Telefónica

Telecommunication Networks and Metaverse

A New era of Internet

Digital Public Policy, Regulation and Competition - Position Paper

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Executive summary

The Metaverse and the necessary disruption in telecommunications networks

The promises of new digital services brought by the Metaverse, where the immersive experience is the most striking, represent a challenge for all elements of the value chain involved in their provision, a challenge to which telecommunications networks are no strangers.

A new era of digital services

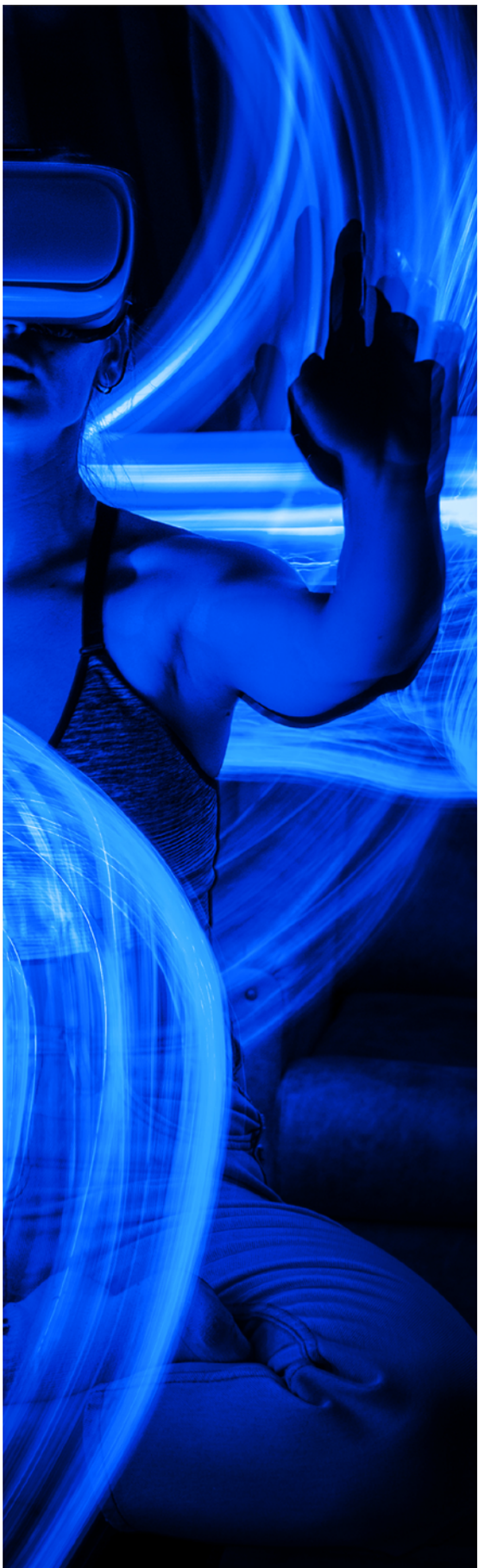
The customer experience when entering the Metaverse differs substantially from the current Internet access experience. The Metaverse must offer a continuous, ubiquitous and massive experience. This means that telecommunications networks have to ensure service qualities with the same requirements of continuity, ubiquity and predictability.

The current Internet model is not sufficient

The way in which digital services are currently delivered over the Internet and the way the quality of services is improved have reached a limit that cannot be surpassed unless the limitations of the traditional best effort and service agnosticism model of telecommunications networks are altered.

The new role of telecommunications networks in the Metaverse

The need to provide customised telecommunications networks fitted for many different services require them to be programmable. Average users simply do not know what to require from the network. Only developers know what their services need, so they are those that will include these requirements in the design of their services and require them from the network. This concept is known as *Network as a Service* (NaaS) and to make it a reality, operators are creating interfaces with the network (APIs).



New business models in the Metaverse

The current business model of telecommunications operators, based on charging users for the access service, appears to be insufficient given the complexity and diversity of requirements that are foreseen. Therefore, to ensure sustainability and the investment effort involved in preparing telecommunications networks for the Metaverse, business models that do not involve the end user should be allowed, as is already the case for some services provided over the current Internet, such as CDNs.

