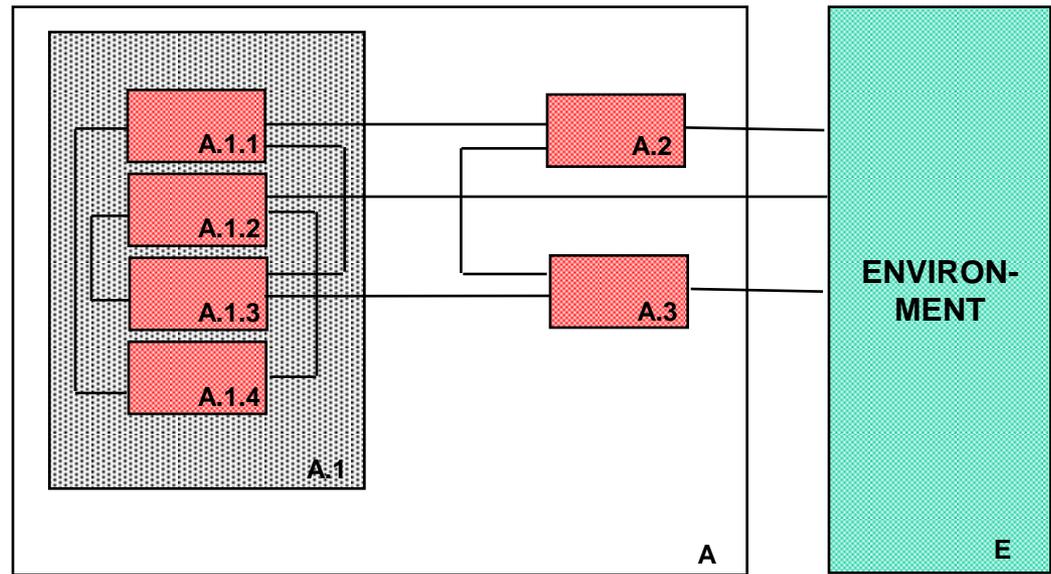


# FAA Interface Management Architecture Versus Interfaces

A system architecture defines the family relationships between the components in a system

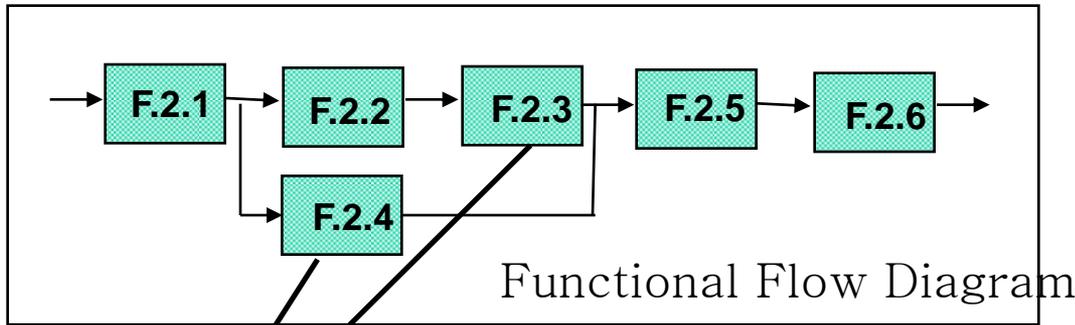


Interfaces identify ways in which the components cooperate and are related and give insight into system behavior

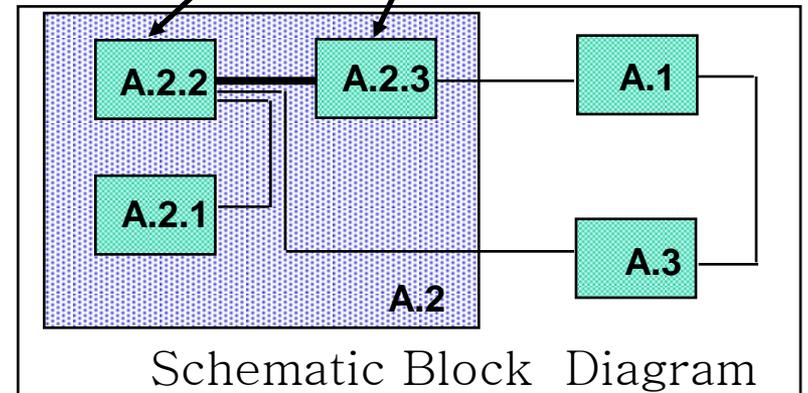
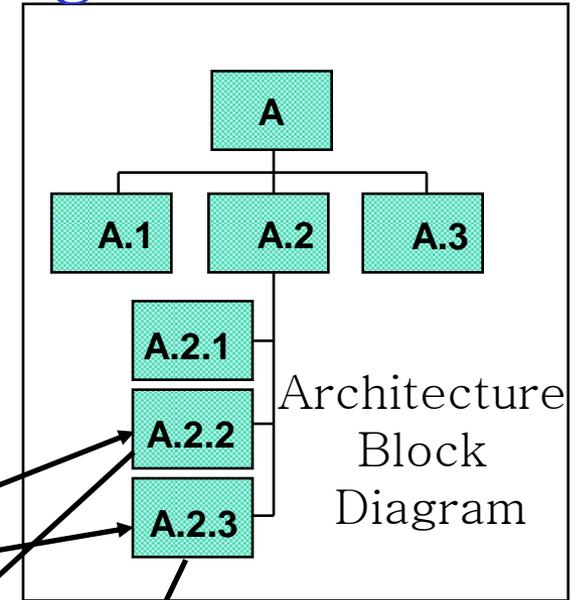


