OCTVQE Zaptel Echo Canceller

User's Guide

(Preliminary)

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1 INTRODUCTION

The OCTVQE Zaptel Echo Canceller is a software package that consists of a Linux executable that performs echo cancellation on systems that use Zaptel, a computer telephony hardware driver. The application communicates with the Zaptel driver through a kernel module.

The application provides industry-leading echo cancellation and voice quality enhancements. This product can only be used by systems that use computer telephony hardware that communicates through the Zaptel driver.

2 FEATURES LIST

2.1 Echo Cancellation and Voice Quality Enhancement

- Acoustic echo cancellation
- Line echo cancellation - 128 ms tail echo cancellation
- Excellent subjective quality in all conditions
- High quality NLP with spectral comfort noise
- Configurable adaptive noise reduction (ANR) algorithm

2.2 Linux Application and Kernel Module

- Linux 2.4 and 2.6 Kernel series support on x86 and x86-64 CPUs
- Up to 16 simultaneous channels
- Latency of 20 milliseconds
- Easy channel monitoring of live voice streams
- Software upgradeable

2.3 Performance

The OCTVQE Zaptel Echo Canceller was benchmarked on various systems. The table below provides some metrics of the average CPU time required for some common processors, for the default channel configuration.

CPU	Average time to process 20 ms
Intel ® Pentium 4 ® 3.0 GHz	240 us
AMD Athlon™ XP 3200+ 2.2 GHz	230 us
AMD Athlon™ 64 X2 Dual Core 4200+ 2.2 GHz	275 us

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3 INSTALLATION

3.1 System Requirements

The module must be installed on an x86 or x86-64 system running a Linux distribution with a kernel of the 2.4 or 2.6 series. Computer telephony hardware configured on a working Zaptel driver installation is required.

Each supported channel uses approximately 46 Kbytes of system memory.

NOTE: Zaptel driver installations without computer telephony hardware, using the "*ztdummy*" timing module, do not meet the system requirements. Voice samples do not go through Zaptel in pure VoIP applications.

3.2 Downloading Archive

The latest version of the OCTVQE8 software is always available from:

http://www.octware.net/downloads/

ftp://ftp.octware.net/pub/octvqe8/

The latest version can be downloaded using FTP or HTTP protocol, using command line tools like *wget* or *ftp*.

Two different files are needed to build a complete package. One is the base package needed to interface with low-level Zaptel routines, the other is the actual echo cancellation service binary. The echo cancellation service binary is optimized for certain specific CPU. The appropriate package file should be downloaded according to the target CPU.

3.3 Archive Contents

The compressed OCTVQE - Zaptel Echo Canceller archives (in .tgz format) can be decompressed using the following command in a shell window:

```
[root@localhost temp_dir]# tar -zxpf octvqe8-01.04.01-base.tgz
[root@localhost temp_dir]# tar -zxpf octvqe8-01.04.01-<arch>.tgz
```

Here are the contents of these archives:

Filename	Description
octvqeug5000-xxx.pdf	This document, the application’s user guide.
ReleaseNotes.txt	Release notes.
README	Readme file containing brief installation instructions.
octwareec.h	This header file provides the hooks for the OctWare Echo Canceller into the Zaptel interface.
octvqe/octvqe_linux.c, .h	The OCTVQE kernel module source files.
octvqe/octvqe_ioctl.h	The OCTVQE kernel module I/O control defines, for channel statistics.
octvqe/Makefile	Makefile necessary to compile the OCTVQE kernel module.
octvqe/octvqed	The echo cancellation and VQE service binary.
octvqe/octvqed.8	The echo cancellation service command description manual.
octvqe/octvqed.init	Script to make the service auto-loading at system start-up.
octvqe/octvqed.conf	Channel parameters configuration file.

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Upon receiving the OCTVQE - Zaptel Echo Canceller archives:

1. Extract the archives contents and verify that all the files listed above are present.
2. Read through ReleaseNotes.txt for backward compatibility and version-specific information.

3.4 Building and Installing the Octvqe Module

Since it is necessary to build the module for the Linux kernel running on the target machine, the package provides the necessary source files to do so.

In principle, the module should be compiled whenever the version of the Linux kernel is changed on the target machine. To compile the module, the corresponding Linux kernel source tree must be installed on the compiling machine.

Compiling the *octvqe* kernel module also requires the Zaptel source to be available. The source includes the default echo canceller that ships with Zaptel. This echo canceller will be used when the *octvqed* service is not running. The following guidelines assume that the Zaptel source code is located in */usr/src/zaptel*.

