DARPATech, DARPA's 25th Systems and Technology Symposium
August 9, 2007
Anaheim, California
Teleprompter Script for Dr. Joseph Durek, Program Manager, Strategic Technology Office – The Warfighter Presentations

Transparent Walls and Dirt

» **JOSEPH DUREK:**
We've all heard the old saying, "You can run but you can't hide."

But terrorists and other enemies are trying to do just that -- hide.

Not to get away from us but – as Dr. Honey pointed out -- to take the advantage away from us.

It's a simple and effective strategy.

By burrowing underground our adversary puts tons of rock between us and WMD manufacturing.

By tunneling under security perimeters, his hostile intention is hidden until he is ready to strike.

By blending into the urban landscape, he limits our ability to react.

In all these cases,
we are reduced to fighting these "shields" of rock and plaster before we can get to him.

It's estimated that there are thousands of strategic underground facilities spread across

dozens of countries–
with a significant fraction of them hiding weapons of mass destruction, missiles, or military leadership.

And they're proliferating.

They also present a very serious organizational challenge for the foreseeable future.

The threat of hiding enemies isn't restricted to underground facilities, either.

We are all familiar with
Al Queda's use of natural caves to regroup and
plan attacks.

Or the smuggling of rockets into southern Lebanon using
man-made tunnels.

Or Iraqi insurgents blending into the urban terrain of Baghdad.

We read the headlines of their carnage, but we don't see them under the dirt or behind concrete and plaster walls.

If we think of rock and walls as barriers to be broken down,
our progress will be slow and hard.

But if we think of them as media to transmit information,
if we turn the situation around so that the shield becomes a tool or a weapon to leverage against the enemy,
we can make significant progress.

Instead of struggling against our adversaries shields, where we don't

even know that there is anything there,
I want to know how to make these physical shields “transparent”.

Let me elaborate on what I mean by that.

First, we want to see through our adversaries shield.

Our adversaries’ hiding takes away our traditional “vision”.

We need to replace this with a vision developed using other kinds of signals to give us a three-dimensional blueprint.

Without ever having
to be inside.

Think of creating an image based on sounds – for instance,
I’ve never seen the robin’s nest in my yard but I know which tree it’s in, when it’s feeding time, and when the squirrels are getting too close.

How do we build this vision?

We exploit that fact that every single UGF or building creates telltale signs that describe the hiding place.

They are there and
they are unavoidable.

Thermal anomalies outside cave entrances,
or heat issuing from ventilation shafts.

The sound of whirring machines or
people breathing or
hearts beating.

Plant and animal life in or around the surface.

Even emptiness has its own gravity signature that we can use.

Are these signals easy to use?

No.

And they are often
buried in clutter –
think of the nesting robin in the middle of a freeway during rush hour.

But the signal is still there.

And if we can detect these signals, this will enable us to see with "extrasensory awareness".

An early step on the path of constructing alternative "visions" is the Low Altitude Airborne Sensor System (LAASS) which images underground facilities using the acoustic and electromagnetic signals that leak through the shield.

Given the constraints and "noise" of the flying platform, each individual sensor measurement may be comparatively fuzzy.

Viewed as pixels of an image, however, they provide an overall picture.

Though each cell contains little more information than color and position, together they provide information on the layout of the facility.

And if there are
no signatures

readily available –
our view is dark –
we can shed light on it.

The exploration industry serves as a model,
having developed electromagnetic and seismic technologies to
illuminate oil reservoirs or leaking tanks –
through the geology.

We want to probe the urban jungle as well, interrogating
building interiors to
identify floorplans,
locate adversaries, and find anomalous quantities of material.

But this brings new challenges.

For instance, the Visibuilding program is striving to make active radar a viable probe.

But to do so,
they must untangle the complicated scattering of energy inside the building to provide a clear picture.

I need you to expand this notion of “vision”, thinking in three, and even four, dimensions including time.

Beyond the hum of machinery, perhaps there’s useful information in the sequences of switching or variation in power currents.

Are there other ways to interrogate a building, through either
passive listening or
active probing?

And what if we want to see deeper inside a building, or into a basement?