# FAA Interface Management

## Interface Identification Logic



FUNCTION	REQUIREMENT	ARCHITECTURE
F.2.1		A.2.1
F.2.2		A.2.1
F.2.3		A.2.3
F.2.4		A.2.2
F.2.5		A.3
F.2.6		A.1

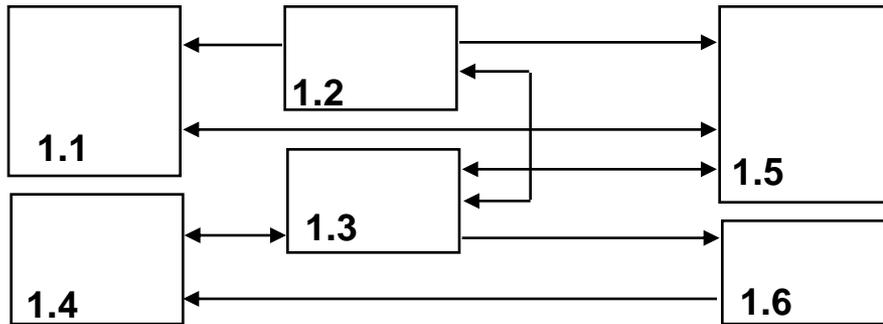


Interfaces Are Pre-determined  
By Requirements Allocation

# FAA Interface Management

## Two Identification Media

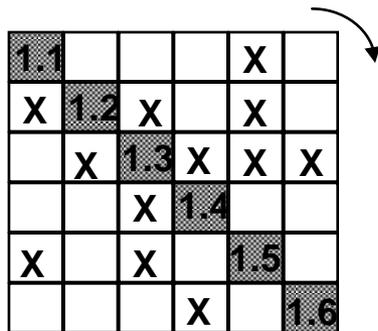
### Schematic Block Diagramming



**Lines define interfaces**

**Blocks Are objects only from the system architecture**

### N-square Diagramming



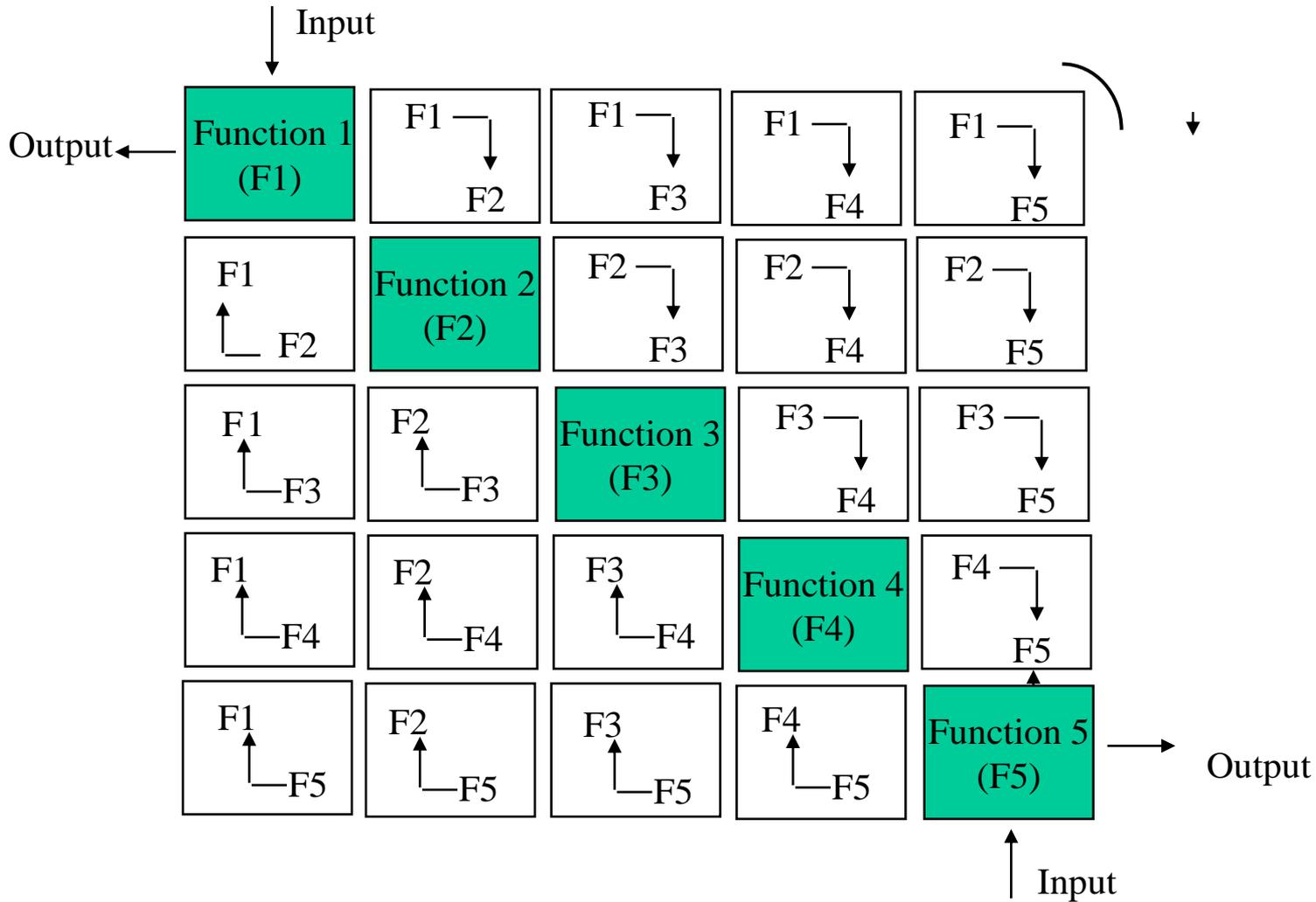
**Marked intersections define interfaces**

**Diagonal blocks are objects only from the architecture diagram**

**Arrow indicates interface directionality**

# FAA Interface Management

## The N-Square Model



# FAA Interface Management Composite N-Square Diagram

Architecture  
Identification  
On Diagonal

Item 1.1.2  
Team 2

Item/Team  
Interface  
Boundary

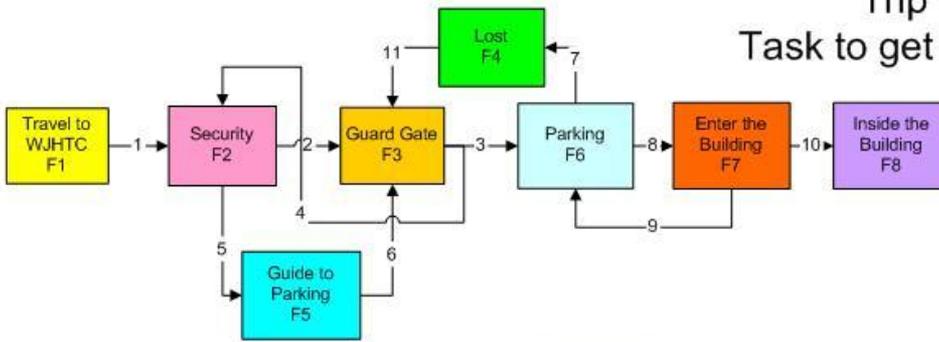
Item/Team  
Interface  
Boundary

Item 1.1.3  
Team 3

Item 1.1.1  
Team 1

# Trip to WJHTC

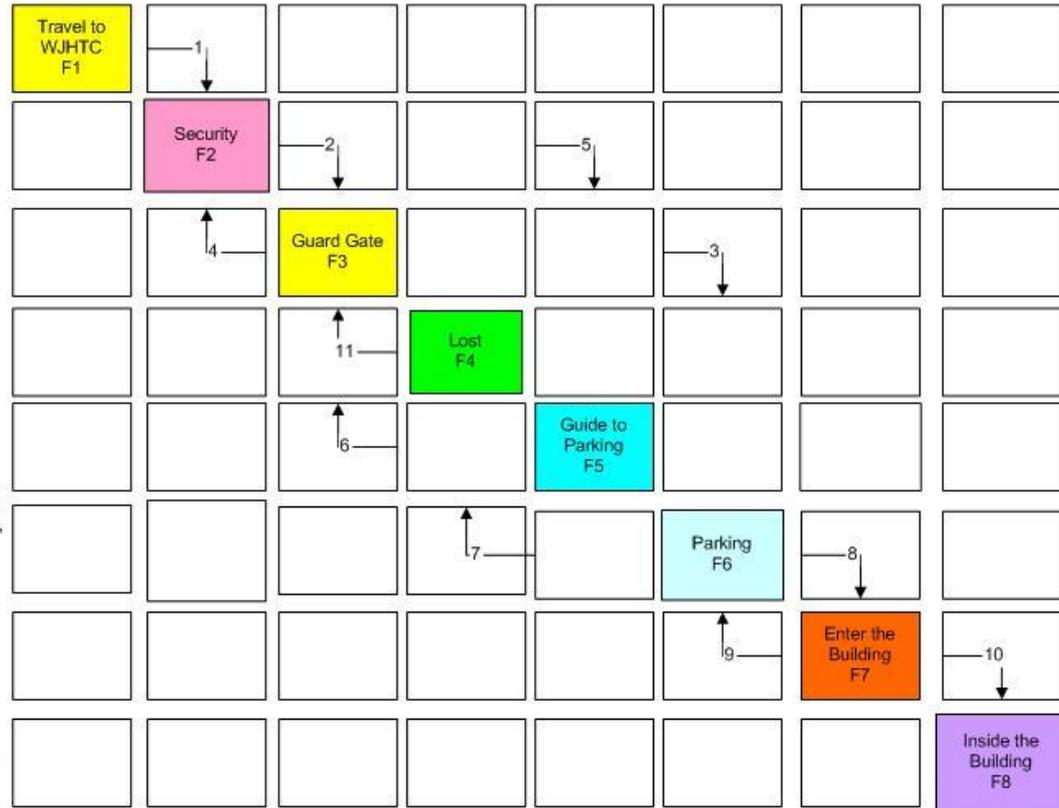
## Task to get in to the building.



This is an example of how to use an N^2 Chart in doing a task. This same technique works with interfaces.

### Trip to WJHTC

#### Task to get in to the building.



F1 Travel to WJHTC: Go to Security to be let in, (1).

F2. Security: Verifies that you should be let in. Go to Guard Gate, (2). If you are lost, call your party to help you in getting parked and into the building, (5).

F3. Guard Gate: Permits access and directs you to parking, (3). If you are lost, sends you back to Security, (4).

F4. Lost: Your are lost, go back to the Guard Gate for help, (11).

