Telenor Sweden
Automated network quality management

Introduction

This case study details how Telenor Sweden, a large Swedish telecom operator, automates activities related to enhancing end-customer quality experience with Netrounds.

Telenor Sweden's main goal was to achieve automation of service quality assurance in their IP network: verification, optimization, monitoring, and troubleshooting of services such as IPTV. Traditionally, many of these tasks are labor-intensive, requiring expensive and complex hardware and software tools. A secondary goal of Telenor was to enable cross-organizational collaboration.

The content of this study describes how Netrounds was able to significantly streamline this work by simplifying and automating more than 50% of manual tasks. Test and monitoring is automated for the full life-cycle of services; from pre-launch validation and provisioning (activation test) to real-time monitoring and automated troubleshooting.

In addition, the case study shows how Netrounds helps promote collaboration, within the organization as well as with external consulting partners and suppliers.

Benefits gained:

- Improved end-user perceived quality
- Increased service launch velocity
- More efficient and competitive collaboration in the organization
- Shorter regression testing cycles

Background

Telenor Group is one of the world's major telecom operators with 178 million mobile subscribers and a large customer base on their wired broadband network. They have operations in 11 markets and approximately 30,000 employees worldwide.

Telenor's Swedish subsidiary, Telenor Sweden, is a successful competitor in the Swedish market that offers both wired and wireless services.
The support for automation of tests has been improved thanks to the cooperative dialog we have with the Netrounds team, and the combination of automation with its simplicity of use makes Netrounds an important strategic testing tool for us to achieve higher efficiency and quality.

Steven Muir  
Manager, Terminals & CPE Team  
Telenor Sweden

Telenor Sweden has experienced similar challenges to other network operators worldwide: an ever-growing network complexity resulting from the endless introduction of new platforms and new advanced services, along with an increase in traffic volume and customer quality demands. Furthermore, the intensifying market competition requires enhancements in service launch velocity, as well as a cost-efficient organization; yet at the same time, the resources for quality assurance are strained and problems are not being found during pre-deployment testing, ultimately driving additional costs for customer service and support.

One of the key factors Telenor identified as imperative to improve service launch velocity and service quality was the introduction of automation in the service quality assurance process. This requirement had been around for several years, but it had not been acted upon as most systems available for this task were expensive, and it was considered difficult to find the time needed to introduce automation.

Another key factor identified was to improve the collaboration with suppliers so that more thorough and specific testing could be conducted according to Telenor’s network conditions and actual service realizations. In the past, situations had frequently occurred where new important services were scheduled for launch but had to be delayed for several months after verification tests revealed bugs in a supplier’s hardware or configurations just before the launch date. Only after several iterations of manual regression testing were the services finally ready for release.

In Telenor’s search for a system to suit their needs, Netrounds was identified as capable to fulfill all their project requirements:

1. Easy to implement and simple to use
2. Supports automation of service tests and monitoring
3. Supports collaboration, which is needed for efficient work with partners

Current situation

Telenor Sweden’s operations center has a goal to decrease the number of faults and misconfigurations that affect customers, thereby increasing customer satisfaction and decreasing churn. Netrounds is seen as an important tool to increase the visibility of customer-impacting issues, and the solution is used in the production network for active monitoring. This is a proactive approach, where issues are detected before customers notice, or suffer. Telenor is able to detect and prioritize problems based on how customer traffic is impacted by delay, jitter, and packet loss. These measurements very faithfully reflect what the customers are experiencing when using services such as IPTV, Internet, and VPN.

The production tool is also used by third-line support in order to automate troubleshooting at customer sites. The same tests that can be performed in a lab during development may be repeated on-site (using saved, replicated test sequences). This means that lab and live
results are fully comparable, as the test execution is identical down to the last packet. It is not an uncommon situation among operators for different tools which are not comparable to be used in the lab and in operations. This means it takes longer to troubleshoot faults in the network, and customers are subjected to longer downtimes.

Several groups within Telenor Sweden – those responsible for customer-premise equipment, service management, and support – identified Netrounds as a solution to their specific testing and assurance challenges. These groups use Netrounds prior to installation of new hardware and software in their equipment deployed at customer premises (CPEs) for their mobile and wired platforms, as well as their access platforms (both fiber-to-the-home switches and DSLAMs). Some of the features that are tested with Netrounds are:

- Performance
- Long-term stability and quality
- Broadband TV (IPTV) in combination with peer-to-peer traffic – this has been confirmed as a real-world problem for some CPEs
- Quality of Service (QoS) and prioritization mechanisms
- Security

A large portion of the testing activities are automated using Netrounds. This, first of all, increases the number of tests that can be executed since tests can be performed outside business hours. The automation also frees up expensive technical expertise so that the staff can put extra effort into tests that cannot be automated and conduct those more thoroughly. Moreover, thanks to the increased test coverage, fewer problems are likely to surface in the live production network.

