ETC@USC

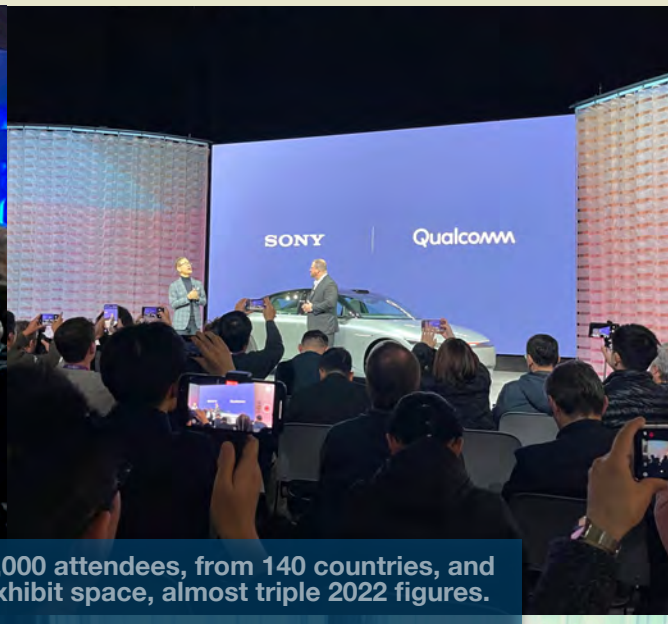
CES 2023 REPORT

Partnerships & Innovation
Innovation may come from startups but to scale it takes giants. Matter matters, connecting IoT.

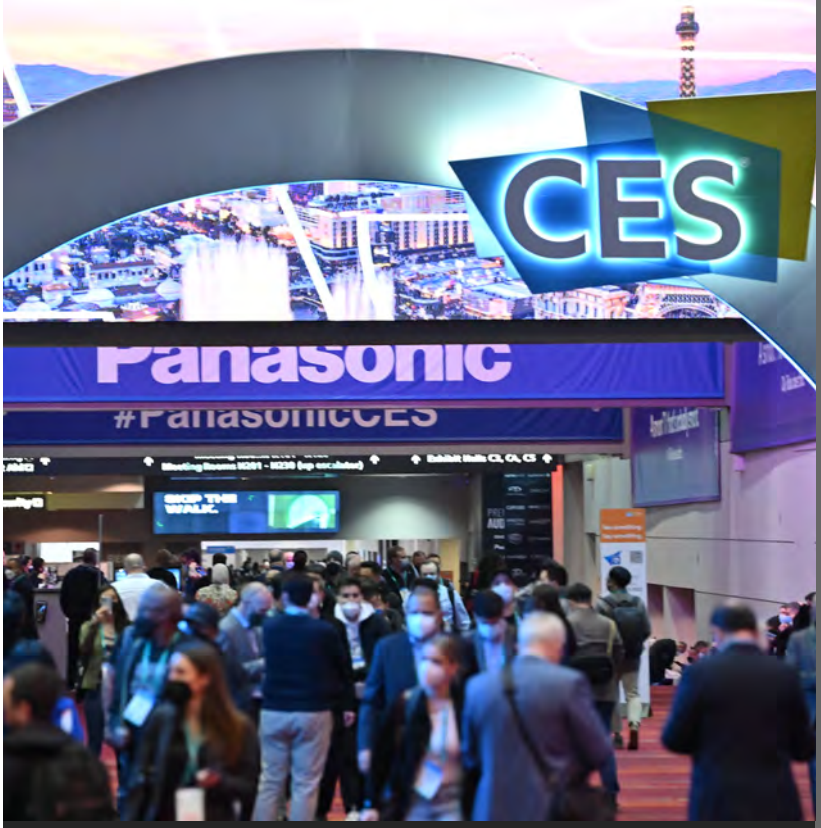
Generative AI
Widely referenced but hardly seen; make no mistake: this is a landmark achievement in machine learning.

AR & Immersive Experiences
Enterprise products leading way in AR and haptics; Light field displays add new dimension.

CES 2023: Connection, Collaboration, and Cooperation



What a difference a year makes. More than 115,000 attendees, from 140 countries, and 3000 companies filled 2 million square feet of exhibit space, almost triple 2022 figures.



ENTERTAINMENT TECHNOLOGY CENTER@USC

CES 2023 REPORT

The Entertainment Technology Center@USC 2023 CES Report Leadership and Content Team

Leadership
Kenneth Williams, Executive Director + CEO
Edie Meadows, CAO

Editorial
Rob Scott, ETCentric Editor
George Gerba, Media Experience Consultant
Don Levy, CES Reporting Lead
Sade Korbieh, Layout

Correspondents
Debra Kaufman, Journalist
Paula Parisi, Journalist, ETCentric
Phil Lelyveld, Director, Immersive Media Initiative
Yves Bergquist, Director, AI and Blockchain
Dennis Kuba, ETCentric Consultant
Rachel Joy Victor, Strategist, Designer + Worldbuilder / USC Graduate
Rylan Pozniak, Student, USC Iovine & Young Academy

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TABLE OF CONTENTS

Sections

4 Introduction and ETC Trends and Topics
What matters most for media and entertainment

10 CTA Trends, Research, and Recap
The Consumer Technology Association

17 Artificial Intelligence
The next generation of AI products

25 Displays and Traditional CE
Highlights of some of the best consumer electronics coming to homes

31 Multiverse?
More than one metaverse, consider many and a multiverse future; advances in AR enter market

45 Immersive Enablers
New products and innovations leading market shifts and opportunities

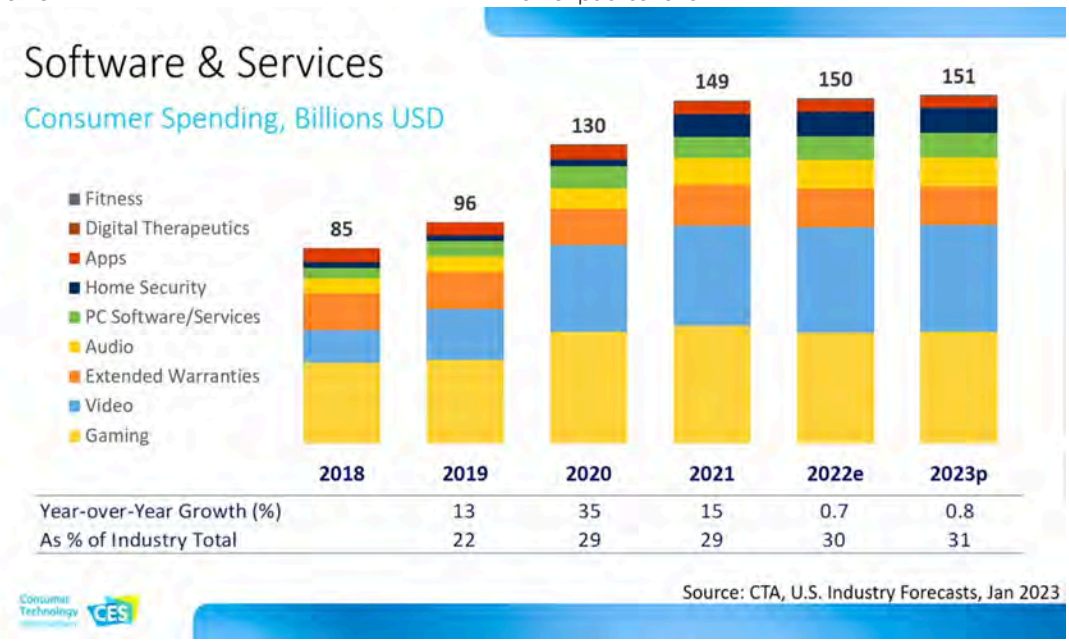
51 Mobility
Innovations in transportation, sustainability, environmental concerns, and urban reinvention

54 Policy and Regulation
Policy leaders, government and corporate officials focus on issues

61 ETC@USC Reporting
Throughout CES, editors attended conferences to bring ETCentric readers news with a sharper focus on topics of importance

66 Curated Articles
In addition to ETC's original reporting, the following pages provide links to articles from other publications.

Consumer Technology Association (CTA) figures quantify the rapid pandemic prompted consumer spending on software and services. As the market stabilizes, video and gaming represents almost two-thirds of the market.



About this Report

The 2023 CES Report is presented by the Entertainment Technology Center at the University of Southern California (ETC), a research center and think tank organized within the School of Cinematic Arts. Find more Information at etcenter.org, read the latest industry technology news at etcentric.org, and subscribe to our free Daily News Brief. Our reporting from CES 2023 presented here, and in a narrative presentation by ETC analysts that becomes available after the completion of a series of live-onsite briefings, highlights products, technologies, companies, issues, and trends important to media, entertainment, and technology companies.

About ETC

The Entertainment Technology Center at the University of Southern California is a think tank and research center that brings together senior executives, innovators, thought leaders, and catalysts from the media & entertainment, consumer electronics, technology, and services industries along with the academic resources of the University of Southern California to explore and to act upon topics and issues related to the creation, distribution, and consumption of entertainment content. As an organization within the USC School of Cinematic Arts, ETC helps drive collaborative projects among its member companies and engages with next generation consumers to understand the impact of emerging technology on all aspects of the media and entertainment industry, especially technology development and implementation, the creative process, business models, and future trends. ETC acts as a convener and accelerator for entertainment technology and commerce through research, publications, events, collaborative projects and shared exploratory labs and demonstrations.

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What a difference a year makes. More than 115,000 attendees, from 140 countries, and 3000 companies filled 2 million square feet of exhibit space, almost triple 2022 figures.

Mid-day at CES Tech East 2022

ENTERTAINMENT TECHNOLOGY CENTER / CES 2023

ETC TRENDS AND SUMMARY

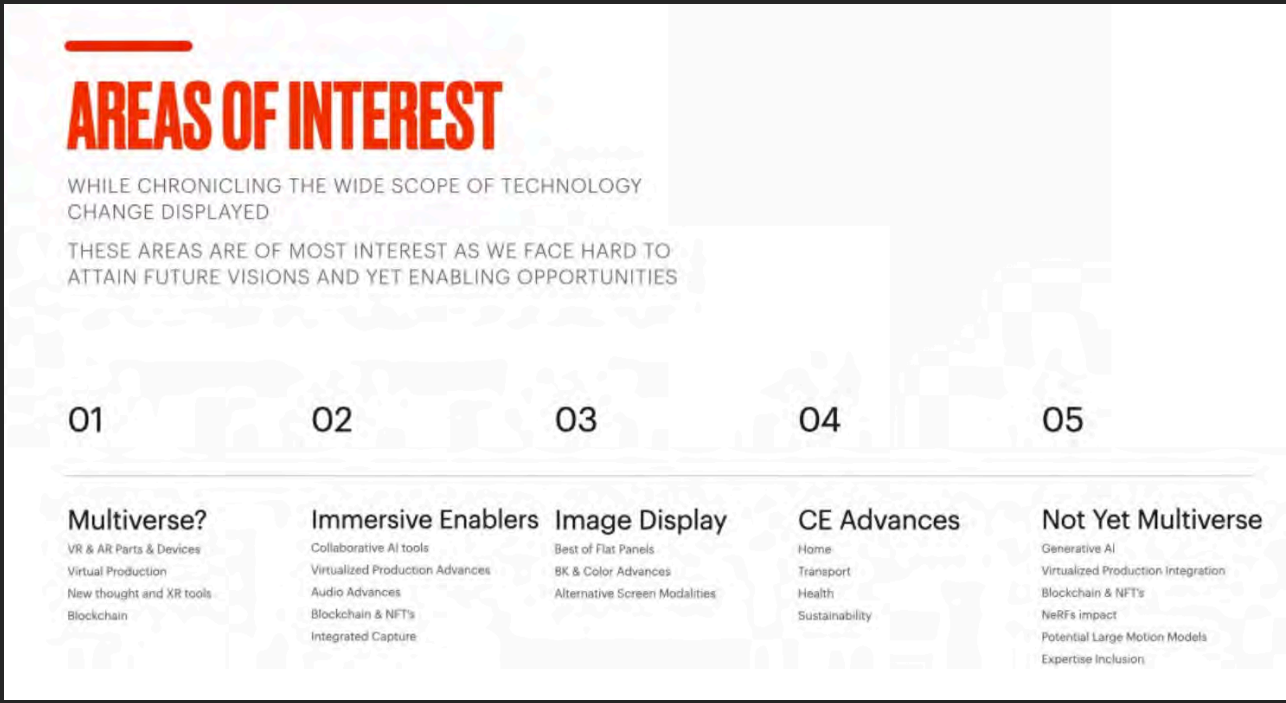
For four days in January, CES becomes the nucleus of global innovation. If groundbreaking technology and product introductions characterized CES during the first two decades of this century, the current CES flew the flag of innovation and how breakthrough technologies can be applied.

By Don Levy and George Gerba

Connection, collaboration, and cooperation are three words that underscore almost everything we saw during CES 2023. We anticipated this would not be a show of breakthrough innovations. Instead, we expected innovative ways to use recent advances. In broad categories, AR, haptics, and AI were much in evidence. Interesting light field displays and curved screens caught our eye. There were fewer cars but way more commercial vehicles and components driving "software-defined mobility." TVs were secondary to connected ecosystems in Samsung and LG's displays, while creators took center stage for Sony, Canon, and Nikon. Clear across the show, innovation may come from startups but to scale it takes giants.

This year's CES was more than twice the size of CES 2022, which shrank at the last moment when a surge in COVID cases collided with the show dates. This year, 115,000 participants, including 40,000 from 140 different countries attended, surpassing the pre-show projection of 100,000 and far more than last year's 45,000.

Conference sessions were generally well attended. Keynote presentations from leaders of John Deere, AMD, BMW, Delta Airlines, and just announced automaker and mobility provider Stellantis do not include a



typical consumer products company. But the president and CEO of NASDAQ discussed "What's Next for the 21st Century Economy," Coindesk produced a half-day Web3 conference program, and the C-Space was the hub for marketing, adtech, and entertainment.

Finding nascent threads at CES is one of the necessary realities of its increasing inclusion of all things technical. The show where flashy products and brilliant big screens always get attention, has become ever broader in scope.

This year heralded at CES, the metaverse was a stated focus for 2023. Behind the sparkling exhibits, we sought not just one XR specific delivery platform, but rather the activity and new tools enabling the growing multiverses that have been here for years — especially tools that enable the immersive experience and inspire creatives to make change happen. We sought fresh approaches to NFTs and how smart contracts fueled by blockchain deepen experience and chronicle engaging memories.

We've organized around five key areas of focus this year:

1. **The Metaverse (initiated in 1992)**
2. **Immersive Enablers (and next-gen creative enablers)**
3. **Image Displays**
4. **CE Advances and Trends**
5. **The 'Not Yet Metaverse'**

While almost every company in all sectors at CES this year tout how they are relevant and necessary in the age of multiverses, a delivery format is not the most important issue but rather, we think, how generative AI will impact creativity and change our industry, opening it into many delivery opportunities with increasing direct personal experience.

There is a measure of seriousness to CES today as the show has evolved from its roots as a "gee whiz" gadget show. While some of this is public relations positioning from the Consumer Technology Association (CTA), owners and producers of CES, the pervasiveness of technology in our lives presents both opportunities and issues. CES declared

"Human Security for All" as its theme and partnered with the United Nations Trust Fund for Human Security (UNTFHS) and the World Academy of Art and Science on the Human Security for All (HS4A) global campaign to foster food security, access to healthcare, personal income, environmental protection, personal safety, community security and political freedom.

The show floor at CES can be viewed as a market indicator. For example, a shift in the television and display manufacturers became evident as the size and scope of leading Chinese companies, notably Hisense and TCL, grew along with the quality of their products.

Digital Health is another segment that has steadily grown from sidebar to significance. As this segment grows, we can see related tech such as AR and sensors associated with products and services. Whether the combination of these technologies and products have a meaningful role to play in entertainment remains to be seen but with more immersive worlds and activities on the horizon, it is worth watching.

What was not on display can also be revealing. The collapse of crypto exchange FTX and decline in cryptocurrencies dampened Web3 and Fintech. Other than Samsung's folding and expandable Flex Hybrid, satellite messaging services from Bullitt. and Qualcomm there wasn't that much new in mobile phone products. 5G, the buzzword of the show a few years ago, was a whisper except that its rollout enables a myriad of products and services imagined in the future. One example is what Kim Libreri, chief technology officer of Epic Games, showed in Sony Honda Mobility's prototype car, saying the most natural way to visualize important data within the car is through intuitive interactive photo real augmentation, which is what Unreal Engine does best.

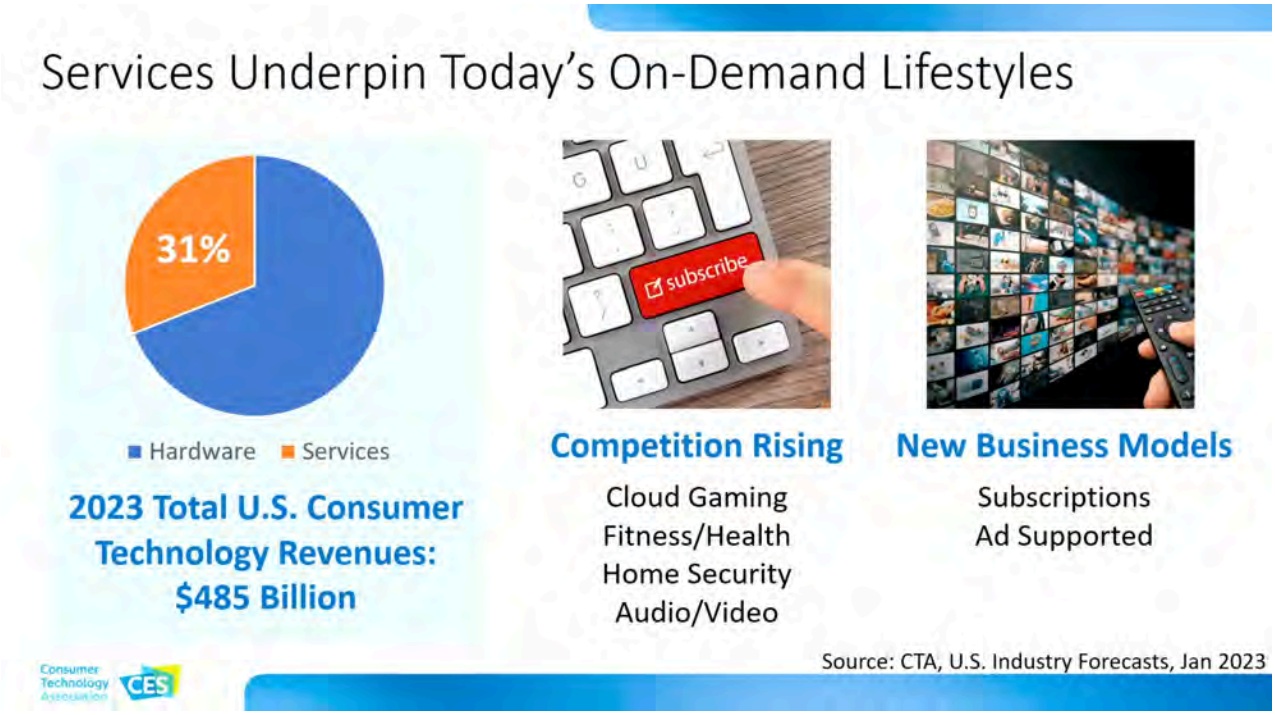
Eureka Park, the startup arena, was dominated by country booths, ,aggregating startups from their regions. This meant fewer individual booths and a shift in tone. Only a few years ago Eureka Park was a tabletop showcase in a basement ballroom. It was a

place where we first saw autocomplete for phones. Another year, a viable digital wallet appeared and was quickly acquired by Samsung for its mobile phones.

Despite the changing composition of the Eureka Park layout, there were still several AR, AI and audio advances included in our report.

The pre-show launch of ChatGPT elevated the discussion of, and interest in, AI. Where everyone seemed to inject metaverse into their pitches last year, AI was everywhere. With post CES-buzz, ChatGPT's servers are now regularly overwhelmed with users getting pithy messages written by the AI in a variety of styled and literary voices.

Whether CES will ever return to its peak in-person attendance of 175,000 in 2020 is questionable, especially with digital venue options and widespread media coverage. Nonetheless, CES retains its crown as the leading showcase for technology and innovative enterprise.



CES TECH TRENDS TO WATCH

By Don Levy

CTA's vice president of research Steve Koenig kicked off the pre-show media briefings with his take on "Tech Trends to Watch." Artificial intelligence, Web 3.0, digital health and augmented reality predictively top his list with a distinctive side note: Watch how enterprise — business at scale — innovates on top of recent tech innovations.

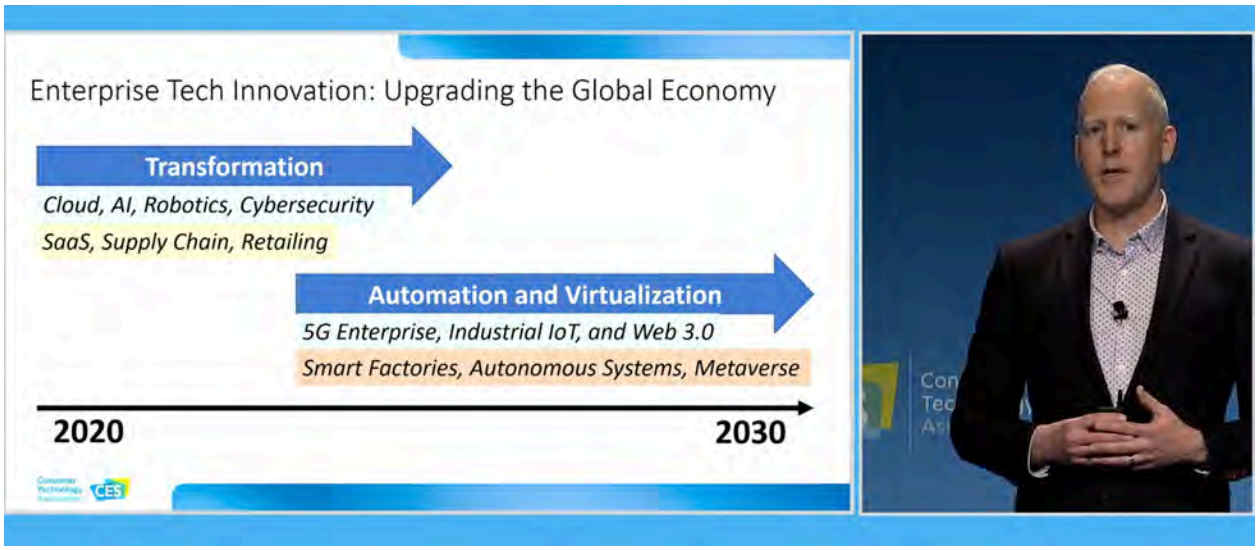
Koenig pointed to four key enterprise tech areas to watch: connected intelligence, quantum computing, autonomous systems and 5G industrial IoT applications.

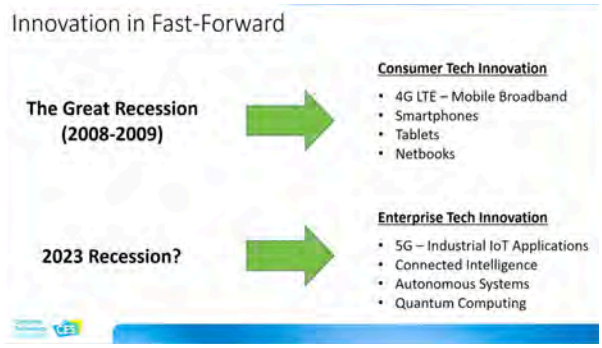
Lean, nimble startups may be the birthplace of innovation, something that made Eureka Park, the CES startup arena, the must-see exhibit hall. But, said Koenig, we are now in an era where major companies recognize the value of these innovations and will apply them in innovative ways.

