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On telecom services evaluation

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Abstract. Communication specialists around the world are facing the same problem: shifting from circuit switching to packet switching. Network paradigm shift means the transition from Signal System Seven (SS7) signaling to Internet Protocol (IP). SS7 is a set of protocol standards that controls signaling for the public switched telephone network, allowing mobile carriers around the world to pass information across their networks. The transition to IP assumes that the IP protocol will be the only means of communication between the transport layer and applications. Telecom services evaluation due to the transition from Time-division multiplexing network to IP are considered and some lessons for Russian telecommunications are named.

Keywords: circuit switching, packet switching, ISDN, SS7, intelligent network, softswitch, SIP, AS-SIP.

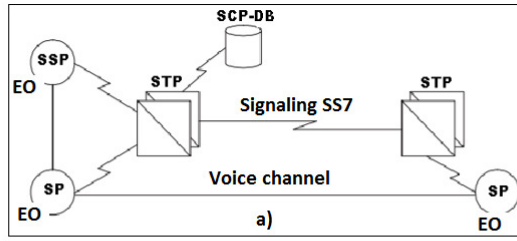
1. Introduction

Communication specialists around the world are facing the same problem: shifting from circuit switching to packet switching, from ISDN signaling and AIN (Advanced Intelligent Network) architecture to all-IP world. For example, most of the broadcasters now recognize that IP networks are more flexible, cheaper to upgrade and extremely reliable when configured correctly [1]. For operators, all-IP world lets bypass security problems in SS7 [2], etc. In the same time, this process has own issues, especially, on the global level [3].
The article is devoted to the discussion of the telecommunications development strategy. We will provide examples to illustrate the difficulties that complicate the transition from CS to PS to web-oriented services.In Section 2, we discuss the orientation towards AIN. In Section 3, we discuss the transition from TDM to IP. Sections 4 and 5 consider MFSS services.In Section 6, some lessons for Russian telecommunications are named.

2. On the orientation towards AIN

The AIN architecture was developed by Bell Labs in the 1970s. The basic AIN design includes (Figure 1):

- STP (Signaling Transfer Point)



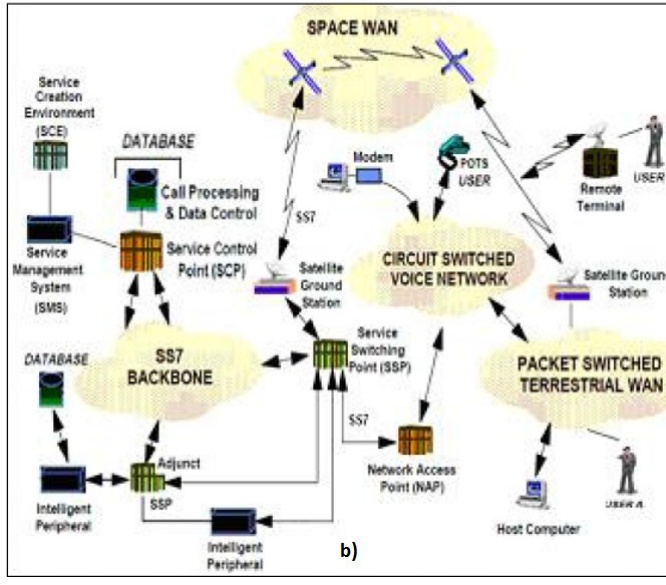


Figure 1. a) AIN basic design. b) An implementation of AIN Service Architecture

- SSP (Service Switching Point)
- SCP-DB (Service Control Point with Database)
- each End Office (EO) contains Signaling Point (SP).

The AIN provides integrated "one stop" end-user services, such as voice, data, video, email, images, office applications, and 800 services. SS7 is a means by which elements of telephone networks exchange information. Information is conveyed in the form of messages. SS7 defines the procedures for the setup, ongoing management, and clearing of a call between users. The key points of AIN are the following: Service Control Point and Database of services, as well as TCAP (Transaction Capabilities

Application Part) - a main protocol in the SS7 protocol stack, providing access to databases.

