Urban Combat
Brad Tousley

The year is 2025.
US joint and coalition forces have been deployed to a distant country to stabilize a very turbulent situation.

Revolutionary forces are attempting to overthrow a recent democratically elected government, and a military coup was recently averted.
Indigenous forces using mortars transported by local vehicles and ready to rapidly deploy, shoot, and re-cover are common.
Also enemy forces carrying rifles and wireless communications are attempting to control critical nodes in the capital of this country and seize power.
Their actions are coordinated by local command and control cells housed in office buildings and using common commercial equipment and communication systems in innovative ways.
An infantry company as part of the US rapid reaction forces has been tasked with the 1 hour mission to secure several objectives including the command and control cell within a 100 square block urban area of the capital of this small country.

The urban area consists of up to 4 story buildings with shops and offices and some residential structures.
The power is intermittent in this area, and motor vehicle traffic consists of a mix of patrolling revolutionary forces and looters and rioters. Snipers have been shooting at pedestrians and vehicles from rooftops. Explosive devices and ambushes are suspected to be in a number of locations. American helicopters and UAVs have begun aerial reconnaissance over the capital, and they are being routinely engaged by surface to air missiles and rocket propelled grenades.

It will be a very difficult mission for this infantry company.
While being transported intratheater, the company commander recounts military urban combat studies and the lessons of Iraq in 2003-2004, Kosovo in the 90's, Afghanistan in 2002, and the Soviet experience in Chechnya. The commander continues to plan as the engines whine and his soldiers sleep.

My name is Brad Tousley of the Tactical Technology Office at DARPA, and today I intend to tell you of a new DARPA thrust into Urban Combat, which would provide technical solutions and new military concepts of operation to help this infantry company quickly accomplish this combat mission in the year 2025.
These dismounted forces would move quickly over this urban terrain, quickly resolve friend from foe from noncombatant, employ new techniques in precision lethal and nonlethal force, control the terrain by isolation and rapid three dimensional maneuver, and provide overwhelming protection for US dismounted forces in the face of an uncertain adversary.

We intend to greatly enhance the dismounted soldier as a system.

Much of the worlds population lives within extended urban regions, and as a result US soldiers, Marines and Special Operations forces must be capable of conducting responsive military operations in these urban zones, such as attacking, defending, peacekeeping, security, and stabilization.

Urban zones exist in developed and underdeveloped geographic regions of the world and are populated by various nationalities and ethnic groups. Adversaries will seek to exploit the complex nature of the urban zone and compel the US to engage in asymmetric military operations there.

They will form in small groups and will use traditional operational security techniques and the buildings and structures of the urban environment to disperse and provide cover and concealment for insurgency operations.
They might use available weapons such as rifles, grenades, explosives, RPGs, and automatic weapons from rubble, windows, rooftops and hardened structures to harass and disrupt US operations.

They could use wireless and messenger based communications to move quickly and avoid detection and deterrence.
These types of operations are the most difficult for dismounted forces to conduct and control, and that is precisely what we will be confronted with.
We have seen these challenges in the streets of Baghdad, the British in Basra, and Russians in Chechnya.

The urban environment is very complex and Joint Vision 2010 does not necessarily apply for our dismounted soldier in the urban battlefield.
Existing sensors do not allow for a transparent view of the surroundings.

Buildings and structures preclude long range surveillance and reconnaissance and our threats are able to hide among the population and conduct "hit and run" operations.
US soldiers will be always be required to "close with and destroy" the enemy to control the urban zone.
We cannot simply assume that standoff precision engagements will be acceptable to achieve our goals of controlling the urban environment.

Controlling the urban environment does not assume that lethal force is necessarily beneficial in achieving military objectives.
If this were the case then simply reducing the urban zone to rubble and ignoring combat identification and traditional rules of engagement would be acceptable.

Our forces have to be highly discriminating and judicious in conducting urban operations.

We have to discriminate the adversary from the noncombatant and, when we use lethal force, do so with precision to achieve our tactical and strategic goals.
In many cases our goals can be achieved by influencing our adversaries without the use of lethal force.
We need to develop new and innovative ways to legally and justly apply nonlethal force and effects based operations in urban environments.

What can TTO do to answer these challenges?
How can we help the troops conduct operations in urban environments, using both lethal and nonlethal weapons?
What about survivability, active sensing, protection, mobility, and countermobility?
We are looking not just for new systems and technologies for prosecution of urban warfare, but also completely new operational methods for our soldiers, Marines, and special operations forces.

