INTESA SANPAOLO
INNOVATION CENTER

INDUSTRY TRENDS REPORT
**TECHNOLOGY, MEDIA
AND TELECOM**

TMT IN PNRR: FIELDS OF APPLICATION

FROST & SULLIVAN

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EXECUTIVE SUMMARY

In April 2021 the Italian government launched the **National Recovery and Resilience Plan** (Piano Nazionale di Ripresa e Resilienza, PNRR) which forms part of the European Union's Next Generation EU (NGEU) package of €750 billion post-pandemic investment. The Plan is developed around three main axes – digitisation and innovation, ecological transition and social inclusion – and aims to repair some of the economic and social damage caused by the Covid-19 crisis while at the same time supporting the country with negotiating climate change and narrowing territorial, generational and gender gaps.

The **Technology, Media and Telecom** (TMT) sector is one of the chief beneficiaries of the PNNR and is notably being shaped by the first of six missions which is focused on enabling Italy's digital transformation and fostering innovation. It is also impacted, to a lesser extent, by mission three and mission four which are focused on developing infrastructure for sustainable mobility and supporting with education and research.

In this context, as the worst impact of the pandemic starts to wane, businesses' priorities are shifting from survival to growth and **cloud architecture** is core to their "exit" strategies. The focus is on the hybrid multi-cloud which is enabling edge and serverless computing while Artificial Intelligence (AI) is expected to revolutionize its utilization.

The advent of the cloud is playing a key role in enhancing **data interoperability** with Big Data Analytics (BDA) vendors increasingly looking to provide platforms that allow exchange and analysis across sources. Overall, a nascent Insights as a Service (INaaS) model is emerging which will enable a greater degree of data monetization.

Transformation is occurring across sectors but **process digitization** has the potential to improve operational efficiencies and enhance citizens' experiences in the government arena in particular. Here, cognitive automation is the next step after robotic and knowledge-based intervention with AI enabling machines to make complex decisions.

The advent of the cloud, the increase in data and the growth in digitization will in turn require a renewed focus on **cybersecurity** and the roll-out of **high speed and very high capacity networks** to deliver new capabilities and experiences to end-users.

By 2030, 200 billion devices are expected to be connected globally and spending on measures to mitigate and manage emerging threats will escalate accordingly with Distributed Denial of Service (DDoS) software an area of investment. In parallel, 5G will continue to be rolled out but will be superseded by 6G and emerging solutions like Cognitive Radio (CR).

The PNRR also touches on areas such as **Earth Observation** (EO) where mapping and monitoring technologies and services for urban development purposes, amongst others, are growing strongly. Interest is supported by rapid advances in satellite and imaging technology such as High-Altitude Pseudo Solutions (HAPS) and spectral sensing.

Transport digitization and the advent of **school 4.0** are other key areas of innovation. Technology, Media and Telecoms are changing the way in which people and goods move and generating growth opportunities across public and private infrastructure with advanced sensors enabling Intelligent Transportation Systems (ITSs) and smart logistics operations. In the classroom, Covid-19 has accelerated the transition from flip-charts and analogue boards to interactive and digital solutions while personal tutor robots, gamification solutions and Augmented Reality (AR) technologies represent the future for learning.

This **Industry Trends Report** examines many of the principal enabling technologies and key application areas within the TMT sector which are being shaped by the National Recovery and Resilience Plan. It provides an overview of the status quo and delivers a view on the innovations which will shape each segment in the mid- and long-term.

CLOUD
ARCHITECTURE

As the impact of the pandemic starts to wane, businesses' priorities are shifting from survival to growth and the cloud is core to their "exit" strategies

On-going COVID-19 related challenges include supply chain congestion, worker shortages and the continued need to respond to changing public health and safety mandates and requirements. Businesses across sectors are, however, leveraging technology to rebuild customer relationships, automate and streamline processes and grow revenue and margins. Adoption of the cloud and the role out of associated architecture is an essential element of this with respondents to Frost & Sullivan's The State of the Cloud survey ranking the cloud as the most important technology for achieving their business priorities.

