ROADMAP TO NEAR-TERM DEPLOYMENT OF UNMANNED AERIAL VEHICLES (UAV) FOR TRANSPORTATION APPLICATIONS CHARGE TO PARTICIPANTS

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UAV2003 WORKSHOP OBJECTIVES

- UTILIZE GEOSPATIAL RS PRODUCTS AND TOOLS DEVELOPED OVER PAST 5 YEARS BY DOT/NASA RS MULTIMODAL TRANSPORTATION APPLICATIONS PROGRAM (4 UNIVERSITY CONSORTIA, >12 TECHNOLOGY APPLICATION PROJECTS, INCLUDING UAV UTILITY DEMONSTRATIONS)
- CAPTURE THE BENEFITS OF PARTNERSHIPS DEVELOPED WITH STATES, LOCAL AGENCIES, SHARE KNOWLEDGE AND RESOURCES
- IDENTIFY TRANSPORTATION NEEDS FOR RS IMAGING OR DIGITAL DATA COMMUNICATIONS, COST-EFFECTIVELY MET BY UAV'S : *MATCH UAV TYPE TO MISSION NEED, PERFORMANCE ENVELOPE AND COST*
- *UAV'S COMPETITIVE EDGE?* WHEN, WHY AND HOW CAN UAV'S COMPLEMENT OR REPLACE COMPETING (MANNED OR NEAR-GROUND SENSOR) DATA SOURCES
- *MARKET PULL OR TECHNOLOGY PUSH?* SHOW WHEN, WHERE, WHICH AND HOW UAV'S CAN BE USED FOR TRANSPORTATION AND/OR HOMELAND SECURITY
- *IDENTIFY BARRIERS TO UAV'S NEAR-TERM DEPLOYMENT*
- *IDENTIFY PROMISING OPTIONS TO OVERCOME BARRIERS:SYNERGY WITH OTHER EFFORTS (NASA ERAST ALLIANCE, ACCESS 5, TAAC, AUVSI, UAV FORUM)*
- *DEVELOP UAV ROADMAP FOR NEAR-TERM TRANSPORTATION USERS*

REMOTE SENSING APPLICATIONS TO TRANSPORTATION SECURITY

- RS IMAGERY FOR GEOSPATIAL INFORMATION FOR:
  - INVENTORY AND SIMULATIONS OF REGIONAL INFRASTRUCTURE SYSTEMS
  - SCENARIO PLANNING AND ANALYSIS
  - CONTINGENCY PLANNING
  - DISASTER VISUALIZATION AND MONITORING
  - EMERGENCY RESPONSE MANAGEMENT
- TAILOR CHOICE OF REMOTE PLATFORMS AND SENSORS TO NEED (UAV/MAV, HELICOPTERS, AIRCRAFT, TETHERED BALLOONS, SATELLITES)
- RECOGNIZE LIMITATIONS:
  - OBSCURATION (SMOKE, DUST, NIGHT, WEATHER, DEBRIS PLUMES)
  - GROUND SWATH, SPATIAL, SPECTRAL, TEMPORAL RESOLUTION
  - INTERMITTENCY (REVISIT TIME, DEPLOY ON DEMAND)
  - COST, AVAILABILITY, RELIABILITY, USER-FRIENDLY?

UPSIDE OF UAV PLATFORM

- COMMERCIALLY AVAILABLE, NOW PROVEN FOR MULTIPLE MILITARY AND CIVILIAN APPLICATIONS
- MANY COMMERCIAL PROVIDERS, WIDE RANGE OF COST, ATTRIBUTES
- FLEXIBILITY IN MISSION PROFILE, TASKING, LONG DWELL TIME
- ABILITY TO OPERATE IN HOSTILE, TOXIC ENVIRONMENTS
- UAV'S HAVE A NICHE PERFORMING *DULL, DIRTY AND DANGEROUS* MISSIONS
- UAV'S NICHE MARKET TO ASSESS, MANAGE AND REDUCE NATURAL AND TERRORISM DISASTER LOSSES:
  - QUICK RESPONSE TIME
  - IMAGERY
  - IN-SITU MEASUREMENTS
  - EMERGENCY COMMUNICATIONS RELAY PLATFORM

