

TELEMATICS – THE ESSENTIAL CORNERSTONE OF GLOBAL VEHICLE AND TRAFFIC SAFETY

Peter Rieth

Recipient of the NHTSA award for "Safety Engineering Excellence", 19th ESV 2005

James Remfrey

Ulrich Stählin

Continental Automotive Systems

Germany

Paper Number 07-0360

ABSTRACT

The networking of active and passive safety (APIA) is the fundamental basis for comprehensive vehicle safety. Situation-relevant information relating to driver reactions, vehicle behaviour and traffic environment are fed into a crash probability calculator, which continually assesses the current crash risk and intervenes when necessary with appropriate measures to avoid a crash and reduce potential injuries. APIA provides effective protection not only for vehicle occupants but also for other, vulnerable road users. As this functionality up till now only relates to the vehicle itself, the next logical step is enhancement leading to the ultimate goal in safety performance, telematics. The integration of this embedded, in-vehicle wireless communication system allows Car-to-Car (C2C) and Car-to-Infrastructure (C2I) functionality for, e.g. hazard warning. This is an integral element of the cascaded Active Passive Integration Approach.

This paper describes the current status in the functional potential attained by networking active and passive safety systems (APIA) and introduces the next ultimate step towards global vehicle and traffic safety, telematics.

INTRODUCTION

It is still common practice to develop passive safety systems – which help mitigate crash-related injuries – as autonomous units, in a separate process from the development of active safety systems that help avoid crashes. The first decisive improvements in vehicle safety came in the mid-1960s with the introduction of the safety passenger cell, the three-point seat belt, and the optimized crumple zone – all focused on passive safety. With increasing numbers of ABS systems as standard equipment in the late 1980s, the foundations for active electronic safety systems (preventing the accident from happening) were laid.

Just how effective the networking of active vehicle safety systems can be, was first demonstrated by Continental in a primary phase in 2000, through the

Reduced Stopping Distance (RSD) project. In what was called the “30-meter car”, the tires, air springs, variable dampers and electro-hydraulic brakes were linked to form an optimized overall system. As a result, the car’s braking distance from an initial speed of 100 kph was cut from 39 meters to 30 meters, and the total stopping distance was reduced by up to 13 meters, compared in each case with a standard production model.

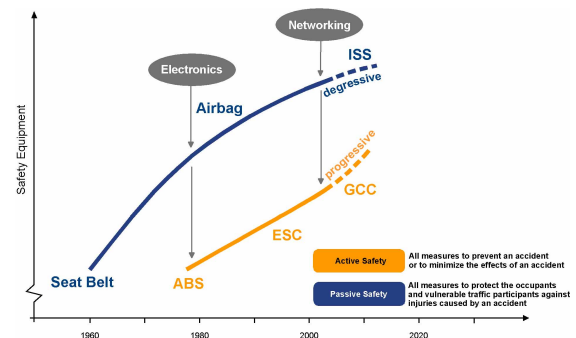


Figure 1. Zero fatalities Vision? Active safety to come.

Since then, important electronically controlled systems in both the active and passive safety areas have become standard specification in a broad-based vehicle population, systems such as ABS, ESC, belt tensioners, and airbags. These are, however, designed as stand-alone systems (Figure 1). Active and passive safety developments have remained two separate domains.

In order to attain optimum protection, however, these systems must be networked by collecting information on vehicle behaviour, vehicle environment, and driver reactions, merging the data, evaluating it, and translating it into coordinated protection measures.

Today, Continental’s know-how in the fields of active and passive safety, innovative driver assistance systems, and tire technology is being channelled into the company-wide APIA (Active Passive Integration Approach) philosophy, in order to achieve a decisive step closer to the vision of a vehicle that can prevent crashes and mitigate injuries (Figure 2).

