

DOF1 System

DEVICE TO OPEN AND CLOSE THE PLATFORM DOORS ON LINE 1

Client: RATP

Equipment:

- Line 1 of the Parisian subway
- 26 equipped stations
- 52 equipped trains

Standards : 61508, EN50126, EN50128, EN50129

Safety level: SIL3 on the inopportune opening failure of the doors



In the context of the "Paris Subway Line 1 Automation" project, the SIL3 DOF1 safety system, which is independent from the automatic train system, will command the opening and closing of the landing doors installed on all the line's platforms. This system will be used with existing trains MP89 and will be compatible with the new automatic trains MP05 that will progressively replace the current ones. DOF1 also prevents the train doors on the opposite side of the platform from opening.

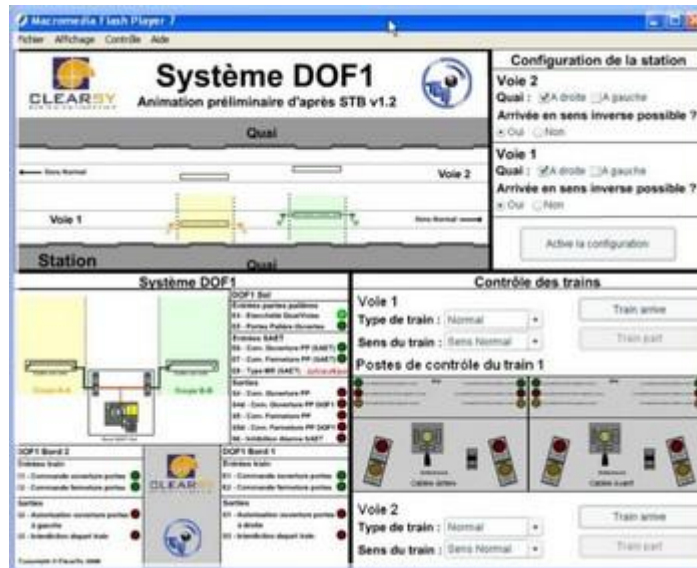
DOF1 will then be disassembled when all the automatic trains are in operation on Line 1. Then the trains MP89 will be operate on the line 4 and DOF1 will installed on this line to enabled the correct side door, and in the future control platform screen doors.

The DOF1 system includes an embedded portion on the train that processes the train door opening and closing commands made by the conductor and sends the command to the portion located in the platform's technical office. The command to open the door is processed and sent to the landing doors.

The train/ground link is effected via a mat installed on the rails, which creates a magnetic loop with a sensor installed on the train's bogie.

This system is SIL3 level safe to enable the correct side door of the train. The platform screen doors can only be opened when the train has reached the platform with a SIL3 safety level. The solution is based on Siemens SIL3 automatons.

Clearsy is the Project Manager and responsible for the study and manufacturing of equipment series to be installed throughout the line. It is working in partnership with TLTI, more specifically responsible for the production of equipment, mechanical and electronic parts.



Capture of graphic animation carried out with Brama

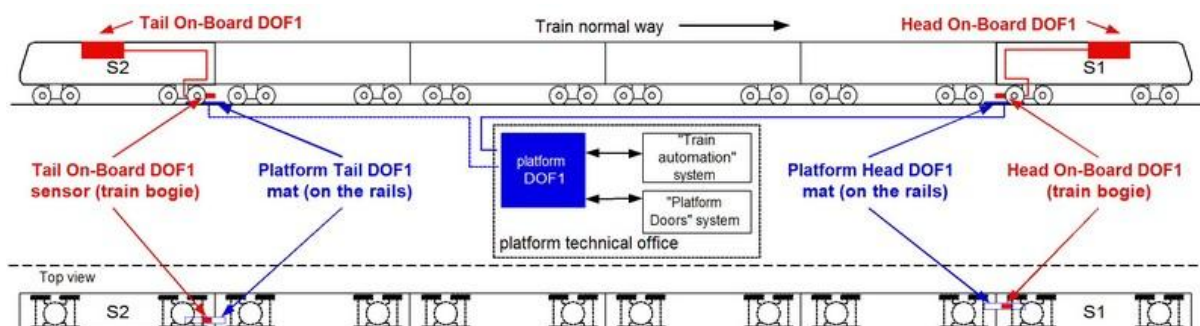
Clearsy adopted an original method to submit to the call to tender: a B model of the specifications was performed with the Composys tool, then graphically animated with the Brama tool. We were therefore able to define the needs of the RATP by transcribing our understanding of the system into a model and then validating this understanding by animating the system in various scenarios viewed on the screen. Questions could therefore be asked and a detailed response provided, as the system must be designed in only six months.