We would like to treat the single soldier as a system and make them capable of precise lethal and nonlethal effect, extreme three dimensional mobility and countermobility, and dramatically improve their personal survivability.
I will highlight some concepts in each of these areas.

First, consider new techniques for precision area and point weapons - weapons include both projection of lethal force, but also nonlethal influence weapons.
Precision is needed in terms of centimeters of dispersion at 100's of meters.

For example, think of networking rifles together in an urban environment so that a squad of soldiers can engage multiple targets in a synergistic fashion.
By networking intelligent, interactive rifles small infantry teams can fire in unison at different targets - restricting the enemies ability to respond in a serial fashion.

Another example: Can we develop lightweight stabilization systems for rifles or sighting systems so that every soldier can view a target with the accuracy of a trained sniper, and accomplish this with a minimum of training?
Could we embed actuators within small arms to compensate for the shooting dispersion from breathing and the human heartbeat?
Could we actively slew the rifle and automate the firing in order to guarantee shot placement? More precise fires implies less wasted ammunition to achieve the desired effect.

What if we were able to replace the handheld pistol with a hands free weapon?

Typically pistols are of little to no use in the urban zone.

A hands free weapon would be extremely useful for dismounted infantry use in and around buildings, roadways and parks: to provide short range, high volume, adjustable coverage, lethality for soldiers entering confined spaces facing multiple targets.
A hands free weapon which consists of electronically fired caseless ammunition fired from the forearm would be a novel urban capability.

Is it possible to develop hand or rife launched wireless or fiberoptic teleoperated cruise grenades that provide 10cm accuracy with 2 minute loiter time and adjustable lethality to engage around buildings?

New nonlethal concepts that incapacitate the adversary are highly desirable.
We would like to immobilize potential threats particularly in the case of uncertain target identification.
We would prefer to immobilize our adversary and render them incapable of response, without delivering lethal effects.

Are there ways to deliver radio frequency or optical energy in a point or netlike fashion to subdue one or many potential threats - for a period of seconds to minutes?
Is it possible with adjustable power, multiwavelength, modulated high power light emitting diode based systems to dazzle or distract potential threats to stun them or disorient them.
These nonlethal "light weapons" could provide an agile active optical system offering a new nonlethal capability as well as targeting and illumination source.

Is it possible to develop free flying projectile tazers to electrically subdue an adversary?
How small can we make these tazers?
What are the limits of these nonlethal projectiles?
Could soldiers or Marines deploy electromagnetic dragnets to immobilize large numbers of potential combatants in a populated remote urban zone?

The next area we are considering is active sensing, including approaches such as LADAR or RF systems.
We imagine systems that are lightweight and worn by the soldier as part of the uniform ensemble.
Active sensing would allow two critical capabilities to be achieved - the discrimination and identification of adversaries from noncombatants in urban clutter and the use of precision aimpoints and covert target designation for friendly forces.

To paint a picture - this animation begins with a squad scanning the area with head-mounted infra-red sensors and rifle-mounted LADARs.
It indicates how soldiers in 2025 might detect concealed threats.
Initial cueing is provided by observation of the flash of the LADAR beam off the enemy's optics or other reflective surfaces.

The scene is then zoomed for a closer look, but the target is partially obscured, so a second soldier also zooms the target area.
His view is also obscured, so data is passed between the two soldiers and their views are merged.
This results in a more complete three-dimensional picture that can be rotated for better understanding.
The first soldier then selects his target and a red targeting icon appears to both soldiers.
The second soldier also selects a target and both are engaged rapidly.
Note how range discrimination might be used to detect and ID targets in clutter.
The second half of the animation illustrates another situation in which shots from three enemy soldiers are detected and localized using helmet mounted acoustic sensors.
The enemy is located and zoomed as before, and after another exchange of shots the imagery is switched to a high resolution visual image for positive identifiction of the enemy.
However, due to the long range, it is difficult to maintain an accurate aimpoint, so the rifle stabilization system is activated, and two of the enemy are engaged.
The third enemy has hidden behind the the wall and is not visible to the soldiers, so an indirect teleoperated precision area weapon is used - in this case what I might call a "cruise grenade".

The information gathered from soldier worn active sensing could be projected in a virtual way in front of the soldier, sort of a heads up display, or directly onto the soldiers retina.
The coupling of retinal projection with active targeting could change the way we do weapons sighting.
The active sensing can determine shapes and facial features in shadows and through windows, provide 3 dimensional feature discrimination, and provide a rich set of information about the local urban environment.

