

Targeting and Engagement TIA – Willful Intent

Current Capability:

- Conventional targeting and engagement systems for direct and indirect fire capability

FY	Desired Capability	S&T Challenge	S&T Solution
Near Term FY11- FY15	<ul style="list-style-type: none"> • Accurate target location for dismounted warfighters, at standoff distances, in all terrain and weather conditions, including urban and mountainous with cloud cover • Light-weight, low cost target detection, recognition, and identification out to effective ranges of small arms and crew served weapons in day, night, and all weather conditions • Coordinated threat response with remote weapons stations 	<ul style="list-style-type: none"> • MEMS based gyro compassing using high-Q (~500k) silicon based disc resonating gyros with Angle Random Walk of 0.004 deg/rt hr and Bias Stability of 0.04 deg/hr, resulting in an azimuth accuracy of 4 mils achievable in 4 minutes through MEMS scale wafer trimming and high vacuum packaging • Lower SWIR dark current to increase signal to noise ratio through novel ROIC design, extending identification range and eliminate the need for a thermal electric cooler for an integrated SWIR/LWIR imager by implementing non-uniformity correction algorithms across the operational temperature range for lightweight, low power targeting and observation systems • Integrated stabilization, data fusion, compression algorithms, frequency hopping techniques, advanced communication protocols, and object oriented GUI software for networked sensors and remote weapon systems onto multiple platforms 	<ul style="list-style-type: none"> • Hemispherical resonator gyro, micro-electromechanical system (MEMS) tuning fork gyro, MEMS silicon based disc resonator gyro, accelerometers, and electronic components packaged in complete inertial measurement units (IMU) • Integrated Vis-NIR-SWIR-LWIR sensors in a single focal plane array • Boomerang and CROWS II integrated via 4CE software hosed on Tough-book computers and multiple systems networked via the PRC-117G radio
Mid Term FY16- FY20	<ul style="list-style-type: none"> • Handheld inertial navigation targeting in all environment and weather conditions, including GPS-denied • Lightweight, day/night wide FOV target acquisition for individual dismounted warfighters • Self defense, precision engagement, and escalation of force from unmanned ground and surface platforms 	<ul style="list-style-type: none"> • MEMS based inertial navigation using high-Q (~1M) disc resonating gyros with Angle Random Walk of 0.001 deg/rt hr and Bias Stability of 0.01 deg/hr, resulting in an azimuth accuracy of 1 mils achievable in 60 seconds through MEMS scale wafer trimming and high vacuum packaging of MEMS based gyros, and through integration of MEMS based accelerometers • Fabricate Gradient Index lenses from low density polymers with optical transparency (90+%) and sufficient dispersion (Abbe# 30-90) by varying polymer optical properties and the refractive index (delta n=0.2) to create an optical lens element with a 75% weight reduction while increasing the number of resolvable pixels by 50% • Accurate identification and simulation of kill-chain functions that can be optimally served by semi-autonomous systems for self-defense and precision engagement, reducing dependency on RF links 	<ul style="list-style-type: none"> • MEMS quartz based disc resonator gyro, MEMS 5 deg. of freedom spinning mass gyro, electronic components, accelerometers, and position tracking in a complete inertial navigation system • Miniaturized GRIN lens and other imaging technologies to provide enhanced SWAP and FOV • Unreal Development Kit (UDK) based M&S, virtual simulations, electro-optic based target detection and video tracking algorithms, RWS gunner logic/behavior programming, an autonomy kit, object detection/classification algorithms, and world model of the Advanced Perception System (APS) from the Small Unit Mobility Enhancement Technologies (SUMET) program

