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NEW ADVANCES IN TRANSPORTATION AND SERVICE DELIVERY

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P R O C E E D I N G S

MR. WEST: Good morning. I'm Darrell West, vice president of Governance Studies here at the Brookings Institution, and I'd like to welcome you to this event on new advances in transportation and service delivery.

So there are a number of new features in the transportation area. Autonomous vehicles are being tested in major cities, ride sharing services are becoming more prominent, remote sensors are gathering information on road conditions, traffic, and weather, as well as other things, and unmanned aerial systems are being deployed for firefighting disaster relief and law enforcement, among other areas.

As an example, at the time of the Notre Dame cathedral fire in Paris, drones helped firefighters locate the location of the fire and the intensity of the flames, and then that enabled them to devise certain strategies. And so that was a way to gather information at a time when people were not exactly sure what was happening.

But at the same time that we have all these new developments, there are very important issues in terms of personal privacy, human safety, legal liability, and the kinds of regulations that we need in order to deal with these types of issues. It's a question in terms of how privacy can be maintained in the face of smart transportation features, how should federal and state agencies oversee these new technologies, how should we think about some of these new models going forward.

So to help us with these issues, we have three distinguished experts here with us today. So Mark Bathrick is director of the Office of Aviation Services at the U.S. Department of the Interior, Darshan Divakaran is a program engineer in the North Carolina Department of Transportation, and Margaret Taylor is fellow in our governance Studies program at Brookings and also senior editor and counsel at Lawfare.

So, Mark, I'd like to start with you. Tell us how the Department of Interior is using these technologies. Earlier you were telling us Interior manages over 500 million acres in the United States, so that certainly is a major responsibility. What have your

experiences been, what has worked well, what hasn't worked well?

MR. BATHRICK: Well, thanks, Darrell. And thank you, it's a pleasure to be here.

For the Department of the Interior, with the vast responsibilities we have as the largest land steward in America, of your land, all public land, it's really been a game changer for us. And we see benefits in what we call the four Ss. We're a science-based organization. We manage your land based on the science that we get from sensing. So we are able to get more persistent sensing with better resolution, we are able to take that data and analyze it and be transparent about it because we recorded through the use of unmanned aircraft systems. So we're better managing through better sensing.

Safety is our second S. We aren't necessarily taking many pilots out of the cockpit, although we are removing some of them from some of our most dangerous missions. But we are reducing the risk for many of our employees on the ground who have done a lot of these missions in traditional ways that are pretty dangerous, like inspecting dams by putting an engineer over the side on a rope to inspect the dam. We don't have to do that anymore with drones.

And then the third one is savings. You know, our entire fleet of over 670 drones within the Department of the Interior costs less than many of the single manned aircraft that we fly. There's training savings, there's maintenance savings. We've flown over 20,000 flights and I think we've had 10 mechanical failures out of those 20,000 flights. Very reliable. And we've saved over $14 million last year alone on just operational savings by substituting small unmanned aircraft for those traditional methods.

And the final one is service. We get about 49 percent of the vote about when we're going to go out and do our missions, whether that's fire, flood, volcano, or even migrations, and, you know, checking on your land, search and rescue certainly. And so we're much more responsible when we can take that aircraft literally out of someone's back pack rather than going down to the airport and scheduling a helicopter.

So those are the four things that we've really seen are a real game changer in our Department.

MR. WEST: Okay, thank you.

So, Darshan, you work in the North Carolina Department of Transportation, and I know over the weekend you were busy with Hurricane Dorian. And he was telling us earlier that they conducted 50 flights just to try and keep track of possible risk right there.

Tell us about your experience and how the State is thinking about this topic.

MR. DIVAKARAN: Sure. So as mentioned, with Hurricane Dorian luckily nothing major happened. But with Hurricane Florence last year we were well prepared with disaster response. With Hurricane Florence we had over 250 flight missions as conducted, and it was the first time where it was organized, you know, well organized where private and public sectors worked together with federal agencies, your traditional state agencies that are responding to disasters, with no incidents, no accidents. So that was a great game changer for us, that we could work with traditional agencies that wouldn't earlier accept the help provided to them.

But when it comes to North Carolina DoD and North Carolina as such, we have a history to keep up with the Wright Brothers. You know, we have to continue that tradition of being first in everything. I hope no one from Ohio is here checking into this. (Laughter)

MR. WEST: Actually, I was born in Ohio, so.

MR. DIVAKARAN: Too bad we can't change the history, but we take the credit for everything they did in North Carolina. And for us the main thing is that we would be like to be first in everything that's good. And we started with first in drone safety in 2017 where we started integrating safety training programs, workshops, conferences that focused on educating agencies, our public safety folks, our recreational pilots, everyone, even folks who are not interested in flying drones, but would just like to know about drones. We started with that. But then we also moved towards being first in medical package delivery, which

took place -- the first test was done last year, but actually right now the operations are live taking place every week at WakeMed Hospital where Matternet and UPS have partnered together and able to do medical package delivery.