How about soldier protection and survivability in urban environments?
Can we take advantage of advancements in materials to create new body armor suits substantially better and lighter than Kevlar and SAPI plates and which might be coupled with polymer and optical technology to control the perceived signature of the soldier?
Can we make the soldier blend into the urban zone on demand, and also provide dramatic changes in their personal survivability?
Can these systems provide embedded biological sensing and self healing for future soldier health augmentation?
Soldiers today wear battle dress uniforms or Nomex suits with flak jackets.
Soldiers of the future might wear chameleon like lightweight suits that provide greater protection than today.
We welcome your high risk high payoff ideas in enabling this vision.

If we consider the urban zone - we are often concerned with the third dimension.
Adversaries shoot frequently from rooftops and windows.
Dominant pieces of terrain in an urban environment frequently are the "high ground".

One way to defend against threats above the ground is to use exoskeletal technology.
Exoskeletal technology seeks to enhance the physical ability of the soldier to carry more, further and a higher combat pace.

I would pose the problem in a slightly different way.
How can we develop mobility mechanisms to enable our soldiers, and Marines and Special Forces to dominate the third dimension?
We own the night - why can we not own the third dimension?
Can we develop systems - portable ones - that allow US troops to scale up and down the exterior of manmade structures in a rapid fashion?
Although fear of heights might initially be a factor, this would change the paradigm of climbing and Australian rapelling in an urban zone such that our forces could rapidly traverse up and down the third dimension.
If our troops could reach the top of a four story building to emplace an observation post or to dispatch a sniper, and do so in three seconds that would be a new spiderman capability.
Fire and maneuver would then include maneuver up and down building exteriors as opposed to relying on internal or external stairways or ladders.

In this animation, we illustrate the detection of insurgents using Prowler micro air vehicle penetrating radar concepts, mapping the structure of the command and control cell building and detecting potential threats in a manner similiar to a CAT scan.
(pause)

Friendly forces develop and display a plan requiring advanced mobility techniques.
A special rope is shot over the building.
The end of the rope has a material that adheres to the wall of the building much like a Gecko.
The rope contracts when the soldier applies an electrical current and he is lifted to the top of the building.
After scanning the area, he climbs over the top, assisted by Gecko knee pads, and signal for his wingman.
They deploy into the building and become visible on the CAT scan.
Because the soldier network knows their location, they are marked as friendlies with a blue dot overlay.
(pause)

The soldiers remaining on the ground have no cover, so their uniforms are caused to blend with the background.
(pause)

The soldiers within the building proceed to their objective over the enemy command and control room.
Simultaneously, the soldiers on the ground attempt to enter.
However, an armband sensor detects elevated levels of explosive particles, indicating a possible booby trap.
The soldiers retreat and fire a door-breeching munition that rams open the door and activates the booby trap.

The sound is detected by the enemy, and two of them run to investigate.

The friendly soldiers set up a 5-second delay explosive and exit to secure the command and control room.

The soldiers on the ground are confronted with the enemy on the stairs and a lucky shot wounds one of them.
His partner fires a blast round and both enemy are incapacitated.
The wounded soldier is losing blood, but sensors in his uniform detect this and constrict around the wound while also applying medication.

As the prisoners are brought down a MEDEVAC unit is called and is able to respond quickly by viewing the soldiers GPS coordinates.
The final TTO area of interest in Precision Urban Combat is denial or countermobility: that is, denying the adversary the use of certain urban terrain or structures in the urban environment.
Combat units would prefer not to have to guard territory that needs to be denied to our adversaries, allowing our troops to simply proceed to the area of most concern.
Consequently we need to examine and conceptualize techniques of volumetric denial.

There are different ways to deny area to an adversary.
We wish to develop unmanned volumetric denial approaches.
For example - foam or sticky glue are two techniques.
Can we develop projectile deployed foams or glues which greatly expand once emplaced - effectively denying threat mobility? Can we develop electromagnetic techniques to deny structures and urban avenues of approach which are unattended and affordable and controllable in range and scope? Finally can we deploy nets on command to deny threats or noncombatants moving through zones we wish to deny?

Various DARPA officers and others have worked component issues of urban warfare technology for many years, to include passive sensors, lightweight communications, exoskeletal technology, and foams and glues.
TTO would like to leverage this technology and others to develop our soldiers as integrated combat systems.
We want to couple aspects of those technical areas with improved active sensing and lethal/nonlethal concepts to enable dramatic changes in way we conduct urban operations.
We look forward to your good ideas and energy.

Thank you for your attention.