EXPLORE
International Journal of Engineering & Technology
CENTRE OF PROFESSIONAL RESEARCH PUBLICATIONS
ISSN 2049-3444

International Journal of Engineering and Technology Volume 3 No. 2, February, 2013

Engineering Order Wire Implementation

Chittajit Sarkar
Swami Vivekananda Institute of Science and Technology
West Bengal University of Technology, Kolkata, India

ABSTRACT

Purpose of this paper is to describe the hardware design implementation of the Enigneering Order Wire. Engineering Order Wires (EOW) allow field engineers to communicate during installation, commissioning and maintenance of telecommunication networks. EOW must be robust and shall operate with a minimum of resources even if parts of the network are out of service.The EOW-system is capable of functioning in a ring.These functions have made the EOW-system in large number of PDH-installations and simple SDH networks.

Keywords: *CODEC, DTMF, EOW, FPGA, G.703, PDH, SDH, SLAC, SLIC.*

1. INTRODUCTION

The DTMF-EOW (Dual Tone Multi Frequency – Engineering Order Wire) is a System which provides network wide Telephone service functionality between Telecommunication sites over a single (embedded) 64kbps channel. Since In-band/channel DTMF tones are used for signaling, this module is called as DTMF-EOW. This is to Minimize the Bandwidth required. When the module is used in an SDH network the 64 kbps channel is normally placed in SDH section overhead byte E1 or E2. Since the E1 and E2 bytes are multiplexed in to the SDH frame at the final stages of transmission the impact of network infrastructure on these bytes is very less. Hence as soon as the Communication medium (optic fiber) is good communication is guaranteed for the users. This feature will help the customers to install/ configure/ maintain their Equipment properly. Apart from this, special features are also included for enhancing the performance of the system. These Special features includes selective calling, group calling etc. The digital EOW format is DSC proprietary. The bit rate is nominally 126031 bit/s. Of this only half or 63kbit/s is the actual voice data. The digital EOW signal is sent between modules via cables. The physical format here is ITU V.11.

2. COMMUNICATION INTERFACES OF EOW

Four digital EOW channel, 126 kbps propietery asynchronous channels. Two of the four channels can be configured as G.703 standard 64 Kb/s channels. 2-wire EOW phone interface (POTS).

2.1 EOW Telephone Interface

The EOW Telephone is connected to the SLIC(Subscriber Line Interface Circuit), The SLIC Powers the Telephone and also converts the 2-wire telephone signal to/from a 4-wire transmit and receive signal. A programmable tone generator is used generate various sine wave tones and added to the telephone signal in both transmit and receive directions.

2.2 G.703 Interface

Apart from the digital EOW channels the EOW module will be able to send and receive the data over G.703 interface. Here the data is framed and transferred as per ITU-T recommendation G.703(Physical/electrical characteristics of hierarchical digital interfaces).to make it compatible the G.703 interface output inserts fill bytes to make up its 64 Kbit/s or 8 Kbytes/s stream from the internal 7.877 Kbytes/s. The G.703 interface input removes fill bytes to get a nominal rate of 7.877 Kbytes/s into the receiver FIFO buffer.

2.3 Digital EOW Channel

On the digital EOW interface side the received signal may be either the old standard digital EOW signal or a G.703 standard 64 Kbit/s format signal. The bit rate of the old standard EOW signal is 126 Kbit/s but the speech data rate is only 63 Kbit/s. The received EOW signal is buffered and the bit rate is converted into a parallel stream of 8 bits at 7.877 kHz. The FIFO buffer will either retransmit the previous byte or skip one byte depending on the bit rate of the input signal. The framing of the digital EOW channel is same as old digital EOW format.i.e 8 data bits and one extra bits for signaling purposes. This additional bit may be used for one of four purposes -to represent the even parity/ E/M signaling/ ring toggling/ advanced embedded signaling,

