First of all, let's go to the future and our first speaker is Chris Althaus, CEO of the Australian Mobile Telecommunications Association. Do we have one little visual before we bring him up? A joke? I dare not say a joke because it implies automatic laughter and that's a judgment only you can make. $50 or I tweet this out. That's pretty good. Don't you reckon? Thank you very much.

I'll come back to Chris, the CEO of the Australian telecommunications mobile association - the peak for all of Australia's mobile telecommunication. Please welcome Chris.

(APPLAUSE)

CHRIS ALTHAUS: Thank you very much, Julie. Thank you, Teresa, for the opportunity to come along again. Always good to attend ACCAN events. So, we're going to talk about mobile, and I'm going to give you a sense of not only where we're heading, but just a quick contextual piece around where we've been. We can move through this quite quickly. That's our history in this market - we're at 33 million-odd subscriptions and operations for 22 million people, so it's around 130% market penetration. Smartphones are probably pushing up toward 100%. We are right into our mobiles. That graph is important because it shows the generations and, most particularly, the fact that they overlap, which is relevant a bit later on. 2016 - the global version of AMTA, the GSMA, did a Mobile Connectivity Index. They surveyed 132 countries against four parameters - infrastructure, affordability, consumer and content. There are Australia's scores: Infrastructure - 73. Affordability - 82. Consumer - citizens with awareness and skills needed to value and use the internet and the cultural environment that it promotes; did extremely well there - 94. And then content availability - online content - just under 90. Out of 132 countries, that placed us, globally... ..first. So we are, without question, a global leader in this space in terms of our network quality and those are the parameters - we punch above our weight.

But we're still only a little market. What that means in terms of market dynamics is a whole raft of things, but one very particular thing is this - the volume of traffic that we generate. The green curve is a graph from Ericsson in 2010 - looks very similar to the red curve in 2017 - the difference is, on the vertical axis in 2010, we're talking about exabytes per year. In 2017, only seven years later, we're talking about exabytes per month. So, a huge, huge increase in global volumes, and that's what happens in this market. Very typically, the volumes of traffic traversing networks will double on an annual basis in Australia. That is a challenge. But we can talk about that later. Also just reflect on this - even though we have very high data volume increase - and this is a little bit old now, the ACMA - I'm not sure whether they've updated this - this is 2015, but it shows you that all but 7% of download activity is taking place over fixed networks. So if you ever get the sense of, "Oh, it's a mobile world and fixed doesn't matter," well, this will tell you a different story. You'd also be aware that convergence is something we've been talking about for a long time. Convergence is alive and well. Even more so now than perhaps ever before in the interrelationships between fixed and mobile infrastructure and networks. That's probably why our one mobile-only carrier is just investing heavily in an nbn offering, and the new fourth player entering the market - which has been one of our biggest fixed operators - is entering mobiles with the purchase of spectrum and a promise of a fourth mobile network. So the convergence theme is very much a part of the current, and will very much be a part of the future. So, where are we headed? You hear people talk about digital disruption - also industrial revolutions. There's been three of them. We're about to walk into the fourth. You probably think of the first two as things like steam trains and printing presses and so on. In the third, it was a digital revolution. Now we're starting to walk into the fourth industrial revolution, where it's a marriage of physical, digital and biological systems. That's going to be quite profound, and it's one of the attributes that is spoken about quite a lot, and you've covered a lot today in many of the aspects that will go under that big heading of a fourth industrial revolution. Mobile, in this space, is - let's go back one... We're talking about 5G. So it's our fifth generation of mobile technology. Hugh Bradlow talked about the hype cycle around AI. Well, I'd have to tell you there's a fair old hype cycle around 5G as well. It's intriguing, because a hype cycle is under way, but we don't actually know what 5G is yet. So the standards are being written, and there's a time line that's going to probably result in commercial deployments around 2020. There'll be some fantastic demonstrations going on before that. But we can talk about what 5G will do. And we're talking about the responsiveness of the network, we're talking about the ability to connect billions of devices, and we're talking about capacity and speed. And those three things are probably the cornerstone of what we will regard as 5G. If you want to split that into blocks of use categories, you could probably do so by talking about extreme mobile broadband. That's kind of an extension of what we've seen to date. You'd also talk about massive machine communications. Frank will cover this in a minute, because that's the IoT space. You also talk about critical machine communication. That machine could be a robot, it could be a factory production facility, or it could be remote surgery. But what we're talking about in all of these cases is a combination of latency and capacity. If you look at this graph, you get an idea of the sorts of things that are possible. The Y axis is your latency or your delay or your responsiveness. The top of that axis is a millisecond. A millisecond is basically real-time. You'd want a millisecond, if you were lying on an operating table and someone was doing remote surgery. Bit rich to say, "Cut - no, stop, don't do that... ..too late." Millisecond with enormous capacity and throughput. Virtual reality, augmented reality... The important thing to note, though, in the white section of that curve - that stuff, we're already doing now. It's capable with 4G. If you look at the X axis - the horizontal axis - you look at the bandwidth throughput - it's kind of suggesting that 4G is in the 100 megabits per second range. That's not right, because 4G has advanced. You could do a gigabyte over 4G. But you're talking about lots of gigabytes in the 5G world. This is all a combination of person to person, person to machine, and machine to machine applications. Latency and throughput are the core characteristics that you will look for. Now, Wayne down the back - the video man - we're going to play a video to demonstrate this. I hope it works...