Therefore, our recommendation is that legislators and regulators:

- Refrain from automatically expanding traditional regulation to the new technological paradigm required by the Metaverse.
- Pursue a harmonious development of the Metaverse under a Level Playing Field between all participants in the value chain.
- Be cautious before making hasty regulatory decisions that could distort the functioning of the Metaverse.
- Differentiate between the collaboration required for the standardisation of solutions and the competitive processes in different markets.

01
The Metaverse and the necessary disruption of telecommunications networks

There are different and varied definitions of what the Metaverse is, and one of the most accurate is this from the European Commission's budget amendment proposal under the title "*A Space for the Metaverse*"[1]: the Metaverse is the convergence of ideas that have been present for some years now in the digital environment: Virtual Reality (VR), Augmented Reality (AR) and blockchain technology. This space encompasses a network of virtual environments accessed through different devices where users can interact, socialise, work, play and consume in an immersive digital environment that mirrors many of our real-world habits.

The expectations that the Metaverse has created about experiencing digital services through these immersive interfaces anticipate a technological revolution with respect to the traditional way of producing the digital services we have been using through the Internet.

The current configuration of the Internet itself is also impacted by this revolution, both in terms of the technical capabilities that telecommunications networks will need to offer, as well as the *best effort*[2] principle that characterises it, since a mere increase in the capacity of telecommunications networks will not satisfy the needs that are envisaged[3] .

There is no doubt that innovation will find solutions to these challenges and that it will require efforts on the part of all participants in the Metaverse value chain. However, it is not possible to anticipate which links in the value chain will provide the best solutions to the new Metaverse requirements. It is therefore essential that all participants in all links of the value chain have similar expectations of profitability and sustainability to justify the required investment efforts, because the solutions will come from a process of trial and error. To make this possible, all participants must be able to compete and have the same opportunities to thrive. All must start from a *level playing field* that does not limit their ability to innovate, compete and eventually grow.

At Telefónica we are working to make Metaverse services a reality and we are convinced that the best option is to take advantage of all the capabilities offered by modern telecommunications networks.

To this end, we are committed to the "API-fication" of our networks. APIs[4] that will enable a new relationship model between telecommunications networks and applications and services, so that the developers of these Metaverse applications and services can define the quality parameters they need for their service to function properly. This is called *Network-as-a-Service* (NaaS). These APIs will be similar to those that already exist, for example, in the operating systems of mobile devices that allow developers to manage the different components of the device, such as the screen, the camera or the GPS location, as they wish.

We do not yet know what the Metaverse will look like or whether different metaverses will co-exist in parallel, each with its own intrinsic characteristics

and its own digital services. However, it seems reasonable to think that each of the digital services that will make up these different environments will require specific characteristics in the behaviour of the telecommunications network over which they will be provided.

The rest of the document is structured as follows. Section 2 describes the dawn of a new era for digital services, of which the Metaverse will be the flagship. Section 3 will explain why the intrinsic constraints of the telecommunication networks that make up the Internet architecture, may prevent the development of these new services. The next step, of course, is to anticipate how the telecommunications network would have to evolve to cope with these new requirements, which is done in Section 4. Section 5 complements this by identifying possible business models that make the evolution described above viable and sustainable. Finally, Section 6 concludes and makes recommendations based on the proposed analysis.

02

A new era of digital services

The multiple attempts to develop Metaverse services are already beginning to offer users more satisfying experiences than the conventional way of accessing digital services. The various possibilities that are emerging, such as the immersive interface that allows the user to enter the virtual world both in interaction with other users and in the use of services, confirm their potential.

