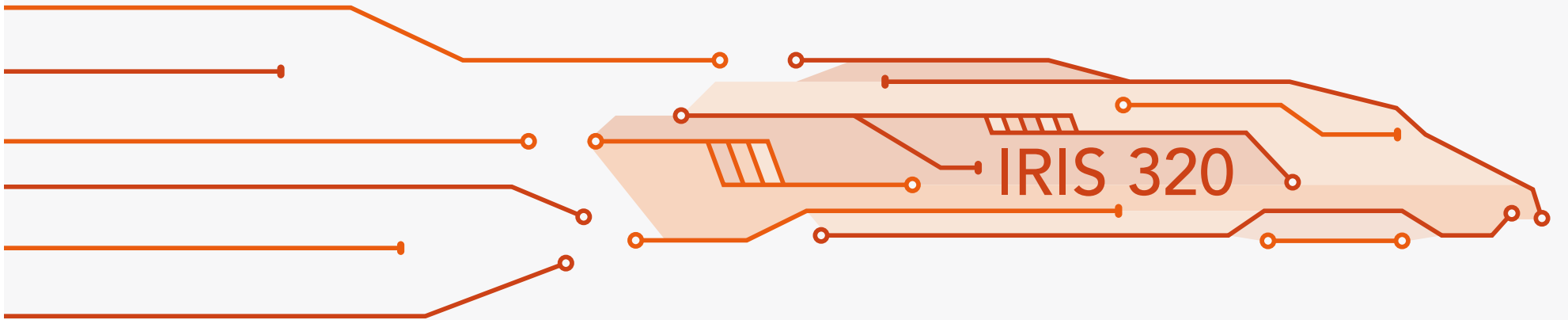
IRIS 320
AN ESSENTIAL RECORDING TRAIN FOR MAINTENANCE



AN AMBITIOUS TECHNOLOGICAL CHALLENGE

IRIS 320 is a reference laboratory trainset with an exceptional operating range implemented to monitor the high-speed rail network continiously. It is manned by SNCF engineers and technicians who can use it to perform inspections and measurements on both high-speed and conventional networks without impacting on commercial-service traffic.

All these measurements are processed in real time, allowing maintenance teams to flag up urgent remedial maintenance procedure without delay possible for the maintenance teams to flag up urgent remedial maintenance data without delay. The collected data are also analysed to develop preventive maintenance process.

IRIS 320 is a running laboratory with the potential for further development. Using it, SNCF Réseau can optimise its maintenance operations and costs, while enhancing safety, boosting punctuality and improving passenger comfort.

Creating a high tech train of this kind was a major technological challenge masterly managed by the SNCF teams.

IRIS 320 MID-LIFE UPGRADE

After 20 years of service, including 10 on high-speed lines, IRIS 320 was recently given a new lease of life courtesy of a mid-life upgrade that took 11 months to complete.

While IRIS 320 was out of service, a commercial-service TGV, codenamed “IRIS by TGV”, was equipped with monitoring systems to record all the signalling and track data needed by the maintainers to ensure safety and regularity on high-speed lines.

This replacement trainset will now serve as back-up in the event of unscheduled downtime of the newly revamped IRIS 320.

PERFORMANCE FIRST

INSPECTIONS AT 320 KM/H

This dedicated recording train can carry out inspections at high speeds, a technological feat in itself, and can be runned during daytime between commercial service high-speed trains, thereby providing free access slots to the track during night to be allocated to works and maintenance operations at night for allocation to works and maintenance operations.

With this arrangement, IRIS 320 can monitor more than 120,000 km of track per year.

320
km/h

ACCURATE AND CONCURRENT MEASUREMENTS

Track, signalling, overhead line and telecommunications parameters can all be measured concurrently. Combined with sophisticated positioning data, the result is a detailed and highly accurate overview of the state of the network.

Accurate and reliable measurements

BOOSTING MAINTENANCE EFFICIENCY

FASTER FEEDBACK

Real time data is obviously vital to rapid action in the event of emergencies.

Maintenance operators have full access to all data within 48 hours, a crucial advantage to enhance regular and preventive maintenance operations.

