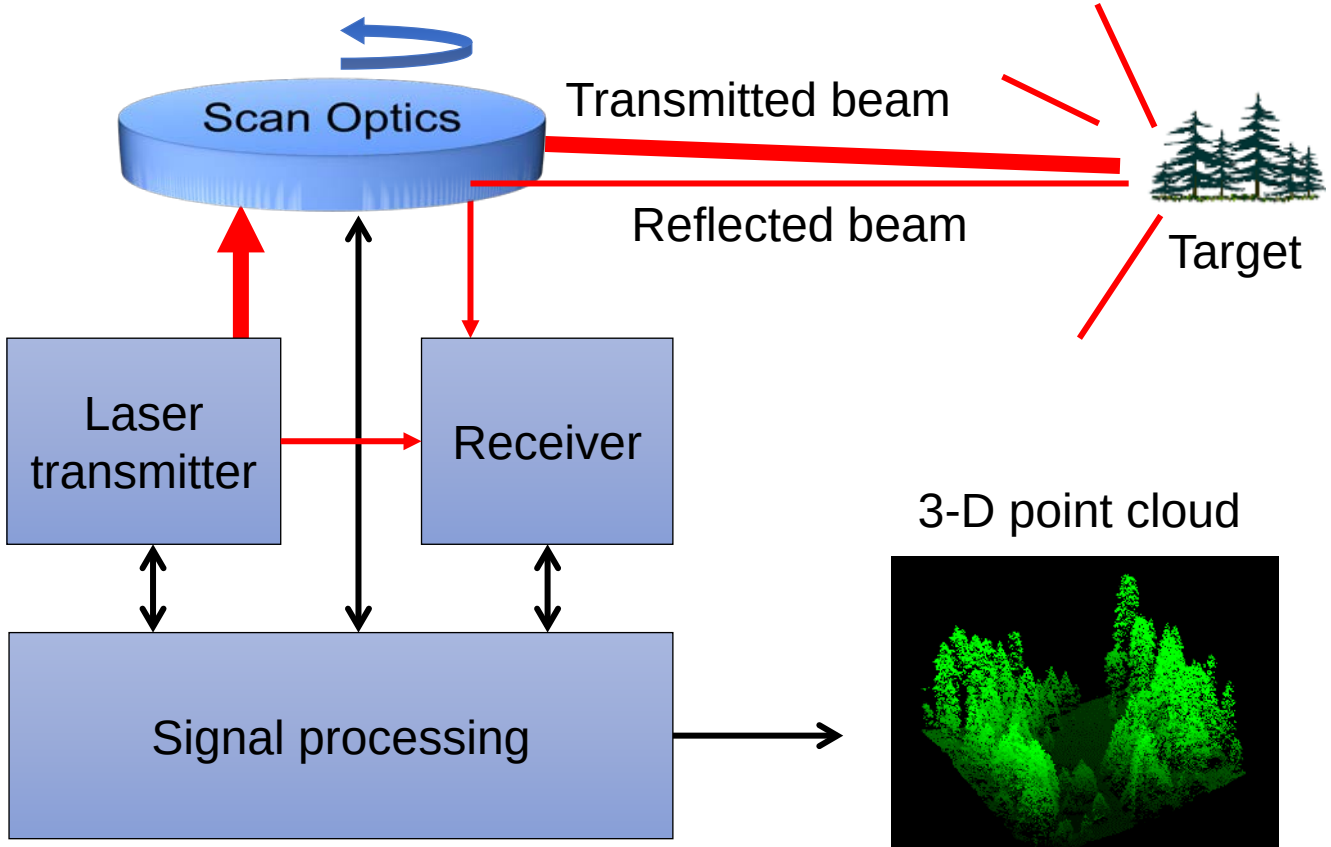
Driverless Anything and the Role of Lidar

Alex Lidow, Ph.D.
CEO and Co-founder

Agenda

- What is lidar
- How lidar works
  - Signal
  - Scanning methods
  - Lasers
  - Detectors
- How lidar is integrated into autonomous cars
- The future

What is Lidar?



http://ucanr.edu/blogs/green//blogfiles/11605_original.png

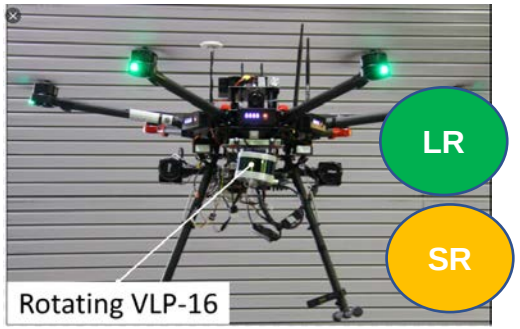
Where is Lidar Used Today?

