



Implementing Global Air Traffic Management (ATM)

MITRE

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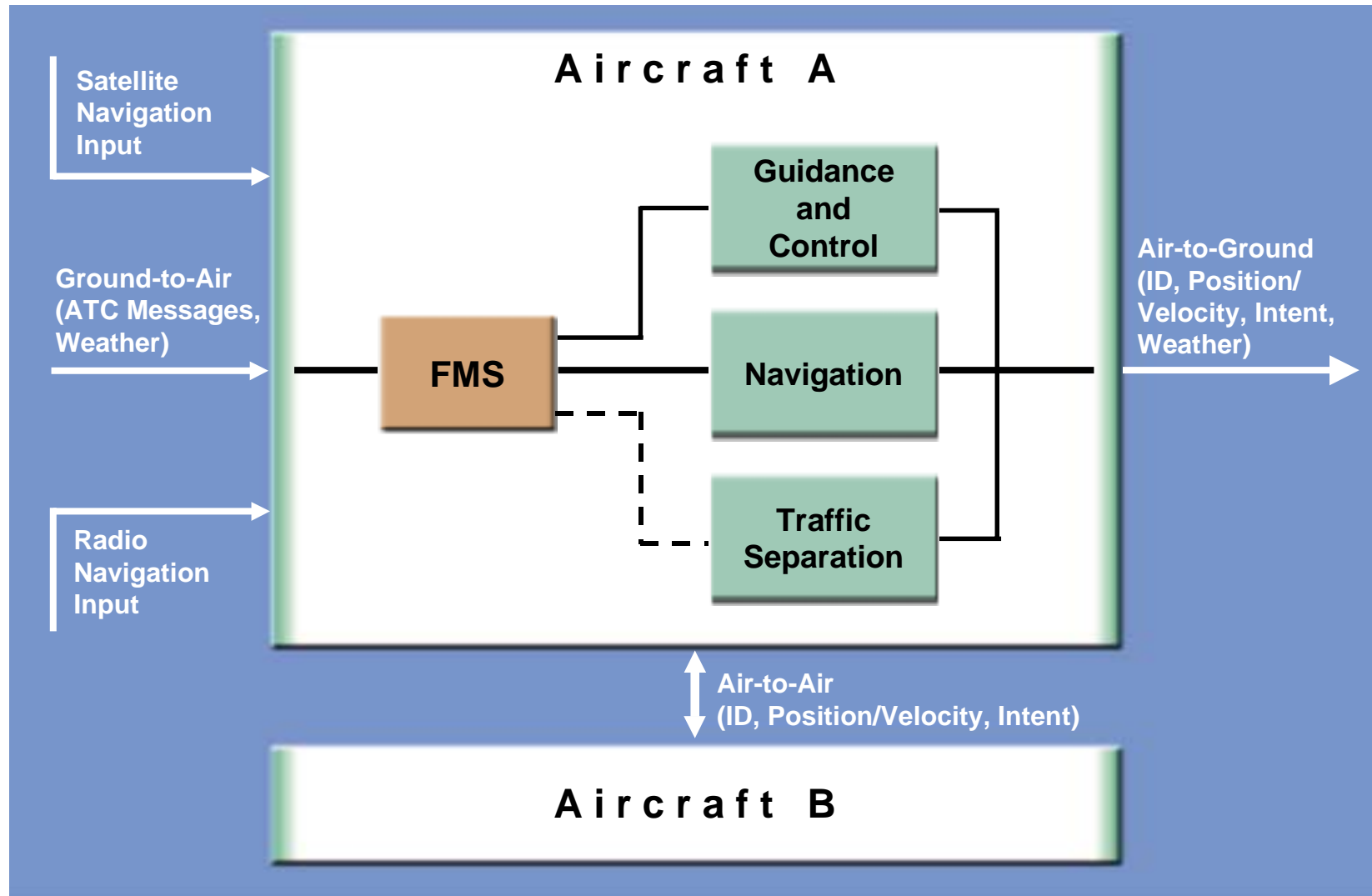
Introduction

