Massive MIMO Optimization with Compatible Sets

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2019

Massive MIMO Optimization With Compatible Sets Technical Report

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March 26, 2019

Contents

1 Introduction

In this report we provide results for those experiments and scenarios whose results were omitted from our paper [1]. In Tables 2–1, we provide a reference of the experimental parameters used, however, readers are referred to the paper for a full explanation of the meaning of each parameter and the method for conducting the experiments.

The following results are contained in this report. For Experiment 1, the column generation iteration number vs. the dual objective for maximum ratio combining with optimal and static power control, as well as for zero forcing with fair, optimal, and static power control. Experiments 2 and 3 were omitted from the paper, and so full results for these experiments are provided here. For Experiments 4 and 5, results are given here for scenarios 2–6.

References

[1] E. Fitzgerald, M. Pióro, and F. Tufvesson, "Massive MIMO optimization with compatible sets," *IEEE Transactions on Wireless Communications*, 2019, in press, available at https://arxiv.org/abs/1903.08260.

Experiment	Near distance	Far distance	Other parameters
1	50 m	200 m	
2	200 m	400 m	
3	50 m	100 m	
4	50 m	100 m	μ: 1, 5...50; step 5, K: 20
5	50 m	100 m	K: 4...40, step 4
6	50 m	500 m	K: 40 total: 8 near, 32 far

Table 1: Experiment configurations.

Parameter	Value
$\hat{\rho}$	10 dB
$\hat{\rho}$	10 dB
M	100
μ	1.0
S	1
P	12
α	3.7
R	200 m
K	40

Table 2: Parameters used for experiments

Scenario 1		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	10	10
Far	2	2
Scenario 2		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	2	2
Far	10	10
Scenario 3		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	2	10
Far	10	2
Scenario 4		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	10	2
Far	2	10
Scenario 5		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	10	2
Far	10	2
Scenario 6		
Group	**Uplink demand $\hat{h}$**	**Downlink demand $\check{h}$**
Near	2	10
Far	2	10

Table 3: Scenarios for experiments

2 Experiment 1

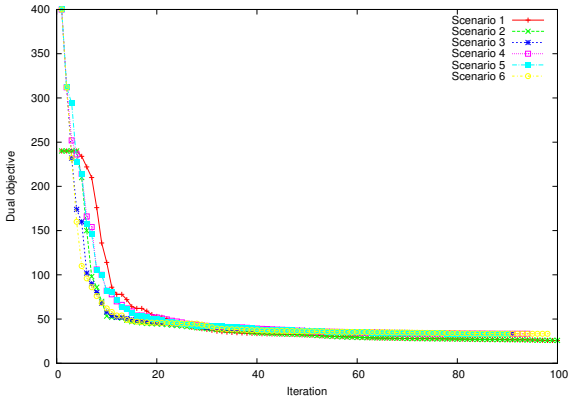

Figure 1: Iteration number vs. dual objective for MRC with optimal power control

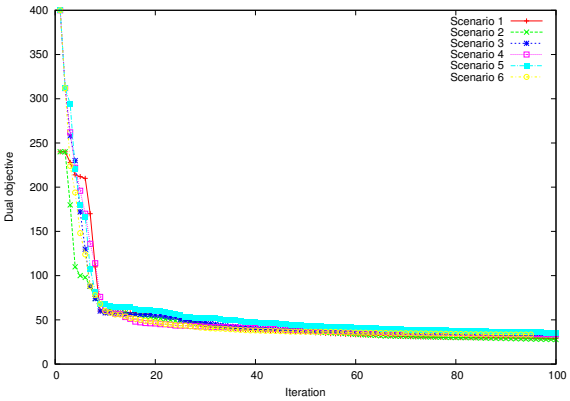

Figure 3: Iteration number vs. dual objective for MRC with downlink power control

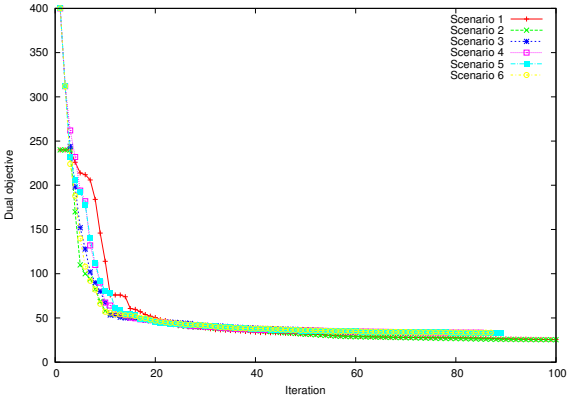

Figure 4: Iteration number vs. dual objective for ZF with fair power control

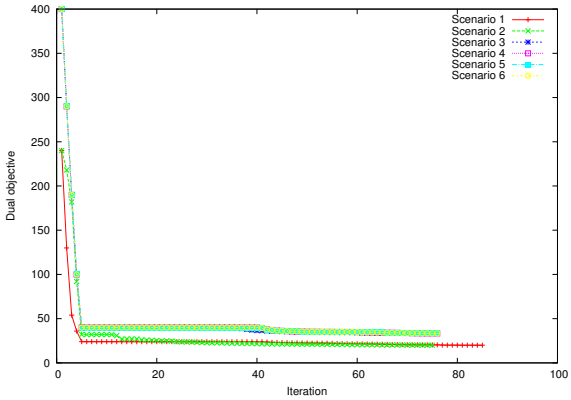

Figure 2: Iteration number vs. dual objective for MRC with static power control

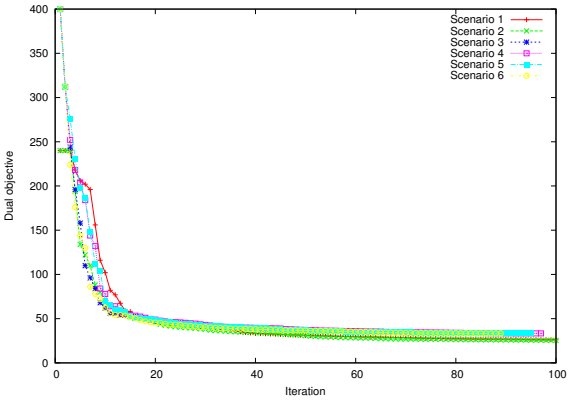

Figure 5: Iteration number vs. dual objective for ZF with optimal power control

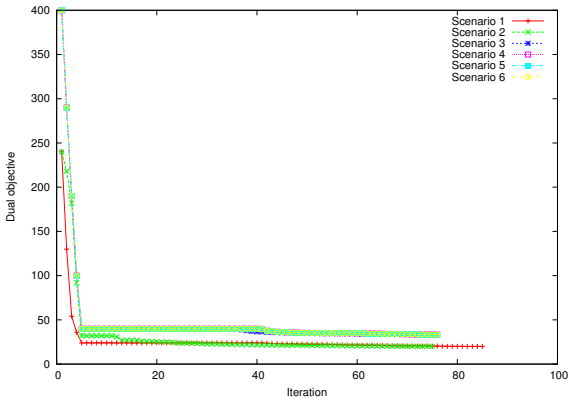

Figure 6: Iteration number vs. dual objective for ZF with static power control

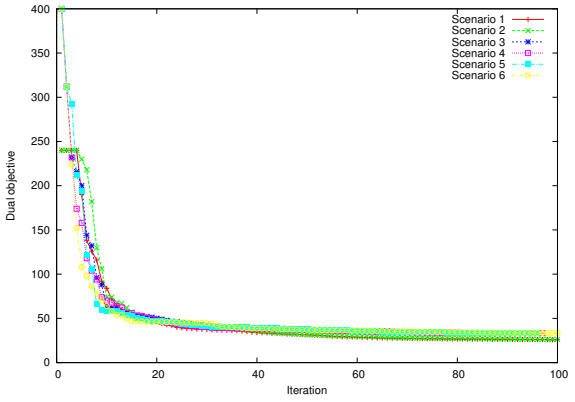

Figure 7: Iteration number vs. dual objective for ZF with downlink power control

3 Experiment 2

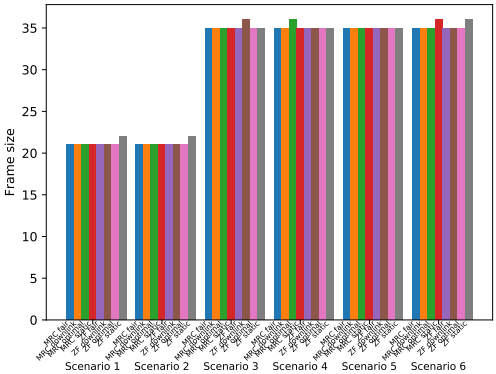

Figure 8: Frame size

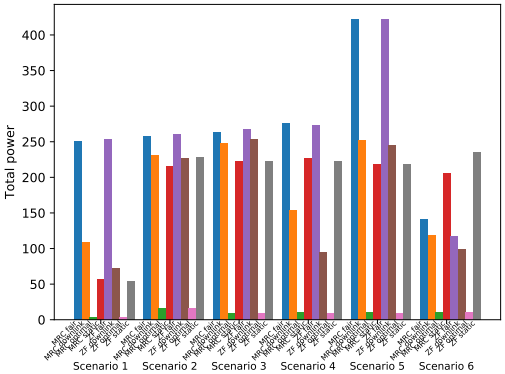

Figure 9: Total power

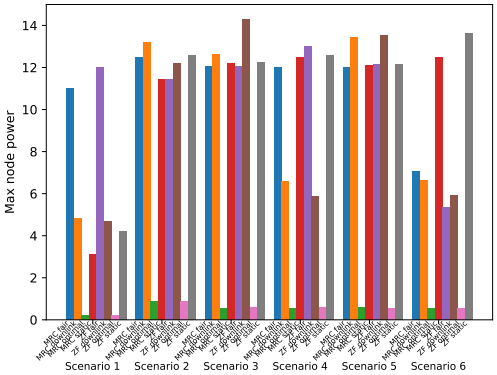

Figure 10: Max node power

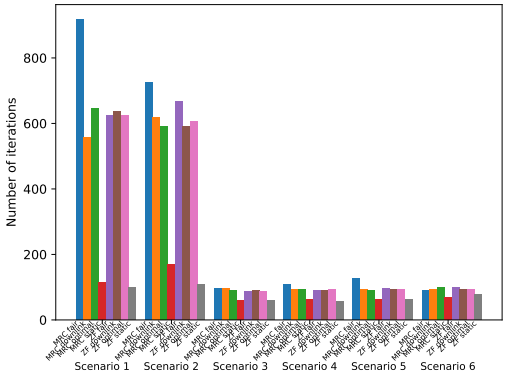

Figure 11: Number of pricing problem iterations

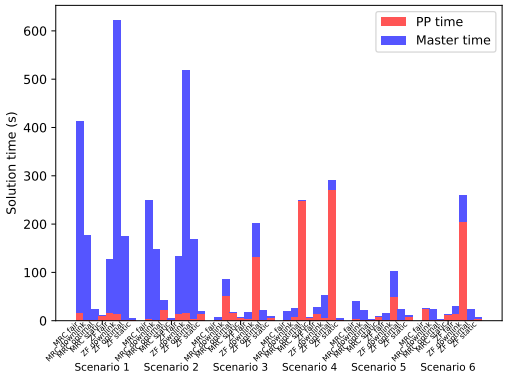

Figure 12: Solution time

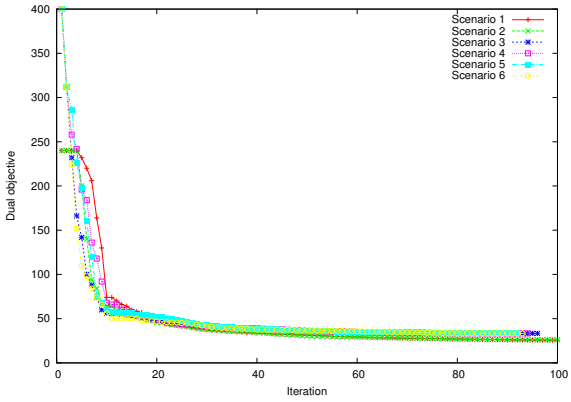

Figure 13: Iteration number vs. dual objective for MRC with fair power control

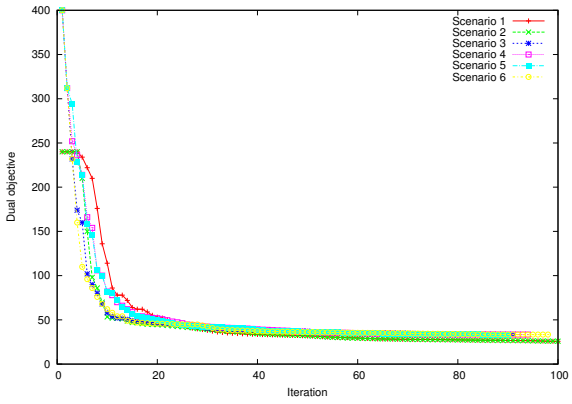

Figure 14: Iteration number vs. dual objective for MRC with optimal power control

