WAVE by AGC

Dyn Lock s.r.o.

DYN TEDES s.r.o.

WAVEANTENNA

Aesthetic Glass Antenna solution seamlessly integrated

"Elevate your connectivity"

What is WAVEANTENNA ?

- **Technologies:**

4G/5G bands, WiFi (2.5GHz, 5GHz and WiFi 6E), FWA

- **Mechanical:**

Different antenna size and frames

- **Variants:**

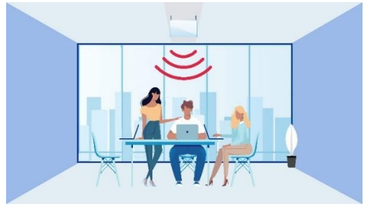
Transparent, Printed, LED version, Low EMF,…etc

- **Installation possibilities:**

On window, Wall installation, Ceiling installation

Where can WAVEANTENNA help you ?

WAVEANTENNA – WIFI / P5G

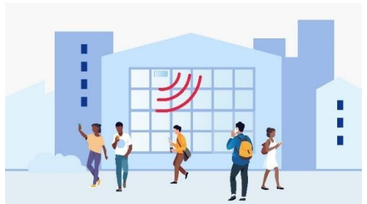


Enhance visual interior experience

Wi-Fi and Private 5G deployments in high end spaces must conciliate coverage performance with design constraints. Any visual pollution must be avoided and the position of every terminal device must be wisely chosen to fully deliver the signal.

Thanks to its superior design, WAVEANTENNA – WIFI / PRIVATE 5G integrates seamlessly in your living space without compromise on connectivity performances.

WAVEATTOCH

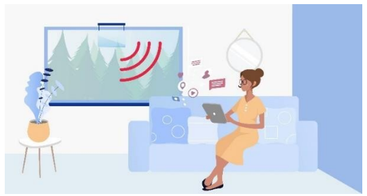


Enhance outdoor network densification

Urban areas face major challenges when deploying mobile networks: booming of data traffic, compliance with EMF limits, deployment limitations.

WAVEATTOCH removes barriers to 4G/5G network densification by installing transparent glass antenna indoors behind the glazing.

WAVEANTENNA - FWA

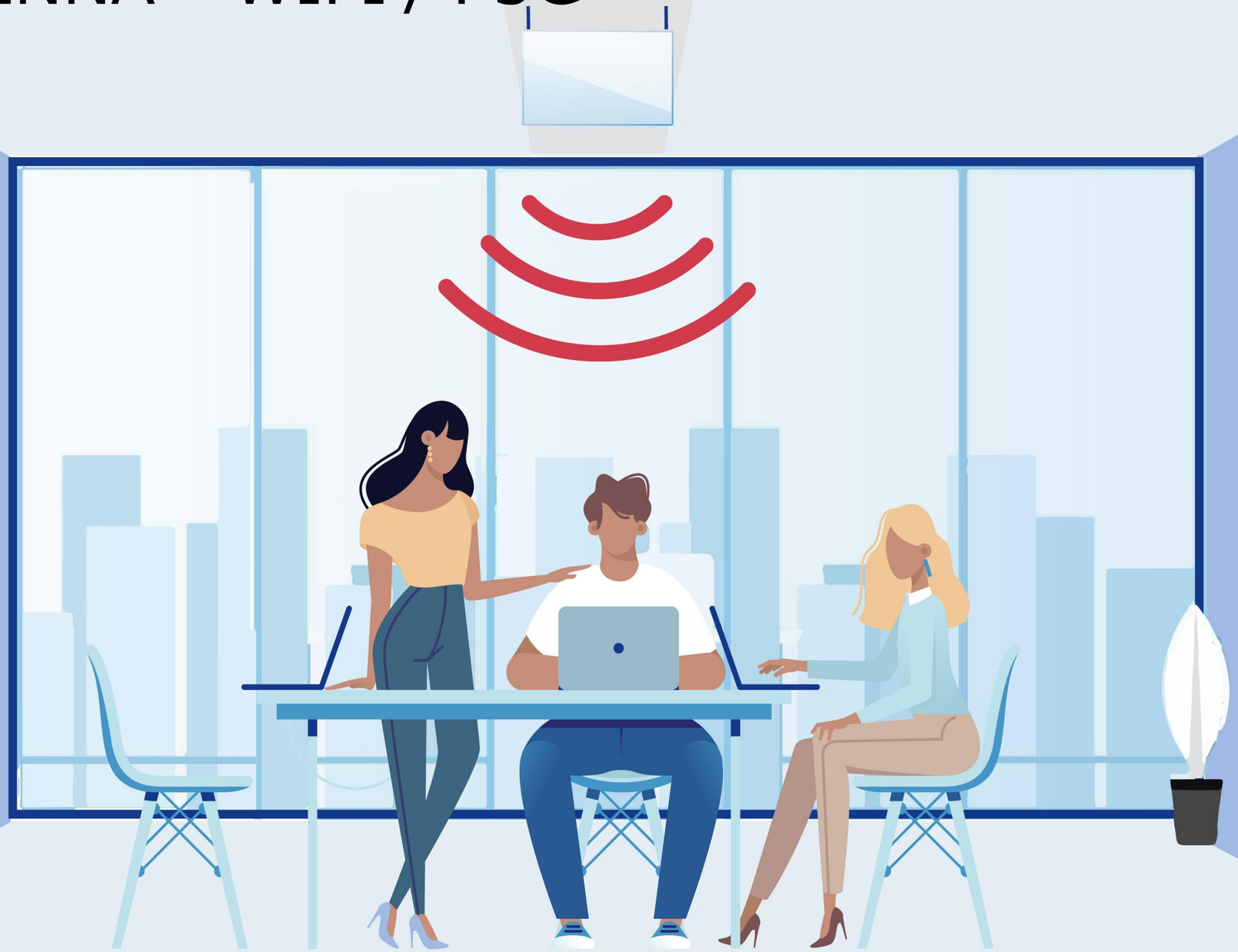


Enhance the deployment of Fixed Wireless Access

Current FWA solutions for insulated buildings face a major challenge to transmit a high-quality signal with a non-intrusive, simple and clean installation.

