Poster: Is 5G a Hit? A Look into 5G Adoption in France

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Abstract

The rollout of 5G promises major improvements in speed, latency, and connectivity over previous-generation radio access technologies. Our study analyzes Orange's nationwide 5G network in France, combining longitudinal data on infrastructure deployment with data traffic patterns. Early results show that while 5G coverage has steadily expanded and is presently reaching the vast majority of the user population, adoption by mobile subscribers remains limited, leaving much of the new capacity underutilized.

ACM Reference Format:
Antonio Boiano[†], Máximo Pirri[†], Diego Madariaga, Nadezda Chukhno, Cezary Ziemlicki, Zbigniew Smoreda, Alessandro E. C. Redondi, and Marco Fiore. 2025. Poster: Is 5G a Hit? A Look into 5G Adoption in France. In *Proceedings of the 2025 ACM Internet Measurement Conference (IMC '25), October 28–31, 2025, Madison, WI, USA.* ACM, New York, NY, USA, 2 pages. https://doi.org/10.1145/3730567.3768589

1 Introduction and methodology

5G promises step-changes in bandwidth, latency, and service flexibility across enhanced mobile broadband, massive Internet of Things (IoT), and critical communications. Initial commercial deployments since 2019 [6] adopted a Non-Standalone (NSA) architecture, leveraging the 4G core to facilitate the initial release of the new technology [7]; fully fledged Standalone (SA) later introduced an end-to-end 5G core. Market reports track coverage and uptake [3, 5], and many client-side studies benchmark user-perceived performance [4, 8, 9], but longitudinal *operator-side* views of nationwide Radio Access Network (RAN) planning and utilization are hard to come by [10].

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IMC '25, Madison, WI, USA

ACM ISBN 979-8-4007-1860-1/2025/10
https://doi.org/10.1145/3730567.3768589

Our study examines both how a tier-1 Mobile Network Operator (MNO) planned coverage and capacity and how subscribers actually used 5G over time. From the vantage point of a tier-1 MNO, *i.e.*, Orange, we (*i*) chart over five years of 5G NSA/SA RAN deployment and (*ii*) measure adoption via two years of network-side traffic. Our work builds upon the following data collected by the MNO.

RAN deployment: We access the operator's radio site configuration system that provides per-antenna (*i.e.*,, eNodeB and gNodeB) location, orientation, frequency band, and operational status. We probe the database and extract weekly snapshots of the whole 4G/5G RAN infrastructure from January 2020 to July 2025.

Mobile data traffic: Traffic measurements are continuously collected by the MNO from July 31, 2023 to July 31, 2025 using passive probes at both RAN and Core Network (CN) equipment. For the purpose of this study, antenna-level traffic loads are aggregated in time with a 15-minute resolution.

Demographic zoning and data: To carry out parts of our study, we also employ data and statistics provided by the French National Institute of Statistics and Economic Studies (INSEE). In particular, we consider two different subdivisions of the French territory based on geographical (commune zoning) and demographic criteria (IRIS).

2 Longitudinal 5G RAN evolution

We first summarize how 5G was rolled out across France, disentangling spectrum layers and infrastructure deployment pacing. Figure 1 shows a steady mid-band rollout through 2024—dominated by 3.5 GHz (over 97% of mid-band antennas)—followed by an abrupt low-band (700 MHz) capacity layer in early 2025 that nearly doubles nationwide 5G cells within weeks. No commercial mmWave (26 GHz) is present in the target network [2]. This pattern reflects a two-phase strategy: initial coverage with 3.5 GHz (triplet sectors per site) is followed by a synchronized capacity uplift enabling Carrier Aggregation (CA) across low- and mid-bands.

3 Coverage versus capacity

In order to disentangle the planning strategy that underpins the RAN evolution above, we look at the per-site 5G capacity added, and how this differs from 4G.

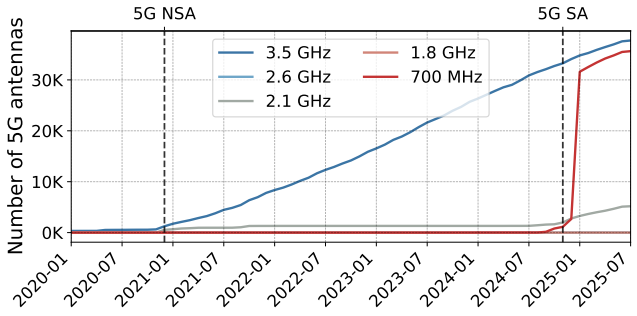

Figure 1: Timeline of deployed 5G antennas by band (2020–2025). Mid-band grows linearly; early-2025 brings a rapid 700 MHz capacity layer.

