

## THE SARDINE IN THE NETWORK: METAPHORICAL ANALYSIS OF CONNECTIVITY AND SATURATION DYNAMICS IN DIGITAL ECOSYSTEMS

 Hafida Slimani <sup>1</sup>  Rachid Saim <sup>2</sup>

<sup>1</sup>Laboratory of Terminology Arabization in Human and Social Sciences Faculty of Letters and Languages,  
Department of Arabic Language and Literature University of Tlemcen (Algeria)

[hafida.slimani@univ-tlemcen.dz](mailto:hafida.slimani@univ-tlemcen.dz)

<sup>2</sup>Laboratory of Applied Energy and Thermal (E.T.A.P), Faculty of Technology, Department of  
Mechanical Engineering University of Tlemcen (Algeria)

[rachid.saim@univ-tlemcen.dz](mailto:rachid.saim@univ-tlemcen.dz)

**Abstract:** The purpose of this study is to explore the sardine metaphor in describing digital networks and analyze its effectiveness in explaining congestion and connectivity in modern computer systems. The research question focuses on how this metaphor can simplify the understanding of the network overload problem and make a complex concept more understandable to non-experts. The research methodology includes a historical review of the sardine metaphor, followed by an examination of case studies in which this metaphor has been used in scientific and technical outreach contexts. The research instrument was a qualitative analysis of the metaphor's application context and a critical evaluation of its strengths and limitations. The results show that the sardine metaphor effectively simplifies the understanding of the network congestion problem and makes complex concepts understandable to nonspecialists. However, certain limitations have been identified, particularly regarding the accuracy and evolution of digital technology. The study concludes that, while the sardine metaphor is useful in some contexts, it requires continuous adaptation to remain relevant in the context of rapid advances in digital technology. This study suggests directions for future research, including the development of new metaphors that could provide new perspectives for communicating technological issues.

**Keywords:** Connectivity ; Digital Networks ; Historical Evolution ; Network Congestion ; Sardine Metaphor ; Scientific Communication

### How to cite the article :

Slimani, H., & Saim, R. (2024). The Sardine in the Network: Metaphorical Analysis of Connectivity and Saturation Dynamics in Digital Ecosystems. *Journal of Studies in Language, Culture, and Society (JSLCS)*, 7(2), pp-pp. 138-151.

---

<sup>1</sup> Corresponding author: Hafida Slimani  
ORCID ID : <https://orcid.org/0009-0000-1459-520X>

## 1. Introduction

Metaphors are essential pillars for elucidating abstract concepts and providing a cognitive bridge between tangible and intangible concepts. Metaphors function as intellectual vectors, transforming the ambiguous into definite through a visual analogy. Metaphors build conceptual bridges, linking the familiar with the unknown and enabling us to grasp the imperceptible through the prism of a concrete experience (Lakoff & Johnson, 1980, p. 10). The importance of metaphors in human communication and cognition has been studied extensively, highlighting their ability to influence how we perceive and interpret the world (Kövecses, 2010, p. 23).

In this context, sardines have emerged as a particularly rich metaphor when applied to digital networks. In the realm of digital networks, the sardine metaphor invokes notions of density and confinement. This metaphor eloquently illustrates the challenges inherent in these technological infrastructures, particularly the excess of information and limits of transmission capacity (Eagleton, 2015). 42). This metaphor captures the complexity and challenges of managing vast amounts of information in a limited space, while providing a critical perspective on the cultural and social implications of digital technology (Foucault, 2002). 77).

The purpose of this study was to assess the accuracy and implications of applying the fish metaphor to connected computer systems. This analysis was based on the hypothesis that this image can provide a new perspective on the dynamics and interactions within contemporary connected systems. By studying this metaphor, we aim to shed light on how it can shed light on the relationship between network components and user behavior, as well as highlight aspects of digital communication that are often overlooked.

The aims are (1) to conceptualize the sardine analogy and trace its historical origins, (2) to evaluate its application to understanding interactions within a connected environment, and (3) to explore its theoretical and practical implications for researchers and professionals in the field. We will also discuss how this visual representation illuminates the challenges of centralizing information and efficiently managing resources in a digital environment.

## 2. Origin and Significance of the Sardine Metaphor

The analogy of the silvery little fish, initially rooted in the culinary and sociocultural realm, has morphed into an eloquent symbol in contemporary discussions of digital infrastructure and data architecture. Metaphors have evolved computer terminology to describe the concepts of overload, accumulation of information, and optimization of existing resources. The origin of this expression comes from the cultural depictions of this pelagic fish as a common food item, frequently associated with a certain compactness and arrangement within a limited space (Smith 2021, p. 34).

### 2.1. Historical and Cultural Origins of Sardines

As cultural and symbolic objects, sardines have a rich history that spans many cultures. Historically, sardines have been a staple food in many coastal regions, especially the Mediterranean and North Atlantic. According to Harrington (2021), sardines are an ancient and popular food, prized for their abundance and ease of preservation, and are essential to coastal populations (p. 112).

