Applying Service-Oriented Architecture to Archiving **Data in Control and Monitoring Systems**

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Overview

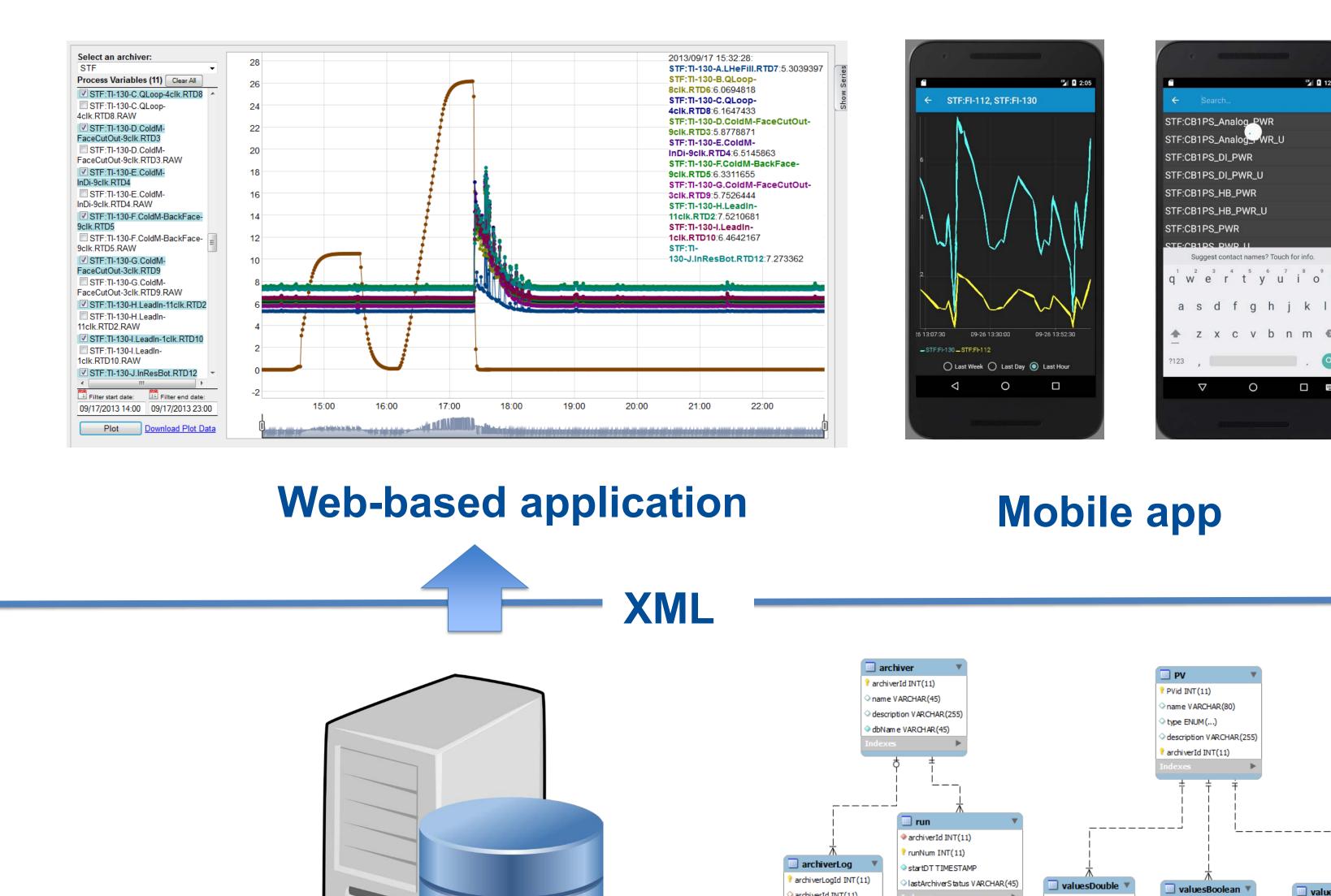
Current trends in the architecture of software systems focus our attention on building systems using a set of loosely coupled components, each providing a specific functionality known as service. It is not much different in control and monitoring systems, where a functionally distinct sub-system can be identified and independently designed, implemented, deployed and maintained. One functionality that renders itself perfectly to becoming a service is archiving the history of the system state. Such a service, built as a microservice and designed to archive time-series data, has been developed for the Mu2e Solenoid Test Facility at Fermilab.

Presentation Layer

The Presentation Layer includes two applications used for data visualization: a Web-based application and a mobile application. The Web application allows for historical trend analysis via charting and data extraction. The user chooses a set of data to be visualized by selecting the appropriate archive, data tags, and a time range. The Android mobile app shows real-time trends (hour, day, or week long) of selected data tags from the chosen archive.

