

# Autonomous Driving: A Dream on Rails?

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## Abstract

This position paper argues for a consistent vision regarding the implementation of autonomous driving in a fully automated traffic system. More specifically, it highlights differences in expectations regarding flexibility of individual traffic versus a fully autonomous and interconnected transportation system that is almost completely detached from the driver. The paper argues for a common vision, which could address some of the proverbial “elephants in the room” sooner rather than later.

## 1 Motivation

The future of driving is an autonomous one. While hardly a statement is ever universally accepted, it would be difficult to find many would dispute this one, at least in the current, rather enthusiastic, climate. Considering the strong and still ongoing push towards fully autonomous (i.e., Level 5) and connected vehicles in virtually all areas of transportation (individual transport, fleet operations, last mile solutions, railway systems), manual operation of vehicles will probably not stay around forever. We are not quite sure of the exact day yet, but somewhere someone wrote down its expiry date – and that date is drawing closer every time a new step towards autonomous vehicles and their integration into traffic is made.

This rather definite stance on the eventual ubiquitous presence of autonomous driving does not in itself give us a clear vision of exactly how our future (autonomous) environment will look like, however. To provide a more precise example of this: All levels of driving automation as they are defined in the SAE International Standard J3016 (SAE 2014) foresee the technical capabilities for intervention up to level 4, and management at level 5, by a human driver, should the necessity arise. In their definition of an automated system’s capabilities, they explicitly exclude warning and momentary intervention systems, which do not automate any part of the dynamic driving task on a sustained basis. It appears that

the definition errs on the side of caution, so that even a fully autonomous level 5 car of the future might contain the means for the driver to “take the wheel” for whatever reason might be necessary – which only makes sense if that driver is actually capable of doing so. Now let us put this into contrast with the vision of a more inclusive autonomous individual traffic, where motoric capabilities are less important (or even wholly unimportant) and even a driving license is not necessary anymore (Open Roboethics Initiative 2014). But what good is an intervention-ready system, if there is no one behind the wheel who could possibly intervene? It seems that there are at least two visions at work here, which clash with one another.

## 2 Visions

The first is a more technically oriented one, where fallibility and unexpected circumstances are assumed. Much like with modern computers and other (fully or partially) automated entities, human-mediated troubleshooting and intervention capabilities are seen as a necessity for successful operation of such a system in all expected and unexpected circumstances. Naturally, regular computer use does not require a driving license, and dedicated tech support exists. But then, a home computer requires less time-immediate intervention capabilities – unlike a vehicle transporting its “user” at up to or over 100 miles per hour. If an autonomous driving system fails at a critical moment while driving at high speed, one can hardly afford to call and wait for tech support to arrive. Even a level 5 autonomous vehicle with fully system-operated fallback capabilities could potentially benefit from intervention capabilities by a human driver, as no fallback system will be infallible itself. A bug free system, which can anticipate and handle all possible circumstances does not yet exist for any context, so it would rather unrealistic to expect such from autonomous driving systems.

This is where the second vision comes into play, which is more centered around possibilities and opportunities presented by this new technology. If the car essentially operates itself, it opens up a lot of individual traffic opportunities for individuals unfit to operate a manual vehicle: the physically and mentally disabled, minors and children, adults without a driving license, or even drunk people who might otherwise cause an accident in manual traffic would not even have the *chance* to cause any harm. But this requires a 100% failsafe autonomous system without ever requiring any mediation from a human beyond inputting a destination – which, at least so far, seems even beyond the SAE’s wildest dreams.

To be fair, today’s non-autonomous traffic can hardly be considered safe, so why not provide autonomous vehicles, which are at least safer than what we have now? This sounds like a sensible approach, until one considers whether or not they want to be the person who will eventually have to explain: “All right, so while our cars do kill

people on a regular basis, that casualty quote is kept to an acceptable minimum of 0,02% of all passengers. We, therefore, consider our system safe, especially when compared to the situation in 2020.”

Let us, however, for a moment grant that a fully autonomous and absolutely failsafe system is possible and feasible. After all, we are talking about the future, where the possibilities are only as limited as our imagination. We will then soon find that there is yet another clash of expectations in autonomous driving, this time related to the ‘individual’ in individual traffic. Operating a (non-autonomous) car has the advantage of flexibility as opposed to e.g., trains, which depend on fixed stations and timetables. But the envisioned future is not an individual or isolated one. It is rather one of interconnected traffic with autonomous agents in constant communication with each other. Research already pushes strongly towards car-to-car communication for autonomous vehicles (Thierer and Hagemann 2014).

Now imagine such a fully automated traffic environment, where everything works perfectly and cars communicate with each other to resolve conflicts and guarantee a fluid and maximized as well as optimized traffic. Everything is well, as long as the passenger gets into their vehicle, enters a destination, and then waits until they arrive at said destination. But what if the driver suddenly decides they want to stop somewhere for shopping or visit a relative who just happens to live somewhere in the vicinity. Will the system be able to accommodate such requests easily or will we rather have a situation like in today’s railways systems, where one delay often causes ten others – precisely because they are synchronized and, therefore, do *not* operate individually. Are we trying to eat our proverbial (autonomous) cake and have it, by envisioning what is basically a sophisticated railway system with stations everywhere but without any delay chain reactions? Could such a system even be developed or is it not a fundamental issue of it being possible to have only one, but not the other? We do not know the answer to this question, but more importantly, we rarely see it even being asked (Hoogendoorn et al. 2014).

### 3 Summary

We really should clarify what exactly we *expect* from autonomous vehicles. It is, as the brief analysis in this paper intended to show, a deceptively simple question. Depending on how we decide to answer it, however, it could change the direction autonomous driving takes in the future in rather dramatic ways. Right now, we risk chasing technical innovations that lead to an autonomous environment, which might not bring with it the advantages we (or some of us) had envisioned. It is for this reason that we would want to participate in this workshop and exchange ideas and impressions with other researchers or professionals working in the field of

autonomous vehicles. This is the right time to shape what is still more of an informed premonition into a concrete objective for autonomous driving research.

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