Optimizing road safety with Siemens’ tunnel control technology

The summer travel season has begun. According to Swiss statistics on traffic to popular vacation destinations, some 2.4 million cars, recreational vehicles, motorcycles and busses crossed the Swiss Alps via the Gotthard, San Bernardino, Grosser St. Bernhard and Simplon tunnels in July 2006, with every second vehicle originating from a country other than Switzerland. The Swiss Federal Office for Spatial Development (ARE) predicts that the number of motor vehicle passengers in Switzerland will rise as much as 30 percent by 2030. In light of the growing volume of traffic, increasing attention is being paid to road traffic safety in both the public and private sectors. For decades Siemens has been an innovation leader in this important field, developing road safety technology for numerous applications. Several examples of current and future technologies in this area are outlined below.

Tunnel control center – The centerpiece of tunnel control and safety

The most dangerous sections of highways and expressways are tunnels, where accidents can have particularly disastrous consequences. Rescuing the injured and dealing with breakdowns is considerably more difficult than on the open road. Accidents, fires and excessive carbon monoxide values must be detected and dealt with quickly. Siemens I&S offers advanced traffic control solutions and safety and information systems that optimize road safety. To enable a rapid, appropriate response to alarms and accidents, all relevant data must be bundled and suitably displayed and action must be initiated. This is where the tunnel control center takes center stage.

Technology

Existing tunnel control centers have usually been equipped with widely varying hardware and software designed to conform to local regulations and technical standards. The Siemens Industrial Solutions and Services Group (I&S) has developed a control system that integrates a multitude of safety components and control models, enabling
communication between proprietary developments and standard industry components. The system brings together traffic guidance and control equipment, safety technology, lighting, ventilation and power supply equipment, emissions measurement, and fire alarm and emergency call systems. Traffic can be controlled either automatically or by active operator intervention. If a fire alarm is activated, for example, the traffic lights at the tunnel entrance automatically switch to red and the tunnel is closed.

Reference projects
With a length of 3,820 meters, the Nefise Akçelik tunnel in Turkey is the country’s longest expressway tunnel. Siemens I&S provided the complete traffic control technology for the project, from a tunnel control center to traffic guidance systems, power distribution systems, the lighting, ventilation and fire protection equipment, radio systems and camera monitoring equipment with automatic event detection. The tunnel was constructed to cut travel time from one hour (along a 42-kilometer coastal road) to 15 minutes. Its state-of-the-art equipment makes the Nefise Akçelik tunnel one of the world’s most advanced tunnels. An automatic detection system identifies vehicles that have stopped or are moving in the wrong direction, pedestrians, sudden changes in vehicle speed, congestion, extraneous objects on the roadway or smoke, and immediately triggers the alarm systems accordingly. The system also analyzes a multitude of data – such as an increase in the carbon monoxide level, impaired visibility or changes outside the tunnel – and automatically activates defined operating plans to respond to each situation. To ensure a comfortable and safe journey, lighting can be adapted to tunnel conditions and the ventilation system can be controlled.

A wireless communication system enables contact with various public services from within the Nefise Akçelik tunnel. For example, drivers’ attention is quickly drawn to special situations in the tunnel via radio transmitters, providing them with safety and warning information by messages or variable-message signs. General announcements can also be made through 252 loudspeakers in the tunnel. The automation system ensures that the ventilation, lighting and traffic control systems function quickly and reliably in case of a fire. A total of 84 jet fans have been installed and, about every 100 meters, foam fire extinguishers have been provided, along with fire closets, including dry-type fire extinguishers. An additional, water-type fire extinguishing system is supplied from a tank with a capacity of 370 cubic meters that is automatically constantly monitored. The tank is kept filled at maximum level by diesel and jockey pumps.
A further reference project for an integrated traffic control system is scheduled for completion in March 2009 in the canton of St. Gallen in Switzerland. Traffic in the St. Gallen area has been increasing annually by an average of four percent in the last few years and will continue to increase due to the construction of large shopping centers and a new soccer stadium, creating the necessity for powerful new traffic management systems. More than 600 variable message signs for lane signaling, speed indicators and alarm signals will guide drivers safely along the road and give warning of any hazards that lie ahead. The traffic data will be recorded by distributed equipment before being centrally processed and compressed. The control requirements derived from this procedure will then be passed on to the traffic computer. Five tunnels and 96 display panels will be controlled by the system.

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Tunnel radio and emergency call systems ensure rapid response
The Tauern freeway is one of the most important north-south connections in Austria. The Hiefler and Ofenauer tunnels between the Pass Lueg and Golling junctions have a total length of 3,600 meters and are among the oldest freeway tunnels in Austria. In view of the heavy traffic through these tunnels, they have now both been equipped with an advanced tunnel radio system from I&S and an emergency call system from Siemens IT Solutions and Services.

Technology
The tunnel radio system distributes signals via the GSM mobile radio network. The advantage of this construction is that in case of fire or damage in a section of the tunnel an emergency call can be made via radio from the other accessible sections. The system is not impaired by fire or other damage.
The emergency call systems function with VoIP technology. They transmit emergency calls made in person from the emergency location as well as system messages and
commands such as “Emergency Call Alarm,” “Niche Doors Open” or “Flashing Traffic Light On” that can be given by pressing a button on the emergency call system. The calls are transmitted to the emergency call center unimpaired by any kind of ambient noise. The emergency call systems from Siemens IT Solutions and Services guarantee good contact with the person seeking help. The voice quality is extremely high.

