Updated 4Tx Pilot Patterns for IEEE 802.16m

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Samsung Electronics

Venue:

Re : TGm Call for Contributions and Comments 802.16m-08/003r6 for Session 59

Base Contribution:

IEEE C802.16m-08/0006

Purpose:

To discuss and adopt the proposed text in the revision of the 802.16m SDD

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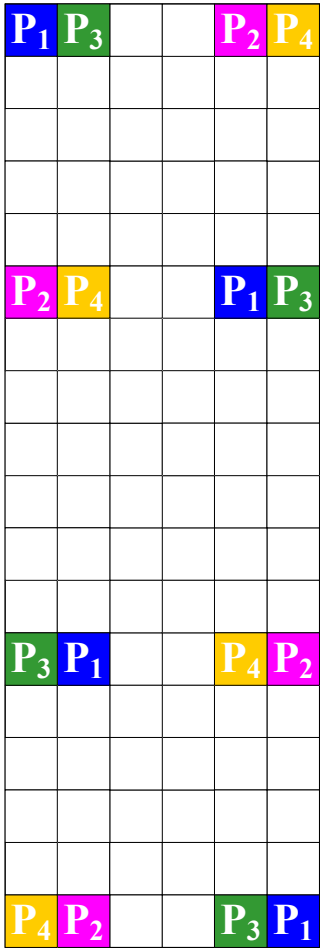
Background

- 4Tx pilot pattern has been adopted in the latest SDD
  - Page 80, section 11.5.3, IEEE 802.16m-08/003r6
- 8Tx pilot pattern is being proposed in IEEE C802.16m-08/0007

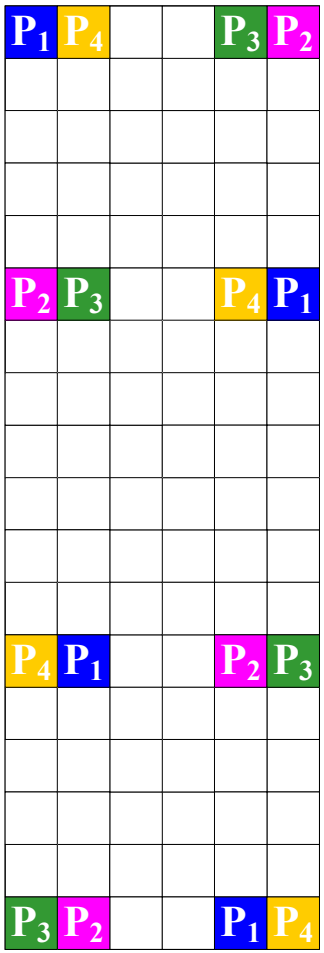
Current 4Tx Pilot Pattern

- Channel estimation performance for {P_1, P_4} is different from that of {P_2, P_3}
- Two sets of MMSE or interpolation weights are required
  - One for {P_1, P_4}, the other for {P_2, P_3}



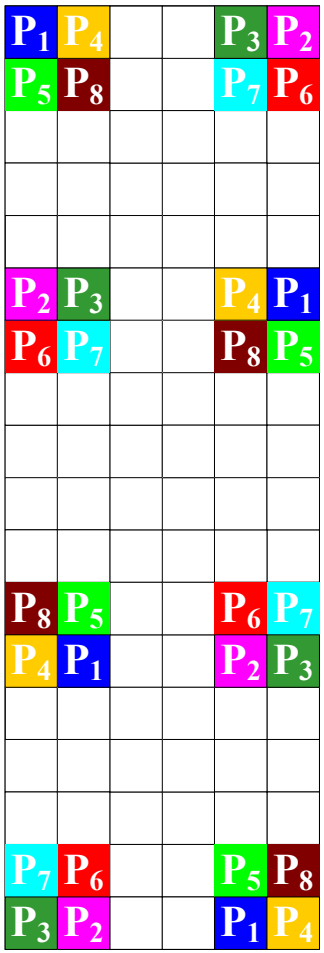
Updated 4Tx Pilot Pattern

- All 4 pilot streams have mirrored pilot patterns
- Occupy the same set of subcarriers as the original 4Tx pilot pattern
- One sets of MMSE or interpolation weights for all 4 pilots
- Significant complexity reduction



8Tx Pilot Pattern

- 8 pilot streams
  - Overhead: 4/108 = 3.7% each
  - Total overhead 32/108 = 29.63%
- Mirrored pilot patterns
  - Reuse the 4Tx pilot patterns for P_1, P_2, P_3, P_4 (See previous page for updated 4Tx pilot pattern)
  - Pilot patterns for P_1, P_2, P_3, P_4 mirror in time or frequency
  - Pilot patterns for P_5, P_6, P_7, P_8 mirror in time or frequency
  - Low complexity implementation of channel estimation
  - Easy to adapt for 5-symbol subframes (by removing the 3rd or 4th symbol in the pilot pattern for 6-symbol subframes)



Simulation Assumptions

- 4Tx Pilot Pattern
  - Current vs. Updated
  - Rank-1 precoder cycling
  - Channel models:
    - Ped A 3kmph, Ped B 3kmph, Veh A 30kmph, Veh A 120kmph
  - MCS
    - QPSK 1/2, QPSK 1/3, 16QAM 1/2, 16QAM 1/3, 64QAM 1/2, 64QAM 1/3
  - 3 contiguous PRUs
  - 2D MMSE channel estimator per PRU

- Metric:
  - BLER
  - MSE

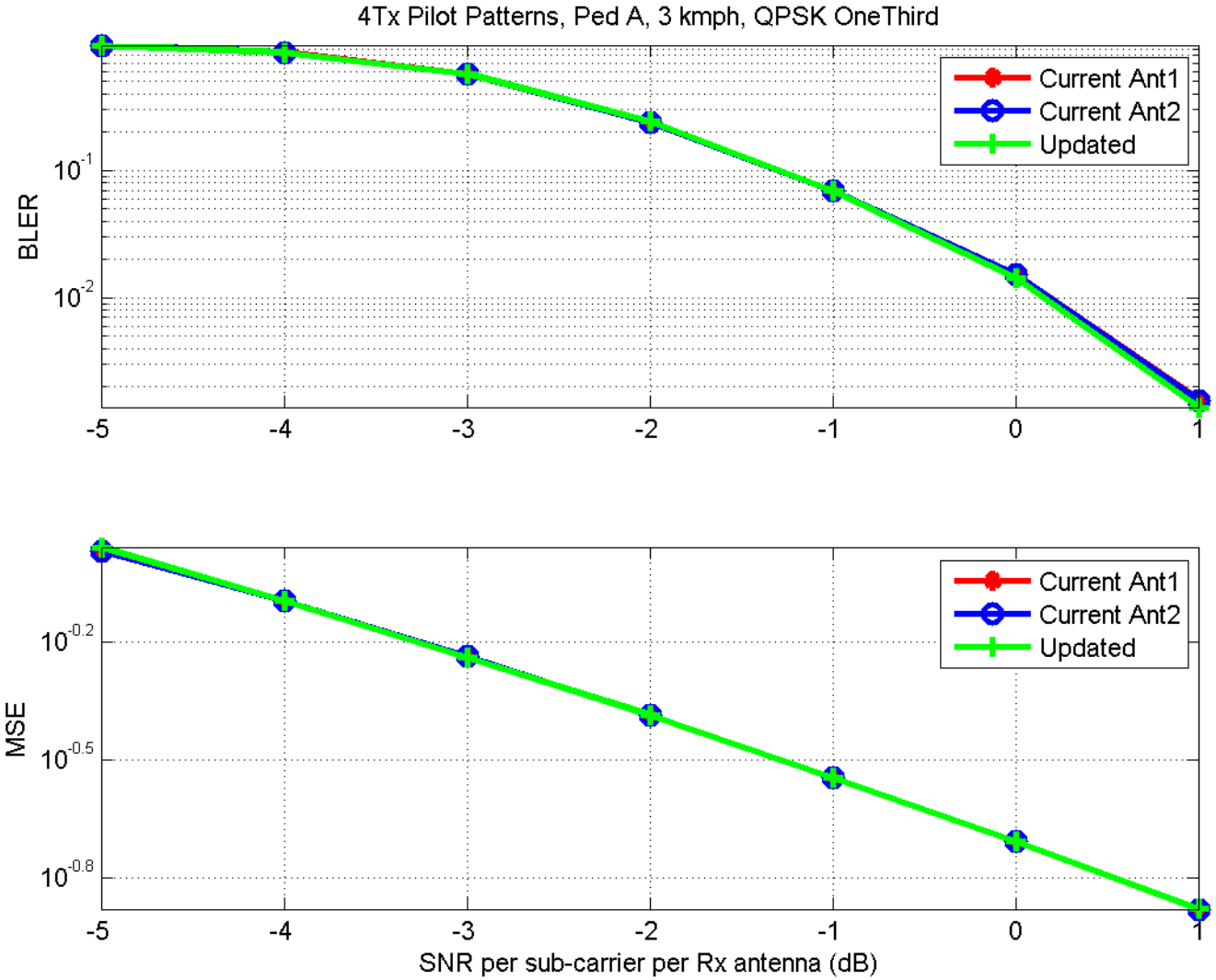
Summary

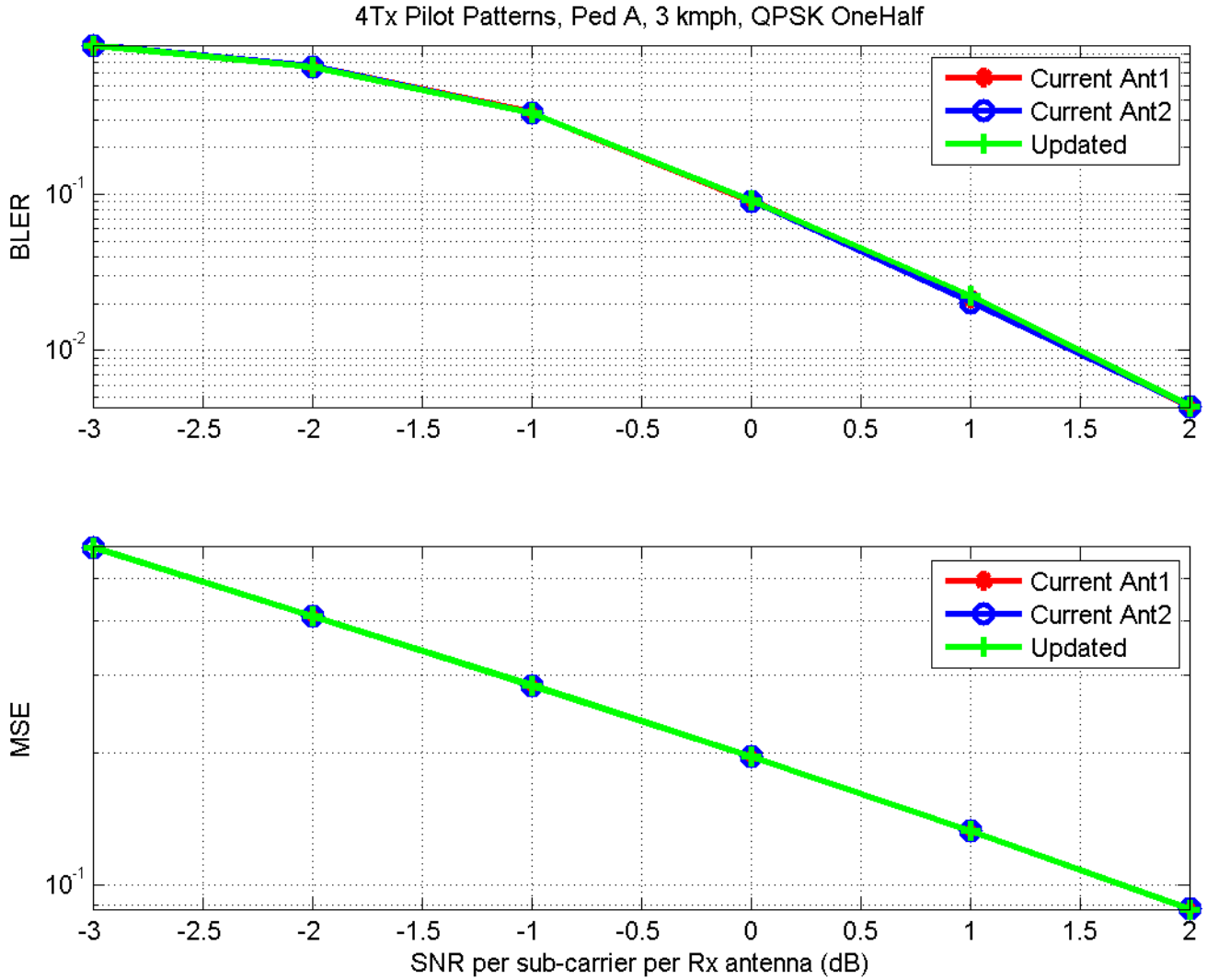
- Updated 4Tx pilot pattern achieves the same or slightly better performance than the current 4Tx pilot pattern
- All pilot streams achieve the same performance with the updated pilot pattern
- Updated 4Tx pilot pattern allows lower implementation complexity than current 4Tx pilot pattern

