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AI and electronic communications networks

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The “Future networks” cycle of inquiry led by Arcep and its Scientific Committee

What formats might future networks adopt? How will they affect Arcep’s job as their regulator? What new players or changes to business models might we see in the sectors regulated by the Authority?

To fuel this forward-looking work, and obtain a 360° view of these developments over the next five to ten years, Arcep asked twelve highly qualified individuals from academia, business and industry, bringing a wide range of expertise, to join the Authority as part of a Scientific Committee. To round out the deliberation process, Arcep teams also maintain an ongoing dialogue with specialised players from the ecosystem: telecom operators, telecom vendors, internet companies, service providers and local authorities.

This work culminates in an ongoing series of dedicated briefing notes that are freely available on the Arcep website, and designed to inform public debate.


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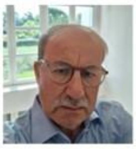
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Where can I access the other briefing notes?

As of publication of this note (June 2025), a first briefing note has already been published:

“Telecoms with an IT core” (October 2024).

Upcoming notes will be published on the “Future networks” page.

“AI and electronic communications networks”

Briefing note: “Future networks” cycle of inquiry – June 2025

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AI and electronic communications networks

1 Introduction

Artificial intelligence (AI) in electronic communications networks is by no means a new topic, as testified by the briefing note published in January 2020, during Arcep's first "Future networks" cycle of inquiry[1]. AI models and their applications have been developing at an accelerated pace since then, and their adoption is increasingly widespread, notably after the launch of ChatGPT. This AI assistant has demonstrated the power of generative AI systems and ignited tremendous enthusiasm for the technology in every sector of the economy. In addition to technological developments, the regulatory landscape has also changed with the adoption in 2024 of the AI Act that establishes a framework for the development of this technology in the European Union.

In the briefing note published in 2020, it appeared that operators were still hesitant about using AI to manage and optimise services. Today, there is no longer any doubt that AI will play a major role in networks' operation. Although present in the electronic communications landscape for several years now, some actors believe that AI is poised to enjoy an added boost in this sector.

The purpose of this new briefing note, then, is to revisit the topic of the use of AI in networks, with a dual objective: to analyse the developments that have occurred since the publication of the first note in 2020, and to complete the analyses of the briefing note on "Telecoms with an IT core"[2] published in 2024, in order to better understand how AI and networks' virtualization and cloudification will shape electronic communications in future.

To this end, the briefing note offers an analysis of electronic communications network developments enabled by AI, of the impact that its growing adoption will have on infrastructures and users, and of emerging issues. Aware of the vast scope of this topic, this note does not aim to be exhaustive. Instead, it focuses on the reality in the field in France, and highlights the main lessons learned from interviews and discussions that were carried out to inform the work on this subject.

The first part of this note includes fixed and mobile network use cases, that are either already in place or being planned for the coming years. It also takes stock of the growing integration of artificial intelligence in the networks, through standardisation work and the ways in which operators are adopting these innovations.

The briefing note then explores the outlook for new services that could emerge as a result of this increased use of artificial intelligence in the electronic communications sector, as much in consumer as business markets. This leads to an analysis of their potential impact on traffic and network performance.

Lastly, the note explores the issues and challenges ushered in by this rising prominence of AI in networks, notably changes to the value chain and the relationships between the ecosystem's players, environmental implications, data and regulatory questions, as well as the work and challenges that need to be undertaken to foster the emergence of responsible and sustainable AI.

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[1] Arcep, 2020. Future networks – Briefing Note No. 6 (in French) – L'intelligence artificielle dans les réseaux télécommunications https://www.arcep.fr/uploads/tx_gspublication/reseaux-du-futur-AI-dans-les-reseaux-janv2020.pdf

[2] Arcep, 2024. Future networks Briefing Note – Telecoms with an IT core https://en.arcep.fr/uploads/tx_gspublication/futur-networks-telecoms-with-an-IT-core_ENG_041024.pdf

1.1 Artificial intelligence: what does it mean?

Artificial intelligence (AI) refers to a set of techniques that give IT systems the ability to imitate certain human capabilities, such as reasoning, learning and perception. It is divided largely into two approaches: symbolic AI and machine learning (ML).

Symbolic AI is based on logic and representations that can be understood by humans. It relies on explicit rules and structured knowledge bases, which brings them close to human reasoning. This approach nevertheless comes up against its limitations when faced with complex tasks involving variations that are unpredictable or require dynamic adaptation.

Machine Learning, on the contrary, is not based on a pre-established logic. It uses algorithms that are capable of learning from massive datasets, to identify trends and model behaviours. These models can adopt different architectures and adapt thanks to optimisation processes designed to minimise an error or maximise performance. Unlike symbolic AI, machine learning does not possess any explicit reasoning, but rather learns to detect and exploit underlying data structures. This approach is particularly effective for tasks such as image recognition, machine translation and error detection.

Machine learning has taken hold in the field of electronic communications thanks to the massive amounts of data that networks generate on a daily basis. It is used to anticipate outages, optimise traffic management, and to personalise the services being marketed to users. Symbolic AI remains little used in this sector, as most research is focused on improving machine learning models.

Some models, such as large language models (LLM) – which have become very popular with the emergence of chatbots such as ChatGPT, Mistral and Perplexity, and computer vision[3] models – are especially costly to develop and require considerable resources to operate. Their training is based on vast datasets and employs infrastructures capable of managing hundreds of millions, if not several billion parameters. This complexity means not only very high energy and financial costs, but also ethical, data privacy, copyright protection and environmental challenges. Added to which, beyond the training phase, their deployment and real-time inference require powerful infrastructures, which makes these technologies inaccessible to a great many organisations, and confines their adoption to players that have substantial means, such as Big Tech companies.

AI is not, however, limited to these large-scale models. Many more classic algorithms from different branches of machine learning provide the ability to satisfy a wide array of needs with smaller computing and data requirements. Machine learning encompasses several sub-domains that utilise different techniques and target an array of use cases.

Supervised learning

This approach uses labelled data to train models that can predict outcomes based on new inputs, or unseen data. The most common algorithms include linear regression, random forests and neural networks. Its applications range from image classification to time series forecasting.