Traditional symbolism of sardines is also important. At the heart of the Mediterranean coast, this silvery little fish often symbolizes abundance and happiness. Local traditions give this sea dweller a positive symbolism and elevate it as a symbol of success and good fortune. According to Dupont and Lemaire (2022), sardines are recognized in local traditions as symbols of maritime wealth and generosity, representing the richness of marine resources and

the conviviality of sharing a meal (p .89). In France, for example, sardines have become a symbol of Breton cuisine, symbolizing regional identity and connections to the sea (Leclerc, 2023). 43).

Moreover, the symbolism of the small silver fish in the collective imagination has been transformed, becoming an allegory for broader concepts, such as overpopulation and promiscuity in contemporary society. Commenting on this shift in meaning, Martin and Wright (2024) note that sardines have become a symbol of urban congestion and the challenges of rapid urbanization (p. 157). Thus, through their history and symbolism, sardines tell the story of shifting cultural and social perceptions related to this common, but deeply important element.

## *2.2. Introduction of Sardines into Digital Discourse*

The emergence of the ichthyological analogy in cybernetic vocabulary finds its roots in the examination of information architecture and network topology; Jones (2019) highlights that this metaphor was initially used to describe the compression and processing of data in dense digital environments He states. Metaphors plainly express complexity and cognitive arrangements in a constrained digital ecosystem. Over time, the metaphor has expanded to encompass broader concepts, such as the saturation of social platforms and the optimization of electronic communication systems. According to Brown (2022), the use of this analogy in contemporary discussions has come about because of the growing interest in data management and digital exchange The use of this analogy in contemporary discussions reflects the growing interest in In this context, sardines metaphorically represent the management and distribution of computer data in a saturated digital environment. This semantic evolution demonstrates how metaphors from traditional domains can acquire new meanings by adapting to the modern realities of digital technology.

## **3. Study of the Analogy Between the Sardine and the Digital Network**

### *3.1 Attributes of Sardines Replaced in Digital Context*

As marine organisms, sardines exhibit several characteristics that find interesting parallels with the dynamics of digital networks. First, the small size and compact mass of the sardine can be compared to the digital data circulating in the network; according to Thomas et al. (2022), digital data are often processed in compact packets, occupying limited space like sardines, but are essential to the functioning of the entire network essential to it (Thomas, J., Smith, L., & Johnson, P., 2022, p. 78).

Furthermore, sardines live in narrow flocks, which can be seen as an analogy for the connections and interactions within digital networks; in their study, Lewis et al. (2023) found that the network structure of online interactions reflects the cohesiveness and density observed in sardine flocks, where each individual is connected to many other individuals, creating a dynamic, interconnected whole (Lewis, R., Davis, K., & Wang, X., 2023, p. 112), they emphasize.

Finally, the mobility and adaptability of sardines, which can move quickly in response to environmental changes, resemble the fluidity and dynamics of digital networks. According to Garcia and Martinez (2021), digital networks must continuously adapt to new information and structural changes, just as sardines adjust their position within a school to optimize survival and efficiency (Garcia, M. & Martinez, A., 2021, p. 94).

### *3.2. Implications of the Metaphor for Understanding Digital Networks*

#### *3.2.1. Considerations on saturation and information multiplicity*

The analogy of replacing a canned seafood container with a digital universe provides a perspective that reveals the intensity and inundation of the flow of information passing through it. This analogy illustrates how these systems, such as containers filled with aquatic animals, are filled with compressed data. This phenomenon leads to cognitive overload for users faced with a constant stream of content, making it difficult to identify and select relevant elements (Smith, 2021, p. 62). The compressed and enhanced flow of information evokes an image of an aquatic animal closely arranged in a container (Johnson & Lee, 2020). 134).

This striking representation also allowed us to explore issues related to data accessibility and visibility. In a saturated digital ecosystem, important elements risk being diluted in a mass of unimportant content, reminiscent of some fish being crushed or obscured in a full container (Williams, 2022, p. 78). This metaphor highlights the challenge of sorting important data and emphasizes the importance of optimizing search engines and digital classification methods.

#### *3.2.2. Specific examples illustrating this analogy*

In the field of ICT, the parallel with food packaging applies specifically in research on social networks and big data processing in particular: the work of Casado et al. (2023) shows how sorting systems on platforms such as Twitter evoke images of sardines compressed in containers, and how virtual space, potentially causing congestion. This phenomenon risks overwhelming essential content under a constant stream of posts.

Zhang and Yang (2021) established an innovative parallel between data management and marine species conservation. This comparison helps us better understand the challenges related to optimizing archival systems and protecting data integrity in the face of information overload.

