Siemens PLM Software

Autonomous driving, smart cities and the new mobility future

Automotive

Andrew Macleod
Director of automotive marketing for Mentor product suite

Introduction

In the unfolding drama that is the upheaval of our transportation system, the lead actor is most certainly the self-driving car. It's the charismatic and by now familiar protagonist that you'd be forgiven for thinking might single-handedly upend everything about the way we travel, provided we can just sit tight for a few more turns of the Moore's Law cycle and continue to tune the onboard artificial intelligence (AI) until it's just right. Computers can beat chess and Go masters. Surely they can master rush hour traffic too, right?

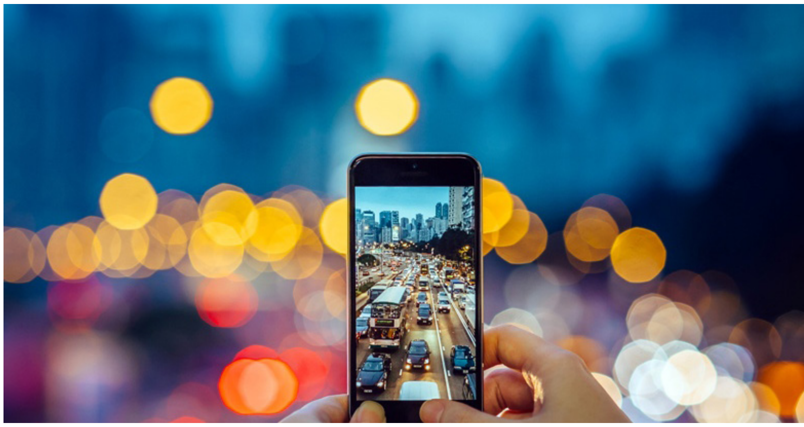
Well, maybe not, at least not by themselves in the near term. In actuality, autonomous vehicles are embedded in a dense ecosystem-like web of related factors, seen and unseen. Decidedly tech-free examples of the latter are local traffic laws and cultural norms, almost certainly more determinative of driving behavior and safety outcomes than any particular vehicle feature. And surely the best example of the former is smart city infrastructure, ever more instrumented with connected sensors feeding large-scale analytical systems delivering tangible benefits.

A significant and growing portion of these sensors are on current and late-model vehicles themselves. Already more than half of all cars sold contain telematics packages, today used for everything from navigation, infotainment, and smart diagnostic and maintenance service, and eventually enabling ancillary services like more accurate insurance rates. Connected car momentum is readily apparent in the market for new cellular network connections, which continues to grow even while the global smartphone shows signs of leveling off. As just one example, of AT&T's nearly 10 million new cellular subscriptions in 2017, two-thirds (6.4 million) were to automobiles. As recently as 2014, connected cars didn't even register on AT&T's new subscriber rolls.

The point is that even if autonomy is still mostly in the R&D, balky-science-project phase, vehicle connectivity is increasingly here today. And that's good news since connected cars deliver a meaningful subset of the societal upside promised by their eventual fully autonomous future selves, especially when it comes to safety, traffic management and navigation.

But beyond the dashboard, as the world becomes vastly more urban, the real star when it comes to transportation, including mobility services, and connected and eventually autonomous vehicles, may well be the smart cities. All the many benefits that are ascribed to our self-driving future – lower carbon emissions; remade, human-scale cityscapes with parking lots giving way to parks; dramatically lower cost-per-mile traveled; personalized door-to-door services available to a much wider swath of the population – perhaps depend more than anything else on an increasingly intelligent civil infrastructure.

Some of the gains and goodness are here now and just because of burgeoning vehicle to infrastructure connectivity. For example, reactive traffic signals and traffic management software are helping the Seattle Department of Transportation reduce travel time on so-called "worst commute days" by a whopping 40 percent along a particularly congested corridor. The benefits add up dramatically over time, especially in a city with some of the nation's worst traffic. In an average year of 260 days of commuting, shaving just 10 minutes a day gives a Seattleite back 86 hours annually.



