Self-Alignment Transmit-Array Millimeter-wave Antennas

18/10/2017

Radiall

Millimeter-wave antennas for backhaul point-to-point links

Targeted applications

- Fronthaul & backhaul for mobile networks
- 5G Smallcells
- Industrial site, campus dedicated networks

Typical use case

- Distance from **100m to 10km**
- High data rate from **1 to 20 GB/s**
- Small antennas ⌀ **120 to 600mm**

Typical backhaul budget links in the millimeter-wave bands

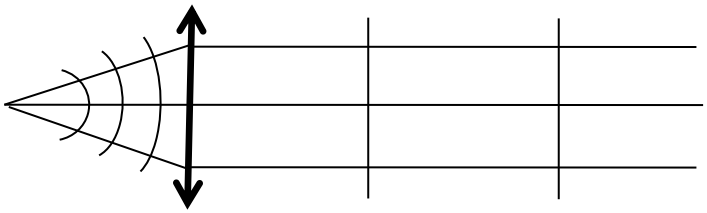
	38GHz band	V-band 32dBi	V-band 38dBi	E-band 43dBi
	Licensed	**Unlicensed**	**Unlicensed**	**Licensed**
Frequency band	**38-40.5**	**57-66**	**57-66**	**71-86 GHz**
Antenna diameter	300 mm	100 mm	200 mm	300 mm
Antenna HPBW	2.0°	3.5°	1.8°	0.9°
Antenna gain	**38 dBi**	**32 dBi**	**38 dBi**	**43 dBi**
Tx PA limit	GaAs	ETSI limit	ETSI limit	GaN
Tx power	20 dBm	10 dBm	10 dBm	20 dBm
EIRP	58 dBm	42 dBm	48 dBm	63 dBm
Distance	**12.8 km**	**370 m**	**790 m**	**10.2 km**
Atmospheric attenuation	-1.37 dB	-4.8 dB	-10.3 dB	-4.1 dB
Rx Power	-50 dBm	-51 dBm	-51 dBm	-49 dBm
UL or DL Bandwidth	1.25 GHz	3.5 GHz	3.5 GHz	5 GHz
Receiver Noise factor	6 dB	8 dB	8 dB	8 dB
SNR	25 dB	20 dB	20 dB	20 dB
Link Capacity (Shannon)	10.4 GB/s	23.3 GB/s	23.3 GB/s	33.3 GB/s
Coding + network overhead	25%	25%	25%	25%
Data rate	**8.31 GB/s**	**18.6 GB/s**	**18.6 GB/s**	**26.6 GB/s**

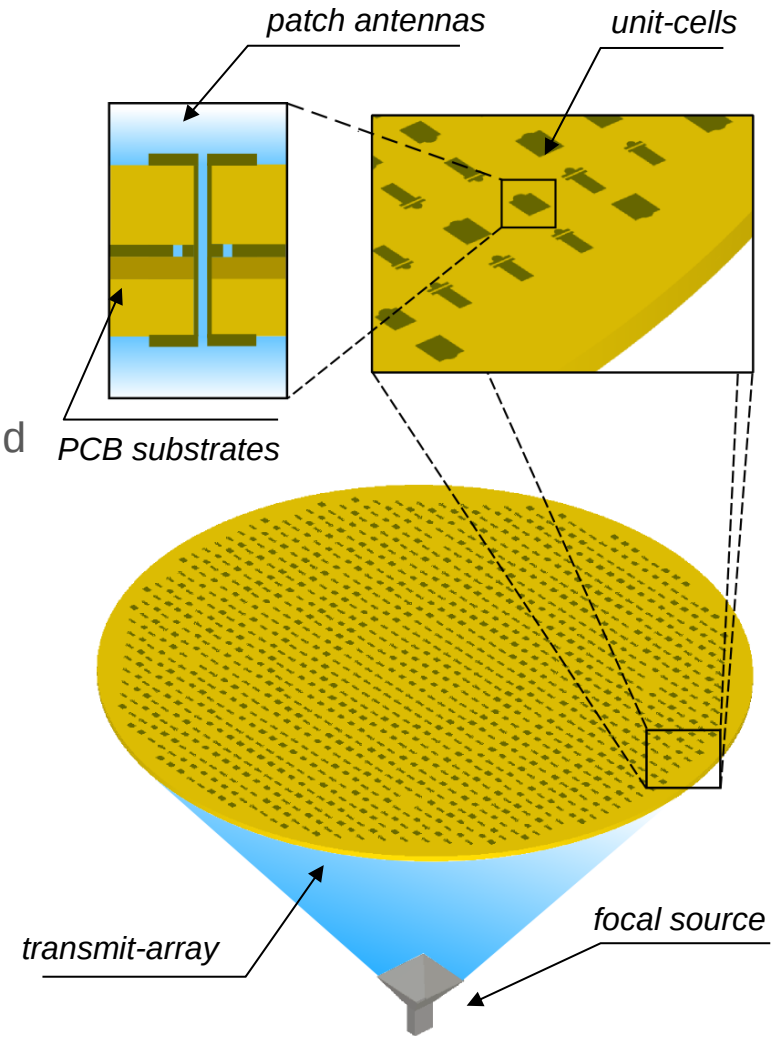
Radiall 32dBi V-Band antenna

- Small form-factor
- Robust design for hash outdoor conditions
- WR-15 waveguide flange
- Based on an innovative transmit array technology
- Full support and customization for integration in any radio equipment

Transmit Array Technology

1. An EM wave is radiated from a horn-like structure called the **focal source.**
2. The wave propagates through a **transmit-array** made in a multi-layer ***PCB*.**
3. Unit-cells receive a fraction of the incident wave and retransmit it with a **phase shift**.
4. The transmit-array acts as **Fresnel lens**, thus obtaining the high gain.





