**In the Matter Of:**

*PHILIPS NORTH AMERICA LLC vs*

*GARMIN INTERNATIONAL*

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*JAY DEE KRULL*

*September 17, 2020*

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LEXITAS™

A. Yes.
**Q. And it states:**
**"Garmin's organizational structure for the following areas: engineering, design and research and development, manufacture, fabrication and assembly, and marketing sales and promotion."**
**Do you see that?**
A. I see it.
**Q. Are you prepared to testify concerning Topic 12?**
A. Yes.
**Q. Okay. If you could go to the next page, page 10.**
A. I'm there.
**Q. Great. And you see Topic 24?**
A. Yes.
**Q. It states:**
**"Garmin's implementation of GPS functionality in each of the accused products."**
**Correct?**
A. Yes.
**Q. Are you prepared to testify concerning Topic 24?**



A. Yes.
**Q. And then the next topic, 25. Do you see that?**
A. I see it.
**Q. It states:**
**"For each of the accused products that include GPS functionality, the operation of such functionality, including any calculated outputs derived from GPS waypoints as well as the methods** by which the accused products (including any Garmin app or server) calculate those outputs."
Is that correct?
A. That's what it says, yes.
**Q. Are you prepared to testify concerning Topic 25?**
A. Yes.
**Q. So, without revealing any privileged communication between you and your counsel, what did you do to prepare to testify concerning Topics 12, 24, and 25?**
A. I've worked at Garmin for almost 31 years, and I met with my attorneys to prepare for these topics.



**Q. Did you review any documents concerning these topics?**
A. No.
**Q. Okay. Did you speak with anyone to prepare for your deposition other than counsel?**
A. No.
**Q. And how much time did you spend to prepare for today's deposition?**
A. I didn't time it, but over an hour.
**Q. Thank you. I would like to discuss your education and employment background right now.**
**So starting with school, where did you attend college?**
A. Yes. I attended Pittsburg State University in southeast Kansas. I graduated in 1986 with a bachelor's degree in computer science and a minor in math.
**Q. And did you do any studies after you received your bachelor's?**
A. Miscellaneous continuing education but nothing that was a degree-seeking effort.
**Q. What was your first job out of college?**
A. I worked as a computer programmer for Cerner Corporation.
**Q. And I'm sorry. I don't have my realtime**



**feed.**
**So did you say you've been at Garmin for 31 years?**
A. Almost. I started October 25th, 1989.
**Q. Okay. What was your first position at Garmin?**
A. A software engineer.
**Q. And if you could just -- you don't have to go into excruciating detail, but if you could just give me your career path at Garmin, that would be great.**
A. All right. I started as a software engineer, evolved to a project lead, became a team leader and was assigned individuals to report software -- other software engineers to report to me. Eventually moved to be a manager where I led multiple team leaders.
Then I moved up to be a director where I led other managers who led team leaders who led software engineers.
Then I moved sideways to be the director of software excellence, is my current title, where I'm responsible for consumer engineering, software development processes, tools, techniques, those types of things.

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My job description includes a bullet that's labeled "other duties as assigned." And over the last decade I've done lots of other duties beyond just the software engineering mainly because of my history and experience at Garmin, so forth.

**Q. So software excellence. That's your --**

A. That is my current title, the director of software for consumer engineering.

**Q. Okay. And how long have you held this position?**

A. On the order of ten years. I don't remember the exact transition date.

**Q. Okay. So that's a really wide variety -- trajectory you've had at Garmin. So you had mentioned before that you had -- you've worked in GPS. And I think we should probably just start with what does GPS stand for?**

A. The global positioning system.

**Q. Okay. And how does it work?**

A. All right. In layman's terms, there is a constellation of satellites. There needs to be a minimum of 21 to be considered a complete constellation. Generally, there are 24 or more that are considered to be hot spares. They're in orbit and functioning. In the beginning of Garmin, there

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were less than 21 satellites available.

So the system was not operational yet when we first began. So that was very important, a huge milestone for the U.S. government and military who sponsored the GPS system. It is free to use worldwide.

The word "global" really refers to the fact that you can use it anywhere in the world 24/7, from pole to pole, anywhere around the equator.

These satellites are moving at a very high rate. We can leverage that to improve the accuracy of how the GPS works. The basic functionality of GPS is position, velocity, and time.

