ANVoIP101

IP-Based Intercom System

Introduction

Intercom system manufacturers are changing their products to meet customer demand, evolving from traditional analog systems to IP-based products to leverage widespread innovation in IP-based communication systems and to make them ready for cloud services.

Intercom systems are used in a variety of applications: residential, office buildings, hospitals, schools, and industrial facilities. These systems can have a wide range of units, starting with a few units, such as in a single-family home, which operate in a LAN environment, to many tens of units, such as in a multi-site commercial deployment.

Figure 1 illustrates an example IP-based intercom system in a residential setting. The system consists of units located at the door, within multiple rooms, and special areas such as home office, patio, gym, etc. Many of these systems provide access via a user's smartphone, so users can act and/or respond from a fixed unit or from any location (at home or even away from home). Some of the systems also work with VoIP phones. The system is controlled by a local intercom controller, which is often a SIP-based agent, and may also be connected to the internet via a router, through cable, DSL, or other means.

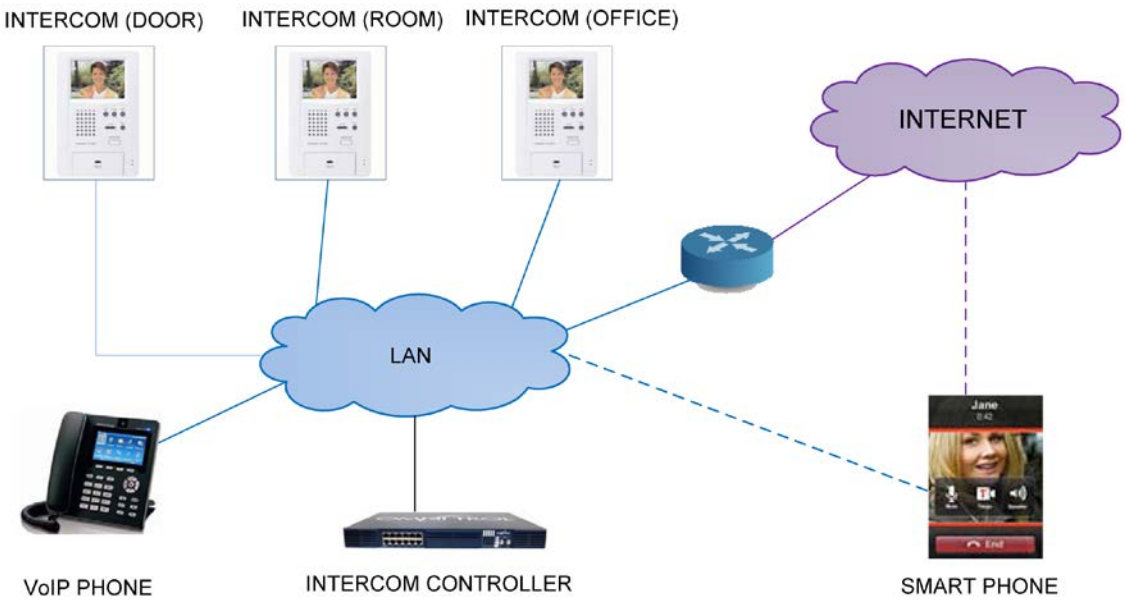

Figure 1. Example of Residential IP-Based Intercom System

By comparison, larger deployments of IP-based Intercom Systems have many more units which can be located at multiple sites. Multiple sites are connected via WAN systems (see Figure 2).

