

Simulation of Data Transfer between PLC and EPICS

Pablo Campero, Mary Ann Antonioli, Peter Bonneau, Brian Eng, Amanda Hoebel, George Jacobs, Mindy Leffel, Tyler Lemon, Marc McMullen, and Amrit Yegneswaran

Physics Division, Thomas Jefferson National Accelerator Facility, Newport News, VA 23606

April 12, 2019

The PLC tags to EPICS process variables (PVs) simulation for the control and monitoring system of Hall C’s SHMS and HMS, described in this note, was done to understand the implemented hardware components and developed software processes.

For the simulation, the following hardware components were used: a PLC, an OLE (Object Linking and Embedding) Process Control (OPC) Server, OPC Client, EPICS base application, and EDM/CSS editor screens. All components communicated via Ethernet, Fig 1.

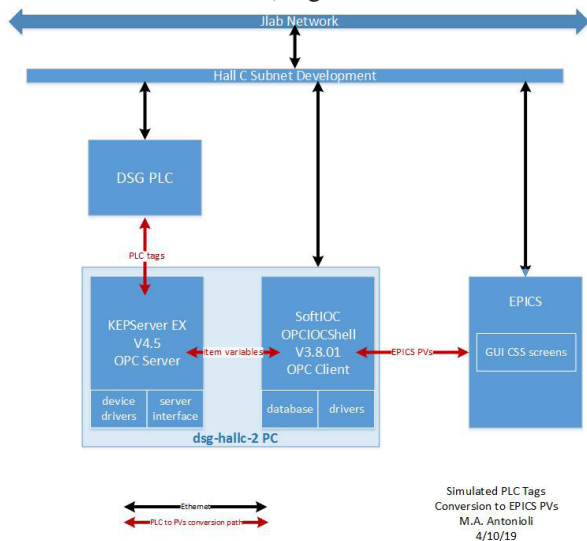


FIG. 1. Simulation setup for PLC tag to EPICS PV conversion.

The OPC server, KEPServerEX v.4.5, used in the simulation is similar to KEPServerEX v.6.5 used for HMS/SHMS, Fig. 2. The OPC server makes PLC tags available to the OPC client, OPC-IOC-Shell software v.3.8.0.1, which reads/writes the *items variables*—name given to the PLC tags after they are converted by the OPC server. The OPC client converts the *items variables* into EPICS PVs, which are available to any EPICS application connected to the Hall C subnet, Fig 2.

For the simulation, the DSG PLC was configured with the Allen Bradley 1756-L72 ControlLogix controller and PLC code was written in RSLOGIX5000 v.20 to automatically and continuously generate random values for each PLC data type—simple integer, double integer, real, boolean, and string.

For each PLC data type, two PLC tags were created, one with PLC-Controller scope and the other with PLC-Program scope. PLC tags’ scope determines the level (controller or program) at which the OPC Server reads/writes the PLC tags.

The OPC server configuration was based on the following:

- settings of the properties that enable communication between OPC server and PLC (channel properties)

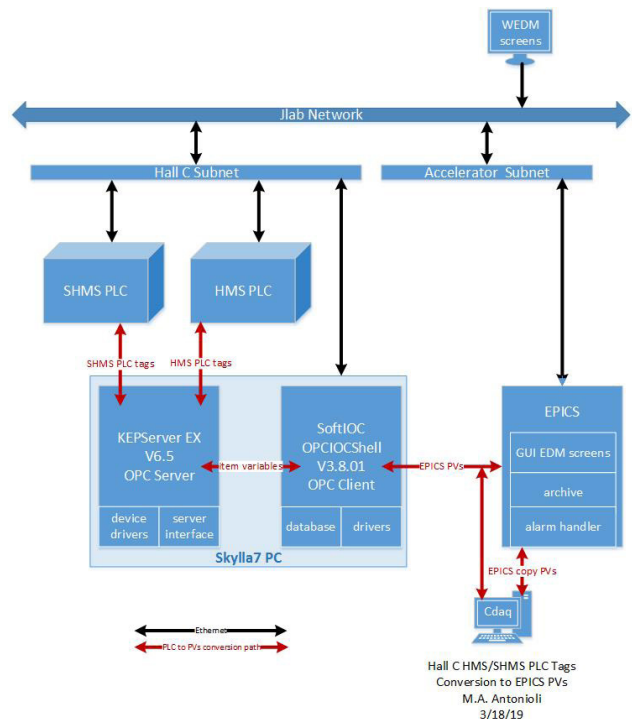


FIG. 2. SHMS and HMS PLC tags to EPICS PVs conversion process diagram.