Automated Guided Material Handling Robot

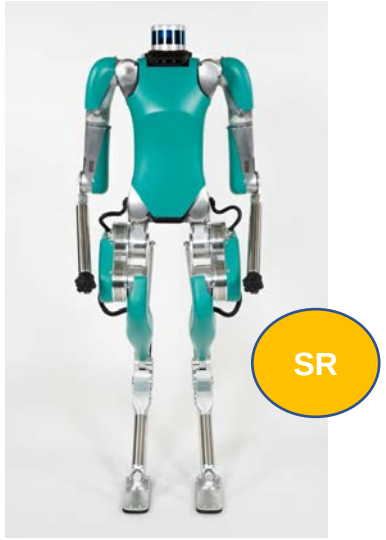
Lidar Robotic Vacuum

Lidar Robotic Delivery Vehicles

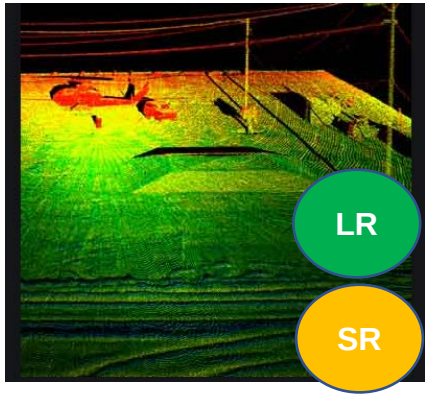
Lidar Robotic Security Robot



Drone Navigation and 3-D Mapping



Humanoid Robots and Cobots



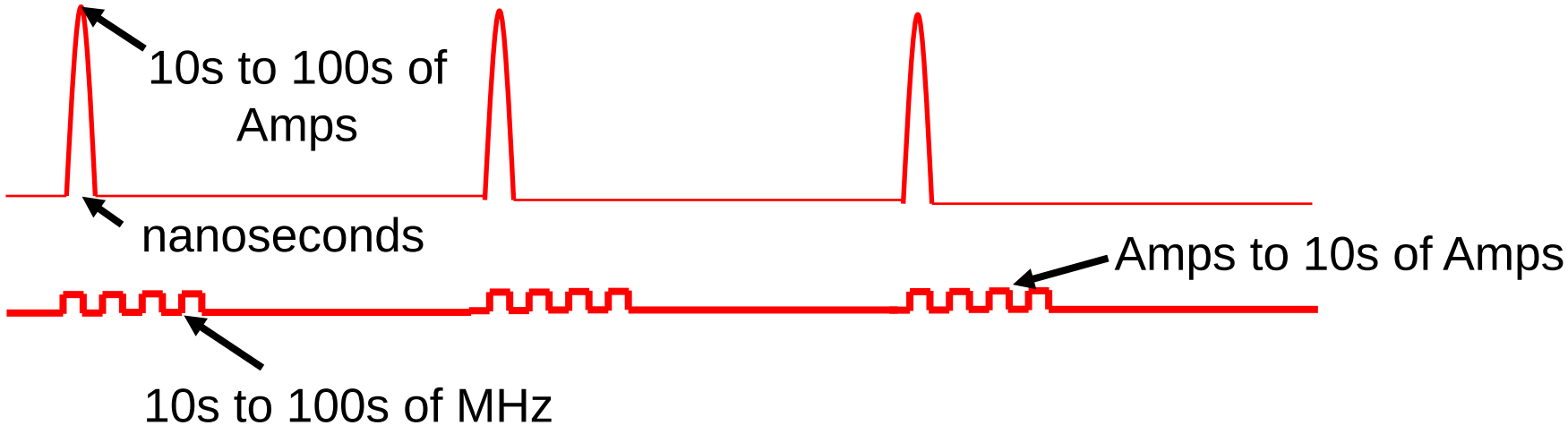
Lidar Surveillance Systems

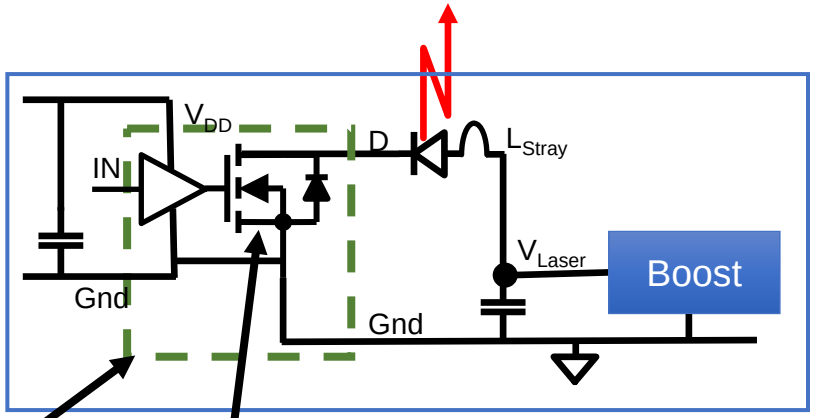
Autonomous Vehicle Navigation

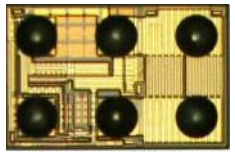
Laser Transmitter

Long range direct time of flight

Short range indirect direct time of flight

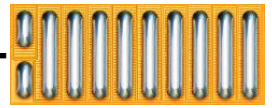






eGaN IC

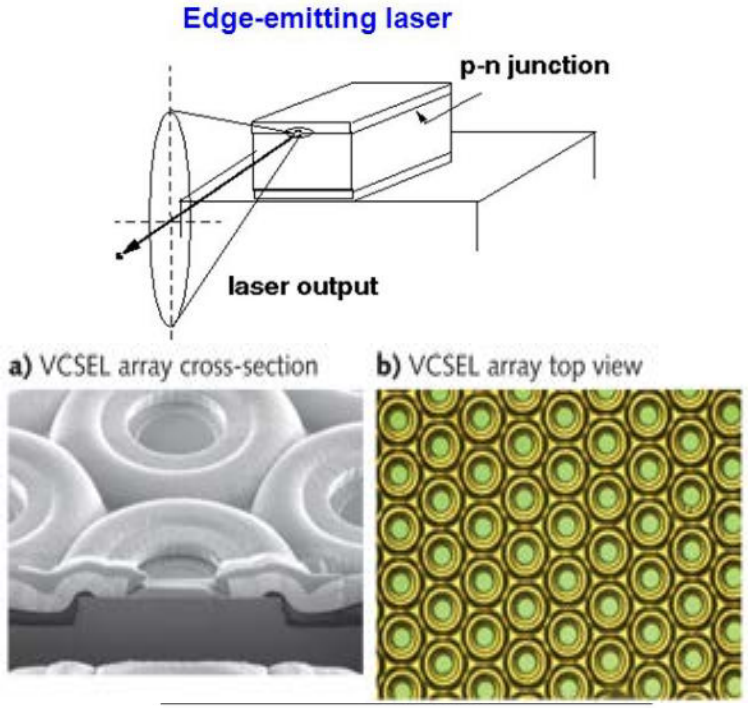
eGaN FET



Lidar Scan Methods

https://spectrum.ieee.org/tech-talk/semiconductors/optoelectronics/mit-lidar-on-a-chip

