Podcast Transcript - Smartphone Battery - Not all mAh are Created Equal

[00:00:06] **Peter:** Hello, and welcome to the latest edition of The Counterpoint Research Podcast. Today, we have a special guest joining us from DXOMARK. DXOMARK, as you may know, has been a quality benchmarking firm that scientifically assesses many different aspects of smartphones, or I guess it's most well-known for its smartphone camera scores.

But recently, and I think in an excellent move DXOMARK has added batteries to the mix. So here to introduce and talk about testing batteries and batteries for smartphones in general is DXOMARK's battery units, director, Olivier Simon. Olivier, thanks very much for talking to us today. And it's great to have you.

[00:00:49] **Olivier:** Well, thank you very much, Peter. And thank you for having me.

[00:00:52] **Peter:** So Olivier, we were talking just before we started recording the podcast here that we've both been around the mobile industry for a long time, but maybe you'd like to quickly introduce to listeners your extensive history.

[00:01:05] **Olivier:** Yeah, sure. I like to say that when I started in the telecom industry France didn't have any star on their football jackets, but yeah. I'm an engineer in electronics and computer. I spent, as we just said most of my career in the telecoms starting at Phillips consumer communications, then Gen plus. LG for about 10 years including a rotation of a year and a half in the headquarter in Seoul. And more recently I was the CTO for Wiko, a French mobile phone brand. So, yeah. I'm very familiar with all the challenges that the OEMs face when designing and developing new mobile phones.

[00:01:51] **Peter:** Excellent. Well, great. Great to have you with us. And yeah. DXOMARK, you know, I've been following particularly the smartphone camera ratings for many years, and I truly rely on them. And I think that the testing protocols that you go through you know, the best in the industry. And as I say, you've started now with battery scoring, and I think that started in sort of the springtime May time this year. Right? So, what was the, the main driver for covering the battery space as well?

[00:02:21] **Olivier:** Yeah. Well as you correctly said, yes DXOMARK has many, many, many years of expertise in assessing camera quality not smartphone cameras, by the way, they also are experts in audio for two or three years now.

We launched display score last year. And yes, this is correct. We've just released our brand new batteries score in May this year after a very intensive full year of developments. And why did we go for battery? Well, Batteries is always challenged. So, a battery needs to cope with a growing demand for data for computing power smartphones always come with a new features, continue to bring more screen pixels, even sometimes more, more than one screen.

And it's a balance. And. And for battery life battery experience is always challenged and, you know, we're without battery, there is no experience at all. Right. So yeah. And from a user

perspective, well usually it will be presented with milli amp hour (mAh) or Watts, you know, it's not really straightforward as, as an information to grasp for, for anyone.

So yes, we know that there is a need for an independent benchmark that users can trust to deliver an unbiased, transparent and comprehensive battery test and our goal was to compare all brands in the same way so that we can guide the end users in their buying this with our battery score.

[00:04:06] **Peter:** Excellent. Yeah. So, I mean, certainly I think in the consumer research that we do when we ask consumers what they like and what they dislike about the smartphone, battery life is often, you know, near the top of the items that they dislike. So it's you know, clear pain point now, you know, counterpoint tracks, you know, smart phones and we do a lot of analysis of the.

Specifications. So, we pull out the milli amp per hour associated with each smartphone. So to us, it's a spec, it's a number. And we also look at recharging protocols as well, whether it's wide or high speed charging or wireless charging. So, you know, thinking about milli amp hour, for example, what does it really mean is, is that can I just sort of say, okay, this is 5,000mAh so it's going to be better than this one, which is only 3,500mAh.

[00:04:58] **Olivier:** Well, yes and no. Actually yeah, milli amp hours is a unit that measures the charge capacity of your battery. It's a bit like the number of litters in your gas tank in your car. So yeah, when you talk milli amp hour, If you're going in a garage and the sales guy is telling you, this guy has a 60 liter gas tank. This car has 40 liter gas tank.

