EXACTO

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Agenda

Agenda:

- 0900 Security Overview - James Fisher (DARPA-IXO)
- 0915 Welcome – Lyndall Beamer (PM) and Dr. Robert Tenney (IXO Director)
  - –Agenda Rvw / Today's intent
  - –DARPA / IXO's Charter
- 0930 Program Overview
  - –Program motivation
  - –Vision / Notional ConOps
  - –Objectives / Goals
- 1000 User Perspective – CPT Keith Bell (Army Sniper School)
- 1030 Break
- 1100 User Perspective – Graham Giles (Triple Canopy)
- 1130 User Perspective – Bill Dodge (MTC Technologies)
- 1200 Lunch (Provided)
- 1300 Acquisition Strategy – Dr. Lyndall Beamer
  - –Program Plan, outputs, schedule & events
  - –Near term program events (source selection schedule)
- 1320 BAA Description / Proposal Overview – Stephen Davis (DARPA-CMO)
- 1350 General Questions & Answer
- 1500 Break
- 1500-1700 Industry Networking Session (and 10 minute one-on-ones)*

Welcome to EXACTO Industry Day

Dr. Robert Tenney
Director, Information Exploitation Office

What is DARPA?

The Defense Advanced Research Projects Agency is the central R&D arm of the Department of Defense with the primary responsibility to conceive, explore, and demonstrate breakthrough system concepts and the most advanced technologies.

What is DARPA's Mission?

Maintain Superiority

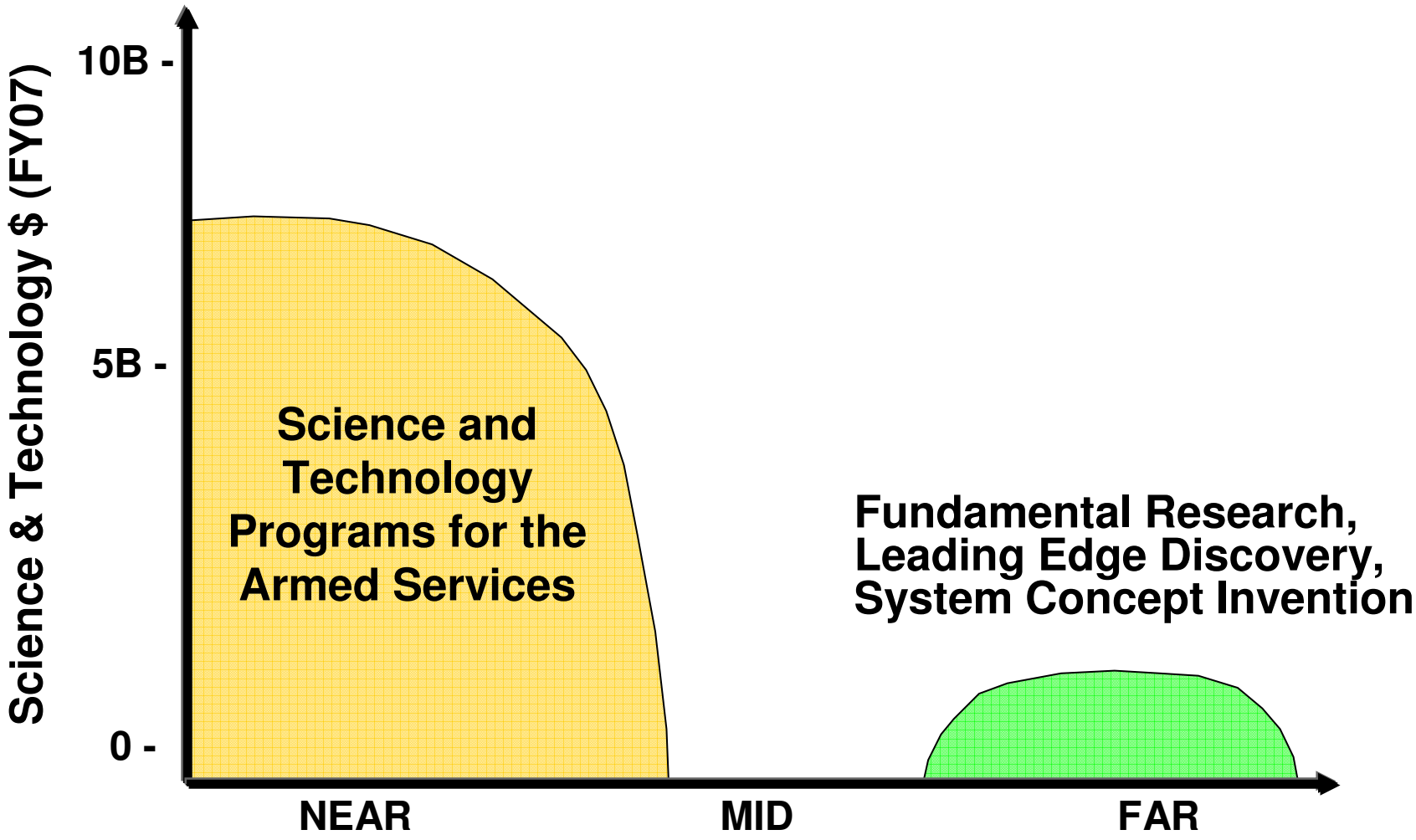
Prevent Surprise

- *DARPA's mission is to maintain technological superiority of the US military and prevent technological surprise from harming our national security by sponsoring revolutionary, high-payoff research that bridges the gap between fundamental discoveries and their military use.*

