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Advanced Intelligent Network for Wireless Communications

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Abstract

Advanced Intelligent Networks (AIN's) are telecommunications networks that are capable of providing advanced services through the use of distributed databases that provide additional information to call processing and routing requests. The advanced intelligent network (AIN) is a combination of the SS7 signaling network, interactive database nodes, and development tools that allow for the processing of signaling messages to provided for advanced telecommunications services. In this paper we explore the general architecture of AIN. We also explain the role of AIN for mobile communication. The proposed idea in this paper are two major directions in AIN for mobile communications which are wireless access technology and increased network functionality. Wireless access technology is aiming at low power, light weight, efficiently used spectrum and low-cost operation and maintenance. The increased network functionality is achieved through the use of SS7 for a call control and database transactions.

Keywords: *Intelligent Networks, SS7, Mobile Communications, Service Management System, Signal Transfer Point*

1. Introduction

Advanced Intelligent Network is a particular kind of network which is evolving from the Intelligent Network (IN). In fact, an advanced intelligent network has got an independent architecture. This independent architecture allows telecommunication service operators to create and modify services very quickly according to network performance and a customer's requirements. In the intelligent network concept, the service providers require more control to offer new services. Further, the intelligent network is able to separate various specifications, creation, and control of telecommunication services from the physical switching network such that the Home Location Register (HLR) and the Visitor Location Register (VLR) are no longer integrated in the Mobile Telephone Switching Office (MTSO).

The essence of the AIN is that, the current PSTN is evolving into what is known as the Advanced Intelligent Network (AIN). In the old PSTN, the control functions for telephone services (service logic) are implemented in software that runs in telephone switches. In the AIN, service logic is implemented by Service Logic Programs (SLPs) that run in Service Control Points (SCPs). SCPs are, in most cases, ordinary commercially available microprocessor-based workstations or servers, running the same insecure operating systems that are used on most Internet hosts. SCPs communicate with switches through the SS7 network. In addition, SCPs will have connections (sometimes via other machines) to the telephone companies' corporate data networks to support such functions as customer service and billing. There are also plans to offer customers an Internet interface for changing their service parameters—such as the number to which their calls should be forwarded.

2. Network Characteristics of Advanced Intelligent Network (AIN)

AIN is evolving from IN. The various characteristics of AIN can be listed as under:

- It is a programmable network operable by either user or carrier provider, or both.
- Capable of rapid introduction of new services.
- AIN is service independent.
- Supplier transparent i.e. o en system architecture (OSA).
- Accessible for other service providers as well.
- Common channel signaling (CCS) makes out of band signaling.
- AIN makes use of CCS to deliver the call set-up signaling and the network information.
- Service logic- invokes AIN service logic programs (SLPs).
- The use of CCS can increase the speed of process for call process and information delivery.

- The CCS network uses digital channels with the SS7 protocol at a rate of 56 kbps.
- In this AIN, the traffic channels are never tied up for signaling.

3. Elements of AIN and Interfaces of AIN

3.1 Elements of AIN

An AIN consists of the following elements:

1) Service Switching Point
The Service Switching Point (SSP) is a telephone switch. In order to participate in the AIN, a switch must be upgraded to run a version of software that conforms to the AIN call model and has triggers at specified points in the call setup sequence. If a trigger is enabled, the SSP will, at that point in call setup, send a request to the SCP asking for instructions about how to proceed with the call setup.

2) Service Control Point
The Service Control Point (SCP) is the brain of the AIN. The SCP invokes service logic programs. The common channel signalling network allows the SCP to fully interconnect with AIN switching systems via a signalling transport (STP). The switch (SSP) will consult the SCP at various points in the call setup sequence. The SCP will run its Service Logic Programs, consult its (customer-specific) databases, and return instructions to the switch. There is a requirement that the instructions be returned very quickly since the switch is in the middle of a call setup and the customer is waiting for the ringing tone to start. An SCP can provide service to multiple switches. The switch and SCP communicate over the SS7 network.

