U.S. ARMY COMBAT CAPABILITIES DEVELOPMENT COMMAND – ARMAMENTS CENTER

Evolution in Small Arms Fire Control Technologies: Present to FY25

Ross W. Towers

Future Technology Team Lead

FCDD-ACW-FN

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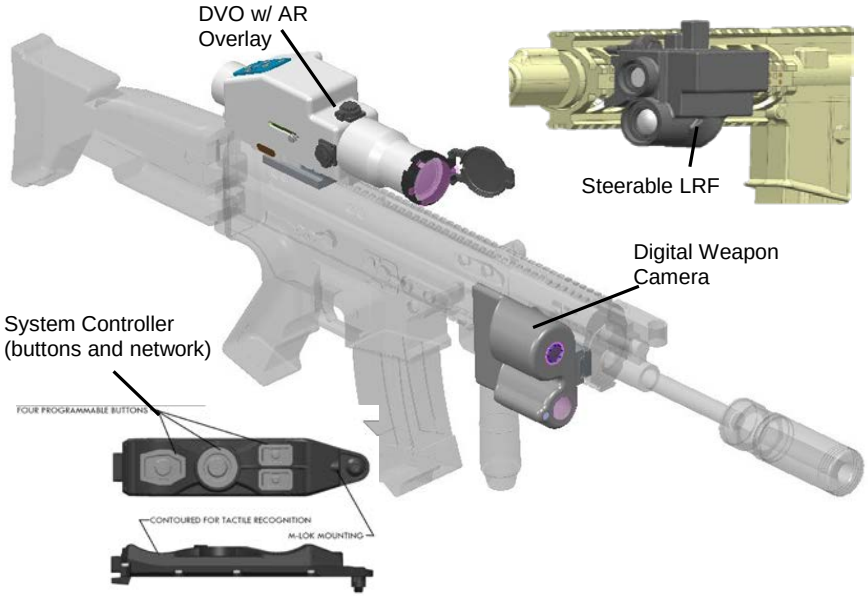
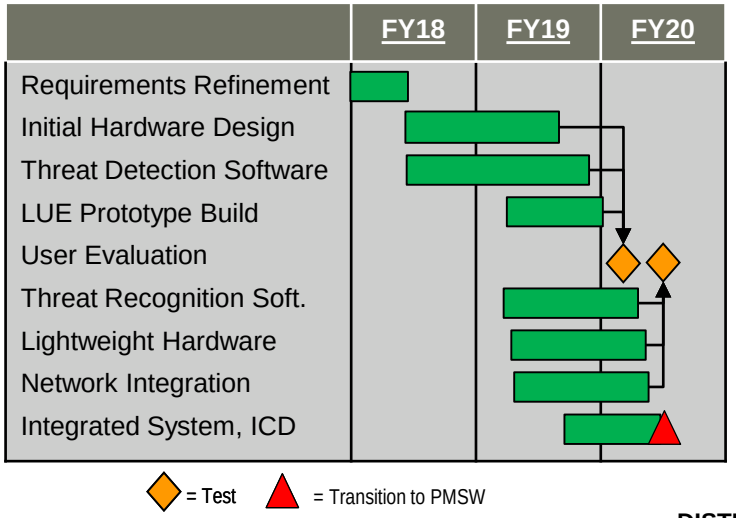
Current Efforts (through FY20)

SQUAD COMBAT OPTIC PERFORMANCE ENHANCEMENT (SCOPE)



Schedule



Purpose:

- Pair with the Next Generation Squad Weapons Technology (NGSWT) to mitigate the dismounted combatant threat, as described in Small Arms Ammunition Configuration (SAAC) Study. Develop Fire Control Technologies which meet Next Generation Squad Weapon Fire Control tech insertion timelines and drive down risk on emerging aim augmentation technology for rapid integration/fielding.