(VIDEO)

>> What we're looking at is a complete transformation of the way we see wireless networks today. So 4G was really all about communications with people and delivery of video, and with 5G, I think what we're going to see is a complete transformation where we're talking more about connectivity for machines so that they can transform our lives and deliver services much faster, much quicker than we could ever perceive today.

With 4G today, there's higher latency in the wet - this is the amount of time it takes to transmit data from the device to the network and back again. With 5G, that communication path will allow you to communicate much quicker, and you'll be able to control machines.

So in this demonstration here today, we have this camera, which is recording the position of this ball on this plate. And then this position is recorded by a mobile edge cloud-computing environment then is intelligently controlling these robots, sending them the commands across the network to balance this ball on the plate. In this first demonstration, you can see on the screen here behind me we're showing the current latency of what would be a 4G network. It's around 90 milliseconds to 100 milliseconds. On the right-hand side - you'll be able to see this line move as we move the ball on the plate. What I'm going to do is move this ball right now... ..and we can see the oscillations here tracked on this graph, and how long it takes for the robots to collaborate with each other to get the information they need to balance the ball on the plate. Then we're going to switch it into 5G mode... ..and we can see on this graph here that we've now gone from around 90 milliseconds to around 3 milliseconds - so much, much lower latency in the network. I'm going to do exactly the same again... ..and we can see that it only took one oscillation there to correct the ball. So you can see how the reduction of the latency of the network improves the communication between the machines, which is critical for future networks.

I think, for society, for humanity as a whole, what we're going to see is a transformation of our existing technologies to automate everything. So you can imagine healthcare, automotive, or in the mining industry or in other areas with our very critical or dangerous to humans - we can actually send a machine in and control them remotely over a 5G wireless network because of that low latency in the network. So, a huge transformation in the way we utilise our network and what we're able to control and do with our machines.

