Intel® Signaling System 7 Solutions

Enabling Intelligent and Wireless Networks...
Voice Portals and Beyond

Introduction

Signaling System 7 (SS7) is a packet-switched data network that forms the backbone of the international telecommunications network. SS7 plays an important role in both wireline and wireless networks. It was designed to improve network operation and to provide enhanced services. Unlike earlier inband signaling systems, SS7 is a separate, fully redundant network, working within the existing voice network to control it. The network architecture of SS7 has greatly improved the performance of the public telephone network by facilitating faster call set up, routing, and supervision. It has also made possible a wide variety of enhanced services including toll-free dialing, 900 service, wireless roaming, and Custom Local Area Signaling Services (CLASS) features such as Caller ID.

SS7 was developed in the United States but has since been adopted globally. SS7 has been traditionally used within the Public Switched Telephone Network (PSTN), but it is increasingly being used to interconnect the PSTN with next-generation Internet Protocol (IP) and wireless networks. Telecommunication equipment designers use SS7 extensively to build enhanced services platforms, central office (CO) switching platforms, voice portals, media servers, pre-paid wireless systems, Voice over IP (VoIP) gateways, and a variety of other telecommunications-related infrastructure.

This white paper will provide you with a high-level view of SS7 network and software architecture, discuss some of the benefits and applications of the technology, and show you how the Intel® SS7 product line can be used to enhance your computer and telecommunication networks. A list of relevant acronyms and a short glossary is provided for your convenience at the end of this paper.

1.0 An Overview of SS7 Services

SS7 provides three basic types of services.

- **Call Control**—Fast and reliable common channel or "out-of-band" signaling for call control and circuit switching
- **Intelligent Network—**Implementation of Advanced Intelligent Network (AIN) services
- **Mobile/Wireless—**Public mobile communications capabilities such as roaming, location management, Short Message Service (SMS), and follow-me/one-number service

1.1 Network Architecture

The conventional SS7 network has three major components.

- **Service Switching Points (SSP)** are telephone switches connected by SS7 links. SSPs process calls and may send SS7 messages to transfer call-related information to other SSPs. They may also query Service Control Points (SCP) to obtain the information needed to route a call.
- **Signal Transfer Points (STP)** are switches that relay messages between network switches and databases. They route messages to the correct signaling link, based on information contained in SS7 data messages.
- **Service Control Points (SCP)** contain centralized network databases designed to provide enhanced services. The SCP receives a query from an SSP and returns the requested information. For example, when you dial an 800 number, the SCP looks up that number in a table and provides the SSP with the actual number required to route the call. (It is not the number you dialed.) The routing number can vary depending on the day of the week, time of day, or other factors.

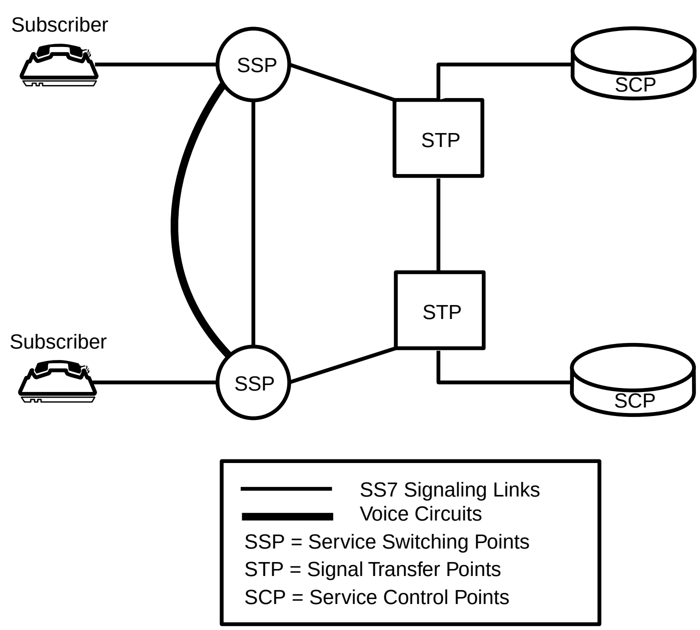

Figure 1: SS7 Network Architecture

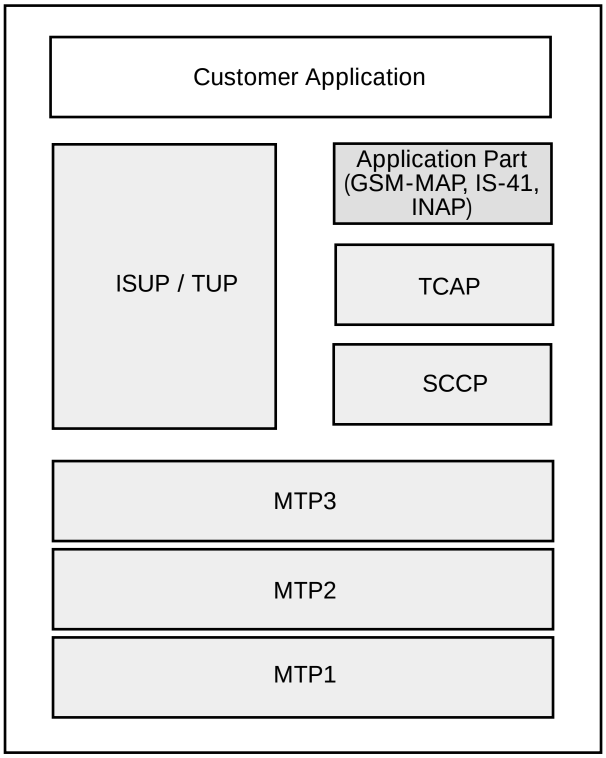

Figure 2: SS7 Protocol Architecture

1.2 Protocol Architecture

SS7 is a layered software architecture that consists of message transfer and user parts.

Message Transfer Part (MTP)

- **MTP1-3 (transport) MTP** provides the physical, link, and network layer functions. The overall purpose of MTP is to transport information reliably from the upper layers (including the user parts and SS7 applications) across the SS7 network.

User Parts

- **ISDN User Part/Telephone User Part (ISUP/TUP)** ISUP/TUP provides standards-based and network-specific call control services for wireless and wireline public networks
- **Signal Connection Control Part (SCCP)** SCCP provides address resolution services (i.e., global title) for locating services in the network
- **Transaction Capabilities Application Part (TCAP)** TCAP transports transaction-oriented data across the SS7 network and implements standard Remote Operation Service Element (ROSE) services for applications such as GSM-MAP and IS-41. These “applications” provide Intelligent Network services such as home location register or Short Message Service.
- **Global System for Mobile Communications-Mobile Application Part (GSM-MAP), Interim Standard-41 (IS-41), and Intelligent Network Application Protocol (INAP**) These are transaction-based services that allow development of applications such as Short Message Service, and access to Home Location Register (HLR)/Visitor Location Register (VLR) for wireless networks, and other Intelligent Network applications.

  NOTE: IS-41 is also known as TIA-41.

1.3 Advantages of SS7

- Faster call set up
- More efficient use of network resources
- A tested and reliable signaling protocol with global acceptance
- Support for network convergence
- Support for large, high-density, high-reliability systems
- Scalable architecture
- More cost-effective than Integrated Services Digital Network (ISDN) and Channel Associated Signaling (CAS)

2.0 SS7-Enabled Applications

A field-proven, highly versatile solution, Signaling System 7 is used extensively in network and carrier-based applications and infrastructure because of the substantial benefits it offers. The following scenarios demonstrate how you can use Intel® SS7 building blocks to create applications in different markets.

VoIP Gateway

Voice over Internet Protocol (VoIP) gateways enable calls placed over an Internet Protocol (IP) based network to be routed seamlessly to telephones on the public network. That is to say, they make it possible for the circuit-switched public telephone network to talk to an IP packet-based network, and vice versa. With the rapid growth of IP-based voice, and its increasing adoption by major carriers and corporations, gateways are growing in size and now support thousands of calls. This increase in scale and the need to implement carrier-grade IP gateways has made SS7 the protocol of choice for connecting IP gateways to public telephone networks. An added advantage is that the PSTN already uses SS7 as its signaling mechanism of choice. Support for SS7 is crucial if VoIP-based services are to provide telephone service that can connect to users on public networks.

Enhanced Services

Carriers are currently offering a wide variety of enhanced services including voice and fax messaging, one-number/follow-me, and pre-paid services to their customers. SS7 provides access to the database lookup capabilities on which these services depend, using call control and messaging functions between the central office switch (SSP) and the Service Node or Intelligent Peripheral.

Wireless Network

SS7 plays an important role in both wireline and wireless networks. As the basis for GSM and IS-41 networks, SS7 allows wireless subscribers capabilities such as automatic roaming, which are transparent to the user.