75% of companies see the cloud as an essential technology with the hybrid multi-cloud most suited to developing and deploying value-added applications

Just a decade ago, the cloud was largely considered to be an alternative data center and a less costly way to procure, compute and store resources. Today, Frost & Sullivan's annual The State of the Cloud survey, which was conducted in October and November 2021 with 803 global IT and business decision makers, shows that organizations recognize the cloud as a strategic business enabler and foundation for broader digitalization.
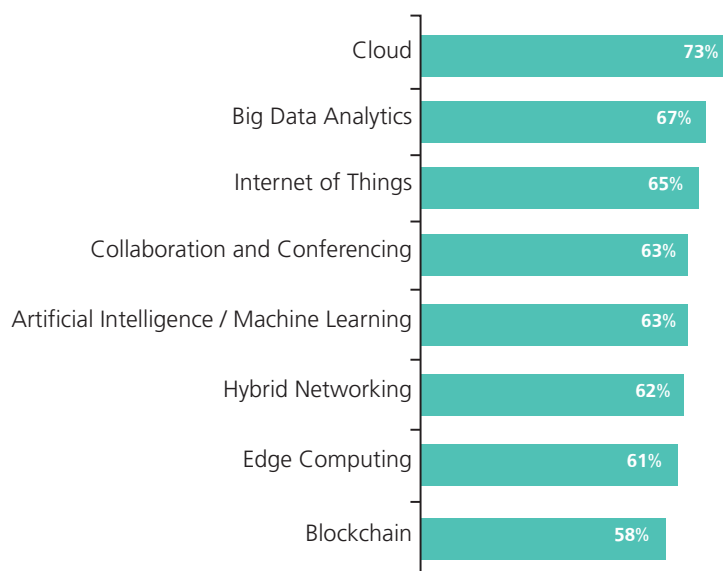
Industries are not, however, embracing the cloud at the same pace. Two sectors which have been more heavily impacted by the pandemic than most – healthcare and retail – are more convinced of its value. Healthcare players have come to heavily rely on cloud technologies for applications such as the provision of telehealth whilst brick and mortar retailers hastened to adopt cloud-based models to maintain revenue during lockdowns.

In contrast, the more conservative education industry lags behind with considerably higher levels of skepticism and less urgency. Although many schools pivoted to the cloud to enable distance learning, the public sector in general is less concerned by digitalization.

Whatever the industry, the hybrid and multi-cloud are becoming the architectures of choice for forward thinking businesses with 84% of organizations using or planning to add the former in the next two years and 83% deploying or considering the latter.

- **Hybrid cloud** combines the public and private clouds and also on premise legacy infrastructures, interconnected by technology that allows data to be shared between them. Hybrid cloud works as a computing solution

IMPORTANCE OF TECHNOLOGIES TO ACHIEVE BUSINESS PRIORITIES, GLOBAL, 2021

Technology	Percentage
Cloud	73%
Big Data Analytics	67%
Internet of Things	65%
Collaboration and Conferencing	63%
Artificial Intelligence / Machine Learning	63%
Hybrid Networking	62%
Edge Computing	61%
Blockchain	58%

- **Multi-cloud** is the combination of multiple public clouds or multiple private clouds or a mix of both. It brings the best cloud solutions from more than one provider and aims to eliminate ant reliance on any single vendor or instance

If workers were still largely based in corporate offices and connected to monolithic apps with attached storage, there would perhaps be no need for the hybrid, multi-cloud. Today's applications and data – and the users and machines that access them – are, however, often dispersed across multiple locations.

Modern app **development tools**, including micro services, Application Programming Interfaces (APIs) and low-code or no-code platforms, and **deployments options**, such as visualization containers or "serverless" solutions, have loosened the bonds between code and the underlying infrastructure making it easier for providers and users to build, deploy and continually optimize app delivery.

Organizations are increasingly implementing hybrid and multi-cloud configurations and selecting multifaceted hybrid cloud management platforms to transform standalone compute, storage and network IT resources into a seamless, well-orchestrated architecture.

