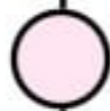# BUILDING THE METAVERSE

THE MEGADECK:

160+ COMPANIES

7 LAYERS

9 MEGATRENDS

ONE CREATOR-LED FUTURE

JON RADOFF
Author, *Building the Metaverse* blog
CEO, Beamable

Lenses to View the Metaverse

What is the Metaverse?

Why the Metaverse
Experiences
9 Megatrends

How Value Flows through the Metaverse Industries
7 layers of the value-chain
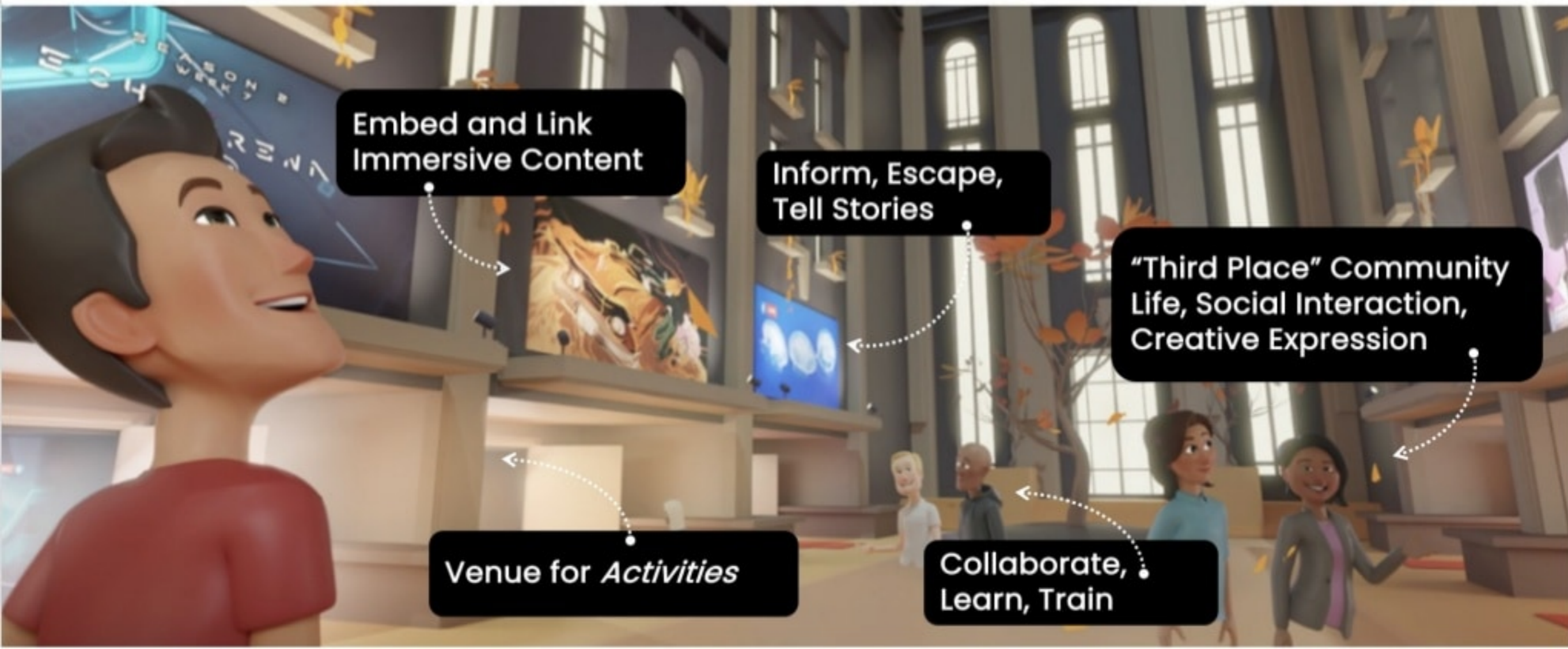
Who is building the metaverse?
160+ companies/projects cataloged and categorized

How Metaverse Network Effects and Business Models work

What does the Metaverse do?

The metaverse is the next generation of the Internet: it enables **creators** to deliver connected, **immersive** experiences based around **activities**.

Embed and Link Immersive Content

Inform, Escape, Tell Stories

"Third Place" Community Life, Social Interaction, Creative Expression

Venue for *Activities*

Collaborate, Learn, Train

Properties of the Metaverse

Emphasis on **activities**

...in immersive **places** in which the self is present

...crafted by an exponential rise in **creators**

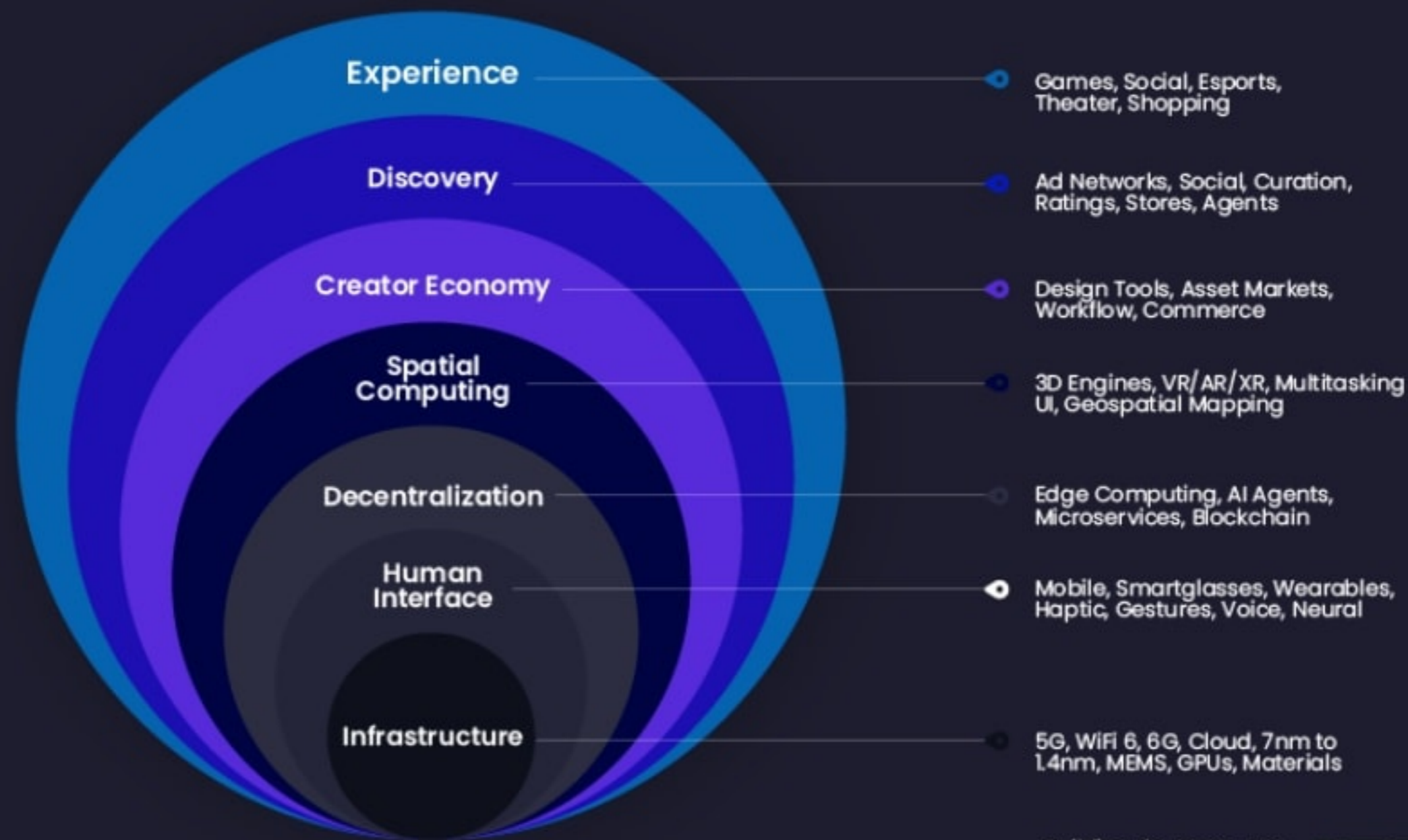...with the ability to **link and embed** immersive, emergent content

The metaverse is not a future: it is already here. It is a conversation about *becoming*, not simply being.
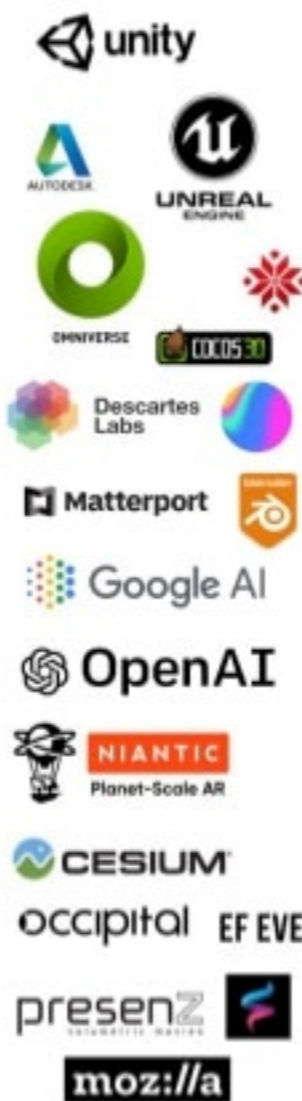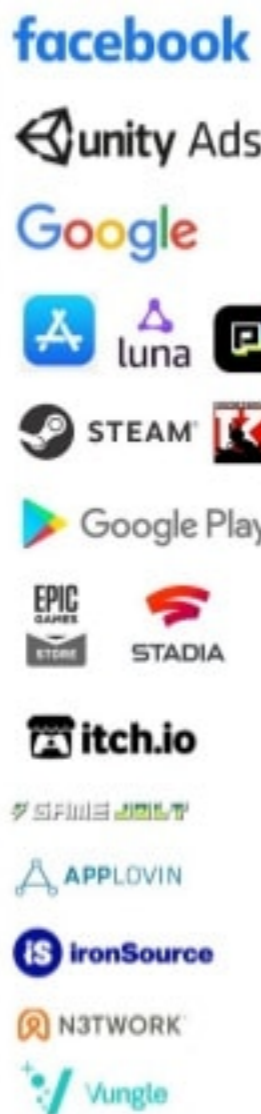
The Seven Layers of the Metaverse

Experience — Games, Social, Esports, Theater, Shopping

Discovery — Ad Networks, Social, Curation, Ratings, Stores, Agents

Creator Economy — Design Tools, Asset Markets, Workflow, Commerce

Spatial Computing — 3D Engines, VR/AR/XR, Multitasking UI, Geospatial Mapping

Decentralization — Edge Computing, AI Agents, Microservices, Blockchain

Human Interface — Mobile, Smartglasses, Wearables, Haptic, Gestures, Voice, Neural

