INTRODUCTION
Today traffic safety is a major health issue. The numbers of killed and injured in traffic accidents globally every year are staggering. The World Health Organization WHO has estimated the numbers of fatalities to approximately 1.2 million and about 50 million people being permanently disabled as a result of road traffic incidents. Unless serious measures are taken, WHO estimates that the numbers will increase by 65% over the next 20 years. Apart from the tragedies and human suffering the societal costs are high. For some developing countries the toll of traffic accidents will be threatening the growth of their economies.

In 2007 Volvo Cars presented its Vision 2020. This vision states that the company's aim is that no one is to be killed or injured in a Volvo by the year 2020. Included in the interpretation of this vision is also that the Volvo vehicles should not cause any injuries and fatalities among vulnerable road users.

In the eleven years and two vehicle generations that remain to 2020 strategies for how to reach this vision need to be constantly examined and revised and extensive knowledge of how to develop the safety systems further need to be acquired.

Co operations between different stakeholders for traffic safety such as, road holders, governments, vehicle manufacturers and research organisations will be highly important for meeting the vision. Among other things, such co operations will be necessary when building systems for vehicle to vehicle and vehicle to infrastructure communication, essential in advancing traffic safety beyond present limits.

Safety systems that can make decisions to stop vehicles and avoid accidents represent the next phase in the progress of vehicle safety systems. In the development of these new systems special attention need to be given to protection of vulnerable road users.

Combined preventative and protective safety systems i.e. so called 'Integrated safety', will clearly be most efficient in reducing risks of injuries and fatalities. As an example of the potential of the 'Integrated safety' strategy the Collision Warning and Full Auto Brake system and its projected benefits in reducing injuries and accidents both to vehicle occupants and vulnerable road users will be presented.

CHALLENGES IN THE DRIVE TOWARDS ZERO INJURIES AND FATALITIES
Vehicle safety has taken major steps during the last four decades. It is estimated that the risk of being seriously killed or injured as an occupant in a passenger car has been cut down to one third in the years from the mid-sixties to the year 2005.

Improving road traffic safety towards the target of zero deaths and serious injuries will pose many challenges and obstacles to governments, road authorities and car manufacturers globally.

It is estimated that human error, distraction or the human limited capability is involved as a contributing factor in almost all crashes. One important task of the safety systems that need to be developed is therefore to aid the drivers and, if the systems determine that further actions are needed, intervene and prevent or mitigate the crash.

Within the road transport system there is a large spread in the level of driver capabilities. Historically, a lot of emphasis has been placed on driver education and driver training and indeed, this is important. A number of countries globally have fine-tuned the driver education, training and tests for getting a drivers license to a level where, most likely, it will be difficult to do major additional improvements. For many countries, however, there are still large potentials in improving driver training and licensing young drivers.

It can never be politically acceptable to limit the access to use of the system only to those individuals who meet higher capability demands than the requirements for passing the drivers license tests. We also know that the driver capabilities will vary throughout the active driving years. This means that the spectrum and range of driver capabilities will also, for the foreseeable future, remain wide and it is necessary to assume that a large portion of the drivers in the future will show very much of the characteristics of the presently low performing and low capability drivers.

The conclusion is that, if applying the highest levels and the best driver trainings available today and the likely levels of trainings in the future, it
will not be sufficient in substantially improving the quality of the large mass of drivers in the road transport system. When considering the wide range of drivers with different capabilities due to age, training and experience it is unavoidable and necessary to apply measures were the consequences of human errors are limited or eliminated. Thus, the vision of reaching zero serious injuries and fatalities needs to rest on the improved capabilities to avoid or reduce the consequences of incidents and crashes on the infrastructure and the vehicles.

As a consequence, the major challenge of any long-term visions for traffic safety is that they have to rely on improved, safe and reliable vehicle and infrastructure designs in reaching the long-term goals.

The basic strategy in the drive towards zero injuries and fatalities is to aid the drivers in making the right decisions and taking the right corrective actions. If, however, the car is observing that the driver is not making the correct actions and the circumstances are found to be such that the car is heading towards a crash the systems in the car should act to avoid or mitigate the consequences.

