Non-Uniform Constellation for DTMB system

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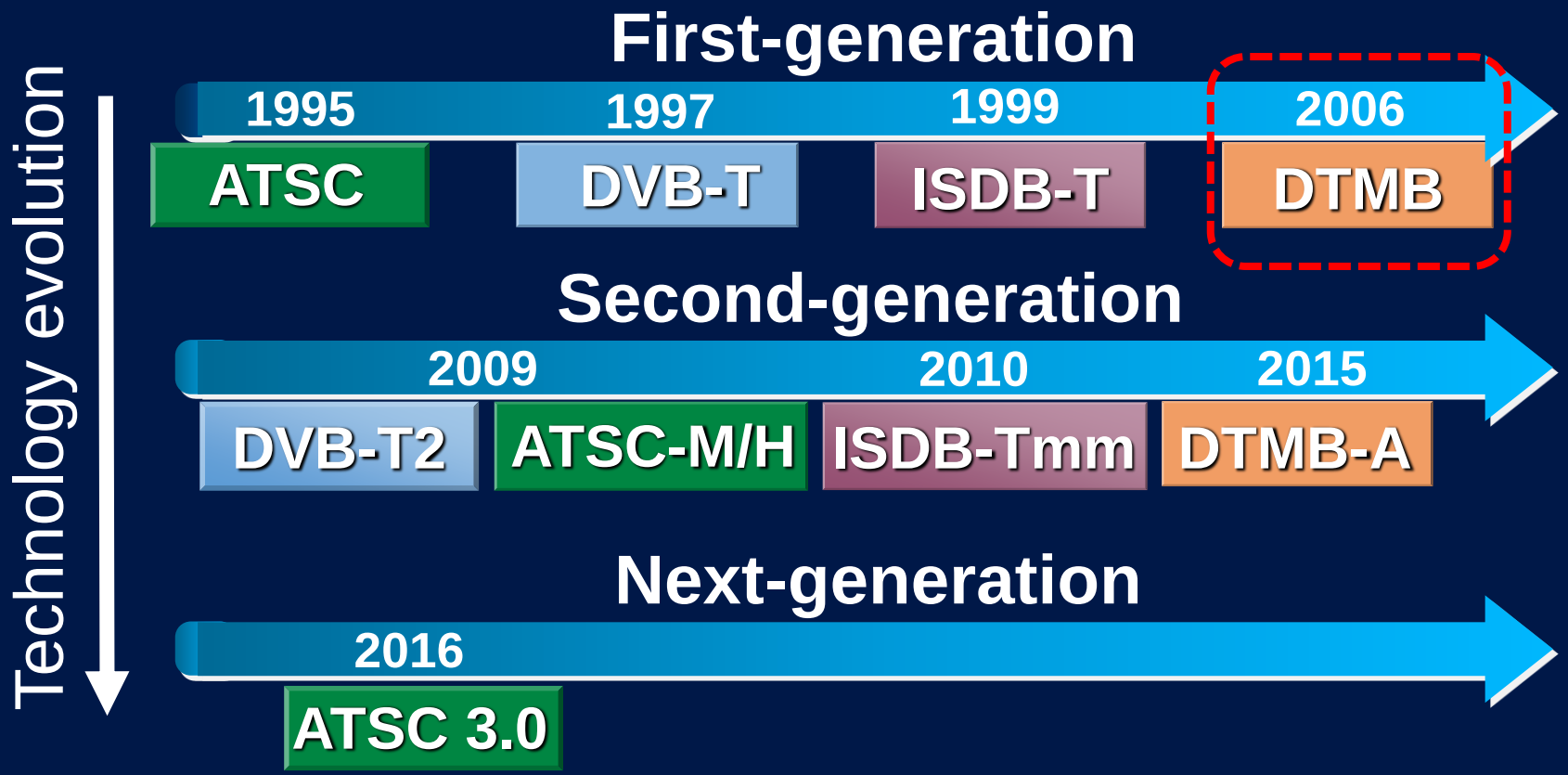
Outline

- Introduction
- Fundamentals of Channel Capacity
- DTMB system model
- Non-Uniform Constellations (1D vs. 2D)
- Design principles
- Simulation results
- Validation and analysis of results.
- Conclusions

DTTB standards evolution



Trends in Broadcasting standards physical layer

Multiple Services over a single broadcast channel

Efficient channel utilization (power, capacity, coverage)

