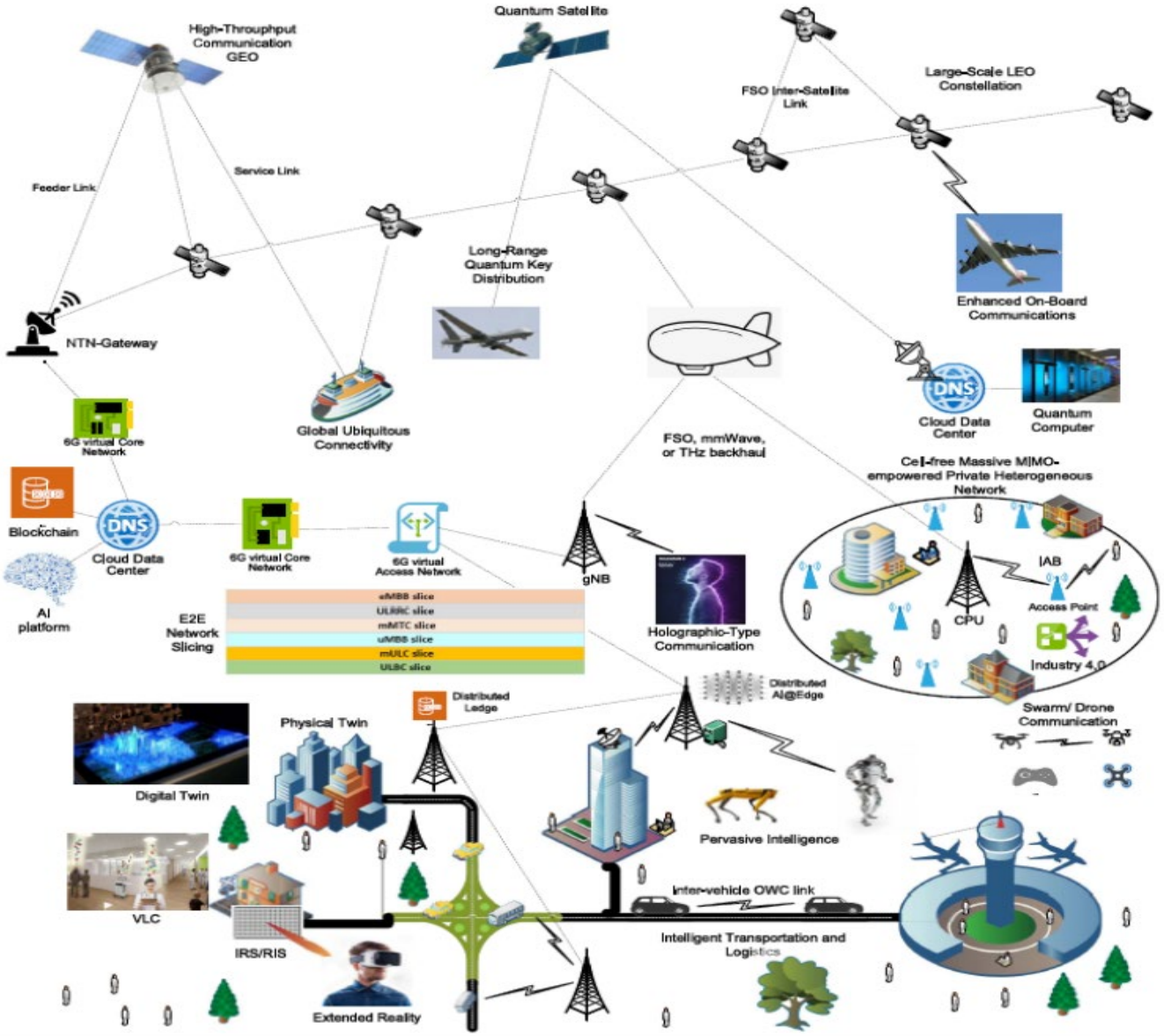
# La futura red móvil 6G y el Medio Ambiente



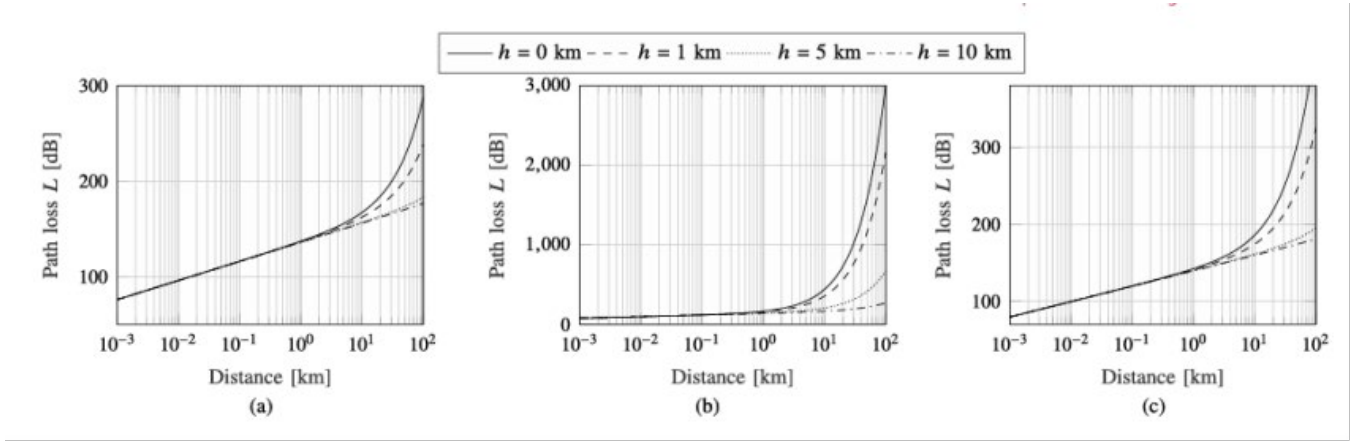
[José Javier Martínez Vázquez. Coordinador]
[Área Especial nº 6. Teledetección y Sensores Medioambientales]

