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Metaverse Intelligence (METINT)

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Abstract

We are at the beginning of developments where the Metaverse environment, which brings together the virtual and real worlds, is becoming three-dimensional, and where studies in the field of cyber intelligence will provide intelligence platforms with vastly different functions, potentially revolutionizing our overall perspective on intelligence. This study examines the potential use of the Metaverse environment—whose initial applications we are currently experiencing in gaming, healthcare, and business—for intelligence services and its potential to create a new intelligence field, by reviewing existing literature in the intelligence domain and adopting a comparative approach. In this context, applications where virtual and real worlds intertwine in the ongoing wars in Ukraine and Gaza, particularly targeted killing systems, are evaluated as having opened a new era for intelligence activities in the Metaverse environment. This article focuses on how intelligence services can benefit from the Metaverse environment under the title "Metaverse Intelligence (METINT)", used at the first time as a term in that article, the possible working principles in this new field, and the need for concept and structuring. The predictions about using technologies like artificial intelligence, Internet of Things, and Blockchain employed in the Metaverse environment under a new intelligence framework may be included in this study for the first time in this article. In this study, after first addressing the digital transformation of power, how the Metaverse environment works will be explained, and the development of Metaverse intelligence and fundamental principles thereof will be emphasized. It is concluded that metaverse progressively provides a unique environment and opportunities for the intelligence functions and the intelligence services should promptly adapt their processes, structure and platforms into that domain.

Keywords

Metaverse, "Metaverse Intelligence", Artificial Intelligence, Intelligence Technology, Internet of Things

1. Introduction

As an idea, the metaverse has first mentioned in a science fiction written by Neal Stephenson in his novel "Snow Crash" issued in 1992. The novel cited a future where individuals could experience themselves in a vast virtual world, conducting business, socializing, and exploring a digital domain (Mittal et al., 2023, p. 2503). Widespread awareness on Metaverse has began in 2021 with Mark Zuckerberg's announcements (Meta, 2021). The term "Metaverse", coined from the fusion of "meta" (great) and "universe", denotes a three-dimensional world. Through this evolution, virtual and physical realms are becoming increasingly intertwined, interdependent, and inseparable (Marsili, 2023). The Metaverse represents a three-dimensional virtual environment where users interact via avatars (Ritterbusch & Teichmann, 2023). It holds transformative potential to enhance our physical world through innovative, immersive experiences (Dwivedi et al., 2022). Research company Gartner predicts that by 2026, at least 25% of people will spend time in the Metaverse for work, entertainment, shopping, or education (Gartner, 2022). In the future, the Metaverse will emerge as a vast domain leveraging technologies like Web 3.0, 5/6G, the Internet of Things (IoT), augmented reality (AR), virtual reality (VR), cloud computing, cybersecurity, blockchain, and digital currencies (Patni & Choudhury, 2024).

One certainty about the Metaverse is that it will evolve far faster than the physical universe. While accelerating the flow of matter, energy, and information, it will also help rectify imbalances among them and enhance stability for real-world applications. This environment, where people interact through avatars for myriad purposes, promises a structured, perpetual way of life within a three-dimensional space powered by the future internet (Mortezapour, 2025, p. 146). Two key technologies underpinning this new lifestyle are the Metaverse and artificial intelligence (AI). Their intersection carries revolutionary potential for communication across virtual worlds while offering significant opportunities for the intelligence community. Undoubtedly, the Metaverse will not only provide new methods of intelligence collection and analysis but also give rise to a new type, function, and even structure of intelligence. For this new intelligence paradigm, "Metaverse Intelligence" (METINT) may be the most fitting term. METINT could revolutionize holistic intelligence approaches, covert operations, and propaganda efforts—potentially redefining our very understanding of intelligence.

With the digital transformation of national power, functions like defense and intelligence will increasingly migrate to the Metaverse. This article aims to explore the Metaverse's potential applications for the intelligence world, drawing from its current state to establish a functional and structural framework for METINT. Key questions include: What will METINT's conceptual framework entail? How will it integrate into existing intelligence cycles? And how will it be structured as an intelligence discipline? METINT, with its unique capabilities, could drive revolutionary changes in collection methods like HUMINT, CYBINT, COMINT, ELINT, and SIGINT. It can influence covert operations and psychological warfare. It may as well influence covert operations and psychological warfare—for instance, by generating mass fear through engineered hallucinations. Targeted assassination campaigns, as seen in Ukraine and Gaza currently, could adopt even more innovative methods via fabricated entities within the Metaverse.

To gain a comprehensive understanding of the Metaverse and its implications for intelligence services, the research methodology was primarily desk-based and comparative. It involved the review of both scientific literature and informal sources not originally written for intelligence studies such as academic reports and commercial papers. The interdisciplinary nature of the Metaverse required the adoption of a multifaceted research approach, combining intelligence literature, disruptive technologies, and computer science, especially from the area of requirements engineering. The study adopted a qualitative methodology to analyze metaverse environment and how to use that for future scenarios use cases, helping to forecast the potential challenges and opportunities for intelligence services. This study will first examine relevant technologies, then address the digital transformation of national power and AI's contributions to intelligence, before focusing on the Metaverse's nature and implementation. Finally, we will propose an intelligence framework for the Metaverse, explore data engineering within it, and identify clues for how intelligence agencies might leverage this space.

It is employed a systematic approach to gather relevant papers involving multiple steps. Firstly, an extensive literature was conducted review using various academic databases, including but not limited to IEEE Xplore, ACM Digital Library, ScienceDirect, Springer Nature, Web of Science, CSIS, Gartner, Meta, Human Rights Watch, and Google Scholar. Publications were included if they were written in English, published between 2017 and 2025, and addressed the Metaverse, intelligence, artificial intelligence, digital transformation, or data engineering. These platforms are widely recognized for their comprehensive coverage of scholarly articles in the field of intelligence studies, computer science and artificial intelligence. Based on initial searches, a substantial number of papers were obtained, totaling approximately 56 across the different databases. These papers were then subjected to a systematic screening process to filter out irrelevant or duplicated studies. The inclusion criteria for our analysis encompassed papers that focused on the application of AI technologies within the Metaverse context and explored the use of intelligence services.

2. Artificial Intelligence and Intelligence Operations

AI plays a pivotal role in the Metaverse's development and functionality. By integrating AI with AR/VR, blockchain, and networks, the Metaverse creates secure virtual environments that offer reliable, always-on platforms. AI agents and virtual ones serve as interactive objects within the Metaverse. These objects show real-life behaviors, participate in conversations and respond to user interactions. In order to introduce the phenomenon of intelligence in the metaverse, it is useful to first analyze the contributions of artificial intelligence to the field of intelligence in recent years.

Meta (formerly Facebook) and Microsoft had launched a major project transforming the Internet environment with virtual reality, 3-D computing, and blockchain technology. Immediately after the October 7, 2023 attacks in Gaza, the Meta company initiated studies on the use of Metaverse in the battlefield. The first task of the studies based on finding and killing Hamas militants was placing listeners (bugs) in the cyber and electronic field for target identification (fixing bugs) (Meta, 2023). Many US and Israeli companies collaborated on this project (Human Rights Watch, 2024). Thus, control of Gaza completely passed to the Israeli military through surveillance technologies, artificial intelligence, and other digital means that determine who will be shot where and when. Behind Israel's "watch and kill" system, which hunts many militants in Gaza and Lebanon, stands the US technology giants and Metaverse studies that have achieved a definitive edge in artificial intelligence and computing.