And more benefits still, especially related to safety, come from so-called connected vehicle technology that links vehicles, smartphones and traffic signals. Here's how it works: a 5.9 GHz dedicated short-range communications (DSRC) device in the car (either factory-installed or aftermarket, or possibly a 5.9 GHz-enabled phone carried by the driver) broadcasts basic data about vehicle location, direction, speed and a host of other information. This data is picked up by roadside equipment that in turn sends traffic signal countdown information back to nearby vehicles, warning drivers of potential red light violations, or of pedestrians, cyclists and even animals on the road ahead. The technology can go so far as to suggest the car initiate automatic braking and collision avoidance based on calculations about a potential crash with a moving object ahead.

Siemens connected vehicle technology is being tested in New York City, Tampa, Ann Arbor, Columbus, Tampa and most recently in Las Vegas. The United States Department of Transportation Highway Traffic Safety

Administration estimates that 80 percent of crash scenarios involving non-impaired drivers could be addressed with this sort of two-way, vehicle-to-infrastructure communication.

Expect the story to get that much better as autonomous vehicles begin showing up in these cityscapes, with radically improved abilities to make decisions in real-time based on fused high-resolution sensor data about the surrounding environment and powerful AI and neural networks. Smart city and connected car technologies will augment what these robot cars can do on their own, especially as more vehicles are plugged into the network. Metcalfe's law says that the value of a telecom network increases proportionally to the square of the number of connections. And that law holds true whether these connections are from human users of laptops, tablets and phones, or from AI-powered cars, trucks and shuttles.

From Tesla to the world's largest automakers, nearly all manufacturers have promised to launch autonomous cars within a decade. Public trust in the technology, which had slowly risen in recent years, hit a speed bump in early 2018, likely due to a spate of well-publicized fatalities involving self-driving cars, including the world's first pedestrian fatality. A much-cited April 2018 survey by AAA found that 73 percent of Americans don't trust autonomous vehicles, up from 63 percent in late 2017. Some of the reticence may come from an uncertain legal and regulatory environment, though likely some of the on-the-record concerns are more than the realm of dystopic science fiction than fact. Jack Gillis, director of public affairs for the Consumer Federation of America told The Verge: "We live in a new reality where autonomous vehicles can be weaponized. On AV cybersecurity, Congress is simply asleep at the wheel."

Of course the last tectonic shift, from the horse to Henry Ford and his vision for affordable cars for the masses, wasn't without its hiccups and notable critics. Winston Churchill, for example, declared that "I have always considered that the substitution of the internal combustion engine for the horse marked a very gloomy milestone in the progress of mankind." (It bears noting that Sir Winston, an early member of the Royal Automobile Club, was known as an avowed automobile enthusiast who used his advance for his World War I memoir, well over $150,000 in today's dollars, to buy a Rolls Royce Cabriolet.)

Sure, there is no shortage of self-driving buzzkills even now, likely because the hype cycle is in full swing when it comes to the autonomous future. However, the billions of dollars of pre-orders for the Tesla Model 3 suggest that enthusiasm for cutting-edge technology remains as strong as ever. And the example of autonomous technologies which have taken root in aviation, shipping and rail service over the years, mostly unquestioned by the public, suggest an example that might be followed in the auto industry, once the marketing frenzy dies down and the regulators wake up.

For now, across the spectrum of manufacturers and suppliers, massive investments are being made that are helping to solve previously unassailable problems in various technical domains. Here are five such areas to watch:

1. Low power design and analysis

Autonomous driving prototypes outfitted to the gills with sensors, chips and roof-mounted spinning LIDAR sensors, use 40 laptops of power. Among other problems, this unwieldy assemblage vastly restricts range since many of the vehicles are electric as well. The task is to create high-compute, low-power chips, and to optimize batteries and sensor fusion systems for range and longevity with rigorous CFD and other simulation.

2. AI/machine learning, visual and neomorphic computing
Autonomous driving generates vast amounts of data, easily petabytes per year based on the average amount of driving done in the United States. A new computing paradigm is needed that can handle the deluge and deliver real-time, intelligent data processing, analysis and decision making.