The thing is the whole fact is that things are changing and it's changing at a fast pace. For North Carolina DoD we are the number one DoD in the Nation for integrating drone technology because we do everything and anything that's related to drones. We don't focus just on infrastructure and monitoring and inspection, but we do beyond that. We get into research where we work with agencies like State Highway Patrol on crash and reconstruction, we're going to underwater vegetation mapping with the environmental folks, disaster response, package delivery, even working with our recreational pilots to find spaces to fly.

All together our role has been not just, you know, a focus within the State, but it's been a national thing. We have become a national leader in education and outreach and we hope to continue that tradition with this technology moving forward.

MR. WEST: Okay.

So, Margaret, we've heard a little bit about the details of the state and federal levels in terms of how particular agencies are using some of these new models. How do you see the policy and regulatory issues in this space? What should we be worried about; how should we be thinking about these topics?

MS. TAYLOR: So I think, if I may, start with a little bit of sort of an illustrative examples of interesting things that people are using drones for, because I think it kind of shows rather than tells what some of the challenges are.

So let me just go through a few. I think it's really interesting and fascinating. You know, when we think of drones in the commercial space, you know, I think probably all of us are thinking delivery. Now Amazon is working obviously on these programs. You can imagine a drone delivering things in urban areas, to homes, delivering to remote rural areas. Very exciting, very efficient, presumably. So that's an interesting space. So I'm going to go

through each of the interesting applications and then come back to some of them and explain some of the risks.

So agriculture, lots of potential in the agriculture space. There are these really cool predator birds called robirds that can be deployed across a field scaring away other birds that eat the crops. So you can preserve more of your crops. Precision agriculture. You know drone swarms that can tell a farmer exactly what's going on in his fields very efficiently. Location drones -- this is a really interesting one -- that can track specific animals in a herd. So like use facial recognition software on a cow, a particular cow that might be sick or that can come in and, for example, diagnose a sick cow. So you can imagine just all these really interesting things that could make farming and agriculture more efficient.

Fighting a wildfire, which was referred to earlier. Flying a drone over a wildfire can yield really valuable information for firefighters about where the fire is, where it's going, how to stop it.

Law enforcement. Surveillance applications. I read a statistic that three out of four public safety agencies say they are already operating drones or working on implementing a drone program to assist in their law enforcement efforts. So, you know, better tools for them. As has already been discussed briefly, improvements in emergency response, healthcare, and medical applications.

And just the last one, climate related. I think these are really fascinating. You can go on YouTube and see drones being flown over, you know, beautiful mountains and glaciers. And you can just imagine it's being done using those drones to monitor climate change, to see what's going on with glaciers in remote areas where currently it's very difficult to get to.

Other things, using drones to generate electricity from high altitude winds using something called a box wing drone. That's sort of in development.

So all these interesting things, lots of possibility. Private industry is just

pursuing this and is really being very inventive. But as we all know, there are risks associated with these things and when there are risks associated with, for example, public safety, that's where regulation comes in, that's where policy comes in.

So back to delivery systems. Back in May in Switzerland a 22-pound Swiss post drone crashed about 50 yards away from a group of children. That drone program was suspended at that time. These questions are really tactile because what happened with that drone, as I understand it, is that the parachute that deployed once the drone was flying out of the sky actually shredded. And so the questions they're asking themselves, and lots of jurisdictions are asking themselves, are what are exactly the right safety standards, does doing a backup parachute, two ropes instead of one, how is it going to work exactly. Because when you have a drone crashing near a bunch of children, that gets people scared and engaged and against the technology.

Also in the delivery system, fears -- we were talking about this earlier -- fears of jobs going away. Right now Amazon -- you know, there's a guy who drives a truck and he pulls up in front of your house and he brings the package right up, so what's that guy gonna do? Is he now going to now be a drone operator? Like what's going to happen? Is he going to be trained to do that?

Law enforcement, and I think we'll get into more of this, Darrell, but you have to balance civil liberties obviously, privacy concerns. Citizens are going to wonder what the police are doing with the information that is being collected as it flies over, for example, a protest, taking pictures of everyone who is engaged in the protest. There also needs to be deconfliction with manned aircraft, the avionics of manned aircraft when you use drones.

Firefighting, especially firefighting. When an unauthorized drone enters a wildfire space -- so like somebody with either malicious intent or just a clueless person who's like, oh, I'm going to fly my drone and there's a wildfire nearby, that means all of the helicopters and planes that are fighting the fire have to then be grounded. So you have to

deal with the unauthorized UAS that might be coming into that system.

And, finally, back to climate. I just heard this a couple of days ago, some climate activists near Heathrow Airport, it's called Heathrow Pause -- I guess Heathrow is adding another runway -- and some climate activists are planning to use commercial drones to fly them into the no fly five-kilometer zone to protest the addition of that runway, to highlight the impact of air travel on the environment. And that's scheduled to begin on September 13. Unclear how long it will last. Probably those operators of those drones will be arrested. They're actually asking for drone operators to volunteer to come in and operate the drones as people get arrested so that more can backfill.