You don't really know what it's going to drive you to. Right. So. It's a similar for the smartphone. The milli amp hours described the amounts of capacity you have in your smartphone, but your autonomy will depend on a lot of factors. It will depend on screen resolution it will depend on your chip set, the modem quality of antennas. Hardware integration, software optimization. Since the launch in May, we've already measured 50 smartphones and among them 20 share the exact same 5,000mAh battery capacity. And what we measure is that the autonomy, it brings ranges from 41 hours to 85 hours. So, there's a big disparity among those 5,000mAh we've measured.

And it's a bit similar for the Watts information that come with your charger spec. The watt are the maximum power delivered by the charger. It's a bit similar to the speed at which you can fill up your gas tank in your car, but it's only the peak power of the charger.

And this cannot be maintained throughout the charging process. Some points you have to slow down the charging speed to keep the battery cooled and safe. And so we start to see 120 watts chargers coming, but actually the 120 watts are only kept for a few seconds in order to keep the battery safe. We've also measured some 31 chargers, which actually never deliver more than 25.

So yeah, those are specs and it gives an indication, but it doesn't translate immediately in an experience. And, of course, your experience will depend a lot on your usage and your charging rituals.

[00:07:23] **Peter:** Yeah. And that sort of brings us onto the question of the procedures that you go through to test these, because as you say, everyone is different, right? So you live in a different you know, radio environment. You may be very far from a base station or very close to a base station, or you may use Wifi 90% of the time, or all these sort of things and maybe have a screen brightness that it is for level. So how do you actually kind of go about trying to factor all this into a reasonable testing protocol?

[00:07:52] **Olivier:** Yeah. And this is a great question. Yes. So, when designing a protocol at DXOMARK, we always use a very consistent approach and it's always been seen for a camera, audio, display as well as battery. We first start by. And the nice thing, sorry, the way people use their phones. So we tried to understand their habits, what they expect, what are the pain points that they face. And once we're very familiar with that, we design a protocol that reproduces in our labs and also going outdoors that reproduce these habits in a very robust environment to design a repeatable protocol. So for battery, for example our testing protocols involve up to 150 hours of testing. So that means 150 hours of both charging discharging the phone and that results in about 70 measures which combined into a hundred parameters that all contributes to our battery score. So, I like to quickly explain here those 70 measurements, 30 of them are autonomy measurements and these autonomy, we combined with battery capacity to calculate the discharge current.

So, what is the discharge current? It's the ratio of battery capacity over autonomy. And it measures the speed at which specific usage will drain your battery. So, for example, if I have a 5,000mAh, which brings 10 hours of video playback, for example, it means that the discharge current for this platform is 5,000mAh.

By 10 hours, that's 500mAh. And yet if I have a different device with 4,000mAh, for example, bringing the same 10 hours of autonomy, then the discharge current is just 400mAh. So they will bring the same autonomy for the use case. We just measure the speed at which they drain the battery.

And in this case, 500mAh versus 400mAh. So, so this is how. All these 70 measurements become a hundred parameters taking to account those discharged.

[00:10:04] **Peter:** Hmm. Okay. And what about the radio environment? Cause you said earlier that the base band system, the antenna quality and so on also has a big impact. A smartphone is a complex system, right? So you're not ever just doing one, you know, there's not ever just one application running. There's a whole suite of radio activities going on in the background. So how do you kind of manage the environment such that all phones are measured in some way?

[00:10:30] **Olivier:** Yeah. Well, so the first thing our lab is based in France next to Paris. And yeah, the phones we test will attach to a French network, of course. So, we cannot test each and every network combination out there from our lab in Paris. An Indian network operator or a Verizon or in the US we, we test on one French carrier network, which is Orange France, and yes, you're right. The network conditions can be fluctuating.

So, to cope with that, our lab is actually a Faraday cage. So, a Faraday cage will isolate the device on the test in a totally controlled environment. Spare them from any external disturbances on the rooftop of our building. We have an antenna pointing at an Orange post

and a network repeater is sending a robust network, which is constant inside the Faraday cage so that the network conditions everyday will be identical inside the cage where we test the phones.

