Assured Urban Operations
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You can't watch the news these days without noticing that the art of war has changed.

It is no longer fought on a traditional battlefield with large, open spaces.
Saddam Hussein is found hiding in a foxhole underneath a building and Jessica Lynch is held hostage in a city hospital.
Our military has unique challenges that they've never faced before, and realize that unless we can develop new solutions to the challenges posed by urban environments, the United States will not maintain the strategic advantage we've always had.
DARPA's Special Projects Office is working on several programs to support urban operations where political realities don't allow us to operate freely and our inherent technological superiority is the most diminished.
Our forces must now operate in buildings without foreknowledge of building layouts and streets and alleyways that expose them to multiple attacks and provide easy escape to the enemy.
They are also dealing with improvised explosive devices such as car bombs and suicide bombers.

In order to help them address these challenges, we must achieve better intelligence preparation of the battlefield.
Two of the initiatives you heard about earlier today will be leveraged to help with this - LAASS and ISIS.

As Greg Duckworth mentioned in his first presentation, today's cities contain a maze of urban canyons and underground tunnels.
The recent activity in Iraq has demonstrated that the complex urban environment hides high-value facilities and interconnecting tunnels that allow leadership to evade capture.
By leveraging the low-altitude airborne sensor system, LAAS, we will be able to find and target these facilities and provide urban war fighters with the information they need to greatly simplify their searches.

Larry Corey spoke to you about the ISIS technology, which will provide a picture of all people and vehicles moving on the ground.
We will apply this technology to track people emerging from buildings of interest and follow them as they move to new locations.

Imagine the impact it will have if ISIS tracks the movement of individuals for months.
Hidden webs of connections between people and facilities will be revealed.
At any point in time, we will be able to get a current picture of individual movement, group meetings or unusual deployments.

In addition to creating solutions to uncover hidden locations and track movement, DARPA wants to develop the ability to create detailed maps of the inside of buildings without entering.

Imagine if our troops had been able to develop a detailed map of the interior of the hospital where Jessica Lynch was being held before going in.
What if they were able to locate and classify personnel inside the building and discern guards from hostages? What if they had knowledge of how long personnel paused at particular doors to work locks or other security devices? An internal

layout of a building prior to entry and the ability to improve the fidelity of the map as an operation moves through the facility would greatly diminish the inherent advantage of a defensive force.
We could level the playing field by learning what they know.
But how can this be achieved?

The activity inside urban structures coupled with wall-penetrating RF radiation may allow us to map out the internal structure of a building and identify personnel within it.
This application is not possible with today's technology that would be rapidly multi-pathed and yields a tangled nightmare of signal and stationary clutter returns.

One possible way to address this problem is to focus on the Doppler-shifted signals due to personnel movement and activity within a structure.
A multi-static Doppler radar could be used to exploit the motion of personnel and may provide just enough advantage that the multi-path clutter inside the building can be deconvolved and the position and velocity of personnel estimated uniquely.
We challenge the experts in this audience to solve the signal association and residual clutter rejection problems in the target-rich environment or identify different approaches that can take advantage of the Doppler shift from personnel motion.

Once the necessary intelligence has been gathered and we move into the combat, or attack phase, our superiority in traditional war fighting involving massed troops, heavy armor and air power has never been more pronounced.
It must be extended, however, to individual soldiers to provide them the same superiority at all levels of conflict.
DARPA believes this goal can be aided by developing tools to enhance situational awareness to identify the threat being faced and new man portable capabilities to control access routes.

Ask yourself, is it possible to develop the internal mapping system I described earlier into a tactical system that troops could carry with them as they engage the enemy? A system that could begin mapping out a building as our forces knock the door in, locate personnel within the building, and dynamically track those personnel as the team moves.
The strategic mapping system that I described before does not have specific size, time or power constraints.
The ideal tactical system, however, would have to be man portable, fast and integrated into the systems already carried by our troops.
Can the emitters designed for intelligence gathering be linked to provide the same type of information on the fly or can hardware be miniaturized so that a team could carry all the components with them? Can the signal processing be optimized to provide the information in real-time, or is there a completely different approach?

During combat, access control of the battlefield also becomes critical.
Indigenous forces control the location of the conflict and have much greater knowledge of the area and routes leading to it -- a significant tactical advantage.
If we can control the access routes to target buildings or areas, we can reverse that advantage.

Controlling routes using personnel or armored vehicles requires a large force and exposes our troops to threats such as snipers and rocket propelled grenades. The use of temporary barriers has the potential to help control access without a major personnel presence.

Let's continue with the Jessica Lynch rescue analogy.

If our team, armed with a map of the interior of the hospital created using Multi Static Doppler Radar technology, also had the capability to seal off corridors nearly instantly as they moved through them, they would have had the ability to cut off opposition forces.

Imagine how much easier it would have been to ensure their escape route remained open.