FWA service solves this problem with a solution combining a WAVETHRU treatment to let the signal go through the window and a transparent glass antenna connected to CPE.

WAVEANTENNA – WIFI / P5G



Wi-Fi Deployment – Pain points

Conventional deployment of WiFi access points (APs) with integrated antennas is not suitable for some configurations:

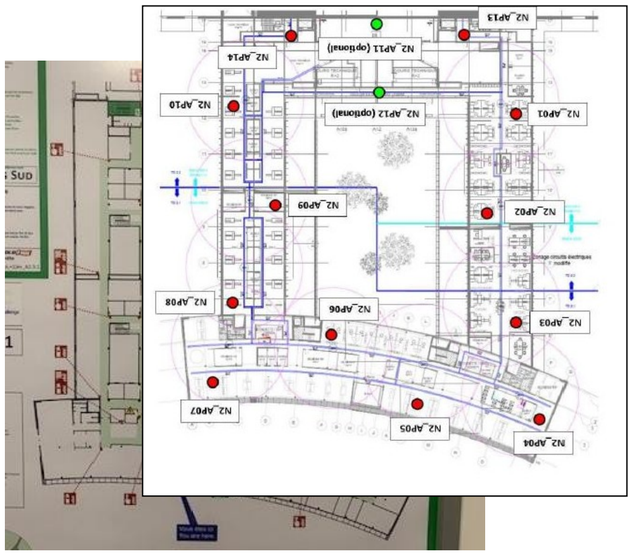
- Large space to cover (ceiling height > 7m, corridors, aisles, etc.)
- High-density coverage required (meeting rooms, auditorium)
- Materials (metal, gyproc, etc.) can interfere and attenuate the Wifi signal (- 3 dB in false ceilings)

Current solutions :

1. **Deploy external antennas or relocate access points in visible areas → aesthetics –, visual pollution**
2. **Increase the number of AP in false**

Multiplicity of visible electronic equipment jeopardizes the overall aesthetic → essential in high-end environments or in retail sector where the customer experience is crucial

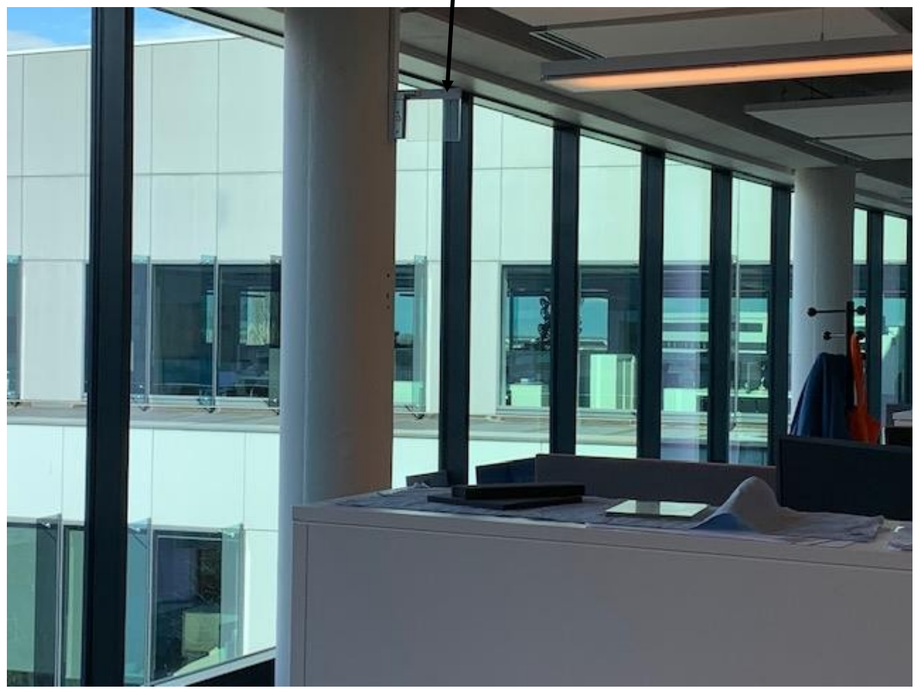
On large projects, the cost of fire safety system equipment + connectivity is high (hardware & manpower)

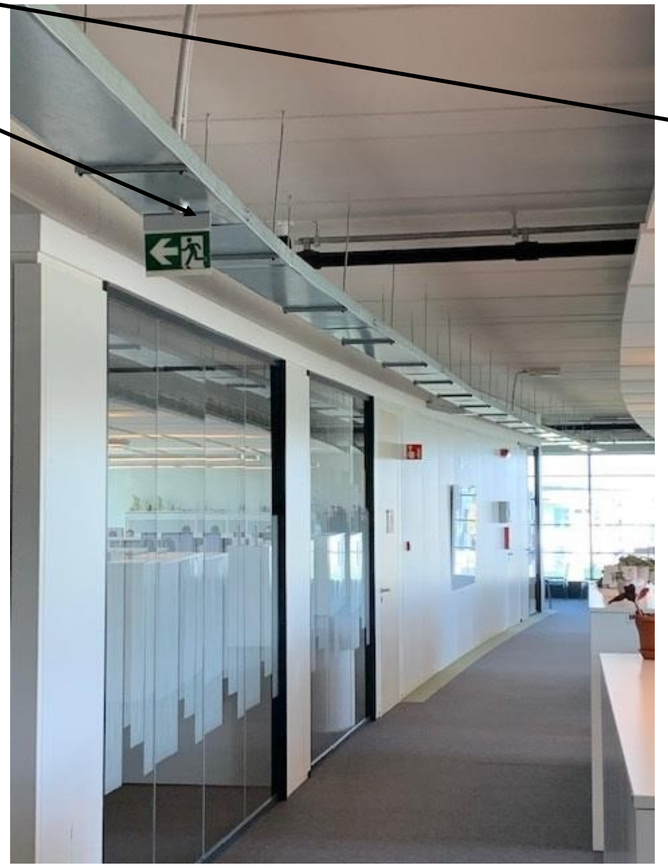


WAVEANTENNA-WIFI Solution

Seamless integration in building interiors

- **<u>Design</u> adapted for a smooth integration in modern and elegant interiors.**

