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ASSESSING CHINA'S TECHNOLOGY REACH
IN THE WORLD

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Introductory Remarks:

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Panel Conversation: Global Technology Infrastructure:

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Panel Conversation: U.S.-China Technology Competition

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P R O C E E D I N G S

GENERAL ALLEN: Ladies and gentlemen, good morning. My name is John Allen. I'm the president of the Brookings Institution and it's my sincere and great pleasure to welcome you all for an online conversation on China's growing technology and its technological reach and its prowess in the world today.

This morning's webinar compliments the recent publication of papers from the Brookings series, "Global China: Assessing China's Growing Role in the World". Indeed, it could not come at a timelier moment as our Nation and the rest of the global community battle the COVID-19 pandemic and as geopolitical landscapes are profoundly shaped as a result.

Involving scholars from across the Brookings Institution, our Global China series is a two year initiative that seeks to provide an empirical baseline for understanding the trajectory of China's influence in Asia and other regions around the world. And it's in partnership with the Ford Foundation and we're very grateful for that support. It examines issues of foreign policy, the economy, and of course technology.

And on this issue, while the rise of China's technological edge has long been recognized, its significance is best underscored by today's ongoing global crisis. Employing surveillance technology to track and restrict and record citizens' movements, China implemented an extreme response to curb the COVID-19 pandemic within its own borders. The country is also testing the use of both autonomous and 5G supported delivery systems that transport medical supplies and minimize person-to-person contact. As well it has utilized its own production capabilities to create medical equipment called PPE, or personal protective equipment, for its own population. Indeed, it has sent these same products around the world in a gesture as so-called masked diplomacy, or COVID diplomacy, something no other country is doing at such a scale.

Yet these actions also come at a cost. The use of surveillance technology alone raises serious questions of privacy. Furthermore, we must consider how China's intensifying technology competition will relate to the ever-increasing U.S.-China tensions. Also to the U.S. alliance management

challenges and our complex and shifting global supply chain and debates over economic and technology decoupling, and certainly the regulation of large technology firms.

So to that end, today's event will consist of two panels, the first of which will address issues surrounding China's ambitions and progress and building out what we might call global technological infrastructure. And the second will address how we should understand the trajectory of U.S.-China technology competition. We'll have the privilege of hearing form colleagues from both inside and outside Brookings, and we're especially pleased to have experts from the Center for Security and Emerging Technology at Georgetown University, led by director Jason Matheny, to whom I will be turning the podium in just a moment.

It's always good to see you, Jason, and thank you for joining us today.

MR. MATHENY: You too, John. And thanks to you and Brookings for your leadership. Thanks also to Tarun Chhabra who, in addition to his general responsibilities for this project, spearheaded CSET's participation from the start. Finally, thanks to the authors and to all of those who are joining today for your resilience during COVID and for not losing sight of the challenges that will confront us beyond this crisis and beyond this decade.

No one needs an introduction to Brookings, but I'll say a little about CSET. We're a new research center at Georgetown University focused on studying the security impacts of emerging technologies, supporting academic work and security and technology studies, and delivering nonpartisan analysis to the policy community. We have an unusually large pipeline of translations of original sources, particularly from China, and a large data effort to analyze data sets relevant to science and technology, including scientific publications, patents, investments, and workforce data. Partnering on this project with Brookings was a natural. And I'm so pleased with the results, which have informed and challenged much of my thinking about China and technology.

I'm looking forward to the discussions today. And to kick us off I'm honored to introduce Chris Meserole of Brookings who will moderate our first panel.

MR. MESEROLE: Thank you so much, Jason, for the kind introduction and to General

Allen as well.

As mentioned, our first panel will take an in depth look at the digital technology infrastructure that China has been developing. And to do that with this panel we are fortunate to have with us today five esteemed scholars and colleagues on technology China. We have Nicol Turner Lee, a Brookings Fellow in Governance Studies who wrote a great paper we recently released on 5G in China. We have Sheena Chestnut Greitens, a professor at the University of Missouri and a nonresident Senior Fellow at Brookings who authored a terrific paper on Chinese exports of safe city and surveillance technology. We have Carrick Flynn, a research fellow from the Center for Security and Emerging Technology at Georgetown University who wrote what in my view has already become a vital paper on semiconductor manufacturing. We have Frank Rose, a senior fellow in Foreign Policy at Brookings who published a great piece on China's efforts in the space race. And we also have, last but not least, Aaron Klein, a Fellow in Economic Studies at Brookings who has a fascinating paper on Chinese digital payments.

We've got a lot of ground to cover and relatively little time. So I'm going to start out by asking each panelist to briefly introduce their particular technology domain and what China is doing in that space, and then we'll move to a discussion about the policy implications before opening to Q&A.

So, without further ado, Nicol, I'm going kick it over to you. Nicol, 5G is a technology that just about everyone has now heard of, but almost no one actually understands. Can you walk through what 5G is and what China has been developing and, you know, how China has been developing and deploying it?

MS. TURNER LEE: Yeah, thank you, Chris. And I want to thank General John Allen, as well as Jason, for kicking this great event off. And I'm very grateful to our colleagues at the China Center for involving me in this initiative.

So what's interesting, Chris, I think you're completely right that people often hear the term "5G" but they don't quite know what it's referring to. So I'm going to give you, to the best of my ability in my few minutes, just a quick technological overview and then why it's important to this conversation.

You know, I think compared to 4G LTE, which is probably the G that most of us are actually using right now, the promise of 5G is pretty exciting because of the fact that it has peak download speeds as high as 20 gigabits per second and lower latency, which is particularly important at this time. You know, not to bring in the COVID-19 pandemic, but this movement towards remote medicine is going to require the type of latency that does not disrupt the connection between individuals or between enterprise based software. That would be pretty important, particularly as we see more remote access sin agriculture or more enablement of the internet of things.

And so I share that because as my friend, Tom Wheeler would say, you know, we talk about the 5G networks as hardware, but in this particular case there's a software element to it, which I think also has some cybersecurity concerns, which is really at the root of my paper. We as a country here in the United States actually took on 4G LTE and out of that came the digital sharing economy, the Facebooks of the world, you know, Google. When we look at the ride sharing economy of Uber and Lyft, for example, those were all enabled through the ability to have higher and faster bandwidth that enabled us to use our smart phone devices to really engage in these very rudimentary functions that have now become part of a way of life. And if we look at the period that we're in now, having access is even more important.

So how does that relate to China? You know, in this what I call a race or competition to 5G -- and I have gotten some feedback, well maybe it's not a race, maybe it's more like a sprint, maybe it's more like a marathon, or heck, maybe it's a competition, the bottom line is whoever actually gets there first is going to demonstrate global leadership. And when I say global leadership in the paper, I'm really referring to the fact that China has actually done a couple of things, Chris -- and then I'll wrap up. They've been able to release the type of multi band spectrum that will actually equip these devices to do some really neat things, where the United States, we've been spectrum stuck. As Roger Entner would say, we have a spectrum imbalance, and that's sort of forcing us to throw out as much government based spectrum and reallocate that to commercial purposes based on consumer demand.

The second thing that we have a problem with is the global supply chain. And I'm very

enlightened by General Allen's comments about PPE. The same challenges that we have of PPE is the same challenges we're going to have when we realize that we really have little competition within the United States and less cooperation with European countries when it comes to 5G equipment.

And I would say, lastly, as we look at why this is important, whoever gets there first has I think the biggest, biggest advantage, and that is standard setting. And so, Chris, I'm one of those people who has been watching this debate and I'm one of those people that's always advocating for the people when it comes to the availability of networks to be able to do really cool things. But the challenge that I see with China -- and I'll wrap up here -- is whoever gets to this race to 5G at the end will essentially be the global leader when it comes to standards, security, device interoperability, and other functions that I think are at the heart of this network that we're actually, you now predicting known and unknown innovations, right, of the future.

So I think it's just really important for us to actually put that in perspective. And I'm really happy to be amongst people where we can actually talk about this in ways that lends itself towards either some global cooperation or some understanding, right, of how important it is to drive the force of these new technologies that are essentially disrupting legacy models, as well as creating new and emerging platforms for development.

MR. MESEROLE: I'm glad you brought up the idea of this, you know, not necessarily being a race, but maybe a marathon. You know, how do you see that playing out going forward in the next, you know, few years? I mean there's one kind of 10-20 year cycle where it's more of a marathon, and then there's one in the next few years when 5G is rolled out. Is that something that the U.S. is involved in right now or is it really something that's kind of being led by China at the moment?

MS. TURNER LEE: You know, it's so funny. I think if I were to look at the U.S. and China on this, I would say that now the marathon in terms of, you know, updating outdated policies or figuring out what types of spectrum bands could be available or made available quickly to market, right. I think we're actually getting this. If you actually look at the trade, every day new spectrum is being optioned by the Federal Communications Commission.

So I personally think as we look at this as a race or a marathon, the key thing is the United States cannot just catch up, right. We have to continue to exercise I think the global leadership that we've exercised when it comes to 4G LTE technology. Europe pretty much defined the standard when it came to 3G, the United States stepped in and did 4G. And what's more imperative, Chris, to your question, is on the brink of this is AI. So this extent to which both countries are actually embracing AI technologies and have the platforms that are ready to support things like augmented and virtual reality, that will be at the crux of this.

And that's why I think actually the United States is -- you know, it may not be winning more so on the infrastructure side of it, but we definitely are engineering in terms of our research and development. These are American companies that are at the forefront of self-driving vehicles and AR and VR. So I think going forward, to your point, for me the geopolitical battle is Sander Say (phonetic). You know, when you get down to it, whoever actually defines what that network, how it's configured, what the safety and security measures around, is essentially -- and I know in our work together, you know, these national security concerns are real and they also drive market competition on the back end, right, because whoever gets there first will basically define the infrastructure configuration of that network.

So I always say to people -- and I should stop here -- particularly in my area of domestic policy, let's figure out how to do something that's calibrated. And I actually suggest that if you haven't read the report, I suggest like a really simple three point plan, because I don't think the United States wants a nationalized 5G network like China. I mean we're not China, right. But what we do need is we need some coherency around what we're actually doing from a public policy front, and we need some more technical coordination, so we don't have what Entner has called the spectrum imbalance. So we could at least be in the stage where we're still on the field versus sitting on the sidelines trying to figure out how to catch up.

MR. MESEROLE: No, it's a great point. And I really appreciate the point about standards in particular, which I think we're going to come back to frequently throughout this discussion.

And before we kind of turn to standards, which I think touches all of the different layers of

infrastructure that we're talking about, I do want to continue with some of the level setting on what these technologies are. So I'm going to turn it over now to Aaron Klein to talk a little bit more about digital payments.

Aaron, you know, for us it kind of just seems very seamless, you go and pay with your credit card or, you know, maybe even you have a smart phone and you pay with that. We don't really think much about it, but China has done some really innovative things in that space and I'd be curious, you know, for your thoughts on what China has been doing and why that matters.

MR. KLEIN: Yeah, thank you very much, Chris, and thank you to the Center, thank you to General Allen, and everybody else.

The world has changed. We invented this technology in the 1960s with these little magnetic strips and these little plastic cards. And we go anywhere in the world and we think this thing is going to work. And, in point of fact, when this thing actually -- when you get down to it, right, this isn't Visa, this isn't southwest, you have to go all the way to the back and you find that there's a bank behind it. This one happens to be Chase, this bank we know if as American Express. These are bank based system that move money from one person, a buyer, to another person, a seller or a merchant, through a network of two to three to sometimes even more banks, and each bank takes a little bit of a fee. A lot of Americans misunderstand this business model. This business model is not about interest. This business model is primarily about something called swipe fee, which is the little bit of money, 2, 3, 4, 5 percent that merchants pay when you transact things. This system, invented in the United States originally around restaurants, has become the global leader of payments. And when you control the payment network, you control a lot of other things.

And this has also become core and integral to bank profit models. This is one of the main stools of banking. Well, enter China. In China the merchants didn't want to pay these small fees and the banks kind of didn't really aggressively successfully figure out how to market this situation. And that (inaudible) of fintech. And there are two main fintech providers in China, AliChat and WeChat and WePay.

And let me briefly explain. They use something called a QR code. This is mine. Everybody gets one when you sign up. And there are two ways that you can use this at the register to pay for something. One, you can just pull it up and the other person will scan it, or two, you take out your smart phone and you scan their QR code. So you only need one of those two things to work. And, in point of fact, immediately when that happens money comes out of your digital wallet and moves straight into their digital wallet. No bank, no intermediary, no fee. And this system took off like a hockey stick. There are over 1 billion monthly users on each platform alone. You can go almost anywhere in China and use one of these things. You can be on the top of the Great Wall of China and there's a guy with a cart with a set of waters and he has a little piece of paper -- doesn't even have a phone himself, has a piece of paper, and you scan it and you move your money back and forth.