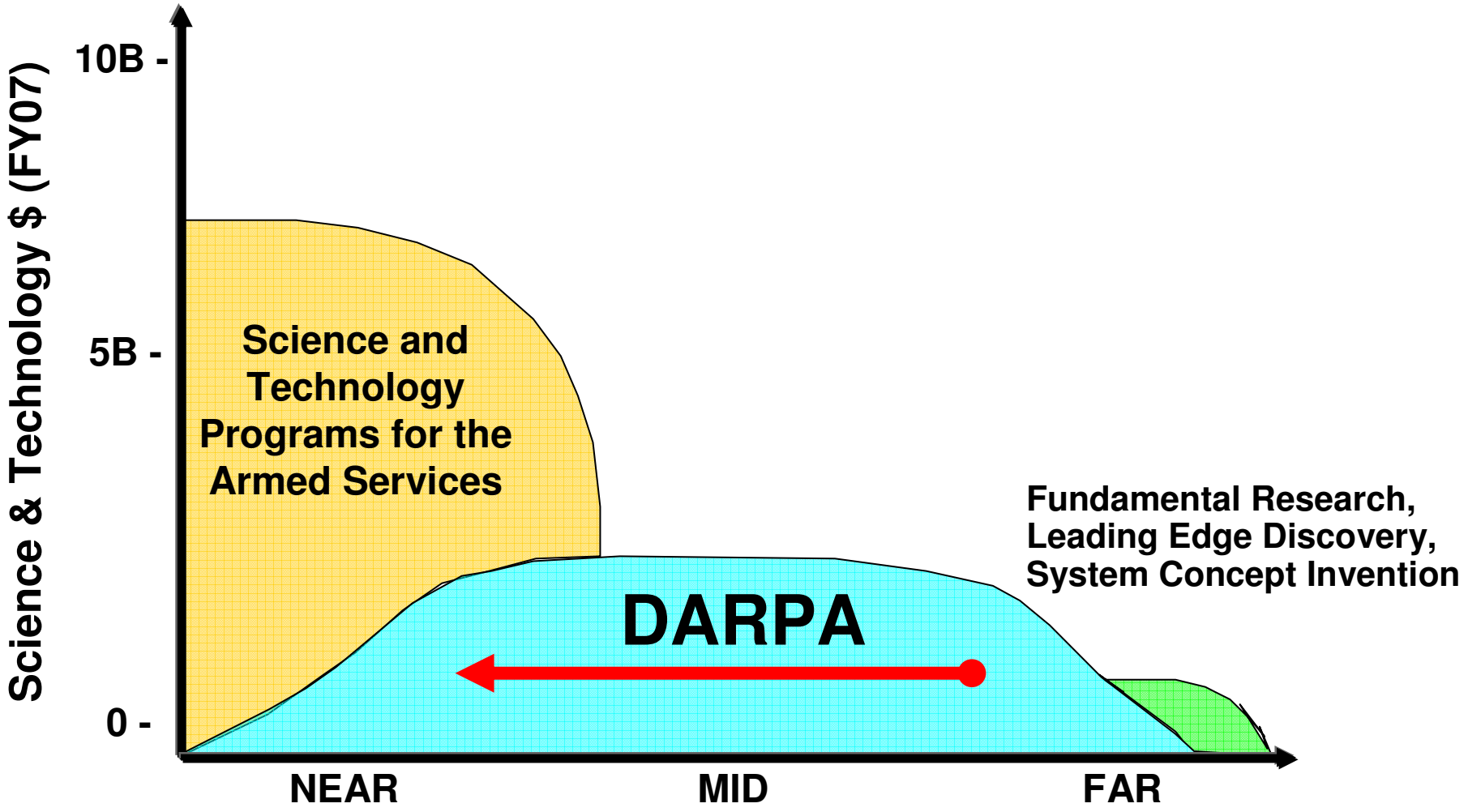
High Risk

High Payoff

DARPA Role in Science and Technology



DARPA Role in Science and Technology



DARPA Accomplishments

1960

Transit

VELA Hotel

SATURN

M-16

1970

ALTAIR

Mouse

Ground Surveillance Radar

ARPANET

ATACMS

Assault Breaker

Center for Monitoring Research

1980

JSTARS

Stealth Fighter

TALON GOLD

Sea Shadow

MIMIC

GPS

Speech Recognition

BRIDGING THE GAP
1958 DARPA 2008
50 YEARS
POWERED BY IDEAS

Command Post of the Future

Autonomous Ground Vehicles

X-45

Mobile Robots

JSF Engine

LSTAT

2000

Uncooled IR

Pegasus Launch Vehicle

1990

DARPASAT

Phraselator

Exoskeleton

SUO SAS

MEMS

Global Hawk

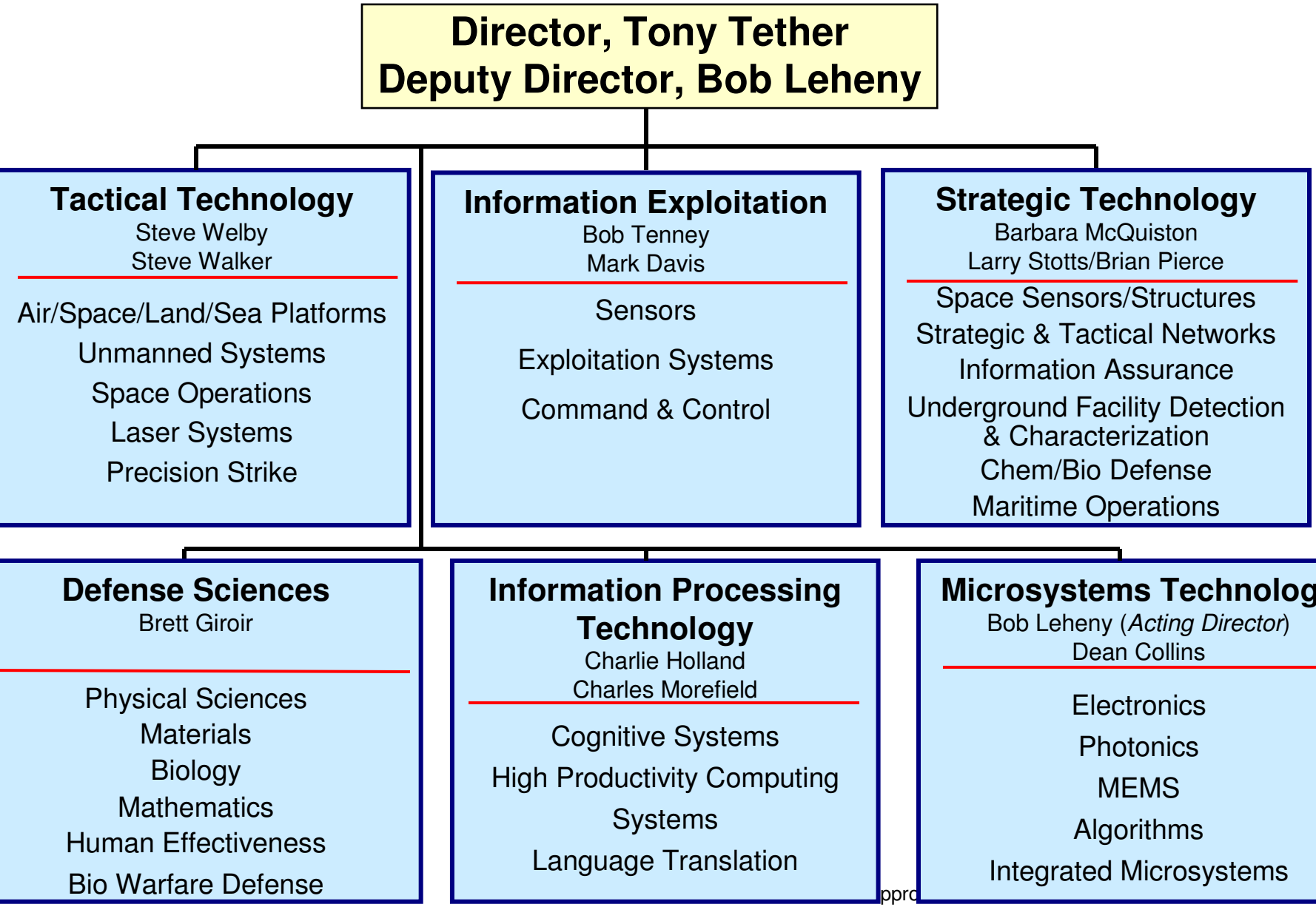
Predator

BAT

Advanced Cruise Missile

Taurus Launch Vehicle

DARPA Organization



EXACTO

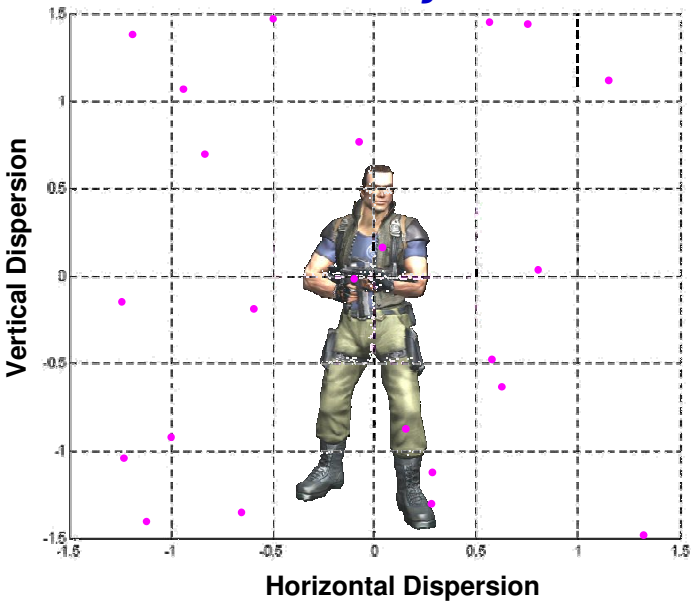
(EXtreme ACcuracy Tasked Ordnance)

