P1 / VEHICLE-TO-VEHICLE COMMUNICATION
Vehicle-to-vehicle communications moved one step closer to reality

P2 / cont. CAR TO CAR COMMUNICATION
The researchers took a leap forward by trying this practically on road

P3 / AGILE ROBOTS-ATLAS
Atlas is a high mobility, humanoid robot designed to negotiate outdoor, rough terrain.

P4 / FUEL-CELL VEHICLES
FCVs run on hydrogen gas rather than gasoline and emit no harmful tailpipe emissions.

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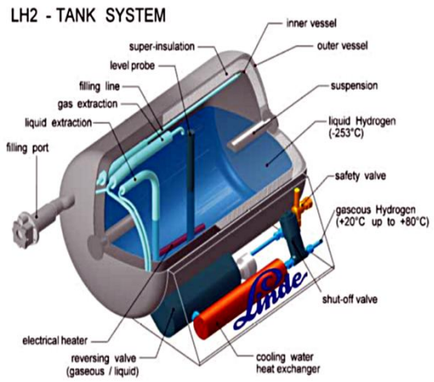
Fuel-cell Vehicles

Zero-emission cars that run-on hydrogen

Fuel-cell vehicles have long promised several major advantages over those powered by electricity or hydrocarbons. The technology has only now begun to reach the stage where automotive companies are planning launches for consumers, however. Initial prices are likely to be in the range of $70,000 but should come down significantly as volumes increase within the next couple of years.

Unlike batteries, which must be charged from an external source and can take from five to 12 hours depending on the car and charger, fuel cells generate electricity directly, using hydrogen or natural gas. In practice, fuel cells and batteries are combined, with the fuel cell generating electricity and the batteries storing it until demanded by the motors that drive the vehicle. Fuel-cell vehicles are therefore hybrids and will likely also deploy regenerative braking, which recovers energy from waste heat, a key capability for maximizing efficiency and range.

Unlike battery-powered electric vehicles, fuel-cell powered ones have a long cruising range—up to 650 kilometers per tank (the fuel is usually compressed hydrogen gas); a hydrogen fuel refill only takes about three minutes. Hydrogen is clean-burning, producing only water vapor as waste, so fuel-cell vehicles using



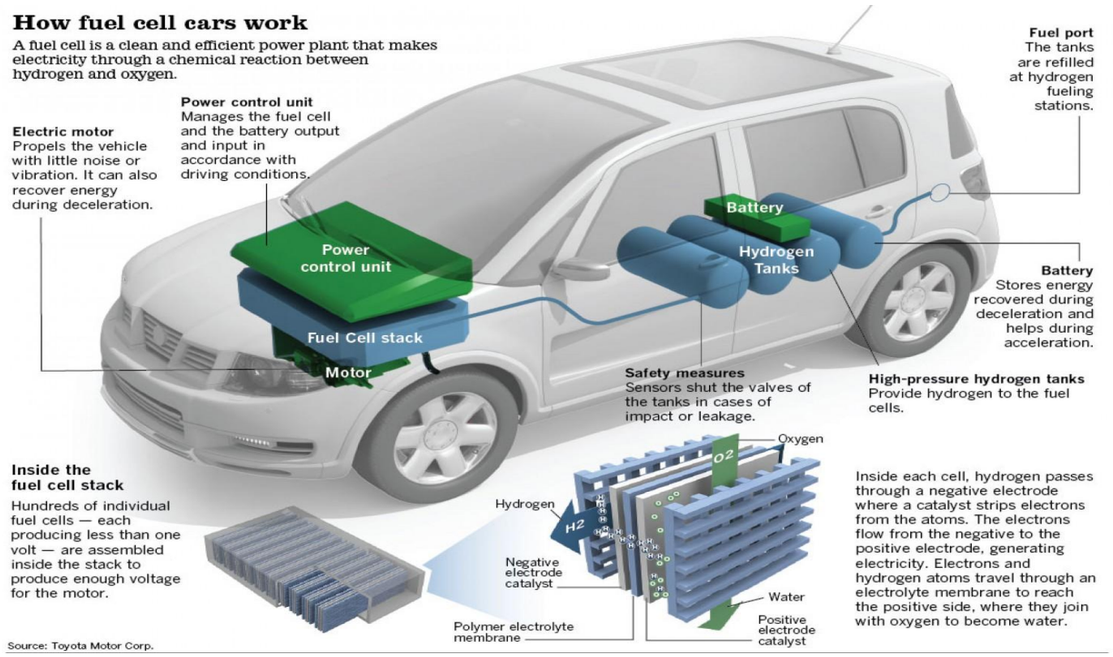
hydrogen will be zero-emission, an important factor given the need to reduce air pollution.

