Tactical Technology Office

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Breakthrough Technologies for National Security

DARPA's Portfolio Today

Diminishing returns for monolithic systems

Information is exploding

First-mover advantage

Rethink complex military systems

- Electromagnetic spectrum dominance
- Position, navigation & timing beyond GPS
- Air superiority in contested environments
- Maritime system of systems
- Robust space
- Overmatch on the ground
- Defense against mass terrorism

Harness information

- Scalable cyber capabilities
- Electronics with built-in trust
- Big data tools
- Next-generation AI

Create technological surprise

- Outpacing infectious disease
- Neurotechnologies
- Synthetic biology
- Chemistry, physics, math, materials
- Understanding complexity
- Human-machine symbiosis

These focus areas are part of a broad and diverse portfolio of DARPA investments
Focus areas change over time as some succeed and others fail and as DARPA identifies new challenges and opportunities

DARPA Technical Offices

BTO
BIOLOGICAL TECHNOLOGIES OFFICE

- Biological Complexity at Scale
- Neurotechnologies
- Engineering Biology
- Restore, Maintain and Improve Warfighter Abilities

DSO
DEFENSE SCIENCES OFFICE

- Math, Modeling & Design
- Physical Systems
- Human-Machine Systems
- Social Systems

I2O
INFORMATION INNOVATION OFFICE

- Empower the Human within the Information Ecosystem
- Guarantee Trustworthy Computing and Information

MTO
MICROSYSTEMS TECHNOLOGY OFFICE

- Electromagnetic Spectrum
- Tactical Information Extraction
- Globalization

STO
STRATEGIC TECHNOLOGY OFFICE

- System of Systems (SoS)
- Battle Management/ Command and Control (BMC2)
- Communications and Networks (C&N)
- Electronic Warfare (EW)
- Intelligence Surveillance, and Reconnaissance (ISR)
- Positioning, Navigation, and Timing (PNT)

TTO
TACTICAL TECHNOLOGY OFFICE

System Focus Areas:

- **Ground**
- **Maritime**
- **Air**
- **Space**

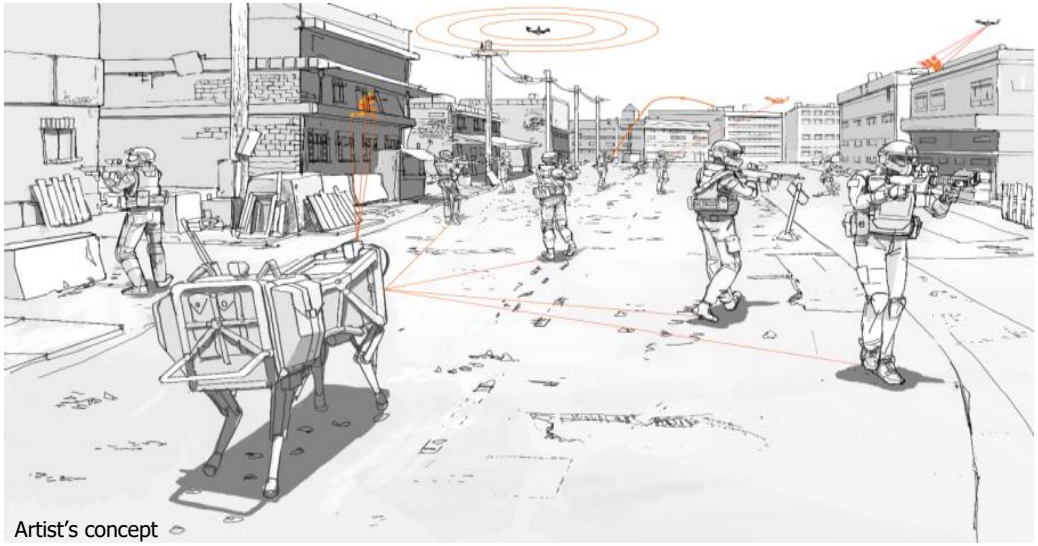
Crosscutting Themes:

- **Agile Development**
- **Cooperative Autonomy**
- **Unmanned Systems**
- **Power and Propulsion**

