INFORMATION PROCESSING TECHNIQUES OFFICE

Tactical Aircraft to Increase Long Wave Infrared Nighttime Detection (TAILWIND)

Industry Day
May 1, 2009

Melanie Dumas

BRIDGING THE GAP DARPA POWERED BY IDEAS

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Agenda

0900	Opening Remarks	Melanie Dumas
0905	TAILWIND Program Overview	Melanie Dumas
1000	Contracting Details	Steve Davis
1015	Break	
1045	Q&A	All
1200	Adjourn	

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TAILWIND Discussions

- **This Meeting is held at the UNCLASSIFIED Level only.**
- **There will be NO CLASSIFIED discussions in this venue.**
- **The Industry Day Participants include:**
  - U.S. Industries
  - DoD Agencies
  - Universities
  - Foreign Nationals

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TAILWIND Program Overview

- Military Challenge
- Program Vision
- Technologies Sought
- Program Structure
- Program Metrics

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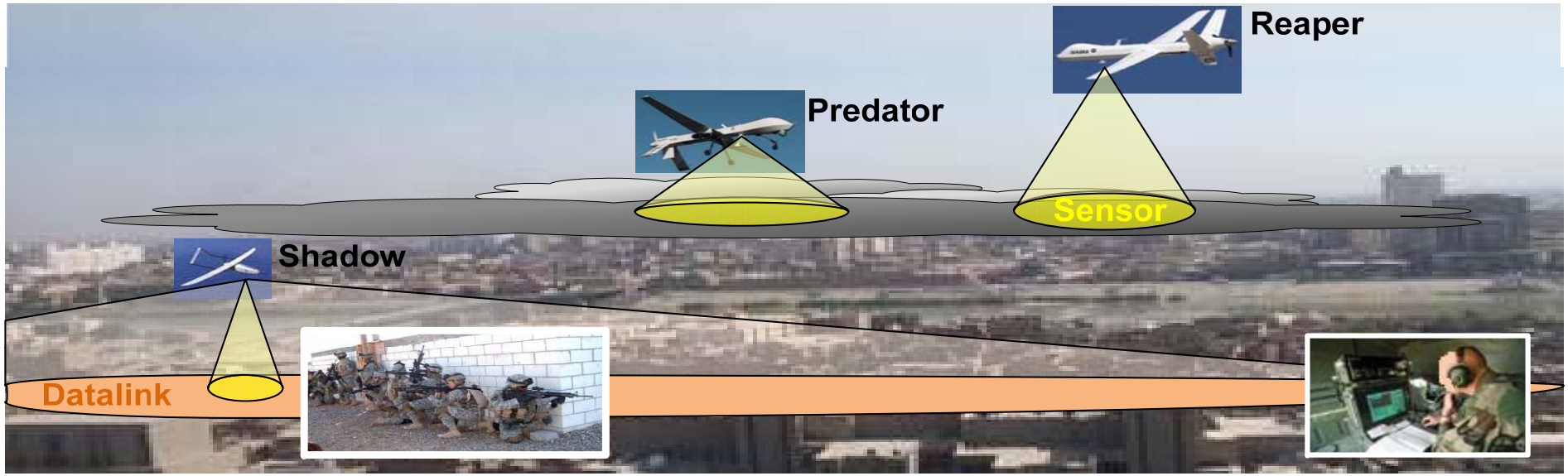
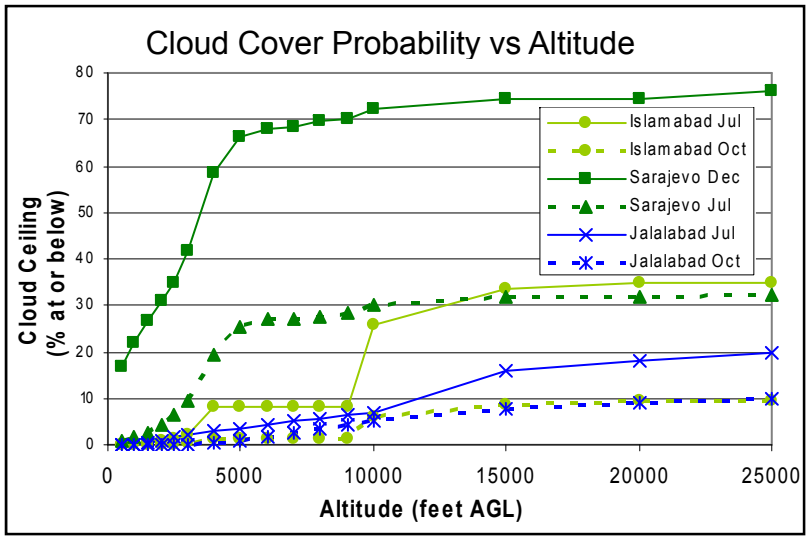
Military Challenge





