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The Dispatcher

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Telematics Industry Insights by Michael L. Sena

Unmanned Vehicle Systems That Fly

THEY HAVE MANY NAMES AND MANY USES. They are all commonly, and mistakenly, referred to as 'drones' (see sidebar). The official name in the US, designated by the Federal Aviation Administration in 2005, is 'Unmanned Aircraft System' or UAS. This is the term used by the Association of Unmanned Vehicle Systems International (AUVSI), which is a nonprofit organization devoted exclusively to advancing the unmanned systems and robotics community, in the air, on the ground and on and under the sea. It has more than 7,500 members from government organizations, industry and academia. After my visit there in early February, it has one more.

Unmanned Aircraft Vehicle, or UAV, is the most common term referring to the device that is flying. A UAV is defined as a "powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload".[1] That definition covers a lot of ground (or, in this case, air).

At CES in January, UAVs were one of the three main attractions. The others were hoverboards and virtual reality. Last year's novelty, autonomous cars, seemed to have moved to mainstream, even though they are farther away from real reality than UAVs. The reason UAVs are receiving so much attention is because they can do so many different things in so many different industries, and, in contrast to self-driving cars, they would already be in operation if it were not for government regulations lagging a bit behind. There are quite a few lessons to be learned by the car industry from all aspects of UAVs, especially in the regulatory arena.

The technology is not new, and for most commercial applications, it does not involve rocket science—in contrast to drones that are used for military purposes. The devices being developed for package delivery, aerial photography, pipeline surveillance, crop dusting and more are familiar to most today. The majority are quadcopters, that is, helicopters with four rotor blades, but they can be any shape or size, from hummingbirds to large enough to carry a human or heavy payload.

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Why are they called drones?

When you look up the word 'drone' in a dictionary you find that it can refer to nature, vehicles, chemicals, literature, entertainment and music. Until the military absconded with the term, most people thought of bees when they heard the word 'drone'. A drone is "a male honey bee that is the product of an unfertilized egg. Unlike the female worker bee, drones do not have stingers and do not participate in nectar and pollen gathering. A drone's primary role is to mate with a fertile queen."[2] Except for the fact that drone bees fly and so do UAVs, there does not seem to be much in common between them.

I searched further and found a post by Andrew Hennigan, pilot of gliders, light and ultralight aircraft. He offered the following: "The exact details are perhaps lost in the mists of time, but the most common explanation is this: In 1935 the Royal Navy deployed a new unmanned aerial target, the DH82B. *Since it replaced an earlier target called the* Fairy Queen, *the B version was called the* **Queen Bee**. *Somehow the association with the word bee led to people calling these unmanned aircraft "drones" or "target drones", possibly reinforced by the sound and role. The* Queen Bee *was in fact just a remotely piloted* Tiger Moth, *which by then was obsolete and could be used for target practice."*

A further search came up with a reference to a book published in 2008 by Steven Zaloga, Unmanned Aerial Vehicles, which told basically the same story as related by Mr. Hennigan. The US military adopted the term during WWII and it has stuck.

Lyft gets a lift and Sidecar is salvaged: GM behind both moves

In December, 2015, General Motors announced that it was investing $500 million (€449 million) in ***Lyft****, the world's second largest global taxi company behind Uber. According to the press announcement, 'the two companies will work together and create a network of on-demand autonomous vehicles, with GM as the preferred provider of short-term used cars to Lyft drivers through rental hubs in a number of US cities'. Presumably, the 'autonomous cars' part will come well after the 'short-term used cars' part. Uber is well ahead of Lyft in self-driving cars research and in market share. (Lyft lost $127 million in just the first half of 2015.) OnStar 'on board' in the GM Lyft taxis will also give customers and drivers a better experience, says the news release.*

Sidecar *tried and failed to compete with Uber and Lyft. Initially, it was pure peer-to-peer, allowing anyone who had a car to sell rides to anyone who needed them—more carpooling than taxi service. Uber and Lyft eventually started doing the same. Uber's peer-to-peer service is called UberX. Sidecar shut down on 31 December 2015, four years after it was founded, following attempts to change from being an on-line taxi/ride sharing/carpooling service into a fast food delivery company.*

On 19 January 2016, GM announced that it was acquiring for an undisclosed sum the assets and intellectual property of Sidecar, along with hiring its CTO and Sidecar co-founder and twenty other employees. The other co-founder and CEO is not part of the deal, although GM will obtain a license to a 2002 patent in his name: "System and method for determining an efficient transportation route." (Ed: I wonder how many patents have that description.)