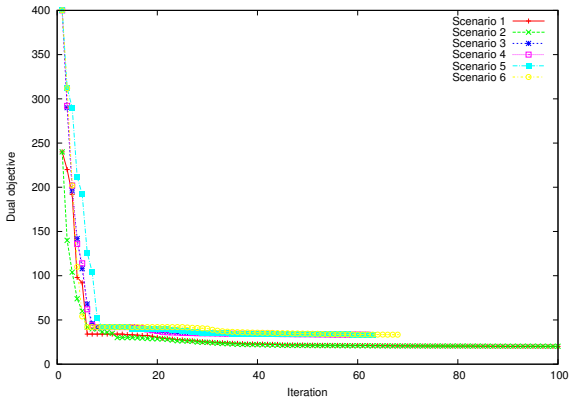

Figure 15: Iteration number vs. dual objective for MRC with static power control

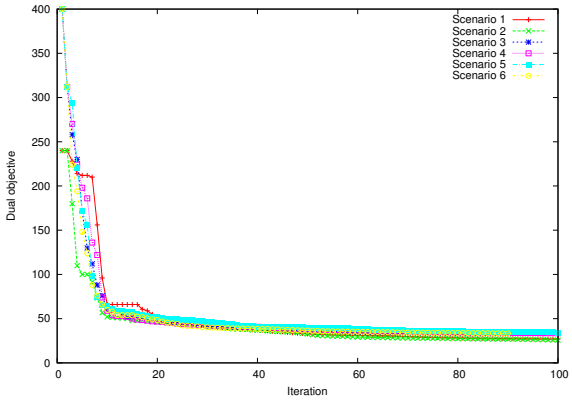

Figure 16: Iteration number vs. dual objective for MRC with downlink power control

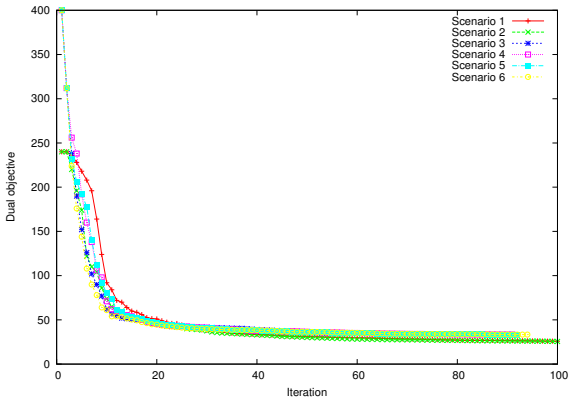

Figure 17: Iteration number vs. dual objective for ZF with fair power control

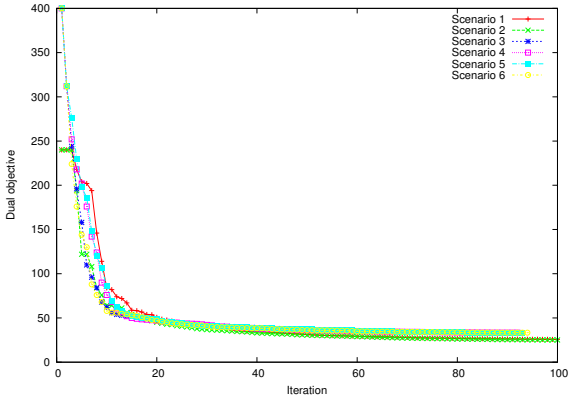

Figure 18: Iteration number vs. dual objective for ZF with optimal power control

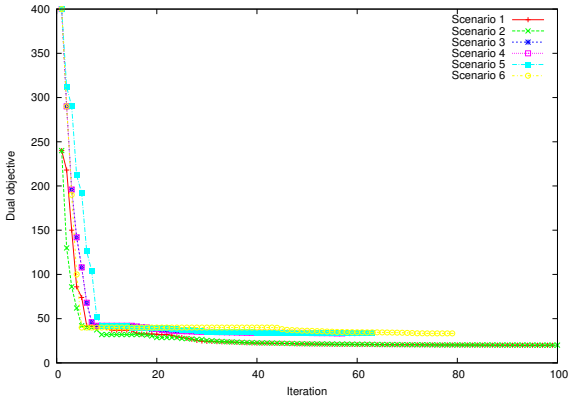

Figure 19: Iteration number vs. dual objective for ZF with static power control

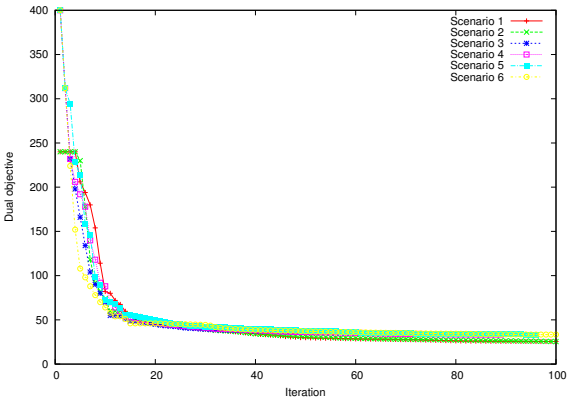

Figure 20: Iteration number vs. dual objective for ZF with downlink power control

4 Experiment 3

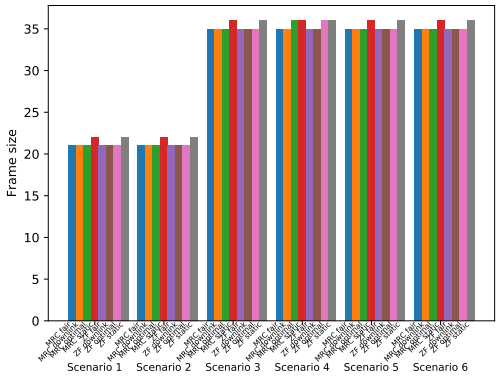

Figure 21: Frame size

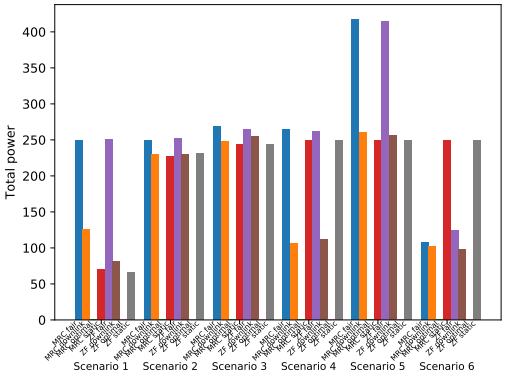

Figure 22: Total power

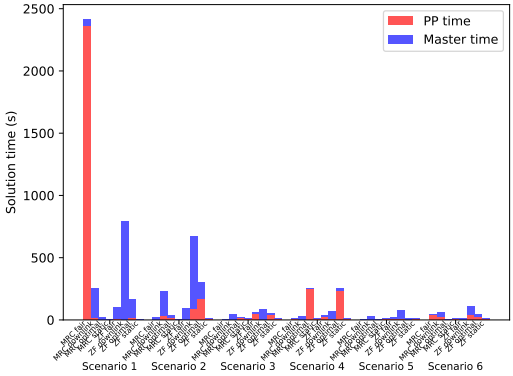

Figure 25: Solution time

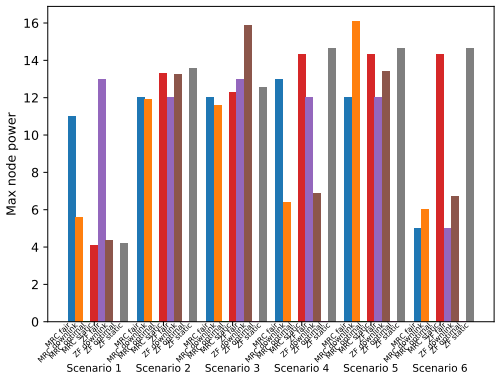

Figure 23: Max node power

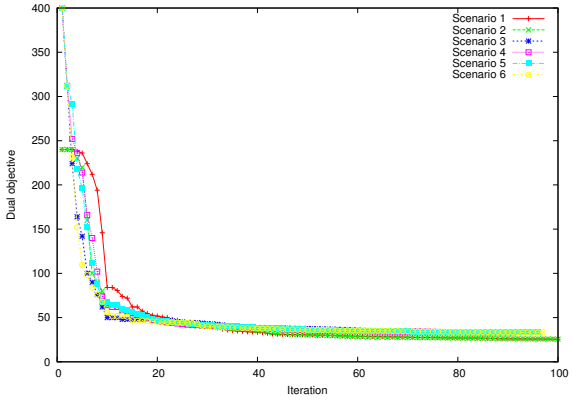

Figure 26: Iteration number vs. dual objective for MRC with fair power control

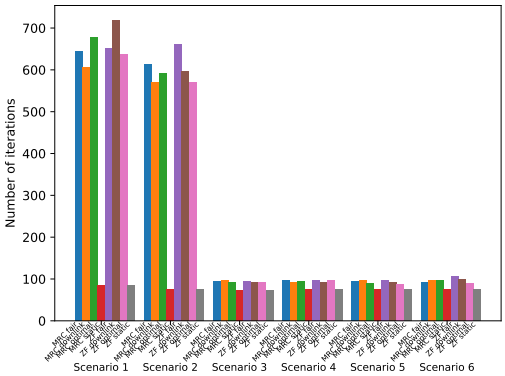

Figure 24: Number of pricing problem iterations

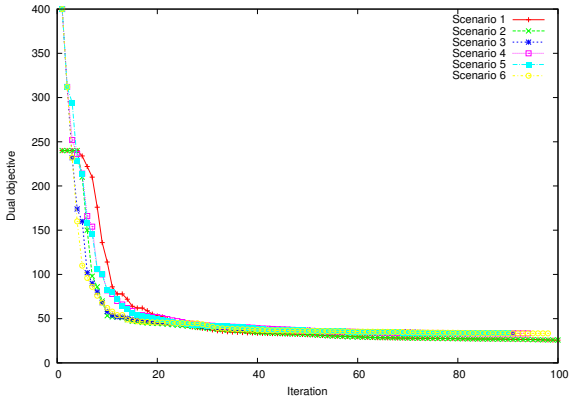

Figure 27: Iteration number vs. dual objective for MRC with optimal power control

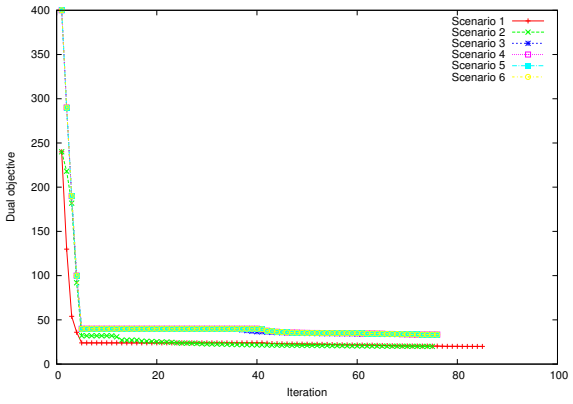

Figure 28: Iteration number vs. dual objective for MRC with static power control

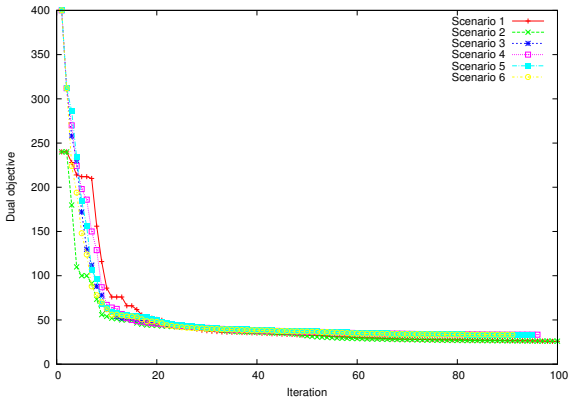

Figure 29: Iteration number vs. dual objective for MRC with downlink power control

