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Telematics Industry
Insights by
Michael L. Sena

THE DISPATCHER

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5th Annual SmartDrivingCars Summit

The focus of the 5th Annual Princeton SmartDrivingCars Summit is deployment of Safe, Equitable, Affordable, Sustainable, High-quality Mobility seeded in a Trenton, New Jersey Operational Design Domain. In the lead article, I provide the background to the Summit, its original and eventual objectives, and what the positive outcome the Summit means for moving forward with the goal of mobility for everyone.

Dispatch Central

***Someone lit a fire under NHTSA** – With a full-fledged Administrator finally confirmed, NHTSA decided it was also time to take the driver assistance tem bull by the horns. All auto OEMs were directed to report on incidents that occurred while their systems were active.*

***THE ECONOMIST continues to get tolls wrong** – They finally understand that urban area transport does not work like it did a century ago, along spokes to the hub. But they cannot give up the idea that congestion charging is not the miracle cure for all mobility shortcomings.*

Musings of a Dispatcher

***Past, Present, and Future** – The Evolution of digital maps and ADAS.*

It has been twenty years since the ADASIS Forum was founded, and Forum members took the opportunity to celebrate their accomplishments. As a founding member, I was invited to join them and offer my views on where the industry is headed.

The first issue of *THE DISPATCHER* was in November 2013. I reported on a telematics conference, on call center services, what car companies are doing with their connected car programs, what insurance companies are doing with car companies. I saved some space for big data and vehicle-to-vehicle communications. When I decided to print out all of the issues that I have written since then and bind them into a book, including up to and including March 2022, there were fifteen hundred pages. That was too many pages for a single book, so I divided them into three. The first book contains all of the six-page issues, up to October 2018. The second and third books contain the longer newsletters with the current two-column format. I'm a printed page kind of person. I read neither books nor magazines on screens, and I prefer re-reading my own newsletter on paper. So the three volumes are now on my bookshelf, waiting for me to pick them up and leaf through the pages. We shall see if there will be a fourth.

THE DISPATCHER

Telematics Industry Insights by Michael L. Sena
July 2022 – Volume 09, Issue 08

Princeton Fifth Annual SmartDrivingCars Summit

5TH ANNUAL PRINCETON SMARTDRIVINGCARS SUMMIT
2-4 JUNE 2022
PRINCETON, NEW JERSEY

*The focus of the **5th Annual Princeton SmartDrivingCars Summit** is deployment of Safe, Equitable, Affordable, Sustainable, High-quality Mobility seeded in a Tren-ton Operational Design Domain that is readily expandable, once successful, throughout Mercer County, NJ. It is repeatable in the entire State of New Jersey, delivering a service that can readily serve many of New Jersey's daily 30+ million non-walking person trips.*

The Summit is organized by PRINCETON UNIVERSITY Professor Alain Kornhauser with cooperation of the CITY OF TRENTON, the N.J. DEPT. OF TRANSPORTATION, and the Office of Governor Murphy. The goal is to facilitate the scalable deployment of highly-assisted driving and driverless mobility of people and goods for safer streets, stronger communities, and more opportunities.

Here is the Mayor of Trenton, second from right, with Trenton residents during the SmartDrivingCar Summit preview tour.

Safe, Equitable, Affordable, Sustainable, High-quality Mobility for Everyone

THIS WAS THE theme of the **5TH ANNUAL SMARTDRIVINGCARS SUMMIT** held in Princeton at the beginning of June. I was not able to travel back to the U.S. to take part in the Summit after having been there just a few weeks before, so I will not be able to give you a first-hand report as I have for the three previous Summits. My first visit back to the U.S. in three years had been planned to coincide with the original date for the Summit, in early May. My plans were too far along when events conspired to cause a change to the Summit date, from early May to early June. However, I have played a small part in the planning for this event, and I spent two days in Princeton with Professor Alain Kornhauser during my trip. While there, the venue—but not the date—for the Summit had to change once again.

What I am going to try to do is to provide the background to the Summit, its original and eventual objectives, and what the positive outcome the Summit that was held in Princeton on the 2nd to the 4th of June 2022 means for moving forward with the goal of mobility for everyone.

A service for people who really need a ride

If you can afford to own your own car, if friends or family are willing and able to take you everywhere you need and want to go, if mass transit satisfies all of your travel requirements, or if you have the money to take a taxi whenever and to wherever you need to travel, you are not among those for whom this service is intended, at least not at first. This is the overriding premise for the work that has been undertaken by those involved in *SmartDrivingCars* from the time of its inception, and it is the foundation for all work moving forward.

After four years of discussing how a mobility service based on driverless vehicles could be provided for those who really do need a ride, it was time to prove that the concept could work. The 5TH SDC SUMMIT was intended to serve as

the kick-off for a proof of concept that would show the concept's feasibility from social, economic, and technological perspectives. From the time that planning started for the 5TH SUMMIT, which was immediately following the end of the 4TH SUMMIT in April, 2021, it was the goal to have the entire event in the location for the test, Trenton, New Jersey.

Trenton was chosen as the ideal place to make the test for a number of reasons. It is the capital of New Jersey where the Governor's office and the NJ DEPARTMENT OF TRANSPORTATION are located. It is only 12 miles (19 kilometers) from Princeton where the CARTS team is based. CARTS (CORPORATION FOR AUTOMATED ROAD TRANSPORTATION SAFETY), is a 501(c)(3) organization[1] established by PRINCETON Professor Alain L. Kornhauser to manage the driverless car project in Trenton, Trenton MOVES, and eventually in other areas. Most importantly, Trenton is an excellent choice for a proof of concept because a large percentage of its 82,000 residents (down from its peak of 128,000 in 1950) do not have access to their own car.[2] Fully 29% of occupied housing units have no vehicles available. This compares to 11.2% for the entire state, and 8.5% for the entire country. Occupied housing units with only one vehicle available is 38.6% for Trenton, 33.7% for the state and 32.5% for the country. The figures for two vehicles per occupied housing unit are 24.4% for Trenton, 36.1% for the State and 37.1% for the country.

Trenton has a larger percentage of residents who have a household income that is close to the official poverty level, and many of them have some form of disability. The national average for persons in a household with a disability is 12.7%. For New Jersey, it is 10.7%. For Trenton it is 15.2%. 38.5% of those with a disability in Trenton are over 65 years of age, compared to 30.6% for the state, and their median income is $17,583, compared to $30,086 for the state. Median household income for Trenton as a whole is $37,002, compared to $82,245 for the state and $64,944 for the country. The poverty threshold for a family of four is $26,496.

Trenton meets another important criteria: journey to work. The average commute time in the U.S. is 26.9 minutes, with 4.6% of workers using public transportation. In New Jersey, the average commute is 32 minutes and 10.8% use public transportation. New Jersey's location explains the longer commute and higher public transportation usage. It is sandwiched between two of the country's largest cities, New York City, number one, and Philadelphia, number six, the former across the Hudson River and the latter

1. A 501(c)(3) organization is recognized by the U.S. Internal Revenue Service as a nonprofit that is organized and operated exclusively for exempt purposes set forth in section 501 (c) (3), and none of its earnings may inure to any private shareholder or individual.

2. The U.S. Census asks how many households have access to vehicles, in combination with where people commute to and from, and whether they commute with a personal vehicle to help transportation planners create mass transportation and metropolitan plans that are compliant with various regulations. https://www.census.gov/acs/www/about/why-we-ask-each-question/vehicles/

The State of New Jersey

across the Delaware. Pushing up the NJ average is the fact that the commute time to NYC is 81.6 minutes, and only 26.6% of those commutes are by car. For Trenton residents, their average commute time is 25.6 minutes, and 8% use public transportation, almost double the national average but lower than the state average.

Trenton MOVES: By, for and in the community

Trenton MOVES (*Mobility & Opportunity Vehicles Equity System*) is the name given to the test project that will explore during a two-year period the feasibility of deploying vehicles, which can eventually be driverless, for delivering affordable mobility.[3] A planned 100 vehicles will provide on-demand, shared service for up to eight passengers per vehicle within the 8.2 square miles (21.25 square kilometers) comprising the city, with extensions beyond the city limits to important work, commercial and service facilities. This is the project's operational design domain (ODD). Trenton MOVES is led by the NJ GOVERNOR'S OFFICE, the *NJ DEPARTMENT OF TRANSPORTATION*, the CITY OF TRENTON, and CARTS.

3. https://talktrenton.org/trenton-moves

Figure 1: Proposed Phased Operational Design Domains and Conceptual Design of Mobility Hubs for the Trenton Affordable Mobility Project.

In December 2021, the *NJ DEPARTMENT OF TRANSPORTATION* issued a *Request for Expressions of Interest* (*RFEI*) for the *Trenton MOVES* Project. The *RFEI* was sent to any organization requesting a copy, and its objective was to encourage leading companies working with self-driving/driverless vehicle technologies to assist them in deploying their systems in New Jersey and to focus their attention on the vision of affordable, high-quality, on-demand mobility. The GOVERNOR'S OFFICE committed to provide vision, leadership and guidance in order to successfully attract $75 million from the U.S. DEPARTMENT OF TRANSPORTATION for operating the test, including paying the salaries of attendants in the test vehicles.

