UNITED STATES MARINE CORPS
MARINE CORPS SYSTEMS COMMAND
PROGRAM EXECUTIVE OFFICER LAND SYSTEMS
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PEO LS
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PEO

MARCORSYSCOM
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JOINT LETTER

From: Commander, Marine Corps Systems Command
Program Executive Officer Land Systems

To: Distribution

Subj: MARINE CORPS SYSTEMS COMMAND AND PROGRAM EXECUTIVE OFFICER LAND SYSTEMS SCIENCE AND TECHNOLOGY NEEDS

Ref: (a) Marine Corps Systems Command and Program Executive Officer Land Systems ltr 3966 of 23 Mar 2020

Encl: (1) Marine Corps Systems Command and Program Executive Officer Land Systems Science and Technology Needs Prioritized List
(2) Marine Corps Systems Command and Program Executive Officer Land Systems Science and Technology Needs Matrix

1. Background. To ensure the naval laboratories understand our science and technology needs, Marine Corps Systems Command (MARCORSYSCOM) and Program Executive Officer Land Systems (PEO LS) publish an annual list of possible Naval Innovative Science and Engineering (NISE) program topics for consideration. This letter is an update to our previous submittal, reference (a).

2. Discussion. Enclosure (1) contains a consolidated list of science and technology needs submitted by MARCORSYSCOM and PEO LS programs. We believe naval laboratory investment in these areas would both accomplish the goals of National Defense Authorization Act (NDAA) Section 219 and make a direct improvement in the ability of our nation's Marines to accomplish their missions and return home safely. We would appreciate your consideration of the enclosed needs in your respective areas of cognizance as you continue to implement NDAA Section 219.

3. Action. Request the naval laboratories identify any NISE funding related to MARCORSYSCOM and PEO LS science and technology needs.

4. The MARCORSYSCOM point of contact is the Chief Technology Officer, Mr. Luis E. Velazquez, at (703) 432-3638 or email at luis.velazquez@usmc.mil. The PEO LS point of

contact is the Director of Advanced Technology, Mr. W. Scott Story at (703) 675-2151 or email william.story@usmc.mil.

JOHN M. GARNER
Program Executive Officer

A. J. PASAGIAN
Commander

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MCSC/ PEO LS S&T Needs Prioritized List

POC	National Defense Strategy Priority	Marine Corps Force 2025 Line of Effort	Joint Capability Area	Desired Capability	Benefit to the Program/War fighter	Possible Approaches
Program Executive Officer Land Systems (PEO LS)						
W. Scott Story PEO LS	Missile Defense	Air Defense	Force Protection	Real time spectrum management for G/ATOR (TPS-80)	The RF spectrum is a contested environment. Developing real time spectrum management will enhance Electronic Protection and interoperability with other RF systems in host nations.	Developing improved spectrum monitoring, advanced signal processing algorithms, and communication/radar interoperability strategies.
W. Scott Story PEO LS	Advanced Autonomous Systems	Air Defense	Force Application	Battle Management Aid	Provide an integrated capability to pair geographically diverse sensors and weapons within the EABO concept to aid in the management of engagement decisions within the required reaction times to ensure mission success.	AI/ML to pair sensor/weapons to engage threats that meet doctrine priority.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Protection	Precision C-UAS EW Techniques	Precision C-UAS EW Techniques Provide ability to increase effectiveness including hard kill capability while reducing RF spectrum and power required for effects.	Developing a Software Defined Radio (SDR) Module that can be integrated on current and future ground USMC EW assets. Developing protocol-based detection and mitigation techniques to function on the SDR.
W. Scott Story PEO LS	Advanced Autonomous Systems	Air Defense	Force Application	C-UAS Data fusion and AI/ML	Solutions to provide data fusion to enable AI/ML-based identification of targets and a decision engine to recommend mitigation solutions while taking into account weapon magazine depth.	Development of non-proprietary algorthims to enable radar, optics, RF data fusions and target identification. Standards based sensor outputs should be used to reduce effort of utilizing algorthims on different sensors.
W. Scott Story PEO LS	C4ISR	Air Defense	Force Application	Enhanced EO/IR systems for improved threat and autonomous threat detection and accurate identification of Group 1-3 UAS and FW/RF aircraft.	Improved detection and identification of air threats will aid Marines in selecting appropriate mitigations based of a correctly identified threats much faster resulting in greater likelyhood of sucessful mitigation. Autonomous Identification of the target type (ideally to include model) will also lessen cognitize load on Marines.	Solution could be improved mid-wavelength infrared (MWIR) EO/IR with MWIR zoom to 20x with improved stabilized gimbal while limiting SWAP growth.
Portfolio Manager (PfM) for Command Element Systems (CES)						
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	AI managed networking in a contested environment	AI sensing the contested invironment and countering by fluxuating the entire network to enable constant communicaiton	**Ties to item 1** Development of AI which can sense the environment, if one or all of the nodes are in a contested environment then the AI should switch the all of the nodes automatically to an none contested network.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Extended range for transmission systems that are not satellite dependent.	In planning for communicating in a satellite denied environment, the Marine Corps intends to employ line-of-sight and troposcatter communication systems. While the range of these systems have increased over time, they could still be a critical limitation, especially when trying to connect to theater level headquarters.	1. Extending current system ranges through unmanned aerial relays or sea-based (LRUSV) relays. 2. Higher power systems with larger antennas for systems that are expected to be out of range for adversary fires or detection capabilities.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Ship-to-shore Troposcatter Communications	Current troposcatter technology can not achieve reliable connectivity from ship-to-shore over operationally relevant ranges due to the yaw and pitch of the ship. If this were possible, Marines would have a means to communicate with ships over a longer range in a satellite denied environment.	**Tie to item 2** 1. Stabilizing mechanism for ship-based troposcatter antennas. 2. Development of troposcatter systems with broader horizontal and vertical beam widths. 3. Using software that enables the link establishment and management of a very intermittent signal.
Portfolio Manager (PfM) for Ground Combat Element Systems (GCES)						
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range and Precision Fires	Command and Control	One to Many Missile Planning and Fire Control	Provide ability to provide mission planning and fire control to multiple remote missile launchers via one controller safely and securely. Enables coordinated target hit time and continuity of operations if an operation center becomes unavailable.	-Remote fire control and with launcher and weapon status availability -User selectable launcher and weapon arming and firing -Safe and secure use of tactical radio network
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range/Precision Fires	Force Application	Self location In GPS denied environments	GPS is required for nearly all aspects of a call for fire. If GPS is denied (A2AD or environmental considerations), the ability to execute calls for fire and air support is severely diminished. Self location is required to develop and knowledge of all battlespace entities (including friendlies) for situational awareness.	On Demand Digital Surface Model would provide high resolution mensurated imagery to all users computed on-demand at the needed location. This technology would also benefit from the ability to accept and process new imagery as it is collected. A visual positioning system would allow the computation of the location of camera (user) and all locations in the scene (targets) automatically. A radio timing waveform would allow computation of the position of a radio (and user) based upon the location of other radios on the network. If one radio knows its location, all radios know their locations - this could be accomplished via traditional surveying means or imagery.
Bryan Freeman PfM GCES	C4ISR	C2 in a Degraded Environment	Command and Control	Beyond Line of Sight high bandwidth LPI/LPD network for communications between ground and unmanned surface craft at very long ranges (>500 km)	Enable control of unmanned surface vehicles without enemy detection	Network aware radios which adjust power and bandwidth depending on conditions
Program						
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Mobile communication network for Force on Force Training	A high bandwidth, low cost mobile communication network that accommodates video, audio, Position Location Information, text messages and multi-cast messages from 2500 players during Force on Force training.	Use of Long Term Evolution Advanced (LTE-A) to achieve 4G / 5G speed

Enclosure (1)