There are many similarities between the Israeli and Ukrainian fronts. Israel implemented a version of Ukraine's Spider Web Operation against Iran. Mossad smuggled hundreds of explosive-laden quadcopters into the country using trucks and commercial ships. The Ukraine war has birthed a new intelligence paradigm within NATO, driven by Western AI-powered systems. Intelligent intelligence systems will generate their own solutions in the battlefield of the future with machine learning. Of course, this will also have applications in hybrid warfare, cyber warfare, social engineering, psychological operations and disinformation. In the new world of intelligence, emerging technologies such as artificial intelligence, advanced sensors, cloud computing and advanced analytics will be the backbone of intelligence collection, processing and exploitation. These technologies will enable the expansion and automation of various collection and information processing activities in the intelligence sector to change adversary behavior and better adapt to operational domains. Now is the time to develop more insidious applications, allocate resources and move faster than others in emerging areas of disruptive technology that no one thought of.

AI algorithms enable smarter search, data fusion, and visualization. With deep learning, patterns, trends and threats in the data become more visible and are integrated into the analysis. With AI, the analyst and data scientist searches more intelligently for the intelligence question and pulls together the invisible pieces. AI can be used to intensively collect, assess, analyze and distribute data and intelligence. Modern AI capabilities include:

- Information collection and analysis,
- Facial, speech, and handwriting recognition,
- Sentiment analysis,
- Gait recognition and
- Behavioral analysis (Spiegeleire, Maas, & Swejis, 2017, p. 47).

Beyond surveillance, AI enhances meaning extraction and intelligence utilization. It excels at identifying trends within data troves, enabling near-real-time analysis by sifting through vast information streams. In this direction, it is used to sift through large chunks of information for near real-time intelligence analysis.

A huge information bank is emerging for all people in the world, not only that, but our behavior is being monitored, measured, recorded and analyzed in real time (Mayer-Schonberger & Cukier, 2017, p. 142). Your relationships and life dynamics can be tracked pictorially with your information on social media. One of the techniques developed to analyze such big data is Natural Language Processing (NLP). NLP is a computational automation system using artificial intelligence and language application to help make sense of human (natural) language in social media. Machine-learning algorithms establish statistical correlations for human analysis (Bollen, Mao, & Zeng, 2011). Another contribution of NLP to the intelligence gatherer is to distinguish between necessary and unnecessary information. This type of filter is also called "precisification" (Bowick & Chambers, 2012, p. 606). Another application of NLP is that it reveals the architecture of relationships with multiple layers of classification. Thus, more advanced relational analysis can be performed.

The use of artificial intelligence in autonomous systems complements the machine's ability to select, identify and engage the target. Some autonomous systems can be used for surveillance purposes. For example, to defend ships, bases or other potential targets (such as rocket and missile defense) (Russell & Norvig, 2009, p. 17). Artificial intelligence and machine learning are the main areas of application in unmanned systems and in the autonomization of machines. Machine Learning aims to enable machines to have decision-making mechanisms. Especially in unmanned systems, these methods are widely used in areas such as command and control, navigation, perception, recognition and precaution, image processing and behavior determination.

It is predicted that artificial intelligence will make a great contribution to intelligence analysis. In this context, countries have to carry out Electronic Intelligence (ELINT), Communication Intelligence (COMINT) and Image Intelligence (IMINT) activities, which are evaluated under the main heading of Signal Intelligence (SIGINT) based on artificial intelligence systems in order to operate decision-making mechanisms independently. Cyber and electronic warfare sensor systems are needed to conduct intelligence with artificial intelligence/machine learning in the operational environment. These sensor types include Synthetic Aperture Radar, Electronic Intelligence, Full Motion Video and Third Generation Forward Looking Infrared Sensor. Of course, new software systems and databases are also required.

AI-powered systems can quickly process large amounts of data and detect suspicious behavior and threats earlier. Example use cases include data analytics, facial recognition technologies and digital espionage;

- **Data Analytics:** Intelligence agencies use AI to extract meaningful information from large data sets. In particular, data collected from sources such as social media, e-mail and phone calls are analyzed by AI to identify potential threats.
- **Facial Recognition Technologies:** AI-powered facial recognition systems al-

low for the rapid identification of potential suspects or terrorists. AI-powered security cameras are used in critical areas such as airports, border gates and public buildings.

- **Digital Espionage:** Artificial intelligence has increased the capacity to spy in the digital world. Especially in the field of cyber intelligence, tasks such as infiltrating the digital infrastructures of enemy states, data collection and password cracking have become more effective with artificial intelligence.

Sensors and computing tools at the cutting edge of technology, integrated with artificial intelligence and cloud computing, will transform intelligence in terms of location, method and speed in the execution of operations and decision-making (Katz, 2020). Therefore, intelligence agencies must now innovate faster than their competitors to rapidly develop, field and utilize technological intelligence tools. The technological advantage in the field of intelligence will be rapid and at scale. Although artificial intelligence will have many contributions to analysis, it is clear that it cannot have the full capabilities of the human mind and emotions. Rather than replacing the human element, the application of artificial intelligence in intelligence science creates the need for qualified people who can use artificial intelligence. However, as the struggle shifts to the Metaverse, we need to prepare for a new competition in the virtual world that involves humans.

3. What Is the Metaverse? Evolution and Potential Thereof

We can call "metaverse" multi-domain environments where humanoid virtual interaction is experienced between physical and virtual objects, implemented with advanced virtual reality (VR) and haptic technology (Marsili, 2021, p. 95). The Metaverse expands virtual and mixed reality possibilities, facilitating interaction between physical and digital worlds, bringing these two worlds closer together. Potential applications in the Metaverse construct and direct 3D objects while also providing more intuitive, human-centered interfaces through AI (Marsili, 2021, p. 98). If we connect from the virtual world to the real world, the Metaverse's impact on intelligence and military operations becomes easier to understand. In such an environment, the convergence of cyber and electromagnetic operations plays a crucial role in achieving dominance across the entire spectrum (JCS, 2022).

According to entrepreneur and author Matthew Ball: "The Metaverse is a more evolved version of Web 3. *When largely completed, it will be an environment within a series of decentralized, interconnected virtual worlds where people can do everything they do in the physical world*" (Armstrong & Reeve, 2021).

The Metaverse is an interdisciplinary ecosystem created by different embedded technologies with various layers throughout its architecture. Simply put, we could call it the three-dimensional version of today's internet. Several elements move between physical and virtual worlds in the Metaverse environment. The key element among these is users. A user moves through the virtual world using AR/VR glasses or Head-Mounted Displays (HMDs). These tools allow users to both interact within the virtual environment and perform different activities. Other key elements include the Internet of Things network enabling interaction between physical and virtual worlds, virtual service providers, and physical service providers. Some of the inseparable technologies in the Metaverse are shown in **Figure 1**.