We also have inside the Faraday cage, of course, a WiFi access point. because some of the usages with test on cellular, some are on WiFi. As you said, we also control the lighting conditions inside the Faraday case. Actually, we've designed four test plans, two of which are run inside this valet gauge.

So, the first one is called a typical usage scenario. And inside the valve, they gauge, we have a. The robots. We have some robotic fingers that will actually perform actions on the touch panel of your phone. Just like you use your phone, just like everyone is using your phone by doing clicks and swipes on, on the touch panel. And in our typical user scenario, the robots will play a scenario that starts at 7:00 AM in the morning we'll finish at PM in the night and we'll implement kicks and swipes to browse the internet, play games check social networks, make phone calls in a scenario that that has about four hours of screen time per day, then there is a night and in the next morning, the robots will continue the exact same test scenario, do the exact same routine until the battery dies.

And that first test plan gives us the autonomy you can expect on the full battery. When you're an average user, of course, mobile phones are mobile. So we also take them outdoors for mobility test and here we test the autonomy you can expect in specific usages of users. When, when they're on the go like a GPS, navigation, or shooting photos and videos, again, making phone calls and checking social networks basically.

those two first test plans are done with factory default settings. Two first test plans. We'll measure the out of box experience you can expect on any new smartphone. The third test plan is also done inside the Faraday cage and share we, we will calibrate all device settings. The screen brightness is calibrated. The sound pressure level of the speakers is calibrated. The refresh rate of the screen is calibrated so that we measure all phones on the same foot providing this similar user experience.

And here we'll measure each and every possible usage of a smartphone. Like again, making phone calls, streaming video, over WiFi cellular gaming, and those three test plans will provide us an array of autonomy measurements. And we compliment those tests with a third test plans about charging of course. And share we'll measure. The time and energy that is needed is required to go from a fully depleted battery to a fully charged battery. But it's not really a user experience. Usually, you will always plug your phone before it pairs down.

Right? So, we also check how much autonomy you recover in a quick five minutes, power top-up of your battery at different states of the battery. When the battery percent indicates. Shows 20%, 40%, 60% and 80%. So those are all first four test plans, measuring autonomies and the charging experience. Yeah. Again, 70 measurements and 150 hours of test.

[00:14:50] **Peter:** Yeah, it sounds extremely comprehensive, but I'm glad to hear that it sounds like the robots get a night's sleep at least, so.

[00:15:02] **Olivier:** Yeah. And they also have a lot of fun playing games and checking the social networks.

[00:15:10] **Peter:** Maybe you should get them a social network account that they can publish some of the thoughts too.

Okay. Thanks Olivia. So, it sounds like there are three key attributes that you're testing. So, autonomy how long the battery lasts doing certain activities, charging method, so how long it takes both to recharge fully, but also to top up a battery from a certain point. And then I think which to me is the most interesting is the efficiency. So, you know how well. The device uses its store of current to manage certain negativities. But do you apply a particular weighting on how each of these factors is considered?

[00:15:55] **Olivier:** Yeah, so all our autonomy measurements contribute to the autonomy CEP score that contributes to the global barrier score. So, this autonomy CEP score has the biggest weight. It has the weight of three for several reasons. One of them. yeah, there are still many people out there who have the habit to channel the phone overnight a few years back. Actually we had no choice, but power up the phones every night because they had a hard time making it throughout the day.

So still autonomy remains the key factor for us with the biggest weight of three, then charging has the weight of two. We say that whatever your charging ritual, there will be occasions like, you know a long weekend or a business trip or a special event where you will need to rely on quick power boost to make sure that you can continue your journey.