So, you know, this is a complicated space. There's upside and there's downside too. And the risks need to be sort of dealt with. And that takes the regulatory regime.

But I would say, Darrell -- and then I'll conclude my comments here -- you know, this technology -- I'm a governance person, I'm not really like a drone person per se -- this technology, it is just a new technology and all of the tools that we usually use to regulate and infuse these technologies with our values, it's the same process and the same types of considerations for any technology. So I don't see this as a brand-new sort of sui generis space. We should be using the tools that we have in the policy regulatory space to mitigate risks to people and also promote the benefits.

MR. WEST: Okay. Thank you.

So, Mark, Margaret has raised a number of policy and regulatory issues, privacy, surveillance, human safety, with law enforcement, like how long should the data collected through unmanned systems actually be stored? How is Interior thinking about these issues? And, by the way, we did try to get a representative of the FAA, which is the major agency in this area, to speak on the panel, but were not successful in doing that. Are there changes the FAA needs to make in response to some of these policy and regulatory issues?

MR. BATHRICK: So I think to start the first part of your question, what are we doing, the good news is, as Margaret said, these are aircraft. By definition they are aircraft. And thanks to the great states of Ohio and North Carolina we've had aircraft for over 100 years now. So we're getting pretty good at how to operate these things. And I say that when it comes not only to safety, but also to privacy and being a nuisance, you know, whether that's noise or just buzzing people. We already have laws against that kind of stuff. And the other good thing is we've had law enforcement, and law enforcement done from the air for as long as we've had -- pretty much as long as we've had aircraft. So all of those were policy decisions about, you know, what you can take from the air in terms of imagery and sensing and how long you can keep that data. Thankfully it's already been handled by law enforcement professionals and policy professionals, and so we didn't have to reinvent that.

It was reiterated in 2015 with a presidential memo on privacy and transparency that President Obama signed. And all the agencies that are operating drones, Interior being one of those, has a privacy impact assessment. You can go on our website, which we're very proud of -- chock full of information -- and you can see how we use the drones and how long we keep the data and how we keep that data, depending on what we're taking.

The one thing we have been very keen about in our program is to emphasize that the data is currency and just because you have an object you're trying to take an image of, you're probably taking imagery of other things. And so our biggest thing that we've done in privacy is we train all of our operators, all of our program managers, to talk to the public before you launch. Because if you tell people what you're going to do, and you're probably not going to tell them you're doing an active law enforcement operation, but if you're doing a search and rescue, you're doing a habitat survey, wildfire, you tell them you're out there doing that, they're always very appreciative. And the one question they ask is, hey, can we see the video, it's probably pretty cool. And then once you do that, they put

their imaginations to bed and it's all good.

So I think it's really just a lot of common sense, both on the safety and the privacy side.

MR. WEST: Darshan, I'll put the same question to you. At the federal level what types of new policies and/or new regulations do we need to consider? And, secondly, because you're operating at the state level, what about the differing jurisdiction of state versus federal agencies? How is that working out and are there changes we need to make there?

MR. DIVAKARAN: So, you know, as Mark pointed out on the privacy issue, yes, there is the whole concern on who's using and what's the data coming out it, but when it comes to state agencies, I would say that for us it's not FAA, you know, slowing the progress down technically, it's more states themselves slowing the progress. There are some states who are ready to go ahead faster, but there are some states who are still figuring out who is going to lead a drone program within the state, who is going to do what in the state. I've talked to states where they are having a basic issue of like -- I would say like half of the DoDs are still figuring out who should be the UAS champion within their agency. And when you are trying to move this technology further in our faster pace, if you take manned aviation, which has taken over 100 years to -- and it's still trying to perfect the whole model -- you have unmanned systems that you are expecting within 5 years to keep up with manned aviation, and the reality is that's not possible. And the only way to do that for state agencies is to work with the federal agencies to see how data can be shared to them, how with the integration pilot program -- the FAA's UAS integration pilot program -- there's a great opportunity for state and local government agencies to work with travel government and to work with FAA to help. You know, those three main focuses were -- one was how state and local government agencies, travel government agencies can regulate the airspace below 400 feet, can help regulate, and then second was how do we bring in new innovation and technology, not just within the United States but outside companies to come together. And

third was how does this also help in the economic development for the states and for the United States overall.

All this really -- it is like one and a half -- it's about two years into it and there's a lot of success coming out of it, which was not -- you know, two years back, you wouldn't see this. And when we were sitting on the other side of the table we felt that regulations were restricting. It's not there to get regulations in place, FAA needs data. And the only way for FAA to get data is where public and private sectors work together and provide the data. And for a state like us, you know, North Carolina, many of the folks who are sitting down here are partners with us and they have worked with us to make this successful. The success of a program is also the success of the industry and the people working with it. So when we are sharing this data, FAA is ready to work creating new regulations.

So the Part 135 came out of all this. Before getting into the integration pilot program, no one even thought about 135 Operations. And 135 Operations always existed on the manned side.

MR. WEST: Could you explain what 135 Operations are?

