TRENDS TO WATCH IN THE SOFTWARE-DEFINED VEHICLE

October Interview with Dr. Nadim Maluf

Automotive OEMs and consumers today are increasingly looking for features defined by software, such as driver assistance, infotainment, and intelligent connectivity. We recently sat down with Dr. Nadim Maluf, cofounder and CEO at Qnovo, a major software supplier to electric vehicle OEMs, to get an insider's perspective on trends to watch in the software-defined vehicle.

Q: Nadim, can you tell us about your background?.

Dr. Nadim Maluf: I'm an engineer, an entrepreneur, and a physicist. I earned my Ph.D. in electrical engineering at Stanford University, and I taught electrical engineering as a consulting professor at Stanford. I realized early on that academia was not my calling in life and moved on to pursue a career in industry and entrepreneurship.

My first claim to fame came in the mid-to-late nineties with something called a TPMS. That's a tire pressure monitoring system. It is the little dashboard display in your car that tells you what your tire pressure is. That was my introduction to the automobile industry. It also gave me a good understanding of the hesitancy of the car industry to adopt new technologies. In 2010 we launched Qnovo, since we knew that batteries were going to be the future.

At first, Qnovo offered solutions for the smartphone space. In 2015, we completely reorganized the company and focused exclusively on software. We never looked back. The best thing about software is that you can apply it, or define it, to address evolving needs for almost any industry. That gave us the energy and the confidence to expand from smartphones into electric vehicles (EVs).

Q: What does your software offer battery makers who supply the EV manufacturers?

A: Qnovo's SpectralX© Battery Management Software offers three benefits. One is the performance, improving the EV driving experience. Fast charging is where we shine, reducing EV charging times to nearly 20 minutes.

The second is predictive safety, which takes battery health and degradation into consideration, quickly identifying defects in batteries. This protects drivers from lithium-ion battery malfunctions that may spark fires in electric cars, bikes, and scooters, and it saves on costly recalls for the OEMs.

The third is optimizing less expensive Chinese batteries and making them perform as well as Korean and Japanese batteries. This saves electric car companies 20 to 30 percent in production costs.

ABOUT DR. NADIM MALUF

Dr. Nadim Maluf is the cofounder and CEO of Qnovo, an award-winning developer of predictive battery management software that enables batteries to safely charge faster with extended longevity. These software solutions provide OEMs with real-time and predictive diagnostics to maximize performance and prevent explosions and fires for any type of lithium-ion battery. Prior to launching Qnovo, Dr. Maluf was entrepreneur-in-residence at U.S. Venture Partners and executive vice president at LumaSense Technologies.

Q: Can you actually improve the range of the battery?

A: Yes, this is something Qnovo does quite well. It's a matter of efficiency. We can increase it by about 10 to 20 percent. This is because batteries are not fully utilized when they come from the manufacturer. For example, the Tesla Model S has a battery capacity of 100 kilowatt-hours, but you're really only accessing 90 kilowatt-hours, or less. Our software can increase that so that instead of accessing 85 or 90 kilowatt-hours, you can access 98 or 99 kilowatt-hours.

That access in kilowatt-hours equates to up to 10 percent greater EV range. Alternatively, you can reduce the size of the battery and save through reduced size and weight, which is substantial. A battery costs approximately $100 per kilowatt-hour. So a 100 kilowatt-hours EV battery is $10,000, which is huge. Ten percent savings equates to $1,000. That's a large sum for most OEMs and often the difference between making money and losing money.

Q: Does it matter at all whether your underlying platform is a real-time performer like an RTOS?

A: Absolutely. We're collecting data from the battery continuously. We measure the voltage and current from each and every cell all the time. We need that data to reconstruct through our models the chemical processes taking place inside the cell. The performance of the operating system software helps minimize the latency of the data collection.

Q: Outside electric vehicles, do you see your technology running anywhere else?

A: We're seeing EVs across all sectors of mobility, from two-wheelers all the way up to commercial vehicles. We're getting input from agricultural tractors and vehicles. They want to electrify. The mining industry tells us, "We can't mine for lithium using diesel mining equipment."

We're also seeing aggressive traction in energy storage. Capital is flowing into the national charging infrastructure for EVs. In order to support a mid-adoption scenario of 33 million EVs on the road by 2030, the nation will need millions of charging stations.

Q: As a software provider, what changes do you see coming that are related to the full lifecycle of EV deployment?

