Near-Capacity Achieving Modulation Formats for Optical Transmission Systems

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METRO-ACCESS
& SHORT RANGE COMMUNICATIONS

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Challenge?

Modulation

"…Conveying a message signal, for example a digital bit stream or an analog audio signal, inside another signal that can be physically transmitted…"

Nontrivial problems

1.- Exploring the theoretical limits of capacity

2.- Efficient utilization of existing resources

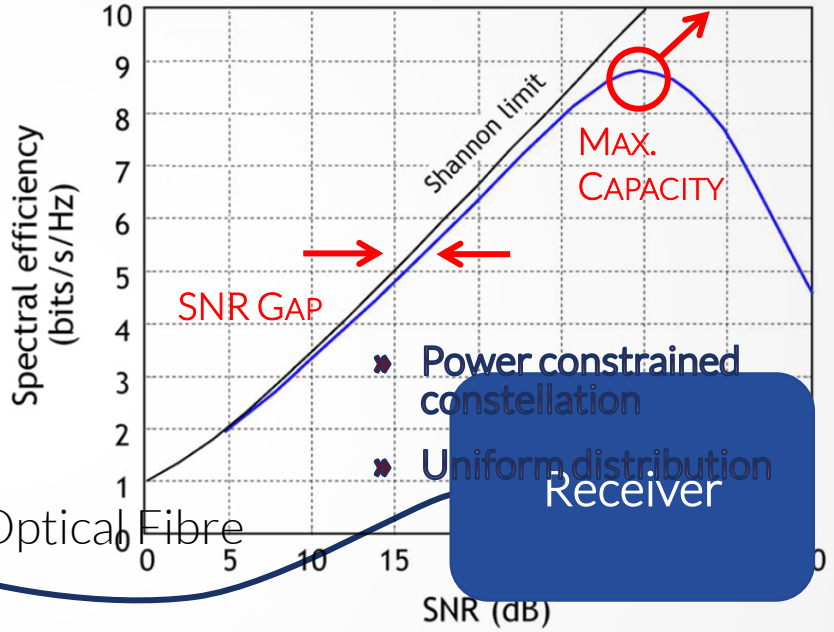
THEORETICAL LIMITS OF CAPACITY…

Channel Capacity

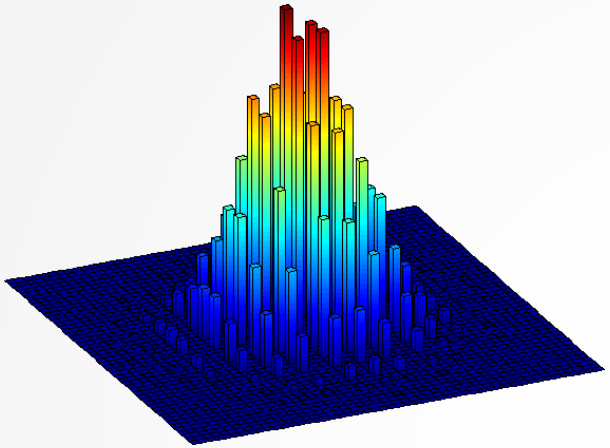
N x N

1. In power-constrained bandwidth-limited AWGN channels, non 2D-Gaussian pose an energy inefficiency → SNR GAP
2. Nonlinearities induce severe power-dependent distortions → MAX. CAPACITY

