



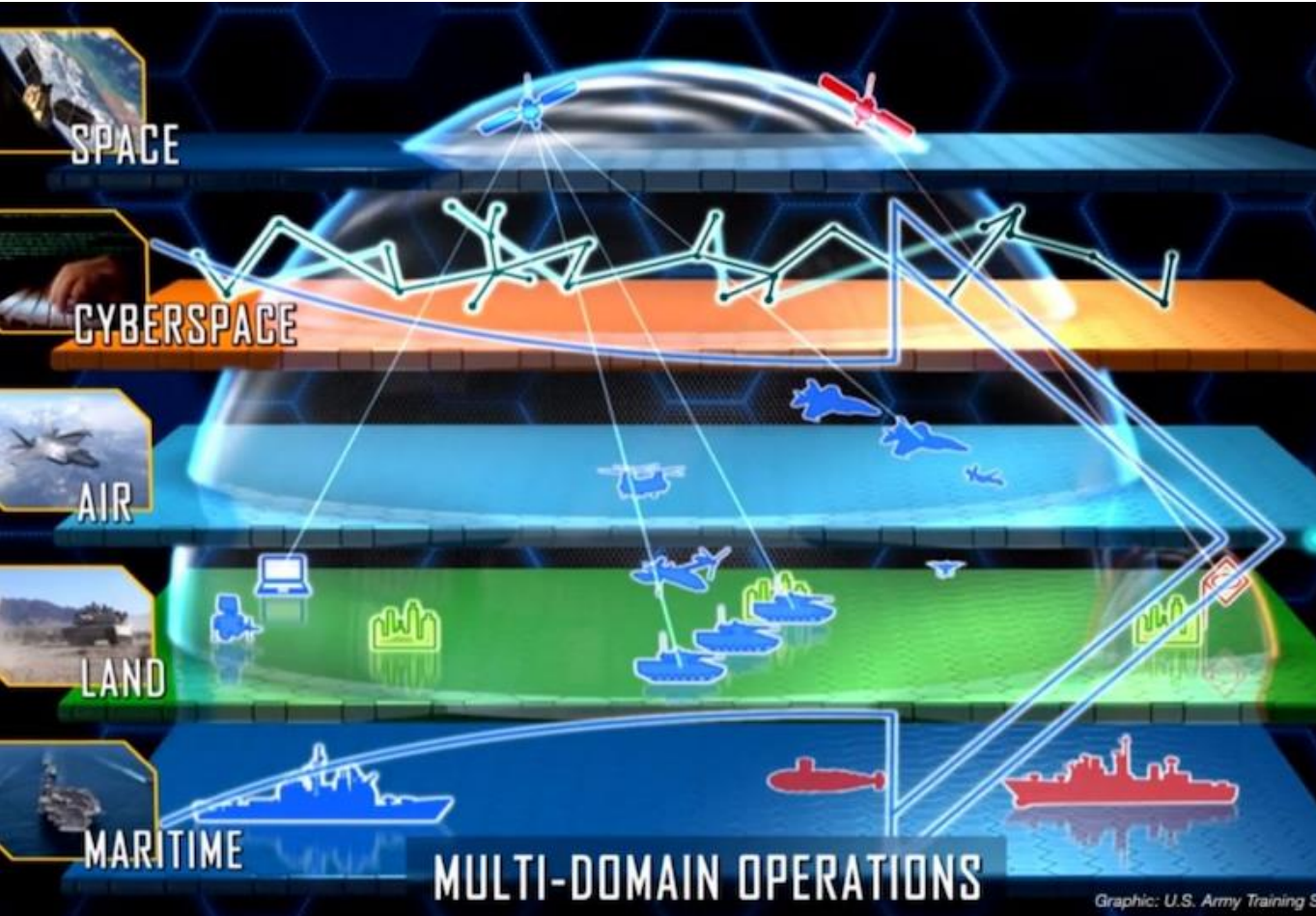
Doolittle Institute Technical Showcase Multi-Domain Weapons Technologies – Part II: Tailorable Trajectories

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Multi-domain operations (MDO) are military operations across all domains, enabled by integrated systems and strategies

