Connected Ecosystem

Telecommunication Infrastructure as a Driver of Global Transformation

Home Banking · Smart Working · Education and Training · Entertainment and Sports · Security

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Telecommunication Infrastructure as a Driver of Global Transformation

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Introduction

In the last decade, the telecommunications sector has undergone a structural repositioning within the global economic architecture. Historically framed as a vertical industry in its own right, whose performance was measured almost exclusively on the basis of direct revenues and traffic volumes, the Telco sector is today acknowledged by major economic institutions as a true general-purpose technology. It is a transversal enabling infrastructure: its real impact no longer only resides in its own financial statements, but rather in the positive externalities it generates, i.e. in the ability to provide other sectors with the tools to operate, scale and innovate.

This document examines their strong interdependence through the analysis of five strategic macro-areas: home banking, smart working, education and training, entertaining and sports and citizen safety. The choice of these specific investigation areas responds to a precise analytic criterion: in each one of them, ultrabroadband networks and advanced 5G mobile connections have ceased to represent a mere channel to optimise processes, becoming a primary requirement for operational continuity.

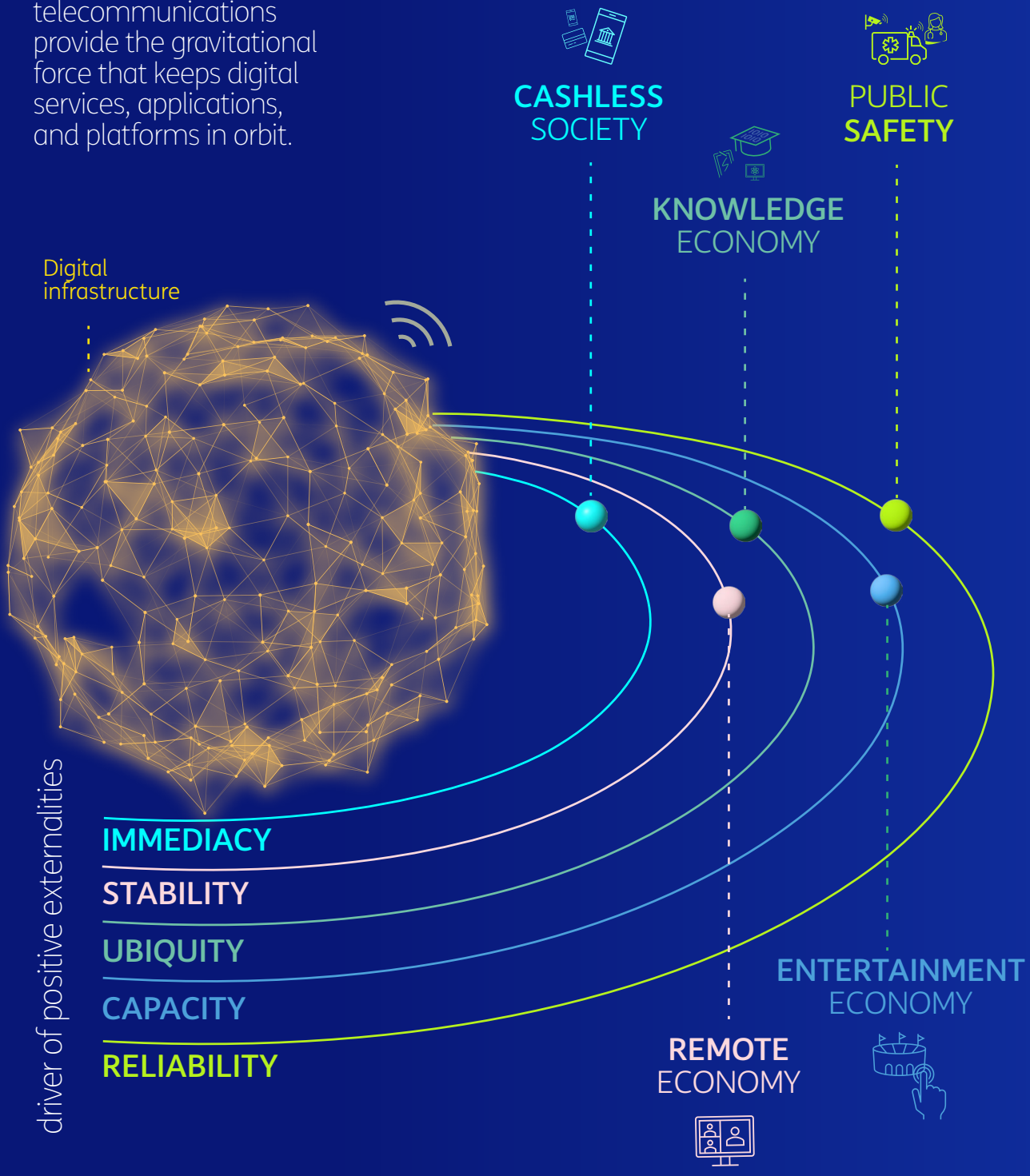
Specifically, in the financial sector, networks determine capital accessibility and prevent social exclusion linked to bank desertification; in the labour sector, connectivity has become a synonym of organisational resilience and energy security; in education, it represents the main vector to mitigate territorial disparities; in entertainment, it imposes new technological standards for the simultaneous management of large data volumes; and, in public protection, the reliability of real-time data has become the basis for citizen health control and the predictive monitoring of the territory. In all these areas, network infrastructure adequacy does not translate into a mere difference of convenience or speed but established the right of effective access to digital citizenship.

This report is focused on the measurement of the cause-effect relationship between infrastructure investments – characterised by very high capital intensity for constant technological modernisation – and the value generate in the production and social systems that rely on those networks. This paradigm takes on a critical and unique importance in the Italian context. Our country is facing a complex transition phase in which the investment drive has historically been confronted with orographic and demographic heterogeneity that has often slowed the homogeneity of network coverage.

Measuring the impact of telecommunications, therefore, means providing an essential reading tool not only for sector operators, but also for policy makers, public administrations and stakeholders called to define Italy's development, cohesion and competitiveness policies. For each of the five macro-areas, the report combines an analysis of global trends and international and national benchmarkings (OCSE, Banca d'Italia, Italian Government) with a selection of metrics and documented case studies at the national level. The aim is to anchor the analysis to factual and verifiable contexts, providing an empirical framework that enables an assessment of the country's position within Europe and global dynamics, as well as the scope and priorities for structural interventions over the next decade.

Telecommunications are a cross-cutting enabling infrastructure that generates positive externalities for multiple sectors.

The digital system can be viewed as a solar system: telecommunications provide the gravitational force that keeps digital services, applications, and platforms in orbit.

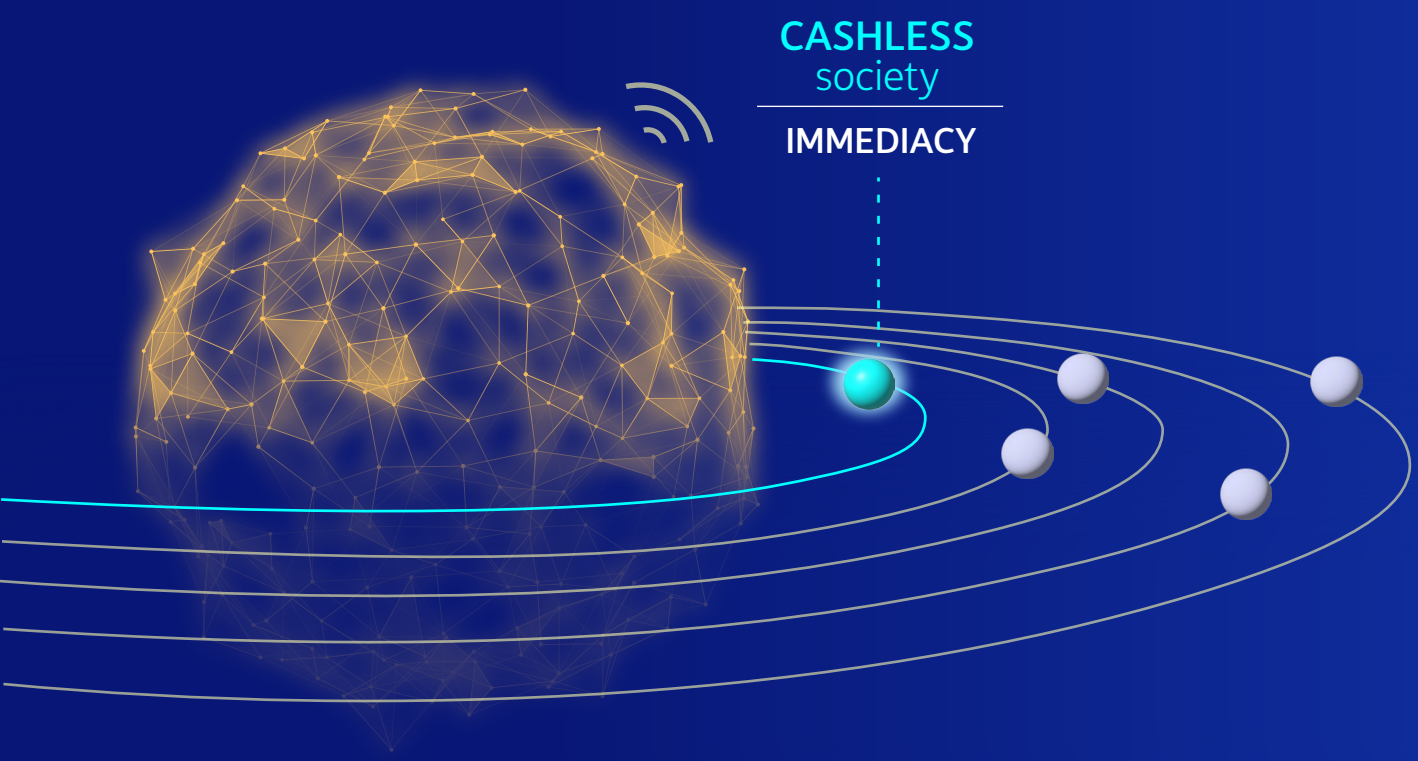


INDICE

CHAPTER 1

Home Banking and digital transactions: the backbone of a cashless society

Connectivity has become the new bank branch, making payments, financial transactions, and digital services increasingly secure and accessible.



20,500 transactions per minute with payment cards or e-money

45% of national consumption paid digitally

€55 bn **in positive externalities** from digital payments

72% CO_2 emissions **lower** than the **physical exchange of cash**

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E-payments are the operational infrastructure of a cashless society. They can be made with or without a card, through electronic wallets or e-money tools, but in all cases, they are based on a common technical sequence that must occur in real time and under conditions of maximum reliability.

Within this process, payments are split into three fundamental phases: an immediate transaction authorisation, the exchange of information between merchant's and customer's banks (clearing) and the final settlement of the sales. All those phases depend on the availability of stable, low-latency and always-on network connections, as even a few seconds of delay could compromise the outcome of the operation.

A key role is played by security: today, digital transactions are protected by Strong Customer Authentication mechanisms, that require at least two verification factors between password, device and biometrics, and by 3D Secure and 3D Secure2 protocols, which dynamically link authorisations to amounts and beneficiary. In this context, telecommunications contribute by cooperating in fraud prevention with their infrastructures.