DOT 2003 STRATEGIC PLAN : HOMELAND AND NATIONAL SECURITY OBJECTIVE

- "*ENSURE THE SECURITY OF THE TRANSPORTATION SYSTEM FOR THE MOVEMENT OF PEOPLE AND GOODS, AND SUPPORT THE NATIONAL SECURITY STRATEGY*":
  - REDUCE THE VULNERABILITY OF THE TRANSPORTATION SYSTEM AND ITS USERS TO CRIME AND TERRORISM.
  - INCREASE THE CAPABILITY OF THE TRANSPORTATION SYSTEM TO MEET NATIONAL DEFENSE NEEDS.
  - IN COOPERATION WITH THE NEW DEPARTMENT OF HOMELAND SECURITY (DHS), ENSURE THAT THE NATION'S TRANSPORTATION SYSTEM IS ABLE TO FUNCTION EFFECTIVELY WHILE UNDER ATTACK OR AFTER NATURAL DISASTERS STRIKE.
  - MAKE ESSENTIAL CONTRIBUTIONS TO THE DEFENSE DEPARTMENT'S STRATEGIC MOBILITY THROUGH MANAGEMENT AND OPERATION OF THE NATION'S STRATEGIC SEALIFT RESERVE - THE READY RESERVE FORCE.

DOT MODAL MISSIONS IN TRANSPORTATION SECURITY

- FAA (WITH DHS/TSA): SAFETY CERTIFICATION OF DESIGN FOR AIRPORTS, AIRCRAFT, AIRWAY FACILITIES, NAS C3I
- FHWA: MAINTAINS STRATEGIC HIGHWAY NETWORK (STRAHNET, 61,000 mi) AND CONNECTORS (1,700 mi) TO MILITARY BASES, PORTS AND AIRPORTS FOR DEFENSE AND EMERGENCY MOBILITY; BORDER CROSSINGS AND NAFTA PRIORITY FREIGHT CORRIDORS
- FMCSA: DOCUMENTS AND CLEARS FOREIGN MOTOR CARRIERS FOR FREIGHT (HAZMAT)
- FRA: RAIL SYSTEM SECURITY PROGRAM, SHARED USE TRACK AND ROW (PASSENGER AND FREIGHT TRAINS)
- FTA: TRANSIT SECURITY AND EMERGENCY PREPAREDNESS, LEAD FOR BIO/CHEM TERRORISM
- RSPA: OFFICE OF EMERGENCY TRANSPORTATION (OET) CMC (24/7), OFFICE OF PIPELINE SAFETY)OPS), HAZARDOUS MATERIALS (HAZMAT), CIVIL RESERVE AIR FLEET (CRAF) MOBILIZATION
- MARAD: READY RESERVE FLEET MOBILIZATION (RRF), WORK W. DHS/CG AND US NAVY ON PORT SECURITY GRANTS AND UPGRADES

TRANSPORTATION AND HOMELAND SECURITY: WHERE, WHEN, HOW CAN UAV'S HELP?

- HEIGHTENED AWARENESS OF VULNERABILITY OF INFRASTRUCTURE, OPERATIONS AND COMMUNICATIONS
- URGENCY TO PRIORITIZE NEEDS AND PROTECT MOST CRITICAL FACILITIES AND NODES; EMERGENCY RESPONSE PREPAREDNESS
- IMPROVED INTERAGENCY COORDINATION: FEDERAL, STATE, LOCAL AND FIRST RESPONDERS
- LIMITED KNOWLEDGE AND RESOURCES- NEED FOR PUBLIC-PRIVATE-PARTNERSHIPS (P3) TO COST-SHARE
- BUT: FEDERALIZATION OF SECURITY, RESTRICTIONS ON INFORMATION ACCESS (INCLUDING GIS AND RS DATABASES),
- DOT AND DHS (TSA, USCG, TSWG) INVITE NEW IDEAS, PROMISING TECHNOLOGIES, COST-EFFECTIVE SOLUTIONS
- *CAN UAV'S BE RAPIDLY DEPLOYED ON-DEMAND FOR TRANSPORTATION AND OTHER HOMELAND SECURITY NEEDS?*