So, charging as the weight of two. And efficiency is not entirely a user experience. It's measured both in the efficiency of a full charge. So meaning how much energy is needed to fill up the energy capacity of your battery. And it's also measured by like you said the efficiency when in use or the speed at which the batteries drained. And yes. So this efficiency CEP score as a weight of one is still, it's very important for the what we say is that, you know, an efficient device will provide a better autonomy with a smaller battery and actually translates into an immediate benefit for the user that a smaller battery provides. Good autonomy means it's sexier design. It's also assigned for us, have a better quality of build. So, an efficient device is built with a power efficient components and there's that special care that has been made for the hardware integration software integration. So, it's in a word it's more optimized and a sign of a better quality. And the third one, well efficiency is key for us because actually it saves electricity and you know, it's good for the planet.

[00:18:17] **Peter:** Yeah. I mean it wasn't so long ago that I mean, particularly uses of certain devices, you would find them the middle of the day hunting for a power source because you know, the phone would not last a full day. Thankfully, I think, you know, those days are more or less behind us, although it still occurs sometimes.

[00:18:36] **Olivier:** Yes exactly. I've had a recent story of a colleague trying to plug the phone in toilets of an airport to try and continue the journey.

[00:18:46] **Peter:** Yeah. So it's those sort of odd situations maybe, but in general use, I think most phones now last a day, w one of the things that we talked about a little bit beforehand that I think must be very difficult to test is the durability of batteries.

And I think this is becoming important for many, you know, even at the sort of government level, we just been through this COP 26, you know, and as you say, you know, the

environment is an important factor so that you know, that the ability for a battery to last a long time in terms of you know, years or a number of charge recharge cycles. But I guess that's very difficult to test, right?

[00:19:24] **Olivier:** Yes, of course, it's my dream to be able to test it and to test it fast. But unfortunately there's no easy way yet. Actually, you, you still need to drain the battery and charge and drain and charge for a number of cycles before you start to see the erosion and to give and to anticipate what the durability of this battery will be. And it takes yeah, a 100 or 150 cycles. And you know, you have to do soft cycles. Otherwise you damage the battery more. So you can only do maximum two cycles per day, so 150 cycles is an awful amount of time for us. But definitely it's something that I dream of doing. And I'm probably going to add to my protocol in the near future.

[00:20:11] **Peter:** So kind of moving it to the results that you've seen so far. You know, I've looked at, looked at these and there's the thing that sort of stands out for me is that there's not so much correlation between price and performance in the battery scores. I mean, in the camera domain you can see, I mean, obviously there are exceptions, but on on average, the more you pay for a smartphone, the better the camera is. But that doesn't seem to be the case here in the battery schools.

[00:20:36] **Olivier:** Yeah, well yeah, as you can expect devices in more premium segments, have bigger screens have more things to handle. Yeah. So in our top scores, in the first two places, I have two device belonging to our high-end segment, which is between $400 and $600. So the OPPO Reno 6 and the realme GT Neo 2 are the first two devices in my rankings. Then number three, I have four different device. The iPhone 13 Pro Max, which is an ultra premium devices, starting at a bit more than a thousand dollars. And I also have two advanced devices, so between $200 and $400 device, the OnePlus Nord CE 5G and the vivo Y72 5G. And again, another high-end device, the Xiaomi 11T 5G at $499. I have to say that also in my top 10, I have also two essential device, which are device price below $200, but actually there is a form of correlation. Usually, the higher end device will struggle with autonomy because, you know, they bring a lot of fancy features, many screen pixels.

But they also catch up with a fast charging and on the other end in the lower end, more affordable smartphones with less pixels on the screens, less features will provide usually a good autonomy. But on the other end, they will struggle with charging time. So actually, you know, rankings in the middle, the high-end device, which both start to democratize the fast charge and have a better balance of specs are very well-represented in our rankings.

[00:22:24] **Peter:** Yeah, this is really interesting. So I guess it sort of highlights the fact that there's, there's no kind of straightforward way to kind of correlate price and performance because there's so many other things going on. As we talked about earlier, you know, a smartphone. It's a system device.

