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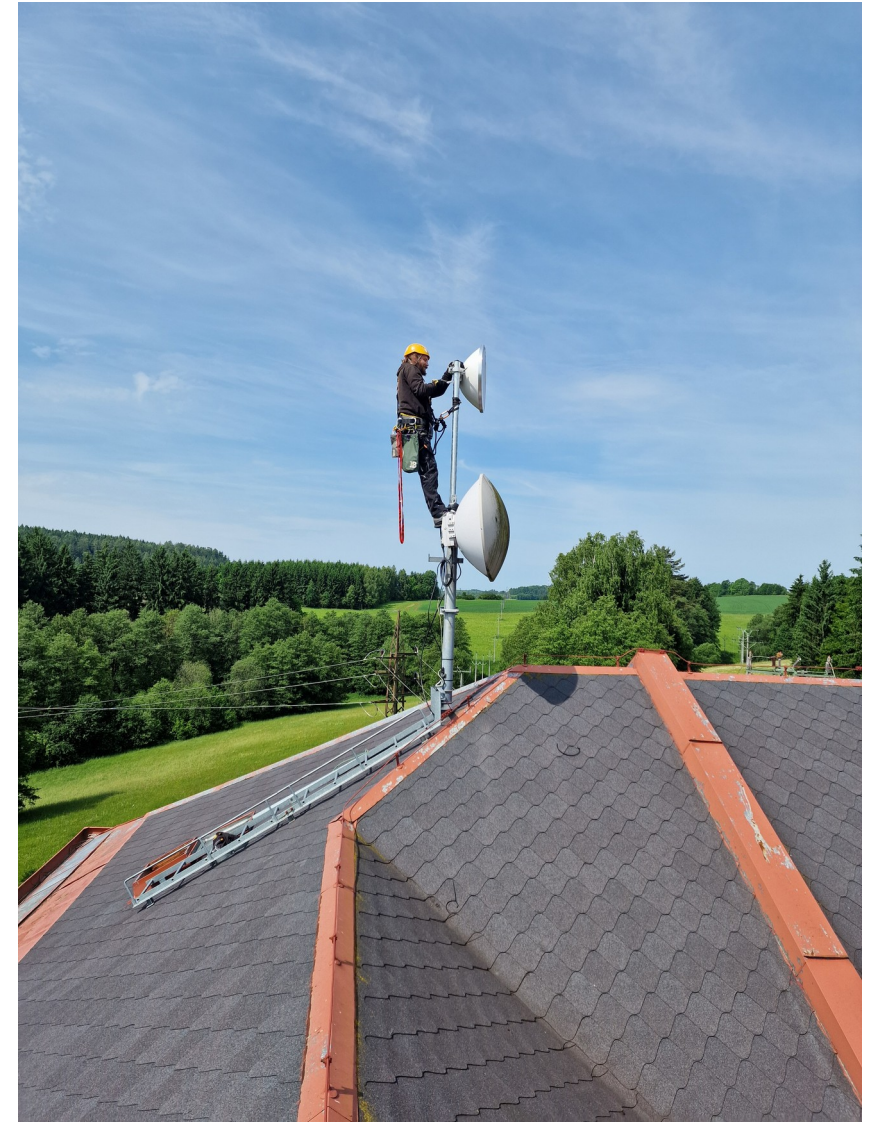
# Microwave technologies in practice

Ing. Jan Stejskal

VanCo.cz

- In telco 25+ years
- Based in Czech Republic
- 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

# Introduction





Is there a future for MW links?