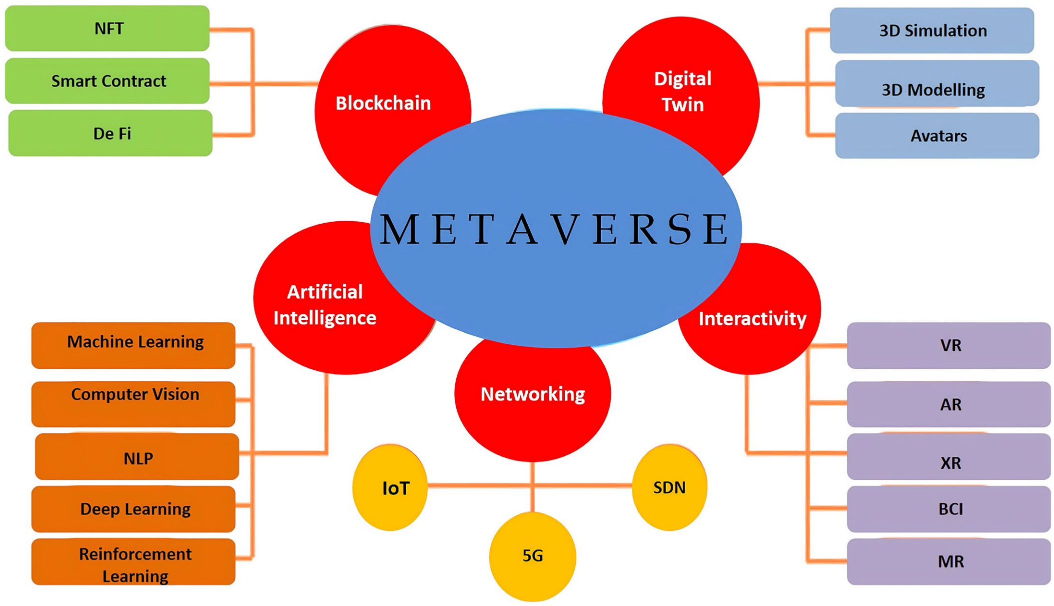

Figure 1. Technologies constituting the metaverse.

Fundamentally, Metaverse technologies consist of virtual reality (VR), augmented reality (AR), mixed reality (MR), Internet of Things (IoT), Blockchain, and artificial intelligence (Kallman, 2018). The combination of artificial intelligence with virtual reality, augmented reality and mixed reality technologies has paved the way for new intelligent experiences that include humans. We are witnessing transformative developments that enable user interactions, realistic simulations, and applications in diverse environments by combining all these realities with AI (Huynh-The et al., 2023).

The Metaverse uses AR/VR technologies to merge virtual worlds with reality. In these virtual worlds, efforts are made to create augmented or virtual reality experiences where people can have real-time experiences. In other worlds, users can work and move in addition to interacting with each other. Although the Metaverse isn't completely real, some platforms contain real elements.

Augmented Reality offers various wonderful tools to perfect existing environments and present an enhanced version of reality, ultimately providing the best experience (GeeksforGeeks, 2018). Essentially, AR adds various digital elements to make the real world better and more useful than before (Rauschnabel, 2021). AR technology helps ensure security, training mechanisms, and simplifying systems.

The Internet of Things, provides connection and communication between many devices like smartphones, smartwatches, medical devices, etc., using various technologies including sensors, wireless networks, and nanotechnology (Aghdam et al., 2021, p. 199). IoT, together with other technologies, is transforming human life by making things (objects) easier for us to use. Thus, the quality of human life is also improving.

Blockchain is one of the disruptive technologies that can completely change the way we communicate with each other online and offline. It is a continuously growing ledger of blocks that are linked and secured by cryptography (Iansiti & Lakhani, 2017, p. 119). Blockchain technology creates a decentralized recording system that is resistant to data and transactions falling into the hands of other organizations and being subsequently altered.

Computer vision algorithms provide virtual objects that allow us to perceive and interpret virtual information from the virtual and real worlds in the Metaverse. This technology helps avatars and virtual assets to recognize and interact with objects, movements, and facial expressions, enabling more continuous and realistic interactions with users.

Machine Learning (ML) techniques are used to train artificial intelligence models and algorithms that enable learning and adaptation based on user interactions and data in the Metaverse.

Data is collected via the Internet of Things and sensor networks and is used to develop a digital twin. A digital twin, which is a virtual model of a physical object, uses real-time data. Virtual and physical service providers help maintain the virtual and real environments in the Metaverse.

The source of the data can be databases, files, Application Programming Interfaces (APIs) (two software learning from each other) or streaming information platforms. Data mining in the Metaverse is currently in its initial phase. Although data mining tools become obsolete very quickly, extracting data in the Metaverse will provide very valuable data insights. The data collected in the Metaverse comes in multiple formats. This data can be received from the user's hardware in the form of controller actions, eye movements, and head turns. The user's behavior in the environment influences various trends and habits, for instance, affecting data points. These data points are key to refining the experiences presented to the user. Memory is where the processed data is stored and resides, such as a database, a data warehouse, or a cloud storage solution. In the final stage, the data is used for analytics, model training, or powering AR experiences.

Ensuring data quality, security and personal data protection (privacy) is of utmost importance, especially in any technological environment dominated by augmented reality (AR) and artificial intelligence. Data quality refers to the accuracy, reliability, and consistency of the data. In augmented reality (AR) and artificial intelligence applications, high-quality data is necessary for accurate AR overlays, proper AI model training, and meaningful insights.

A Digital Twin refers to the digital representation of physical objects (Croatti et al., 2020, pp. 44, 161). This digital copy created in the virtual world uses technology with three main parts: the real object, its digital copy or virtual equivalent, and the data link between the physical and virtual objects.

Using artificial intelligence algorithms, VR systems generate realistic virtual environments, simulate human-like behaviors, and provide adaptive interactions. AI-powered intelligent agents and virtual assets in VR environments understand user input and engage in human-like, continuous, and ongoing interactions. Furthermore, AI-powered computer vision enables VR systems to track user movements, understand gestures, and provide a more intuitive and immersive user experience.

The current capabilities of the Metaverse, combined with artificial intelligence, are constantly evolving, continuously offering a wide range of possibilities for human-like and intelligent virtual experiences. Some of the current Metaverse capabilities that use artificial intelligence are (Yang et al., 2022a):

- Intelligent Virtual Agents.
- Personalization and Contextualization.
- Realistic Simulations.
- Natural Interaction.
- Intelligent Content Generation.
- Machine Learning and Adaptation.
- AI-Assisted Creativity.
- Social and Collaborative Experiences.
- Data Privacy and Security.

Beyond basic tools like personal computers, smartphones, and a robust internet infrastructure, having an unconventional experience environment requires owning many different tools: virtual reality headsets, augmented reality glasses, sensor technologies, and software programs prepared for such environments. The construction of these technologies, while not yet fully reflecting the Metaverse, is continuously progressing. In the next decade, significant developments are expected in the Metaverse field, along with Web 3.0 technologies. Consequently, these technologies are having a significant impact on how users interact with each other and how they relate to the internet.

4. Metaverse Intelligence (METINT)

Intelligence can be defined as the capability that uses meta-cognitive processes to learn from past experiences and adapt to the environment to enhance learning (Sternberg, 2020, p. 87). The Metaverse Intelligence can be defined as special intelligence structure, method, or asset adapted and used with novel technological capabilities such as artificial intelligence, 3D internet, Blockchain, to operate within metaverse environment combining physical and virtual worlds, offering significant opportunities for the intelligence community. The rise of new technologies, especially the Metaverse, has created a distinct culture in the expression of virtual experiences. A new and unprecedented form of intelligence is emerging in this environment. The Metaverse, just like the internet and other technologies that came before it, brings a new culture (Hovan George et al., 2021, p. 7). The unique characteristics and dynamic interactions of the Metaverse require cognitive flexibility, problem-solving abilities, and the technological proficiency to navigate and influence the evolving cultural and technological landscape (Mourtzis et al., 2022, p.

