



Software quality assurance

**Reliable software
solutions for industrial networks**



Westermo produces reliable software solutions for industrial applications



Extensive software testing is one of the reasons behind the success of WeOS, which has become one of the most popular operating systems among industrial network engineers.

Westermo is a leading provider of networking products for industrial applications. Westermo develops and manufactures Ethernet switches and routers that are used to build data communication solutions for monitoring and control systems. These systems are used in industries such as transportation, water and wastewater, oil and gas and process industries.

Monitoring and control systems are often critical to operations within these industries, which mean it is extremely important that they do not fail. Downtime of an industrial system can lead to huge financial losses or place equipment, workers or the public at risk. The data communication network supporting these industrial systems is therefore incredibly important.

In a world that is becoming increasingly digitized, data communication networks are more complex and must meet greater demands in terms of functionality and reliability. Westermo's success, in addition to its reputation for producing extremely robust and reliable products, is its world-leading WeOS operating system. This software has been specifically developed to create resilient and reliable industrial network solutions that are easy to configure and maintain. By doing so, this has made WeOS one of the most popular choices for industrial network engineers.

Reliability is another key factor in the success of WeOS. To maximise reliability, extensive tests are conducted to ensure the software is working properly. A combination of manual and automated software tests makes it possible to perform both an intelligent selection and an extremely large quantity of tests. With more than 3 000 tests running every day, all year round, test coverage is outstanding. This is why WeOS has become the most reliable software on the market for industrial network products.

Test framework minimizes the risk of software failure

Having a range of networking devices powered by the same software, WeOS, and unique testing processes developed and performed at the company's testing facilities in Sweden gives Westermo a major advantage over other manufacturers.

This has allowed Westermo to create a specific test framework for WeOS, which enables all resources to be concentrated on that software. The test framework has been developed over many years and is now in daily operation within Westermo's software test laboratory. When features and functionality are added to the WeOS software, new automated tests are developed and these are executed every day, resulting in millions of completed tests.

The extensive software test processes have been developed to identify any possible quality issues, which will reduce the risk to an absolute minimum of releasing software with any quality issues to the market.



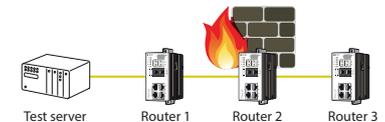
Test framework example:

To achieve maximum authenticity, all tests are performed on the final product and configured as it would if it was installed in a real customer application.

For example, a test of a firewall may consist of three products; the outside node (router 1) trying to communicate through the firewall, the firewall node (router 2) blocking the communication, and the inside node (router 3) which is being protected. The test framework will first configure the nodes and then hand over control to the test case for execution.

In this test case there might be 4 steps:

- Ensure that the outside can reach the inside
- Configure the firewall rules
- Ensure that the outside no longer reaches the inside
- Clean up used resources and terminate gracefully



Research by Westermo R&D

Research performed by Westermo has led to the publication of several scientific papers, of which industrial doctoral student Per Strandberg's paper on "Automated System Level Regression Test Prioritization Using Multiple Factors" was awarded Best Research Paper at the International Symposium on Software Reliability Engineering (ISSRE) in Ottawa in 2016.

- P E Strandberg, D Sundmark, W Afzal, T J Ostrand, and E J Weyuker. (2016). "Experience Report: Automated System Level Regression Test Prioritization Using Multiple Factors." In ISSRE 2016, Ottawa, Canada.
- P E Strandberg. (2017). "Software Test Data Visualization with Heatmaps – an Initial Survey." In MRTC Technical Report of April 2017, Mälardalen University.
- J Danielsson, S M H Ashjaei, M Behnam, T Sörensen, M Sjödin, and T Nolte. (2017). "Performance Evaluation of Network Convergence Time Measurement Techniques." In ETFA'17, Limassol, Cyprus.
- P E Strandberg, T J Ostrand, E J Weyuker, D Sundmark, and W Afzal. (2018). "Automated Test Mapping and Coverage for Network Topologies." In submission.
- P E Strandberg, E P Enoiu, W Afzal, D Sundmark, and R Feldt. (2018). "Test Results Communication – An Interview Study in the Embedded Software Industry." In submission.

It is possible to take part of these scientific papers

[INSERT DESCRIPTION WHERE TO FIND THE PAPERS]



**Westermo head office and
manufacturing facility**

640 40 Stora Sundby, Sweden

Westermo research and development

Metallverksgatan 6
721 30 Västerås, Sweden

Phone: +46 16 428000

Fax: +46 16 428001

Web: www.westermo.com

E-mail: info@westermo.com