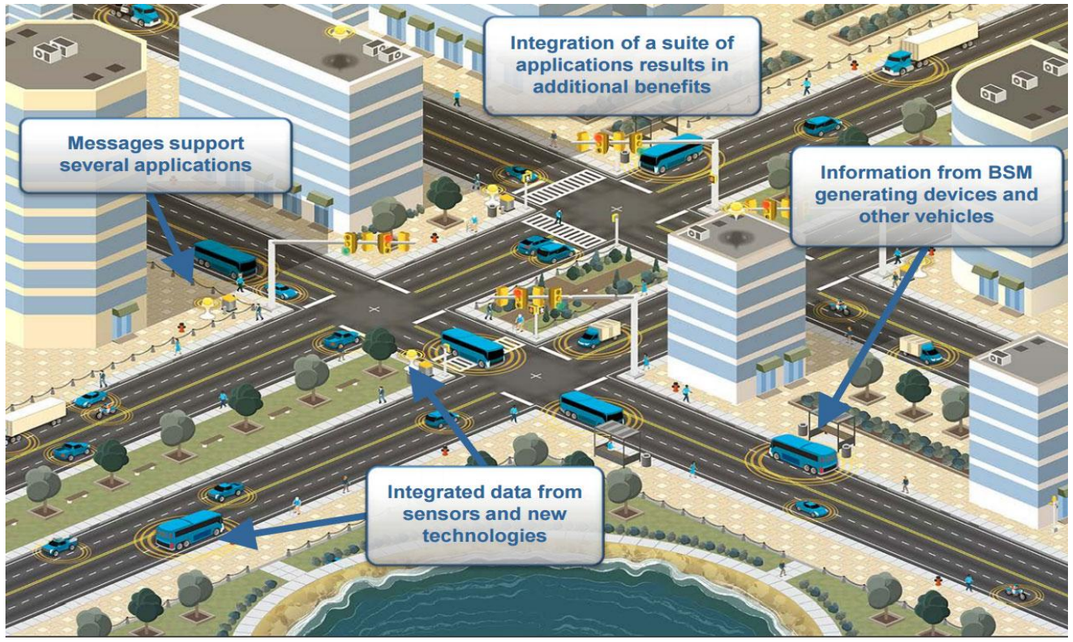
There are a number of ways to produce hydrogen without generating carbon emissions. Most obviously, renewable sources of electricity from wind and solar sources can be used to electrolyze water—although the overall energy efficiency of this process is likely to be quite low. Hydrogen can also be split from water in high-temperature nuclear reactors or generated from fossil fuels such as coal or natural gas, with the resulting carbon dioxide captured and sequestered rather than released into the atmosphere.

As well as the production of cheap hydrogen on a large scale, a significant challenge is the lack of a hydrogen distribution infrastructure that would be needed to parallel and eventually replace gas and diesel filling stations. Long-distance transport of hydrogen, even in a compressed state, is not considered economically feasible today.

Innovative hydrogen storage techniques, such as organic liquid carriers that do not require high-pressure storage, however, will soon lower the cost of long-distance transport and ease the risks associated with gas storage and inadvertent release.

Mass-market fuel-cell vehicles are an attractive prospect because they will offer the range and fueling convenience of today's diesel and gas-powered vehicles while providing the benefits of sustainability in personal transportation. Achieving these benefits will, however, require the reliable and economical production of hydrogen from entirely low-carbon sources as well as its distribution to a growing fleet of vehicles, expected to number in the many millions within a decade.





THERE'S PLENTY OF buzz around the connected car these days. The reason? The cloud.

There is a common refrain heard from nearly everyone gathered in Detroit to attend the World Congress on Intelligent Transport Systems this week: Connected cars will be the ultimate Internet of Things. They will collect and make sense of massive amounts of data from a huge array of sources.

WHAT IS V2V?? Simply put, the first generation of V2V systems would warn the driver but not take control of the car. Later implementations would improve to brake or steer around obstacles and eventually merge with self-driving cars. Here's our rundown of V2V technologies and some of the implications…

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To do all that, they need the cloud. Because connected cars need data. Lots of data. Automobiles today are already packed with an impressive amount of processing power, because some 100 million lines of software code help run the typical luxury vehicle. But as connected cars before were sophisticated rolling wired devices, the amount of information flowing back and forth from them will skyrocket. And so they will demand for the cloud's scalability and storage capabilities.

