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E-STORE **WiFi**Shop.cz

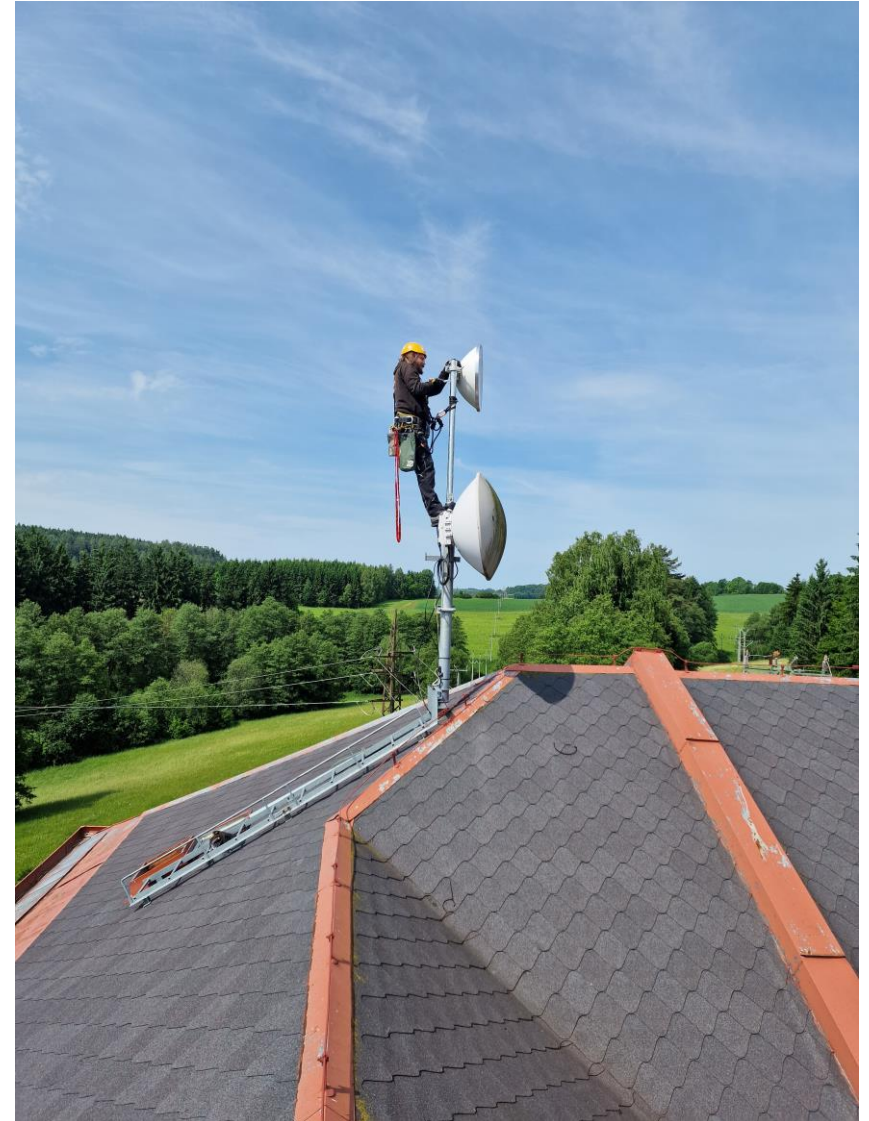
Microwave technologies in practice

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Introduction

- In telco 25+ years
- Based in CZ, covering middle Europe
- Distribution of all tier one manufactures – Aviat, Ceragon, Ericsson, RACOM, SAF, SIAE
- More than 10 000 MW links installed, more than 20 000 links sold



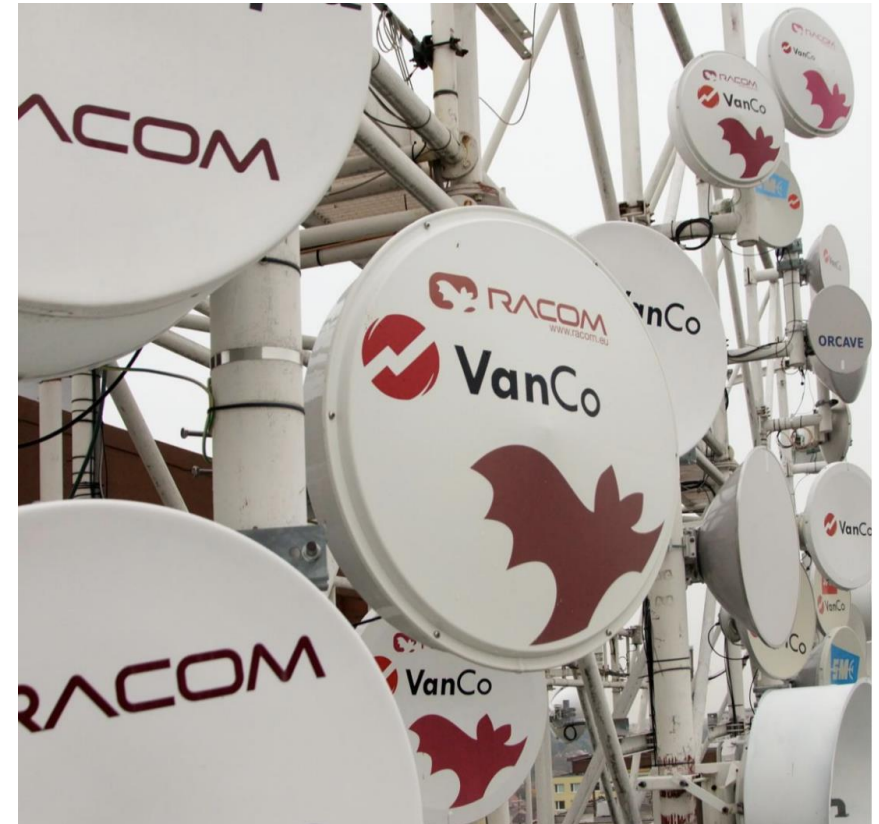
Is there a future for MW links?

