AMY ALVING --SPO OVERVIEW

Good afternoon, and welcome to the Special Projects Office portion of DARPATech.
In SPO, we are developing systems solutions to emerging threats and challenging environments.
We do whatever it takes to solve the problems , and this afternoon you will hear about opportunities across the spectrum of technology development - from platforms, to sensors, to information processing... and most important, in integrating these all together into systems that demonstrate new solutions to the problems.

So, what do we mean by emerging threats?
You know that DARPA's charter is to prevent technological surprise.
So, in SPO, we don't limit ourselves to countering the threats of today.
We're looking ahead, to how technology could be used against us in the future, how our adversaries might try to turn our own technological sophistication against us, and how the environments in which we will fight will pose new challenges.
You'll see that many of our efforts are designed to anticipate the future, to enable our forces to be ready to meet these threats when they materialize.

Now, which problems are we working on?
At the last DARPATech, we discussed our work in defense against four classes of threats: chemical and biological weapons, underground facilities, GPS jamming, and tactical missiles.
I'll say more about the first three in a minute, but first let me briefly bring you up to speed on that last category.

One program we discussed last time is targeted at the emerging threat of cruise missiles.
Here we are not concerned with the high-end threat: costly, stealthy, and technologically sophisticated missiles that only the most advanced nations can acquire.
Instead, we focused on the cheap, low-tech cruise missiles that can easily be bought on the international weapons market, or they can be rigged together by equipping a small aircraft with an autonomous navigation system and loading onboard explosives, or even WMD.
Unlike high-end cruise missiles, these weapons are readily available at low cost to even unsophisticated adversaries.
We need to be able to defeat them without spending millions of dollars per kill.
The right solution is to use our existing surveillance architecture to cue to a low-cost interceptor.
If we had a low-cost, all-weather seeker, we could make this all work for under $100,000 per kill.
So DARPA has been investing in this seeker through our "Low Cost Cruise Missile Defense" program.
We have now produced the first batches of low-cost, Ka-band transmit/receive modules.
We are developing these into a compact seeker, in partnership with the Air Force.
This will enable the Air Armament Center's first low-cost, dual-role air-to-air and air-to-ground missile defense system.

Later today, we'll talk about some related new work in the area of tactical surveillance, in which we are developing a powerful new multi-function radar integrated into an airship.
This system will be able to provide the cue, or "handover basket", to this low-cost seeker - as well as carrying out many other functions, all without an in-theater logistics tail.
More on that in a moment.

Another of the emerging tactical missile threats we addressed at the last DARPATech is the class of enemy air defenses such as shoulder-fired STINGERS that use visible or infrared emissions instead of radio frequencies to detect, track, and target our aircraft.
Our adversaries are moving to these so-called "RF-silent" techniques precisely because our countermeasures against RF air defenses are so effective.
We created the MEDUSA program to extend our aircraft countermeasure suites to identify, locate, and damage these visible or infrared air defense systems as soon as they attempt to target our aircraft.
This capability will ensure the US air dominance that the RF-silent air defenses are attempting to threaten.

So, as you can see, we are making substantial progress in dealing with the tactical missile threats, and this evening you can visit our booth to learn more about the status of these two programs.

For the remainder of this afternoon, we will be describing our interests in the other three focus areas, as well as in two new ones.
In the familiar area of chemical and biological weapons, we are expanding to include radiological threat.
In meeting the challenge of underground facilities, we have a new focus on finding and targeting such facilities on tactical timescales.
In the navigation arena, we are interested in enabling GPS-free navigation, whether GPS is unavailable because of jamming or because of environmental effects.
One new area is called "tailored tactical surveillance"; here we are working on tailoring the mix of platforms and surveillance payloads across all phases of battle to provide the right information at the right time, without breaking the bank on logistics.
The last area is concerned with assuring safe operations in the urban environment.