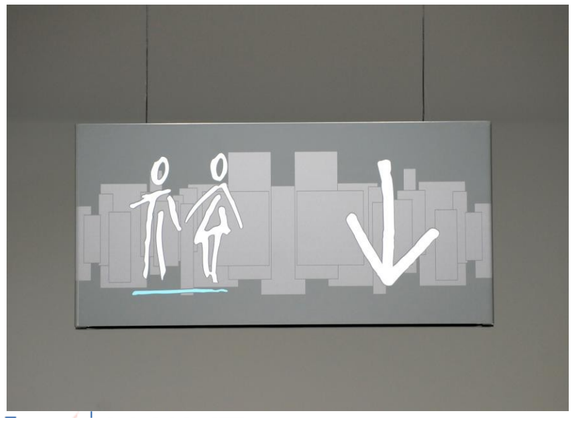


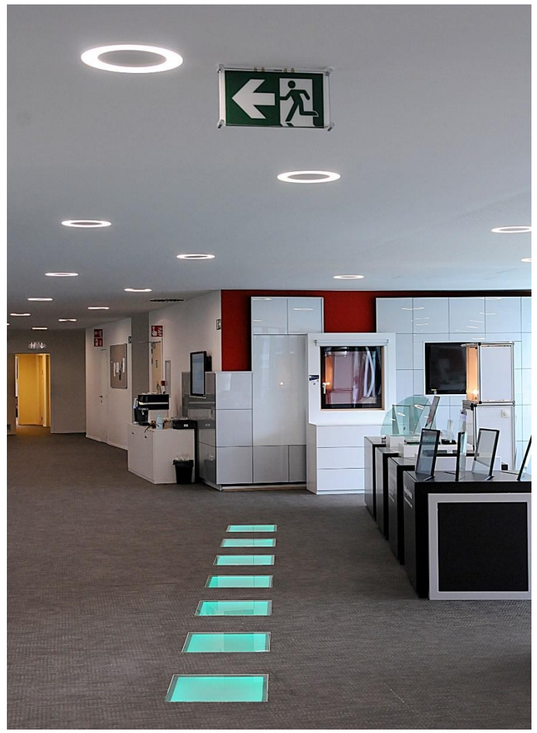


WAVEANTENNA-WIFI Solution

Double function : Antenna & signage

Antenna integration in mandatory or functional signage in building ⟶ <u>The antenna is invisible.</u>

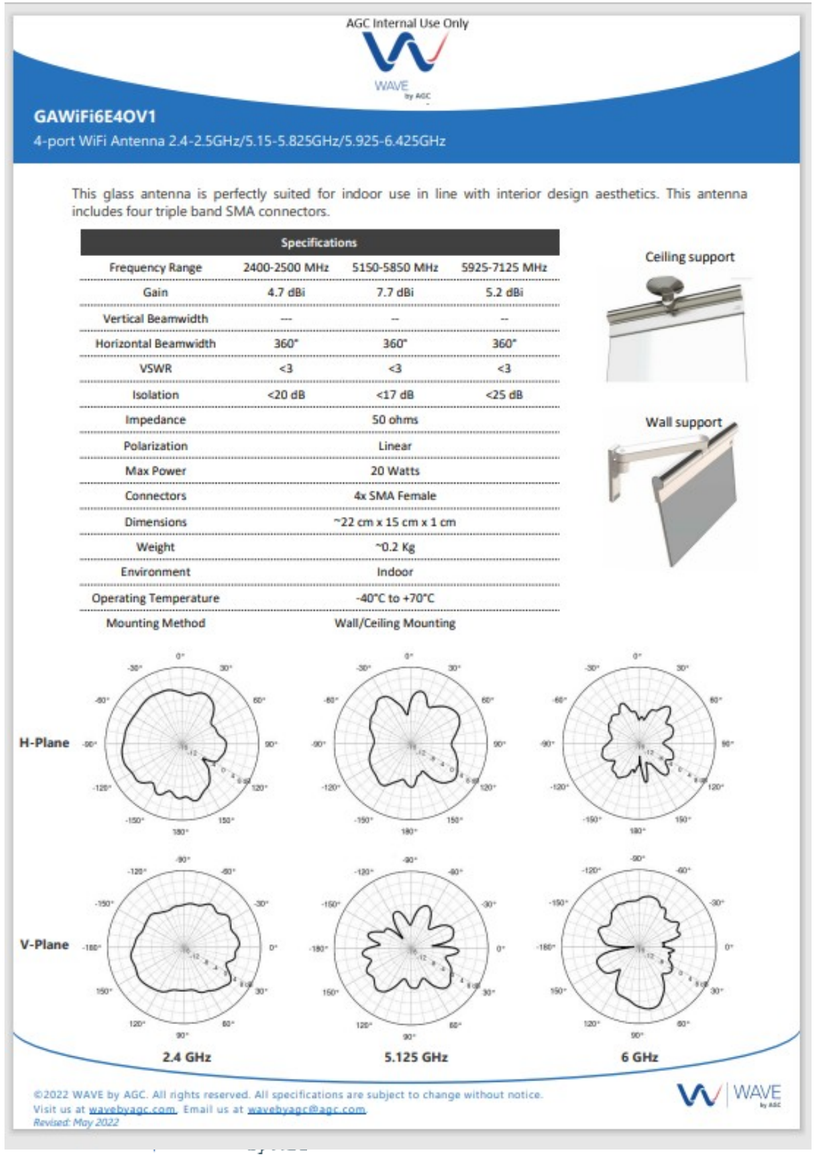




Use the antenna as and ad or an information banner ⟶ <u>The antenna is part of the branding experience</u>

WAVEANTENNA-WIFI Solution

Coverage Performances and Specifications



AGC Internal Use Only

WAVE by AGC

GAWiFi6E4OV1

4-port WiFi Antenna 2.4-2.5GHz/5.15-5.825GHz/5.925-6.425GHz

This glass antenna is perfectly suited for indoor use in line with interior design aesthetics. This antenna includes four triple band SMA connectors.