In fact, mobile networks allow the integration of context signals invisible to users, e.g. consistency between SIM and device, the actual presence of network terminals or the detection of anomalous events such as suspicious SIM replacement or recent portability. This information, conveyed via standardised networks' APIs, enables banking systems to strengthen authentication or block potentially fraudulent transactions before they cause economic damage, providing very quick responses. To give an order of magnitude, consider that in 2025, out of about 14.8 billion cashless transactions in Italy, 10.8 billion were made with payment cards or e-money, i.e. around 20,500 operations per minute[1]. Not all transactions automatically require a SCA (for example, those below a specific payment threshold) but the amounts defrauded in transactions without SCAs are almost 3 times higher than those protected by strong authentication (precisely, 2.8x). This infrastructural level is directly linked to daily operations and highlights how, behind every apparently simple transaction, there is constant coordination among TLC networks, banking systems and digital platforms, without which the e-payment structural growth would be technically impossible. The evolution towards a cashless society is not driven solely by banks, but is materially enabled by telecommunications infrastructures, which allow devices to interface in real time, securely and anywhere across the territory.

Economic, social and environmental impacts in Italy

The European House-Ambrosetti report[2] (2026) provides a snapshot of the systemic value generated by the digital transition of payments. Network infrastructures supporting a cashless society do not only represent a technological evolution but are a formidable wealth generator: over the last ten years, the positive externalities of this transition have generated in Italy over 55 billion EUR.

This impact is reflected in six main dimensions of cause-effect. Firstly, there is a drastic reduction in cash management costs: according to Banca d'Italia, the average social cost of cash transactions is around 0.33 EUR per operation. The evolution of e-payments allows for a reduction in average cost of transactions over time owing to scale economies and technological innovation[3]. The second dimension concerns the security of transactions: networks eliminate the risk of using counterfeit cash, recovering huge slices of economic value that would otherwise

be lost. The third is the stimulus to economic development: according to The European House – Ambrosetti Community Cashless Society estimates, each cashless transactions activates an overall economic value along the payment chain up to around 0.6 EUR, including financial, technological and infrastructural services[2]. The fourth dimension is linked to fair taxation. The fifth highlights time savings: the TEHA Group[2] estimates that cashless payments in a physical store enables to save 25 seconds compared to the same operation carried out in cash. Finally, the sixth dimension regards environmental sustainability: owing to the dematerialisation enabled by telecommunications, every single cashless transaction reduces CO2 emissions by 72% compared to the physical cash exchange[2].

The adoption of these technologies travels more and more on mobile radio networks and connected devices. During 2024, Nexi has driven the growth of mobile payments in Italy recording an increase of 61% on expenses made on their own circuit through smartphone and smartwatch connected to cellular networks[4]. This data is corroborated by a +36% of Nexi cards that, also in 2024, have been virtualised directly on digital wallets such as Apple Pay, Google Pay and Samsung Pay[4].

Mobile Money global landscape and financial inclusion

Broadening the landscape internationally, GSMA's 2026 State of the Industry Report on Mobile Money[5] certifies the role of mobile networks as the global finance backbone. During 2025, the mobile money industry has brought in over 2 trillion dollars through digital portfolios[5]: if it took 20 years to reach the first trillion dollars in annual transactions, only four years were needed to double this figure[5]. By analysing 2025 flows, peer-to-peer digital transfers were 42% of the total value, followed by cash-based (37%) and interbank transactions (21%[5]). Mobile Money providers who participate in a Global Adoption Survey register a positive EBITDA in 80% of cases, with an ARPU increased by 15% – from 1.52 dollars in September 2024 to 1.75 dollars in June 2025 – and overall revenues increasing by 27%[5].

These flows integrate more and more with the Digital Public Infrastructures (DPI), interoperable systems of digital identity, payments and exchange of data enabling governments and businesses to provide secure and large-scale services. Over 100 countries have already launched smart payment systems. Brazil, with its Pix system, represents the most advanced case: in 2024 only the system has been used by 96% adults and 84% businesses, processing 63.4 billion transactions for a total value of 4.5 trillion dollars. As documented by the World Bank's 2025 Global Findex Database[6], telecommunications companies in sub-Saharan Africa have catalysed financial inclusion offering transactional accounts via mobile phone: in 2024, 40% adults in that region had a mobile money account, compared to 27% in 2021[6]. In the same period[6], in Latin America and the Caribbean, the share shifted from 22% to 37%.

Security and Artificial Intelligence

To ensure security and consumers' trust in networks which carry trillion of dollars is a growing priority. Telephone operators started implementing Artificial Intelligence to combat frauds by identifying millimetric anomalies[5]. The M-PESA service in Kenya exploits AI to detect unusual patterns in real time; providers such as Airtel Money Rwanda use Machine Learning algorithms trained on historical fraud cases to predict and block criminal activities before they cause damage[5].

Digital structural overtaking: the role of mobile networks

The transition towards a cashless society has reached a point of no return. In 2025, e-payments

in Italy had reached a record share of 518 billion EUR, covering 45% of the overall national consumption and consolidating a structural overtaking on the use of cash[7]. POS terminals in Italy had reached 3.6 million installations, with Smart POS raised to 19% of the total and POS Software to 165 thousand units[7]. In 2025, innovative payments had reached 84.9 billion EUR (+45% compared to 2024), i.e. 16% of the entire Italian e-payment market[7]. This market share is driven by contactless and by NFC technology integrated into smartphones and wearable devices – tools that, to authorise transactions in fractions of a second, need a stable, secure and ultra-low latency 4G or 5G connection.

Smartphones as a "new banking branch"

The 2024-2025 ABI Lab Report[8] certifies that smartphones – and the mobile network infrastructure that powers them – have become the "new branch" for millions of citizens. 80% of Italian banks records on their apps a higher number of active customers than the traditional web portal, with a growth of +5.5% compared to 2023[8]. Without the digital infrastructure provided by telecommunications, operational volumes would be technically impossible: there are over 406 million authorised transactions carried out via app (+16% on an annual basis) and a boom for instant bank transfers, grown by +50.6% (57.7 million operations[8]). 91% of banks allow payment of the F24 model via app, 77% processes automatic payments through camera, and one in two offers complex tools for personal financial management on the move[8].

Sector's investments on Cloud, AI, Cybersecurity Infrastructure

Behind this mobile interface there is a massive upgrade of back-end technology infrastructure that binds banks and telecommunications with a double tread. In 2024 only, Italian banks' investments in technology have reached 6.3 billion EUR; of these, between 2020 and 2024, over 2 billion have been allocated to cybersecurity, to protect sensitive data transit on networks. 2025 Fintech investigation on the Italian financial system by the Banca d'Italia[9] finds that, in the years 2023-2024, expenditure in new technology (net of traditional systems) exceeded 1 billion EUR, with further growth of 1.4% expected for the years 2025-2026[9]. Banks are increasingly adopting cloud computing – essential to make services accessible remotely – and generative Artificial Intelligence, i.e. technologies that are totally dependent on Telcos' ultrabroadband backbones. Around one third of intermediaries intends to integrate AI-based risk assessment tools under the new European AI Act, transforming the financial sector in a data-driven ecosystem which operates exclusively through telecommunications networks.

This technological evolution is flanked by a further level, less visible but increasingly decisive, regarding customers' digital identity and fraud prevention. In Europe, the development of authentication and fraud protection APIs such as SIM Swap, Number Verification and KYC Match indicates the progressive rapprochement across telecommunication operators, payment service provider and fintech realities. These tools aim to replace more fragile or less efficient verification procedures, making remote interaction with banking services more secure and less frictional. In parallel, the European regulatory framework reinforces this tendency: in fact, the EU Digital Operational Resilience Act[10] (DORA) places the digital resilience of the financial sector at the centre of operational governance and also gives importance to the role of critical third-party suppliers, among which infrastructures and telecommunication services that support digital finance's daily operations. In this perspective, the quality of the network is no longer just a factor of technical continuity, but an integral part of the overall reliability of the banking ecosystem.

The Italian case: connectivity, home banking and the paradox of declining banking access

So far, the narrative of a cashless Italian society returns an image of linear progress: more networks, more connected devices, more transactions. And yet, there is a dimension of the phenomenon that the aggregated data tend to obscure, and which is perhaps the most revealing of the structural role of telecommunications in the financial system: what happens in places not covered or poorly covered by the network.

Banca d'Italia measured this effect with econometric rigour[11]: in municipalities where broadband diffusion is poor, the probability of families using digital banking channels drops by 5.3%. In peripheral territories, every percentage point less in broadband coverage translates into a fraction of the population without home banking – and, as the branches' physical network gets thinner, in a fraction of the population tout court excluded from banking.

The "bank desertification" phenomenon, monitored by the Osservatorio of First CISL Fondazione Fiba[12] based on Banca d'Italia and ISTAT data, in 2025 reached dimensions which qualify connectivity as a national cohesion issue. Over the year, Italian banks closed further 516 branches, reaching a total of 19,140 – steadily below the 20 thousand threshold. Nearly half of Italian municipalities is now without a single bank branch. They amount to 3,457, or 44% of the total, 75 more compared to the previous year. Around 4.9 million Italians live in totally desertified municipalities, while a further 6.5 million live in municipalities with only a single branch left. The geography of closures dispels the cliché that it is exclusively a peripheral problem: from the end of 2021 to 31 December 2025, the percentage of closed branches in Rome (–14%) and Milan (–16.1%) was higher than the national average (–11.6%).

In this context, home banking ceases to be a convenience and becomes a financial surviving infrastructure. The numbers of adoption in Italy provide a picture of real but still incomplete growth: the share of customers with home banking contracts has reached 73 out of 100 inhabitants (68 in 2023), and the use of online bank transfers reached 93% of the total – a share that would have seemed implausible just a decade ago. Banca d'Italia, in the Quaderno di Economia and Finanza no. 682[11], illustrates how the digitalisation of banking channels shows a positive correlation with the profitability of institutions and negative correlation in the number of physical contact points, indicating a progressive replacement between the supply and demand channels: banks close down branches, and customers migrate spontaneously towards the app.

The Italian paradox emerges confronting the speed of bank desertification with the slowness of digital adoption: in the years 2024-2025, the use of Internet banking grew just by over one percentage point, from 55% to 56.4%, remaining far from 67.2% European average recorded by EURtat in 2024[13] and even more from France (78.3%), Spain (74.8%) and Germany (70.7%) levels. The gap widens further when looking at older age groups: between 65 and 74 years, digital channels are used by 36.7% of Italians, against 47.9% European average. These demographic groups are in fact the most exposed to the loss of physical contact points, and the less prepared to compensate them with home banking – a short-circuit that highlights how the development of network infrastructure in the less covered areas is not just a market issue, but a social inclusion imperative. Filling the gap with the European average means, first of all, bringing stable and high-speed connectivity in the less covered Municipalities: according to the causal relation documented by Banca d'Italia, each percentage point of broadband penetration achieved in internal areas traduces into a measurable share of citizens who acquire the ability to manage their accounts remotely.

In short - **e-Payments**

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What are they

card
debit/credit/ prepaid

cardless

e-money
prepaid, e-money account/wallet

How the process works

SECURE transaction

Authorisation
in real time

Clearing
(exchange of data between banks)

Settlement
(net balance calculation and settlement)

Why TLCs are important

Pagare. In tempo reale.

The successful completion of the operation depends on the availability of fixed/ Wi-Fi/mobile connections.

