

Moderator: I'm joined by Thurman Case, he's the long-time CFO at Cirrus Logic, and Carl Alberty, who runs Mixed-Signal Group at Cirrus Logic. So thanks both of you guys for joining us today. Appreciate it.

Thurman: Thanks _____.

Moderator: And I'll go ahead and maybe I'll just start at a high level with the first question. For maybe those less familiar, this is a webcast presentation, less familiar with the story, can you give maybe a quick background on Cirrus, maybe your products, a little bit of your history, kind of where your focus is in the market?

Thurman: Cirrus is actually over 30 years old, and so, we are a fabless semiconductor. We have no manufacturing. Recently, most of our markets today are portable markets and the handset market is what's driving most of our revenue, although we have a lot of product stuff going on that Carl will be touching on throughout, I think the rest of this. We have around 1500 employees.

About four years ago we acquired a company called Wilson Micro Electronics. That acquisition really opened the door and has allowed us to penetrate more of the Android market, of the handset market and the other sites of the portable market, so it has been somewhat transformative. We're starting to see a lot of traction based on that acquisition.

So with that, most of our – we're located in Austin, Texas is where our headquarters are, but we have a large group of teams that are located in the UK, in London, in Newbury, and our biggest facility there is in Edenborough. We have a couple of other smaller facilities in both the US and the UK. So that's kind of that in a nutshell and we can dig into the product stuff.

Moderator: And maybe just another sort of transitioning question, but I know you guys just reported last week. But if you could comment on sort of what you're seeing just generally in terms of the demand environment, given all the geopolitical stuff that's kind of been going on, I guess now for – we've anniversaried[sic] it. I guess it's over a year. But sort of what the demand environment is, how much you guys are or not being impacted by sort of what's out there.

Thurman: I mean in a general sense, it's been largely not a factor for us. Most recently the inclusion of Huawei on the entity list has been an annoyance, frankly. It's not a material piece of our business, but we've been working to supply them with some of our amplifier technology and had had some success in working with them to provide really high quality boosted amp solutions. Again for the same fundamental value proposition that we've had success with other customers with boosted amps. So that's definitely been a step backwards, albeit not a big one relative to the overall business. So we're hopeful that that shakes loose and we

can get on with providing high quality solutions into that customer, as well as the rest of that market and the rest of the handset market. But otherwise there hasn't been a meaningful impact relative to the last year of challenges.

Moderator: And when you say meaningful you mean – I know you've added, last couple of quarters you've added a second 10% customer. This isn't preventing a third 10% customer. In other words, Huawei. You just mentioned them. It's not preventing them from being that sort of size and scale or maybe it is.

Thurman: No, I mean it's for sure slowing down their potential to get to that level of business for us. And we could for sure see a path to growing a good bit of business with them around some of our amplifier and driver products. But they certainly weren't anywhere near that run rate for us as of yet.

Moderator: Okay. And I'm assuming it hasn't slowed the design win momentum and the kind of work you're doing with them. It's just being able to...

Thurman: I mean at this point we've applied for all the necessary licenses with the US government. We have started seeing small purchase orders for some of the components. But as of yet, until we're issued or not issued a license from the government, we can't provide any technical support. So that's what we're doing at the moment, just trying to comply with the regulation and just hope that it gets cleared up as fast as possible.

Moderator: And then in terms of the markets you play in, Thurman mentioned you're primarily focused on the wireless space. I think it's over 90% of revenue. As that market sort of matures and flattens, kind of what of we're seeing now, what's your strategy to continue to grow and put up the growth numbers you have in the past? I mean is it lead with content? Is it expand in the Android space? Maybe all of the above.

Carl: It's really both. I mean over the last 12 to 18 months, we've really been expanding into Android, winning a lot of on the back of our boosted amplifier technologies. So a couple of years ago we've made a big transition into 55 nanometer with our amplifiers, which gave us the capability to integrate a lot of signal processing, which is our core strength, with the high voltage boosted amplifiers and deliver a really, really small low-power solution. And that was really met with open arms by the market, and so we've continued to chip away at it. I mean on average, an Android handset is not going to move the needle. There's a couple of them that can, but by and large, you've got to win a whole bunch of them and we've just been ticking away at it one design at a time. For the last 12 to 18 months, so that's been really encouraging.