MR. DIVAKARAN: The 135 Operations, so in the manned aviation side you have your air carriers that transport people, you know, your airlines and everything, and then you have package delivery and cargo delivery. Those are your 135 operators. And how they operate is very different from commercial air carriers and everything. So there are certain regulations around it which could be like pages, maybe multiple pages. And when it comes to unmanned side, they realize that you're Part 107 Operations. That's the FAA Part 107 license is not enough for package delivery. So they came up -- said Part 135 Operations. Now Part 135 Operations is not something which we can just give a sheet of paper and say you need to X mark all these things and give us everything. FAA is figuring out what for manned aviation might have been thousands of pages, how does it become hundred pages or less for the unmanned system side?

So we are working -- not just us, but other nine states are also working with FAA to see what is required. You know, things like air wilderness for aircrafts, training standards for aircrafts. All these things are coming into practice so that after this any and every company is able to replicate this process and FAA can change the regulations. Say two or three years from now package delivery is no longer a dream, it's a reality. Like night operations, first it used to be like it's difficult to get night operations, now, night operations are more easy to get.

So these are the things where we are seeing the changes taking place, but it's also us as such that are restricting this progress. And that is where the regulations cannot be changed just because of a specific need of one company or a state, it has to be a mutual understanding between all the states that this is the progress towards the right direction.

MR. WEST: So, Margaret, I'd like you to answer your own questions about the need for new policies and regulations. How should we address privacy, how should we protect privacy, how do we promote human safety? On law enforcement, how long should law enforcement store data that they collect via drones?

MS. TAYLOR: You are very interested in that question, and I'm not sure I have a specific answer for you.

I think 180 days is the incidental collection sort of time period. So that's how long law enforcement generally would keep incidental collection of information and sort of get rid of it. So that I think, as Mark said, has been sort of a feature of law enforcement generally.

So maybe the best way to answer the question is to sort of talk about how I see the phases of these types of regulations and policies going. I think the sort of phase one was back in 2015 when the Department of Defense and the Department of Energy were given sort of legal authorities to sort of protect their own stuff. Obviously, that doesn't speak to all of these innovations in the commercial space. Phase two on the sort of legal side, and

it's currently being implemented, I think of as being -- so 2018 there was a law, the Federal Aviation Reauthorization Act included a whole big section in UAS, on drones, including a particular section called the Preventing Emerging Threats Act. And what that did was give the Department of Homeland Security and the Department of Justice enhanced legal authorities on the law enforcement side, among other things. And, you know, before that it was not clear that there were adequate federal sort of penalties for something like an unauthorized operation of a drone. And just as an example, it is being put into practice. On September 3 the U.S. Attorney in Philadelphia announced charges against a Bangor, Pennsylvania person. He was charged with a number of offenses, but one of them was knowingly operating an aircraft when not registered. He had a DJI Phantom 3, which is a drone you can just buy, seven improvised explosive devices, and ten firearms. And the quote from the U.S. Attorney was it does not take much imagination to conjure up the enormous harm that can result from the combination of illegal firearms, explosives, and drone aircraft.

So all levels of law enforcement were sort of involved in this action, so I think it's showing how a law that was passed can actually be put into practice to get, again, the normal sort of -- we think of as governance, laws, regulatory systems going in this space to deter people from weaponizing a drone and flying it and terrorizing their neighbors.

The future, which I think of as phase three, the future is figuring out -- from a public safety perspective I think is figuring out -- and this is the next big space, and we've talked a little bit about this -- is putting in the right law enforcement and regulatory framework so that state and local entities can also have the authorities that they need to protect the public. I think that is an underdeveloped space, but I know -- and a lot of it has to do with these issues, Darrell, about privacy, thinking through that, what is right for each community. So this is like the next phase. And just to be very specific, I think, you know, to protect the public going forward, state and local law enforcement are going to need three things. They're going to need remote identification so they can actually identify when there's a drone

that's a threat, UAS traffic management, so understanding what's going on in the space, and then the third thing would be the counter UAS. So this is the -- you know, if there is a drone that is a threat -- for example, going to hit critical infrastructure or something -- what can state and local law enforcement entities do to actually sort of like pull it out of the sky. And answering that question is a combination of technological developments that I think need to be encouraged, but also be in the regulator space, like making sure it's done right.

MR. WEST: Mark, I'm wondering if it's time that we should rethink how we think about airspace. So when you -- and I know both of the gentleman on the panel are pilots -- so other than landings and takeoffs most pilots are operating above 1,000 feet. When we're thinking about drones and unmanned systems, and certainly at the hobbyist level, we're thinking about activities under 400 feet. And so right now there's a lot of regulation at the pilot level, not so much regulation at the lower levels, but should we start to rethink how we think about the airspace so that the levels are starting to mix a little bit. Drones are developing better capabilities. It used to be there was a line of sight requirement, that as long as the operator -- the drone was in the line of sight of the operator, there were few restrictions. But, of course, drones now can stay in the air for an hour, they can go five to ten miles, so they're going well beyond the line of sight.