Unsupervised learning

Contrary to supervised learning, this approach works with unlabelled data to discover hidden patterns or structures. Use cases include tasks such as customer segmentation and anomaly detection. LLM are trained primarily using self-supervised or unsupervised learning, but also include supervision and reinforcement stages.

[3] Computer vision is a field of artificial intelligence that uses machine learning and neural networks to teach computers and systems to extract significant information based on digital images, videos and other visual inputs, to make recommendations or take measures when they detect defects or problems.

Reinforcement Learning (RL)

Here, an agent[4] learns by interacting with a dynamic environment and by receiving feedback in the form of rewards or punishments for its actions. This approach is commonly used for games, robotics and network optimisation.

These three machine learning approaches provide complementary solutions, each tailored to specific contexts and challenges. When combined, they can improve the performance and adaptability of intelligent systems in a variety of areas, ranging from scientific research to industrial applications, including use cases for electronic communications networks that will be discussed below. These include deep learning, which is a subset of machine learning focused on the use of neural networks to perform tasks such as classification, regression and representation learning. “Deep” refers to the use of several layers in the neural network. Deep learning can be supervised, unsupervised or reinforcement, depending on the algorithm and the goal.

2 AI for networks

2.1 AI for fixed networks

The “Plan France Très Haut Débit” national ultrafast broadband rollout scheme accelerated the deployment of optical fibre in France, making fixed networks an essential infrastructure for digital practices. The massive adoption of this new infrastructure led to widespread use of the “STOC” system[5], highlighting the challenges surrounding the quality of installations and network sustainability. AI took hold as a key tool for automating the supervision of installations and the detection of faulty work.

2.1.1 A proven use case: computer vision supporting fixed networks

One widespread AI application in fixed networks is the use of computer vision for automatically analysing images and extracting relevant information, such as fault detection. This area of application has given rise of a range of solutions being marketed by innovative SMEs. For several years now, commercial operators[6] and their subcontractors have committed to providing an account of all of their service calls and field work, which has given infrastructure operators[7] access to a large volume of data for training and perfecting models designed to support and evaluate service calls on fixed networks.

Every infrastructure operator today uses these tools to monitor several dozen locations via photos and to verify, after the fact, whether the service call was carried out in accordance with quality standards. These tools thereby create the ability to automatically detect whether the wrong optical path was used at the connection point, the presence of unused patch cords at the shared access point, or the proper labelling of connecting cables, with a degree of certainty of between 90% and 99%. Thanks to this systematic monitoring of every service call, infrastructure operators can make commercial operators accountable by implementing charge-back mechanisms for identified faulty work, and so creating an

[4] AI agents are software systems that use AI to pursue objectives and perform tasks on behalf of users. They are capable of reasoning, planning and memory, and have a certain degree of autonomy to make decisions, learn and adapt.

[5] “STOC” refers to a system used in France to provide end users with a fibre connection, whereby the infrastructure operator (IO) in charge of the network subcontracts deployment of the last mile to a commercial operator (CO).

[6] Commercial operator: an operator providing electronic communications services and benefitting from access to networks deployed by infrastructure operators.

[7] Infrastructure operator: an operator that established and/or operates and optical fibre network.

incentive for them to improve the quality of their service calls, and guarantee a more future-proof network.

Computer vision is also used for other applications such as categorising damaged infrastructures reported by citizens. This visual recognition of collected images makes it possible to identify whether the damage actually exists and to set the priority ranking for the repair.

2.1.2 Outlook for the coming years

In the coming years, computer vision will continue to progress, becoming more reliable, increasing the number of points that can be monitored while reducing the amount of data needed to train the models, thanks to more powerful algorithms and optimised learning methods.

In addition, fixed networks are expected to benefit from the development of more autonomous networks that function with minimal human involvement. By way of example, by monitoring network usage in real time and analysing traffic trends, AI can help improve quality of service while reducing congestion. It can also identify and repair faults before they affect end users. Because they are so complex, these developments are taking place only gradually. Some operators that deploy this type of application set an initial goal of fault detection, which will evolve towards diagnostic capabilities, then the resolution of incidents, e.g. security, performance or network congestion.

2.2 AI for mobile networks

There have already been a host of announcements about the use of artificial intelligence in mobile networks. Sixth generation mobile networks (6G), which are still in the design and standardisation stage, are promising to be “AI-native”, in other words to have an architecture that is structurally based on artificial intelligence. However, the integration, if not co-development, of new AI and mobile network technologies are coming at a time when artificial intelligence is already being used operationally in the field, and when new use cases that, today, are still in the planning stage, could take off in the coming years. Lastly, it should be mentioned that several of the AI use cases listed below can apply to wireless local loops, the backhaul network and the core network.

2.2.1 Existing use cases

As indicated in the introduction, the term “artificial intelligence” can encompass a vast array of technological realities. In the case of mobile networks, machine learning is already a proven technology found in certain network sub-components. Some operators use them to detect abnormal behaviours in certain cell site elements (batteries, cooling) to prevent technical malfunctions. The classification and processing of alerts at the radio access network (RAN) level is another example of a fault prevention application. AI is also used to introduce energy-saving or green features, such as dynamic frequency band shutdown during off-peak hours, predicting radio cell traffic profiles, or constructing cell site profiles to improve their settings.

Machine learning can produce highly satisfactory results for this type of use case with relatively little computing capacity, using only CPUs (central processing units) and minimal GPU (graphics processing unit) resources. This type of “supervised” learning requires labelled data, which is not the case with certain more advanced deep learning algorithms. If using machine learning for this type of use case can evolve towards more complex models, in particular by employing deep learning, it is not always clear that it will result in markedly more relevant outcomes that would justify the coordination needed to implement the solution, and the associated financial means.

Large language models (LLM), meanwhile, also find use cases in mobile networks. They are used for problem-solving tasks. Some customer support line workers, responsible for addressing subscribers’ requests, are trained using this type of model, for instance. Engineers and technicians with some operators also use these models for querying and updating databases compiling installation procedures and fault resolution protocols.

AI applications for individual companies or public sector entities' private mobile networks include modelling the quality of indoor coverage, for instance.