And you know, all of those components in the system contribute to the power use, power drain, but also I guess, efficiency. And maybe we come and talk about some of those in a minute, but you know, maybe a good point here is to what advice would you give to OEMs you've worked for, you know, smartphone makers, what would you advise them? And in terms of how to optimize the battery performance.

[00:23:09] **Olivier:** Yes. So first of course, it's a careful selection of components. So, the CPU, the screen mainly must be power efficient good designer antennas to also have a low cost on data. You know, the biggest pain point for example is the pixel. So, the more pixels, the higher refresh rates, they will have a direct impact on your autonomy. It's not only a challenge for the number of pixels that need to be lit. It's also the challenge of the full UI and the full UI that needs to run on more pixels requiring more computation, more Ram. And for that reason, some OEMs will you know, launch a smartphone with quad HD resolution, but by default we'll offer a full HD UI, for example Yeah. And of course, one of the key one points to really pay attention to is the quality of the modem antennas and focus on trying and providing the lowest. Possible when idle, because as a user, when you're not using your phone, you expected that it doesn't drain your battery, which of course is not true. As you said, it's a living thing. It's a very complex system and it's always grooming things in the background, doing a bit of stuff, staying connected to the network, to get your notifications or whatever. But yeah, having a, a great a low power consumption during idle time is also key to provide a good experience.

[00:24:44] **Peter:** Excellent. So, yeah. Interesting. You mentioned the software and hardware integration. I think you mentioned that earlier as well. And so Android powers a huge number of phones? iOS obviously is just with apple. And I think one of the things that you've highlighted is that given that apple manages both the software and hardware and works on a very integrated way the products tend to be very efficient, but, you know, can we make any sort of generalizations about whether, you know, iOS is better at some things or Android is better at others gaming, for example,

[00:25:21] **Olivier:** Well, so in the database that we have measurements we have four iOS phones and actually those for iOS phones are all on the top of our score for efficiency in this in discharge. So, they have the lowest current drains in most situation. And as you said, this is easier for apple. They are doing the chipset, they are doing specifying the hardware and making the hardware design. They have the OS of course, and most of the apps as well. So, It does show in all our measurements and the top spots for the discharge score are all trusted by Apple phones with a minimum of 115 points.

When the best Android has a 104. What we see also is that Android is progressing. So, we saw a significant progress brought by Android 11 versus Android 12. And we start to measure Android 12 as they are released. So I think we have all the pixels, of course, supporting Android 12, a few Samsung as well, that will start measuring and, and other device coming up.

Yeah, we'll have to have another chat at some later time to see the benefits of Android 12 versus Android 11 regarding benefits of each and every device, actually, in terms of autonomies. The, the apple phones come with usually smaller batteries compared to Android phones. So overall in autonomy, there is no clear winner on who is providing the best experience between Android and Apple, but we see in the performance of the platform itself, that apple is ahead.

[00:27:07] **Peter:** Yeah. So I guess, because they have that better efficiency they can manage with a smaller battery I guess helps from a, cost point of view, both in terms of dollar cost, but also in environmental cost as well. And I guess one of the other kind of key components in the system and interestingly, we have Qualcomm launching their new application processor for the high end.

So to the different AP process and manufacturers, do they have a big impact on the overall battery performance? And if so which players to do better than.

[00:27:41] **Olivier:** Yes, we have an extensive database of measurements now. So we start to see trends, but, you know, it's very difficult to evaluate and compare those chips at solutions in a fair comparison, because as you said you know, they always come. What we test is always coming in a very rich system which will have a different screen size, different hardware integration, different features. So, so it's really very difficult to compare chipsets one to another, in a very precise manner. But except maybe for the Samsung Galaxy S21 series where you know, they come in two flavors, one is on the the homemade Exynos platform and the other one is on a Qualcomm.

And yet we measure both and we still see that Exynos is slightly behind Qualcomm for that. The, the autonomy score on Exynos is 51 and the string Snapdragon version providing these exact same hardware is, is four points ahead with a score of 55 for automony. If I try and compare a MediaTek and Qualcomm, there's a very, very small gap.

