



Episode 11 – Space Debris, Congestion and the Wall-E Effect

Speaker: Dr. Michael K. Simpson, Executive Director, Secure World Foundation – 21 minutes

John Gilroy: Welcome to Constellations, the podcast from Kratos. My name is John Gilroy and I'll be your moderator today. Our guest today is Michael Simpson, Executive Director of Secure World Foundation. Michael, how are you?

Michael Simpson: I am doing well.

John Gilroy: Well, Secure World Foundation, sounds like it should be in Washington D.C. or something, but we'll get into that later. Tell us about your background please.

Michael Simpson: I have had three academic presidencies and been a professor at two different universities, three different universities actually. Now, work in space policy, which really is about as interesting a field as you could hope to be in and near the end of a career that long. It has tied me to an airplane seat perhaps more than I might want, but space has become a very international endeavor and that's par for the course, I guess.

John Gilroy: I went to your LinkedIn profile and I kind of scrolled down and saw your degrees. I think my mouse broke. I mean, there's a PhD, there's an MBA, there is a BA, there's this, President of this university, President of that university. You've had some leadership positions in very distinguished areas and I think they have a good person for the Secure World Foundation to talk about many of the topics. When I go to your website and look around the word that pops up a lot is this concept called space sustainability. What does that mean to you and what does that mean for our audience?

Michael Simpson: Well, I mean, what we really are talking about is how do we make sure that we use space in a way that we not only have it available for all the services it provides in our current time, but also ensure that it's available for both innovation and applications in decades to come. Obviously, threats to that would be space debris, the inability to manage a growing demand for placing objects in orbit, perhaps even a potential conflict in space that could create nearly non-navigable circumstances. We work with a lot of people around the world to recognize that we have a common interest in making this particular limited resource work for as many people as possible and we make some progress into a stiff wind.

John Gilroy: If you could maybe crystallize in two or three concepts here what kind of socioeconomic and national benefits can you derive from use of outer space?

The logo for "Constellations Podcast" features the word "Constellations" in a bold, black, sans-serif font. A yellow arc with a blue star at its end curves over the letters "n" and "s". Below "Constellations" is the word "Podcast" in a smaller, black, sans-serif font.

Constellations

Podcast

Michael Simpson: Well, I think there are a number of things that we've almost come to take for granted. We go to an ATM, we draw out money, we don't even think about the fact that in a very substantial number of cases in the developed world, that transaction is timestamped within a thousandth of a second because of a connection to a satellite, making it very easy to document and to verify exactly when the transaction took place. We overlook sometimes the fact that when I was in high school getting a good accurate weather forecast a day in advance was a pretty special thing. Now, routinely we see substantial accuracy in weather forecasts three or more days in advance and we think we're making progress towards the current holy grail, which is the seven day forecast that really is almost always accurate.

Satellites are doing all of that. We navigate from place to place with GPS, or with any of the three other competing systems, depending upon where we are in the world. We plan our cities with remote sensing from earth observation satellites that can give very precise indications of elevation, water conditions, human habitation, vegetation. All of that has become a part of the way we build our communities, part of the way we sustain our communities. If we were to lose those capabilities, there are not terrestrial alternatives that are as effective, or as cost-effective as the services that we're providing from satellites on orbit.

That becomes a part of modern life in a developed country like the United States, or in countries like in Europe, or Japan, but it also is a critical part of the replacement of infrastructure for developing countries, which have made substantial gains in their ability to use a distributed computing, and crowdsourcing through communications in part because significant pieces of terrestrial infrastructure have been replaced by satellite, and that we sometimes overlook when we think about what the impact would be if we were to lose substantial capabilities in orbit.

John Gilroy: Last night I was at your website and I was taking notes with a piece of pen and paper, just old-fashion, and I wanted to write down Secure World Foundation. I wrote down, "Secure World Forum." I was like, "Well, it's almost like you provide a forum for international groups to get together and exchange information on some of these concepts involved in space sustainability." Is that right?