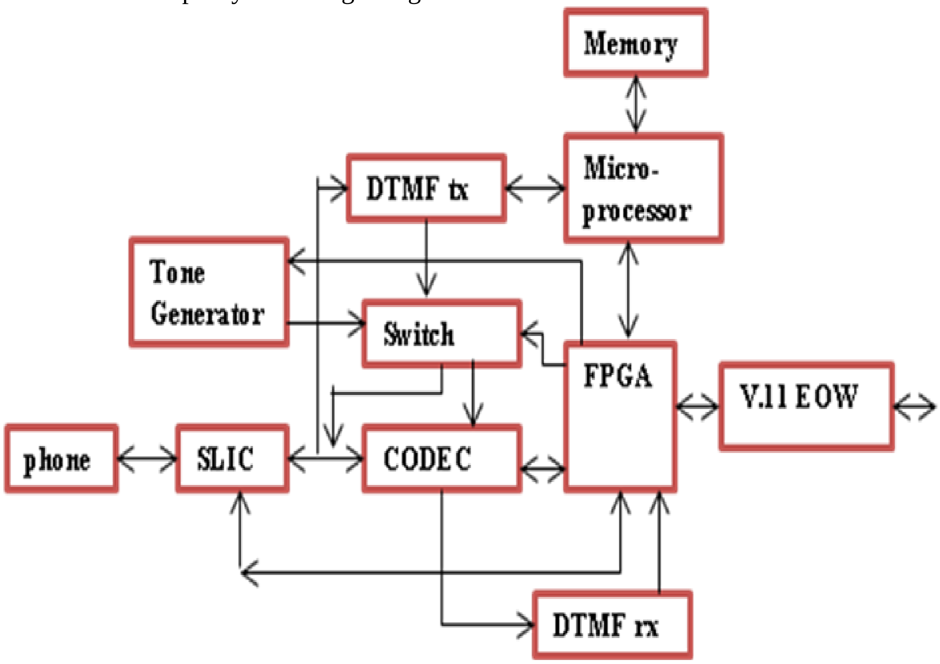


Fig.1 general block diagram of DTMF EOW

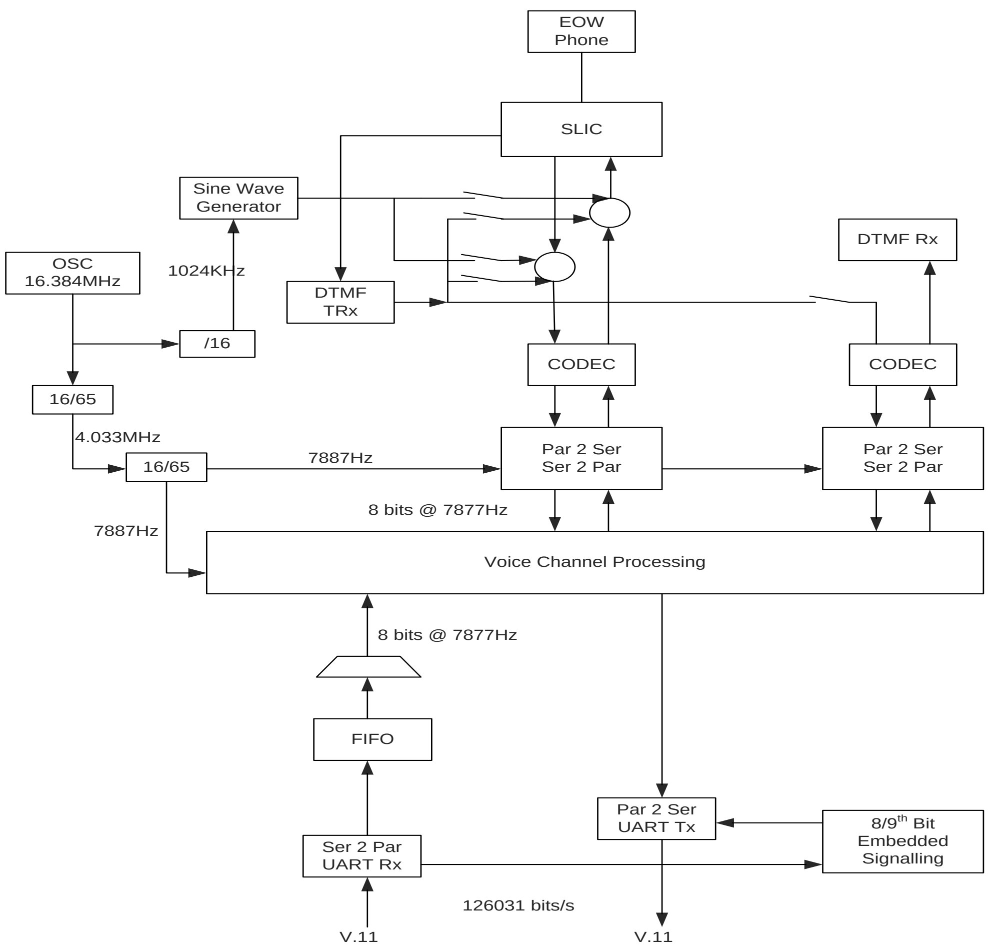


Fig.2: Detailed DTMF EOW Block Diagram

3. GENERIC REQUIREMENTS OF EOW

The central part of the voice channel block diagram is the 7.877 kHz 8 bits wide voice channel processing. Ideally this should happen at 8 kHz but to be compatible with the old EOW module signals it happens at a 123 Hz lower frequency. The input voice signals are: all the digital EOW inputs, the EOW telephone input and the DTMF signalling input. In the central block all input signals are added to make up the output voice signals. The telephone is connected to a SLIC, subscriber line interface circuit, via a relay. The SLIC supplies 48V to the telephone and converts the 2-wire telephone signal to/from a 4-wire transmit and receive signal. The relay is used to switch a ringing signal to the phone. The ringing signal and various other sine wave tones are generated from a programmable tone generator. The tone output can be added to the telephone signal in both transmit and receive directions. A DTMF, dual tone multi frequency, receiver is always connected to the EOW telephone. This DTMF receiver listens for commands from the EOW telephone. Another DTMF receiver is always connected to the audio signal output from the voice channel processing block. This DTMF receiver listens for commands from the EOW line. The voice signal processing clock frequency and other clock frequencies are derived from a common reference crystal oscillator with accuracy better than +/- 100 ppm.

