University of Illinois at Urbana-Champaign
Dept. of Electrical and Computer Engineering

ECE 101: Computing Technologies and the Internet of Things

Autonomous Driving: Safety and Other Issues

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Safety Devices Added to Trains in Mid-19th Century

The red grill in front of this train engine

- was invented by Charles Babbage
- in 1838, about 16 years after
- he invented the programmable computer.

Its common name reveals its purpose:

cow catcher

Cow Catcher Ensures that Train is Safe, But Not Cow

A cow on train tracks
- might be pushed down
- under the engine's wheels,
- derailing the train.

With a cow catcher, the cow is
- flung to the side
- (and invariably killed)
- without damaging the engine!

Another Scenario: To Swerve or Not to Swerve?

You're driving on a narrow mountain road.

Suddenly, someone runs down the hill onto the road.

You don't have time to brake!

Do you swerve off the road and over the cliff, **or run Pat down?**

Does it depend how many family and friends are with you in the car?

Whose Life Comes First?

**What's more important,
human life or passenger safety?**

If a car has to decide between
- hitting a human and
- endangering the vehicle (and thus the passengers),
- what should it do?

Again, an Exact Answer is Not Easy to Give

Perhaps a better question would be …

How much danger does the car need to be in to deliberately run down a human?

What if the human is pointing an automatic rifle at the car?

Ok, we'll save that last question for society to answer.

Impact of Autonomous Driving?

Let's talk a bit now about
the potential broader impacts
of autonomous driving.

US Culture Encourages Car Ownership

In the US,
- most people own cars—
- sometimes more cars than people!

The culture encourages
- freedom of moving about
- over long distances.

Culture Creates Inefficiency and Overuse of Energy

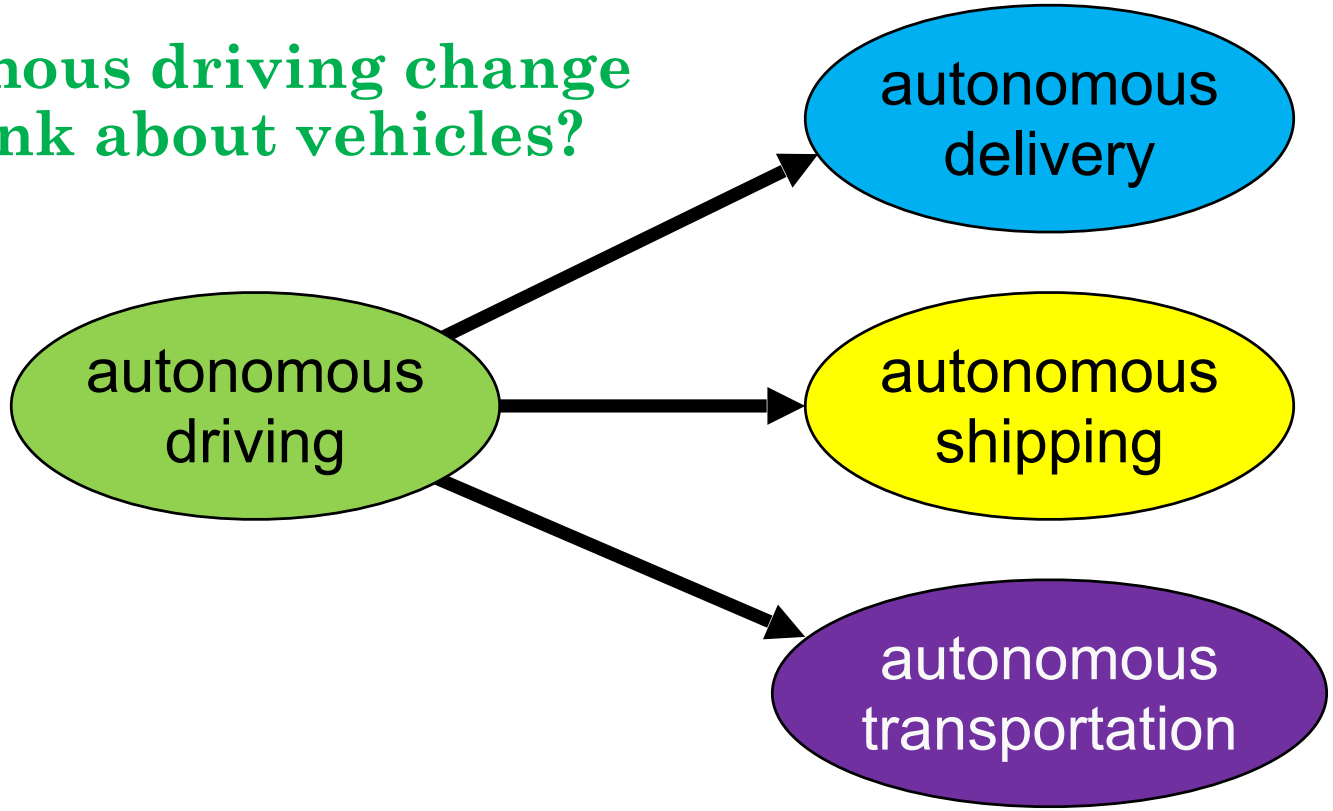
As a result,

- public transportation is underfunded,
- highways are overcrowded, and
- US **transportation use of petroleum** accounts
- for **~4% of** the **world's total energy use**
- (that would be a fair share if we didn't use any other energy, but it's only a quarter of what we use).