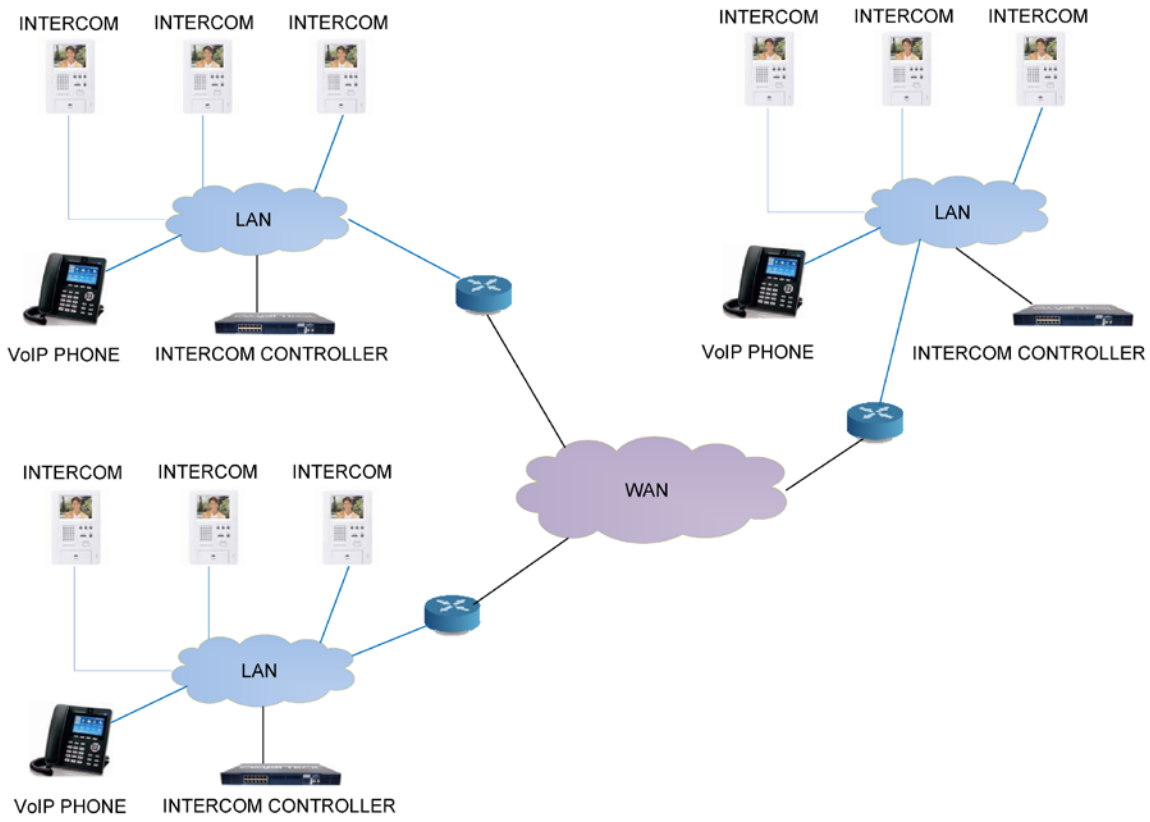

Figure 2. Example of Multi-Site IP-Based Intercom System

IP-based intercom systems provide significant benefits when compared to their analog counterparts; in particular, they enjoy cost reductions as follows:

- Sharing existing infrastructure, since they can plug into existing LAN interfaces
- Sharing existing networks elements for VoIP, such as SIP connectivity
- Lowering installation and implementation costs
- Integration into existing networks including life safety or emergency systems
- Scalable integrations to 100's of intercoms- locally, regionally or globally
- Using power-over-Ethernet (PoE) to simplify installation
- Support an additional network device using dual RJ45 connections
- Reduced power consumption through the use of EEE and other “green” enabling standards

IP-Based Intercom Endpoint (IEE)

At the core of these new intercom systems is the IP-based intercom endpoint (IIE). These endpoints form the basis of a variety of intercom applications – for example, residential, office buildings, hospitals, and manufacturing facilities. Depending on the application, these IIE can be configured with a range of functionality; for example, in a residential intercom solution, the endpoints include door units, room units, and outdoor units.

Figure 3. Example of IP-Based Intercom Endpoint (IIE)

Typical endpoints provide a variety of interfaces which together support a rich set of functions: microphone, speaker, (some may also have handsets), push button control, LCD display, and network interfaces. They also offer hands-free operation.

Some endpoints also include digital control of external devices, such as door lock, sensors, cameras, and other security devices. Figure 3 details the interfaces of a typical IIE. These endpoints can typically be installed efficiently since they only need Cat 5 wiring with PoE.

