PRINCIPLE OF USING VIRTUAL HLR IN MOBILE COMMUNICATION SYSTEM

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Annotation: *The article is devoted to virtual HLR in mobile communication systems and the deployment of a virtual environment, the main task of which is the deployment, processing, storage and transmission of information.*

Keywords: *HLR, MSC, VLR, mobile communications*.

In a mobile communication system, each operator has its own database, which contains information about all subscribers belonging to its PLMN. This database may be organized in one or more HLRs. Information about the subscriber is entered into HLR at the time of subscriber registration (the subscriber concludes a service contract) and is stored until the subscriber terminates the contract and will be removed from the HLR registry.

The information stored in the HLR includes:

1. Subscriber ID (i.e. IMSI, MSISDN);
2. Information about additional subscriber services;
3. Information about the subscriber's location (for example, MSC - SA service area);
4. Subscriber authentication information.

HLR can be executed either in its own network node or separately. If the HLR capacity is exhausted, an additional HLR can be added. And in the case of organizing several HLRs, the database remains single - distributed. The recording of data about the subscriber always remains unique. Data stored in the HLR can be accessed by MSCs and VLRs belonging to other networks as part of providing inter-network roaming for subscribers[1].

The main functions of HLR include:

Management of a database containing all information about subscriber subscriptions. Since the HLR is a database, it must be able to process data at higher speeds in response to a request for data, as well as update requests. t other network nodes. For this reason, HLR acts as a database management system. Each subscriber record contains a large number of important parameters.

Communication with MSC. The HLR must be able, when establishing a connection with an MS, to contact the MSC serving that MS to obtain the necessary call routing information. By analyzing the MSISDN, the MSC learns which HLR, located anywhere in the global GSM network, needs to be contacted to obtain information about the subscriber.

Communication with GMSC. The GMSC, in the process of establishing a connection with the MS, requests information from the HLR about the location of the MS, the HLR provides this information in the form of call routing information. If the MS is in DETACHED state, the HLR will inform the GMSC that there is no need to further route the call. By analyzing the IMSI, the GMSC knows which HLR from the entire global network controls a given MS.

Connection with AUC. The HLR must obtain new authentication parameters from the AUC before any action is taken to use subscriber information or make changes to it.

Communication with VLR/ILR. When an MS enters the service area of a new MSC, the VLR responsible for that service area requests information about the MS from the HLR, which stores the data of the subscriber using this MS[2]. The HLR provides the VLR with a copy of the subscriber information, updates the subscriber location information, and instructs the VLR, which previously stored the subscriber information, to the need to delete information about this subscriber[3].

HLR can be implemented in the same network node as MSC/VLR, or can be implemented as a separate hardware node. The specific implementation depends on the network capacity.

To carry out the scientific research, I chose the HLR of the global vendor in the field of telecommunications services from the company ZTE.

ZTE HLR/HSS is a distributed database designed for storing user data in the networks of mobile operators of GSM/UMTS/LTE standards. ZTE HLR/HSS contains complete information about the operator's subscriber profiles. Including the unique SIM card code (IMSI), telephone number (MSISDN), information about the place of last registration of the subscriber, a list of available services and other parameters[3].

The key subscriber data field in ZTE HLR/HSS is IMSI (International Mobile Subscriber Identity) - an international mobile subscriber identifier that is assigned when connecting to the operator's mobile network.

The main function of ZTE HLR/HSS is to control the movement of mobile subscribers by:

1. sending data about the subscriber to VLR or SGSN when the subscriber first connects to the network;

2. mediation between GMSC or SMS and VLR to provide incoming communications or incoming text messages;

3. deleting data about the subscriber from the VLR when the subscriber leaves the coverage area[3].

To implement these tasks, the following information is stored for each subscriber in ZTE HLR/HSS:

1. IMSI-MSISDN link, subscriber status;

2. current location of the subscriber (VLR and SGSN);

3. CAMEL subscriber profiles;

GPRS profile for subscriber access to a packet data network; additional types of services (ADS) provided to the subscriber. To authenticate subscribers, HLR/HSS implements a built-in authentication center AuC (Authentication Center)[3].

