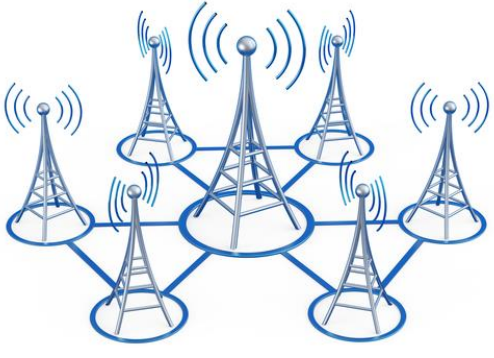
Sharing scenarios of 5G (IMT-2020) networks with the incumbent and future satellite communication systems



AGENDA

- Past and Present: IMT VS. FSS
- 5G
- Satellite Communications
- Future: IMT AND FSS


IoT
5G
Lte
SWiFi
Past and Present: IMT VS. FSS

IMT, FSS: WRC-15 Outcome

WRC-15 AI 1.1: IMT Identification, C-band specific:

3400-3600 MHz: Global allocation to IMT, except some APT countries

3600-3700 MHz: No IMT, except 4 CITEL countries

3700-4200 MHz: No IMT

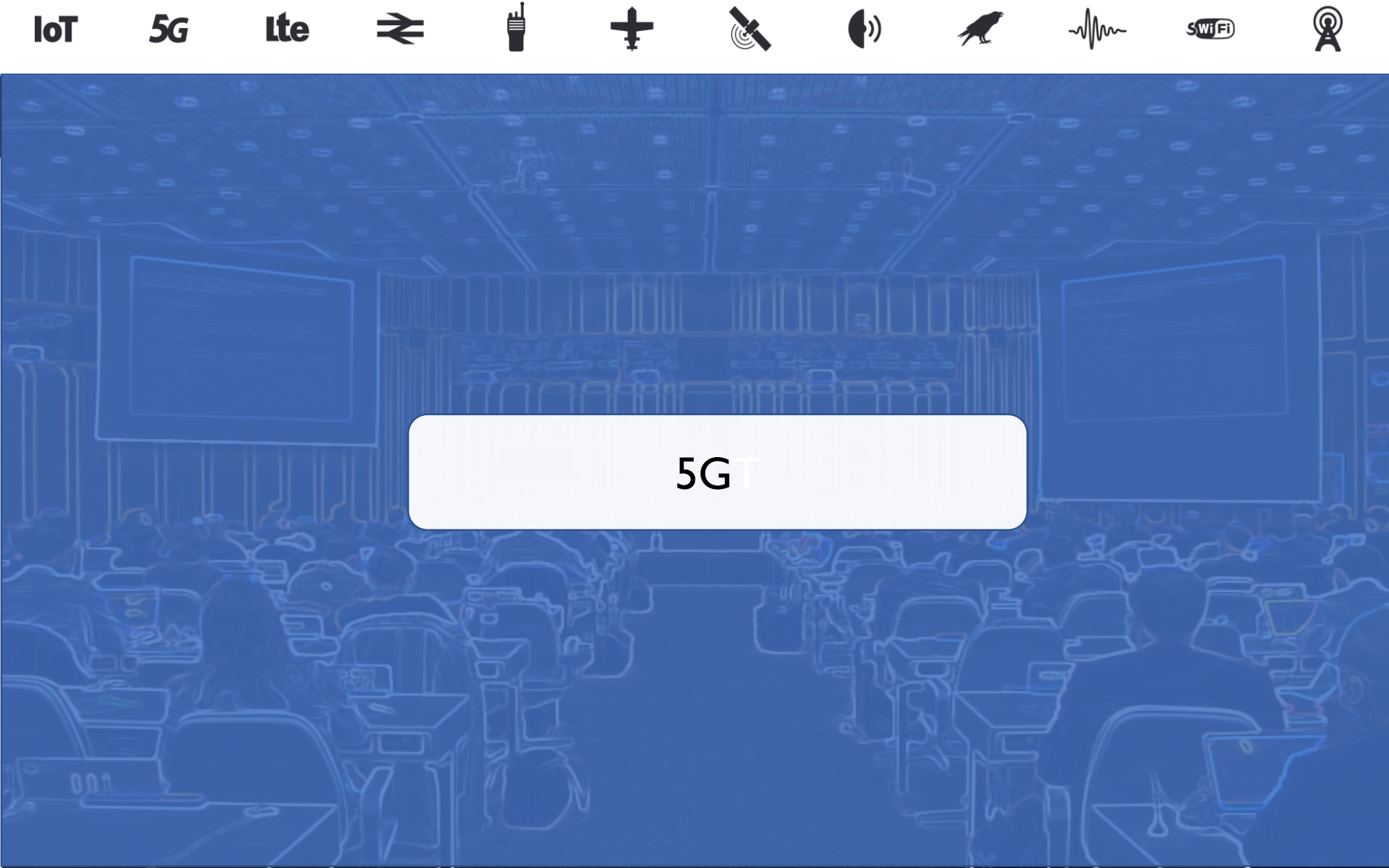
Note: The 3600-3800 MHz band is harmonized for IMT use throughout the European Union by European Decision.

