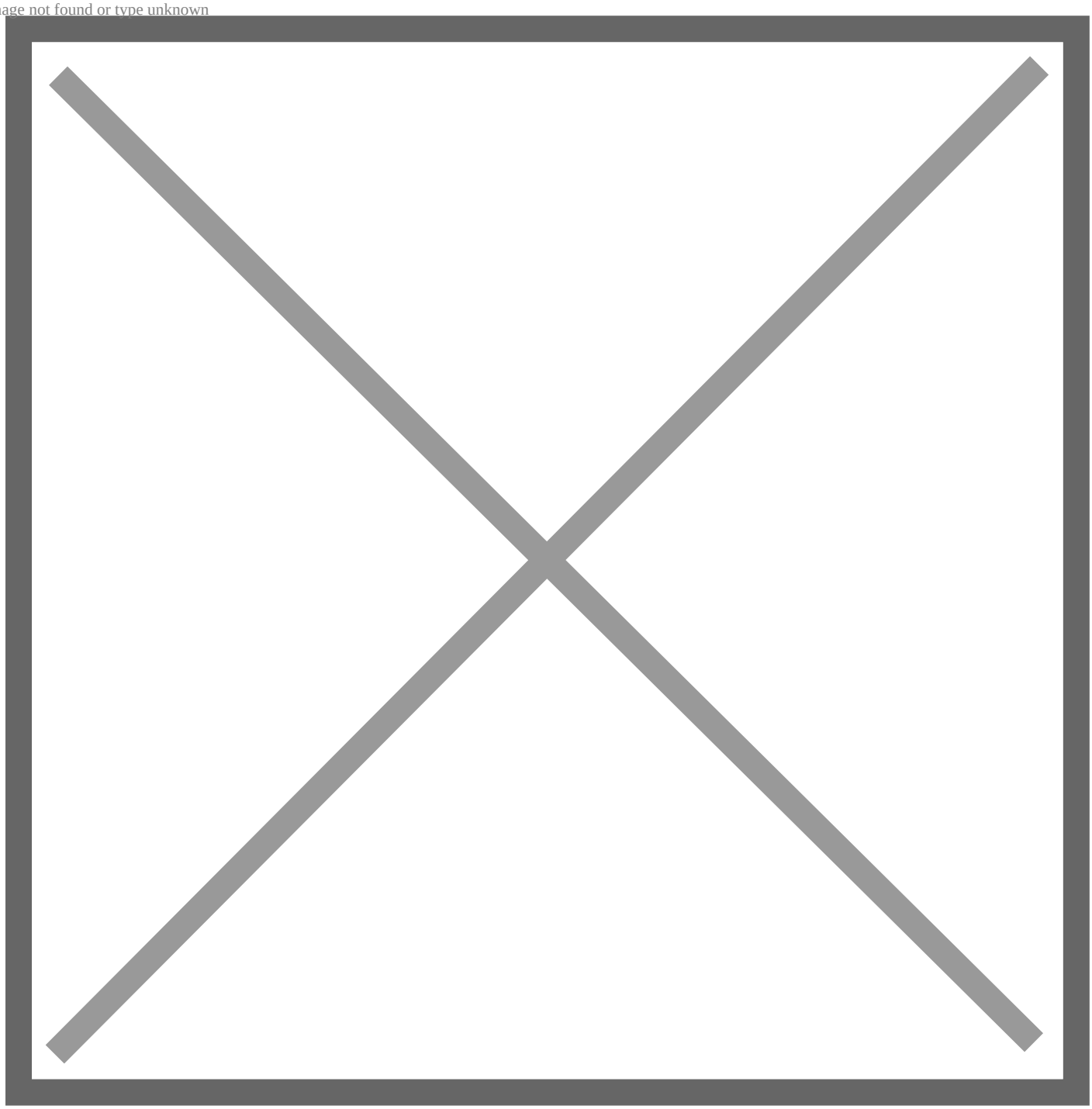
27. Sound Check - Creating Your Car's Audio Experience

May 12, 2020

Image not found or type unknown



We sit down with some of the people who are creating the sound systems in Toyota and Lexus vehicles and they teach us about everything that goes into designing, creating, and testing car sound systems?—?from the trained listeners who are actually paid to sit in cars and listen to music (that's?gotta?be a dream job for a lot of teenagers out there),?to how they make sure those thumping bass speakers don't make your car rattle louder than the music, and beyond.

Our guests are Nicki Cogar (Senior Audio Evaluation Engineer, Toyota Research & Development),? Brad Hamme (Senior Manager of Acoustic Engineering, HARMAN International), and Kyle Roche (Product Planning Manager, HARMAN International).

Full transcript below.

Tyler Litchenberger: [00:00:00] Welcome back to another episode of Toyota Untold. There's a pretty good chance that you've listened to a podcast in your car, specifically, maybe it was this podcast. But do you know how much work goes into making sure that you can actually hear us, or your favorite song, or your favorite playlist? It turns out, there's a lot of thought and planning that goes into designing the car audio experience.

So, we sat down with some of the people who are creating the sound systems in Toyota and Lexus vehicles. And they taught us about everything that goes into designing, creating and testing car sound systems from the trained listeners who are actually paid to sit in cars and listen to music, my dream job, to having making sure those thumping bass speakers don't make your car rattle louder than the music and beyond.

