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RADIO ACCESS TECHNOLOGY DISCOVERY IN MOBILE WITH HETEROGENEOUS ENVIROMENT

Ms. Hricha Arya,
Student [M.Tech. CSE]
Galgotias University, Plot No-17A Greater Noida, India.

ABSTRACT

Discovery in mobile in heterogeneous environment an available radio access technology (RATs) is one of the most challenging issues in the heterogeneous wireless network environment. Especially, discovering WLAN, which support high data rates but have limited service coverage, and high flexibility for the users. In this paper, we propose three WLAN discovery schemes which are based on the upcoming IEEE 802.21 standards. In the proposed schemes, we exploit the information on neighboring WLANs from a MIH information server to discover available WLANs as soon as possible. Our simulation results show that the proposed schemes can enhance the performance of RAT discovery. In the heterogeneous environment of mobile communication and the radio access technology that proposed to The protocol operation consists of four stages. Cognition (through external triggering), Discovery of RAN/RAT capabilities, Negotiation and allocation, Handoff decision-making and execution.

Keywords: Heterogeneous Environment, RAT discovery, Handoff decision, MIH, IEEE 802.21.

1. INTRODUCTION

The integration of different wireless communication technologies is the important factor in the next generation wireless communications. The different network environments offer the Internet access to users, any where anytime, and with better Quality of Service (QoS). The integration of heterogeneous wireless networks has some issues such as vertical handoff, admission control, security guarantee, and power management for a mode terminal (MT) [3].

IEEE 802.21 standard defines Media Independent Handover (MIH) mechanisms that enable the enhancement of handovers in heterogeneous networks [1].Each wireless technology in the join networks has its own characteristics that complement others.

For example, Wireless Local Area Networks (WLANs) which are based on the IEEE 802.11 standards support higher data rates than other wireless access technologies. In contrast, the IEEE 802.16 (WiMAX) or 3G networks cover relatively large areas,
but they provide smaller data rates than WLANs. Due to such distinctive characteristics, the integration of WLANs with other wide area access networks is one of the most famous examples in network integration scenarios.WLANs with 3G systems has been studied actively by research communities and standardization bodies defined the partnership such as 3GPP/3GPP2 consortium, IEEE, and ETSI [2-4] between WLANs and the IEEE 802.16 based networks also has gained much attention. In this IEEE 802.16 proposed that 802.16e base stations (BSs) periodically broadcast the information on the density of WLAN APs [6].

A WLAN discovery scheme of utilizing 3GPP networks to broadcast the channel information on WLANs [7]. In the utilized the location service server (LSS) which stores the geographical information of WLAN AP locations [5]. With the help of the LSS, a RAT can turn on its WLAN interface only if the WLAN is available. In this paper, we propose efficient WLAN discovery schemes for heterogeneous wireless networks to reduce the energy consumption and detection time of WLANs. The proposed schemes utilize the IEEE 802.21 MIH services to provide information on WLANs to a RAT in a heterogeneous environment. Since the IEEE 802.21 standard supports media independent services, a MT can obtain the information on WLANs regardless of the currently connected network type. A main strong point of our schemes compared to existing work is that we consider a case where some APs are not managed by an information server. Note that most of WLAN APs are independently owned and managed unlike commercial networks.

Mobility is the important feature of a wireless cellular communication system. Usually, continuous service is achieved by supporting handoff (or handover) from one cell to another. Handoff is the process of changing the channel (frequency, time slot, spreading code, or combination of them) associated with the current connection while a call is in progress [8]. Handoff is divided into two broad categories— hard and soft handoffs [2]. In soft handoffs, both recourse existing during the handoff process such as new resources and those resource which is used during the handoff process. Poorly designed handoff schemes generate very heavy signaling traffic and there by a decrease in quality of service (QoS).

The reason why handoffs are critical in cellular communication systems is that neighboring cells are always using a disjoint subset of frequency bands, so negotiations must take place between the mobile station (MS), the current serving base station (BS), and the next potential BS. Other related issues, such as decision making and priority strategies during overloading, might influence the overall performance.