2.2.2 Outlook for the coming years

In addition to existing uses, different areas of application for AI technologies are being developed and tested by ICT sector companies. This section highlights some of the innovative directions being explored to apply AI to electronic communications networks, and which are likely to emerge in the coming years. Some of the applications have also been flagged by other publications, including the report from BEREC[8] and the WIK-Consult[9] report on behalf of Austria's regulator, which can provide useful complements to this briefing note.

Digital twin networks

Digital twins have the potential to transform electronic communications network management by providing precise virtual replicas of physical infrastructures. This technology gives operators the ability to simulate, monitor and optimise their networks proactively, thereby reducing costs and improving performances[10]. Features include the ability to anticipate potential failures, trial new configurations and plan updates without disrupting actual service. This is a particularly useful approach to managing the complexity associated with stacking multiple mobile network technologies, along with the growing number of features in the most recent generations. AI technologies can be used to design digital twins, notably specialised machine learning algorithms for data aggregation, generation and visualisation. These technologies therefore help make the results of digital twins' predictions and simulations more accurate and reliable.

Leading telecom vendors already offer solutions implementing the use of digital twins which, for now, appear to only be deployed in targeted parts of the network. In the coming years, however, there will be a trend towards broader deployment of digital twins, covering every network building block and delivering more advanced functions. In France, some operators are beginning to develop their own digital twin project, designed using artificial intelligence technologies, and gradually incorporating network building blocks by first seeking to reproduce the core network's behaviour. The main benefit would lie in simulating the impact of certain core network reconfigurations by minimising the number of trials that need to be conducted under real, or semi-real world conditions. The number of tested reconfigurations and updates could thus be increased considerably. Whereas, today, core network reconfigurations take time before being widely deployed, as they can have considerable effects on every subscriber, the trials carried out on a digital twin that accurately mimics the core's behaviour could help to significantly reduce adoption time for these reconfigurations. Better still, a parallel AI model could have the goal of maximising the core network's performance while testing countless configuration scenarios on a digital twin.

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[8] BoR (23) 93 BEREC Report on the impact of Artificial Intelligence (AI) solutions in the telecommunications sector on regulation

[9] Wik Consult, 2024. AI in Telecommunication: The Current Use of AI in the Austrian Telecommunications Sector

[10] Digital twins on the agenda for telecoms | Nokia.com: https://www.nokia.com/bell-labs/bell-labs-consulting/articles/digital-twins-on-the-agenda-for-telecoms/

Digital twin networks can also prove beneficial to private 5G networks, by enabling network configuration simulations, real time quality of service and coverage monitoring, notably at manufacturing sites where connectivity performance can affect automated infrastructure operations.

Autonomous networks/Zero-touch networks

As with fixed networks, mobile networks are also expected to benefit from the development of advanced automation solutions, for optimising their management as their complexity increases. Generally speaking, mobile network deployment and administration mobilise and generate massive amounts of structured data. Which makes these activities especially well-suited to optimisation via AI technologies. Some autonomous network solutions offer an architecture based on unified data collection which includes the radio access network (RAN), the core network and the transport network for feeding centralised machine learning models capable of controlling the entire network. AI plays a central role in this application by analysing network data in real time, detecting anomalies and taking corrective measures in an autonomous fashion. Zero-touch networks are thus a logical progression of self-organising networks (SON), which were standardised by 3GPP in 2008, and which already back then aimed to bring more automation to networks.

There are ambitious projects in the works, such as the one from TM Forum[11] dedicated to creating a fully autonomous network. It employs a relatively standardised approach, with six levels of automation in relation to the system's maturity. Some operators in France are planning to build their own autonomous network, and leading telecom vendors have already incorporated autonomous network solutions into their product line. In the coming years, this technology will continue to evolve steadily towards more advanced levels of automation, driving the emergence of intent-based networks. Under this model, the operator will define an objective for the network, such as a QoS or download performance level, that will be achieved thanks to AI being integrated into the autonomous network.

AI Native

According to the International Telecommunication Union (ITU)[12], AI-native networks refer to a new paradigm in which AI is not simply an added function, but rather an integral part of the network architecture from the design stage, which enables unprecedented levels of automation, optimisation and intelligence. These will be capable of self-management, self-optimisation and even self-repair, giving them the ability to satisfy the demands of future applications.

This is a different approach to the current one where AI is an added component on top of old network elements or embedded in more recent components, and so replacing old elements bereft of these features. The way that AI currently integrates with network building blocks does not allow for unified network operation that could provide a complete AI cycle including pre-validation, real time assessment and optimisation that would require efficient data processing to guarantee a high-performance AI system and a harmonious integration of computing systems, data streams and models to ensure good quality of service (QoS)[13]. AI-native could be a pillar of future mobile networks, with applications that can run on preinstalled AI capabilities and modules, notably in the case of 6G networks[14].

Although the concept of AI-native is becoming increasingly prevalent in the electronic communications ecosystem, it does not yet have a formal and concrete definition. This is likely to change over time, as

[11] Autonomous Networks – TM Forum: https://www.tmforum.org/topics/autonomous-networks/

[12] ITU – FG AINN: https://www.itu.int/en/ITU-T/focusgroups/ainn/Pages/default.aspx

[13] Iovene, M., Jonsson, L., Roeland, D., D'Angelo, M., Hall, G., Erol-Kantarci, M. and Manocha, J., 2023. Defining AI native: A key enabler for advanced intelligent telecom networks. Ericsson, Czechia

[14] China Mobile Research Institute (CMRI). (2022) 6G Native AI Architecture and Technologies White Paper

future mobile network technologies develop. Moreover, while every equipment supplier is developing a clear vision of the design and architecture of an AI-native network, operators appear to be remaining cautious about their intentions in this area.

AI-RAN: Focus on mobile access networks in the AI-native era

Developments are also expected in radio access networks (RAN), notably following the work of the *AI RAN Alliance*[15] begun in 2024, whose aim is to improve RAN performance and capacity thanks to AI. Within this alliance, operators, telecom vendors, universities, startups, GPU suppliers and hyperscalers are working together to develop a new generation of RAN.

