ECE 480 TEAM 2

Implementing IPv4 Mobile Internet Protocol on a Smartphone Device

An Application Note

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Mobile IP serves as an answer to an ever expanding need for an internet connection on the move. This guide will describe the details of how information is sent and received from an internet capable smartphone device. It does this using the Mobile Internet Protocol established and enforced within the routing layer of the network protocol stack. Applications and future opportunities are examined and outlined.

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Introduction

Imagine having to plug your mobile phone into a phone jack every time you wanted to use it. You could be anywhere, at all different locations, but in order to get a connection, that phone had to be tied in to the traditional network. Suddenly, your mobile phone doesn't seem so mobile. As the world and the people in it began to grow, as did the need for a more mobile solution to the current protocols that governed our technology. No longer was it acceptable to be dependent on the traditional network, but now expected to be free from wires. This is the reason and concept behind Mobile IP. (Biswas)

Wireless networks, on the most basic level, are very similar to the traditional wired connections. Most of the concepts regarding traditional wired connections still hold and are a great base for learning networks in general. However when dealing with wireless networks specifically, there are some themes that differentiate these types of networks from conventional wired connections. Some of the key issues include: network topology, network connection, energy management, environmental conditions, and limited resources. Although all of these issues affect wireless networks differently than they do wired networks, the most important is network connection and how an actual connection is attained.

Key Words

Mobility – the amount a user can move with active sessions

Foreign Agent – acts as a correspondent between the mobile node and its home agent

Home Agent – maintains a mapping between the home IP address and the care of address

Correspondent Node – the host in communication with the mobile node

Mobile Node – maintains a network connection with its home network regardless of location

Care of Address – the address issued from the Foreign Agent to a mobile node

IP-Tunneling – the means which datagrams are routed through the network to the mobile node

Foreign Network – a network in which the mobile node is not registered as home

Home Network – the network that the mobile node is officially registered to

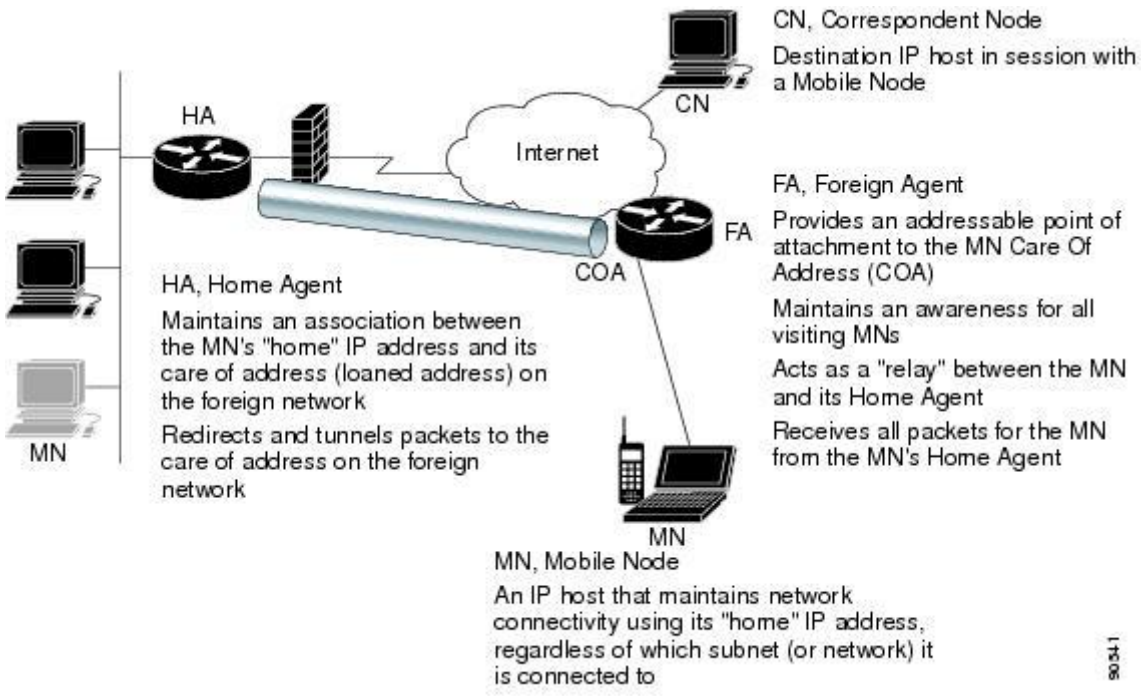

Figure 1: Summary of Implementation

Implementation

The issue of actually attaining a connection in a wireless solution depends on the amount of mobility for a given wireless host. The host can have low mobility and only move within its own subnet, mid-mobility where it can move across different networks with no active services, or finally high mobility where the user can move to and from anywhere with active sessions. This idea of high mobility with active sessions is the focus regarding Mobile IP and is the most common today. Full mobility encompasses the idea that a mobile host should have no restrictions, therefore allowing it to move while creating and receiving active sessions. This machine, be it a cell phone, notebook, or any other mobile device follows the idea of Mobile IP.

Agent Discovery

The first difficulty with wireless networks and a mobile device that Mobile IP concentrates on is addressing. Addressing works within a wireless network by having a mobile host maintain two IP addresses as it moves network to network. It maintains a static IP address that is tied to its home network and a dynamic IP address regarding its current location. The static address is registered to the home-agent at the home network and while travelling, the dynamic IP address is registered to the foreign-agent of the current network. When a mobile device enters a network, it must determine where it is located and what agent to use. A mobile device discovers an agent in a process much like a link-state advertisement. This process is where the agent periodically broadcasts its address so that the mobile host can compare it with its own in order to determine if it is at home or not. While at home, the mobile device interacts with

the network much like a conventional wired host, yet if the mobile node determines that it is indeed not at home, then it needs to become registered with the foreign-agent.

Registration

In order to become accessible when travelling, the mobile device needs to register itself within the network it is currently located. Mobile IP implements the idea of registering with an agent in order to keep some kind of "connection" with the particular network. In the registration process for the mobile node, the mobile node must first acknowledge the foreign-agent's broadcast. Once the foreign-agent has become aware that a new mobile host would like to register within its network, it allocates a new Care of Address for the mobile node. This address is the address of the foreign-agent and is sent to the mobile host. Along with sending this to the mobile node, the foreign-agent also sends a registration request to the home-agent of that mobile host. This is done so that the home-agent can bind, much like TCP sockets, or make a mapping between the static addresses of the mobile nodes it is responsible for and the care of addresses now assigned to those same mobile nodes. Since the home-agent knows that one of its mobile nodes is currently away, it now needs to prepare for routing.

IP Tunneling

Next, to facilitate routing, Mobile IP requires the home-agent to make use of the idea of Proxy ARP. For Proxy ARP, the home-agent sends out a message informing all of the other nodes at home to send their packets, originally intended for the mobile node, now to the MAC

address of the home-agent instead. This insures that any and all packets destined to the mobile host are now received at the home-agent first. This entire process is repeated each and every time the mobile node changes networks. Therefore the home-agent can now use its mapping of the static address to the care of address to tunnel the information all the way to the mobile node. By using tunneling, the home-agent guarantees that information is first routed through the care of address, and hence the foreign-agent. Once the foreign-agent receives the packet, now it can simply deliver the respective data to the mobile node itself. This is the process that a correspondent node follows to interact with the mobile node, however the mobile node can send out going data directly.

Summary

Overall, this process is managed through Mobile IP so that a mobile device that has high mobility can still actively create and receive information. Much like conventional wired networks, the mobile device is associated with a particular physical network. Yet unlike traditional networks, the mobile device can move to any network and still receive data seamlessly without the user executing any particular action. Although this form of triangular routing is somewhat inefficient, newer versions still require the use of this Mobile IP solution until it configures a means for direct transmission both ways. This requires additional software and more protocol. In general, explaining Mobile IP, or simply connecting to a network wirelessly, highlights the fact that all of the additional difficulties that wireless networks contend

with increase the complexity and force issues that are not present within conventional wired connections.

Applications

Just as the conventional wired protocols needed to adjust for a more mobile world, the actual technology that it supported was also experiencing growth. Wireless networks allowed for the redevelopment of many traditional technologies and the creation of various new applications considering the increased freedom. Although issues like network connection become far more complicated in networks without wires, wireless networks are the current focus of development and present many unique and useful applications.

One of the most exciting applications of wireless networks would still have to be the mobile phone. The mobile phone started out simply as such. It was just a traditional phone altered for use on the go. Mobile phones were more similar to a robust walkie-talkie when compared to the smartphones of today. Currently, mobile phones have grown into very popular mobile devices that host a wide array of applications. Some of the most interesting applications include the ability to mobile video-chat and mobile control. Mobile video-chat allows the mobile phone user to wirelessly videoconference with another mobile phone user. This creates the option to have apparent face to face conversations from and to anywhere, with anyone, in real time. This development is astonishing to think about. The latter application, mobile control, makes use of the idea that more and more non-mobile devices are receiving IP addresses. The IP

addresses allow that device to send and receive data through the internet. More or less, mobile phones can now control non-mobile devices such as the dishwasher. This application allows the user to some extent run their home away from home.

As the market and demand on mobile phones grows, so does the innovations that surround them. A great new innovation concerning energy management within wireless network applications is the idea of Wi-Fi power. Since the world has a growing dependency for their mobile phones, it therefore has a reliance on those devices to always be powered. RCA has developed a way that may potentially allow mobile phones to never run out of battery. (Rosenberg) This idea, called RCA AirPower, makes use of the fact that mobile phones connect to the internet through Wi-Fi and therefore it can convert the energy radiated in a wireless signal into a usable charge. This advancement would definitely allow for around the clock care free use of mobile phones, but it could also be practical to many other applications.

Another application of wireless networks that has a particular impact on science is the wireless control of biomedical devices. Much like the idea of mobile control, biomedical devices can be manipulated from anywhere. This applies to both implantable and non-implantable devices. Suppose you needed a special surgical procedure and this could only be performed by one doctor. This doctor is in another country, and you do not have time to travel. This application would allow for that particular surgeon to control the surgical devices local to you, through a wireless means and perform the procedure. This would have vast implications for healthcare in struggling countries. This idea of wireless control of biomedical devices also extends to implantable devices. Wireless deep brain stimulants allow for the control of that

portion of the brain. (Kamboh) This gives way to many wireless solutions to epilepsy, Parkinson's disease, and others.

Conclusion

Overall, wireless networks allowed for the redevelopment of many traditional technologies and the creation of various new applications. Although key issues like network topology, network connection, energy management, environmental conditions, and limited resources complicate networks without wires, wireless networks are the current focus of development and present many unique and useful applications. Mobile IP was introduced in order to manage a mobile device that has high mobility so it can still actively create and receive information. Although Mobile IP is somewhat inefficient, it highlights the fact that wireless networks struggle with issues that are not present within conventional wired connections. Whether it is a cell phone, notebook, or any other mobile device, all of these machines provide mobile solutions that we take for granted.

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