**Season One: Episode Two**
*Digital Infrastructure: Where Does The Internet Come From?*
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**Luke Charest:** So I'm sitting here in the Chelsea neighborhood of Manhattan and you're over there in Amsterdam. And if I look at Google, it tells me we're seven hours apart from each other by flight. So it takes my body seven hours for you, for me to get over there and hang out with you. And yet I'm talking to you and our voices are traveling nearly instantaneously, right.

**Minesh Mashru**: So if we were to go to the Atlantic Ocean and we would look to the bottom of the Atlantic Ocean, we would find cables running under the Atlantic Ocean. A lot of these cables now are transferring data from different continents.

**Luke:** I'm Luke Charest and this is my colleague Minesh Mashru; we're video-chatting over Zoom, like so many of us have done on a daily basis since the pandemic began. He's the head of infrastructure investing at Cambridge Associates, so he knows a lot about how all this works.

**Minesh:** If you think what is it that's actually traveling? So with fiber, essentially lights.

**Luke:** Yes -- when you're talking on Zoom, your voice and image gets turned into data. And if you have a fiber optic network from your internet provider, it's data in the form of different colors of *light*.

**Minesh:** It's not exactly the speed of light, but it's not far from it.

**Luke:** You, at nearly the speed of light. That's why video calls work well ...most of the time... But it's *more* than conversations, streaming TV shows, and emailing that matter.

Data usage covers every aspect of life, and it's growing: from connected appliances, to autonomous cars, and even futuristic-seeming things like remote surgery. And not everyone has access to this high-speed fiber optic internet.

But, why does this matter? And what are the implications for investing in these wires -- this *digital infrastructure*?

[THEME MUSIC]

**Luke:** This is Unseen Upside from Cambridge Associates -- it's investments beyond the returns. This season we're meeting the people who take risks on the technology that will change the way we live -- and hear why they're doing it.

When you hear the word *infrastructure*, you usually think of roads or bridges, and that's of course correct. But we also need physical infrastructure to power our digital lives: things like data centers, towers, and our focus this episode -- cables, which are made up of hundreds of copper or fiber wires wrapped together.

You're likely thinking -- I just use wifi at home. No cables or wires here! That's true, but cables carry data to your home, where it's converted to wifi once it reaches your router.

And all this modern digital infrastructure has roots in the Second Industrial Revolution.

**Minesh** And I would like to take us back to maybe the start of the 20th century, thinking about where this all began and it began with the onset of telephones. Thereafter came television. And that's really the medium that was used there that was copper, copper, to get voice signals from one end to the other. And then when the Internet started to come to being, creative people found, well, OK, why don't we use the same medium that's going to every single house, more or less in the developed world for sure to actually provide data services.

**Luke:** And while copper wiring is still cheaper to maintain and its networks still exist worldwide, it's not going to be able to keep up.

What are the smartest people saying out there about how much our data, again, loosely defined our data consumption is going to grow in the next five years, the next decade? ...Because anecdotally, the average person has seven devices, I think I'm looking at five or six just right around me in this office. What is that going to look like in the future here?

**Minesh**: It's only going in one direction. And it's not just driven by what we're doing with videos or social media, but it's across industries. It's the rise of the digital economy and industries moving increasingly digital, whether that's with an e commerce or other disruption that's occurring or industries utilizing more and more analytics. And so, this is rising at a phenomenal rate. I think the estimates that I've seen data probably rising by four to five-fold in the next five years, and it's already risen dramatically in the last few years.

**Luke:** So the existing copper wiring -- which turns your voice and image into an *electrical* signal, by the way -- can't hold enough data and isn't fast enough. Light -- fiber -- is faster than electricity. And we just went through a bit of a stress test in the last year and a half.

How did we meet the need of kind of the global citizenry, if you will, over this past year or so of the covid environment?

**Minesh**: I was speaking to different CEOs of companies, running fiber operations or integrated digital infrastructure businesses. And a lot of them had been receiving calls from customers, including hospitals and the like, that were very worried. They were very worried. You know, can we continue to operate if we're not connected anymore? And they needed more bandwidth. So short term solutions were absolutely needed to make sure that critical infrastructure could be maintained.