Intelligent Peripheral also plays an important role: its functions include tone generation, voice recognition, speech and data compression, dialing recognition, and much more, including tactical and strategic services for personnel identification. The Adjunct provides the same operation as the SCP but is configured for one or fewer services for a single switch. The Network Access Point (NAP) is a switch that has no AIN functions. It is connected off a SSP and interfaces to trunks with SS7 messages. It will route the call to its attached SSP or AIN services based on the called and calling number received. Channel switching network subscribers, as well as packet switching network subscribers, can be AIN users. Point out the attention to the Service Creation Environment (SCE) as a standardized means for service software development.

3. MFSS - the transition from TDM to IP

The Information System Network paradigm shift means the transition from SS7 signaling to IP protocol. It is assumed that the IP protocol will be the only means of communication between the transport layer and applications.

Note that SIP protocol was designed to solve a small but important set of issues and to allow interoperability with a broad spectrum of existing and future IP telephony protocols. SIP is regularly deployed alongside SOAP, HTTP, XML, VXML, WSDL, UDDI, SDP, RTP and a variety of other protocols.But SIP, as a signaling protocol, does not have the ability to break into ongoing calls. The support for Multi-Level Precedence and Preemption (MLPP) can be used instead. For this reason, particularly, Assured Services SIP protocol was invented. Understanding the differences between AS-SIP and standard SIP is not a trivial task.RFC 5638 (Simple SIP) specifies the support of only 11 RFCs necessary to create a SIP appliance with presence, instant messaging, audio and video communications. The UCRrequires support for nearly 200 RFCs. It is the substantially large number of requirements for the end instrument that make AS-SIP different from the typical SIP stack.

The most important step for network modernization is the replacing of channel switching electronic Multifunctional switches (MFS) by packet switching routers under AS-SIP signaling. The transition phase is based on Multifunctional SoftSwiches (MFSS) developed by CISCO.

The MFSS (Figure 2) will be interfacing between the TDM and IP backbone network and will have much more complex circuit-switched based interfaces along with simple packet-switched based IP interfaces. The ISDN network uses ISDN User Part (ISUP) signaling protocol for the session/call control. So, MFSS will also need to provide ISUP-SIP interworking function (IWF). It is expected that TDM switching portion of the MFSS will be retired as soon as all users/systems migrate to IP.

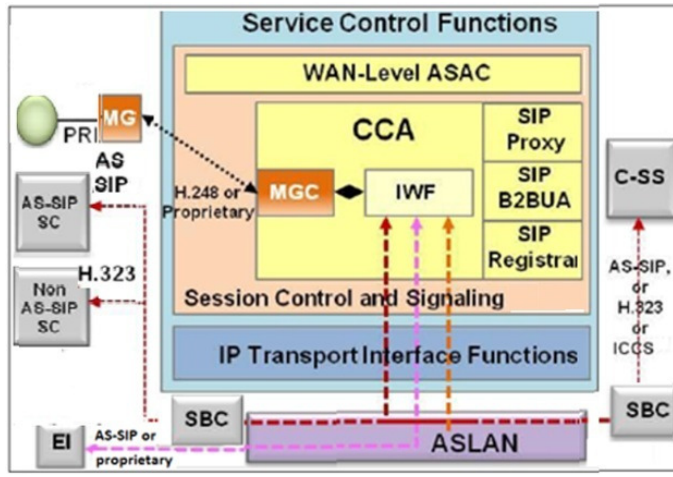


Figure 2. Reference model for Multifunction SoftSwitch.

The MFSS provides all required PSTN/ISDN interface functions, including ISUP, CCS7/SS7, and CAS signaling and media conversion. A signaling gateway (SG) deals with all signaling protocols such as ISUP, CCS7/SS7, and CAS. The MFSS also operates as a media gateway (MG) between TDM circuit-switching and IP packet-switching under the control of the media gateway controller (MGC) while communications control protocol like H.248 is used between MG and MGC. Besides, there are EI (End Instrument) and AEI (Assured Services End Instrument), following AS-SIP, as well as PIE (Proprietary Internet Protocol Voice End Instrument). H.323 is the leading protocol for video conferencing. With its superior handling of video and conference control, no other protocol comes close to matching the capabilities of H.323 for video.

4. MFSS services

Take an attention to the Service Control Function (Figure 3). The SCF cooperates with 19 servers by a lot of protocols. Besides, the UC Extensible Messaging and Presence Protocol (XMPP) supports the full potential of Instant Messaging (IM), Chat, and Presence.

