8051 VoIP Application Note

1.1   Introduction

VoIP function is realized by using 8051 EVB and Voice Module.

1.2   Objective

To increase VoIP competitiveness through cost reduction and short development schedule.

1.3   Operating Principle

1.3.1 Internet Connection

By using WIZnet's TCP/IP i2Chip W3100, Internet access is made by interfacing with the chip without an operating system.

1.3.2 Voice Processing

G.723.1 CODEC supported by CT8022 made by DSP Group is used for voice processing.

1.3.3 Voice Data Transmission

Voice data is transferred by using the simple transport layer UDP, without RTP/RTCP processing.

1.4   Components

1.4.1   8051EVB

MCU: Atmel's 89C51

Memory: 32K flash memory, 32K RAM

Network: W3100(TCP/IP), RTL8201L(PHY)

1.4.2   Voice Module

Codec: CT8022A11AQC

AD converter: MC145483

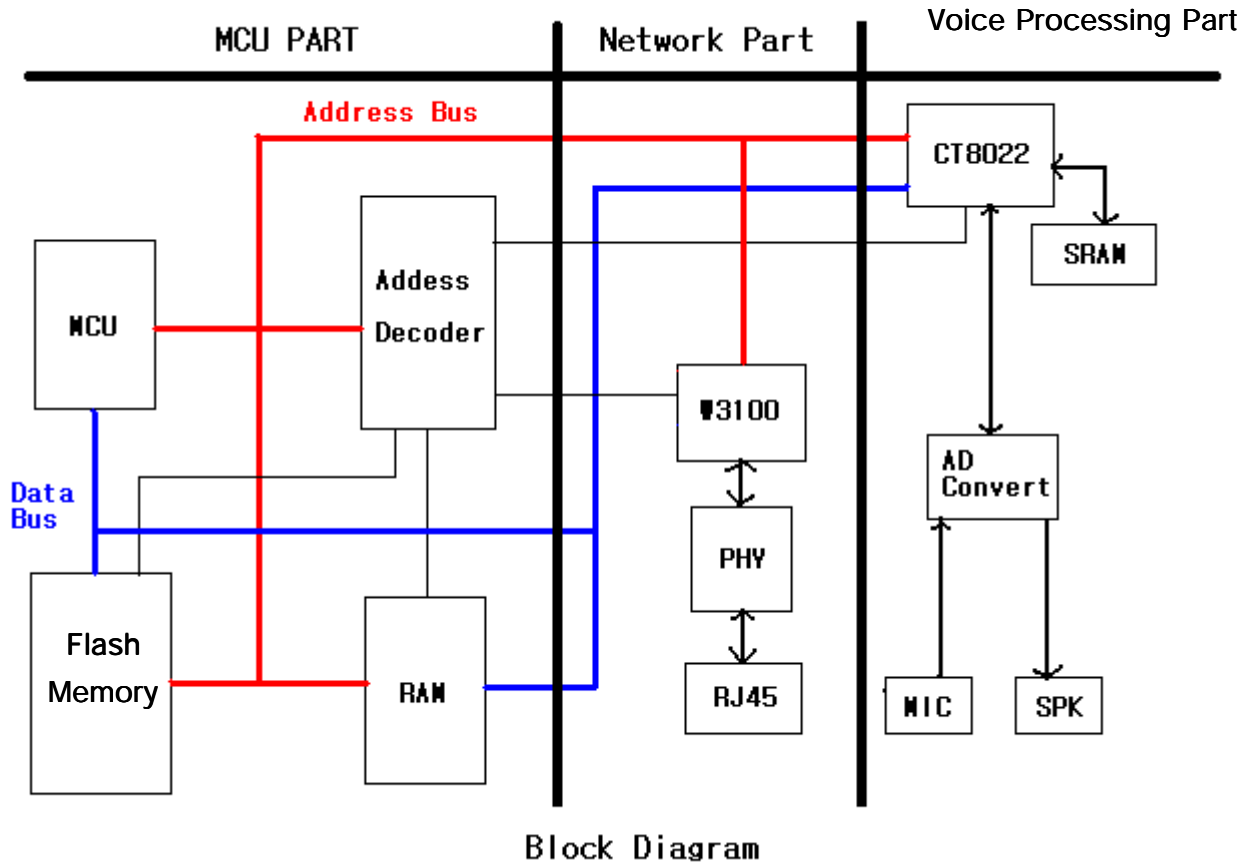### 1.4.3   PC Application Program for VoIP Test

