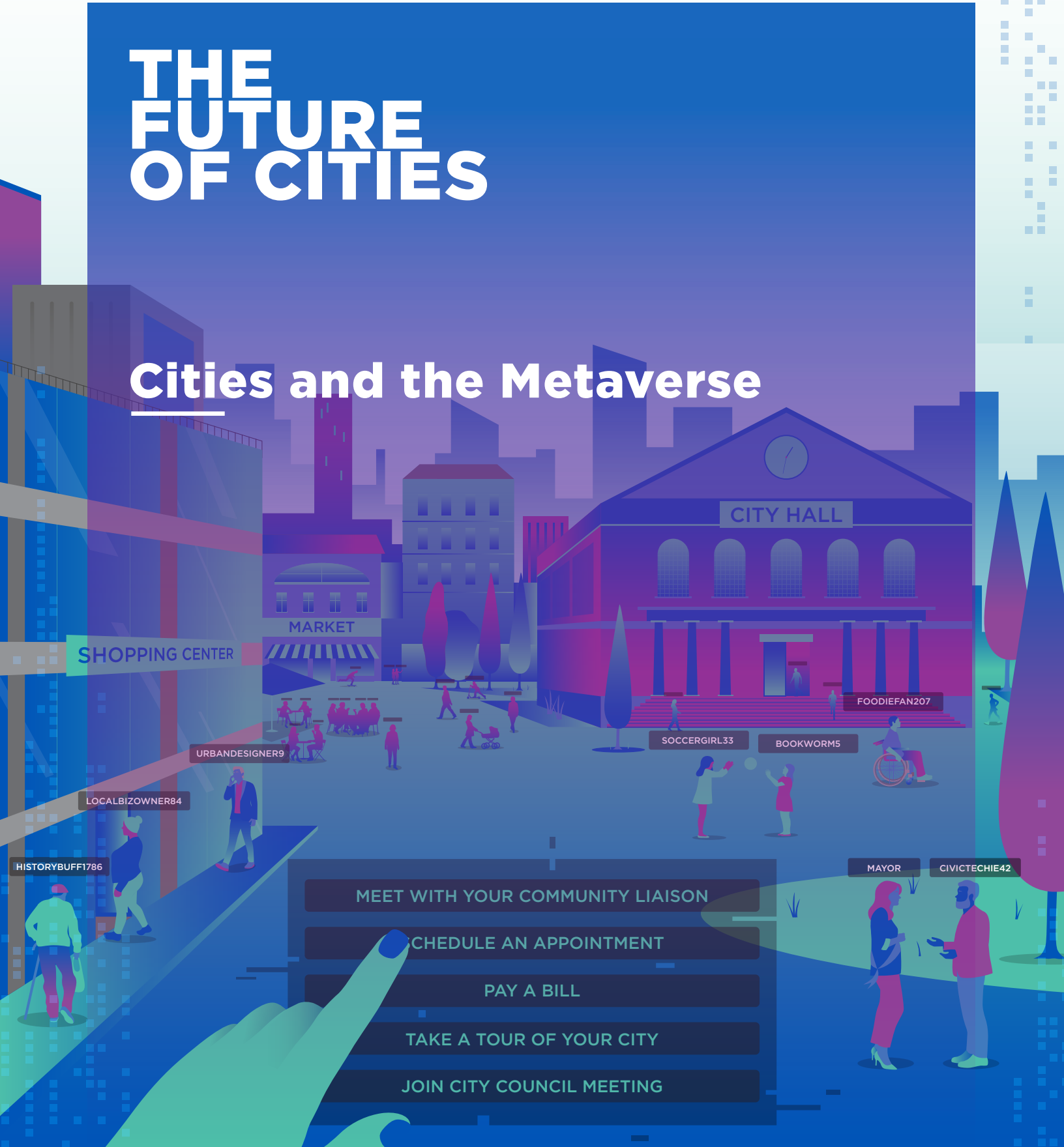


THE FUTURE OF CITIES

Cities and the Metaverse



SHOPPING CENTER

MARKET

CITY HALL

URBANDESIGNER9

LOCALBIZOWNER84

HISTORYBUFF1786

SOCCERGIRL33

BOOKWORM5

FOODIEFAN207

MAYOR

CIVICTECHIE42

MEET WITH YOUR COMMUNITY LIAISON

SCHEDULE AN APPOINTMENT

PAY A BILL

TAKE A TOUR OF YOUR CITY

JOIN CITY COUNCIL MEETING



About the National League of Cities

The National League of Cities (NLC) is the voice of America's cities, towns and villages, representing more than 200 million people. NLC works to strengthen local leadership, influence federal policy and drive innovative solutions.

NLC's Center for City Solutions provides research and analysis on key topics and trends important to cities, creative solutions to improve the quality of life in communities, inspiration and ideas for local officials to use in tackling tough issues, and opportunities for city leaders to connect with peers, share experiences and learn about innovative approaches in cities.

