

# China Trade: Huawei & Why it Matters

## Huawei Audiocast: Expert Call

Bank of America  
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### Who is Huawei?

Earlier this week, Ajay Kapur, Head of EM Strategy for Global Research, moderated a discussion with Walter Jennings, former Huawei executive and BofAML Telecom Equipment analyst, Tal Liani, and Semiconductors & Semiconductor Equipment analyst, Vivek Arya. Below is the link to the audiocast, followed by the transcript for those who prefer to read the discussion. The call covers topics like the history of Huawei, how it changed the landscape of the telecom equipment industry over the past decade, and what the US government fears the most about this company in the future. The conversation sets the stage and is centered around Global Research's thinking that we have reached a peak in globalization and the trade war is much more than just tariffs on goods.

From its roots as a provider to Chinese telecoms, Huawei now operates in 170 countries and generates \$110bn of revenues. Huawei specializes in Telecom Equipment, but has become the second largest maker of smartphones, and Consumer/Enterprise now accounts for 60% of sales. Originally, Huawei relied on government financing and support as well as strong customer service and cutthroat culture to win business, but bolstered by a \$15bn R&D budget, Huawei is now a leader in 5G patents, and China's push into 5G, supercomputers and big data provides Huawei with a head-start on its principal competitors Nokia and Ericsson.

The US accounts for less than 1% of its revenues, but Huawei remains vulnerable to trade war politics. While China consumes 36% of all integrated circuits, China produces less than 6%, predominantly in memory and other lower value chips. Our team believes that China is a decade away from achieving the scale, software, and IP of the industry leaders, and even if Huawei has stockpiled chips ahead of an export ban, their phones cannot operate without access to standardized software from companies like Google. Though China could retaliate by blocking exports of rare earths, which are critical to making electronic component, the US could probably find replacement capacity within a year or two.

[Listen to the audiocast here](#)

If you prefer to read the transcript rather than listen to the audiocast, it is included below, following a list of related research.

Cross Asset Strategy  
Global

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Refer to important disclosures on page 14 to 15.

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## Other relevant research

BofAML research group has published extensively on the US/China Trade War, deep dive on Huawei, and the implications for the economy and various segments. Some of the key research notes on this topic include:

### Macro Research

[China: An Equity Strategist's Diary: After Huawei, where else the US government may target](#) - David Cui

[Global Economic Weekly: Tariff termites](#) - Ethan S. Harris

[Equity Strategy Focus Point: How to trade trade: an equity investor's guide](#) - Savita Subramanian

[Global Liquid Markets Weekly: Is the trade war just about trade?](#) - Robert Cheng

### Sector Research

[Semiconductor Capital Equipment: Trade turmoil: semicap equipment another point of US leverage](#) - Vivek Arya

[US Semiconductors: Trade turmoil: darkest before dawn, see Q3 resolution, note attractive 5G Buys](#) - Vivek Arya

[Hikvision \(A\): 80% domestic SoCs; impact of potential US ban limited; firm growth/valuation; Buy](#) - Robert Cheng

[Electronics Manufacturing Services \(EMS\): Taking a look at EMS company footprints. Can manufacturing move back to the U.S.?](#) - Ruplu Bhattacharya

[Global Semiconductors: Primer picks: enhanced oppty amidst trade tensions in structurally important sector](#) - Vivek Arya

[US Semiconductors: Huawei olive branch: hoping it drives resolution but limited n-t benefit](#) - Vivek Arya

[Technology - Asia-Pacific \(H/A\): Huawei-related risks loom over Asia Tech supply chain](#) - Robin Cheng

[US Semiconductors: Huawei ban: major direct and indirect effects, but could be part of negotiation](#) - Vivek Arya

[Wireless Equipment: Huawei bottom-up revenue highlights opportunities for NOK, ERIC, CSCO](#) - Tal Liani

[Technology - Asia Pacific \(H\): Huawei smartphone deep dive: Buy supply-chain leaders with content upside](#)

### Company Research

[ASML Holding N.V.: Thoughts on trade/tech war implications](#) - Adithya Metuku, CFA

[MediaTek: 4 reasons to reiterate Buy rating on MediaTek amid recent Huawei turbulence](#) - Robin Cheng

[MediaTek: Positive read-across from court's ruling against Qualcomm](#) - Robin Cheng

[Apple Inc.: Stock already reflecting a tariff hit on iPhones; a deeper look into US-based mfg](#) - Wamsi Mohan

[Samsung Electronics: First take on US\\$6bn smartphone sales upside at the expense of Huawei](#) - Simon Woo, CFA

## Transcript of audio file

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*Script Edited for Clarity*

### Operator:

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Good day, everyone, and welcome to the China Trade, Who is Huawei and Why Does it Matter Audiocast. Today's audiocast is being recorded. At this time, I'd like to turn the conference over to Mr. Ajay Kapur. Please go ahead, sir.