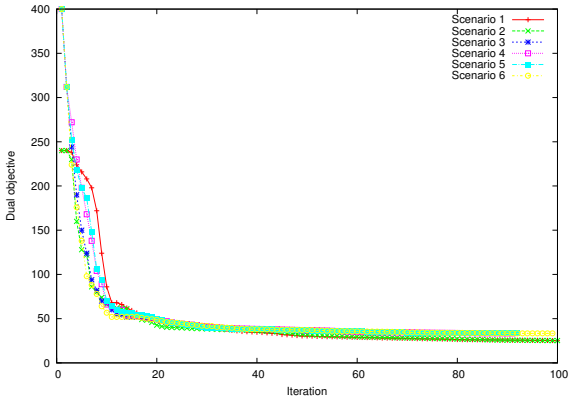

Figure 30: Iteration number vs. dual objective for ZF with fair power control

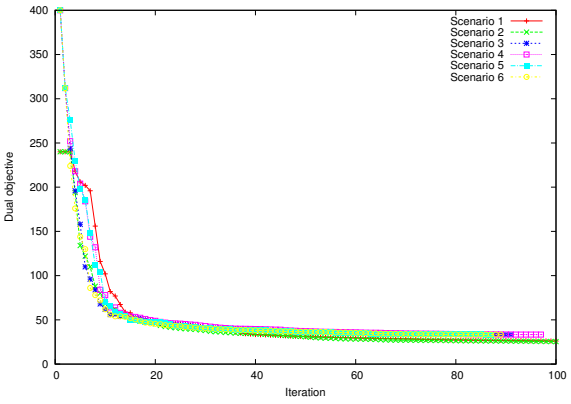

Figure 31: Iteration number vs. dual objective for ZF with optimal power control

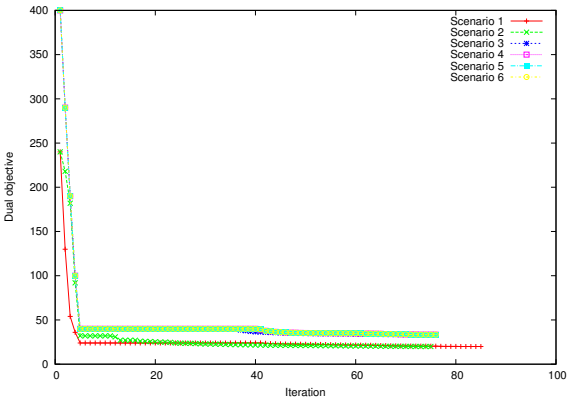

Figure 32: Iteration number vs. dual objective for ZF with static power control

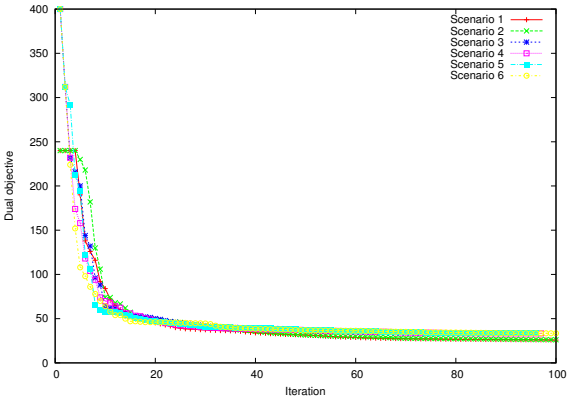

Figure 33: Iteration number vs. dual objective for ZF with downlink power control