Infrastructure — 5G, WiFi 6, 6G, Cloud, 7nm to 1.4nm, MEMS, GPUs, Materials

Building the Metaverse
Jon Radoff

Metaverse Market Map

Experience	Discovery	Creator Economy	Spatial Computing	Decentralize	Human Interface	Infrastructure

Experience: FORTNITE · NIANTIC · WAVE · Together Labs · RIOT GAMES · HOLOGATE · Hasbro · Activision Blizzard · FABLE · EMBRACER GROUP · NCSOFT · MINECRAFT · BEAMDOG · UBISOFT · EA · CCP · Tencent 腾讯 · ZEPETO · Nintendo · XBOX GAME STUDIOS · UPLAND · PlayStation STUDIOS · NetEase Games · NEXON · RTFKT · Beat Games · VALVE · Gather · 2K · WARGAMING.NET · lilith · Supernatural · twitter · NETFLIX · miHoYo · AltspaceVR · YouTube · Spatial · facebook · THETA.TV · Clubhouse · twitch · DISCORD · zoom

Discovery: facebook · unity Ads · Google · App Store · luna · STEAM · Google Play · EPIC GAMES STORE · STADIA · itch.io · APPLOVIN · ironSource · N3TWORK · Vungle

Creator Economy: unity · EPIC GAMES · BEAMABLE · ROBLOX · EC ROOM · facebook horizon · IMPROBABLE · Xsolla · MANTICORE GAMES · mod.io · Microsoft · SANDBOX · skillz · Adobe · async. · genvid · SOMNIUM SPACE · Decentraland · Polystream · BUILDBOX · GameMaker Studio 2 · ARIA · SUPERWORLD · shopify · gravity sketch · SUBSPACE

Spatial Computing: unity · AUTODESK · UNREAL ENGINE · OMNIVERSE · COCOS3D · Descartes Labs · Matterport · Google AI · OpenAI · NIANTIC Planet-Scale AR · CESIUM · occipital · EF EVE · presenZ · mozilla

Decentralize: Microsoft · Ava Labs · WEBASSEMBLY · IMMUTABLE · IBM · ethereum · polygon · WAX · Dapper · enjin · ubuntu · Algorand · rally · THETA · ARAGON · Polkadot · ION · CARDANO · OpenSea · evernym · WOLF · makersplace · SuperRare · Crucible · neuno · N · RP1 · M

Human Interface: oculus from facebook · Apple · XBOX · PlayStation · Nintendo SWITCH · SAMSUNG · Microsoft HoloLens · t5 · HUAWEI · VIVE · NEURALINK · LIGHTFORM · VUZIX · nreal · RAZER · VARJO · magic leap · AVEGANT · amazon alexa

Infrastructure: aws · Azure · nvidia · Google Cloud · DFINITY · AMD · MARVELL · Qualcomm · Qorvo · SKYWORKS · intel · verizon · T Mobile · AT&T · vodafone · fastly · Akamai · CLOUDFLARE · agora · bandwidth · EQUINIX · DIGITAL REALTY

LAYER 1 EXPERIENCE

Many people think of the metaverse as 3D space that will surround us.

But the metaverse is not 3D or 2D, or even necessarily graphical; it is about the inexorable *dematerialization* of physical space, distance, and objects.

Third Places

"...your first place is your home, and your second is your workplace, but your third place is where you relax in public, where you encounter familiar faces and make new acquaintances."
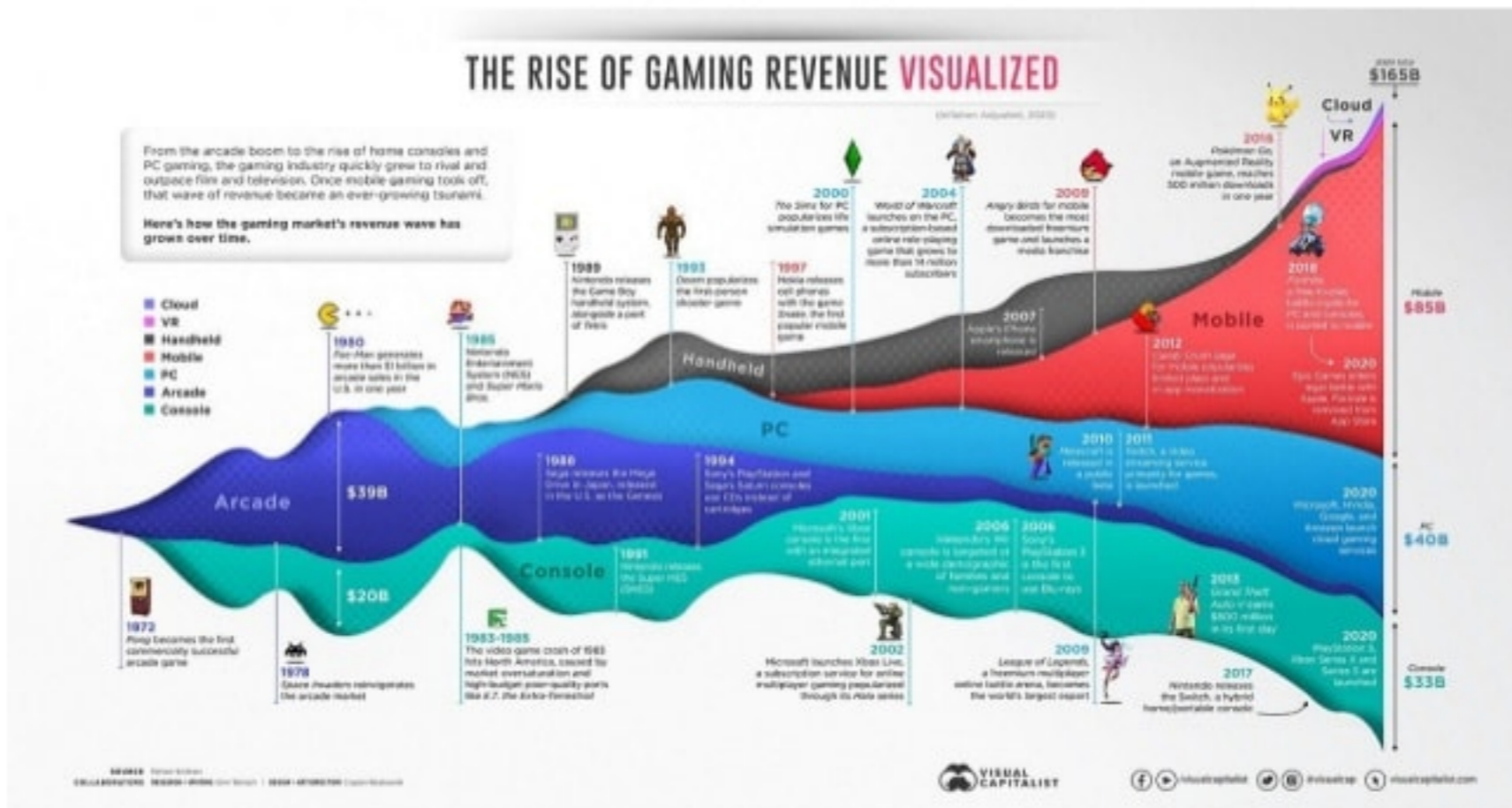
– Rebekah White

Rec Room Social Experience

Experience: Games

Growth of Game Revenue over Time

The Pandemic Accelerated Games

U.S. Games Market Dynamics
2021 Total Consumer Spending by Month, USD Billions

Total Video Game Spend and Change vs YA

Spending (USD, Billions) — Chg vs YA
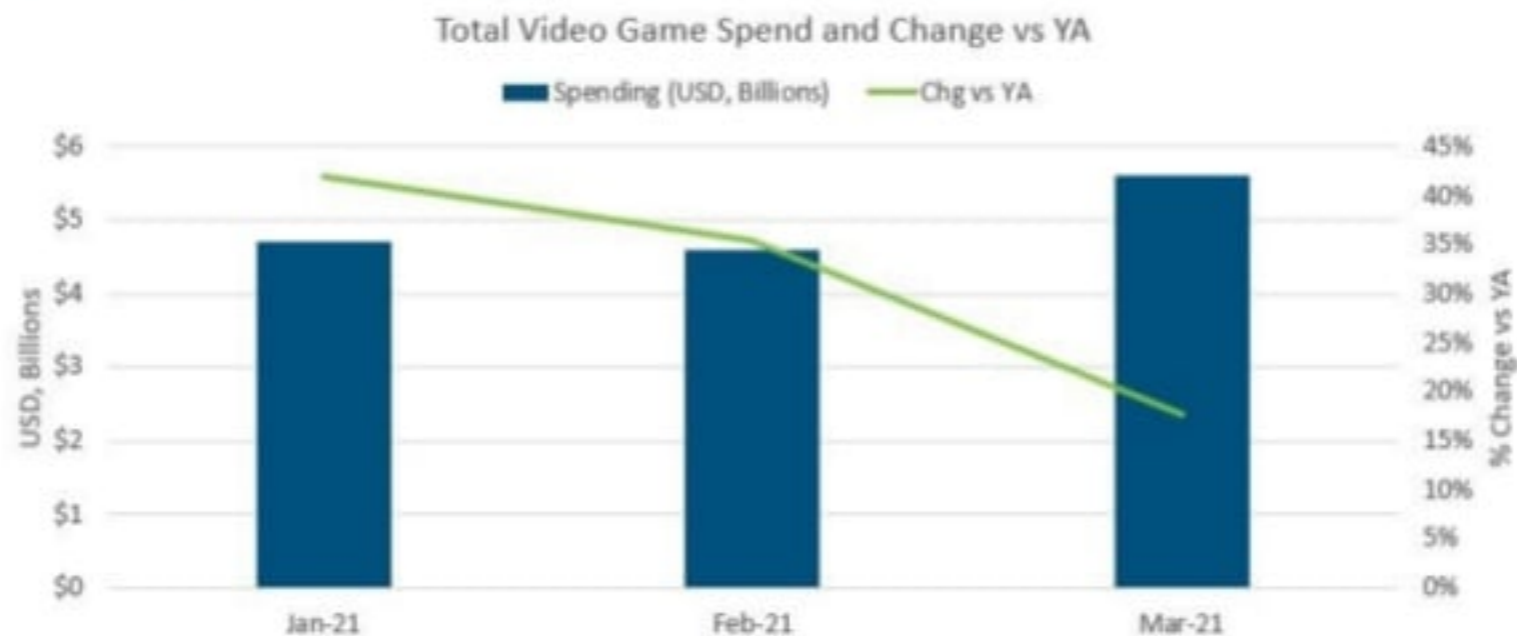
Source: The NPD Group

Game Attention ➡️ Game Revenue

The Live Games Trinity

Monetization
Convert community attention into virtual
item purchases; optimize economics

Content Train
Retain and reengage community
through frequent content updates

Live Events
Boost community engagement
by delivering scarce, real-time activities