- **The objective of modern day air transportation is to provide safe, efficient and profitable operation while satisfying user preference/convenience to the maximum extent possible**
- **Technology advancements have contributed significantly to increasing the capabilities of ATM, but continued effort to improve the overall system performance is necessary**
- **Successful implementation depends on:**
 - **Understanding the functional elements and their interrelationships**
 - **Understanding the impact of technology advancements on system performance**
 - **Taking lessons learned seriously**

Functional Elements of Airborne ATM

- **Flight management system (FMS)**
- **Guidance and control**
 - Acceleration and velocity control
- **Navigation**
 - Position determination
- **Traffic awareness and separation**
 - Relative position determination

Functional Elements of the Airborne ATM

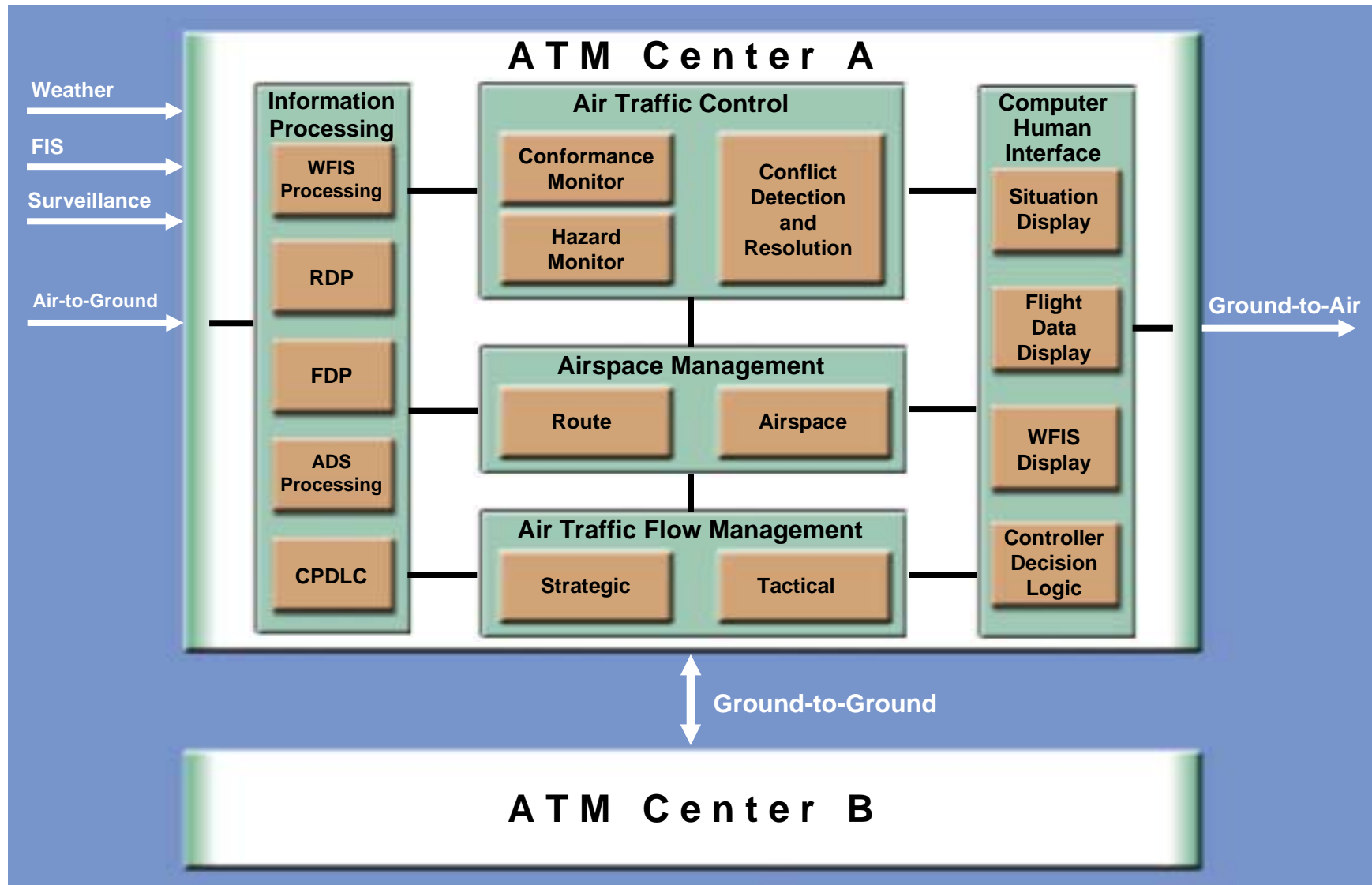


NOTE:  = I/O Processing, Computer Human Interface, and Cockpit Display

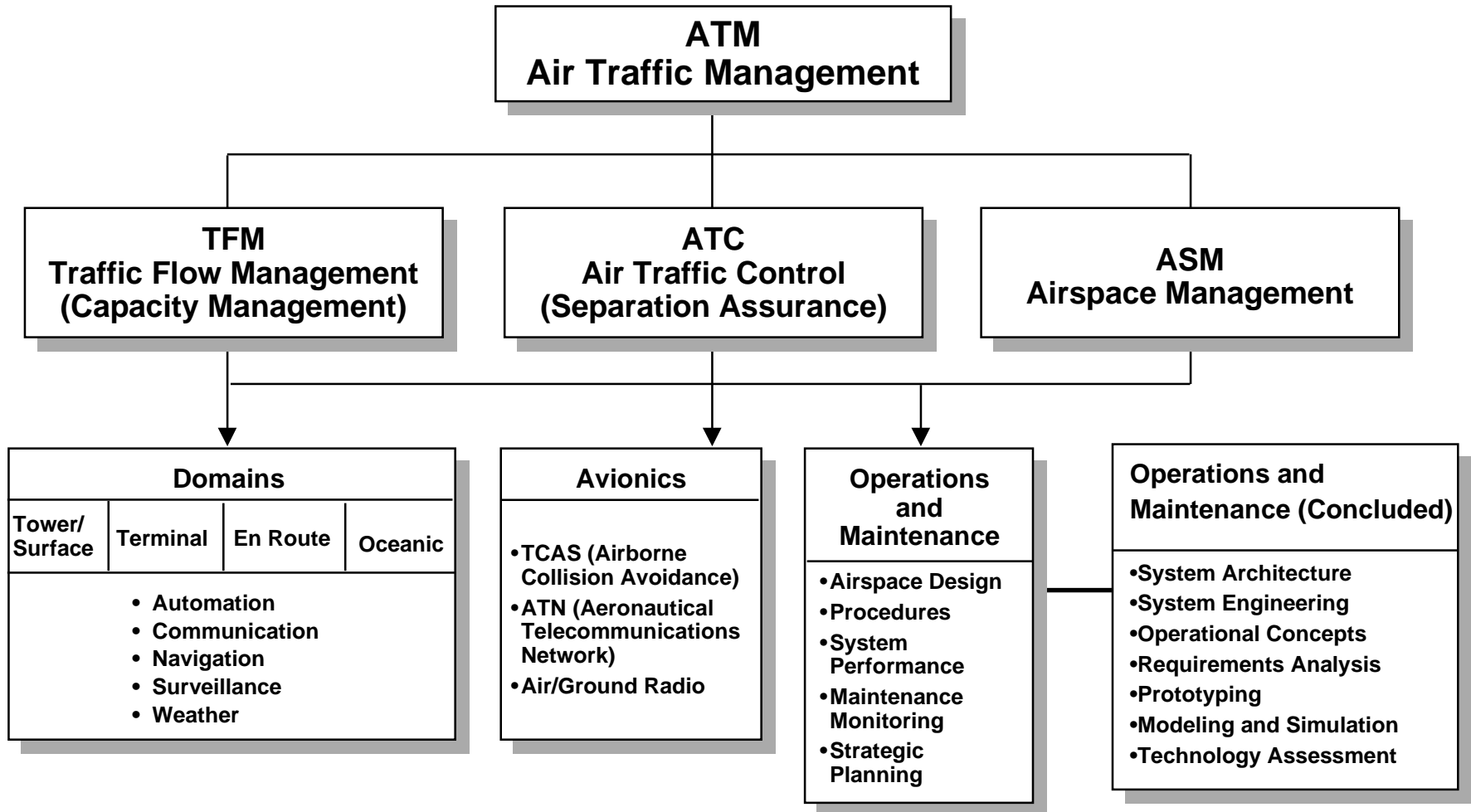
Functional Elements of Ground ATM

- **Information processing**
 - RDP, FDP, ADS processing, WFIS processing, CPDLC
- **ATC (separation assurance)**
 - Conformance monitoring, hazard monitoring, conflict detection & resolution
- **ATFM (capacity management)**
 - Strategic flow planning, tactical flow control
- **ASM (airspace management)**
 - Airspace organization, national route system
- **CHI (computer human interface)**
 - WFIS/situation/flight data displays, controller decision logic

Functional Elements of the Ground ATM



ICAO ATM Definition

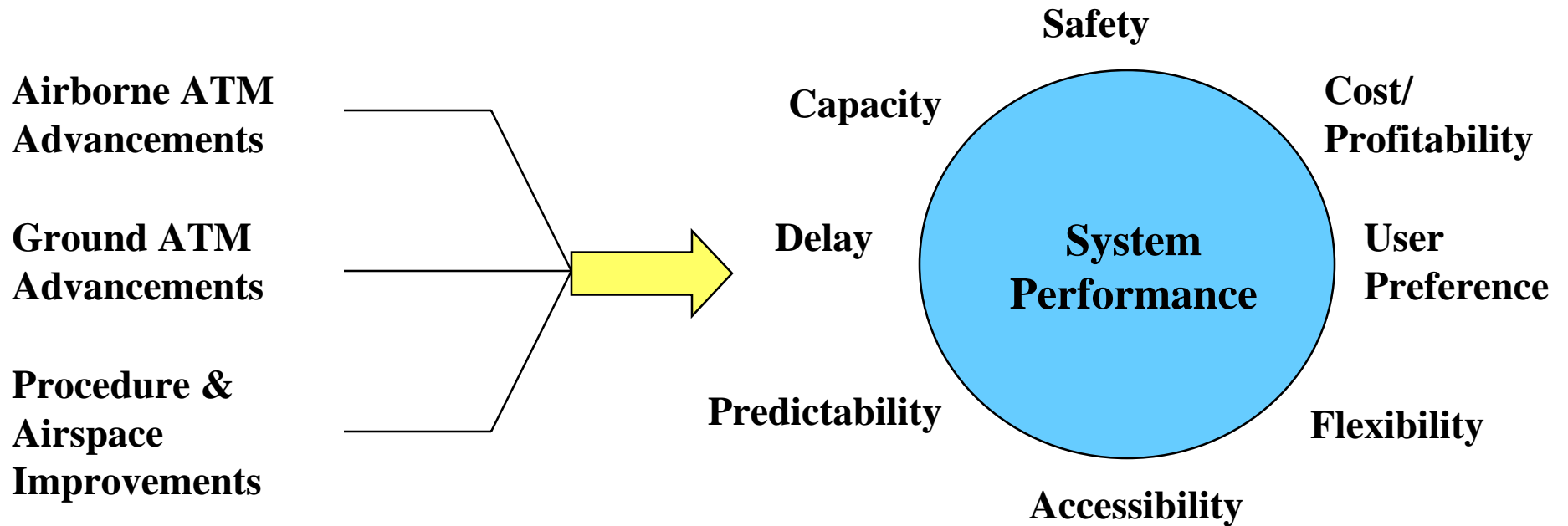


Relationships/Dependencies with Communication, Navigation and Surveillance Systems