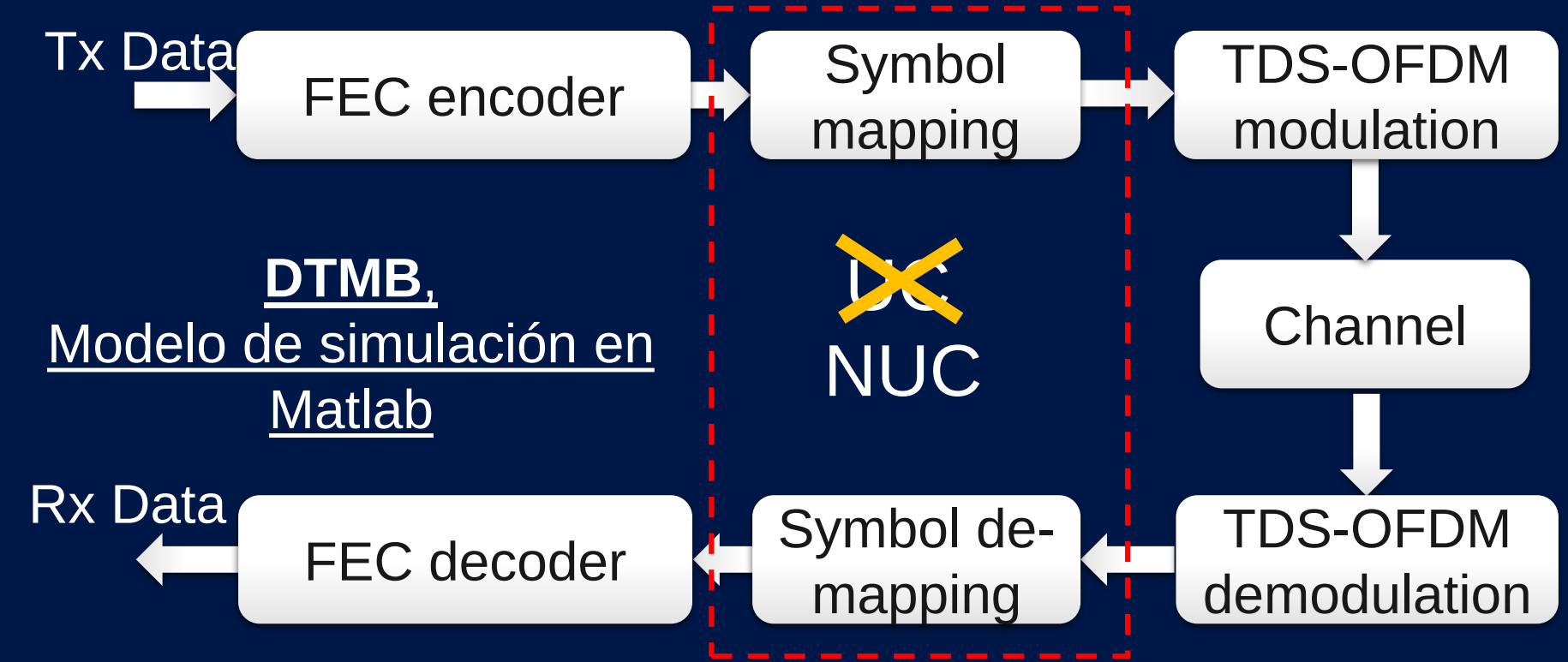
Digital TV and multimedia broadcast

Convergence of Broadcasting and Broadband Communications

Channel Capacity

- Shannon´s limit, C_c

DTMB channel coding and modulation

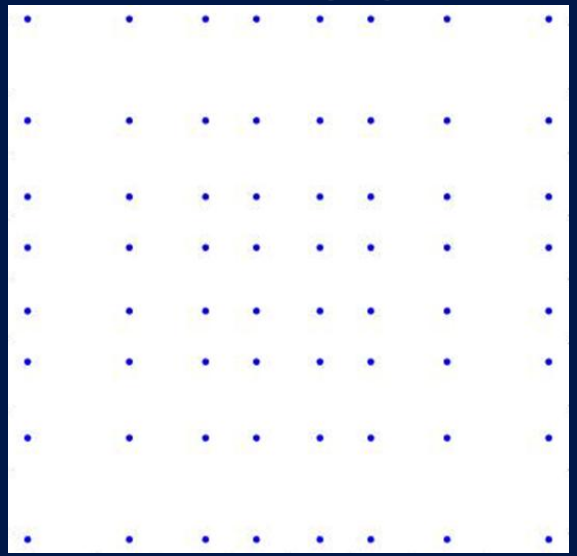


DTMB,
Modelo de simulación en Matlab

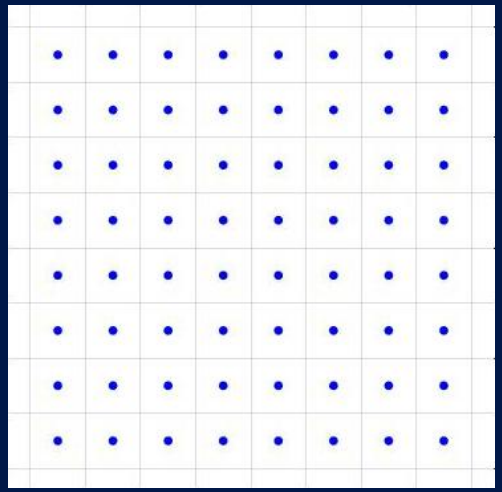
UC: Uniform Constellation

Non-Uniform Constellation (NUC)