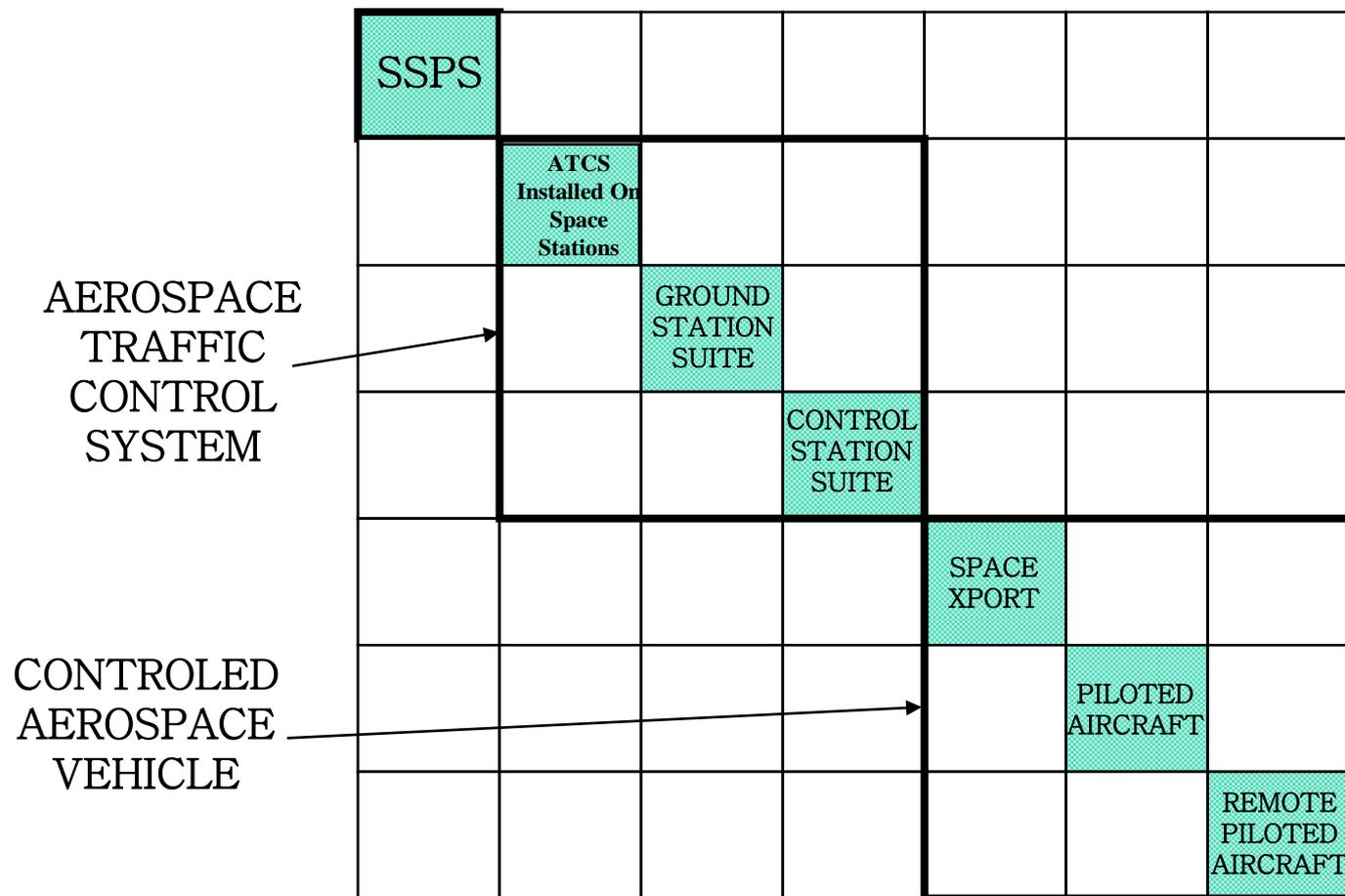
F5. Guide to Parking: Personnel help you in parking and getting into the building. Go back to the Guard Gate, (6).

F6. Parking: Find a parking spot and park the car. If the car is parked, go to the building, (8). If you cannot find a space or cannot get into the building, go to Lost, (7).

F7. Enter the Building: Try to enter the building. If you get in, go to Inside the Building, (10). Otherwise, go back to Parking, (9).

F8. Inside the Building: Go do your business.

# FAA Interface Management Functional Requirements Identification



# FAA Interface Management Dimensional Control and Safety Considerations

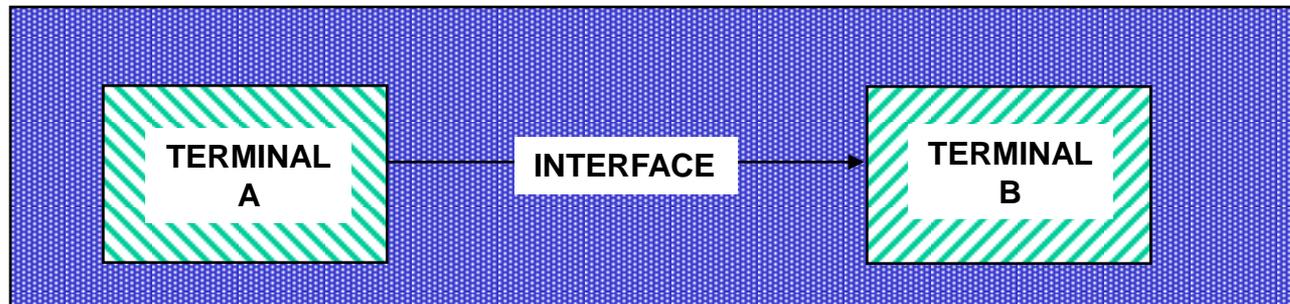
- **Define the interface terminal requirements such that each side may deviate from a desired norm as much as possible while maintaining the interface, thus providing a robust design.**
  - **For a example, purchasing 1” lumber and cutting 1” slots for shelves will produce unstable bookcase, since 1” wood is less than 1”.**
  - **However, measuring the width of the wood and cutting slots 1/8” wider than lumber provides both stability and ease of assembly.**
- **Consider automatically aligning interfaces that cannot easily be connected incorrectly.**
- **Consider human factors and safety considerations, consciously identifying potential interface connection failures and ways to mitigate these concerns.**

# **FAA Interface Management Exercise Requirements**

- > The Phased Array Radar System (PARS) shall transmit signal greater than strength X with frequency Y.**
- > PARS shall complete one scan in 6 seconds.**
- > The transponder shall receive signals of strength greater than or equal to X.**
- > The transponder shall transmit a reply within  $.1 < t < .2$  microseconds.**
- > The transponders signal shall contain IFF.**
- > The transponder shall have an availability of .99995.**

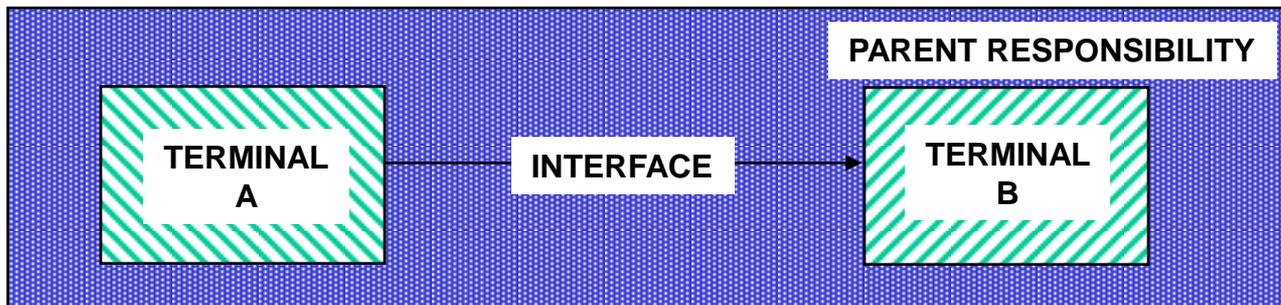
# FAA Interface Management

## Interface Responsibility



**Why is interface responsibility and work more difficult to manage than item development?**

# FAA Interface Management Responsibility Options Survey

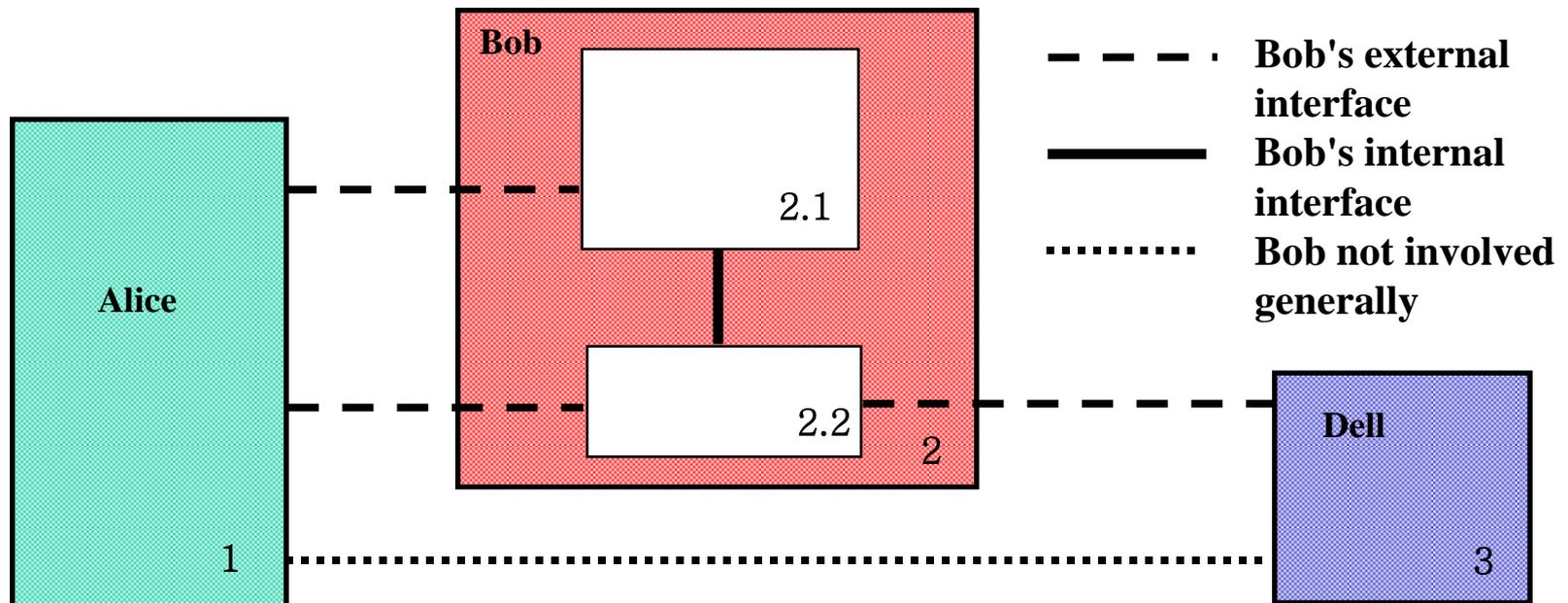


STUDENT VOTE	

- RULE 1** Responsible terminal agents share interface responsibility
- RULE 2** Sending terminal agent responsible for interface development
- RULE 3** Receiving terminal agent responsible for interface development
- RULE 4** Mutual parent agent responsible for interface development

