ASEC 2025 Conference

The 6th International Electronic Conference on Applied Sciences

09–11 December 2025 | Online

MDPI

Testing and validation procedure of Communication between an Industrial Robot Controller and a PLC via SLMP IoT Protocol

Fábio M. Braz[1], Angilberto Muniz Ferreira Sobrinho[1], and Fábio de Souza Cardoso[1,]

Universidade do Estado do Amazonas and Manaus/Brazil

INTRODUCTION & AIM

One of the main challenges of Industry 4.0 is ensuring effective communication between different automation systems, such as industrial robots and PLCs. This study presents a validation procedure for communication between an industrial robot controller and a PLC using the SLMP protocol over TCP/IP. The SLMP protocol, developed by the CC-Link Partner Association [1], enables standardized communication between industrial devices using conventional Ethernet networks. The implementation was carried out in the RAPID language and validated through systematic tests measuring success rate, response time, and communication errors.

METHOD

The experiment was configured in a controlled environment using a point-to-point connection between the robot controller and PLC without intermediate network devices. The robot controller was programmed in RAPID language connected directly via Category 5 Ethernet cable to an industrial PLC, using TCP port for SLMP communication. Specific memory areas were configured in the PLC using internal relays (type M), particularly M0-M15, with the PLC configured to replicate the state of bit M2 to M3 for bidirectional communication verification. The physical setup is shown in Figure 1.

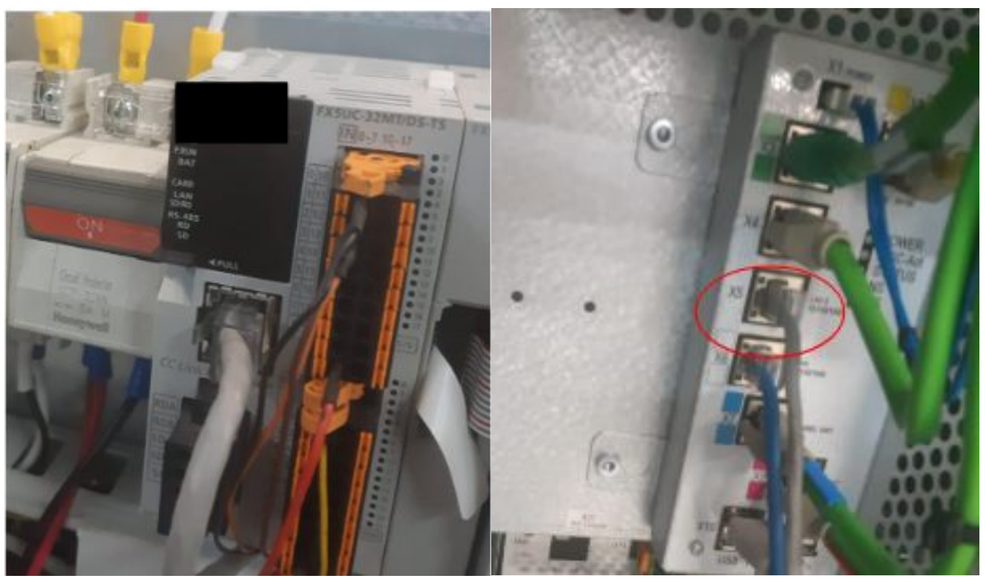

Figure 1. Experimental setup: PLC (left) and robot controller (right).

A testing algorithm was developed that executes 100 cycles, alternating a test bit between values 0 and 1. In each cycle, the algorithm measures the time required to execute write and read operations using SLMP protocol, verifies synchronization between sent and received values, and records all relevant metrics. The algorithm uses precise timing functions to measure response times and calculates statistics including success rate, average response time, communication errors, and synchronization errors.

RESULTS & DISCUSSION

The experimental results demonstrated that the SLMP protocol implementation over TCP/IP provides highly reliable and efficient communication, as shown in Table 1. The tests achieved a 100% success rate across all 100 cycles, with an average response time of 11.3 ms. No communication errors or synchronization errors were detected throughout the entire testing period.

Table 1. Summary of experimental results over 100 test cycles.

Performance Metrics	Results
Success Rate	100%
Average Response Time	11.3 ms

CONCLUSION

The results validate that the SLMP protocol implemented in RAPID language effectively establishes communication between robot controllers and PLCs. With 100% success rate and 11.3 ms response time, the solution proved suitable for industrial applications [2]. The absence of errors indicates implementation robustness, providing a foundation for Industry 4.0 interoperability solutions.

FUTURE WORK / REFERENCES

1. CC-Link Partner Association. SLMP Reference Manual, 2016.
2. S. Y. Lee, M. Sung. Appl. Sci., 2022.