

FULL STACK 5G PHYSICAL LAYER TRANSCEIVER Design for NOMA in Mobile Heterogeneous Networks

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Supervision Team

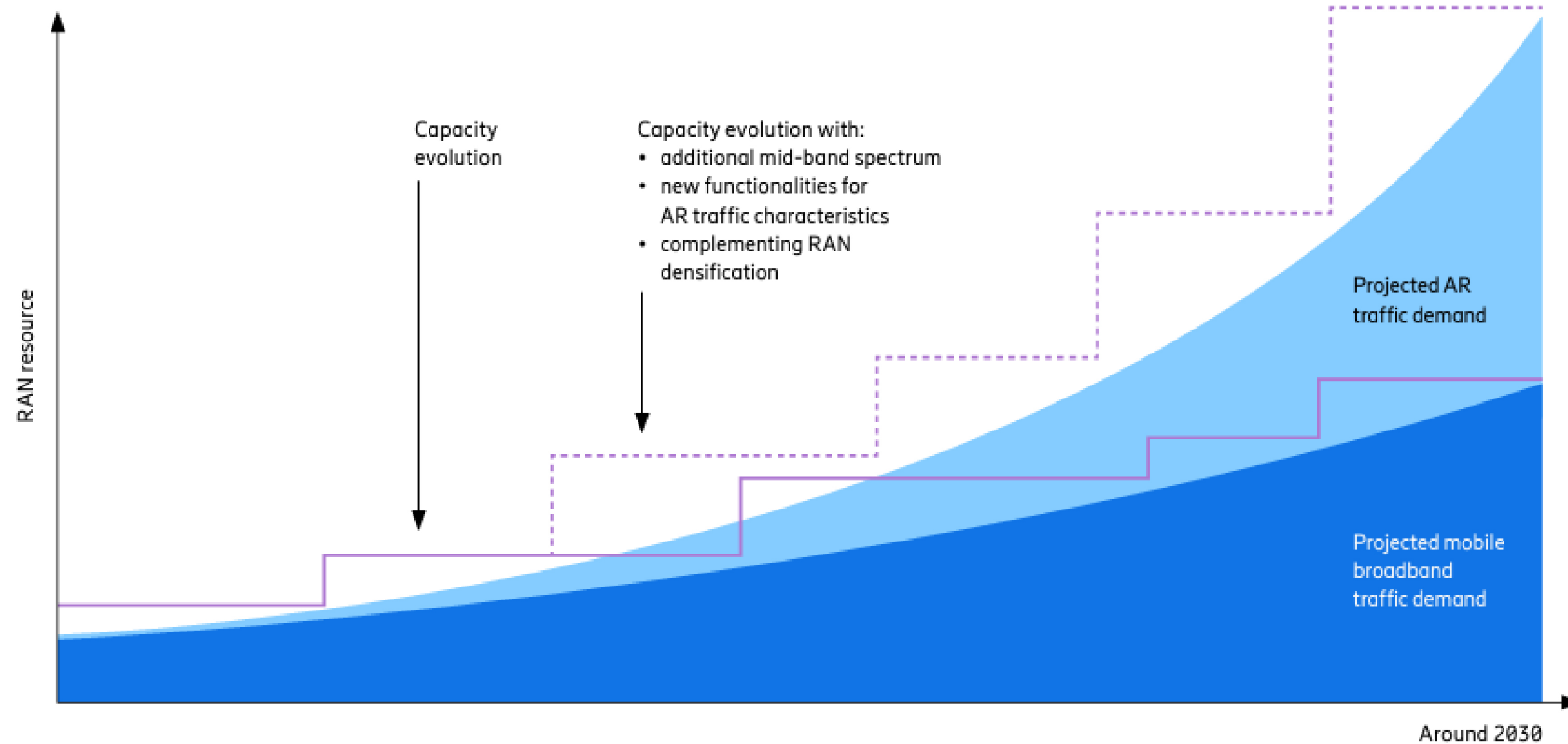
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Prof. Cham Athwal

Prof. Taufiq Asyhari

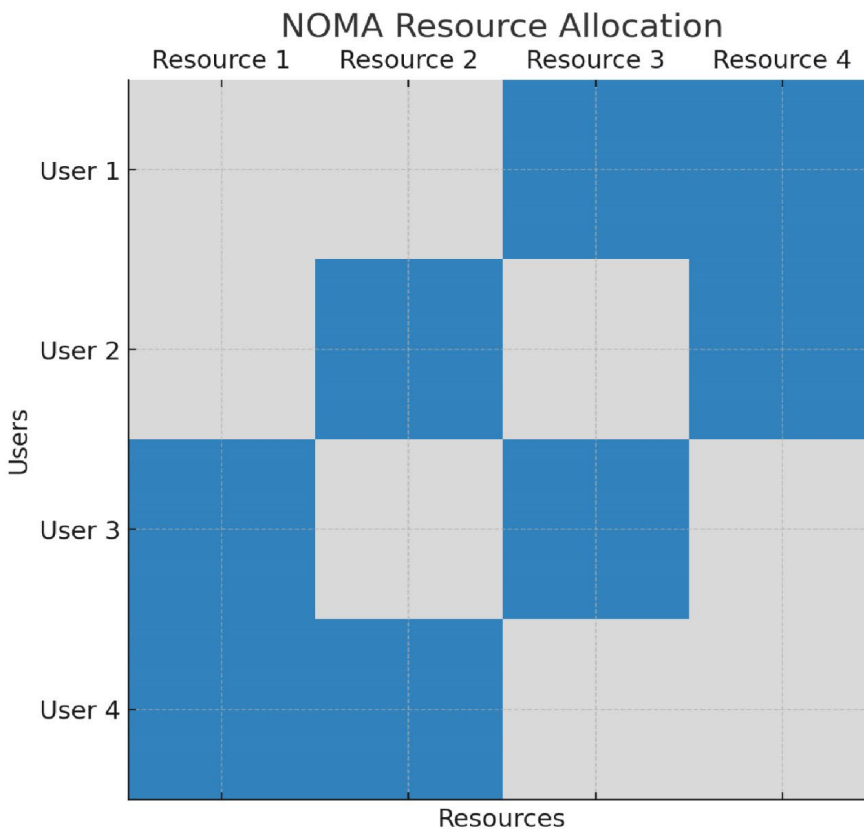
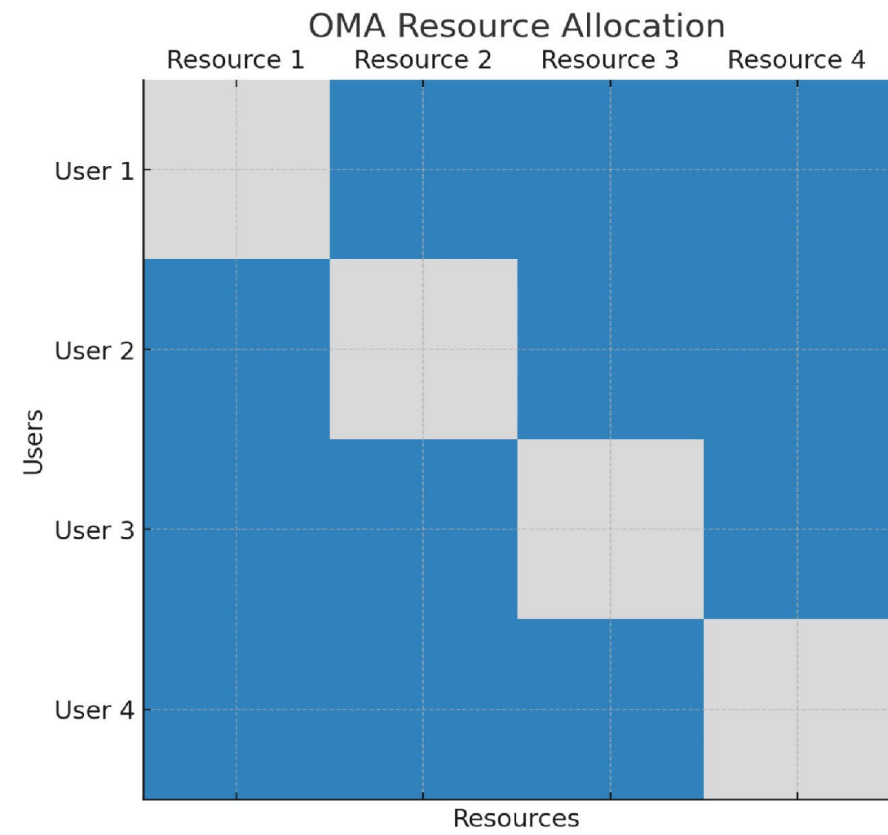
Prof Mohammad Patwary

