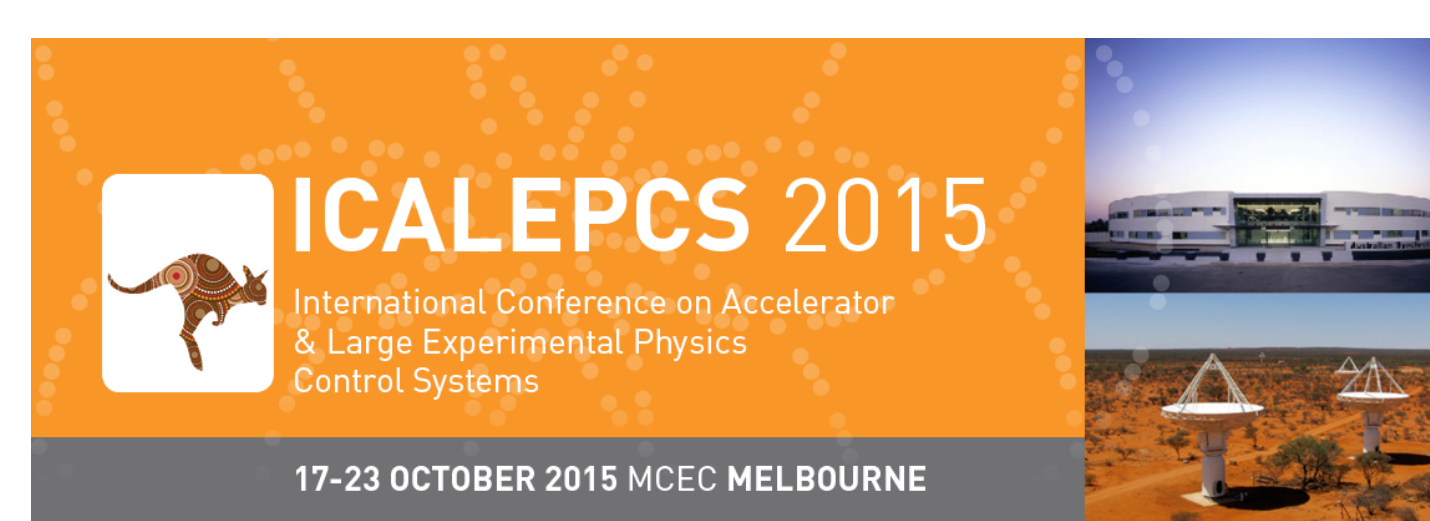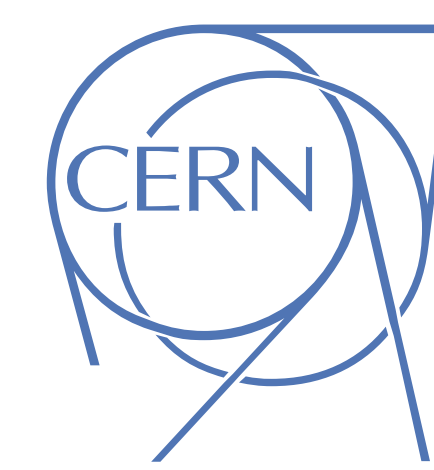# SCALABLE WEB BROADCASTING
FOR HISTORICAL INDUSTRIAL CONTROL DATA

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Abstract

With the widespread adoption of asynchronous web communication, thanks to WebSockets and WebRTC, it has now become possible to distribute industrial controls data (such as coming from devices or SCADA software) in a scalable and event-based manner to a large number of web clients in the form of rich, interactive visualizations. There is yet, however, no simple, secure and performant way to query large amounts of aggregated historical data.

