Safety Enhancement of Vehicles

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SITUATION

Road traffic injuries

- Were the **Ninth** leading cause of death in 2015.[1]
- By 2030 , expected to be the **Seventh** leading cause of death

Safety Systems Categories

- Active Safety Systems: Collision Prevention
- Passive Safety Systems: Passenger Injury Minimization

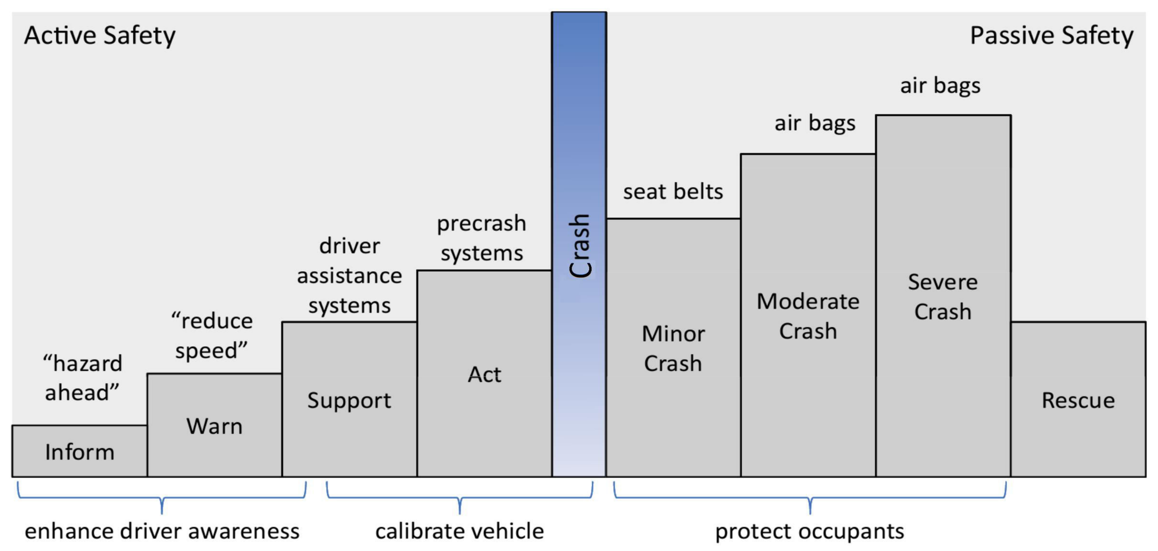

Figure 1: Stages of Safety Systems[2]

PROBLEMS

Limitation to Current Systems

The current systems work well but they can only react to one vehicle ahead.

For the active safety systems to prevent crashes, they gather useful information from their surroundings using(see figure 2):