Future Heterogenous Network Usages & Demands



Traffic Growth and Capacity Evolution Prediction (Ericsson Mobility Report 2023)

OMA VS NOMA



OMA Transmission
(5 Channel, 5 User)

Channel 5: User 5

Channel 4: User 4

Channel 3: User 3

Channel 2: User 2

Channel 1: User 1

NOMA Transmission
(5 Channel, 10 User)

Channel 5: User 9 & 10

Channel 4: User 7 & 8

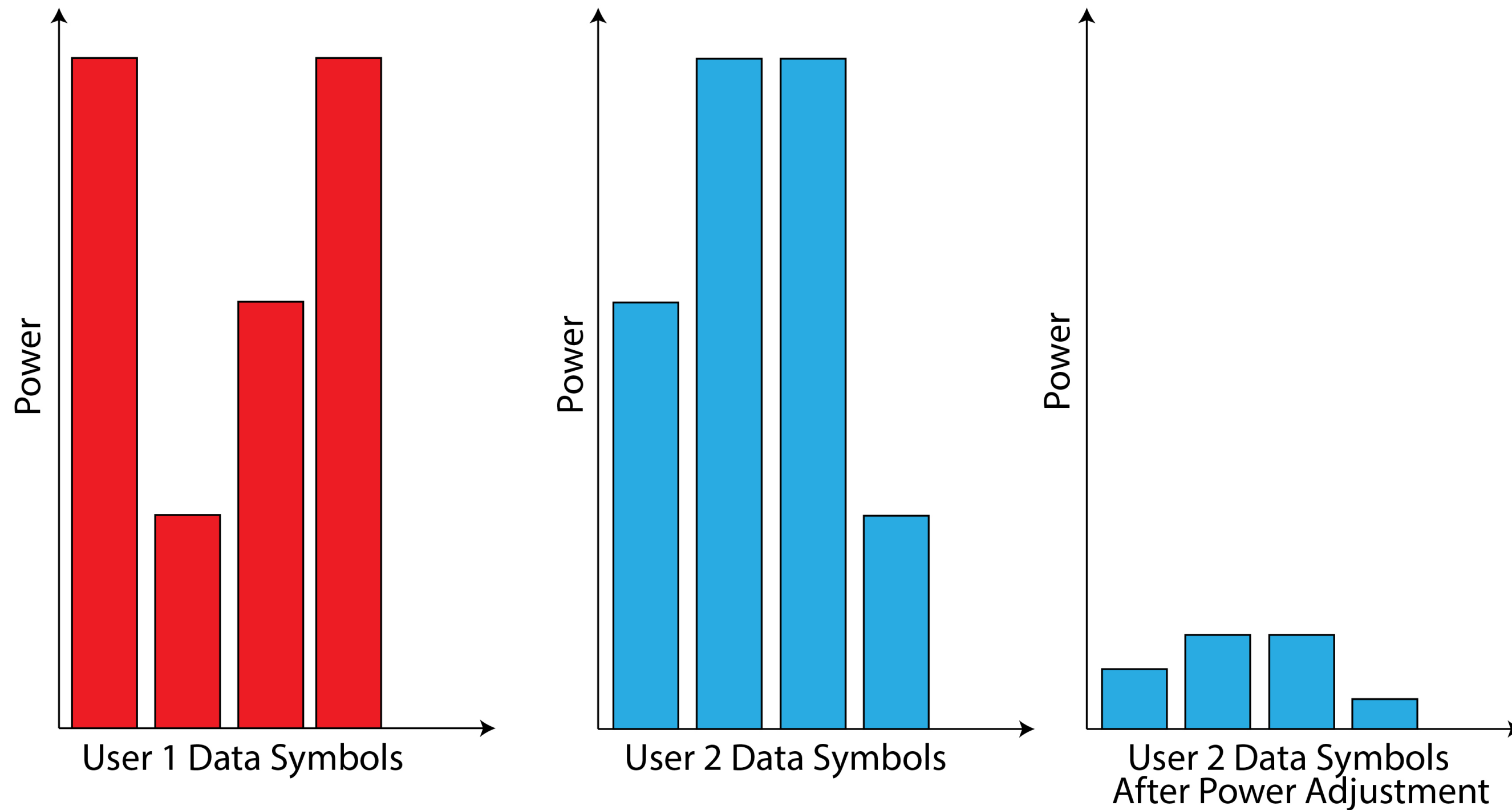
Channel 3: User 5 & 6

Channel 2: User 3 & 4

Channel 1: User 1 & 2

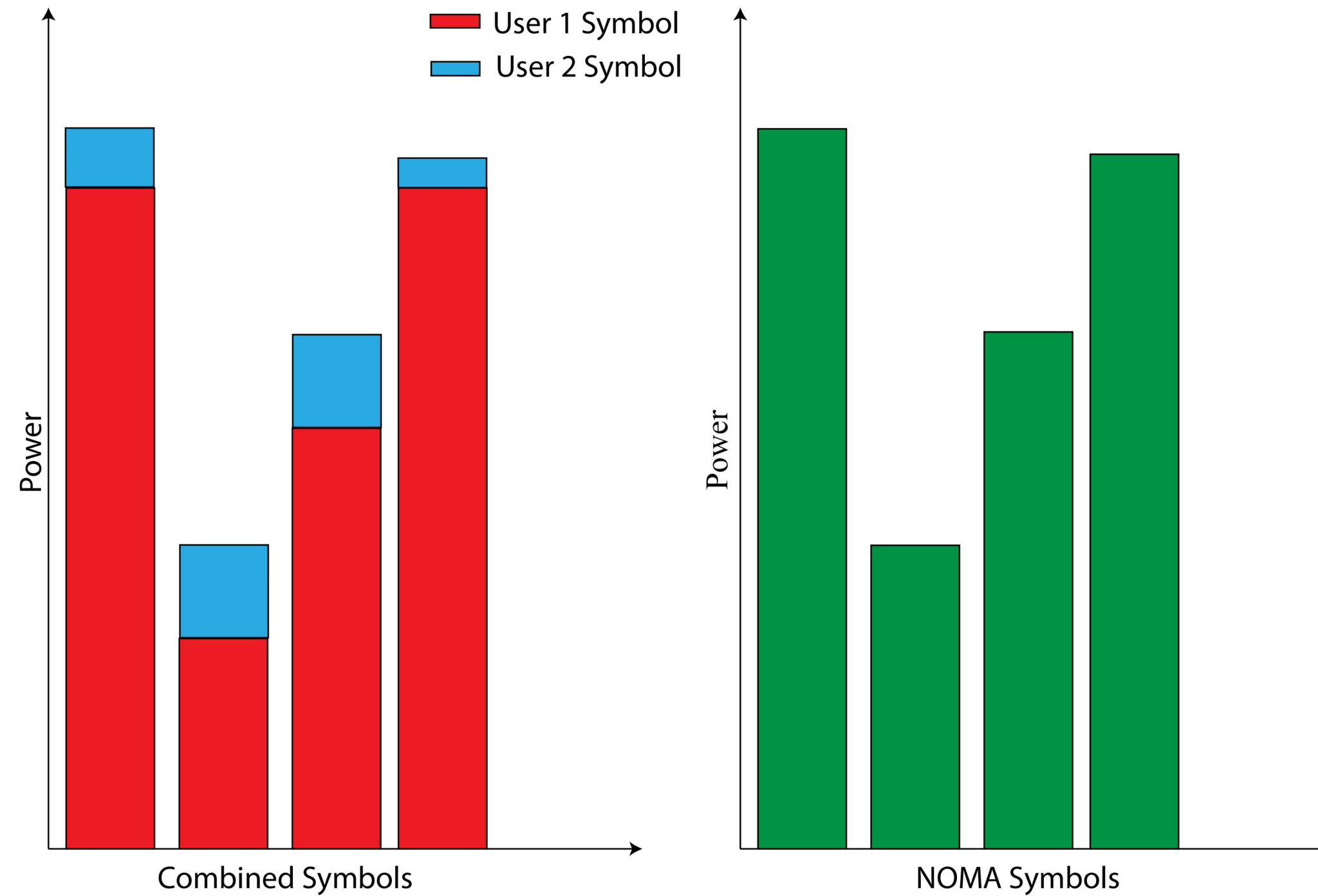
NOMA Transmission Data Preprocessing

Power of User 2 depends on Condition and Requirement of User 1 and User 2.

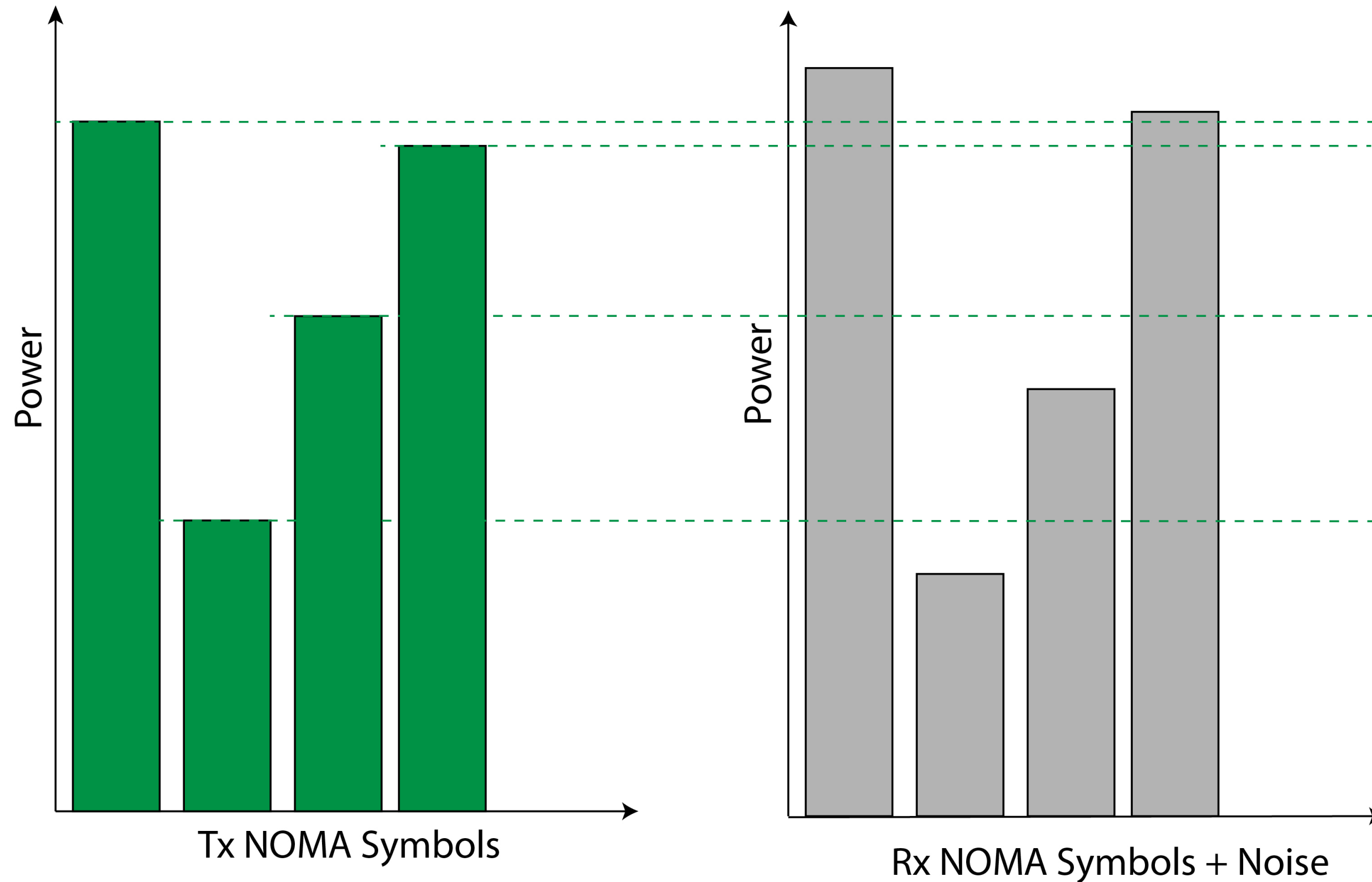


NOMA Transmission Multiplexing

How to efficiently design a multiplexer for N NOMA user?