# La futura 6G y el Medio Ambiente



# LA PROPAGACIÓN A FRECUENCIAS 6G

## La futura 6G y el Medio Ambiente



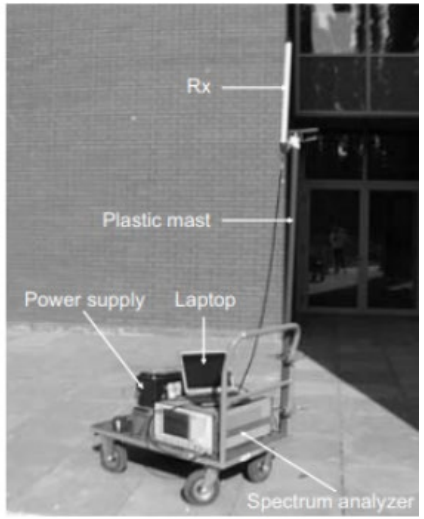

150 GHz 183 GHz 230GHz

5G
-140 dBm
-44 dBm

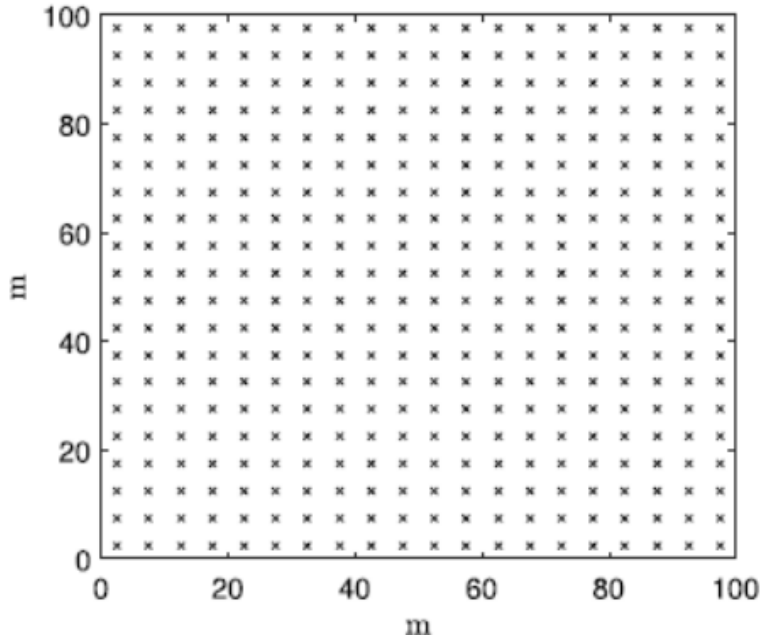
BER

| Window # | $f_c$ [THz] | $B_{3dB}$ [GHz] | Loss at 10 mm [dB] | Loss at 1 m [dB] | Loss at 100 m [dB] | Absorption Loss [dB/Km] |
|---|---|---|---|---|---|---|
| W1 | 0.245 | 210 | 60.18 | 80.18 | 120.18 | 3 |
| W2 | 0.41 | 65.61 | 64.65 | 84.65 | 124.65 | 20 |
| W3 | 0.49 | 86.21 | 66.2 | 86.2 | 126.2 | 40 |
| W4 | 0.66 | 152.59 | 68.79 | 88.79 | 128.79 | 60 |
| W5 | 0.84 | 141.91 | 70.88 | 90.88 | 130.88 | 80 |
| W6 | 0.94 | 47.3 | 71.86 | 91.86 | 131.86 | 150 |
| W7 | 1.03 | 57.98 | 72.65 | 92.65 | 132.65 | – |

