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KICS Korea Information and Communications Society
ETRI Electronics and Telecommunications Research Institute
KCA Korea Communications Agency

Problem Statements and Requirements for Mobile Oriented Future Internet

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***Abstract*—It is envisioned that Future Internet will be evolved toward mobile-oriented environment. In this paper, we propose the requirements for Future Internet to be considered in the design of Future Internet Architecture, together with the analysis of problems of current Internet from the perspective of mobile environment.**

***Keywords*— mobile; problems; Future Internet; requirements; architecture**

I. INTRODUCTION

With the wide popularity of smart phones and the emergence of various wireless/mobile networks, the environment of the Internet has rapidly being changed from fixed-based to mobile-based. For instance, the number of mobile users will be more than 1.6 billion in around 2014 and exceed the number of desktop users [1].

However, we note that the mobile trend was not considered as a major goal in original design of the Internet. In other word, we can say that the current Internet was designed mainly for fixed hosts rather than for mobile ones. According to the emergence of mobile hosts, this has naturally enforced the deployment of patch-on protocols to the Internet to support the mobile environments, such as Mobile IP [2] and its variations. Such patch-on approach, however, inevitably causes inefficiency and limitations. Therefore if we consider re-design of the Internet, the mobile environment should be supported by the architecture itself.

When we design Future Internet architecture, the first step is the establishment of essential requirements. In this paper, we provide a set of requirements for mobile oriented Future Internet through the problem analysis for current Internet in mobile environment.

The remainder of this paper is organized as follows. Section II discusses the problems of current Internet in mobile environment and proposes the corresponding requirements. We conclude this paper in Section III.

II. PROBLEMS AND REQUIREMENTS IN MOBILE ENVIRONMENT

A. Assumption on fixed hosts

In current Internet, the packet delivery is accomplished on the implicit assumption of fixed host. In Future Internet, it is no longer valid assumption [3]. The assumption will cause much inefficiency and many limitations in mobile oriented network environment.

[Requirement 1]

- ***Mobile hosts should be considered as basic user.***

B. Static ID structure

IP address is almost a single identifier (ID) over network, transport and application layers in current Internet. In case of moving hosts, ID for routing in network layer should be updated for routing, but the one in upper layers should be kept for session continuity. This discrepancy requires unnecessary indirect protocols to support mobile hosts [2].

The allocation of locator (LOC) such as IP address is also inappropriate in mobile environment. In case of moving host, the LOC, which indicates the attachment point to the Internet, is likely to changeable. So, it may be meaningless to assign a changeable ID in the fixed form.

IP address is also allocated to a node's interface. It means that multiple interfaces need multiple IP addresses. In the multi-homing context, it is very inefficient in current and future network environment where multiple accesses coexist [4].

[Requirement 2]

- ***ID for identification should be separated from LOC for routing.***
- ***Static LOC should not assigned to mobile hosts.***
- ***ID should be allocated to host itself, not host interface.***

C. Patch-on and centralized mobility support

In mobile oriented environment, the mobility support is an essential requirement, not an additional feature. Existing TCP/IP protocols have so far focused on fixed hosts, and thus the mobility support has been considered as just a special or additional functionality. This leads to development of some mobility protocols in the form of patch-on the TCP/IP protocols. Such mobility control tends to induce unexpected performance degradation such as triangle routing, overuse of proxy agent, etc.

In addition, most of the current mobility schemes are based on a centralized forwarding anchor, such as Home Agent [2]. One big problem is that the centralized anchor introduces large volume of unnecessary traffic to the Internet. In the context of performance, it also tends to make the routing path

longer, which results in non-optimal routes and performance degradation. Moreover, the centralized approach is vulnerable to a single point of failure or attack [5].

[Requirement 3]

- ***Mobility support should be provided in the form of built-in rather than patch-on.***
- ***Forwarding for mobile hosts should be provided in the distributed form.***

D. Integrated control with data message

The control messages are usually more mission-critical than normal user data messages. Nevertheless, in most of current Internet protocols, data delivery and control function are integrated and implemented at the same devices, and the data and control traffics are routed along the same path, as shown in the IP and ICMP protocols. Generally mobile environment requires more control messages in more critical conditions. Accordingly, if control messages are affected according to user data traffic condition, the performance degradation may be out of boundary for specific services.

[Requirement 4]

- ***Control plane should be separated from data plane.***

E. A common delivery mechanism for heterogeneous and diverse networks

Current Internet assumes a common IP protocol stack over all Internet nodes according to the famous hourglass model. However, networks environment will be more heterogeneous, which are ranged from simple lightweight networks to highly reliable networks. For instance, wireless networks are likely to have quite diverse characteristics from sensor networks to cellular networks. Also the backbone network is evolving to full optical network with very high bandwidth. Accordingly, a single common delivery mechanism such as IP routing may not effectively support the network heterogeneity and diversity [6].

[Requirement 5]

- ***Use of different delivery mechanisms should be allowed according to the characteristic of networks.***

F. Host-based end-to-end protocol

The end-to-end argument has been a driving force to the Internet success. However, this principle also has some disadvantages from the operation perspective. Typical examples are difficulty in deployment, performance, resource sharing, locality, etc. [7]. Considering Future Internet is envisioned as a social infrastructure, the operation perspective should be recognized as an essential requirement.

[Requirement 6]

- ***Not only host-based protocol but also network-based protocol should be considered.***

G. No consideration of wireless mobile hots

In current Internet, it is implicitly assumed that a host is always active so that it can receive the incoming packets at any time. However, it may not be true in a certain mobile/wireless environment [8]. For instance, mobile hosts such as smart phone may be in idle, dormant or sleep mode frequently where they may not response immediately for incoming packets. This inactive condition of mobile hosts brings unacceptable packet loss.

In addition, the power saving is the most essential requirement for mobile hosts. However, we note that the current Internet protocols have been designed without any special consideration on this issue. It may cause big inefficiency in power consumption in mobile hosts.

[Requirement 7]

- ***Idle/sleep mode of mobile hosts should be supported.***
- ***Power saving of mobile hosts should be considered.***

H. Possible connectionless

In wireless environment, stable connection may not be guaranteed according to network environment [9]. In this case, packets will be lost if a certain capability to prevent the loss is provided. This problem will be more critical if the packets are so important that loss is not allowed.

[Requirement 8]

- ***Intermittent connection should be supported, if necessary.***

I. Routing scalability

Host-/Network mobility is to make the prefix aggregation of inter-domain routing so becoming a major factor to make current routing scalability problem more critical [10].

[Requirement 9]

- ***Mobility should be considered together with scalability in new routing and addressing architecture design.***

III. CONCLUSIONS

Mobile environment is one of the most critical factors to be considered in the design of Future Internet. In this paper, we analyzed some problems of current Internet from the mobile perspective and proposed corresponding requirements. We believe that this work will be the first step for the design of mobile oriented Future Internet architecture.

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