Wireless networks incorporate advanced and comprehensive signaling and control systems. Even when the mobile unit is within its home network, location tracking is required for authentication, hand-off functions, and call termination. System operators are looking to offer their customers increasingly sophisticated levels of mobility, all of which can be provided by SS7's advanced signaling functions.

Call Center

SS7 can be used in large call centers to improve efficiency, provide new functionality, and reduce telecommunications costs. SS7 provides answer and call termination supervision, resulting in more efficient operation and lower operating costs. Key benefits of using SS7 in an outbound call center application include:

- Faster call set-up, answer detection, and call tear-down
- Ability to include more information with the call
- Ability to reduce telecommunications costs by leasing or purchasing high-capacity trunks
- Easy upgrade to new services

3.0 Intel® SS7 Solutions

The Intel SS7 product line consists of boards as well as server and software solutions that are designed to meet a wide variety of customer requirements. A complete SS7 software stack is provided to run on these products.

Intel offers a modular, open architecture for building functional, reliable, cost-effective public network applications and services. In addition, Intel SS7 products can be used to build SS7 network elements (NEs) and Advanced Intelligent Network (AIN) platforms such as:

- Service Control Points (SCP)
- Intelligent Peripherals (IP)/ Service Nodes (SN)
- Signal Switching Points (SSP)
- Signal Transfer Point (STP)
- SS7-IP Signaling Gateway (SG)
- Home Location Register (HLR)
- Visitor Location Register (VLR)
- Authentication Center/ Equipment Identification Register (AuC/EIR)
- Mobile Switching Centers (MSC)
- Radio Network Controller (RNC)
- 3G Serving General Packet Radio Service Support Node (SGSN)
- 3G Gateway General Packet Radio Service Support Node (GGSN)

Applications

These SS7 network elements can be used in both wireless and wireline networks. Common applications include:

- Voice portals
- Follow-me/one-number services
- Voice mail and unified messaging
- Voice-activated dialing
- Short messaging services
- Network call center
- Call completion
- Least-cost routing /telecom resale
- International callback
- Local number portability
- 800/Freephone
- Caller ID
- Virtual private network (VPN)
- Prepaid phone/calling card

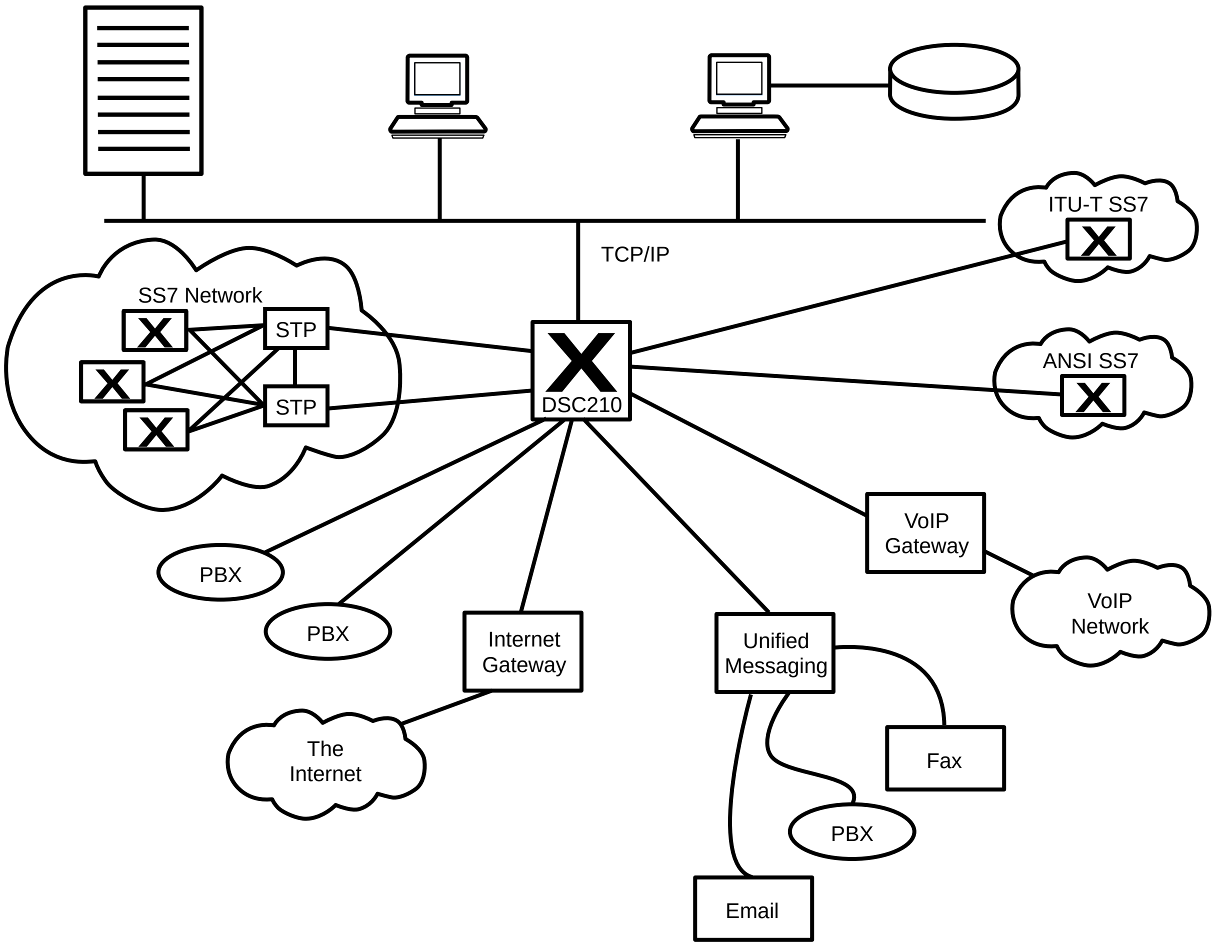

Figure 3: DSC Unit within a Network

3.1 Intel® SS7 Hardware Offerings

SS7 Digital Signaling Converter

The digital signaling converter (DSC) works within an existing network as an intelligent switch. Housed inside the DSC unit are Intel SS7 boards and the application software needed to provide a variety of turnkey solutions. DSC capabilities include:

- Connection to eight adjacent, or 32 non-adjacent switches (via STPs)
- Simultaneous use of ANSI, ITU-T, China, French, UK, and Japan SS7
- On-box number translation (with whitelist and blacklist)
- Dual redundant configuration
- In-call parameter manipulation (ANI, DNIS, etc.)
- Ability to connect to a remote PC via IP for number translation, advanced routing, billing, statistics, etc.

The DSC can convert a wide variety of protocols including:

- One variant of SS7 to another
- ANSI
- ITU-T
- China No 7
- Japan
- SS7 to ISDN
- Access protocols
  - NI2
  - Q.931
  - QSIG
  - DPNSS

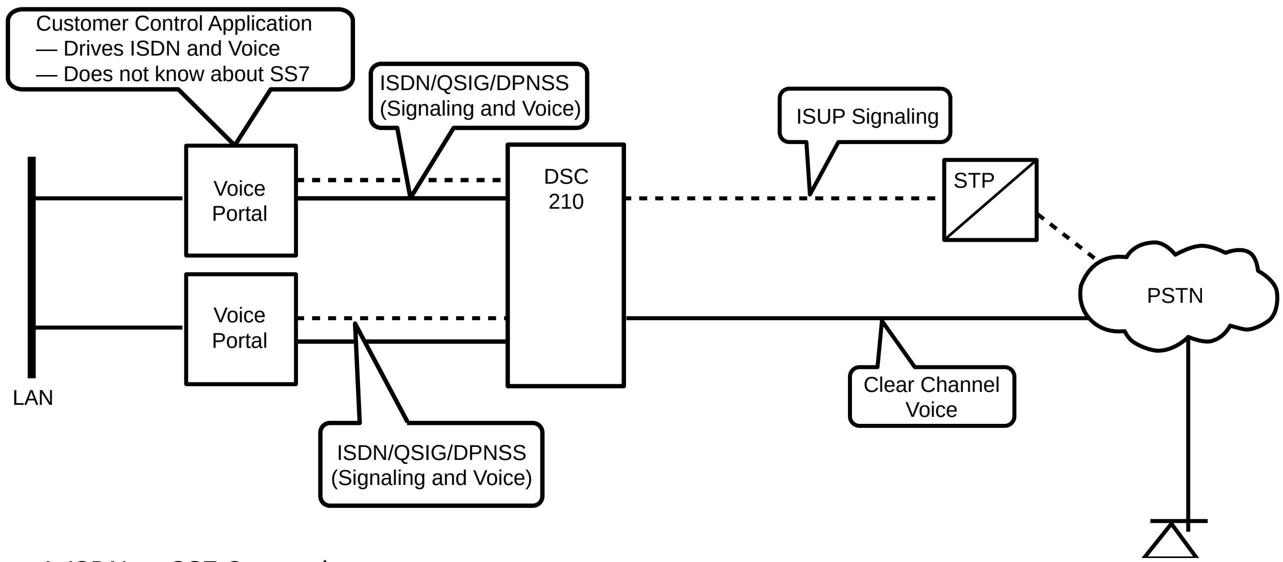

Figure 4: ISDN-to-SS7 Conversion

Intelligent switching functions of the DSC unit includes:

- Routing based on the dialed number
- Prefixing/deleting of routing digits
- Conversion from overlap signaling to en-bloc signaling
- Automatic retry and re-route
- Configurable circuit selection (hunting)

ISDN-to-SS7 Conversion

Some developing countries use SS7 to connect telephone equipment to the public network. Let us suppose that you own a small company that has the opportunity to sell a substantial amount of voice portal equipment in one of these countries. The problem is that your products only support ISDN connectivity. The digital signaling converter can solve this problem easily. Think of it as a signaling appliance. No changes are required to your existing ISDN-based application. All the configuration details for ISDN and ITU ISUP can be contained within the DSC unit. It can be treated as a black box once it is configured.