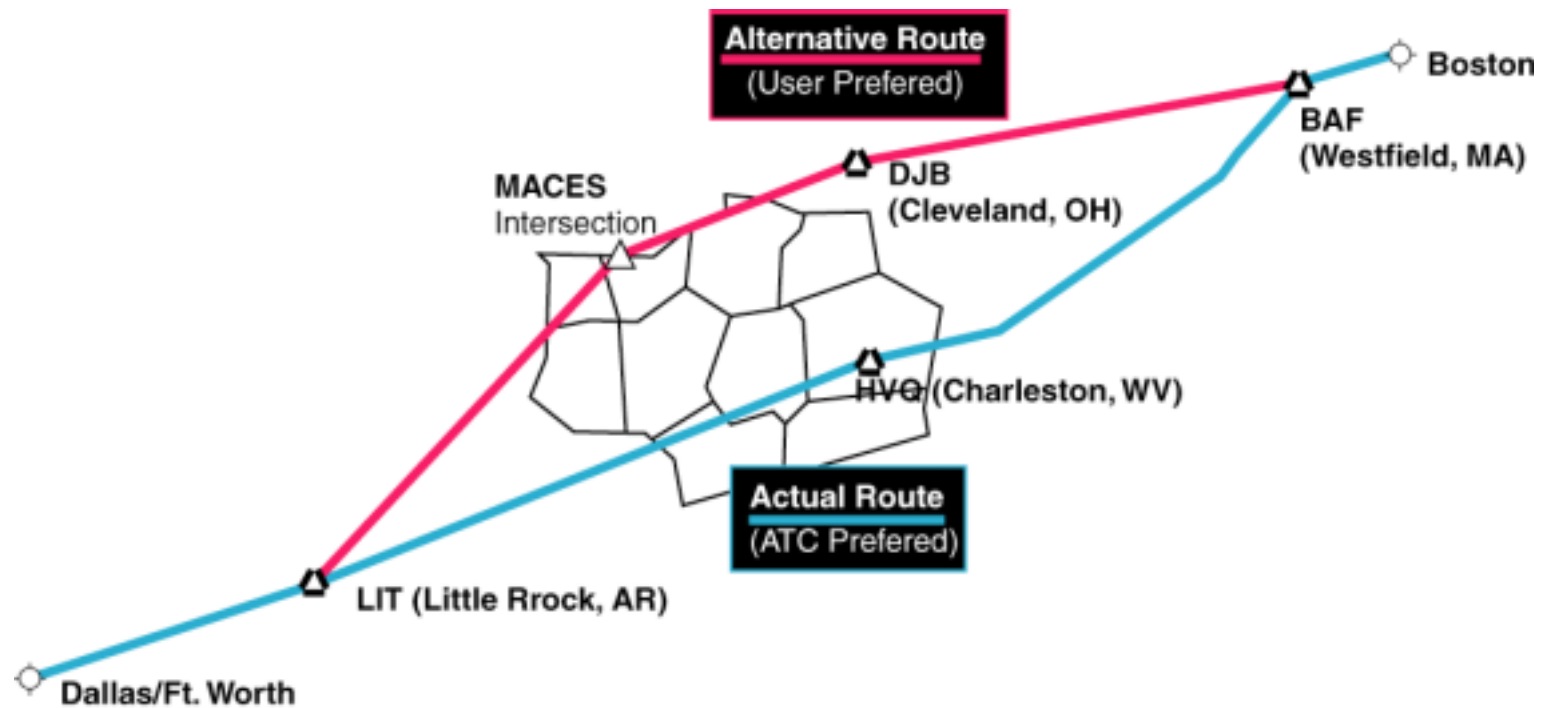
- Successful ATM implementation requires a modern communication, navigation and surveillance infrastructure