**Luke:** But short-term solutions won't be viable moving forward. Installing fiber is expensive, and governments need to decide whether to pay for it themselves or let private sector investors help them catch up.

And these digital infrastructure decisions are playing out all over the world at this moment. In many cases, China is regarded as the model for the rest of the world. They have had a massive buildout of fiber, covering nearly 80% of the country. Which does more than bring people faster internet.

**Minesh**: China, I think, has clearly recognized that very early and seen an opportunity to really build out their society and empower it**.** I've heard of fantastic stories, you know, where you have people who don't even have a computer in rural China are able to kind of go into town to e-commerce station that Alibaba has set up and go off and do that e-commerce. And yet we have to get to rural areas. You know, that there's a massive population that you can reach. So you want to be able to kind of serve every citizen and not just those in the city.

[SCENE CHANGE]

**Luke:** It's 9:30 p.m. in New York City and I'm chatting with Andrew Kwok. He's the CEO of HGC Global Communications, a leading telecom company based in Hong Kong. It's 9:30 a.m. the next day for him.

I read a recent article about HGC bringing some fiber optic technology to a remote village in Hong Kong. How big an impact can something like that have for more rural populations that are may be on legacy copper infrastructure or no digital infrastructure?

**Andrew Kwok**: Yeah, so around one and a half years ago the government in Hong Kong has put up some subsidies to encourage the operator to expand our fiber into those suburbs, which mainly they are only enjoying copper wire for the Internet as a very fundamental service. So, we got involved and luckily, we are one of the two who were awarded with the overall suburban expansion in Hong Kong. So, I think at this

moment, our very fundamental and down to earth point of view is that no matter if you're talking about digitization or whatsoever, basically you've got to have fiber.

**Andrew：** So, we welcome this opportunity and we have to improve that, and on top of the fiber that we are expanding, we are starting to put in a lot of other services, for example Smart Village.

**Luke:** The Smart Village is the next step of what areas with new fiber optic networks can do that they couldn't do before. Ultimately, the goal of Smart Village is to improve daily life for citizens in rural villages -- with things like smart traffic lights, telehealth access, and even fire detection.

What initially led you to work in this industry?

**Andrew**: Luke, I'm very embarrassed to tell you. That is was kind of fate after my graduation. I had two choices. One is join the bank and the other one is join the communication, telecommunication. At that time, a bank in Hong Kong would like to recruit me. And the Cable & Wireless also sends me an offer. And eventually I pick Cable & Wireless for one very simple reason. You know, when you are 20 something years old, you don't care much about money. So, you only want to see the world, travel around picking up a suitcase and then going onto a plane.

**Luke:** At HGC, Andrew still travels the world. He is in charge of over 700 employees building telecom infrastructure - including fiber networks - throughout Southeast Asia.

**Andrew:** We do have twenty-six years of experience and also history. We started with a fixed line business in Hong Kong business, a lot of fiber in underground. So later on we expanded into international. Also we do have around 23. I lost track my friend, 22 or 23 countries we do have an office there.

**Luke:** Now for listeners that aren't as close to kind of telecom trends in Asia...What are some of the trends you're seeing in the region?

**Andrew:** Luke, it is a very big question.... I think all of us may know that the digitization started with a foundation of a network, which is a fiber network, no matter if you on 5G or even in the future for 6G and all that….You've got to have a fundamental foundation, which is fiber. And in my humble opinion, again, is that in this coming 10 or 20 years of time, I don't think there would be any technology to replace the fiber.

I think in Asia, no matter in Asia or around the world, there are two things that are leading and pushing the trend of the digitalization pace. First is the population. The second one is the technology and also the advancement of the economic ecosystem in that location. So this is my classification of how successful will that digitization pick up.

**Luke:** Now, as you think a couple say five years out, is there enough fiber out there to meet the demand from consumers and the advent of 5G? Or does more and more need to be built from an infrastructure perspective to handle future demand?

**Andrew:** If you take a look at the U.S., we are talking about around 20 percent of fiber to the household only, and those are more concentrated in the metro, a lot of suburban locations. And all my US friends say they want to work in the Metro, but they want to live in the suburbs, where it's very quiet. So those are big opportunities.