System-on-Chip (SoC)-Based Intercom Endpoint

Micrel's KSZ8382 family of system-on-chip (SoC) products provides a complete solution for IP-based intercom endpoints for a wide range of intercom applications. The SoC has built-in support for interfaces required for an endpoint (Figure 4) – hence only a few additional external components are needed to create a fully functional endpoint. The KSZ8382 SoC is the ideal choice for IP-based intercom endpoints, backed by Micrel's high-reliability and solution robustness proven in commercial, industrial, and automotive applications around the globe.

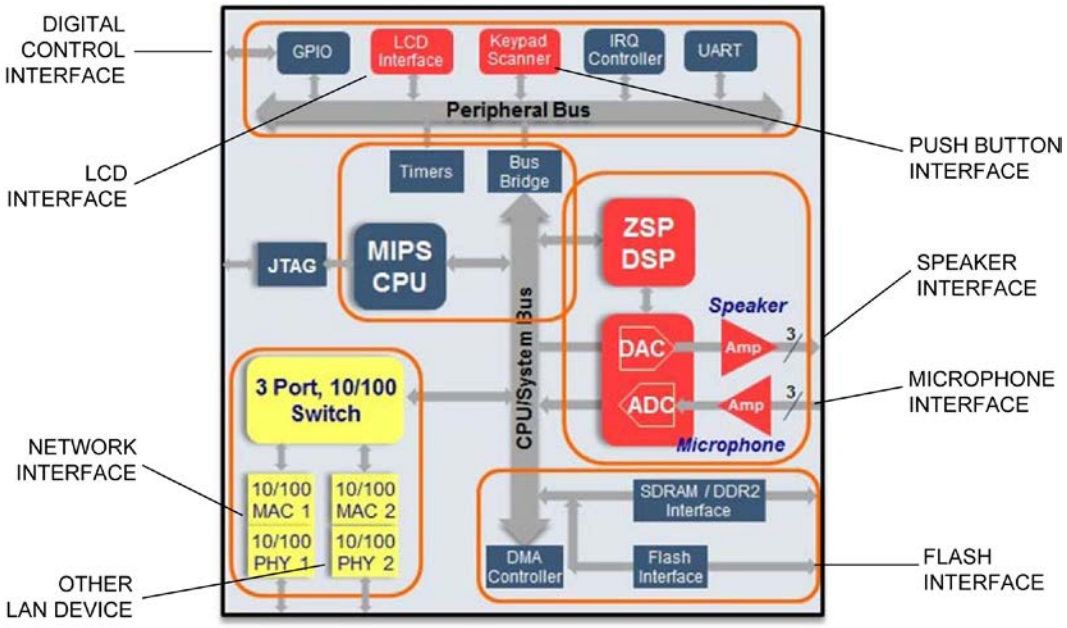

Figure 4. SoC Block Diagram

The KSZ8382 implements a multiprocessor architecture with embedded RISC CPU and powerful DSP, providing a flexible VoIP platform with narrowband and wideband voice processing and excellent voice quality.

Embedded Processing Resources

- **CPU and Memory**: The SoC has a MIPS32 RISC processor for configuration and network protocol processing, SDRAM and DDR2 interfaces, and Flash interface
- **DSP**: ZSP400 DSP offers high-quality voice/audio processing, 8kHz/16kHz 16-bit ADC/DAC with integrated amplifiers, narrowband and wideband CODECs

Intercom Interfaces

- **Network**: 3-port 10/100BaseT Ethernet switch; integrated low-power PHY transceivers
  - IGMP snooping to handle multicast traffic (RFC 4541)
  - VLAN support (IEEE 802.1Q)
  - Energy-Efficient Ethernet (IEEE 802.3az)
- **GPIO**: Can be used for a variety of functions including door control, indicators, etc.
- **Keypad Scanner**: Can be used to support push buttons and even a full telephony keypad
- **LCD Interface**: Supports SPI (8-bit parallel interface)

Firmware: CPU and DSP

The firmware for Micrel's KSZ8382 has a modular architecture to provide developers with variety of options in developing their endpoint application (Figure 5):

1. **Access at Call Control**: For a turnkey solution, developers can leverage the built-in SIP call manager from the endpoint application. The layers below handle media transport and DSP functionality.
2. **Access at Media Transport**: For developers who have their own SIP software (or want to implement other call control protocols) can use the RTP/RTCP access for media transport. As described in Option 1, the layers below handle network and DSP functionality.
3. **Access at DSP Resources**: For developers who want their own call control and media transport (standards-based or even proprietary) can access the DSP resources directly.