MCSC / PEO LS S&T Needs Matrix

POC	National Defense Strategy Priority	Marine Corps Force 2025 Line of Effort	Joint Capability Area	Desired Capability	Benefit to the Program/War fighter	Possible Approaches
Program Executive Officer Land Systems (PEO LS)						
W. Scott Story PEO LS	Missile Defense	Air Defense	Force Protection	Increased dynamic range on G/ATOR (TPS-80)	Reducing clutter induced saturation would increase the reliability of target detections. Also, this would increase interoperability with other radars and communication systems (e.g. 5G) increasing siting flexibility of the radar.	Developing improved analog to digital converters. Developing higher third order intercept low noise amplifiers. Also, developing low loss switchable filters for T/R modules.
W. Scott Story PEO LS	Missile Defense	Air Defense	Force Protection	Detection and Tracking of Hypersonic vehicles with G/ATOR (TPS-80)	Hypersonic vehicles are an emerging threat that is relevant to the USMC mission. Developing means to detect and track these weapons are prerequisite to mitigating this threat.	Developing improved signal processing. Developing higher power T/R modules.
W. Scott Story PEO LS	Missile Defense	Air Defense	Force Protection	Real time spectrum management for G/ATOR (TPS-80)	The RF spectrum is a contested environment. Developing real time spectrum management will enhance Electronic Protection and interoperability with other RF systems in host nations.	Developing improved spectrum monitoring, advanced signal processing algorithms, and communication/radar interoperability strategies.
W. Scott Story PEO LS	Advanced Autonomous Systems	Air Defense	Force Application	Battle Management Aid	Provide an integrated capability to pair geographically diverse sensors and weapons within the EABO concept to aid in the management of engagement decisions within the required reaction times to ensure mission success.	AI/ML to pair sensor/weapons to engage threats that meet doctrine priority.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Protection	Precision C-UAS EW Techniques	Precision C-UAS EW Techniques Provide ability to increase effectiveness including hard kill capability while reducing RF spectrum and power required for effects.	Developing a Software Defined Radio (SDR) Module that can be integrated on current and future ground USMC EW assets. Developing protocol-based detection and mitigation techniques to function on the SDR.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Protection	Low Collateral Effects C-UAS Interceptor	Provide capability to defeat Group 1-2 UAS with low collerateral damage risk of explosive kinetics effects to counter individual UAVs and SWARMs.	Developing an interceptor that utilize EW, High Power Microwave, or other low collateral effects to negate UAVs at relevant ranges. Interceptors that launch from vehicles, ground launch (via portable kits), and hand launched for dismounted forces are of interest. Autonomy for all stages of flight is needed.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Protection	Hardkill C-UAS Interceptor for Groups 1-3	Provide capability to defeat Group 1-3 UAVs to counter individual UAVs and SWARMs.	Develop an interceptor that uses hard kill effects to negate UAVs at relevant ranges. Ideal solutions would be able to be launched from a JLTV turret. Autonomy for all stages of flight is desired.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Protection	Increased Power on JLTV	Need the ability to have onboard power output or power systems that are capability of providing power (up to 60Kw) to future High Energy laser Weapons Systems or Fire Control Radars.	Powertrain alternator or power generation/storage systems that have limited size and weight impacts.
W. Scott Story PEO LS	Forward force maneuver and posture resilience	Air Defense	Force Application	Fire Control Radar	The development of a 360 degree azimuth fire control radar will enable cruise missile defense when cued from a surveillance radar or Navy Integrate Fire Control Network.	Development of a relatively low-cost non-rotating multi-face AESA radar in X-Band or higher is a likely approach. This could be an adaptation of existing single face or modular radars to support multiple faces simultaneously. Ideal solution would be able to mount on a JLTV
W. Scott Story PEO LS	Advanced Autonomous Systems	Air Defense	Force Application	Autonomous or remotely controlled vehicle	Autonomous or remotely controlled vehical for intercept capability without significant increase in force structure. This also can reduce risk to personnel as capability is likely to become a target.	Command/Control architecture which enables platform to receive direction, maneuver to location, establish launch position, and fire cued interceptor on command.
W. Scott Story PEO LS	C4ISR	Enhanced Command and Control	Command and Control	Multi-Function Information Warfare/Spectrum Equipment	Provides common spectrum equipment (LPI/LPD Coms, EW, Passive detection/tracking), data fusion that reduces SWAP impact on platforms to allow for additional weapons to be integrated on the platform. Reduces lifecycle cost as modular components can more easily be replaced for improved capability without the need to replace complete systems. Facilitates modular upgrade paths reducing program cost compared to new complete system acquisition.	Use of modular open standards with well defined interface control documentation and integration development kit documentation to support acquisition of best of breed capability for each component. Potential integration of capabilitiy into MFEW or MEGFOS systems.
W. Scott Story PEO LS	Advanced Autonomous Systems	Air Defense	Force Application	C-UAS Data fusion and AI/ML	Solutions to provide data fusion to enable AI/ML-based identification of targets and a decision engine to recommend mitigation solutions while taking into account weapon magazine depth.	Development of non-proprietary algorthims to enable radar, optics, RF data fusions and target identification. Standards based sensor outputs should be used to reduce effort of utilizing algorthims on different sensors.

Enclosure (2)

W. Scott Story PEO LS	C4ISR	Air Defense	Force Application	Enhanced EO/IR systems for improved threat and autonomous threat detection and accurate identification of Group 1-3 UAS and FW/RF aircraft.	Improved detection and identification of air threats will aid Marines in selecting appropriate mitigations based of a correctly identified threats much faster resulting in greater likelyhood of sucessful mitigation. Autonomous Identification of the target type (ideally to include model) will also lessen cognitize load on Marines.	Solution could be improved mid-wavelength infrared (MWIR) EO/IR with MWIR zoom to 20x with improved stabilized gimbal while limiting SWAP growth.
W. Scott Story PEO LS	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Battlespace Awareness	Battle Management System	Provides the ability to form tactical level coordinated battle teams to enable the performance of tasks with greater aggregate effectiveness.	Multiple domain level integration of radios, MFOCS-II, NOTM, JBC-P, JCTDs, MUOS and other Joint Battle Command system into the local vehicle Fire Control System.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Battlespace Awareness	Vision System	Provide 360/Hemispherical SA to enable enhanced target identification, POI visibility, and local vehicle SA	The ability to monitory a 360 degree wide FOV and then DRI with-in that FOV and send target to Fire Control System with as few steps as possible.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Hunter-Killer Capacity	Provide rapid target hand-off and slew-to-cue between the vehicle commander and the gunner with independent, stabilized sensors and controls.	The ability to monitory a 360 degree wide FOV and then DRI with-in that FOV and send target to Fire Control System with as few steps as possible.
W. Scott Story PEO LS	Joint Lethality in Contested Environment	Information Warfare	Force Application	Electronic Attack	Provide the ability to disrupt enemy communications and movements while on the move.	Constant monitoring and classifying enemy communication with minimal input and oversite.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Marine Expeditionary Units and Forward Deployed Forces CPG 2019	Force Protection	Counter UAS	Provide the organic capacity to avoid (kinetically, non-kinetically) UAS attacks.	The ability to detect, enemy UAS, jam or soft kill UAS while on the move.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Marine Expeditionary Units and Forward Deployed Forces CPG 2019	Force Application	Extended Range, Automatic Target Detection, Recognition, and Identification (DRI)	Provide ability to DRI human/vehicular/aerial targets beyond the MER of the organic weapons in day/night and through obscurants increases SA and allows ARV to shape the battlespace.	Enhance the Machine learning capacity of the DRI System so that when targets are DRI with 'man-in-the-loop' the system can automatically up-date the library to enhance the next engagement.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Signature Management/Deception	Provide the ability to manage vehicle thermal/IR/EM signatures related to communications, as well as the ability to mask EM signature, project a false EM signature, and/or project decoy emitters.	Both monitor and manage the vehicle thermal/IR/EM signature while on the move and change or mask that signature as needed to avoid detection or present false signature. Coating and materials for improved vehicle signature management. Quieter cooling fans without loss of air flow performance or durability.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Control and recovery "X" unmanned systems	Provide the ability to launch, control, and recover organic UAS with sensors and control UGV. Provide the ability for remote operation of a wingman vehicle to include remote driving.	The ability to launch and recover UAS from under armor and while on the move will be imparitive in future operations.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Active Protection	Provide the ability for soft and hard kill capabilities to avoid hits from AA threats; deny UAS attacks; protect occupants from directed energy weapon attack; and project false EM signatures.	Low cost and Low weight solutions
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Survivability and Protection	Provide the ability to protect the occupants and the system from medium caliber Direct Fire threats (see classified annex).	Low cost and Low weight solutions
W. Scott Story PEO LS	Resilient and agile logistics	Logistics	Logistics	Maximize power generation and storage within the confined space and weight restrictions on combat vehicles	Provide high electrical power generation/storage to support future capabilities and growth while meeting shipboard battery-level Navy safety testing	Battery storage and small, quiet, low weight hybrid power generators. 1. Li-Ion batteries, 2. Fuel cell APU, 3. Ultracapacitors
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Marine Expeditionary Units and Forward Deployed Forces CPG 2019	Force Application	Lightweight materials and Advance Manufacturing technologies	Drive overall weight reduction in the hull, chassis, and other smaller components.	Redesign some sections of the hull or compartments to reduce weight and share components by minimizing bracing and/or support structure. Put all the mass where the protection is needed and use low weight materials inside the vehicles.
W. Scott Story PEO LS	C4ISR	Information Warfare	Command and Control	Cross Domain solution for multiple domains with interoperability with different radio systems	Reduces electronic footprint in vehicles that are equipped with numerous systems and must utilize separate gear for accessing different domains	Recommendations include looking at industry solutions that may need to be modified to meet DoD and Service level policy and standards.
W. Scott Story PEO LS	C4ISR	Information Warfare	Command and Control	Software Defined Radios to consolidate the amount of physical hardware needed on C4ISR	Reduces the requirement of physical hardware for each specific radio system needed for a multi-radio (C4ISR) system. Allowing better utilization of minimal space in vehicles that are equipped with multiple radio systems hardware.	Recommendations include looking at industry solutions that may be need to be modified to meet DoD and Service level policy and standards.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Logistics	Force Protection	Wheeled combat vehicle durability	Increase resistance to damage from environmental exposure to tires, wheels, and external suspension, drivetrain and braking components.	Lightweight tire protection/run-flat technology, damage tolerant pneumatic systems and sealing capabilities, corrosion resistant brake and suspension systems, and drivetrain sealing.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Logistics	Force Protection	Vehicle corrosion prevention and control	Increase operational availability and decrease maintenance burden	Connector, fastener and coating technology without use of prohibited materials. Achieve fastener performance equivalent to chromium/cadmium plating while maintaining cost and strength.