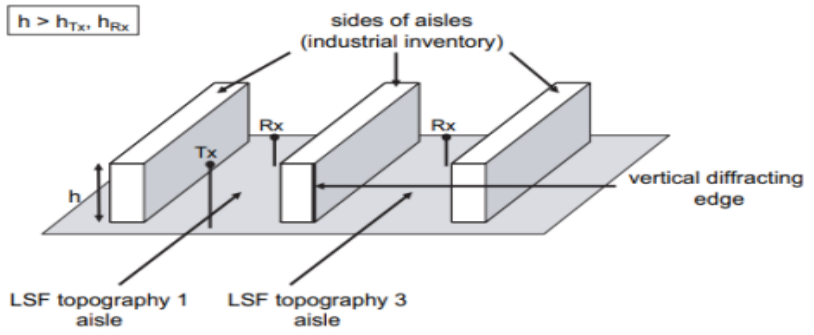
#CONAMA2024

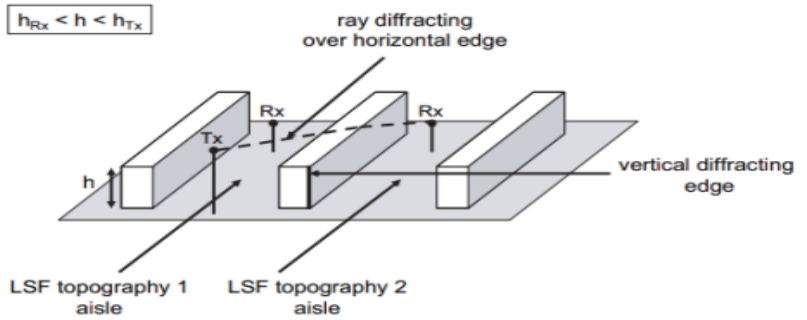

2008




2018

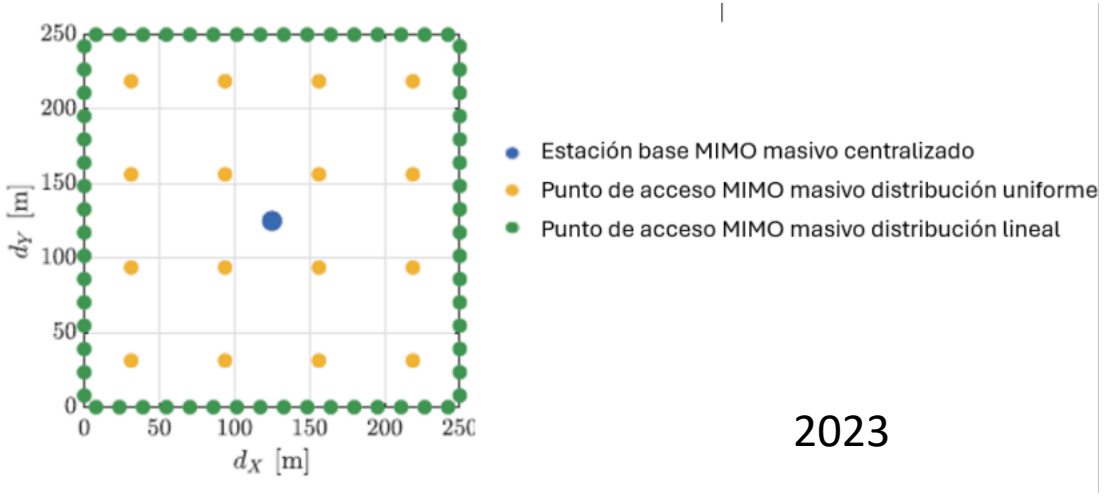



(a) LSF topographies 1 and 3

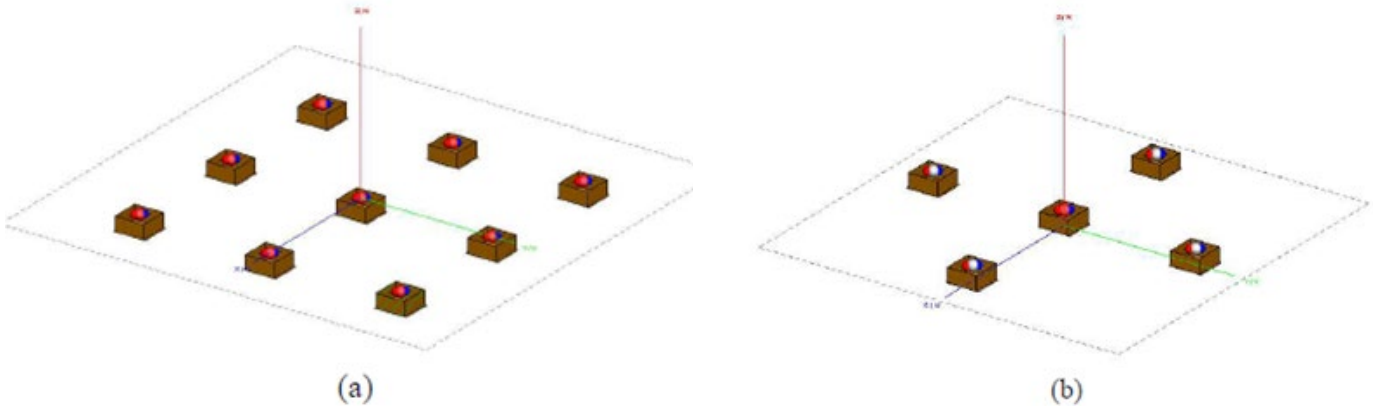



(b) LSF topographies 1 and 2

**INDUSTRIA 4.0**




2023

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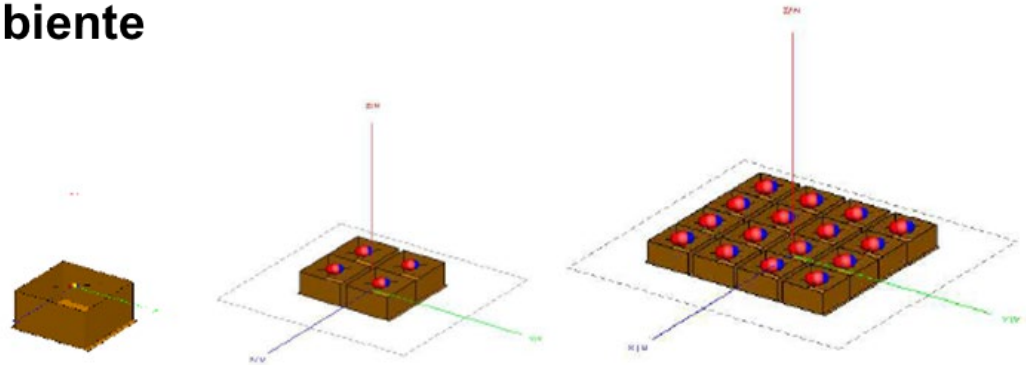
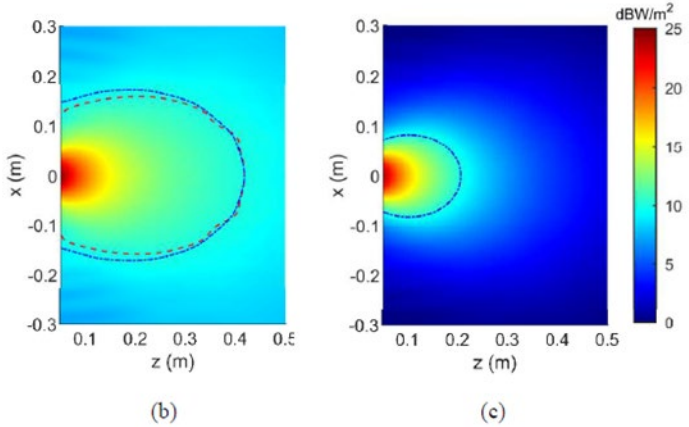
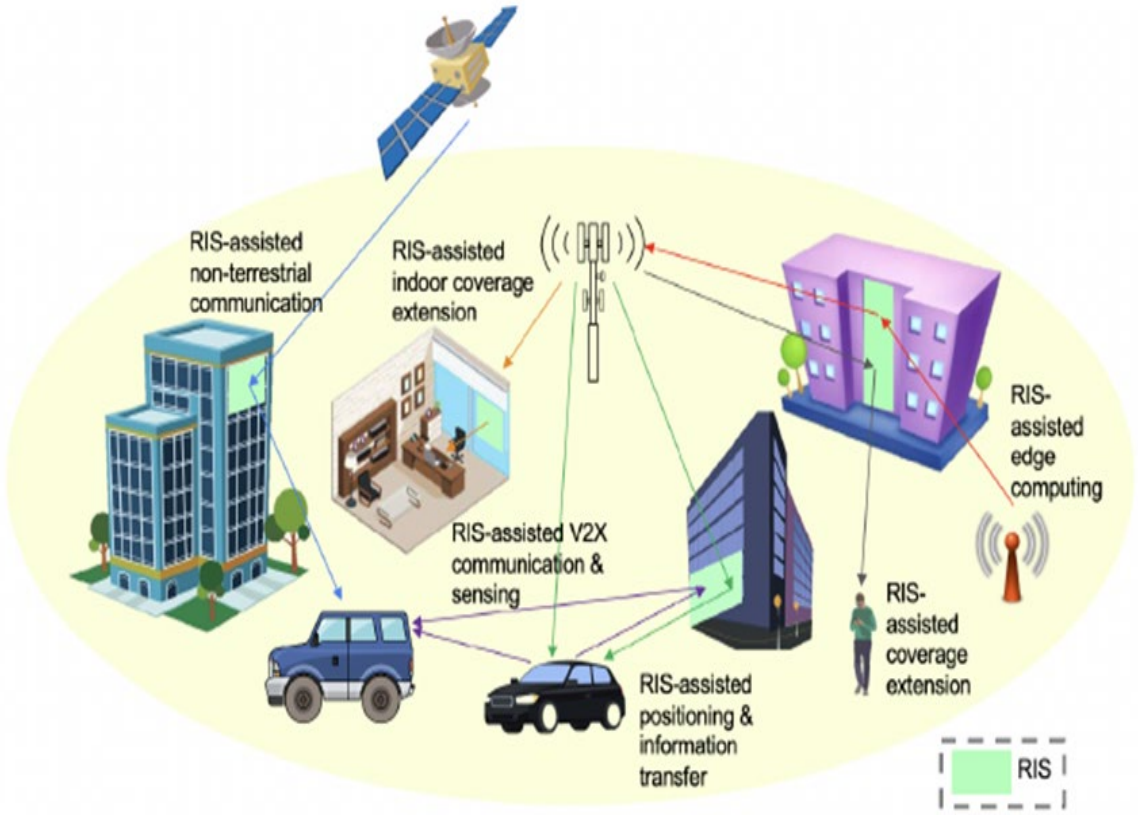