Targeting and Engagement TIA – Willful Intent Continued

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**Far
Term
FY21-
FY25**

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| <ul style="list-style-type: none"> • 10m target location error (TLE) at standoff distances, accounting for all sources of error, including azimuth, self location, vertical angle, range, and meteorological effects • Remotely deployed tags with delivery and activation system to mark targets of interest at near to extended stand-off distances • Automatic target detection, recognition, identification, tracking, and hand-off capability at stand-off distances in dismounted targeting systems • Miniaturized, inertial-based, autonomous navigation of munitions for GPS-denied environments and no available laser designation • Lightweight, day/night, wide Field of View (FOV) target acquisition for crew served weapons | <ul style="list-style-type: none"> • Develop technologies for enhanced vertical self location accuracy; and ability to receive, manage, and transmit locally-generated meteorological messages integrated with local ground sensors to compensate the theoretical targeting solution • Develop miniaturized marking technology (delivery survivable) suitable over extended ranges • Develop real-time, sensor data fusion, automatic target recognition and processing power system, in a dismounted package • Develop affordable, high-shock, and thermally resistant, MEMS inertial navigation, guidance, and control technologies • Develop Graduated Index of Refraction (GRIN) lenses coupled to curved FPA | <ul style="list-style-type: none"> • Angle of arrival of GPS M-code or other reference signal to determine accurate vertical self location; and meteorological data collection and targeting compensation algorithms for onboard targeting system computing and hand-off • MEMS based inertial navigation technologies for assisted projectile markers having adequate power for signal transmission and observer-initiated activation (by laser, RF, or other means) • Pattern recognition algorithms using IR, active illuminated SWIR, or other sensor arrays against classification libraries of target types; and identification and mitigation of processing limitations • MEMS based inertial navigation, advanced material composition, ultra-high Q and ultra-high dynamic range or inertial components having micro level angle random walk (ARW) and simplified control scheme • Combined GRIN lens, curved FPA, and advanced signal processing on crew served weapons to provide day-night target acquisition |
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Endstate:

- All-encompassing targeting and engagement capabilities, enabling responsive and flexible “Fires as a Commodity” to individual warfighters, netted for shared situational awareness throughout the sensor-to-shooter chain, providing precision fires and massed fires ability, against unconventional and hybrid threats across the full range of military operations and environments.

Advanced Ammunition TIA – Willful Intent

Current Capability: Conventional munitions for direct and indirect fire capability

FY	Desired Capability	S&T Challenge	S&T Solution
Near Term FY11- FY15	<ul style="list-style-type: none"> Affordable extended range fires for battalions Enable defeat of all targets in urban terrain and other complex types of terrain Improve munition reliability and first round Probability of Kill (PK) Reduce weight and logistics burden of ammunition 	<ul style="list-style-type: none"> Develop advanced propellant technologies that increase impulse within existing 81 mm mortar maximum operating pressure Develop predictive capability to understand and optimize the synergistic effects of superimposed and sequenced kill mechanisms in novel warhead designs Apply high reliability commercial silicon based MEMS technology to weapons initiation trains for improved SWAP and reliability Develop structural high ignition temperature propellants and associated initiation mechanisms impervious to normal weapon environments, eliminating the need for a conventional cartridge case 	<ul style="list-style-type: none"> High nitrogen propellants and new propellant formulations/granulations DoE atomic level models coupled with Eulerian and Lagrangian hydrocodes that predict combined performance of conventional kill mechanisms including linear explosively formed penetrators, shaped charges, rigid body penetrators, high explosives, and fragments Miniature MEMS based low-energy reactive bridges, novel primary explosives/propellants, and safe-arm technologies HMX based high ignition temperature propellant, using commercial structural resins as PNP binder replacement
Mid Term FY16- FY20	<ul style="list-style-type: none"> Affordable extended range fires for companies Defeat of targets behind walls (both combatants and doubly protected items) Insensitive primary explosives and fuzes for advanced warheads 	<ul style="list-style-type: none"> Develop advanced propellant technologies for the 60 mm mortar Develop advanced warheads and fuzes that delay detonation until the penetrator enters the protected space Develop high output explosives with low sensitivity 	<ul style="list-style-type: none"> High nitrogen propellants and new propellant formulations Physics based modeling and optimization of advanced penetrating warheads, combining multiple effects (i.e. Munroe, Misznay-Schardin, spall, etc) Porous chromium oxide matrices that control the ignition and detonation of high output explosives combined with advanced nano-circuits for reduced explosive sensitivity
Far Term FY21- FY25	<ul style="list-style-type: none"> Affordable extended range fires for individual warfighters Scalable warhead effects for shoulder launched missiles and mortars 	<ul style="list-style-type: none"> Develop propulsion technologies that can be used to extend the range of guided bullets Develop warhead configurations allowing variable and tailorable output 	<ul style="list-style-type: none"> Nano-materials for propellant with significant advantages in propulsion output Unique configurations of MEMS based fuzing, variable output explosives, and advanced kill mechanism combinations

