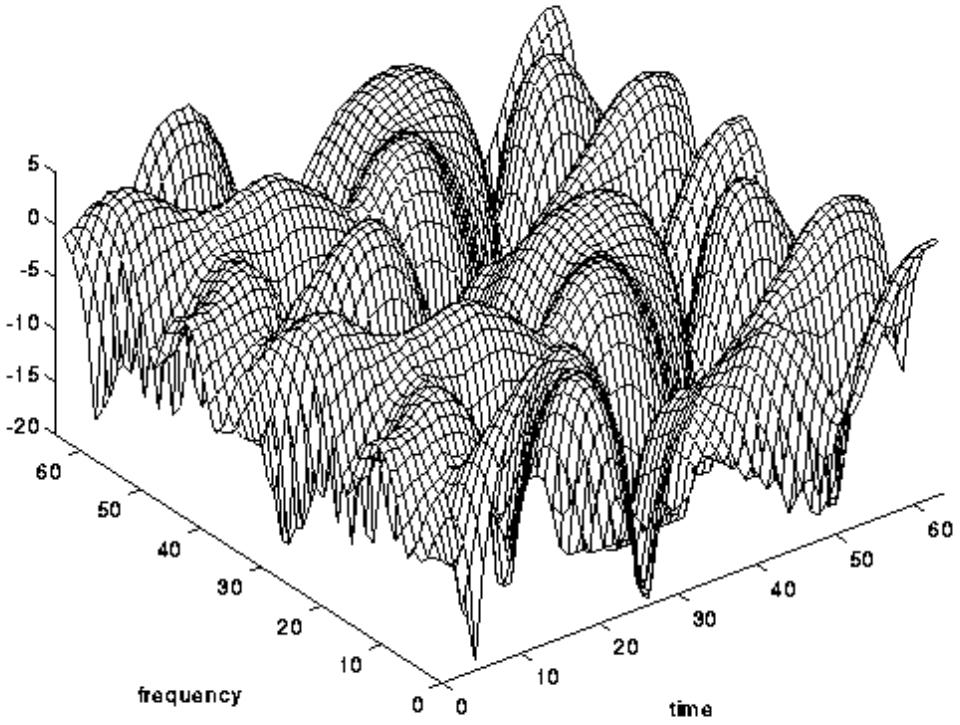
DIGITAL MODULATION



MUM - South Africa - July 2013

Presented by:
Hannes Willemse

Miro Training Consultant

NHD Electronics (TUT)
Mikrotik: MTCNA, MTCWE
Radwin: Certified Trainer
Ubiquiti: UAC Certified Trainer
Vivotek: VEC Certified Trainer

Miro Experience *Founded 2002*

Midrand • Cape Town • Durban • Nelspruit • Sub Sahara

Wireless

RADWIN
MikroTik
UBIQUITI NETWORKS
AirNET
Mti WIRELESS EDGE LTD.
Laird TECHNOLOGIES
LINKRA Networks
WAVION WIRELESS NETWORKS

Networking

EDIMAX NETWORKING PEOPLE TOGETHER
EnGenius
BUFFALO
Edge-corE

VoIP

digium The Asterisk Company
digium Switchvox
ATCOM
Grandstream Innovative IP Voice & Video
snom
Panasonic
QUINTUM TECHNOLOGIES INC.
POLYCOM

