



Summit for Space Sustainability

Breakfast Keynote

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Moderator: Jacqueline Feldscher

Speakers:

Matt Desch, Chief Executive Officer, Iridium Communications

Dan Hart, Chief Executive Officer, Virgin Orbit

Jacqueline Feldscher: Great. Thank you for that introduction and thank you for joining us today, and an extra thank you for the Secure World Foundation for putting together a timely discussion.

My name is Jacqueline Feldscher. I'm a national security and space reporter at POLITICO. I write our weekly POLITICO Space newsletter, which I'm sure all of you have. As everyone in this room knows better than anyone, space is an integral part of everyday life. Everything from GPS to weather satellites, military satellites. Space economy is predicted to grow to about one trillion dollars over the next two decades.

All that potential could just disappear if we don't use space in a sustainable way. [inaudible 0:38] orbits as space becomes more congested, and the rise in constellation of hundreds of thousands of satellites increases the challenges of using space [inaudible 0:47].

Who can and should solve this problem? It's something you guys have been thinking about for the past day at this conference. Yesterday we heard the government's perspective. You heard from Administrator Bridenstine about what the administration is doing.

International groups like United Nations are also attacking this problem. But both those avenues for change are pretty slow-moving, and it's unclear if there's even an appetite for any further international agreement. After that, today we're hearing what industry should be doing and is doing to solve this problem.

We're joined by two CEOs of prominent space companies, who have already been very well introduced, so I'm not going to bother repeating that. Without further ado, let's get started. Matt, I'd like to start with you, just sort of a broad question of why space sustainability is important to your company?

Matt Desch: Well, we wouldn't exist if space sustainability isn't established. As many of you know, the conditions, or the history that Ron so graciously said, we had a very bad day in 2009. I got that call from my chief satellite officer that said, "I've got some bad news and worse news. Which one do you want?"

I hadn't been in the space. I was a 30-year veteran of the [inaudible 2:13] world, the early days of cellular and that sort of thing, but I had just [inaudible 2:18] here to the space.

I said, "Well, give me the bad news." He said, "We lost the contact telemetry from SC33." I said, "God, what's worse than that?" He said, "Well, we looked on the space conjunctional and it's number six. It could have hit something."

I said, "Oh, has that ever happened before?"

[laughter]

Matt: He said, "Not in 60 years of man's outgoing spaceflights and satellites -- nothing's ever run into anything before." I remember we got together in a room, in our conference room, and I said, "Do you think anybody will notice?"

[laughter]

Matt: My head of government services said, "It's going to be on the evening news tonight." I go, "Really? Cool."

[laughter]

Matt: We got more satellites. It's not a big deal." I think I immediately became aware of the implications of what that meant, and of course the debris that that caused and given the [inaudible 3:17], I guess, over the last 10 years as every article starts out with SC33 and Iridium.

It's made us acutely aware of the problem of the environment in Low Earth Orbit. We've had I think more experience than anybody else flying through a fairly congested area. We take the full environment extremely seriously, because if we don't, then our future is at stake. I think the future of many other companies in this new economy are at stake too.

I think it goes without saying we've spent a lot of time thinking about working and making sure that we at least clean up after ourselves. Glad to talk about where communications [inaudible 4:02].

Jacqueline: Let me just pose the same question to you about how you're thinking about space sustainability at Virgin and why it's important.

Dan Hart: First of all, at Virgin, the sustainability of our environment is in our DNA. It's just a core value that Richard Branson bred through all his companies. As a matter of fact, he was with us on Thursday morning and one of our employees asked a question very similar to what you were just asking.

They asked Richard and Adam about how do we keep the environment clean and how do we help clean it up if there was a need to? Richard was very forthright that this is a really critical issue ahead of us. It's a new environment, similar to the ocean. It's one that's much less mature. As a launch vehicle company, of course, our job is to get satellites up for people like Matt. Companies are doing business in primarily Low Earth Orbit, and we take our responsibility to keep the environment clean seriously. We do that in a few ways.

One, we're very careful that when we deploy spacecraft that all the analysis and the care is taken that there's no chance of recontacting and colliding with it. In addition, it's really important that we work with government agencies to make sure that the path is clear. The role of government in providing that information and having real situational awareness of what's going on in the near term and as Matt points out in the long term is critically clear.