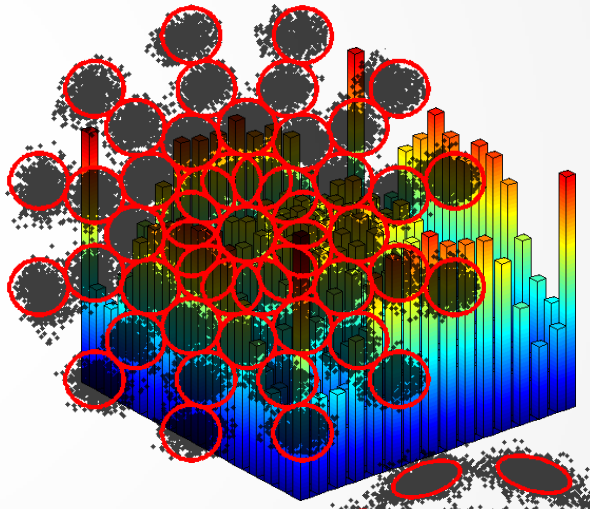
CONSTELLATION SHAPING



Constellation Shaping

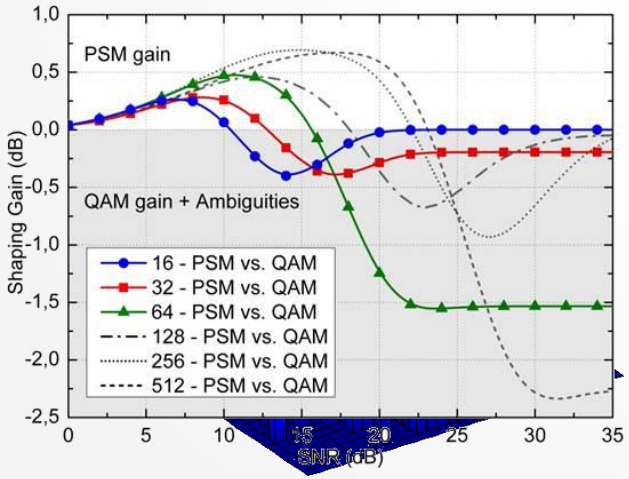


Additive White Gaussian Noise



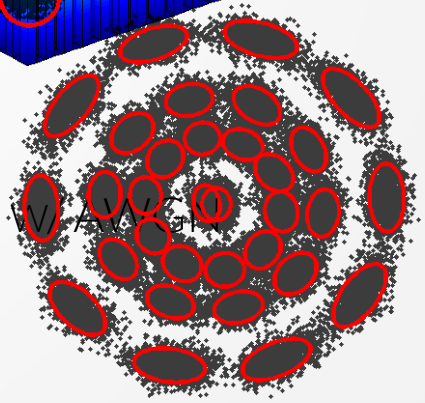
Experimental Demonstration of Capacity-Achieving Phase-Shifted Superposition Modulation → ECOC'13 & JLT'14

Gaussian Distributed Phase Noise



BER=0 for 300000+ bits

Self-Phase Modulation (SPM)

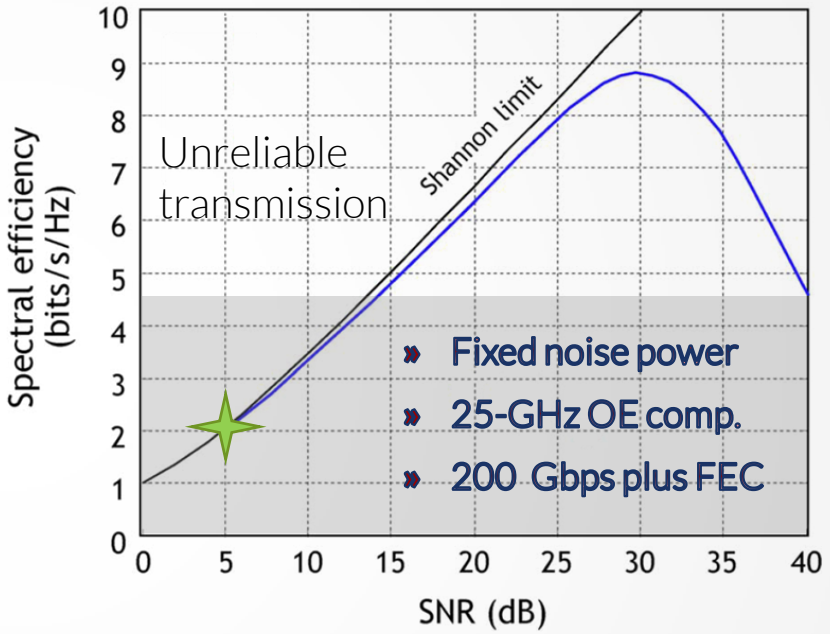


Efficiency Trade-off...