Industry Day

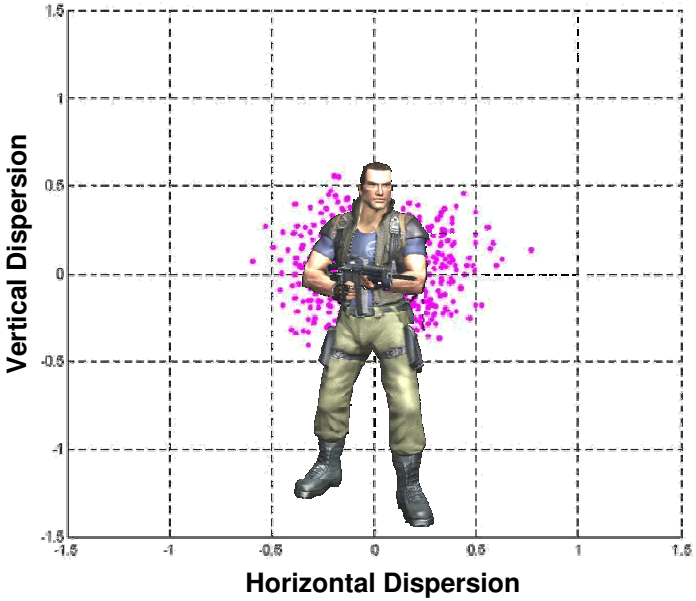
Lyn Beamer
DARPA / IXO

December 11, 2007

Today



Tomorrow

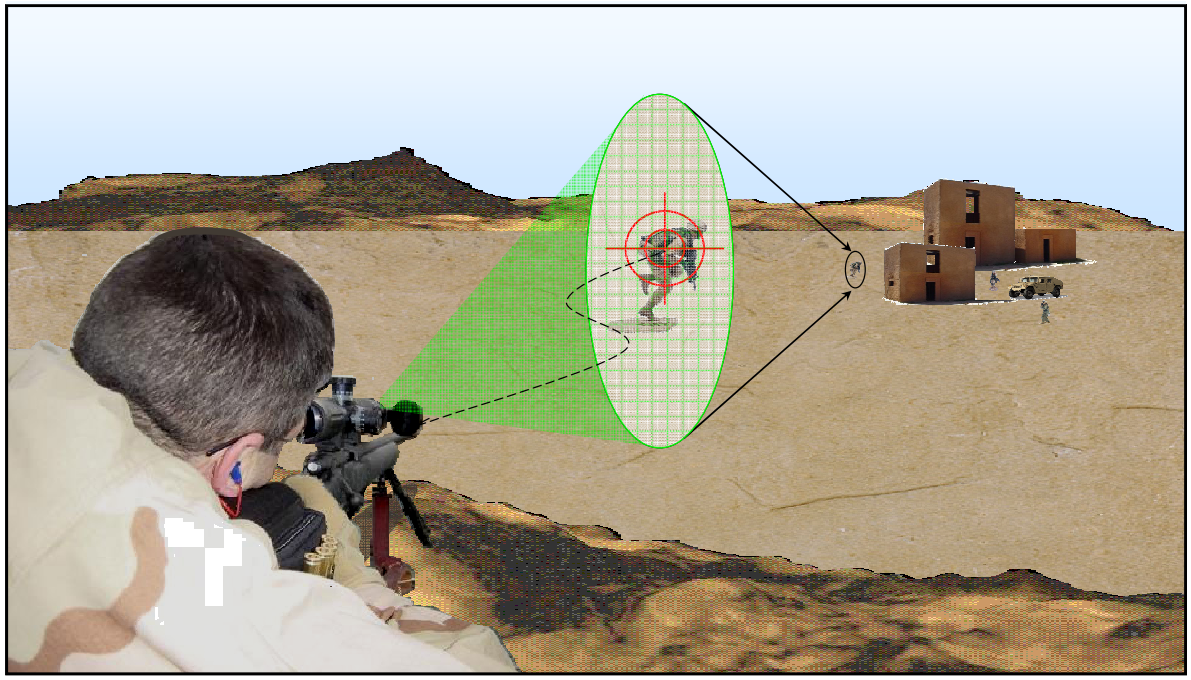


Deadly Accuracy at Extreme Range

EXACTO Concept

EXACTO is a system composed of:

- **An optical guidance system that provides information to direct the projectile to the target regardless of environmental or target perturbations**
- **An actively-controlled 50-caliber projectile that uses this information for real-time directional flight control**



EXACTO delivers high accuracy against moving targets under environmental conditions

Military Utility

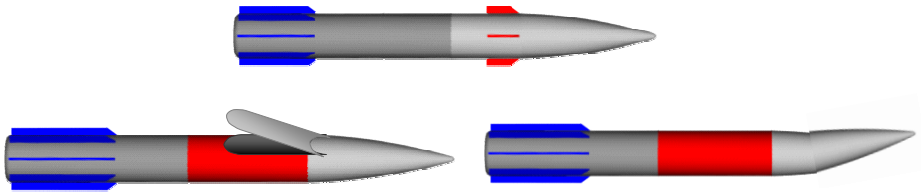
- **Need for trained snipers has increased from ~250 to 800 in one year, which translates to increased training costs and the need for additional test ranges**
- **90% of shots taken by school-trained snipers are hasty (e.g., time critical targets of opportunity)**
- **Snipers are unable to take a shot the vast majority of the time due to:**
  - **Environmental factors (wind, moving target moving, risk of collateral damage, etc.)**
  - **Limited skill set and lack of shooter confidence of successful hit**
  - **Ability to exit the scene safely if position is compromised**

EXACTO will increase the range of effective sniper fire

Trajectory Control Feasibility

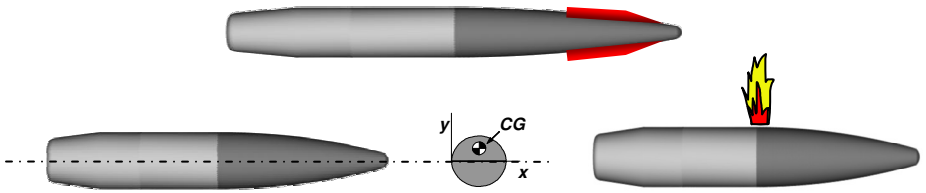
Fin-Stabilized Trajectory Control Methods

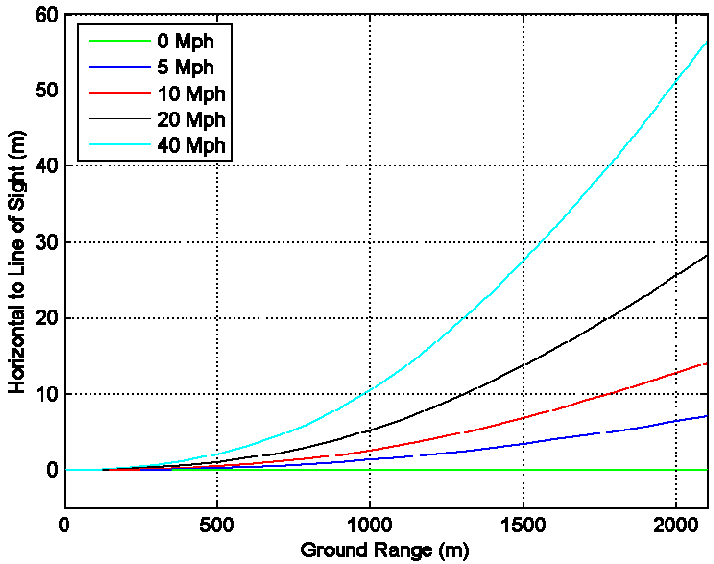
- Stabilized by aerodynamic forces generated by tail fins
- Trajectory control derived from lift/drag generated by canards, body flaps, or a change in body geometry



Spin-Stabilized Trajectory Control Methods

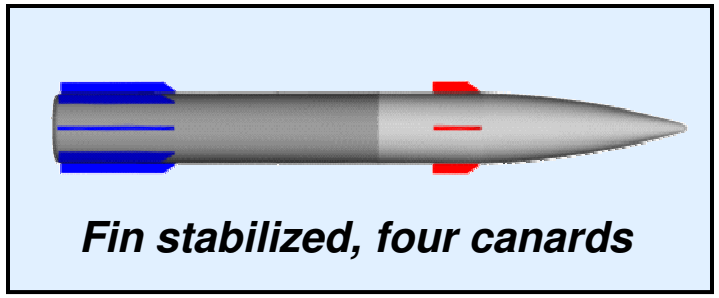
- Stabilized by gyroscopic forces
- Trajectory control derived from torque produced by an internal clutch, internal off-center mass, or an exploding squib