Operations are dynamic, complex and engage multiple operational nodes



NATIONAL DEFENSE STRATEGY: THREE CORE TENETS

Integrated deterrence

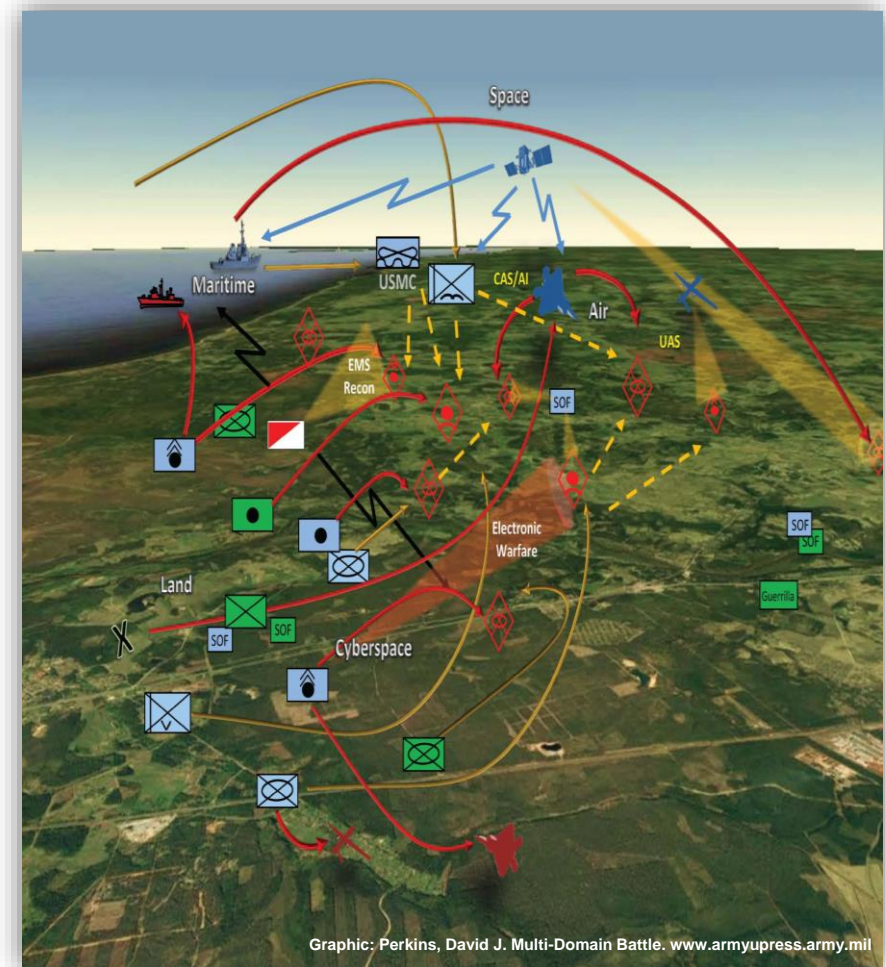
- Deter adversaries by synchronizing efforts across warfighting domains, regions and the spectrum of conflict in conjunction with all instruments of U.S. national power

Campaigning

- Sequencing logically linked military activities to shift the security environment in favor of the United States

Building enduring advantages

- Accelerating DoD modernization for the future fight



Source: Association of the US Army



KEY ENABLING TECHNOLOGIES FOR INTEGRATED DETERRENCE AND CAMPAIGNING

Enable long duration operations for real-time target discrimination and identification, tracking, aim-point selection, prosecution

- Advanced Fire-control/propulsion coupling
- Advanced data collection and processing
- Next generation dynamic propulsion technologies
- Novel initiation, energetics, and tailorable trajectories

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Dynamic Fire control/propulsion coupling, Advanced Data Analytics, Next Gen Propulsion



On-the-fly discrimination and targeting using fusion of sensor and effector information

- Power hungry – multiple modalities for sensing, discriminating, prosecution – two-way communications between all nodes and commanders
- Latency – need real-time sensing and battlefield mapping, analysis, decision making, communications to command and other nodes
- Robustness – AI/computer vision challenges; spoofing, miscalculations, weather, contested areas, etc.