1.1 INTRODUCTION TO CELLULAR NETWORKS

The cellular network consists of several cells with each cell covering a certain geographic area. In each cell one base station is present. The cell area is determined by the signal strength within the region, which in turn depends on many factors such as height of the transmitting antenna, presence of hills, valleys and tall buildings, and atmospheric conditions. Therefore, the actual shape of the cell may be in the form of zigzag shape. However, the cell is approximated as hexagon. Because the hexagon is a good approximation of the circular region and it allows a

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larger region to be divided into no overlapping hexagonal sub regions of equal size [10]. All mobile users in the cell are served by this base station (BS). These base stations allocate frequency channels to the mobile station (MS) or users for communication when a call is made. The mobile user is blocked when there the base station cannot allocate a free channel to it.

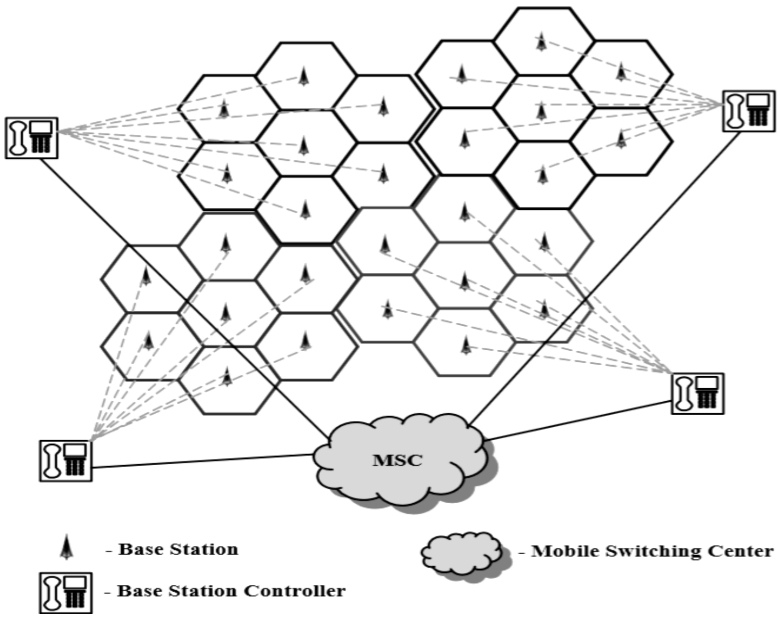

Fig 1.1

When a mobile user using a frequency channel of that particular base station reaches the boundary of the cell and moving to another cell, it needs to free the current channel and should acquire a channel from the neighboring cell to maintain connection. This procedure is called handoff or handover. These base stations are again linked to the base station controller (BSC). The set of base station controllers are connected to mobile switching center (MSC) which is responsible for controlling the calls and acting as a gateway to other networks. This cellular network scenario is shown in Fig. 1.1.

RELATED WORK

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In IEEE 802.11 WLANs that discover of potential WLAN APs is accomplished by means of a medium access control (MAC) layer function called scanning according to the IEEE 802.11 standard. There are two types of scanning mode: passive mode and active mode. In the passive scanning mode, a terminal listens to each channel of the physical medium one by one for beacon frames. During the passive scanning mode, the terminal waits for at least a period of time longer than the beacon interval, before it switches to the next channel. On the other hand, a terminal in the active scanning mode transmits a probe request frame containing the broadcast address as its destination and waits for probe responses from APs. If no response has been received by minimum channel Time, then the next channel is scanned. If one or more responses are received by minimum channel time, the terminal waits for more responses at most maximum channel time.

With mobile broadband (MBB) growth and evolution of the network, the network is becoming dense and complex, each site can be up to seven bands spectrum, five modes (GSM/UMTS/LTE-FDD/TD-LTE/WiFi), and five layers network architecture (Low-frequency macro coverage layer/ high-frequency capacity layer/ hotspot Micro capacity layer/ indoor Pico layer/ WiFi hotspots). If lack of effective coordination, it cannot effectively use all of the wireless network resources and cannot guarantee user experience. Meanwhile, intelligent terminals, pads and other types of users' equipment (UEs) spread quickly, and the service types of MBB increase rapidly. In such a multi-layer/multi-band/multi-mode wireless network, a question on how to improve the utilization efficiency of radio resources, to guarantee QoE of MBB service, to simplify multi-RAT network management, is a huge challenge of the Single-RAN.