Beyond that, we've started, as we talked about, moving into new adjacent spaces like haptic drivers. And we'll continue to kind of build out that roadmap and add more capability and functionality that will drive additional content around that whole kind of input, sensing, and tactile feedback application set. And then outside of that, we think there's more opportunity for us to be chasing low-power, low-latency signal processing related product types and handsets. So it was for sure an expansion of content opportunity for us longer term. Smartphones are still the biggest market in the world for what we do. So again, just layering market share and new application spaces outside of the core audio and voice stuff is going to drive meaningful growth over the next couple of years.

And then placing bets around what could be the next big thing, which is always a question that we get and we never know the exact answer to. But we've got enough IP that's so relevant to so many different applications that require ultra-low-power and low-latency signal processing that we've got enough bets on the table to kind of be ready for things that emerge like wearables and other connected devices that are exciting longer term, so.

Moderator: You guys have always sort of had a steady content story and then you've always had those years where you have this sort of seismic move in content every few years. And is 5G that kind of opportunity for you guys or is it more gradual? I mean as 5G kind of becomes more mainstream, whether that's, may not be next year, but maybe it's 2021 or whenever those phones start to really hit volume. I mean is that the same kind of a step function content story for you guys or is it just more gradual?

Carl: Yeah, there's nothing specific around 5G architectures that'll drive a significant change to audio subsystem architectures. So it's really just us continuing to do what we've done for so many years, which we'll continue to – from some cycles to the next, we might be investing in cost reduction, while adding functionality and just kind of tick-talking amongst the various different amplifiers, drivers, and codecs that we do supply. So nothing specific around 5G.

Moderator: And then you mentioned adding features and functions, and that's something, again, you've done consistently, even with your core audio codec lineup. And I think you – first, I guess I'd be interested in sort of – I know you recently announced a new customer, a custom codec win, with that customer. Is the right way to think about that that that's sort of last year's codec, if you will, that's been upgraded and carries a higher ASP than last year's codec? I mean is that...

Carl: So the product we're ramping reflects, again, a lot of the same things we've been doing for a while since we moved to 55 nanometer from 180, that was a big jump. That opened up, again, just similar to what the amps did 12 to 18 months ago, but just opened up more signal processing capability. And so, I think the way to think

about it is we've got a big portfolio of mixed-signal kind of IP around data conversion. It's just high precision analog on both the input side and the output rendering side, and a bunch of processing capability that can sit in the middle.

And customers, who are pretty crafty around knowing how to stitch things together, whether that's for audio or just general purpose mixed-signal and non-audio use cases, I think we've continued to see more and more applications where it makes sense. Like, hey, I have all these data converters that are converting microphones or playing back audio to a headset or a speaker, but I've got these other things that could make use of this low-power, low-latency kind of mixed-signal hub.

So we continue to really stay two steps ahead on the IP development so that we've got the right mix when we're looking at, okay, what does the product need to do and we can pull things out of our portfolio that are ready to instantiate in a product. So it's really more about just continuing to drive innovation around low-power and low-latency signal processing.

So in this design cycle we're continuing to push new, higher performance data conversion. We've got some new variants that offer ultra-low-power for some more always-on use cases and more signal processing as a result of that in terms of just driving lower power overall.

Moderator: So it's more about performance on this, if you call it an upgrade cycle or for this new custom codec versus – I was going to ask if there are any like sort of features or any new functions that had been added along.

Carl: I would say it's mostly about delivering improved performance, lower power, and at a total system level just a lower size. I mean size is an absolute premium. I mean every little bit of cubic space in the phone basically relates to battery life. And so, the more we can do to make the thing smaller in every dimension and have less components around it, the better off we'll be. So that's a large – the reflection in this cycle is largely about really optimizing and allowing the customer to do what they want to with some of our signal processing capability, adding features we may or may not know about. But that capability is there for them to take advantage of with that ultra-low-power DSP capability.

Moderator: And because you talked about it, I know this particular custom – it sounds like this particular custom codec is still on 55, but are you getting sort of that push from any of your larger customers to kind of do another shrink and try to get down to – and what would the next node be, I guess for you _____?