Scarcity is partly responsible for this corporate epiphany, he noted. Supply chain issues are part of it but human resources, or more accurately, the scarcity of people to perform a variety of jobs is leading companies to turn to tech to get tasks done. Perhaps this point was made to set up the keynote by John Deere, which is leading the way in autonomous driving applied artificial intelligence, and a concerted environmental and sustainability emphasis on "doing more with less."

Advances in augmented and virtual reality, especially in retail, are not only creating new shopping experiences but increasing demand to ship purchases. This, he suggests, will lead to self-driving trucks. If you think this is only imagination, cart-sized self delivery is already a thing in cities, including Los Angeles.

In the virtual shopping experience Koenig described, a real salesperson and a real

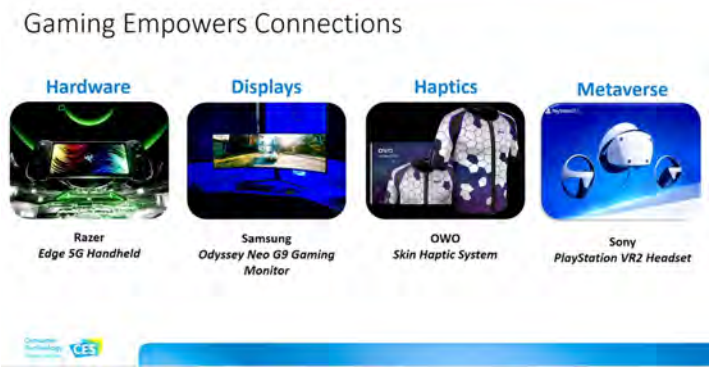


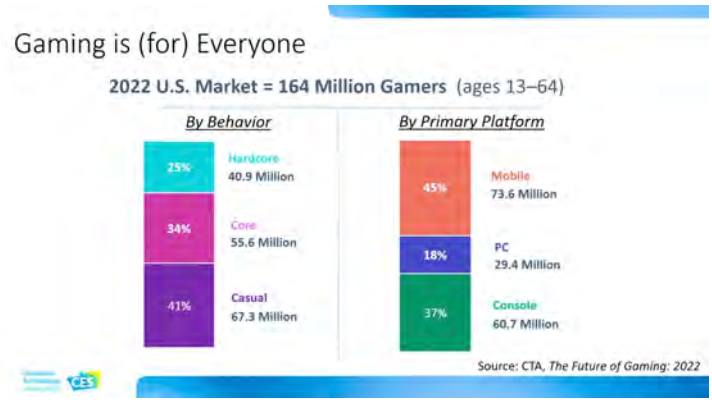


MORE: CES TECH TRENDS TO WATCH

shopper meet in a virtual store. In this hybrid environment, human interaction is key. Technology is an enhancement, not a replacement.

This led Koenig to the final chapter of his presentation: a riff on games. An update on Sony's next-gen VR headset was teased, but Koenig's main point was to say that in a future of hybrid experiences, where human interaction is facilitated in an immersive, virtual world, look at games and gamers. Gamers have been the pioneers of online communities, showing how technology can bring people together and build communities.





CTA CES RECAP

From the Consumer Technology Association

CTA Wrapped Up its Show with this recap

CES® 2023 ended today after an incredible week of product launches, major company announcements and innovation that will help to solve global challenges. CES shattered expected attendance drawing over 115,000 industry professionals – marking the largest audited global tech event since early 2020. With over 3200 exhibitors, including 1000 startups, CES 2023 showcased the next era of innovation from transportation and mobility to digital health, sustainability, Web3, metaverse and beyond.

For the first time, CES had a theme focused on Human Security for All. CES partnered with the United Nations Trust Fund for Human Security and the World Academy of Art and Science on the Human Security for All (HS4A) global campaign to foster food security, access to health care, personal income, environmental protection, personal safety, community security and political freedom. The products unveiled at CES 2023 tackle global issues such as access to clean water, food security, smart cities infrastructure, sustainable energy solutions, personal security and more. CES also featured the latest in accessibility tech, with innovation helping those in the disability community.

“CES 2023 was the great reconnection and rocked by every measure - from attendance to the keynote stage to press conferences and product debuts on the exhibit floor – showing the entire world that in-person events are BACK!” said Gary Shapiro, president and CEO, CTA. “The innovation unveiled this week will drive economic growth and change in meaningful ways to improve our lives and create a better future for the next generation.”

CES 2023 by the Numbers:

- Nearly 2.2 million net square feet of exhibits (70% larger than CES 2022)
- 3200+ exhibitors, including 1000 new exhibitors
- Over 115,000 attendees (pre-audit figures)

CTA CES RECAP

- Over 40,000 international attendees from more than 140 countries (pre-audit figures)
- 4800 global media from 69 countries (pre-audit figures)
- 60% of Fortune 500 companies represented

Top Trends at CES 2023

With over 3200 companies, including Abbott, Amazon, Bosch, BMW, Canon, Delta, Google, Hisense, John Deere, LG Electronics, Microsoft, Qualcomm, Panasonic, Samsung, Sony and Stellantis launching products, key trends on the CES show floor included:

Human Security for All – With unprecedented global challenges, the HS4A campaign was a central theme at CES 2023 highlighting the importance of collaboration and innovation across all industries, and all countries, to improve the human experience.

Automotive and Mobility – With some 300 vehicle tech exhibitors, CES 2023 was one of the largest auto shows in the world. Keynotes from BMW, John Deere and Stellantis and products launches from global companies focused on self-driving tech, electric vehicles and personal mobility devices for land, air and sea.

Digital Health – CES 2023 brought more digital health innovations and brands to the global stage, showing how rapidly the market is growing. Innovations included digital therapeutics, mental wellness, women's health tech and telemedicine.

Sustainability – Global brands like John Deere, LG, Samsung and Siemens showcased how innovation can conserve energy and increase power generation, create sustainable agricultural systems, power smart cities, and support access to clean water.

Web3 and Metaverse – For the first time, CES 2023 had a dedicated Metaverse area on the show floor, highlighting groundbreaking sensory technology building immersive, interactive digital worlds. A Web3 Studio, produced by CoinDesk, was the focal point of the Web3, Metaverse and Blockchain area at CES.

Startups – Eureka Park at CES featured 1000 startups from countries, regions and territories, including Japan, Korea, France, Italy, Taiwan, Turkey, Hong Kong, Netherlands, US, and Ukraine. Technology included renewable paper solutions to reduce CO2 emissions; AI technology used to reduce food waste; solar technology to capture both electrical and thermal energy; personal safety apps and more.

While CES 2023 concluded on January 9, on-demand content from the show will be available through February on CES.tech. Visit CES.tech for keynotes, sessions, product announcements and show floor coverage. Download CES b-roll and view the high-res image gallery here.

CES returns to Las Vegas, January 9-12, 2024.

KEYNOTES AND CONFERENCE SESSIONS

CES Keynotes in 2023 curiously did not include a traditional consumer electronics company - no Samsung, Sony, or LG. Instead, John Deere, AMD, BMW, Stallantis

(Click images to play)

CTA State of the Industry and John Deere

BMW

C-Span Keynote

AMD

STELLANTIS

Click on any of the banner arrows to access conference session videos and highlights from the show floor.

C Space, where media and marketing take center stage, featured sessions on talent, brands, NFT's, content creation, AI, data, and research.

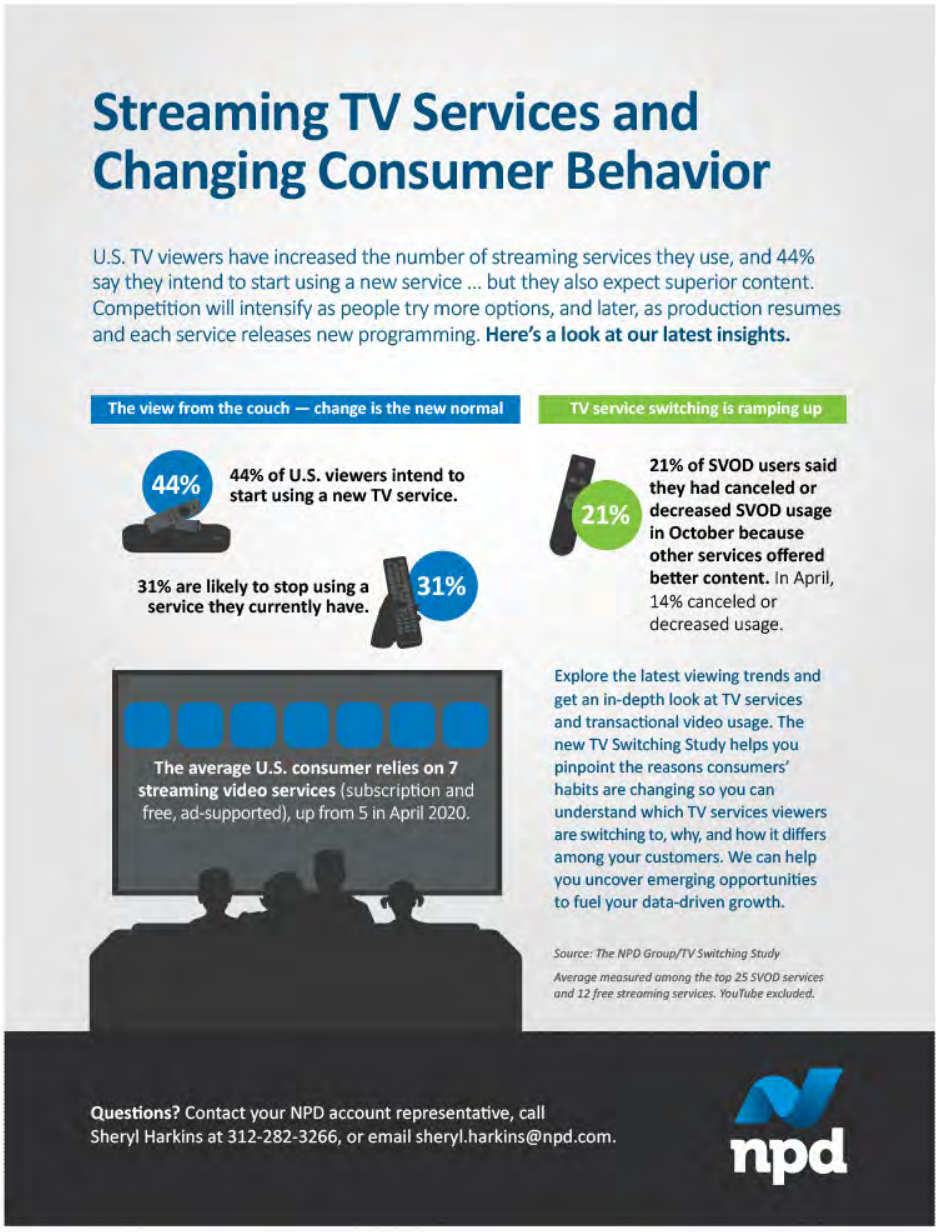
The Solving for Tech sessions explored a variety of topics, including Decrypting Crypto, FinTech, Experiential Retail, Social Shopping, and Game Health.

CONSUMER TRENDS

NPD Group Analyzes Changes in Consumer Trends

By Phil Lelyveld

The NPD Group's Paul Gagnon and Ben Arnold presented "7 Ways the CE Consumer Has Changed" in the last few years. U.S. consumer attitudes and behaviors changed from early-pandemic lockdown to the slow reopening, and then the fear of inflation and recession. In general, consumers are buying more for individuals than for shared home experiences, they have equipped themselves for remote work which may suppress future sales until they are ready to upgrade, and they buy when bargains appear even if they plan to actually open them for a holiday or special occasion.



Gagnon and Arnold addressed the following trends identified by The NPD Group.

Consumers are willing to pay more: Prices went up during the pandemic due to shortages and supply chain disruptions. That primed consumers for decreased price sensitivity just as prices started to go up due to inflation.

Non-traditional shopping seasons grow: Amazon created Prime Day in July as a global purchasing event. Other retail firms have built on both Prime Day and Black Friday; for example, Best Buy (October 10-12), Target (October 6-8) and Walmart (October 10-13).

Demographic changes matter: In 2022 consumers with incomes over $100K per year accounted for 46 percent of all consumer tech spending. Consumers ages 18-24 spent the most on notebook PCs, ages 25-34 led TV purchases, ages 35-44 were the largest purchasers of notebook gaming PCs,

CONSUMER TRENDS

ages 45-54 were the largest cohort for desktop gaming PCs, and ages 55+ bought a significantly higher share of tablets.

Tech products are essential: The spike in work-from-home and remote schooling drove a spike in tech resource purchases. Consumers are buying for individuals within the household rather than shared resources for the household. Looking forward, 31 percent say that they will cut back on buying tech products in 2023, while only 25 percent plan to cut back on gaming and streaming.

Online and social shopping: The e-commerce share of total tech dollars spent increased from 44 percent in 2019 to 57 percent in 2022. This includes online purchases for both home delivery and in-store pick-up at brick-and-mortar retailers. Additionally, 20 percent of consumers plan to use social media to research products, a bump from past responses.

Technology to make life better: Item trackers, like the Apple AirTag, have achieved 41 percent revenue growth in 2022. Digital health tech similarly showed 31 percent revenue growth.

Flexible work: Desktop monitor sales grew 78 percent in 2020 and another 7 percent in 2021.

Looking toward the near future, The NPD Group is watching experimentation with features-as-a-service. Last November, Mercedes-Benz announced that it would lock faster acceleration for its EQ electric models behind a $1,200 annual pay wall. NPD posited it is possible that a display manufacturer may make one full-featured device and sell it at different price points and subscription levels depending on which features are unlocked at the point of sale.

Executives Explore the Impact of Customer Intelligence

By Don Levy

The role customer intelligence plays in delivering seamless, personal experiences was the topic of three conference sessions organized by Acxiom, a leading customer intelligence company and data-driven solution provider. While the industry leaders and panel discussions drew from the automotive sector, the insights have broader implications. Details were also released in Acxiom's Automotive Customer Experience study. "These survey findings highlight how critical it is for brands to have a genuine understanding of people and how hard it can be to deliver the right message at the right time," said Steve Schmith, director of automotive strategy at Acxiom.

"Marketing as a one-size-fits-all mindset is long gone," he suggested.

In the first session, Ajay Kapoor, global director of performance marketing at General Motors, and Chad Engelgau, president and CEO of Acxiom discussed how GM is harnessing "people data" and technology to create lifetime engagement and customer value.

"The art of the possible" is what Kapoor called a guiding principle to GM's approach to products and services as they build a bigger and broader ecosystem. "It will not be up to one company to solve," he said. Instead, there needs to be more collaborative relationships, inside and out. One example he cited is a partnership with Microsoft to deploy new software-defined vehicle services.

"Brands that invest in knowing their customers and providing specialized experiences throughout the customer lifecycle will excel, and we're going to see a new emphasis on personalization in the automotive space," Microsoft posted as CES opened.

"No longer are buyers 'stuck' with the static experience delivered upon vehicle purchase. In-car personalization through connected and software-defined vehicles unlocks the ability to provide ongoing updates to the vehicle experience."

The byproduct of a broader ecosystem is more data, provided organizations open access and opportunities for collaboration – something many companies have not

CONSUMER TRENDS

always done. “We need to drive 100 years of history into a 5-year change cycle,” said Kapoor.

Examples of the ecosystem Kapoor suggested were represented on the Innovations in Data panel, moderated by Schmith, and featuring Joshua Aviv, founder and CEO of SparkCharge; Ed Chung, CFO of Jerry; Chad Collier, CEO and founder of CarSaver; and Dan Roarty, chief digital officer of FLASH.

All of these companies, from financing and insurance to battery recharging and parking spaces, help customers at different stages of the purchasing and ownership cycle.

As the car transforms, entire new value chains and opportunities emerge, transforming the customer experience. This was the subject of the third and final panel, a cautionary one about potential missed opportunities moderated by Acxiom’s GM and head of IPG Solutions Joyce Turner.

Turner started the discussion with her own realization of personalized entertainment when she said she has “cut the cord.”

“Brands can design who your customer is and how we should interact,” said Justin Evans, global head of analytics & insights for Samsung Ads. Samsung, through Samsung Plus, now provides abundant free TV and a personalized user experience.

Vicki Poponi, former chief marketing officer at Honda and now VP and auto industry advisor at Salesforce, calls every interaction “a signal.” Each signal allows for hyper-segmentation and a highly personalized customer journey. “Put yourself in the customer’s head,” she recommended.

Patrick Roman Gut, VP and head of sales for Adlook, suggested that advertising is a way to enrich the user experience. When asked for a singular piece of marketing advice, he said, “stop thinking that you already know.”

Samsung’s Evans summed up the session: “Data is in service of a business outcome. Focus on the outcome.”

GENERATIVE AI HAS ITS WAR OF THE WORLDS MOMENT

By Yves Bergquist

ChatGPT came too late (end of November) to make a significant impact on CES this year, but the cacophony of opinions about the generative AI model definitely made its way to Vegas. The timing was perfect. Just as the crypto crash left the hype industry paralyzed, OpenAI launched ChatGPT in what now feels like a nerdy and frustrating tech version of the Rolling Stones' Altamont concert in '69 (with computer scientists as the Hells Angels). Make no mistake: this is a landmark achievement in machine learning — perhaps the single greatest since the 2006 paper by Hinton, Salakhutdinov, Osindero and Teh on back propagation in deep neural networks. However, it's critical that industries, including M&E, distinguish between hype and reality.Of particular interest to him was: NVIDIA's Omniverse updates (now free, 3D marketplaces, integration with Epic's MetaHuman) are very impressive. To me it means that they're becoming the central platform (operating system) for 3D.

ChatGPT is a version of OpenAI's latest large language model (LLM), GPT-3.5, optimized for dialogue with humans. As far as OpenAI has been willing to share publicly (quite a bit more than previously, actually), ChatGPT uses similar training data as GPT-3 (45TB of text), and has the same initial number of parameters (175 billion). That's around 3x less than its two closest competitors, Turing NLG (Microsoft, 530 billion) and PaLM (Google, 540 billion), and 100x more than GPT-2.

Like all large language models, ChatGPT does one critical thing very well: using its gigantic training set to guess the probability that one word or part of word (a token in NLP) will come after another. This is a traditional natural language processing method called an n-gram model, but on T-Rex steroids.

What makes ChatGPT unique — and powerful — is the amount of manual (human) fine-tuning that this probabilistic model went through. OpenAI used a method called Reinforcement Learning through Human Feedback. In implistic terms, RLHF is a method whereby human analysts prompt GPT-3 and manually "reward" (or not) the responses on how "aligned" they are with the human intent (like teaching a puppy how to play soccer with a pocket full of treats).

Another human team then ranks the rewarded responses from most to least useful, creating a new class of labels, which is then used to re-train the model. Rinse and repeat.

The human in the loop's ranking greatly improves the model's "alignment," which in machine learning means that it's both accurate and relevant to the prompt, an area where GPT-3 was seriously lacking. It also reduces the size of the model (1.3 billion parameters for the RLHF-powered InstructGPT, close precursor to ChatGPT). Finally, this manual scoring does a much better job at weeding out toxicity in the output text.

The result is impressive. ChatGPT can produce coherent and often insightful text in many specific styles, and perform many natural language tasks at human level. When it's good (often) the machine-output text is indistinguishable from human output, which is probably why the education industry is (justifiably) freaking out. When it's bad (also often), it betrays inescapable yet fundamental flaws in OpenAI's methodology: it is hyperscale parroting, not

GENERATIVE AI HAS ITS WAR OF THE WORLDS MOMENT

intelligence per se. But it works, which is why it's garnering so much attention.

Just like its parent, GPT-3.5, ChatGPT is a mix of different sub-models, each capable of handling specific tasks and types of human knowledge. This approach greatly improves the quality of the outputted text for these use cases in these domains. But it also means that it leaves out many other domains, tasks and types of knowledge, where the model hasn't been trained.

The lack of proper reasoning modules means that ChatGPT fails at simple arithmetic or logic ("10 pounds of feathers are lighter than 10 pounds of steel"). It often answers questions in ways that are grammatically correct (high accuracy) but don't make any sense in the real world (low alignment).

This is because the model has been fine-tuned on tens of thousands of human contexts, but far from all. So when a prompter hits the model with something it's been trained to "understand," it can pastiche at a level unseen before. But when in unknown territory, it fails spectacularly. More importantly, ChatGPT is still an extension of the same broad methodology, deep learning, that covers only one aspect of intelligence: learning on training data.

So yes, it's been fun seeing the techno-optimists and techno-pessimists agree on something. But behind the attention-grabbing hyperbole about ChatGPT is a fundamental reality of the tech industry: keep your eyes on the builders, not the commentators. There's no tech without products. And there are significantly less high-tech products on our tables than in our podcasts.

In many ways, the past six weeks of the tech press have felt like an extended version of Orson Welles' 1938 "War of the Worlds" radio broadcast, minus the street mobs. No, ChatGPT is not artificial general intelligence (not even close). No, this isn't the end of Google (they're doing well with AI, thank you). No, as we heard at CES, 90 percent of content won't be machine-generated in two years. No, it's not the end of writing.

As often, we find the truth by following the money. And in the attention economy there's big money in hysteria for tech commentators and their book agents, not to mention OpenAI's lucky stockholders.

Here is what's most likely to happen:

1. **A handful of creators will leverage Generative AI models to take their workflows to the next level.** Our most precious commodity is time. Those creators who can leverage ChatGPT into their workflow to laser-focus their time on the core craft of exploring higher-level human narratives will win the era of augmented content creation.

2. **Some cool apps will emerge.** Most of our short-form communication is made of commoditized, pro-forma replies that we do mechanically for the performance of politeness. This will be automated, thankfully. And ultimately written politeness will disappear altogether when it's clear that machines, not people, have been thanking you for years.

3. **The cat-and-mouse game between digital marketers and content distributors will become nuclear warfare.** We'll see a dramatic amplification of the already overwhelming abundance of high calorie, low-nutrient digital content (bad tweets, biased product reviews, boring

GENERATIVE AI HAS ITS WAR OF THE WORLDS MOMENT

Instagram posts) designed to game the search and content recommendation platforms. ChatGPT will make this problem exponentially worse. And yes, some clever junk content publishers will make a lot of money for a little while. And yes, search engines will need to apply enormous efforts to combat them.

4. **4. Education will get seriously disrupted.** By automating regurgitation, ChatGPT will force the education sector into the modern age of teaching kids how to digest oceans of public information to solve complex, systems-level problems.