654). A variety of human capabilities in the cognitive, emotional, social, and technological domains are needed in the Metaverse.

The emergence of a new digital culture adapted to the Metaverse environment necessitates a fundamental re-evaluation of intelligence theories to integrate this new cultural paradigm. Traditional theories and assessment tools are insufficient for a comprehensive intelligence approach within the new Metaverse framework. Given the unique features of the Metaverse and its demands for cognitive flexibility, social intelligence, cultural adaptation, and technological competence necessary to engage with the new virtual experience, existing intelligence models are inadequate. Therefore, an etic-emic approach (looking from within to understand the culture) must be adopted to develop a new theory specific to Metaverse intelligence. "Metaverse intelligence" can be developed by using the environment, living within it, working effectively, and identifying specific intelligent and intelligence-related needs as illustrated in Figure 2.

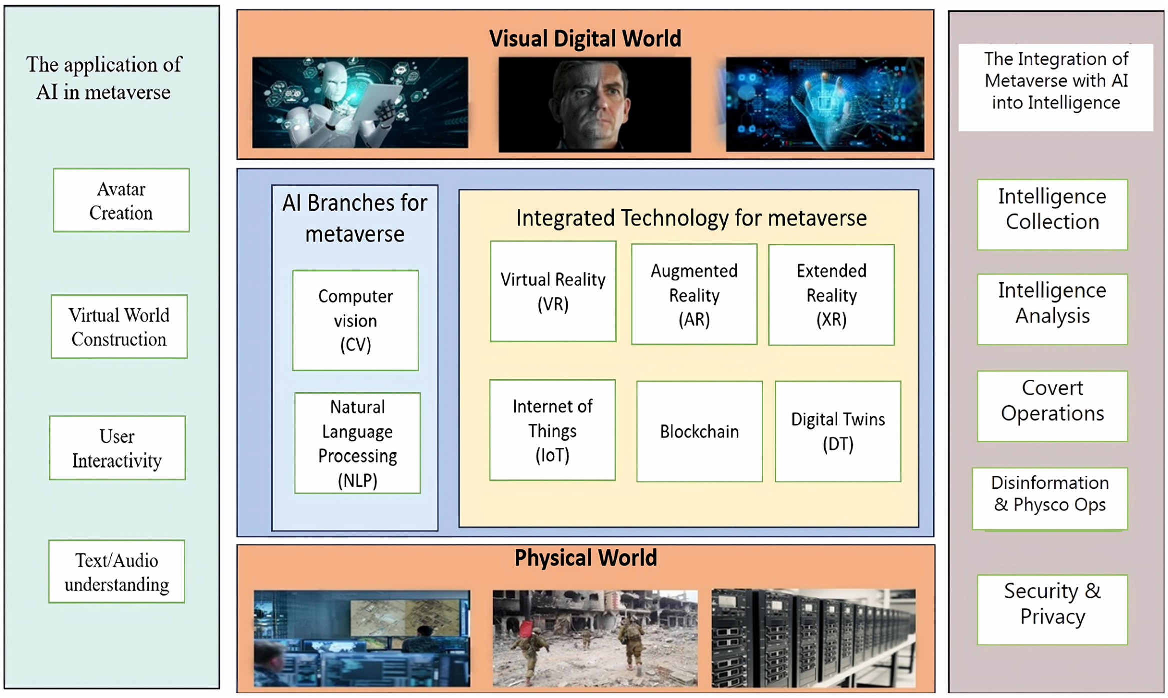

Figure 2. AI-powered metaverse and intelligence functions.

Although filtering information in Metaverse environments may seem advantageous, it is considered not to be beneficial. In terms of individuals' trust and potential dependence on Metaverse content, it can lead to negative consequences in perception management (Tseng et al., 2022, p. 9). Navigating the virtual environment of the Metaverse and adapting to any culture requires integration with intelligence. The Metaverse architecture provides a unique advantage in supplying additional information, but we cannot say that this information is always accurate or flawless. It is crucial to be cautious to avoid misinformation or the unintentional misuse of information (Carter & Egliston, 2023, p. 492).

It is inevitable that this new culture will be explored and that intelligence will undergo a fundamental transformation due to the demands of its different dimensions. Similar to the real world we live in, intelligence within the Metaverse can be evaluated from various perspectives. New intersection points are emerging between the Metaverse and military intelligence, social intelligence, scientific intelligence, and even cultural intelligence. In these evolving virtual environments, individuals can coexist and work collaboratively. This situation necessitates a multifaceted understanding of intelligence and the adaptation of its dynamics to suit the intelligence expectations of the new technological and cultural environment.

There are several potential benefits to using the Metaverse in intelligence systems. First, actors can enter facilities from anywhere and continuously monitor events virtually, remaining in the same environment as if they were face-to-face. Second, the Metaverse can provide resources and services quickly. This capability will streamline operations and prevent losses by avoiding delays in emergencies. Third, in remote locations lacking professional consultation and assistants, users can provide remote control and support regardless of distance and travel limitations. Fourth, transportation and service costs, along with physical visits and footprints, are reduced. Another benefit of the Metaverse is acquiring seamless monitoring functionality with VR and AR technologies, without geographical barriers. Lastly, it reduces feelings of stress and anxiety in users.

Currently, artificial intelligence algorithms engage with large volumes of data, and the reliability of that data is crucial. AI algorithms require better resources to solve problems effectively. However, sharing high-accuracy and personal data/intelligence over the existing internet is difficult. Therefore, most AI research focuses on a personal agent that can access pre-determined massive databases in a local environment (Yu & Yu, 2023, p. 45). However, in practice, many interesting systems are either too complex to create a suitable model in a static, pre-determined environment, or their dynamics are variable (Haenlein &Kaplan, 2019, p. 9; Jordan & Mitchell, 2015). The use of drones in different functional areas (intelligence, electronic countermeasures, direct attacks, etc.) and different operational environments (land, sea, air, amphibious) renders flexibility important for dynamic conflict situations. While cyber and metaverse connectivity is becoming increasingly intertwined for key capabilities such as drones and other network-dependent operations, they are becoming increasingly intertwined.

In Silicon Valley, new virtual sectors are being created where artificial intelligence will replace humans. In the future, these systems are expected to completely replace human cognitive systems and make complex decisions fully autonomously. This autonomous software, when integrated into unmanned aerial vehicles by the US, will initiate a new era for both intelligence gathering and striking targets. Now next in line is a new Metaverse killing and intimidation campaign where AI-powered holograms will have data fusion capabilities along with deepfake videos. This new project, designed within the internet environment that will now be three-dimensional, also forms the basis of our thoughts in the field of Metaverse intelligence.

5. The Concept of Metaverse Intelligence

The fundamental law of intelligence is always the same: there is a piece of information (data, news, intelligence) to be obtained, and you want to acquire this information through a method (collection). The two actors in the system are the "user (customer)" who needs this information and the provider, which is the "intelligence organization or the assets/methods it uses. Each method or collection asset (human, satellite, computer, etc.) tries to achieve results within its own specific environment.