Ways Games Monetize Attention

Coin Op

Advertising

Subscriptions

Franchise Loyalty

Skill-based

Virtual Items

Forecasted Virtual Item Revenue Share

Percentage of Game Revenue from Virtual Items

95%

75%

50%

20%

2010   2015   2020   2025 (forecast)
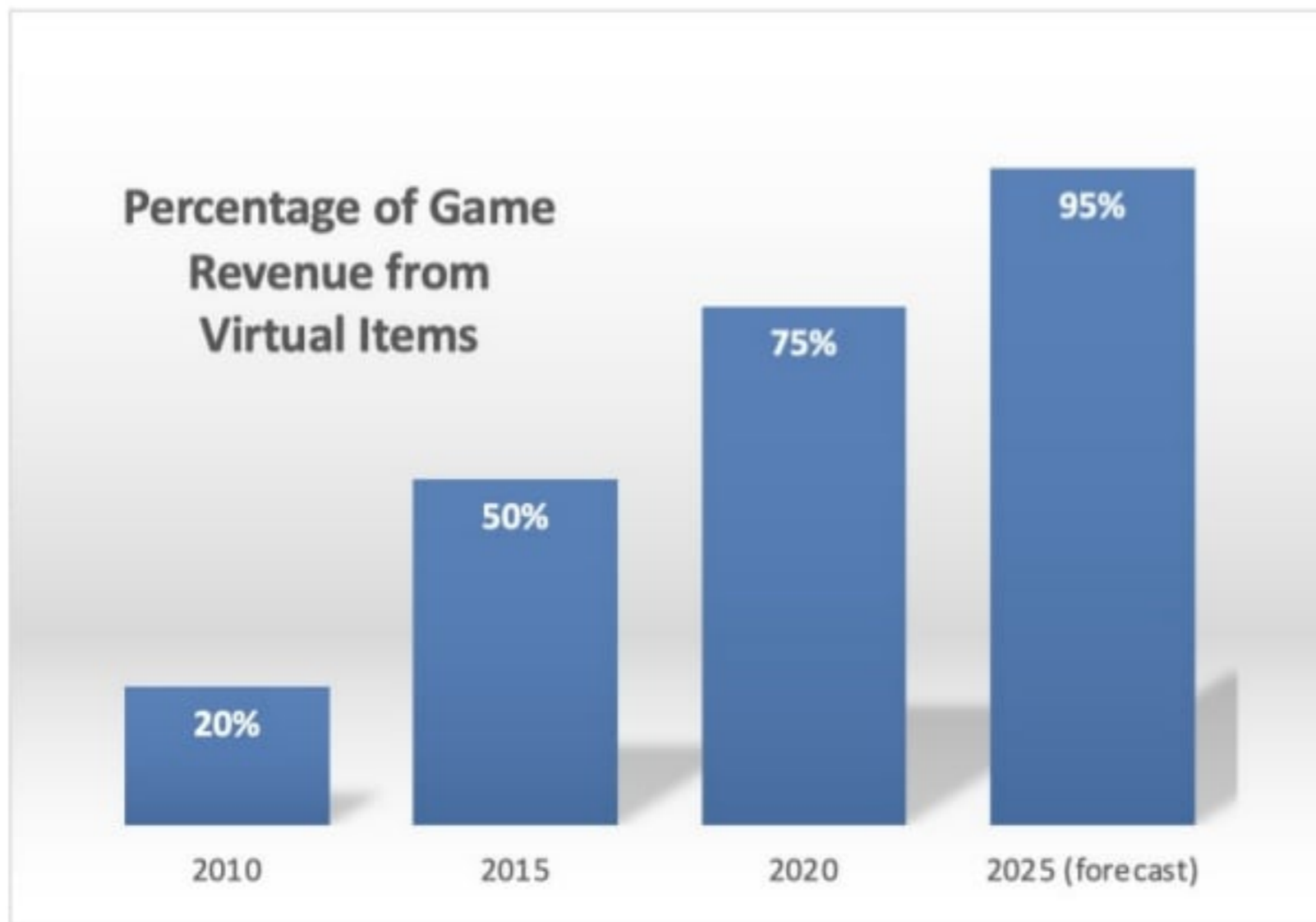
Data Source: ARK Invest Big Ideas 2021

Gamification

…used to mean adding badges and leaderboards to an app.

No longer.

What began in games now informs almost all the other experiences of the metaverse:

Storytelling, immersion, aspiration, progression, identity, socialization

Experience: Immersive Commerce

- **Shopify** (featured to the right) envisions shopping enhanced by virtual and augmented reality

- Shopify also collaborates through VR to design their shopping experiences
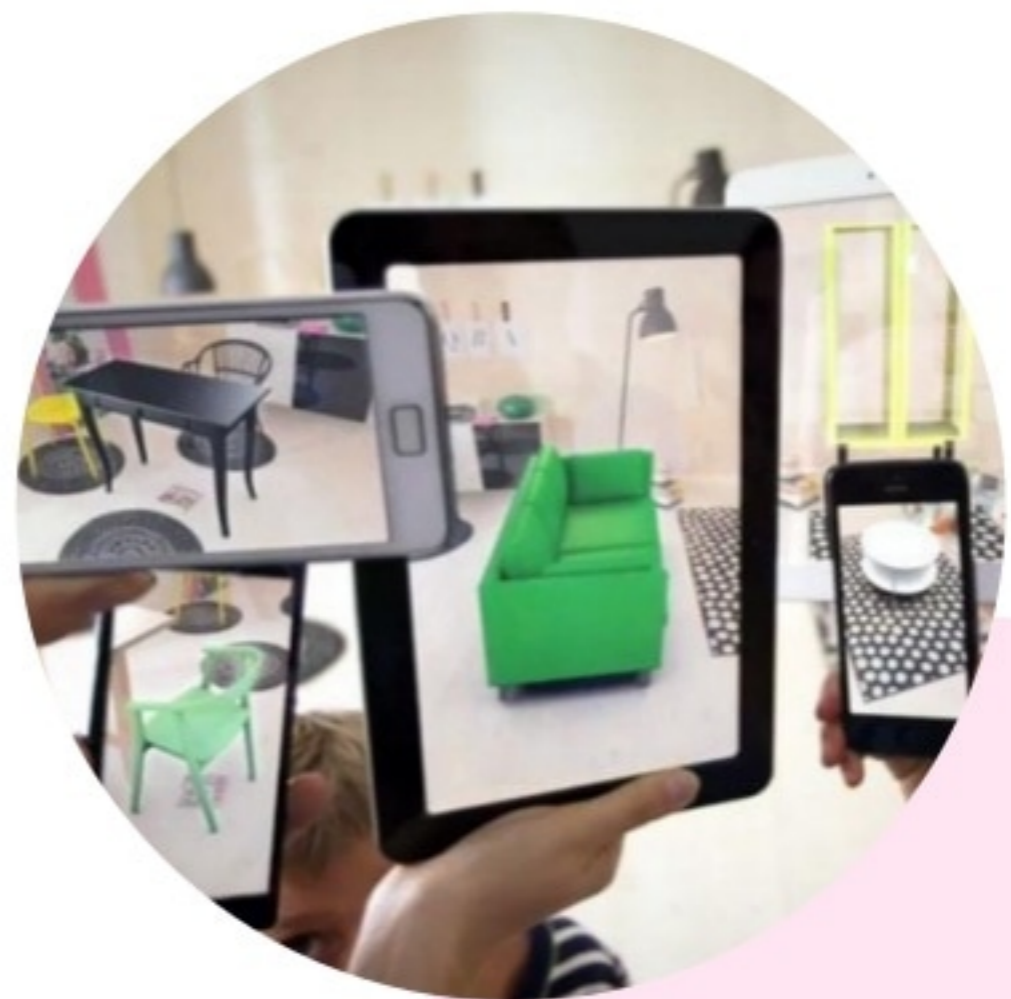
Experiences: Collaboration

- **Gather.town** provides a game-like virtual office environment in 2D, supported by livestreaming video

- **Spatial** takes a more 3D graphic approach to workplace collaboration
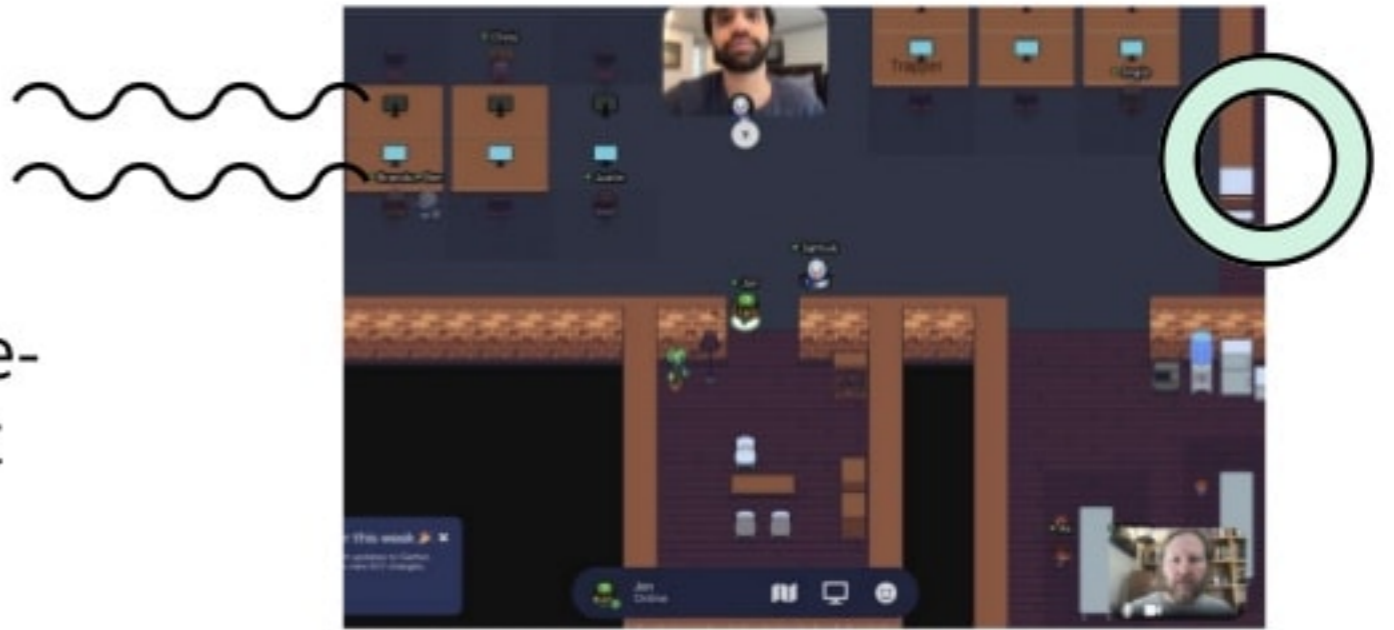
Experiences: Real Estate

Matterport has created VR exploration of real estate
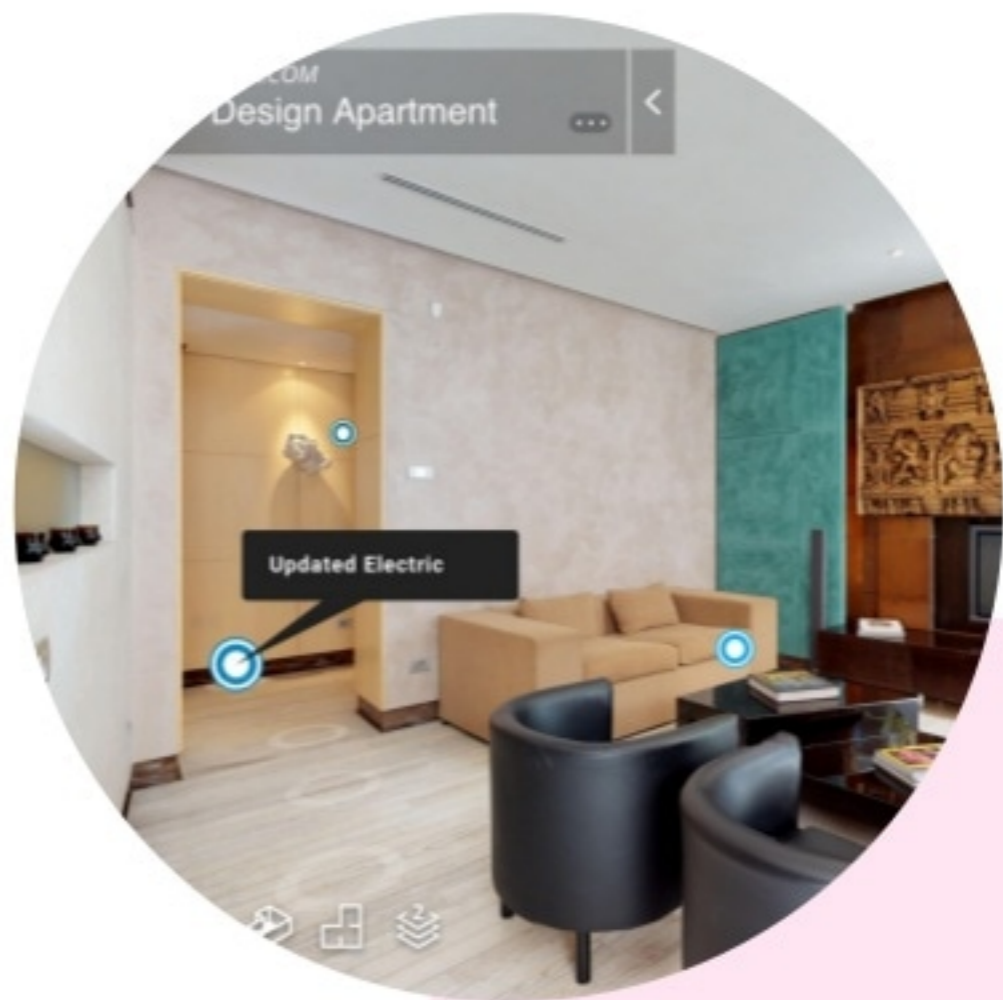
Experiences: Travel
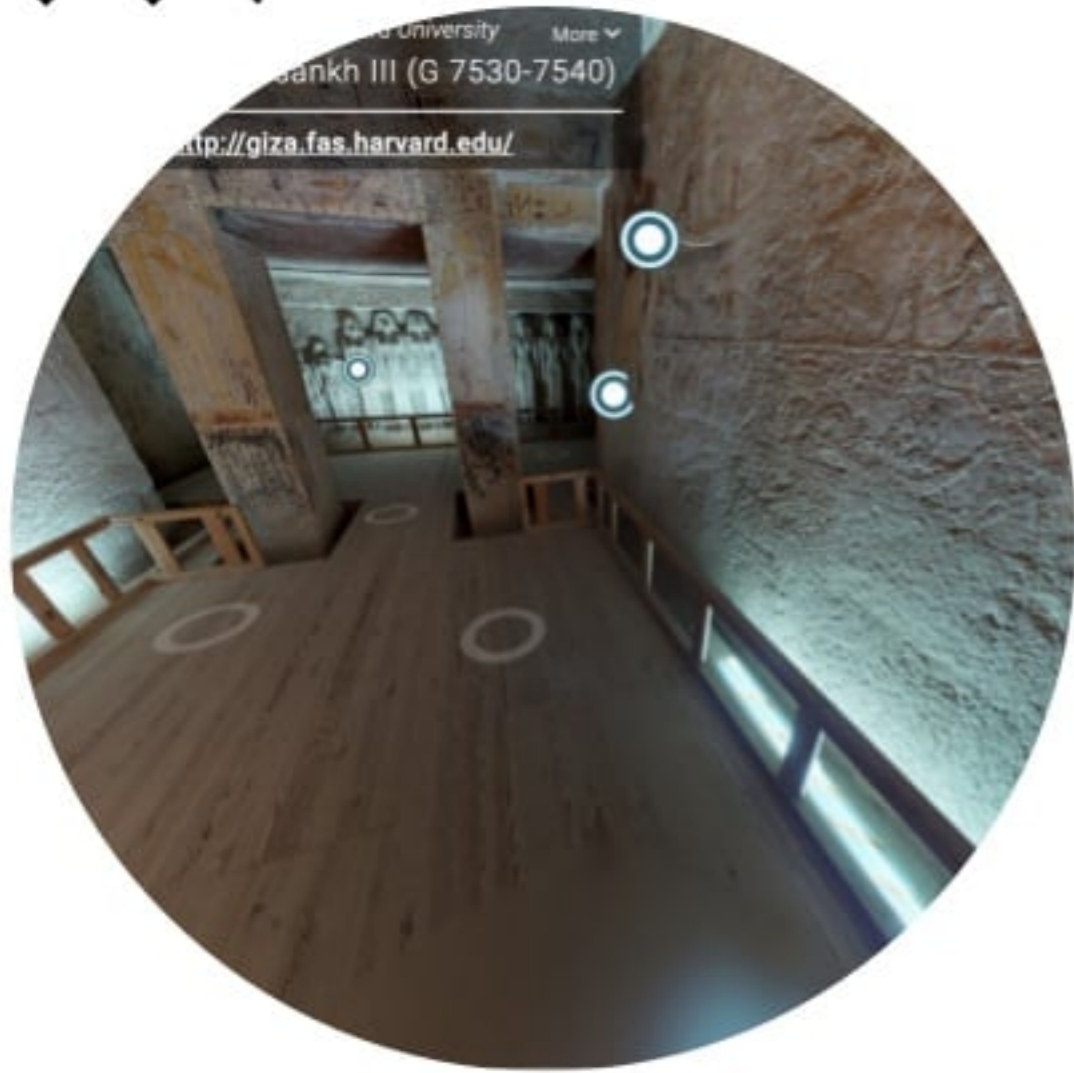
- Matterport created a way to explore Egyptian heritage sites through VR
- Imagine a future where you encounter spaces in real-time, socially, with fellow travelers through telepresence
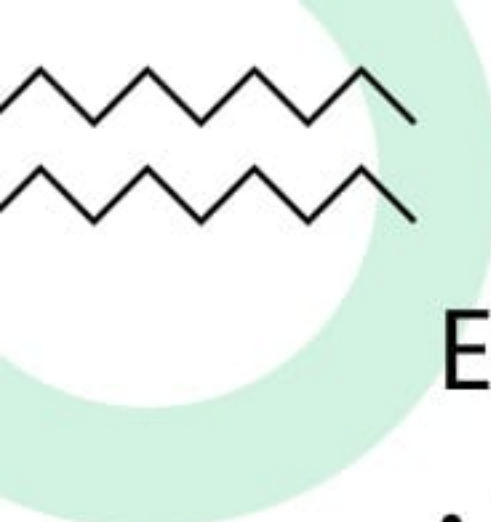
Experiences: Design Architecture, Engineering

Interoperable, immersive spaces that simulate machines, fluids and traffic allow designers and engineers from different disciplines to collaborate together.

Featured at right: **NVIDIA Omniverse**

Experiences: Automotive

- Design Collaboration
- Simulating autonomous vehicles
- Selling (virtual showrooms)

Science Fiction?

Or Science Future?

"In the 22nd century, things were **constructed in virtual space first**. Once complete, the plans were uploaded to an auto-factory, which built the entire item using 3D printers, roamers and nanites."

— We Are Legion (We Are Bob)

Image: NVIDIA

Experiences: Learning and Education

- Immersive learning
- Classroom simulations
- Classroom travel
- Interactive, social education
- Transport educators from anywhere
- Learn from anywhere
- "Gamified" learning
- Skill-based training with augmented data/instructions

Image Credit: stem.T4L

Experience: Fitness

- Remote personal training via video
- Home gym using **Tonal**, **Peloton**, **Beachbody**
- Immersive, gamified fitness with **Supernatural VR**
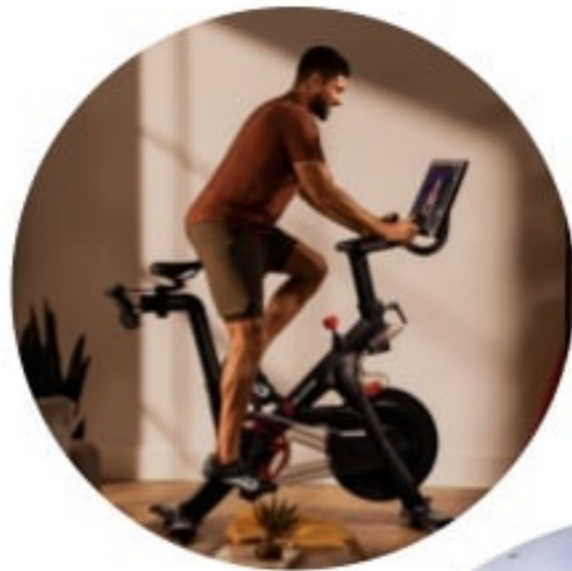
Experience: Volumetric Livestreaming

Brings immersive livestreaming into the realm of any 3D space

Featured Left: **EF EVE**

Image Credit: Florian Olivo

Experience: Esports

- Evolution of traditional sports
- Live tournaments and competitions
- "Spectacle" events
- Immersive live events will increasingly move into the metaverse, just as physical events will grow in popularity

Experiences – Live Music

- Transport fans into virtual concerts

- Add unique, immersive effects to the experience

- Allow anyone to experience from a front-row seat

- Featured right: Wave XR

Experience: Transforming the Physical World

- Immersive Theater
- Augmented Real-World Spaces
- Live Action Roleplaying
- Geospatially-aware applications

Towards an Age of Abundance

What happens when physical space is **dematerialized?** Formerly scarce experiences may become **abundant.**

Image: Ashwin Vaswani

"Abundance is not about providing everyone on this planet with a life of luxury—rather it's about providing all with a life of possibility."