This paper presents an implementation of such an architecture, which is able to make massive quantities of pre-indexed historical data stored in ElasticSea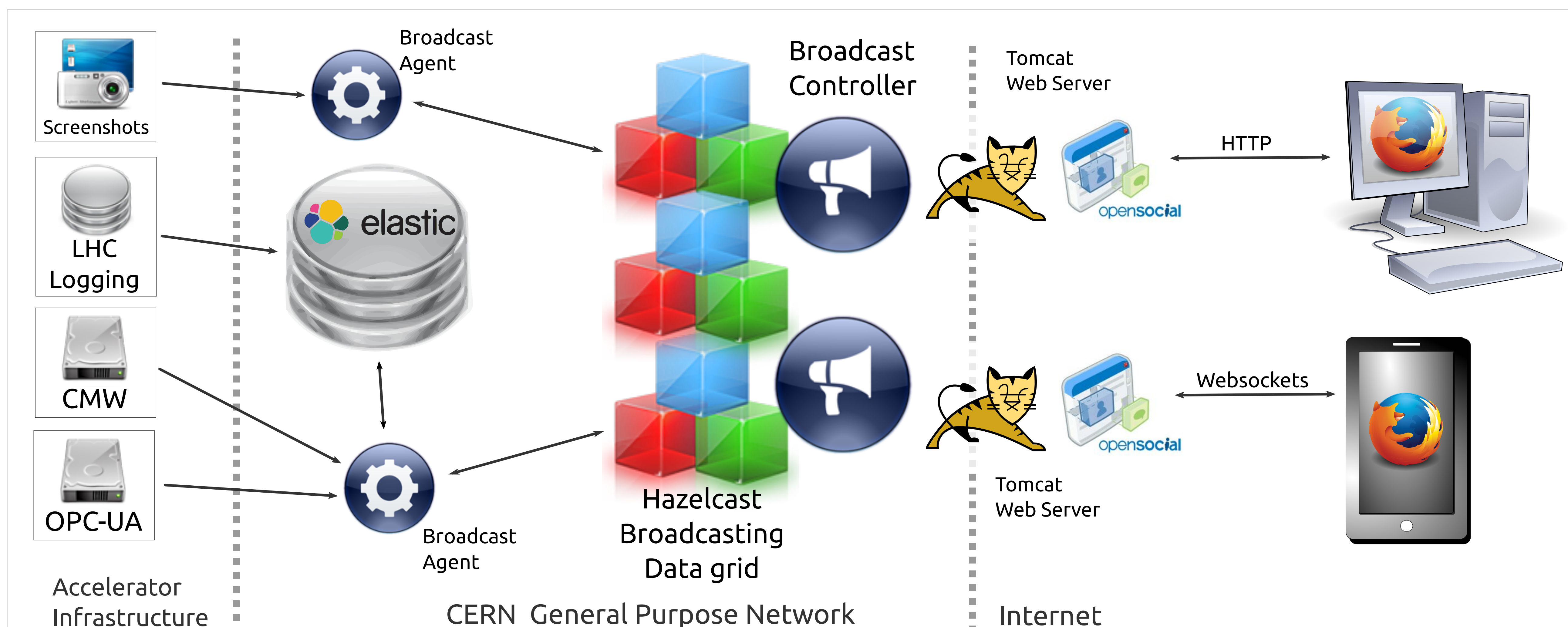rch available to a large number of web-based consumers through asynchronous web protocols. It also presents a simple, Opensocial-based dashboard architecture that allows users to configure and organize rich data visualizations (based on Highcharts Javascript libraries) and create navigation flows in a responsive, mobile- friendly user interface.

Such techniques are used at CERN to display interactive reports about the status of the LHC infrastructure (e.g., Vacuum and Cryogenics installations) and give access to fine-grained historical data (such as stored in the LHC Logging database) in a matter of seconds.

Objective

Provide on-demand instant access to historical LHC infrastructure data through appealing, interactive and reusable visualizations.

Architecture

Screenshots — LHC Logging — CMW — OPC-UA

Broadcast Agent

elastic

Broadcast Agent

Accelerator Infrastructure

Broadcast Controller

Hazelcast Broadcasting Data grid

CERN General Purpose Network

Tomcat Web Server — opensocial

Tomcat Web Server — opensocial

HTTP

Websockets

Internet

Web Visualizations

The CERN Engineering Dashboard relies on two major web visualizations technologies:

HIGHCHARTS

Highcharts is an open-source Javascript library that offers thirteen different chart types (line charts, pie charts, gauges, polar charts etc..) , flexible advanced formatting, a complete event API and incremental data loading. Its code high quality and excellent performances offer an ideal way to create reusable data visualizations for the LHC Dashboard. Combined with ElasticSearch, it gives dashboard users instant access to a month of data history aggregated on the fly.

