United States Air Force
Unmanned Aircraft Systems Flight Plan
2009-2047

Headquarters, United States Air Force
Washington DC
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USAF Unmanned Aircraft Systems Flight Plan 2009-2047
Executive Summary

Unmanned aircraft systems (UAS) and the effects they provide have emerged as one of the most "in demand" capabilities the USAF provides the Joint Force. The attributes of persistence, endurance, efficiency, and connectivity are proven force multipliers across the spectrum of global Joint military operations. This document presents a *USAF Unmanned Aircraft Systems Flight Plan 2009 to 2047*. It is an actionable plan, characterized by Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy (DOTMLPF-P) recommendations, balancing lessons learned with future requirements. The vision is the USAF postured to harness increasingly automated, modular, globally connected, and sustainable multi-mission unmanned systems resulting in a leaner, more adaptable and efficient air force that maximizes our contribution to the Joint Force.

The USAF UAS Flight Plan describes a family of unmanned aircraft consisting of small man-portable vehicles, including micro and nano-sized vehicles, medium "fighter sized" vehicles, large "tanker sized" vehicles, and special vehicles with unique capabilities, all including autonomous-capable operations. The concept is to build a common set of airframes within a family of systems with interoperable, modular "plug and play" payloads, with standard interfaces, that can be tailored to fit one or more USAF Core Functions in support of the Joint Force's priorities.

The methodology behind this Flight Plan was to integrate present and anticipated future requirements from across the Combatant Commands, Office of the Secretary of Defense, and the other Services. The USAF Core Functions were used to define desired unmanned aircraft capabilities and effects. Recommendations for synchronized and sequenced DOTMLPF-P solutions are provided to help ensure that UASs continue to be the Joint Force multipliers and enhancers they are today while carefully bounding risk.

Specific policy implementation will ensure that the USAF is capable of leading, investing, acquiring, and employing UAS. Recommended actions include the creation of a high fidelity simulator with the goal of transitioning to simulator-only operator initial qualification training (IQT); establishing standard UAS interface data rights for the fielding of service-oriented open-system architectures; developing and procuring new command and control systems based on new open architecture; implementing independent logistics assessments (ILA); demonstrating and implementing technologies supporting airborne sense and avoid (ABSAA), auto takeoff and land capability (ATLC), small unmanned aircraft systems (SUAS) air launched capability, electronic attack (EA) capability for UAS, high altitude airships (HAA) and tech demonstration of MQ-M (medium sized) like modular payloads for UAS. These actions will be linked with other Service efforts whenever practical to provide truly Joint capabilities to the warfighter at the lowest total cost.

It is imperative to develop Airmen who are experienced in UAS employment and operations. Employment of these systems is increasingly complex and personnel require the necessary training and opportunities for advancement that will create a cadre of future USAF leaders. This Flight Plan presents options for UAS career paths to build a foundation for the development of officer and enlisted aircrew with UAS experience. Such a path is needed to meet the future challenges facing the USAF and the Joint Force through 2047.

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Secretary of the Air Force

Norton A. Schwartz
General, USAF
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List of Abbreviations

ACTD	Advanced Concept Technology Demonstration
ACC	Air Combat Command
ADM	Acquisition Decision Memorandum
AEHF	Advanced Extremely High Frequency
AESA	Active Electronically Scanned Array
AESW	UAS Aeronautical Systems Wing
AETC	Air Education and Training Command
AFCS	Air Force Corporate Structure
AFGLSC	Air Force Global Logistics Support Center
AFHSIO	Air Force Human Systems Integration Office
AFOSI	Air Force Office of Special Investigation
AFRL	Air Force Research Laboratory
AFSC	Air Force Specialty Code
AFSO21	Air Force Smart Operations
AFSOC	Air Force Special Operations Command
AFSPACE	United States Space Command Air Force.
AI	Artificial Intelligence
ALPA	Airline Pilots Association
AL-SUAS	Air-launched Small Unmanned Aircraft System
AMC	Air Mobility Command
AoA	Analysis of Alternatives
AOC	Air Operations Center
AOPA	Aircraft Owners and Pilots Association
AOR	Area of Responsibility
AS	Acquisition Sustainment
ASC	Aeronautical Systems Center
ASIP	Airborne Signals Intelligence Payload
AT&L	Acquisition, Technology, and Logistics
ATDL	Advanced Tactical Data Link
ATLC	Automatic Takeoff and Land Capability

ATM	Air Traffic Management
AWACS	Airborne Warning and Control System
BACN	Battlefield Airborne Communications Node
BAMS	Broad Area Maritime Surveillance
BATMAV	Battlefield Airman Targeting Micro Air Vehicle
BES	Budget Estimate Submissions
(B) LOS	(Beyond) Line-of-Sight
BMC2	Battle Management Command and Control
BQT	Basic Qualification Training
C2	Command and Control
CAF	Combat Air Forces
CAM	Centralized Asset Management
CAMS	Core Automated Maintenance System
CAP	Combat Air Patrol
CAS	Close Air Support
CBA	Capabilities-Based Assessment
CBM+	Condition Based Maintenance Plus
CBP	Customs and Border Protection
CBT	Computer Based Training
CCDR	Combatant Commander
CDL	Common Data Link
CEA	Career Enlisted Aviator
CFR	Code of Federal Regulations
CJCSI	Chairman of Joint Chiefs of Staff Instruction
CLS	Contract Logistics Support
CNAD	Conference of National Armaments Directors
COA	Courses of Action
COCOM	Combatant Command
COE	Center of Excellence
CONEMP	Concept of Employment
CONOPS	Concept of Operations
COTS	Commercial Off-The-Shelf
CRRA	Capabilities Review and Risk Assessment
CSAR	Combat Search and Rescue
D&SWS	Develop & Sustain Warfighting Systems

DARPA	Defense Advanced Research Projects Agency
DCA	Defensive Counter Air
DCGS	Distributed Common Ground System
DFG	Defense Fiscal Guidance
DHS	Dept of Homeland Security
DIRLAUTH	Direct Liaison Authorized
DMO	Distributed Mission Operations
DoD	Department of Defense
DOTMLPF-P	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities, and Policy
DRU	Direct Reporting Unit
EA	Electronic Attack
ECSS	Expeditionary Combat Support System
EHF	Extremely High Frequency
EISS	Enhanced Integrated Sensor Suite
eLog21	Enterprise Logistics for the 21st Century
EMP	Electro Magnetic Pulse
EO/IR	Electro-optical/infrared
EW	Electronic Warfare
E-WSO	Enlisted Weapon System Operator
F2T2EA	Find, Fix, Track, Target, Engage, Assess
FAA	Federal Aviation Administration
FAA	Functional Area Analysis
FLTC	Focused Long Term Challenges
FNA	Functional Needs Analysis
FOA	Field Operating Agency
FOL	Forward Operating Locations
FoS	Family of Systems
FSA	Functional Solutions Analysis
FSS	Fixed Satellite Service
FTD	Field Training Detachment
FTU	Formal Training Unit
GCS	Ground Control Station
GDF	Guidance for the Development of the Force
GIG	Global Information Grid

GMTI	Ground Moving Target Indicator
GPS	Global Positioning System
GWOT	Global War on Terrorism
HAA	High Altitude Airship
HALE	High Altitude Long Endurance
HPT	High Performance Team
HRR	High-Range Resolution
HSI	Human-Systems Integration
HVT	High Value Target
IADS	Integrated Air Defense System
IBS	Integrated Broadcast System
ICAO	International Civil Aviation Organization
IDIQ	Indefinite Delivery, Indefinite Quantity
IED	Improvised Explosive Device
ILA	Independent Logistics Assessment
ILCM	Integrated Life Cycle Management
IMDS	Integrated Maintenance Data System
INS	Inertial Navigation System
IPL	Integrated Priority Lists
IPT	Integrated Process Team
IQT	Initial Qualification Training
IR	Infrared
ISR	Intelligence, Surveillance, and Reconnaissance
IW	Irregular Warfare
JCA	Joint Capability Areas
JCIDS	Joint Capabilities Integration and Development System
JCOE	Joint UAS Center of Excellence
JCTD	Joint Concept Technical Demonstration
JFC	Joint Force Commander
JFCC	Joint Functional Component Commander
JFCOM	Joint Forces Command
JICD	Joint Interface Control Documents
JIOP	Joint Interoperability Profile
JPALS	Joint Precision Approach Landing System
JPG	Joint Programming Guidance

JPDO	Joint Programming Development Office
JSTARS	Joint Surveillance and Target Attack Radar System
JTAC	Joint Tactical Air Controller
JUAS	Joint Unmanned Aircraft System
JROC	Joint Requirements Oversight Council
JTTP	Joint Tactics, Techniques and Procedures
KPP	Key Performance Parameter
LCM	Life Cycle Management
LCMP	Life-Cycle Management Plan
LD/HD	Low Density, High Demand
LHA	Logistics Health Assessment
LOS	Line of Site
LPI/LPD	Low Probability of Intercept or Detection
LRE	Launch and Recovery Element
LVC	Live, Virtual, and Constructive
LVC-IA	Live, Virtual, and Constructive Integrating Architecture
LVT	Live and Virtual Training
MAC	Multi-Aircraft Control
MAJCOM	Major Command
MALD-J	Miniature Air Launch Decoy – Joint
MCE	Mission Control Element
MEM	Micro-Electronic Machines
MILSATCOM	Military Satellite Communications
MIP	Military Intelligence Program
MIS	Maintenance Information Systems
MP-RTIP	Multi-Platform Radar Technology Insertion Program
MQT	Mission Qualification Training
MUOS	Mobile User Objective System
NAS	National Airspace Systems
NDAA	National Defense Authorization Act
NextGen	Next Generation Air Transportation System
O&M	Operations and Management
OCA	Offensive Counter Air
OCO	Overseas Contingency Operation

OCR	Office of Coordinating Responsibility
OEM	Original Equipment Manufacturer
OIF	Operation IRAQI FREEDOM
OODA	Observe, Orient, Decide, and Act
OPCON	Operational Control
OPFOR	Opposition Force
OPR	Office of Primary Responsibility
OSD	Office of the Secretary of Defense
PAD	Processing, Analysis, and Dissemination
PB	President's Budget
PBFA	Policy Board on Federal Aviation
PDM	Program Decision Memorandum
PE	Program Element
PME	Professional Military Education
(A)POM	(Amended) Program Objective Memorandum
POR	Program of Record
PPBE	Planning, Programming, Budgeting, and Execution
PPDL	Predator Primary Data Link
QC	Quality Control
QDR	Quadrennial Defense Review
RAE	Resource Allocation Effectiveness
RAMS	Reliability, Availability, Maintainability and Sustainability
RDT&E	Research, Development, Test and Engineering
R&E	Research and Engineering
RF	Radio Frequency
ROI	Return on Investment
ROMO	Range of Military Operations
RSO	Remote-Split Ops
RTO	Responsible Test Organization
SADL	Situation Airborne Data Link
SAR	Synthetic Aperture Radar
SATCOM	Satellite Communications
SCO	Supply Chain Operations
SDB	SATCOM Data Base

SEAD	Suppression of Enemy Air Defense
SIGINT	Signals Intelligence
SLIM	Systems Lifecycle Integrity Management
SME	Subject Matter Expert
SO	Sensor Operators
SOA	Service Oriented Architecture
SOCOM	Special Operations Command
SPG	Strategic Planning Guidance
SSM	System Sustainment Manager
STANAG	Standardization Agreement
STUAS	Small Tactical Unmanned Aircraft System
SUAS	Small Unmanned Aircraft System
SUPT	Specialized Undergraduate Pilot Training
TACC	Tanker Airlift Control Center
TACON	Tactical Control
TE	Training Enterprise
TES	Tactical Exploitation System
TF	Task Force
TFI	Total Force Integration
TOA	Total Obligation Authority
TPAD	Tasking, Processing, Analysis and Dissemination
TRANSCOM	United States Transportation Command
TRL	Technology Readiness Level
TSAT	Transformational Satellite
TTP	Tactics, Techniques, Procedures
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle
UCP	Unified Command Plan
UCS	UAS Control Segment
UHF	Ultrahigh Frequency
WGS	Wideband Global SATCOM
WR-ALC	Warner Robins Air Logistics Center
WSOMS	Wideband SATCOM Operations Management System
XDR	Extended Data Rate

1. INTRODUCTION

1.1 Purpose

This Flight Plan is an actionable plan to achieve the USAF vision for the future of UAS. The USAF will implement the actions described within to evolve UAS capabilities. Given the dynamic nature of emerging technologies, this Flight Plan is a living document crafted to be updated as benchmarks are achieved and emerging technologies proven. Specifically, this plan outlines initiatives from 2009 to 2047 in DOTMLPF-P format that balance the early USAF unmanned lessons learned with current and emerging unmanned technology advancements. This inaugural plan focuses all USAF organizations on a common vision. The outline and milestones will be articulated with greater specificity through collaborative efforts. The vision is for a USAF positioned to harness increasingly automated, modular, and sustainable UAS resulting in leaner, more adaptable and tailorable forces that maximize the effectiveness of 21st Century airpower.

1.2 Assumptions

Ten key assumptions guided the development of the flight plan:

1. Integration of manned and unmanned systems increases capability across the full range of military operations for the Joint fight.
2. UAS are compelling where human physiology limits mission execution (e.g. persistence, speed of reaction, contaminated environment).
3. Automation with a clear and effective user interface are the keys to increasing effects while potentially reducing cost, forward footprint, and risk.
4. The desired USAF outcome is a product of the “system” of capabilities (payload, network, and Processing, Analysis and Dissemination (PAD)) and less a particular platform.
5. Modular systems with standardized interfaces are required for adaptability, sustainability, and reducing cost.
6. Agile, redundant, interoperable and robust command and control (C2) creates the capability of supervisory control (“man *on* the loop”) of UAS.
7. DOTMLPF-P solutions must be synchronized.
8. Industry will be able to deliver the needed technology in time for system development.
9. The range, reach, and lethality of 2047 combat operations will necessitate an unmanned system-of-systems to mitigate risk to mission and force, and provide perceive-act line execution.
10. The benchmarks outlined in this Flight Plan are achievable within USAF budgetary constraints.

1.3 Vision

This Flight Plan's vision is for a USAF:

- Where UAS are considered viable alternatives to a range of traditionally manned missions.
- That harnesses increasingly automated, modular and sustainable systems that retain our ability to employ UASs through their full envelope of performance resulting in a leaner, more adaptable, tailorable, and scalable force that maximizes combat capabilities to the Joint Force.
- Teaming with the other Services, our allies, academia, and industry to capitalize on the unique combination of attributes UAS provide: persistence, connectivity, flexibility, autonomy, and efficiency.
- That strives to get the most out of UAS to increase joint warfighting capability, while promoting service interdependency and the wisest use of tax dollars.

2. BACKGROUND

2.1 Basic Environment

UAS have experienced explosive growth in recent history, providing one of the most "in demand" capabilities the USAF presents to the Joint Force. The attributes of persistence, efficiency, flexibility of mission, information collection and attack capability have repeatedly proven to be force multipliers across the spectrum of global Joint military operations. UAS not only provide information to senior operational decision makers, but also directly to Joint and Coalition forces operating in the field or in congested urban environments. UAS can aid forces in combat and perform strike missions against pre-planned or high-value opportunities, minimizing risk of collateral damage when it is a major consideration. UAS also have the ability to take advantage of the capability inherent to the Remote Split Operations (RSO) concept to flex assets between areas of responsibility (AORs) based on Joint Force Commander (JFC) and SECDEF priorities. Most USAF UAS are operated beyond line of sight (BLOS) from geographically separated location; therefore producing sustained combat capability more efficiently with a reduced forward footprint.

2.2 UAS Characteristics

An unmanned aircraft is not limited by human performance or physiological characteristics. Therefore, extreme persistence and maneuverability are intrinsic benefits that can be realized by UAS. Given that they are unmanned, potential UAS operational environments can include contested and denied areas without exposing a crew to those risks. Further, the size of the aircraft is not constrained by life support elements and size of the person. Ultimately unmanned airpower can be carried in a backpack with commensurate capabilities.

Future UAS will require access to an interoperable, affordable, responsive and sustainable tactical network system of systems capable of satisfying Service, Joint, Interagency, and Coalition tactical information exchanges. This tactical network system will be distributed, scalable and secure. It includes, but is not limited to, human interfaces, software applications and interfaces, network transport, network services, information services and the hardware and interfaces necessary to form a complete system that delivers tactical mission outcomes. The tactical network system operates as independent small combat sub-networks connected to each other and to the Global Information Grid (GIG). The advantages of this structure make worldwide real-time information available to the pilot as well as worldwide real-time dissemination of information from the UAS. Terrestrial based resources and connectivity allow specialized skills to be called upon on demand when and where needed.

UAS increase the percentage of assets available for operations due to their distributive nature. It may be possible for initial qualification training of UAS crews to be accomplished via simulators almost entirely without launching an aircraft, enabling a higher percentage of aircraft to be combat coded and available for other operations. The resulting deployment and employment efficiencies lend greater capability at the same or reduced expense when compared to manned equivalents.

UAS will adopt a UAS Control Segment (UCS) architecture that is open, standard, scalable and will allow for rapid addition of modular functionality. This architecture will enable the warfighter to add capability, offer competitive options, encourage innovation and increase cost control. It can also dramatically improve interoperability and data access, and increase training efficiencies. Flexibility will allow adapting the man-machine interface for specific Military Service's Concept of Operations (CONOPS) while maintaining commonality on the underlying architecture and computing hardware. Furthermore, a Department of Defense (DoD) architecture utilizing a core open architecture model will allow competition among companies to provide new tools like visualization, data archiving and tagging, and auto tracking.

As technologies advance, UAS automation and hypersonic flight will reshape the battlefield of tomorrow. One of the most important elements to consider with this battlefield is the potential for UAS to rapidly compress the observe, orient, decide, and act (OODA) loop. Future UAS able to perceive the situation and act independently with limited or little human input will greatly shorten decision time. This Perceive-Act line is critical to countering growing adversary UAS threats that seek automation capabilities (ref. Annex 1). As autonomy and automation merge, UAS will be able to swarm (one pilot directing the actions of many multi-mission aircraft) creating a focused, relentless, and scaled attack.

3. PROCESS

3.1 Methodology

The unique characteristics and attributes inherent in UAS provide the basis to determine future missions where UAS would enhance Joint Forces combat effectiveness. The goal of this process was to determine appropriate mission areas where UAS would best serve the JFC. The relevant mission areas were then prioritized based on inherent UAS capabilities and limitations. Actions required to achieve these capabilities were viewed through the lens of Joint DOTMLPF-P to articulate the USAF decisions required to achieve the requisite capabilities. Since the Flight Plan spans all systems across all potential missions over a 40-year period, the solutions are assembled as a portfolio of capability milestones over time. It is important to note that this is not a Capabilities Based Assessment (CBA). However, this process provides the initial steps for future CBAs and analysis.

The UAS Flight Plan development process consisted of five primary steps:

Step 1: Define UAS-enabled Mission Areas.

Joint strategic documents were reviewed to identify mission areas where UAS could best serve the Joint Force. The Joint Capability Areas (JCA) describes the portfolios of capabilities that are then applied to meet DoD challenges. Services then link their core functions to the JCAs to identify how they contribute to these Joint capabilities. The USAF core functions are: Nuclear Deterrence Operations, Air Superiority, Space Superiority, Cyberspace Superiority, Command and Control, Global Integrated Intelligence Surveillance and Reconnaissance, Global Precision Attack, Special Operations, Rapid Global Mobility, Personnel Recovery, Agile Combat Support and Building Partnerships. These are broken down further into means (capabilities and associated mission areas) to support the Joint capabilities. In this process, each of the USAF core functions and the associated means were assessed to determine those that UAS attributes would best support. This resulted in a list of current and emerging USAF UAS-enabled core functions and means. The UAS-enabled USAF means were then mapped to Combatant Command (COCOM) Integrated Priority Lists (IPLs) to determine the capabilities and mission areas that could be enhanced by future UAS technology investments.

Step 2: Apply Capabilities Review and Risk Assessment (CRRA) results to identify near- and far-term operational gaps and shortfalls to the defined UAS-enabled mission areas.

The above UAS-enabled mission areas were then compared against the results of the CRRA to determine where UAS technologies provide the greatest potential to mitigate gaps and shortfalls to the Joint Force. This resulted in a list of UAS-enabled capability areas.

Step 3: Prioritize UAS-enabled capability areas.

The capabilities were sorted first by whether they were priority shortfalls for both the COCOM and the USAF and then by the likelihood an investment in UAS technology could address the shortfall. Given the weighted priority of the capability and the severity of the shortfalls (as identified in the CRRA), prioritized capabilities and operational mission requirements for UAS investment were developed.

Step 4: Develop Capability Portfolios.

The prioritized UAS-enabled capability areas were analyzed against a list of potential technologies, activities or process changes where execution of, or investment in those changes would impact UAS functionality, management or employment. The capabilities were articulated in DOTMLPF-P format and then linked with dependent activities. Sets of dependant activities that aggregately achieved a definable step toward the Flight Plan vision were designated as a capability portfolio. The resulting portfolios form a critical path that lead toward the UAS Flight Plan vision.

Step 5: Determine immediate Action Plan.

Using the capability portfolios, prioritized near- to mid-term, USAF DOTMLPF-P courses of action were assessed for resources and time anticipated to implement or effect the necessary change. These courses of action were shared with other Services to identify potential areas for teaming. Some of the critical and time-sensitive courses of action require immediate action. This set of immediate actions was then presented as a decision briefing to USAF Senior Leaders.

3.2 Implementation Plan

The Deputy Chief of Staff for ISR (DCS/ISR) (HAF/A2) will present UAS issues for decision through the normal corporate processes and timelines. Technology development areas will be integrated through the Air Force Research Laboratory (AFRL) Focused Long Term Challenges (FLTC) process. Updates on UAS actions and decisions required of SECAF/CSAF will be presented on a quarterly basis. HAF A2 will ensure that the updates are approved across the applicable Deputy Chiefs of Staff and MAJCOMS before they are presented.

3.3 Roles and Responsibilities

The USAF initially relied upon a cross-matrixed USAF UAS Task Force to invigorate the nascent UAS expertise. The FY10 Program Objective Memorandum (POM) continues funding for this organization.

Subsequent annual iteration of the UAS Flight Plan process methodology described above ensures a USAF postured to harness increasingly automated, modular and sustainable UAS resulting in leaner, more adaptable and efficient forces that maximize our contribution to the Joint Force.

3.4 DOTMLPF-P Immediate Actions:

The following DOTMLPF-P immediate actions were identified. These initiatives are not the comprehensive list of what must be done for the programs but are intended to show the initial steps toward the flight plan vision. As such they will be accomplished if funding and resources can be identified after they are prioritized relative to the existing program development actions:

D: Assess options for UAS units to support multiple Combatant Commanders (CCDRs) by 4QFY10

O: Focus Aeronautical Systems Center (ASC) on all components of all types of UAS including Small UAS (SUAS) and High Altitude Airship (HAA) for more effective development and acquisition by 4QFY09 (test-bed for Life Cycle Management Excellence)

O: Stand up two SUAS squadrons by FY10

T: Demonstrate High Fidelity Simulator: Up to 100% Initial qualification training (IQT) (MQ-1/9, RQ-4) by 4QFY10

M: Demonstrate onboard Airborne Sense and Avoid (ABSAA) 3QFY10

M: Implement improved Multi-Aircraft Control (MAC) in MQ-1/MQ-9 ground control stations (GCS) by 4QFY10

M: Demonstrate enhanced MAC technology and Concept of Employment (CONEMP) for Airborne launched SUAS from MQ-1/9 class UAS, for UAS MAC-like teaming and enhanced “through-the-weather” intelligence, surveillance, and reconnaissance (ISR) in 4QFY10

M: Demonstrate an interoperable, standards-based, Service-oriented open architecture command and control for MQ-1B/C, MQ-8, MQ-9, RQ-4 by 3QFY10

M: Demonstrate HAA UAS in 3QFY09

M: Concept demonstration of MQ-medium-sized (MQ-M)-like modular capability in FY10

M: Demonstrate MQ-9 Auto Takeoff and Landing Capability (ATLC) by 4QFY10

M: Implement protected communications for MQ-1 and MQ-9 by FY14

M: Demonstrate UAS Electronic Attack (EA) Capability for MQ-9 by 4QFY10

L: UAS Leaders: Develop, promote and assign leaders with UAS experience to key enterprise positions as soon as possible

L: Define UAS personnel career paths, training and sourcing by 1QFY10

P: Airspace Integration: Propose comprehensive National Airspace Integration Policy to the Office of the Secretary of Defense (OSD) by 4QFY09

P: Review and provide product support and Independent Logistics Assessment (ILA) policy guidance for future systems fielded through the rapid acquisition process; publish interim guidance by 1QFY10

P: Validate Flight Plan through Joint Capability Integration Development System (JCIDS) by 4QFY09

P: Define UAS personnel Air Force Specialty Codes (AFSC) career paths, training and sourcing by FY10

3.5 DOTMLPF-P Future Portfolio Actions

The immediate actions enable the evolution of the capabilities outlined in Annex 4. Over time, families of small, medium and large systems will be developed to become capable of supporting most air missions. To achieve this, the flight plan identifies two common attributes that will be realized over time through technological advancement. First, modularity provides a way to upgrade, augment or replace technologies while preserving the bulk of one’s investment. Systems can be managed as a portfolio of potential capabilities able to adjust quickly to the battlefield needs and to grow and adapt as these needs evolve. Secondly, advances in computing speeds and capacity over time will enable systems to make some decisions and potentially act on them without requiring human input. Policy, legal considerations, CONOPS and doctrine will determine the level of human input required for specific aspects of missions. The interdependent DOTMLPF-P steps describe the increments of capabilities achieved through the development of these attributes over time.

