5G: novelties and deployment issues

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www.cnit.it
What is CNIT? (www.cnit.it)

- National Inter-University Consortium for Telecommunications (37 Italian Universities+7 CNR research units)
- Mission: basic and applied research and advanced education in ICT
- 1300+ researchers; **100+ own employees**
- Funding from private companies and competitive programs only:
  - H2020: 48 projects, **11 of them coordinated by CNIT**
  - 2018 budget: 124 projects (39 EU+37 Ntl+48 Industry), 18M€
  - Recent results: **5 EU projects on applications of ICT; 3 EU projects on 5G ranked #1 in their calls; 1 on cybersecurity (EU competence network); 1 on autonomous vehicles; Flagship Graphene, Flagship Quantum Information**
- No “structural” funding, a problem for overhead and labs equipment
  - (e.g., Germany 30%, Spain 50%, Switzerland 50% of total budget)
Better performance
(speed, density, ...)

Currently being deployed
5G: Revolution
• New scenarios, new use cases, new (non–human) users
• End-to-End, including the core, not only the cellular section
• The software network
  • Cloud, SDN, NFV
    • ... from a typewriter to a word processor
1) Enhanced Mobile Broadband
2) Ultra-reliable and low latency
3) Massive IoT
Network Softwarization
5G network slicing enables service providers to build virtual end-to-end networks tailored to application requirements.

4G networks do not enable the range of services that the future requires. 5G will be faster and more flexible.

Source: ITU News
• We are interested in mobile communications and thus we would like to have radio coverage
  • “Improved speed and capacity ... This requires carriers to add 3 to 10 times the number of existing sites to their networks”
    • Deloitte report 2018

• World population
  • 1950: 2 billions and a half
  • today: 7.7 billions (... and things too...)
  • We need more food, subways, ... and more antennas
    • Tokyo 2020: municipality providing 8.300 buildings, 4.500 plots of land, traffic lights poles, billboards for base stations deployment
    • 5G not an archaeological find: it has been designed on purpose
• Now, higher EMF thresholds are useful from a radio coverage perspective
  • Easier to cover a given area (especially if new sites are not possible)
  • Quicker to cover a given area
  • Cheaper to cover a given area
  • Coexistence with previous generations
  • In general, more flexibility

• BUT, risky logical process:
  1. 5G is coming
  2. 5G implies higher EMF thresholds (ain’t necessarily true)
  3. “Higher thresholds endanger public health”
  4. 5G is bad
• Given current public opinion (see 5G bans in some towns):
  • Political decision: leave thresholds as they are
  • Talk to the people and explain (see following slides)
  • Ease and even support/plan and fund the sites’ deployment process (and share them sites)
Network capacity and EMF levels (ideal.)

- 1 cell
- 1 telephone line, or 1 gigabyte/s
  - (example!)

* Will the Proliferation of 5G Base Stations Increase the Radio-Frequency Pollution? Luca Chiaraviglio, Giuseppe Bianchi, Nicola Blefari-Melazzi, Marco Fiore
• 26 cells
• 26 telephone lines, or gigabytes/s
  • (example!)
• 60 cells
• 60 telephone lines, or gigabytes/s
  • (example!)
• 200 cells
• 200 telephone lines, or gigabytes/s
  • (example!)
Network capacity and EMF levels (Model)

- Path loss: ITU model
- 3700 MHz
- Minimum power at the receiver: 90 dBm
- Scatter plot
- Credits to Luca Chiaraviglio
Network capacity and EMF levels (Model)
Network capacity and EMF levels (Model)
Network capacity and EMF levels (Model)

Received Power [dBm]

-40
-50
-60
-70
-80
-90

[m]
0 200 400 600 800 1000

[m]
0 200 400 600 800 1000

256
Network capacity and EMF levels (Model)

Received Power [dBm]
• Cellular net is bidirectional...
Netwk capacity and EMF levels (ideal.)

• Cellular net is bidirectional...
• Cellular net is bidirectional...
Network capacity and EMF levels (ideal.)

• Cellular net is bidirectional...

http://www.cdqtorrinomezzocammino.it/misurazioni-di-campi-elettromagnetici-e-prestazioni-delle-reti-2g-3g-4g/
Network capacity increase

- From 2G to 4G: $1,000,000 \times 5 \times 25 \times 1600 = 1,000,000$
- Smaller cells = factor of 1600

Source: Cooper’s law, Misha Dohler
• More antennas
  • More network capacity
  • Better distribution of EMF levels from base stations
  • Lower EMF levels from cell phones
    • ... and longer battery life

Will the Proliferation of 5G Base Stations Increase the Radio-Frequency Pollution?
Luca Chiaraviglio, Giuseppe Bianchi, Nicola Blefari-Melazzi, Marco Fiore
Thank you

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