Functionality

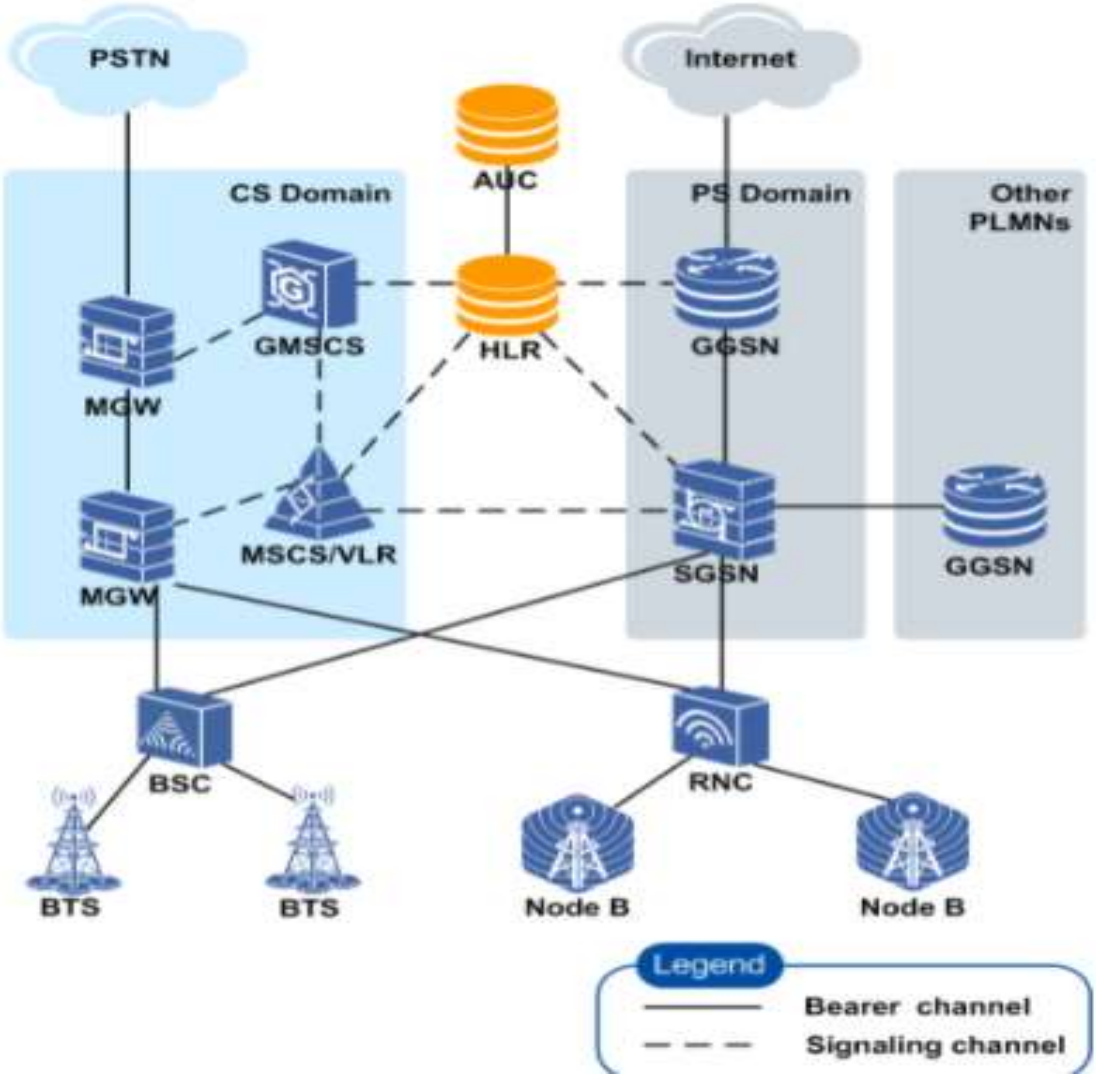

Fig 1. ZXUN USPP (HLR/EPC HSS) in GSM/UMTS network[3]

GSM/EDGE radio access system. It consists of a BSC and a BTS and provides wireless resources for MS access.

Radio access network of the third generation mobile communication network. It consists of an RNC and a NodeB and provides wireless resources for MS access.

As the core of the CN system, ZXUN iCX (MSCS) manages mobile stations (MS) within its coverage and implements voice channel switching. ZXUN iCX (MSCS) also serves as an interface between mobile communication systems and circuit switched networks such as PSTN, ISDN and PSPDN[3]. It implements functions such as network interface, common channel system and billing. In addition, it manages SS7, radio auxiliary resources and mobility management

between RNS and CN. To establish call routes to an MS, each MSCS can function as a Gateway MSCS (GMSCS)[3].

VMSCS: Responsible for processing MO and MT traffic, roaming and moving traffic, SMS, non-call value-added services and MS location-based services within its coverage area[5].

GMSCS: Responsible for processing traffic between PLMN and other PLMN, PSTN and ISDN networks.

TMSCS: Responsible for processing tandem traffic in the PLMN network.

VLR is a database that stores the necessary information for ZXUN iCX (MSCS) processing incoming and outgoing calls to MS within its coverage, such as subscriber numbers, location area identifier in which subscribers are located, and services provided to subscribers[4].

SSP is a smart network service switching point that provides measures to identify CAMEL OSS service call request processing, interact with ZXUN iCX call processing (MSCS) and call services, change call processing/connection function as needed, and process smart service requests in service control point (SCP).

The MGCF is a network element for interworking between IMS services, CS domain services and PSTN services, implementing a dialogue between the SIP control signaling in the IMS domain and the BICC/ISUP signaling in the CS domain.

MGW is a network element of the network access layer as an operator-class media gateway. It implements a dialogue between the information format in mobile networks and the information format in PSTN networks. In addition, it supports various voice and data services.

The SGSN is responsible for managing, processing and forwarding packet domain services.

GGSN implements routing and encapsulation of data packets between the 3G network and external data networks.

