# Wireless Communication Project Report 1 distributed resource allocation for hybrid networks

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**Abstract**

This is not a formal academic article since this is the preliminary step of this project. In this report, some basic research results about the distributed resource allocation for hybrid networks are presented, including the tentative definition and range of the terms, the specific goal and model fitting the topic and some algorithms already proposed and the analysis of them.

# 1 Make the topic clear

Here we give some tentative definitions about the concepts involved in this project to clarify this topic and narrow down the range on which we should focus.

## 1.1 Distributed Resource Allocation[1]

An allocation procedure to determine a suitable allocation of resources may be either centralized or distributed:

•In the centralized case, a single entity decides on the final allocation, possibly after having elicited the preferences of the other agents. Example: combinatorial auctions.The auctioneer holds all the information about the objects.

•In the distributed case, allocations emerge as the results of a sequence of local negotiations steps. Such local steps ma or may not be subject to structural restrictions. Example: bilateral deals. The transaction happens between two agents, each holding some objects to exchange.

### 1.2 Hybrid Networks

By the term of HYBRID, we mean heterogeneous networks differing from physical layers, access techniques and transmission standards, etc.
And HYBRID NETWORKS as whole refers to a situation that an area is covered with multiple heterogeneous networks at one time. Two root classes are wired and wireless networks. And in wireless network field, cellular network, wireless local area network(WLAN) and ad hoc network are the three most common forms.

## 2 Model and goal

Following the definitions given above, we propose a model with basic requirements.

Given an area covered with (a) cellular network(s), say GSM(CDMA,WCDMA etc. are also OK and we will consider in later reports).And also some parts of this area are covered with WLAN ,say one of the 802.11x WiFi standards. And end-users' equipments(EUE) are multi-mode and those networks are all available to those end-users. And what's more, those EUEs can be used to build ad hoc networks between each other.

We interpret the model in this way:

The resource we want to allocate is the "access to service", which in this project are the access to the phone calling, internet surfing, and other data flow services. And since the hybrid networks exist, the services provided by those heterogeneous networks are different, and to meet the demands of the end-users and optimize the whole accessing system, we want to find a way to judge and choose the access to the service for the users.

We will start from simple situations when handovers happen only between cellular and WLAN networks,and to develop an algorithm for handover is our goal. And later we can add ad hoc to the routing strategy, and later we wish we could do something more complicated.At last we will simulate our model and check the results.

## 3 Algorithms

The key technology discussed is called vertical handover, and it is easy to understand. Suppose a mobile node is changing from one network to another, if these two networks are the same, we call this horizontal handover, otherwise we call this vertical handover.

And the vertical handover decision algorithms are classified to 4 classes[2]:

1. Taking the signal strength as reference parameter. When the signal strength meet the threshold, the handover decision is made.[3, 4, 5]

2. The fuzzy logic based or the neural network based algorithm. The signal strength, network bandwidth and node transmission speed and other factors are all taken into account to make the handover decision.[6, 7, 8]

3. The cost function method. This method express the network cost as a function whose parameters are bandwidth, time delay, service fee, etc. And the end-user compare every cost possible from different networks and choose the minimal cost case.[9, 10, 11]

4. The system optimal method. In this method the goal is to find a threshold above which the system is optimized.[12]

The former 3 classes of algorithms are all standing in the position of the mobile nodes, and serve to enhance the performance of the nodes, while the 4th class is taking the system's view.

# 4 Integrated access

Ref [14] gives 4 methods for AP in WLAN to have access to Cellular:

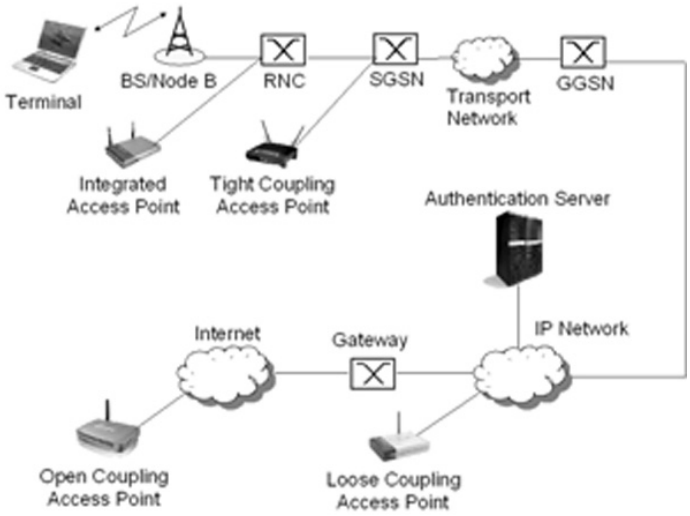
•Open Coupling
This scenario is an open standard and is used for access and roaming. The term Open coupling indicates that there is no real integration effort between two or more access technologies. The WLAN and UMTS networks are considered as two independent systems that share a single billing scheme between them. Although a common database is used between the two; separate authentication procedures are used (i.e. SIM based authentication for UMTS and simple user name and password for WLAN). Thus a current session in use will always have to be terminated as it enters to a new RAT. Hence seamless handover will never be possible.

•Loose Coupling
In this scenario, there is a common customer database and an authentication procedure. In loose coupling the operator will still be able to utilize the same subscriber database for existing 3G clients and new RATs (WLAN) clients, allowing centralized billing and maintenance for different technologies. However the new link AAA-HLR requires standardization. Loose coupling is defined as utilization of a generic RAT (WLAN in our case) as an access network complementary to current 3G access networks. It utilizes the common subscriber database without any user plane Iu interface, i.e. avoiding the SGSN, GGSN nodes. As at present this is regarded by many the most attractive solution.

•Tight Coupling

The key characteristic of this scenario includes the possibility of seamless handover between UMTS and a WLAN. As a consequence it requires additional standardization as opposed to the perviously discussed methods. In tight coupling, the generic RAT network is connected to the rest of the UMTS network (the core network) in the same manner as other UMTS RATs (UTRAN, GERAN) using the Iu interfaces by means of Interworking Unit (IWU). One of the most relevant aspects of tight coupling interworking is that it foresees the definition of the Iu interface between different radio access technologies making vertical handover possible.

•Integration
This scenario is similar compared to the previous method regarding seamless handover. However in this case a WLAN can be viewed as a cell managed at the RNC level. This concept is not widespread because robust network planning is not pertinent for WLANs yet; owing to lack of geographical condensed presence of the system .i.e. interference levels are not considered because in common scenarios geographical spreading of Access Points (AP) ensures lack of interference from neighboring cells. However it should be noted that this method would be the ideal case from the end user perspective.



The interwork access forms[13]

For this WLAN/Cellular integrated interworking, the problems arises in the aspects of admission control, improvement in QoS and load balancing.[16, 17, 18]

# 5 Summary and prospect

In this report we present the definition and range on which we focus. And then we give the model fitting the requirements of the topic. At last the 4 main vertical handover decision-making algorithms and the WLAN/Cellular integrated interworking

are researched. The next step of our group is to go real deep into the mechanism of vertical handover and try to figure out and add something to the routing strategies.

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