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Winter 12-10-2002

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Dong Wang

Pingping Han

Songrong Qian

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Dong Wang, Pingping Han

Department of Computer Science

Fudan University

Shanghai, China

(cndwang, pingping_han)@yahoo.com

Songrong Qian

Department of Communication Science Engineering

Fudan University

Shanghai, China

sqian@fudan.edu.cn

Abstract

Mobile ecommerce is immersed rapid familiar to other high-flying Internet markets. With the fast developing of wireless connections and Internet, electronic commerce more and more moves to mobile environment. Streaming, as a rapid growing application in Internet, will be more used in mobile ecommerce. In this paper, we'll review the network protocol used in mobile ecommerce and streaming technology. An optimized architecture is given based on MPEG-4 and Mobile Ipv6. The core streaming protocol used in this architecture is RTSP/RTP proposed by IETF. This system gives one possible implementation of streaming over wireless network. Two key bottlenecks we found in this project are wireless bandwidth and mobile client power. To avoid the two problems, self-adaptive methodology is used. Let streaming application be adaptive to the wireless network environment to improve streaming performance.

1. Introduction

With the fast growing of wireless connections and Internet, mobile ecommerce is immersed as other high-flying applications. Enterprises are incorporating mobile commerce into their operation as a way to cut costs, generate revenue and gain efficiencies. Consumers are also like to accept multimedia content while not static ones. Applications will be developed for the mobile ecommerce and enable enterprises and consumers communicate efficiently. Of course, these applications and new mobile ecommerce solutions will drive the growth of mobile ecommerce.

Streaming as another fast growing application in Internet catch more and more users' attention. With the emergence of webcasting, users enter into a new world of digital content. Wireless communication gains the huge success and will be integrated into Internet. While wireless network is deferent from wireless network, streaming over wireless network is challenging. In wireless network, bandwidth is low, latency is large and mobile handset is not powerful. All these characters are critical to move streaming over wireless network. To solve these problems, we use self-adaptive methodology to let the upper layer applications to be adaptive to the lower network environment. Wireless network is not stable. Bandwidth and latency is always changing. To make streaming be adaptive to the wireless network is a possible solution. When wireless network performance decreases, change

the streaming bit rate to a lower value that the wireless network can provide. Then users can receive smooth stream in mobile environment. It's critical to mobile ecommerce.

This paper is organized as following. Section II will review the protocols used in mobile network. In section III, streaming technology is discussed. Streaming over mobile network architecture is defined in section IV. Future work is discussed in section V. Section VI gives our conclusion.

2. Protocols in Mobile Network

IP(Internet Protocol) is designed for wired network. How to use it over wireless network is challenging. Mobile IP [1] and Mobile IPv6 is the network layer protocol standard proposed by IETF to supporting roaming between different networks.
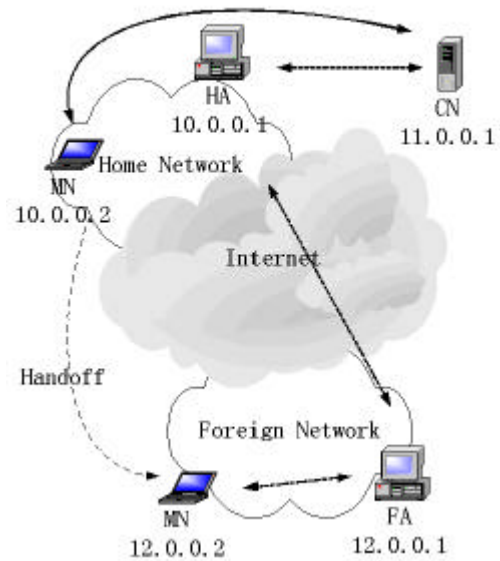

Figure 1. Mobile IPv4

In wired network, when node is connected to an IP network, it has a static IP address that identifies itself and one default router to communicate with foreign network. However, mobile device will connect to different network and will use different IP address and router. For example, a laptop computer may be connected via an Ethernet card at home. At office, it's connected via wireless LAN. When on bus, it goes online through a GSM connection. Different connection media supports different service. Also only one IP address without Mobile IP is not possible. User

needs to change the IP address when changing connection. But changing IP address will make upper layer application not work. Mobile IP and Mobile Ipv6 are Internet standard to provide mobility in network layer. To upper layer, IP address is not changing with Mobile IP/IPv6. So they provide transparency to upper layer.