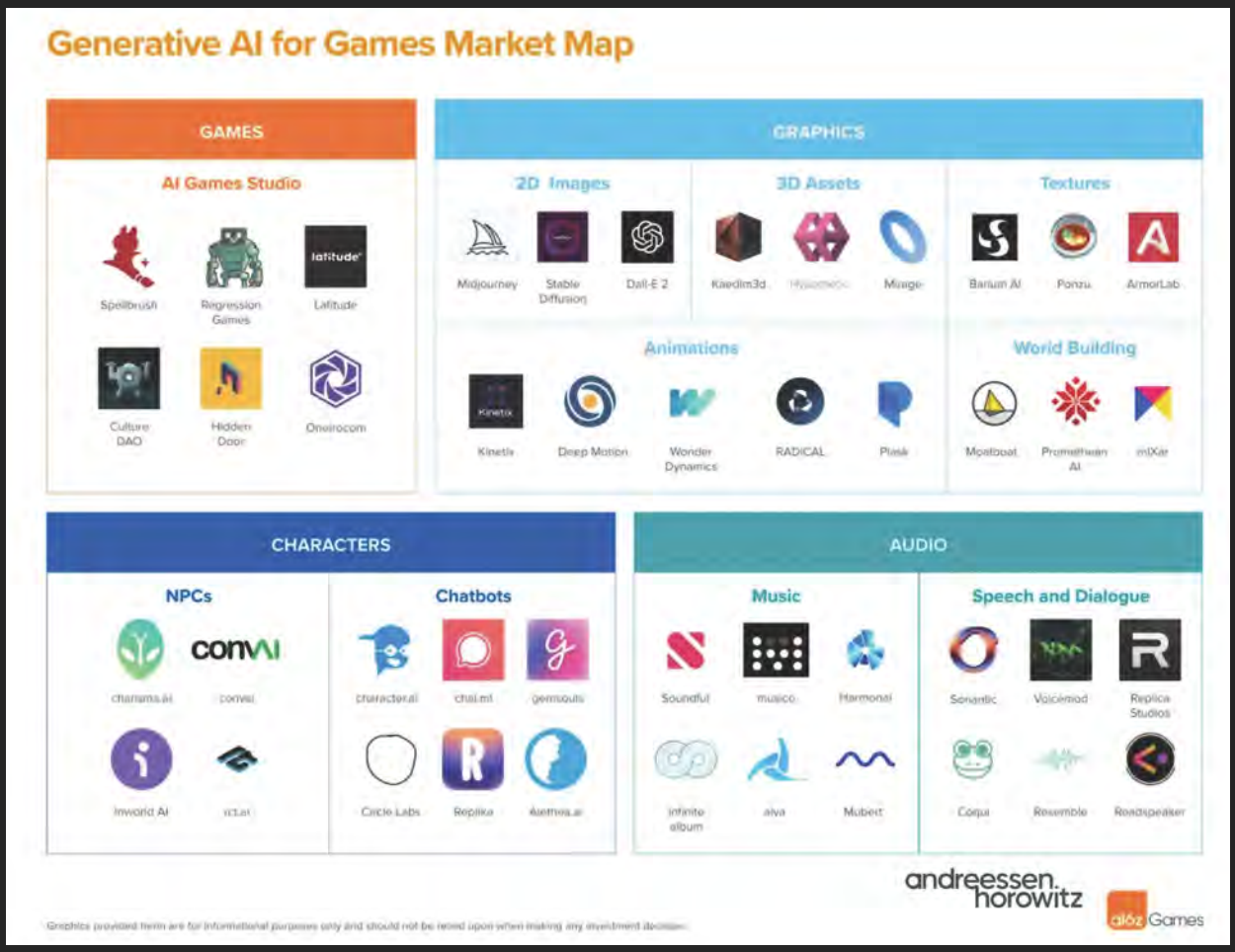
5. **5. Curation will continue to rule.** And Hollywood will as well. In an ocean of content, the value lies with curation and personalization. Time being the world's most precious commodity, exhausted digital denizens will pay a high premium for a service that can deliver them the exact content that they need or that inspires them. And nobody is better at sorting this signal from the noise than the giant talent-filtering algorithm called Hollywood, which also knows something Silicon Valley keeps ignoring: people actually hate technology.

Editor's Note: This post is an editorial from Yves Bergquist, ETC's director of AI and Blockchain.

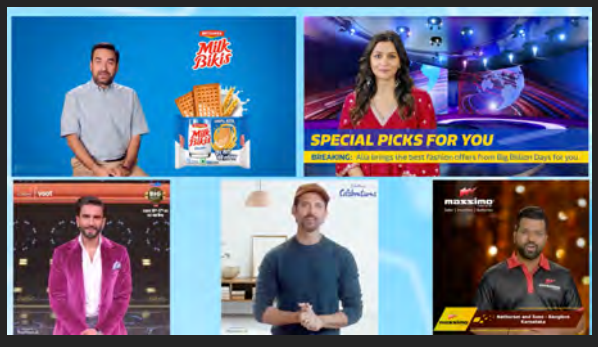
Artificial Intelligence: New Rules and Tools - Digital Policy Summit panelists, from left to right: Stephanie Fiore, Elevance Health, Farzana Dudhwala, Meta; Laura Caroli, European Parliament; Elham Tabassi, National Institute for Standards and Technolgy (NIST); and CTA's Doug Johnson, the moderator.

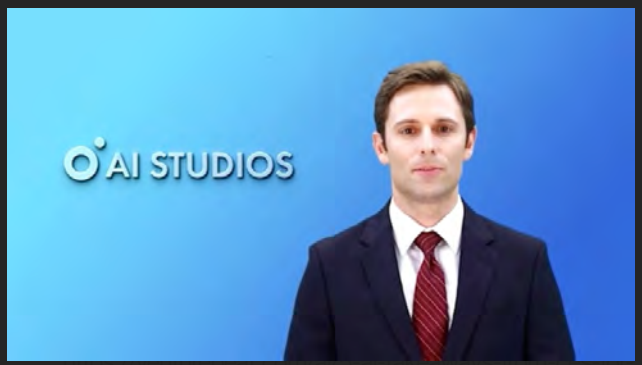
Both the European Parliament (the EU's law-making body) and the U.S. National Institute of Standards and Technology (NIST) were represented on a CES panel on "AI Rules and Tools," moderated by CTA vice president of emerging technology policy Doug Johnson. Also on the panel were executives from Facebook parent Meta Platforms and insurance provider Elevance Health, for a robust discussion on how to arrive at standards and regulations for the powerful — but often industry-based — AI technologies that will also be accepted by countries around the world and industries with competing interests.

See more on page 56



Rephrase.ai's deep tech generative AI technology creates video for business communications. Largo.ai provides data driven intelligence specific to entertainment; DeepBrain AI Studios creates natural avatars; Acapela created My Own Voice a vocal archive that can be applied to text. Designed to help individuals losing their voice.





Nvidia Intros AI Impact on Gaming, Omniverse, Laptops

By Debra Kaufman

At Nvidia's CES 2023 keynote, executives revealed new products and innovations in laptops, gaming, the omniverse, robotics and auto technology. Nvidia senior vice president of gaming Jeff Fisher focused on the company's AI developments, emphasizing that, "AI will define the future of computing," and adding that "this has influenced much" of what the company is showing at CES. He highlighted the company's "new era of laptop computing," powered by its Ada Lovelace architecture, GeForce RTX 40 Series GPUs and new 5th generation Max-Q technologies with DLSS 3 for quadrupled speed.

Gaming laptops with the RTX 40 Series GPUs, which will begin shipping in January, run the gamut from the most powerful RTX 4090 to the RTX 4050. Nvidia reports that laptops with the RTX 4090 and 4080 cards can transmit a 4K resolution image to three monitors simultaneously at 60 fps, with video export speed double that of last generation GPUs.

Nvidia has not yet revealed which laptop partners will first introduce laptops with the new chips, but The Verge states that "Nvidia calls out partners like Alienware's new X16, Dell, Acer, Gigabyte, MSI, Samsung, Lenovo and Razer in multiple form factors."

According to PC Gamer, Nvidia's RTX Video Super Resolution uses AI to remove artifacts and then upscale video to 4K from imagery with native resolution of between 360p and 1440p to 4K.

Also newly launched is the GeForce RTX 4070 Ti, faster than the GeForce RTX 3090 T, with the Ada Lovelace architecture providing the speed increase at almost half the power. Nvidia reports that, at $700, GeForce RTX 4070 Ti will deliver over 120 fps on a 1440p monitor for numerous modern games including "A Plague Tale: Requiem," "Warhammer 40,000: Darktide" and "F1 22."

The Frame Generation technology added to DLSS in October will provide RTX users with a quadrupled AI-powered performance boost in over 250 released creative applications and games.

Nvidia also showed off its updated Omniverse Enterprise for increased performance and a "generational leap" in real-time RTX ray and path tracing and "streamlined workflows to help teams build connected 3D pipelines and develop and operate large-scale physically accurate virtual worlds."

Adobe Substance 3D Painter, Autodesk Alias, PTC Creo and Kitware's ParaView are now supported in Omniverse Connectors for "seamless connected workflows." Omniverse DeepSearch — now widely available — uses AI to search very large untagged 3D databases via natural language or 2D reference images.

Nvidia Brings GeForce NOW Cloud Gaming to Vehicles

By Paula Parisi

Nvidia will bring GeForce NOW cloud gaming to cars via Android and web browsers. At CES 2023 the company announced automakers Hyundai of South Korea, Sweden's Polestar and Chinese EV maker BYD as the first streaming partners, with titles including "Cyberpunk 2077," "The Witcher 3: Wild Hunt" and "Fortnite" among initial offerings. While Nvidia did not announce a launch date for the new service, it said GeForce NOW will "stream a real-time, full PC-gaming experience to software-defined cars." The company added that in-vehicle gaming can "enhance time spent charging or riding in vehicles."

Drivers will be able to stream and play games on dashboard screens "while parked," and passengers

can "game in the back seat if screens are available," Nvidia said in a blog post.

"The increasing power of in-car infotainment systems and the prevalence of ever-larger displays has widened the availability of more advanced titles," writes The Verge, noting that "although some automakers have delivered only half-hearted gaming efforts (like BMW's AirConsole partnership)," while "others, like Tesla, have taken the prospect more seriously."

Tesla has offered in-car game streaming since 2019, when Tesla Arcade was launched, and recently added Steam access to newer vehicles.

In all, a library of more than 1,000 games will be made available on the automotive platform. Nvidia's blog post specifies the Hyundai Motor Group, which includes the Kia and Genesis brands, uses "Nvidia DRIVE in-vehicle infotainment across its entire lineup," and says that "BYD, the world's leading manufacturer of new energy vehicles, announced it would build its NEVs on the Nvidia DRIVE Hyperion platform, starting in the first half of 2023."

It states "Polestar is also using Nvidia DRIVE for its software-defined architecture, with the upcoming Polestar 3 powered by the Nvidia DRIVE Orin system-on-a-chip." Nvidia DRIVE automakers "will offer vehicles that are as entertaining as they are intelligent with the addition of GeForce NOW," the blog post states.

Introduced in 2015 as a platform to design and control autonomous vehicles, Nvidia DRIVE also controls in-vehicle screens. Announced in September, Nvidia DRIVE Thor — Orin's successor — can simultaneously run Linux, QNX and Android. And Nvidia DRIVE Concierge "lets passengers watch videos and experience high-performance gaming wherever they go," allowing them to "choose from their favorite apps and stream videos and games on any vehicle screen."

While Android and the Internet will deliver GeForce NOW games to vehicles, Nvidia DRIVE Concierge will manage those streams within the car (a role that could expand over time).

While The Verge points out that Nvidia "offered no further details on what technical specs might be required for access," it adds that the company continues to improve GeForce NOW, "adding support for 1440p resolution at 120 fps in Chrome and Edge browsers last August."

Engadget cautions as to the cost, noting that "while basic GeForce NOW use is free, you can pay up to $200 per year for the full experience before you factor in the cost of the games themselves."

Sony Focuses on Creators and the Power of Technology

By Don Levy

Inspired by the "universal human desire to experience joy, wonder and amazement, moments that move people's hearts and connect them to one another, what we call Kando," Sony chairman, president and CEO Kenichiro Yoshida began Sony's CES media briefing by celebrating creators. Evident was a more unified corporate direction and concrete examples of Sony divisions working together. Movies, television, music, games and sports, and ways for audiences to experience them, were prominent examples. Following an exhilarating clip from the upcoming feature "Gran Turismo," based on the PlayStation game, the prototype for the first Sony Honda Mobility car rolled out.

The launch of Sony's first nano-satellite for Star Sphere, an educational project that provides an opportunity to think about the global environment and social issues, led Yoshida into a discussion of the CMOS image sensor that is at the heart of Sony's new Venice 2 cinema camera (used on such blockbusters as "Top Gun: Maverick"), and has been added to the company's pan-tilt-zoom (PTZ) camera, the FR7.

He also noted Sony Innovation Studios for its virtual production work and Sony Pictures acquisition of visual effects studio Pixomondo.

Introducing Nicole Brown, president of Tri-Star Pictures, Yoshida said he was particularly excited to introduce diverse voices and perspectives to audiences. "The Woman King" was one example of original, director-driven, culturally relevant and fun entertainment.

SONY & HONDA & EPIC & QUALCOMM

For “I Wanna Dance with Somebody,” the musical biopic of the Whitney Houston story, Brown said they are working with the original master recordings to create “a sonic experience so you feel like you’re in the room as the legend Whitney Houston is singing just to you.”

PlayStation Productions president Asad Qizilbash, director Neill Blomkamp and Sanford Panitch, president of Sony Pictures Entertainment Motion Picture Group, previewed “Gran Turismo,” based on the incredibly successful PlayStation franchise.

In the clip and behind-the-scenes footage they showed, previously impossible camera positions promise exhilarating angles along with the game’s signature views. At the heart of the movie is a true and emotional story.

Next, Yoshida introduced a proof-of-concept service for sports fans that enables them to experience gameplay on the field based on actual game data.

Jim Ryan, president and CEO of Sony Interactive Entertainment, highlighted success of PlayStation 5 with more than 30 million units sold and anticipation for the latest PlayStation VR. He also announced a new, configurable game controller designed especially for players with disabilities. Called Project Leonardo, “It’s a true canvas that enables many gamers with disabilities to craft their own play experience,” said Ryan.

Yasuhide Mizuno, chairman and CEO of Sony Honda Mobility unveiled a prototype for the group’s first EV, currently called Afeela. Loaded with technology and a true software defined vehicle, the car will be available for pre-orders in 2025 with the first North American shipments expected in 2026.

Kim Libreri, chief technology officer at Epic Games, developer of the Unreal game engine, suggested some novel applications for this car that strives to redefine both space and time.

Yoshida’s final guest was Cristiano Amon, president and CEO of Qualcomm, who came to the stage to talk about a long, successful collaboration with Sony that will take on a new dimension as the Sony Honda Mobility car goes into production.

LG MG Wireless OLED.

DISPLAYS

CES: LG Unveils Its Low-Latency Wireless 97-Inch OLED TV

By Paula Parisi

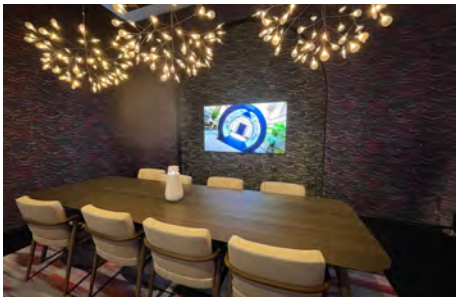
LG Electronics has unveiled a 97-inch OLED TV billed as a "zero connect" wireless solution that is generating praise at CES 2023. Capable of real-time video and audio transmission at up to 4K 120Hz, the new OLED TV M3 eliminates the need for HDMI or AV cabling from set-top boxes, soundbars, receivers or game consoles, requiring only a power cord. The LG M3 TV comes with a separate Zero Connect box that sends video and audio signals wirelessly to the 97-inch screen. Because the box can be located away from the television, the result is designed to be a sleeker, distraction-free viewing environment.

CNET writes the 97-inch LG Signature Series M3 OLED, as the wireless model is known, "puts all other TVs to shame," adding that "wireless TV is real, and it's coming this year." LG introduced a wired 97-inch model at CES last year and continues to offer what is "the biggest OLED TV in the world," according to CNET, which lauds OLED for having "the best picture quality available."

The back of the Zero Connect box features HDMI inputs and other connectors, while the TV

Samsung Odyssey OLED Gaming Monitor

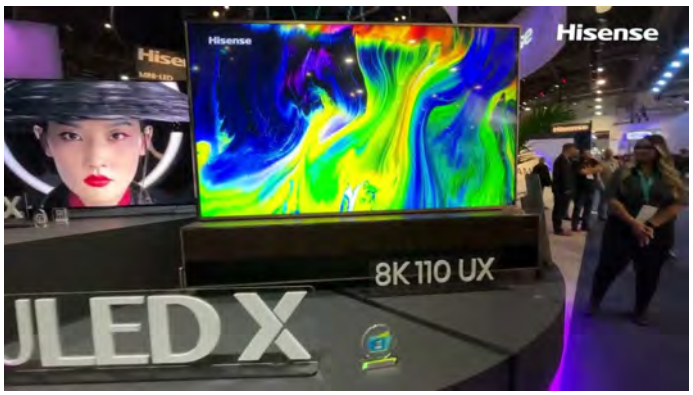
LG - Born to Game Monitor



TCL Mini LED 4K TV

itself has no inputs at all. The TV's power cord is "artfully [hidden] inside one of the stand legs." The box can be placed at up to 30-feet from the screen. CNET's writer describes the image sent wirelessly from a box-connected Blu-ray player as displaying "flawlessly, to my eye."

Although LG did not reveal details on price or availability, CNET notes "for reference, LG charges $25,000 for its standard, wired 97-inch OLED TV and $2,900 for a 77-inch one, so regardless of size the M3 won't be cheap."



While wireless TV configurations have been a focus for set designers of late, Digital Trends says "this is the first time we've seen a TV manufacturer put all of its connection eggs in the wireless basket," noting reluctance has historically "been due to the nature of wireless signals — they tend to be highly susceptible to various kinds of interference — and the desire to avoid angry customers who can't get reliable pictures and sound."

Specifying that the wireless M3 on display at CES was a "pre-production model," Tom's Guide reports that "latency — a potential issue for gamers who want the fastest, most responsive gameplay experience — would be 'much lower than 20ms' and 'almost imperceptible,'" according to LG.

Further details can be found in LG's announcement. Aside from the 97-inch M3, LG also showcased three other series of wired OLED TVs at CES 2023: the Z3, G3 and C3 OLED models, which "up the brightness factor," CNET reports.

Nvidia's AI Upscaling Tech to Tackle Blurry Web Video

By Rob Scott

Nvidia announced during CES this week that it plans to roll out its RTX Video Super Resolution feature in February for web video content viewed through Google Chrome and Microsoft Edge browsers. The company promises AI upscaling up to 4K quality, but the feature requires a PC

running a Nvidia 30- or 40-series GPU. The technology — which can upscale video with resolution between 360p and 1440p, including 1080p, and up to a 144Hz frame rate — has already been available on Nvidia Shield TV and Shield TV Pro streaming media players. However, introducing browser support should significantly increase its audience.

According to The Verge, "a video demonstration of the tech at work on 'Apex Legends' footage shows edges being sharpened, and video artifacts reduced. Nvidia's demo shows RTX Video Super Resolution at work on a YouTube video, but its blog post notes that should work on 'any video watched in a browser,' which should cover other streaming services like Netflix."

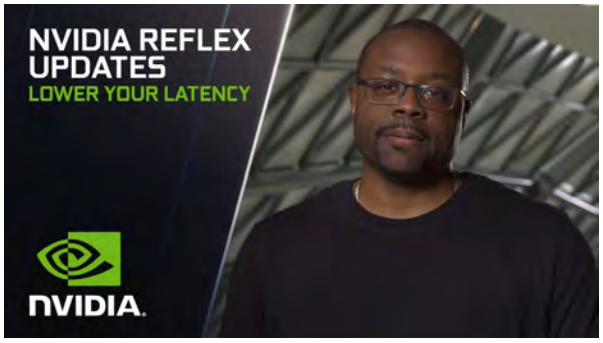
Nvidia's "tool cleans up any jagged bits, using the AI power of the tensor cores embedded in modern GeForce GPUs," explains PCWorld. The process removes "blocky compression artifacts, which are large pixel blocks that cause distortion" and "gives the input a good scrub down and then makes it bigger. The idea is to improve video quality on larger displays and make binging your favorite shows more pleasant to look at."

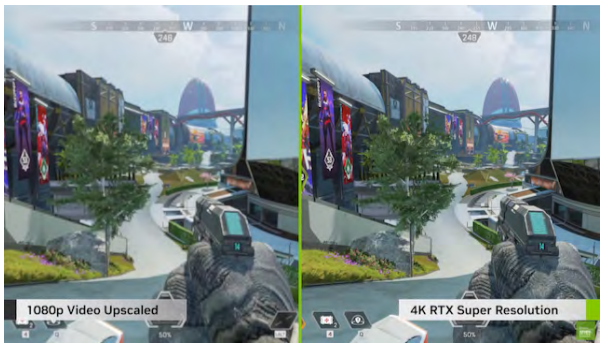
"Upscaling really is the future of PC performance," suggests PC Gamer, "and it was only a matter of time before someone turned one of these clever algorithm's attention to our binge-watching habits."

To see the 4K AI upscaling for Chrome and Edge browsers in action, Nvidia Studio has posted a short video demo (see screen grab to the right). According to one viewer's comment: "Ever since using the Nvidia Shield

with AI upscaling for movies, I have wanted it everywhere! Getting it on PC is fantastic."

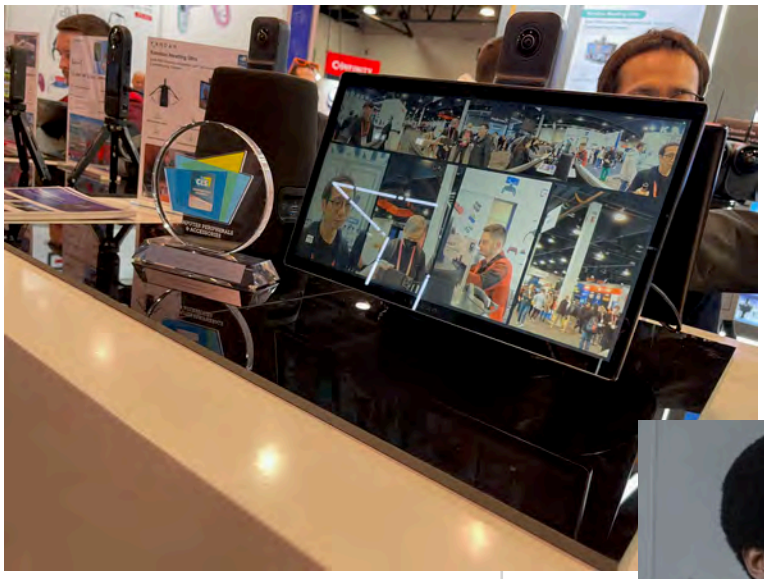
Other comments seem equally enthusiastic, although not surprisingly there are numerous requests for Firefox support and a future in which similar tech can help with lower resolution video.



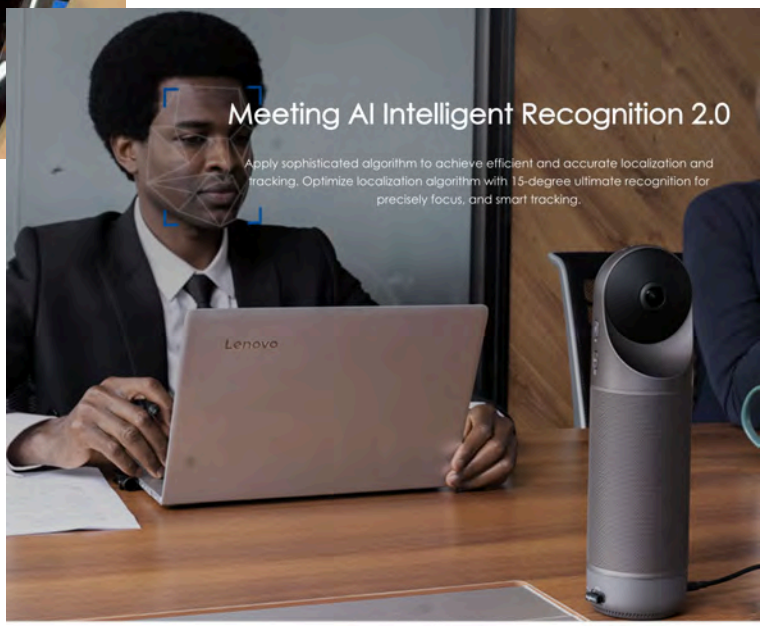


XGIMI Horizon Pro
4K image quality and image size up to 200 inches. 2200 ANSI Lumen. Built in Harmon Kardon sound in a $1499 package.

