The Legal Problem of Software in Vehicles

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Introduction Increasingly, vehicles are equipped with electronic devices that control and even drive it instead of the driver. These devices, which include speed and parking sensors, as well as connectivity like bluetooth, are controlled by software. In addition, in the future, vehicular communication will be added to vehicles, which is expected to significantly increase road safety. However, as these components take more control from the driver, liability for accidents becomes a more difficult problem, especially in applications like Cooperative Adaptive Cruise Control (CACC)[1]. In addition, there is a lack of security in existing systems, as shown by recent work on hacking the vehicle itself[2]. As is common for hacking, such attacks rely on incorrect implementation of standards and other programming errors by the component manufacturers[3].

The problem The question is, who is liable when a crash is caused not by the driver, but the software? An important part of the problem is that car manufacturers do not typically build all the components of the car themselves, but buy off-the-shelf devices from seperate manufacturers. These seperate manufacturers typically provide their devices as a blackbox: thus, the car manufacturer has to spend much more to test and secure the vehicle, because they cannot simply examine the devices and software themselves.

This problem relates to cyberspace because future applications will provide connectivity to both other cars, creating a vehicular 'internet', as well as providing internet services. In addition, hacking and software play a significant role here as they do in cyberspace.

Because this is mainly a type of problem related to accidents in which damages must be paid between private parties, it falls under private law. The problem may also play a role in criminal law, for example if one of the manufacturers has sold hardware with a virus or if a cracker was involved in the accident [4].

An example situation Consider a case where two cars were driving on an otherwise deserted highway, both using a CACC-like system to maintain their speed and distance. Each vehicle has the following relevant components: a GPS receiver, forward and backward sensors to detect vehicles, a speed sensor for its own speed, an IEEE 802.11p radio[5] and a processing unit with software that makes decisions about acceleration, each built by a different manufacturer. An accident is caused by the back vehicle through the simultaneous deviation of several sensors that cause the decision logic to accelerate, while the forward car is actually breaking. For example, the GPS receiver reports a slightly different position, the forward sensor detects the vehicle at a larger distance and the beacon message[6] sent by the front vehicle also slightly deviates from reality. These events together cause the software to decide to accelerate, while the front vehicle is not accelerating, causing a crash with significant damage to both vehicles. We assume both drivers are properly insured as required by the Dutch WAM law by two different insurance

[1] In CAAC, the car drives itself to consistently maintain a shorter distance at a higher speed, usually on a highway.

[2] Karl Koscher, Alexei Czeskis, Franziska Roesner, Shwetak Patel, Tadayoshi Kohno, Stephen Checkoway, Damon McCoy, Brian Kantor, Danny Anderson, Hovav Shacham, Stefan Savage: *Experimental Security Analysis of a Modern Automobile*. IEEE Symposium on Security and Privacy, Oakland, CA, May 16-19, 2010.

[3] For simplicity, I will assume component manufacturers write their own software. I do not know how often this is the case in reality.

[4] Here, cracker is used to mean a malicious hacker, ie. someone that commits what the Dutch call *computervredebreuk*. While the argument for such either case could be similar, it is disregarded for the remainder of this document.

[5] This is a WiFi-like radio that will be used for vehicular communication.

[6] A CACC-like system operates in part by each vehicle reporting its position, speed and other information in a periodic message called a beacon.

companies[7]. One of the two insurance companies may file a suit against the car manufacturer of the back vehicle citing that the technical malfunctions were the cause of the accident. The question in this situation is; is the manufacturer liable for the damages?

The legal argument Primarily, the owner of a car is liable for the damages it causes to the rest of the world[8], unless there is *overmacht* or when the damages are caused by some other legal person for whom the owner is not liable. However, this does not apply to wild animals or other vehicles, nor the objects contained within those vehicles[9].

If multiple events, for which different legal persons are liable, occur at the same time while it is not clear which of them caused the event of damage, but at least one of these must be the cause, then the payment of damages falls to all the legal persons liable for these events[10]. Applying this to the case, the insurance companies may attempt to use this argument to demand this payment from the component and car manufacturers. For these manufacturers, it is important to know whether the driver or owner of the vehicle were involved in an event that caused the damages; if so, the damages required are reduced[11].

In case law[12], we find that a company is not liable for complete damages caused by an event if the damages are disproportional to the amount of money paid for the service that this company provides[13]. This can be applied to provide some insight on the legal problem at hand; usually, a component manufacturer typically only delivers a component, its software and perhaps in the future also (security) updates for that software. The cost of such a component is disproportional to the damages that will occur in a serious car accident[14]. Thus, it may be concluded that not the component manufacturer is liable, but the car manufacturer, which delivers the end product and could not defend against a claim using this case.

Clearly, current legislation assumes that components are under full control of the driver, placing liability with the driver if he causes an accident[15]. However, considering the increasing production of electronic components that function autonomously, as well as the introduction of systems that will warn drivers based on messages communicated inside a vehicle, or between several vehicles, the driver can no longer be the sole liable party in the event of a crash caused by a malfunction in one or several of such electronic components, or by faulty interaction between these components. The component manufacturers, who have designed the hardware and written the software for the malfunctioning components, cannot be held liable for all damages as per the previously mentioned case law[16]. Thus, current legislation would point to the car manufacturer, which also performs quality assurance and other testing for the vehicle, to be liable for malfunctioning components. However, the court will also consider that is impossible for the car manufacturer to design a quality assurance programme that will exhaustively test all the components built into the vehicle, not to mention interaction with other vehicles. Thus, the court must decide on some division of damages, or deny the insurance companies these damages as it is their buisness risk[17].

Conclusion Currently there is no specific legislation or case law for drivers, component and car manufacturers, and insurance companies to solve a dispute resulting from a traffic incident caused by a malfunction resulting from incorrect interaction between components and incorrect communication[18] between different vehicles. This document discusses the problem, provides a short legal argument based on current legislation and jurispudence, and proposes a solution where the court divides the damages among the manufacturers.

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[7] If this were not the case, the following case law would also be relevant: LJN BP5945, Rechtbank Arnhem, 200048, which is about who has to prove a victim was not wearing a seat belt

[8] WVW1994 article 185:1

[9] WVW1994 article 185:4

[10] Burgelijk Wetboek 6:98 and 6:99

[11] Burgelijk Wetboek 6:101, specifically; *Wanneer de schade mede een gevolg is van een omstandigheid die aan de benadeelde kan worden toegerekend, wordt de vergoedingsplicht verminderd.*

[12] Found with the help of a blog post of Arnoud Engelfriet: `http://blog.iusmentis.com/2011/09/19/ben-ik-aansprakelijk-voor-de-fouten-in-mijn-software/`. The article itself explains software companies should use a Terms and Conditions document for this purpose; in the dicussion, the case law is mentioned.

[13] The case law is HR 05-05-1968, NJ 1968, 102, commonly known as the *Vliegtuigvleugel-arrest*

[14] A few dozen euros compared to thousands.

[15] WVW1994 article 185:1

[16] The *Vliegtuigvleugel-arrest*.

[17] However, this would create a very undesirable situation where insurance companies would deny to insure vehicles with devices whose main purpose is to **improve** road safety. Since acceptance is the only achievable if these devices are actually purchased, this contradicts the common interest.

[18] This refers to the communication by the vehicles, not between drivers.