Now, let me explain a couple of different elements of this, because it's a little bit foreign to people, but it's very powerful. Alipay is kind of like Chinese Amazon. And when you put money in this wallet and you transact between businesses, there becomes a giant incentive to leave money on this platform, because there's a very small fee charged sometimes to the user to download the money back to your bank account. So what happens? Well, you buy the rest of your stuff. Think, if you're a restaurant, customers pay you on it, then you buy things from your suppliers on it. The more you use, the higher your ranking goes on your profile. Ask yourselves, if 10 percent of your salary was deposited directly into Amazon, would you spend it? What type of competitive features or values would that provide to people selling on this platform versus not?

The second element, WeChat pay, WeChat is kind of like Chinese Facebook combined with a set of messaging situations. And, again, think about if Facebook knew every business that you bought from. And think about if every business on Facebook knew every other business that you bought from. The value of monetizing that data becomes incredibly important to that platform.

And so what you've seen is these platforms rise, bringing in more merchants, being able to start to monetize these data, and provide a legitimate threat to the American dominance and hegemony of these little plastic cards. In fact, if you go around the world -- now within the United States,

particularly any place with Chinese tourists, Las Vegas, Disneyland, go down Fifth Avenue in Manhattan, and you'll see little signs, "we accept WeChat pay", "we accept Alipay", even Walgreen allows that, for example.

You know, this is going to start to become one of the dominant forms of global payments, and that has tremendous ramifications for the banking system and for U.S. foreign and domestic policy.

MR. MESEROLE: Thank, Aaron. That was a great kind of primer on what these technologies are. Can you speak -- I'm going to come back to you a little bit more on some of the policy angles, but before we do so, like can you just speak a little bit more about what's at stake for the U.S. if we lose that kind of -- right now kind of American credit cards and American digital payments tend to be -- or at least Western forms of digital payments tend to kind of be the dominant means of transacting around the world.

And it sounds like, from what you said, some of these Chinese digital payment systems are now spreading outside of China. You know, what's at stake for the U.S. and our allies with that?

MR. KLEIN: Well, number one, this is a large business and these are hundreds of billions of dollars a year in payments and in data flow.

Number two, there's this potential ability of all that data. Think about all that data that's getting put out, right. When people have to move into a different segment or a different platform, if it gets adopted by American consumers, which I think is unlikely, but if it gets adopted more globally in the third world, then all of that data and information goes to China.

Lastly, the U.S. is increasingly been using the payment system as a means of foreign policy. You anger America, we threaten to cut off your access. Remember Mnuchin made a comment recently toward Iraq about an Air Force base, well maybe we'll cut you out of the U.S. payment system. If you're a country, you have to be able to process these cards in order to have your economy work. And because this processing essentially goes through U.S. systems, that give us tremendous use. It gives us use in sanctions, money laundering, but also as a tool of foreign policy. Not too far ago -- I'm old enough to remember something called traveler's checks. I'm also old enough to remember when both parties

thought Russia was an enemy. And in that process, at one point we leaned on Visa as a way to counteract some of what Russia was doing by threatening to take them off of the payment system. Think about what type of disruption that would be.

Now, imagine if China is offering an alternative. There would be zero disruption. All you have to do is sign up for an Alipay account. And then think about how that information is going to hook onto their platform to do business. Is the future of business globally in the third world and developing countries in China's sphere of influence? Is that going to be Alipay or Amazon? That payment system provides a tremendous incentive and network to tip those scales.

MR. MESEROLE: Thanks so much for providing that lay of the land. And also just a reminder of how old I've become with the -- I remember traveler's checks too.

We'll sort of go back to kind of the -- I think what you were getting at is kind of some of the weaponized interdependence, you know, arguments about how financial systems are used, which I'm sure we'll circle back to in a bit. But I do want to continue on with some of the level setting.

We've talked a lot about 5G and digital payments so far. I think most people are at least aware of what those are, but there's another piece of the digital kind of infrastructure that's being built out, or technological infrastructure that's being built out that's a little bit more opaque to many of us. And that has to do with advanced semiconductor manufacturing and these things called photolithography machines, which I love to geek out about, but that don't really roll off the tip of the tongue very well.

And so we're very fortunate to have Carrick Flynn joining us, who can kind of hopefully provide a bit of an overview of what those technologies are and how China has been developing them.

Over to you, Carrick.

MR. FLYNN: Thank you, Chris.

So in the paper I wrote with my co-author Saif Khan for this series, we distinguished between sort of three layers of technology. The first is the computer chips themselves. The second is the factories where the chips are built, which are called fabs, which is short for fabrication. And then the third is the manufacturing equipment which goes into the fabs, the factories, and actually makes the

physical chips. So China is behind, but has been catching up in designing chips. They are also behind, but have also been catching up in making the fabs that, you know, actually make the chips. But China basically doesn't make any of their manufacturing equipment that actually goes into the fabs and actually makes the chips. What's more important is that China probably can't make this equipment.

So to understand why, we have to like go back and think about the chips. State of the art computer chips have billions of transistors. And these have future sizes as small as five nanometers. For a sense of how small five nanometers is, your fingernail grows five nanometers in five seconds. So the machines that make something that precise and that complex are, as you'd imagine, themselves really precise and really complex.

So in the question in particular that you mentioned photolithography equipment, photolithography is a fantastic example of this. So photolithography equipment is just one piece of equipment in the manufacturing process. There are many dozens of pieces that are involved. It is so difficult to make photolithography equipment at a scale of five nanometers that there's only one company in the world that can do it. So this company, it's based in the Netherlands, the only thing it does is make photolithography equipment to make computer chips. That's it. That's its entire business model. It has a market cap of $100 billion.

Now, there are other companies that make photolithography equipment to make computer chips, but they can't get to that small of feature sizes, so they're making like older generations of computer chips. Now, these companies, these older companies, have as much relevant expertise as you could possibly have. If they can break into the market for the state of the art machines, they absolutely would. There is an enormous amount of money in it. The reason that they don't is because they can't, and the reason they can't, even with all their experience, is because it's almost impossibly difficult.

Now, China has basically no existing industry or experience with this at all. So if it wanted to get into this, it would have to start from zero. Now, if China did manage to do this, did manager to climb this, you know, $100 billion mountain, all it would have would be one piece of equipment. They

would still have to start from scratch and climb, you know, dozens of other mountains to have all the other pieces of equipment.

So what does any of that matter? So in order to make many state of the art weapons systems or surveillance systems, you need state of the art computer chips. They go into everything. You need these chips to make super computers, which design atomic weapons or hypersonic missiles, these chips are obviously essential to 5G, and to many of the technologies you need for techno authoritarianism, and to anything at all to do with artificial intelligence.

Now, if China can't make its own state of the art chips, they'll have to import those chips from us. And that means there's an opportunity to use targeted export controls to deprive the Chinese state and other potentially bad actors from using these chips and developing these technologies. And this could have quite an effect in terms of, for example, the AI arms race everyone talks about.

Now, we already use a lot of targeted export controls on chips to China. This is like a known avenue. The problem is we can't have like one hand that's withholding chips while the other hand is giving China the equipment to make their own. So it's an unusual choke point, but if we impose stricter export controls on the manufacturing equipment today, the equipment like photolithography equipment, we can maintain control of the chips tomorrow and into the foreseeable future.

MR. MESEROLE: That's a great over, Carrick. Thank you. And I loved the analogy, the fingernail analogy. When I read that in the paper I almost laughed out loud. Like that was a brilliant way of putting it.

MR. FLYNN: I had to repeat it. It blew my mind when I found it there.

MR. MESEROLE: Such a great way of illustrating exactly how small these things are.

And one of the just immediate follow up questions I would have is, before we kind of hopefully get back to the export control issue -- because I know that that's also going to be relevant to even some of the -- you know, potentially the policy responses to things like surveillance, exports, that Sheen Greitens is going to be talking about -- but before we get to that, can you talk a little bit more about kind of China's maiden 2025 effort and like, you know, what is it that's proving so difficult for them to be

able to kind of manufacture in a way that Western companies can?

MR. FLYNN: Yeah, so China is spending an enormous amount of money trying to get semiconductor independence. And the way it's mostly been doing this is by building fabs and then buying the equipment to fill it. Now, at this point China has not caught up. It's doing a good job closing the gap though. Not with chip manufacturing equipment. Again, it's just importing that, with actually building the fabs and making the chips, and to some extent also with the chip design.

So the way it's been able to do this with especially the chip fabs is by using subsidies equivalent to like 40 percent plus of a firm's revenues through billions of dollars worth of IP theft. And this isn't like a number grabbed out of the air, this is like there are lawsuits that have settled for billions of dollars over the IP theft, as well as poaching thousands and thousands of Taiwanese semiconductor experts at amazingly exorbitant salaries -- salaries that make me wish I was a Taiwanese semiconductor expert.

So by hook and crook they've sort of learned how to build these fabs and chips. They've done a tremendous job of catching up and closing that. And what I would say if the United States and our allies continue exporting the manufacturing equipment, I think China could catch up potentially in the next 10 years. It's not guaranteed, because this is an enormous industry, but it's quite possible.

Now, if they did, it wouldn't exactly be the sort of leapfrogging that they talk about in China, at least in this industry. More likely it would be something like a displacement. There's this interesting dynamic where a state of the art fab costs as much as $20 billion to build. And what this means is that there's only really room, because of the chip demand in the world, for maybe about three fabs at the state of the art, and this will be three fabs anywhere in the world.

So if China, you know, ends up as one of those three fabs, what it will do is take one of the other three who are there under market pressures and basically bump them out of the market. Now, I don't know who would be able to actually end up out away from the state of the art, but it's very easy to imagine how China doing this could potentially mean that the United States itself would not have the state of the art fab and that we would have to start getting our chips from Taiwan or Korea or China, in which

case the strategic situation would be significantly worse than it is now.

MR. MESEROLE: Yeah, it's a great point. We'll come back to that, because I think the strategic situation is ultimately where we need to kind of -- how we need to contextualize the discussion.

But before we get to that, I do want to turn it over to Frank Rose now to talk a bit about another -- not so much necessarily technology, free technology like 5G or digital payments, but talk about the effect of, you know, technological infrastructure on the space race and, in particular kind of its impact on some of the strategic competition between the U.S. and China.

MR. ROSE: Well, thanks so much, Chris. It's great to be here.

You know, over the past couple of decades China has devoted significant resources into developing its space program in two ways. The first has been civil space work, things like space exploration, space science, global navigation, like our GPS system. They have their own system called BeiDou. However, there are also devoting significant resources into their military space program. You know, some of the things that they're doing, like reconnaissance and communication in the military sphere are the same things that the United States does. However, there are some more concerning developments. And, from my perspective, the development of China's anti satellite program, in my view, is of great concern to the United States.

Now, in 2007 China conducted a kinetic energy intercept/destruction one of their own satellites about 850 kilometers in outer space, which created 3,000 pieces of debris larger than 10 centimeters, which will stay in orbit for perhaps hundreds of years, putting at risk the satellites of all nations.

Now, the U.S. and the Soviets developed similar systems in the Cold War, but they never really moved forward with large scale deployment of these capabilities for a couple of reasons. One, the damage that ASAT weapons could do to the outer space environment. For example, in the early 1960s we tested a nuclear weapon in outer space. It seemed like a good idea at the time, but we damaged and destroyed a number of our own satellites and other countries' satellites. And, secondly, there was a strong link between nuclear deterrence and space systems. You didn't want to attack someone else's

other satellite because they used that for nuclear command and control in their early warning.

So at the end of the Cold War development of ASAT systems essentially stopped for a variety of reasons, the politics, Russia didn't have the money to pursue them, et cetera, et cetera. But that changed again in 2007, as I mentioned a little bit earlier, when China conducted an ASAT test against one of its own satellites. The question is, why did China do that given the potential damage that ASAT weapons could do to the space environment? Very simple, the Chinese have been watching how the United State and its allies fight wars since the early 1990s. And what they have determined is that outer space is critical to how the U.S. projects power globally.

The United States uses space assets to detect, track, and target potential adversaries. Therefore, these ASAT weapons are designed to negate that U.S. superiority or asymmetric advantage. And as long as the United States and its allies are dependent on space systems to project power, China is going to continue to invest large amounts of resources in these anti-satellite capabilities.

