



U.S. ARMY TANK AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

Winning in Close Combat:

Leveraging Autonomy for Multi-Domain Battle

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Winning in Close Combat: Ground Forces in Multi-Domain Battle

What we've observed

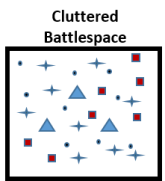
Changes in the Character of War

Lethal, Contested, Complex Operations

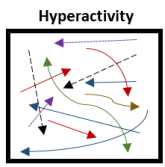
- ❑ Hybrid adversaries ... regular, irregular, criminal, terror ... contesting all domains (Land, Maritime, Air, Cyber, Space)
- ❑ Potential for overmatch ... proliferation of capabilities and technology... increased lethality and range; long range precision fires and massed fires (Stand-off)
- ❑ Operations among populations in complex terrain ... including dense urban
- ❑ Proliferations of WMD, cyber, and space capabilities
- ❑ Information influences actions and decision making...increased speed of human interaction
- ❑ Adversaries seek to avoid U.S. strengths, remain illusive, and exploit U.S perceived weaknesses
- ❑ Increased efforts to develop artificial intelligence (AI) and autonomous systems; off-the-shelf technologies in use

Out-gunned, Out-ranged, Out-protected, Outdated, Out of Position

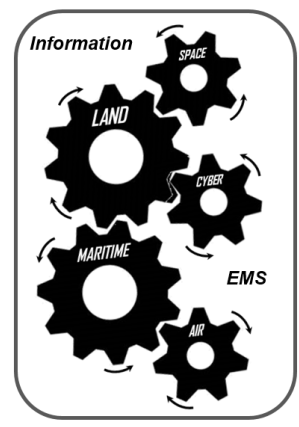
Creates a Battlefield that is...



Mix of military and civilian personnel, facilities, and equipment makes effective targeting challenging. Urban environments may often be cluttered.



Sensors and precision weaponry enable dramatically faster, more intense, and lethal operations.

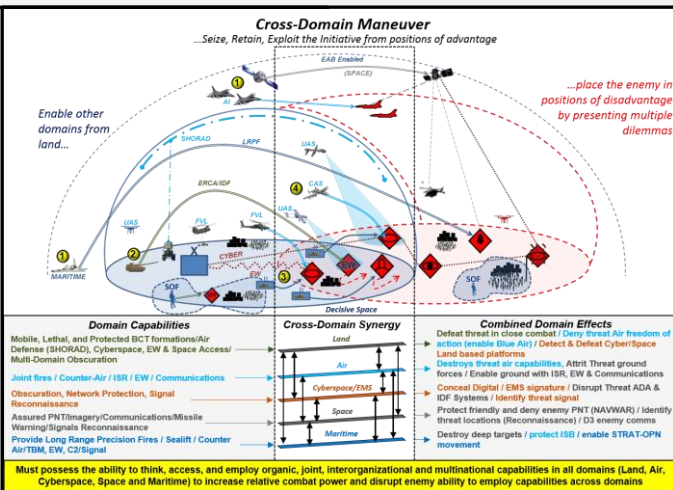
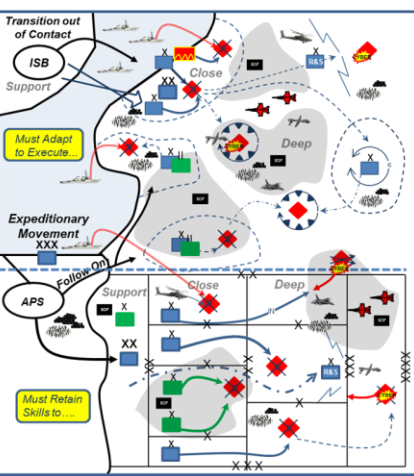


What will happen

- ❖ Transregional "hybrid" threats operate in varying OEs, leaving no safe havens, and increased complexity in dense urban areas
- ❖ The range of actors and availability of mass communications on the battlefield increase complexity and velocity of human interaction
- ❖ Increased speed of actions occurring in all domains; often times simultaneously
- ❖ Hyperactivity challenges ability of EAB commanders to manage pace and tempo of actions in the OE
- ❖ Decisive space shifts between domains throughout conflict
- ❖ Communications becomes degraded for periods of time
- ❖ Battlefield becomes more lethal, fluid, and dispersed challenging sustainment, mission command, situational understanding as well as human endurance and unit resiliency
- ❖ Battlefield frameworks and operations assume more nonlinear constructs
- ❖ Decision making is either decentralized to allow for rapid adaptation to changes in the OE or opportunities are lost
- ❖ AI and autonomous systems will fundamentally change the character of war

What we must prepare to do...