How much of the area do we need to sample –
for instance,
can we interrogate the entirety of a building from its exterior?

From only one side?

What are the observables, how do they leak out of the building, and how do we exploit them to tell us about the interior layout, mobility corridors, occupancy, and
hostile activities?

All this is just scratching the surface, so to speak.

We need – to use an appropriate figure of speech -- to dig deeper.

Next, we want to reach behind the shield.

I promise you that the answer to an enemies' thicker roof is not a bigger bomb.

Instead, we are looking for ways to make rock and walls "transparent" to defeat and permeable in every way.

The way to solve this problem is with new perspectives.

For example, the Strategically Hardened Facility Defeat program is developing and validating new non-nuclear penetrator approaches that allow us to reach a shielded target buried deep below hard rock.

Are there other perspectives to render a facility useless and defeated

that circumvent the huge mass of overlying rock, cement, and dirt?

In my yard, a sonic gopher repellent chases away rodents without actually destroying the tunnels
he dug.

Is there a similar philosophy we can use against adversaries
who insist on hiding underground?

Finally, we want to operate within the shield.

Once we break through the shield, we have to do three things to gain the same level of familiarity
as the enemy.

We need a map.

And a means to navigate.

And the ability to communicate.

All in an environment where our radio dependent technologies like radios and GPS
don’t work.

DARPA is exploring some ideas in the Robust Surface- and Sub-Surface Navigation programs to use signals in the environment or beacons to restore navigation inside buildings and underground.

In this case, the confusion of urban clutter actually becomes our ally.

But this only addresses one of our needs.

My question to you is whether we can satisfy
all three needs – a map,
a GPS, and a radio –
with one system.

And can we do it without leaving breadcrumbs?

With your help,
we at DARPA are making progress in all of these goals.

Yet, there are challenges we need to embrace to make more rapid progress.

Each of these is critical
if we want our forces to confront hidden adversaries with confidence, familiarity, and the advantage:

First, the solution is not one scientist.

It's human nature to turn to a single technology to solve a problem, striving to make our sensor better – more alert to the threat, less sensitive to noise.

But, for example, what is that best technology when looking for tunnels?

Is it gravity, which reveals the absence of material?

Is it eletromagnetics, which exposes the absence of conductive material in the void?

Or is it temperature, exposing the entrance
by the air flow.

To be frank,
I'm not sure I can pick the most definitive evidence.

The point is I shouldn't have to – combining signatures over space, time, and modalities may be the only way to provide a complete picture.

I need scientists across all disciplines – chemistry, biology, physics, economics, statistics –
to recognize how you can contribute part of the complete solution.

Next, the solution is not a thousand soldiers.

I just finished talking about collecting signatures across many disciplines.

And we need them to search for shielded enemies as well as to interrogate their shields.

This all sounds like a lot of equipment and people to deploy and operate them.

The geophysical exploration industry is proficient at detecting underground structures – their livelihood depends on it.

But they arrive at a site with trucks of equipment, large crews,
and put the sensors where they need them for as long as they need them to get their answer.

This is not operationally feasible, where the people deploying and operating a system should not be vulnerable or exposed.

And equipment shouldn't be unattended and easily discovered or destroyed.

Solving the problem of our adversaries shielding is hard; I'm giving you a harder problem –
to do it with minimal intrusion and exposure.

Finally, don't just negate their advantage –
reverse it!

We need to make technological leaps,
not merely keeping up with adversaries
changing tactics.

Again using the example of gravity, we can exploit the hole that the adversary dug –
that wasn't there until he decided to hide.

Since our enemies are trying to use infrastructure against us, what are the ways we can use it against them?

Our goal at DARPA is to turn our adversary's chosen hiding place against him.

We want our adversary to struggle against his terrain while he's fighting us, and not the other way around.

That's what we're about
at DARPA.

Vaulting into the future ahead of our adversaries, not simply reacting, and rethinking what is even considered possible – such as making an opaque world thoroughly transparent.

Now, let me introduce my colleague,
Jennifer Ricklin,
who will raise our sights to focus on seeing through clouds and fog.