You can easily argue that our systems need to be improved further. Keffler is a nice thing to have for orbit. We're very predictable, but the analysis and the awareness and the sensor arrays need to be there so that we can coordinate.

The other thing that we do and need to do more as a community is look at how we deorbit our stages and the timing of that. Our goals are to try to get down within about five years. The current criteria that is out is for everybody to be 25 years, which seems like a long time given the current trends of putting up large amounts of satellites.

The last one, which may be the most important, honestly, is that we design our systems so that they passivate and sustain in one piece until they naturally deorbit. We spent a lot of time analyzing our system, making sure that we vamp all of our pressure bottles in the systems if one gets finished with its job.

Jacqueline: To follow up on that, will you have any further requirements for your customers that they meet certain requirements to be sustainable when you launch them?

Dan: We, at this point, don't apply requirements on our customers. That's really their responsibility. Our requirements we put are on ourselves to make sure that we're responsible. I will say that the other thing that we are doing is we're starting to talk to companies, like Ross, that are looking at how we clean up if there is a bad day.

There is a very important role that will be played by companies that develop the technology to go up and if a satellite has a problem, happens to have a major failure and can't get out of its orbit that something go up and haul them out.

Jacqueline: Matt, can you talk a little bit about what steps Iridium is taking to [inaudible 8:07]?

Matt: Before that 2009 event, we had never moved a satellite. It didn't make sense to because there wasn't the data to move satellites. We had the ability, but the data was had at the Air Force

was plus or minus a kilometer. Where are we going to move? We're probably going to move into trouble just as likely as moving out of trouble.

After that date everything changed, and our relationship with the Air Force and [inaudible 8:40] evolved dramatically. I think we're the poster children for that sort of relationship with the government on surveillance and visibility of exactly where things are. We have moved 437 times since that time.

Divide that over 10 years, that's probably a little less than once a week. We're making a move. We have a very defined environment system when we move satellites. We have a very tight relationship.

We've given that information out online exactly what the probabilities of a collision have to be in three days, two days, one day, constantly sharing information, making sure that we both know potential burn plans. We're getting very good at it, and we're very...It's become not a business issue whatsoever.

It's not a problem. It doesn't take additional effort. It's just part of the way we think and act and ensure that we will stay safe in space. We've also shared information. We've not made this real public, but I remember a story I heard, [inaudible 9:58] Kessler syndrome. It was described to me, and I thought that was quite interesting.

When I saw that Don Kessler's email address one time, I sent him a note. He'll tell this story too. Said, "You don't know me, but I'm the CEO of Iridium. I'm interested in the syndrome by your name." [laughs] "Maybe we should talk sometime." I got an email back out of Don in about three and a half minutes, I think it was.
[laughter]

Matt: Saying, "I've been looking for you for years."
[laughter]

Matt: "Hoping I might be able to generate a dialogue. Is the NASA base still contracting? Can I get the team and NASA to come by and maybe we could share some information?" We spent a lot of time because living for 20 years in space, we have a lot of knowledge and experience about what the neighborhood is like.

Not just the big events, but small events and all kinds of things that are necessary to help think about how to design spacecraft more sustainably. Let them take micro hits in ways that will allow them to not break apart, not do anything.

Then, of course, you talked about deorbiting. We made our deal, if you will, with the US government way before even the 25-year standard was born. There were no standards back in the

'90s when Iridium was launched. It freaked everybody out to launch, "My God, 95 satellites? Are you crazy? They'll all come raining down. It'll be horrible."

Now, of course, we look like slackers with only that few many satellites. It was concerning to people. Motorola agreed for a one-year deorbit. That was our requirement. We solidified that with the government years later and did all our planning around one-year deorbit.

Even when the standard came about, we kept it at a one-year standard. Last year, when we launched our next-generation network, we knew we could start deorbiting our satellites despite the people who were going to miss our players. We had to get them out of space. We now have deorbited all but one.