SS7 Benefits in this Application

- Existing hardware and software require no modification
- Opens new markets segments without requiring additional time and money to modify applications to make them SS7 compatible

  NOTE: With signaling conversion, the number of inbound and outbound T-1 circuits must be equal when using voice and signaling mode operation. In signaling-only mode, you can use many ISDN D-channels with single or multiple SS7 signaling links.

Intel® Offering

- Two servers with Intel® Pentium® processors (shown as Voice Portals in Figure 4) running Windows® 2000 or Linux
  - — Host the application
  - — Contain Intel® Dialogic® brand T-1 or E-1 voice boards to terminate voice circuits
    - A D/600JCT-2E1 board, for example
- One DSC210 board
  - — Terminates SS7 signaling to and from the network
    - MTP layers 1-3 (lower level messaging)
    - ISUP signaling (call control protocol)
  - — Terminates ISDN/QSIG/DPNSS signaling to and from Dialogic boards
  - — Passes audio from PSTN side of DSC to the Dialogic board side of the DSC

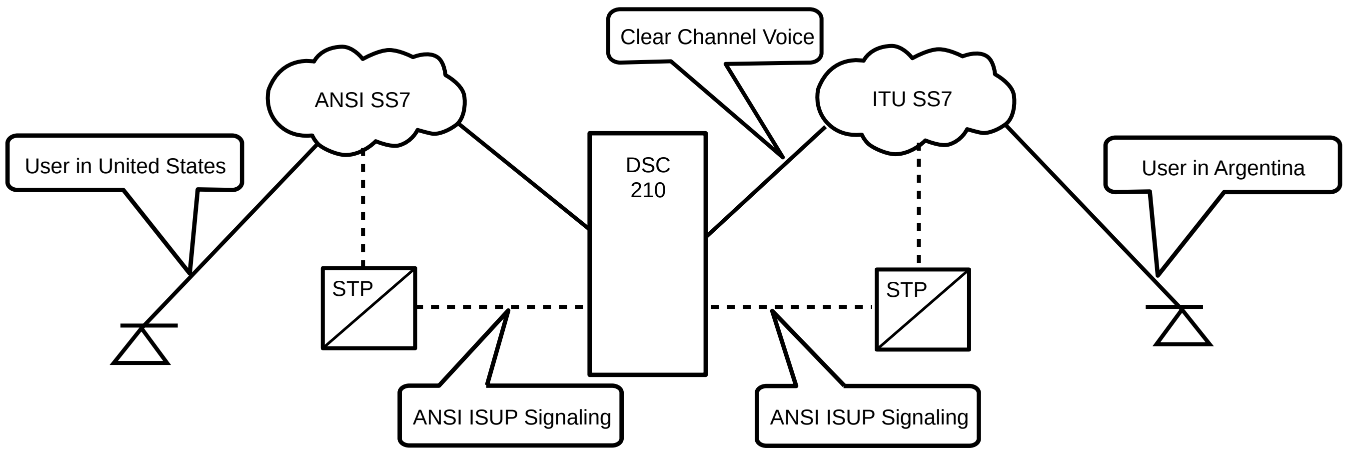

Figure 5: SS7-to-SS7 Network Conversion

SS7-to-SS7 Network Conversion

Imagine that a network operator has both an ITU SS7 network and an ANSI SS7 network and is currently paying a third party to do the protocol conversion. Under these conditions it would make sense for the network operator to build an interface between the two SS7 networks. The cost savings would mean lower rates for the customers.

In addition, situations may arise where equipment was purchased that does not interoperate with a carrier's other equipment. This happens occasionally. SS7 to SS7 conversion will, for example, allow an ITU-T based feature server to operate in an ANSI network — or an ANSI modem bank to interconnect to an ITU-T network.

The digital signaling converter (DSC) offers solutions for these kinds of problems and has these additional features:

- Parameter Manipulation
- Whitelist
- Blacklist
- Global Title
- Local Number Portability
  - — Using the Intelligent Service Control option

SS7 Benefits in this Application

- Protocol conversion
- No application code required

Intel® Offering

- One DSC unit
  - — Terminates SS7 signaling to/from ITU SS7 network
    - MTP layers 1-3 (low-level messaging)
    - ISUP signaling (call control protocol)
  - — Terminates SS7 signaling to and from ANSI SS7 network
    - MTP layers 1-3 (low-level messaging)
    - ISUP signaling (call control protocol)
  - — No audio transmission is required
  - — The T-1/E-1 spans should be configured as "clear channel"
    - No A-Law/μ-Law conversion is provided

Pre-Paid Wireless Service

Customers can prepay for cellular service and avoid having to sign a long-term contract with their cellular provider. An automated Voice Response Unit (VRU) can be used to keep users informed about the number of remaining minutes they have. The following example uses SS7 ISUP signaling for call control to connect to the VRU and SS7 TCAP messages for associating the cellular phone number with the remaining number of minutes.

SS7 Benefits in this Application

- Roaming
- Permits a "Brand X" cell phone to use the name brand cell towers and Mobile Switching Centers
  - — The billing is handled by SS7 and TCAP
- Prepaid credit notification via Short Messaging Service (SMS)
  - — Customers are told how many minutes of call time remain

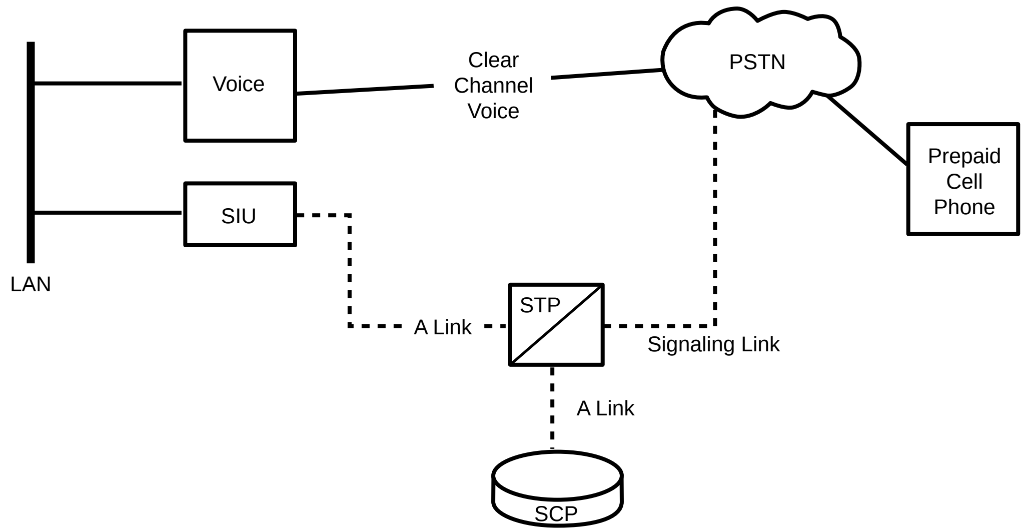

Figure 6: Pre-Paid Wireless Service

- Message waiting service
  - Customers are told someone is attempting to call them when they are on another call
  - Uses SMS
- Targeted advertising
  - For example, if a subscriber has just landed in Washington, D.C. and uses the phone for the first time, the service provider can send short informational messages such as local events of interest
- Call set up time
  - SS7 reduces call set up to a few seconds, which translates into a rapid return on investment
    - If R2/MF is used instead of SS7, it can take ten or more seconds to place an outbound call. The user must wait even longer, resulting in a higher bill.

Intel® Offering

- Intel Pentium based server containing:
  - T-1 or E-1 voice boards to terminate voice circuits
  - A DM/V960A-4T1, for example
- SIU131 server to terminate signaling and communicate with SCP
  - MTP layers 1-3
  - ISUP signaling
  - SCCP/TCAP protocols
- Ethernet® network running TCP/IP to connect the two servers

Voice Portal

A large specialty products company is seeking to improve customer service by allowing customers to access information about their orders 24 hours a day. Naturally, they hope to add this service at minimal expense. They have decided to use Automatic Speech Recognition (ASR) and Text To Speech (TTS) to reduce the number of agents required to support around-the-clock service.