C. Jouanlanne et al., "Wideband Linearly Polarized Transmitarray Antenna for 60 GHz Backhauling," IEEE Trans. Antennas Propag., vol. 65, no. 3, pp. 1440–1445, 2017.

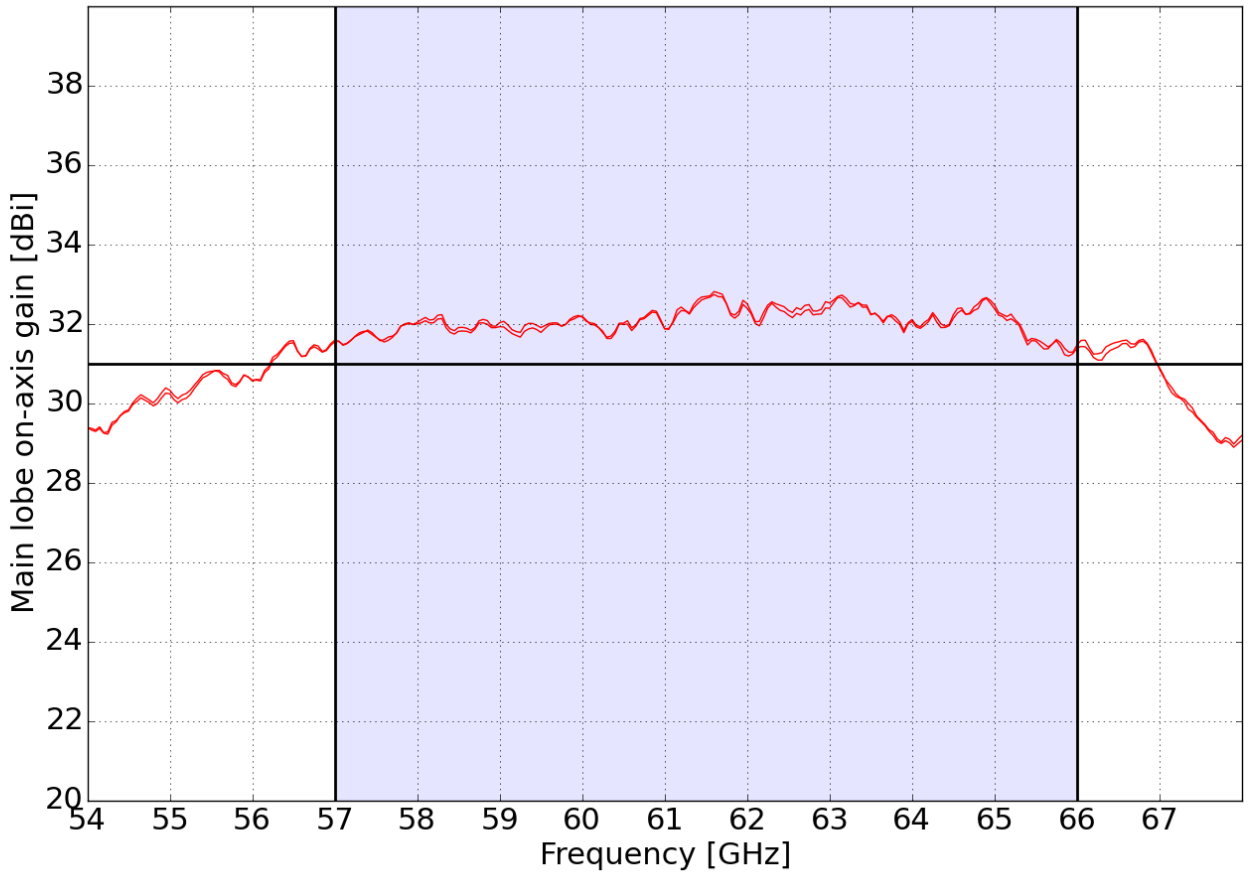
Electrical characteristics

Part number	R380840000
Frequency range (GHz)	57-66 GHz
VSWR (max)	< 1.5
Gain (typical)	32 dBi
Gain (min full band)	31 dBi
3 dB beamwidth	3.5º x 3.5º
Polarization	Linear
Compliance standard	ETSI Class 2
Flange Type	WR15 (UG-385/U)

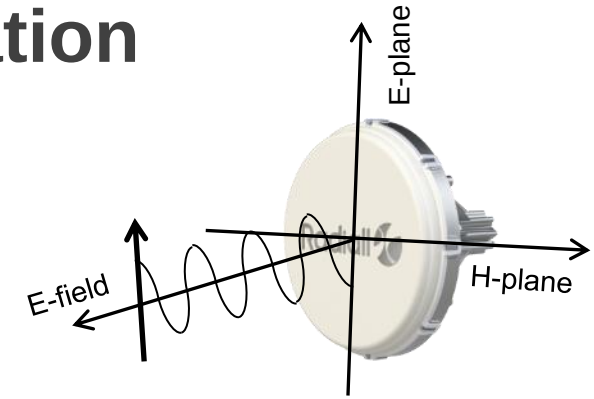
Mechanical & Environmental characteristics