Trade-off

Sensitivity – Spectral efficiency (SE) – Complexity

SENSITIVITY SE COMPLEXITY



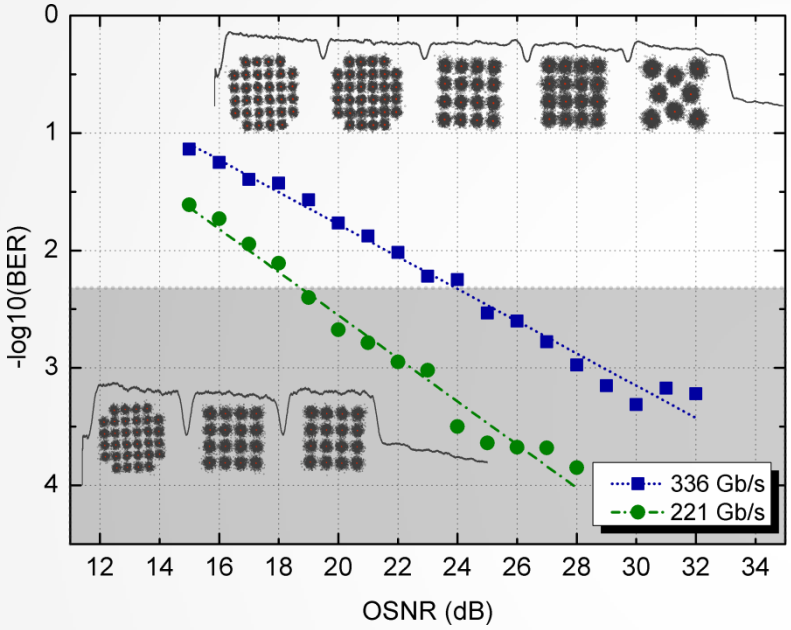
SIGNAL POWER

MODULATION LEVEL

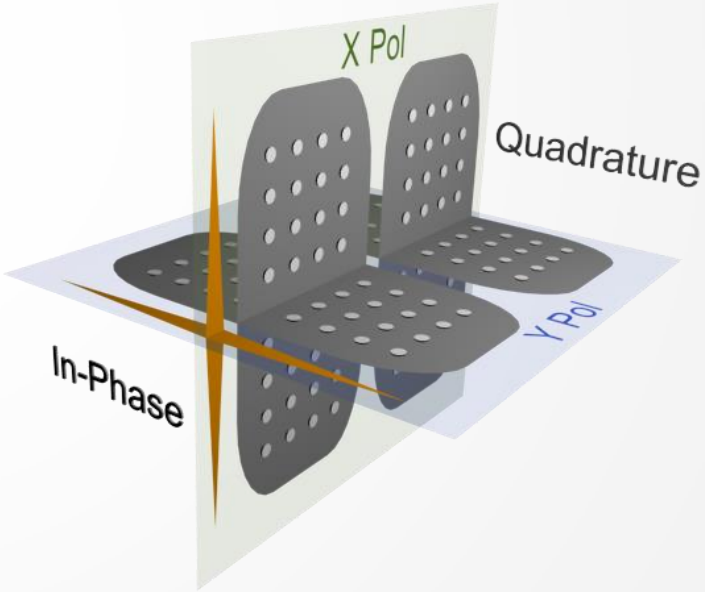
NYQUIST FILTERING

R.-J. Essiambre, JLT **28**, 4 (2010)

Coherent MultiCAP



- 300+ Gbps in 25 GHz I/O Electronics!
- Successful 450 km SSMF transmission



8-dimensional space

- 1 Post-deadline paper OFC'13
- 3 regular papers OFC'14
- Ongoing patent process
- Consideration for standards

What should I remember?

ADVANCED MODULATION FORMATS are key technology for procuring efficient high-speed optical data links in the future.

Fundamental open problems exist

THANK YOU

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