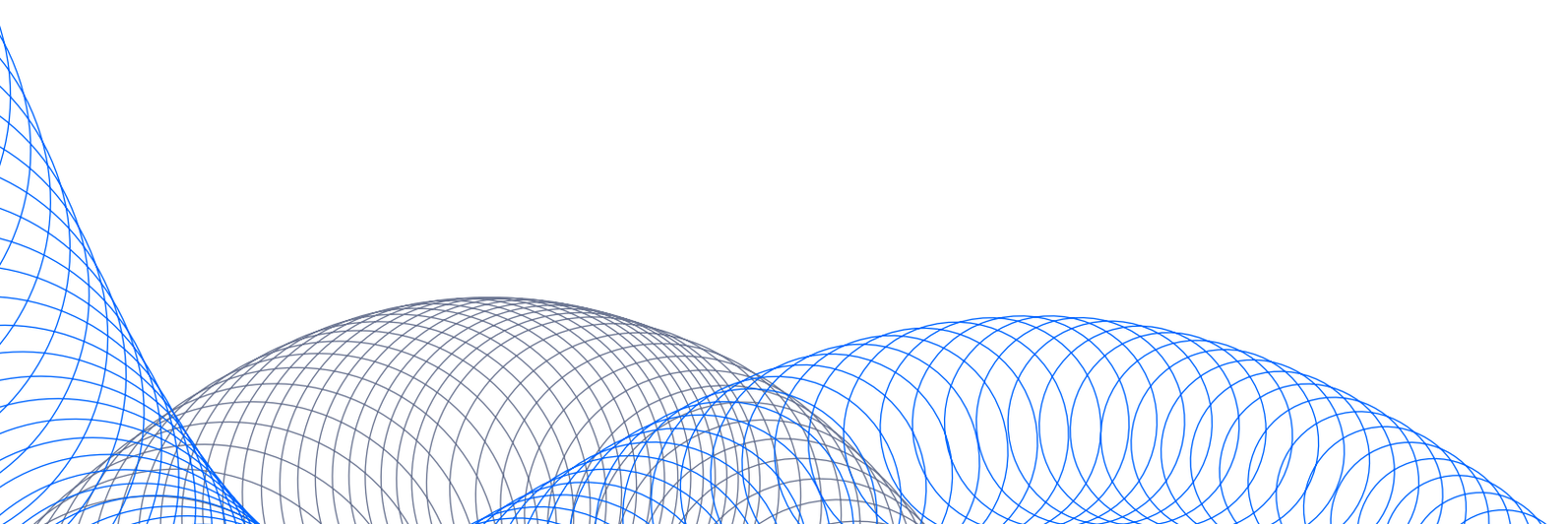
The first trials are focused on immersive use of familiar services, such as e-shops as an enhancement of online shopping, but the possibilities go far beyond. These first lower-performance Metaverse services, which are being built over the Internet and its *best effort* model, will be followed by other services that will demand new and unpredictable capabilities from all production factors involved in the delivery of a continuous, ubiquitous and massive experience. These demands will be particularly intense on telecommunications networks, as they cannot be met with the current Internet *best effort* model.

Moreover, as it happens with all innovations, once the technological tools are in place to satisfy those first demanding services, new uses will emerge that we cannot imagine now. It is well known that product differentiation increases social welfare[5], as it allows the different needs of users to be better satisfied. Therefore, the more services the Metaverse offers that are tailored to the preferences shown by different users, the more welfare will be created.

What is currently unknown is what attempts to build the Metaverse there will be and which services will succeed. They are likely to be many and differentiated, and will probably evolve over time. They will have different demands on the productive factors involved such as computing, storage and devices and, of course, networks.

The only way to find out what society wants is through trial and error. That is, entrepreneurs and developers have to test their ideas to see which ones can succeed.

In line with this, it is also necessary that telecommunications networks, as a platform for innovation through the Network as a Service (NaaS) concept, have the necessary incentives to take the risks of discovering the capabilities to be implemented, and that their successes are rewarded, as this is the basis of any innovation initiative.



03
The current Internet model is not enough

The Internet is first and foremost a network of networks. It is the interconnected mesh that connects users to each other and to online services. One of its fundamental characteristics is the possibility of developing services that can be offered in abstraction from the telecommunications networks through which they are provided; the *Over-The-Top* services (*OTTs*).