Telecommunication operators contribute to the development of APIs (*Application Programming Interface*) so that companies, PAs and developers can access mobile network functionalities in a standardised manner.

Examples of Network APIs functionalities: identity/number verification, fraud prevention, geo-localisation, on-demand network quality, verifying that a phone number is associated with a specific SIM/device, detecting whether a suspicious SIM swap has occurred.

***APIs** are "interfaces" enabling two software to communicate in a standardised manner*

244 cashless payments per citizen, every year (Italy)

72% card/e-money
24% transfer/crediting
4% cheques

over **2x** payments with card or e-money 2020 - 2024

Source: ECB Payments transactions (Key indicators) – PAY https://data.ecb.europa.eu/data/datasets/PAY/dashboard

In short – **Home banking: the effectiveness of a strong authentication in blocking frauds**

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What is it

Security procedure introduced by e-payments European regulation (PSD2) to verify that payments are really authorised by customers, thus reducing the risk of fraud.

Strong Customer Authentication (SCA) requires at least 2 factors between:

something you **own**

something you **know**

something you **are**

How the process works

3D Secure 2

amount and **beneficiary** verification

request via app

*****

confirmation

context signals verification

Why TLCs are important

Smartphones/SIMs are not just an object: they are a digital identity that lives on the network.

Connectivity and network signal reliability help enabling the authentication and making it more reliable.
TLCs reinforce security "behind the scenes": they do not replace bank/PSP, but cooperate in combating frauds, for example to prevent potential number "theft" (SIM swap, fraudulent portability, deviations).

Every time an operation is authorised, apart from what we see on screen, there is an intangible work of networks and controls which contributes to making home banking and e-payments more secure.

National operations:

50 fraudolent transactions over **1M** SCA-enabled bank transfers

Cross-border transactions (1H 2025):

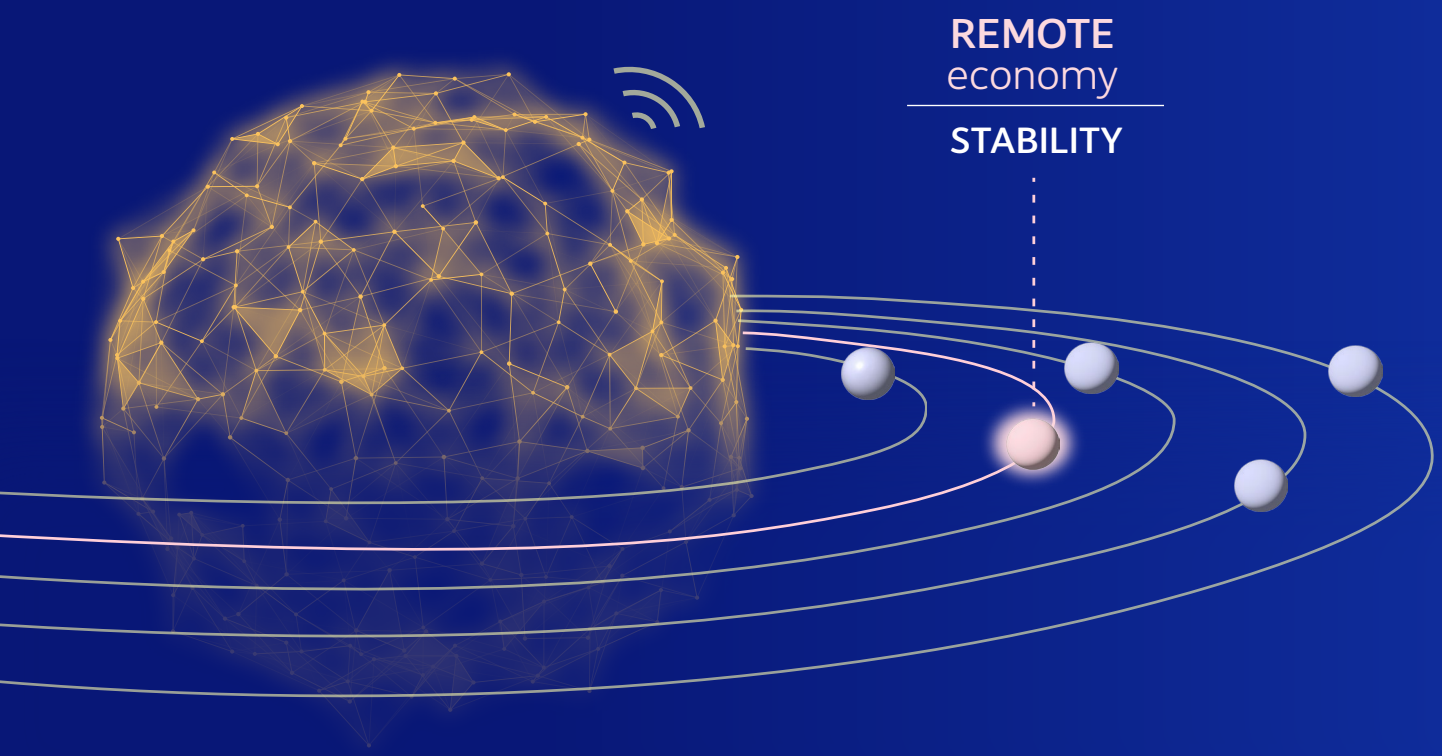
14€ frauded out of 1 million € via bank transfer

Fonte: Banca d'Italia, Rapporto sulle operazioni di pagamento fraudolente in Italia - I semestre-2025

CHAPTER 2

Smart Working: telecommunications at the heart of a “remote economy”

Digital networks enable millions of people to work from anywhere, transforming time, productivity, and sustainability into value for both businesses and workers.



3.57M
smart workers in Italy

95%
of large companies have implemented **structured** smart working **initiatives**

+15 - 20%
estimated increase in **employee productivity** under structured smart working

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Smart working is an organisational model that allows to work remotely or in hybrid mode through seamless access to digital tools, collaborative platforms and cloud applications. Before the work even begins, a remote workday triggers a real data marathon.

During the access phase, networks allow corporate service address resolution, the establishment of encrypted connections, the implementation of security policies and authentication completion through Single Sign-On and multi-factor authentication systems. In many cases a secure channel is also opened, such as VPN or Zero-Trust architecture, that allows data to travel securely across customer's devices and corporate infrastructure.

During working days, tools as video meetings, chats and screen sharing generate simultaneous audio, video and data flows which must remain stable and synchronised. The quality of the experience depends on measurable network parameters, such as latency, jitter, packet loss and especially upload capacity, often underestimated but crucial for webcam and content sharing.

Even work on documents and cloud applications is a crucial phase of remote work, since files being uploaded, downloaded and modified in real time by several persons require connection continuity and fast response times to avoid disruptions or version conflicts. The network does more than just transport data: it manages traffic dynamically to maintain real-time cooperation. Remote working adoption is directly proportional to the coverage and computing and transmission capacity of modern telecommunications infrastructures.

Remote economy and global infrastructure

The structural evidence provided by OECD in the "Implications of Remote Work Adoption in Place-Based Policies" (2021) report[14] highlights a fundamental point: there is a positive and strong correlation between remote work potential and wage levels. This correlation is not directly causal – remote work does not generate the increase in itself – but is mediated by skill levels: jobs which can be performed remotely are, largely, human-capital-intensive occupations that already benefit from above-average pay. Telecommunications have enabled this working segment to detach its value from a physical location, while also highlighting a global polarisation. As highly qualified professionals exploit the network to get access to global markets, less specialised workers are exposed to intense international competition that, on some micro-tasking platforms, can drive median earnings down to about 2 dollars per hour, a figure that more recent literature nevertheless places within a range of approximately 1-to-6 USD per hour, depending on the platform and the measurement methodology used.[14bis]

In this context, the future role of Telcos will be to provide connectivity both for consumption and to produce complex value, enabling upskilling paths also in geographically disadvantaged areas.

The 2025 OECD report "Workforce Insights from Central Governments"[15]shifts the focus on public institution, showing that smart working has gone from being an emergency measure to a retention strategic lever. Remote work today is inextricably associated with greater well-being and a better balance between private and professional life. The report clarifies as well a remunerational paradox: even though smart

working is perceived as a non-monetary benefit of great value – a compensating differential which can partially replace wage increases in the employee's perception – monetary wages remain the primary motivational driver. Smart working therefore is an organisational pre-condition, not a substitute for wage policies. Owing to network stability, central administrations can today compete with the private sector for talent acquisition, providing a flexibility that before would have been technically unfeasible.

To allow this remote economy to exist, network providers had to physically transform the planet. The OECD Digital Economy Outlook 2024[16] quantified this effort: between 2019 and 2023, the subscription share of "gigabit" offers in OCSE countries grew by 250%, going from 4% at the end of 2019 to 14% in December 2023; two-thirds of fixed subscriptions boasted nominal speeds over 100 Mbps. As to mobile, data traffic volume for single subscription has nearly tripled in five years, from 4.7 GB per month for SIM card in 2018 to 13 GB per month in 2023. Over the course of a decade, investments in the communications sector in OCSE countries have grown by 39% (CAGR 3.3%); in the five-year period 2018-2023, the rise has been 18% (CAGR 3.4%), taking the overall expenditure to 290 billion dollars PPP at the end of 2023, while suppliers' revenues grew much more slowly (CAGR of 1.3%), taking the share of investments over revenues from 16.5% to 19%. These capitals have been mainly used to expand optical fibre and 5G and decommission obsolete copper DSL networks. The outcome, measured by Ookla, is that between Q4 2019 and Q4 2023 the median download speed in OCSE countries grew by 169%, while that in upload – essential for videoconferences and file transfer – has more than doubled (+207%). Latency was reduced by 20%, an enabling factor which is vital for critical applications such as remote surgery.

The centrality of fixed infrastructure emerges even more clearly when observing the composition of the traffic: in 2024 fixed networks transported around 87.5% of European Internet traffic, confirming that remote work, while also relying on mobility, still depends primarily on the quality of home and business broadband. Connectivity demand, moreover, shows a growth trajectory that is not structural: according to the latest published by Connect Europe (the European association representing telecommunications operators) in its State of Digital Communications 2026 report, fixed network data traffic in Europe increased from 989 Exabyte in 2024 to 1,104 Exabyte in 2025, while mobile network data traffic rose from 149 to 169 Exabyte during the same period[17]. For smart working, these figures do not merely point to a quantitative increase of consumption but describe the intensification of an ecosystem in which videoconferences, cloud access, file sharing and collaborative tools require increasingly higher, more stable and widespread network capacity.

The link between digital and green transitions

The ICT sector is the backbone of this evolution: between 2011 and 2021 it grew three times faster than the entire economy of OCSE countries. The combination of networks, IoT and AI allows for industrial automation (Industry 4.0), precision agriculture, smart grid management and transport optimisation through AI-enabled digital twins. All this closely unite the digital and green transitions. The pandemic has accelerated the shift of human activities towards cloud servers accessible through private VPN networks, and today it is estimated that around one third of employed people still wishes to have the possibility of teleworking.