5 Experiment 4

5.1 Scenario 2

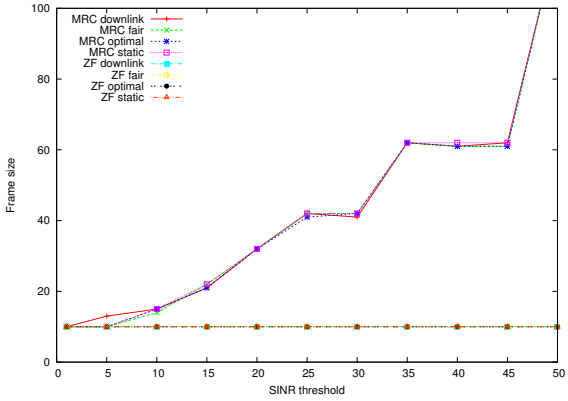

Figure 34: Frame size

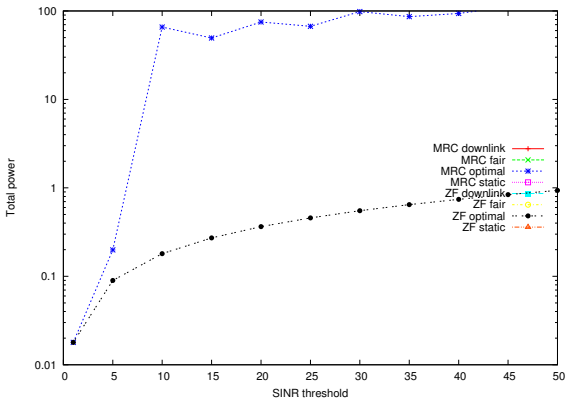

Figure 35: Total power

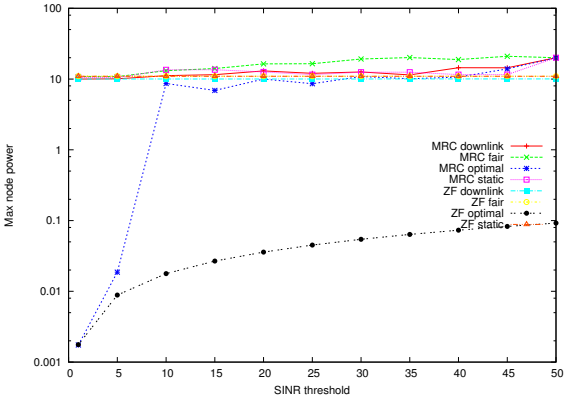

Figure 36: Max node power

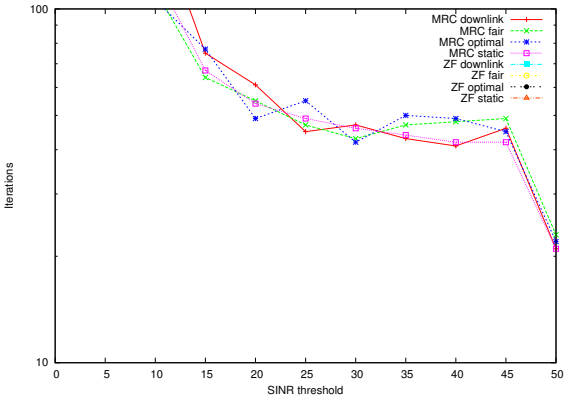

Figure 37: Number of pricing problem iterations

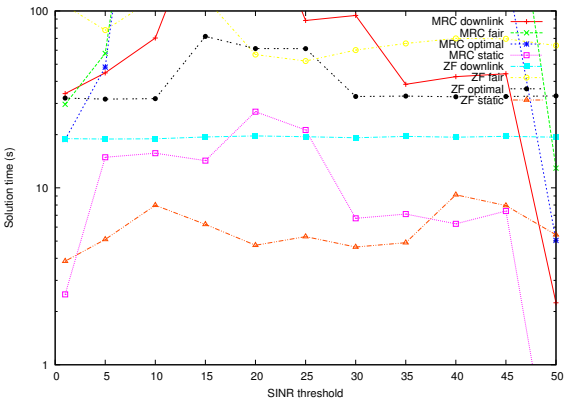

Figure 38: Total solution time

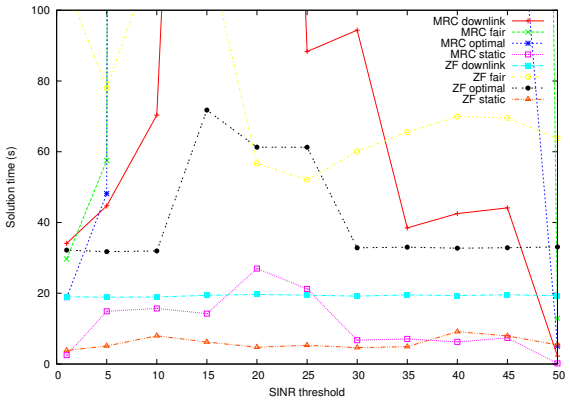

Figure 39: Total solution time, enlarged view

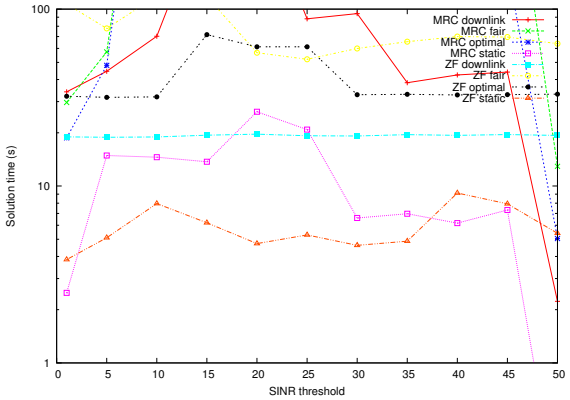

Figure 40: Solution time for pricing problem

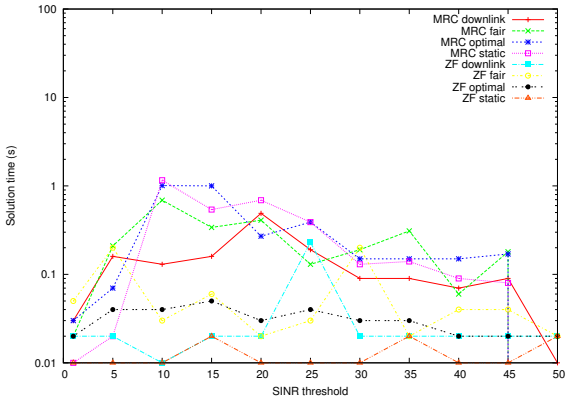

Figure 41: Solution time for master problem

5.2 Scenario 3

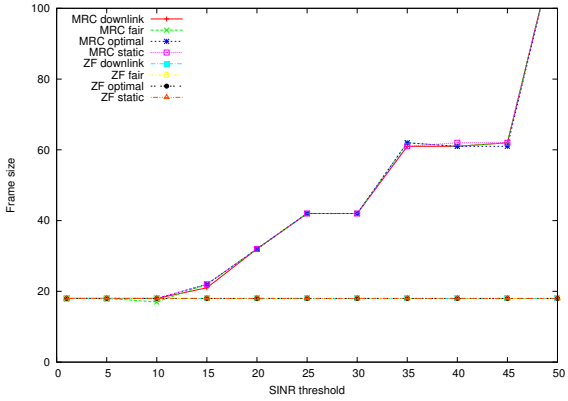

Figure 42: Frame size

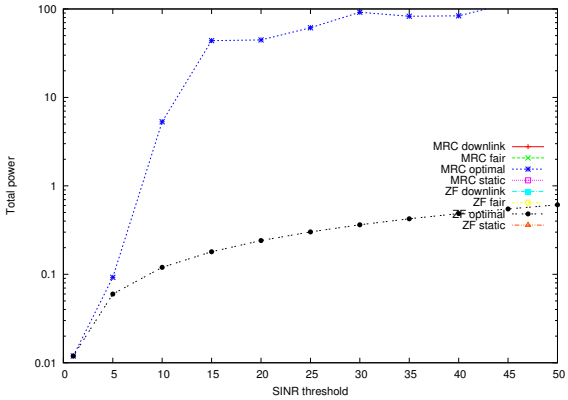

Figure 43: Total power

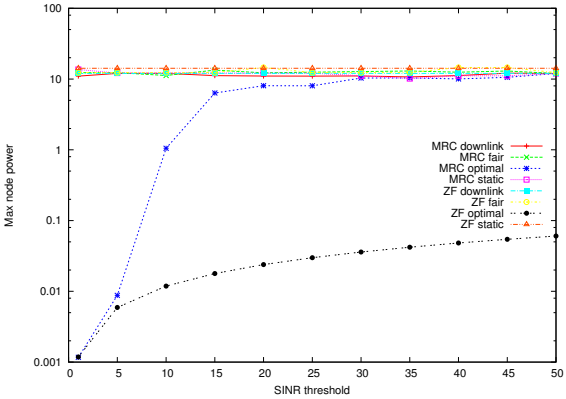

Figure 44: Max node power

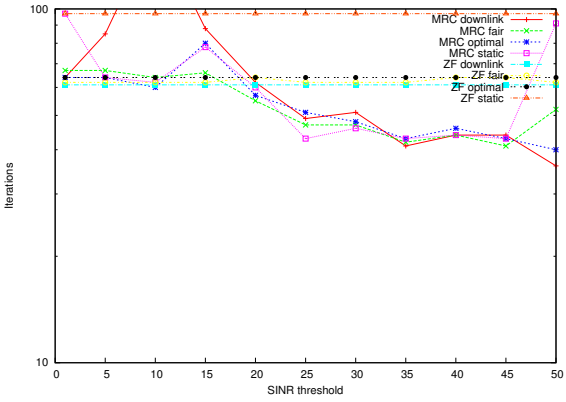

Figure 45: Number of pricing problem iterations

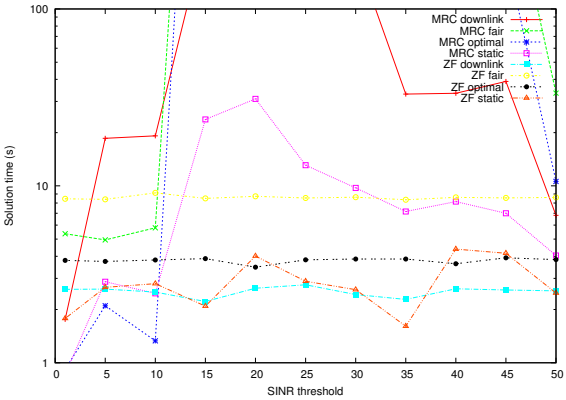

Figure 46: Total solution time

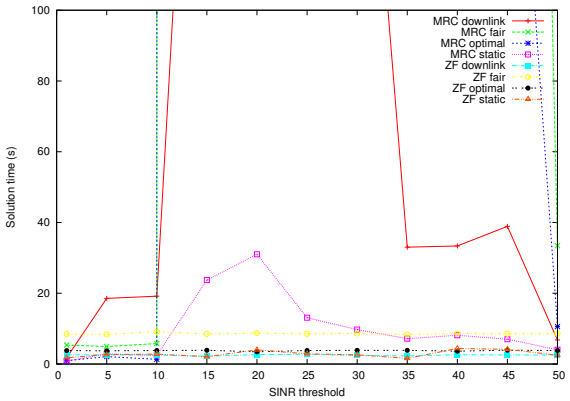

Figure 47: Total solution time, enlarged view

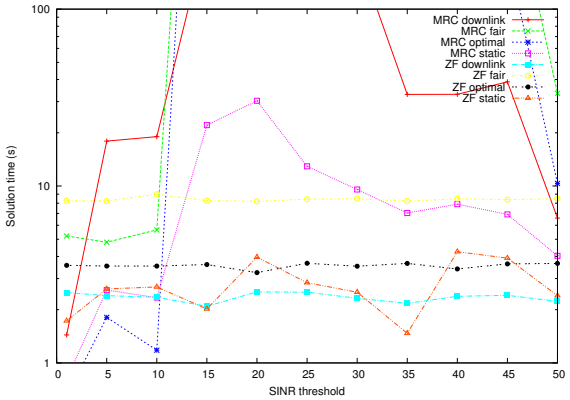

Figure 48: Solution time for pricing problem

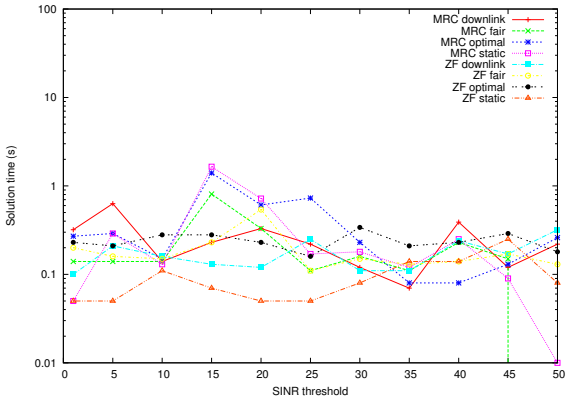

Figure 49: Solution time for master problem

5.3 Scenario 4

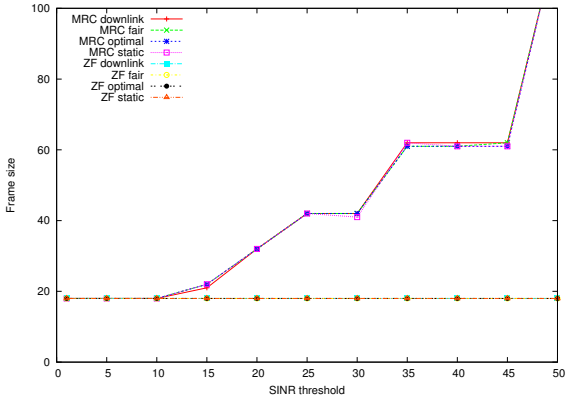

Figure 50: Frame size

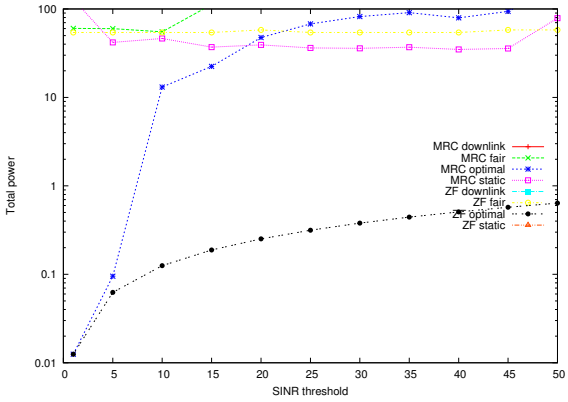

Figure 51: Total power

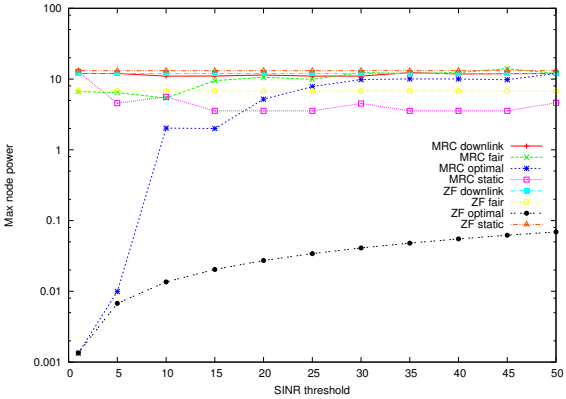