Michael Simpson: Yeah, I think that's very insightful. Sometimes people try to figure out where we stand on the think tank spectrum, and in many ways we're not a classic think tank. We do run fora. We are a catalyst of conversation. We often say when we're planning an event that one of the measures of success is that we bring several people to the table that should have been talking to each other, but hadn't been, and we allow that conversation to develop. There's a certain amount of optimism and confidence that if enough people of different opinions come to the table, reconcile those differences, and adopt a path forward, that

The logo for "Constellations Podcast" features the word "Constellations" in a bold, black, sans-serif font. A yellow arc with a blue star at its end curves over the letters "n" and "s". Below "Constellations" is the word "Podcast" in a smaller, black, sans-serif font.

Constellations

Podcast

that path is going to get followed, and that it's going to be an important contribution to shared activity in space, shared decision making in space, and hopefully eventually to enough structure to that decision making that people can predict what will happen in orbit and what their potential competitors are going to be doing with earth orbit.

In all those cases, we advance sustainability to the extent that we have people sharing information transparently with each other and that in turn builds confidence. It's a method that's worked for us. It's helped us to address root causes of conflict, rather than the tools of conflict. In a number of cases, we think it has made permanent improvements in the way people make decisions together about space and some of the challenges it can present.

John Gilroy: Well, Michael, it's 2018. I'd be remiss if I didn't mention Twitter. If I go to your organization's Twitter feed, the hashtag is #SpaceDebris, which many people don't realize this is a major problem out there, isn't it?

Michael Simpson: Yeah. I mean, we use that hashtag a lot. I mean, it's not our primary hashtag, but it is an area with which we are very closely identified because we were certainly an early voice when talking about the need to, first of all, mitigate the creation of new debris, and secondly, to keep up the effort to study ways in which we might actually actively remove debris in the future. We joke sometimes that we have been so successful that we almost have contributed to the WALL-E effect, this idea there's so much debris up there that you cannot launch through it, but we are nonetheless facing a few situations in which concentrations of debris in critical orbits are complicating the challenge of operating in those orbits, and of launching into those orbits.

We have recently seen some data that indicates that the debris problem in the geosynchronous arc may be somewhat larger than we thought. That's worrying simply because there's only so many places in the geosynchronous arc that are available for useful application, and if we really mess them up, we would have substantial challenges in operating. That should be a matter of concern, since that's the arc from which a huge portion of satellite broadcast takes place, and where much of satellite communications takes place. The so-called Clarke orbit that appears to allow the satellite to be stationary over the equator, and therefore enables much of the world to benefit from having a very, very, very high radio tower in space.

John Gilroy: Michael, I talk with a lot of software developers and they throw around this phrase, "Unintentional consequences," and maybe space debris is unintentional, but in outer space there are also intentional consequences too. There's contested space out there and I think what your forum, your foundation tries to do is maybe promote cooperative solutions to some of this conflict, some of this space situational awareness. Hmm?

The logo for 'Constellations Podcast' features the word 'Constellations' in a bold, black, sans-serif font. A yellow arc with a blue star at its end curves over the 'o' and 'n' in 'Constellations'. Below the main title, the word 'Podcast' is written in a smaller, black, sans-serif font.

Constellations

Podcast

Michael Simpson:

Yeah. We do try to get people together to talk about the reality that there are security issues in space. We, along with the United Nations Institute for Disarmament Information and Research, UNIDIR, we sponsor a conference every year in Geneva, and also with The Simons Foundation of Canada, looks at space security issues across a very wide range. That is, security that comes from the loss of access to a satellite, that is security on the ground of people's day-to-day lives, but also security issues of potential conflict in space that could produce additional debris, could produce substantial disruption in the availability of satellite services because of blinding, or spoofing, or whatever.