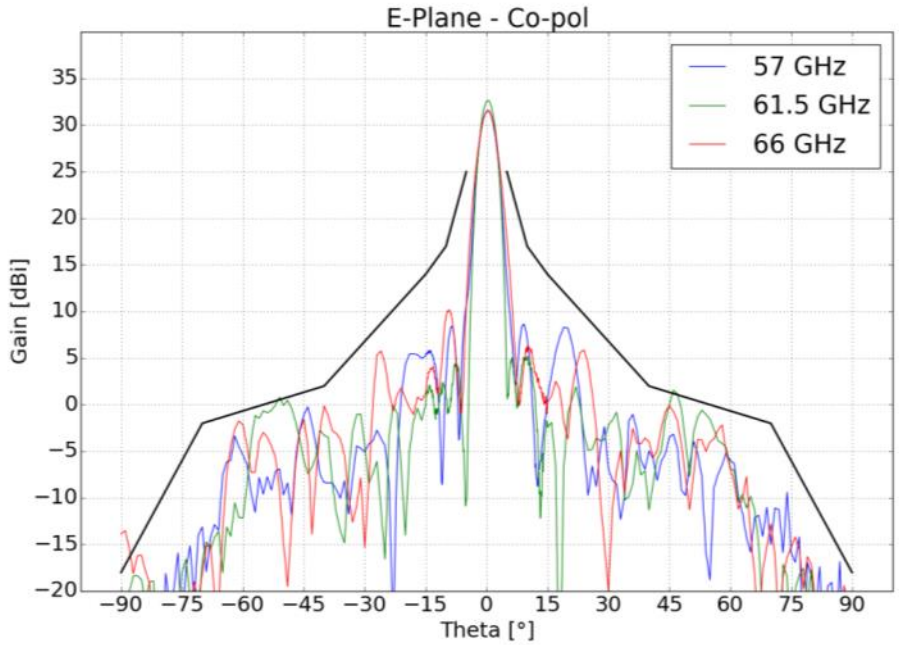
Part number	R380840000
Diameter	121 mm
Length	86.2 mm
Weight	380 g
Temperature	-55 / +60 ºC
Chassis material	Zinc
Radome material	Polypropylene
Ingress protection	IP67
Solar loading	UV resistant
Rain, Ice, Humidity	Water repellant radome

