

# Driving with a DIVA

by Jean-Louis Golbery, Citilog, France

*Since the Mont Blanc Tunnel tragedy in 1999, driver safety has become the key issue in today's road transport solutions. The largest tunnel infrastructure in the world successfully solves this crucial problem with the most advanced video incident detection system*

**R**oad traffic management technologies, CCTV in particular, provide a lot of data. The challenge is to turn this highly diversified flow of data into useful information. On the one hand reducing the quantity while improving the quality on the other.

This is where Automatic Video Incident Detection fits into the picture: by providing a system that will automatically warn tunnel operators of any incident within the field-of-view of a camera. The system uses standard CCTV cameras and works in the background, all day, every day. It provides assistance to the tunnel operators, only attracting their attention where and when it is necessary.

This solution becomes extremely useful when 350 cameras must guarantee the utmost safety in the largest underground highway in the world, currently under construction.

The A86 West section of highway is the missing link in the 80km long A86

ring around greater Paris. After a long wait, the underground A86 link-up is now possible thanks to recent advances in large diameter tunnel boring technology. In a region where traffic congestion is increasing every year, the A86 link-up will save a great deal of time and energy for drivers. This road communications lynchpin will bring a 45 minute journey down to barely a 10 minute ride.

This highly innovative tunnel, bored between 20 and 90m deep, will feature two superposed independent carriageways, each level carrying one-way traffic only. This prevents the risk of head-on collisions. Both levels will comprise a two-lane carriageway (high speed and low speed lanes) and a hard shoulder for emergencies.

Due to the unique design of the superposed roads, the access to the A86 tunnel will be reserved for light personal and commercial vehicles that are less than 2m in height. Consequently the visibility of the monitoring CCTV cameras is therefore restricted to an

extremely low vertical stand point above the passing traffic. Needless to say that this special road tunnel environment is not suited for current automatic video incident detection technologies.

This is the reason Cofiroute, the tunnel project owner, turned to Citilog to find the best solution for detection results. The DIVA\* concept (Détection Instantanée des Véhicules Arrêtés or Instant Detection of Stopped Vehicles) was born.

In addition to other security measures like a maximum speed of 70 km/h, the tolling access control, around-the-clock manned control centre rooms, DIVA operates over 350 colour cameras positioned every 100m on average, attached to the tunnel ceiling at a 2.2m height between the two-lane carriageways.

## A French DIVA

If the tunnel is unique, so is the DIVA architecture. Each camera transfers its video stream through two parallel video networks. Each network is the replica of

the other, and both will be running at the same time with redundant hardware materials. Two parallel sets of Citilog's analysers will simultaneously process the images from the cameras, and report every anomaly at a stunning speed of less than 10 secs once the incident has occurred.

All Citilog's analysers will be monitored by two redundant Citilog's communication servers, one instantly replacing the other should the first one fail, in order to transfer the alarms to the control centre rooms. The safety and control office is then alerted and receives the near-live images of any traffic anomaly detected (stationary vehicle, slow traffic, etc). A pre- and post-incident digital video clip is immediately available to quickly assess the situation. This notification system enables the control staff to visually identify the type of intervention required. Saving valuable response time. Saving lives.

Other great innovations proposed with DIVA lie in the implementation of specially designed algorithms by Citilog. A major improvement is related to an unprecedented association of different algorithms for different purposes. A self-learning one, extracted from the Citilog's VisioPaD system, allows incident detection over the entire image (instead of limited zones) without any configuration. Unlike traditional video incident detection systems, this is a real plug-and-detect solution that completely takes away any time-consuming and complex system configuration (masking, calibrating, set-up, etc). Another algorithm will disregard irrelevant objects in the field of view as disturbing noise that

*Cutaway diagram of the two-deck tunnel*



*MediaTunnel enhances tunnel safety and security (All images Photothèque Cofiroute)*

could potentially lead to false alarms. A third one, used in Citilog's MediaTunnel, will help differentiate the shapes and sizes of moving objects in the picture.

### Long term implications

Citilog and Cofiroute have developed a very close working relationship in designing DIVA as a dedicated video-based incident detection system for the A86 tunnel. This project-specific traffic management tool will clearly contribute to constantly monitoring and evaluating the system performance. Not only must Citilog deliver a perfect

## Unlike traditional video incident detection systems, this is a real plug-and-detect solution that takes away any time-consuming, complex system configuration

DIVA system, but DIVA itself has to perform efficiently in the long run. As detection regression is not an option, it is highly important to ensure a sustained and beyond-expectation performance over time. Video simulations initiated due to a database of short video sequences

or permanent recordings from DIVA will help to set performance goals and establish benchmarking tests. Quarterly project reviews between Cofiroute and Citilog are the key to successfully and consistently improving the algorithms, and therefore providing an always safer and more secure tunnel environment.

### Building expertise

Such a colossal video incident detection system could not have been technologically possible without Citilog's past successes with similar high safety

expectations. The Fuxing tunnel in Shanghai or the four Manhattan tunnels in New York insisted on the same top security standards as used in the A86, for road users in high-density urban tunnels with low ceiling clearance.

Other field of expertise for such systems can be found in the Melbourne City Link (Australia), Sao Paulo (Brazil), Santiago (Chile), Liège (Belgium), over 40 tunnels in Spain and in the cross-border Mont Blanc tunnel where Citilog's algorithms now provide a safer route between Italy and France.

### Conclusion

The A86 tunnel is an exceptional underground structure that stands out by its size, design and technology specially developed to make it safe and secure. This state-of-the-art road infrastructure sets new top security standards for all the future tunnels operators keen on handling a reliable and efficient video incident detection solution such as DIVA. ■

*DIVA (Détection Instantanée des Véhicules Arrêtés/Instant Detection of Stopped Vehicles) concept and design by Cofiroute. The A86 highway is managed by Cofiroute. [www.cofiroute.fr](http://www.cofiroute.fr)  
[www.a86ouest.com](http://www.a86ouest.com)  
DIVA development by Citilog*