4. EFFECTIVE DATE:

This document is the United States Air Force Unmanned Aircraft Systems (UAS) vision (2009-2047). This UAS Flight Plan (FP) is effective upon receipt. Direct Liaison Authorized (DIRLAUTH).

5. OFFICE OF PRIMARY RESPONSIBILITY (OPR):

The office of primary responsibility for implementing this plan, institutionalizing UAS, and coordinating approval of any updates is Colonel Eric Mathewson, HAF A2U. Colonel Mathewson can be reached at 703-601-4084.

6. ADDITIONAL REQUIREMENTS:

a. Modifications to the flight plan will be coordinated through the HAF A2U.

b. Annex 5, lists the actions the USAF could undertake to accomplish USAF UAS transformational goals and provides specific guidance to implement the actions as approved.

ANNEX 1- DOTMLPF-P ASSESSMENT OF UAS THREATS- Classified

1.1 Threats

1.2 Vulnerabilities

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ANNEX 2- GAPS AND SHORTFALLS-Classified

2.1 Application of Gaps and Shortfalls

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ANNEX 3- CURRENT PROGRAMS

<table>
<tr><th>UAS Category</th><th>Maximum Gross Takeoff Weight (lbs)</th><th>Normal Operating Altitude (ft)</th><th>Speed (KIAS)</th><th>Current / Future Representative UAS</th></tr>
<tr><td>Group 1</td><td>0-20</td><td>< 1,200 AGL</td><td>100 kts</td><td>Wasp III, FCS Class I, TACMAV, RQ-14A/B, BUSTER, BATCAM, RQ-11B/C, FPASS, RQ-16A, Pointer, Aqua Terra, Puma</td></tr>
<tr><td>Group 2</td><td>21-55</td><td>< 3,500 AGL</td><td rowspan="2">< 250</td><td>Vehicle Craft Unmanned Aircraft System, ScanEagle, Silver Fox, Aerosonde</td></tr>
<tr><td>Group 3</td><td>< 1320</td><td rowspan="2">< 18,000 MSL</td><td>RQ-7B, RQ-15, STUAS, XPV-1, XPV-2</td></tr>
<tr><td>Group 4</td><td rowspan="2">> 1320</td><td rowspan="2">Any Airspeed</td><td>MQ-5B, MQ-8B, MQ-1A/B/C, A-160</td></tr>
<tr><td>Group 5</td><td>> 18,000 MSL</td><td>MQ-9A, RQ-4, RQ-4N, Global Observer, N-UCAS</td></tr>
</table>

Figure 1: Joint UAS Group Classification (JCOE CONOPS)

3.1 Small UAS (SUAS)

Small UAS represent a profound technological advance in air warfare by providing not only the commander, but individual service members' life-saving situational awareness. The need for situational awareness and full-motion video (FMV) dominates urgent requests from the field. The USAF recognized the unique utility and capabilities of SUAS during initial phases of Operation IRAQI FREEDOM (OIF) where the USAF purchased Pointer SUAS for combat control units. Furthermore, the SUAS Family of Systems (FoS) represents a unique approach and challenge to the larger manpower structures supporting UAS operations. SUAS are highly effective in supporting integrated manned and unmanned mission sets beyond those met by the MQ-1/9 and RQ-4.

Battlefield Airman Targeting Micro Air Vehicle (BATMAV)
Wasp III

The Wasp III is a hand-launched, horizontal-landing SUAS that carries an integrated forward and side-looking electro optical (EO) camera with pan, tilt and zoom. This modular payload is swappable with an infrared (IR) imager. The aircraft can be manually flown or programmed with GPS-based autonomous navigation to perform day or night reconnaissance and surveillance missions at low altitude within a range of three miles. The current purchased inventory is 221 systems with 442 aircraft. Wasp III is funded through USAF Special Operations Command (AFSOC) funding lines, using an Indefinite Delivery, Indefinite Quantity (IDIQ) contract to accommodate rapid technology and development changes. This contract is used by all service components in Special Operations Command (SOCOM) to purchase SUAS.

Wasp III has the following performance:
Altitude: Max 1,000 ft; Normal Operations: 50-150 ft
Range: 3 miles; Endurance: 45 minutes
Maximum Speed: 40 mph; Cruise speed: 20 mph

Force Protection Airborne Surveillance System
RQ-11 Raven
The Raven is a hand-launched, deep stall vertical landing SUAS (Group 1) that carries a dual forward and side-looking pan/tilt/zoom EO camera and an IR camera. The aircraft can be manually flown or programmed with GPS-based autonomous navigation to perform day or night reconnaissance and surveillance missions at low altitude within a range of 7 to 10 miles. The current purchased inventory is 36 systems with a total of 108 aircraft.

Raven has the following performance:
Altitude: Max 14,000 ft; Normal Operations: 150-500 ft
Range: 7-10 miles; Endurance: 60-90 minutes
Maximum Speed: 60 mph; Cruise speed: 27 mph

Scan Eagle interim solution:
The Scan Eagle is a catapult-launched, SkyHook land/retrieval SUAS (Group 2) that carries an inertially stabilized camera turret containing an EO or IR camera that provides a persistent stare capability and small vehicle resolution from up to five miles away. The aircraft can be semi-manually flown by human operators or programmed with GPS-based autonomous navigation to perform real-time situational awareness missions and force protection information missions at low altitude with a range of 68 miles. The current inventory is one system with six aircraft.

Scan Eagle has the following performance:
Altitude: Max 16,500 ft; Normal Operations: 1000 – 2,500 ft
Range: 68 miles; Endurance: 20+ hrs
Maximum Speed: 80 mph; Cruise speed: 55 mph

Raven and Scan Eagle systems have both been purchased with Global War on Terrorism (GWOT) supplemental funding.

3.2 Medium UAS

MQ-1 Predator:
The Predator is an armed, multi-role, long endurance UAS (Group 4) that carries an EO/IR payload, laser target marker, laser illuminator and signal intelligence (SIGINT) payloads. Rated USAF pilots fly these aircraft by one of three methods. These methods are: manual flying, semi-autonomous monitored flight and pre-programmed flight. With two data link options, Predators can be flown LOS within approximately 100 miles of the launch and recovery base or flown BLOS via satellite datalinks. Missions can be controlled from the launch base or through remote split operations (RSO) from worldwide-based mission control elements. The crew and aircraft can re-role to any component of the kill chain during one mission while performing the following missions and tasks: intelligence, surveillance, reconnaissance (ISR), close air support (CAS), combat search and rescue (CSAR) support, precision strike, buddy laze, convoy overwatch, raid overwatch, target development, and terminal air control. Predators are used primarily for persistent ISR functions. The Predator force objective is 185 aircraft, funded through the Military Intelligence Program (MIP).

The Predator has the following performance:
Max Altitude: 25,000 ft; Employment altitude: 10,000-20,000 ft
Max speed: 120 KIAS; Loiter speed: 80 KIAS
Operational Endurance: 22 hrs
Max payload: 300 lbs externally

MQ-9 Reaper:
The Reaper is an armed, multi-role, long endurance UAS that carries an EO/IR payload, laser target marker, laser illuminator and synthetic aperture radar (SAR). Seven external hard points allow an open architecture variety of weapon and SIGINT payloads to be carried. Rated USAF pilots fly these aircraft by one of three methods. These methods are: manual flying, semi-autonomous monitored flight and pre-programmed flight. With two data link options, Reapers can be flown LOS within approximately 100 miles of the launch and recovery base or flown BLOS via satellite datalinks. Missions can be controlled from the launch base or through remote split operations (RSO) from worldwide-based mission control elements. The crew and aircraft can re-role to any component of the kill chain during one mission while performing the following missions and tasks: ISR, CAS, CSAR support, precision strike, buddy laze, convoy overwatch, raid overwatch, target development, and terminal air control. Reapers are used primarily for persistent strike functions while possessing loiter time for ISR functions as well. The Reaper FY10 force objective is 319 aircraft. This will enable a transition plan for growth to 50 Reaper and Predator combined combat air patrols (CAP) by 4QFY11 and all Reaper by FY16.

The Reaper has the following performance:
Max Altitude: 50,000 ft; Employment altitude: 25,000-30,000 ft
Max speed: 240 KIAS; Loiter speed: 100 KIAS
Operational endurance: 18 hrs
Max payload: 3000 lbs externally

3.3 Large UAS

RQ-4 Global Hawk:
The Global Hawk can be operated LOS or BLOS and transmit its data to the USAF Distributed Common Ground System (DCGS) or other nodes including the Army tactical exploitation system (TES) for exploitation and dissemination. The Global Hawk force structure contains two baseline models, RQ-4A and RQ-4B, in 4 production blocks, funded by the Military Intelligence Program (MIP).

Seven RQ-4A Block 10 aircraft are equipped with EO, IR, and SAR sensors. Six RQ-4B Block 20 aircraft will be equipped with the Battlefield Airborne Communications Node (BACN). BACN provides a Tactical Data Link gateway between Link 16, the Situation Airborne Data Link (SADL) and the Integrated Broadcast System (IBS). Through BACN, users of these three systems can share information and form a common tactical picture. Further, BACN provides an Internet Protocol based networking capability so military networks can interface and share content across both secure and open internet connections. BACN provides the capability to "cross-band" military, civilian and commercial communications systems. Further, BACN allows soldiers on foot, or platforms without advanced communications systems to connect via cellular phones, existing narrow band radios, or even an airborne 802.11 to the battle field network. Forty-two RQ-4B Block 30 aircraft will have the Enhanced Integrated Sensor Suite (EISS) with EO, IR, and SAR and the Airborne Signals Intelligence Payload (ASIP) for SIGINT collection. Twenty-two RQ-4B Block 40 aircraft will have the Multi-Platform Radar Technology Insertion Program (MP-RTIP) payload; planned capability includes Active Electronically Scanned Array (AESA) radar with concurrent high-resolution SAR imagery, high-range-resolution (HRR) imagery, and robust Ground Moving Target Indicator (GMTI) data.

The ground stations (10 for the multi-INT systems; 3 for the Block 40) consist of a Launch and Recovery Element (LRE) and the Mission Control Element (MCE). The crew is two pilots (1 for MCE, 1 for LRE), one sensor operator, and additional support that include one Quality Control (QC) manager, and one communications technician.

The Global Hawk has the following performance:
Max Altitude: 65,000 ft (Block 10), 60,000 ft (Blocks 20/30/40)
Max speed: 340 KTAS (Block 10), 320 KTAS (Blocks 20/30/40)
Max endurance: 28 hrs
Max payload: 2,000 lbs (Block 10), 3,000 lbs (Blocks 20/30/40)

3.4 GWOT - Supplemental to Baseline Funding

The Predator program has surged its combat air patrol count more than 520 percent since the beginning of the GWOT. Much of the bill for this surge has been paid through GWOT supplemental funding to cover UAS operational flying hour expenses, rapid materiel upgrades and satellite communications (SATCOM) data link expenses. As the Predator and Reaper programs transition into the future of global security, their respective funding is also transitioning into stabilized base line programming. This "Supp-to-Base" transition, requested by the SECAF, is currently being evaluated through departmental assessments of funding needs. Predator and Reaper Supp-to-Base funding information will be forthcoming in the final report by SAF/FMB.

The RQ-4 Global Hawk has no current supp-to-base funding requests.

GWOT funding is now transitioning to Overseas Contingency Operations (OCO) funding.

3.5 Manpower

USAF UAS GOAL:
50 MQ-1/9 CAPs, 3 RQ-4 CAPs by FY11, and 14 Groups of 1-3 SUAS
50 MQ-9 CAPs, 9 RQ-4 CAPs by FY16, and 14 Groups of 1-3 SUAS

The Secretary of Defense in response to COCOM critical FMV needs directed that Services maximize UAS procurement and fielding. The USAF identified the maximum manufacturing production rates of critical system components to establish the USAF UAS goals. The UAS TF works in close conjunction with HQ AF/A1, AFSOC, ANG, AFRC and other Major Commands (MAJCOMs) to determine the total UAS community end-strength to meet the USAF UAS goals mentioned above. Like all combat aircraft, UAS require personnel with sufficient skills in sufficient numbers to perform their tasks. Currently, increased system and mission complexity requires more advanced training. Similar personnel models used for manned platforms with regard to duty day and levels of supervision are applicable to UAS. This applies to maintenance, operators, intelligence and support personnel. The USAF used these models to determine the manpower required to achieve their goals. The largest manpower requirements include: Pilots (~1650), Sensor Operators (SO) (~1440), Mission Intel Coordinators (~900), PAD (~5300), Maintainers (~5500), and SUAS Operators (~680) for a total UAS community of nearly 15,000 Airmen.

Medium and Large UAS PILOTS: Currently, the USAF UAS pilot force is approximately 100 short of its Group 4 and 5 requirements. The requirement is to expand to over 1,100 crews in the next 3-5 years. Historically, the USAF manned UAS units using experienced pilots. This strategy accommodated the rapid acquisition and fielding of an Advanced Concept Technology Demonstration (ACTD). It allowed for short IQT programs (approximately 3 months) and allowed for an immediate injection of the pilots into a near-solo combat environment (e.g. no experienced flight lead or aircraft commander). However, recent growth has rendered this strategy unsustainable. The USAF has researched multiple options to the challenges of sourcing, training, sustaining and "normalizing" of UAS pilots. The two primary options that were developed for final consideration are described below. The USAF elected to conduct a "Beta Test" to determine the viability of option 1 (described below); this is the only option the AF is currently evaluating. Another option that was considered (option 2) is also described below and is provided for informational purposes only.

OPTION 1 – Non-traditional pilot: The USAF is testing a completely new training program with the goal to develop a UAS pilot career field with specialized UAS training distinct from current manned aircraft pilot training. A non-traditional pilot training path creates an additional source of UAS operators and relieves the UAS manpower burden on the current Specialized Undergraduate Pilot Training (SUPT) pipeline. Furthermore, training can be specifically tailored to the needs of the UAS community.

OPTION 2 - Irregular Warfare (IW) Pilot Track: An alternative option for a 5th track out of SUPT tailored for UAS pilots is supported by the Combat Air Forces (CAF). SUPT students would graduate after the T-6 phase with an instrument rating and finish training at a UAS formal training unit (FTU). These pilots would be capable of filling all Group 4 and 5 UAS requirements as well as manned IW platforms such as MC-

12W. HAF/A3/5 in conjunction with the applicable MAJCOMS would determine any applicable "rated" requirements these pilots could also perform. This option validates USAF commitment to IW as a core USAF mission.

Medium and Large UAS SO: USAF UAS Sensor Operators (SO) traditionally came from the intelligence 1N1 Imagery Analyst community (approximately 90%). There is an increased emphasis from the field for a more aviator centric career field similar to the 1A4 Career Enlisted Aviator (CEA) community. The USAF reviewed this issue and determined that while UAS SO tasks do demand an aviation-mindset and training, they are not airborne duties. Though the skills for UAS SO and 1A4XX are nearly a match, the risks of UAS SO are less than airborne duty. Requiring an aviator for this duty is unnecessary. To best manage the SO personnel training and development, CSAF established a new UAS SO career field (1U1X1).

Medium and Large UAS MISSION INTELLIGENCE COORDINATORS: The mission intelligence coordinator position was created in response to the ever increasing demand on the crew for information integration. This position is unique to the MQ-1 and MQ-9 because of the heavy emphasis on ISR and the fusion of data from numerous terrestrial based communication systems. Currently this position is manned from several sources, primarily 1N0 squadron intelligence positions and 14N intelligence officers. Crew duty days closely mirror those of the UAS crew. The USAF is actively addressing this position and developing courses of action (COAs) to standardize it.

Medium and Large UAS MAINTENANCE: Similar to the other manpower intensive positions, the UAS maintenance community is proactively developing long-term normalization plans that meet Joint requirements while balancing USAF manpower goals. Presently all Global Hawk organizational-level maintenance is USAF. In the case of MQ-1/9 however, 75% of ACC and 100% of AFSOC organizational-level flight line maintenance requirements are performed by contractors. HAF/A4/7 and HQ ACC both favor 100% replacement of organizational level flight line contractors with funded military authorizations.

OPTION #1 – MILITARY AND CONTRACT MAINTENANCE MIX: As UAS continue to proliferate; contract maintenance has become a necessity. Further, contractors do not affect the USAF end strength and many of the systems today have demonstrated success with contract maintenance.

OPTION #2 – MILITARY MAINTENANCE: This option will normalize UAS maintenance, enable development of a robust training pipeline and build a sustainable career field for the fastest growing segment of USAF aircraft maintenance. This option is more responsive, and potentially less expensive.

PAD/DCGS: As demand grows for UAS, so does the demand for intelligence analysts and the products they generate. The USAF chartered an ISR Forces Cross Functional Working Group tasked with planning for new growth to meet this increase in demand. The importance of solving the manpower shortfall is imperative as technology continues to outpace the USAF ability to source and train analysts. The USAF is working in close conjunction with AFRC to develop solutions to PAD manpower challenges. Additionally, the ANG is standing up two new locations to mitigate this capability challenge. Shortfalls exist due to the long training timeframes required for linguists (1N3) and the total training capacity available for imagery analysts (1N1). The USAF successfully resourced manpower to meet the accelerated UAS need in the FY10 POM, but sourcing and training airman while surging operations remains difficult. Directing the advanced research agencies such as Defense Advanced Research Projects Agency (DARPA) and AFRL to develop technological solutions that automate many labor intensive functions inherent to USAF DCGS and PAD is being explored.

SUAS: The USAF is committed to determining the correct method to man a sustainable normalized SUAS career force. AFSOC is the lead command for SUAS. Today, SUAS operations are considered additional duties to most other career fields, such as security forces, relieving the typical pressures of sourcing the crews. Most SUAS operators are also the maintainer and SO. However this additional duty adds a significant workload to units operating SUAS. Group 1 SUAS are employed by Battlefield Airmen and Security Forces for the specific purposes of battlefield situational awareness, force protection and aiding placement of fires. Considered a piece of equipment and an additional qualification, Group 1

SUAS are employed in tandem with other individual capabilities necessary for mission accomplishment. The Battlefield Airmen requirement, currently the only Air Force Program of Record, states the SUAS must be organically carried, launched, operated and recovered by a single individual. The initial attempt at fielding an interim Group 2 SUAS called Scan Eagle, demonstrated the requirement for dedicated SUAS operators and maintenance operators.

SUAS Operator: The individual responsible for the safe ground and flight operation of the unmanned aircraft and onboard systems. These operators are equivalent to the pilot-in-command of a manned aircraft. Regardless of the piloting method used, the individual is piloting a USAF aircraft requiring aviation skills. Those skills will be taught to individuals through the USAF training processes and will produce a certified pilot/operator for that particular group vehicle. Group 2 and 3 operators may require a viable and distinct career field that should be incorporated into the overall USAF career pyramid.

SUAS Sensor Operator (SO): The SUAS SOs may be dual qualified as a SUAS operator. This position mainly applies to the multi-mission UAS. Most USAF Group 1 and 2 SUAS do not have a separate sensor operator requirement.

POTENTIAL Group 2 SOLUTION: AFSOC is developing a sensor operator solution that will allow them to cross flow from manned ISR systems to large UAS sensor operators and then transition to Group 3 UAS Pilots. The rapid fielding of small UAS may alleviate the current shortfall for UAS capabilities such as FMV. Lessons learned from early UAS experiences provide the impetus to develop a professional career path and appropriately man the squadrons required to execute the USAF mission (for all sizes of UAS).

SOLUTIONS:

The USAF must immediately initiate positive actions at all levels to establish a long term, sustainable, normalized UAS culture. This will require senior leadership involvement, personnel and development processes, and realistic training development. Management must:

1. Program for the required manpower needs to meet the USAF UAS goals.
2. Assess and adjust UAS pilot development path, to include incentive pay and career incentive pay issues, as required.
3. Choose between CEA E-WSO and ground-only sensor operator.
4. Resource the labs for the development of automated PAD systems.
5. Assess maintenance strategy for organizational-level UAS aircraft and communications maintenance and adjust programming in FY12.
6. Lay appropriate foundations so SUAS can correctly develop manpower requirements.

Senior leader involvement is imperative to ensure that the personnel planning and development processes support the needs of the UAS community. Leaders must ensure that processes are in-place and followed for requirement identification, development and tracking to support a highly reliable UAS end state. The personnel process must fully support UAS needs while balancing the needs of other USAF missions.

It is expected that the UAS community will grow significantly in the near term. As the technology advances (especially with multi-aircraft control and autonomy) the community will overcome many of the current manpower challenges. This is significantly dependent upon a high level of attention given to the technological enablers chartered in this Flight Plan in order to realize this vision.

3.6 Human Systems Integration (HSI)

HSI is a disciplined and interactive systems engineering approach to integrate human considerations, including human capabilities and limitations, into system development, design, and life cycle management. Doing so will improve total system performance and reduce cost of ownership. The major domains of HSI are: manpower, personnel, training, human factors engineering, environment, safety, occupational health, survivability, and habitability. (AFI 63-1201).

As our USAF modernizes, UAS will continue to provide new and improved capabilities that will require unique interfaces with other operations, systems, and operators with a wide spectrum of skills and training to operate, maintain, support and sustain these systems and interfaces. Regardless of where the human interfaces occur, or the sophistication of the system and its flight control capability, the ultimate success of the systems will depend on the effectiveness of the human interfaces. The enabling concepts, front end analyses, and the requirements related to the human must be captured early and then continuously applied within the acquisition processes. High Performance Teams (HPTs), Integrated Process Teams (IPTs), working groups, and program offices must be able to comprehensively address the human-centric issues for all UAS systems. The requirements for these HSI solutions will be defined and advocated by the lead MAJCOM for the weapons system, either ACC, AMC or AFSOC. An HSI representative will be assigned as a core member on every UAS HPT. This representative will be provided with reach-back capability to each HSI domain. USAF HSI Subject Matter Experts (SME) and HSI domain practitioners will assist the UAS community in addressing the various human-centered domains in the requirements and systems engineering processes. These practitioners and SMEs will serve as focal points for integration of those concerns into UAS requirements, technology development, systems design and development, manufacturing, test and evaluation, operation, sustainment, and disposal.

To ensure the human is considered early in the UAS decision matrix, HSI will be:

1. Applied in the front end analyses (Functional Area Analysis (FAA), Functional Needs Analysis (FNA), and Functional Solutions Analysis (FSA)).
2. Addressed in the DOTMLPF analytical solution process.
3. A key consideration in Analysis of Alternatives (AoA) planning and execution.
4. Used to develop and support source selection criteria and weighting for contracted development efforts.
5. Used to conduct proactive domain trade-offs to facilitate total system performance.
6. Assessed throughout the system life-cycle, particularly in Test & Evaluation with measurable and testable requirements.

The USAF Human Systems Integration Office (AFHSIO) and AFRL 711th Human Performance Wing will provide the organizational expertise for USAF HSI. These organizations will assist UAS teams in conducting HSI analyses and provide SME support to HPTs, IPTs, working groups, and program offices.

ANNEX 4- EVOLUTION OF CAPABILITIES

4.1 Family of Systems:

Future UAS should be multi-mission, all-weather, net-centric, modular, open architecture and employ leveraging appropriate levels of autonomy. They should also be able to carry any standard payload within in its performance envelope, with dial-a-yield, dial-an-effect and be multi-mode capable. Additionally, some platforms may consider optionally manned capability. Modularity is the ability to mix and match weapons and sensors to meet given mission requirements on a given platform. Furthermore, modularity is the key enabler for UAS mission agility, flexibility, adaptability, growth capability and mission effectiveness that encourage innovation and low costs. Modularity provides the way to upgrade, augment or replace technologies while preserving the bulk of one's investment. Beyond the limits of current DoD Research, Development, Testing and Evaluation (RDT&E), developing a modular system is a way to leverage discoveries and developments that happen elsewhere. Open Architecture implements publicly available components whenever possible allowing competition among multiple suppliers. This concept extends from the airframe and payloads to supporting network systems to the ground stations used for aircraft/payload control and management. The UAS FoS can be managed as a portfolio of potential capabilities, able to adjust quickly to the battlefield needs and to grow and adapt as these needs evolve.

The envisioned capabilities will be implemented as a series of incremental advancements across the DOTMLPF spectrum. As technologies are developed, they will be demonstrated in operationally relevant increments so they can further mature. Through this process the force provider can refine the requirement and all other DOTMLPF actions can be synchronized. This requires a robust system of systems test and evaluation capability to rapidly transition increments of capability from research and technology development to operational fielding.

Modularity enables multi-aircraft, multi-payload and multi-mission flexibility for the joint force. A system of systems enables cost effective measures that increase capabilities by distributing weapon and sensor capabilities across a formation of aircraft. Individual vehicle capabilities and payloads can be tailored and scaled to mission needs. The avionics architecture and sensors on the aircraft must be capable of rapid changes of payload types and provide users and maintainers with "plug and play" capability.

The USAF will incorporate an Enterprise Architecture for Live, Virtual, and Constructive (LVC) simulation called the LVC Integrating Architecture (LVC-IA). The future UAS must be interoperable with the LVC-IA so it can arrive "ready to fly" at any range or with any simulated blue force or opposition force (OPFOR) during training, testing, and similar activities.

