

# Performance Evaluation of Codebooks Proposed for IEEE 802.16m

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Discussion and approval

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# Introduction

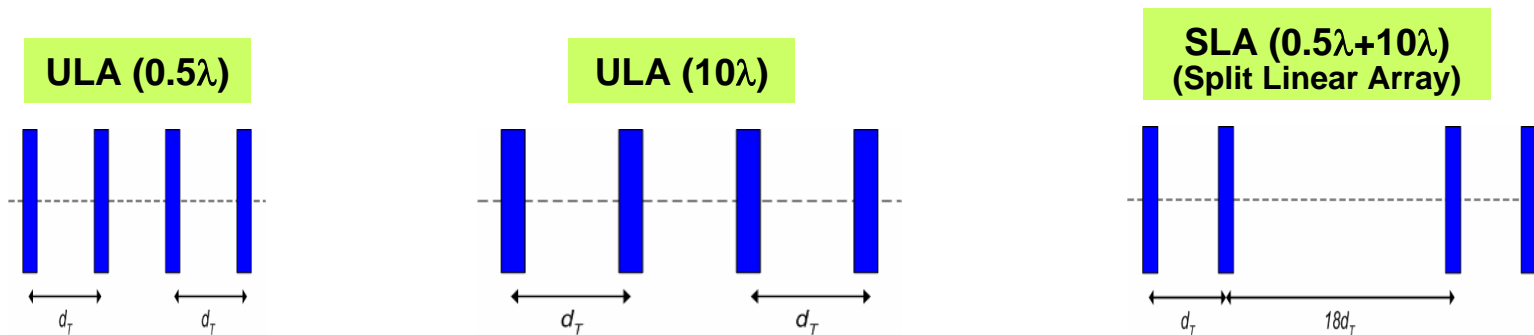
- A DFT-based codebook has been proposed in C80216m-MIMO-08\_063, C80216m-08\_851r1, C80216m-08\_1187.
- Performance evaluation was provided in comparison to other proposed codebook with link-level simulations.
- A detailed complexity analysis and a review of important codebook properties was also provided in C80216m-08\_1187.
- This contribution provides the performance evaluation with system-level simulations, considering updated proposals from Session #57 in Kobe.

