Spatial Computing:

Your Next Strategic Advantage

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BCG has had experts in unique relationships with XR device teams for years, from Google Glass, Magic Leap, Quest and more recently the Apple Vision Pro. Our Spatial Studio team looks back on its experience to understand the strategic implications for where this technology is now.

Strategy today has turned into the science—and art—of staying ahead of technology, finding the use cases that provide competitive advantage, curating for quick-win proof-of-concept opportunities, and understanding both the tech and people side of successfully scaling. As we look across the tech landscape, the next strategic opportunity in emerging technologies is clearly spatial computing. As Generative Artificial Intelligence (GenAI) becomes our collaborative partner on-screen, the advantages of taking that power off-screen are yet to be imagined—and that is a strategic opportunity for any organization!

Prepare Yourself for Spatial Computing

The roots of spatial computing trace back to location-based technologies that have proliferated through GPS-based applications that connect digital information to real-world locations. The recent attention to the phrase "spatial computing" itself was brought on in part by the hype around the metaverse in the last few years, but unlike the virtual worlds that make up that vision, spatial computing brings digital into our physical world, merging realities and contextualizing information. Instead of looking at digital, we are already in digital. To be "in digital," we need devices that help us see this invisible layer of experiences and information, such as smartphones, tablets, and headsets.

Global giants such as Ikea and Crate & Barrel have pioneered augmented reality (AR) apps that place furniture in your rooms virtually; Warby Parker lets you virtually test to see how eyeglass frames look on your face; and Nike provides customers the ability to measure their shoe size and then find the perfect pair in a nearby store. In July 2022, Nike and RTKFT even launched a hoodie that, when seen through an AR app, sprouts Icarus-like wings, offering customers, and their avatars, an experience impossible in the real world.

According to BCG's March 2024 analysis, spatial computing's **overall market revenue is estimated at $138 billion.** This includes $74 billion of B2B specific revenue, with an overall 38% CAGR through 2030 as these developments expand into every industry and function.

Members of the BCG Spatial Studio Team on Apple headset launch day; Mike Boselowitz, Kristi Woolsey, and Komal Sharan

Technology Advancing on All Fronts

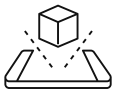
Spatial computing has been quietly under development for years, but recent hardware advances and the intersection with other technologies are pushing this tech into the headlines. In January 2023, Magic Leap confirmed that its ML2 headset had been approved for use in medical operating rooms; in October 2023, Meta launched Meta Quest 3, which includes its device management platform that makes it easier for businesses to deploy at scale; and around the same time, early engagement with Apple's eagerly awaited Vision Pro made it apparent that this next-gen device will follow the pattern of the iPhone and Apple watch and revolutionize how people think of headsets and extended reality (XR)—the umbrella term covering AR, virtual reality (VR), and mixed reality (MR).

However, change is never about a single technology. Our devices make information visible in the real world and that information comes from and through other maturing technologies. In late 2023, Microsoft put out a video specifically describing the world of work with a combination of technologies: The industrial worker, wearing a Microsoft HoloLens headset, simply asks Copilot to display relevant information in the headset.

The HoloLens headset has been around for years, but it never really took off in part because of image resolution (headset technology has since improved significantly) and the GenAI-driven Copilot (showcased in the video) not yet existing. The convergence of GenAI, the Internet of Things (IoT), 5G mobile networking, robotics, Web 3.0, and XR has set the stage for disruption.

> Spatial computing may feel like an uncharted frontier today, **but there's no denying its transformative capabilities for companies that grab the opportunity.**

Spatial Computing Killer Apps



At its core, spatial computing equips digital information with the ability to recognize its location and thereby interact with the real world. Because of this physical-virtual integration, it reduces the cognitive load of context switching when we look from a real-world object to the instructions or:

- receive and access information in context from IoT, (Gen)AI, and other sources;
- design and test fit representations of products, experiences, and scenarios in their actual physical context;
- learn and practice in virtual environments so that we may develop muscle memory without risk or cost;
- collaborate across distances in what appears to be the same meeting room but is in fact a number of different ones; and
- go, be, do, and experience things and places we never could before.