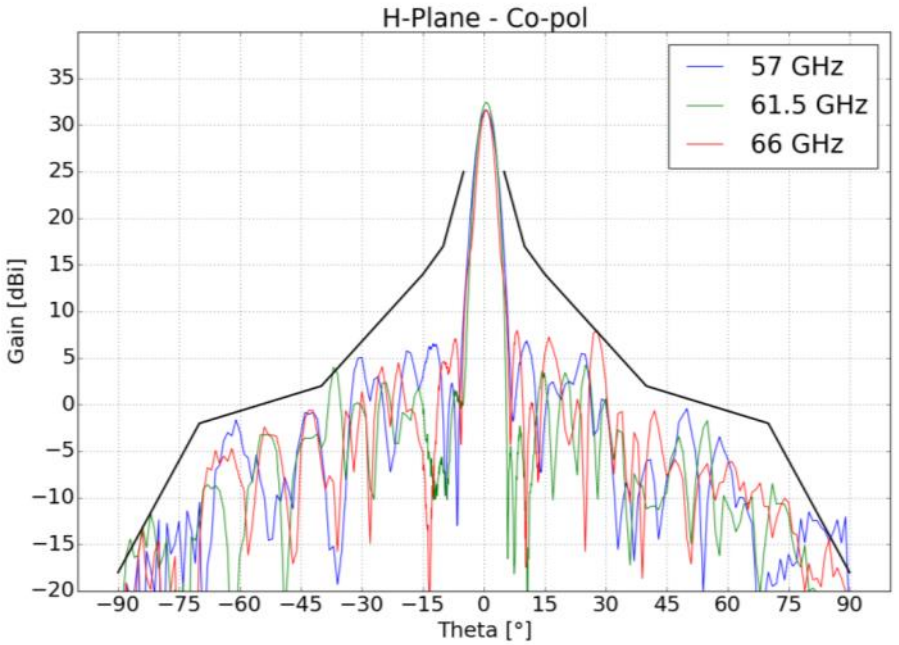
Gain vs. frequency



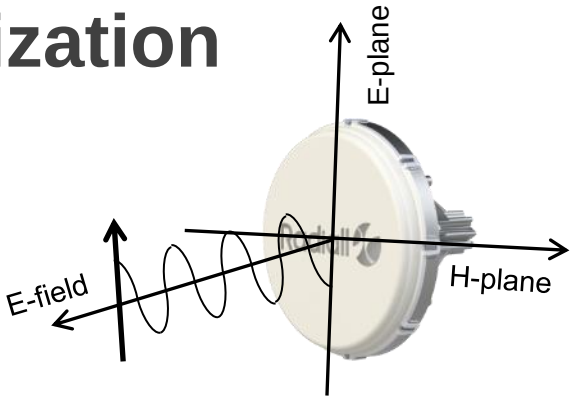
Radiation Pattern – Co-Polarization

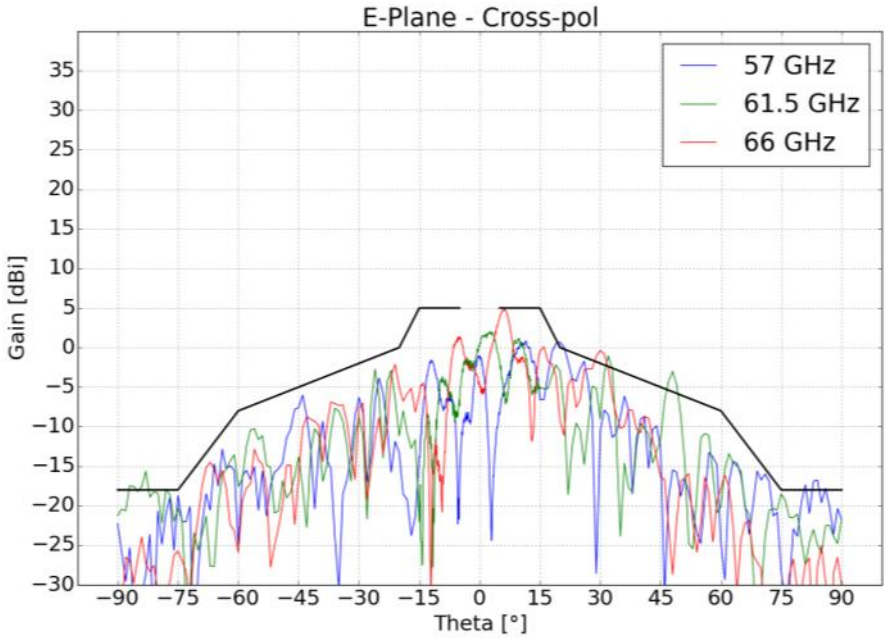


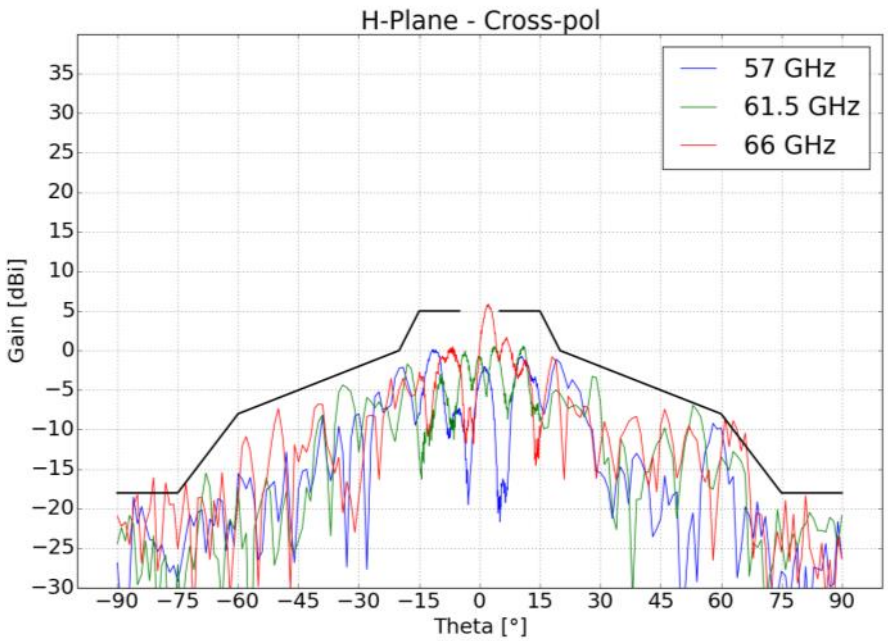




Radiation Pattern – Cross-Polarization





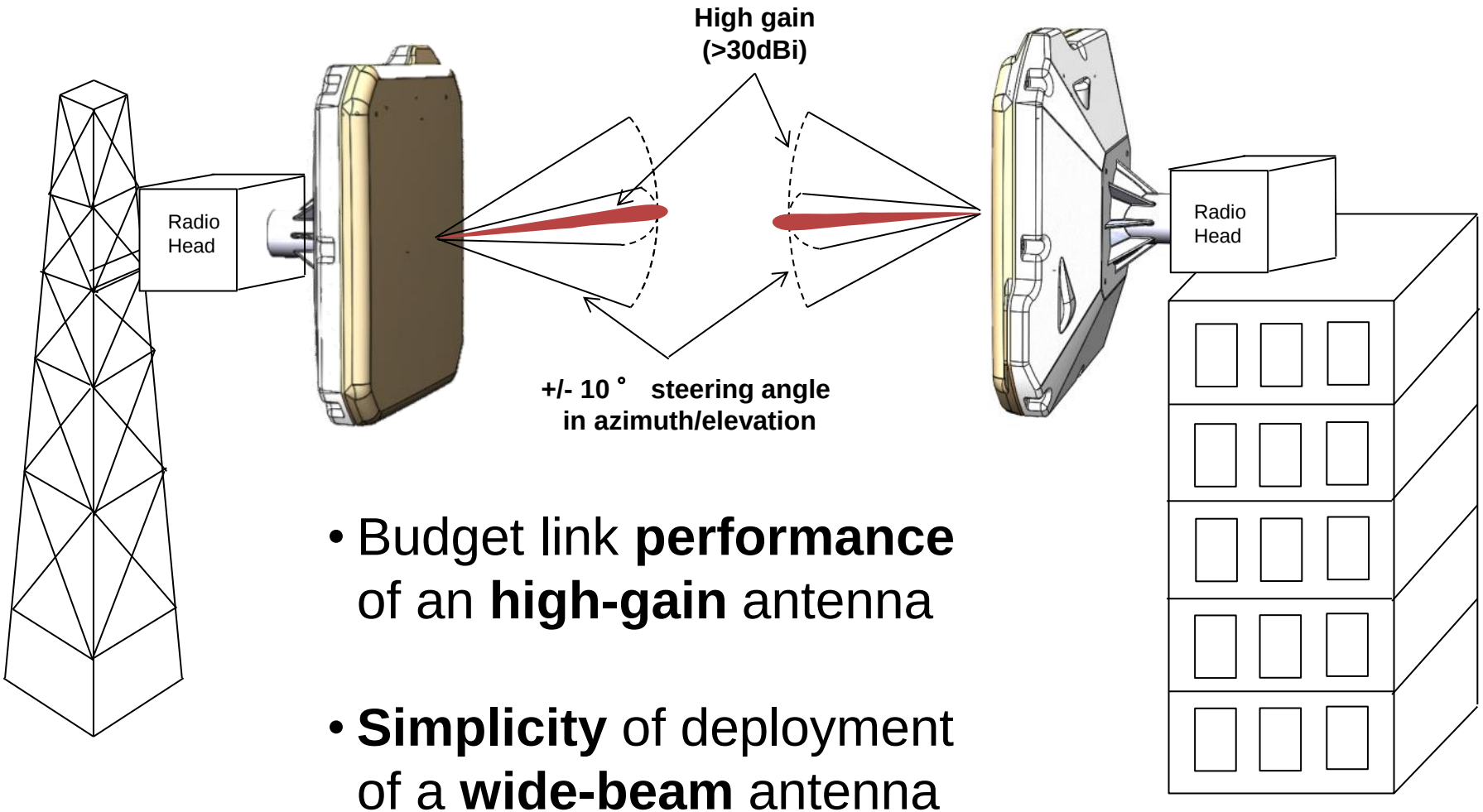


High gain antennas increase distance and data rate …
… but need accurate alignment

- Require a long manual alignment procedure at network deployment.