Carl: I think it's more about us being proactive in knowing that, okay, one of the key things we get paid for and value we provide is just really pushing the envelope on

making them smaller and lower power. So again, that is such a premium and it's sometimes hard to put a value on. Well, you're going to get paid for making it this much smaller at a board level. But that's absolutely what we're investing in from an R&D perspective.

So we've been investing in 28 nanometer for our voice biometric product line. That largely is a digital chip. And there's a straightforward shrink of that with 22 nanometer that we've been investing in for quite some time now in terms of redeveloping all of our analog and big signal IP in that process node to, again, have IP ready for when we want to make that leap in terms of product. Again, focused on much lower power and much smaller size, similar to 55.

That is not – it's not a cost reduction investment by any stretch, but when you look at the value that we can get out of the size and power reductions, and then really enable more features to get added in, in a smaller footprint. I mean the digital shrink in that is pretty compelling and the dynamic power is significantly lower. So that adds up to be a really good roadmap for us in terms developing the next generation kind of mixed-signal content in 22. They're still a good ways out.

Moderator: Great. And I'm curious, just if you look at the ASP, let's say like-to-like, last year versus this year's new custom codec. Sort of what that means in terms of ASP boost for you guys in rough numbers, percentages, any kind of color you could give.

Carl: Yeah, we're certainly not on the precipice of huge increase in terms of content. So it's certainly, again, it's an investment in better performance and lower power, so we do expect to get some value out of that, but it's certainly not a huge, huge leap as we've seen sometimes in the past, so.

Moderator: And I know it's a custom codec, so meaning, I assume that it means it can't be sold to another customer beyond the one you've announced for it. But how much of that IP can you reuse and how fast could you get a similar type product, maybe more standard Cirrus _____ customers

Carl: A lot of the underlying technology is Cirrus technology. Obviously with certain large customers we have collaborated and integrated their IP, and in some cases allowed them to program and deploy their own technology and assets on our products with development tools and things of that nature. So a lot of the core underlying IP is Cirrus Logic. And if there were a bunch of meaningful opportunities to go build these kinds of smart codecs for handsets, we'd certainly be doing that.

Those opportunities are reasonably limited, so there's no real restriction around what we can do with a lot of that IP in terms of reuse for other products and other

customers. But the kind of traditional smart codec market for handsets in the Android space is still what it has been for quite some time, which is, there's opportunities, but they're a little bit more few and further between.

Moderator: But would you say they're, like in the Android space, because it's an important part of your story, is there a growing appetite for smarter codecs? I mean it seems like – if I name names, I mean I know Huawei's kind of four letter word right now, but it's sort of not their fault. It seems like they've climbed the stack in terms of performance over the last few years. They've become a lot more focused on that high-end or flagship kind of phone. So I mean have seen more opportunity there or is it still too early?

Carl: I mean, in that account, not really. I mean they do have their own internal teams developing chips for their phones, including some audio functionality. So again, I think the overall opportunity is a little bit limited. I mean we see the most pull and draw in the Android ecosystem for the amplifiers and the haptic drivers and the related kind of sensing technology that comes with those applications. And significant traction around moving to multiple speakers and moving down the tiers into the mid-tier kind of price phones. So we do see opportunity.

We've had some smart codec design wins in mid-tier phones in the China's space over the last three to six months, so that's exciting. It's driving growth in the Android space. But I would say by and large, a lot of the customers in that ecosystem still rely heavily on reference designs from Qualcomm and their ability to color outside those lines is reasonably challenged. So our success has come when partnering with customers who have a better idea of what they want. They have assets they want to deploy or they're looking for very specific features and use cases around always-on and things of that nature that they either can't get from another supplier or can't get the custom and the really strong support that we provide to all of our customers. And so, there are opportunities, but it's not really changed in the last few years in terms of the breadth of that opportunity for

_____.

Moderator: You aren't digging around on it because it seems like with all that attraction you have on the amp side, haptic side, whatever, that you'd be able to eventually pull in some customers on the codec side. But I also understand that it's more of a – it sounds like it's more of a general purpose codec. And, obviously, historically those guys have all used a lot of integrated audio. To me it sounds like, from what you're saying, for the foreseeable they continue to come and buy from Cirrus. They'll buy boosted amps or whatever to enhance their performance, what's fundamentally sort of limited integrated with audio.