A move toward an interoperable service-oriented architecture (SOA) enables modularity and protects investment in unique subsystems, releasing the Services from proprietary bonds. On large, medium and some small systems an open architecture will facilitate modular system components. SOA enables modularity within a family of systems that enable interchangeable platforms and controls as shown below in Figure 2. Well managed interfaces change more slowly than the technologies that drive the subsystems development. Adopting and maintaining standard UAS interfaces (e.g. industry, international) protects the customer's investment in developing new subsystems. Architectures developed to support this flight plan will be built, approved and governed in accordance with *AFI 33-401, Air Force Enterprise Architecture*.

Autonomy will be incorporated where it increases overall effectiveness of UAS. Today primarily automation will be implemented to decrease operator workload. This will initially include auto takeoff and land and transit operations. It differs from full autonomy in that the system will follow preprogrammed decision logic. It will however be more dynamic than simple preprogrammed flight in that the aircraft will alter its course automatically based on internal sensors and inputs from external sources to include traffic and weather avoidance. This will mature to conduct benign mission operations in the near future. The DOTMLPF-P actions needed to achieve full autonomy are outlined later in this annex. This autonomy will also apply to ground operations, maintenance and repair. Aircraft will integrate with other vehicles and personnel on the ground during launch and recovery to include auto taxi. Touch labor will also begin with auto ground refueling and stores loading. In the future increasing levels of touch maintenance and repair will be performed by autonomous ground systems.

The near-term concept of swarming consists of a group of partially autonomous UAS operating in support of both manned and unmanned units in a battlefield while being monitored by a single operator. Swarm technology will allow the commander to use a virtual world to monitor the UAS both individually and as a group. A wireless ad-hoc network will connect the UAS to each other and the swarm commander. The UAS within the swarm will fly autonomously to an area of interest (e.g. coordinates, targets etc.) while also avoiding collisions with other UAS in the swarm. These UAS will automatically process imagery requests from low level users and will "detect" threats and targets through the use of artificial intelligence (AI), sensory information and image processing. Swarming will enable the UAS network to deconflict and assign the best UAS to each request.

Loyal wingman technology differs from swarming in that a UAS will accompany and work with a manned aircraft in the AOR to conduct ISR, air interdiction, attacks against adversary integrated air defense systems (IADS), offensive counter air (OCA) missions, command and control of micro-UAS, and act as a weapons "mule," increasing the airborne weapons available to the shooter. This system is capable of self-defense, and is thus, a survivable platform even in medium to high threat environments. The loyal wingman UAS could also be a "large" UAS that acts as a cargo train or refueling asset.

Sets of platform capabilities for FoS: Actionable investment strategies must be tied to expected needs. The priority for the near-term capability development and fielding can be derived from CRRA and IPL analysis. Sets of platform capabilities can be combined into potential mission sets. These mission sets can be notionally linked to the expected retirement of platforms to identify the recapitalization opportunities. Figure 2 shows the notational mission sets realized by overlaying the technology development timelines on to these recapitalization opportunities.

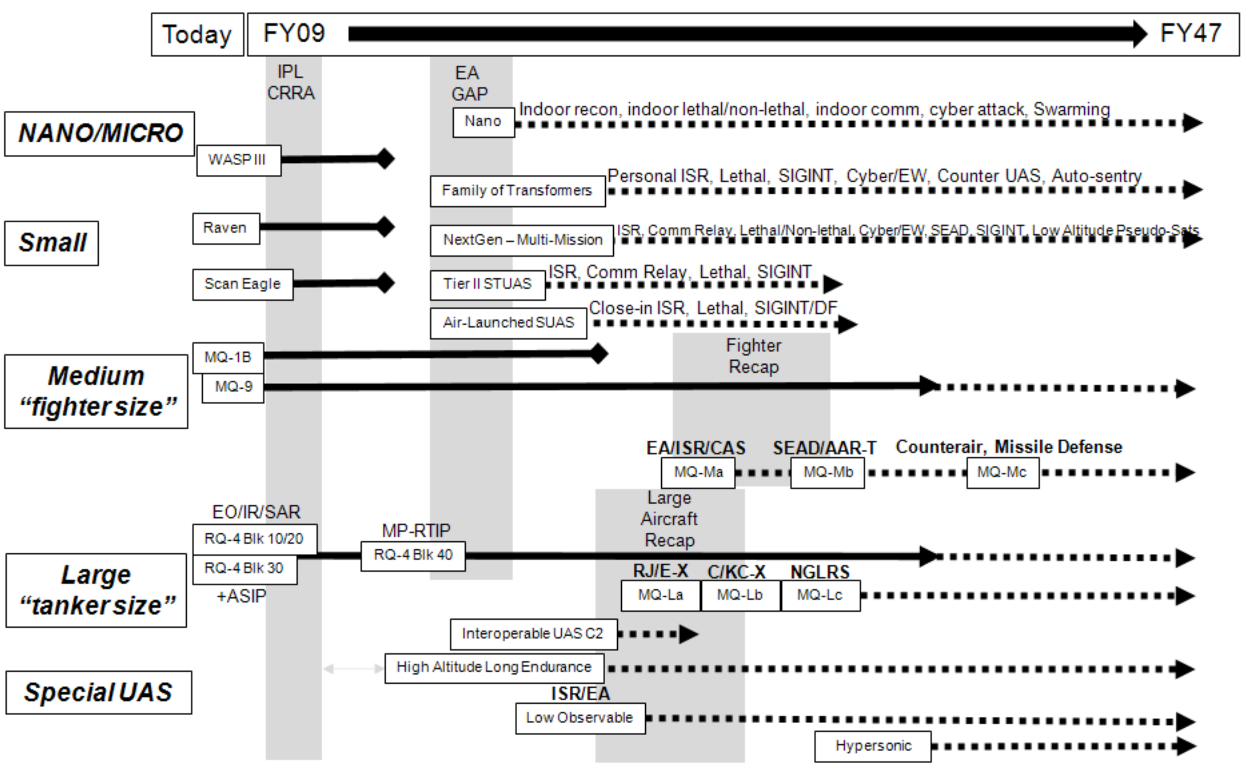

Figure 2: Potential sets of platform capabilities for UAS

The current projections of technology development continue to show a strong link between future missions and size of platform. Size, weight and power capacity of an aircraft will define payload options, performance and therefore missions. For example, propulsion and munitions will advance, but nano and small systems are not realistically expected to deliver significant kinetic effects over intercontinental distances. This high level view of expected timing of capability needs and technology readiness will be organized by families of platforms (nano/micro, small, medium, large and special).

4.2 Small UAS FoS

AFSOC is the USAF lead for SUAS. AFSOC devised a FoS approach with four major subclasses to include: the Nano/Micro, Man-portable, Multi-mission and Air-launched UAS. This approach includes the processes, equipment, procedures and ground control stations that should be MAC-enabled and network capable, but not constrained by either.

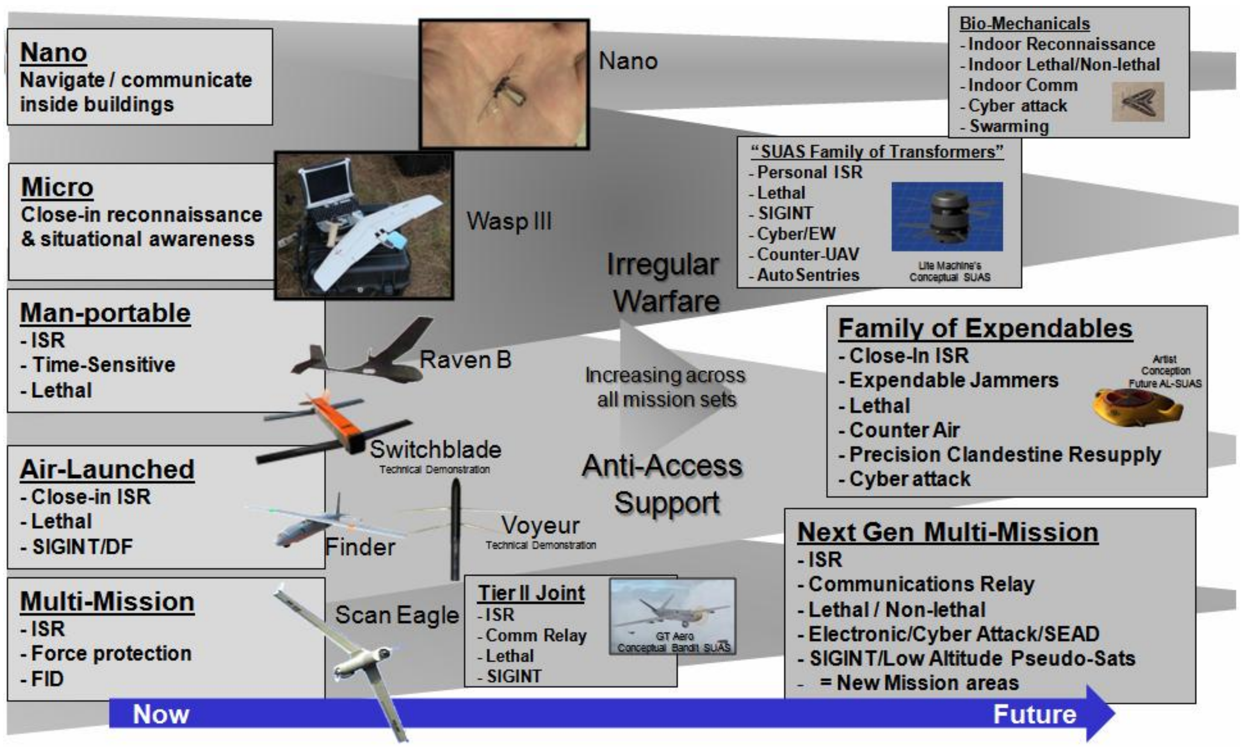

Figure 3: SUAS Family of Systems

Nano/Micro SUAS (Group 1): Aircraft capable of conducting a variety of indoor and outdoor reconnaissance sensing missions using micro-electronic machines (MEMs) technology. The system provided to individual battlefield airman must be mobile and carried within his/her individual load.

Man-portable SUAS (Group 2): Aircraft that address the need of small Battlefield Airmen teams for a more robust, greater endurance, mobile, man-portable system carried by the individual team in either mounted or dismounted operations. These systems also have the ability to sense, engage and destroy threat targets with focused lethality at close ranges within 10km.

Air-launched SUAS (AL-SUAS) (Group 2 or 3): Aircraft that address the need for off-board sensing from manned and unmanned aircraft. These can be controlled from the parent aircraft or surface teams trained to operate them. AL-SUAS provide the flexibility to conduct off-board sensing missions, focused lethal engagements and multiple diverging target tracking. Air-launched capability includes two basic threads – expendable and recoverable assets that provide unblinking eye coverage to maintain chain of custody.

Multi-mission SUAS (Group 3): Aircraft that close the gap between man-portable and Predator and/or Reaper mission allocation and capabilities.

SUAS Game-changing Capabilities: The asymmetric game-changing capability of SUAS impacts all levels of conflict. The USAF must employ a FoS approach that provides capabilities which are integrated, flexible and effective. SUAS must be integrated to support IW while continuing preparation for a near-peer anti-access threat. SUAS will play a key role in supporting manned assets in engaging more targets, providing decoys, jamming and disrupting enemy attacks. Other nations are allocating increased resources to develop SUAS to counter and possibly negate expensive and more capable systems by saturating them with large numbers of SUAS simultaneously. SUAS will play a key role in warfare including emerging counter-UAS missions due to their expendability and low cost. It is possible that the next inexpensive asymmetric threat will be a SUAS, i.e. an “airborne IED.” Any synchronization efforts must contain key steps and milestones affecting the entire USAF UAS spectrum of capabilities.

There are DOTMLPF-P actions that are required for the normalization and integration of SUAS into the USAF manned/unmanned force mix.

4.2.1 SUAS Doctrine:

Nano/Micro: Development of the nano/micro class will introduce capabilities never before realized. These include the ability to perform surveillance missions inside buildings and in confined spaces. Further, the use of bio-mechanical technologies will require legal and doctrinal development on how these potentially lethal systems are employed.

Air-launched: Navy and USAF are leading efforts on air-launched systems. Joint doctrinal shifts may be needed to address how AL-SUAS are employed. Past lessons should be applied to use of AL-SUAS to enable more effective manned-unmanned defensive counter air, suppression of enemy air defenses (SEAD), and special operations missions.

Multi-mission: The full spectrum of SUAS employment, from tactical (e.g. armed overwatch, force protection) to strategic (e.g. EA, high value target (HVT)) game-changing missions, will require a thorough review of Joint doctrine to address allocation versus apportionment decisions from the JFC to the organic level.

4.2.2 SUAS Organization:

Nano/Micro, Man-portable, and Air-launched: No organizational changes are anticipated for these classes of UAS.

Multi-mission: Multi-mission aircraft capability requires the establishment of SUAS squadrons which support overarching air-expeditionary units. Currently, flight operations are conducted inconsistently across AFSOC, USAF Office of Special Investigation (AFOSI) and Force Protection forces. Aircraft maintenance, logistics, flight authorization, safety risk mitigation and crew currencies are not conducted and documented to a common standard appropriate for this class of vehicle by all users. Since these platforms have significant kinetic energy based on their weight and speed, they can cause significant damage. Mishaps could be avoided by applying sound operational risk management. The best practices developed within AFSOC augmented by flight considerations developed by airmen across Services over the past 60 years need to be codified in SUAS flight standards. This organization is essential to successfully develop and implement a safe flying program. Tactics from operational lessons learned can be developed and employed across all SUAS platforms to support all missions. This is particularly significant for weapons employment and integration with air and ground operations. These squadrons will also be essential to advance integration of SUAS with other aircraft in the National Airspace System (NAS). Sound maintenance and logistics can be developed through consolidation to increase the system effectiveness rates. Further, SUAS capable of supporting total FMV orbit requirements are not tasked for those missions because crews are not trained and reach back has not been funded or implemented for these systems.

4.2.3 SUAS Training:

The USAF must address training issues from a Joint perspective due to the proliferation of SUAS in all the Services. The Joint Requirements Oversight Council (JROC) recently directed Joint training for new Group 2 Small Tactical UAS. This training includes Basic Qualification Training (BQT) (screening and airmanship), Initial Qualification Training (IQT) and Mission Qualification Training (MQT). The first step in institutionalizing and standardizing SUAS operations in the USAF is for the SECAF to approve Air Force Policy Directive (AFPD) 11-5 “Small Unmanned Aircraft Systems Rules, Procedure, and Service.” Once approved, AFPD 11-5 will generate 15 Air Force Instructions (AFIs) that will govern SUAS training, standardization/evaluation, and operations for the entire USAF. Further, USAF will support follow on Joint training for all SUAS IQT followed by USAF-unique MQT. In addition to SUAS operators, USAF will develop specialized training for SUAS maintenance personnel to develop their unique skill sets.

4.2.4 SUAS Materiel:

Simulators must be developed that address USAF SUAS and utilize Joint training assets where applicable. Emerging MEM technology will require new procedures and acquisition strategies as rapid technology turn-over will dictate faster re-capitalization. The integration of AL-SUAS onto manned and unmanned platforms will require platform modifications and potential materiel solutions. Logistical structures will need to address streamlined SUAS replacement and repair in theater.

4.2.5 SUAS Leadership and Education:

Education of SUAS-unique capabilities may need to be incorporated into all levels of Professional Military Education (PME). The Air Force Learning Committee (AFLC) will vet this through the Force Management Development Council (FMDC) for the appropriate level of emphasis and curriculum development.

4.2.6 SUAS Personnel**:**

USAF needs to consider how to develop a SUAS career path. Further, the USAF must address the impact of SUAS on personnel performing PAD. PAD has traditionally been reserved for larger ISR systems. Air-launched and Multi-mission aircraft will provide the opportunity to expand globally networked ISR capabilities. Both these SUAS FoS members will impact PAD manning as the systems mature and the demand for SUAS products increase.

4.2.7 SUAS Facilities:

Nano/Micro, Man-portable: Minimal impact

Air-launched: Special storage facilities will be required for AL-SUAS.

Multi-mission: New facilities will be required to support Tactical UAS squadrons. Further, SUAS missions require access to live fire ranges and realistic Joint urban training areas with the capacity to support integrated manned and unmanned flight operations.

4.2.8 SUAS Policy**:**

Operation of SUAS requires policy development to reflect their operational construct and rapid technology turnover. To the extent necessary and practical, policy for SUAS mirrors that of policy already established for manned aviation activities.

4.2.9 SUAS Summary**:**

USAF must fully integrate SUAS and embrace the capabilities to maximize the effectiveness of the total force. The USAF must address manning of SUAS and tactical UAS squadrons. SUAS boost the USAF involvement in Irregular Warfare and will play a significant role across the full Range of Military Operations (ROMO).

4.3 Medium FoS 2020 to 2047

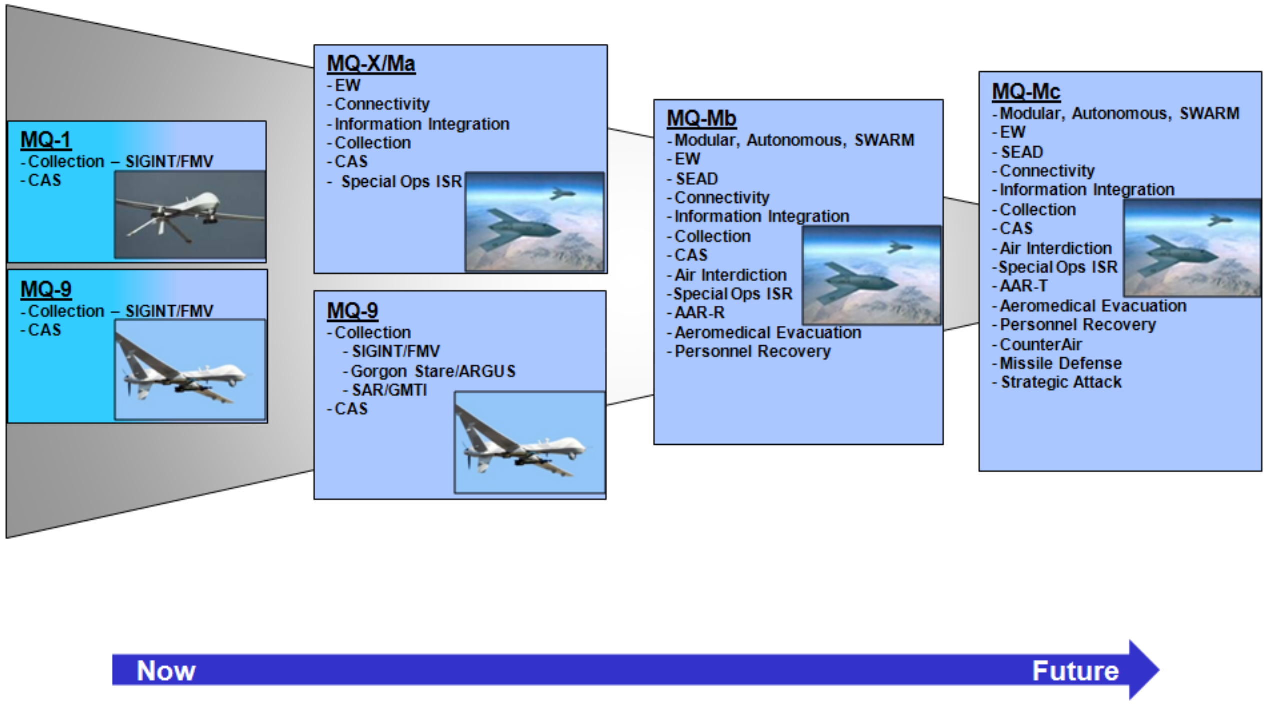

Figure 4: Medium System Evolution

Currently the USAF is analyzing the need for a follow on to the MQ-9, designated the MQ-X. Originally this system was to be rapidly fielded and would share many characteristics with the current fleet of aircraft. As MQ-X analysis and development slip, more MQ-Ma capabilities can be incorporated in the design. The USAF vision for a medium sized UAS (MQ-M) by 2020 is an enhanced autonomy, modular, open architecture and networked system built around a common core airframe. This aircraft can be tailored with capabilities shaped to the mission needs of the supported commander and allocated as needed throughout theaters. With RSO, global employment of any of these aircraft from any GCS worldwide will maximize capability available to the Joint Force. The envisioned aircraft of the future should incorporate modular structural elements as well as payloads for optimal mission performance. The sensors will be interchangeable so the payload can be optimized for the assigned Joint missions and new capabilities can be integrated without redesign of the platform. An open architecture interface for weapons allows air-to-ground and air-to-air weapons employment from current and future weapon inventories. As the MQ-M evolves over time an air refueling configuration in the 2030 timeframe will allow the aircraft to serve as a small tanker, extending the missions of other aircraft. The global distribution of responsive and flexible multi-role, medium-sized UAS will serve combatant commanders with a networked scalable capability with a minimum forward footprint.

The acquisition and fiscal efficiency of MQ-M manifests itself through a single airframe configurable for all mission sets including Air Interdiction, ISR, CAS, EA, Communications Gateway and Air Mobility missions. As senior leaders allocate assets throughout theaters, the same airframe will be deployed to all locations along with payload modules for the mission sets. In a fiscally constrained environment, this system of systems allows for consolidated logistics, maintenance and training centered on a single airframe core. This may include an optionally-manned capability.

Evolving from our current medium-sized unmanned aircraft today (Predator and Reaper), this long range vision of medium-sized core UAS will go through three phases of evolution, MQ-Ma, MQ-Mb, and MQ-Mc. MQ-Ma will be networked, capable of partial autonomy, all-weather and modular with capabilities supporting electronic warfare (EW), CAS, strike and multi-INT ISR missions' platform. Each aircraft will be flown from an advanced, MAC-capable, ground control stations. Automation will be incorporated for fully automatic takeoff and land and as automation matures, in-transit flight will be automated so operators will direct but not be required to control aircraft from launch until on station to conduct the mission. Autonomous ground taxi will be introduced as technology required for safe operations matures. The first level of loyal wingman will be incorporated to increase the mission effectiveness of manned platforms. The baseline capabilities of MQ-Ma will influence the AOA and shape the subsequent system development for the MQ-X. The extent of impact will be determined by MQ-X timelines. As MQ-X program decisions are extended into the future, the more they will incorporate MQ-Ma capabilities.

MQ-Mb will merge capabilities from the MQ-9 and MQ-X/MQ-Ma into a system with a wider spectrum of capabilities. This may include SEAD, Air Interdiction, Special Ops ISR, the ability to receive air refueling, aeromedical evacuation and personnel recovery. Modular and autonomous technologies advance the level of MQ-Mb flexibility and effectiveness for the Joint Force Commander. Cooperative engagement will link UAS into formations to simplify enroute transit and enable machine-to-machine links between manned and unmanned aircraft. Autonomy will also enable some ground touch maintenance such as aircraft ground refueling. SWARM technology will allow multiple MQ-Mb aircraft to cooperatively operate in a variety of lethal and non-lethal missions at the command of a single pilot.

Finally, the MQ-Mc will possess the full spectrum of capabilities to serve all combatant commanders world-wide for most missions. Through technology advancements, MQ-Mc will incorporate the capabilities of all previous generation MQ-M aircraft in addition to executing new missions such as defensive counter air (DCA), Strategic Attack, Missile Defense and SEAD.

4.4 Large-size Unmanned Aircraft System 2020 to 2047

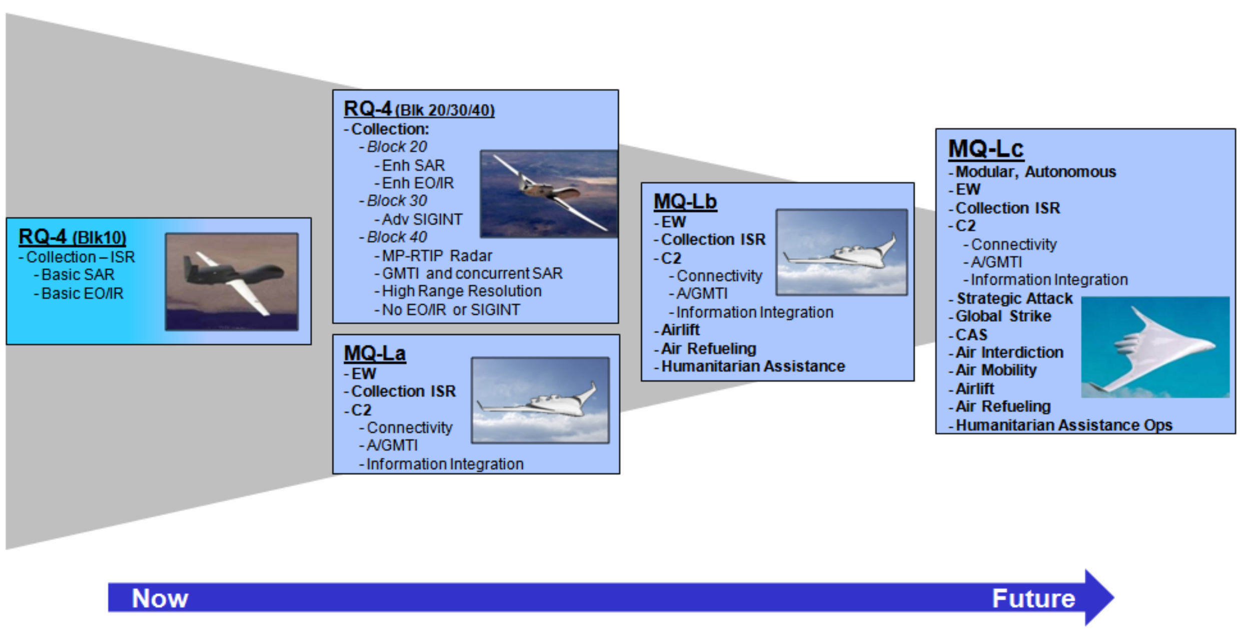

Figure 5: Large System Evolution

The USAF Vision for a large-sized UAS (MQ-L) by 2020 is similar to the medium-sized UAS evolution leveraging autonomous, modular and open architecture technologies. The MQ-L will be capable of performing today's manned heavy aircraft missions with one common core airframe.