Enabling Light, Mobile Forces

- Extend and enhance the situational awareness of small units
- Enable rifle squads to shape and dominate their battlespace (kinetic and non-kinetic)
- Modular unmanned logistics and transport to the tactical edge
- Improved detection range, accuracy and robustness
- Unit level improvements for all operations phases

Shaping the Present


Artist's concept

Squad X
Goal: New capabilities and unit-level experimentation

Creating the Future

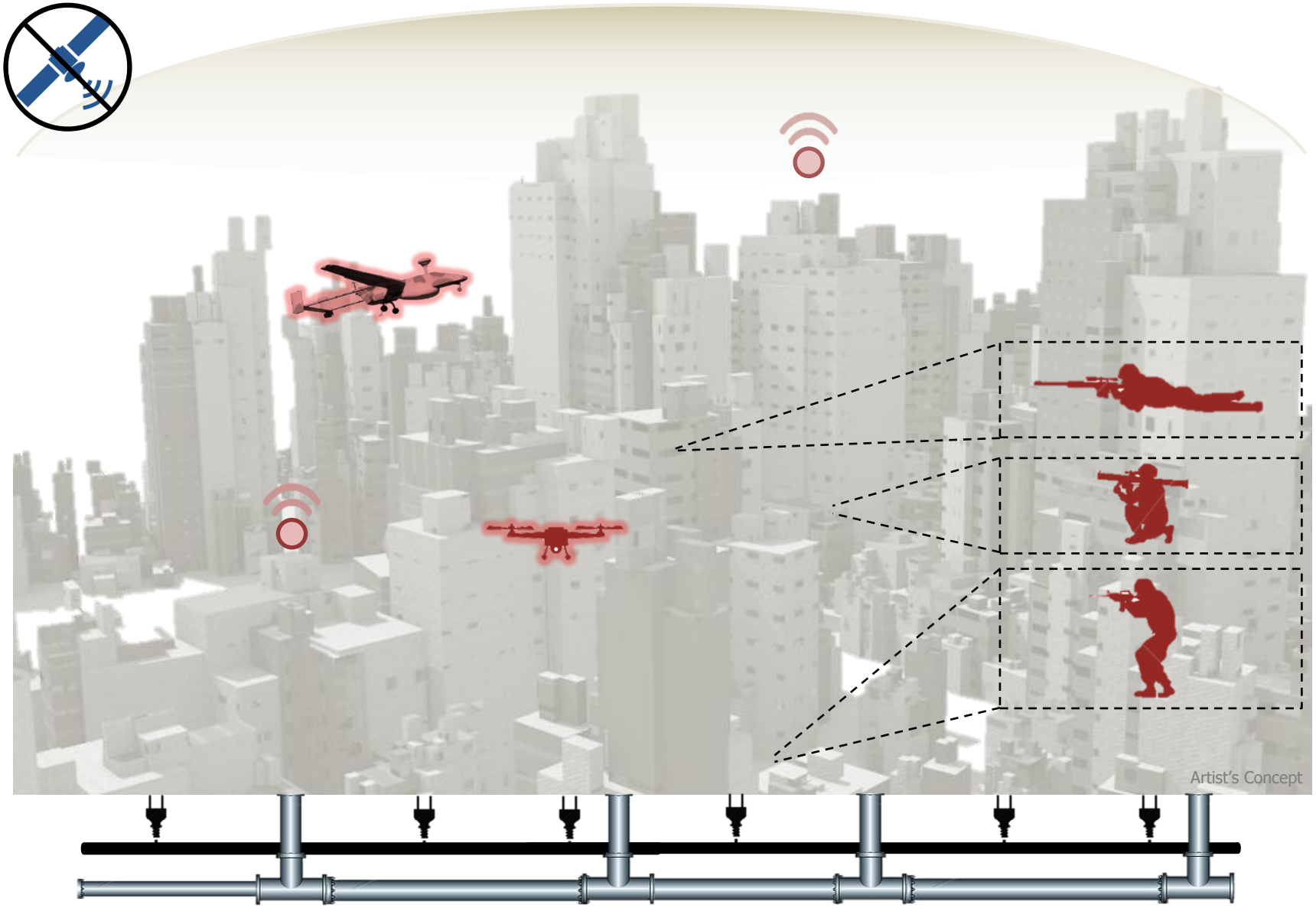
Ground Experimental Vehicle Technologies (GXV-T)
Significantly improving mobility without sacrificing survivability