Deeper fires, Extended Ranges and Durations



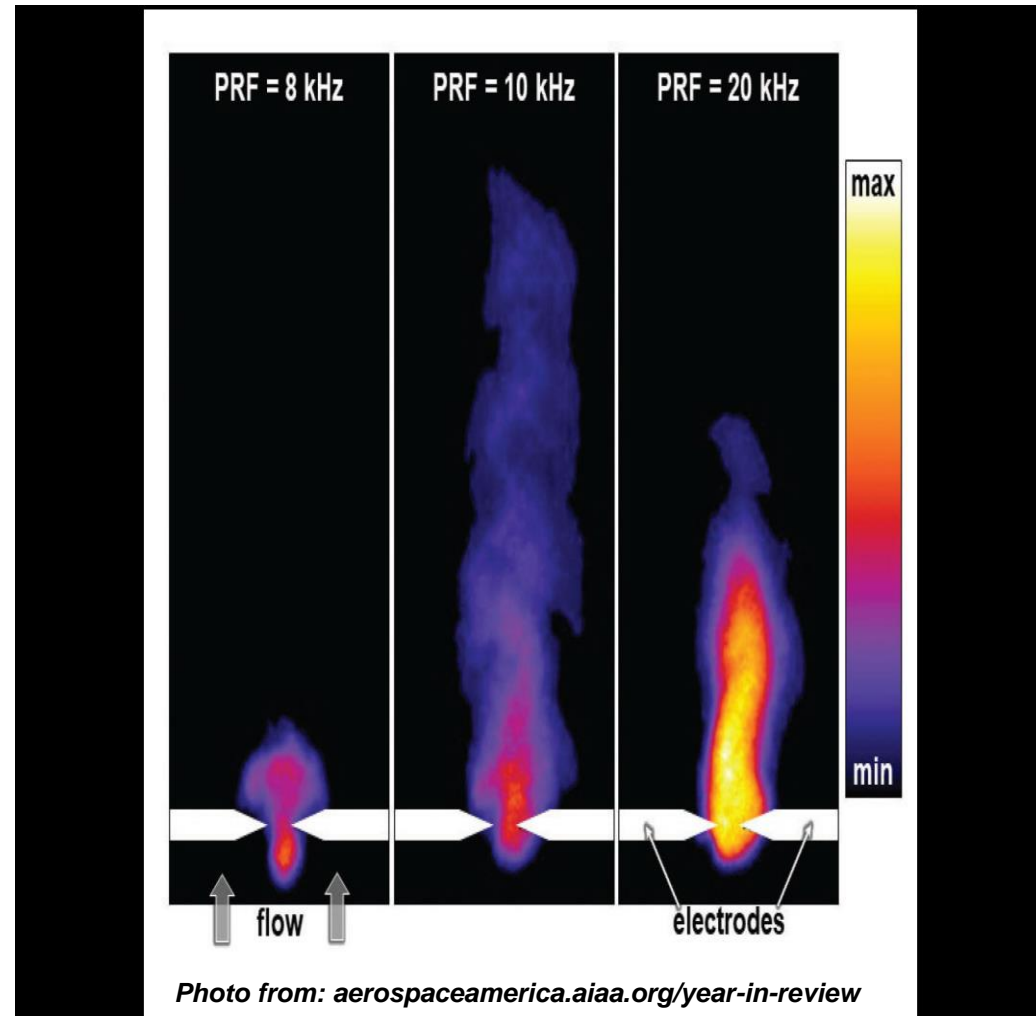
- Survivability/Robustness – Estimate initial trajectory conditions; adapt for counter-measures, battlefield, nodes
- Range - typically constant burn rate, initiated at launch; size scales with duration – limits other capabilities
- Terminal Engagement - Need maneuver authority to close with target; must have reserve power to engage
- Adapt - Modify trajectory to close with dynamic targets using modular propelling charges and rocket motors

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NOVEL INITIATION, ENERGETICS, AND TAILORABLE TRAJECTORIES

- Ignition adapts during trajectory, terminal maneuvers and target engagement – temporal and spatial
- Not just fixed firing tables and sensing: on-board analytics to determine muzzle velocities combined with assets and battlefield mapping to achieve desired outcomes
- Extended range and duration of travel enabled by intelligent propulsion, burn rates and on-board fire control for target prioritization and prosecution

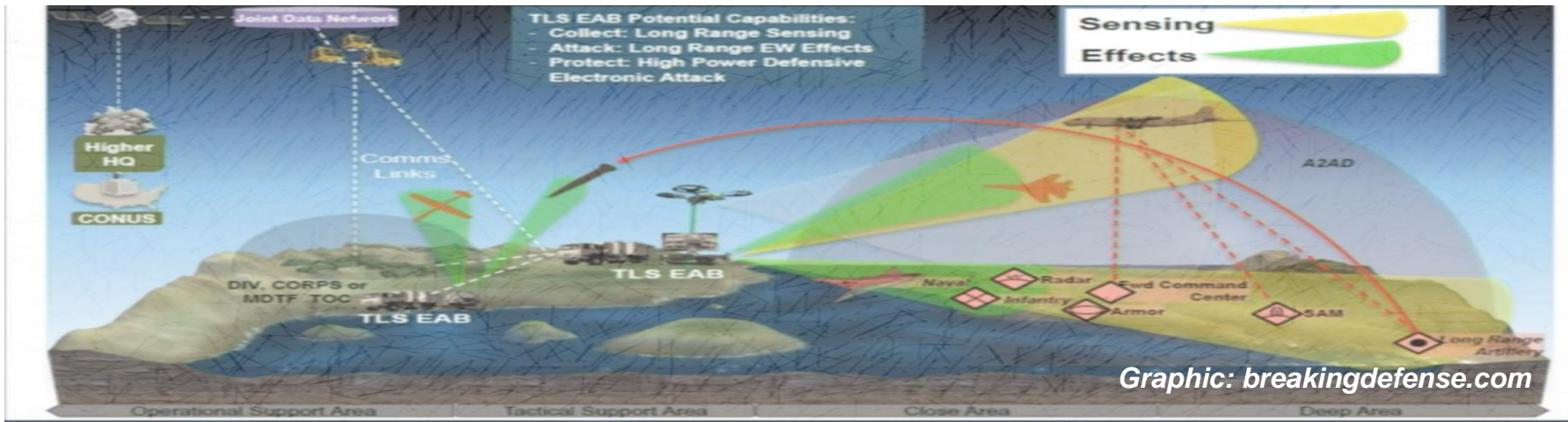




Unclassified CONCLUSION



- Component technology development and system integration is critical to transforming the military landscape
- Jumping down the path of buzzy technologies like AI/ML may not be the cure all; attention to simple countermeasures of denial, deception and camouflage during design and integration is critical.
- System must be robust to loss of nodes, communications, etc
- System must be modular, inter-operable and stand-alone capable



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