GM will start to see a new set of services under the ***Maven*** *name, which GM has trademarked: "Application software for connecting vehicle drivers and passengers and for coordinating transportation services; software for use in planning, monitoring and controlling urban transportation.*

Unmanned Vehicle Systems That Fly (Continued from P.1)

It is illegal to fly a UAV in the United States for commercial purposes, and as of December 2015, all hobbyists must register their UAVs if they weigh over 0.55 pounds (0.25kg), including payloads. As part of the *FAA Modernization and Re-form Act of 2012*, the Secretary of Transportation has the authority to issue exemptions to the commercial flight restriction to allow testing. The FAA began accepting applications for exemption in May 2014. As of September 1, 2015, the FAA had approved 1,407 of over 2,600 it had received.

Amazon was one of the companies that obtained an exemption. It was granted on April 8, 2015. Prior to this, Amazon was testing its *Prime Air* package delivery UAV either indoors or under the guise of a hobby application. Since April, it has been actively testing a device and the entire infrastructure around delivering packages to customers within 30 minutes of the placement of an order. According to Amazon's filing, the UAV will have a weight of less than 55 pounds, be rotopowered, operate on batteries and deliver payloads of five pounds or less.

Neither Amazon nor Google, which is also developing its own UAV, is taking part in any of the testing being done at one of the six FAA-designated. In February I met Ms. Rose Mooney, Executive Director of the Mid-Atlantic Aviation Partnership, a test site run out of Virginia Tech. She said that both companies visited MAAP and the other sites once they received their exemption, and then announced that they would test on their own.

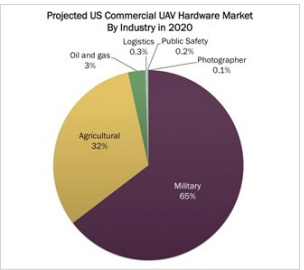
According to a report prepared by AUVSI,[3] "…sUAS are poised to be one of the fastest-growing industries in American history. According to AUVSI's Economic Impact Report (see Appendix A), which is currently the most comprehensive study ever performed on the UAS industry, within 10 years of unmanned aircraft systems (UAS) integration into the NAS, the industry will represent an $82 billion segment of the U.S. economy and generate over 100,000 new high-paying jobs."

The FAA and the U.S. Department of Transportation have given strong endorsements for the economic and safety benefits of UAVs, but they are moving slowly and cautiously. In 2012, Congress gave the FAA until 2015 to develop rules for military, commercial, and privately-owned UAVs to operate in U.S. airspace. The FAA had originally promised the rules by 2011. They missed the 2015 deadline. In March 2015, the Federal Aviation Administration (FAA) and the US Department of Transport (DOT) announced a new set of proposed, and it is those rules that are now under review. Two difficulties with those rules are the requirement for line-of-site operation (i.e., no autonomous flights) and daytime use only.

"At Amazon, our energy comes from inventing on behalf of customers. Amazon Prime Air, a new delivery system that will get packages to customers in 30 minutes or less using aerial vehicles, is one invention we are incredibly passionate about. We believe customers will love it, and we are committed to making Prime Air available to customers worldwide as soon as we are permitted to do so."

This is the latest incarnation of an Amazon Prime Air delivery UAS, shown in November 2015.

The largest UAV that has received an FAA exemption is the Yamaha RMAX. It is a scaled-down helicopter with a petrol engine. It has a flight time of over an hour and can carry a payload of 16kg. It has been used for agriculture in Japan for two decades.



Military applications of UAV hardware will continue to dominate in the near future. AUVSI forecast that agriculture will be a strong second.

Electric Car Charging: There's a lot to think about

I DO NOT OWN AN ELECTRIC CAR. That means I cannot walk in the shoes of those who do. If anyone who reads this article is an electric car owner and finds anything that I have written to be incorrect, I would appreciate hearing from you. My principal reason for writing this article was to learn about the current state of charging electric vehicles.