In order to ensure this fundamental feature, Internet networks were modelled under the principles of *best effort* and *service agnosticism (stupid networks[6])*. That is, networks that do not need to ensure any specific quality (best effort) and do not need to know the services offered over them (service agnostic), treating all data traffic in the same way. These were the premises adopted to be able to establish interconnections between different networks in an agile manner, since nothing was demanded from the receiving network apart from its "best effort".

As a result, interconnections between networks proliferated in a very short time. This is how the Internet was born and continues to function today for the most part, with the technological and commercial evolution of telecommunications networks with respect to the Internet focused exclusively on providing greater bandwidth, although other aspects such as reliability, coverage and energy efficiency have also improved.

Unlike in the telecommunications network, there has been an immense innovation over the networks. On the one hand, new services have appeared, from websites to any of today's social networking and e-commerce platforms. On the other hand, we have also seen an impressive evolution in the technical way in which these services are offered in search of higher quality to compete against contestant services, as this differentiation improved their chances of success in attracting customers. This has been possible because the services offered by Internet platforms are not required to be homogeneous among themselves, nor are they subject to any obligation of neutrality.

Thus, in order to offer a better perceived quality, services have been offered closer to the users. That is to say, instead of offering services in a centralised way from a specific point on the Internet (from a single facility), they are now provided from different geographical points, seeking proximity to end users. This has happened, for example, with video-on-demand services or cloud services. This is the only way to improve quality with a *best effort*, *service agnostic* network configuration. Such solutions, moreover, unleashed a new wave of service innovation that utilised these perceived quality increases in ways not previously thought of.

Thus, today's Internet can be characterised as *OTT* services close to the user on *best effort* and *service agnostic* networks. Platforms' investment is channelled, instead of into the network where they can

hardly improve quality, towards hosting services, *Content Delivery Network* (CDN) and distributed *cloud computing*, as identified by BEREC in its Internet Ecosystem Report[7]. But it is no longer sufficient to set up a server and wait for the service to succeed, as was the case at the dawn of the Internet thanks to the above configuration. The barriers to entry now lie in the OTT world, in the investments required to increase quality by bringing the service closer to the user.

However, this Internet architecture is not sufficient for the Metaverse. The limitations of the current Internet are already detected in the first attempts to provide immersive environments in which the above-mentioned option of bringing the service even closer to the user continues to be explored. One example is the current virtual reality or augmented reality glasses, which install the necessary software on the device and combine it with the use of the Cloud to support processing. These solutions cannot offer a satisfactory experience both at home and outdoors, either due to the weight of the devices, their autonomy or their computing and storage capacity.

In addition to these limitations, it should be noted that, according to some estimates[8] the proper functioning of the Metaverse will require networks to offer very low levels of *latency* and *jitter* for traffics up to 20 times higher than today, as well as 1000 times more processing capacity to help lower latency and jitter in the Metaverse servers[9]. It is simply unfeasible and unsustainable to provide these levels of quality consistently to everyone, all the time, everywhere.

Even more, network capacity available to everyone in the same way would not ensure a sufficient experience in the consumption of Metaverse services[10], as the requirements of these services will not only vary from one service to another, they could even be contradictory. Additionally, it is very likely that a given service may vary its network requirements at different times.

04

The new role of telecommunications networks in the Metaverse

The limitations described above in meeting expectations for immersive visual experiences already show beyond doubt that the *best effort* and *service agnostic* configuration that characterises telecommunication networks to deliver the Internet will not work for many of the services in the Metaverse.

The solution currently being explored that complements the efforts described above to make the Metaverse a reality requires moving beyond the current configuration of networks designed for the Internet. This is the only way to enable access networks to offer higher performance to satisfy the different requirements of Metaverse services.

This new approach explores the capability of today's access network technologies to be programmable, i.e. the capabilities of 5G and its *network slices* to provide different qualities over the same mobile network, improvements over fibre optics, new versions of WIFI and EDGE services, all combined to meet the quality demands of the Metaverse.