**Ajay:**

Thank you. Hello, everyone. Welcome to our call on China Trade, Who is Huawei and Why Does it Matter. My name is Ajay Kapur, head of emerging market investment strategy. Today, I'm delighted to be joined by Walter Jennings, who until last year worked at Huawei and was responsible for their global corporate reputation working across 170 countries.

We're also joined by Tal Liani who covers telecom equipment and Vivek Arya, who covers semiconductors and semi- cap equipment stocks. The aim of this call is to first understand the history of Huawei, the Chinese telecom equipment maker and smartphone maker, how we got to where we are today, and the implication of the proposed restriction of key technology sales to Huawei.

Before we begin, we need to put the recent technical skirmish between the U.S. and China in a broader context. Our global research department thinks that the U.S.-China trade war is more about geopolitics and not just about economics. The implications for the markets are enormous and highlights two themes that we think may dominate the investment landscape for the next decade.

First, we think we reached a peak in globalization. That is so yesterday. We see the world dividing into two camps, the U.S. camp and the Chinese camp. Just two data points on de-globalization. The global cross-border bank lending as a percent of world GDP was 42% in 2007 before the financial crisis. Now, that global cross-border bank lending has almost halved to 22%. Second point. Between 1987 and 2007, world trade grew 7% per year or twice the pace of global GDP growth. Post-the financial crisis, global trade is growing just in line with world GDP at about 3% per year. So we've already seen in the last ten years a significant de-globalization and we think that's going to continue.

Second point. We see the trade war more about technological dominance over the next few decades versus just the importation of cheap goods. This will have a long run implication for capital spending in both China and the U.S. over the next decade. So this is very important. So with that 40,000-foot view out of the way, let's now zero in on the current technology tension with Huawei.

Welcome, Walter. Thank you so much for joining us. I know you worked for Huawei but maybe for our audience, please can you explain when and what you did for the company?

**Walter:**

Thank you very much, Ajay and greetings to everyone. Thank you for including me on this call. As Ajay said in the introduction, I had worked at Huawei as Vice President, Global Corporate Communications, working out of their headquarters in Bantian Shenzhen in Southern China. There, I was a member of a small team that looked after global reputation in 170 countries worldwide. That team encompassed media relations, government relations, influencer relations, think tank associations, et cetera. And this was very much at the global level.

Within Huawei, there are different divisions and different communications professionals with responsibility for product, services, or specific divisions. The role I worked on was very much on global corporate reputation. So that's the background.

**Ajay:**

Excellent. Could you give us, Walter, some details about the history of Huawei over the past 20 years, and what was their genesis? How did they grow that rapidly? Where did they grow? So just a little bit about the company itself.

**Walter:**

Look, Huawei is 31 years old. It was founded in Shenzhen and in fact, it used to be called Shenzhen Huawei Technologies. It was one of the first private companies founded in the Shenzhen Special Economic Zone. And when it started, it was a telco equipment importer and reseller. And yet, they ran into problems almost in the first years where they couldn't guarantee the quality, couldn't guarantee the price

And so after a few years started researching, developing, and creating their own kit. The history of Huawei, it's important to understand its foundation. This was one of the first private companies in China and when Huawei went to the major cities to try to engage with the state-owned enterprises to sell telco equipment, it found zero reception. The large state-owned enterprises didn't understand and did not want to work with private companies.

So Huawei's very first contracts were in the more remote areas of China where it was going to places with no roads, no electricity, no infrastructure, no telephony and they were capable of setting up telephone systems. For the first 25 years, Huawei was focused on telco. And as it grew across China, it then expanded internationally, predominantly into developing countries. It is expert at going into a nation that has no infrastructure, has no telephony and being able to install in some of the hardest to reach, most difficult places in the world.