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YES

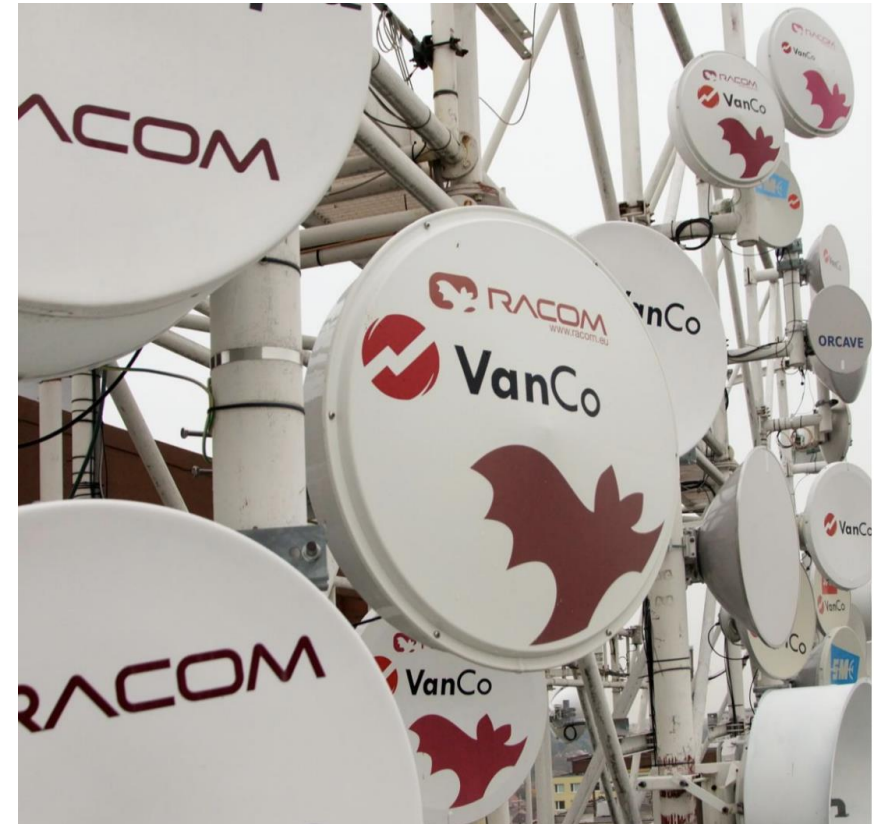
Is there a future for MW links?

- Connectivity needed – factors to be considered:
 - Capacity
 - Distance
 - Reliability
 - Price
 - Deployment speed



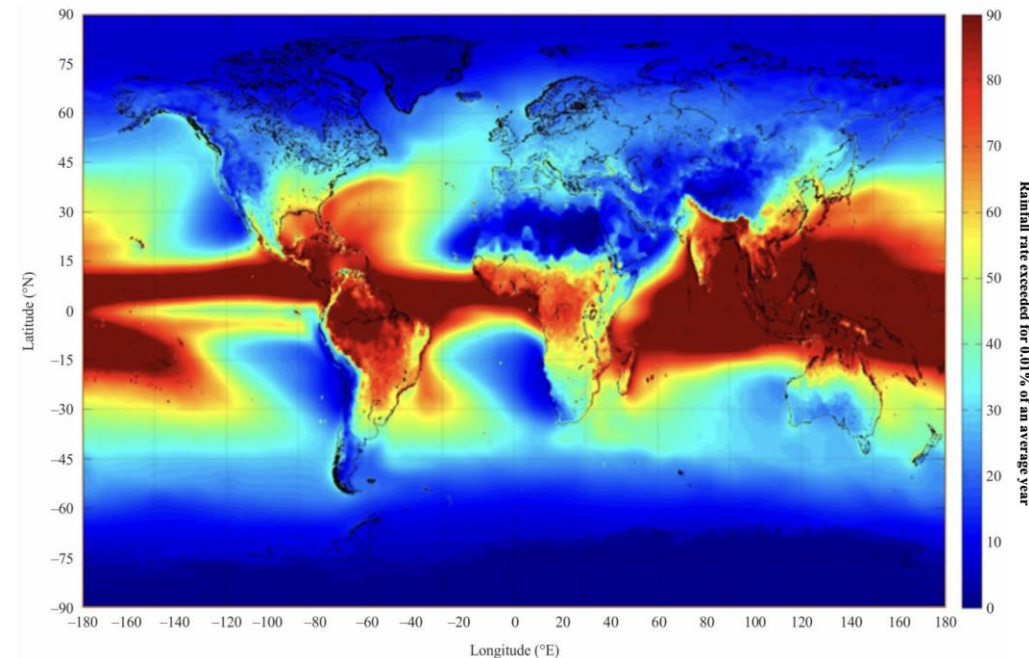
Is there a future for MW links?