CONSTANT DEVELOPMENT

Since SNCF's own in-house engineers man and operate IRIS 320, they are in the best position to manage the various measuring systems, propose and introduce upgrades. Research is currently in hand to develop measuring systems to supplement those already in use.

KEY FIGURES
SNCF RÉSEAU

52 000
collaborators

4
technical specialities

4
HSL infrastructure maintenance operating Centres

30 000
km of line
(2,100 km of HSL)

FOR THE BENEFIT OF PASSENGERS

15 000
trains per day
(700 TGV high-speed trains per day)

5 million
passengers per day

MEASURING SYSTEMS

SCOPE AND VARIETY

IRIS 320 is equipped with a multiple sensors, cameras and lasers for ongoing network status analysis: accelerometers, inertial measurement units, high-speed imaging and line-scan cameras, effort sensors and surface pressure sensors, electric arc detecting system: the high-speed network is under close and constant supervision.

DATA ACCURACY

The position of all sensors along the trainset is precisely known, so that data recorded in real time can be precisely located to within less than five metres. This information is then further refined by the Test & Measurement Department of the Engineering & Projects Division during the batch processing operations carried out before transmission to the Infrastructure Centres.

75 sensors in action
2 roof-mounted monitoring domes
13 antennas (4G-GPS-GSM-R)
17 measuring systems

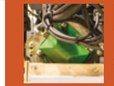
Measurements spatial resolution of 10 to 15cm
Redundancy of the localization systems to ensure a spatial accuracy equal to 5m

SENSORS, DETECTORS AND MEASUREMENTS

IRIS 320 is fitted with 15 different types of sensor for measuring the track, signalling, catenary, IT and positioning system data under supervision.
Much of this cutting-edge equipment has been specially developed for IRIS 320 and its deployment is under the responsibility of the Engineering & Projects Division.

- TRACK
- SIGNALLING
- CATENARY
- IT SYSTEM
- POSITIONING SYSTEM
- VIDEO

COMPLETE RANGE OF MEASURING INSTRUMENTS



ICC AND RT SENSORS (1)

SIGNAL REPEATER SENSOR (CRO)

ROOF DOME CAMERA & CAB

ELECTRIC ARC DETECTORS

IVV SENSORS (2)

GEOV2 BEAM (3)

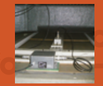
ABE SENSORS(4) & ENCODER

KVB ANTENNA(5)

TELECOM ANTENNA

ZT(4) SENSOR PANEL

ZT(6) TRANSMITTER LOOP



ZT(6) RECEIVER LOOP

IVOIRE BEAM (7)

MAGNELEC BEAM (8)

1. Short-circuit current intensity sensor (Signalling)
2. Vehicle Track Interaction (Track)
3. Track geometry (Track)
4. Axle-box accelerometers (Track)
5. Operating conditions of beacons used for speed control (Signalling)
6. System for monitoring the operating conditions of the electric capacitor (Signalling)
7. IVOIRE: rail running surface defect detector (Track)
8. Beacons used to fix regularly positioning data at 10 km intervals (Positioning)

TRACK SENSORS

GEOV2 beam is used to precisely measurement track geometry (vertical and lateral) under realistic load (transmitted by the rooling stock). The different parameters (track level and alignment, twist, gauge, cant) are processed in accordance with SNCF standards (short and long wave bases) to deliver real-time or batch processed Mauzin and European standard (EN13848-2) measurement data for ranges D1, D2 and D3. These measurements are correlated with axle box accelerometers adta, that could give a relevant assessment of vertical track geometry. These axle box accelerations can also be used to detect areas presenting a high density of rail surface defects.

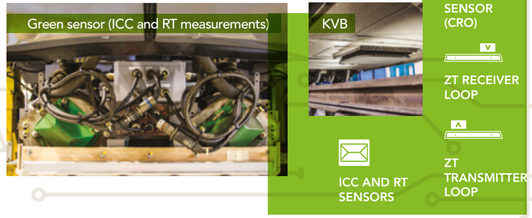
Vehicle-track interaction indicators (vertical and lateral vibrations transmitted to the train from the interaction force generated at the contact surface between wheel and rail) is measured by means of accelerometers mounted on the body of the train (on the floor) and the bogies at three different points along the trainset.