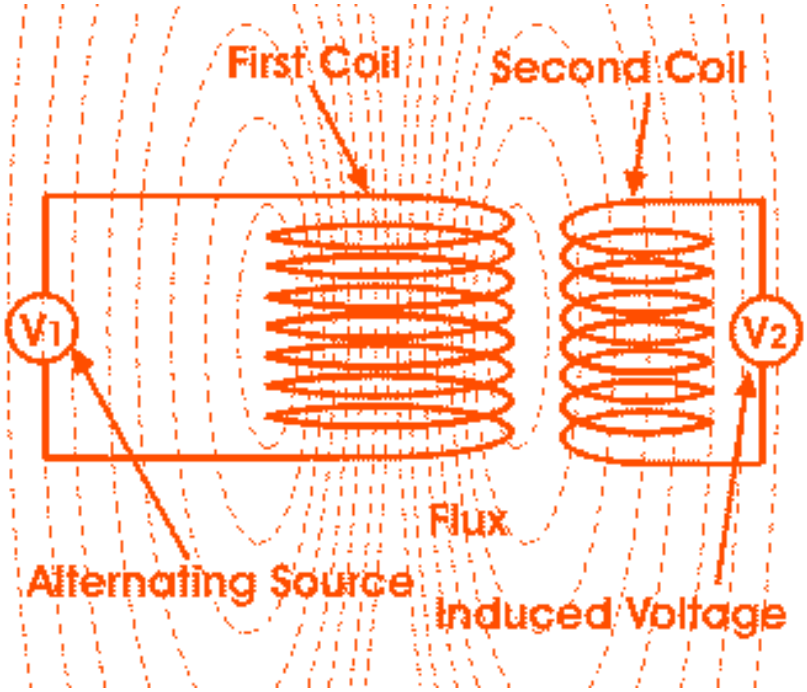
IP Video

VIVOTEK
QNAP
milestone
The Open Platform Company

The challenge:

How do we get information through the air from one point to another point?