Specifications			
Frequency Range	2400-2500 MHz	5150-5850 MHz	5925-7125 MHz
Gain	4.7 dBi	7.7 dBi	5.2 dBi
Vertical Beamwidth	---	--	--
Horizontal Beamwidth	360°	360°	360°
VSWR	<3	<3	<3
Isolation	<20 dB	<17 dB	<25 dB
Impedance	50 ohms		
Polarization	Linear		
Max Power	20 Watts		
Connectors	4x SMA Female		
Dimensions	~22 cm x 15 cm x 1 cm		
Weight	~0.2 Kg		
Environment	Indoor		
Operating Temperature	-40°C to +70°C		
Mounting Method	Wall/Ceiling Mounting		

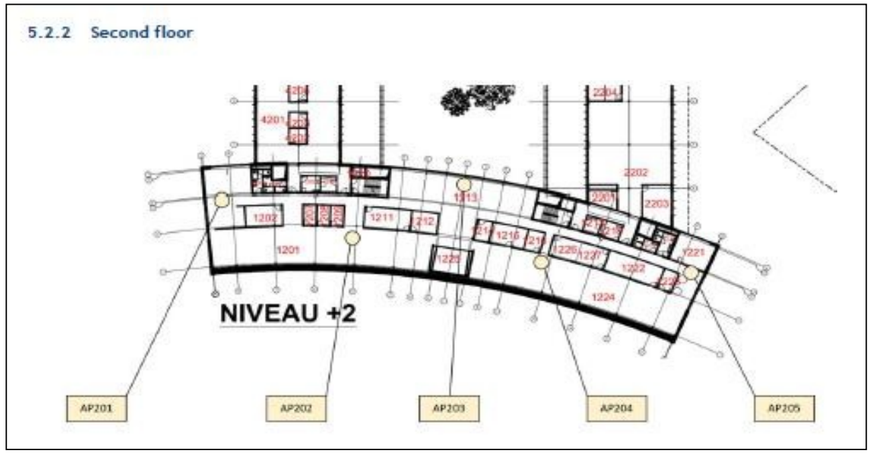
Ceiling support

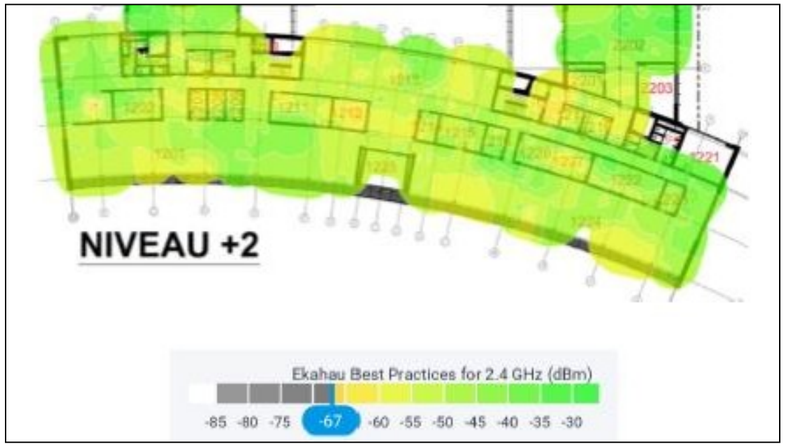
Wall support

H-Plane

V-Plane

2.4 GHz 5.125 GHz 6 GHz





Coverage tests were realized in our Technovation Center for 11 localizations on 2 levels. For each localization, Wi-Fi Glass Antenna has been installed and plugged on an Access point (Extreme AP 410ie) with SMA cables.

Taking into account the cable losses (length of cable ranges from 0,5 m to 2 m), Glass Antenna coverage performances are similar to any internal/external antenna of the market (omni-directional).

Performance tests for uni-directional antennas are ongoing.

Key benefits for key stakeholders – Premium buildings

IT Function, Engineering offices, Architects, Estate Project Developers

Enhanced visual experience

- WAVEANTENNA WIFI solutions blend harmoniously into your customer interiors thanks to their elegant design and different variants (transparent, printed, functional).

Network coverage and cost optimization

- WAVEANTENNA WIFI solutions reshape network deployment, reaching previously inaccessible locations.
- Avoid hassle and costs to camouflage unaesthetic Wifi devices.
- Cost savings on design + purchase + installation for Antenna with security / functional signage.

Tailored solutions with AGC expertise

- WAVEANTENNA WIFI solutions offer flexible options, powered by AGC's connectivity on glass expertise. From 4G/5G to antenna dimensions, we fine-tune details for seamless integration.

Key benefits for Integrators

Improved revenue

- A new fringe of the market (high end buildings, airports, train stations, retail, etc.) convinced by a top-notch technical and design product.

Brand reputation

- Be recognized as an innovative brand to introduce disruptive products like WaveAntenna on the market. Competitive advantage.

Ready

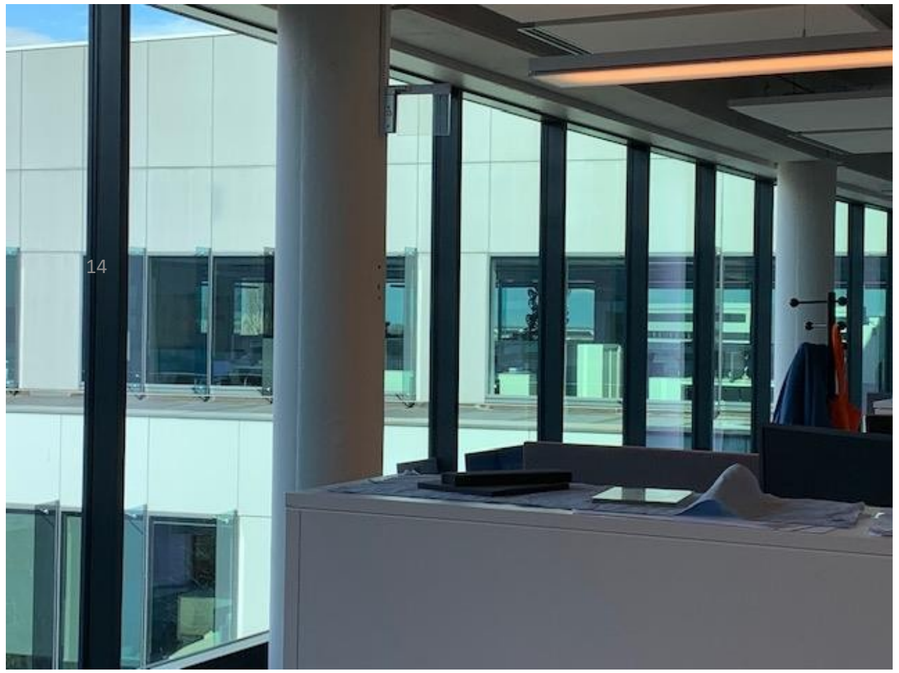
- Certified product, able to plug to any AP brand
- Delivered at your entry door in a box with installation kit
- WAVEANTENNA registered in Ekahau (Wifi design software). Soon in Hamina.

