5GITALY

The Global Meeting in Rome

DECEMBER 4th, 5th, 6th 2018

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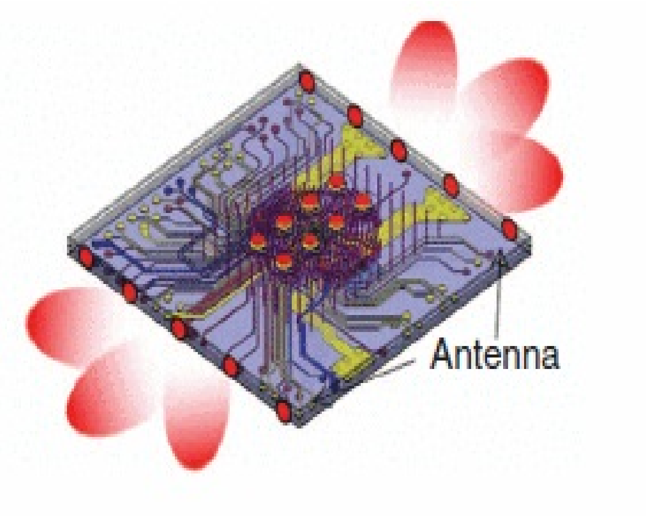
CNIT Talk: Antennas and Sensors for 5G



Giuseppe Mazzarella, Professore, CNIT / Università degli Studi di Cagliari

Presidente **SIEm**

Outline

- Antenna design for 5G
- New antenna configurations for 5G
- Interaction with the environment and the user body
- Integration of sensors in 5G systems

Wireless systems antennas: custom or off-the-shelf?

Depends on:
- Frequency band
- Service requirements

For UHF cellular services, antennas are (presently) standard ...

… actually, not always:

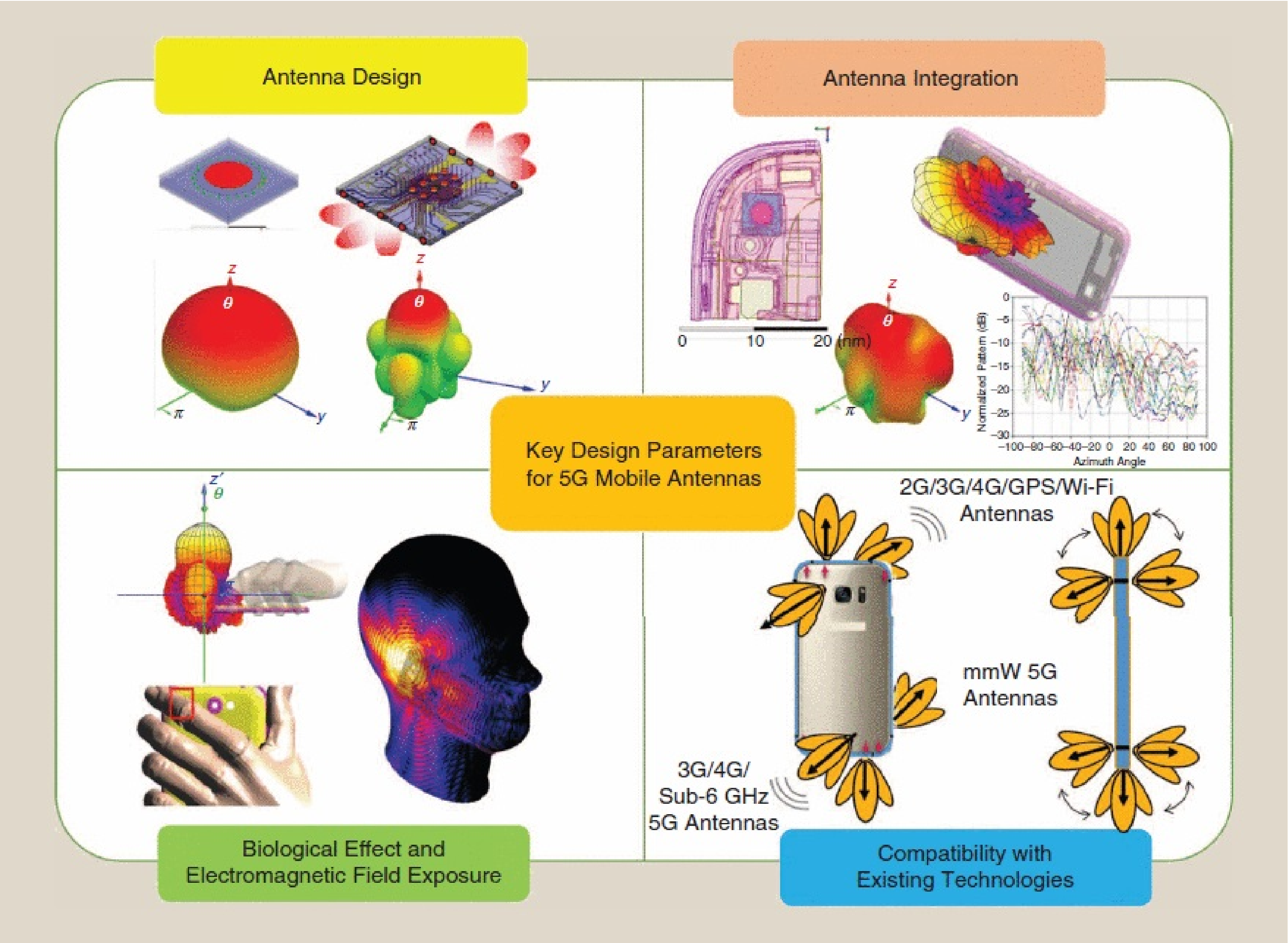
NEWS

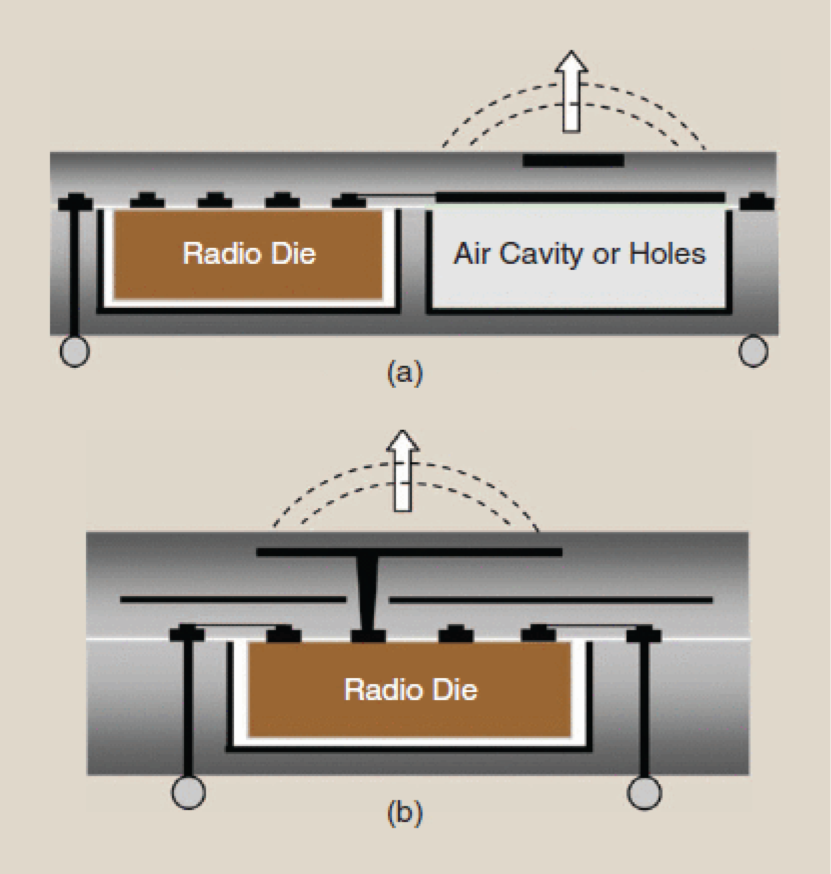
Apple Responds to iPhone 4 Antenna Problem