W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Logistics	Force Protection	Improved Tires. Run flats are heavy reducing payload and increasing wear and tear on suspension and powertrain.. Tires for CTIS are susceptible to punctures	Development of Tire that meets CTIS requirements but are more robust for punctures or are self sealing.	Work with industry to develop more robust tires for CTIS applications.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Improved ground combat vehicle mobility, safety, and ride quality	Increase terrain available for ground mobility and increase operational tempo in order to achieve positional advantage across the battlefield.	Wheel/tire, suspension and drivetrain technology to increase soft soil mobility. Powertrain technology to increase available power and torque providing greater acceleration and top speed. Improved suspension for increased dynamic stability, roll-over resistance, and ride quality
W. Scott Story PEO LS	Resilient and agile logistics	Logistics	Logistics	Condition Based Maintenance (CBM) capabilities to enhance a platform's operational availability while decreasing total ownership cost.	Vehicle is equipped with sensors and interrogators to simplify the logging and reporting of necessary maintenance and operational feedback/reports. The Vehicle system should be capable of monitoring and analyzing sub-system level usage and changes in performance to predict required maintenance before failures occurs.	Develop sub-system monitoring, logging and storage capability to capture parameters and fault codes from CAN Bus and ECN to infer health with total system available. Implement an infrastructure to get data into a database for AI and human analysis. Analyze ongoing data stream for further refinement of algorithms and models. As undetected faults are encountered, expand monitoring capability with additional sensing, storage, and transmissions as cost and impact can be justified. Develop a physical and/or virtual operations center where first line maintainer and units can reach back for help on maintenance issues. Center includes expert mechanics for all aspects of active equipment with full access to up-to-date and comprehensive technical documention and models. Center has ability to order parts as required and facilitate rapid delivery to affected unit.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Improve vehicle and occupant survivability	Reduce injuries resulting from Improvised Explosive Devices (IEDs) and reduced weight increases combat effectiveness and survivability	Lightweight and/or higher performance armor and spall liner, improved blast protected seating and lower leg protection, and fire resistance/protection.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Vehicle laser eye protection providing protection for direct view optics across the laser threat spectrum	Enhanced protection from proliferated laser threats with without loss of visual light transmission.	Enhanced coating and reduced power usage for active approaches.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	1. Better performing fire suppression systems by improving the rapid distribution of conventional fire suppression agents (pressurized HFC227ea) within vehicle cabs while minimizing impulse noise. 2. Develop low/non-toxic fire suppression agents that are effective against pooling/puddling fuel fires and that minimizes the overall weight of fire suppression systems carried aboard vehicles. 3. Establish more accurate personnel injury criteria when testing fire suppression systems that use liquid agents that can rapidly flash into a gas phase (such as agents containing water).	Lower Weight for fire suppression systems and lower noise levels for the systems	Development of improved agents and distribution systems.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Vehicle Protection against Anti-Armor Threats	Increased platform and warfighter survivability against widely proliferated anti-tank guided missiles (ATGM), rocket propelled grenades (RPG) and recoilless rifle rounds (RR). Complete system or components that enable pre-shot detection, post-shot detection, threat tracking, soft kill, and/or hard kill of threat systems. Early detection of threat systems enables activation of countermeasures and increases survivability. Soft kill avoids depletion of hard kill countermeasures. Hard kill is last chance to defeat threat before relying on armor.	Detection of threat optics via optical augmentation and lasers. Detection of threat electronics. Automatic recognition of threat systems in images across all spectrums. Close-in and long range persistent multi-spectral smoke/obscurants to defeat guided mechanism. Electronic attack and jamming. Dazzling seekers. Damaging seekers with lasers or electromagnetic energy. Multiple, small individual countermeasures which cover a section of vehicle.

W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Low-cost armor steels for tactical vehicles that are not prone to environmental cracking like the steels currently in use for armored vehicles (ACV, LAV, JLTV, MRAP).	Reduce sustainment and replacement costs of critical armor by extending life-cycle, reducing environmental impacts to armor materials. Improvement in vehicle readiness.	Revised steel armor specifications (MIL-DTL-46100) with additional test(s) to identify materials that are less susceptible to environmentally assisted cracking. Recognition of the 550 hardness class of steel armors. Processing/integration guidelines (cutting, bending, and welding) to enable successful integration of armor steels into vehicle structures.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Survivability and Protection	Provide the ability to protect the occupants and the system from medium caliber Direct Fire threats (see classified annex).	Work with government an industry to find armor solutions that can withstand the threats
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	High fidelity vehicle threat modeling capability	High fidelity modeling capability will reduce risks to vehicles in a changing threat environment and enable rapid development and fielding of design improvements plus potentially reduce test costs.	Validated high fidelity models of vehicle blast and fragmentation mine and IED threats. Validated high fidelity models of anti-armor threat (ATGM, RPG and RR) interaction with hard-kill APS countermeasures and residual vehicle and occupant effects.
W. Scott Story PEO LS	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Lightweight materials and Advance Manufacturing without significant cost increase.	Drive overall weight reduction in the hull, chassis, and other smaller components.	Work with government and industry to find new lighter weight materials that can be used in the vehicle or new types of lightweight armor that will reduce overall weight
Portfolio Manager (PfM) for Command Element Systems (CES)						
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	**LPI/LPD tactical data/voice communications** in frequencies ranges up to 5 GHz. Operationally and threat driven definition of LPI/LPD tactical data communications.	Ability to transmit and/or receive data/voice in the proximity of enemy forces with low probability of detection and/or interception. Ability to continue to use prioritized services (such as tactical chat/targeting data) on the network with intermittent connectivity and very low bandwidth.	LPI/LPD waveforms, reduced SWAP smart antennas, network management architecture for intermittent connectivity and very low bandwith, threat-based communication planning tools.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	**Extended range (Beyond Line of Sight)** for transmission systems that are not satellite dependent.	In planning for communicating in a satellite denied environment, the Marine Corps intends to employ line-of-sight and troposcatter communication systems. While the range of these systems have increased over time, they could still be a critical limitation, especially when trying to connect to theater level headquarters.	1. Extending current system ranges through unmanned aerial relays or sea-based (LRUSV) relays. 2. Higher power systems with larger antennas for systems that are expected to be out of range for adversary fires or detection capabilities. 3. Directional capabilities to increase gain and range
Brad Crane PfM CES	Advanced Autonomous Systems	Information Warfare	Battlespace Awareness	**Artificial Intelligence improvements.** Automatic Semantic tags for identified objects based on sensor ontology	Improved identification and discoverability of Intelligence data. Improved detection, classification and recognition of data	Computer vision and other artificial intelligence and machine learning techniques.
Brad Crane PfM CES	Evolve innovative operational concepts	Information Warfare	Command and Control	**Modeling and Simulation (M&S) Conceptual Models** to be implemented in the fielding of the Wargaming Capability materiel solution.	Facilitates and enhances the Marine Corps wargaming mission, in accord with the USMC vision for next generation wargaming as outlined in the 38th CMC Planning Guidance.	**Note: This may fall across multiple Lines of Effort. This should tie in capability planning to other efforts listed in our S&T needs** Some conceptual models may already exist and only require integration; some may require development work prior to integration; some which have already been implemented within the WGC material solution may require validation.
Brad Crane PfM CES	Advanced Autonomous Systems	Information Warfare	Battlespace Awareness	**Persistant unmanned hydrographic sensing (Maritime ISR)** for wide-area maritime situational awareness in support of Expeditionary Advanced Base Operations.	Once a zone has been cleared, provides wide-area, beyond-line-of-site, maritime situational awareness to provide for indications and warnings, and the timely cueing of additional ISR assets and/or fires to mitigate threats.	Swarming seaborne and/or underwater multi-modal sensors. Resilient sensor network that provides information on demand. Means to emplaced or deliversensor remotely (e.g., via unmanned systems).
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control Battlespace Awareness	Wide-bandwidth EW/EA (specifically wide spectrum) with reduced EM signature and LPI/LPD capability. Integrated Communications. Detection, classification, and identification of objects at tactically significant distances.	At distances under 10km, the frequency is jam resistant. Additionally, higher bandwidth will allow for faster data transmission. Improved Situational Awareness and threat detection. Include Information Operations.	Recommendations include consideration of new waveforms and FPGA/processing requirements and new SDR development. Smart Antennas and Precision Timing.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	PLI without need for GPS	This would allow for the user to be able to report PLI without relying on the GPS constellation.	
Brad Crane PfM CES	C4ISR	Information Warfare	Command and Control	Methods and technology that protect tactical information and communications from Cyber attack	Ensure that tactical information and communications are secure. Provide multi-level classification capability. Provide protection at OSI layers 2-6.	IA Virus Protection, Multi-level security capable, small form factor C2 electronics, anti-tamper protections for unattended sensors
Brad Crane PfM CES	Advanced Autonomous Systems	Information Warfare	Command and Control Battlespace Awareness	Voice Control, Language Translation and recognition capabilities.	Manage capabliity at a distance (100s of meters) or while on the move in a tactical vehicle. Provides ground units and analysts the tools needed to understand native speakers and text to inform decision making.	Automatic Language Translation / recognition for control or recording. Two-way translation (i.e., text to text; speech to text; text to speech; speech to speech). Translation of low resource langagues. Artificual intelligence enabled natural language processing and semantic analysis, including dielect identification.