Endstate:

- Improved lethality and dominance of the individual Warfighter within his area of influence through advanced warhead, propulsion, and ammunition technologies, enabling engagement of the enemy from greater distances, with tailorable effects, improved reliability, reduced collateral damage, while lightening the load.

Advanced Weapons TIA – Willful Intent

Current Capability:			
<ul style="list-style-type: none"> Conventional weaponry for direct and indirect fire capability 			
FY	Desired Capability	S&T Challenge	S&T Solution
Near Term FY11- FY15	<ul style="list-style-type: none"> Precision fires for battalions Reduce the weight of weapon systems and components Extend the service life of weapon systems 	<ul style="list-style-type: none"> Develop for 81mm mortar a low cost, highly integrated, miniaturized guidance, navigation, and control system providing 5 meter CEP precision Demonstrate the utility of reducing combat load by increasing warfighter “kills-per-kilogram” Economically design and apply superalloys to weapon systems in order to minimize erosion, extend service life, reduce weight, and enhance high temperature performance 	<ul style="list-style-type: none"> Low cost canard actuation system, MEMS based fuzing, extended range propellants, abbreviated guidance laws, SASM GPS, terminal seeker based guidance, and tail kit for the M821/M889 81mm mortar munitions Caseless ammunition small caliber weapons technologies Flow-forming small bore, thick walled, lightweight gun barrels out of superalloys such as L605, Rene 41, Stellite 21, Inconel 718, etc.
Mid Term FY16- FY20	<ul style="list-style-type: none"> Precision fires for companies Improved life cycle performance for small arms (reduced barrel erosion, improved operational performance) Affordable fires accuracy and lethality against small tactical platforms from small manned tactical platforms Covert tagging of enemy vehicles and combatants 	<ul style="list-style-type: none"> Develop a miniature guidance, navigation, and control system for a 60mm mortar Develop new materials and materials production techniques to provide consistent high weapon performance Develop a remotely operated, stabilized weapon station mount of less than 200 lbs Develop tag dispersion techniques that provide more than 95% coverage of all targets within 25m diameter from 2 km standoff range 	<ul style="list-style-type: none"> Flow-form processing, super alloys, and advanced composite materials Integration of micro-pulsed laser designator, integrated day-night optics, lightweight minor caliber weapons, and low cost missiles Airburst warhead for 81mm mortar with infrared reflective and other unique signature tagging technologies
Far Term FY21- FY25	<ul style="list-style-type: none"> Precision fires for the individual warfighter Nonlethal engagement capability 	<ul style="list-style-type: none"> Develop low cost, ruggedized, miniature 6 DOF navigation grade inertial system Develop inexpensive non-lethal weapons effects and munitions, in coordination with Joint Non-lethal Weapons Directorate (JNLWD) 	<ul style="list-style-type: none"> Gun hardened , miniature MEMS based INS Directed energy, electromagnetic pulse generators, variable density projectiles, and phaser technologies
Endstate:			
<ul style="list-style-type: none"> Lightweight, reliable, accurate weapons systems, enabling organic and inorganic scalable lethality Fires as a Commodity, against diverse unconventional and hybrid threats, with the ability to escalate from non-lethal to lethal force from ground, air, and naval platforms, across the full range of military operations. 			