Carl: Right. And the brilliant – I mean frankly, the great part about our move to 55 for the amplifier is we could integrate DSP capability that would in other phones be

in a 55 nanometer smart codec. And so, it's a bit of an end around in terms of being able to provide low-power DSP capability in the amp, which is a much easier bridge to cross for a customer in terms of coloring outside the lines of a reference design. So we can shoehorn some of that codec functionality into a boosted amp because it has a DSP integration. And then as we get multiple of those, and especially with multichannel use cases it becomes more complex, and the DSP value really shines.

Moderator: So if I shift gears a little bit, from an in market perspective, smartphones remain the primary driver, I think for your business. I know a lot of analysts talked a lot, I think starting four or five years ago, about IoT and how big of an opportunity. And I think a lot of people still think it's going to be. It's just taken a little while longer to develop. I guess maybe if you look and you consider that voice, I think is clearly becoming, whether it's Alexa or Siri, whoever, voice is becoming a growing theme, let's say it that way, and AI technology advances. I guess what kind of opportunities that open up for you guys? How big of a focus is IoT for you guys?

Carl: I mean IoT for us still is a bit of a catchall for a bunch of applications. We do see voice proliferating as a primary, not the only, but definitely a primary user interface on a lot of these applications, especially ones that don't have touch or don't have screens in some cases. So we do continue to see strong pull, albeit in a very fragmented market. I mean there's still just hundreds and hundreds of customers building all sorts of things that are voice-enabled.

So we've got good reference design programs with companies like Amazon around enabling customers who don't have that voice capability to get to market faster with two microphone, four microphone, and these kind of high-performance voice capture solutions. So we see traction in that space. We see lots of opportunity for voice. And then there's also really interesting conversations happening on the back of just the voice pickup and being able to process in a room full of screaming kids and a TV on. That's a really hard acoustic challenge in and of itself.

But then layering on top of that authentication of the user, which is based upon our kind of secure biometric voice technology that we acquired back in 2015. So layering that on as a capability so the smart devices know whether it's Thurman or I talking and kind of can set profile. And, of course, can set secure kind of applications around that. But fundamentally it's also the ability to know different family members and just drive different user experiences around that voice experience, which again is super exciting.

So we don't think about IoT in the context of a lot of things outside of voice-enabled products. I mean that's the biggest driver of it for us today. And that cuts

across a lot of things. These smart speakers, wearable devices kind of fallen to the same kind of technology bucket. Cameras and things within the home that relate to security and whatnot all fall into that bucket that, again, leverage a lot of the same underlying technology. And then just gets re-swizzled to be suited for that application.

Moderator: Well, because you guys have kind of, I would say honed your craft and solving that small form factor, high performance kind of solution in handsets. I would assume that that would be a lower bar in IoT than it is in handset or am I thinking of that wrong?

Carl: Only, again, because that IoT space contains so many different applications, it's hard to say that definitively. If you look at some of the bigger ones today, like plugged in the wall small speakers, yeah, it's hard to get that value extracted in the same way you do in a handset that's – every milliamp hour is precious. But there are like a ton of emerging applications that are in the IoT category that will run on these little nickel-size batteries, where battery life is hugely, hugely important. Which is similar challenges we see in some of the wearable space and even some of the wireless headsets that have just tiny, tiny batteries and the customers are constantly trading off, how do I add capability and like cool user experiences without making the battery life like six minutes. And so, that's a real good sweet spot for us. And we would expect that to replicate in some IoT things. It's just not clear yet what that really looks like for us longer-term.

Moderator: You bring up A&C and that's a good segue. I know you've talked in the past about that being a hurdle, just the small, small form factor and being a hurdle to some of the, I think a lot of forecasts. Again, that's another one like IoT. I think people forecast starting a few years ago, a lot faster adoption of A&C. Actually I'll just ask you. I'm curious. Is moving to like 28 nanometer or a smaller node, is that sort of critical in A&C starting to take off? And maybe as part of that answer, I'm curious, sort of where are we with that A&C transition now in your eyes, what that TAM looks like today, things like that.