In Mobile IP and Mobile IPv6 protocol, the main problem is how to maintain one IP address while in different network. They use HA(Home Agent) to provide transparency for upper layer. When MN(Mobile Node) is at home network, it uses its own home address as normal IP. While MN moves to foreign network, all the packets between MN and CN(correspondent Node) are relayed by HA. So CN will not be care about where MN is, since it only needs to know MN's home address. MN at foreign network will use its COA(Care-Of Address) to communicate with home agent. The main idea in Mobile IP is using agent to provide transparency. One problem here is that triangle routing exists. It will decrease transmission performance. So in Mobile IPv6, Binding Cache is used to avoid it. There is a binding cache in CN and HA, which is maintain a map between MN's home address and care-of address. Then, when MN moves to foreign network, it will send binding update to CN and HA. CN will communicate with MN using this care-of address while not through HA. Triangle routing problem is avoided.
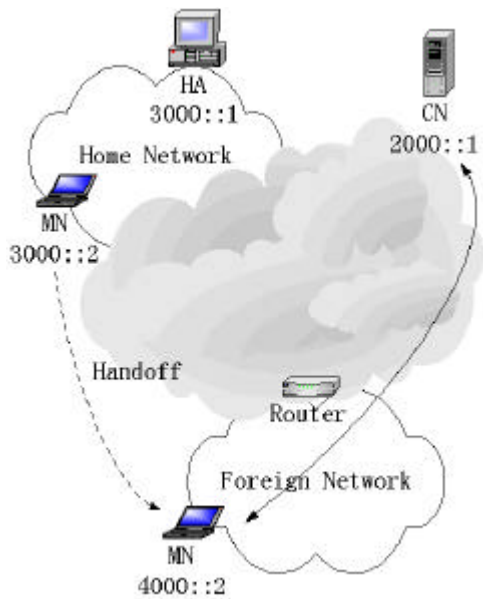

Figure 2. Mobile IPv6

Handoff time interval is important to users, since real-time applications cannot be tolerant to large delay time. There're two handoff mechanisms, Network Initiated Handover and Mobile Initiated Handover. In network initiated handover, the router has predictive information about the new point of attachment to which the MN will move prior to the actual movement of the Layer 2 connection. The router initiates signaling to the MN and HA to start the Layer 3 handover. In mobile initiated handover, the MN has predictive information about the new point of attachment to which it will move, or it chooses to force movement to a new point of attachment. The MN initiates signaling to the router to start the handover.

3. Streaming Technology

Streaming is the ability to distribute "continuous" digital content over networks in real time. Digital content can be streamed to any network device. Different network has different performance. That performance will determine the streaming quality. Below, some figures are listed.

Streaming Media Capabilities by Bandwidth

Connection	Bandwidth
Modem	28.8-56Kbit
ISDN/Frame Relay	64-128Kbit
Cable Modem/DSL	100Kbit-1Mbit
WLAN	1Mbit-10Mbit
Corporate Networks	1Mbit+

Table 1. Connections and Bandwidth

Streaming Transfer Rates

Medium	Transfer Rate
Audio	*Under 22Kbps*
Typical 2001 Internet streaming	*56Kbps to 300Kbps*
VCR/TV quality	*1-2 Mbps*
HDTV quality	*6-9 Mbps and eventually higher for MPEG-4*

Table 2. Streaming Transfer Rates

Some market trends will influence the streaming technique and its application according to [6] [7].
- Advances in encoder and production techniques
- Proliferation of broadband access to consumer and enterprise users
- Increased number of powerful PCs capable of playing rich streaming media
- Web site differentiation for broadband users

3.1 MPEG-4

MPEG-4 is the most recent multimedia standard developed by Joint Technical Committee ISO/IEC JTC 1, Information Technology. MPEG-4 standard implies that motion video can be manipulated to a form of computer data and can e stored on various storage media transmitted and received over existing and future networks and distributed on existing and future broadcast channels. MPEG-4 provides features that include Scalability, Shape coding, Error resilience, Face animation, etc.

Below is some key features of MPEG-4 System:

- MPEG-4 Systems provides a consistent and complete architecture for the coded representation of the desired combination of streamed elementary audio-visual information. This framework has a broad range of applications, functionality and bit rates. Through profile and level definitions, MPEG-4 Systems establishes a framework that allows consistent progression from simple applications (e.g., an audio broadcast application with graphics) to more complex ones (e.g., a virtual reality home theater).
- MPEG-4 Systems augments this architecture with a set of tools for the representation of the multimedia content, viz., a framework for object description (the OD framework), a binary language for the representation of multimedia interactive 2D and 3D scene description (BIFS), a framework for monitoring and synchronizing elementary data stream (the SDM and the SyncLayer), and programmable extensions to access and monitor MPEG-4 content (MPEG-J).
- MPEG-4 Systems completes this set of tools by defining an efficient mapping of the MPEG-4 content on existing delivery infrastructures. This mapping is supported by the following additional tools: an efficient and simple multiplexing tool to optimize the carriage of MPEG-4 data (FlexMux), extensions allowing the carriage of MPEG-4 content on MPEG-2 and IP systems, and a flexible file format for authoring, streaming and exchanging MPEG-4 data.

4. Optimized Streaming over Mobile Ipv6

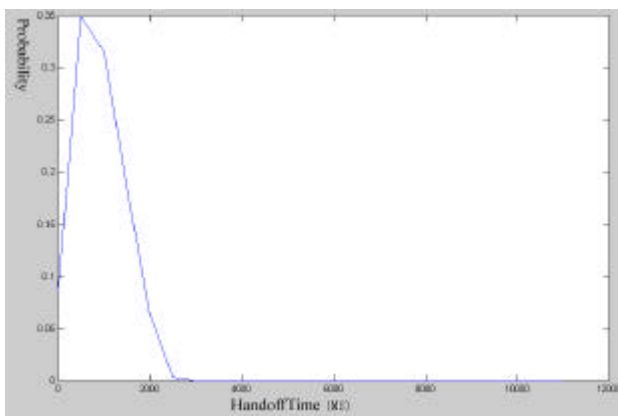### 4.1 Features of Mobile IPv6

Handoff time

Figure 3. Mobile IPv6 Handoff Time

Below, a typical handoff time is given in Figure 3. We can see that the average handoff time in mobile ipv6 is 1.5m. The handoff time will directly influence the streaming performance. In the handoff interval, the streaming packets

will be dropped. So the faster the handoff, the better the performance when handoff.

4.2 Objectives

This implementation is to enhance streaming transmission in mobile network. Wireless or mobile network is challenging to multimedia applications. It's different from wired network. Some characters of wireless network: 1) Error prone network; 2) Slow handoff; 3) Packet transmission are critical to upper layer applications. While multimedia applications require more bandwidth and even rate, some challenges stay here. This project is to enhance streaming quality when handoff in mobile network.

4.2 Methodology

To enhance streaming quality when handoff, more function should be added in network layer and upper layer. In network layer, we modify mipv6 to add an interface. This interface is to provide previous and current network performance to upper layer. Latency and bandwidth are concerned. In the upper layer, we modify RTSP protocol to adapt streaming transmission to the current environment.