The technological advances expected for the coming years[16] include an evolution in RAN design that enables the integration of optimisation at different levels thanks to AI, in synergy with virtualisation. Radio access network performance could thus be improved, building on advances that are already available, notably at the radio interface and signal processing level which would become AI-native, thereby optimising the processing chain. By the same token, AI could facilitate beam management and optimisation. Radio resource management would also benefit from AI through more dynamic and efficient allocation. Lastly, improved energy and spectrum efficiency are likely to be a major focus, with the goal of reducing energy consumption, and so the cost of operating RAN components, while optimising spectrum use. These advances are referred to as "*AI for RAN*".

Meanwhile, other innovations aim to create a shared infrastructure for the simultaneous operation of AI and RAN to perform tasks not related to the RAN ("*AI and RAN*") and to allow AI applications to run in a decentralised and more effective manner thanks to the radio access network's infrastructure ("*AI on RAN*").

2.3 AI increasingly present in standardisation work on network technologies

The growing integration of AI in networks is leading standardisation bodies to engage with this topic more and more. The scope of the ITU[17] working group on Future networks and emerging technologies includes the orchestration and use of AI in networks.

Several 3GPP[18] working groups have added AI to their agenda. It is worth noting that AI models themselves have not been standardised. Standardisation efforts are focused more on monitoring and overseeing AI models' performance, governance, as well as standardised approaches to data collection (training) and improving models[19].

Since the 3GPP Release 18 (5G Advanced), published in 2024, AI standards have been incorporated into radio interfaces. AI is also among the changes planed for Release 19, on which work began in early 2024. These workstreams now extend to uses based on generative AI, for which standardisation targets include radio access networks (RAN) – for instance, for the compression of channel state information, beam management and positioning, as well as optimising the network's energy

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[15] AI-RAN Alliance: https://ai-ran.org/

[16] AI-RAN Alliance Vision and Mission White Paper

[17] ITU: International Telecommunication Union

[18] 3GPP: 3rd Generation Partnership Project is a cooperation initiative between standardisation bodies that produces mobile communication protocols.

[19] Montojo, Juan. Overview of AI/ML related work in 3GPP. Presentation in "ETSI AI Conference 2025". Available at: https://docbox.etsi.org/Workshop/2025/02_AICONFERENCE/SESSION05/3GPPRAN_MONTOJO_JUAN_QUALCOMM.pdf

consumption – and the core network, notably for analysing network data to predict and attenuate risks of congestion[20].

In addition, CEN/CENELEC[21] created a technical committee dedicated to artificial intelligence[22]. This committee will be responsible for crafting horizontal standards for supporting the AI Act's requirements, and which can apply to the electronic communications sector. These standards will also pertain to harmonising terminology and concepts, AI ethics and trustworthiness, as well as cybersecurity and interoperability.

2.4 A strategy of gradual adoption of AI for networks

Discussions with stakeholders reveal that AI is being integrated into networks in a gradual fashion. A similar observation emerged in works on network virtualisation and cloudification published last year (Networks with an IT core). Even if every operator in France has their own vision of deploying AI in networks, most are taking a bottom-up approach: business teams identify and propose solutions that address concrete needs, such as improving operations and fault resolution.

Although operators remain open to solutions offered by telecom vendors, they are developing multiple use cases internally by capitalising on available data, and on their knowledge of the network and its operation. Telecom vendors' solutions are not always turnkey products: they require adjustments, if not dedicated training for the operators' staff. Moreover, some applications require close collaboration with operators to test and calibrate the models.

At a time when AI is perceived as lever for innovation and improved operational performance, operators are taking a cautious approach. They are opting for a gradual deployment to be able to obtain a precise measure of the outcomes, the impact on network performance indicators, associated costs and return on investment (ROI). This strategy can also be attributed to the fact that AI does not always outperform humans. In some instances, even when an AI solution is available, a less automated solution can be preferable.

In light of international comparisons, the pace of AI integration in networks appears to depend on the degree of infrastructures' virtualisation, as well as the overall investment momentum for deploying new networks.

2.5 How AI will change the workplace

The pragmatic approach described above does not prevent the emergence of new paradigms, or even profound changes in electronic communications industry businesses as they stand today, notably with the advent of the notion of an "augmented workforce" where AI is used to assist staff members. AI applications currently help in resolving incidents, automating the work of filling out forms, and formulating responses for customer support teams. These innovations will help staff to be more agile and operators to improve their performance. Despite increasing automation, nothing shows that humans will be removed from network operations and replaced with AI.

Businesses' more operational branch may also be poised to undergo a dramatic transformation in the coming years. This will be made possible by a combination of augmented reality, creating the ability to superimpose virtual elements on a real environment, and artificial intelligence applied to computer

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[20] Karapantelakis, A., Alizadeh, P., Alabassi, A., Dey, K. and Nikou, A., 2024. Generative AI in mobile networks: a survey. Annals of Telecommunications, 79(1), pp.15-33.

[21] CEN/CENELEC: European Committee for Standardization/European Electrotechnical Committee for Standardization

[22] https://www.cencenelec.eu/areas-of-work/cen-cenelec-topics/artificial-intelligence/

vision. Thanks to mobile applications or smart glasses with integrated AI components capable of recognising network elements and how they function, it will be possible to identify network equipment and display contextual information directly in the technician's line of site, in real time. The technician could therefore receive contextual and accurate instructions on both the elements they are working on, and those surrounding them. They can also be guided throughout the service call, thereby reducing the risk of error. By automating a portion of analysis and diagnostics, augmented reality combined with computer vision would transform work in the field, making service calls more fluid, precise and efficient, and so improving network quality and reliability.

3 Does the growing integration of AI in networks open the way for new services?

Developing innovative services is becoming a key challenge for operators, not least because of the need to monetise network investments. As a result, the rise of artificial intelligence represents a source of hope for reviving the sector and creating new business models. A number of innovative services are thus likely to be rolled out in the coming years.

Operators are banking on long-term strategic partnerships to develop these new services, with prime examples today that include Vodafone and Microsoft[23] or Orange and Mistral AI[24]. Concrete avenues do already exist for releasing new services, both B2B and B2C.

