NGMN
Next Generation Mobile Networks

Heterogeneous Networks – White Paper Summary

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1 INTRODUCTION

Fostering a successful ecosystem for the deployment of LTE/SAE as the next generation mobile network (NGMN) and its related services is a major goal of the NGMN Alliance's Ecosystem Working Group. As part of the working group's findings it identified that one of the important areas for further investigation is that the deployment of NGMN is expected to be an evolution that will see NGMN being deployed alongside existing networks in the form of heterogeneous networks, i.e. interworking networks composed of different technologies operating in distinct frequency bands. Thus network operators face a number of challenges as they move towards the deployment of NGMN. The role of the Ecosystem Task Force on Heterogeneous Networks is to investigate potential barriers to NGMN deployment in heterogeneous networks where the heterogeneity is across technologies. Therefore, the Heterogeneous Networks task force has focused on the immediate issues that will face operators during the first deployment stages. These issues are (i) co-existence of existing technologies with a new NGMN deployment and (ii) the impacts from the lack of consistency in network performance between the existing technologies and NGMN.

The analysis undertaken is based on four use cases that aim to provide specific and realistic examples of the type of network deployments for NGMN in heterogeneous networks. Specifically there are three that deal with single operator deployments and one that deals with roaming between two operators. Each of these use cases is examined in the context of specific technology combinations. The following technology combinations for multi-mode terminals:

- LTE with other 3GPP technologies (i.e. LTE/HSPA & EDGE; LTE TDD, LTE FDD, EDGE; LTE TDD, LTE FDD, TD-HSPA & EDGE
- LTE with CDMA2000

Where use cases required two separate terminals, these were only considered in terms of non-3GPP technologies since it was the view that the 3GPP technologies would be available with LTE as multi-model terminals (i.e. no LTE only terminals).

Use case one describes a "Single Operator with a Multi-mode Terminal" case. This is a basic use case where there is a single operator deploying a limited coverage NGMN network beside an existing non-NGMN network. The multi-mode terminal would provide access to either network depending on the coverage of each network and a range of other factors (including access steering). It is restricted to technology combinations for multi-mode terminals below on the basis that they will be are available for these technologies. In this use case it is expected that a user with a multi-mode terminal will roam across the operator's networks and expect the user experience to be seamless.

Use case two involves a "Single Operator with Two Separate Terminals". This is an extension of use case 1 for non-3GPP technology combinations where it is assumed that a multi-mode terminal is not available. It describes situations where an operator deploys a limited coverage LTE network alongside an existing non-3GPP technology. For example, users could have a built-in WiFi chip in a laptop or netbook etc and then a LTE USB terminal or two separate wireless USB (or similar) terminals. WiFi is included in this use case because this type of interaction is already available today for the 3GPP 3G technologies where the use of WiFi for data off-load is an important consideration. However, it is unlikely there will be wide area contiguous coverage of WiFi, so this would also imply that the LTE network may be of broader coverage.

Use case three addresses a "Single Operator with Two Separate Terminals in Two Separate Devices". This is a case to describe a similar scenario to 2. above, but where there are two separate devices (e.g. (i) a handheld games console with one technology and TV or large screen device with another, or (ii) a netbook/tablet/smartphone and a PC). This use case focuses on mobility between devices that may be more mobile to ones that may be less mobile but give a better user experience.

Use case four involves “Two Operators with a Multi-mode Terminal - national and international roaming”. This case is essentially the same as use case 1 but with two operators. An example of this type of use case can be found where roaming between operators is used as a means for extending network coverage. For example one operator (A) may build a network with CBD with limited metropolitan coverage and then enter a roaming agreement with another operator (B) to provide service outside the area of operator A's network. In the NGMN context this type of roaming could enable an operator that does not want to deploy LTE to enable roaming into another operators LTE network, subject to appropriate commercial arrangements. Alternatively, it could enable a new LTE entrant with no other network to deploy a limited coverage LTE network and then negotiate roaming to another operator’s non-NGMN network.

2 CONCLUSIONS AND RECOMMENDATIONS

The analysis of these use cases leads to the following conclusions and general recommendations for the mobile industry and particularly for the operators.

2.1 Barriers to Heterogeneous Network Deployment

The analysis performed by the task force on Heterogeneous Networks clearly indicates that the 3GPP standards already go a significant way to supporting the early deployment of LTE in heterogeneous networks comprised of either other 3GPP or non-3GPP technologies. There is also evidence of continuing development within the 3GPP of improved interworking with all of these technologies. The standards for non-3GPP technologies are also evolving to address the issues of interworking with LTE. This is particularly evident in the development of the eHRPD standards. The IEEE also provides solutions for interworking between LTE with IEEE standards based technologies.

This means that the barriers to deployment of LTE in heterogeneous networks from the perspective of interworking between the different network technologies are minimal. The options available give operators some choice in how to support such a deployment. What is not clear at the moment, and was not within the scope of this work, is to what extent these solutions will be available in network infrastructure for the first deployments of LTE. If the devices are capable of supporting a high levels of interworking based on the relevant 3GPP standards, then it is also important that the network infrastructure also provides the same level of support. It is expected that any review of the infrastructure capabilities would be a natural part of the due diligence carried out by operators.

2.2 Operator Requirements

Feedback received from a number of operators in the Task Force expressed the view that with respect of mobility (i.e. radio access network selection, camping, handover between radio access and active-idle transition):

- that it is important that the process is under operator control
- it should be robust and reliable

2.3 Relative Performance Issues

With respect to performance issues for heterogeneous network deployment, the performance differences are reducing over time with the evolution of the existing technologies. How operators minimise the impact of performance differences, either through technology upgrades, network design or other approaches remains as a strategic issue for operators to manage. One important factor is to ensure that the latest evolution (revision) of the existing technologies is integrated into multi-mode devices as this should provide operators the opportunity to minimise performance differences.

2.4 HetNets

HetNets are an important area for the ongoing deployment/evolution of LTE but that falls outside the scope of the early deployment focus of this paper. Hetnets are the use of a multi-layered architecture of different cell sizes to cost-effectively support the emerging wireless data traffic demand. Whilst usually considered within the context of a homogenous technology, they can also be applied across technologies (i.e. heterogeneous in technology). This is expected to develop into an area of major importance as traffic demand grows. While out of scope for this paper, it is recommended that the issues for HetNets be considered for further investigation either by the NGMN Alliance or another relevant industry forum.

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