Telenor Sweden also has a goal to increase the responsibilities of their suppliers by tasking them with the duty of fully testing the Telenor Sweden releases before sending them to Telenor. Not infrequently, operators are required to validate many software releases from a supplier before arriving at one that conforms to the specification. Netrounds is seen as a valuable tool for improving the quality assurance process and the support functions while staying in control of how tests are executed and which features are tested and approved prior to deployment. Telenor is able to share tests and monitors with its suppliers, allowing each supplier to make sure that software and hardware conform to the specifications before delivering them. This frees up more time for engineering resources to spend on value added work.

**Future plans**

Telenor’s future goal is to automate more than 70% of its testing and assurance activities. To achieve this goal and fully realize the benefits of automation, the Netrounds solution can be deployed throughout the organization, replacing error-prone, resource-demanding manual methods. Cross-functional knowledge sharing is often a challenge in
large organizations, but adopting a solution across the organization that automates manual work among groups and reduces faults and errors can bring significant benefits.

Using a solution that is applicable to all phases in the network lifecycle provides a number of advantages:

- Teams can collaborate both internally and externally.
- Necessary tests can be developed by experts and shared among groups.
- Tests can be shared to suppliers for simple reproduction.

Netrounds can be used by external test partners and suppliers to execute tests that Telenor has specified. This makes it possible for Telenor staff to work more strategically while retaining control of the test process.

**Conclusion**

Netrounds helped Telenor Sweden to achieve their project goals of automating labor-intensive service test and assurance activities and increasing cross-organizational collaboration with partners by providing them with an easy-to-use, easily deployed, and scalable solution.

With Netrounds, Telenor Sweden:

- automated more than 50% of manual tasks related to verification, optimization and troubleshooting of the IP network
- introduced shorter regression testing cycles and increased service launch velocity
- improved collaboration externally with partners and suppliers to minimize service launch delays and increase efficiency and operational cost savings
- improved customer satisfaction and quality of experience.

Since its initial deployment at Telenor Sweden, Netrounds has evolved with Telenor’s needs and goals, adding test features and improved support for automation as required. As today’s technical complexity and competition increase daily, automation is seen as a key factor in staying competitive and ensuring a market-leading customer quality experience.
Appendix I: Netrounds use cases for a network operator throughout the service lifecycle

This section explains how Netrounds is used to test and monitor services throughout the service lifecycle.

Automated lab testing

Many of the manual tests typically performed during regression testing of new firmware releases for network devices can be automated with Netrounds. In this use case, 3–10 measurement devices are connected to a reference lab setup. This makes it possible to stress test customer premises equipment (CPE) such as triple-play Residential Gateways (RGWs) and access networks. Netrounds helps ensure that expected levels of performance, quality, stability and security are met. As much as 70% of manual efforts can be automated, increasing both service velocity and quality as well as making staff resources available for more advanced tasks that are not possible to automate.

Pilot testing

After new equipment firmware has been verified in the lab environment, it is common for a few selected nodes to be upgraded in the production network before the entire network is updated. The purpose is to find problems that might potentially slip through the lab testing process, while affecting only a limited number of subscribers in the production network.

Because Netrounds is fully distributed, it is simple to deploy Netrounds Test Agents on-site at the selected pilot nodes. By reusing the identical automated test suites that were used during the pilot tests in the lab, it is possible to find and fix problems that only surface in fully realistic situations. This decreases the duration of the pilot testing and shortens the time to service launch.

Verification of backhaul and business L2/L3 VPN connections, activation tests

Netrounds provides a vast array of features for multilayer testing and verification of networks, from Layer 1 to Layer 7. Among these features, the following are of special interest for validating backhaul as well as VPN connections.

- Regular UDP and TCP sessions for measuring delay, jitter, and packet loss: ranging from quick checks to multiple-day stability tests.
- QoS policy profiling test for verifying bandwidth shaping based on QoS classes.
- TCP throughput test according to RFC 6349, a standard which captures user experience.
- Ethernet service activation testing compliant with ITU-T Y.1564 and MEF Carrier Ethernet 2.0.
- Transparency and security tests.
In cases where it is not possible to install a Test Agent on-site, Netrounds can perform reflector-based measurements using, for example, TWAMP or Y.1731.