Data Storage Layer

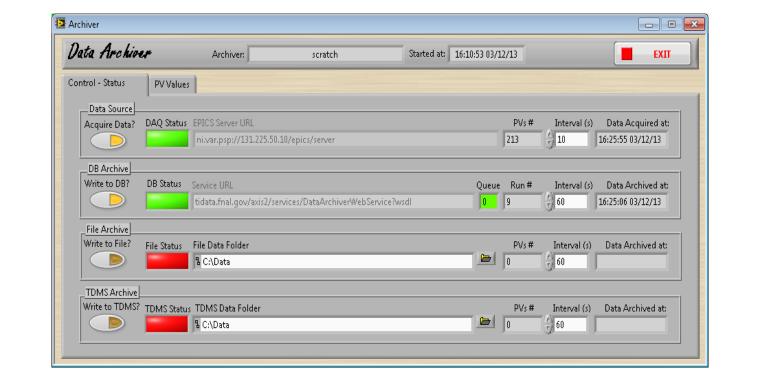
The data storage layer comprises a microservice with an XML-based API and a storage mechanism based on relational database management system. The a specifics of an R&D testing environment allowed the choice of a standard relational database for a timeseries data repository. The data is organized into archives, each of which store a set of runs consisting of sets of time-series data.





Data Archival Layer

The Data Archival Layer allows for concurrent execution of multiple archivers; each archiver collects data from the Data Acquisition Layer, aggregates them, and submits them to the archival microservice in the Data Storage Layer. Two additional file-based storage options include high-throughput TDMS formatted files, and ASCII CSV formatted files for ad-hoc use.



Data Archiver	Archiver:	scratch St	arted at: 16:10:53 03/12/13		ΕΧΙΤ
Control - Status PV Values					
				Acquired at: 16:	26:35 03/12/13
PV Name		Value	Timestamp	Severity	Status
STF:CuShuMagRes		0.000000	1/1/1970 12:00:00 AM	UDF	ERR_UDF
STF:CuShuMagRes.RAW		0.000000	1/1/1970 12:00:00 AM	UDF	ERR_UDF
STF:EI-1-W24FT320		53.681000	3/12/2013 4:26:27 PM	UDF	OK
STF:EI-2-24EB60		53.681000	3/12/2013 4:26:27 PM	UDF	OK
STF:EI-3-NI-PS17		53.681000	3/12/2013 4:26:27 PM	UDF	OK
STF:EI-4-Y050MX85-Volt		84.244071	3/12/2013 4:26:27 PM	UDF	OK
STF:ET-1.W24FT320-Voltage		10.736200	3/12/2013 4:26:27 PM	UDF	OK
STF:ET-2.24EB60-Voltage		10.736200	3/12/2013 4:26:27 PM	UDF	OK
STF:ET-3.NI-PS17-Voltage		10.736200	3/12/2013 4:26:27 PM	UDF	OK
STF:ET-4.Y050MX85-Voltage		7.847447	3/12/2013 4:26:27 PM	UDF	OK
STF:FI-100		0.00000	3/12/2013 4:26:27 PM	UDF	ERR_NaN
STF:FI-176		0.00000	3/12/2013 4:26:27 PM	UDF	ERR_NaN
STF:FIC-100_active		FALSE	3/12/2013 4:10:48 PM	UDF	OK
STF:FIC-100_control		0.00000	3/12/2013 4:26:28 PM	UDF	ERR_NaN
STF:FIC-100_gain		1.000000	3/12/2013 4:10:48 PM	UDF	OK

Archiver: console

Archiver: PV statuses

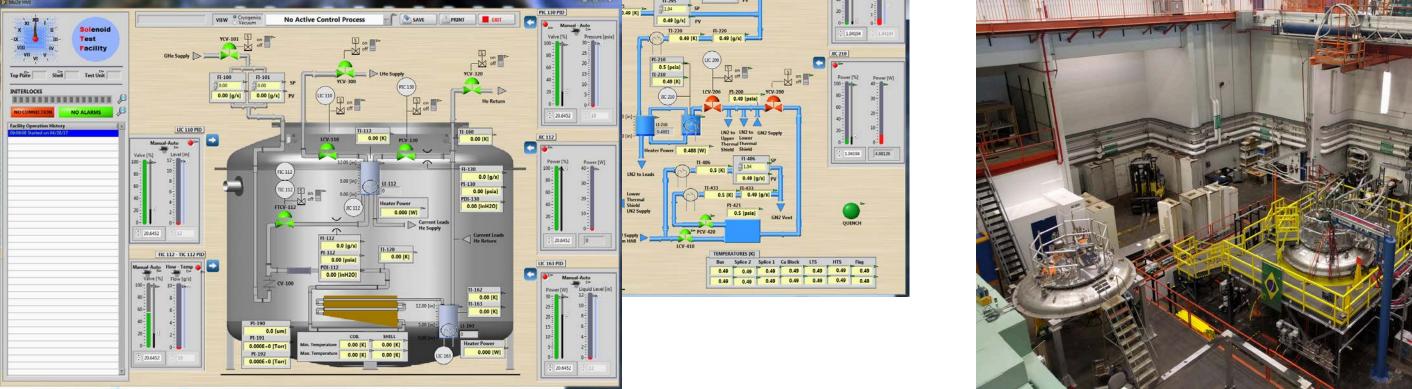
EPICS PV, LabVIEW SV

Data Acquisition Layer





The Data Acquisition Layer provides access to PVs via the EPICS Channel Access interface and LabVIEW shared variables. Using the IFIX gateway developed as part of the facility control and monitoring system, the archiver can also gather data from iFIX SCADA systems.



Control and monitoring system



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