Lasers



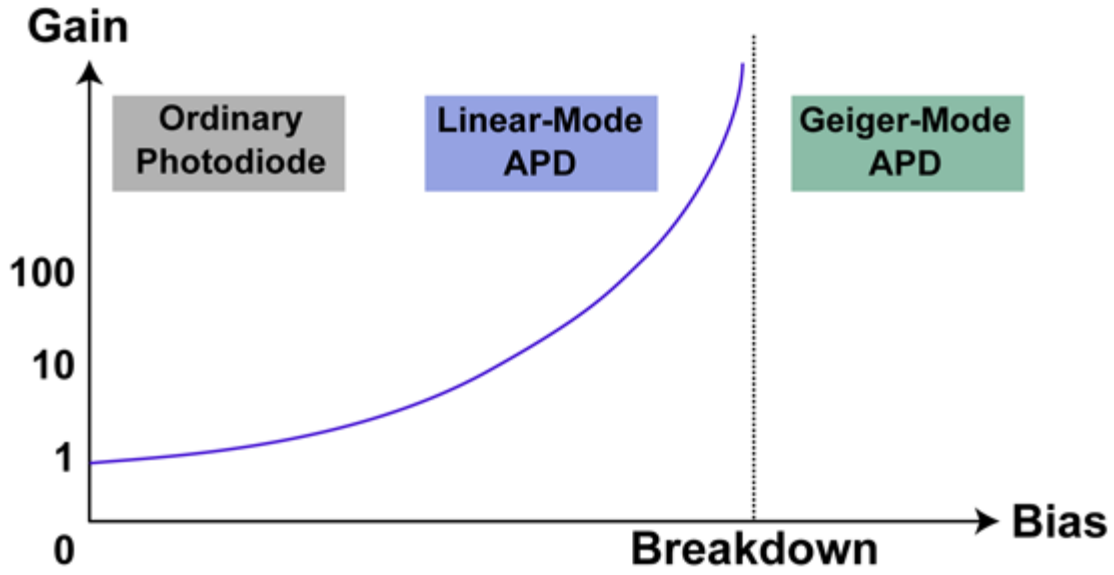
http://www.laserfocusworld.com/articles/print/volume-50/issue-12/features/vcsels-for-manufacturing-high-power-vcsel-arrays-make-ideal-industrial-heating-systems.html

VGEN-SP

LIDAR Ytterbium Pulsed Fiber Lasers

Detectors

- Photodiode
- Avalanche Photo Diode (APD)
- Geiger-Mode APD



Value of eGaN® Devices

- Long range lidar (scanning and spinning)
  - Very small with very high peak current
  - Very, very fast
- Short range lidar (ToF camera)
  - Very small size
  - Very high frequency capability
- *eGaN integration reduces size, increases speed, and reduces cost*

Direct Time of Flight (DToF)

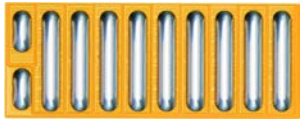
EPC2001C
Quad laser (all 4 in parallel)
OSRAM SPL S4L90A_3 A01
V_{bus} = 75 V

$I_{LASER,peak}$ = 135 A (total)