There were twenty responses, of which three were judged to be capable of delivering a solution: MAY MOBILITY (Texas), NAVYA (France), and BEEP (Florida). *Waymo* (Alphabet-owned), *CRUISE*

(GM-owned), *Argo AI* (Ford/VW own 40% each), *Aurora Innovation* (public), and Zoox (*Amazon*-owned) chose not to respond. May Mobility provided a vehicle to the Summit from Thursday through Saturday which was used for demonstrations, both in Trenton and in Princeton.[4]

During the past year, the CARTS team, led by its Executive Director, Jerry He, have been working with the Trenton Mayor's Office and community organizations to determine the extent of need for and interest in mobility alternatives to private cars and current public transportation options. The team met with groups of residents as well as with the superintendent of schools, the head of public safety, members of the city council, special needs mobility providers and other organizations. Both the need and interest were found to be very high. For those who do not have access to a car and are dependent on public transport, getting to where they need to go each day is a constant struggle, and they would welcome an alternative that offered more frequent service to destinations all around the city and to working and shopping centers at the edges of the city. Here are a few of the interviews:[5]

Carla is a disabled resident of one of the publicly-subsidized residential areas in Trenton. He is physically challenged as a result of car accidents and hesitant to drive. She relies on her sister for transportation, but is unable to attend physical therapy treatments as frequently as she should because of the lack of transportation. She sees the opportunity of enjoying a more active life with Trenton MOVES.

Tanya is a social worker and mother of three. She takes care of children in an afterschool program, and sees that participation is uneven because of the lack of transportation, or parents concerned for their children's safety do not allow them to walk on their own. She spends a large sum of her money transporting herself and her family, and thinks bus rides take too long and make it hard for her to get to work on time. Taxis are too expensive. She sees Trenton MOVES as a way to save her money.

Amanda is a resident of Donnelly Homes, another publicly-subsidized residential area, which was to be the site of the Summit. Amanda would like to work in a warehouse in nearby Robbinsville, where Amazon, Mercedes-Benz, Kinko, Walmart and FedEx have workplaces. However, she cannot afford the $48 commute with Uber/Lyft, even though it is only sixteen minutes. She wants to use the Trenton MOVES service as soon as possible

4. https://www.youtube.com/watch?v=II0R3LurjPk

5. Information provided by CARTS Executive Director, Jerry He.

What emerged from these meetings and discussions was a concept for the pilot with fifty pick-up and drop-off points called "kiosks" within five minutes or less walking distance from any location in Trenton. These would need to be supplemented with door-to-door pick-up and drop-off for nonambulatory riders, but the thinking, which needs to be tested, is that by having meeting points that provide both shelter and information, ride sharing can be facilitated, further reducing costs of operation. Routes are not fixed, as is the case with bus service, and those sharing a vehicle would be travelling to the same destination or destinations along the optimum route to the farthest destination. Service would run from 6:00 a.m. to midnight seven days a week. The team has estimated that there will need to be 100 vehicles to provide a satisfactory level of service. A preliminary fare has been set at $0.40 per passenger mile, although determining what a fare should be will also be an important part of the test.

Choosing a location for the Summit

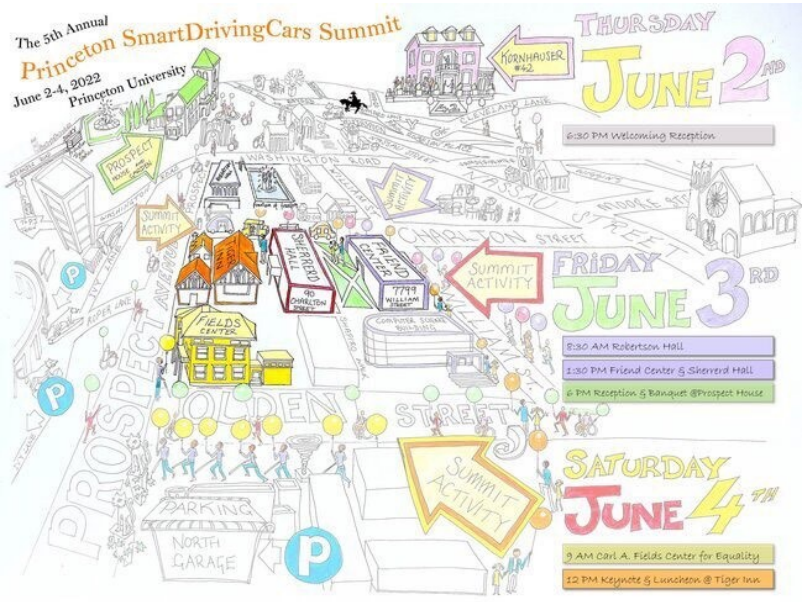
A place in Trenton close to where many of the users of the service would reside was the obvious location to hold the Summit. First choice was Trenton Central High School. It has the meeting facilities and auditorium where sessions could be held, and it has both large paved and grassed areas where vehicle demonstrations could be conducted and exhibitors could set up their displays. Everything looked good until someone at the high school told the Mayor's Office that the auditorium would be used for administering college entrance exams on the planned date for the Summit, and any use of outside facilities would not be allowed. This is when it was decided that the Summit had to move from May to June.

The SDC Summit as an event on the grounds of Donnelly Homes would have looked something like the scene below.

CARTS, in consultation with the other organizers of Trenton MOVES, then discussed having the entire event at Donnelly Homes. This seemed like a more ideal location because many of the eventual shuttle riders would be coming from this residential area. The plan was to make it an event, not just a series of panel discussions, exhibitor booths and demonstrations. It was going to be a fair which would attract people of all ages from the entire city. What better way to have a kick-off for the pilot than to have as many potential users of the service experience the concept right from the beginning. It would be a perfect opportunity for people to express their opinions, offer suggestions for improvements, and sign up as test volunteers?

A month before the Summit, during the time I was in Princeton visiting Alain, there was a online meeting with the Summit organizers and the police to discuss security. It was the first time the Chief of Police was in one of the planning meetings. His reaction was unexpected. He said it would be difficult to guarantee the security of those participating in the outdoor event from any group intent on disrupting it. He talked about the possibility of rival gangs using the event to exercise their territorial claims.

This ended any thoughts of holding the Summit at Donnelly Homes. What about returning to the High School? That door was also closed due to a clash with other planned activities. There was only one alternative left: hold the entire Summit at Princeton. Venues that had been reserved were finally booked, panel participants were informed where they would be meeting, and the Summit was successfully held between the 2nd and 4th of June.



All's well that ends well

The 5TH ANNUAL SMARTDRIVINGCARS SUMMIT was held at facilities in Princeton, starting with the traditional reception at Alain Kornhauser's home hosted by Alain and his gracious wife, Elizabeth. However, the CARTS team was not ready to give up on linking the Summit to Trenton, so on Thursday morning they had arranged for a press conference outside Trenton City Hall with Mayor Reed

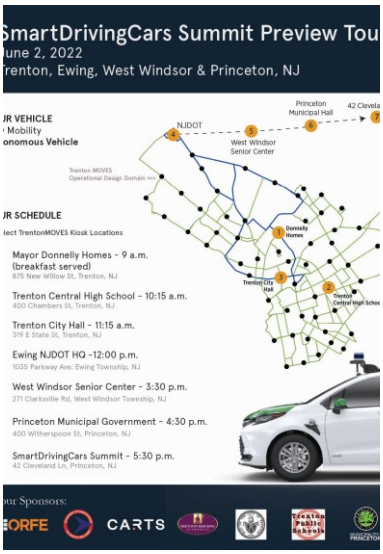
Gusciora making an address to the press officially introducing the start of Trenton MOVES. MAY MOBILITY'S Daisy Wall brought their car to Trenton, and, following the press conference, it was used to demonstrate the Trenton MOVES concept at Donnelly Homes, Trenton High School and other sites around the city. I don't know if Carla, Tanya, or Amanda got to take a ride in the vehicle, but according to Ken Pyle, who documented the entire three days of the Summit and took the photos, lots of Trenton residents did and gave a smile and thumbs up to the experience.

I was able to listen in on some of the presentations. I heard Florida State Senator Jeff Brandes, Bernard Soriano of the California Department of Motor Vehicles and former director of the Arizona DOT Kevin Biesty. Brandes and Biesty said that their states decided not to create new legislation to allow driverless testing, while Soriano explained how California has taken a much more active position in registering, licensing and monitoring the tests. New Jersey hasn't take a positon on this yet. As I have stated in this newsletter, if state laws are going to be changed, they should be done in concert with existing regulations that determine how vehicles can be driven on the roads of America.

Dr. Robert Hampshire, Assistant Secretary of Research and Chief Science Officer of the U.S. Department of Transportation gave a keynote speech. He stress the importance of community engagement in any tests performed in a community, and he reinforced the message that safety is the number one priority for implementing any new automotive technology.

For CARTS, the City of Trenton and all those who will be involved in Trenton MOVES, the real work starts now. I will keep you posted on its progress.

Trenton Mayor Reed Gusciora, center, spoke at a press conference Thursday, the 2nd of June at City Hall with Princeton Professor Alain Kornhauser and Daisy Wall of MAY MOBILITY on the first day of the Fifth Annual SmartDrivingCars Summit and the kick-off for Trenton MOVES. The preview tour began at Donnelly Homes with the May and Jilani Garrett, Executive Director of the Trenton Housing Authority, in attendance. See the route of the tour below.