Chris, you're muted. I can't hear you.

MR. MESEROLE: I have officially become that guy in a public party that forgot to unmute himself. I apologize to you all and to our audience. (Laughter)

I'm not going to -- hopefully going to be a little bit more articulate than this, but can you kind of lay out a little bit more, like what's at stake if they start taking down our satellites, right? Like why is this such an important technology? Not just to kind of the American military, but kind of our society and economy?

MR. ROSE: Well, you know, as I like to say, space is critical to just about everything we do here on earth. It facilitates global navigation through things like the global positions system, or GPS, enables global communications, allows the military to detect, track, and target adversaries, helps us verify arms control. If you can deny the United States and its allies access to outer space, you can achieve significant military advantage here on earth.

So what should the United States and its allies do? Well, we face a fundamental dilemma with regard to outer space and China. On one hand, China is developing this full spectrum of

anti satellite capabilities designed to degrade, potentially destroy our satellites. On the other hand, we have a number of key challenges to the space environment. Orbital debris, the rise of mega satellite constellations, and a number of other challenges. So the challenge that the United States and its allies have going forward is how do we develop a strategy that allows us to protect against China's anti satellite capabilities, but at the same time provides entry so we can work together with China on issues of mutual concern, like orbital debris.

MR. MESEROLE: Yeah, that's great. I want to come back in a minute or two to the issue of cooperation and kind of some of the bilateral ways we might be able to make some progress on that.

But before we do so, I want to turn it over to Sheena Greitens, who has done some amazing work on surveillance technologies. Again, kind of not necessarily one particular discreet technology, but kind of how China has been using them and developing them for surveillance purposes and beginning to export them, and in particular kind of looking at -- you know, her paper deals with the demand side of Chinese exports and looking at kind of some of the factors that might be involved with, you know, why some countries are more likely than others to have these exports.

So, I'll turn it over to you, Sheena. Just kind of give a lay of the ground, an overview of the space and what China is doing.

MS. GREITENS: Thanks, Chris. I just want to say a brief thank you to Brookings and CSET for putting together this fantastic set of papers. I learned a ton from reading the papers that are part of this panel, as well as the second panel later this morning. They span a huge range of issues, but there are a lot of really interaction points that I hadn't anticipated or necessarily expected. And so I just wanted to thank you guys for putting together the discussion, and to you for moderating the panel, especially under the remote circumstances, which I think you get extra points for difficulty on that.

So surveillance technology is really interesting. It feels like we barely go a day right now without there being some sort of story about one of the surveillance technologies that China is developing and now exporting. And there's been a lot of attention mostly to the mechanisms of data collection, so facial recognition enabled sunglasses or some of the video camera CCTV systems, the number of

cameras that China is accessing.

But when my research team and I started looking into the global spread of this technology, one of the things that struck us as politically most important was specifically how the technology was being used in policing and public security or public safety. And for that, sort of one of the core features that was so powerful about what China was exporting or providing to the world actually didn't have to do with just the cameras and the hardware, but the capacity for data integration.

And so the paper for Brookings actually focuses on these surveillance and public safety or policing platforms that not only collect, but also then integrate and analyze data. And so what I'm going to do, since Brookings did this fantastic graph and map, is to just show you quickly what the growth of that trend over the last 10 years or so has looked like. Okay. So what you're looking at here is the growth in these platforms over time. So when I say platforms, you know, I'm not just talking about Hikvision selling cameras, even if those cameras are enabled with facial recognition. These are all countries that in some city or some state, the number countries that have adopted this sort of platform that does not only the data collection but the data integration and then turns around and uses it for policing and public security, and sometimes outright political repression.

And so you can see here an almost exponential growth. Over time we're looking at potentially around half the countries in the international system have someplace in the country that's adopted this technology, typically in one of the major cities. And here's the map of where those countries are distributed across the globe. And so you can see from 2008, the Beijing Olympics being a major demonstration point or kickoff of the start of this technology, to the end of last year -- we cut off the data collection in December for this map. These are all the places where this technology is in use. So if you travel to one of these countries you may well be captured or monitored by one of these systems.

And so what's really interesting about this is that a lot of these stories and media reporting have focused on how this is changing life within China, but I think there are a lot of implications, and this is really now no longer a question about Chinese domestic technology and domestic surveillance, but what happens when you export that technology to a huge range of political systems

around the world. And I'll add just briefly, you can see by looking here, this is not just other non

democracies, but a good number of democracies as well have at least experimented with or piloted these

systems in a major city.

So this is really something that has come from China, but it's having implications for

urban governance all over the world today.

MR. MESEROLE: That's great. Thank you, Sheena. And just looking at your map, I

think one of the things that's really just striking is that point that you made about how this isn't really just

about a technology that China is developing domestically, but it's got a lot of global implications as it's

being rolled out. And because it touches on surveillance, it's really kind of, for those of us who care about

democracy and human rights, like this is a really important issue. And I'd be curious for more of your

thoughts about what the U.S. and its allies should be thinking about in terms of how to respond to the

spread of these technologies around the world, not just within China, but around the world.

MS. GREITENS: Sure. It's a great question and I'll add that I think that this is something

we're going to be grappling with for a long time. As I was finalizing the paper, I was watching the

unfolding debate about COVID-19 and surveillance and the use of some of these tools being ramped up

in places like South Korea and Taiwan, which have had a relative amount of success in managing their

Covid-19 outbreaks.

So I'll also say that I think we're just beginning to think through the implications, but I

would group the implications that we might care about in this conversation into three main sort of baskets

or categories. One is these issues of data privacy and data security. There's an ongoing debate. The

U.S. government says that Huawei, for example, which is the major provider of these safe city type

platforms, that that data has a special unique technical back door where it's accessible to Chinese law

enforcement. And so data security and data privacy I think are real issues. We've seen places like Malta

and the Philippines when there is push back on how the data is owned, protected, and managed saying

no, the data is all being kept domestically, it's subject to our laws, our privacy regulations. But we actually

don't know in the vast majority of cases what the technical or the legal infrastructure governing data

privacy and data security really looks like. And that's going to be an emerging discussion, again, that I think is going to be going for a long time.

The second issue has to do with the factor that you mentioned, wanting to contextualize this discussion, which is if this technology becomes widely used for urban governance globally, then how does that change the role of technology in U.S.-China strategic competition. In some cases Chinese development assistance is being used to help finance some of these projects. And one of the things that we find is that countries that have a sort of formal partnership with China, according to the very nice ranked list the ministry of foreign affairs gives us, that is actually a pretty good predictor of the adoption of this technology.

So there's a correlation between the spread of this technology and China's global strategic priorities, which suggests to me that this particular type of technology is linked to global strategic competition or Chinese global strategy -- however you want to frame that.

I'm happy to come back to that later, but I'm mindful that we have limited time and I want to just briefly mention the third issue, which is the one that you began your question with, about the potential for this technology to contribute to democratic backsliding in human rights. I'm actually doing a project now to look at what happens to human rights and the quality of democracy when this technology is introduced. And we don't have a very good sense of the answer right now. There's a lot of concern. This technology isn't very well regulated. There was a great piece by Mira Rapp-Hooper and Samm Sacks in *Foreign Affairs* recently talking about how the political frameworks for regulating technology have lagged behind the experimentation with technology itself. And I think that's particularly true right now with the Covid-19 discussions and policy experimentation that we're seeing as everybody tries to get a handle on how to deal with the virus.

But right now we see that this technology is going to both democracies and autocracies and we don't really have a good sense in either kind of system whether this is going to negatively impact human rights and democratic backsliding, but we've seen cases in which the technologies have been used to surveil political opponents. And on the other hand, the countries that adopt this technology

frequently talk about how helpful it is, or how helpful they believe it will be in terms of improving public safety, attracting investment, boosting economic growth, because crime is such a drag on investment and economic productivity. And so there are some potentially cross-cutting effects on public safety, democracy, and human rights. And so I think it's really important going forward that U.S. policy tries to get a handle on some of these questions to that we can have the right conversations, both in international forums and with individual countries, about why this technology is appealing and what the alternatives might be that are more compatible with democracy and civil liberties and human rights.

MR. MESEROLE: I want to pick up on that kind of last thread. I think one of the things you touched on in your paper and touched on elsewhere has to do with kind of standards bodies, and the role of some of these technologies. I know we talked about that earlier and I'm going to get back to Nicol in a minute on that, but is the U.S. -- like are there standard bodies involved with some of these technologies like facial recognition and, if so, is the U.S. kind of invested in those conversations or is kind of China more invested in them? Is that an area where we can potentially kind of push back on the use of surveillance technology for non democratic purposes?

What's your take or sense on that?

MS. GREITENS: Yeah, so I was really interested to hear Dr. Turner Lee's comment about the importance of standard setting, because this is an area where I see China exercising a fair amount of what was quiet and is increasingly being scrutinized global leadership. So China has domestic bodies that look at what their standards are going to be and then they have been fairly coordinated and fairly assertive I would say about trying to promote those standards in international forums, like the UN's ITU. And so one of the things that the paper notes is that right now the ITU has gotten almost all of its proposals for global standards for safe city type technology and the use of facial recognition technology from Chinese tech companies. So we do have Chinese tech companies writing the global rules. About half of the standards that they've proposed have been adopted by the UN as the global standard.

So that's really important. And one of the things that I think we need to be talking about, and the paper calls for, is for the United States to have a comprehensive strategy about standard setting.

And I think that's particularly important in an area like surveillance technology, but I'm biased. It's what I work on. But this is really important for how we think about the use of police power, the use of the state's monopoly on violence, these things that really affect citizens' lives in both democracies and autocracies.

And so I think it's really important that the United States have a comprehensive strategy, unless we want Chinese tech companies writing the global rules for how facial recognition is used in policing. The United States needs to figure out what it wants the alternatives to look like and then to work with like minded countries -- because there are plenty of them -- to promulgate a set of standards that we believe are fully compatible with civil liberties and human rights. And I think that's pretty urgently needed right now.

MR. MESEROLE: I'm going to go out on a limb and say that you might not be too biased in thinking that maybe the U.S. and its allies probably don't want the Xi regime writing the rules of the road globally for facial recognition tech. And thank you for that kind of great comprehensive answer.

Dr. Turner Lee, I want to turn it over to you in the kind of 5G space. Dr. Greitens just kind of laid out again kind of some of the -- she mentioned the ITU and some other standard setting bodies. You know, how do standards come into the conversation around 5G?

MS. TURNER LEE: Well, that's so interesting listening to Sheena's great presentation. Sorry, guys, it's like the two ladies here. I was really intrigued by that map because what actually happens in that map sort of demonstrates where we actually might be headed on the 5G space in terms of these dual ecosystems, right. And in 5G we have this other political concern, which is around the use of Huawei equipment, right, which is actually making it more difficult to navigate through I think what was suggested in that previous presentation. You know, the national security concerns around the network, where are vulnerable points. And we're seeing our allies not necessarily coming on board with the complete ban that we've actually put in the U.S. But we also risk this U.S. through this alienation exactly what Sheena is talking about, where Asian companies or Chinese telecoms are making their own standards while we're going through this process. And we're sort of fighting, you know, another part of the battle with regard to the exclusion from our networks.

And so I think going forward that is like the biggest question that we have right now, Chris. I mean when the Trump Administration sort of moved to full out ban ZTE and Huawei, what we actually saw was no actual response to this. And as a result U.S. companies who have a lot of embedded equipment from Chinese telecoms, you know, within their existing networks, it became more difficult for us to navigate. And in a case, like I suggested with 5G, where you're on a time clock -- you know, you're not only talking about the spectrum, but you're talking about the propagation of small wireless cells, right, antennae to make the propagation to work right in terms of densification, you're also talking about the application and the R&D, you're talking about the safety and security concerns.

And so, again, going back to the prior conversation, and if we don't get raps on what that looks like, we'll essentially see a 5G network that is primarily Europe and U.S. on one hand, and maybe Africa and China on the other hand in terms of the way we've actually split that marketplace. And so, you know, we're working -- I think there are mobile standards that are pretty much internationally recognized, but places like the ITU, and the fact that China is also developing its own set of standard bodies when it comes to their technology.