Carl: I mean, so Cirrus was part of that party, thinking that market would evolve faster than it actually did. And when we think about that market, it's headsets overall, not just A&C. I mean we viewed A&C as a flagship feature, but we thought there would be fragmentation within digital headsets that require low cost, USB codecs for wired headsets, discreet headphone drivers and smart codec for wireless or Bluetooth products. And then up to and including our smart codecs that had the continuously adaptive A&C. So that was disappointing in terms of the speed at which that market evolved.

I mean it's certainly moving at a pace that's faster than it has, especially around true wireless headsets. There's a couple of pretty compelling products in the

market now that are starting to get customers more active in that category. We're starting to see more headset or handset OEMs get rid of the 3.5 millimeter jack, which is creating content opportunity for basic headsets and adapters, which to be clear is not really the part of the market we're chasing. Because in that space, I mean, it is all about cost because you're adding incremental cost to an already challenging kind of macro level smartphone environment. So it's sensitive. We do have wins in that space. We've got things coming.

But more of our investment is around this truly wireless headset application. And it's, again, not as much focused on A&C as a key feature because of the challenges around power and just cost of implementing that type of continuously adaptive solution. So we certainly have that on the roadmap in terms of building products that hit a power level, which 22 would be a great example of one path to get to an ultra-low-power implementation of architecture for a continuously adaptive A&C. We're not there yet.

So the roadmap and the things that we shipped today are largely products that are built around wired or like tethered together wireless headsets, so not optimized for single channel A&C kind of power. But it is something that's in development. We've got some exciting things coming before we get to that point, just in terms of enabling truly wireless headset designs across multiple different customers.

Moderator: Have you said what the timeline is to 22 for you guys? Is it three years out, two years out, five years out?

Carl: No, we haven't really talked about it specifically. We don't have a specific interception in terms of customer product cycles. We're, again, just trying to get ahead of that in terms of developing the IP and being ready to start putting that together. So we've got all of our core mixed-signal IP kind of designed in 22 and we're kind of getting ready to really go fully qualify all that, such that it could put into a product. So that is going to be a couple, three years away before that's anything mainstream.

Moderator: So let's switch gears again. You mentioned voice bio a few times. We haven't talked too much about MEMS mics, but we're kind of talking about A&C. The way we look at it anyway, and I'm curious if you agree, those are sort of two of the larger market opportunities for you guys that would be incremental, largely incremental anyway. So I'm curious if you agree with that. And then sort of any update on maybe what the timing looks like for voice bio and/or MEMS mic to, I guess sort of get into the sort of more mainstream for you guys, more material contributor to the topline.

Carl: So we would agree that voice bio and MEMS do represent two of the bigger chunky audio and voice related kind of SAMs for us that are under penetrated. I

mean with voice bio being a new technology. So we continue to work really closely with a couple of key customers on that kind of design for voice biometric, just given that there haven't been any OEMs that have really fully launched a secure voice biometric solution. So it's definitely a learning curve associated with getting customers just wrapped around like, how do you build the product, how do you test it, how do you really verify that it's a secure user interface?

So in parallel with working with a couple of key customers, which are largely on track. As we've been talking for the last few quarters, we were working with FIDO, which is a kind of standards body, around online user authentication. And just this last quarter believe we were the first kind of FIDO certified voice biometric chip solution. So that puts us in a good and kind of credible position with the couple of customers that we are engaged with.

So as I mentioned, it is still a pretty steep learning curve. We've got customers doing active design with the product that we would hope to see on the market next year. And so, we're still excited about that. And frankly, the applications for voice biometric, kind of user authentication outside of the handset, are still super exciting, if not, in the grand scheme of things, bigger as we look long-term. I mean these, these IoT devices that have voice as an interface is a potentially huge application for it. Your car knowing whose sitting in the driver's seat is another killer application. And I think there's probably a whole bunch more that we haven't even thought yet.

So we continue to look at business models and just how you scale the different kind of solutions that we could deliver, just given the different requirements of things like cars versus handsets. So things are moving ahead on the voice bio side.

Moderator: It's a software that's the hang-up? I mean obviously there's a lot of algorithms, I would assume and I don't know how much of that comes from the customer. Maybe it depends on what market you're targeting with it. But I mean I'm curious what the hurdle is on voice bio, the biggest hurdle as you see it.