On the digital EOW interface side, the received EOW signal is buffered and the bit rate is converted into a parallel stream of 8 bits at 7.877 kHz. The FIFO buffer will either retransmit the previous byte or skip one byte depending on the bit rate of the input signal. The G.703 interface output inserts fill bytes to make up its 64 kbit/s or 8 kbyte/s stream from the internal 7.877 kbyte/s. The G.703 interface input removes fill bytes to get a nominal rate of 7.877 kbyte/s into the receiver FIFO buffer as shown in fig.2.

4. APPLICATION HARDWARE

4.1 SLIC

The SLIC is AG1171[5] by Silver Telecom. It is a ringing slic, i.e., with inbuilt DC-DC converter to generate ring voltage. SLIC operates at both 3.3V and at 5V. SLIC outputs a High condition on SHK signal during Off-Hook condition. FPGA controls the ring signals (F/R and RM) to SLIC. TIP and RING signals are interfaced to RJ11 jack to connect with a standard 600 ohm impedance telephone. The analog side is interfaced to CODEC.

4.2 CODEC

"AM79Q5457" by Legerity is a 4-channel CODEC. Channel-1 is used for EOW phone and channel-4 is used for DTMF signaling. Transmit and receive frame signals are separate for all channels and is controlled by FPGA. Unused channels 2 & 3 will be power downed. PCM or digital side of CODEC is interfaced with FPGA. 8-bit sampling with A-law coding technique is used.

4.3 SWITCH

For switching of DTMF tones and signaling tones, like Dial tone, busy tone, information tone etc., to EOW line and EOW phone side, analog switch is used. Switches are controlled from FPGA. "DG444" or CBTLV3125PWR will be used.

4.4 DTMF Receiver

MT8870DS DTMF receiver or MT88L70 can be used[1]. The DTMF receiver is always connected to listen to the embedded EOW line. The DTMF receiver outputs a "tone valid" signal. This signal goes to the FPGA where it can generate interrupt. The valid 4-bit DTMF code can be read by FPGA upon getting tone valid signal.