- Require on-site realignment interventions (after strong meteorological events or natural disasters).
- Require heavy and rigid mounting structures.

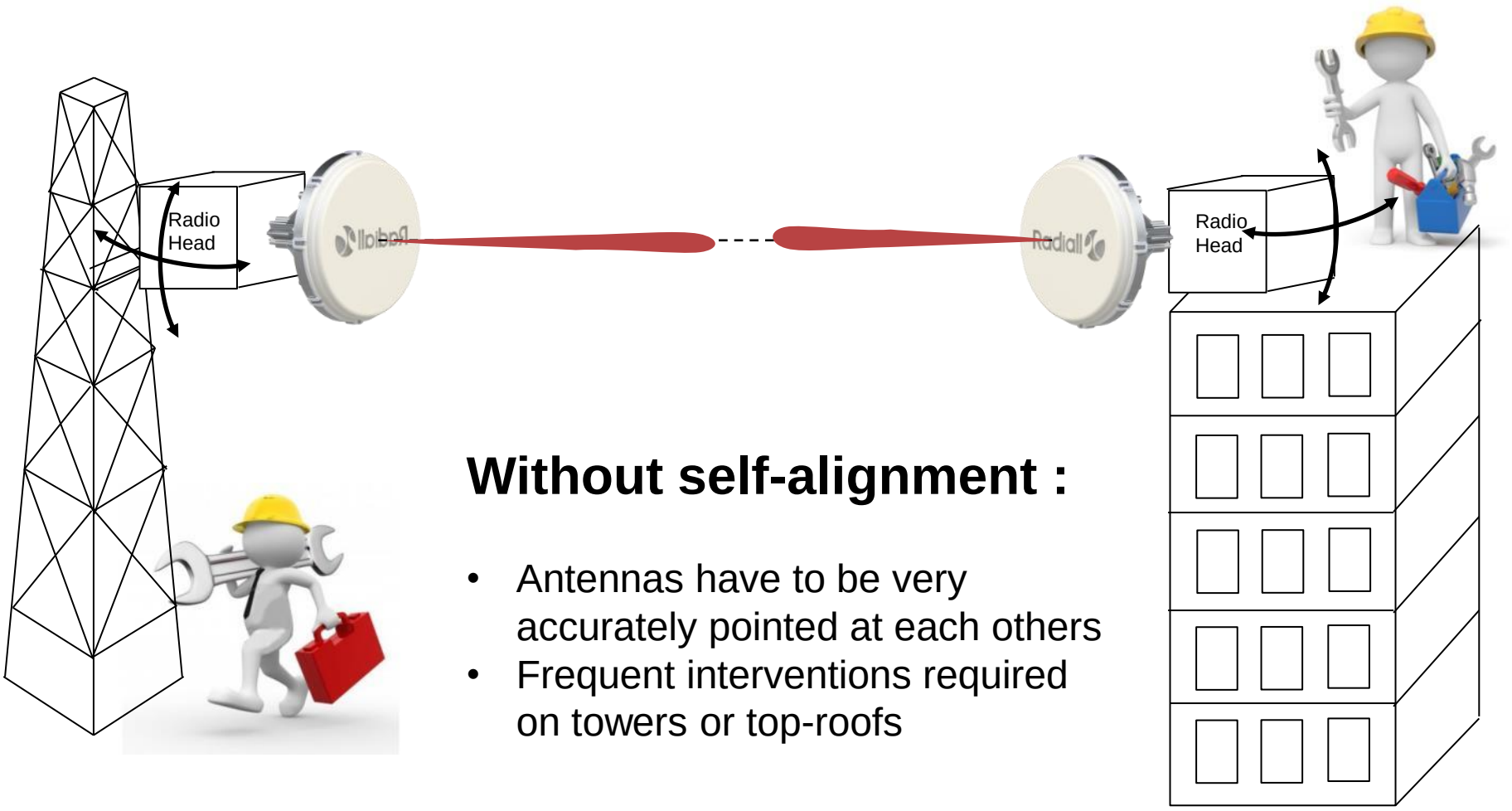
Our self-alignment technology simplify the antenna beam alignment

Self-Alignment Use Case



- Budget link **performance** of an **high-gain** antenna
- **Simplicity** of deployment of a **wide-beam** antenna