- Connectivity needed – factors to be considered:
 - **Capacity**
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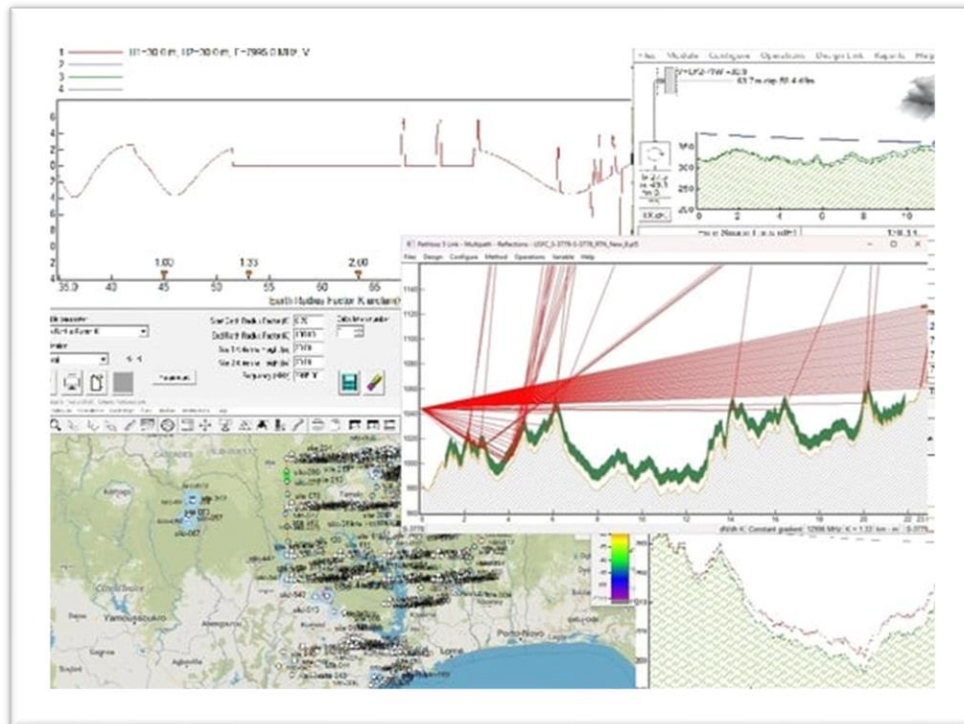
Let's look closer: Reliability

- Calculation methodologies based on the recommendations ITU-R P.837-7 and ITU-R P.453.
- Counts with:
 - Atmospheric attenuation
 - Rain attenuation and rain probability
 - Multipath, Atmosphere refractivity
- No problem to achieve 2 Gbps / 20 km link with 99.997% availability (14 mins/year)
- Complicated? No way! Use calc tools!



Use calculators!

- For hardcore professionals:
Pathloss



- For fast, simple, free and accurate results:
VanCo Link Calculator

The screenshot shows the VanCo Link Calculator web interface. It features a form with several input fields for configuring a link calculation. The fields include:

- Manufacturer:** A dropdown menu with "Ericsson" selected.
- Model:** A dropdown menu with "MINI-LINK 6363/6365" selected.
- Frequency:** A dropdown menu with "18" selected, followed by "[GHz]".
- Transmission mode:** A dropdown menu with "1024QAM / 3784.0 Mbps" selected.
- TX Power:** A text input field with "16.0" and "[dBm]".
- Sensitivity:** A text input field with "-52.0" and "[dBm]".

Below the form, there is a section for "ndpoints." with a distance input field showing "26.79 [km]" and a button labeled "USE GOOGLE MAPS". At the bottom, there is a map showing the geographical context of the link, with a red line indicating the path between two points. The map includes labels for various locations and a search bar.

Let's look closer: Capacity

- 1 Gbps? 10 Gbps? 100 Gbps? It's just about the right technology!
 - Wider channels
 - Higher modulations
 - Multiple streams
- ... and a lot of math ☺