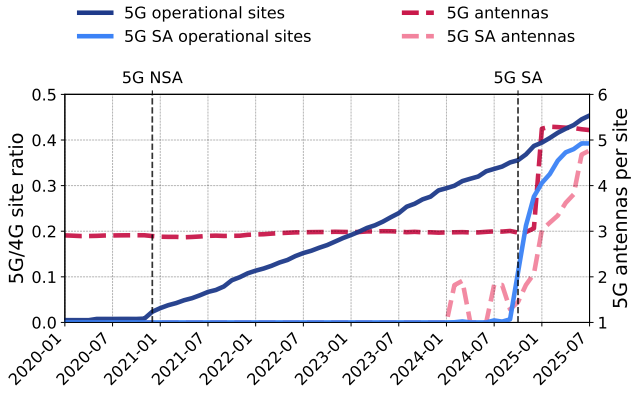

Figure 2: Coverage and capacity of the 5G RAN infrastructure, along with a focused view on 5G SA. Vertical lines indicate the start of commercial availability for 5G NSA and 5G SA.

Figure 2 tracks the coverage attained by the 5G RAN, measured as the ratio between the number of active 5G and the number of active 4G sites. Accordingly, 5G coverage is characterized by a steady growth from late 2020, reaching nearly half of 4G sites by mid-2025. A separate geographical analysis shows that French communes covered by 5G service reached more than 90% of residents. Regarding 5G capacity, the figure indicates a constant number of three 5G antennas per site (typical sector triplet) until late 2024, followed by a sudden increase beyond five antennas per site in early 2025, indicating co-sited low-band layering to increase 5G capacity. Figure 2 also reveals that, if we focus only on 5G SA infrastructure, it has rapidly grown in terms of coverage and capacity since its initial commercial availability in October 2024, reaching levels comparable to the full 5G deployment in a remarkably shorter period–which is expected given the software-only nature of SA rollout.

4 Utilization and adoption

We next relate the provisioned capacity to the actual served traffic, focusing on aggregate trends and per-antenna loads.

Across sites where 4G and 5G coexist, total 5G traffic more than doubles its share in two years yet sits just above 20% of 4G by mid-2025; the growth trend is ~0.5 percentage points per month as per Figure 3 (left). Per-antenna loads (not shown for brevity) peak in late 2024 with downlink 5G ~20% above co-located 4G, but drop after

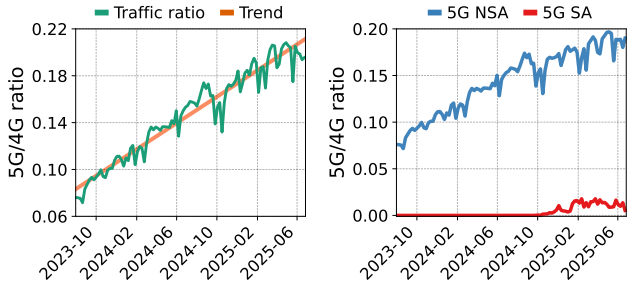

Figure 3: Total 5G traffic volume normalized over 4G total traffic with weekly granularity (left), with separate breakdowns for 5G NSA and 5G SA (right).

the early-2025 capacity layer, indicating supply outpacing demand. Overall, the typical 5G antenna serves about half the co-located 4G demand despite widely cited 5× capacity gains [1, 10].

Also, notwithstanding the broad availability of 5G SA previously discussed, Figure 3 (right) shows that 5G SA traffic demand stabilizes around one order of magnitude below NSA, accounting for ~1% of the total 4G traffic volume. Indeed, the analyzed data indicate that almost all available 5G antennas remain unused by SA mobile devices in the target network by mid 2025.

Acknowledgments

This work was supported by CoCo5G, grant no. ANR-22-CE25-0016, funded by the French National Research Agency; and by 6G-IRONWARE project (CNS2023-143870) funded by MICIU/AEI /10.13039/501100011033 and the EU NextGenerationEU/PRTR. N. Chukhno's work was funded by the European Union, Grant Agreement number 101206327 (6G-AI-TANGO).

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