

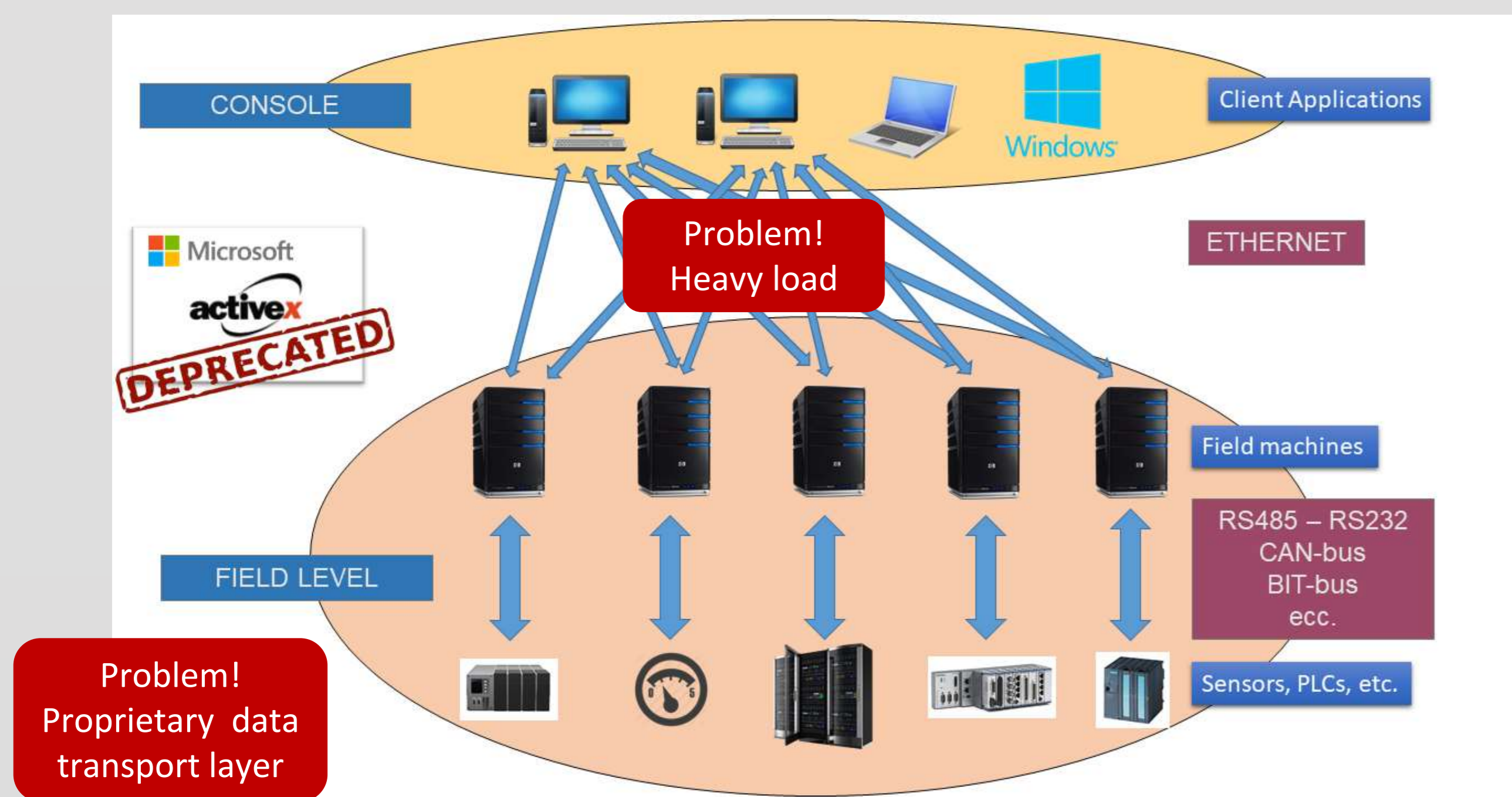
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