Bu

dness case for and the benefits of embedding  
Netrounds Test Agents in OpenWrt devices

Executive Summary

This business case is based on interviews and experiences from an 
ongoing project with a European operator, anonymized as EuroTel in 
this document.

It is expected that the proposed solution will not only reduce 
problem resolution times and cut the average call handling time of 
each customer support call, and thus improve customer satisfaction – 
a top priority for most service providers today; it will also significantly 
reduce Operational costs (OPEX) thanks to reduced number of 
customer field visits. For EuroTel, the payback period for introducing 
the proposed solution is calculated at less than 12 months.

EuroTel and its network operations and customer care organizations 
have set a number of important and ambitious goals for the coming 
year in order to become more competitive:

- Improve proactivity;
- Reduce first line customer support contact rates;
- Divert inbound support calls towards self-service online 
  alternatives;
- Reduce support case resolution time to improve customer 
  satisfaction.

One critical challenge today is diagnosing problems more efficiently, 
regardless of how customers report them: through online self-
service procedures or in inbound support calls. The present solution 
proposal makes it possible to automate and improve diagnostics by 
enhancing the test and measurement capabilities in the Home 
Gateways (HGWs) acting as EuroTel’s demarcation devices at the customer 
premises.

The solution will reduce the number of inbound support calls by 
enabling provision of advanced diagnostics via EuroTel’s self-service 
portal. It will also make customer support staff more confident in the 
recommendations they give to customers and provide more
professional customer contact, ultimately improving overall customer satisfaction.

The solution is provided via a collaboration between Netrounds and a leading global vendor of OpenWrt-based Home Gateways. Netrounds is a Swedish test and measurement company whose products are already used by several groups within EuroTel.

This document describes the use cases, the solution itself, and the expected benefits as stated by EuroTel's support staff who have insight into and expertise in the relevant workflows.

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1 Introduction

The main drivers for enhancing the test and measurement capabilities in EuroTel's Home Gateways (HGWs) are:

1. Faster resolution of customer issues.
2. Improved customer satisfaction.
3. Reduced first line customer support contact rates and diversion of inbound support calls towards self-service online alternatives.
4. Increased proactivity with problem resolution.
5. The ability to retrieve reports and benchmark Quality of Experience (QoE) for customers connected to different access networks (fiber/copper), where some of these could be off-net connections outside the direct control of EuroTel.

The main stakeholders identified within EuroTel are:

1. 1st, 2nd and 3rd line support, all wanting to reduce incoming support calls, improve customer satisfaction, and reduce the time to problem resolution of customer issues.
2. Delivery teams, who are interested in knowing immediately if a delivery has been successful or not. This is part of the goal to increase proactivity.
3. Management, which can make more informed future strategic and operative decisions thanks to improved benchmarking reports on network performance and customer experience when delivering services over different networks. More informed decisions hopefully lead to increased sales and less churn.

2 Communicated needs from EuroTel

2.1 Improving support flow and customer satisfaction

There are two main problems today in this area:

- The first problem is that customers tend to call customer service whenever they experience an issue, even if it is not an issue in EuroTel's network. In fact, more often than not, it turns out on further investigation that the cause of the problem is found in the customer’s own home. These calls use extensive customer support resources, so if this type of call can be reduced, large amounts of money and resources can be saved.

- The second problem is that customer support lacks sufficient tools to quickly determine whether a customer-reported problem resides in the customer’s home environment or in EuroTel's network. In other words – who owns the problem, and what actions should be taken?

Given the volume of incoming calls, there is room for major improvements in order to reduce unwanted costs, for example:
Enhancing Diagnostics Functionality in Home Gateways

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• Unnecessary replacements of fully working HGWs.
• Sending contractors to the customer site for an on-site investigation.
• Assigning own staff for troubleshooting.

Furthermore, there is room to shorten support ticket resolution times to maintain customer satisfaction.

The sections that follow detail the use cases and how the Netrounds solution improves the situation.

2.1.1 First-line and second-line support

EuroTel estimates that around 0.2% of their customer base makes a support call every month related to network performance issues. Having enhanced measurement functionality in the HGW is expected to have reduce the support call volume related to expected network performance issues by 50%. In more detail, the estimated benefits are:

• Shorter call handling time for 1st line support – each call is expected to be a few minutes shorter on average.
• Fewer truck rolls – the best estimate by EuroTel points to a substantial reduction in the number of truck rolls each month.
• The customer will have a more professional experience during the call or when visiting the EuroTel web portal – this will increase customer satisfaction, although the improvement is hard to quantify.

The ability to measure network performance to and from the HGW has by far the greatest positive impact. IPTV is less of a problem for 1st and 2nd line support, but – as clarified below – the main issue for 3rd line support.

Network performance measurement capabilities would help both fiber and copper customers. Customer support can see today what rate a DSL modem has synced up at, but they have no means of testing its actual performance in terms of throughput experienced by the customer. This causes a level of insecurity which ultimately drives costs and increases the time to resolve customer issues. For fiber customers, there is even less information available.