Filling urgent COCOM needs first, the MQ-La, with SAR/GMTI advanced SIGINT capabilities, will complement the Global Hawk in multi-INT ISR missions. The MQ-La has the potential to replace other large manned battle management command and control (BMC2) platforms such as Joint Surveillance and Target Attack Radar System (JSTARs) and Airborne Warning and Control System (AWACS) as they approach recapitalization. Manpower requirements will be reduced during loiter and transit-operations due to increased automation and autonomy. These efficiencies are amplified when multiple large payload aircraft are teamed together through loyal wingmen technology under the direction of one pilot.

The all-weather MQ-Lb will be a multi-mission endurance aircraft capable of ISR, EW communications gateway and air mobility operations. These capabilities will enable a Large UAS FoS approach through modularity. Appropriate sets of payloads will "plug and play" in a bay. Some of the potential payloads include ISR, EA, BMC2, pallet lift capability or fuel tanks. Autonomy will increase for auto take off and land seamlessly integrated with civil and military traffic. Loyal wingmen will mature such that formations of manned and unmanned transport aircraft will disperse to land at point of need separately from each other. As technologies mature, ground operations from taxi through ground refueling and standard pallet loading will be conducted with only human monitoring of autonomous actions. For this and the follow on platform, Air Mobility Command (AMC) requirements will be balanced with Air Combat Command (ACC) ISR requirements.

The MQ-Lc common core airframe will serve as the foundation for all missions requiring a large aircraft platform. In addition to MQ-Lb mission sets, the MQ-Lc will harness autonomous and modular technologies to present capabilities to the Joint Force Commander that include air mobility, airlift, air refueling, EW, multi-INT ISR, strategic attack, global strike, CAS, air interdiction and humanitarian assistance operations. The evolution of technologies to accomplish this will begin with predictable flight scenarios, such as large cargo delivery services. This concept will develop into collaborative systems that can optimize multi-aircraft mission effectiveness. Applicable technologies are being developed and demonstrated in laboratories and universities today.

4.5 Special Category System

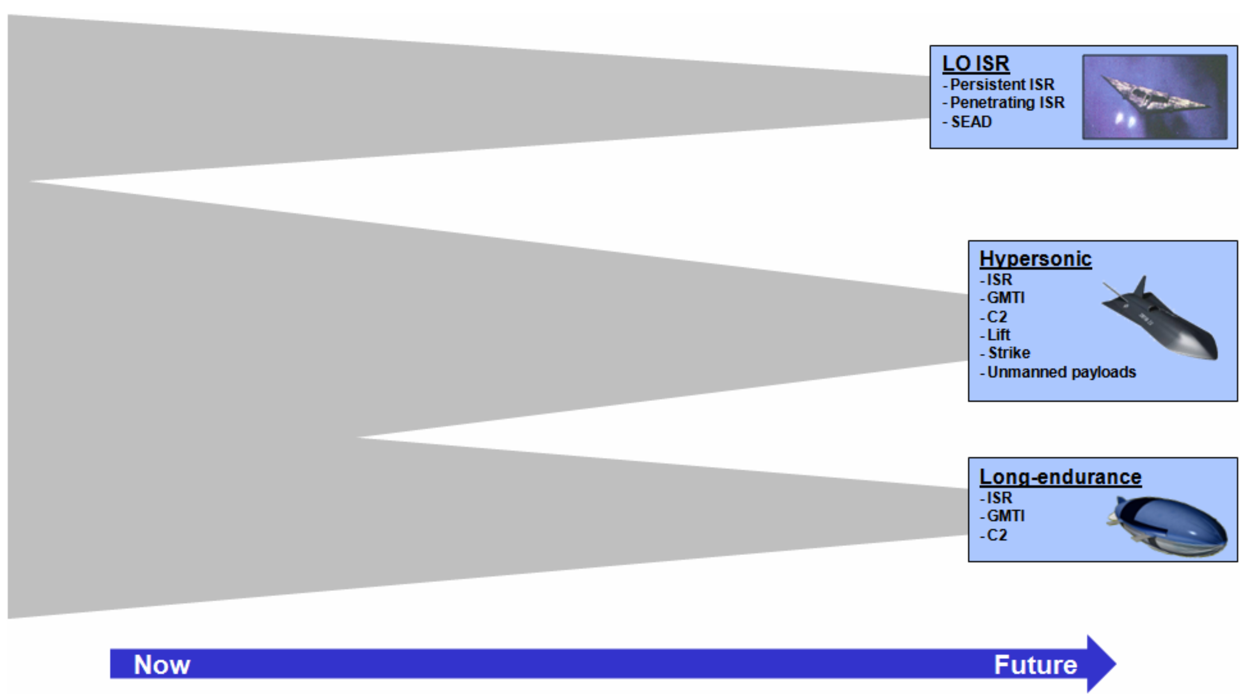

Figure 6: Special System Evolution

The USAF vision for specialized UAS (figure 6) will set a number of foundational principles to guide their development and ensure compatibility with other systems. These are systems where aircraft design is integral to mission success and must be built as open architecture, non-proprietary systems to allow for cost-effective upgrades and competitive integration. Where possible, payloads must be modular in nature to allow for acquisition efficiency while maximizing operational flexibility. Finally, extreme performance parameters such as ultra-long endurance or hypersonic flight will demand high levels of autonomy. These systems may require reconsideration of maintenance and logistics support in order to adequately service the aircraft. The sensitive nature of future specialized UAS will likely drive these programs to be developed in the classified environment.

The maturity of the technologies required for the representative missions vary widely. Stealth technology sufficient for some threats is available today, but stealth technologies that would allow long loiter in a high threat environment requires further development. Extremely long endurance platforms, including high altitude balloons or large lifting surface aircraft, are under development and could be available in the near to mid-term time frame. The longest lead technology of the three depicted are hypersonic systems. The only truly hypersonic vehicle flown today is the Space Shuttle. Propulsion technology and materials that can withstand the extreme heat will likely take 20 years to develop. This technology will be the next generation air game-changer. Therefore the prioritization of the funding for the specific technology development should not wait until the emergence of a critical COCOM need.

4.6 Path to Autonomy- DOTMLPF-P Synchronization

Advances in computing speeds and capacity will change how technology affects the OODA loop. Today the role of technology is changing from supporting to fully participating with humans in each step of the process. In 2047 technology will be able to reduce the time to complete the OODA loop to micro or nano-seconds. Much like a chess master can outperform proficient chess players, UAS will be able to react at these speeds and therefore this loop moves toward becoming a “perceive and act” vector. Increasingly humans will no longer be “in the loop” but rather “on the loop” – monitoring the execution of certain decisions. Simultaneously, advances in AI will enable systems to make combat decisions and act within legal and policy constraints without necessarily requiring human input.

Authorizing a machine to make lethal combat decisions is contingent upon political and military leaders resolving legal and ethical questions. These include the appropriateness of machines having this ability, under what circumstances it should be employed, where responsibility for mistakes lies and what limitations should be placed upon the autonomy of such systems. The guidance for certain mission such as nuclear strike may be technically feasible before UAS safeguards are developed. On that issue in particular, Headquarters Air staff A10 will be integral to develop and vet through the Joint Staff and COCOMS the roles of UAS in the nuclear enterprise. Ethical discussions and policy decisions must take place in the near term in order to guide the development of future UAS capabilities, rather than allowing the development to take its own path apart from this critical guidance.

Assuming the decision is reached to allow some degree of autonomy, commanders must retain the ability to refine the level of autonomy the systems will be granted by mission type, and in some cases by mission phase, just as they set rules of engagement for the personnel under their command today. The trust required for increased autonomy of systems will be developed incrementally. The systems’ programming will be based on human intent, with humans monitoring the execution of operations and retaining the ability to override the system or change the level of autonomy instantaneously during the mission.

To achieve a “perceive and act” decision vector capability, UAS must achieve a level of trust approaching that of humans charged with executing missions. The synchronization of DOTMLPF-P actions creates a potential path to this full autonomy. Each step along the path requires technology enablers to achieve their full potential. This path begins with immediate steps to maximize UAS support to CCDR. Next, development and fielding will be streamlined, actions will be made to bring UAS to the front as a cornerstone of USAF capability, and finally the portfolio steps to achieve the potential of a fully autonomous system would be executed.

4.6.1 DOTMLPF-P Synchronization Near Term

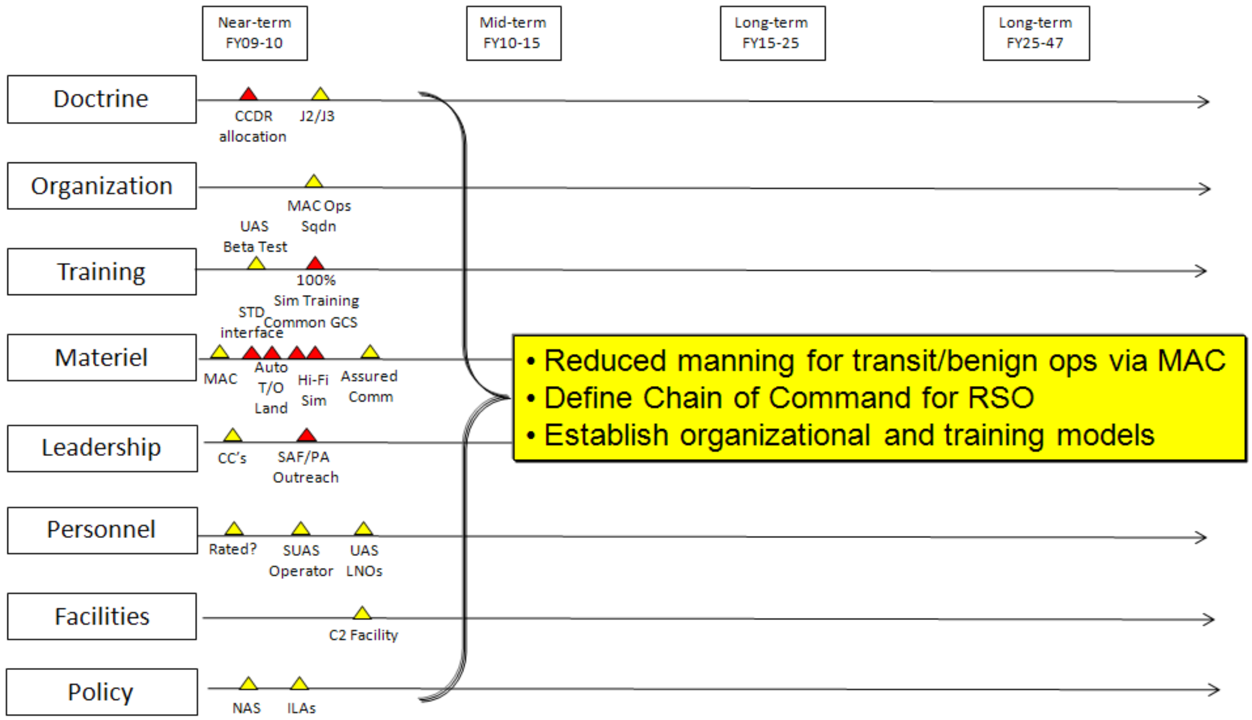

Figure 7: DOTMLPF-P Synchronization- Near Term

The first portfolio step links dependent DOTMLPF-P actions related to increasing operational efficiencies. MAC applies today's technology to automate basic mission profiles with man in the loop to multiply operational efficiency. The portfolio of critical actions to increase operational efficiencies include doctrinal changes that strengthen the chain of command for network enabled operations, organizational and materiel actions to make MAC a reality, and training efficiencies garnered through materiel, personnel and policy actions. Each of these actions is depicted along a DOTMLPF-P stratified timeline as a colored triangle. Red triangles represent actions that require senior leader involvement to achieve requisite levels of capability on schedule. Yellow triangles are dependent actions that need attention but not necessarily direct senior leader involvement. As depicted in the highlighted text, the linked actions to procure, train and organize are expected to reduce the operator manning for transit up to 40%. This may also provide some surge capacity for specific benign missions.

The portfolio of critical actions necessitates a certain level of cultural change within the USAF through UAS leadership institutionalization. These actions can and should be accomplished relatively quickly. Additionally they will have a direct impact on UAS support to Combatant Commanders and as such, they are the core of the immediate actions described in Annex 5.

4.6.1.1 Near-Term Simultaneous Actions

The number of the DOTMLPF-P steps need to begin simultaneously to see results in the near term. Most of these immediate actions are described in Annex 5. There are several that are underway that just need sufficient attention to complete in sequence. There is an ongoing discussion on how to manage multi-role platforms. In the past, intelligence and combat operations platforms were tasked through two separate prioritization processes. Multi-role UAS operate in the seam between these two processes so there is a certain level of friction between the competing priorities. Equitable doctrinal solutions need to be developed to reduce this friction and maximize the utility of these UAS. This step also identifies two perpetual DOTMLPF-P activities. First there needs to be a concerted coordinated public affairs communications strategy to highlight the USAF UAS accomplishments and emerging positions on UAS issues. Secondly, facilities that support the equipment and operations need to be built as new units and missions stand up.

4.6.1.2 Additional Near-Term Actions: Communications Network Issues

Assured communication between the unmanned aircraft and control station(s) for both C2 and the collection payload is an important step toward full autonomy. There must be a migration from today's dependency on a SATCOM control model to a tiered network system capable of supporting today's operations while providing a bridge to the UAS vision. The Advanced Tactical Data Link (ATDL) is a component of a network system that can support this bridge to the future. The ATDL is an open systems network transport component of the DoD tactical network system of systems, comprised of a family of waveforms optimized to support information movement between airborne, ground-based and maritime assets in the contested, permissive and anti-access battlespace. The DoD tactical network system of systems is part of the GIG that supports tactical military operations. It includes, but is not limited to, human interfaces, software applications and interfaces, network transport, network services, information services and the hardware and hardware interfaces necessary to form a complete system that delivers tactical mission outcomes. The tactical network system operates as independent small combat sub-networks opportunistically connected to each other and to the GIG. The overarching requirement for the DoD tactical network system of systems is to provide the right information, at the right time, properly disseminated and displayed, so warfighters can deliver tactical mission outcomes. Information superiority, delivered by the DoD tactical network system of systems and enabled by the ATDL, integrates platforms, sensors, C2 and weapons in performance of their assigned missions to improve mission outcomes and enables improved decision-making. Integration enabled by ATDL will extend to any platform, for example 4th and 5th generation fighters, maritime assets, C2 systems, weapons, UAS/UCAVs in ways appropriate for the mission and fiscally prudent. Developed jointly, ATDL will enable the joint community to implement an interoperable, timely and affordable DoD-wide approach.

Communications planners need to consider: available bandwidth, datalink upgrades, range between source and receiver, required network infrastructure, detectability, and security in a contested environment. These issues are of particular concern for the ISR mission when communication is desired without exposing either the sender or receiver to possible hostile interception. Bandwidth requirements become more demanding for stealthy operations such as cooperative engagements that require low-probability-of-intercept or detections (LPI/LPD) radio frequency (RF) communications. Line-of-sight datalinks with LPI/LPD properties are a necessary technology enabler for future flights of stealthy UAS because we must have datalinks that are survivable and impervious to electromagnetic pulse (EMP) or other denial efforts. Under the USAF's traditional RSO model, UAS will require significant bandwidth for the foreseeable future to assure communications of BLOS transmission of both C2 and payload data. The concern for assured bandwidth has the attention of Congress. The National Defense Authorization Act (NDAA) for 2009 requires that DoD provide a detailed report on bandwidth requirements, availability, cost, and mitigation technologies being employed across the Department.

While there will be a substantial growth in available Military Satellite Communications (MILSATCOM) over the next 20 years, the lack of synchronization between the on-orbit space segment, and fielding of UASs without the terminals required to make use of that capability will drive us to seek commercial and "surrogate satellite" alternatives:

1. Commercial SATCOM: While today's UAS almost exclusively use commercial SATCOM, it has some major drawbacks. First and foremost, commercial SATCOM is an open commodity where the DoD competes with numerous other communications users (i.e. TV, international telephone, data, and facsimile). Also, commercial SATCOM transponders are sized for the community they intend to support which ranges typically from 36-54 MHz. While that transponder size is sufficient for Predator / Reaper it is less than adequate to support Global Hawk's Block 20/30/40 full throughput needs. Finally, while figures vary with each lease, commercial SATCOM bandwidth typically costs approximately $40K per MHz per year. If all 50 Predator/Reaper caps remained on commercial

SATCOM, the annual recurring cost would be approximately $25M assuming an individual cap data rate growth to 12.8 Mbps.

2. "Surrogate Satellite" systems: High altitude lighter-than-air systems can function as surrogate satellites relaying information between ground, other airborne sources, and satellites. Using standard network data link protocols, to include a network version of the common data link (CDL), Link 16, and its successor, UASs will be able to relay voice, video, and data using a network that includes Lighter-than-Air Systems. Ultimately this would reduce the amount of dedicated SATCOM (including costly commercial SATCOM) required for UAS operation. Therefore the USAF should research and demonstrate potential applications of unmanned lighter-than-air platforms to support a variety of missions to include communications relay in a permissive environment.

The reality is that while we can continually improve the capability of systems providing communication from one point to another, there is never a 100 percent guarantee it will reach the other end. From a terrestrial standpoint, we have all witnessed when the "network's down" even the most robust architectures are subject to some level of degradation at one time or another either due to malfunction or malicious intent. Given the complex nature of USAF unmanned aircraft operations using remote split operations, it is critical that communications be as robust and assured as possible. Redundancy provides invaluable help to guarantee communications if one path is degraded. Warfighters need assured, near real-time access to SATCOM resources to exercise positive command and control, and to disseminate intelligence information during all operational phases for the duration of the mission. This requires synchronizing each segment of the SATCOM system. If communications satellites with life spans of roughly 15 years are launched but the terminals are delayed, the intended capability will be delayed; in essence, reducing the satellites' effectiveness. It is critical that we pursue smart, rapid fielding of terminals needed to make use of the mission essential assured communications satellites being fielded over the next 20+ years.

4.6.1.2.1 Mobile User Objective System (MUOS)

MOUS is an array of geosynchronous satellites being developed by the DoD to provide global narrowband (typically 64 Kbps and below) SATCOM for assured C2 communications for the United States and allies. MUOS is intended primarily for mobile users (e.g. aerial and maritime platforms, ground vehicles, and dismounted soldiers) and will extend users' voice, video, and data communications beyond their lines-of-sight; MUOS will provide global coverage and dense foliage penetration through ultrahigh frequency (UHF) transmissions sending the right data to the right person at the right time.

4.6.1.2.2 Wideband Global SATCOM (WGS)

WGS will be the primary wideband MILSATCOM solution to support UAS for the next 20+ years. Based on recent senior leader decisions, the WGS constellation was changed from a 6 to an 8-satellite geosynchronous constellation. The first three (SVs 1-3) Block 1 WGS will provide approximately 137 Mbps maximum throughput per user and the second three (SVs 406) Block 2 WGS will provide approximately 274 Mbps maximum throughput for up to two users per satellite. For Predator and Reaper, WGS Ka-band compatible terminals will start fielding 2nd quarter Fiscal Year 2011. By 4th quarter Fiscal Year 2013 there should be 5.4 GHz of Ka-band capacity globally available for Predator, Reaper, and Global Hawk, along with other Ka-compatible platforms (air and ground) competing for bandwidth. At that time frame we will have roughly 30 percent of our Predator and Reaper airborne terminals capable of using WGS but there will be no Global Hawk Ka-band capable platforms. The first Ka-band BLOS capable Global Hawks will not be fielded until 2016-2017; until then Global Hawk will have to rely on commercial Ku-band SATCOM.

Once the WGS 8-ball constellation is fully fielded and operational (est. 4th Quarter FY16), the USAF anticipates having 40 percent of our Predator/Reaper fleet operational with Ka-band compatible terminals. Based on the potential number of caps (81) planned for in FY16 and using the maximum surge data rate, the total bandwidth required would be 1.296 GHz. Fifty- three percent of those caps (43) would still require commercial Ku-band SATCOM for a total commercial Ku-band requirement of 688 MHz Based on the $40K cost per MHz, that will result in an annual commercial SATCOM lease cost of $27.5M (without inflation) based on a per cap requirement of 16 Mbps.

With the development of various UAS platforms, demand for the use of WGS (Ka-band and X-band) will increase. The type of mission will likely dictate the type of SATCOM and associated terminal required. UAS with deep, stealthy strike missions will likely require protected communication (through Advanced Extremely High Frequency (AEHF), while AWACS/JSTARS-like UAS replacement platforms may require both AEHF and assured (MUOS, WGS) narrowband/wideband communications. This will require significant synchronization and the further development of software programmable terminals. The USAF will assess the consolidation of a UAS Systems Wing to better manage all aspects of UAS operations to include commonality of system components and synchronization with space and terminal segments.

4.6.1.2.3 Spectrum Management

Available radio frequency spectrum, just like fuel or power, is an essential enabler for UAS operations. Hence, planning is an essential function needed to help deconflict operations. Close coordination with the Combined Forces Commander frequency manager is critical to safety and mission success. Operators should be aware of the frequency characteristics of UAS, the bandwidth requirements for sensor products, communication relay throughput, platform emission patterns and characteristics for all links, as they relate to the electromagnetic environment where they plan to operate. Knowledge of these factors will enable the operator to clearly articulate radio frequency requirements to the frequency manager for frequency allocation and deconfliction.

UAS operators who use LOS links for control of UAS and receipt of sensor products also must coordinate with the appropriate spectrum manager to deconflict from other users. Planners must consider emitters in the local areas of both the GCS and aircraft to avoid mutual interference with other systems. For BLOS operations, regulatory requirements, potential interference, and availability of military and/or commercial satellite access should be considered. Operators must have a solid understanding of the spectrum environment and bandwidth limitations to maximize effective use of all assets.

4.6.1.2.4 Protected Communications

In many instances protection of critical communication paths and the security of the information flowing through them is vital to national security interests. Satellite systems can encounter a number of threats to include: jamming, interference, direction finding, interception, intrusion, physical attack, as well as ionospheric scintillation and other effects (e.g. the affects of nuclear detonation). In the future, C2, and to a lesser extent wideband payloads will be available via “Protected” Communications using the AEHF constellation. Based on the electromagnetic spectrum they operate in and the capabilities built into the satellite the terminals and antennas employed, they can provide global, highly secure, protected, survivable communications for Joint forces. Additionally, platforms, such as Reaper and other evolving UAS will be able to take advantage of protected communications and potentially with a much higher throughput when technologies are fielded such as the EHF extended data rate (XDR) and XDR Plus (XDR+). USAF will support development of non-proprietary UAS terminals to take full advantage of emerging on-orbit military communications satellites, and reduce reliance on commercial satellites to the maximum extent possible.

4.6.1.2.5 Bandwidth Management

Many of the current unmanned systems use commercial-off-the-shelf (COTS) data link equipment that offers the developers reduced costs and shorter development periods. One of the major problems associated with using commercial RF for military applications is that the frequencies used to receive in the commercial Ku-band are identified as fixed satellite service (FSS) and not primarily intended for air-to-ground aeronautical application; hence, we have either a low, non interference priority within the United States or we may be prohibited from use altogether in other countries. To mitigate this, new systems need to plan ahead for comprehensive spectrum supportability of their primary and alternate datalink communication solutions. Further, UAS systems of the future should incorporate the latest efforts in bandwidth efficiency. That includes following new efficient modem standards and initiatives in improved compression algorithms and modulation schemes (e.g. Phoenix Terminal which transmitted 440 Mbps of data through a 125 MHz transponder) and programs such as Wideband SATCOM Operational

Management System (WSOMS) designed to adjust power levels, modulation, and coding to optimized WGS bandwidth use. The USAF should support initiatives in compression, modulation schemes, and advancements in modem design that will support capabilities like "dial-a-rate," "dial-a-modulation," etc. with the intent of optimizing bandwidth use.

Many of the solutions to assured communications rely on the aircraft knowing where it is in space and time. Currently UAS rely extensively on Global Positioning Satellite (GPS) position and time synchronization. The relatively weak broadcast signal from space can be jammed, precluding UAS operations. Until onboard systems that do not rely on GPS can be fielded, assured position, navigation and timing is a critical UAS concern.

Finally, as a hedge against the ability of an adversary to deny us the use of our datalinks, we must continue to dovetail unmanned and manned capability so that lacking datalink assuredness or the political will to use autonomous strikes, the USAF will still have the ability to hold strategic targets at risk. This must include the synchronization of the development of both manned and unmanned asset and the modular UAs that may have an optionally-manned capability.