– Peter Diamandis

WHY THE METAVERSE?

Image: Richard Horvath

9 Megatrends Shaping the Metaverse

Virtual Mainstreaming	Machine Intelligence	Simulating Reality
Challenges by Open Platforms	Rise of Cybernetics	Accelerating Distributed Networks
Walled Garden Ecosystems	Low-Code Platforms	Blockchain Adoption

« ──────────── **»**
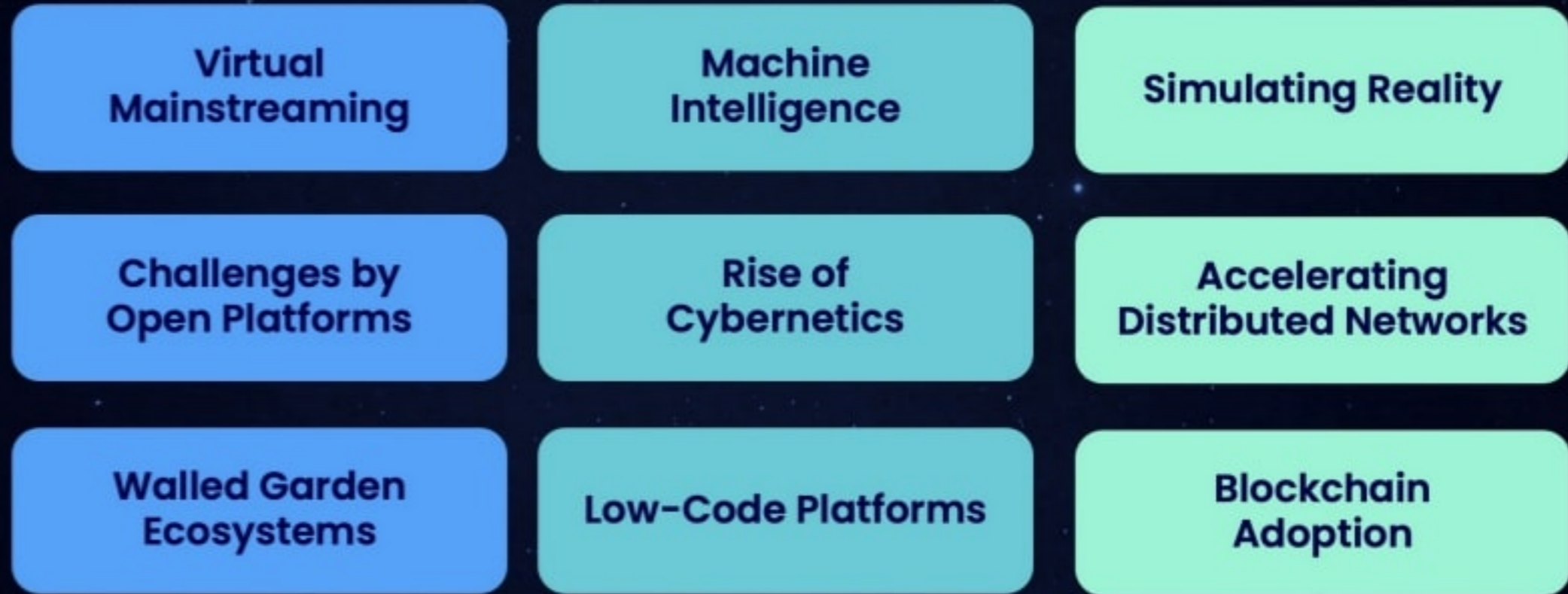
MORE SOCIAL
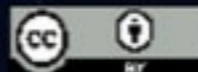
Building the Metaverse
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MORE TECHNOLOGICAL

Megatrend: Virtual Mainstreaming

- People increasingly have more of their lives invested in their digital identity

- For many people, the virtual is now as "real" as the physical

Covid-19 Accelerated the Virtual

Extent of Working from Home During, Before and After COVID

Work Status: May and December 2020

Working from Home	41.9% / 36.2%
Not Working	32.6% / 27.2%
Working on My Business Premises	25.6% / 36.7%

Percent of Workers

● May 2020   ● December 2020
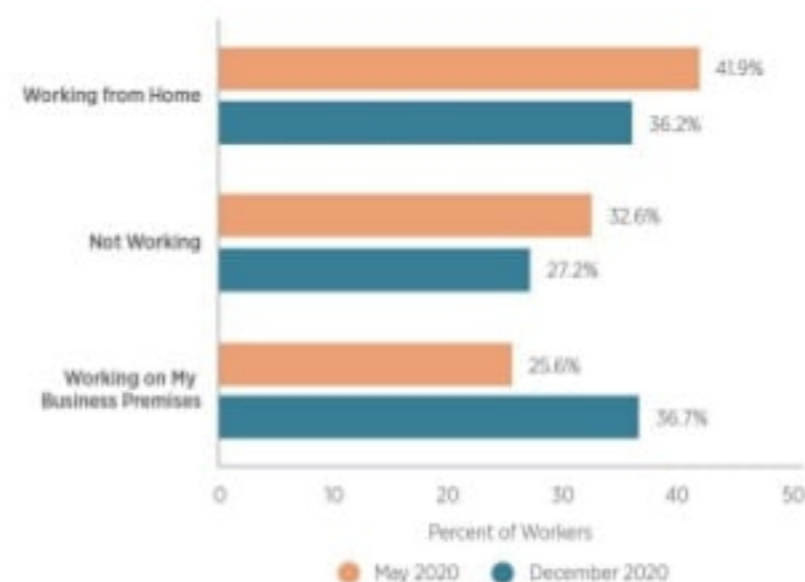
Share of Paid Days Worked from Home

● Estimate   -- Employer Planned   ▨ 95% Confidence Interval
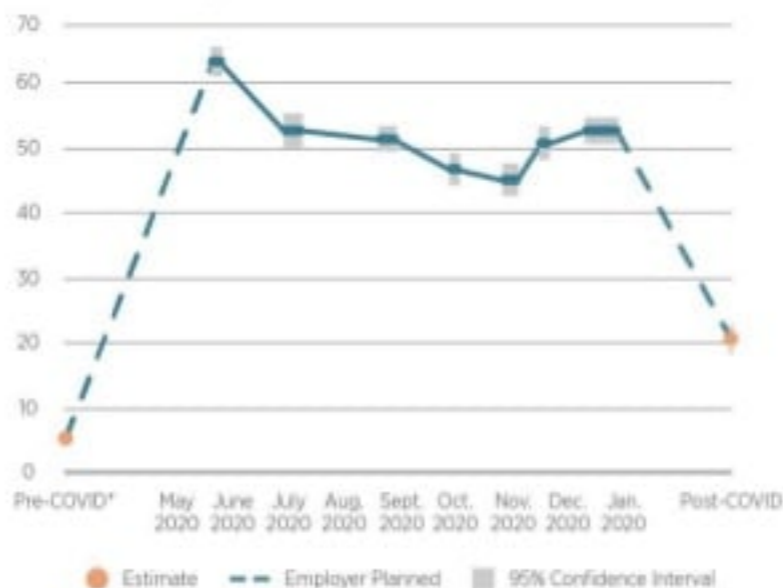
*Pre-COVID estimate taken from the 2017-2018 American Time Use Survey

Source: Responses to the questions: "Currently (this week) what is your work status?" and "After COVID, in 2022 and later, how often is your employer planning for you to work full days at home?"

Notes: Data from 22,500 survey responses collected in May, July, August, September, October, November, and December 2020 by Inc-Query and QuestionPro. Each wave collected 2,500 responses, except the August and December waves, which collected 5,000. We re-weight raw responses to match the share of working age respondents in the 2010-2019 CPS in each (Industry x state x earnings) cell.

Becker Friedman Institute

Teens were already there

Six-in-ten teens spend time with their friends online on a daily or near-daily basis

% of U.S teens who say they get together with friends online or in person (outside of school or school-related activities) ...

	Every day or almost every day	Several times a week	Less often
Online	60	21	19
In person	24	26	50
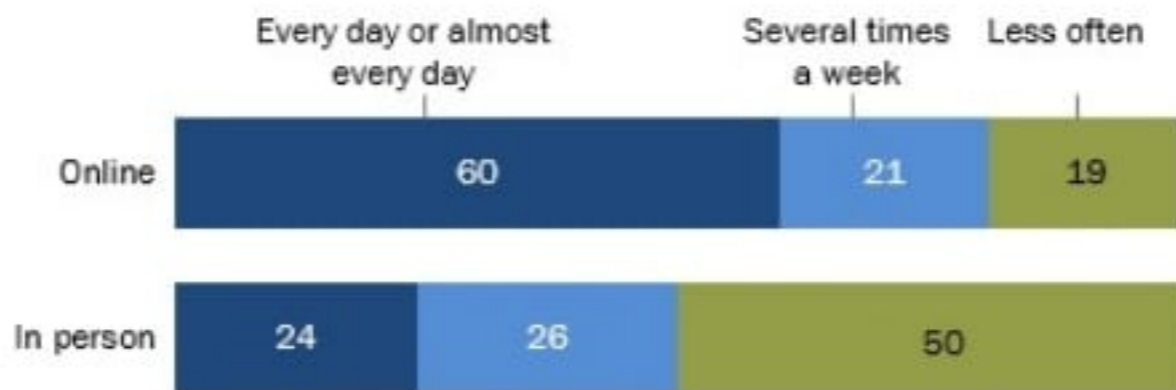
Note: Respondents who did not give an answer are not shown.
Source: Survey conducted March 7-April 10, 2018.
'Teens' Social Media Habits and Experiences"

PEW RESEARCH CENTER

"Identity will be the most valuable commodity for citizens in the future, and it will exist primarily online."