Artist's concept

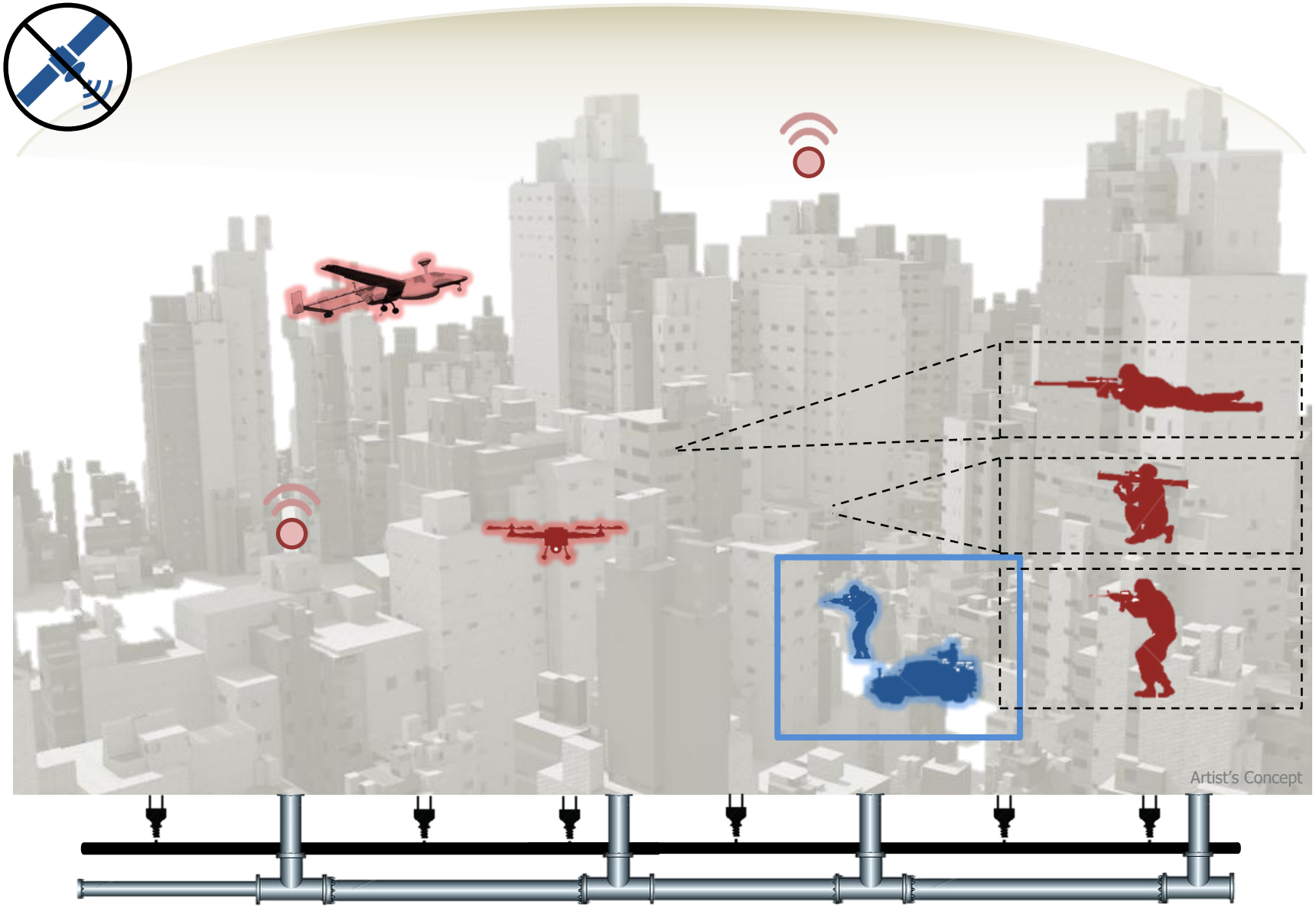

Artist's concept

Aerial Reconfigurable Embedded System (ARES)
Goal: Enhance the effectiveness of small units