Solution
Electro Magnetism

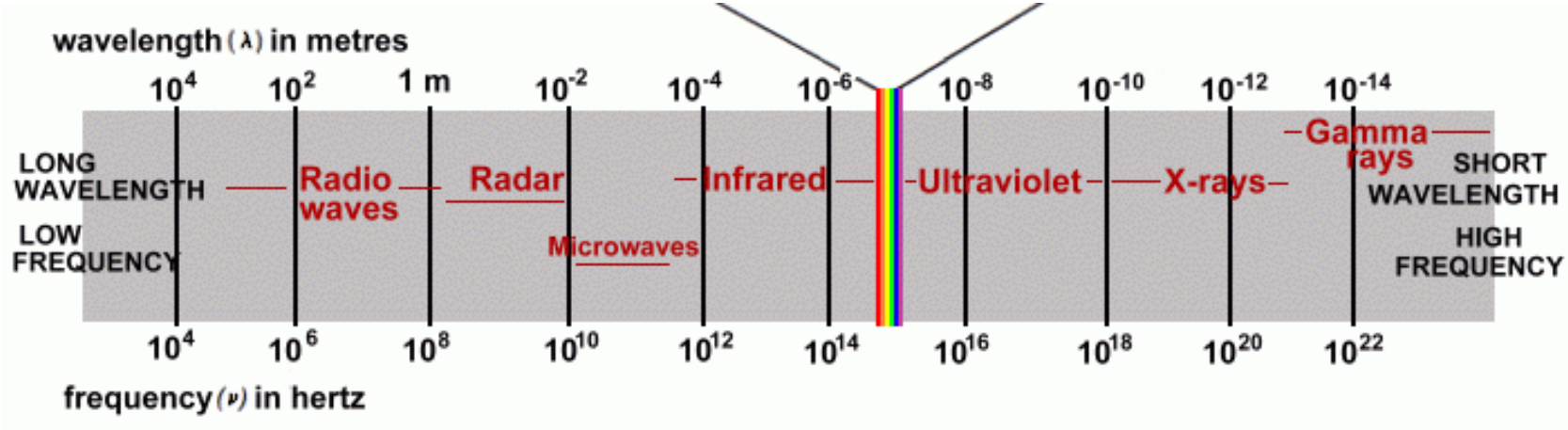


The challenge

Distance

Solution

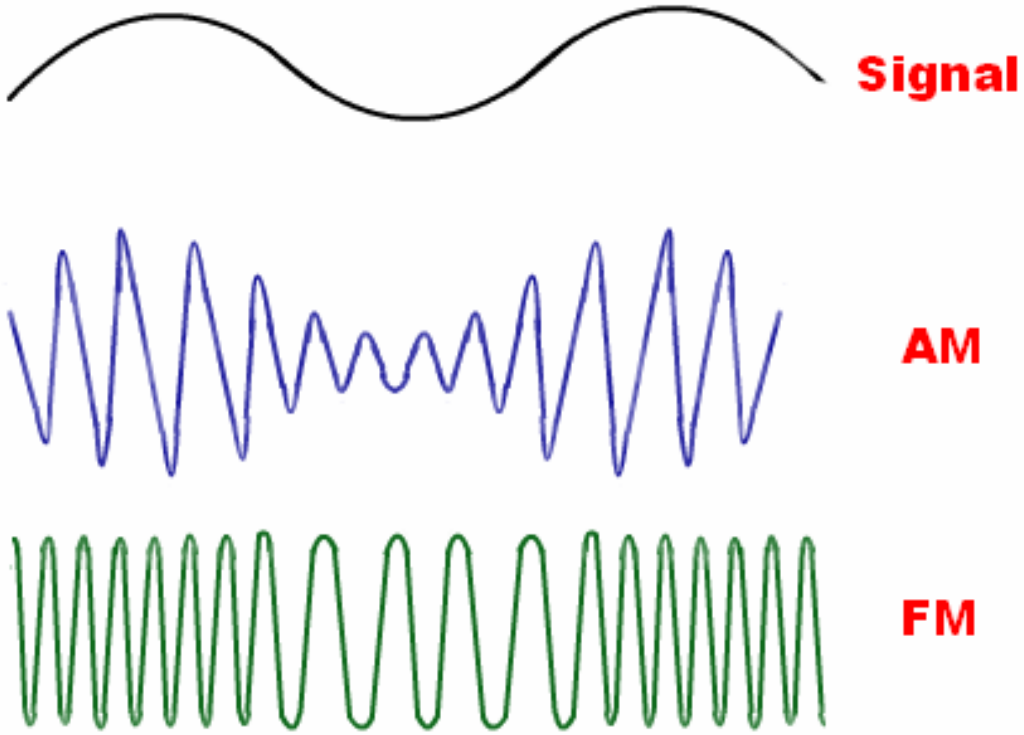
The same electromagnetic waves but in the Radio Frequency spectrum



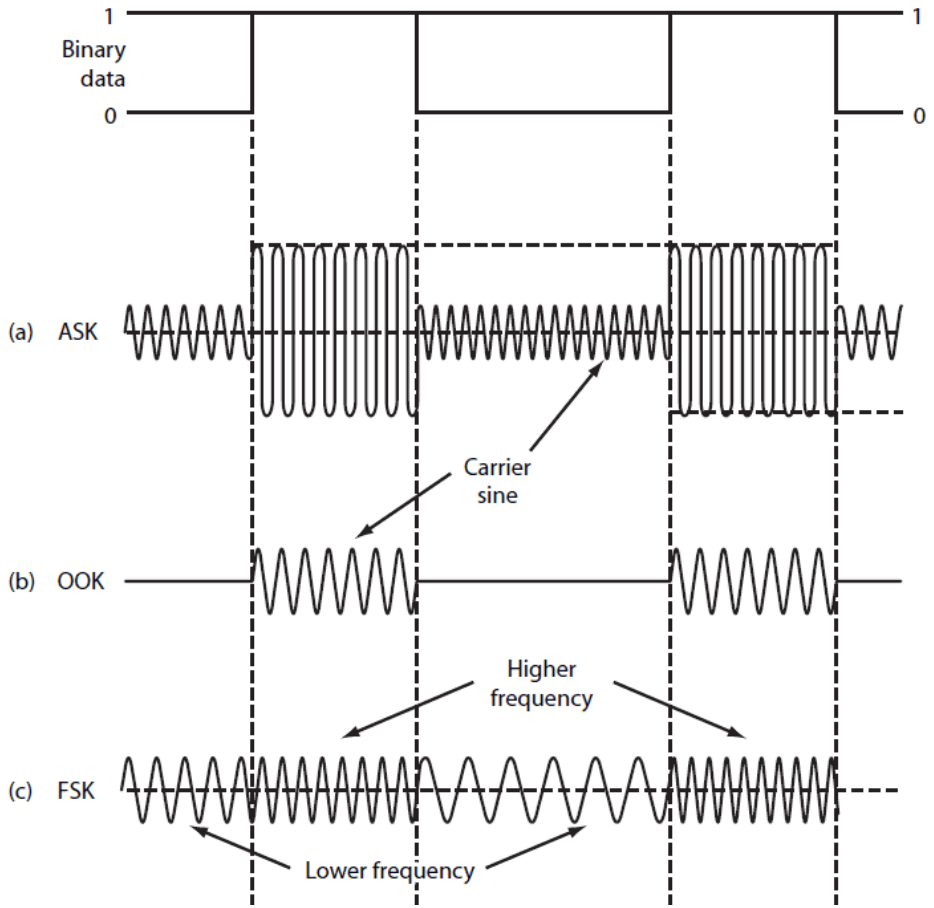
Next Challenge

To trasmit data over the link

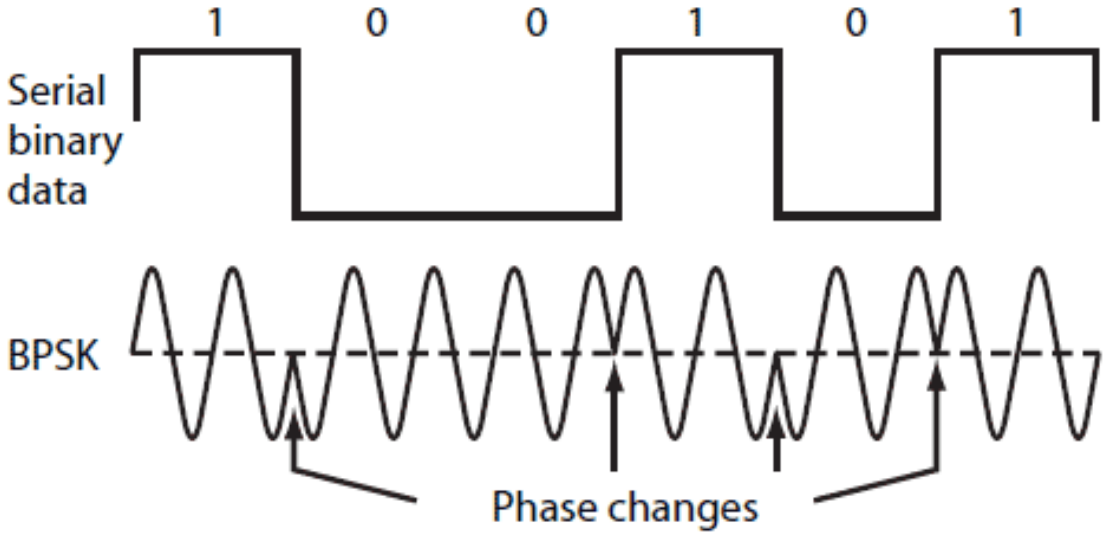
Analog Data



Digital Data



Digital Data



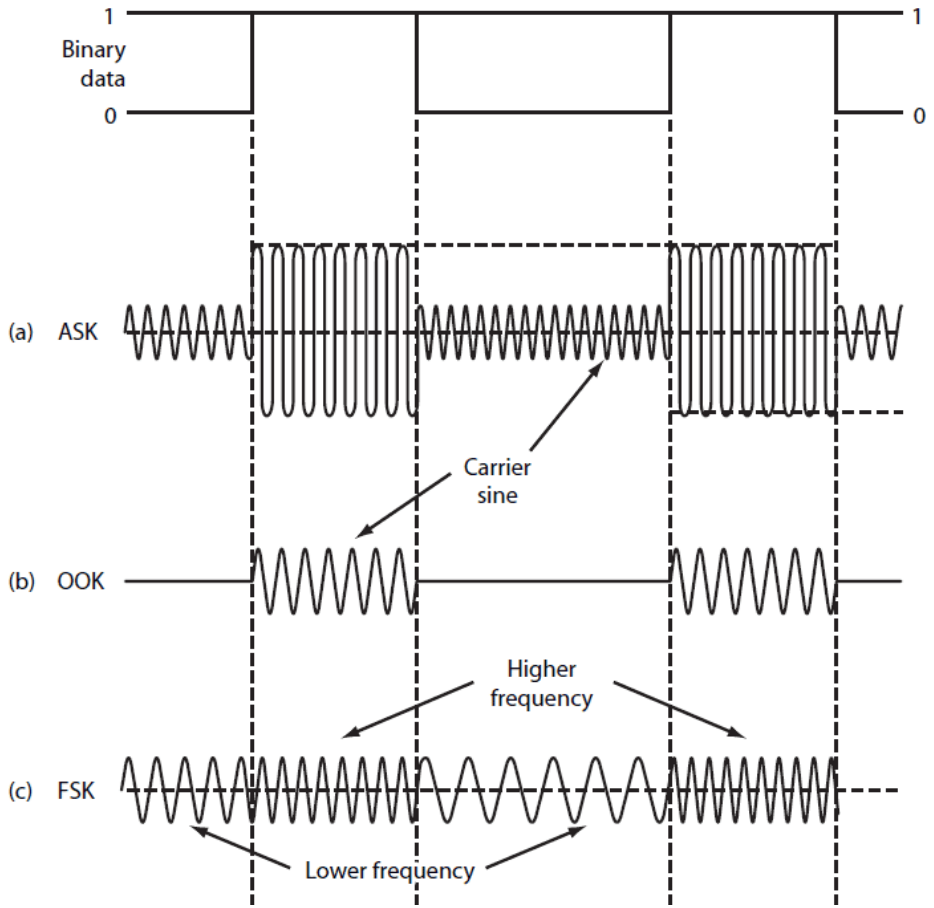
Next Challenge

Throughput

ANALOG

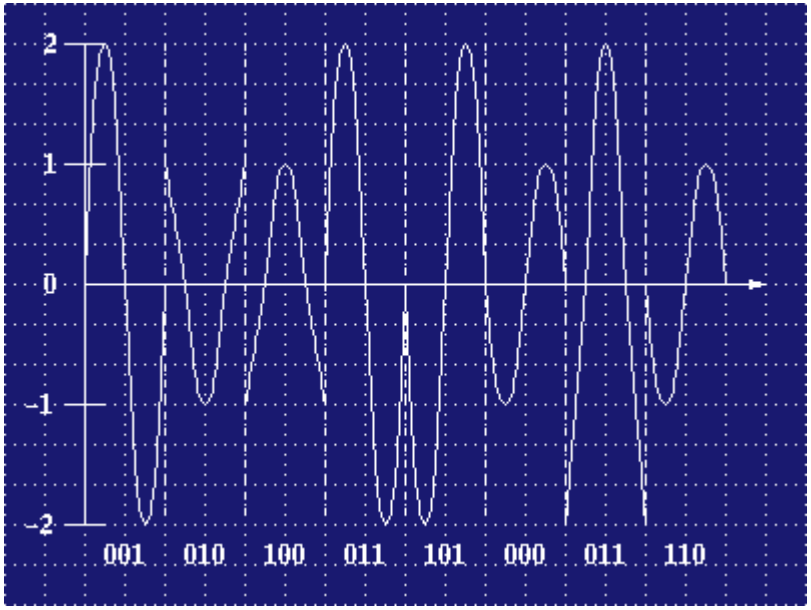
DIGITAL

Throughput


1
Binary
data
0
1
0
(a) ASK
Carrier
sine
(b) OOK
Higher
frequency
(c) FSK
Lower frequency

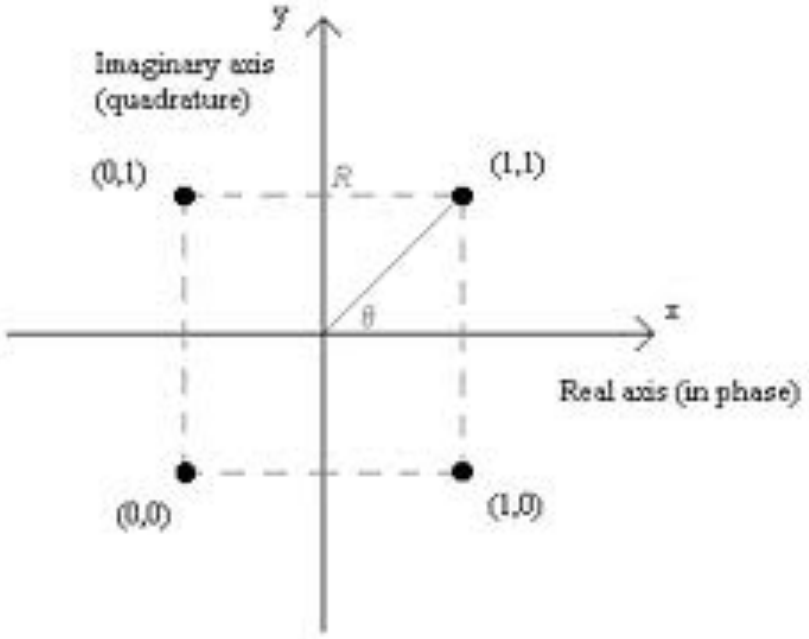
Solution
Better Modulation