DARPA is very interested in developing barrier materials that can be rapidly deployed by troops in the field.
Some barrier types being explored include hardening foam that expands rapidly to block a door, portal or roadway.
This type of barrier will deny access to opposition forces but will be easily opened by our forces, potentially with chemical solvents.
The challenge is to develop barriers that can be rapidly emplaced with no site preparation, materials that don't require soldiers to carry heavy loads, are man portable with application techniques that create strong bonds with many different surfaces; and are reversible.
Another approach is to develop slippery materials that prevent personnel or vehicles from gaining traction on a surface.
Developing custom slicks using oil or Teflon products may appear simple when dealing with asphalt roads, but how can we make them work on dirt or gravel? How could they quickly be neutralized like their foam counterparts so our forces maintain their ability to maneuver?

Preparation and combat are only part of our challenge in urban environments.

As we saw in Iraq, once the battle has been won, significant work still remains.

Stability and support operations have become increasingly important.

This role has not traditionally fallen to American soldiers, but has now become a fact of life.

In fact, the success of this portion of a mission can be the determining factor by which an entire engagement is judged.

Our forces desperately need new tools to combat the threat from insurgent forces and guerilla warriors who know no law of conflict and use improvised explosive devices indiscriminately while hiding behind a civilian population.

Some of these improvised explosives include roadside bombs, car bombs, or the notorious suicide bombers.
We've all seen the news coverage on Iraq and the continued struggle in the Middle East, where suicide bombs exemplify the most dramatic and deadly weapons employed in urban operations against United States interests.
The ability to quickly detect hidden explosives and neutralize them will greatly improve the chances of stability operations succeeding.

Our goal is to develop the ability to detect explosives from a distance to allow neutralization before it reaches the intended target.
This is an extremely difficult proposition because vapor pressure of many explosives is very low and difficult to detect, detonating electronics may have no unique signature, and many different types of materials and configurations can be used.
Can you think of a way to identify bombs by sensing the presence of the explosive, triggering device, or electronics before it meets its target? DARPA already has ongoing efforts to try and detect remote RF-based triggering devices, but what new approaches can be used if the trigger is not RF-based?

Could a crowd be interrogated by a low power microwave emitter that creates a detectable response from a suicide bomber carrying a belt of explosives embedded with shrapnel? If the shrapnel is in the wrong orientation, or not even used, will your approach still create a detectable response? Can any of these or other technologies be applied to passively examine vehicles and identify car bombs, which have a larger signature but can travel at much faster speeds? Neutron interrogation of vehicles coupled with sensitive detectors has been shown to detect explosives weighing less than 100 lbs, but this approach only works at close distances with a significant time lag and exposes vehicle occupants to radiation.

We are interested in capabilities that could provide detection at a distance for explosive devices made from a variety of energetic compounds.
Once a potential threat has been identified, the next step is to neutralize it.
We need new ideas on how to not only neutralize the electronic trigger mechanisms of improvised explosive devices, but also incapacitate potential suicide bombers quickly but without any lasting health effects.
DARPA is developing a high intensity electromagnetic pulse generator that can be used to short circuit electronics, but the power and space requirements are substantial.
In fact, a truck must be used to carry the equipment.
Can you think of a way to develop a more-focused system that has less power requirements or a lower power system that requires more time to work that can still be man portable? What other options are there to render a device safe from a distance?

Sometimes disablement from a distance is not required.
As was seen in Iraq, improvised explosive devices can be planted throughout a city and discovered by personnel before detonation.
This is the traditional realm of the explosive ordinance teams, who have the risky and time-consuming task of disarming these devices by disabling the trigger device.

A potential alternative that could be safer and more time effective would be to create rapidly deployable blast shields that allow detonation of the device by directing the blast away from personnel.
Existing blast shields require significant time to setup and prepare.
We are interested in ideas for blast shields that can be quickly deployed and are substantially stronger than existing methods.
They could be constructed from a rigid foam that has sufficient strength to deflect the blast and can be stored in a compact container that rapidly deploys and envelopes the device with minimal risk to the operator.
The proposed blast shields must provide significant weight, space and time advantages over traditional blast shields and be designed for use in hostile environments.

The countermeasures against chemical, biological and radiological weapons that Wayne Bryden discussed earlier will also be a huge help in the urban environment.
Traditional explosives are only one of our worries with toxic industrial chemicals and traditional chemical and biological agent threats.
Although it is difficult to create or procure refined weapons grade chem/bio materials, toxic industrial chemicals are ubiquitous in urban environments and can be weapons of opportunity that cause significant panic and loss of life over an area much larger than conventional explosives.

The Radiation Decontamination (RD) program Wayne referenced is also important to counter the effects of dirty bombs on building surfaces.
The ability to identify contaminated surfaces and rapidly clean them ensures that our troops will not be forced to withdraw from a conflict pre-maturely.

Now that you know a bit more about several of the problems facing our troops as we operate in today's uncertain and changing war zones, I hope you agree that it is up to those of us in this room to find solutions to the challenges created by the shifting tactics of our adversaries.
We must ensure that our troops have the appropriate information to help prepare for battle and quickly adjust strategies.
Individual soldiers must have the ability to dominate their direct surroundings and control the battlefield.
Capabilities are needed to deal with the new role of stabilizing operations in hostile environments after combat.

We welcome your ideas on how to bridge the gap between our dominance on today's traditional battlefields and the more complex battlefields of tomorrow.
Thank you.