At present, the coexistence of several networks assumes the existence of different capabilities. Not all of the existing terminals can support all radio systems, so multi-RAT networks cannot fully substitute for the different type of services to support performance. For example, throughput rate of data is faster than other RATs in the recent LTE network. In addition, the VoLTE (Voice over LTE Initiative) is proposed by GSMA [8] so as to ensure continuity of voice calls when a user moves from an LTE cell to a non-LTE cell. According to service requirements,

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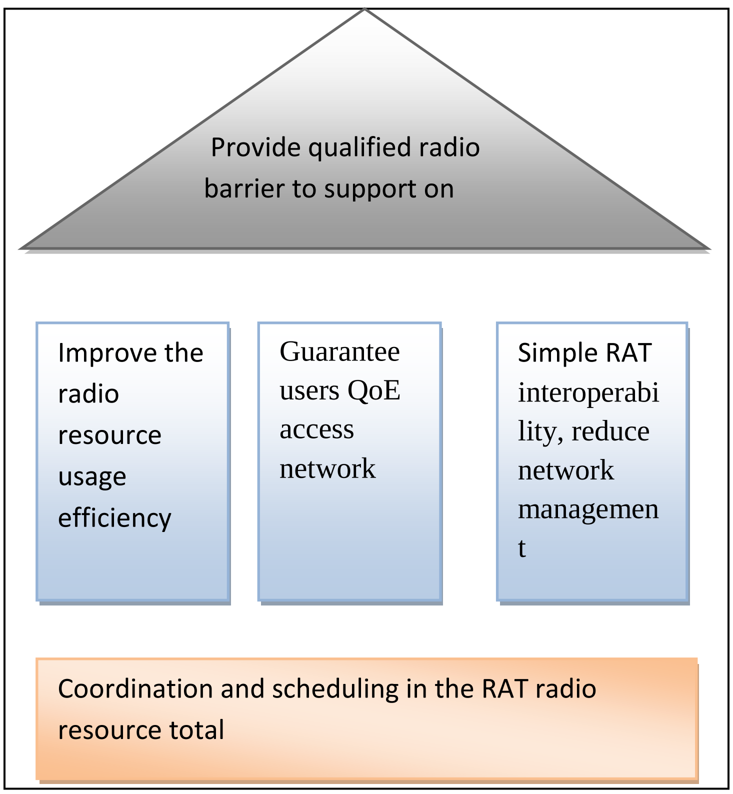
SRC needs real-time unified management of all wireless resources so as to coordinate the usage of resources in different RATs (Figure 1.2), in order to meet the following targets:

- Improve the overall utilization of radio resources.
- Guarantee users that they get consistent service experience regardless the used system.
- Simplify the process of multi-RAT interoperability, reduce network management difficulty.



PROPOSED WORK & APPROCHED FOR THE SOLUTION

Before proposing new RAT discovery schemes for a mobile in a heterogeneous environment , we introduce a conventional WLAN discovery scheme based on periodic switching. The timing model of the periodic switching scheme [1]. When a MT turns on its WLAN interface, it scans

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all channels via active or passive scanning modes. If one or more APs are detected after scanning, the MT associates with a new AP and starts to use the WLAN interface for data communications. Otherwise the WLAN interface is turned off during the switching interval T. Our aim is to design an advanced WLAN discovery scheme based on MIIS of the IEEE 802.21 standard. We assume that a MIH-capable to obtains the information on WLANs as follows.

Radio access technology discovery mainly selects the access network by dynamically considering a variety of network selection parameters such as: QoS offered by the network, cost of service, the QoS of applications running at the moment, the preferences of the end- user, wireless signal perception, power requirements of each network interface. Also, the method introduces a new network discovery approach, which provides the efficient performance when the network discovery is performed on devices such as smart phones, PDAs which are very sensitive to the power usage.

The Proposed method using mobile-controlled handover decision enables the mobile node to select the best network depending of various criteria's such as network conditions, costs, user preferences and so on.

