

## 5G – The Enabler of the Next Generation of Connected Services

### **Introduction: Fifth time's the charm**

One can almost be forgiven for suffering G fatigue. Over the years we've been inundated with new Gs – and an LTE or several – promising the best in mobile broadband functionality. 2G, 3G, LTE, 4G ... and now, 5G. As ever in the tech world, there is much hype over this new number. Can it really be all that much better than its antecedents?

In a word, *absolutely*. Once implemented 5G is anticipated to top out at speeds of roughly 20 gigabits per second, very far above even the quickest commercial fibre optics networks on the market today. To say that the step up from that to 5G speed is massive is a severe understatement. Additionally, 5G holds the promise of ultra-low latency (i.e., delay from input to outcome).

That kind of speed is not only helpful for the implementation of advanced assisted driving technologies and, further down the road, autonomy – it is *essential* for those functionalities. It almost goes without saying that a vehicle operating mostly or entirely on its own will have to crunch vast piles of data at lightning-quick rates. This goal cannot be reached on current standards; 5G is the technology that will get us there.

And keep us there for some time. As Paul Wilson, smart city advisor for communications industry association TM Forum puts it, '5G has the potential to cover all the data needs of self-driving cars.'

In this paper, we'll take a brief look at how we got to this stage, how 5G promises to accelerate us into the autonomous driving future, and when we might expect this future to occur. Strap in and hold tight, we're in for quite an intense ride in the coming years.

### **Big data, big plans**

For those who might be unfamiliar, the 'G' in 5G and its forbears stands for 'generation.' Each G (including LTE, which is sort of a pre-4G, not to be confused with the later LTE-A and LTE-A Pro) is a set of standards established by the International Telecommunication Union, an arm of the United Nations.

Each has been a big step up from its predecessor. 2G, established in the nascent days of widespread mobile device use, basically allowed for phone calls, rudimentary text messages, and the exchange of very limited amounts of data. 3G was the technology powering the early smartphones from the

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last decade, and as those devices became more data-dependent, the faster and more robust 4G was developed.

5G is on its way and will be with us quite soon, however we might have to wait some time for it to become the norm. ‘The 5G standard will be agreed in 2020, although many components are now widely agreed and understood,’ says TM Forum’s Wilson. ‘It will however take most of the following decade for the 5G rollout to be complete, because 5G represents a fundamental digital transformation of the telecoms industry and that will take some time to happen.’

The leap from 4G to 5G will require telecoms providers to build out fresh infrastructure for the new standard. And since 5G holds the promise of linking the increasing number of ‘smart’ objects together, establishing it will depend on a vast number of tech companies finding ways to collaborate with a myriad of partners. These include but are by no means limited to the makers of virtual reality headsets, for example, or the companies manufacturing new-generation refrigerators, digital thermostats and, of course, connected cars.

‘In a way, [it’s] uncharted territory,’ Borje Ekholm, CEO of Ericsson, said to CNBC recently. ‘We are connecting new things... this will require us to enter into new partnerships, new collaboration [and] new business models basically.’

It’ll be a much more digitalised world when they come out the other end. At the risk of stating the obvious, that the smartphone in your pocket right now is more powerful and sophisticated than the one you owned only a few short years ago, and it’s going to continue advancing at exponential rates. Meanwhile, the Internet of Things –the collective name for the once-mundane everyday objects now being plugged into the connected world – is becoming more prominent. Ditto for data-hungry augmented and virtual reality games/applications. These three developments alone are going to require much wider pipes carrying data at significantly higher speeds. Adding the vast numbers of increasingly connected automobiles into the mix amplifies this need.

Once 5G lands, it will change a great deal about the mobile connected universe. It will be an enabler, freeing solutions providers and car makers to develop new technologies and roll them out quickly, on the back of a wireless standard that can support them. In turn, consumer demand for such functionalities will encourage the establishment of the infrastructure underpinning 5G.

## **V2X: Your car thinks and communicates**

Even current-model cars cruising along on Level 2 functionalities are prodigious data eaters and emitters. They’ll be even more ravenous as we push towards Level 5, with systems taking on more and more sensory responsibility from the driver.

A car’s sensors will provide the system’s ‘eyes,’ but as a human driver uses mental bandwidth to process his or her environment, assisted/autonomous solutions will utilise that fast 5G pipe. The



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standard ensures that the amount of data needed to do this will pass back and forth as needed, but there's another crucial element of 5G that makes this work – the almost complete absence of latency.

Taking a few moments of time to wait for a web page to load on your smartphone is tolerable; experiencing hang time whilst adjusting to a skidding wreck in front of us on a motorway could very well prove fatal.

Higher-level assisted, and autonomous, operations require the ability to make split-second decisions, to adjust to situations in the safest way possible. This, it nearly goes without saying, is necessary when an automobile is interacting with the environment around it. The list of vehicle-to-everything (V2X) elements a car needs to be aware of and communicate with is long and daunting. Traffic signals and signs, hazards/roadblocks, infrastructure that sets limits on speed and operation, etc. etc. etc.

This line-up, naturally, includes fellow vehicles gliding down the road. Vehicle-to-vehicle (V2V) solutions will allow automobiles to not only see and track each other, but to communicate between themselves as well. The safety benefits of this are obvious, but of course this depends on data transmission speed and near-instant reaction time.