If you flash forward 30 years, now the company is in 170 countries and America accounts for less than 1% of its revenue globally. So from a sales perspective, the U.S. doesn't matter. But the news this week around restrictions on imports by Huawei will dramatically impact the business. But if you look at the history, this is a company that is used to hardship, that has worked in some of the most remote places in the world and can provide reliable equipment.

It's got an installation that's furthest north in the Arctic Circle. That same kit is in the Sahara Desert. That same kit is in the jungles of Borneo. So it's used to tough situations and this current challenge, I think in some ways, is custom made for Huawei.

**Ajay:**

Excellent, Walter. Let's just drill down a little bit more into that. So by product and by region, which markets do they now dominate?

**Walter:**

So seven years ago, Huawei separated from a single company into three divisions and the company today is built around carrier, enterprise, and consumer. And it wasn't until last year that enterprise and consumer was more than 50% of the company's revenue. So historically, 25 years, it was just selling to other telcos. And so very much if you look around the world where Huawei operates, in those 170 countries, it's predominantly there working with national telco provider. In many cases that's run by the national government.

Yet, the enterprise and particularly the consumer business has grown in the last seven years. Seven years ago, there was no consumer business whatsoever and today it's the second largest set manufacturer and sales of smartphones globally. So enterprise still has some room to grow but there, you're looking at a wide range of B2B solutions in the tech sector.

**Ajay:**

Okay. So that's the past. And going forward, which markets do you think they want to dominate in the future?

**Walter:**

It's been interesting, Ajay, watching Huawei accidentally become a consumer brand. This was a storied, stable, conservative telco equipment manufacturer that had grown quite

comfortably over its first two and a half decades. What has really shifted for Huawei has been the change to a consumer brand. And it has intentionally competed in the high-end smartphone business and avoiding the cheap, older, white-label phone market that it used to operate in.

So you'll continue to see Huawei growing as the telco equipment provider of choice for most countries in the world. It has a technological step ahead of many companies in terms of 5G. Huawei has been a big proponent of the standards that were globally accepted to underpin 5G technology and it has got a great percentage of the patents required to implement 5G technology. So you will always see Huawei with a strong base of telco equipment as well as then a very fast growing smartphone business, and then a smaller but still very capable enterprise business.

**Ajay:**

Excellent. Is the company profitable given that it's not a listed company? And do they receive any government financing?

**Walter:**

Huawei is hugely profitable. I started with Huawei four years ago and they had revenue of 49 billion U.S. dollars. This last December - March 31, they announced audited results of \$108 billion. They do report strong results in terms of profitability and also, this is a company, and I think this is one of the secrets that you have to pay attention to, that invests tens of billions of dollars in research and development.

So of the 200,000 employees Huawei has worldwide, 80,000 are full-time research and development and last year, I think the spend on R&D was 15 billion U.S. dollars and similar levels of profitability. The company is not listed. It is purported to be the world's largest employee-owned company. Yet as you have seen in recent articles, there are questions over the voting rights of those shares.

The Financial Times came in and did a review of the blue books. So if you Google Financial Times Huawei shareholding, you'll see that their analysis says that the owner, Mr. Ren, owns some 1.2% of the company whereas the remainder is owned by the employees.

**Ajay:**

Okay. Great. All right. One more question for you, Walter, and then I'll circle back to you after I speak with Tal and Vivek. But understanding that you have personal experience working for the company, based off your history, can you tell us a bit more about the work culture at Huawei, who do they hire, where do they hire from, how motivated are the employees, and what keeps them motivated?

**Walter:**

Look, I think that the culture is one of the - is probably the number one strength Huawei has. It has a very uniform culture globally. I don't think it's what I would call a healthy culture, however it is one that is built around the concept of hardship and adversity. Mr. Ren is famously quoted, Mr. Ren is the founder, as having said that the only benefit every Huawei employee is guaranteed is hardship.

Here in Hong Kong and China, you hear a lot of interviews and articles around the hardship culture, the wolf culture where people will fight to outdo each other and go after the weakest link. But it has a uniform culture. The majority of the employees are recruited from second-tier technical universities all across China. And once you join Huawei, you're given a choice. If you want to be eligible for shareholding, you sign a special type of contract that makes you eligible but one of the conditions is that you give up all of your annual leave for the duration of your career at Huawei.

And also, they have a forced retirement age at 45. Because by the age of 45, you're either a multimillionaire from the employee share ownership. Or if you're not very wealthy than you have not been effective in your job. So out you go.