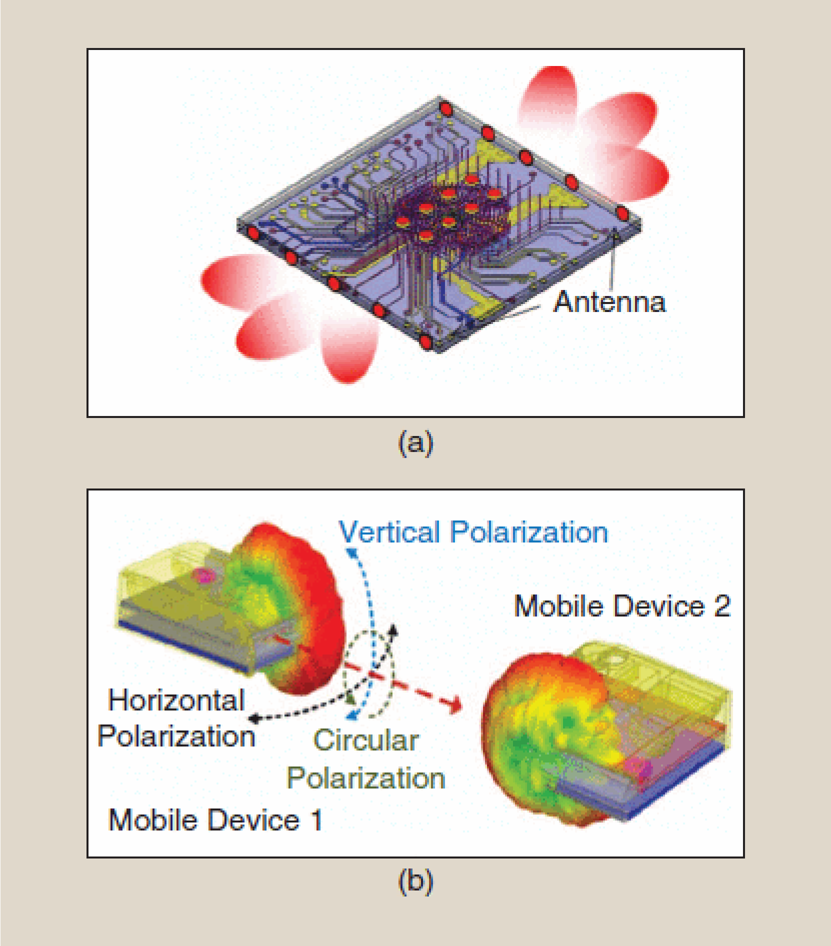
By Daniel Ionescu

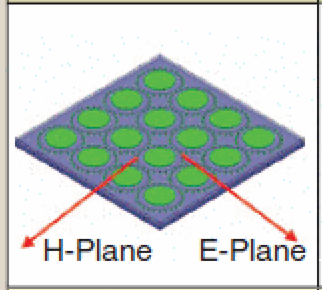
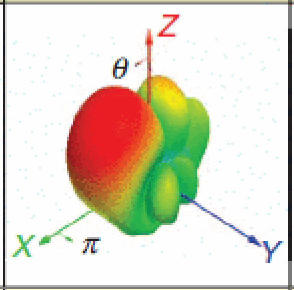
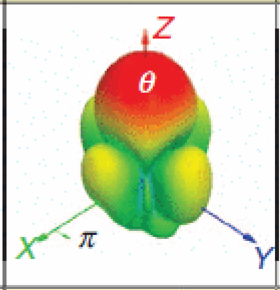
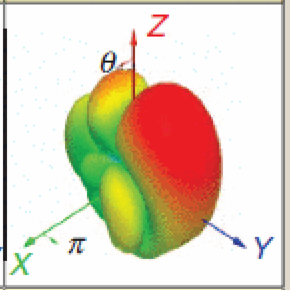
PCWorld | JUN 25, 2010 5:11 AM PT

At mm-waves, antenna customization is the key to deliver services with high added value.