3) Service Data Point
The Service Data Point (SDP) is a database server for the SCPs. It implements the Service Data Function (SDF). It contains the customer-specific databases that are queried by SLPs during call setup.

4) Intelligent Peripheral
The Intelligent Peripheral (IP) serves a switch (or perhaps several switches), to which it is connected by an ISDN link. It provides such services as recorded announcements, voice recognition, and the collection of DTMF tones for later transmittal, when a customer, for example, is entering a PIN number. The Adjunct Processor (ADJ) provides the adjacent SSP (to which it is connected by an Ethernet link) with SCP-like services requiring faster response than can be obtained over the SS7 network from remote SCPs. Both the ADJ and the IP can run some SLPs.

5) Service Creation Environment
The Service Creation Environment (SCE) is a development environment for Service Logic Programs (SLPs). The Service Management System (SMS) provides an interface between the SCE and the SCP for deploying new SLPs. It also provides other management functions such as the provisioning (initial setup) of services for customers, and the updating of individual customers' call processing options.

6) AIN Switch
Routs a call to an IP to ask for a function. When the IP completes the function, it also collects the user's information and sends it to AIN service logic(resides in SCP)via the AIN switch.

7) Operational System (OS)
Provides memory administration, surveillance, network testing and network traffic management, maintenance and operation.

8) Signal Transfer Point (STP)
The Signal Transfer Point (STP) is an SS7 packet switch. These, too, are part of the existing network. This is a point that interconnects the SCP and AIN switching systems.

9) Service Management Systems (SMS)
It provides three functions as under:
(i) Provision-creates service order, validation, load record;
(ii) Maintenance-resolves record inconsistency, tests call processing logic, performs special studies;
(iii) administration- creates service logic, maintains service data.

3.2 Interfaces of AIN

The interfaces between AIN network elements are as under:
a) Between the switching system and SCPs or adjunct systems using SS7 signaling.
b) Between the switching system and IPs or service nodes using ISDN.
c) In AIN, between SCP and SMS using the X.25 protocol.
d) Between end users AIN services; may be either conventional analog or ISDN interface.

4. General Architecture of AIN

The AIN general architecture with the indicated AIN interfaces has been shown in figure 1 . In cellular systems, the channel link between the mobile switching system and the user does not make use of ISDN. Because, a 64 kbps

ISDN channel needs a bandwidth of 64 kHz for radio transmission .In cellular systems, the data rate of a channel is 16 kbps or less, and needs only a bandwidth of 25 kHz or less. Using less channel bandwidth increases more spectrum efficiency.

The AIN system uses a Service Creation Environment (SCE) to created advanced applications. The SCE is a development tool kit that allows the creation of services for an AIN that is used as part of the SS7 network. A service management system (SMS) is the interface between applications and the SS7 telephone network. The SMS is a computer system that administers service between service developers and signal control point databases in the SS7 network. The SMS system supports the development of intelligent database services. The system contains routing instructions and other call processing information. To enable SCPs to become more interactive, intelligent peripherals (IPs) may be connected to them. IPs are a type of hardware device that can be programmed to perform a intelligent network processing for the SCP database. IPs perform processing services such as interactive voice response (IVR), selected digit capture, feature selection, and account management for prepaid services. To help reduce the processing requirements of SCP databases in the SS7 network, adjunct processors (APs) may be used. APs provide some of the database processing services to local switching systems (SSPs).

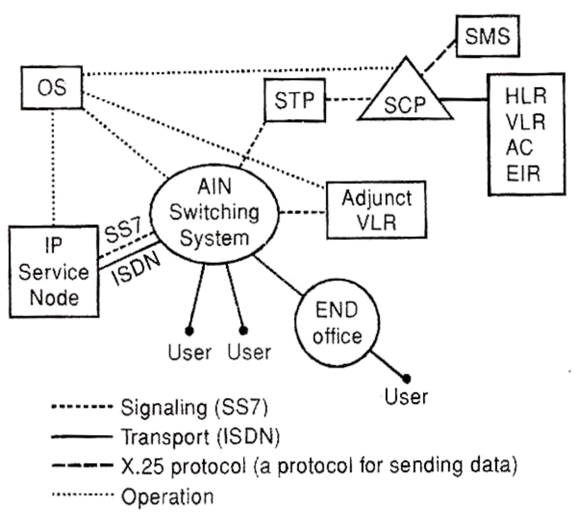


Fig.1 Illustration of AIN system architecture

5. SS7 Network and ISDN for AIN

In this section, we discuss SS7 network and various related issues.