Thank you to our friends at Nokia for that demonstration. It gives you a sense of the difference between the networks. Having said that, there are a vast array of applications and services that won't require that level of latency. But it's a classic example of the real-time nature of future networks, and the sorts of features that they're going to be able to deliver in terms of applications. Now, we've spoken about connected cars already a lot today. I guess the important thing that I want to emphasise is - driving is one aspect, but connectivity in a car is another. So you're looking at all of the diagnostics within the car in terms of internal connectivity and external connectivity - maps, navigation, weather, emergency service applications, et cetera. This will be, without doubt, one of the sort of primary, new frontiers, if you like. I think Hugh Bradlow described it in similar terms - for the future under a 5G network, or a combination of 4G and 5G. Similarly, the previous discussion around agriculture and agriculture and logistics - you're moving product, you're tracking product. You're moving your produce - there are also profound implications for the insurance sector. We've heard that mentioned a couple of times today. Imagine what you'd be able to do for your insurance premium if you can demonstrate water usage at a lower level. If you can demonstrate crop or produce management at a higher level in the insurance context. There are literally boundless opportunities here to look for efficiency and to create value. There'll be some challenges in doing all of that. It's going to be a connected community. And one critical part of that connected community is going to be the mobile network, which will be - for the foreseeable future - a combination of 4G and 5G. A 4G network is already going through some iterations - 4.5G, you'll hear referred to. There's even a 4.9G, which is an LTE Advanced Pro Standard. So these sorts of network developments are going to gradually give rise to this plethora of applications that will touch every part of how we live. It's a classic triple-bottom-line policy situation in so far as there are huge environmental gains to be made here, there are huge social connectivity gains to be made and, of course, economic. It's a bit hard to put an economic number around something that we don't know exactly what it is yet. But that hasn't stopped industry having a crack. And not surprisingly, the numbers are pretty big. The most recent effort that I've seen points to 2035 across all sectors of industry, and you're talking US$12.5 trillion to US$13 trillion globally. Their huge numbers. The productivity implications are enormous. And it's going to be a challenge for industry to get this job done. And what does that mean? For us, it's innovation investment and infrastructure. We can only do this by pulling three levers - use the latest generation, build more network, and buy more spectrum. They're the three primary elements that we've got to manage the growth in volume of data, et cetera. Mobile network architecture is going to change. You will see what we're calling small cells be added to the architecture of a mobile network. Those small cells will be much more easily secreted within the built environment, but they will be critical to a much denser coverage layer. Frequencies available to the network will also change. We've typically got low frequencies right now in play - you'll get mid-to-high 3.6 gigahertz, for example. Then we're getting up into millimetre wave - never been there before - for mobile. Millimetre wave is incredibly short wavelengths. You must have dense infrastructure to manage it, but it's got very, very good characteristics for carrying data. The key issues for us - we need to get policy awareness of 5G. We're working with government on that. We've got a program of spectrum reform, including the identification of pioneer bands for 5G, and we're also looking at mobile deployment network regulatory reform. All critical to the future. We've got extended forecasts of growth. Enormous productivity opportunities. We've just got to get the regulatory settings right. It comes down to this: "The possibilities that are going to exist in this next, fourth industrial revolution, are limitless when you connect everybody with a device with the power that the smartphone currently has. Klaus Schwab, who runs the World Economic Forum, is probably right - we don't know half of the things that we're going to be able to do yet because it hasn't been thought of. It's all bit of a "Beam me up, Scotty! "- moment. Thank you.

(APPLAUSE)

JULIE McCROSSIN: Obviously I see this is as an opportunity for the Jetsons competition. I want you thinking overnight about, and sending in to Peabody - imagine what your life would look like - how will it be different where 5G is going? A couple of quick questions - we'll have our next speaker, then there'll be a chance for more questions. I just thought, while they're fresh in your mind, any questions or comments? Thank you...

>> Yeah, Malcolm Morgan. You talk about speed - it really concerns me when you consider that you're going to Sydney to Melbourne is 1,000km, round figures. If you've got a terminal in Melbourne responding to something in Sydney, you're looking at nearly half a second. So you really can't say that 5G is going too any faster than 2G.

CHRIS ALTHAUS: What's going to happen - the critical thing is, we're getting to a point where the performance requirements are faster and faster so, you must locate the infrastructure closer to the terminal exactly. So you will have not only the classic version of infrastructure - you'll have the layer of small cells, but you'll also go to the actual device. The device will be part of the network and will contribute to that.

>> I agree with that, but it's the back connection, not the access network, that matters.

CHRIS ALTHAUS: The backhaul's absolutely critical. That's why we look at fibre and the nbn situation as a natural partner.

>> And fibre is half the speed of (?) full-time so it takes twice as long. So you need to have the far-end terminal a lot closer with 5G than 4G.

CHRIS ALTHAUS: That is exactly right.

JULIE McCROSSIN: If you don't enter the Jetsons competition, I will personally punish you. It's not too late.

>> I've entered.

JULIE McCROSSIN: I'll give this bloke two entries. You can have more than one idea - this is a meritocracy! Quickly - are there any health issues likely to be perceived, or actual? What do we know?

