

USING SPATIALLY ENCODED VIDEO FOR HIGHWAY OPERATION, EVENT MANAGEMENT AND MAINTENANCE

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Abstract:

The French motorway company SAPN has invested in geo-referenced video and IBI Group's RouteMapper browser software to provide staff with access to spatially encoded video images of the highway network..

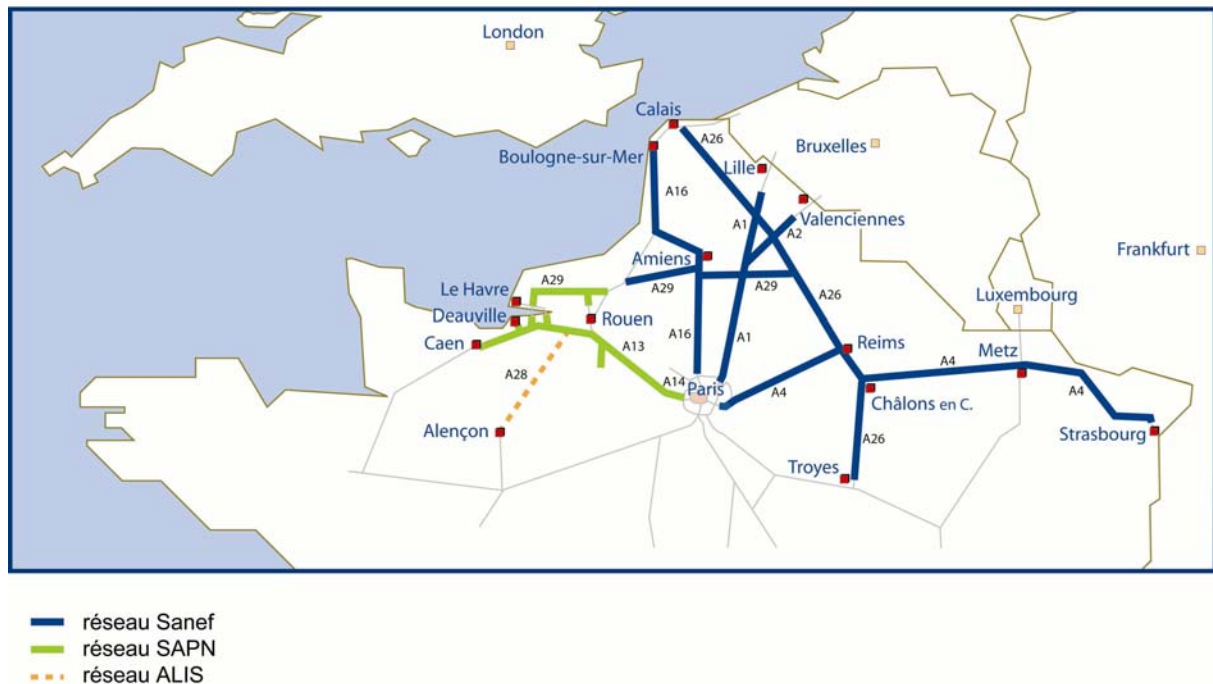
This article describes how the power of combined imagery and positioning within a single application has helped SAPN to improve the efficiency and quality of its operation, management and highway maintenance activities.

INTRODUCTION

La Société des Autoroutes Paris Normandie (SAPN) operates a 368 km network between Paris and the Normandy coast. The network comprises suburban sections with heavy volumes and peak period congestion and long distance inter-city sections with lower traffic volumes, but which are often congested during busy weekends.

SAPN takes a proactive view of the maintenance and management of its network and has invested in various ITS technologies to improve the safety, comfort and reliability of journeys.

Exhibit 1: SAPN Network (shown alongside network of Groupe Sanef (parent company))



The company has been using IBI Group's RouteMapper spatially encoded video technology to provide staff with a geo-referenced video library of the SAPN network. Using the RouteMapper system, users are able to:

- easily view an image of any part of the network
- view image position on the corresponding map
- position objects and undertake measurements of distances within the image
- digitise and annotate specific locations for subsequent retrieval and display alongside the image
- complete virtual drive throughs to simulate driver views of the roadway and infrastructure
- export images for use in third party applications

SPATIAL VIDEO TECHNOLOGY

Spatial video was born out of the ability to merge video and positioning technology to create sequential images that are spatially referenced. Recent advances in digital video (image quality and cost reduction) and positioning technology (GPS, inertial navigation) have significantly improved the quality of spatial video technology in recent years.

In its simplest form, spatial video systems are comprised of three main components: data acquisition, data processing, and data browsing.

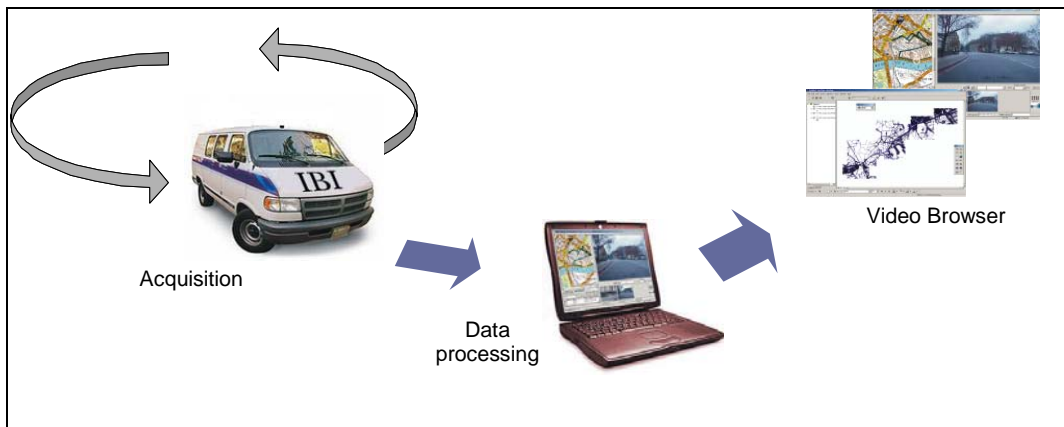


Exhibit 2: Spatial video collection

In the acquisition stage, data is collected using a spatial video acquisition system that typically includes digital cameras, navigational equipment (GPS and usually secondary navigation to recover position during GPS dropout) and an on-board workstation to store the surveyed data. Key elements that affect the quality of acquisition include image sharpness, accuracy of position and level of synchronisation between the cameras images and navigation equipment.