The company has also chosen to use SS7 to connect to the PSTN. SS7's faster call set up supports high-quality customer service, and it also provides reliable disconnect supervision, which ensures that the company is only paying for the actual time that users are connected. This represents a substantial improvement over the company's current system, which cannot detect when callers hang up. The company is billed for the extra time that elapses before the disconnect is detected.

When the application receives indication of an incoming call, it compares the calling number with an existing database of customer telephone numbers. If the number is found in the database, the caller can confirm his/her identity with a password and check the account balance, order status, or shipping status. If the calling number is not found in the database, the application will prompt the caller for an account number. The calling number and account number will then be entered into the database for future reference. The added security this provides is a major benefit to banks and other financial institutions.

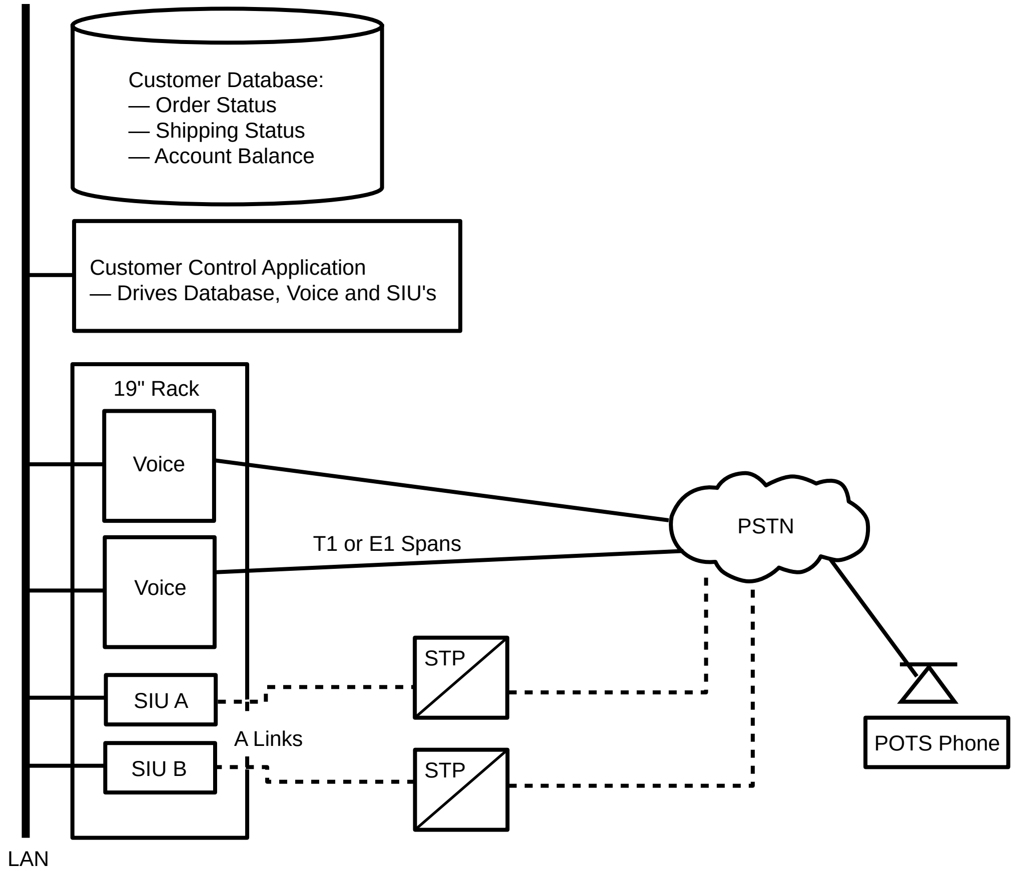

Figure 7: Voice Portal

SS7 Benefits in this Application

- Provides faster call set up, reliable disconnect, and security
- A dual signal interface unit (SIU) configuration will provide resilience not available with ISDN or CAS signaling

Intel® Offering

- One server with an Intel® Pentium® processors running Windows* 2000 or Linux
  - Hosts the customer's application
- Two servers with Intel® Pentium® processor running Windows 2000 or Linux containing:
  - T-1 or E-1 voice boards, utilizing CSP technology, to terminate voice circuits
    - A DM/V1200A-4E1, for example
- Two SIU231 boards to terminate SS7 signaling
  - MTP layers 1-3 (lower level messaging)
  - ISUP signaling (call control protocol)

Short Message Service (SMS)

A company that leases vending machines can save money on fuel by reducing the number of trips required to restock its machines. Keeping the machines restocked will also increase profits. These goals cannot be achieved using a routine, once-a-week delivery schedule. The company needs to be able to monitor the machines on an ongoing basis. One way to do this uses the Short Message Service (SMS) available on SS7. SMS employs store-and-forward messaging using the MAP protocol. No audio transmission is required here, only signaling.

Company trucks can also be configured to send location information via an onboard global positioning device, using Unstructured Supplementary Services Data (USSD), an SS7 feature. USSD allows point-to-point communication and is not subject to the store-and-forward delay inherent in SMS messaging.

SS7 Benefits in this Application

- This kind of application could not exist without SS7 MAP messaging

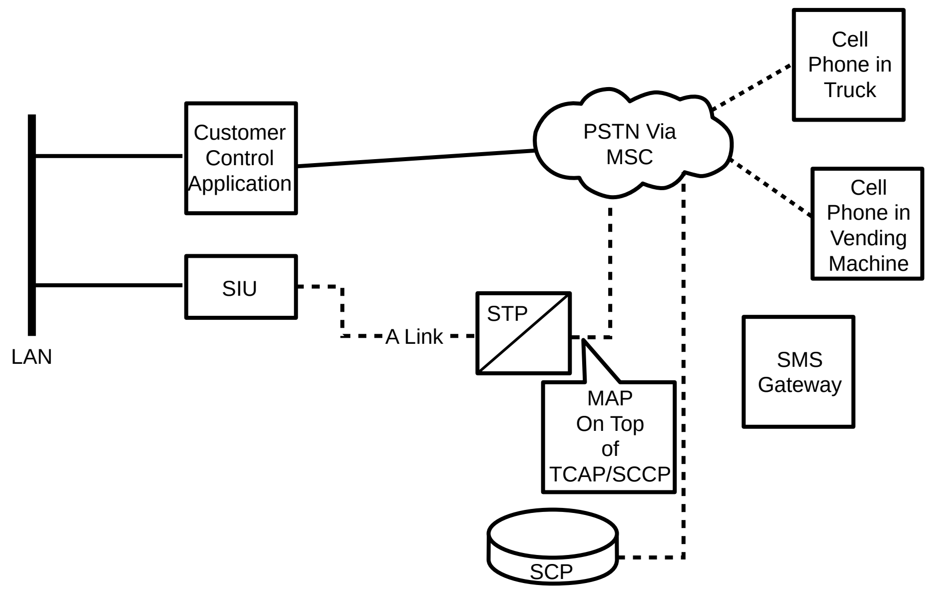

Figure 8: Short Message Service (SMS)

- TIA-41 (IS-41) and GSM MAP support, running on top of TCAP and SCCP protocols, make it possible for users to send location-based short messages to cell phone users

Intel® Offering

- One server with an Intel® Pentium® processor running Windows 2000 or Linux
  - — Hosts the application
- One SIU231 board to terminate SS7 signaling
  - — MTP layers 1-3 (low-level messaging)
  - — SCCP protocol (enables routing of TCAP messages)
  - — TCAP protocol (database access protocol)
  - — GSM MAP Protocol (SMS-related protocol)
  - — TIA-41 (IS-41) Protocol (SMS-related protocol)
  - — MAP protocol (SMS-related protocol)

Creating an SS7 Interface Board for a PBX

A company that manufactures PBX systems decides to add SS7 support to increase sales and extend the life of their products. They are experts in the design and manufacturing of PBX boards but they do not know how to develop an SS7 protocol. The Intel SS7 software stack provides an easy solution.

Intel provides the software necessary to run ISUP, TCAP, SCCP, MAP1-3, and other protocols included in the SS7 stack.