VoIP development board and PC application program for actual voice data transfer

1.4.4   Firmware

W3100 driver, CT8022 driver, PC Application linked program

2.1 Operation

2.1.1 Block Diagram

Block Diagram

2.1.2 Memory Map

0x0000 – 0x3FFF: external Flash Memory

0x4000 – 0x7FFF: external RAM

0x8000 – 0x8FFF: W3100 Register

0x9000 - 0x93FF: LCD (not used)

0x9400 - 0x97FF: Graphic LCD (not used)

0x9800 – 0x9FFF: CT8022

0xA000 – 0xFFFF: W3100 transmit and receive buffer

Refer to 8051EVB.PDS, VM.PDS file

2.1.3 Operating Mechanism

2.1.4..1 Voice data transmission

Raw voice data inputted through a microphone is converted to digitalized data after AD conversion, and the digitalized data is compressed by G.723.1 voice compression codec of CT8022. MCU then verifies whether any data

has been created by CT8022 and saves such data in external RAM. By using the W3100 UDP channel, the data saved in the RAM is transmitted to the PC application program connected to the Internet.

2.1.4.2 Voice data reception

By using the UDP channel, PC Application transmits G.723.1 compressed voice data to the VoIP System connected to the Internet. After W3100 verifies whether any UDP data has been received over the Internet, VoIP System MCU then reads such data from the W3100 receive buffer, and the data is saved in the RAM. UDP data saved in the RAM is transmitted to CT8022, and G.723.1 compressed data is decoded by CT8022. The decoded data is converted into analog data through the AD converter, and the data is finally transmitted through the speaker to the user.
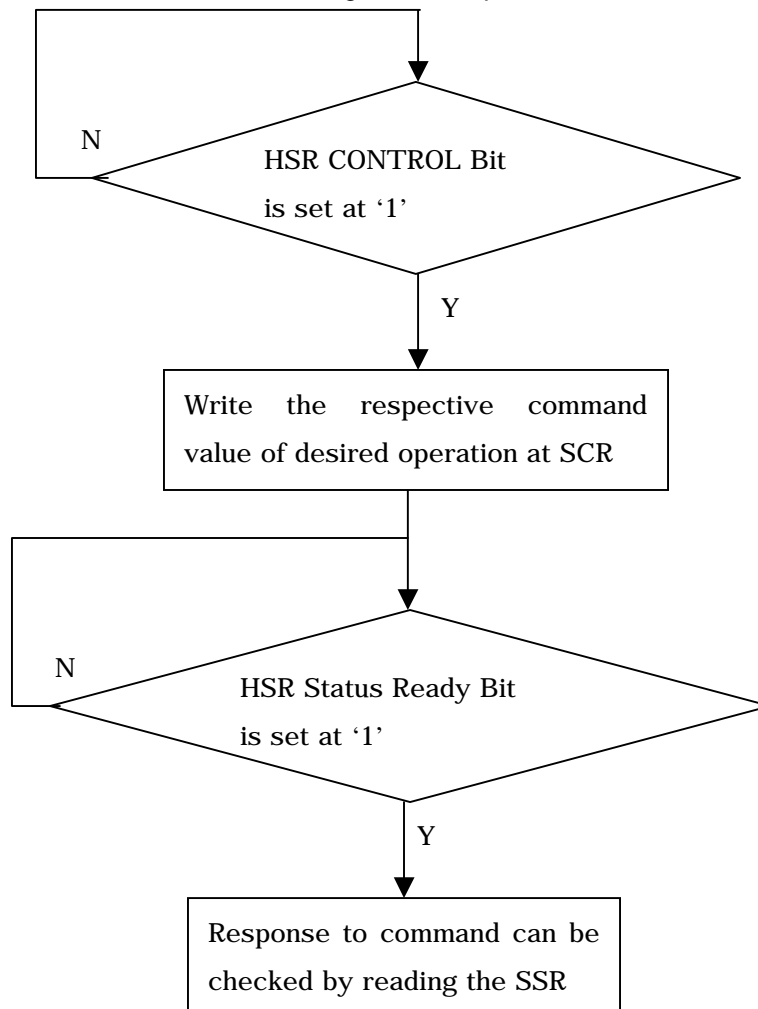
3.1 Key Technology

3.1.1 W3100 control

Refer to W3100 Datasheet and manual

3.1.2 CT8022 control

CT8022 is controlled through 3 registers: Hardware Status Register (HSR), Software Command Register (SCR) and Software Status Register (SSR).