BLUF: As part of the Joint Force, Army forces deploy and transition rapidly from expeditionary movement to cross-domain maneuver with combined arms formations that operate semi-independently, enabled by mission command, to conduct joint combined arms operations and seize, retain, and exploit the initiative; defeat enemy forces; and achieve operational objectives consistent with national objectives.



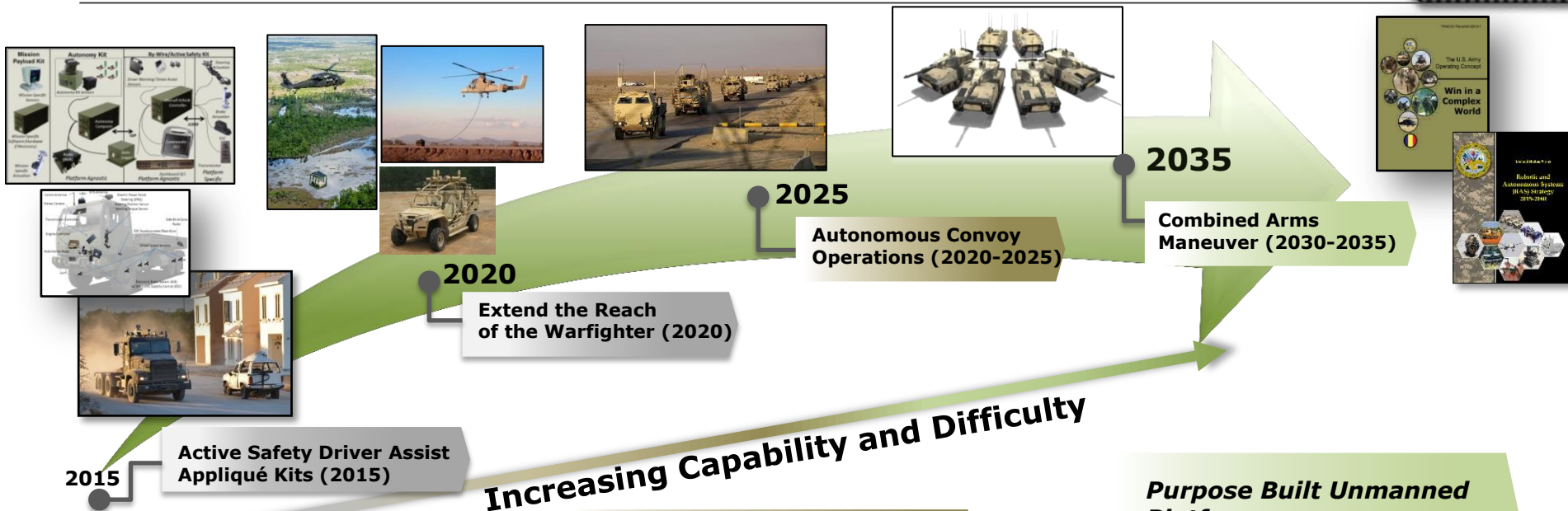
4 Components of the Solution:

- ❑ Conduct Cross-Domain Maneuver
- ❑ Operate Semi-independently
- ❑ Conduct continuous Integrated Reconnaissance and Security Operations across domains and echelons
- ❑ Execute Mission Command



*Illustration

Autonomous Systems Strategic Capability Progression



Increasing Capability and Difficulty

Near Term Capabilities



Fully Integrated Kitted Solutions

- Fault-Tolerant Architectures
- Enable unmanned cargo delivery
- Enhanced Platoon, Squad, and Soldier situational awareness.
- Autonomy augments the Solider

Mid Term Capabilities

Autonomy Augmented Legacy Systems



- Remote Lethality
- Semi-Autonomous Mobility
- Man/Unmanned Teaming Capability on legacy systems
- Autonomy as a force multiplier

Far Term Capabilities

Purpose Built Unmanned Platforms



- Advanced machine learning
- Enable manned and unmanned teaming in both air and ground maneuver through scalable sensors, scalable teaming, Soldier-robot communication, and shared understanding
- Autonomous system operates as team member



Soldier Involved Experimentation & Modeling



Balancing Physical and Virtual Soldier Assessments to Develop Next Generation Capabilities