Like the Copilot system, Clearsy uses a development process that integrates the B method, from the system specifications up to the code stage. The B models developed participate in demonstrating the system's safety and the level of availability of the system that must be very high in order to ensure fluid traffic.

The animation system is available on Brama's site: www.brama.fr

Details of the various constituents of the DOF1 system



The diagram above portrays the installation of the Dof1 system. It comprises 2 parts:

- The first is installed in a technical zone close to the platform and is equipped with landing doors. It is called **“DOF1 Sol et Antenne Dof1 Sol” (Ground Dof1 and Ground Dof1 Loop antenna)**.
- The second part is installed at the front and the rear of the train interior. This second part is called **“DOF1 Bord et Antenne Dof1 Bord” (Onboard DOF1 and Onboard Dof1 Loop antenna)**.

Communication between the train and the ground is made using a magnetic loop connection, provided by an Loop antenna comprising two pieces of equipment referred to in the plan as Onboard Dof1 Loop antenna and Ground Dof1 Loop antenna.

Communication between the Ground Dof1 (at the platform) and the Dof1 onboard the train is only possible when the “Onboard Loop antenna” equipment is aligned above the “Ground Loop antenna” equipment, that’s to say when the train is correctly positioned in the station.

The use of a magnetic loop guarantees that there is no interference with communications between the ground and a train which isn’t alongside the platform.

The side and ground systems communicate with each other by using a secure series protocol. The side and ground modems modulate and demodulate the digital signal in a current loop.

In this way, the DOF1 system comprises:

- A Ground DOF1 cabinet placed in a technical zone on each platform. It receives the opening and closing instructions emitted by the conductor and transmits them to the side of the platform. These instructions can also be received from the SAET (an automatic system, which is active when trains are on automatic pilot), and can be transmitted to the sides as well.



Automatons situated in the Ground DOF1 cabinet.

- “Ground DOF1 loop antenna” equipment situated on the track on the ground at the beginning of the platform (at the front of the train when it is stopped at a station) to ensure doors open to the right. This equipment is aligned above the “Onboard DOF1 loop antenna” ground equipment when the train is correctly positioned in the station; that is to say within around 1 metre of the targeted theoretical stoppage point. The “Ground DOF1 loop antenna” equipment comes in the form of a belt, the dimension of which takes into account the desired stoppage zone of around two metres.



General view of 2 wagons and their bogies



Onboard DOF1 loop antenna prototype fixed onto the bogie

- Two “Onboard DOF1 loop antenna” equipment parts at the front and rear of the train situated on the train’s bogies. These are connected to the Onboard DOF1 and ensure communication with the ground equipment.



Example of the track Belt

- Two Onboard DOF1 situated inside the train, which enable the conductor's instructions to be relayed as well as the reception of data from the Ground DOF1, thus ensuring the coherence of the safety instructions.

The Onboard DOF1 loop antenna must be installed at the rear and the front of the train, which is operational in both directions (a train at the end of the line goes back in the opposite direction, the rear of the train becoming the front and the conductor changing cab). For 'standard' stations equipped with two platforms and for which the opening of the train doors is performed to the right, a single Ground DOF1 Loop antenna is installed at the front of the platform. Two loop antenna are needed for stations where both the opening of the doors and the platform are situated on the left hand side.