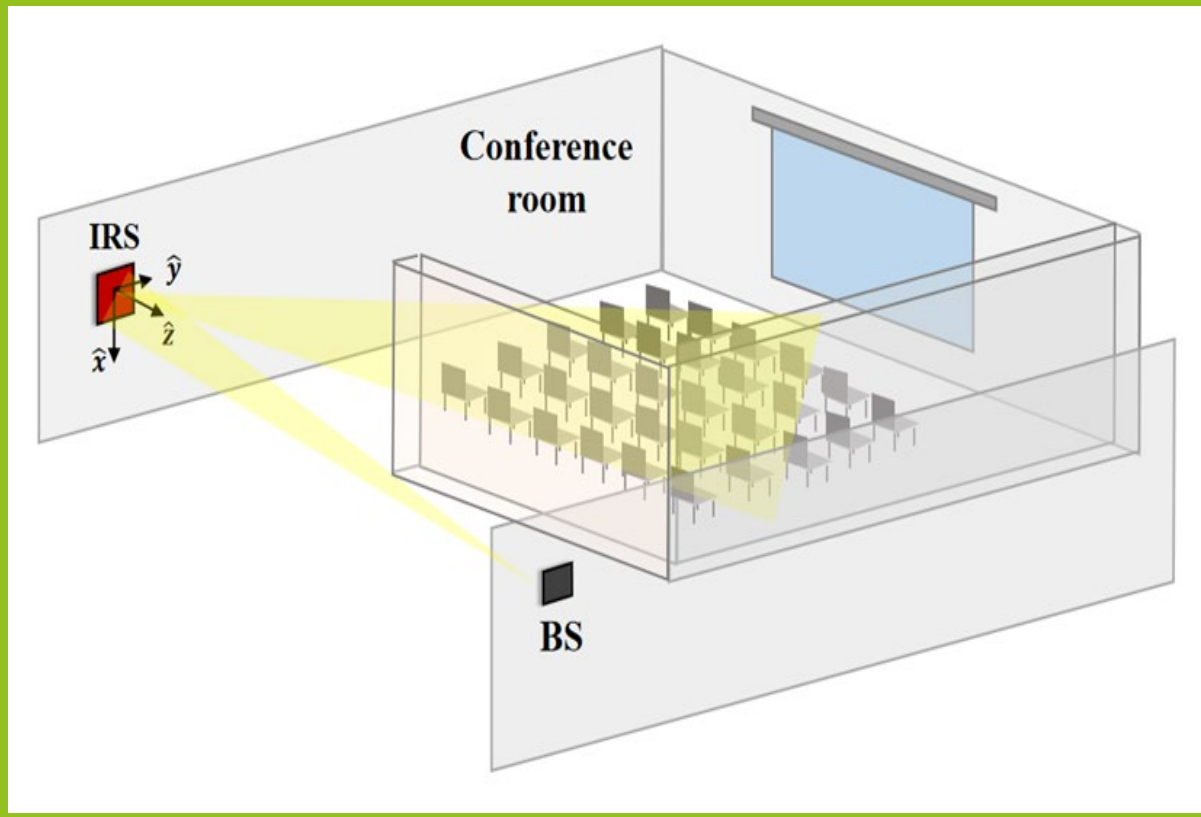
## NIVELES DE REFERENCIA
## 4 VATIOS PIRE