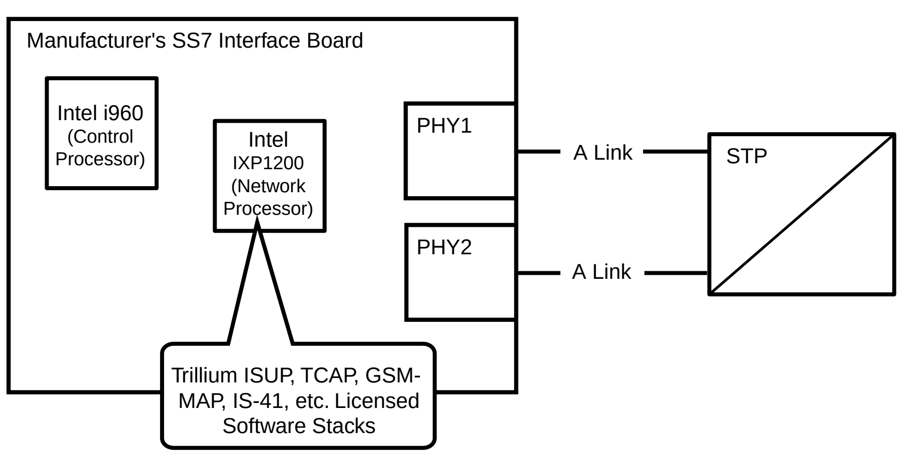

Figure 9: PBX Manufacturer Creating SS7 Interface Board

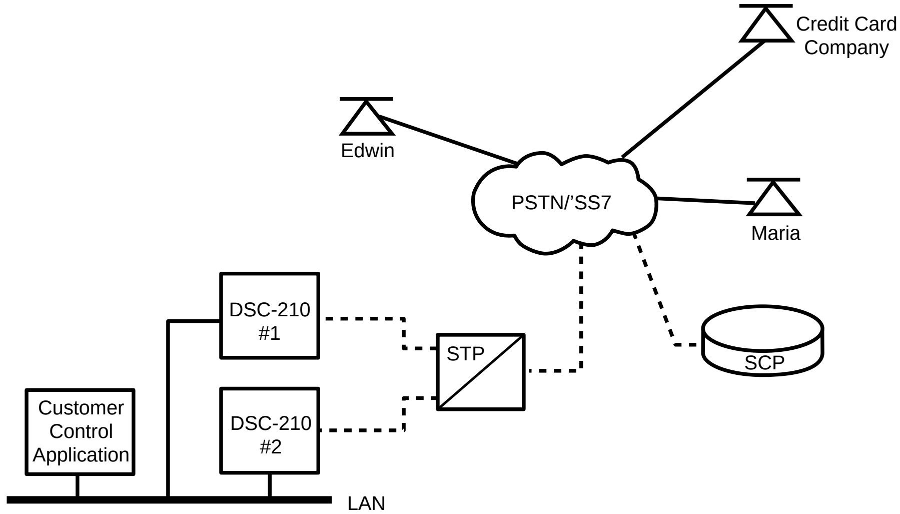

Figure 10: Intelligent Network

SS7 Benefits in this Application

- Customer grows market segment by adding SS7 connectivity
- A field-tested SS7 stack
- Hardware manufacturers can remain focused on their core competencies

Intel® Offering

- Intel i960® Control Processor on the manufacturer's board
- Intel IXP1200® Network Processor on the manufacturer's board
- Running the SS7 software stack
- SS7 licensed software for the desired protocols
  - — MTP1-3 and ISUP, in this example

DSC Intelligent Network

Imagine that a customer ("Edwin") is tired of receiving unsolicited telephone calls from credit card companies offering a lower introductory rate. Edwin calls his local telephone company and asks if he can block all calls from certain telephone numbers. His service provider is pleased to tell him that this service is available for only a few dollars a month. Here's how it works.

The service provider sets up a "blacklist" of callers—identified by their telephone numbers—that are blocked from reaching the customer. After two months of peace, Edwin decides to block all callers whose telephone number he does not recognize. The service provider removes the blacklist and sets up a "whitelist" of acceptable telephone numbers, which Edwin has determined in advance. All other callers will get a message telling them that their call cannot be completed.

Figure 10 shows that Edwin has added Maria to his whitelist. However, when the credit card company, or anyone else not on Edwin's list calls, the call will not go through, and Edwin will not be inconvenienced.

SS7 Benefits in this Application

- Provides the underlying technology that makes the call blocking service possible

Intel® Offering

- One server with an Intel® Pentium® processor running Windows 2000 or Linux:
  - — Hosts the application
  - — T-1 or E-1 voice boards to terminate voice circuits
    - A DM/V1200A-4E1 board, for example
- Two DSC units (for resilience), plus Intelligent Service Control (ISC) Software
  - — Terminate SS7 signaling to and from ITU SS7 network
    - MTP layers 1-3 (low-level messaging)
    - ISUP signaling (call control protocol)

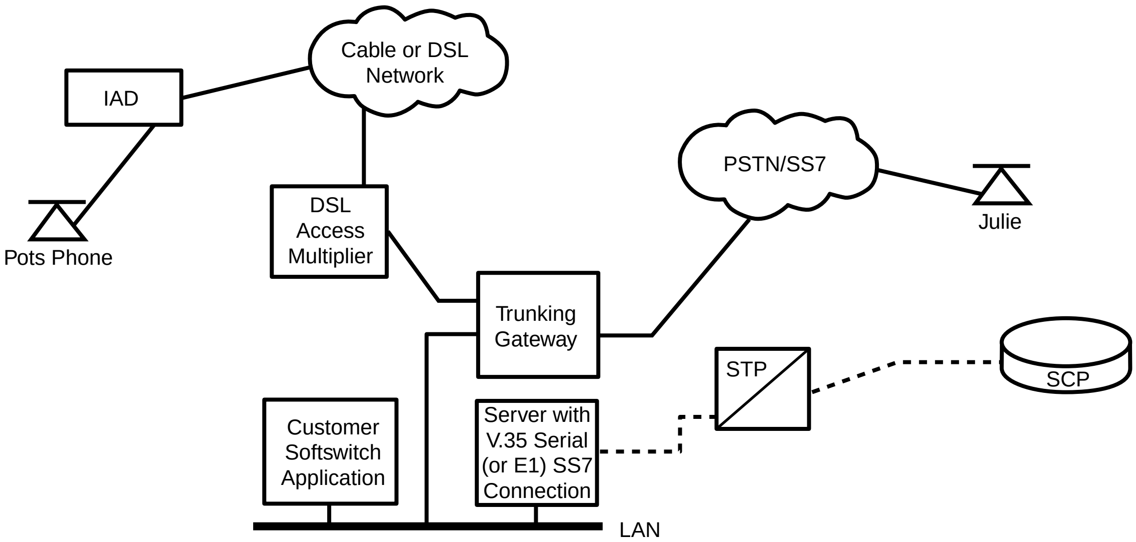

Figure 11: Softswitch

- — Terminate SS7 signaling to and from ANSI SS7 network
  - MTP layers 1-3 (low-level messaging)
  - ISUP signaling (call control protocol)
- — No audio transmission is required
  - The T-1/E-1 spans should be configured as "clear channel"
  - No A-Law/µ-Law conversion is provided

Softswitch

Cable companies and broadband service providers are increasingly looking at voice services to generate revenue. Their goal is to provide toll-quality service plus enhanced features using their existing cable or DSL connections. The equipment is already in place to route a broadband signal from the cable/DSL network to each user, but a PSTN connection must be added on the network side to enable voice.

Figure 11 shows one method for accomplishing this. The voice information is carried to/from each subscriber using Internet Protocol (IP). IP call control is used to handle the traffic from the provider's head end to a user's Integrated Access Device (IAD). IP traffic is converted for transit on the PSTN at the head end. SS7 is used to integrate the TDM-based traffic with the PSTN.

SS7 Benefits in this Application

- Integrate the TDM-based traffic with the PSTN
- Allows users to configure call handling
  - — Call forwarding
  - — Ringing order (cell, office, home, or all at once)

Intel® Offering

- Intel 32-bit platform to run the application.
- Intel licensed SS7 software for the desired protocols
  - — MTP1-3 and ISUP, in this example

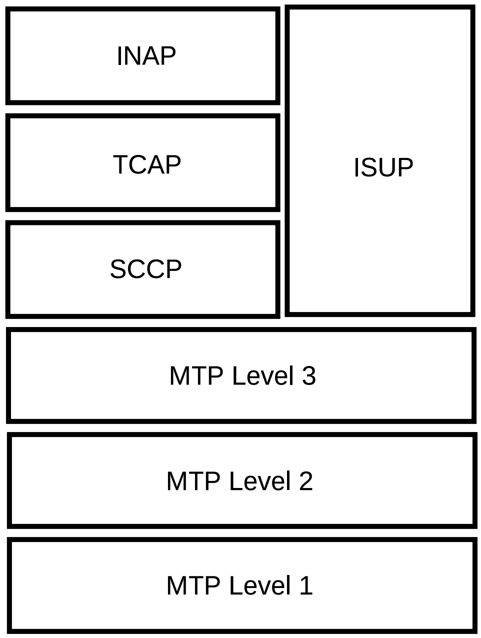

Figure 12: Complete Narrowband SS7 Stack

3.2 Intel® SS7 Software Offerings

Narrowband SS7 Stack

The Intel SS7 telephony software source code solutions enhance and extend the signaling capabilities of telecommunications networks. The solutions offer a complete standards-based implementation and are ideal for equipment manufacturers seeking to reduce time to market by using proven products. Intel carrier-grade SS7 products provide scalability, security, quality, reliability, speed, and increased network utilization for the converged network.