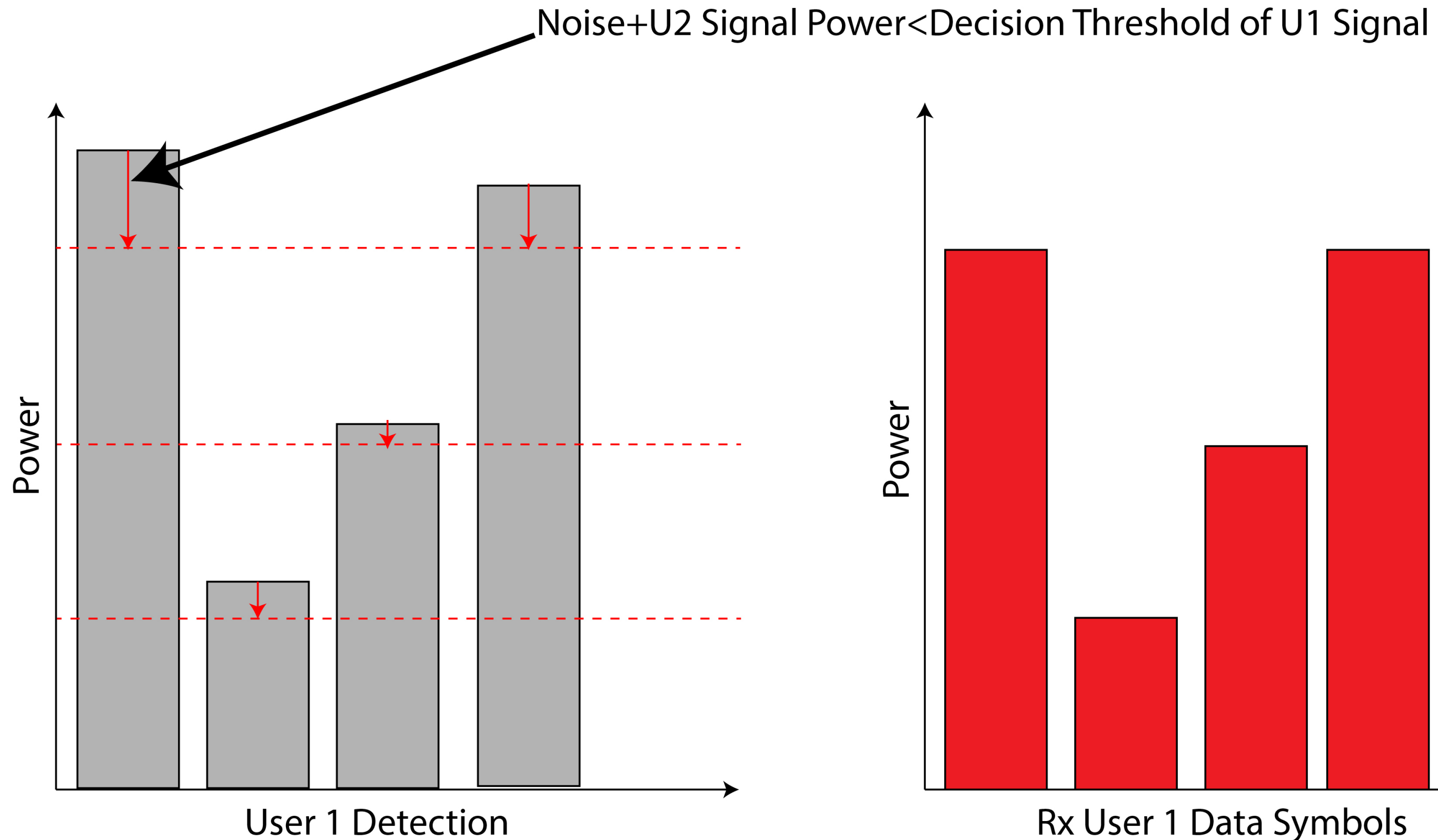


NOMA Detection Received Signal



NOMA Detection

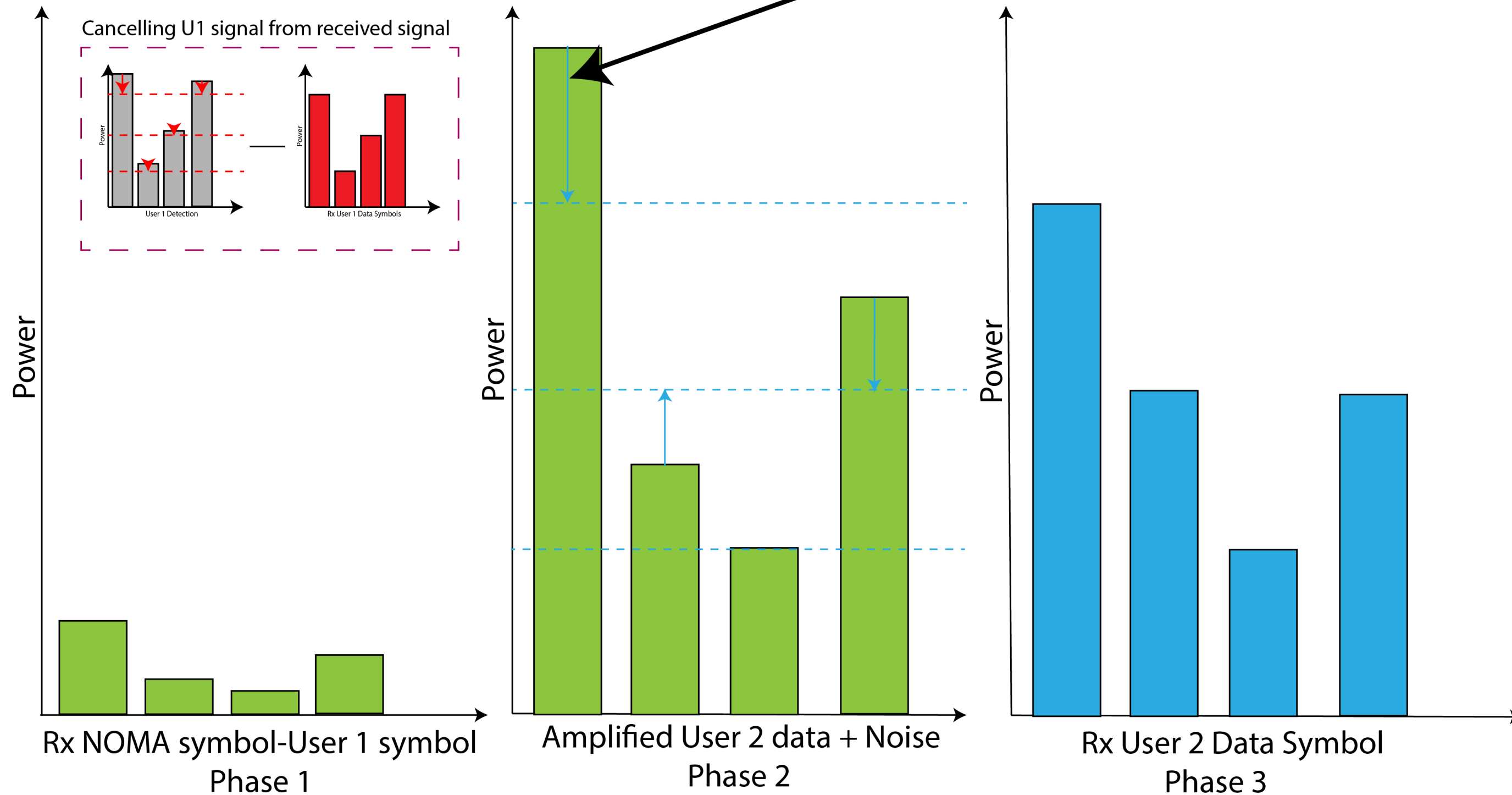