ATM Functional Elements		Dependencies		
		Communication (Sat Comm, Data, Link, ATN, etc)	Navigation (GNSS, SBAS/GBAS, etc)	Surveillance (ADS, Radar, etc)
Airborne	FMS	X	X	
	Guidance/Control	X		
	Navigation	X	X	
	Traffic Separation	X	X	X
Ground	Information Processing	X		X
	ATC	X		X
	ATFM	X		X
	ASM	X		
	CHI	X		X

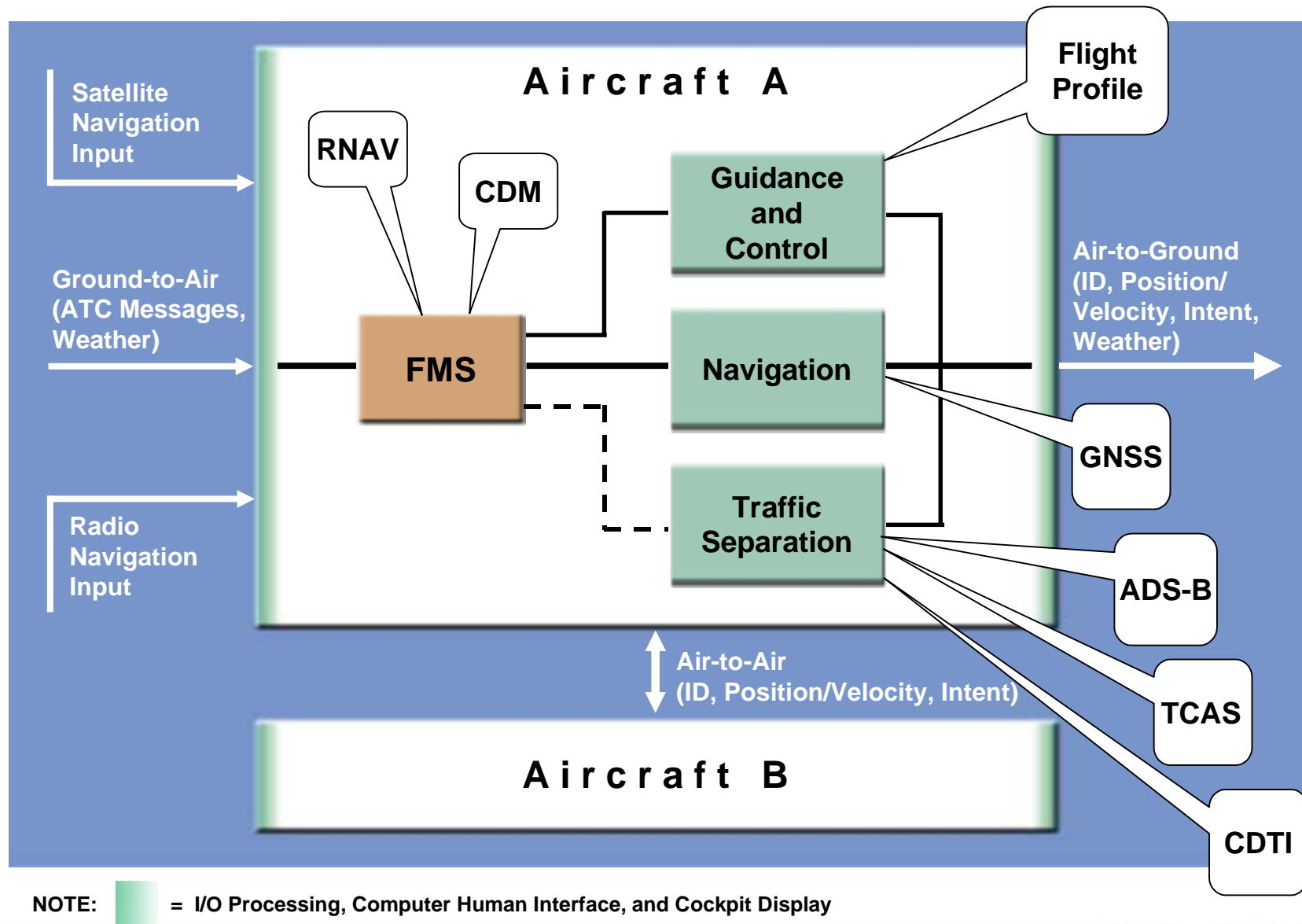
Impact of Advanced ATM on Aviation System Performance



