Chapter 17

Access Network Selection in a 4G Environment

Vasuky Mohanan  
School of Computer Science, Universiti Sains Malaysia, Malaysia

Rahmat Budiarto  
Networked Computing Center, Surya University, Indonesia

Sivakumar Ramakrishnan  
School of Materials and Mineral Resources Engineering, Universiti Sains Malaysia, Malaysia

ABSTRACT

4G networks provide bandwidth of up to 1Gbps for a Mobile Node (MN) that is moving at pedestrian speed. On the other hand, it also supports mobile nodes that can move at a speed of 250 km/hr with bandwidths value of 100 Mbps. This sets the premise of a network that supports diverse needs. This goal will be harder to achieve if Network Selection Problems (NSP) are not addressed comprehensively. NSP refers to the selection of target access network selection from a collection of Candidate Networks (CNs) when MNs are moving from one access network into another. The most logical way of achieving this is to select the “best” network. This translates to identifying performance values of the CNs. The analysis in this chapter shows clearly that access network selection done based on limited criteria is detrimental in achieving optimum communication. Instead, this chapter suggests a framework that would be complementary to a 4G network.

INTRODUCTION

According to International Telecommunications Union Radio Standardization Sector (ITU-R), a 4G network must be able to provide bandwidth of up to 1Gbps for mobile nodes that are moving at pedestrian speed. Additionally, a 4G network must also enable a MN that’s moving at the speed of 250 km/hr to achieve a bandwidth of 100 Mbps. As per these requirements, a 4G network is expected to satisfy diverse needs spreading over two extreme ends. On one hand, mobile nodes (MN) moving at pedestrian speeds achieve very high throughput and conversely, high speed MNs are also capable of achieving high throughput. In order to satisfy these seemingly opposing needs, an efficient and intelligent access network selection mechanism is needed. Current access network selection mecha-
Access Network Selection in a 4G Environment

This section focuses on literature in the area of network selection. Essentially, a method that solves NSP consists of two main components: 1) a weight specification component and 2) a

nism chooses the next target network to handover to by using limited set of criteria. Access network selection mechanism that uses single or limited criteria to decide candidate network (CN) ranking increases the chance of handing over to unsuitable target network. This is because limited criteria may not define a context wholly. This in turn will be detrimental to the level of quality of service (QoS) achieved. So far, ITU-R has recognized 2 candidate technologies to support 4G network namely LTE-Advanced and IEEE 802.16m. Both these standardizations are capable of meeting ITU-R’s 4G requirements. Unfortunately, the technical benefits these technologies espouses will not trickle down to the communicating MNs unless the access network selection method makes the right decision and selects the best target network.

An access network selection method in a 4G environment must take into account various criteria from all the main stakeholders (user, MNs, and CNs) in order to provide a holistic solution. This scenario is made even more challenging by the fact that MNs are now capable of connecting to different types of access networks using multiple interfaces. A typical scenario facing an access network selection method is a large pool of CNs of different access types to choose from, for MNs of varying speeds, each running multiple applications that have its own set of QoS requirements that must be satisfied. Another reality facing access network selection is to enable Always Best Connected (ABC) to MNs by choosing the best target network. ABC can mean different things for all the three main stakeholders hence the need to collect necessary criteria values from all three. It is very challenging to support ABC in a 4G environment as MNs in this environment can go up to 250 km/hr speed thereby the changing of access network connection will occur often and rapidly. Researchers have shown that two of the most popular mechanism used to collect criteria values is through mean value of past sessions (MVP) and most recent value (MRV). Both these mechanisms are mirror opposites of each other and both have been criticized, MVP for not taking into account recent changes and MRV for not considering historical data. Mobility scenarios in a 4G network are highly dynamic therefore a hybrid of both these methods would be more suitable in identifying the respective criteria values. The access network selection mechanism must also be flexible in adapting to fast changing environment i.e. a MN that suddenly moves at high speed, a CN that is increasingly choked with large amount of traffic and a user who’s running two different applications with diverse needs.

Current access network selection mechanism use single or limited criteria to identify the context on which the selection occurs and this will not scale up to the more challenging 4G environment. Current access network selection methods tend to allot static weights to the criteria. Predetermined weights that are fixed will not correctly represent a scenario that has changed. The next section in this chapter proceeds by discussing and analyzing current and popular network selection problem (NSP) solutions. Next, a thorough discussion on the chosen 4G candidate technologies is done. Based on the literature review of existing approaches on NSP as well as the technicalities of 4G candidate technologies, a new framework that we believe will be more suited to the dynamic 4G environment that would also be complementary to the 4G candidate technologies is presented. The next section presents results that emphasize the efficacy of this new framework. Thereafter, a section on how this proposed framework can be implemented is presented. Next, recommendations and suggestions for future improvements are discussed followed by conclusion.

RELATED WORK

This section focuses on literature in the area of network selection. Essentially, a method that solves NSP consists of two main components: