Mobile IP in Next Generation Intelligent Network

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Abstract

The future mobile host will be designed as multi-mode terminal equipment with the functionality of mobility management and session continuity under vertical roaming. These are the key issues of heterogeneous next generation intelligent networks, such as WLAN/WMAN/GPRS/UMTS inter-working network. For many years, the intelligent network (IN) has intended for fixed and mobile convergence (FMC), however it is widely in circuit switch-based only. The next generation of intelligent networks (NGIN) will provide a packet switch-based information processing, retrieval and transfer services in a transparent way, including intelligence aspects of handling imprecise and inconsistent information, particularly in IP-based mobile user. In this paper, we studied and overviewed the distinct core network architecture of mobile IP in next generation intelligent network.

1. The Evolution of Intelligent Network

The traditional Intelligent Network (IN) is network architecture intended both for fixed as well as mobile networks. It allows operators to differentiate themselves by providing value-added services in addition to the standard telecom services such as PSTN, ISDN and GSM services on mobile phones.

The IN was developed based on the Signaling System #7 (SS7) protocol between telephone network switching centers and other network nodes owned by network providers which creates a highly reliable packet switched network to link all the network elements. The key insight of the IN was in moving the services away from the switches on onto separate platforms, such as Service Control Points and Service nodes. The benefit was to decouple the development of new services from the development of the switches and to ensure that serviced could be developed by companies other than the switch vendors. There was a very ambitious set of objectives for the IN, but these were scaled down in actual implementations [1].

The Advanced Intelligent Network (AIN) is the variant of IN developed for North America. The standardization of the AIN was performed by Bellcore on behalf of the major US operators. In North America the SR-3511 and GR-1129-CORE protocols are used to link switches with the IN systems such as Service Control Points (SCPs) or Service Nodes.

In the IN model, as defined by the ITU-T, the INAP (Intelligent Network Application Part) protocol, which is layered on top of SS7, is used to link switches with IN systems. The European Telecommunications Standardisation Institute (ETSI) has taken a lead role in this area, and has standardized IN Capability Set 1-Restricted (CS1-R), and later CS2. Most vendor IN implementations are at CS1-R or CS2; a number of IN vendors also offer proprietary extensions. While CS3 and CS4 have been published, there is little ongoing work in IN standards.

It is unlikely that all IN vendors will actually implement all of the CS3 and CS4 standards. On the other hand, a number of operators implemented their own IN platforms, and now seek to reduce the ongoing costs of supporting these platforms. These two trends have created an opportunity. Since the operators are now looking at how to replace these products in the network, the Parlay/Open System Architecture (OSA) Application Programming Interfaces (APIs) provide a way to develop telecommunications applications using modern software technology, such as Java and Web Services. The Parlay/OSA APIs provide access to core functions of the telecommunications network, such as call control, location, charging, account-management, payment, user-interaction and many others [2].

The Parlay (APIs) were developed by the Parlay Group, which is an open consortium from the telecom and IT industries. The Parlay APIs were designed to be technology-independent, and they work equally well for fixed and mobile networks, and for current and next-generation networks. The Parlay APIs form the API layer of 3GPP's OSA. The Parlay/OSA APIs are jointly developed and published by the Parlay Group, ETSI and 3GPP, and are freely available.

The Parlay/OSA APIs were designed to work on multiple types of networks: fixed-line IN networks, mobile networks using CAMEL, Wireless Intelligent Networks, and next-generation IP based networks.

All enhancements i.e. open systems, new services, various features and the interoperability capability have evolutes the traditional IN to the next generation intelligent network (NGIN) which works on IP based network.

2. Mobile IP

In IP based network, a node decides the next-hop by determining the network information from the destination IP address of the packet. In contrast, the higher level layers maintain information about connections by the IP addresses of both the endpoints and the port numbers. Thus, while trying to support mobility on the Internet under the existing protocol suite, two mutually conflicting requirements are encountered; a mobile node has to change its IP address whenever it changes its point of attachment, so that packets destined to the node are routed correctly, and to maintain existing higher layer connections such as TCP connection, the mobile node has to keep its IP address the same. Changing the IP address will cause the connection to be disrupted and lost.

Mobile IP (MIP), which is an Internet Engineering Task Force (IETF) standard communications protocol, is designed to allow mobile device users to move from one network to another while maintaining a permanent IP address [3].

A mobile node (MN) have two addresses; a permanent home address (HoA), which is a static IP address out of the mobile nodes home network. The second address is called a care of address (CoA), which is associated with the network the mobile node is visiting. Additionally, there are two kinds of entities in Mobile IP:

A home agent (HA) stores information about mobile nodes whose permanent address is in the home agent's network.

A foreign agent (FA) stores information about mobile nodes visiting its network. Foreign agents also advertise CoA, which are used by Mobile IP.

A node wanting to communicate with the mobile node uses the home address of the mobile node to send packets. These packets are intercepted by the home agent, which uses a table and tunnels the packets to the mobile node's care-of address with a new IP header, preserving the original IP header. The packets are decapsulated at the end of the tunnel to remove the added IP header and delivered to the mobile node.

When acting as sender, mobile node simply sends packets directly to the other communicating/correspondence node (CN) through the foreign agent. This is known as triangular routing, as shown in figure 1. If needed, the foreign agent could employ *reverse tunnelling* by tunnelling mobile node's packets to the home agent, which in turn forwards them to the communicating node. This will be needed in networks whose gateway routers have ingress filtering enabled and hence the source IP of the mobile host would need to belong to the subnet of the foreign network else the packets will be discarded by the router.