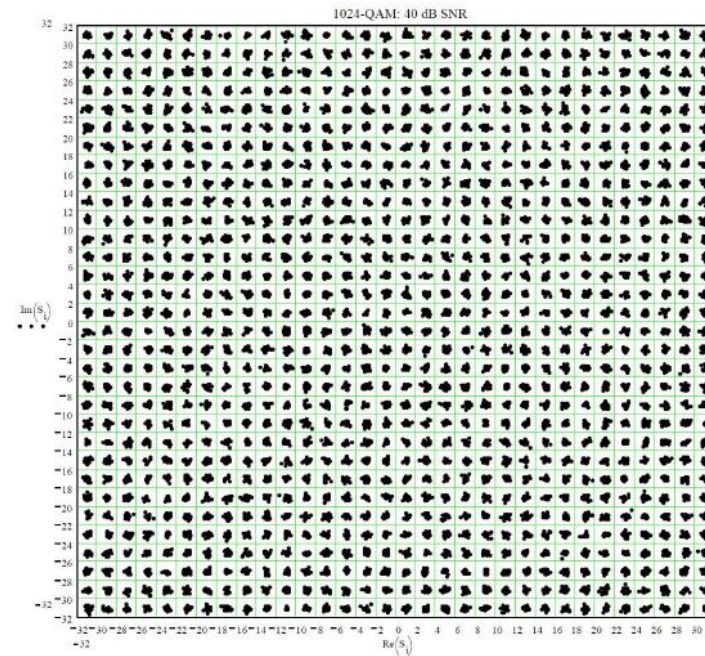


Figure 3 – 1024-QAM at SNR = 40 dB

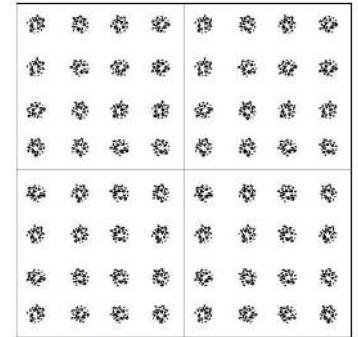


Fig. 1B CW Interference

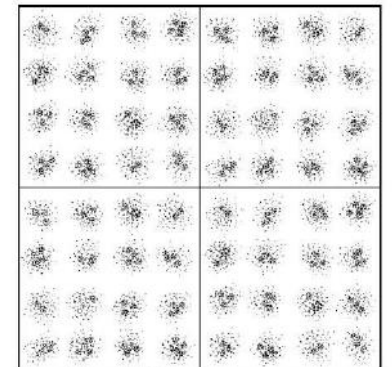
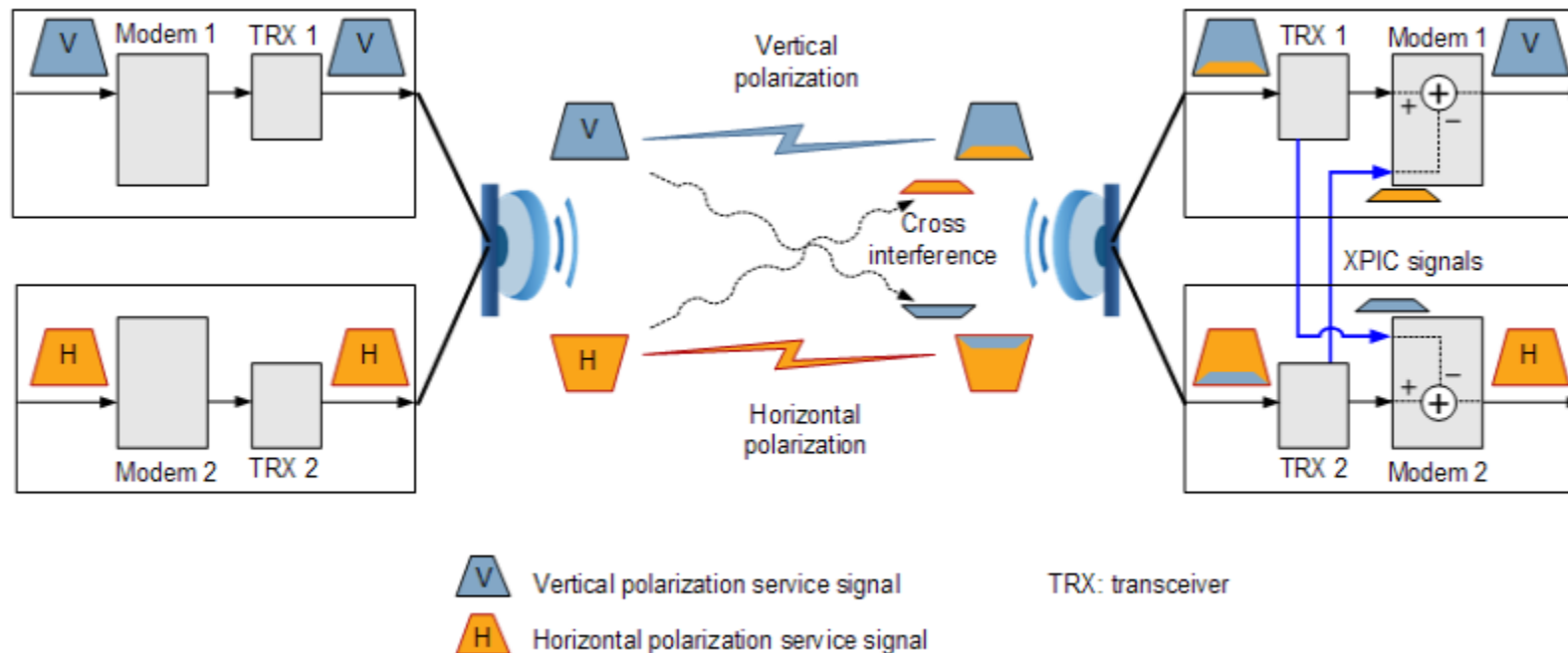


Fig. 1A Noise

XPIC

- Cross-Polarization Interference Cancelling
- Two signals on the same frequency but with different polarizations



XPIC – real use cases

- Compact, easy to deploy
- Link distance - 12 km
- Deployed as 2 Gbps, instant upgrade to 4 Gbps