So how should we think about regulations in those areas? And then also what about no-fly zones? Like there are some areas around airports -- clearly, we don't want drone activity there. How broadly should we think about no-fly zones?

MR. BATHRICK: Well, Darrell, if we look at the airspace, I kind of look to where we've been. When we first fielded aircraft, and as they continued to improve in technology and in the markets that they served, we designed the airspace to fit those markets and the technology that was available. If you look at the unmanned aircraft space, we have a completely new class of aircraft. So we have great new technologies and we have new markets. And, as you said, as a Navy pilot I rarely flew below 1,000 feet unless I was on the training mission, a specific low-level training mission, or taking off or landing, you

know, the transitory through that. That airspace that we're currently flying all these drones

in, no one ever cared about. And evidence of that is we don't monitor that space. And UTM

is such a big issue because we didn't do anything down there.

So I think we have somewhat of a fleeting opportunity because no one is

talking about doing this. We have an opportunity, a blank canvas if you will, to design this

space. And our state partners and local partners, I think there are opportunities for them to

be involved. Local governments permit folks that put scaffolding up and do inspections on

buildings, to paint buildings, do window washing. I think that that same thing could apply to

drones doing those missions. Because if I'm an airplane pilot and I'm flying that close to a

building, I've got bigger problems than your drone. And so I think that there are things that

we should do there, especially when you're thinking about -- we're talking about small or

medium aircraft, if you talk about larger ones, you talk about urban air mobility in the future.

You know, now is the time to design that air space thinking forward rather than all the

sudden we get all this in place and now where are we going to put all this stuff.

So I think that's an opportunity we need to take advantage of.

MR. WEST: Okay.

Darshan, I'll put the same question to you, and maybe also add the package

delivery component to it, because that is an area that is likely to grow.

MR. DIVAKARAN: So I would say that a few things to think about is, first of

all, the words no fly zone, it's pretty confusing. Like, you know, even in the manned aviation

site, you have different airspaces, you have restricted airspace and all, but all have certain

criteria. So you would call certain areas, like airports, as responsible fly zones because

when it comes to flying at airports, there are two things, one is flying actually in the airport,

airport inspections, drones can be utilized, can benefit airports. You know, big airports,

small airports alike. Small airports you have limited staff and limited staff as a result you can

only do limited checks, and drones can be integrated into those small airports to do

inspections around the inspections of wildlife, night inspection, day inspection. Now, that's

flying within the airport.

Now you have operations around the airport, that could be your infrastructure, like rail, you have roads that need to be monitored. Now, all of these are traditionally -- you know, infrastructure monitoring that is done in the manned side, like bridge inspections and all, which is traditionally done -- you know, they do not go through airport authorization to get the work done. And these areas are pretty much areas closer to the airport where -- this is where there has to be a whole understanding of what is exactly a no-fly zone. Like particular infrastructure, you know, power plants and all those things, you can understand those are no fly zones. Others are responsible fly zones where you have certain restrictions, but certain authorities have that permission or are granted access based on certain conditions. Like it's not your Part 107 that's going to really change anything, it's going to be the future regulations that are going to come in. Like part 107 and -- we were talking sometime back earlier -- is like a student pilot license. All it gives you access is that, okay, someday you might become a pilot, but it's not going to guarantee you that you're going to become a private pilot, instrument pilot, commercial pilot, nothing. It's just a student pilot license that you are part of the training, you're going to do this. Then you have to go through a set amount of process to become an expert. Now, a private pilot cannot fly into clouds, cannot fly in the night. Now, these things are defined on the manned side, but when it comes to Part 107, you have your Part 107, you can do anything. No. That's the changes that need to come before the airspace. Before even we hit the airspace area, it's understanding what your license is valid for. You have to have extra mount of training to operate infrastructure area, airports. Then it comes to package delivery, you already have 135 Operation, what does that 135 Operation entail, is that you can fly packages. But when it comes to questions like crossing a road, if the road is maintained by the state, who has the right to permit that crossing taking place.

So those type of things are a concern when it comes to package deliveries. You will be crossing roads, you will be crossing over people, you're going to be crossing

over infrastructure that could be critical infrastructure or just state-owned infrastructure. Who has the right? And that is still a debate that -- traditionally, anything that takes off from the air is under FAA's jurisdiction. But through the integration pilot program, we are trying, which is still a process, not like we are close to finding a solution to it. It's still trying to identify that. And when it comes to FAA, they have asked us to provide data to prove that crossing roads is a safe thing when it comes to package delivery. So you have your drone, you have parachute on it, you have experts that are trained hours on it, you have packages that are like medical packages that go through the whole permission. You know, you have a whole different permission to use anything beyond just water and stuff. You have to go through all the authority. You have everything. Now comes the big obstacle is you can't fly over a road.