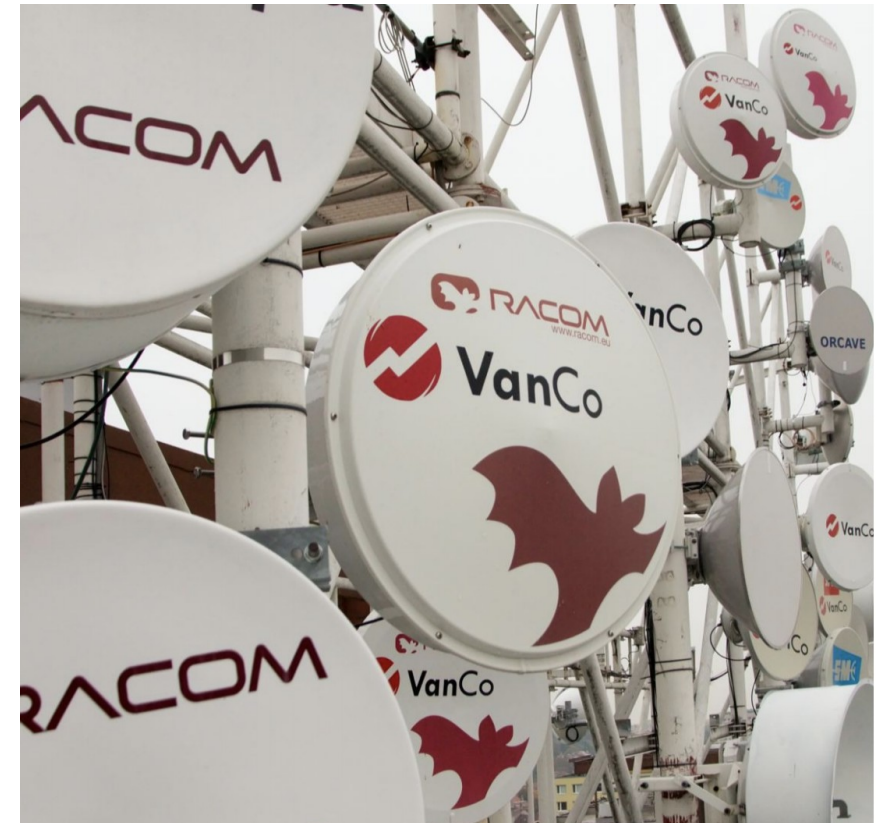


Is there a future for MW links?

YES

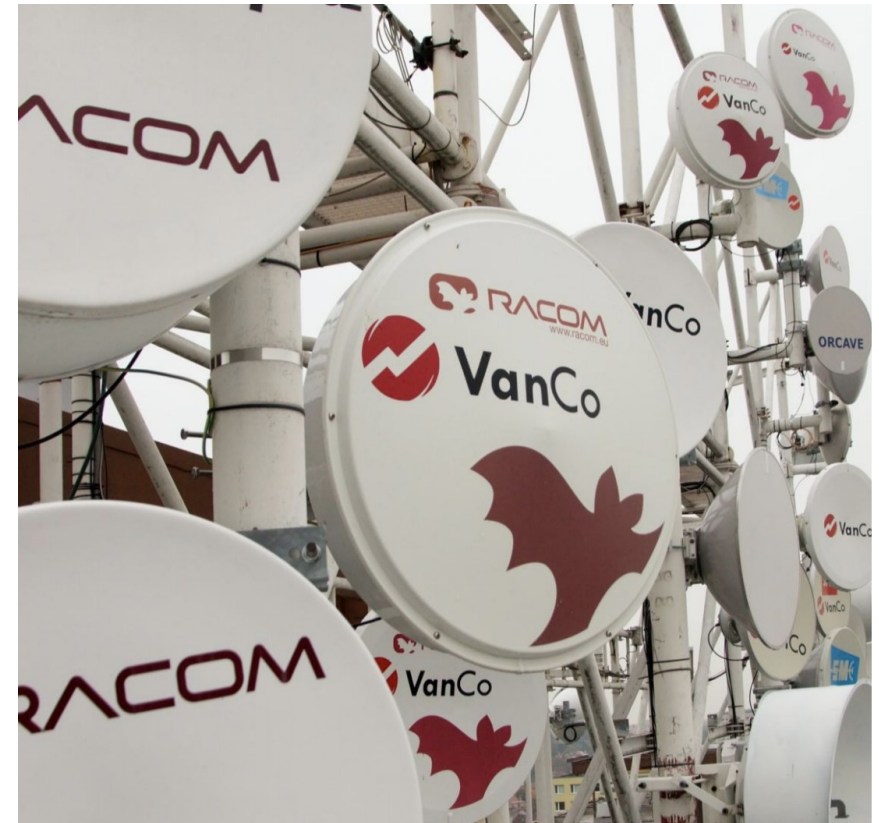
# Is there a future for MW links?

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



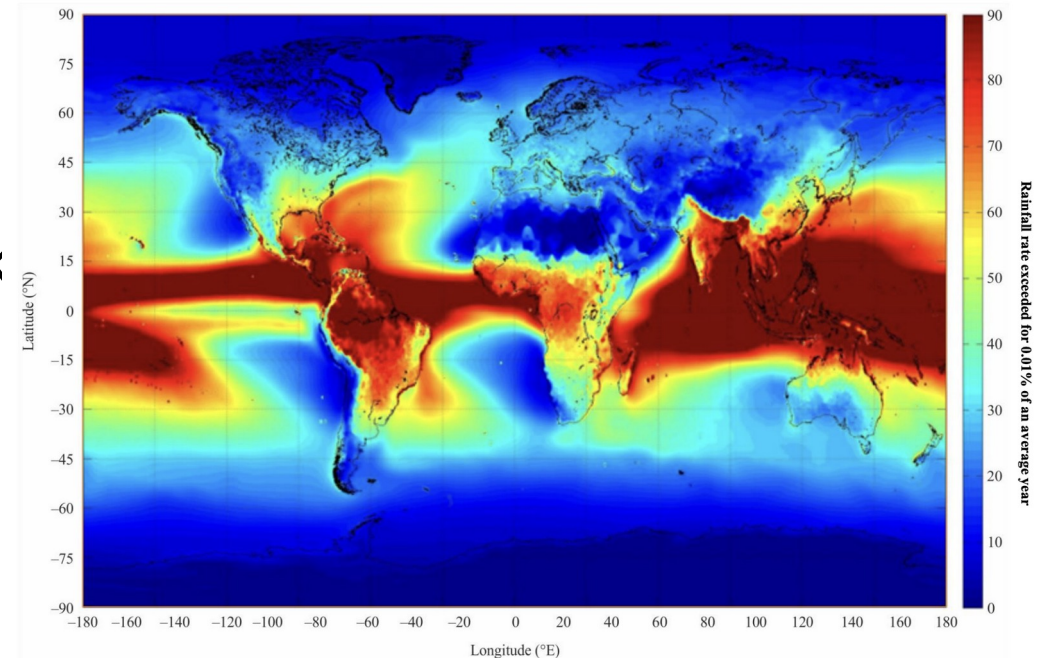
# Is there a future for MW links?

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



# Let's look closer: **Reliability**

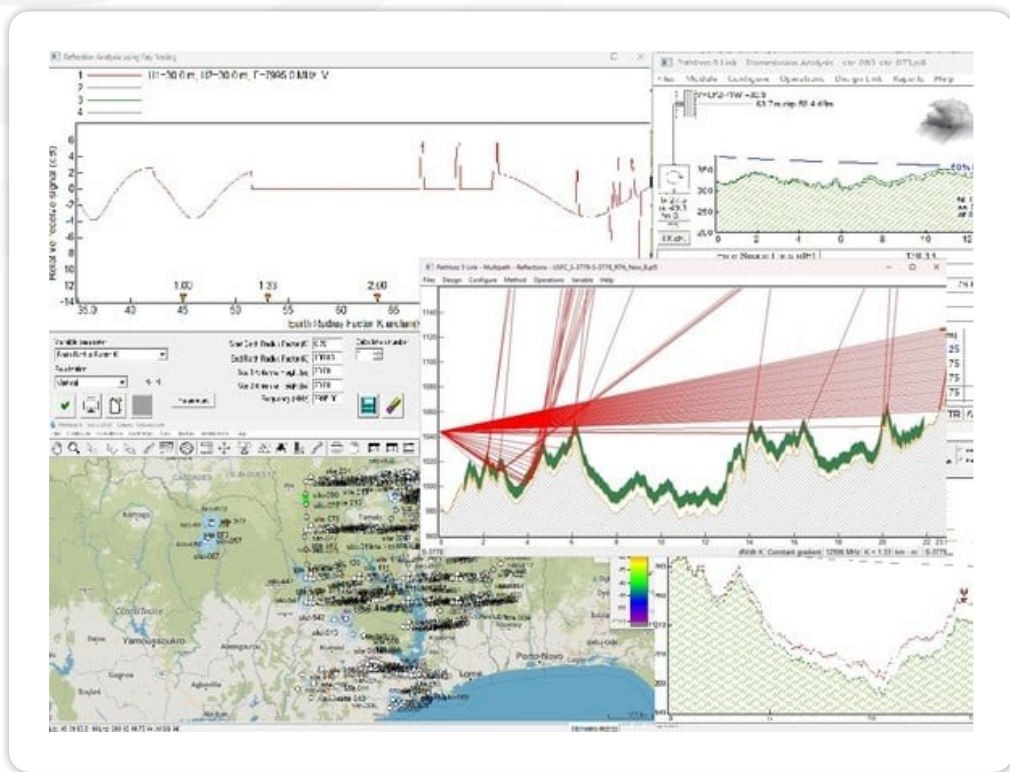
- Calculation methodologies based on the recommendations ITU-R P.837-7 and ITU-R P.453.
- Counts with:
  - Atmospheric attenuation
  - Rain attenuation and rain probability
  - Multipath, Atmosphere refractivity
- No problem to achieve 2 Gbps / 20 km link with 99.997% availability (14 mins/year)
- Complicated?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



# Use calculators!

- For hardcore professionals:  
**Pathloss**

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




Link name <input type="text"/>	Channel width * <input type="text" value="220 XPIC"/> [MHz]
Manufacturer * <input type="text" value="Ericsson"/>	Transmission mode * <input type="text" value="1024QAM / 3784.0 Mbps"/>
Model <input type="text" value="MINI-LINK 6363/6365"/>	TX Power * <input type="text" value="16.0"/> [dBm]
Frequency * <input type="text" value="18"/> [GHz]	Sensitivity * <input type="text" value="-52.0"/> [dBm]

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**Endpoints.**

Distance  [km] or [USE GOOGLE MAPS](#)

Zadejte vyhledávací dotaz



The map shows two endpoints marked with red circles: Bratislava (labeled 'Bratislava') and Budapest (labeled 'Budapešť'). The map covers parts of Slovakia (Rakousko) and Hungary (Maďarsko). Major cities like Vienna, Prague, and other regional hubs are also visible.