URET Significant Benefits: Evolution to User-Preferred Routing with Safety Assurance



Functional Elements of the Airborne ATM

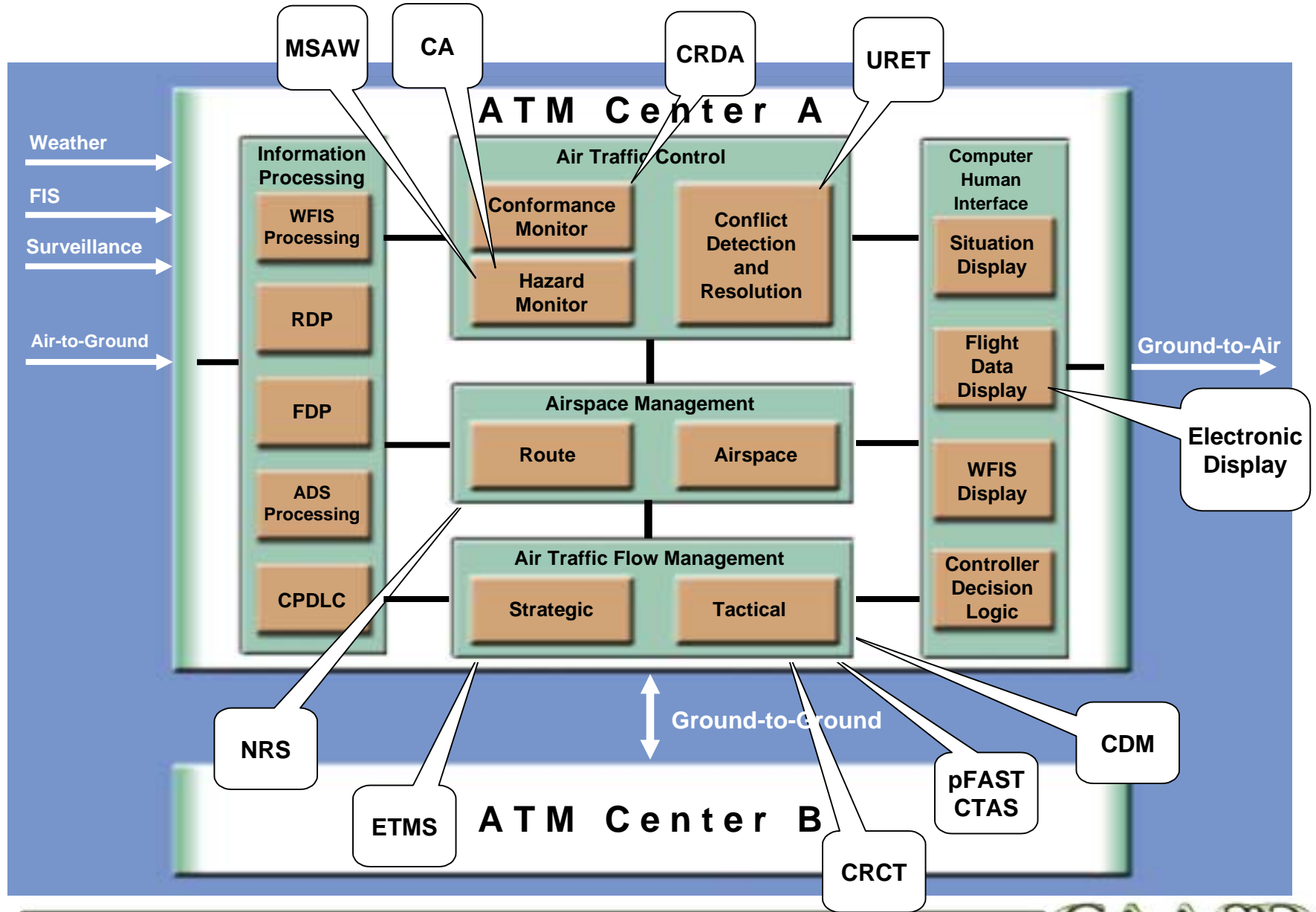


Airborne ATM Implementation

Functional Elements	Recent Technology Advancements	Lessons Learned	Future Directions
FMS	RNAV, Autoland, Data Link integration, CDM*	<ul style="list-style-type: none"> • Current ATC rules prevent full utilization of FMS & RNAV • Data link implementation must be evolutionary 	<ul style="list-style-type: none"> • ATC instruction integration • FMS/RNAV procedure enhanced
Guidance & Control	Flight profile algorithms	<ul style="list-style-type: none"> • How soon/how far automation could be pushed 	<ul style="list-style-type: none"> • More automation-driven procedures
Navigation	GNSS with RAIM, Augmented GNSS*	<ul style="list-style-type: none"> • Overly optimistic on GNSS' susceptibility (precision approach) 	<ul style="list-style-type: none"> • Integrated navigation capability
Traffic Separation	ACAS/TCAS, ADS-B*, CDTI*	<ul style="list-style-type: none"> • TCAS proven to be the premier airborne safety assurance capability • ADS-B's safety benefit to GA evident 	<ul style="list-style-type: none"> • ADS-B, CDTI • Conflict resolution & applications

Note: *being implemented

Functional Elements of the Ground ATM



Ground ATM Implementation

Functional Elements	Recent Technology Advancements	Lessons Learned	Future Needs