# FAA Interface Management

## Interface Responsibility Classes



# FAA Interface Management

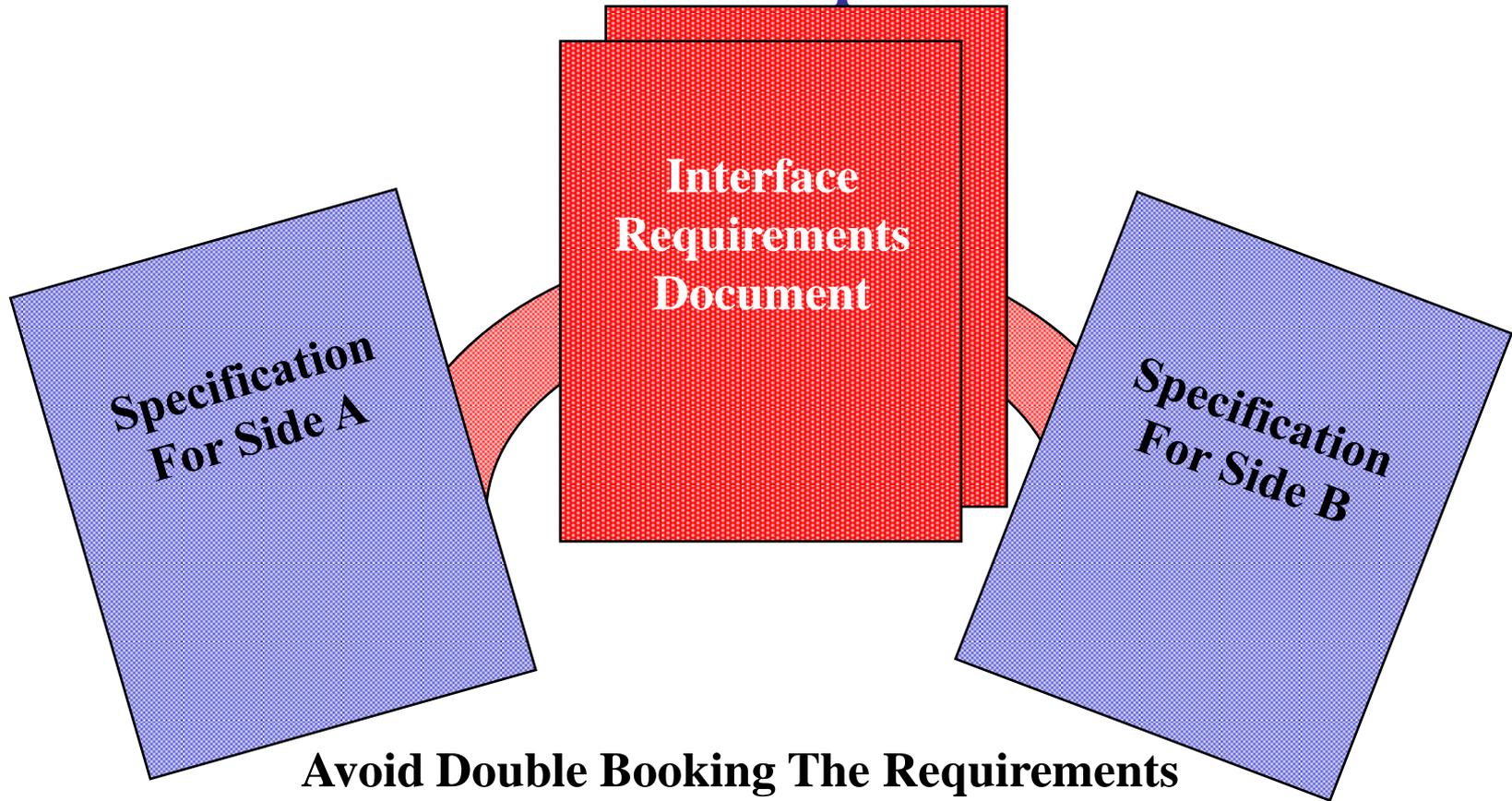
## FAA Interface Documents

- **Interface Documentation**
  - Interface control plan (ICP)
  - Interface requirements document (IRD)
  - Interface control document (ICD)
  - Interface change request (ICR)
  - Interface change notice (ICN)
  - NAS change proposal (NCP)
  - Legacy Systems Specification pair
- **Documentation Sequence**
  - **IRD (CM thru NCP to NAS Configuration Control Board (CCB))**
  - **ICD (CM thru domain CCB; only to NAS CCB if no IRD exists)**
  - **Interface Change request (CM at appropriate level)**

# FAA Interface Management Interface Control Planning Section of SEMP Summarized in the Exhibit 300 Attachment 3)

- **Define the interfaces covered**
- **Responsibilities for system elements and interfaces**
- **Define the IWG procedures through which the signers agree to work**
- **Provide forms (paper or electronic) to be used and detail how they will flow to achieve specific purposes**
- **Define documents to be created and how they will be created and approved**

