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The LSA Database to Drive the Accelerator Settings

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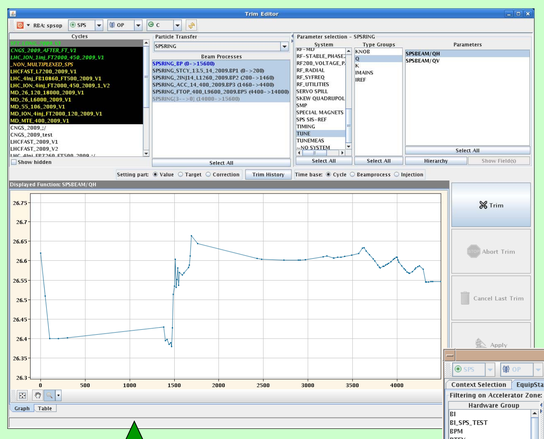
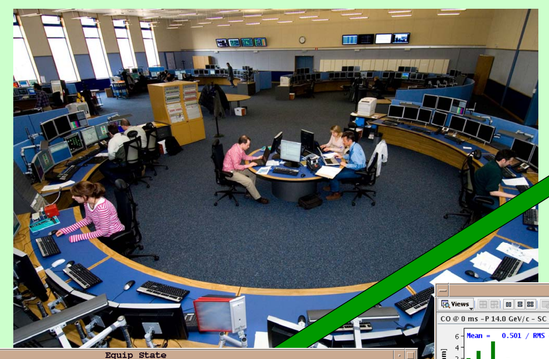
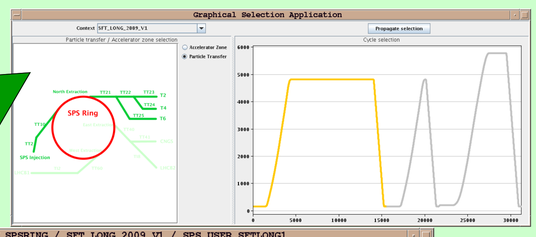
Abstract

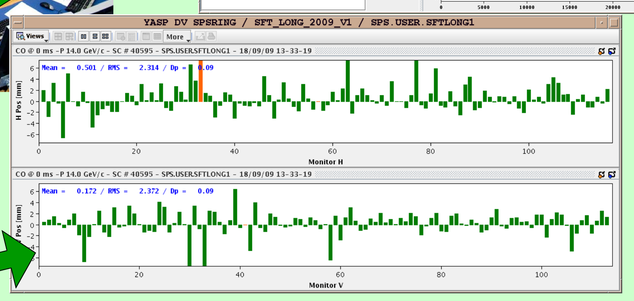
The LHC-era Software Architecture (LSA) used to operate the particle accelerators at CERN is dependent on an on-line database to manage both high and low level parameter settings, including their evolution over time. Accelerator optics models, control sequences, reference values, are amongst the other entities being managed within the database. The LSA database can be considered as being located between the operators and the accelerators; therefore performance, availability, and security of the service as well as data integrity are paramount. To meet these requirements the LSA database model has been carefully developed, all database access is tightly controlled and instrumented, business logic is implemented within the database, and there is a semi-automatic integration with other key accelerator databases. Currently 8.6 million settings for some 40 thousand devices of the LEIR, SPS, and LHC accelerators are being effectively managed.