The impact of smart working goes far beyond organisational flexibility: it has become a pivot of the geopolitics of energy. During the recent energy crisis, defined "severe and long" by the European Commission, the document of the

Head of the Technical Secretariat of the Undersecretary of State for Technological Innovation and Digital Transition[17] has revealed that the International Energy Agency[18] indicated remote work as one of the main immediate levers to counter resource scarcity. The introduction of just 3 additional smart working days to compatible duties reduces national oil demand in such a measure to transform smart working in an "energy security tool". As a result, this changes the paradigm for Telcos: managing infrastructure no longer means a mere provision of video cooperation, but rather ensuring digital resilience, cybersecurity and identity management in an uninterrupted chain capable of holding under prolonged systemic pressure.

The Italian case: data, impacts and potentials

If the global framework and OCSE delineate the systemic coordinates of a remote economy, it is in the concrete experience of Italian businesses and workers that these trends find a clearer operational translation. According to the Smart Working Observatory 2024-2025 of the School of Management of the Politecnico di Milano[19], in Italy operate around 3,575 million smart workers, with 95% of large businesses which formalised structured initiatives and 53% of the staff of large companies – equal to 1,945,000 people – who works remotely regularly. The public sector, historically slower in adoption, registered the most significant leap forward (+11%), with 555,000 employees of the Public Administration operative in smart working. Italian Telcos, as companies whose existence is intertwined with network infrastructures, naturally position themselves as advanced laboratories of the working models they themselves enable for the rest of the productive system.

A particularly significant effect for the country's territorial cohesion is the South Working phenomenon, documented by the 2020 SVIMEZ Report[20]. This phenomenon visibly emerged during the pandemic, when, according to a Datamining survey on a panel of 150 large companies, around 45,000 young professionals began working remotely in the South of Italy, while retaining their jobs with major companies based in the Centre-North. Including employees in smaller companies and the banking and insurance sectors, the number of Southern Italian workers involved reached 100,000 units. Moreover, in companies that had implemented remote working on a large scale, as many as 13% of employees was able to work directly from Southern Italy. These figures reflect more than a mere contractual change, but a specific infrastructure-enabled shift that generates benefits in terms of territorial cohesion. By helping retain qualified human capital, telecommunications allow wages paid by companies in Northern Italy to be reinvested in local economies across Southern Italy, generating a valuable structural asset for territories historically at risk of depopulation.

The technological infrastructure provided by telecommunications is the absolute prerequisite of smart working. According to the classification proposed by Mariano Corso, Scientific Head of the Smart Working Observatory of the Politecnico di Milano[19], TLCs enable four essential categories: Social Collaboration (cloud tools and services for real-time relations between teams), Mobility (platforms ensuring operational continuity in motion through 4G and 5G connections), Security (advanced network protocols for the protection of sensitive data exchanged remotely) and Workspace Technology (intelligent technologies for the optimisation of hybrid physical environments). In this context, the telecommunication networks transform the physical space, dematerialising the office and allowing the synchronous management of virtual teams.

Despite the proven effectiveness of telecommu-

nications technology, the adoption of remote working faces cultural challenges, particularly in the public sector. Within local PAs, the use of remote working remains limited not because of technological shortcomings, but for a deep-rooted cultural lag: managerial practices still centred on visual supervision and presenteeism, heterogeneity of professional profiles considered difficult to perform remotely, and insufficient training in remote leadership. Only 16% of public bodies has truly mature remote working projects in place, and only 13% has started workspace redesign initiatives[19]. Yet, closing this gap is essential to the long-term sustainability of the public administration. According to the latest available data from Politecnico di Milano (2024)[19], only 6% of public-sector employees report being satisfied with their jobs, whereas 19% is content with their work-life balance. Between 2024 and 2028, the PA will have to manage the turnover of approximately 682,000 employees. Moreover, 8% of public-sector employees had resigned in the previous twelve months, while 22% plan to do so within the following 18 months in pursuit of a better quality of life. For the digital natives of the Generation Z, flexibility is often a non-negotiable precondition for evaluating public employment. The deployment of ever faster networks, fluid collaborative interfaces and transparent security tools is the means to progressively overcome managerial resistance, facilitating the transition towards objective-based work.

On the productivity level, the Smart Working Observatory[19] estimates an increase of between 15% and 20% for single worker in structured models – those where smart working goes beyond mere remote work but entails a redefinition of objectives, operational autonomy and leadership modes. Connectivity replaces visual monitoring with a result-oriented approach, freeing the worker from open space disruptions and generating a context of greater concentration. By applying 15% average value to the 3.57 million of Italian smart workers, the systemic impact on the country's economy is estimated to be in the order of tens of billion EUR, should the model be extended to all potentially eligible workers.

The environmental dimension is quantified in a survey by ENEA – the National Agency for New Technologies, Energy and Sustainable Economic Development – conducted on a sample of 1,269 public employees in Bologna, Turin, Trento and Rome in the four-year period 2015-2018 and published by the international journal Applied Sciences[21]. The results are clear-cut: working remotely even just 2 days per week, for around 100 days per year, avoids the emission of around 600 kg of CO2 per worker per year, i.e. a reduction of 40% compared to per capita emissions from private transport calculated by IEA for Italy[18]. In terms of material resources, this corresponds to the saving of 260 litres of petrol and around 150 hours saved on the commute between home and the office. Networks do not just eliminate commuting: they modify behaviours. 24.8% of the workers examined stated to have adopted more sustainable mobility modes – public transport, bicycle, walking – when not in the office. Connectivity, in this sense, does not merely reduce direct emissions: it acts as a lever for cultural change regarding urban mobility.

At corporate level, adopting smart working for two days per week with space optimisation already allows for saving of around 500 EUR per year per workstation. If we combine this to the reduction of the surface area of around one third – a desk sharing model where the desk is no longer allocated to a single individual but shared based on actual presence – savings can rise up to 2,500 EUR per year for each employee.

This equation becomes possible only when networks ensure staff availability regardless of physical location: without stable connectivity, the office remains an unavoidable operational

necessity; with it, it becomes a design choice. For the worker, a day in smart working means on average of 74 minutes of travel time saved, that on an annual basis correspond to approximately seven working days returned to the individual. Net economic savings on the cost of transport, petrol and meals out amount to around 1,000 EUR per year for people working remotely two days per week.

This is contrasted by an increase in domestic utilities estimated by Altroconsumo in around 300 EUR per year for the electrical component, a variable figure depending on frequency of remote work and energy efficiency of the home. Yet, net balance remains favourable to the workers: the network returns time and money, transferring a share of the savings that the digital infrastructure allows to generate within the system to them.

In short - **Smart Working: the "data marathon" behind a remote working day**

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What it is

A set of **simultaneous flows - audio, video, messages, shared screen** - which must remain stable and in sync

How the process works

secure connection

authentication and access policy

activation of a secure channel
between users' device and corporate infrastructure

Why TLCs are important

Working. In continuity.

Agile working appears simple only on the surface. In fact, it is made possible by an infrastructure that combines security, access, cooperation and service continuity. Networks "adapt" traffic according to loads and conditions, while routing and managing data packages to maintain a stable communication and allow real-time cooperation.

The technological infrastructure provided by TLCs is the definite prerequisite for agile working: ***without reliable connectivity, collaborative tools, access to corporate systems and essential digital services cannot work.***

Connectivity therefore represent the enabling layer of the digital experience; however, the quality of end-service performance may also depend on additional infrastructural components, such as servers, cloud platforms and authentication systems, with which networks operate in an integrated way.

1 in 2
employees structurally operate in agile working
in large companies

-600 Kg CO_2 per worker, per year

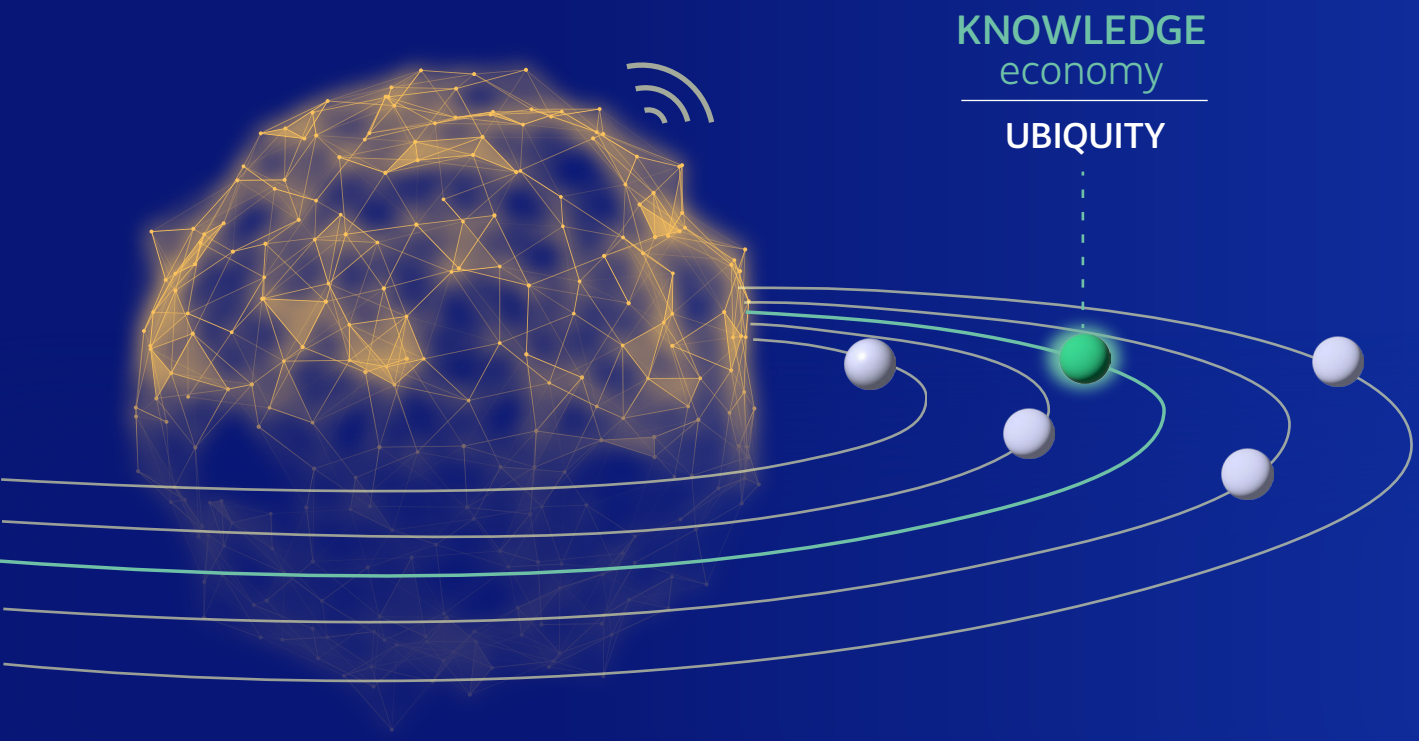
1 whole week regained over a year
taken from the home-to-office commute

Source: Osservatorio Smart Working 2024-2025 del Politecnico di Milano; ENEA, studio su Roma, Torino, Bologna e Trento (2015-2018), pubblicato su Applied Sciences (2023); CODACONS, Comunicato stampa 14 febbraio 2022

CHAPTER 3

Education and training: connective infrastructure as a GDP driver

Connecting students and schools helps building the skills, inclusion, and economic growth that will shape the future.