Dispatch Central

Someone lit a fire under NHTSA

NHTSA RELEASED A report in June 2022 summarizing the results of data collection efforts it has made to identify crashes which have occurred while driver assistance systems were active in vehicles. Data are from 1 July 2021 through 15 May 2022. It was a **Standing General Order** issued last summer requiring automakers to report crashes involving driver assistance systems that was the legal basis for collecting the data.[6] Here is the relevant passage from the Order:

NHTSA's statutory mandate includes the exercise of its authority to proactively ensure that motor vehicles and motor vehicle equipment, including those with novel technologies, perform in ways that "protect the public against unreasonable risk of accidents occurring because of the design, construction, or performance of a motor vehicle, and against unreasonable risk of death or injury in an accident." 49 U.S.C. § 30102(9).3 Both Automated Driving Systems (ADS) and Advanced Driver Assistance Systems (ADAS) are "motor vehicle equipment" subject to the requirements of the Safety Act. See id. § 30102(8). Given the rapid evolution of these technologies and testing of new technologies and features on publicly accessible roads, it is critical for NHTSA to exercise its robust oversight over potential safety defects in vehicles operating with ADS and Level 2 ADAS.

OEMs were provided with a portal and a form that could be filled in online. (The form is included at the end of the document referenced in the sidebar.) There were four criteria which determined whether an OEM had to file a report:

1. A subject vehicle (whether equipped with ADS or Level 2 ADAS) is involved in a crash on a publicly accessible road in the United States (including any of its territories);
2. The ADS or Level 2 ADAS on the subject vehicle was engaged at any time during the period from 30 seconds immediately prior to the commencement of the crash through the conclusion of the crash;
3. The crash results in any individual being transported to a hospital for medical treatment, a fatality, a vehicle tow-away, or an air bag deployment or involves a vulnerable road user; and
4. Notice of the crash is received ten (10) calendar days or more after being first served with Standing General Order 2021-01.

6. Incident Reporting for Automated Driving Systems (ADS) and Level 2 Advanced Driver Assistance Systems (ADAS) issued by the U.S. Department of Transportation NHTSA. https://www.nhtsa.gov/sites/nhtsa.gov/files/2021-08/First_Amended_SGO_2021_01_Final.pdf

NHTSA has been under pressure from legislators and the press to investigate why Teslas have been involved in so many fatal accidents. Tesla crashes, extending back to Joshua Brown's death in Florida in 2016, have been the subject of intense media and judicial attention. President Biden appointed Steven Cliff as his NHTSA Administer upon assuming office in January 2021, and Cliff followed through with the order to collect data, not just on Teslas but on all vehicles operating within the U.S. and its territories.

Here's what the numbers show. During the ten months, 392 crash reports were filed by ten OEMs.[7] Of those, 273 were reported by Tesla. That's 70% of the total. Honda reported 90 incidents, Subaru reported 10, and the rest reported 5 or fewer. Among the incidents reported, six people died (five in Teslas) and five were seriously injured. NHTSA has been investigating 35 Tesla crashes when Autopilot has been engaged resulting in 14 deaths dating back to 2014.

7. The OEMs filing reports were BMW, FORD, GM, HONDA, HYUNDAI, PORSCHE, SUBARU, TESLA, TOYOTA, and VW.

NHTSA has also used the order to investigate data on crashes or incidents with cars being used by companies to test driverless vehicle operation, most of which occur in built-up areas with cars moving a low speeds. These include field tests being performed by *Waymo*, CRUISE, ARGO, among others. These are not included in the 392 crash reports. This group of vehicles were involved in 130 incidents, one of which resulted in a serious injury, 15 in minor-to-moderate injuries and 108 with no injuries.

"The data may raise more questions than they answer"

This is what Administrator Cliff said speaking at a news conference in connection with the report's release. He's right. My first question is: Where are Mercedes-Benz and Volvo? These two companies have been leading the way with ADAS for over twenty years. Their cars are connected to back-end telematics systems which receive notification whenever a crash sensor is triggered, so they have the data. Do their systems work so well that they actually did not have a single incident in the U.S. during the past ten months when their ADAS functions were active? If so, then that in itself is a great advertisement for their systems.

My second question is why there is such a difference between Tesla and all the others. If its lane keeping and crash avoidance systems are so much worse, how can it be allowed to operate on any roads? Or is it just the case that Tesla decided that it had to report everything and the others were more lax? One article covering the report stated incorrectly that "companies such as Tesla

collect more data than other automakers, which might leave them overrepresented in the data." Except for FORD, all of the OEMs reporting data have back-end systems for receiving data from vehicles, particularly in case of a crash. So does STELLANTIS, VOLVO, MERCEDES-BENZ, and JLR, who are not represented in the report. HONDA is an exception. A HONDA spokesperson said that its reports were based on "unverified customer statements regarding the status of ADAS systems at the time of the reported crash".[8]

Well done so far, NHTSA. It's tough to make up for four lost years under the former guy's administration. I asked Princeton Professor Alain L. Kornhauser for his view on NHTSA's actions. *"It is a good beginning,"* he said. *"However, a lot of the data is redacted and the sampling bias associated with the widely varying mechanisms by which the various OEM source the data is extremely challenging."*

Now the hard work has to start. NHTSA needs to assemble all the troops in NHTSA, including the team working on NCAP. This is not the time for the NCAP group to run their own race, setting up separate criteria and test routines to evaluate driver assistance functions. NHTSA must determine what should be added to or clarified in the *FEDERAL MOTOR VEHICLE SAFETY STANDARDS*. Are there *FMVSS* standards covering all of the new functions which the OEMs are adding, or are the OEMs being given too much latitude to push the boundaries of *FMVSS* and create functions that stretch the regulations too far?

Second, you must sit down with UNECE WP.29 to determine what actually needs to be done to have a single and inclusive view of all driver assistance systems. This is where the data assembled by NHTSA can be of the greatest assistance.

Third, while it is going to take Administrator Cliff's energy that could be more productively used on other matters, he needs to have a conversation with legislators who are making this into another political football. One group of senators sent a letter to NHTSA saying they were "*deeply troubled*" by the data and called for NHTSA to "*use all its investigative and regulatory authorities to shed needed light on this out-of-control industry and impose guardrails to prevent more deadly crashes*." If anyone is "out-of-control" it is the U.S. congress. NHTSA under Cliff finally appears to be doing its job; let them get on with it.

8. *THE WASHINGTON POST*. *Teslas running Autopilot have been in roughly 273 crashes in less than a year*. June 15, 2022.

The Economist: Right analysis, wrong solution

I AM WAITING for the masked journalist at The Economist to finally retire. Who is he? He hauls out his trusty shibboleths every time he sees an opportunity to write about roads and transport. Congestion charging is his answer to all that ails the movement of people in and around urban areas. He reminds me of Gus Portokalos (played by Michael Constantine), father of the bride in the 2002 movie, *My Big Fat Greek Wedding*. Gus believed that Windex was the magic cure to every problem. The Economist journalist's claims that congestion charging cures everything from the equivalent of diarrhea (too many cars on the roads) to constipation (blocked roadways).

It was a *Leaders* article in *THE ECONOMIST MAY 21ST 2022* issue that fired me up this time: *"Travel after covid-19: From asterisks to spiderwebs"*. Ridership is down on all public modes of transport, most of all on the undergrounds/subways. In New York City, the subway is two-thirds as busy as it was before the pandemic. In London, the underground is running 40% below pre-covid on weekdays, but it is only down 20% on weekends. Bus and car ridership in the London area is down during the weekdays, but cars are at pre-covid levels on weekends, and buses are down only 15% on weekends compared to 20% on weekdays.

Our invariant journalist concludes that travel patterns have now changed permanently (i.e., forever). *"Rush-hour commuting has collapsed,"* he says. *"Well-paid workers in the knowledge economy are working more from home—something they had started doing before covid—and more trips are being made between places outside of the urban hub, rather than to and from the urban hub."* He says further that *"urban travel is no longer radial",* in-and-out of a city center to-and-from satellite communities, like spokes on a wheel. "*It is now comprised of many different types of trips between satellites and isolated destinations."*

It has taken him quite a long time to recognize a phenomenon that has been prevalent for over twenty years. I wrote about it in my 2008 book, Beating Traffic. Even back then, 60% of the jobs in metropolitan areas were outside of the central hub, in the suburbs and exurbs. Even back then, cars had supplanted mass transit for most trips; not just work-related trips, but all types.

Now that he has updated his thinking, what does he suggest? *"Instead of building more radii, along the lines of London's new Elizabeth Line, or the tunnel being dug at huge expense under the East*

River in New York, they (governments) should make it easier to travel around cities, from one satellite to another." Well, that's exactly what cars have been doing for the past fifty years, but he has other ideas. *"For the time being, governments will have to shell out to keep public transport systems from collapsing. But another source of money will eventually have to be found to replace lost fare revenue*. (Here it comes.) *The best one is road pricing. Countries should stop holding referendums on congestion charging schemes and get on with creating them."*

Here is the statement which, for me, witll live in infamy, long after the ink on this journalist's quill pen has dried up: *"Road pricing ought to be primarily for managing demand and raising money for public transport. Other levers—regulations, subsidies, fuel duty—can be used to get people out of the most polluting vehicles."*

I guess Eton didn't teach either civics or basic economics when our journalist was in school. He preaches like a missionary who is convinced that everyone who doesn't worship at his chosen altar is a misguided, unfortunate heathen. If 80-90% of people use cars to solve their daily transport puzzle, why should they also be financially penalized, expecially for the purpose of funding a mode of travel that does not meet their needs—nor fully meet the needs of the 10-20% who must use it because it is the only alternative to having their own car? And when car drivers are milked dry, will the state start to tax sidewalk walkers or bike lane bikers or church goers or pub frequenters to pay for public transit?

If we believe that public transport in urban areas is a public good that cannot pay for itself through the fare box, then everyone who lives in the service area covered by that public transport should contribute to its financing, whether or not they drive a car, ride the bus, subway, trolley, scooters or whatever will come next. Taxes pay for public services that are used by everyone. Garbage trucks, ambulances, police cars and other public service vehicles

use roads. Firemen don't take the bus or trolley to a fire. A person suffering a heart attach isn't going to bicycle to the hospital.

What troubles me most about *THE ECONOMIST* journalist's attitude is his complete lack of understanding of and appreciation for the relationship between ability to pay for transportation and the need to be able to make journeys in the fastest possible and least expensive manner. Financially disadvantaged people need to get to places just as much—if not more—than rich folks who can afford to pay whatever level of congestion charging fee that is demanded. Now that *THE ECONOMIST* journalist understands that public transport does not work for the journeys that people want and need to make, why on earth make it more costly to use the transport mode that does do the job for most of the people? Why not consider an alternative, like the one described in the lead article to this issue?

The boys and girls pumping gas in New Jersey, the last 'Service Stations', don't dress up like this Swedish service station attendant shown in a photo taken on a cold winter day in the 1960s. It hangs on the wall of our favorite konditori in Strängnäs. Attendants were already gone by the time I arrived in Sweden in the late '70s.

ARGUMENTS WILL CONTINUE over whether congestion charges in and around cities are good or bad as long as there is no agreement on the objective of the tolls. Are they simply another method of collecting more money for the city, region or country to pay for public services? Are they intended to reduce the number of cars on the roads, and, if so, to what end? To make it more convenient for the well-off and more costly for the less fortunate; to reduce environmentally harmful emissions; to get more people to work on time? The argument might be settled if we could use a proven method, like Bayes' theorem, which solves for the probability that something will or will not happen. But we need to know what probability we are looking for. I would like to test the objective of delivering increased mobility to those who cannot afford their own car and the probability that this in enhanced with congestion charges.

I am going to make an attempt to apply Bayes' or some other method to this conundrum. If any reader would like to join in, please make your voice heard.

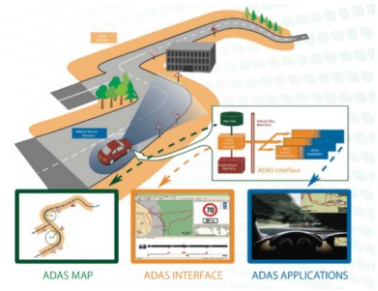
THE NEW YORKER humor

It runs on its conventional gasoline-powered engine until it senses guilt, at which point it switches over to battery power

Musings of a Dispatcher: Eyes on the Back Story

ADASIS Forum 20th Anniversary

On the 28th of June 2022, a group of men and women representing current and past members of the ADVANCED DRIVER ASSISTANCE SYSTEMS INTERFACE SPECIFICATION (ADASIS) FORUM met in Brussels to celebrate the Forum's 20th anniversary. I was asked to address the gathering and give my thoughts on the evolution of digital maps and ADAS towards automated driving.



The ADAS Horizon Concept

The evolution of digital maps and ADAS

"IF YOU CAN LOOK INTO THE SEEDS OF TIME, AND SAY WHICH GRAIN WILL GROW AND WHICH WILL NOT, SPEAK THEN TO ME."

MACBETH, 1:3

WILLIAM SHAKESPEARE

WHERE ARE WE headed with digital maps for cars and trucks and buses and everything else that moves on the ground? Everyone in the room celebrating the 20th anniversary of the *ADASIS FORUM* surely had their own ideas about how to answer this question. On board the vehicle; in the cloud; at the edge; a little or a lot of all of the above. When a dozen-or-so of us met twenty-two years ago at the invitation of NAVIGATION TECHNOLOGIES, early in the *New Millennium,* before 911, it was to discuss one view on where maps should be headed: in an electronic horizon that would act as an additional sensor to see what neither the vehicle nor line-of-sight-limited sensors could see. It would be a pared-down version of the navigation data for roads in the vicinity of the vehicle. Everyone agreed that it was a good idea, we brought it to ERTICO in 2002, and twenty years later, version 3.1 of the *ADVANCED DRIVER ASSISTANCE SYSTEMS INTERFACE SPECIFICATION* is in use in many cars and trucks around the world.

Twenty years ago, discussions about map data in digital form, whether as a navigation aid or as an additional sensor, were about how digital maps would help to improve driving safety, reduce driver stress and increase fuel economy. I heard no talk about removing the human from the driving task, just relieving him or her from some of the driving burden and at the same time making the vehicle's control systems more responsive to the actual road conditions. Did we have WHERE 2 TECHNOLOGIES[9] on our radar screens in 2002, and when it was acquired by Google in 2004, did we see Google Maps arriving a year later? Did we have an inkling that the *DEFENSE ADVANCED RESEARCH PROJECTS AGENCY* (*DARPA*) *Grand Challenge*, announced in 2002 and held in 2004 in the Mojave Desert, would result in billions of dollars spent over the next twenty years on developing and bringing to market driverless vehicle technologies? Or did we imagine in our wildest dreams that one of the two major map producers, NAVTEQ, would be acquired

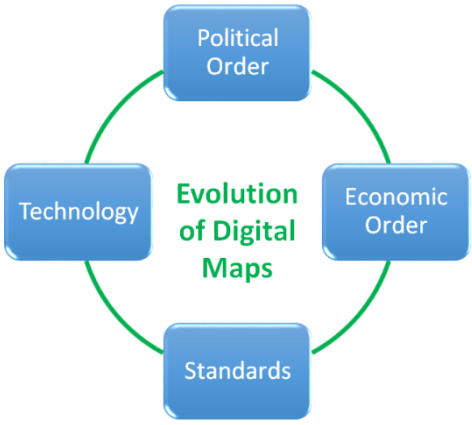
9. WHERE 2 TECHNOLOGIES was an Australian company founded by two Danish brothers that 2 is a GPS navigation service that notifies drivers of upcoming traffic, tie-ups, and automatically suggests alternate routes. It was acquired by Google on the 9th of October 2004. In the same month, Google acquired Keyhole, a geospatial data visualization company (with investment from the CIA), whose application suite, Earth Viewer, emerged as the highly successful Google Earth application in 2005 while other aspects of its core technology were integrated into Google Maps. In September 2004, Google acquired ZipDash, a company that provided real-time traffic analysis.

in five years by a Finnish mobile phone maker named NOKIA who would sell its entire phone business five years later to MICROSOFT for less than it paid for NAVTEQ—and eventually sell the company it renamed to 'HERE' to three German car OEMs? Or could we fathom that a company most of us had not even heard of, *PALM-TOP SOFTWARE*, would buy the other major map data producer.

What is certain is that in the next five, ten, or twenty years we will see developments made with digital maps that have not yet entered the public discourse, and that many of these developments will be made by companies that do not yet exist. But I contend that new developments of any kind are rarely, if ever, spectacular breakthroughs, even if they appear to be. The *iPhone*, called a revolutionary device, was simply the cobbling together of the mobile phone, the Internet, and APPLE's iPod, which was itself a MP3 version of SONY's Walkman. I'm reminded of a recent cartoon in *THE NEW YORKER* in which two cave dwellers are sitting beside a fire. One says to the other: "I didn't invent fire, but I was the first person to put stones around it." We are like turtles sitting on the backs of turtles that came before us, and it's turtles all the way down.

"I didn't discover fire, but I was the first to encircle it with stones."
THE NEW YORKER, MAY 30, 2022

If we want to understand where we are going with digital maps, we have to be aware of what is happening outside the map box.



Innovations and disruptions will come from many different places. Most importantly, we must look beyond technology, to what is happening in society, in business, in governmental activities, and most of all with attempts to define standards. We need to keep our eyes, ears, and minds open for the ***backstories***[10] to both see and understand what is causing the developments.

The road we've travelled to arrive to where we are today has been a long and winding one. <u>At the end of this article</u>,[11] I have provided my narrative of that journey from the time I first drove on to the road fifty-two years ago, back stories and all. Moving forward, from where we are today, there are two forces which are engaged in a battle to decide how location data and location-referenced data shall be used by individuals, by companies, and

10. A 'backstory' is a story that tells what led up to the main story or plot (as of a film).

11. When you have read that section, join me back here to continue from where that narrative ends to what the future holds.

by governments. I don't want to depict the forces as good or evil, white knight or black knight, red party or blue (although the colors are switched in the U.S.). Motives and objectives guiding each force are honorable and just, at least in the eyes of their sponsors and advocates. However, depending on which force prevails (because one force will prevail), there will be significantly different results for everyone working with and using digital maps.

Today, digital maps are indispensable

Where we are today is in a world where digital maps are indispensable. There is at least one map application running on all smartphones, which are all enabled with positioning devices, and many applications rely on map positioning for their operation. Whether drivers use their built-in navigation systems or their smartphone routing application, they rely on digital devices for wayfinding.[12] A large percentage of new vehicles have integrated connectivity allowing the wireless exchange of information between the vehicle and the people in the vehicle with external providers of services. Location-related services range from roadside or emergency assistance, traffic information, road condition information, route planning advice, updates to on-board data—including map data—to many, many more. Various types of sensors have been added to vehicles to augment the driver's ability to see and react to driving conditions and to communicate this information to vehicle systems that can take over the driving task. Map data processed in an electronic horizon is one of these sensors.

12. https://www.thedrive.com/news/44915/automakers-should-just-stop-trying-with-in-car-navigation

Vehicle OEMs and their suppliers are using all of these new connectivity, sensor and data processing capabilities to increase the comfort, convenience and safety of vehicles for their occupants, other vehicles' occupants, and pedestrians, as well as contributing to achieving societal goals, such as reducing fuel consumption and improving traffic management. But these developments have also captured the attention of regulators in both the U.S. and the EU, who now see the possibility to exert greater control over vehicles through their communication channels. The improved functionality of vehicles has also irritated third party service providers who have come to view automakers as competitors rather than their customers, delivering services that were once their sole domain. There are increasing demands from government and third parties to gain access to in-vehicle data and to deliver data directly to on-board systems. What are the forces? They are the same two we encounter every time the role of government is discussed: collectivism vs. individualism; the Leviathan vs. the Humanitarian.