1) LIDARS 2) RADARS 3) CAMERAS

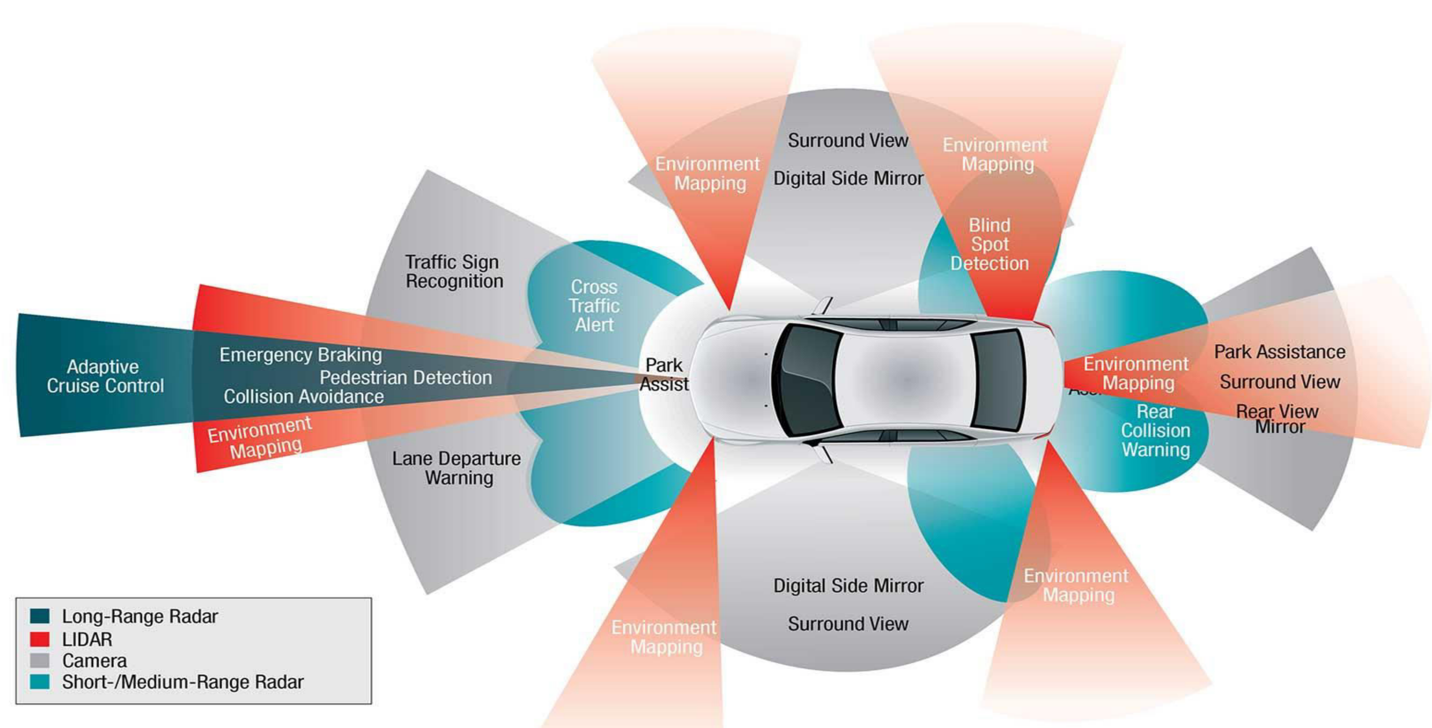

Figure 2: Sensory-based Information Gathering[3]

All the information gathered goes to Electronic Control Units(ECU) that control parts of the car.

The systems' limitations are:

1) Distance in which they can react to a possible threat(150m).

2) Information gathering for decision making under imperfect driving conditions.

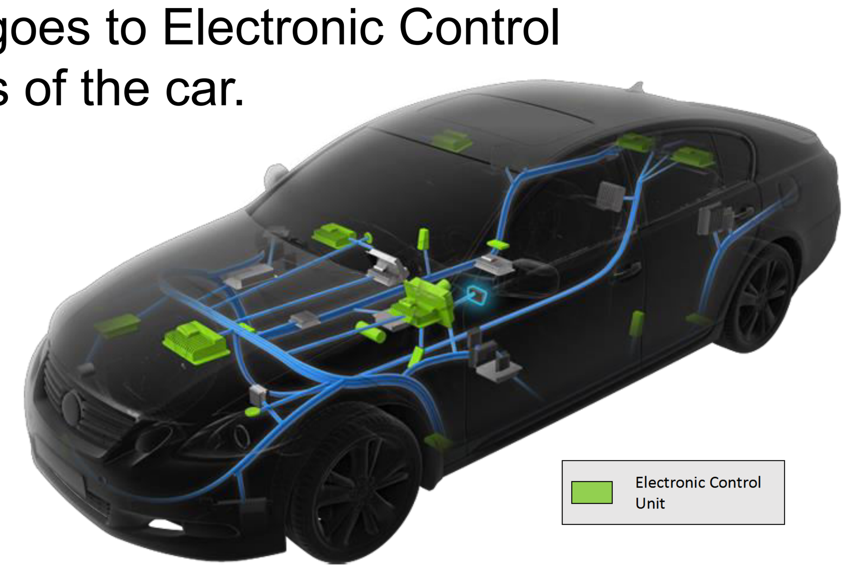

Figure 3 Location of ECUs in a Vehicle[4]

Weight of Vehicles

With the addition of these safety features, the weight of vehicles has increased.

Being hit by a vehicle that is 454kg heavier increases the probability of death in an accident by 47%.[5]

SOLUTIONS

Vehicular Ad Hoc Networks (VANETs)

- VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 250 meters of each other to connect, creating a network with a wide range.[6]
- As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created.
- These networks have no fixed infrastructure and instead rely on the vehicles themselves to provide network functionality.