Intel® Offering

Intel offers extensive support for:

- **MTP2**—ITU (can be used for China), ANSI, NTT, TTC
- **MTP3**—ITU, ANSI, NTT, TTC, China, ETSI, Telcordia*
- **MTP3-B**—ITU (B-ICI), ANSI, TTC
- **ISUP**—ITU (can be used for China), ANSI, ETSI, Telcordia, NTT, FTZ, Italy, Singapore, Russia
- **TUP**—China
- **SCCP**—ITU, ANSI, China
- **TCAP**— ITU (can be used for PRC), ANSI, ETSI, TTC
- **INAP**—ITU, ETSI, Telcordia
- **MAP**—ETSI (MAP GSM), ANSI (MAP IS-41)

Benefits

- Fully portable, hardware-independent products enable integration into any processor and operating system
- Simple, fully featured, and flexible interfaces
- Mature product, integrated into a wide variety of solutions, ensures interoperability
- Accurately implements standards and assures interoperability

Broadband SS7 Stack

For applications designed to handle greater traffic and requiring more processing power, Intel offers a broadband version of the SS7 stack.

- **MTP Level 3 – B**—Broadband signaling, message handling, and network management
- **Q.2140**—SS7-to-ATM convergence
- **Q.SAAL**—Reliable transfer of data and signaling messages
- **AAL/ATM**—Physical interface

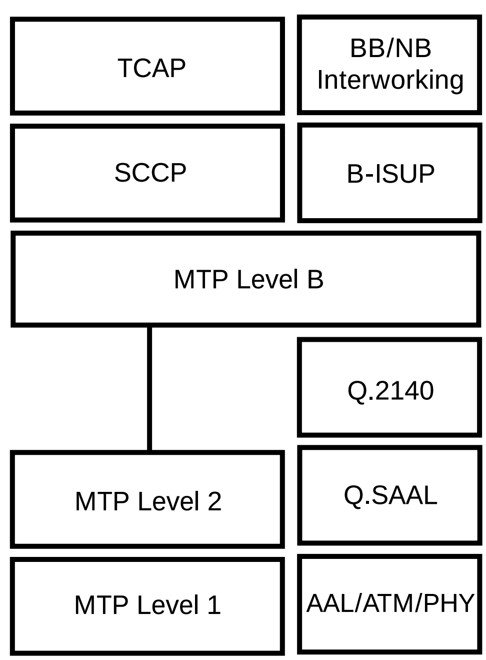

Figure 13: Complete Broadband SS7 Stack

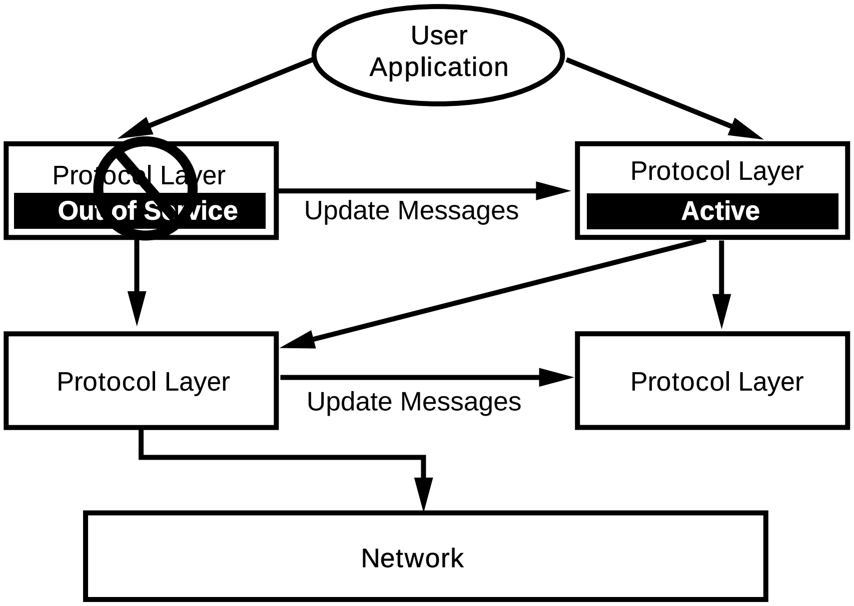

Figure 14: Fault-Tolerant High-Availability Solution

Benefits

This stack can be used in a variety of network elements including:

- Mobile Switching Centers (MSC)
- Radio Network Controller (RNC)
- Serving General Packet Radio Service Support Node (SGSN)

Fault-Tolerant High-Availability Solutions

Intel provides fault-tolerant, high-availability (FT/HA) communication layers and stacks. These can be classified as applications that provide services to a system user. An FT/HA solution maintains active calls during software and hardware failures. The Intel solution is provided in the software and gives system designers and engineers total freedom when choosing their hardware platform and operating system (kernel or user space). Developed primarily for telecommunications products, the Intel solution is also applicable to other types of products requiring high availability.

The FT/HA architecture lets you replicate a node and turn these nodes into an FT/HA system. Most equipment manufacturers use dual-processor architecture with active and standby subsystems. The Intel FT/HA solution enables the standby subsystem to maintain state information through state updates from the active subsystem. These updates prevent the loss of state information, enabling an orderly switchover from the failed subsystem to the standby subsystem. Figure14 illustrates this functionality.

Benefits

- Increased system availability via software redundancy
- Essential for 99.999% (“five-nines”) carrier-grade availability requirements

Intel® Advantages

- Modular
  - — Add-on components
- Offers software-based, active-standby configuration for redundancy
- Increased system availability via software redundancy
- Fault-tolerant and non-fault-tolerant protocol layers can co-exist
- Active and standby layers can reside in different locations
- Controlled (manual) and forced (automatic) switchover

Distributed Fault-Tolerant

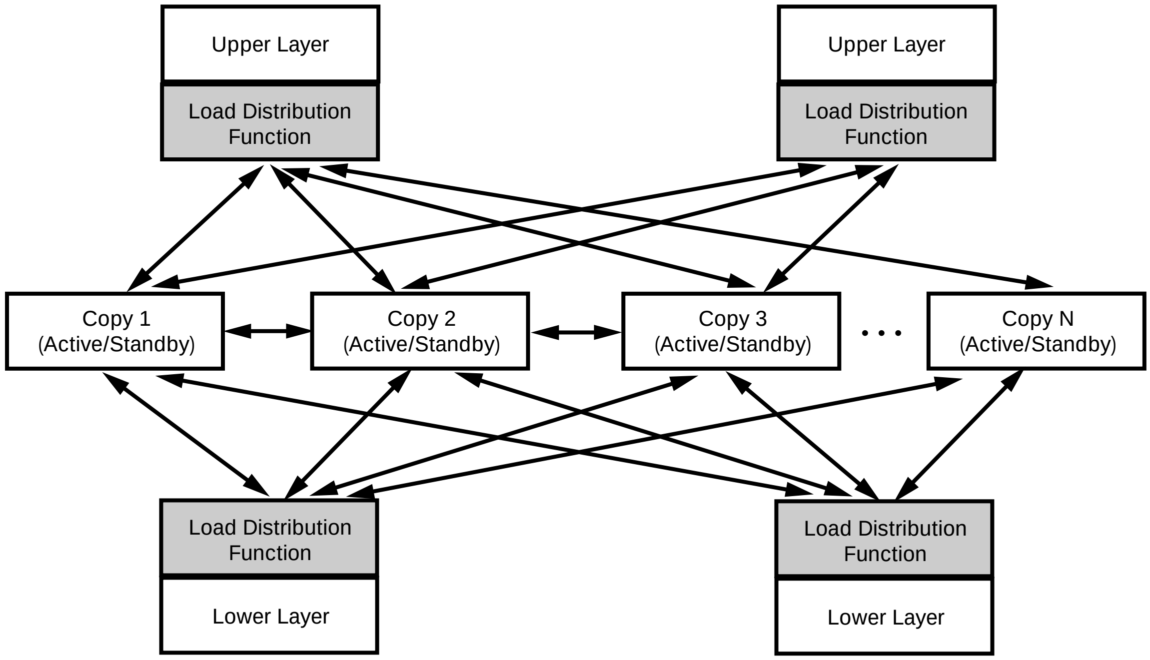

Figure 15: Distributed Fault-Tolerant High-Availability Solution

High-Availability Solutions

Trillium® portable distributed fault-tolerant/high-availability (DFT/HA) solutions have been extended to include distributed processing across multiple processors. These solutions provide the high-performance and scalability demanded by network infrastructure manufacturers.