The most demanding services or those with a more critical scope of application (e.g. remote driving of drones in rescue missions, or holographic communication services) will have to incorporate in their designs the capabilities that will be required of the access networks for their proper functioning. For this reason, the concept of network API-fication has been conceived in order to be able to incorporate such a complex asset as the telecommunications network in a simple way into the development process of a Metaverse service.

The API-fication of the network consists of adding an abstraction layer to the access networks that will allow the network functions to be integrated into the Metaverse service development environments, creating a user-friendly interface for service developers. Through this interface, they can ask the network for specific behaviour and do it in the same way as they already handle any other hardware or software resource, which will allow them to adapt quickly by continuing to use their usual tools.

So, this abstraction layer would be a kind of operating system, like Android for mobile devices, or Windows for computers, but in this case for the telecommunications network. And these APIs would be like the programming functions that would allow them not to have to worry about which network their service will be used on, nor about its topology, nor, of course, how it does it, just as the aforementioned operating systems isolate them from the specific hardware of the device.

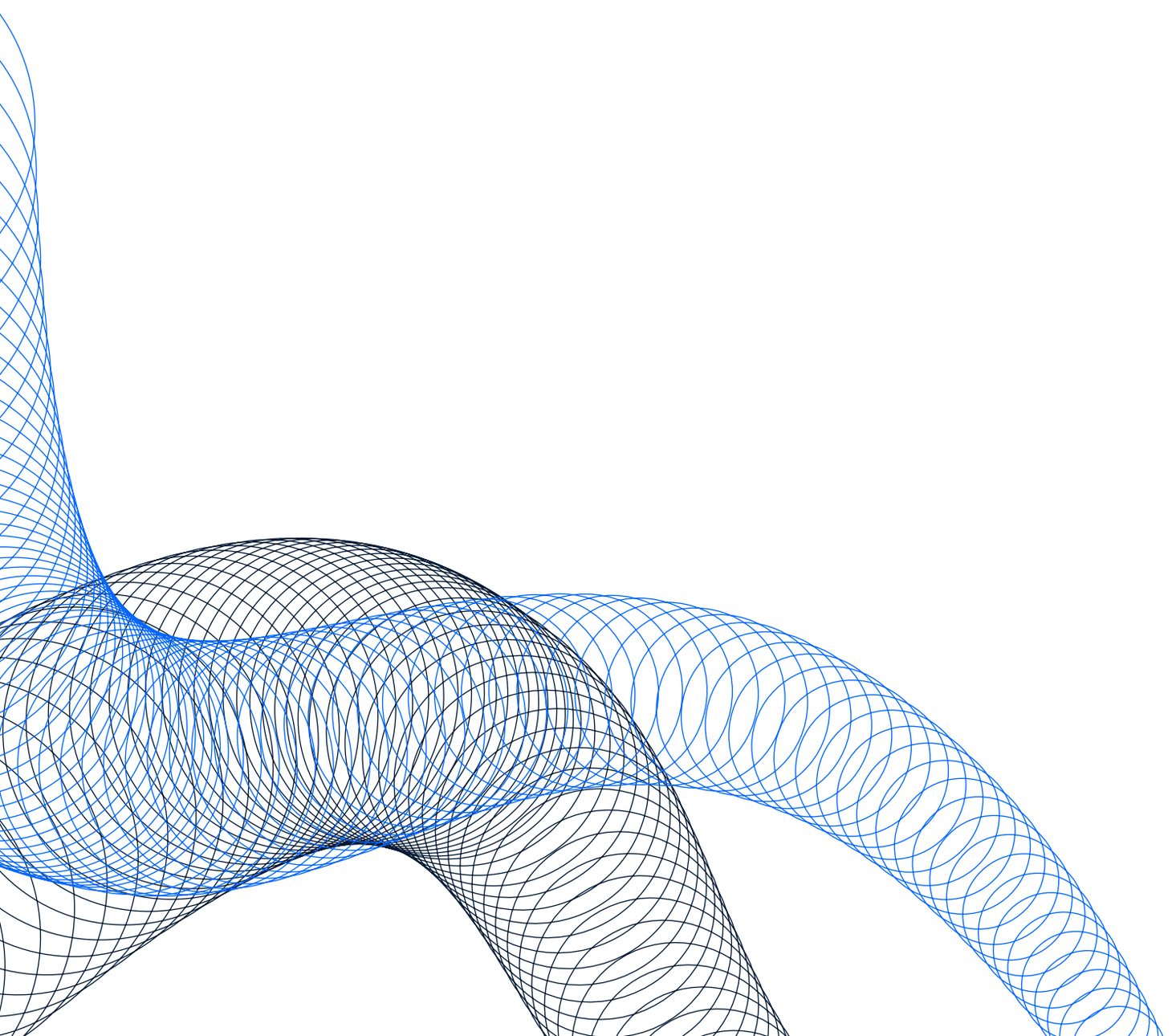
Note that through the API-fication of access networks thus conceived, the fundamental characteristic of the original Internet of being able to innovate new services by abstracting from the network layer over which they are to be provided is maintained, but without the need to suffer the constraints of the *best effort* principle. Therefore, it will only be necessary to develop a service once to offer it globally. In addition, networks would remain *service agnostic*, i.e. they would not need to know who owns the service that is using their network, only what technical requirements it needs.