For IPTV, the possibilities of troubleshooting and demarcating problems are satisfactory for DSL customers. EuroTel gets good information from the DSL line, and it is also possible to retrieve information from the set-top-box (STB) connected to the TV. Problems residing north of the DSLAM cannot be investigated in detail, but such problems are quite uncommon and thus do not affect customer experience significantly. Of all calls that are made per month for IPTV related issues, around 95% are solved immediately by 1st line support. Most often the problems relate to how the TV box is connected inside the home.
Summing up the potential benefits for EuroTel per year:

- Truck roll reduction resulting in savings of around 300-500k EUR – a significant amount.
- Faster resolution of support cases: for every truck roll avoided, the resolution time is cut by several days. Clearly, this has a huge impact on the customer experience.
- Each year, 20,000 calls could be shortened by an estimated 3 minutes. The main benefit here is the improved customer experience achieved by more professional support. This also saves an additional 40 man-days per year.
- Improved customer satisfaction. This is perhaps the most important benefit, but it is hard to translate into definite figures, like its positive impact on customer churn.

The goal of reducing the total number of support calls is also addressed as the tests can ultimately be triggered via the EuroTel web portal where both relevant and informative answers can be delivered automatically. This means customer will not need to call customer support and wait in a queue – win-win.

### 2.1.2 Third-line support

For third-line support, the average daily customer support contact rate is naturally less in comparison to first and second lines. The most frequent support cases, however, are ones related to IPTV problems. The second most common type of support case concerns network performance issues.

The current goal of 3rd line support is to solve the problems and inform the customer within 2.5 days. In most cases this is possible, but not always. For example, when a contractor must be sent to a customer for an on-site visit, this alone adds 2.5 extra days to problem resolution time.

Today, a contractor is sent out by 3rd line support personnel thousands of times every year. The contractor checks if everything is connected correctly, and quite often, some type of measurement is made from the contractor’s PC to rule out problems with the customer’s PC and home network connection. If the problem is not due to issues in EuroTel’s network, then the invoice should be sent to the customer. However, in reality, it is believed that EuroTel covers this cost in most cases, even if the problem is at the customer end.

The benefits of being able to trigger a measurement of IPTV quality and/or network performance are faster resolution of complex customer issues by 3rd line support personnel and reduced cost for customer visits made by contractors (because these visits can be made less frequent).

Eliminating 50% of contractors’ customer visits would save hundreds of thousands of euro annually, and perhaps more importantly, the
resolution time for customer cases could be reduced by up to 50%. Besides saving internal resource cost, this will also improve customer satisfaction.

2.2 Needs for improved insight into customer experience

As EuroTel is also delivering services over other operators’ networks – without direct control by EuroTel – the need to understand how services are experienced from a customer perspective is more important than ever and carries a very high business value.

Data of interest for Customer Quality Benchmarks are, for example, network performance from a customer perspective (throughput, loss, delay, jitter) and IPTV quality when comparing deliveries made by EuroTel end-to-end with deliveries made via off-net connections.

The benefits of this kind of analysis are significant from a strategic point of view.

2.3 Needs from delivery team point of view

EuroTel wanted to implement automatic testing every time a new HGW is connected to the network. This addresses the goal of increased proactivity in finding and fixing potential issues before they affect customer quality of experience. Troubleshooting and fault resolution could be initiated immediately, leading to a reduction of OPEX and increased customer satisfaction.

If the test result shows bad connection quality, EuroTel would contact the customer to resolve the issue. A very positive customer experience would most likely result.

3 Solution Overview

This chapter describes the proposed solution in more detail. The solution consists of three main parts:

- A server component that coordinates the Netrounds Test Agents, runs tests, and collects results. The server has a northbound API that is used by EuroTel’s OSS/BSS to automatically trigger tests and collect results. As an alternative, test results are sent via SysLog messages to an appropriate receiver.

- Embedded Test Agents: code that is installed on the OpenWrt-based HGW and runs the actual active tests to and from the customer location.

- Test Agents (in various formats) connected in the core part of the network. Network performance tests are conducted between these Test Agents and the Embedded Test Agents in the HGWs.

See the figure below for a high level description of the three main steps involved in performing a test or initiating a monitoring session:
1. A test is requested over the backend, either by support staff or by the customer using EuroTel’s web portal.

2. The Auto Configuration Server (ACS) configures the HGW and enables the Netrounds Embedded Test Agent.

3. The backend system uses the Netrounds API to initiate the active tests and measurements for the specific HGW.

The Netrounds solution provides three main measurement features:

1. Network quality measurement and long-term stability assessment

2. Network performance and throughput measurement

3. IPTV quality

See sections 3.1–3.3 below for a description of these features.

3.1 Use Case 1: Network quality measurement and long-term stability

This measurement only needs a centrally located Test Agent; it does not require an Embedded Test Agent in the HGW. The ACS (Access Control Server, used to provide boot time configuration of the HGWs) activates a “UDP echo responder” (a built-in function) in the HGW to be tested. The central Test Agent then initiates a test stream towards the HGW which reflects that stream back to the central Test Agent where the network performance metrics are calculated (loss, delay, jitter). This test is ideal for measuring quality and stability over longer periods of time.
Two-way metrics are measured for loss and delay which provide a basic understanding of potential problems (especially over longer periods), but UDP Echo does not make it possible to pinpoint in which of the directions problems occur.