User 1 Data Detection



NOMA Detection

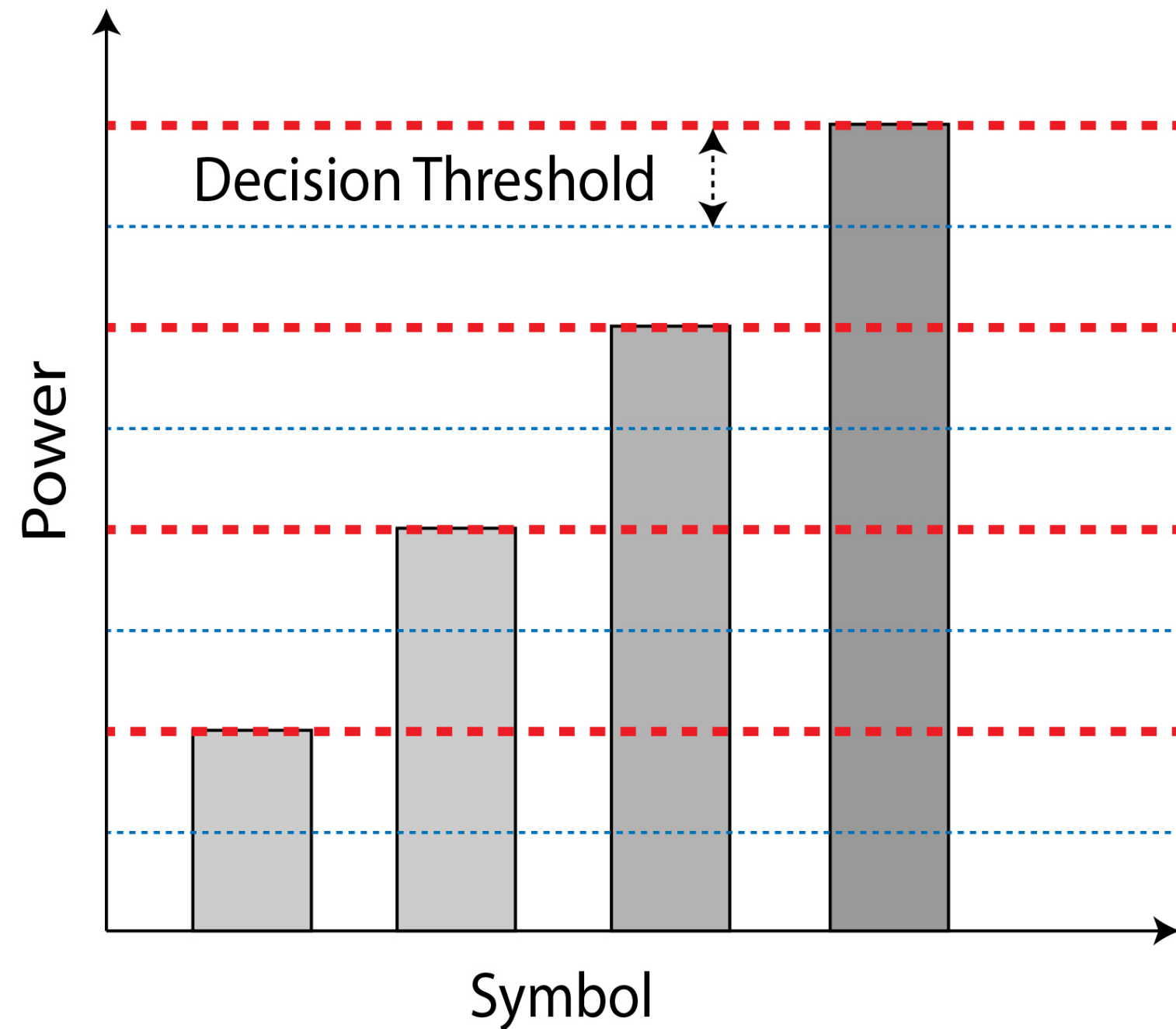
User 2 Data Detection (SIC)