4.5 DTMF Tranceiver

MT8888C DTMF transceiver or MT88L85 can be used[2]. The DTMF receiver in the transceiver is always connected to listen to the signal from the EOW phone. This makes it possible to receive commands from the EOW phone before opening for the EOW line. DTMF transceiver interrupts microcontroller [3] via FPGA [4] on receiving a valid DTMF tone from EOW phone.The decoded 4-bit DTMF value is directly read by microcontroller. The transmitter part is used to send DTMF signals while establishing a communication channel. The DTMF transmitter in the DTMF transceiver can be independently added to two different places: to the EOW line and to the output signal to the EOW phone.

4.6 Tone Generator

A sine wave generator is made by FPGA internal circuits and some external resistors. This tone generator can generate tones to the ringing signal amplifier or to the EOW phone in case of dial tone, busy tone etc.

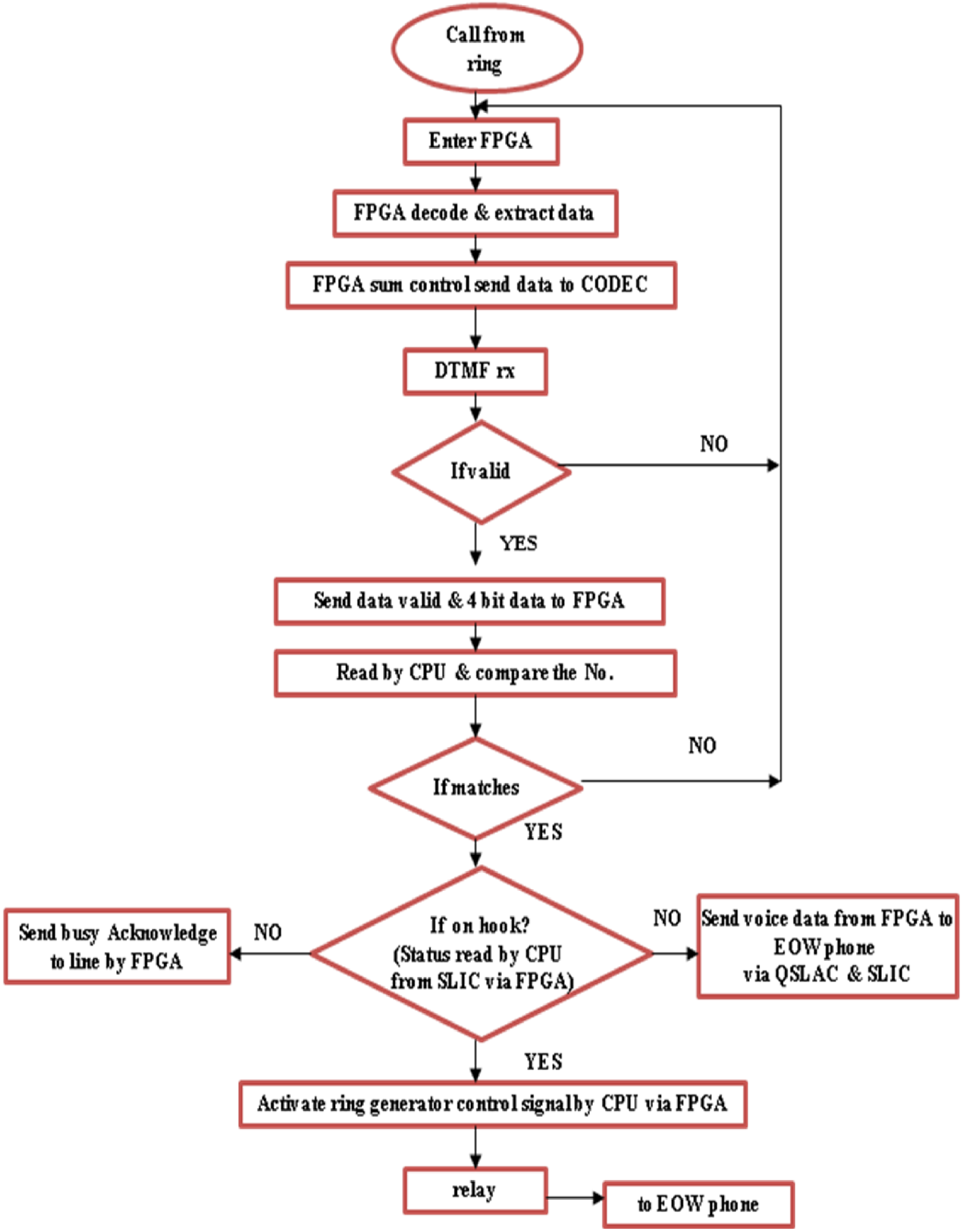
4.7 V.11 Interface

Digital output of EOW is given out through v.11 interface via RJ45 connectors. DS34LV87TM/ AM26LV31 & DS26LV32ATM are proposed to be used as differential driver and differential receiver.

4.8 Hardware Timers

Only one oscillator 16.384 Mhz can be used. This will go to FPGA and FPGA will derive all other clocks for the system.