- Tactical UAVs such as Shadow have “soda straw” coverage area
- Current sensor resolution and coverage area insufficient to track dismounts automatically day and night
- High Altitude UAV Electro-Optical/Infrared (EO/IR) persistent surveillance sensor visibility obscured by clouds

Current sensor footprint, resolution, and cloud cover limit our ability to track dismounts at night

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TAILWIND Enables Persistent Surveillance

Programmatic Objectives

- Fly Sensor Package for Shadow
  - 3.14 Mpixel uncooled long wave infrared (LWIR) microbolometer focal plane array (FPA)
  - 9 Mpixel Color camera

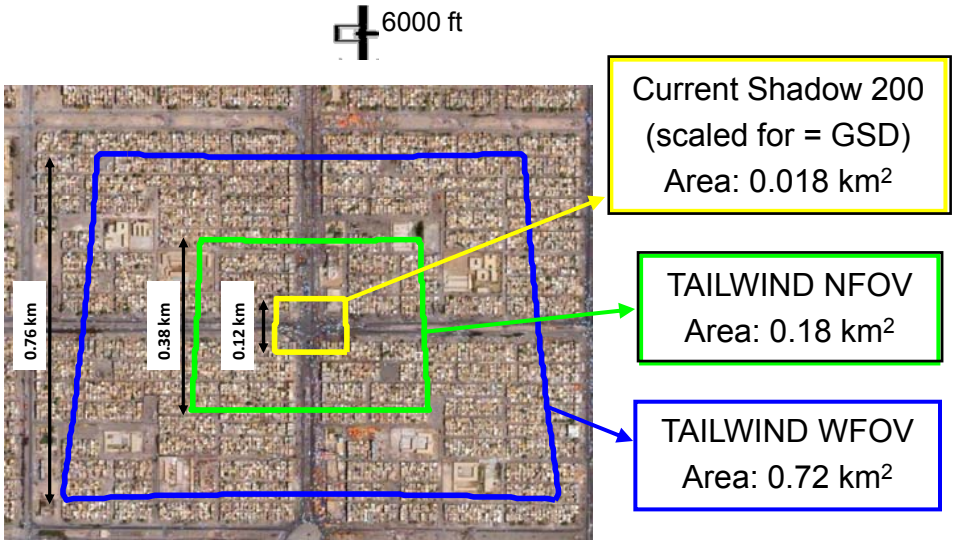
Shadow Tactical UAV

- Provide Day/Night Detection and Tracking of vehicles and dismounts

Sensor Ground Sample Distance (GSD)

	LWIR	Color
Wide FOV	0.50m	0.22m
Narrow FOV	0.25m	0.11m

- Enable Image Processing and Exploitation
  - On-the-fly 3D context generation
  - Automated user alerts
  - Disseminate images to multiple users
  - Archival Storage and Retrieval



Sadr City, Baghdad (approximately to scale)

TAILWIND provides 10x footprint of current nighttime imaging sensors, in Shadow form factor, with resolution and algorithms enabling real time dismount tracking