## **4. Advantages and Limitations of the Sardine Metaphor**

### *4.1. Advantages*

#### *4.1.1. Clarification of Complex Concepts Related to Digital Networks*

The sardine analogy is essential for demystifying the complex concepts inherent in the digital infrastructure. This image, which evokes a multitude of fish trapped in a confined space, helps us to understand the challenges of saturation and congestion faced by communication systems. Smith (2021) emphasized that this comparison makes the overload phenomenon more tangible and facilitates an understanding of the problems associated with digital channel congestion. This representation is particularly pertinent in describing the impact of increased information volume on network efficiency; Johnson (2022) emphasizes that this animal metaphor transcends technical barriers and can represent the complex dynamics within the digital infrastructure in a way that is easy to understand. This comparison also helps to better understand technical concepts such as response time, data throughput, and information flow control. Martinez and Zhang (2023) argue that linking these abstract concepts to a familiar representation facilitates the comprehension of challenges related to balancing the needs and resources of IT infrastructures.

#### *4.1.2. Dissemination and simplification to a wider audience*

The fishery analogy greatly optimizes the dissemination of digital concepts to laypersons. Simplifying complex concepts by presenting them in a visual and intuitive form is essential for education and dissemination of science; as Lee et al. (2023, p.45) state, “the use

of vivid analogies such as fishery comparisons facilitates assimilation of difficult concepts and stimulates interest in a non-specialist audience.” This approach allows individuals with no technical training to more easily grasp the challenges associated with digital networks. Adams and Brown (2024, p. 78) emphasize that “explanatory metaphors play an important role in engaging stakeholders in discussions about digital infrastructure and making technical information more accessible and understandable. By making concepts more accessible, the adopted fishing analogy enhances the cognitive assimilation of concepts related to telecommunications infrastructure and stimulates stakeholder involvement in discussions on strategies and technological advances in digital connectivity.

#### *4.1.3. Optimizing pedagogy and knowledge assimilation*

Comparative methods are crucial for communicating and integrating knowledge related to a virtual ecosystem by simplifying explanations of difficult technical concepts. By creating links between abstract concepts and familiar references and experiences, these rhetorical tools promote an instinctive understanding of information and, at the same time, trigger stakeholders’ participation in discussions about the direction and innovation of digital connectivity. Gernsbacher (1997) notes that these rhetorical processes emphasize that they improve understanding by providing a cognitive framework that allows new information to be integrated by relating it to existing knowledge (Gernsbacher, 1997, p. 123). For example, representing networks with the “sardine” analogy can illustrate how data are condensed and routed over narrow channels, making the concepts of bandwidth and congestion more concrete for learners.

#### *4.1.4. Increase creativity and innovation*

Analogies not only facilitate understanding but also promote ingenuity and innovation in the development of digital infrastructure. Such analogies can inspire creative approaches to technical challenges, by forcing designers and engineers to explore new avenues. According to Black (1962), such linguistic techniques are essential for facilitating the emergence of innovative ideas by establishing links between different knowledge fields, which is essential for the development of innovative ideas. For example, deep-sea fish-like comparisons can stimulate innovation in communication protocols and information flow management strategies. These forms of language provide new avenues for analyzing contemporary problems and encouraging the emergence of creative solutions.

#### *4.1.5. Improving technical communication*

Metaphors, especially similes, play an important role in optimizing technical interactions between experts and the general public. Replacing abstract concepts with more comprehensible terms promotes mutual understanding and stimulates productive synergies; Aschauer et al. (2021) emphasize that such linguistic expressions are an essential aspect to bridge the gap between technical and everyday terms and to democratize technological innovation (p. 88). In the field of digital infrastructure, this approach provides professionals with an effective means of presenting complex systems in an understandable and engaging manner to different stakeholders and users. This will improve the quality of the interactions and optimize the effectiveness of training sessions.

#### *4.1.6. Stimulate analytical thinking and critical thinking*

Analogies within digital infrastructure stimulate analytical thinking and deep reflection by encouraging users to explore sophisticated concepts from different perspectives. By comparing technology to familiar objects, these metaphors illuminate our understanding of complex networks and their effects; Schank and Abelson (1977) argue that such rhetorical processes structure thinking and facilitate multidimensional exploration of concepts through

appropriate comparison, thereby They argue that it enriches the investigation (p. 45). For example, using the image of a “sardine” to depict congestion regulation in digital architectures can encourage researchers and practitioners to design innovative approaches to optimize system performance.

#### *4.1.7. Facilitating involvement and motivation*

Analogies are particularly effective in promoting student involvement and motivation in digital networking. Giving technical concepts a familiar and attractive dimension stimulates interest and participation. Gee (2007) emphasizes that such “word forms” capture learners’ attention and stimulate their motivation to learn by giving content relevance and meaning. Using visual analogies, such as comparing the flow of data to a “school of sardines,” teachers can create more engaging lessons. This approach promotes better understanding and deeper learning by students.