UAV REMOTE SENSING TECHNOLOGIES AND PRODUCTS FOR TRANSPORTATION SECURITY

- STAND-ALONE, OR AS COMPLEMENT TO "GROUND TRUTH" INFORMATION ON HOTSPOT (IR, CHEMICAL OR NUCLEAR SIGNATURE)
- PROVIDES BASELINE (NORMAL) TRANSPORTATION INFRASTRUCTURE LOCATIONS, CONDITIONS AND OPERATIONS FROM RS SURVEILLANCE AND MONITORING
- ALLOWS MODELING "WHAT IF" SCENARIOS OF ATTACK DELIVERY AND LOCATION, DAMAGE AND RESPONSE/ EVACUATION PLANS
- MUST DETECT, RECOGNIZE EVENT SIGNATURE FOR DAMAGE ASSESSMENT AND RECOVERY PLANNING
- NON-INTRUSIVE SOURCE OF SYNOPTIC, CONTEXTUAL INFORMATION ON DAMAGE FOOTPRINT, PROPAGATION
- TAILOR TO NEED TYPES OF UAV PLATFORM AND SENSORS (HELICOPTERS OR OTHER ROTORCRAFT, AIRCRAFT, GLIDERS, BALLOONS, SATELLITES)

SURVEILLANCE: HIGHWAYS, PORTS AND CARGO TERMINALS

FLIR Systems Portland Oregon

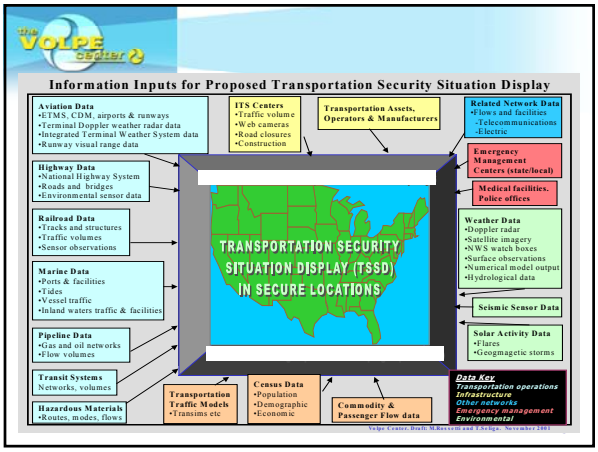
Route 1 Pacific Coast

Port of Galveston, Texas

PIPELINE & RAIL SYSTEM SURVEILLANCE

Trans-Alaskan Pipeline

Northeast Corridor



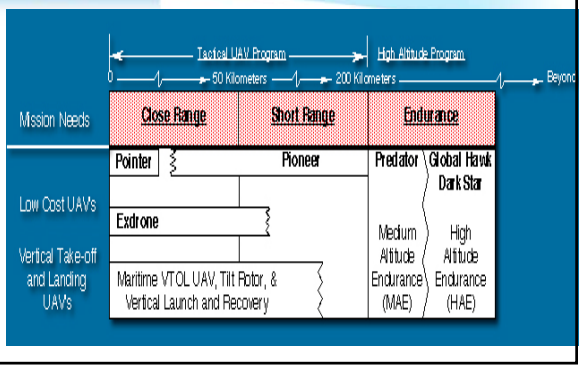
WHY USE UAV AIRBORNE SENSORS?

- READILY AVAILABLE TECHNOLOGY- OVER 200 COMMERCIAL VENDORS
- ABILITY TO OPERATE IN HOSTILE ENVIRONMENTS FOR D3 (DIRTY, DULL OR DANGEROUS) MISSIONS
- CAN DEPLOY ON DEMAND
- FLEXIBILITY IN TASKING: SURVEILLANCE OR DISASTERS, ETC.
- PLUG AND PLAY PAYLOAD (TAILORED SENSORS) POSSIBLE
- HIGH-RESOLUTION VIDEO OR DIGITAL IMAGERY AND SENSORS
- REQUIRES REMOTE CONTROL, TRACKING AND TELEMETRY LINKS
- LARGE AREA COVERAGE
- WAYPOINT TRACKING: PROGRAMMED LINEAR OR AREAL SCANS
- REMOTE AREA COVERAGE (E.G., ALASKA PIPELINE, DESERTS)