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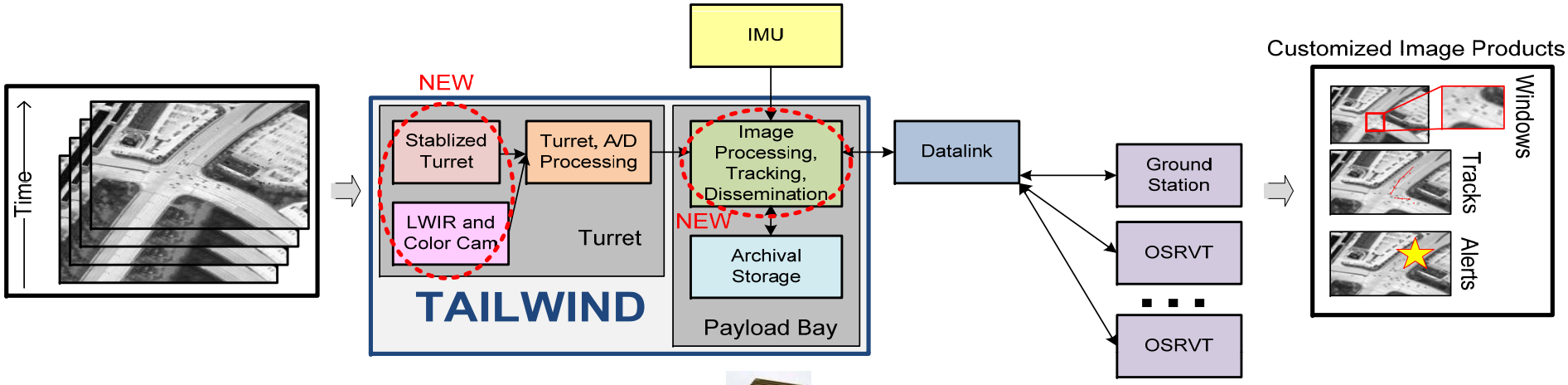
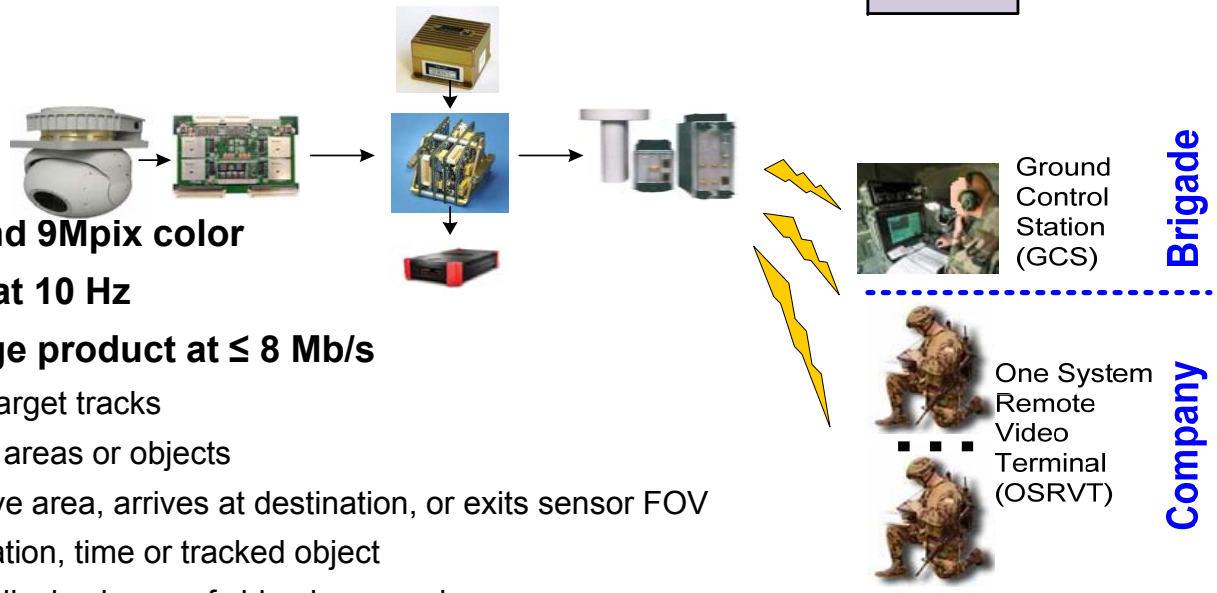
System Architecture





Input: 3.14 Mpix LWIR and 9Mpix color airborne imagery at 10 Hz

Output: Requested image product at ≤ 8 Mb/s

- Dismount and vehicle target tracks
- Image chips to monitor areas or objects
- Alerts: object enter/leave area, arrives at destination, or exits sensor FOV
- Intuitive queries by location, time or tracked object
- Video Summarization: display hours of video in seconds

Key technology challenge is to package image processing and dissemination system onboard where payload bay SWAP limits the number of processors and bus connections.

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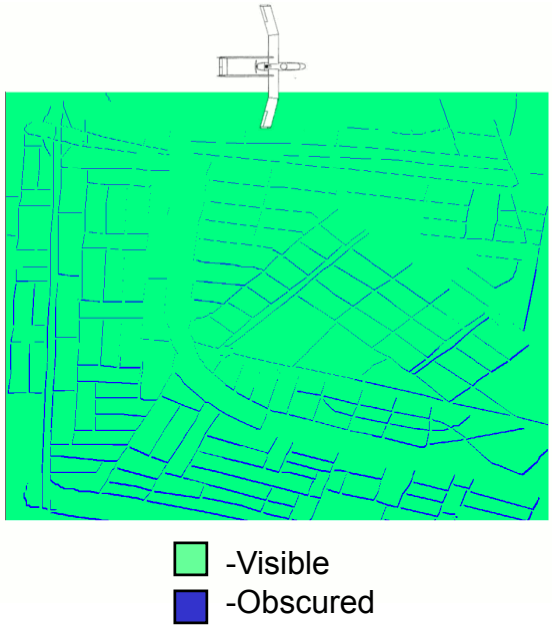
Tracking in Urban Areas

