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Delivering innovation to the ground terminal space segment

Isotropic Systems was founded to deliver innovation to the ground terminal space segment with next-generation antenna technology based on scientific advances in the field of optics. With their unique antenna design, terminal costs are expected to be a fraction of those available on the market today, making the technology a key enabler for bridging the digital divide and accessing greater satellite market share by closing the most challenging business cases. Amy Saunders met with John Finney, Founder of Isotropic, to learn more about the company's objectives, progress, and roadmap to launch.

Question: Can you outline the reasons behind the founding of Isotropic Systems, and tell us about its ultimate objectives?

John Finney: Isotropic's overall objective is to provide disruption to the ground terminal space, just as we're seeing today with high throughput satellites (HTS). We've got a very unusual industry dynamic right now, with somewhere in the region of US$16 billion of HTS investment, of which at least US$9 billion in NGSO constellations, but yet nowhere near the same degree of investment focus going into the ground segment. In my opinion, that's because those investing heavily in HTS space segment believe that the ecosystem is there to support them, to innovate and come up with solutions that fit nicely in their plans. That's a fantastic opportunity for us.

What we aim to do is to provide an enormous amount of price disruption and fuel industry growth. There's a number of phased array and flat panel antennas today that we're hearing a lot about in the press. Those antennas fit nicely into the top end of the pricing pyramid, for enterprises with a business model that includes a high willingness to pay very high prices for electronically steered antennas such as aeronautical, super yachts, etc. The reality of being at the top of the pricing pyramid is that the volume is low; there's only so many aircraft and yachts in the world.

The idea of HTS was to create a greater market share for the satellite industry. It was really looking at consumer applications, the Internet of Things (IoT), connected cars, a very wide variety of market segments. Part of the HTS business model also aims to bridge the digital divide either directly with consumer broadband applications or indirectly serving terrestrial operators with enabling capacity with dramatically

John Finney, Founder of Isotropic

lower transport costs. That's a huge swathe of under-connected or unconnected individuals who live in remote locations, have low income levels, and have limited access to steady state power. The lower the cost to get a terminal to the service for the first time, the more customers you can service. But, if we can access that market, the volume is going to be vast.

At Isotropic, we want to focus on the enablement of the business model for HTS, for all frequencies. It's about having comparable technology to the current phased array and flat panel antenna products, but at a tiny fraction of the price.

Question: What can you tell us about the technology behind Isotropic's innovative antenna?

John Finney: The technology comes from the field of optics. Recent scientific advances have received a lot of attention in academic fields for the notion that you can manipulate light to appear invisible; we're literally talking about invisibility cloaks. Professors in this field say that you can theoretically have a lens which flips down in front of a surgeon's hands, and when they're looking straight through this lens, the light coming from the hands, including the shadows, would be refracted away from the eye, allowing the surgeon to effectively see through their own hands during the operation. Another example is the ability to cloak a device, manipulating the way light passes through that device to make it invisible. It's all about the controlled bending of light to achieve very interesting optical effects.

In pursuing a solution that massively reduces the price of current technology to address the lower sections of the pricing pyramid, we identified those recent scientific breakthroughs as a potential opportunity, because radio and light waves propagate in the same way. We spoke to the major players in those fields, and performed some very early stage research with academic institutions to establish the potential to use this science to create an antenna. That was a couple of years ago now, and we have made tremendous progress since. From there, we went into the product development risk reduction, and now we've progressed to advanced design and engineering. For example, we have now established that our technology can meet Federal

Communications Commission (FCC) specifications at extreme angles both in Ku and Ka-bands, and can handle the pointing accuracy required with relative ease.

We have created an antenna which is essentially an optical beam forming array comprising of super element modules, which when combined allow us to control the way that the radio wave propagates. The net breakthrough of our technology is that we only use 20 percent of the number of parts compared to a phased array solution. For example, for a 65cm Ku-band phased array antenna, you'd probably have 4,000 radiating elements: We'd have less than 800.

That challenge with current phased array and FPA design is very simple; until now, there has never been a way for the existing technology to decouple the scanning performance of an antenna from the number of associated feeds and cost drivers required to create one beam pointed in any given direction. I'm really proud of the Isotropic team, they have taken away the Achilles' heel of phased array and enabled us to offer a price point that is disruptive from the first unit to ship from our factory and not relying on volume over time.

Ultimately, the way our technology is put together delivers a massive price differential that we're planning to bring to market, which addresses the high throughput segment perfectly.

Question: Where are you right now in terms of technology development and funding?