The cloud also provides sophisticated processing and analytical capabilities. The cloud is the central hub where all of this quickly changing, far-flung information will pass through. It will provide the platform for making sense of this data. And the cloud is also the home for building and developing the apps and programs

Vehicle-to-Vehicle Communication

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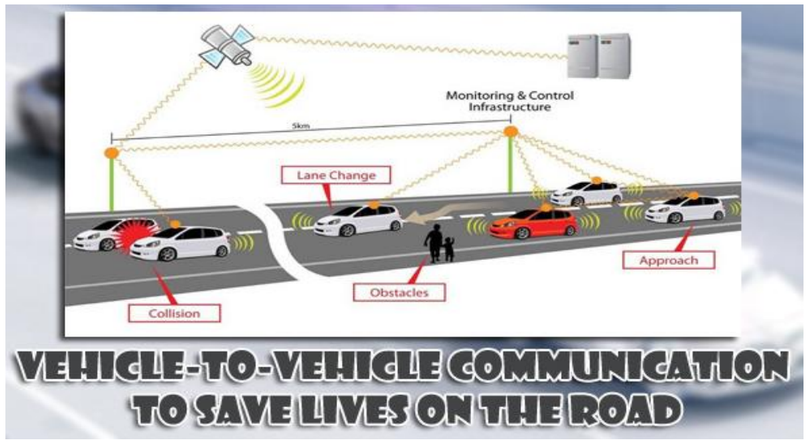
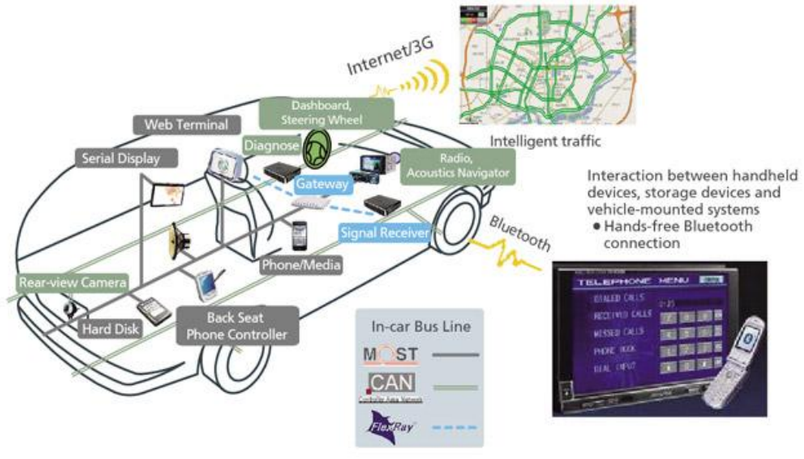
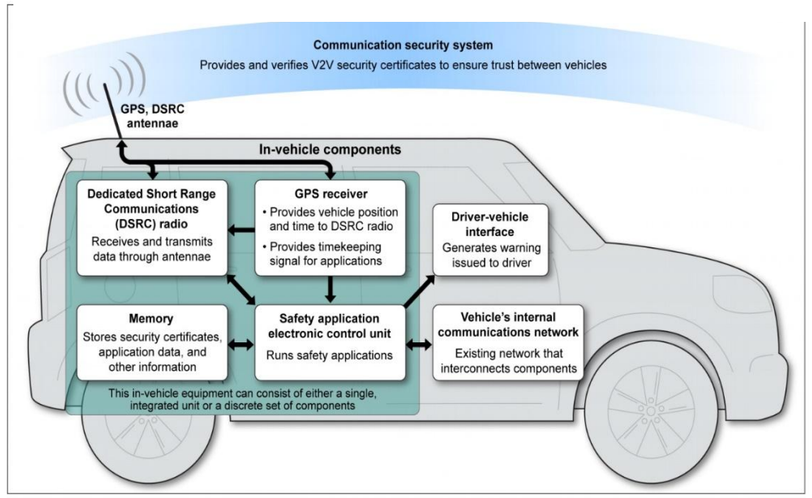
used by cars on the road. What does that add up to practically? A car linked to the cloud, tapping into your apps, devices, and preferences will tailor the driving experience to you. When you're getting ready to go out in the morning, your car will link to the cloud and check the weather, your to-do list from your calendar, and the traffic to help you plan your route for the day, rerouting you when you're on your way if you get behind schedule or run into traffic. Or a rental car would recognize you when you slip into the driver's seat and automatically adjusts to your preferences — changing the mirrors, giving you an update from your calendar of your schedule, and lining up your iTunes playlist.

Connected cars, meantime, will help cities and states cut down on congestion and improve safety. On the road, cars will talk to each other, automatically transmitting data such as speed, position, and direction, and send alerts to each other if a crash seems imminent. This future of vehicle-to-vehicle, or V2V communication, is already in the works, with the U.S. Department of Transportation announcing early this year that it plans to start taking steps to enable V2V communication.

At the same time, communities are mapping out ways to put connected cars at the center of more energy efficient, smarter traffic management systems. IBM conducted a smarter traffic pilot with the Dutch city of Eindhoven, demonstrating how the connected car automatically shares braking, acceleration and location data that can be analyzed by the central traffic authority to identify and resolve road network issues.