WRC-19 Agenda Item 1.13 – further spectrum identification for IMT

- Over 33 GHz of spectrum are under study
- Potential identification of IMT in frequency bands where FSS is allocated as a primary service:

Candidate band	Potential sharing band	Allocation in ITU Region 1
24.25-27.5 GHz	24.65-25.25 GHz	FSS (E-s)
37.5-40.5 GHz	37.5-40.5 GHz	FSS (s-E)
40.5-42.5 GHz	40.5-42.5 GHz	FSS (s-E)
42.5-43.5 GHz	42.5-43.5 GHz	FSS (E-s)

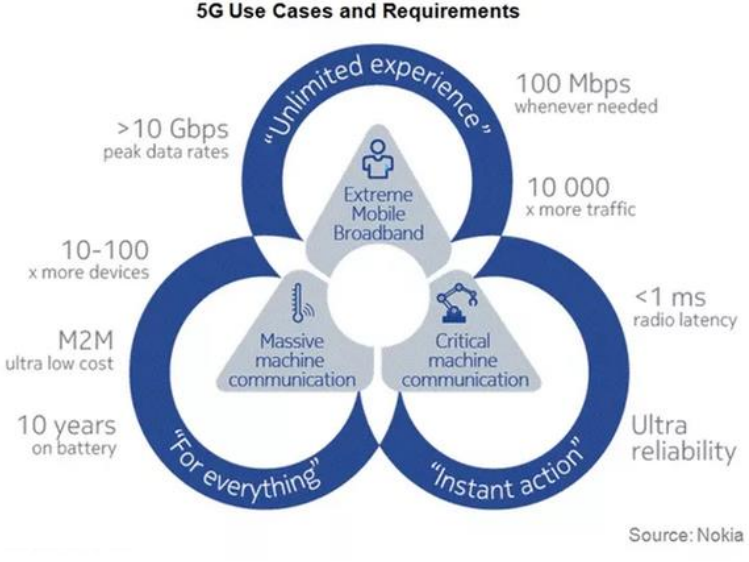
Note: the 24.25-27.5 GHz ("the 26 GHz band") has been identified as a pioneer band for 5G mm-wave use in Europe.


IoT
5G
Lte
SWiFi
5GT

5G Overview

5G is expected to address three key usage scenarios:

Enhanced Mobile Broadband:
an evolution beyond 4G to provide multi-gigabit per second (Gbps) data rates for applications like virtual reality, UHD video streaming, and more



M2M:
Including the ability to support a massive number of low cost IoT connections with very long battery life and wide coverage including inside buildings