4.6.2 Mid-Term DOTMLPF-P Actions

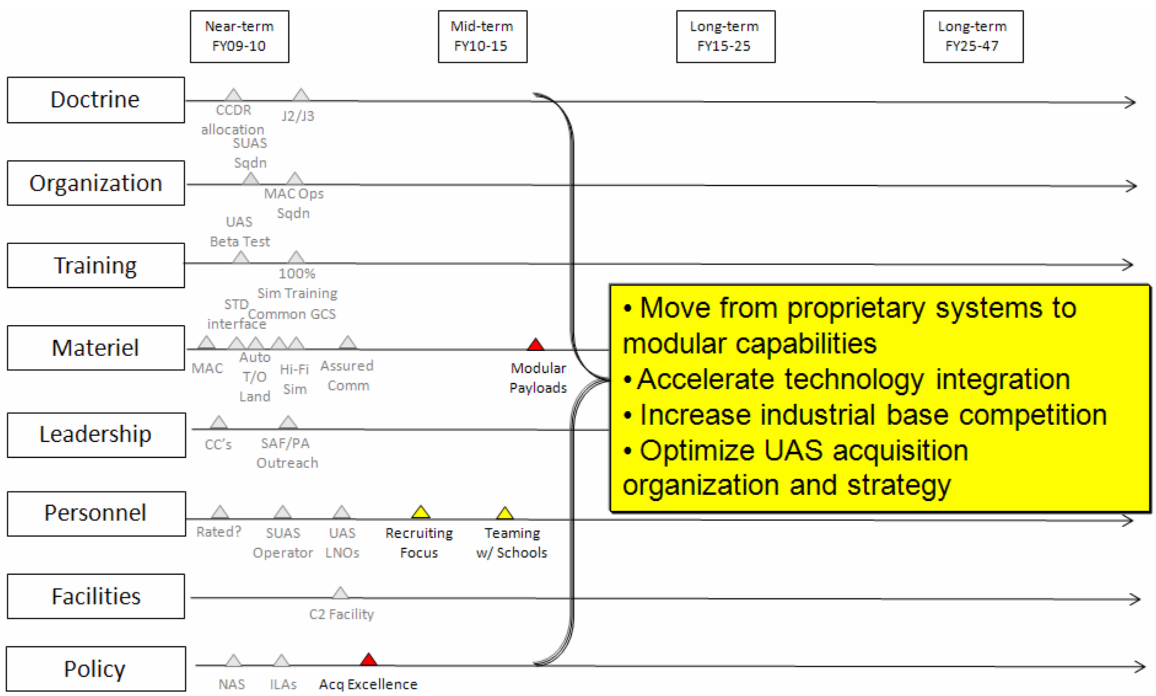

Figure 8: Mid Term – Accelerate Innovation

The current acquisition system is focused on individual programs meeting specific performance measures of cost, schedule, and capability. Program managers are held accountable to a certain extent. However, there is often a lack of incentive to go beyond requirements. The level of innovation is typically capped at the level of technology development of the least capable component of the complete system. Further, revolutionary concepts are difficult to translate into materiel solutions but iteratively mature as separate aspects and technologies related to the concept are achieved. The best way to spur on this process is to structure the acquisition to reward rapid innovation. In this way, each aspect of the desired end state will be integrated and improved as quickly as possible even if it isn't the intended final end state. Autonomy for a system-of-systems is a revolutionary concept that can be advanced through rapid innovation. This aspect of the mid-term actions is broken out separately since all follow-on actions hinge on this.

Current acquisition of proprietary systems further delays the innovation required for autonomy. The manufacturer may not be able to easily make changes to the operating system required to advance autonomy while meeting program performance requirements. The initial programmatic method to advance innovation is to facilitate competition on system components by defining standards. Through the definition of standard interfaces and modular systems designed for innovation, autonomy can be incrementally integrated and refined throughout the process.

Appropriate acquisition policy for disruptive technologies such as UAS has been a challenge for DoD. From inception as ACTD, UAS development, procurement, and fielding have followed a unique process. This has continued as most systems were funded before needs were defined, especially small systems demonstrated and immediately purchased to support Joint Forces. The fallout of this process is the lack of institutional buy-in and common programming goals within DoD. OSD Acquisition, Technology, and Logistics (AT&L) staff have been directed to take a more directive role in managing what would normally be a Service Title 10 process. Recent policy decisions including Acquisition Decision Memorandums (ADMs) and Program Decision Memorandums (PDMs) focus on requirements driven acquisition strategies. This is all being normalized through the Aeronautical Systems Wing (AESW) structure as described in Annex 6.

There are other interdependencies across the DOTMLPF-P spectrum that are critical to pursue simultaneously to guide USAF UAS development, acquisition, and fielding. Doctrine defining how multi-role UAS are allocated to support the CCDR is critical to determine prioritization of capability development. Without a clear definition of requirement, the need for more of the capabilities UAS can provide cannot be curbed, thus trapping the USAF into a reactive, rather than the deliberate Planning, Programming, Budgeting and Execution cycle (PPBE). The USAF UAS community also requires dedicated leadership to articulate how the policy will be implemented and to set the priorities for the UAS AESW.

The UAS leadership and AESW need materiel and personnel solutions to achieve the innovation enabled by the doctrine, organization, leadership and policy streamlining. Three critical elements will form the nexus of this innovation. Standard interfaces between the vehicle and control station and between the vehicle and payload will free industry to develop the next generation systems and components needed to support the CCDR as well as other government departments and agencies. Just as open architecture software exponentially advanced computer applications, UAS system interface standards will improve current UAS innovation. Immediate actions related to standard interfaces and modular payloads are described in more detail in Annex Five. One of the highest impact areas for innovation is automation. This will require advance research guided by Joint operational imperatives which can best be accomplished by USAF UAS personnel teaming with research schools.

4.6.3 Long Term

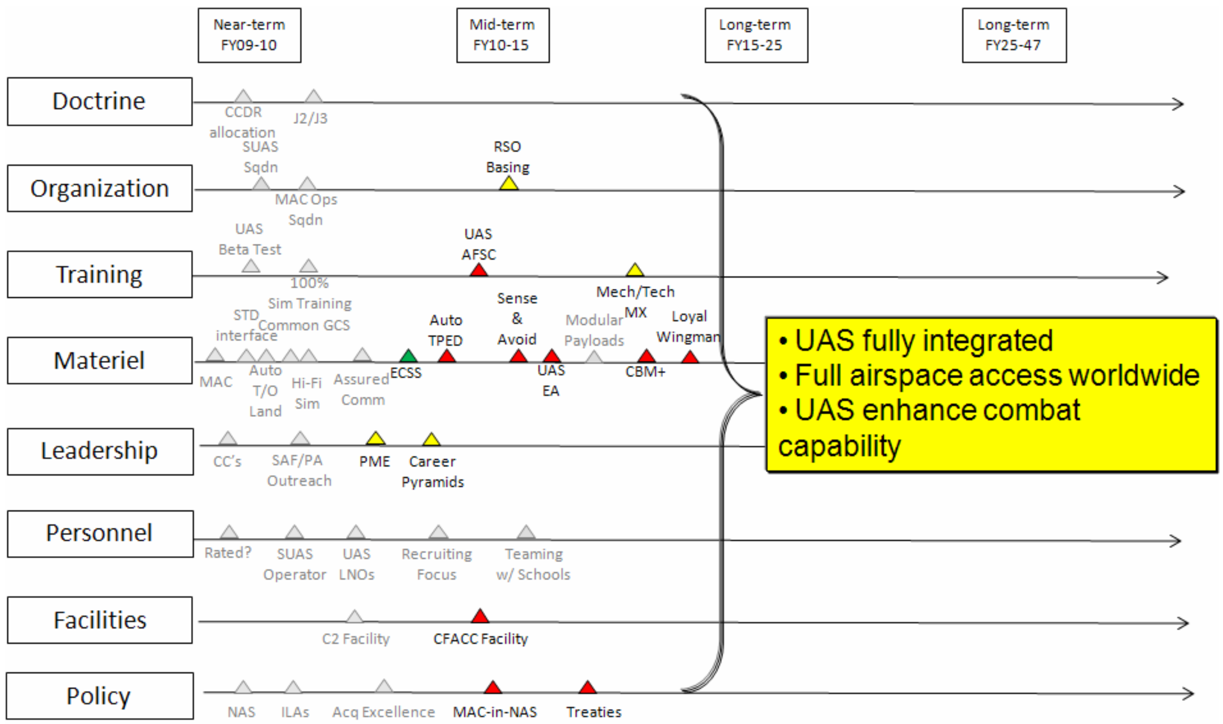

Figure 9: Long Term – Fully Integrate UAS

The third portfolio step on the path toward autonomous capability links dependent DOTMLPF-P actions in order to fully integrate UAS with all other assets worldwide. These entail full integration with all airborne traffic in the National Airspace System and International Civil Airspace through technology, procedural, training, and policy changes. UAS will fly formations with manned and unmanned aircraft as required by the operation. The USAF will provide graduate level UAS support to Joint Warfighter through organizational changes. These changes will establish optimum networked RSO basing, software that performs automatic PAD to move from collecting information to knowledge, and career tracks that reward the top performers throughout all appropriate enlisted and officer AFSC.

4.6.3.1 NAS Integration

A challenge to fully integrate UAS is NAS access. Over the years as manned aircraft operations increased, rules were developed to increase the safety of flight. The most basic method of deconfliction is to see and avoid other aircraft (14 CFR 91.113). This is assumed as the most basic universal means when all other procedures and equipment have not prevented a conflict situation. See and avoid also holds the pilot as the one ultimately responsible in any visual environment. This is a major consideration and therefore, this precedent that has served us well in the past, is not easily changed or replaced.

Integration efforts will go beyond airspace access to better integrate collected materials into the intelligence process. Current combat airspace procedures for UAS were developed for uncontested airspace. Our forces can dictate deconfliction procedures and create segregated airspace for operations at will. This cannot be taken for granted since host nations in theater may have restrictions on UAS operations that reduce their effectiveness. They could be limited by the same type of approval and procedures as they face in the NAS or under current International Civil Aviation Administration Organization (ICAO) rules. The issue of clearance to launch UAS sorties when well outside the combat zone is related also. The combat urgency of the CCDR will not necessarily be shared by the host nation outside the combat zone, resulting in approvals for flight not being expedited. UAS support to combat may be thwarted by lack of airspace integration capability. The sense and avoid technological solutions coupled with the DoD and FAA rulemaking can serve as a model for international airspace solutions.

Part of the reason the FAA has delayed the development of rules and standards, is due to pressure from other NAS users. The USAF does not seek to place restrictions on civil or general aviation users of the NAS, but rather will develop policy, technologies and Tactics, Techniques, and Procedures (TTPs) to integrate UAS operations into the NAS in a way that is entirely compatible with the rest of the flying public. A public affairs effort will be required to educate aviation audiences on the USAF position. The USAF UAS TF will ensure coordination of this effort with AF/A2, AF/A3, and SAF/PA.

4.6.3.2 Long Term Technology Enablers

See and avoid has not been defined in terms of minimum detection distance, minimum field of view, or minimum scanning rates/patterns. There are many variables that affect this analysis including pilot skill, pilot flight currency, density of traffic, and flight speeds. Further, the level of acceptable risk has not been defined. Additionally, there are also no development standards for Sense and Avoid. Technological solutions are being matured in the labs, but have not been approved yet because the standards do not exist and the modeling and simulation to make the safety case is just beginning. Prototype materiel solutions are now being integrated for demonstration and test. Over the next several years this technology will mature, culminating in certified airborne sense and avoid systems and associated Federal Aviation Administration (FAA) rulemaking to implement.

The same technologies that keep UAS from any airborne collision will also enable UAS formation flight. Coordinated missions and cooperative target engagement will provide the same mission efficiencies as manned aircraft. Total bandwidth may be reduced since only one unmanned aircraft within the formation will need the link for some phases of flight.

The actions to gain unfettered airspace access and fly in formation will greatly expand the level of information collected. Today, most full motion video as well as imagery is used real-time but then “falls on the floor” and is not optimally analyzed to extract more knowledge of the enemy. Automated tasking, processing, analysis and dissemination (TPAD) will optimize tasking of multiple assets to best meet real-time collection needs while providing a means to analyze a greater portion of the data/imagery collected. Further, analysts will be able to synthesize more information into collective knowledge.

4.6.3.3 Career Pyramid Development

Most personnel performing operations, intelligence, and link support are assigned to UAS for only one tour. Though these personnel have performed well, the experience is capped at three years. The culture and experience can continue to mature if there is a planned career pathway or pyramid. This growth is essential to support the CCDR at the graduate level. Other Services and potentially coalition partners, will eclipse USAF operational support pertaining to experience if UAS assigned personnel are not retained for a career. The success of the operation is dependent on having aircraft, control stations, and the associated links functioning at peak performance. Training and personnel management of these ground crews and technicians will advance and reshape career fields. Further, the UAS is only effective if the pilots and mission managers have critical real-time information and can integrate what they collect and do into the Global Information Grid (GIG). This requires careful consideration when developing training appropriate to UAS operators and support personnel.

Aircraft and communications UAS maintenance career field management will transform as well. First, dependence on organization-level contract maintenance will be reduced as current systems mature. Unique design and supportability attributes of existing and future UAS and a growing maintenance experience base will enable a transition to a more generalized organizational-level mechanical and technical (mech/tech) AFSC structure. This evolution in maintenance specialty structure will further meld with the overarching future strategy for the maintenance career fields as part of Training Enterprise (TE) 2010 initiatives. The vision of a UAS mech/tech AFSC construct for organizational-level maintenance will be similar to that currently being utilized on F-22 bases.

4.6.4 Long Term (FY25-47) Path Toward Full Autonomy

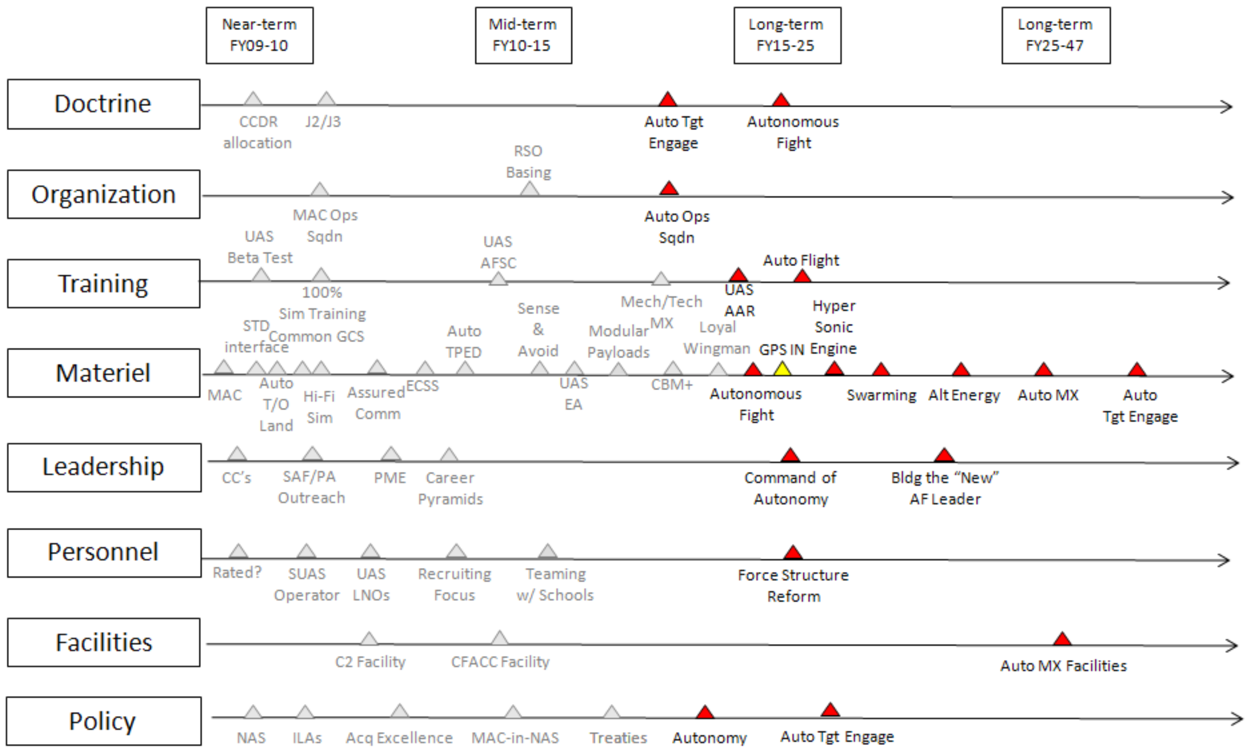

Figure 10: Long Term – Full Autonomy

The final portfolio step leverages a fully autonomous capability, swarming, and Hypersonic technology to put the enemy off balance by being able to almost instantaneously create effects throughout the battlespace. Technologies to perform auto air refueling, automated maintenance, automatic target engagement, hypersonic flight, and swarming would drive changes across the DOTMLPF-P spectrum. The end result would be a revolution in the roles of humans in air warfare.

4.6.4.1 Long Term (FY25-47) Technology Enablers

Assuming legal and policy decisions allow, technological advances in artificial intelligence will enable UAS to make and execute complex decisions required in this phase of autonomy. Today target recognition technology usually relies on matching specific sensor information with predictive templates of the intended target. As the number of types of targets and environmental factors increase the complexity of and time to complete targeting increases. Further, many targeting algorithms are focused on military equipment. Our enemies today and those we face in the future will find ways to counter our systems. Autonomous targeting systems must be capable of learning and exercising a spectrum of missions useful to the Joint Warfighter. However, humans will retain the ability to change the level of autonomy as appropriate for the type or phase of mission.

4.6.4.2 Force Structure Reform

Personnel costs will shift from operations, maintenance, and training to design and development. Today flight control software has demonstrated the first stages of self healing by isolating malfunctions during self test and at times, compensating for loss of aircraft wing or tail surfaces. Also today, stealth surface repair is accomplished by machines, not manual labor. As technology advances, machines will automatically perform some repairs in flight and routine ground maintenance will be conducted by machines without human touch labor. Fewer operators will be “flying” the sorties but directing swarms of aircraft. There will be cascading DOTMLPF-P implications on facilities, organization, training, and force structure. Skills to prepare, launch, and perform combat air operations will no longer be required only on the flight line but in the technology development offices as well. New tactics can be either programmed in at any time from Distributed Network Support locations, or the system will learn from the experience of others in the swarm. Through these advances, systems and equipment can deploy forward with little if any human presence unless required for acceptance.

A key challenge to realizing the vision will be to develop and maintain the right skill sets of systems and operational software developers, mission directors, and future USAF leaders. Design teams must plan for the flexibility to change tactics and levels of response to situations. The team members need to be selected for basic skills and then further trained to build systems that can fight the battles at all levels of conflict in all environments. Relatively few mission directors will be needed so issues of career advancement and selection criteria will be challenges for future leaders. These leaders will also require different skills to employ air power that is largely non-human. In the future, the warrior will have incredible combat power and responsibility with a smaller logistics footprint.

ANNEX 5- IMMEDIATE ACTION PLAN

5.1 DOTMLPF-P Immediate Actions

The following are issues requiring immediate attention in order to successfully implement the UAS Flight Plan. These issues have been examined and solutions have been proposed using the DOTMLPF-P construct. For each issue an OPR and Offices of Coordinating Responsibilities (OCRs) are proposed. Additionally, the materiel initiatives are competing for immediate funding to accelerate development and demonstration. AF/A2 will present updates on these issues through the corporate process. Actions and decisions required of SECAF/CSAF will be presented on a quarterly basis.

5.1.1 Doctrine:

Objective: Assess options for UAS units to support multiple CCDRs if needed by 4QFY10.
OPR: LeMay Doctrine Center; OCR: ACC and AFSOC

UAS reach-back operations coupled with long endurance platforms have the potential to blur apportionment directives. For example, the current Expeditionary Wing Commanders are tasked to support more than one theater with the same crews and control stations. This can extend to a single unit supporting multiple AORs. However this ability also challenges existing doctrine that normally only assigns a given unit to a single CCDR. When portions of a given service unit (squadron, group, wing) are supporting multiple AORs (e.g. The 347th expeditionary wing), it is essential to determine who or what organization allocates a given capability on a minute by minute basis.

Solutions to this issue will require doctrinal and organizational changes to include possibly establishing a level of command with authorities to reallocate forces by the 4QFY09. This issue is similar to the allocation of strategic airlift through the 618 Tanker Airlift Control Center (TACC). Joint Functional Component Commanders (JFCC) for ISR (STRATCOM JFCC ISR) and Transportation (TRANSCOM) will address the UAS that primarily support those respective functions; however multi-role long range systems do not currently have an overarching functional COCOM. This is further exacerbated because today two separate tasking organizations require UAS assets and three when UAS take on a significant cargo transportation role. Multi-role UAS need to support JFCC ISR tasks as well as air tasking order (ATO) force applications missions. This challenge will increase since the MQ-9 has been designated to backfill missions currently met by 250 older fighter aircraft slated for early retirement. These competing tasks must also be balanced by the command authorities under this initiative.

Nontransferable command authority established by Title 10 (“Armed Forces”), United States Code, section 164, is exercised only by commanders of unified or specified combatant commands unless otherwise directed by the President or SECDEF. Combatant command (command authority) cannot be delegated and is the authority of a combatant commander to perform those functions of command over assigned forces involving organizing and employing commands and forces, assigning tasks, designating objectives, and giving authoritative direction over all aspects of military operations, Joint training, and logistics necessary to accomplish the missions assigned to the command. Combatant command should be exercised through the commanders of subordinate organizations. Normally this authority is exercised through subordinate Joint Force Commanders and Service and/or functional component commanders. Combatant command provides full authority to organize and employ commands and forces as the combatant commander considers necessary to accomplish assigned missions. Operational control (OPCON) is inherent in combatant command.

CCDR APPORTIONMENT OF GLOBALLY CAPABLE SYSTEMS: A single unit cannot be simultaneously assigned with specified OPCON or Tactical Control (TACON) to multiple CCDRs. Any transfer of forces between CCDRs requires Presidential or SECDEF approval. However, a single unit can be used in support of multiple CCDRs, but there are two major drawbacks:

1. CCDRs need the certainty of the UAS capability via their exercise of OPCON and TACON. Partial or temporary “ownership” of a capability that may be pulled back by a higher HQ makes it nearly impossible to effectively plan or execute in a fluid operational environment.

2. Legal command authority and responsibility issues could arise if portions of an operational mission fail and an investigation traces the cause back to the source of the tasking and orders. This scenario may be putting the "lending or owning" CCDR in the position of being responsible for an operational mission that they were not actually executing operational authority over.

TWO POTENTIAL COA'S THAT COULD BE PURSUED SIMULTANEOUSLY:

1. Long term "permanent" solution: Title 10 USC, and the resulting Unified Command Plan (UCP), must be reviewed in light of modern capabilities. A single Joint Command, at the National level, could be empowered to oversee and prioritize global operations for those assets capable of participating in a "global joint force." That command would have the ability to coalesce and allocate any available assets (UAS, space, airlift, global strike, cyber, et al). In this paradigm, the term "available" takes on a unique meaning. Other than staff support, no forces would be assigned to that Senior Command, however the Command would have SECDEF-like authority to rapidly swing forces (capabilities) from one CCDR to another. Those forces would be under the OPCON and TACON of the gaining CCDR for a specified duration.

2. Short term "current" solution: While doctrine recommends that forces should be attached to (and under the OPCON of) the commander charged with the responsibility for mission execution (e.g., CDRUSCENTCOM), it also allows for deviation based on changes in the operational environment. The current OCO presents a relatively unique operational environment that crosses many CCDRs AORs. With a carefully constructed Direct Support agreement between CCDRs, the SECDEF could – in the case of Predator/Reaper operations – designate a functional CCDR as a supporting commander and CDRUSCENTCOM (or any CCDR) as a supported commander for all missions. The functional CCDR, through COMACC, then places UAS units in direct support to CDRUSCENTCOM through CENTAF/CC. A properly written directive needs to be created, establishing authorization for the commander of the UAS units to respond directly to the operational mission requirements and tasking of AETF/CC.

5.1.2 Organization

Objective: Focus ASC on all components of all types of UAS including SUAS and HAA for more effective development and acquisition by 4QFY09 (test-bed for Life Cycle Management Excellence)
OPR: AFMC; OCR: SAF/AQ, HAF A1, and HAF A2 UAS TF

Currently UAS Acquisition is stove-piped by weapon systems. There are a number of issues that are common to medium and large size UASs that would benefit from common coordinated approaches. Some of these issues include datalinks, sense and avoid systems, and standard interfaces.

ASC will focus on full institutional integration of all UAS in the USAF. This includes aircraft, modular payloads, communications infrastructure, and ground stations. The goal is to foster appropriate Joint UAS Acquisition with emphasis on innovation, rapid acquisition and fielding. Ideally, the USAF will be recognized as a UAS acquisition Center of Excellence, delivering Joint UAS Capabilities with best practices that can be exported across DoD.

Objective: Stand up two SUAS squadrons by FY10.
OPR: AFSOC OCR: HAF A1, HAF A2 UAS TF, ACC, and AFOSI

The new squadrons will ensure that all USAF SUAS operations are consistent with other USAF flight operations. These squadrons will provide direct support to key Battlefield Airmen units and their unique deployments. The first step toward establishing these squadrons will be an analysis of the SUAS mission requirements supporting AFSOC, Force Protection, AFOSI, and COCOM ground component forces. The analysis will leverage the expertise of Airmen related to flight operations, maintenance, logistics, training, career field management, and network C2. Organizational options will be developed to support CONEMP for the requisite missions. These options may include forward deployed flights and permanent detachments. This organization will be scalable to support specific AFSOC Force Protection, and OSI SUAS missions as well as theater missions directed by the AOC.