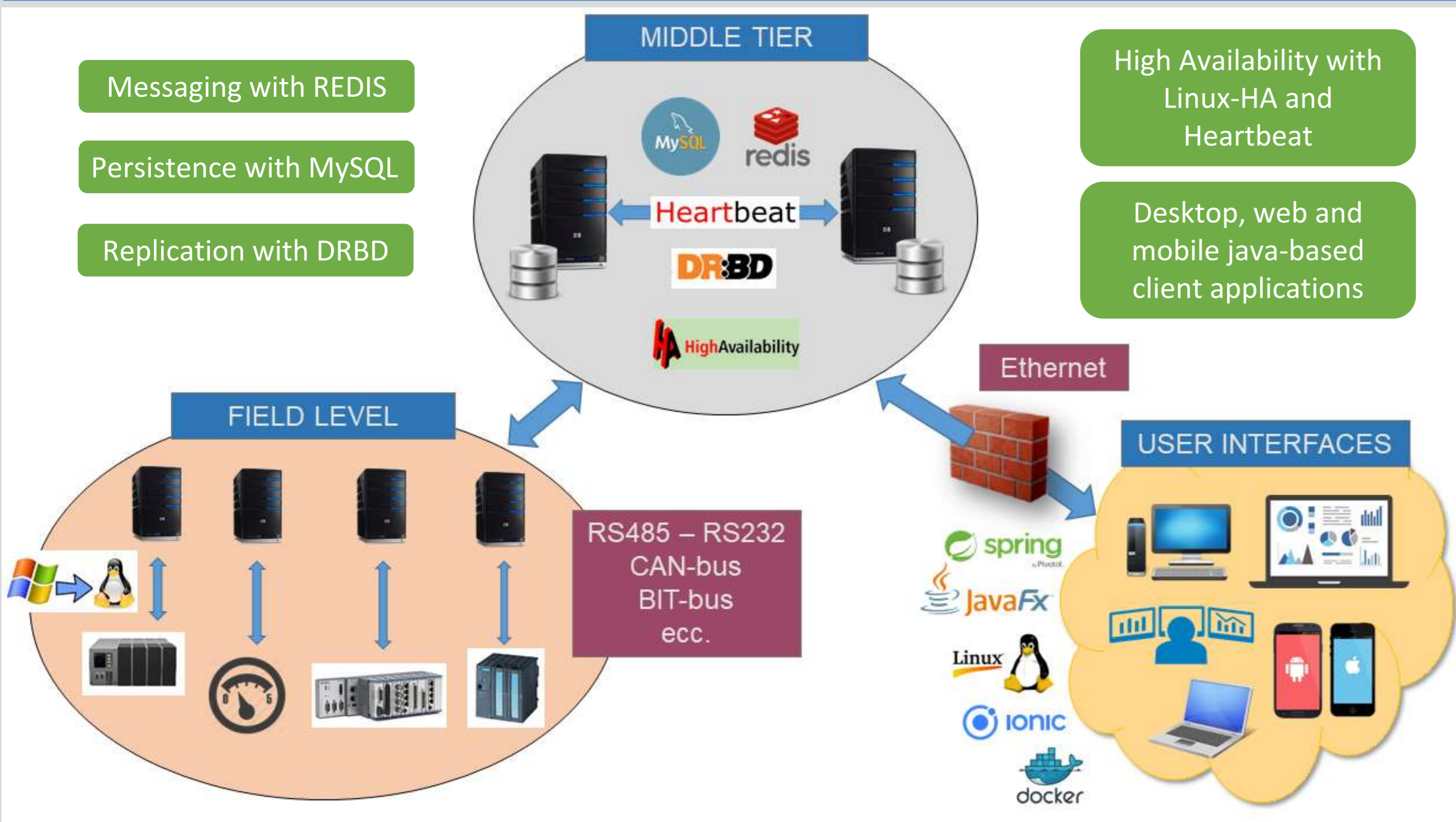
Abstract