Noise X Power amplifier < Decision Threshold of U2 Signal



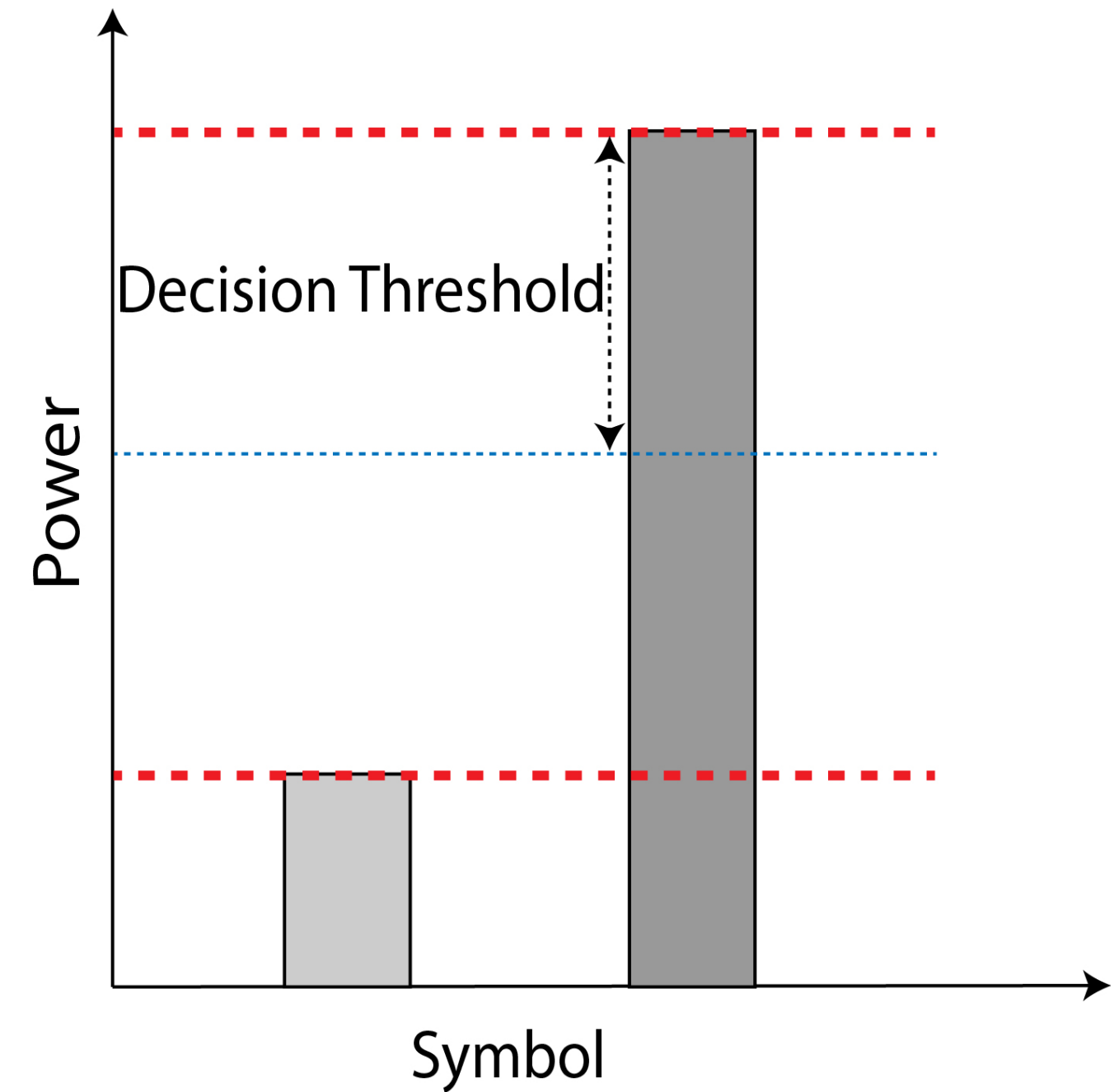
Modulation Order & Noise Tolerance

Modulation Order 4

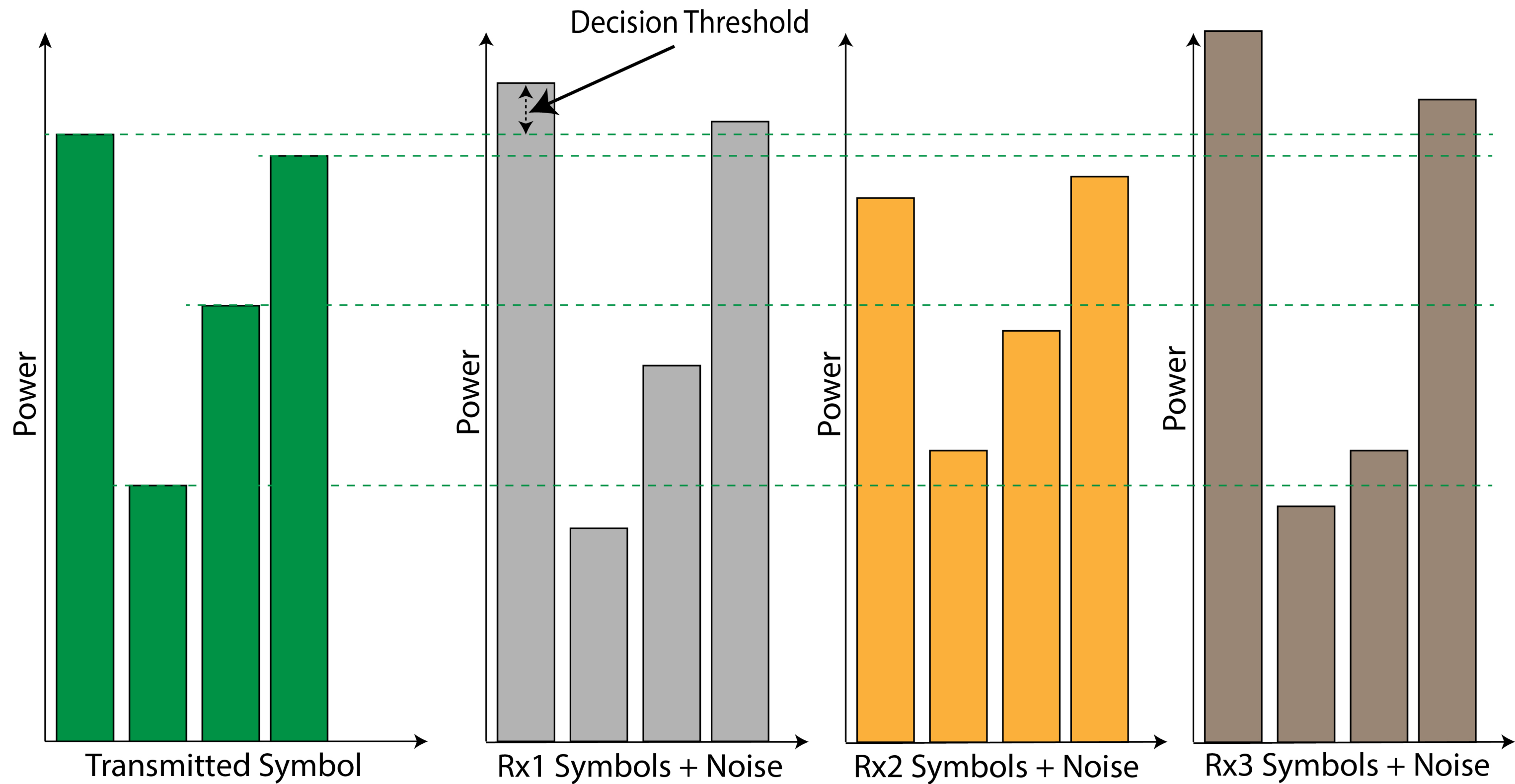


Symbol Power