- **Track vehicles and dismounts in urban terrain**
- **Leverage 3D models to deal with urban occlusion**
- **Create miniaturized server for onboard exploitation**

Orbit over urban terrain



Urban obstruction simulation using 3D models

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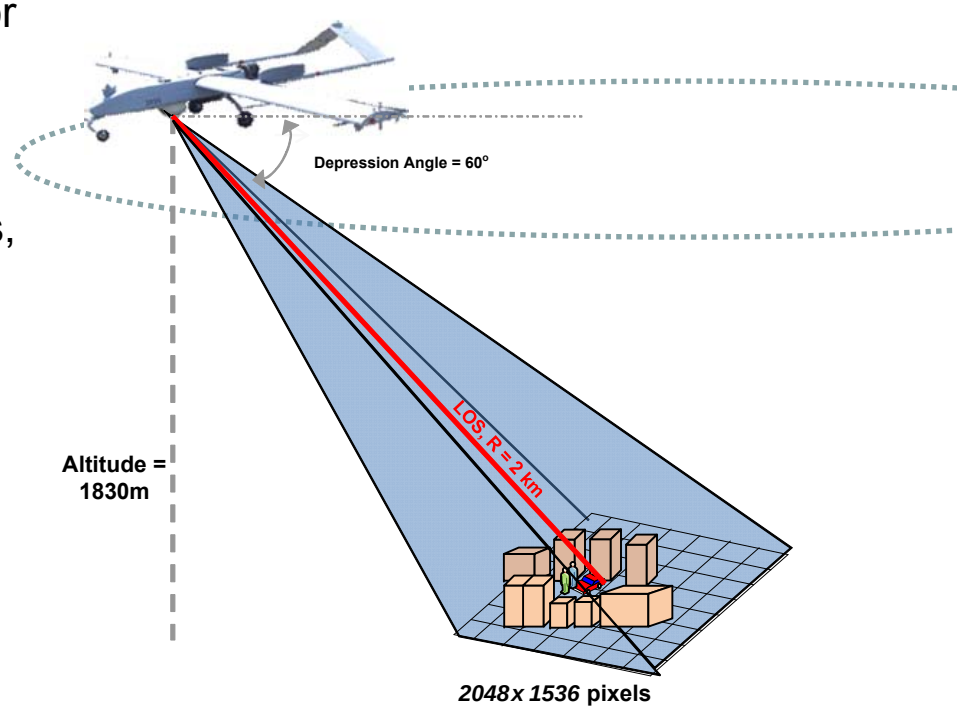
TAILWIND Tracker

- **Automated Detection and Tracking Software for Urban Terrain**
  - Detect, track all vehicles and dismounts in frame
  - When track designation selected, process archival and current imagery
  - Output result in real time (< 2 seconds)

- **3D Model**
  - Output wireframe image with dimensions and (desired) file with OpenFlight, GeoTIFF, or Google Earth vector data (TAB, SHP)
  - Use model to reduce false alarms due to motion parallax
  - Recommend use model for shadow maps, traffic analysis, and occlusion regions
  - Build model from one orbit around AOI, complete model construction within 2-3 additional orbits



Persistent Area

WFOV	NFOV
0.46 km^2	0.12 km^2

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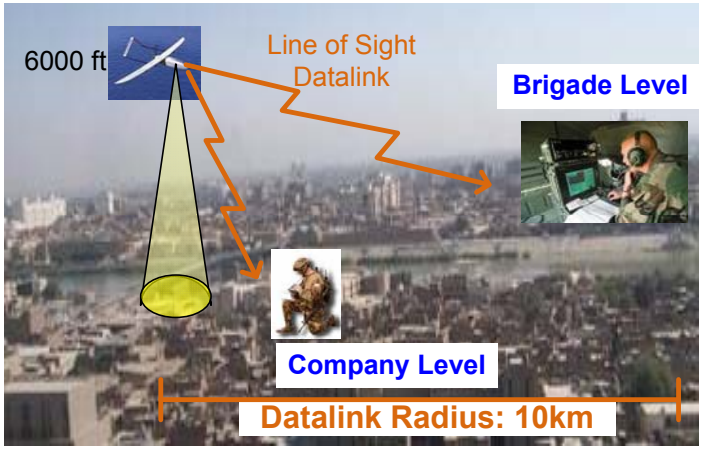
Image Products to Multiple Users