Our guests today are Nicki Cogar, Senior Audio Evaluation Engineer for Toyota Research and Development; Brad Hamme, Senior Manager of Acoustic Engineering, Harman International; and Kyle Roche, [00:01:00] Product Planning Manager, Harman International. By the way, don't worry if you have no idea what some of those titles means. We'll get to that here in a minute. Now, let's hop into our conversation with Kyle Roche from Harman International.

Kelsey Soule: So, now we're with Kyle Roche, who is Product Planning Manager for Harman International. So, Kyle, welcome to the podcast, first.

Kyle Roche: Thank you for having me.

Kelsey Soule: So, can you tell us a little bit about Harman International and what you guys do?

Kyle Roche: Yeah, Harman, we've been around for a long time. So, we started in 1953 with Sidney Harman, as you could probably figure out from the name. But we've grown a lot over the last 60-70 years or so. So, we have a pretty significant business. We're in consumer products. You'll see our Bluetooth speakers, our headphones. You'll see our pro products in arenas. You'll see our automotive products in cars and other … all types of OEMs. So, we work with Toyota, we work Lexus, as well as other [00:02:00] partners. And we do both audio products, head units, and then also some software connected services. So, we're a pretty broad company. And we actually were acquired by Samsung three years ago. So, we are a subsidiary of Samsung today.

Kelsey Soule: Okay, cool. So, before I get into this, when people say head units, if you're sitting in the car, where is that?

Kyle Roche: Yeah, the head unit, the easiest thing is for me to identify, it's the screen that you see. So-

Kelsey Soule: That's … yeah.

Kyle Roche: It is the screen in the center stack, a lot of people call it in the car. And that is where, you know, you're controlling most of your-

Kelsey Soule: Yeah.

Kyle Roche: … bluetooth, your radio, your phone calls, things like that, so.

Kelsey Soule: Perfect, thank you. And then, can you tell us a little bit about Harman's relationship with Toyota and Lexus?

Kyle Roche: Yeah. So, in '98, actually, we approached Toyota Motor Corporation in Japan about working with them as an audio partner. So, we've actually been working with [00:03:00] Toyota as a global business partner since '98. Our first car with Toyota was the Camry actually back then.

Kelsey Soule: Oh, nice.

Kyle Roche: And then, Lexus was kind of a unique story. Mark Levinson is a really expensive audiophile brand. Some of our products are upwards of $20,000 for an individual item. And we weren't quite sure who we were going to work with. And Lexus ended up being that perfect partner. So, we have an exclusive partnership with them. We've been working with Lexus since 2000. Our first vehicle was the LS back then. So, we've just grown our business since then.

Kelsey Soule: Yeah. So, we read an article from Wired in like 2018 where they talked about that and how Mark was pretty specific about what brand he wanted to work with. So, can you talk a little bit about how you guys chose Lexus or, you know, what … what was so … what was so great about Lexus that he was so picky that that's the brand you picked to work with?

Kyle Roche: Yeah. Mark Levinson [00:04:00] actually started … the actual Mark Levinson human, started by creating the pre-amplifiers for Woodstock. So, he was an electrical engineer that was all about perfection.

Kelsey Soule: Okay.

Kyle Roche: And so, really, why I say that is because he was really skeptical of putting speakers in a car. A lot of people think of car audio systems 'cause you see them every day, but a car has a lot of sound going on.

Kelsey Soule: Yeah.

Kyle Roche: It has road noise. It has various things that prohibit from it being "perfect." And so, Lexus really melded or brought to us the best opportunity because the integrity of their cars are so good. They're so structurally sound that you don't have as many, many issues, as much road noise as you might with other OEMs. And so, it worked really well for us. And obviously, it's been going really well where we're coming up on year 20 shortly.

Kelsey Soule: So, he didn't really want to put speakers in cars at all because it wasn't the [00:05:00] perfect environment.

Kyle Roche: Exactly. Yeah. He … he was really about two-channel listening. When I say that, that's two speakers in front of you trying to get the most out of that listening experience possible. And so, for him, this was a bit of a, "Let's see if the situation will work." And over the conversations that we had, we were really able to assure both him and our engineers at the time that it was gonna work. And so, like I said, it's really been a … it's really blossomed into a great partnership over the years.

Kelsey Soule: Nice. Okay. So, tell us a little bit more about companies like Harman that make a business out of audio systems and vehicles. Is that more in fashion today, instead of like aftermarket audio parts?

Kyle Roche: Yeah. The audio industry, particularly in cars, has changed a lot over the last … especially 10-15 years. You know, 15 years ago, you would've seen a lot of aftermarket product being sold. Nowadays, when you buy a [00:06:00] car, a lot of people expect the upgraded audio system to be as good or better than way be what they could upgrade it to. And so, there are some competitors in this space, many brands that you might know. You know, Bose is one that's pretty, pretty obvious

Kelsey Soule: Yeah.

Kyle Roche: For us though, we have a pretty robust line of brands. We have 10 brands as a company. We work with a lot of different organizations and a lot of different OEMs in the automotive space. And … and so, we feel that, you know, our offering and what we're able to provide today is as good or better than any aftermarket offering.

And that's really what we're trying to do. We're trying to give customers what they would ideally get if they were to upgrade. And so, I think, also, we had commented on it a bit earlier, it's really hard to update cars nowadays. All the technology in those cars has really not made it easy for people to swap things out like it was maybe in the past.