One thing on that, Chris, we're behind. And I can't say it enough to U.S. legislators, when we think about this, we're doing really great stuff in the now, but China has been experimenting on mid band spectrum before we even thought about it. And so I think just having that ability to be ahead of the game is also going to influence your ability to drive not just the standards but the diffusion of the technology with the networks. And that should be disconcerting to companies where they will be told by the U.S. that they cannot do business there, even though there are other European companies that we can -- just recently Nokia and Ericsson came before congress to sort of bid their case -- but how do you manage that while standards are being developed. And that is the biggest question I think for 5G infrastructure today that -- the conversations of U.S. domestic policy were relevant, but now this global race is even more important as we go forward.

MR. MESEROLE: I couldn't agree more with that.

Frank, I think you had a point that you wanted to jump in on?

MR. ROSE: Yeah. Thanks very much. You know, listening to all the other panelists, the one thing that kind of brings all of these papers together is that the U.S.-China competition is essentially about who will control the global information technology infrastructure and standards. And this point brings to mind the "heartland theory" put forward by British geographer and strategist, Halford Mackinder in the early 20th century.

Mackinder argued in his theory whoever controlled Eurasia, or the heartland, would control the world. I think an argument can be made that in the 21st century, whoever controls the information infrastructure will dominate the world.

MR. MESEROLE: Wow, it's a pretty bold claim. So it sounds like you're saying the great game has shifted from central Asia to the tech sector writ large?

MR. ROSE: You know, I think there is an argument -- now, it's not an exact transfer, but if you look at what Nicol has talked about in 5G, what I have talked about in space, this data is critical to military operations, it's critical to sanctions, it's critical to the economy. If you can put yourself in a way to control the commanding hypes, that will make you the dominant global power.

Something to think about. Maybe there's a paper in there.

MR. MESEROLE: I think there's probably more than one paper in there. And I want to kind of kick it back to you. You know, it's interesting that you would frame it that way right now. And also I think one of the things that was really interesting about your paper was the emphasis on bilateral cooperation, which I wanted to come back to as well. And we've talked about standards bodies, which tend to be a little bit more multilateral. One of the interesting things about your paper was the focus on bilateral cooperation. Is there a way of kind of -- if this great game is kind of before us, is there a way of cooperating a little bit to kind of mitigate it -- the graver risks associated with it, so to speak.

MR. ROSE: Chris, I think the answer is yes, with caveats.

First, we need to understand that the Chinese civil space program is a wholly owned subsidiary of the People's Liberation Army. So if you are to cooperate with them on civil space, there's a chance some of that technology could go back to the military. However, this is not the first time the

United States has faced a peer competitor and tried to find ways to cooperate with them in outer space. In the early 1970s the United States and the Soviet Union has the Apollo-Soyuz mission.

So the bottom line is yeah, there are practical things we could do, but I would say we would need to do three things to make that happen. First, the United States would need to develop a comprehensive strategy for dealing with China in outer space, which links the civil with the national security concerns. Secondly, we would need to get relief from congress, which currently has some pretty severe restrictions on our ability to cooperate with China in the civil space area. And, third, we have to identify some useful practical projects. One idea that Charlie Bolden, the former head of NASA, put out there was inviting China to join the International Space Station.

But the bottom line is I think there are some practical things that we can find to work with China on in civil space, but we're going to have to make that part of a comprehensive strategy.

MR. MESEROLE: I love the point about the comprehensive strategy. And I want to kind of -- because one other -- you know, we need to have a comprehensive strategy that encompasses kind of bilateral efforts and also multilateral efforts on things like facial recognition technology or 5G, but there's also kind of a strategy -- I want to come back to you, Carrick, on some of the hardware side of this.

In your view, how would export controls kind of fit into -- because I think that's kind of -- you're right, that that's one of the key pieces of leverage we might have when it comes to something like pushing back on China's use of these technologies for human rights abuses, things like that. How do, in your view, export controls kind of fit into any kind of comprehensive strategy for that? And is it feasible, in your view, that we might be able to see the U.S., Japan, Netherlands, et cetera, start to implement these? I think Netherlands has done some export controls already. I'd love to get your feel for where that's going in the future.

MR. FLYNN: To start with the last part of your question first, the Netherlands recently revoked the license to export the photolithography equipment I was discussing earlier, which I think was a huge step. And there's a Wassenaar Agreement, which is a multilateral export control arrangement, and on that there are pieces of semiconductor manufacturing equipment. The problem is that you can always

just grant an exemption and exemptions seem to be granted quite frequently. The sort of line in the sand you see on the Wassenaar Agreement is that you shouldn't be able to make future sizes 45 nanometers or below. Now, China is down as far as 14 nanometers and below because countries, including the U.S., just keep giving them the equipment. Just, you know, exemption, exemption, exemption. So there's an ability to tighten that.

Now, the semiconductor manufacturing equipment industry, because of all the costs involved, much like the state of the art fab thing, it's extremely concentrated. So you really actually basically just need the cooperation of Japan, the U.S., and the Netherlands and that's sufficient to do it. Once you have those, once you guarantee sort of Chinese dependence, then there's an opportunity to do export controls in a targeted way on the chips. And here you can do all sorts of things. And what's good about this is that it creates option value. You could also just not. If for some reason like it's fine, let them purchase whatever. But on the other hand, if there's some company that's selling some particularly problematic piece of surveillance equipment that uses (inaudible) networks for facial recognition, for example, you know, we might just be able to withhold the chips. And it's not clear they could make that indigenously.

I think as an overall orientation, I like the approach of cooperation, of cooperating where you can. And I think there are a lot of areas were we could do potentially quite good cooperation on things like AI. Another colleague of mine at CSET has done some great work on opportunities to cooperate on technical AI, safety research, and standard setting. But with the option value such that -- especially for the particularly dangerous technologies, it can just be something that democracies as a group say no.

MR. MESEROLE: And I think that it will be interesting and exciting I think to kind of see that conversation play out, to see whether we do come together and say no. Like in particular, we've gotten some questions even for this event about kind of how China's using these technologies in Xinjiang and elsewhere and really -- the view of myself and I think a number of other colleagues now -- ways that are really repressing human rights at a scale that we haven't really seen before. And so I'm hopeful or

optimistic, or cautiously optimistic I guess, that we might be able to, as a set of democracies that care about human rights, find some ways of pushing back on that. And I think the export controls that you mentioned might be at least one way of potentially doing that.

I'm going to turn it over to Q&A in a minute, but before I do, I want to come back to Aaron Klein. We've had this conversation now about standards and bilateral cooperation and export controls. How aggressive should the U.S. and its allies be on the kind of digital payment space in trying to push back on the growth, you know, Alibaba and other platforms as they're moving into that space internationally? Like if we tried to put in place kind of more aggressive efforts to contain that, would it work or would it potentially even accelerate China's efforts in that space?

MR. KLEIN: Well, look, it's not entirely clear to me when people talk about digital payments what exactly they're referring to, right. I mean most money is digitized. You see these billions and trillions of dollars moving around in this Covid space and it's not as if there's some giant printing press running paper. But what Covid has shown is that America's payment system is woefully behind the rest of the world.

I mean Frank has been talking about the space race, right. We won the space race in the 1960s. We put a man on the moon and back. We did that faster, using 1960s technology, than we got a single person their Covid money today, in 2020. Think about that. In 50 years we can't move money from Uncle Sam to millions of people in a pandemic faster than we could with giant transistors sending a person in a rocket ship to space. Now, in China they don't have these problems. In China they have a flow of payments that can move much, much faster.

And in the U.S. you can't stop the modernization of payments. There's a moving of money that has to occur in any economy and more advanced countries are going to move towards more advanced payment systems. I think what we need to do in the United States is sit back and realize that there's a cost of our inaction. Our system works really well for the rich. Everybody is getting 3 percent points and cash back on the Amex and, you know, if you weren't one of the 20 million Americans who lost your job, you can wait a little bit for your COVID stimulus to check in. But one of our Brookings

colleagues put out that 40 percent of mothers in her survey were too broke to get food for their children. Meanwhile, they're waiting for this COVID stimulus check that is waiting somewhere.

If we don't modernize our payment system in the United States, we are going to fall behind China. We've already fallen behind -- I'll leave with this point -- England created a real time payment system in 2008, Mexico in 2004, Brazil in 2005, Switzerland in 1998, Japan in 1972. The Federal Reserve is currently forecasting a real time payment system in the U.S. sometime between 2023 and 2024. We can't afford to just sit back and wait while the rest of the world leapfrogs us two, three, four generations of technology.

MR. MESEROLE: That's a fantastic point.

Nicol, I want you to come in if you want.

MS. TURNER LEE: Yeah, just real quick. I'm listening to this conversation and I really want the people who are watching and listening to sort of have one thing resonate with them. You know, this is a very hard conversation to have, to compare apples to apples, right. We live in a society which is much different than China; we have different democratic values and leadership, scope of leadership, that dictates why some of these things take longer in the U.S. I mean if I were to say that the U.S. was competing in 5G, I kind of would be wrong, because we have to go city by city and state by state to ensure that the placement of the equipment needed to propagate these signals is actually something that we're doing in a way that respects local authority.

And so I think going forward -- and I'm thinking what Aaron said in terms of some of my interests over the years and incumbent -- why we don't have mobile payment system here in the United Statements, particularly for communities that are mostly subjected to the digital divide and to poverty. A lot of it has to come to do with respect for our incumbencies, right. And what we've actually built in terms of the checks and balances, both to a regulatory perspective and a legislative perspective.

So I think going forward, I think the question we all should be asking, are we in a race to China or are we in a race to a value chain versus the supply chain that makes sense for us and other allies that have the interest of placing human interest first and human values first and not necessarily

profits second, but a diffusion of a technology that in many respects becomes transformational.

And that's what I think we saw with 4G LTE to a certain extent. We didn't see a technology that was just set aside for certain types of users, but we saw a technology that was diffused not just in the U.S. but across the world.

So I wanted to bring that up, Chris, because I know that like in the space that I talk about it's very hard for us in the U.S. to say hey, let's be like China. And I think Frank's point and Sheena's point on data is important. We don't have the same type of privacy implications and data privacy lack of concerns. We're not a surveillance country, and so we cannot sit there and say we're all the same starting line and we're going to do the same thing as China, because we're not. It's not going to fly in our country. So what we have to figure out is, how do we bring value to these conversations and how do we bring value in ways that help us solve problems, both from the economic perspective, but also the problems that we just don't know about yet, right. And where do you leverage the technology to actually create that?

And so I just wanted to put that out there because I always feel like we can go back and forth, and you and I have been to China and others and it's one of those things like it's just real interesting, right, as these technologies evolve. And what Covid-19 showed us in the U.S. is that with the stroke of a pen we can at least engage in national pilots. And if some of those things work better, there might be the risk of removing some of those regulatory strongholds to do something different.

MR. MESEROLE: Thanks for bringing all of that up. And I really love the framing of thinking about this in terms of value chains and not just supply chains. Really resonated.

Dr. Greitens, did you have a point you wanted to come in on?

MS. GREITENS: Yeah, just really quickly I wanted to follow up on this idea of needing to be mindful of what local communities are looking for and respect for local autonomy.

I realize this isn't quite the same way that Dr. Turner Lee meant it in the United States, but one of the things that was quite striking to me as I looked at adoption of Chinese safe city technology around the world was that there was genuine local demand for this technology in places. So I mentioned

before that one of the biggest predictors of adoption of this technology was whether or not you had a strategic partnership with China.

But another significant predictor was the level of violent crime that a country experienced. And many of the places that were adopting this technology, when they explained or justified that decision -- and these are often subnational officials, they're often mayors, they're often state officials, so it's not always that different than the United States. The subnational politics and subnational variation becomes really important to communities and to leaders.

And so I think the point there is that ironically -- and I say this with a lot of hesitation as someone who studies China -- but it's not all about China. And I want the United States to be attentive to balancing its sort of concerns about China and the risks of the sort of technology that's being "pushed" out of China with an awareness of these local conditions. And I think that a one size fits all message -- yes, we want our messages to be coherent, but a one size fits all message isn't actually what we're seeing Huawei doing in its marketing -- it's quite regionally specific -- and runs the risk of sort of sounding like we're not paying attention to the genuine concerns of our partners in countries where they feel like they need a solution. This is the best option that they see. It may be being subsidized. Yeah, it's not perfect, but they're going to give it a try. We may not think that's the right decision or we may have concerns about the implications of the adoption of that technology, but I think those conversations are going to be a lot more productive if we have a real awareness and our messaging reflects that we understand what the local demand drivers are for this technology. It's not just a China story, it's a story about what's happening in almost 100 other countries around the world, and maybe more. And that's just not a one size fits all story. So ironically, maybe a less coherent message might be more effective and more accurate for what we're seeing in the world.