Figure 52: Max node power

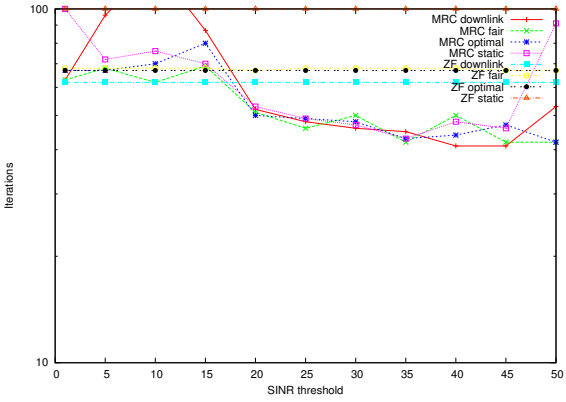

Figure 53: Number of pricing problem iterations

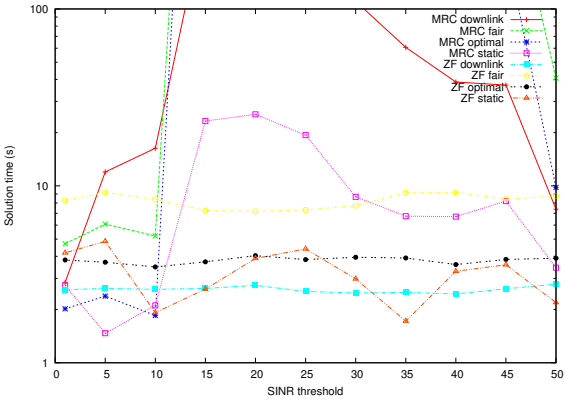

Figure 54: Total solution time

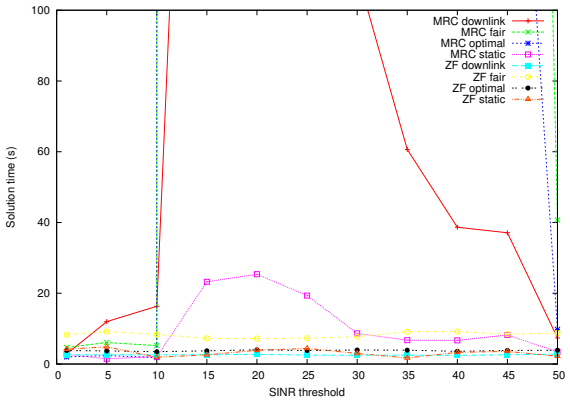

Figure 55: Total solution time, enlarged view

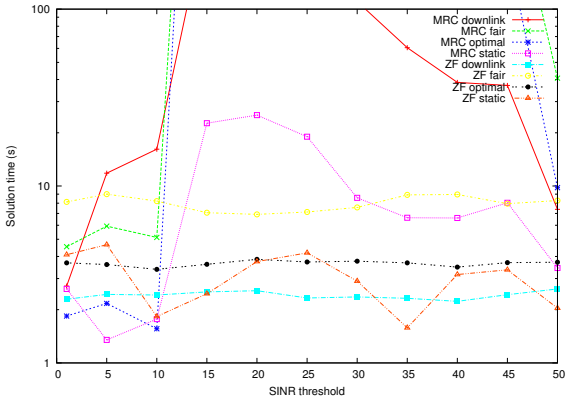

Figure 56: Solution time for pricing problem

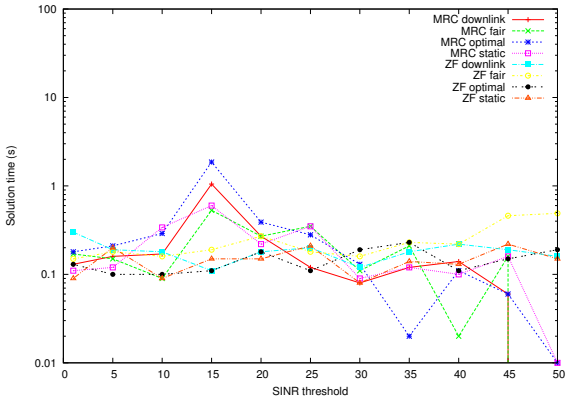

Figure 57: Solution time for master problem

5.4 Scenario 5

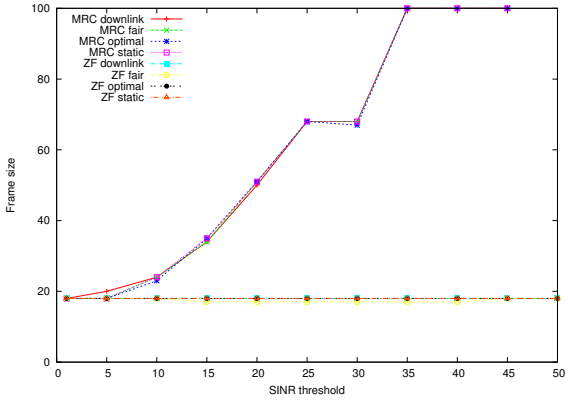

Figure 58: Frame size

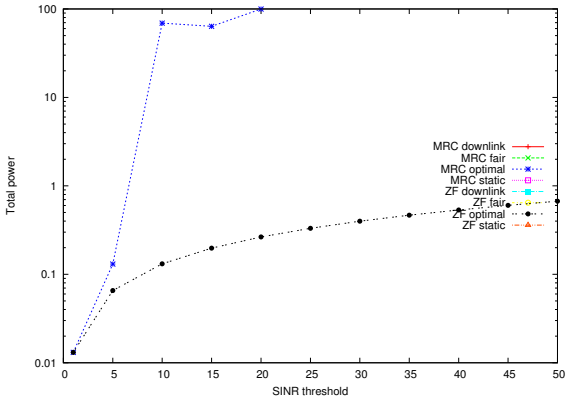

Figure 59: Total power

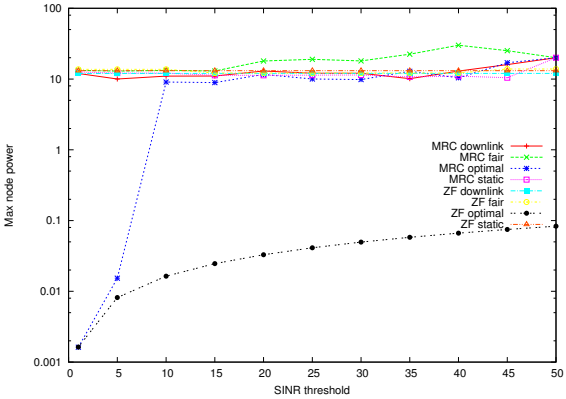

Figure 60: Max node power

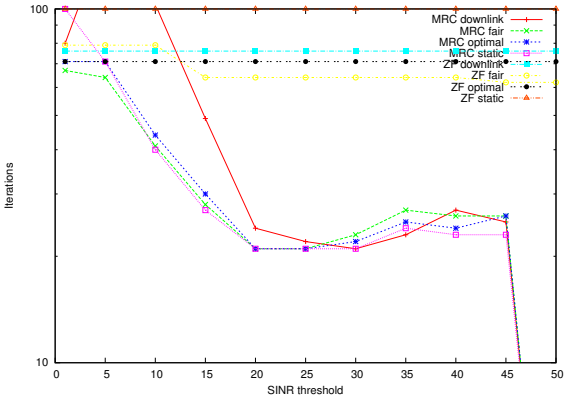

Figure 61: Number of pricing problem iterations

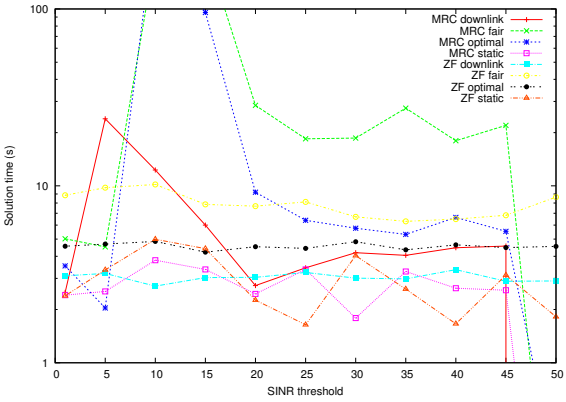

Figure 62: Total solution time

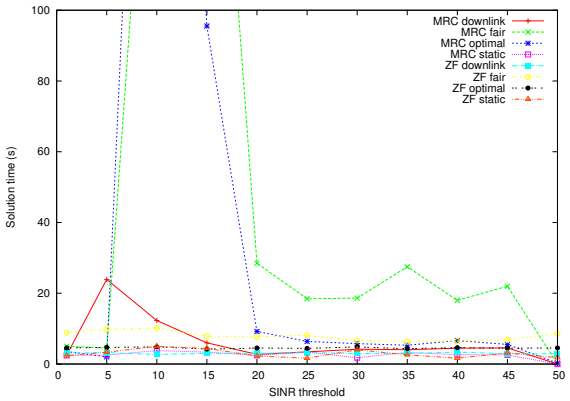

Figure 63: Total solution time, enlarged view

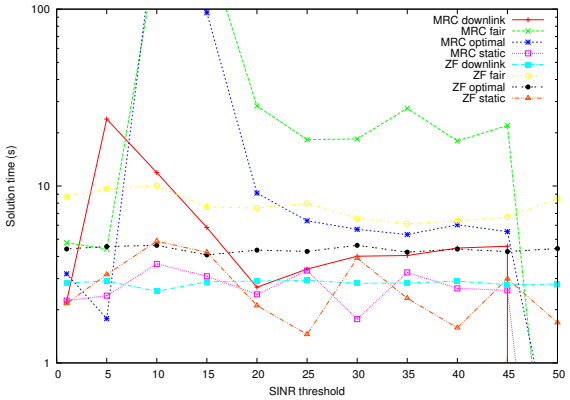

Figure 64: Solution time for pricing problem

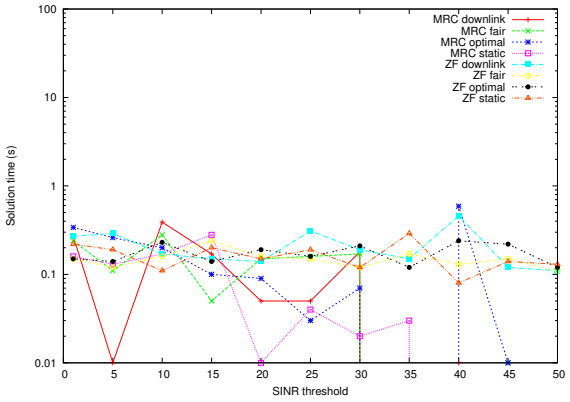

Figure 65: Solution time for master problem

5.5 Scenario 6

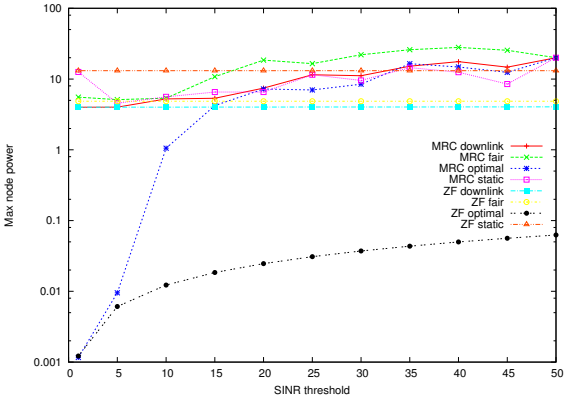

Figure 68: Max node power

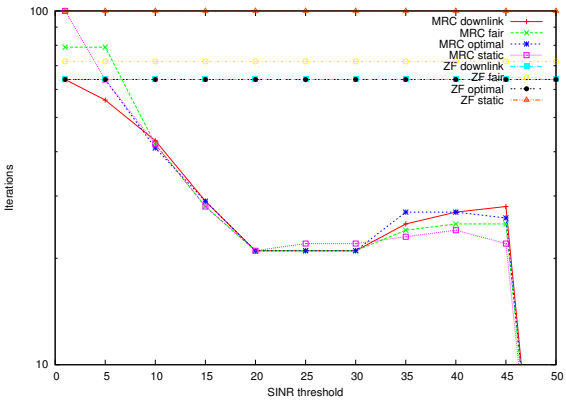

Figure 69: Number of pricing problem iterations

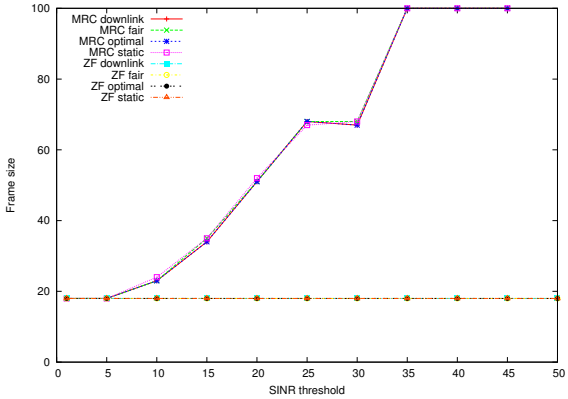

Figure 66: Frame size

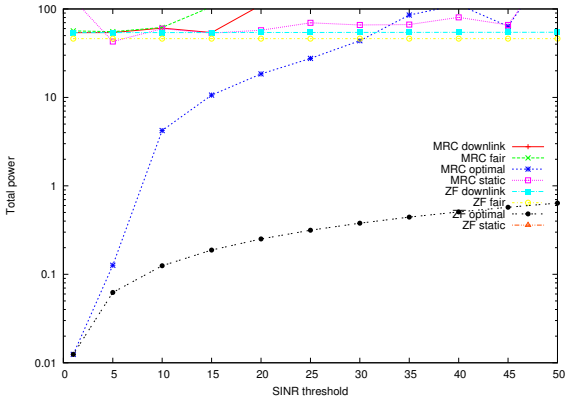

Figure 67: Total power

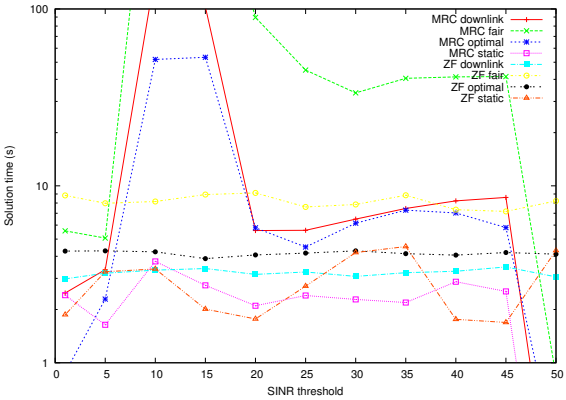

Figure 70: Total solution time