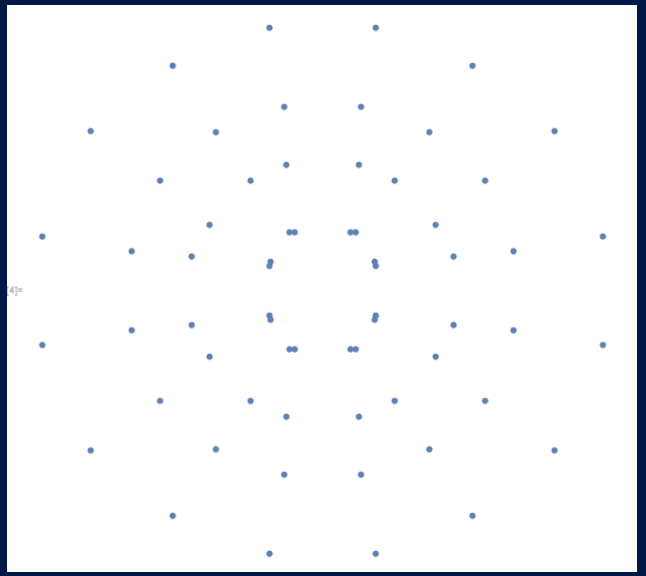
1D-NUC



UC



2D-NUC



X:
Symbol alphabet size.

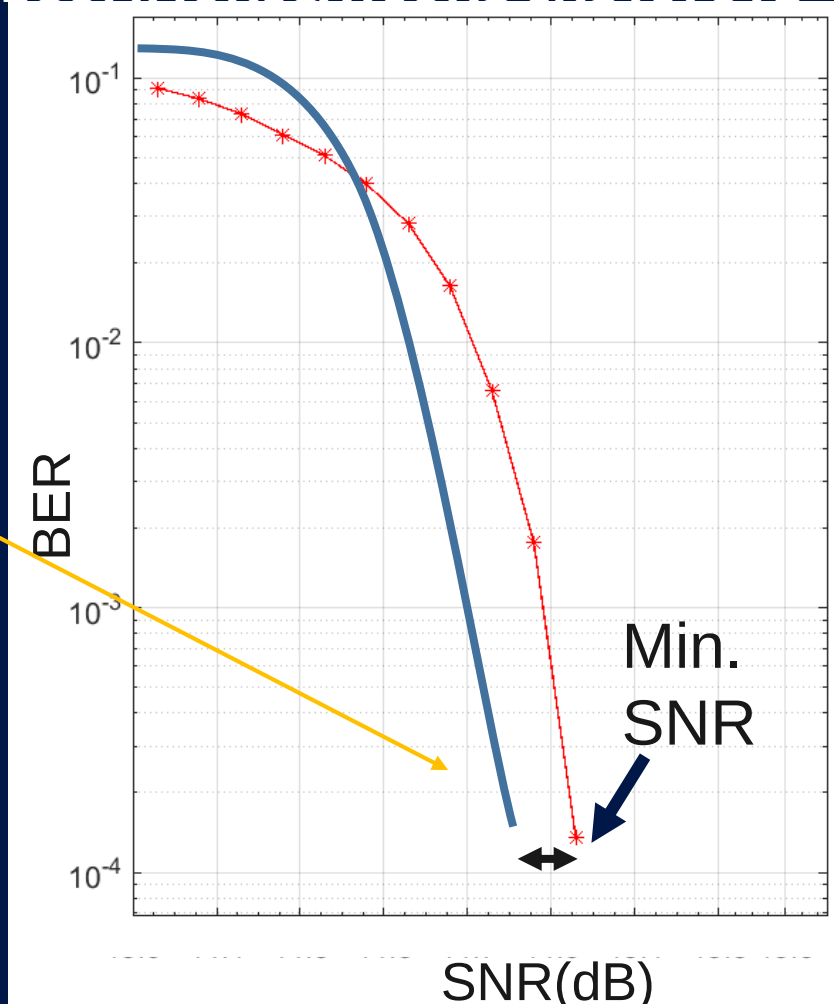
μ:
Constellation geometrical shape.