NASA UAV RDT&E OPPORTUNITIES

- **NASA DRYDEN FLIGHT RES. CTR.- UAV BUSINESS UNIT:**
- ERAST PROGRAM MGT, EDWARDS AFB RESTRICTED AIRSPACE
- TEST-RANGE: TRACKING, TELEMETRY, COMMUNICATIONS, FIXED OR MOBILE DATA TRANSMISSION AND DISPLAY, MISSION CONTROL CENTERS, UAV R&T PLATFORMS (HELIOS, PATHFINDER PLUS, ALTAIR, PROTEUS)
- LEAD ON ACCESS 5 PARTNERSHIP WITH FAA, DOD, INDUSTRY FOR NAS INTEGRATION OF HALE UAV'S
- **NASA AMES- UAV APPLICATIONS CENTER**:
- COLLABORATIVE R&D FOR SCIENTIFIC AND COMMERCIAL UTILIZATION OF UAVS AS HIGH-RESOLUTION IMAGING PLATFORMS IN NATIONAL AIRSPACE; FIRES, DISASTER ASST., COFFEE AND VINEYARDS, ETC.
- **NASA/GODDARD-WALLOPS FLIGHT FACILITY (WFF):**
- SMALL UAV (EXDRONE, AEROSONDE) MISSION REQS., PERFORMANCE ENVELOPE, VIBRATION CHARACTERISTICS
- PAYLOADS TESTING FOR EARTH SCIENCE RES. & APPLICATIONS

UAV CATEGORIES BY RANGE, ALTITUDE, ENDURANCE



NASA/GSFC/WFF UAV CATEGORIES

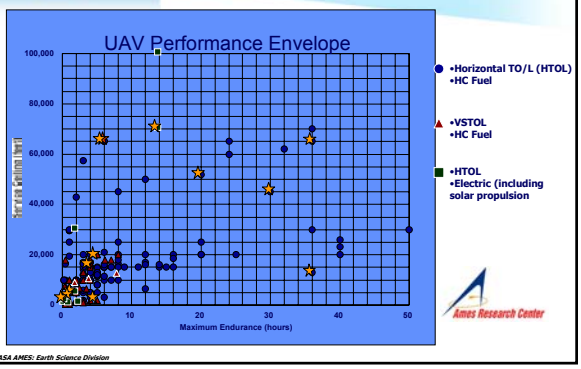
Other U.S. UAV Development/Production Activity

Local	Regional	Endurance
Shadow 200	Shadow 600	Chiron
AV Pointer Micro Bimp	Truck	BQM-34
SASS Lite Blimp	Skyeye	Model 324
Javelin	Eagle-Eye	Model 350
Porter	Aerobat (A24-2)	Model 410
Tem	Spectre II	GNAT 750
H-7B	Seabat	Altus I
H-7F	S-Tec Sentry	Altus II
H-7H	Hunter	Pathfinder
Freewing Tilt-Body	Outrider	Perseus B
Huntait		Raptor
Prowler		Thesues
Flash		Helios
HIT		
Aerobot (FS-24)		
Aerosonde		
Cyper		
X AP		

UAV TYPES:SIZES, PAYLOADS, ALTITUDE, RANGE (database at http:/uav.wff.nasa.gov)

UAV Name	Endurance	Payload Weight	Altitude
Aerosonde	40 hrs.	2.2 lbs.	20,000 ft.
Altus2	24 hrs.	330 lbs.	65,000 ft.
BQM-34	1.25 hrs.	470 lbs.	60,000 ft.
Exdrone	2.5 hr.	25 lbs	10,000 ft.
Global Hawk	42 hrs.	1,960 lbs.	65,000 ft.
Gnat 750	48 hrs.	140 lbs.	25,000 ft.
Pioneer	5.5 hrs.	75 lbs.	12,000 ft.
Shadow 200	4 hrs.	50 lbs.	15,000 ft.