Let's begin with defenses against chemical and biological weapons.
At the last DARPATech our "Immune Building" program was just getting underway.
That program seeks to protect buildings from an indoor release of chemical or biological agent.
The challenge is that a building serves to naturally contain the agent and - worse - that the ventilation system effectively spreads the agent throughout the building.
Our vision was to co-opt the ventilation system to cause it to isolate, not spread, the contaminant.
We have now carried out experiments on this concept and found it extremely effective.
A critical enabler of our success is the "active" response of the ventilation system - that is, the protection system recognizes when an agent has been released and causes the ventilation to behave differently.

The Immune Building is the first, large-scale implementation of a real-time, active response system to the chemical or biological threat. Its success proves it is possible to change our military's response paradigm from one that focuses on after-the-fact consequence management to one that actively intercepts the threat and prevents our troops from being exposed to the agent.

Based on the success of that first "active response" system - for buildings - we are now initiating an effort to bring a similar approach to protecting our troops on the battlefield.
There, the threat is a cloud of chemical or biological agent that is carried on the wind toward our troops.
Today protective measures would include having our troops don protective gear, wait out the passing of the cloud, and then decontaminate all of their clothing and equipment to remove any harmful residue.
All of these reactive protective measures interfere with the operational tempo of the mission, even assuming they work without a hitch.
On the other hand, we could avoid these protective steps if we could neutralize or knock down the cloud before it reached the troops.
Our new program to make this possible is called TACTIC, and you will hear more about it today.

Radiological weapons are another emerging threat we are addressing.
The media regularly covers reports of illicit traffic in radiological material, often with connections to terrorist organizations.
The concern with dirty bombs is not usually immediate death, because the levels of radioactivity left behind are likely to be fairly low.
But radioactivity could be spread over a wide area, making a large number of buildings unfit for human occupation for months or years to come.
This radioactive residue cannot simply be washed away, because the radioisotopes form covalent bonds with the building surfaces.
These bonds are not broken by water or other available washing solutions.
If a military base were contaminated with radiation in this way, it could impair our ability to carry out our military missions.
For this reason, SPO is working on ways to break these bonds, to enable clean up after a dirty bomb.

Later this afternoon Wayne Bryden will tell you more about all of our activities to defend against chemical, biological, and radiological weapons.

Greg Duckworth will then talk about our work in meeting the threat posed by underground facilities.
While "bunkers" have been in use for decades, they are regaining popularity.
This is in large part because during the Gulf War we so convincingly demonstrated our ability to take out surface buildings at will.
Underground facilities may be elaborately constructed, deeply buried complexes, where the depth of the structure provides physical protection from surface weapons.
Or they can be simply "cut-and-cover" structures, where a thin layer of earth might provide little physical protection but is designed to conceal activities and intentions.

Or they may even be naturally occurring caves, such as in Afghanistan - and some of those natural caves may be inhabited by our enemies and some by non-combatants.
In cities, military bunkers could be hidden beneath other, non-military surface buildings.
And whether they are caves or under cities, the underground structures might be connected to each other, providing concealed entry and exit routes for combatants.

So underground facilities really represent a diverse class of structures - but they share common challenges: they are designed specifically to make it difficult for our surveillance and reconnaissance assets to determine where they are and what is going on inside.
At the last DARPATech, we focused on characterizing the more elaborate class of facilities, and we described our interests in using multi-mode, networked, ground-based sensors to monitor the pace of activities and to identify targeting vulnerabilities.
Now we are expanding our efforts to finding previously unidentified facilities - including those hidden under other buildings or inside caves.
We are also interested in mapping the connectivity of such structures.
And we are pushing to do these things on tactical, not strategic, timescales.

The next category of problems comes from trying to navigate in environments without GPS.
Last year, we described our GPX program, to deal with GPS jamming.
Here, we have developed airborne transmitters. These replace, at close range, the timing signals from distant satellites.
We wanted a system that would work with the thousands of GPS receivers already in the inventory. So we restricted our solutions to software, not hardware, modifications to the receivers.
We will wrap up this program this spring by demonstrating a full navigation solution using four airborne transmitters.
Now, we are examining whether we can take this solution one step farther: we would like to avoid bringing any replacement transmitters into theater.
Perhaps we could navigate using man-made signals already in the environment - for instance, those from television towers or communications satellites.
The receiver would have to handle flexibility in the navigation waveform, but our forthcoming software radios should meet this requirement.
This means we could perhaps convert our radios into jam-resistant navigation devices, without adding logistics burden in theater.