About the Authors

Lena Geraghty, Innovation and Sustainability Director, Center for City Solutions

Tina Lee, Senior Research Specialist, Center for City Solutions

Julia Glickman, Senior Coordinator, Center for City Solutions

Brooks Rainwater, Senior Executive and Director, Center for City Solutions

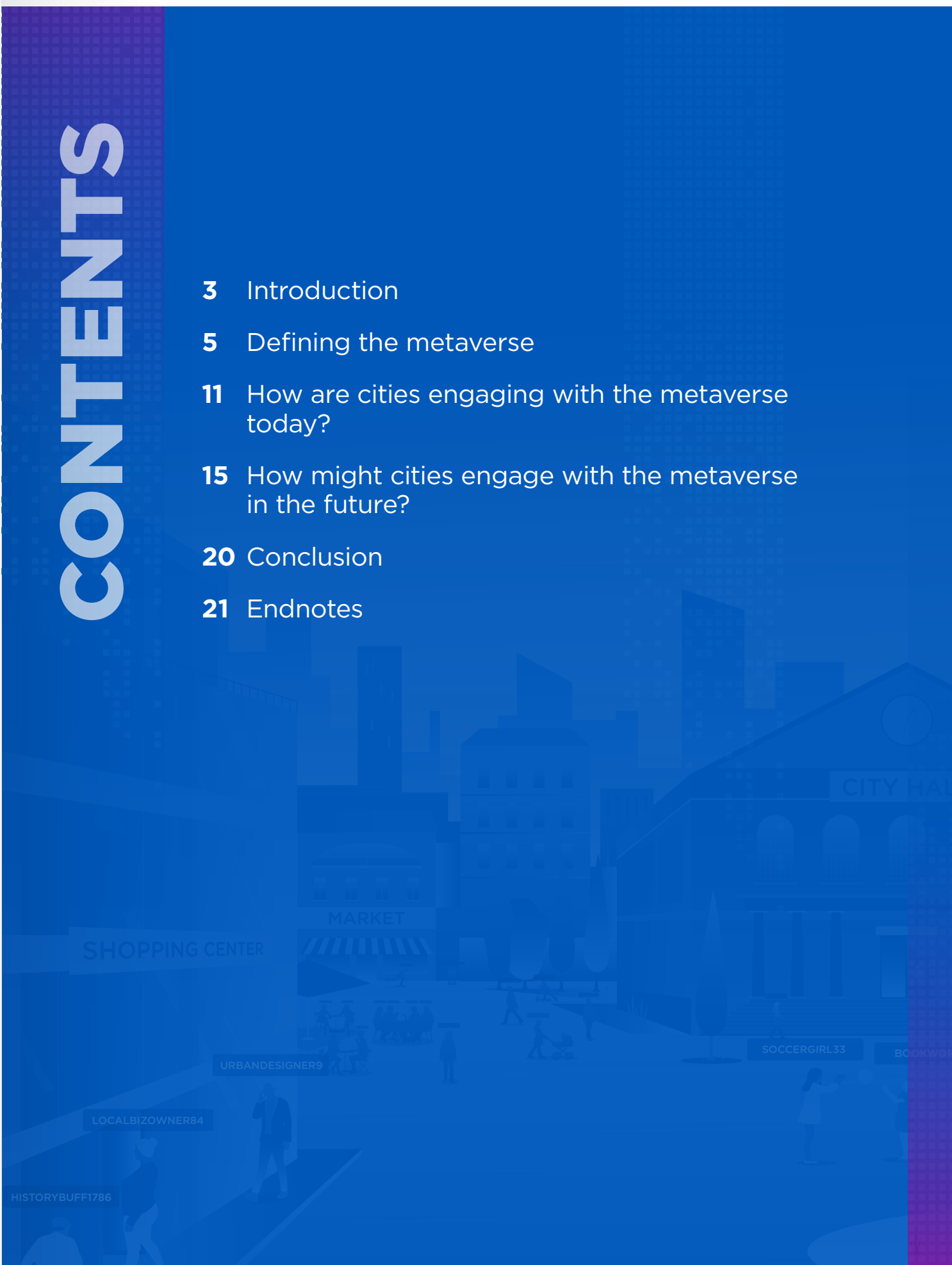
Acknowledgements

The authors would like to acknowledge **Adam De Cata**, Head of Partnerships, Decentraland, and **Otto Boudet**, Deputy Chief of Staff for Mayor Francis Suarez, City of Miami, FL, for their valuable insights

The authors extend thanks to **Clay Dillow** for copyediting and **Evan Potler**, Founding Partner, Chief Creative Officer at Factor3 Digital for design.

CONTENTS

- 3 Introduction
- 5 Defining the metaverse
- 11 How are cities engaging with the metaverse today?
- 15 How might cities engage with the metaverse in the future?
- 20 Conclusion
- 21 Endnotes



INTRODUCTION

Cities are the places where people come together, live, love, work and play. Human connection is one of the most critical components of day-to-day life. Much of the world quickly learned how to connect with one another and access services in virtual environments in response to the COVID-19 pandemic. However, we lacked the ideal tools for connecting in this way. Zoom meetings, Google Chat and good old fashioned phone calls provide a poor simulation of the physical world. What if a true simulation of our physical world could be recreated in a virtual manner? What value would this bring to people's lives, what challenges would it present, and would it ultimately prove to be a net positive for cities?

Technologists and science fiction writers have explored various ideas around virtual reality — and the metaverse — for decades, with various iterations coming online in fits and starts. Whether through video games, online spaces like *Second Life* or stories like *Ready Player One*, the future of cities and their residents will include a virtual world where people

can immerse themselves in a simulacrum of the everyday. Much of the recent discussion pointing toward a more fully developed version of this virtual space or metaverse has come about alongside the development of Web 3 technologies — those that will fuel a much-hyped future internet that is decentralized, more anonymous and fueled by digital currencies.

Imagine a future where community members can interact “face-to-face” with building department personnel on the plans for their new deck from the comfort of their own homes, comment at a virtual public meeting from their office chairs, or even connect with their mayor without having to step into city hall. The technology and vision to create these kinds of virtual spaces and facilitate meaningful interpersonal interactions within them is finally here, and the impacts to society are not yet entirely understood. Leaders need to think about what these technologies will mean for cities as they plan for the years and decades ahead.



LEADERS NEED TO THINK ABOUT WHAT METAVERSE TECHNOLOGIES WILL MEAN FOR CITIES AS THEY PLAN FOR THE YEARS AND DECADES AHEAD.