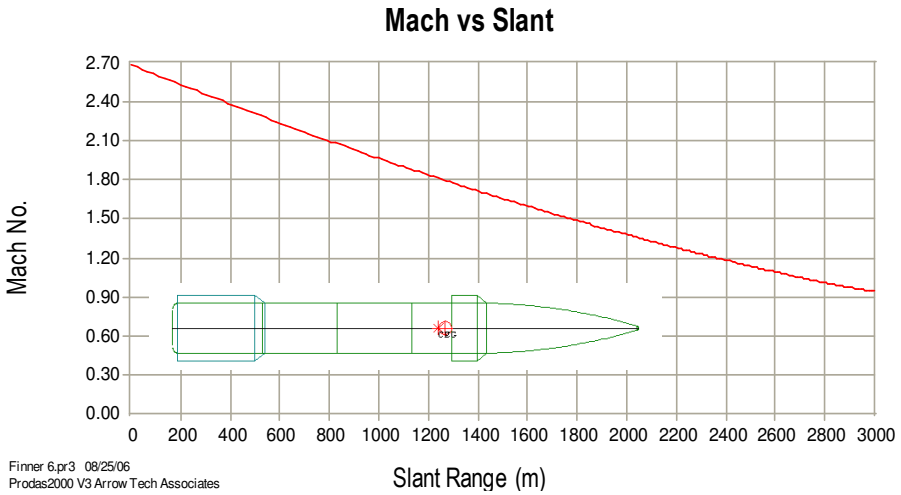
- Various aero-actuation control methods examined in seedling study

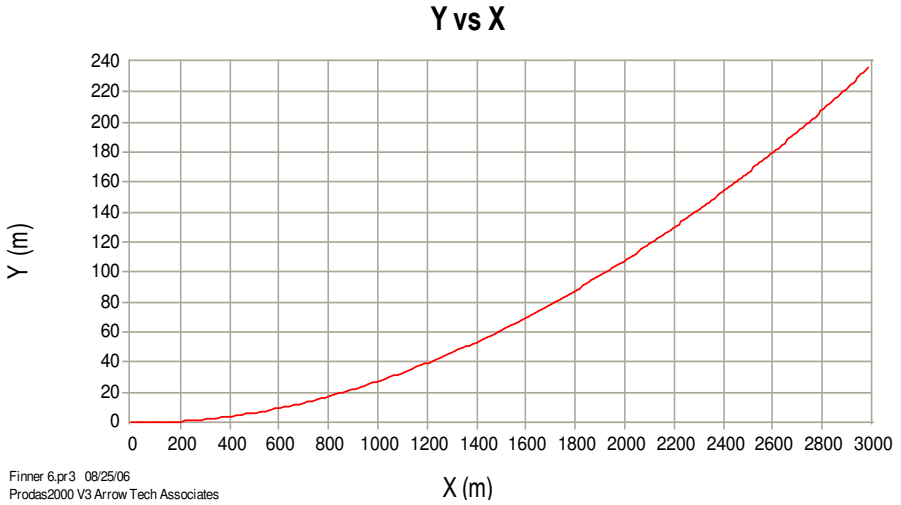
Trajectory Control Feasibility



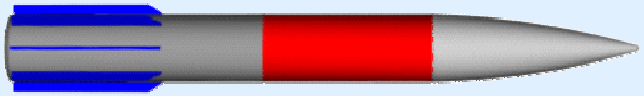
Fin stabilized, four canards

- **Configuration examined using 6-DOF trajectory simulation code, PRODAS *(PROjectile Design & Analysis System)***

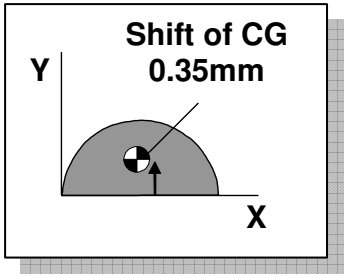


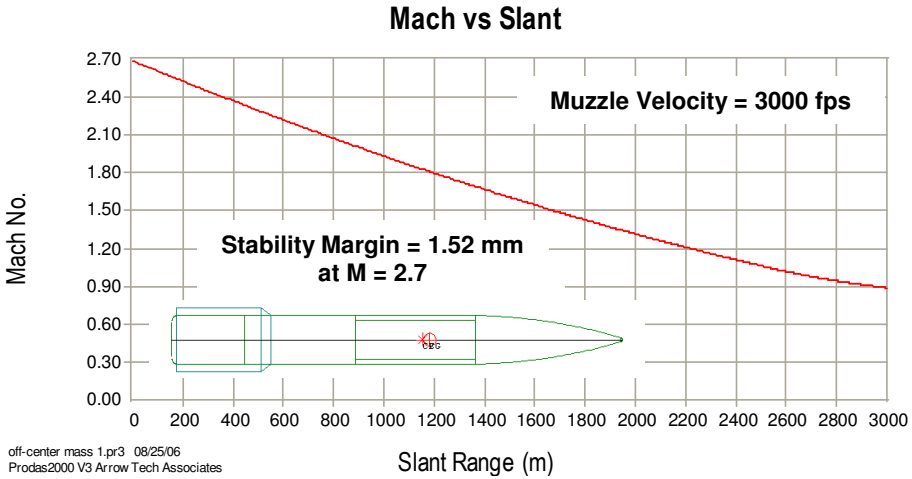


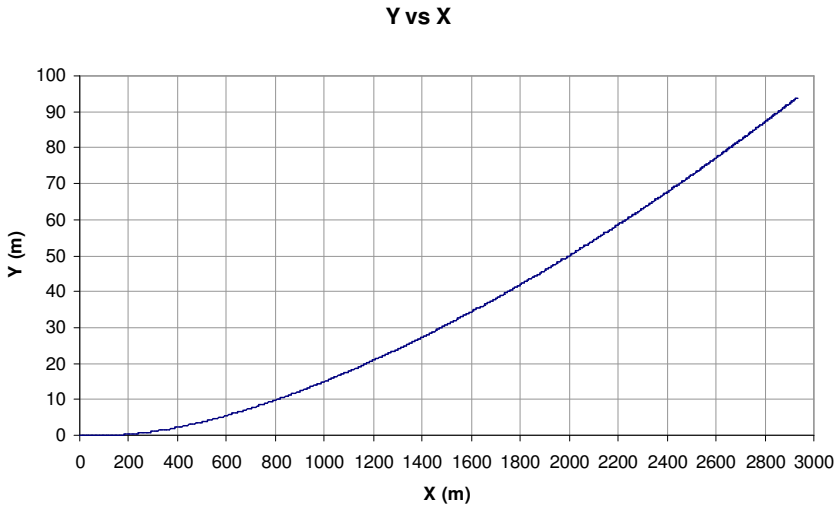
Off-Center Mass Trajectory Control



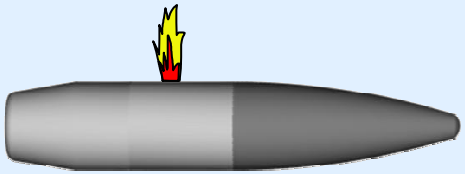
Fin stabilized with internal off-center mass