27,000
schools
to be connected at
1 Gbps through the plan
"Piano Scuola Connessa"

64%
of schools have
wired classrooms
and **laboratories**
in all school buildings

80% of the
italian schools have
projectors, digital whiteboards or **interactive displays** in all classrooms

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In data-driven economies, the role of school networks takes on a significance that goes beyond the simple transmission of knowledge, to become the material basis of global competitiveness. The OECD Digital Economy Outlook 2024[16] illustrates how the introduction of digital technologies is drastically reducing the demand of repetitive and routine jobs, creating an urgent need to train ICT specialists capable of developing applications and managing networks. In schools, the use of generative Artificial Intelligence can radically transform learning, whereas a solid broadband connectivity enables the so-called "flipped classrooms", where pupils study complex contents at home through videos on-demand to then practice in class with their teacher. Specific technical competences such as basic software programming have become essential in everyday life, even useful for configuring the privacy of a device, creating a website or assessing personal expenses.

Impact modelling: networks, learning and GDP

"Connecting learners: arrowing the educational divide", a 2021 study by The Economist[22], mathematically quantifies the cascading effect of the increase in school connectivity. The transnational economic model shows how increasing the levels of school connectivity by 10% leads to an increase in actual years of schooling equal to 0.6%, which in turn leads to a GDP per capita increase by 1.1%. In detail: each additional percentage point of school connectivity improves student learning outcomes by 0.06%; in turn, each additional percentage point of learning improvement generates a GDP per capita increase by 0.19%. The overall outcome is a global GDP per capita increase by 0.11 % for each point of school connectivity achieved. It is worth noting that of this 0.11%, only 11.5% stems directly from the cognitive improvement of children, whereas the remaining 88.5% stems from the social role of the connected school. In peripheral communities and developing countries, a school equipped with Telco networks works as a community hub where citizens can vote, get access to public resources, manage payments via online banking, organising during natural disasters or pandemics[22].

Excellence and disparities: international cases

Virtuous models show that infrastructure investment choices produce measurable effects on countries' educational and competitive performance. In the United States, that have one of the best-resourced school systems in the world in terms of economic and technological resources, only 743 schools (just 1% of the total) are not yet connected to the Internet; however, the gap is shifted on households, where 25% of households – especially those with low-income and in rural areas – does not have broadband at home. This generates the so-called "homework gap": at least 70% of teachers regularly assign tasks that require the Internet, creating a structural barrier for non-connected students[22]. At the other end of the spectrum lies Finland, third worldwide for the quality of education in the Global Competitiveness Index: in 2010 it was the first country to turn 1 Mbps Internet access in a legal right for citizens, combining this choice with a 10 million EUR fund to establish a programme of 2,500 tutors trained in the use of IT in education[22]. Portugal, with its 2007 eEscola governmental programme, provided equipment

and mobile broadband internet connectivity to over 1.7 million beneficiaries, achieving a net improvement in standardised tests and climbing from 31° to 19° place in the Global Competitiveness Index under the Technological Readiness section[22].

Against this backdrop, the latest European data help assess the maturity of the infrastructure underpinning digital education. Across the European Union, 96.8% of households is covered by 5G, 74.1% by FTTP (Fibre-to-the-Premises) and 85.5% by fixed very high-capacity networks. This represents significant progress, but it is not yet sufficient to ensure consistent access and quality across the digital learning experience[23]. The challenge emerges even more forcefully in medium-term projections: without increased investment capacity, by 2030 around 41.8 million Eu citizens risk remaining without FTTH coverage[24]. In practical terms for the education and training systems, this means that the digital education gap depends not only on the availability of devices or platforms, but also on the presence of connectivity capable of consistently supporting access to content, virtual classes, cloud services and new data-driven learning applications.

The digital skill gap in Italy

The technological acceleration generates a structural paradox: while networks become increasingly fast and pervasive, the gap between the skills required by the market and those actually possessed by the workforce widens. To generate value, telecommunication networks require literate users. According to DESI 2026[23], only 54.3% of Italians between 16 and 74 years have at least basic digital skills; although this figure represents an 8.9% year-on-year increase relative to the DESI 2025 benchmark[25] – and exceeds the 2025 national trajectory of 51.7% – it remains below the EU average, which rose to 60.4% in the 2026 report, up from 54% the previous year and far from the 80% target established by the European Commission by 2030[23]. The data highlighted by Ipsos Flair 2025[26] and Istat is particularly concerning for young people: 46% perceive technological innovation as a threat rather than an opportunity.

The picture fragments further over three lines. From a generational perspective, Istat 2025 data shows that 71.7% of 20-to-24-year-olds have at least basic digital skills. This share falls to 49.1% among 55-to-50-year-olds, to 41% among 60-to-64-year-olds and to 27.4% among 65-to-74-year-olds[27]. Even among digital natives, intensive social media use does not necessarily translate into critical and professional digital skills. From a territorial perspective, Istat 2025 data confirms a marked divide between Italy Centre-North and the South: the best-performing regions are Emilia-Romagna (61.2%) and the Autonomous Province of Trento (61.1%), while Campania (42.7%) and Calabria (40.2%) rank at the bottom[27]. From an educational perspective, Istat 2025 data further shows that among people aged 25–54, 86.1% of those with a high level of education have at least basic digital skills, compared with 33.5% of those with no more than a lower secondary education. Only 31% of Italians attended digital training courses over the previous year, compared with the EU average of 41%. This gap calls on Telcos to broaden their scope, by combining their role of connectivity providers with that of digital literacy institutional partners in the more vulnerable areas.

Italian investments: NRRP as a structural lever

To address these gaps, the NRRP allocated around 49.8 billion EUR – 27% of the total – to digitalisation, as reported by MEF in the 2023 document "Italia Domani"[28] and confirmed by the State of Digital Decade 2026 Italian Country Report by the European Commission. Resources have been distributed across business innovation (13.38 billion), schools and universities (7.6 billion), digital healthcare (7.4 billion), digitalisation of PA (6.74 billion) and digital infrastructure and connectivity (6.31 billion)[28]. Despite the substantial endowment, the Parliamentary Budgetary Office30 reports that in the first quarter of 2025, only 47% of digital funds had been significantly engaged[29]. Telcos have to face administrative bottlenecks: fragmentation of interventions, shortage of technical staff in local bodies for managing tenders and authorisation defers the deployment of vital infrastructures for the country.

The Italian case: from Distance Learning to Connected Schools

International data on links between school connectivity and GDP per capita find a precise – albeit still incomplete – programmatic translation in Italy. Understanding the Italian case means reading two trajectories in parallel: the emergency urgency, with the Covid-19 pandemic as a brutal accelerator, and the structural response embodied by the National Recovery and Resilience Plan. The health crisis made it visible the infrastructural gap in schools: when distance learning became the only possible method, the establishments in internal areas had to face the impossible choice between connecting and disappearing. In this context, Open Fiber's cabling work has taken on a meaning that goes far beyond its technical dimension. As of March 2021, Open Fiber's network had reached about 4,900 school buildings throughout the national territory[28]. The case of the city of Lecce has become emblematic: cooperating with the municipal administration, Open Fiber connected 12 schools in just 5 days, transforming an emergency in an opportunity for rapid modernisation[28 30].

First-hand accounts from school managements convey the tangible nature of this transformation. The school head of the Istituto Comprensivo Palena-Torricella Peligna, in the Chieti province – whose complex was located in Lettopalena, a small municipality in the inland Basso Sangro-Trigno area of Abruzzo – stated that, owing to optical fibre, there were no service delays or disruptions, enabling not only Distance Learning, but also the renewal of the School Board via distance elections, videoconference talks with parents and online orientation activities for final-year classes[30]. It is precisely the "community hub role" that The Economist study bestows on connected schools: not a digital classroom, but a citizenship safeguard[22].

The structural response of the countrywide system has arrived with the Scuola Connessa plan, the most ambitious intervention ever implemented in Italy for school connectivity[28]. Financed under the NRRP with 400 million EUR, the Plan aims to bring symmetric 1 Gbit/s connectivity in about 27,000 school buildings. The ambition is strengthened by the complementary "Italia 5G" initiative, that allocated an additional billion EUR to the fibre-optic connection

of over 20,000 schools and health care facilities.

This dynamics is recorded by Osservatorio Scuola Digitale 2024[31], whose updated data for the 2022-2023 school year reflect the state of technological transition in Italian schools. Internet connectivity is considered adequate to handle the administrative workload by 95% of schools, with 11 regions above and 7 below this threshold32. On the actual speed front, 19% of school establishments is equipped with 1 Gbps or higher download connections; 30% stays between 100 Mbps and 1 Gbps, 24% between 30 and 100 Mbps, whereas 11% of establishments is still with connections below 30 Mbps, thus limiting advanced educational potential. As to upload – crucial for material submission and cloud platform interaction – 15% of establishments has speed of 1 Gbps or higher, 27% stays between 100 Mbps and 1 Gbps, and 22% still has uploads lower than 30 Mbps, a bottleneck that Telco infrastructures are called upon to resolve. The arrival of broadband from outside, however, would be useless without an adequate internal signal distribution: LAN and Wi-Fi cabling covers the totality of establishments in 64% of schools, is present in more than half establishments in an additional 20%, and is totally absent in 3% of establishments that are excluded from any form of educational digitalisation[31].

Where there is a high-performance internal network, this generates an immediate cascading effect on the use of devices. The OECD report "Measuring Innovation in Education 2019"[32] certifies that between 2009 and 2015 the percentage of 15-year-old students who accessed desktop computers at school dropped from 83 to 77%, while those that used laptop and notebook shifted from 15 to 32% – a clear reversal representing the liberation from the constraints of fixed laboratories[32]. Today, around 80% of Italian schools states to own projectors, interactive whiteboards or monitors in every classroom, whereas the total lack of these devices is limited to 0.1% of establishments[31].

An open challenge: speeds and actual coverage

The latest data show that average network speeds in Italy are increasing rapidly, although a structural gap remains. In the first quarter of 2026, the median fixed-network download speed in Italy reached 121.17 Mbps. This was lower than in France (340.29 Mbps), Spain (271.72 Mbps), the Netherlands (237.98 Mbps), Portugal (221.93 Mbps) and the United Kingdom (175.36 Mbps), and higher only than in Germany (105.92 Mbps)[33]. Adoption also remains a critical issue: as of September 2025, FTTH/B coverage in Italy had reached 72.2% of households, but the take-up rate – the proportion of covered households that actually subscribe to a fibre service – stood at just 29.9%, one of the lowest rates in the European comparison[34]. In terms of latency, in the first quarter of 2026 Italy recorded the widest gap among G7 countries between the 10th and 90th percentiles (9–68 ms), directly indicating lower network stability under load compared with its international peers[33].

However, the real scope for improvement lies in next-generation network architecture. According to the European Commission's "State of the Digital Decade 2026" report, Italian fibre-to-the premises (FTTP) coverage reached 77.6% of households, representing year-on-year increase of 9.6%, placing Italy above the EU average for both FTTP (74.1%) and 5G (99.8% versus the EU's 96.8%). Nevertheless, a gap remains regar-

ding overall fixed very high-capacity network coverage (VHCN: 77.6% in Italy compared to 85.5% across the EU), driven by persistent coverage gaps in rural areas[23]. The future mission for Telco is to accelerate fibre deployment and densify 5G networks to extend coverage in inland areas and Southern Italy. Bridging this infrastructure divide is an essential technical prerequisite for digital education and inclusion policies to translate into genuine technological democratisation across the country. Finland made access to the Internet a legal right in 2010; through the NRRP, Italy is building the physical infrastructure needed to make that right effectively accessible to every student, regardless of the postal code into which they are born.