Modulation Order 2

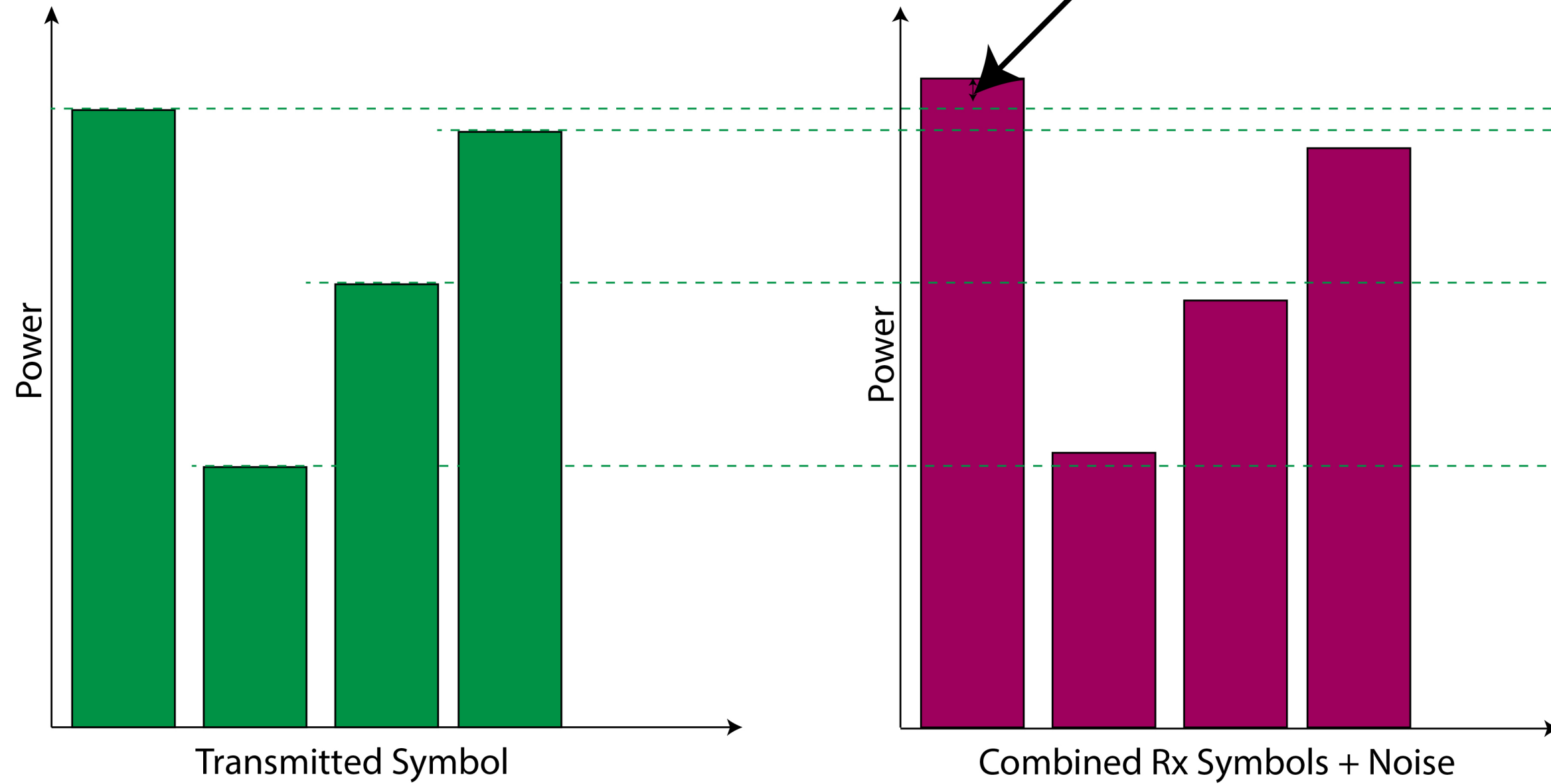


MIMO & Noise Tolerance



MIMO & Noise Tolerance

Lowers the effective Noise
Can have positive impact on NOMA performance
Allow more power for superimposed NOMA layer