CHRIS ALTHAUS: The range of frequencies that we use, or are likely to use, are covered by the current standards. We look at the World Health Organization effort, which has done probably more research into this subject than most things that we use day to day. The short answer is no, there's not been a case of an identified health impact. That doesn't mean that we don't stop research. So as an industry, we contribute to research on an annual basis in this country, and there's an ongoing research program. One of the challenges globally, however, is that the research dollar is justifiably being pulled into areas where there are major health concerns. When you can't find a health concern, it's increasingly difficult to attract research money to devote to this subject. Nevertheless, there's an ongoing research program. From the standards point of view, we're absolutely on song, and there's going to be no implications on health, but we're still monitoring it.

JULIE McCROSSIN: I'll give one more question or comment, so you don't forget it. This is the time of the afternoon where the human brain can lapse. Anybody else with something on their brain they'd like to say? A big round of applause, thank you.

(APPLAUSE)

I'd like to welcome now Frank Zeichner, CEO of Internet of Things Alliance Australia, and co-founder of it, which has over 330 government, industry and research corporate members. That will have changed by the end of his presentation - that is the rate of increase in his membership. I'm not joking. They have over 550 participants. He's also director of Knowledge Economy Institute here at UTS, and Industry Associate Professor in Engineering and IT. Please welcome Frank.

(APPLAUSE)

FRANK ZEICHNER: Thank you very much, Julie, and a special thanks to ACCAN for inviting me to this event, and very much appreciate their work in this area and their support of the IoT Alliance as well. So, I thought - I've got a few slides, and I thought I'd concentrate more on the consumer and the community, because it's an aspect of the Internet of Things that we haven't spent a lot of time on, except some of the negative aspects, and I'll talk a bit about what we're doing about maybe ameliorating some of those. Our by-line is seizing the Internet of Things opportunity for Australia, and the reason that we exist is because we think that there's a benefit for our economy and society in applying...

JULIE McCROSSIN: Just bring that a little bit closer...

FRANK ZEICHNER: Whoa... ..in applying IoT where it makes sense. We're a rallying industry, but the great resource of not only capability but energy is the community, and is our citizens. I want to draw an analogy and a parallel between the effect that we saw and we've experienced through the introduction of the internet, and then say what might happen with the Internet of Things. When the internet came along, we didn't really have an idea of how it was going to affect things. We saw that it connected computers to computers and people to computers, and we could share data a bit more, and we didn't quite know, and we were on this endless search of what, in those days, was the killer app, which turned out to be a million apps. A story I like to bring up is - it disrupted industries in such an amazing way that we didn't expect. In 2013, for the first time ever, the number of billable legal minutes in the world went down!

(LAUGHTER)

Which I think is a fantastic statistic. It's from a lawyer. I thought, "Gee, how could that be? There are more people, and we're no less litigious than we used to be - we may be more..." The reason is the business model of the law profession involved a partner with sub-partners and researchers underneath. And the internet allowed us to do our own research. And so that cost equation - that pyramid - was changed. That's because we could all of a sudden share information and, in fact, the internet has allowed us to even change governments, in some places, as we saw in the last few years. The sharing of data, the creation of blogs, the changing of the media industry - that's what the internet has done. So, now throw your mind into what could the Internet of Things do and be? That's what I want to talk about. I just want to position it...