So a user/receiver, right, a device, electronic device, that a user possesses and carries with them and can reference is receiving satellites and data from -- measurements, I should say, distance to the satellite measurements plus data that defines where the satellites are in orbit, what their orbital path is. It's fairly complex.

But, in the end, what the receiver provides is where you are in terms of latitude, longitude, and altitude, or elevation if you're on the ground, right, how far above mean sea level that you are. And then velocity would be the direction you're

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traveling and the speed. Those two things combined, there's a velocity vector, very important for GPS, and one of the things that makes GPS far superior to any of the previous navigation systems.

And then time. GPS provides very accurate time source.

There are ground stations that monitor the GPS system. That's all done by the U.S. military. The ground stations determine, okay, where the satellites are and continually keep them up to date with correction information.

There are also augmentation systems in place to model atmospheric interference and be able to provide that to local devices to enhance the accuracy of the base GPS capability.

**Q. Thank you.**

A. You're welcome.

**Q. So, with that explanation of GPS, let's get more granular. And if you would describe how Garmin has used GPS -- the GPS functionality in its products. And if it would be helpful to talk about a specific product, the fenix 3 or am I saying the brand correctly? Is it fenix?**

A. fenix is one of our smart watch families.

**Q. And does it have a GPS sensor?**

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A. Yes.

**Q. And how does the GPS sensor in the fenix 3 work? What does it do?**

A. It does all of those things that we just talked about. So the sensor -- the GPS sensor itself provides that position, velocity, and time; right? So it is a very accurate watch for that reason. But it can also monitor a user's movement among many more things that are not GPS-related.

**Q. So does the fenix 3 then calculate outputs from the GPS sensor? Is that ...**

A. It provides information based on the GPS sensor.

**Q. What type of information?**

A. Well, again, position, velocity, and time. So, for instance, it can record a track log of where you traveled.

As a fitness device, if you want to go out and exercise for a particular time or a particular distance, it will time that for you. It will keep track of how far you've traveled. You don't have to go run around a, you know, measured track in circles. You can take off and go anywhere, any distance, and it will keep track of, you know, how far you've gone.

You can monitor that and decide, okay, I'm halfway the distance; I want to turn around and go home. You don't even have to go the same path, but it would help you if you wanted to. Especially if you were in an unfamiliar area and you just wanted to retrace your steps, since it knows how you got there, it can guide you back.

So it provides navigation based on the -- let's refer to it as a breadcrumb trail like Hansel and Gretel. We refer to that as a track log, but it's very smart about how it determines when to record points. And then you can configure that to be more or less so that it can guide you back.

That data can then be transferred through your mobile phone to the cloud at Garmin and store all your activities. You can come back later, review them. You can superimpose that track log on a map. You can review your performance and other metrics, such as heart rate, while you're running.

**Q. So what you just described in general, is that what is meant by GPS speed and distance in some of the materials that come with your products, because it's --**

A. So speed and distance would be determined by the GPS information.



**Q. And this is pulling the information from the GPS satellites to identify where you were and when you were there and then doing the calculations how long it took you to the next location?**

A. Almost. Don't forget the -- the velocity, the speed, is very important. It's very complicated in terms of when you're moving that slow, especially when you're walking or running. The difference in speed is tricky to measure.

Yes, GPS provides a very accurate value, but then how we apply that and display that to the user is very important, especially if you have that strapped to your wrist. You're talking about the fenix. It's a watch.

As you swing your arm, if you can visualize, as the arm is coming forward, it's going faster than the rest of your body. As your arm is going backwards, it is going slower than the rest of your body. And it takes a bit of math and tuning to get that right.

**Q. So can you describe in more detail the method that Garmin is using to calculate these outputs that it's gathering through the GPS sensor?**

A. Sure.

The next level of -- any one measurement



from the satellites, right, you can take those, triangulate, do the math, come up with, okay, here's where we're at in the four coordinates -- latitude, longitude, elevation, and time -- right? All four are important.

And then, if you're moving, that calculation for position is not as accurate as velocity.

So -- let me pause and ask my attorney.

Do we have IP protection for this? We're getting into some stuff that's Garmin proprietary.

MS. LAMKIN: We can mark the transcript confidential, Mr. Krull.

THE WITNESS: Okay. Good.

MS. LAMKIN: So note to the stenographer to please mark confidential going forward.

THE WITNESS: Now, some of this is just general GPS. That's what makes GPS better than other navigation systems and so forth. But I don't want to have to stop and point out each piece. All right?