5.1 Evolution of SS7 Network

This is an out-of-band signalling method in which a common data channel is used to convey signalling information related to a large number of trunks (voice and data). Signaling has traditionally supported.

(1) Supervisory function , e.g., on hook-/off-hook to indicate idle or busy status;
(2) Addressing function, e.g., called number; and
(3) Calling information, e.g., dial tone and busy signals.

5.2 Common Channel Signaling

The introduction of electronic processors in switching systems made it possible to provide common channel signalling. In 1976, Common Channel Interoffice Signaling (CCIS) was introduced. CCIS is based on the International Consultative Committee on Telegraphy and Telephony (CCITT) Signaling System No.6 recommendations and called CCS6. The CC6 protocol structure was not layered. It was a monolithic structure. The signalling efficiency was high.

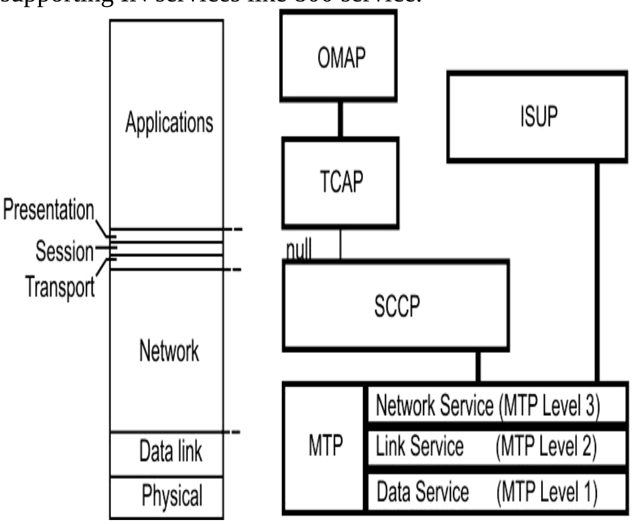
In 1980, CCITT first recommended SS7 a signalling system for digital trunks. The layered approach to designing SS7 protocols was being developed for Open System Interconnection (OSI) data transport. Also, the High-level Data Link Control (HDLC) bit-oriented protocols had an influence on the development of SS7 system.

5.3 Protocol Model for SS7

The inefficiencies of layered protocols are far outweighed by their flexibility in realization and management of complex functions. The protocol becomes more aligned with the seven –layer OSI reference model as shown in figure 2(a). The seven layers are physical, data link, network, transport, session, and presentation and application layer. The SS7 protocol model has been shown in figure 2(b) for comparison with the OSI model. In SS7 the Message Transfer Part (MTP) provides the OSI layered protocol model as level 1 data service, level 2 link services and level 3 network services.

The full level 3 service is provided by the Signalling Connection Control Part (SCCP). SCCP provides an enhanced addressing capability that may be considered as level 3+ or a level close to level 4.Layers 4 to 6 in the OSI model do not exist in the SS7 protocol model. The Transaction Capabilities Application Part (TCAP) levels are considered the same as the application part (level 7) in OSI.

The Application Service Element (ASE) is at the same level as OMAP. TCAP includes protocols and services to perform remote operations. The primary use of TCAP in these networks is for invoking remote procedures in supporting IN services like 800 service.



(a) (b)
Fig.2 (a) OSI Model (b) SS7 Protocol Model

OMAP provides the application protocols and procedures to monitor, coordinate, and control all the network resources which make communication based SS7 possible. ASE is for the MTP routing verification test (MRVT), which uses the connection less services of TCAP, MRVT is an important function of OMAP.