Regarding consumer services on fixed networks, one concrete example is to offer customers personalised audiovisual content through their modem or STB, thanks to generative AI. Users can interact with an AI assistant that can ask them contextualised questions, to then suggest a selection of content in real time. AI also creates the ability to analyse fibre customers' consumption habits, thereby increasing subscriber engagement and satisfaction. On mobile networks, operators are focused on providing free access to generative AI models[25].

Other consumer services could be improved in the coming years, such as using AI to detect fraudulent and spam calls seamlessly, without having to download a specific app or perform frequent updates, or providing an AI assistant that can answer calls.

Moreover, improvements enabled by AI in dynamic resource management for 5G SA network could allow operators to introduce new products such as VIP access on-demand[26]. This would involve offering rapid subscription via the device for a limited time chosen by the user, as was trialled in the Chinese market in 2024.

A range of prospects are opening up for services aimed at businesses, in particular thanks to the networks' convergence with the cloud and AI. Among the solutions being planned are RCS (Rich Communication Services) combined with AI assistants, for more reliable and more personalised sales communications. Other types of solution, such as AI assistants incorporated into mobile plans that would deliver call transcripts and summaries, in addition to interacting with the company's information

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[23] https://www.vodafone.com/news/corporate-and-financial/vodafone-microsoft-sign-10-year-strategic-partnership-generative-ai-digital-services-cloud

[24] https://newsroom.orange.com/orange-et-mistral-ai-signent-un-partenariat-strategique-pour-accelerer-le-developpement-de-lia-en-europe/

[25] https://www.corporate.bouyguestelecom.fr/archives-communique-presse/partenaire-telecom-exclusif-de-perplexity-en-france-bouygues-telecom-est-le-seul-operateur-a-offrir-a-tous-ses-clients-un-acces-gratuit-au-moteur-de-recherche-ia-perplexity-pro/

[26] https://www.gsma.com/get-involved/gsma-foundry/gsma_study/intelligent-packet-core/

systems, are already being marketed in France. Market players that were interviewed believe that AI applied to industrial IoT in real time is another promising avenue.

Integrating AI into the opening up of networks could pave the way for a new range of innovative services for businesses. The use of API (Application Programming Interfaces) enhanced by AI models for authentication at the network level, providing an effective solution for combatting fraud in financial services or on service platforms, is one example of this convergence of technologies.

The growing trend of designing equipment with embedded artificial intelligence, using a small number of settings that will not compromise the models' performance, could open the way for new use cases. These include autonomous driving, with an increased level of safety, or employing user devices to assist businesses in decision making, notably at manufacturing sites where connectivity is often lacking. Developing on device AI was the impetus behind Qualcomm's recently announced partnership with Mistral AI[27].

With a view to future AI-native networks, radio access networks could provide prospects for the emergence of innovative services thanks to the "AI and RAN" and AI on RAN" features mentioned in Section 2.2.2. Possibilities include providing computing power to RAN and other services that need it, and using that power to improve AI services' performance enabled by decentralised infrastructures.

4 AI use and its impact on network traffic

An IPSOS-Cesi[28] survey from early 2025 revealed that 39% of people in France actively use artificial intelligence in their daily lives, chiefly in a personal capacity, but also for work – a figure that rises to 74% for young people between the ages of 18 and 24. These figures demonstrate that AI-based practices are becoming more and more popular. The trajectory of increased traffic in the coming years could be quite likely. For the electronic communications sector, this raises questions about its impact on these new use cases.

According to the interviews conducted with operators, no substantial change in traffic resulting from customers' use of generative AI has been observed as yet in France. But players do anticipate a sizeable uptick in the coming years[29,30]. Anticipating these changes remains a complex exercise, and several of the players interviewed believe that we are on the verge of a disruption in user habits, which is creating a great deal of uncertainty over likely scenarios.

As a result, operators' chief concern is that the increased use of AI tools could drive up overall traffic, and upstream traffic's share of the total[31] – keeping in mind that electronic communications networks, and mobile networks in particular, are currently established based on their being more downstream than upstream traffic, as end users download more data than they send. Applications that incorporate AI (e.g. those based on generative AI, online games backed by AI, XR/AR based on AI etc.) that will require more data to be uploaded could alter the nature of traffic, and force a restructuring of the networks. Preliminary analyses on the AI tools available to the general public concluded that it is the

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27 https://www.qualcomm.com/news/releases/2024/10/qualcomm-and-mistral-ai-partner-to-bring-new-generative-ai-model

28 https://www.ipsos.com/fr-fr/intelligence-artificielle-quels-sont-les-usages-des-francais

29 Impact of GenAI on mobile network traffic, Ericsson mobility report, Novembre 2024 https://www.ericsson.com/en/reports-and-papers/mobility-report/articles/genai-impact-on-mobile-network-traffic

30 Source: The AI revolution impact on 5G data traffic | Nokia https://www.nokia.com/blog/the-ai-revolution-preparing-for-a-surge-in-5g-uplink-traffic/

31 This impact could also include the duration of upstream traffic spikes, which would affect peak time traffic profiles (hence network provisioning).

ones that use image and videos, and those that require synchronisation with the cloud for AI requests that can generate up to several dozens of Mbps of uplink traffic[32]. Other tools can also be very demanding in terms of latency in order to run smoothly. Another example is that of a robotaxi[33] service available in China, which provides rides in self-driving cars. Every car generates and uploads up to 100 Gb of data a day. For this service to function properly, it requires an uplink bandwidth of around 100 Mbps for transfers in real time, with an end-to-end latency of under 50 milliseconds.

Solutions do, however, exist to adapt to this potential AI-driven reshaping of traffic. First, some edge computing AI models can be deployed, in other words closer to customers and data-generation sources, or directly on devices (e.g. for tiny AI models[34]) when they are equipped with a CPU/GPU and enough memory. These AI models generate less traffic because they do not need to communication with centralised data centres. However, despite moving some of the load to edge hardware (devices, network gateways, edge computing servers), there are no plans for tools to operate entirely locally. Operators could also makes use of slicing[35] for dynamic resource allocation, and to be able to manage upstream traffic spikes generated by the use of new AI tools. Lastly, the assumption that radio access networks will evolve thanks to AI (e.g. more optimised management at the scheduler level) could be useful in absorbing some of the traffic that will be generated, albeit in an isolated fashion, this hypothesis seems an insufficient response to the scenario of a massive traffic surge.