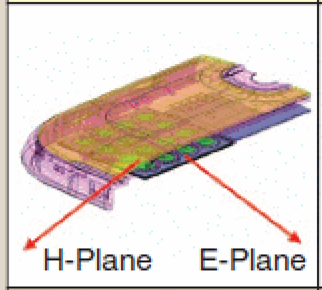
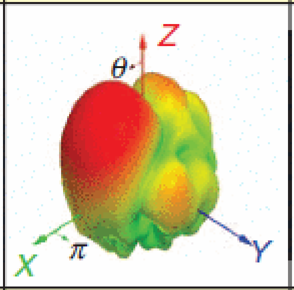
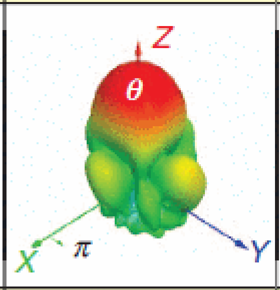
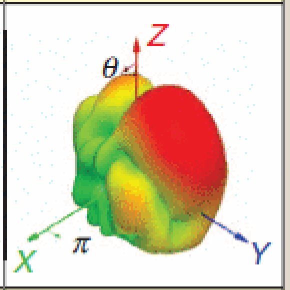

Antenna Design
Antenna Integration
Key Design Parameters for 5G Mobile Antennas
Biological Effect and Electromagnetic Field Exposure
Compatibility with Existing Technologies
2G/3G/4G/GPS/Wi-Fi Antennas
mmW 5G Antennas
3G/4G/ Sub-6 GHz 5G Antennas
Normalized Pattern (dB)
Azimuth Angle
0 10 20 (mm)


Radio Die
Air Cavity or Holes
(a)
Radio Die
(b)