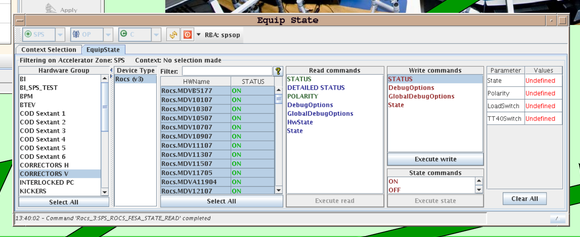
Control Room Applications



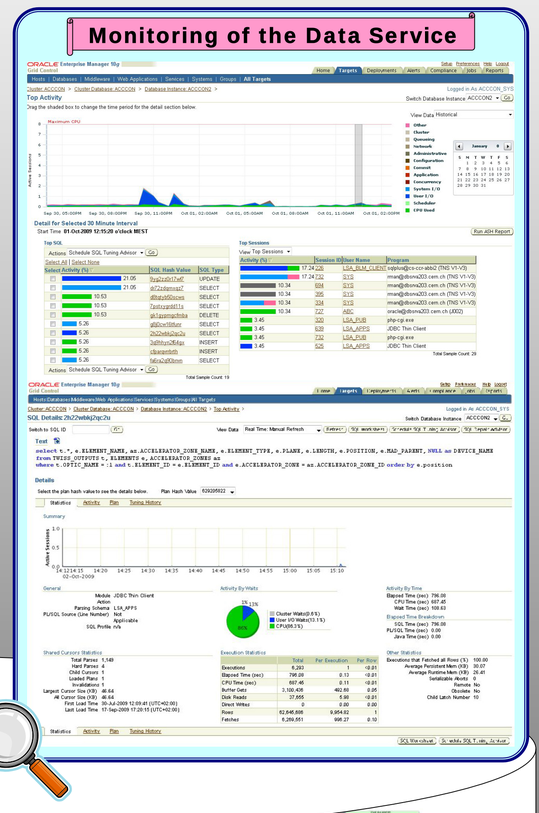




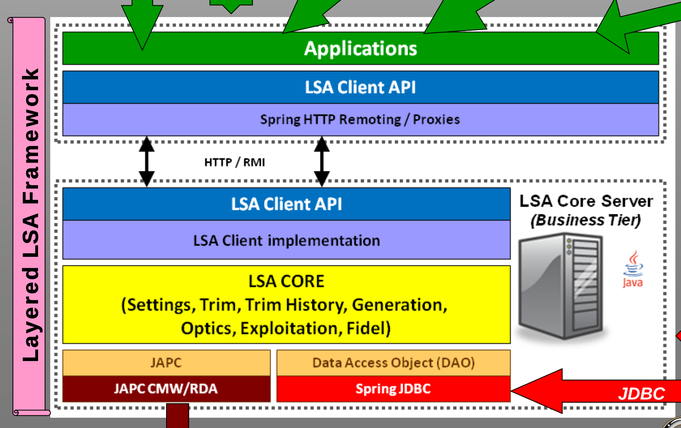




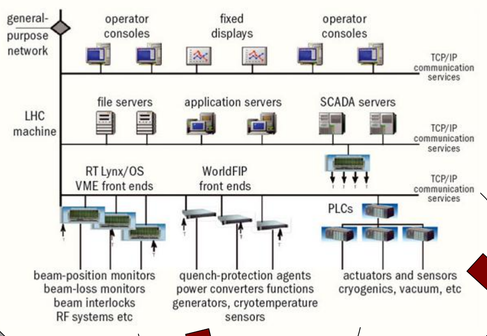
Monitoring of the Data Service



Layered LSA Framework



Control System Infrastructure



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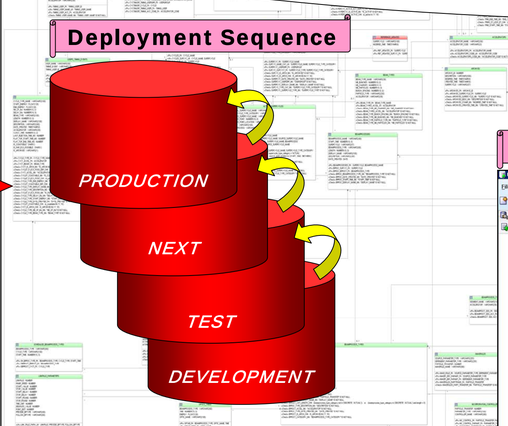
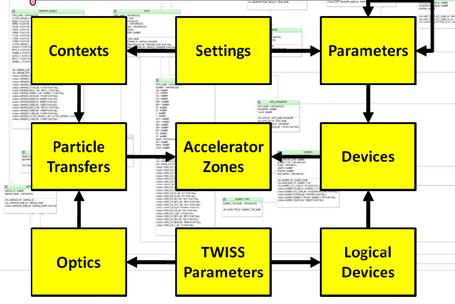
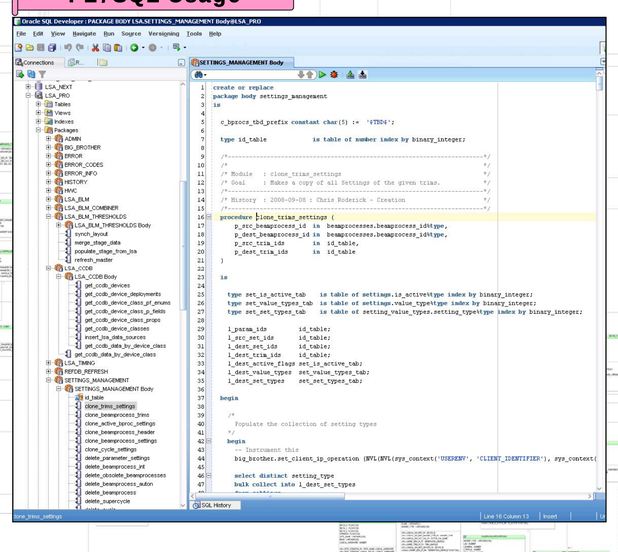
Deployment Sequence



