

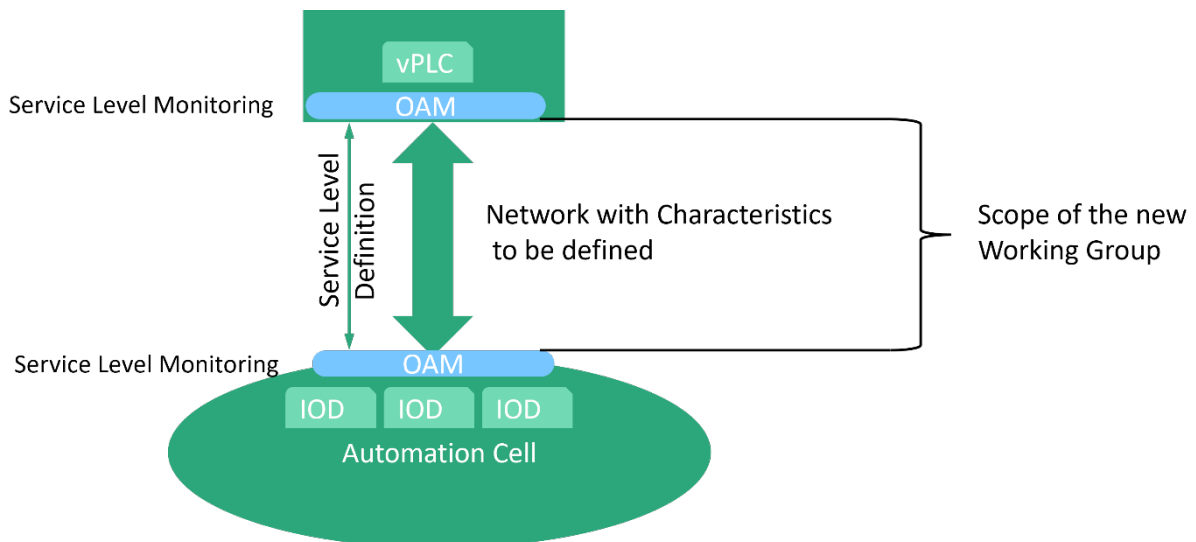
Call for Experts

Virtual PLC Network Performance

AdHoc WG 13

Introduction

Users of the PROFINET Technology more and more use virtual PLCs instead of physical PLCs. A virtual PLC (vPLC) is a software-based version of a traditional programmable logic controller, designed to run on general-purpose computing platforms rather than dedicated PLC hardware. As a vPLC runs on a general-purpose computing platform and as possible network latencies need to be considered, the overall input to output performance of such a system is of interest. The connecting network between the vPLC and the PROFINET IO Devices has an impact on the IO performance of the system. The objective of the AdHoc working group is the definition of performance criteria (service level definition) for the connecting network between the vPLC and the PROFINET IO Devices. The following figure shows the simple setting. Multiple automation cells may be connected to one host with multiple vPLC instances.



Previous work on these questions is already available [GAF2024], [GIV2014], [IMA2020], [JAV2022]. The AdHoc working group shall in the first step conduct a more detailed analysis on existing studies. In a second step the AdHoc working group shall evaluate whether existing standards with respect to network quality from the IT domain can be used for the definition of network quality parameters. Possible standards to be considered may include [ITU-T G.8013/Y.1731], [IEEE_802.1Q] und [IEEE_802.1ag].

Objectives of the working group

The AdHoc working group shall work on the following topics:

- Typical System structures for
 - Classical PLC with PROFINET IO.
 - Virtual PLC with on premise computing host with PROFINET IO.
 - Virtual PLC with cloud-based computing host with PROFINET IO.
- Agreement of measurement methodologies for the evaluation of the network quality according to the previously described standard.
- Discussion about possible additional network quality characteristics / quality indicators with reference to the various PROFINET Conformance Classes.
- Discussion about the impact of additional network latency / network load due to netload in the communication network between the IO devices and the computing host.
- Derivation of requirements for the maximum allowable network load.

Cooperation

The AdHoc working group is seeking experts with **in-depth knowledge of quality of service for Ethernet-based communication systems.**

Expected outcome of the AdHoc WG work

The AdHoc working group is expected to generate the following output:

- Agreed System structure for the reference platform.
- Agreed quality of service indicators for the transfer of PROFINET real-time data
- Typical results with respect to isochrony, delay, reaction time and jitter for the real-time behavior for standard PLC, vPLC hosted on premise, vPLC hosted in cloud.
- Recommendations for network load on the transfer network.

Call for participation

Interested companies are requested to contact

Prof. Dr. Karl-Heinz Niemann (karl-heinz.niemann@hs-hannover.de)

by February 27, 2026.

List of Literature

- [GAF2024] Gaffurini, Massimiliano; Bellagente, Paolo; Depari, Alessandro; Flammini, Alessandra; Brandão, Dennis; Rinaldi, Stefano; Sisinni, Emiliano; Ferrari, Paolo: On computing and real-time communication performance of containerized virtual PLCs: 2024 IEEE 20th International Conference on Factory Communication Systems (WFCS). IEEE, 2024; S. 1–4.
- [GIV2014] Givehchi, Omid; Imtiaz, Jahanzaib; Trsek, Henning; Jasperneite, Juergen: Control-as-a-service from the cloud: A case study for using virtualized PLCs: 2014 10th IEEE Workshop on Factory Communication Systems (WFCS 2014). IEEE, 2014; S. 1–4.
- [IEEE_802.1ag] IEEE LAN/MAN Standards Committee, IEEE 802.1ag:2007: IEEE Standard for Local and Metropolitan Area Networks Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management. IEEE, Piscataway, NJ, USA, 2007. URL: <https://doi.org/10.1109/IEEESTD.2007.4431836>.
- [IEEE_802.1Q] IEEE 802 LAN/MAN Standards Committee, IEEE 802.1Q-2022: IEEE Standard for Local and Metropolitan Area Networks—Bridges and Bridged Networks, 2022. URL: <https://standards.ieee.org/ieee/802.1Q/10323/>.
- [IMA2020] Imanto, Teguh; Adriansyah, Andi: Performance Analysis of Profinet Network in PLC-Based Automation System: 2020 2nd International Conference on Broadband Communications, Wireless Sensors and Powering (BCWSP). IEEE, 2020; S. 47–52.
- [ITU-T G.8013/Y.1731] International Telecommunication Union (ITU), ITU-T G.8013/Y.1731 (06/2023): Operation, administration and maintenance (OAM) functions and mechanisms for Ethernetbased networks, 2023. URL: <https://www.itu.int/rec/T-REC-G.8013-202306-l/en>.
- [JAV2022] Javier Perez, Diogenes; Walzl, Josef; Prenzel, Laurin; Steinhorst, Sebastian: How Real (Time) Are Virtual PLCs?: 2022 IEEE 27th International Conference on Emerging Technologies and Factory Automation (ETFA). IEEE, 2022; S. 1–8.