Kelsey Soule: Yeah. So, why is this a good business? We saw something about how like 70% of [00:07:00] 18 to 24-year-olds prefer to listen to music in their cars. So, I'm assuming that's a key factor in your guys' success.

Kyle Roche: Yeah. I mean, music really drives people's emotions. You know, you listen to your favorite artists and you really … it can … it can make you really excited. It can make you sad. It can make you a lot of different things. And so, music is emotional and … and so, we want to make, you know, people's drives to work, and when they're … they need a chance to just get away and relax, we want to do that and we want to be able to provide that in the best situation possible.

And so, for us, streaming has really helped us out because it's so easy now to have essentially any song you could ever think of in your car. And so, a lot of that is driving those millennials and those Gen-X listeners to be able to or to want better audio in their cars because they can listen to anything that they could possibly think of at the … you know, right at their fingertips.

Kelsey Soule: [00:08:00] So, do you guys have any part of that though or are you … is … is kind of like your success and your customer is dependent on the technology of another industry?

Kyle Roche: Yeah, yeah.

Kelsey Soule: Like you're, kind of, dependent on another industry to create new methods of listening, so that you can take that music and make a better experience.

Kyle Roche: You are spot on. We are as dependent on streaming as we were in the '90s with CDs.

Kelsey Soule: Right.

Kyle Roche: You know, it's … it's always kinda been that, you know, audio, it's reliant on artists making good content. It's reliant on, you know, record companies producing that content and getting it out to people. And then, it's reliant on good audio systems making it sound-

Kelsey Soule: Right.

Kyle Roche: … the way the artist actually wanted it to sound when they recorded it. And so, for us, we all work together. We have some good partnerships and some good relationships. And I think streaming, really, the benefit of it is it's just made a lot of great content available so easily.

Kelsey Soule: Right. [00:09:00] I mean … and I don't know how involved you guys are in … in the next steps for … for content or music or whatever but like, what's next? 'Cause obviously streaming is huge now, but, I mean, there's got to be the next best thing.

Kyle Roche: Oh yeah. I mean, my background is kind of unique. I've worked in wireless technology for a long time. And so, for me, the next best thing streaming will continue to be how we consume music. But what I'm excited about is the quality is going to continue-

Kelsey Soule: Yeah.

Kyle Roche: … to get better. A lot of people don't necessarily realize that when they're listening to something that isn't great quality, they just assume it is. And so, as, you know, 5g you've probably heard about-

Kelsey Soule: Yeah.

Kyle Roche: … as that becomes more available in the market and your internet speeds, I guess is the best way to put it, gets stronger-

Kelsey Soule: Yeah.

Kyle Roche: … you're going to be able to stream higher and higher quality sound, which the [00:10:00] higher it gets, the bigger the files … file size, the bigger the file size, you know, the harder it is to stream if your connection's not strong. And so, those are the types of things that I'm excited about because you're going to be able to get these really great master level recordings in your … on your phone direct to your car or to your headphones, and it's going to sound great. And even at this point, we really can't do that 'cause we don't have the bandwidth and our internet connections or data connections to cover it. So, it's pretty exciting.

Kelsey Soule: Nice. Okay. So, do you think you're going to see a shift in the industry as things like ride sharing becomes more popular? But obviously, like the ride-sharing vehicles are still going to need like systems, but maybe less vehicles that need them.

Kyle Roche: Yeah. There's … there's this funny analogy that we kind of toss around in Harman and you might hear in some of our, you know, PR announcements. We call it EPM, experience per mile, instead of RPM. And so, what we're essentially banking on, [00:11:00] really, is that as ride sharing and vehicle people, different types of people that are purchasing vehicles for different reasons changes, everyone's still going to want a good multimedia, good audio experience in their car. Like I said, we do a lot of things, not just audio. And so, for us, we want to make sure that we can offer different companies and different users what they might be interested in. You know, think about a self-driving car, it's kind of boring if you can't listen to music. So-

Kelsey Soule: That's true.

Kyle Roche: … we have some pretty high expectations about what we can provide as cars evolve and different types of people are buying cars for different reasons.

Kelsey Soule: Okay. So, is there … first of all, is there anything else that I haven't covered from like your business perspective that you feel like listeners may need to know or maybe helpful for them.

Kyle Roche: Ah, that's a good question. No. I think that … you know, I think for me in my job, what I'm trying to do on a daily basis is to help Toyota and Lexus [00:12:00] prove the value of an upgraded audio system. So, you know, when you go into a dealership, and you're looking at a Toyota Camry, and it's a $25,000 to $30,000 car, our upgrade may cost you another thousand dollars, potentially another $2,000 depending on how it's packaged. And so, you know, we're just always trying to find ways to continue to show our brands, help … help the partnership and … and these types of things show why there's value in having upgraded audio, why it's going to add value to you owning the car, and, you know, to your driving experience. You know, it's gonna make your commute just a little bit better is kind of what I always like to say.

Kelsey Soule: Yeah. So, if it is $1,000 to $2,000 more, what's … what's the sell? Like why … why should somebody pay $1,000 or $2,000 more to have an upgraded system?

Kyle Roche: I mean, for me, I probably touch my volume knob and my audio system as much as anything in [00:13:00] my car, maybe my steering wheel or my gas pedal, maybe more. So, for me, I'm paying a little bit more for something that I use on a daily … daily basis is pretty important.

Kelsey Soule: Yeah.