Design principle of NUCs

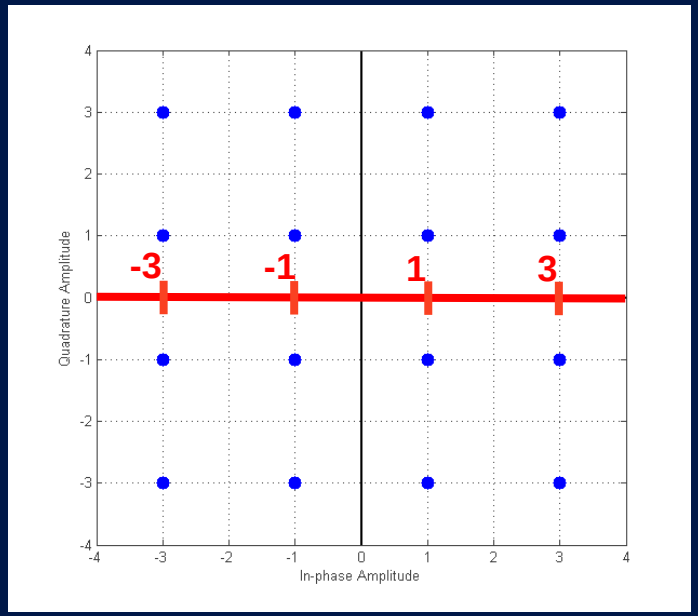
$C_B = f(\mathbb{X}, \mu, SNR)$

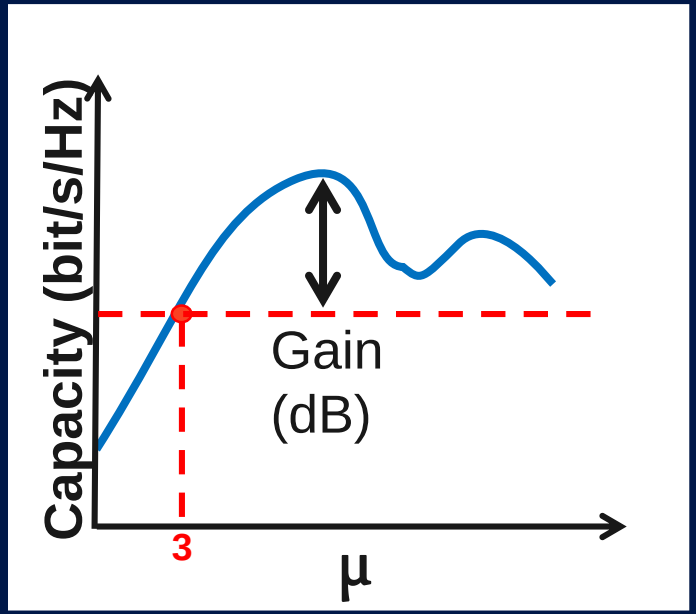
16-QAM
64-QAM
256-QAM

¿ μ ? → maximize → C_B



Design principle of NUCs





$C_B = f(X, \mu, SNR)$

Optimization algorithms

Dimensions		Constellations			
		4-QAM	*16-QAM*	*64-QAM*	*256-QAM*
DOFs	1D	0	1	3	7
	2D	0	6	30	126

Lineal search

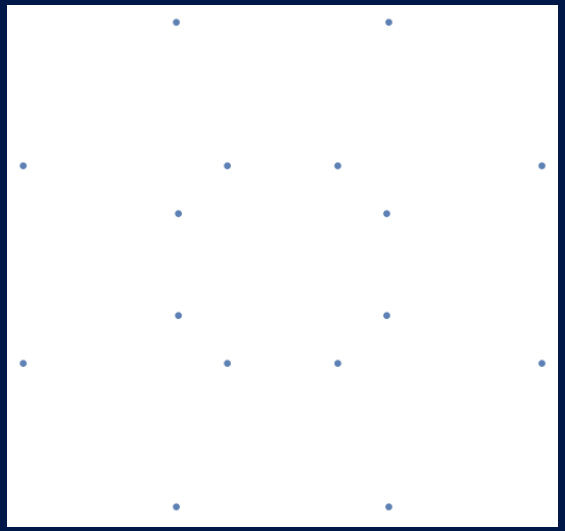
1D NUCS

Gradient search

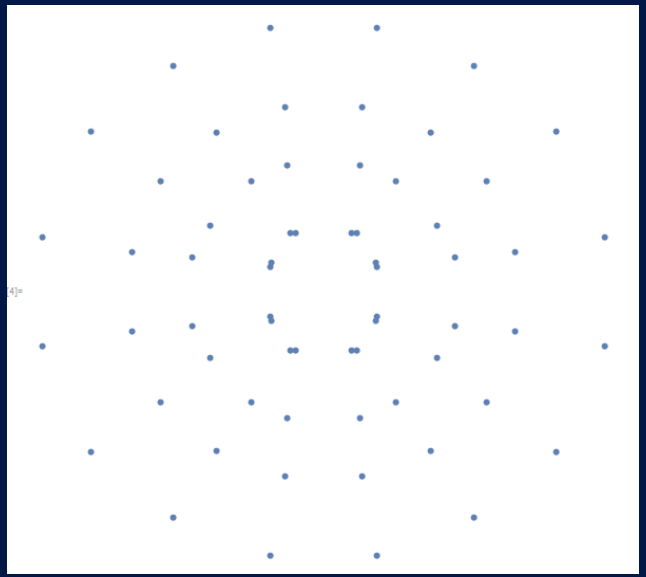
2D NUCS

Particle Swarm Optimization (PSO)