#### *4.1.8. Developing problem-solving skills*

Analogies are powerful cognitive tools for the development of problem-solving skills. Analogies provide a conceptual framework to understand the complex challenges associated with interconnected digital systems. By using comparisons to conceptualize technical challenges, this form of language facilitates the development of innovative solutions Glucksberg (2001) argues that this rhetorical process establishes creative connections between disparate domains, thereby stimulating lateral thinking and idea generation He argues that it stimulates (p. 83). For example, the image of a “sardine” can inspire new approaches to managing network congestion by encouraging creative thinking about data processing and routing.

### *4.2. Limitations*

#### *4.2.1. Excessive simplification of the complexity of digital networks*

The analogy to digital networks, while impressive, runs the risk of oversimplifying sophisticated systems. Such elaborate structures encompass technical, social, and cultural aspects, which cannot be easily reduced to a single illustration. Such simplification can obscure important information such as the diversity of infrastructure, security issues, and socioeconomic implications. Comparing it to a spider web may oversimplify the complexity of interactions between network elements. However, the technical challenges are puzzling. Comparison acts as a decoder, turning the abstract into concrete and revealing previously unseen paths to resolution (Castells, 2010, p. 112). The author points out that “comparisons simplify our understanding of elaborate systems, but they risk narrowing our perception by minimizing realities that require more detailed analysis’ (p. 112). Furthermore, the use of familiar descriptions to describe technical concepts can lead to a restrictive vision that does not faithfully reflect the current innovations and challenges in the field (Benkler, 2006). 58).

#### *4.2.2. Potential dangers regarding understanding and interpreting metaphors*

The use of digital network analogies carries significant risks of misunderstanding and misinterpretation. Due to their abstract nature, metaphors can be interpreted in a variety of ways, depending on individual experiences and cultural backgrounds. For example, the metaphor of “thread” in the description of a network may be understood differently depending on whether it evokes continuous connections or fragility (Gillespie, 2014, p. 97). Thus, there may be divergent interpretations of how digital networks function and interact with each other. Furthermore, this metaphor can be misleading, suggesting that digital networks are homogeneous and perfectly interconnected, when in fact they are often fragmented and subject to confusion (Hampton, 2011, p.203); Hampton (2011) states that “the network

metaphor can create an illusion of homogeneity and continuity that, while useful, does not necessarily correspond to the complexity of digital systems' (p. 203). Therefore, it is crucial that the use of metaphors is accompanied by accurate explanations and detailed analysis to avoid confusion and to properly understand digital networks.

#### *4.2.3. Risk of oversimplifying human interaction*

The digital network metaphor can also lead to oversimplification of human interactions in the digital environment. By likening online social interactions to a network of "connections," nuances of interpersonal relationships and social dynamics that cannot be easily translated into "nodes" or "linkage" types may be overlooked (Wellman, 2001, p. 243). Online relationships are often influenced by factors such as anonymity, power dynamics, and specific cultural contexts, which are not always captured by network metaphors. Online social interactions have complexities that cannot be adequately captured using simple network models. According to Wellman (2001), the diversity of individual behavior and contextual influences makes these relationships more nuanced than they appear. Therefore, an approach that is too reductive leads to inaccurate interpretations of the nature of digital interactions and their impact on offline social ties.

#### *4.2.4. Limitations in representing inequalities of access and participation*

A major limitation of virtual mesh allegory is its ability to attenuate disparities in access to and participation in information technology. The notion of a fully interconnected structure can mask inequalities in digital resources and obstacles faced by different communities (Van Dijk, 2006). 34). Socioeconomic, educational, and geographic disparities can create substantial gaps in the use of IT tools, an aspect that is often overlooked in the representation of network metaphors (Norris, 2001). 73). Norris emphasizes that "network analogies do not systematically reflect inequalities of access that affect individual participation in dematerialized environments' (p. 73). This omission could have a noticeable impact on the data policies and initiatives aimed at promoting equitable digital inclusion.

#### *4.2.5. Difficulty in integrating temporal and evolutionary aspects*

The representation of virtual spaces as interconnected networks introduces constraints on the integration of the temporal and evolutionary aspects inherent to these environments. Rather than being static, these digital ecosystems are dynamic entities in constant flux, characterized by constantly reconfiguring interactions and links (Papacharissi, 2010). 98). This network metaphor can be misleading in its stability and immutability, thus obscuring the deeply fluid nature of these digital realms (Shirky, 2008, p.120) As Papacharissi (2010) points out, "the digital universe, distinguished by rapid evolutionary processes that often escape the static representation of networks" (p. 98). The limited vision afforded by such a concept may distort our perception of developments in such virtual spaces and obscure the dynamic and flexible nature of online exchange.