XGIMI Halo+ and Samsung Freestyle
Designed for portability and go anywhere viewing.



Kandao Meeting Pro 360
Kandoa Meeting Pro 360 provides panoramic capture, omnidirectional mics, smart focus, and tracking to facilitate remote collaboration, learning, and conferencing. The device was a CES2023 Innovation Award winner.



Matter Smart Home Protocol Marks Major Trend in 2023

By Rachel Joy Victor

While smart home technologies have often made a strong showing at CES, adoption has been hampered by issues of interoperability. This year at CES saw the widespread reveal of Matter (originally known as Project CHIP), a new smart home standard designed to support interoperability. Matter was originally announced in 2019 as a partnership between Apple, Google and Amazon to create an open-source smart home standard. Today, if CES 2023 is any indication, the standard is becoming more prevalent across a wide variety of connected devices and different product sectors.

Initially, Project CHIP (Projected Connect Home over IP) was formed with the goal of giving developers "one standard for building their products," according to Google. As we reported in 2019, the consortium of companies with smart home assistants were also joined by the Zigbee Alliance, which was creating a smart home association with manufacturers of smart object lines such as Samsung SmartThings, Philips Hue, and others.

Previous entrants in the market, like Wi-Fi, Bluetooth, Z-Wave, and Zigbee's own play, failed to corner the market — often because they weren't able to meet the variety of smart home needs. Today. Matter has become "an open-sourced connectivity standard created by over 200 companies … that leverages existing technologies — Thread, Wi-Fi, Bluetooth, and Ethernet — to allow all of your devices to communicate with each other locally, without the need for a cloud," reports *The Verge*.

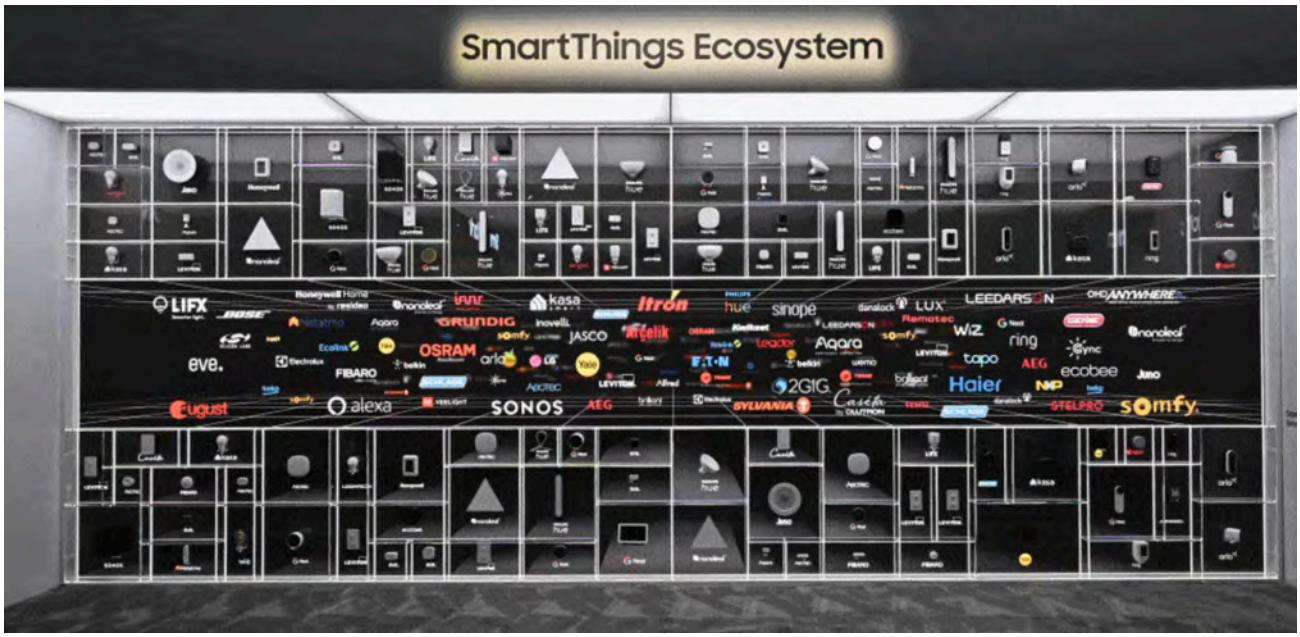
Part of what makes the standard more likely to be adopted is that Matter is not introducing a new standard wholesale. Rather, it is built as an extension on current IP technologies. The fact that the devices communicate with each other locally and not over the cloud helps both with issues of speed and privacy.

At CES this year, use of the standard was touted by Samsung, LG, and a bevy of other smart device manufacturers. *The Verge* staff declared Matter their CES Best of Show winner, noting: "every company with a toe in the smart home is paying attention to Matter."

Of course, this isn't to say that the system is without its issues. As originally pitched, it promised to offer backwards compatibility to support smart devices that already exist on the market, but the big players in the space are choosing to do so on a case-by-case basis.

Lack of interoperability in the smart home's space created a walled garden that made it easier to build a moat around existing users. Baseline connectivity was often the product sell, but with an interoperability standard, companies will have to innovate on top of the standard. While Amazon, Apple, and Google are utilizing the Matter standard across some of their product categories, they have been generally closed about if and when they will generalize to Matter use across all product types.

Nanoleaf, a pioneer in SmartHome technology with an extensive catalog of smart lights, announced five new Matter-compatible products at CES.



Still, Matter provides a hopeful note to the smart home industry. By increasing competition, Matter will force companies to innovate on user experience. Increased ease of use also has the likelihood of expanding the market.

Mitch Klein, executive director of the Z-Wave Alliance (as quoted in *The Verge*): "If this is successful, everyone sells more … Market penetration increases, the stagnation of the smart home in terms of growth is going to increase, and new product categories will open up."

An enabling of seamless utilization also provides a helpful baseline from which media companies can build out an at-home entertainment experience that is contextualized to individuals.

Mui Board brings a Matter control panel on a piece of wood

MULTIVERSE?

By Rylan Pozniak

Rylan Pozniak is an undergraduate student at USC's Iovine and Young Academy and active content creator in this emerging sector. He joined the ETC team at CES with the specific mission to report from his point of view and share his perspective.

Driving up the neon-clad Bladerunner-esque tunnels of the Tesla Boring Company Tunnel in Las Vegas immersed me in the innovative wonderland I was about to experience at 2023's CES. The expo was full of bleeding-edge technologies in everything from computers to robotics to entire cars. I particularly focused on the emerging trends in XR and AI, what were my favorite takeaways, and what implications they have for the future.

HechicerIA

I was blown away by HechicerIA, a ChatGPT-style tool for generating entire 3D game environments and levels. You can even import your own 3D models and IP as inputs into the tool. It was originally intended to be used only for creating 2D videos that used camera shots in the game engine, but I believe there is a much greater potential for HivenchaIA to be used to rapidly prototype interactive game experiences for the metaverse and VR/AR. Disney could start with a 3D model of Mickey Mouse, type "Create a log cabin in the middle of a forest with a river, and Mickey Mouse emerges from a portal adjacent to the cabin" and--in just a few minutes--HechicerIA would output an entire interactive 3D world ready to be played in the game

HechicerIA, a ChatGPT-style tool for generating entire 3D game environments and levels.
https://youtu.be/alqbflh1m3U

engine! Forget coding, just type the game of your dreams, and get a game all set up for you! Currently, HechicerIA only generates visual assets, but once could easily imagine generating game logic like interactions with a desktop keyboard or VR headset hand controllers to be associated automatically with the generated assets. The future is one where the ability to rapidly create highly-detailed, rich, photorealistic worlds is democratized to the masses.

Owo Haptic Shirt

As I donned the Owo Haptic Shirt, my physical body felt like it was getting stabbed with a medieval sword, shot with a cannon, and . While there's already an entire industry around haptic wearables for XR, what makes Owo so unique is it looks just like a regular shirt—no bulky vest required. Besides just looking more natural and being much easier to put on by yourself, experiencing bodily haptics in a slimmer form factor greatly improves the gameplay experience since it's much lighter than its competitors, providing a more believable user experience. Out of all the haptic systems out there, a device like Owo could be the most likely technology to democratize haptic technologies to the masses.

Magic Leap 2 Floats up to the Cloud

The Magic Leap 2 AR headset's integration with NVIDIA Omniverse is extremely cool. For the first time ever, you can remotely stream photorealistic 3D renderings and realtime reflections from just a XR website! Magic Leap showcased an AR demo of a highly-detailed car 3D model. The way this works is that an external desktop computer renders the high-quality 3D car model, which Omniverse streams through the cloud to Magic Leap 2. Magic Leap's on-device sensors and capabilities only have to worry about the standard AR tracking and object persistence that it's already quite good at. In the short term, the AR industry will continue to experience significant restrictions on trying to squeeze every ounce of graphical processing and computational power out of a very thin glasses-like form factor, but WebXR could be the solution. This basis could have massive implications for the future of AR content creation to be more complex and interactive than ever before.

Vive XR Elite Passes Through Passthrough AR

One of the most high-profile XR announcements at CES was the Vive XR Elite, especially its brand new passthrough AR feature in a sleeker-than-ever form factor. The quality of the passthrough is the best I've seen so far as of 2023 in any headset. But passthrough in general is a developing technology that still doesn't quite replicate seeing reality through your own eyes, such as how the Magic Leap works by directly seeing through glass into the world, rather than simulating reality by looking through a camera feed of the real world. I am quite excited by the improved AR fidelity in this much slimmer and lighter size of the glasses, and can't wait to see what new AR applications can be enabled by the Vive XR Elite.

METAVERSE

Ant Reality

Ant Reality showcased some very interesting lenses that can be incorporated by manufacturers to produce new AR glasses. There were different types of AR lenses that were demoed with varying FOVs, levels of glass transparency, and even one that was able to totally darken the real-world background behind the AR visuals. In future versions, I feel like many AR headsets on the market today could benefit from the types of lenses that Ant Reality creates due to the slim form factor and very high pixel resolution and field of view. An exciting AR hardware adventure lies ahead.

Lumus Z-Lens Waveguide Shows Future of AR Glasses

By Paula Parisi

Lumus introduced its second-generation AR eyewear technology, the Z-Lens 2D waveguide, at CES 2023. The Israeli-based supplier for OEMs making AR glasses says the new architecture accommodates AR projector modules that are 50 percent smaller, with outdoor compatible brightness and seamless prescription integration, setting the stage for a new class of AR glasses that are sleeker and more efficient. “In order for AR glasses to penetrate the consumer market in a

meaningful way, they need to be impressive both functionally and aesthetically,” said Lumus CEO Ari Grobman. “With Z-Lens, we’re aligning form and function, eliminating barriers-of-entry for the industry and paving the way for widespread consumer adoption,” Grobman added in an announcement. Z-Lens continues the trajectory Lumus initiated two years ago with its Maximus 2D reflective waveguide technology. With Z-Lens, “Lumus hopes the tech will be the AR bridge to the exciting possibilities of the metaverse,” according to VentureBeat.

Building on what VentureBeat calls “the superb image quality and high luminance efficiency advantages of its predecessor, Maximus,” the more compact Z-Lens will provide glasses manufacturers with more flexibility, and ultimately more natural looking AR glasses. “This new optical

tech could make AR glasses look much cooler,” enthused ZDNet, while TechCrunch says it paves the way for “AR glasses that don’t look too dorky.” The Z-Lens optical engine offers 2K x 2K resolution and full color, with 3,000 nits brightness suitable for use in daylight via glasses that to third-party observers will look virtually indistinguishable from regular eyewear.

At CES, there was much enthusiasm for the Lumus Z-Lens “direct bonding of optical elements for prescription glasses, which can be licensed and utilized by manufacturing partners,” according to VentureBeat, which writes that “this feature allows consumers to customize their AR eyeglasses to their vision without bulky, heavy inserts, enabling them to be utilized as normal eyewear.”

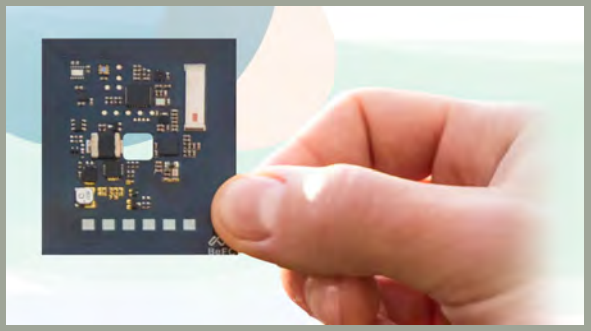
The first prototypes of Lumus Z-Lens will feature a 50-degree field of view, however the company has a product roadmap reaching greater than 80 degrees. Other plusses include distortion-free real world images, low light leakage (which means onlookers can’t see what the glasses wearer is

2Pi

MIT spin-off 2PI develops novel metasurface-enabled flat optics technology.

Somalytics

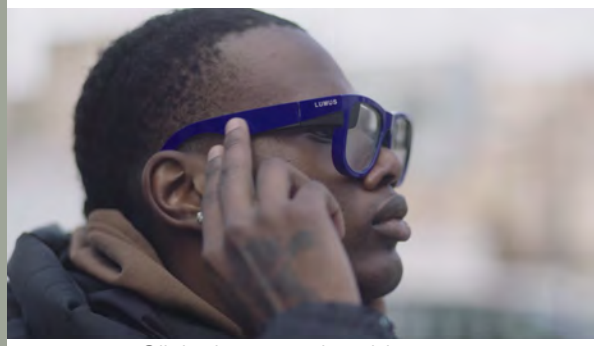
Somalytics' patent-pending carbon-nanotube paper composite (CPC™) capacitive sensors establish a new sensor category and "feel" human presence at greater distances. Somalytics' new eye, gesture, touch and fluid monitoring sensor technology applies to eye tracking, consumer electronics, wellness monitoring, safety applications, the Internet of Things, and transportation.



BeFC - Bioenzymatic Fuel Cells

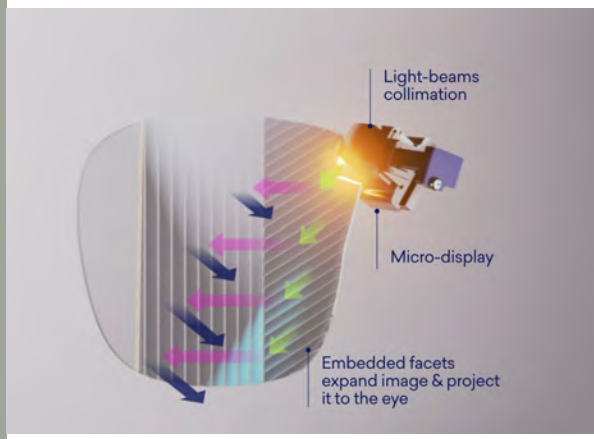
BeFC was founded on decades of pioneering biofuel cell research, pivoted towards emerging markets in the packaging, wearable and single-use medical markets. Their OEM products combining an organic energy solution with an eco-friendly sensor platform.

viewing) and battery efficiency Lumus says is 10 times greater than that of competing waveguide tech.In AR glasses with lenses that use Z-Lens reflective waveguides, the lenses "function as the 'screen' on which content is displayed, originating from any of a variety of micro-display technologies including microLED, LCoS or laser-based micro-projectors, integrated into the top perimeter corner of each lens cutout," VentureBeat explains.



Click above to play video

TechRadar calls Z-Lens architecture "the future of augmented reality glasses" and says Lumus "makes a lens that's nothing short of perfect. Or a waveguide, I should say, the technical term for projecting an image onto or into the glasses in front of your face."



EXPERTS ASK IF GAMING WILL LEAD SHIFT TO THE METAVERSE

By Debra Kaufman

The idea that gaming might be the industry sector that eventually leads everyone else into the metaverse is being discussed extensively online and elsewhere. During a compelling CES panel, GamesBeat lead writer Dean Takahashi moderated an exploratory conversation about that possibility with a group of today's leading game innovators and executives. Takahashi noted that the panel's concept comes in part from Meta vice president of content & play Jason Rubin, who said that the metaverse will need a game engine, therefore game developers will be the first to create it.

Tilt Five co-founder and chief executive Jeri Ellsworth, whose company makes AR glasses for tabletop games, declared she's a "strong believer that gaming leads a lot of technology." "The metaverse is currently very hard to define," she admitted. "But it's easier to delight people than create a utility tool. At Tilt Five, we want to make something relatable and give users a slice of the metaverse on their table."

At Munich-based holoride, a tech startup focused on next-gen in-car experiences, chief executive and co-founder Nils Wollny agreed. "When people play, the technology goes into the background," he said, noting the influence of author Johan Huizinga's Homo Ludens: A Study of the Play Element in Culture, which emphasizes the importance of play in shaping society.

"The next stage of the Internet moving off the screen into space will have a massive societal impact," Woolly suggested.

Upland co-founder and co-chief executive Dirk Lueth, who is also the co-founder and chair of the Open Metaverse Alliance (OMA3), stated that games are defined by interacting with others. "The metaverse won't succeed if it just has better game play but you can't interact with family and friends," he said. "Web3 empowers user-centric things, which is what makes it so novel. It can disrupt Big Tech."

At AREA15, an immersive entertainment venue in Las Vegas, chief technology officer Mark Stutzman described his site as "a black box of curated experiences throughout the world that helps folks move from spectator to participant."

"Gaming and story are what drive any immersive experience," he said. "I'm not sure what the metaverse will end up being, but just like Tilt Five, I think it will be an overlay of different worlds on top of the physical world where we can still interact."

"The thing that's been missing throughout the product development cycle is that adoption drives what sticks," he added. "What the world and platforms will be depends on what the consumer adopts and deploys. I'm bullish on all of it."

He added that he thinks the right path will be an open platform. "There has to be a way to build a larger and larger experience," he said. "But there are so many walled gardens at the moment."

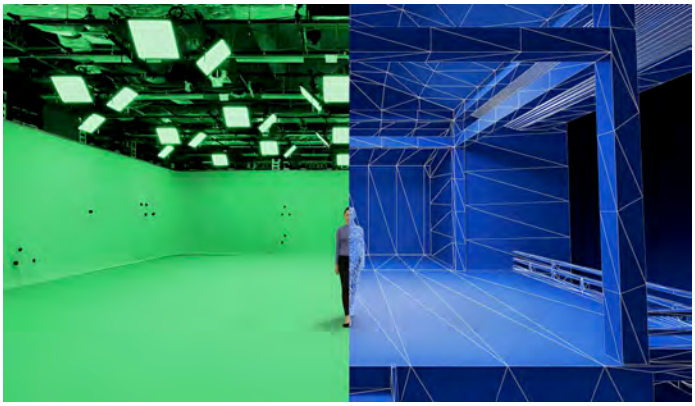
Ellsworth noted that this path "will change the monetization" of the big companies. "Game companies realize the dilemma," agreed Lueth, who noted that generative AI in the hands of consumers will create a lot of innovation. "If their customers can sell it, it will be tough in the gaming industry. People will disappear if they don't change their business models fast enough."

CANON AND SONY TOOLS PROVIDE A VIRTUAL TAKE ON SPORTS

By Rachel Joy Victor

At CES this year, Canon and Sony both showcased multi-camera capture technologies with an eye towards attracting a younger generation of viewers. Canon's Free Viewpoint video system (using an AI-powered ring of high-resolution cameras in a stadium or arena) and Sony's combined tools from its Hawk-Eye vision processing company and recently-acquired AI-based data visualization firm Beyond Sports can create low-latency virtual reproductions of live sports. The capture from multiple angles enables the virtual reproduction to offer interaction that a simple video stream does not, though each technology is distinct in what it offers.

At the show, Canon's Free Viewpoint technology was branded as more of a virtual production solution, used in the creation of a volumetric scene for director M. Night Shyamalan. Overall, however, the company is more focused on sports applications for the system.



The data emerging from these rig systems isn't high-fidelity, but can provide a clean enough volumetric model with a 3-second delay from capture to stream. Currently, the technology is being piloted in the NBA, used by the Brooklyn Nets and Cleveland Cavaliers for instant replays on regional streams or social media posts.

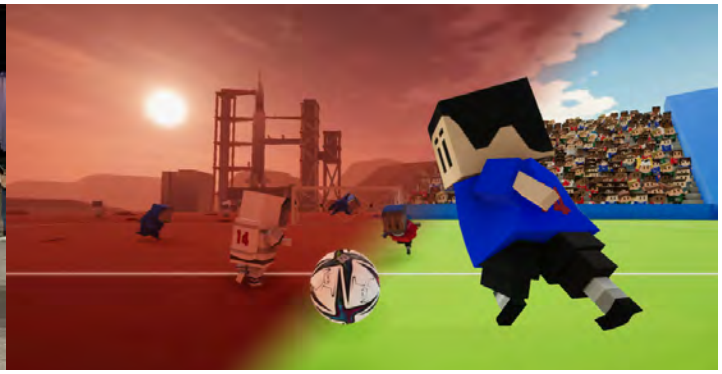
While Free Viewpoint offers the advantage of volumetric capture, Sony's Hawk-Eye is probably more commonly recognized for its sports capture tools. Hawk-Eye offers a 29-point ball and skeletal tracking system, which it is then able to translate into virtual reproductions.

Working with their sister company, Beyond Sports, Hawk-Eye recently released Gameface, an app with interactive versions of these reproductions.

Targeted towards a Gen Z audience, Gameface uses Roblox-esque block characters as virtual player stand-ins. Users can set the game within an environment of their choice and re-skin player uniforms as they desire. They can also choose one of a number of defined views from which to watch the game, and zoom in to catch specific details. (The possible views are determined by the specifics of the Hawk-Eye rig at the stadiums the game took place in.)

Hawk-Eye also recently launched a more built-out version of a virtual integration with Manchester City's Premier League team, building a metaverse world where fans can meet each other and interact with 3D recreations of previous games. Although the latency for converting live positional tracking to a virtual recreation is low (under 0.5 seconds according to the company), the Manchester City game recreations currently aren't available in the virtual world until a day after they are played.

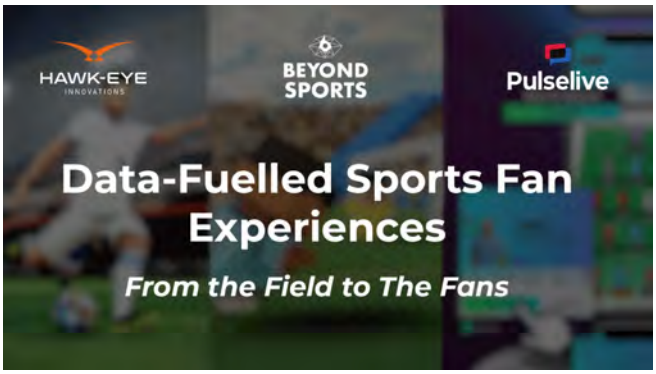
While there are subtle distinctions between what each technology can offer, they both share a challenge with making the technology an addition worth paying for. Free Viewpoint could support a targeted build-out of the

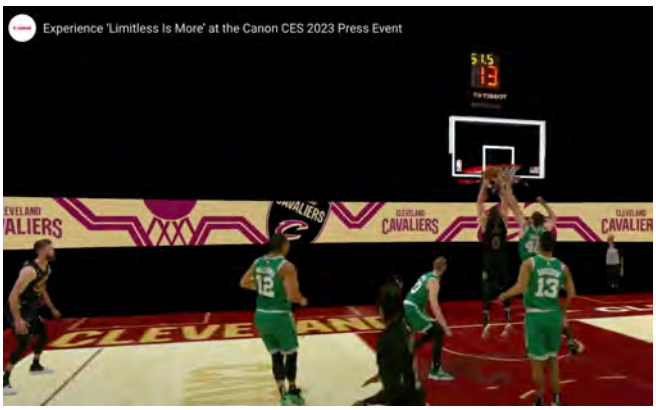


virtual stadium tickets that saw popularity during the pandemic. An experience that offers unique positional views would provide product differentiation between ticket options, although it does raise the question of whether that is a feature of physical reality that should be replicated virtually.