From a technology point of view, adoption continues to move up the stack with Platform as a Service (PaaS) emerging as the preferred model amongst users

Depending on their needs, companies from the private and public sector are selecting cloud services from each layer of the IT stack

Software as a Service (SaaS) places the least burden on the enterprise; much like consumer apps, business SaaS requires only an internet connection to deploy. The most ardent Software as a Service users are currently large organizations with more than 5,000 employees which represents a change from past where the feeling was that SaaS offerings did not permit sufficient customization to meet their needs.

Increasingly, the choice of cloud service provider is driven by **Platform as a Service**. Platform as a Service provides users with access to a range of advanced functionalities and allows organizations to quickly build, integrate and deploy applications. PaaS gained prominence during the pandemic primarily among mid-sized companies that were looking to rapidly pivot their operations to the cloud.

Infrastructure as a Service (IaaS) is the most popular service and has highest penetration amongst business with 1,000 to 1,499 employees which are looking to offload costs.

OFFERING	DEFINITION
SaaS	A multi-tenant, hosted application deployment option, in which the provider manages the application and the underlying cloud infrastructure. Users access the application via subscription or pay-per-use
PaaS	A set of cloud-hosted tools and functions that facilitate the development and delivery of cloud-based applications. Some PaaS capabilities are available at no charge and others are charged based on usage
IaaS	A computing environment in which organizations access compute or storage resources on-demand from third-party service providers. The cloud service provider is responsible for housing, running, and maintaining equipment and allocating resources among clients whilst the client supplies and manages its own applications

Microsoft is a key vendor in the public cloud space …

The company provides Microsoft Azure which was previously known as Windows Azure. The Microsoft Azure platform delivers a wide range of cloud services to help customers meet their storage and computing needs. These include virtual machines, object storage and Content Delivery Networks (CDNs).

Microsoft's main innovations have been to enable customers to seamlessly manage and operate on premise and cloud resources with a single user-friendly dashboard that consists of Linux, Windows virtual machines and Kubernetes clusters and databases.

In addition, Azure supports application development in any programming language and via platforms of the customers' choice, deploying them easily wherever they are needed. Microsoft also provides an in-built comprehensive security management and AI-enabled threat protection Azure cloud solution.

… whilst Oracle is a leading player in the public cloud

The company supports customers with their mission critical storage needs. Its Oracle Cloud solution efficiently integrates clients' databases and applications into a single common platform. In addition, the Oracle Cloud significantly reduces customers' operational costs by providing higher utilization on a shared platform across multiple applications.

Oracle's main innovations have been to provide a single pane of glass for planning, provisioning and managing end-user applications. The company was among the first to run virtual machines, clustered servers and its engineered systems "as a Service" in customers' private clouds. Oracle also offers managed cloud services that deliver end-to-end private managed cloud services across its portfolio of application and IT infrastructure.

The hybrid multi-cloud is enabling edge computing which in turn requires new network and services that support data transportation amongst end-points

As businesses embrace hybrid environments in order to better enable the Internet of Things (IoT) and support further expansion of remote work, connectivity becomes a critical part of digital transformation. The growth of IoT applications and the associated need to process large amounts of data quickly and efficiently is driving the deployment of new network technologies and services to support transport amongst endpoints and allow data processing both within datacenters and at the "**edge**" of the network:

- **Software-Defined Networking** (SDN) is to networks as virtual machines are to servers, enabling physical resources to be pooled and consumed on-demand by decoupling the control plane of the network from the physical infrastructure. This offers scalability and agility, allowing hybrid applications to travel over the best network to meet bandwidth, latency and security needs based on real-time context and application requirements

- **Network Function Virtualization** (NFV) decouples additional features of networking, such as routing, firewalls, traffic optimization and session border controls, from the physical infrastructure. As with SDN, NFV offers greater agility and the ability for enterprise IT departments to change network criteria and governance policies as needed to meet hybrid application requirements

- **Software-Defined Wide Area Networks** (SD-WAN) facilitate automated, optimized, secure connectivity over 5G endpoints and other edge computing nodes. They also help enable application distribution among multiple clouds by allowing pre-defined policies regarding best-practice routing or security

