GMU Applying SE

Ron Stroup
Chief System Engineer for Airborne and Ground System Integration

Evolution of ATC/ATM

Past
Procedural Separation

Estimate current & future aircraft positions

Present
Radar Separation

Know current & estimate future aircraft position

Future
Trajectory Separation

Know current and future positions
Future Concept - Tactical

- Timeframe is present (current aircraft position and performance) to less than 5 minutes into the future (intended trajectory).

Future Concept - Strategic

- Timeframe is from 5 minutes (intent trajectory) to 30-90 minutes - although the flow time can extend into strategic flow at times of high volume to individual markets.
- The timeframe for TFM is from as little as 30 minutes to 24 hours.
System Engineering

Objective: Consistently provide balanced solutions to complex FAA needs.

Definition – A discipline that concentrates on the design and application of the whole system as distinct from the parts. It involves looking at a problem in its entirety, taking into account all the facets and all the variables and relating the social to the technical aspect.

System: An integrated set of constituent parts that are combined in an operational and/or support environment to accomplish a defined objective. These parts include people, hardware, software, firmware, information, procedures, facilities, services, and other support facets.

SE Functions

AMS Life Cycle & Associated SE Processes

Mission Analysis
- Functional Analysis
- Integrated Technical Planning
- Synthesis
- Integrity of Analyses
- Validation

Service Life Extension
- Functional Analysis
- Synthesis
- Trade Studies
- Interface Management
- Integrity of Analyses
- Validation

Investment Analysis
- Integrated Technical Planning
- Functions Analysis
- Synthesis
- Trade Studies
- Interface Management
- Integrity of Analyses
- Validation

Full Life Cycle
- Requirements Management
- Risk Management
- Specialty Engineering
- Configuration Management
- Life Cycle Engineering
- Maintain System Engineering
- Process

Solution Implementation
- Functional Analysis
- Synthesis
- Trade Studies
- Interface Management
- Validation & Verification
- Integrated Technical Planning

In Service Management
- Interface Management
- Integrity of Analyses
- Verification

http://fast.faa.gov
SE Responsibilities

System Engineering Responsibilities by Life Cycle Phase

Continuous Agency Strategic Planning
- Architecture Planning (Enterprise)
- NAS Requirements Development (Enterprise)

Mission Analysis
- Operational Concept Development (Enterprise)
- Capital Planning (Enterprise)
- Capability/Service Shortfall Definition (Domain)
- Risk Management (Enterprise)

Service Life Extension
- Risk Management (Domain)
- Service Shortfall Projection (Enterprise)
- NAS Improvements and Technology Insertion Planning (Enterprise/Functional)

Investment Analysis
- Operational Requirements Development (Domain/Functional)
- Alternatives Analysis (Domain)
- Investment Analysis (Domain)
- Investment Decisions (Domain)
- Cost, Schedule, and Performance Baseline Development
- Benefits Baseline Development and Risk Management (Domain)

Solution Implementation
- Program Planning (Functional)
- System Requirements Development (Functional)
- Specification Development (Functional)
- Acquisition (Functional)
- Risk Management (Functional)
- Deployment Planning (Enterprise/Functional)
- Installation (Functional)
- In-Service Decisions (Enterprise)

In Service Management
- Configuration Management (Enterprise)
- Performance Monitoring and Analysis (Domain)
- Risk Management (Domain)
- Service Shortfall Projection (Enterprise)
- NAS Improvements and Technology Insertion Planning (Enterprise/Functional)

WHY System Engineering?

Air Transportation System Engineering, GMU, April 6, 2005
Breakdown

- 753 Operational requirements
- 22 Capabilities
- 77 Operational Improvements
  - 26 current
  - 51 new

Current Services
Examples – Separation Assurance

<table>
<thead>
<tr>
<th>Current</th>
<th>Next</th>
<th>After Next</th>
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<tbody>
<tr>
<td>Oceanic separation</td>
<td>Oceanic pair-wise maneuvering</td>
<td>Oceanic separation mimics En Route separation</td>
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<tr>
<td>En Route separation</td>
<td>Data link</td>
<td>Reduce separation to 3 mile everywhere</td>
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<td>Terminal separation</td>
<td>RVSM above 29000</td>
<td>Provide target data to pilots and surface</td>
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<td>Aircraft provided intent data</td>
<td>vehicle operators</td>
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<td>Alternate surveillance sources for non-radar airspace</td>
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<td>Enhanced target data to service providers for surface and runway separation</td>
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Mission Roadmap Initiatives