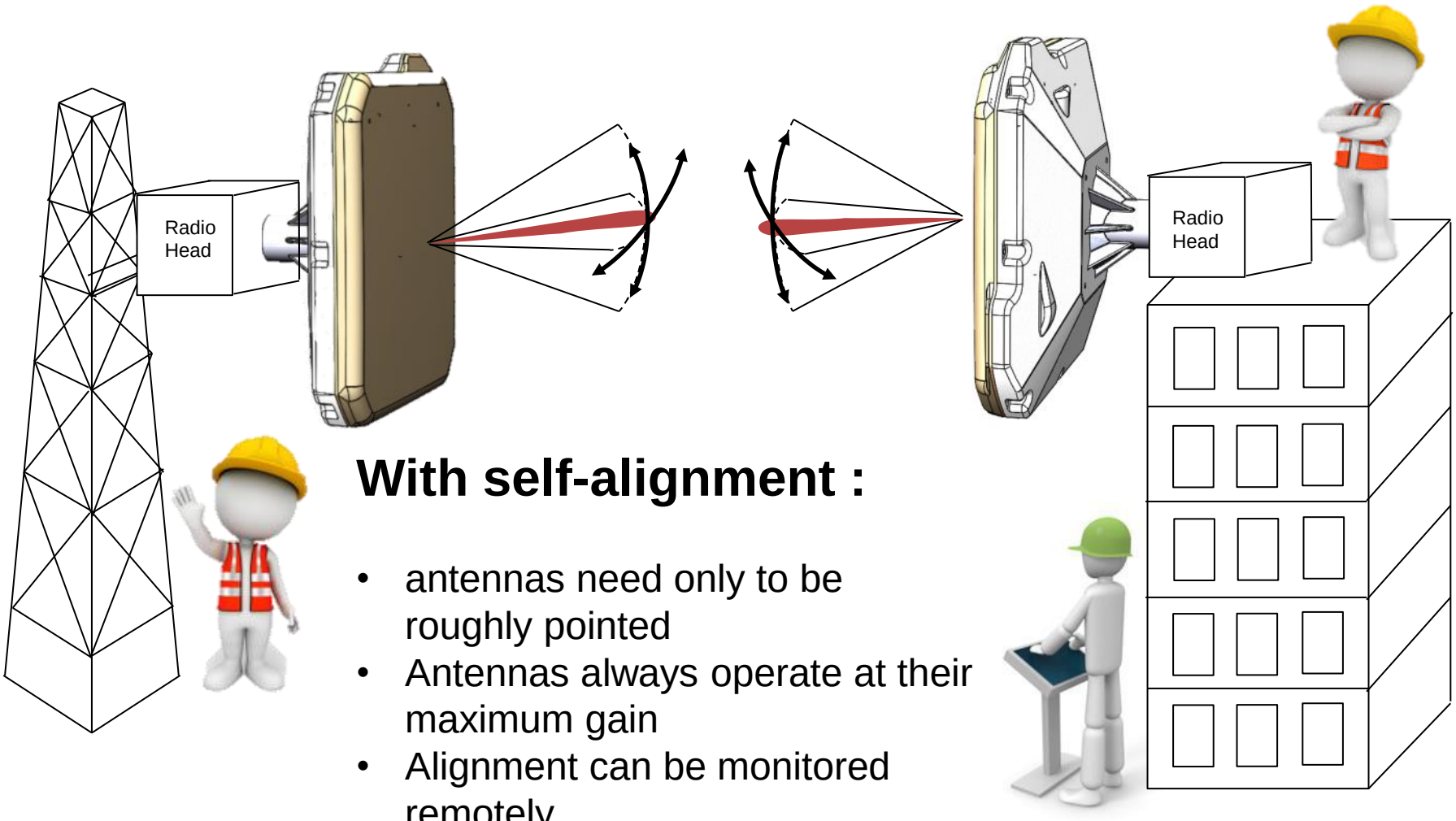
Self-Alignment Antenna Deployment



Without self-alignment :

- Antennas have to be very accurately pointed at each others
- Frequent interventions required on towers or top-roofs