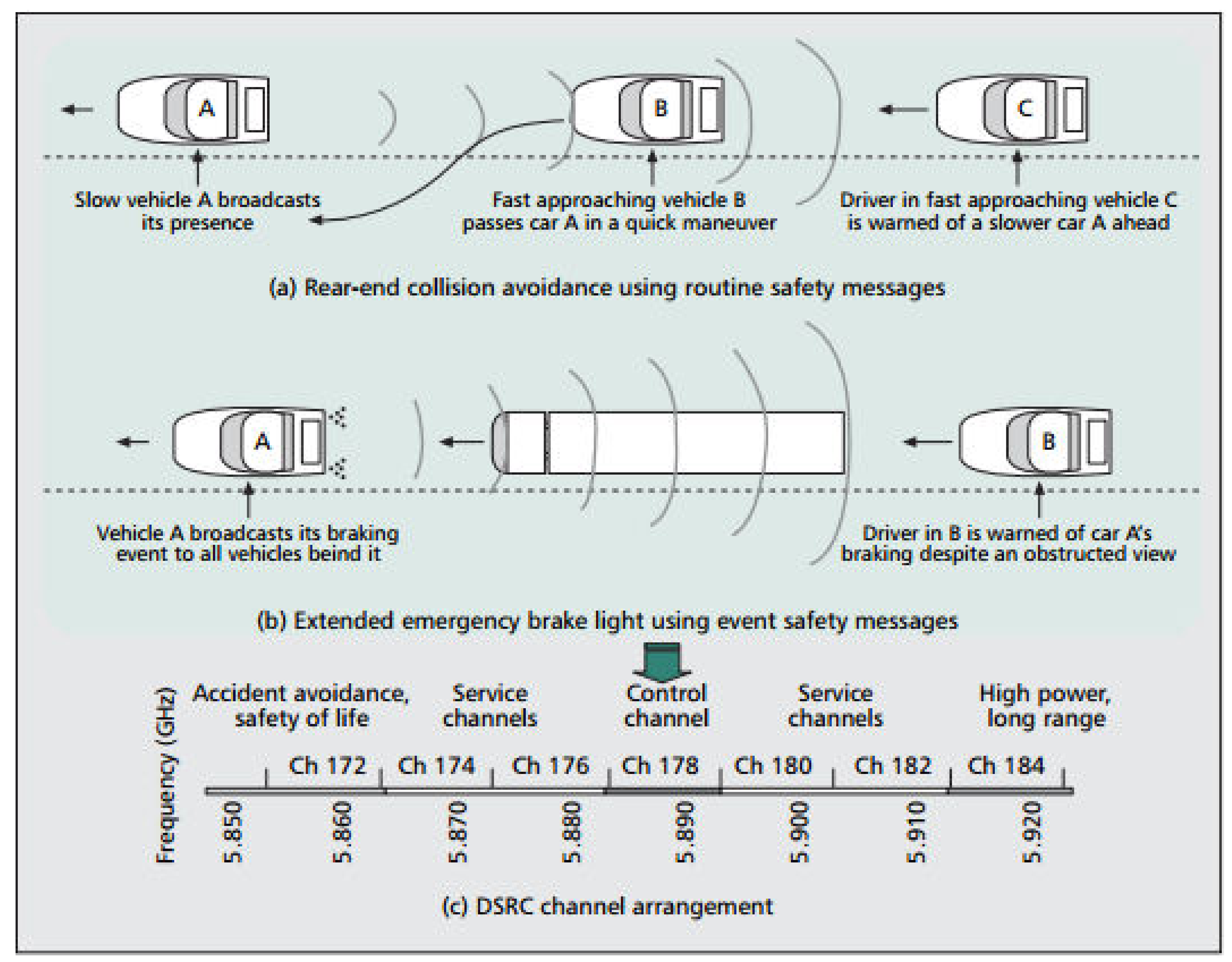

Figure 4: How Vanets work[8]

Event-driven messages are sent when a hazardous situation is detected.

Periodic Traffic messages proactively inform neighbouring vehicles about status:[8]

- Position of the sending vehicle
- Speed
- Potential traffic jams
- Braking distance
- Steering wheel position
- Pedals Position

Licensed spectrum should be established in the 5.8/5.9-GHz band.[7]

Establishing vehicle communication minimizes reaction time.

Structure of Vehicle

About 360 Kg of Advanced High Strength Steel(AHSS) is used on average in a vehicle.[9]

We propose the usage of Super Steel instead.