To understand where spatial computing can deliver business value, a BCG team synthesized potential use cases from hundreds of actual client scenarios across industries and business functions. These were then sorted by the functional affordances spatial computing would provide, resulting in five categories that every business can use as a framework: Engage, Innovate, Train, Collaborate, and Entertain. (Exhibit 1)

Exhibit 1 – These categories provide a framework for discovering use cases

	1 Engage	2 Innovate	3 Train	4 Collaborate	5 Entertain
Description	**Contextual Analytics** Combining physical and digital, delivering assistance, data or information in context	**Generative Design and Data** Design and test new products, spaces, services and experiences	**Simulation and Evaluation** Practice without consequence or risk and evaluate manual and technical skills	**Virtual Workplace** Connect across distances in virtual spaces	**Unreal Experiences** Live experiences that are unlikely or impossible
Use cases	• Info layering for assembly, repair, tourism, healthcare, etc. • Enhance customer experience (virtual try-ons, tours, etc) • Classify what you see (Inventories)	• Collaboration with (Gen)AI for new product and service design • Algorithms for faster iteration • Test/simulate with users or service providers to de-risk physical pilot and build	• Learn new skills and practice while doing • Simulate risk scenarios with no-risk • Remote expert support	• Remote assistance & collaboration • Enhanced meetings, presentations, and sales	• Immersive experiences in gaming, theme parks, and attractions. • Real-space broadcasts for TV, sports, cinema • Enhanced live event experiences
Opportunities	• Improve speed and accuracy of response • Reduce labor • Remote expert support	• Increase iterations leading to higher quality • Reduce cost and risk of innovation and change	• Reduce training and response times • Increase retention • Reduce risk and insurance	• Improve interpersonal interactions across distance	• Improve emotional wellbeing • Provide a mental and emotional escape

Engage

By using spatial computing to provide contextual assistance in the form of real-time data and expert guidance for installation, inspection, service, and repairs, companies will improve the precision, safety, and speed of operations. Just as doctors already benefit from AR navigation during complicated surgical procedures, field engineers will be able to access visual data and remote expertise in real time. Spatial computing overlay can capture and transfer scarce expertise and leverage limited experienced resources across distances. The business question is where access to real-time spatial information would generate fresh value.

Innovate

Iteratively designing, prototyping, evaluating, and refining products in collaboration with GenAI and utilizing three-dimensional virtual representations will greatly speed up product and service development, de-risk the innovation process, and shrink time to market. GenAI will deliver millions of potential solutions, simulations will run scenarios against those solutions and down select; then XR experiences will provide more accurate user testing data, and once ready to make real, IoT will continue to make the virtual model smarter, allowing it to be used for training, marketing, business scenario planning, and more. The business question is where a de-risked accelerated innovation process would provide benefit in your organization.

Train

Spatial computing enables risk-free skills assessment and development, allowing for real-world scenarios, safely practicing new skills, and creating muscle memory for faster and more accurate real-life response. Walmart, Verizon, and the NFL have all been using VR for training for years, allowing employees and players to practice their responses to, for example, Black Friday crowds, armed robberies in retail locations, and football plays. The value of this approach is already proven and likely to be one of the most common spatial computing applications. People who train using VR or AR retain those skills at a significantly higher rate, learn four times faster, and are 40% more confident in their abilities. The business question is where in your organization the speed of response brought on by development of "muscle-memory" would add value.

Collaborate

Organizations that use spatial computing to create virtual spaces for remote meetings and collaboration are better prepared for our post-pandemic increase in remote working. In early 2022, a BCG team used VR as its primary remote collaboration tool in an eight-week experiment. They experienced and evaluated over 40 different VR collaboration platforms, cataloguing features and functionalities against types of meetings and interactions. This research found that users rated connecting in virtual environments second only to in-person meetings, with video conferencing platforms ranking significantly lower. VR collaboration platforms allow remote team members to share a space, not just a screen. The business question is where in your organization it would be valuable to increase collaboration, productivity, and/or retention by using spatial computing to improve connection across distances.

Dutch MacDonald with the Apple Vision Pro

Entertain

Spatial computing is designed to deliver experiences that transcend the analog world's constraints. Filmmakers craft interactive experiences that can't exist, history buffs tour ancient sites, and elders can visit places they've always wanted to without leaving their assisted living facility. Video gaming companies are showing the way. Roblox, for instance, recently launched a spatial computing version of its gaming and social app, Meta Quest Roblox Beta, which over a million people downloaded in just the first five days. The business question is where providing or partnering in such impossible experiences would return value for your organization.

Spatial Computing Technology

Spatial computing is a new form of human-computer interaction. Like our computer screens and mobile devices, it is a human-friendly view into computer data supported by our core systems. If your core systems are not robust or secure, if your information architecture, data, and methods through which you access that data are not working well, if you have difficulty with your websites and mobile apps, then your organization is not ready to embrace the potential of spatial computing. (Exhibit 2)