- network adapter used to communicate between the DSG PLC (the *device* OPC client) and OPC server
- device driver configurations, which depend on the PLC model
- PLC host name/IP address.

Once the OPC server configurations were completed, a new Tag Group was created. This group contained all the PLC tags. It is in this section that the properties for each PLC tag—ID name, PLC tag address, data type, data access permissions, and scan rates—were assigned. Figure 3 shows the final configuration of the OPC server to enable data transfer between DSG PLC and the EPICS SoftIOc (*software* OPC client).

The *software* OPC Client runs the windows command `st.cmd`, which must be configured with the OPC Server address, database file names and OPC Group. The created database had all inputs and outputs (PLC tags/EPICS PVs) and the address of the OPC server. The *software* OPC client reads/writes the values and PV fields from the database. Once `st.cmd` and database files were configured, the `st.cmd` ran the database file and the conversion from PLC tag to EPICS PVs was completed.

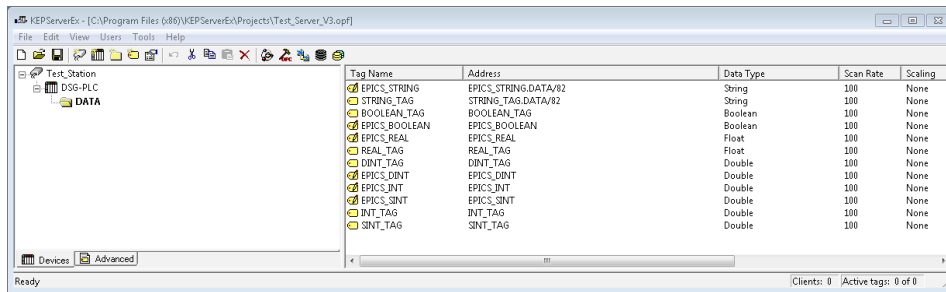


FIG. 3. Final configuration of the KEPServerEX running to allow data transfer between the DSG PLC and EPICS SoftIOc (OPC Client). Left column shows the Tag Group and the right columns show PLC tag configurations.

A CSS-BOY screen was developed to give the option to read/write different data type values of the PLC tags and convert them to EPICS PVs or vice-versa. The screen also shows the results of the simulation in real time. Figure 4 shows a snapshot of the simulation with the values transferred between the DSG PLC and OPC client hosted on *dsg-hallc-2* PC server computer.

To conclude, OPC server and OPC client were configured and executed on *dsg-hallc-2* server. Communications between the DSG PLC controller, OPC server, OPC client, and EPICS-CSS screen were tested. Data transfer between PLC and EPICS was simulated successfully; the hardware components and software processes are understood.

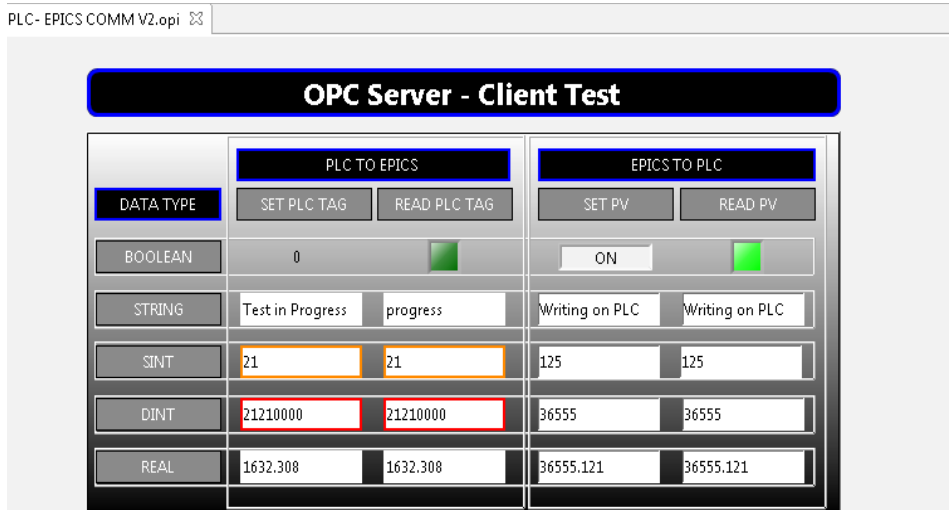


FIG. 4. CSS-BOY screen showing a snapshot of data conversions between PLC tags ↔ EPICS PVs. The PLC to EPICS section shows the transaction: set PLC tags → EPICS PV → read PLC tags. The EPICS to PLC section shows the transaction: set EPICS PV → PLC tags → read EPICS PV.