The major challenge in designing the vehicle systems to aid drivers is to understand the human behavior and capabilities and how this influences the way to communicate about potential conflicts and risk situations. Human behavioral research is therefore needed in order to assure that the vehicle systems help drivers to act in the right way, also even if not having been trained in how to use the systems. [6],[7].

LONG-TERM STRATEGIES FOR ZERO DEATHS AND SERIOUS INJURIES

The strategies for designing systems for the drive towards zero injuries and fatalities must be covering the full sequence of events of potential conflicts, starting from the beginning of a drive, through incidents, crashes and ending with the post-crash sequence.

![Figure 1. Sequences of events from non-critical, through critical and to post-crash events.](image)

In view of the fact that we are at the beginning of a learning curve on how to design preventative safety systems no perfect systems will be offered on the markets in the first phases of the development. However, it is important that the first steps are taken and that they are taking the level of safety forward.

A very important ingredient in the drive towards zero injuries and fatalities is that co-operations are established between governments/ authorities, vehicle manufacturers, standardization organizations, research organizations and interest organizations. These co-operations need to establish shared views on strategies forward, agreements on division of responsibilities, and a shared view on the interfaces between the cars and the infrastructure.

As stated previously, in the drive towards zero injuries and fatalities, the consequences of human incapability and lower level of human reliability must be eliminated.

An important part in meeting the targets is to develop systems to enable vehicle to vehicle communication (V2V) and vehicle to infrastructure communication (V2I). This will help to give both cars and the infrastructure a full picture of the status and presence in the traffic systems in order to aid the systems in making the rights decisions.

TECHNOLOGY DEVELOPMENT NEEDED FOR DRIVE TOWARDS ZERO INJURIES AND FATALITIES

Volvo believes that the basic technologies for meeting the goal of zero injuries and fatalities are known today. In addition to more extensive research it is a matter of how to apply, finance, distribute and activate the technologies.

At the same time as the development of protective systems will continue the design of preventative safety systems will need to accelerate and the applications will be covering more of the aspects for mitigating or avoiding crashes. The development has, however, now advanced into a new phase with more intelligent systems, e.g. including object detection and automatically activated systems. A range of preventative systems has been developed and more are under way during the next couple of years. The potential of saving lives and reducing injuries of the integrated preventative and protective safety systems is high [1], [2], [3], [4], [5], and will most likely take us a long way towards the target of zero deaths and serious injuries. By the year 2020 the benefit from
preventative safety systems is expected to reach a level similar to the present level of protective safety systems. Of particular interest will be the design of integrated safety systems for the protection of vulnerable road users. Volvo will in the near future introduce an advanced safety system that will detect pedestrians and, if the driver does not act in a conflict situation, automatically brake while applying full braking effect, i.e. 1.0g. If the braking is still not enough to avoid a collision with the pedestrian the impact speed will be lowered and the protective safety system in the car will help to mitigate the injuries.

The new advanced safety systems being developed offer large potentials for working towards the target of no fatalities or serious injuries. However, future systems involving Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) communication will be needed in order to reach all the way towards the long-term targets.

Co operation between Governments, authorities, industry and academia will play a major part in the drive towards the target. These co operations can potentially help to create common platforms for, e.g. division of responsibilities, data sharing, common view on design of interfaces between car system and infrastructure, etc. The development of technologies for Vehicle to Vehicle communication (V2V) and Vehicle to Infrastructure communication (V2I) will require extensive co operation in order to achieve the necessary levels of standardization and political support for the penetration into the transportation system.

CONCLUSIONS

The drive towards zero injuries and fatalities will not occur in giant leaps but involves a continuous strive forward. These steps need to be taken in order to make sure the development is heading in the right way and that we can evaluate and profit from the knowledge acquired by each step. Although the necessary technologies for reaching the targets are basically already known today major investments in research and field testing are needed in order to develop, adapt and implement them in future generations of vehicles. Tax incentives, insurance premium discounts, etc. are needed in order to support the penetration of the system in to the markets.

REFERENCES