The force for application optimization and data security

This is the force for maintaining the status quo. It promotes the view that automotive companies should decide which systems are installed in their vehicles and which service providers are commissioned to deliver communications, data, and all types of assistance to buyers of (or subscribers to) their vehicles. Today, within the EUROPEAN UNION and with three exceptions, automotive OEMs do have control over these decisions. They decide on the architecture for their communications system, choose the mobile network operator, decide on the what is free to the customer and what is part of a subscription, and where the data is delivered (i.e., to which telematics service provider or to which cloud server). They decide who delivers the map data for ADAS, navigation, and traffic information functions, who provides the software for these functions, and who delivers all types of infotainment services that are integrated into the vehicle. The first exception is the regulation requiring the installation an EU-specified eCall systems in all passenger vehicles. The second exception allows third-party access to vehicle OBD information and vehicle repair and maintenance information.[13] The third is a new regulation that requires vehicles to have intelligent speed assistance (ISA) which can function with sign recognition along with on-board location-referenced speed limit data.

13. On-board diagnostics (OBD) is an automotive term referring to a vehicle's self-diagnostic and reporting capability. OBD systems give the vehicle owner or repair technician access to the status of the various vehicle sub-systems.

OEMs fought all of these incursions. They had their own eCall systems, which they continue to offer and customers continue to prefer to the single-function eCall systems, and they argued that it was unfair for the government to force them to share the fruits of the work they had invested heavily to develop their diagnostic systems. On ISA, they were able to remove a requirement that the system could actually control the vehicle's speed, rather than just providing a warning when the speed is exceeded.

There are two principal arguments used by the automotive OEMs to bolster their case for continued control over data, both coming into and going out of the vehicle. These arguments are clearly stated in a document prepared by ACEA on behalf of the European automobile manufacturers and delivered to the European Commission:[14]

14. https://www.acea.auto/files/ACEA_Position_Paper_Access_to_vehicle_data_for_third-party_services.pdf

- Safety and Security – Data access must occur only through off-board means since direct third-party access to vehicular electronic systems (proposed by the Commission) would jeopardise safety, cybersecurity and vehicle integrity.

- Liability – Having regard to the vehicle manufacturer's obligations under product liability law, the responsibility for ensuring secure end-to-end communication between the vehicle and the off-board facility must remain exclusively with the vehicle manufacturer.

The force for customer choice and data sharing

This is the force for turning over to the owner, subscriber, driver or occupant of a vehicle the right to determine how and by whom the data generated by the vehicle they own or in which they are travelling shall be used. Private companies that feel they have been placed in a disadvantageous position by the automotive OEMs have appealed to governments to extend the laws that opened access to emissions and vehicle repair data to include over-the-air communication of location-referenced data for roadside assistance, insurance, tire status, among others.

In the EU, cover for developing legislation that would require OEMs to open their vehicles, allowing data to flow in and out, as well as allowing third parties access to vehicle functions and resources, is the European Commission's proposal for a Data Act, announced in February 2022. It would regulate who can use what data and under which conditions. The Commission says it will "*increase contractual fairness, make business data available for the common good, and allow easier switching between cloud services*". These goals will be achieved by "*facilitating data flows through technical standards and interoperability*".

DG GROW[15] believes the Data Act must be supplemented with further legislation controlling access to vehicle data, functions and resources. It has issued a *Call for Evidence for an Impact Assessment* of access to vehicle data. Its justification is a belief that the Data Act on its own "*will not go into sufficient details of access to functions and resources, crucial for the provision of data-dependent services in the automotive sector…and to ensure that the Data Act is properly implemented in the automotive/mobility ecosystem, its principles could be complemented by measures to standardize the data sets concerned and to ensure access not only to data, but also vehicle functions and resources*".

The vehicle data component is currently in the consultation stage. Consultation on the Data Act ended in May 2022, and it is now being prepared for presentation to the European Parliament for legislative action. It won't be adopted overnight, but as we have seen with similar proposals, the Commission has a way of getting

15. *DG GROW* - The Commission's *DIRECTORATE-GENERAL FOR INTERNAL MARKET, INDUSTRY, ENTREPRENEURSHIP* and SMEs is responsible for EU policy on the single market, industry, entrepreneurship and small businesses.

its proposals passed by the Parliament, and then all the countries must follow.

How will the data be transferred? The Commission continues to push its 802.11p/DSRC solution for Vehicle-to-X communication, in spite of the fact that both the telecommunications and the automotive industry have moved on to Cellular-V2X. The Commission is also trying to find every way possible to implement its so-called 'national access point' concept which would set up a "*single access point (in every member country) for ITS users to discover ITS data and foster its sharing and re-use*".[16] Both of these initiatives were either denied or put on hold by the European Council when it refused to approved the Commission's proposal to implement its 802.11p-based solution, in part because it felt the Commission was overreaching its mandate and in part because the Commission was promoting a technology solution when it has a legal obligation to remain technology neutral.

16. https://transport.ec.europa.eu/system/files/2022-04/its-national-access-points_0.pdf

It is not only in the EU countries of Europe where government is seeking to force companies to share data. In the U.S., the Department of Justice Antitrust Division and the Federal Trade Commission have decided that Big Tech companies have become too powerful and have too much control over individuals' data. They have suggested it is time to break them up, as government did with AT&T and almost succeeded in doing with Microsoft. As a first measure, they are trying to force them to share the data they collect and the algorithms they use to process the data with would-be competitors.

What greater government control will mean for digital maps

I see three scenarios for how this will play out if the EU and/or the U.S. push through data sharing or create government data processing points, and each of them will change the relationship of automotive OEMs to suppliers of digital map data and developers of ADAS. In the first scenario, the vehicle manufacturers simply turn over their infotainment, communications and data processing systems to an external party, like Google or Apple or a tier one supplier like Denso or Continental that takes on the responsibility of managing all information processing. Volvo Cars has already moved in that direction by contracting with Google for providing all navigation and information software. It will then be the external parties who will have to contract with owners/drivers/occupants to process their data.

In the second scenario, OEMs stop selling their cars completely and provide them only on a subscription basis. This puts them in the position of owning the vehicles. The OEMs will fight for having the possibility of an exclusion from the requirements to use third parties suppliers chosen by subscribers, claiming that it is the owner's right to make such decisions. It will take only one, large country to back their objections to push through such an exclusion. This is what happened with obtaining the right to continue with third-party eCall services, which Germany and France demanded in order for them to vote in favor of EU eCall.

In the third scenario, the OEMs comply with the requirements for data sharing, but lose their enthusiasm for installing and operating complex communications infrastructure. Any data sharing occurs through the customer's mobile device, and all third-party services, including eCall, are handled through the single-function public eCall service. ADAS functions would become blackbox applications, disconnected from off-board data processing.

You will not find these scenarios in any of the Commission's reports. They are filled with platitudes claiming that data sharing and direct vehicle access by third parties will make everyone happy and prosperous, including the OEMs who, as usual, do not know what is best for themselves. Once the laws are passed, the industry will adapt, as it always does, and everything will be fine, says the Commission or the FTC or DOJ. If not fine, then at least different.

If you don't answer the question in an informed way, an uninformed person will answer it for you

Where we are with digital maps and ADAS at present, with governments demanding greater control of their data by customers and more oversight on data usage, reminds me of what occurred with eCall in the EU beginning in 2002. A group within the Commission decided that take-up of connectivity systems was moving too slowly and determined that if the EU mandated an eCall system all car companies would have to install systems that could be used for all types of applications. At the time, several OEMs had already begun to roll out telematics systems in Europe and the U.S. The Commission continued to ignore this progress as incidental, primarily because the OEMs were building privately-controlled systems rather than delivering data directly to the public emergency services. This was impossible, and there would have been no services at all if those services depended on the 112 call centers having the capability to receive data messages and display

EU Digital Markets Act

The EU Digital Markets Act (DMA for short) identifies digital services that fall under its purview, defines characteristics that make a service provider a "gatekeeper," creates rules and ex ante obligations for those gatekeepers, and establishes punishments if those obligations are not met.

In its proposal, the European Commission "limited" the regulation to companies providing "core platform services." The word "limit," however, is misleading. The list includes nearly every significant digital service: online marketplaces and app stores, search engines, social networks, video-sharing platforms, operating systems, cloud services, certain interpersonal communications services like WhatsApp calls or web-based email services, and advertising networks affiliated with any of the above. In its final version of the bill, progressive MEPs pushed successfully to add three new core platform services: web browsers, virtual assistants (such as Siri or Alexa), and connected TV.