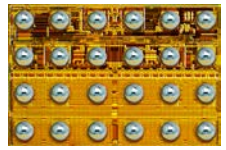
Current t_{pw} = 2.51 ns

Optical t_{pw} = 2.85 ns

EPC2001C

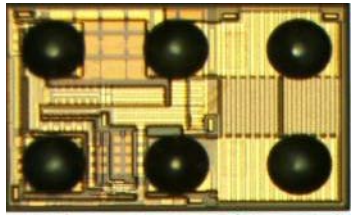


Discrete

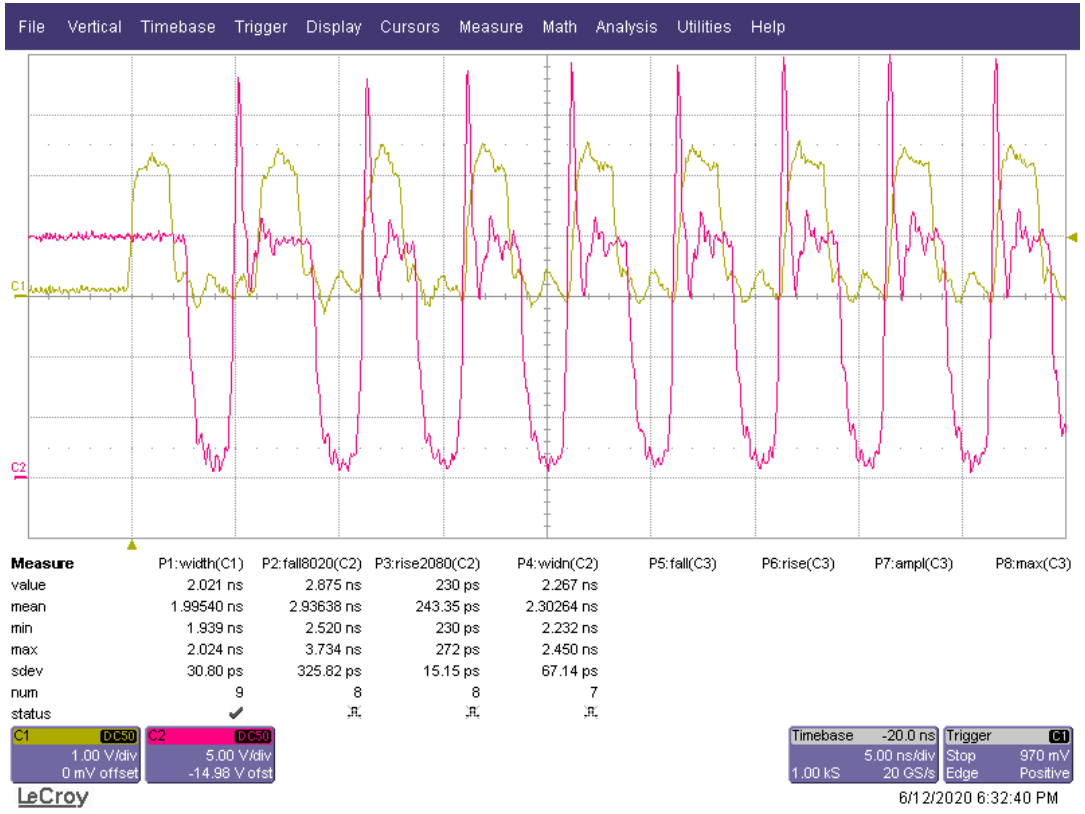


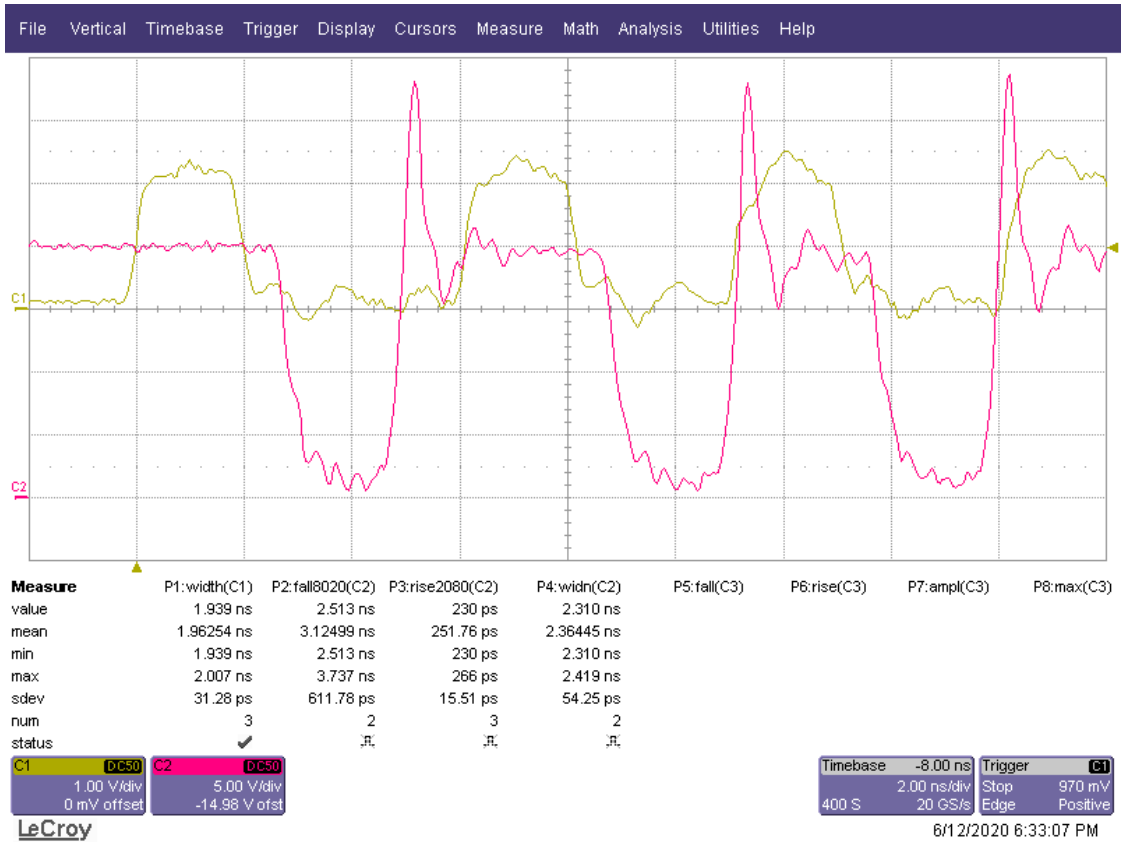
Dual Channel IC

IToF @ 200 MHz @ 9 A

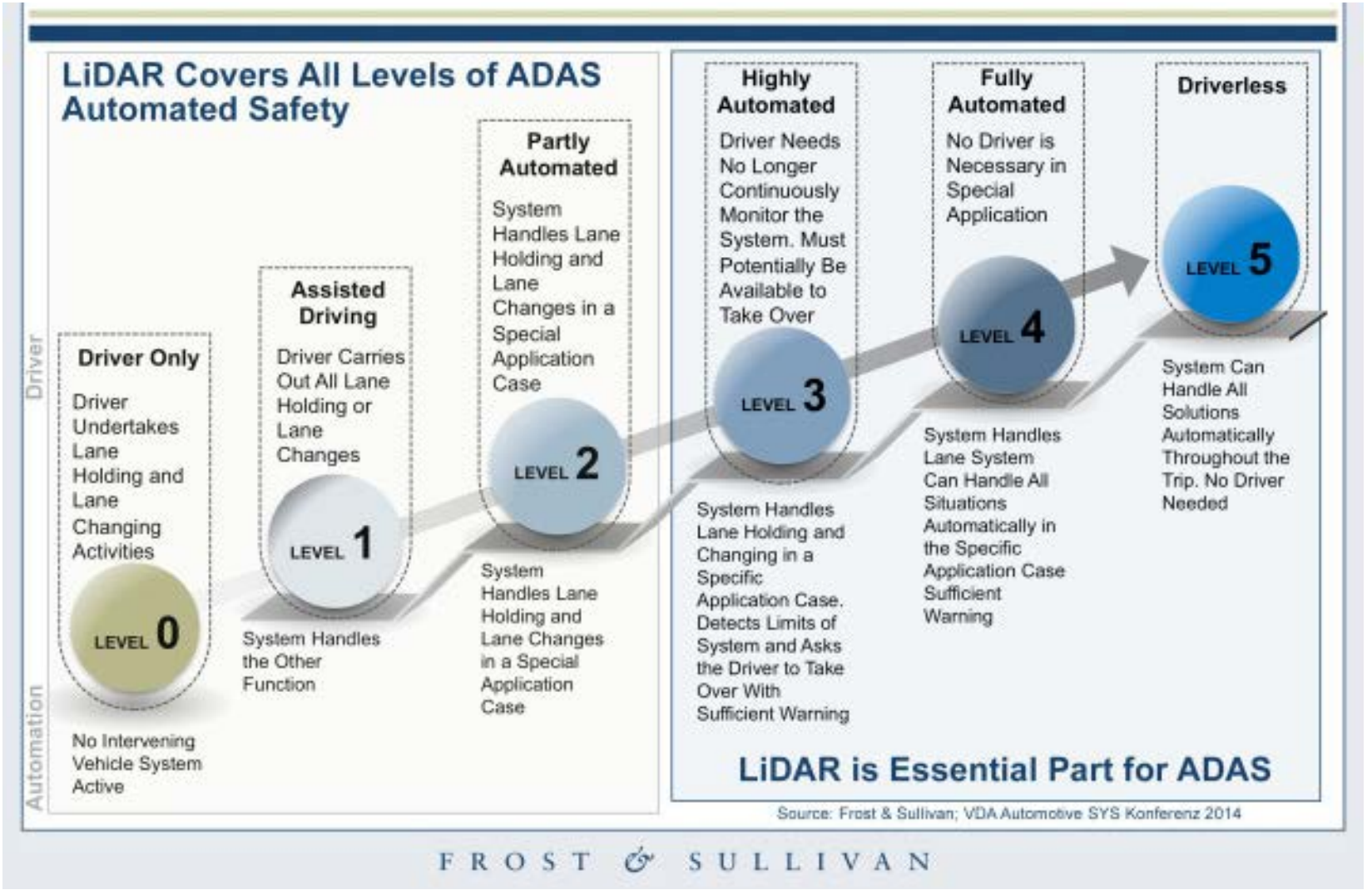