Within the Metaverse, for AI-powered virtual agents, a dynamic and engaging environment is created where users can act in previously unimaginable ways through adaptive experiences and realistic simulations. Consequently, the Metaverse reality is entirely digital, and every person, thing, action, choice, and purpose can generate data.

To generate data in the Metaverse and, when necessary, to make swift decisions and conduct operations with AI based on this intelligence, we must create a smart (AI-using) environment with appropriate actors, hardware, software, and applications. In a metaverse environment, at least the following can be expected;

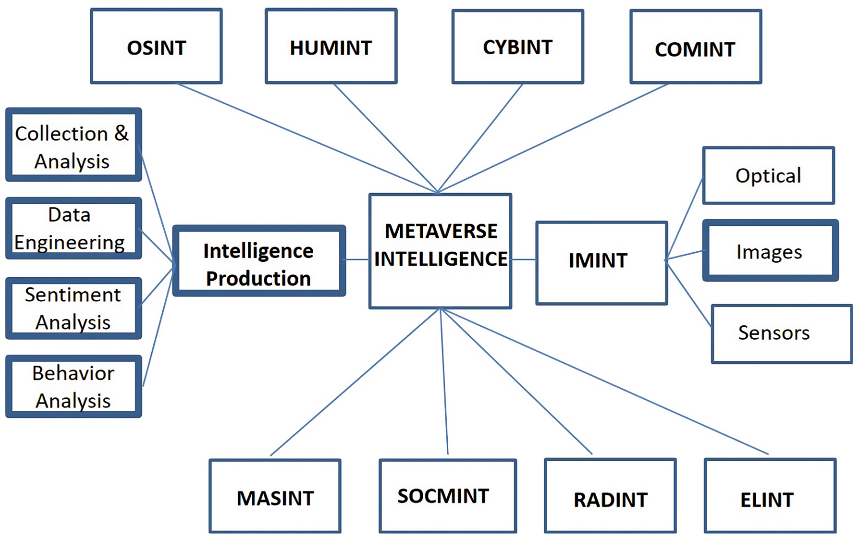

Figure 3. METINT and intelligence connection.

(1) Decision makers, operators, controllers and other technical (autonomous) elements that build, operate and improve the environment.

(2) The environment itself: the physical world, avatars of designated actors within the virtual world, and other environmental elements (buildings, rooms, safe houses, equipment, etc.).

(3) Supporting programs: Web 3.0, 5G/6G internet, software, intelligence-functional applications (using AI), technologies (blockchain), etc.

(4) Other collaborating environments: different intelligence functions (COMINT, ELINT, SIGINT, etc.), (physical and virtual) covert operations units, propaganda and disinformation elements, etc. (Figure 3).

METINT distincts from the CYBINT/OSINT as unique data types and operational capabilities. Although the formers use the cyber lines and methods in two dimensional visual world, METINT is performed in three dimensional meta environment combining the physical and virtual world. To do that, METINT uses avatars, sensors, cameras or other real world assets to operate even in the virtual world. So that METINT provides different data sets and analysis requiring particular data engineering, as explained at below section, and operational capabilities such as intelligence collection, covert operations and perception management. Metaverse visual world construction embraces different technologies including Augmented Reality, Virtual Reality, Extended Reality, and mixed reality and their corresponding tasks. The majority of VR, AR, and XR systems use an optical see-through or video see-through display to record visual data (Żelaszczyk & Mańdziuk, 2023, p. 302).

A Metaverse environment is designed for the needs of a specific region, conflict, or long-term monitoring/tracking system. For example, a separate Metaverse environment can be designed for northern Syria in the fight against terrorism, or for the Black Sea to monitor the activities of the Russian navy. These environments can be expanded over time, integrated with other environments, and even used for international cooperation. In essence, while the Metaverse is the three-dimensional environment of cyber intelligence, it is much more than that because it also encompasses the real world. When establishing a Metaverse environment, one can start by transforming the cyber environment, but in this very new field, creative ideas that are constantly renewed for designs, methods to be applied in intelligence acquisition, target-locking applications, and covert operations come to the forefront.

Metaverse is a persistent, unified network of 3D virtual worlds that will eventually serve as the gateway to most online experiences, it will also underpin much of the physical world. These concepts, which were formerly restricted to science fiction and video games, are now being developed to revolutionize for the intelligence services to operate in metaverse environment. Those efforts require a deep discussion about how we can create a Metaverse intelligence using different AI technologies (Qamar, Zahid, Mehreen, 2023, p. 128). Applications of metaverse for a intelligence operation needs four main stages at least;

(1) Avatar creation and customization:

The process of creating immersion involves creating virtual scenes in the Metaverse and displaying them to users, using inspiration from computer vision, graphics, and visualization techniques. Users can engage with others in a real-world setting without any physical restrictions by becoming a Metaverse Avatar. In the Metaverse, during various social interactions, specifics like the Avatar's facial features and micro-expressions, as well as the entire body, can impact user perceptions (Cheng, Zhang, Li, & Yuan, 2022).

(2) Metaverse world construction:

Visual world Creation tasks which are critical to the success of every Metaverse application can be divided into three main parts: scene generation and recognition, Non-player character (NPC), and Player character (avatar) construction. Users will encounter numerous vibrant and realistic scenes in the Metaverse (Salah et al., 2023). Making physical-based constructions is one method for creating 3D models. This is accomplished by using 3D measurement techniques, photogrammetry and notably laser scanning to build digital twin models.

(3) User interactivity:

The Metaverse offers users, the digital world, and the physical world sophisticated, multimodal interaction services. The main obstacles to ensuring immersive experiences are real-time data flow and multi-player interaction across various Metaverse zones. First, although more intensive rendering computations are needed, intelligent devices facilitate the powerful perception and interaction capabilities of the Metaverse (NVIDIA Developers, 2023). Second, users must synchronize and switch services seamlessly between the physical and digital worlds in various Metaverse zones to employ diverse Metaverse services. Lastly, in a large-scale, complicated situation, flexible setup and optimization of multidimensional network resources are also important for multi-player engagement.

(4) Text/audio understanding:

To completely support text- and speech-based interactive experiences between human users and virtual assistants in the Metaverse, NLP approaches should be merged (Open AI, 2023). The major method of communication between entities (avatars, virtual people, or even non-human things) in the Metaverse is voice, which is seen as one of the key interfaces for humans to enter the Metaverse. The two primary tasks involved in voice processing are automatic speech recognition and text-to-speech (or speech synthesis), which converts voice signals to text or vice versa. Additionally, audio signals might be converted into binaural signals so that people might experience auditory immersion and a feeling of the position of the sound source in an enclosed area.

To form a metaverse environment for intelligence operations, followings steps may serve based on the specific real time conditions and missions expected:

- Define the mission and boundaries of real environment(s) to operate.
- Configure the metaverse environment with visual and physical elements (avatars, sensors etc.) as explained above.
- Clarify the interactivity and processes within metaverse.
- Sustain the cycle and feedback.

Let's provide an example related to the Black Sea environment to illustrate how we will generate intelligence in a Metaverse environment:

(a) Within the Metaverse environment, the entire designated physical (real-world) sector, in short, the Russian navy's personnel, warships, weapons, etc.—all actors to be monitored—are placed under tracking and surveillance through applications.