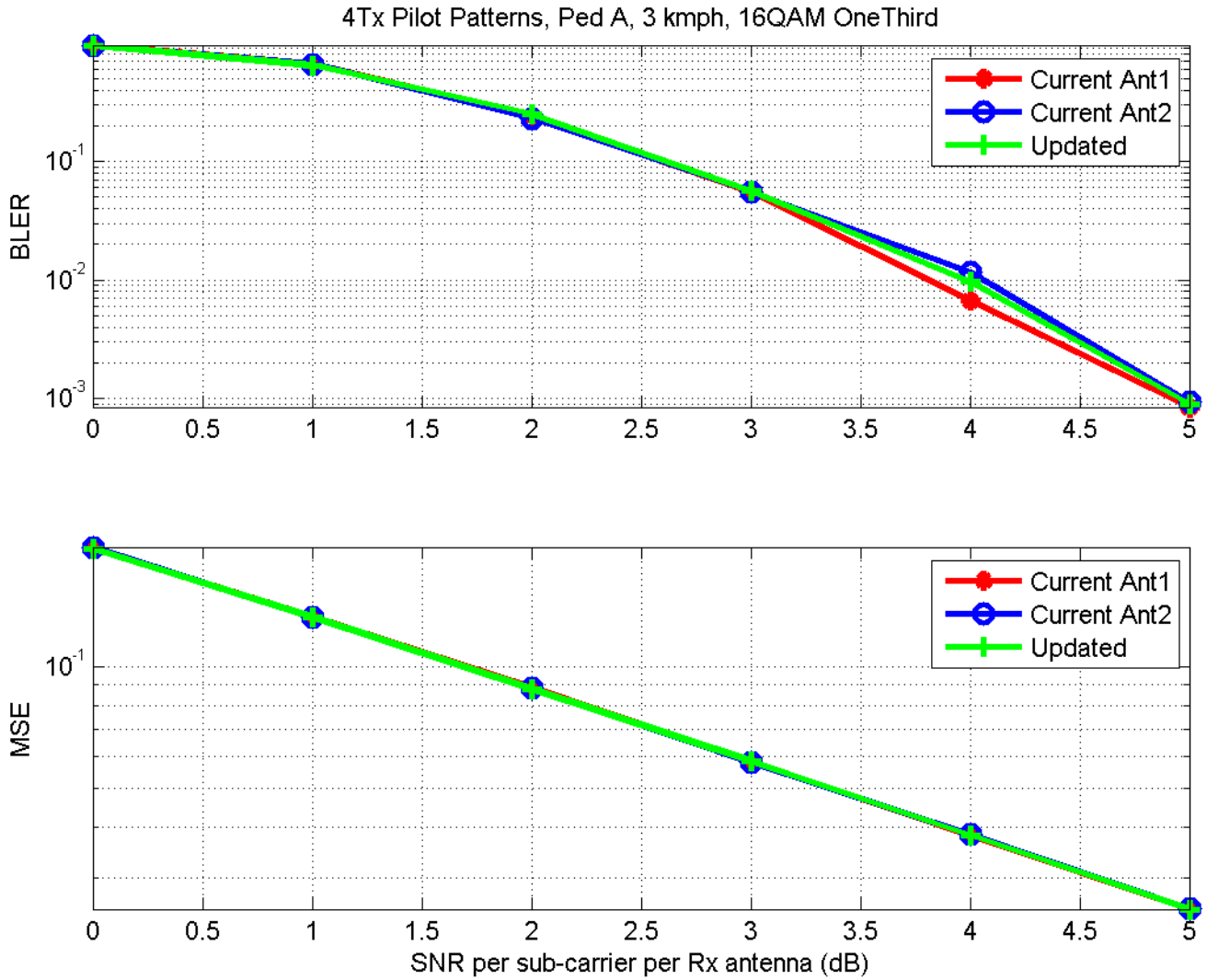
Recommended SDD text change

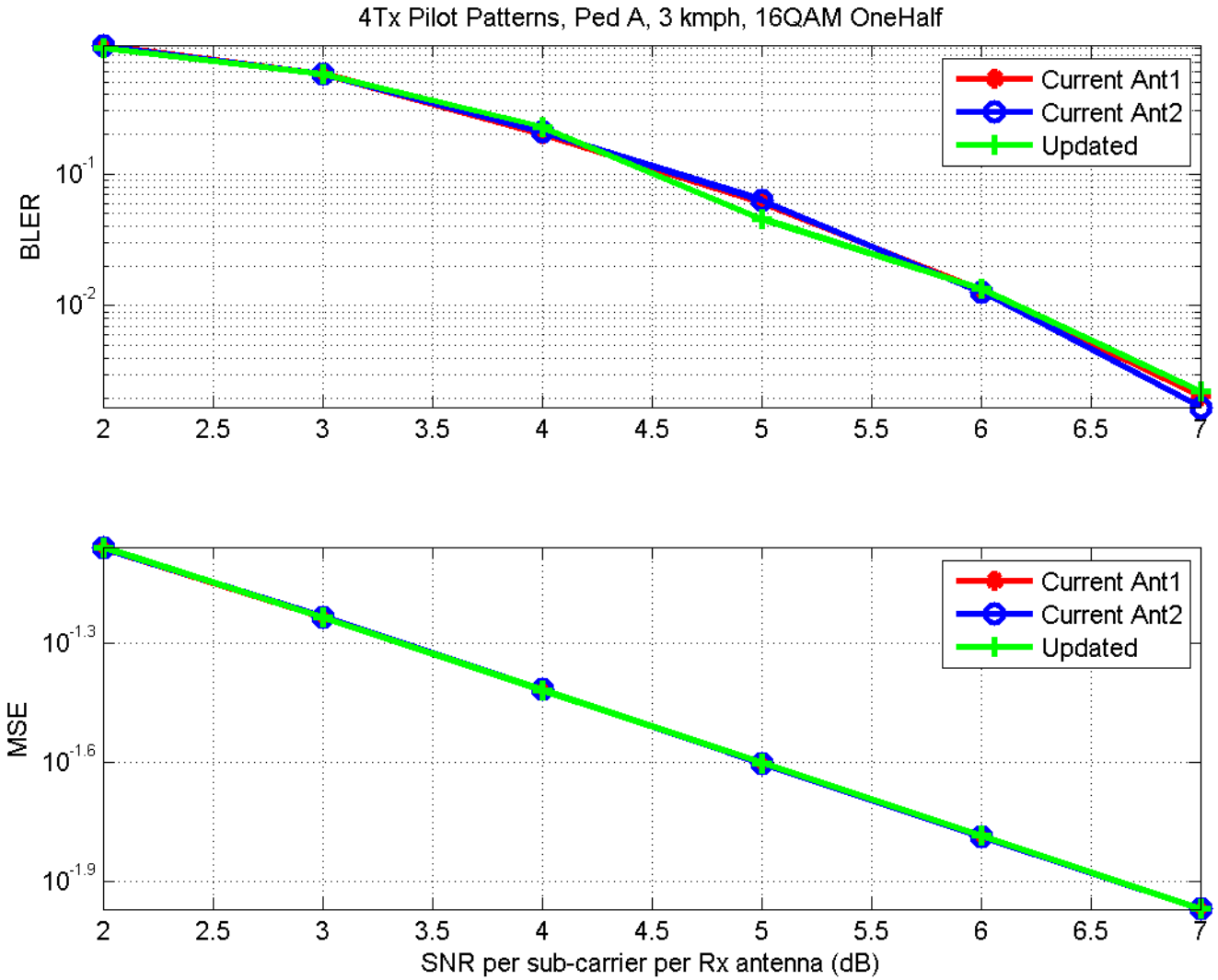
- Section 11.5.3, page 80, line 1
  - Replace figure 42 by the figure in page 4 of contribution C802.16m-08_0006

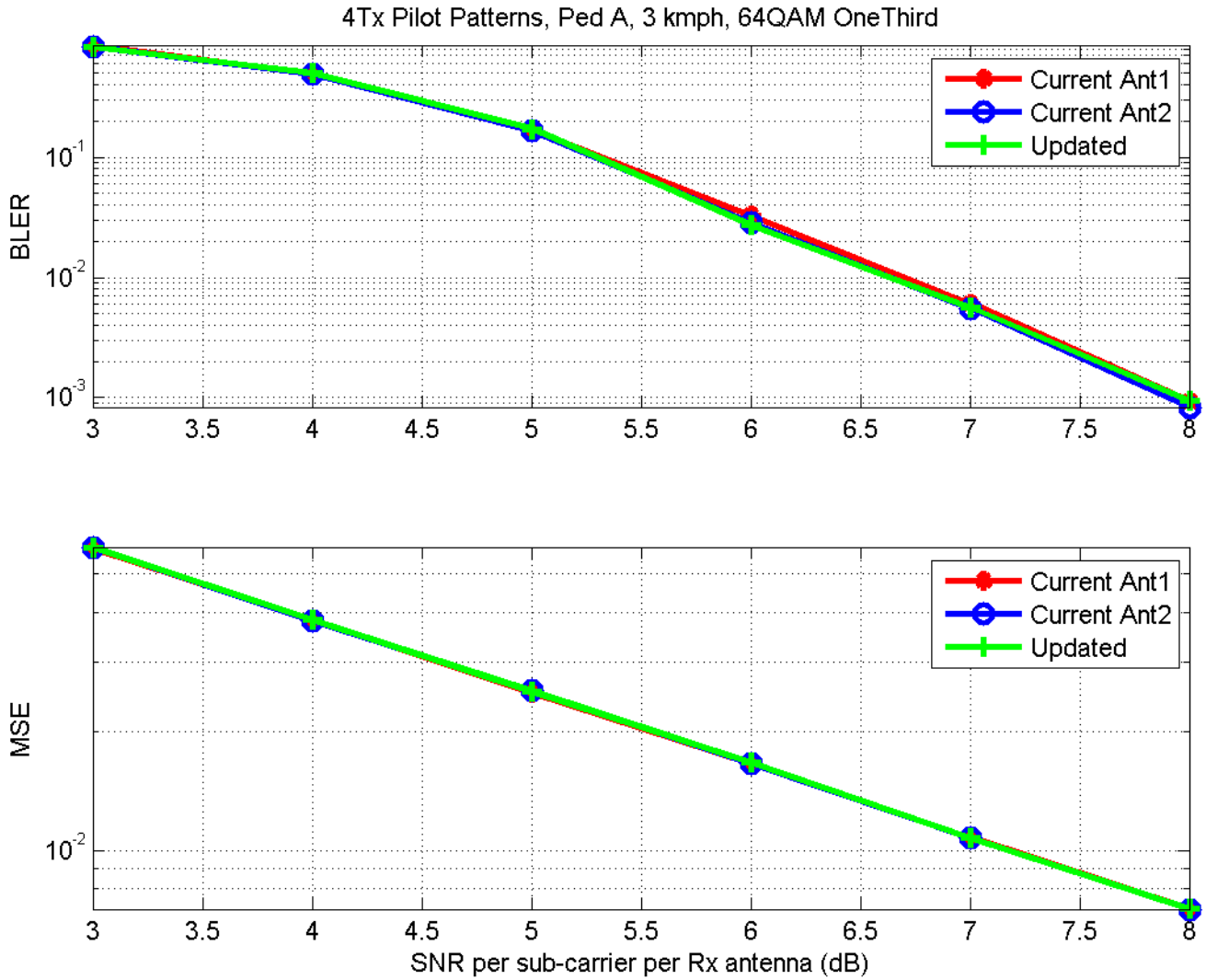
SIMULATION RESULTS – 4TX PILOT PATTERNS

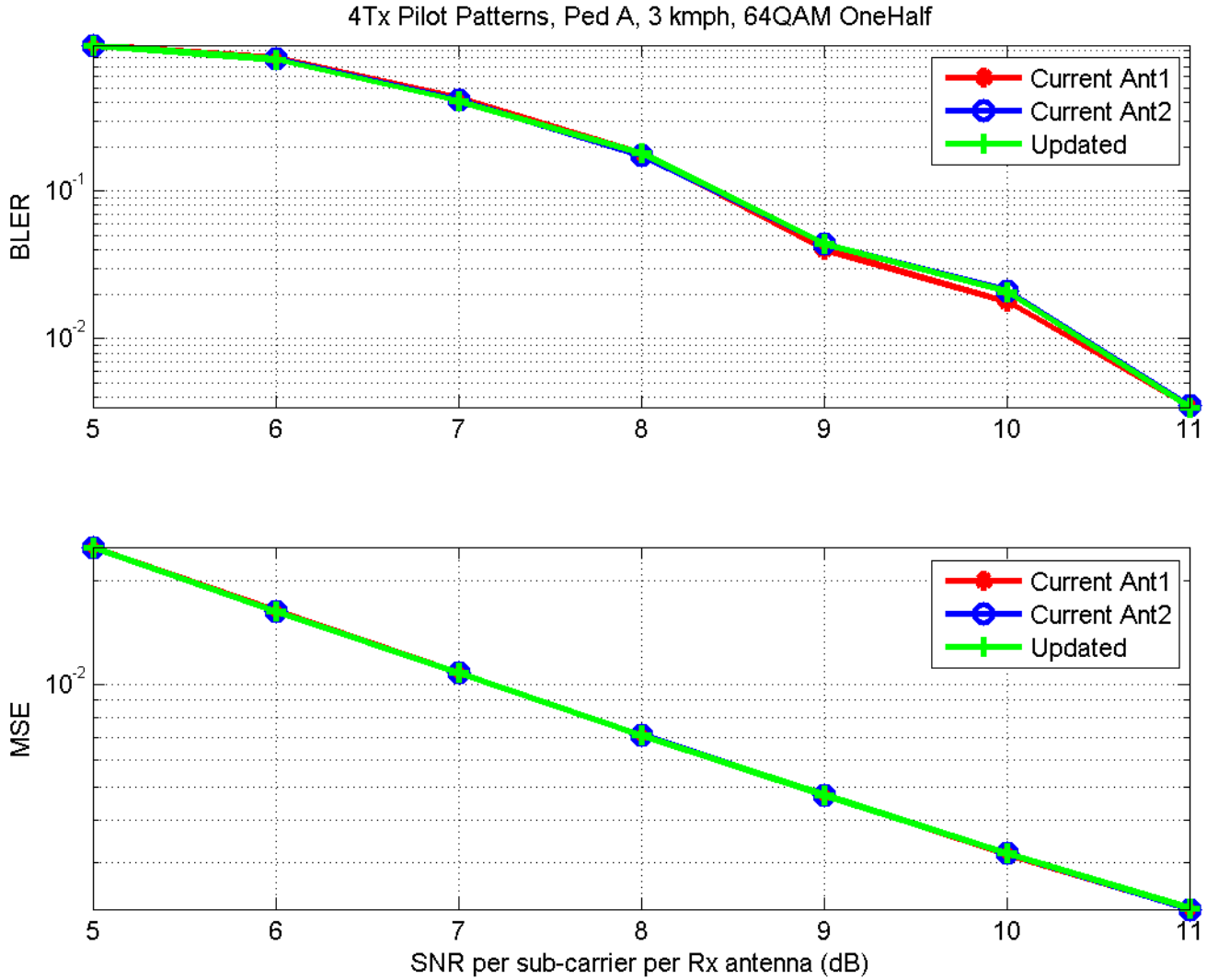

4Tx Pilot Patterns, Ped A, 3 kmph, QPSK OneThird
BLER
10^{-1}
10^{-2}
-5
-4
-3
-2
-1
0
1
Current Ant1
Current Ant2
Updated
MSE
$10^{-0.2}$
$10^{-0.5}$
$10^{-0.8}$
-5
-4
-3
-2
-1
0
1
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)

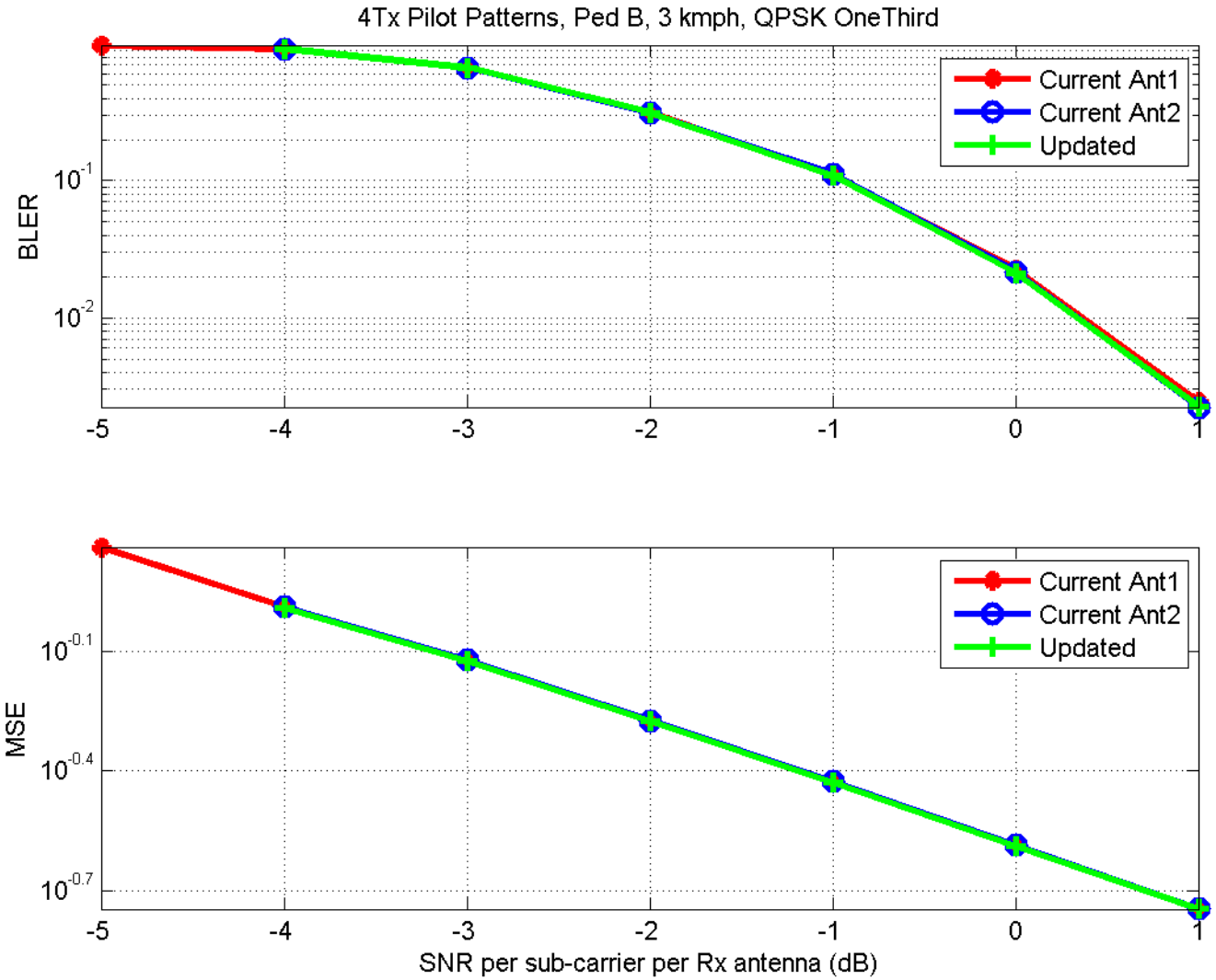

4Tx Pilot Patterns, Ped A, 3 kmph, QPSK OneHalf
BLER
10^{-1}
10^{-2}
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
Current Ant1
Current Ant2
Updated
MSE
10^{-1}
SNR per sub-carrier per Rx antenna (dB)

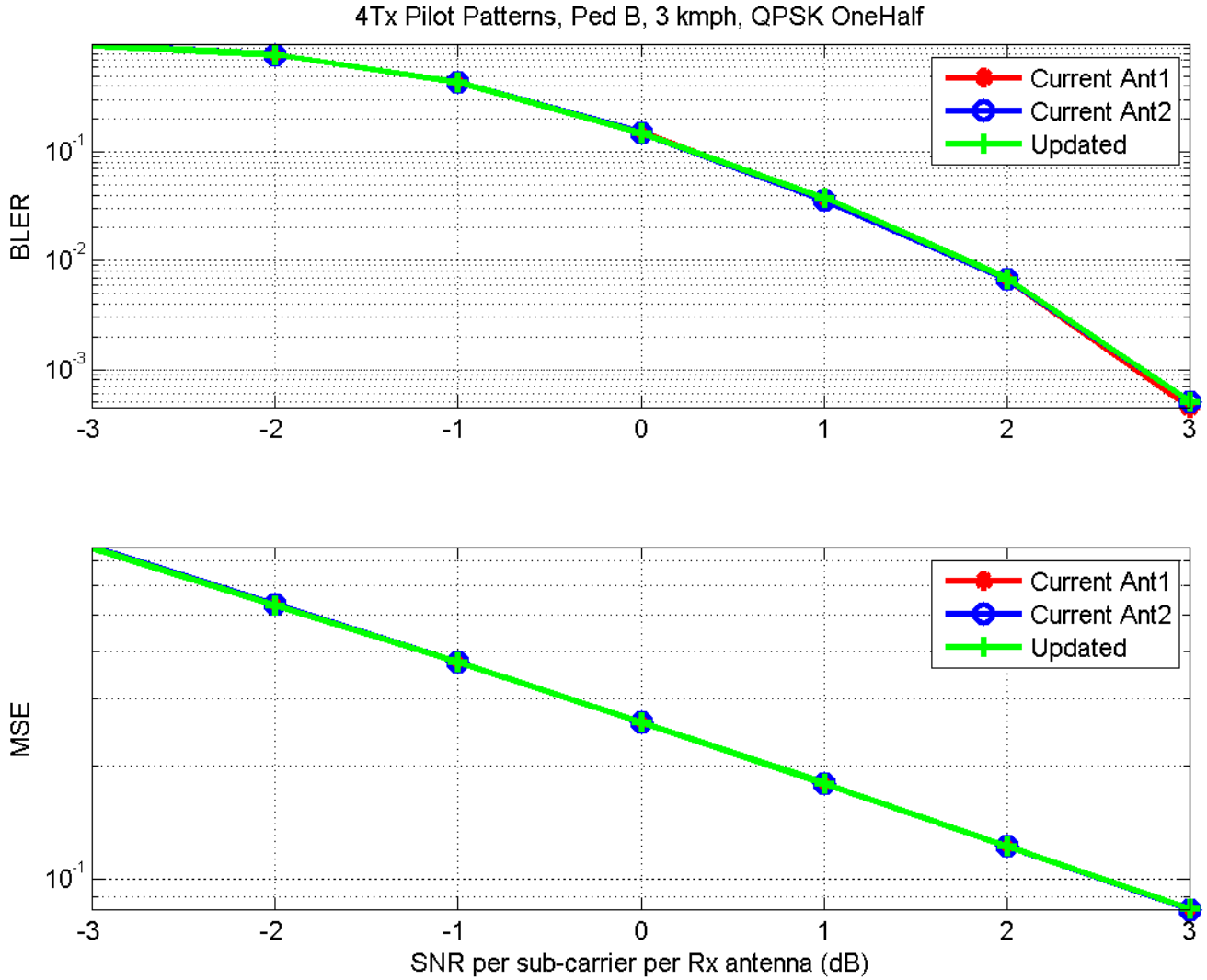

4Tx Pilot Patterns, Ped A, 3 kmph, 16QAM OneThird
BLER
MSE
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated
10^-1
10^-2
10^-3
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

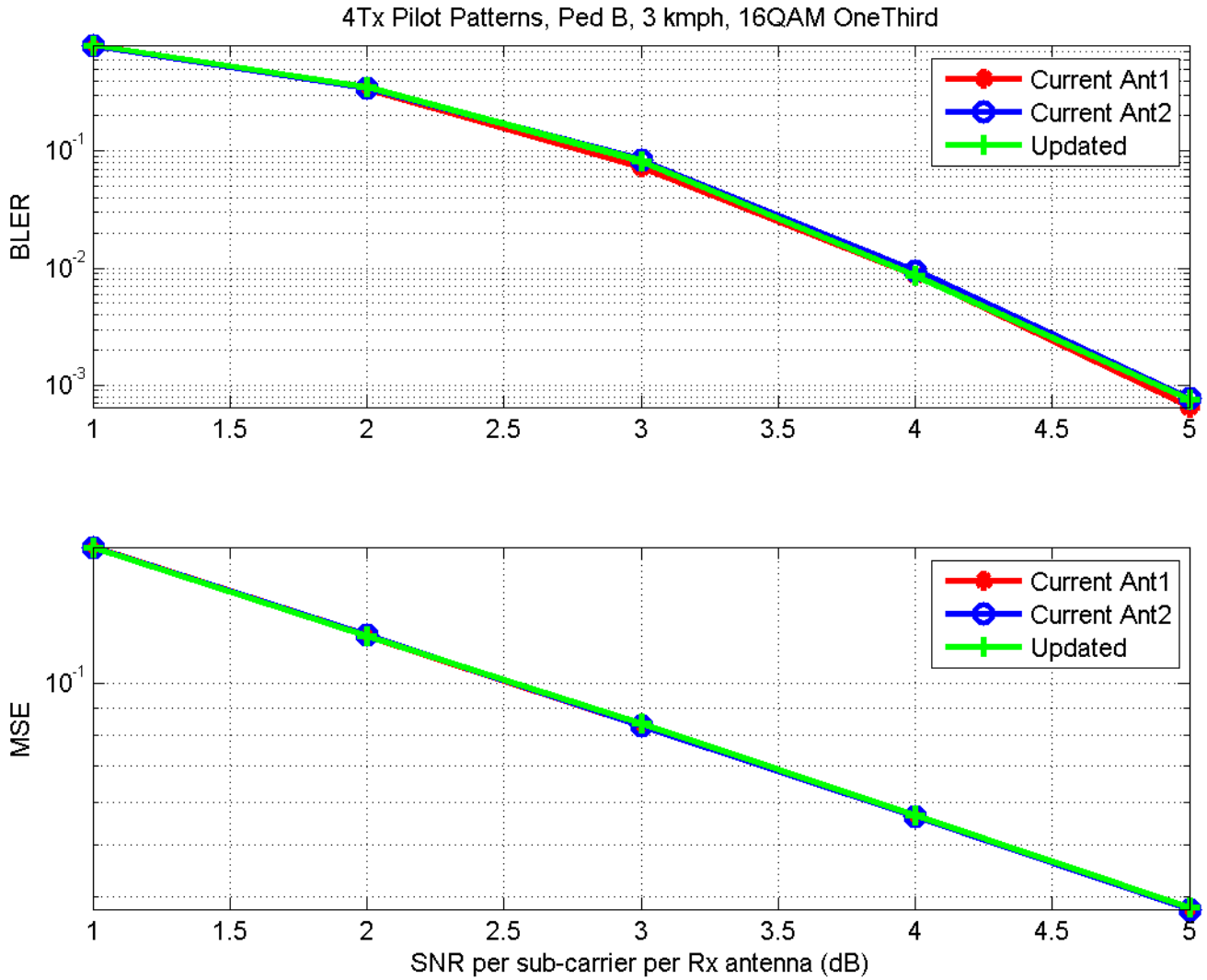

4Tx Pilot Patterns, Ped A, 3 kmph, 16QAM OneHalf
BLER
10^{-1}
10^{-2}
Current Ant1
Current Ant2
Updated
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
MSE
$10^{-1.3}$
$10^{-1.6}$
$10^{-1.9}$
SNR per sub-carrier per Rx antenna (dB)

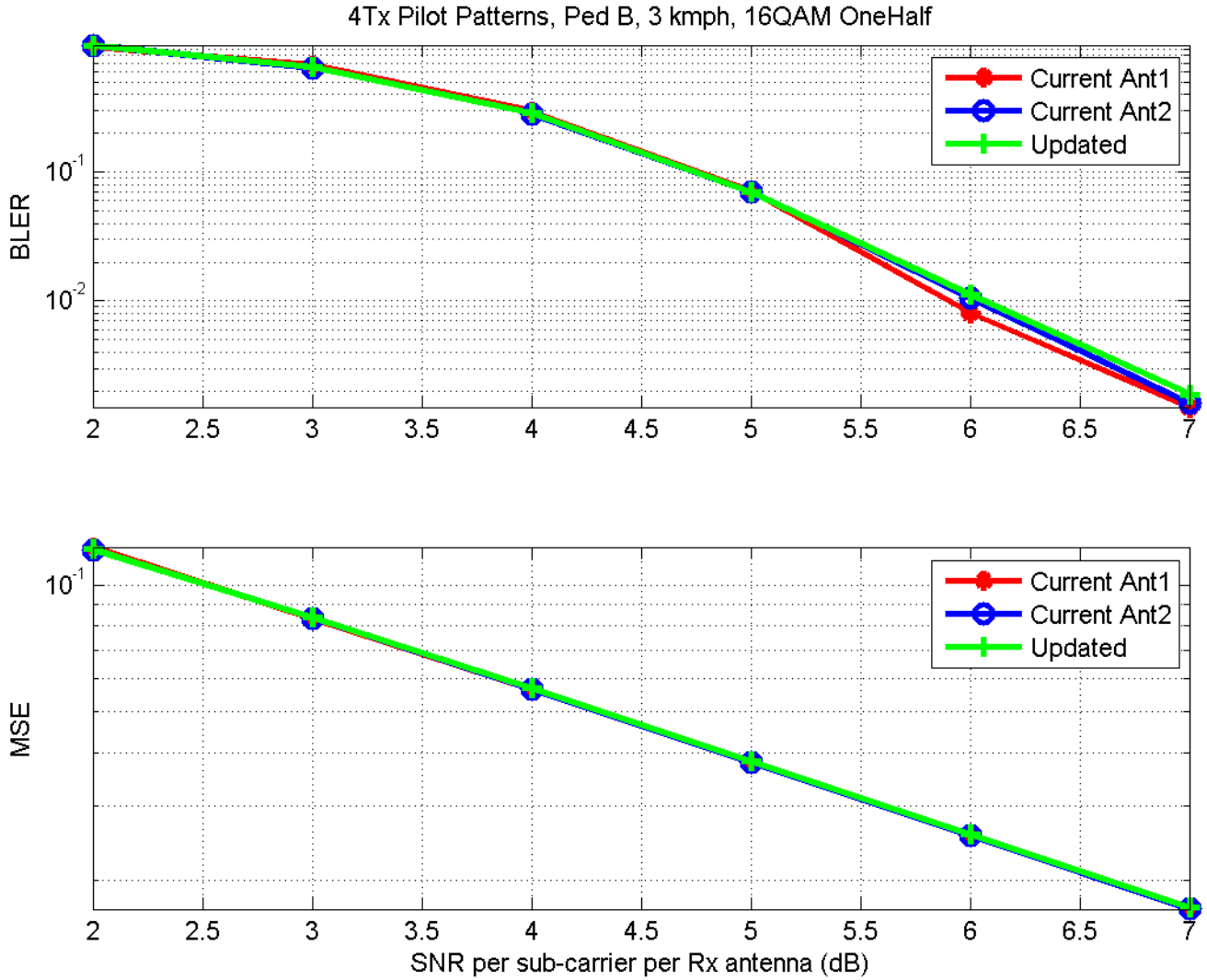

4Tx Pilot Patterns, Ped A, 3 kmph, 64QAM OneThird
BLER
10^{-1}
10^{-2}
10^{-3}
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Current Ant1
Current Ant2
Updated
MSE
10^{-2}
SNR per sub-carrier per Rx antenna (dB)

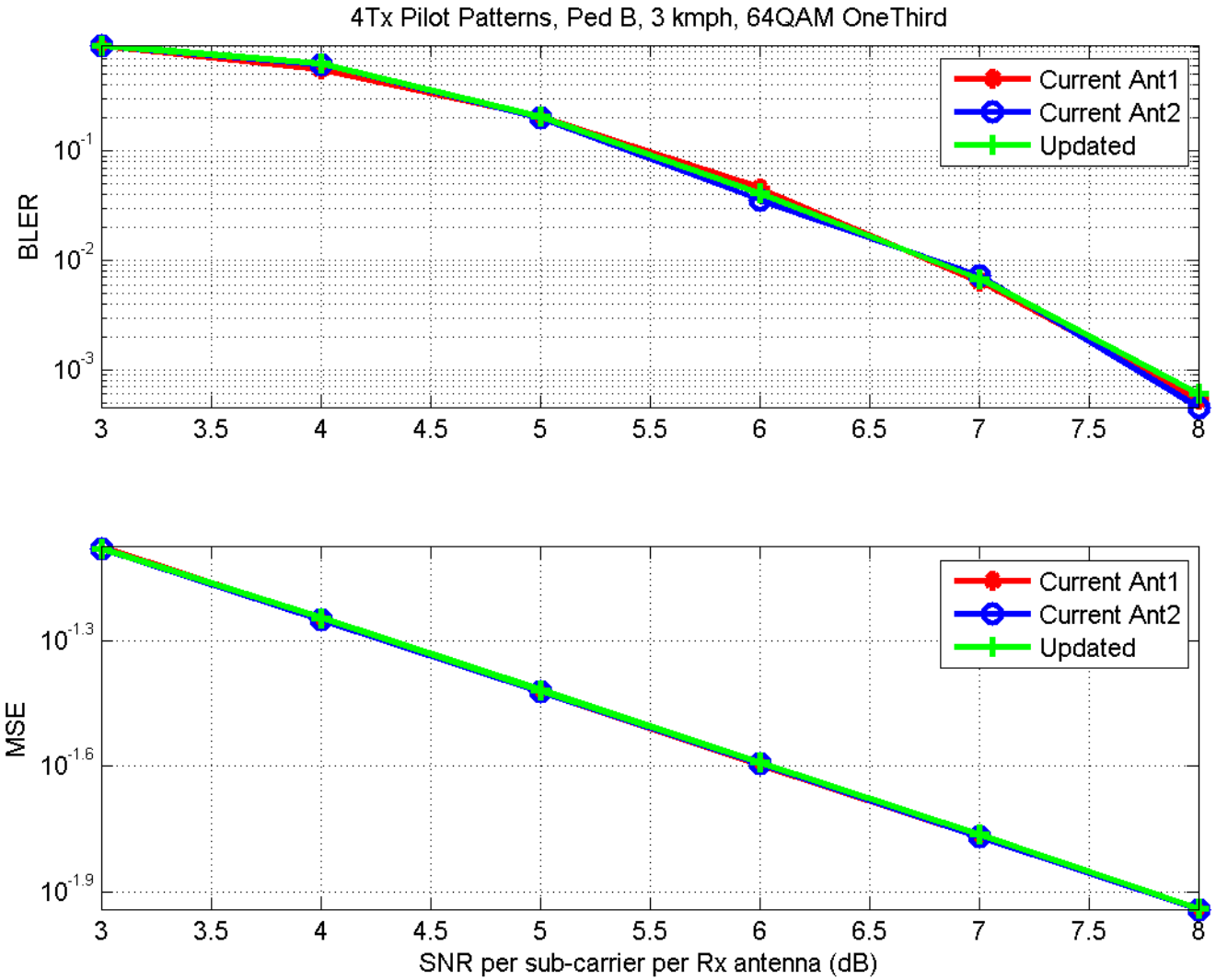

4Tx Pilot Patterns, Ped A, 3 kmph, 64QAM OneHalf
BLER
10^{-1}
10^{-2}
5
6
7
8
9
10
11
Current Ant1
Current Ant2
Updated
MSE
10^{-2}
5
6
7
8
9
10
11
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)

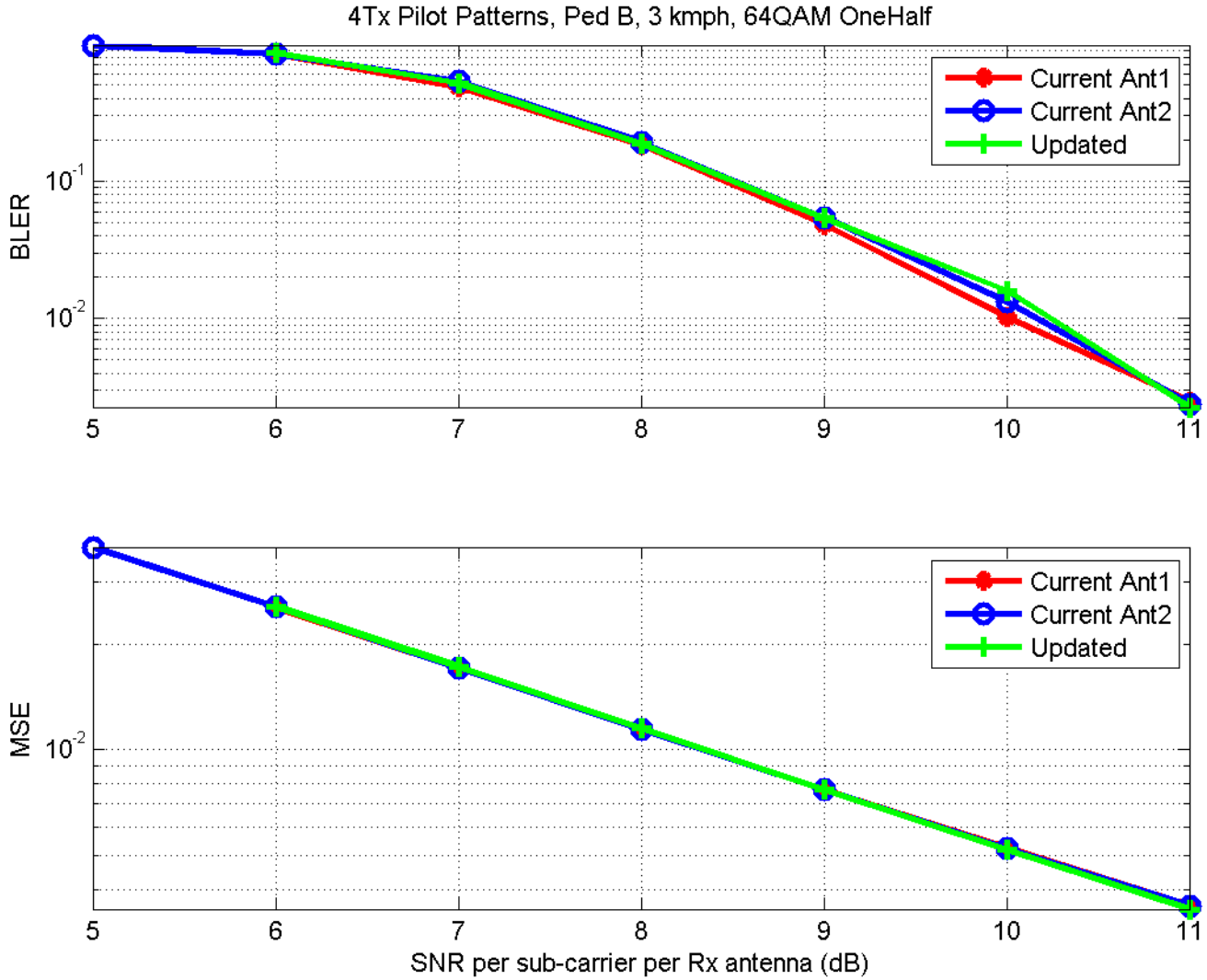

4Tx Pilot Patterns, Ped B, 3 kmph, QPSK OneThird
BLER
10^{-1}
10^{-2}
-5
-4
-3
-2
-1
0
1
Current Ant1
Current Ant2
Updated
MSE
$10^{-0.1}$
$10^{-0.4}$
$10^{-0.7}$
-5
-4
-3
-2
-1
0
1
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)

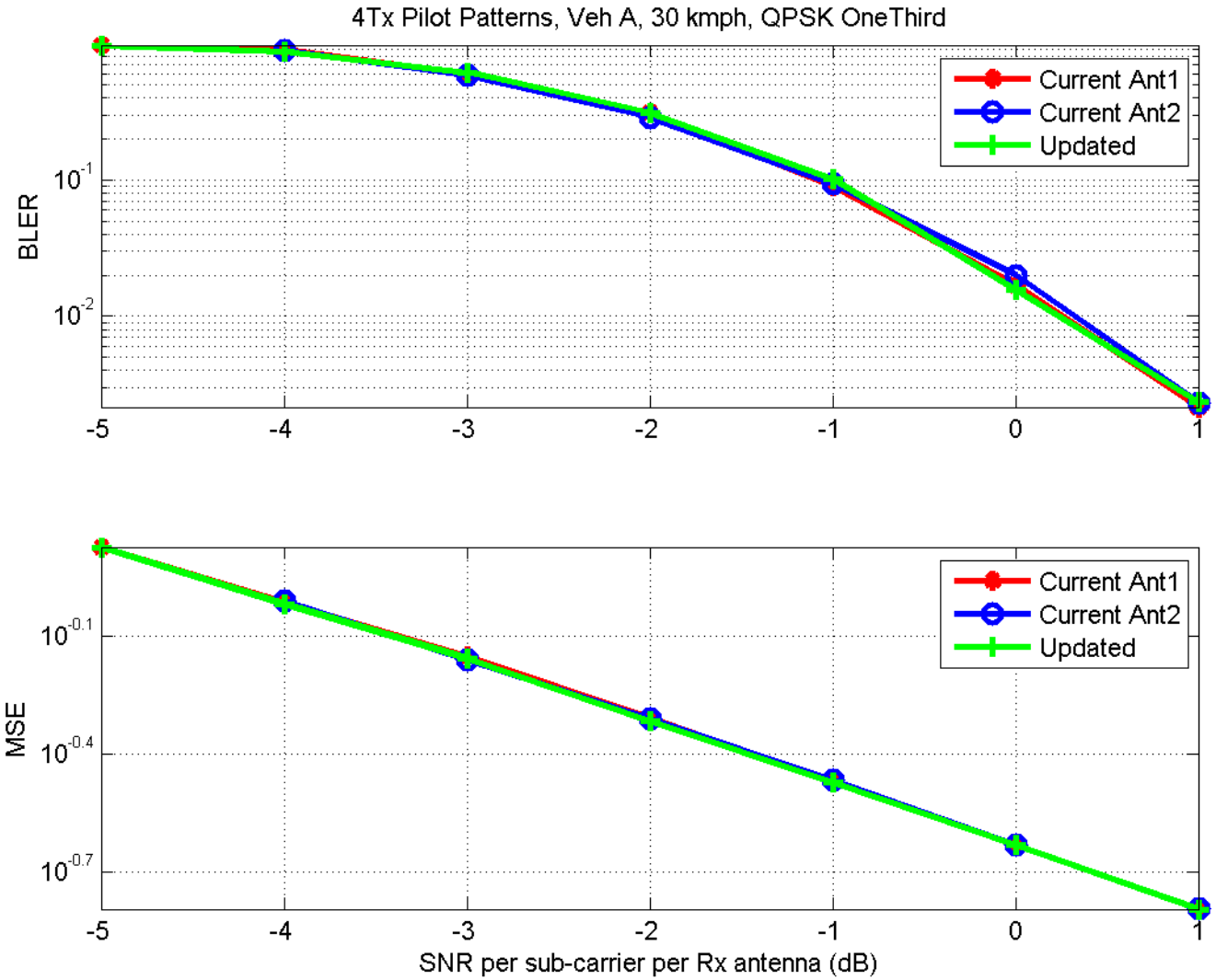

4Tx Pilot Patterns, Ped B, 3 kmph, QPSK OneHalf
BLER
10^{-1}
10^{-2}
10^{-3}
-3
-2
-1
0
1
2
3
Current Ant1
Current Ant2
Updated
MSE
10^{-1}
-3
-2
-1
0
1
2
3
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated

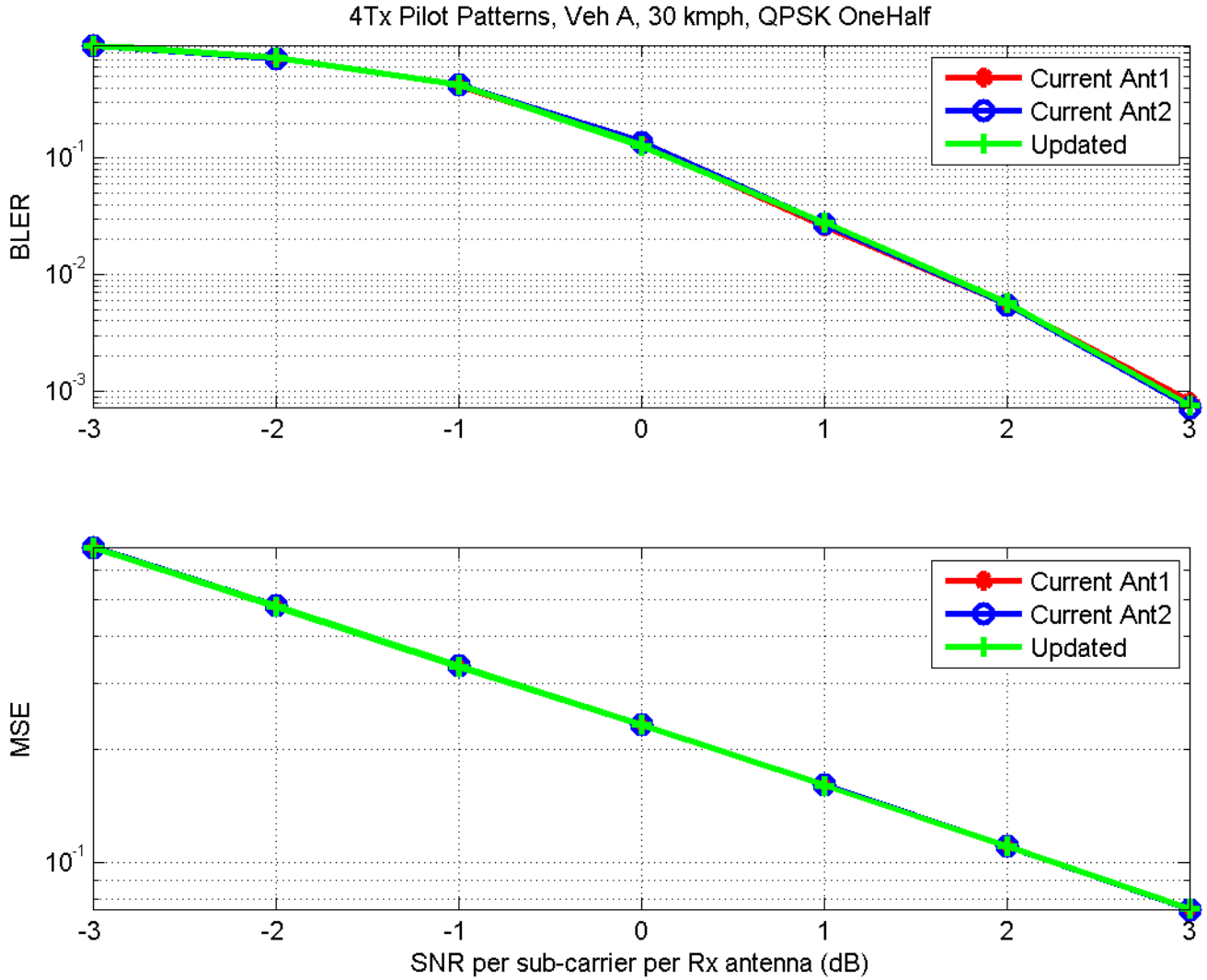

4Tx Pilot Patterns, Ped B, 3 kmph, 16QAM OneThird
BLER
MSE
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)

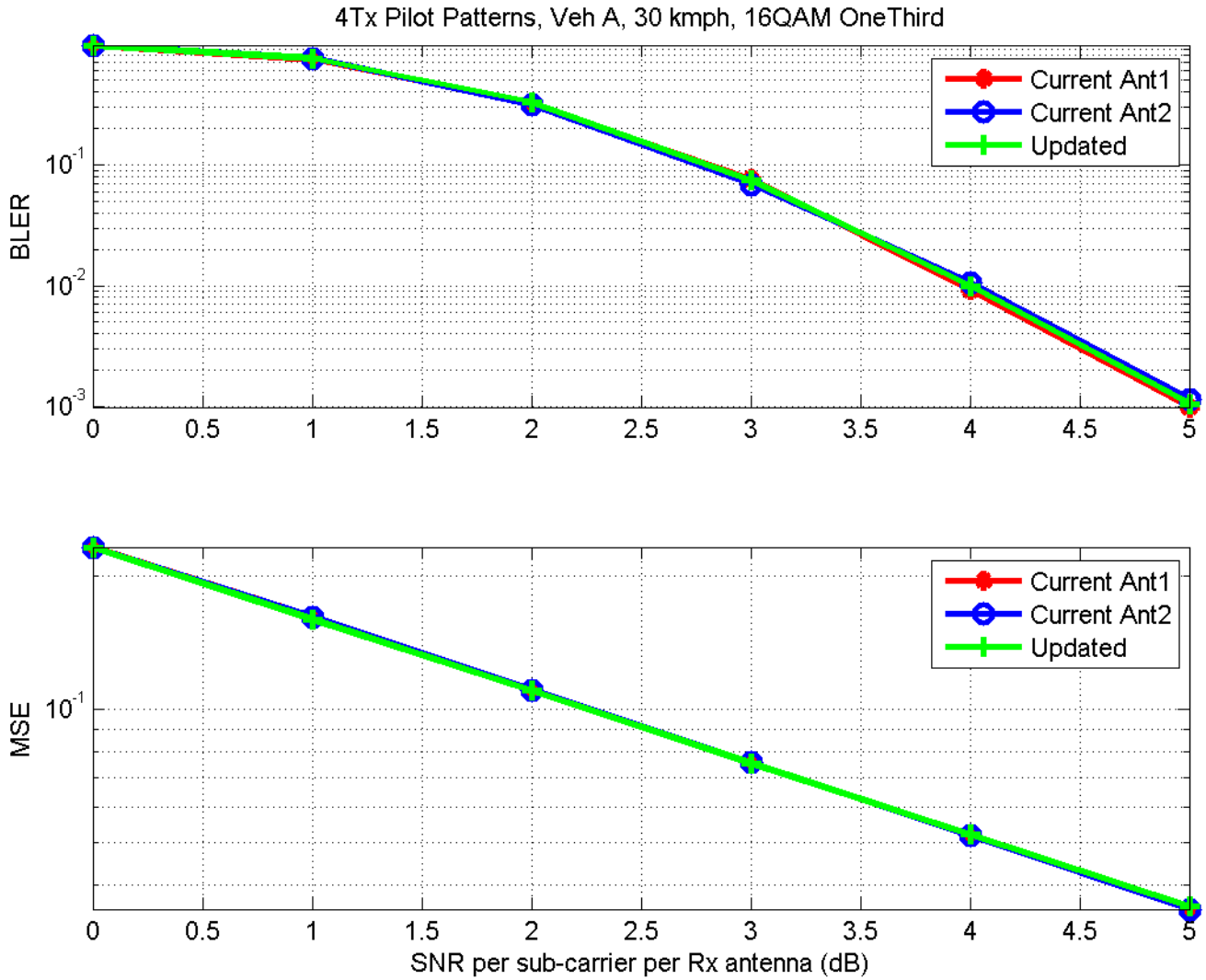

4Tx Pilot Patterns, Ped B, 3 kmph, 16QAM OneHalf
BLER
10^{-1}
10^{-2}
Current Ant1
Current Ant2
Updated
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
MSE
10^{-1}
Current Ant1
Current Ant2
Updated
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Ped B, 3 kmph, 64QAM OneThird
BLER
10^{-1}
10^{-2}
10^{-3}
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
Current Ant1
Current Ant2
Updated
MSE
$10^{-1.3}$
$10^{-1.6}$
$10^{-1.9}$
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Ped B, 3 kmph, 64QAM OneHalf
BLER
10^{-1}
10^{-2}
5
6
7
8
9
10
11
Current Ant1
Current Ant2
Updated
MSE
10^{-2}
5
6
7
8
9
10
11
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Veh A, 30 kmph, QPSK OneThird
BLER
10^{-1}
10^{-2}
-5
-4
-3
-2
-1
0
1
Current Ant1
Current Ant2
Updated
MSE
$10^{-0.1}$
$10^{-0.4}$
$10^{-0.7}$
-5
-4
-3
-2
-1
0
1
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated


4Tx Pilot Patterns, Veh A, 30 kmph, QPSK OneHalf
BLER
MSE
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated
10^-1
10^-2
10^-3
-3
-2
-1
0
1
2
3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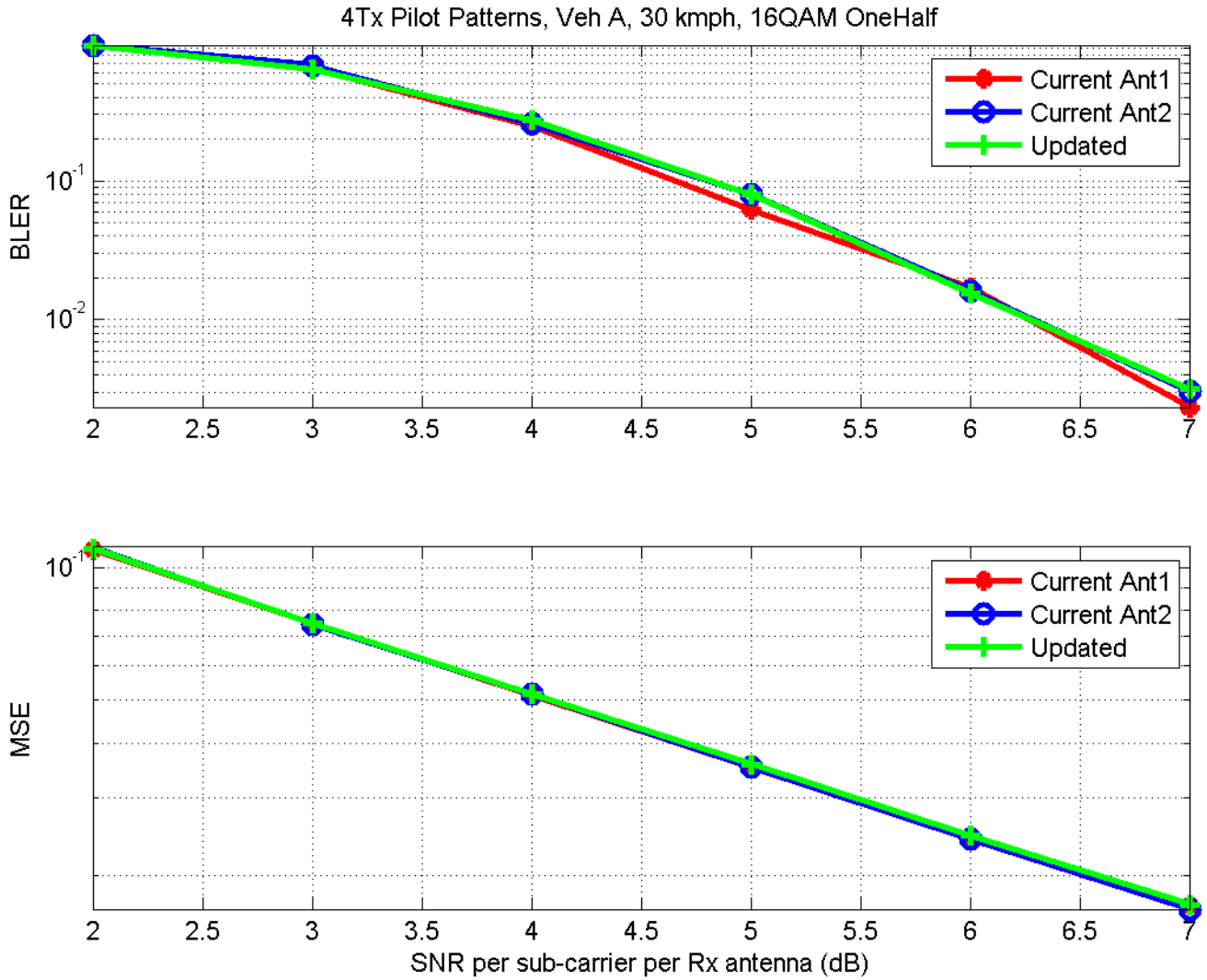
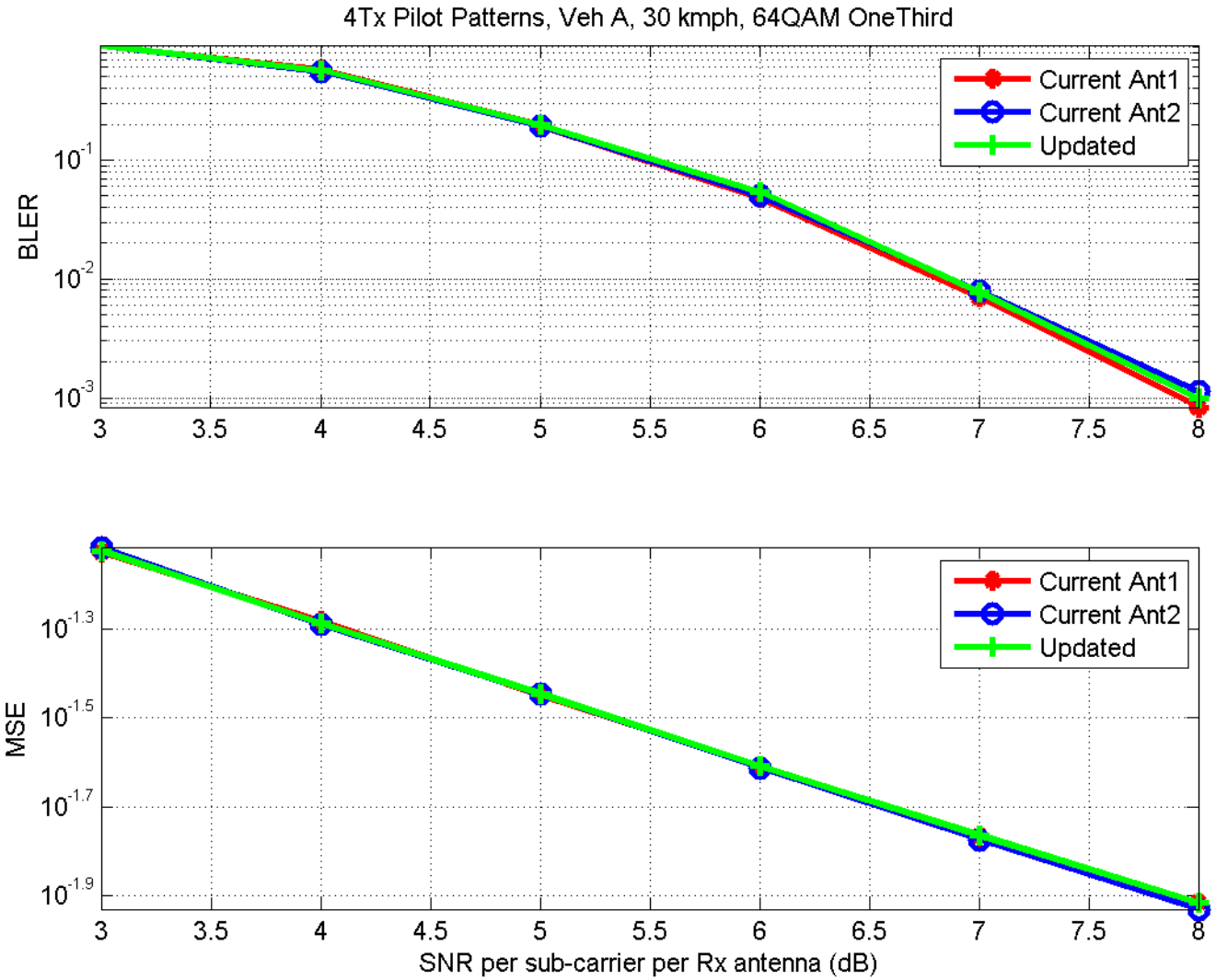
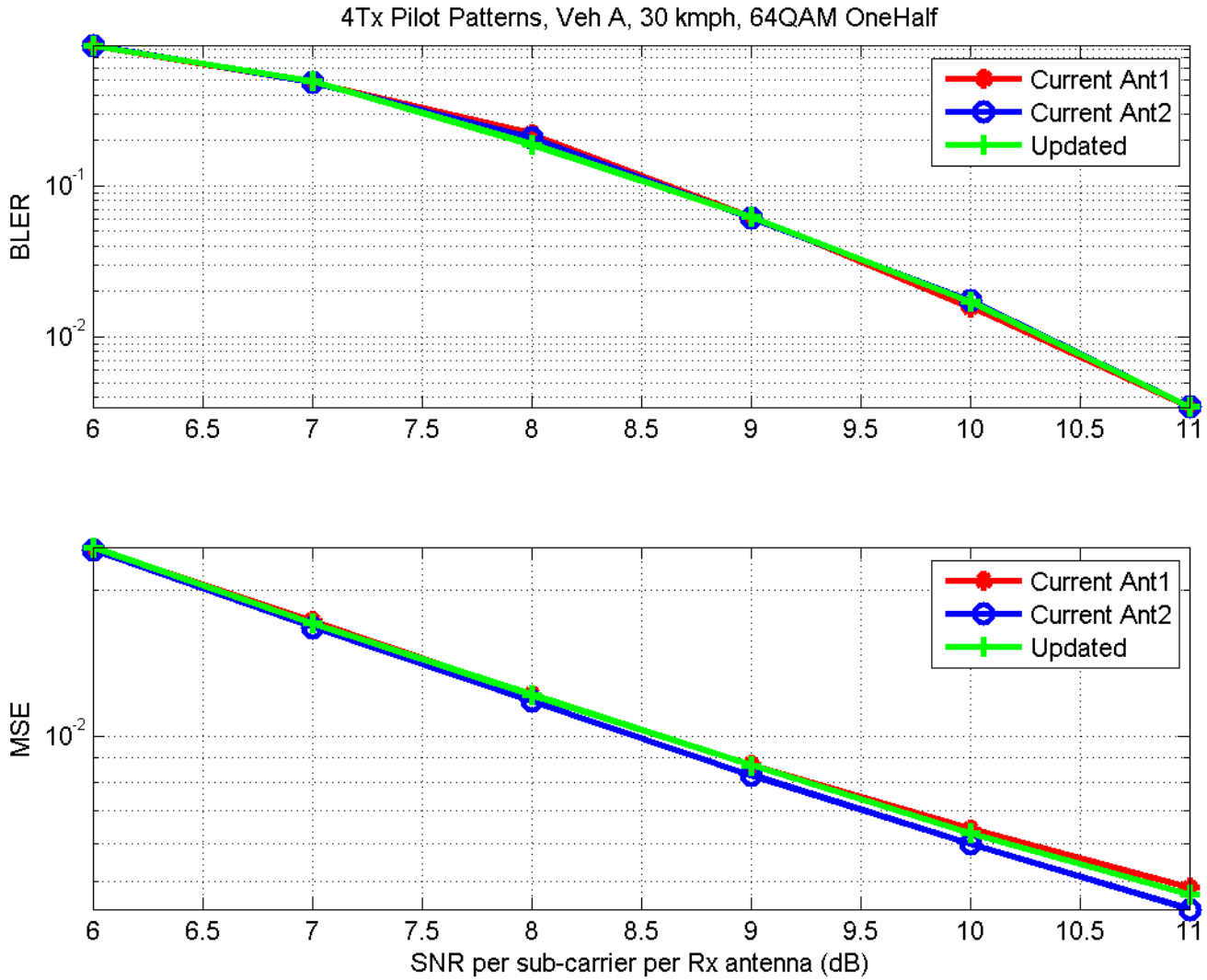
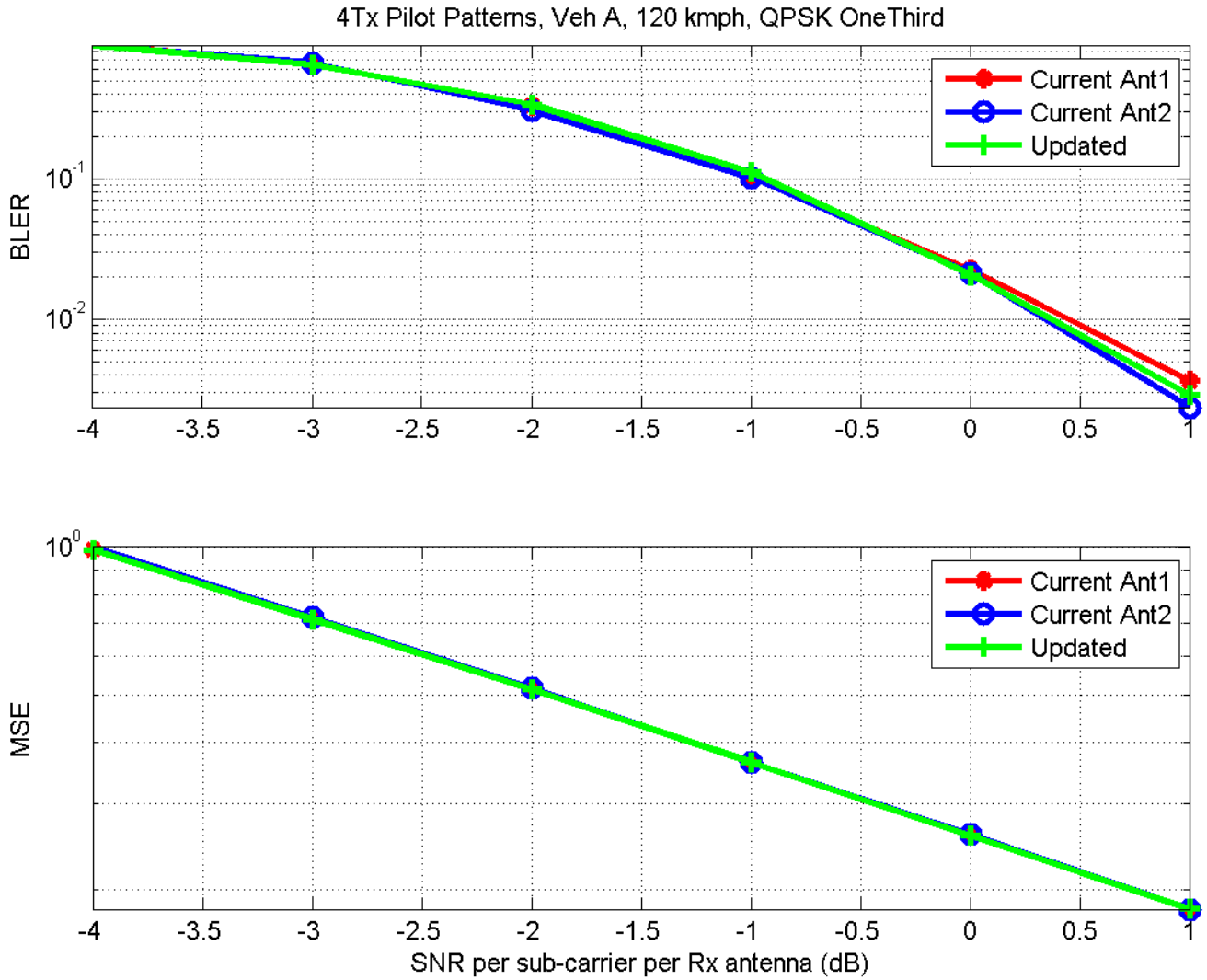
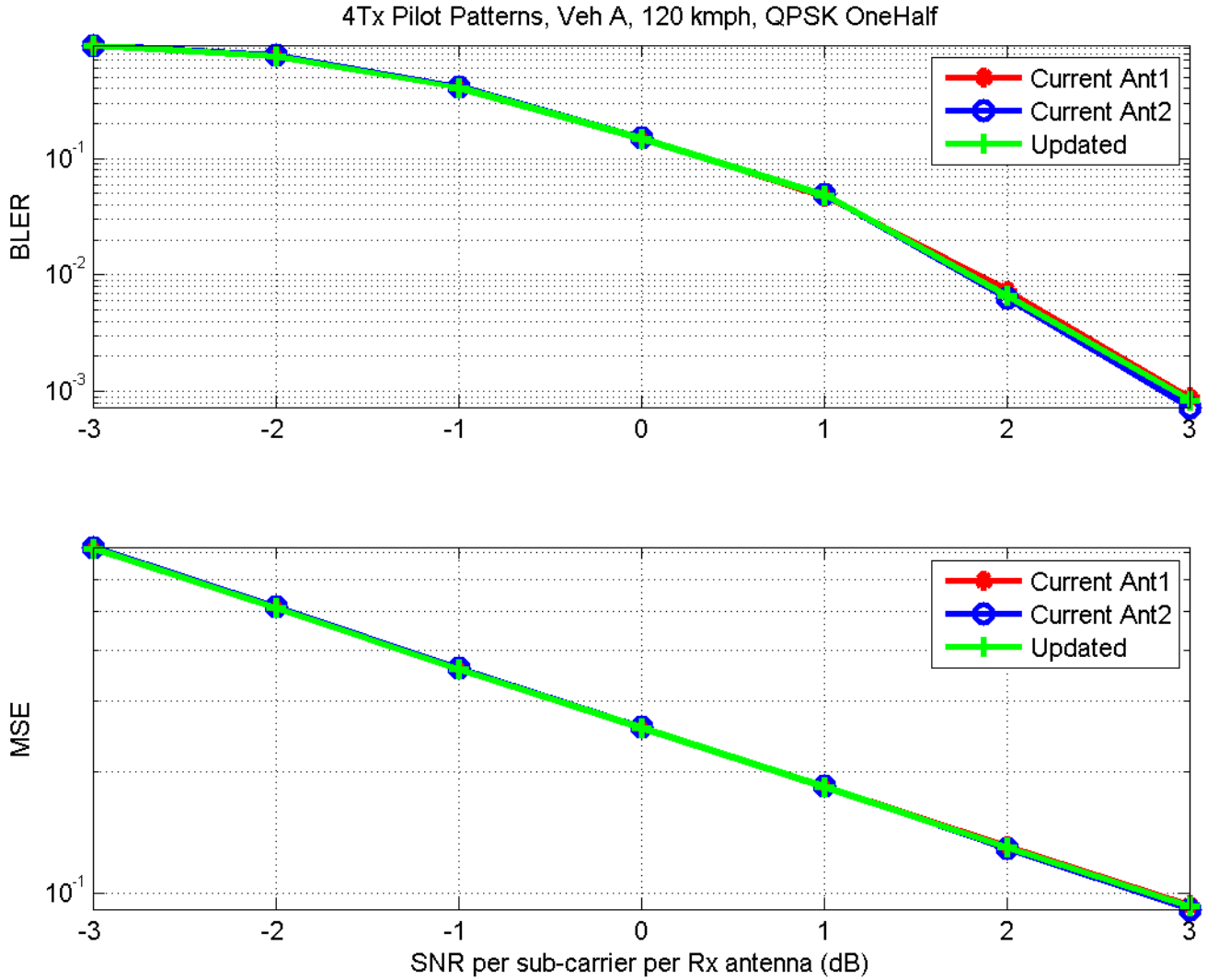
BLER
MSE
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)

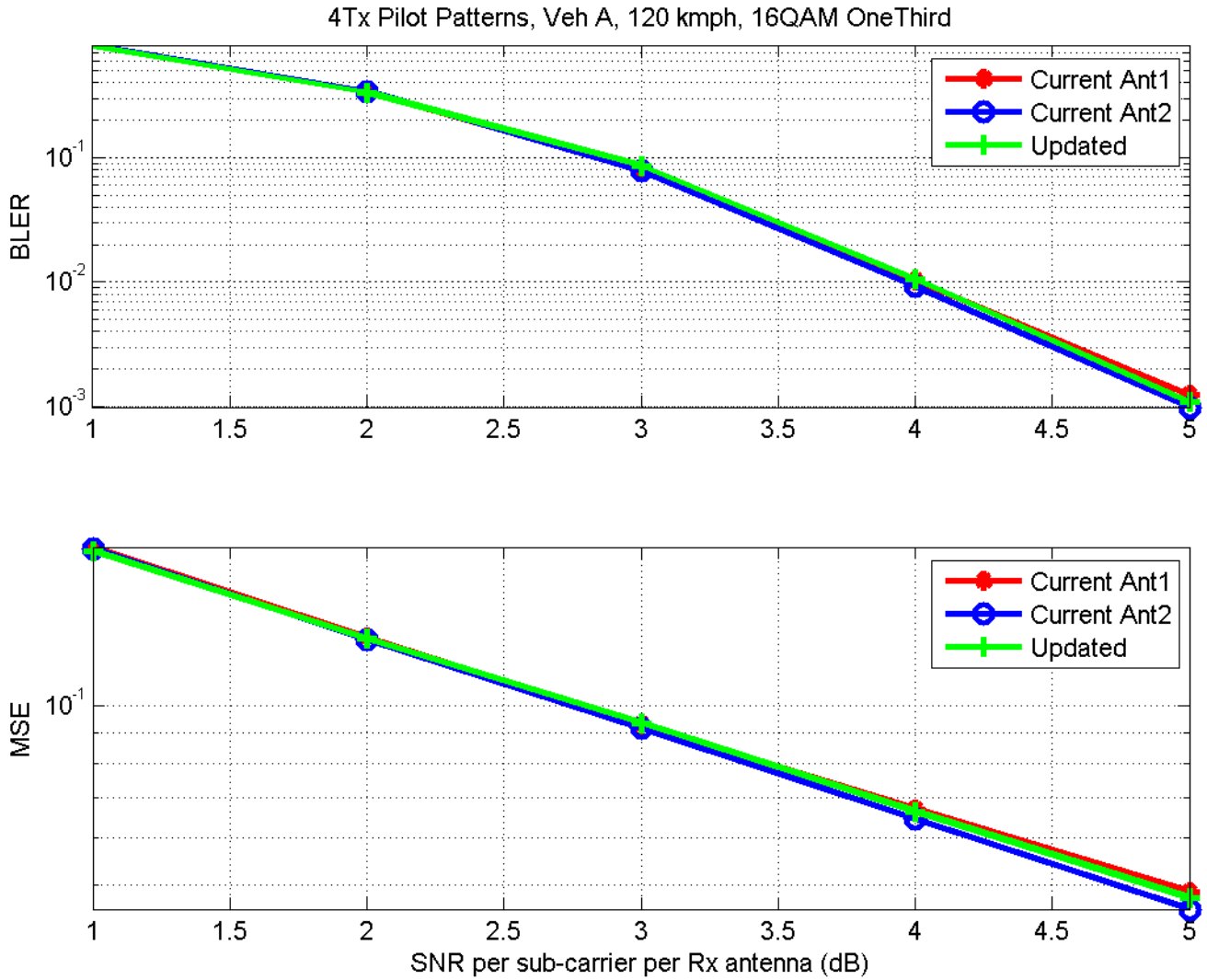

4Tx Pilot Patterns, Veh A, 30 kmph, 16QAM OneHalf
BLER
10^{-1}
10^{-2}
Current Ant1
Current Ant2
Updated
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
MSE
10^{-1}
Current Ant1
Current Ant2
Updated
2
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
SNR per sub-carrier per Rx antenna (dB)