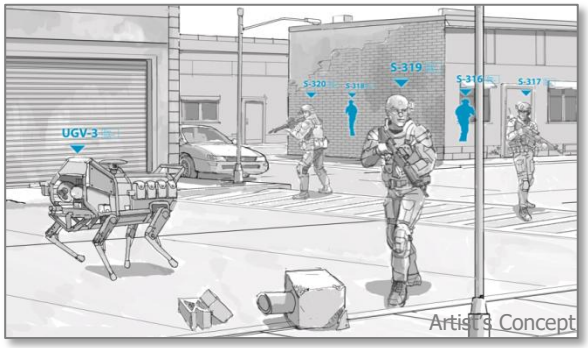
Future Battlespace: Complex Urban Environments

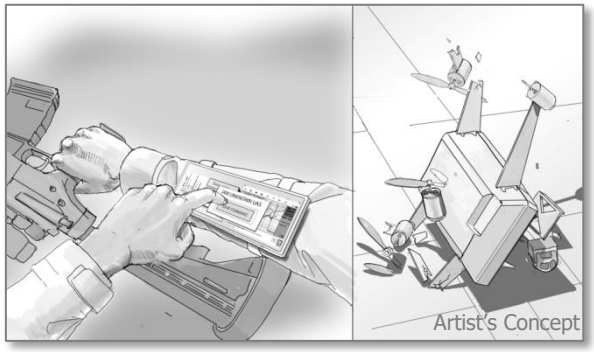


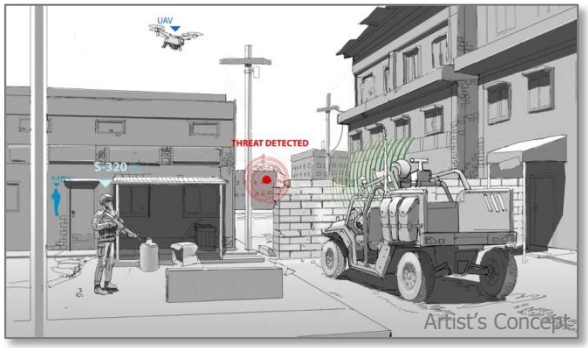
Future Battlespace: Complex Urban Environments



Squad X Portfolio







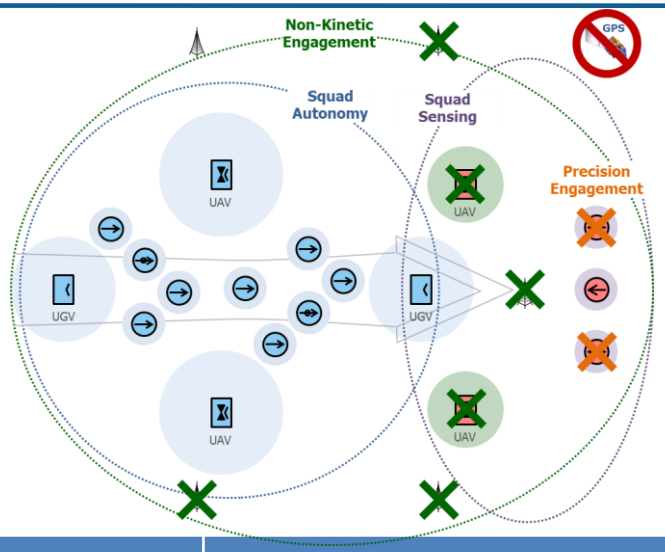
Vision:

- Extend and enhance the situational understanding of the Squad to its entire operational environment
- Increase the Squad's maneuver time and space through optimized use of their physical, cognitive, and material resources
- Enable the Squad to shape and dominate their operational environment through synchronization of fire and maneuver in the physical, electromagnetic spectrum, and cyberspace domains

Objective: Squad X seeks to design, develop, and validate system prototypes for a ***multi-domain*** combined arms squad. Squad X will overmatch its adversaries through the ***synchronization*** of fire and maneuver in multiple domains.