– Eric Schmidt, The New Digital Age

Cybercrime & Toxic Behavior
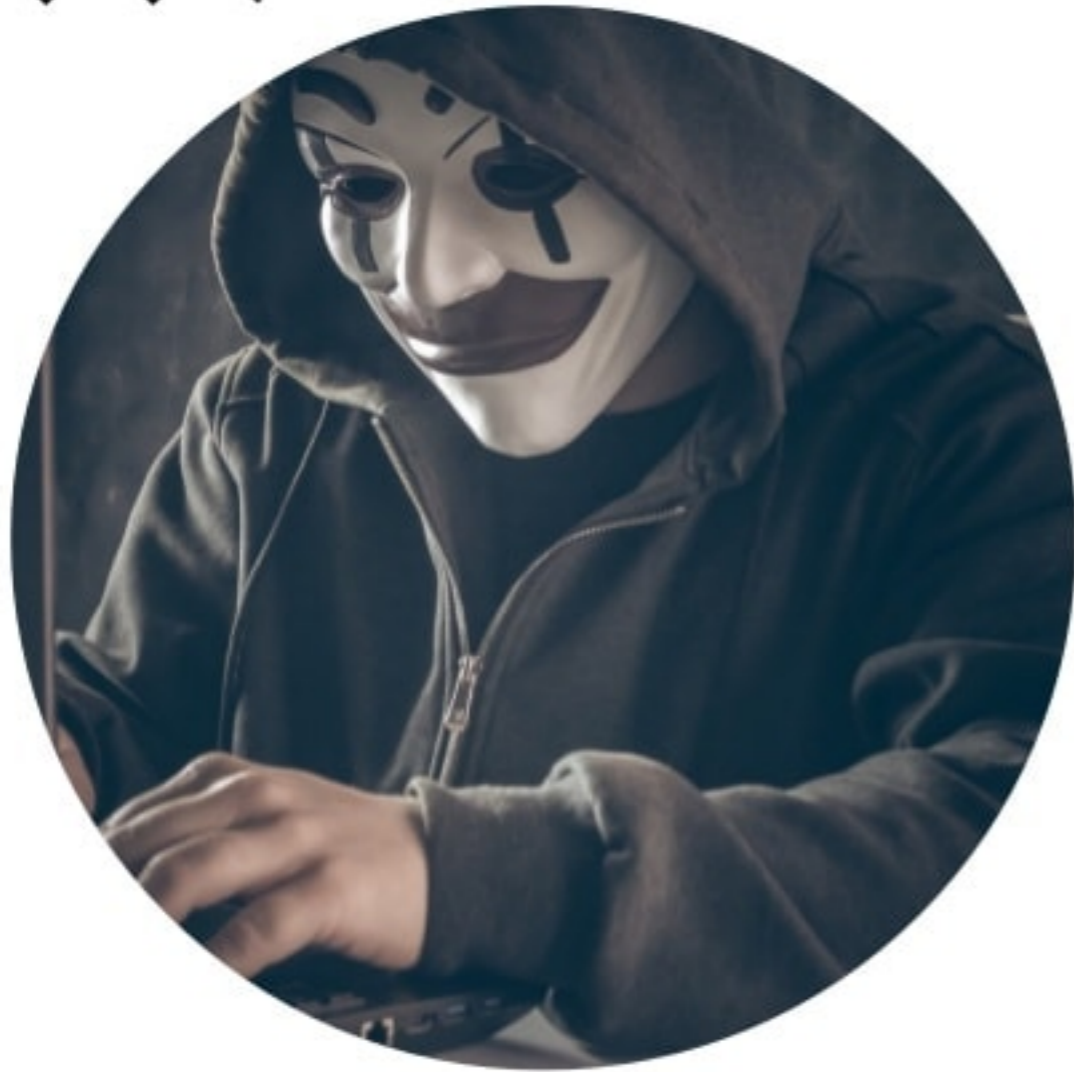
Image Credit: Bermix Studio

- As the virtual became real, it became a place for antisocial behaviors as well…

- Cybercrime

- Fraud

- Bullying

- Cheating

Virtual Items

- Virtual Items are increasingly as valued by people as real-world items

- Collecting, customizing, using

- Value is a function of affinity (liking), utility (what can you do with it?) and scarcity

Items in a Virtual Economy

Value

Higher Affinity-Utility

More Scarce
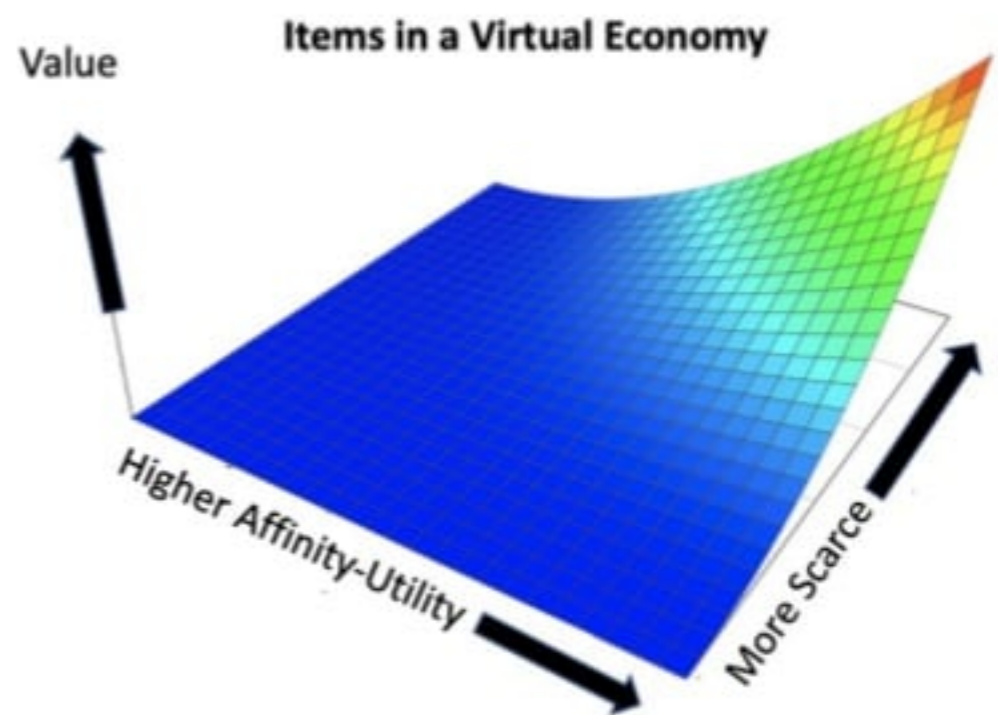
Megatrend: Low-Code Platforms

50%

Medium/large companies will use low-code and serverless platforms by 2023, according to Gartner... **but this underestimates the disruption to be caused when a whole world of creators are equipped with new, faster tools.**

Unity 3D Studio
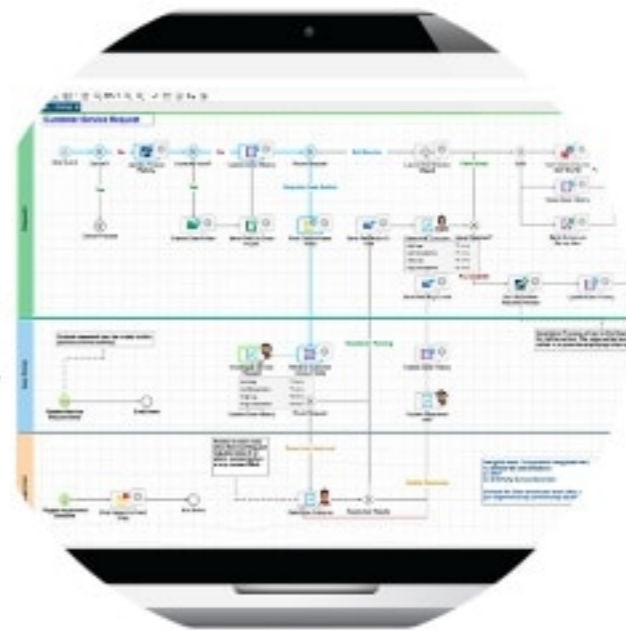
Appian Process Modeler

Shopify

Megatrend: Machine Intelligence

- Deep Learning
- AI Assistants
- AI Agents
- Virtual Beings
- The AI as a creative collaborator
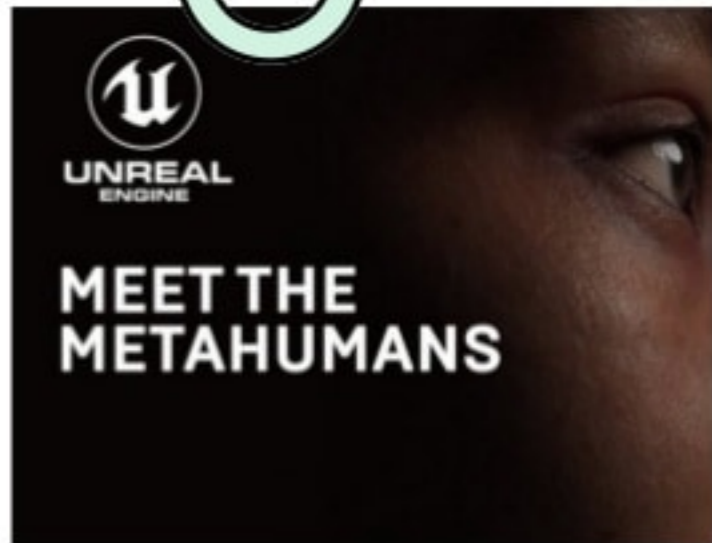
Virtual Beings

Machine intelligence will power conversations, emotions, behaviors of characters you'll meet—and even befriend—in the metaverse.

Featured: Epic's Metahumans; Fable's VirtualBeings; AIDungeon

Machine Intelligence:
Helping Creators

Promethean AI uses prompts from a creator to manufacture entire virtual landscapes—like the one shown here.

Megatrend: Rise of Cybernetics

Cybernetics: *the integration of human sensory and motor systems with computers.*

- Game controllers

- Haptics

- VR/AR

- Smartglasses

- Brain-computer interface

The metaverse will not simply be a place we go *into*. The metaverse will be *everywhere around us*.

Megatrend: Simulating Reality

- Real-time Ray Tracing

- Real-time Physics Simulation

- Real-time data feeds from the Internet of Everything

- Geospatial and traffic data

- "Oracles" with real-time financial data

Image: Penforhire

Megatrend: Challenges by Open Systems

Standards such as WebAssembly and WebXR now make it possible to deliver compiled, compact, fast code and experiences as an alternative to walled-garden platforms.
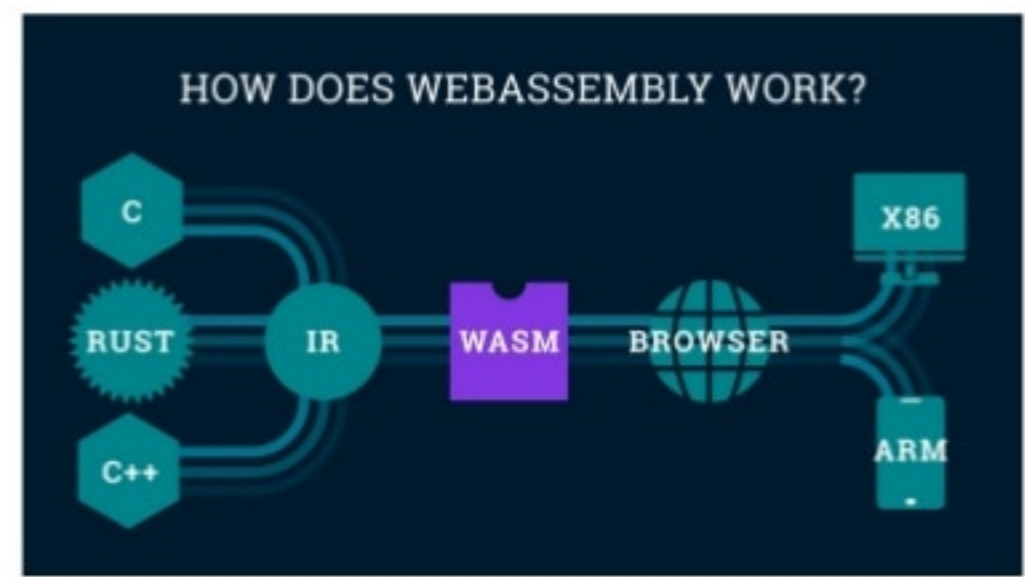
Image: Interlogica.it

