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Teleprompter Script for Dr. Thomas Bussing, Program Manager, Tactical Technology Office

IMAGINE: Getting There Fast

» **THOMAS BUSSING:**

"Speed kills."

Transportation safety officials and driving instructors have been telling us that for years, and the data confirms it.

The faster a vehicle is moving, the less time there is to avoid a collision, and the greater the chances that somebody won't survive.

This sounds to me like the kind of fundamental truth the U.S. military should exploit.

And, in fact, that's what brought me to DARPA.

I want, with your help,

to develop

high-speed weapons

for our nation.

By high-speed I mean airborne, land based and sea based weapons that not only travel fast –

Mach 2 or much higher – but can be launched fast to respond almost instantly to strategic and tactical opportunities.

Such capabilities would have a profound effect not only on military strategy and tactics but also on our national foreign policy.

The advantage of striking fast is hardly a new idea.

More than 2,000 years ago, Julius Caesar built one of history's most successful military careers on his ability to move and strike so quickly

that he often caught his adversaries –

even those who knew him and his tactics well – completely off-guard, often enabling him to defeat opposing forces

far larger than his own.

In one famous instance, Caesar's legions struck with such unexpected speed and force that they obliterated the opposing army in five hours.

In reporting his success to the Roman Senate, Caesar conveyed the speed and totality of his victory with three simple words: "Veni, vidi, vici." –

"I came, I saw,

I conquered."

I came to DARPA to help make these ideas relevant to 21st Century America.

I want America to have the capability to strike so quickly, precisely,

and forcefully that we can neutralize the advantage of any adversary in a conventional war.

To have the option of demonstrating our military capabilities with a

single, decisive, surgical strike so impressive that not just nation-states but insurgent and terrorist groups would hesitate

to attack us.

Let me be practical –

what if enemy forces are massing along the border of one of our allies.

What if the number of ground troops is overwhelming,

and strongly supported with armor battalions, surface-to-air missiles, sophisticated C4ISR, Theater Ballistic Missiles, and tactical WMDs.

What if, our forces in the area are drastically overmatched?

Are there viable options even with these daunting disadvantages?

Yes, if within an hour or two we could strike a paralyzing blow from bases in CONUS or

from sea, land, and

air platforms

around the world.

Moving at between 2,000 and 10,000 mph, these hypersonic weapons would be very difficult or impossible to defend against and, even before the battle begins, the enemy's advantage is largely neutralized,

and the balance on the battlefield tipped in our favor.

Another example,

which is very real today,

is a top-ranking terrorist leader is spotted entering a building.

The information races up the chain of command, and within minutes the decision is made to strike.

Within moments a hypersonic weapon is launched by our fleet.

Less than twenty minutes later, compared to hours for an aircraft or cruise missile delivered bomb,

a projectile traveling at Mach 6 strikes the building.

The immediate building is utterly destroyed,

with minimal collateral damage.

Scenarios such as these are possible and I came to DARPA to help make them happen.

As significant as they are, weapons are only one example of high speed delivery systems.

DARPA envisions technologies for a

wide range of

“get there fast” missions.

For example, manned hypersonic vehicles delivering payloads over great distances in

very short times.

Or, another “get-there-fast” mission might involve vehicles giving us access to space in hours,

not days or weeks.

How about small, collaborating high speed UAV’s delivering payloads or conducting time-sensitive ISR missions?

Or, unpiloted transport vehicles that deliver munitions, supplies and people rapidly, and, *incidentally*, land vertically or on short runways AND survive in a battlefield environment .

What makes the development of such high speed capabilities a DARPA-hard problem?

Many things.

There are steep technical challenges to overcome in propulsion,

thermal protection and thermal management, materials, guidance, sensors, fuses and novel manufacturing methods.

In addition, we need to integrate all these elements and capabilities into packages that are small and lightweight enough to be practical and, of course, affordable.

As a prelude to future opportunities, let's talk about several game changing "get there fast" activities currently underway at DARPA.

First, reusable High Speed propulsion,

like the engine cycle being developed for the Falcon program.

Current gas turbine engine technology can propel a combat aircraft to about Mach 2.

That's good

but not good enough –

it is only halfway to

Mach 4 where the transition to a scramjet

is feasible.

Scramjets function pretty well about Mach 4.

How do we resolve this performance gap between Mach 2 and 4?

One approach is to extend the performance of turbine engines to tolerate the tremendous heat generated in reaching speeds approaching

Mach 4.

In this area, DARPA is preparing for a High Speed Turbine Engine demonstration by ground testing an expendable Mach 4 turbojet.

Complementing this work is a demonstration of a Mach 4-7 air-breathing hydrocarbon fueled scramjet engine.

If both of these demonstrations are successful, we must then find some way to ensure that these two means of propulsion work together seamlessly.

But the ultimate challenge is to develop a vehicle with a single engine combination, a Turbine Based Combined Cycle capable of taking-off, accelerating to Mach 6, and landing.

This is a very hard problem given the extreme thermal and mechanical forces at play.

A key challenge is to scale up, to be demonstrated sub-scale, Turbine Based Combine Cycled engines to full scale systems.

We do not have all the answers and

welcome your help.

Going up the speed scale, we're looking long-term at developing Hydrogen Fueled Hypersonic Cruise Vehicles capable of both Mach 9 and long range operation.

Pushing even harder on the accelerator,

we're also working on a flight demonstration of a hydrogen fueled scramjet engine capable of propelling an aircraft to Mach 10 (7600 mph).