DEFINING THE METAVERSE

Because it is still being envisioned, there is no agreed upon definition of the metaverse. In short, the metaverse is the next evolution of the internet with a focus on the integration of physical and digital experiences. For some users, the metaverse is an online space meant to digitally recreate the real world. For others, it is a shift in how they interact with their world, using technologies like 3D computing, **augmented reality** (AR), **virtual reality** (VR) and **blockchain** to form new immersive virtual world experiences that have the potential to overlay digital information on our physical world. The metaverse can be a place to play and relax while escaping the real world or it can be a space to do the work of life virtually.


The web and how we use it continuously evolves. Each shift brings additional flexibility for users and increased capacity for engagement with others. The metaverse relies on movement toward Web 3, where users have more control over their experiences and increased ability to engage with other users in new ways. Several layers of the metaverse must be in place to make this future a reality. Realizing this vision will require new foundational technologies (infrastructure, human interface, decentralization, spatial computing) and an expanded role for creators in developing new design tools, business models, goods and services.¹



AUGMENTED REALITY: Overlays visual, auditory or other sensory information onto the real world through devices such as phones or smart glasses to enhance a person's experience of the physical world.

VIRTUAL REALITY: Immerses users in a complete simulated experience using virtual reality headsets like those created by Oculus, Sony and Valve. These computer-generated environments can be explored in 360 degrees and most commonly involve stimulus through sight and sound.

BLOCKCHAIN: Distributed digital ledger that stores data. Blockchain technology forms the backbone of cryptocurrencies but is also used for smart contracts, banking and asset transfers (e.g., NFTs).



THE METAVERSE RELIES ON MOVEMENT TOWARD WEB 3, WHERE USERS HAVE MORE CONTROL OVER THEIR EXPERIENCES AND INCREASED ABILITY TO ENGAGE WITH OTHER USERS IN NEW WAYS.

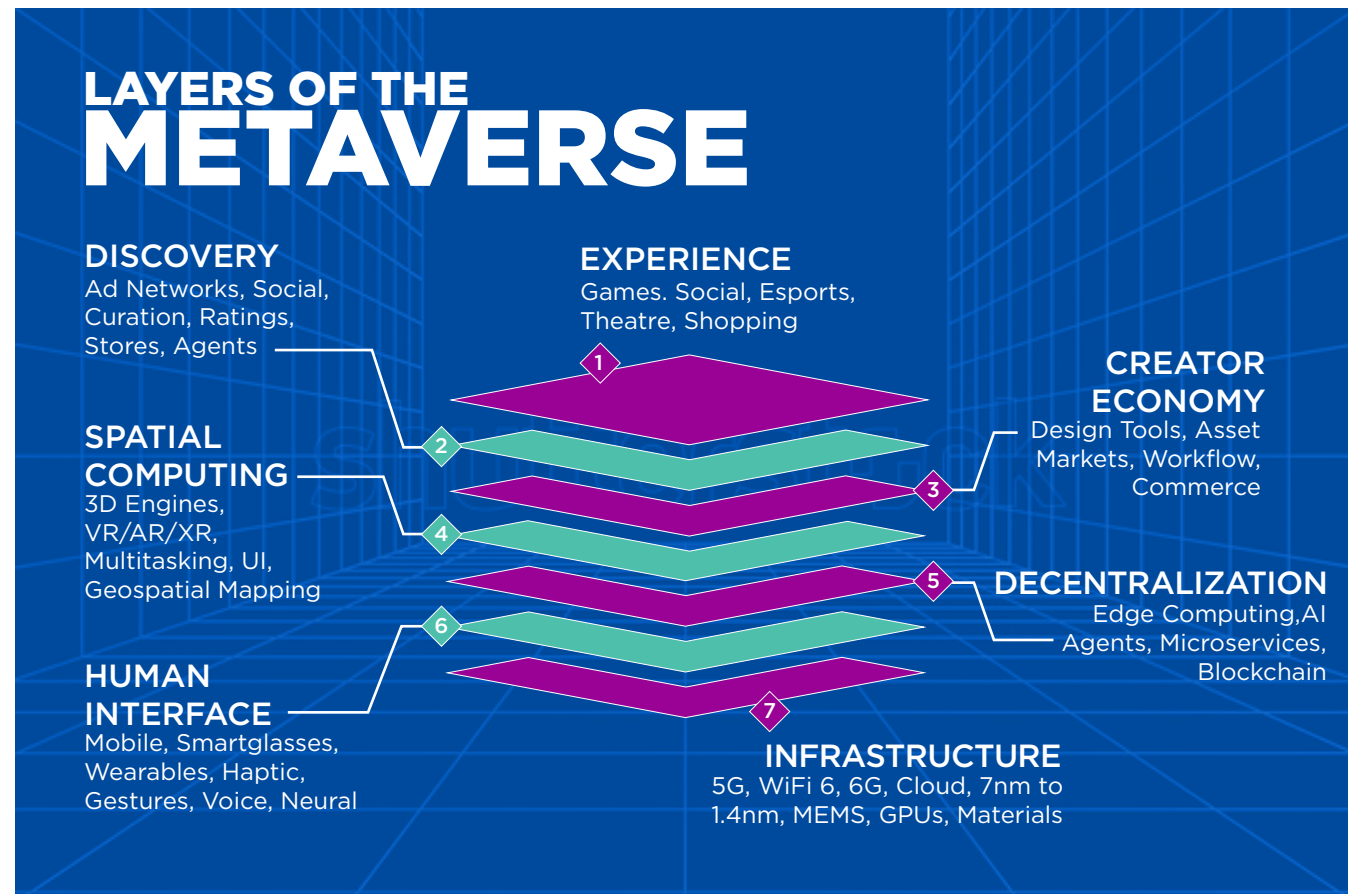
Web 1.0 – Read-only web. Users read and share information over webpages created by a limited group of creators but cannot interact with the content. This enables one-way communication but there is little user control over the experience.