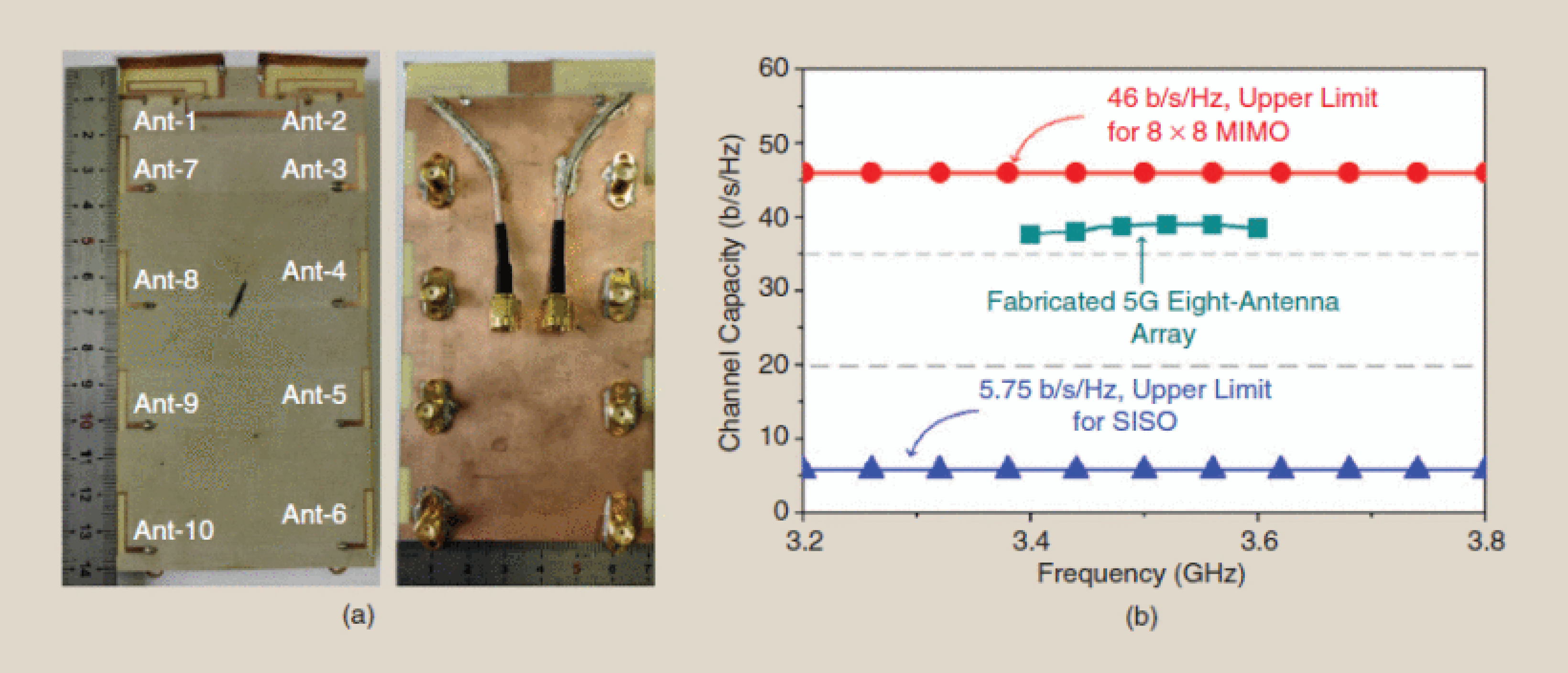

Antenna
(a)
Vertical Polarization
Mobile Device 2
Horizontal Polarization
Circular Polarization
Mobile Device 1
