



Cognitive intelligence in spectrum management

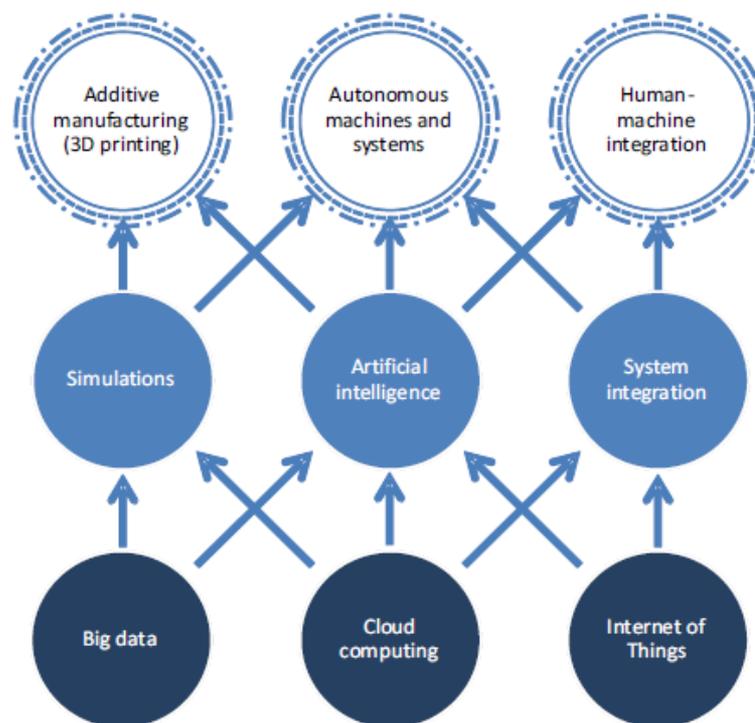
From theory to practice

Jaime Afonso

Inteligência artificial e as ciências rádio

12º Congresso URSI, Lisboa 14 de dezembro 2018

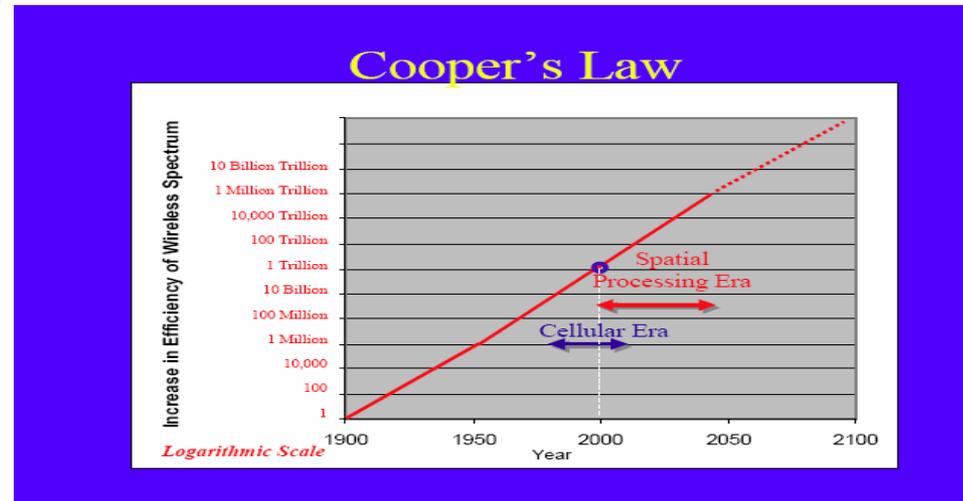
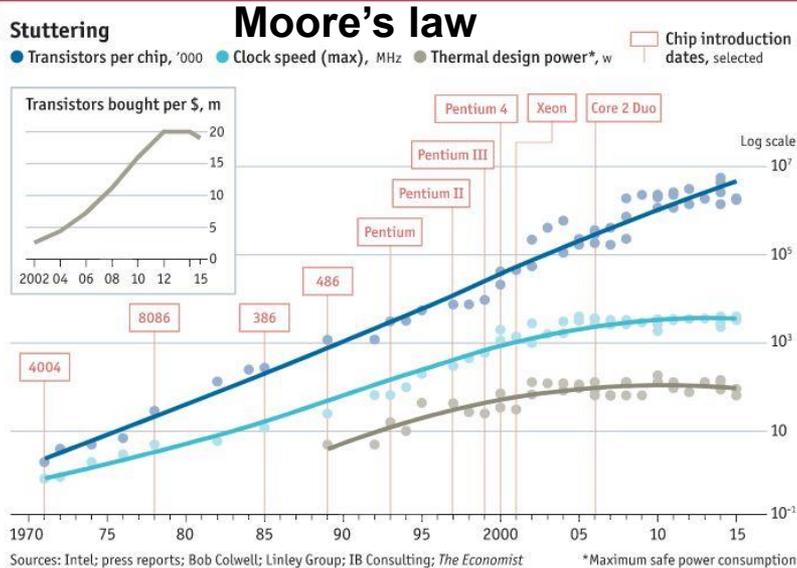
AI in context