5.1.3 Training:

Objective: Demonstrate high-fidelity simulator (100% IQT) by 4QFY10
OPR: AFMC; OCR: SAF AQ, SAF XC, HAF A2 UAS TF & A3/5, and ACC

Developing a high-fidelity simulator capable of meeting 100% IQT is the intent of this objective. The explosive growth in UAS creates the need to dramatically increase training capacity, quality, and efficiency in UAS systems and capabilities. In April of 2008, SECDEF directed the services to “Look at training in a different way than we have in the past”. His comment was driven by the inability of the services to meet the required surge in UAS operations as a result of shortfalls in training production. A key contributor to this training shortfall is the current generation of simulator’s lack of a realistic training environment.

Support the programmed fleet of assets provides to COCOMs can be maximized with high-fidelity simulators developed to meet ACC specific requirements. Due to training requirements, manned platforms typically deploy only a third of their assets to combat. The higher the fidelity of the simulation, the less there is a need for live flight. Potentially training throughput would be doubled by not being tied to range, weather and other aircraft sortie limitations and more resources can be devoted to combat. Once initial training is complete, UAS crews could maintain continuation currencies and mission skill sets without generating home station sorties. This added flying training can be accomplished without risk of aircraft mishap. Some home station sorties will be generated to meet required maintenance training and readiness.

Training and materiel solutions for this issue include three levels of modification of existing UAS simulators. These modifications are high-fidelity realistic presentations of sensor operations and UAS systems components with LVT and Distributed Mission Operations (DMO) capability. The first priority is a high-fidelity database supporting realistic sensor displays. These imagery simulation enhancements will be leveraged into the RQ-4 simulator as well. This database is critical not only for SO training, but also for other aircraft pod simulations. Both the Navy and Army are potential Joint partners for the database development. The second level of modification will include a mission coordinator station, low-light simulation, Joint Tactical Air Controller (JTAC) simulation integration, improved flight characteristics and improved emergency procedures simulation. These improvements enable MQ-1 and MQ-9 simulators to perform all IQT training with the exception of missions that require participation with other aircraft. The third level of modification will link the simulator with DMO and LVT systems.

Until these systems are developed, not only do aircrews require sorties to train with JTACs and manned aircraft during IQT, but JTACs, manned aircraft crews and maintainers will require UAS sorties to meet their training requirements. Redirecting FY09 RDT&E funding supports the development and implementation of standards for all future UAS simulators. If funded, the goal is 100% of IQT to be accomplished in simulators as soon as possible.

5.1.4 Materiel and Personnel:

Objective: Implement improved MAC in MQ-1/MQ-9 GCS 4QFY10
OPR: AFMC; OCR: SAF AQ/XC, SAF/XC, HAF A2 UAS TF, HAF A3/5, and ACC

Current operations restrict a single operator to controlling a single aircraft with limited ability to operate different UAS types from a ground control station. Several hours per day per UAS may be required for transit between launch and recovery locations and the mission area. Additionally, excess resources are used when two UAS are required to maintain one continuous orbit. Major portions of collection missions can be managed through existing levels of automation technology. This technology coupled with improved HSI controls and displays, will allow a single pilot and four SOs to control up to four aircraft simultaneously for benign operations. This effort upgrades existing MQ-1 and MQ-9 MAC GCS with new software, enhanced interfaces and incorporates lessons learned from thousands of combat hours flown in MAC. If funded the initiative will “MAC-up” the last 7-10 GCS off of the MQ-1/MQ-9 production line. Technologies advanced through MQ-1 and MQ-9 MAC lessons learned could be implemented on other systems to provide similar efficiencies. The qualification training will also need to be adjusted for MAC-enabled operations.

Objective: Demonstrate air-launched SUAS enhanced MAC technology 4QFY10.
OPR: AFMC, AFSOC, OCR: SAF/AQ, HAF A2 UAS TF, HAF A3/5, and ACC

Air-launched off-board sensing is required for some missions particularly when there is a need to see below cloud decks. These aircraft could be controlled from the parent aircraft or handed off to other aircraft or surface teams to maintain chain of custody for high value targets. This concept will be integral to next generation gunship and next generation UAS CONEMPS. Additionally, security forces team could more efficiently monitor an entire base perimeter with ground launched MAC system as opposed to multiple SUAS operators attempting to achieve the same effect. One pilot could direct the aircraft without the need to continuously coordinate with several other operators to avoid gaps in coverage while deconflicting flight paths of all the aircraft. Enhanced SUAS MAC is expected to significantly increase number of aircraft controlled simultaneously since the simpler flight profiles and missions lend themselves to increased automation.

For this demonstration the MAC concept is applied to multiple air-launched SUAS. Spectre Finder UAS will be controlled and managed as an extension of the MQ-1 and MQ-9 systems. These tube-launched expendable SUAS will also have modular payloads. This will demonstrate UAS MAC-like teaming and enhance “thru-the-weather ISR”. If funded, the demonstration would be the first in a series to develop CONEMPS for manned-unmanned defensive counter air, SEAD and special operations missions. The Navy is a potential partner for this demonstration.

Objective: Demonstrate with simulation an interoperable, standards-based, open architecture unmanned C2 segment to enhance inter-Service interoperability by 3QFY10
OPR: AFMC OCR: SAF/AQ, SAF/XC, HAF A2 UAS TF & A3/5, ACC and AFSOC

Standards and interoperability are keys to the Joint forces gaining Information Superiority in today’s network enabled environment. The Joint and Service communications system must possess the interoperability necessary to ensure success in joint and multinational operations as well as with other government and non-government agencies. Interoperability can be achieved through: commonality, compatibility, and standardization. Planners must know the capabilities and limitations of the other components communication system resources and must be able to integrate them into the Joint Communications system plan. As new UAS systems are developed, it is essential they are designed with open-system architecture components (i.e. air vehicle terminals, ground terminals, terrestrial connections) in mind; and that future interoperability is not compromised by acceptance of proprietary connectivity components. All USAF UAS development and procurement initiatives should comply with recognized standard interfaces and with the Interoperability Key Performance Parameter (KPP) through the JCIDS process.

Interoperability standards provide the common medium for unmanned systems interfaces by:

1. Reducing life cycle costs – the cost to develop, integrate, and support unmanned systems is reduced by eliminating custom “stovepipe” implementations
2. Providing a framework for technology insertion – with a common interface, as new technologies are created, those technologies can be easily integrated with minor to no modification to existing systems
3. Adapting to the expansion of existing systems with new capabilities – with the framework to support new technologies, the types of missions that current systems can perform increases

The U.S. Government has recognized the importance of standards within the DoD to support the rising number of unmanned systems. Interoperability standards are now being written into Public Law, specifically with regards to Standardization Agreements (STANAGs) such as STANAG 4586. Public Law 109-163 from Jan 6, 2006 states that: “those vehicles use data formats consistent with the architectural standard for tactical unmanned aerial vehicles known as STANAG 4586, developed to facilitate multinational interoperability among NATO member nations.” In addition to STANAG 4586, Military

Standards such as MIL-STD 188-165A, INTEROPERABILITY OF SHF SATELLITE COMMUNICATIONS PSK MODEMS, are essential standards that must be complied with during the development and procurement phases. Bottom line: Interoperability is the key to agile evolution.

Specific developmental actions are required to support the Flight Plan initiative on Standard UAS interfaces. These actions are targeted to achieve improved mission integration and support the AT&L initiative for interoperability and commonality. This demonstration expands UAS C2 capabilities for inter-service interoperability within families of systems as CONOPs/CONEMPs require. It will determine any additional functionality that needs to be incorporated in future C2 architectures. Specifically the initiative is intended to develop and demonstrate interoperable, standards-based, open architecture command and control for UAS families of systems that may include MQ-1, MQ-8, MQ-9, MQ-X, and RQ-4 through the application of the *Standard UAS Interface* guide developed by the Army. The key Joint UAS C2 architecture and interface standards to be developed are aircraft control and data sharing standards, mission integration data standards, distributed aircraft and payload operations standards, and multi-aircraft control standards. In FY09 Joint Interoperability Profiles (JIOP) will be developed from CONOPS, CONEMPs and vision documents which in turn will be used to define Joint UAS C2 architectures. In FY10 Joint Interface Control Documents (JICD) for each junction in the joint architecture will be developed followed by a Joint working group using the Joint Concept Technology Demonstration (JCTD) approach to develop standards.

Objective: Demonstrate Airborne Sense and Avoid (ABSAA) technology and CONOPS in 3QFY10
OPR: AFMC; OCR: SAF/AQ, HAF A2 UAS TF & A3/5, and ACC

UAS airspace integration is a top UAS priority of DoD. The exponential increase in the number of UAS supporting combat operations creates a demand for airspace access to conduct test and training. A combination of policy and sense and avoid technology development and fielding is essential to meet this need. Some technology development has been accomplished but delivering systems and payloads supporting immediate COCOM needs had taken precedence. OSD AT&L has challenged Services to fund technology development required to meet the UAS programs' airspace integration Key Performance Parameters (KPPs). SECAF has further refocused efforts through tasking to the HAF to develop an executable plan for sense and avoid. If funded, this initiative would demonstrate ABSAA for Reaper-class UAS and inform ABSAA solutions across the family of UAS. This directly supports SECAF and OSD tasking.

Objective: Demonstrate High Altitude Airship UAS in FY09
OPR: AFMC; OCR: SAF AQ, HAF A2 UAS TF, A3/5, and ACC

The utility of high altitude long endurance capability has the potential to support many mission areas. Near peer space and cyber competitors create the need for these capabilities. Aerostats and specialty aircraft have the potential to mitigate these risks. Additionally, capacity limitations of the current communications and datalink architecture require deployable gateways to connect all combat forces to the worldwide information system. These high altitude systems can provide connectivity where no capability or infrastructure exists today. If funded, this high altitude airship demonstration would assess their utility for ISR, communications, and navigation (GPS) payloads. At the completion of the demo the AF will make a decision on pursuing an operational HAA capability. As a follow-on, these platforms may provide a means to employ new sensors to support Joint Operations while the technologies are developing to miniaturize these payloads for integration on other UAS. The Army and Navy have interest in this capability as well.

Objective: Demonstrate technology for MQ medium sized (MQ-M)-like," modular payload platform in FY10.
OPR: AFMC; OCR: SAF AQ, HAF A2 UAS TF & A3/5, and ACC

The current DOD acquisition process emphasizes technology demonstrations. This initiative supports this new OSD direction. The intent of this effort is to identify high payoff system and mission attributes and CONEMPS, and demonstrate the critical enabling technologies to mature from the current generation of remotely piloted vehicles to an effective multi-mission Next Generation UAS. More importantly the flight plan identified modularity as a critical capability advancement of these aircraft. Modular payloads will consider EA, CAS, strike and multi-INT ISR missions. This modular technology demonstration will also be used to refine the human system interfaces for the advanced ground control station. Technology integration lessons learned from this demonstration will be used to define modularity standards for the MQ-X/MQ-Ma and follow on USAF UAS programs. The design will also advance the understanding of interface standards for service-oriented architecture payload control.

Objective: Demonstrate MQ-9 ATLC by 4QFY10 and accelerate fielding
OPR: AFMC; OCR: SAF AQ, HAF A2 UAS TF, HAF A3/5, and ACC

As with all aircraft, most safety incidents and accidents occur during the takeoff and landing phases of flight. Some efforts have been made to develop an ATLC for medium and large UAS. There have been challenges aligning the multiple program dependencies and concurrent engineering. This has been exacerbated by the limited capacity of the current manufacturer to develop these technologies. If funded, the flight plan initiative would accelerate ATLC by breaking it into three phases, a limited capability auto land followed by a full capability and redundancy, and lastly a Join Precision Approach Landing System (JPALS) compliant capability. FY09 investments could be made in the technology leading to a touchdown demonstration in FY10 and fielding of the limited landing capability in FY11. Once proven, ATLC will be rigorously tested to comply with JPALS requirements. This program will be accomplished in close coordination with the other Services' ATLC efforts.

Objective: Protected Communications for MQ-1 and MQ-9 by FY14
OPR: AFMC; OCR: SAF AQ, SAF XC, HAF A2 UAS TF, HAF A4/7, and ACC

Both the MQ-1 and MQ-9 use the proprietary datalinks that are unencrypted and as such susceptible to enemy exploitation. The Predator Primary Data Link (PPDL) used by both UAS requires higher data rates to support new sensors and OSD mandated secure Common Data Link (CDL). Congress added funding to accomplish this, but did not account for the retrofit of the existing fleet.

If funded, the protected communications initiative would complete the separate development, integration, and test of the data link equipment for the MQ-1 and MQ-9 fleets. This will be accomplished in phases for each of these systems. VORTEX will be integrated in FY10. Simultaneously, the initiative will accelerate the ongoing data link improvements to meet NSA Type 1 secure BLOS & LOS data links commensurate with OSD and operator requirements.

Objective: Demonstrate UAS EA Capability for MQ-9 by 4QFY10
OPR: AFMC; OCR: SAF AQ, HAF A2 UAS TF, and ACC

The retirement of the Navy's EA-6B Prowler in 2012 will result in an EA capability gap for the USAF. In order to fill this gap, consistent funding, Service sponsorship and RDT&E will be necessary. One option to meet this gap is a MQ-9 equipped with EA capability. This new capability would be demonstrated in two phases. The first phase in FY10 would determine the viability of EA capability onboard a MQ-9. Specifically the demo will identify and mitigate potential risks of co-interference between the UAS C2 links and the EA techniques employed to defeat enemy systems. The results will be leveraged to develop a common architecture for next generation UAS EA. This architecture would define the key family of pods, systems, and links required for integrated next generation stand-in and stand-off EA. This architecture will be modular, scalable, reprogrammable, networked and persistent. The second phase will demonstrate UAS EA on spatially separated platforms to enable unconstrained battlespace access by denying enemy awareness of, or ability to track friendly air operations by 4Q12. Integrated architecture will be demonstrated with available hardware and software (e.g. Miniature Air Launch Decoy – Joint (MALD-J).

5.1.5 Leadership, Education and Personnel

Objective: Promote and assign leaders with UAS experience as soon as possible
OPR: HAF A1; OCR: HAF A3/5

UAS operations clearly present unique challenges. However, due to the growth of UAS requirements and former policies of returning UAS qualified pilots back to manned aviation, there is a lack of UAS-expert leaders, decision-makers, and subject matter experts in key positions within the HAF, Joint, and OSD staffs. This shortfall has resulted in decisions that frequently are fragmented, reflect legacy culture, and limit innovation. In addition, UAS experience is needed to lead and motivate a UAS career track within the USAF.

DoD-wide interest in UAS issues demand highly synchronized USAF activities to successfully and expediently support the Joint Force. Implementation of the USAF UAS Flight Plan needs an engine to bring it to an adequate level of institutional maturity. The HAF UAS Task Force will coordinate the USAF efforts until such time as flight plan actions can be normalized.

Leadership, Education and Personnel solutions include identifying and grooming future UAS-expert senior leaders (within both the officer and enlisted ranks), assigning hand-picked UAS experts to the Air Staff by 3QFY09, and proliferating UAS experts throughout the Joint and OSD staff as resources allow.

Objective: Define UAS personnel career paths, training and sourcing by 2QFY10.
OPR: HAF A3/5; OCR: HAF A1, HAF A2 UAS TF, HAF A4/7, AFSOC, ACC, and AFRC

The manpower challenges and solutions described in section 3.5 of this document require formal integration in the USAF personnel system. Since UAS are becoming a greater proportion of USAF operations, career path development for all associated operations and logistics personnel needs to account for this reality.

5.1.6 Policy:

Objective: Propose National Airspace Integration Policy to OSD by 4QFY09
OPR: HAF A3/5; OCR: HAF A2 UAS TF, ACC, AFSOC, AFRC, and HQ AFFSA

By 2015 every state will have UAS flying sorties supporting DoD missions. As our nation brings home the forces deployed to Iraq and Afghanistan, a JCOE study estimates that it will take 1.1 million UAS flight hours annually to stay prepared for future conflict. Ninety-one percent of these UAS missions including most ANG Title 32 missions will need to transit classes of airspace UAS cannot currently access because they don’t meet the most basic flight safety requirement to see and avoid. Until this is resolved there are limited basing options with the necessary access to airspace.

The DoD’s strategy is to incrementally develop UAS airspace policies, procedures, and material capabilities in partnership with the FAA to support DoD’s FY10-15 bed down plan. This includes resolution of issues surrounding airworthiness, pilot/operator training standards and communications. The strategy also includes partnering with the FAA and other interagency stakeholders to insure UAS operations are incorporated into the Next Generation Air Transportation System. DoD is currently focusing on:

1. **Policy**: The National Defense Authorization Act for FY09:

    a. Establish a joint DoD/FAA executive committee for conflict/dispute resolution and act as a focal point for airspace, aircraft certifications, aircrew training and other issues brought to the committee

    b. Identify conflict/dispute resolution solutions to technical, procedural, and policy concerns

    c. Identify technical, procedural, and policy solutions to achieve the increasing and ultimately routine access of such systems into the National Airspace System

2. **Procedural:** The IPT, in conjunction with the FAA is participating in a Joint UAS Workgroup. This WG is created to identify near-term policy and procedural solutions; specifically:

a. Gather the requirements from DoD, NASA, and DHS for UAS airspace access over the next 5 years
b. Conduct safety assessment and hazard analysis based on the requirements, using existing material where available and advocating additional studies.
c. Using study results, make determinations about where access may be increased procedurally or technically.
d. Document results and recommendations in a plan; provide results to JPDO/NextGen.

3. **Materiel:** The near-term goal is the development of a ground-based capability to meet 14 CFR Part 91.113 Sense and Avoid requirement for local operations. The IPT designated the Army as DoD lead to develop a ground-based collision avoidance system that will provide situational awareness to the UAS pilot. While the local ground based system is being fielded, airborne SAA standards and modeling and simulation validation tools will be developed.

The long-term goal is an ABSAA system that will autonomously provide collision avoidance in a safe and efficient manner in all classes of airspace. The main focus of this goal is the Common Sense and Avoid Program that links the Global Hawk and Broad Area Maritime Surveillance efforts. PDM III provided the direction and funding offset for this capability.

5.2 Independent Logistics Assessments

Objective: Review and provide product support and ILA policy guidance for future systems fielded through the rapid acquisition process; publish interim guidance by 1QFY10.
OPR: SAF AQ OCR: HAF A4/7 and A3/5

ILAs are critical to ensuring effective and efficient product supportability for USAF equipment. Once operational, system supportability and material availability results can be directly linked to the amount of effort applied to conducting thorough ILAs throughout the acquisition process. Quoting from the Independent Logistics Assessment Handbook published by AFMC/A4 in January 2006:

“The USAF’s ability to maximize joint warfighting effectiveness is predicated on establishing and maintaining a foundation of logistics support throughout the system life cycle. To develop this logistics support foundation and sustain essential Warfighter performance, the logistics workforce must sharpen the focus on product support and sustainment planning and implementation, particularly in the early acquisition phases. A solid product support strategy is built around the acquisition logistics requirements and sustainment elements and is the result of continuous assessment and stakeholder collaboration. Independent logistics assessments that encompass all programmatic aspects relevant to supportability, logistics, and readiness are conducted to help accomplish these objectives.”

One of the important lessons learned from the acquisition of MQ-1 and RQ-4 directly from the ACTD process has been that it led to the failure to fully plan for life cycle product support. This combined with the fact that no assessments like ILA were available to highlight and help mitigate those risks adversely impacted overall supportability of these two systems. Fortunately, material availability has been maintained at acceptable levels due in large part to proactive Systems Program Office (SPO) leadership and heavy Contract Logistics Support (CLS) expenditures. However, with foresight and increased attention to acquisition logistics, future programs can be fielded in a more normalized and fiscally efficient environment.

5.3 Bandwidth Requirement

Objective: New UAS programs coordinate their anticipated BLOS data and comm. link bandwidth requirements with appropriate managers beginning FY09.

OPR: AFRL OCR: AFSPACE

There is a need for a comprehensive requirements process that would identify the communication requirements for all UAS systems. Classified special category systems do not have any visibility in the SECRET SATCOM Data Base (SDB). Consequently when architecture studies or AoAs are done, these demanding set of requirements are not considered. Hence results regarding “sizing” of future SATCOM architectures/systems, and possible communication layer trades (e.g. SATCOM vs. Airborne Comm. node) will be skewed and inadequate to address the entirety of the UAS system of systems communications needs.

ANNEX 6- ENTERING THE CORPORATE PROCESS

6.0 Key DoD Corporate Processes

There are three key processes within the DoD that must work in concert to deliver the capabilities required by the CCDR: the requirements process; the acquisition process; and the Planning, Programming, Budget, and Execution (PPBE) process. The primary requirements definition process is the JCIDS, described in Chairman of Joint Chiefs of Staff Instruction (CJCSI) 3170. The interrelationship between these processes is depicted in figure 10.

The three key DoD corporate processes were, for the most part, bypassed for UAS procurement and fielding. The first systems were developed through the ACTD process. In the absence of a defined requirement, these systems did not compete well for funding through the PPBE process. Many systems were procured as a result of direct congressional inserts and GWOT funding. As COCOM demand for UAS support increased, the fleet size was not limited to the POR but how fast systems could be produced and fielded. SUAS faced similar challenges and did not align with the corporate process. Long term planning and sustainment cannot rely on an OCO funding strategy. The flight plan outlines the first steps to align with the corporate processes.

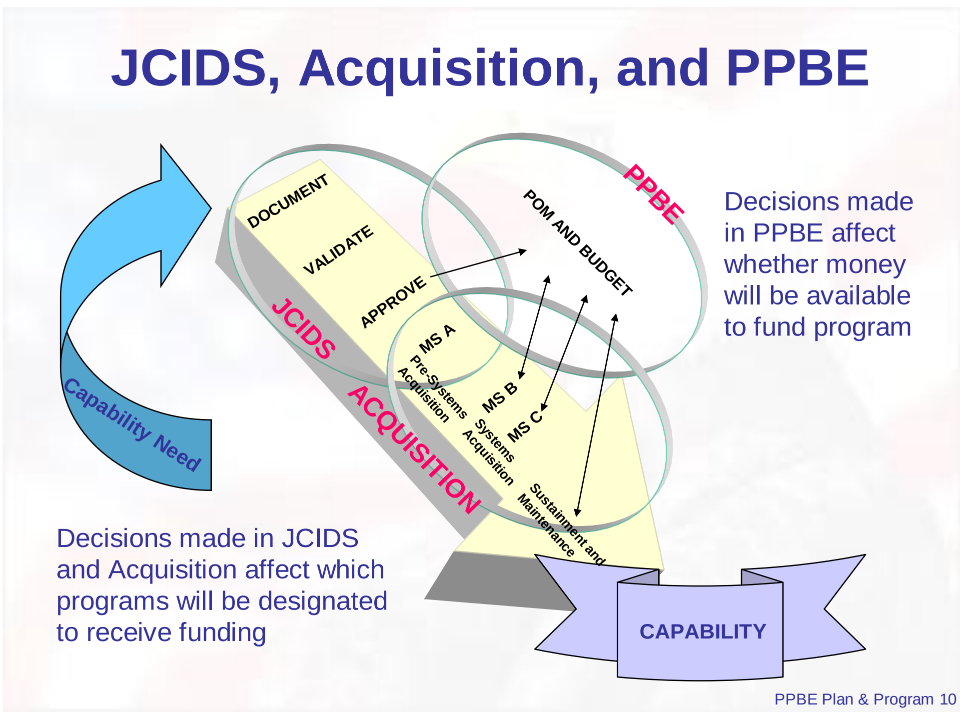

Figure 11: DoD Corporate Processes

6.1 JCIDS Process

The primary objective of the JCIDS process is to identify the capabilities required by CCDRs to successfully execute their missions. These capabilities are evaluated across the full range of military operations to determine their operational performance criteria. DOTMLPF-P changes are initiated whenever current capabilities do not meet the criteria. Services develop capability roadmaps to guide their investments to satisfy these requirements over time. The USAF uses these plans to guide the CRRA process. The CRRA is the primary process to prioritize USAF capability shortfalls. CRRA assessments contribute to development of USAF requirements and the JCIDS process. None of the current USAF UAS were developed as a result of the JCIDS process. The JCIDS documentation and approval was accomplished after the systems were procured. This occurred at the end of the ACTD in the case of

Predator and Global Hawk, and commensurate with Congressional appropriations in the case of Reaper. The USAF UAS Flight Plan provides the vector for the CRRA and subsequent JCIDS analysis required to develop the capabilities and integrate them with Joint solutions.

6.2 PPBE

In the PPBE process, the Secretary of Defense establishes policies, strategy, and prioritized goals for the Department. COCOMs provide inputs to CJCS and SECDEF through their IPLs. The process results in resource allocation decisions that balance SECDEF guidance with fiscal constraints. These details of allocation decisions are described in the POM and Budget Estimate Submission. The USAF surpassed Quadrennial Defense Review targets for increasing UAV combat air patrols over Iraq and Afghanistan, but is still unable to meet the COCOM requirements. Additionally, UAS could support 27 (54 percent) of the 50 capability gaps identified in the FY06-11 IPLs. This flight plan is intended to influence the USAF corporate process and subsequent input to the POM/BES on funding priority of UAS for Joint operations.