We have averaged now, from path [inaudible 12:15] , which we also agreed not to take all the energy out of the satellite when you're done. It takes about a week to get it to the lowest possible orbit. It's been an average of 19 days to do deorbits of that kind. We've had 58 satellites now that have deorbited and burned up, I hope. [laughter]

Matt: We are at this point only have one satellite still left to deorbit. Later, I'll give it a chance for Dan to talk a bit more here, too. I am still concerned about the incentives of sustainability. I want to get into that because the fact is there's still a number of rocks in space that we created. We have worked very, very hard to be as responsible as possible, but there's still debris out there. There are still things that can create problems despite all the efforts that we've made. We have a lot of experience. For a perspective about how that happened and what new operators might be thinking about, but I'll save that for a second.

Jacqueline: You guys both describe that your companies are taking individually to try to not need to bring to operate sustainably, but broadening out to look at industry more broadly, where does the industry role here begin and the government role end in terms of making sure that you are acting in the best way? Dan, do you want to give me thoughts on that to start off?

Dan: Honestly, his answer has been great. As businesses, we have responsibility to take care of the environments that we operate in, and we do in all forms. Not everybody does. What we need to do is we need to all as a community recognize that and share ideas and technology that allows us to operate in the cleanest way we can.

That's what we as industry...there's a meeting point where government...As Matt just mentioned, incentives do play an important role. In a growing industry you would rather at this point emphasis incentives than penalties. That's the other thing. I think that government should play a role in providing incentives for companies that operate in a clean way.

We do terrestrial. We can do it in space. Government can also help to provide services that allow us to. Governments can be also the bearer of technology and coordination on information, space situational awareness, traffic control in space.

Those are really key things that the government can bring to bear so that we have all the information that we need. A combination of incentives and maybe potentially in the future some penalties where if somebody makes a big mess, there's a price to pay. Those are all ingredients that I think will be, must be a part of our space economy as we go forward.

Jacqueline: Matt, how do you get industry to buy into this collectively? Obviously, if there are government incentives, that will help some. How do you really everyone to buy in, and do you need some sort of [inaudible 16:04] to make it happen?

Matt: I'm going to try to be provocative, but I don't know if you can get an industry to truly buy into it. I think the incentives, unfortunately right now are extremely perverse as it relates to this problem. I know that from experience.

I will start out by saying I was talking to somebody, a reporter, a couple weeks ago, and he said, "But you're already up there, so you can kind of keep everybody out, right?" I said, "First of all, I'm in lower orbit." Lower orbit is the neighbor. It's not a business [inaudible 16:39]. All the people who are in lower orbit are doing many different things, including even...

I think what people are really concerned about are the mega constellations that we know of, especially the ones at higher altitudes, that are going to have [inaudible 16:56] magnitude greater number of satellites. Those are business partners [inaudible 16:59]. I don't compete with any of those. I'm in a completely different business than they are. I want them to succeed. I want them to get up there.

I'm rooting for them. However, I know what they're thinking. I know they have to get into space right now. Remember, the whole concept in space is downsizing and making things work less long in space as opposed to longer in space, less exquisite systems, more commercial components, more changing out your networks faster.

That isn't necessarily the direction technologically that leads to more reliability and less issue. It's natural. You can't deny that, and it's hard to prove exactly how or what it is, but that's not necessarily the [inaudible 17:52] daylight.

In addition, and I know the feeling, when things get bad and you don't have the money and you don't have the customers, you don't sit there and think about what are my best practices and what should I do.

You think about how do I get my business in operation? What are my shareholders thinking about? What do I have to do to be successful here and survive? Maybe even [inaudible 18:15] because of the concerns that you have.

The pressure is really on these new business cases to get into space are immense. I really feel for a lot of people. We are finally after 30 years over and over the lines are going to be successful and thrive, but it was not that way for 29 of those years, necessarily.

I worry that industry left to its own devices, going through a set of best practices are not going to be incentive alone to necessarily follow all those practices.

There's going to have to be, I agree with Dan. That is as opposed to penalties, but ways strong incentives in some ways. I've even said, I'm not for regulation, but want a set of rules that everybody has to follow. That's not unusual. We don't say, "Stop signs are optional up here," not up to it. We do have smart regulations when we do it.

It's not inappropriate. They should be international in scope, and everybody has to follow them. If you don't, you have to view that there will be something and might need to be penalties or something else. Certainly, things like not creating more problems. It's going to be a while before we clean up what we have. Let's just not create any more.

There is a natural thing up there called gravity which helps. Unfortunately, it takes a long, long time. Our rock in space from only where we are, which is only 485 miles into American air is not a hundred years, even at that low altitude.