Dual Carrier, Multi Carrier ABC, XPIC

Local

IP-50C - DB Hotel Labe

MRMC & Frequencies - Radio: Slot 1, Port 1 & Radio: Slot 1, Port 2 (XPIC)

Script ID	4524, BW:224 MHz, OBW:212 MHz, 165.691-2007.912 Mbps
Operational Mode	Adaptive
Maximum profile	Profile: 10, 2048 QAM, 2007.912 Mbps
Minimum profile	Profile: 0, 2 QAM, 165.691 Mbps

Remote

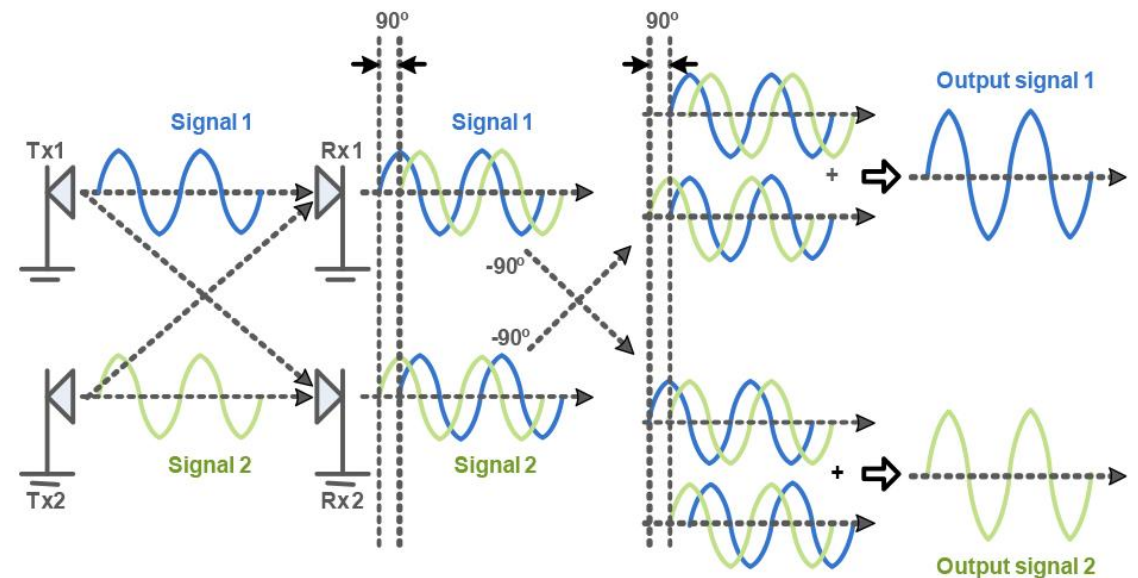
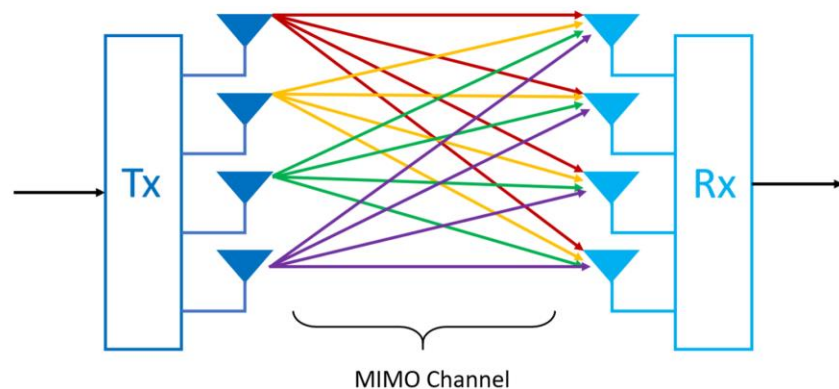
IP-50C - Jencicenet

MRMC & Frequencies - Radio: Slot 1, Port 1 & Radio: Slot 1, Port 2 (XPIC)

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MIMO

- Multiple Input Multiple Output
- Based on several (typically 2) streams with the same frequency and multiple antennas with exact space separation
- Uses the principle of multipath propagation of radio signals and known phase shift