I think if I filtered by all the device having a full HD resolution, so a 1080p screen. Then it's, it's kind of a fair comparison. The best MediaTek device is the vivoY72 5g coming with the Dimensity 700 5G SoC from MediaTek and the overall efficiency in this challenge, the overall score is 103 points.

And in the same with the best Qualcomm is on Snapdragon 750G 5G which comes on the OnePlus Nord CE 5G. And this one has 104 points. So you see very, very similar performance. The Dimensity chips is ahead of the Qualcomm in most usages, except that Qualcomm is better for all video usages.

In a similar way, if I compare from OPPO, the Reno 6, which is our current top score with it's a bigger brother, there Reno 6 Pro. The Reno 6 comes with Dimensity 900 from MediaTek and it has the same discharge efficiency score of 103, same like the Dimensity 700 on the, on Reno 6 Pro which comes with a Snapdragon 875 SoC and it comes with discharge score of 94. So here comparison is not totally fair because I Reno 6 Pro will bring more features compared to Reno 6, but actually even there, if I just focus on all the video usages, the average current drain in video for the Reno 6 Pro is 229mAh, which is ahead of the Dimensity 900 chip of the Reno 6, which comes with 274mAh.

So a bit, a bit more 50 something mAh more in video usages. So do see in our database, some capacities and some differences between those solution vendors. And again yeah. The Apple a 14 /15 Bionics chipsets by Apple. Well, I cannot compare them head-to-head with the other CPU's because they come with their own environment on iOS, own chipsets, own apps but in all usages,

[00:31:06] **Peter:** Yeah, I think your answer to the complexity here and the, you know that certain applications, you know, will perform slightly better on some\, slightly worse than others, but you have to again, take this, this whole system into consideration.

So I think we've probably done as much as we can here in this discussion to pick for the complexities, but also to highlight the, you know, the great work that you're doing. So, thanks Olivier.

[00:31:33] **Olivier:** Well, thank you very much, Peter.

[00:31:36] **Peter:** Yeah, just before we wrap up, obviously we're kind of heading into one of the peak sales seasons you know, in many parts of the world. So, any last thoughts for listeners as the, you know, maybe looking to buy a new smartphone for themselves or for a loved one?

[00:31:53] **Olivier:** Yeah, well, to conclude, I would like to stress out again, the fact that the, you know, million powers not totally relevant and definitely should not guide your buying decision. I think you know as I said earlier, you don't buy your car based on, on the size of the gas tank. Right? So, I think. Yeah. I encourage people to go check out our reviews on the dxomark.com to find the clear information on the overall better experience you can expect with your next smartphone.

As we said, you should check. You can also go down into more details and the sub-scores of autonomy charging and efficiency. And you'll see that we'll also provide direct and straightforward information. For example, the charging times. So, you will know how much capacity you recover in 30 minutes and how long it takes to go from zero to 80% of a full charge, how long it takes to go to a full charge. Very straightforward autonomy per profile. So that gives you a kind of range depending on your usage of the autonomy you can expect.

So, we'll provide you with a light usage profiles with which is two and a half hours of a screen on per day. Moderate usage profile, which gives the autonomy you can expect when you have about four hours of screen on per day and intense a usage profile with seven hours of screen on time per day.

So, depending on your usage, you will have a good expectation of where the autonomy experience will be for in your case.

[00:33:27] **Peter:** Excellent. Thank you very much. So that was Olivier Simone from DXOMARK, thanks Olivier. For your time today, really enjoyed the discussion.

[00:33:37] **Olivier:** Thank you very much, Peter. It was a pleasure.

[00:33:41] **Peter:** All right. And to our listeners. Thanks for, thanks for tuning in and please you know, subscribe to Counterpoint Podcast for any for any future additions and, and check back. And we wish you a great. Bye now.

[00:33:54] **Olivier:** Thank you. Bye.