Kyle Roche: So, that's kind of the way I look at it is, you know, like I said, if you're having to commute, if you just need a break from the kids or from something that's going on at work, music can be that outlet for a lot of people. And for me, I see the value in listening to it the best way possible. I mean, people are consuming more and more music in their car than they ever have before. And a lot of that is because of streaming and podcasts and things like that. So, we want to make sure that everything sounds great. You can hear people's voices, and all the … you know, all the instruments and musicians sound great whenever they're performing.

Kelsey Soule: Would the average person have heard an upgraded sound system?

Kyle Roche: Probably today, yeah.

Kelsey Soule: Yeah.

Kyle Roche: We're in a … we're in a very, very large map or, essentially, every automotive manufacturer in the world has some type of [00:14:00] audio … upgraded audio system. I can't tell you how good it sounds or not.

Kelsey Soule: Yeah.

Kyle Roche: We believe that ours sound the best but that's just because-

Kelsey Soule: Yeah.

Kyle Roche: … you know, we work on, it's pretty. But most people in some way have heard it. But also, being in a car and sound isn't the only way you should know good or bad sound, in my opinion. You've been in a theater, you may have gone to a concert, you may have got … spent a little bit more money than you are comfortable with on a good pair of headphones, you've probably heard good sound before. And so, we want to try to reproduce that in the car. But like I said earlier, Harman International makes audio products for every area of your life. And so, we're trying to improve all of those. So, if you may have not hit it in the car, maybe you've hit it in some other area-

Kelsey Soule: Yeah.

Kyle Roche: … that allows you to, at least, have a general understanding of if it's better.

Kelsey Soule: Yeah. Awesome. So, thanks again for joining us on the [00:15:00] podcast today.

Kyle Roche: Appreciate it.

Kelsey Soule: Yeah.

Kyle Roche: It was great.

Tyler Litchenberger: Thanks again, Kyle. The next conversation with Nicki Cogar ad Brad Hamme dives even deeper into the process, taking us from the very beginning of the design phase to the moment you turn on your ignition from your new car. Plus, you'll get a lot of insight into how our brains actually process the sound coming out of all of those speakers.

Kelsey Soule: Welcome to the podcast. Can I have you guys introduce yourselves and tell us what you do for work?

Nicki Cogar: All right. Hi, I'm Nicki Cogar. I am the Senior Audio Evaluation engineer in ES4 for Toyota R&D. I kind of help lead the team for all of our audio evaluations.

Kelsey Soule: Awesome.

Brad Hamme: Hi. I'm Brad Hamme. I am the Senior Manager of Acoustic Engineering for Harman. I take care of all of our Toyota JBL and Mark Levinson accounts.

Kelsey Soule: All right. So, I guess maybe before we even get started, if you guys [00:16:00] can like explain what that means 'cause, a lot of times, when you talk to people, they have these titles and you're like, "What does that even mean?" So, obviously, you both have … you're here today because you have something to do with how sound happens in our vehicles. So, Nicki, first, what does your job, your day-to-day entail? And how does it affect our customers and their vehicles?

Nicki Cogar: Oh, it's a lot. I do pretty much every range of evaluation from audio, voice recognition, Bluetooth, navigation, sound tuning, speaker placement, packaging, audio concept development, target setting. So, anything you kind of hear or interact with in your driver's seat that has to do with the microphone or the head unit or sound, I have a part in.

Kelsey Soule: Awesome. And Brad?

Brad Hamme: So, what my team and I do is work with Nicki's team, and [00:17:00] we integrate all of our speakers into a vehicle, doing that as a job in and of itself. We also work to integrate the different components, not just from a mechanical standpoint, but from an acoustical standpoint. So, we want to make sure that when we're providing a speaker that it's actually providing the sound we're trying to get out of it.

Kelsey: Awesome.

Brad Hamme: Once we do that, we do the critical listening and the actual tuning of the vehicle. So, this is when we get into the car, we listen, we measure, we listen, and kind of iterate back and forth till we get something that is a very enjoyable sound system.

Kelsey Soule: Cool. So, how did either of you get started in this very specific field of work? Like are you audiophiles?

Nicki Cogar: I guess, yes. I would say I am. From a young age, I loved music. I, you know, sang in choir, and I really wanted to be a singer. But then, it turned out wasn't meant to be. So, then, I turned into, when I was 16, car audio systems. I worked at Circuit City and-

Kelsey Soule: Oh! Throwback!

Nicki Cogar: Yep. Sold … sold car stereos and [00:18:00] speakers and installed them in people's cars. And it, kind of, created something for me that any day I have a rough day, I just go sit in my car and just crank up the music, roll down my windows. So, I am the person you will see at the stoplight car dancing-

Kelsey: Yeah.

Nicki Cogar: And I want to give that to all of our Toyota customers.

Kelsey Soule: Oh. So, it's something that you're really passionate about because it's like … it's something that, you know, calms you down and it's an enjoyable part of your day.

Nicki Cogar: Absolutely.

Kelsey Soule: And ever since the days of Circuit City. It must've been an interesting job.

Nicki Cogar: Very.

Kelsey Soule: We'll come back to that. Okay. So, Brad, what about you?

Brad Hamme: Interestingly enough, Nicki and I started off by hating each other because I started at Best Buy

Kelsey Soule: Oh wow!

Brad Hamme: I'm just kidding about the hate things.

Kelsey Soule: Competitors. It was like Radioshack.