PRINCIPAL
ABBREVIATIONS

AA	Advanced Analytics		**DDV**	Data Discovery and Visualization
AaaS	Analytics as a Service		**DPI**	Deep Packet Inspection
ADSL	Asymmetric Digital Subscriber Line		**DSA**	Dynamic Spectrum Access
AES	Advanced Encryption Standard		**DWDM**	Dense Wavelength Division Multiplexing
AI	Artificial Intelligence		**EP2P**	Ethernet Point to Point
AON	Active Optical Network		**ECN**	Edge Computing Network
API	Application Programming Interface		**EO**	Earth Observation
AR/VR	Augmented Reality/Virtual Reality		**EPON**	Ethernet PON
B	Billion		**ETA**	Estimated Time of Arrival
BAS	Breach and Attack Simulation		**ETL**	Extract, Transform and Load
BDA	Big Data Analytics		**FIR**	Far Infrared
BPON	Broadband PON		**FTTx**	Fiber To The Everything
CAGR	Compound Annual Growth Rate		**GaAs**	Gallium Arsenide
CASE	Connected, Autonomous, Shared and Electric		**GaN**	Gallium Nitride
CDN	Content Delivery Network		**GPON**	Gigabit PON
CLE	Customer Located Equipment		**GPU**	Graphics Processing Unit
CR	Cognitive Radio		**HAPS**	High-Altitude Pseudo Solution
CRN	Cognitive Radio Network		**HD**	High Definition
CSP	Cloud Service Provider		**IaaS**	Infrastructure as a Service
CWDM	Coarse Wavelength Division Multiplexing		**ICMP**	Internet Control Message Protocol
Cx	Customer Experience		**INaaS**	Insights as a Service
DaaS	Device as a Service		**IoT**	Internet of Things
DCB	Digital Collaboration Board		**IPTV**	Internet Protocol TV
DDoS	Distributed Denial of Service		**ISR**	Intelligence, Surveillance, Reconnaissance

ISV	Independent Software Vendor		**R&D**	Research & Development
IT	Information Technology		**RAN**	Radio Access Network
ITS	Intelligent Transportation System		**RF**	Radio Frequency
Lidar	Light Detection and Ranging		**RFID**	Radio Frequency Identification
LMS	Learning Management System		**RPA**	Robotic Process Automation
LTE	Long-Term Evolution		**SaaS**	Software as a Service
M	Million		**SASE**	Secure Access Service Edge
M&A	Mergers & Acquisitions		**SDK**	Software Development Kit
MIMO	Massive Input Massive Output		**SDN**	Software-Defined Networking
ML	Machine Learning		**SD-WAN**	Software-Defined Wide Area Network
MSO	Multiple System Operators		**SiGe**	Silicon Germanium
MSSP	Managed and Professional Security Service Provider		**SOC**	Security Operations Center
NFV	Network Function Virtualization		**Telco**	Telecommunication Company
NLP	Natural Language Processing		**TPU**	Tensor Processing Unit
OCR	Optical Character Recognition		**TTP**	Tactics, Techniques and Procedures
OEM	Original Equipment Manufacturer		**UAV**	Unmanned Aerial Vehicle
OLT	Optical Line Terminal		**UDP**	User Datagram Protocol
ONT	Optical Network Terminal		**US**	United States
OT	Operating Technology		**V2I**	Vehicle to Infrastructure
PaaS	Platform as a Service		**V2V**	Vehicle to Vehicle
PHY	Physical Layer		**V2X**	Vehicle to Everything
PON	Passive Optical Network		**VoD**	Video on Demand
PoP	Point of Presence			
QoS	Quality of Service			

ABOUT INTESA SANPAOLO INNOVATION CENTER:

Intesa Sanpaolo Innovation Center is the company of Intesa Sanpaolo Group dedicated to innovation: it explores and learns new business and research models and acts as a stimulus and engine for the new economy in Italy. The company invests in applied research projects and high potential start-ups, to foster the competitiveness of the Group and its customers and accelerate the development of the circular economy in Italy.

Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

For further detail on Intesa Sanpaolo Innovation Center products and services, please contact
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