Sevana PCAP Analyzer - User Manual

Introduction

Sevana PCAP Analyzer (*pvqa_pcap*) is a command-line tool for analyzing VoIP call quality from network packet capture (PCAP) files. It extracts RTP audio streams, decodes them, and provides comprehensive voice quality metrics using Sevana's Perceptual Voice Quality Assessment (PVQA) technology. It tries to detect audio problems: echo, clipping, silence, background noise. The tools is capable to decode SIP signalling and extract audio streams using network & codec information from SIP.

What You Can Do With This Tool

- Analyze recorded VoIP calls for quality issues
- Get MOS (Mean Opinion Score) ratings for voice calls
- Detect audio problems: echo, clipping, silence, background noise
- Extract and decode audio streams to WAV files
- Generate detailed JSON or text reports
- Analyze SIP call flows and correlate with RTP streams

Supported Audio Codecs

- G.711 (A-law and μ-law)
- G.729
- iLBC
- Opus
- AMR / AMR-WB (may require additional licensing)
- GSM-EFR (may require additional licensing)
- EVS (may require additional licensing)

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Getting Started

Prerequisites

1. **License file**: You need a valid *pvqa_pcap.lic* license file from Sevana (or API key to use with the license server)
2. **Configuration file**: A *pvqa_pcap.cfg* configuration file
3. **PCAP file**: A network capture file containing VoIP traffic

Quick Start

1. Place your license file and configuration file in the same directory as the tool
2. Run the analyzer:
   ```
   ./pvqa_pcap --input your_capture.pcap --config pvqa_pcap.cfg
   ```
   The –config option may be missed if configuration file is named *pvqa_pcap.cfg*
3. View the output report

Configuration File

The configuration file uses YAML format. Create a file named *pvqa_pcap.cfg* with the following structure:

```yaml
pvqa:
  license: pvqa_pcap.lic
```

License Options

The *license* field supports three formats:

Format	Example	Description
File path	*pvqa_pcap.lic*	Path to local license file
License URL	*license://apikey@license.server.com*	License server URL

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Command-Line Reference

Basic Syntax

```
pvqa_pcap [OPTIONS] --input <pcap_file> --config <config_file>
```

Required Options

Option	Description
--input <file>	Path to the PCAP file to analyze
--config <file>	Path to the configuration file

Output Options

Option	Description
--json-format	Generate JSON output instead of plain text
--united-report <path>	Save report to specified file; use - or *console* for stdout
--audio-output <dir>	Save decoded audio streams as WAV files to this directory
--save-sip <file>	Save extracted SIP messages to file
--log <file>	Write processing log to file

Processing Options

Option	Description
--threads <n>	Number of processing threads (default: 1). Use *0* for all CPUs
--single-pass	Use single-pass analysis mode (faster, uses more memory)
--no-decode	Skip audio decoding; generate network statistics only
--verbose	Show detailed processing output

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Progress Display

Option	Description
--progress none	No progress output (default)
--progress print	Print progress percentage to console line by line
--progress show	One-line progress display

Filtering Options

Option	Description
--filter-call-id <id>	Process only streams matching this SIP Call-ID
--filter-ptype <type>	Process only RTP streams with this payload type (can specify multiple)
--max-stream-count <n>	Limit analysis to first N streams
--match-stream-id <id>	Process only the specified stream ID

SIP Options

Option	Description
--grep-sip	Look for SIP traffic (UDP/TCP) and correlate with RTP streams
--require-sip <code>	Only process RTP streams that have SIP handshake with specified response code

Advanced Options

Option	Description
--esp-icv-size <size>	ESP ICV hash size for encrypted traffic
--silent-tail <seconds>	Check for silence at end of stream (specify duration in seconds)

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Option	Description
--version	Display version information and exit

Usage Examples

Basic Analysis

Analyze a PCAP file and display results on console:

```
./pvqa_pcap --input call_recording.pcap --config pvqa_pcap.cfg
```

Generate JSON Report

Create a machine-readable JSON report:

```
./pvqa_pcap --input call_recording.pcap --config pvqa_pcap.cfg \
    --json-format --united-report analysis_report.json
```

Extract Audio Files

Decode and save audio streams as WAV files:

```
./pvqa_pcap --input call_recording.pcap --config pvqa_pcap.cfg \
    --audio-output ./decoded_audio/
```