Brad Hamme: Yeah. I actually got started as a music major in college. I was also a marching band instructor and a music teacher for a while. I decided to leave that. The politics behind of teaching in a public [00:19:00] school were not a great fit for me. And I ended up going from the aftermarket and finding a job at this small little company called Harman. And the rest went from there. I started off as a technician and worked my way through to being in charge of the acoustic engineering team.

Kelsey Soule: I'm wondering what the … I think you said you're an engineer, right, Nicki?

Nicki Cogar: Yes.

Kelsey Soule: I'm just wondering what the qualifications are for somebody to do this job, like to be involved with the … sitting in the vehicle, and listening, and making sure it's an enjoyable experience, like what do you have to know to … you know what I mean? Like … I like music but I can't just sit in the car and say, "Yeah, everybody else is going to want to hear it the way that I do."

Nicki Cogar: So, for us, we go through kind of a training, Harman training, if you will, where we do listen to quite a few different audio clips, so we can pick out different frequencies. And, of course it helps if you're very keen for hearing and being able to detect and pick up those things. [00:20:00] We're very lucky that a lot of the people that are very interested in this do have good hearing, so we can usually sit in a car, but it takes a lot of

work of listening to those songs and the tracks that we use for tuning to be able to pick out what maybe is lacking or what is wrong about them.

Kelsey Soule: So, if you guys can just walk us through where this process starts for you. So, let's just say we're making a brand-new car, what part do you guys come in? In the … in the … is it in the design phase, like you're like deciding how many speakers each car needs? Or is it after, and they've already decided for you, and you're just testing what's already been decided?

Brad Hamme: So, we actually start before the car has even begun the design phase.

Kelsey Soule: Okay, cool.

Brad Hamme: There's a point where the chief engineer of each program decides here's the vision that they want for the vehicle. From that point, we work with our internal benchmarking team who lets us know where are things in the industry. You know, we don't want to put [00:21:00] 400,000 speakers into a Toyota Yaris. Maybe I do. I mean, Nicki and I do.

Kelsey Soule: It depends.

Brad Hamme: But, you know, it would be … it wouldn't be a very effective system for that vehicle. So, we want to understand where we are, what's the … what's the value, what are we looking for for the target audience, because we want to make sure we're developing something that the end user really, really loves.

Once we do that, then we start with the nitty gritty engineering, packaging the speakers. Nicki and my team work very, very close together throughout the last two years of a program trying to make sure we get things where we need them, even down to brackets that mount door handles. You know, we want to make sure even those aren't rattling.

Kelsey Soule: Okay. So, it's more than just speakers.

Brad Hamme: Yes. It's an entire vehicle system. Yeah, down to road noise.

Kelsey Soule: Okay, 'cause I was wondering, you know, if you're designing or if you're working for the design team on space, it's not just speakers that you're considering. It's the proximity of the speakers to … to other things that may make noise. I mean, [00:22:00] I feel like there's … every part of the car contributes to the sound.

Nicki Cogar: You are correct. Most people don't know that.

Kelsey Soule: Yeah.

Nicki Cogar: So, like Brad said, we … we used to come in kind of after the concept phase and work with them for tuning. We're starting to get a little bit more front-loaded where we're trying to help come up with some of the audio concepts, what is our target audience, what do we want this car to be able to achieve from kind of our … our benchmarking of competitors, benchmarking our own vehicles, to find out what our customers do and don't like about our current vehicles, so that we can try to use that to make them better. And yeah, we work very closely after that to try to make everything like, where is our … where is our speaker going to sit in the door?

Kelsey Soule: Yeah.

Nicki Cogar: What angle isn't going to be? How is that door trim going to impact that speaker? And then, how do we get all of the sound from all of these wonderful speakers to hit your ears, so that you're not just hearing

one, or [00:23:00] two, or-

Kelsey Soule: Right

Nicki Cogar: … the front or the rear.

Kelsey Soule: Yeah. So, how … do you often have to negotiate with the designers for space?

Nicki Cogar: All the time.

Kelsey Soule: So, I mean, how do you even decide … you know, you mentioned 18 speakers in Yaris. It's a small car. But I mean, that may be the optimal listening experience for somebody. How do you decide for the average person what the right amount of speakers is in a car? How do you come to a conclusion and you're like, "I'm good with this"?

Brad Hamme: Sure. So, I had mentioned it earlier, but we have a benchmarking team at Harman. It's a group of trained listeners. What they do is they take in all the vehicles that are currently on the market and evaluate them. What's really interesting about our training listeners is that if we took 400 untrained listeners that have nothing to do with audio, we put them … we have them do the evaluation, they rank order the exact same as our trained listeners.

So, our listening group isn't trained to bias to a product. It's trained to bias to what the average listener is going to enjoy. What do humans enjoy? That's how we can start, so we know what people [00:24:00] want to hear. And then, we know based on the size, we can predict the cabin space. So, a small car, we're going to have a different set of speakers to align closer to where the occupants are. We get into something as big as, you know, a Sequoia-

Kelsey Soule: Yeah.

Brad Hamme: We're going to need extra speakers to fill the volume of the cabin.

Kelsey Soule: And then, I guess, you have these trained listeners, right, that are … that are trying to figure out how the average person would want to listen but everyone listens to music, and different music, and music differently, right? So, how do you really come up with an average?