It is important to emphasise that networks must not only handle the use cases enabled by AI, but also balance workloads created by model training and executing the inference phase, both of which are data and computing power intensive. AI model learning requires very high bandwidth interconnection and low latency between data centres, which makes the network a decisive factor in performance. AI will create a real strain on infrastructures, but will also be an essential lever for their adaptation, notably thanks to automated resource optimisation and more intelligent traffic management.

5 The issues and challenges for networks, created by the growing adoption of AI

5.1 Changes in the value chain and ecosystem dynamics

The briefing note on “Telecoms with an IT core” had already pointed to the advent of new types of player in the sector. The growing integration of AI in networks adds increasingly prevalent AI model providers to the landscape. As it stands today, there is very little interaction between the consumer generative AI market (LLM and the hyperscalers that host them, against the backdrop of a race to increase computing power) and the market for dedicated AI business applications, that often run locally, with typically small, economical models and companies that are hyper specialised in these issues (whether startups or tech industry veterans such as telecom vendors, or operators themselves).

As a result, the overall sentiment amongst industry players seems to be that the issues in the two markets are different, particularly in terms of the investments required from new entrants. A number of companies operating in the specialised AI application market expressed the view that general purpose models cannot provide value-added, either now or in the short term, on the highly specialised applications that electronic communications networks require. Looking further down the road,

[32] This concerns requests for editing/retouching photos taken in real time, for instance.

[33] https://www.mobileworldlive.com/apollo-go-robotaxis-give-travel-experiences-a-lift-in-the-mobile-ai-era/

[34] Referred to as “Tiny ML” that can be deployed on smaller capacity devices (e.g. to integrate AI in IoT connected objects).

[35] Slicing gives operator the ability to create independent virtual networks on the same physical infrastructure and thereby optimise resources for specific uses.

questions remain over very rapidly evolving, general purpose AI models' capacity to "feed" specialised models (and to interact autonomously with them) to deliver features that could become useful for electronic communications network operators. Medium and long-term cooperation agreements between operators and generative AI model developers (which in some cases are also cloud computing solution providers) could change the current scenario.

This change concerns not only AI's integration in networks, but also its potential to the open the way for new services being offered by operators thanks to more general purpose AI. Operators' privileged access to fixed and mobile connectivity service subscribers allows them to gather useful information, which can be combined with the power of AI to craft new products.

In the meantime, the ecosystem of specialised AI for electronic communications networks seems very piecemeal, with no dominant player and no must-have service. The actors that were interviewed do not believe that any company has yet acquired an insurmountable technological advantage over new entrants (even if the battle for relevant training data, generated by operators' networks, is underway and could prove a major impediment for any company that does not have access to them), nor a head-start in terms of computing capacity (most of the specialised features that players mentioned were relatively economical compared to large models).

Every company today is developing a value proposition around AI for electronic communications networks, particularly with the trend towards virtualisation. Telecom vendors are incorporating more and more AI-based features in their products, hyperscalers are offering cloud computing services enhanced by AI models, and even operators are investing in the development of in-house solutions. The ecosystem is taking shape within this fast-paced development of AI, and new players wanting to invest in the sector will not have to contend with high barriers to entry.

It should be noted that the sector is evolving within an especially dynamic ecosystem, where new players and new technologies are emerging at an accelerated pace. A convergence between cloud services, artificial intelligence and the networks appears to be taking shape, opening the way to increased cooperation between hyperscalers, operators and telecom vendors. All of which share a common interest: creating value in the sector and capturing a portion of that value thanks to innovative services, in which AI plays a central role.

The current consensus is that no single player – neither an operator, an equipment supplier, or a hyperscaler – has all of the skills necessary to carry the transformation induced by this technological convergence single-handedly. As a result, in addition to the aforementioned bilateral agreements, new initiatives are emerging to foster cooperation and innovation within the ecosystem, such as the AI-RAN Alliance[36] and Global Telco AI Alliance[37].

At the same time, market players are working to differentiate themselves by diversifying their business. Telecom vendors, for instance, are taking a growing interest in the developer ecosystem, notably through the evolution of APIs for networks, which could accelerate with AI. Some hardware companies are looking to market more specialised equipment for electronic communications networks, while some operators are developing their own cloud infrastructure. The goal remains the same: to offer more innovative products and services, with AI as a key strategic element.

[36] https://ai-ran.org/

[37] https://www.telekom.com/en/media/media-information/archive/agreement-jv-for-telco-specific-llm-1068392

5.2 AI tools already improving network resilience and security, but could also create new vulnerabilities

Artificial intelligence can create newfound abilities to anticipate failures on electronic communications networks. But the complexity of systems based on AI algorithms is also creating new threats to networks' reliability, on top of the weaknesses shared by all systems. It is crucial to ensure that AI systems function as planned. The massive use of data also creates new vulnerabilities, not least the risks of cyberattacks targeting AI systems' input data, as well as attacks on their inference algorithms, which could constitute points of entry leading to network failures[38]. Even if these risks remain unlikely due to in-depth knowledge of the model and the data required to utilise them, they must not be overlooked. Careful integration of AI in the networks is vital to preventing them.

Regarding AI's contribution to network security and resilience, some operators are adopting preventive mechanisms that utilise analysis of weak signals to identify potential outages ahead of time. As mentioned in Section 3.1.1 of this note, tools based on computer vision offer image classifications for scoring the health of network infrastructure. This approach gives operators more detailed visibility on the state of their equipment, and makes it easier to schedule targeted work on the most vulnerable components. The use of computer vision also creates the ability to analyse any issue reported by users to determine whether it is new issue, if repair work is required, and if it needs to be prioritised.

Work is also underway on mobile network modelling using digital twins. The purpose of these simulations is to accurately locate the nodes causing disruptions, along with the affected hardware. In future, autonomous networks will be capable of making incident identification and resolution more agile. At the same time, some companies are integrating intelligent assistance systems to support technicians carrying out maintenance operations.