3.2 Use Case 2: Network performance and throughput measurement

This is one of the main features requested by EuroTel and the feature that is expected to have the most substantial business impact.

To overcome the limitation in the capabilities offered by the UDP Echo method in Use Case 1, this scenario includes Netrounds Embedded Test Agents enabled in the HGW. This is done remotely by the ACS.

Active test traffic is sent to and from a central Test Agent. The test is a TCP throughput test that shows the amount of bandwidth the customer is getting.

Note: Netrounds is evaluating maximum bandwidth that can be generated and received with the Test Agent inside the HGW. Initial validation shows the achievable TCP rate to be somewhere in the range of 400–600 Mbit/s. TCP rates also depend on which HGW platform is used due to limitations in the HGW CPU. In spite of these limitations, the majority of customers are covered by the proposed testing scenario.

The figure below illustrates how unidirectional network performance and throughput are measured:
In this scenario, Netrounds Embedded Test Agents are activated in the HGW through the ACS to measure network performance using both UDP and TCP as protocols. All metrics are measured one-way which makes it possible to pinpoint the specific direction, either upstream or downstream, to the customer location.

3.3 Use Case 3: IPTV quality

This is the main feature requested by 3rd line support. The Netrounds Embedded Test Agent is activated in the HGW and a measurement of IPTV quality is started. There are two possibilities:

1. A measurement is started on a specific channel (for instance CNN) where the customer has reported a problem. This means that 3rd line support is controlling which channel is to be measured and monitored.

2. A measurement is started that will follow the same channels as the customer is watching at that moment. If the customer switches to a different channel, so will the test agent that is measuring and monitoring the channel.

The measurement results in the HGW can be compared to the statistics retrieved from the set-top box (STB) used to understand where problems are occurring. If the measurements indicate problems at the STB, but not at the HGW, it can be confidently concluded that the problem is within the customer’s premises.

Likewise, the Test Agents located in the core network could concurrently participate in IPTV monitoring, making it very simple to isolate faults that are present in the core part of the network.

The figure below illustrates the IPTV quality test scenario described above.
4 Summary of Benefits

The benefits of implementing Netrounds Embedded Test Agents in HGWs at EuroTel can be summarized in two main areas.

The first benefit is related to OPEX and CAPEX savings. The total savings are expected to have a payback period of less than 12 months for most service provider environments and organizations.

See the table below for an example template used for ROI analysis. Some of the numbers are filled in for illustrative purposes. To get a complete ROI, the calculation is made using conditions specific to each individual service provider.

<table>
<thead>
<tr>
<th>Input Assumptions</th>
<th>#</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of subscribers</td>
<td>#</td>
</tr>
<tr>
<td>Ratio of customers calling network support per month</td>
<td>0.2%</td>
</tr>
<tr>
<td>Average call handling reduction (in minutes)</td>
<td>3</td>
</tr>
<tr>
<td>Ratio of calls that can be reduced by above</td>
<td>50%</td>
</tr>
<tr>
<td>Total number of truck rolls per year</td>
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</tr>
<tr>
<td>Number of replaced HGW per year</td>
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</tr>
<tr>
<td>Cost for mistakenly replacing a functional HGW (EUR)</td>
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</tr>
<tr>
<td>Reduced number of truck rolls per year - 1st/2nd line</td>
<td>50%</td>
</tr>
<tr>
<td>Cost for truck roll (EUR)</td>
<td>150</td>
</tr>
</tbody>
</table>
## Input Assumptions

| Hourly rate for 1st/2nd line support staff (EUR) | 35 |

<table>
<thead>
<tr>
<th>Troubleshooting OPEX Savings 1st and 2nd lines</th>
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<tbody>
<tr>
<td>OPEX truck rolls/year</td>
</tr>
<tr>
<td>OPEX troubleshooting/year (shorter calls)</td>
</tr>
<tr>
<td>CAPEX unnecessary replacement of working HGW's</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Troubleshooting OPEX Savings 3rd line</th>
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</thead>
<tbody>
<tr>
<td>Faster troubleshooting</td>
</tr>
<tr>
<td>OPEX truck rolls/year</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Delivery Team OPEX Savings</th>
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</thead>
<tbody>
<tr>
<td>Deliver the service right the first time</td>
</tr>
</tbody>
</table>

## Overall Business Aspects

| Increased sales | # | # | # |
| Less churn      | # | # | # |

<table>
<thead>
<tr>
<th>Total Savings (EUR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#</td>
</tr>
</tbody>
</table>

The second benefit, and perhaps the most important outcome, relates to the fact that the solution will improve customer satisfaction, as well as meet a number of other important goals. These goals, specifically outlined by EuroTel in this case, are also top priorities for most service providers as these goals help to reduce customer churn and OPEX.

- Improved proactivity
- Faster resolution of customer issues
- Diversion of inbound support calls to self-service online alternatives