Brad Hamme: So, the average is just based on what we've done with mass populous experiments. We've tested so many different groups. We're now getting into the point where we're testing. Are there different regional preferences? Are preferences based in location? Are they based on any traits of human beings? So, we're starting to dive more into that data. But in general, the … the average is the average for a reason,

Nicki Cogar: And maybe that's where our group [00:25:00] kind of comes in with our surveys that Toyota gives to Toyota owners. So, I can look up and find out for the last five years, our Corolla owners, or our last five years of Camry owners, what complaints or what likes do they have that they've commented and fed back to us on our audio systems, so that we know maybe where we're going in the correct direction and where we're going in the wrong direction.

And then, we also use a lot of JD power appeal data to find out how we're doing compared to our market segment, so that we can find out if there's, you know, small, compact people are trending toward this vehicle. So, they really like this vehicle. We'll get that vehicle, benchmark it, and then try to figure out maybe what we're doing differently. And then, what does the Toyota customer for that segment, what are they looking for? Do they have comments of like, it's weak, or there's, you know, too much bass, or not enough sound? So, we

kind of reflect those comments back [00:26:00] from our customers, and then work with Harman to try to balance the system that they've put together to get that performance that our customers are looking for.

Kelsey Soule: Okay. So. Can you give us a little like one-on-one lesson on sound systems? We did some research and found that there's like four categories that go into an audio system. Can you explain the categories and how they're important to the process?

Brad Hamme: So, one of the … the things that we look for are the qualities found in spatial representation. Normally, it's just referred to as spatial. This is the imaging that comes up when you're listening. So, if a recording artist has somebody who's a vocalist recording in the center of the studio, when it's played back in your car or in any system, it should sound like the artist is right in front of you center.

Kelsey Soule: Yeah.

Brad Hamme: If there's a guitar off to your far left, obviously, you should hear that to your far left. So, the imaging is just making sure that as you play back the recording, you're [00:27:00] giving the true intent of how it was originally recorded at that time.

Kelsey Soule: That is a completely different level of music experience that I did not know was intended for me.

Brad Hamme: Yes.

Kelsey Soule: I will think about that now.

Nicki Cogar: So, yeah, we've … we've been really working to try to make kind of our … our vehicle kind of like a stage. So, if the stage is set up in a certain way with, like he was saying, guitars, and drums, and piano in different places, that's what we're trying to do with our speaker system is lay out that same stage only in your vehicle.

Brad Hamme: Yeah, exactly. I mean, imagine if you're at a live concert-

Kelsey Soule: Yeah.

Brad Hamme: … for instance, you are not standing next to the drummer behind a guitarist, right? You're sitting in the audience viewing everything.

Kelsey Soule: Yeah.

Brad Hamme: In this case, the sound stage is literally a stage. It should be in front of you and spread out. So, the image is going to be spread out and in front of you. And I'm waving my hands as if people can see that.

Kelsey Soule: No, I get it. Okay. So, what are the other three categories that affect the sound?

Brad Hamme: The number one is going to be spectral.

Kelsey Soule: Okay.

Bead: [00:28:00] Spectral is the balance of different frequencies across the spectrum; hence, spectral. So, is the base, the midrange, the treble, are these in line? Are there any frequencies that have spikes standing out? I mean, TNSs, for instance, the reason we have screens in front of our microphones is to prevent that. Well, we can reproduce … reproduce that in a vehicle by artificially boosting anywhere between 4 to 6K, depending on kilohertz … sorry, depending on where we want to emphasize that or, for instance, if we have a reflection in the

vehicle, one of our only ways to get around that is by kind of reducing that with equalization and tuning. That way, you can still listen to your audio system, but not hear somebody doing the very heavy sounds.

Kelsey Soule: Wow. So, I always wondered why in your vehicle, they even give you the option to adjust the levels because, I mean, the average person doesn't really know what they're … I would assume, doesn't know what they're doing to adjust. And every time I've ever done it, I've made the situation significantly worse. So, is it just for the 2% of [00:29:00] people that know how to adjust it to … you know, why is that an option?

Brad Hamme: So, we tune the cars, so that it detent. It's the intended sound. So, if you were to go into this, we have artist-intent commonly used in the audio world. Meaning, are we playing back the audio source the way it's supposed to sound? Artist intent from my team of acoustic engineers and Nicki's team, we have detent set as our reference. That's our intent. From there, we know that everybody has different preferences. I will always argue reference. I will never argue somebody's preference. It's like, "Oh, you don't like Thai food. You're wrong." You-

Kelsey Soule: Yeah.

Brad Hamme: You can't really win that battle.

Kelsey Soule: Yeah, that's true.

Brad Hamme: So, this allows people to still customize the experience they're looking for. So, if they're. In the mood for rolling down the street like we used to, and you crank up the bass and turn the mid and treble down, so you just have pure bass coming up.

Kelsey Soule: Yeah, yeah, yeah. Yeah. So, okay. So, then, I think the others are dynamic and integrity. Ding-ding-ding.

Brad Hamme: Ding-ding. [00:30:00] So, dynamics is how does the sound get reproduced when it's really quiet and really loud? So, if you listen to the quiet level and slowly turn up the volume knob, your music should sound the same. The reason this might be confusing as to why we have to do that is because humans hear differently at different volume levels. So, if you turn music down, humans are very, very unsensitive – which is a word that's not correct, but I used it anyway – to bass. We are highly sensitive to midrange. As you turn up the volume, the differences between bass, midrange and treble becomes smaller. So, we actually have to adapt the tuning in the vehicles depending on where you put your volume knob.

