Chapter 80
Mobile Laboratory Model for Next-Generation Heterogeneous Wireless Systems

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ABSTRACT

Failure to integrate heterogeneous wireless systems generally makes it difficult, if not impossible, for the continuation of remote working or remote experiments when human operators and equipment coexist through networks in a collaborative environment. Mobile laboratories using ubiquitous mobile communication for next-generation heterogeneous wireless systems have prospects for increasing the operation of distributed communication and mobile ubiquitous systems. All "technology assessors" concur that tomorrow's society will have access to smart objects (mobile devices or apparatuses, mobile equipment, e.g. robots) that contain "programs" that will assist with communication in everyday life. However one of the tomorrow's challenges will consist of programming those objects to cooperate with and control telecommunications technologies. For a Mobile Laboratory to ensure consistent mobility in an environment, it must combine various wireless networks as a single integrated system. In this chapter we propose a Mobile Laboratory Model with mobile devices that take advantage of multiple mobile gateways by using Internet Protocol (IP) as the interconnection protocol to achieve the objective stated above.

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INTRODUCTION

Ubiquitous wireless networks enable us "to be freely mobile". This is due to the fact that our need to work in teams at distributed locations often requires that we always favor specific physical locations. This makes us increasingly depend on constant connectivity to a wider range of networks.

Today, the proliferation of mobile devices of all kinds (such as Smart cellular phones, Personal Digital Assistant (PDA), Laptops, etc.) as well as wireless communication technology are supporting the development of mobile learning or teaching, resulting in an advantage as an inevitable extension of mobile distance-education in general and e-learning in particular (Brown, 2005). Mobile learning is currently contributing to the quality of education by improving and optimizing interaction between different participants. Also, it is contributing to expansion of the population of stakeholders to include those who have no fixed access infrastructure (rural residents, for example) and those who are constantly mobile (e.g. the business community).

However, considering the rapid miniaturization of electronic devices and the increase in network communication capabilities, all futurologists concur that tomorrow's society will be that of smart objects (mobile devices or apparatuses, mobile equipment, e.g. robots); "programs" in all objects of everyday life that will be communicating to help us (Ngom, Saliah-Hassane, Diop & Niane, 2009). One of tomorrow's challenges will consist of programming these objects in conjunction with telecoms technology to have them cooperate, while controlling them. Therefore, new architectures and new models of mobile laboratories can be invented in order to contribute in developing mobile learning. In this chapter, we propose a Mobile Laboratory Model (MLM) with mobile devices taking advantage of multiple mobile gateways by using Internet Protocol (IP) as the interconnection protocol.

Firstly, we present the Mobile Laboratory Model and its components, and then we study two scenarios of feasibility tests. Finally, we conclude with test results.

OVERVIEW OF MOBILE LABORATORY MODEL

The Mobile Laboratory Model environment is wireless. The MLM center point comprises one or more wireless nodes that will facilitate connection to the other mobile components of the MLM. The nodes may have one of three of the following roles in the MLM:

- A node can operate as a simple connecting (or broadcasting) node to link the other mobile components;
- A node can be a mobile gateway able to provide a shared Internet connection;
- A node can also play both above roles in the MLM.

In the first case, the node will operate as an Access Point. In the second case, the node interconnects the mobile laboratory to the Internet by using IP as interconnection protocol. It has another interface wireless Local Area Network (LAN) and forms a shared Internet connection to link the other mobile components in the mobile laboratory. Where this node plays both roles, it will be a connecting node and will have an interface connected to the Internet or a Mesh Network, in general a Wireless Wide Area Network (WWAN). Thus once the MLM is deployed, components can remotely access tools, laboratory applications, etc. via the Internet. They can also communicate with other mobile or fixed devices through other channels such as a Mesh Network and other mobile environments with MLM interconnection features.

Multiple wireless links can be considered for the Mobile Laboratory (ML) communication to a

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