Run the following commands as root in a terminal in order to compile and install the *octvqe* kernel module:

```
[root@localhost temp_dir]# cd octvqe8-01.04.01
[root@localhost octvqe8-01.04.01]# cp -rf octvqe /usr/src/zaptel
[root@localhost octvqe8-01.04.01]# cd /usr/src/zaptel/octvqe
[root@localhost octvqe]# make
[root@localhost octvqe]# make install
[root@localhost octvqe]# killall octvqed
[root@localhost octvqe]# rmmod octvqe
[root@localhost octvqe]# depmod
[root@localhost octvqe]# modprobe octvqe
```

NOTE: The ‘*killall octvqed*’ and ‘*rmmod octvqe*’ commands are only required if upgrading from a previous version. Please make sure to also remove any module that depends on the *octvqe* module as well (for example, *zaptel*).

3.5 Rebuilding and Installing the Zaptel Module

Since the default Zaptel installation does not contain the OctWare OCTVQE software, the Zaptel source files must be modified and recompiled. This allows Zaptel to use the *octvqed* application for echo cancellation. Again, the following guidelines assume that the Zaptel source code is located in */usr/src/zaptel*.

The Zaptel version number is required before proceeding with the rebuild since the location of the files to edit depend on it. If rebuilding an 1.4.8 or older version of Zaptel, the files to edit are in the */usr/src/zaptel* directory. If rebuilding a 1.4.9.2 or newer version of Zaptel, the files to edit are in the */usr/src/zaptel/kernel* directory. The command examples in the following instructions are taken from a 1.4.8 installation. **Users running the 1.4.9.2 or newer version of Zaptel must not forget to add */kernel* to the source path.**

Here are the steps to follow in order to rebuild and install the Zaptel module.

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Copy the *octwareec.h* definition file from the installation package to the Zaptel source directory:

```
[root@localhost octvqe8-01.04.01]# cp octwareec.h /usr/src/zaptel
[root@localhost octvqe8-01.04.01]# cd /usr/src/zaptel
```

Edit the *zconfig.h* file in order to define OctWare's echo canceller. Search within this file for the keyword ECHO_CAN and replace the default echo canceller with the OctWare echo canceller by commenting out the built-in echo canceller and adding the following line:

```
#define ECHO_CAN_OCTWARE
```

Edit the Zaptel *zaptel-base.c* source file to include OctWare's echo canceller. Search for the ECHO_CAN keyword and add the following lines:

```
#elif defined(ECHO_CAN_OCTWARE)
#include "octwareec.h"
```

Run the following commands to compile and install the Zaptel drivers with the new echo canceller:

```
[root@localhost zaptel]# make
[root@localhost zaptel]# make install
```

Remove the old Zaptel module (as well as any other Zaptel dependent modules) and reload the newly created Zaptel module:

```
[root@localhost zaptel]# rmmod zaptel
[root@localhost zaptel]# modprobe zaptel
```

3.6 Registering the Octvqed Service

In the case where a per-channel license service is used (OCTVQE8 package), a registration utility needs to be used to download a license that activates channels. This has to be done only once, before starting the *octvqed* service for the first time. Additional channel licenses can be purchased and activated at any time.

There are two versions of the register utility, one for 32 bit systems and one for 64 bit systems. They are differentiated by their suffix which is 32 or 64. The registration utility can be downloaded from:

http://www.octware.net/downloads/

ftp://ftp.octware.net/pub/register/

The registration procedure is detailed below.

First, change the permissions of the register utility file found in the package source directory (replace XX by 32 or 64 depending on your version). Change the user and group ownership of the file to “root”.

```
[root@localhost octvqe8-01.04.01]# chmod 500 registerXX
[root@localhost octvqe8-01.04.01]# chown root.root registerXX
```

Internet access is required from the Zaptel installation host to be able to register the OCTVQE software for licensed use. Outgoing traffic on TCP (enough permission to open an SSL session) must be allowed in order for the register utility to successfully communicate with OctWare’s license server and finalize the registration process. Also, the name of the first ethernet device found on the host that will run the OCTVQE software must be “eth0”, for the registration sequence to complete. The other Ethernet devices found on the system are not considered when generating the license. Run the application:

```
[root@localhost octvqe8-01.04.01]# ./registerXX
```

If the register utility starts up correctly, enter the Activation-Key that you have purchased. Follow the on-screen instructions.

Repeat the same procedure if more then one license needs to be generated. The utility also supports a “batch” activation mode, where the Activation-Keys are passed to the application using a file, one Activation-Key per line. Use the –b option.