MIMO – real use cases

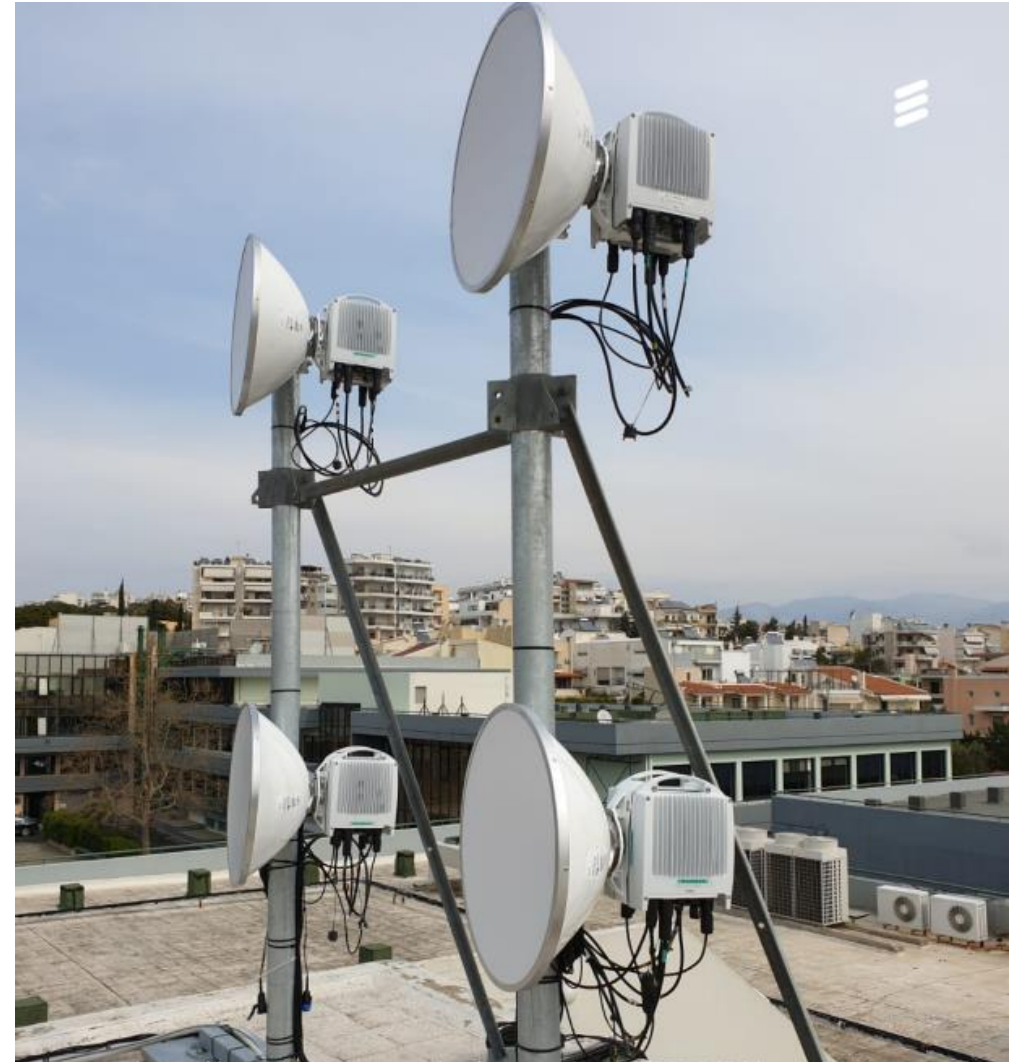
- 2x Ceragon IP-20C, 28 MHz, MIMO 4x4 (2x XPIC link in LoS MIMO configuration)

⇒ **1 Gbps capacity in 28 MHz channel**



MIMO – real use cases

- E-Band setup
- 8x Ericsson MINI-LINK 6352
- 4x dual pol antenna
- 2.5 GHz channel / 18 dBm
- Link distance 1.5 km
- Linc calc for 100 Gbps ... 99.9995%



Let's look closer: Distance

- 20 Gbps link for 10 km with only 60cm antennas?

Total adaptive availability			
Modulation Link 1	Modulation Link 2	Total Capacity	Availability
4QAM_strong	-	151 Mbps	100 %
4QAM_std	-	176 Mbps	99.99984 %
16QAM_strong	-	302 Mbps	99.99953 %
16QAM_std	-	352 Mbps	99.99939 %
32QAM_std	-	441 Mbps	99.99888 %
64QAM_std	-	553 Mbps	99.99791 %
128QAM_std	-	654 Mbps	99.99628 %
256QAM_std	-	754 Mbps	99.99159 %
512QAM_std	-	855 Mbps	99.97011 %
512QAM_std	BPSK_2_strong	1257 Mbps	99.95377 %
512QAM_std	BPSK_2_std	1538 Mbps	99.90644 %
512QAM_std	BPSK_std	2220 Mbps	99.88303 %
512QAM_std	4QAM_std	3586 Mbps	99.85689 %
1024QAM_std	-	946 Mbps	99.84965 %
1024QAM_std	16QAM_strong	4165 Mbps	99.75981 %
1024QAM_std	16QAM_std	6408 Mbps	99.68109 %
2048QAM_std	-	983 Mbps	99.44091 %
2048QAM_std	32QAM_std	7811 Mbps	99.33404 %
2048QAM_std	64QAM_std	9176 Mbps	98.23614 %
2048QAM_std	128QAM_std	10542 Mbps	80.99599 %
Average capacity: 10229 Mbps			

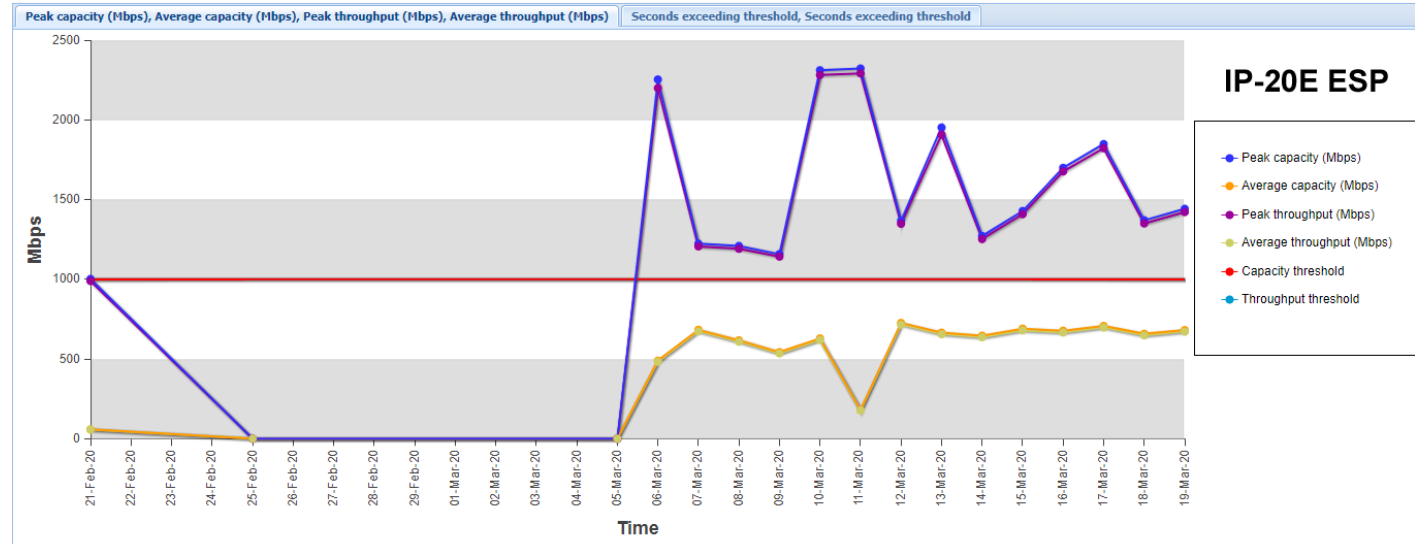
Multiband

- Combination of E-band (80 GHz) with lower frequency
- One dual-freq antenna or two antennas next to each other

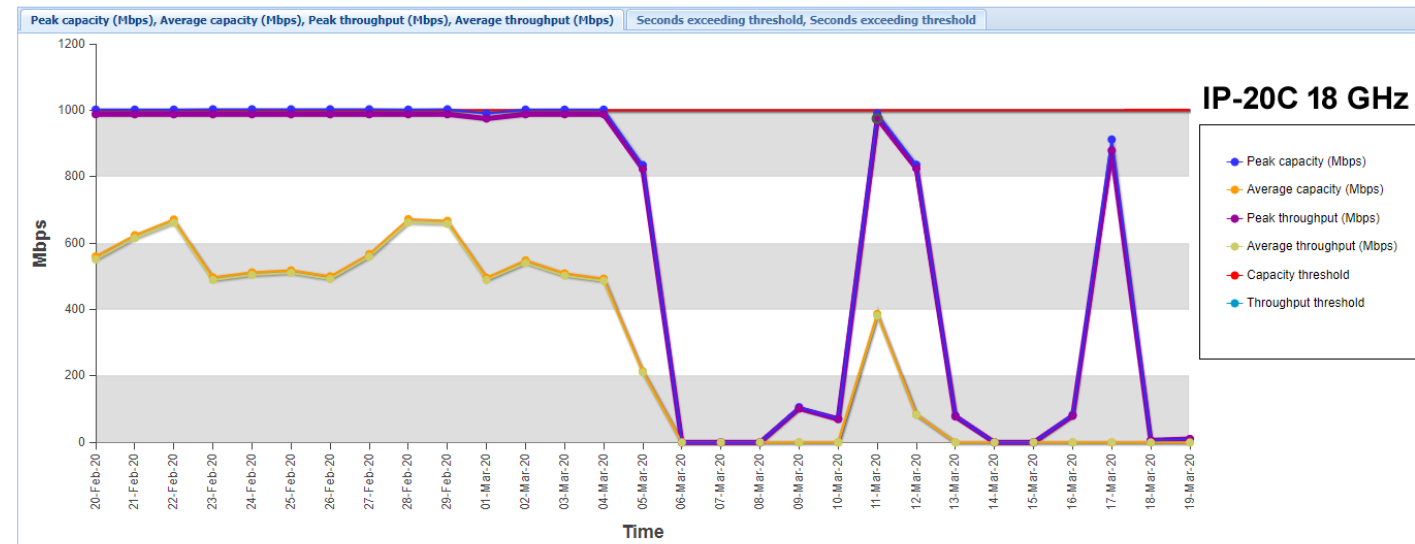


Multiband – real use cases

Capacity & Throughput PM report (Slot 1, Port 1, 24 hours)

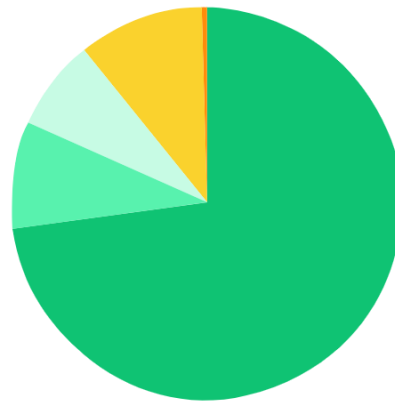


Capacity & Throughput PM report (Main Carrier ABC, Group #1, 24 hours)