Lastly, AI can help strengthen digital infrastructures' security. There are a number of solutions for identifying abnormal behaviour likely to reveal attempted security breaches. These tools are capable of detecting equipment whose activity exceeds usual data transfer thresholds, thereby enabling a detailed analysis of the observed anomalies.

The briefing note "Telecoms with an IT core" had highlighted how virtualisation made networks more vulnerable, due to the criticality of telecom services, the confidentiality of the data being relayed over them, and the growing number of open interfaces. AI nevertheless appears to be evolving into a tool for increasing networks' resilience and security, as a response to the growing complexity induced by technological developments, despite the new aforementioned vulnerabilities.

5.3 Environmental issues to consider

Generally speaking, AI models' increasing capacities and adoption also raise environmental concerns, particularly with respect to energy consumption. AI's environmental impact can be attributed largely to the fact that the technology relies on physical infrastructures and hardware, such as data centres for training models and using them.

Knowing that digital technology's carbon footprint could triple between 2020 and 2050, and that data centres' global electricity consumption could double between 2022 and 2026 in large part because of AI[39], it seems vital to factor environmental considerations into the development of this technology, notably for electronic communications networks where its use is expected ramp up on the short to medium term.

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[38] Reno, J., Inam, R., Ulbert, A. (2023). Trustworthy AI - What it means for telecom. Ericsson, Tech. Rep

[39] International Energy Agency (IEA), Electricity 2024, 2024.

5.3.1 The environmental impact of AI in networks still hard to estimate

It does not yet seem possible to obtain an accurate and reliable assessment of the proportion of the electronic communications sector's greenhouse gases that can be attributed to AI, resulting from direct or indirect effects. Based on the interviews that were conducted, this can be explained in large part by the difficulty in obtaining the exhaustive data that players would need to calculate this estimate, combined with the limited ability to factor in the entire life cycle of AI-based services, mainly because these new models and equipment designed with embedded AI are not yet mature enough. Estimates of their impact after their large-scale deployment will therefore no doubt differ from estimates based on the impact of prototypes during the research stage.

It should also be noted that the work being done on AI's environmental footprint is focused mainly on the use of generative AI. Most of common use cases for electronic communications networks do not use generative AI, however, but rather more traditional models whose impact is much smaller than that of generative AI's large language models.

It also emerged from the various interviews that AI's increasing integration in electronic communications networks could in fact have positive environmental effects. Introducing AI into these networks could result in major advances in the management and optimisation of fixed and mobile electronic communications networks, by helping to reduce the footprint of operations (reduction in technicians' travel and optimisation of their service call routes) and by improving the system's performance by making it more energy efficient (managing mobile networks' sleep/standby settings).

5.3.2 Incorporating environmental concerns into the development and use of AI in electronic communications networks

Very few generative AI companies and users have yet to publish any data on the environmental impact of implementing and using this technology. Which means that these technologies are likely to be conceived, developed and, eventually, used without considering their impact on the environment.

These environmental concerns can, however, be incorporated into generative AI systems in different ways. To this end, best practices and recommendations, such as the General Policy Framework for the Ecodesign of Digital Services[40], already exist based on the current state of play, designed to increase awareness amongst AI stakeholders and its users, which are not necessarily aware of its environmental impact and energy consumption. These practices could nevertheless be supplemented, particularly at the European and international level, to enable the development of more frugal, sustainable and transparent AI, which would be a net positive for competitiveness, the environment and major societal issues.

5.4 Data issues

The development of artificial intelligence depends heavily on having access to data, in many instances to vast quantities of data, while also meeting certain quality criteria. These data need to be processed by the model for training purposes, whether generative AI or not. For instance, the computer vision tools described in Section 3.2.1 require a large number of photos to train their model. Their reliability is indeed based on the number of images available to train them: the degree of accuracy is around 50% with 10 photos, improves significantly with 100 photos, and becomes satisfactory with 1,000 photos.

[40] Provided for in the Law on Reducing ICT's environmental footprint of 2021, this reference document was produced by Arcep and Arcom in association with Ademe, and in collaboration with Dinum, CNIL, and Inria.

Another aspect of data processing is data quality. The data must be recent and collected in harmonised formats. Before being able to analyse them, they need to be upgraded (or converted), which takes a great deal of a company's time and resources. Several of the stakeholders that we queried spoke about how important it is to have high quality datasets to obtain interesting outputs after being processed by AI, stressing that not having them could prove an impediment or even delay the development of AI tools for networks.

Use of this data raises several issues, the main one being the ability to access these data. This access can occur through multiple players, which alters the level of confidentiality for each of them. Data can be processed directly by the providers of AI systems (as is the case when using a generative AI model on a platform) or in a silo (e.g. when using a model locally). Data are clearly becoming a vital asset for operators at a time when AI is being integrated more and more into networks, and there is a trend amongst telcos of wanting control over these data and properly supervising how they are shared, which is often confined to only a few partner hyperscalers (for cloud computing solutions for processing in silos) or telecom vendors (for deploying AI solutions targeted to specific network building blocks).

For AI models designed to improve network performance, telecom vendors often require data from operators to develop them. These can be generic data, such as information on traffic profiles or RAN-related technical constraints. When deploying these solutions, the models are fed operational data, with the training phase typically carried out internally by the operators who retain ownership of their data. The performances and the outcomes expected from the models are thus influenced by operators' strategy, which is reflected in the data they provide.

According to the interviews conducted for the purpose of this note, access to electronic communications network data, which is usually confined to operators and large telecom vendors, is viewed as an impediment to smaller companies' and academic researchers' ability to develop innovative solutions.

Data-related issues can also be influenced by existing regulation, such as the GDPR governing the use of personal data used to train these models, or the Data Act on matters of interoperability that could hamper the development of certain models. It is nonetheless worth noting that none of the players mentioned being directly affect by these regulations, in terms of the practices they had adopted, and due to the more technical nature of the sought-after data.