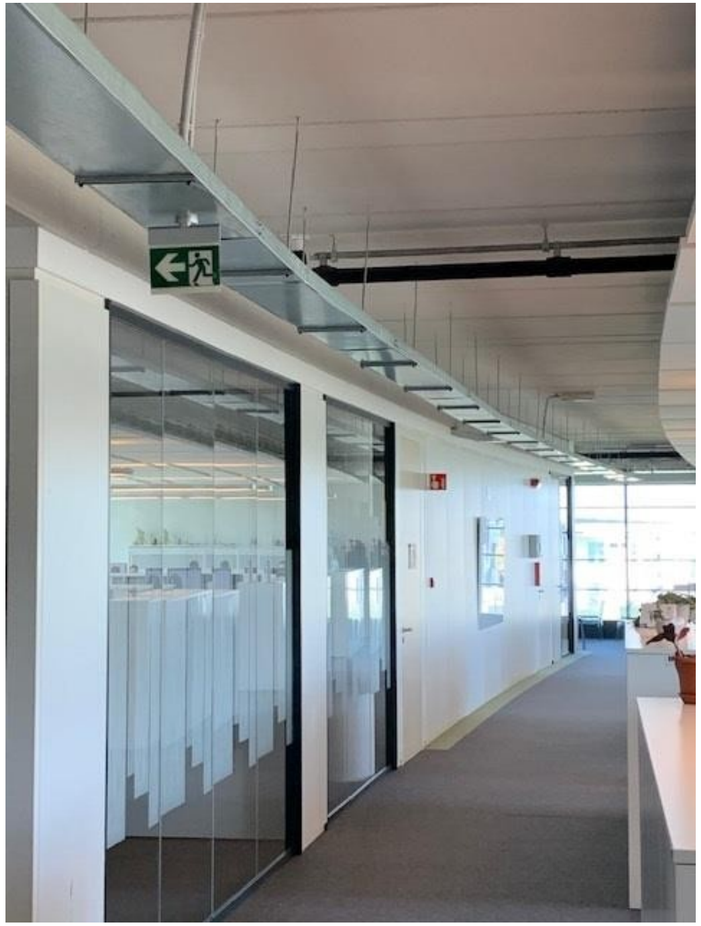
ekahau
WIRELESS DESIGN

References (1/3)

AGC Technovation Center – Belgium – Wi-Fi

- 11 Antenna installed
- 2,4 and 5 GHz
- Wall and Ceiling versions
- Transparent, logo printing, exit sign printing





References (2/3)

NTT Office – Belgium – Private 5G

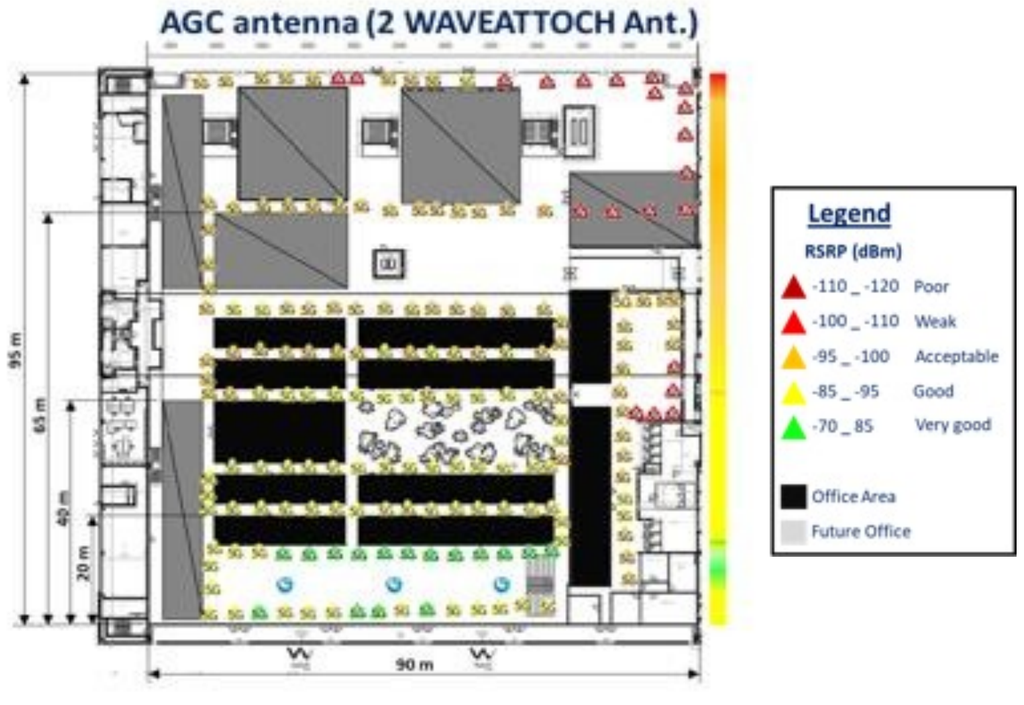
- 1 Antenna installed (4 MIMO - 5G C-band)