D3 Data-Driven Documents
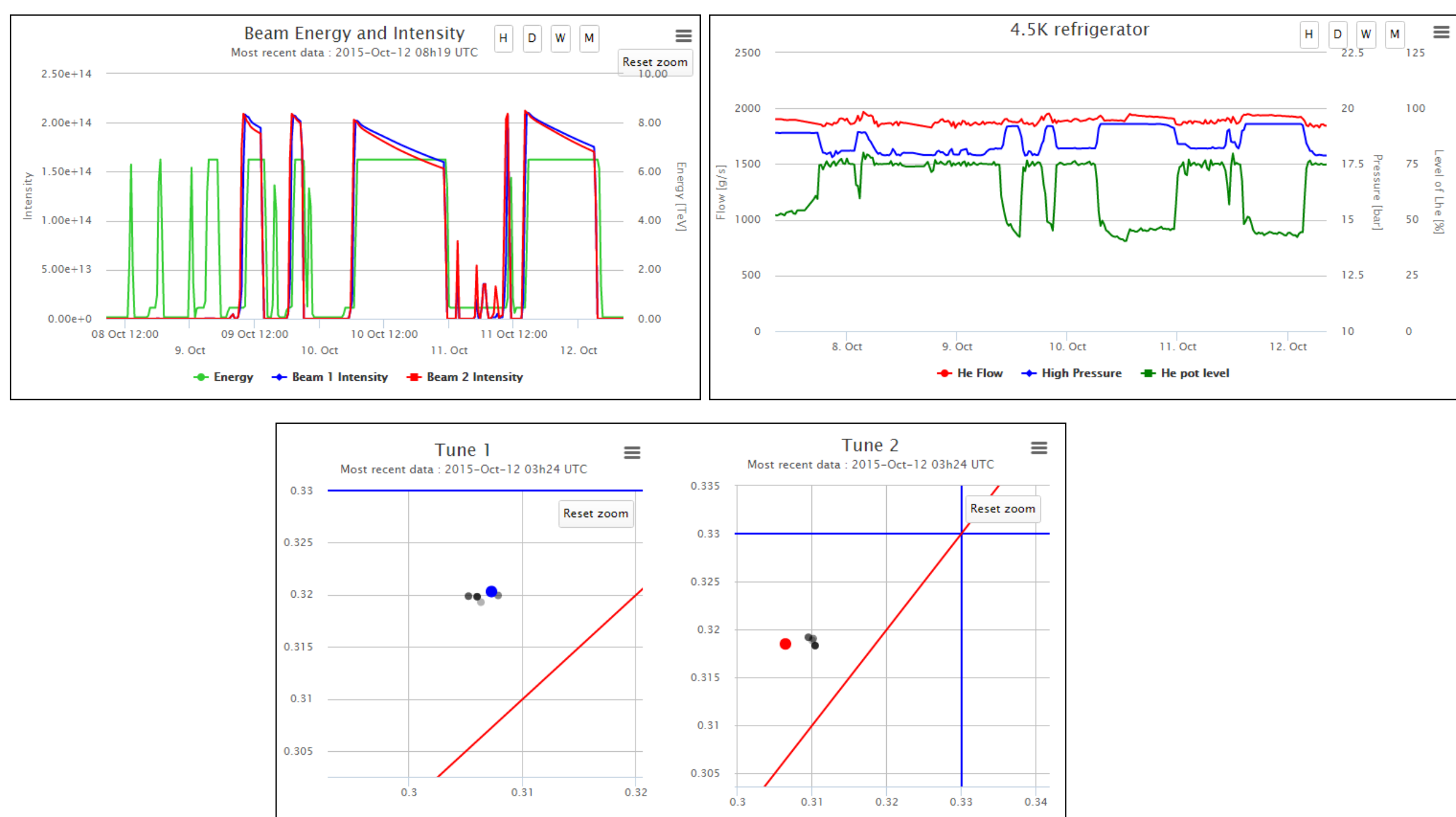
D3.js is an open-source Javascript library that allows to bind data to visual elements and animations. It features a rich toolbox of transformation effects, tweening algorithms, interactive event handlers and layout routines that greatly simplify the creation of custom visualizations. In the case of the LHC Cryogenics field, we can easily display the live status of the installations in a format that is familiar to all LHC users and operators.
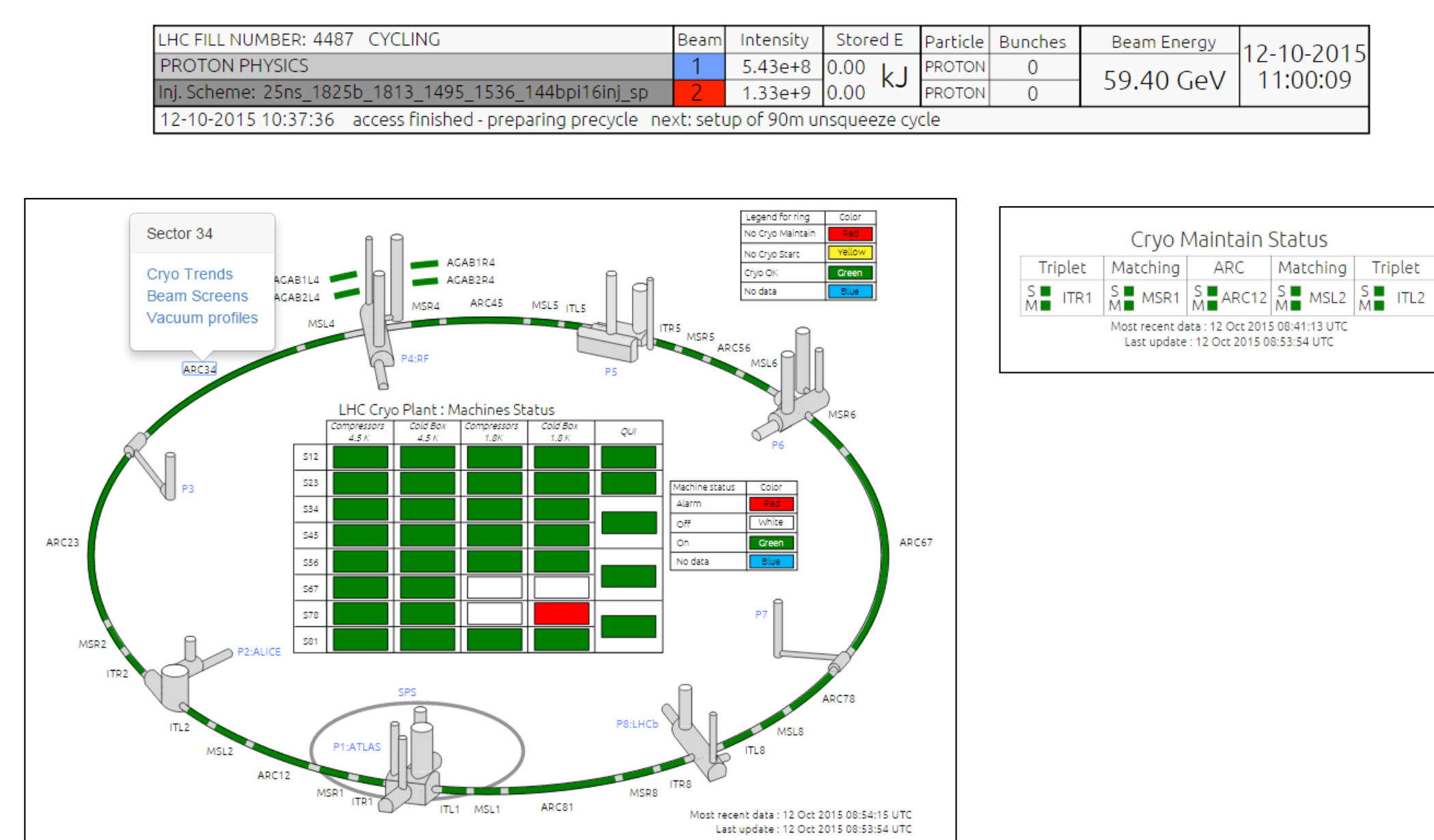
Conclusions

Advances made in the past few years in the matters of Java clustered data storage and in-memory data grid technologies have made affordable the deployment of large and scalable data distribution media, such as the one used by the CERN Engineering Dashboard.
The emergence of a new web standard entitled "Web Components" is, however, poised to revitalize web content reuse and offer a widely accepted method of implementing content sharing.

Already supported on all major web browsers, Web Components offer the right balance of the ease of usage and implementation of strict content separation versus code security practices.
The CERN Engineering Dashboard is certainly bound to explore the capacities of this social technology, as a means of overcoming the artificial boundaries imposed by software vendors in the free exchange of data and interactive data visualization gadgets.

EN Engineering Department