Getting past the hype

What Gartner's Technology Hype Cycle teaches us about the autonomous vehicle, by **Bern Grush** and **John Niles**

Much is written about the expectations for autonomous vehicle technology. The attention is deserved. Surely the switch from driver to driverless is as remarkable as was the switch from horse to horseless 120 years ago? A science fiction fantasy at the 1939 World's Fair is finally showing up in bits and pieces as automated driver assistance systems in many automotive brands. Robotic vehicle features like lane keeping and automatic braking are on their way to becoming the norm. AVs are just around the corner.

OR ARE THEY?

Every year Gartner Inc., an information technology advisory, publishes its Emerging Technology Hype Cycle (fig 1). This model based on observations of hundreds of trajectories of successful technologies, arranges emerging technologies on a time spectrum of five phases from "*Innovation Trigger*" to the "*Plateau of Productivity*". All technologies go through these developmental stages: they get over hyped, disappointment sets in, and after some time the technology is viewed more realistically and settles into a role where it is most useful. With this model, which CeBIT describes as "astonishingly accurate",[1] Gartner is a telling seer for the progress of robotic vehicle technology.

The Autonomous Vehicle first appeared on Gartner's 2010 Emerging Technologies Hype Cycle[2] about a third of the way up the *Positive Hype* slope toward the *Peak of Inflated Expectations*. In 2010 self-driving hype was about Sebastian Thrun winning the DARPA challenge, retellings of the General Motors exhibit at the 1939 World's Fair, and how many thousands of lives robotic vehicles could save since most accidents are caused by human error.

From 2012 to 2014 Gartner gradually promoted the Autonomous Vehicle from halfway up the *Positive Hype* slope to the *Peak of Expectations*, which it reached in July 2015[3] (Fig 1). In 2010, Gartner positioned the Autonomous Vehicle as "more than 10 years from mainstream adoption". By 2012, Gartner upgraded this prediction to "the Plateau of Productivity will be reached in five to 10 years", a five-year advance in 24 months. That projection has remained unchanged since then.

THE TROUGH OF DISILLUSIONMENT

A lot of excitement (and hype) has indeed built since 2010. But as with all technologies studied by Gartner, the full, Level 5 autonomous vehicle is now inescapably poised to fall into the *Trough of Disillusionment* and recover on the *Slope of Enlightenment* before it reaches the *Plateau of Productivity* within Gartner's estimated 2020 to 2025.

The impending slide through Negative Hype and into the Trough of Disillusionment

has started, manifesting as barriers to the gradual, market-envisioned feature creep through advanced driver assistance systems. This household ownership model would spawn 20 or 30 lucrative years for consumer vehicles and technology companies, as they would eventually reach pervasive uptake of SAE's Level 5 autonomy (Fig 2, top).

One of the barriers is that humans generally come to rely on assistive technologies quickly and incautiously. The reliability with which drivers will remain attentive while using intermediate levels of semi-autonomous features, or be able to rapidly re-refocus their attention in the event the vehicle requests oversight, is very challenging.[4,5] Driving becomes the distraction.

Another barrier is the organization of public infrastructure. Near term use of fully autonomous, Level 5, vehicles implies either mixing them with semi-autonomous ones on the same roadway, setting up separate lanes and safe-havens at great expense, or as Google (and now reportedly, Ford[6]) has elected, jumping immediately to Level 5 AVs skipping the intermediate semi-robotic levels altogether. Of course Level 5 AVs would suffer severe access limitations in their first decade or so. The owner of a Level 5 AV would be able to use it only on fully qualified lanes and areas. These would not likely appear quickly given the social, political and funding hurdles that slow any major change to our public spaces. Access-anxiety for early adopters of Level 5 AVs would be worse than the range-anxiety afflicting early EV adoption.

A further barrier to consumer ownership of fully robotic vehicles will be financial. Because the technology for robotic mobility will evolve so rapidly, household vehicle lifespans will plummet and their ability to retain resale value after purchase will be abysmal. These vehicles will not have 12-15 year life spans as now. Three years would become a more typical expectation for even meagre value retention. If you are on your second or third smartphone, you will understand.

For consumers who can't use them or can't finance them, how much more disillusionment is needed?