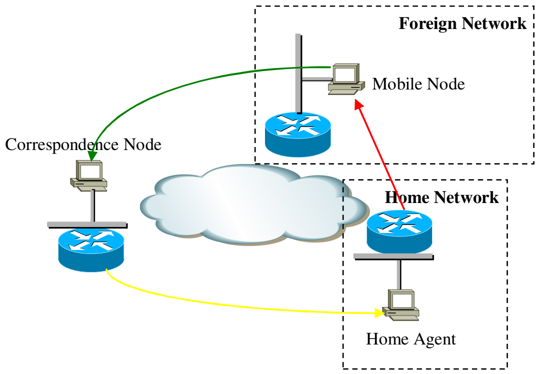

Figure 1. Triangular Routing on Mobile IP

The MIP protocol defines an authenticated registration procedure by which a mobile node informs its home agent(s) of its CoA(s) as illustrated in figure 2. It also defines an extension to ICMP Router Discovery, which allows mobile nodes to discover prospective home agents and foreign agents; and the rules for routing packets to and from mobile nodes, including the specification of one mandatory tunneling mechanism and several optional tunneling mechanisms.

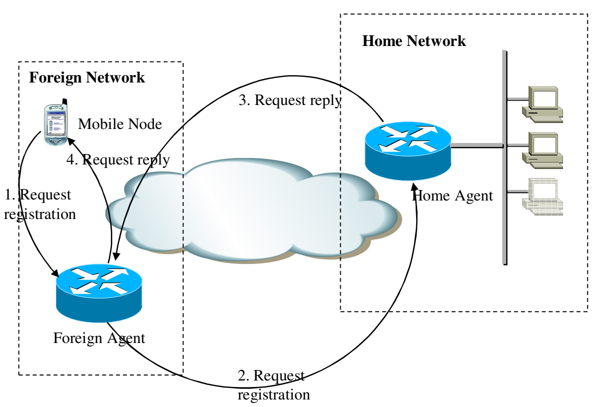

Figure 2. Registration process in Mobile IP

3. Next Generation Intelligent Network

The main goals of Mobile IP are to make mobility transparent to the higher level protocols and to make minimum changes to the existing Internet infrastructure [4].

However, there are several issues that may become the hard challenges for its development and implementation. Routing optimization may be the first issue in which some set of extensions may not be supported by all nodes.

In addition, however, a bottleneck in INs and their corresponding services is increasingly problematic. Customers have become more critical of service functions and experience as both are unsatisfied via traditional IN services. Moreover, network architecture has increased in complexity due to the simultaneous deployment of PSTN, GSM, NGN, and IMS. The convergence of mobile IP and other platform such as fixed networks (as Fixed Mobile Convergence – FMC), and legacy analogue network is also the main challenge, as well as the interoperability with old, current and future feature of services.

Some issue might be solved by using the next version of IP, IPv6, that is out of this paper's scope. Another solution is by implementing the next generation intelligent network (NGIN). The NGIN solution is compatible with traditional IN and delivers unified and convergent services. The NGIN solution also supports multiple network types including IMS, and integrates multiple external enablers to facilitate further service innovation. The NGIN platform enables the real fixed/mobile convergence on top of both legacy and IP Multimedia Subsystem infrastructures.

A major benefit of the new Convergence Service Solution is the rapid and cost effective design and roll-out of homogenous services across all subsidiaries of a global telecom operator's group. This portability can be achieved without the technical complexity and cost inconvenience traditionally associated to global operations. A service can be written once and subsequently deployed multiple times across the various operating companies - irrespective of the underlying network characteristics and network vendors. The solution enables a complete range of facilities for a mobile office environment and home communications services that can be used from fixed, mobile or hybrid terminals alike regardless of the end user's location.

The architecture of NGIN can be seen in figure 3, below.

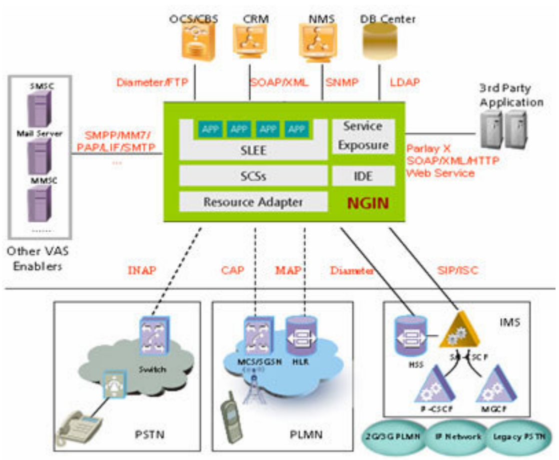

Figure 3. NGIN Architecture (Huawei) [5]

4. Conclusion

In this paper we have studied and described the mobile IP in next generation intelligent network. The evolution and some drawbacks of Intelligent Network (IN) to support future requirements are also carried out, as well as the mobile IP concept and NGIN architecture. The NGIN is able to interact with existing service systems through service brokers to ensure the development of existing services. Traditional IN services can be directly developed in the NGIN for traditional network customers. The NGIN separates services from access protocols with the protocol packaging mechanism (SCSs layer), and enables access capabilities through multiple network protocols. An NGIN service platform can provide services for customers in different networks such as PSTN, PLMN, NGN, and even IMS. Based on its open architecture and scalable capabilities, the NGIN can adapt to various potential situations to ensure the smooth evolution of the service solution.

5. Acknowledgments

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