## IMPACTO AMBIENTAL DE INSTALACIONES

# La futura 6G y el Medio Ambiente

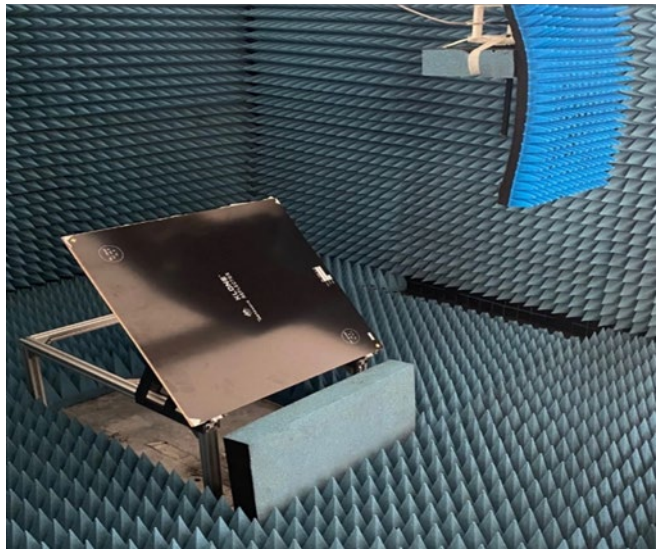



**SUPERFICIES RIS**

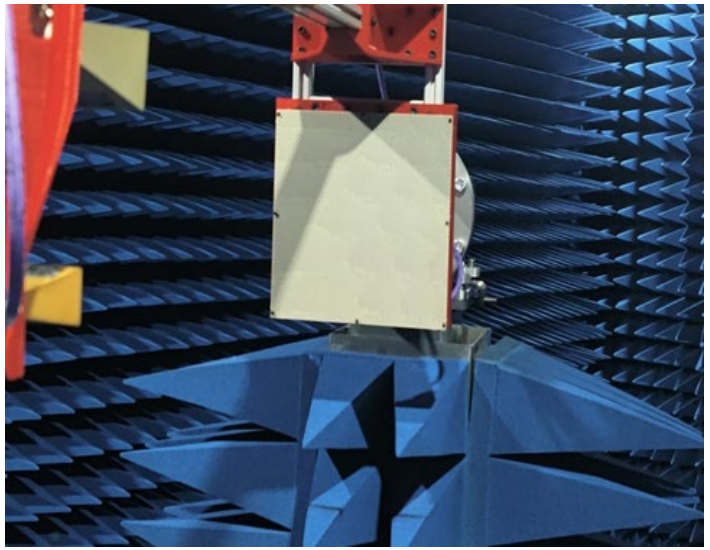
## [Reflectarrays] RIS

27,6 GHz URJC/UNIOVI



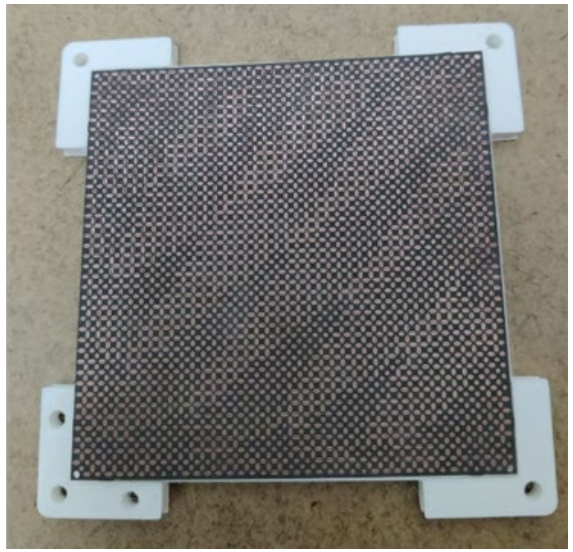
40 x 40  20° x 20°  G=100  r= 9

28 GHz y 39 GHz



20 x 20  2,2° y 2,8° G= 5.600/8.100  r=70/85

100 GHz URJC/UPM

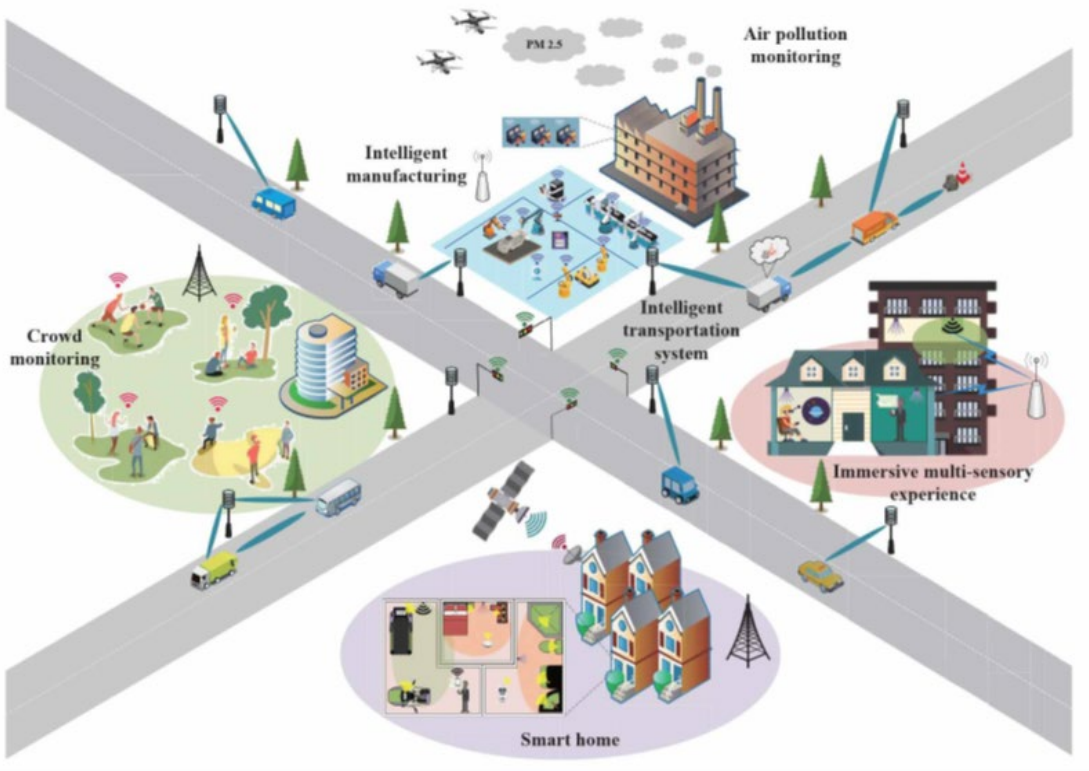


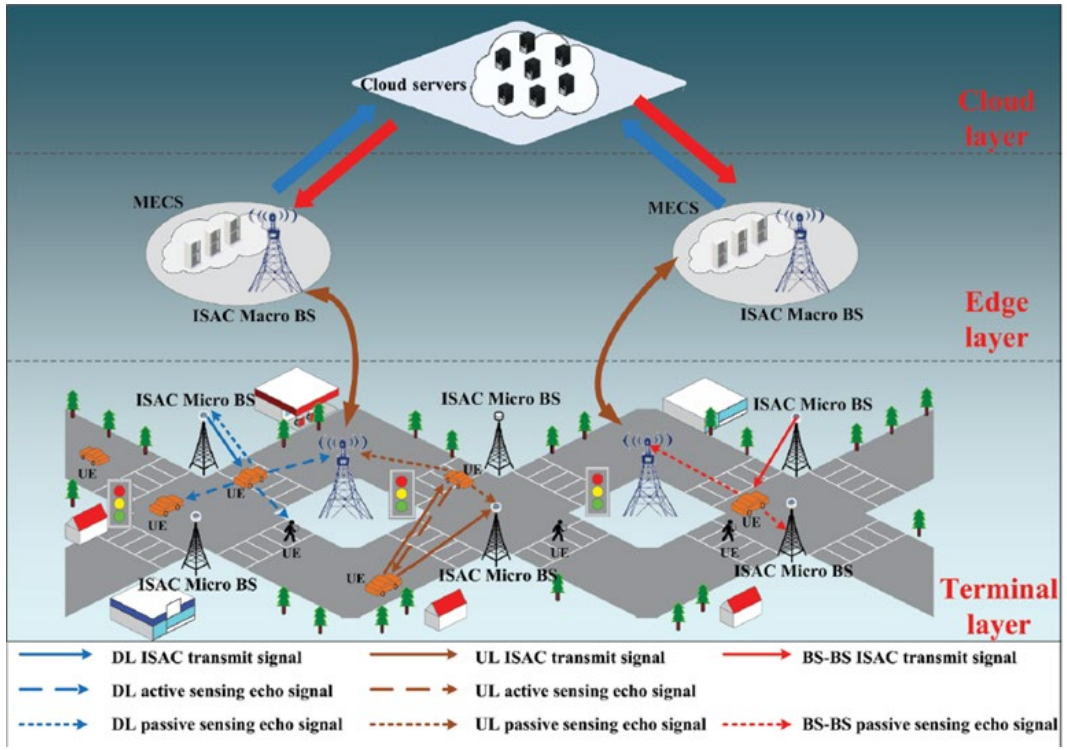
6,7 x 6,7  10,5°x10,5°  G=500  r= 20

**UNIVERSIDAD REY JUAN CARLOS, UNIVERSIDAD POLITÉCNICA DE MADRID Y UNIVERSIDAD DE OVIEDO**

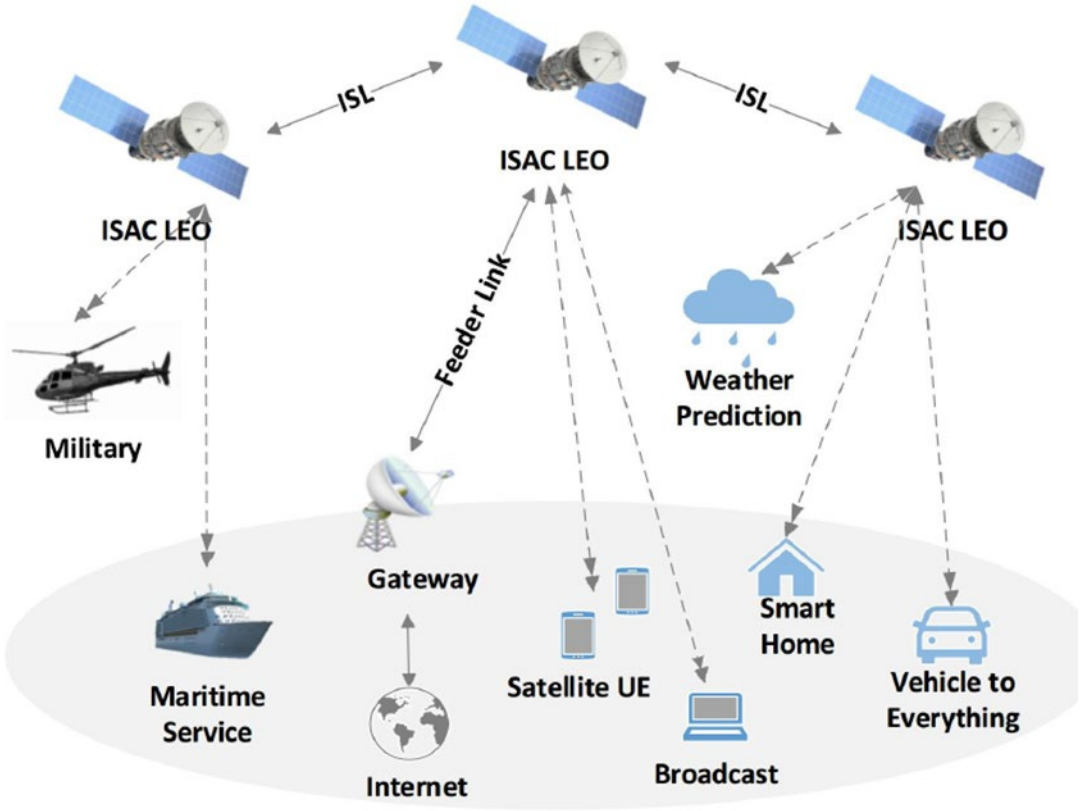
**La futura 6G y el Medio Ambiente**

# LA FUTURA RED MÓVIL 6G Y EL MEDIO AMBIENTE



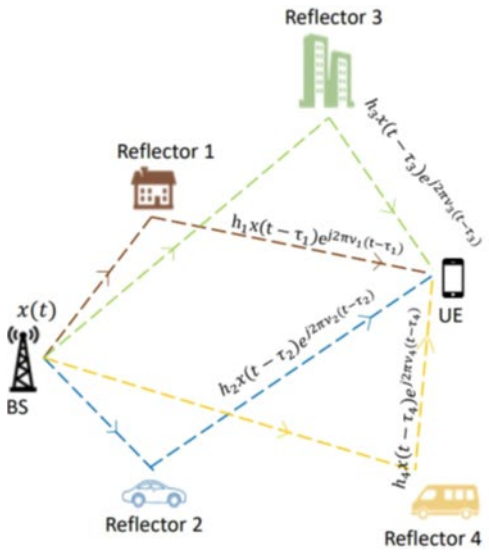

**Iniciativas Joint Signaling & Communications JSC y Integrated Sensing & Communications ISAC**

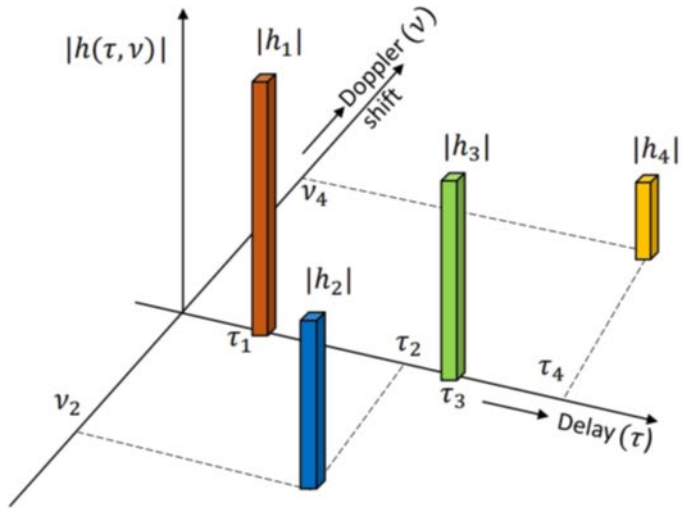