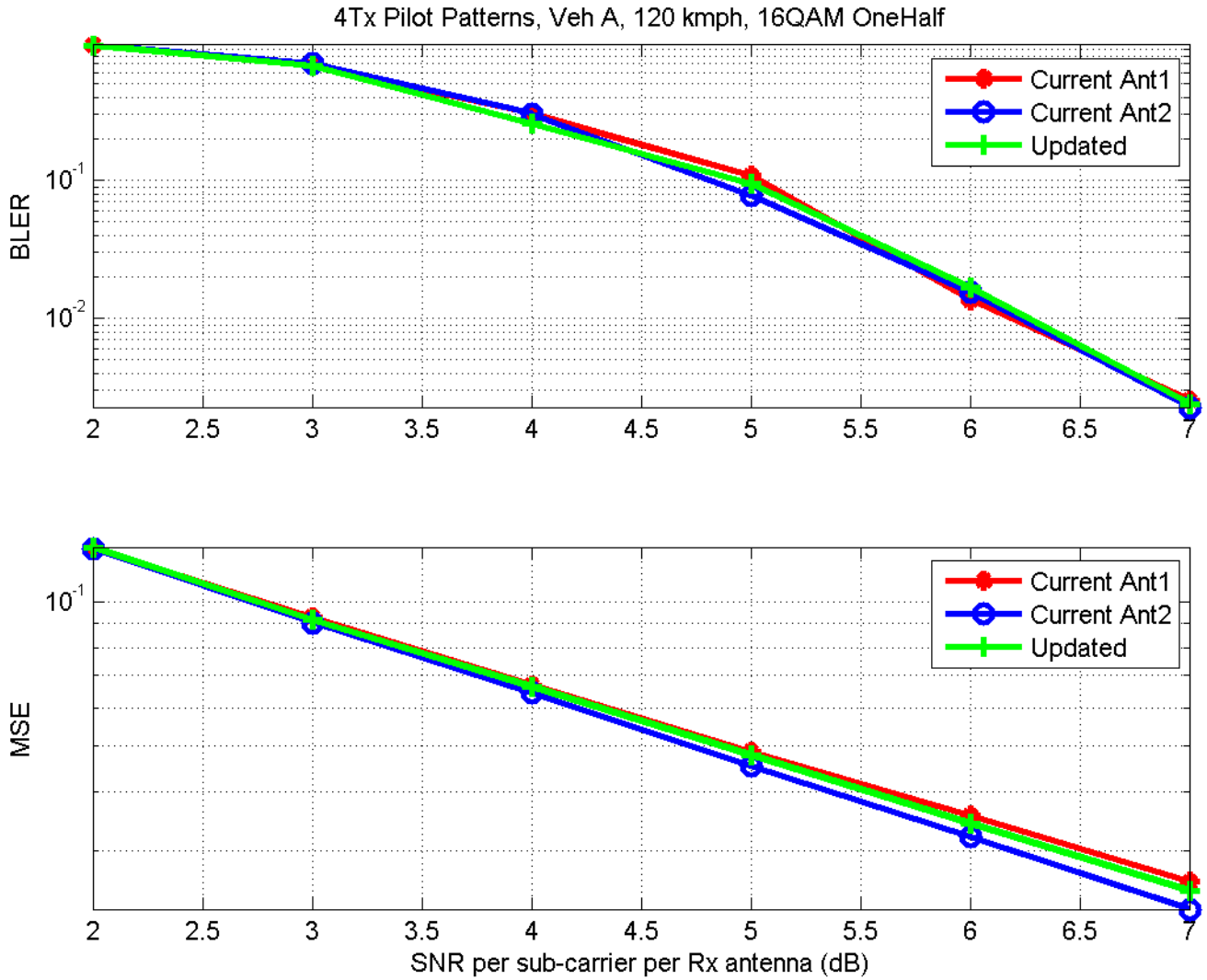

4Tx Pilot Patterns, Veh A, 30 kmph, 64QAM OneThird
BLER
MSE
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated
10^-1
10^-2
10^-3
10^-1.3
10^-1.5
10^-1.7
10^-1.9
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8

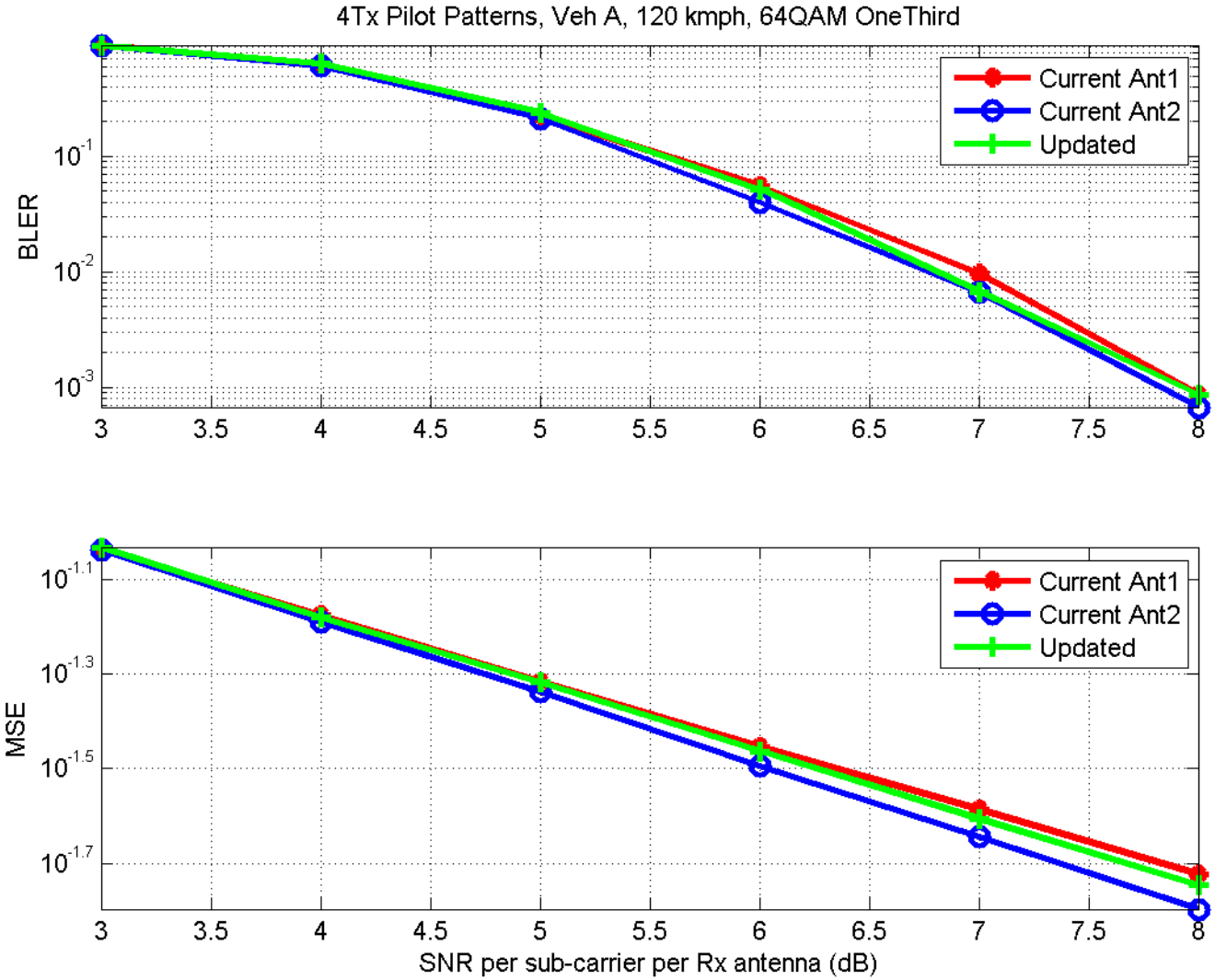

4Tx Pilot Patterns, Veh A, 30 kmph, 64QAM OneHalf
BLER
10^{-1}
10^{-2}
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
Current Ant1
Current Ant2
Updated
MSE
10^{-2}
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated

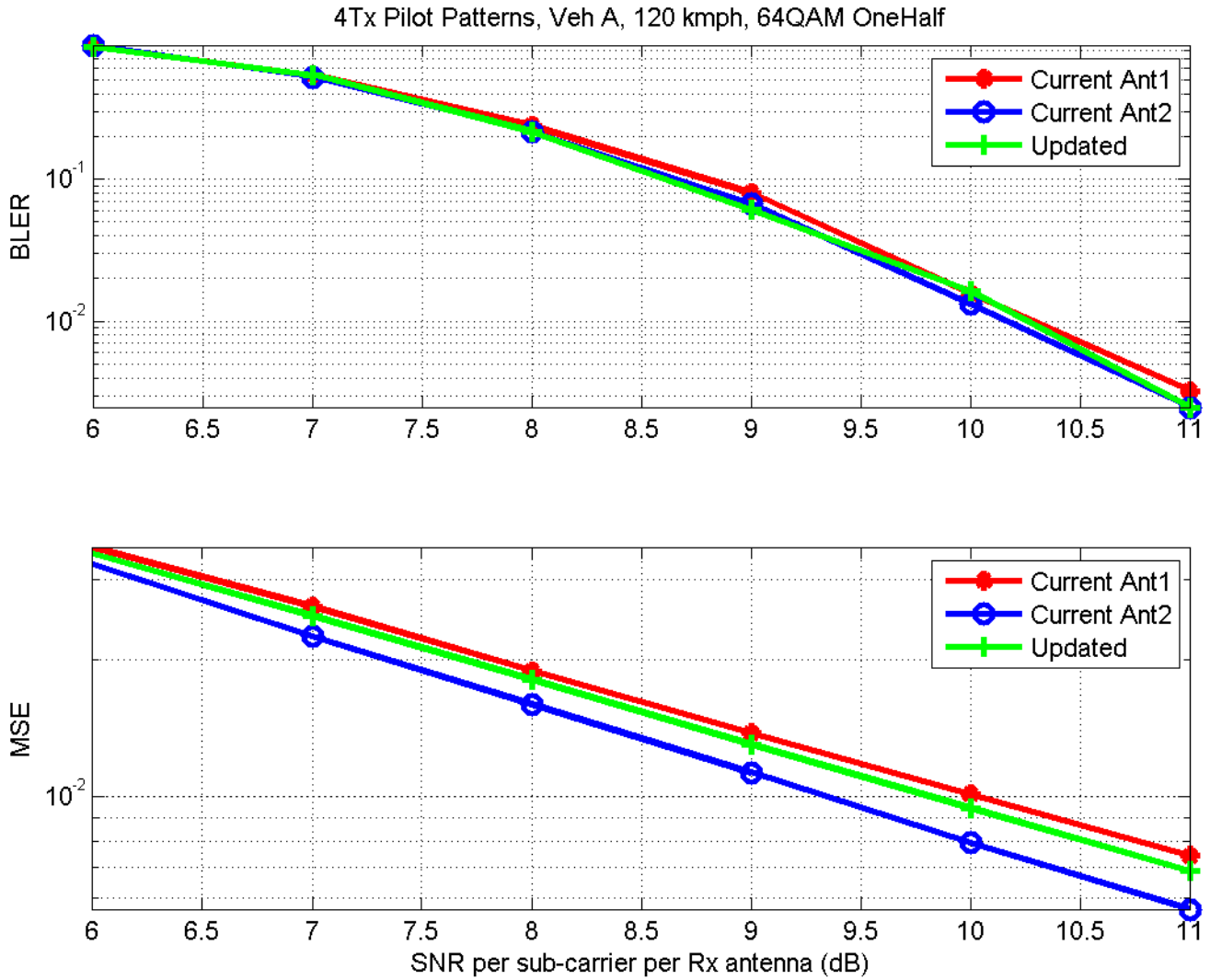

4Tx Pilot Patterns, Veh A, 120 kmph, QPSK OneThird
BLER
10^{-1}
10^{-2}
Current Ant1
Current Ant2
Updated
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
MSE
10^{0}
Current Ant1
Current Ant2
Updated
-4
-3.5
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Veh A, 120 kmph, QPSK OneHalf
BLER
10^{-1}
10^{-2}
10^{-3}
-3
-2
-1
0
1
2
3
Current Ant1
Current Ant2
Updated
MSE
10^{-1}
-3
-2
-1
0
1
2
3
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Veh A, 120 kmph, 16QAM OneThird
BLER
MSE
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Veh A, 120 kmph, 16QAM OneHalf
BLER
MSE
Current Ant1
Current Ant2
Updated
SNR per sub-carrier per Rx antenna (dB)


4Tx Pilot Patterns, Veh A, 120 kmph, 64QAM OneThird
BLER
MSE
SNR per sub-carrier per Rx antenna (dB)
Current Ant1
Current Ant2
Updated


4Tx Pilot Patterns, Veh A, 120 kmph, 64QAM OneHalf
BLER
10^{-1}
10^{-2}
6
6.5
7
7.5
8
8.5
9
9.5
10
10.5
11
Current Ant1
Current Ant2
Updated
MSE
10^{-2}
SNR per sub-carrier per Rx antenna (dB)