For this reason, standardisation of these APIs is essential. In this way, developers of new Metaverse services will be able to use them on any operator's access network, while maintaining one of the most valuable features of the Internet for them: it is designed once, and delivered globally, regardless of the network through which the service is accessed. Telecommunications networks must evolve to become another open platform in the Metaverse ecosystem, under the *Network-as-a-Service* (NaaS) model. To this end, Telefónica participates in the GSMA's CAMERA alliance[11].

It is clear that to meet the needs that the Metaver-

se will demand, it will be necessary to innovate on at least these two complementary fronts: further development of devices and API-fication of the network as described above. Whether the location of the processing capacity is in the terminal or in the network will depend to a large extent on user demands, but also on other factors such as privacy and sustainability. There are advantages and disadvantages to both alternatives, and it is not possible to determine which way will best meet these needs a priori. For example, concentrating processing power in the terminal would offload the network and allow for more network-independent operation, but it entails higher device cost, higher power consumption, and possibly more inconvenience for the user.

The only way to determine which combination of the two will be the one in which the solutions should be placed is the competitive process of trial and error between firms that opt for varying degrees of combination of the two, and submit them to the users for consideration.



05
New Metaverse business models

The business models that have developed over the Internet have evolved as new requirements have been added to the network concept with content and applications at the edge of the network.

These models have evolved from subscription through payment of fees (still in force for certain services such as *streaming* services), to payment through the viewing of advertisements or the transfer of data in exchange for being able to use these services and applications at zero monetary price.

Business models have also appeared where the end user is not directly involved. This is especially true in the mobile environment, where app developers pay to upload their apps or content to *App Stores* and often also establish a *revenue share* with these platforms on user purchases of their apps.

As explained above, the only way to improve user quality in the consumption of content and applications in a *best effort* configuration is to bring the content delivery points closer to the user. This has generated a business model of Content Delivery Networks (CDNs) in which content owners pay third parties (CDNs) to deliver content closer to users. Thus, it is not the end user who pays to have the content closer and improve its quality. They delegate this decision (and payment) to the providers of these services (the OTTs).

The new requirements that the Metaverse will demand in terms of quality could generate its own business model, similar to what happened with CDNs, so that it is the service provider or developer who is responsible for making payments to those who offer them these necessary qualities, in this case the operators. For example, through APIs that allow them to interact with telecommunications networks. This NaaS business model would be no more than an extension of virtualised services such as Software as a Service (SaaS), Platform as a Service (PaaS) or Infrastructure as a Service (IaaS).