5.4 SS7 Network Link Deployment for AIN

The SS7 links can provide high-speed service because of the common channel signalling. Based on the connection among the entire resource element, there are six links from A to E.

A link	STP ⟷ SCP	
	STP ⟷ SP/SSP	
B/D and C links	STP ⟷ STP	
E link	STP ⟷ SP/SSP	
F link	SP/SSP ⟷ SP/ SSP	

The SS7 network link deployment chart is shown in figure 3. The interfaces between any two entities are indicated by the letters from A to F.

5.5 ISDN

Signaling has evolved with the technology of the telephone. The Integrated Service Digital Network(ISDN) is used to integrate all – digital networks in which the same digital exchange and digital transmission paths are used for provision of all voice and data services. Signaling in ISDN has two distinct components.

a) Signaling between the user and the network node to which the user is connected (access signalling). The SS7 signaling is not used between the mobile user and the network node.

b) Signaling between the network nodes (network signalling).

The current set of protocol standards for ISDN signalling is Signaling System No. 7(SS7).

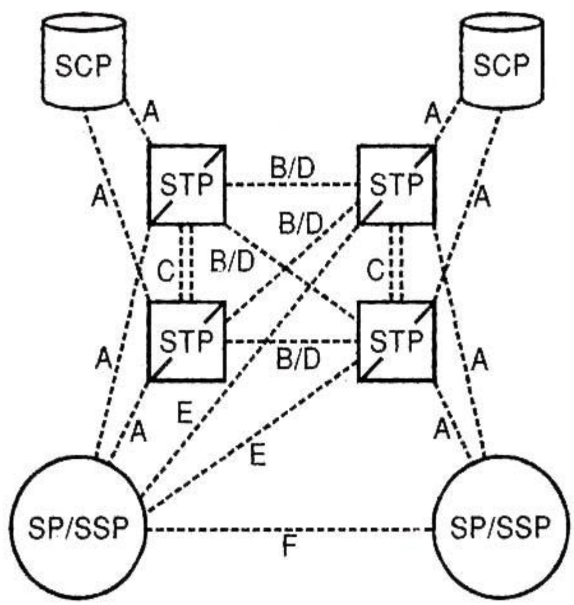


Fig3. SS7 Network Link Deployment

5.5.1 ISDN-UP

In the SS7 protocol model, functions not covered by the SS7 levels will be provided by the ISDN-UP protocol, such as the signalling functions that are needed t support the basic bearer service and supplementary services for switched voice and data applications in an ISDN environment.

5.5.2 B-ISDN

The broadband ISDN will support a range of voice, video, data , image and multimedia services using available resources. These resources include transmission, switching and buffer capaci5ty, and control intelligence. The target is to provide switched services over Synchronous Optical Network/Asynchronous Transfer Mode (SONET/ATM) transport using signalling based n the extended ISDN protocol.

6. AIN for Mobile Communication

The AIN for mobile communication has to meet a unique requirement: the call has to reach the mobile station in a required time frame which it is in motion. Therefore, the call processing time or the handoff time has to be within a specific limit, otherwise the mobile station can move out of the coverage area and the call either cannot be connected or will be dropped.

6.1 Two Major Directions in AIN

Two major directions in AIN for mobile communications are wire access technology and increased network functionality. Wireless access technology is aiming at low power, light weight, efficiently used spectrum and low-cost operation and maintenance.

The increased network functionality is achieved through the use of SS7 for a call control and database transactions. Mobility is the main concern in the connection less structure of the protocol, which has to be suited to real-time applications. The Mobile Application Part(MAP) can be applied to mobile communications. The exchange of data between components of a mobile network to support end user mobility and network call control are taken care of by MAP. The MAP is an application service element. The MAP of CCITT SS7 is shown in figure 4.

TCAP is composed of both the component sub layer and transaction sub layer. The component sub layer provides the exchange of protocol data units, invoking remote operation and reporting their results.