Disclose with the approval of NTT Belgium

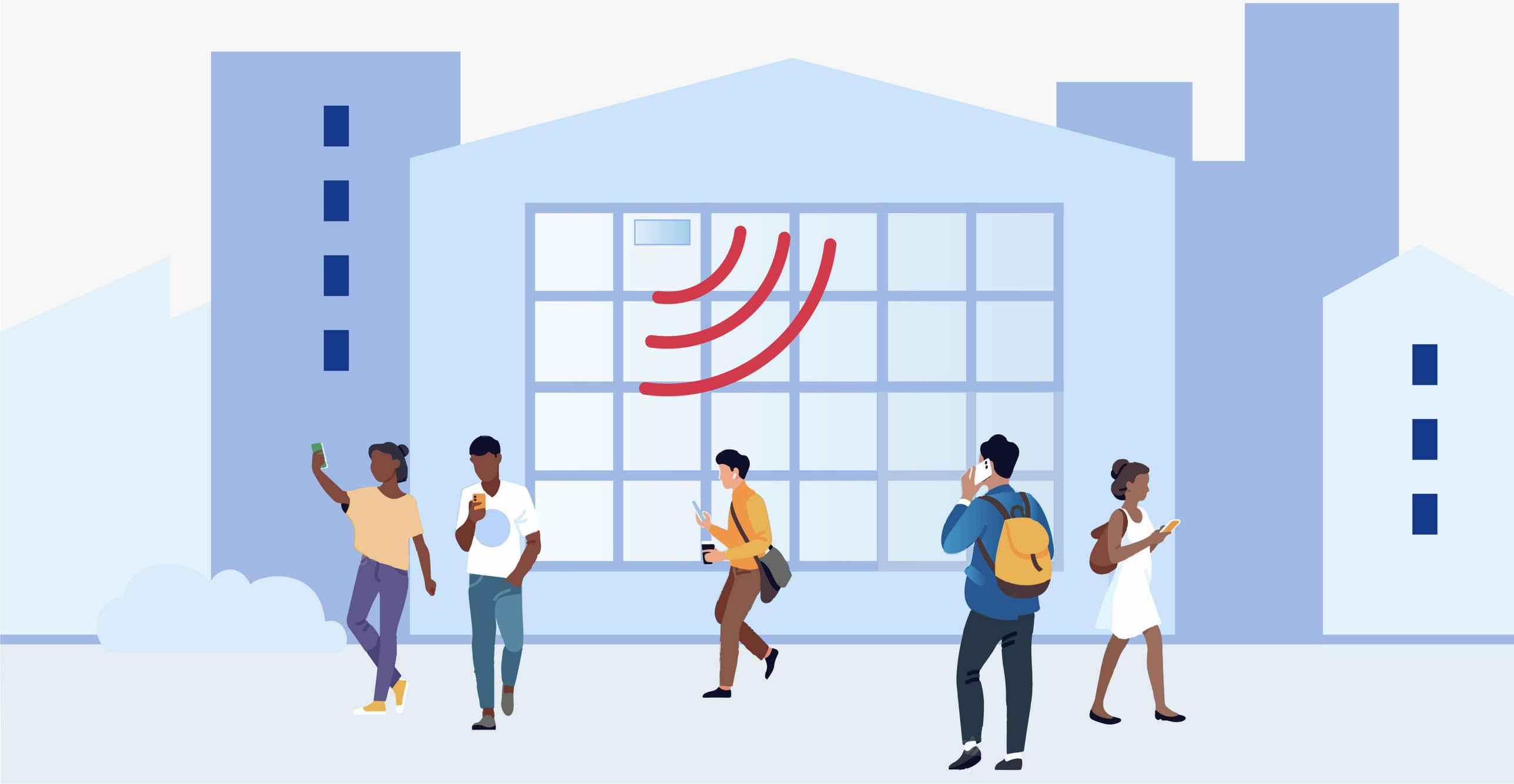
References (3/3)

A6K – Belgium – Private 5G

- 2x AGC antennas (4 MIMO - 5G C-band) installed
- Private 5G network supplied by Proximus
- Indoor coverage first - Ready for outdoor coverage
- Private 5G SA network – Nokia RAN equipment
- Antennas connected on macro RRH + Attenuators



WAVEATTOCH

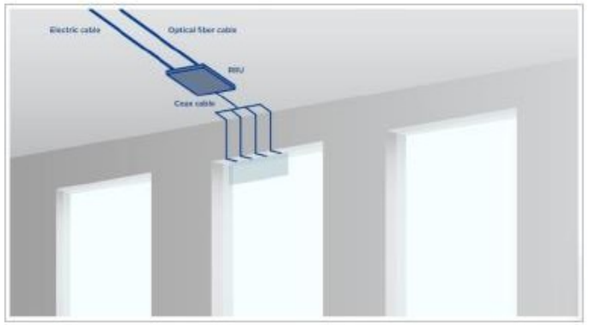


WAVEATTOCH – Pain points & Solution

- **Motivation:**
  - Densification:
    - Need in high density areas
    - Rarity of rooftop places
  - Coverage:
    - Historical and architectural implementation limits
    - New technology trends
  - Real differentiation needed by some customers

- **How AGC can Help:**
  - Use the façade as new place to provide coverage
  - Transparent antenna allow high densification (with low power) without affecting the visual
  - Indoor antenna/electronics installation: Less visible for the final user
  - Match the constraints of historical buildings, architectural and technology trends

Use the facade to provide coverage



References (1/3)

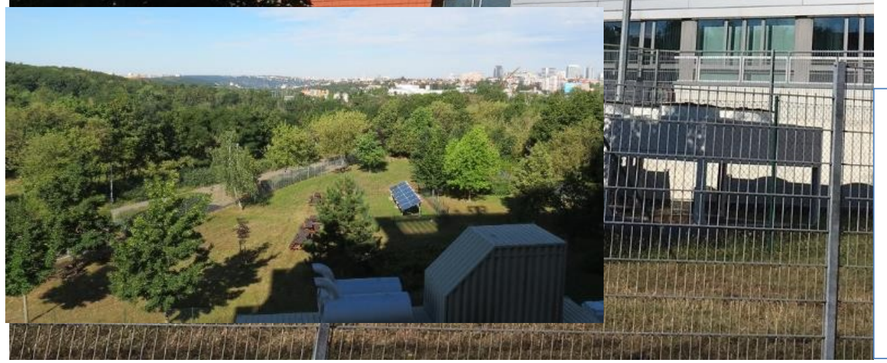
Japan

Connected to small cell indoor

Hiroshima area
5G Antenna, single band
3.6-3.7 GHz // 4.5-4.6 GHz
4 ports
5 W max / port
Gain 9dB – Tilt 20°
Beam width H/V 30° / 30°