So as a company, this is not a soft easygoing firm and if they are facing difficulties then that is what they expect. So kind of the company where they eat nails for breakfast and get ready to face the day.

**Ajay:**

Okay. Great. Thanks so much for that, Walter. I'll circle back to you soon. Let me just shift to Tal Liani to understand the concern of the U.S. government about Huawei. Tal can give us a U.S. perspective of how Huawei has changed the telecom equipment market. So Tal, thanks for joining. First question for you is how did we get to this point where one supplier, Huawei, is so dominant a vendor in the telecom equipment market?

**Tal:**

Thanks, Ajay. So you asked Walter how successful they are and I want to give some numbers because their success is phenomenal. Huawei, their published 2018 revenues was \$105 billion and in the last four years, listen to the numbers of year-over-year revenue growth -- 31% in 2015, 24%, 23%, 14%. These are the growth rates for the past four years. This is basically \$100 billion hardware company that grows like a midcap software company and that's just a reflection of their success.

In the last four years, the same four years, they grew their market share in base stations, in radios, from 20% to 31%. They grew their routers from 16 – routers market share – from 16 to 26%. It's a phenomenal success. If you just look at their service provider revenues, they are two times bigger than Cisco and they're three times bigger than Ericsson. So it doesn't matter how you look at it, from which angle, Huawei is a huge success.

Now you ask me the question of how did they become such a big player? If you rewind to 2003, Cisco sued Huawei that the routers used the software of Cisco. If you used to do what's called ping, you called the Cisco – the Huawei router – what you got on the screen was actually Cisco and it actually said Cisco, so there was a lawsuit in 2003 that was settled in 2004 and the vendors in the market will tell you that in the early days of Huawei, they got their technology from other vendors directly or indirectly. That's number one. Number two, you heard about the R&D money that they spend today, they spend \$15 billion a year on R&D, that's more than their competitors combined so it's a very different organization today versus what it used to be 20 years ago and certainly you have more graduates, software engineer graduates in China than you have in the U.S. You have money that is being spent on R&D so that's certainly what's fueling the growth today.

But there were [two other] – three other reasons why they are so big. Number one, Chinese government provided unlimited funding. When Huawei goes to do infrastructure projects, funding goes together with the project and that helps a lot smaller players and number two, Chinese pricing was extremely aggressive. The complaint in the market before was that you cannot compete with Huawei because the first time they go to market, there is a mandate to the country manager to lose every dollar they want, there is no question about profitability for the first two years, they just need to get the contract. And once they get the contract, they go in for two years and only then, once they're in, then they can raise prices and they can upsell some software and services and be more profitable. So it was a combination of technology, funding and aggressive pricing.

And the last part I want to say, which is more the issue of the last few years, China is the biggest telecom market in the world. China Mobile has a billion subscribers. Just to put it in perspective, Verizon has a 150 million. The U.S. entirely is 300 million. Just one carrier in China is three times bigger than the U.S., so if Huawei is the prime vendor for

this Chinese carrier, then they take the technology and the experience they gain there and they bring it to other parts of the market and that's how they became so big and successful.

**Ajay:**

Well, that's an incredible story, so given that they're so successful, how do you think that the telecom equipment landscape has changed over the past decade because of Huawei. And you sort of alluded to it but do you think it is Huawei's technology superiority or was it government subsidies that's driven their market share gains?

**Tal:**

So let's start with the first question, what was the impact on the industry? I want to throw here three names that no longer exist but existed for a hundred years before Huawei appeared in the market, Alcatel, Lucent and Nortel. Some of them went bankrupt, some of them got acquired when they were down to their knees, they got acquired by others because the only way to compete with Huawei was to merge and create a bigger entity and Alcatel got bought, Lucent merged with [Alcatel] then they together merged into Nokia. Nortel was bought by Ciena and so and so forth. So the impact on the industry was tremendous. Companies dealt with it in one of two ways, either they couldn't deal with it, which is the case of Alcatel, Lucent and Nortel or that they just left the market completely and the revenues of Cisco in China is almost zero. The revenues of Ciena is zero, the revenues of (Amdocs) is zero.

These vendors all decided that they're exiting the Chinese market because they can't compete with – against Chinese vendors in China and again, China is the biggest market globally for com equipment.