(b)

Tilt Angle	30° H-Plane	Boresight (0°)	30° E-Plane
			
Maximum Gain	12.6 dBi	13.3 dBi	12.2 dBi

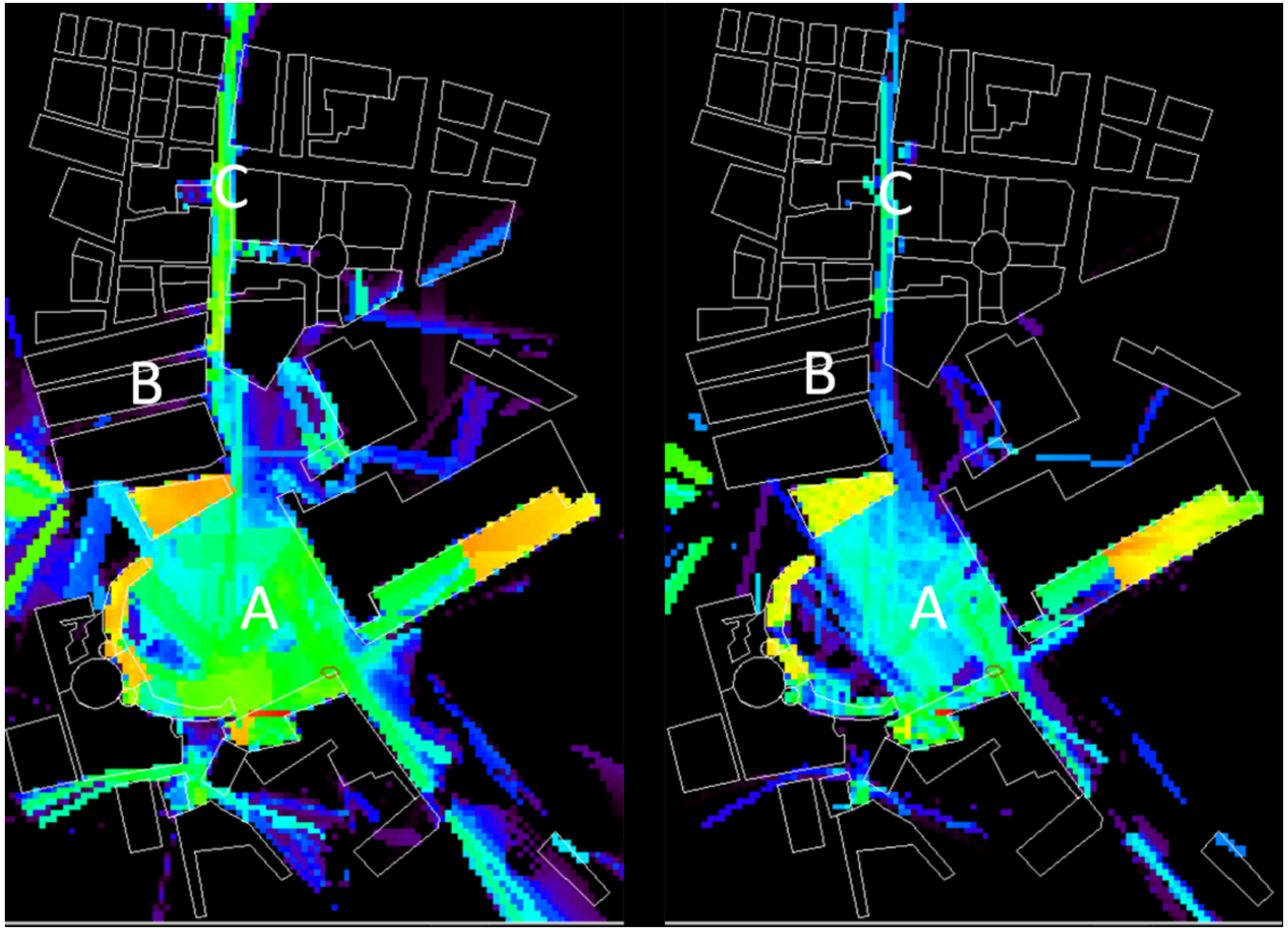
(a)