Web 2.0 – Read-write web. Users can not only read, write, modify and interact with content, but they can also communicate and collaborate with other users. This enables two-way communication, but this experience happens through established platforms or websites, largely controlled by big technology organizations.²

Web 3.0 or Web 3 – Future of the web. As envisioned, users interact through blockchain technologies that enable a decentralized system of engagement in digital spaces. Users have the power and ability to create and control their creations (avatars, digital assets), exchange value (cryptocurrencies, non-fungible tokens) and self-govern (decentralized autonomous organizations).

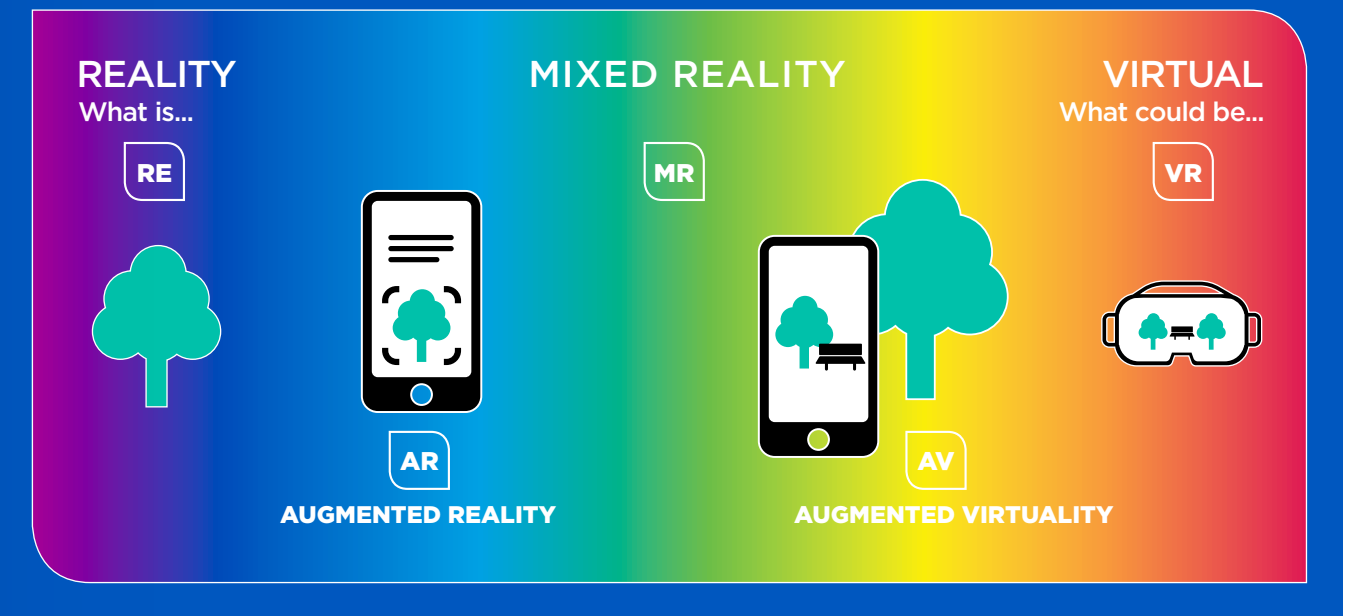
Although the metaverse is a newer term for most, it has an extensive history in video gaming. CyberTown, an online community with 3D chat rooms and virtual life gameplay, launched in 1995. It laid the foundation for video games like Second Life (2003), Roblox (2006) and Minecraft (2011), which center on virtual worlds and community building. These games and others start

with each user creating an avatar, a digital representation of the user's body and persona, before enabling them to explore the virtual world around them and connect with others. Users access these video games through gaming consoles, personal computers and VR devices like headsets. Other games seek to blend the physical and virtual worlds. Games like Pokémon Go,



Source: Radoff, J. (2021, April 7). *The Seven Layers of the Metaverse*. Medium. www.medium.com/building-the-metaverse/the-metaverse-value-chain-afcf9e09e3a7

THE VIRTUALITY CONTINUUM



Source: Anderson, M. J. (2015, June 22). *Augmented or Virtual: How Do You Like Your Reality?* Trekk. <https://www.trekk.com/insights/augmented-or-virtual-how-do-you-your-reality>

Ingress and Harry Potter: Wizards Unite use a smartphone's camera, gyroscope, clock and GPS to superimpose the gaming environment on the player's actual world so that players are operating in a state of mixed reality.

The metaverse is no longer just about video gaming. Social experiences like musical performances and sporting events are already happening in the metaverse. In August 2020, social media platform TikTok and musical artist The Weeknd hosted a live, interactive and immersive concert for more than 275,000

concurrent viewers.³ Online video game Fortnite has already held several successful concerts within its virtual environment. Rapper Travis Scott performed for 12.3 million concurrent and 27.7 million unique users. Singer Ariana Grande's concert allowed attendees to play Fortnite minigames, like racing and target practice, while enjoying the experience.⁴ Even the Super Bowl, one of the most viewed events on live television, joined the metaverse during Super Bowl LVI when Miller Lite partnered with Decentraland, a 3D virtual world browser-based platform, to host a virtual event.⁵

TIMELINE OF THE METaverse

- 1992 ● Metaverse coined in Snow Crash by science fiction writer Neal Stephenson
- 1995 ● CyberTown
- 2002 ● Digital twins
- 2003 ● Second Life
- 2006 ● Roblox
- 2009 ● Bitcoin and blockchain
- 2010 ● First prototype of the Oculus Rift VR headset
- 2011 ● Ready Player One by writer Ernest Cline | Minecraft
- 2012 ● First known NFT
- 2015 ● Ethereum | Smart contracts
- 2016 ● Pokémon Go
- 2017 ● Decentraland
- 2018 ● Axie Infinity, NFT-based game
- 2020 ● First concerts in the metaverse
- 2021 ● Facebook rebrands to Meta Platforms Inc. (Meta)
- 2022 ● Microsoft acquired video game maker Activision Blizzard | H&M store in the metaverse