In general, virtual reproductions, especially those derived solely from positional tracking, lose out on a key feature of what makes watching matches fun: the ability to see the expressions of players on the field. Losing that key feature — especially for dedicated fans that follow players and not just the game — can't be compensated for with a broader range of angles to view the action from.

Beyond Sports attempts to get around this problem by abstracting out the data to virtual avatars that bear no resemblance to the players and positioning the experience as a gamified one. But for those who aren't already a fan of the sport, seeing the same game — even with viewpoint control and youth-friendly visuals — might not make the experience more engaging.





THINGS TO WATCH

Dimension X Demos Bonfire Virtual Story Creation Tools

By Rachel Joy Victor

For the most part, exhibitors in the Gaming and Metaverse areas at CES 2023 didn't touch on the latent problems with consumer adoption of the metaverse. While worlds like "Fortnite" and "Roblox" that draw consistently high MAUs do so because they offer fun mechanics, the many metaverse platforms on exhibit generally did not provide compelling reasons for why companies — much less consumers — should spend time in their worlds. Dimension X's booth was a standout on the floor, however, as it showcased Bonfire, a soon-to-be-released tool to enable the seamless creation of narrative mechanics within virtual worlds.

Bonfire offers a drag and drop visual creation engine that is built to support narrative interaction. The problem to solve, according to Dimension X's co-founder and CTO Kyle Ringgenberg: "I built this gorgeous world and brought my people into the world, now what?" The tool offers a visual story tree that enables creators to easily encode branching logic for interaction within the world.

The foundational units for the front-end narrative builder are Sparks, which take a visual asset (any glTF file can be pulled into the system) and pair it with a behavioral logic script that accounts for cause and effect.

Within a given instance, this allows assets to change states based on how they have been interacted with. Sparks can fall under a number of different categories (environment, animals, weapons, etc.). Bonfire comes with pre-programmed categories and inheritance structures for these categories, but savvy users can use the system to program their own.

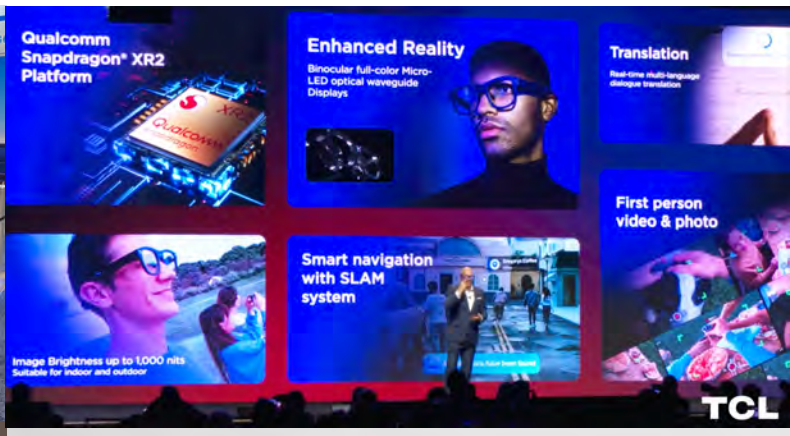
Currently, Bonfire's use case is targeted towards smaller, curated experiences within virtual worlds created on their native platform. The team has seen interest around enabling "Dungeons & Dragons"-style experiences, or educational offerings where teachers can lead their classroom through space.

By using Sparks as their baseline asset type, however, Bonfire is building a system that accounts for the ways that an asset exists in the context of story — enabling an important experiential unlock for virtual world creation.

Although the current functionality is limited to its native app, a key feature on Bonfire's roadmap is the launch of an SDK that will enable Sparks to export to other experiences. This would make it easier for creators to deploy narrative experiences and interactive quests within virtual worlds, while ensuring that narrative interoperability is aligned with technical interoperability.

Set to have their open release at the Game Developers Conference (GDC) this March in San Francisco, Dimension X is planning to roll out a private beta even sooner, targeting creators who attended the Metaverse Creator Summit last year.

Dimension X is a Silicon Slopes company with offices in Dallas, Texas and Salt Lake City, Utah.



MOBILE GAME EXECS TALK ABOUT IMPACT OF EMERGING 5G

By Debra Kaufman

According to a group of game experts, 5G will likely skyrocket the reach and power of mobile games. IQ Labs founder Julian Mitchell moderated a conversation with Activision Blizzard vice president Jonathan Stringfield, Niantic director of product management Tom Emrich and THNDR Games chief executive Desiree Dickerson on the current and future prospects of mobile gaming. Emrich pointed to Niantic's Campfire that gives players a place to connect. "The industry outside gaming has embraced it as the new social network," he said. "Games are more than games — they're synonymous with the metaverse."

Stringfield pointed out that mobile gaming has the biggest audiences. "That's where the marketing opportunities are," he said. "We're looking to expand all our IP into this space."

Dickerson noted that her company's mobile games reach a bigger demographic than traditional games, as well as users across the globe "who can't participate in traditional gaming because they can't afford a gaming PC or console."

"We have a lot of problems with people with poor Internet access or low-resource phones," she said. "With 5G, these [users] would have a much better experience."

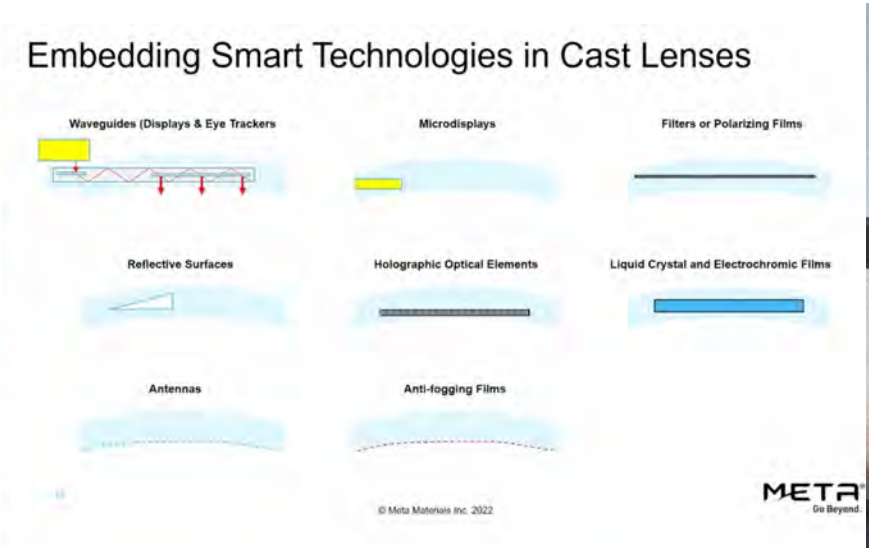
That will include U.S. users who don't get broadband, said Stringfield, who added that 5G also "will enable a lot of experiences in AR, moving computational requirements to the cloud."

Dickerson added that, "as a small gaming company, 5G widens the aperture for monetization and better experiences for our users." It also opens the door to in-game advertising, she said, as well as "the real world value" of a payment level integrated across social commerce.

Panelists agreed that 5G will enable more active experiences that counter the stigma of gaming as a passive activity. Niantic's Emrich is not only excited by 5G but also Wi-Fi 6, Wi-Fi 7 and edge computing, which could provide more immersive AR and enable shared AR experiences.

"At CES 2023, we're seeing the rise of mixed reality," he said. "It showcases AR and VR as two sides of the same coin … The future of gaming is about enabling players to continue creating the immersive world."

In the meantime, concluded Stringfield, "gaming is leading the path to the metaverse." "These are the unique experiences that people will seek out once the barriers are removed by 5G," he said.



META Materials ARfusion

MetaMaterials technology platform encompasses three core capabilities, holography, lithography, and wireless sensing using proprietary "MetaMaterials" that interact with light and energy in ways that go beyond nature. Demonstrations of holographic touch screens, 5G transmission, and an invisible layer that can be applied to prescription eyeglass lenses to enable AR impressed. The AR fusion platform enables a variety of devices to be embedded within the cast lens, according to the company. These include waveguide and micro displays, liquid crystal and electrochroamatic foils, micro cameras and LEDs, polarized foils, sensor foils, holograms, and transparent antennas.

Breylon offers "A window to a whole new world."

MIT Media Lab spin-off Brelyon, founded in 2018, demonstrated its Ultra Reality screen technology and Fusion, its new 8K field of view approach. The display tech uses computational optics to essentially offer a curved 120-inch 3D "theater-like experience" via a 32-inch desktop monitor, which the company suggests is ideal for entertainment, gaming and enterprise applications "beyond screens, into the metaverse." The concept relies on realistic depth effects and image composition techniques to provide users with a plug-and-play, high-fidelity, virtual experience that does not rely on VR headsets.

METAVERSE?

Magic Leap 2 Exhibits Impressive Dimming Capabilities METAVERSE

By Phil Lelyveld

The most impressive feature of the Magic Leap 2 demo at CES 2023 involves Global and Segmented Dimming. Global Dimming is a feature that dims the entire display without dimming digital content to make text and images more solid and precise. Segmented Dimming dims specific portions of the display to enhance legibility and clarity of selected content, and can also be used to focus attention to areas or components of interest. Both of these features produced outstanding visual results during our CES demo. Segmented Dimming produced very bright digital objects in front of a well-lit room, while Global Dimming could be used for VR immersion.

Magic Leap describes the $3,299 ML2, which launched last year, as "the most immersive enterprise device." The company emphasizes an AR wearable that is secure ("enterprises retain control of their data … store data anywhere and use any preferred cloud setup"), open (choice, ease of use, and support on an open platform — Android AOSP-based) and collaborative ("collaborate in real time across time zones").

At its CES booth, Magic Leap is promoting applications for a range of key areas such as enterprise, design, manufacturing, training and medical. Booth demos of AR solutions on ML2 include Cisco Webex Hologram and Nvidia's Omniverse, among others. The company also debuted its new remote assistance reference application, Magic Leap Assist.

Chief exec Peggy Johnson announced during AMD's keynote that ML2 is the first AR device to earn IEC 60601 certification, a collection of tech standards to ensure the safety and effectiveness of medical equipment.

The field of view is currently 70 degrees, which may need to be widened going forward. Resolution is 1440×1760 per eye, with a 120 Hz refresh rate and 2000 nits maximum brightness. Four eye-

METAVERSE?

tracking cameras constantly adjust the lenses to avoid eye strain.

The Magic Leap rep called the current version of hand tracking "rudimentary." The wire frame hand came close to overlapping on my hand in AR mode as it did a good job tracking my movements. More impressively, the Segmented Dimming rendered my hand invisible while clearly displaying the wire frame hand.

HTC Launches Vive XR Elite with VR and AR Capabilities

By Paula Parisi

HTC plans to release a $1,099 Vive XR Elite headset by the end of February, heralding a year of competitive, price-sensitive virtual reality gear targeting consumers along with the Meta Platforms $400 Quest 2. Crowdfunded firm Goovis and its $800 VR headset made it onto the list of CES 2023's Crowdfunding Island success stories, as compiled by Kickstarter ad firm Jellop. The Vive XR Elite offers AR capability in addition to VR in a form factor that approaches something like glasses, as opposed to the usual bulky headwear. An allowance for AR apps opens the door to practical applications in everyday life in addition to entertainment applications in the metaverse.

"Years after unofficially exiting the consumer VR space in favor of enterprise products, HTC has returned with its first standalone headset for consumers," Engadget reports, detailing the Vive XR Elite, which offers "VR and passthrough mixed reality (MR)," is pricier than the Meta Quest 2 but more affordable than the Meta Quest Pro (typically $1,500, but advertised as low as $1,300 online).

"This Vive headset looks, more than ever, like it's a stepping stone to future AR glasses," notes CNET of the AR/VR mixed reality shuffle. "We see where mixed reality is going to create a whole new suite of use cases," HTC Vive GM Dan O'Brien told CNET at CES 2023, adding, "we know the virtual reality use cases are great. The AR side is amazing, too."

O'Brien acknowledged to CNET an aborted 2015 attempt at AR, outlining as next steps "you need a 5G network, a really robust one to make AR go to scale — you need a cloud infrastructure to deliver to those types of wearables."

Similar to the Meta Quest Pro, Quest 2 and Vive's own enterprise targeted Focus 3, the Vive XR Elite relies on Qualcomm's Snapdragon XR2 chip, but "adds a higher-resolution 110-degree field of view, LCD displays with 2K resolution per eye that can run at 90Hz" and "a boosted 12GB of RAM along with 128GB of storage," reports CNET.

HTC's latest is "mostly standalone" in that it "can connect to PCs to run SteamVR or HTC's VivePort software, or connect with Android phones," CNET writes, noting that "its potential as a bridge to AR experiences seems like the most impressive feature."

At 340 grams, the Vive XR Elite is less than 50 percent as heavy as the Quest Pro. "It gets even smaller by unclipping the back battery strap and adding glasses arms that can turn the headset into a modified pair of VR glasses, which could just plug into an external USB-C charger or battery for power," explains CNET, adding that "the rear hot-swappable battery gives about two hours of life."

Meanwhile, Goovis — with connectivity to "a phone, laptop, computer, set-up box, cast, drone, PlayStation, Nintendo Switch, and more" via HDMI or type-C cable, according to the firm — previewed its upcoming G3 Max at CES 2023. Goovis promises "an 800-inch screen anytime and anywhere," thanks to "twin customized OLED displays" for an "immersive cinematic experience just like sitting in the theater."

Jellop released a roundup of crowdfunded technologies as part of the CES 2023 Eureka Park.

METAVERSE?

Contact CI Shows Maestro EP Haptic Feedback Gloves METAVERSE

By Phil Lelyveld

Ohio-based startup Contact CI has launched its Maestro EP haptic gloves that work by mirroring the human body's sheathed tendon design. They provide light- to moderate-haptic feedback by pulling on a cloth sock covering each fingertip. There is also vibrotactile feedback technology in the glove's fingertips. The "multi-force ergonomic haptics" product is compatible with any system designed for hand tracking (for example: Meta Quest 2). The Department of Defense and enterprises are already purchasing the gloves at $3,750 a pair, primarily for simulation training purposes, while Contact CI continues to improve the design for a wider commercial rollout.

Unlike other haptic feedback gloves that use a mechanical rigging on the back of the hand to physically push and pull on fingertips, the Maestro EP has sheathed cables that move imperceptibly between the forearm-mounted mechanism housing and the fingertips. The lightweight housing looks bulky, but during my demo inside a VR headset it had no impact on my experience. That is probably because it is sewn into the forearm sheath so the glove and forearm move as a unit.

All of the haptic feedback is in the fingertips so pushing buttons and flipping switches is a natural and effective application. However, catching objects was less effective because they involve your palm more than your fingertips.

In Contact CI's CES 2023 press release, USAF simulator chief innovation officer Margaret Merkel weighed in on the quality of the Maestro DK3 haptic interactions: "Contact CI has done an excellent job of blending force feedback and vibrotactile feedback, they have been able to create complex tangible interactions like switchology tasks inside VR cockpits while using a wireless lightweight wearable glove."

While Contact CI is selling the gloves in their current form, it is clear from the care required to put the gloves on properly that the design has to be made simpler and more robust. However, their embedded cable approach enables them to withstand rugged use, so they have the potential of being a successful consumer peripheral product.

THINGS TO WATCH

Displace Demos First Totally Wireless OLED Flat Screen

By Paula Parisi

technology. Transportable and configurable,

Displace is a new wireless TV that promises to take the pain out of mounting a flat screen. Powered by a proprietary hot-swappable battery system, the 55-inch 4K flat screens are under 20 pounds and can be affixed "to any surface" using an active-loop vacuum technology. Transportable and configurable, multipleDisplace is a new wireless TV that promises to take the pain out of mounting a flat screen. Powered by a proprietary hot-swappable battery system, the 55-inch 4K flat screens are under 20 pounds and can be affixed "to any surface" using an active-loop vacuum technology. Transportable and configurable, multiplemultiple Displace TVs can be used in combination "to form any sized TV," according to the startup, which debuted the system at CES 2023. Each Displace TV comes with four rechargeable batteries, each averaging about a month of life for an average usage of six hours per day.

"Displace is effectively creating the next computing platform and the potential applications are limitless," company founder and CEO Balaji Krishnan said in an announcement. "Displace completely reinvents the television with its hardware and software technologies, and user interfaces that will not only change the way people enjoy entertainment in their homes, but will also advance the entire television industry."

The 55-inch 4K Displace TVs can be hung throughout a home or combined to form multiple sizes, including "a massive 110-inch television with 16K resolution." The TVs feature a 4K camera and Wi-Fi 6E. They wirelessly connect to a base unit that is plugged into an electrical outlet and can be kept inside a closet or elsewhere hidden inside a home.

The base unit features an AMD CPU, Nvidia GPU and Wi-Fi 6E. "Displace can do without a power cord is because it doesn't do very heavy processing onboard. It's basically streaming media from a base station that comes with the device and performs the rendering," writes Engadget.

Since each processor box can run multiple TVs (up to 8, according to CNET, which offers a video report), Displace is offering discounts on purchases of more than one set.

Displace TVs are mainly controlled by hand gesture movements, in addition to touch and voice interfaces, making it easy to browse, play and control content. Engadget references "a very 'Minority Report'-esque gesture that involves 'grabbing' the content from one screen and 'throwing' it at another one nearby."

A "thumbs-up" gesture instructs the set to have content follow you, displaying on different sets as you walk around the house. The sets use facial recognition and computer vision technology to help with seamless transitioning between rooms.

As for stability, "Displace demoed the capability of its proprietary mounting system on a fabric-coated wall, as well as a glass window," reports ZDNet, noting that the mount "readjusts" periodically to ensure solid contact.

At $3,000 per TV, Displace is not cheap. Preorder reservations for 100 units are available for U.S. customers via the Displace website, with sets expected to ship "by late 2023," says the company.

Targeted Sensory Immersion at the Japanese Exhibition

By Rachel Joy Victor

The sluggish consumer adoption of virtual reality has pointed to a

A Whiff of the Future

AromaPlayer and AromaJoin
For use in streaming video and virtual reality/extended reality metaverse applications.

The AromaPlayer scented platform is powered by the AromaShooter that can instantly switch between various scents without any residual effect.

Parso Wearable Directional Speaker
Directionally focused sensory experiences extend to environmentally located audio with Parso speakers from Tokyo-based startup AFUR

broader hesitation with immersive technologies that separate the user from their environment. In response, a niche market has evolved for technologies that unobtrusively live on the body while contributing an augmented sensory experience when needed. (See earrings that also offer directional audio from a company called Nova, for instance.) The Japanese exhibit section of the CES Eureka Park startup arena, however, showcased a more environmentally integrated — although still individualized — vision of immersion.

Aromajoin, a digital scent technology firm, offers a directional scent shooter (as opposed to a scent diffuser) that uses six basic scent capsules to create a range of chemical scent configurations. Scent, which is the sensation most closely associated with our limbic systems, has the ability to elicit strong emotions when used properly — thus providing a helpful storytelling complement for sensory immersion.

AromaPlayer, a web application powered by the company's proprietary Aroma Shooter tech, enables creators to cue specific scents in sync with specific visual beats. The scent cue can be added on a video's timeline just as a sound clip might be, with the option to modulate the exact scent as well as timing and duration.

Scent as a storytelling tool can be a challenge, as the brain's ability to process scent and taste isn't as targeted as its ability to process sight and sound. This is compounded by the fact that scents are formed by chemicals that can linger in the air, diluting the specificity of new scents.

The "lingering" typical of scent diffusers is caused by the use of liquid as a medium for the scent; Aromajoin's scent technology uses a proprietary "dry and solid" scent that can dissipate faster, enabling a scent switching speed of 0.1 seconds.

Directionally focused sensory experiences extend to environmentally located audio with Parso speakers from Tokyo-based startup AFUR, also found within the Japanese exhibit area. Unlike typical speakers with directivity angles of around 90 degrees, the Parso speakers offer directional audio at a 10 degree angle, enabling sound to be directed to a single individual.

While directional audio is not new, Parso's speakers are wireless, small enough to be wearable, and depending on their positioning can offer directional stereo sound. The speaker is also marketed as being compatible with the elements and able to be used while biking or camping.

Together, both Aromajoin and Parso point to a desire for environmentally-based personalization of sensory experiences that enable immersion. Less obtrusive than on-the-body immersive technologies, these spatially located hardware elements also point to a future of augmented reality that could move beyond a predominantly visual experience.

Multisensory Experiences

OVR Technology, a Vermont-based startup digitizing scent for meta verse and digital experiences, is teaming with WildventureXR to release a scent-driven multisensory experience to some of the most iconic biomes on earth that provide new and exciting ways to engage with nature.

Arome D'Art

Arome D'Art and Soundmatters announced a portable fragrance system that can be docked in the Level 10 UPstage360mk2 100-watt omnidirectional sound system

Samsung Flex Hybrid Mobile Device Can Fold and Slide

By Paula Parisi

Samsung Display has debuted a concept mobile device that both folds and slides, the Flex Hybrid. The company's "smart mobile device" prototype unfolds to reveal a display on the left side, with the right side sliding outward to expand screen real estate. The Flex Hybrid's OLED screen expands from a 10.5-inch 4:3 configuration to a 12.4-inch 16:10 display. Samsung Display also previewed two larger displays at CES 2023, the Flex Slidable Solo, which expands in a single direction, and the Flex Slidable Duet, which grows on both sides, from 13 or 14 inches of screen space to 17.3 inches.

"It's not hard to imagine the display eventually being used in a foldable smartphone, allowing the device to be unfolded for a small tablet-style experience and then un-slid when you want to enjoy a film or game on a larger screen," The Verge writes of the Flex Hybrid, adding that "it might be a while" before it reaches the masses, "if ever."

That caveat is based on the fact that "the prototype builds upon concept devices that Samsung Display has been showing off for years," though it has "yet to release any of these more advanced displays in a consumer-ready product," with the exception of foldable phones, according to The Verge, which says the Flex Hybrid is the first Samsung prototype to combine foldable and slidable screens in one device.

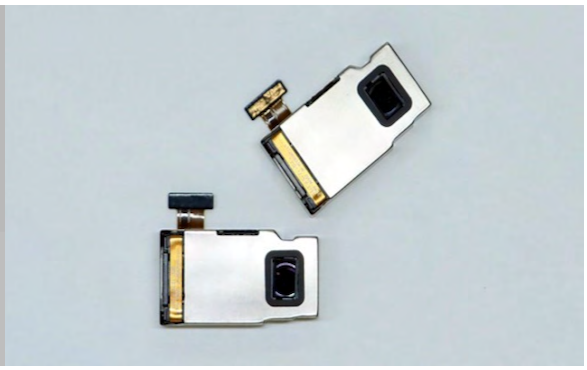
"Samsung wants gadgets of the future to do more than just fold in half," writes CNET, noting that "the Flex Hybrid folds closed like a notebook, but opens up to reveal a tablet-sized display with an adjustable screen."

Foldable phones account for a small fraction of phone sales, but "the Galaxy Z Fold and Galaxy Z Flip have become well-established within Samsung's mobile device lineup," CNET reports, adding that "the company's early entry into the foldable phone space has given it an edge in terms of market share as Samsung accounts for more than 88 percent of the foldable smartphone market, according to Omdia."

The 17-inch large-screen slidable display (previewed at Intel Innovation 2022 by Samsung Display CEO JS Choi in September and making its first "public appearance" at CES) "is very portable at only 13-14 inches but can be expanded to 17.3 inches for multitasking purposes, playing games, or watching movies," Samsung explained in a press release.

