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Mobility Supported by IN in UMTS/B–ISDN

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Abstract

Mobility functions such as personal mobility, terminal mobility, location management and handover control are primary tasks for mobile networks. The next generation mobile network, is proposed to be integrated and become a part of the fixed network. Therefore the fixed network must be able to handle such mobile-specific functions. Intelligent Network (IN) could be one of the solutions for integration between mobile and fixed networks. By using the intelligent network concept, a mobility function could be viewed as a type of IN service. Each mobility function could be implemented in a modular way, separated from switches and implemented at the IN service control point. This will avoid switch-by-switch upgrading and reduce switch complexity and cost. In this paper, we describe how the IN could be placed on top of the mobile and fixed network to provide mobility functions.

1. Introduction

In the future, existing telecommunication networks will be complemented by mobile networks with similar numbers of users. According to Chia’s forecast [1], it is expected that about 50 percent of all communication will involve at least one mobile terminal in the year 2000. Next generation wireless networks such as UMTS (Universal Mobile Telecommunication System) will use Broadband Integrated Service Digital network (B–ISDN) as a backbone network to provide different types of service and access to other networks. This means the mobile network may be integrated and become a part of the Integrated Broadband Network (IBN).

One of the major tasks is how the fixed network like B–ISDN can handle mobility requirements. The UMTS/B–ISDN mobile-specific functions (location management, handover, security, authentication, etc.) could be implemented by the IN as IN-like services.

In this paper, we present how IN can be used to provide mobility functions in UMTS/B–ISDN. In section 3, we explain the basic IN concepts and discuss how the UMTS/B–ISDN integration could be benefited by IN. An enhanced functional model in the local exchange site is proposed in section 4. Section 5 illustrates an example of a UPT (Universal Personal Telecommunication) service which provides personal and terminal mobility. Simplified location updating and handover information flow diagrams are given in section 6. Section 7 provides discussion and conclusion.

2. UMTS

UMTS is one of the third generation wireless networks, which is being developed in Europe and is expected to start its services early next century. The goals of UMTS are to integrate services that different second generation wireless networks have provided, and provide advanced broadband services (e.g. video telephony and multimedia services) up to 2 Mbits/s in the 2 GHz frequency band (1.885–2.2 GHz). A possible network architecture (Public/Business environment) is shown in fig. 1 [2, 3] and the service provision model is described in [4].

The basic UMTS network consists of three sub-networks: Radio Access Network (RAN), Core/Fixed Network (CN), and Intelligent Network (IN).

- **Radio access network**: provides mainly radio related functions and some basic local switching and transmission functions. It also contains interfaces to the CN and IN.
- **Core/fixed network**: consists of B–ISDN local and transit switches, and the transmission system providing switching, and call and connection control.
- **Intelligent network**: could provide mobile-specific functions like handover, and location management. It also stores user related data (e.g. user service profiles) to support access to the network and mobility.

3. IN Concept

In the first phase, the IN CS–1 (Capability set 1) was considered as a method for telecommunication service providers to create fast new services on existing fixed networks [5]. Now, the IN is conceived as “plug in” modules. They may add mobility functions (such as handover, location management, etc.) to the B–ISDN. They are implemented by software (service logic programs) at service control points (SCPs) without switch-by-switch upgrading.
The basic IN concept is to separate service control and service data from basic call control (Fig. 1). The Service Control Function is activated through a trigger point in the Basic Call State Model (BCSM). The separation of service control and call control will result in transfer of service control from the switches to SCPs. This will make it easy to implement services in a modular way and reduce switch complexity and cost.

In B–ISDN signalling, the calls are controlled by separate call and connection (bearer) control. Call control is responsible for user service checks according to the user service profiles, invoking a service logic program in the MSCP, and coordinating multiple services within a call. Connection control is responsible for allocating resource and routes between endpoints that meet QoS constraints and for call admission control functions [6].

There are advantages to the separation of connection and call control, e.g., multiparty and multimedia control can be provided. IN CS–1 can only provide point-to-point connection to handle one call/connection control between two users therefore an enhanced IN is necessary to meet B–ISDN capabilities.

4. Functional Model in the Local Exchange Site

The functional model of the Local Exchange (LE) site abstracted from the UMTS network architecture is shown in Fig. 2 [7]. In the LE, the Service Switching Function (SSF) is divided into SSFbc (bearer control) and SSFcc (call control).

In IN CS–1, the BCSM does not have mobility procedures (e.g., authentication, location management, handover) which are needed for the mobile network. Therefore the existing BCSM needs modification by adding some more states and Detection Points (DPs) [5].
three state models: BCSM, resource state model, and connection state model [8].