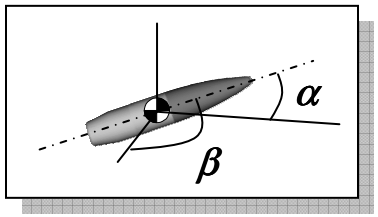


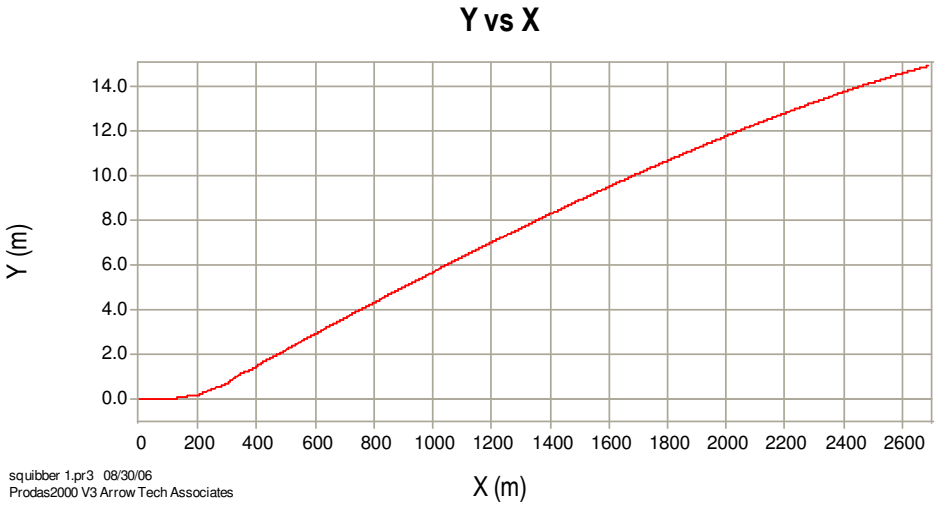


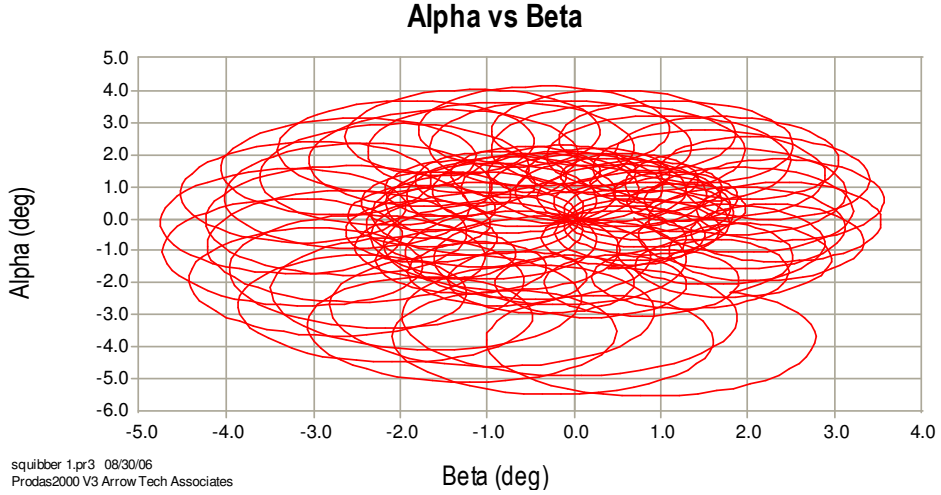
Exploding Squib Trajectory Control



Spin-stabilized with explosive squibs placed around projectile periphery



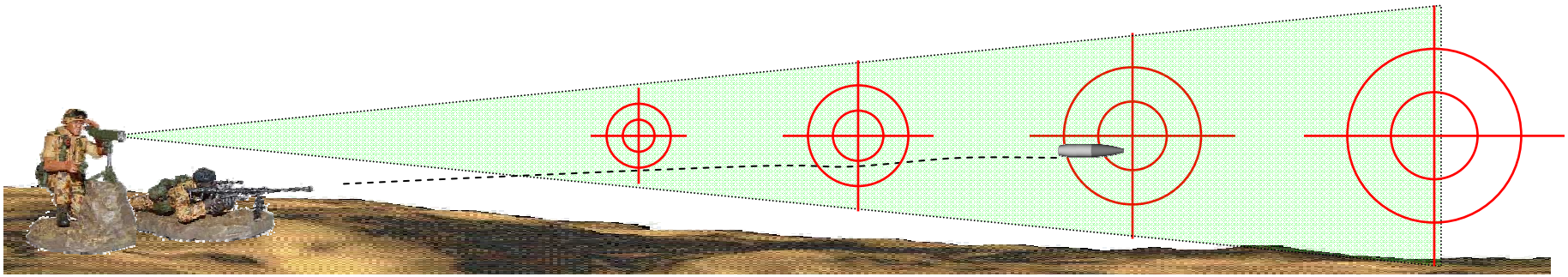




Guidance and Control Feasibility

- **Requirements**
  - **Capable of withstanding 100,000-g setback loading**
  - **Volume less than 2 cm^3**
- **Various guidance methods examined; laser beamrider system most promising**

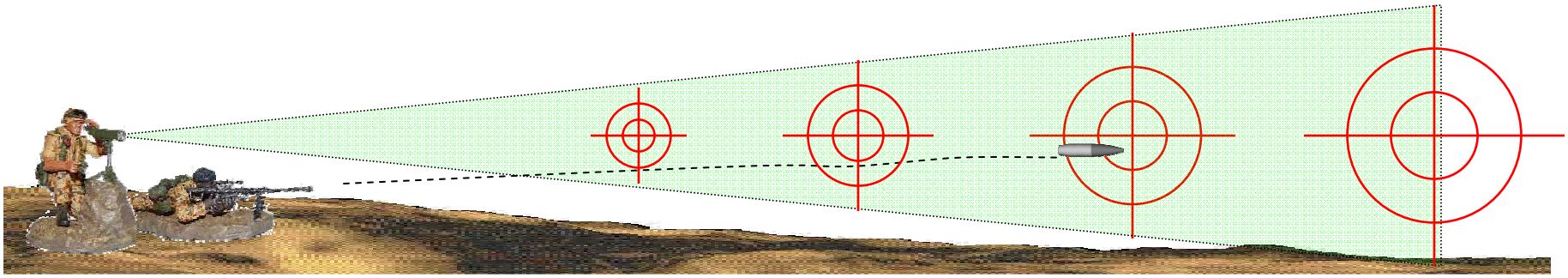
Category	Type	Implementation	Weakness
Navigation	Inertial	Inertial Measurement Unit	Size, shock
Radio Frequency	Command	RF Communication Link	Antenna size
	Beamrider	Conical Scan Multiple Beam	Beam resolution
Electro-Optical (Infrared)	Semi-Active Laser	Quad-Detector Laser Spot Tracker (detector in nose)	Bullet aperture vs. laser power
	Beamrider	Temporally/Spatially-Encoded Laser Beam	System size, but viable
	Reverse Homing Beamrider	Quad-Detector Laser Beam Tracker	Detector size limits fidelity
	Command	Laser Communication Link	Tracking laser power



Potential Guidance Methods

- **Laser Beamrider System**

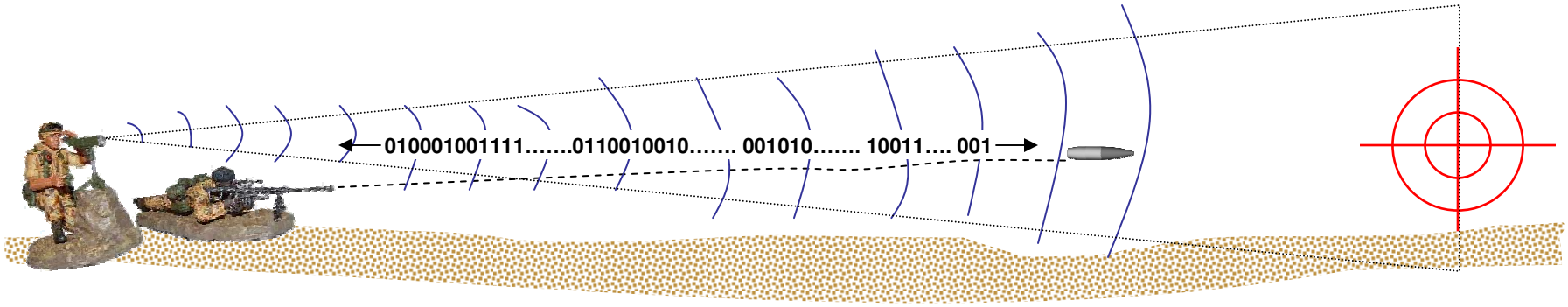
Advantages	Disadvantages
Projectile tracking not required	Easiest implementation requires flat trajectory
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable
Moderate onboard processing	Not fire and forget
Requires single laser photo diode	Roll orientation sensor required
Requires low laser projector power	Difficult to meet seeker volume requirements
Shock hardening should be achievable	Communication method may be susceptible to supersonic shock effects and vortex shedding