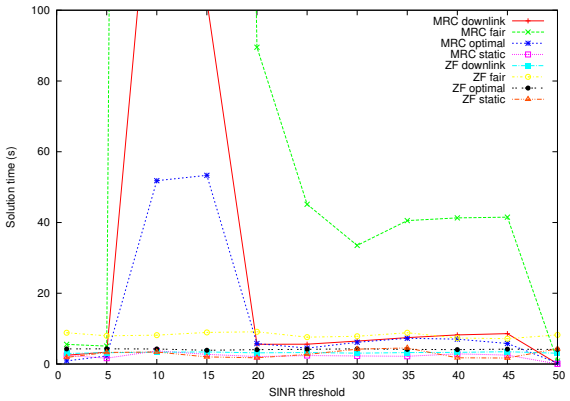

Figure 71: Total solution time, enlarged view

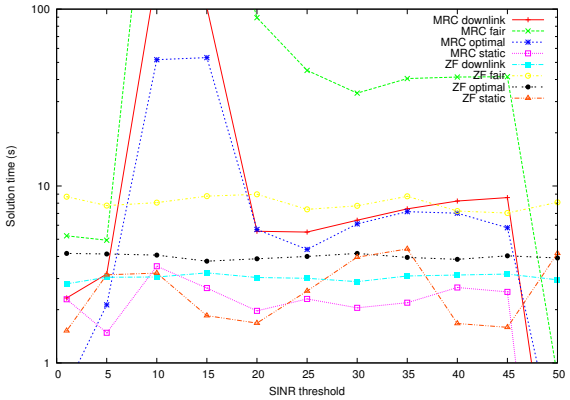

Figure 72: Solution time for pricing problem

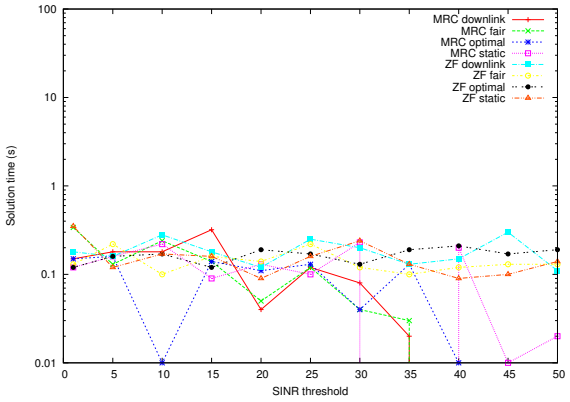

Figure 73: Solution time for master problem

6 Experiment 5

6.1 Scenario 2

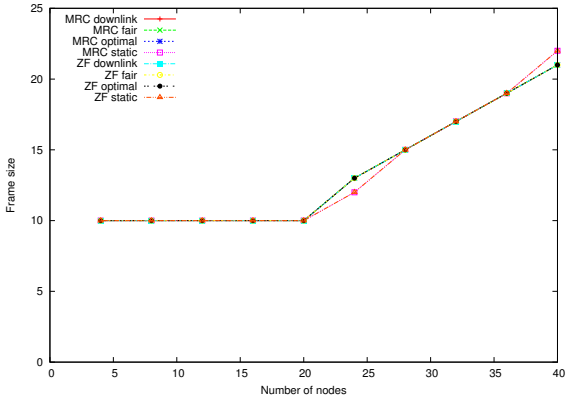

Figure 74: Frame size

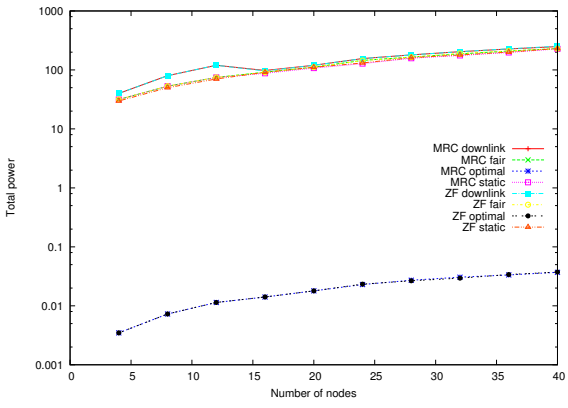

Figure 75: Total power

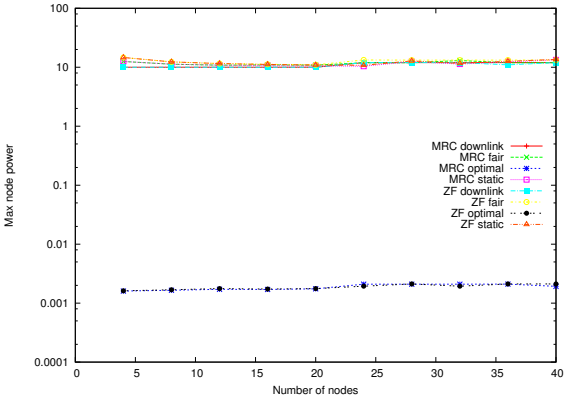

Figure 76: Max node power

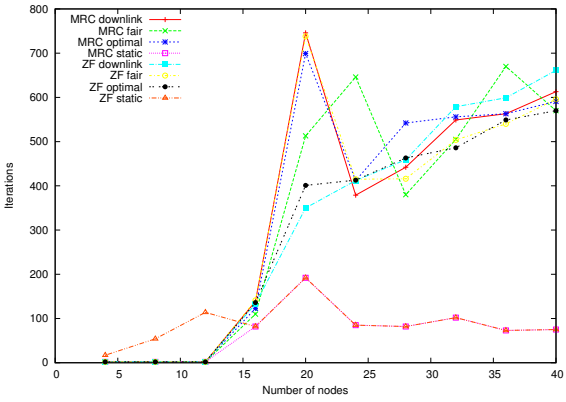

Figure 77: Number of pricing problem iterations

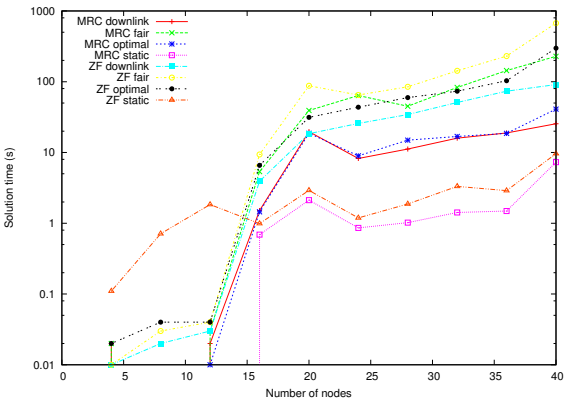

Figure 78: Total solution time

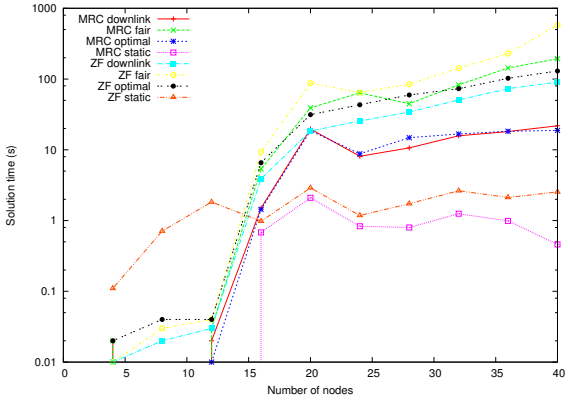

Figure 79: Solution time for pricing problem

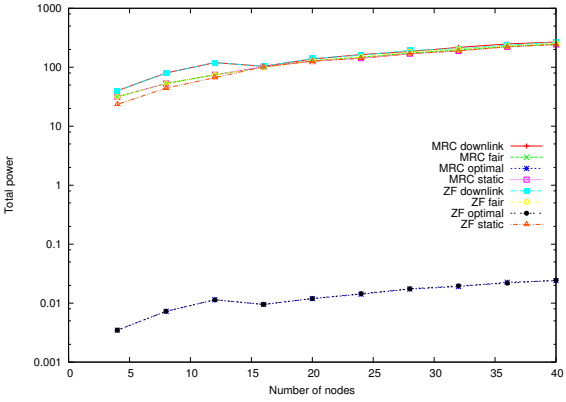

Figure 82: Total power

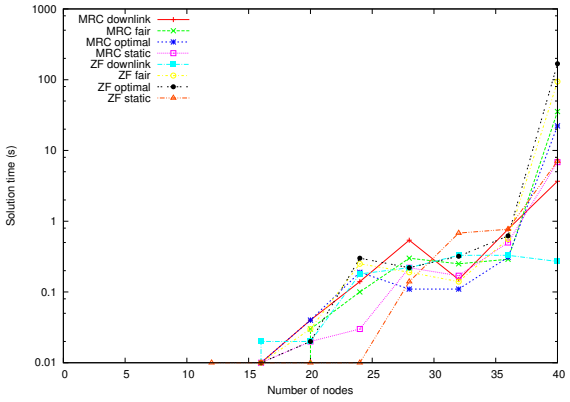

Figure 80: Solution time for master problem

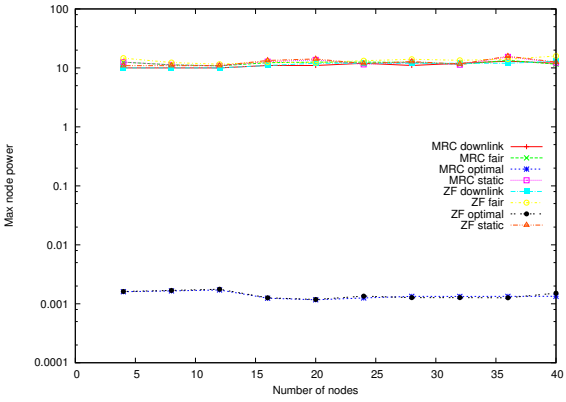

Figure 83: Max node power

6.2 Scenario 3

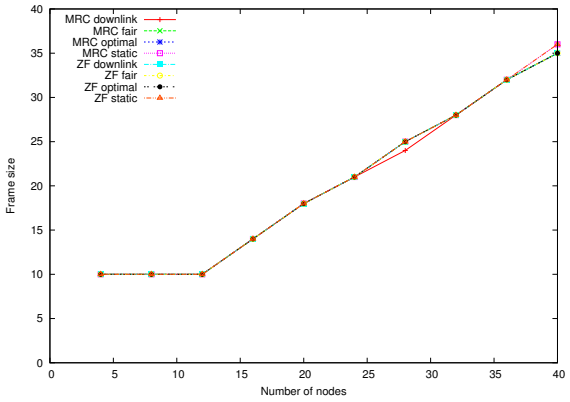

Figure 81: Frame size

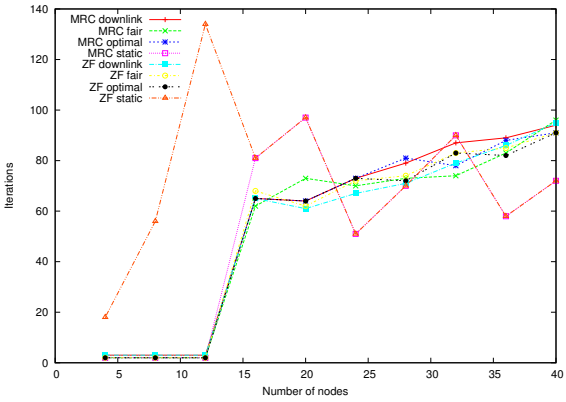

Figure 84: Number of pricing problem iterations

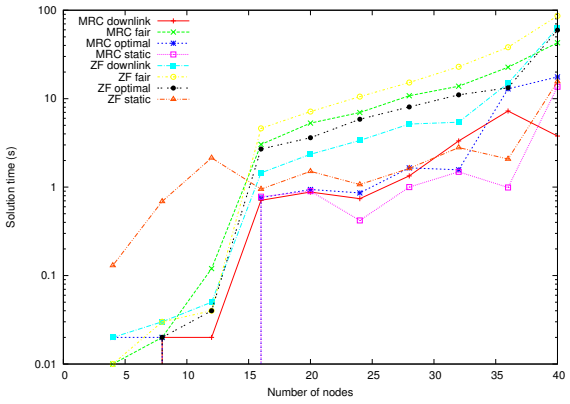

Figure 85: Total solution time

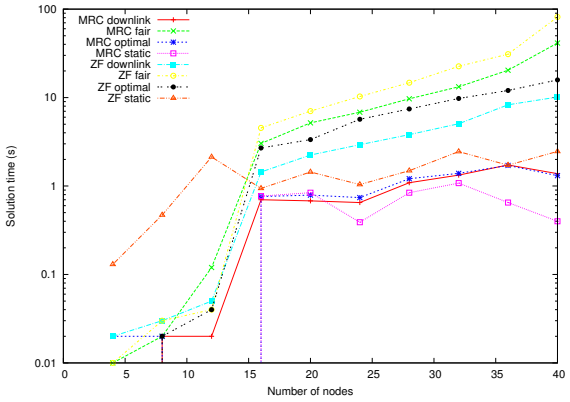

Figure 86: Solution time for pricing problem

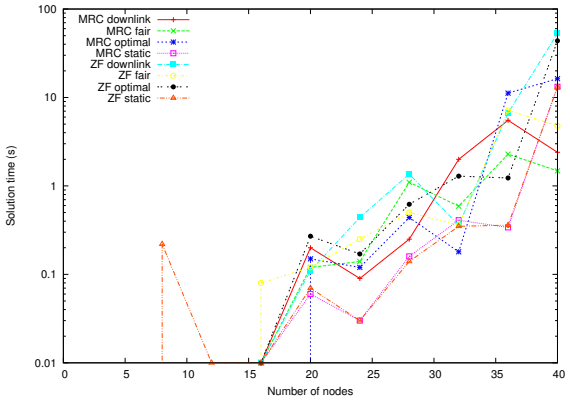

Figure 87: Solution time for master problem

6.3 Scenario 4

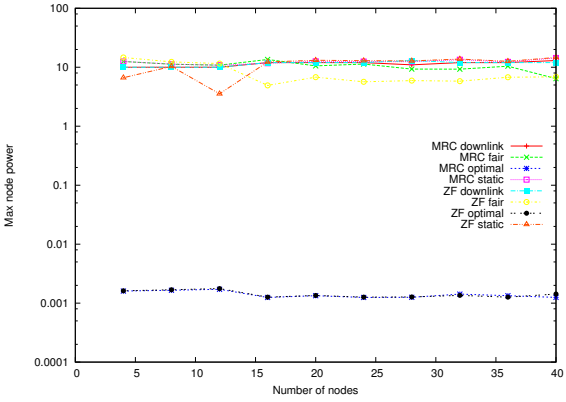

Figure 90: Max node power

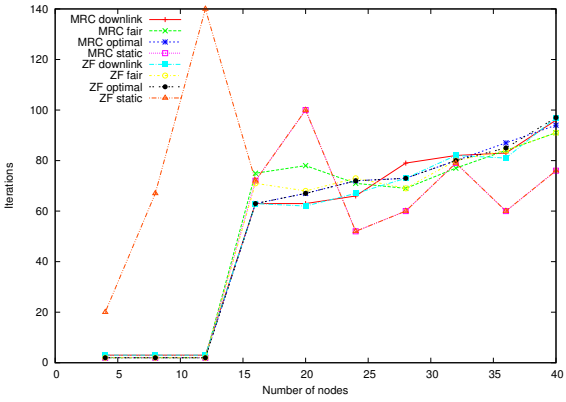