Verification of mobile backhaul transmission and business VPN connections has traditionally been done by means of RFC 2544 throughput measurements. However, RFC 2544 is an old standard which is no longer recommended for use by IETF, and Netrounds provides similar functionality which covers the same ground and more.

As an alternative to activation tests, data and reports are sometimes taken from passive device counters. However, this data does not give sufficient information about the quality of service and cannot be correlated with individual end user experiences, making the evaluation of actual customer quality extremely difficult or impossible.

**Real-time monitoring of triple-play and business services**

Netrounds supports in-production monitoring of network services, providing periodic SLA compliance reports and alarm capabilities in case of quality degradation. Monitoring of quality-demanding services such as IPTV, digital cable TV, IP telephony, L2/L3 VPNs, SD-WAN performance and other business-critical services is considered absolutely necessary for achieving professional network operations. Netrounds helps solve problems proactively and provides the means for quick remote troubleshooting without truck rolls.

**Second-line and third-line troubleshooting**

Netrounds helps minimize costly problems through automated quality assurance testing and monitoring; however, unexpected problems that appear when the network is put into production can also be quickly isolated and solved remotely with Netrounds. This kind of troubleshooting is done in four steps as explained below. The first three steps can be handled without dispatching a field technician and thus make for highly cost-efficient troubleshooting.

1. Netrounds’ active Test Agents can use built-in responder functionality in routers, switches and computers to triage faults, thereby allowing most faults to be isolated without additional tools. Depending on what features are supported in the intermediate equipment, bandwidth, QoS marking, delay and packet loss can be analyzed. For advanced use cases, this triage can also be automated and built into solutions such as fault and performance management systems.

2. For more detailed remote measurements, a subscriber may download and install a virtual Test Agent on various router models such as universal CPEs from Cisco, Nokia, Juniper, OneAccess, Advä, Telco Systems, or other service routers supporting virtualization, or even computers. This allows the customer to do advanced and automated functionality and performance tests – end-to-end, edge-to-edge, and at intermediate points in the network.
3. Netrounds’ active Test Agents can also be used for browser-based speed tests. This makes it possible for subscribers to trigger network performance measurements themselves using an ordinary web browser. All test results are stored on the Netrounds cloud servers, providing network operations support staff with full visibility into the subscriber’s achieved performance. The initiation of the browser-based speed test may need manual work, but several tools exist for automating this if necessary. Since the analysis is always available to the operator, the analysis too can be automated.

4. If the first steps still do not provide sufficient details to the support team, a measurement appliance may have to be deployed at the subscriber location. The plug-and-play property makes it possible for a customer to pick up and connect a measurement appliance at home, using a Wi-Fi, mobile, or Ethernet connection. Once the connection is established, in-depth testing can be done by an automation tool or by second- or third-line support teams. As an alternative, a field technician may easily transform an ordinary laptop into a professional measurement appliance and bring it to the subscriber location. The actual testing and analysis is completed remotely by second- or third-line support staff, minimizing the need for highly trained personnel in the field.
Netrounds capability overview

Network Performance testing leverages the real-world traffic generated by Netrounds active Test Agents. Traffic streams for TCP/UDP can be crafted with custom throughput rate, packet sizes, destination ports, and QoS headers.

Reflector-based Network Performance testing is based on traffic sent by Netrounds active Test Agents towards built-in reflector functionality in (for example) routers, switches, CPEs, and base stations. Again, traffic streams can be configured with custom rates, packet sizes, destination ports, and QoS headers.

IPTV and Digital Cable TV measures the video quality of existing MPEG video streams. Multiple channels can be measured concurrently at multiple locations.

Wi-Fi and Mobile measures the quality of existing wireless (Wi-Fi or mobile) connections. For Wi-Fi connections it is possible to switch between different channels and access points and to configure various settings, allowing troubleshooting of the connection. Similarly, for Mobile, it is possible to switch between different frequencies and networks (APNs).

SIP communications enables measuring of call quality and call setup times using the built-in SIP clients in the Test Agents.

HTTP and DNS make it possible to measure download rates and response times measured towards existing HTTP and DNS servers.

Network Speedtest is a feature that enables operators and enterprises to set up their own speed test server/responder that allows end users to assess network performance within a relevant part of the network rather than involving the Internet.

Security testing is used to quickly identify and eliminate potential security weaknesses in order to prevent loss of data or service interruption.

Remote Traffic Analysis is a feature for capturing traffic remotely from measurement devices located anywhere in the network.

Transparency testing contains a complete set of test cases to verify if a Layer 2 or Layer 3 point-to-point connection has the correct characteristics in terms of protocol transparency and Class of Service marking/remarking.