The transaction sub layer is responsible for establishing a pseudo-association service for exchange of related protocol data units. The interrogations and transfer of information take place by using the ASE of the MAP and the component sub layer of TCAP. A number of MAP procedures relate to

(1) Location registration and cancellation.
(2) Handling of supplementary service.
(3) Retrieval of subscriber information during call establishment.
(4) Handoff, and
(5) Subscriber management including location information request and retrieval.

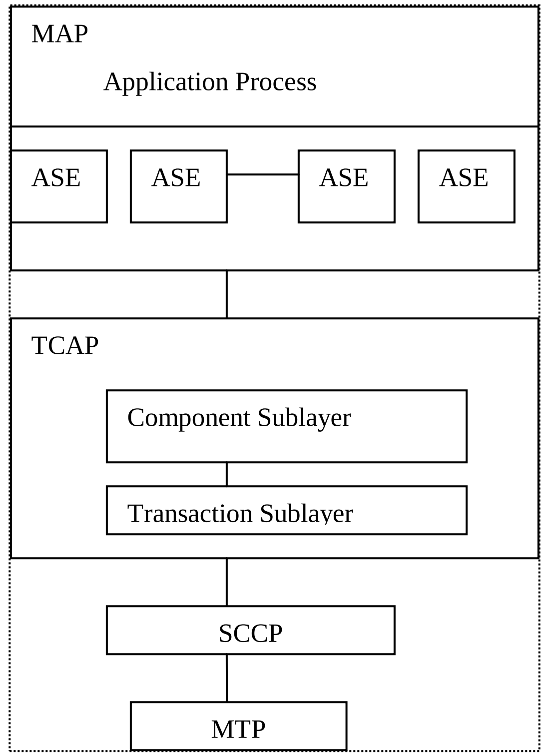


Fig4 . Illustration of map of CCITT SS7

The AIN mobile system architecture is shown in figure 5, which is the same as figure 4 except the SSP is replaced by the MSC and SMS collocates with the Service Creation Environment (SCE), which defines new features and services.

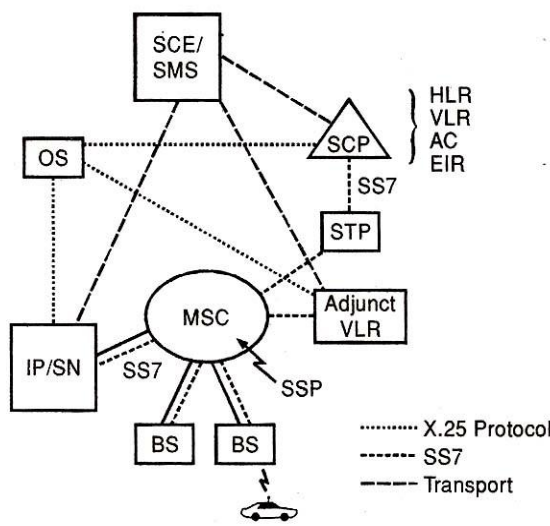


Fig.5 Illustration of architecture of Mobile Communication

7. Conclusions

The Advanced Intelligent Network (AIN) is a combination of the SS7 signaling network, interactive database nodes, and development tools that allow for the processing of signaling messages to provided for advanced telecommunications services. In this paper we explored the general architecture of AIN. We also explained the role of AIN for mobile communication. The proposed ideas in this paper are two major directions in AIN for mobile communications which are wireless access technology and increased network functionality. Wireless access technology is aiming at low power, light weight, efficiently used spectrum and low-cost operation and maintenance. The increased network functionality is achieved through the use of SS7 for a call control and database transactions.

References

[1] Abdi R. Modarressi, Ronald A. Skoog, "Signaling System No. 7: A Tutorial", IEEE Communications Magazine, July 1990, pp. 19-34.

[2] Robrock, R.B. "Plumber Is Charged In Call Forwarding Theft", New York Times NATIONAL, Sunday, January 29, 1995, p. 32.

[3] Robrock, R.B., "The Intelligent Network—Changing the Face of Telecommunications", *Proceedings of the IEEE*, Vol. 79, No. 1, January 1991, pp. 7-20.

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