Second, outside of that, what the vendors decided is to go upmarket. They understood that they cannot compete with Huawei on volume, they cannot compete on basic technologies, they can compete on high-end technologies because Huawei, until today, is being considered not at the top end of the range in terms of technologies, so you can see better software, more integrated solutions, et cetera, et cetera. By the way, the technology gap closes over time, you know, I'm sure that 20 years from now, we're not going to talk about Huawei being slightly behind in technology because that's certainly not the case in many areas today, wireless one of them. But that's the way that companies dealt with it.

The second question that you asked me [is what was you know,] was, it technology superiority or government subsidies [in] the first 20 years, certainly it wasn't technology superiority. It was government subsidies, it was government funding, unlimited losses that they were willing to take in the first few years of penetration to customers that enabled them to go to a customer and solve the problem with, basically, airplanes full of engineers. You have an issue? You run into issues with a customer, you basically bring 50 people to the customer, work around the clock, solve the problem and move on. Money was not the issue. So certainly it was fueled and enabled by subsidies and funding, government funding and technology was brought on to the – it was always there, a certain level of technology, but technology expertise was brought on later in the cycle.

**Ajay:**

Excellent, so just shifting gears a little bit Tal, the U.S. government is very concerned about cybersecurity and Huawei. Could you please elaborate on these concerns?

**Tal:**

Sure. I want to add something to your previous question, because I want [it to be ] to give a picture of the next 20 years, not just the previous 20 years. Huawei today has more patents on for 5G than Ericsson, Nokia, Cisco and many others. They invented heavily – they invested heavily in R&D and the question remains, if they invested so

much in R&D, what's going to be their position in key markets like wireless the next 20 years, just because they have more patents than others and that's a question I'll just leave out because it's really what's going to shape the next few years.

Cybersecurity, major concern, a little bit of political issue also but a major concern, just on pure kind of cybersecurity issues. There was [you know] an economist [who] reported that British Telecom found the software of Huawei intentionally or unintentionally full of so much bugs that it enabled anyone that knew what they were doing to tap into the network and they started – British Telecom started to replace Huawei's Node B. These are parts of radios, kind of base stations in the market, with another vendor because of these software issues. Australia, New Zealand, Canada, U.S. of course, all of these decided or said that Huawei software is full of bugs and is enabling third parties and other countries and adversaries to enter the network and it represents a major cybersecurity breach.

The reaction of countries depends a little bit on the security affiliation. There is a group called the Five Eyes, which includes Canada, U.S., [England or] United Kingdom, Australia and New Zealand and all of them, all these five countries decided together that this is a major cybersecurity threat and you saw them one after another making announcements and taking steps to push out Huawei from 5G. Other countries are concerned, less concerned, like Germany because at the end of the day, Huawei identified this as a risk and they allocated \$2 billion to solve the software and they also said that they would provide the entire software stack to the carrier so they can have full control over it and they are not – to ease their concern over cybersecurity. So certainly there was an issue, Huawei is trying to deal with it, some carriers are taking the risk, if I can call it this way, some carriers disagree to do it and it really depends on – a little bit on the political affiliation as well.

**Ajay:**

Okay, great, so there are some holes in the cheese so let's move on to the U.S. government and what bans does the

U.S. government have on the deployment of Huawei products into the U.S. and for how long have these bans been in place and are there any other countries that have similar bans?

**Tal:**

Right, so U.S. is unique because U.S. said many, many, many years ago that they disallow Huawei to be in their network. Recently, they also said that they disallow U.S. officials to have Huawei cell phone because they found that there are security issues also within the cell phone. There were all sorts of reports that were about semiconductors and special devices within the phones that enable someone that knows what they are doing to tap into the phone. So Huawei has been pushed out from the U.S. market many, many years ago. By the way, just in a nutshell, kind of think about it, when you think about Huawei's success, when you think about the growth and the size of it and think about that that's the entire – this entire success is without the U.S. market because less than 1% of the revenue is in the U.S. so their success outside of the U.S. is a multiplier of what I can show you because the U.S. is not present in the numbers.

Now, U.S. banned – there was a point of time when Level 3 wanted to introduce Huawei because of low pricing and the U.S. government told them that because 25% of their traffic belongs to the U.S. government, they will have to guarantee them that none of the U.S. government traffic or affiliated companies will go on Huawei equipment when it goes through Level 3 network. So certainly it's being pushed out of the market for the cybersecurity concerns and as I told you, now there is additional concern over the devices, over the handsets.