The following is a basic protocol for CT8022.

CT8022 control is mainly carried out according to the above flowchart. Refer to CT8022 Datasheet for detailed information.

3.1.3 CT8022 Driver

Refer to provided source CT8022.H, CT8022.C , Datasheet

Function	**InitCT8022()**
Description	Initilizes CT8022 Codec setting is made after Device, internal ROM and SRAM are checked.
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**DeviceSelfTest()**
Description	Device Check, internal ROM and 31K SRAM are initialized and tested.
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**CodecConfig()**
Description	Starts G.723.1 codec SCLK = 2.048MHz, FCLK = 8KHz settings Sets Frame Rate at 240 Word/30ms
Parameters	None
Return value	None

Function	**SetRecordMode()**
Description	Sets Record Mode Sets Record Rate (compressed Frame Size =12 Word) Sets Host Sync Poll Mode Starts Recording
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**SetPlayBackMode()**
Description	Sets Playback Mode
	Sets Playback Rate (G.723.1)
	Sets Host Sync Poll Mode
	Starts Playback
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**RxTxReady()**
Description	Checks transmit, receive buffer status
Parameters	None
Return value	Transmit Buffer Ready: TX_READY, Receive Buffer Ready: RX_READY
	Transmit Buffer Busy: RXTXBUSY

Function	**CommandReady()**
Description	Waits until Command is ready to be released
Parameters	None
Return value	None

Function	**StatusReady()**
Description	Waits until CT8022 is ready to respond
Parameters	None
Return value	None

Function	**GeneralCommand(INOUT INT_TYPE* _com)**
Description	Releases general command to HSR, returns corresponding response.
Parameters	INOUT _com: used as command as an input, used as response as an output
Return value	None

3.1.4 Link between Application and VoIP

Two channels of W3100 channels are used. One channel is used as the TCP channel to transfer control message with the PC Application, and the other channel is used as the UDP channel for actual voice data transfer. Refer to

i2PhoneV5_Linked_Message_Definition.doc for Cotrol message definition and protocol. PC Application is programmed for single user, and multi-user is available in case of actual VoIP System.　Voice communication is limited to one-to-one under the environment provided.

3.1.4.1　　Link-related API

Function	**InitVoiceModule()**
Description	Initializes all variables, device required for linkage
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**SendVoice()**
Description	Transmits voice data recorded through W3100 UDP channel to the other party
Parameters	None
Return value	None

Function	**RecvVoice()**
Description	Saves and plays voice data and IP informaiton of the other party as received through W3100 UDP channel
Parameters	None
Return value	Success: S_OK, Failure: S_FAIL

Function	**VMConnect(BLTYPE _userip)**
Description	Creates voice channel upon request of call by other party
Parameters	IN _userip: IP information of the other party
Return value	Success: S_OK, Failure: S_FAIL

Function	**VMDisconnect(UCHAR _callindex)**
Description	Disables voice channel upon request of ending to a call by the other party
Parameters	IN _userip: IP information of the other party
Return value	`

Function	**ParseVMCtrlMsg(SOCKET s,CTRLPACK* ctrlmsg)**

Description	Receives and analyzes request message of the other party
Parameters	IN s: channel for control message OUT ctrlmsg: control message received
Return value	None

Function	**SendVMCtrlMsg(SOCKET s,CTRLPACK* msg)**
Description	Transmits responding message to the request message of the other party
Parameters	IN s: channel for control message OUT ctrlmsg: control message received
Return value	None

Function	**GetFullDuplexIndex()**
Description	Looks up for call index of the other party engaged in two-way voice communication
Parameters	None
Return value	Call Index

Function	**IsVoiceConnected()**
Description	Is the voice communication service being presently carried out?
Parameters	None
Return value	Voice channel in use: S_OK, not in use: S_FAIL

Refer to VM.C, VM.H file for detailed information.

4.1 Conclusion

In comparison to the VoIP service over an OS-embedded system, VoIP with WIZnet TCP/IP i2Chip W3100 can be developed in faster time period at much less cost. VoIP with W3100 can also be incorporated in other applications such as Internet videophones, Internet broadcasting and Internet phones. As W3100 chip can be used for Internet connection, the chip can be utilized in various Internet related applications.