Interactive Graphics User Interfaces (GUI) and a new message exchange protocol are parts of the modern Control System designed and developed to control and monitor the accelerators and beamlines at **Istituto Nazionale di Fisica Nucleare - Laboratori Nazionali del Sud (INFN LNS)**. We used the most innovative open source frameworks and architectures to build several kinds of applications: a web-based application, an interactive synoptic panel and a mobile app. The new protocol for the message exchange between the field devices and the control user interfaces uses the in-memory data structure store **Redis** as a message broker. Several outline tools allow the calculation of the beam intensity and the automatic acquisition of the beam contour for future beam replication. Moreover, a relational database is used to store all the machine and beamlines parameters every day for each experiment.

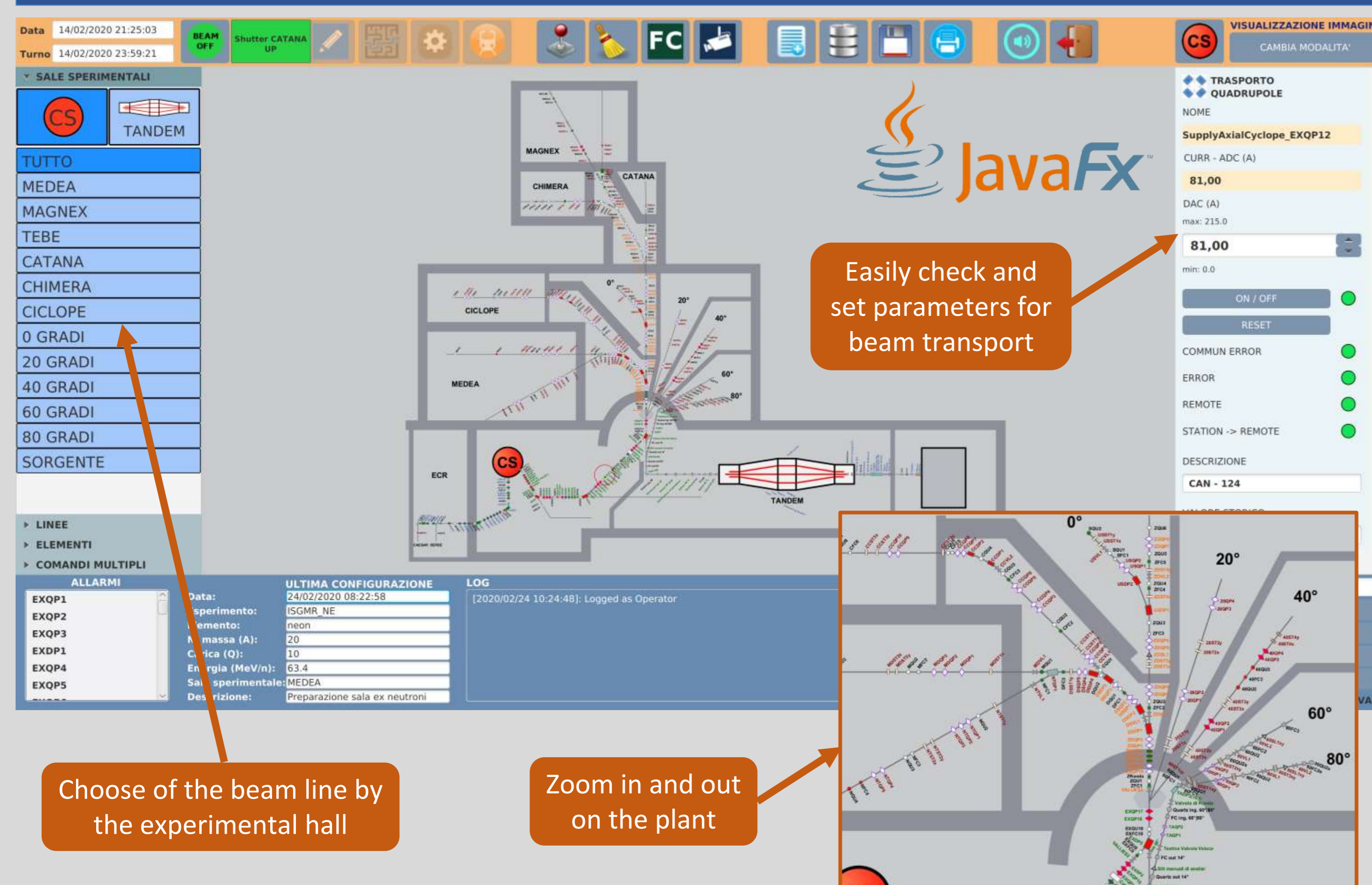
Previous System Architecture



New System Architecture

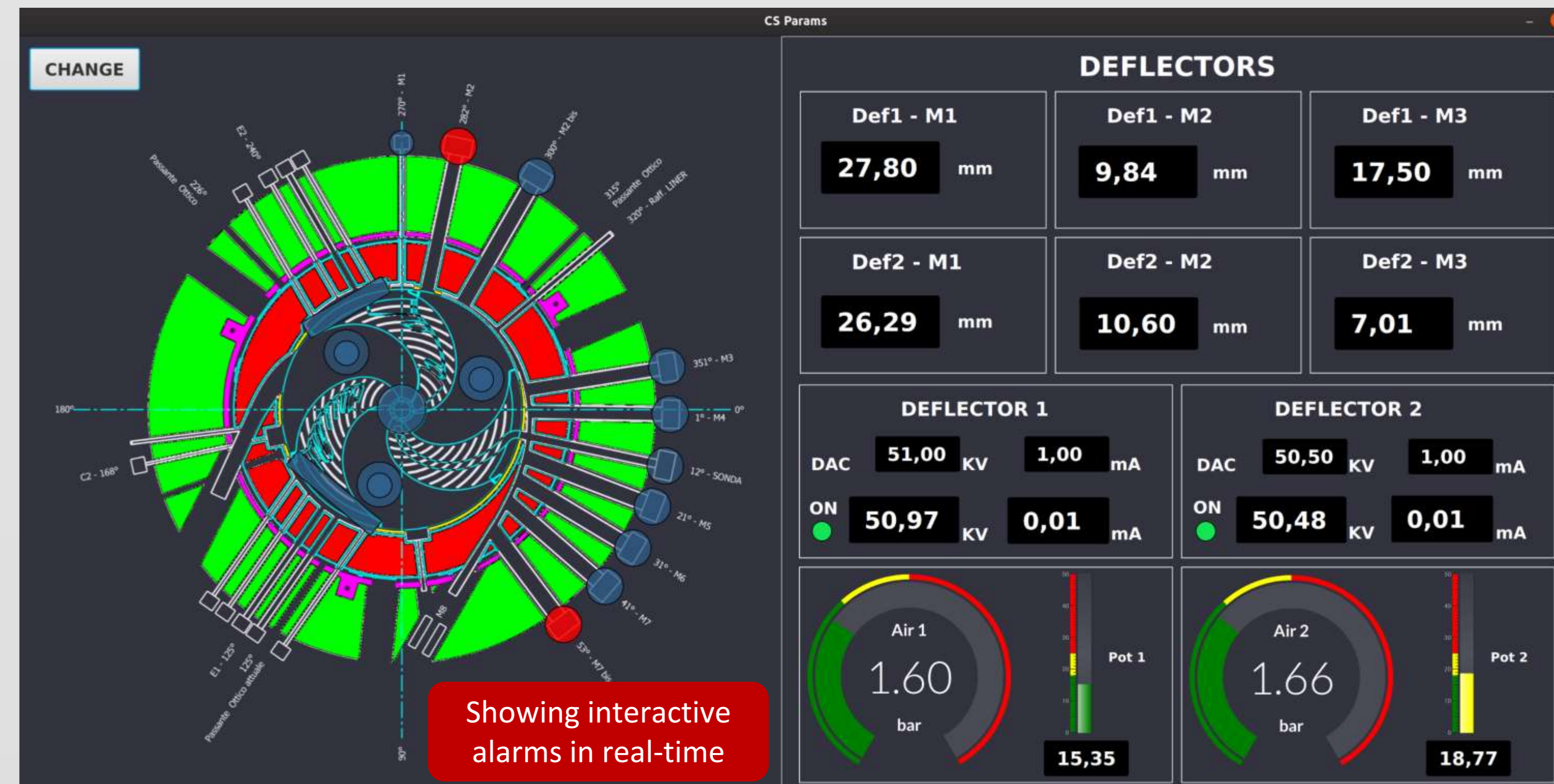


New Interactive Synoptic Interface for Beam Transport



The screenshot shows a JavaFX interface for 'SALE SPERIMENTALI' and 'TANDEM'. It features a detailed beamline diagram with various components like 'MAGNEX', 'CHIMERA', 'CICLOPE', and 'SORGENTE'. A red box highlights 'Easily check and set parameters for beam transport'. Other elements include 'Choose of the beam line by the experimental hall' and 'Zoom in and out on the plant'.

New Accelerator Synoptic Interface