THINGS TO WATCH

Samsung Flex Hybrid



LG Innotek Zoom Camera Module

Samsung also unveiled a concept it's calling the New Digital Cockpit, targeting self-driving vehicles. Combining 34-inch and 15.6-inch OLED panels, Samsung says the large screen can be used to display entertainment in autonomous driving mode. "Samsung Display wants the world's self-driving car startups to know it has the equipment ready for when their vehicles hit the road," says The Verge.

LG Innotek Intros Optical Zoom Camera Tech for Mobile

By Paula Parisi

LG exited the smartphone market in 2021, but its LG Innotek division continues to supply components, and is touting a major breakthrough with its Optical Telephoto Zoom Camera Module to be unveiled this week at CES 2023. As part of the rear-mounted smartphone camera systems, the new optical zoom allows still images and video to be magnified by four to nine times "without image quality degradation even when zooming from long distance," the company says. The results are achieved by integrating the telescopic camera functions that are mostly applied to professional DSLR and mirrorless cameras.

The new optical zoom process eliminates so-called "camera bump" using software exclusively developed by LG Innotek over the past 20 years, recently optimized with tech from Qualcomm.

The two companies are collaborating to promote software for optical continuous zoom that will be applied to the new premium Snapdragon 8 Gen 2 Mobile Platform, LG Innotek CEO Jeong Cheol-dong said in a news announcement.

Specifically, the new mobile zoom features enhances optical image tuning in areas including auto-focus, auto-exposure, auto-white balance, lens shading correction and much more. "Users will be able to focus quickly and the photos and videos will have stunning image quality," the announcement claims.

"The camera component supplier has unveiled a telephoto module with real moving optics to cover a 4-9x range — no digital zoom required," The Verge summarizes, explaining that "while most other long smartphone cameras use image-quality-degrading digital zoom to reach beyond their native focal length, LG's design uses moving lenses — much like a traditional DSLR camera lens — which preserves image detail."

LG's Optical Telephoto Zoom Camera Module also includes optical stabilization, which The Verge calls "a must-have if you're trying to take pictures at 200mm," noting the use of "a tiny, extremely precise actuator to move lens elements for zooming; the company says it can move in increments of 1µm." This new design will allow phone manufacturers to eliminate the need for multiple rear-facing camera lenses, conserving space and reducing power consumption.

Android Central suggests Samsung's Galaxy S24 Ultra may be among the first devices to use what LG Innotek is informally calling its new "Optical Zoom Camera."

THINGS TO WATCH

Project Leonardo PS5 Controller Aims for Accessibility

By Paula Parisi

Sony wants to make gaming inviting for all players, including those with limited mobility, and to that end unveiled at CES 2023 a customizable controller kit for PlayStation 5 codenamed Project Leonardo that the company has in development. The configurable controller aims "to help many players with disabilities play games more easily, more comfortably, and for longer periods." The circular controller lets players create a personalized controller by mapping buttons, swapping hardware and creating personalized profiles. Though specifically designed for the PlayStation 5, it will work in tandem with many third-party accessibility accessories.

The device also has four 3.5mm auxiliary ports so that you can plug in third-party accessories that might be beneficial to you, and you can also use Project Leonardo in conjunction with a DualSense controller," The Verge reports.

"The controller itself lies flat on a table or can be mounted on a tripod; it doesn't need to be held," Engadget writes.

Among the customizations detailed in Sony's announcement:

Button mapping allows the controller's buttons to be programmed to any supported function. Multiple buttons can be mapped to the same function. Conversely, players can map two functions (like "R2" + "L2") on the same button.

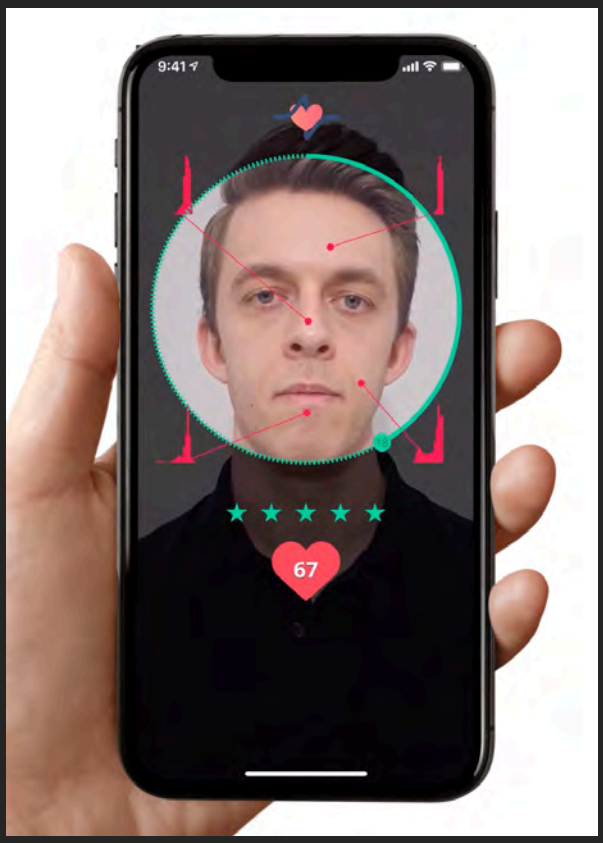
Control profiles let players store their programmed button settings as control profiles, easily switching between up to three profiles by pressing the profile button.

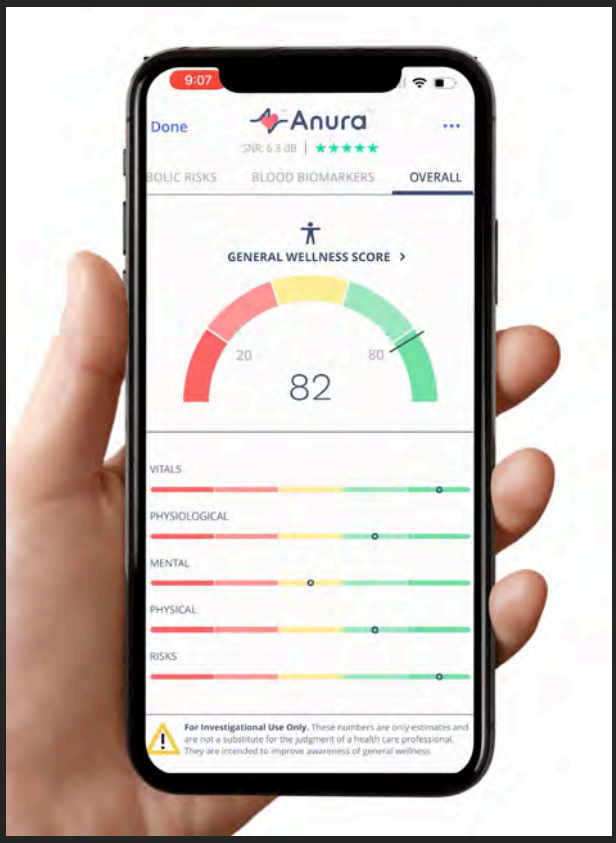
Hardware customizations are possible using a robust kit of swappable components, including a variety of analog stick caps and buttons in different shapes and sizes. Using these, players can craft a wide array of control layouts. The distance of the analog stick from the game pad can be adjusted to suit the player's preference.

Sony says Project Leonardo was created to address common challenges faced by many players with limited motor control, including difficulty holding a controller for long periods, accurately pressing small clusters of buttons or triggers, or positioning thumbs and fingers optimally on a standard controller. Organizations that offered input in the design phase include AbleGamers, SpecialEffect and Stack Up.

"With Project Leonardo, Sony is taking clear cues from Microsoft, which has been a leader in accessibility tech, particularly in the gaming space," Engadget writes, noting "Microsoft released the Xbox Adaptive Controller in 2018." Last year at its Ability Summit, Microsoft announced the opening of an Inclusive Tech Lab on its campus in Redmond, Washington.

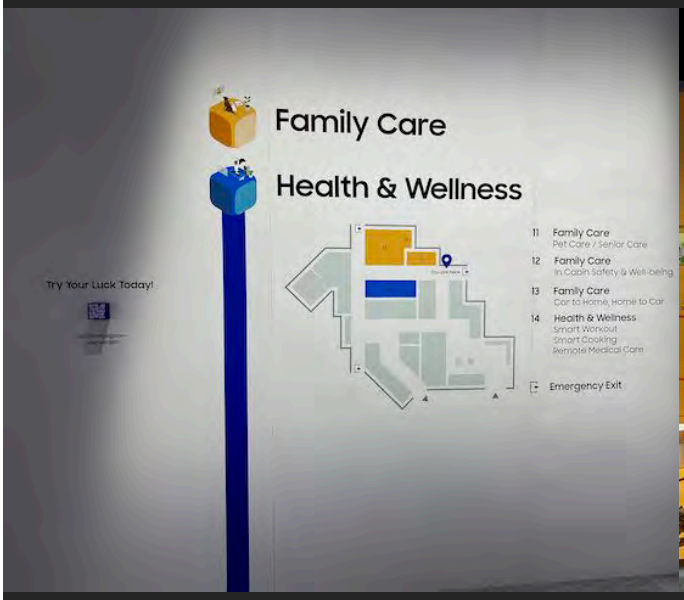
Engadget says the Xbox Adaptive Controller retails for $100, while there's "no word on how much Project Leonardo will cost" and no release date.





Anura

Toronto-based Nuralogix showed Anura, a health and wellness measurement app that uses the camera on a mobile device to access general wellness. "Take a selfie, know you're healthy," is the headline on their website. The same technology is applies to another product, DeepAffex™ engine, which is a cloud-based Affective Intelligence platform that utilizes innovative facial blood-flow imaging technology to provide powerful analysis of human physiology and psychological affects. The company sees opportunities to Add vital signs to the gaming experience with players' heart rates, stress levels and emotional states in real-time. A trial version of Anura Lite is available on the Apple App Store and Google Play.



Samsung and Wellness

Digital health continues to become more and more part of the CES conversation. Samsung devoted major sections of their booth to products and services for families, pets, and seniors. It is all part of leveraging and growing their SmartThings ecosystem.

Stellantis booth at CES featured a Peugeot concept car

AUTOMOTIVE: STYLE, MOBILITY, SENSORS

CES is now one of the largest and most influential auto shows in the world. Innovations in transportation, sustainability, environmental concerns, and urban reinvention.

This year, John Deere, the agriculture equipment giant, and Stellantis, the parent company of such brands as Chrysler, Jeep, Fiat, Alpha Romero, Peugeot and Maserati, offered keynotes and visions for a sustainable future. The buzz has shifted from autonomous driving to electricity, connectivity, and software. Autonomy is almost a given, with numerous commercial vehicles coming to market. Autonomy is also evident in the vision

MOBILITY

for in-car games and entertainment. This was clearly in evidence in the **Mercedes** booth, for instance, where the keyword was “excitement.” Their car featured numerous entertainment brands by name on the outside and onscreen inside.

CARIAD

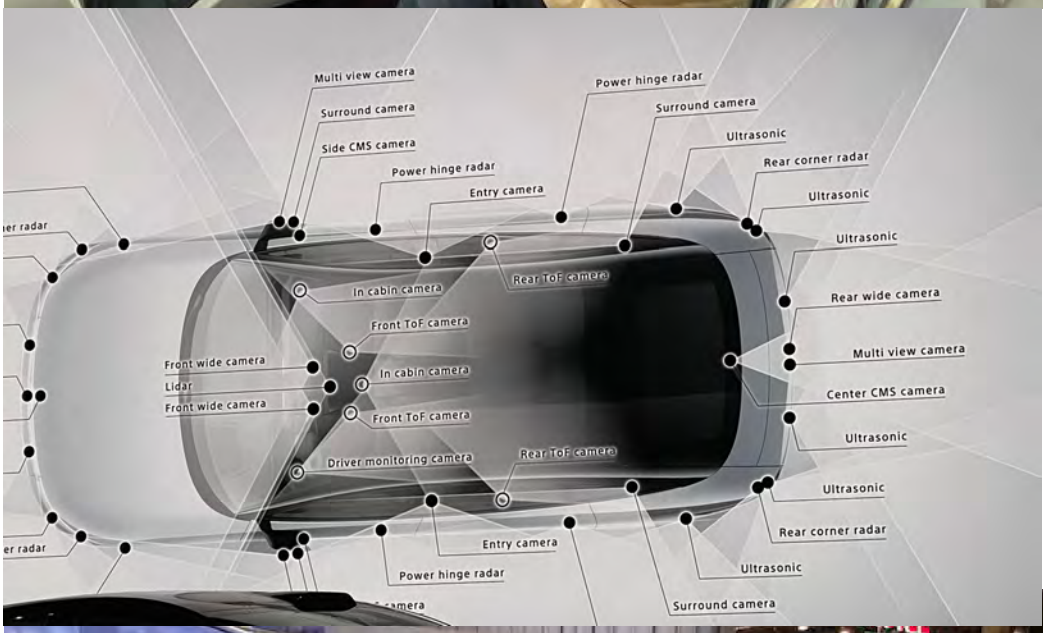
CARAID is a major automotive software developer. They were recently named by VW to unify their technology. Working closely with Microsoft and others from a new technology hubs in Seattle and Silicon Valley, CARIAD develops automotive technology solutions in the areas of automotive cloud, the digital vehicle experience and automated driving. One of the major solutions developed by the local US team is the Volkswagen Automotive Cloud: In close partnership with Microsoft, the local team is creating a unified backend for all Volkswagen Group brands – an important backbone for continuous over-the-air updates for software-defined vehicles. First customer vehicles will be connected to Volkswagen Automotive Cloud in 2024. CARIAD solutions are heavily invested in infotainment and in-car gaming.

Lightyear 2

Solar cells on its body surface and highly efficient motors embedded in the wheels help make Lightyear a changeless commuter car in sun-drenched areas like the Southwestern U.S. The company has some 40,000 pre-orders booked since January. However, it’s Dutch parent company, Atlas Technology, which was also developing a super-luxury sedan, entered bankruptcy at the end of January, placing the future of this sub-$50,000 vehicle into some question.

MOBILITY

Sony Honda Mobility, the joint venture between Sony and Honda, introduced AFEELA. Luxurious and stylish with abundant infotainment features the AFEELA makes extensive use of Sony's imaging and sensing capabilities. For example, 45 cameras feed into the vehicles safety and autonomous driving systems. The car is a case study in partnerships with Sony and Honda leveraging their respective expertise. The car incorporates Qualcomm's Snapdragon Digital Chassis, which is a comprehensive set of cloud-connected automotive platforms essential for software enabled vehicles.



Senator Jacky Rosen (D-Nevada), a former computer programmer, brought Senator Mark Warner (D-Virginia) and Ben Ray Luján (D-New Mexico) to the CES stage to talk about their top technology interests in the new year.

POLICY AND REGULATION

Federal Tech and Innovation Priorities for the New Year

By Debra Kaufman

Senator Jacky Rosen (D-Nevada), a former computer programmer, brought Senator Mark Warner (D-Virginia) and Ben Ray Luján (D-New Mexico) to the CES stage to talk about their top technology interests in the new year. All of them serve on committees with core interests in the future of technology. In addition to serving on six committees, Rosen is on the subcommittee on cybersecurity; Warner is chair of the Senate Select Committee on Intelligence among other committee assignments; and Luján is a member of the Committee on Commerce, Science and Transportation among others.

Warner has three tech-centric priorities for 2023. “Russia has been manipulating our social media platforms and we’ve done nothing about it,” he said. “Putting guardrails on social media is one of my big priorities. We need to come back to a privacy bill, data portability, dark patterns and the debate about Section 230.”

Second, Warner is focused on cybersecurity, especially related to healthcare. “Unless and until we can make sure cyber protections are built-in and not bolted-on, we won’t get it right,” he said, noting that the committee put out a white paper on the subject a few months ago and is looking for suggestions.

POLICY AND REGULATION

Last, he said, is the technology competition with China. "That and national security are inextricably tied," he said. "That competition has to be dealt with in a serious way."

Luján agreed with Warner and added the issue of the digital divide. "There's tremendous opportunity across America, but we need to look at where the dollars should go," he suggested. "States like New Mexico, Texas, Alaska, Nevada and California are faced with the similar challenges of hard-to-reach areas. "In closing the digital divide, we hope to bring attention to digital equity and digital literacy," he added.

One of Rosen's top priorities is to "fully implement the bipartisan infrastructure bill." She noted that that she helped write the broadband section to make sure FCC maps reflect realities on the ground. Luján added that "anyone can challenge the FCC maps" and urged listeners to do just that.

Rosen also wants to push to enhance cybersecurity, in particular nurturing talent in that sector; she and Marsha Blackburn (R-Tennessee) introduced a bill to create a Civilian Cyber Security Reserve Act, which would enable citizens to move in and out of government roles.

Luján added that national security clearance reform also must be addressed, and Warner stated that immigration reform will also help fill the ranks of cybersecurity professionals in the U.S.

Government Plans to Address the Digital Divide in 2023

Consumer Technology Association (CTA) vice president of regulatory affairs J. David Grossman introduced U.S. Assistant Secretary of Commerce Alan Davidson, NTIA administrator, who addressed the CES audience on federal plans to expand broadband access in 2023. "As you all know, the Internet today is the essential tool in our modern world," he said. "Yet, in 2023, millions of people in this country don't have the access or skills they need to take advantage of the Internet." After 20 years of talk, he added, the Bipartisan Infrastructure Law will now provide over $65 billion to invest in that mission.

Davidson noted that the NTIA (National Telecommunications and Information Administration) is, by law, the president's principal advisor in communications policy, including expanding broadband Internet access, managing spectrum and making sure the Internet remains an engine of growth. The first step in 2022 was to lay the groundwork, awarding planning grants to tribal and minority communities. The next move, he said, will be determining how much each state and territory will get.

"This is a moment of great challenge and opportunity," he said. "It's not often that we spend tens of billions of dollars. In the past, we did that to bring water, electricity and highways to everyone in America. This is our big infrastructure moment."

NTIA will also be active in "invigorating more competition in the wireless space so that new players can emerge." "China has been part of the problem," said Davidson. "It's creating global security risks we can't ignore any more. There are a limited number of trusted players."

He pointed out that $1.5 billion in the CHIPS Act will "help break open that market." He added that they will also "move forward on Open Radio Access Network technology."

Second, said Davidson, NTIA will be launching a national spectrum strategy to develop a long-term plan for Federal and private use. "We are the federal manager of spectrum usage but we appreciate the imperative that we

must lead the innovative use of spectrum resources in the U.S. to bring new products to market," he said. "We have a limited resource and we want to meet the federal and private missions."

He added that "we need private sector input and we want to build the best possible communication network and Internet with you."

The third big area that NTIA will focus on in the coming year is privacy. "The U.S. needs a comprehensive federal privacy law," Davidson asserted. "It's probably surprising for those of us who have worked in this space so long that we still don't have one. A national law is better than a patchwork of state laws. We need baseline safety for consumer protection, and we'll be looking at harms in the area of civil rights and privacy."

Last, Davidson mentioned AI and machine learning. "NTIA plans to safeguard ML and AI systems," he said. "They remain very opaque right now. We want assurances they are safe, effective, reliable and lawful. The private sector has to be a major leader here. We will be requesting input on what AI audits could and should look like and if different industry sectors will need different types of audits."

"2023 will be a very busy year for NTIA," he concluded. "It's an ambitious mission and part of our message is we want to work with all of you to make this a reality."

Addressing Challenges to Creating Global AI Standards

By Debra Kaufman

Both the European Parliament (the EU's law-making body) and the U.S. National Institute of Standards and Technology (NIST) were represented on a CES panel on "AI Rules and Tools," moderated by CTA vice president of emerging technology policy Doug Johnson. Also on the panel were executives from Facebook parent Meta Platforms and insurance provider Elevance Health, for a robust discussion on how to arrive at standards and regulations for the powerful — but often industry-based — AI technologies that will also be accepted by countries around the world and industries with competing interests.

European Parliament senior policy advisor Laura Caroli described "the complex legislative process" in Europe to arrive at agreed-upon solutions. Currently, a vote is expected by March on a proposal put forward by the European Commission that went through Parliament and the Council to transform the draft into a "common text." If approved, its regulations will be applied in 2026, she said.

Elham Tabassi, chief of staff in NIST's Information Technology Laboratory (ITL), noted that the non-regulatory agency under Congress aims to drive U.S. innovation and promote standards and measurements.

We created "an open transparent collaborative process to create a framework for AI risk management," she stated. "The first thing we need to do is understand the risks and the context in which it's being deployed. We want it to be fair and non-biased." The result, she said, must be "flexible but measurable."

With AI applications in healthcare, Elevance Health director of digital health technology policy Stephanie Fiore recommended that the application of policy should be realized "in sector-specific ways." Noting that healthcare in the U.S. is already highly regulated, she added that "as states propose AI policies we want to make sure there is alignment" with already existing rules.

Meta AI policy & governance manager Farzana Dudhwala reported that her company

initiated the global program Open Loop to "think about effective laws and rulemaking." "These laws can sound brilliant but when a lot of players actively implement them, you can find many things that don't work," she stated.

Caroli revealed that, for the EU, "requirements such as transparency, accuracy, cybersecurity and quality management are for the provider who develop and market the system."

Tabassi agreed that "the risk-based approach is very powerful," since it includes context and outcome based on human-centric approaches. Dudhwala described that efforts to achieve that fairness is "tricky … to get right," due to the structural inequality of existing datasets. She concluded that, "standards are incredibly important but … it's a minefield."

As Risks Rise, Experts Reimagine Path to Cyber Safety

By Debra Kaufman

At a CES panel, CISA director Jen Easterly sounded the alarm on the current state of cybersecurity in the U.S. "We cannot accept that ten years from now it will be the same or worse than it is now," she said. "All the critical infrastructure we rely on is underpinned by a technology base that was created in an insecure way." As head of the Cybersecurity and Infrastructure Security Agency, Easterly is in a position to assess the coming damage, projected to be $8 trillion this year. Moderator Rajeev Chand, Wing Venture Capital partner led Easterly and CrowdStrike chief executive George Kurtz in a discussion on how to halt the increase of cyber-insecurity.

Kurtz identified poor passwords and "the Achilles heel of backwards compatibility" for creating "gaps" enabling cybercrime. "The curve of technology from version 1.0 to 2.0 and beyond creates gaps because so many older versions remain out there," he said. "We're dealing with very insecure protocols to support backwards compatibility with them."

When Chand asked about the state of preparedness among big companies, Kurtz replied that it depends on the business sector. "Finance companies and others that are regulated have much better preparedness," he said. "But if it's a cost-constrained business, it's harder to spend the money."

For that reason, CISA is focused on getting C-Suite executives and boards of directors to "really embrace cybersecurity as a matter of good corporate policy"

"We have to think of it as a persistent, transparent relationship between corporation and government," Easterly said, noting the importance of a shift to "secure-by-design" products. "Decades of insecure design of technology is a fundamental safety issue," she said. "We've accepted that software is developed with all kinds of flaws and we haven't incentivized companies to keep it safe. This is a serious responsibility that companies need to take, and we can't let tech off the hook."

Kurtz concurred with Easterly's assessment. "A lot of companies at CES are at the leading edge of technology innovation but at the low end of cybersecurity," he said. "Problems exist if there is an imbalance." Although Easterly emphasized that, "consumers need to know what is in their technology," Kurtz countered that, "consumers shouldn't have to think about security."

"If you put the onus on the consumer, you've already lost," he suggested.

Easterly agreed. "We put the burden of safety on consumers who least understand the threat and have the ability to defend themselves," she said. "It's about how we build the technology that's the most secure out of the box. And chief executives and boards are responsible for cyber risk."

