From an owner’s perspective
My Credentials

• I responded to a Facebook post looking for a Tesla owner with Autopilot
• I own a Tesla with Autopilot 2.0
• I drive 66 miles, commuting from Madison to Berlin each workday, much of it using Autopilot
• I’ve driven to Boston, Maine, New York and all over Connecticut
• My First Experience with Autopilot
• Anyone use an semi-autonomous vehicle on a regular basis?
• Anyone experience an semi-autonomous vehicle before?
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Auto-Steer</td>
<td>Steers the car within lane markers on highways, and back roads. Up to 90 mph on the highway and 5 mph over the speed limit on back roads</td>
</tr>
<tr>
<td>Auto-Speed/Brake</td>
<td>Accelerates and brakes to maintain a speed and a distance that you choose from cars in front of you</td>
</tr>
<tr>
<td>Auto-Lane Change</td>
<td>Changes lanes on the highway, after it determines there's no one in the way</td>
</tr>
<tr>
<td>Summon</td>
<td>Drives the car in and out of your garage, steering, splitting the distance between walls and other cars, all without anyone in the car</td>
</tr>
<tr>
<td>Auto-Park</td>
<td>Parallel or perpendicular parks the car</td>
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What Can Autopilot Currently Do?


# How Autopilot Currently Works?

<table>
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<td><strong>Activate</strong></td>
<td>Pull a stalk back twice. Keep your hands on the wheel, or put them back on if it prompts</td>
</tr>
<tr>
<td><strong>Supervise</strong></td>
<td>It’s a lot like supervising a 16 year old after they've been driving fairly well for a little while, but still have to pay attention to everything</td>
</tr>
<tr>
<td><strong>Take Over</strong></td>
<td>You do what is intuitive – turn the wheel, press the brake or accelerator, or press the stalk backwards</td>
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Center Display
What Works Well?

- Highways
  - Straight or curved
  - Stop-and-go traffic
  - Speeds up to 90 MPH
  - Changing lanes

- Back roads with good lane markings
- Pulling in and out of garage
- Tesla’s Autopilot is intuitive and informative
  - It automatically reduces the speed on a turn if it is not maintaining itself within the lines
- It automatically reduces the speed if the speed limit reduces on back roads
- Heavy rain
What Is A “Work In Progress?"

- Sometimes it feels like a 16 year old, oversteering and overreacting
- Construction zones
- Slowly slowing down from higher speeds to stop
- Letting cars in from an on ramp
- Lanes that split into a lane veering off without continuous markers
- Contoured roads where the lane markings are temporarily out of view
- Back roads with just a center lane marker
- Heavy mist, light glare from road on I95 in NY
What Makes It work?

• Hardware
• Software
• Data
• Lane markers, other cars, obstacles, etc.
Cameras, Ultrasonic Sensors, Radar and GPS
Radar
Radar
Software

- Traditional Programming (ITTT)
- Computer Vision (identifying lane markers and the side of the road, street signs, lights, cars, kids, and soccer balls)
- Machine Learning / Neural Networks
Software

- Connected to the internet: cellular and Wi-Fi
- Regular software updates
- Live software operates the vehicle
- Next beta software version is learning and testing itself while the live is driving, or driver’s driving
- Software represents what the developers could anticipate, and millions of miles by thousands of drivers.
• Map data
• High Definition Mapping
• Fleet Learning – Currently, tens of thousands of cars, millions of miles.
• Everything is being recorded - Hands on the wheel, foot on the pedal, how hard the pedal is pressed, how long the pedal is pressed, etc., etc. etc.
• 10 seconds of video, GPS location, speed, etc., etc., etc. is recorded when the driver takes over and sent to Tesla.
• Using driver corrections from multiple drivers (crowd sourcing) it learns and develops it abilities to drive.
• Tesla explains Autopilot warnings, features and operation during an orientation

• First time activation requires the review and acceptance of instructions and warnings

• After activating there are reminders to keep hands on the wheel

• While driving there are varying degrees of messages:
  • Hands on wheel reminders
  • Take over immediately
  • Autopilot no longer available

• It is made clear that the driver is responsible
Warnings
• Learn how it really works now and is planned to work in the future

• Data, Data, Data
  • Feed it data
    • Visual data: Markers (lane, signs, etc. for both real-time computer vision and the development of high definition mapping)
    • Map data
      • Embed speed limit
      • Embed warning signs in the data
      • Provide construction data, historical accident location data, real-time traffic data
  • Get data
    • Accident data
    • Disengaged data – driver or low confidence
    • Use this data to make improvements (signs, lane markers, map data)