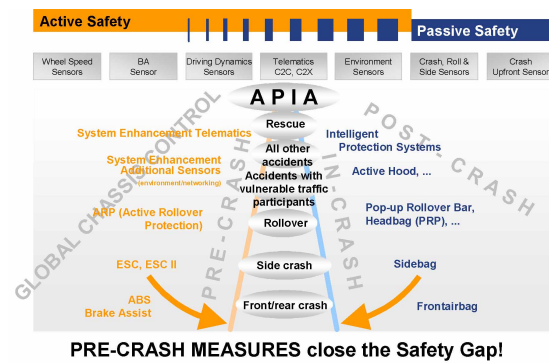


Figure 2. Active Passive Integration Approach APIA.

Integrating active and passive safety

APIA brings together the vehicle's active and passive safety systems to form a network. The basic principle is the networking of the driving dynamics data supplied by the Electronic Stability Control ESC with the signals describing the driver's behaviour and the APIA's environmental sensors.

The key integration component of the APIA software is the crash probability calculator, which constantly processes and evaluates incoming data. For any given situation, the calculator computes a hazard potential that reflects the current crash probability.

Should the hazard potential exceed defined limits, the crash probability calculator initiates a function and time staged protection strategy (Figure 3). If, for example, two vehicles are driving nose to tail, various levels of crash probability and pre-crash protection measures can be determined from their relative speeds and the distance between them. Beginning with an acoustic, visual or haptic warning, these can extend from prophylactic (reversible) belt tensioning, adjustment of seat (anti-submarining), backrests and head restraints, to closing the windows and sunroof.

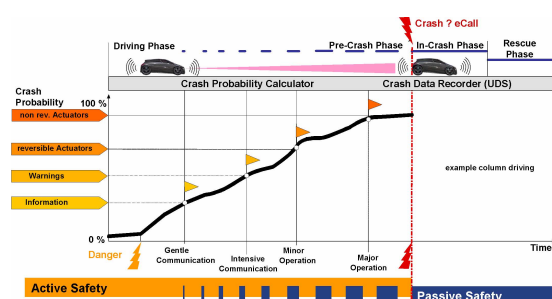


Figure 3. Crash Probability Calculator.

Simultaneously, the brake system is preconditioned by boosting the system pressure from pre-fill all the

way to limited automatic pre-braking and extended brake assist function.

The full range of measures described above is only available if the vehicle is equipped with a full-power brake system including Electronic Stability Control ESC designed to accept external control signals and distance monitoring sensors such as those featured in ACC systems.

Sophisticated anti-lock brake systems with brake assist functions and adaptive cruise control systems give the driver greater and more comfortable control over the forward dynamics of the vehicle. Modern stability management systems such as ESC can now prevent many skid-related crashes. In addition, electronic control units for airbags, seat belts and rollover protection have significantly improved occupant protection over the last few years.

Advanced environmental sensors will play a key role in the development of the car of the future designed to prevent crashes and mitigate injuries. Continental has developed a pre-crash Closing Velocity (CV) sensor. This highly dynamic sensor, which features a wide short-distance detection range, is ideal for detecting events very near to the vehicle and enables precise predictions of the severity and direction of an impending crash. This information enables the crash probability calculator to activate the multi-stage Smart Airbags appropriately. Apart from improving occupant protection, the CV sensor in combination with additional contact sensors mounted on the front end of the vehicle can also serve to enhance pedestrian protection.

For the short to mid-range vehicle environment, in addition to the existing radar and infrared sensors, Continental is currently working on the development of ISF – the Infrared Sensor Family. The sensors have the potential to cover both the short- and mid-range environment, so that APIA's active safety systems (preconditioning of the brake system, extended Brake Assist, ...) and passive safety systems (reversible occupant positioning and retention, vehicle interior preconditioning, Smart Airbags, ...) can be realized..

Another step towards greater safety will occur with the integration of image-processing camera systems. Continental is currently working intensively on such systems, which for the first time will be able not only to detect objects but also to classify them. The appropriate safety systems for a given situation can then be activated even more effectively, providing optimum protection for vehicle occupants and other road users.