# 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 😊

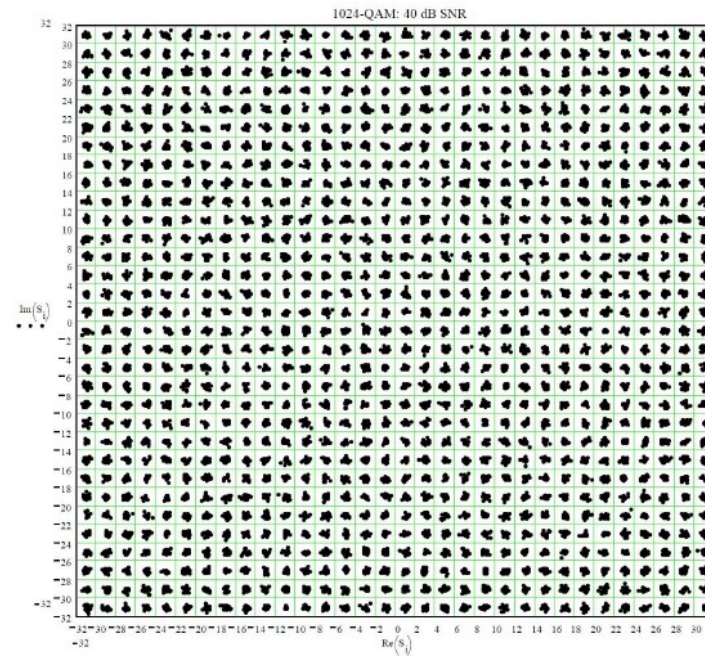


Figure 3 – 1024-QAM at SNR = 40 dB

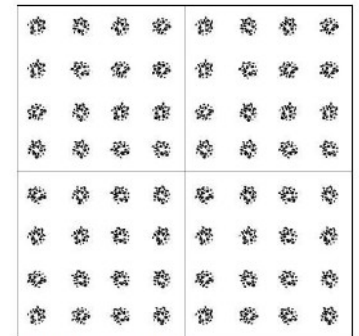


Fig. 1B CW Interference

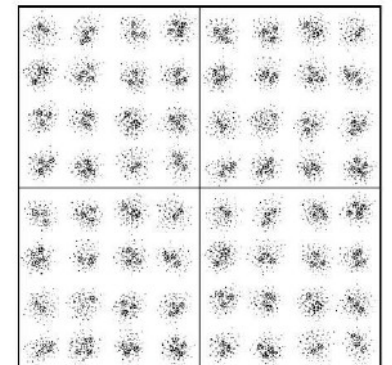
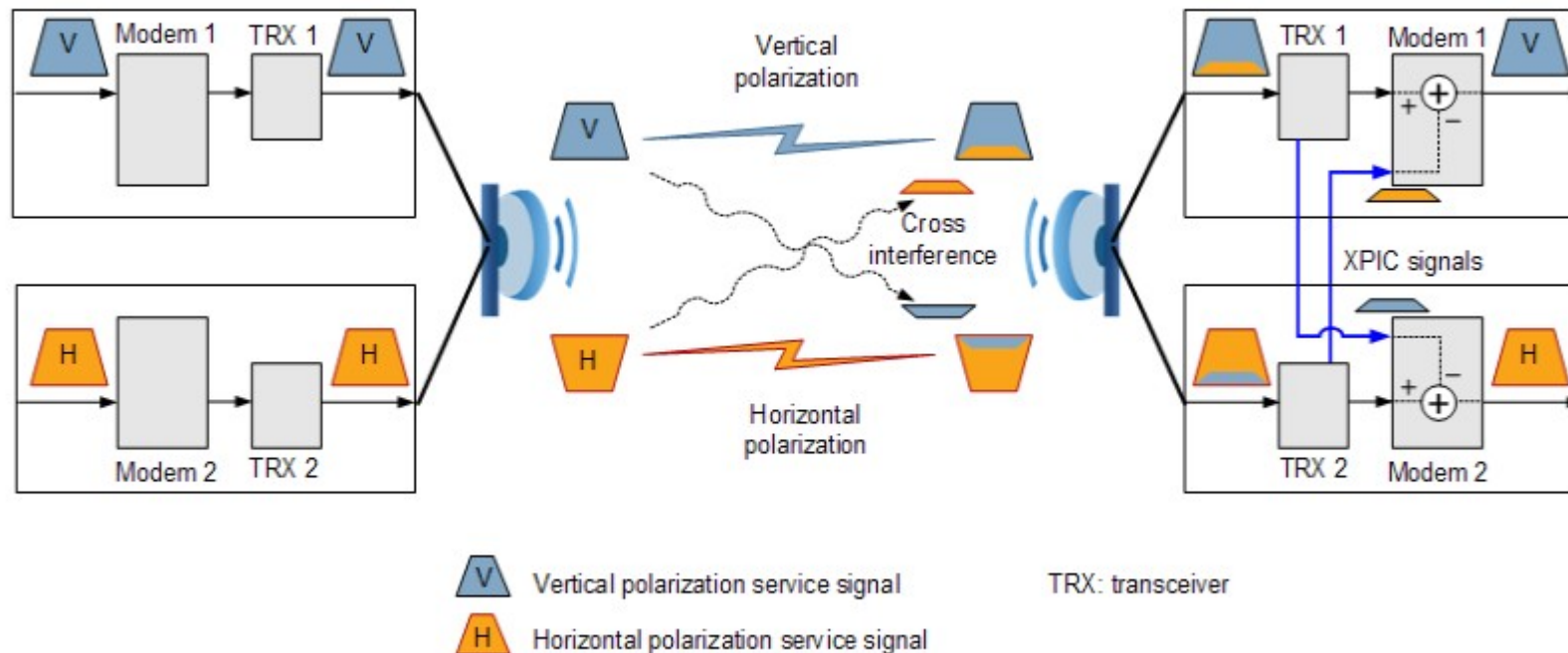


