# THE LHC POST MORTEM ANALYSIS FRAMEWORK

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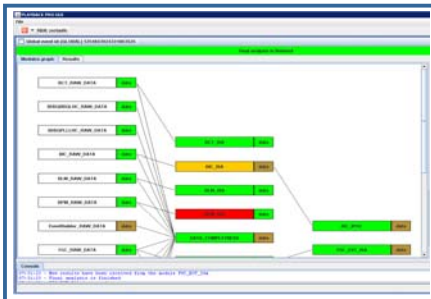
***Abstract***

*The LHC with its unprecedented complexity and criticality of beam operation will need thorough analysis of data taken from systems such as power converters, interlocks and beam instrumentation during events like magnet quenches and beam loss. The causes of beam aborts or in the worst case equipment damage have to be revealed to improve operational procedures and protection systems. The correct functioning of the protection systems with their required redundancy has to be verified after each event. Post mortem analysis software for the control room has been prepared with automated analysis packages in view of the large number of systems and data volume. The chosen implementation has been a multi-level analysis framework, allowing for automated analysis and qualification of a beam dump events based on expert provided analysis modules.*

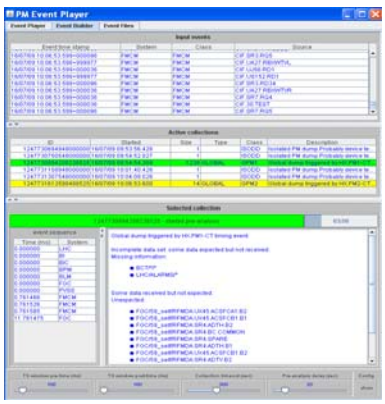
***GUI and Analysis Modules***

*Numerous analysis modules for magnet powering, beam losses and orbit, machine protection, etc.. have been implemented for commissioning and later operation (using different programming languages) and were integrated into the Analysis Framework.*



***PMA Scheduler***

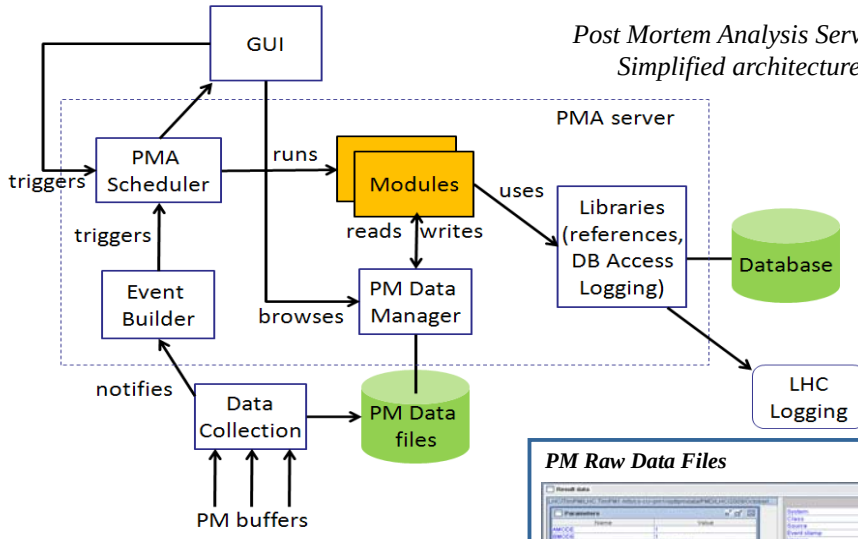
*Based on event type, a predefined configuration of analysis will be scheduled for execution. Status and dependencies of analysis modules will be monitored throughout the analysis session and according bookkeeping of errors is provided.*



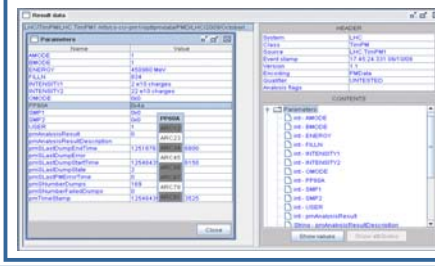
***Event Building***

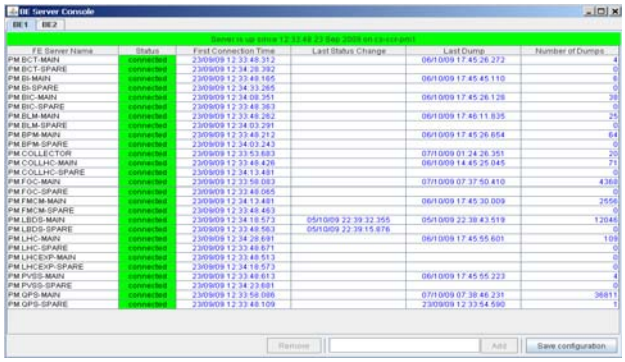
*Based on pattern recognition in the incoming PM data stream.* Multiple event builders might run in parallel and provide event details to framework for detailed analysis.

*Post Mortem Analysis Server – Simplified architecture*




***PM Raw Data Files***





***Post Mortem Data Collection***

*Relies on redundant hardware infrastructure with main and spare collection servers for each client system.*

*Diagnostic and Monitoring tools supervise the functioning of the system and assure coherency of the redundant data storage.*

***Conclusions***

*Parts of the LHC Post Mortem System have been extensively exercised during the Hardware Commissioning period of the LHC and valuable experience with equipment systems for magnet powering and the analysis of related data could be gathered. The territory of beam related data is however rather unexplored, and initial operation of the LHC machine will be an important period for the PM system to further tune analysis modules and progress in the understanding of possible correlated failures and their identification. After the initial validation of the system it will become a more and more important challenge to provide tools to compare the results of different beam dump events against each other. The main goal will be the identification of similar fault scenarios and to establish a knowledge database of possible failure scenarios and their detection based on the provided Post Mortem data.*