Database Archiving System for Supervision Systems at CERN: a Successful Upgrade Story

**Motivation**

**WinCC OA File Archiver:**
- Used by 200 WinCC OA systems for LHC and technical infrastructure
- Stable, proven technology
- Performance scalability issues
- Complicated maintenance on many SCADA nodes

**WinCC OA Oracle RDB Archiver:**
- Already used in a few hundred controls systems at CERN
- Proven scalability and performance for large systems
- Centralized architecture eases management and handling of the SCADA nodes, provides better tools, and enables data analytics

New requirement for the 13 TeV run of the LHC: the magnet protection system (QPS) needs data archived at a rate of 200,000 values/s

**Archiving architecture prior to re-design**
- Several WinCC OA Value Archive managers write historical data to local disk files
- Custom WinCCOA LoggingManager programs query data, transform to XML and send to a dedicated data loader application of the LoggingDB service
- The architecture would not scale to meet the new requirements for LHC Run II

**Archiving architecture after re-design**
- Single high-performance RDB Archive Manager writes data to central Oracle DB
- Data requiring long-term storage is transferred over a DBLink to the LoggingDB
- Standard database transfer job mechanism, used by other LoggingDB clients, serves all applications and provides diagnostic and statistical information
- Data stored in the LoggingDB can be made available in WinCC OA transparently

**Index organized tables**
- Key ingredient for optimization of readout path
- Access by index identified as the primary data-access pattern (transfers, trend plots)
- Query performance increased by a large factor
- Storage-space consumption reduced up to 50%

**Row size reduction**
- I/O bottleneck in the database due to Oracle’s REDU log size (data-recovery stream)
- Option to eliminate redundant/unnecessary data

**Time based partitioning**
- Growing IOT leads to degraded query performance
- Time-based partitioning (partition pruning)
- Queries on views with pushed-predicate hints
- Data retention policy (3 months in daily partitions)
- Automated partition-manager jobs for 200 schemas

**Data recovery performance test**
- Simulate a database-outage scenario in a set-up mimicking the LHC magnet protection system (QPS)
- Data buffered by RDB Archivers during DB outage
- Buffers inserted at maximal rate once DB becomes available
- Even in degraded mode (1 DB node) complete recovery in acceptable time.

**Migration**
- A challenging task, not only from a technical standpoint, but also from a coordination point of view.

**Conclusion**
- Migration completed in time for Run II of the LHC
- Single consistent archiving technology CERN-wide
- Satisfactory performance and reliability
- Optimisations available to all WinCC OA users