THE SLOPE OF ENLIGHTENMENT

Happily, there is a solution to this impending slump in enthusiasm for the fully self-driving car. Just as the barriers to the household market for Level 5 autonomous vehicles are becoming apparent,[7] the application of robotic vehicles to public transit is gaining advocates. We see successful instances of the use of robotics for transit applications on constrained routes and limited networks[8] via government-franchised, private investment as well as public investment. Already, on the public side, there are semi-robotic vehicles providing very high frequency transit in closed environments such as airports (driverless circulators among terminals) and elevated rail systems (Vancouver, B.C.'s SkyTrain system). Meanwhile, the private sector is quickly developing its own transit routes, still driven by human drivers, such as Chariot and Uber-

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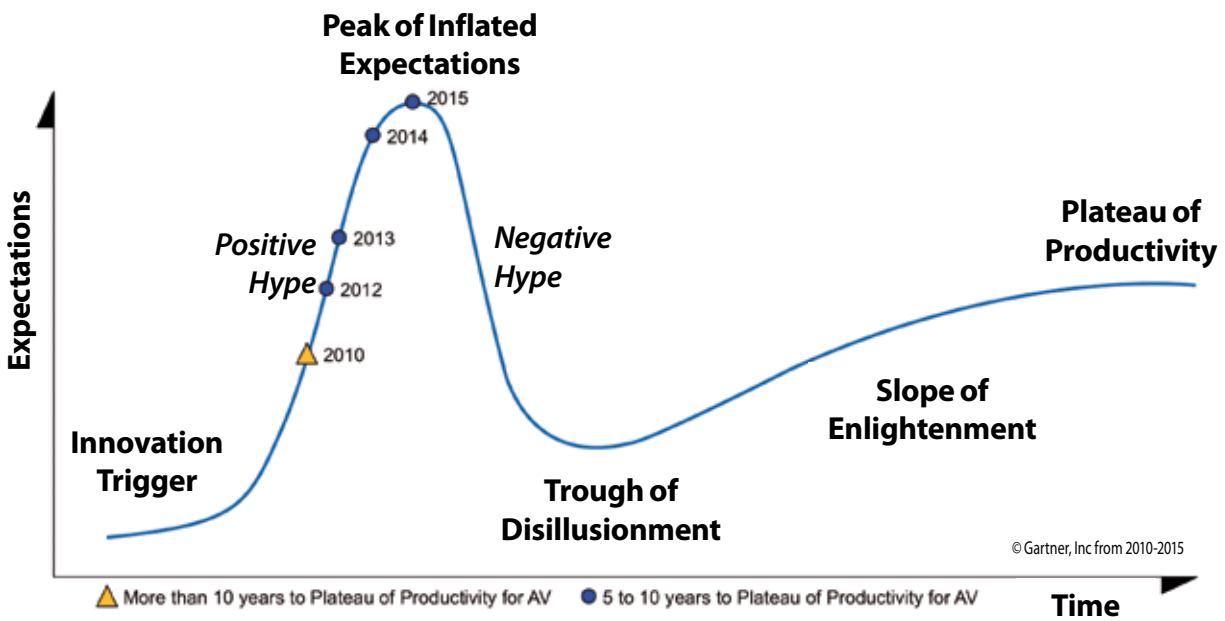
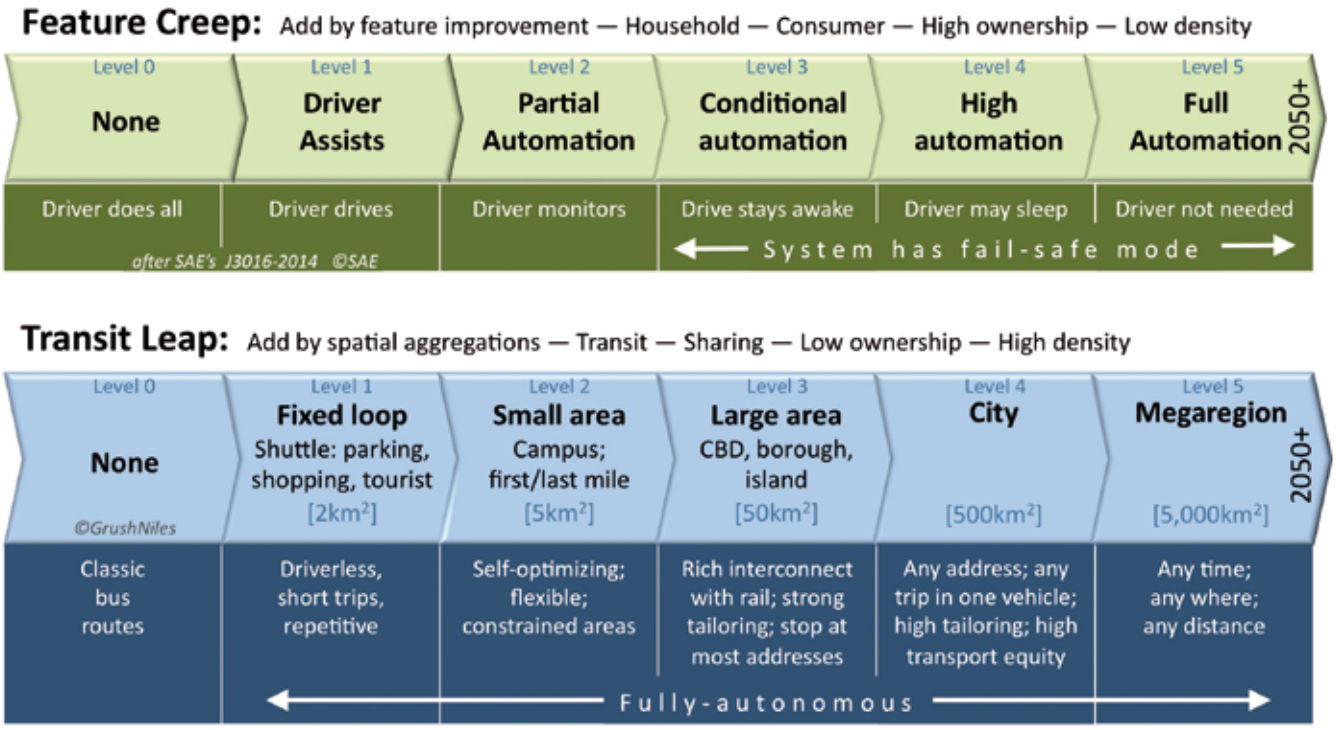