EPC21601 integrated laser driver





The Pathway to Self Driving Cars

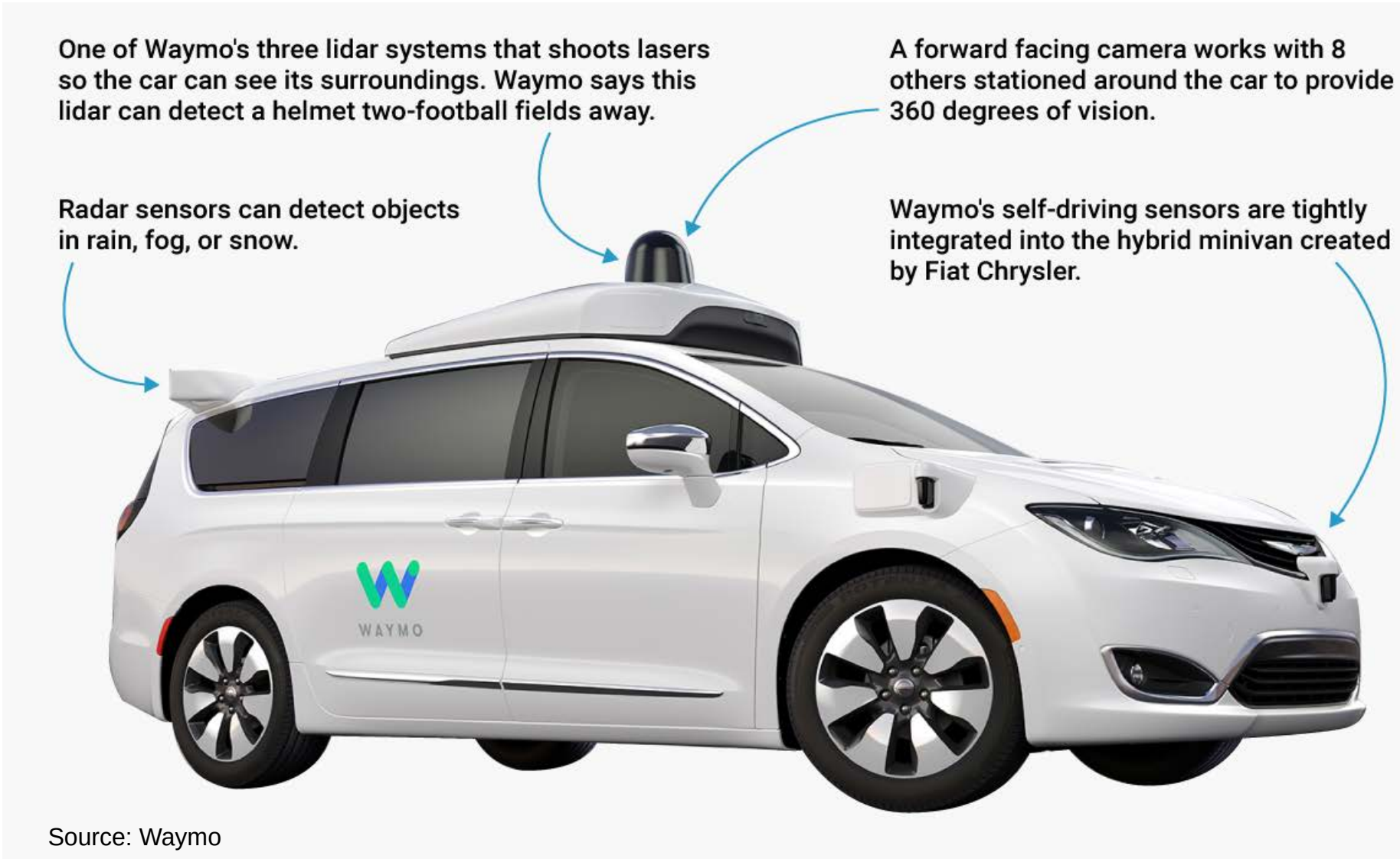


What is Required for Autonomous Cars?

300 meters (approximately 11 seconds at 60 mph)

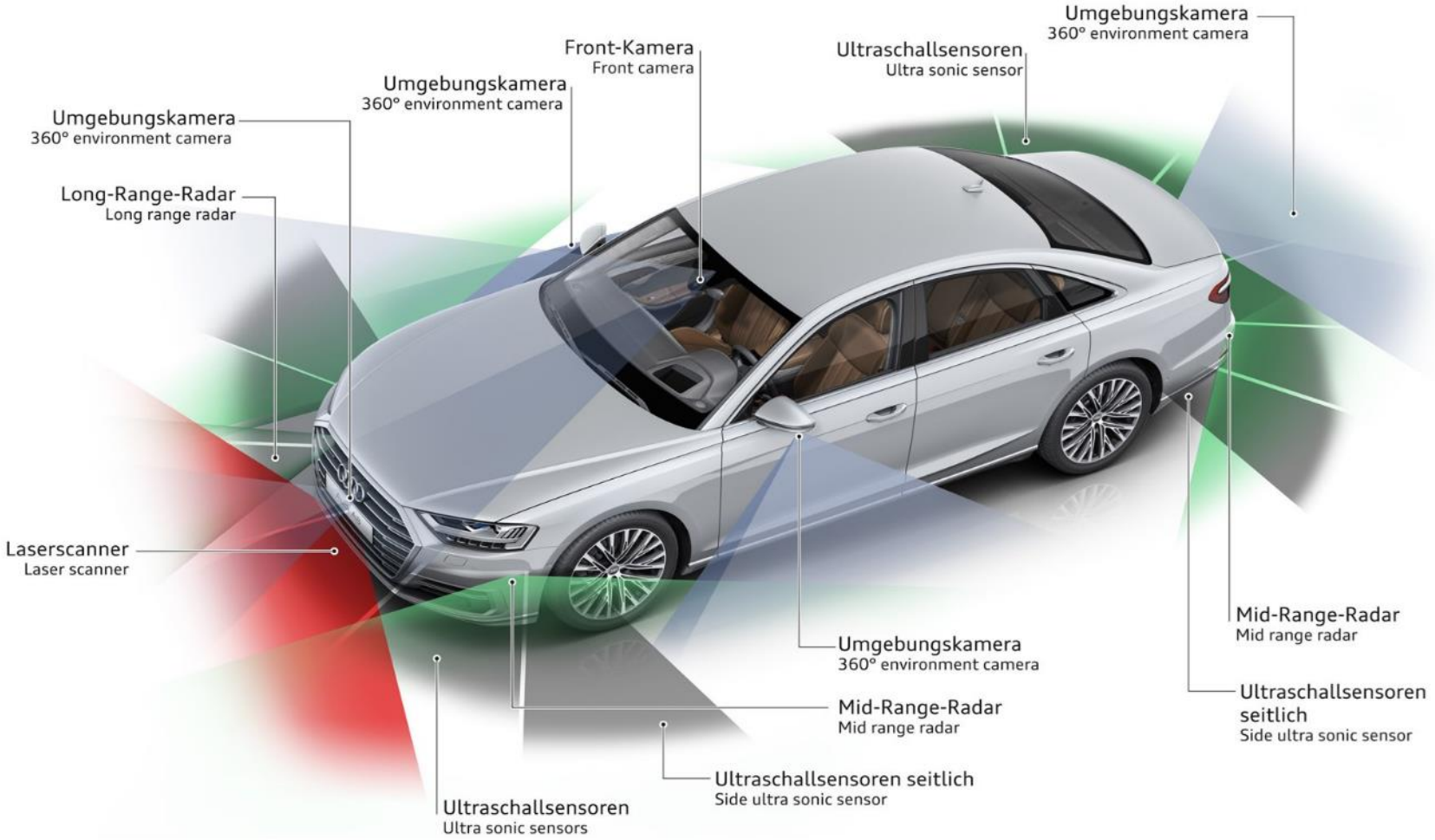
- Higher output lasers
  - Going to longer wavelengths (1440 nm vs 903 nm) allows for higher output power without danger to the human eye
    - 1440 nm lasers are more expensive
  - Edge emitting LEDs are more efficient than VCSEL and have superior columnation
    - VSEC lasers can be lower overall cost, but shorter range
- More sensitive detectors
    - Geiger mode can detect single photons but takes time to “reset”