Telematics integration

The "seeing" car of the future will feature onboard intelligence, data interchange with other vehicles, and telematics information, allowing it to actively avoid a large proportion of potential crashes (Figure 4).

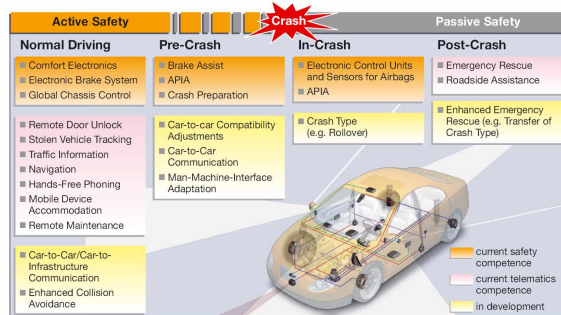


Figure 4. APIA-Functions.

With comprehensive vehicle safety and traffic management becoming more and more critical aspects of global mobility, the essential cornerstone Telematics will play an important role in efforts to integrate embedded, in-vehicle wireless communication systems into our Active Passive Integration Approach (APIA), which focuses on creating cars that avoid crashes, prevent injuries and provide immediate assistance if a crash proves unavoidable.

Telematics – eCall

Continental's Telematics systems help to make cars safer and provide a "wireless life-line" to emergency assistance the critical seconds after a crash occurs. In case of an accident, the eCall Telematics Control Unit (TCU) in the car will transmit an emergency call that is automatically directed to the nearest emergency service. eCall can be triggered in two ways. Manually operated, the voice call enables the vehicle occupants to communicate with the trained eCall operator. At the same time, a minimum set of data will be sent to the eCall operator receiving the voice call. In case of a severe accident the information on deployment of e.g. airbags or in-vehicle sensors will initiate an automatic emergency call. When activated, the in vehicle eCall device will establish an emergency call carrying both voice and data directly to the nearest emergency services (normally the nearest 112 Public Safety Answering Point, PSAP).

The life-saving feature of eCall is the accurate information it provides on the location of the accident site: the emergency services are notified immediately, and they know exactly where to go. This results in a drastic reduction in the rescue time.

Estimations for eCall carried within the E-MERGE project and the SEiSS study indicate that in EU-25 up to 2.500 lives can be saved per year, with up to 15 % reduction in the severity of injuries.



Figure 5. eCall – Rescue Chain.

Telematics – Car-to-Car (C2C) and Car-to-Infrastructure (C2I) Communication

Under development is Dedicated Short Range Communication (DSRC) for vehicles, which allows receiving of traffic and warning information directly from other cars, even those not visible to today's environmental sensors. Examples for DSRC applications are shown in the following. (Figures 6 to 9)

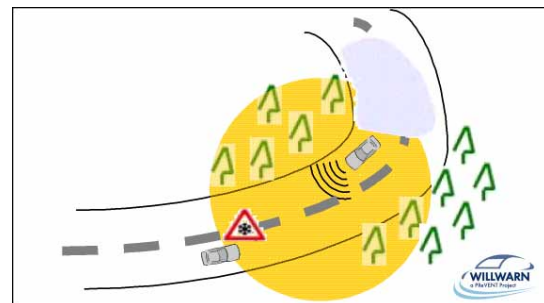


Figure 6. Hazard Warning.

Hazard Warning

The driver is warned if his vehicle approaches a potentially hazardous situation on the road ahead. Hazards can be construction zones, breakdown situations, accidents, end of traffic jams, imminent forward collision, black ice, etc.