(b) By identifying the behavioral patterns and tactics of these actors, it becomes possible to deceive and entrap them with our own real naval assets in crisis situations, to issue misleading orders by imitating commanders' voices, and to destroy them in designated trap zones (as Western forces are currently doing with trapped aircraft and ships in the Black Sea).

While integrating with the real world through avatars in the system, results will be achieved by tracking targets with their coordinates, hooking into characters with applications, exploiting their weaknesses, and detecting their communications among themselves. Normally, the hooked person/element must be connected to the internet because the system is based on the internet. When this is not possible, their continued presence in the system can be ensured through a device that continues to operate in their immediate vicinity (a mobile phone, a smartwatch, an application with another underlying algorithm like a pedometer on their phone, a special gift, etc.). The target must be drawn into your environment through attractive or deceptive methods and kept there; their actions must be tracked with algorithms; the information from applications must be evaluated by artificial intelligence; and a result (information, operation, perception management) must be obtained after an autonomous/semi-autonomous decision-making process.

The Metaverse should be thought of largely as a game-like environment. Therefore, it should be considered that those involved in managing the environment should be good players. This game is played within a real world with simulations and virtual actors. The game managers use wearable smart accessories/glasses in the environment. The Metaverse environment should be viewed from both a hardware and software perspective. The person must unknowingly use the hardware, remain in the environment, and be steerable by the avatars and applications in the environment. The internet infrastructure of the established system must not be hacked, and avatars and applications must be constantly renewed with creative ideas. For the security of connections, it is important for each Metaverse environment to be independent and to develop protective methods for the security of its own encryption and systems.

Although METINT may initially be seen as a sub-branch of cyber intelligence, it will soon replace it, as the trend is towards a three-dimensional internet. It will no longer be just about listening to conversations; with Metaverse applications now being adopted in the medical world, a person's heartbeat, for example, can also be tracked. With a Metaverse application, not only your location but also the route and distance you have traveled will be determined. What is important here is creativity and developing suitable applications accordingly. Among these applications, voice and facial recognition stand out today. But the real issue is to bring the target audience into the Metaverse environment and to keep them there continuously. The person should be directed to an environment (internet, mobile phone, an innocent-looking application, etc.) where they feel "I must be here too." The geography of this in a broad sense is Metaverse geopolitics.

In conclusion, the Metaverse environment will use creative deception methods to attract the target audience and will create not only target intelligence but also perception. The Metaverse can function very rapidly at every stage of the intelligence cycle (collection, classification, processing/analysis, and dissemination). It can quickly read intentions through behavioral analysis. The system essentially serves intelligence agencies like the NSA, whose mission is a global surveillance and monitoring system, best. For countries, it can be most helpful for target intelligence and for point intelligence in the intelligence activities of a specific region. From a national intelligence system perspective, it should be considered not as a part of a specific intelligence agency but as an independent structure with its own functions, and even the establishment of multiple Metaverse environments according to mission areas should be contemplated.

6. Metaverse and Data Engineering

"Data science" includes fields such as statistics, data modeling and analysis, computer vision, and machine learning (with artificial intelligence). The information we obtain through data science helps us decide what will happen next or understand how the world works. Data science is a discipline where computers and algorithms perform scientific operations. It extracts information and insights from both structured and unstructured sources. It uses this information and understanding in a wide variety of environmental applications. Data science techniques come from various disciplines such as statistics, computer science, and domain knowledge.

Data engineering is a crucial part of harnessing the power of AR and artificial intelligence. The effective collection, storage, and preprocessing of data for AR and AI applications optimize actions and provide meaningful and accurate experiences. Ensuring data quality is a key part of data preparation. This involves checking for inconsistencies or errors in the data. Effective data engineering is the backbone of successful AR and AI applications. So, applications run with accuracy, efficiency and reliability.

Data collection is the process of gathering different types of data to train artificial intelligence models and develop AR applications. In the context of AR, images, videos, sensor data, and three-dimensional models are very important. These data types help in the accurate creation of AR overlays and experiences to interact correctly with the real world. Data collection methods can include (Patni & Choudhury, 2024):

- **Sensor data**: Instruments that come from various sensors (GPS, weather sensors, accelerometers, gyroscopes, etc.) and help to understand the user's movements and environment.
- **Image and video data**: Images and videos collected especially to train artificial intelligence models for object recognition and tracking AR movements.
- **Three-dimensional (3D) models**: 3D models of objects and environments are generated or scanned for realistic AR interactions. For example, for an AR application to be used in a design, three-dimensional data of furniture, room layout, and real-world textures are collected. Users use this data to virtually place furniture in the environment.

Data integration is the process of combining and consolidating data from multiple sources to create a connected and comprehensive view. In the context of AR and artificial intelligence, it is essential to combine data collected from different sources such as databases, APIs, sensors, and external applications into a single dataset for analysis, model training, and enhancing the AR experience. Data integration methods can include (Caudell et al., 2003, p. 26):

- **Extract, Transform, Load (ETL)**: The ETL process involves extracting data from various sources, transforming it into a standard format, and loading it into a central repository for easy access and analysis.
- **Data Virtualization**: Data virtualization technologies enable real-time access and integration of data from different sources without the need for physical movement or data replication. For example, when an AR application provides real-time translations, data integration provides language datasets from many different sources like language repositories and data libraries to deliver comprehensive and accurate language translation capabilities.
- **Data Pipelines**: Data pipelines are structured processes through which data moves, is transformed, and prepared for organized and automated storage, analysis, and use. They regulate the journey of data from its source to its destination, ensuring it arrives with the necessary transformations and data quality.

Several problems arise without data integration knowledge. Data from various sources remains disconnected and disparate. Meaningful insights cannot emerge in this fragmented data environment. If there is no proactive approach to data integration, valuable information remains locked away in silos.

Effective data storage is important for the usability of the massive amounts of data generated by AR and artificial intelligence applications. Properly organized and stored data ensures fast retrieval, seamless processing, and reliable application performance. Data storage methods may include:

- **Databases**: Databases such as relational or NoSQL (purpose-driven) databases can be used to store the structured and unstructured data generated by AR and artificial intelligence applications.
- **Cloud Storage**: Cloud platforms can be used to provide scalable and secure storage, easy access to data from anywhere, and provisions for redundancy and backups.
- **Distributed File Systems**: Using file systems like the Hadoop Distributed File System for efficient storage and processing of large datasets.

The data preprocessing process is the extraction, transformation, and organization of collected data for use in analysis or training of artificial intelligence models (Bejnordi et al., 2017). This stage is crucial for ensuring the accuracy and reliability of AR and artificial intelligence applications. Data preprocessing methods include:

- **Data cleaning**: Removing or correcting inappropriate and inconsistent data to improve database quality.

- **Feature engineering**: The selection and engineering of appropriate features to enhance the performance of AI models related to the data.
- **Normalization and Standardization**: It is the scaling and standardization of data so that certain features of AI models are not biased. For example, in an AR application using AI for language translation, the data process involves cleaning and organizing multiple datasets, embedding appropriate features for more effective translation, and standardizing text formats.

Increasing database size and model performance by generating synthetic data through image or text analysis.