Megatrend: Blockchain Adoption

Ethereum Unique Addresses Chart
Source: Etherscan.io
Click and drag in the plot area to zoom in
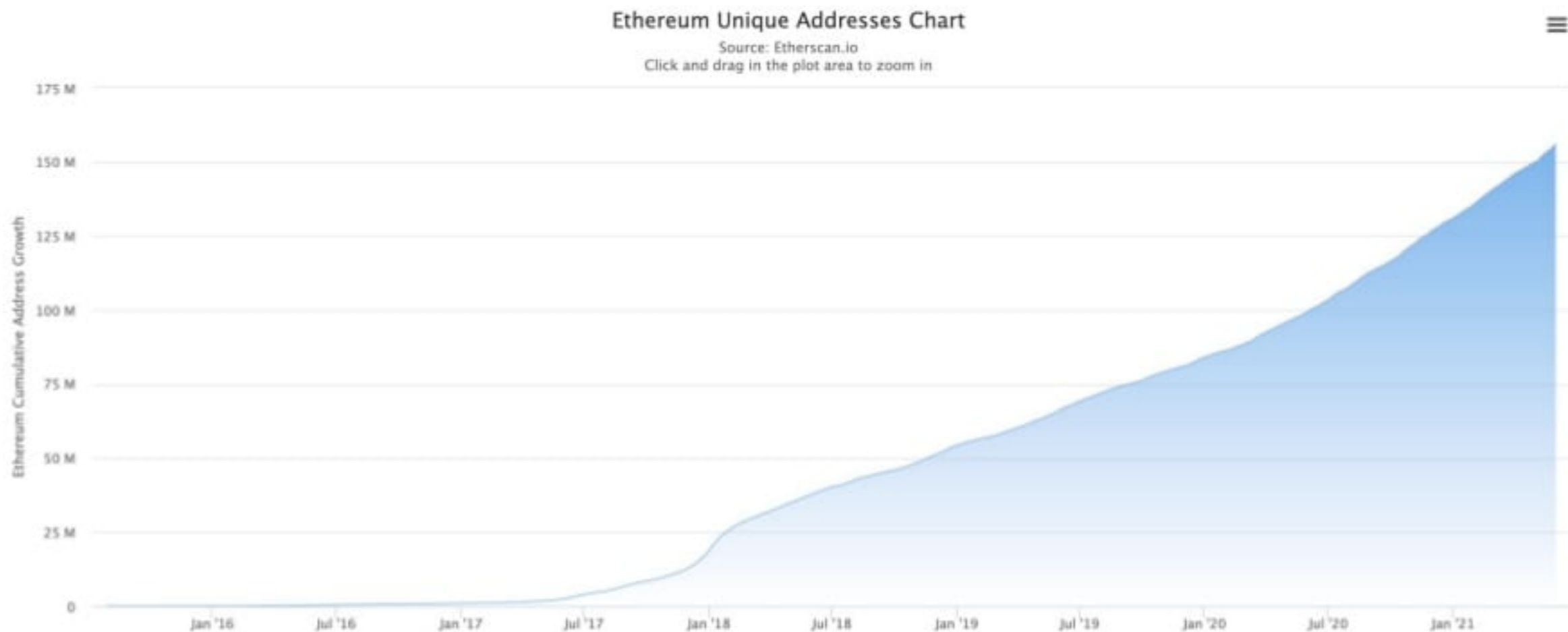
Source: etherscan.io

Blockchain Adoption: Smart Contracts

- Autonomous, trustless, secure, transparent contracts on smart-contract blockchains such as Ethereum

- Counterparties may be anonymous

- Use cases include record storage, title to assets, governance, insurance, supply-chain automation

Image: Scott Graham

Blockchain Adoption: NFTs

- NFT = Non Fungible Token

- An application of smart contracts

- Provides decentralized, trustless, programmable asset ownership and exchange with provable scarcity and provable provenance

- Use cases include real estate, art, music and gaming

Megatrend: Walled Garden Ecosystems

Not every application or every world will be open. Sometimes permission, integration, curation, and control are desirable features of a platform or application.

Company Highlight: Roblox

- "YouTube for Games" – social network and discovery

- Creator tools to make games and experiences

- Play from within the Roblox application
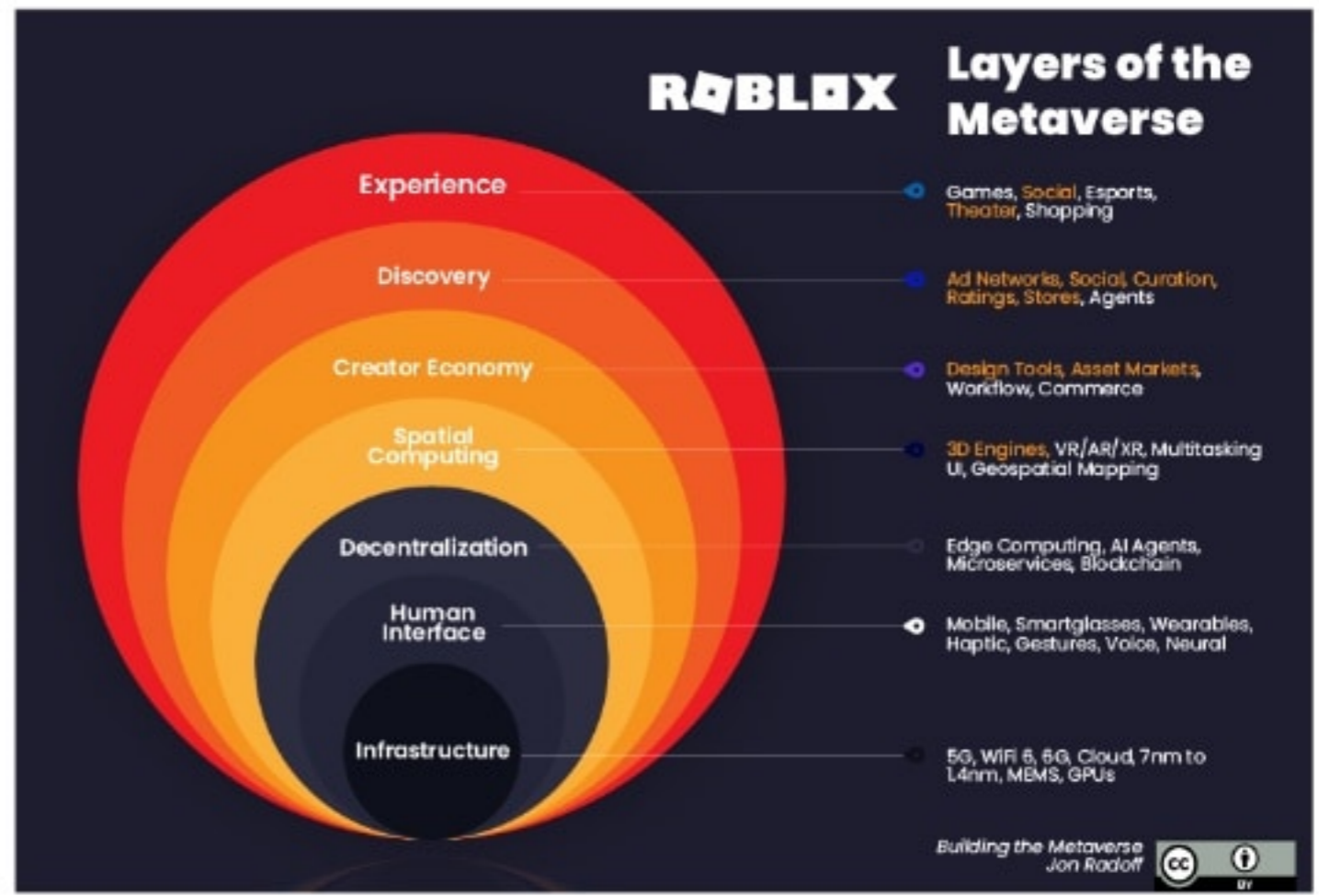
Walled gardens
aren't a problem.

Too few walled
gardens would be a
problem.

Megatrend: Accelerating Distributed Networks

- 5G and 6G networks
- Exponential increase in speed, concurrency and latency improvements
- Computing at the edge: down the street or even in your home
- "Computation on tap"

LAYER 2 DISCOVERY
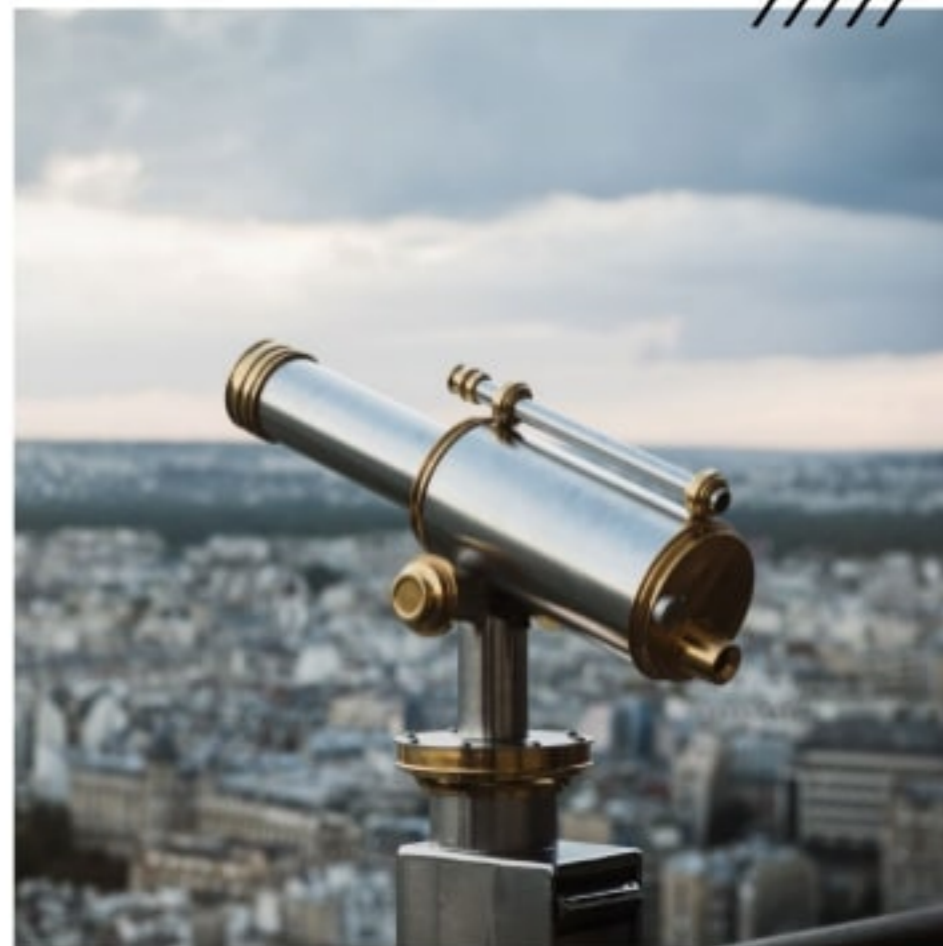
Inbound Discovery

- Real-time presence
- Community-driven content
- *N* of your friends like *App*
- App stores (along with reviews, ratings systems, and categorization/tagging)
- Curation — via featured application listings in stores, taste-makers, and "influencers"
- Search engines
- Earned media

Discovery via Outbound Marketing

- Display advertising
- Spam (email, LinkedIn, Discord)
- Notifications

Community-Driven Content

Content marketplaces will become an alternative to application marketplaces as a means of discovery.