**Ajay:**

Okay, great. Thanks so much for that, Tal. I'll circle back to you pretty soon. Let's turn to the semiconductor industry, where there are indications that Huawei would like to become more self-sufficient. Let's get some perspective from Vivek who covers semi-stocks and semi-cap equipment stocks for us. So, Vivek, what percentage of the global semiconductor components does China consume?

**Vivek:**

Thanks, Ajay and I'm glad to be on this very important and timely call. So China plays two roles, first as an end consumer of semiconductors and second as somebody who takes these semiconductors and then turns them into higher value electronics. So if you look at overall electronics production, kind of the super set, there is some that goes for domestic applications and then some obviously, a lot more that goes out for export. So in 2018, China consumed about 155 billion or 36% of all the integrated circuits or ICs that were produced globally, of which say roughly a half or so were for domestic applications whereas a lot of the remaining was for the overseas export market. Of the 155 billion that the Chinese companies consumed, only 24 billion or say mid-teens or so of that was produced internally but say that only 5 or 6% of the global IC production is done in China. And if we actually dig one level deeper, most of that domestic production is in memory and (foundry) products and actually a lot of it is from overseas companies operating in China.

So for example, Hynix, Samsung, Intel, they have big memory fabs operating in China and all this means that if we actually look at China's domestic capability in designing and producing semiconductor ICs, it's very limited.

**Ajay:**

Excellent. And so they have a big trade deficit in semis, that's clear. So what type of semis do the U.S. manufacturers supply to Huawei?

**Vivek:**

Sure, it actually ranges all the way from just intellectual property, so for example a Broadcom providing Huawei with some very critical IP blocks that Huawei might use in its own silicon production to programmable chips from say a Xilinx or an Intel that are going into a lot of these radios that Huawei needs for 5G to analog chips such as radio frequency chips that go into a lot of Huawei smartphones. So for example, a [Skyworks] or Qorvo have Huawei as nearly a 15% customer for them. So from a semiconductor side, I think these companies are very intimately involved.

Then if you step outside of semiconductors, we of course have very large companies such as Google who are providing very critical Android software to the Chinese smartphone makers, without which it's very hard for these smartphone makers to sell their products in the high end market in China or you know, it's nearly impossible for them to sell it in overseas markets where customers look for that standardized Android software and the Play Store and a lot of those very important Google apps so in the last few weeks, there was a lot of concern that what if Huawei has stockpiled inventory and maybe that can help them get past some of these trade hiccups that you are seeing near-term. I mean, they could have stocked pile some hard inventory - but how do you stock pile software or IP? So, I do think that, you know, if this trade thing is not resolved, then there are going to be some issues for Huawei.

**Ajay:**

Okay, Vivek, so clearly they have pretty significant dependence on U.S. suppliers, semiconductors and software apps and so on. So how much capability does Huawei have to produce in-house components now? And if not, how does this potential U.S. ban impact their business?

**Vivek:**

Sure. So, I think it could be - it could really impede their progress. You know, they have no internal manufacturing capability. They do rely on getting their chips manufactured at Taiwan Semiconductor because the main foundry within China which is SMIC really is - I would say nearly a decade behind what Taiwan Semiconductor can do. So, while Huawei clearly needs these leading edge foundries to produce these semi-conductors - even if they can do the design internally - and then as I mentioned, during the design process, they need this very critical IP from say a Broadcom or memory from say U.S. players such as a Micron or from Korean suppliers. And the whole thing needs to come together and if a single piece is missing, I think that can really impede Huawei's progress in this market.

**Ajay:**

So, I have a tough question for you Vivek. How do companies protect their intellectual property from being stolen?

And do you think technologies have been stolen?

**Vivek:**

You know, in the last decade we have seen tremendous consolidation in the semi-conductor space because of cost and complexity of chip making have gone up substantially. There are only three fabs that can produce high-end chips -- TSMC, Intel and Samsung. And one really needs a lot of scale to deal with them to justify the large upfront cost of designing these chips. There's a lot more software and IPs required to produce high-end semi-conductors.