In short - **Connected School: when connectivity becomes an educational infrastructure**

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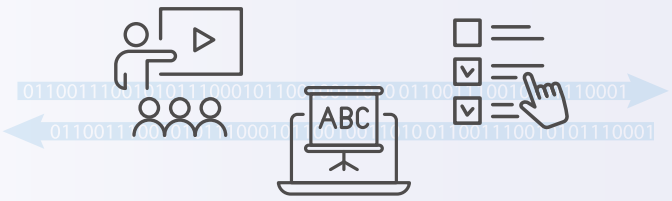
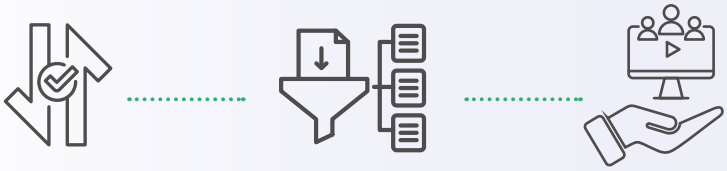
What it is

e-learning platforms, streaming of educational content, cloud services for administrative management and school-family communication



How the process works



reliable connectivity
continuous and fast data transmission

traffic management
prioritisation of videos, contents and interaction

Access to digital services
e-learning, cloud, electronic gradebook, AI

Why TLCs are important

Learning. Everywhere.

In data-driven economies, school connectivity is no longer just about "*bringing the Internet into the classroom*". **It is the foundation on which the skills demanded by the labour market – and, over time, a country's competitiveness – are built.**

Owing to broadband, learning is no longer confined to school hours. Models such as flipped classrooms enable pupils to study complex contents at home through videos on-demand, and to use class time for exercises, discussions and in-depth study.
Along this, generative Artificial Intelligence applications enable more personalised teaching that can adapt to individual paces. Competences such as basic software programming, once reserved to specialists, are becoming tools of digital citizenship. All this only works with a stable, fast and continuous connection.

school connectivity **+10%** = **~1.1%** GDP per capita

in the long run

only **54.3%** of Italians* has **basic digital competences**

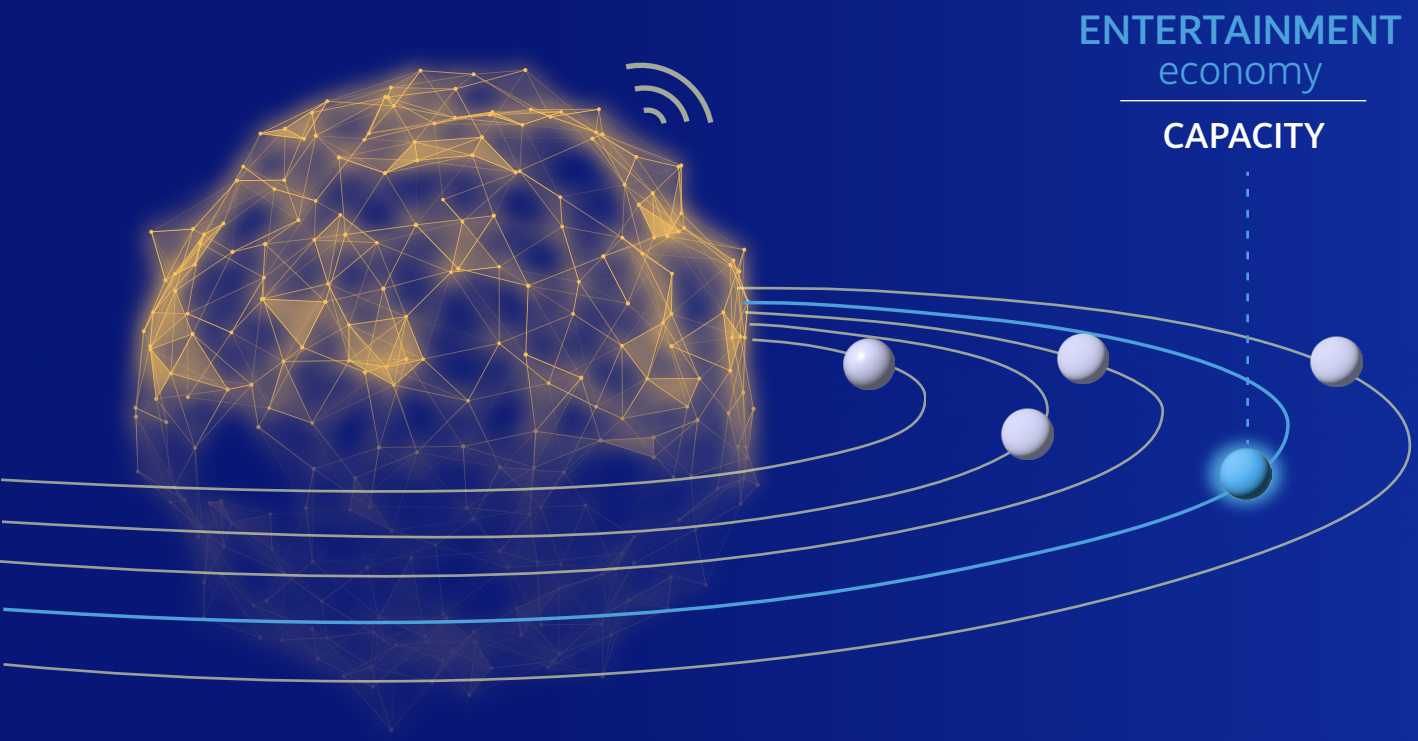
Fonte: The Economist, Connecting learners: Narrowing the educational divide - 2021; Dati DESI 2026

*(Age group: 16–74 years)

CHAPTER 4

Entertaining and Sports: “smart arenas” infrastructures and a new fan experience

Every live event puts networks to the test and highlights the essential role of telecommunications in the modern digital experience.



28M
RaiPlay streams
during
Sanremo 2026

108.5M
Social video views
generated by the
Sanremo final

91%
of Gen Z satisfied
with the digital
sport experience
at home

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Digital entertaining and sports in streaming are one of the more complex tests for telecommunication networks, in particular when content is consumed live by a very large number of users simultaneously. Differently from on-demand content, which can be distributed beforehand owing to through cache systems and Content Delivery Network, live events originate in real time and must be immediately recorded, processed and distributed across the entire digital delivery chain. This requires signal ingestion processes, transcoding to adapt it to various connections and devices and to rights protection systems, all under a seamless quality monitoring.

During a live event, networks are managed minute by minute to ensure the best possible experience, as even differences of a few milliseconds can affect content perception, especially in sport events. Video feeds are divided into small segments that are assembled in sequences dynamically adapted to transmission conditions, prioritising fluidity even at the cost of temporarily reducing quality.

A concrete example of this infrastructure stress is represented by major national events: during the finale of the 2024 Sanremo Music Festival, streaming reached simultaneously around 800,000 spectators, up by above 120% (+126%) compared to the previous year. During the 2026 Sanremo Music Festival, RaiPlay registered 28 million legitimate streams over the course of five days, with a daily average of nearly 5 million spectators and peaks of around 700,000 devices simultaneously connected during the most anticipated moments of the live broadcast. On the social front, the finale alone generated 108.5 million visualisations, up by 13% compared to the previous year. These figures show how a single television event is now capable of generating nationwide distributed loads across multiple infrastructures – broadcast, streaming and social – in real time[35]. This explains why sport and entertaining are undergoing a genetic transformation in which telecommunications play the leading role and modern sports facilities require a network density that was unthinkable until just a few years ago – not only for the audience but also for the automation of the events themselves.

Digitalisation of working spaces: Telefonica's experience

The 2021 "Sport 4.0" report by Telefonica[36] highlights field applications tested in Spanish professional football. At Atletico Madrid's Wanda Metropolitano Stadium, the first 100% digital European infrastructure has been developed. Its extensive network allows tens of thousands of fans to enjoy connectivity as reliable as their home Wi-Fi, while enabling the club to manage lighting, sound systems and resource efficiency in real time.

In Barcellona, the adoption of 5G networks complemented by Edge Computing (computing centres at the edge of the network, to achieve zero latency) allowed the implementation of WIMU biometric sensors and Real Track systems: players' biological data and statistics can be transmitted to the coach in real time and overlaid on Augmented Reality video streams, enabling critical in-game decisions based on real physiological data.

Deportivo La Coruña's Abanca-Riazor stadium has the Europe's most extended 5G network ever installed in a stadium: exploiting enormous upload bandwidths and virtually non-existent latency, Telefonica has tested an automatic broadcasting transmission system powered by Artificial Intelligence, capable of professionally broadcast the event worldwide without having

to physically move the mobile tv units to the stadium, drastically cutting costs and making the broadcasting of local and regional sports commercially profitable.

The needs of a new generation of viewers

This proliferation of technology reflects the new market dynamics identified by the Capgemini Research Institute (2023)[37], in a report involving 12,000 sport fans from 11 countries, in addition to 15 professional athletes and field experts. The data show a clear generational divide: 91% of Generation Z fans (between 18 and 27 years) report being fully satisfied by technology-enhanced sports experiences enjoyed at home, against 69% of fans aged over 70. Moreover, 69% of surveyed fans stated a preference for watching sports outside the stadium as technology continues to improve. For those attending live events, network infrastructure helps addressing long-standing inconveniences. Some 71% of spectators report a lack of timely notifications about queues for restrooms and refreshments, while 67% express frustration at missing live action due to waiting times. Digital solutions – including in-app ticketing, IoT sensors monitoring bottlenecks, and seat-based food pre-ordering – literally transform crowd logistics.

The appetite for this type of "tech-enhanced experience" is considerable: 56% of fans states that they would recommend a sport to others precisely because of the way it uses technology while 80% of fans has increased their spending on technology-related merchandise, wearable devices or immersive technology[37]. The list of innovations enabled by high-speed networks is extensive. During an international friendly match between AC Milan and Cologne, bodycams and microphones connected to players allowed fans to follow the action in real time from the athlete's visual perspective. On the PGA Tour, an application enables fans to visualise the trajectory of the ball in Augmented Reality and in real time. During Tokyo 2021, a synchronised swarm of 1,800 remotely controlled drones illuminated the sky generating patterns. In Formula 1, 360-degree VR channels provide continuous live feeds from pit garages and around the circuits.

The 5G Broadcast and Multicast solution

The 2022 5G VISTA project[38] tested the use of 5G Broadcast/Multicast to manage heavy data traffic in crowded venues. Unlike traditional and easily congested point-to-point data exchanges, this model adopts a "one-to-many" approach, whereby transmitters simultaneously deliver the same data signal to large numbers of users within the stadium. This enables the live streaming of ultra-high-definition video, with multiple angles that fans can select in real time, the display of statistical overlays, the processing of secure wireless payments by vendors and pop-up outlets, and the minimisation of service disruptions[38].

Early applications of this level of connectivity date back to 2019 at the Dallas Cowboys' AT&T Stadium, where a partnership between Samsung and Nexus Studios used an Augmented Reality Cloud platform and 5G devices to allow fans to view players' performance statistics as they moved across the field and take photos with AR-generated holograms during the interval. In the same year, the Korean operator SK launched the 5GX app, a cloud-based service that enabled users to choose between 12 different camera angles of a baseball game in real time. The app attracted an audience 20% larger than that of the corresponding traditional television broadcast.