6.2.1 POM

The POM is a comprehensive description of the proposed programs. Each program is projected as a time-phased allocation of resources (forces, funding, and manpower) six years into the future. In addition, the DoD may describe important programs not fully funded (or not funded at all) in the POM. In February 2008, the USAF presented congress with an $18.7 billion list of unfunded requirements. The list included additional Global Hawk and Predator UAS. This was only a small percentage of total USAF unfunded requirements.

Almost all USAF ISR systems including UAS are currently in a “surge mode.” GWOT funding in response to this COCOM urgent need has consistently expanded the UAS program beyond planned force structure. Additionally, new systems were procured without establishing a Program Element (PE) or associated POR. For example, only one of the small UAS has a USAF PE. The USAF is attempting to migrate supplemental OCO funded capabilities to the baseline budget. STRATCOM is performing an analysis to determine how much of the operations are being sustained by supplementals. A clearer understanding of this requires accurate financial reporting. In compliance with Federal Accounting Standards, many of the unfunded ISR and UAS IPL requirements should be “booked” as a contingent liability in the USAF Financial Statements. This would give budget planners a more accurate view of the dollars that will be spent in future years. This accounting needs to precede the FY11 budget cycle.

6.2.2 BES

The budget converts the long range programmatic view into the format used by Congress for appropriations acts. DoD includes justification documents with the BES. Part of the conversion to develop the BES is a repricing of the POM. SAF/FM adjusts program dollars to real price costs based on “actuals.” The “actuals” are related to the cost of labor and end strength and include: Civilian personnel measured in work-years, Military personnel end-strength adjustments, and Working Capital Fund reprice for supply and depot business area workload requirements. These are vetted through the USAF Corporate Structure (AFCS) and then sent to OSD Comptroller as a combined POM/BES. Further, the justification for the UAS budget did not account for the urgent COCOM requirements and subsequent GWOT plus up. The UAS flight plan will assist the staff in prioritizing funding tradeoffs and provide a basis for the justification of the BES.

6.2.3 Entering the USAF Corporate Process

In order to move the UAS to the baseline budget, it is important to develop a strategic plan for entering the USAF Corporate Process. At the headquarters level, a hierarchy called the AFCS analyzes and integrates the budgets and missions of the MAJCOMs, Direct Reporting Units (DRUs), and Field Operating Agencies (FOAs) into a seamless USAF budget. At its lowest level, this structure consists of USAF Panels that have responsibilities for particular portfolios. UAS have primarily been competed as ISR platforms. The flight plan identifies current and future UAS capabilities and missions that impact nearly all the panels. More significantly, the UAS Flight Plan attempts to move from a platform based to an effects based force structure.

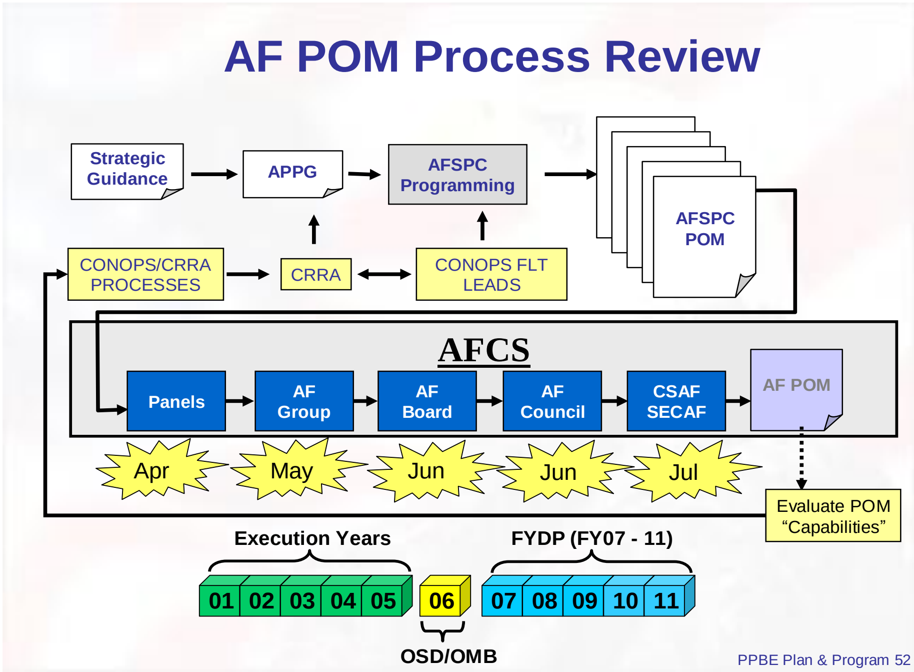

Figure 12: USAF POM Development Timeline

The following schedule is a USAF POM Development Notional FY10 Timeline:
Notionally, the Timeline for FY11 will mirror the FY10 Timeline by 1 year (CY09-CY10). However, due to the completion of the FY10 President's budget (PB), USAF Planners and Programmers should remain flexible in building the UAS APOM for FY11.

15 Jan	•MAJCOM Programmers Conference
Jan-Feb	•APPG/PPI Signed
22 Jan – 7 Feb	•PEM Parades / Panel Integration
31 Jan	•AF Efficiencies Strawman Due
4 Feb	•4-Star Program Summit
5-7 Mar	•Corona South
10 Mar	•COCOM Brief Combined AFG/AFB
11-12 Mar	•PEO/ALC Brief Combined AFG/AFB
14 Mar	•AF Efficiencies RAPIDS Due
7-25 Apr	•VCSAF Vector Check
28 Apr – 2 May	•AFB Pre-Brief
26-30 May	•AFC Pre-Brief; VCSAF Vector Check; SECAF/CSAF Vector Check
4-6 Jun	•Corona Top
10 Jun	•AF Council Review
18 Jun	•SECAF/CSAF Review/Approval with MAJCOM CCs
19-30 Jun	•Program Guidance to FM
30 Jun – 2 Jul	•FM Executes Program Guidance
18 Jul	•POM to OSD

Figure 13: FY10 Notional Timeline

Objective: Develop a strategic financial plan for migrating UAS as a supplemental-funded capability to the baseline budget. The strategic plan should include but not be limited to manpower, acquisition, and sustainment. The goal of which will be to link budget requirements to capabilities and requirements. OPR: SAF/FM, OCR: UAS TF

6.3 Acquisition Strategy

6.3.1 Unmanned Aircraft Systems Acquisition Overview

JOINT FOCUS: Successful acquisition strategies for UAS cannot be based on a platform centric model. This is a significant shift from most major USAF acquisition programs. Achieving platform or system component stated requirements independent of how it integrates with Joint forces in the world wide information network is counterproductive. Acquisition professionals must understand the full operating architectures simultaneously supporting the users around the world. At any given moment, the UAS could be sending information directly LOS to an individual soldier, while military intel analysts in the United States are correlating it with other imagery to derive precise coordinates, and other analysts at separate locations are watching for evidence of IED activity and high value individuals at the scene. Acquisition “success” is not optimizing the platform for a single mission, or sequential missions, but optimizing how the system integrates with the network. To do this UAS acquisition professionals must understand the Joint operating environment. They must understand how the UAS shares information with other Service, Joint, and Coalition systems and C2 infrastructure. Acquisition professionals must also understand the anticipated capacity of the network. A technical datalink solution optimized for a USAF system that conflicts with other Joint users may be grounded by the COCOM. This acquisition paradigm is applicable to all groups of UAS.

There are numerous UAS initiatives underway in the USAF and in the DoD that are not integrated. These initiatives are dependent on each other and need to be synchronized to achieve their intended capability. This requires a master acquisition integrator. This has a significant impact on UAS acquisition strategy which relies on the prioritization of these initiatives for success. Identifying dependencies and setting acquisition priorities is critical to the success of the new UAS concept.

GOALS:

1. Deliver increased capabilities with reduced acquisition cycle times.
2. Reduce cost structure and measure outcome-based performance.
3. Drive strategic decisions that create the most value for customers and stakeholders.
4. Reinforce credibility with DoD and other services.

METHODOLOGY: Based on 4 Pillars

1. Master integrator of compelling well defined Joint requirements derived from Global CONOPS. Employ leading-edge technologies that guide the development of future effects-based UAS capabilities.
2. Rigorously apply innovative cost and performance management techniques that reduce cost structure, and streamline acquisition processes.
3. Stable funding through better budgets and better value. Improved timeliness, accuracy and relevance of financial information.
4. Incentivize industry through competition by maximizing the use of open architectures and the development of common industry standards for UAS procurement.

UAS FLIGHT PLAN ACQUISITION SOLUTIONS:

Objective: Focus ASC on all components of all types of UAS including SUAS and HAA for more effective development and acquisition and fund additional manpower and resources to ensure success by 4QFY09 (test-bed for Life Cycle Management Excellence)
OPR: AFMC; OCR: SAF/AQ, HAF A1, and HAF A2 UAS TF

Currently UAS Acquisition is stove-piped by weapon systems. There are a number of issues for example that are common to medium and large size UAS that would benefit from common coordinated approaches. Some of these issues include datalinks, sense and avoid systems, and standard interfaces.

ASC will focus on full institutional integration of all UAS in the USAF and provide funding for additional manpower and resources to ensure success. This includes aircraft, modular payloads, communications infrastructure, and ground stations. The goal is to foster appropriate Joint UAS Acquisition with emphasis on innovation, rapid acquisition and fielding. Ideally, the USAF will be recognized as a UAS acquisition Center of Excellence, delivering Joint UAS Capabilities with best practices that can be exported across DoD.

The USAF must employ leading-edge technologies that guide the development of UAS capabilities and establish better communication with stakeholders and industry, and incentivize "fair and open" competition. To this end, the USAF should conduct a rigorous NG UAS AoA process to determine the best method of applying the evolutionary requirements identified in the UAS Roadmap. The USAF will apply the most current CJCSI 3170 and DoDI 5000.02 guidance for UAS while adopting the acquisition lessons learned and formalize as part of Develop & Sustain Warfighting Systems (D&SWS) efforts. In order to incentivize fair and open competition in the process, the USAF will work with DoD and industry to establish common standards. Further, USAF will ensure UAS capabilities are considered in every acquisition or modification/derivative acquisition strategy.

6.3.2 Unmanned Systems Acquisition Management:

One critical step to manage the systems will be for ASC to hold the systems engineering and system integrator contracts. Currently the USAF does not own the data rights for MQ-1, MQ-9, or RQ-4. This management action is essential for future systems to retain the ability to define and oversee the details of the integrated UAS environment. This would begin with the stated requirements, and then build on the MAJCOM developed CONEMPs to aid in defining the optimum suite of technologies that would best fill the capability. DoDI 5000.02 prescribes the specific requirements for RDT&E. As technologies are developed, they will be demonstrated in an operationally relevant increment so they can further mature while the force provider refines the requirement and all other actions can be synchronized. This requires a capstone Test and Evaluation Strategy (TES) for UAS platforms and payloads to address the unique aspects of each system and how it will integrate as a system-of-systems. In the process, the SOA interface standards would be refined. ASC would apply this to optimize the suite of technologies for the MAJCOM defined system-of-systems architecture. The TES for UAS would address other unique challenges of testing UAS platforms and payloads that include selection of the responsible test organization (RTO) for developmental testing, contractor as the RTO, contractor proprietary information, test airspace access under current FAA rules, range safety, data telemetry, and incremental development of capabilities. AFMC will determine resources needed for these actions potentially including increased funding and manpower.

6.3.3 Budget Investments:

The USAF UAS Flight Plan will guide the development and implementation of an integrated enterprise-level investment strategy approach that is based on a joint assessment of warfighting needs. All potential and viable alternative solutions, including cross-service solutions, new acquisitions, and modifications to legacy systems should be considered. This strategy will also draw on the results of ongoing and completed studies.

Migration to a new UAS baseline budget will begin after a thorough assessment of requirements and available resources that should be coordinated and or consolidated to affect an integrated enterprise level investment strategy. Supplementals have been used extensively to rapidly expand the UAS fleet beyond the POR and add new capability. A significant part of the capability funded by supplemental funding needs to be advocated and funded within the baseline USAF total obligation authority (TOA). This will require a more disciplined approach to budgeting that requires a better linkage of budget investments to capabilities and Warfighter requirements.

The USAF has a significant challenge to deliver the required level of UAS capability based on a growing affordability problem for manned and unmanned systems. Specifically, operating costs, military personnel costs, and acquisition costs continue to escalate at a rate significantly higher than inflation. Through both a near and long-term investment strategy, AFRL can make a positive change and reverse the trend of our growing affordability problem for Unmanned Aircraft Systems. This is based on the equation: Total USAF Capability defined as (Current Readiness + Future Capability) = TOA received in dollars multiplied by Resource Allocation Effectiveness (RAE) multiplied by the Sum of Process Efficiency defined as (Outputs divided by Cost).

The procurement and sustainment of UAS provide an opportunity to improve the "Sum of Process Efficiency" by increasing Return on Investment (ROI). This is accomplished by first determining the metrics to evaluate capability. The technical solutions will then be compared to the metrics. This comparison will become the basis of a cost benefit assessment of the solutions. UAS acquisitions will be aimed at getting "needed performance not excessive performance," and avoid the tendency to chase the next level of technology to the detriment of fielding sufficient capabilities in a timely manner.

6.3.4 Open Architecture:

The current USAF UAS GCS do not support the UAS vision and limit flexibility and sustainability. Closed architecture does not support UAS modularity and plug-n-play adaptability. Open architecture would also support the requirement levied on DoD in the FY09 NDAA. Section 144 of this Act established the requirement for Common Ground Stations and Payloads for Manned and Unmanned Aerial Vehicle Systems which is best met through an open architecture approach. USAF must require an open architecture with clearly defined, non-proprietary interface and enforceable standards.

Objective: USAF will field an open-system architecture design by 3QFY10. USAF will provide leadership to OSD's effort to develop a Joint Ground Control System.
OPR: AFMC, OCR: SAF AQ, HAF UAS TF, HAF A2, HAF A4/7 and A5R

6.3.5 Technology Assessment for Tactical UAS:

SAF/AQ interviewed stakeholders from 20 commercial and 10 government organizations to identify developing technologies which could be applicable to next generation Tactical UAS. The list of technologies was narrowed based on the industry-recognized technology readiness level (TRL); only those technologies at TRL 6 or higher were deemed to present acceptable risks. TRL 6 is defined as system/subsystem model or prototype demonstration in a relevant environment (Ground or Space).

The resulting list of technologies was assessed against the desired characteristics identified by the operational assessment. Multiple technology solutions were identified that should achieve identified desired characteristics across the various categories. SAF/AQ found a number of TRL-6 options for payloads available today. By 2012 the technologies needed for expanded operations in the NAS, adverse weather, advanced payloads, multi-aircraft formations and ATLC with onboard systems are expected to be ready.

1. Ensure all UAS systems identify their SATCOM requirements through the supporting MAJCOM (e.g. ACC/A8Q) for C2 and payload relay in the Joint Staff/USSTRATCOM managed SATCOM Data Base (SDB) if there's a possibility that SATCOM will be a potential solution for beyond-line-of-sight (BLOS) communication.
   ** Note: It should be noted that some SATCOM systems that support UAS operations are classified; while these cannot be described within this document, they are known by UAS communications planners and planners must ensure these capabilities are not overlooked in future SATCOM studies/architectures/systems.

2. Conduct a business case analysis to determine the best support and maintenance strategy for future UAS systems OPR: A4, OCR: UAS TF

3. Develop a strategic financial plan for migrating UAS as a supplemental-funded capability to the baseline budget. The strategic plan should include but not be limited to manpower, acquisition, and sustainment. The goal of which will be to link budget requirements to capabilities and requirements. OPR: SAF/FM, OCR: UAS TF

6.4 Relationship with Other Organizations

6.4.1 Internal DoD Components

The OSD UAS Task Force is leading a Department-wide effort to coordinate critical UAS issues and to develop a way ahead for UASs that will enhance operations, enable interdependencies, and streamline acquisition. The Task Force is responsible for shaping the policies, procedures, certification standards, and technology development activities critical to the integration of DoD UAS into the global airspace structure and to support those systems that are required to fulfill future operational and training requirements. Unmanned aerial systems of the Department of Defense must operate within the NAS for training, operational support to the combatant commands, and support to domestic authorities in emergencies and national disasters. The task force is currently organized as shown:

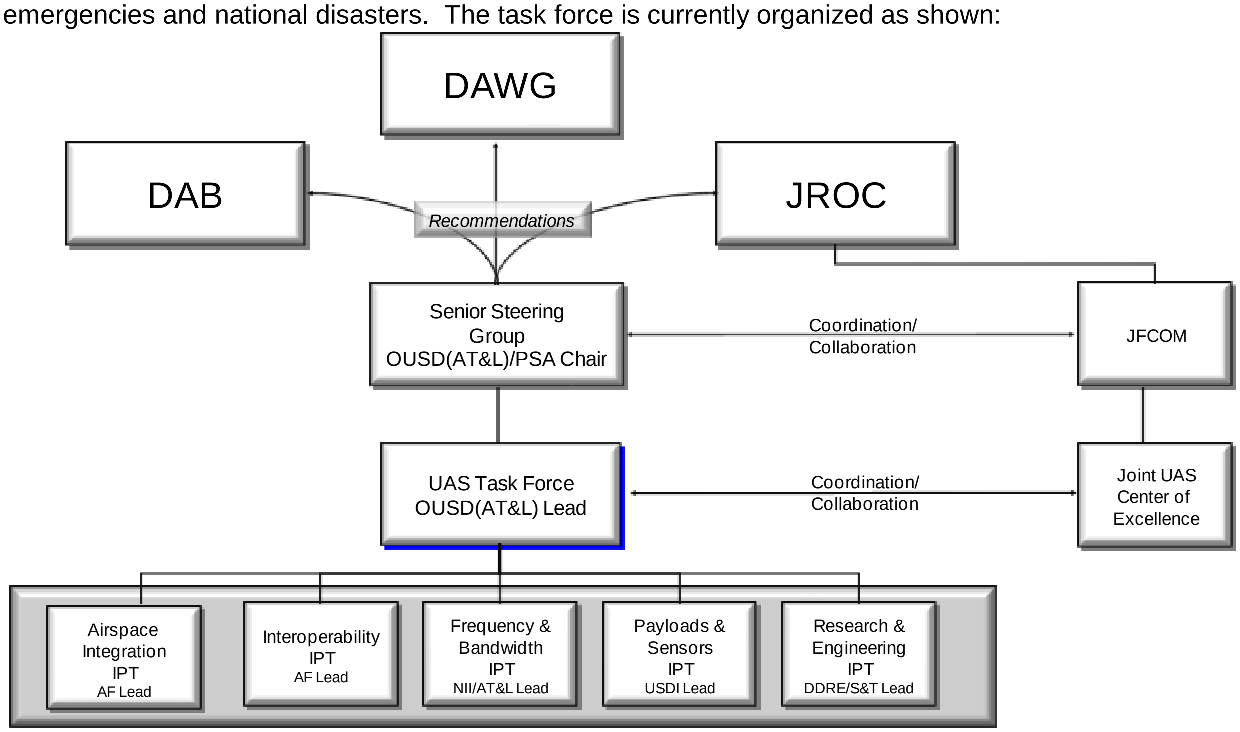

Figure 14: OSD UAS Task Force Structure

Currently, the USAF co-leads the Airspace Integration IPT and will pursue co-lead responsibility for the Standardization and Interoperability, and Payloads and Sensors Integration Integrated Product Teams. The USAF will continue to provide substantial technical expertise and support in the areas of Frequency and Bandwidth and UAS Training and Employment IPTs.

RESEARCH AND DEVELOPMENT IPT: The Research and Development IPT is tasked to identify critical Warfighter deficiencies with potential to be supported with UAS, and to link Science & Technology investment and Advanced/Joint Concept Technology Demonstration efforts. Developed an initial inventory of on-going UAS Research and Engineering (R&E) activities, and consolidated list of R&E needs/challenges for UAS.

STANDARDIZATION AND INTEROPERABILITY IPT: The Standardization and interoperability IPT is responsible for developing interoperability standards profiles for incorporation into the Joint Capabilities Integration Development System. Profile will support a Predator/Sky Warrior ACAT 1 program. Completed the Full Motion Video (FMV)/LOS Unmanned Systems Interoperability Profile, and developing a government-owned GCS Interface that is STANAG 4586-based. Other USIP Development Plans in progress include BLOS SATCOM Waveforms, Target and Weapon Application, Synthetic Aperture Radar and Still Imagery, and UAS Weaponization.

PAYLOAD AND SENSOR INTEGRATION IPT: The Payload and Sensor IPT is responsible for assessing operational requirements, identify potential joint acquisition solutions, and recommend integrated training and sustainment to optimize UAS payload and sensor development and fielding. Immediate focus is on Predator and Sky Warrior data-links, EO/IR and SIGINT payloads supporting the OCO. The USAF and the Army are currently procuring common data-link and EO/IR cameras, and are jointly developing an ASIP-2C SIGINT capability. While the IPT has been focused primarily on the Predator and Sky Warrior programs, they will be shifting focus to include other UAS.

AIRSPACE INTEGRATION IPT: The Airspace Integration IPT is responsible for DoD compliance with Congressional direction contained in the National Defense Authorization Act for FY 09 for DoD UAS. The IPT's Charter states three specific responsibilities: Establish a joint DoD/FAA executive committee for conflict/dispute resolution and act as a focal point for airspace, aircraft certifications, aircrew training and other issues brought to the committee; Identify conflict/dispute resolution solutions to the range of technical, procedural, and policy concerns; Identify technical, procedural, and policy solutions to achieve the increasing and ultimately routine access of such systems into the National Airspace System.

FREQUENCY AND BANDWIDTH IPT: The Frequency and Bandwidth IPT is responsible for developing an integrated UAS frequency management plan for all DoD UAS to support the full range of mission requirements. The immediate focus is to improve the systems frequency spectrum availability and efficiencies for the OCO. Long range coordination is conducted with allies overseas to insure frequency deconfliction will allow operations outside of CONUS and within combat zones without interfering with host nation or allied use of the spectrum. The USAF will provide technical assistance on this IPT, but since it will involve treaties it must be negotiated at the Federal level.

TRAINING AND EMPLOYMENT IPT: The Training and Employment IPT is tasked to improve efficiencies in UAS training and employment. The Joint Requirements Oversight Council will coordinate the development of UAS training activities and operations employment. The JUAS COE has developed and validated a minimum set of operator qualification requirements and standards for UAS operations in the NAS, and continues to develop Joint minimum training qualifications and standards for all UAS groups. The USAF will provide technical assistance for the development of training programs and standards, but it is incumbent on each Service to insure that UAS pilots/operators meet the CFR requirements for operations, and each Service will develop its own tactics, techniques, and procedures for operations to meet Service, Joint and Warfighter needs.

JOINT UNMANNED AIRCRAFT SYSTEM CENTER OF EXCELLENCE (JUAS COE): Future unrestricted access to the NAS will depend on certification of UAS operators and airworthiness, reliability of flight software, and the maturation of sense and avoid technologies. The JUAS COE developed the Joint Concept of Operations for Unmanned Aircraft Systems, providing the fundamental guidance and an overarching CONOPS for joint operations employment of unmanned aircraft systems UAS through a representative range of military operations. This capabilities-based approach to UAS employment enhances the joint and coalition operators' ability to execute assigned missions and tasks. The document establishes joint guidance, considerations, and concepts for optimum UAS employment across the range of military operations. The CONOPS focuses on both the operational level of warfare and civil support, and is intended for use by joint and coalition forces in preparing their appropriate system operational and program plans, supporting Service, joint, and coalition doctrine, and CONOPS.

DoD POLICY BOARD ON FEDERAL AVIATION (PBFA): The Executive Director of the PBFA has been directed to create a joint working group, composed of both operational and air traffic service representatives, to standardize and formalize air traffic control and operations procedures for UAS. Each service has provided one operational and one air traffic services representatives to serve on this group to participate in the development of DoD policy and planning guidance for comprehensive airspace planning between the DoD, the DOT, and the FAA for UAS operations.

6.4.2. Governmental Departments and Agencies

THE FEDERAL AVIATION ADMINISTRATION: The FAA is tasked with developing a roadmap for UAS airspace integration to include flight safety cases from flight rules, aircraft systems airworthiness requirements, and operator training requirements. The FAA, through its Unmanned Aircraft Program Office is developing a joint interagency activity, led by the FAA and DoD, to implement a phased approach of procedures, policy, and technology. Currently a significant amount of FAA resources are being used to work collaboratively with DoD in the development of sense and avoid capability and system safety levels.

The FAA, in conjunction with the Joint Planning and Development Office, has been tasked to develop the Next Generation Air Transportation System (NextGen). NextGen system planning currently does not address UAS capabilities. DoD, in partnership with NASA, Department of Homeland Security, Department of Transportation, and Department of Commerce are working together to ensure that UAS operations are compatible with NextGen system design.

CONGRESS: Congress has determined that UAS have become a critical component of military operations and are indispensable in the conflict against terrorism. UAS must operate in the NAS for training, operational support to the combatant commands, and support to domestic authorities in emergencies and national disasters. As recognized in a Memorandum of Agreement for Operation of Unmanned Aircraft Systems in the National Airspace System signed by the Deputy Secretary of Defense and the Administrator of the Federal Aviation Administration in September 2007, it is vital for the Department of Defense and the Federal Aviation Administration to collaborate closely to achieve progress in gaining access for unmanned aerial systems to the National Airspace System to support military requirements.