You get up to only 1,100-1,200 kilometers, a little bit above us where some of these constellations might be, it's over a thousand units. There is nothing you can do to solve that. You can't get enough space tug to deal with that.

You have to make sure that you create an environment for those satellites already [inaudible 20:36] . That by the operator, that they do it at the appropriate time, and take them out of space before they become thousand-year rocks.

Jacqueline: Opening had talked about if you were into [inaudible 20:49] far below what current rule is. What's the break number there in terms of how good they may be [inaudible 20:57] ?

Dan: The correct numbers, Matt.
[laughter]

Matt: In three years, ah no. It's a business trade-off. Obviously fuel, it's longevity. It's another, a number of other things. The problem I have more than anything else about the years coming. Five years, I'm fine with.

Something in a handful of years, I think, is a lot more appropriate than something like 20, 25 years, which are way longer than careers and other [laughs] things. Unfortunately, the lives of businesses don't last 25 years, so how are you going to enforce some of those things?

The problem is that it isn't solved, isn't talked about enough. Everybody's starting to agree with at a certain altitude things have to be controllable. You have to share information. You have to have spacecraft that are maneuverable. They have to be deorbitable. They have to burn up in the atmosphere.

All those are things that everybody agrees with Best Practices. The one I don't think is talked about enough is the fact of how to avoid rocks in space. Rocks is a highly technical term for those few. It's something that they found controllable.

Once it becomes uncontrollable, it doesn't matter what policy you have for. It's going to be up there basically as a missile to collect and create more debris. The point is, to me, the most fundamental problem we have to solve is avoiding rocks.

I worry a little bit about we don't talk enough about that because we don't want to get into reliability standards. How do we evaluate an operator? Whether they're acting appropriately in terms of their own statistical analysis. When should they deorbit? When they shouldn't deorbit?

It's one thing to say at the end of life, make sure you have enough fuel so that all your satellites can come down at the five years [inaudible 22:57] of them.

What temperature of your satellite will still be controllable at that point? If you remember, our satellites last for 21 years as a constellation. They were built to last seven to nine years. Not that far different in terms of a design standard and things are being built today.

Yet, we created, inadvertently, using highly reliable components almost 30 percent rocks in space that will be up there a long time. What if you launched 1,000 satellites, 5,000 satellites, 12,000 satellites? Take half that to break, take 10 percent creating rocks. We are creating an environment that may feel an environment that isn't sustainable.

We can talk all we want to around the edges of how long should satellites continue to stand in your [inaudible 23:55] , but if you don't take care of that issue of not creating too many rocks in space, we're in trouble.

Dan: On rocks, I think the [inaudible 24:06] rocks is one part. That's where you're taking point from [inaudible 24:14] . I would say, number one, that I'm not sure that we'll ever wipe out creating rocks because how many levels of redundancy and how many single points of failure possibilities...That's where I think [inaudible 24:38] that sanitation is going to play a role. We're going to get into a place and the question will be who pays for it, that's the real [inaudible 24:52].

Nobody in their business plan has a sanitation wedge in their budget, and it'll probably be governments initially. I think going up and point by point cleaning up the larger pieces will become a booming business over the next decade.

Matt: I don't disagree. I'm all for sanitation. My problem is I'm worried that people in talking sanitation will think that the problem of creating rocks isn't important anymore. If you think it'll be cleaned up, why worry about it? Somebody else will come along and clean it up later. Unfortunately, the science of sanitation may be evolving and improving, but the economics of it hasn't. The cost to clean up the debris that we have up there in any kind of time frame is immense.

No one seems to be tackling that issue whatsoever. We know that getting money to do that is getting governments to all agree to do that.

If they don't all agree to do it, it's not going to happen. I don't know that disaster has occurred yet that will spur everyone to action. These kinds of meetings are helpful, but I don't know that they're forming that global consensus quite yet. It's still just a boiling frog as the temperature goes up.

Unlike that when an airline full of passengers collided over Los Angeles and it created the FAA and the air traffic control systems we know of. I don't know if we can afford that here. That was a localized problem. The problem with space when it gets to this point, it'll be too late. We can't make rocks impossible, but we can do a lot of things to prevent them.