The first thing is that industry likes to talk about - and I like to talk about as well, I suppose - improving productivity. There are many, many, many use cases you can come up with that. Mark talked about some great advantages you can get out of the farming industry. There are just a myriad of opportunities there. A myriad. Indeed, a case I like there is that chilled beef is worth more than frozen beef. If the consumer can know the difference, you can pay twice as much. Same beef. Now, you just make that available to a consumer on his mobile phone, or electro spectral sensing - bingo. So we have a lot of technologies that can improve the value of our products, so, from a productivity and branding point of view, deadset no problems. What we haven't really been talking a lot about is sustaining the environment, empowering citizens, and in fact the combination of the environment, citizens, productivity creates a whole lot of really amazing, innovative services. So that's what really excites me. And we keep talking about the doll - I don't care about dolls. That's an opportunity for some individuals. But there's way more interesting stuff that can happen. OK, let me give you the one slide that sort of tries to explain what the Internet of Things is...! Everyone's gotta have one! On the left - the internet. We're connecting - and it's still got a fax machine therein, but whatever - fax machines, PCs, mobile phones connected together. Then on the right-hand side, what we now have is this utter, amazing plethora of things we could connect. And as Hugh said, most of these are not connected today, but will be and can be connectible. It's a whole range of things - we heard about home automation, a little bit about wearables, heard about home health, water management, food and agribusiness, manufacturing, transport, retail, electricity - what's interesting about all of that is that the data that supports that - the sensors that can support that - can come from anywhere. It doesn't have to come from the water utility. It doesn't have to come from the electricity utility. It doesn't have to come from the EPA. It can come from whoever and whatever wants to sensor - whatever community of interest and can and wants to do something. That is the power and the availability of what can be done with the Internet of Things. So all of a sudden, now we have the possibility of a crossover between consumer and industrial, and in business models that we have not yet thought about. So that, for me, is the amazing opportunity. That's what excites me. And it's the empowerment side of it that is exciting. One of the little instantiations - and Catherine mentioned it - a little project we've got here called TULIP - we run off a low-power WAN base station up here. We're now sensing temperature and air quality. You may not know - the EPA measures air quality in Sydney in seven places only. 22m up on top of, um... ..Rozelle Hospital, and another one down at Randwick, and a few others. Whenever you hear about what the air quality is in Sydney - they interpolate it from that data. That's it. Does that tell us what the air quality is out here, if there's bad traffic or something in the tunnel? No. Can we find out, measure ourselves? The cost of measuring is way, way lower than it used to be. The ability for us to now connect - effectively - for free, is absolutely available. Can we share that data with our cities or with the EPA? Absolutely. For me, the opportunity to do something and cross these boundaries is where the magic is. And, frankly, where the opportunity is for people. For us not to be disengaged from technology, but to actually use it to engage. Now, I think it's not only for the people who know, but for the people who are disadvantaged today, I think that - I think was it... ..Greg? Yeah, Greg. What he's done and what he's using - I've seen great examples of people with disability who are coming up with their own solutions because they can, because it's easier and cheaper and more reliable to do it themselves, because they can customise it for themselves. And so, I think that's where the opportunity lies.

I've just mentioned - I think I stole my own thunder on TULIP - this is a fantastic thing. What's great about this is that anybody can join. You can make your own sensor, connect for free, then store it on your own storage system. Why is it now possible? It never has been before. Because the cost of all these things has dramatically dropped. The cost of a gig of data in 1985 was $250,000. It kept dropping by a factor of 10 every 10 years. Now it is approximately zero. You can store a gig of data in 15 different service operators today for nothing. So it's not a storage issue. It's an access issue, a data management issue, a data principles issue. Those are the things that the IoT Alliance is looking at. What can we do to make it clearer, simpler and easier for how people share data? It's not possible for any one person or organisation to collect all the data. But if we have many people collecting, then it's a question of sharing, not of collecting. That's where opportunity lies.

I wanted to say a little bit about the risk. We heard a little bit about risk and trust, and it's about security, it's about privacy, it's about safety, and it's a real issue. It's a real issue that we have, that we inherited from the internet days, is still with us. We have abysmal behaviour out there in the market today. We have codes of conduct for weeding out bad devices today that, dare I say, ISPs have signed up to. They are not followed.

(LAUGHS)

They are not enforced. It's going to get worse when we introduce lots and lots and lots of these little things on the end that aren't well looked after. What's the IoT Alliance doing about it? We are going to attempt to do a world-first - introduce security trust marks for IoT devices and services. Now, that won't guarantee you won't get hacked. But it'll guarantee - it's like you're roadworthy - it'll guarantee that it'll have a password that is not a default one. It'll guarantee that it'll have automatic patching capability, or whatever it does - whatever those features are - and we're in the produce of defining that process, and the testing and certification regime, today. Our ambition is that Australia gets a reputation for being secure, as well as safe, for products. Secure for IoT services, which is a great ambition, I think. And it will make - I think we can all participate in that process. We've got 170 different organisations in our start-up work stream, and educating them about the importance of security is our first step. And it's a big one to take. But for me, I think it's a risk, but it's an opportunity. I regard that security and privacy concerns we have around the Internet of Things are a bit like to cars were to transport a hundred years ago. We heard about the car analogy. We had many deaths before we even considered having lines in the road, traffic lights, seatbelts. We've sort of honed down to saying, "It's sort of anticipatable to have 1,000 or 2,000 deaths a year in Australia. That's OK. We don't need any more regulation." It says everything about - it can't be perfect, it won't be perfect, and somehow society accepts a certain level of risk. We haven't worked out what the level of risk is Internet of Things land. It sure ain't perfection because it can't be achieved. We want to set up a benchmark for what is the minimum acceptable level so we know it won't become a bot-net on the day you open it. Believe me, we know there are modems also sold that are bot-net within a minute. Some include video cameras going into our prisons! Own modems delivered for the nbn today by ISPs. We have poor performance, even though everyone recognises how important it is, everyone proselytises about how their customer should be doing it and they aren't necessarily doing it themselves. I am not as far as Hugh as about putting people in jail but eventually we might have to go there if we don't pull our socks up. My two messages were massive opportunity for people empowerment. It is making it part of working together. ACCAN is part of that process. I welcome community involvement in developing what we think is an acceptable level of risk for us to manage and to understand that that's the bargain we are making. That's it.