Optionally, the generated licenses can be verified using the –p argument to the register utility:

```
[root@localhost octvqe8-01.04.01]# ./registerXX -p
OctWare Product Registration Utility
Copyright (C) 2007, OctWare Inc.
Reading directory '/var/lib/octware/licenses'...
Product OCTVQE8 (quantity 2) found in file OCTVQE8-OCT-XXXXXXXXXXXX-2.lic
Product OCTVQE8 (quantity 1) found in file OCTVQE8-OCT-XXXXXXXXXXXX-1.lic
```

The register application is used for all OctWare products. Therefore, licenses for other products may appear in this list when the –p argument is used. The register utility will print the information for all license files found in the */var/lib/octware/licenses* directory.

It is EXTREMELY important to BACKUP the files found in */var/lib/octware/licenses* directory. This directory contains the Host-ID specific license files for the current system. These licenses are locked to the MAC address of the Ethernet devices found on the system. Creating a backup of this directory will allow a complete restoration of the OCTVQE channels that were licensed using the register utility when doing a new operating system installation. This will prevent unnecessary interactions with your key distributor, requesting authorization to increment the Activation-Key that was already used.

Here are the register utility command line options:

-b FILE: Read activation keys from FILE.

-h:	Display the help menu and exit.
-l:	Display the license information for the program and exit.
-p:	Display the licenses installed on this host.
-v:	Print the version of the register utility, openssl toolkit and curl library.

3.7 Starting the Octvqed Service

Start the echo cancellation service simply by running *octvqed* as root. The application will detach from the calling terminal and will run in the background.

```
[root@localhost octvqe]# ./octvqed
```

Here are the available command line options:

-c NUM:	Start the *octvqed* service using NUM channels.
-f CONFIG:	Read channel configuration from config file CONFIG instead of */etc/octvqed.conf*.
-h:	Display the help menu and exit.
-l:	Display the license information for the program and exit.
-v:	Print the version of the *octvqed* daemon and the version of the OCTVQE API and exit.
-x:	Run *octvqed* in debug mode, the server will not detach from the terminal.

3.8 Automatic Startup Script

The OCTVQE service can be automatically loaded at startup using an init script. The procedure outlined below must be followed to have the service automatically launched when the host boots.

First, the *octvqed* application binary must be permanently installed on the host. We recommend installing the *octvqed* file in the */usr/sbin/* directory:

```
[root@localhost octvqe]# cp octvqed /usr/sbin/
```

Then locate the init script example in the package's *octvqe* directory. This file should be copied and renamed to your system's initialization directory, where the init procedure launches all service processes. The file name should be the same as the name of the service, *octvqed*. Under Fedora Core, this is in the */etc/rc.d/init.d/* directory:

```
[root@localhost octvqe]# cp octvqed.init /etc/rc.d/init.d/octvqed
[root@localhost octvqe]# chown root.root /etc/rc.d/init.d/octvqed
[root@localhost octvqe]# chmod 755 /etc/rc.d/init.d/octvqed
```

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Changing the file permissions to executable instructs the system’s init procedure that this script is executable when the system is booting. If the *octvqed* application executable has been installed into a directory different from */usr/sbin/*, edit *octvqed.init* to reflect the changes. Then instruct the operating system that this new service should started and stopped automatically:

```
[root@localhost octvqe]# chkconfig --add octvqed
[root@localhost octvqe]# chkconfig octvqed on
```

The script can be used to control the OCTVQE service, with the following arguments:

start: Starts the OCTVQE service.

stop: Stop the OCTVQE service.

restart: Stop and Start the OCTVQE service.

Alternatively, most distributions support the */etc/rc.d/rc.local* user initialization script. The OCTVQE service could be started using this file, however this will not kill *octvqed* very cleanly during a reboot or shutdown.

Since starting service processes at boot time differs among distributions, it is best to consult the OS documentation for how to do this.

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4 CHANNEL CONFIGURATION

4.1 Default Configuration

By default, the echo cancellation channels are configured like this:

Parameter	Value	Description
Tail Length	64 ms	Maximum tail length used by the echo canceller. For optimal results this value should not be set higher then the longest expected echo path delay.
Default ERL	9 dB	The default ERL in decibels that is assumed by the NLP when not converged, e.g. at the beginning of a call.
Adaptive Noise Reduction	no	Adaptive noise reduction (ANR) enable flag.
ANR Improvement Ratio	12 dB	Represents the target attenuation of the background noise. This parameter defines the ratio of the noise before and after the ANR algorithm is performed. Only active when ANR is enabled.
ANR Segregation	18	Controls the aggressiveness of the ANR algorithm. It is used to adjust the module that differentiates between noise and voice. When configured as “More aggressive” the algorithm will be more likely to consider a signal as noise and suppress it. Only active when ANR is enabled.

