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Teleprompter Script for Lt Col Fred Kennedy, USAF, Program Manager, Virtual Space Office

Protection

» **FRED KENNEDY:**
let's talk today about how DARPA is thinking about protecting space assets – those circling eyes and ears that have allowed us to enjoy unmatched ISR capabilities for decades.

This past January,
we watched as the Chinese successfully destroyed one of their own satellites in low earth orbit.

That was a wake-up call…

…especially for folks who may not have noticed that more and more nations are joining the
"space club," and that charter members like China continue to add to their impressive space resumes.

To be sure, it seems unlikely that China's leaders would want to spark a space arms race with the United States.

But what happens if and when these capabilities proliferate?

What if they end up in the hands of a rogue state with little to lose?

One that might relish a high-tech shot at the world's only remaining superpower?

The technology is already out there.

Many nations and organizations are building their own micro satellites and using others' launch capabilities to hitch a ride into orbit.

Others are rapidly figuring out how to get to orbit
on their own.

History has shown time and again that once someone demonstrates a new capability,
on earth or in space,
it won't be long before these capabilities show up in other people's hands.

The inventor needn't set out to maliciously proliferate key technologies;
in most cases, the example is enough—
if others know it can be done, they'll find a way to do it too.

Imagine if, five or ten years from now, a rogue state decides to launch a very small satellite into the vicinity of one of our more important space assets in low Earth orbit.

Now, our rogue initially tells us, "Not to worry."

They're simply watching the watcher, verifying our good intentions.

But then the rhetoric changes.

They accuse the United States of eavesdropping.

They demand we

“close our shutters” over their territory.

They claim our reconnaissance activities are provocative and a possible precursor to military action.

Through diplomatic channels, we politely refuse to comply with their demands, citing our abiding interest and presence in space for over half a century—

—freedom of the skies.

What happens next?

Well, our space asset begins to malfunction.

We’re unable to control it the way we’d like.

Is this a coincidence?

No.

There’s a direct correlation between activities of the rogue’s “monitoring” platform and the anomalies we observe on our spacecraft.

Then, the ultimatum:
If we don’t comply with their “reasonable” requests, the rogue claims they can do more than cause reversible “malfunctions.”

Of course, they add, they’d rather not have to do that.

The question is…
who flinches first?

We could just accept that the genie really is out of the bottle — other nations will deploy better systems and present greater threats, and this trend will continue, even worsen.

Consequently,
operating in space will just be a lot tougher.

Quite frankly, we find this approach unacceptable.

There are really only
two options open to us:

Meet the challenge down low, or migrate outward — away from our competitors.

Since most of our space club newcomers will have only a very limited deployment capability, their reach is bounded to Low Earth Orbit—
no more than about 1,000 kilometers in altitude.

For systems that really do have to stay low,
we should seek ways to aggressively protect them; but for other capabilities, we should envision sending them to higher orbits, as high as geosynchronous orbits and beyond,
35,000 kilometers above the earth.

Only a handful of countries can place space assets this high.

The key to meeting the challenge of other nations in Low Earth Orbit is developing the ability to get our own satellites into place very rapidly – much faster than ever before.

It's the classic OODA loop — get inside the other guy's decision process and launch a response before they realize what we're up to.

If we discover a rogue state is about to launch a suspicious payload,
we should be prepared to throw up our own response within a matter of hours.

Yes, hours.

DARPA envisions launching
very small satellites – aptly named TICS,
for Tiny, Independent, Coordinating Spacecraft.

Each of our TICS might weigh no more than
ten pounds — and each would be lofted into orbit via advanced boosters which will look a lot less like conventional rockets and a lot more like tactical munitions.

Small missiles such as AIM-7s or HARMs.

They'd be fired off the rails of stock fighter aircraft, much like their conventional cousins.

They'd be inexpensive to build, simple to load and launch, and autonomous once they reach orbit.

TICS could be launched in any direction,
without relying on expensive ranges, whenever the need arises.

In hours,
not months or years.

For our rogue,
detecting a TICS launch would be very difficult,
if not impossible.

Your average launch is a real production, with huge boosters assembled on purpose-built pads over periods of months, in two fairly obvious locations on each side of the continental US.

Everyone can watch,
and they do.

TICS would be something else altogether.

Any suitable fighter aircraft could deploy TICS from any base around the globe.

To the casual planespotter, it would appear to be a typical takeoff followed by a
run-of-the-mill missile test.

We get flexibility of deployment and the element of surprise,
all in one package.