JULIE McCROSSIN: Fantastic, thank you. A round of applause please.

(APPLAUSE)

JULIE McCROSSIN: Could I invite Chris to come on stage and join Frank. I have a spare microphone under my arm. You can answer questions from your seat. There are people still trying to reduce the road toll. Some of the arguments for the driverless vehicles will utilise those, particularly in the trucks on the roads and so on. You know that new technology for measuring if we are using prescription drugs while we are driving is a relatively recent issue. I am obsessed with road safety. I do a lot of driving as you know. I might start with questions for Frank but questions or comments generally and probably both gentlemen will react to them. Any questions or comments relating to all that we have heard, particularly around Internet of Things.

>> Angus from Darwin. A lot of IoTs operating in the public bandwidth sphere, 700 megahertz, there is a lot of players in that space, including randomly the military. What kind of future do you see for regulation or contention in that space?

FRANK ZEICHNER: This is a good one for Chris as well. There will be definitely contention.

(LAUGHS)

I think there are two - three worlds, at least. There's the government-controlled military world.

JULIE McCROSSIN: Keep it close to your mouth.

FRANK ZEICHNER: Who definitely will have a requirement. I don't know enough to know what that is and how they value that against conflicting and competing interests.

There's the carrier market that have a quality of service SLA - not obligation but something they want to go for, shall we say? We are not seeing too many SLAs right now but I'm hoping they will. They require to have services up. They provide critical services, need guaranteed bandwidth, so carriers are getting 700 megahertz.

Then shared bands, wi-fi bands used for shared requirements where you just have local access which anyone can put it out. It's low-cost, free to use and it is being used right now. Frankly, the biggest growth right now in IoT is in those bands.

JULIE McCROSSIN: What's is significance for the uninitiated?

FRANK ZEICHNER: For the uninitiated - wi-fi and cellular? Wi-fi and low-power WAN, these are technologies you can connect to that simply connect you to the data network. They don't track where you go necessarily. They don't roam. They don't hand off between places where you go. They work only in the local area of that base station. But, in fact, many things you sense don't move. When they move a long way, you absolutely need a mobile network if you want to track where it goes all the time in real-time. I don't know if helped or not!

JULIE McCROSSIN: Anyone want to ask a further question.

In terms of the military, I've been doing mapping of the spectrums in Darwin and the military white noise, the public channels, for about 5km around a military base which kind of does pacemaker reporting and interesting other things like that but I am just wondering, at the moment there is no legislation that controls them not doing it. When I talk to them, they said, "It's ours, go away".

They are pretty good at doing that. There is two aspects. One is there is currently a spectrum reform process going on where the government is literally building a new Radio Communications Act. We asked them to do that because the old one wasn't a complete train wreck but it was out of date. Part of that new Act is going to change fundamentally how spectrum is planned and managed, including, interestingly, government holdings of spectrum. They are included in the mix because spectrum is a finite resource and anyone who wants more spectrum typically means someone else has to have less spectrum. Defence hold a lot of spectrum. This new spectrum review process and the new contact will give them an ability to share it. Even lease it. I doubt they'll ever sell it but they could even do that.

There is quite a deal of change coming in in a contemporary spectrum management system. How that affects what you're seeing up there - you know, the defence environment is quite a unique one.

JULIE McCROSSIN: Anything further? Thank you.