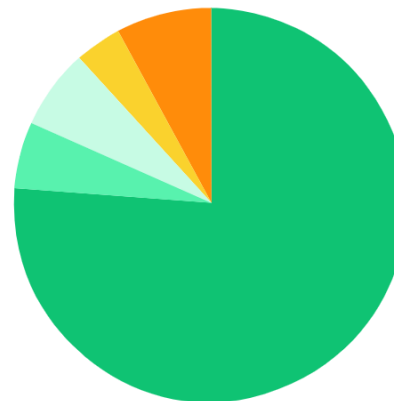


Stabilized antennas

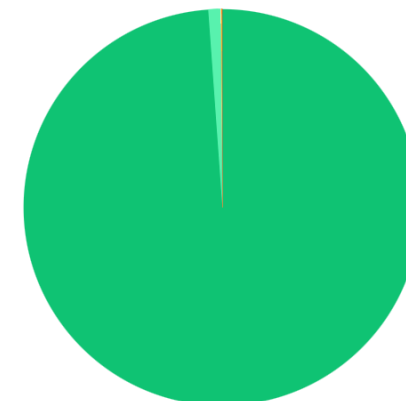
- For 80 GHz band
- Mechanically stabilized feeder
- Enabling long hops with higher capacity



Regular antenna
20m height



Sway compensation **Off**
28m height



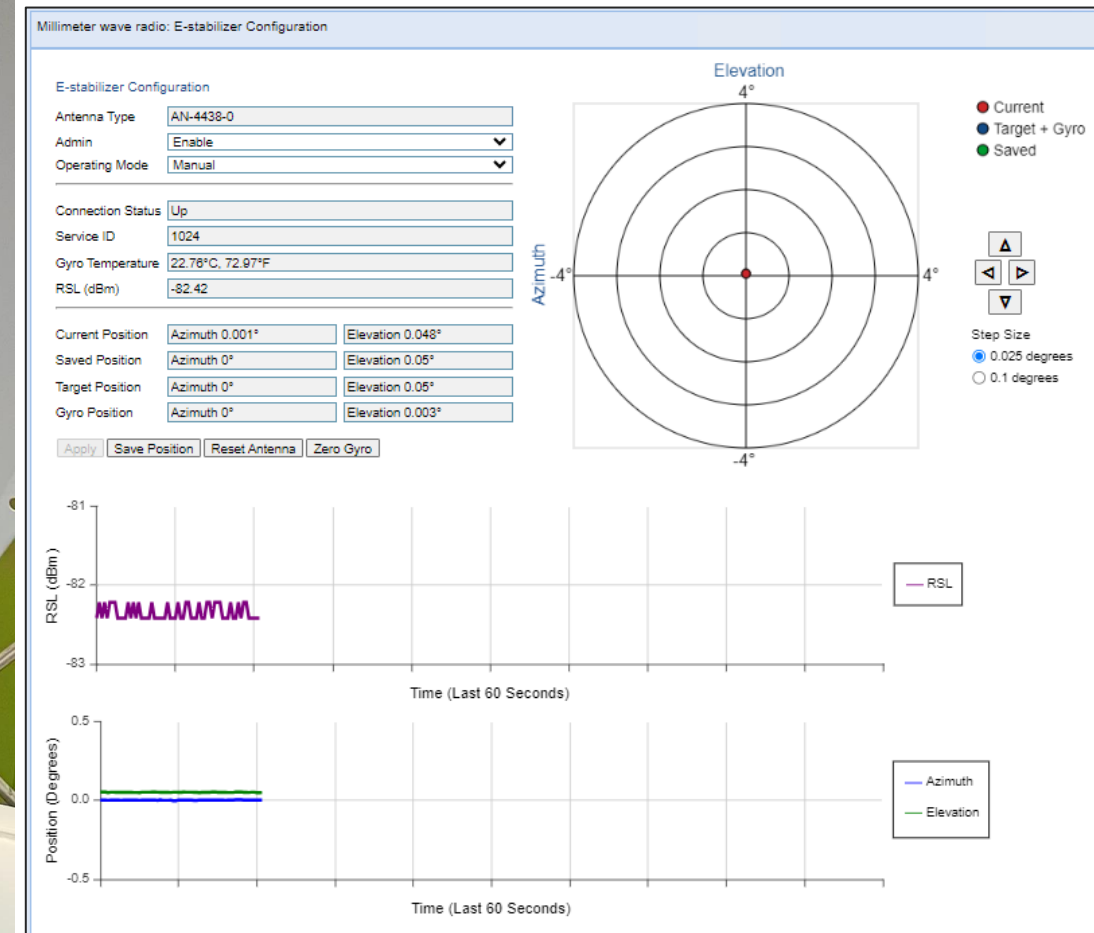
Sway compensation **On**
28m height

■ 512QAM ■ 256QAM ■ 128QAM ■ 64QAM ■ 32QAM ■ Down

6.5km long link

Stabilized antennas

- Compensates for movements in any direction (both Vertical and Horizontal)
- Pole swing and sway in rates of up to 10 Hz
- Deflection of up to 4°



Conclusion

- MW link = still fastest and cheapest way how to get a connectivity
- Over the past years smoothly moved from hundreds Mbps to 10 Gbps as typical deployment
- New technology and signal processing algorithms can:
 - Increase the distance
 - Boost the capacity
 - Lower the fees for frequency use
- New frequency bands (D-band, W-band) are on the way!



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Thank you!

www.vanco.cz

www.wifishop.cz