

Source: Motorola
Title: Multicell EMBMS CQI Feedback
Document for: Discussion
Agenda Item: 7.9

1. Introduction

The introduction of multicast broadcast single frequency network (MBSFN) mode offers a promising opportunity to efficiently deliver E-MBMS services throughout a network. However, in order to provide an optimal balance between coverage and resource provisioning, a simple feedback mechanism such as MBSFN physical layer measurement or CQI reporting [1] is desirable. In this contribution we investigate the effectiveness of CQI measurement reporting in optimising MBSFN coverage and transmission efficiency.

2. Simulations

A three ring hexagonal grid layout was simulated with UE drop locations confined to the inner two rings with dual port UE receiver operation assumed in spatially uncorrelated channels. Two sets of simulations were carried out.

The first set of simulations, the performance evaluation set, is concerned with evaluating the actual spectral efficiency and coverage performance of the network. The performance metric used is coverage (%) vs. spectral efficiency (bps/Hz) where a user is defined as in outage if the simulated packet or frame erasure rate (FER) at a specific location in the defined coverage area is greater than 1%. The relationship between coverage and spectral efficiency for the Case 3 deployment scenario is shown below in Figure 1.

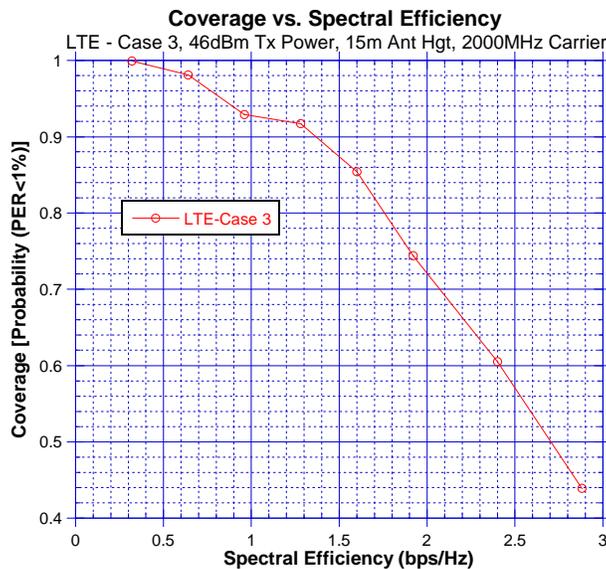


Figure 1 - Performance Evaluation Set: Coverage versus spectral efficiency for Case 3

The second set, the performance control set, is used to model the generation of CQI reports. Although no specific approach to CQI feedback is proposed here, methods such as that described in [2] may be used. Each UE generates a report indicating the minimum of eight possible transport block sizes/MCS combinations, given in Table 1 of [3], which can be supported at a specified error rate – 1% FER in this case. As each report is fed back to the network, a plot of coverage vs. spectral efficiency is updated. A target coverage $C_{\text{Target}} = 0.98$ was used to generate an estimated supportable spectral efficiency from the plot.

A drawback of this approach is the order in which UEs make their reports influence the estimated supportable spectral efficiency. That is, if UEs in good locations make reports then the estimated supportable spectral efficiency will be optimistic and coverage will be less than C_{Target} . Therefore, multiple trials were made with a fixed number of UEs generating the CQI reports in each trial. The 5%-tile and 95%-tile estimated supportable spectral efficiency was recorded for each fixed number of UEs and is shown below in Figure 2 for Case 3.

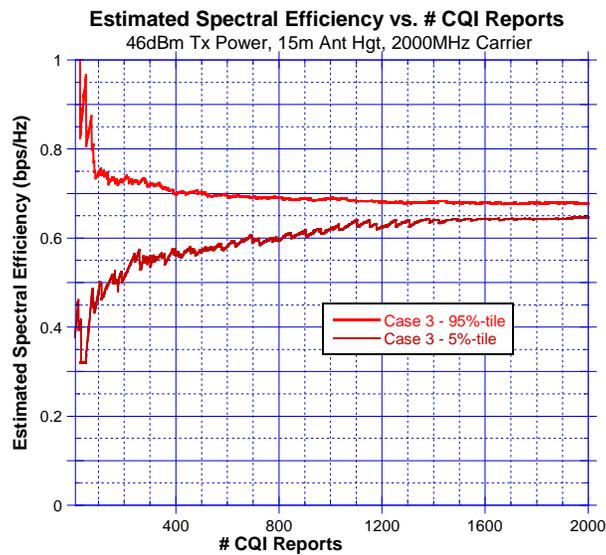


Figure 2 – Estimated supportable spectral efficiency versus number of CQI reports.

It should be noted the supportable spectral efficiency at the 98% coverage level from Figure 1 is 0.68 bps/Hz. As the number of CQI reports increase, the 5%-tile and 95%-tile estimated supportable spectral efficiency curves converge near these respective values after around 800 CQI reports.

The experienced coverage for the 5%-tile and 95%-tile estimated supportable spectral efficiencies are given below in Figure 3. Both curves converge near the $C_{\text{Target}} = 0.98$ ¹ with increasing number of CQI reports, ultimately falling within $\pm 0.5\%$ of the target outage for 800 CQI reports.

¹ Note: In the limit, the 5%-tile and 95%-tile curves converge to 97.7%. It is likely this is a statistical artifact due to the independent generation of the performance evaluation set and performance control set.

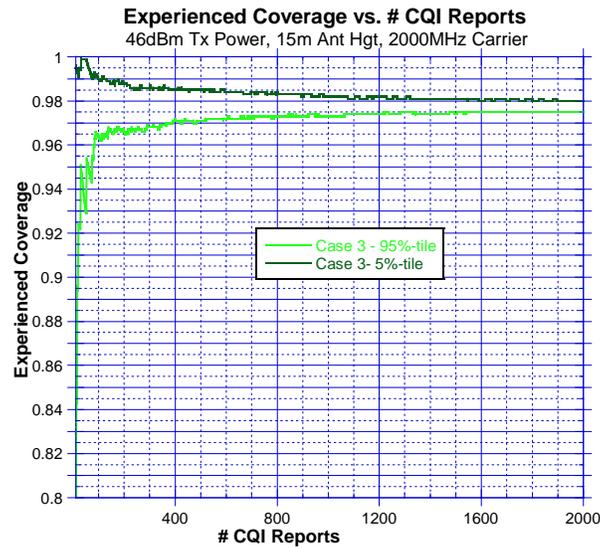


Figure 3 – Coverage provided by estimated supportable spectral efficiency.

3. Conclusions

In this contribution the effectiveness of CQI measurement reporting in optimising MBSFN coverage and transmission efficiency was investigated. It is shown that with 800 CQI reports, a reasonable estimate of the supportable spectral efficiency can be made to within $\pm 0.5\%$ of the target coverage level using the investigated CQI report mechanism.

1. References

- [1] R2-070726, Motorola, "Uplink Feedback for EMBMS", St. Louis, USA, Feb. 12-16, 2007.
- [2] R1-071349, Motorola, "Uplink Common Control Channel", St. Julians, Malta, March 26-30, 2007.
- [3] R1-071433, Motorola, "Additional Results on EMBMS Transmission Configurations", St. Julians, Malta, March 26-30, 2007.