Czech Republic

Connected to DAS to cover garden



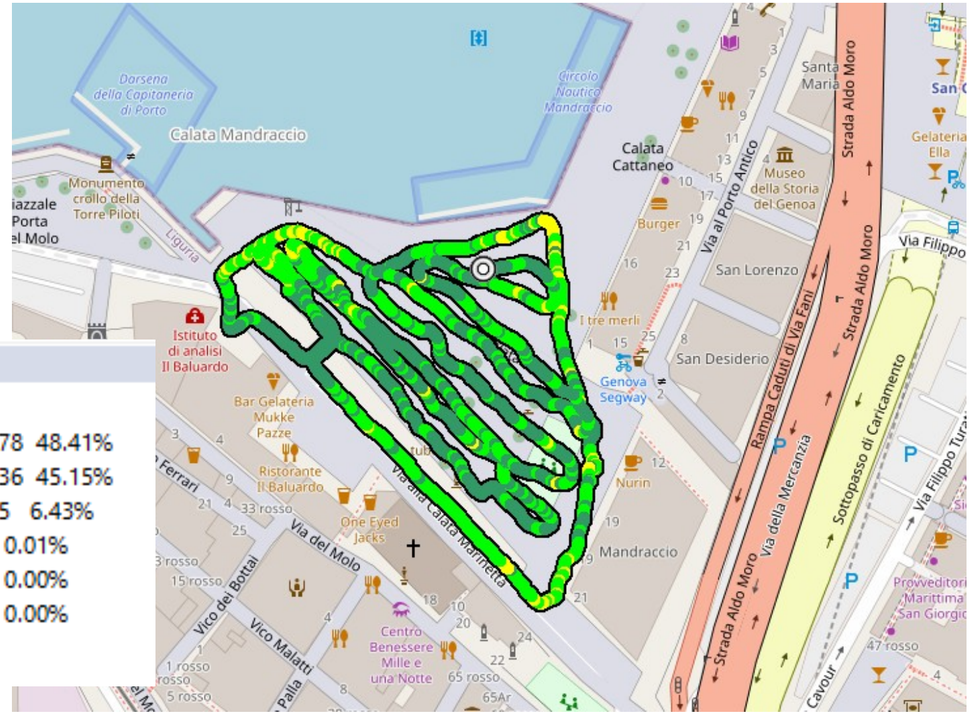
Prague
1.8 GHz // 2.1 GHz
2+2 ports
5 W max / port
Gain 7dB – Tilt 15°
Beam width H/V 65° / 35°

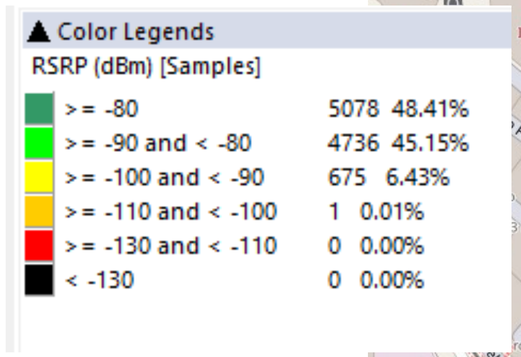
Disclose with the approval of Docomo and T-Mobile

References (2/3)

Fastweb project in Italy

- Indoor installation for outdoor coverage
- 1 WAVEATTOCH (4 MIMO - 5G C-band **4x5W**) installed
- Antenna Frequency 3.5GHz
- Antennas connected to an Ericsson RRU
- Very low back radiation needed (<2 V/m)





Disclose with the approval of Fastweb

References (3/3)

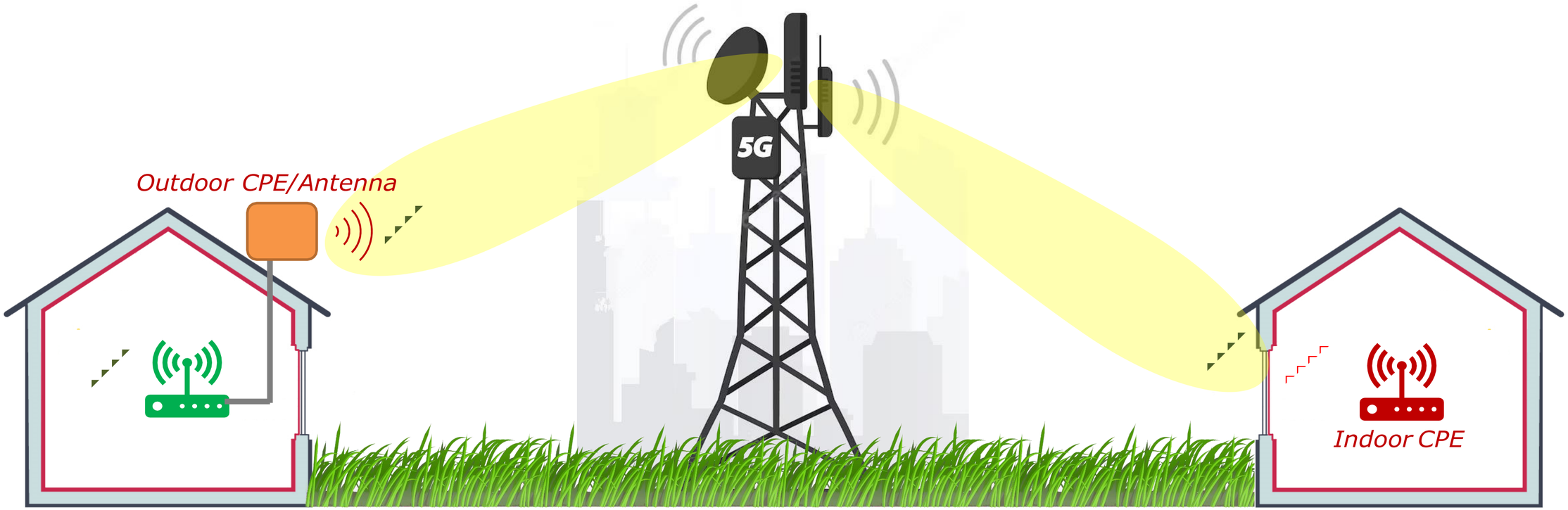
Proximus project in Belgium

- WAVEATTOCH with lighting
- 1 WAVEATTOCH (4 MIMO - 5G C-band)
- Antenna Frequency 3.7GHz

Disclosure with the approval of Proximus

WAVEANTENNA - FWA

FWA for Insulated Buildings – Pain Points



- Need for an outdoor unit, drilling required.