MR. MESEROLE: I mean it sounds like you're also just making a case for nuance, right. I mean we need to -- you know, it's easy to fall into a kind of black and white, U.S. versus China, one size fits all kind of argument, and yet you're right, I think. The point is very well taken that we need to have some nuance, especially as we roll it out to different localities around the world.

I do want to -- you know, I could talk with you all day and just ask -- you know, pick your brains with my own questions, but I want to turn it over to some of the audience.

We have one question from Simran (phonetic) at the University of Oxford who is basically asking what role education should potentially play in any kind of response. You know, if technology is kind of the fulcrum of a lot of geopolitical conflicts or competition, what role, in addition to kind of standards and other policy activities we can undertake, what role education should play in that.

Do any of you have strong thoughts about the role of education going forward in this space?

MS. GREITENS: I can talk a little bit about that if you want.

I mean first of all I think that it's really important and I think we could have a conversation, but I'll defer to the co-panelists who focus on the domestic governance part of this to talk about American policy. I think it's important to recognize that tech challenge and the role of education is very much a work in progress in China as well. It is something that Xi Jinping -- and I know some of the papers have focused on this, that Xi Jinping has talked about as being a primary resource for China's technological goals and technological development.

But what's really interesting in studying the adoption of surveillance technology is that even if you go around and talk to people in China, they identify human capital and the ability to actually operate and use this technology to its full potential as one of the sort of limiting factors right now. And so I think that's why China has the focus on developing human capital and tech talent that it does. But let's also not sort of overstate the omniscience or the sort of super ability to use this technology. In China it's still very much I think a work in progress and that story isn't written yet. And, again, then that leads to the question of, you know, what the U.S. and other countries are doing to foster education and tech talent development.

MS. TURNER LEE: Chris, I could jump in.

I think on the domestic side, just to sort of piggyback on what Sheena said, I mean I think we've not done the greatest job in preparing tech talent in this country. You know, if we look indigenously

at the populations that are here, we have a challenge. We have disparities that come when it comes to where you live, what kind of school you go to, all the way up to the food chain of who actually makes the decisions at some of our leading tech companies. And that's problematic if this is something that we want to embrace as a more inclusive ecosystem and one that we know in all of the papers and all of the conversations that we've had today, has the potential for not just technological innovation, but economic development in jobs.

And so we have a disparity when it comes to the preparedness of people in the United States to take on not just -- and I was thinking about Carrick's paper -- not just the high engineering jobs, but we have problems with people taking on the rudimentary can I install fiber job in this country. And that's a problem, right, when we're trying to actually compete on a large scale and actually bring our talent and capability in thinking to other places.

So I totally agree with Sheena. Like we on our side, on the domestic policy side we've had investment in tech education really change by administrations. And so it's very partisan I think when it comes to that, as opposed to looking at it as something that is necessary and fundamental to any child or adult's education in society.

MR. MESEROLE: You know, I loved that point about education and the value of education.

I want to pivot to another question that we've got, which is -- we've gotten a bunch of questions actually about education, but we've also got a lot about COVID, understandably, and the impact of COVID on -- you know, as we've been talking about surveillance technology. Obviously that's a part of any kind of policy for tracking and tracing potential patients.

And we got one question in particular about thermo scanning and the use of kind of temperature checks as individuals are going into stores and office places, et cetera, which the -- Shayla (phonetic),the person who asked the question, was concerned about the privacy implications of that.

Do you have either for that issue specifically or just kind of more broadly at a higher level, do you have concerns about the way that COVID is resetting kind of the global conversation around

surveillance technologies writ large? Dr. Greitens?

MS. GREITENS: Yeah, sure. So the short answer, do I have concerns about how COVID is resetting the conversation is yes. But I think it's going to be a more complex conversation than we might expect, in part because some of the places that used technology quite aggressively to tackle the COVID were not just China, which has this massive surveillance project already, but places like South Korea and Taiwan. And South Korea has said specifically, okay, we're doing some things, these are going to be temporary measures, here's the end -- you know, here's when we're going to stop doing this, here's when the data will be erased. So there's a clearer conversation about both the expansion of the scope of surveillance and what the limits or the rollback process will be. But that's really unusual. And every society or country is going to have to decide what's own set point is on how far it wants to go on surveillance and then what kinds of limits or rollback process it wants to put in place.

So I hesitate to say that South Korea should be a model, because I don't want to suggest that that means that these specific features or decisions or policies should be copied. But what I think is quite interesting is that there's been a more self-conscious conversation about what's the expansion, what are the limits and then at what point will we roll it back.

In the absence of that kind of direct conversation up front, we tend to see that crisis leads to the expansion of surveillance and then it's tough to walk it back because nobody wants to be responsible then for well what if it happens again, right. Then I as a policy maker feel like I'm responsible for the loss of American life or human life if we're talking about countries beyond the United States.

And so I think that the potential is if we don't have these conversations now, that the use of this technology is going to expand faster than policy can keep up. And we also won't have a clear sense or a clear vision articulated for the limits and the process of rollback.

So I think that's a really important conversation to have, but we're just at the beginning and I hope we talk more about it soon.

MS. TURNER LEE: Chris, just a shameless plug. We put out a paper on this on this on Brookings' website. So myself and other scholars across Brookings are actually talking about public

health surveillance and particularly where that is problematic in the U.S. Just had to put it out there.

MR. MESEROLE: Well, go to the Brookings website. I'm sure it will be front and center and I encourage everyone to read that paper. We're all for shameless plugs here.

Speaking of that, I know, Aaron, you had a finger up, so I want to turn it over to you as well.

MR. KLEIN: I wanted to give some feedback on something Sheena said. In this conversation about surveillance, if you think about the payment system, it is one of the most effective tools for surveillance and one of the least effective tools that we have. We in the 1960s, to try and catch the Mafia (inaudible) set up an anti-money laundering system. And we set this number of $10,000, which is if you use cash of more than $10,000, right -- cash is the ultimate anonymous source of financial transactions -- that there had to be a report, a piece of paper filed. And as an economist, we appreciate what happens when you set an non index (phonetic) number. So we set this threshold in the 1960s and it was really meant to capture big dollar transactions. You could have walked in, bought a fully loaded Cadillac in cash, not triggered this thing. In fact, you could have bought two. But we didn't index it, and what happens? Fifty years later of non index you can't buy a single car in cash and not get that transaction, right.

And in point of fact, we let this anti money laundering regime continue to expand in different ways, right. So we bootstrapped it to cash narco trafficking in the '80s, then pivoted to Al Qaeda after 9/11 in terrorist financing. And now we collect so many of these transactions, these suspicious activity report filings, and it comes at a cost, and the cost is often borne by those who can least afford it.

So when this PPP, this small business lending thing came out and banks were tasked with giving essentially grants to all these small businesses, they were required to do all this anti money laundering stuff on who they provided funds for. And so the first thing they did was well, no new customers. We can only serve our existing customers. A lot of that was driven by this hidden anti money laundering thing that the Treasury has left going on auto pilot, collecting more and more information and it has real consequences. There were businesses in America that did not get PPP funding to deal with this

COVID crisis because of an anti-money laundering regime situation.

Now, does anybody think that we were trying to use COVID to recheck small businesses across America to see who was funneling money where they shouldn't? No. But these surveillance systems put in place get left on auto pilot and they have drastic ramification when we least expect it, and often when we can least afford it.

MR. MESEROLE: You know, I think it's probably a great place for us to wrap up. In just terms of thinking about this as a marathon rather than a sprint, like what we put in place now, especially in light of COVID, is really going to be with us for potentially decades to come. And I think it kind of underscores the importance of the conversation we just had around digital infrastructure, its use in surveillance, and its impact on some of the geopolitical issues that we discussed.

Before we kind of wrap for break -- I think we've got about 10 minutes before the next panel -- I just want to say thank you to all of my fellow panelists here. It was a really enlightening discussion. You always know it was a great panel when you learn way more than you knew when you started. So thank you very much.

And we'll go on break right now and then we'll be back in a few minutes. Thank you.

MR. CHHABRA: Good morning, for those of you logging in from the United States, and welcome to everyone watching from around the world. My name is Tarun Chhabra, I'm a Fellow with the Foreign Policy Program at the Brookings Institution, and also with the Center for Security and Emerging Technology at Georgetown University.

I'm delighted to welcome everyone to today's second panel of our webinar, a part of our Global China Project. And today we're going to be talking about a series of papers that we've just published on China's technological reach around the world. Following a terrific panel this morning moderated by my colleague, Chris Meserole, where the focus was on a number of particular technologies, as well as the idea of global technological infrastructure, and what China's ambitions and achievements have been to date in that.

In the second panel we're really going to focus on how this translates into U.S.-China

competition, and we'll look at it from two directions. We'll be looking at it in terms of how developments in technology themselves will shape, or are already shaping U.S.-China technology competition, but also the ways in which other dimensions of U.S.-China competition are shaping technology and its development themselves.

So we have a really stellar panel to talk about all of this today. We have Mike Brown, who's the director of the Defense Innovation Unit. We have Elsa Kania who is an adjunct senior fellow at the Center for a New American Security. We have Andrew Imbrie, my colleague at Georgetown Center for Security and Emerging Technology. We have Scott Moore, who is the director of the University of Pennsylvania's China program with Penn Global. And we have Tom Wheeler who is a visiting fellow with the Governance Studies program at the Brookings Institution, and the former chairman of the Federal Communications Commission.

So thank you all very much for joining us today, and thank you for all of your contributions to our Global China Project. We're very appreciative of it.

I think to kick us off I'd like to turn to you Mike, if we may. You have written a paper with colleagues, Eric Chewning, who was the former chief of staff to Secretary of Defense Mattis and Pav Singh, your colleague at the Defense Innovation Unit. You've written a paper about a superpower marathon is the way that we ought to be thinking about U.S.-China technology competition.

So I want to ask you just a very basic question, kind of at the start of this, which is: What is the -- what are the geopolitical intentions of China that are informing your view that this is really about a marathon? How should we understand those, and how do China's technology ambitions fit into that picture? So over to you, Mike.

MR. BROWN: Okay. Thanks, Tarun, delighted to be here today. I think we can take Xi basically at face value in terms of his geopolitical intentions. He's made it pretty clear. Soon after he was elevated to his current role, he made a speech which has now been translated. It basically says: China's mission is not to join the world order that the U.S. created after the Second World War, but to rival the U.S.

And we've all become familiar with some of his terms in subsequent speeches, about national rejuvenation, it's a time for China to be ascendant on the world stage, and Asia for Asians, which in my mind means he intends for China to be the hegemon for the Eastern Pacific and for Western Asia. That certainly includes territories he views as his own, Hong Kong, Taiwan, South China Sea, and certainly expanded beyond that with the Belt and Road Initiative.

He clearly views, as does the rest of the Politburo, that science, technology and innovation are key to growing the economy, China is already the world's second largest economy, and he very much subscribes to the view that it's the strong economy which will mean that China has its own national security.

He's clearly stated that he wants China to catch up and surpass the U.S. in technology. So I think we're well beyond the time when China is hiding its strength and biding its time, and I think that we're in an era where he intends to make China great again, meaning restore China's position that he feels they've historically held for most of the last 5,000 years, as being a key, if not the key global power in the world of Asia and the Western Pacific -- I'm sorry, Eastern Pacific.

In terms of a containment strategy which of course we successfully used in World War II, or after World War II in the Cold War, it's too late for that. We began that strategy when the U.S., after the Second World War, had 75 percent of the world's GDP, and the Soviet Union was war-torn after the Second World War.

So China's economic scale, or even the second largest economy with ambitions to overtake us and be the first, their integration in the world being the largest trading partner to dozens of countries, their desire and ability to manipulate world institutions for their own advantage, well outlined in their China Standards 2035 Project, the follow-on to Made in China 2025.

And the fact that we don't have sufficient consensus among allies about what to do in a global China strategy among our allies, it means that it's too late for containment. So we're not going to be successful deploying that same strategy with China.

MR. CHHABRA: And Mike, thank you very much. So you, with other colleagues of the

Defense Innovation Unit back in 2018 wrote a paper about Chinese technology transfer strategies, and you called for tighter investment restrictions, among other things, in that paper. So tell us again, how should we think about the balance then between defensive measures, and more affirmative measures, how would you how weigh that?

MR. BROWN: Well, interestingly enough when we wrote that paper, folks jumped on the defensive part of the strategy, what we do to strengthen CFIUS, export controls, and I think that's something you have to do, but you're never going to win in a technology race with defense. So I don't think it should be the U.S.'s goal to thwart China's rise, our goal needs to be to make the U.S. the most productive, innovative, competitive economic power in the globe, and to enable our own growth.