Combination of some of the previous modulations

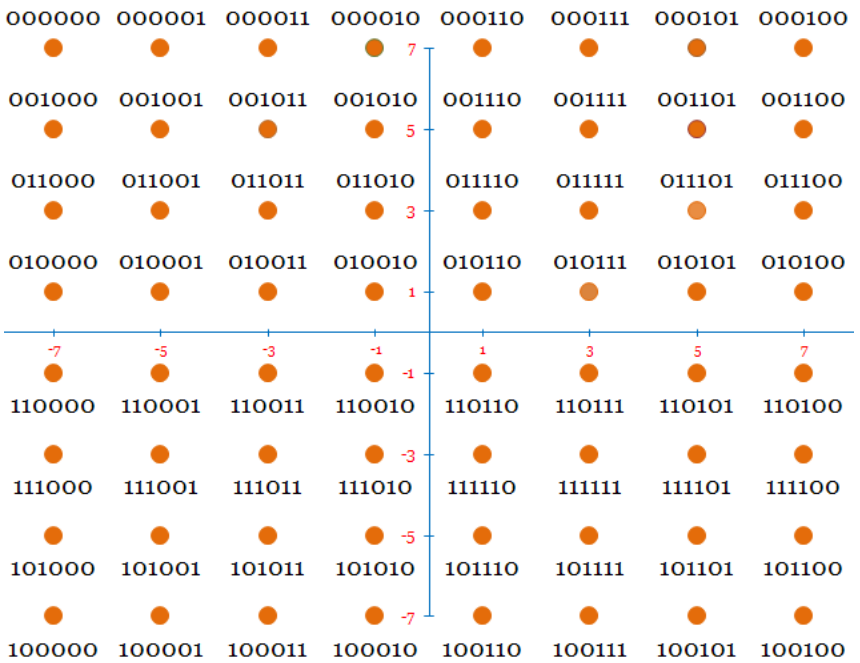


Quadrature Amplitude Modulation

4 QAM

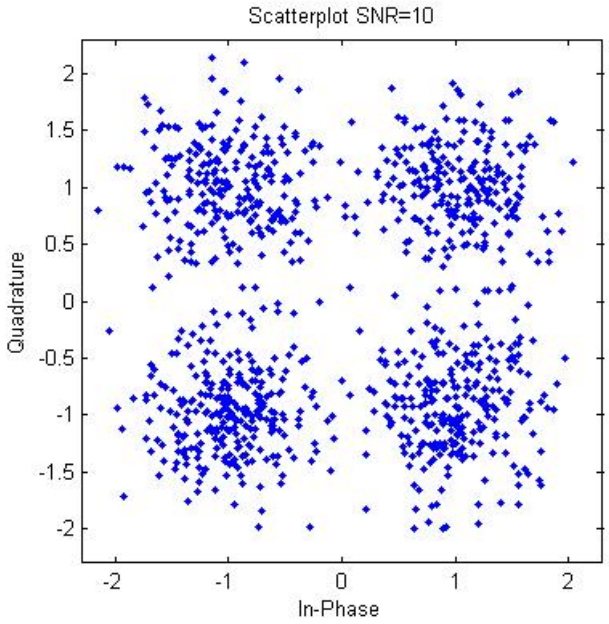


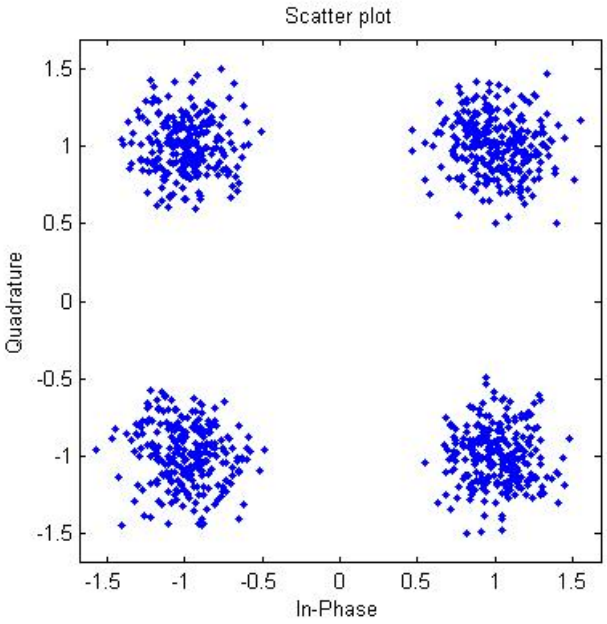
64 QAM



MIRO DISTRIBUTION

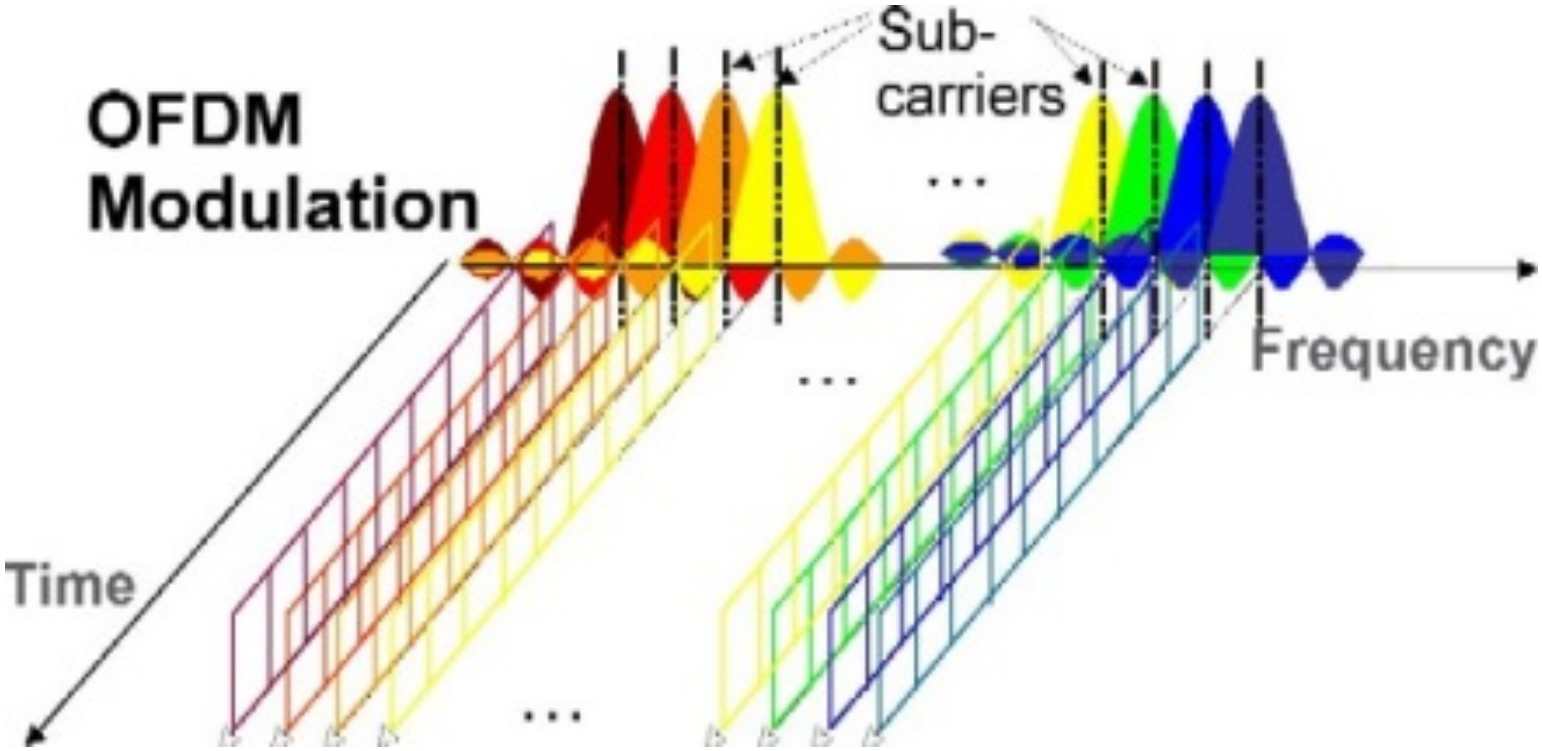
Challenge
Linear amplification
Noise





Solution - OFDM

Orthogonal Frequency Division Multiplexing



802.11

802.11	Modulation	Coding	Req Link SNR	Max Tp	Min Sig