Product:

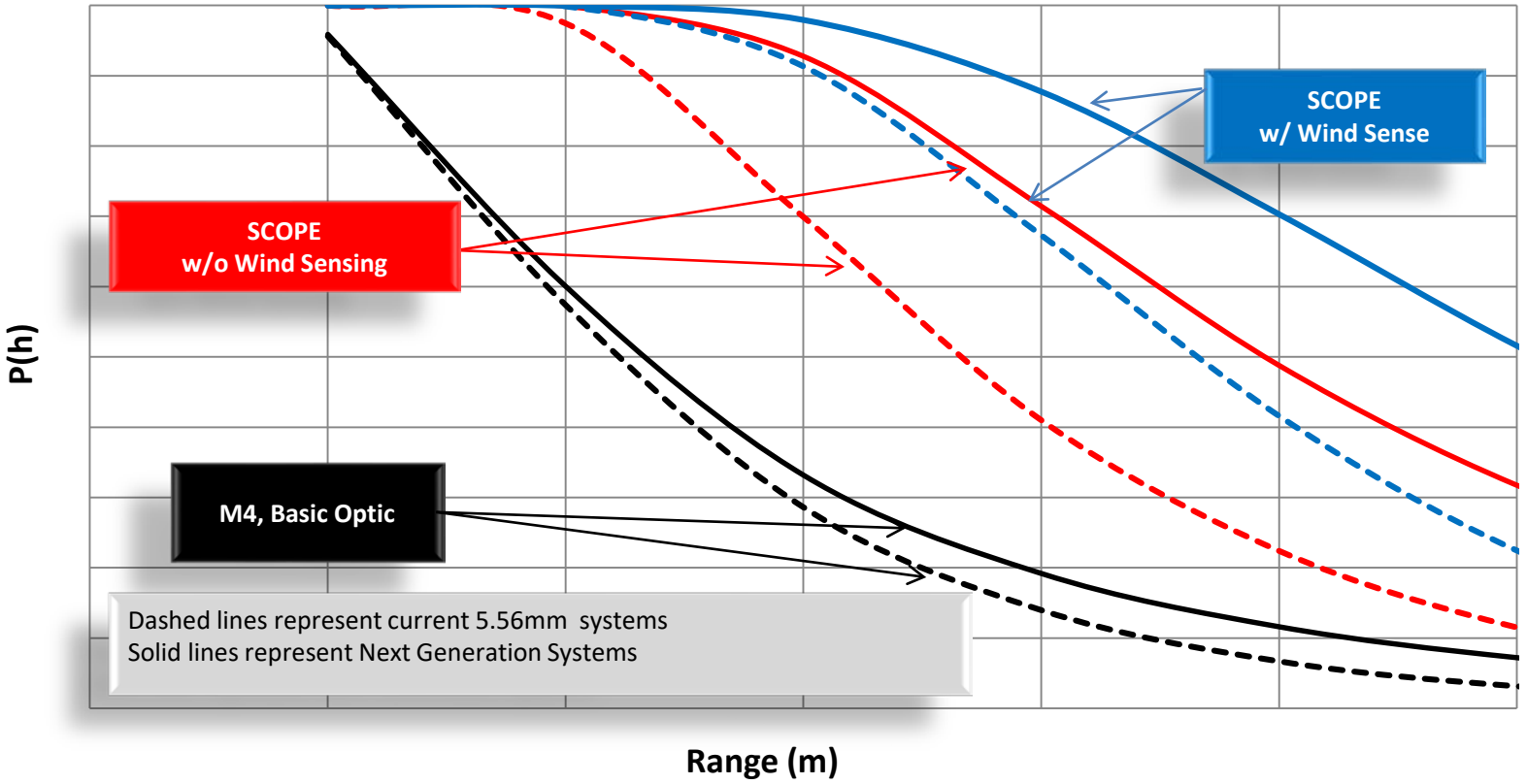
- Full System Interface Control Documentation, including hardware/software/firmware for platform upgradability/maintainability
- Rapid Integration of Digital Fire Control Elements for TRL 6 Rifle-Mounted Advanced Fire Control Optic, including:
  - Digitally Enhanced Aiming when paired with aim augmentation capable weapon platform (steerable barrel, electronic trigger, etc.)
  - Automated Target Recognition/Tracking Algorithms
  - Direct View Primary Optic with Augmented Reality Overlay
  - Steerable Rangefinder which accommodates for aim error
- Integrated Design leveraging Emerging Technologies
  - Artificial Intelligence (AI) for threat recognition and prioritization
  - AI Framework for integration with higher order data systems
  - Advanced Optical Materials for order of magnitude weight savings