So, if you think about the balance, the far more important strategy is: What can we do to invest in ourselves, in the U.S. It's only that investment means we need to do more basic research, that's certainly what government and academia need to do, that's been a proven strategy. That is something from the Cold War that we can take forward and use again.

But I think now the more important and more difficult strategy is going to be what do we need to reform our business thinking, and our capital markets, to move away from short-term thinking, to be more long-term oriented. So we've been on a path since the 1980s, something that's called the "shareholder revolution" that has increasingly gotten our focus on efficiency of capital and short-term measures. This is not the right approach for a superpower marathon with China which takes a very long-term view, and views technology and innovation as key to developing national capability as part of a national strategy.

So we can see kind of the evidence of this over the landscape, the focus on quarterly earnings, focus on stock price, shorter periods for holding stock now that most stocks are held institutionally verses by individuals, CEO comp plans embody this, we have the shortest tenure we've ever had for CEOs, activism, private equity, share buybacks, they all feed into this short-term thinking in our business community.

And I saw this firsthand as the CEO of two public companies in Silicon Valley from the

'90s through the (inaudible) and the teens, this infuses all of our thinking, and we have to reform this or we're not going to be successful in competing with China.

MR. CHHABRA: Thanks, Mike. And would you say just a little bit about some of the policy tools that you think we ought to be using to address some of the short-termism?

MR. BROWN: Absolutely. What we have to start thinking about, what can we do to bring institutional shareholders on board with this strategy, we can't have businesses fighting with their owners in this, so we need to be thinking about what are some of the longer-term measures that we should be using, that would certainly involve decade-long measures of: what are we doing to bring new capabilities? As opposed to, what are we doing just to increase stock price in the short term?

I think we've got to think about the fact that our economy is based on lots of financial transactions, and whether that really serves us for the long term, the ability to focus on what have we achieved in one year or three years, which is, you know, what a private equity model is based on, and so activism works.

We've got to rethink that, and you could envision maybe there should be incentives for long-term growth, long-term capital appreciation, long-term capability development, could do that with tax incentives, and maybe some of the short-term financial transactions, especially those that, and in many cases, have gutted capability, sent manufacturing offshore, shed hardware businesses, which now we wish we had in our supply chain here in this country.

Those kinds of transactions, maybe there should be a penalty for that. You could envision that your tax policy could encourage long-term investment, more R&D, tax credits as an example which is shown to be pretty elastic in research, and away from a purely financial transaction-based economy.

MR. CHHABRA: Thank you, Mike. So, I want to turn now to Elsa, to talk a little bit about the application of emerging technologies to military uses. Elsa, we hear a lot about the concept of civil military fusion, you've written a lot about that as well.

Can you tell us, to start with, what does the People's Liberation Army mean when we see

writing about quote/unquote, "intelligentized warfare", and what role does a PLA see for what are often called AI weapons in advancing its broader military objectives? And particularly, vis-à-vis certain conflict scenarios with the United States.

MS. KANIA: Well, that's a great question. Thank you. I'm very glad to be joining you all of this morning for the conversation. I guess I'd say to start that it's become increasingly clear under Xi Jinping that, as Mike just said, innovation is seen as critical to strategic competition.

And I've really traced this back to as early as 2014, around the same time the U.S. Military was starting the Third Offset, when Chinese military leaders were looking at the notion of an emerging revolution in military affairs, in the way that the character of conflict was changing with advances in emerging technologies. From unmanned systems, to artificial intelligence, and concerned about how to keep pace with, or at least avoid falling behind the United States, in this -- in this intensifying competition.

And this notion of intelligentization or *jour non qua* (phonetic), this concept that Xi Jinping has personally highlighted, as an important direction for Chinese military modernization, in order to adapt to the ways that the character of conflict is changing from what is described as informatized warfare to this new phase, or new era perhaps, of intelligentized warfare, in which there's greater importance for emerging technologies on the battlefield.

And AI is starting to be incorporated into the system of systems that enables joint operations in more and more ways going forward, across every domain, across a range of applications. And nearly every service of the PLA since then has started to pursue some of these applications and capabilities, building upon existing programs, and seeking to integrate AI into preexisting weapon systems.

So there's definitely a technological dimension of this competition in which AI is prominent, and Chinese Military strategists even talk about this notion of seeking to design future warfare, or set the terms in which the battle will be waged by being on the forefront of emerging military technologies.

And that's, when Xi Jinping calls upon the PLA to be a world-class military by mid-century, being at the cutting edge of these new frontiers is a critical component of that agenda and objective going forward. And some of the more concrete manifestations of this have been AI-enabled, or increasingly autonomous capabilities across a range of systems, and weapon systems.

And of course the question of what exactly autonomy is, or how to draw the line between a drone that might be remotely piloted relative to one that has some degree of intelligence, so to speak, can be ambiguous. But certainly there is evidence that, for instance, some of the drones at the PLA Air Force is starting to feel but the GJ-2, or Attack 2, a high-end drone that has some level of autonomy, and including perhaps in operational contingencies.

Some of the loitering munitions that have been deployed like the WS-43 or the CH-901 also have some level of autonomy, and there's increased attention to this notion of suicide drones as potentially relevant in operational contingencies.

And as we think about potential conflict scenarios, as a worst-case scenario, certainly for instance a potential Chinese invasion of Taiwan, one could envision that these kinds of cutting-edge capabilities could be important, for instance, a missile campaign to overwhelm Taiwan's air defenses, or even the use of unmanned autonomous systems for logistics, and for amphibious operations.

So certainly these kind of high-end capabilities would be relevant in that kind of conflict scenario, but in an era when we're seeing increased attention to peacetime competition as well, I would anticipate that some of the earliest ways in which we'll see AI start to play out will be in these virtual domains, cyber operations, psychological operations, aimed at influence and beyond that, and certainly a lot -- a lot to try to keep track of as this progresses, but this I think will continue to be an important element of this competition.

MR. CHHABRA: Thanks, Elsa. I mean how would you assess the PLA's progress to date in developing and adopting some of these technologies? Obviously the PLA doesn't have the same recent battlefield experience, so how do they overcome that, both in terms of thinking about training data and adapting these technologies to TTP's, and so on?

MS. KANIA: This process of military innovation will be inherently challenging for the PLA given some aspects of its culture, the ongoing reforms that continue to be quite disruptive, and as you mentioned this lack of recent operational experience, and Chinese Military leaders recognized that. They're concerned about this lack of experience in combat, and concerned about how the PLA would actually perform, and that kind of contingency.

So there's a focus on a very realistic, what's described as actual combat training, as well as what I describe as attempts to learn without fighting, so wargaming, military simulations that inform theoretical research and exploration of some of these concepts and theories.

And the process of learning and experimentation, starting to bring together strategists, and technologists, this notion of trying to integrate expertise in military theory with expertise in military technology, such as the initiatives underway at the Academy of Military Science.

So certainly there will be critical challenges ahead, especially when it comes to data, some of the same bureaucratic impediments in the U.S. military space, in terms of having the underlying infrastructure, as well as the training data to start to develop and implement these systems, as well as testing and reliability, as there's greater progress and deployment.

But there's certainly, relative to other elements of military competition, the U.S. and China are starting from closer to the same point here. The U.S. may have a slight advantage and some fronts, but for some of these challenges there's certainly the U.S. Military and the PLA are grappling with these issues in parallel.

MR. CHHABRA: Thanks, Elsa. So I want to turn from artificial intelligence now to the life sciences, and ask you a question, Scott, because I think whereas there's a lot of policy focus on AI right now, I think a lot of technologists will tell you, looking ahead, they'll probably be as much, if not more, on biotechnology going forward. And Scott, you've written a great paper for us as well on China's ambitions and progress to date in biotech.

So, please, if you would, just kind of frame for us China's biotech ambitions, writ large. And also if you would, you know, because there's so much concern about different norms and how

biotech would unfold in China, give us both the dystopian picture, and then give us potentially a more hopeful scenario about how we -- how this unfolds over the next couple of decades, and which you think we're more likely to see.

MR. MOORE: Thanks, Tarun. And good morning everyone. It's certainly a little easier to paint a dystopian than a hopeful or optimistic picture, but I'll certainly do my best. Before I get to that though, I really want to thank Tarun, you again, and then as well as Brookings, and CSET for this project, and for convening us this morning.

I thought it's really exciting, and interesting, and important set of issues. So I think in terms of thinking about biotech, it's helpful to just kind of begin with a thumbnail sketch of the history of Science and Technology, and with apologies to actual historians of science.

I think if you were to try to reduce that to a sound bite it might go something like this: that in the 19th Century a lot of the really important advances that we made came from mastering chemistry. So things like artificial fertilizer that really, you know, we take pretty much for granted now, but really made modern life and modern society possible.

As we move into the 20th Century mastering physics allowed us to develop nuclear energy as well as, of course, nuclear weapons. And then as we look into this century, I think it's fair to say that the really revolutionary transformational advances in science and technology are going to come from biology.

So that's I think, really, at a very kind of big-picture level, why it matters and why you see a lot of increasing interest in the sector from governments, as well as from the private sector and from researchers. The other important thing to know about biotech kind of from a global perspective is that the U.S. has really been the dominant player in most parts of the sector, pretty much throughout the post-war period.

I think particularly from sort of roughly the late-'60s into the early 2000s, it really approached kind of near hegemony. There were really very few areas of the biotech sector where you didn't see U.S. companies at universities, and research institutions really kind of playing the leading role.

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But as we got into this century, and it became more and more apparent what advances in areas like synthetic biology could potentially mean for transforming the sector, a lot of different countries have started developing plans, and policies, and strategies to try to boost their own domestic biotech sectors and industries.

Of those though, China is really the only one whose scale could potentially kind of pose a threat to American preeminence in the biotech sector. And just to give you one sense of that, one of the, sort of, headline policy targets for China in the biotech sector is for biotechnology to account for roughly 4 percent of China's GDP actually by this year, and in comparison in the U.S. it makes up roughly half of that, or around 2 percent of GDP.

The pandemic is obviously, completely kind of skewed GDP figures, but that just gives you some sense of kind of the level of ambition and relative aspiration for development of the biotech sector in China versus the U.S. So that's where, from an economic and kind of military competitiveness point of view, you're seeing a lot more concern for developments in this sector from the U.S. and other Western countries.

The ironic thing though, about this kind of competitive framing is that there are probably few areas or sectors where there're stronger reasons, in principle, why you wouldn't want bilateral, multilateral and international cooperation. So if you think about things like strengthening biosafety, preventing synthetic bioterrorism, which I think is one of the most concerning things we're going to have to start thinking about in this in this century.

And of course some people have already, vaccine development, these are all areas where there's a really strong kind of public good, or quasi-public good aspect, and therefore really strong rationale, in principle, for cooperation.

In practice though, as we all know, both from kind of a policy, and a politics perspective, things are really kind of driving more, more towards divergence, whether it's regulations or laws in China which are some of the most restrictive in the world when it comes to biomedical data sharing.

And in fact they're so stringent that I guess was two years ago, the government forced

(inaudible) Peking University to shut down a long-running collaboration with Oxford, apparently in breach of some of these regulations. So it's really had a profound, I think kind of chilling effect on international collaboration in biotech. Or things like, you know, there have been for years, growing signs and fears that biotech has been a major focus of IP theft, and non-traditional intelligence collection on the part of Chinese actors.

There are a lot of -- you know, and then obviously in the pandemic era all of the kind of political contention over the source of the pandemic and everything, all of those things are heading very much in the wrong direction in terms of cooperation. And so I think although there's this strong kind of principal reason why we should want cooperation, and that's what I would characterize is the optimistic case.

I think the realistic case and scenario is just continuing down the path that we're on, which is to see biotech, primarily, in terms of kind of zero-sum national competition. I think that's going to be quite harmful for innovation, although I think it probably does favor the U.S., at least in the short term, because in most parts of the sector U.S. companies and institutions do, I think, maintain an edge over competitors elsewhere, particularly in China.

What I really think will suffer is cooperation and public good which, you know, I'd argue we need more than ever as we continue to wrestle to try to control this pandemic, and confront things like climate change as well. So I'll just say I think, you know, there is an optimistic scenario, but I think unfortunately it's not the most realistic one on current trends.