How Waymo's Self Driving Car "Sees"



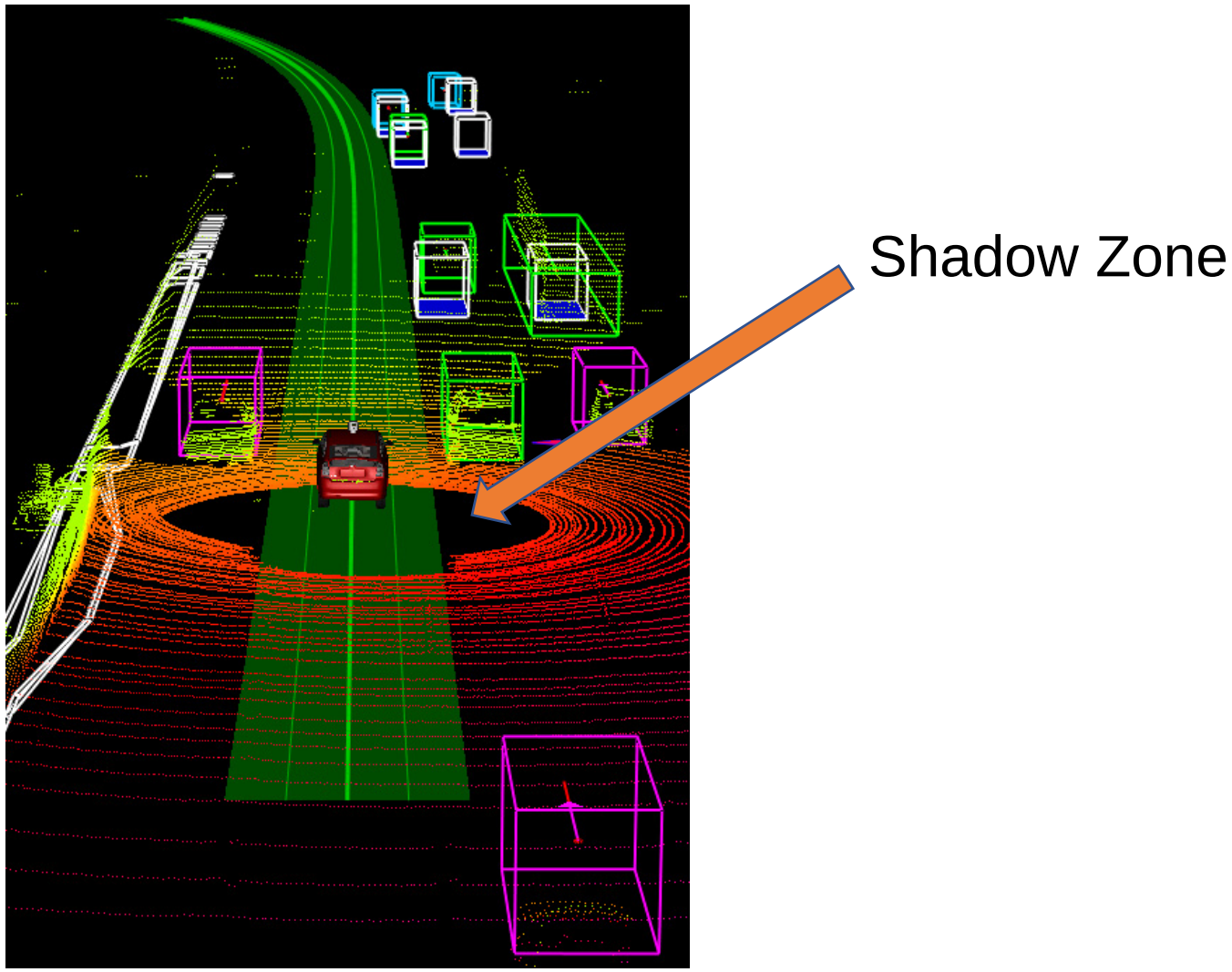
Source: Waymo

How Audi's ADAS 3 A8 "Sees"