A: Customers want real, tangible benefits. These are the features Qnovo provides. Fast charging is very important. If you drive an EV, you know this.

Another is meeting battery life expectations. How do you ensure that? For a passenger car, the lifespan of 100,000 to 200,000 miles may be enough, but that's nowhere near enough for commercial fleet trucks.

Lastly, safety is very important. The last thing you want is a battery blowing up in your garage.

Q: Why couldn't we be powered by solar on the car? Instead of digging up all these raw minerals?

A: If you run the math, it's not enough. It would take forever. Looking at the big picture, much of this comes down to a need for greater efficiencies and large scaling of battery production. To address the level of transformation being demanded for electrification, roughly 600 new mines need to come online between now and 2030 for raw material extraction. If we can improve the efficiency or the longevity value by just 20 percent, that's 150 mines we can eliminate and do better for the environment.

Q: Could every nano cell in your car's paint job be a mesh network and generate all the energy you need?

A: Yes, technically it is possible. But it would take a very long time and, given the science and the physics involved, there is no efficient, affordable way to do it. The realistic answer is no. I've actually written about this very subject on my blog.

However, it's a very interesting idea, and there's absolutely no shortage of innovative ideas in the battery space. It's encouraging to see so much innovation globally. The challenge is: How do you make money doing it? Venture money is flowing in large quantities into the car battery space. But how many of these ventures will make it to the point where they can compete economically with existing solutions? That is a tough question.

Q: What do you need the ecosystem around you to do to help with innovation?

A: I think innovation is going to be driven by the charging infrastructure. What are the issues that people are focused on in terms of EVs and batteries? First, it's EV range anxiety. A big concern is: Where is a charger located if I go on a drive longer than my range? And another area is safety. Drivers are concerned about vehicle safety.

Range anxiety, charging, infrastructure, and safety. These are real challenges right now. We see a lot of innovation effort focused on finding solutions. We're seeing governments investing in the needed infrastructure. We're seeing all those catalysts coming into play to support the ecosystem. But not all the innovations will make it to the finish line.

Q: What do you think could derail the progress of EV innovation?

A: I don't believe we can derail the current progress in our global transition to electric. That train has left the station. Perhaps the real question is: What would slow it down? Today, the adoption of EVs is hampered by three or four things. The first is range anxiety. This includes the charging infrastructure and the charging experience. How fast and how reliable is it?

Another major point is cost. If you look at where EVs are today, they're in affluent societies, not emerging economies. But you could make two-wheelers and three-wheelers in a way that's efficient.

And then the last one is safety. If the industry can address these concerns, the EV momentum will continue. If not, it will begin to slow down.

Q: Is there a way to talk about safety in the EV industry that's on the record?

A: I think it's very clear now that carmakers recognize that the brand is theirs to protect. With battery fires, even if the warranty covers it, irreversible damage could be done to their brand. We've seen this in the smartphone industry with battery fires in the past.

This compels EV makers to say: How do I protect my brand? How much can I trust my battery vendors? The battery vendors do have a large role to play. They'll be involved in inspections, field diagnostics, guarantees, and safety. But ultimately, it's the responsibility of the car companies, because they understand that their customers, regardless of which vendor's battery is inside, are theirs to protect.

Q: What major trends do you see for the EV industry as you look out over the five-year horizon?

A: Stability in the supply chain is and will continue to be a major factor.

Collaboration is another. It's very important that we have collaboration with other software vendors, as well as the hardware suppliers, in order to spur innovation.

We're going to see greater acceptance of electrification in vehicles. Here in the Bay Area, where I live, three out of four new cars are EVs. But when I travel, I'm hard-pressed to see any EVs. That willingness to adopt and invest in EVs — we're going to see more of it.

I'm hoping prices will begin to drop to make EVs more affordable for a wider range of buyers. I think that's an important one.

I also believe that, by 2028, the EV driving experience will not only mirror but perhaps exceed that of a combustion-engine vehicle. That includes the range, the infrastructure, and the whole EV charging experience.

Ultimately, what makes me the most concerned is protectionism across national boundaries. Right now, we're seeing global tensions, especially around raw materials for batteries. The big question is: How do we engage across borders?

The last prediction I want to make here is this: There are many companies that have been around since the 1930s in the automobile industry. They go back 100 years. Some of them will not be around in the next decade, but there is a lot of opportunity and there is room for many winners.

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