The other part of dynamics is if you're listening to a song, and it's really quiet, like in the case of classical music, and then it jumps in with a huge bass drum hit, that should be a huge bass drum hit. And if the recording was intended to scare you with this loud to quiet, the quiet to loud, all these changes that our system needs to be able to reproduce that [00:31:00] to.

Kelsey Soule: Wow! So, then, obviously, the integrity is just like the … the overall integrity of, of the sound, I'm assuming. Like the way it sounds to the person consistently while they're in the car. No?

Brad Hamme: Yes. It's also the integration into the vehicle. So-

Kelsey Soule: Alongside the other things that make noise?

Brad Hamme: Exactly.

Kelsey Soule: Yeah.

Brad Hamme: The term that we commonly use as BSR for buzz, squeak, and rattle.

Nicki Cogar: Right. So, kind of the integrity of the system is to make sure that we're not losing our low frequencies due to door rattle. So, sometimes, our speakers will be … have so much power that, all of a sudden, we're met … like rattling the sheet metal or the door trim. And now, it's kind of overwhelming, the sound, and you're not actually getting the … the true bass sound or the true midrange sound. You're just basically getting sound from the buzz and rattle of the vehicle. So, we do a lot to make sure that the integrity of the vehicle is keeping up to make sure that the … the sound can be heard.

Kelsey Soule: Oh, nice. Okay. So, [00:32:00] how … speaking of … I mean, I know that the speaker can cause other sounds, but like how do you account for things that are not in your control, AKA like road noise?

Brad Hamme: There's several technologies that we can use. You know, there's various different forms of road noise cancellation or active sound cancellation that can be used. In general, there's also still an amount of sound that has to be dealt with in a different way, and that's where we get into tuning. Again, the subjective listening. Nicki's team and ours, we'll get into the car and actually drive. And we'll spend at least one to two days driving the car, making sure that all these different speeds, all these different road services, we still make sure the sound is good. It's hitting what we're looking for.

Kelsey Soule: So, then, if we talk upgraded sound packages, is it really worth it for the average person? I mean, obviously, as I'm speaking, like I'm not noticing the difference, or maybe I am and I don't even know it, but I don't think my car does not have an upgraded sound system. So, when is it worth it?

Nicki Cogar: In my [00:33:00] opinion, always.

Kelsey Soule: I know, right? But you guys are like, obviously, heavy into this. So, does the average person going to notice a difference? And what is the difference?

Brad Hamme: So … and again, double-blind testing, the average person will definitely notice a difference, and they will still rank order their preference, the same as trained listeners. So, that would lead me to make a factual conclusion that yes, it does make a big difference. Anybody who enjoys music, even slightly, will hear the difference. What I would say is listen to the exact same vehicle because every vehicle has a different set of compromises because it's a different room, different acoustics, listen to one that has standard sound, and then listen to one that has premium sound. I think almost everybody will see that difference.

Kelsey Soule: What would you say is the main difference or a tangible difference you could call out between the bass model and the JBL upgrade at Toyota?

Nicki Cogar: One of the things I guess you could look at is our JBL systems have more power, they have more speakers, [00:34:00] so you're going to get a much fuller range of sound; where our bass grade speakers, we have a full-range speaker but we don't have separate subwoofers or tweeters. So, reproducing the sound is kind of limited. You're going to have a frequency range that you can get low but not the ultra-low that you-

Kelsey Soule: Okay.

Nicki Cogar: … can get from a premium sound system because you've got a subwoofer added in there. Or the highs might sound good, but if you have that tweeter or that horn tweeter in there, you're going to get the crisp, clear sounds of sopranos and cymbals. So, like the high shakers. Different instruments and different vocals are going to sound completely different in the two vehicles.

Kelsey Soule: So, you guys are throwing out some terms here. What is a tweeter?

Nicki Cogar: A tweeter is a very small speaker. Like … like the one inch or-

Kelsey Soule: Okay.

Nicki Cogar: … so that are your high frequency range.

Kelsey Soule: Okay.

Nicki Cogar: So, you might only play like from one kilohertz above or from five kilohertz above [00:35:00] just from that small speaker. So, it's … it's basically primarily made to reproduce the very high frequency sound; where your larger speakers reproduce your low frequency sounds, your bass.

Brad Hamme: Yup. Another thing that you'll hear a huge difference is with imaging. So, we were talking about where things are placed in the audience stage. And dynamic capability is great too.

Kelsey Soule: Can you guys give us some examples of some different sounds that people will know that you here at what frequencies? Like what sounds goes with what frequency? If we're talking about an Ariana Grande riff where it goes so high that, you know, it's piercing my ears, and then the example that goes along with it?

Brad Hamme: Sure. So, in the case of Ariana Grande, my guess, without analyzing, is the high frequency will probably be closer to around 5 to 6 kilohertz. So, that would be where the tweeters start.

Kelsey Soule: Okay.

Brad Hamme: They play much higher.

Kelsey Soule: Okay.

Brad Hamme: Getting up to 20 kilohertz would be like a dog whistle.

Kelsey Soule: Okay.

Brad Hamme: So, something we wouldn't quite hear. Some of us can, especially younger listeners. [00:36:00] If you think about a triangle or bells-

Kelsey Soule: Yeah.