Exhibit 2 – Diagram of HCI system layers

Spatial computing technology is a new form of Human-Computer Interaction

Browser

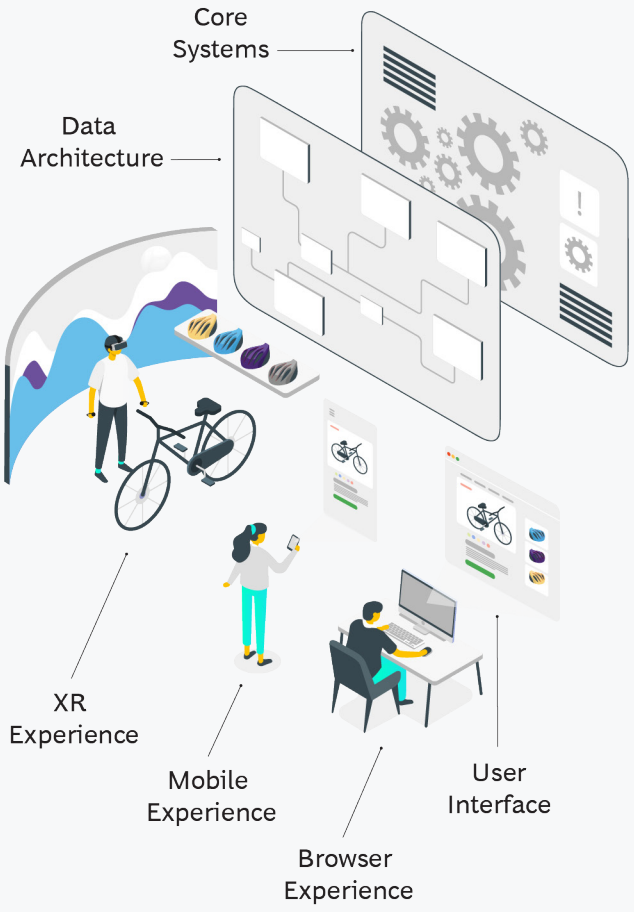
- **1989** AOL "You've got mail" Compumarket e-commerce
- **1994** First known online purchase (from Pizza Hut)
- **1995** Amazon.com

Mobile

- **1997** 2 mobile-enabled Coca-cola machines installed in Finland
- **2002** Motorola asked to develop standards for mobile commerce
- **2011** Google wallet launches