>> Keith again, a quick comment on defence spectrum. The defence has very large holdings which they often have on a just-in-case basis. What Chris is saying is quite pertinent because, for probably 99.9% of the time, they're not using it but they'll need it if anything happens drastically and then they'll need it urgently so finding ways to lease or share it with the contingency for access in emergencies is probably the nub of the issue.

JULIE McCROSSIN: Thank you. Teresa here. Probably more for Chris. This is a question we get asked a lot at ACCAN. I know 5G is still under development but people want to know how 5G will interact with 4G and 3G. Will they have to upgrade their phone to get a 5G phone or it just the machines that will be using 5G? Will the 3G network be switched off? These are the things people are asking. Will they be disadvantaged if their area doesn't have 5 G?

CHRIS ALTHAUS: It is part of an evolution. I guess we expect, to some extent, a similar transition that we've already seen but I think it's going to take longer because the 5G device and the chip sets that are required and the frequencies those devices will use, they will come - 2020 we are talking about commercial deployment but you will see a 4G/5G ecosystem for the foreseeable future. I guess, in a device sense, you will see a gradual turnover, just as we've seen 3G to 4G.

Certainly there will be applications that 5G will attract at the extreme mobile broadband end of use but when you think it's much more part of the so-called industrial internet so, for the consumer, unless you want to be doing your streaming of 4K videos et cetera and using device in smarthomes, smart city, et cetera, the 5G devices will come but as we have seen it before, Teresa, it is a natural revolution.

JULIE McCROSSIN: What does G stand for?

CHRIS ALTHAUS: Generation. Although, very unkindly, when we launched 3G, we were teased it was games, gambling and girls.

FRANK ZEICHNER: I will make the point the cost of the extra transceiver in mobiles when you move from 3G to 4G, maybe 4G to 5G is something you can afford to put into a $1,000 phone maybe but for Internet of Things there will be a fit-for-purpose transceiver. You will have it as low-cost as possible because you will have billions of these things out there, you will not have multiple technologies. You will put out the one that's optimised for that, that might be one byte a day, that's different for 5 G technology.

I have been involved in this industry for a long time. Started my career off in telecom, Telstra. We are seeing this now in the Internet of Things, a challenge where Australia seems to be a consumer of the innovation and equipment that requires - is required to run our networks and now we're facing a situation where, if we look, for example, in the Internet of Things and this wi-fi low-power, long-range space, what we're seeing is the issue where the technology is actually not designed to effectively work on the Australian spectrum and in the Australian environment. I think all too often we see a situation where, you know, we have to sort of, in some way, sit back because we're a smaller market. I suppose I'd just be interested in both of your perspectives about where are we at the table of actually positioning the fact that we are a little bit unique and it has a massive flow-on effect and it's called cost. For the very reason that we have problems with connectivity in regions. I think that gentleman highlighted that. I'd be interested in your perspectives. Are we at the table? Do we have any influence? Or will we continue to just have to deal with this situation of being a consumer and then having to deal with that?

FRANK ZEICHNER: This is right in our Chris's...

JULIE McCROSSIN: Put it close to your mobile.

FRANK ZEICHNER: The mobile carriers using cellular, they are leveraging the fact it is a global standard and the global spectrum management of that is well in hand. They're leaping on board. That's translatable everywhere. That's why they are so passionate about we need the spectrum because it means we can transfer that device to any country in the world. It changes quite radically when you look at the shared bands around the world because they're not the same. So we suffer and our best bet, frankly, is to hop on board the biggest market, which is Asia. If we are going to align with anybody, be aligned with Asia because that's where the numbers are, that's where all the middle class will be that will be buying and we should absolutely abandon the idea of having anything that looks like an Australian spectrum allocation.

(LAUGHS)

CHRIS ALTHAUS: Too true. We are a technology taker. We're an advanced market in mobile but we are still a little tiny market. We are at the table. Spectrum management planning is broken up into three regions around the world. We are region three which is the Asia Pacific, Frank's right, it is where the huge growth is in many respects so there is great gravitas that we bring because we are technically advanced. We can't bring mass market gravitas but we can bring knowledge and experience and many of my members - in fact, the global members - actually recognise Australia as somewhat of a test bed, test market, for innovation in mobile because we're keen on it and you can deploy and get a reaction. That flows into the global environment. But there have been examples in the spectrum environment where the ACMA and the Australian Government has batted well above its weight in terms of forcing more global adoption of our band plan structure. 700 megahertz, the digital dividend is a classic example. We are at the table, we punch above our weight but, given the smallness of our market, we are still fundamentally constrained by that reality.