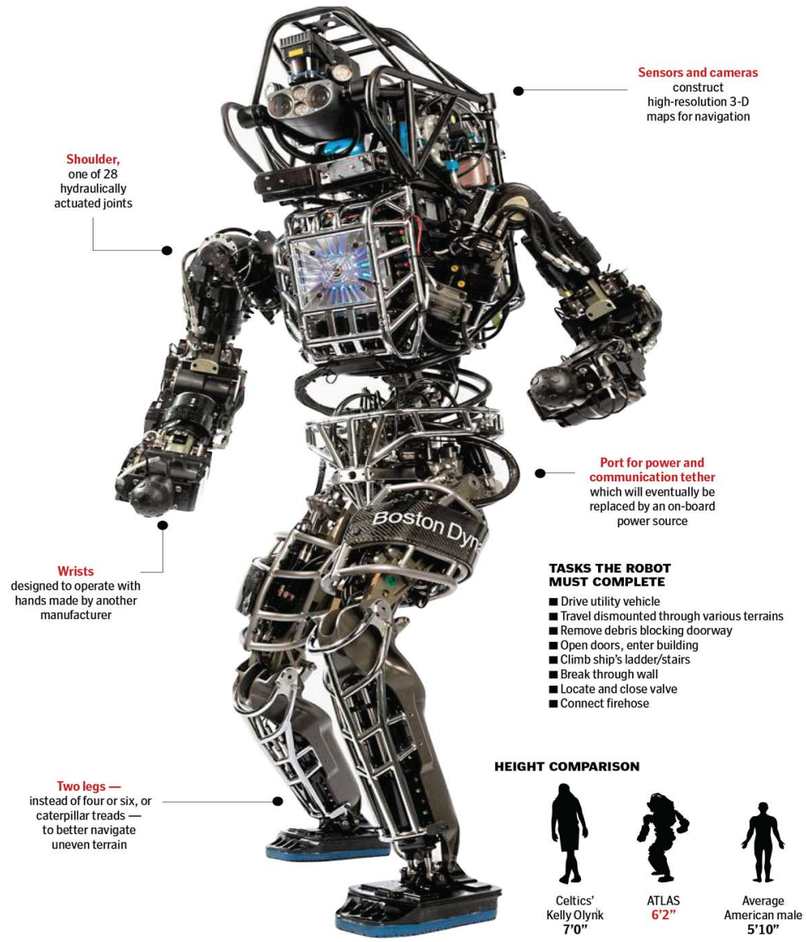




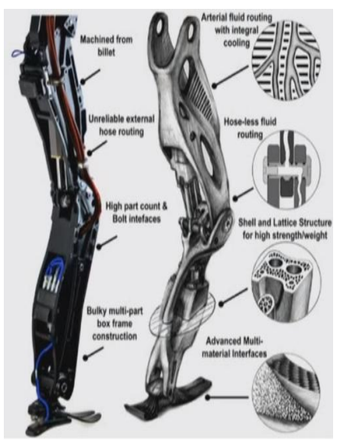
Sources: Crash Avoidance Metrics Partnership and GAO.

Agile Robots

Computer scientists have created machines that have the balance and agility to walk and run across rough and uneven terrain, making them far more useful in navigating human environments.



Atlas isn't ready to take on home or office chores: its powerful diesel engine is external and noisy, and its titanium limbs thrash around dangerously. But the robot could perform repair work in environments too dangerous for emergency workers to enter, such as the control room of a nuclear power plant on the brink of a meltdown. But as it gets up and running, Atlas won't be a bad example to chase after.



Meet Atlas, a humanoid robot created by Boston Dynamics, a company that Google acquired in December 2013. Walking is an extraordinary feat of biomechanical engineering. Every step requires balance and the ability to adapt to instability in a split second. It requires quickly adjusting where your foot will land and calculating how much force to apply to change direction suddenly. No wonder, then, that until now robots have not been very good at it.

Robots that walk properly could eventually find far greater use in emergency rescue operations. They could also play a role in routine jobs such as helping elderly or physically disabled people with chores and daily tasks in the home.

Marc Raibert, cofounder of Boston Dynamics, pioneered machines with "dynamic balance"—the use of continual motion to stay upright—in the early 1980s. As a professor at Carnegie Mellon University, he built a one-legged robot that leaped around his lab like a pogo stick possessed, calculating with each jump how to reposition its leg and its body, and how aggressively to push itself off the ground with its next bound. Atlas demonstrates dynamic balance as well, using high-powered hydraulics to move its body in a way that keeps it steady. Just as you instinctively catch yourself when pushed, shifting your weight and repositioning your legs to keep from falling over, Atlas can sense its own instability and respond quickly enough to right itself. The possibilities opened up by its humanlike mobility surely impressed Google.