I learned two things as a result of this exercise. One is the answer to the question: Why bother to own an EV? It is a bother to have to plug in the car to make sure you have enough battery power to get you to the next plug, wherever that plug may be. Owning and using an electric vehicle is about as far to the other side of the spectrum from using Uber for all your transport needs as one can get. The main reason folks put up with the extra work—besides the good feeling one has about reducing one's personal emissions footprint—is the tax credits that are offered in some countries (e.g. $7,500 in the US) and the potential for a very low cost of operation. Once you have bought the car and installed the home charging station, your costs are a fraction of paying for petrol, diesel, ethanol or LNG—of course depending on the cost of these fuels and the cost of electricity.

Electric cars are more expensive than a 'normal' car of similar size. You don't have to buy a €100,000-plus Tesla to drive an EV, but even a Nissan Leaf is about €5000-8000 more than a comparably-sized car with similar features. Nissan says the cost of the home charging station, including installation, is around $2,000 plus permit and taxes. It consists of a 240 Volt circuit connected to the special Nissan charging station. The end that plugs into the Leaf is a standard SAE J1772-2009 connector for Level 1 and 2 charging. I will come back to this. The station is waterproof, so it can be installed outside as well.

I found a helpful electric vs. regular car cost calculator on a site to figure the equivalent cost of operating an EV (www.befrugal.com/tools/electric-car-calculator). I ran a comparison of a Nissan Leaf versus a Nissan Rogue in my old home state of Pennsylvania. With current costs of petrol/diesel in PA at $1.72/gallon, the payback was eight years with electricity at $0.13 per Kilowatt-hour (kWh). The price of fuel needs to be around $2.00/gallon for a five-year payback. I did the same calculation for Sweden where petrol is the equivalent of $4.55/gallon and our kWh price is around $0.07. Breakeven is in one year.

A Nissan Leaf residential charging station

Now to charging and the second thing I learned. EV charging is much, much more complicated than I had ever imagined. That is, if you really want to understand everything that is going on. Fortunately, you don't need to understand watts, ohms, amps, volts or kilowatt hours if you want to own and drive an EV. You will, however, need to know how long it will take for your car to get enough of a charge to take you to where you want to go, and for that you will have to understand the difference between slow and fast charging.

In addition to the residential charging stations sold by each EV car-maker, there are public charging stations offered for a fee or free at curb side, in parking lots or garages. In the station

at Sweden's Trafikverket shown here, there is a standard 220-240V plug, and the owner uses a cable that is

Is delivered as standard equipment with the vehicle. If this plug were in the U.S., it would be 120 Volts/15 Amps, and it would take around 15 hours to fully charge an empty battery. (That's Level 1.) At 240V/30A (Level 2), which is standard in Europe and installed with the home charger in the US, it will take 8-10 hours. Hopefully, the Mitsubishi owner is just topping up or has a long meeting.

Owning what is called in the parlance a battery electric vehicle (BEV), versus a plug-in hybrid EV (PHEV) or an ICE (internal combustion engine), requires a different approach to driving. It requires planning. The smaller the battery capacity, the shorter the range. In order to make a long trip that exceeds the range of a to-and-from journey from your home charger, you need to know that you can find charging stations along your journey's path. Ideally, you should not have to book a room in a local hotel while your car charges in order to be on your way to the next station. And that is where fast charging comes in, Level 3.

The public charging station above, installed by Danish company CLEVER, is at a motorway interchange where there is fuel and McFood. It has three 'pumps', one AC and two DC fast chargers.[4] One of the DC fast chargers is a CHAdeMO (Nissan Leaf). The other is ComboChargingSystem (BMWi3) developed by SAE. The AC charger is a Type 2 connector system

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Toyota and Kymeta Team Up On Satellite MPSConnectivity

Back in 1997, when Volvo was developing its Volvo On Call system for the US market, the cellular network there was based on analogue AMPS technology. There were plenty of places where there was no coverage, and the company felt obligated to explore all possibilities for reaching emergency services from anywhere. Orbcomm was the answer it came up with. Fortunately for the Volvo On Call program—a Thule-sized antenna would not help sell cars—Orbcomm declared bankruptcy and Volvo, like every other OEM, admitted they could be no better than a cellular phone call.