POLICY AND REGULATION

Focus on People Component for Strong Cyber Strategy

By Debra Kaufman

Cybersecurity was a major topic at CES 2023, and one panel described strategies around one of the important and often ignored components: people. Moderated by Strategic Cyber Ventures chief executive Hank Thomas, panelists examined people's personal relationship with cybersecurity, how they fall victim to cybercrime and how they could be incentivized to take more responsibility for their online activities. Terranet Ventures executive in residence Carole House, who was recently director of cybersecurity at the National Security Council in The White House, said that seeing individuals badly impacted "elevates cybercrime as a national imperative."

T-Mobile US senior vice president and chief security officer Timothy Youngblood said that one thing he's taken from a career at multiple Fortune 500 companies is that "security is a people business." "All it takes is one person to make the wrong decision," he noted.

He recommended person-based training from retail stores to executive suites. "We run phishing campaigns on a monthly basis to see if it's working," he said. "We see if they make the right choice. But we don't overwhelm them with training."

For Steve Thomas, chief executive and co-founder of HackNotice, a threat awareness company, cybersecurity training is part of the problem. "The major companies in that space make videos about security, and training is often the first and last stop to making someone security aware," he said. But the real problem, he continued, is that "most people in companies think that security isn't their job, so they don't do it."

His company specializes in using real security events as teachable moments to show how people are personally targeted. "Once you realize you're under threat, you start acting very differently," he explained. "We show how people are personally targeted and the best practices they can take."

House is sympathetic to the impact on people when the government is hacked. "But I also think that it makes you a sounder institution to have recognition of the liability and business interests in being secure among companies," she noted.

Moderator Thomas brought up the 2015 OPM breach when the U.S. Office of Personnel Management was hit. "It educated a lot of people with security passes about the danger," he said.

Educating the ordinary person is necessary to get a grip on ever-increasing ransomware attacks and other breaches. "For employers, it's building an environment of security, and our biggest help is to ask employees, without being adversarial, to be part of the solution," said Thomas.

Thought Leaders Discuss Status of Smart Infrastructure

By Debra Kaufman

Smart infrastructure is already a reality said panelists on "Smart Infrastructure: Building the Future," a CES discussion moderated by RePure co-founder and president Michael Don Ham. "It's not the future, it's now and it is opening up a lot of business models for decarbonization and electrification," declared Logical Buildings co-founder and chief executive Jeff Hendler. ADT head of multifamily Scé Pike agreed, noting that the possibility of a recession is not to be feared in this context. "Times of recession are the opportunity for true creative destruction when you can build the future," she suggested.

Telit vice president of product management for IoT modules Marco Argenton stated that,

POLICY AND REGULATION

"developing products in the IoT space enables solutions" for the smart infrastructure that is the backbone for smart cities.

At Carnegie Mellon, Metro21 Smart Cities Institute executive director Karen Lightman agreed. "We already have the technology," she said, revealing that she's worked on 60+ pilot projects using smart infrastructure.

"People, procurement and policies — which aren't as progressive — are where it gets complicated." She added that transparency and edge computing as well as the trust of the community will be needed.

Focusing on privacy, Pike pointed out that most of the $3 trillion real estate industry is owned by very large institutions. "We have to engage with the renters and delete their data if they want you to," she said, adding that "given the choice, most renters don't care."

Argenton described the European perspective on privacy. "We are becoming the custodians of a lot of private personal business information," he said. "But we have to keep in mind that privacy is important — but security is even more important."

In response to Ham's question about technologies the panelists are paying attention to, Hendler identified devices such as smart meters and smart thermostats. "By giving access to the end user, it gives them responsibility to measure and manage their use," he explained.

Lightman pointed out that accessibility of these devices depends on the locale's electric company. "Part of the issue is to change laws to incentivize people to use less energy," she said. Panelists agreed that "having partners and interoperability are important" to be able to build scalability.

As Risks Rise, Experts Reimagine Path to Cyber Safety

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Tech Industry Aims for Connectivity to Everyone via 5G

By Debra Kaufman

Government and industry executives discussed their roles in ensuring Internet connectivity to all Americans via 5G. Moderated by CTA vice president of regulatory affairs J. David Grossman, panelists touched on the major obstacles to ubiquitous connectivity. Qualcomm senior director of government affairs Leslie Barnes noted that, "it's important we consider all the technologies for last mile connectivity." "Where fiber is impractical or cost prohibitive, fixed wireless access is a possibility, and it's cost effective," she said. "It's a fast-growing solution that now covers over 35 million households and 2 million businesses."

Amazon head of wireless and spectrum policy Jaime Hjort described her company's Project Kuiper, its low earth orbit (LEO) constellation to bring fast, reliable connectivity to underserved communities in partnership with Verizon. Upcoming milestones in 2023 include "the launch of the first prototype satellites."

The company is also investing in Amazon Web Services, partnering with carriers such as Dish, and has just launched private 5G networks.

The National Telecommunications and Information Administration (NTIA), said senior advisor Philip Murphy, will be focused on a long-term strategy on how to leverage resources. "We're thinking about shared spectrum technology and how we get people to take advantage of innovations," he said.

At the Louisiana Office of Broadband Development & Connectivity, executive director Veneeth Iyengar noted that, in his state of 4.5 million people, 1.5 million don't have access to high-speed Internet. "We're a public startup," he noted. "We have to work at a level of urgency."

Grossman pointed out that the FCC has launched broadband maps, with an upcoming deadline for public comment. "The feds are delivering from a mapping and policy perspective for the first time in its history," he said. "The maps are a good step but an imperfect product. This is going to be an iterative process. We'll continue to submit feedback on a real time basis for a finished product that will make deployment efficient."

Murphy added that, "we're required to find the unserved locations via the map." "On June 30, we hope to have sufficient data to award the allocations to each state," he said. "But the map will continue to evolve as broadband is deployed."

Next-gen applications include, according to Barnes, "more millimeter wave in dense areas to address the growing demand for data," as well as "an increased focus on AR, VR and MR to support applications beyond gaming, such as healthcare."

Hjort emphasized that "affordability is a top priority for us." She is also enthused about Citizens Broadband Radio Service (CBRS) spectrum that can be used for private mobile networks.

ETC@USC REPORTING

Throughout CES, editor Rob Scott, George Gerba, Paula Parisi, Deborah Kaufman, Phil Lelyveld and Don Levy attended live and virtual press conferences and monitored conference sessions to bring ETCentric readers news with a sharper focus on topics of importance to ETC member companies. Stories that have not already appeared elsewhere in this report are presented to you here.

Encoding Environmental Intelligence with New Chip Tech

The design of truly contextual experiences — whether for utility or entertainment — requires a knowledge of both the user and the environment they are in. This becomes especially relevant when we think of what it means to build interesting mixed reality experiences. CES this year showcased a variety of computer vision AI software tools oriented towards understanding environmental context. At Eureka Park in the Venetian, however, MantiSpectra's chip sensor technology provided a peek into the benefits for user experience enabled by environmental intelligence arising from hardware. Continue reading CES 2023: Encoding Environmental Intelligence with New Chip Tech

Kardome Audio Solution Could Serve Virtual Production

The rise of virtual production stages has elevated the importance of finding a solution to echoing and sound distortion on the set. A company called Kardome that has created a sound isolation technology and "Spatial Hearing" solution for automobile cabins may have a solution applicable to the virtual stage. At CES, the company was demonstrating targeted speech and voice tech that brings clarity to speech recognition devices. According to Kardome, its "AI-driven Spatial Hearing and noise reduction technology facilitate a seamless voice recognition experience in any acoustic environment, from the quiet to the chaotic." Continue reading CES: Kardome Audio Solution Could Serve Virtual Production

Startup Leverages AI to Address Problematic Acoustics

There are a growing number of companies working on technologies that strive to make a person's voice more intelligible to the listener over speakers, headphones, hearing aids and other consumer audio devices. Augmented Hearing, a Danish startup launched two years ago, is one of the more interesting companies at CES 2023 focusing on this space. The firm's software-based solution runs on iOS, Windows and other CE operating systems. Their solution could mitigate the current trend of people across all age groups turning on closed captioning because they often find video dialogue difficult to understand. Continue reading CES: Startup Leverages AI to Address Problematic Acoustics

Audi-Backed Startup Holoride Brings Motoverse to Cars

Audi-backed startup Holoride is bringing virtual reality entertainment to vehicles via a puck-like device it says consumers can integrate into any vehicle. The product, unveiled at CES 2023, marks a turning point for the company, which thus far has focused on B-to-B sales to automakers, although the company's primary focus has been Audi vehicles. The suggested retail price on the consumer offering is $799 for a package that includes the device retrofit, an HTC Vive Flow headset, a safety strap and a one-year Holoride subscription. The Holoride retrofit is also available standalone for $199. Continue reading CES: Audi-Backed Startup Holoride Brings Motoverse to Cars

Digital Disruptors Focus on the Connected Car Industry

Mobile Electronics Association president Chris Cook quizzed CES panelists on innovations in the smart car space. Accenture digital strategist Monika Minarcin noted that AI doesn't just power autonomous driving but also voice recognition, digital assistants and precision marketing. At Humanising Autonomy, chief executive Maya Pindeus is using behavioral AI to build a global standard for interaction between people and machines. DarkStar Vision chief executive Joe Scalisi is working on a passive color night vision solution that he believes can "enhance the automotive sector" with rear view mirrors and motorcycle helmets. Continue reading CES: Digital Disruptors Focus on the Connected Car Industry

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Panasonic's First Hybrid Autofocus Mirrorless Cameras

Panasonic has unveiled two new hybrid full-frame mirrorless cameras — the Lumix S5II and S5IIX — that use a new autofocus system that will potentially make them competitive with similar offerings from Canon, Nikon and Sony. Coming in the spring and winter, these updated models feature a new 24.2-megapixel sensor with 779 phase-detect AF and 315 contrast points. The new chip also has Dual Native ISO with an ISO range of 100-51200 (50-204800 expanded). The models are powered by Panasonic's new L2 Engine, said to process at twice the speed of its predecessor, improving overall performance and reducing rolling shutter distortion. Continue reading CES: Panasonic's First Hybrid Autofocus Mirrorless Cameras

Crypto Leaders Weigh Benefits of Wallets, Self-Custody

CoinDesk managing editor Toby Bochan, who moderated a CES panel on "How to Keep Control of Your Crypto" noted the industry is in a "crypto winter" in the aftermath of the FTX meltdown. Panelists pinpointed crypto wallets and other self-custody technology to create trust and ease-of-use for wary customers. Bitski head of product Jasmine Xu noted that newbies face unfamiliar phraseology and uncertainty about the security of their crypto assets. Exchanges are intimidating and untrustworthy for many considering crypto. Xu's company stores keys in a digital wallet, she said, to "give consumers the safety they need." Continue reading CES: Crypto Leaders Weigh Benefits of Wallets, Self-Custody

Samsung Neo G9 Curved Gaming Monitor Wows Crowd

The Samsung Odyssey Neo G9 is a 1000R curved 57-inch gaming monitor that uses quantum mini-LED technology for pixel resolution of 7,680 × 2,160 at 32:9. Announced in November as the first monitor with DisplayPort 2.1 support, it has 240Hz refresh rate and connects with the Samsung Gaming Hub for cloud gaming. Samsung, which is calling the Neo G9 "the world's first single monitor with dual ultra-high-definition resolution," says it will ship later this year and did not announce pricing. The company also announced the 49-inch Odyssey OLED G9. Continue reading CES: Samsung Neo G9 Curved Gaming Monitor Wows Crowd

Asus Upgrades Popular ROG Zephyrus Gaming Laptops

At CES 2023, Asus refreshed this year's models of its popular ROG Zephyrus gaming laptops. The new flagship M16 comes tricked out with 13th Gen Intel i9 and Nvidia RTX 4090 graphics. The RTX 4080 variant starts at $3,900. Also arriving in the first quarter of 2023 are updates on the G14 and ROG Zephyrus Duo 16, with options including AMD Ryzen 9 Zen 4 or 13th Gen Intel processors and Nvidia GeForce RTX 40 Series GPUs. On the display front Asus offers the ROG Nebula, powered by mini-LED powered Nebula HDRs. Next-gen cooling rounds out the package. Continue reading CES: Asus Upgrades Popular ROG Zephyrus Gaming Laptops

Razer Edge Cloud Gaming Handheld Arrives January 26

The upcoming Razer Edge, a gaming handheld built for streaming, may change how players interact with cloud games. With a 6.8-inch AMOLED display at 2,400 x 1,080 FHD+ resolution with a 144Hz refresh rate, the Razer Edge and Razer Edge 5G from Verizon start at $360 and are designed for ever-connected mobile play. Razer says its latest handhelds are the first developed exclusively for the latest Snapdragon G3x Gen 1 Gaming Platform. They include active cooling "for long gaming sessions playing top AAA titles and native games on the go without having to compromise performance." Continue reading CES: Razer Edge Cloud Gaming Handheld Arrives January 26

Intel Rolls Out 13th-Generation Lineup of Laptop CPUs

Intel announced its 13th-gen family of laptop CPUs, including new entry-level chips and its flagship Core i9-13980HX, the high-end of its mobile processor collection (based on Raptor Lake architecture), featuring 24 cores and an impressive boost speed of 5.6GHz. The HX-series includes similar features to Intel's 12th-gen lineup, such as 32 EUs of onboard graphics capability

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and support for DDR5 and DDR4, but promises significantly faster speeds to multithreaded performance. When compared to the earlier Core i9-12900HK, Intel claims game performance increases of up to 12 percent and a massive 74–79 performance jump when rendering a scene in Blender. Continue reading CES: Intel Rolls Out 13th-Generation Lineup of Laptop CPUs

HP Designs Dragonfly Pro Laptops for Hybrid Workforce

HP is targeting the prosumer market with an offshoot of its Elite Dragonfly business line, introducing the Dragonfly Pro Windows laptop and Dragonfly Pro Chromebook at CES 2023. Targeting freelancers, creators and hybrid workers, the aim is to simplify purchasing choices by offering basic configurations and limited customization. "HP is taking the headache out of hybrid by delivering powerful and best-in-class ecosystem experiences," said Alex Cho, president, personal systems, HP Inc. By 2027 freelancers will account for more than 50 percent of the total U.S. workforce, HP projects. Continue reading CES: HP Designs Dragonfly Pro Laptops for Hybrid Workforce

2023 LG Laptops Include Gram Style in Iridescent Glass

LG is injecting some glitz into its flagship laptops with the introduction of its Gram Style line of glass case iridescent portables. The LG Gram Style comes in 14- and 16-inch configurations, and like the featherweight gray units that came before them are slim and lightweight. The main distinction is the luminous, color-changing finish that LG says will "shine and shift dynamically, moving and changing depending on the light and angle," with more exotic color variations in the pipeline. LG was displaying various patterned Gram Style lids at its CES booth in purples, pinks, polka dots and more, asking visitors to vote their favorites, with the winner said to be coming to market. Continue reading CES: 2023 LG Laptops Include Gram Style in Iridescent Glass

LG Demos 17-Inch OLED, 8-Inch 360-Degree Foldables

LG Display showcased several prototypes at CES 2023. As part of its Advanced Mobility Lifestyle exhibit, the South Korean company touted an 8-inch, 360-degree foldable OLED that could be used for future smartphones or autos. The revolutionary technology "enables a device to fold both ways to bring greater utilization, as users can now choose different form factors according to their task," says LG, attesting to its durability "even when folded more than 200,000 times, while its special folding mechanism minimizes wrinkles along the folding areas." The company also presented a 17-inch foldable OLED that is "almost entirely crease-free." Continue reading CES: LG Demos 17-Inch OLED, 8-Inch 360-Degree Foldables

Asus Spatial Vision Brings Glasses-Free 3D to Laptops

Engineered for game design and other 3D workflows, the Asus Vivobook Pro 16X 3D OLED offers glasses-free spatial imaging. To do this, the laptop leverages something Asus calls Spatial Vision, an autostereoscopic OLED technology that creates a set of images for each eye using real-time eye tracking tech. With the 3D mode activated, the images are then projected through a microscopic layer of lenticular lenses built into the display panel. The technology is similar to the SpatialLabs technology Acer debuted in 2021, with one big difference: a Spatial Vision screen will appear 3D to multiple onlookers simultaneously. Continue reading CES:Asus Spatial Vision Brings Glasses-Free 3D to Laptops

Lenovo Offers Dual Screens with Its New Yoga Book 9i

Designed for hybrid workers, Lenovo's new dual-screen Yoga Book 9i received several best of show awards at CES 2023. With two 13.3-inch, 2.8K OLED PureSight displays, Lenovo is calling this 9i refresh "the first full-sized OLED dual screen laptop." One hundred percent DCI-P3 color accuracy and Dolby Vision HDR offers users ultra-vivid images, sharper contrast, and richer detail, according to Lenovo. The Yoga Book 9i responds to hand-gestures for moving between screens and resizing windows, the setup has a haptic touchpad and keyboard, as well as a detachable keyboard that turns off when not in use. Continue reading CES: Lenovo Offers Dual Screens with Its New Yoga Book 9i

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Samsung Freestyle Projector Adds Game Hub, Features

Samsung is adding new features to its small Freestyle projector for 2023, with support for the Samsung Gaming Hub and image expansion using Smart Edge Blending, which lets viewers combine two of the devices to watch content in a 21:9 configuration with no manual lining up or adjusting. The Gaming Hub provides streaming apps from Xbox, Amazon Luna, Nvidia GeForce NOW and more. Subscribers to Xbox Game Pass Ultimate or other high-performance cloud gaming services can stream directly on the Freestyle so long as the Internet connection is robust enough. Continue reading CES: Samsung Freestyle Projector Adds Game Hub, Features

Nanoleaf Debuts New Matter-Compliant Smart Lighting paragraph

LED lighting firm Nanoleaf is debuting innovations at CES that include "learning smart light switches" under the banner Sense+ Controls. The devices span categories such as hardwired Smart Light Switch, Wireless Smart Light Switch and Nala Learning Bridge, all of which work with Matter, a global interoperability protocol designed to help smart homes run smoothly, running on the low-powered Thread mesh networking standard. The new Sense+ Controls products feature motion and ambient lighting sensors that automate routines. The Nala Learning Bridge facilitates color-differentiated, soft-glow night lights and connects via Thread to Wi-Fi or Ethernet. Continue reading CES: Nanoleaf Debuts New Matter-Compliant Smart Lighting paragraph

Samsung Introduces an Easy-to-Use Smart Home Hub

Samsung Electronics announced its new $60 SmartThings Station, which the company describes as "an easy-to-use, affordable smart home hub and fast charging pad." The product is designed to provide consumers with "simple control and interoperability of multiple connected devices." SmartThings Station is one of numerous solutions touted at CES that are compatible with a growing collection of smart home products, including those that are labeled as Matter devices. The Matter home automation standard, which helps connect devices built with the Thread low-power mesh networking protocol, had a significant presence at CES. Continue reading CES: Samsung Introduces an Easy-to-Use Smart Home Hub

Canon Demos VR for Movies, Sports, Video Calls

Canon went all-in on VR at CES, demonstrating how the technology can be applied beyond games. As part of a partnership with director M. Night Shyamalan and his upcoming Universal Pictures thriller "Knock at the Cabin," Canon invited attendees to don a VR headset and interact with characters from the film using the company's Kokomo software for 3D VR video calls. The camera-maker's goal is "to bring people closer together by revealing endless opportunities for creators," Canon USA president and CEO Kazuto Ogawa said, invoking the theme "Limitless is More." The company demonstrated solutions spanning entertainment, sports, communication and more. Continue reading CES:Canon Demos VR for Movies, Sports, Video Calls

Samsung Promotes Device Connectivity, Sustainability

During Samsung's CES press conference, chief executive and head of the Device eXperience (DX) Division Jong-Hee (JH) Han emphasized twin themes for the company at this years' confab. First is to deliver on the promise of smart devices. "It's about connecting all the devices that make up your life from home to workplace to car," he said. Second, he added, is "a more sustainable future." The company's vice president of corporate sustainability Inhee Chung announced that the DX Division will reach net zero carbon emissions by 2030, with a commitment to achieve that for the entire company by 2050.. Continue reading CES: Samsung Promotes Device Connectivity, Sustainability

OS-Supplier Roku to Launch Its Own Line of Smart TVs

Roku, whose software the firm claims is used in a third of U.S. TVs, will release its own line of televisions this

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year. The San Jose-based company, known for its smart TV OS, plans two models: the Roku Select and a higher-end Roku Plus, according to an announcement at CES 2023. Available in 11 models ranging from 24- to 75-inches, the Roku Select and Plus Series TVs will focus on streaming features associated with the brand, with prices ranging from $119 to $999. The new Roku TVs will include access to free live TV, news, and sports, plus popular Roku features like Find My Remote and Private Listening. Continue reading CES: OS-Supplier Roku to Launch Its Own Line of Smart TVs

Superimaging Creates New Clear Window Display Tech

Last year we told you about VideowindoW, a high resolution clear-glass display that transforms windows, including the entire glass curtain of a skyscraper, into a black and white video screen. This year at CES, Superimaging Display showcased a proof-of-concept demo of a simpler approach to transparent window displays. The company has developed a thin film embedded with nanophosphors that display visible RGB images when excited by ultraviolet light from a DLP projector. The thin film can be attached to any glass surface, and the image is visible but translucent in daylight. Continue reading CES: Superimaging Creates New Clear Window Display Tech

Razer Updates Kiyo Pro to Launch Its First 4K Webcam

Razer introduced its latest plug-and-play webcam at CES, the Kiyo Pro Ultra, a $300 4K device that features AI-powered face-tracking and an HDR mode. The company claims its first 4K webcam touts the "largest image sensor ever used in a webcam" and promises "DSLR-like video quality." The new device — which records 4K at 30 fps or 1080p at 60 fps — has a dust cover similar to that of its predecessor, the Kiyo Pro, but Razer has introduced additional protection with a built-in physical privacy shutter. It has also added an omnidirectional microphone, which should help it compete in the webcam market. Continue reading CES: Razer Updates Kiyo Pro to Launch Its First 4K Webcam

In addition to ETC's original reporting, the following pages provide a curated set of articles…

Keynote and Press Event Videos

CES 2023 Keynotes (CTA Videos)

AMD's CES 2023 Keynote in 10 Minutes

AMD CES 2023 Keynote Live Blog: Dr. Lisa Su Kicks Off the Biggest Tech Event of the Year

AMD CES 2023 Keynote Live Blog: Ryzen 7000X3D, 65W CPUs, and RDNA 3 Announcements

CES 2023: Arnold Schwarzenegger Speaks at BMW's Keynote

Experience 'Limitless Is More' at the Canon CES 2023 Press Event (Video)

CES 2023 C Space Keynote: Trust, Community, Diversity Key Drivers of Attention Economy

Gigantic and Smart Machines Took the CES 2023 Stage

LG's Official CES 2023 Press Conference (Video)

Nvidia's CES 2023 Keynote in Under 10 Minutes (Video)

Nvidia CES 2023 Live Blog: AI, Cars, and GPUs

Samsung's CES 2023 Keynote in 6 Minutes (Video)

Samsung's Official CES 2023 Press Conference (Video)

Sony's CES 2023 Keynote in Under 9 Minutes (Video)

Sony's Official CES 2023 Press Conference (Video)

TCL CES 2023 Event: Everything Revealed in 9 Minutes (Video)

TCL's Official CES 2023 Press Conference (Video)

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In addition to ETC's original reporting, the following pages provide links to articles from other publications published before, during and immediately after the show, curated by ETC consultant Dennis Kuba and ETC staff. You will find these headlines linked to their sources and cataloged by relevant categories.