Metaverse systems have a greater potential than conventional systems for collecting highly sensitive data. Access to such sensitive data poses a serious threat to the protection of personal information. In a modified or leaked virtual environment, the probability of accessing private information on the Metaverse platform or service systems is very high. For example, while a user is using the platform, avatar data such as audio or video recordings could be secretly listened to, or an attacker could create a fake avatar for malicious purposes. Therefore, the security and protection of users' private data are vital. For this purpose, Blockchain technology is being integrated as a solution for data security in the Metaverse system.

The Metaverse's ability to host large-scale virtual environments heightens the risk of unauthorized reproduction and use of IP, leading to a heightened need for stringent enforcement mechanisms. For example, the unauthorized use of digital assets could be linked to broader forms of fraud, identity theft, cybercrime, counter-intelligence. Furthermore, jurisdictional challenges arise when trying to enforce IP rights across different virtual environments. The decentralized and global nature of the Metaverse means that traditional law enforcement methods, rooted in geographic boundaries, become less effective. This highlights the need for new approaches that can operate effectively in the borderless world of the Metaverse.

The decentralization of many virtual platforms also complicates law enforcement efforts, as it becomes more difficult to track, identify, and prosecute offenders. This fluid, borderless landscape requires law enforcement agencies to develop new strategies and adapt their tools to keep pace with technological advancements. The tools must be able to track digital assets, analyze blockchain transactions, and gather digital evidence while adhering to legal standards. As this digital realm continues to evolve, it is crucial for stakeholders to develop adaptive strategies that address the unique risks and opportunities presented by the Metaverse.

7. Metaverse and Intelligence Architecture

Metaverse platforms collect user data in various forms, such as personal information, preferences, and behavioral tendencies. Transparency and obtaining user consent regarding data collection are important. Users should know what data is being collected and for what purpose and should have the option to grant or withhold consent. Metaverse platforms must use strong encryption methods and have secure data storage practices to ensure the security of user information. Access controls and authentication mechanisms provide an additional layer of protection. Consequently, the Metaverse paradigm provides tracking data not only for various companies and social institutions but also increasingly for scientific structures and, ultimately, for intelligence organizations (Weinberger, 2022, p.310).

After the data is collected, an artificial intelligence model is used to extract insights from the collected data for predictions. Within the Metaverse, artificial intelligence algorithms can analyze massive datasets in real time, providing insights and decision-making capabilities. The fusion of these technologies transforms theoretical discussions into real-world applications. Together, Blockchain and artificial intelligence create secure and intelligent digital environments within the Metaverse. These environments provide useful information across a wide spectrum, from personalized data to enhanced security and privacy. The connection of artificial intelligence to the data integration process is a core element of the system. AI is used to optimize data integration through data matching, object resolution, data enrichment, and predictive analytics. AI technologies make integration more effective and understandable by identifying behavioral patterns, relationships, and anomalies within the data.

Data integration is the nexus of artificial intelligence and database systems. The main goal of a data integration system is to create a unified interface by accessing very different data sources. These sources can include conventional database systems, legacy systems, or even structured files accessed through interface programs (Khezr et al., 2019). A significant challenge of data integration is that data sources are created independently and autonomously. These sources may include data systems from a wide variety of fields, such as relational databases, which can be further complicated by hidden data accessed through legacy systems and interface programs (Lam & Hashmi, 2022, p. 621; Grigaliūnas et al., 2023; Yang et al., 2022b).

Improperly integrated data is subject to inaccuracies, inconsistencies, and duplications. This undermines the reliability of decision-making processes and leads to costly errors. Decisions are affected by the quality and availability of data. When data remains fragmented without being integrated, a comprehensive and accurate picture of the situation cannot be obtained. However, it can be difficult to effectively organize data-driven strategies and insights. Such a lack of information hinders the ability to use the full potential of data for strategic planning, intelligence analysis, and other necessary intelligence functions (Xia et al., 2017).

A proper intelligence architecture can be summarized as follows. There are three environments in question: the agent's environment, the adversary's environment, and the Metaverse's environment. Agents interacting with adversaries in the Metaverse environment are supported by blockchain technology, which provides safety, security, and data protection. The Metaverse environment is the main part of this new architecture. Agents and other actors, analysts, collectors, etc., register and enter the environment via the blockchain and are represented by avatars in the Metaverse environment. A process for a METINT ops is seen in **Figure 4**.

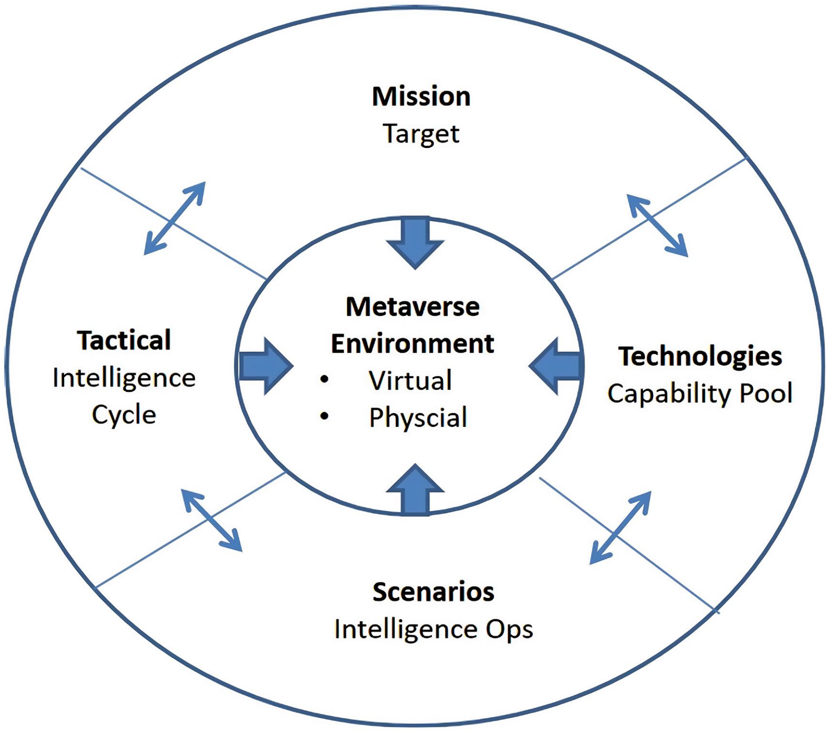

Figure 4. METINT operations.

All interaction activities and data such as images, conversations, texts, videos, and intelligence data between actors are collected, transferred, and stored on the blockchain. This data is used for intelligence predictions and operations with explainable artificial intelligence models. New approaches to AI models provide logical reasoning for intelligence predictions and ensure reliability, explainability, interoperability, and transparency for intelligence collection and predictive intelligence. In conclusion, the proposed architecture provides transparency and trust for both intelligence collection and the data security of the system.

In recent years, very little research and innovation have been seen at the intersection of blockchain technology and intelligence. The driving forces behind this convergence are the need for security and protection in sharing intelligence data and the increasing scope of modern intelligence systems (Ghosh et al., 2023, pp. 11, 38). As technology develops, studies related to blockchain's use in data sharing, data storage, data retrieval, consultation processes, and its combination with other cutting-edge technologies have increased.