So how does that happen? And that is the changes that need to be made, is who has the authority after a certain altitude. And if you're actually flying over a person's property, does he have the right, does the state have the right. That authority, once we figure that out, then we can start hitting the airspaces and say, okay, up to 400 feet, 100 feet is this, 200 feet is that, you have responsible fly zones, you have restricted fly zones. That's where we have to still work towards, and that is where the problem is, is that urban air mobility and stuff, it's -- you know 2015 we talked about drones, 2020 we're saying now you're going to be having urban air mobility, 2025 what is the next? It's moving too fast and people really don't have that -- people are lacking patience to work with the inner agencies that are -- you know, you don't understand that these are traditional agencies that are seeing new technologies. They're not going to be like, yes, tomorrow you can get anything and everything that's done. You need to have the patience to move forward with them.

MR. WEST: So, Margaret, Darshan has raised some interesting questions in terms of who has authority, who should have authority, who should have the right to decide these complex questions.

Then, also, I'm just curious, given the overlapping jurisdictions and the lack

of clarity on some of the rules, how do we think about issues of legal liability when harms take place?

MS. TYLER: So that is a very good question. And I think, again, my answer would be we go to our traditional tools for how we think about legal liability. And I think those tools will work pretty well. The questions that I have going forward, though, relate to, for example, automation. When you have automation -- and I think this is a space that needs to be developed from a regulation perspective, from the law's perspective. I think there's a lot of lack of clarity there. Add in something like artificial intelligence, which is another one of these technologies which is also coming down the pike and will be integrated I'm sure at some point with UAS, other technologies, for example 5G. When you're integrating all these technologies together and you have artificial intelligence, there are some really, really, really tricky questions I think that are going to be coming down the pike.

I'm not sure as I sit there that I have the answer to those questions, but those are --

MR. WEST: Actually if you did you probably wouldn't be sitting here.

MS. TYLER: Yeah, yeah, that's right. (Laughing) But I mean you're right, like these are the questions that need to be addressed. And I agree that technology is just developing at a much faster pace than our ability from a governance perspective to think through these issues and implement them. And again, as I said before, like infuse our values, our ideas of liability, into these technologies so that the right people can be held accountable.

So it's probably not a satisfying answer for you, Darrell. If I did have the -- when I do have the answers I will get back to you on that. How's that? (Laughter)

MR. DIVAKARAN: (Inaudible) for the next panel.

MR. WEST: One last question for the panel, then we can open the floor to questions and comments from the audience, and that concerns the need for infrastructure investment. So we're talking about a lot of different aspects of transportation changing,

autonomous vehicles, the ride sharing services, the use of remote sensors, unmanned systems that we've been talking about. How are both state governments, as well as federal agencies, thinking about infrastructure? Do we need new designs in terms of how we think about urban areas? How are you thinking about that?

Mark?

MR. BATHRICK: Again, Darrell, I think the first part of the infrastructure is the airspace and I'm concerned we're not taking advantage of the opportunity to look at the airspace, particularly the below 400 feet airspace, and see what we could do with that to maximize safety, as well as the opportunity for drones.

As a user, largest non-military drone program in the world, I think so far, I'm concerned about the ability to get performance scalability and cost. And so when I hear about infrastructure like UTM, I keep asking who's going to pay for that. As a pilot who, even at 30,000 feet has lost radar contact in clear air, I worry about the -- and lost a lot of cell phone calls down low -- how well that's going to work and whether we need to invest that infrastructure.

Beyond vision line of sight is the best, everyone wants that, but I look at best is the enemy of better, and better is the enemy of good enough. And I'll you, we found that visual line of sight, as you get done you drive to another spot and you do more visual line of sight, is good enough and it's a lot better than what we had before drones, which was nothing. And so I worry about that we're going to over regulate and over equip drones that don't ever need to fly beyond visual line of sight. And I see some of that infrastructure being placed on here because of fear, security, and safety fear.

You know, I was at a Nationals game last year and the guy came over the loudspeaker and said everybody please get up and go to the concourse. It was a beautiful day, I don't know what was going on. When we got to the concourse and then after we got our beers we figured out that there was lightening within 10 miles. And so that was a non-material solution to a threat. And so why we can't do that for some drone threats instead of

putting lasers and guns and all sorts of stuff. And have we really thought through -- you know, that's great infrastructure, but have we thought through the consequences when we shoot down that drone on mall and it falls on a D-Day survivor, and it was a 10-year-old kid who didn't know the rules?

So I think there's a lot of stuff that we have to think about in terms of policy, in terms of investment before we make that. We might end up with a lot of stuff we don't really want.

MR. WEST: Darshan, your thoughts on infrastructure investment.

MR. DIVAKARAN: So infrastructure is what we do, you know. That's what our role is, the Department of Transportation. We maintain all the infrastructure in our state and all the other DoDs do respectively in their states. For us, there may be more models, but I believe there are two models to this. One is to build heliports, you know, drone ports, or all these things. That's one model people have been saying is you need to build this over buildings, over certain areas. And, you know, they get prepared for the future for urban air mobility.