- Service Initiatives
  - Service Improvement – Enhance Performance over current Service
  - New Service Instance – Add existing Service at new location
- Service Attributes
  - Safe
  - Efficient (Expeditious, Orderly, Transparent, Equitable/Fair)
  - Dynamic (Flexible, Adaptable, Scaleable, Predictable)

- Infrastructure Initiatives
  - Infrastructure Improvements
    - Enhance Infrastructure in support of Service Improvements
    - Add Infrastructure in support of new Service Instance
    - Enhance/Add Infrastructure in support of Infrastructure Improvement with no change to existing Service
  - Infrastructure Attributes
    - Safe
    - Efficient
    - Cost-Effective
    - Reliable / Available
    - Compatible / Interoperable
    - Secure

Mission Roadmap Context

1. Organizational Initiatives
   (Establish Focus Areas and Performance Measures…)

2. Mission Roadmap
   (Strategy for Satisfaction of Initiatives over time)

3. Concept & Reqs Def
   (Effective solutions for Needed Improvements)
A TO Service – Infrastructure Relationships

<table>
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<tr>
<th>Services</th>
<th>Service Performance Improvements</th>
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<tr>
<td>Current</td>
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<tr>
<td>SI Instance</td>
<td>Service Enhancement</td>
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<td>SI Enhancement</td>
<td>Service Expansion</td>
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Service Improvement Attributes
- Safe
- Efficient (Expeditious, Orderly, Transparent, Equitable/Fair)
- Dynamic (Flexible, Adaptable, Scaleable, Predictable)

Infrastructure Performance Improvement
- Infrastructure Enhancement
- Infrastructure Expansion

Current - Today's Service
- Service Enhancement
- Infrastructure Enhancement
- Infrastructure Expansion

New II
- Infrastructure Improvement
- Service Expansion

Service Improvement Attributes
- Safe
- Efficient
- Cost-Effective
- Reliable / Available
- Compatible / Interoperable
- Secure

Automation Roadmap DRAFT

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<th>Domain Convergence Analysis</th>
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Navigation Roadmap - DRAFT

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Surveillance Evolution – A/G

**Near-Term**
- Route & Procedure-based Operations

**Mid-Term**
- Architecture: Information processing, distribution, Use by DST, Procedures and display information

**Far-Term**
- Information-based Operations

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Air Transportation System Engineering, GMU, April 6, 2005
## Communication Evolution – A/G

### Near-Term
- Voice-based analog environment
- Air Transportation System Engineering, GMU, April 6, 2005

### Mid-Term
- Transition to networked communications for both voice and data
- Introduction of digital voice
- Consolidation of circuits
- Integration of automation and A-G systems

### Far-Term
- Fully networked system
- Common voice switch deployment
- Introducing robust reconfiguration functionality

### General
- Fully networked system
- Common voice switch deployment
- Introducing robust reconfiguration functionality

### Systems
- ANICS
- FTI
- VSCS
- VHF A/G
- DVRS
- FIS

## Navigation Evolution – A/G

### Near-Term
- Conventional navigation capabilities
- Introduction of RNAV capabilities
- Introduction of RNP requirements
- Conventional step-down non-precision approaches
- Pt. To Pt. Route structure

### Mid-Term
- Increasing GPS-based capabilities
- Flexible RNAV capabilities
- Introduction of vertically guided instrument approaches
- Consolidation of conventional navigation infrastructure
- ILS segmented and extended by WAAS

### Far-Term
- Introduction of GPS-based precision approaches
- Consolidation of approach infrastructure
- Wide-spread use of RNP/RNAV capabilities
- Continuously stabilized decent vertical guidance

### General
- Introduction of GPS-based precision approaches
- Consolidation of approach infrastructure
- Wide-spread use of RNP/RNAV capabilities
- Continuously stabilized decent vertical guidance

### Systems
- VOR
- DME
- VOR/DME
- TACAN
- NDB
- ILS (LOC, GS, MB)
- LDA
- GPS

### General
- Transition to networked communications for both voice and data
- Introduction of digital voice
- Consolidation of circuits
- Integration of automation and A-G systems

### Systems
- ANICS
- FTI
- VSCS
- NVS
- VHF A/G
- New A/G Comm
- Data Link
- DVRS
- FIS