Fig. 1A Noise

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



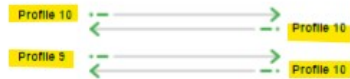
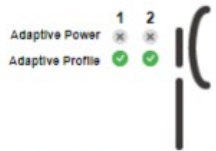


# XPIC – real use cases

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



Dual Carrier, Multi Carrier ABC, XPIC



Local

Remote

▲ 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

▲ IP-50C - Jencicenet



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

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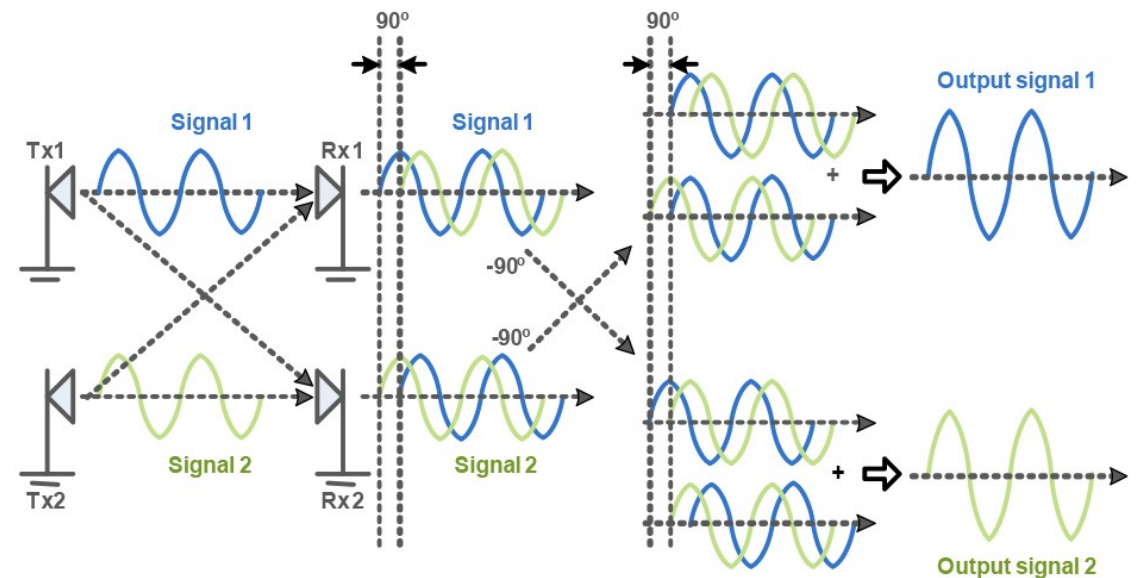
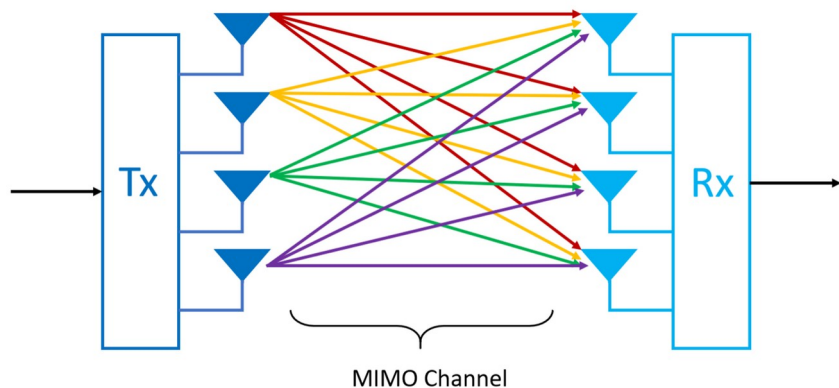