Enhanced manned/unmanned teaming one aspect of
Squad X Core Technologies (SXCT) and Squad X Experimentation programs

Squad X Core Technologies (SXCT)



Purpose:

- Develop new organic technologies for the rifle squad that:
  - Give dismounted squads enhanced situational awareness
  - Enable them to shape and dominate their battlespace
- Provide a basis for future system development efforts through modeling, simulation, and baseline experimentation

Key Technologies:

- The four technical areas are: Precision Engagement, Non-kinetic Engagement, Squad Sensing, and Squad Autonomy
- The program end state is a set of capabilities (live and in hardware-in-the-loop simulation) that individually demonstrate significant potential to augment the dismounted squad
- Potential transition partners include: USA Maneuver Center of Excellence, USA RDECOM, PEO Soldier, Office of Naval Research, Marine Corps Warfighting Laboratory, Marine Corps Systems Command, and Special Operations Command

Metrics:

- Program metrics vary by Technical Area

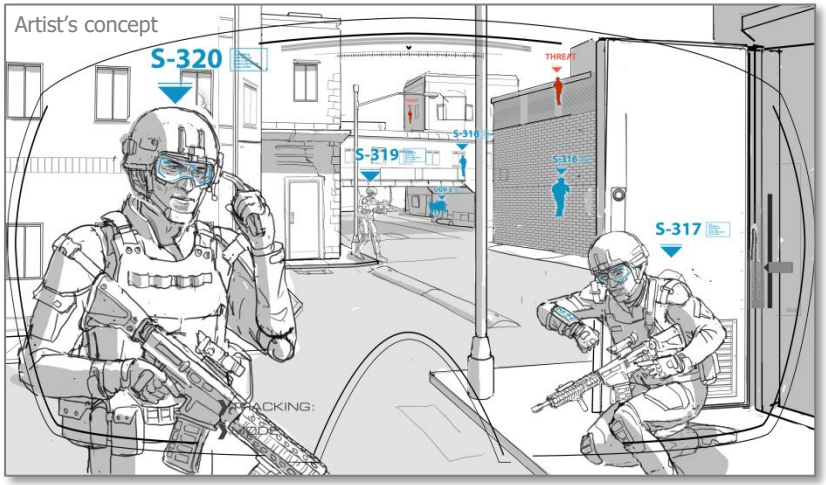
Precision Engagement	
Accuracy	2 m CEP
Mass	≤ 1.0 kg
Recoil Energy	≤ 70 joules

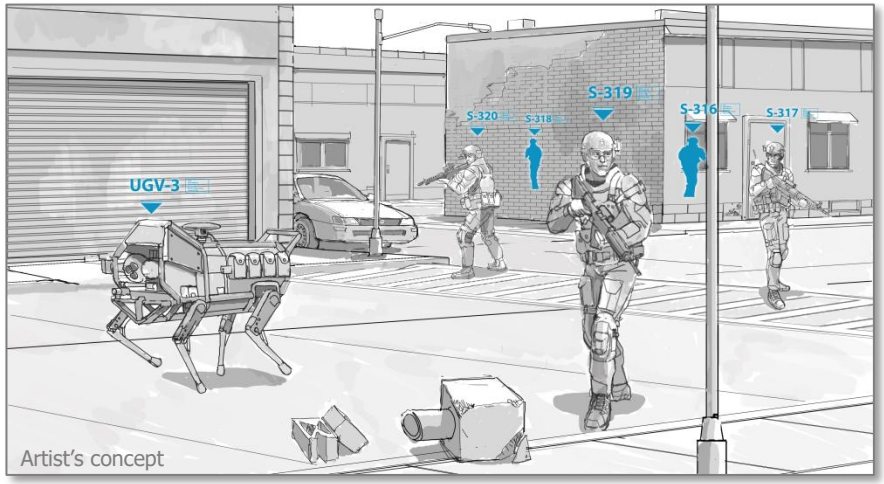
Non—Kinetic Engagement	
Squad Speed	≥ 2 m/s
Mass	≤ 900 g
Volume	≤ 500 cm^3