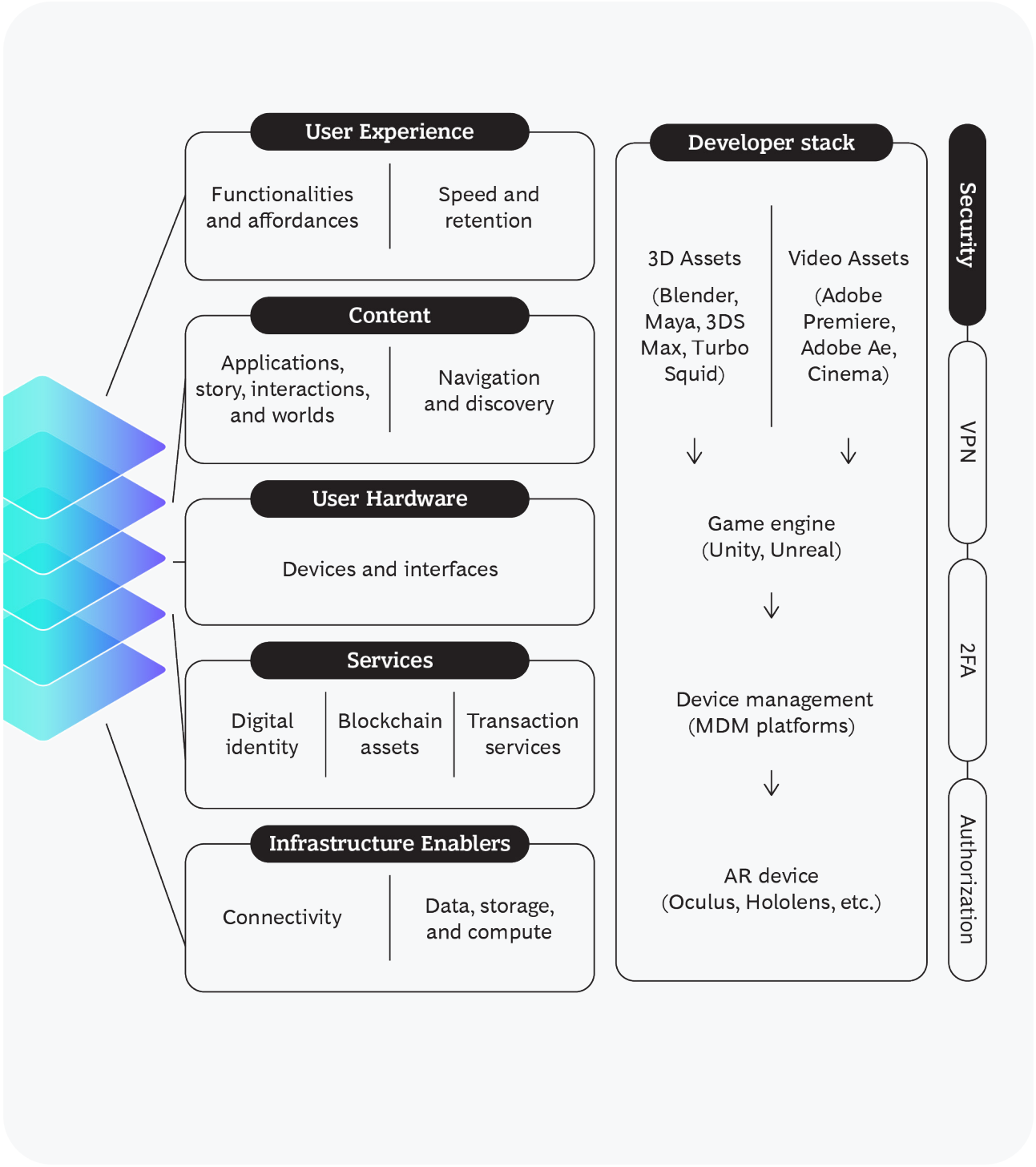
XR

- **2016** Ebay launches first VR department store
- **2019** Oculus launches "Quest" a stand-alone headset

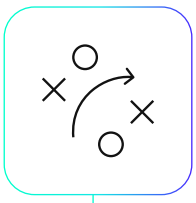


Using the technology at scale entails seamlessly integrating hardware, software, infrastructure, and the appropriate user interface to deliver value for the user and, in return, value to the organization. The spatial computing tech stack must address the unique challenges of spatial interactions, which include ties to existing data sources. (Exhibit 3)

Exhibit 3 – Diagram of spatial stack



Launching Your Spatial Technology Strategy



Investing in spatial computing seems daunting, but even with only small efforts in quick-win use cases, you can build internal understanding of where the value lies for your organization, where the skills and knowledge gaps are, and what internal and external resources are needed for execution.

There are four steps to get you started:

1. Identify and define use cases

Use the five-category framework presented earlier to identify potential use cases within your organization and then prioritize them based on difficulty to execute and impact or value returned—and remember people change management when considering difficulty. Select a few use cases that could provide quick wins and plan out the smallest, fastest program that could demonstrate those wins.

2. Proof of concept

Launch a limited number of proof of concepts (PoCs) to validate the technical feasibility, the desirability for the user, and the value return for the organization. Most organizations do not have internal spatial computing capabilities, so it is important that the vendor that builds this PoC is not just a one-off solution provider and includes business, design, and build capabilities to get to an integrated solution. The use case and PoC development will drive device decisions: smartphone, tablet, headset, or a combination of the three.

3. North Star and roadmap

Your use case prioritization and PoC experiments will provide you with a good sense of where your spatial computing strategy could win. But to scale, you will need to define your aspirations and create a roadmap to get there. Your work in the previous steps is likely already pointing you toward B2C, B2B, or internal applications and it is important in the early stages to select areas of focus. It is also important to establish ground rules for organizational usage including considerations of privacy and ethics, employee safety and well-being, and consistency of brand experience. This North Star guidance will help you select the first few programs to launch. In this step, you will create a roadmap for each initiative that allows you to start with a PoC, set aside time to test implementation with a limited pilot, and then plan for scale.

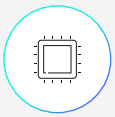
4. Scale

Spatial computing scale, like any other tech transformation, follows BCG's 10%-20%-70% rule: In any transformation, 10% of the effort involves the algorithm or software design-build, 20% the hardware and technology itself, and 70% the business processes and change management. Your efforts at this point have been primarily around the technology and use cases, but scale is a people effort and should follow change management best practices. (Exhibit 4)

Exhibit 4 – BCG's 10-20-70 rule

Pioneers of technology transformations typically dedicate:

10% of investment to use-case definition and software design build



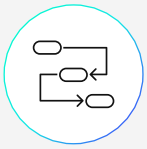
20% of investment to hardware and supporting technology

70% of their investment into business processes, upskilling, and change management

These four steps will get your spatial computing strategy launched, delivering value and competitive advantage.

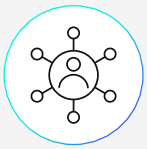
"Spatial computing" isn't just another buzzword; it's the next frontier. Only companies that experiment with its potential and harness its power will win.

Three Considerations for Spatial Computing



How will it integrate with existing systems?

Companies must assess how spatial computing will dovetail with their current operational and technological setups. A strong foundation for digital, systems, data, and security is essential.



Is it user-centric enough?

Spatial computing is immersive and experiential. Its potential is unlocked only when executives prioritize the development of value-delivering user experiences.

Do we have a plan for constantly innovating with the technology?

Spatial technologies are changing rapidly, requiring the adoption of a mock-up, user test, and pilot approach. Companies must foster a culture of quickfire innovation, continuous learning, and constant adaptation if they want to stay relevant.

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