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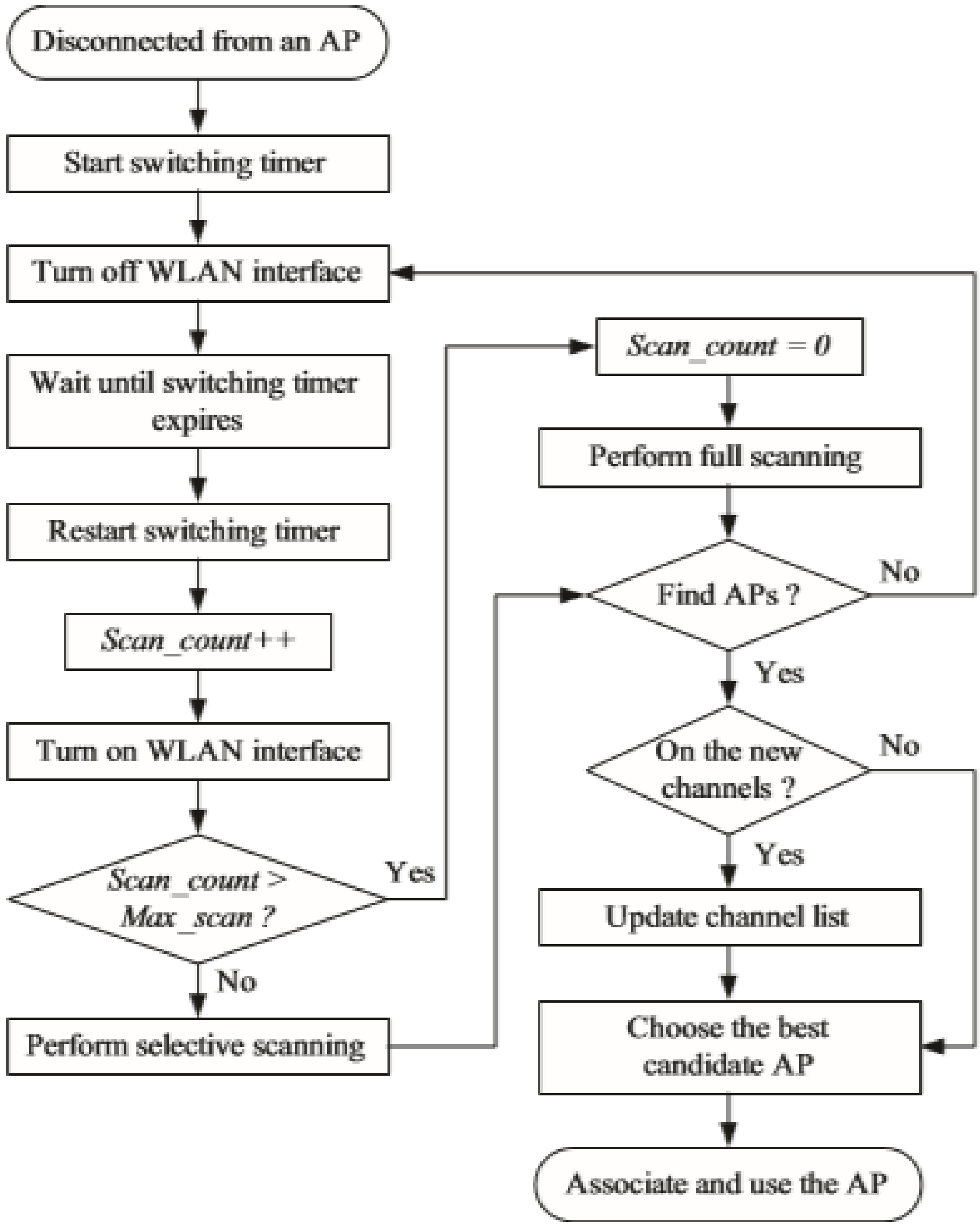

The handover process is divided in three phases:

- Network discovery.

- Handover decision.
- Handover execution.

In the network discovery the mobile node determines what wireless networks are available. The Handover decision is responsible for decision to which network to connect and the handover execution performs the actual switch to other network to transmit the data [10].

We propose a RAT discovery scheme that reduces the scanning time by limiting the number of scanned network. In this scheme, the receiving MIH Get Information response, a MT constructs a list of channels used by nearby APs to perform scanning for selected channels (selective scanning) rather than for all network (full scanning). There already have been several approaches that adopt selective scanning for the fast AP discovery. however, this designed to reduce the energy consumption of MT as well as the discovery time. Fig. 3 shows the overall operations of RAT discovery.