Twenty years later, a Redmond, Washington (Microsoft's home) company called Kymeta has developed a

Six-sided antennas fit into receptacles on the roof of Toyota's Mirai concept car. (Credit: Kymeta)

Lightweight, flat profile antenna that can be integrated into a vehicle's roof panel. In addition to the potentially ubiquitous coverage compared to cellular, satellite communications offers a wide data pipe and stable connectivity in times of natural disasters.[6]

Toyota has the exclusive right for on-car testing of the Kymeta technology. It has lent the company test cars and participates in an investment fund. It recently provided $5 million for further development.

mTenna™ Technology

Kymeta: On the mTenna suite of products, tunable elements are arranged in a precisely calculated pattern. Radio frequency (RF) energy is scattered when the elements are activated holographically generating a beam. The direction of the beam is defined by the specific elements that are electronically activated—a design that allows for both continuous and instantaneous changes in direction. As more companies begin to launch low earth orbit and medium earth orbit constellations, our software-driven antennas can rapidly and smoothly acquire and switch satellites in a fast-moving LEO constellation without dropping the connection.

Over-the-Air Updating of Software and Firmware

ONE OUT OF EVERY 5.4 vehicles currently running on U.S. roads is in need of repair of a safety issue serious enough to have been part of an official federal recall.[5] That means there are more than 47 million vehicles in the U.S. with open recalls. This is an increase of 27% from one year ago. The U.S. National Highway Traffic Safety Administration (NHTSA) reported that in 2015 there were close to 900 recalls affecting a record 51 million vehicles. Around 10 million of those vehicles will not get fixed.

There are legal requirements in most countries that prescribe how the owner of a vehicle must be informed of a fault that is safety related. Each country has its own specific definition of a safety defect, but they are all generally similar. The definition provided by the UK Vehicle Safety Branch of the Driver and Vehicle Standards Agency is the following:

A safety defect is a failure due to design and/or construction, common to a number of vehicles, which is likely to affect safe operation and pose a significant risk to the driver, occupants or others. Such defects involve sudden and catastrophic failure with little or no warning to enable the driver to take preventative action, and cannot normally be identified by routine maintenance or obvious changes to the vehicle's normal handling or performance. (Vehicle safety defects and recalls: Code of Practice)

There are strict rules for how a vehicle manufacturer must manage a recall in the U.S. and most EU countries. The vehicle owner must be notified by registered mail (not e-mail); dealers and distributors must be notified and told what to do to fix the problem; and, the defect must be fixed at no charge to the owner. All that said, there is nothing that NHTSA can do to force the vehicle owners to make the fix, even though it is clearly in their self-interest to not drive a vehicle that is potentially a death trap. States in the U.S. have various regulations and car inspection routines, and there is the possibility to reject cars that have not had recall defects fixed, but, apparently, it does not work well in practice.

During the past twenty-five years, computer-based electronic control units (ECUs) have gradually replaced many of the mechanical and pneumatic control systems in vehicles. A 2013 study released by Frost & Sullivan found that mass market cars by then had at least 20-30 million lines of software code, while premium cars could have as much as 100 million lines controlling essential systems. According to Frost & Sullivan, the average cost of the software code is $10 per line and it is steadily increasing. They estimate that by 2020 the amount of software will increase by as much as 50 percent.

With more and more of a car's functions being controlled by software, it should not be surprising that software failures are responsible for more and more recalls. It is estimated that between 60% and 70% of all recalls in North America and Europe are due to software problems.

When your laptop or smartphone software needs updating or fixing, you don't schlep into a repair shop and leave it for a few days, do you? You download the update over an Internet connection, preferably 4G or Wi-Fi. Why didn't car makers plan to do the same? One did. Tesla. And it did it for the same reason laptop and phone makers and all software developers deliver OTA updates: If they waited until their products were perfect, they would never have brought them to market. Tesla was developing a completely new car from scratch, filled with lots of software-controlled gadgetry. Investors will not wait forever to see whether they should keep on investing or pull the plug. When the 'Musketeer' took over control of Tesla, he brought with him a software development mindset, not the 'try-to-get-it-right-to-avoid-a-recall mindset of an auto executive.