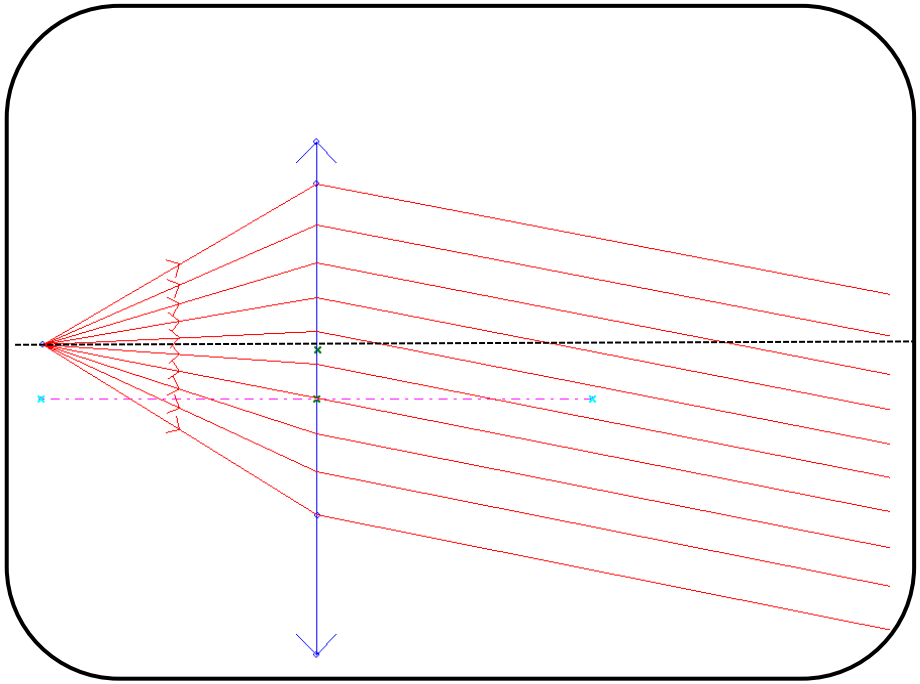
Self-Alignment Antenna Deployment

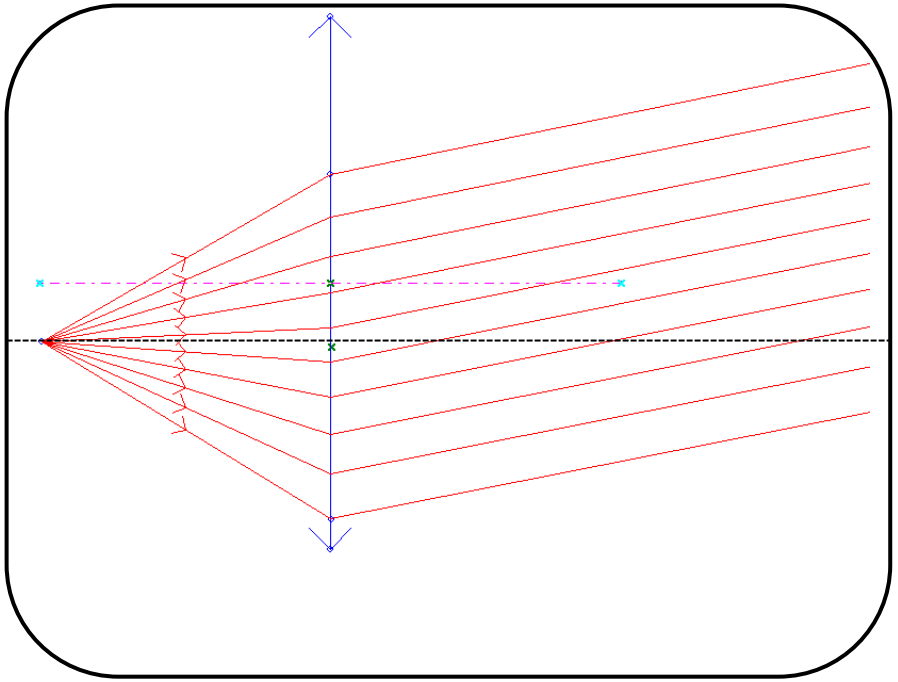


With self-alignment :

- antennas need only to be roughly pointed
- Antennas always operate at their maximum gain
- Alignment can be monitored remotely