# FAA Interface Management IRD Discipline

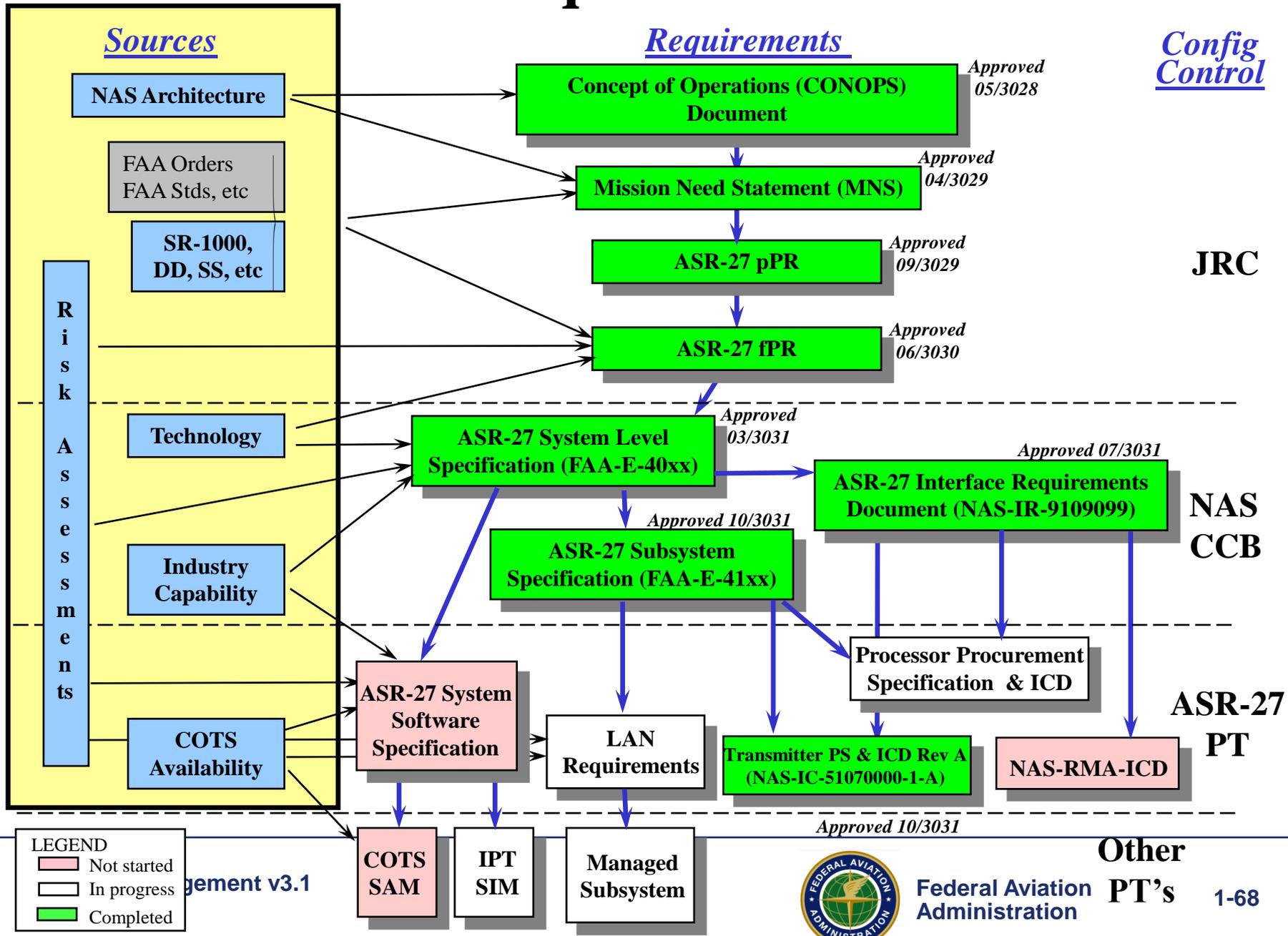


# FAA Interface Management

## Living and Passing ICDs/IRDs

- **Living ICD/IRD (FAA today)**
  - Specifications reference the ICD/IRD for interface requirements
  - No interface requirements in either specification
  - ICD/IRD survives throughout the program life
- **Passing ICD/IRD (FAA legacy)**
  - Specifications contain the mature interface requirements
  - The ICD/IRD is a management tool to move to maturity
  - ICD/IRD passes from program when all requirements are defined

# ASR-27 Requirements Flow down



JRC

Revalidated  
8/99

Approved  
12/95

Mission Need Statement

Mission Need Statement

Approved  
9/99

NIMS Phase 2 iRD

Operational Requirements Document

Approved  
3/97

Approved  
4/26/00

NIMS Phase 2 fRD

NAS  
CCB

Approved  
3/31/98

NIMS System Level Specification v1.0

Approved  
3/26/98

NIMS Managed Subsystem Specification  
FAA-E-2911

Approved  
12/18/01

NIMS System Level Specification v1.1  
FAA-E-2912

Approved  
6/97

NIMS Interface Requirements Document  
NAS-IR-5107000

NIMS PT

Approved 6/99

NIMS System  
Segment  
Specification

SNMPV1Rev A  
ICD  
NAS-IC-51070000-  
1A

Approved 12/02

SNMPV 3  
ICD  
NAS-IC-51070000-  
2

Approved 6/99

OLE/OPC  
ICD  
NAS-IC-  
85030001

SAI ICD

NAS-  
MD-  
790 ICD

Proxy  
Agent

LEGEND

- Not started
- In progress
- Completed

COTS  
MIB

IPT  
MIB

Other PT's

Managed  
Subsystem

# NIMS FAA-STD-025e Example

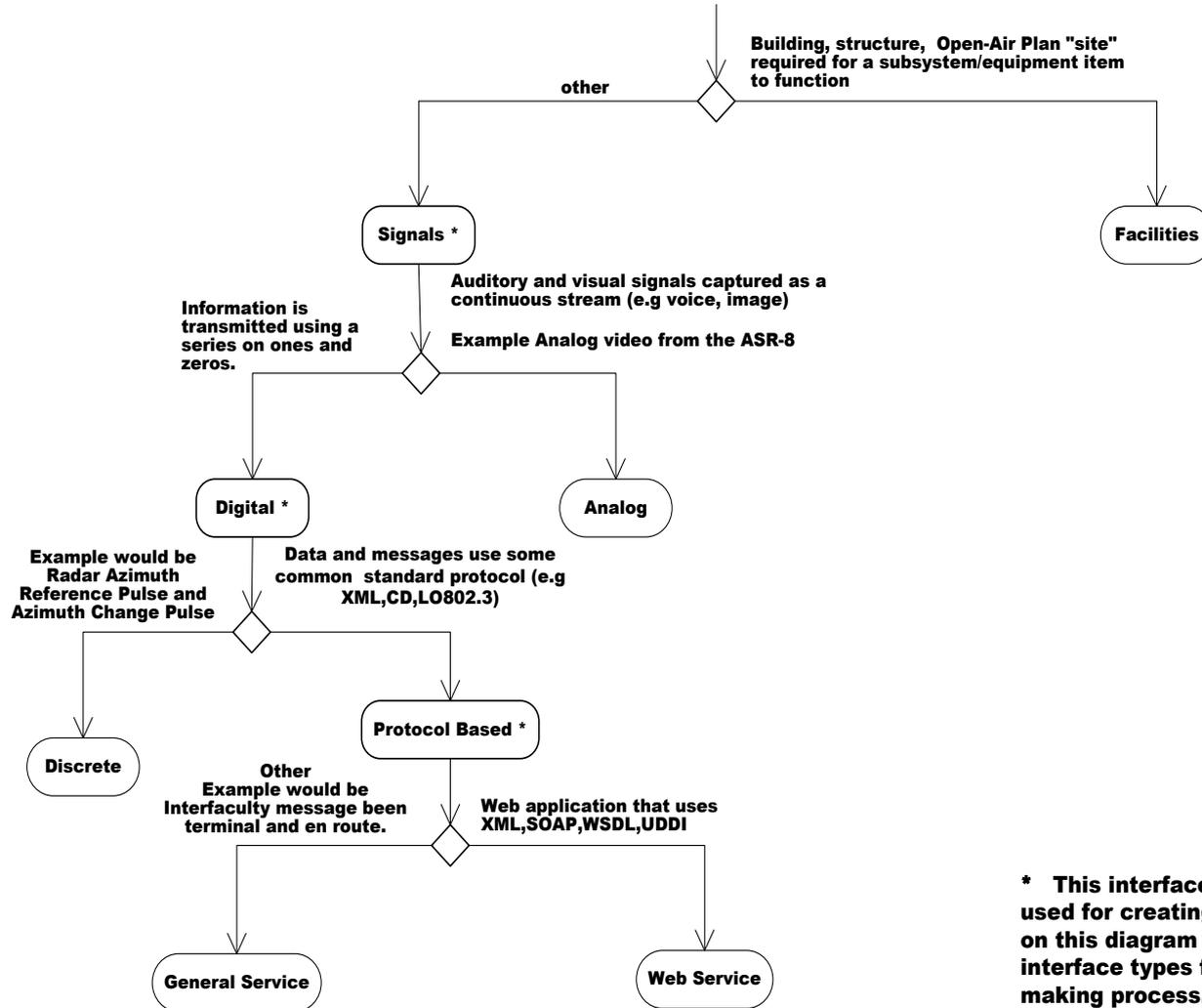
Standard Preparation of Interface Documentation  FAA-STD-025e	Interface Requirements Document NAS Infrastructure Management System Manger. Managed Subsystem  NAS-IR-51070000	Interface Control Document NAS Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 1  NAS-IC-51070000-1	Interface Control Document NAS Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 3  NAS-IC-51070000-2	Guidance Document Guidance for Implementing a Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 3	Remote Maintenance Monitoring System Interface Control Document  NAS-MD-790 Revision A
General Requirements 4.1.2 (page 22)	General Requirements 3.1 (page 4)	General Requirements 3.1 (page 6)	General Requirements 3.1 (page 5)	General Requirements 4.1. (page C-18)	System Overview 1. (page 1)
Functional Requirements 4.1.3 (page 23)	Functional Requirements 3.2 (page 5)	Functional Requirements 3.2 (page 7)	Functional Requirements 3.2.1 (page 7)	Functional Requirements 4.2 (page C-20)	System Operational Requirements 3. (page 4)
Application process 4.4.1 (page 25)	Application process 3.2.1 (page 5)	Application process 3.2.1 (page 8)	Application process 3.2.1 (page 7)	Application process 4.2.1 (page C-20)	System Operational Requirements 3. (page 4)
Identification of Each Application Process 4.4.1.1 (page 25)	Identification of application process 3.2.1.1 (page 5)	Identification of application process 3.2.1.1 (page 8)	Identification of application process 3.2.1.1 (page 7)	Identification of application process 4.2.1.1 (page C-20)	System Operational Requirements 3. (page 4)
Information code/structure 4.4.1.3 (page 25)	Information structure 3.2.1.3.2 (page 8)	Information structure 3.2.1.3.2 (page 11)	Information structure 3.2.1.3.2 (page 12)	Information structure 4.2.1.3.2 (page C-33)	Message Text (Information Field) 3.3 (page 10)

# NIMS FAA-STD-025e Example

Standard Preparation of Interface Documentation  FAA-STD-025e	Interface Requirements Document NAS Infrastructure Management System Manger. Managed Subsystem  NAS-IR-51070000	Interface Control Document NAS Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 1  NAS-IC-51070000-1	Interface Control Document NAS Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 3  NAS-IC-51070000-2	Guidance Document Guidance for Implementing a Infrastructure Management System Manger. Managed Subsystem Agent Using the Simple Network Management Protocol Version 3	Remote Maintenance Monitoring System Interface Control Document  NAS-MD-790 Revision A
Security 4.4.3 (page 28)	Security 3.3 (page 13)	Security 3.3 (page 32)	Security 3.3 (page 32)		
Responsibility for Verification 3.3.1 (page 20)	Quality conformance inspections 4.4 (page 14)	Quality conformance inspections 4.4 (page 33)	Quality conformance inspections 4.4 (page 24)		