Tilt Angle	30° H-Plane	Boresight (0°)	30° E-Plane
			
Maximum Gain	10.9 dBi	12.5 dBi	11.7 dBi

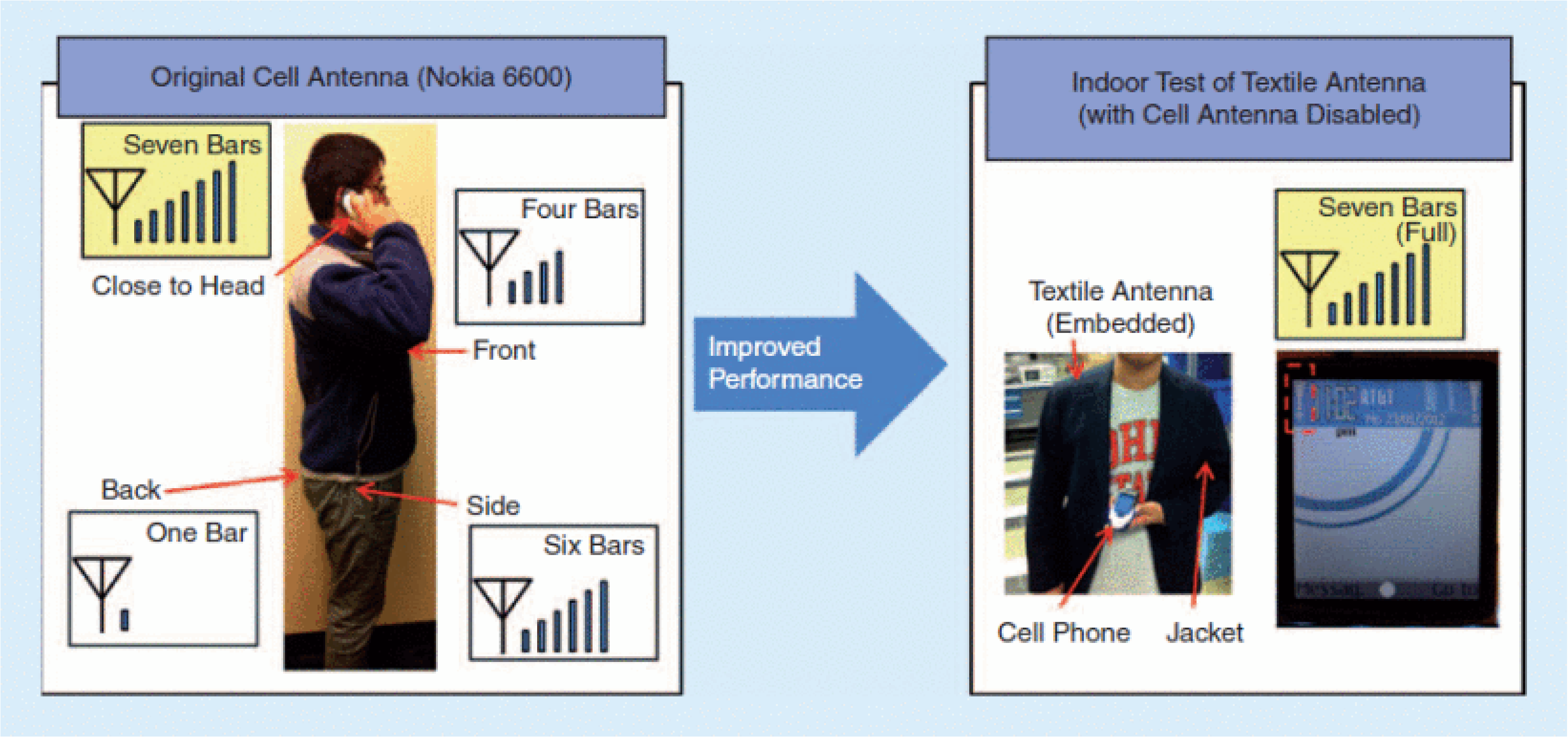
(b)