So, I think that combination of scale and software and IP requirement are some of the biggest barriers to entry in this market. But as Tal noted, you know, Huawei came from being a nobody to actually being somebody who has very strong pattern portfolio in 5G for example. Their internal silicon design team called High Silicon is able to produce a lot of very sophisticated components. So, they have definitely gotten better over time. And, you know, we can debate whether they did all that organically or whether that was through technology transfer or what not.

The point is that they are at a point where they have become a lot more advanced - but they still need to depend on a lot of external resources to get those things actually put into real chips and then to get those real chips into products. And then those products -- such as a smart phone -- depends on software from Google, right, to actually make it work and have it be sold in a lot of markets. So, it's a very tightly interconnected ecosystem here.

**Ajay:**

Okay, that's very interesting Vivek. All right, let's quickly turn to (Walter) again to gain any insights into his view on their reliance on U.S. semis and their future plans. So (Walter), do you think that Huawei - that they ultimately want to get into the semi space and compete against U.S. manufacturers?

**Walter:**

You know, Ajay, one of the hallmarks of Huawei is its cooperation with partners. If you come to their global headquarters in Shenzhen, you'll see they have a phenomenal display of the various technologies but not all of that is just from Huawei. One thing Huawei does very very well is it partners with others. And in fact, Mr. (Ren) is famed for having said that Huawei does not want a bigger slice of the cake. It wants to make the cake bigger.

Mr. (Ren) believes Huawei has a founding role in the development of global culture and structure. And the way it's going to do that is by partnering well with others. And when you come into their headquarters, you see the logos on the wall of Hewitt Packard,

Microsoft, IBM, (Accenture) - every major American technology company works expediently close with Huawei.

So, Huawei itself does not want to dominate end-end production of every element that's required in this business. That's never been its goal. Huawei sees itself as at the center developing the new concept and then working really well with partners globally. So, what I think we're likely to see now is the shift to supply anywhere -- but America -- in order to be able to ride through whatever trade tensions come along.

**Ajay:**

Okay great. Thanks (Walter). All right, I just want to go - circle back to both Vivek and Tal. And in the interest of time, if we can just keep our answers reasonably brief. So, Vivek, are you concerned about the long-term threat from Huawei in these semi-conductor space given that their track record in telecom equipment was so brilliant.

**Vivek:**

No, I think Huawei is absolutely a force to be reckoned with, right. You know, Tal gave some of the statistics. If you look at wireless pay stations or optical or smartphone markets, they have anywhere between 15 to 25% market share. You know, in Q1 when the smartphone market was down 4%, their smartphone shipments were up 50% and they just left past Apple to become number two in the market. So, they're absolutely a force to be reckoned with. But, you know, back to the barriers to entry, you absolutely need a very long, you know, list of IP. You need those relationships with these large fabs and then at the end of the day in certain consumer markets, you're still dependent on these very standardized software from these ecosystem companies such as Google.

So yes, I think Huawei is a force to be reckoned with, but at some point, you know, there are certain things with, you know, they can spend another 10 or 20 years and it will be very hard for them to get past some of those limitations.

**Ajay:**

Okay. And so last week, in your most recent research note you wrote that the U.S./China cold war and technology is here to stay. So, briefly, how do you envision it playing out?

**Vivek:**

Sure. You know, I don't know if there are easy answers. I think it will have to be some form of "co-opetition." China is a competitor but also with its middle class a very large customer -- Apple -- over the last year sold over \$52 billion of product which makes them among the top three or four operating companies there. So, China's status as a growing customer absolutely has to be respected. You know, if you look at the market, emerging industry of artificial intelligence, it relies on getting lots of data to improve the quality of predictions. And in China, it's very easy for the government to get lots of data. So that says that it could actually be easier for China to go ahead - to be ahead in the field AI.

If you look at the other emerging market of 5G, Tal mentioned how large China Mobile is and how many patents Huawei has in 5G. But another part of this is the government just gives spectrum away to the telecom carriers. And there is a very big top-down strategy of rolling out new technologies. So, China could be very early in the mass rollout of 5G. You know, we could go through other markets such as supercomputers also where China now has the most number of machines in the global 500 list. So, in all these cases, though, this still requires components from the U.S. companies.

So, the question for the U.S. will be, "Will it just let China continue to get ahead thinking that, okay, maybe them getting ahead means a larger middle class and hence a bigger customer for U.S. products" - or does U.S. try to kind of slow down that progress and get ahead itself. I think that push and pull will continue to play out.