Many current metaverse platforms are built on blockchain-enabled applications and facilitate economies based on decentralized finance (DeFi) and cryptocurrency. This means users can purchase virtual property, goods and services, or **nonfungible tokens (NFTs)** in the metaverse and pay for them with whatever cryptocurrency the platform uses — Mana for Decentraland, SAND for The Sandbox, ETH for OpenSea. The use of cryptocurrencies gives more power to users, reducing transaction costs, ensuring security via the blockchain and enabling them to personally benefit by monetizing their virtual worlds.

As the concept of the metaverse becomes more mainstream, technology companies have announced changes to their business models that reflect their planning for the future of the metaverse.



NONFUNGIBLE TOKEN (NFT): Unique digital asset that represents a real-world object (e.g., art, music, photo, GIFs, collectibles, video game items, etc.) and whose data (e.g., proof of ownership, certificate of authenticity, sale information, etc.) is stored on the blockchain where it can be traded or sold.

In 2021, Facebook rebranded itself as Meta and shared plans to shift its focus to new technologies that will help people connect and explore the metaverse.⁶ In January 2022, Microsoft announced plans to acquire video game maker Activision Blizzard in what many see as an attempt to expand into the metaverse.⁷ However, the metaverse is still being envisioned and built by a wide array of tech providers, developers, creators, entrepreneurs and end users.⁸

FOR MORE INFORMATION ON THE BLOCKCHAIN, CHECK OUT NLC'S BLOCKCHAIN IN CITIES REPORT.

→ WWW.NLC.ORG/RESOURCE/BLOCKCHAIN-IN-CITIES

HOW ARE CITIES ENGAGING WITH THE METAVERSE TODAY?

As the metaverse becomes more fully defined, its utility in local governments will also become clearer. However, cities are beginning to explore how it can benefit governmental operations and support community needs. The journey to the metaverse will be iterative. As new technologies advance, we can explore the idealized version of the metaverse – a self-sustaining and persistent virtual world that exists independently, alongside and intertwined with the physical world.⁹

While the private sector has made the greatest strides towards building the metaverse, governments are engaging with the emerging technologies at its core and in some cases are investing in its future use. Augmented and mixed reality, the internet of things (IoT), digital twins, and blockchain are all foundational technologies vital to the metaverse, and cities are already deploying them for uses ranging from tourism to resource management.

Several cities have utilized augmented reality (AR) to support tourism and their local economies.¹⁰ The Buffalo Olmsted Parks Conservancy in Buffalo, NY, developed a mobile app that allows visitors to scan signs in the parks and see a historical view of the park overlaid on the spot they are standing.¹¹ This feature allows visitors to engage with the park in new ways, and was supported by the


state's Division of Tourism through the Regional Economic Development Council Initiative with the explicit purpose of drawing tourists to these parks to boost the local economy. Other cities have built similar experiences in downtowns, retail districts or historical sites. The novelty of this technology is an attraction for tourists on top of the sites themselves, connecting visitors more fully with the place.

Internet of things (IoT) solutions are used by many cities to provide useful, real-time data about physical space and how people are moving through the city. This technology has numerous potential applications, but is often used for monitoring traffic patterns, utility usage and environmental factors, such as air quality, noise and temperature. Pittsburgh, PA, has deployed adaptive traffic signals which change the lights based on actual traffic to reduce commute times and fuel consumption. The smart traffic system has reduced travel delays in Pittsburgh by about 20 percent.¹² The pilot study also found these devices could reduce total emissions by 39,000 tons annually if deployed citywide.¹³

 **INTERNET OF THINGS (IOT):** Networks of devices that communicate with each other to monitor and analyze activity, resource use and other real-time data.



IoT devices gather data that cities can use to gain insight into government operations and service provision. These technological advancements have already shown their value for cities in making city operations and resource usage more efficient. The data collected through IoT allows cities to understand trends and behaviors, but is also foundational to technologies that blend the digital and physical worlds, including AR, mixed reality and the metaverse. A virtual environment may integrate IoT collected data to reflect the real-world conditions that a user is experiencing.

 **DIGITAL TWIN:** A digital twin is a virtual model designed to accurately reflect an object or system. More specifically, a digital twin would be a digitized copy of a city, built as a virtual scale 3D model.¹⁴

Cities are also creating **digital twins** to model how changes to the city's physical environment will impact things like traffic congestion, environmental emissions and sea level rise. In Massachusetts, the Boston Planning and Development Agency (BPDA) has created a digital twin that maps the city's physical landscape, from water and sewer systems to tree canopies.¹⁵ In the case of one controversial development proposal, the digital twin was used to assess shadows that a proposed new building would cast on a popular park, leading BPDA to modify the building plans and minimize the impact on the park.¹⁶

Digital twins are a powerful tool for urban planning, as they allow cities to anticipate specific impacts of new buildings, street changes or other land use decisions. By enabling data-driven planning, digital twins can also save cities money by predicting costly future effects of decisions made

today. ABI Research, a tech intelligence firm, predicts that U.S. cities will achieve \$280 billion in cost savings by using digital twins to increase efficiency in energy, transportation and infrastructure.¹⁷

Cities are also using the blockchain to facilitate smooth and transparent exchanges of information. Many smart cities initiatives rely on the blockchain to share data from sensors, record financial transactions and execute smart contracts because it creates a single source of information that all stakeholders can access and trust. In 2018, Austin, TX, piloted a program to give people experiencing homelessness a digital identity stored on blockchain. This digital system securely stores key identifying documents, such as a social security card or medical records, that are necessary to access services or medical care. Systems like this help ensure that logistical burdens like a lost personal document do not keep public services from those who need them.¹⁸ The University of Texas, Austin,

a partner in this program, is building on the results of the pilot to develop an improved digital tool the city can use in the future.¹⁹

The metaverse is being built on a blockchain foundation. Much of the envisioned functionality — exchange of value through cryptocurrency, acquisition and trading of collectibles and NFTs — and the priorities of the metaverse — decentralization, security, interoperability, privacy — align with the capabilities of the blockchain. Embracing the metaverse will require that cities better understand how information is, and should be, collected and shared with others.