What we have come to understand is that a key factor in reducing that risk is to be able to hang on long enough for more countries than just the United States, and to some extent Japan, and Europe, to have other people who are dependent on space assets. There's kind of a symmetry that occurs in the current space security environment in which China and Russia are not as dependent on space as the United States, Japan, and Europe, and that therefore you can at least create a theoretical hypothetical situation where it might be less risky for Russia or China to disrupt space operations than certainly would be for the United States to intentionally do that.

On the one hand, fortunately, both China and Russia are becoming more dependent on space. They're using space more. They're seeing the advantages of space more. The Chinese after messing up orbit, after taking out their Fengyun weather satellite in 2007, have conducted tests that can be argued to have been anti-satellite tests, but they have not actually hit anything. They have aimed to miss, or they have fired tests that simply test the capabilities of the altitude, capabilities of a ground-based missile, but they seem to have learned the lesson that making a debris mess out of middle earth orbit is not a good idea.

Part of the reason they come to that lesson is that it was creating problems for their own space station, this debris cloud that they created. As countries become more dependent, they become less likely to be cavalier in the creation of a situation that would be traumatically disadvantageous to them, as well as to their potential enemies. The flip side to that of course is that for countries that have been quite dominant in space, the United States clearly, to some extent, Europe, although not militarily. The capabilities it has indicate it wouldn't take very much for Europe to develop a military capability beyond that of the French and the British. Those countries begin to see competition.

They begin to see, "Oh, China and Russia now are getting as good as we are." It's a yin and yang situation that does involve a great deal of conversation, not just with the countries, but with the constituencies of those countries to indicate that it may be a good thing eventually the countries are more equal in their capabilities, but it's always scary to the one that's been dominant. In this case,

Constellations

Podcast

certainly militarily dominant, the United States, to see that other countries are gaining rapidly in their space capabilities. The Europeans showed us with the Schuman plan that if you create an economy in which attacking your neighbor destroys your own economic base, you create a somewhat more stable environment. I suspect we are evolving in that direction with the use of space by a larger number of countries, but we certainly aren't there yet.

John Gilroy: When you talked about China, I took notes and wrote down, "Irresponsible action." I'd like to maybe put things in dollars and cents. What are the cost implications in the area of space sustainability for some of these irresponsible actions? I mean, these can be relatively expensive for other players, can't they?

Michael Simpson: Well, yes. I mean, economically it's tough to estimate that, because you really don't have a lot to extrapolate from. I mean, we've had one major collision. Cosmos and a functioning Iridium satellite and an out-of-service, defunct, Soviet-era Cosmos satellite, obviously had a collision that produced a fairly substantial amount of debris. Interestingly, in that case, there was no financial settlement. In part, because the Iridium satellite was fully depreciated. The implications for business continuation of the loss of service of that one satellite were not sufficient to underlay a process in any court. The issue of fault was tough to deal with, because the argument could be made that Iridium had been warned that there was a potential conjunction.

In that case, their actions did not avoid the collision. Iridium, of course, makes the comment that, "They get so many warnings they can't react to all of them, or they'd be out of fuel, and half the life of the satellite." That complicates this whole question, figuring out what is the cost, and what is the liability. The other way of course to try to get at this issue, is to say, what if we were to lose, say, 50% of the broadcast capability that exists in geosynchronous orbit? An event that could occur if a large solar flare, for example, damaged all those satellites on the sun side of the planet.

I've seen estimates that go up to trillions of dollars. Certainly, in the many hundreds of billions of dollars, because you have to replace all that capability, and you're not going to do it right away. All the lost service has to be taken into account. This is one place where you go back to sort of primordial economics and the answer as far as the number is concerned is lots. Just imagine replacing half of the communication's capability in GEO.

John Gilroy: Wow. Solar flares are awfully hard to predict, and no one knows what's going to happen. However, there could be human induced interference on satellites as well. I mean, I've heard of situations where there's radio frequency interference too. It could be natural or manmade as well, but this can impact our ability to sustain space, can't it?

