CINC (Convergent Inter-Networking Controller)

Abstract

The features and benefits of the Convergent Inter-Networking Controller (CINC) are described. CINC can be used as a stand-alone gateway and as part of the larger AECOS solution.

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1. Introduction

The Convergent Inter-Networking Controller (CINC) is a multi-purpose gateway and telephony server, with the goal to give the user easy access to information from the phone similar to the web experience. When bundled into an AECOS system, InterLinear Technology's e-business platform, it provides all the functionality required of a PSTN-interfacing device for inbound and outbound calls, under control of AECOS. On its own it can serve as a media gateway able to accept and route Voice-over-IP (VoIP) and real-time Fax-over-IP (FoIP) calls, featuring Universal Port technology.

In section 2 various hardware configurations for CINC and its modular software architecture are explained in more details. Sections 3 through 5 describe various applications CINC can be used in: *Universal Messaging* (section 3), *Media Gateway* (section 4), and *Unified Communication* (section 5).

2. Components

CINC consists of several hardware and software components, put together in modular and distributable fashion.

One advantage of CINC lies in the fact that it was designed from ground up to be scalable, in hardware and software, over a wide range of different requirements. CINC is scalable from a single T1/E1 up to more than 14 T1/E1 ports. Software features like advanced calling features, text-to-speech, voice recognition, etc. can be configured in or out. Further some of these features, like text-to-speech and voice recognition, are based on a client-server model, and can, therefore, be distributed over a variety of servers for load balancing.

2.1 Hardware

CINC uses common-off-the-shelf hardware components.

Any PC chassis can be used, but it is recommended to use industrial-strength PC's or compact PCI chassis. When space is spare, as it is typical in server farms, 1U-high chassis are a good alternative and can be used as field-replaceable units.

Any Intel-based motherboard (or system board for cPCI) with one or more processors can be used. Ethernet ports can be on-board or in separate cards, depending on space requirements (a 1U chassis would demand on-board Ethernet).

Telephony cards are non-proprietary. CINC supports cards from Brooktrout and NMS Communications (formerly Natural Microsystems), and also from Dialogic for limited functionality. This guarantees that there is no dependence on a single vendor and provides interoperability by design.

A common cPCI chassis supports up to 7 telephony cards, allowing for up to 14 T1/E1 ports. In a later release each of the cards can carry up to 4 T1/E1 ports with simultaneous connections on all the channels, leading up to 28 T1/E1 ports per chassis.

2.2 Software

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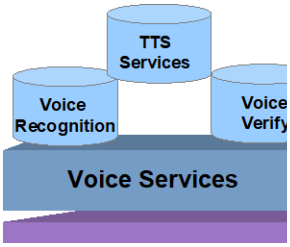

3. Universal Messaging

CINC can serve as gateway for Universal Messaging. Consumers can access their inbox through CINC with almost the same convenience and functionality as from the web. They can navigate through the interactive-voice-response (IVR) menus by giving voice commands that are processed with help of a versatile automated-speech-recognition (ASR) engine. They can listen to their email or fax envelopes using a powerful text-to-speech (TTS) system. Further, they can manipulate messages in almost all the ways as available on the web (listen, delete, forward, reply, etc.). Subscribers and people from an address book can be recognized by their names, instead of by phone or fax number or by email address.
This application also allows for consumers to listen to their daily schedules.

4. Media Gateway

In addition to be a Universal Messaging gateway, CINC can be a media gateway providing ingress and egress for VoIP and real-time FoIP calls, thus giving consumers a dial-tone experience virtually indistinguishable from the PSTN service. When bundled together with other CINC options like Universal Messaging or advanced calling features of the Unified Communication Suite, this experience can be even enhanced in many ways. This is where the power of CINC really lies. Further, CINC can automatically distinguish between incoming voice or fax call, i.e. it features Universal Port technology.

4.1 Voice over IP (VoIP)

The implementation of VoIP depends heavily on the vendor of DSP cards, but in all cases open standards are observed. So far, CINC supports H.323 for Brooktrout cards using Brooktrout's H.323 stack, and for NMS cards using the RadVision H.323 stack. Later, CINC will also support H.248 (Megaco) and SIP.

CINC with *InterAct module* :

InterAct is a software module that allows different card based VOIP gateway servers to work together in a common network environment. In other words, service providers and companies which normally use "single vendor" VOIP gateway servers can now upgrade with different vendor's VOIP gateway servers without the need to replace their legacy gateways. CINC with InterAct software allows a multi-vendor VOIP gateway system in a single network.

Quality in VoIP:
A major issue concerning the quality of VoIP is *latency*, the delay between the origination and the reception of speech. Consumers are accustomed to the toll quality of domestic calls having a delay of at most 150ms. They usually experience a similar quality with international calls, but sometimes, especially when satellite connections are involved, the delay can be larger than 500ms which is difficult to accept. It is important to keep delays under control, with the goal to have delays smaller than 150ms most of the time, and smaller than 300ms at all times.

Because of its importance a more detailed review of the issue is presented here. There are several sources for delay; some of them lie within the gateway, and some of them in the packet network. Of course, CINC cannot do anything about the delay in the network. Inside the gateway, delays add up from framing (what is the time length of a voice packet?), buffering (how many frames are kept together?), packetization (how long does it take to insert header information and payload data into a network packet?), de-packetization, jitter buffering (what is the average number of voice packets kept in a buffer before being played) , and processing (what is the amount of time needed by the processor to do the work). Jitter buffering is a necessity of VoIP networks because of the nature of packet networks: the time of delivery of packet data is not guaranteed and can vary considerable. The variability in the arrival rate of data is called *jitter*. To compensate for *jitter*, most systems buffer at least one packet of data from the network before passing it to the DSP. These *jitter buffers* can significantly reduce the occurrence of data starvation; without *jitter buffers* there is a good chance that gaps in the data will be heard during the speech. On the other hand, because jitter buffers increase the latency, the brute force use of jitter buffers can diminish voice quality in an unacceptable manner.

To keep the voice quality at its optimal level, CINC *incorporates dynamical jitter buffer management*. It constantly monitors the quality of the packet transmission and adjusts the jitter buffer dynamically to prevent gaps in speech, but minimally enough to avoid large latency over sizeable periods of time.

4.2 Fax over IP (FoIP)

CINC supports various modes of fax handling.

Real-Time Fax using T.38 Protocol

When consumers send a fax from a fax machine to a remote fax machine through a FoIP network, they do not notice much difference compared to a fax transmission using the PSTN only – just the setup might take a little bit longer.

CINC supports real-time fax according to the ITU T.38 standard under the umbrella of the H.323 standard, where T.38 is just another encoding format in parallel to voice coders like G.723 or G.711. T.38 describes a mechanism for transferring facsimile documents in real-time by IP fax gateways and includes the following steps (after setting up the call with H.323 and choosing the T.38 coder after detecting fax signals):

1. Demodulating incoming T.30 fax signals at the sending (or emitting) gateway
2. Translating T.30 fax signals into T.38 Internet fax protocol (IFP) packets
3. Exchanging IFP packets between emitting and receiving T.38 gateways
4. Translating T.38 IFP packets back into T.30 signals at the receiving gateway
5. Modulating T.30 signals and transferring them to the receiving fax machine.

Store-and-Forward Fax

CINC also supports fax termination and origination. This way, consumers have more options: they can elect to have faxes sent at selected times, they can save faxes into files and view them from the web, and/or they can originate faxes from the PC or the web. One of the services CINC can offer is the multi-media conversion that converts PDF and Microsoft Office files into fax compatible TIF files.

5. Unified Communication

CINC offers advanced calling features. These features show the power of IP-based communication. CINC's next release will incorporate Voice XML (VXML) allowing the rapid development of new applications similar to the web paradigm.

5.1 InterActive Messaging

InterActive Call allows the notification of consumers, scheduled or ad-hoc, with the option that the called person can interact with an IVR menu and potentially even call back to a live person.

5.2 Call Forwarding, Call Filtering and Call Screening

- Call Forwarding allows consumers to specify a list of alternate numbers where they can be reached if they are not at the default number.
- Call Filtering is a powerful feature giving consumers the ability to treat calling persons differently, based on caller id.
- Call Screening allows the called person to reject a call and redirect it to voice mail.

These calling features can be used in concert or in unbundled fashion.

6. Hardware Specifications

Processors:

CPU Type: 50 MHz PowerPC 401 or 233 MHz SA110 StrongArm
Local DRAM: 32MB
DSP Type: TMS320C/54x Series
Quantity: 12 baseboard (CPCI); 6+6 (PCI)
MIPS: 100
Local SRAM: 32K words internal/128K words external
Shared SRAM: 128K words per 6 DSPs

CompactPCI Platforms:

Voice Channels: Up to 96 T1 / 120 E1 per card
Physical: 1 slot 6U Eurocard; NEBS Compliant; Hot-Swappable; Passive Rear I/O
CT Bus: ECTF H.110: T8105 (Lucent)
TDM Capacity: 4,096 time slots

PCI Platforms:

Voice Sessions: Up to 48 T1 / 60 E1 per card
Fax Sessions: Up to 24 T1 / 30 E1 per card

Physical: 1 full-size PCI slot
CT Bus: ECTF H.100: T8105 (Lucent)
TDM Capacity: 4,096 time slots
CT Bus: MVIP-90: FMIC chip (Mitel 90810)
TDM Capacity: 512 time slots
CT Bus: SCbus: SC-4000 ASIC (VLSI)
TDM Capacity: 512 full-duplex time slots

T1/E1 Interfaces & Signaling:
Connector: RJ48; 2 or 4 (CPCI); 1 or 2 (PCI)
T1 Robbed Bit, E1 CAS
ISDN PRI: N.A., ETSI / Euro ISDN

Power and Environmental:
Base card: 12.4W CPCI; 1.5W PCI
Base card with mezzanine: 2.5W PCI only
Operating Temperature: 0º-50º C
Humidity: 10% to 95% non-condensing

Firmware Specifications:
Voice Formats G.711, G.723.1, G.729a
IP Networking Protocols: H.323 V2 stack provided, support for alternate protocols
Voice/telecom features: Real-time voice-stream processing, gain control, echo cancellation, voice play/record, DTMF detect/generate
Telecom/call progress and call control: DTMF, DNIS, and ANI detection
Fax protocols: Demod/remod, FaxRelay T.38, T.30