The road to tomorrow: streets need to be as smart as the cars driving on them

It’s not enough for future vehicles to be shared and self-driving – a smart upgrade of our cities and streets is also required

By LUKE DORMEHL
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Flying-car enthusiasts may plan to make roads redundant, and virtual telecommuting evangelists seek to do away with the need to travel at all - but for now, it’s self-driving lorries or the smaller autonomous vehicles currently being tested in parts of the UK, including Greenwich, Bristol, Milton Keynes and Coventry, at the transportation vanguard.

Autonomous vehicles promise to have a much bigger effect on our roads than simply giving individual drivers an easier commute. “We are very interested in how autonomous cars could have an impact at the city scale,” says Carlo Ratti, director at MIT’s SENSEable City Lab, and co-author of The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life.

“Our position is that they promise to have a dramatic impact, because they could blur the distinction between private and public modes of transportation,” he says. “’Your’ car could give you a lift to work in the morning and then, rather than sitting idle in a parking lot, give a lift to someone else in your family, your neighbourhood, your social-media community, or city.”

How much of an impact would this have on city congestion? More than you think. One recent paper published by MIT suggested that the mobility demand of a city such as Singapore could be met with 30 per cent of its existing vehicles, were there a publicly accessible fleet of self-driving cars. That number could be slashed a further 40 per cent if passengers on similar routes shared a vehicle. “This implies a city in which everyone can travel on demand with just one-fifth of the number of cars in use today,” Ratti says.
But whether or not families are willing to give up the status symbol of multiple cars in favour of a sharing economy (and over the next ten years this seems unlikely), there are still smart technologies which can - and will - reduce traffic levels.

"Think of the street as a very complicated version of musical chairs," says Anthony Townsend, a researcher whose work explores the intersection between technology and cities. "An urban street is the most scarce, expensive piece of land and resource. Everybody wants to be on it and they don’t want to share with anyone. There’s only so much of it, so the more you can co-ordinate it, the more benefits you can get."

Right now, Townsend points out, 30 per cent of traffic in cities is caused by people driving around looking for parking. That is a problem that the Alphabet-owned Sidewalk Labs hopes to solve. It recently offered Columbus, Ohio - the winner of a recent $50 million (£37m) Smart City Challenge, organised by the US Department of Transportation - the use of camera-equipped vehicles similar to Google’s Street View cars, to count the number of available parking spaces in the city, as well as reading relevant parking signs. Aggregating this with data from Google Maps, it will then help direct drivers to empty spaces.

Just like the internet of things - through which the combined "smarts" of simple devices working together represent exciting possibilities - so too will the ability of vehicles to communicate with the world around them transform the next decade.

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"The idea is pretty simple," says Dean Pomerleau, an AI researcher who built one of the world’s first neural-network-powered self-driving cars (and drove it across
America), all the way back in 1995. “The notion is that every car will be equipped with short-range communication technology that allows it to learn about other vehicles in its vicinity - as well as upcoming construction zones or other road hazards that have either been programmed in or reported by other vehicles.”

Vehicle-to-vehicle communication will ensure our roads run more smoothly. One idea being explored by the SENSEable City Lab is for sensor-laden vehicles to pass through intersections by communicating and remaining at a safe distance from each other, rather than grinding to a halt at traffic lights.

“In other terms, you move control from the traffic flow level to the vehicle level,” says Ratti. “Doing that, you can create a system that is much more efficient and can significantly reduce queues and delays, because then you can make sure the vehicles get to the intersection exactly when they have a slot. This system will became possible when there is a certain level of intelligence in every car - and it will be a natural consequence of the driverless revolution.”

Uber launched self-driving taxis in Pittsburgh earlier this year.
As these technologies gain momentum, expect to see another new norm: smart roads. Like smart vehicles, smart roads will use a variety of embedded sensors, Wi-Fi connectivity, AI algorithms and other technologies that a traditional "dumb" road lacks.

At present, we’re only beginning to see cities factoring this kind of smart infrastructure into their plans. For example, the city of Copenhagen has undertaken a number of pilot schemes to investigate the effects of smart roads - with a slew of environmental, safety and other benefits. Smart street lighting, for instance, becomes brighter when cyclists are crossing busy road junctions: making motorists more aware of their presence, while saving power at other times by not having illumination running at full capacity.

A system set up by the Copenhagen Intelligent Transport Systems, meanwhile, features Wi-Fi access points which anonymously detect road users’ mobile phones as they pass along the Copenhagen street on which they are located. By triangulating multiple access points, the position of road users’ phones can be pinpointed in a way that lets streets be mapped for mobility, safety and CO2 emissions.

Another demonstration of smart roads is evidenced in Songdo, South Korea, where millions of sensors are deployed in the city’s streets, electrical grids and other key infrastructure elements. This allows the flow of people to be continuously tracked in a way that lets the city make "smart" decisions. There has also been investigation into technologies such as smart cameras equipped with algorithms for spotting pedestrians, or scanning the licence plates of passing cars with a view to both controlling features such as street lights, and monitoring and predicting traffic flow.

These notions of "smart lighting" which can adapt intelligently to traffic will become increasingly popular. Monitoring the collective batteries of electric vehicles opens up possibilities such as building charging points at exactly the right location - or even incorporating special lanes into certain roads so that electric vehicles can be charged as they travel along them.
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This ability to draw on data gathered by smart vehicles will also begin to dictate the work of town planners as they construct new roads or modify old ones. Last year, the Google-owned traffic app Waze teamed up with the city of Boston to reduce local traffic. In exchange for advance notice from city authorities about planned road closures, Waze agreed to share data gathered from its users with Boston’s traffic management centre.

In the short term, the collaboration made Waze a more valuable tool to Bostonians by letting them plan routes to reach their destinations quickly and more efficiently. Longer-term, this data exchange will help Boston to fine-tune its traffic light timings and urban planning.

The mass adoption of new technology has always impacted the development of cities and will continue to do so. The success of Henry Ford’s Model T car - introduced in 1908 - helped replace convoluted medieval or Victorian roads with gleaming motorways and dual carriageways equipped for fast car travel. Expect to see a similar transition for the age of big data: one which will be cleaner, safer - and more pedestrian friendly.

That’s not to suggest that there won’t be challenges. The big changes on our roads - whether it’s 2016, 2026 or further forward - will force governments, as well as private enterprise, to embrace truly smart vehicles and the possibilities they promise.

As Anthony Townsend points out, "It’s policy that’s going to affect these changes. Cars didn’t take over the city until cities put rules in place that allowed it. It was a choice that city governments made. That’s one of the things that’s often uninformed about speculation that’s coming out of Silicon Valley now. They think they’re going to solve all the problems the car created by just putting in some software. It’s a lot more complicated than that.”