It is worth to pay attention to TCAP (Transaction Capabilities Application Part) Application Server. The TCAP enables the deployment of advanced intelligent network services by supporting non-circuit related information exchange between signaling points using the Signaling Connection Control Part (SCCP) connectionless service in SS7 networks of

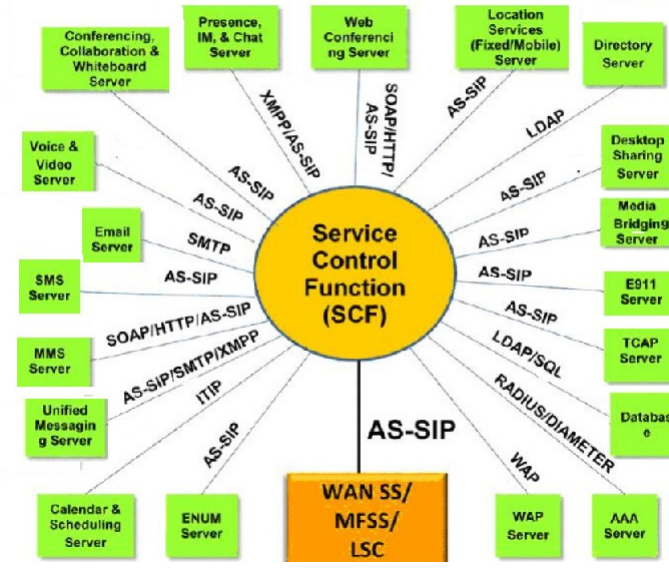


Figure 3. Service Control Function and its 19 servers

the TDM network. A service switching point (SSP) uses TCAP to query a signaling point control point(SCP) to determine the routing number(s) associated with a dialed 800, 888, or 900 numbers. The SCPuses TCAP to return a response containing the routing number(s) (or an error or reject component) back to the SSP. Calling card calls are also validated using TCAP query and response messages.

5. IETF moves towards MLPP services

The Multilevel Precedence and Preemption (MLPP) service is the key feature of AS-SIP. It allows properly validated users to place priority calls. If necessary, users can preempt lower priority phone calls. Precedence designates the priority level that is associated with a call. Preemption designates the process of terminating lower precedence calls that are currently using the target device, so a call of higher precedence can be extended to or through the device. This capability assures high-ranking personnel of communication to critical organizations and personnel during network stress situations, such as a national emergency or degraded network situations.

RFC 4542 [4] describes six precedence classes, in descending order:

1. Executive Override (or Flash Override): used by the Commander in Chief, Secretary of Defense, and Joint Chiefs of Staff, commanders

of combatant commands when declaring the existence of a state of war. Commanders of combatant commands when declaring Defense Condition Flash Override cannot be preempted.

2. Flash Override: the same users. Commanders of combatant commands when declaring Defense Condition One or Defense Emergency and other national authorities the President may authorize. Flash Override cannot be preempted in the DSN.
3. Flash: reserved generally for telephone calls pertaining to command and control of military forces essential to defense and retaliation, critical intelligence essential to national survival, conduct of diplomatic negotiations critical to the arresting or limiting of hostilities, dissemination of critical civil alert information essential to national survival, continuity of federal government functions essential to national survival, fulfillment of critical internal security functions essential to national survival, or catastrophic events of national or international significance.
4. Immediate: reserved generally for telephone calls pertaining to situations that gravely affect the security of national and allied forces, reconstitution of forces in a post-attack period, intelligence essential to national security, conduct of diplomatic negotiations to reduce or limit the threat of war, implementation of federal government actions essential to national survival, situations that gravely affect the internal security of the nation, Civil Defense actions, disasters or events of extensive seriousness having an immediate and detrimental effect on the welfare of the population, or vital information having an immediate effect on aircraft, spacecraft, or missile operations.
5. Priority: reserved generally for telephone calls requiring expeditious action by called parties and/or furnishing essential information for the conduct of government operations.
6. Routine: designation applied to those official government communications that require rapid transmission by telephonic means but do not require preferential handling.

MLPP is intended to deliver a higher probability of call completion to the more important calls. The rule, in MLPP, is that more important calls override less important calls when congestion occurs within a network. More than one call might properly be preempted if more trunks or bandwidth is necessary for this higher precedence call.A video call (perhaps of 384 KBPS, or 6 trunks) competing with several lower- precedence voice calls is a good example of this situation.

6. On the future service capabilities

Service capabilities are the integration of voice, video, and/or data services delivered ubiquitously across a secure and highly available network infrastructure, independent of technology, to provide increased mission effectiveness to the war fighter and business communities.

For example, Voice Features and Capabilities are the following:

- Call Forwarding: on Busy Line, Don't Answer, Selective Call Forwarding
- Multi-Level Precedence and Preemption (MLPP): Interactions With Call Forwarding , at a Busy Station, No Reply at Called Station
- Precedence Call Waiting: Busy With Higher Precedence Call, Busy With Equal Precedence Call, Busy With Lower Precedence Call, No Answer,Line Active With a Lower Precedence Call, Call Waiting for Single Call Appearance VoIP Phones
- Call Transfer: at Different Precedence Levels, at Same Precedence Levels
- Call Hold
- Three-Way Calling

The capabilities described in the previous section are provided through a collection of services, where a service is defined as 'a mechanism to enable access to a set of one or more capabilities'.

7. Some lessons for Russian telecommunications

On emergency services. Development of the system 112 is a complex project of national importance. The project covers all aspects of the life of Russian society. In the course of its realization are exposed many shortcomings of the country's economy, accumulated over a quarter-century of capitalism development. To illustrate the diversity of network requirements NG9-1-1, we present the scheme of NG9-1-1 activities for single US state. According to official documents [5], the future network of emergency services has to be packet-switched networks. Particularly it noted that NG9-1-1 network must support multimedia and practically cover all aspects of social life, as shown in Fig. 4. It is worth to consider the transition to the AS-SIP protocol.

On critical infrastructure protection. Data network is of the highest importance for the sustainable city.In order to increase its reliability, we offer the new architecture of the data network.It should not focus on client-server architecture (data centers and terminals), but on a fully distributed architecture, in which each object is acting as a terminal and a server at the same time and where critical objects interact with each other using DDS publish-subscribe model to specify the QoS. This applies particularly to sensor networks, mobile units, the operational headquarters on the site of disaster and others. Messaging zones can overlap with global data networks.

Circuit switching versus packet switching. Conduct a systematic study and compare the features of circuit switching and packet switching technology. A policy of import substitution has discussed now in Russia. If we really go for the construction of communications networks on its own, it should return to the state of knowledge achieved before - some 20 years ago, and to develop them further. In this case, the system SS7, as well as intelligent network are reasonable to consider as a reference point. In Russia, the gap from the more advanced countries is the great one,

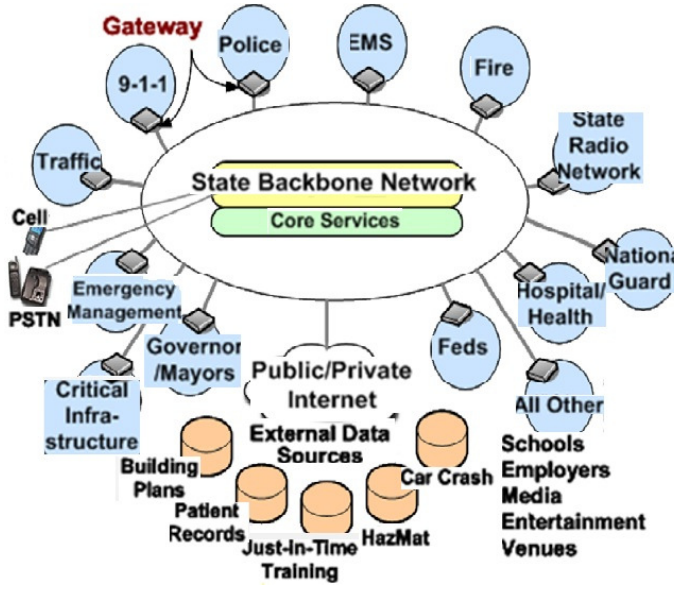


Figure 4. NG9-1-1 activities for a single U.S. state [5]

especially on the packet switching technique, which requires a high level microelectronics. Therefore, channel switching is presently preferred

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