For example, when they occur, I can tell you the incentives are going to be, "I got 60 more satellites waiting to go next week. I know I probably have a problem with some of them, but if I wait and figure it all out and debase them and remake them, I'm telling you it's going to take a couple of months. Do you really wanna do that?"

The whole point of this is move fast, iterate. They still look at value mindset is we'll move it and we'll improve it. We can't afford to be in that situation. You guys stop, and I'm very interested in some of the technologies I've seen in terms of automatic deorbit systems. They've got to be reliable.

I'd hate to have one of my satellites fall out of space on its own because it suddenly was having a bad day and decided to deorbit itself. I'd rather start thinking about the implications of that science. Will that be mandated? I don't know. I'm sure it'll add cost, and it'll add cost to an already difficult business case, but interesting idea.

I'd like to explore that a bit more because if it did become a rock and it had an autonomous system will automatically take it out on its own for a small incremental cost to that asset as opposed to others.

There are challenges with that, too. I don't think we should dismiss taking care of rocks.

Dan: I agree with you. Both of those are huge challenges. Adding systems to satellites which adds weight, and, as you mentioned, the company's struggling on the business case. It will be very difficult for them to [inaudible 28:27] that.

When things get to this role of government and if it imposed, what happens to the development in space as you come in is a very complex array. At the same time, you can't argue at all. If a satellite can take care of itself, it's so much better than if it's waiting for later. Both of them need to be planned accordingly.

Matt: Probably one of the greatest moves made in the last two or three months on this whole issue is they set the site on a lower altitude down to an altitude short of [inaudible 29:07] boosts. I know there are other implications. I'm not in the middle of any of that. That's for other people to decide. I'm just thrilled that they made that decision.

It's a very responsible decision. It means that they can take care of itself over time. My hat's off to keep on doing it.

Dan: That's another consideration that I don't think is any renewed forethought in the discussion which is what are the implications going higher? Is that affecting our [inaudible 29:39]? That's not in anybody's architectural trade space.

Jacqueline: Dan, I want to back up for a second. You said that companies don't have allotted into their budget to pay for of these rocks that they [inaudible 29:54] with. Should that be something in the future that companies just budget for having to clean up a certain percentage of what they're launching?

Dan: There's some really interesting bot experiments you can do on this. It's a combination of how industry got run together. I don't think it makes sense for industry or companies individually to put line items in their budget that are how many missions into orbit to clean up their mess. On the other hand, there probably is some, eventually, both on the setup side as well as penalty side some way to gather the funds. I'm talking about this is long term because it was Matt said this been something we have [inaudible 30:50] right now.

There's got to be a way to where governments are working with industry and where there are problems, funds are found to make missions to take care of them. Again, we don't have all the technologies to do that. We're getting to the point where we have the technologies. We're very close to handle the big rocks.

The biggest problems are areas where, again, rocks come apart. We're not near the technology yet that would deal with those problems.

Jacqueline: This is something people have been talking about space handling of space debris for a number of years now. It feels like we're at a tipping point where these constellations going up, with more people entering space. Do you think now is the time for action? Do you think something is actually going to happen now, and, if so, why? Matt, can we start with you?

Matt: I thought the time to act was five, six, seven years ago. I worried it's been 10 years now [inaudible 31:57] this issue has been [inaudible 31:58]. Really, we're still just talking about it. We should be doing a lot more than we are, and I'm afraid we'll be talking about this from 10 years from now.

There is the potential for significant creation of significant and increased hazard of space over the next five years. I'm afraid we're going to miss that window, and I think it's very likely we'll miss that window. I guess we'll be in the cleanup phase at that point, but I'm not sure that we'll have the business [inaudible 32:39] for doing that.

I'm concerned. As [inaudible 32:47] said, it is big space. Look at all the technically stuff that's supposedly in our altitude, still only have to move all our satellites, in all the times where 14 times a day, each one of our 66 satellites or 75 satellites go around the earth. Still only having to move once a week, and that's only to avoid a 1 in 10,000 chance that something might happen. It's fortunate that this isn't life threatening. I'm not trying to make this into next year if something doesn't happen then it's the end, but it's getting worse. It's not getting better, and I think it's going to get worse before it gets better. I don't know what will force that true tipping point where something happens that absolutely reverses that course. We're not there yet, and it needs to happen soon. I hope we're not talking about this in five years. I enjoy it because job security here on a panel to talk about this.
[laughter]

Matt: That's not what I'm looking for at this point in my career.