After disconnecting from an AP, the MT starts ‘switching timer’ with the switching interval T and turns off its WLAN interface. When the switching timer expires, the MT restarts the timer and increases the value of Scan count which is set to zero initially. Then it turns on the WLAN interface and decides whether to perform selective scanning or full scanning. In case Scan count does not exceed the pre-defined threshold Max scan, the MMT tries to discover APs by selective scanning. If the MMT fails to discover APs until Scan count exceeds Max scan, then it resets Scan count to zero and performs full scanning. (How to determine the optimal value of T and Max scan is outside the scope of this paper). After the scanning operation, if the MT fails to detect any APs, it turns off its WLAN interface again and waits until the next switching timer expires. If one or more APs are found, then it uses the WLAN interface for data transmission and voice transmission.

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Simulation & result

The performance of the system is evaluated under the following three different

scenarios showed in Table 1.

Table

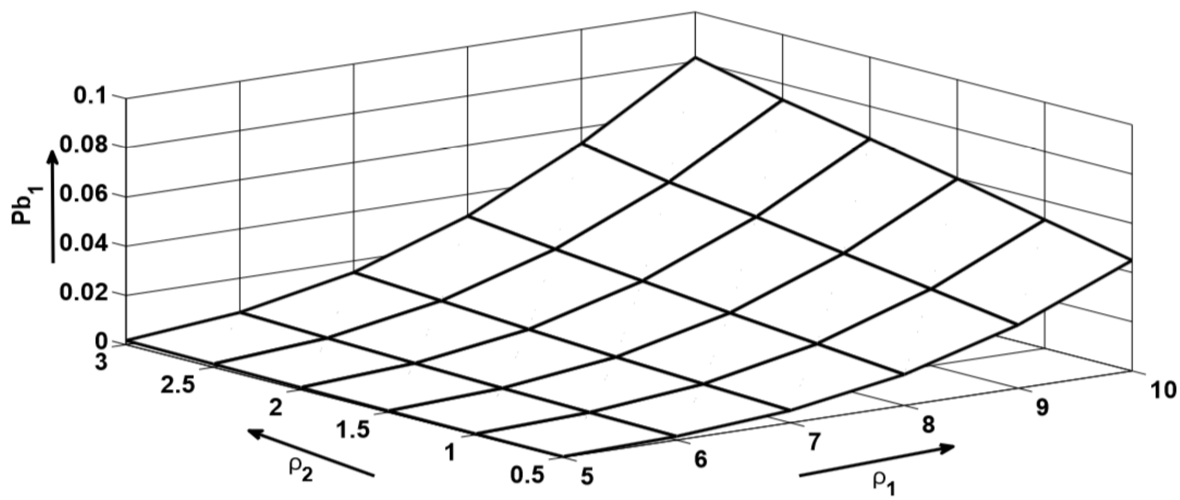
Scenario I				Scenario II				Scenario III			
Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value	Parameter	Value
b_1	2 *channels*	ω_1	0.8	ρ_1	5	ω_1	0.8	b_1	2 *channels*	ρ_1	5
b_2	1 *channel*	ω_2	0.2	ρ_2	3	ω_2	0.2	b_2	1 *channel*	ρ_2	3

• Scenario-I is for varying traffic intensity of class-1 and class-2 calls that gives a comprehensive view of the expected load on a HetNet. The traffic intensity describes the number of call requests received by the fixed network elements,in a unit area element during a time interval.