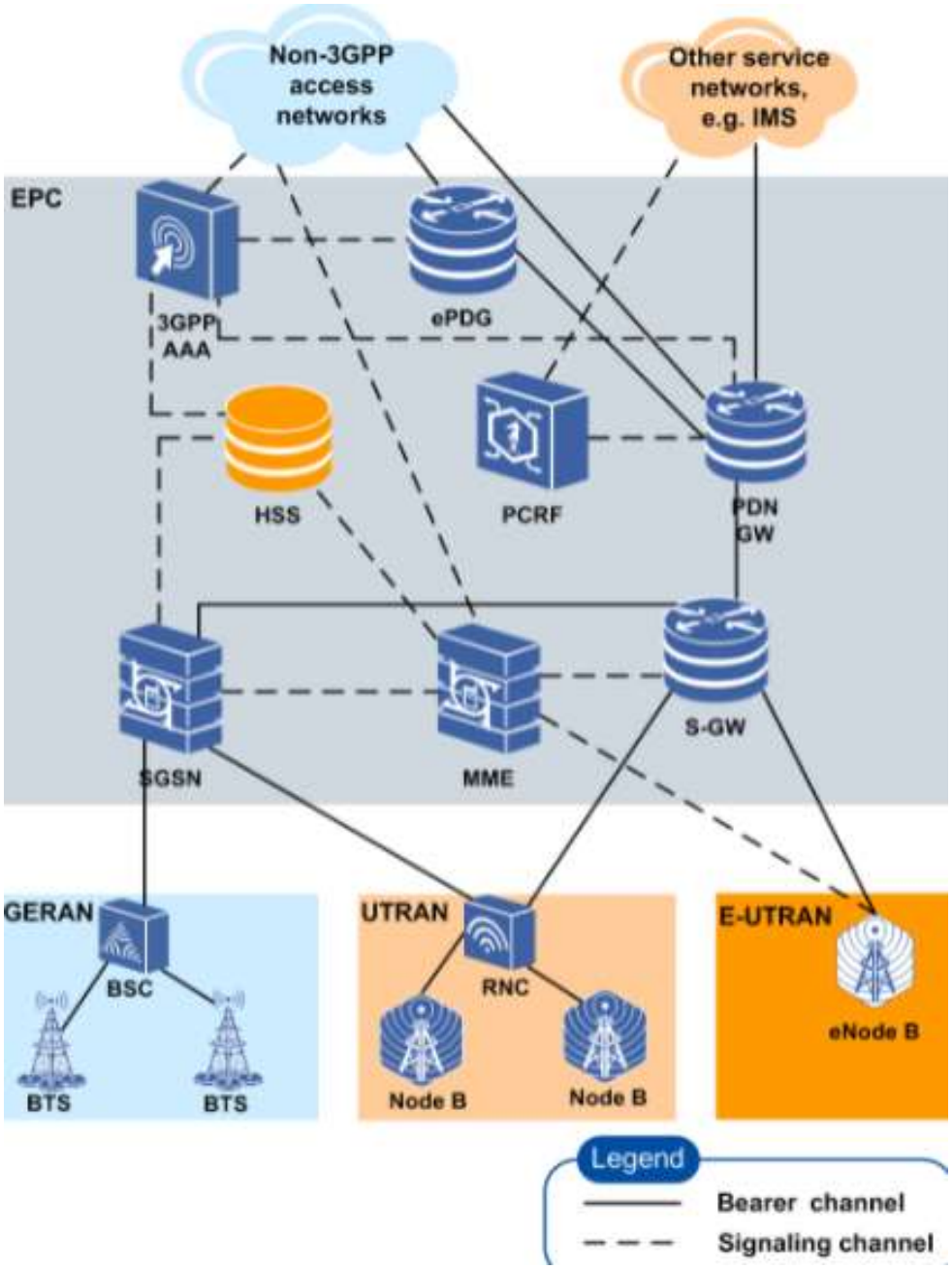

Fig 2. ZXUN USPP (HLR/EPC HSS) in LTE network

The MME is the key control node for the LTE access network. It is responsible for the tracking and paging procedure, including retransmissions, as well as the user equipment (UE) idle mode. The MME is also involved in the bearer activation and deactivation procedures and is responsible for selecting the SGW for the UE during the initial connection process and during internal handover, which involves relocating a Core Network Node (CN)[3].

The MME is responsible for authenticating the user against the HSS; if the user is roaming, the MME terminates the S6a interface against the user's home HSS. All non-access layer (NAS) signaling terminates at the MME, which is also responsible for the creation and distribution of UE Temporary Identifiers (GUTIs).

Conclusion.

Virtualization of network equipment has brought many new and promising opportunities to the world of high technology and computers and server systems, which have been enthusiastically received by the majority of users. Many companies are already implementing server and desktop virtualization technologies. Virtualization technologies have proven their effectiveness in many examples. The advantages of virtualization are obvious and significant in relation to traditional systems; the main advantages of such systems are:

Reduced hardware costs.Virtualization allows you to significantly reduce costs for server equipment. Tens and even hundreds of virtual servers can operate simultaneously on one physical server.

Reduced maintenance costs. Fewer equipment is easier and cheaper to maintain.

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