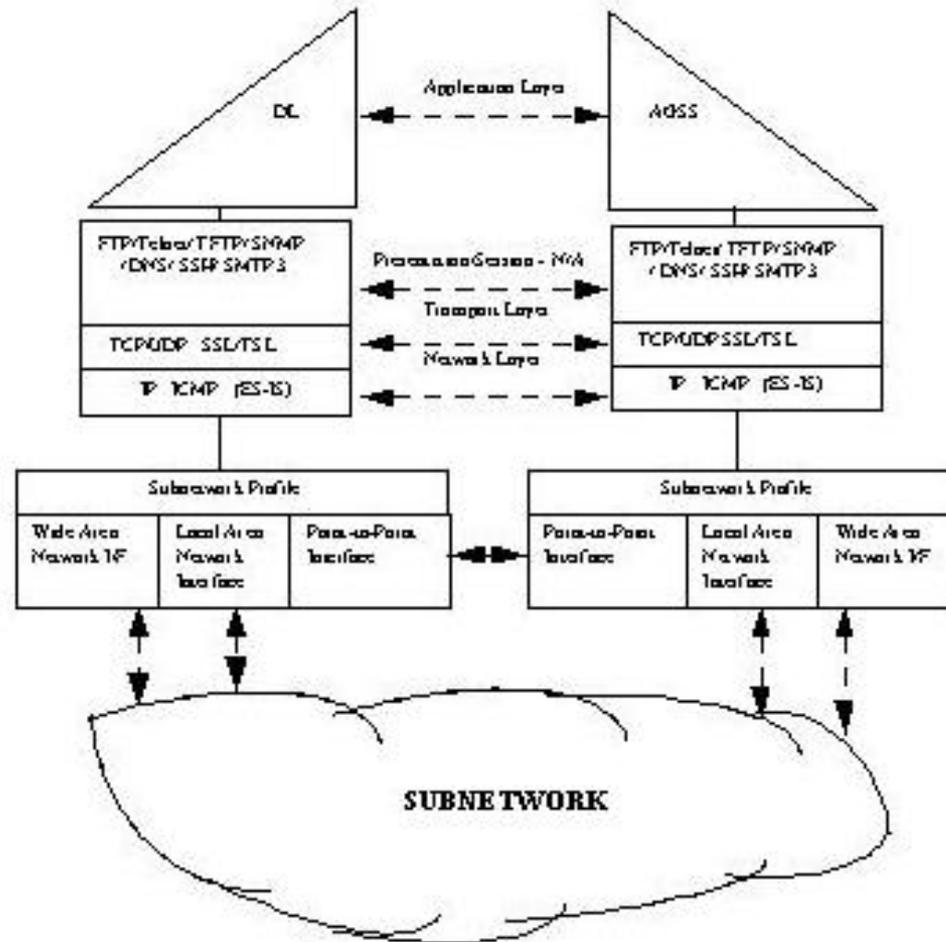


# Interface Tree for Table of Content

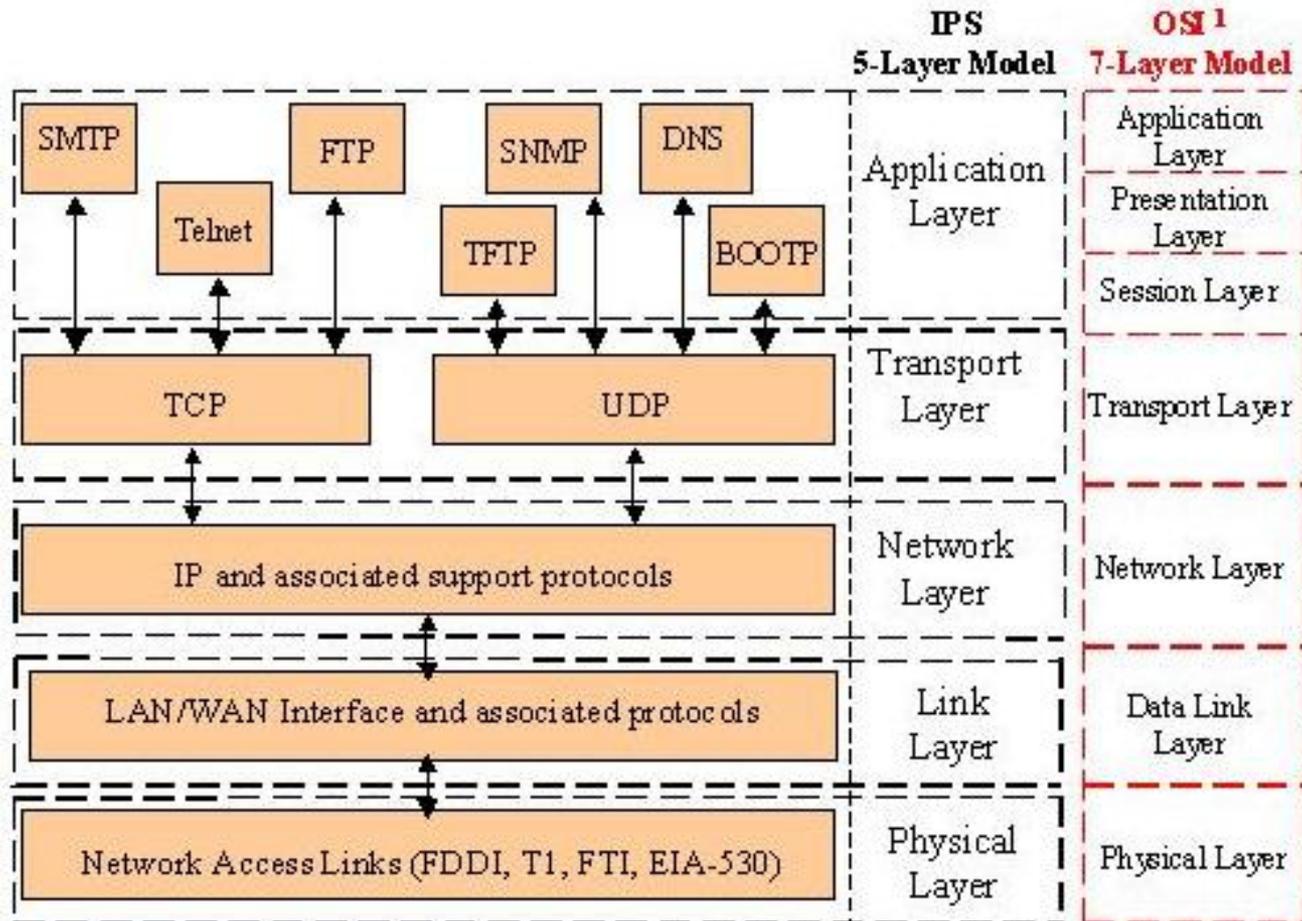


\* This interface type shouldn't be used for creating IRD/ICD. It is used on this diagram is only to group similar interface types for facilitating decision making process.