Squad Sensing	
Accuracy	0.9
Squad Speed	≥ 2 m/s
Mass	≤ 350 g
Volume	≤ 200 cm^3

Squad Autonomy	
Abs. Position	≤ 6 m
Interventions	0
Mass	≤ 350 g
Volume	≤ 200 cm^3

Squad X Experimentation (Squad X)





Purpose:	Key Technologies:	Metrics:
• The objective of the Squad X Experimentation program is to design, develop, integrate, and validate system prototypes that enable next-generation combined arms for the dismounted squad • The resulting Squad X systems would maximize squad performance in increasingly complex, multi-domain operational environments	• Enable the squad to understand their entire operational environment: physical, electromagnetic spectrum, cyberspace • Optimize use of the squad's limited physical, cognitive, and material resources • Synchronize fire and maneuver in the physical, electromagnetic spectrum, and cyberspace domains • Potential transition partners include: USA Maneuver Center of Excellence, USA RDECOM, PEO Soldier, Office of Naval Research, Marine Corps Systems Command, and Special Operations Command	• The System Prototyping phase seeks to demonstrate successful execution of missions with synchronized fire and maneuver against line-of-sight threats 300 meters or greater from the squad • The System Development Phase seeks to execute a capstone experiment with multiple Squads X; Performer(s) will be expected to demonstrate synchronized fire and maneuver against non-line-of-sight threats at distances greater than 1,000 meters from the squad

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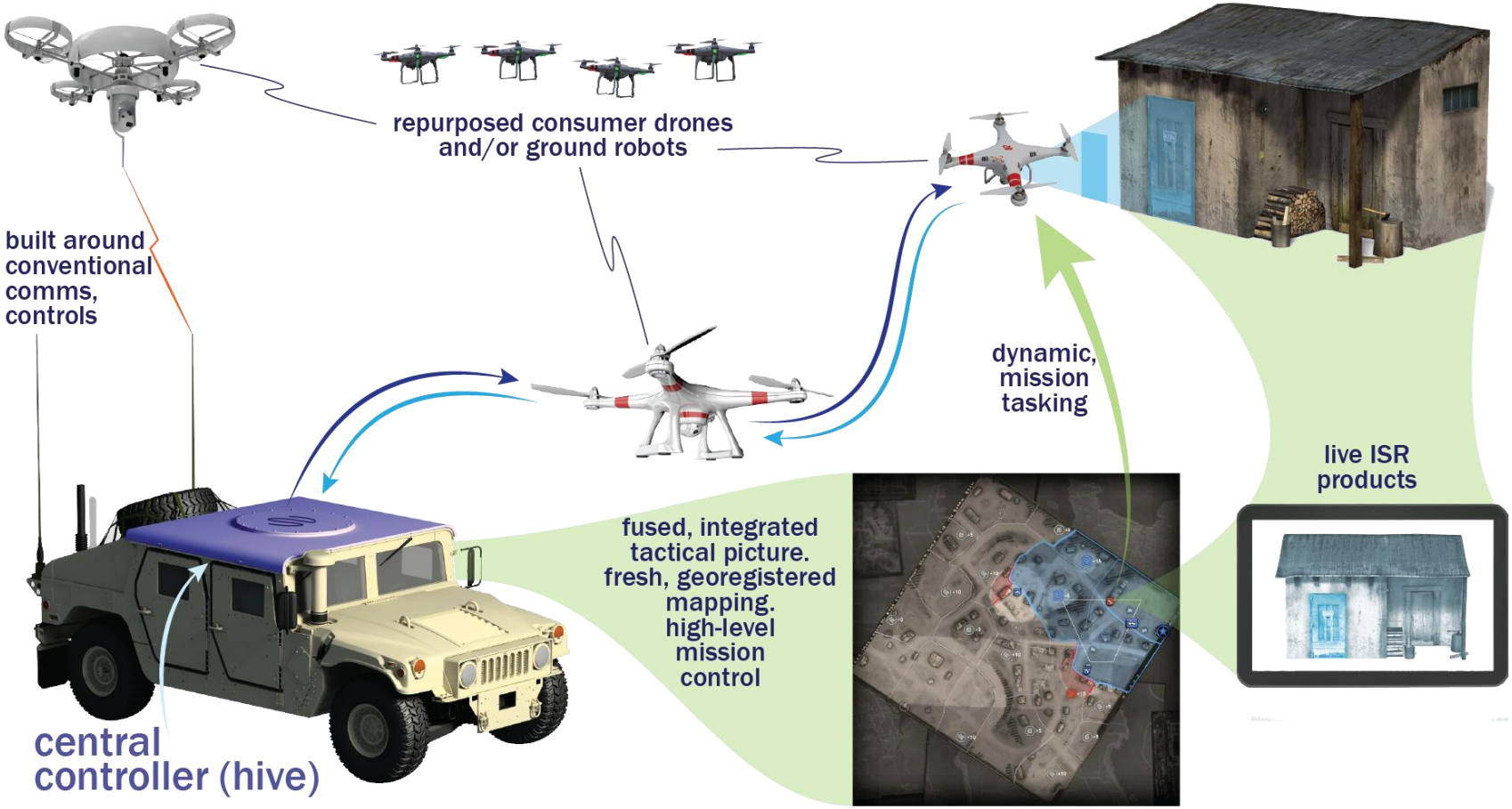
Centralized Command of Commercial Drones (C3D)