Figure 91: Number of pricing problem iterations

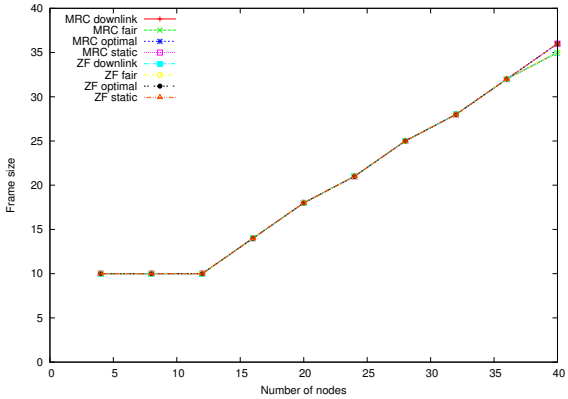

Figure 88: Frame size

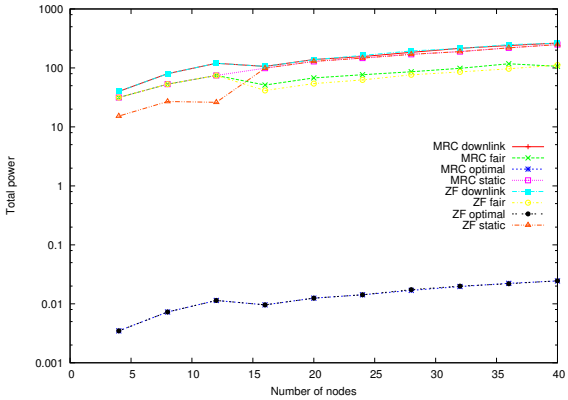

Figure 89: Total power

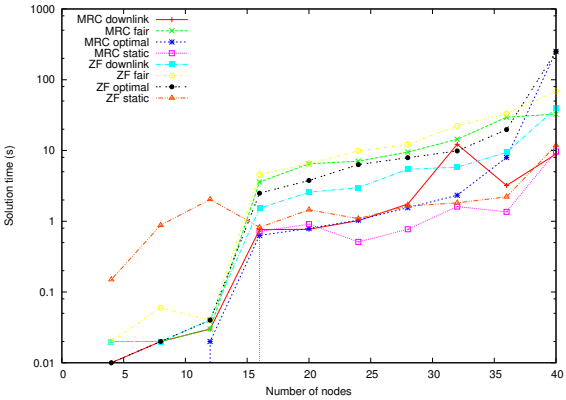

Figure 92: Total solution time

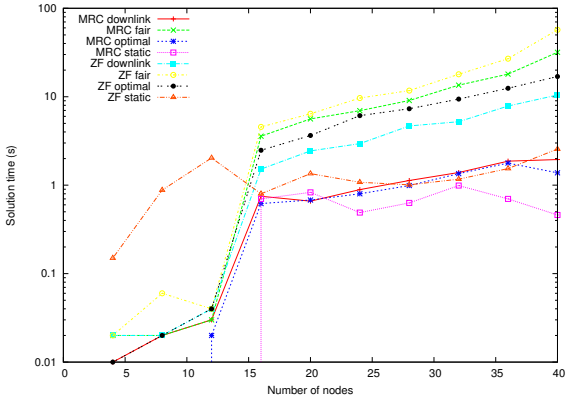

Figure 93: Solution time for pricing problem

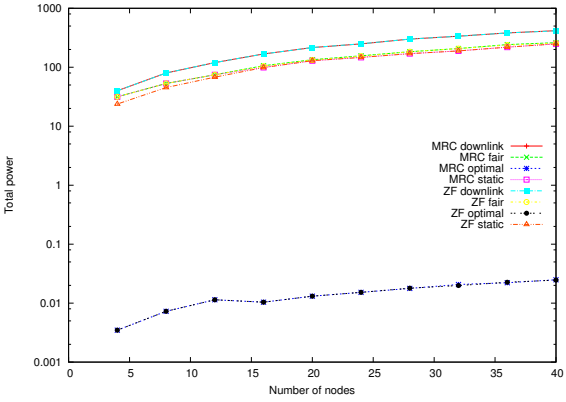

Figure 96: Total power

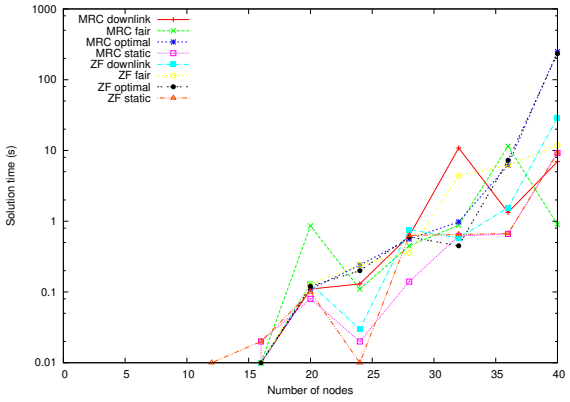

Figure 94: Solution time for master problem

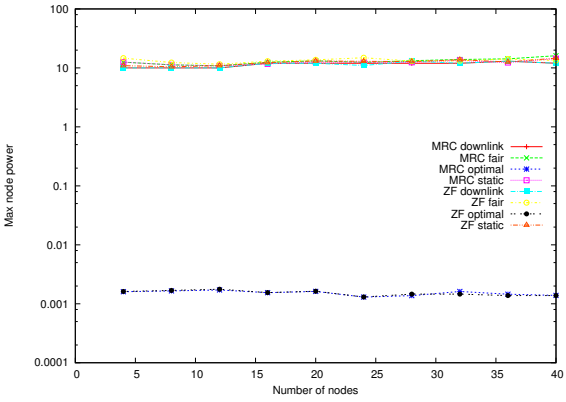

Figure 97: Max node power

6.4 Scenario 5

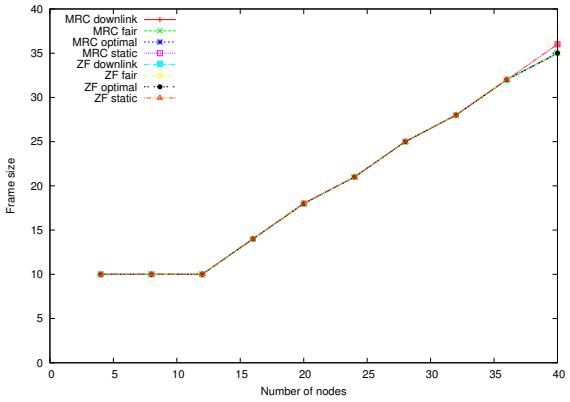

Figure 95: Frame size

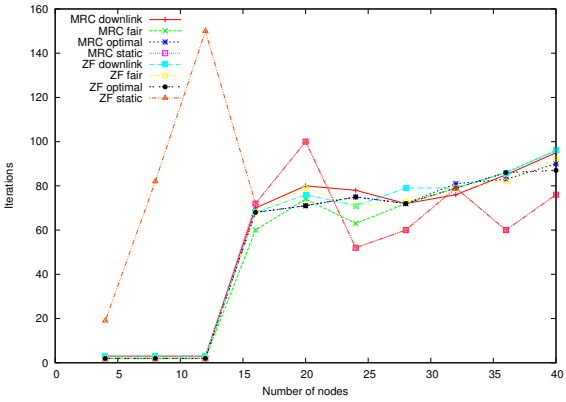

Figure 98: Number of pricing problem iterations

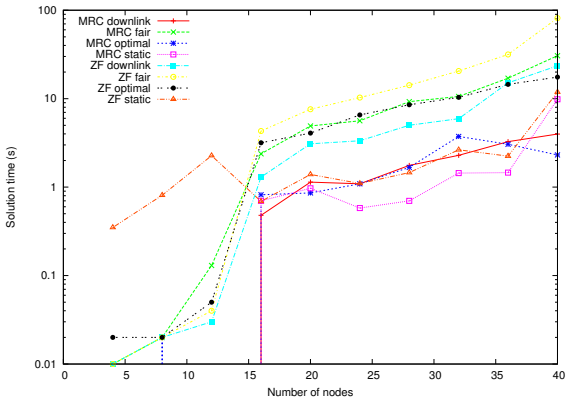

Figure 99: Total solution time

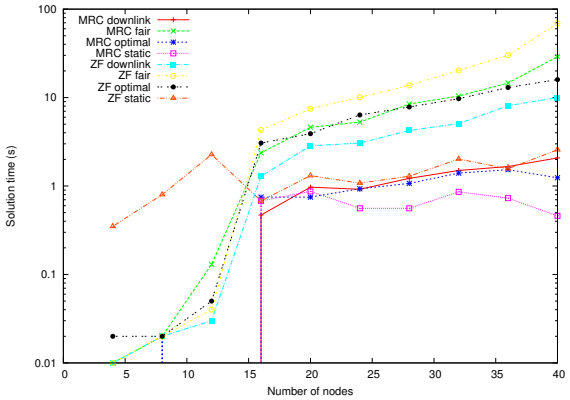

Figure 100: Solution time for pricing problem

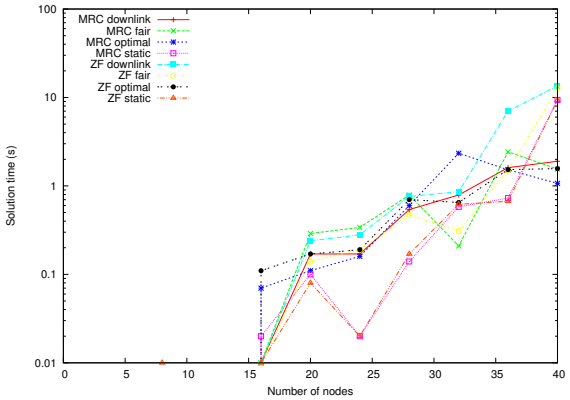

Figure 101: Solution time for master problem

6.5 Scenario 6

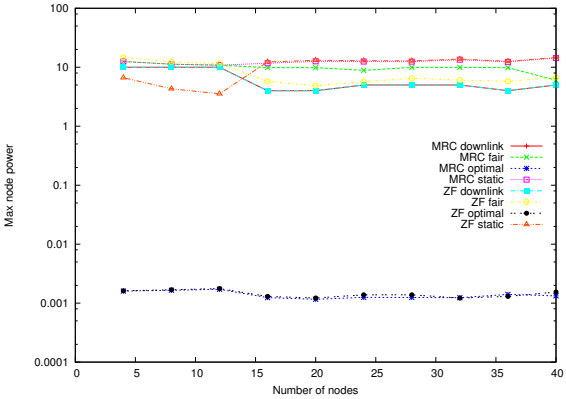

Figure 104: Max node power

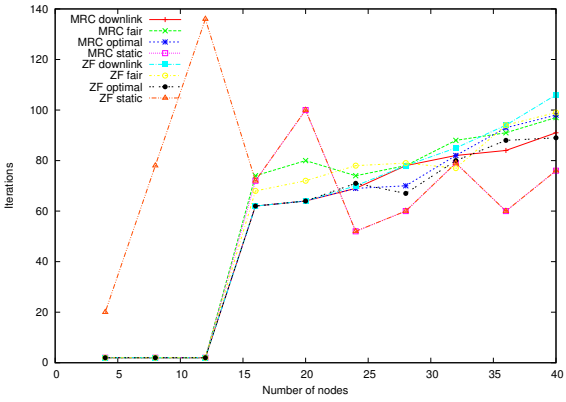

Figure 105: Number of pricing problem iterations

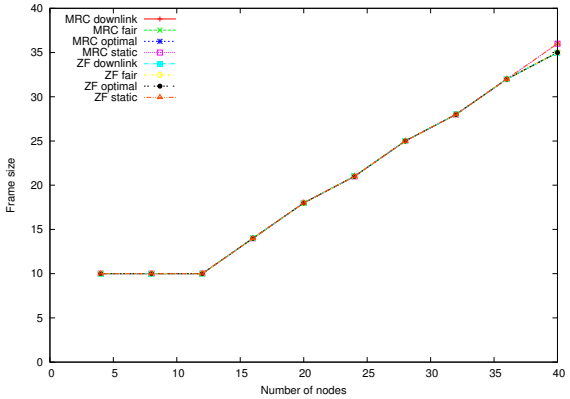

Figure 102: Frame size

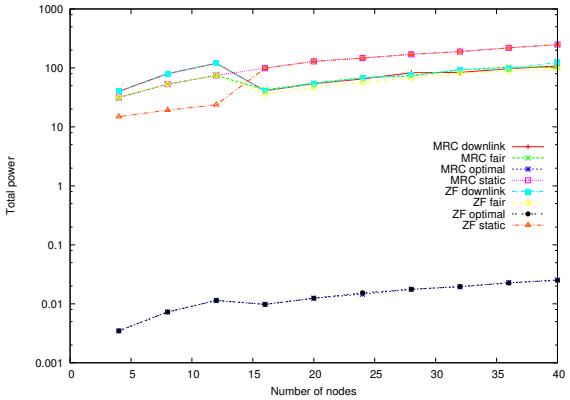

Figure 103: Total power

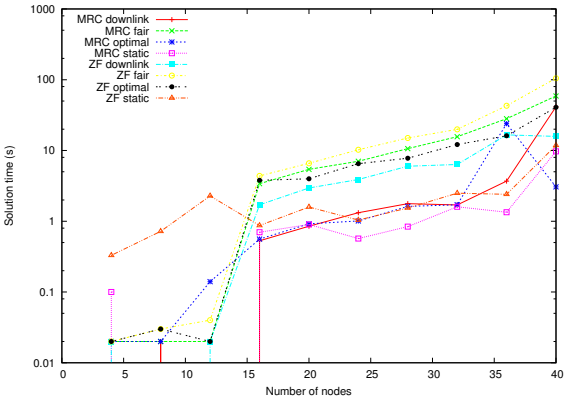

Figure 106: Total solution time

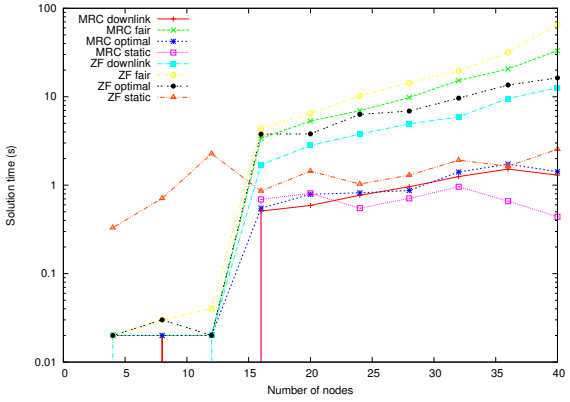

Figure 107: Solution time for pricing problem

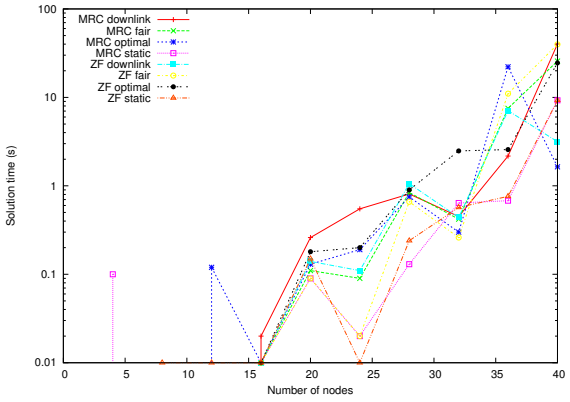