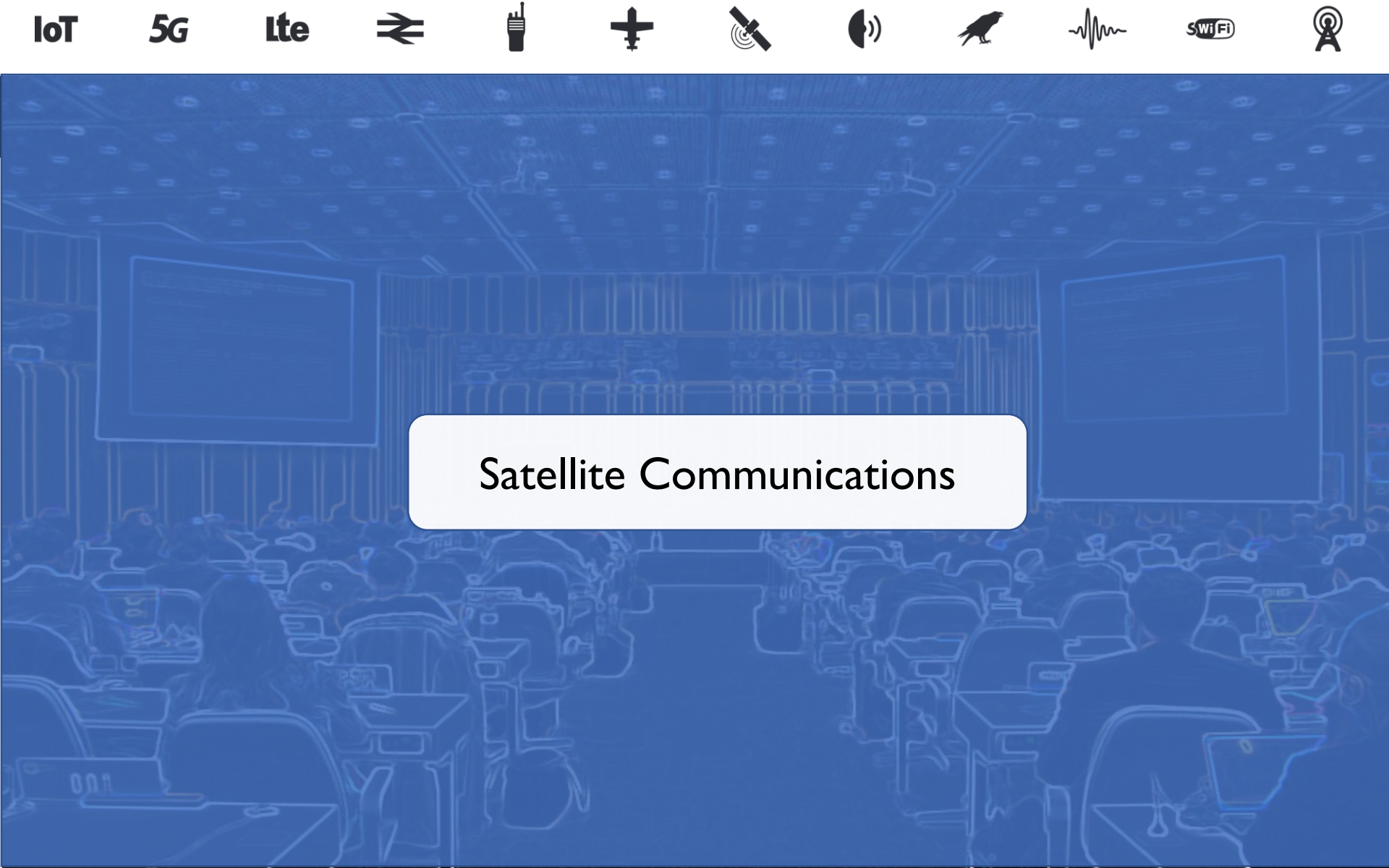
Ultra-reliable communications:
low latency (sub-1ms) and high availability, reliability and security to support services such as autonomous vehicles and remote surgeries

5G Case for more spectrum

Above 24 GHz:
The availability of wide contiguous bands, which would allow the use of wider bandwidth channels (100–500 MHz or more), and advanced antenna technologies:

- Significantly higher data rates to be delivered in areas of very high MBB traffic density.
- Better range and reliability

1-6 GHz bands:
Offers a good mixture of coverage and capacity benefits.
Specifically, **the C-band (3.3-3.8 GHz)** is expected to form the basis of many initial 5G services, which will later on spread into higher frequencies.