Payoff:

- TRL 6 demonstrator of fire control technologies, including hardware for Soldier touch points and feedback
- Initial increment AI capability, appropriate for dismounted use
- System Design to Improve P(I) at max effective range of the weapon in order to mitigate threat (per SAAC modeling)
- Drive advancement of bleeding edge technologies required to achieve objective capabilities outlined in Next Generation Squad Weapon Fire Control requirement and support Soldier Lethality CFT vision

POC: Ross W. Towers, FCDD-ACW-FN
ross.w.towers.civ@mail.mil

PROBABILITY OF HIT



Black is what is currently fielded

Red is the capability provided by SCOPE

Blue is the capability provided by SCOPE and POWS

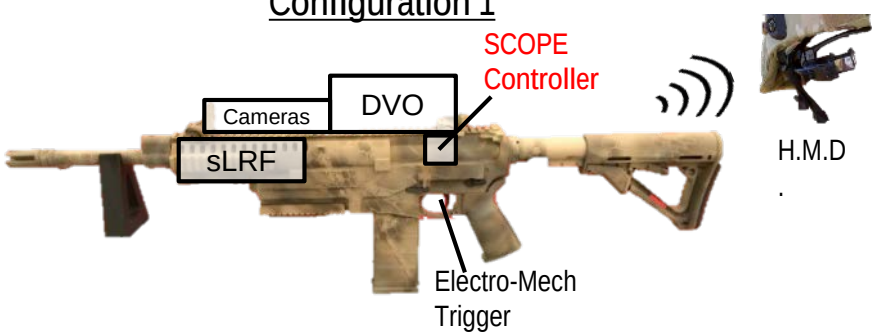
ONE FIRE CONTROL

Fire Control combines technologies in order to enable the shooter to get rounds on target

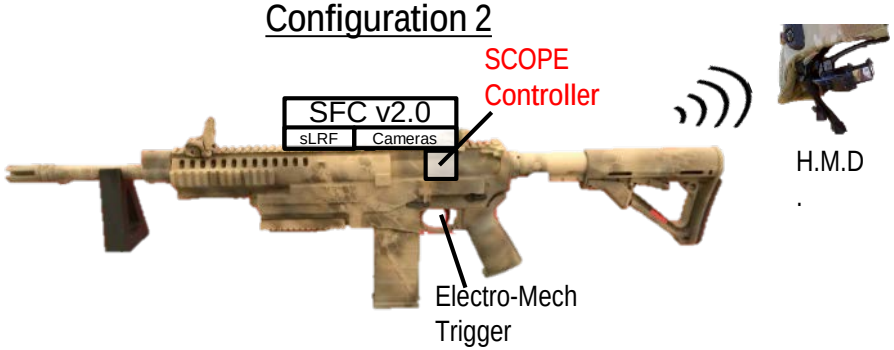
- SCOPE Architecture builds on existing hardware, and allows for infinite configurations
- Current designs leverage direct view optic (DVO), but capability to accommodate future digital technology is *intended* from inception (day and night, visible and IR systems)
  - Interface definitions allow for "plug and play" with digital optics and imagers
  - Legacy devices can be readily modified to interface with the architecture (STANAG 4740)