Assume one Mobile Node was playing movie from Correspondent Node source. The Mobile Node switched from one network to another network and handoff occurred. The environment changed including bandwidth and latency. Assume the previous network bandwidth is 100k and the current is 60k. If the streaming rate is 90kbps, the current bandwidth clearly can not afford the streaming. Then packet dropping will be serious. So we need an mechanism to deal with it. In our implementation, when handoff, the network layer (mipv6) told upper layer the round bandwidth. The upper layer (RTSP) will decide how to deal with it. Of one condition, RTSP will request low rate steam to be adapted to the low bandwidth. Of other condition, RTSP will request high rate stream to improve the media quality since the bandwidth is enough after handoff.

In this project, Mobile IPv6 support in linux (www.mipl.mediapoli.com) is used to provide mobility in network layer. Streaming server uses Darwin Streaming Server (www.apple.com) and client uses MPEG4IP (www.sourceforge.net/project/mpeg4ip). MPEG4 stream is used to test streaming.

Other relative projects and methods such as [2] [3] [4] [5] focus on improvement in network layer. They provide mobility and are transparent to upper layer, which is different from our method. Since the network performance is critical to streaming, we provide network feature to upper layer.

4.3 Challenge

1) We choose Darwin Streaming Server (DSS4) as it's open source and supporting mpeg4. Port DSS4 to ipv6.

2) Add a function in Mobile IPv6 protocol stack to

provide network bandwidth and latency to upper layer. It's difficult to test bandwidth. Round bandwidth is given here.

3) Support more SDES items used to change streaming rate.

4) Application console toLet the user decide what to do when handoff.

4.4 Implementation

In the network layer, we add an module to detect network performance. Its function is to detect the current network bandwidth and latency and provide them to upper layer. In application layer, we use User Control Panel to get user's decision. The decision will directly influence the transport layer and represent layer.
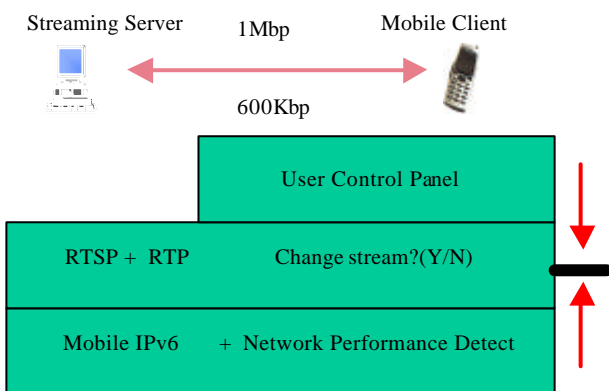

Figure 4. Architecture

Let's see the process in mobile network. When MN is in home network, the bandwidth it could use is 1Mbps, which is provided by the NPD (Network Performance Detect module). When MN is switched to foreign network, NPD module will detect the handoff and provide the new network performance to the upper layer. Assume the bandwidth in foreign network is 600kbps. Sure, if MN is playing video in 800kbps, the handoff will cause so much packet dropping. The video quality will remain poor in the foreign network. In our architecture, the User Control Panel will capture the handoff event and get the network performance from the NPD module. There're two strategies here. Let user decide or let MN auto configure. Each strategy is an decision to be adaptive to the current network performance. In this example, just let user decide how to do with the handoff. It could be using low bit rate streaming to get fluent video or just going back to the older network.

5. Future Work

About future work, we'll focus on the module of Network Performance Detection. How to detect the network performance while consuming little network resource is important to the architecture. If possible, prediction of the new network will improve the system performance very much. Another important task is to research the strategy. It's more close to user. We should make a tradeoff about it.

6. Conclusion

This paper provides a possible solution to how to improve streaming quality in mobility environment. we use self-adaptive methodology to let the upper layer applications to be adaptive to the lower network environment. In the network layer, we add an module to detect network performance. Its function is to detect the current network bandwidth and latency and provide them to upper layer. In application layer, we use User Control Panel to get user's decision, which will influence the transport layer and represent layer. An implementation is given.

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