Source: The next production revolution, Implications for Governments and Business, OECD, 2017

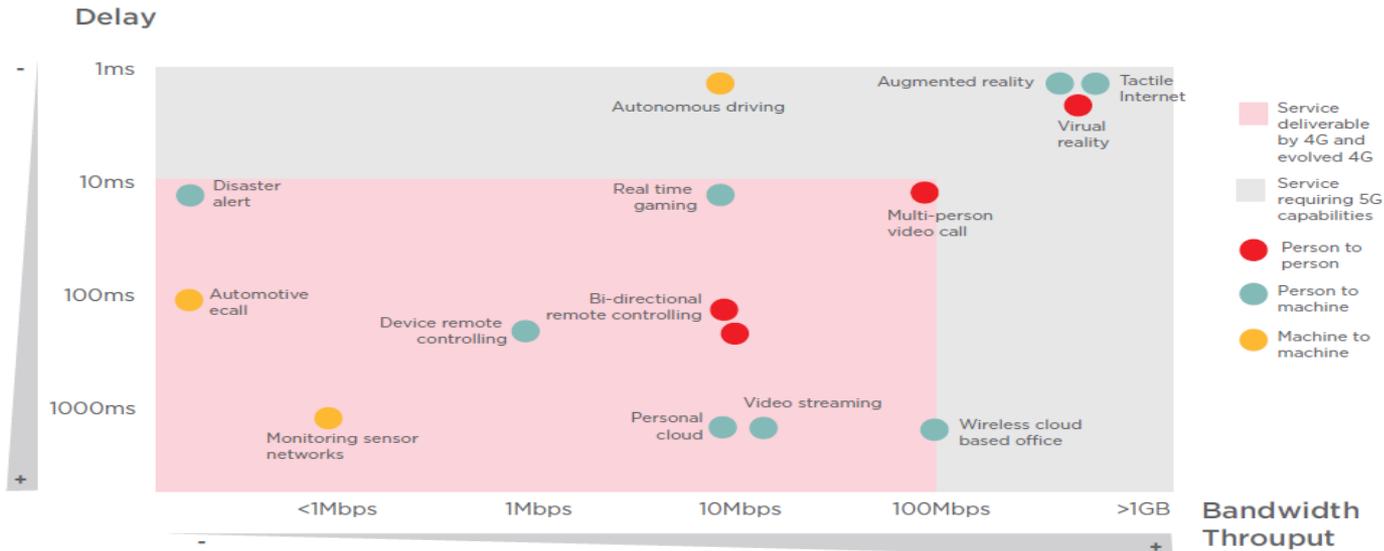
- Reliable, secure, high bandwidth telecommunications infrastructure
- Radiocommunication as one of the key enablers
- Trends in digital technology

“The exponential nature of technology”



- The building block of 5G, including the internet of things (IoT)
- Mobility is king and... (more) spectrum is required!