**Ajay:**

Thanks Vivek. I'm glad you brought up 5G. I want to get back to Tal to gain perspective on how this impacts the 5G rollout and the recent issue about "rare earth products" that are critical to the U.S. supply chain. So, first Tal, quickly remind us why 5G is so important for both China and the U.S. And what is 5G? And what do you think is further ahead in 5G deployment?

**Tal:**

So, I'm going to give you a broader answer that ties into what Vivek said. China consumes in the neighborhood of 40% of global semi-conductor production. It manufactures less than 5%. And they have a stated strategy to close this gap. What they did with 5G is, they made a consortium of a few companies -- internal Chinese companies -- to have leadership in 5G. And they have more patents than anyone else on 5G. And again, you cannot compare one patent to another because it's like your kids - one is smarter, one is in math, one is smarter in reading - but at the end of the day they have more patents than others in 5G.

And 5G is important because it's a new technology that you start from scratch, you build networks and they can really dominate the global or they can lead global deployments if they have the right experience. China wanted - China understood that dominating on 5G starts in house - starts within the country. So, they allocated the frequencies faster than anyone else. They started deployment - started faster than anyone else. And there is already 5G huge trials that are the size of carriers in North America. Over the last year and a half, they are already huge trials and actual deployment already started in - at the beginning of this year.

So, when you ask me who is ahead of the game, the answer is absolutely, no doubt - China is ahead of the U.S. when it comes to 5G deployment. In the U.S., spectrum was not allocated yet and remains to be seen how long it takes - 12 to 18 months - how long it takes us to get the 3-1/2 gigahertz spectrum that we need for 5G.

That gives the Chinese - that gives Huawei a great test site -- if I can call it this way -- that is huge in size to test and deploy and perfect 5G technologies that they can later on take it to other parts of the country. And it's important for them because it's a question about world dominance of technology. Then there is the waterfall effect on how they - it impacts the semi-conductor industry - the ability to gain expertise and dominate an industry of hence said devices, consumer applications around it. So, it - there is a whole ecosystem around 5G and they want to be the first so they can dominate the space.

So far, even Ericsson and Nokia are saying -- as well as the carriers -- that the technology -- 5G technology of Huawei -- is ahead of the game versus the technology of the others because they had to develop it for the Chinese market two years before you had to develop it for the North America and European market that didn't start yet.

And that's where - that's why Huawei is so advanced in 5G versus other makers of equipment.

**Ajay:**

Interesting. So, one last question for you Tal. At the moment, recent actions around selling semi-conductors to Huawei illustrates a weakness in their supply chain - in China's supply chain. In the technology landscape, are there any inputs that the U.S. is reliant upon the Chinese for such as ((inaudible))? What are they? And is this a real concern?

**Tal:**

So, President Xi visited to a rare earth facility recently which sends a warning signal to China that China - sends a warning signal to the world that China may use rare earth ingredients as retaliation measures against the U.S. And that's going to cut off U.S. companies from supply. The U.S. relies on China for about 80% of what's called the rare

earth's imports. These are metals that are used in electronics and optics, for example, to make the magnet in your GPS.

These are actually - and now the policy part. These are actually not that rare. These components are as common as copper like cesium, for example. And they are found all over the world. But the mining process is hard and very polluting and this is why so far it's mostly produced in China. The problem is timing. It's a problem of timing - meaning, yes, we had it in the 90's. Right now if China is going to block off export from China of these metals or these rare earth components, the U.S. will have difficulties to manufacture certain electronic components - but it will take it probably a year to find different facilities to fund different facilities in different parts of the world whether it's Asia or Africa - and to bring up production. In the 90's the price spiked up when there was shortage of supply at one point but then very quickly within a year, it came down as capacity was brought up.

What you see now is a lot of short-term tactics between the two countries to try and bring the trade negotiation into the table and everyone is trying to improve their position. This will all create short-term noise if it happens. But in the long run there are solutions around it especially for the U.S.

**Ajay:**

Great. Thanks Tal. And this has been a fascinating conversation. So, just to conclude - as I highlighted at the beginning of this program, the trade war is really a proxy fight for both China and the U.S. to compete for technological dominance over the next decade which itself is a by-product of what we view as a peak in globalization. So, stay tuned given that there will be many more unattended consequences that we will share with you as this team unfolds.

My thanks to Walter Jennings, to Tal Liani and to Vivek Arya. Thank you all.

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