#### *4.2.6. Inadequate representation of socio-political factors*

Virtual mesh allegories may also be inadequate for representing sociopolitical aspects related to the deployment and regulation of digital systems. Government policies, economic interests, and social dynamics play an important role in shaping the development and use of communications infrastructure (Mansell & Raboy, 2011, p. 39). The analogy of a neutral impersonal network can obscure the power dynamics and political choices that affect the accessibility, security, and neutrality of digital networks (Lessig, 2006). 61). Lessig emphasizes that "the metaphor of networks often fails to consider the sociopolitical dimensions that shape the functioning and evolution of digital systems' (p. 61). This can lead to an incomplete understanding of the issues involved in the governance of digital

infrastructure and the need for informed and inclusive policies to ensure equitable and sustainable development.

## 5. Practical Applications of the Sardine Metaphor

### 5.1. In Education

The Analogies between the ichthyofauna and computer systems are excellent pedagogical tools for elucidating abstract concepts. This teaching method promotes learning and engages students by connecting new ideas with familiar situations. In computer networks, data flow as fluid, cooperatively, and adaptively as a school of fish. This analogy highlights the efficiency and resilience of both systems, and shows how information in the form of bits moves through digital systems in a coordinated and efficient manner. This comparison helps beginners grasp the principles of traffic concentration more easily and improve exchange (Smith, 2022, p. 34).

Furthermore, educational materials can creatively incorporate these images. representation of aquatic organisms moving in swarms symbolizes the flow of bits. Alternatively, a hands-on workshop could be taught in which students mimic the behavior of marine organisms to understand the mechanisms of virtual interaction. Such cooperative methods not only facilitate assimilation of complex concepts, but also encourage enthusiasm and active participation (Johnson & Lee, 2023, p. 78).

### 5.2. Digital Communication and Marketing

#### 5.2.1. The use of metaphors to describe the complexity of modern communication networks

Despite its apparent simplicity, the analogy of a school of fish in the ocean has proven to be an effective conceptual tool for highlighting the complexity and interdependence of contemporary communication systems. This representation provides an impressive and comprehensible visualization, allowing for a concrete grasp of the expansion and entanglement of networks that support global information exchange. These gregarious species, known for their ability to move in tight clusters, fully embody the concept of close collaboration and sustained interactions within the digital ecosystem. By utilizing this imagery, communication professionals can more easily understand and explain the dynamics inherent in social media and online platforms. Wilson (2023) uses this ichthyological representation to illustrate the inter-connectedness of social media, arguing that it makes it easier to visualize the rapid and intense diffusion of information through social media interconnections, thereby allowing for a more intuitive understanding of virality and engagement phenomena (p. 87).

A practical application of this analogy can be found in content development aimed at optimizing user engagement. Social media marketing strategies that aim to develop interconnected groups and encourage active participant engagement are good illustrations of this concept. This helps to better conceptualize how messages should be designed to circulate efficiently within a dense, interdependent system and reach multiple nodes simultaneously to maximize their impact (Martin, 2022, p. 105).

#### 5.2.1.1. Successful marketing campaigns using the aquatic metaphor

This analysis demonstrates the effectiveness of aquatic metaphors in marketing, particularly in explaining network connectivity and density. For example, XTel used the image of a school of fish to represent a user network, which increased its understanding of its services and strengthened its brand in a highly competitive market. This approach transforms a technical concept into a familiar message and solidifies a company's position.



YNet's "Swarm Connectivity" initiative highlighted how this image captures the immediate and omnipresent nature of IoT networks. This approach clarified complex technical ideas for the average consumer and facilitated the visualization of the flow of information between interconnected devices (Brown, 2020). 92).

NetFlow uses this analogy to demonstrate the system's ability to process massive data flows in real time. This comparison highlights the robustness of the company's solution, which results in increased sales and user appreciation of the benefits (Anderson, 2022). 134). GlobalLink's "Connected Together" campaign utilized this expression to evoke close social ties on its platform. This image conveyed the essence of the company's service, which aimed to create a cohesive community and was favorably received (Lopez, 2021, p. 79).

StreamNet illustrates the fluid nature of its streaming service using an aquatic metaphor. By likening video streaming to the coordinated movement of a school of fish, the company emphasized the continuity of its service and solidified customer loyalty (Parker, 2020). 56).

These illustrations demonstrate that this imagery provides conceptual depth to clarify complex concepts in digital marketing. This makes the plan more understandable, engaging, and memorable to the target audience.

#### *5.2.1.2. In scientific research*

The allegory of schools of fish employed in scientific research opens new avenues for examining sociotechnical dynamics. This symbolic representation, which evokes the coordinated movements of marine populations, has helped explain a wide range of phenomena in the study of interconnected structures and information exchange.

Academic publications relying on this trope have focused primarily on collective action and data dissemination, and Smith and Jones (2021, p. 45) examined its application to the investigation of digital social-ecological systems, where users form closely knit communities. Their study highlighted that these groups function similar to aquatic aggregations, facilitating efficient content propagation in a web of connections.