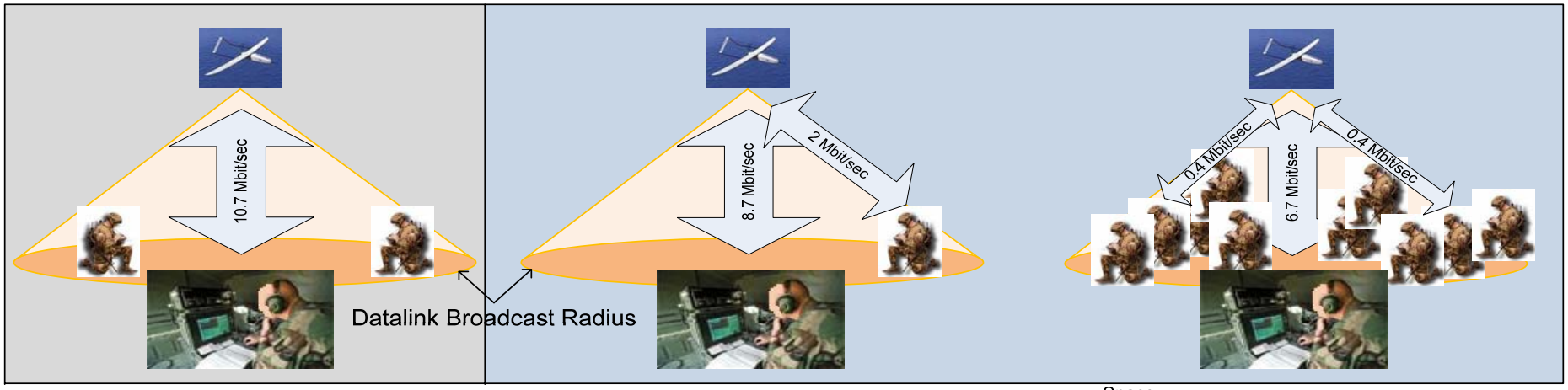
One System Remote Video Terminal (OSRVT)

- View broadcast images within Datalink range
- Provide company level image product controls

Adaptive bandwidth utilization

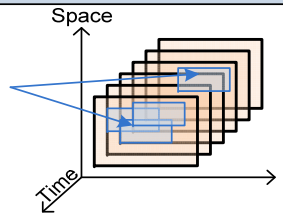
- Compress image based on number and requirements of different users
- Adjudicate bandwidth based on priority





Traditional Model:
One Video for all

TAILWIND Model:
Up to 10 Image Products
in Space and Time



Break the traditional model that everyone must share same sensor viewpoint!

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[m1]Phil Owen to provide detailed dimensions

Key Technologies

- **TAILWIND Tracker for Urban Terrain**
  - Detect and Track dismounts and vehicles
  - Facilitate tracking next to buildings with 3D building model
  - Save time by cueing users to relevant targets and target track history

- **Server in the Sky**
  - Process 3.14 Mpixel LWIR FPA + 9 Mpixel color FPA, ≥ 10Hz
  - Provide image products to multiple soldiers with adaptive data dissemination
  - Custom hardware design based on SWaP limitations of Shadow Payload Bay
  - Desirable for hardware to apply across sensor modalities and airborne platforms

Description	Specification
Weight	50 lbs
Power	< 300W peak
Image Processer Size	Fits in Shadow Payload Bay
Turret Diameter	10 in
Turret Stabilization	50 µrad LOS control
Ruggedization	Pass Shadow environmental and flight tests
System Cost	≤ $300k each for quantity > 100 units