The Italian case: from Vodafone's 5VREAL to Milano-Cortina Olympics

The innovations described in the preceding paragraphs – the smart arena in Barcellona, the AI-automated broadcasting system at La Coruña stadium, the 5G Broadcast deployment during the World Cup– are not confined to international examples. In Italy, three documented initiatives show how 5G technologies are being applied to address similar challenges, in contexts ranging from a university sports facility in Trentino to the global showcase of the Olympic Games.

The most innovative and technically advanced project is 5VREAL (5G Volley Reality Experience & Analytics Live), developed by an Italian consortium comprising Vodafone Italia, Libera Università di Bolzano, EMG Italy, Fondazione Bruno Kessler and the sports analytics company Small Pixels. Funded under the MIMIT programme supporting the development of 5G technologies (Asse II), the project addresses the challenges associated to the real-time analysis of sporting events. Its solution exploits the 5G low latency and high data transmission capacity to send video feeds to the Broadcast Centre in Cologno Monzese, where EMG Italy's Edge Computing system processes photograms in real time with AI algorithms developed by Fondazione Bruno Kessler and the Vision Computing Lab of Università di Bolzano. By combining three simultaneous video feeds, the system detects and tracks the ball's three-dimensional on-field location providing coaches with real-time analytic data on its position, speed, trajectory and time between touches – effectively turning smartphones in an advanced tactical analysis tools.

In terms of stadium connectivity, the OpenSignal analysis conducted at Serie A stadiums provides a direct measure of 5G performance under high-density conditions[39]. The 2023 results show that TIM's 5G network achieved average download speeds of 334 Mbps, more than twice those recorded by Vodafone (158.2 Mbps) and around four times those of Iliad (83 Mbps) and WindTre (64 Mbps). These are not laboratory measurements, but results obtained in real-world conditions while tens of thousands of people were simultaneously sharing photos, videos and live streams on social media – one of the most demanding environment a mobile network could ever face[39].

The most significant development – and the one that places Italy at the heart of a global technological landscape – is the 5G Broadcast trial carried out by RAI and the European Broadcasting Union (EBU) during the Milano-Cortina 2026 Winter Olympics. Building on the demonstrations conducted at Paris 2024, RAI and the EBU launched the first large-scale pre-commercial trial of a technology designed to address a structural challenge already identified by the 5G VISTA project. Unlike conventional mobile streaming, 5G Broadcast transmits a single signal that can be received simultaneously by all compatible devices within the coverage area, combining the efficiency of digital terrestrial broadcasting with 5G standard, without congesting networks or consuming viewers' mobile data allowances. During the Games, the partners assessed reception quality, service robustness and user experience across the metropolitan areas of Rome and Turin, while also exploring potential applications for public warning and emergency services.

In short - **Entertaining and sports: networks' live test**

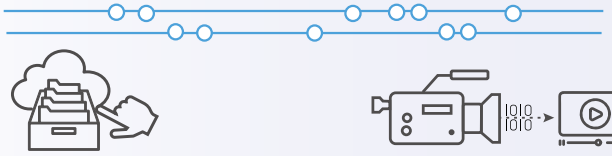
What it is

Millions of simultaneous viewers watch "live" content expecting maximum quality, continuity and fluidity, with very low tolerance for latency and buffering (spinning wheel")

How the process works

Minute-by-minute system management

Networks and delivery chains monitor and manage traffic to maintain the best possible "Quality of Experience"



on demand

part of the traffic "brought closer" to users beforehand through caches and/or CDNs

live streaming

ingested, processed, distributed, transcoded and encrypted content

Why TLCs are important

Experience the live event. Even from a distance.

When many users connect simultaneously, networks must be able to handle traffic peaks, ensure stability and minimise latency and disruptions. Telcos manage network capacity, routing and real time operations, often redistributing traffic across different areas to prevent service disruptions while dynamically adapting them to transmission conditions.
During large live events, same as in radio broadcasting, operators can adopt techniques enabling to distribute a single stream to all users requiring it, instead of replicating it thousands of times.

During live events, a single weak link in the "invisible" delivery chain can impact millions of users at the same time, despite the efforts of the many actors involved in delivering the service.

700,000
devices connected during Sanremo 2026 peak times

over **2,2M**
big match viewers
(ex. Inter-Juventus)

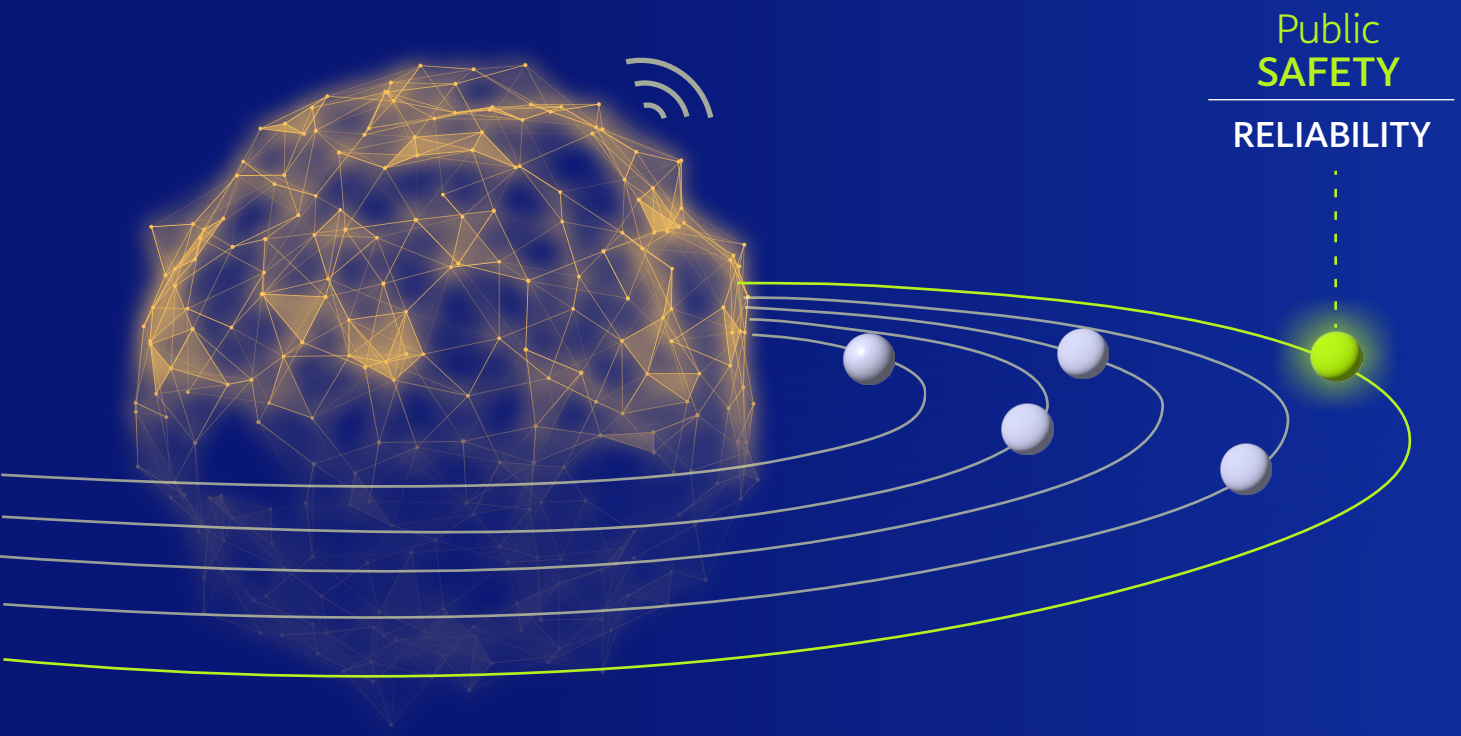
up to over **7,6mln**
viewers: daily record

Source: AppLogic Networks; Akamai's TrafficPeak; Akamai Cloud / Linode luglio 2024; comunicato stampa Rai - 1 marzo 2026 numero 36; HD blog, 4 novembre 2025; https://www.strettoweb.com/2024/04/serie-a-numeri-dazn-telespettatori-partita-vista/1721207/

CHAPTER 5

Citizens' security: telecommunications for territorial protection

Telecommunications are the invisible backbone that enables healthcare, emergency response, mobility, and public safety.



HEALTHCARE

900,000 telemedicine services delivered by Italian pharmacies in 2024

+172% growth in teleconsultations 2023 vs 2022

MOBILITY

6 in10 Italians support the uso of **AI** for **smart urban traffic management**

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Telecommunication networks are the invisible infrastructure underpinning the daily security of Italian citizens. Every 118 call, every signal from a street sensor, every clinical data sent by a chronic patient to its physician travels on a TLC network. Without a reliable, protected and low-latency connectivity, emergency systems, connected hospitals, intelligent transport and operational plants lose their effectiveness. In 2024[40] Italy's TLC delivery chain – represented by Asstel – generated operator revenues of 27.2 billion EUR and maintained investments in network infrastructures at 6.5 billion EUR, ensuring comprehensive coverage and quality of service despite the economic pressure affecting a sector characterised by intense price competition. This chapter examines three strategic areas in which TLCs already play a key role in enabling safety and security: healthcare and telemedicine, connected mobility and infrastructures, video surveillance and emergency management.

A healthcare system that is transformed by networks

Italy is undergoing a profound transition in its healthcare system, driven by the NRRP and the growing demand for territorial assistance. Telemedicine – tele-examinations, teleconsultations, telemonitoring of clinical parameters – is today recognised as an essential component of the National Health Service, and its expansion directly depends on the quality of TLC networks: a slow or unstable connection makes it impossible to transmit health data in real time or perform video consultations without disruptions. 5G, with very high speed and latency below a millisecond, represents the qualitative leap which enables high-precision telemedicine: from constant cardiac monitoring to telerehabilitation, up to tele-ICU for peripheral units.

The numbers speak for themselves. AGENAS' National Telemedicine Platform planned to assist 300,000 patients by the end of 2025, through 21 regional infrastructures and a single national contact office[41]. In 2024 only, Italian pharmacies provided over 900,000 telemedicine services, with more than a tenfold growth compared to the previous decade (for a total of 1.6 million services between 2014 and 2023)[42]. In networks monitored by Health Italia in 2023, teleconsultations in Italy have grown by 172% compared to 2022, with strong expansions as to cardiology and diabetology[43]. In 2024, the Italian expenditure for digital healthcare solutions reached 2.47 billion EUR, up by 12% compared to the previous year, of which around 1 billion allocated by NRRP to telemedicine[44]. On the professional front, today the national platform involves 42,674 general practitioners, 121,969 specialised doctors, 6,650 primary care paediatricians, 99,161 nurses and 121,597 healthcare professionals in the use of telemedicine tools and stations[41]. According to Osservatorio Sanità Digitale, 35% of specialised doctors and 43% of general practitioners used tele-examinations in the last year, whereas 33% of specialists and 35% of GPs resorted to telemonitoring[43]. Surveys on digital healthcare show a high propensity of Italian citizens towards remote healthcare tools: nearly 80% declares themselves favourable to video consultations and monitoring solutions, appreciated above all for the possibility to access healthcare without having to travel – a crucial benefit for people with mobility problems and residents in internal areas[45].