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Over-the-Air Updating (Continued from P.4)

OTA is not just for recalls. Since 2012, Mercedes-Benz has been updating the infotainment apps that run on some of its vehicle's head units by letting the *mbrace2* embedded telematics system communicate directly with the smart phone running the apps. This allows the customer to decide which apps it would like to run in the vehicle, rather than having to accept the app supplier chosen by the OEM. Improving driving comfort can also extend how the vehicle handles in different situations. Tesla has shown that even features of vehicles which have been considered fixed until the advent of re-programmable ECUs are now variable. These include rate of acceleration and maximum speed.

BMW is one of several companies currently offering its customers OTA map updates. It is a standard feature for BMW *Connected Drive* customers. At non-defined but regular intervals, the Connected Drive back-end communicates with the vehicle's on-board unit and initiates a download of incremental map data updates. This ensures that the amount of data needing to be transferred is minimal. The OBU's internal SIM is used for the connectivity. The navigation system is unaffected by the data transfer process. When the downloading is completed, the incremental changes are applied to the map database.

BMW navigation screen showing OTA map update in progress with 97% complete

Tesla has designed its cars from the outset to allow powertrain updates to be delivered over-the-air since most of the company's vehicles allow ECUs to be accessed via the vehicle's central telematics system. Some examples of updates it can make are:

- Improvements to acceleration times
- Remove or reduce restrictions to allow for increases in top speeds
- Location-based air suspension that remembers potholes

A vehicle exists in many different states from the time it is assembled in a factory until it is disassembled and recycled. It is therefore essential that the entire life-cycle of a vehicle is considered when developing a technical solution to secure over-the-air updating of a vehicle's electronic control units, software or data storage devices. Secure in this context means providing protection from unlawful, undesirable and unqualified intervention in, or access to, vehicle systems. Properly designed Internet- and cellular-connected on-board devices are the crucial starting points. A well-designed over-the-air telecommunications method is vital for achieving the highest level of security.

Proven techniques and technologies exist for designing secure on-board systems and for delivering firmware and software over-the-air (FOTA/SOTA) updates to vehicles, but there are currently no common standards or industry practices for how an on-board system should be designed to achieve the highest level of security for both safety and security services and the broader range of infotainment services. What is known by all OEMs is that security of their on-board connected vehicle systems can be breached, and the consequences can be dire.

FOTA/SOTA is the focus of intensive standardisation efforts at this time so that it can become the norm.[7] Cost savings for the OEMs are potentially huge, but the big incentives are the increased customer satisfaction with continuously updated software, and many, many fewer unsafe cars on the road.

U.S. and EU Type Certification

Since it was established, NHTSA has issued dozens of safety standards, and it maintains an extensive database on vehicle crashes. However, the agency neither approves motor vehicles or parts as complying with its standards nor collects information from manufacturers as to compliance. The law puts the onus for enforcement of federal standards on automakers. It provides that "A manufacturer or distributor of a motor vehicle or motor vehicle equipment shall certify to the distributor or dealer at delivery that the vehicle or equipment complies with applicable motor vehicle safety standards prescribed by NHTSA."

Certification of a vehicle must be shown by a label or tag permanently fixed to the vehicle. The law also makes manufacturers responsible for testing of vehicles and liable for recalls and penalties if they are later found not to meet NHTSA's standards. After a new model is in the market, NHTSA buys vehicles from dealers and tests them at its own facilities to determine whether they comply with current standards. If NHTSA determines there is noncompliance, it can encourage the manufacturer to recall the model to correct the problem, or it can order a recall.

In contrast to the U.S. system of self-certification, the comparable EU vehicle system is based on government regulatory approval in advance of manufacturing. Until the 1950s, European vehicle safety regulations developed separately in each country. Interest in harmonizing vehicle regulation emerged as part of the process of European economic integration. The European vehicle regulatory regime now includes both EU directives, which must be implemented by all member states, and standards promulgated through a United Nations organization (United Nations Economic Commission for Europe-UNECE), which may be implemented at the discretion of a national government.

The system of type approval based around EC Directives provides for the approval of whole vehicles, vehicle systems, and separate components. Type approval is the confirmation that production samples of a design will meet specified performance standards. Each Member State is required to appoint an Approval Authority to issue the approvals and a Technical Service to carry out the testing to the Directives and Regulations.