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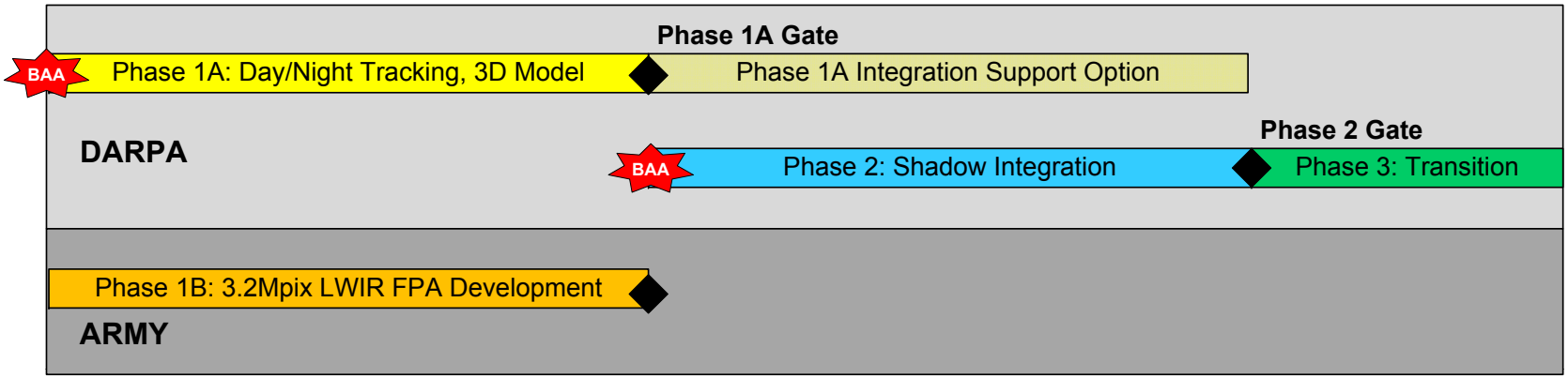
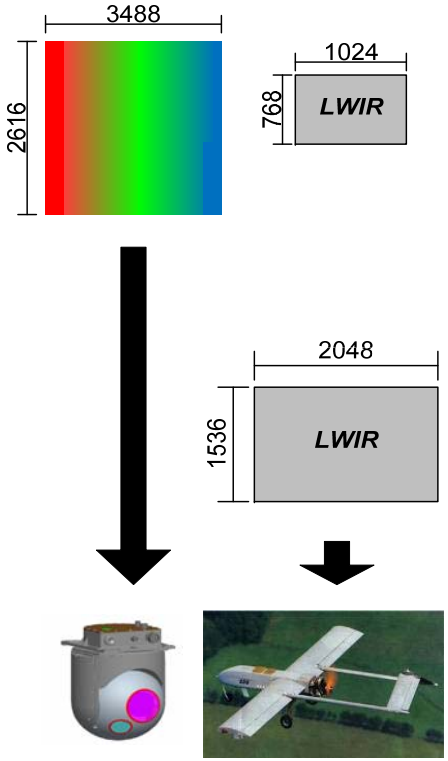
Program Summary



- **Phase 1a (DARPA):**
  - Develop tracking software, 3D models
  - Data collect manned flight test
  - Sensor: LWIR FPA + 9Mpix Color
- **Phase 1b (Army NVESD):**
  - Demonstrate 3.2 Mpix LWIR FPA
  - Provide chips GFE for Phase 3 effort
- **Phase 2 (DARPA):**
  - Shadow Integration
  - Unmanned Flight Test
- **Phase 3 (DARPA, Army): Transition**



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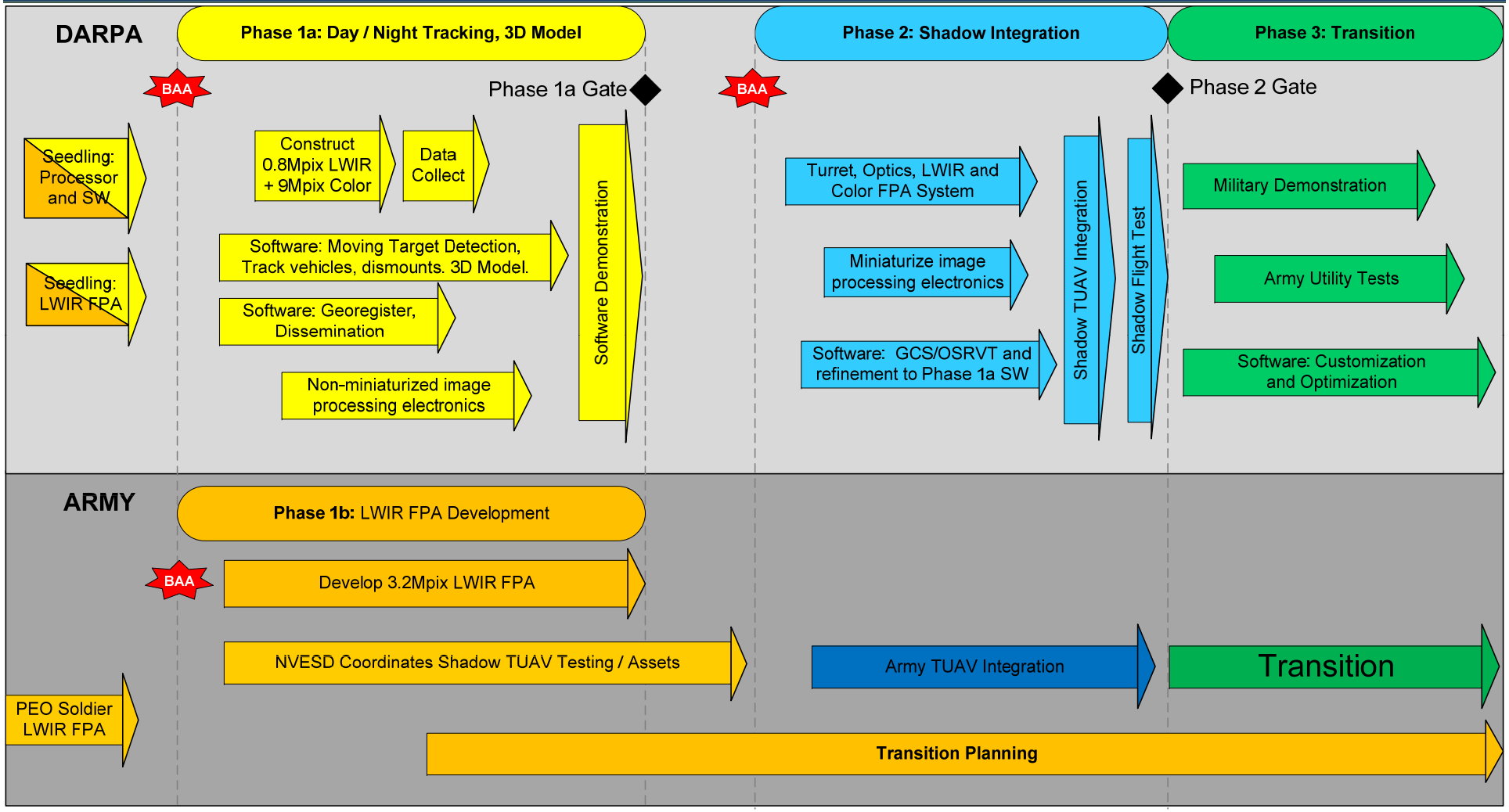
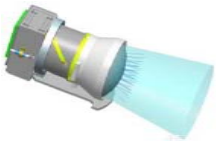
Detailed Program Plan