Another promising concept that DARPA is pursuing to use speed to our advantage, is the Oblique Flying Wing.

The Supersonic Flying Wing is a very aerodynamic and structurally efficient shape, offering the possibility of an unprecedented combination of range, speed and endurance.

We can vary the sweep of the wing surfaces.

We can change the shape to a high aspect ratio,
long wing span,

for efficient loiter or cruise at low speeds.

We can also change the shape to a high fineness ratio, short wing span, for efficient high speed flight.

Such an asymmetric platform has inherently less drag than symmetrically swept wings, allowing more efficient supersonic flight and promising efficient subsonic operations and reducing dependence on in-flight refueling.

Operationally, the Oblique Flying Wing's capability for supersonic flight improves its survivability and reduces its response time.

And being able to carry large payloads increases its productivity and reduces the number of assets required to achieve campaign objectives.

DARPA is developing an Oblique Flying Wing Program X-Plane to test these ideas in flight.

We are making good progress, but still need your help in developing and implementing this important concept.

In another area requiring speed, DARPA is involved in rocket engine and flight demonstrations of systems capable of providing low cost, immediate response to situations requiring the insertion of small satellites and other payloads into orbit.

In addition to addressing the challenges of propulsion, DARPA is looking to develop expendable hypersonic glide vehicles for evaluating aerodynamics, materials, and subsystems to be used in re-usable vehicles.

And in terms of exploring applications of hypersonic technologies,

we have just begun a program to demonstrate our ability to deliver a persistent ISR capability anywhere on the globe within one hour and remain on-station until the mission is accomplished.

All of this is fine and good for high speed systems and hypersonic aircraft, but what about high-speed missiles?

Well,

we're making a solid start.

DARPA and Office of Naval Research's Hypersonic Missile Flight program is in the midst of demonstrating a Mach 6 air-breathing hydrocarbon-fueled dual-combustion ramjet specifically for use in hypersonic weapons.

In all these activities

we are looking to you

to help us develop and demonstrate these ideas and concepts.

After all, these are very hard problems.

Speed is so vital to success that DARPA and the Department of Defense are pursuing

two major capabilities:

Medium Range

Time Critical Strike and Long Range

Time Critical Strike

missiles.

A Medium Range

Time Critical Strike Missile would have a notional range of between 500 and 800 nautical miles and travel between Mach 3 and Mach 6...

while a Long Range

Time Critical Strike Missile would have a range of between 1000 to 3000 Nautical miles and

travel at Mach 5

or much faster.

The Medium Range

Time Critical Strike example demonstrates an important principle.

It's the principal that we can seize an opportunity to neutralize a known threat, as in neutralizing the advantage of a large opposing military force in the opening stages of a war.

The Long Range

Time Critical Strike example also demonstrates this principle,

seizing an opportunity to neutralize a known threat

early in a campaign.

Hypersonic weapons can be used to achieve more than the destruction of a specific target!

They can change the behavior of an adversary.

An army that has suddenly lost its most critical technical assets and its decisive advantage will be forced to reconsider its plan to attack.

Terrorist and insurgent groups and leaders who see the speed and precision with which we can strike will be forced to curtail activities that might expose them to similar treatment.

And when our adversaries realize there is no defense against these weapons, our nation gains an important edge.

Caesar understood this.

By demonstrating clear military superiority based on intelligence, speed and surprise, he was able,

in many cases,

to thwart his enemies without waging war.

When battle was required, Caesar fought.

But when he could further his aims without bloodshed or the expenditure of treasure – by the power of his reputation built upon speed – he did so.

The costs of fighting a

full-scale conventional war can be extremely high.

And this says nothing of the loss of life or the disruption of the lives of individuals and the fabric of our society.

Suppose we can develop hypersonic weapons with a reasonable investment.

Suppose we can produce them inexpensively.

We could then use them effectively to change the behavior of our adversaries before hostilities erupt into war.

Just think of how much treasure and how many lives might be saved?

How much more secure might our nation be?

How much stronger our position in the community of nations and our ability to peaceably advance our national policies?

There could be no higher return on our investment.

But we must have innovative ideas to guide such an investment.

We need technologies that can pinpoint targets to within a meter or less and track them

second-by-second.

We need innovative ways to shorten our Command and Control decision

time line.

We need affordable, reliable hypersonic or near hypersonic weapons that can be configured

for just the right effect.

The right effect could be an appropriately-sized warhead or even no warhead at all depending upon how we chose to exert influence.

The payload should be small enough that carrier platforms can transport and launch many of them.

And to minimize development and production costs,

they should use existing components, platforms, and support systems whenever possible,

and take advantage of advanced manufacturing techniques.

All in all,

we need to shorten every element of the kill chain, and give our leaders the maximum military and political advantage possible.

I can not emphasize enough the importance of developing and producing affordable systems.

Ultimately, the user will do a value trade on any new system.

Only if the trade is favorable, and I believe it must be eye watering,

is the likelihood that the system will be developed and procured high.

My ultimate goal is to enable our country to deliver appropriate military power anywhere in the world virtually instantaneously,

before an enemy has time to prepare and react.

It is a challenging goal, but one that is worth pursuing, because achieving it will profoundly affect not only the future of America's military but our nation's long term ability to succeed in its foreign policy.

I am sure everyone in this room understands the importance of being able to influence others from a position of strength.

I believe, that if weapons of this type were available today, they would strongly change the face of warfare!

Thank you.

And now I’m pleased to introduce my DARPA colleague Dan Newman who will talk about Operating without Restrictions.