▲ **Figure 1: Gartner's Emerging Technology Hype Cycles from 2012-2015 indicate the rising hype for the Autonomous Vehicle peaking in 2015. Gartner Hype Cycle model and the positioning of the AV in its context from Gartner, Inc. 2010-2015**



▲ **Figure 2: [top] Feature Creep as expressed in the five-level autonomous vehicle standard, J3016 from the Society of Automotive Engineers. Only the level 5 vehicle in fully autonomous (no driver controls needed); [bottom] five levels of Transit Leap spreading autonomy by spatial transit extensions rather than by household consumer purchase. All vehicles in Transit Leap Levels 1 through 5 can be fully autonomous SAE Level 5 vehicles**

HOP. One can easily imagine these routes persisting—and growing—as operating costs drop during the transition to robotics. These public or commercial TaaS applications would address most or all of the barriers faced by early, access-limited, self-driving vehicles in the driveways of household consumers. As this happens, the autonomous vehicle could find an important niche in disrupting transit—and with more, not fewer, transit jobs, as described below.

By design, public transit vehicles are limited in their routes and spatial ranges. Targeted, spatially constrained, affordable, roadway preparation would be associated naturally as autonomous transit applications and routes are mapped and prepared one-by-one. There would be no opportunity for access anxiety among users of such services. Add robotic, on-demand taxis and shuttles — limited networks at first, extended over time—in seamless multimodal integration with each other, along with rail and autonomous transit vehicles. With focused effort and public-private cooperation, significant transportation-as-a-service (TaaS) systems can be realized in the early 2020s.

Driverless vehicles in public service would be designed with life cycles appropriate to rapidly evolving technology and high vehicle-turnover due to 10 to 16 hour daily use cycles. With lower per-mile user costs, user-fees can be set for cost recovery. With growing ridership, user-fees could support public-private partnerships (P3s) as investors and fleet managers.

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INTRODUCING TRANSIT LEAP

Transit Leap means public-use, robotic, shared-mobility applications that start small, expand by demand, grow, merge, and spread (Fig 2, bottom). The core motivation for focusing on *Transit Leap* is to accelerate the arrival of Gartner's *Plateau of Productivity* and all the promised social value of robotic mobility.