But I also feel like coming from the manned aviation side, you know, for example, North Carolina has 72 public airports. Not all of them are utilized. You have barely like one flight or two flights taking off from some of these airports, which some do not even have flights taking off in a couple of days. And if you have infrastructure already built in these airports, why would you want to build a whole different area? You would want to utilize the available resources first. So like when we -- this is also during my stern pilot days, when I used to be flying -- this was in Florida. We used to go from airport to airport looking for cheap fuel because we have to build those 100 hours. And you go to certain airports and there's nothing, but they have a brand-new building, they have a tower, but there's nothing around. There's so much space there.

If you can utilize that space to create the future, that's great. If that space runs out, then utilize the next space available. But preparing, investing in something that it is

future and putting so much money towards it right now, and not sure when this is going to be

a reality. Initially it used to be 2020 was the date that people talked about. Now that's

looking like 2025, maybe 2030. We have a committee created within the DoD called Beyond

Surface Transportation. That's a 2030 vision. So we have already thought about 2030. So

we have skipped 2025 at a far range.

But this is something where industry -- this is basically something where it's

going to be not the traditional approach. You're going to have industries investing. You will

have state investing, and maybe using federal land and federal areas, also state areas. So

for the success of this it has to be from all sides. But like as Mark mentioned about counter-

UAS technology, setting up systems like that and all, it's something which people have taken

it out of proportion right now. Everyone wanted a drone, now everyone wants a counter-

UAS technology. (Laughter) Us being the hotline for all unmanned systems problems within

in the state, like police departments calling us and saying in the shooting range where folks

are practicing somebody is flying a drone. They are two solutions, either shoot it down, or

second thing is they wanted to buy a counter-UAS technology. You can go and buy. There

are very good products out there, but you ought to understand the rules around it.

Companies that have created drones have also created a solution to mitigate it. You have to

see that.

So I think altogether it is like when it comes to putting in money towards

these technologies, also seeing what traditional resources we have, first use that and then

move to the next step.

MR. WEST: Okay.

Margaret, your thoughts on infrastructure and then we'll take questions from

the audience.

MS. TYLER: I guess I would just note for the audience that there are a

couple of notice of proposed rulemakings out on, for example, UAS flight restrictions near

critical infrastructure facilities. Actually this one is scheduled to come out this year. So there

are opportunities for people to provide their comments, their thoughts, their views on these issues and how these types of things can be done better.

So, again, governance -- I'm a governance person -- encourage everyone to raise your voice on these issues, get interested and get educated. There are opportunities for just normal Americans to have input on these issues at both the federal and the state levels.

MR. WEST: Okay. Let's open the floor to questions or comments. There are microphones coming up. There's a gentleman right here on the aisle. And if you can give us your name and organization please.

SPEAKER: Good morning, Gary (inaudible). As somebody who spent most of my flying career below 1,000 feet, 2 comments I'd like to make.

One, the assumption in the conversation when you talk UASs here is these were all rotary wing UASs, right. We did not mention fixed wing at all. But my point is that specificity in language, particularly as you rate those FARs, is going to be important.

The second part is that below 1,000, as I mentioned, is not unoccupied. And the pilot workload at 500 and below is -- well, let's say considerable. Your time for response is different. When your margins, if you're recommending 400 and below for unmanned systems flying all over the place, one person blinks and you wind up having two different airplanes with spinning parts in close proximity to one another.

So as you propose policy or language, finding a way, whether it's augmented crash avoidance systems, or something else, that's got to be part of the solution set because I spent a lot of time with the big sky, little bullet, and that's not always a recipe for success.

MR. WEST: Comments from our panel?

MR. DIVAKARAN: Totally agree with that. And, you know, below 1,000 feet -- and this is where it comes back to this package delivery -- when you're doing it below 1,000 feet you have your -- so take an example, medical delivery between hospitals. You

have your medivac helicopters, you have your military helicopters that hardly look at no terms, they just fly. And then you have your crop dusters. Again, in a city you're not going to see a crop duster just flying on top of this thing, but you have diving operations that take place. You have a lot of stuff that is going on below 1,000 feet.

And the thing is, when it comes to fix wing, rotor wing, that's a whole different ballgame there. Rotor wings have the potential to be more restricted in where they operate, you can control it. But when it comes to fixed wings it needs more space. Then you have the hybrid between both of that, which has the capability of a rotor wing and -- so you have different technology, different understanding. But what it comes back to as yes, we can regulate airspace at 400 feet, but people then want 500 feet, then they want 600 feet, they want 700. You know, it's become like -- the question earlier was about when does data -- how long do you store data. We have become data hoarders basically. We just don't know when to delete anything. And the same thing when it comes to airspace. We have 400 feet restriction, but there are 50 people who still want to fly over 400 feet just because there's a restriction. They're like, yup, 450, I've done it, that's not a big deal. I'm like okay, you can talk to me about it, but.

That's thing, we are thinking about regulating 400 feet, we may be thinking about regulating 1,000, but it keeps piling up. Changes have to come within regulation. But also the operators. That's why I say, the Part 107 is not enough, it's a start. Once you get more professional people and as -- and something else Margaret pointed out was when you do package delivery the traditional package the driver stops, and he comes and drops the packages or he has additional help. Will he become a drone pilot? Yes, that is how it's going to be. Before computers came in, you trained the people who were in that role to learn how the computers are used, but then the future people you hired were people who understood how to operate a computer.