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# MIMO

- 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

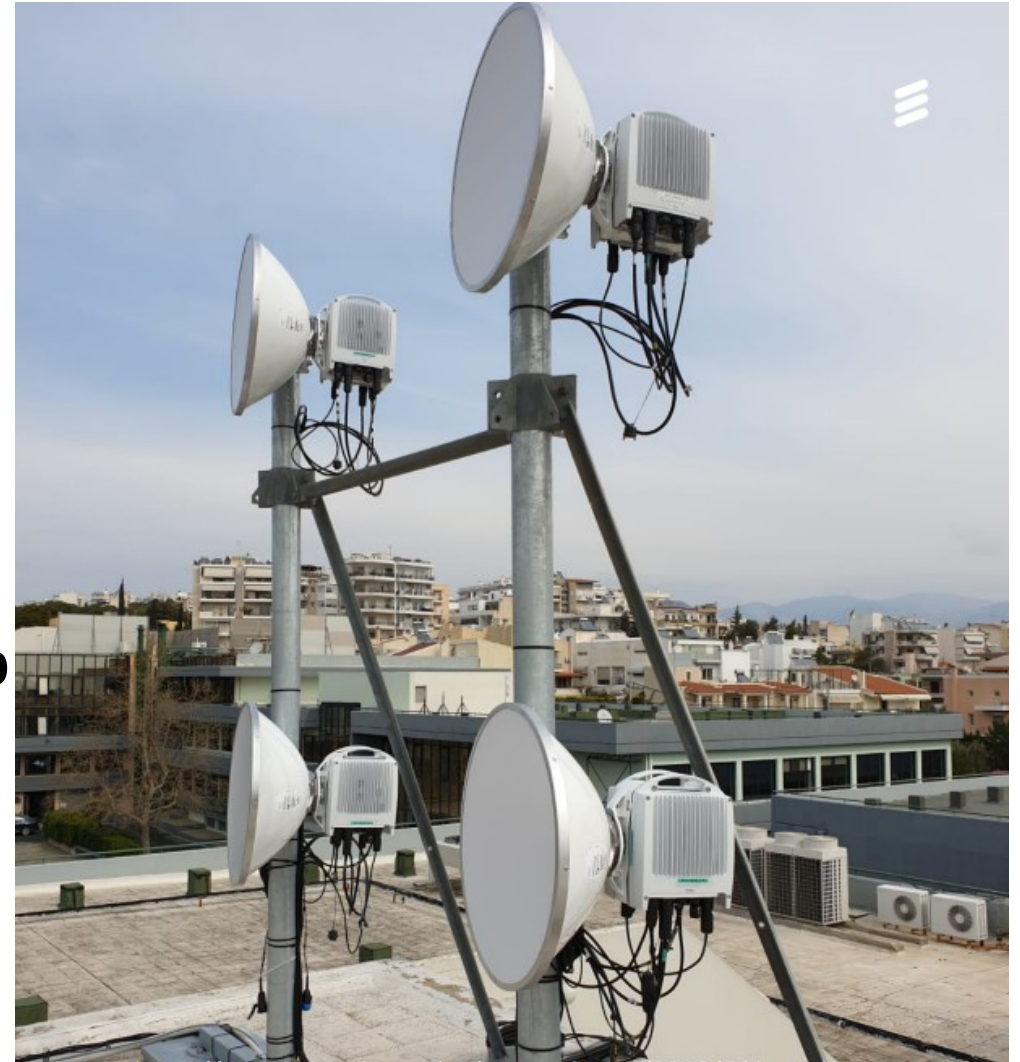
- 2x Ceragon IP-20C, 28 MHz, MIMO 4x4 (2x XPIC link in LoS MIMO configuration)

⇒ **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%**





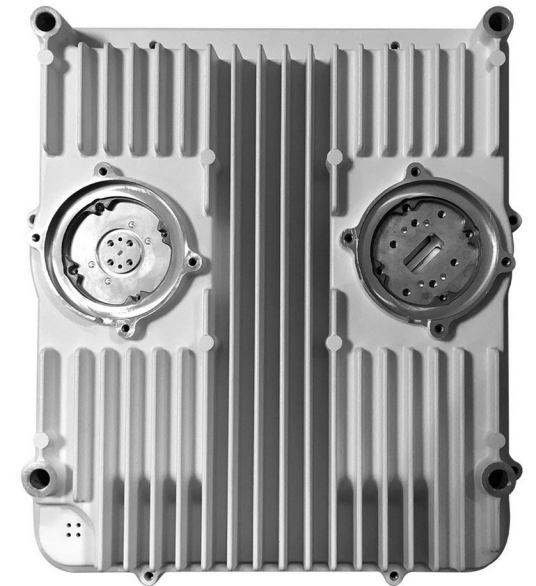
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## Let's look closer: **Distance**