The patent-pending DFT/HA software, coupled with Intel's broad suite of communications software solutions, enables manufacturers to build products meeting today's stringent carrier-grade telecommunications requirements. Trillium DFT/HA products are designed for active/standby dual-node architecture and scaleable multi-node architecture. They allow for a number of active and standby nodes to be configured and for the active nodes to share the system load. In this way, different processors can be active and standby for each other, providing an N+M configuration. Figure 15 illustrates this functionality. This N+M configuration goes beyond a pure distributed solution with no standby nodes in the system. In a non-redundant solution, if the active node goes down, the services provided by that node are no longer available.

Benefits

- Build high-performance, scaleable systems
- Offers load distribution capabilities while maintaining system redundancy
- Supports 99.999% ("five-nines") carrier-grade availability requirements

Intel® Advantages

- Built on fault-tolerant, high-availability (FT/HA) foundation
- High performance and scalability achieved by distributing processing load across multiple processors
- Co-existence of distributed and non-distributed protocol layers
- Modular
  - — Add-on components
- Software-based, active-standby configuration for redundancy
- Active and standby layers can reside in different locations
- Run-time state update of standby
- Controlled (manual) and forced (automatic) switchover

3.3 Other Intel® Carrier-Grade Products and Technologies

Intel is a leading network, applications and infrastructure building-block supplier of CompactPCI products to computer and communications OEMs. The company can call on more than 25 years of experience in the telecommunications business, and extensive experience with operating system support.

Intel's telecom products and solutions are based on industry standards, and include:

- Next-generation CompactPCI*, high-availability, high-bandwidth Internet applications that work with a wide variety of operating systems
- Network driver support in Intel's advanced multiprocessing and high availability technologies
- Effective implementation of next-generation network strategy, built around the Communication Platform Architecture, providing innovative products based on solution stacks
- A complete line of carrier-grade chassis and single-board computers based upon the CompactPCI standard
    - These products provide high availability and redundancy, and follow the PICMG 2.16, PICMG 2.13, and Compactnet standards and specifications that are emerging in the telecommunication industry
- Technical support team and field-level application engineers available during all phases of development and production

Opportunities Abound

The most promising opportunities are in the carrier-level telephone equipment manufacturing market segment where developers require the high quality and reliability of CompactPCI products.

Applications in the carrier telephony market segment include billing systems, interactive voice response systems (IVR), SS7 gateways, directory services, call routing applications, and more.

In the Carrier/ISP data market segment, applications include DSL access concentrators, and IP gateways. Intel products such as CompactPCI can allow users to employ straightforward implementations and avoid duplication of hardware, services, and administration.

CompactPCI products can also be found within Internet and wireless communication infrastructure. Such infrastructure is common in many industries including defense, industrial control, transportation, health care, telecommunications, and customer premises equipment.

High Availability

Any downtime experienced in a mission-critical environment, whether planned or unplanned, can be very expensive — in dollars, lost productivity, and missed opportunities. 99.999% ("five-nines") availability is typically required in such an environment.

Companies have traditionally used expensive, proprietary mainframe systems to host critical applications. These systems usually contain specialized hardware and software. A high level of redundancy is required to achieve complete availability. The high cost of these fault-tolerant systems does not compare favorably with the low cost and open architecture of desktop technology, and companies are starting to look for other options.

High availability (HA) systems offer cost-effective solutions. An HA system is constructed from standard components, yet offers the redundancy necessary to reduce the probability of interruptions. This kind of system is generally referred to as "fault-resilient."

The Intel HA architecture incorporates redundant CPUs, power supplies, and cooling fans in a single enclosure. The redundant CPU is in "hot standby" mode, backing up the active CPU. Resource management and database information are synchronized between the active and the standby hosts via a bi-directional serial port and an Ethernet channel. The system minimizes the duplication of expensive peripherals through an N+1 hot-swappable peripheral board architecture. The additional (+1) "standby" peripheral is online and ready for use should another peripheral fail.

Redundant System Slot

Redundant System Slot High Availability (RSS HA) CompactPCI systems from Intel address application requirements such as those found in e-Commerce and in central office telecommunications applications. These systems feature built-in redundancy for active system components such as power supplies, cooling fans, system master CPU boards, and alarms. RSS HA CompactPCI systems are designed for 99.999% uptime. This can translate to an allowable downtime of only 5.25 minutes per year.

RSS HA is addressed in the PICMG 2.13 specification but there is no standard implementation. Companies handle RSS HA in different ways. Intel's solution is hardware-based, and employs bridging on a system slot board. Hardware failover to the standby processor can take less than one microsecond.

The PICMG 2.16 Standard

PICMG 2.16 is a recent standard for CompactPCI boards. It provides a packet-switched backplane (PSB) for Ethernet, the most widely used network protocol.

The combination of PSB, Ethernet, and CompactPCI provide the following advantages:

- Reduced integration time for embedded system
  - Reduces time to market
- HA capabilities increase system reliability
- Compact design of power supplies, fans, and sheet metal provides improved density and performance
- Conversion of cables to printed circuit board (PCB) traces
- Greater board capacity
- Increased scalability
- Improved immunity to electrical noise
- A more precise and open specification

The PICMG 2.13 Standard – System Slot Hot Swap

PICMG 2.13 is currently being drafted to support system slot redundancy, which will allow the system slot CPU (system master) to be hot swapped to provide additional reliability. System slot redundancy is a requirement of many carrier-grade applications.

Creating hot swap capability is not simply a hardware issue. The operating system, drivers, and application software must also be considered. Progress is being made in these areas. In the interim, CompactPCI vendors are implementing proprietary solutions in order to meet current customer demand.

Intel is Ready to Help

Intel is ready to help you implement reliable, high-quality Signaling System 7 (SS7) solutions for call control, intelligent network, and wireless applications quickly and easily with a full line of SS7 building blocks.

Intel products have a proven history of helping companies make the most of revenue opportunities available for supplying global communications services in today's growing business markets. Intel is an industry leader in the manufacture of open hardware and software products for voice, fax, Internet telephony, data, voice recognition, speech synthesis, network interface and call center management that are the building blocks in many of the leading communications solutions on the market today.

For more information on SS7 products, please call 1-800-755-4444 or send email to telecomsales@intel.com.

Details on SS7 products can also be found at http://www.trillium.com and http://www.datakinetics.co.uk

For a complete listing of available Intel CompactPCI single-board computers and chassis, visit http://www.intel.com/network/csp/products/cpci_index.htm

Acronyms Used in this Document

3G – Third Generation

ANI – Automatic Number Identification

ANSI ISUP – American National Standards Institute ISDN User Part

ASR – Automatic Speech Recognition

AuC – Authentication Center

CAS – Channel Associated Signaling

CSP – Continuous Speech Processing

CPU – Central Processing Unit

DNIS – Dialed Number Identification Service

DSL – Digital Subscriber Line

DSLAM – DSL Access Multiplier

DSC – Digital Signal Converter

DPNSS – Digital Private Network Signaling System

EIR – Equipment Identification Register

EuroISDN – European ISDN

GGSN – Gateway General Packet Radio Service Support Node

GPRS – General Packet Radio Service

GSM – Groupe Speciale Mobile

HA – High Availability

HLR/VLR – Home Location Register/ Visitor Location Register

IAD – Integrated Access Device

INAP – Intelligent Network Application Protocol

ISC - Intelligent Service Control option

ITU ISUP – International Telecommunications Union ISDN User Part.

ISUP – ISDN User Part

ISDN – Integrated Services Digital Network

MAP – Mobile Application Part.

MSC – Mobile Switching Center

MTP – Message Transfer Part

MTP1 – Message Transfer Part Layer 1

MTP2 – Message Transfer Part Layer 2

MTP3 – Message Transfer Part Layer 3

NE – Network Elements

OEM – Original Equipment Manufacturer

PCB– Printed Circuit Board

PHY – Physical interface

PICMG – PCI Industrial Computer Manufacturers Group

POTS– Plain Old Telephone Service

PSB – Packet-Switched Backplane

PSTN – Public Switched Telephone Network

RNC – Radio Network Controller

RSS – Redundant System Slot

SS7 – Signaling System 7

SMS – Short Message Service

SIU – Signaling Interface Unit

SCCP – Signal Connection Control Part

SGSN – Serving General Packet Radio Service Support Node

STP – Signal Transfer Point

SCP – Service Control Point

SIU – Signal Interface Unit

TCAP – Transaction Capabilities Part

TDM – Time Division Multiplexing

TIA-41 – Telecommunications Industry Association 41 (also known as IS-41)

TTS – Text To Speech

USSD – Unstructured Supplementary Services Data

VoIP – Voice over Internet Protocol

VRU – Voice Response Unit

Glossary

3G

An ITU specification for the third generation of mobile communications technology. Analog cellular was the first generation, digital PCS the second.