# Performance evaluation

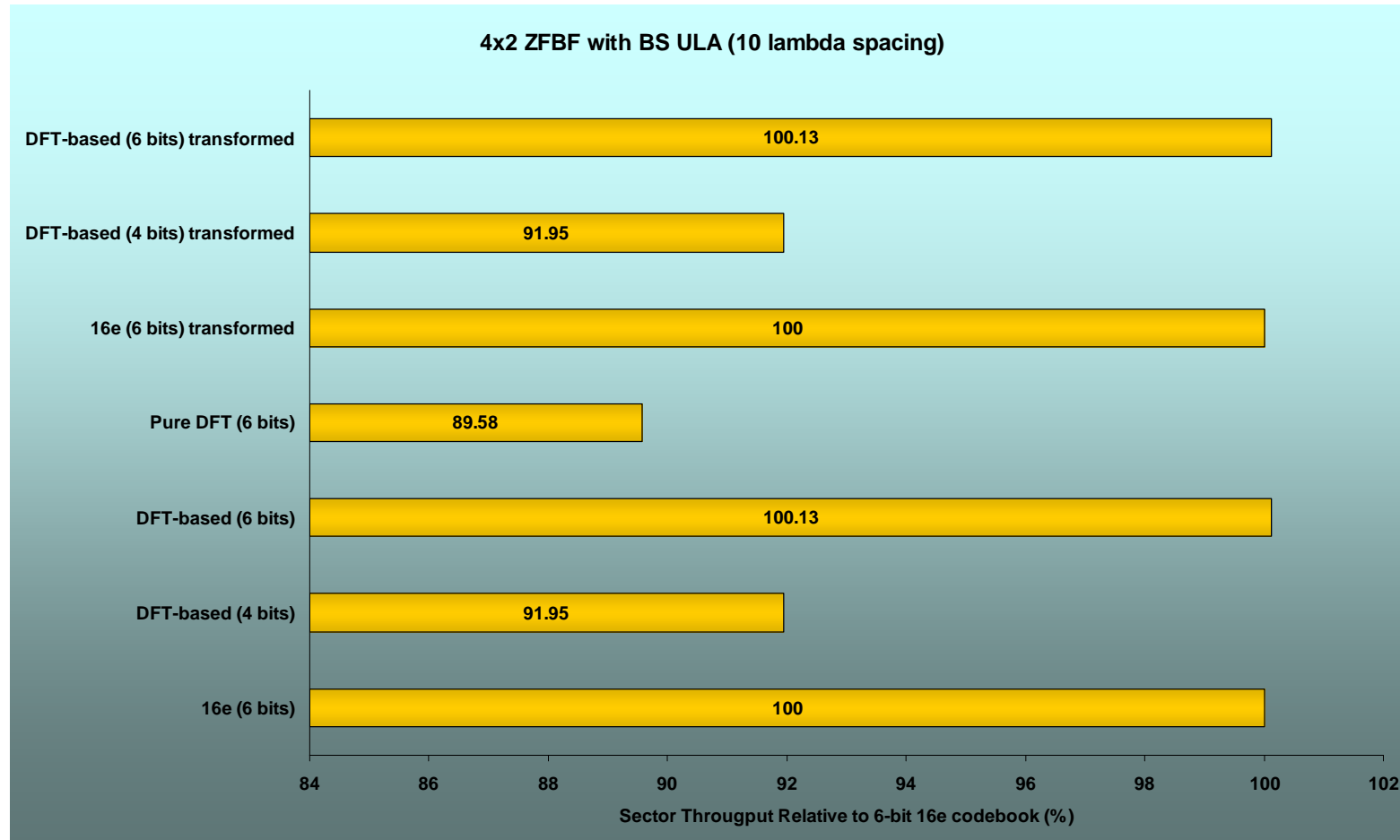
- Codebook (CB) candidates for MU-MIMO with ZFBF
  - 16e CB (6 bits): optimized for uncorrelated channel
  - Pure DFT CB (6 bits): optimized for correlated channel
  - DFT-based CB (4 bits): robust compromise in different scenarios
  - DFT-based CB (6 bits): robust compromise in different scenarios
  - Transformed DFT-based CB (4 bits): optimized for correlated channel
  - Transformed DFT-based CB (6 bits): optimized for correlated channel
  - Transformed 16e CB (6 bits): optimized for correlated channel
- References
  - Transformed codebook: C80216m-08\_1182r3
  - DFT-based CB (4 bits): C80216m-08\_1187

# BS Antenna Array Configurations

- System Level Simulations Environment
  - 19 Cell – 3 sector, Freq. reuse = 1
  - 4x2 MU-MIMO, 16 active users, 3 km/h
  - Rank adaptation (up to 4 scheduled users), HARQ-on
  - CQI calculated based on interference power
  - 3 types of Antenna Configurations (Ped B, 8 degrees AS)
  - Dual polarized arrays are an important deployment scenario to be simulated later

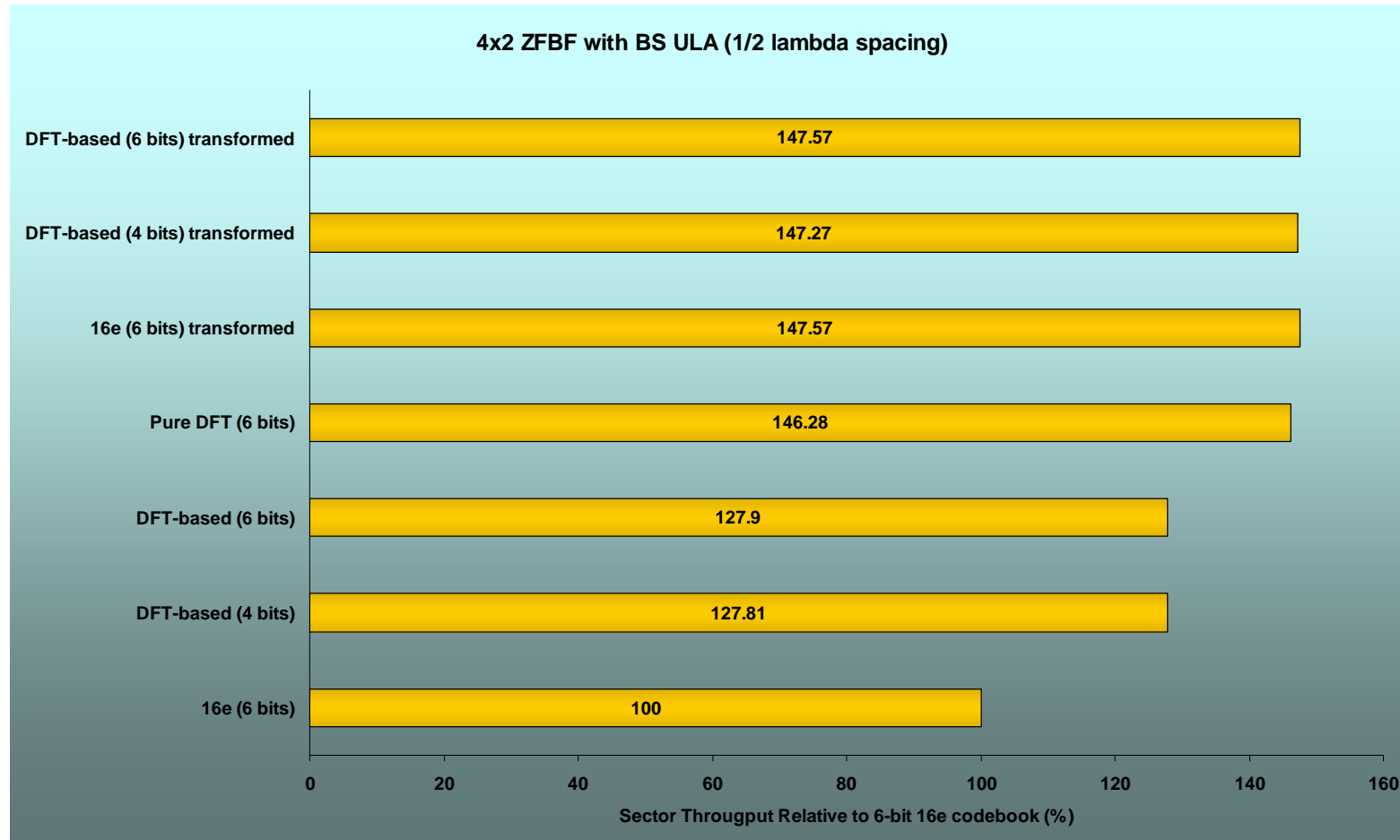


# Sector Throughput of ZFBF in DL 4x2 ULA with 10 wavelengths spacing



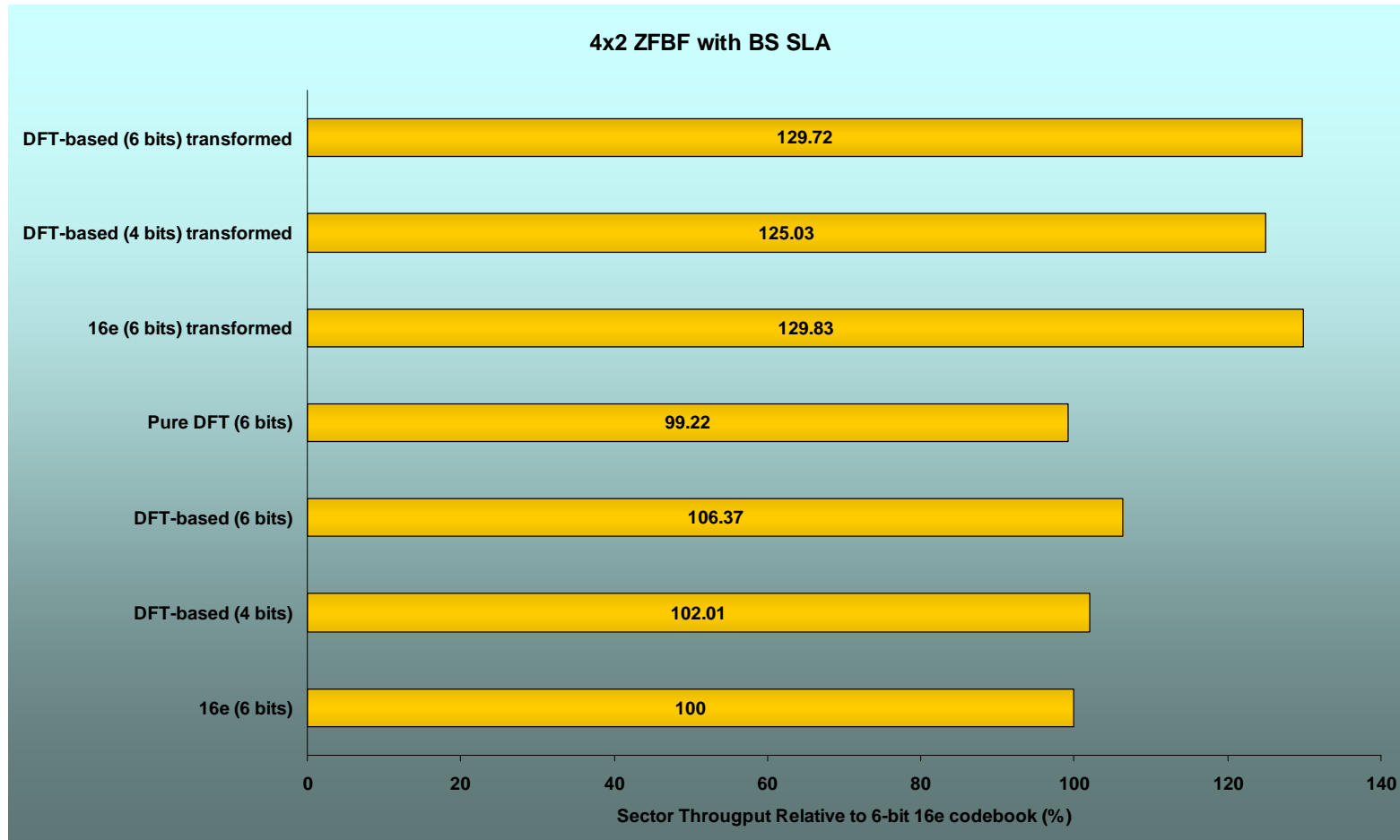
6-bit DFT-based codebook shows similar performance as the 6-bit 16e codebook  
Long-term correlation-based transformation provides no gain in uncorrelated channels

# Sector Throughput of ZFBF in DL 4x2 ULA with 1/2 wavelength spacing



Transformed 4bit DFT-based codebook achieves same performance as the Transformed 6-bit 16e codebook and Transformed 6bit DFT-based codebook

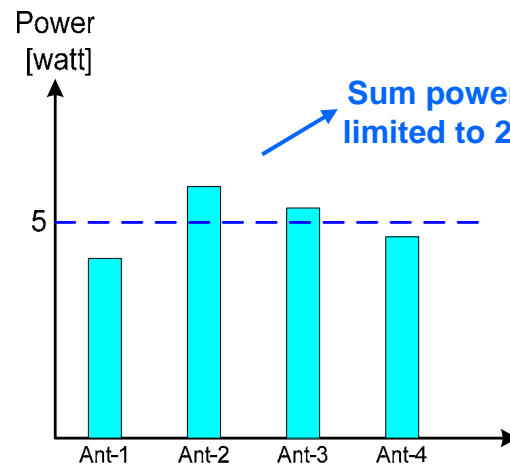
# Sector Throughput of ZFBF in DL 4x2 Split Linear Array



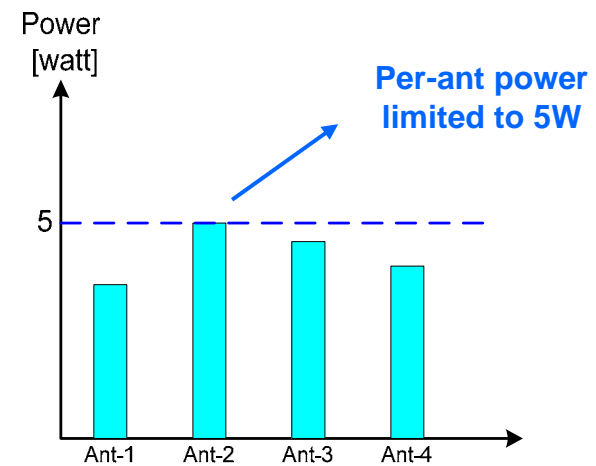
Same trend as in correlated channels

# Power fluctuation effect between antennas

- Constant modulus property
  - Definition: Every elements of codebook vector has same magnitude
  - Good for per-antenna peak power limit
  - DFT-based codebooks have a constant modulus property, while 16e-based do not



**Total power limitation**



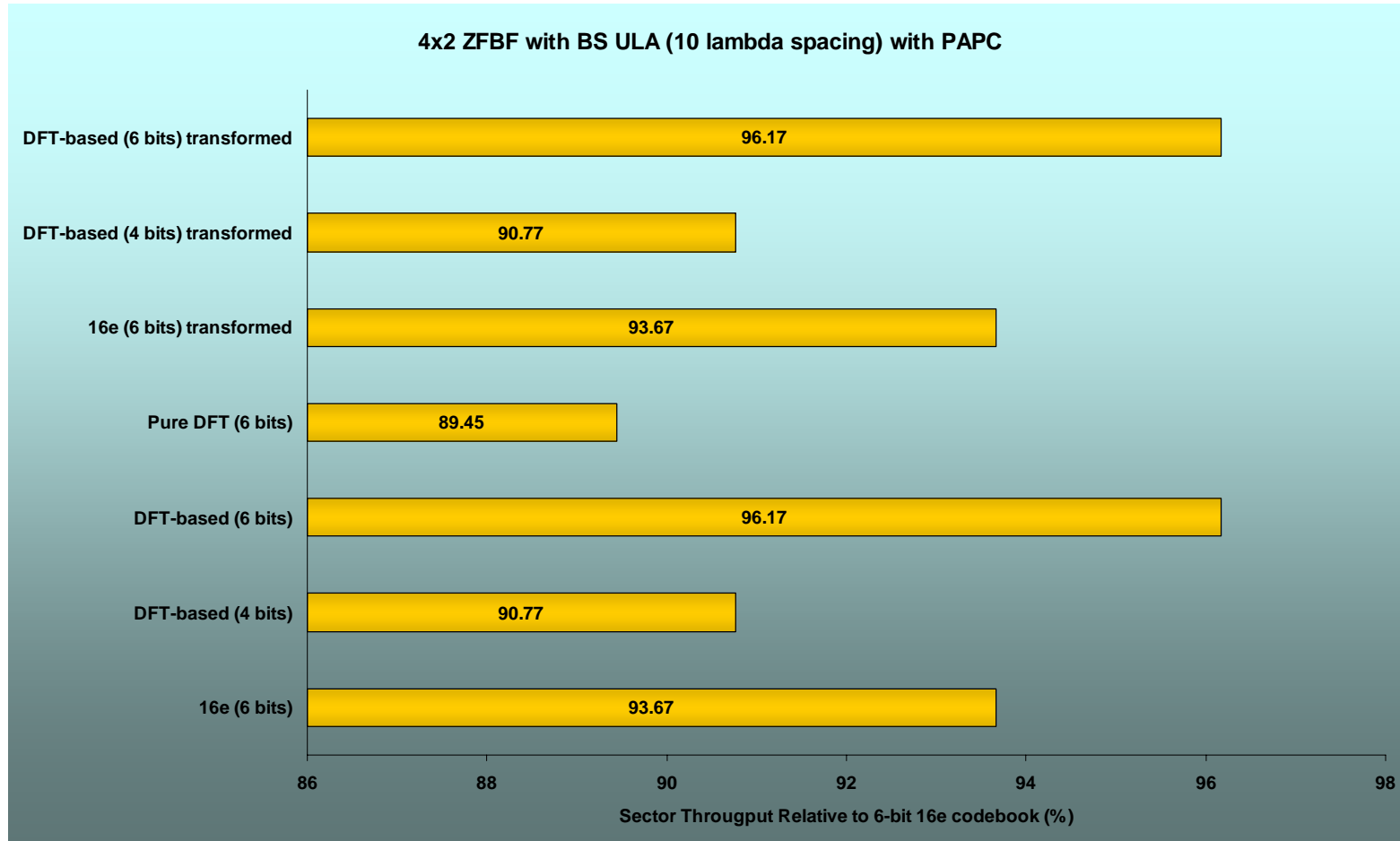
**Per-ant. Peak power limitation**

**Power adjustment frame by frame**



# Sector Throughput of ZFBF in DL 4x2

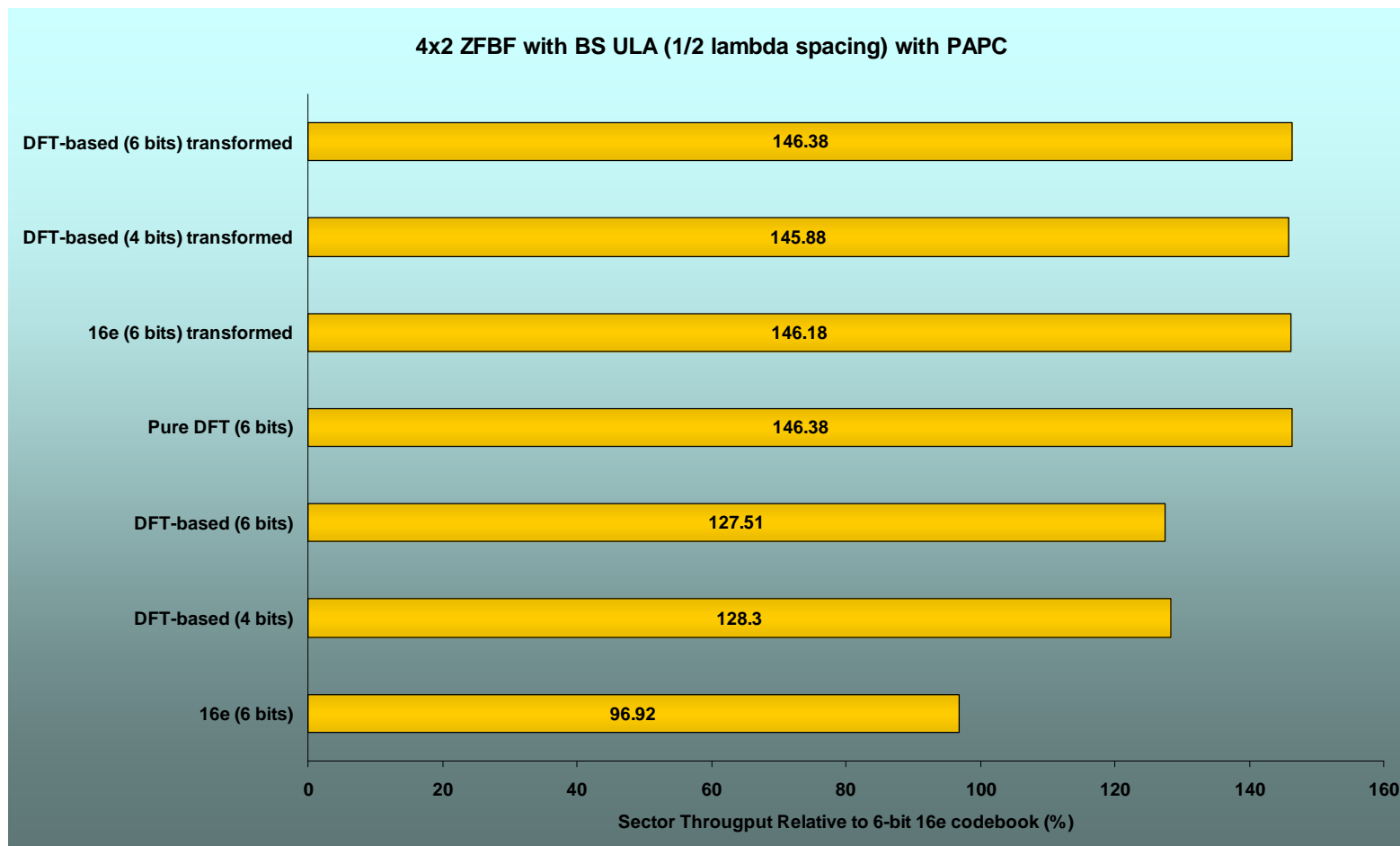
ULA with 10 wavelengths spacing and per Antenna Peak Power Limitation