So, for instance, in the early days at Garmin, one of the things that really surprised me, right, as us geeky engineers are sitting around the lunch table and talking about our various areas of



what we're working on, the fact that GPS velocity -- because it's not based on delta position. All right?

The old systems, what we had to do was you calculated a fix. You said, okay, we were here at this point in time. And then some time period later -- the faster the better, of course -- but sometimes it was tens of seconds. And you got a new answer. Now we are here; right? So how much time elapsed and how far did we travel?

So that determines your speed. So you can display that. It also determined the direction you're traveling; right? So the two together are your velocity vector.

I remember doing a test at a previous employer. We were in an airplane, and we were testing a LORAN system. And I remember starting the clock when we initiated a turn. So now we're banking, we're turning the airplane, and we're -- you know, time's counting. And the system was able to determine we were turning in 20 seconds. And we were excited. Wow. It can do that.

With GPS and Garmin's very first implementation 30 years ago, we could do it in a second. You could be at walking speed, not flying speed, but walking speed, turn 90 degrees, and on the next update the device knew that you had turned and now how fast you're going that way. That's how huge of an advantage the GPS had over previous systems.

Now, part of that is we were not doing that traditional distance-over-time calculation. In fact, much the opposite. The geeky piece here that really excited me back in the day was that we're calculating speed based off of the carrier phase of the signal coming from satellites.

Now, again, remember earlier I said the satellites are moving much faster than we are? In fact, there's a component of Einstein's theory of relativity that comes into the fact that the timing systems on the satellites get out of sync with Earth here because they're going faster than we are, significantly faster.

So if you picture sitting at a train crossing, right, and a train is coming, and you can hear it come; right? It's making a noise. And then it goes by you, and then it's going away from you. Right? When it was coming towards you, the sound waves are compressed because each new sound wave, it was closer to you when it generated it; so those are



closer together, which makes a higher frequency sound, what we perceive; right?

As it goes by, then that sound drops in frequency because now the train is generating sound each time further away from us for that sound wave is now wider, not as narrow as it had been. So you hear this Doppler effect of (indicating), and off it goes.

And I'm sorry, Stenographer, you can't type that sound.

But, any way, it's a sound that starts higher in frequency and drops as it goes by in front of you to a slower frequency. All right.

We leverage that component, the fact that some of these satellites are going away from us and some are coming towards us to determine -- and it's fancy math, and I have a minor in math. I would have to review the code and study it for days to come back and tell you, okay, exactly how that works.

But, conceptually, that's what we're leveraging. It's that Doppler effect and the fact that they're moving towards or away. And once you figure out, you know, where you're at, now you can use that to fine tune and come up with a velocity



vector. Are you going up? Are you going north, south, east, west, or some combination in between? And that determines, then, where you're at.

Now, that is very accurate. The math that you use to do the triangulation to determine, okay, this is the position, the coordinates of where I'm at on -- or above Earth, right, is dependent on the spacing of the satellites; right? A triangle would be a perfect solution in two dimensions, a pyramid in three.

So if you were in the middle of the pyramid, you'd be able to determine your solution to what we would calculate in scale normalized as 1.0 dilution of precision.

As you get further away from the center of that pyramid, then you start to lose, right, and your number gets higher. So the fact of confidence and accuracy would drop; right? Your confidence wouldn't be 1.0; it would be maybe 1.5 or 2. And it comes at some point when the satellites are all in one quadrant of the sky. So you're backed up against the building and you can't see the others.

Keep in mind that at all times, when you're standing on the Earth, well, the Earth is this big honking rock that blocks the signal from the



satellites on the other side of the Earth. So we only get to see things beside us and above us; we never get to see things below us in terms of signal.

So the vertical component of GPS is even less accurate than the horizontal component. But if you have satellite spaced around you -- and the more the merrier; right? -- you can actually get a dilution of precision that's less than 1 that says, okay, we're overdetermining the solution and coming up with something even more accurate than a standard geometric triangle would provide.

Now, all that being said, no matter how accurate that is, the velocity vector is better. So the technique that was used to improve the positioning is that you leverage the velocity and you heavily filter the position computation, right, compared to where it was last.

But you don't filter it to where it was last. You propagate it by the velocity vector. And you say, okay, if I was there and my velocity is this and this amount of time has passed, now I should be here.

So you actually filter the new math with the predicted new location with velocity, and now then you can maintain a much higher precision -- or

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