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# Conversations with...

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### 5G: Connectivity Gets Its Space Age

As 5G connectivity replaces 4G over the next decade, we think we will all be amazed at how profoundly it changes our lives. From autonomous vehicles to intelligent refrigerators, from remote surgery to smart factories to hundreds of applications that we can barely imagine today, by the 2030s 5G is likely to be at the heart of how our world works. Yan Taw (YT) Boon, Director of Research (Asia), talks about why it is so important, and how we might invest in it.

### What is 5G?

Fifth-generation connectivity is the combination of a number of new technologies which will create a telecommunications network that can work 100 times faster and connect 100 times more devices than the current 4G standard. You will hear a lot of new jargon associated with these technologies—"millimeter waves," "massive multiple input, multiple output," "sub-six gigahertz"—but the main things to know are that it will radically reduce "latency," which is the amount of time it takes for a device to connect to a server and initiate a data transfer, and it will increase the speed at which data can be shared.

With 5G, it will take seconds rather than minutes or hours to download a movie to your smartphone. But it's the lower latency that is especially important, as this will help to make things like remote robotics and the "Internet of Things" a pervasive reality.

The Internet of Things is the term we use to describe a network of devices installed with advanced software and artificial intelligence. Today, we are used to our computers and smartphones being networked. Over the coming years, we'll get used to a whole range of devices being connected, from our home heating systems to our refrigerators to our cars. An intelligent refrigerator could learn your shopping patterns and order more eggs when you're running low. Those eggs could be delivered by an autonomous vehicle. Unlike the current prototypes that rely on sensors to "see" the world around them, that vehicle would also be enabled by the super-low latency of the 5G network to communicate directly with other road users, pieces of road infrastructure, traffic monitoring services and ridehailing platforms. The same low latency enables a robot to respond to a human user with an imperceptible delay: in China, we have already seen 5G enable remote surgery over thousands of miles, for example.

Add it all together, and we can begin to imagine 5G-enabled smart households, smart factories, smart warehouses, smart hospitals and smart cities. And just as 4G put the internet into smartphones and created the foundations for social media, we think 5G could create a seedbed for entirely new business models. In fact, IHS Markit estimates that 5G will help create over \$13 trillion of economic growth and 22 million new jobs, globally, between now and 2035.

We like to say that if 3G was the motor car and 4G was the airplane, 5G is the space travel of connectivity.

#### Amazing! When can I start eating from my smart fridge?

We already see some limited availability of 5G connectivity in countries such as China, Korea, Japan, Switzerland, Germany and the U.K. Smart cities are probably some way off, however.

The rollouts for 3G and 4G each took around four to five years. For 5G, we should assume a decade. Why so long? In large part, it's due to the fact that the uses of 5G technology are so much broader than for 4G: As we mentioned, this isn't just about getting the internet on your phone, it's about turning thousands of everyday objects into communicating "devices." That means upgrading the existing telecommunications infrastructure to work with "massive MIMO" technology and freeing up the frequency spectrum to carry all the data. But it also means embedding an entirely new communications infrastructure into our everyday world, and moving through multiple product cycles as devices are kitted out with smart software.

We see this happening in two five-year phases. Phase one will see coverage extension on the mid- to low-band wireless spectrum: that is, getting 5G up and running for the existing communications network. Phase two, which we think will bring the real opportunity, will see 5G rolled out on the "high-band" or "millimeter wave" spectrum above 24 gigahertz. That is what will enable the exchange of vast amounts of data at super-high speeds, but it will also demand much denser, "small-cell" communications infrastructure.

Having said that, it's very encouraging that, even at the earliest stages of phase one of the 5G rollout, where we are now, we are already finding a lot of exciting investment opportunities.

#### What does that investment opportunity set look like?

We look at three different areas for investment: the network infrastructure; equipping the Internet of Things; and new, 5G-enabled services and business models.

The first area is a live opportunity today. As 5G base stations are built out, we are seeing substantially increased demand for semiconductors, optical fiber and other components. Demand is also rising for the testing and measurement equipment necessary for the research and development stage of the rollout. This is likely to increase still further as we move from the focus on low- to mid-band coverage and base stations toward high-band coverage and a proliferation of small cells.

The second area is an incipient opportunity. As devices evolve to enter the Internet of Things, we are looking for manufacturers of the sensors, displays, mobile processors, radio frequency components and software that will be essential to make them intelligent and connected. The cloud computing and other technology giants will join the traditional telecom companies in the infrastructure build out, but it is here that they will really come into their own.

The third area comprises some incipient opportunities and many, many more opportunities that we can barely imagine today. Services that are already relevant in the 4G world, such as cloud computing and network security, are likely to see substantial growth in the 5G world. But, just as 4G helped create some of the tech, social media and platform giants of today, 5G will support and demand more new services, applications and business models. There is also likely to be a competitive bifurcation between companies across a range of sectors that embrace the potential of 5G connectivity for their business early, and those that lag.

The multi-stage opportunity, the complexity of that opportunity and the potential for competitive bifurcation are all strong arguments for addressing the 5G investment theme through active management. At Neuberger Berman, we think our team of more than 40 dedicated equity research professionals, utilizing a high level of access to company management, cross-sector insights and the input of a professional data science team, is well resourced to identify the true winners in the emerging 5G landscape.

## Are there any potential roadblocks for 5G? Is national security a potential problem, or the longer-term effects of the COVID-19 outbreak?

National security has certainly been one of the big 5G stories in the media, particularly as it pertains to a certain market-leading technology company out of China. This is not surprising given that 5G will involve embedding communications networks more broadly than ever into critical national infrastructure, and more deeply than ever into our homes. On the other hand, our security has always been at risk from the moment we logged onto the internet from our desktops or our smartphones.

And while it is tempting for other governments to suggest that Chinese companies pose a particular security risk because of their perceived relationship with the Chinese authorities, we should not discount the fact that companies from other countries that wish to maintain access to China's marketplace might be just as susceptible to government influence. Ultimately, we suspect that a lot of the resistance we currently see has more to do with global competitiveness in the 5G race than with genuine national security concerns— and is therefore a sign of just how powerful an investment theme this is.

Security is not a new concern, then. To the extent that it is a bigger concern in the 5G world, we regard it as more of an opportunity than a risk: the \$13 trillion potential of 5G will not be given up lightly, which means solutions for and protections security breaches are likely to be in high and constant demand.

The COVID-19 outbreak is an era-defining event in so many ways, and not least for the future of 5G connectivity.

As I speak, we are all bracing for a decline in global economic growth on a scale unseen since the Great Depression of the 1930s. Just imagine how much greater that impact would have been economically and psychologically had so many of us not been able to work from home and stay in contact with our loved ones. Now imagine how much more shelter we'd get with smart warehouses running smart inventories across our supply chains, remotely controlled robots harvesting crops and completing other essential work with minimal human contact, and completely autonomous logistics getting everything from factory to front door in a sterile environment. It's science fiction today, but it could be science fact in a decade or so, thanks to 5G.

That is the kind of vision that persuades us at Neuberger Berman that 5G connectivity, and its successors, is potentially one of the broadest and most important growth investment themes seen for decades.

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