Figure 108: Solution time for master problem

7 Experiment 6

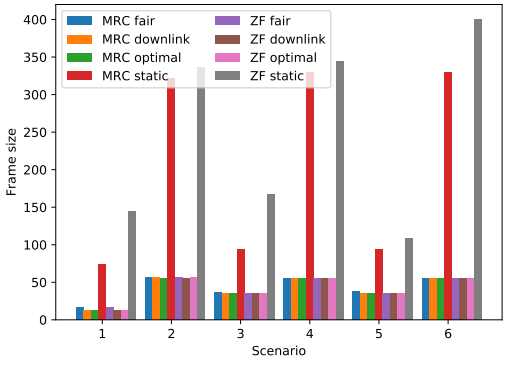

Figure 109: Frame size

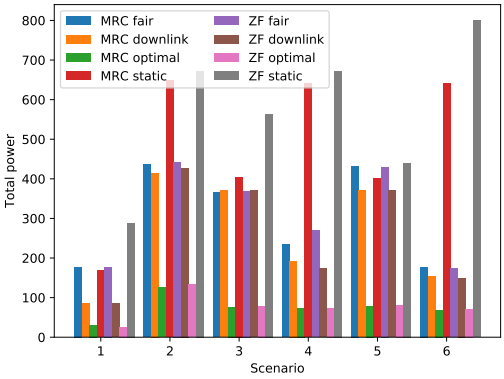

Figure 110: Total power

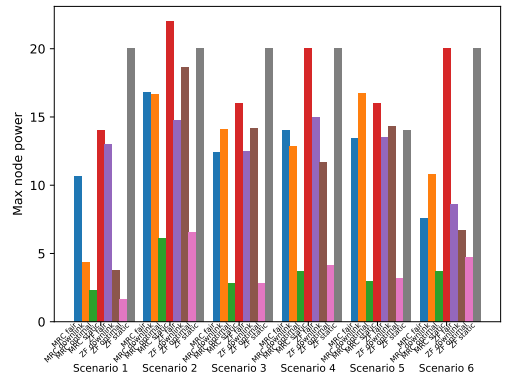

Figure 111: Max node power

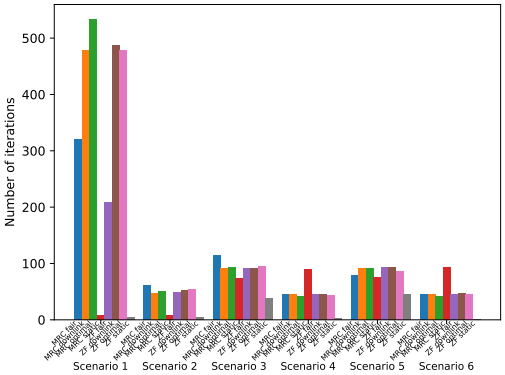

Figure 112: Number of pricing problem iterations

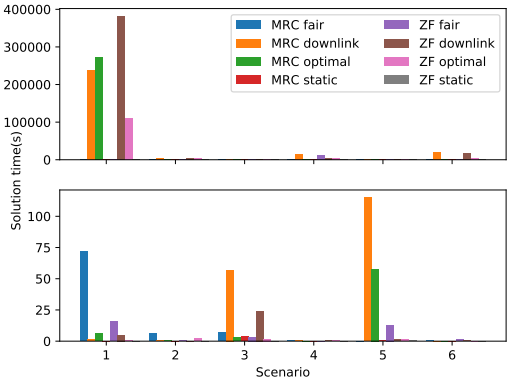

Figure 113: Solution time for the pricing problem (top) and main problem (bottom)

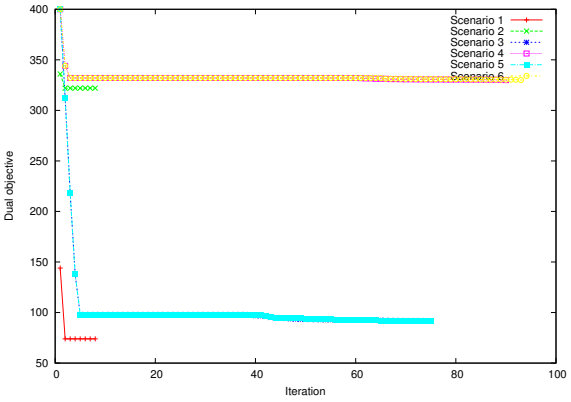

Figure 116: Iteration number vs. dual objective for MRC with static power control

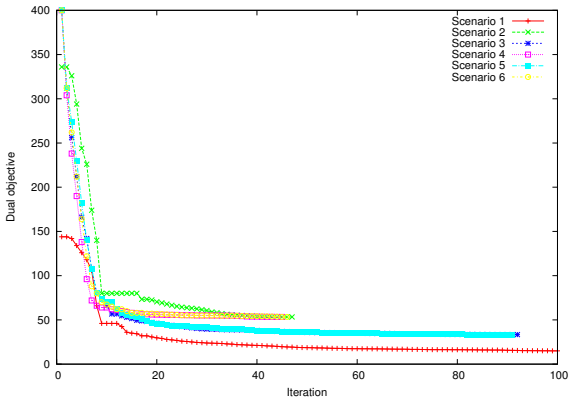

Figure 114: Iteration number vs. dual objective for MRC with fair power control

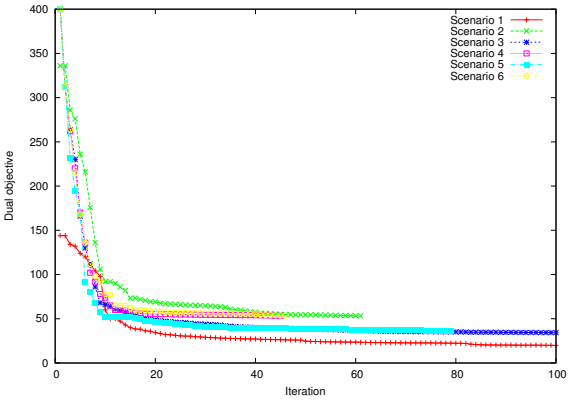

Figure 117: Iteration number vs. dual objective for MRC with downlink power control

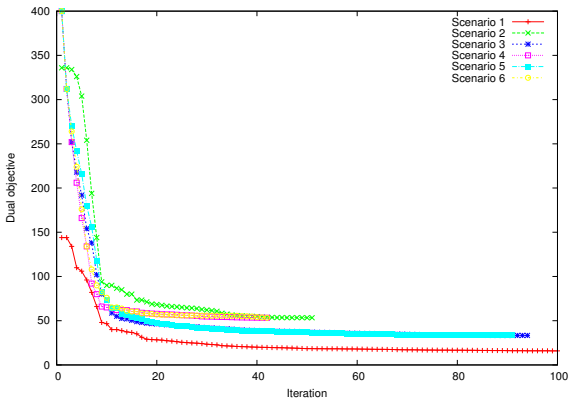

Figure 115: Iteration number vs. dual objective for MRC with optimal power control

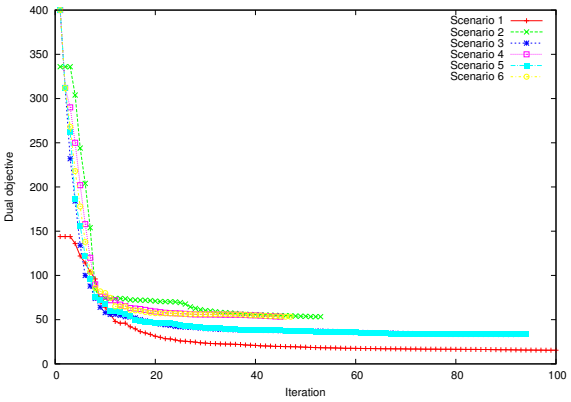

Figure 118: Iteration number vs. dual objective for ZF with fair power control

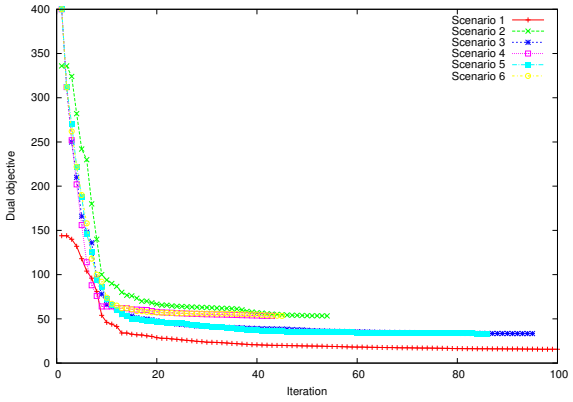

Figure 119: Iteration number vs. dual objective for ZF with optimal power control

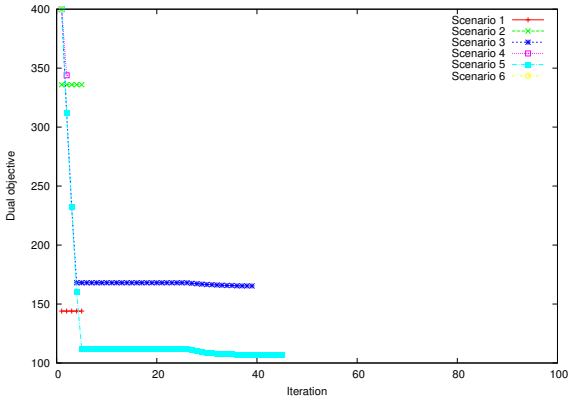

Figure 120: Iteration number vs. dual objective for ZF with static power control

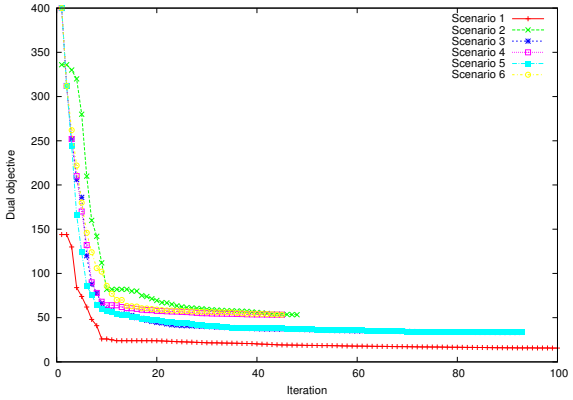

Figure 121: Iteration number vs. dual objective for ZF with downlink power control