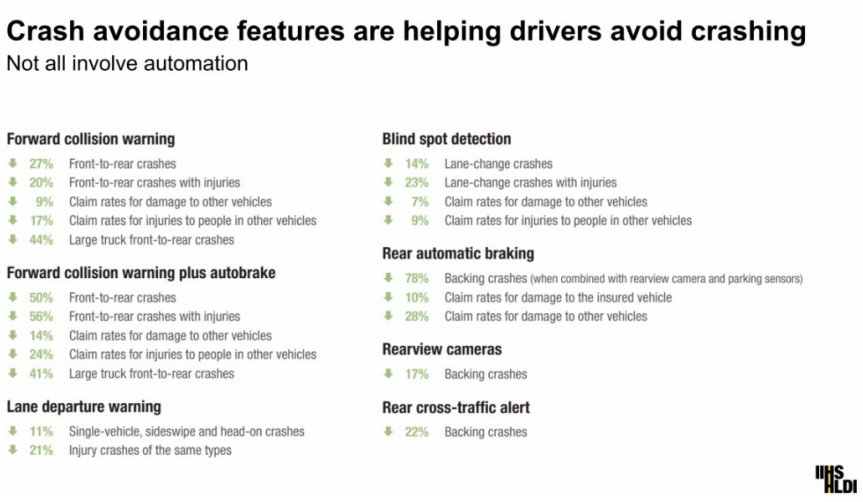
DMA prohibits gatekeepers from using personal data mined from one of their services to benefit a separate service they offer—for example, META using data collected on *FACEBOOK* for targeted ads on *INSTAGRAM*. Other provisions include a prohibition on requiring users to subscribe to one's services, a prohibition on restricting how business users of a gatekeeper's platform sell their same service on another company's platform, and requirements for transparency on advertising prices. Other prohibitions are on self-preferencing, restrictions on targeted advertising without consent, and requirements for interoperability with third-party software.

https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2022/05/the-digital-markets-act-a-new-era-for-the-digital-sector-in-the-eu.pdf

them on a digital map application. Even today, twenty years after the Commission announced they would have a public eCall system installed in all cars, there are 112 call centers in Europe that have no possibility of accepting the EU eCall messages, and most OEMs continue to have their third-party services. The Commission created the narrative, which was that the automobile industry was not doing its job and it would have to step in and do it themselves.

I recognized the same gambit recently when I was sent the same article by two friends. It was an article in the *NEW YORK TIMES* on the 8th of June 2022 by Dade Metz which had the main title: ***How Safe Are Systems like Tesla's Autopilot? No One Knows***. The subtitle was: *Automakers and technology companies say they are making driving safety, but verifying these claims is difficult*. Anyone familiar with what TESLA is doing, compared to what the companies gathered in Brussels to celebrate the 20th anniversary of the founding of the ADASIS Forum are doing, know that the main title of the article is comparing apples and lemons, and the subtitle is just plain wrong. TESLA's Autopilot is a small subset of the full suite of advanced driver assistance systems. It is adaptive cruise control (ACC) with a degree of automated lane keeping, and it works about as well as other ACCs and ALKs—as long as the drivers don't abuse it by taking their hands off the wheel and ignoring what is going on in front of the vehicle. Unfortunately for the drivers who do, and for the responsible, law-abiding car companies, TESLA management encourages misbehavior.

We do know that ADAS reduces crashes and saves lives. NHTSA has stated that ADAS technologies "not only helps to keep you and your passengers safe, but also other drivers and pedestrians."[17] The U.S. Insurance Institute of Highway Safety (IIHS) has shown the effectiveness of collision warning, collision intervention and driving control systems in reducing crashes (see chart). For example, Forward Collision Warning has been shown to reduce front-to-rear crashes by 27%; Blind Spot Detection has reduced lane change crashes with resulting injuries by 23%; Rear



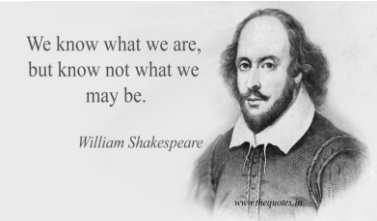
17. https://www.nhtsa.gov/equipment/driver-assistance-technologies#technology-saves-lives

Automatic Braking (when combined with rearview camera and parking sensors) has reduced backing crashes by fully 78%.

Journalist Metz is confusing Teslas being illegally used in driverless mode with vehicles that are equipped with full-fledged, legal and certified driver assistance systems. He can be forgiven for this error because the automotive industry—OEMs, suppliers, trade publications, and investors alike—have allowed the confusion to exist and even encouraged the public to believe that cars were ready to drive themselves. They are not, but the work being done on ADAS, and in particular on map-based ADAS, will continue to make all vehicles safer, more comfortable to drive and more energy efficient. That is the message that should be appearing in global publications like the *NEW YORK TIMES*. That should be part of the mission for everyone working with ADAS, especially the **ADASIS FORUM,** as it begins its third decade of work.

Digital Maps for the Vehicle – 1970-2022

We know what maps are, but not what they might be



My first encounter with digital maps was when I was still in graduate school. During a 1970 summer job in the *PRINCETON RESEARCH CENTER FOR URBAN STUDIES*, I was introduced to the *GBF-DIME* files developed by the U.S. BUREAU OF THE CENSUS for storing geographic information that would be used to record geographic-referenced census data. With the *Dual Independent Map Encoding* system, intersections, streets, and blocks became analogous to points, lines and polygons. These *DIME*-encoded vector objects, rooted in Cartesian geometry, became known as *Geographic Base Files*. Beginning in the 1970s, all U.S. cities were digitized in this format, and these files provided the schematic map for each city's streets, address ranges, and geostatistical codes relating to the CENSUS BUREAU's tabular statistical data. The *GBF-DIME* files became the reference framework for the *Topologically Integrated Geographic Encoding and Referencing* system, known as *TIGER*, that was created for the 1990 census. TIGER added the road and polygon geometry that was missing in GBF-DIME. Although TIGER topographic data was created from large-scale USGS maps (1:100,000), which had a positional accuracy of approximately 50 meters, they were the first step along the road to fully attributed, high resolution map data that we are using in our navigation and electronic horizon systems today.

The Back Story - One of the main reasons the Census Bureau decided to create TIGER for the 1990 census was to eliminate discrepancies between census geography, as shown on census maps, and census population counts, as shown on tapes and printed reports. In 1980 and before, there were blocks on census maps for which there were no population counts, and population counts in census tables for which there were no blocks on a census map. Why was this important? A federal court ruling, 'Wesberry v. Sanders, 376 U.S. 1 (1964)' meant that each congressional district, senate district, and house district in a state must have approximately the same population as every other district of that kind in the state, so in drawing district boundaries, the members of the legislature need to know the population of each proposed district with some degree of precision. Politicians want their districts to include the most people who will vote for them.

When I entered the world of commercial maps in 1977 as the manager of a 'skunk works'[18] based in Boston for the Swedish map publisher ESSELTE MAP SERVICE, there were no overlaps between

18. 'Skunk works' is often used to describe any team that "works outside the regular organizational structure to develop something new. These teams may also be physically separated from the rest of the organization in a remote location to minimize interference or maintain secrecy" (Brown, 2007). Their aim, as a team of generally 6-25 people, is to develop something quickly with minimal management constraints.

those groups who were producing printed maps for public consumption and those people who were working on visualizing geographically-referenced data for analytical purposes. ESSELTE was one of the Big Five global map publishers at the time.[19] In the 70s, ESSELTE had the lead in applying the latest technologies to map production. Using computers to make printed maps was their goal. There was no discussion about using digital map data for other purposes, and there was no data readily available for creating maps equal in quality to what their cartographers were achieving with scribing tools and peelcoat. In the minds of ESSELTE's managers, computers would reduce the cost (and bother) of employees, and allow their company to bring new maps to market faster and at a lower cost.[20]

We didn't invent how to convert geographic data into digital form in our Boston offices. The computer-aided design and drafting (CADD) tools to do that had already been developed for creating architectural and engineering drawings (which is where I started), and for developing the artwork for printed circuit boards that would be etched on semiconductors (which was the main business of our computer programming team). Laser plotters for PCB output turned the vector artwork into film that could be color separated. What we did invent was the equivalent of putting stones around the campfire, a way of getting the digital data directly into color separated films for multi-color printing.[21] Our "invention" was to link two different systems, a vector-based system for data capture and manipulation and a raster-based system for cartographic design and film separation.

The Back Story – Minicomputers from Digital Equipment, Prime, Wang, Computervision and others, mainly located in the Boston area, were revolutionizing all types of office and manufacturing tasks in the 1970s. However, it was International Telephone and Telegraph's order in 1962 of fifteen DEC PDP1 computers for one of its switching systems that gave the minicomputer industry the boost it needed. DEC made it through a difficult financial patch and never looked back. Compared to mainframes, minicomputers were cheap, and every business saw them as a way to reduce costs and increase profits. Architecture, engineering and map publishing companies were no exception.

Looking for maps in all the wrong places

It was in the early-to-mid 1980s that we find the first major attempts to use digital map data for navigation. While ESSELTE's competitors, as well as governmental cartographic agencies, were busying themselves with converting their production from manual to digital form using the techniques pioneered by ESSELTE,

19. ESSELTE MAP SERVICE, RAND MCNALLY, KÜMMERLY+FREY, BARTHOLOMEW, and DE AGOSTINI.

20. Articles I wrote in the 1980s on computer-aided mapping for printed maps and other applications.
http://www.michaellsena.com/wp-content/uploads/scans/cgw_1983_7.pdf
http://www.michaellsena.com/wp-content/uploads/scans/cgw_1988march_reprint.pdf

21. http://www.michaellsena.com/wp-content/uploads/scans/cgw_1989july.pdf

people from outside the cartographic industry kept knocking on their doors asking if they would be willing to provide their data for navigation systems. The answer was always no, but the data wouldn't have been usable for that purpose in any case. GIS technology that would have provided topologically structured data for routing purposes was not up to the task of creating cartographic-quality databases. That would come later, within a few more years. Finally, they stopped asking and started building their own databases. KARLIN & COLLINS, which became NAVIGATION TECHNOLOGIES, ETAK, and TELE ATLAS were all going to do what private map publishers and government ordnance surveys had not yet done: They were going to create navigable digital map data. And they did, for the first rudimentary navigation systems developed by MOTOROLA, BOSCH, PHILIPS, and ALPINE, among others.