High-Performance Analysis

Use all available CPUs for faster processing:

```
./pvqa_pcap --input large_capture.pcap --config pvqa_pcap.cfg \
    --threads 0 --progress show
```

Analyze Specific Call

Filter analysis to a specific SIP call:

```
./pvqa_pcap --input multi_call.pcap --config pvqa_pcap.cfg \
    --filter-call-id "abc123@192.168.1.100"
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Network Statistics Only

Get network metrics without audio decoding (faster):

```
./pvqa_pcap --input call_recording.pcap --config pvqa_pcap.cfg \
    --no-decode --json-format
```

Full Analysis with All Outputs

Complete analysis with audio extraction, SIP logs, and JSON report:

```
./pvqa_pcap --input call_recording.pcap --config pvqa_pcap.cfg \
    --json-format \
    --united-report report.json \
    --audio-output ./audio/ \
    --save-sip sip_messages.txt \
    --log analysis.log \
    --threads 4 \
    --progress show
```

Understanding the Output Report

The JSON report is organized into several sections. Let's examine each one.

Packet Counter

The first section provides statistics about packets found in the PCAP file:

```
{
  "packet_counter": {
    "data": [
      {
        "name": "IP packets",
        "value": "21442",
        "info": "Number of found IP packets"
      },
      {
        "name": "UDP packets",
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

```
        "value": "18889",
        "info": "Number of found UDP packets"
      },
      {
        "name": "RTP packets",
        "value": "18817",
        "info": "Number of found RTP packets (without RTCP)"
      },
      {
        "name": "RTP packets (unknown payload)",
        "value": "0",
        "info": "Number of found RTP packets without known payload type i.e.
failed to associate with voice codec"
      },
      {
        "name": "RTP packets (without SIP info)",
        "value": "0",
        "info": "Number of found RTP packets which do not belong to any SIP
call"
      },
      {
        "name": "RTCP packets",
        "value": "72",
        "info": "Number of found RTCP packets."
      },
      {
        "name": "RTP endpoints",
        "value": "7",
        "info": "Number of found RTP endpoints/tuples"
      },
      {
        "name": "SIP packets",
        "value": "123",
        "info": "Number of found SIP packets (UDP and TCP)"
      },
      {
        "name": "SIP TCP packets",
        "value": "123",
        "info": "Number of found SIP TCP packets"
      },
      {
        "name": "SIP UDP packets",
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

```
        "value": "0",
        "info": "Number of found SIP UDP packets"
      },
      {
        "name": "SIP INVITE requests",
        "value": "9",
        "info": "Number of SIP INVITE request messages"
      },
      {
        "name": "SIP INVITE responses",
        "value": "21",
        "info": "Number of SIP INVITE response messages"
      },
      {
        "name": "BYE requests",
        "value": "3",
        "info": "Number of SIP BYE request messages"
      },
      {
        "name": "BYE responses",
        "value": "0",
        "info": "Number of SIP BYE response messages"
      },
      {
        "name": "IP packets fragmented",
        "value": "0",
        "info": "Number of fragmented IP packets"
      },
      {
        "name": "IP packets non-fragmented",
        "value": "40330",
        "info": "Number of non-fragmented IP packets"
      }
    ]
  }
}
```


Each entry contains *name*, *value*, and *info* fields. The *info* field provides a human-readable description of each counter.

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

SIP Statistics

The next section summarizes SIP call states:


```
{
  "sip_statistics": {
    "data": [
      {
        "name": "Semistarted calls",
        "value": "0",
        "info": "Calls with initial INVITE but without 200 OK"
      },
      {
        "name": "Started calls",
        "value": "3",
        "info": "Calls with initial INVITE and 200 OK response"
      },
      {
        "name": "Semicomplete calls",
        "value": "0",
        "info": "Calls with initial INVITE + 200 OK + initial BYE request"
      },
      {
        "name": "Complete calls",
        "value": "3",
        "info": "Calls with INVITE/200 OK and BYE/ACK"
      },
      {
        "name": "Finished calls",
        "value": "0",
        "info": "Calls without INVITE but with BYE"
      },
      {
        "name": "Maximal number of used RTP tuples",
        "value": "18",
        "info": "Maximal number of simultaneously used RTP peers"
      },
      {
        "name": "Bad SIP messages",
        "value": "0",
        "info": "Number of SIP messages failed to parse"
      },
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

```
      {
        "name": "Calls with media",
        "value": "3",
        "info": "Number of SIP calls with detected media RTP streams."
      }
    ]
  }
}
```

This helps you understand call completion rates and identify incomplete or failed calls in the capture.

