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TOM SMURDON: So there's Bogo, yeah, thanks. So we didn't use any early reflections at all, and as we were going through, we were seeing how many voices I could spatialize. I told the engineer what I was going to do, and I was like, "Just give me any feedback, anything, if I'm pushing any limits on anything," never heard a peep out of him, so we got up to 64 spatialized voices, that's the limit of the spatializer anyway, so we used everything. We had multiple first-order ambisonic loops for music, ambiences, bugs, weather, and then there was a ton of animations for Bogo to make her feel realistic, and once again, since this is a 6 DOF headset, it's untethered, and people are wandering all over the place, you have to make sure, like you create sounds like you would on the Rift, where you make sure all the sounds are coming from the right locations, like all the vocalizations are coming from the mouth, footsteps are coming from the feet, because you don't know where that listener is going to be listening from. Now, Pete was talking also about early reflections. We didn't use any on Bogo, because the player, it wasn't that kind of game, but if you're on a game let's say where there's a robot and a train and they're a danger to the player, I would put early reflections on those two things, just because you need to know where your enemies are, where sounds are coming from. The early reflections make the spatialization work better, and it's super important like for these two things, but everything else, it's all going to spatialize pretty well, but that just helps it out a little bit more, so just things that are important to the player, put early reflections on. We did use a shared reverb on everything on Bogo. It was a fixed cost, it wasn't a big deal. I also threw I think a compressor and limiter on the main bus. It's all on the CPU, so never heard any complaints from anybody, and everything ran really well. So mixing for the Quest, it has those built-in speakers. I don't know if anybody was in the Carmack talk, but he was talking about the number of people in gear who were not using headphones, and it was the majority of people not using headphones. That means people putting in the gear, had their phone slapped on their face, and whatever speaker was in that phone, the sound was just blasting out. That was a really bad audio experience. When they came up with the Oculus Go headset and they showed us the speakers, at first Pete and I were leery. We were just like, "Oh, there are speakers, I don't know how this is going to sound." But once we got the headset on and tried it out, it sounded really good. We were super happy with it. It had good stereo separation, because your head is actually blocking the speakers from each side, and things spatialize pretty well on it. Now on the Quest, we do have bigger drivers, so there's a little more low end. There still is not a lot of low end, so if you're going for that audiophile experience, there is two headphone ports, one on either side, you can use either one of them, and I think one of the jokes internally was like, "If you might have a friend who wants to listen to what you're doing at the same time, they can plug into the other one." I don't know how good that is, but it's a thing that's there. You know, also it's hard to put on headphones while you're blindfolded, so the speakers actually work really well. We're super happy with them. When creating sounds, I use Nuendo, whatever DAW you use is fantastic, and then I'll make my sounds, and then I'll kind of build a project with all the sounds that I'm putting into the game itself, and then I'll run our plug-in – like I use the VST version of it, we have it for all systems – I'll run our plug-in and put all the sounds through the plug-in, and then I'll EQ a little more, try to get things to sound better. Now, there is a pinnae notch in there, but that moves depending on the angle of the sound from where you're at, so you don't want to dial up that pinnae notch, because that will ruin all your externalization. It will also ruin like all the spatialization. So just kind of get that in there, so you get an idea of what the filter sounds like, EQ it, pull that VST

plug-in off, because you don't want to bounce anything down with the VST plug-in on, and then use those sounds to put into your middleware or into Unity or Unreal or whatever you're using. By the way, Bogo was made using Unreal and Wise. So we had all the sounds, everything sounds good, watch for the notch, get a rough feel for the mix, and the thing is,

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it doesn't really translate well, like speakers you're listening to, you have to mix in the Quest headset. So this is going back a little bit, I was talking to some people about this already, do your build, get it on the headset, and get somebody to take notes. If you don't have somebody to take notes, just put your phone on record and talk into your phone. You want to be in the headset and doing the experience, and it has to be in the headset to get a good mix. I'll just keep saying that over and over again. When you walk up to something, you want to test your attenuation curve, so let's say Bogo is over there, and I'm walking up to Bogo, it's like does that sound natural? When I get right next to Bogo, does it get too loud? Make sure to watch all of that. It's a different experience when you have this full freedom to walk around and listen to everything, but the attenuation curves are super important. So here we've got Brandon and Andy, Andy's taking the notes, and Brandon would say stuff like, "Oh, Bogo's voice is too loud, like 3dB. Those footsteps over here, turn them down 2dB. Music, the music is overpowering at this spot, like 4dB," and we just throw all these notes together. You go back in, make your changes in your middleware, send it to the headset again, go through it again. Keep repeating this until you get a good mix. Also, there is a Guardian built in, but some experiences are going to have a smaller play space. Bogo had a small play space, so we needed some way to warn the player that you were leaving this play space, so there's loud parts and soft parts in the experience. We were thinking, well, if we put sounds on it, if we put a loud sound on, let's say during the fireworks part, that's sound is going to be way too loud during the soft parts. If we put a soft sound that sits over here, you're not going to hear it in the fireworks part. So we're just like, hmm, you know what we could do, we'll just try the absence of sound. We did a low-pass filter that ramps nice and smooth, so it's not jarring to the player, because you still want to keep everybody immersed, just let them know that they're, you know, about to step out of the play area. Here's a little clip of what we did.