Potential Guidance Methods

- **RF Command System**

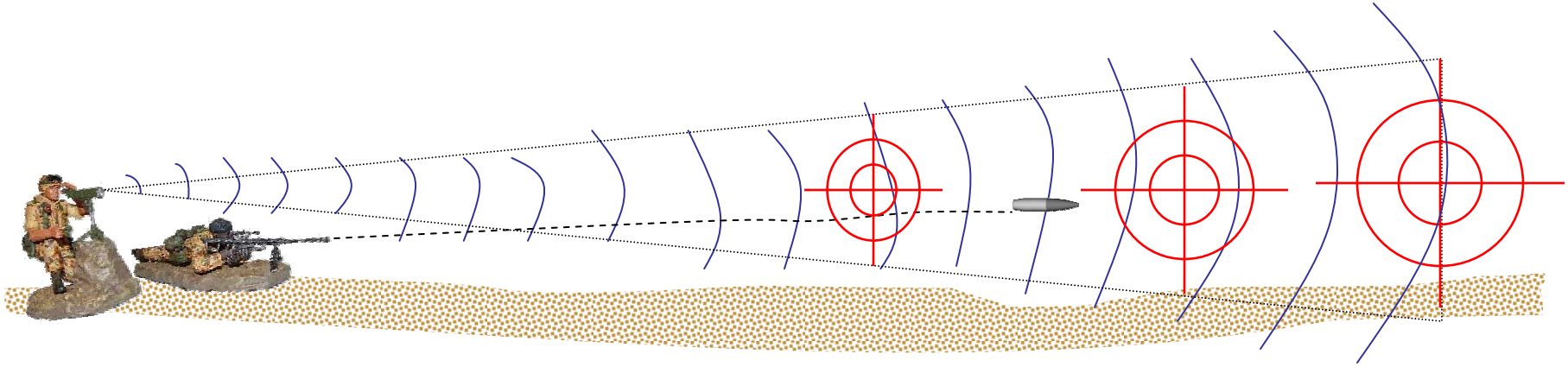
Advantages	Disadvantages
Multiple trajectory possibilities	Requires projectile tracking
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable
Moderate onboard processing	Requires RF link that is susceptible to jamming
Shock hardening should be achievable	Roll orientation sensor required
Communication method likely immune to supersonic shock effects and vortex shedding	Difficult to meet antenna volume requirements



Potential Guidance Methods

- **RF Beamrider System**

Advantages	Disadvantages
Projectile tracking not required	Easiest implementation requires flat trajectory
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable
Moderate onboard processing	Requires RF link that is susceptible to jamming
Shock hardening should be achievable	Low beam resolution at long range
Communication method likely immune to supersonic shock effects and vortex shedding	Difficult to meet antenna volume requirements

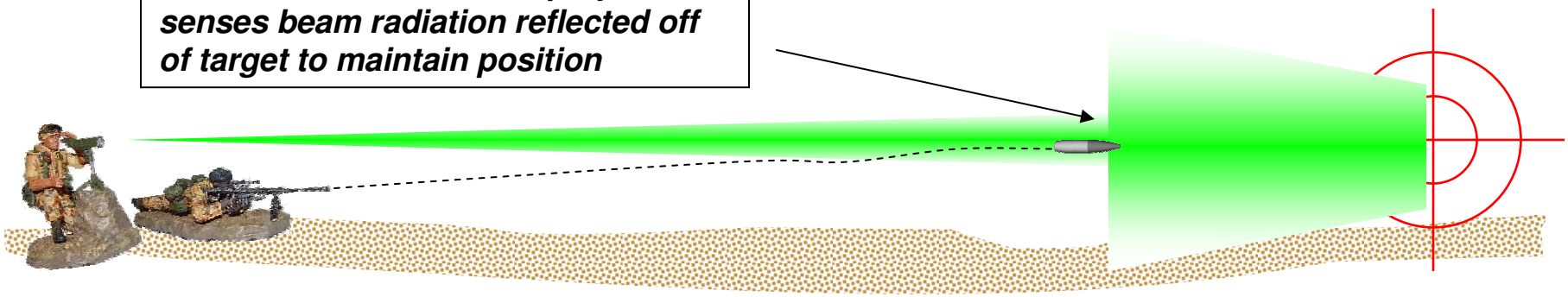


Potential Guidance Methods

- **Semi-Active Laser System**

Advantages	Disadvantages
Projectile tracking not required	Narrow field of view would likely require flat trajectory
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable – potential challenge with seeker in the nose
Moderate onboard processing	Not fire and forget
Shock hardening should be achievable	Difficult to meet seeker volume and aperture requirements
Low susceptibility to jamming	Would require a very powerful designator that is not man-portable

Quad-detector at nose of projectile senses beam radiation reflected off of target to maintain position

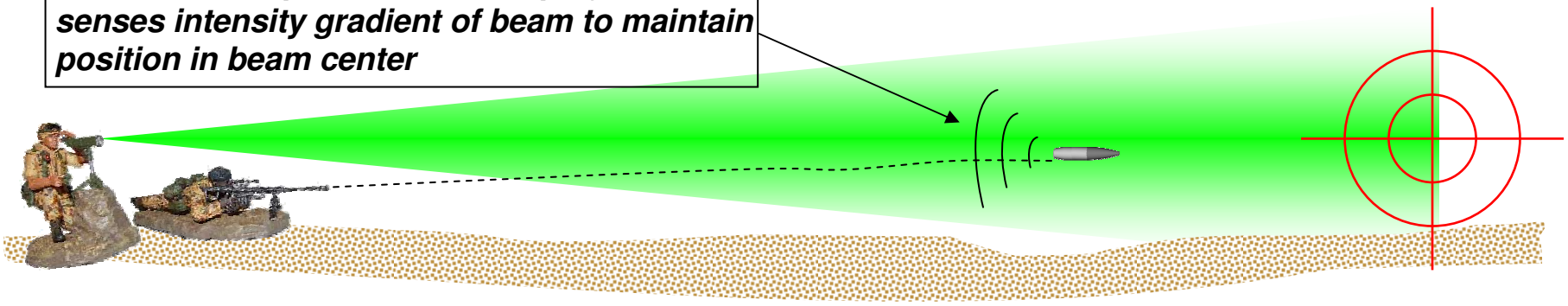


Potential Guidance Methods

- **Reverse Homing Beamrider System**

Advantages	Disadvantages
Projectile tracking not required	Easiest implementation requires flat trajectory
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable
Moderate onboard processing	Not fire and forget
No roll orientation sensor required	Quad-detector may not have sufficient fidelity to provide beam position in addition to orientation
Requires low laser projector power	Difficult to meet seeker volume requirements
Shock hardening should be achievable	Communication method may be susceptible to supersonic shock effects and vortex shedding

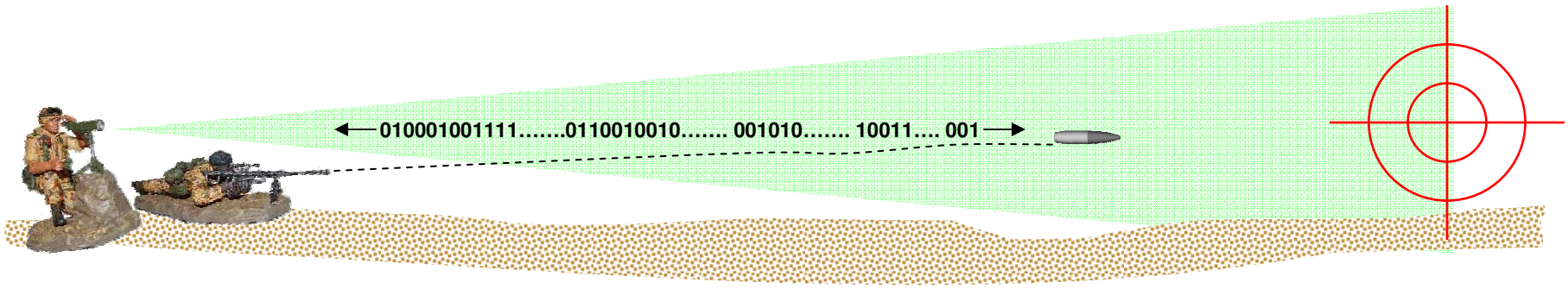
Quad-detector placed at rear of projectile senses intensity gradient of beam to maintain position in beam center



Potential Guidance Methods

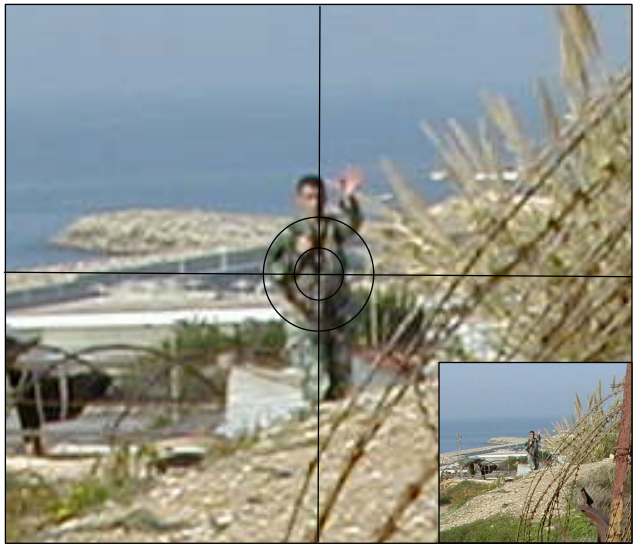
- **Laser Command System**

Advantages	Disadvantages
Multiple trajectory possibilities	Requires projectile tracking, possibly a high power laser
Trajectory updates possible throughout flight	Projectile must be aerodynamically or gyroscopically stable
Minimal onboard processing	Requires laser link
Shock hardening should be achievable	Roll orientation sensor required
Requires single laser photo detector	Difficult to meet seeker volume requirements
Requires low laser projector power for communication	Communication method may be susceptible to supersonic shock effects and vortex shedding