Optimized constellations – 2D NUCs

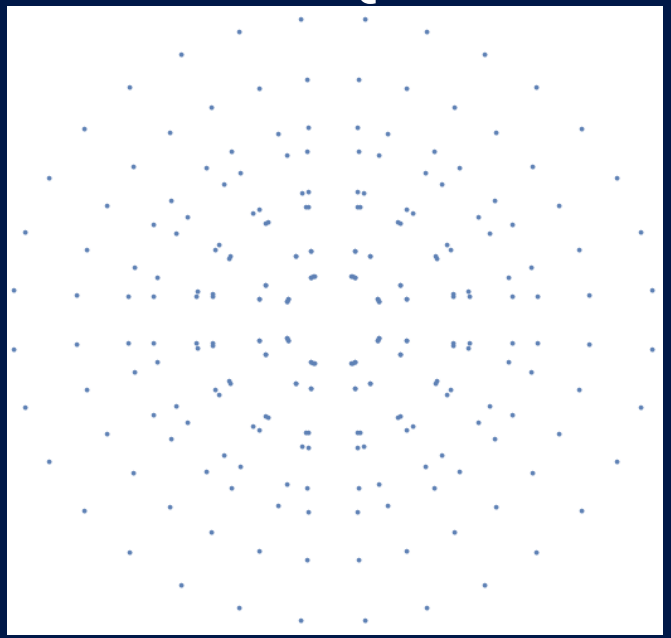


16-QAM



64-QAM

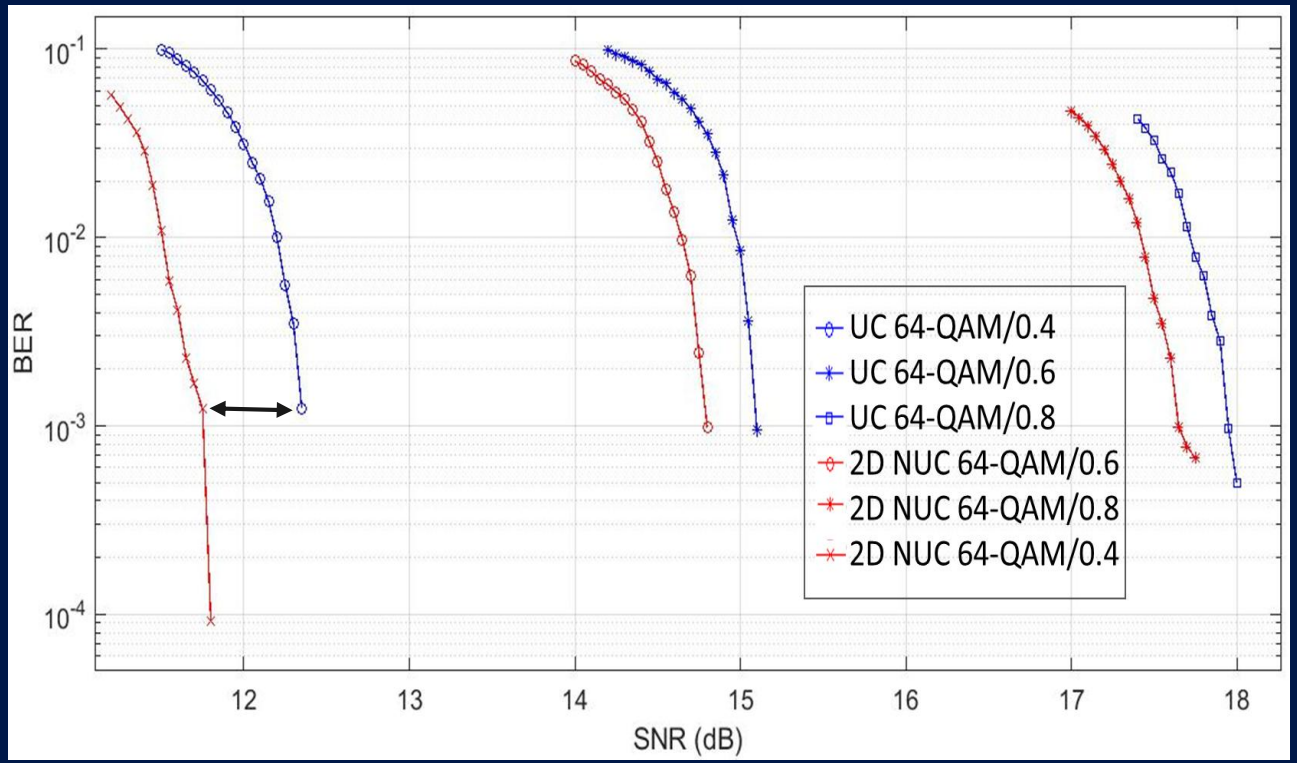