Moreover, it seems reasonable to think that end users do not have the capacity to know the demands that each of the Metaverse services will require of the telecommunications networks and, therefore, to make technical decisions on the configuration of their access. Thus, as with CDNs, it will have to be the developers, who know what kind of network behaviour they need at any given moment, who will have to make these decisions.

06

Conclusions and recommendations

Conclusions

In order to meet the technical demands required for the development of the Metaverse, a new wave of innovation in telecommunications networks will be needed for the following reasons:

1. The original design of the structure of the networks offering Internet access on the principles of *best effort* and *service agnosticism* for transport will not be sufficient to meet the technical demands that the new Metaverse services will require.

2. A more efficient and effective allocation of available resources and identification of emerging needs will require a closer relationship between the service provided over the telecommunications network and the telecommunications network itself.

3. The use of APIs (API-fication of the network) makes it possible to industrialise these relationships between applications and services with the network. Furthermore, in order for developers of these applications and services to obtain an environment that is conducive to incorporating these APIs, they need to be able to access the largest potential customer base with them. Therefore, it is necessary for the industry to make an effort to standardise these APIs, as this can be a decisive factor in their success.

Recommendations

1. Refrain from automatically expand traditional regulation to the new technological paradigm required by the Metaverse.

The *Open Internet Regulation* anticipates the context in which networks will have to face new demands, e.g. that the perception of immediacy will be increasingly necessary, by foreseeing the existence of Specialised Services alongside traditional Internet Access. Incorrect, or non-technically biased interpretations of such concepts would be particularly damaging in creating considerable uncertainty at a decisive moment.

2. The harmonious development of the Metaverse requires a *Level Playing Field*.

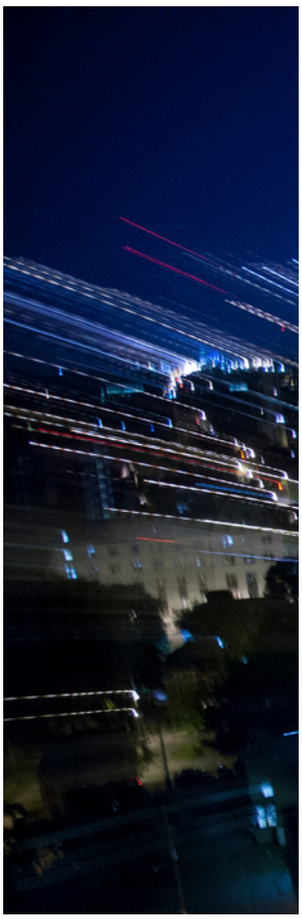
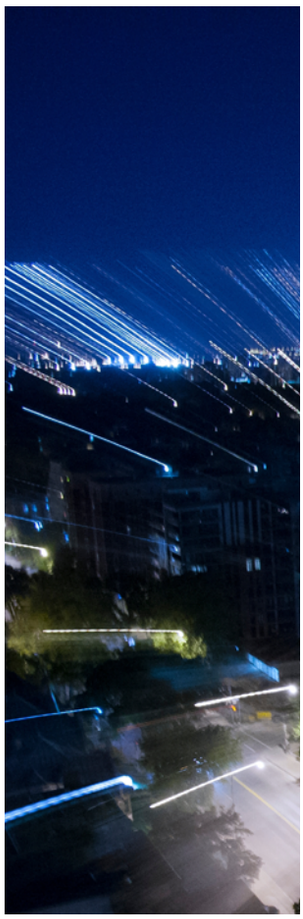
As explained above, the emergence and success of the Metaverse relies on intense collaboration between all actors involved in the value chain, and all participating activities must evolve in a coordinated manner in order to solve the problems that arise. In this context, it is essential that these actors find themselves in similar regulatory situations, a *Level Playing Field,* which allows them to find appropriate incentives for all of them.