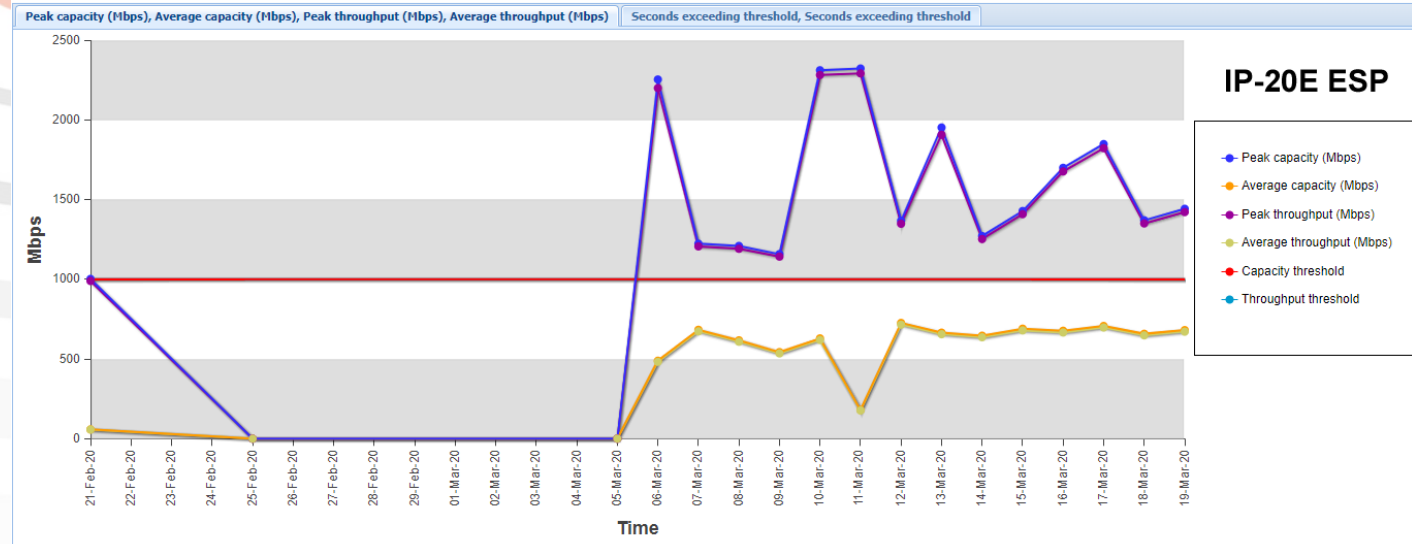
- **Multiband**

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

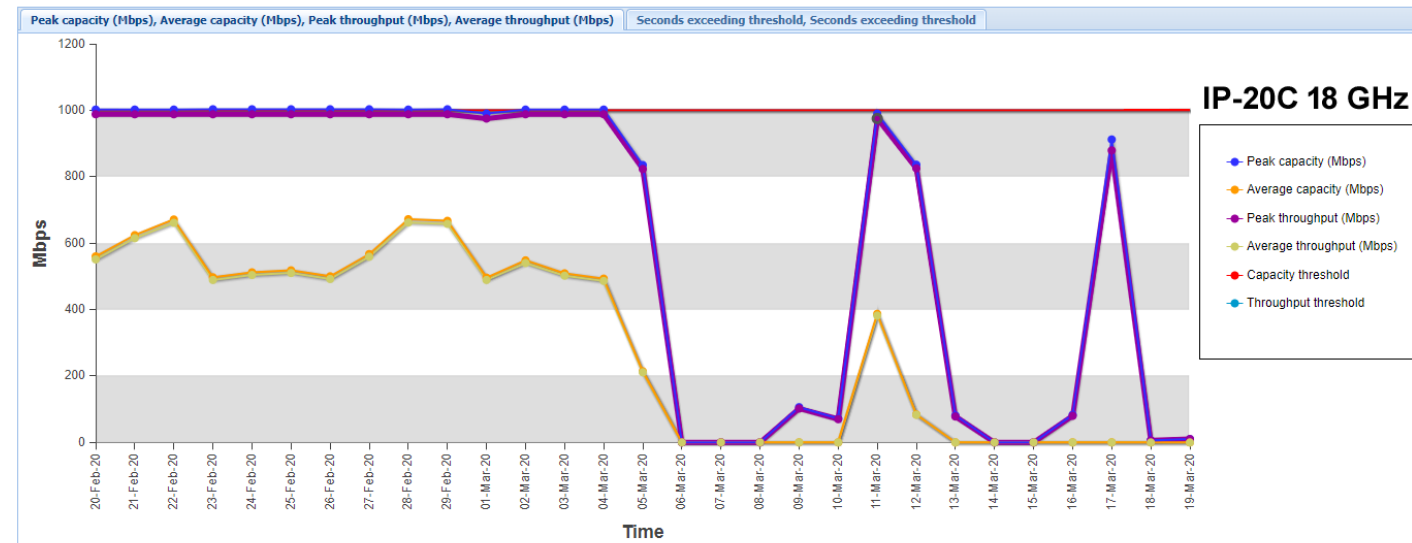


# Multiband – real use cases

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

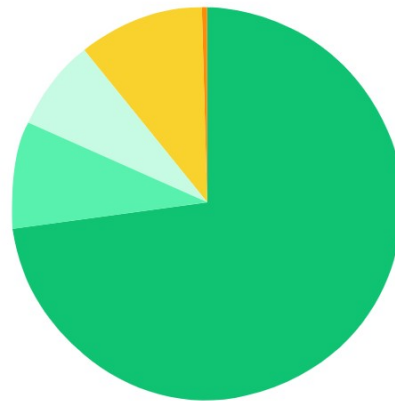


Capacity & Throughput PM report (Main Carrier ABC, Group #1, 24 hours)