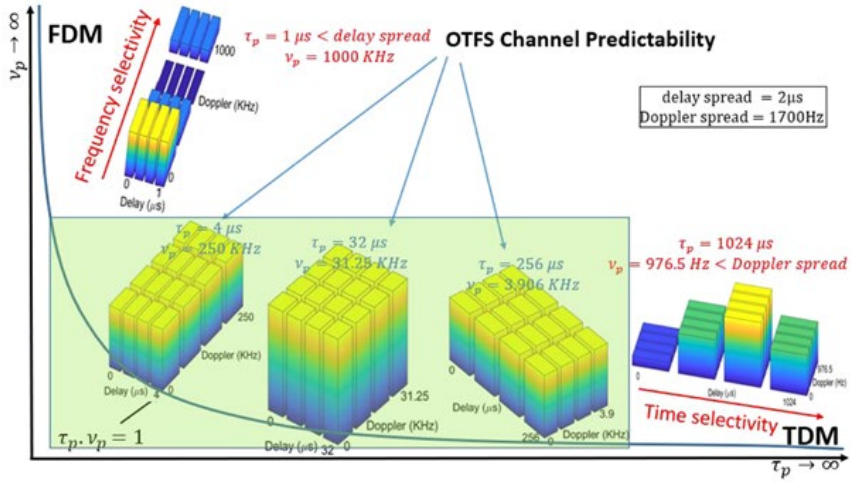

[PLATAFORMA ISAC] Propuesta constelación LEO

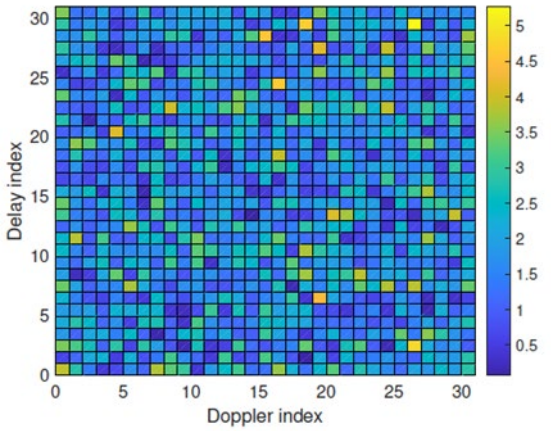
## La futura 6G y el Medio Ambiente

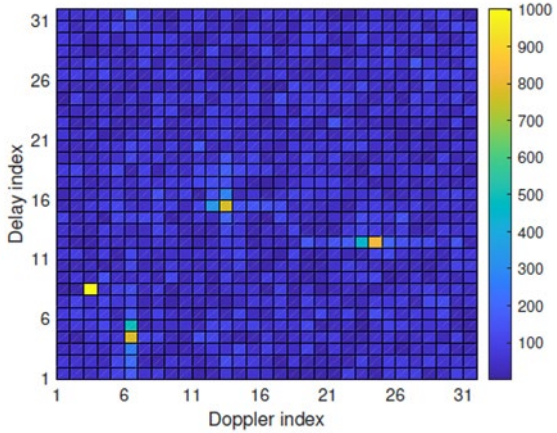
# [OTFS] Plano D-D



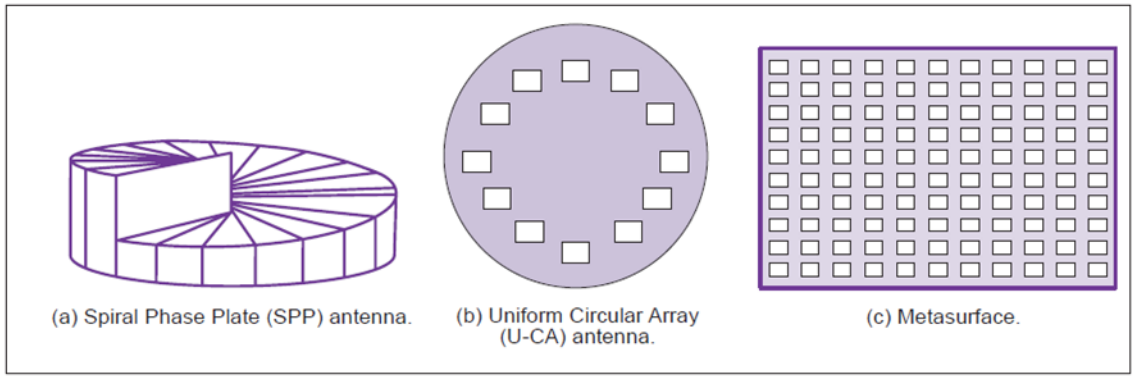



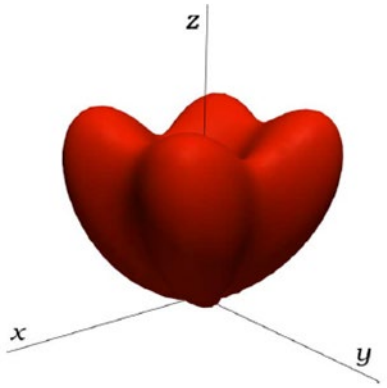



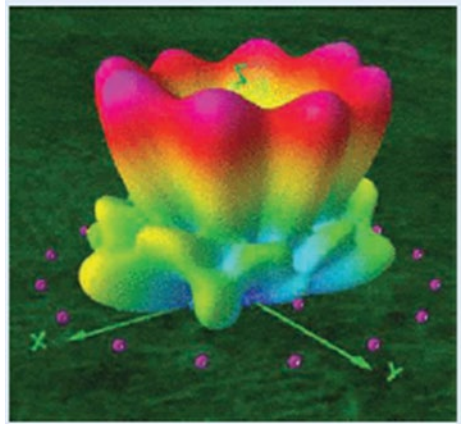

**La futura 6G y el Medio Ambiente**

# La futura 6G y el Medio Ambiente

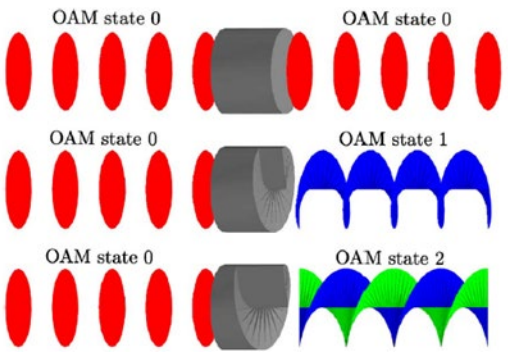
## MODOS OAM

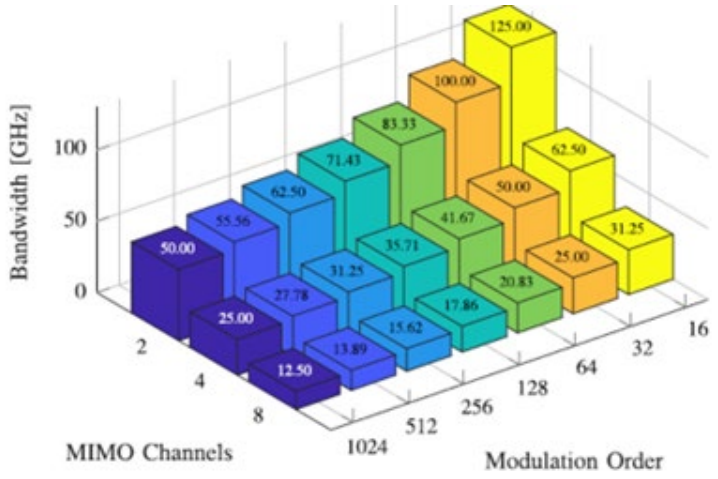


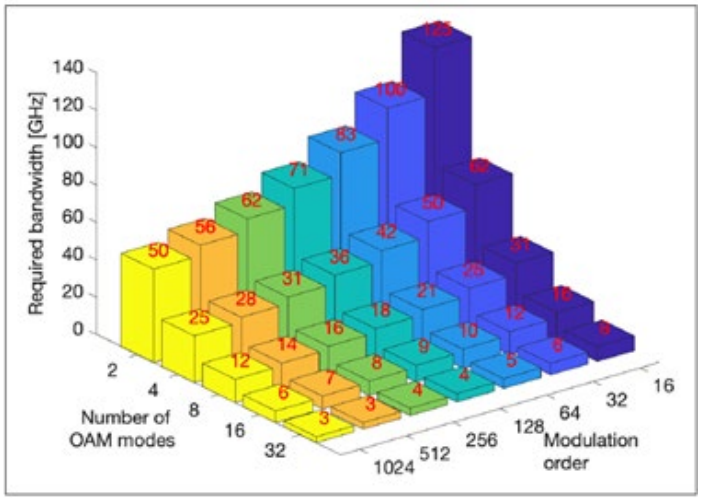



#CONAMA2024



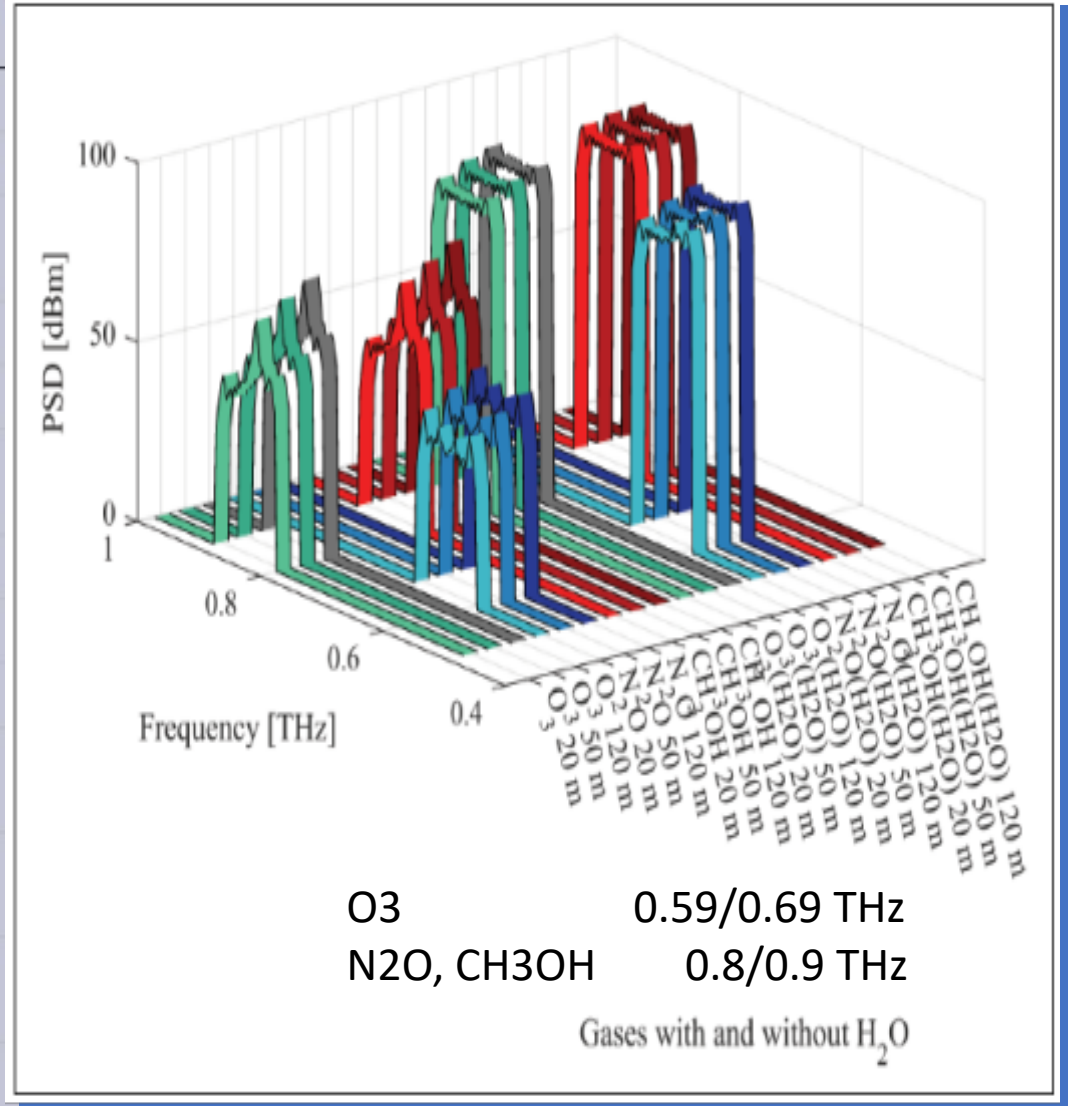




2023

2024

# La futura 6G y el Medio Ambiente

| Gas | Proposed technique using path loss | | | | Techniques developed using spectroscopy | |
|---|---|---|---|---|---|---|