Satellite Communications

Satellite applications overview

TV Broadcast

Fixed VSAT

Content Distribution

Government and Military Satcom

Safety services

IP satellite video and hybrid broadcast-broadband

Comms on the move (planes, cars, ships, trains)

Consumer Broadband

Mobile Backhaul

M2M Communications

20cm Flat Panel Antenna

Satellite Case for Spectrum

Above 24 GHz:

- Traditional applications demand more BW:
  Increased demand for TV services in HD format, and deployment of UHD

- New applications and non-GSO constellations demand higher data rates:
  A shift towards Ka-band, and later to 40 GHz (V-band), is expected

- C and Ku-bands are highly congested, while finding a space in the traditional Ka-band for a new system is also becoming a challenge

C-band:

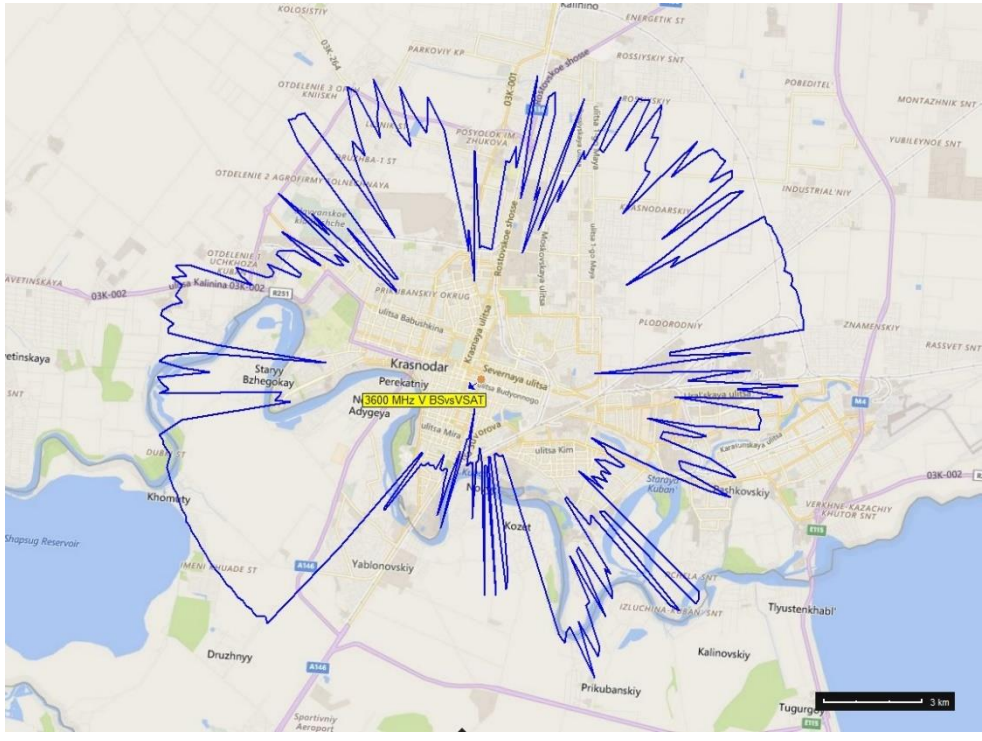
- Wide coverage
- Favorable propagation characteristics
- Heavily used by satellites for decades