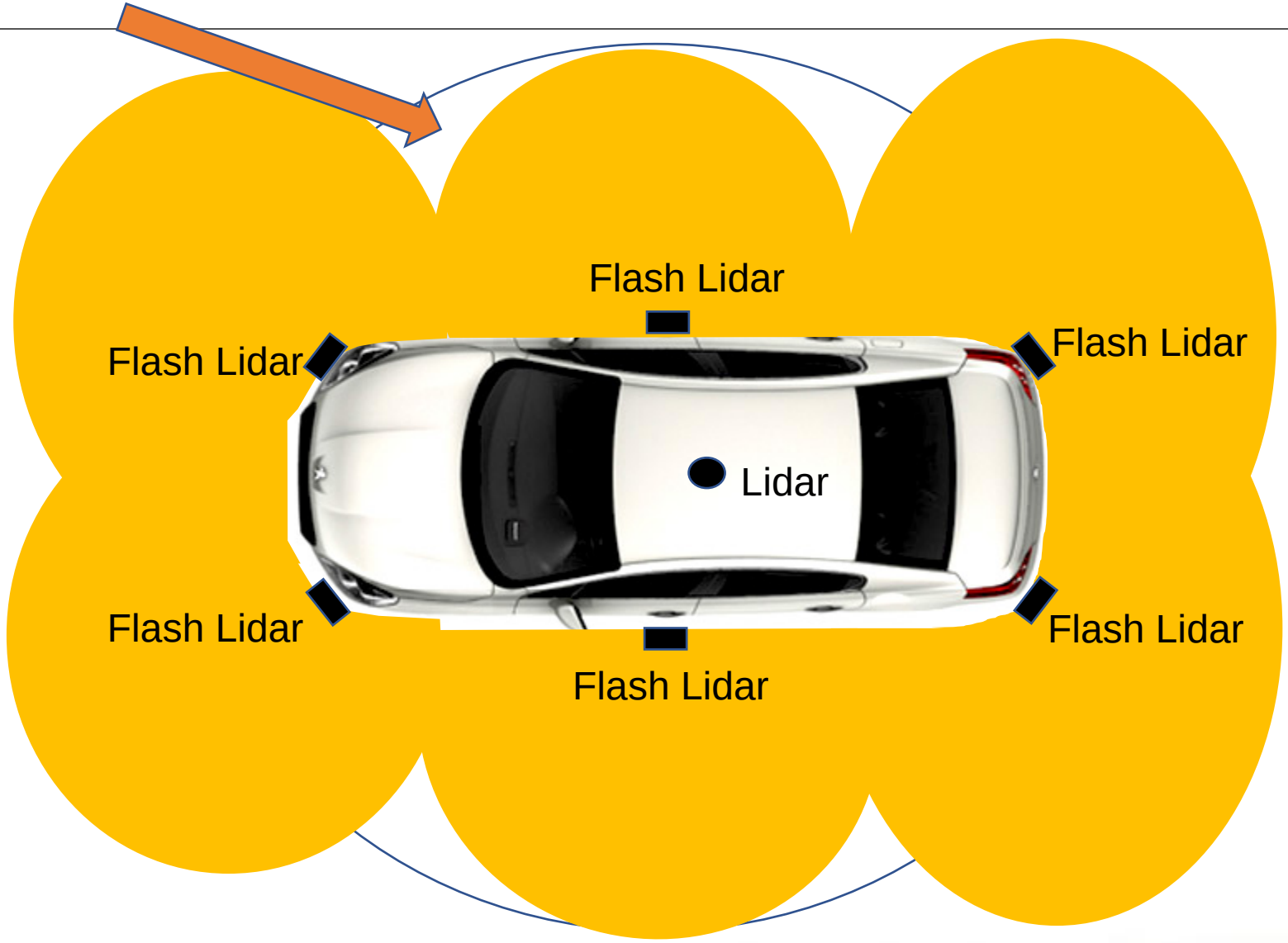


http://images.car.bauercdn.com/pagefiles/74157/audi_a8_level3_01.jpg

How Lidar Might be Deployed



Shadow Zone


Flash Lidar
Flash Lidar
Flash Lidar
Lidar
Flash Lidar
Flash Lidar
Flash Lidar

Lidar Myths

- *Lidar can’t see in fog, snow, or rain*
  - Lidar can see as well as, or better, than a human
- *Spinning disk lidar is unreliable*
  - There are lots of reliable spinning disks in every car
- *Lidar is too expensive*
  - Flash lidar is much less expensive than spinning lidar
  - Automotive companies have a way of grinding down cost

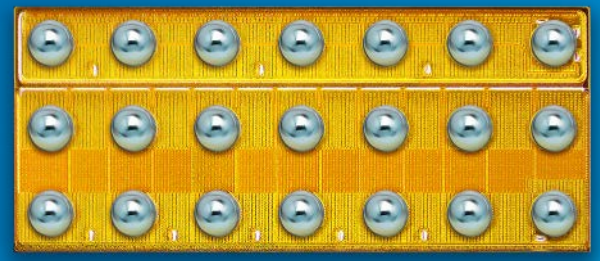
The Future

- Lidar will be used on all cars and lots of robots and UAVs
- Lidar will be about as expensive as a headlamp
- Lidar (scanning) + lidar (flash) + camera will be able to handle most autonomous functions

EFFICIENT POWER CONVERSION

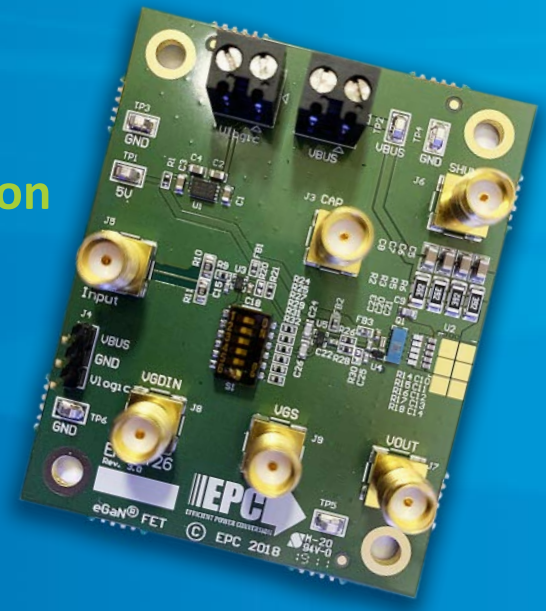
How To GaN Video Series

3rd Edition Textbook



eGaN® FETs and ICs

Evaluation Kits



epc-co.com