John Finney: If we're speaking about technology readiness levels (TRL), we're at levels 4-6 right now for different parts on our system; some parts are on the eve of going into TRL 7. That means that we're about to produce some of our first proof of concepts. We've already done proof of concepts at 10GHz to check the performance of our design in terms of the main lobe, the side lobes, the scanning performance and the characteristics that we're looking for. Now what we're doing is adapting an array, which is to conform with satellite requirements focusing on Ku-band. We have an optical proof of concept that is undergoing final testing and we are working towards and end-to-end demonstration of the transmit/receive chain by the year-end.

We're funded for Ku-band right now, but we're also talking to a number of operators about their plans for Ka and higher bands. If we decide to prioritise Ka-band, it'll either be because we've gained new funding to enable us to do that, or because of increased participation from some of the players that have a vested interest in our technology.

One of the great things about the timing of our business is that satellite operators are currently in a planning and construction phase for HTS global systems, so we're perfectly positioned to get into that straight off the bat as the timing of our first product release [2H 2019] meets the arrival of those systems.

The feedback we're getting so far is that, if we do everything we say we're going to do, in the timescales we say we're going to do it, we're going to be classed as a strategic enabler for the satellite industry. It's very clear that the price of the terminals to distribute that capacity is critical to our potential customers' business case. The HTS business case relies heavily on the beam fill rate and system overall fill rate and with so much capacity coming online, our role will be to help those

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operators achieve accretive returns for shareholders by providing customers with much much lower cost infrastructure on the ground.

Question: Which end user applications do you expect to provide the greatest opportunities for Isotropic?
John Finney: We expect that our technology will be used across all of the pricing pyramid, from super yachts and aeronautical at the top, the mobility market as a whole, through to connected cars, IoT and the digital divide at the bottom.

Consumer broadband in the non-GEO HTS space is going to be a big opportunity for us; we're talking about very low-priced terminals that can be placed in homes, schools, wherever. A significant number of terminals are expected to be deployed as a result of the recent boom in non-GEO filings. In fact, NSR doubled their forecast in terminal numbers between the first and second editions of their market report because of the number of planned and funded non-GEO satellite systems announced. An extra two million terminals are expected as a result over the next ten years. Since that second report, even more filings have been made, and more projects have been funded, so the opportunities are only going to increase, and it's important to recognise that those systems rely almost entirely on electronically steered antennas rather than motorized tracking.

In addition to the consumer broadband segment, there is the connected car market, which although currently very early in its life, is going to expand rapidly very soon. There are 120 million cars being built every year, so even though the role of satellite is arguably going to be very low, it's a major opportunity for Isotropic to participate in that market because the numbers are so large even if the role of satellite captures a very low market share.

Our antenna apertures are going to be a big selling point, spanning 20cm to 1.5m on a practical level, whereas most of the current electronically steered antenna systems have severe limitations in scaling beyond 70cm. Because of our price points, there will be a good number of customers who want to exploit that technology to go to much higher apertures because they can afford to do so, while there will be others that want to take advantage of the fact that we can have a very small antenna at low cost. Our unique ability to have multiple links with the same antenna, but without any added cost, is another major selling point that differentiates us from alternative technologies. With phased array antennas, for example, if you want to have another beam from the same antenna, you basically have to increase the array in a linear way and your cost increases in line.

Question: Do you have any plans for partnering with satellite operators, integrators or resellers in the future?
John Finney: We will of course have strategic partnerships, but since the overall objective is to offer price disruption, we have to be careful of agreements that narrow our ability to sell to the universe of customers that are out there in the very long term.

Right now, what we're doing is what all good start ups do; focusing on developing the technology and making sure that we're funded to do that, whilst creating a truly great place to work as we are continuously hiring.

Question: What do you anticipate the biggest challenges going forwards might be?
John Finney: Scaling up the organisation is always a challenge, as is the case for any start up. We've hired tremendously well, so we have a great team, and we want to keep the quality of that team as we grow. All of the critical risk reduction is behind us, so what we're looking at now is about how well we execute as a company, making sure that our planning is well thought-out. It's really about how the company is managed and how we evolve.

Question: What plans do you have in line for the rest of 2017?
John Finney: Our focus is to prove the optics beyond dispute. When we get to our next funding milestone towards the end of this year, we'll be wanting to put devices in the hands of customers to connect to their own satellites, to enable them to further evaluate our technology for themselves.

We will secure a significant amount of funding to make sure we can do everything we need to during that phase. We'll also need to have a confirmed roadmap for the first and second generation products, in which we'll need to confirm our strategic alliances in terms of contract manufacturing and components manufacturing. Most of all, we will continue our passion for leaving behind the notion of flat panel antennas and race towards the next generation of 'high throughput terminals,' an entirely new class of antennas pioneered by Isotropic Systems, designed to match the performance of high throughput satellites. ■