Advanced Intelligent Network (AIN)

A more recent version of the Intelligent Network.

A-Law

A Pulse Code Modulation (PCM) coding and companding standard used in Europe and in other areas outside of North America. A-Law is the encoding method used in the 2.048 Mbps, 30-channel PCM system known as E-1.

ANSI-41

A standard for transaction-based services that allow the development of applications such as Short Message Service and access to HLR/VLR for wireless networks.

Automatic Number Identification (ANI)

Often referred to as “Annie”. A service that identifies the phone number of the calling party. Technically, ANI is available on both analog and digital lines, but most often it is restricted to digital services like 800 numbers. The ANI digits can be used by an application to do things such as display a complete customer account profile on a salesperson’s PC screen before the salesperson ever talks to the customer.

Authentication Center (AuC)

A database used in mobile telecommunications systems to identify subscribers. It also contains subscriber data related to features and services. It forms part of the Home Location Register (HLR).

Blacklist

A list of callers—identified by their telephone numbers—that are blocked from reaching the customer. The customer generates the list and the local telephone company implements it.

Caller ID

Caller ID is a generic term usually applied to a service provided by a local telephone company that displays information about the calling party (for example, name, number, or both) on the called party’s display telephone, attached display unit, or computer screen. Caller ID is a CLASS service.

Custom Local Area Signaling Services (CLASS)

CLASS consists of number translation services such as call forwarding, automatic callback, and Caller ID, available within a customer’s Local Access and Transport Area (LATA) from a local telephone service provider.

CompactPCI

An open specification supported by the PCI Industrial Computer Manufacturers Group (PICMG), which is a consortium of companies involved in using PCI technology for embedded applications. CompactPCI combines the performance of the Peripheral Component Interconnect (PCI) standard with a robust mechanical form factor that is ideal for embedded applications. The performance characteristics are tailored to industrial environments.

Dialed Number Identification Service (DNIS)

A feature of 800 lines that allows a system with multiple 800 lines to determine which 800 number the caller dialed. This allows incoming calls to be routed on the basis of a variety of criteria including the geographical area from which the call originated.

En-Bloc Signaling

Signaling in which address digits are transmitted in one or more blocks, each containing sufficient address information to enable switching centers to carry out progressive onward routing.

Equipment Identification Register (EIR)

A database used to verify the validity of equipment in mobile telecommunications services. It can provide security features such as blocking calls from stolen mobile stations and preventing unauthorized access to the network.

Failover

Failover refers to a backup mode in which the functions of a system component (such as a processor, server, network, or database) are taken over by secondary system components when the primary component becomes unavailable through either failure or scheduled down time.

Freephone

A telephone service that permits the cost of the call to be charged to the called party, rather than the calling party.

General Packet Radio Services (GPRS)

A packet-based wireless communication service that promises data rates from 56 Kbps to 114 Kbps and continuous connection to the Internet for mobile phone and computer users. The higher data rates will allow users to take part in videoconferences and interact with multimedia Web sites and similar applications using mobile handheld devices as well as notebook computers

Global System for Mobile Communication (GSM)

A digital mobile telephone system, which is widely used in Europe and other parts of the world. GSM uses a variation of time division multiple access and is the most widely used of the three digital wireless telephone technologies (TDMA, GSM, and CDMA). GSM digitizes and compresses data, then sends it down a channel with two other streams of user data, each in its own time slot. GSM operates at either the 900 MHz or 1800 MHz frequency band.

Home Location Register (HLR)

An ultra-high-speed database containing the current home serving cell for a mobile handset.

Integrated Access Device (IAD)

Customer premises equipment used to aggregate diverse traffic types such as voice and data.

Integrated Services Digital Network User Part (ISUP)

Provides standards-based and network-specific call control services for wireless and wireline PSTN networks.

Intelligent Network (IN)

A telephone network architecture that separates service logic from switching equipment, allowing new services to be added without redesigning switches to support those new services.

Intelligent Network Application Part/Protocol (INAP)

Efficiently enables network services and customer applications within the distributed environment of the Intelligent Network. Networks using INAP deliver easily programmable services on a per customer basis, such as follow-me, televoting, pre-paid, and credit card calls.

Intelligent Peripherals

A network system in the Advanced Intelligent Network (AIN) Release 1 architecture containing a resource with a Resource Control Execution Environment (RCEE) functional group that enables flexible information exchange between a user and the network.

Interim Standard 41 (IS-41)

Renamed ANSI-41 on becoming a standard.

Internet Message Access Protocol (IMAP)

A standard protocol for accessing e-mail from a local server.

Local Number Portability

Allows telephone subscribers to keep the same telephone number as they change their operating environment (home, car, street, workplace, etc.).

Message Transfer Part (MTP)

Provides physical, data link, and network layer functions. MTP transports information from the upper layers (including the user parts and SS7 applications) across the SS7 network. Refers to level 1 through 3 in the SS7 protocol stack (MTP1-MTP3).

Mobile Application Part (MAP)

SS7 standards that address the registration of roamers and the intersystem hand-off procedure in wireless mobile telephony.

Mobile Switching Center (MSC)

A switch providing services and coordination between mobile users in a network and external networks.

Mu-Law (µ-Law)

A Pulse Code Modulation (PCM) coding and companding standard used in North America and Japan. (-Law is the encoding method used in the 1.544 Mbps, 24-channel PCM system known as T-1.

Network User Part (NUP)

A variation of ISUP used in the United Kingdom.

Out-Of-Band Signaling

Telecommunications signaling on a channel dedicated for that purpose and separate from the channels used for the telephone call itself. Out-of-band signaling is used in Signaling System 7, the latest standard for the signaling that controls the world's telephone calls.

Overlap Signaling

The process of setting up a call by sending dialed digits one at a time, as they are dialed by the originating device.

QSIG

QSIG is an ISDN based protocol for signaling between nodes of a Private Integrated Services Network (PISN). QSIG can be used in all of the following applications:

- Multi-vendor PBX networking
- Attachment of ancillary equipment (e.g., voice mail systems, paging equipment, wireless base stations) to a PBX network
- Virtual Private Networks (VPN)
- Broadband private networks
- Linking Trans-European Trunked Radio (TETRA) areas
- VoIP (H.323) applications

Remote Operations Service Element (ROSE)

An application layer protocol that allows remote operations at a remote process.

Roaming Service

Ability to access the Internet when away from home for the price of a local phone call or at a charge considerably less than standard long distance charges.

Short Message Service (SMS)

A service for sending messages of up to 160 characters to mobile phones that use Global System for Mobile (GSM) communication.

Remote Operation Service Element

The Remote Operation Service Element (ROSE) provides the mechanism for an application entity to cause some operation to be performed remotely, possibly receiving a result from that operation.

Service Switching Points (SSP)

Service Switching Points are telephone switches connected by SS7 links. The SSPs process calls and may send SS7 messages to transfer call-related information to other SSPs. They may also query Service Control Points (SCP) to obtain information needed to route a call.

Signaling Connection Control Part (SCCP)

Provides address resolution services, such as global title, for locating services within the network. SCCP is available in two versions: connectionless only and connection-oriented plus connectionless.

Signaling Data Links

Used to connect SS7 signaling points. In most countries, these links are 56 or 64 Kbps data facilities. The physical interface to an intelligent peripheral is either a T-1 or E-1 interface, or a V.35 connection.

Signal Transfer Points (STP)

Switches that relay messages between network switches and databases. They route messages to the correct signaling link, based on information contained in SS7 data messages.

Telephone User Part (TUP)

A variation of ISUP without Integrated Services Digital Network (ISDN) support, which is used in China and France.

Time Division Multiplexing (TDM)

A technique for transmitting multiple voice or data signals simultaneously over the same transmission medium. TDM interleaves groups of bits from each signal one after another. Each group has its own “time slot” and can be identified and extracted at the receiving end.

Time Division Multiple Access (TDMA)

A technology used in digital cellular telephone communication to divide each cellular channel into three time slots in order to increase the amount of data that can be carried.

Transaction Capabilities Application Part (TCAP)

Used for transporting transaction-oriented data across the SS7 network. TCAP implements standard Remote Operation Service Element (ROSE) services for applications such as GSM-MAP and IS-41. These “applications” provide IN services such as Home Location Register or Short Message Service.

Unstructured Supplementary Services Data (USSD)

USSD supports the transmission of information over the signaling channels of a GSM network. USSD provides session-based communication, enabling a variety of applications such as prepaid roaming and chat.

Visitors' Location Register (VLR)

A local database maintained by the cellular provider to track users who are roaming in the provider's home territory.

Voice over Internet Protocol (VoIP)

VoIP technology enables real-time transmission of voice signals as packets of data over the Internet or other IP-based network.

Whitelist

A list of callers—identified by their telephone numbers—that are allowed to reach the customer. The customer generates the list and the local telephone company implements it. A whitelist is the opposite of a blacklist.

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