Even as the metaverse emerges in its earliest stages, several cities have announced plans to have a presence there. Cities around the world have looked to technology to better their cities and connect with residents in new ways. By investing in the metaverse, these cities are on the frontlines of exploring how the metaverse will impact and benefit cities.

EMBRACING THE METaverse WILL REQUIRE THAT CITIES BETTER UNDERSTAND HOW INFORMATION IS, AND SHOULD BE, COLLECTED AND SHARED WITH OTHERS.



CITY SPOTLIGHT

Shanghai, China

Shanghai issued a five-year development plan that named the metaverse one of four frontiers for exploration. In 2021, the Shanghai Municipal Commission of Economy and Information Technology released a plan encouraging exploration of the metaverse across industries, both in the private sector and for public services. The commission plans to increase research and development of underlying technologies that will build the metaverse, including smart sensors and blockchain.²⁰

Santa Monica, CA

Santa Monica was the first U.S. city to enter the metaverse. The city now offers a virtual way to experience its downtown district through FlickPlay, a Santa Monica-based metaverse social app company.²¹ In its partnership with Santa Monica, FlickPlay provides users an interactive map of the city's retail district where they can collect tokens as they move around the city. Some tokens can be used to unlock digital experiences in the app and others can be redeemed for physical items at retailers in the area.²²

Santa Monica's participation in the metaverse allows users to explore this exciting new technology, but also benefits the local economy. Through the app, users are drawn to visit real world local businesses, and the app aims to increase foot traffic in underutilized spaces.

Seoul, South Korea

In 2021, the Seoul Metropolitan Government announced its plan to become the first city to fully enter the metaverse.²³ As part of the five-year metaverse Seoul promotion master plan, Seoul will invest \$3.3 million to develop a communications platform that will enable the city to provide services to its residents in the metaverse.²⁴ The city's metaverse ecosystem will accommodate all areas of Seoul's municipal administration, from traffic enforcement to tourism. In Seoul's "Metaverse 120 Center" residents will meet with avatar public officials in a virtual office for public services previously only available in person at City Hall. This entirely new use of the metaverse would enable governments to provide key services and engage with residents in a lifelike way while overcoming space limitations, distance between residents and city hall, language barriers and other obstacles to in-person interactions.

Along with transitioning government services to the metaverse, Seoul is introducing a virtual tourist zone which will host some of Seoul's largest tourist attractions virtually. Seoul's most popular festivals will be held in the metaverse, starting with a traditional Bosingak bell-ringing ceremony on New Year's Eve. Moving cultural events into the metaverse will allow people from around the world to connect with the city and establish Seoul as a global hub for emerging technology by displaying one of the city's most impressive technological accomplishments.

HOW MIGHT CITIES ENGAGE WITH THE METAVERSE IN THE FUTURE?

What can the metaverse be in the future? Read major news outlets or talk to people working on building the metaverse and you will get the same answer: “Anything. The possibilities are endless.” The same holds true for what the metaverse can mean for city governments.

Cities like Santa Monica, Seoul and Shanghai provide early indications of where city use of the metaverse is heading. Although it will be a while before Seoul, or any other city, manages to develop a fully functional virtual world, other cities are likely to move into the metaverse via digital city halls and other city operations

in the near term. Further down the line, more advanced conceptions of the metaverse may be commonplace in our daily lives.

The possibilities in the metaverse are endless. The metaverse can help bring public services online. Instead of having to go to city hall to file printed paperwork, residents can simply enter the metaverse and submit digital paperwork there. The metaverse can help city staff model scenarios with a digital twin, allowing cities to prototype changes and determine their impacts before implementing them in the physical world. Cities can make use of the metaverse in a

variety of ways, ranging from the simple to fairly advanced applications of the technology. The following scenarios represent just a few of the possibilities the metaverse enables.

Simple Scenario: Ahmed is starting a computer repair business. He has read up on the local requirements and filled out all the necessary paperwork. He makes an appointment to get his business license application reviewed and approved by his city’s Permitting and Licensing Department. On the day of his appointment, he enters the metaverse through his smartphone, where his avatar appears in a waiting room. He can see his completed application in the

metaverse and spends a few minutes reading over his application materials once more. He sends a quick chat message to let Jess, an Administrative Specialist in the city’s licensing department, know that he is here for his 2:00 pm appointment. At 2:00 pm, Jess’s avatar appears in the waiting room. A button pops up on the screen prompting him to join Jess and her avatar in her office. Once in the office, Jess verifies that nothing is missing from Ahmed’s application and answers a few questions about next steps with the building inspector who is coming to confirm Ahmed’s office space is ready for customers. Ahmed and Jess wave goodbye before he signs out of the metaverse.

CITIES CAN MAKE USE OF THE METAVERSE IN A VARIETY OF WAYS, RANGING FROM THE SIMPLE TO FAIRLY ADVANCED APPLICATIONS OF THE TECHNOLOGY.

How might cities engage with the metaverse in the future?