A concrete case of 5G-enabled telemedicine is the project led by Vodafone, Politecnico di Milano and Humanitas, which demonstrated how 5G enables the remote management of patients affected by COPD and asthma by transmitting and processing large quantities of clinical data in real time[46]. Another project involves cardiopathic patients monitored through sensorised garments: the data is sent to an AI platform which assesses the state of health in real time during

daily activities[46]. Estimates indicate that home telemonitoring of cardiac patients can reduce hospitalisation days by 26%[47], reduce hospital costs by 49%[48]and the mortality for all causes up to 30%[47]. At the European level, 14.7 million people had used Connected Care solutions by the end of 2024, with growth estimates up to 23 million by 2028, equal to an annual increase of 11.8%[49].

Smart mobility and secure infrastructures

Modern transport systems depend on connectivity to an increasing extent. From real-time traffic management to vehicle diagnostics, from bus fleets to multimodal integration (Mobility as a Service, MaaS), TLC networks are the backbone of a safer, more efficient and sustainable mobility. The report Smart Italy 5G by TIM's Research Centre has calcolato che by 2030, in the logistics and transport sector, 5G could generate economic benefits exceeding one billion EUR owing to efficiency recovery and real-time data availability on transport vectors; the automotive sector, whose transition towards connected and autonomous vehicles is 5G-enabled, is expected to generate total benefits of 3.2 billion EUR per year by 2025[50].

In the smart city sector, the Italian market was worth approximately EUR 1.03 billion in 2025, broadly in line with 2024, when it had grown by 5% compared with 2023. Smart mobility represents one of the main areas of investment, with a value of approximately EUR 220 million – excluding shared mobility and electric vehicles – equivalent to 21% of total investment[51]. 42% of Italian municipalities launched smart city projects in 2024, and 91% expressed an intention to do so within the next two years[51]. 59% of Italian citizens in large municipalities is in favour of the use of AI for the smart managing of urban traffic and 46% supports the use of AI for emergency monitoring[51]. Two Italian cases concretely demonstrate this potential: in 2025 Turin was awarded "Top MaaS City" at the MaaS Star Awards promoted by MaaS Alliance, due to the MaaS ToMove project, a smart integrated urban mobility system cofinanced by NRRP and managed in cooperation with the Ministry of Infrastructures. In Genoa, buses, undergrounds, funiculars and lifts have been integrated in a single connected network in cooperation with Hitachi, creating a unified public transport system monitored in real time for around 750,000 inhabitants.

5G networks also enable a continuous monitoring system of roads, bridges and civil engineering works: sensors integrated into the materials transmit structural data on vibrations, strains and pressure variations, allowing to detect anomalies before they become hazards. The 2025 Smart Infrastructure Report by TIM Research Centre estimates that digital road infrastructure monitoring can reduce road network management costs by up to 31% and prevent up to 27% of collapses of older structures[52]. ANSFISA (National Agency for the Safety of Railways and the Security of Road and Motorway Infrastructure) aims to digitalise verification and preventive maintenance processes through smart monitoring technologies enabled by TLC networks. The same report estimates 2.6 billion EUR in potential savings by 2030 for the water sector owing to smart meters and advanced monitoring systems – in a country where water losses reach 42% at the national level and exceed 55% in the South – and 700 million EUR in annual savings for electric networks owing to IoT sensors and advanced platforms to optimise distribution[52].

Urban security and emergency management

City security increasingly depends on the ability of TLC networks to transport large sensor-based, geolocated video data volumes in real time. Modern urban security is based on the ability to

collect, transmit and decode real-time information. Video-surveillance is no longer limited to simple image recording, but it becomes an operational tool for territorial control. Cameras, integrated with smart analysis systems, can transform videos into useful indicators, such as event detection, feed count or identification of anomalous behaviour, reducing the transmission of sensitive images to the minimum and respecting privacy-by-design principles. In this model, connectivity is the element that avoids fragmentation since without reliable TLC networks, cameras and sensors remain isolated systems.

According to data of the Smart City Observatory by the Politecnico di Milano[51], security, safety and surveillance accounted for the largest area of expenditure over the 2021–2023 period, featuring in 65% of all smart city projects. Today, however, the value of these projects stands at approximately EUR 102 million, up 7% year on year, and is exceeded by environmental and territorial monitoring, worth approximately EUR 120 million (+10%). Smart government projects amount to EUR 85 million, representing a 13% increase. At the operational level, Milan has introduced an advanced video surveillance system comprising cameras connected to a centralised platform that uses AI to analyse traffic flows and detect anomalous behaviour. Turin and Genoa have implemented environmental monitoring systems equipped with air- and water-quality sensors and automated anomaly reporting to operations centres. According to a survey of Italian citizens, 60% of respondents in Northern Italy report that intelligent video surveillance systems are present in their local area, compared with 54% in Central Italy and 40% in Southern Italy. These figures highlight persistent territorial divides that telecommunications networks can help to bridge.52.

Further evidence of the key role of telecommunications in society concerns smart emergency calls, such as eCall systems, that in case of incident automatically activate a call to 112 and concurrently send a minimum set of essential data, among which location and vehicle identification. The eCall system is not a continuous tracking system, but rather a tool that activates only when necessary to speed up rescue operations. Technologies such as Advanced Mobile Location allow to drastically improve localisation accuracy, reducing the area of uncertainty from km to a few hundred meters. With the evolution of 4G and 5G networks, and in perspective of 5G standalone, it is possible to ensure priority and reliability of emergency communications even in scenarios of severe network congestion.

Standards developed at the European level with the active participation of Italian operators have opened the door to the use of 4G and 5G infrastructures for public safety critical services, with safe priority lanes, guaranteed priority over commercial traffic and advanced encryption capability. This means that every ambulance, police patrol car or operative centre can always be online, geolocated and tracked in real time. AI-enabled tele-triage systems have grown by 48% in recent usage, whereas predictive analytics of urban risks is now available in major Italian municipalities. In natural disaster scenarios, where terrestrial networks are often damaged, TLC satellite networks are the backbone of emergency for the coordination of Civil Protection. International incidents – Haiti, Fukushima, floods in the United Kingdom in 2007 – confirm that TLC communications are the first to be restored to enable effective rescue operations. In Italy, the mountainous and internal areas of many regions are not yet covered by 3G/4G networks: here, satellite communications integrated into terrestrial networks can ensure operativity in case of crisis.

In this context, the protection of strategic infrastructures takes on a growing importance also at the European level. The Cable Security Action Plan presented by the European Commission in February 2025 explicitly indicates how network security can no longer be seen from a local or urban perspective but must also encompass subsea connections and the critical nodes underpinning data circulation in the continent[53]. At the same time, regarding operational resilience and emergency response, greater integration between 5G terrestrial networks and satellite communications, with diversi European operators that have been preparing direct-to-device services between the end of 2025 and the beginning of 2026[53]. As of citizen safety, this development is relevant because it broadens the possibility of service continuity in remote areas or crisis contexts, strengthening the ability of networks to remail operational also when traditional coverage is partial or compromised.

Open challenges and the delivery chain role

So that TLC networks may fully realise their security potential, it is necessary to address numerous structural challenges. Regarding territorial coverage, at the end of November 2024 the 1 Giga Plan had achieved only 1.2 million connected households (35% of the target provided for that date), against a programmed 60%[54]. The internal, mountainous and Southern areas still remain partially uncovered, exactly where emergences and distance make connectivity more crucial[54]. As of cybersecurity, the growing integration of public security systems in TLC networks requires advanced protection: according to CISA[55], 45% of critical infrastructures sectors has suffered at least one cybersecurity incident. This is why the Italian TLC ecosystem is investing in solutions which can ensure data integrity and the continuity of critical services. Regarding the integration between mobile networks and emergency services, 4G and 5G networks can already structurally support 118, Civil Protection, firefighters and police forces services, but systematic public-private agreements enabling its widespread use are still lacking. Finally, nearly 30% of telemedicine cases listed by the Ministry of Health registered slowdowns due to technical interconnection issues. To ensure adequate digital infrastructure also in rural and mountainous areas it is a necessary condition for a fair and safe healthcare system.

Asstel and the entire telecommunication value chain are well aware of their strategic role, which has progressively evolved from that of a connectivity provider into that of an orchestrator of security digital ecosystems. Investments in infrastructures, workforce training – indeed, in 2024 nearly 95% of employees across the value chain received upskilling and reskilling[40] training – and the commitment for widespread territorial coverage contribute to building the invisible infrastructure that underpins Italy's security. The results achieved so far are tangible: more than 900,000 telemedicine treatments delivered in 2024[42], 300,000 patients cared for through the national platform[41], a 172% increase in teleconsultations in 2023 compared to 2022[43]; the potential to prevent 27% of structural failures in ageing infrastructures and reduce road management costs by 31% through digital monitoring[52]; and 4G and 5G networks that are technically ready to support public security services, pending a regulatory and contractual framework that enables their systematic use. The direction is clear: telecommunications are no longer a passive cost for security, but a structural solution capable of addressing Italy's demographic, environmental and operational challenges.

What it is

Cameras monitor the environment and, through intelligent analytics, transform images into actionable information. As a result, operations centres receive valuable data to support decision-making and coordinate activities.

privacy by-design

Wherever possible, data is processed locally and only aggregated indicators, not video footage, are shared

How the process works

Key locations monitoring

roads, accesses, sensitive areas

Sharing of analysis results

not the whole video: "event detected", "count", "anomalous behaviour"

Control room

for city authorities coordinators

Acting and coordinating

Why TLCs are important

Without connectivity, cameras remain "isolated islands".

Telecommunications networks link cameras, sensors and operations centres, **delivering information where and when it is needed**. By integrating different systems into a single operational environment, they enable coordinated actions and content-aware decision-making.

Video-surveillance generates "output data" (uplink) and requires a stable connection (not just high nominal speed), flow segmentation, monitoring and protection (encryption/controls).

In short - **eCall and emergency calls**

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What are they

a **voice call to 112** is initiated

a smart emergenvy call in the event of an accident

sends to operational center a **minimum set of data (MSD)**

location, hour, vehicle identification and event details

How the process works

automatic activation

in the event of a serious accident, through sensors (airbag)

manual activation

via SOS button

call to 112 and MSD packet delivery

sending rescue operators

Why TLCs are important

Protection. When it counts.

eCalls and crash detection technologies reduce the time between an accident and the activation of rescue operations, even when occupants are unable to place an emergency call.

The Advanced Mobile Location (AML) is a solution that combines data from smartphone sensors and location technologies such as Wi-Fi, GPS, improving localisation accuracy from several kms to around 100 metres. The information is transmitted via mobile network to a Public Safety Answering Point (PSAP) which receives emergency communications (ex. 112 calls), manages and activates/directs rescue operators (ambulance, police, fire and rescue services) to the event location.

With the introduction of 5G Standalone (5GSA), it will be possible to prioritise emergency communications and protect AML flows from delays or losses.

in ITALY (2023)

98%

emergency calls placed **through mobile phones**

+56%

eCalls 2021-2023

10-minutes reduction in emergency response time

= **an average one-third reduction in potential deaths**

Source: European Commission (2025). Post-crash data. European Road Safety Observatory. Brussels, European Commission, Directorate General for Transport; Report from the Commission to the European Parliament e al Consiglio on the effectiveness of the implementation of the single European emergency number "112" (2024)

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Connected Ecosystem

Telecommunication Infrastructure as a Driver of Global Transformation

2026