In 1987, I was in my third year of consulting to the AMERICAN AUTOMOBILE ASSOCIATION (AAA). Like a few other automobile clubs around the world, AAA produced maps and atlases for its members, and I was helping them to convert from their manual techniques to digital. AAA was approached by a sister club in The Netherlands, ANWB, with a request to join them in making an investment in TELE ATLAS. I accompanied AAA management to The Netherlands to meet with ANWB and TELE ATLAS. When we returned to the U.S., AAA asked me to prepare a study to determine who was doing what with navigable digital maps. It was as a result of this report that, in addition to TELE ATLAS, I first met ETAK and NAVIGATION TECHNOLOGIES, and had my first contact with the early, rudimentary navigation systems. When the report was completed, AAA made an investment in NAVIGATION TECHNOLOGIES, and a few years later, the AUTOMOBILE ASSOCIATION in Great Britain joined RENAULT and PHILIPS with investments EUROPEAN GEOGRAPHIC TECHNOLOGIES, the European subsidiary of NAVIGATION TECHNOLOGIES. As a result of AAA's initial investment, NIPPONDENSO, the Japanese automotive tier one supplier, made an even larger investment and the race was on for who would become the dominant supplier of navigable digital map data to the automotive industry.

The Back Story – In 1985, Ronald Reagan and Mikhail held their first summit, Margaret Thatcher was Prime Minister of the United Kingdom, and Japan was an economic powerhouse. China was on no one's map. Sony in Japan, Philips in Europe, and Motorola in the U.S. were vying for domination in all types of electronics, including in-vehicle systems. Liquid crystal displays and optical compact discs were about the revolutionize in-vehicle entertainment industry, and navigation systems would be-

https://ndrive.com/brief-history-gps-car-navigation/

The 1981 Honda with Electro Gyro-Cator navigation unit was the first truly automotive navigation system was developed almost forty years ago by Honda, Alpine and Stanley Electric and it was called the Electro Gyro-Cator. Introduced in Japan, in 1981, this "inertial navigation system" used a small helium gas gyroscope and it was more like the systems used by fighter pilots in the Cold War. Inertial navigation systems are based on a pretty simple principle: if you know where you started, you know how far you travelled, and if you know which direction you were headed in, then it should not be difficult to know where you are. Apply that concept continuously, and you've got the workings of a basic navigation system.

Translucent maps had to be placed in the screen manually and would scroll over a monochrome 6-inch screen used for lighting and pinpointing purposes. The unit was optional for the equivalent of about $2,750 – nearly 25 percent of the price of the actual cars themselves.

come a must-have feature for all of the tier one radio suppliers who already owned the instrument panel real estate where a navigation system would be placed. It would take another ten years before the first systems were introduced as both factory-fit and aftermarket systems, but all of the tier ones knew they had to have the map data in order for the systems to work.

Satellite positioning: A gift from heaven

In 1983, the U.S. government opened up its GPS for private use. The military originally had no intentions on opening the system to the public. But in 1983, a Soviet SU-15 shot down a Korean passenger jet. Realizing world-wide GPS could have prevented the tragedy, then-President Ronald Reagan opened this system to the public on September 16, 1983. However, the public version would have its accuracy fuzzed to a radius of about 100 meters to ensure that only the U.S. military had the best data available. During the 1980s and 1990s, GPS quality was degraded by the United States government in a program called *Selective Availability* with a positional accuracy of only around 100 meters.[22] So GPS served as only a rough confirmation of the approximate location of the vehicle, while dead reckoning was used for following the map data that had a positional accuracy of 12.2 meters.

Selective Availability was discontinued on the 1st of May 2000, in accordance with a law signed by President Bill Clinton. From that point forward, the U.S. government committed to broadcasting the GPS signal in space with a daily global average user range error (URE) of ≤2.0 meters (6.6 ft.), with 95% probability, across all healthy satellites in constellation slots. Actual performance is said to be typically much better. The world of digital maps and navigation changed dramatically after that.

The Back Story - Where would we be today with automotive applications of digital maps if the U.S. government had not opened up GPS in 1983, and had not removed selective availability in 2000? The EU's civilian GNSS, Galileo, did not go live until 2016, and it will not be fully operational until this year. By the time it first went on line, systems and services designed for GPS were ready for the higher accuracy enabled by Galileo, even though the service areas were initially limited.

Standards are the thing in which we capture…everything.

In November of 1992 I attended my first meeting of what would become *ISO/TC 204/Working Group 3: ITS Geographic Data*.[23] The meeting was held in Hildesheim, Germany at the offices of *Bosch Cartographic Services*, a group that eventually was incorporated into Tele Atlas, which had moved to Ghent, Belgium. I was there

Global Positioning System

In the early 1970's, the U.S. Department of Defense (DoD) wanted to ensure a robust, stable satellite navigation system would be available. Embracing previous ideas from Navy scientists, the DoD decided to use satellites to support their proposed navigation system. DoD launched its first Navigation System with Timing and Ranging (NAVSTAR) satellite in 1978. The 24 satellite system became fully operational in 1993 and became known as GPS for Global Positioning System.

https://thespacereview.com/article/626/1

22. https://pubs.usgs.gov/fs/1999/0171/report.pdf

23. https://isotc.iso.org/livelink/livelink/fetch/-8846111/8847151/8847160/ITS_Standardization_Activities_of_ISO_TC_204.pdf?nodeid=19964169&vernum=-2

representing VOLVO, although I did not officially start work as a VOLVO employee until the 1st of January 1993. Also in the room were representatives from many of the European automakers, the major radio electronics companies, and the three digital map companies, NAVIGATION TECHNOLOGIES, ETAK, and TELE ATLAS. BOSCH had licensed ETAK technology and set up their own production operation for European maps. I was very familiar with these companies, and it was how I became familiar with them that was the reason I was in that room about to start work for a European car company. I recall being amazed with how far this group had come with developing the vocabulary for a completely new field of endeavor. This group laid the foundations for the navigable database industry. My small contribution would be to constantly remind the group that they would be replacing methods of way finding that had been perfected over a few hundred thousand years.

Competition between NAVIGATION TECHNOLOGIES and TELE ATLAS was brutal. It mirrored the competition among their automotive clients and the tier one navigation system suppliers. But the swords and shields were left at the doors of the meeting rooms where standards would be prepared. ISO TC/204/WG3 had three tasks to perform: standardizing the map data transfer format (GDF); standardizing the physical storage format (PSF) of the map data to be read by the navigation system; and standardizing a location referencing system to match data from one map source to another, particularly for referencing traffic data incident locations. During the four years that I was a member of WG3, we met in Europe, the U.S., Australia, and Japan, usually in connection with an *ITS WORLD CONGRESS*. These were as much team- and trust-building events as working sessions. I marveled at how my younger colleagues could show up at 9:00 a.m., ready to dig into the details of defining data models and database schemas, after a night of emptying all the beer dispensing machines in Tokyo or closing the bars in Sydney.

King Arthur's Shield

We finished GDF because the companies receiving the data and their OEM customers wanted to have multiple suppliers. We did not even start the PSF work because the tier ones were convinced that their own PSF provided them a competitive advantage in speed of delivery, better graphic display, minimum storage requirement, or better attribute handling. Location referencing was an orphan in WG3, but it became extremely important in standards work being done at the EU level for the RDS-TMC activities.[24] An attempt to standardize the PSF was made first by the ITS Map

24. Radio Data System-Traffic Message Channel (RDS-TMC) is a European-developed and standardized means of delivering real-time traffic information via a sub-carrier of FM radio. Transmitted data is decoded by a receiving device such as a satellite navigation system and translated into text or speech traffic alerts.

Committee within ERTICO, which I chaired and which Jean-Charles Pandazis served as secretary. When that was blocked by the tier one navigation system suppliers, the automotive OEMs led by VOLVO and RENAULT tried to obtain agreement from all other OEMs to cooperate. That was scuttled by three German car companies who decided that they would work together on a PSF and then invite all others to use it. That effort became the Navigation Data Standard (NDS).[25]

25. The Navigation Data Standard is a standardized format for automotive-grade navigation databases, jointly developed initially by BMW, Mercedes-Benz, VW, and their suppliers. NDS is an association registered in Germany. Members are automotive OEMs, map data providers, and navigation device/application providers.

During the first two decades of ITS standardization, country and regional standards groups, such as CEN and ETSI in Europe and IEEE and SAE in the U.S., also played important roles in developing standards and contributing to the work of ISO TC/204. During the past five years, *UNECE* and WP.29 have taken a more leading role in standardizing applications that incorporate the use of digital maps. The *UNECE SUSTAINABLE TRANSPORT DIVISION* provides the secretariat services to WP.29, the *World Forum for the Harmonization of Vehicle Regulations,* that incorporates into its regulatory framework the technological innovations of vehicles to make them safer and more environmentally sound. U.N. Regulation No. 157: Uniform provisions concerning the approval of vehicles with regard to Automated Lane Keeping Systems, entering into force 22 January 2021, is the latest and most important digital map data-related result of its efforts.

The Back Story – Establishing ISO TC/204 was an important and positive step, but there can be no doubt that the reason it was created was to prevent one of the three regions from obtaining a dominant position in either data or system provision. ISO functioned as a forum where industry players from the three major regions could discuss and agree on a general direction for their products, but for ITS Geographic Data, there have been no standards that have become industry-wide. ADASIS and NDS were never taken into ISO or any regional standardization bodies. WP.29 standards will change this situation because they are intended to become incorporated into the type approval regulations in many countries and the Federal Motor Vehicle Safety Standards in the U.S.