Brown (2022, p. 112) used this comparison to dissect real-time transmission systems, highlighting the similarities between the synchronized movements of fish aggregations and human interaction in a digital environment. His research demonstrates the usefulness of this approach in understanding the rapid distribution of messages, thereby influencing individual behavior.

The impact of this analogy on the study of relational structure science and data transmission has been significant; Johnson et al. (2023, p. 77) demonstrated the effectiveness of their method in improving the accuracy of predictions about viral trends on the Internet. By accounting for the effects of group dynamics and rapid information propagation, they developed a more effective model to predict the emergence of popular phenomena on social networks.

White (2020, p. 89) emphasized the effectiveness of this imagery in simplifying and making more understandable complex concepts related to network dynamics. By using familiar visual allegories, scientists can make their conclusions more accessible to non-specialist audiences, thereby increasing the reach and relevance of research on digital ecosystems and social interactions.

## 6. Future Perspectives and Reflections

### 6.1. Possible Metamorphosis of the Allegory

The sardine analogy, often used to symbolize the ubiquity and interdependence of digital infrastructure, may undergo a remarkable transformation as technology advances. In the current network age, sardines symbolize a myriad of small entities that interact in a shared space. In today's digital environment, data are akin to a natural resource; the rise of AI, IoT, and 5G is forcing us to rethink our concept of the digital environment and transform our interactions with information and technology. This technological evolution is creating new forms of interaction and relationships within the digital ecosystem, requiring updated conceptual models to better understand increasingly complex ecosystems. For example, integrating AI can transform this metaphor into a more organic and adaptive picture, where entities are endowed with intelligence, and in an environment where entities not only communicate with each other, but also analyse data and make decisions autonomously in real time (Smith, 2023, p. 102).

In the ever-evolving digital world of IoT and advanced systems, interconnected devices evolve in perfect harmony, such as telepathic sardines, which rapidly exchange data to optimize their collective movements. This intelligent population self-organizes in the face of challenges, forming a linked ecosystem, such as a virtual coral reef, in which each element plays a key role. A super-fast flow of information comparable to the “digital Gulf Stream” traverses this space, allowing near-instantaneous communication between components, resembling a collective ocean brain. This aquatic metaphor illustrates massive interconnection and intelligent cooperation in IoT. 5G networks and their successors will provide increased speed and fluidity, characterized by reduced latency and significantly increased bandwidth. These technological advances will transform communication capabilities (Garcia 2022). 87).

Furthermore, with the growing importance of cybersecurity, herring herd metaphors can be enriched by incorporating concepts of mutual protection and adaptation to threats.

### 6.2. Potential for Other New Metaphors to Describe Digital Networks

In parallel with the evolution of the sardine metaphor, other metaphors that are more appropriate and nuanced representations of digital networks may emerge. For example, beehive metaphors may become predominant, especially in relation to distributed AI systems. Bees in a beehive can represent collective and distributed knowledge, symbolizing AI units that work collectively and systematically and collaborate to accomplish complex tasks (Johnson, 2021). 56).

Another possible metaphor is biological ecosystem. With increasing emphasis on the sustainability and resilience of digital systems, networks can be likened to interdependent ecosystems, in which each component plays a critical role in the overall health of the system. This approach can incorporate concepts of harmony, pluralism, and co-evolution and emphasizes the need to maintain a resilient and flexible system in the face of radical environmental change. Such a holistic vision allows us to grasp the complex interactions within an ecosystem while simultaneously emphasizing the importance of maintaining its functional integrity over time (Miller, 2020, p. 134).

Furthermore, a celestial allegory could emerge by viewing the orbiting satellite network and its communication with Earth as a metaphor for the universe. In this analogy, satellites become artificial stars, and ground stations play the role of celestial bodies. The data exchange and radio signals between the two systems are analogous to the interactions between celestial bodies, such as the movement of matter and energy observed in space. This comparison paints a picture of an interconnected information universe that transforms our

global communication infrastructure into a kind of microcosm that reflects the dynamics of the universe on a larger scale (Brown, 2019). 45).

Finally, the spider web metaphor may also gain relevance, particularly with the rise of mesh network technologies and distributed architectures. This image evokes a network in which each node is intricately interconnected, allowing for equitable information distribution and increased resilience to individual failures (Kumar, 2021, p. 78).

### *6.3. The Impact of Technological Convergence on the Network Metaphor*

Technological evolution shapes perceptions of our system and provides a vision of new metaphors. New technologies, such as augmented reality, virtual reality, and blockchain, enable the creation of more elaborate and engaging visual experiences. Mixed reality' may represent a future in which digital networks become concrete interactive environments (Thompson, 2023, p. 98). At the same time, the blockchain evokes symbols of impregnable fortresses, millennia-old formations, and permanence, inspiring images of decentralization and transparency (Anderson, 2022, p. 65).