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Fire in a tunnel – laser technology prevents the worst consequences
If fire breaks out in a tunnel, there is no time to lose: emergency services must be alerted, the fire must be contained far as possible and the build-up of smoke prevented. This is where modern tunnel systems come in. With the Fibrolaser system, Siemens Building Technologies has developed a special fire alarm system for tunnels which pinpoints the location of the flames in the tunnel and automatically sets all the protective systems in motion: emergency calls, extinguishing systems, traffic signals, ventilation and lighting.

Technology:
The tunnel is fitted with a sensor cable (Fiber Optic cable). This is divided by means of electronics and a software program into sections that measure the temperature and transmit the data to a fire alarm center on the basis of predefined alarm criteria. Measurement proceeds at intervals of a fixed number of seconds. If there is a spontaneous temperature increase of a few degrees, an alarm signal is sent to the tunnel control center with information about the size, development and direction of the fire.

References:
The Montblanc Tunnel in Switzerland has been equipped with the Fibrolaser System since the devastating fire in 1999. The system has been installed worldwide in over 1,500 kilometers of tunnel, including the Rennsteig-Tunnel in Germany, the KP Expressway in Singapore, the San Bernardino Tunnel in Switzerland and the Funing Tunnel in China.
Electronic warning system to keep drivers alert

According to the Deutsche Verkehrswacht, a German road safety organization, momentary drowsiness or inattentiveness is responsible for one in four accidents on German motorways. In the United States, as many as 40 percent of highway accidents are due to drowsiness at the wheel. The economic loss that such vehicle accidents cause each year is estimated at 5 billion euros in Germany alone. Particularly at risk according to the experts are the truck drivers. They are often at the wheel for long hours, frequently at night. Even if they do not actually close their eyes, their reactions can be up to 74 percent slower when they are drowsy or lacking concentration. The upshot is that drowsy drivers cannot react fast enough or with the appropriate response when critical situations arise.

Technology:

A warning system from Siemens VDO helps counter these hazards. The Driver Attention System can detect signs of slackening concentration and drowsiness and warn the driver. It consists of an inconspicuous infrared digital camera in the cab which monitors the trucker’s face and a software program that evaluates the recordings in real time. Based on the driver’s viewing direction and the number and duration of eyelid movements the program can ascertain whether the driver is alert and attentive. If the electronics detect signs of drowsiness, they warn the driver at two levels. First, if concentration slackens, a vibration of the seat prompts the driver to turn his or her attention back to the road. Then, if the cameral registers critical drowsiness, a signal tone of increasing intensity is sounded. The Driver Attention System thus sends a final signal to the driver that it is time to take a break. The system operates in both daylight and after dark, in accordance with the results of current accident analysis. These show that, contrary to widespread opinion, drivers are prone to drowsiness not only at night, but especially in the morning and afternoon.
The Driver Attention System can also be used by car drivers. It is part of pro.pilot, Siemens VDO’s network of driver assistance systems. This is made up of Night Vision, Blind Spot Detection, Lane Departure warning and Adaptive Cruise Control. It is conceivable that, in a further development stage, the latter two of these systems could be combined with the Driver Attention system. By this means the vehicle would be kept automatically in its lane and braked in time to avoid colliding with a vehicle in front until the drowsy driver reacted to the warning signals and took back control of the vehicle.

References:
The system is currently being developed and will not go into production before 2010.

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Safety in railway tunnels
Siemens Transportation Systems contributes significantly to rail safety – outside and inside tunnels. Track vacancy detection equipment and location systems provide information about the location, speed and direction of trains. Electronic interlockings establish route safety and set points, operations control systems in the control center visualize everything that is happening on a line and help drivers make decisions in unexpected situations. Automatic train control systems calculate the relevant permissible speed and initiate braking and stopping.

References:
This technology is in use high-speed trains in the Netherlands. The approximately 100-km rail link from Amsterdam via Rotterdam to the Belgian border has a special feature: because the line runs almost at sea level, a system for monitoring the flood gates has been integrated into the safety concept along with the systems which recognize unplanned stops or smoke in a tunnel and problems in neighboring tunnels.
A further reference is the high speed line between Cologne and Frankfurt: Here the line voltage testing equipment helps rescue services such as the fire brigade to make sure before entering the tunnel that the overhead contact line is no longer live and is earthed. They can then go into action without delay or danger to themselves. In addition, for the Cologne-Bonn Airport link Siemens installed a digitally capable amplifier and antenna system for the BOS radio system and a tunnel radio system. The system facilitates communication with and between the different rescue services in an emergency.

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Further examples for „tunnel technology“:
Emergency power unit (PG)
Power distribution system (PTD)
Ventilation system as well as monitoring system for tunneling (A&D)

Further information about intelligent traffic systems can be found in the internet at
http://www.sbt.siemens.de/firesafety
or
http://www.industry.siemens.de/traffic/en/