Abstracted Data Model



PL/SQL Usage



Database in Numbers

Objects	
Object Type	Count
Tables	279
Indexes	553
Types	4
Sequences	38
Views	85
Materialized Views	2
Functions	6
Procedures	8
Triggers	81
Packages	15

Constraints	
Constraint Type	Count
Unique	343
Referential	299
Value Check	750
Total:	1'392

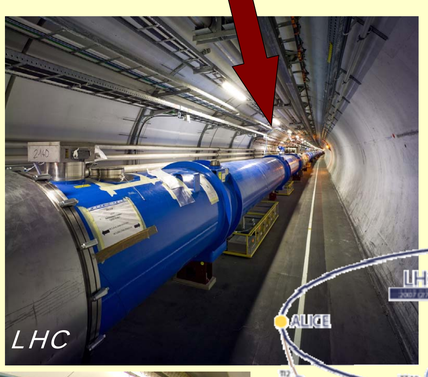
PL/SQL	
Source Type	Lines
Functions	161
Procedures	523
Triggers	1'814
Packages	828
Package Bodies	5'700
Total:	9'026

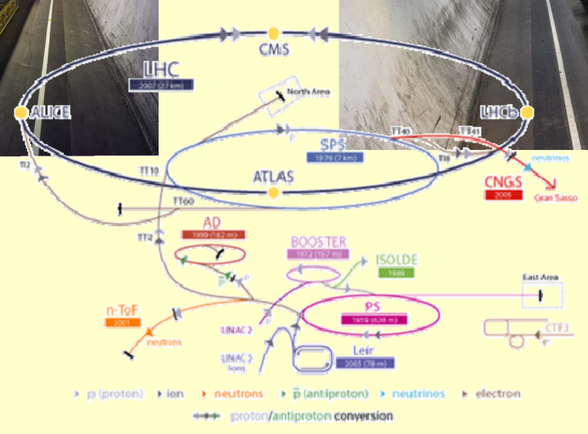
Records in Key Tables	
Table	Records
Contexts	2'316
Setting Headers	8'608'880
Setting Values	449'905'084
Parameters	67'250
Devices	41'951
Particle Transfers	23
Twiss Parameters	1'849'513

ORACLE RAC Cluster

LSA – LHC Software Architecture – Database

CERN Accelerator Complex



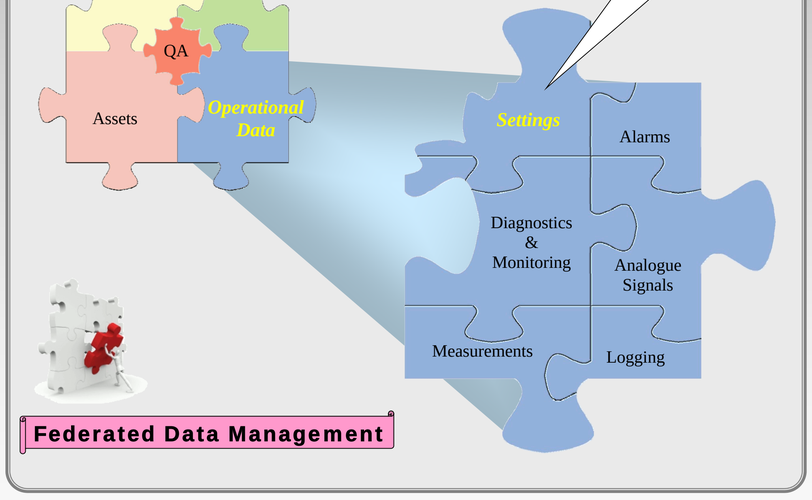


A bit of history:

The Oracle® database management system was already used for LEP at the end of the 1980-ies.

Only during the last years of LEP operation, databases were used in an *on-line* mode.

The ultimate efficiency, with which LEP could be operated, was in large part due to the integration of a well designed control system using a commercial database.



Conclusion

The LSA database is an example of a relational database used to effectively manage a vast and complex dataset for high-level accelerator control. The on-line usage does not hinder the real-time requirements of accelerator operations. The exact match between the actual accelerator settings and the image in the database model is guaranteed. The powers of the DBMS have been acknowledged and utilized to the full potential to form a core component of the LHC-era control system.

References

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[4] R. Billen et al., "Accelerator Data Foundation: How It All Fits Together", ICALEPCS'09, TUB001
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