5.5 Issues tied to existing AI regulation

Few of the stakeholders interviewed appear to have detailed knowledge of the regulations in force (currently the European AI Act, in addition to the aforementioned data regulations).

Understanding the AI Act is key to the issues cited by stakeholders, and particularly the safety component of electronic communications networks, designated by the regulation as the place where use of AI must be supervised as it constitutes a high risk. Its definition still needs to be clarified, and some players have been solicited by the European Commission to contribute to the work of applying the regulation, to help establish a definition commonly agreed upon by the sector, and work appears to be ongoing on this definition of high risk..

As it stands, we know that a safety component is defined as "*a component of a product or of an AI system which fulfils a safety function for that product or AI system, or the failure or malfunctioning of which endangers the health and safety of persons or property*". Under a broad interpretation, this definition can encompass a great many network elements whose failure would result in the network no longer functioning. There needs to be clarification on this matter, to be certain of the scope of the obligations set forth in the regulation.

Operators expect their suppliers to comply with this regulation, and that they consider themselves responsible for complying with obligations and certification. Most of the regulation's obligations are concentrated around releasing products into the market, hence on suppliers. They do, however, also have multiple responsibilities during operators' internal development process. Added to which, the prospect of autonomous networks in the coming years is driving some operators to wonder about how this AI Act will affect networks' evolution.

For large suppliers of AI applications, the approach taken by the AI Act, which consist of focusing obligations on the most high-risk applications, appears to be widely accepted to the extent that the most commonly used applications are subject to comparatively light obligations. Some suppliers are nevertheless concerned about the current development of codes of practice supplementing the regulation, under the aegis of the European Commission, which encourages applying additional obligations on low-risk AI. This could affect the low-risk AI applications used by the electronic communications sector.

5.6 Creating explainable and interpretable AI

One of the first questions asked about deploying AI in networks concerns control. In other words, what does the network actually do when it is perfectly autonomous? By default, AI does not justify itself. It simply attempts to achieve an optimal configuration of the state space it is provide based on one or several instructions. As AI models are deployed in information systems and networks, there becomes a needs to understand the decisions they make. New fields of research are emerging focused on the "explainability" (XAI) and "interpretability" of AI. These are two fundamental concepts whose goal is to better understand AI systems' behaviour. Explainability is focused on the AI's ability to explain its decisions to the people that use it. Interpretability is more of a field of scientific research, whose purpose is to deepen understanding of the inner workings of AI's decision-making mechanics.

The current belief is that there needs to be more transparency over the models being used for electronic communications networks, to reach a more mature level of explainability and interpretability of the models. This could explain the reigning cautious attitude towards adopting AI in networks. It is also a topic that must not be overlooked in the networks' development, and about which telecom vendors appear to already be aware[41,42]. The aforementioned discussions and work being done around regulation (cf. 6.4) and standardisation (cf. 3.3) could create concrete tools to move forward in this area.

In addition to responsibilities tied to a specific solution, it is crucial that operators deploy AI in a responsible manner, to strengthen consumers' trust and make them more operationally efficient. To this end, the GSMA has developed a "*Responsible AI Maturity Roadmap*" to help electronic communications operators assess and improve their responsible AI practices. This roadmap offers a structured framework for evaluating their responsible AI (RAI) maturity level, identifying areas for improvement and aligning their strategies accordingly. It is based on five core dimensions: Vision, Operating Model, Technical Controls, Third-party Ecosystem, and Change Management and Communications, to be able to fully incorporate responsible AI practices within the organisation.

This responsible AI approach should also help foster the emergence of new services, by guaranteeing end users transparency on the integration of AI building blocks in these services, and in how they are relayed.

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[41] Lee, A. (2022). Responsible AI for telecom. Nokia, Tech. Rep.

[42] Reno, J., Inam, R., Ulbert, A. (2023). Trustworthy AI - What it means for telecom. Ericsson, Tech. Rep

6 Conclusion

The growing integration of artificial intelligence in electronic communications networks marks a major paradigm shift for the sector. Concrete applications are already in place, notably for optimising fixed and mobile networks, infrastructure resilience and improving quality of service. AI also opens the way for new services to emerge, as much for businesses as consumers. The convergence between the cloud, AI and networks is redefining business models, pushing operators to beef up their technological expertise and explore new business opportunities. But these advances are not without consequence: potential traffic growth, the need for more responsible AI, and environmental issues all urge a well-controlled development strategy.

The briefing note on "Telecoms with an IT core" identified the operational and organisational issues and challenges involved in the networks' transformation towards increased integration of virtualisation and cloud technologies. It also examined the new resilience and safety/security issues to emerge as a result. It appears that integrating AI technologies can provide solutions to some of these concerns, but also ushers in new risks and challenges for network transformation. Infrastructure virtualisation increases opportunities for integrating AI in the networks, and can be a prerequisite for the ability to take advantage of certain major innovations.

In addition, as with the computerisation of networks, the integration of AI takes place in stages, and at a different pace depending on the use case. Regarding the emergence of new services for consumers and businesses, the integration of AI into these innovations in network infrastructures appears to be opening up more concrete prospects, even if there is not yet any consensus over the services of tomorrow.

This transformation raises strategic competition questions and could redefine market balances over the long term. Is the use of AI likely to reshuffle the deck between the operators that have adopted it and those opting for a more conservative approach? It is still too early to tell, but the pioneers could enjoy a competitive advantage in the market.

Against this backdrop, AI is taking hold not only as a lever for innovation, but also a driver of profound transformation in the electronic communications sector. Its gradual and controlled adoption could be decisive in guaranteeing high-performance, safe and sustainable networks in the coming years.

Annexe 1

Meetings

A series of meetings and interviews was held to inform our deliberations over artificial intelligence and networks. The positions expressed in this briefing note do not, however, necessarily reflect the views of the people we met with or the institutions to which they belong.

The parties interviewed include:

- AFNOR
- Bouygues Télécom
- CEA Leti
- CNRS
- Deepomatic
- ENSEA
- Ericsson
- Firecell
- Free
- Huawei
- IMT
- Institut Montaigne
- Inveniam
- Microsoft
- Nokia
- Nvidia
- Orange
- Qualcomm
- SFR