Advanced Scenario: Jackie, a planner in the city's Planning and Urban Development Department, has been tasked by their boss to identify the potential impact of sea-level rise on the city's beachfront properties and businesses. Using the city's digital twin, Jackie creates a 3D model of the city to explore different climate scenarios through a virtual reality headset based on the latest Intergovernmental Panel on Climate Change sea-level rise projections. Jackie invites their colleague Yui, an engineer in the Public Works Department, to join them in the metaverse. Jackie and Yui are able to walk around together, create a list of neighborhoods most at risk from rising sea levels, and make accompanying notes for both Jackie and Yui to discuss with colleagues in their respective departments. After exploring how different sea-level rise projections will impact properties and businesses, Jackie invites their boss to present options for further research into strategies to mitigate potential risks to beachfront neighborhoods.

Those scenarios answer the question: What could the metaverse be? But an even more important question is: What do we want the metaverse to be, and how will it impact our residents?

With our current understanding of the metaverse, there are many possible "best-case" scenarios.

Increased information: Information about the city and its services are more accessible through the metaverse. Instead of combing through an outdated city website, residents interact with virtual advisors in the metaverse who can help point them in the right directions.

Accessible services: People who have mobility limitations, time constraints with childcare, or fixed work hours do not need to travel to access city services. There may be increased opportunity for self-service outside of typical working hours for services that do not require a city staff person to be present. Moving city services online also means that should future crises like the COVID-19 pandemic arise, city operations will already be equipped to handle necessary changes in government operations.

More community connections: The city can hold cultural events live in the metaverse so people from around the world can attend. This makes events more accessible to city residents who might have mobility limitations or time constraints with childcare and helps city residents feel more connected. This can also help make the city more attractive to outside visitors who might be convinced to come spend time and money in the real world.

New economic opportunity: The metaverse will create a new digital economy. Content creators and entrepreneurs will find near limitless opportunities to thrive in the metaverse. The



metaverse can generate income for residents, entrepreneurs and the city, opening up a virtual economy that is more accessible and provides new goods and services.

But no best-case scenario is worth entertaining without also considering the potential challenges. Governments must learn a lesson from the growing power of the technology sector. Otherwise, the metaverse will perpetuate many of the current challenges associated with increased technology use in cities.

Spread of mis- and disinformation: Social media platforms have played a central role in the spread of mis- and disinformation,

leading to increased polarization and a rising mental health crisis. The metaverse will offer similar opportunities for bad actors to disseminate misleading or false information, and if left unaddressed regulators will once again find themselves behind, rather than ahead of, this threat.

Continued inaccessibility: To access the metaverse, people need a device and enough internet bandwidth to connect to it. Knowing what we do know about the digital divide and inequities in access to new technologies, access to the metaverse will prove inequitable. People may be left behind and alienated should the transition to the metaverse happen too quickly or without regard for access issues.

Rising inequities: With any new technology comes the risk of job displacement. The metaverse will impact the demand for certain jobs and the skills required to do them. Without a thoughtful approach, the metaverse has the potential to increase the inequities in our cities.

In short, the metaverse will not be a panacea that will solve all of our persistent problems. Without care, the things we create will engender the same biases and societal ills that already exist in the physical world. Gentrification in the metaverse has already sparked concerns. Jason Rosenstein, CEO of Portion — an online marketplace for artists and collectors to sell and invest their art — said the 2022 metaverse

land boom is the “first digital gentrification in history.”²⁵ People are already experiencing sexual harassment in the metaverse. In response to a recent harassment incident in Horizon Worlds, Meta’s early-stage VR software for Oculus, Meta added a new Personal Boundary which prevents avatars from getting within four feet of each other.²⁶ But as the metaverse is still in its infancy, it is unclear what other unforeseen challenges might arise. As the metaverse continues to evolve and grow, we will have to address many of the same issues that surround us in the real world. City leaders have the opportunity and responsibility to be active in shaping the metaverse to minimize the negative impacts and maximize its positive potential.



WITHOUT A THOUGHTFUL APPROACH, THE METAVERSE HAS THE POTENTIAL TO INCREASE THE INEQUITIES IN OUR CITIES.

CONCLUSION

Though still in its infancy, the metaverse is quickly becoming a part of our physical and digital lives, and city leaders should anticipate its arrival. Strong civic leadership involves embracing what is next and adapting it to meet community needs, and those cities that choose to invest in the metaverse will be the first to realize the benefits of increased information sharing, more accessible city services, stronger connections with and between community members, and a new virtual economy.

While cities like Seoul, Santa Monica and Shanghai have already begun the foundational work to make these potential benefits a reality, they will only be realized if city leaders are involved in the metaverse’s ideation and creation. This means understanding what the metaverse is and could be, its potential impacts on daily life and the new economy that will inevitably blossom within this virtual domain.

But while advances in technology present new opportunities, they also threaten to leave some people behind. City leaders will need to ensure residents have access to the foundational technologies needed to access the metaverse, taking special care to understand the specific barriers to accessing these technologies so they can bridge any digital divides. Just as Web 2.0 disrupted the way people live, work and play, so too will Web 3 and the metaverse.

CITY LEADERS HAVE AN OPPORTUNITY TO PLAY A PART IN HOW THE METAVERSE COMES TO BE, AND STAYING INFORMED, PROACTIVE AND CURIOUS IS THE CRITICAL FIRST STEP.