The next step is data processing, where the raw survey data is processed, typically into a series of sequential images each tagged with corresponding positional information. Quality control is important at this stage, with various diagnostics being employed to trap positioning errors. Missing or erroneous positional values are normally recovered using secondary navigation data from units collected during acquisition or filled in using advanced data interpolation techniques.

The final step is data interaction, where the data is loaded and viewed in a desktop browser or over the web.

Typical browsers have multiple video windows, a map interface, a back end database to store digitised information and modules for location referencing and 3rd party data display. During playback, the browser displays the video image, survey route and location of data point in a 'moving map' window. The user is able to record points and other features directly from the video into the background database. This includes system-generated data (e.g., latitude/longitude, grid reference coordinate information, distance along track) and as well as user input attributes (descriptive information obtained from the video image, measurements taken in-frame).

THE SAPN DEPLOYMENT

SAPN started using the RouteMapper Desktop based software in 2004 to improve the management of a particularly busy section of the A13 motorway on the outskirts of Paris.



Exhibit 3: Screenshots of RouteMapper Desktop and Web Video Browsers

Following this initial deployment, SAPN wanted to make spatial video available on a more generalised basis across its full 368 km network. As the system was to be deployed to approximately 300 of the company's employees, minimising the need for user side software or data and ensuring a common set of data across the organisation were important criteria for SAPN.

Building on an existing image delivery platform, IBI Group and SAPN worked closely together to define the requirements for a web based version of the software (called RouteMapper Interactive). Using this system, SAPN staff have instantaneous access to video images of the full network, via a standard web browser interface.

The video is linked to both map position (Google / IGN mapping or internal SAPN CAD drawings) and to the chart node based Location Referencing System used by SAPN. The system also includes route navigation features to allow users to control the routes that the video sequence should follow (e.g., mainline vs slip roads). An annotations feature enables the system administrator to add comments against particular locations, which are then displayed alongside the video of that location.

As the system is web based, all staff have access to a common set of imagery and tools, facilitating communication within the company. Existing video can easily be updated or added to as new surveys are completed, with the involvement of the end user. The flexible nature of the back-end database can also accommodate existing spatial video files, a feature which enabled SAPN to reuse some previously collected video files as part of the project.

APPLICATION AREAS

SAPN is using the RouteMapper video in support of a variety of network operation, maintenance and development tasks.

Specific applications include:

- Planning of infrastructure
 - assessment of optimal location and deployment conditions for implementation of signage, ITS equipment, duct, lighting and other infrastructure
- Aid to network studies
 - audit of physical road layout (road markings, hard shoulder, lane merge characteristics)
 - audit of roadside equipment (signage, lighting, etc)
 - assessment of safety risks linked to geometry and infrastructure (visibility of signage, safety barriers, road curvature)
 - conducting virtual drive throughs to provide a driver's eye view of the roadway
- Maintenance and roadworks
 - planning of traffic management (precise location to begin / end lane closures)
 - facilitate communications between depot supervisor and staff on-site
 - planning and location of driver warning signs
 - planning of soft verge maintenance (vegetation and grass cutting)
- Events and crisis management
 - improved knowledge of context, constraints and access points for SAPN vehicle response units, emergency services and operations vehicles
- General aid to decision making through availability of common set of images across the organisation
- Public relations
 - extraction of images for use in promotional material, educational campaigns, and other publicity

BENEFITS

SAPN has realised important benefits through the use of the RouteMapper spatial video system in its operation and maintenance of the network. These include:

- Improved communication within the company and between staff in different offices and on-site
- Reduced site visits (time savings, independence from weather, safety benefits)
- Increased safety for maintenance works

- Reduced impact on traffic from maintenance activities (through ability to better plan works and traffic management)
- Efficiency gains through increased speed of decision making
- Improved quality of equipment placement and network management
- More effective response to events through increased knowledge of road geometry and infrastructure and ability to share information with other stakeholders

Recent results from an internal user survey confirmed that SAPN staff were making significant use of the system and highlighted a number of possible areas for improvements in functionality, which have been incorporated into a second iteration of the software.

CONCLUSION

SAPN has found an increasing number of applications for spatially encoded video technology in the operation and maintenance of its network and in the management of events and crisis situations.

Following an initial trial of the technology to improve management of a 25 km section of the A13 outside of Paris, the company is now using spatial video as a support tool across its full 368 km network. The roll out of a web-based version of the browser has allowed SAPN to make the spatial video available across the entire organisation, without the need for any client side software or data, ensuring a common set of images for all staff to use and significantly simplifying the task of data maintenance and management.

SAPN staff have found many applications for the system in terms of asset inventories and audit, motorway management, network performance and safety studies, infrastructure placement, works planning and public relations.

Following the success of the internal deployment, the company is now considering making the video available to its partner organisations (adjacent road network operators, emergency services, road maintenance companies and key suppliers), so that they too can benefit from access to the geo-referenced video library in their work to improve conditions for drivers on the SAPN network.