3. Hasty regulatory decisions may distort the functioning of the Metaverse.

The Metaverse will be very resource intensive for all actors in the value chain, including telecommunication networks, and new performance parameters are likely to be required. Mechanisms such as the API-fication of networks can greatly facilitate the identification of the resources most in demand by developers and, consequently, end users. In the initial stages, this exploration will be particularly decisive, so the regulator will have to be more cautious before any decision is taken to intervene in this market, taking into account the effects on the efficiency and effectiveness of the allocation of resources to which the APIs give rise.

4. Standardisation does not reduce competitive intensity.

The provision of homogeneous interfaces by operators to Metaverse developers seems to be a prerequisite for its success, as they will not be able to undertake parallel developments for each operator. The same applies to technologies such as 5G, 6G, FTTH, in order to make their launch feasible. This collaboration lays the foundations for a minimum technological dimension, which is extended and reaches society through the usual competitive processes in each market, which in this case will occur both at the end-customer and developer level.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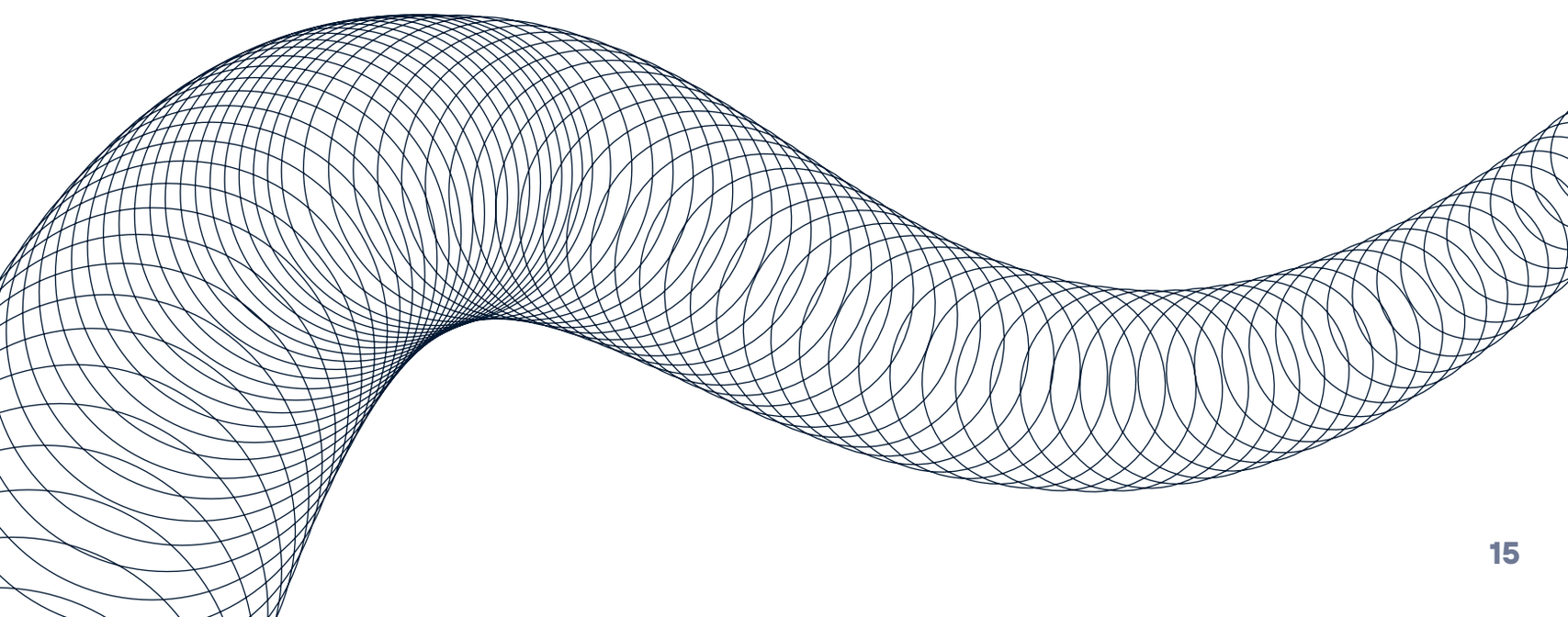

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