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A Primer on Autonomous Vehicles

When people think of "autonomous vehicles" they often picture a vehicle driving itself with either little input from the driver or with no driver at all. That level of autonomy, on a practical level, is still years away. But vehicles with different levels of autonomy are on the road.

A prime example is Tesla. People think of Tesla vehicles as autonomous, but they're not. While the vehicle can "drive" itself for stretches, it does require a driver to be behind the wheel and be in control of the vehicle.

Cadillac recently introduced "super cruise." On many roads where the vehicle's system has access to detailed map data, the super cruise can "drive" the vehicle by itself and the driver doesn't need to put their hands on the steering wheel. If the super cruise encounters something it doesn't recognize – for example, construction – it disengages and gives control back to the driver.

The technology, in fact, even the terminology, around autonomous vehicles is in flux. The U.S. Department of Transportation has an almost hands-off approach regarding development and adoption of autonomous vehicles. That is, it will let the market decide winners and losers.

The Society of Automotive Engineers International (SAE), a U.S.-based, globally active professional association and standards developing organization for **engineering professionals** has created definitions for automated vehicles. The SAE standard recognizes six levels of autonomy:

Level 0 (No Driving Automation) - driver controls all aspects of driving, even if enhanced warning or intervention systems are present

Level 1 (Driver Assistance) - driver handles all controls while on the road, but vehicle can assist with some functions such as adaptive cruise control or lane centering but not simultaneously.

Level 2 (Partial Driving Automation) - driver remains responsible for most safety functions and monitoring surroundings, but vehicle can assist with steering, accelerating, and braking in certain cases. A majority of autonomous vehicles today are operating at this level.

Level 3 (Conditional Driving Automation) - driver control is minimized and automation steps in. Car can manage several aspects of driving including monitoring the environment and changing lanes without any need for human interaction. Driver attention is still required – vehicle will call for driver control when it senses a scenario that it cannot manage.

Level 4 (Significant Driving Automation) - driver involvement is only required when the system is not in use. Once all the requirements have been met, the vehicle is intelligent enough to take control of steering, braking, accelerating, properly reacting to the outside environment, and determining when to use turn signals and change lanes.

Level 5 (Full Driving Automation) - the system completely takes over and there is no requirement for user intervention. The vehicle can operate in any road and environmental condition and controls all safety critical features.