The screenshot shows a circular beamline diagram with a red box indicating 'Showing interactive alarms in real-time'. To the right, there are panels for 'DEFLECTORS' with parameters like 'Def1 - M1: 27,80 mm', 'Def1 - M2: 9,84 mm', 'Def1 - M3: 17,50 mm', and 'Def2 - M1: 26,29 mm', 'Def2 - M2: 10,60 mm', 'Def2 - M3: 7,01 mm'. There are also 'DEFLECTOR 1' and 'DEFLECTOR 2' panels with DAC and ON values, and pressure gauges for 'Air 1: 1.60 bar' and 'Air 2: 1.66 bar'.

Digital Beam Image Processing



The diagram shows a 'LOAD from DB' step leading to a 'Beam contour replication' step. It highlights 'Measure of Centroid, XY standard deviation, etc.' and 'Use of OpenCV libraries'. A 'STORE image, contour and information inside the DB' step is also shown. The final image shows 'Center of Mass X: 280', 'Image resolution: 768x576', 'Center of Mass Y: 298', 'Sigma X: 23', and 'Sigma Y: 50'.

Mobile App with Alarms Notifications



Conclusions

A new software architecture has been developed to optimize and speeding up the tuning procedures of all the elements involved in the beam acceleration. Moreover, the beam quality and the preparation time have greatly improved.

As compared to the previous system the new one shows a considerable optimization of resources, it is more reliable and shows much better performance.

The beam contour image recognition allows to perform a beam shape analysis, hence improving the quality of the beam transport.

The time spent for beam preparation and transport has been significantly reduced approximately by the **50%** and all the applications are flexible, modular, scalable and compatible with other products.

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