WHY OUR TELEPHONES GO TO 5G?

The "G", a generation history

In 30 years, four generations of cellular networks have succeeded each other. The 1 G, created in the 1980s, only allowed the communication of the voice using an analog signal ... which was replaced by a digital signal from the second generation (2G). This time, in addition to the voice, text messages could be transmitted. 3G enabled Internet connection and photo and video transfer, and 4G continued on the same track with more flow.

Always more flow!

The main evolution between one generation and another is flow, the amount of data that can be sent in one second. For example, a 5 MB picture sent over a 4G network will be transmitted in less than 0.05 s. With a flow equivalent to that of 1G, it would take almost ... 42 minutes!

Reduce latency

In addition to increasing flow, the 5G offers a great reduction in latency. This last corresponds to the "delay" of the signal which sometimes creates a shift in our communications. With the new generation of phones, two musicians communicating in 5G could play music together without problem!

Example of insufficient flow

The flow of information is particularly critical when millions of users are trying to communicate at the same time. Have you ever received a text message for New Year's Day a few hours late? This happened when too many of us were trying to communicate at the same time, and some messages were queued.

	1G	2G	3G	4G	5G
Timeframe	1980s	1990s	2000s	2010s	soon
Frequency	824 to 894 MHz	1,8 GHz	1,6 to 2,1 GHz	700 MHz, 1,7 to 2,1 GHz and 2,6 GHz	600 MHz to 100 GHz
Size of frequency band	30 kHz	30 to 200 kHz	15 to 20 MHz	100 MHz	20 MHz to >1 GHz
Data flow	2.4 kbps	64 kbps	2 Mbps	100 Mbps to 1 Gbps	< 20 Gbps
Type of signal	Analog	Digital	Digital	Digital	Digital
Data types	Voice	Voice + text	Voice + text + images + video	Voice + text + images + video	Voice + text + images + video
Transmission delay of a 5 MB photo	42 min	80 s	2.5 s	< 0.05 s	< 0.005 s

Table summarizing the different generations of phones and their characteristics

How is it possible to increase the data flow?
The data flow is closely related to the frequency band. Indeed, each conversation, each exchange of data, occupies part of the available frequency band. The bigger it is, the more data can be exchanged at the same time. Each generation makes it possible to increase the available frequency band.
Outside of the broad band of frequencies given to cellular phones, multiple access or "multiplexing" techniques applied to the signal allow several channels to be simultaneously transmitted without interference. You can find out more about this at Montreal's Polytechnique electrical engineering program!

How far will we go? 6G, 7G ... 125G?

If predicting the future is impossible, we know that the frequency of radio waves cannot increase indefinitely. Indeed, there are some physical barriers that prevent it.

1. The attenuation of the atmosphere

Beyond a certain frequency (from so-called millimeter waves), the oxygen and gaseous water that make up our atmosphere absorb radio signals and prevent them from spreading. This attenuation can be particularly marked at certain very precise frequencies.

2. Technical limit

The higher the frequency, the less the waves are able to move over long distances and the more easily they are blocked by walls. This means that you have to multiply the antennas that relay the signal. A single large antenna for several miles around is not enough ... In densely populated areas, it will be necessary to increase the density of antennas installed on the territory.

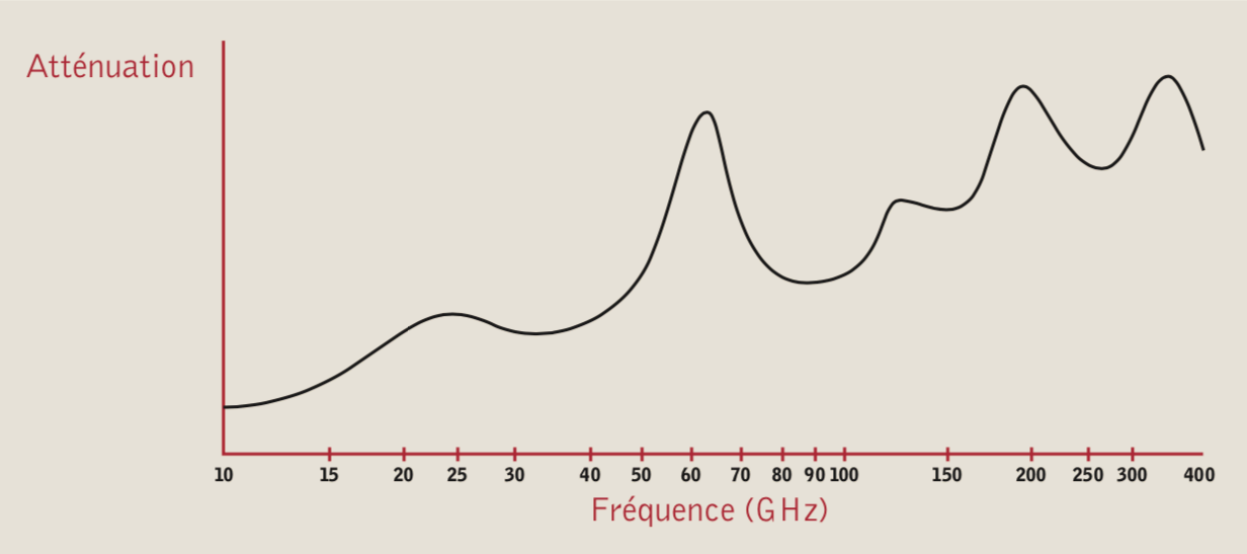

Diagram representing the absorption of certain frequencies by the molecules composing the atmosphere. [Atténuation = Mitigation, Fréquence = Frequency]

Text: Viviane Lalande Technical advisors: Alain Dufour (MOEB/SQCRA), David Dousset and Jean-Jacques Laurin (Polytechnique)