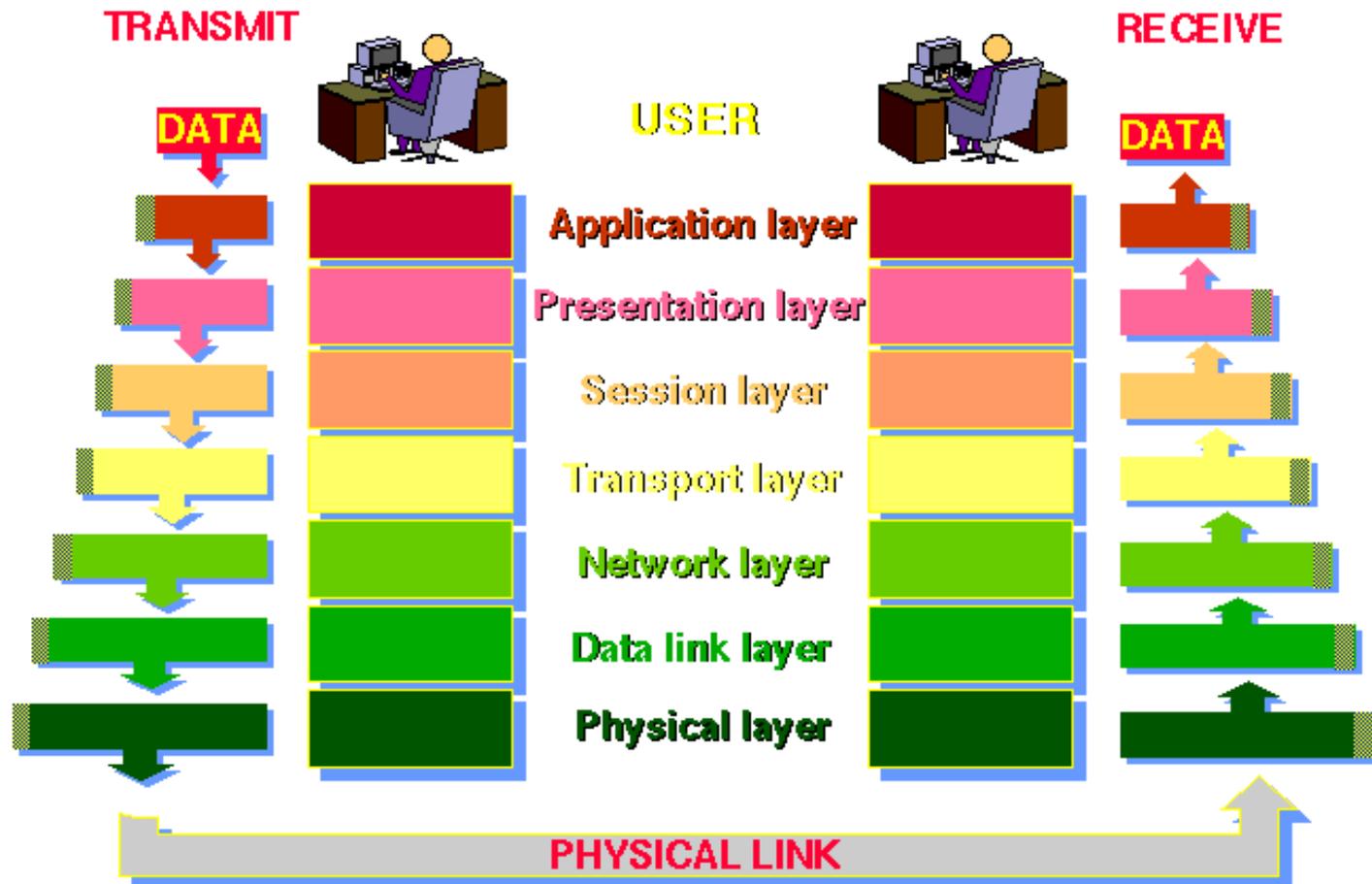
# Software Interface Architecture



# FAA Application Layer



# THE 7 LAYERS OF OSI



# Internet to Open Systems Interface Model

<b>OSI</b>	<b>INTERNET SUITE</b>
<b>7. Application</b>	Application
<b>6. Presentation</b>	
<b>5. Session</b>	
<b>4. Transport</b>	Transport
<b>3. Network</b>	Internet
<b>2. Data Link</b>	Host-to-network
<b>1. Physical</b>	

# FAA Interface Management

## FAA IRD Template (System-System Network)

**Cover Page**

**Approval Signature Page**

**Revision Record**

**Effectivity Page**

**Table of Contents**

**1.0 SCOPE**

**1.1 Scope**

**1.2 Subsystem Responsibility List**

**2.0 APPLICABLE DOCUMENTS: List of all documents  
referenced in Sections 3 and 4**

**2.1 Government Documents**

**2.2 Non-government Documents**

# FAA Interface Management

## FAA IRD Template (Continued)

- 3.0 INTERFACE Requirements/Characteristics**
- 3.1 General Requirements**
- 3.1.1 Human System Interface Requirements**
- 3.2 Functional Requirements/Design Characteristics**
- 3.2.1 Application Processes**
- 3.2.1.1 Identification of Each Application Process**
- 3.2.1.2 Category of Service Required by the Application Process**
- 3.2.1.3 Information Units**
- 3.2.1.4 Quality of Service**
- 3.2.1.5 AP Error Handling**
- 3.2.1.6 Interface Summary Table**
- 3.2.2 Protocol Implementation**
- 3.2.2.1 Application Services**
- 3.2.2.2 Network Services**
- 3.2.2.3 Medium Services**
- 3.2.3 Security**
- 3.2.4 Interface Design Characteristics Table**



# FAA Interface Management

## FAA IRD Template (Continued)

- 3.3 Physical Design Characteristics**
  - 3.3.1 Electrical Power and Electronic Requirements/Characteristics:**
    - Type, voltage, power profile, protection**
    - 3.3.1.1 Connectors (Interface Pin Assignments)**
    - 3.3.1.2 Wire/Cable**
    - 3.3.1.3 Electrical power/Grounding**
    - 3.3.1.4 Fasteners**
    - 3.3.1.5 Electromagnetic Compatibility**
- 4.0 QUALITY ASSURANCE PROVISIONS**
  - 4.1 Responsibility for Verification**
  - 4.2 Special Verification Requirements**
  - 4.3 Verification Requirements Traceability Matrix**
- 5 PREPARATION FOR DELIVERY**
- 6.0 NOTES**
  - 6.1 Definitions**
  - 6.2 Abbreviations and acronyms**

# FAA Interface Management ICD/IRD Questions?

- **Document structure**
- **Document content**



# FAA Interface Management Development Interface Classes

- **Totally in-house development**
  - All interfaces under organizational control
- **Supplier source**
  - Requirements established through procurement specification and statement of work
- **Commercial off-the-shelf (COTS)**
- **Special case where contractors have no contractual relationship on a common program (Scope sheet)**
  - No direct contractual relationship between contractors
  - Contract coverage with common customer
  - Need mutual agreement on interface development

# FAA Interface Management

## Internal Interface Control

- **Interface requirements are not included in specifications; all interface requirements must be listed in IRD**
- **Teams may choose to use a mini passing IRD as a means to reach interface maturity for internal interfaces**
- **Each team should be responsible for their external internal interfaces including integration for lower tier teams**

# FAA Interface Management Associate Interface Control

- **Common interface development control plan**
- **Associate contract clauses**
- **Letters of understanding**
- **Interface working group (IWG)**
- **IWG Secretariat**
- **Technical interchange meetings (TIM)**
- **Interface requirements document**
- **Interface control document**

# FAA Interface Management Contract Clauses

**H.2 Interface Relationship.** The contractor shall work cooperatively with other contractors formally designated by the government program manager to mutually define requirements for interfaces between the items for which they are responsible under this contract and the other party's items and development of compatible designs.

The contractor shall participate in an interface working group and technical interchange meetings in accordance with an interface development plan created and maintained by one of the contractors chosen to act as the secretariat.



# FAA Interface Management Letter of Understanding

**Government Program Office  
ATCS (ASR-27) Program**

We, the undersigned, agree to participate in IWG and TIM meetings in accordance with our independent contracts under the leadership of Green Electronics, Inc. acting as the secretariat. We shall jointly develop a mutually compatible interface between the items for which we are responsible in accordance with the system interface control plan to be created and maintained by the secretariat and approved by the undersigned and the government.

Handwritten signature of Adam R. Bosworth in black ink.

**Adam R. Bosworth**  
Green Electronics, Inc  
ATCS Program  
Program Manager

Handwritten signature of William N. Neverton in black ink.

**William N. Neverton**  
Cosgrove Systems, Inc  
ATCS Program  
Program Manager

Handwritten signature of Martha S. Williams in black ink.

**Martha S. Williams**  
Radzap Division  
ATCS Program  
Program Manager

Handwritten signature of Adrian Alexson in black ink.