Endnotes

- ¹ Radoff, J. (2021, April 7). *The Metaverse Value-Chain*. Medium. www.medium.com/building-the-metaverse/the-metaverse-value-chain-afcf9e09e3a7
- ² Choudhury, N. (2016). World wide web and its journey from web 1.0 to web 4.0. *International Journal of Computer Science and Information Technologies*, 5(6), 8096-8100.
- ³ TikTok. (2020, August 12). *The Weeknd experience, an innovative TikTok live stream, draws over 2 million unique viewers*. newsroom.tiktok.com/en-us/the-weeknd-experience-an-innovative-tiktok-live-stream-draws-over-2-million-unique-viewers
- ⁴ Nishijima, I. (2021, August 30). *Ariana Grande x Fortnite Rift Tour: the apogee of pop culture or just the beginning?* Medium. www.medium.com/headlineasia/ariana-grande-x-fortnite-rift-tour-the-apogee-of-pop-culture-or-just-the-beginning-5052584f8d63
- ⁵ Chaturvedi, O. (2022, February 15). *Miller lite super bowl commercial running in the metaverse*. Techstory. www.techstory.in/miller-lite-super-bowl-commercial-running-in-the-metaverse
- ⁶ Meta. (n.d.). About. about.facebook.com/meta
- ⁷ Barbaro, M. (Host). (2022, January 20). Microsoft and the metaverse. [Audio podcast episode]. In *The Daily*. New York Times. www.nytimes.com/2022/01/20/podcasts/the-daily/metaverse-microsoft-activision-blizzard.html
- ⁸ www.medium.com/building-the-metaverse/market-map-of-the-metaverse-8ae0cde89696
- ⁹ Lee, L. H., Braud, T., Zhou, P., Wang, L., Xu, D., Lin, Z., Kumar, A., Bermejo, C., & Hui, P. (2021). All one needs to know about metaverse: A complete survey on technological singularity, virtual ecosystem, and research agenda. ArXiv Preprint ArXiv:2110.05352. www.arxiv.org/abs/2110.05352
- ¹⁰ Edinger, J. (2021, August 16). *Can augmented reality change how people experience cities?* Government Technology. www.govtech.com/civic/can-augmented-reality-change-how-people-experience-cities
- ¹¹ Buffalo Olmsted Parks Conservancy. (2021, June 29). *BOPC launches updated mobile app*. www.bfloparks.org/bopc-launches-updated-mobile-app
- ¹² Violino, B. (2021, April 22). *How 3 U.S. cities are getting smarter via the latest technologies*. IDG Insider Pro. www.idginsiderpro.com/article/3614765/how-3-us-cities-are-getting-smarter-via-the-latest-technologies.html
- ¹³ Smith, S.F., Gregory, J.B., Xie, X., & Rubinstein, Z.B. (2013, January 31). *A decentralized adaptive signal control system could reduce fuel consumption by 4.3 million gallons and total emissions by 39K tonnes annually, if deployed city-wide in Pittsburgh*. Intelligent Transportation Systems Joint Program Office www.itskrs.its.dot.gov/its/benecost.nsf/ID/f87d2d8bd84588ad85257af3005f6373
- ¹⁴ Tomorrow. City. (2021, March 22). *What is a digital twin?* www.tomorrow.city/a/what-is-a-digital-twin#:~:text=A digital twin is a building to be monitored
- ¹⁵ Solomon, A. (2021, November 1). *Are digital twins the future of urban planning?*. Smart Cities Dive. www.smartcitiesdive.com/news/are-digital-twins-the-future-of-urban-planning/609232
- ¹⁶ Patrick, B. (2018, April 23). *Meet Boston's Digital Twin*. ESRI. www.esri.com/about/newsroom/blog/3d-gis-boston-digital-twin
- ¹⁷ ABI Research. (2021, July 28). *The use of digital twins for urban planning to yield U.S. \$280 billion in cost savings by 2030*. www.abiresearch.com/press/use-digital-twins-urban-planning-yield-us280-billion-cost-savings-2030
- ¹⁸ Poon, L., & Holder, S. (2018, May 31). *The tech that's changing how cities help the homeless*. Bloomberg CityLab. www.bloomberg.com/news/articles/2018-05-31/how-the-blockchain-can-help-the-homeless
- ¹⁹ Falcon, R. (2021, May 3). *Could Blockchain tech be the key to helping Austin's homeless population personal info on hand?* KXAN. <https://www.kxan.com/news/local/austin/could-blockchain-tech-be-the-key-to-helping-austins-homeless-population-personal-info-on-hand/>
- ²⁰ Cheng, E. (2021, December 31). *Shanghai doubles down on the metaverse by including it in a development plan*. CNBC. www.cnbc.com/2021/12/31/shanghai-releases-five-year-plans-for-metaverse-development.html
- ²¹ Staff. (2021, December 7). *Downtown Santa Monica becomes first U.S. city to join the metaverse*. WeRSM. www.wersm.com/downtown-santa-monica-join-the-metaverse-flickplay
- ²² Donato, D. (2021, December 13). *Santa Monica is using the metaverse to gamify its shopping district*. Dot.LA. www.dot.la/santa-monica-metaverse-2656021933.html
- ²³ Seoul Metropolitan Government. (2021, November 8). *Seoul, first local government to start new-concept public service with "metaverse platform."* english.seoul.go.kr/seoul-first-local-govt-to-start-new-concept-public-service-with-metaverse-platform
- ²⁴ Squires, C. (201, November 9). *Seoul will be the first city government to join the metaverse*. Quartz. www.qz.com/2086353/seoul-is-developing-a-metaverse-government-platform
- ²⁵ Editor's Desk. (2022, February 9). *\$.12 million plot of metaverse land sold as the 'first digital gentrification.'* Blockchain Magazine. www.blockchainmagazine.net/1-2-million-plot-of-metaverse-land-sold-as-the-first-digital-gentrification
- ²⁶ Barmann, J. (2022, February 4). *Meta already has a sexual harassment problem in the metaverse*. SFist. www.sfist.com/2022/02/04/meta-already-has-a-sexual-harassment-problem-in-the-metaverse

NLC NATIONAL
LEAGUE
OF CITIES

CITIES STRONG TOGETHER