5. RECEIVE EOW CALL FLOW CHART



6. TRANSMIT EOW CALL FLOW CHART

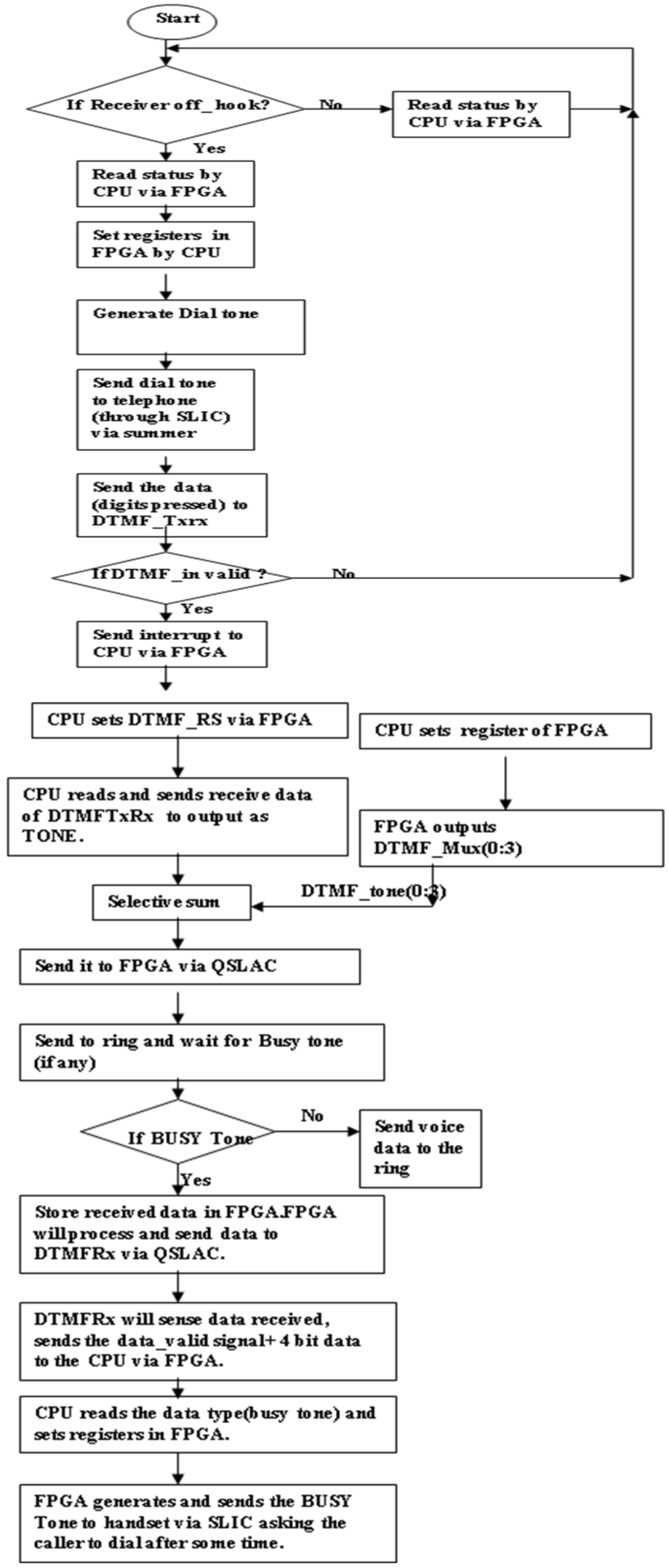


Fig.4: Transmit DTMF EOW call flow chart

7. BLOCK DIAGRAM FOR THE TRANSFER OF CALL

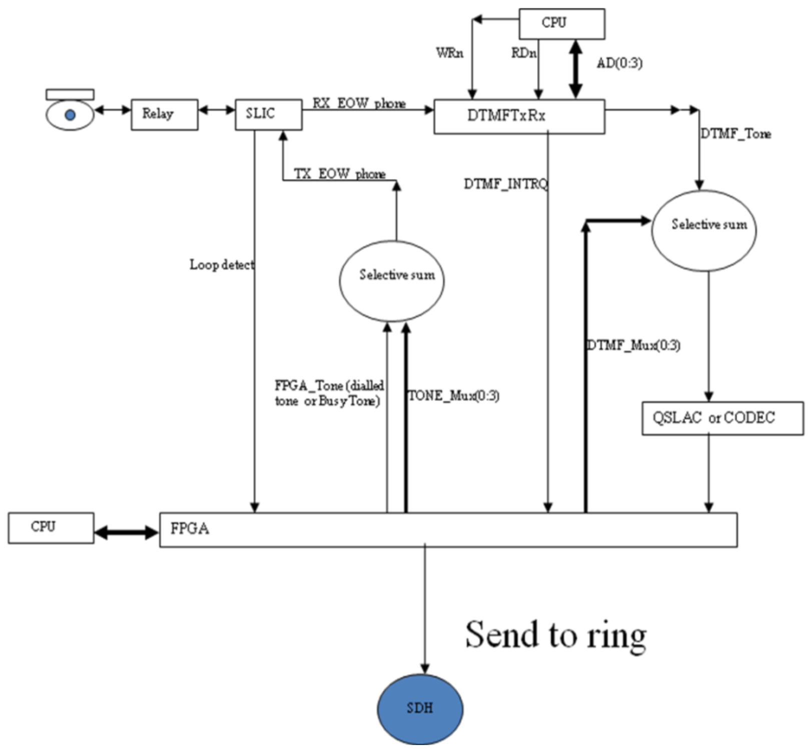


Fig.5: Block diagram for the transfer of call

8. CONCLUSION

Selective voice channel addition can be used for voice mixing from different channel.This can be done in side FPGA.If C0in = EOW phone, PCM channel 1, C1in=Digital EOW channel 1, C2in=Digital EOW channel 2,C3in=Digital EOW channel3,C4in=Digital EOW channel 4,then after voice mixing- output of EOW phone channel will be C0out= C1in+ C2in+ C3in+ C4in,out put of Digital EOW channel 1 - C1out= C0in+ C2in+ C3in+ C4in, out put of Digital EOW channel 2 - C2out= C0in+ C1in+ C3in+ C4in, out put of Digital EOW channel 3 - C3out= C0in+ C1in+ C2in+ C4in and out put of Digital EOW channel 4 - C4out= C0in+ C1in+ C2in+ C3in.

REFERENCES

[1] Data sheets of "MT8870D/MT8870D-1 Integrated DTMF Receiver"by MITEL.

[2] Data sheets of "MT8880C/MT8880C-1 Integrated DTMF Transceiver"by MITEL.

[3] Data sheets of "80C554/87C554 80C51 8-bit microcon- troller – 6 clock operation 16K/512 OTP/ROMless, 7 channel 10 bit A/D, I2C, PWM,capture/compare, high I/O, 64L LQFP" by Philips.

[4] Data sheets of "EPF10K10- Embedded Programmable Logic Device Family" by ALTERA.

[5] Data sheets of"Ag1171 -+3.3V / +5.0V Low Power Ringing SLIC" by Silver Telecom.