All track system data is analysed in real time so that any defects requiring urgent attention can be immediately reported to the maintenance operating teams.

SIGNALLING SENSORS

There are six measuring systems dedicated to the safety equipment monitoring and its main components.

- Track circuit electrical compliance (ICC).
- Intermittent signalling and information system compliance on conventional lines (beacons for speed control speed control [KVB] and repeater signals [CRO] and on high-speed lines [EPI loops]).
- Traction return current circuit compliance (RT) and electric capacitor operating conditions (ZT loop).



CATENARY & VIDEO CAMERA

The train is equipped with a video camera for filming the contact between pantograph and catenary and sending the images recorded to the Infrastructure maintenance operating Centres with the relevant positionning. This provides the Centres with more sophisticated overhead contact line status data and enables potential weaknesses to be better kept under control.

The electric arc measuring system identifies and analyses the arcs generated by pantograph-overhead line contact. By processing the light spectrum of the measured images, it is possible to distinguish between different types of arc and thereby identify those which can be a priori attributed to defects on the contact wire.

TELECOMMUNICATIONS AND GSM-R SENSORS

The "ROMES" and "GSM-R Exploitation" (Operation) test systems is used to measure rail system telecommunications coverage and quality for both railway telecom and private operator networks.

ROMES is used specifically for digital networks such as GSM-R, operator GSM, EDGE, UMTS (3G) and LTE (4G). Real-time data analysis is carried out using animated cartographies.

The system has a sampling rate of 7.5 cm at 320 km/h for coverage measurements and can also pinpoint sources of interference. ROMES is fully compliant with the transmission requirements of the European interoperable signalling system, ERTMS.

"GSM-R Exploitation" is partly automated and used to test the various functionalities available with the GSM-R network.

POSITIONING SENSORS

ENCODER

MAGNELEC BEAM

The positioning system's redundant architecture comprises:

- 2 sources for calculating the train's position in real time,
- 3 automatic position resetting systems,
- 4 axles fitted with incremental encoders to measure the running distance of the train.

The positioning system plays a vital role in indicating the precise location of each measurement. The system in use on IRIS 320 offers unique standards of performance, whatever the measuring system.

On IRIS 320 the train's movement is measured on four of its axles by means of encoders, which produce signals that, when processed, send a "beep" signal to all the measuring systems it each millimetre covered and transmit common distance increments.

IRIS

Position data is provided via two separate channels:

- **The network database in the form of Line-Track-Km marker coordinates:** changes in track are automatically activated from the route data in the system previously indicated by the operator.
- **The GPS database which automatically establishes position data by cross-referencing the Line-Track-Km marker coordinates:** No need for manual initialisation with this system, which locates the train's position via the GPS antenna fitted on the vehicle roof.

MANAGEMENT AND USE OF DATA

THE IT SYSTEM

The IT system designed and developed by the Test & Measurement Department of the Engineering & Projects Division centralises all the data obtained from the measurements performed on board of IRIS 320. Measurements are transmitted to the IT system via optical fibre network to ensure greater reliability and avoid electromagnetic interference. Some one hundred different measured parameters, representing a total of 5 to 6 gigabytes per day, are collected together by the system.

The next objective within this scope is to transmit data in real time, the aim is to transmit data in real time via a 4G network to speed up the process of analysing and exploiting the various measurements.

DATA PROCESSING

Immediate Post processing
The operators on the train can receive, analyse and immediately transmit urgent data indicating some critical zones that could require speed restrictions.

48-hour delivery
All other data are transmitted within 48 hours after being processed and approved. This process enables any defects detected to be confirmed and their position more accurately determined. This information is then suitably formatted to give the maintenance operating teams a highly reliable input.

IT system

The data processing software used on the train and for batch processing operations has been developed in house by the Engineering & Projects Division, it offers a number of advantages:

- full control of real-time and batch processing operations,
- best possible response to maintainers' needs,
- software adaptability to new processing requirements or new developments,
- complete compatibility between in-field and train equipment, a prerequisite for efficiency,
- ability to add and adapt user tools for real-time acquisition and post-processing,
- simulation system capacity.