Carl: I guess the underlying silicon is ready for primetime. It's more just the algorithmic and how you deploy the algorithm, the text, the user, and securely identifies that user against a big, kind of sample set of different or different datasets in terms of voice samples. So I think it's customer kind of education and integration and testing and really verifying that it is in fact secure user authentication, along the lines of a fingerprint.

So I think the long pole in the tent is around, not so much development on our side, but continuing to fine tune the process and drive tradeoffs with a customer who's trying to get their arms around how to design this kind of technology into a product and then be able to be comfortable standing behind it.

- Moderator: Okay. All right. So it's a little bit of the customer just basically getting comfortable.
- Carl: For sure because it's new. I mean it's new technology that's not really been deployed in that kind of embedded application ever.
- Moderator: If I understand it right, it's a little different on the MEMS mic side where I know you guys have the integrated transducer. And I'm certainly no engineer, but I have been told that that's pretty tough to do and I know the yields have been improving there. But we're still, I think last you said, Thurman correct me if I'm wrong, sort of in the hundreds of millions you're getting into now, but you need to be in the multi-hundreds of millions to sort of go more mainstream with like more of a flagship phone and _____ correct me.
- Thurman: Yeah, it's really tens of millions is where we're at right now and we're looking to get to the hundred millions type of engagement. But for now we're proving out and working on our supply chain, which is a big challenge for us.
- Moderator: That you moved to Asia for that, correct me...
- Thurman: Yes. And so, and then to be able to expand our capacity. So we're making progress there, as well as technology, the technology itself. And we would see that as being a smaller opportunity for us to begin with and do something smaller, prove out our technology. Because one of the things we're focused on is to ensure that we are a quality supplier and we're able to live up to our reputation of a high-end, quality supplier. And before we're at hundreds of millions, we have to be very confident of that.
- Moderator: And maybe remind us, since we're talking about, to finish on those two, sort of what that dollar content opportunity roughly would be for voice bio and if you had a full A&C MEMS mic. If I remember correctly, I think it was the better part of \$2 potentially if you had sort of in that 5, 6 mics in an A&C.
- Carl: So on the voice bio, the product that we've got in the hands of a couple customers, we've talked for a long time, it's kind of in that range of the smart codec you find in a flagship phone, so a couple, \$3. The MEMS microphone, obviously it depends on the number of microphones per system. You're example of A&C headset. For one of our kind of continuously adaptive A&C headsets, that would be minimum of five microphones and in most cases six, just to have a secondary voice mic for, again, just better voice performance.
- And, frankly, we've got customers who are religious around digital microphones versus analog microphones, and so you're talking anywhere from 25 to 40 cents

per microphone, depending on which flavor you're choosing and where you're trading off power versus performance. So it does get pretty chunky in multi-microphone applications, which includes handsets. Which is not, as Thurman mentioned, our initial target's not to go completely 0 to 1000 miles an hour out of the gate without really kind of building that infrastructure of proven, reliable supplier that our customers can trust, which they have for several years on all our other core mixed-signal products.

Moderator: I just glanced at my watch. We've got about one minute left, so I don't know if there are any questions in the crowd. Apologize for going along.

Q: A quick one. Just to verify, on the A&C, you mentioned five or six mics, _____, but I would imagine there's a processing piece, too. So we will have like \$3 codec to that total like ASP or how do we think about that?

Carl: I mean frankly our content opportunities in headsets vary a lot. I mean in some applications we're shipping like just really high performance, low-power Class D headphone drivers, which could run anywhere from 25 to 45 cents an ear. In some customers we've got products on the market today. We've got more sophisticated smart codecs that have DSP for doing voice-related features that are in that 50 to 80 cent range per ear. The A&C codecs that we've been promoting traditionally are in that \$2 to \$3 range.

Q: Per ear.

Carl: Well, if it was suited for a truly wireless headset it would be per ear. But as I mentioned earlier, the products that we have, have been largely built around either connected ears or a wired headset. So they're not really ideal solutions for a tiny battery, true wireless headset. So I guess what I'm saying is we don't have a product today that's really well suited for a truly like adaptive A&C solution that gets the mark on a power level.

Moderator: And Carl, that's probably a perfect time to say cut it. So thanks Thurman, thanks Carl for joining. Appreciate.

Carl: Thanks for having us.

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