AUTONOMOUS ? NO. SOCIAL ? YES.

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Figure 0.1. Vehicle A is reporting a pedestrian about to cross the street to car B, while at the same time, uses a lamppost to calibrate its depth sensors and receive an update about an ambulance en route.

Figure 0.2. A layered model

Figure 0.3. Automated Transportation

Making vehicles autonomous is hard, expensive, and possibly does not constitute a complete solution. How could I convince you that an autonomous vehicle is safe, if the country in which you drive does not have a definition for a safe autonomous vehicle, or an autonomous vehicle for that matter? In fact, how could anyone convince anyone else that two months after purchasing such a vehicle it would be not be prohibited for use as an autonomous vehicle, by law?

Autonomous vehicles are hard to achieve, not necessarily because it is hard to identify a car breaking, a pedestrian crossing the road or sensing a slippery surface. They are hard because of questions such as who is to blame for an accident involving two identical vehicles? They are hard because of questions such as where, when, how and from whom will you get your security update? How do you make sure the system is calibrated and functioning properly after a fender bender? What happens when an ambulance tries to push through? Autonomous vehicles are hard because they are just that - autonomous. An analogy from the world of aviation would help realize that there is an underlying structure: even at sparsely occupied 3D space, a pilot has to file a flight plan. The plane could divert from this plan under certain conditions, and up to a certain extent, but traffic in the sky is not random, there are corridors, there is control, there is communication.

While some of the harder issues could be resolved through legislation, they could be viewed from a different perspective; A car is a container for people, trying to get from a source to a destination much like a packet. A street is a container (in the data structure sense) for cars, bicycles, pedestrians, all occupying the road and pavement under a set of rules, that may be broken. A network, in this case, is a container for streets. This train of thought leads to a layered structure, a description of a system, where cars communicate with each other and pass information, lampposts transmit interruptions and assist in calibration. A rushing ambulance is merely a
special case of QoS once viewed as part of a structured network. Figure 0.1 depicts how we could treat a junction as part of a larger system. Traffic legislation becomes specification, and would include a control layer to require that vehicle B has to slow down and vehicle A to move aside. An infrastructure and sensory layer would include the lampposts and on-vehicle sensors. Maintenance sub-layer of the local system would require the owner of car A to service the vehicle should the calibration not succeed. Once viewed as a layered system, much like the OSI model, it is no longer the duty of a single vehicle to traverse the universe as it bravely discovers everything for the first time.

The problems of identifying hazardous situations via machine learning and image processing are all still there, but now the time scales have changed favorably with earlier alert from the system. This different view of social transportation as a system, still requires conflict resolution in real time, distributed system management, classification, communication through various media and resilient infrastructure. It requires multidisciplinary research, modeling, specification, failure analysis. The result, however, could include information that autonomous vehicles do not claim to gather. A simple example could include information such as weight of the vehicle, number of passengers on board, velocity and breaking capability, which in turn would dictate the distance envelope that should be kept. An accident, when viewed as an event in the system, is all at once a request for assistance, re-routing of traffic that would prevent congestion, and faster clearing which contributes to the system resilience.

You would have to find a way to pack an autonomous vehicle with immense compute and sensorial abilities in order to make it safe, and then try to make it cheap enough to be economical. This has already taken a great deal of time and research. Instead, we could start treating transportation as a layered problem, and have incremental advancements as we figure out solutions to different layers. To begin with, a vehicle would implement everything that was achieved so far in image processing, and would share it, get feedback, follow a vehicle sharing the same route. The challenge is to bring together a society of scientists from different fields, to produce a system which is economical, feasible, social.