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Michael Sena works hard for his clients to bring clarity to an often opaque world of vehicle telematics. He has not just studied the technologies and analyzed the services. He has developed and implemented them. He has shaped visions and followed through to delivering them. This newsletter touches on the principal themes of the industry, highlighting what is happening. Explaining and understanding the how and why, and developing your own strategies for your organization, are what we do together.

Saab Says No to NEVS on Name

The owner of the Saab name and Griffin logo have categorically denied NEVS the right to use either. "We have revoked their right to use the brand name and there is no longer a discussion about NEVS using it," said a Saab spokesperson. Just as well. It needs a good electric car name. NEVS will do just fine.

Electric Car Charging (cont. from p.3)

originally proposed by Mennekes in 2009 leading to the colloquial name of "Mennekes". The system was later tested and standardised by the German Association of the Automotive Industry (VDA) as VDE-AR-E 2623-2-2, and subsequently recommended by the European Automobile Manufacturers Association (ACEA) in 2011. Not present on the CLEVER station is the Tesla Supercharger. Why not? Because Tesla is installing its own Supercharger stations all over the world (where it sells its cars), and the plug used by Tesla does not fit any other receptacle. Tesla is not being nasty. Its Supercharger is too powerful for the other BEVs. It charges at a rate of up to 120kW. On the other hand, you can buy converters for the other standards for your Tesla mobile cable so you can charge at any charging station.

The Nissan Leaf, with the SL option, has two charging receptacles: a standard SAE J1772-2009 connector on the right for level 1 and 2 charging (120/220 volts AC) and a JARI high-voltage DC connector on the left designed by TEPCO for DC fast charging (500 volts DC 125 amps) using the CHAdeMO protocol.

The SAE CCS plug is designed so that only one receptacle is needed, not two. The top part of the plug is for AC, and the bottom part is for fast charging. Two pins are added for DC.

It has happened to most of us, at least once. We run out of fuel. Apparently, even Tesla owners—who are promised over 300 kilometers of range, are given multiple warnings when the end is nigh and are shown where they can top up—run out of battery power. There is no reserve tank in the trunk. Either you call for a tow to the nearest charging station or, if you are lucky, you can get a visit from a mobile charging station like the one to the right. I suggest these mobile charging stations add a portable café with hot coffee and snacks to help make the wait a little more comfortable.

Did what I learn about battery electric vehicles make me want to own one? The jury is still out. For driving around town, a BEV might be a good idea. For the highway and for long drives in the wilderness of Sweden, there is still too much to think about.

Footnotes:

1. Fatima Bento, Maria de. Unmanned Aerial Vehicles: An Overview. Inside GNSS (January/February 2008).

2. Definition of 'drone' in Webster's Unabridged Dictionary.

3. AUVSI (March 2013). The Economic Impact of Unmanned Aircraft Systems Integration in the United States.

4. Just in case you have forgotten the electricity basics, alternating current (AC) is used for moving electrical energy over long distances. It is what comes out of the wall socket. Direct (DC) is what is fed into batteries. Every device that has a battery, from the laptop I am writing this newsletter on to my phone and to all those electric cars, requires direct current to charge the battery. If the plug coming into the car is connected to an AC outlet, there needs to be a converter somewhere along the line to the battery that makes the AC-to-DC conversion. On your laptop it is that box on the cable. On your iPhone, it is. And on your electric car it is between plug and the battery. With fast DC charging stations, the conversion takes place in the station, and what comes out of the cable is DC current, ready to load into your car's battery. That means there needs to be different connections for DC and AC.

5. www.reuters.com/article/autos-safety-recalls-idUSL2N15P2F3.

6. According to Kymeta, "less than 10% of the earth is covered by 4G/LTE, and the wireless spectrum it covers is incredibly expensive." Maybe this 10% satisfies 80% of the places where people live, but we tend to want to go to places where people do not live. That is when we really need many of the services that the Connected Car promises.

7. The International Telecommunications Union, Telecom sector (ITU-T), SG17 is responsible for security standards. A work item is *Secure software update capability for ITS Communications devices*. In addition, Working Party 29 or WP.29, a subsidiary body of the Inland Transport Committee of the United Nations Economic Commission for Europe (UNECE) is also engaged in fact-finding in the areas of cybersecurity, data protection and automated driving.