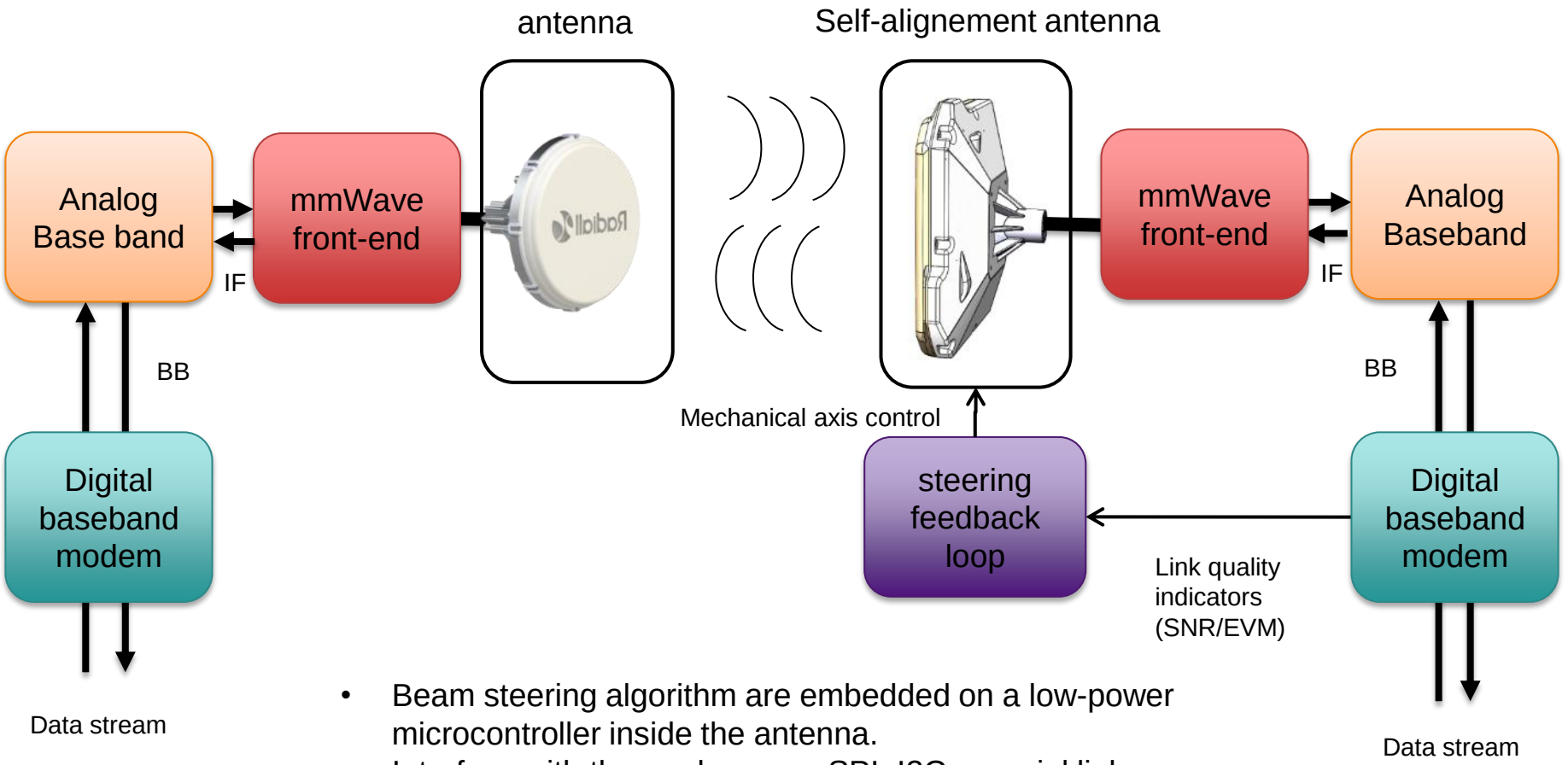
Self-alignment Operating Principle





The beam is mechanically steered by translating the lens inside the antenna

Self-alignment system integration



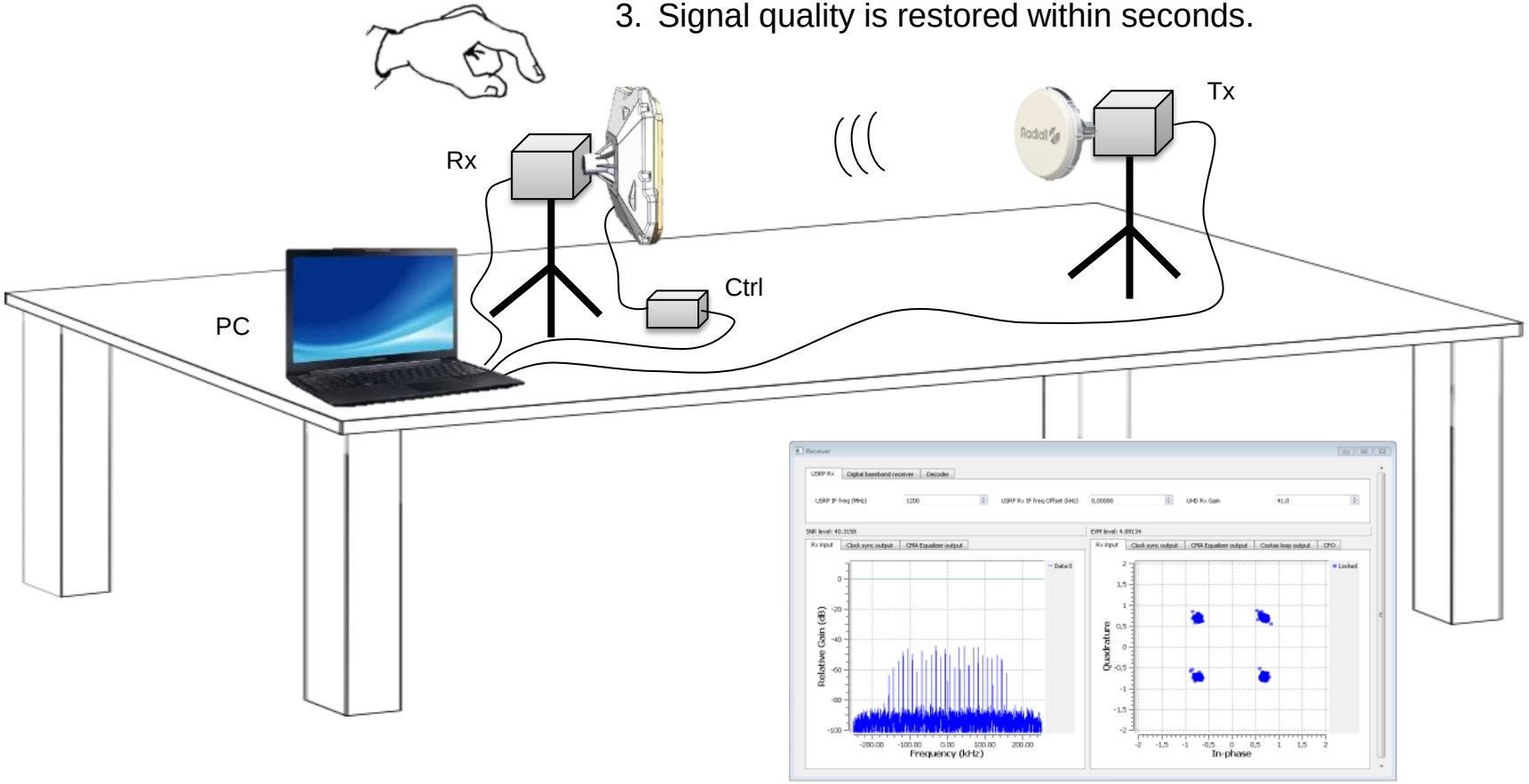
- Beam steering algorithm are embedded on a low-power microcontroller inside the antenna.
- Interface with the modem over SPI, I2C or serial link.

Simplify your integration & installation

Simplify your integration	Simplify your installation
• **Integrate with your radio** full customisation of radome and casing	• **Save energy** Only ~uA @ in deep standby, ~1W @ monitoring, 5W peak @ realignment
• **Interface with your modem** I2C, SPI, serial link or IP socket	• **Speed-up coarse mechanical alignment** ~ 10° az/el angle tolerance
• **Adapt to your power rails** Any DC voltage from 5 to 36 volts	• **Minimize on-tower intervention** by remotely monitoring and re-aligning the beam.
• **Optimize beam control algorithm** to fit your use case	• **Guaranty that antenna is constantly** operating at its maximum gain point

Real-time Proof of Concept

1. When Rx antenna is moved, the signal quality deteriorates.
2. Self-aligment is automatically retuned.
3. Signal quality is restored within seconds.



First time presented @ European Microwave Week 2017 in Nürmberg


Thank you