Global Report Fields

Several top-level fields provide general information:

```
{
  "silent_tail_length_seconds": 0,
  "analysis_duration_ms": 9610,
  "software": "vq_pcap v1.8.10, build 10991"
}
```

Field	Description
silent_tail_length_seconds	Configured silent tail detection length (from *--silent-tail* option)
analysis_duration_ms	Total processing time in milliseconds
software	Version of the analyzer that generated this report

Streams Array

The *streams* array contains detailed information for each RTP stream. Here's an example stream:

```
{
  "streams": [
    {
      "stream_id": 1,
      "rtp_ssrc": 575474971,
      "rtp_src": "192.168.2.93:26484",
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

```
      "rtp_dest": "192.168.2.93:18416",
      "mos_sevana": 3.84458,
      "mos_network": 4.14,
      "rtp_counter": 3135,
      "rtp_lost": 0,
      "rtp_illegal": 0,
      "rtcp_counter": 12,
      "jitter": 0.0416667,
      "delay": 0.152,
      "codec": "OPUS",
      "starttime": 1763112574298,
      "endtime": 1763112636998,
      "is_silent": false,
      "audio": "audio/s_00000001.wav",
      "sip_callid": "fSHCB9emgQqgFDqnwgrVgA..",
      "sip_peer_1": "alice@sip.sevana.biz:5060",
      "sip_peer_2": "bob@sip.sevana.biz",
      "sip_codec": "OPUS ptype: 107, rate: 48000, channels: 2\n",
      "sip_bye": true,
      "ptypes": "ptype: 107 : 3135 ",
      "detector_report": { ... }
    }
  ]
}
```


Stream identification:

Field	Description
stream_id	Unique identifier for this stream
rtp_ssrc	RTP Synchronization Source identifier
rtp_src	Source IP address and port
rtp_dest	Destination IP address and port

Quality scores:

Field	Description
mos_sevana	Sevana MOS score (1.0-5.0) - perceptual audio quality

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Field	Description
mos_network	Network MOS score (1.0-5.0) - based on network metrics

Network statistics:

Field	Description
rtp_counter	Total number of RTP packets in stream
rtp_lost	Number of lost packets
rtp_illegal	Number of packets with sequence/timing issues
rtcp_counter	Number of RTCP packets
jitter	Packet jitter in seconds
delay	Network delay in seconds

Stream details:

Field	Description
codec	Detected audio codec (e.g., OPUS, G711A, G729)
starttime	Stream start time (Unix timestamp in milliseconds)
endtime	Stream end time (Unix timestamp in milliseconds)
is_silent	*true* if stream contains only silence
audio	Path to decoded WAV file (if *--audio-output* used)
ptypes	RTP payload types found in stream with packet counts

SIP correlation:

Field	Description
sip_callid	Associated SIP Call-ID

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Field	Description
sip_peer_1	First SIP endpoint (caller)
sip_peer_2	Second SIP endpoint (callee)
sip_codec	Codec information from SIP negotiation
sip_bye	*true* if call was properly terminated with BYE

Quality Scores (MOS)

MOS (Mean Opinion Score) ranges from 1.0 to 5.0:

Score	Quality	Description
4.3 - 5.0	Excellent	Imperceptible degradation
4.0 - 4.3	Good	Perceptible but not annoying
3.6 - 4.0	Fair	Slightly annoying
3.1 - 3.6	Poor	Annoying
2.6 - 3.1	Bad	Very annoying
1.0 - 2.6	Very Bad	Unacceptable

Sevana MOS (*mos_sevana*) reflects actual perceived audio quality using advanced signal analysis.

Network MOS (*mos_network*) estimates quality based on network conditions (packet loss, jitter).

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Detector Report

Each stream includes a *detector_report* with detailed quality analysis:


```
{
  "detector_report": {
    "mos": 3.84458,
    "rfactor": 0.923913,
    "imps": [
      {
        "Echo": 7
      }
    ],
    "echo": [
      {
        "time_ms": 12490,
        "level": -25.8475,
        "length": 1.86663
      },
      {
        "time_ms": 12990,
        "level": -25.8475,
        "length": 1.86663
      },
      {
        "time_ms": 13850,
        "level": -27.8321,
        "length": 2.048
      }
    ],
    "headers": [ ... ],
    "rows": [ ... ]
  }
}
```


Field	Description
mos	Overall MOS score for this stream
rfactor	R-Factor (transmission rating factor, 0-1 scale)
imps	Array of detected impairments with occurrence counts

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Field	Description
echo	Detailed echo events (see below)

Echo events provide precise timing and characteristics of detected echo:

Field	Description
time_ms	Time offset in milliseconds where echo was detected
level	Echo level in dB (more negative = quieter echo)
length	Echo tail length in seconds

Time-Segmented Analysis

The *headers* and *rows* arrays provide time-segmented quality analysis:


```
{
  "headers": [
    "Time",
    "SNR",
    "DeadAir-00",
    "DeadAir-01",
    "Click",
    "VAD-Clipping",
    "AmpClipping",
    "DynClipping",
    "Echo",
    "SilentCall",
    "Status"
  ],
  "rows": [
    [
      "0.000 : 0.680",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
```


Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

```
      "0.000",
      "1.000",
      "Uncertain"
    ],
    [
      "1.360 : 2.040",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.000",
      "0.478",
      "Ok"
    ]
  ]
}
```


Each row represents approximately 680ms of audio. The columns are:

Column	Description
Time	Time segment (start : end in seconds)
SNR	Signal-to-Noise Ratio issues (0.0 = good, 1.0 = severe)
DeadAir-00	Complete silence in both directions
DeadAir-01	Silence where speech was expected (one direction)
Click	Click/pop artifacts detected
VAD-Clipping	Voice Activity Detection cutting off speech
AmpClipping	Amplitude clipping from overdriven signal
DynClipping	Dynamic range compression artifacts
Echo	Echo detection level
SilentCall	Silent call detection (1.0 = silence, lower = speech present)
Status	Segment quality: *Ok*, *Uncertain*, or *Poor*

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

Detector values range from 0.0 (not detected) to 1.0 (severe). Use this data to identify exactly when and where quality issues occurred during the call

---

Processing Modes

Multi-Pass Mode (Default)

The default mode processes PCAP files in three passes:

1. **Pass 1**: Scans the file to identify all streams and SIP calls
2. **Pass 2**: Decodes audio and performs quality analysis
3. **Pass 3**: Correlates SIP calls with RTP streams and generates report

This mode is memory-efficient for large files.

Single-Pass Mode

Use *`--single-pass`* for:

- Live capture analysis
- When memory & CPU are not the constraints

```
./pvqa_pcap --input capture.pcap --config pvqa_pcap.cfg --single-pass
```

Troubleshooting

Common Issues

“Config file not found”

- Ensure *`pvqa_pcap.cfg`* exists in the specified path
- Check file permissions

“License error” or analysis fails silently

- Verify license file path in configuration
- Check license file is valid and not expired
- For license server: verify network connectivity

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598

No streams detected

- Ensure PCAP contains RTP traffic
- Try with `--grep-sip` to help identify SIP-correlated streams
- Check if traffic uses supported codecs

Low MOS scores on known-good calls

- Verify the correct codec is being detected
- Check for packet loss in the capture itself
- Ensure complete call was captured

High memory usage

- Use default multi-pass mode (avoid `--single-pass`)
- Limit streams with `--max-stream-count`
- Process smaller time segments

Slow processing

- Increase threads with `--threads 0` (use all CPUs)
- Use `--no-decode` if only network statistics needed
- Filter to specific calls with `--filter-call-id`

Getting Help

For additional support:

- Check the included PDF documentation in the `docs/` folder
- Contact Sevana support with your license information

Sevana PCAP Analyzer - Voice Quality Assessment Tool

Sevana Oü
Roosikrantsi tn 2
Tallinna linn, Harju maakond, 10119
Estonia
Phone: +37253686598