JULIE McCROSSIN: Thank you, we will have two more questions and that will probably be where we're up to.

UNA LAWRENCE: Una Lawrence here. I'm interested in the fascinating conversation you've been having, and debate. One of the issues that Frank touched on was less billable hours for lawyers. Obviously - not that I'm concerned about lawyers!

(LAUGHS)

One of the consequences of the Internet of Things has been, that people have been concerned about, is impact on the change of the labour market and the composition of the labour market and what the flow-on effect might be, for example, in transport. If we have driverless vehicles, suddenly there be no more taxi drivers - not suddenly but presumably less demand for taxi drivers, bus drivers, et cetera. I'd just be interested in your thoughts on how that might unravel and what the kind of challenges might be there for all of us in the future?

FRANK ZEICHNER: Excellent question. I've got one really good example where I can see a positive opportunity and a challenge for us to meet it. I was recently at an industrial internet symposium and the head of education for the manufacturing growth centre was talking. I was on the panel. I was moderating that panel. He said that, over the next five years, there will be a net increase in manufacturing jobs of 50,000. I almost fell off my chair. I said, "Gee, who knew? I had no idea, I thought it was dwindling". The question was, "Who will fill the jobs?" Not us because we're not trained to do the jobs that are being created. Strangely enough, in manufacturing, a net increase in jobs but we are not fast enough in educating our work force and the new people in to take advantage of it, so what I see is a shift. I am an optimist. I believe we will shift and that the net jobs will be created and we have to because we are a high-value, high-cost, high standard of living country and we have to be there but we are not yet engineered to meet the challenge. Herein lies the opportunity and the challenge.

CHRIS ALTHAUS: It is also a paradigm shift insofar as if you look at that Industrial Revolution analogy, typically the sorts of jobs that have been replaced have been at the manual work end of the spectrum but when you move into an AI environment where you have intelligence built into systems, lawyers, accountants -

JULIE McCROSSIN: Radiologists are very worried.

CHRIS ALTHAUS: - the repetitive tasks machines may well do more accurately and 24/7. There is a machine somewhere in Western Australia that's laying a thousand bricks a day and will do it seven days a week and doesn't need a rest. But I guess you can look back in history at industrial change and identify similar circumstances and adjustments will be made but it's going to have to be a very mature debate. I have already been in one forum when quite legitimately a union leader stood up and said, "You know where you can put AI because it is going to affect my ability to have members who are employed".

FRANK ZEICHNER: Another interesting factoid I just read was the number of service jobs in Australia has moved from 10% to 20% of our market. Service jobs. We have had a net increase of jobs overall. We know they're coming out of the manufacturing areas and the labour-intensive areas. In fact, I think the people who will be losing their jobs will be software programmers because computers will be doing it much better. It will be the designers. It will be the networkers. It will be the cross-industry innovators. It will be the service people where the jobs growth is. We have to re-adjust ourselves to that.

Hunters and gatherers died out, I suppose that was a bugger but there's not many of us left.

JULIE McCROSSIN: We have someone from Darwin who will challenge on you. Last question or comment. Can we have short answers?

>> Just re-enforcing what Chris was saying about Australia's role in spectrum. One of the best-kept secrets is leadership role Australia has played over the last decade. The digital spectrums plan is largely an Australian design which we sold to the Indians, the Chinese, the Japanese, Koreans and so on. It was adopted in region 3 which is the largest region in the telecommunication union and it was almost entirely an Australian set of ideas and a plan that suited us very well. We might not make the mobile devices much in this country but we are certainly leaders in the regulatory policy setting and the ACMA's role in particular ought to be recognised there.

JULIE McCROSSIN: Let's clap the ACMA.

(APPLAUSE)

These gentlemen have pulled off an almost impossible task. You have been listening to intense things all day and yet you were gripped by them, would you agree, by their quality? Please give them a round of applause.

(APPLAUSE)