8. METINT and Intelligence Services

Intelligence services have already focused their 2025 strategy priorities on three areas Blinde, 2024): modernization through virtualization, mission capabilities using artificial intelligence, and cybersecurity and resilience automation. METINT provides information not only to stakeholders within intelligence services but also to law enforcement, practitioners, analysts, and managers who monitor trends, analyze behaviors, and identify potential threats or conflicts in virtual environments (Rawal et al., 2022). The Metaverse can assist intelligence organizations in the following ways:

- Offering opportunities to increase the value and usability of intelligence.
- Creating a new intelligence environment to counter adversaries.
- Creating new intelligence functions and experiences that will contribute to achieving the ultimate objective.

Metaverse intelligence (METINT), as a special intelligence structure, method, or asset, will operate within its own Metaverse environment. However, some problems may be encountered in integrating Metaverse intelligence into an intelligence organization and its functions. First of all, the classic intelligence cycle is not sufficient to harmoniously integrate all intelligence functions (intelligence collection, covert operations, etc.). Another strategic problem is that an intelligence theory that sets out the conceptual dimension of intelligence has not yet been written. When it comes to the Metaverse, discussions about it as an intelligence function, domain, and a separate organization should be addressed along with the above problems. The formation of a METINT Team is subject to change based on the needs and environment (**Figure 5**).

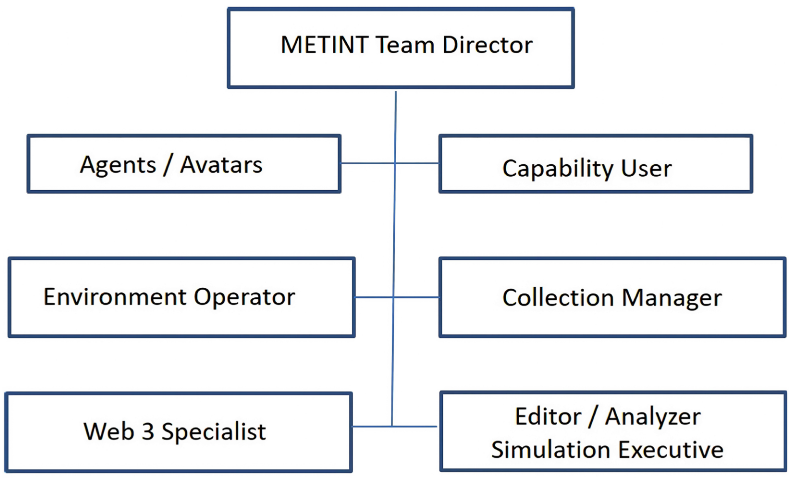

Figure 5. Formation of a METINT team.

In the virtual world of the Metaverse, people appear as avatars, which are copies of reality. Users can change the appearance of their avatars as they wish. This, along with better virtualization, helps in the seamless execution of complex processes and operations. Digitalization and automation can have a great impact on intelligence functions (intelligence production, covert operations, disinformation, etc.). In the three-dimensional internet environment of the future, you can create hallucinations that will frighten people with holograms.

In Metaverse intelligence, contact is made with agents virtually through avatars. The required data, intelligence, and other necessary information are collected using head-mounted sensors. In the Metaverse environment, people are questioned with avatars to gather information about events and their history. Data is processed and analyzed with AI models powered by artificial intelligence and blockchain. The intelligence operation will be executed within the Metaverse using these technologies and projected into the adversary's environment.

The avatars seen in the intelligence Metaverse are actually real people, and most are selected from within the target audience. Everything you see in the Metaverse creates value-added intelligence. The contribution of the Metaverse to the world of intelligence can be as follows:

(1) Gaining a first-mover advantage.

(2) Enriching the intelligence experience.

(3) Contributing to successful intelligence products.

(4) Collecting data.

(5) Collaborating with propagandists.

(6) Establishing a new intelligence base.

(7) Increasing situational awareness.

(8) Engaging avatars for offensive purposes.

(9) Providing resources and materials.

(10) Testing the system.

The METINT concept can be built upon existing models like Open-Source Intelligence (OSINT) and Social Media Intelligence (SOCMINT), adapted to meet the expected needs of the Metaverse. By combining insights obtained from fields like OSINT and SOCMINT, the new METINT framework can make coercive strategies within the environment more targeted and effective.

For all intelligence structures, the main part of the entire architecture is the Metaverse environment, which will provide virtuality to the setting. User avatars, intelligence staff, and operators are created in the environment. During the consultation process, voices are recorded, and data can be extracted using the natural language processing (NLP) process. After the data from NLP is analyzed, if more images or other data are needed for operations, agents request reports from collectors.

In summary, the Metaverse can provide unprecedented creative and new opportunities for intelligence organizations in their intelligence functions. However, complex problems may be encountered in the protection and security of the intelligence environment. As the digital environment evolves, there is a need to develop adaptable strategies for the unconventional risks and opportunities that may be encountered in the Metaverse environment. By anticipating different future scenarios for the Metaverse, identifying potential threats, and developing specialized intelligence assets and collection frameworks, we can protect our intelligence functions on this new digital front.

9. Conclusion

Geopolitics is moving beyond geography, the constraints of demography on national power are diminishing, and new digital developments will play a significant role in ordering the international system in the coming decades. Understanding the implications of this transformation and taking action immediately should be seen as the most urgent national task before us. The digital transformation of power in the 21st century—through the commercialization, operational application, use, and management of new technologies—will be the determinant of national security and prosperity. The extent to which we keep pace with the digital transformation of power will determine not only our place in the new power hierarchy but also how we will resolve crises and conduct our affairs. The digital transformation of power is just beginning. The USA, UK, Japan, Australia, China, Russia, and many other states are becoming less dependent on demography by increasingly creating robotic and AI-powered forces and capabilities. The rising level of use of artificial intelligence, autonomy, and automation is redefining power by reducing the old limits on states' production and coercive capacity.

The metaverse environment is still a very emerging area and will open new avenues for the intelligence services bringing innovation and improvement in this domain. The rapid development of the Metaverse creates a potential for intelligence organizations to establish unique capabilities and advantages through immersive environments where the virtual and real are interconnected. Ongoing wars in Ukraine and Gaza, particularly targeted killing systems, give insights for intelligence activities in the Metaverse environment and open a new era for the intelligence revolution. In that context, we have generated insights on how the intelligence benefit from the metaverse domain and how the intelligence services may adapt their concept, structure, and platforms into metevarse. In that way, as a new intelligence discipline we originated "Metaverse Intelligence" in that article. The creative use of the Metaverse environment, which contains many emerging disruptive technologies, for intelligence purposes will require creativity, scenario development, and complementary technology development, which could be recommended for future articles on the subject.

The transition from traditional digital interactions to more complex, multi-dimensional experiences requires the design and successful implementation of capabilities and features to be used in the Metaverse. Just like other sectors, intelligence has a very attractive future awaiting it in the Metaverse environment. With its unique features and its ability to provide immersive experiences, the Metaverse has significant potential to bring revolutionary innovations to how intelligence services utilize the information sector. The Metaverse can change the direction and content of intelligence as much as it can change the direction of human life. Intelligence operators, using the technologies within the Metaverse, can develop real-time predictions and solutions within various intelligence operations. Different future scenarios predicted for national security must now be integrated into the Metaverse environment and even be shaped around it. Metaverse intelligence, with its new digital-front intelligence assets and functions, much like today's cyber intelligence and as its three-dimensional version, will be an integral part of our national security in the near future.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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