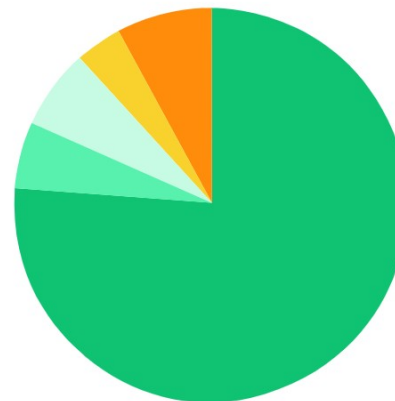


# Stabilized antennas

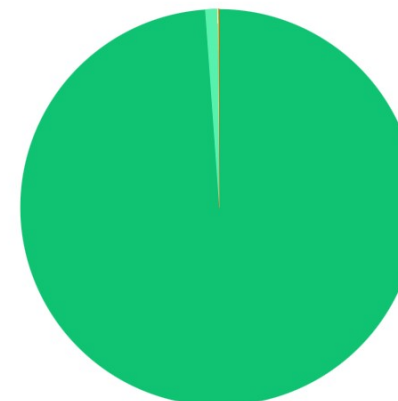
- For 80 GHz band
- Mechanically stabilized feeder
- Enabling long hops with higher capacity



Regular antenna  
20m height



Sway compensation **Off**  
28m height



Sway compensation **On**  
28m height

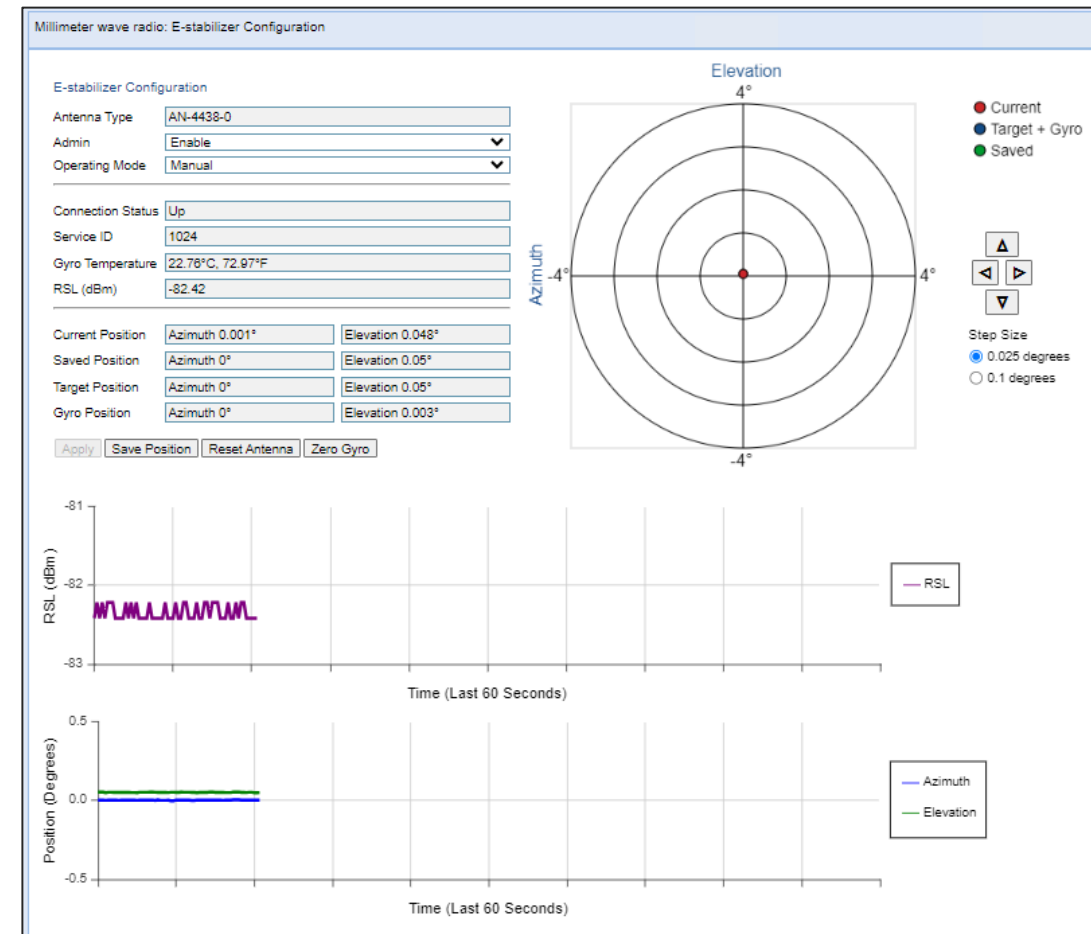
■ 512QAM ■ 256QAM ■ 128QAM ■ 64QAM ■ 32QAM ■ Down

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  $4^{\circ}$



# 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!

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[www.wifishop.cz](http://www.wifishop.cz)