IoT
5G
Lte
SWiFi
Future: IMT AND FSS

5G and FSS : C-band sharing scenario

5G BS parameters:
Power: 5W
Carrier BW: 20 MHz
Gain: 5 dBi
Rooftop antenna 2m

FSS ES parameters:
Antenna Gain: 34 dBi
Carrier BW: 1 MHz

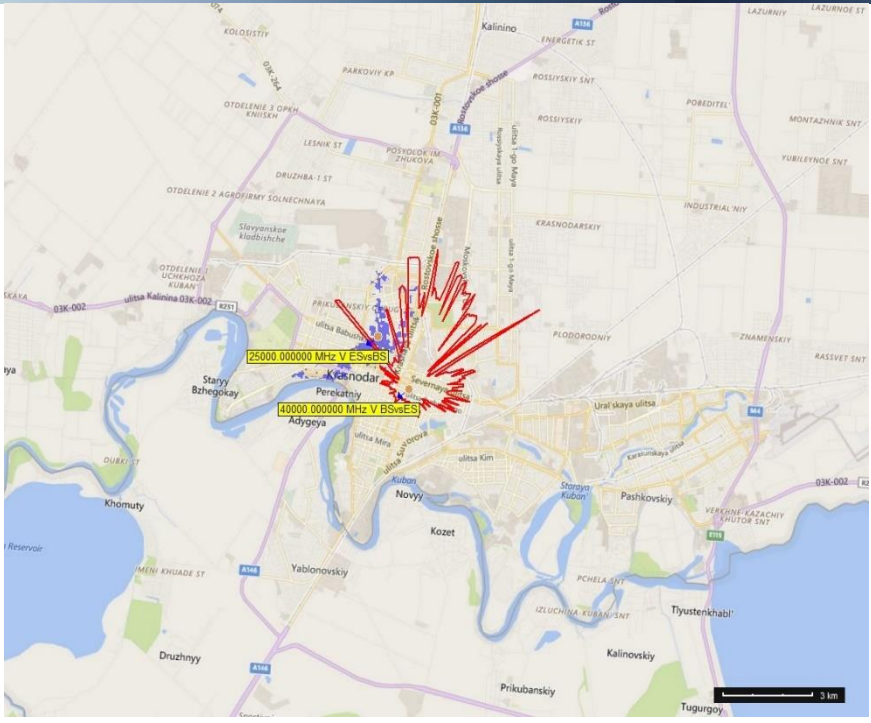


5G station is to be located at 1-12 km away from satellite ES to meet the criteria for compatibility

5G vs FSS : mm-wave bands

5G BS parameters:
Power: 5W
Carrier BW: 100 MHz
Gain: 5 dBi
Rooftop antenna 2m

FSS ES parameters:
Antenna Gain: 45 dBi
Carrier BW: 100MHz
Power: 100W



Red contour: 5G BS "restricted" area around FSS ES at 40 GHz → much smaller than in C-band!

Blue coverage: Transmitting ES exceeds the compatibility criteria to a 5G BS at 25 GHz

5G and FSS frequency sharing: a glance into the future

Past experience

- Technical difficulties to implement frequency sharing
- Applications overlap is not significant
- Winner takes it all approach: mobile "attack" and satellite "defend" spectrum

Future of 5G and FSS co-existence:

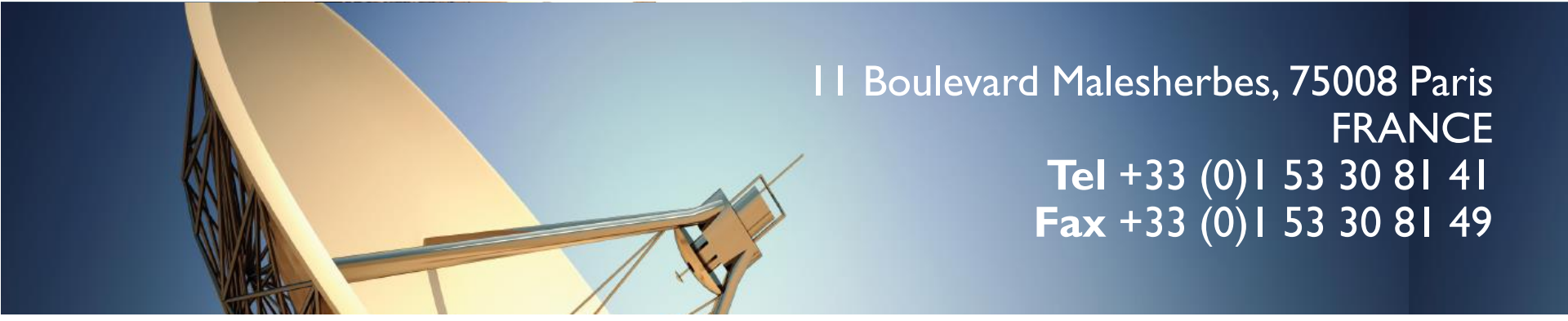
- Higher frequency bands are easier to share
- Satellites will be an important part of the 5G ecosystem
- Frequency bands under discussions are of little current use

5G and FSS frequency sharing: Conclusion

The technical analysis of the satellite vs 5G co-existence is becoming increasingly relevant

The use of appropriate radio engineering tools is mandatory for informed decisions on this case of frequency sharing:

- 5G and satellite communication features implemented in one tool
- Interface with most updated databases of 5G and space/earth stations



Thank you!

Хвала!