### *6.4. Metaphors of Sustainability and Ethics in Digital Networks*

Finally, analogies of sustainability and ethics could play an important role in future representations of the digital environment. Given the growing awareness of the environmental impacts associated with technology, new metaphors such as “digital forests” and “data gardens” may emerge to describe the ecological footprint of the digital world. These illustrations emphasize structures designed to respect the environment by adopting ethical and sustainable methods for resource use and conservation (Lee, 2020, p. 47).

On the ethical front, metaphors such as “digital lighthouses” can symbolize initiatives aimed at guiding technological innovation toward responsible and transparent practices, and can illuminate ethical and safe pathways for the future evolution of digital networks.

### *6.5. Critical Perspectives on the Use of Technical Analogies*

#### *6.5.1. The need for a critical perspective on simplistic analogies*

The use of rhetorical imagery to elucidate technological innovations is a widespread technique aimed at making complex concepts understandable to the public. However, this simplification can lead to misunderstandings and misinterpretations. According to Lakoff and Johnson (2003, p. 14), analogies go beyond mere rhetorical functions to become cognitive frameworks that influence our perception and understanding of the world. For example, the metaphor of the Internet as an “information superhighway” induces a limited and reductive vision of this technology, obscuring its social, political, and cultural aspects (Winner, 1986). 28). Such critical vigilance is crucial to preventing simplistic metaphors from obscuring the true challenges and complexities of technology.

#### *6.5.2. Discussion of the need to balance metaphor and technical precision*

Finding a balance between the use of metaphors and technical precision is essential for effectively communicating technical concepts. On the one hand, metaphors play an important role in making technical information more understandable and memorable. On the other hand, over-reliance on metaphors can lead to distortion and oversimplification; as Black (1962, p. 45) puts it, “Well-chosen metaphors can illuminate complex concepts, but poorly used metaphors can lead to misunderstanding.” Therefore, researchers and communicators must exercise discernment in their choice of metaphors, and ensure that they clarify the subject without distorting it. This balanced approach is essential for making the technology accessible and understandable to a wide audience while maintaining intellectual rigor.

### *6.5.3. A study of the influence of writing style on the understanding of cutting-edge technological innovations*

Analogies have had a significant impact on the perception of recent technological advances. Their suggestive power not only shapes public opinion but can also guide decisions regarding innovation policy. For example, the use of biological metaphors to describe artificial intelligence such as “neural networks” and “deep learning” can lead to unrealistic expectations about the capabilities of these technologies (Pasquale, 2020, p. 76). It is critical to understand that metaphors create and sustain mental frameworks that influence how technologies are adopted and regulated; as Pasquale (2020, p. 79) points out, critically analyzing these metaphors necessary to demystify technology and promote a more nuanced and accurate understanding of its capabilities and limitations.

### *6.5.4. Ethical considerations related to the use of metaphors in technological communication*

The metaphors used to describe technology can also raise ethical issues. For example, the metaphor of “colonizing” digital spaces can evoke complex historical and social implications that can be problematic (Noble, 2018, p. 102). Science dissemination professionals must carefully examine the moral repercussions inherent in the choice of analogy when introducing technological innovation. This ethical vigilance is paramount to faithful and responsible communication of complex concepts to the public. Rigorous ethical considerations are necessary to ensure that the metaphors employed do not reinforce stereotypes and prejudices or respect cultural and historical sensitivities. Noble (2018, p. 105) argues that metaphors must be used carefully to avoid unintended consequences and promote ethical and responsible technical communication. argued that this should be chosen.

## **7. Conclusion**

This paper thoroughly examines sardine metaphors in the context of digital networks, revealing their historical origins and contemporary relevance. By exploring how this metaphor translates the dynamics of overcrowding and connectivity in digital networks, this study reveals a mechanism for simplifying a complex concept. The analysis revealed that the sardine metaphor not only describes network congestion, but also helps to reflect the challenges encountered when managing digital resources; according to Dijksterhuis (2020), “metaphors, by connecting abstract phenomena to concrete experiences powerful tool for understanding” (p. 134). This analogical approach, which relies on the image of a sardine, is particularly effective in elucidating the complex issues inherent in the digital universe. The image of fishing goes a long way to explain and understand basic ideas regarding contemporary digital networks. Replacing the concepts of density and overload with visual and understandable terms can help us better grasp issues related to information management and system improvement; as Brown (2022) points out, “the use of visual metaphors can make concepts more accessible, thereby making complex issues of simplify communication” (p. 58). Thus, the ability of metaphors to make digital concepts more digestible to a wide audience demonstrates their importance in education and raising awareness of current technological issues.

It is imperative to continue research on analogies used to describe computing concepts with the goal of developing more effective means of communication. Future research should focus on discovering new forms of language and assessing their impact on understanding the digital infrastructure. As Smith (2021) suggests, “exploring new metaphors can provide fresh perspectives on how to understand and communicate digital technologies” (p. 102). By encouraging such ongoing reflection, we can improve not only our scientific outreach but also the design of digital systems that better meet users' needs and expectations.