Super-Steel is:

- As strong as Titanium.(see figure 5)
- 13% lighter than AHSS.[10]
- 10 times cheaper than Titanium.

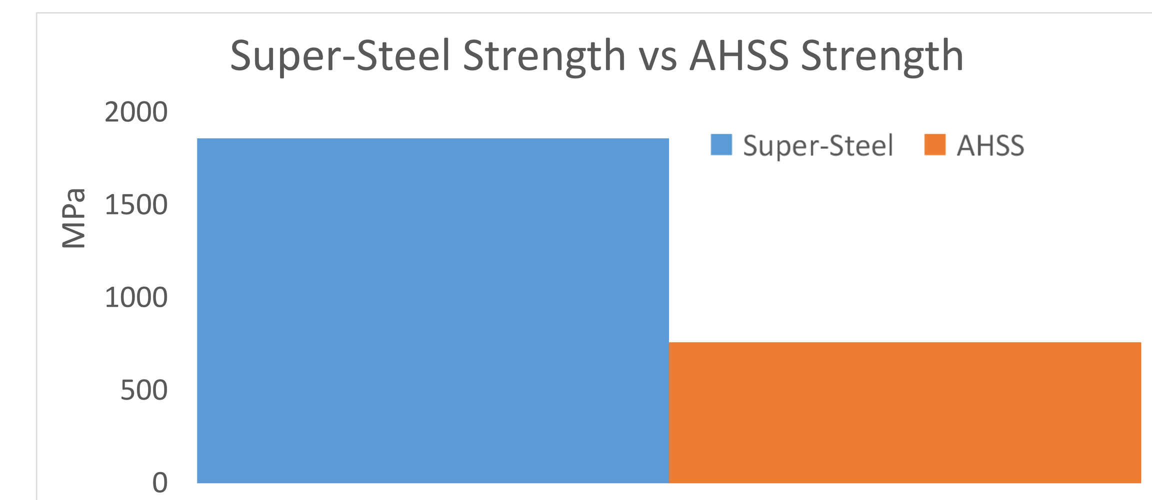

Figure 5: Strength Comparison[11]

EVALUATION

- Vehicle-to-vehicle communication provides safer transportation.
- Installation of Ad-hoc units in cars will take a lot of time.
- With a high vehicular traffic density, frequency channels could suffer from channel congestion.
- Making use of more than one channel leads to multichannel synchronization problems.
- Changing the car components from AHSS to Super-Steel is costly.(See figure 6)
- Super-Steel characteristics provide higher safety structures.

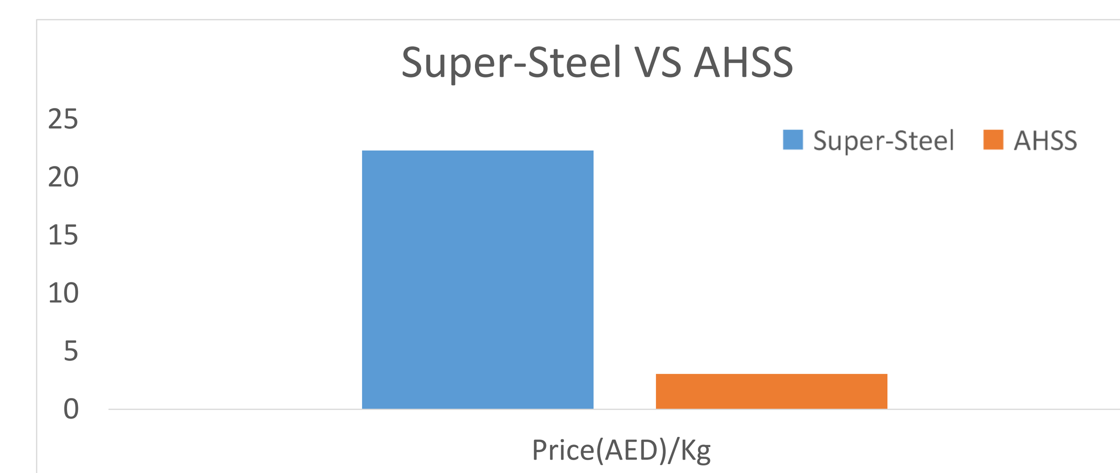

Figure 6: Price Comparison

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