Best of the Best - and Trends to Watch

CES 2023 Attendance Tops 115K

CES: Consumer Technology Association Projects $485B in 2023 Retail Revenues

The Most Noteworthy Tech at CES 2023 We Couldn't Ignore

The Key CES Trends That Are Shaping the Future of Tech

CES 2023: Full Conversation Between Nasdaq Chief Friedman and CTA's Shapiro

The 6 Most Important Tech Trends We Saw at CES 2023

Five Things I Liked at CES 2023 (Shelly Palmer)

The Verge Awards at CES 2023

Digital Trends' Top Tech of CES 2023 Awards

Best of CES 2023: These Innovations Will Reshape the Future (Video)

Best of CES 2023 Recap: Everything Worth Talking About (Video)

CES 2023 – the Biggest Trends to Watch

What to Expect at CES 2023 and This Holiday Season

What to Expect at CES 2023

CES 2023 Is Targeting 100K Attendees and Millions of Square Feet of Booths

CES 2023: Everything You Need to Know About the Consumer Electronics Show

CES 2023: Tech World to Gather and Show Off Gadgets

CES 2023: What to Expect from the World's Largest Electronics Expo in January

The Highlights of CES 2023 – The Must-See Products You Can't Miss This Year

The Tech Trends to Watch for in 2023

What to Expect from CES 2023: From Brighter TVs and Weirder Wearables to Laptops of All Shapes and Sizes

CES 2023: Annual Tech Show Kicks Off as Hardware Startups Face an Innovation Crunch

CES Highlights: World-First Wireless OLED TV, Streaming Turntables, 21-Channel Soundbar and More

The Most Exciting Tech Products Coming in 2023 and Beyond

Must-See Highlights of CES: A Flying Car, Dreamy 8K Projector and the Tesla of the Sea

CES 2023's Four Wildest – and Catchiest – Gadgets

3D Printing

Every Major 3D Printing Update from This Year's Consumer Technology Showcase

Formlabs Inches Toward Mass Manufacturing with High-Volume 3D Printing Solutions

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5G

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I Went Looking for 5G at CES, and Here's What I Found

ITRI Unveils New Collaboration with PEGATRON on 5G Private Networks at CES

5G May Soon Deliver on Its Smart City Promises, CES Panelists Say

Artificial Intelligence

The Best AI at CES 2023: From NeRFs to Translation, AI Is Coming to an App Near You

CES: Could 90 Percent of Content Be AI-Driven by 2025?

AI's at a 'Really Important Moment,' Says Sony's AI Ethics Expert

Five AI Takeaways from CES for Enterprise Business

Here's a Roundup of the Top AI-Powered Products We Saw at CES

Intel and AMD Are Building AI into PCs. It Doesn't Matter Yet – but It Will

Building Inclusive AI Frameworks, Governance at CES 2023

The Best Robots and AI Innovations at CES 2023

Nine of the Best AI Applications from CES 2023

Spatial AI: Samsung's New Plan to Transform Your Home with Voice Commands (Video)

Amazon's Custom-Built 'Hey Disney!' Voice Assistant Will Become Available for Purchase Later This Year

Disney's Magical Companion Debuts at CES with Some Help from Amazon

Audio

CES 2023 to Feature Wi-Fi Streaming Auro-3D Demo

Android Will Auto-Transfer Music from Your Car to Your Phone

NOVELDA Previews Ultra-Wideband Radar Sensor, Enabling Real-Time People Positioning and People Tracking in Smart Speakers

LG's 2023 Soundbars Offer Dolby Atmos and Wireless TV Connections

JBL Reveals Its New Flagship Soundbar at CES 2023: 15 Channels and 1170W of Dolby Atmos Power

JBL Updates Its Tune, Vibe, and Endurance Peak Earbuds at CES 2023

Harman Says Its New JBL Wireless Turntable Doesn't Skimp on Audio Quality

Victrola's Stream Onyx Turntable Makes Listening to Vinyl Over Sonos More Affordable

I Used These New Smart Earrings to Listen to Music – They Totally Surprised Me

Audio-Technica Adds a Mic to Its Iconic M50x Headphones to Target Creators

Samsung HW-Q990C Soundbar First Look: Dolby Atmos Powered by Q-Symphony

New Sennheiser Wireless Earbuds Help You Hear Better in Noisy Places

Wisear Is Building Neural Earbuds That Skip Tracks When You Clench Your Jaw

Brane X Portable Speaker Packs a Hell of a Punch in a Small Package

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Augmented Reality

CES 2023 Was Huge for AR and VR. Here's Everything Important That Was Announced

CES 2023 Revealed Multiple VR Headsets, but Where Is the Public?

The Future of Metaverse and VR Depends on These Glasses-Free 3D Displays

Canon to Show Cinematic Virtual Reality Game at CES 2023

Watch Canon Demo MREAL Mixed Reality Software at CES (Video)

Holoride Launches New Device to Bring VR Entertainment to Any Vehicle

Audi Will Showcase the Holoride VR Experience Platform at CES 2023 in Las Vegas

A Showcase Becomes a Reality: Audi Brings VR Experience Platform to CES 2023

Finding Vegas VR Nirvana in the Backseat of a '67 DeVille at CES

Vive XR Elite Hands-On: HTC's More Portable Answer to the Meta Quest Pro

HTC Builds a Standalone VR/AR Headset to Rival the Meta Quest Pro

HTC Vive XR Elite: Full Presentation (Video)

How the Vive XR Elite Can Do High-End VR in a Half-Pound Headset

HTC's Standalone Headset is an Evolution for Virtual Reality

HTC's Global Head of Product on VR's 'Race to the Bottom'

Eyes-On with Lumus Z-Lens, the Mind-Blowing Future of AR Glasses

Lumus Launches Game-Changing AR Z-Lens at CES

Lumus Shows Off Its Tech in AR Glasses That Don't Look Too Dorky

Pancake 1: New VR Headset Debuts at CES 2023

I Just Tried PlayStation VR 2 at CES 2023 – Here's What It's Like

TCL's AR Glasses Can Translate Conversations in Real-Time (Video)

TCL Makes a Surprising Full-Court Press into the AR/VR Space at CES

Touch, Smell Become the Next Big Thing for the Metaverse at CES 2023

Stop and Smell the Metaverse Roses: Virtual World on Display at CES

Aromajoin Brings Videos to Life by Squirting Your Face with Smells

Arbeon Reveals Its Service for the First Time at CES 2023… "Experience How AR Would Change Your Daily Life in Advance"

It's Like the Power Glove, but for VR

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Stellantis to Keynote at CES 2023: Unveiling Peugeot and Ram Concept Vehicles

CES 2023-Bound Ram Revolution Concept Previews Electric Pickup

Audi Will Showcase the Holoride VR Experience Platform at CES 2023 in Las Vegas

A Showcase Becomes a Reality: Audi Brings VR Experience Platform to CES 2023

Hyundai Motor Group Robots Get Rolling with Pilot Programs to Advance Last-Mile Delivery

Hyundai Managed to Put Its 'Crab-Walking' e-Corner Technology into an Ioniq EV

What Luminar's Acquisition of Startup Civil Maps Means for Its Lidar Future

Innovusion to Provide Live Experiences of Industry-Leading LiDAR for Autonomous Driving at CES 2023

CES 2023: Near- and Long-Range Lidar to Be Showcased

LG Innotek to Come Forward as the 'Total Solution Provider for Future Cars' in CES 2023

Chrysler Could Show Another Revised Airflow EV Concept at CES 2023

Plastic Omnium to Showcase Its Latest Innovations at CES 2023 in Las Vegas

Polestar 3 to Show Off Driver-Monitoring Technology at CES

The Volkswagen All-Electric ID 7 Sedan's Most Interesting Feature Isn't Its Light-Up Paintk

Bosch Is Rolling Out a Security Dashcam Designed for Rideshare Drivers

You Can Finally Buy the Ring Car Cam

ZF and Beep to Launch 'Several Thousand' Autonomous Shuttles in the U.S.

Xperi's Connected Car Team Showcasing Personalized, Infotainment-Rich In-Cabin Experience at CES

Mercedes-Benz Reveals New Charging Network and Tech Updates at CES 2023

Google Launches HD Maps for Vehicles, Volvo and Polestar First to Integrate

Qualcomm's Going Toe-to-Toe with Apple's Satellite Messaging Feature

Qualcomm Pulls Ahead with Driver Assistance Chip Technologies

Chrysler Shows Off New 'Synthesis' Cockpit Demonstrator at CES

Amazon's Alexa Will Soon Help EV Drivers Find a Charger

Aska's Ludicrous SUV-Sized Flying Car Gets Closer to Reality at CES 2023

Google's New Split-Screen Look for Android Auto Is Rolling Out to Everyone

Watch Nvidia's Entire Autonomous Cars Presentation at CES (Video)

We Listened to Dolby Atmos Inside a Mercedes at CES (Video)

Dolby Atmos for Cars Hands-On: Immersive Spatial Audio Hits the Road

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Holoride Launches New Device to Bring VR Entertainment to Any Vehicle

At CES 2023, Google Showed Up as an Automotive Company

Watch Samsung Reveal Its Vision for the Future of Driving (Video)

Chrysler's Future Car Cabins Will Be Built Around Partial Self Driving

The Peugeot Inception Concept Is an EV knife Aimed Straight at the Future

Finding Vegas VR Nirvana in the Backseat of a '67 DeVille at CES

Ram Trucks Knows Its Drivers Don't Want to Plug in Chargers, so It Made a Robot for That

Batteries

A Big CES 2023 Trend: All Battery Power, Everywhere, All the Time

Cameras

Creators Can Record Pro Video from Their Camera Directly to Their iPhone or iPad with This New Device

Novatek Adopts CEVA's Latest Sensor Hub DSP for New Multi-Sensor IP Camera SoC

CES Unveiled

CES Unveiled 2023 All Access with Brian Tong (Video)

Computing

AMD vs. Nvidia vs. Intel: Which PC Giant Won CES 2023?

Intel and AMD Are Building AI into PCs. It Doesn't Matter Yet – but It Will

CES: 13th Gen Mobile Processors Enhance the Creator Experience (Intel Video)

Nvidia Brings GeForce RTX 40 Graphics to Laptops

Nvidia Unveils the $799 RTX 4070 Ti

Nvidia Upgrades GeForce Now with RTX 4080 Performance for Premium Users

Cryptocurrency

CES 2023 Sees Strong Bitcoin and Crypto Footprint

Gaming

These Are All the New Mini-LED Gaming Laptops Announced at CES 2023

The Best Gaming Laptops from CES 2023: ROG, Alienware, Razer, and More

Why 2023 Is the Year to Buy a Gaming Laptop

OLED Gaming Monitors Have Arrived to Kick TVs Off Your Desk

Acer Updates Its Range of Gaming Laptops for 2023

Asus Teases First 27-Inch OLED Gaming Monitor Ahead of CES 2023

Asus Is Bringing More Nebula Displays and Better Cooling to Its Gaming Laptops

Asus Announces New Xbox Controller with a Built-In OLED Screen

Alienware Teases a Monster New 18-Inch Laptop Ahead of CES

Alienware's New Gaming Laptops Include an 18-Inch Beast

Dell's Revamped G-Series Might Be the Best-Looking New Budget Gaming Laptops at CES

Dell's Concept Nyx Gamepad Sure Is... Something

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The Most Exciting Laptop Trends from CES 2023

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Acer Goes Intel-Only with the Latest Aspire Laptops

Acer's Aspire All-in-One Is Impressively Sleek

Acer Simplifies Its Swift Laptop Lineup for 2023

Acer's New Swift Go Has a 1440p Webcam

Asus Debuts an Impressive (Glasses-Free) 3D Display on Its New Vivobook Pro

Asus Shows Off Its First Glasses-Free 3D Laptop at CES (Video)

Asus Could Launch a Massive New ROG Laptop at CES 2023

HP's New Dragonfly Pro Targets Potential MacBook Buyers at CES 2023

HP's Dragonfly Pro Chromebook Has World's First 8-Megapixel Laptop Webcam

CES 2023 Hands-On: HP's Dragonfly Pro, a Sharp Laptop with Special CPU Sauce

The HP Dragonfly Pro Chromebook Is One of the Slickest Laptops of CES 2023

Lenovo's IdeaPad Flex 3i Chromebook Offers a Larger Display and Optional 1080p Webcam

Lenovo's New All-in-One Is All Screen: Yoga AIO 9i Is a Fairly Standard AIO with a Standout Design

Lenovo's New Yoga Book 9i Laptop Has a Second Screen Above Its Screen

Lenovo Yogabook 9i Hands-On at CES 2023 (Video)

The Dual-Screen Lenovo YogaBook 9i Is Unlike Any Laptop I've Seen at CES 2023t

Lenovo's Yoga Book 9i Is an Unprecedented Laptop for People Who Hate Foldables

Lenovo's Dual-Screen Laptop Is Remarkable

Lenovo's New ThinkBook 16p Has a Snap-On 4K Webcam

The LG Gram Style Might Be the Prettiest Laptop of 2023

MSI's Next Laptop Could Have a Mind-Blowingly Good Display

Nvidia Brings GeForce RTX 40 Graphics to Laptops

Nvidia Unveils the $799 RTX 4070 Ti

Nvidia Upgrades GeForce Now with RTX 4080 Performance for Premium Users

Nvidia RTX 4070 Ti Review: 3090 Ti Power for $799

Nvidia RTX 4070 Ti vs. AMD RX 7900 XT: Two Odd Choices for Your Next GPU

Razer Expands to 16- and 18-Inch Blade Laptop Models

Metaverse and Virtual Worlds

Tech Resolutions for 2023: Make an Immersive Internet for Enterprise

Enterprise Support for the Metaverse Flourishes at This Year's CES

Virtual Worlds, Real-Life Use Cases: How Web2 and Web3 Tackled the Metaverse at CES

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Touch, Smell Become the Next Big Thing for the Metaverse at CES 20235

Lenovo's Project Chronos Lets You Beam Yourself into Virtual Worlds

Consumer and Business Interest in the Metaverse Is Growing (Accenture)

Portable Volumetric System: Reality into the Metaverse (Sony Video)

Sony and Manchester City Are Building a Metaverse, but They Need to Prove Why We Should Visit

Dasverse Introduces 'Art Metaverse' on LG TVs at CES 2023

Miscellaneous

Join Analog Devices at CES 2023 to Experience Life at the Intelligent Edge

EMD Electronics to Showcase Technologies and Applications at CES 2023

Zenpack Debuts at CES 2023 with Newly Formed Creative Agency Haptik Studio

The Quirkiest Gizmos and Tech Doodads at CES So Far

Mobile

Cox to Launch Mobile Business, Joining Cable Rivals Comcast, Charter and Altice

The Best Smartphones at CES 2023

The Best and Coolest Tablets We've Seen at CES 2023

New Qi2 Standard for Wireless Devices Ensures Enhanced Consumer Convenience and Efficiency

Wireless Power Consortium Works with Apple on Next Generation 'Qi2' Standard Based on MagSafe

Is Apple Sweating Yet? These 4 Companies Just Turned Up the Heat at CES

Android Phones Are Stealing (and Beating) the iPhone 14's Best Feature at CES

Galaxy Z Fold 5 Prototype with Teardrop Hinge Spotted at CES 2023

BlackBerry to Host Investor Q&A at CES 2023

Lenovo's New Android Tablet Looks Like a Really Big iPad Pro

The Lenovo ThinkPhone by Motorola Is a ThinkPad Owner's Dream

LG Display's Latest Foldable OLED Can Bend in Both Directions

LG Display at CES 2023: 360-Degree Foldable Screen Steals the Show

Qualcomm, Iridium Take Aim at Satellite-to-Mobile Phone Markett

Qualcomm Snapdragon Satellite First Look at CES 2023 (Video)

The Quirkiest and Most Unusual Mobile Tech at CES 2023

Razer's Edge 5G Handheld Is Coming to Verizon This Month for $359.99

Unistellar's Telescope Turns Your Smartphone into a Stargazer

Movies

At CES 2023, Sony's 'Gran Turismo' Flags New Entertainment Strategy

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Canon to Show Cinematic Virtual Reality Game at CES 2023

NextGen TV - and Broadcast Tech

In a Gadget-Light Year, CES Pitches a Connected, Mobile World

Hisense, Sinclair Demo NextGen TV Broadcasts with Advanced HDR by Technicolor

Sinclair Broadcast Group to Demonstrate Enhanced NextGen Broadcast Datacasting at CES 2023

Elektrobit and Airbiquity Partner to Enable the Next Generation of Over-the-Air Services for the Mobility Industry

Tolka to Highlight ATSC 3.0/NextGen TV at CES 2023

Tolka Partners with Pearl TV to Fast Track NextGen TV Adoption

Podcasting

Android Will Auto-Transfer Music from Your Car to Your Phone

Google Is Working on Cross-Device Notifications to Let You Resume Media Playback on the Move

Privacy, Safety, Security

Federal Privacy Standard Needed for Consumer Protection

Tech Legislation Is Shifting from Antitrust Focus to Broadband, Cybersecurity

Senator Mark Warner on Cybersecurity, Musk's Twitter and Legislating Killer Robots

Projectors

The Best Projectors of CES 2023

Formovie Showcases Leading Technology in Projectors at CES 2023

Hisense's Smallest Laser Projector Is Portable and Has a Huge 150-Inch Image Size

This Samsung 8K Ultra Short Throw Projector Is an All-in-One Entertainment Dream

Samsung's 2023 Freestyle Can Combine Projections from Two Units into a Massive Image

The Tiny Samsung Freestyle Projector Can Now Stream Games, Too

Yaber Unveils World's First Smart LCD Projector: Yaber K2s at CES 2023

Must-See Highlights of CES: A Flying Car, Dreamy 8K Projector and the Tesla of the Sea

Remote and Hybrid Work

Canon's AMLOS Solution Among the Top Technologies Named a 2023 CES Best of Innovation Award Winner

Robotics

The Best Robots of CES (CNET Video)

The Best Robots and AI Innovations at CES 2023

Adorable Smart Home Robot Unveiled at CES 2023 Could Be a Great Addition to Your Family

The Adorable Loona Petbot Is Ready to Roll into Even the Coldest of Hearts

This Optimus Prime Robot Was the Coolest Thing at CES 2023

WowWee Returns to Robots with a Dog Named 'Dog-E'

Smart Cities and Infrastructure

5G May Soon Deliver on Its Smart City Promises, CES Panelists Say

Amazon Sidewalk Adds New Partners, Plans to Open to Developers Soon

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Smart Home, IOT, Connected Devices

CES 2023 Smart Home Roundup: All Aboard the Matter Bandwagon

The 8 Most Tempting Smart Home Products from CES 2023

With Human Security as the Theme for CES 2023, Prioritize Safety This Year with These Products

The Best Smart Home Tech of CES: Fresh Ideas from Samsung, LG and More

Smart Home Trends at CES: Matter Support, Immersive Lighting, and LG Sneaker Displays

Matter Smart Home Devices Dominated CES This Year

Matter Explained: What Is the Next-Gen Smart Home Protocol

Matter Interoperability Tops Amazon's CES 2023 IoT Announcements

New Qi2 Standard for Wireless Devices Ensures Enhanced Consumer Convenience and Efficiency

Amazon's Custom-Built 'Hey Disney!' Voice Assistant Will Become Available for Purchase Later This Year

Ambient Photonics Demonstrates Low-Light Energy Harvesting Technology for More Sustainable IoTk

LG's New Minimalistic Appliances Have Upgradeable Features and Fewer Controls

MSI Made a Router with Antennas That Follow You Around Your House

NOVELDA Previews Ultra-Wideband Radar Sensor, Enabling Real-Time People Positioning and People Tracking in Smart Speakers

Samsung's SmartThings Station Combines Wireless Fast Charging with a Matter Smart Home Hub

Spatial AI: Samsung's New Plan to Transform Your Home with Voice Commands (Video)

Samsung's New Wall Oven Lets You Livestream a Video Feed of What's Cooking

The First Smart Deadbolt Capable of Wireless Charging Is Coming This Year

Amazon's Flying Indoor Security Camera (Video)

Ring Offers a First Look at Its Home Security Drone

Social Media

Reddit to Set Up Shop at CES 2023 with Future Tellers Installation

Reddit, Pinterest Preach Brand Safety Amid Twitter Chaos

Twitter Plots an Advertising Comeback. It Begins at CES.

Streaming

The MCU Will Stream in DTS:X in 2023 Thanks to Disney+ and IMAX

Despite Challenges, Netflix Says Its Ad Tier Is Doing Well

Sling TV Rolls Out User Profiles, Promises Faster Pace of Innovation in 2023

Sustainability

CES 2023 Innovation Awards Highlight Home Wellness, Sustainability

LG Presents ESG Vision for a Better Life for All at CES 2023

Connecting Innovation and Sustainability: Samsung's Focus for CES 2023

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Television, Monitors, Displays

The Best TVs of CES 2023

Nanosys Shows Off Next-Gen Electroluminescent Quantum Dot Display Technology

This Next-Generation Display Technology Is Going to Change the World

Is 8K TV Dying? It's Not Looking Good at CES 2023

Dasverse Introduces 'Art Metaverse' on LG TVs at CES 2023

Dell Unveils a 6K Monitor with an IPS Black Panel

Dell's New 32-Inch 6K Monitor Gives Apple's ProDisplay XDR Some Competition

Displace to Debut the World's First Truly Wireless TV at CES 2023

Hisense's UX Mini LED TV Can Produce 2,500 Nits of Peak Brightness

Every Mini-LED Revealed by Hisense at CES 2023 (CNET Video)

Hisense Reveals Massive ULED X 110-Inch TV at CES 2023 (CNET Video)

Hisense and Leica Team Up to Elevate the Laser TV Industry to New Heights

Leica Launches the Hisense-Powered $8,300 Cine 1, Its First 4K Laser TV, at CES

HP's 5K Super Ultrawide Monitor with 'Dual' Displays Makes Debut at CES 2023

LG's Wireless 97-Inch OLED TV Puts All Other TVs to Shame

LG's Newest Generation OLED TVs Up the Brightness Factor

LG's 2023 OLED TVs Are Up to 70 Percent Brighter

LG Infuses AI Deep Learning in Its Latest OLED TVs for Better Picture Quality

LG Wants to Reinvent How You Think of TV Picture Modes

LG Display's Latest Foldable OLED Can Bend in Both Directions

LG Made an (Almost) Wireless 97-Inch OLED TV (The Verge Video)

Panasonic Promises Its Best HDR Picture Yet from 2023 Flagship MZ2000 OLED TV

Panasonic LZ2000 Review: A Flagship OLED TV That Sounds as Good as It Looks

Roku Does the Obvious Thing and Announces Its Own TV Line

Roku Announces Its Own TV Line at CES 2023 (CNBC Video)

Roku CEO Explains Why the Company Is Launching Its Own Line of TVs

Here's Why Samsung and Dell's New Monitors Are So Exciting for Mac Users

CES 2023: Samsung Micro LED – The One and Only (Samsung Video)

Samsung Makes Mini-LED Even Bigger with the Odyssey Neo G9

Samsung Takes on Apple and LG with Its Own 5K Display for Creative Pros

Samsung Bets on MicroLED and 8K for Its Premium 2023 TVs

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Samsung Debuts World's Smallest and Most Affordable microLED TV at CES

Samsung Shows Off the First 77-Inch QD-OLED 4K TV at CES 2023

Sony Breaks from Tradition and Won't Announce New TVs at CES 2023

Samba TV, TCL Announce R&D Partnership

TCL Will Unveil More Large Screen Mini LED and QLED TV Series Starting from Spring 2023

Xumo Expands Smart TV Portfolio with Element Line of 4K Ultra HD TVs

Virtual and Remote Production

Virtual Production: Pre-Visualization to Final Pixels on Set (Sony Video)

Studiobox Is a Remote Video Team's High-Def Dream

Webcams

Acer's New Swift Go Has a 1440p Webcam

HP Unveiled the 620 and 625 FHD Screen-Mounted Webcams at CES 2023

Lenovo's New ThinkBook 16p Has a Snap-On 4K Webcam

Stop Disappearing in Zoom Meetings with Lenovo's Cordless Webcam Light

Razer Says Its Kiyo Pro Ultra Webcam Can Capture Uncompressed 4K Footage

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