- Degraded indoor mobile coverage
- Reduced mobile quality of service

WAVEANTENNA-FWA solution

1. WAVETHRU Large Size Treatment (Sub 6 GHz)

   ⟶ let the signal enter and reach CPE in the room when insulated glass are used

2. WAVETHRU small size (Sub 6 GHz and mm-WAVE)

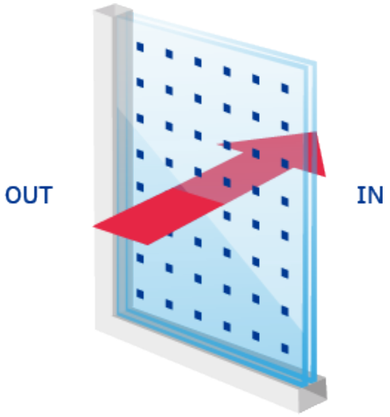
   ⟶ let the signal go through the window and reach CPE located close to window

3. Transparent Glass Antenna connected to CPE (Sub 6GHz)

   ⟶ allow to have non-intrusive antenna placed on the window connected to a CPE

Dyn Lock s.r.o.

DYN TEDES s.r.o.



WAVETHRU Large Size Treatment

Signal through glass
For indoor sub-6 mobile coverage

- Not connected, energy saving
- Reduced EMF exposure
- Multi technologies

Quasi-Deep Mobile Coverage through Glass for sub-6

Insulated double glazing

Mobile Radio Loss	-30 dB
Light transmission	72
Solar factor	38
U-value	1.1

Large size treatment → making façade transparent again
No CPE or repeater behind the glass

Nearly invisible pattern

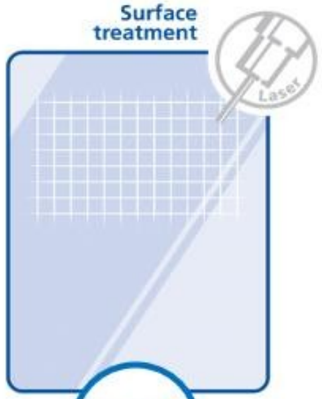
European business for sub 6GHz

<2% treatment

X300

Up to **+25 dB**
Better radio transmission

Surface treatment



	-5 dB
	72
No loss in thermal performances	38
	1.1

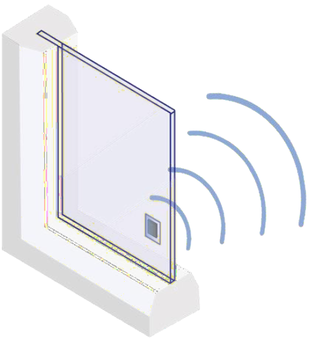
Mobile coverage signal improvement up to 10m deep inside

WAVETHRU Large Size Treatment recovering indoor FWA CPE performance

Indoor CPE can be placed quite far from window.

Dyn Lock s.r.o.

DYN TEDES s.r.o.



WAVETHRU Small Size Treatment

Signal through glass

For indoor sub-6/mmwave FWA CPE

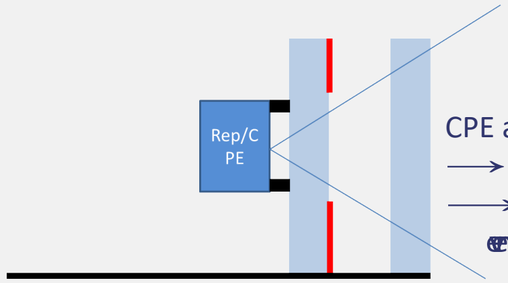
- Multi technologies
- Reduced cost and time to deploy

Mobile Coverage in front of Glass for sub-6 & mmwave

Insulated double glazing

Mobile Radio Loss	-32 dB
Light transmission	72
Solar factor	38
U-value	1.1

Small size treatment ⟶ making façade only in front of t
CPE antenna transparent again
Indoor CPE or repeater in front of glass



CPE attached to glazing
⟶ Enabling wide scanning performance
⟶ Making treatment area limited ⟶ faster operation

Small size treatment

X300

Up to +25 dB
Better radio transmission

No loss in thermal performances

Surface treatment

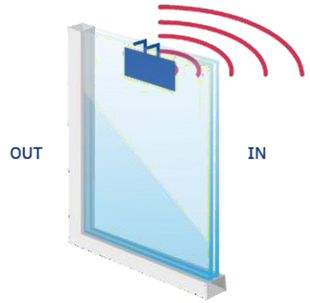
Laser

Mobile Radio Loss	-7 dB
Light transmission	72
Solar factor	38
U-value	1.1

Significant improvement of CPE Throughput

WAVETHRU Small Size Treatment recovering indoor FWA CPE performance

Indoor CPE (or its external antennas) must be placed quite close to WAVETHRU aperture.



Dyn Lock s.r.o.

DYN TEDES s.r.o.

GLASS ANTENNA

Transparent Antenna

For indoor coverage

- Quick and easy roll-out
- Aesthetical solution
- Network densification

Glass Antenna for indoor FWA CPEs with minimized view and space hindrance

External Glass Antennas for FWA CPEs

- Added values of AGC glass antenna solutions

1. Aesthetics and durability

2. Better system level performance
   a) Directional external antennas increase the chance (statistically) for better MIMO performance (i.e. higher MIMO rank)

   b) Placing external antennas behind glazing provides a wider FoV for the antennas and increases the chance for better MIMO performance

   c) Placing external antennas behind glazing decreases the WAVETHRU aperture required in the case of low-e coated glazings → cheaper and faster installation

Thank you foryour attention !

DYN TEDES & DYN LOCK