MR. CHHABRA: All right. Thank you, Scott. We might press you (audio skip) a little more, later in the Q&A. The strategic picture, Elsa and Scott, you've talked about particular technologies, we've talked a little bit about investment, and long-term investment, and policy reforms to facilitate that. One of the papers in the series addressed as an immigration policy, but there are also regulatory and policy levers, including competition policy, which Tom Wheeler has written about for us. And then there's alliance policy as well which Andrew has written about.

So, if we could, I'd like to turn to you, Andrew, next to talk about, in general, what you

think we should be doing with our allies to address this kind of broad range of challenges from China on technology. But also to say we (audio skip) we should be doing on challenges which was the focus of your -- our Georgetown colleague, Ryan Fedasiuk, so.

MR. IMBRIE: Well, thank you so much, Tarun. And I just want to echo Scott's thanks to all the panelists, to General Allen, Jason Matheny, and everybody else who have participated today. I've learned a great deal. So it's a pleasure to be here with all of you.

So when I wrestle with this question I've found myself turning to a paper that the former Director of the Office of Net Assessment, the late Andrew Marshall wrote in the early-'70s, where he really sort of developed the early views about competitive strategies, and I think there are some lessons that we can apply to our alliances' strategies today.

He noticed back then that we were in a long-term strategic arms competition with the Soviet Union, that that competition was poorly specified, but could be shaped in ways that would be favorable to enduring U.S. strengths. And so therefore, the U.S. should assess the balance of strategic forces, clarify its goals, and then match its strengths to the relative weaknesses of the Soviet Union.

And of course the U.S.-China relations today are different, and in some respects far more complex than U.S.-Soviet relations were during the Cold War, notably in the levels of economic interdependence, and the role of a host of emerging technologies that we've been talking about today. And as the other panelists, of note, there is a delicate mix between competition and cooperation that we need to strike a delicate sequence that needs to happen, so that calls for nuanced strategies.

And I think some of Marshall's insights can be applicable here. I'll just mention three that would apply to our alliance strategy. The first is that America's broad network of alliances and partners isn't just a strategic advantage it's an asymmetric advantage, and so instead of competing dollar-for-dollar, or missile-for-missile, we can really have an opportunity to leverage this alliance network to shape the environment into which China rises,

The second would be that we need to adapt our alliances if they're going to succeed, and we need to adapt them in ways to respond to emerging threats below the military threshold, and

particularly areas where China and Russia have tried to apply wedge strategies to sow division, to undermine the credibility of our commitments.

I mean, Rod Cooper (phonetic) and others have done some really interesting research on this. I think one lesson from Andrew Marshall's work is that we need to be thinking about the kinds of nuanced net assessments that will allow us to identify anomalies and patterns in the spending choices and in the strategic choices of China, and then to figure out how we can match up our relative strengths to their weaknesses.

And the technology, in particular, I think this is clearly going to be an area where it's central to economic power and therefore to long-term military power. And one of the areas I think we really need to focus our alliances on is agile technology alliances in discreet areas. I think some of the surprising results that I found in my research, is I thought we would start with a core group of allies, and cooperation would radiate out from there.

But what I found is that a sort of team-of-teams or a system-of-systems approach is more effective. Where depending on the technology, whether it's biotech, cyber, mobile network platforms, AI, it's going to -- you're going to want to work with a different cluster of partners, depending on the technology and your strategic objectives.

So on the matter of AI, you know, the focus of my paper with Ryan Fedasiuk, in the *Global China Series* was specifically on how to defend against the transfer of sensitive technical information, and what we found, if you look at any of the pathways by which China seeks to acquire this information, whether it's through strategic acquisitions, through PhD scholarships, or through technology entrepreneurship competitions, and it's multifaceted, the United States has to work with allies because it's only one of the targets.

If you take something like strategic acquisitions and investment, you know, more than a half of China's tech-related investments go to U.S. allies and partners. If you look at its scholarship programs, again, the U.S. only accounts for about a third of that.

And so U.S. allies and partners really are a strategic tool. We're already doing a lot

across the government, but what's needed is to bring a lot of these initiatives together in a strategic

approach that will allow us to really leverage this unique and asymmetric advantage.

MR. CHHABRA: Thank you, Andrew. And if you could just say briefly, you know, what is

the -- what's the architecture that we need to do that? I mean is that something that should be coming out

of the State Department, the Defense Department, all of the above, and what are the fora for cooperation

where we should be doing this, particularly if, as you suggest, we need to kind of be engaged in kind of

ad hoc cooperation depending on the area?

MR. IMBRIE: Thanks, Tarun. I would say a couple things. One is that we need more

coordination without more centralization, per se, so we need to have a strategic approach, but each of the

different agencies can play a critical role. So if you're talking about more R&D collaborations, obviously

NSF, the Departments of Energy, DARPA play a critical role, if you're talking about norms and standards,

NIST, Commerce, State, they're also incredibly effective.

Same on the defense side, you know, there are going to be different players on the U.S.

side, but we need more coordination. Internationally I think the key is to really think about optimal fora as

well as optimal allies. So if you're going to focus on data sharing, projects with privacy preserving

machine learning, or more on human capital development, you're going to want to think about which

multilateral fora is the most effective, and where the critical mass is, where U.S. allies and partners

interests match U.S. interests.

And so a lot of this will depend on sort of nuanced approaches depending on the area

and this will require, you know, sort of careful net assessments about where our interests lie and how

they match up.

MR. CHHABRA: Great. Thank you, Andrew. So let's turn now to another kind of policy

regulatory lever, and that's domestic competition policy, we've been talking a lot about U.S.-China

competition. But, Tom, you've written a paper on domestic competition policy and why that's going to be

critical for competing with China.

And just to back up a little bit for our audience here, I think if you asked a lot of people

who were with us on this right now, they would say, wait, I thought -- I thought that Google didn't want to work with the U.S. Government, or other big tech companies didn't want to work particularly with the U.S. Military. But you make the point in your paper that we've seen a shift there, and you see a number of leading executives from large companies in the United States say, you need us, you need us as national champions. So tell us, where is that coming from and what should we be doing about it?

MR. WHEELER: Well, thanks, Tarun. And the Brookings CSET project here is a great idea and it's an honor to be on with this distinguished panel. I think that my point here is really a bookend to what Mike Brown was talking about. Because he kind of pointed out the irony that U.S. companies' focus on profits, often driven by market dominance, ends up aiding China's cause.

And what I look at is, you know, you look at it the wondrous products that these new companies that started in garages or dorm rooms have brought us with their nano-economic superpowers, and they are using that power to shut down competition, to expand their market control, and as a result to shut off competition-driven innovation, all the while that they are building facilities and working to cooperate in China.

And so my concern, and what my paper is about, is that the absence of a pro-competitive, public-policy orientation in this country actually advantages China. That market control, market dominance that we've seen in the principal big tech companies, thwarts competition-driven innovation.

You know, I used to sit there and listen to these companies tell me about how regulation thwarts innovation. And it's not without a degree of validity, but basically what it says is: let us make the rules. Let us make the rules to advantage ourselves. And as that began to become exposed for the self-serving purpose as it is, there's a pivot that's taking place to play the China card.

To say, oh, regulation will hurt our ability to compete with China. But the opposite is what is true, that we need competition-driven innovation at home so that we're not putting our eggs all in one basket, so that we can let a thousand innovative flowers bloom.

And the point that Mike makes in his paper is particularly appropriate here, because he

talks about the fiduciary responsibility that big tech companies have.

And that means that innovation that is under corporate control is innovation that is done for corporate benefit, and what we need to do is to have innovation that moves mountains rather than innovation that moves markets, and we need -- and to get there we need to find exactly what are our challenges. And it is doubtful that we will be able to out-implement China.

They're a command economy, we've heard throughout the morning about how their data is much richer than ours, but we can out-innovate China, if we have policies that will encourage this competition-driven innovation. So my concern is that the: "don't regulate us" theme of big tech is actually anti-American in terms of its impact, because it thwarts the very innovation that we need to be able to take on China.

And so instead of following China, and anointing some national champions, what we need to be doing is acting like America, and embracing good old-fashioned American competition-driven innovation, and having policies that do that.

MR. CHHABRA: Thank you, Tom. You really focused on old data in your papers.

MR. WHEELER: Right.

MR. CHHABRA: So tell us a little bit about why that's so central.

MR. WHEELER: Well, the capital asset of the 21st Century is data, it's information. You know, the capital asset of the 20th Century, 19th and 20th Century were hard assets, like coal, or iron, or other raw materials. But now our economy is built on the use of data, and the fascinating thing is that that data is very different from 20th Century assets.

You know, it is when you burned a piece of coal it was done for, data is inexhaustible, you create a new user to Facebook, you just used the same data you used before, that data is also iterative, in that when you use data to create a product you create new data, that can be used to either improve or create new products.

And the third difference is that it is non-rivalrous. You know, if I have a hunk of coal you can't use it, but if we share data then we all ought to be able to enjoy its benefits, and so that's what I call

for in the paper, is we need a competitive policy that says: let's look at the asset of the 21st Century in terms of 21st Century terms, rather than in terms of Industrial Era terms where we seem to be stuck right now.

MR. CHHABRA: Thanks, Tom. One of the -- one of the arguments I think you would hear from some of the companies, is they would say, well, you need our massive R&D budgets, right. You need us to be spending that money that we're spending on R&D. So what is -- what's the solution of that? Is it public money? Is it a different way of thinking about innovation? What's your answer to that one?

MR. WHEELER: Well, yes of course it's public money. And one of the tragedies is that we haven't been appropriate -- I'm sure I see Mike nodding his head -- we haven't been appropriately funded. I mean as talked about in the paper how the Government of Shanghai spends more on non-defense artificial intelligence R&D than the entire United States Government does. Okay. So we need, we need to have a Federal program that says, yes, we're serious, we're putting the resources here.

Secondly it's, you know, I talk in the paper about how the CEO of Google says, hey, you know, we can invest and not have to expect a return for five or ten years. Well, I was a venture capitalist for a decade before I went to the FCC, that's what VC is all about. You invest for a long-term kind of return. And you cannot make those investments, however, if what you're looking at is a market that is already tightly controlled in the future of which is tightly controlled because of the dominance of the incumbents.

So, if we're going have investment: yes we need government investment, yes we need private investment, and we need the basis for that private investment to have a chance that it can actually return to its risk takers.

MR. CHHABRA: Thanks, Tom. Okay. So we have about 20 minutes left. I want to get to some of the great questions that have been posed to us. But I want to ask you all one more question before we -- for all, which is: in the areas where you've been looking, what is China's most significant obstacle to achieving its ambitions? So it's kind of a straightforward question I think for Elsa and Scott, in

terms of AI and biotech respectively.

But for Andrew I think that question is kind of what challenge is China facing in picking off U.S. allies to engage in the kind of cooperation that you're advocating, Andrew.

I think for Tom, you know, does China itself not face some of these problems with anti-competitive activity with some of its large tech companies? How do we expect China to deal with that?

And maybe for Mike I think the question would be, you know, what obstacles do you see to the broader aims of a digitization, right, that have been quite, you know, front and center for a lot of China's tech ambitions? So maybe we could start with you, Mike, on that one.

MR. BROWN: Thanks. First I'd like to just make a comment about what Tom was talking about. So my nodding head indicated, I certainly agreed with his perspective, and I think he's spot on, what you have to complement that with, as we look to make the U.S. more competitive, is what can we do with both Federal R&D, as well as encouraging more business R&D so that you can focus on the long term.

The irony of the venture capital example that Tom gave is, you're expected to do that as a venture-backed company, and then as soon as you're a public company, completely the opposite. Don't invest for the long term, but give me something that will give me a return in one quarter. That's not the way to be competing with China. They have a very different way of rewarding their companies.

So, I think that's important as well the spillover effects of that Federal research. When we invest in long-term research which is best able to be done by the Federal Government because we have a longer time horizon, we don't have the short-term financial objectives of that. We have the benefit of creating new capabilities and even new industries. We used to reward that in corporate performance when we had IBM Corporate Labs, and Bell Labs, and those kinds of institutions in our country. Not so much these days after the shareholder revolution.

But with Federal R&D we get the long-term thinking, the breakthroughs, and the spillover effects, I think China very much recognizes, allow all of those, a thousand companies that can be innovative to take that benefit, that technology breakthrough, and then create industries and companies

around that. You've seen that with GPS and the internet spawning companies like Uber, and Airbnb, et cetera. So I think that's an important complement to what Tom was talking about in terms of making U.S. more competitive in the long term.