Handover is one of the most important and complex call handling processes in mobile networks; which maintains a call when a user is moving to the areas covered by other base stations (BSs). In [9], the handover control is mapped into Call Control (CC). In [10], the author proposes a call function to support the call and handover control. The handover control will be supported by B-ISDN multi-party call capability which views a handover as the addition of a third party to a two-party call. Subsequently the old bearer connection is deleted. As handover can occur at any state of a call, it is better to separate the call and handover control. We treat the handover only as a connection related function and a handover model residing in the SCF is proposed. The handover model uses the B-ISDN capability of separation of call, resource and connection control. Therefore the handover model can control the Resource Control Function (RCF) and Bearer/connection Control Function (BCF) directly through the SSF and bypass the Call Control Function (CCF) and BCSM. This will make the handover process easier and faster regardless of CC and BCSM. Depending on the handover control, UMTS could have intra-CSS (Cell Site Switch), inter-CSS, and inter-LE handovers. The B-ISDN LE should be enhanced to handle such functions.

5. Personal and Terminal Mobility

Generally there are three types of mobility: personal, terminal and service mobility.

- **Personal mobility**: provides a user access to any terminal at any time on the basis of a personal number. The network should also be able to provide services according to the user’s service profile.
- **Terminal mobility**: provides the mobile terminal access to networks from different locations and the networks should be able to track the mobile terminal based on its identity.
- **Service mobility**: provides capability to a user to choose terminals and locations to receive subscribed services.

A scenario is given in Fig. 3 to show how the fixed Terminal Equipment (TE) can reach a Mobile Terminal (MT) by using the IN concept. The IN concept is to store a Universal Personal Telecommunication number — MT address — Location Area (UPT—MTA—LA) translation tables and user profiles in the distributed Mobile Service Data Points (MSDPs). This provides Personal Mobility (PM) and Terminal Mobility (TM) for the UMTS/B-ISDN network. In this case, TE initiates a call setup message including UPT number and transfers this message to LE. The LE will trigger MSCP to ask an address translation. We suggest that the MSCP first check the local database MSDPlocal whether the MT is located in the same LE, if not, it queries the MSDPvisit address from MSDPmhome where the MT was originally subscribed and registered. Then the MSDPvisit will translate the UPT number to MTA then to LA and relay it to MSCP. The MSDPmhome may also contain the UPT translation tables depending on the database topology. In this example, we ask the address translation information from the MSDPlocal first, because it may optimise signalling and reduce signalling transmission time if the mobile terminal is in the same area of the LE to which the fixed terminal is connected.

![Figure 3. MT incoming call from fixed TE](image-url)
6. Location Updating and Handover

Before a user can make outgoing calls or receive incoming calls the user must register to a MT and the MT must register to the network to inform the user’s current location to the network. This procedure is called location registration (updating). This information for UMTS is stored in the distributed database MSDP. Fig. 4 describes the simplified location updating information flow. We assume an MT roams across the boundary of LA which is covered by a different LE. It will send a location update message including identity of the MT to LE/MSCPnew which is located in the current area. The LE/MSCPnew will then get authorisation parameters and user profiles from the MSDPold (which is a database located at the previous location). After authorisation by the LE/MSCPnew, it will inform the current database MSDPnew and the home database MSDPhone to update their location registers, and finally delete the information in the location register in MSDPold.

Fig. 5. illustrates an example of the inter-CSS handover in which authentication has been left out. During the inter-CSS handover, CSSold will pass the handover request to the MSCPnew through the MSCPcss.old, then the HM which is resided in MSCPcss will control the RCF and BCF to add a connection between the SSFbc/LE and CSSnew. Finally the old connection between the SSFbc/LE and CSSold is released.

7. Conclusion

The Intelligent Network can offer network operators and services providers a great flexibility to create and manage services by implementing services in a modular way. IN services are controlled by service logic programs within IN service control points to make the fixed backbone network generic. The paper has discussed the IN concept and shown some simplified IN applications like UPT, location updating and handover services. The current IN CS-1, is not able to provide multiparty, multimedia and mobility services. Enhancement of IN is therefore needed to meet the future services such as mobility and broadband multimedia service. The interface between SSF and SCF, and the relationship between SSFcc and SSFbc and BCSM will be defined in further work as well the interaction between each functional and state model will be addressed. Object-oriented techniques could be a useful approach for defining these interfaces and models.

Figure 4. Simplified location updating
References