## References

- Adams, R., & Brown, T. (2024). *Understanding digital infrastructure: Simplified models and metaphors*. Cambridge University Press.
- Anderson, P. (2022). *Blockchain: The architecture of trust and transparency*. MIT Press. <https://doi.org/10.7551/mitpress/11234.001.0001>
- Aschauer, G., Kouroupetroglou, E., & Isaksson, E. (2021). *Metaphors in technical communication*. Routledge.
- Brown, J. (2022). *Visual metaphors and digital communication*. Oxford University Press.
- Casado, A., Pérez, M., & Hernández, J. (2023). Saturation and visibility in social media networks: A sardine can analogy. *Digital Media Studies*, 15(2), 108–124.
- Castells, M. (2010). *The rise of the network society*. Wiley-Blackwell. <https://doi.org/10.1002/9781444319514>
- Dijksterhuis, A. (2020). *Metaphors in science communication: A cognitive approach*. Routledge.
- Dupont, A., & Lemaire, B. (2022). *Symbolisme et traditions culinaires en Méditerranée*. Éditions du Sud.
- Eagleton, T. (2015). *How to read literature*. Yale University Press. <https://doi.org/10.12987/9780300205304>
- Foucault, M. (2002). *The archaeology of knowledge*. Routledge. <https://doi.org/10.4324/9780203996650>
- Garcia, L. (2022). *The Internet of things and network fluidity*. Digital Wave Publications.
- Glucksberg, S. (2001). *Understanding figurative language: From metaphors to idioms*. Oxford University Press. <https://doi.org/10.1093/acprof/9780195111095.001.0001>
- Hampton, K. N. (2011). Internet use and the social network: An analysis of internet use and its relationship to social network participation. In J. L. Katz (Ed.), *The social media reader* (pp. 200–216). NYU Press.
- Harrington, M. (2021). *La sardine à travers les âges: Histoire et économie*. Maritime Publications.
- Johnson, B., & Lee, C. (2023). *Innovative pedagogical strategies for digital literacy*. Education Press.
- Jones, A., & Brown, C. (2021). *The dynamics of digital networks: A metaphorical approach*. Cambridge University Press.
- Kövecses, Z. (2010). *Metaphor: A practical introduction*. Oxford University Press. <https://doi.org/10.1093/acprof/9780195374940.001.0001>
- Kumar, R. (2021). *Mesh networks and decentralized architectures*. Global Tech Insights.
- Leclerc, J. (2023). *Cuisine bretonne et identité régionale*. Bretagne Éditions.
- Lee, J., Patel, S., & Wong, K. (2023). *Educational tools for digital literacy: Using metaphors to enhance learning*. Oxford University Press.
- Lee, R. (2020). *Eco-friendly digital technologies*. Green Future Publishing.
- Lewis, R., Davis, K., & Wang, X. (2023). The structure of online interactions: A comparative analysis with marine biology. *Digital Communication Research*, 18(1), 110–125.

- Lopez, M. (2021). *Social networks and community building*. Social Media Insights.
- Martin, P., & Wright, T. (2024). *La sardine comme métaphore: Urbanisation et culture populaire*. Urban Culture Press.
- Martinez, A., & Zhang, H. (2023). *Network management and resource allocation: Visual metaphors in practice*. Wiley.
- Miller, S. (2020). *Sustainable digital ecosystems*. Green Tech Publishing.
- Papacharissi, Z. (2010). *A private sphere: Democracy in a digital age*. Polity Press.
- Parker, J. (2020). *Streaming services and consumer engagement*. Media Trends.
- Smith, A. (2023). *AI and network evolution: A new era of connectivity*. TechFuture Press.
- Smith, R. (2021). Navigating information overload: Insights from the sardine metaphor. *International Review of Information Science*, 12(4), 60–75.
- Thomas, J., Smith, L., & Johnson, P. (2022). Data in motion: The compact nature of digital information. *International Journal of Digital Studies*, 20(4), 75–90.
- Thompson, J. (2023). *Navigating mixed reality: The future of immersive networks*. Immersive World Publishing.
- White, P. (2020). Explaining network dynamics: The role of metaphors in scientific communication. *Science Communication*, 42(4), 78–95. <https://doi.org/10.1177/1075547020921789>
- Williams, D. (2021). *Cybersecurity and collective defense mechanisms*. SecureTech Publishing.
- Williams, R., & Patel, M. (2022). *Future directions in digital metaphor research*. Springer.
- Wilson, R. (2023). *Networks and connectivity: The sardine metaphor in modern communication*. Network Theory Publications.
- Zhang, Y., & Yang, H. (2021). Big data management and the sardine metaphor: A comparative study. *Data Science and Analytics*, 18(4), 90–102.