Brad Crane PfM CES	Preparedness for War	Information Warfare	Battlespace Awareness	Reduced Sized Wide Band Antennas	Reduced SWAP for intelligence collection at the tactical/squad level. Enabler for LPI/LPD communications.	**Tie to item 1** HF Microstrip Antennas. Photonic Antennas. New wideband low SWaP antennas.
Brad Crane PfM CES	Preparedness for War	Protected Mobility/Enhanced Maneuver	Protection	Stand off detection of explosives and explosive pre-cursor components	Detection of IED explosives outside the blast zone will save Marine lives. The desire is for standoff explosive detection vice trigger detection. Optimally, the technology desired is an explosive hand held or man portable device that can detect out of the blast zone, ID the explosive and geolocate the explosive.	Novel sensing modalities.
Brad Crane PfM CES	C4ISR	Information Warfare	Battlespace Awareness	Data Compression, Bandwidth Utilization, Asynchronous Downloads	Improved utilization of network resources and reliability of communications and sharing of data	Stabilized UDP (i.e. Aspera); New Efficient Algorithms
Brad Crane PfM CES	Advanced Autonomous Systems	Information Warfare	Battlespace Awareness	Management, sharing, fusion, and analysis of large data sets to the tactical edge.	Allows for overwhelming amounts of data to be correlated and condensed into actionable information.	Standards-based, semantic tagging of data. Low SWAP high data throughput devices.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Long haul reach back with reduced EM signature and LPI/LPD capability to include BLOS at tactically significant distances.	Provide long reach back communication transmission BLOS in SATCOM denied environment.	**Tie to item 2** Directional narrow angle transmission via absorption or reflective capabilities/methods, and/or beam forming
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Battlespace Awareness	Small CSfC certified Wireless Solution that allows wireless connection to tactical radios and offline wireless capability to other EUDs at the tactical edge	Multiple EUD connections to each tactical radio and the network they provide. Offline capability allows users to wirelessly share C2SA info locally.	DataSoft wireless remote access point (SBIR), Glenaire Mission Manager hub, LPI/LPD wireless
Brad Crane PfM CES	Advanced Autonomous Systems	Information Warfare	Battlespace Awareness	Multi-spectral imaging for threat detection and idenficiation.	Ability to correlate data from distributed and multi-spectral sensors. Effecitvely detect, classify and identify targets in distrubted or otherwise limited operating conditions.	Advanced sensing modalities for object detection, classification and facial recognition in low light. Articial intelligence-enabled multi-spectral sensors and analysis of relative performance gain.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	BLOS 5G tactical cloud computing on a single enclave	reduced hardware requirement, increase in C2 data throughput and access to information.	**Tie to item 2** Establish a 5G tactical network, increase computing capability for a single enclave, and develop the capabilities to establish 5G or the capability of 5G BLOS, cross domain solution on a single enclave
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	AI managed networking in a contested environment	AI sensing the contested invironment and countering by fluxuating the entire network to enable constant communicaiton	**Ties to item 1** Development of AI which can sense the environment, if one or all of the nodes are in a contested environment then the AI should switch the all of the nodes automatically to an none contested network.
Brad Crane PfM CES	C4ISR	Protected Mobility/Enhanced Maneuver	Command and Control	Lighter, Smaller Transit Cases	Most communications equipment is required to be transported in transit cases to protect the equipment from impact but these cases add considerable weight and bulk to our systems. Lighter and smaller transit cases would allow Marines to take more overall capability aboard ships and to the field.	1. Leverage newer materials and innovative designs to protect equipment with less bulk and weight. 2. Current technologies from outside of the communications community (e.g. football helmet technology from companies like VICIS) could possibly provide this benefit. 3. A prize challenge could be used to tap into commercial technology held outside of DoD-focused companies.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Aerial Relay for Free Space Optics	While FSO brings considerable advantages, it is has a limited range and transmits through a very directional beam. Having an aerial relay of some type could considerably increase the operational scenarios in which it can be used.	**Tie to item 1** 1. Existing or new drones could be used as an FSO platform. 2. HALO or other aerostat systems could be used as an FSO platform. 3. NRL's work on tracking technology could be leverage to overcome the challenge of keeping a direct line-of-sight connection on an unstable platform. 4. Multiple connection capable FSO system (one to many)
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Extended range for transmission systems that are not satellite dependent.	In planning for communicating in a satellite denied environment, the Marine Corps intends to employ line-of-sight and troposcatter communication systems. While the range of these systems have increased over time, they could still be a critical limitation, especially when trying to connect to theater level headquarters.	1. Extending current system ranges through unmanned aerial relays or sea-based (LRUSV) relays. 2. Higher power systems with larger antennas for systems that are expected to be out of range for adversary fires or detection capabilities.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Beam-stearable antennas	Provides Marines with better options when balancing the trade-offs between range and LPI/LPD.	**Tie to item 1 and 2** 1. Many of these are in development now.

Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Government Waveforms	Throughout DoD, there are interoperability issues and operational security risks associated with our reliance on vendor developed waveforms. Developing government owned waveforms would increase interoperability between systems and services while also decreasing the risk of adversarial exploitation.	**Tie to item 1** 1. Leverage government laboratories to begin development of waveforms on a joint established priority basis.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Ship-to-shore Troposcatter Communications	Current troposcatter technology can not achieve reliable connectivity from ship-to-shore over operationally relevant ranges due to the yaw and pitch of the ship. If this were possible, Marines would have a means to communicate with ships over a longer range in a satellite denied environment.	**Tie to item 2** 1. Stabilizing mechanism for ship-based troposcatter antennas. 2. Development of troposcatter systems with broader horizontal and vertical beam widths. 3. Using software that enables the link establishment and management of a very intermittent signal.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	High bandwidth communications that balance emitter signature characteristics.	This would allow the fleet to reduce signature while maintaining high bandwidth communications.	**Tie to item 1**
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Directional antennas suitable for employment at the squad and below.	This would allow for the fleet to be able to control their signature and increase their link closure rates.	**Tie to Item 1 and 2**
Brad Crane PfM CES	C4ISR	Information Warfare	Command and Control	LPI/LPD assessment tools	This would allow the program office to assess and characterize signature management capabilities and provide a threat based product to the fleet.	**Tie to item 1**
Brad Crane PfM CES	C4ISR	Information Warfare	Command and Control	LPI/LPD visualization tools	This would be an interactive visualization tool that would demonstrate threat based signature management properties for a communications / EW plan.	**Tie to item 1** Update current planning tools (NRL Builder, SPEED) with signature management properties.
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Network bridging	This would allow for interoperability for Fleet systems to bridge radio networks for voice and data.	**Tie to item 2**
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Waveform bridging	This would allow interoperatbility for Fleet systems that operated on different waveforms, such as different MANET waveforms.	**Tie to item 2**
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Arial Relay for RF systems	Retransmission would allow for lower power, directional transmission to a relay drone. Aids the Fleet in signature management.	**Tie to item 2** 1. Existing or new drones could be used as an relay platform. 2. HALO or other aerostat systems could be used as an relay platform.
Brad Crane PfM CES	C4ISR	Protected Mobility/Enhanced Maneuver	Command and Control	Solar powered Arial Relay	Similar to the above, but based on solar power to reduce the logistics tail and to increase on station endurance.	**Tie to item 2**
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Tactically employable antenna shielding to create directionality.	This would allow the force to help minimize signature in unwanted directions along with increasing link closure rate in the desired direction.	**Tie to item 2**
Brad Crane PfM CES	C4ISR	C2 in a Degraded Environment	Command and Control	Multi-purpose comms / SIGINT / EW broadband antennas	Antennas that are multi purpose reduce the logistics footprint and mission footprint. Currently antennas are suboptimal and based on frequency range.	**Tie to item 1 and 2**
Portfolio Manager (PfM) for Ground Combat Element Systems (GCES)						
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Method for Infantry Marines to direct a UAV or Loitering Munition to an area of interest without requiring active control of the UAV	A Marine operating a UAV controller cannot do other tasks, and their eyes are occupied with the equipment. This frees up the Marine to do other tasks and improves survivability and mission effectiveness	Coded laser pointer which the UAV detects and moves over the area of interest Other methods which require only a single Marine to operate, are easy to use, small, and lightweight.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Logistics	Utilization of Smart Fabrics/Interactive Textiles for health monitoring of the wearer	Allows health and biometric monitoring without requring a wearable sensor, such as a FitBit or OURA Ring	Fabric which can be made into uniform or be part of a uniform, along with a method to collect, analyze, and display the data.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Lightweight, rapid deployment and recovery decoys which function in all-weather environments. Systems of interest include all artillery systems (missiles and cannon), Fire Direction Center vehicles and emissions, and logistics support vehicles	Increases survivability of fire support Marines and materiel and exposes enemy knowledge prior to direct engagement	System which emulates the size, RF signature, visible and IR signature, of USMC systems.

Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range and Precision Fires	Force Application	Warhead Improvements for Missiles	A warhead with the same yield and smaller size would enables system trades such as longer range, better seekers, etc, which increase weapon performance. Similarly, increased warhead performance in the same size enables trades such as smaller salvo sizes to achieve the same effects. Note: An improvement of at least 25% lower weight or 25% higher yield is needed to make transition viable	Reactive materials, higher yield energetics, better IM performance (allows easier logistics)
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range and Precision Fires	Force Application	Rocket Motor Improvements	Rocket motors for missiles are expensive and haven't been improved for some time. A lower cost and/or higher performance rocket motor technology will allow for trades such as increased range, lower cost, and higher speeds. Note: An improvement of at least 25% in any category is needed to make transition viable	Improved energetics, improved rocket motor design. SFRJ.
	Joint Lethality in Contested Environment	Long Range and Precision Fires	Force Application	Improved Cruise Missile Range	Longer range has clear benefits including putting launchers further from enemy weapons	Improved fuel for missile engines, improved missile engine designs
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range and Precision Fires	Command and Control	One to Many Missile Planning and Fire Control	Provide ability to provide mission planning and fire control to multiple remote missile launchers via one controller safely and securely. Enables coordinated target hit time and continuity of operations if an operation center becomes unavailable.	-Remote fire control and with launcher and weapon status availability -User selectable launcher and weapon arming and firing -Safe and secure use of tactical radio network
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range/Precision Fires	Force Application	Low cost, high reliability rocket motor.	Improves affordability and reliability of rocket assisted artillery rounds and missiles.	
Bryan Freeman PfM GCES	C4ISR	Long Range/Precision Fires	Command and Control	Low Probability of Detection/Low Probability of Intercept (LPD/LPI) communications and architecture for manned/unmanned teaming of fires assets	Increases the survivability and mission effectiveness of unmanned ground fires platforms	Manned/Unmanned teaming will vastly improve survivability of systems, but only if the enemy cannot detect or interfere with the control of these assets. Suggest utilizing efforts done to control UAV's. Network and architecture should be able to determine minimum power and waveform needed to achieve reliable communication to minimize probability of detection. Range between nodes is 1-2km.
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Force Application	Penetrating/Non-line of sight sensors	Increases warfighter effectiveness and survivability in uncleared vegetation, jungles, structures, and rolling terrain	- Distributed networked EO sensors at unit level - Longer wavelength sensors, such as RF to detect enemy emissions - Non-traditional sensor such as acoustic, seismic, or magnetic sensors for individual use - Application to detect enemy activity and warn users (gunshots, engines, human activity)
Bryan Freeman PfM GCES	C4ISR	Information Warfare	Force Application	Hidden Target Detection	Detection of camouflage, mines, IED's, control links, triggering mechanisms, remote weapon stations, lasers, radars.	- Multispectral, multicolor, polarimetric imaging with ability to maintain resolution, frame rates, range, resolution, and field of view - Aided target detection via signal processing, AI, or ML at the individual level or through local shared network
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Long Range/Precision Fires	Force Application	Computationally enhanced target acquisition of weapons and personnel by handheld optics and loitering munitions	Increase target acquisition range beyond limits of sensor noise or optical spot size. Assist in the recognition of weapons and personnel of interest not under gaze in near real-time.	Various frame integration, contrast enhancement, and super-resolution techniques. Compare live imagery against local signature library or push samples to remote libraries via Warfighter Network.
Bryan Freeman PfM GCES	C4ISR	Close Combat Lethality	Command and Control	Secure wireless for individual and squad worn devices	Elimination of unreliable, cumbersome, heavy, and costly cables	Secure short range LPI/LPD wireless with VPN like encryption
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Improved Detectors for Weapon Sights	Improve Weapon System Effectiveness Improvements by: 1) Providing DRI ranges of 2000/1500/1200m 2) Providing ability to see through glass and Plexiglas 3) Providing ability to detect camouflage targets and materials 4) See NIR Pointers (860nm - 1064nm) 5) Display laser designator PRF codes	- Multiband detector - Multiple detectors compactly integrated with Multiband optics
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Reduced Signature Marker	Improve survivability by reducing signature required to mark targets for other warfighters	- Reduced signature marker (small coded pulses which can be integrated to provide spot to friendly forces) - Cooperative passive ranging and bearing by combining views of multiple individual squad and weapon optics, possibly with azimuth sensor device - Target cueing metadata shared across squad Infantry VR shared via Visual Augmentation System

Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Close Combat Lethality	Force Application	Reduced SWaP for Infantry Optics while maintaining or improving performance	Reduce head mounted sensor size reduces fatigue and reduces injury potential Lower power reduces weight and logistical burden of batteries	- Reduced sensor sizes - Lower cost high operating temperature (HOT) cooled sensors - Digital Low Light Sensors to replace Image Intensifier tubes - Low cost compact lens design, such as gradient-index - Alternative DVO architectures and housings to save weight - Improved processing efficiency for digital imaging and displays
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Improved Small Arms Aiming	Increases warfighter effectiveness and survivability	-Low signature range finding and ballistic calculation - Target Point of aim tracker for moving targets - Daylight visible optical overlay/data injection which accounts for zoom - Low cost environmental sensors to refine ballistic calculations - 'Trigger interrupt' function to delay firing until optimal aim point has been achieved
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Low probability of detection ranging for individual weapons	Improved survivability by eliminating laser range finders	- Multiple or focus based ranging
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Information Warfare	Force Application	Low probability of detection target handoff	Improves survivability by avoiding laser pointers	- Tiered power and data rate radio networks to share high resolution video or low data rate cueing metadata across squad - Low cost and weight wired network for temporary/ad-hoc static positions
Bryan Freeman PfM GCES	C4ISR	Information Warfare	Force Application	Small Unit sensor and intelligence fusion	Improves mission effectiveness and survivability	- Tagging of faces associated with hostile events - Continuous air guard (UAS warning) - Consolidate and retain unit sensor data and apply techniques utilized by persistence surveillance systems
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Infantry ID of human target at maximum range of weapons	Enable positive ID (specific individual) to enable engagement of targets under all weather conditions, day and night, and behind glass	Exploit different wavelengths, sensor fusion, reduced pixel pitch on sensors
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Determination of trade space of different wavelength imagers vs utility in battlefield environment, specifically infantry optics	Enables the development of performance specifications for future infantry weapon optics	Working with PMO, determine and report on utility of different wavelength imagers against relevant military targets in different operational environments (e.g., urban, jungle, etc.) under operational conditions (day/night, urban day/night, all weather conditions). Include possible waveband image fusion under these conditions.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Long Range/Precision Fires	Force Application	Improved all-weather, all-surface mortar baseplate pad	Allows mortars to be effectively emplaced in hard and soft materials, such as concrete, lava, tundra, ice, snow, marsh, and other difficult terrains, and protect the baseplate from damage and wear.	Advanced materials and/or pad designs
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Low Power Variable Lighting Sensor	Replace expensive and easily damaged image intensifiers with low cost, low power, general purpose imaging sensor with daylight to overcast starlight capability. Inclusive of visible-light band and extending into infrared region.	High dynamic range, small pixel, solid state sensor with extremely low noise or pixel level amplification stage. Sparse color pixel array patterns. Utilization of commercial foundries.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Imaging through solid materials	Acquire and track personnel targets for engagement at infantry ranges through solid materials, including walls and/or foliage.	Various sensing approaches, including individual sensor platforms or networked, small groups for increased effective aperture size.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Application	Allow for Marines to engage the enemy at a faster rate of fire, for longer periods of time, with reduced risk of ammunition cook-off	Reduced footprint; improved survivability.	Develop new materials and heat mitigation techniques for the of M27, M240 and M249 weapon systems. Use of energetic materials.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Protection	Reduce acoustic, thermal and visual signatures of hand held weapons	Reduced probability of detection.	New materials [and novel design approach].
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Protection	Single lens laser eye protection providing protection for warfighter and optics across the laser threat spectrum using a single lens for each application with no or minimal tint.	Enhanced protection from laser threats with reduced logistics burden.	Enhanced coating and reduced power usage active approaches.

Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range/Precision Fires	Force Application	Develop general purpose low cost mortar round for air delivery by UAV and traditional mortar launchers	Increases fire delivery options without increasing number and type of munitions carried by infantry.	Traditional mortar round with improved fuze to add ability to set and drop from UAVs
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Close Combat Lethality	Force Application	Develop multi-target warhead for use by shoulder-launched assault weapons and air drop by UAVs.	Increases fire delivery options without increasing number and type of munitions carried by infantry. Increases lethality of infantry by enabling top-attack against all armored vehicles.	Dual shape charge/bunker busting munition with fuze capable of operating from shoulder launchers and UAV air drop.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Protection	Improved transparent armor protection, which is lightweight, performs at all temperatures, and doesn't lose transparency over time.	Improved transparent Armor will increase survivability of the Marine Gunner in our turrets and vehicles. Increased durability reduces logistical burden required to replace transparent armor which loses its transparency	Improved materials to increase performance at temperature extremes and reduce weight of the system.
Bryan Freeman PfM GCES	Preparedness for War	Logistics	Force Support	Virtual parachuting simulation	Allow Marines to develop cognitive repetition of skills and decisions required for successful parachute operations based on actual target terrain and conditions.	Team level/individual level simulator/application and virtual reality devices, which work with current Marine Corps personal equipment. Three person point of view applications to teach flight characteristics of parachute performance, environmental effects, and detectability.
Bryan Freeman PfM GCES	Advanced Autonomous Systems	Logistics	Force Support	Parachute integration with UAV/UAS	Provide a low cost mode of delivery for Class VIII supplies from UAV/UAS platform to increase area of coverage and survivability of the UAV/UAS platform.	A mothership UAV/UAS to receive requests to deliver Class VIII supplies to on-call locations. The mothership can loiter over the battlespace to deliver Class VIII supplies during the golden hour to distributed forces.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Advanced Materials and Survivability for Sub-Surface and Airborne Capabilities	Clandestine insertion of reconnaissance force by parachuting to provide information to the commander.	Develop parachutes to open lower than current systems while maintaining the ability to land on a point target. Develop materials which lower detectability by electrical, optical, infrared, or image intensification capabilities. Develop semi/autonomous powered vehicles to launch from aircraft and land forces on a point target while lowering detectability.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Reduced Signature (Midwave and Longwave Thermal) for clothing kit and weapons	Increased protection by reducing signature in the battle space in low light and limited visibility situations.	Coating and materials to break up or eliminate signature to thermal sights.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Reduce weight, cost, and improve flame resistant protection, comfort, and material durability of flame resistant organizational gear (clothing)	Reduction in weight and improved comfort will result in improved mobility, lethality and survivability for the warfighter. Improved protection will increase survivability and decrease injuries.	Identify new/novel materials or treatment processes.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Reduce weight, improve pack-ability and increase the comfort and temperature range for mountain cold weather clothing	Reduction in weight and pack-ability improvement will result in improved mobility, smaller space inside pack without sacrificing insulating properties of equipment after compression and extraction and reduced lethality and increased survivability for the warfighter.	Identify new/novel materials, designs or treatment processes.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Adaptive camouflage	Camouflage that changes and can blend into changing backgrounds	Identify new/novel materials or treatment processes.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Logistics	Logistics	A more durable water repellent treatment for clothing/gloves. Protective clothing often has a fluorinated durable water repellent (DWR) finish to provide water repellent protection. This finish loses its effectiveness over time when it is exposed to harsh water elements, petroleum, oils, lubricants (POLs), and low surface tension chemicals.	A more durable treatment will provide the water repellent protection for the life of the garment, resulting in improved comfort, mobility and lethality for the warfighter. Loss of water repellency leads to less effective protective clothing layers (e.g. picks up too much water and can lead to hypothermia).	Identify new/novel materials or treatment processes.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Lighter weight and/or higher performance armor materials for hard armor, soft armor, and helmets.	Improved mobility and reduced weight increases combat effectiveness and survivability	1. Identify new/novel materials to reduce the cost and more importantly the weight of ESAPI, such as carbon nano-tube, polyethylene, graphene. 2. Identify new/novel materials to reduce the weight of soft armor used in body armor such as tactical vests. 3. Identify new/novel materials or material applications/manufacture to reduce the weight and improve the performance capability of helmets

Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Biomedical fidelity and correlation of mechanical forces transmitted through PPE/New Ballistic testing method that would allow a better prediction of the effectiveness of new PPE protection systems against energy transfer into the body to replace current clay system and backface deformation measurement techniques.	Establish necessary protection levels that could allow reduction in weight and packability improvements. Will allow better evaluation of products to ensure effectiveness against injury to the warfighter and increase survivability.	DIC, LOAD CELL STAND, Membrane displacement.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Lighter weight but durable materials for load bearing equipment.	Improved mobility and reduced weight increases combat effectiveness and survivability	New materials or new application of existing materials to increase durability of load bearing systems while reducing overall system weight.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Better characterization of operational threats (grenades, artillery) and how to simulate these threats effectively for testing of PPE.	Improved understanding of protection capabilities and improvement in mobility increases combat effectiveness and survivability.	Creation of a model or creation of new test methods in lieu of standard RCC and FSP fragments.
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Close Combat Lethality	Force Protection	Improved hearing protection for Marines while maintaining situational awareness	Marines resist wearing hearing protection if it reduces their ability to hear other battlefield sounds or ability to communicate. This leads to permanent hearing loss, reducing quality of life for active duty, retired, and former Marines and adds to lifetime medical costs borne by the nation	Passive (non-electrical) protection which automatically engages when needed.
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Close Combat Lethality	Force Application	Improvements in hearing protection for higher sound pressure levels (above 180dB) for impulse and repetitive noise while retaining or improving situational awareness and not reducing ability to achieve cheek weld for effective primary weapon employment	Improving the warfighter ability to shoot, move and communicate on the battlefield	Improve helmet fit, facial covering, and effectiveness of the comms within the helmet
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Close Combat Lethality	Force Application	Man portable powered paraglider for insertion missions	Means of insertion that does not require vulnerable aircraft to enter enemy airspace and allows Marines to insert without being detected	Powered paraglider with range and carrying capacity
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Exoskeleton to improve performance and load bearing of individual Marines	Provide exoskeleton system that will better distribute the load the Marines are carrying, reducing the stress and injures on the body, and reducing the thermal stress	Improve Individual Marine physical performance by reducing thermal stress and improve mobility
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Electronic Textiles (eTextiles) for health monitoring	Provide capability to monitor the health and fitness status of the wearer for Team Lead monitoring and prevention of respiratory distress	Improve Marine Rifle Squad physical performance by monitoring team member bio and respiratory responses
Bryan Freeman PfM GCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Protection	Improve helmet protection capability to mitigate/reduce blast wave effects.	Reduce the occurrence or severity of TBI from blast events.	A quick reaction sealing or baffle system that could block the blast pressure waveform from getting under the helmet without impacting comfort from a thermal stand point would eliminate the source of Traumatic Brain Injury (TBI) concussion to the area under the helmet.
Bryan Freeman PfM GCES	C4ISR	C2 in a Degraded Environment	Command and Control	Beyond Line of Sight high bandwidth LPI/LPD network for short range control of autonomous vehicles	Enable control of unmanned ground vehicles at short ranges without enemy detection	Network aware radios which adjust power and bandwidth depending on conditions
Bryan Freeman PfM GCES	C4ISR	C2 in a Degraded Environment	Command and Control	Integrate USMC and Navy fires kill chain	Integrate Naval Fire Network with AFATDS for the Naval Strike Missile and OPF Loitering Munitions	
Bryan Freeman PfM GCES	Advanced Autonomous Systems	Long Range/Precision Fires	Force Application	Command a platoon of unmanned fires platforms as a single unit. These platforms include unmanned ground missile launchers, unmanned surface vessels with loitering munitions, and between airborne loitering munitions. This is commonly called swarming	Increased firepower provided by each fire team with the same number of personnel.	Command/Control architecture which enables one firing platform to receive direction and direct the other platforms without intervention by the firing platoon. Tasks include maneuver to location, establishing firing position, firing weapons on command, and coordination of end game attack between each airborne weapon.

Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range/Precision Fires	Force Application	Self location In GPS denied environments	GPS is required for nearly all aspects of a call for fire. If GPS is denied (A2AD or environmental considerations), the ability to execute calls for fire and air support is severely diminished. Self location is required to develop and knowledge of all battlespace entities (including friendlies) for situational awareness.	On Demand Digital Surface Model would provide high resolution mensurated imagery to all users computed on-demand at the needed location. This technology would also benefit from the ability to accept and process new imagery as it is collected. A visual positioning system would allow the computation of the location of camera (user) and all locations in the scene (targets) automatically. A radio timing waveform would allow computation of the position of a radio (and user) based upon the location of other radios on the network. If one radio knows its location, all radios know their locations - this could be accomplished via traditional surveying means or imagery.	
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Close Combat Lethality	Battlespace Awareness (Intel)	Sensor blending	Provide ability to blend scene from different sensors (Visible, SWIR, MWIR, LWIR) to provide better situational awareness	- Advanced coatings on lenses to allow multiple wavelengths through one channel - Locate "key markers" in each frame to help overlay images	
Bryan Freeman PfM GCES	Preparedness for War	Logistics	Logistics	Improved Affordable Battery for Loitering Munitions	Current and near-term future small loitering munitions utilize Li-ion battery technology. These need to be charged regularly, including aboard ship. Recharging represents a potential safety hazard and required time and effort. What is needed is a long shelf life non-rechargable electrical energy source which is affordable and safe to store.	LiSO4 battery technology Thermal batteries	
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Force Application	Image/beam stabilization	Improves handheld recognition/designation range and reduces carry weight by removing tripod	-MEMS gyros - mathematical algorithms to predict handheld jitter	
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Force Application	Target tracking	Provide ability to designate/direct fire at moving targets	- Machine learning based off of current targets speed/direction to predict location in next frame	
Bryan Freeman PfM GCES	C4ISR	C2 in a Degraded Environment	Command and Control	Beyond Line of Sight high bandwidth LPI/LPD network for communications between ground and/or surface craft and loitering munitions at range	Enable control of weaponized UAS without enemy detection	Network aware radios which adjust power and bandwidth depending on conditions	
Bryan Freeman PfM GCES	C4ISR	C2 in a Degraded Environment	Command and Control	Beyond Line of Sight high bandwidth LPI/LPD network for communications between ground and unmanned surface craft at very long ranges (>500 km)	Enable control of unmanned surface vehicles without enemy detection	Network aware radios which adjust power and bandwidth depending on conditions	
Bryan Freeman PfM GCES	Advanced Autonomous Systems	Long Range/Precision Fires	Force Application	Loitering Munition 'Dash Mode' to enable rapid delivery from launcher to target area	Increase responsiveness and survivability	Drop-off rocket booster, restartable rocket motor, non-electric variable output propulsion such as turbofan engine.	
Bryan Freeman PfM GCES	Advanced Autonomous Systems	Long Range/Precision Fires	Force Application	Loitering Munition Anti-Ship Warhead/Payload	Increase effectiveness of OPF loitering munition against surface vessels	Reactive material warhead, EW, EMP effects	
Bryan Freeman PfM GCES	C4ISR	Information Warfare	Force Protection	Enhance threat identification capability, all through the automation, correlation and fusion of the sensor and intelligence data in the TPC	Increase the efficiency and effectiveness of fires for effect.	Utilize the existing TPC RADARS and GCFS acoustic systems data to create a common picture including munitions tracks, firing positions, and other data to speed up decision making, increase confidence in the combined sensor data, and reduce time to call for fire.	
Bryan Freeman PfM GCES	Joint Lethality in Contested Environment	Long Range/Precision Fires	Battlespace Awareness	Automated targeting decision aids that will consider everything known about a target, everything known about the surrounding location and rules of engagement to optimize recommended actions in the TPC	Improve timeliness and appropriateness of decisions-making and other responses.	Utilize the existing TPC RADARS, GCFS acoustic systems, AFATDS data, Intel sensors, HUMINT, and the like to create a picture of the battlefield situation to assist in rapid decision making.	
Portfolio Manager (PfM), Logistics and Combat Support Element Systems (LCES)							
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Light Weight Ammunition Packaging	Ammunition packaging takes up significant percentages of the weight and volume being transported throughout the entire USMC enterprise. Lighter and more compact options would have an immediate impact in carrying more ammuition or increasing transportation methods.	1. Composite or Plastic containers that can withstand the current metal container requirements 2. interlocking containers to eliminate overpack materials such as wood boards, wire, etc.	Ammo

Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Bulk Fuel Movement, Ship-to-shore connector	Provide bulk fuel deliveries to the beach, or at off-shore way points, in contested environments, in support of distributed operations.	1. Composite ISO containers, containing fuel bladders and pump systems, that can be towed to the shore, transported on LCAC/LCU/other, or anchored to the sea floor. 2. Heavy duty fuel bladders that can be towed, transported on LCAC/LCU, or anchored to the sea floor. 3. Fuel foraging/scavenging.	Engineer Systems
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Improve standoff explosive threat detection, mitigation and neutralization capability. To inlcude obstacles.	Allow operators to find mines or IEDs, prevent casualties and collect forensic data. Detect, breach or clear explosive threats in the littorals and up to in-land objectives during mounted and dismounted operations. To enable amphibious and ground maneuver.	1. Stand-off detection of mines and minefields in the surf zone. (Neutralization or mitigation?) 2. Mitigate and/or neutralize mines in the Surf Zone and Beach Zones. 3. Stand-off detection capabilities of explosives or explosive precursor components. 4. Improved ground penetrating radar or other detection means of locating IEDs and triggering mechanisms. 5. Autonomous IED detection capabilities. 6. Submerged lane clearance and proofing systems. 7. Precision navigation tools to permit maneuver through mine fields both in the surf zone and in-land.	Engineer Systems
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Man portable and low power water purification	Reduced size, weight and power requirements for water purification and reduced water supply logistics burden.	1. Small unit water purifier that removes heavy metals and salts for very lightweight, very low power potable water production. 2. Lightweight energy efficient gray water recycling. 3. Light weight energy efficient desalination system for potable water production. 4. Lightweight energy efficient black water recycling.	Engineer Systems
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Logistics	Logistics	Improve Expeditionary Advanced Bases (EAB) energy efficiency	SECNAV & CMC directive for Operational Energy Awareness/Demand Reduction. Improved energy generation, storage, and distribution for small units. Support Distributed Maritime Operations (DMO) and Littoral Operations in a Contested Enviroment (LOCE)	1. Optimizing power distribution and load leveling on EABs through intelligent systems. 2. Light weight modular/scalable energy storage units for use with mircrogrids and small hybrid power systems. 3. Multi-fuel heating and power generation systems. 4. Shelters with increased insulation, reduced cube and weight, and integrated passive cooling. 5. Ultra-lightweight and compact renewable power solutions. 6. High energy density batteries with "zero-voltage" drop, small cube and light weight. 7. Power foraging/scavenging. 8. Fuel foraging/scavenging. 9. Scalable energy storage.	Engineer Systems
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Logistics	Logistics	Improve energy efficiency for dismounted Marine Forces in distributed operations	SECNAV & CMC directive for energy efficiency and reduced weight.	1. Improved small flexible solar panels. 2. Renewable power options for non-desert and covered locations. 3. Ultra-lightweight and compact renewable power solutions. 4. Extended life batteries. 5. Reduce fossil fuel usage and batteries needed to conduct and support ground operations through intelligent controllers and metering/monitoring systems. 6. Composite rigid-wall shelters to reduce weight, and reduce fossil fuel consumption for transport, heating and cooling.	Engineer Systems
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Increase Mine/IED neutralization standoff	Provide more standoff distance to minimize casualties.	1. Small, light weight pre-detonation capabilities that are scalable. 2. Autonomous C-IED systems. 3. Autonomous littoral mine detection and neutralization	Engineer Systems
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Expeditionary survivability/construction at multiple, and austere, EABs.	Ability to rapidly construct and repair battle positions for force projection and protection.	1. rapidly construct, emplace and reconstitute hardened and survivable battle positions. 2. Expeditionary, autonomous construction and material equipment.	Engineer Systems

Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Battle Damage Assessment and repair of landing and operating surfaces, bridges, and road surfaces.	Ability to ensure landing and operating spaces are available to support flight operations. Ability to inspect bridges for use. Identify road damage prior to use, or ahead of vehicle movement.	1. UAS to survey BDA and identify sites in need of repair. 2. UAS mounted LIDAR and GPR sensor packages to determine extent of damage and provide early identification for repair needs. 3. Combined UAS/UUV capabilities in single platform capable of inspecting locations under water an in the air.	Engineer Systems
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Force Support	Combat Casualty Care	Provide, and improve, advanced casualty care to greatly improve battlefield treatment, prolonged field care, extended patient handling, and evacuation over long-distances. Provide decision tools to act as "force multipliers" for medical personnel.	1. Acute care devices that provide a reduced size, weight and power, and are capable of being used in all operational environments including aircraft. 2. Hand-Held, ruggedized blood, water and airborne pathogen surveillance/detection. 3. Blood, plasma, reagents and vaccine refrigeration devices that provide a reduced size, weight and power, and are capable of being used in all operational environments. 4. Rapid resupply of medical consumables and blood products via UAV. 5. Local/Remote inventory level monitoring and automated resupply request for medical consumables. 6. Freeze-dried Plasma that requires no refrigeration, long-shelf life, fast reconstitution, durable or rugged packaging. 7. Medical Common Operating Picture. 8. Medical Decision Tools. (AI and ML) 9. Standardized training tools.	Supply & Maintenance Systems
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Logistics	Advanced diagnostic and repair capabilities in distributed and denied environment	Permit Marines to repair and maintain systems when there is no availability of technical support and depot-level repair	1. Built-In-Test features 2. Common small, lightweight, diagnostic tools. 3. Predictive maintenance tools. 4. Advanced tools and kits for repairs	Supply & Maintenance Systems
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Force Application	Extend transparent armor useful life and reduce weight/cost	Reduced life cycle Operational and Support (O&S) cost required to replace the glass (every 2-3 years); reduced vehicle downtime, increased readiness, and reduced maintenance.	Use of alternative materials and bonding technology, in order to reduce or eliminate de-lamination problems, increase resistance to rock strikes and other projectile damage.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Improve vehicle mobility, safety and ride quality	Reduce roll over, improve soft soil mobility and increase operational tempo in order to achieve positional advantage across the battlefield.	1. Optimizing Vehicle Cone Index (VCI) 2. Increasing the low-end acceleration.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Reduce tactical vehicle weight	Tactical vehicle weight reduction has the potential to increase our expeditionary capability by: 1) Reduce transportation requirements by lightening the load. 2) Increase vehicle payload weight capacity. 3) Reduce wear on the dynamic components and increasing Reliability, Affordability, Maintainability (RAM) and decreasing total life cycle cost. 4) Increase fuel efficiency and reducing required fuel convoys.	Potential technologies to reduce weight of tactical vehicles include composite materials, lightweight armor and nanotechnology.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Force Application	Improve vehicle and crew survivability	Reduce injuries resulting from Improvised Explosive Devices (IEDs), EFPs and RPGs	Underbody protection, seats, blast mats. Side protection lighter protection. Active protection.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	C4ISR	C2 in a Degraded Environment	Force Application	Provide tactical vehicle plug and play Command, Control, Communications and Computers (C4) architecture	The development of tactical vehicle communication architecture standards and data fusion would increase compatibility among vehicles, ease logistics by reducing the number to dissimilar spare parts and aide in the development and design of future tactical vehicles.	Common well defined interfaces as well as power and thermal management technologies in order to maximize the efficiency and interoperability of communications gear within tactical vehicles.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Joint Lethality in Contested Environment	Protected Mobility/Enhanced Maneuver	Force Application	High fidelity vehicle blast modeling capability	A high fidelity modeling capability will reduce test costs and reduce risks to vehicles in a changing threat environment.	High fidelity models and blast testing for validation.	Light & Medium/ Heavy Tactical Vehicles

Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Logistics	Increase tactical vehicle fuel efficiency	Meets Secretary of the Navy (SECNAV) & Commandant of the Marine Corps (CMC) directive for energy efficiency. (Reduces fuel costs, decreases required convoys, extends the tactical reach of the Marine Air-Ground Task Force (MAGTF)).	1. Propulsion improvements, weight reduction, lightweight materials/components and drive train improvements. 2. Efficient Auxiliary Power Units (APUs) for silent watch missions instead of vehicle idle. 3. Improve vehicle power and thermal load management.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Force Application	Longer lasting CARC Coatings, Greases, New Coatings for Corrosion Mitigation	Decrease Maintenance and WIR of Assets due to corrosion	improved coating processes for new acquisitions and new processes for maintenace. Coatings on smaller components. Greases	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Low-cost armor steels for tactical vehicles that are not prone to environmental cracking like the steels currently in use for tactical vehicles (JLTV, MRAP). Cheaper Armor Solutions	Reduce sustainment and replacement costs of critical armor by extending life-cycle, reducing environmental impacts to armor materials. Improvement in vehicle readiness. And developing new low cost armor solutions.	Revised steel armor specifications (MIL-DTL-46100) with additional test(s) to identify materials that are less susceptible to environmentally assisted cracking. Processing/integration, guidelines (cutting, bending, and welding) to enable successful integration of armor steels into vehicle structures.	Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Forward Force Maneuver and Posture Resilience	Protected Mobility/Enhanced Maneuver	Force Application	Improved Tires. Run flats are heavy reducing payload and increasing wear and tear on suspension and powertrain.. Tires for CTIS are susceptible to punctures.	Development of Tire that meets CTIS requirements but are more robust for punctures or are self sealing and run flat tires for lightweight vehicles.		Light & Medium/ Heavy Tactical Vehicles
Dave Keeler PfM LCES	Resilient and Agile Logistics	Logistics	Force Application	Second Source Parts Reverse Engineering	Reduced Part costs due to second source	Parts that are showing a high demand that go to single source of supply we send out for reverse engineering. Note government cannot have drawings of the parts that state proprietary. (need to discuss with IP lawyer	Light & Medium/ Heavy Tactical Vehicles
Program Manager (PM) for Training Systems (TRASYS)							
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Mobile communication network for Force on Force Training	A high bandwidth, low cost mobile communication network that accommodates video, audio, Position Location Information, text messages and multi-cast messages from 2500 players during Force on Force training.	Use of Long Term Evolution Advanced (LTE-A) to achieve 4G / 5G speed	
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Outdoor Force on Force Training	Provide Force on Force training to the War Fighter in challenging environments (dense foliage, stand-off distance, partial obscuration of target, …), challenging weather (heavy, snow, sand storm, …), and realistic battle damages caused by the weapons. Current USMC Force on Force training systems, Instrumented Tactical Engagement Simulation System (I-TESS) use laser transmitter to simulate weapons projectiles for the fly out and adjudication of damage to the target. The effectiveness of ITESS is greatly reduced due to the impact of environments, weather and due to the limitation of the laser technology itself to accurately simulate battle damage.	Fusion of multiple data source (visual data from camera, GPS data, laser data) to improve accuracy and range of simulated indirect fire and small arms weapons	
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Head Mounted Display for Outdoor Force on Force Training	A light weight, ergonomics Head Mounted Display, used as Augmented Reality training device for the Joint Terminal Attack Controller (JTAC) and Forward Observer (FO).at UMSC training ranges. The desire is for the HMD to operate in an outdoor environment with limited terrain features.	None Known	
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	GPS Denied Force on Force Training	A lightweight, man worn, self-coordinate generating module producing position location information with a high degree of accuracy and precision in environments where GPS signals degrade below usable levels.	Fusion of multiple data sources (accelerometers, gyroscopes, and magnetometers) and Kalman filter fusion to improve position location for dismounted Marines.	
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Immersive Outdoor Targets	Provide targets that create a realistic, immersive environment for the War Fighter during range training exercises.	Incorporate aural and visual cues with battlefield effects and shootback capability into live fire ranges and targets.	
Rachael Germansky PM TRASYS	Preparedness for War		Force Support	Indoor and Outdoor Holographic Targets	Provide realistic targets are more immersive and have a lower sustainment cost.	Aerial Burton Laser Plasma Holograph	

Program Manager (PM) Marine Corps Cyber Ops (MCCO)						
PM MCCO				Cyber data standardization. Data standards for data derived from many data sources in a form useful in development of Artificial Intelligence system.	The amount of data acquired in cyberspace far exceeds the ability of an analyst to review and is often in a form only interpretable by machines. Data standardization is the first step to havign clean data, which is a prerequisite to developing Artificial Intelligence systems, which is a prerequisite to automating traditionally manual tasks.	Review existing best practices in the context of USMC METs in cyberspace to identify tasks best suited for automation. Once specific tasks are identified, data and standards which support automation of those tasks can be established.
PM MCCO				Artificial labeled cyber data generation.	Provide requisite amounts of labeled cyber data for use in the development of AI algorithm. Facilitate automation of manual analyst tasks.	Leverage and modify existing PCTE/JCTE architecture to generate synthetic labeled datasets.
PM MCCO				Cross-domain training of cyber ML algorithms.	Removes the burdon of identifying and labeling datasets for use in production AI systems. Speeds development and delivery of AI systems.	Identify and evaluate domain adaptation algorithms best suited for ingest of cyberspace data
Marine Corps Tactical Systems Support Center (MCTSSA)						
Dr. James Baker MCTSSA	Preparedness for War	C2 in a Degraded Environment	Battlespace Awareness	Ability to utilize digital waveform techiques to achieve higher data throughput in the HF frequence band (3-30 MGz)	Increased data throughput of current HF Radio technology	- Develop antennas with higher availible bandwidth capability in the HF frequence band. - Develop advanced digital waveforms for achieving higher throughput.