As if these functionalities weren't demanding enough, there's the need for an automobile to do humans one better and possess a kind of 'super-sense.' The sophisticated assisted and self-driving systems of the future will have the ability to 'see' ahead of a person's line of sight, to anticipate upcoming traffic and obstacles before they become problems.

And unlike you or I, these systems will utilise always-on, 360-degree vision. After all, many potential accidents aren't only located ahead of the windscreen, but to the sides and occasionally in the rear. Vehicles with higher-level functionalities will maintain a state of constant alertness in all directions, 'seeing' much farther than a pair of human eyes. That capability is breath-taking, but it's not feasible on the current wireless standard.

The upcoming one, however, won't come cheap. A report published in January from consultancy Accenture estimates that in the U.S., wireless operators are poised to collectively put in as much as \$275 billion over a period of seven years to build out 5G infrastructure. They'll get something for their money, though – Accenture estimates that the 5G roll-out could create up to 3 million jobs, and increase gross domestic product by \$500 billion.

A large chunk of that, of course, would come from those armies of data-hungry automobiles prowling American roads. '5G-powered smart city solutions applied to the management of vehicle traffic and electrical grids alone could produce an estimate of \$160 billion in benefits and savings for local communities and their residents,' Accenture's Tejas Rao said. 'These 5G attributes will enable cities to reduce commute times, improve public safety and generate significant smart-grid efficiencies.'



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Accenture's projections might well underestimate the value 5G-enhanced driving solutions bring to society. With robust systems in place for avoiding accidents - either of the pile-of-bricks-in-the-middle-of-the street or out-of-control-car-heading-right-this-way variety – it's conceivable that that amount could be much higher. After all, there will be far less damage to vehicles, infrastructure and, most precious of all, human occupants.

## The fast lane to autonomy

Like TM Forum's Wilson, most pundits believe the parameters of the 5G standard will be finalised in 2020, with roll-out to being immediately thereafter. However, there are some that believe we can expect it to arrive sooner. A group of nearly two dozen big wireless service providers and equipment makers have pledged to agree a standard called 5G New Radio earlier than that.

'For consumers, this means they're going to get an elevated broadband experience in 2019,' said chipmaker Qualcomm's Rasmus Hellberg to CNET earlier this year.

This matters because the group's participants read like a Who's Who in American and, indeed global, telecoms. AT&T is on board, as is Vodafone, Ericsson, British Telecom, Deutsche Telekom, and NTT DoCoMo. Trials of 5G NR are set to begin later this year.

It's not that these companies are necessarily eager to dive into the connected car world, although some will be serious players on this field. It's also because bottom-up demand from other applications will push the establishment and roll-out of an acceptable 5G standard. The need for broader pipes in the mobile device sphere is obvious; perhaps less apparent is the rise of IoT solutions. Some of these newly-connected objects will be just as hungry for fast data transfer and low latency as the sharpest of cutting-edge assisted driving systems.

'[I]nterestingly in IoT, there are many devices which should be served timely [albeit] with low data rates,' Lancaster University research Zhiguo Ding said in an interview with the Institute of Electrical and Electronics Engineers' Spectrum magazine. 'One example is wireless healthcare, where wearable devices (heart monitors, biosensors, etc) need to send patient data timely to hospital servers'.

Solutions providers and vehicle makers are busily preparing for the immediate future of 5G. As you read this, many are in various stages of testing systems and equipment that will run under the new standard. Truck and bus manufacturer Scania, in collaboration with fellow Sweden-based company Ericsson, has a remote driving pilot program in which an operator drives a Scania bus over a 5G network built by Ericsson. In Asia, Chinese companies Huawei Technologies, SAIC Motor, and China Mobile successfully demonstrated a similar arrangement with a SAIC Motor car driven by a remote operator using China Mobile's 5G technology.



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Although it's tempting to dream about what kinds of functionalities we'll have at our disposal when 5G starts to blanket the world shortly, we don't yet know for certain what these will be. Gauging by the rapid evolution of assisted/autonomous solutions thus far, we can assume that these will continue to develop – in the usual fits and starts – along the broad lines of the SAE's levels of automation.

As of now there are many thoughts about when we'll finally hit Level 5, which Toyota Research Institute's Gill Pratt described in a wonderfully succinct way as 'where a car can drive fully autonomously under any traffic or weather condition in any place and at any time'. It's still difficult to say when exactly this happy time will occur, regardless with 5G about to land, at least we know we'll have the necessary data infrastructure in place.

## **Conclusion: Towards a driverless world**

The best inventions, and the sharpest technology, are useless without the infrastructure to support them. We can confidently say that everyone involved in advancing connected car technology from helpful driver assistant and navigation aid, to 100 percent take-the-wheel autonomy is aware that this won't happen without 5G. We can add telecoms services providers, people labouring on IoT solutions, medical technology specialists, and a great many more individuals to that list. 5G is the technology that will power the advanced solutions in all these categories, and many more additionally.

We have a brave new technology on our hands. We also have the will to agree its standards, and the desire to roll it out as quickly and as widely as feasible. Because of this need and desire we can expect it'll be up and running in what will seem like a hot minute. It's coming in the very nearest future. That's because the future, after all, depends on it.

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