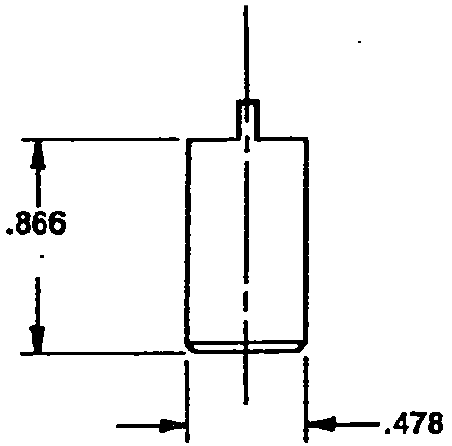
Sighting the Target

- **The EXACTO targeting system may include new capabilities for rifle scopes**
  - **Image stabilization**
  - **"Target lock"**
  - **Multiple simultaneous magnification ("picture in picture")**



Power to the Bullet

- **The EXACTO projectile will require a small, stable power supply**
  - **Traditional (e.g. Li)**
    - **storage lifetimes of ~4-7 years @ RT**
    - **lose ~10-15% of their capacity/yr**
    - **60 W-hr/kg, 6 kW/kg (small size)**
  - **Thermal batteries**
    - **20+ year storage life**
    - **smallest ever made is ~10x larger than required**
    - **40 w-hr/kg, 3 kW/kg (small size)**



Acquisition Strategy

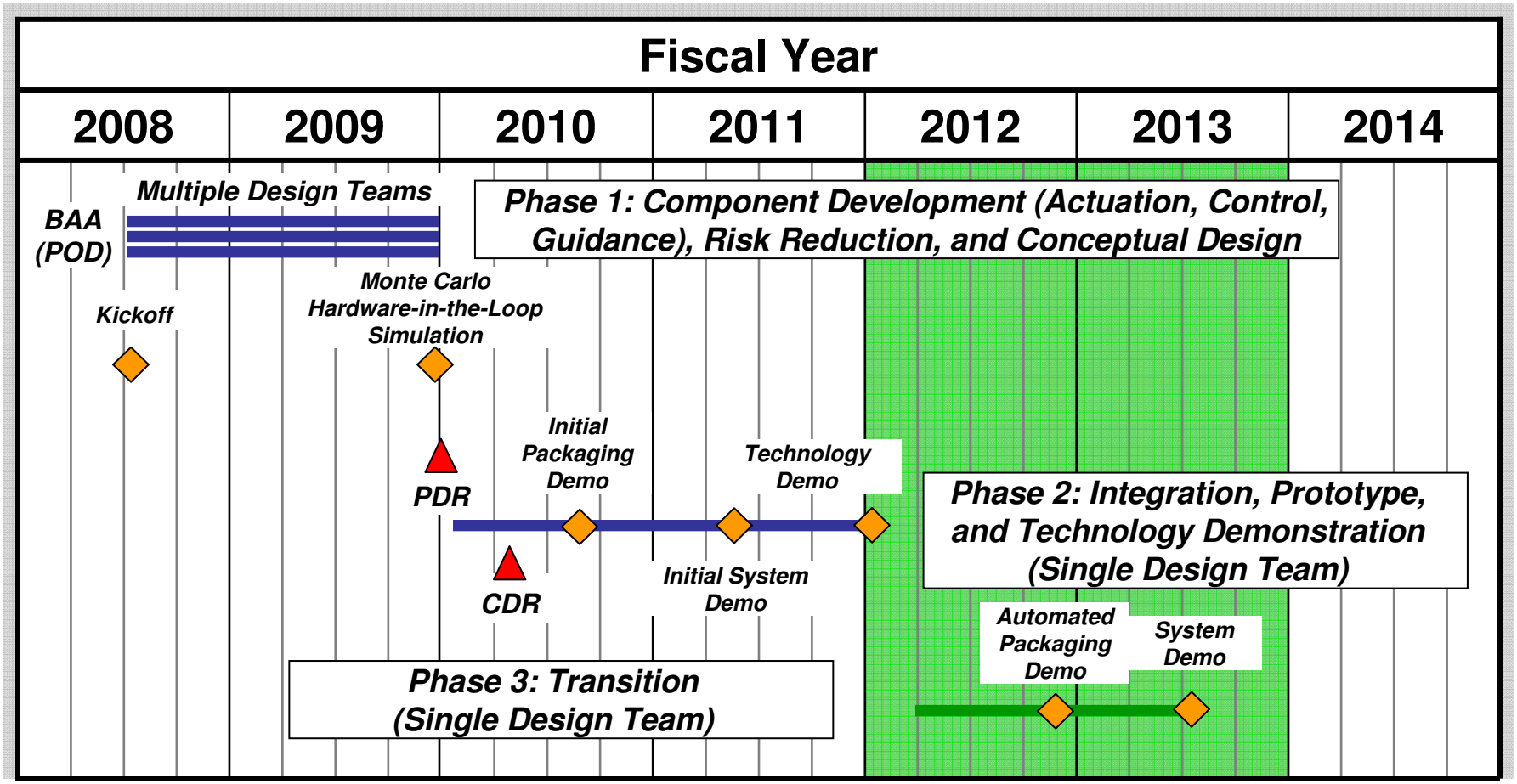
EXACTO Prototype System

- **Non-Tradeables**
  - **Meets performance objectives**
    - **Effectiveness at range**
    - **Accuracy**
    - **Projectile will have at least the same energy as a standard 50 cal round**
    - **Environmentally independent performance**
- **Highly Desirables**
  - **No heavier than current system**
  - **Equivalent volume to current system**
  - **Use current rifles without modification**
  - **Permits use of standard ammunition**
  - **10 year shelf life of cartridges in typical storage environment**
  - **Inherently producible**
  - **Inherently low cost**
  - **Secure, tamper-proof permissive action link (PAL)**
  - **Minimal training**
- **Desirables**
  - **Greater than required range**
  - **Greater than required target velocity**

Acquisition Strategy

- **Three phase program:**
  - **Phase I: Component Development, Preliminary Design and Performance Validation**
    - **Component development and risk reduction testing**
    - **Monte Carlo Hardware in the Loop Simulation**
    - **Prototype System PDR**
  - **Phase II: System Integration and Prototype Demonstration**
    - **CDR of prototype system**
    - **Fabrication of prototype gun system and shells**
    - **Prototype system live fire demonstration**
  - **Phase III: Operational Assessment (Program Transitioned to User)**
    - **User testing in operational environment**
    - **Automated manufacturing demonstration**
    - **Optional fabrication of additional prototype gun systems and shells to support further user evaluations**
- **Single full and open competition via BAA to address all program phases**
- **Progression to subsequent program phases contingent on meeting end of phase go/no go criteria and availability of funds**