MCS 0	BPSK	1/2	9.3 dB	15 Mbps	-88 dBm
MCS 1	QPSK	1/2	11.3 dB	30 Mbps	-82 dBm
MCS 2	QPSK	3/4	13.3 dB	45 Mbps	-79 dBm
MCS 3	16 QAM	1/2	17.3 dB	60 Mbps	-76 dBm
MCS 4	16 QAM	3/4	21.3 dB	90 Mbps	-73 dBm
MCS 5	64 QAM	2/3	24.3 dB	120 Mbps	-68 dBm
MCS 6	64 QAM	3/4	26.3 dB	135 Mbps	-65 dBm
MCS 7	64 QAM	5/6	27.3 dB	150 Mbps	-63 dBm
MCS 8	BPSK	1/2	12.3 dB	30 Mbps	-85 dBm
MCS 9	QPSK	1/2	14.3 dB	60 Mbps	-79 dBm
MCS 10	QPSK	3/4	16.3 dB	90 Mbps	-76 dBm
MCS 11	16 QAM	1/2	20.3 dB	120 Mbps	-73 dBm
MCS 12	16 QAM	3/4	24.3 dB	180 Mbps	-70 dBm
MCS 13	64 QAM	2/3	27.3 dB	240 Mbps	-65 dBm
MCS 14	64 QAM	3/4	29.3 dB	270 Mbps	-62 dBm
MCS 15	64 QAM	5/6	30.3 dB	300 Mbps	-60 dBm

MikroTik

Auto Data Rate

Data rate is decreased upon failure and frame is sent again.

Weakest Link

802.11

Keep on trying until frame go through.

NV2

Still busy trying and adjusting then time slot is over

Weakest Link

802.11

Good for weakest link bad for network

NV2

Good for network bad for weakest link

Weakest Link

Set Data Rate manual to lowest level with least retries.

Increase antenna gain.

802.11	Modulation	Coding	Req Link SNR	Max Tp	Min Sig
MCS 0	BPSK	1/2	9.3 dB	15 Mbps	-88 dBm
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Thank you for your time.

Q & A

Would like to invite you all to Miro's IP Convergence Conferences in Jhb, Cpt, Dbn and Nelspruit for free training sessions covering MikroTik and other technologies.

www.ip-con.co.za