| | Atmospheric concentration (ppm) | Considered frequency range | Gaussian noise level | Possibility of detection | Frequency range | Detection techniques |
| $H_2O$ | 10000 | 6–8 THz | 1 % | Yes | 0.1–2.25 THz | THz-TDS |
| $O_2$ | 209460 | 0.5–2.5 THz | 0.01 % | Yes | | |
| $SO_2$ | 1 | 0.5–2.5 THz | 0.01 % | Yes | 0.21–0.27 THz | Electronic SMM/THz gas sensor |
| $NH_3$ | 0.01 | 3–5.5 THz | 0.01 % | Yes | 0.1–2.25 THz | THz-TDS |
| $O_3$ | 0.07 | 1–3 THz | 0.001 % | Yes | 0.575–0.625 THz | THz-TDS |
| $NO_2$ | 0.02 | 1–3 THz | 0.001 % | Yes | 0.22–0.33 THz | Continuous-wave electronic THz spectrometer |
| HCN | 0.01 | 1–3 THz | 0.001 % | Yes | 1.1–1.3 THz | Photonic crystal cavity |
| CO | 0.01 | 0.5–3 THz | 0.0001 % | Yes | 0.3–1.1 THz | THz-GPS |
| $CH_4$ | 1.8 | 3–4.5 THz | 0.00001 % | Yes | 2–2.7 THz | THz-TDS |
| $N_2$ | 780840 | 3–5 THz | Reduced until 0.000001 % | No | | |