Transit Leap encourages the incursion of robotic mobility into the urban landscape incrementally, application-by-application and area-by-area rather than car-by-car and owner-by-owner, as has already started with *Feature Creep* technology releases such as Tesla's ADAS and Volvo's planned Level 3 autonomy pilot for Gothenburg in 2017.

The spatially constrained nature of early transit and robo-shuttle applications means that progressive, urbanized regions can jump directly to fully autonomous vehicles, with rapid, tangible applications of SAE Level 5. Courteous, deliberate, cautious, and slow at first, these vehicles address user anxiety and safety while avoiding the distracted-driver issue plaguing semi-autonomous, pre-Level 5 vehicles.

Local, constrained, first-last mile applications expanding gradually into larger areas such as downtown cores, is an immediately available first step. While the first Transit Leap project for each transit agency is the most difficult, as experience builds these applications merge and grow into urban-wide, then region-wide systems, through a connected series of increasingly flexible and capable extensions.

The nature of public service employment will change resulting in job growth in transportation services. Consider a country that currently records 90 to 95 percent of its passenger miles traveled (PMT) in privately owned vehicles and the remainder in shared vehicles (taxi, bus, car-share, shuttle, TNC). Assuming that on average one shared vehicle were to provide four times the PMT of a personal household vehicle and that it wished to halve its total fleet population, such a country would have to triple or quadruple its shared-vehicle portion to support its total (national) PMT. The labour contingent required to manage a tailored and responsive fleet that provides this increased level of TaaS services would, at a minimum, double its current public transit workforce, even as jobs, job training and job expertise changes.

Strategic expansion of the geographic reach of autonomous Transit Leap vehicles will increasingly erode the need for vehicle ownership. Peak car ownership becomes declining car ownership. Stagnant transit ridership and the threat of transit job-loss become growing ridership and job growth.

ROBOTIC TRANSPORTATION CAN'T BE STOPPED

The AV is bound to disrupt both public transit and the use of public-access shared vehicles. The Transit Leap opportunity lies in leveraging this disruption to increase transit ridership (robo buses, robo shuttles), and TNC ridership (robo-taxis). Under a Feature Creep paradigm of consumer ownership of AVs, transit will be disrupted, as well—but negatively. The effect of a strong robotic offering by TNCs competing with a laggard offering from municipal transit will mean a decline in transit ridership and transportation equity. Uber's CEO, Travis Kalanick is on record saying he will provide better transit. The choice facing municipalities is whether to abdicate or grow transit.

Let's face it—there is a massive, 120-year-old automotive industry that is premised on making and selling a physical consumer product. Those commercial enterprises will remain and they will continue to build vehicles better and cheaper—and in greater numbers. The ethos of the status machine, the personal machine, the private machine, the convenience machine, the fast machine, and the sleek-and-sexy machine will remain as will consumer predilections for owning one. This currently saturates at around 0.8 vehicles per capita as national GDP rises,[9] but it will not evaporate.

Left to its own, automotive *Feature Creep* will erode the comparable, already-disadvantaged appeal of transit. Our current world aspires to a "car-in-every-garage", but TaaS is a "ride-for-every-need" world. If we want TaaS we need to change something fundamentally social about transit. Removing the driver from the private car is only an enabler for TaaS and may even be a step backward if municipalities "wait and see".

WHY TRANSIT LEAP?

Gartner's Hype Cycle is descriptive rather than prescriptive. It tells us the SAE Level 5 AV will slump in mass media and consumer perceptions, but not why this will happen. For that we need to watch 2016 and 2017. The Hype Cycle also predicts that there will be a reputation recovery for the technology sometime after that—perhaps as early as 2020. But it is harder to fathom how this will unfold. Since we are certain that robotic vehicle technology is unstoppable and that the nearest mobility market begging for disruption is transit, we define *Transit Leap* as the mechanism to ascend Gartner's *Slope of Enlightenment* and reach their *Plateau of Productivity*.

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The path to the frequently predicted, smart urban future of any-time, on-call, mobility-on-demand will be easier to traverse if the Transit Leap paradigm is deployed. Urban transportation leaders need to not dither in the face of AV technology hype, hope, and fear. City builders need to step up to implementing what is feasible right now. This is how Gartner's Plateau of Productivity for autonomous vehicles could indeed be reached within the five to 10 years predicted.

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