256-QAM



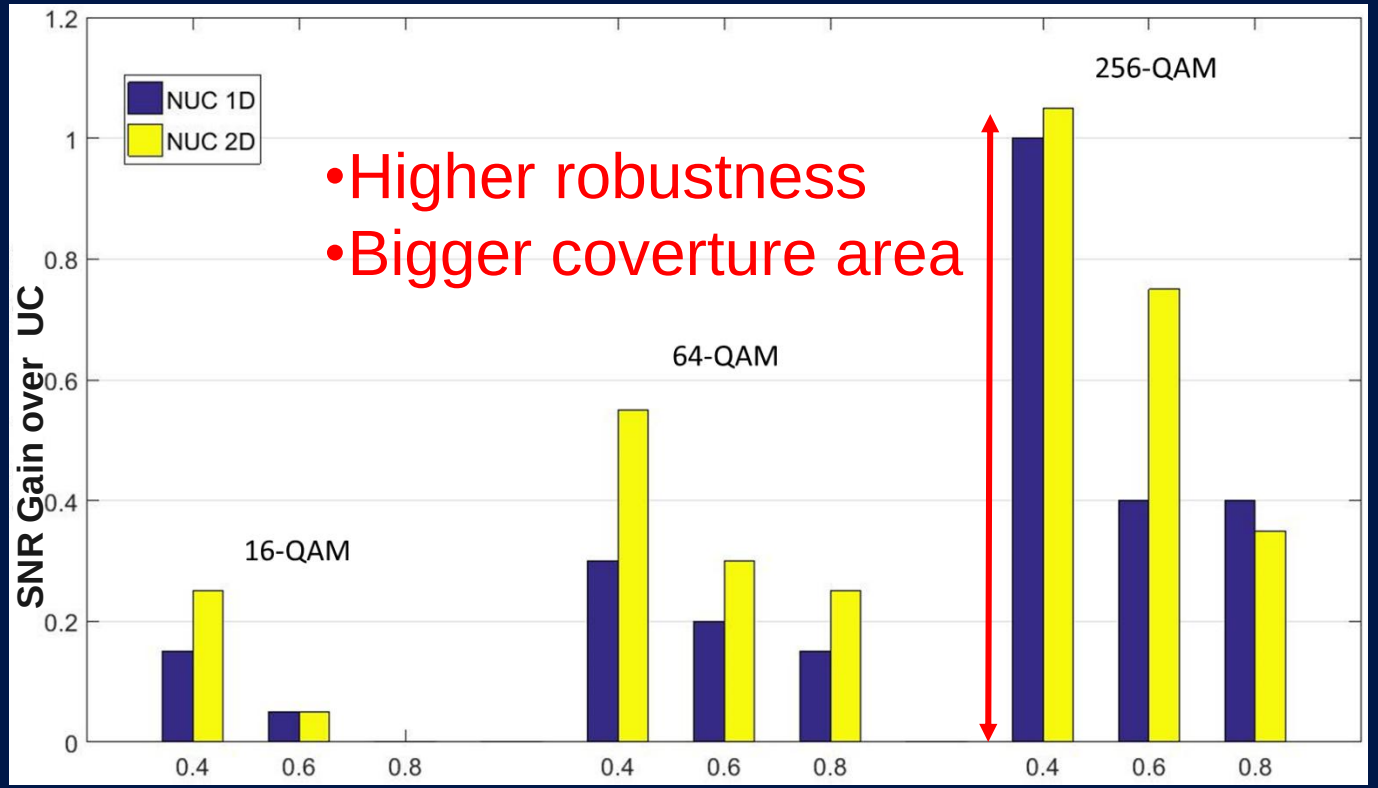
Results validation

- SNR Gain (dB) (Robustness)
- Capacity gain (bit/s/Hz)