Blackhawk


LWIR FPA

Turret

Shadow TUAV

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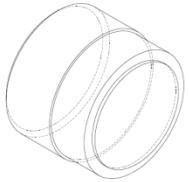
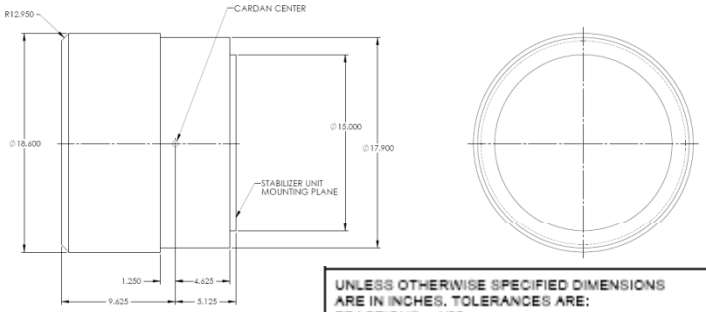
Data Collection

- **Procedure**
  - Performers will create a flight ready data collection device with LWIR FPA + color FPA
  - Plan data collection with Army NVESD
  - Mount device in Universal Gimbal on helicopter
  - Fly pre-determined flight path and route
  - Run scripted vehicles driving and people walking around area of interest
- **Universal Gimbal**
  - Detailed specifications will be provided after contract award
  - For proposals, use gimbal measurement estimates shown on this slide
  - An LN-200 IMU is integrated within the payload volume, and provisions for mounting it must be accounted for in the sensor design

System Specifications	
Gimbal Dimensions (LxWxH)	36”L x 37” swept dia.
Gimbal Weight (no payload)	110 lb.
Payload Weight (typical)	45 -100 lb.
Power Requirement	3.5 – 20A at 28VDC
Cable Weight	5 lb.
Power Conditioner (optional)	14” x 19” x 7”, 22 lb.
Steering & Stabilization	
Stabilization Type	3 axis, IMU
Axes of Inner Stabilization	Pitch, Roll, LOS
Axes of Outer Stabilization	Pitch, Roll, LOS
Vibration Isolation	Yes
Stability (Line of Sight Jitter)	<10uRad RMS
Slew Rates	60°/sec
Order of Steering Axes	Roll/Pitch/LOS
Range of Travel -LOS	Continuous
-Elevation	+/-50°
-Roll	+/-100°
Optional Features	
GPS Interface	Novatel OEM-V
Geo-Pointing	Built in IMU/INS
Remote Control Interface	Yes

Universal Gimbal Payload Bay Estimates for Phase 1





UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. TOLERANCES ARE:
FRACTIONS ± 1/32
DIMENSIONED ANGLES ±1/2°
SURFACE FINISH 63
INTERNAL RADII .030 MAX
GENERAL CONCENTRICITY .002 TIR