The default parameter values are set such that the best subjective results are achieved under most conditions. The defaults can be overridden with a configuration file, as detailed below.

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4.2 Configuration File

It is possible to change the default channel parameter values by using a configuration file that contains the desired settings. By default, the *octvqed* service will look for a configuration file in */etc/octvqed.conf*. This path can be overridden by passing the configuration file with the –f argument to the *octvqed* service. The format of the configuration file is very similar to the configuration files used in Zaptel. The table below lists the parameters that can be configured using the file:

Parameter	Value/Range	Comment
taillength	32 to 128 ms in steps of 16 ms	See description in default configuration table.
defaulterl	-21 to +21 dB in steps of 3 dB	See description in default configuration table.
anr	yes or no	See description in default configuration table.
anrratio	6 to 24 dB in steps of 6 dB	See description in default configuration table.
anrsegregation	1 to 30	See description in default configuration table. A value of "1" is considered the least aggressive while a value of "30" is the most aggressive.
channel	1-16	Channel number, range or list to which the above configuration applies.

Refer to the included *octvqed.conf* file for an example configuration file.

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5 STATISTICS

Channel-specific configuration and statistics can be retrieved via the */proc* filesystem. When the OCTVQE module loads, a */proc/octvqe* entry is created in the virtual filesystem. This entry can be used for displaying channel information. A typical output looks like:

```
[root@localhost ~]# cat /proc/octvqe
OCTVQE-MOD-01.04.01-PR, built on Mar 17 2008 10:27:00
Channel 1 (Active) (Octvqed Connected)
  Tail Length (64 ms), Default ERL (9 dB), Current Call Samples (2328280)
  ANR Algo. (Active), Improvement Ratio (12 dB), Segregation Factor (18)
  Rin/Sin Current Energy (-65 dB, -62 dB), Av. Energy (-68 dB, -65 dB)
  Number Buffers (14551), Buffer Size (20 ms), Av./Max CPU Time (204 us, 304 us)
Channel 2 (Active) (Octvqed Connected)
  Tail Length (64 ms), Default ERL (9 dB), Current Call Samples (2328272)
  ANR Algo. (Active), Improvement Ratio (12 dB), Segregation Factor (18)
  Rin/Sin Current Energy (-65 dB, -59 dB), Av. Energy (-68 dB, -59 dB)
  Number Buffers (14551), Buffer Size (20 ms), Av./Max CPU Time (189 us, 286 us)
…
```

This output contains, among other things, the OCTVQE kernel module version, build date, current and average voice energy levels and number of processed buffers.

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6 SOFTWARE UPDATE

Software updates will be made available through OctWare's FTP and web site, at the following URLs:

http://www.octware.net/downloads/

ftp://ftp.octware.net/pub/octvqe8/

Please make sure to read the instructions enclosed in the new .tgz files when upgrading the OCTVQE software.

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7 REVISION HISTORY

Version	Date	Changes
2.0	March 2008	Updated to match OCTVQE8 01.04.01-PR release. Removed Asterisk 1.2 references and included Asterisk 1.6 instructions.
1.9	May 2007	Added Adaptive Noise Reduction (ANR) feature. Updated performance table following CPU optimizations. Added echo cancellation service manual page.
1.8	April 2007	Added install instructions for the 1.4.1 Zaptel version. Clarifications on the hardware requirements of OCTVQE8. Changed maximum number of channels from 8 to 16.
1.7	March 2007	New link to HTTP site. Clarifications on the default Zaptel echo canceller added. Initialization script read from /etc/octvqed.conf by default.
1.6	March 2007	Instructions to include the Zaptel echo canceller added. Procedure for upgrading from an old version added.
1.5	February 2007	Initialization script clarifications. Performance metrics added.
1.4	February 2007	Minor formatting changes. OctWare logo added. Instructions for downloading archive. Changed default configuration values.
1.3	February 2007	Reviewed for clarity. Online link information added.
1.2	February 2007	Added OCTVQE8 model, registration instructions. Added configuration file section. Added statistics section.
1.1	February 2007	Installation instructions and package content.
1.0	November 2006	Initial release.

For more information on this or other products visit our web site: http://www.octware.net/

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