6-bit DFT-based codebook provides the best performance

# Sector Throughput of ZFBF in DL 4x2

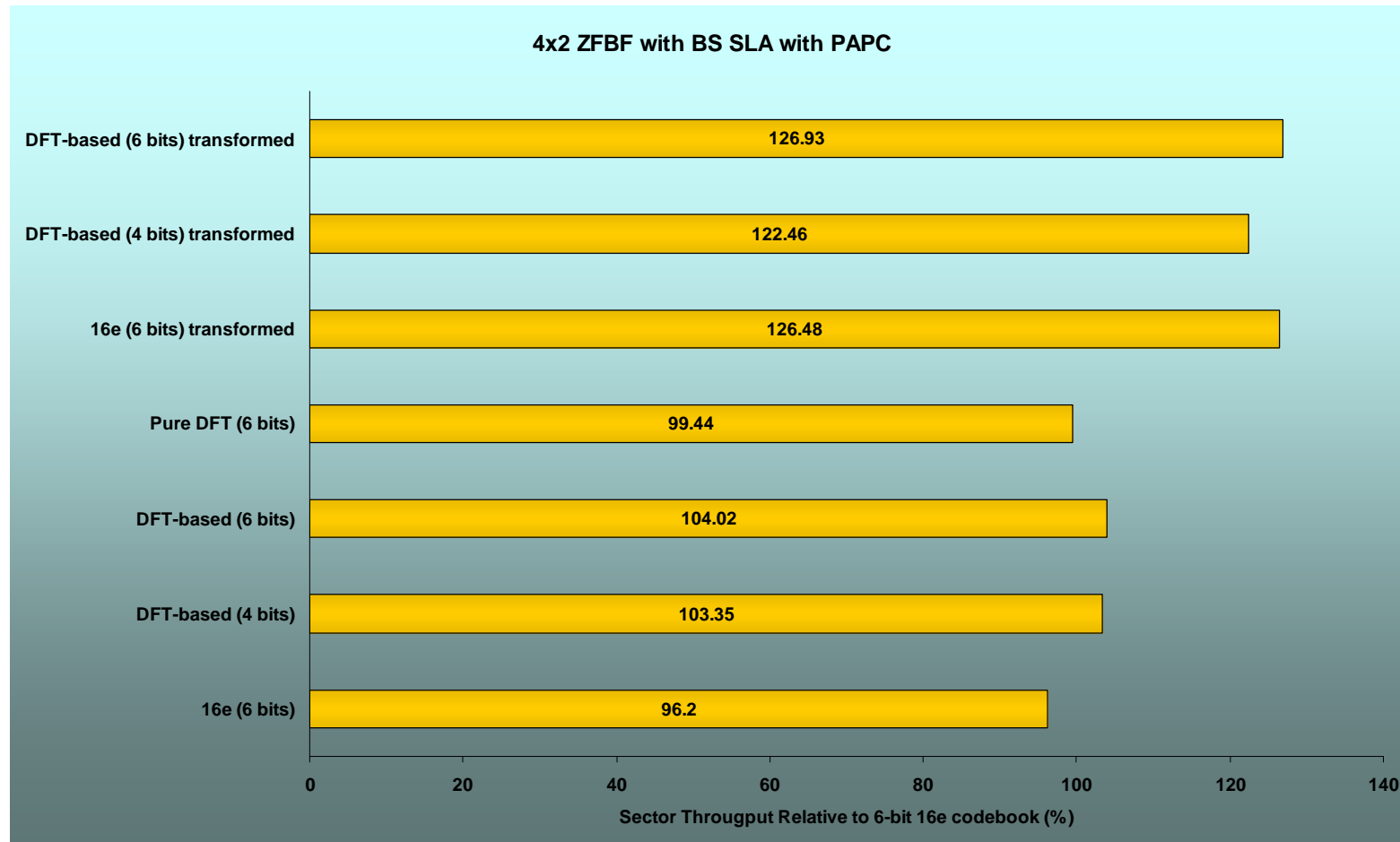
ULA with 1/2 wavelength spacing and per Antenna Peak Power Limitation



Transformed 6-bit DFT-based codebook provides the best performance

# Sector Throughput of ZFBF in DL 4x2

SLA with per Antenna Peak Power Limitation



Same trend as in correlated channels

# Conclusions

- 6-bit DFT-based codebook offers the most robust performance in all channels among all non-transformed codebooks
- Transformed 6-bit DFT-based codebook offers the best performance in all channels
- We recommend that 802.16m considers a 6-bit DFT-based codebook as standard codebook

# Proposed SDD Text Changes

Page 83 line 2

- Replace "For codebook based precoding, the codebook will be a .16e-based and/or DFT-based codebook."
- By "For codebook based precoding, the codebook is a DFT-based codebook."

Page 83 line 40

- Replace "The standardized codebook will be a .16e-based and/or DFT-based codebook"
- By "The standardized codebook is a DFT-based codebook"