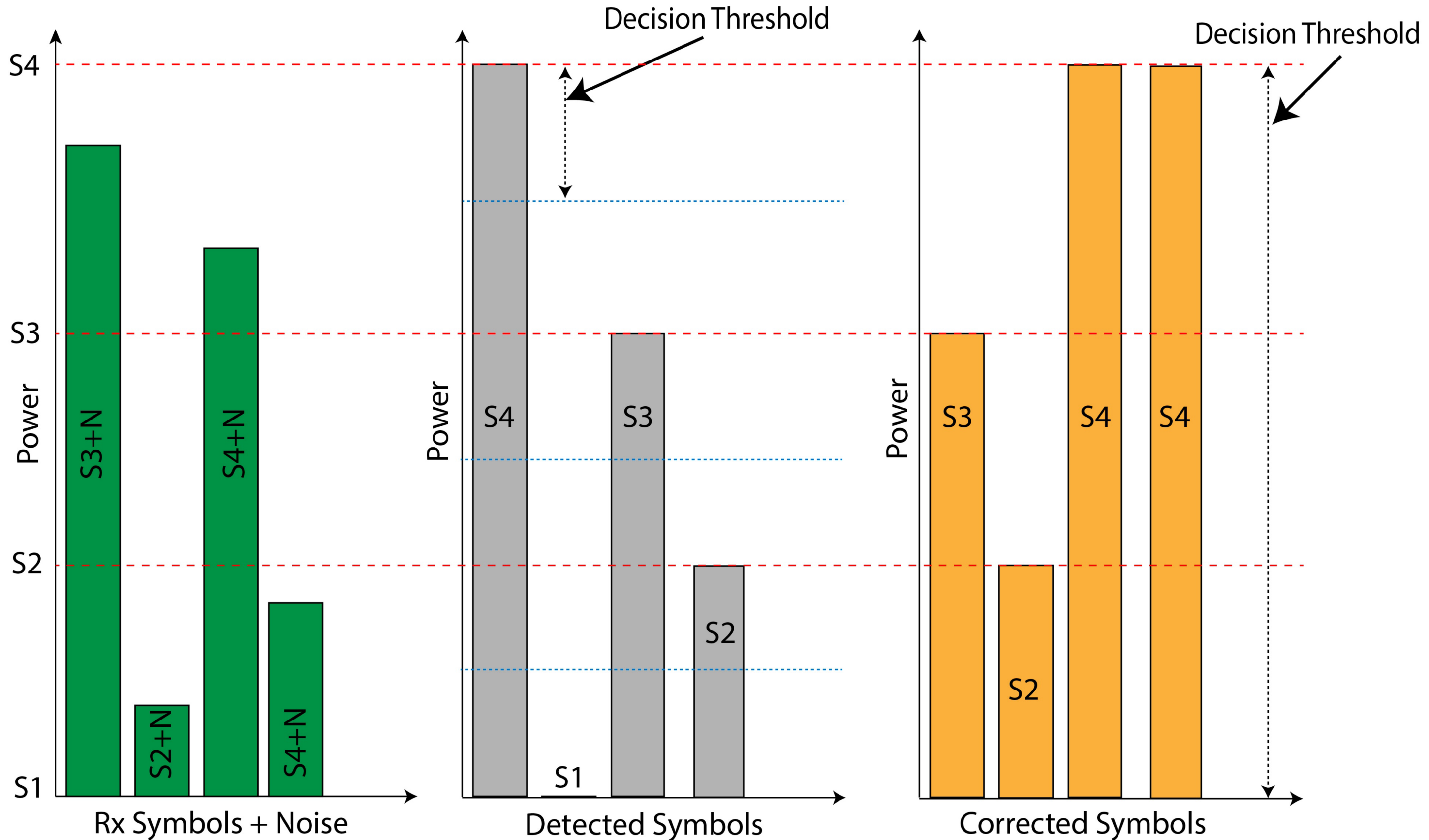


Channel Coding & Noise Tolerance




Channel Coding & Noise Tolerance

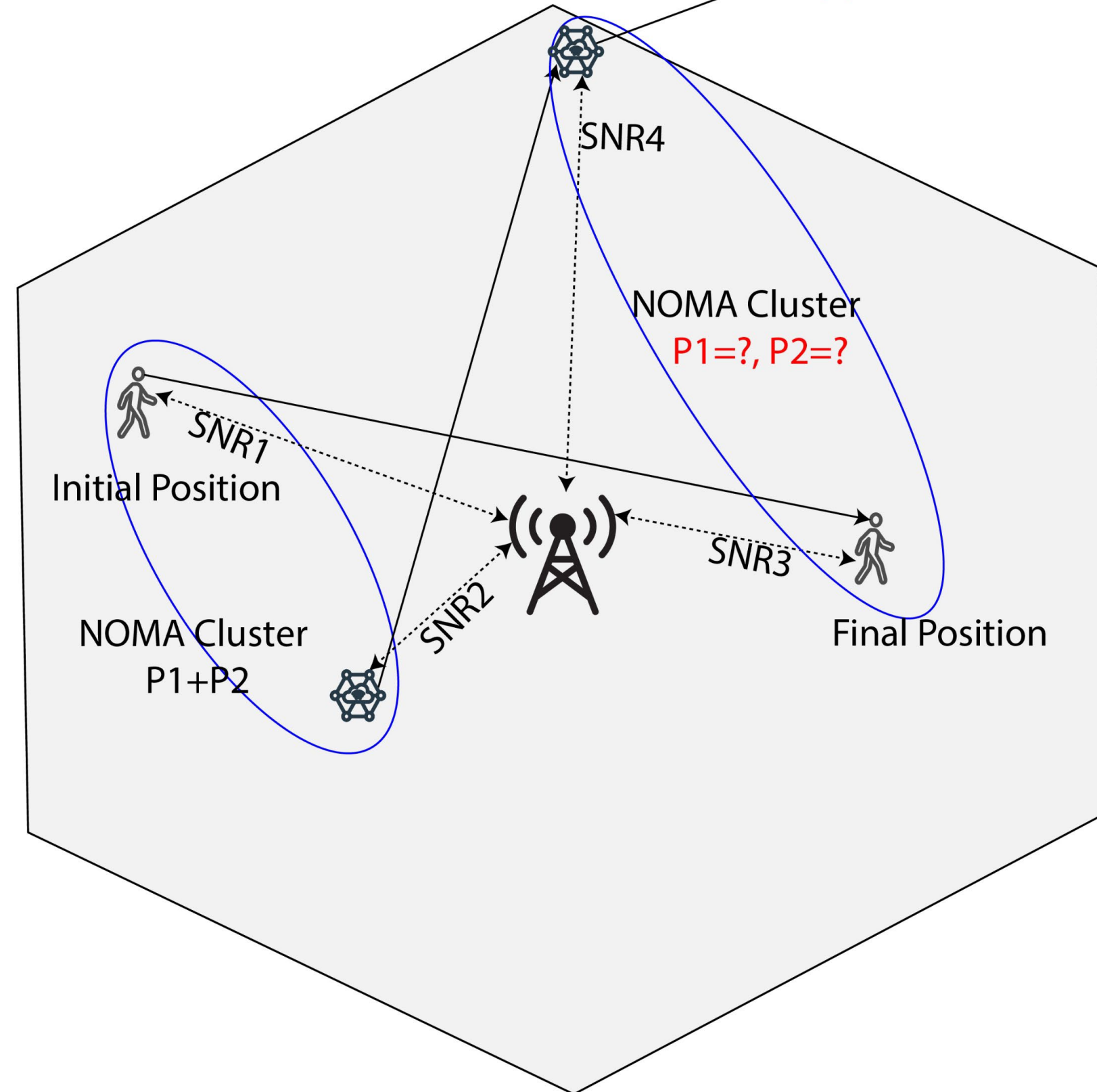
Channel Coding Provide error correction capability



NOMA for Mobile Unicast Transmission

LDM is Applied in ATSC3.0 Broadcasting.
What are the challenges for Unicast Transmission?

 How to manage the NOMA Cluster now?



My Thesis

- Combined factors such as modulation order, MIMO levels, and channel coding achieves higher performance at low SNR, offering a wider degree of freedom in terms of power allocation and number of NOMA layers.
- Quantifying the impact of both residual and non-residual NOMA interference, along with MIMO gain, in the NOMA-OFDM BER analytical model, enhances the prediction of BER.
- Incorporating receiver mobility and fast-fading channel considerations into the NOMA power allocation strategy enhances the sustainability of the NOMA cluster in unicast transmissions."

PUBLICATION

- M. S. Islam, R. Abozariba, D. Mi, M. N. Patwary, D. He and A. T. Asyhari, "Design and Evaluation of Multi-Layer NOMA on NR Physical Layer for 5G and Beyond," in IEEE Transactions on Broadcasting [**Published-Early Access**] **[Chapter 4]**
- M. S. Islam, M. Patwary, R. Tait and E. Peytchev, "Layer division multiplexing for 5G DL transmission within ultra-dense heterogeneous networks," 2020 IEEE 91st Vehicular Technology Conference (VTC2020-Spring), Antwerp, Belgium, 2020 [**Published**] **[Chapter 3]**
- M. S. Islam, R. Abozariba, A. T. Asyhari, M. Patwary, and M. A. Matin, "Feasibility of LDM to Serve User-IoT 2 Pairs in the Future Wireless Network," in A Glimpse Beyond 5G in Wireless Networks, Springer Switzerland 2022, ch. 9 [**Published**] **[Chapter 3]**
- M.S. Islam, J. Hayes, R. Abozariba, A. Aneiba, and A. T. Asyhari, "Evaluating NOMA Link Resiliency Under Mobility: A 5G NR Link-level Simulation", 2024 IEEE International Conference on Communications (ICC2024) [**Submitted**] **[Chapter 5]**

Thank You