With access to the same global COTS drone parts bin, how can the US have superior capability?



C3D research effort: Centralized control of near-unmodified commercial drones for high-level tasking

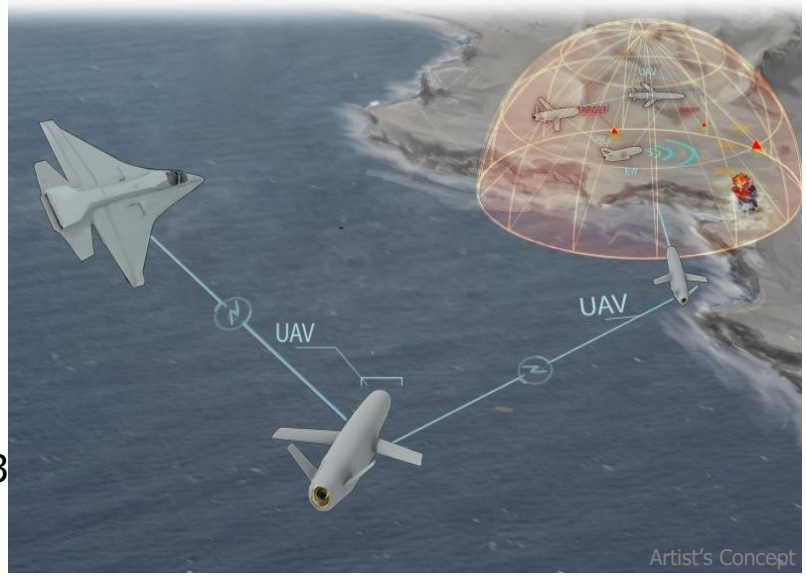
Collaborative Operations in Denied Environment (CODE)

Vision

- Develop advanced autonomy algorithms and supervisory control techniques
- Enhance utility of legacy unmanned aircraft (missiles or UAV) in denied environments
- Foster interoperability of heterogeneous systems

Objective

- Developed capabilities for three reference missions (tactical recon against AAA, DEAD, ASuW)
- Demonstrate algorithm effectiveness in flight using 6 RQ-23 Tigersharks and N virtual assets for one mission
- Demonstrate effectiveness in simulation using operational platforms for all reference missions



Envisioned Benefits for Strike Missions in Denied Environment

Get access → Find target → Identify target → "Survive" engagement → Reduce overkill/underkill

CODE aims to improve ability of existing arsenal to perform in denied environments

AAA	Anti-Aircraft Artillery	DEAD	Destruction of Enemy Air Defenses
ASuW	Anti-Surface Warfare	UAV	Unmanned Aerial Vehicle
UAS	Unmanned Aircraft System	UA	Unmanned Aircraft