SNR Gain of 2D NUCs for 64-QAM



SNR Gain of 1D/2D NUCs over UCs



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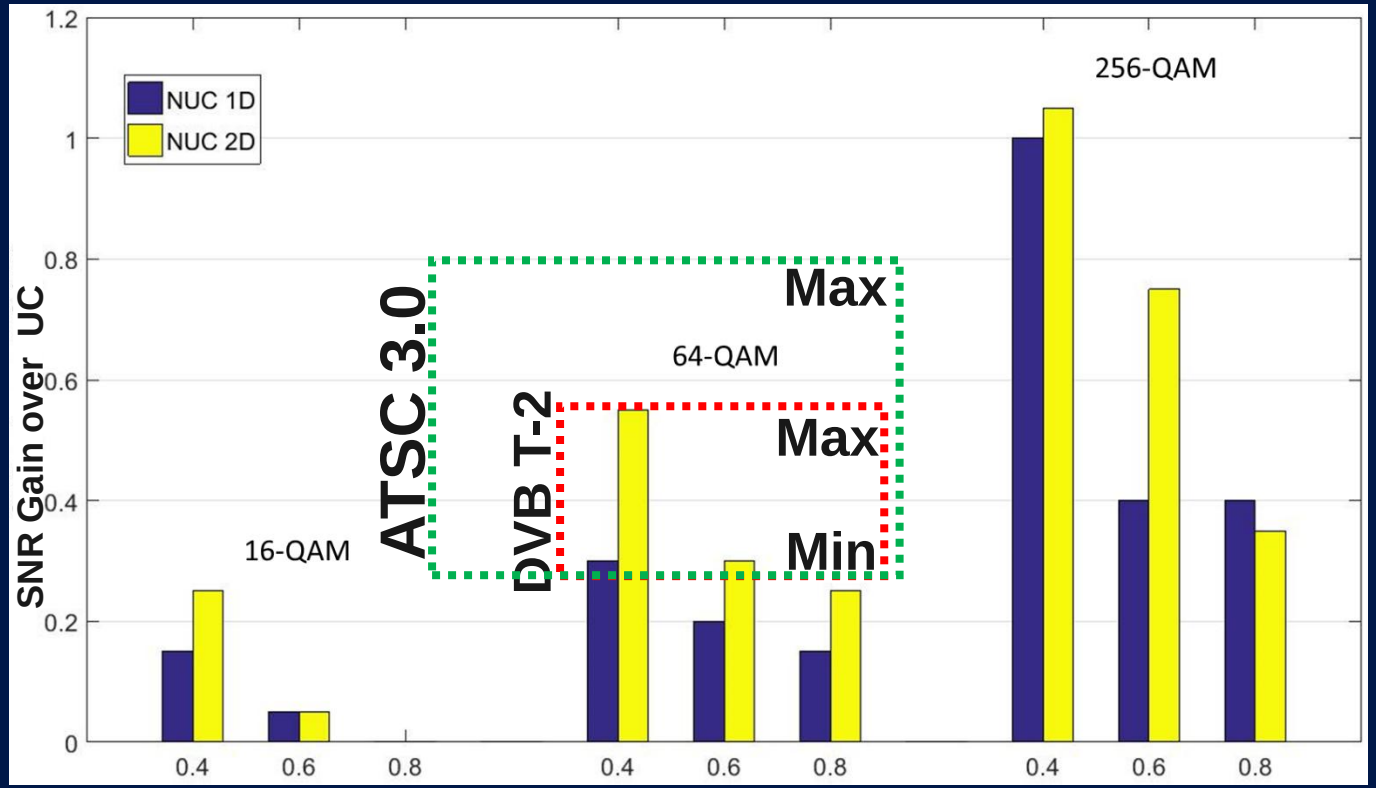