And if you go on coming back into Asia, I can tell you that a lot of Southeast Asian country, they need a lot of fiber because just take a look. When I talk about Hong Kong, the downlink speed is around 240, 250 megabits per second. In village, for example, we are talking about around 50....So even Japan, even a lot of other places, there's a lot of fiber investment opportunity.

**Luke:** My final question is, is more personal, if you think of kind of the everyday citizen or yourself. What about 5G gets you most excited, what usage or application that you can kind of see coming, should people be looking out for that you think will be really exciting in their day to day life?

**Andrew:** Hopefully in the future, I think people shouldn't work five days a week. I think people should only work three days a week. Yeah, although I work 6 days, so unluckily, because we are only in the company for three and a half years, we have a lot of things to do. So but having said that, coming back into our discussion, I think a lot of machine talking with a lot of machine will facilitate a lot of work, which becomes unnecessary for human beings to handle. And hopefully during that time there will be a lot of service time and leisure time for us to think about how to improve our lifestyle, how to do something like chasing after money and using a very back work life in order and squeeze our lot of time for the people.

**Luke:** So if I want to only work three days a week, should I apply for a job at HGC?

**Andrew:** Fine. You come first. I'll tell you what role and responsibility you have. And but however, in this company, several years of time, I tell you that we are very busy. *[laughs]*

[SCENE CHANGE]

**Aaron Werley:** The fibers themselves, which is actually what you know is the real magic as opposed to the cable, which is the collection of the fibers and sort of the armor around it. The fibers are what carry the data. Each fiber is thinner than a human hair when you get down to it.

**Luke:** This is Aaron Werley. He's VP of architecture at Zayo, where he engineers and plans fiber networks. He says a fiber optic cable looks much like any other cable you may see hanging on a pole. But it's what's on the inside that counts. The light that travels through those thin fibers is of different colors -- or wavelengths, which keeps them from interfering with each other...

**Aaron**: This very podcast that we're doing right now is going across one wavelength. Internet traffic could be going on that same pair of fiber, but on a different wavelength

right next to it. And, you know, separate to that could be, you know, a private service for some enterprise.

**Luke:** Fiber also allows for a higher capacity and signal quality over greater distances vs. copper. But, it has to be manufactured first.

**Aaron**: The fiber itself is made in a very complicated and resource intensive process where these huge draw towers are manufactured and this ultra pure glass, if you will, is placed on top, heated up and pulled down the draw tower, creating this, you know, super thin like I said smaller than a human hair, fiber strand. And then ultimately all that fiber, those as I fibers collected, you know, hundreds of them are put into what ultimately is a fiber cable.

**Luke:** I would imagine this is quite a process, but if you had to kind of oversimplify in terms of actually installing fiber, what does that look like?

**Aaron**: Yeah so, you know, directional boring right now is the key installation method for buried fiber. You'll have different manufacturers, you know, typically like a Ditch Witch, which has these long pipes... It's this tank-like apparatus that sits on the side of the road and has these pipes that essentially it pushes into the ground and can directionally steer where it goes as it moves forward, kind of creating that pathway for the conduit and then eventually the fiber to be pulled through.

**Luke:** What's the logic there? Is it literally just so they don't get broken or why put these cables underground?

**Aaron**: So there is a lot of evidence that buried fiber is exposed to less or has less impacts due to, you know, weather events, car accidents. Gunshots is huge, right? People trying to shoot birds off of lines. It happens. And separately, you have sort of, you know, municipality requirements. You can't just go stab poles in the ground and string fiber up everywhere. Much of the infrastructure is required to be buried.

[SCENE CHANGE]

**Luke:** Once the fiber is buried, there's the process of connecting it to data centers and towers -- also parts of the infrastructure of internet connectivity.

And given what we've heard about the demand for more fiber worldwide, this is where private investors are looking at the opportunity. And sometimes they even get to get out of the office and do site visits.

**Simon Soder**: So we did go and do some visits in some of the they call it handholds in in the Netherlands, I think maybe in English, I guess, a manhole, you lift up a lid and you can see some of the cables in the ground. Clearly, fiber is not the easiest one to sort of get a feel for the full physical assets by visual inspection…

**Luke:** This is Simon Soder, a partner at Antin Infrastructure Partners. Antin is one of the most experienced infrastructure investors in Europe and has a unique perspective.