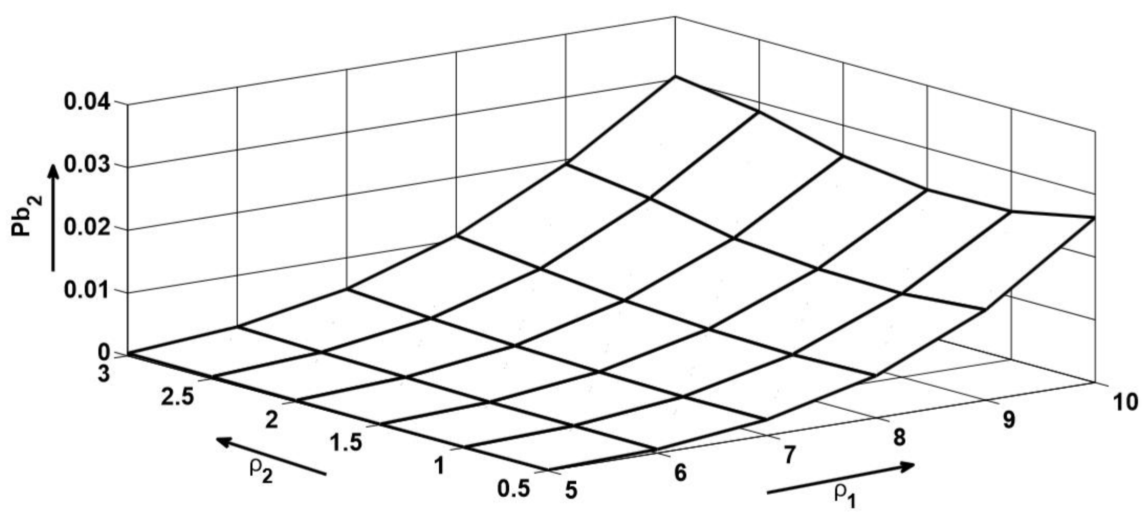
• Scenario-II is for varying required bandwidths for class-1 and class-2 calls.This scenario is to illustrate how varying bandwidth requirements are satisfied under limited resources and the impact on the blocking probability.

• Scenario-III is for varying weight for energy consumption cost in the total cost. This scenario is to illustrate the relative importance of each objective function on the system performance. We evaluate the performance of the system under the three above mentioned scenarios.

Analysis of Results for Scenario I



(a)



(b)

Figure 4.1: Scenario I: Blocking probability versus call intensities (a) blocking probability for class-1 call and (b) blocking probability for class-2.

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In Figure , it can be observed that the higher the call intensities, the higher the blocking probabilities. This is attributed to the fact that the system capacity is fixed. It is also observed that class-2 call intensity does not greatly impact on the blocking probabilities. Thisisduetothefactthatthesystemblockslessclass-2calls due to its lower call intensity. On the other hand, the blocking probabilities of both calls sharply increase when class-1 call intensity is high(from8to10), meaning that the system has less channels to accept new calls in a fast way. Figure (a) shows that the optimal policy blocks more class-1 calls compared to class-2 calls in figure(b).This is attributed to the fact that class1callsrequiremorebandwidthwhich make RATs consume more energy.

Figure (a) and (b) show that when the values of ρ1 and ρ2 are smaller, the initialRATselectionpolicydecidesthatitisbettertoacceptmorecallsinlessenergy consuming RAT (i.e RAT2), in order to save the overall energy. For this reason, the utilization of RAT2 is far better than that of RAT1 at this step. But when both call intensities are getting high, in order to tackle the traffic volume, the optimal policy starts taking more calls in RAT1 which makes its utilization high. Figure (b) shows that the RAT2 utilization goes down and figure (a) shows that the RAT1 utilization goes up when both call intensities are high. This is attributed to the fact that the optimal policy accepts more calls in RAT1 due to its higher capacity.

CONCLUSION

In this paper, we proposed RAT discovery for mobile in heterogeneous environment. The proposed schemes have been designed to discover available networks are efficiently utilizing the MIIS of the IEEE 802.21 standard. In the proposed schemes, a MT obtains the information on neigh boring WLANs from a MIIS server and exploits them to discover networks as soon as possible, while reducing the energy consumption. Our simulation results show that the proposed schemes outperformed the conventional discovery scheme in terms of the energy consumption and the discovery time of WLANs.

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We have proposed an optimization model based on the Semi-Markov Decision Process (SMDP) framework for the problem of selecting the initial Radio Access Technology (RAT) in co-located wireless networks. Our optimal initial RAT selection method considers a cost function that involves a blocking cost and an energy consumption cost associated with deferent weights to support the optimal JCAC decision. For the studied scenario with two co-located wireless networks, our simulation results demonstrate that variations in the weights of blocking cost and energy consumption cost can greatly impact both the system capacity and the network energy consumption. For the scenarios investigated in this thesis, our SMDP model generated 27,283 pairs of state-action for the two co-located wireless networks. As future work, we believe that our proposed SMDP-based model can be extended to support more sophisticated Het Nets architectures (i.e. with more than two co-located wireless networks and several service classes), which of course will involve a huge number of state actions that should be deal with.

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