But jamming isn't the only reason that GPS may be unavailable.
In the urban canyon, or inside buildings, or even in caves the satellite signals are not available, or are so confused by multipath that they cannot be used for navigation.
For this type of environment we are exploring the idea of bringing beacons with us as we enter a city or a building.
Beacons could provide relative position of our troops.
This would help us map out cleared vs. uncleared areas and provide a common picture for understanding where all the friendly troops are located - a key element in avoiding fratricide.

Finally, some of our navigation challenges are for sensors that remain in fixed places for a long time.
For long-duration applications such as these, it may be possible to exploit naturally occurring signals of opportunity, such as the way the local gravitational field varies over time.
That idea is pretty far out there... but that's what makes us DARPA!
Greg Duckworth will describe more about the challenges in the navigation arena and the many paths we are pursuing to deal with the various GPS-denied environments.

Now let me shift gears to our fourth category.
SPO is working to bring about a new vision of tactical surveillance.
First, consider the various phases of conflict - from "Intelligence and Warning" at the strategic end of the spectrum, through "Intelligence Preparation of the Battlefield", to "Conflict", and ending with "Stabilization and Support Operations".
Now, let's focus on how two things change during those phases: access, and mission duration.
Access determines how many assets we can bring close to the battlefield.
It is most constrained in the first phase, somewhat less constrained during IPB, and is least constrained in the last two phases.
Mission duration determines how long we must sustain and resupply those surveillance assets.
It is shortest in the middle phases, which start and end over relatively defined times; and it is longest at either end, because those phases can be open-ended.

Access constraints and mission duration play a central role in how we do surveillance today.
During the Intelligence and Warning phase, access denial leads us to acquire much of our strategic surveillance from space.
The timeliness of these assets is not sufficient for most tactical needs, so space assets have a decreasing role as we move toward Combat.
Therefore, as Combat looms closer, we must bring assets directly into theater to meet our tactical surveillance needs.
Many of these systems are carried on board aircraft; for instance, during the first month of Operation Iraqi Freedom, the US military and it allies used 80 aircraft to fly almost one thousand surveillance sorties.
Whether manned or unmanned aircraft are used, this proliferation of sortie-flying platforms requires a large logistics tail to keep them flying.
As we shift into the Stabilization and Support Operations phase, it is difficult to support the logistics burden of these aircraft over long mssion durations.
So Much of the surveillance mission shifts to troops on the ground - for instance to foot patrols and intelligence officers.
The post-combat environments in Afghanistan and Iraq show just how taxing it can be to sustain our surveillance systems for long periods.

So what is our new vision for tactical surveillance? First, let's address the broad problem of finding and tracking moving targets.
One important element of our vision is SPO's Innovative Space-Based Radar Antenna Technology program, which you will hear about in the next session.

We are developing the technology to allow a space-based radar to provide tactical-grade tracking and targeting of ground moving vehicles and to do so in real time.
A space-based radar with real-time, targeting-quality precision will enable space to support the tactical warfighter.
With the enduring access afforded by space, this capability will be available over all the hot spots in the world, all the time, from long before Combat begins until long after it is over.
And we will get it without bringing large quantities of surveillance aircraft into the theater of operations.

Our other new program for tracking movers is an unmanned, airship-based radar.
This radar will be even more powerful than the more distant, space-based one I just described.
It will surveil and track not only moving ground vehicles, but also all air vehicles in theater.
Moreover, it will be able to track dismounted troops - something very difficult to do today.
And, at the same time, it will have plenty of radar aperture left to provide ultra-wideband communications links for ground users in theater.
It may even be possible to use this radar to illuminate passive RF tags worn by all coalition forces.
This would allow us to unequivocally differentiate friendly and enemy forces.
This airship will sit - and stay - at 70,000 feet.
This is high enough that the airship can be defended even during the Combat stage.
The altitude also provides such a large footprint that the airship can carry out its mission at stand-off ranges before Conflict, during Intelligence Preparation of the Battlefield.
When I say the airship "sits and stays" at 70,000 feet, I mean it is designed to be operational and self-sustaining at its designated station for at least one year before returning to its ground station for any necessary maintenance or resupply.

Together these two types of assets - the space-based and the airship-based radars - will provide extraordinary new capability in seamlessly tracking and targeting ground and air movers, and in providing a wide-band "skyhook" for communications throughout tactical operations.
And with no aircraft to resupply, they will carry out all of these missions with essentially zero in-theater logistics burden to support the sensor platforms.

But there is more to our vision.
During Combat, when the environment is most dynamic, specialized surveillance needs arise that go beyond the problem of finding moving targets.
For instance, it is important to know where previously unused command and control locations are, and this can be especially difficult in urban environments.
As part of our new LAASS program, we are developing ways to locate, target, and assess battle damage for such "pop-up" command and control sites.
This specialized function has relatively short mission duration and benefits from extremely close access.

In this case, we believe that unmanned aerial vehicles are the most appropriate platform.

So our vision is one of "tailored" tactical surveillance, in which we move multi-purpose air and ground moving target radars onto spacecraft and airships, and reserve aircraft for specialized functions that require close proximity; this greatly reduces the overall logistics burden of our surveillance systems.
Beyond simply addressing the logistics issues, this approach will enable brand-new capabilities that will provide a more complete picture of the battlefield to the warfighter throughout all stages of conflict.
Larry Corey will tell you how we are working to make this vision a reality.

The last theme we will discuss today is Assured Urban Operations.
In the future, the world's populations will increasingly gravitate to large urban environments.
We must be prepared to fight and win the Nation's wars in cities of all sizes without resorting to World War II-style "rubbelization".
But the urban environment is challenging.
The vertical dimension limits sightlines for our forces, and distorts or prevents the signal propagation to and from our sensors.
Buildings both constrain the movement of our troops and provide enemy defensive positions that must be cleared one at a time; so urban terrain leads to a complex, almost fractal battlefront that greatly increases the exposure of our troops to attack.
As we shift from Combat into Stabilization and Support Operations, this exposure only increases - whether in maintaining supply lines via convoys of vehicles, or in daily peacekeeping patrols of dismounted troops.
This exposure is made more dangerous because enemy combatants can hide themselves among the non-combatant population, increasing their opportunity to gain close access to our troops.

Later this afternoon Paul Benda will describe a number of activities designed to alleviate problems specific to the urban environment.
For the Intelligence Preparation of the Battlefield stage, we are working on ways to map out the floor plans of buildings before ever sending troops in to clear the buildings; and to find "pop-up" command and control sites hidden inside buildings.
For the Combat stage, we are looking at new ways to shape the urban battlefield: by dynamically and reversibly controlling access routes, so that our ground forces can move where and when we want, while preventing the enemy that same freedom; and by providing enhanced navigation and localization capability, so that we will know where all friendly and enemy troops are, outside and inside of buildings.
And during Stabilization and Support Operations, we seek to remove the effectiveness of low-tech weapons of opportunity that are used in these "fractal front" environments - improvised explosive devices, suicide bombers, and even toxic industrial chemicals and dirty bombs.
The airship program I just described will be especially important, because it will allow us to track individual enemy combatants to the scene of trouble, backtrack them to their safe houses, and thereby route out whole cells of insurgents.

So as you can see, we have a number of exciting initiatives in these five thrust areas covering a spectrum of emerging threats and challenging environments.

Some of the problems I laid out already at hand, while others are not yet here.

But in all cases, we are anticipating our future needs and working hard to develop the necessary solutions today.

With that introduction, I will turn the podium over to Dr. Wayne Bryden, who will speak about our interests in the area of defense against chemical, biological, and radiological weapons.

Thank you.