Program Plan
Notional Schedule Overview



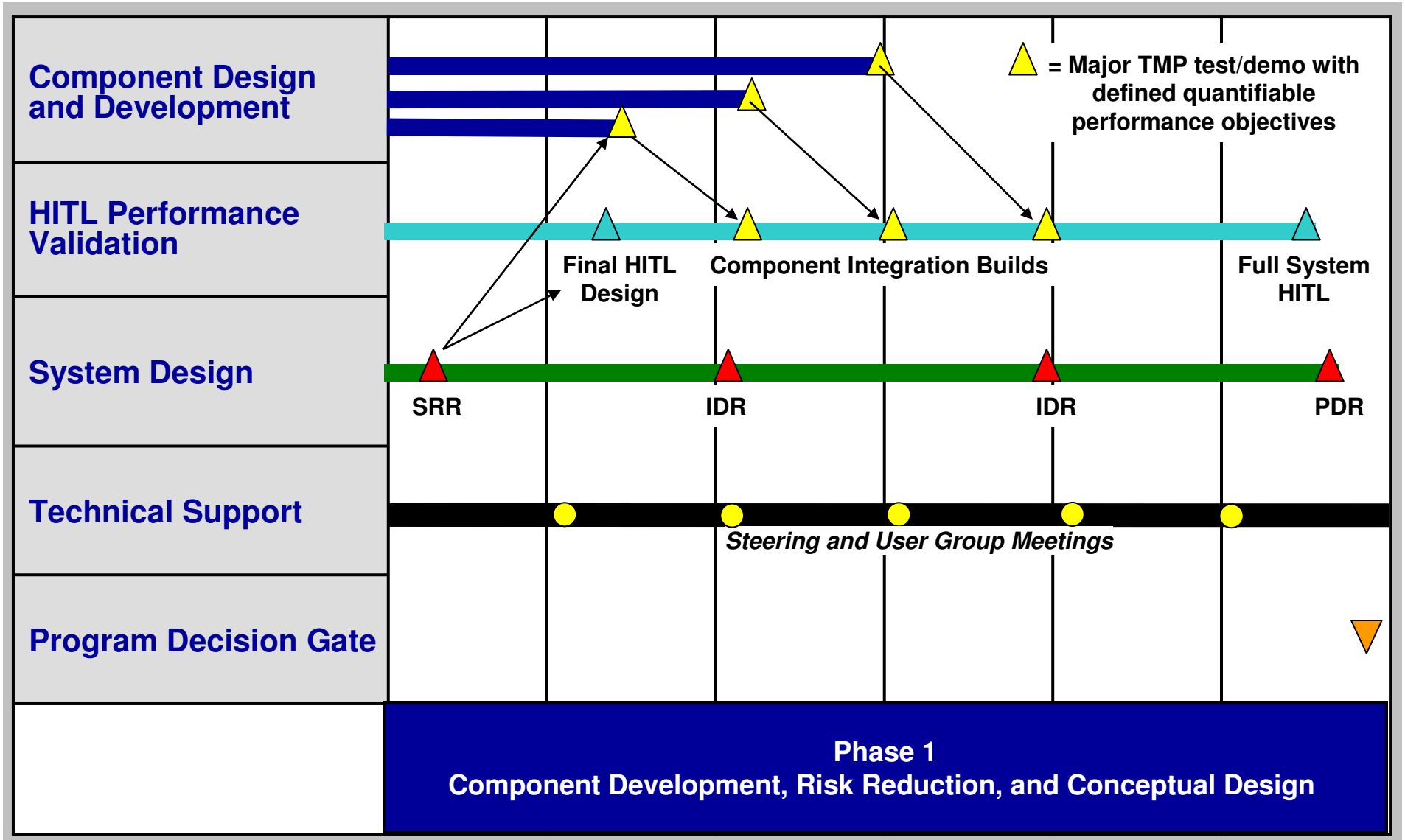
Phase I Program Plan

- **Mature EXACTO system design**
  - **Use standard systems engineering process to progress from system conceptual design through system requirements review, and system design reviews culminating in preliminary design review**
- **Conduct risk reduction of component technologies**
  - **Actuation, control, guidance**
- **Validate preliminary design using Monte Carlo hardware in the loop simulation using 1x scale laboratory components and experimental data at scale**
  - **"Shoot" 1,000 rounds to predict effectiveness at range/target speed in simulated operating environment**
- **Go/No-Go Criteria**
  - **Meets accuracy threshold (percent rounds within radius)**
  - **MOA with transition sponsor for Phase II participation**
- **Major Phase I deliverables complete upon review of HITL results. Phase II proposal update due 1 month after HITL completion. Phase I continues an additional 2 months with design update activities to allow Government to assess go/no-go and evaluate Phase II proposals without a gap between phases**

Phase I Schedule & Deliverables

- **Offerors to propose program review schedule. Government desires quarterly reviews.**
- **Following events/deliverables must be included in review schedule:**
  - **System Requirements Review**
  - **Interim System Design Reviews (quarterly between SRR and PDR)**
  - **Results of major component tests and demos as identified in proposal technology development and assessment plan (NLT 3 months after completion of each major event)**
  - **Hardware in the Loop Simulation Design Review**
  - **Preliminary Design Review**
  - **Hardware in the Loop Simulation Results**

Notional Phase 1 Schedule



Phase II and III Program Plans

- **Phase II**
  - Complete any required additional risk reduction, packaging demonstration and CDR
  - Fabricate prototype gun system(s) and shells
  - Demonstration objectives:
    - Live fire test at a Government test range
    - Shoot 500 rounds to demonstrate effectiveness at range/target speed in operational environment
  - Go/No-Go criteria
    - Meets accuracy threshold in physical testing
    - Transition to service
- **Phase III**
  - User testing in operational environment
  - Automated manufacturing demonstration
  - Optional fabrication of additional prototype gun systems and shells to support further user evaluations

Major Proposal Elements

- **EXACTO System Conceptual Design and Substantiating Experimental Data/Analysis**
- **Initial Technology Development and Assessment Plan**
- **EXACTO CONOPS/Military Utility**
- **Phase II and III Program Plan, Schedule and ROM Cost**
- **Program Team/Key Personnel**

Evaluation Criteria

- **EXACTO System Conceptual Design**
  - **Ability to meet performance objectives**
  - **Substantiation**
  - **Technical/Cost/Schedule Risk**
- **Overall Scientific Approach**
  - **Initial Technology Development and Assessment Plan**
    - **Detailed schedule of Ph 1 risk reduction activities, objectives and metrics for each major event**
  - **Phase I Technical Approach**
    - **Systems engineering approach, modeling and simulation tools, HITL test approach**
  - **Phase I SOW and IMS**
    - **WBS level 4 including critical path analysis**
  - **Phase II and III Program Plans**
    - **WBS level 2**
- **Relevance to DARPA Mission (Military Utility)**
- **Management and Program Team**
  - **Key personnel, program team, ability to do all 3 phases of program**
- **Cost**

BAA Description

BAA Process

Stephen Davis
DARPA/CMO

BAA PROCESS

ELEMENTS OF THE BAA

- Synopsis in FEDBIZOPPS
- BAA covers all info needed to propose
- TIME PERIOD – BAA is open for **45 days**

ELIGIBILITY

- All interested/qualified sources
- Foreign participants/resources may participate to the extent authorized by applicable Security Regulations, Export Laws, etc.
- Government agencies/labs, FFRDC's, can respond unless otherwise restricted from doing so by law/regulation and/or agency specific policy

BAA PROCESS

- PROPOSAL PREPARATION/SUBMISSION
  - Instructions are detailed in the BAA (**Follow closely**)
  - **ALL** questions to BAAXX-XX@DARPA.mil,
  - Q&A and BAA information available on http://dtsn.darpa.mil/ixo/solicitations.asp (**Read Regularly**)
  - Funding instruments = primarily contract(s), no assistance instruments (grants, cooperative agreements), OTA for Prototype may be proposed in addition to a contract, but must adhere to OTA guidance http://www.acq.osd.mil/dpap/Docs/policy/otherTransactions/current%20otguideconformed%20Jan%202001.doc
  - Assert rights to **all** technical data & computer software generated, developed, and/or delivered to which the Government will receive less than Unlimited 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**

BAA PROCESS

- Tech Prop - Mind Page Limitations (**don't use Cost Prop for overflow**)
  - Tech Prop – SOW (by phase, WBS, milestones, deliverables, exit criteria)
  - Cost Prop – Provide **all** Cover Page info
  - Cost Prop – Develop using the same common WBS
  - Cost Prop - FAR Part 15/Table 15-2 (suggested format/content)
  - Provide BOE(s) to support proposed costs (labor & material)
  - Have **all** subcontract proposals ready to submit immediately upon request after BAA closing date

- **Following the proposal instructions assists the evaluation team to clearly understand what is being proposed.**

- **Following the proposal instructions supports a timely negotiation.**

BAA PROCESS

- Be aware of:
  - Organizational Conflict of Interest & Procurement Integrity language
  - CCR, ORCA, & WAWF
  - Export Control language
  - Subcontracting Plan

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

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