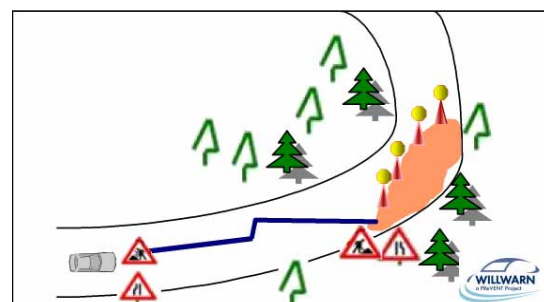


Figure 7. In Vehicle Signing.

In Vehicle Signing

Display or announcement of localized traffic sign information such as speed limits, temporary right of way changes, traffic routing, etc. It is of particular relevance for, but not limited to, dynamic information.

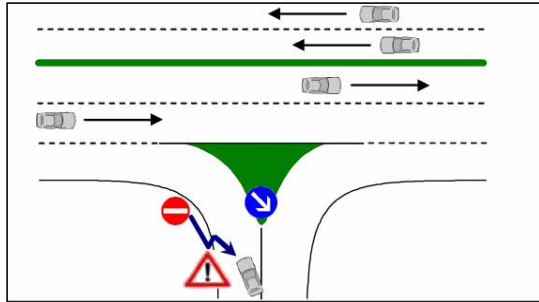


Figure 8. Traffic Rule Violation Warning.

Traffic Rule Violation Warning

The driver is warned if he is about to violate a traffic rule. This includes traffic signal violations, stop sign violations, right-of-way violation and cross-traffic collision avoidance, etc. It is of particular relevance for, but not limited to, dynamic traffic sign information.

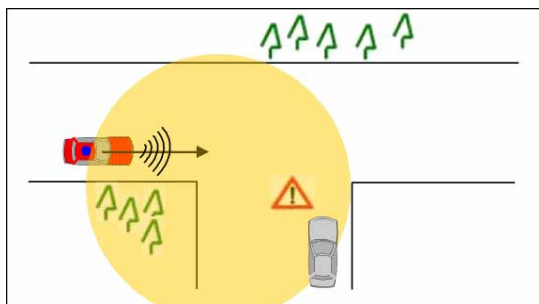


Figure 9. Emergency Vehicle Warning.

Emergency Vehicle Warning

The driver is warned of approaching emergency vehicles which claim the right of way.

Shadowing by other vehicles, as with environmental sensors, will be less of a problem and therefore further increase the range achieved in typical driving situations. In addition, information from the infrastructure can be provided, such as traffic light status, position of road works, local weather information, etc. DSRC will reduce the driving risk by providing local hazard warnings and bring active safety to a new dimension.

Combining DSRC and environmental sensors will lead to cascaded information and actions resulting

in a system capable of providing a safe driving state, helping to prevent crashes and in case needed reduce the severity of a crash. Therefore, the information from DSRC is taken into account first, validated via environmental sensors and accordingly supported by actions such as provided by ESC systems.

Telematics – Connectivity

On the comfort side this next generation of telematics systems will soon offer the motorist even greater freedom at the wheel. Any portable device connected to the vehicle by Bluetooth or USB can be operated either by voice command or from the controls in the steering wheel or instrument panel. In addition, the new telematics systems use wireless connectivity to load address books from the cell phone into the car; they can read out incoming short messages and support personalized ringtones and stored speed dialling numbers. An optional, integral telephone module allows both internet access and service and assistance functions, including automatic emergency calls.

CONCLUSION

Today's vehicles have already reached a high safety standard thanks to current, state of the art technologies such as Airbags and the Electronic Stability Control System ESC. Networked active and passive safety is starting to be equipped to premium class vehicles and will be enhanced by telematics – in this case by eCall. But telematics also offers possibilities for safety related vehicle communication in the future, namely C2C and C2I. The information cascade for safety systems improves the range of APIA. Cascading starts with DSRC, is validated by environmental sensors and the performed actions are supported by electronically controlled safety systems e.g. ESC. Telematics integrated together with APIA offers comprehensive traffic safety and can be combined with service providers with the aim to provide intelligent mobility.

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