**Adrian Alexson**  
Supersat  
ATCS Program  
Program Manager



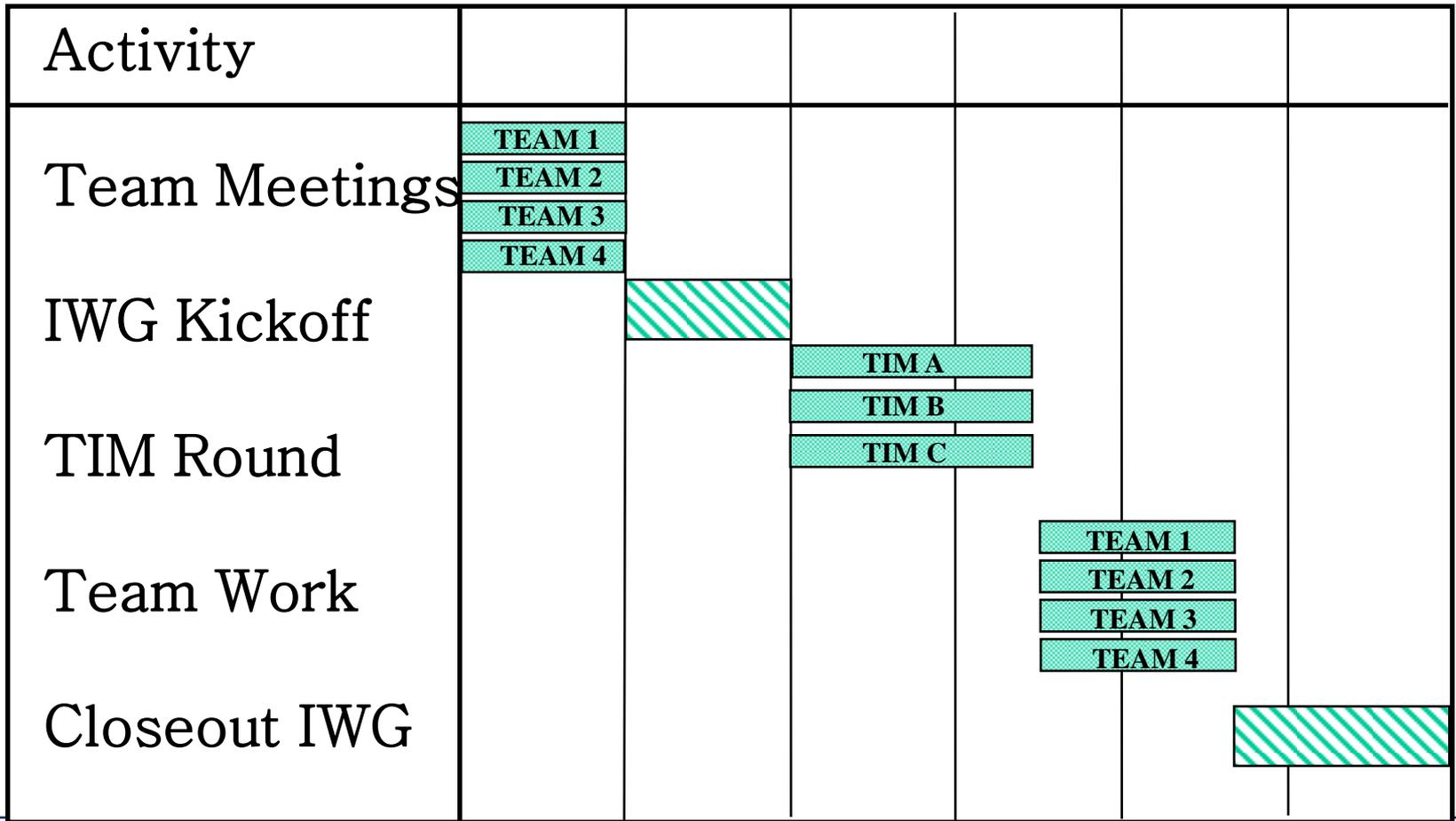
# FAA Interface Management Meeting Sequence

- **Periodic IWG meetings**
  - **Contractors give status and identify problems based On current IRD content**
  - **Secretariat and chairperson may table difficult technical problems to a specific TIM For resolution**
- **TIMs called to resolve specific technical problems**
- **Formal changes through IWG and FAA National Airspace System (NAS) CCB possibly followed by engineering change proposals (ECPs) to effected contractors**

# FAA Interface Management Contractor Responsibilities

CONTRACTOR	INTERFACE		
	A	B	C
1 Green Electronic	TIM A	TIM B	TIM C
2 Cosgrove	TIM A		
3 Radzap		TIM B	
4 Supersat			TIM C

# FAA Interface Management Workshop Sequence



# FAA Interface Management

## TIM

- **TIMs occur between teams to discuss technical issues and resolve a mutual definition of the interfaces the teams are responsible for.**
- **Focus on the one interface assigned and how that interface will have to be configured based on the way your team plans to implement its function.**



# FAA Interface Management Tools

- **The N<sup>2</sup> Diagram**
  - **The N<sup>2</sup> diagram (SEM Figure 4.7-8) assures that all of the functions identified in the functional analyses are reflected in functional interfaces. Each node in the N<sup>2</sup> diagram indicates a possible functional interface. Notice that in the example the Provide Electrical Power and Provide Environmental Control provide power and cooling to the other functions. However, the Provide Guidance and Navigation function does not provide any quantity to the other functions. The N<sup>2</sup> diagram is also used for the physical interfaces.**
- **Schematic Block Diagrams**
  - **The schematic block diagram shows functions in relation to the other functions by how the inputs and outputs feed and are fed by the other functions.**

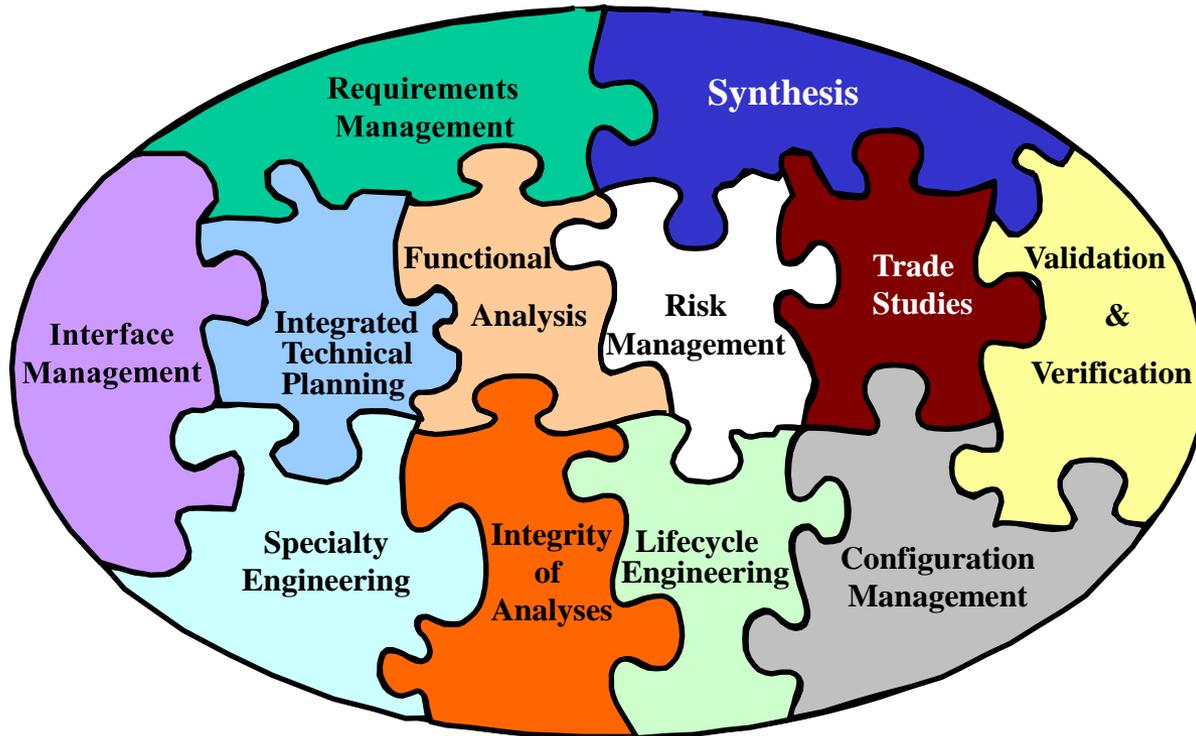
# FAA Interface Management Summary/Questions

- **Where have we been?**
  - **Systems have interfaces and there is no alternative**
  - **Interfaces are hard to develop because they have divided or shared responsibilities**
  - **We must clearly define the need for specific interfaces and precisely define and document related requirements**
  - **N<sup>2</sup> and schematic block diagrams offer effective tools for exposition of needed interfaces and IRD/ICDs a good documentation format**
- **Do you have any questions?**
- **SEM available at <http://172.27.70.63/>**
- **If you have questions later -**

# FAA System Engineering

***Objective: Consistently provide balanced solutions to complex FAA system needs.***

## System Engineering Elements



### WHO DO YOU CALL?

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***Plus System Engineering Process Management***

# The SEM Alphabet Soup

(ala Secret Decoder Ring)

CCB	Configuration Control Board
CM	Configuration Management
Ext	External (to SE)
FA	Functional Analysis
IA	Integrity of Analyses
ICD	Interface Control Document
ICN	Interface change notice
ICP	Interface Control Plan
ICR	Interface change request
IM	Interface Management
IRD	Interface Requirements Document
ITP	Integrated Technical Planning
IWG	Interface Working Groups



# The SEM Alphabet Soup

(ala Secret Decoder Ring)

<b>IWG</b>	<b>Interface Working Group</b>
<b>LCE</b>	<b>Life Cycle Engineering</b>
<b>N2</b>	<b>N-square Charts</b>
<b>NAS</b>	<b>National Airspace System</b>
<b>NCP</b>	<b>NAS change proposal</b>
<b>RM</b>	<b>Requirements Management</b>
<b>RSK</b>	<b>Risk Management</b>
<b>SpecEng</b>	<b>Specialty Engineering</b>
<b>Syn</b>	<b>Synthesis</b>
<b>TIM</b>	<b>Technical Interchange Meetings</b>
<b>TS</b>	<b>Trade Studies</b>
<b>V&amp;V</b>	<b>Validation &amp; Verification</b>