Now, I think a really great place to dive in with you is to learn how you all define the term infrastructure, because I think you guys have a unique approach to the space, right?

**Simon:** I think different people do have different definitions. And we therefore will use what we call the Antin infrastructure test, which consists of five elements, basically, which is does the asset provide an essential service? Does it benefit from barriers to entry? Does it generate predictable cash flows? Does it have an element of inflation linkage? And in some ways, most importantly, does it have some downside protection?

**Luke:** You guys have invested in several fiber companies. You know, why? Like what was appealing to these companies to invest to investors like you and yourself?

**Simon:** One of the trends we'd identified was the strong growth in the amount of data used, which I think today is not really in dispute and most people are aware of it and will contribute to it by watching Netflix or, you know, using things on the phone or uploading things to the cloud, et cetera. But maybe a decade ago, not so much in focus or not in front of mind of a lot of people, but that's when we had identified that macro trend.

And one of the first ones we had identified was the business called EuroFiber. And what they do is two things, if you if you boil it down to two. The simplest elements: one is it provides fiber to enterprise customers, so it provides the fiber line to offices, for example, or schools or hospitals. So enterprise customers and government type organizations. Secondly, it also provides fiber network to large telcos and carriers.

**Luke:** EuroFiber has nearly 24,000 miles of fiber optic cable connecting parts of the Netherlands, Belgium, France, and Germany.

**Simon:** We could see that this will provide an essential service to both enterprises, but also private users and also government organizations. And we could see that it would be supported by a macro trend playing out for a long time. And we could also see that it was something that -- at the time -- it was an underserved space in the sense that there wasn't much capital allocated to it.

**Luke:** Antin has helped EuroFiber grow its revenue by double digits annually. They've since invested in three more fiber companies globally, proving investing in fiber has benefits for investors *and* the citizens who live there.

[SCENE CHANGE]

**Luke:** Ok, this whole episode we've talked about the global need for fiber to support innovation and our increasingly digital lives. But before I let my colleague Minesh in Amsterdam go, I had a couple of questions that were nagging at me.

First -- *Any* kind of wires seems very 20th century. What about companies like Starlink providing broadband connections with satellites? Isn't *that* the future?

**Minesh:** If you think about…let's say you would send me a signal through the air from New York to Amsterdam. Think about the amount of interference that could go between point A to point B, it's absolutely huge.

And the issue is these are not in a geostationary orbit. They're moving all the time. So you need enough of them so that we definitely haven't got to that critical mass here because otherwise you can start to get intimacy in your signal. But even so, you can't control for weather patterns and other things that might happen below you.

**Luke:** And my second nagging question for Minesh...

You mentioned something funny to me as we were kind of chatting about this this podcast. **...**you've actually switched back to copper for your needs in your home...How do you square that in your head and how do you square that with the clients you work with?

**Minesh:** I did recently switch providers, but the reason to switch wasn't completely just driven by moving back to copper. It was maybe a little bit of dissatisfaction with my provider at the time without naming any names... But I recognized that I'd have to switch to copper, which was a concern initially. I'll be honest for like, am I going to get the same speeds, et cetera?

**Luke:** But Minesh had found that his new provider's copper internet was actually fine. Because -- everyone had left that network -- they had moved on to fiber.

## [CREDITS]

**Luke:** If you want to learn more about digital infrastructure investments, please visit our website: cambridge associates dot com slash unseen upside or check out the show notes. Stay tuned for more upcoming episodes of Unseen Upside. If you like what you are hearing, leave us a review and tell your friends and colleagues.

I'm Luke Charest. At Cambridge Associates, our podcast team is led by myself and Hillary Ribaudo.

From PRX Productions, Producer and writer Genevieve Sponsler; associate producer Se'era Spragley-Ricks; Sound design and post-production engineering by Samantha Gattsek. The Project manager is Ian Fox. The executive producer of PRX Productions is Jocelyn Gonzales.

Before you go, one of my colleagues has an important message about the contents of this podcast.

[DISCLOSURE]