The above three options are shown in Figure 5 (access points from the application to the firmware).

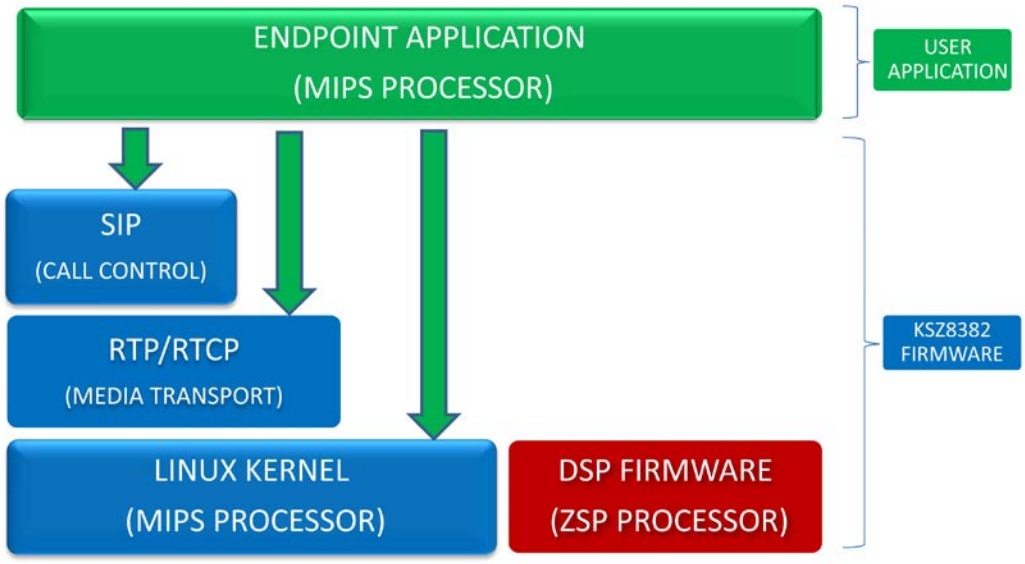

Figure 5. KSZ8362 Firmware Block Diagram

The firmware supports a rich set of intercom functions; a partial list is shown below:

- Send or receive audio streams to/from attached intercom endpoints
- Enable/disable microphones on intercom endpoint
- Handle intercom groups for custom intercom operation
- Activate/read an intercom's onboard relay or sensor
- Create intercom groups for paging
- Send 8-bit PCM or 16-bit .wav files or microphone audio to intercoms or groups
- Set volume level
- Search for intercoms and set their configuration

Endpoint Application Software

Using the features in Micrel's KSZ8382 SoC and the associated firmware, developers can create a variety of Endpoint Applications. These applications could support many communication modes for intercom system, including:

- **Push-To-Talk (PTT)**: The network stack can be used with industry-standard protocols to create access for fast, easy voice connections.
- **Broadcast**: To call all stations for announcements and alerts.
- **Multicast**: For efficient use of network bandwidth, multicast can support group calling.
- **Private Calls**: provides the flexibility for an endpoint to be in a private call with another.
- **3-Way Conference Call**: The embedded DSP provides firmware supports 3-way conference calling. The API can be used to mix audio from two network-side channels and the local audio port to create a conference bridge.

Developers can use these communication modes in any combination to create customized intercom solutions to suit their application.

Conclusion

Innovation in IP-based communication systems is driving the rapid pace of migration from analog to IP-based intercom systems. Micrel's KSZ8382 family of SoCs provides a complete solution for IP-based intercom endpoints that can be used to add cloud services to current analog platforms or to build a completely new IP/VoIP-based application. The KSZ8382 has a high level of integration through the integration of a 3-port switch, PHY and amplifier. It has built-in support for interfaces required for an endpoint; hence only a few additional external components are needed to create a full-featured endpoint. The firmware for KSZ8382 has a modular architecture to enable developers many choices in developing endpoint applications. Together, the KSZ8382 processor and associate firmware can be used to create a wide range of IP-based intercom solutions.

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