3.Wiring complexity and weight
Today's cars have more than 1.5 miles of wiring, and autonomous driving requires more still due to LIDAR, radar and camera sensors. The twin trend of electrification matters here too since wiring harnesses for electric vehicles (EVs) already are more than 20 percent heavier than those for internal combustion vehicles. And compared to their fossil fuel counterparts, EVs have 6-10 times more semiconductor content, as well, further impacting complexity and weight, the optimization of which is vital to implementing acceptable driving ranges.

4.High-speed, real-time communication
Many predict autonomous vehicles eventually will be rolling offices or entertainment pods, loaded with apps and services allowing drivers to work, connect with family and friends or stream their favorite content. All this will happen as the car navigates safely down the road, avoiding hazards while path-planning in such a way to minimize traffic congestion. The infotainment and smart city use cases demand a vastly upgraded car data networks and buses, and a faster, lower latency connection to the world at-large. Eventually, the arrival of 5G connectivity may be a boon to the autonomous world, not only supporting any app or service a passenger could want but also the massive bandwidth requirements associated with vehicles navigating in real-time. And the more immediate deployment of DSRC 5.9 GHz will certainly spur true vehicle-to-vehicle connectivity, enabling cars to learn from each other. A host of related smart city applications also will benefit from reliable, low-latency high-speed DSRC cellular networks, further overhauling the urban mobility experience. For example, DSRC has proven robust in vehicle-to-traffic-management-center communications in various Siemens Intelligent Transportation Systems deployments mentioned earlier, in Seattle and elsewhere.

5. Virtual vehicle verification
Given the in-effect unlimited number of driving scenarios and traffic, autonomous driving requires hundreds of millions if not billions of miles of testing. A whole range of advanced, simulations will be key to meeting this goal, including physics-based simulations of individual sensor data and fusing such simulated data from multiple sensor modalities (LIDAR, radar and cameras) to test and refine algorithms critical for object recognition and driving policy.

Progress is being made across these and other domains, so the long-term autonomous future remains bright even if the industry gets set to pass through some resetting of expectations if not a full-fledged trough of disillusionment. For now, it's no surprise that some of the earliest deployments of self-driving shuttles are in the context of relatively narrow geo-fenced routes where the service that's delivered – pleasant, low-latency travel that eliminates the need to hassle with urban parking – depends as much on synchronous and asynchronous monitoring and nearby service stations as on the vehicle's ability to sense and navigate its local environment at relatively low speeds.

Even the decidedly tech-free considerations of these early deployments – wide median-separated boulevards preferable to narrower two-way streets, environments with dedicated bike lanes and pedestrian thoroughfares/sidewalks preferable to streets where modes of transport aren't segregated – suggest just how important infrastructure is, smart or otherwise.

Smart cities will never compete with autonomous vehicles for attention, either good or bad. However, our improved transportation future may well depend as much on instrumented, connected urban infrastructure as on ever more powerful computers on wheels. And surely it's fun to imagine what's over the horizon, where these two related lines of progress will invariably intersect.

Siemens PLM Software

Headquarters
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 972 987 3000

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 314 264 8499

Europe
Stephenson House
Sir William Siemens Square
Frimley, Camberley
Surrey, GU16 8QD
+44 (0) 1276 413200

Asia-Pacific
Suites 4301-4302, 43/F
AIA Kowloon Tower,
Landmark East
100 How Ming Street
Kwun Tong, Kowloon
Hong Kong
+852 2230 3308

About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of software solutions to drive the digital transformation of industry, creating new opportunities for manufacturers to realize innovation. With headquarters in Plano, Texas, and over 140,000 customers worldwide, Siemens PLM Software works with companies of all sizes to transform the way ideas come to life, the way products are realized, and the way products and assets in operation are used and understood. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm

About the author

Andrew Macleod is director of automotive marketing at Siemens, focusing on the Mentor product suite. He has more than 15 years of experience in the automotive software and semiconductor industry, with expertise in new product development and introduction, product management and global strategy, including a focus on the Chinese auto industry. He earned a 1st class honors engineering degree from the University of Paisley in the UK, and lives in Austin, Texas. For more of his writing, see his whitepaper “Safety first – On meeting the only self-driving requirement that really matters.” Follow him on Twitter @AndyMacleod_MG.

www.siemens.com/plm

71490-A6 6/18 A