DECIMALS
.X ± .020
.XX ± .010
.XXX ± .005

DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994

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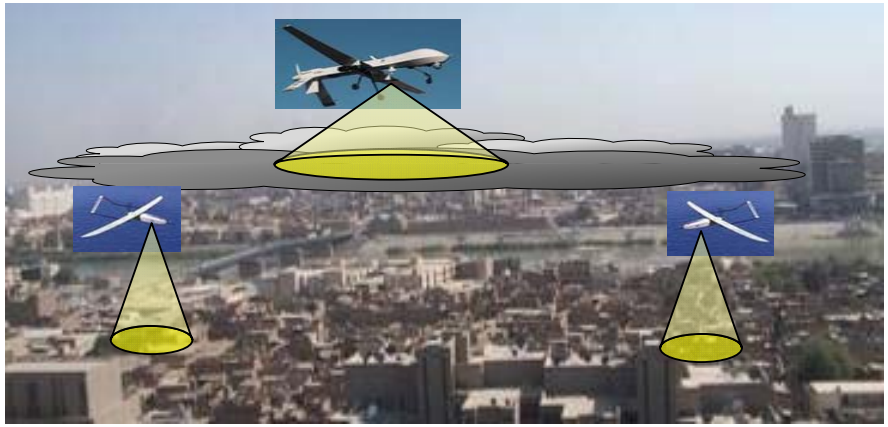
Summary

- First demonstration of Day / Night Persistent Surveillance on the Shadow TUAV



- Onboard tracking algorithms for dismounts and vehicles
- Significantly increased coverage area/resolution
- Real time custom image products for company level operations

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Contact Info

- General Questions: DARPA-BAA-09-41@darpa.mil
- Fax for Questions: (703) 807-0332, Attention: Melanie Dumas
- FAQs: http://www.darpa.mil/ipto/solicit/solicit.asp
- Teaming Page: https://www.csc-ballston.dmeid.org/baa/TAILWINDteaming.htm

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CONTRACTING DETAILS

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BAA Process

- BAA and any amendments posted in FEDBIZOPPS
- BAA covers all info needed to propose
- TIME PERIOD –BAA is open for 60 days from Announcement
- Instructions are detailed in the BAA (Follow closely)
- Following the proposal instructions assists the evaluation team to clearly understand what is being proposed and supports a timely negotiation.
- ALL questions to DARPA-BAA-09-41@darpa.mil
- All interested/qualified sources may respond
- Foreign participants/resources may participate to the extent authorized by applicable Security Regulations, Export Laws, etc.
- Government agencies/labs, FFRDCs, can respond unless otherwise restricted from doing so by law/regulation and/or agency specific policy

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BAA Process

Be aware:

- **Organizational Conflict of Interest & Procurement Integrity language**
- **Central Contractor Registration (CCR), Online Representations and Certifications Application (ORCA), & Wide Area Workflow (WAWF)**
- **Export Control language (ITAR)**
- **Subcontracting Plan Requirements**
- **Data Rights Assertions - Assert rights to <u>all</u> technical data & computer software generated, developed, and/or delivered to which the Government will receive less than Government Purpose Rights**
  - Assertions that apply to Prime and Subs
  - Use defined “Basis of Assertion” and “Rights Category”
  - Justify “Basis of Assertion”
  - This information is assessed during evaluations
- **IP to include any non-Commercial supporting software code, such as libraries, development environments, or runtime environments, which are required for installation, compilation, or execution of the TAILWIND software should have unlimited or government purpose rights.**

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BAA Process

EVALUATION/AWARD

- Government reserves the right to select for award all, some, or none of the proposals received and to award without discussions
- Government anticipates making multiple awards
- No common Statement of Work - Proposals evaluated on individual merit and relevance as it relates to the stated research goals/objectives rather than against each other
- Only a duly authorized Contracting Officer may obligate the Government

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BAA Process

COMMUNICATIONS

- Prior to Issuing BAA – No restrictions, however Gov't (PM) shall not dictate solutions or transfer technology
- After Issuing the BAA – No restrictions, however Gov't (PM/PCO) shall not dictate solutions or transfer technology
- After Receipt of Proposals –Government (PM/PCO) may communicate with offerors in order to understand the meaning of some aspect of the proposal that is not clear or to obtain confirmation or substantiation of a proposed approach, solution, or cost estimate
- Informal feedback may be provided once selection(s) are made

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BAA Process

- Make proposals valid for 120 days
- Include detailed cost breakdown for subs whose costs are or exceed 10% of the total proposed cost. These detailed sub cost proposals may be submitted directly from the sub.

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