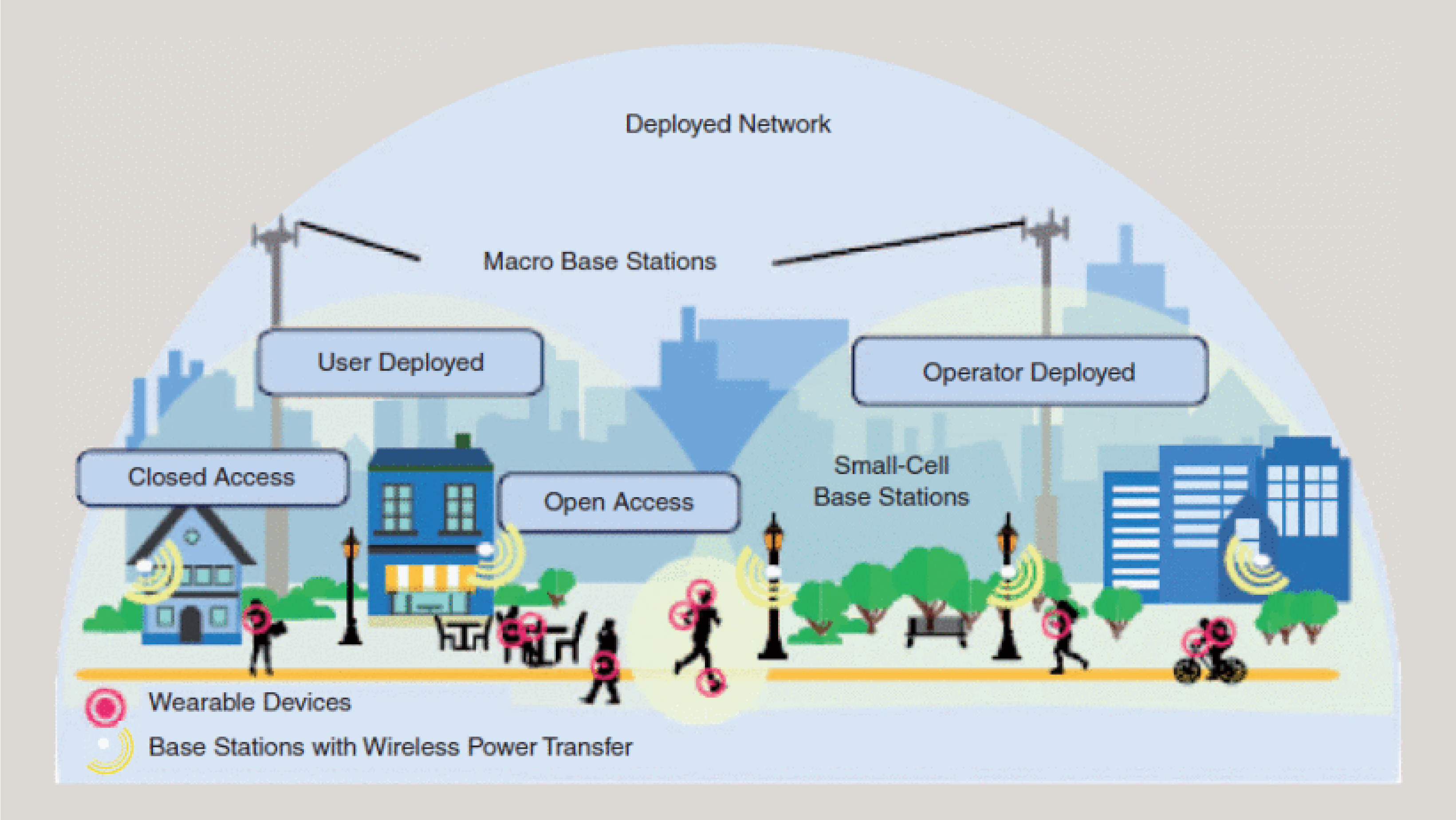

Ant-1
Ant-2
Ant-7
Ant-3
Ant-8
Ant-4
Ant-9
Ant-5
Ant-10
Ant-6
(a)
46 b/s/Hz, Upper Limit
for 8 × 8 MIMO
Fabricated 5G Eight-Antenna
Array
5.75 b/s/Hz, Upper Limit
for SISO
Channel Capacity (b/s/Hz)
0
10
20
30
40
50
60
3.2
3.4
3.6
3.8
Frequency (GHz)
(b)

3.7 GHz



28 GHz


Original Cell Antenna (Nokia 6600)
Seven Bars
Close to Head
Four Bars
Front
Back
Side
One Bar
Six Bars
Improved Performance
Indoor Test of Textile Antenna (with Cell Antenna Disabled)
Seven Bars (Full)
Textile Antenna (Embedded)
Cell Phone
Jacket


Deployed Network
Macro Base Stations
User Deployed
Operator Deployed
Closed Access
Open Access
Small-Cell
Base Stations
Wearable Devices
Base Stations with Wireless Power Transfer

Final Remarks (1)

5G can unleash all its power, and fulfill all promises, only at mm-wave frequencies. The passage from standard UHF frequencies (3.5 GHz) to mm-wave frequencies (28 e 60 GHz) is, for radio-technologies in the "crowdy" space 5G will work, a technical and scientific breakthrough.

The present-days flourishing of new antenna concepts, and of new approach to their use (such as massive MIMO), is the key to support this transition, and allows providers to deliver services with an high added value. And CNIT is on the leading edge of these developments.

Final Remarks (2)

The main challenge is the requirement of a large number of antennas, and sensors, in close proximity of themselves, and of the user body. Some seminal works already exist, but a full solution requires further researches in radio and antenna technology. But the first clues show that the user body is both a possible bottleneck and an opportunity for advanced performance and services, as long as present-time researches, in Italy and abroad, show how to exploit and take benefit of the body size and composition, including them into the antenna behavior.