Information Processing	ADS* & ADS-B*, CPDLC*	<ul style="list-style-type: none"> • Easy to implement ADS for flight monitoring; difficult for ATC separation 	<ul style="list-style-type: none"> • Data fusion • Improved procedures
ATC	Conflict Alert, MSAW, URET*, CRDA*	<ul style="list-style-type: none"> • User participation/consensus • Implementation is site dependent 	
ATFM	ETMS, pFAST*, CTAS*, CRCT*, CDM*, Spring 2000	<ul style="list-style-type: none"> • Build a little, use a little • Procedure enhancement critical to success 	<ul style="list-style-type: none"> • URET expansion • Conflict resolution & decision support
ASM	NRS, Dynamic Resectoring	<ul style="list-style-type: none"> • Most difficult and complicated, but offers great potential for safety/capacity 	
CHI	Electronic FD display, Integrated display*	<ul style="list-style-type: none"> • Technology difficulty & user 	<ul style="list-style-type: none"> • Full implementation

Note: * being implemented

Summary

- **Continued advancements in ATM (airborne and ground) are necessary to meet the overall objectives of air transportation while accommodating the traffic growth**
- **Future directions of improvements include**
 - Maturity in CDM
 - Expanded decision support in ATC, ATFM and ASM
 - Airborne CDTI capability
- **Success can only be realized by integrating technology solutions with the following:**
 - Improved procedures
 - User participation/consensus
 - Evolutionary development approach
 - Continued, focused research efforts