Autonomous Driving Enables Other Uses

Will autonomous driving change how we think about vehicles?

Possibly …

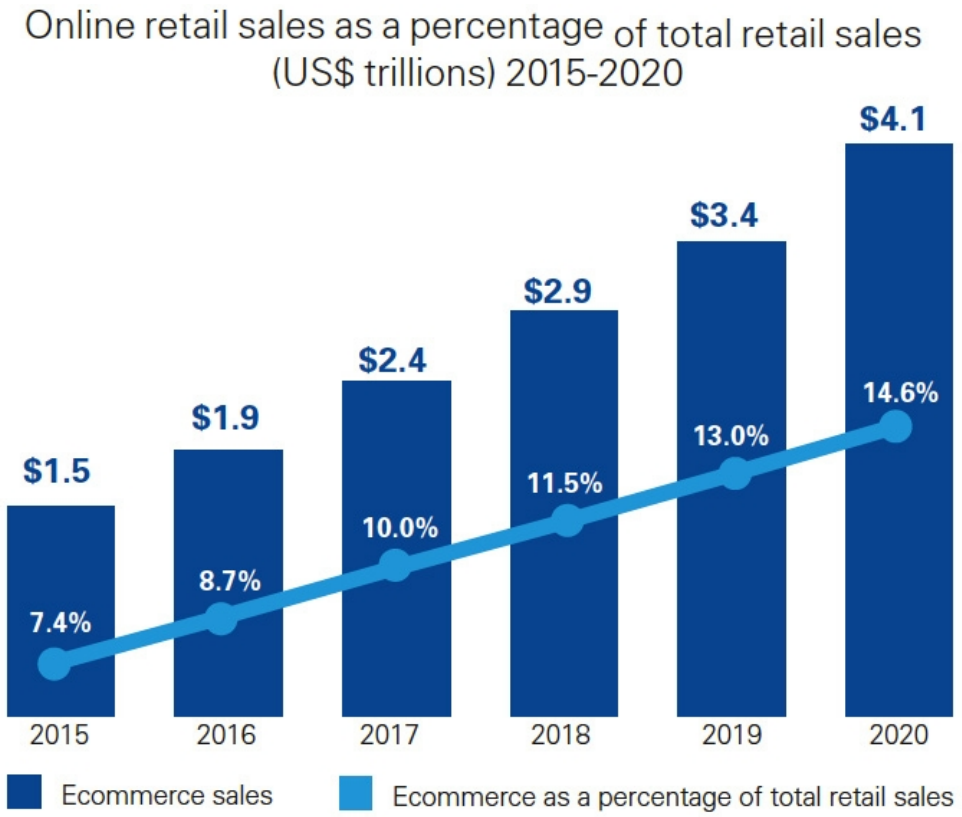


Autonomous Driving Enables Autonomous Delivery

autonomous delivery

Online sales account for nearly 1/6th of all sales.

Autonomous driving enables autonomous delivery of online purchases.



Autonomous Delivery: Efficiency and Other Advantages

Autonomous delivery vehicles can operate 24/7.

Can organize deliveries
- to **optimize fuel efficiency** and/or
- to **schedule for customer preferences**.

Can **coordinate with "smart homes"** to move delivered goods into secure area.

Autonomous Shipping: Optimization of Supply Chains

Autonomous driving enables autonomous shipping (trucks and trains).

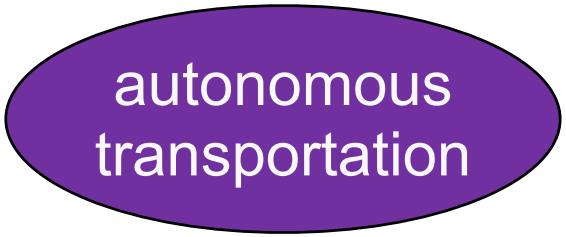
Distribution of goods
- based on average consumption
- adjusted for variations
- in online shopping demand.

Large chains can **integrate**
- **from inventory control** (by robots today in Schnucks)
- **through distribution** all the way
- **to ordering** from suppliers.

Autonomous Driving May Enhance Public Transportation

Transportation rental companies
- such as Uber, Lyft, and so forth
- have become **popular internationally**
- for everything from vans to scooters.

Autonomous driving enables
- these **services to be automated and**
- to be **optimized** for efficiency,
- perhaps overcoming cultural barriers **to public transportation**.



The Songthaew Model of Group Transport

In Chiang Mai, Thailand,
- (human-driven) red trucks
- play the role of group taxis.

Here's how it works:
1. Hail one.
2. Give your destination.
3. If they agree, you hop in back.
4. On the way, they pick up and/or drop off others while heading toward your destination.
5. Prices were standardized recently at $1 for foreigners.

Model Could be Adapted to Autonomous Busses

In the US, the vehicles could be energy-efficient hybrid buses with routes based on requests scheduled online.

1. Schedule your ride and destination, either once or regularly (for work, for example).
2. Bus comes a bit closer to your home, since routes are optimized for riders' needs rather than potential riders.
3. You pay a nominal fee and show up on time (if you're not there, you lose the money, perhaps).

Longer-range services are also possible, with vehicles sized to the group actually traveling.

Terminology You Should Know from These Slides

- autonomous delivery
- autonomous shipping
- autonomous transportation

Concepts You Should Know from These Slides

- why defining an acceptable safety level is difficult
- how autonomous driving might change how we think about delivery, shipping, and transportation