Brad Hamme: … in a percussion section, that's going to be your treble. That's gonna be-

Kelsey Soule: Okay.

Brad Hamme: … your tweeter. A midrange, vocal is a really great example of that

Kelsey Soule: Okay.

Brad Hamme: Horns. So, if you listen to a trumpet in its normal register, that's going to be kind of the upper midrange.

Kelsey Soule: Yeah.

Bead: If you listen to a trombone, its upper range is going to be in the midrange area. If you put on a tuba, you're going to be listening to bass. Kick drum is probably the most prevalent one. If we go back to Ariana Grande, some of the 808 sounds that are putting into-

Kelsey Soule: Yeah.

Brad Hamme: … the digitized drums, the stuff that actually moves you around in the car, that's going to be bass.

Kelsey Soule: Okay. So, as sound experts, would you say that there is an optimum volume to listen? Not preference; reference.

Brad Hamme: So, if we're going to go into reference for audio level, everybody is different in this. But somewhere between 60 to 80 DBA. So, that's … I'll [00:37:00] do a better job of explaining that in a quick second. But that would be a typical listening level that would be pretty comfortable for everybody. DB is just a measure of sound pressure and decibels.

Kelsey Soule: Yeah.

Brad Hamme: And a is an A weighting, which kind of simulates closer to how we would hear it. So, we're taking a measurement that's a little bit subjective in a very mathematical way, and that's how we would apply it. So, you'd kind of get a reasonable level for most people, talking level to just above that. ADDBA, you're not going to be really damaging your hearing. So, I would recommend not going tremendously louder than that for extended periods but certainly have fun.

Kelsey Soule: Yeah. So, if you're … I mean, obviously when you're in a vehicle, and I think my vehicle, the max volume I'm going to say is like 55, whatever that generally means as far as decimals go. I don't know if that's a direct equivalent or if that's just … nope? Just a number? Okay. So, if I had to say like zero to 55 to somewhere straight in the [00:38:00] middle is the safest or can I stay at 55 and be all right? I drive a 4Runner, by the way, if that helps.

Nicki Cogar: Okay. So, your max volume levels should be 63

Kelsey Soule: Okay. Maybe it's 63. You can't just let me go at 55.

Nicki Cogar: Sorry. Yeah, no. So, your max volume level is … is 63, I believe we typically try to have the middle of right around in the 30s. Some of what Brad was saying earlier of the 60 to 80 range, I believe a lot of that kind of stems from our road noise. When we're driving down the road, the typical road noise in our vehicles are going to range from about 65 DBA to about 75 DBA. So, usually, you want your sound to be slightly louder than the noise-

Kelsey Soule: Yeah.

Nikki: … that's being emitted from the road and the wind. So, we try to tune our systems, so that you can kind of achieve that road noise level in those mid-30 to 40 volume levels there. Our systems are all different though. So, [00:39:00] the max volume for one vehicle could get up to 90 or 100 DBA, but then another vehicle might only get to like 92 or-

Kelsey Soule: Okay.

Nicki Cogar: … 95. So, they do kind of vary depending on how much power they have, how many speakers they have, and then the frequency response of the … the cabin.

Kelsey Soule: Nice, okay. So, what is your favorite song and why?

Nicki Cogar: For sound tuning, I like our Vivaldi four seasons track. It's a classical music track and kind of just takes you … it's supposed to take you kind of through the feeling of four seasons. So, it kind of goes through all variety of sounds and kind of different feelings. Personally, I don't know. I'm all over the place.

Kelsey Soule: I was going to say, if you had like … I don't want to make this like dramatic, but if you had one last opportunity to get in your car with an obviously perfectly tuned sound system, and you could take like one final cruise, [00:40:00] what would the song be?

Brad Hamme: This is deep.

Kelsey Soule: I know.

Brad Hamme: If I'm going to pick one, I'll probably go with Grace from Lamb of God.

Kelsey Soule: Do you guys have any sound expert party tricks? Like, when you go to concerts, are you … like, do you enjoy concerts, I guess is a good question.

Brad Hamme: Oh, absolutely.

Nicki Cogar: Yeah.

Kelsey Soule: I was going to say, are you picking out certain things like, "Oh, I would've done this differently," or whatever, but you can still enjoy it?

Brad Hamme: Mmhmm [affirmative] .

Kelsey Soule: What's one of the best concerts you've ever been to from a sound perspective? People who just did it right?

Nicki Cogar: Foo Fighters.

Kelsey Soule: Oh! Did it matter where you were? Like the … the venue?

Nicki Cogar: Yeah. It's … it's different depending on even where you're sitting in that venue.

Brad Hamme: I got to see the Prodigy live. That was at the Fillmore.

Kelsey Soule: Okay.

Brad Hamme: And they put a lot of attention to making sure the … what you'd call the pit area or general admission sounded very, very good. So, with music like that, that's got a lot of synthesized bass, it's kind of hard to make sure it's not [00:41:00] resonating too much in the room. But they … they had gotten everything pretty well done.

Kelsey Soule: Yeah. Nice. All right. Thank you, guys, so much for joining the podcast today. That was honestly super informative for me. There's so much more that goes into … I will be way more appreciative of the sound in my vehicle as I go home today because that's a lot of detail. So, thank you.

Nicki Cogar: Thank you.

Brad Hamme: Yeah, thanks for having us.

Tyler Litchenberger: This podcast is brought to you by Toyota Motor Sales USA Inc. Toyota.