Someone called PNDs GeePeeEssess, and the name stuck

TOMTOM started life in 1991 as PALMTOP SOFTWARE. Its mission was to develop software for handheld computers like the Psion. It changed its name to TOMTOM in 2003, and in 2004, it delivered the first dedicated portable navigation device (PND). TOMTOM went public in 2005 with a market valuation of €50 million. It acquired APPLIED GENERICS in 2006 and formed *TOMTOM TRAFFIC*. It bought TELE ATLAS in 2008 for €2.9 billion. It turned out that it was saved by the

data because the smartphone craze started in 2007 with the introduction of the APPLE iPhone, which, along with Android-based smartphones quickly became the navigation devices of choice for billions of people.

Competitors were quickly attracted to the business, the principal one being GARMIN. I purchased a Garmin PND to take with me on my consulting assignment travels since I was driving rental cars for more than half of my time. Dedicated PNDs provided the opening for navigation software specialists to enter the vehicle, allowing the separation of navigable data, display, positioning and data storage hardware, and navigation software into individual component parts that could be sourced separately by the OEMs.

PNDs, known as GPSs by everyone outside of the automotive industry, popularized in-vehicle navigation for the masses. During a visit with my mother and other family members in 2011, a cousin talked about how much he liked his new Volvo XC90, especially the built-in GPS. My mother, who was then 95 and could never understand what I was working with during the thirty-four years after I left the practice of architecture, turned to me and said: "Is that what you've been doing all this time?"

The Back Story – PNDs were a small part of a global push for miniaturization. A 1991 paper titled Miniaturization Technologies*, produced by the U.S. Office of Technology Assessment (OTA), starts off with the statement that "miniaturization plays a major role in the technical and economic rivalry between the United States and its competitors…Personal computers, portable radios, and camcorders are examples of products that created massive new markets through miniaturization: they added billions of dollars to the GNP of countries where they were designed and built".[26] Everything that made PNDs possible, including small LCD displays, compact memory, integrated circuits, were part of a much larger effort to make all types of electronic devices smaller and more powerful, and within a few years of the first PNDs, the iPhone and other smartphones showed just how small and powerful an electronic device could be.*

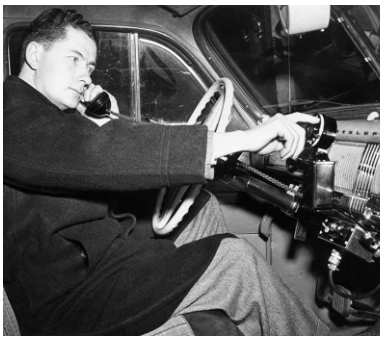
26. https://www.princeton.edu/~ota/disk1/1991/9129/9129.PDF

In-vehicle communications was a double-edged sword

FORD MOTOR COMPANY filed and received a patent for sending the position of a vehicle via a cellular network to a service point. It introduced its RESCU (Remote Emergency Satellite Cellular Unit) system and service in 1996, at the same time as GM's OnStar appeared. Ford's president between 1999 and 2001, Jacques Nassar, claimed that the car would become a phone on wheels. This was at the height and the end of the dot.com period When his effort

to make that so, having cost FORD over $300 million and its partner QUALCOMM another $125 million, resulted in his firing by Bill Ford, it relegated FORD to being a minor player in the in-vehicle communications race, and split the automotive world into companies that would try to use portable devices brought into the vehicle by customers, like Ford with its Sync system, and companies that would integrate full-function communications devices in their vehicles, like the GM OnStar, BMW Connect and Volvo On Call systems.

What I find particularly interesting about what we thought of as a major innovation in 1996 is the fact that the first mobile phone call was made from a car, and the date was the 17th of June 1946. Fifty years earlier! The phone call, to qualify as 'mobile', had to be made from a vehicle because the phone weighed 80 pounds and there was a ton of equipment in the trunk. The photo (right), which is part of an exhibition at the Smithsonian Institution, shows the call being made.[27] Look closely and you will see that the car is a Chrysler.



27. https://www.smithsonianmag.com/innovation/first-mobile-phone-call-was-made-75-years-ago-180978003/

I worked with the *Volvo On Call* development from 1995, while still a Volvo employee, until 2015. During that time I also worked with other telematics system and service initiatives. From a digital map perspective, I saw how these initiatives provided the spark for developing location-based services of all types, and greatly expanded the market for digital map data from NAVTEQ and TELE ATLAS. Companies like PTV in Germany, which delivers map-based applications for logistics and mobility services, sprang up everywhere, eventually offering Internet- and cloud-based map data processing solutions. They eventually led to Google entering the scene with all of its might, having seen how critical the owning of digital map data was to its business model.

The Back Story -- Mobile wireless technology got its start during World War II for troops to communicate in the field. The SRC-536 Handie-Talkie was developed by, GALVIN MANUFACTURING CORPORATION, the company that became MOTOROLA CORPORATION (which developed the first in-vehicle telematics systems) and was used by the U.S. Army during the war. DARPA (Defense Advanced Research Projects Agency) made enabling investments in advanced communications algorithms, processor technology, electronics miniaturization and other aspects of mobile phones.

The last thought DARPA had was for driverless taxis in rich burbs

Digital maps are the foundation for many ADAS functions and for all driverless systems. With map-based ADAS, the driver may know where he is going, but the vehicle also needs to know the

route so that it can do its job of seeing around corners. The system cannot read the driver's mind. And with fully driverless systems, the robotic driver needs to have a destination, unless it is instructed to simply "wander around" waiting for a pickup. The more control given away by the human driver, the more detailed and accurate must be the map data so that the vehicle sensors can do a proper job of keeping the vehicle within its lane and within the rules of the road, while also being on the lookout for non-mapped events, like bicyclists, crossing pedestrians, opening car doors.

There is a direct relationship between increasing the level of driverless functionality and the level of precision and the up-to-dateness of the digital map data. Humans are very good at filling in missing pieces and quickly adapting to changing situations. Robotic systems are not. Not even Google has enough money to put its own data gathering vehicles on all roads in order to keep up with constant changes. This is where crowd sourcing comes in. Crowd sourcing could never have happened at the scale which is now possible without social media and the widespread take-up of social media on mobile devices.

If there is a dark cloud on the driverless car horizon it is the efforts by both EU and U.S. authorities to limit the reach of those companies that have the greatest number of individuals using their social media platforms.

The Back Story – What motivated DARPA to initiate the DARPA Challenge in 2004?[28] Orders from Congress. In February 2000, Congress mandated that one-third of all deep strike aircraft and one-third of all ground combat vehicles should be "autonomous" by 2015. The law implementing autonomous and semi-autonomous vehicle development was intended to: 1) ensure the safety of soldiers by sending robots into harm's way instead of soldiers; 2) reduce soldier deaths due to improvised explosive devices (IEDs); decrease the need for "boots on ground;" and 3) in some cases, create weapons that could outperform their human counterparts (e.g., some aerial drones can stay airborne for up to twenty-four hours). The desert route that the DARPA Challenge's driverless vehicles navigated in 2004 was approximately 110 miles from Barstow, Calif. to Primm, Nevada. A transparency of the route overlaid on the 2004 Grand Challenge route showed almost an identical route from Baghdad to Fallujah, Iraq. The word "autonomous" can have many meanings but in this case it means that vehicles must be fully self-navigating—no remote control or other outside influence on the behavior of the vehicle is permitted.[29]

28. The first Grand Challenge race took place on March 13, 2004. Of the 15 teams that made it to the 2004 starting line, only seven vehicles made it out of the starting gate area and only four made it five miles or farther.

29. https://www.eetimes.com/darpa-challenge-pushes-driverless-vehicles/

We are at the end of the beginning

Depending on how you look at it, the digital map journey has been twenty, fifty or seventy-five years in the making. What happens next? Return to the start of this *Musings* to read my thoughts on that. Ultimately, the future is in the hands of the rule-makers, the legislators. In the democratic countries, it is the bureaucrats in the EUROPEAN COMMISSION, the U.S. DEPARTMENT OF JUSTICE, and the FEDERAL TRADE COMMISSION who are establishing the agenda and formulating the legislation that will apply in their own and other democracies. In the autocratic countries, like China, Russia and their like, digital map data is controlled by and for the state.

What form the legislation takes in democracies depends a great deal on whether the bureaucrats are properly reading the evidence and objectively listening to all those who will be affected by the laws that they will make. I'm not sure that they are; I'm not certain that they want to. I have covered the back story to why this is the case in many of my previous issues of THE DISPATCHER. For the EU, see the May 2021 issue. For the U.S., see the February 2022 issue.

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About Michael L. Sena

Through my writing, speaking and client work, I have attempted to bring clarity to an often opaque world of highly automated and connected vehicles. I have not just studied the technologies and analyzed the services. I have developed and implemented them, and have worked to shape visions and followed through to delivering them. What drives me—why do what I do—is my desire to move the industry forward: to see accident statistics fall because of safety improvements related to advanced driver assistance systems; to see congestion on all roads reduced because of better traffic information and improved route selection; to see global emissions from transport eliminated because of designing the most fuel efficient vehicles.

This newsletter touches on the principal themes of the industry, highlighting what, how and why developments are occurring so that you can develop your own strategies for the future. Most importantly, I put vehicles into their context. It's not just roads; it's communities, large and small. Vehicles are tools, and people use these tools to make their lives and the lives of their family members easier, more enjoyable and safer. Businesses and services use these tools to deliver what people need. Transport is intertwined with the environment in which it operates, and the two must be developed in concert.

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