The logo for "Constellations Podcast" features the word "Constellations" in a bold, black, sans-serif font. A yellow arc with a blue star at its end curves over the top of the letters. Below "Constellations" is the word "Podcast" in a smaller, black, sans-serif font.

Constellations

Podcast

Michael Simpson:

Well, yes. They're two big pieces to radio frequency interference. Intentional interference is certainly very possible. It appears to have occurred in a few cases. Although, pinning it down is really hard, but there seem to be a number of cases where some Middle Eastern satellites, for example, were jammed. That is a matter of considerable concern. Even bigger in many ways, is the fact that as we grow the fleet of satellites in space, the number of objects attempting to use what is a finite radio spectrum, are growing. Currently, the ITU, International Telecommunications Union, manages to assign frequencies in cases where there is potential international interference. They have very, very limited enforcement power. Mostly a bully pulpit, not much better than that.

As more and more services in space seek to communicate their data, or to use frequency to obtain data, because they use it for scanning as well, we are finding tighter and tighter competition for those spectra. Then add to that, that there are terrestrial uses that would love to use the same spectra, and that terrestrial sources generally are more powerful, and so they fairly easily wipe out the capability of the much lower gain satellite communications to reach their intended sources. This is leading some satellite operators to start looking at extraordinary high frequencies up in bands that are known as B, and W, that are just gigahertz bands. I mean, they're just very, very high frequency bands that are subject to substantial interference from clouds, and rain, and dust, which could be used in some strategic ways with well-placed ground stations to get data down. That is a major issue.

The weather community has been concerned about the growing interest in the use of a band called L-band, which is a band that they use quite a bit for providing the data that is important to modern weather forecasting. Again, the satellite's L-band signal is relatively weak, relative to terrestrial L-band signals, at protecting the ability of a ground station to receive a satellite signal, and therefore provide weather data, is getting to be increasingly challenging. Every three years there's a World Radio Conference that tries to allocate these bands, and the last one provided some protection for these bands.

There's growing concern that given the very substantial amount of money involved in terrestrial communications, especially the growing hunger of the market for access to data, that we might eventually make the decision that terrestrial data communications is a higher priority than bringing down weather data in a timely way. One could expect that that could have some nasty consequences if we go from being able to predict landfall of a hurricane, to within say, 50 to 100 kilometers, back to being able to guess at a landfall within 500 kilometers. As people discovered in the Caribbean, it's sort of nice to have at least some idea where the hurricane is most likely to hit.

John Gilroy:

Michael, the Super Bowl's coming up in a few weeks here and I usually give one minute or two minute warnings. I got to give you a one minute warning here.

The logo for "Constellations Podcast" features the word "Constellations" in a bold, black, sans-serif font. A yellow arc with a blue star at its end curves over the top of the letters. Below "Constellations" is the word "Podcast" in a smaller, black, sans-serif font.

Constellations

Podcast

What do you think about the future? Do you think Secure World Foundation's going to get a handle on this, and come to some terms, and try to form the future for a lot of these problems?

Michael Simpson:

Well, I think we've had some success. I mean, we have had success in helping to advance data sharing, so data is more broadly available around the world. We have had success in coordinated decision making about the unlikely, but nonetheless, potentially disastrous effect of an asteroid approaching earth and actually impacting us. As I like to say, in many cases we worry about contested space, we worry about it being contested, congested, and competitive.

I often point out that the solution is it's also congested, contested, and invested, and there is more ... There are more and more countries and companies putting money into space. We have a common interest in protecting this particular asset. The more allies of that kind there are, the more hopeful we can be that if we get the right people to the table, we can reconcile differences, and make sure that space continues to be an asset to us, and our grandchildren, and hopefully their grandchildren. By that time, maybe we're orbiting in satellite still.

John Gilroy:

Well, great. Thank you very much for your time this afternoon, Michael. We are running out of time here. I'd like to thank our guest, Michael Simpson, Executive Director, Secure World Foundation.