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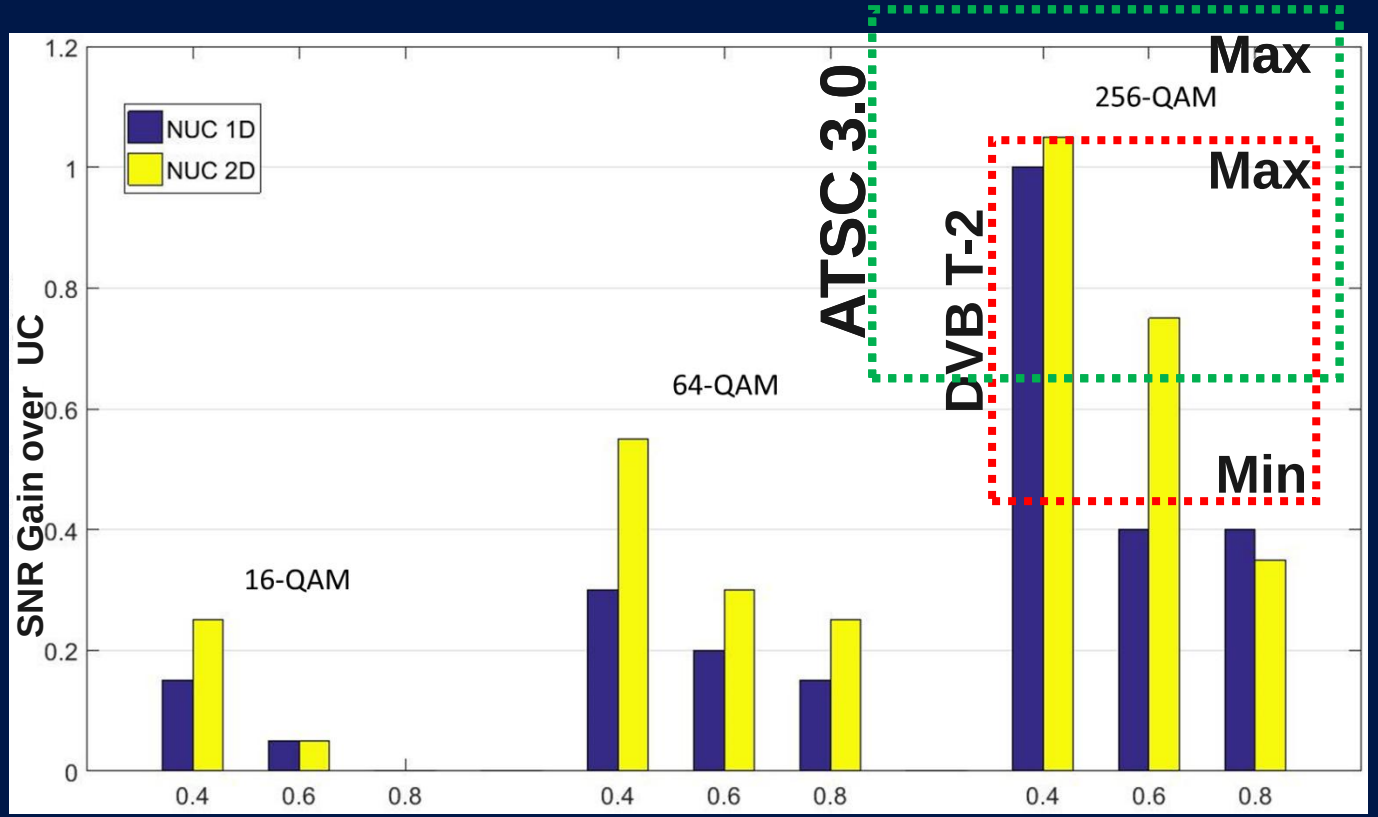
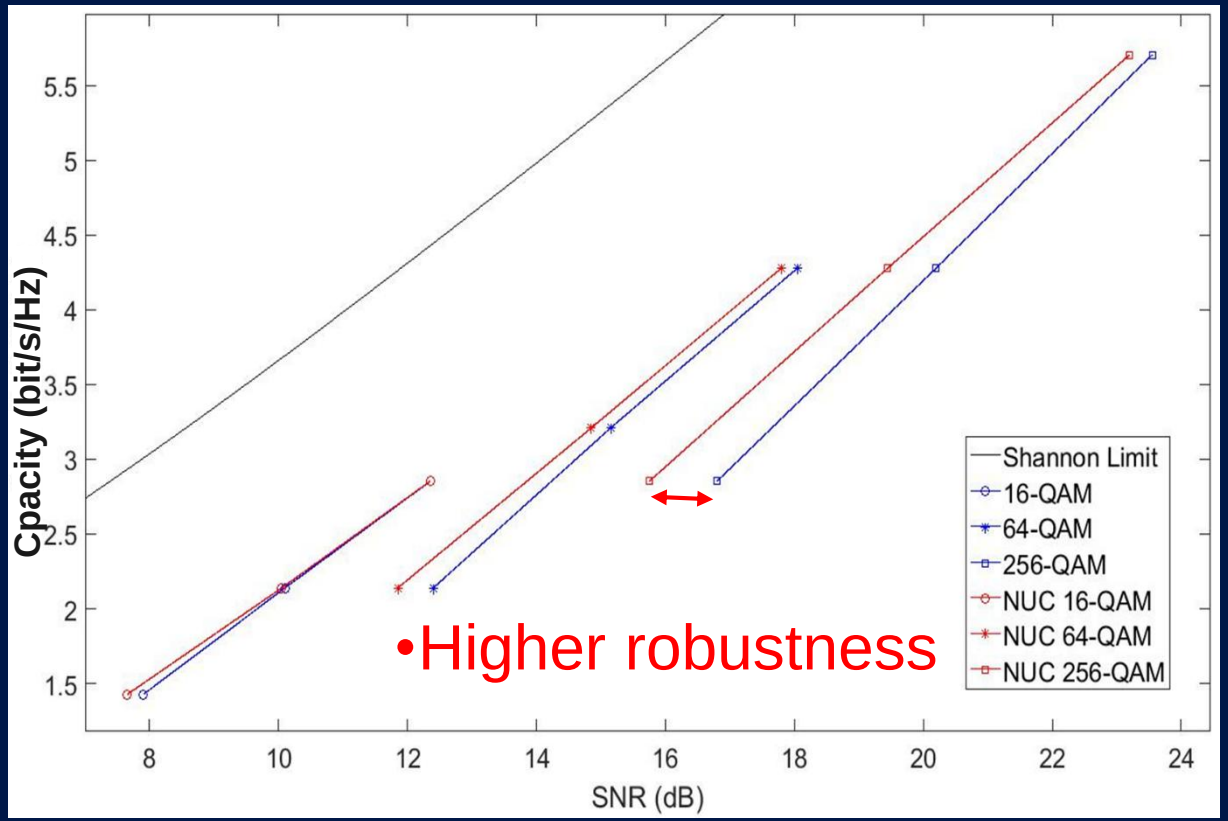


Capacity Gain of NUCs over UC for DTMB



Conclusions

- Different optimization algorithms were implemented for the design of 1D and 2D NUCs.
- SNR Gains of designed NUCs are similar to those in next-generation broadcasting standards.
- Minimum SNR for optimal reception of DTMB system can be lowered by at most 1.1dB, with the application of NUCs.
- In order to approach efficiency of the state-of-the-art broadcasting standard, other techniques should be considered such as the design of better performance FEC codes.

Thank You!