Sample SCOPE Configurations

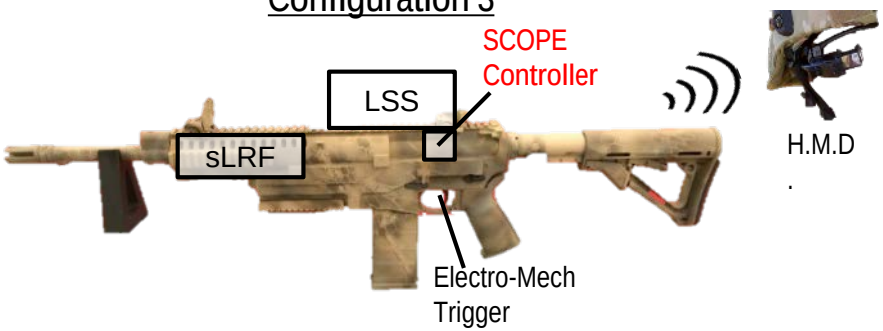
Configuration 1



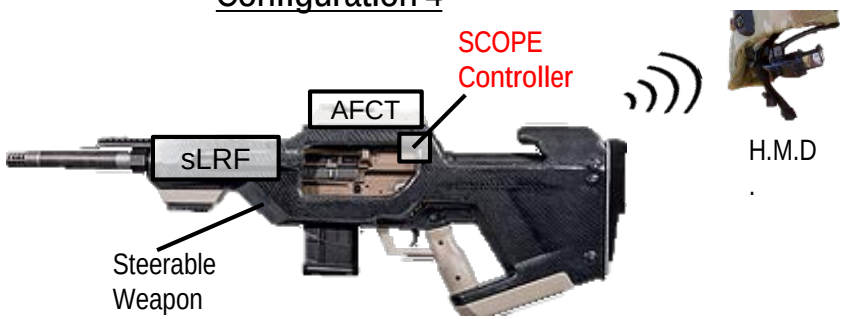
Configuration 2



Configuration 3



Configuration 4



"FIRE CONTROL ARCHITECTURE" OVERVIEW

Fire Control Architecture

System Specific ICD

- References Fire Control Architecture ICD, selected Fire Control Transport ICD, and selected Fire Control Service ICDs
- Defines Subsystem messaging flows

Fire Control Architecture ICD

- Defines rules of the architecture – independent of transport (Ethernet, serial, etc.)
- Defines architecture management functions such as unique interface identification, service discovery, etc.

Fire Control Transport ICDs

- Defines how the architecture works in specific transport environments (Ethernet, serial, USB, bluetooth)

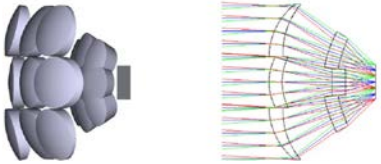
Fire Control Architecture Service ICDs

- Defines various uniquely identified functional services / enabler capabilities
- e.g. SLRF, LRF, ATD, ATD/ATR, DVO, Ballistic Solver, Flashlight,

Planned Efforts (through FY25)

ADVANCED FIRE CONTROL TECHNOLOGY (AFCT)

Shooter AID



Alternative Lightweight Printed Optics

Environment Correction System

Neuromorphic Targeting and Tracking

Purpose:

Design and demonstrate next generation fire control technologies which exploit the rapid technology advancements of Squad Combat Optic Performance Enhancement (SCOPE) and Integrated Visual Augmentation System (IVAS). Integrate solutions which are lighter weight, provide better targeting and prioritization performance, and a definitive increase in target probability of hit (P(h)).

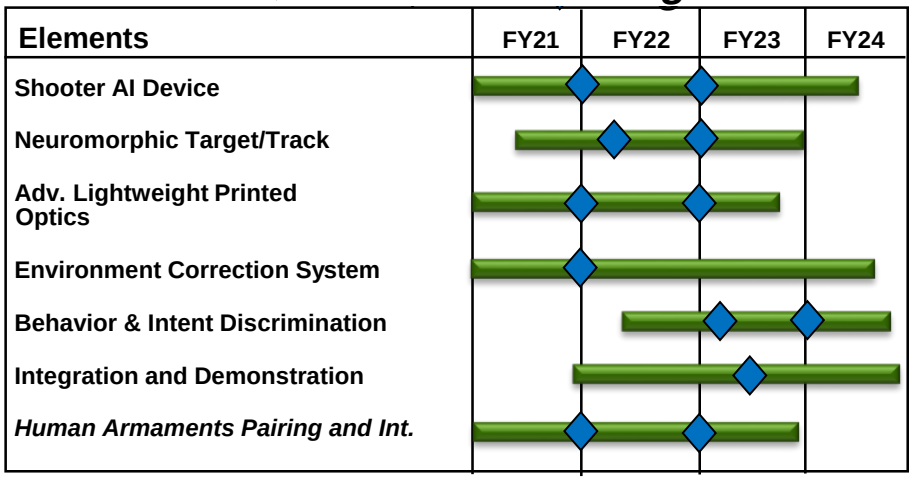
Products:

- **Shooter Artificial Intelligence Device (Shooter AID):** embedded artificial intelligence to integrate network and platform level control to provide target allocation and prioritization between the battlefield network, helmet mounted display, and weapon.
- **Neuromorphic Targeting and Tracking (NTT)**: neuromorphic processing system for automated threat recognition, prioritization, tracking, firing solution automation, and moving target lead generation; coupled with shot tracking to maximize accuracy
- **Advanced Lightweight Printed Optics (ALPO)**: development of optical design solutions extensible to multiple roles (magnifications) which leverage advances in polymer manufacturing (3D printing) to improve probability of detect/ID while reducing cost, weight
- **Environment Correction System (ECS)**: address real environmental shooting condition measurement deficiencies (including cross- and head-wind) for carbine and automatic rifle applications, focused on short range, high speed readings
- **Behavior & Intent Discrimination (BID)**: Target recognition algorithms which include ability to distinguish intent based on threat (motion, posture, etc.) and feed prioritization
- **Human Armaments Pairing and Integration (HAPI)**: exploit ARL research to address system level operational concerns for fire control system operation, including display configuration, physical configuration, and hardware interfacing

Payoff:

- Improved dismounted Soldier lethality:
  - Greater probability of hit, P(h)
  - Enhanced threat detection
  - Enhanced Soldier-System digitally, augmented interface
- Integration with dismounted sensors available to Soldier/Squad
  - Supports Army Decide Faster/Asymmetric Vision
  - Increased Soldier performance from multiple sensors

Schedule & Funding



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POC: Ross W. Towers, RDAR-WSF-N
ross.w.towers.civ@mail.mil

Advanced Fire Control Technologies TECHNICAL APPROACH

- Pursuing parallel, interrelated product thrusts:
  - **Soldier Weapon-borne Artificial Intelligence**:
    - Weapon embedded artificial intelligence
    - Integrates network and platform level control
    - Provides target allocation and prioritization between the battlefield network, helmet mounted display, and weapon
  - **Neuromorphic Based Threat Discrimination**:
    - Neuromorphic based image processing system for automated threat recognition, prioritization, tracking
    - Automated firing solution, including prediction for moving targets
    - Bullet tracking to maximize follow-on accuracy
  - **Advanced Lightweight Printed Optics**:
    - Development of 3D printed optical design solutions
    - Extensible to multiple weapon platforms
    - Leverage advances in polymer manufacturing (3D printing) to improve probability of detect/ID while reducing cost, weight

Develop AI and Advanced Optics to Improve Soldier Lethality

Advanced Fire Control Technologies EXPECTED PERFORMANCE/TRADE-OFFS

- Success will be measured by
  - Probability of correct target recognition
  - Time to effectively engage target(s)
  - Follow-on hit accuracy
  - Weight Reduction
  - Power Management
- Processing Performance Trade-Offs:
  - Expected Performance: Advanced GPU based processors reduce board weight, reduce electrical power consumption relative to conventional solutions (ASIC/FPGA)
  - Trade-Off: System weight and electrical power inversely correlated to processing speed and target recognition reliability; trade-off curve must be developed (inherent part of this effort)
- Optical Performance Trade-Offs:
  - Expected Performance: Gradient Index 3D printed lenses coupled with honey-comb style opto-mechanical 3D printed housings reduce optical system weight
  - Trade-off: Optical quality relative to currently fielded optics may suffer; loss of transmission / hazing is possible

Advancing State of the Science in Fire Control Technologies while Managing Size, Weight, and Power

Questions