So it is that step by step process where regulations have to go. And, also, training has to be integrated.

MR. WEST: Back there along the wall. There's a microphone coming over to you.

SPEAKER: Hi, my name is Gavin. I'm an intern and student here at Brookings in the Governance Policy Department. My question is for the panel concerning will the President's recent disclosure of surveillance imagery in August on Twitter have a positive or negative effect on the interest in creating a novel and innovative policy for drone regulations and investment?

SPEAKER: Mark, that's your question. (Laughter)

MR. BATHRICK: So great question; thank you.

So part of my background, I was a Navy pilot for 25 years and I got to be the drone for part of those missions. I flew photo reconnaissance and found out people don't like when you fly over their country taking pictures and they'll shoot at you or they'll move the stuff out of the way so you can't take pictures. So for me, security is a big deal. I think security needs to be part of every program. And in our program, it was in from the very beginning. We set requirements, encrypted control and encrypted payload link, the ability for us to deny or lock out any information sharing. And we worked with companies, we worked with one particular company to develop a solution to that because they didn't meet that requirement. And I think that the conversation right now on security, as I see in the press, is kind of bifurcated. There is a genuine concern for security, which I agree with, but security comes from good requirements, not from geography. I am probably one of many recipients in this room of free credit monitoring thanks to my personal information being compromised on a server within the government. So location didn't help me there.

I think the other issue is the realization because these drones are very visible that we don't make a lot of electronics, maybe we don't make any electronics in the United States anymore. Anyone buy a Zenith TV lately? So I think there's two conversations that need to go on, and I'm concerned that they're both happening at the same time. And that banning products never generated the U.S. industry. You know,

banning Japanese cars in the '70s never would have kick started the U.S. auto industry. And frankly it's not going to solve the security issue. What's going to solve the security issue is good requirements, both in industry and government, and then adhering to those requirements and only buying products that meet those requirements.

Thanks for your question.

MR. DIVAKARAN: And just to add to that, you know, if you start banning the technologies -- for example, if you ban based on geography, you're going to like -- for public safety agencies, 95 percent of the agencies are not going to be able to use drones because you don't have a technology that can help them in that price point, that comfort level of training. There are a lot of those that has to be understood. Banning is not the solution, it's working with the companies, working, finding a solution to it.

If there is a problem, there's a solution to it. And if the solution can be made together, that's easier for all the agencies to work with.

MR. WEST: Okay. I think we have time for one last question. There's a gentleman right there on the aisle near the back. There's a microphone coming up behind you. And if you can give us your name and organization.

MR. LEWIS: Peter Lewis. I'm with PrecisionHawk and we're on the National Airspace Integration Support contract for the FAA. What I work on primarily as the systems engineer is counter-UAS.

Darshan, one of the things that you mentioned when it came to shooting drones out of the sky, I just want to assure everyone that that's not going to be the only methodology of arresting a drone.

MR. DIVAKARAN: Absolutely.

MR. LEWIS: But it's going to happen. So at the FAA we have three primary concerns. The first one is keeping drones from interfering with manned aircraft. That's the worst thing that could happen, is the drone bringing down a manned aircraft. We saw what happened to Captain Sullenberger with just seagulls bringing that Boeing 757 down, so a

drone would really do an efficient job on a fan jet engine. Secondly, we want to keep drones away from people and, thirdly, away from each other.

So in that process, and I'll just use the placeholder name right now, the one which is local UAS, or unmanned aircraft system network, that's where Verizon and the other air traffic controllers sort of speak for drones. We call it USS-USA service suppliers a/k/a traffic management companies are going to combine all of their known drone locations together, so they can essentially have one big national map including all of the territory spaces in Guam, Puerto Rico, et cetera. So that's in the process of getting done. I just want to assure you and everyone else here that we're not sitting around on the UTM or any of these other technologies. We have a lot of people working on it day and night, and we're making pretty quick progress. It would be great for it to be quicker, but a lot of progress is being made toward that end.

Thanks.

MR. DIVAKARAN: And that's why education plays a key role in this, educating people what counter-UAS technology is and what is the -- you know, the solution to everything is not shooting it down, taking control of it, bringing it over, it's the UTM system, as such. A couple of states are working towards that goal. We ourselves have submitted our model of UTM to FAA, which has given us good feedback and good comments back.

The reality is that we are at one side is flying drone and one side is restricting the drones. We are trying to fill that bridge between, which is UTM and the companies are working with state and local government, with federal government to make that a reality. And that's why the key thing to this is education. We need to take time to educate our folks within the states, and it's not just, you know, FAA's responsibility, it's not the state's responsibility, it's also the industry's responsibility. When you sell your products, educate them also on how to use the products. It's an important part of that.

MR. WEST: Okay. That is a good bit of advice on which to end this panel.

So I want to thank Mark, Darshan, and Margaret for sharing your views, and

I thank you very much for coming out as well. (Applause)

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