UAV'S PERFORMANCE RANGE



NASA AMES: Earth Science Division

SMALL UAV's


I-Star


Aerolight


Dragon Eye


Exdrone


Micro Craft


Pointer

FAA AIRCRAFT AND PILOT SAFETY CERTIFICATION REQUIREMENTS

- AIRWORTHINESS, CERTIFICATION BY TYPE-LONG AND COMPLEX www.faa.gov/avr/avr.air/air200/200home.htm
- FAA NATIONAL AIR SPACE (NAS) RESPONSIBILITIES: AIR TRAFFIC PLANNING (APO), AIR TRAFFIC OPERATIONS (ATO), FLIGHT STANDARDS SERVICE(AFS), REGULATIONS AND CERTIFICATION (AVR) PRODUCTION AND AIRWORTHINESS DIV (AIR), FLIGHT STANDARDS (AFS, AEG), REGIONAL OFFICES- ALL INVOLVED
- "EQUIVALENT SAFETY" REQUIRED FOR REMOTELY CONTROLLED AIRCRAFT (ROA), E.G. "DETECT, SEE AND AVOID (DSA) CAPABILITY
- FAA "CERTIFIED" ABOUT 20 HALE UAVS TODATE: GLOBAL HAWK, PREDATOR, HELIOS UNDER "FAA CERTIFICATE OR WAIVER OF AUTHORIZATION" (MAY 1, 2001, WP REGION AIR TRAFFIC DIV.)
- EXPERIMENTAL AIRCRAFT CERTIFICATE- FAA FORM 8130-7, SPECIAL AIRWORTHINESS CERTIFICATE
- GROUPS I-IV AIRCRAFT (AIRCRAFT CONFIGURATION)
- AIRSPACE CLASSES C,D,E,G; FLIGHT TEST AREAS AND CORRIDORS, RESTRICTED AIRSPACE?

UAV'S BARRIERS AND CHALLENGES

- NATIONAL AIRSPACE SYSTEM (NAS) OPERATIONS REGULATIONS: "FILE AND FLY" IS GOAL , MAY TAKE 6 YRS FOR HALE UAV'S
- CERTIFICATION REQUIREMENTS NEEDED, BY TYPE, FOR:
  - RELIABILITY
  - SURVIVABILITY
  - AUTONOMY-
  - FAIL-SAFE MODES (DETECT, SEE AND AVOID, COM-LINK LOSS)
- SUSTAINABILITY AND MAINTAINABILITY FOR SYSTEM
- ARCHITECTURE: AUTONOMOUS OR GROUND CONTROL?
- GROUND CREW TRAINING & CERTIFICATION (LIKE PILOTS?)
- REAL-TIME PROCESSING AND INFORMATION DISSEMINATION
- SECURITY CONCERNS FOR ROA'S (FRIEND OR FOE?)
- LIABILITY (WHO IS IN CHARGE , RISK ANALYSIS, MGT AND INSURANCE)
- ECONOMICS: SYSTEM AND LIFECYCLE COST FOR HARDWARE, SOFTWARE, DATA PRODUCTS, TRAINING AND CERTIFICATION OF GROUND CREW, ANALYSTS, ETC.

BARRIERS TO AND SOLUTIONS FOR NEAR TERM UAV DEPLOYMENT (EXAMPLES)

- *REGULATORY* : DEVELOP FAA 14CFRXXX REGULATION AND CERTIFICATION FOR ROA'S - COMPLEX LONG, COSTLY AND UNCERTAIN (INTERIM BY WAIVER, OR CLASS ANALOGY)
- *SECURITY*: WHO CONTROLS OR AUTHORIZES FLIGHT PLAN? UAV COULD BE A THREAT; IS TECHNOLOGY CONTROLLED?
- SAFETY: HAZARDS TO OTHER AIRCRAFT, GROUND VEHICLES, PEOPLE AND FACILITIES
- *LIABILITY: MANUFACTURER? OWNER? OPERATOR?*
- *PRIVACY FROM SURVEILLANCE*
- *MARKET & ECONOMIC: PUBLIC? PRIVATE? P3?*
- USE UNREGULATED UAV'S (UUAV)- SMALL (< 500 LBS), LOW-ALTITUDE , LOW COST, MICRO AND MINI UAV (MAV), BUT LIMITED PAYLOAD AND RANGE, ONLY CLASS G AIRSPACE
- SECURE, ENCRYPTED COMLINK, REQUIRE IFF TRANSPONDER (BUT NO SPECTRUM ASSIGNED FOR UAV'S)
- PREVENT ACCIDENTS FOR ALL FAILURE SCENARIOS
- COMMERCIAL OR SELF-INSURANCE
- PUBLIC, LAW ENFORCEMENT SUPPORT
- PUBLICIZE BENEFITS TO PUBLIC (SECURITY, SAFETY), S&T PAYOFFS