Multiple sorties of TICS could place numerous defenders in position to protect our vital assets in low Earth orbit.

Deploying multiple, similar TICS would improve their robustness to threats.

This is a little different from what's been proposed by my colleague, Owen Brown.

He wants to fractionate spacecraft by function, while TICS would be all the same.

Think of TICS as an army, launched individually and then quickly closing ranks to protect our assets.

If a rogue state knocks out one, there'd be more to deal with.

Perhaps they would come together and form aggregate structures…

…shields…

…booms…

…apertures.

TICS payload technologies are becoming available now.

Cubesats and other nanosatellites are riding the microelectronics revolution, with chip-scale avionics, sensors, and actuators leading the wave.

The bigger challenge is getting something as small as a HARM missile to put positive payload into orbit.

Fortunately,
we have some sharp minds in the audience.

I'm charging you folks today to move forward and make systems like TICS and its launcher
a reality.

I think we have a
50-50 chance of accomplishing this within
the next five years – certainly within ten.

That's one way we can meet the challenge in

Low Earth Orbit, but…

…how about
“migrating out?”

We can defuse the threat that small players pose by going where they can’t follow…

By developing critical technologies that enable us to operate space platforms in much higher orbits.

This will be no mean feat.

We’ll be pushing performance limits,
that’s certain.

Today, our civil space program operates cameras and space telescopes with apertures of up to a couple of meters across.

That’s the size of Hubble’s primary mirror.

Lofting our satellites into higher orbits
will require very large single apertures, segmented apertures, or even multiple telescopes with very fine control over their separation,
so that we can combine their inputs and achieve resolutions obtainable today only from much lower altitudes.

Radar and lidar applications pose even greater challenges.

Because of their size and weight, these satellites may actually need to be built in space.

As you push out to these orbits, and especially when you begin to address active methods for remote sensing, power production takes center stage.

Many kilowatts of power will be needed to operate such satellites in high orbit, versus just a few today.

We have the technology for high power now,
in the form of solar arrays like those used to light the international space station.

But… put these on a satellite and it becomes heavy and hard to launch.

So, let’s drop the current paradigm for making power on-orbit.

It’s not just about bigger and bigger solar arrays.

Sure, we’re dealing with a fixed level of solar energy input at earth’s mean separation from the sun, but there may be other ways to get at that power.

One promising technology under development focuses on the use of concentrating optics.

The deployment of a large but ultra-lightweight concentrating optic would enable us to gather the same amount of sunlight as a large solar array, but transmits the energy to a small solar panel capable of accepting the much greater flux from the concentrator—
and rejecting the significant waste heat which is generated when solar energy is converted to electricity.

We’d trade heavy arrays for diaphanous, reflective films and lens systems, and greatly lower the overall mass of these systems.

Such systems will no doubt be complicated to develop, but I know we are up to the challenge, and the payoff will be immense.

Higher power off of smaller spacecraft will permit us to take better advantage of key advances in
electrical propulsion.

Not only does high power and electric propulsion permit efficient access to higher orbits,
it allows spacecraft in these orbits to maneuver to avoid problems.

High power also enables some very interesting capabilities we will need to leverage in these distant orbits.

Remember, help from the ground won't quickly reach systems at altitudes of tens of thousands of kilometers.

They will either have to provide their own protection, or we will have to put special-purpose systems in their orbits to do it for them.

We're taking the first halting steps at building such "first responders" now – very fast, high orbit vehicles that provide both protection and repair services.

Not only would
such systems
deter the bad guys...

They'd also provide maintenance capabilities, such as battery replacement, refueling and
other key needs.

Orbital Express,

a recently completed DARPA mission,
is a possible forerunner of operational first responders of the not-too-distant future.

These systems will be sufficiently mobile to move between key orbital nodes, watch for what doesn’t belong,
and repair or refuel other spacecraft when not on “patrol.”

Without space protection options, we’re faced with a dilemma.

Small operators can asymmetrically threaten our largest,
most expensive assets with impunity,
and — with no way to counter the threat —
we’d be obliged to accept the new status quo.

Now, imagine an America with rapid-response nanolaunch capabilities and small, robust spacecraft to make use of them.

With capable systems maneuvering in high orbits, out of reach of the mischief makers.

In this possible future, we’re not at anyone’s mercy.

We can get there – hundreds or thousands of miles above the Earth – sooner rather than later, but we need your ideas to get us there quickly, affordably, securely.

Thank you.

And now Tim Clark will come up to talk to you about Space Support to the Warfighter.