Jacqueline: [inaudible 34:06] .

Dan: Realistically I think we need to, and we can ramp it up. I don't see a step function happening in the very near term, but the urgency of the red light is there ahead of us. It's not as though we can't operate in space or that we're being heavily impeded, but we see the danger ahead of us, and we very easily could face a situation where we are heavily impeded in a decade or two decades.

I'd like to see at least some good steps made, and there is some activity. Space traffic control is a good idea, and perhaps by some foundation for framework to get set up.

Then we do need to think about and there needs to be the development of some kind of approach to making sure that in our business cases, as all these companies excitedly innovate in space, that sustainability becomes an important factor. We're not there yet. I'd love to see a year from now that there's some kind of dialogue going on across the UN, across Congress that at least starts the language that can then move us forward.

Matt: Dan mentioned the point too. We don't talk much about, I totally agree with him. One area that isn't that expensive is increasing the base situational awareness environment, improving the catalog, adding to it, getting down to smaller [inaudible 36:08] and providing that to all owner operators.

Again, I don't care what agency does it but continue providing that information for free, do it quickly and improve that data. The better data we get, once everybody's using best practices and are able to maneuver and are listening and talking to each other and communicating, that will lower the risk, at least, for operable spacecraft and encourage more of that to happen.

[inaudible 36:38] isn't that dramatic. There's no giant tax. It isn't affordable right now for us to do. That's just smart, definitely.

Jacqueline: We'd going to get to audience questions. Someone had asked about space weather and spectrum. You all talked a lot about debris and collision today, but those are the only aspects

of space sustainability. Are you guys worried at all about these other aspects of having had to use of spectrum and space weather events that could impact our fate?

Matt: Certainly, space weather in a large weather event could have a significant effect on the entire vibration of rocks. We could create a whole host of them. That's a great point.

How we approach radiation susceptibility, in terms of emergency systems or primary systems in being able to set the orbit, ought to be looked at. At least as far as what do we need to de-orbit these things. This concept you mentioned of emergency de-orbit.

The other aspect of that again is were we to have a really major event in space weather, we would have to really accelerate some kind of capability to clean up the environment. That could take decades or longer. The other parts we've got, and the other part of your question...

Jacqueline: Spectrum.

Matt: That's more of an operational consideration for satellites. How are we going to do that? Optical will help with that going forward. Optical communication links are nice for that, but the technology seems to be about there. That's more about satellites coexisting and being able to do their business.

Dan: I don't know that space weather is as high on a data issue list. We're fortunate in Leo to be a little bit more protected than those out in [inaudible 39:05]. In other places, it's quite natural for protection in the atmosphere, even if there is atmosphere in an inner altitude, it does provide some protection, too, especially the bigger events.

Obviously, spacecraft should be protected in terms of radiation issues between [inaudible 39:28]. Don't spare your expense of your timing. Smaller spacecraft do that for a thing just because you don't think it's a concern unless you can fly at low altitude because that's still an important part.

I think we know more or less how to protect against that. In a catastrophic event, I don't know. Acts of God, I can't spare afford in this case. The other one being space weather and we call it spectrum.

Spectrum's another area where there's a pretty well established over the last hundred years ways of managing spectrum, frequency priorities, interference. There's an international body. We're all heading

toward the World Radio Congress here this year.

The ITU, the FCC, and all the different regulatory bodies, it's an approach we all have to take to protect yourself and to manage that. It's pretty well understood we all have to work within it. It's a pain in the neck some days because you're constantly fighting more to protect yourself if they go off and get more spectrum to keep yourself.

That's a well understood process, and I think it's working as well as they can work at this point and will. That is an area where there's a lot of international cooperation. There has been for many

years and an approach that everybody follows regardless of regime or whenever. They come to World Radio Congress and fight their battles, agree to things, working [inaudible 41:06] operators. That's working pretty well.

Jacqueline: Great. We are unfortunately out of time for today. I'm sure the conversation will continue throughout the rest of the conference today. Thank you so much everyone for joining us. A special thank you to our panelists for a great conversation.

[applause]

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