| $CO_2$ | 410 | 8–10 THz | Reduced until 0.000001 % | No | | |
| $N_2O$ | 0.5 | 0.1–1.5 THz | Reduced until 0.000001 % | No | 0.575–0.625 THz | THz-TDS |
| $CH_3OH$ | 0.01 | 0.1–1 THz | Reduced until 0.000001 % | No | 0.22–0.33 THz | THz wave electronics |



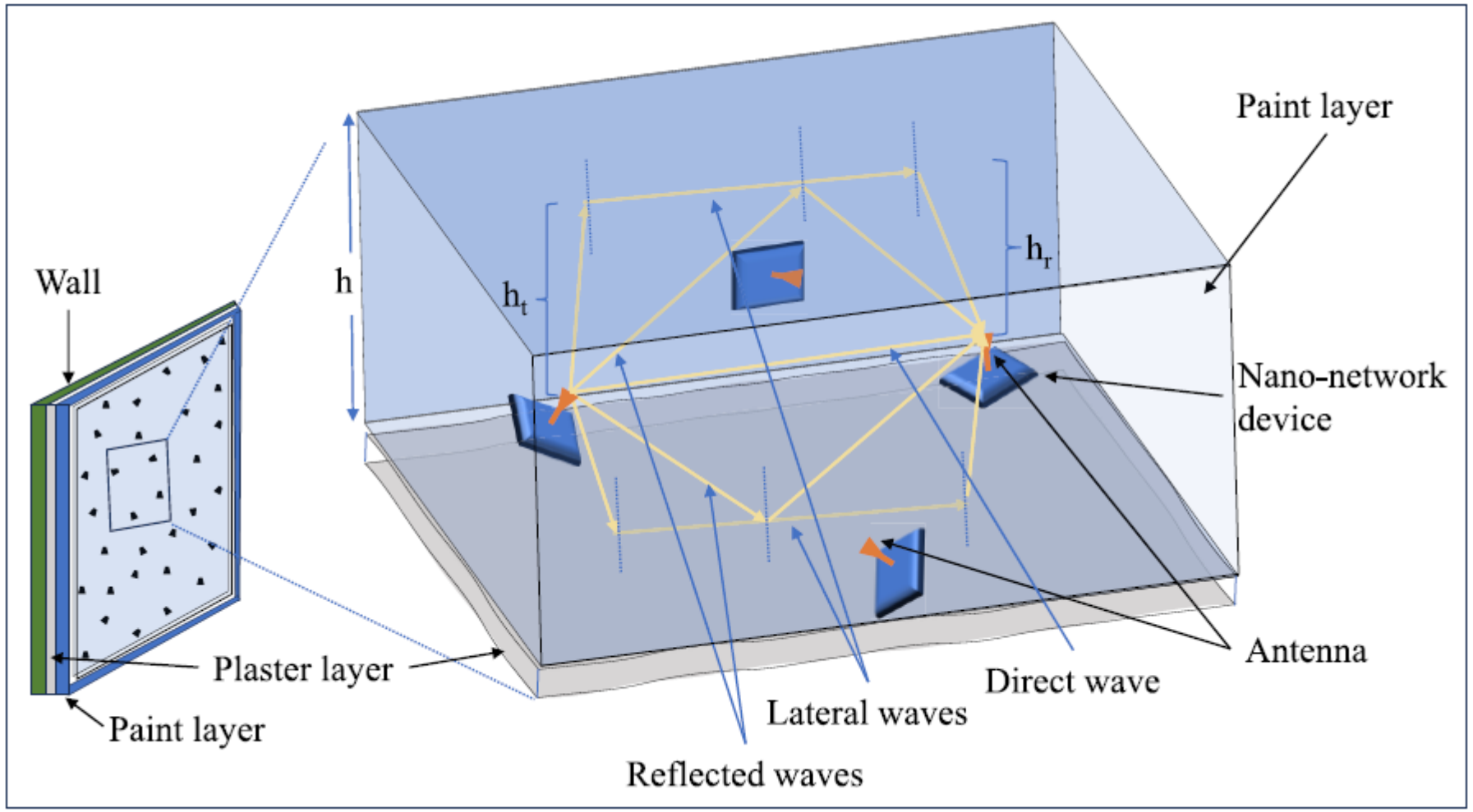

O3 0.59/0.69 THz

N2O, CH3OH 0.8/0.9 THz

Gases with and without $H_2O$

**DETECCIÓN DE GASES CON NANO REDES**

# INTERNET DE LA PINTURA




| Gas | Composition |
|---|---|
| $N_2$ | 78.084% |
| $O_2$ | 20.946% |
| Ar | 0.93% |
| $H_2O$ | 1-3% |
| $CO_2$ | 0.003% |
| $CH_4$ | 1.5 *ppm* |
| $SO_2$ | 1 *ppm* |
| $O_3$ | 0.05 *ppm* |
| $N_2O$ | 0.02 *ppm* |
| CO | 0.01 *ppm* |
| $NH_3$ | 0.01 *ppm* |

**La futura 6G y el Medio Ambiente**

# La futura 6G y el Medio Ambiente

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Martínez de Rioja del Nido, E.
Martínez de Rioja del Nido, D..