To your last question about what obstacles does China face? They certainly face some after the COVID crisis, as we do, because they'll have a lot of competing priorities relative to their technology investment. So I think we're both going to be challenged to achieve our technology objectives there. They still need to catch up in some areas, fortunately, just two examples, jet engines where the U.S. still leads, and of course semiconductor, a design manufacturing capability which are enablers for a lot of the game-changing technologies that we've talked about.

So they're not quite there yet, but I think we can't rest on our laurels, so more investment required. I think that they are strong enough to have indigenous innovation now, so we can't look and say that they don't have enough capability for the indigenous innovation, nor can we say that they don't have a system.

I hear so many people saying, well, the Communist system relies on control at the top that will never be successful. Well, the Communist Party of China has studied the lesson of history, and does not have the Soviet model, they've incorporated so many of the market incentives, that it's more of a decentralized model of innovation. So I think they very much can compete, and that's what makes me very concerned, if we don't wake up and see what we need to do to compete.

And lastly, from a military perspective, it's not clear how well civil-military fusion is going to work. Of course, it's a tremendous advantage. The Defense Innovation Unit spends all day every day trying to encourage innovative companies to work with the Defense Department. And General Secretary Xi accomplishes this is by FIAD (phonetic). So, we have to recognize there are some advantages to their system. I don't know how well that's going to work for them, but that certainly keeps me up at night.

MR. CHHABRA: Thanks, Mike. And since you just -- you ended on civil military fusion, let's go to you, Elsa, on that question. I mean in your -- in your earlier remarks you did mention the lack of battlefield experience. But are there other obstacles that you would point to, particularly for the PLA

and in using AI, and its weapon systems, and other military applications?

MS. KANIA: I think the primary obstacles are data. The military big data in particular, which is distinct from China -- the data that comes out of China's commercial ecosystem, and the PLA, not unlike any bureaucracy, is still struggling with how to manage, process, and best leverage that data.

And additionally, talent of course, the Chinese Military has reformed its approach to recruitment, to a civilian personnel system, they're trying to recruit scientists with the requisite expertise, while also trying to improve the professional military education of their officers, to ensure that they have the skill sets, and proficiencies to command effectively, and on a much more complex battlefield in the years to come. And these aspects of the reforms are still very much a work in progress.

And with regard to military civil fusion, I'd also add that I think -- I would concur with Mike that this is certainly a competitive challenge to the U.S. in the long term, but it's it remains a relatively nascent initiative in some respects. There are indicators of rapid progress on some fronts, including what I've joked is DIU with Chinese characteristics that has been set up, perhaps a compliment to the great work that DIU has been doing. Initially set up in Shenzhen, that's trying to -- it's a very similar mandate of looking to leverage commercial technologies for military purposes.

And there are some number of companies in China including startups, small and medium enterprises, even larger technology companies that have some enthusiasm for supporting military research, and brand themselves as military civil fusion enterprises. A lot of progress on drones, satellites and AI in space systems, as well as commercial wargaming with a special computerized wargaming which is something China has really progressed quite rapidly, and adopting, and even convening a series of national competitions, with piloting AI and wargaming as well.

So, I think -- which is one way of solving the problem of generating data, and trying to anticipate battlefield dynamics lacking the combat experience. And certainly no shortage of challenges, but I think certainly a dedicated focus on recognizing and seeking to overcome them.

MR. CHHABRA: Thanks, Elsa. Scott, for you, I mean if you -- as you look at the development of trans-biotech industry, what are the indicators that you're going to be paying attention to,

and to kind of see whether it's been -- China's been able to overcome some of the obstacles that you do to identify in the paper?

MR. MOORE: Fair. I think the first thing is financing so, you know, biotech is, it's sort of two sides of the same coin. On the one hand there's tremendous promise and kind of frontier technologies, but they're also extremely high risk. And so that combined with the fact that as in other sectors it tends to be the smaller, more agile, you know, small and medium-sized enterprises that are best positioned to produce breakthrough innovations. And yet China's financial system really doesn't provide those types of enterprises with good access to financing.

China's financial system is much more geared towards kind of the better-connected, larger enterprises. So financing is a key thing. I think the second thing is kind of policy. One thing that Tom brought up and I think it's an interesting, distinctive characteristic of China's innovation policy, is that it really empowers local governments to a very large degree, and kind of channels a lot of -- a lot of funding through local governments, also encourages local governments themselves to spend quite heavily on innovation policies.

And sort of what you get from that is like "build it and they will come" model where a lot of times local governments will create these big, sprawling, you know, science parks, and things like that. You know, if you look at I think the great centers of S&T Innovation, they pretty much are organic around the margins I think, local governments, and state governments have done some things to encourage their growth. But it's been a pretty organic model, and I think so far it's not clear that that model really is working very well.

And in fact, I think the sort of headline thing I'd say about China and the biotech industry so far is that China hasn't really gotten a lot of bang for its buck in terms of spending in this sector. That could change depending on what happens with, you know, those other two things. The third thing I would say just a little bit about is politics.

I think Mike was right to kind of caution us against overstating the effect of authoritarian politics, it's certainly not -- you know, it doesn't mean you can't innovate, it doesn't mean that you're not

innovating, but I think it's also a mistake to completely ignore it, and I think -- not that I think anyone on this panel has done so -- but just generally speaking.

And I think if we kind of think about the pandemic era and the responses to it, China is sort of the -- you know political pathologies, and have kind of undermined its standing and its approach to things to a large degree. And so I think going forward we're going to have to -- and Tarun, you'd to ask me to sort of expand a little bit perhaps on sort of dystopian visions.

If we think about things like regulation and control of transgenic organisms, which are combining different genetic characteristics from different organisms, trying to regulate the precursors to potential bio weapons, these are all things that we are going to need China's cooperation do.

On current trends, you know, as I said I don't think that's very promising, I think we're going to have to think quite differently about how to persuade, and perhaps compel to some degree, China's participation in multilateral initiatives like that. And I don't think the idea of compelling cooperation is as much an oxymoron as it might first sound.

MR. CHHABRA: Thank you, Scott. Tom for you, I mean Scott just raised the authoritarian politics. How will authoritarian politics do you think influence anti-competitive behavior by China's largest tech firms? How do you -- how do we think about the flip side of this problem that you write about?

MR. WHEELER: Well, they certainly give great advantage to companies, and creating markets for them, giving them great loans, and the idea is go out with a proprietary technology, that then you get the world hooked on, so that the next generation has to use your technology as well and you're embedded.

But let me pick up on a point that I think both Scott and Mike have raised. Mike talked about this is different from Soviet command and control. Sure, sure it is, you know, we're not living through five-year plans here.

But I had an interesting experience. I was meeting with a bunch of Chinese scholars, and were out late one night in Cambridge, England, we're walking through the streets, and one of them

rattles off something to me in Chinese, and I looked dumbfounded. And he translated.

And it apparently is a current expression over there, which is "the more you try the more you fail" because in a hierarchical environment this is where we want you to go, and if you're not going in that direction then you're going -- you're going to fail, which is kind of the opposite of, you know, Thomas Edison saying, you know: I didn't fail 10,000 times, I just succeeded in finding 10,000 things that didn't work.

And I think that that remains a secret of the United States, and of American entrepreneurism, and the question becomes: How do we take advantage of that? And that's going to be one of our major policy challenges going forward I believe.

MR. CHHABRA: Thank you, Tom. Andrew, over to you on alliances, what challenges do you think China is going to face in picking off U.S. allies, as we're already seeing beginning to happen? What's your prognosis?

MR. WHEELER: Well, that's great. I just want to quickly respond, you know, I think one of the advantages of thinking about alliances is to move beyond a narrow bilateralism on a whole range of issues. So think about R&D, the U.S. and its allies comprise almost two-thirds of global R&D. and there are extraordinary ways we could try to leverage that pool of research and development, and coordinate on shared priorities.

The same on data, you know, data advantage is a really complicated, difficult concept to measure, but thinking about this with our allies, the United States could be linking arms with allies on discreet projects and data to make up for advantages of scale, if China may have those, access to larger more diverse pools of data, we can underline the contrast on values by investments, in privacy preserving machine learning.

And there's more we could do to invest to think about going beyond data to think about systems that are less reliant on perhaps one-shot learning, or a-few-shot learning. So, just some examples of where alliances can play to our strengths.

Specifically on obstacles, you know, I would say a few things. First is, there's a tendency

for China to externalize its internal challenges, and I think at times that can result in it overplaying its hand. And we're seeing that now on some of the mass diplomacy that's been occurring.

The second point I would make is something that Evan Feigenbaum, and others, at Carnegie have talked about, that China is becoming more sophisticated in its use of economic coercive measures, and some of these are meant as wedge tactics to pry apart the United States and its allies. And we've seen that in the Philippines, South Korea, and with Australia. But it's not clear yet that they've really mastered the ladder of escalation, whether mixing more limited and stronger actions together. So I think that's another obstacle.

A final thing I would say is that our alliances are based not just on shared interests, but also on shared values, and deep forms of connectivity, and so they're, in a sense, harder to pry apart, though we've seen significant strains in our alliance network recently. And I think this puts a premium on the United States focusing on rebuilding trust with pragmatic areas for cooperation, focusing on interoperability, especially as regards differential threat assessments. I think that can be a really difficult challenge for making sure that we're operating with common doctrine, common capabilities.

And the final one is just -- it's just leadership, I think to adapt effectively we really are going to have to make sure that we're tending to our alliances, making sure that our capabilities are up to date, and that we're able to adapt effectively to some of the course of measures that China is increasingly relying on.

MR. CHHABRA: Thank you. Okay. So a lot of -- a lot of the questions that we got, including one from Ramona Materi, a number of federal government analysts was: What impact will COVID-19 have on (audio skip) China. Let's do a lightning round for each of you as we wrap up here on that. Maybe we could start with Elsa, then Scott, Tom, Andrew and Mike.

MS. KANIA: Sure. Well, if you believe the Chinese military, they've had zero cases of COVID-19, apparently and that tends to provoke some skepticism. I would say, and given the Chinese Military's extensive involvement in the pandemic response, especially with logistics support, the Chinese Military medical establishments, their work in Wuhan and beyond, I think certainly I'd expect that this will

shift resources away from other priorities. Perhaps away from combat training for the year, though there does seem to be training exercises still underway.

And going forward this will -- this will really elevate the importance of biosafety, biosecurity and biodefense, which is also a concern for elements of the Chinese military that are -- including their support of biological and interdisciplinary technological development. So I think we -- and certainly AI will remain -- will remain a priority among others, but I think certainly this will -- this will highlight the importance of looking at this more holistic understanding of security threats and challenges as well.

MR. CHHABRA: Great. Scott?

MR. MOORE: Yeah, I think similar to what Elsa said, I think, you know, this is clearly -- COVID-19 clearly calls attention to biosafety and biosecurity that kind of part of the biomedical and biotech complex. I think we can continue to see lots of attention paid to that. You know, as I mentioned I think ideally, and in principle that's something that should be in the interest of all countries, but the realities of politics are that we really see, you know, a divergence on that, and increasing intents of course to isolate China when it comes to that.

I have to say though, if you kind of put politics aside, this is the second novel coronavirus in less than twenty years that we've seen originate, at least as far as -- as far as we know in China, and caused a significant public health crisis. So I think there will be a lot of pressure, and need to have some type of investigation into how the novel coronavirus -- this novel coronavirus arose, and how we can prevent future pandemics. That's ultimately what is in everyone's interest to try to determine.

So I think that's, you know, that there's still, it kind of accentuates the underlying need for cooperation and collaboration, but at least in the near term I think from, sadly, a position of pretty low trust. And I hope that we can restore that.

MR. CHHABRA: Because it's new, and I just want to ask Tom, Andrew, and if any of you wants to comment on this before we wrap up.

MR. IMBRIE: I'll just say a quick point, that I do think it underscores the importance of

resilience, and I think this is going to be renewed, particularly on supply chain security. We've heard in the first panel about semiconductor manufacturing equipment. But this is an area, again, where I think the United States and its allies can really think carefully, amid the fog of the crisis, about what resilience might look like, and what steps are going to be needed.

MR. CHHABRA: On that note, thank you so much. This was a great conversation, very enlightening in helping to frame the issues, but also kind of walk through all the levers that the United States actually does have to more effectively compete with China.

Just as a final word, we really want to thank the Ford Foundation for their support of this project, and the editorial Team, and the (inaudible) team of Brookings for putting everything together here today.

And we hope you'll continue to stay engaged with the Global China Project, including some podcasts on the same series that are available on the Brookings website.

Thank you all for joining us today.

MR. WHEELER: Thank you.

MS. KANIA: Thank you.

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