The NDAA for FY09 recommends the Secretary of Defense seek an agreement with the Federal Aviation Administration to establish joint Department of Defense-Federal Aviation Administration executive committee which would:

1. Act as a focal point for the resolution of disputes on matters of policy and procedures between the Department of Defense and the Federal Aviation Administration, and

2. Identify solutions to the range of technical, procedural, and policy concerns arising in the integration of Department of Defense unmanned aerial systems into the National Airspace System in order to achieve the increasing, and ultimately routine, access of such systems into the National Airspace System.

OTHER AGENCIES: The Task Force works indirectly with NASA and DHS through other committees on the development of airspace for UAS operations. Examples include shared facilities at common airfields, mission airspace over natural disasters (wild fires, hurricane damage surveillance, search and rescue, etc).

STRATEGIC COMMUNICATION:

Effective communication is an operational imperative in order to gain and maintain credibility while boosting understanding of and support for UAS operations. A command-supported proactive communication program hinged on communicating timely, accurate and truthful information to American and world audiences is integral to mission success and directly supports the Department of Defense

(DoD) policy of "maximum disclosure with minimal delay" regarding coverage of military activities to include people, assets and operations.

Air Force Public Affairs practitioners seek various avenues/opportunities in which to highlight UAS contributions to the joint warfighter and inform all audiences about the Air Force's mission, people and future. Public Affairs professionals are charged to develop innovative methods for reaching out to diverse audiences provided activities fall within established Air Force Public Affairs guidelines and are appropriately coordinated with MAJCOM and HAF. All public affairs activities are carried out in accordance with AFI 35-101 (Public Affairs Policies and Procedures) and AFDD 2-5.3 (Public Affairs Operations) across the information domain to include print, television and radio, as well as conducting activities directly with the public. In order to conduct a successful communication campaign, public affairs activities focus on three main areas of operation – Media Relations, Internal Information and Community Relations. Additionally, communication strategies are executed at the senior levels of government by appropriate Air Force leadership to enhance leaders' and lawmakers' understanding of UAS current and future roles.

Additionally a strategic communication plan was developed to provide public affairs practitioners and leadership with HAF-generated guidance regarding public affairs activities related to UAS operations. The communication plan is a single source document containing rules of engagement, Air Force positions relating to various topics, key themes and messages and a comprehensive list of questions and answers. The communication plan is a living document that is updated as information changes.

Current public affairs activities include identifying outreach efforts to present the Air Force's UAS vision to DoD, other government users, academia and industry. This is accomplished through strategic participation at key conferences, conducting site visits to Service UAS facilities and developing collaborative relationships. The USAF UAS message is also broadcast by generating internal stories highlighting UAS–related efforts and regular interaction with major media outlets to ensure the Air Force's position is understood. Currently these engagement activities are channeled through SAF/PA and the Air Force UAS Task Force. Because of the volume of requests USAF UAS Task Force staff has an assigned public affairs officer who serves as both a liaison to SAF/PA, leadership and other service UAS units, as well as a single point of contact for information regarding UAS activities.

6.4.3. Industry

Direct engagement with Industry is through the AFMC Program Offices and through the FAA Program Offices. The FAA Technical Center is engaging directly with industry to develop a Modeling and Simulation capability for UAS NAS integration. Indirect contact is through various industry trade shows and conferences such as AFA, AUVSI, TAAC, etc.

The USAF is currently developing both near-term and longer-term sense and avoid capabilities. The near-term solution, funded by the Global Hawk program and managed by AFRL, is to develop SAA for the Northrop-Grumman Global Hawk and Navy BAMS.

6.4.4. Coalition Partners

The NATO–CNAD (Conference of National Armaments Directors) is actively engaged in developing a sense and avoid solution for implementation with European UAS.

6.4.5. International Organizations

ICAO: The ICAO UAS study group was convened to identify UAS issues for its member states and to collaborate with existing ICAO panels to accomplish necessary tasks. This study group will develop an initial guidance document that ICAO can publish as an introduction to the member states. This study group met for the first time in April, 2008, and its first action will be to deliver a circular designed to provide the "ABC's" for UAS operations to those member states that have little to no experience with UAS. The US delegate to this ICAO group is the FAA Unmanned Aircraft Program Office (AIR-160).

EUROCONTROL: EUROCONTROL is the European Organization for the Safety of Air Navigation and is the Air Traffic Manager for the European Continent. AIR-160, under the FAA/EUROCONTROL Memorandum of Cooperation has the lead in collaborating in a number or areas; a) Air Traffic Management (ATM) Integration, b) Establishing Common UAS Required Levels of Safety for UAS Certification categorization/classifications, c) ATM Research and Development, and d) Securing UAS Spectrum Requirements.

6.4.6 Lead MAJCOMs

It is the responsibilities of lead MAJCOMs to establish enabling concepts, draft requirements, and accomplish all aspects of the organize/train/equip mission. The lead MAJCOM for medium and high altitude ISR/Strike UASs is ACC. The lead MAJCOM for airlift and air refueling UASs is AMC. The MAJCOM for SUAS is AFSOC.

ANNEX 7- LIFE CYCLE MANAGEMENT

Goals and objectives for life cycle management (LCM) challenges associated with UAS acquisition and sustainment have been identified for action by the life cycle management community. UAS characteristics and lessons derived from MQ-1 Predator and RQ-4 Global Hawk programs were used to inform the establishment of these objectives. From the LCM perspective, the vision suggested by this flight plan is to improve sustainment for currently fielded systems and build a strategy for acquisition and product support planning for future UAS systems. The three primary LCM goals are:

Goal #1: Improve Current Sustainment Posture
Goal #2: Ensure Product Supportability for Future Systems
Goal #3: Identify & Invest in Reliability, Availability, Maintainability and Sustainability (RAMS) Technologies with Particular UAS Applicability

Each goal will have associated actionable objectives with suggested OPRs and milestone dates. The intent of the goals and objectives are to address those areas of policy, process and technology to enable the UAS end state communicated in previous sections of this Flight Plan.

7.1 Unique UAS Characteristics and LCM Implications

For the LCM community, basic support for unmanned systems is the same as for manned, legacy platforms. Materiel reliability requirements are established for the aircraft, ground station and communications equipment. The system must undergo a logistics assessment – the Acquisition Sustainment (AS) Toolkit, and the Logistics Health Assessment (LHA) prior to an ILA – to ensure product support strategies that enable successful fielding and operational availability. Once fielded, the system components must be inspected and repaired at various levels of maintenance to ensure effective mission generation. However, the LCM community should recognize there are some fundamental differences between manned and unmanned systems that affect assumptions made during the various stages of the life cycle.

1. UAS are by nature, a system of interdependent, dispersed equipment
2. Removing the man from the aircraft allows for increased tolerance for certain risk
3. Mission duration is only limited by energy requirements and system health

These characteristics render unmanned systems unique when compared to manned platforms. The table below suggests some of the implications of these unique characteristics.

UAS Characteristic	LCM Implications
Interdependent, Dispersed Systems	- Dependence on assured/secured communications links - Increased emphasis on ground stations and payloads - Complicates system availability tracking - Fault isolation is more complex
Increased Risk Tolerance	- Increased level of acceptable risk during airworthiness certification and test programs for certain platforms/missions - Willingness and interest to rapidly modify system with emerging technologies and new capabilities
Mission Duration	- Increased subsystem/component reliability requirement - Criticality of onboard diagnostics - Underutilized maintenance ground crews could lead to potential AFSC restructure - Difficulty in accurate spares/provisioning computations

Figure 15: LCM Implications

These unique characteristics and associated implications require a different approach than that of manned platforms in some areas of life cycle management, especially when engaged in requirements generation, systems engineering, product support planning and management. It is within the context of these unique characteristics that the LCM Goals will be addressed.

7.2 Goal #1 Improve Current Sustainment Posture

MQ-1, MQ-9 and RQ-4 are currently deployed and successfully conducting combat sorties in support of OCO. The performance of these systems to date has been impressive and of great use to the combatant commanders. This success is due in large part to superior leadership provided by the responsible SPOs and the responsiveness of the Original Equipment Manufacturer (OEM) prime contractors and their subcontractors. It is however not without significant cost to the government. The lack of any substantive logistics planning during acquisition has resulted in large CLS expenditures, post-production engineering studies and modifications that could have been mitigated with a more rigorous approach. In order to address these issues with currently fielded systems, the following objectives are proposed.

Objective 7.2.1 Review, modify and commit to revised MQ-1, MQ-9 and RQ-4 Program Baselines as part of the FY11 Amended Program Objective Memorandum (APOM).
Summary: Due to their usefulness, the demand for MQ-1, MQ-9 and RQ-4 capabilities has grown significantly. In the case of the Predator, several CAP surges have been directed by both SECDEF and SECAF/CSAF. The Predator POR baseline of 21 CAPs has not changed; however the current USAF goal in support of OCO operations stands at 50 CAPs for combined MQ-1 and MQ-9 operations. This is only one example of the fluid requirements that must be dealt with by the MAJCOMs and Program Offices. Production, test, programming/budgeting, system improvements, configuration control and product support are all adversely affected by this lack of clearly defined operational requirements and adherence to the program baseline. This effort should also include an increase in program baselines (all appropriations) to reduce continuing dependence on OCO supplemental funding.
OPR: AFMC; OCR: SAF/AQ, HQ ACC

Objective 7.2.2 Publish and achieve approval of MQ-1, MQ-9 and RQ-4B Life Cycle Management Plans by 30 June 2009.
Summary: Life Cycle Management Plans (LCMPs) are required for all programs on the Non-Space Program Master List. The LCMP provides the foundational strategy for sustaining a weapon system from production, through active operations and culminating with disposal. It describes the underlying assumptions regarding logistics supportability and concepts of maintenance. This plan is critical to the effective management of all major weapon system programs.
OPR: AFMC; OCR: ACC, SAF/AQ, and HAF A4/7

Objective 7.2.3 *Complete Independent Logistics Assessments for MQ-9 and RQ-4B by 31 October 2009 and submit resultant product support requirements in the FY12 POM.*
Summary: Neither the MQ-9 or RQ-4B programs conducted full ILAs during the course of the acquisition process. The ILA is critical to the sustainment planning process. Completing the ILAs at this point in the system’s life cycle remains an important step to assuring system availability through proper identification of support equipment and provisioning at all levels of maintenance. The AS Toolkit and an LHA must be accomplished prior to the ILA. Accomplishment of these activities in fact make the ILA easier to accomplish and will promote successful fielding and operational availability.
OPR: AFMC

Objective 7.2.4 *Define and expand management role of 560th ACSG System Sustainment Manager (SSM).*
Summary: The SSM provides focus on product support issues during production, fielding and subsequent operations. One of the SSM’s roles is to ensure that the industrial base can support the weapon system throughout its operational life cycle. Maximizing system availability to the Warfighter is a key focus. The UAS SSM was established at Warner Robins-Air Logistics Center (WR-ALC) in 2006 and has taken program management responsibility for the RQ-4A (Block 10). It is the intent of this objective to make the SSM staff more robust and expand management responsibilities to include traditional roles expected of the SSM. This effort should include the initiative to transfer MQ-1B program management responsibilities, once production is complete to WR-ALC with funding programmed for this effort in the FY12 POM.
OPR: AFMC

Objective 7.2.5 *Normalize Operations and Maintenance (O&M) funding through establishment of a MQ-9 and RQ-4B flying hour program; submit baseline requirements in FY12 POM.*
Summary: Currently, the majority of flying hour requirements for UAS are generated from OCO operations and by nature fluctuate (typically rise) from year to year. However, as the fleet grows, there will be more stable flying hour requirements that suggest the time has come to normalize the O&M programming process. Among other benefits, the flying hour program enables MAJCOMs to properly plan and provision for expected operational requirements. Flying hour funding flows to the operational Wings to enable day-to-day O&M expenditures.
OPR: ACC; OCR: HAF A3/5, and A4/7

Objective 7.2.6. *Assess maintenance strategy for organizational-level UAS aircraft and communications maintenance and adjust programming in FY12*
Summary: Presently, 100% of current Global Hawk organizational-level maintenance is military, however future forward operating locations (FOLs) are planned to be contract maintenance. In the case of MQ-1/9, 75% of ACC and 100% of AFSOC organizational-level maintenance requirements are executed by contractors. The maintenance community must proactively develop a long term UAS manning normalization plan. HAF/A4/7 and HQ ACC/A4/A8 both favor 100% replacement of flight line contractors with funded military authorizations. This manning structure will be less expensive and allow greater operational flexibility. The intent of this objective is to clearly define that requirement and submit for manpower funding approval in the FY12 POM.
OPR: ACC; OCR: HAF A1 and A4/7

7.3 Goal #2 Ensure Product Supportability for Future Systems

Product supportability should be a key consideration throughout the acquisition and sustainment life cycle of any system. Beginning with requirements generation, RAMS considerations should extend beyond minimum JCIDS key performance parameters and key system attributes requirements. Systems engineering considerations for future UAS must ensure that the systems can be evolved as capabilities and technologies emerge, and in response to predictable obsolescence challenges. A comprehensive support strategy should be considered early in the life cycle, which then clarifies such considerations as data rights management, organic industrial repair capability development and assignment, and concepts for field-level maintenance. The following objectives target these challenge areas and are informed by MQ-1 and RQ-4 acquisition lessons learned.

Objective 7.3.1 *Define USAF UAS enterprise life cycle management strategy through publication of an UAS Integrated Life Cycle Management (ILCM) White Paper by 30 June 2009.*
Summary: The UAS ILCM White Paper will address expectations for sustainment-related requirements generation, overarching guidance for data rights management plans, vision for development of the industrial base, and integration of Expeditionary Logistics for the 21st Century (eLog21) initiatives into future UAS sustainment concepts.
OPR: HAF A4; OCR: SAF AQ and IE, AFMC, and ACC

Objective 7.3.2 *Review and provide product support policy and Independent Logistics Assessment guidance for future systems fielded through the rapid acquisition process; publish interim guidance by October 2009.*
Summary: Eagle Look Report 06-504 identified requirements and logistics planning shortfalls associated with the ACTD prototyping and subsequent fielding of MQ-1 and RQ-4. Refer to section 5.1.9 for additional detail.
OPR: SAF AC; OCR: SAF AQ and HAF A4

Objective 7.3.3 *Review, revise and codify UAS-related engineering design standards.*
Summary: In order to take full advantage of rapidly emerging technologies and encourage Joint Service interoperability, all components of future unmanned systems must comply with a detail set of engineering standards.
OPR: AFMC; OCR: SAF AQ

Objective 7.3.4. *Ensure current Maintenance Information Systems (MIS) and Expeditionary Combat Support System (ECSS) requirements include UAS-unique information system requirements.*
Summary: Current Integrated Maintenance Data System (IMDS) and Core Automated Maintenance System (CAMS) reporting systems collect mission and operations critical data. IMDS/CAMS software deficiencies have been identified by HQ ACC that must be addressed in future software releases. In addition, future UAS information systems must be able to communicate with ECSS. ECSS is a COTS based system that enables the eLog21 and Logistics Enterprise Architecture future vision for the USAF, both of which are aimed at enhancing logistics by improving processes, consolidating systems, and providing better access to logistics information in the most cost-effective manner. ECSS will leverage the information technology to enable a seamless flow of information across the USAF Logistics and supporting communities. It is critical that as ECSS software development continues that the unique characteristics of UAS support are taken into account. Examples of these unique requirements include ground control station and SATCOM status/utilization tracking, configuration management and the ability to document debriefs across multiple crews.
OPR: AFMC; OCR: HAF A4

Objective 7.3.5. *Review and modify as necessary regulatory requirements dealing with equipment configuration management and aircraft sustainment in the context of unique UAS characteristics.*
Summary: This effort will be targeted at identifying policies that may be considered over-restrictive when considering the dispersed system and risk tolerance nature of UAS operations.
OPR: HAF A4/7, OCR: SAF AC, AQ, AFMC, and ACC

Objective 7.3.6. *Develop enlisted maintenance training strategy for aircraft and communications specialists, to include identification of necessary resources and enabling technologies.*
Summary: This effort will include target dates for UAS pipeline training establishment, programming estimates for dedicated simulators and virtual maintenance training technologies. Training devices at FTDs should be equipped with the latest representative aircraft and ground systems at UAS main operating bases.
OPR: ACC; OCR: AETC, HAF A4/7, and SAF XC

Objective 7.3.7. Align UAS strategic direction (longer term activities) with ongoing transformation of the USAF Logistics Enterprise.

Summary: UAS development must be in concert with the Supply Chain Operations (SCO) initiatives embedded in Enterprise Logistics for the 21st Century (eLog21). USAF Smart Operations (AFSO21) is the guiding program for transformation efforts within the USAF. Develop and Sustain Warfighting Systems (D&SWS) is one of the key enabling processes identified within AFSO21. Supply Chain Operations is a sub process within D&SWS. Supply Chain Operations transformation, also known as eLog21, can be thought of as an umbrella effort that integrates and governs logistics transformation initiatives to ensure the warfighter receives the right support at the right place and the right time. These initiatives range from organizational changes such as the USAF Global Logistics Support Center (AFGLSC), predominant policy changes such as Centralized Asset Management (CAM), engineering improvements like Systems Lifecycle Integrity Management (SLIM), as well as fundamental changes to the way we approach aircraft.
OPR: AFMC; OCR: HAF A4/7 and ACC

7.4 Goal #3: Identify & Invest in RAMS Technologies with Particular UAS Applicability.

Objective 7.4.1. *Increase Condition Based Maintenance Plus (CBM+) funding targeted to deploy available prognostic, diagnostic and associated sensor technologies.*
Summary: Among other attributes, some future UAS are expected to conduct ultra-long endurance missions. As with space-based systems, system health monitoring and assessment will be critical to ensuring continual mission effectiveness and prevent the loss of the aircraft platform. The real-time system health and prognostic capabilities encouraged by the CBM+ approach is uniquely applicable to unmanned systems. DoDI 4151.22 describes CBM+ as the "application and integration of appropriate processes, technologies, and knowledge-based capabilities to improve the reliability and maintenance effectiveness of DoD systems and components. CBM+ uses a systems engineering approach to collect

data, enable analysis, and support the decision-making processes for system acquisition, sustainment, and operations." This objective advocates for increasing RDT&E and production funding for the fielding of those CBM+ technologies that can be advantaged by UAS.
OPR: AFMC; OCR: SAF AQ and AF A4/7

Objective 7.4.2. Support increased funding for RDT&E studies and initiatives that advance mechanical and software self-healing technologies in FY12 POM.
Summary: As with objective 3.1, ultra-long endurance UAS missions, and UAS missions in deep, denied areas will benefit from self-healing technologies that will enable continued mission effectiveness by returning the airborne platform to the operating base.
OPR: AFRL

Objective 7.4.3. Assess and mature automated ground maintenance concepts.
Summary: Future CONOPs suggest the ability for UAS to operate in non-permissive ground environments. The DoD Unmanned System Roadmap identifies automated ground refueling and munitions reloading as potential capability improvements for future unmanned logistics operations. This objective is intended to support studies that will assess the military utility, potential ground operations efficiencies and maintenance personnel risk reduction advantages of automating those functions.
OPR: AFRL

ANNEX 8- TRAINING

USAF UAS training programs have encountered numerous challenges as unmanned aircraft rapidly matured from advanced concept technology demonstrations to substantial programs of record. Many dilemmas confronting the UAS community are common to other aviation training programs such as manpower, material, and fiscal limitations. However, UAS training has several unique challenges since many of the aircraft did not undergo a classic acquisition development and fielding program. Of the five USAF UAS programs operationally deployed, only one has a full scale simulator for initial and mission qualification training. Initial qualification training has been the consistent limiting factor to increased COCOM UAS capability since the 2006 QDR and current training resources provide limited flexibility to expand production capacity as UAS ISR demand continues to grow exponentially.

While demand for the capabilities provided by UAS has dramatically risen, the absolute number of mishaps has also grown (but mishap numbers have decreased as a function of flight hours). Since the inception of the MQ-1, the aircraft's cumulative mishap rate is 14 per every 100,000 flight hours as compared to F-16's mishap rate of 11. Although still higher than the F-16, the MQ-1's mishap rate has substantially decreased from 28 Class A mishaps during the first 100,000 flight hours to fewer than 7 for the most recent 100,000 hours. In the USAF's small UAS community, there have been no Class A or B mishaps to date. A defense science board study on UAVs and uninhabited combat aerial vehicles in 2004 concluded that UAS programs have not yet expended the resources necessary to fix the root causes leading to mishaps. The largest root causes are common with manned aircraft mishaps: human and material factors. While UAS mishaps do not threaten aircrew lives, a 2003 OSD study concluded that it was critical to improve affordability, availability, and acceptance for UAVs as these are all linked to UAS reliability. This reliability goes toward ensuring safety for those on the ground and in the air that may be affected by the unmanned aircraft, as the kinetic effects of a mishap vary greatly with the size of an aircraft involved in a mishap.

UAS training will continue to employ proven aviation methodology derived from AETC and ACC training programs, but will increase use of technology to enable training efficiency. Formalization of dedicated career paths and streamlined, integrated training tracks is crucial to the success of the UAS emerging capability. The success of USAF large UAS programs has been heavily weighted upon highly experienced pilots and maintainers. This has allowed current UAS programs the luxury of only having to provide IQT and MQT training, and no continuation training for inherently single pilot, single aircraft UAS missions. Similarly, maintainers have been largely drawn from existing CAF platforms and go through a Field Training Detachment (FTD) course at Creech and Beale AFB. As newly commissioned officers (enlisted personnel for UAS Groups 1, 2 and 3) begin to form a new cadre of UAS pilots, the foundation of prerequisite experience will be eliminated. Future UAS programs must grow experience from within, a difficult task when a UAS crew may be comprised of one UAS pilot, remotely flying numerous aircraft, with no flight leader or other crew member to provide real-time and post-mission debrief.

Aircraft and communications UAS maintenance training and career field management will transform as well. Dedicated UAS maintenance training pipelines will need to be established at Sheppard AFB AETC. Unique design and supportability attributes of existing and future UAS and a growing maintenance experience base will enable a transition to a more generalized organizational-level mechanical and technical (mech/tech) AFSC structure. This evolution in maintenance specialty structure will further meld with the overarching future strategy for the maintenance career fields as part of TE 2010 initiatives.

A distinct advantage some UAS programs possess over manned aircraft programs is the applicability of high-fidelity simulation for initial qualification training. All major AF large UAS programs will develop robust simulation to support nearly all initial qualification training. Until DMO and LVT systems can meet this requirement, actual sorties will still be required to accomplish some training events such as package integration, JTAC-controlled CAS, and pre/post flight maintenance. SUAS will still require some actual flight training due to the hands on launch and recovery requirements. Simulation must be robust enough for pilot qualification and realistic enough for sensor operator certification. Dedicated ground station trainers and simulators will also provide benefits for aircraft and communications maintenance technicians. This will require additional investment in realistic electro-optical and thermal graphic generation as well as human behavior modeling to provide complex ISR and strike scenario generation. In order to successfully leverage this training advantage, current training paradigms must be adjusted. During an April 23, 2008 press conference, Secretary of Defense Gates challenged UAS communities to “look at training in a different way than we have been in the past” in order to provide more combat capability. The USAF is committed to developing a modern UAS training capability which can adapt to rapidly changing technology, easily surge to meet increased production requirements, and be distributed among global UAS operations.

UAS training will decrease dependence on one-on-one instructor to student training and increase use of personalized learning management, simulation enabled computer based training and virtual instruction. Today a significant amount of the Global Hawk academic training is accomplished using personalized learning management. The goal will be to move all AF UAS training programs to accomplish 75% of all training through self-study allowing virtual instructors to introduce and practice mission tasks with students. Automated academic and device training performance feedback is essential to strengthen standardization and quality. Traditional instruction methods will continue to ensure that proficiency is demonstrated.

Training programs will pursue modular, open architecture training systems whose applications can provide comprehensive training and learning management, computer based training and virtual instructor led simulation. To support anywhere, anytime self-study, UAS simulation must be scalable to provide training in a variety of training environments such as simulation enabled Computer Based Training (CBT), classroom simulation and full mission simulator training. High-fidelity mission simulation must also interface with joint service distributed mission training exercises. DMO and LVT that include the C2 and DCGS/PAD functions are essential to complete critical mission training. The accession of increasing numbers of inexperienced UAS crews, the increasingly complex mission tasking, and the continued trend of single-crew operations (implying no supervision and mentoring by an experienced flight lead or high-time aircraft commander) make realistic interaction with other tactical elements of the joint team imperative. The essence of combat operations (including fog and friction of war) must be designed into scenarios in order to provide the UAS crew with the skills, knowledge, mental tools, and confidence to succeed in time-compressed and uncertain environments.

Measures of effectiveness collection and automated performance feedback are essential elements of UAS training systems to enable self-study. As training technology matures these same tools will be incorporated with UAS flights to collect aircrew performance parameters and provide continuation training automated feedback. A robust automated feedback system integrated with simulation training and UAS flight operations is critical to reducing UAS human factor mishaps.

The USAF is committed to advanced training programs such as the USAF Weapons Instructor Course, as well as Joint Tactics, Techniques and Procedures (JTTP) development proliferated through joint exercise such as Air Warrior, Green Flag, and Red Flag. Joint UAS training may lead to greater training efficiencies and standardization. Training standards may be applied based on the type of airspace access needed by a UAS pilot and the level of Joint mission employment expected. A portion of this training will be through DMO and LVT. Among services’ common UAS programs, streamlined Joint training will ensure that qualified skill sets serve the battlefield and skies in the Joint arena.