At the application level: 5G and AI

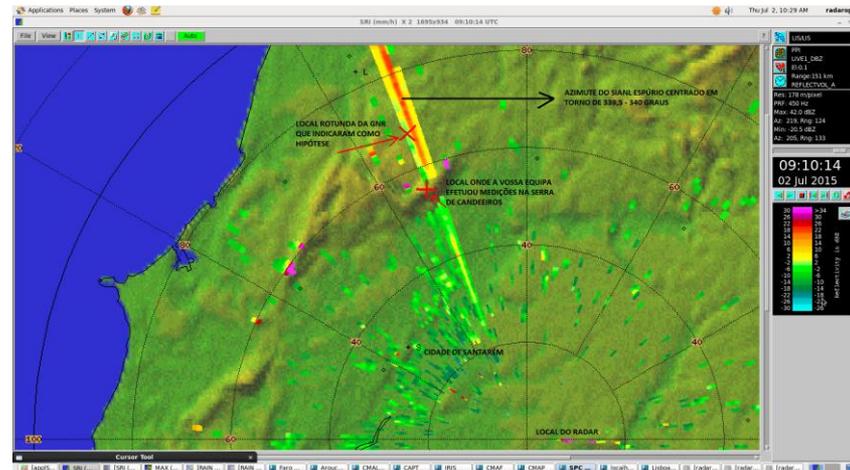


Challenges in managing the spectrum

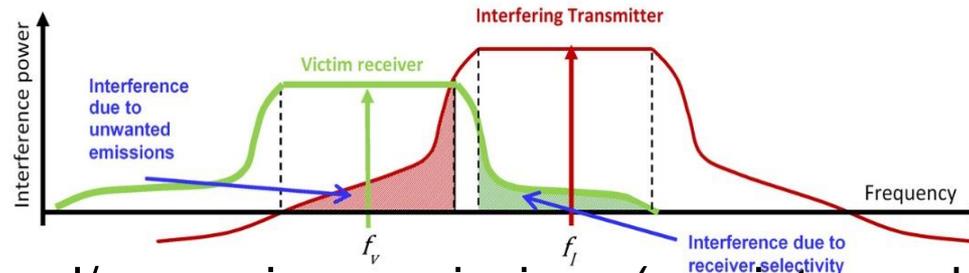
- ▶ Spectrum sharing
- ▶ Cognitive radio: *knowledge* of its operational and geographical environment, established policies and its internal state; to dynamically and **autonomously adjust its operational parameters and protocols** according to its obtained knowledge; and to **learn** from the results obtained.
- ▶ White Space Devices (e.g. IEEE 802.22/11af)
- ▶ Regulatory solutions (e.g. LSA)

- Birth of spectrum regulation goes back to 1920's
 - ▶ Broadcasting and maritime
 - ▶ Interoperability and...
 - ▶ “Interference management”
- ITU Radio Regulations (RR)
 - ▶ international treaty
 - ▶ rational, equitable, efficient and economical use of the spectrum
- Many (and diverse) radiocommunication services
 - ▶ Scientific services, including passive services
 - ▶ Satellite services
 - ▶ Mobile, broadcasting, aeronautical, maritime, etc...
 - ▶ ..and military
- **Question:** how to safeguard the implementation of those services?

- Established in the RR (rule: no “exclusive” spectrum!)
- Digital technologies promotes sharing (e.g. DECT)
- Many mitigation mechanisms has emerged
 - LBT, TPC, LDC, DAA and...
 - Dynamic Frequency Selection (DFS)
- Intelligent sharing
 - Underlay systems (e.g. UWB):** mainly DAA, TPC, LDC
 - Overlay systems (e.g. 5 GHz Radio LAN):** DFS
- Several interference cases!



■ Coexistence implies sharing and... “compatibility”



- ▶ Out-of-band and/or spurious emissions (e.g. intermodulation effects)
- ▶ Receiver parameters (e.g. blocking)

■ Harmonised standards

- ▶ New/updated state-of-the-art parameters for transmitters and receivers required
- ▶ Legacy equipment is an issue...

■ Key takeaways

- ▶ Wireless is a key cornerstone for the future “smart society”
- ▶ AI is intrinsically relying on spectrum
- ▶ Will cognitive intelligence solve all the spectrum current issues?

Obrigado!

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