Real-Time Presence

Instead of focusing on what people like, this is about what people discovering what friends are doing *right now*.

This is highly relevant in a metaverse where so much of the value will come from interacting with friends through shared experiences.

Company Highlight: Epic

- Discovery via Epic Game Store
- Competitors: Steam, App Stores, etc.
- Epic also provides their own experiences (Fortnite) and the Unreal Engine for building 3D projects

Layers of the Metaverse

- Experience — Games, Social, Esports, Theater, Shopping
- Discovery — Ad Networks, Social, Curation, Ratings, Stores, Agents
- Creator Economy — Design Tools, Asset Markets, Workflow, Commerce
- Spatial Computing — 3D Engines, VR/AR/XR, Multitasking UI, Geospatial Mapping
- Decentralization — Edge Computing, AI Agents, Microservices, Blockchain
- Human Interface — Mobile, Smartglasses, Wearables, Haptic, Gestures, Voice, Neural
- Infrastructure — 5G, WiFi 6, 6G, Cloud, 7nm to 1.4nm, MEMS, GPUs

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Jon Radoff

LAYER 3

CREATOR ECONOMY

Content-Community Complex

Customers are now content-creators and content-amplifiers as well as consumers. In the past, there was the notion of "user-generated content" when referring to mundane features like blog comments or uploading a video. Now, content isn't simply generated by people: it *emerges* from their interactions and feeds into the substance of the conversations within their communities.

Evolution of Creator Economies

Market Participants (log-normal)

Pioneer Era

Creativity-led, but needs brand new tech. First-mover advantage

Engineering Era

Creativity constrained by engineering capacity. Efficiency added by tools and middleware.

Creator Era

Mass democratization. Creator-centric platforms. Disruption of tech-constrained incumbents.

Time
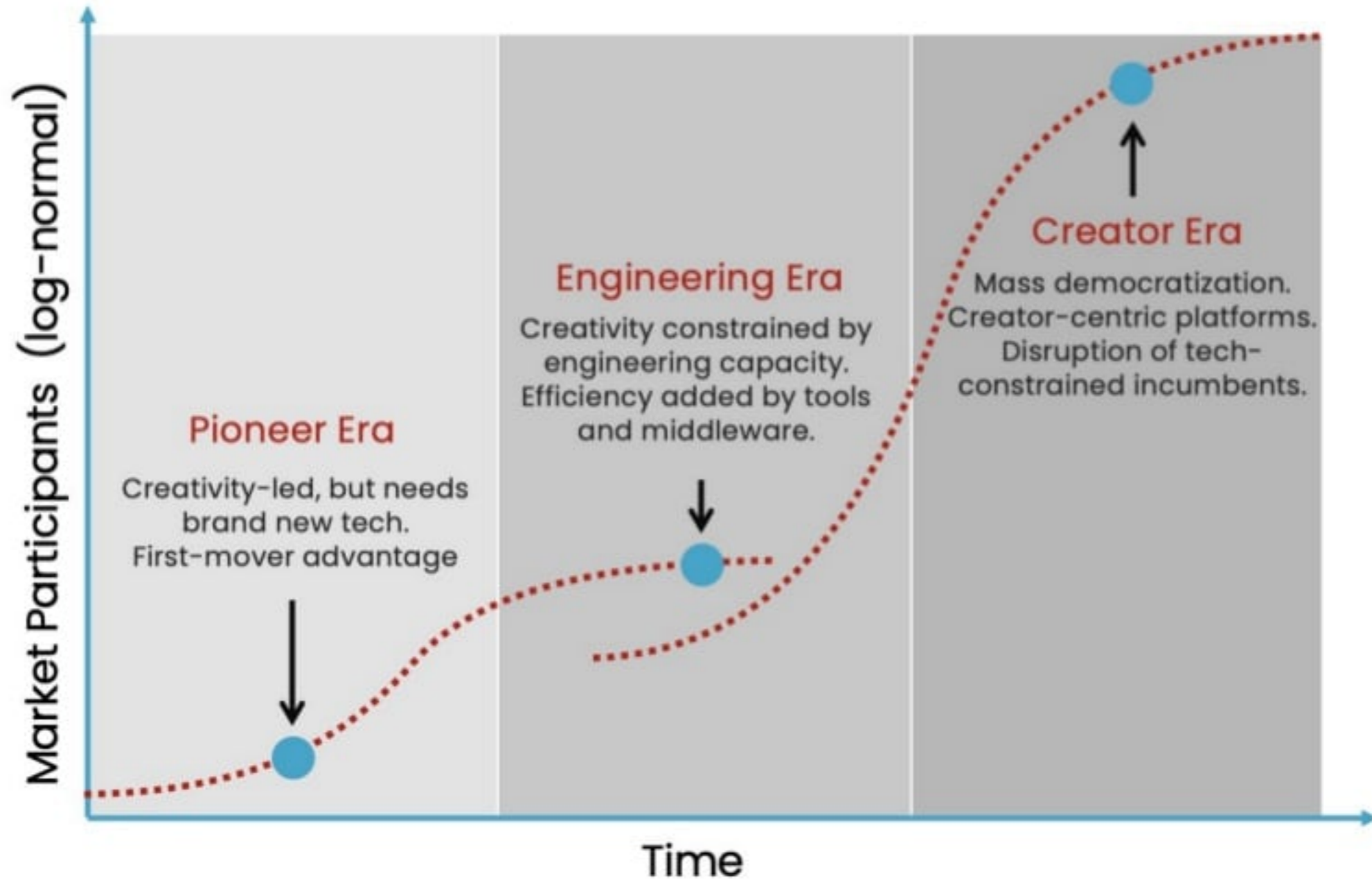
Company Highlight: Unity

- Most widely-deployed 3D engine

- Monetize with an ad network that reaches billions of devices
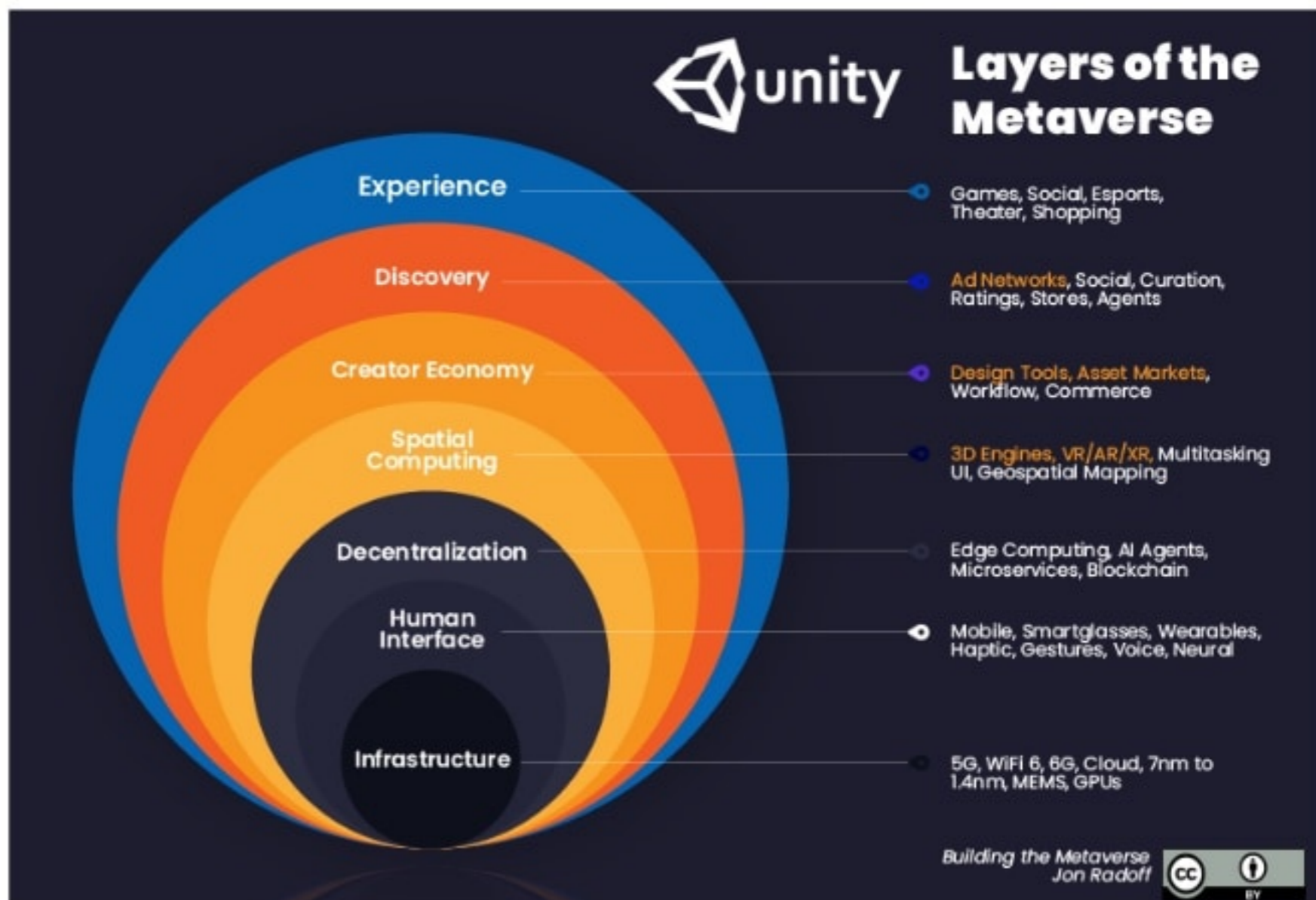
BEΛMABLE

- Mission: make it as easy to build a live game as it is in Roblox—but with the freedom to do build, sell and distribute it however you want.

- The company I started to bring serverless, low-code development to the world of live games
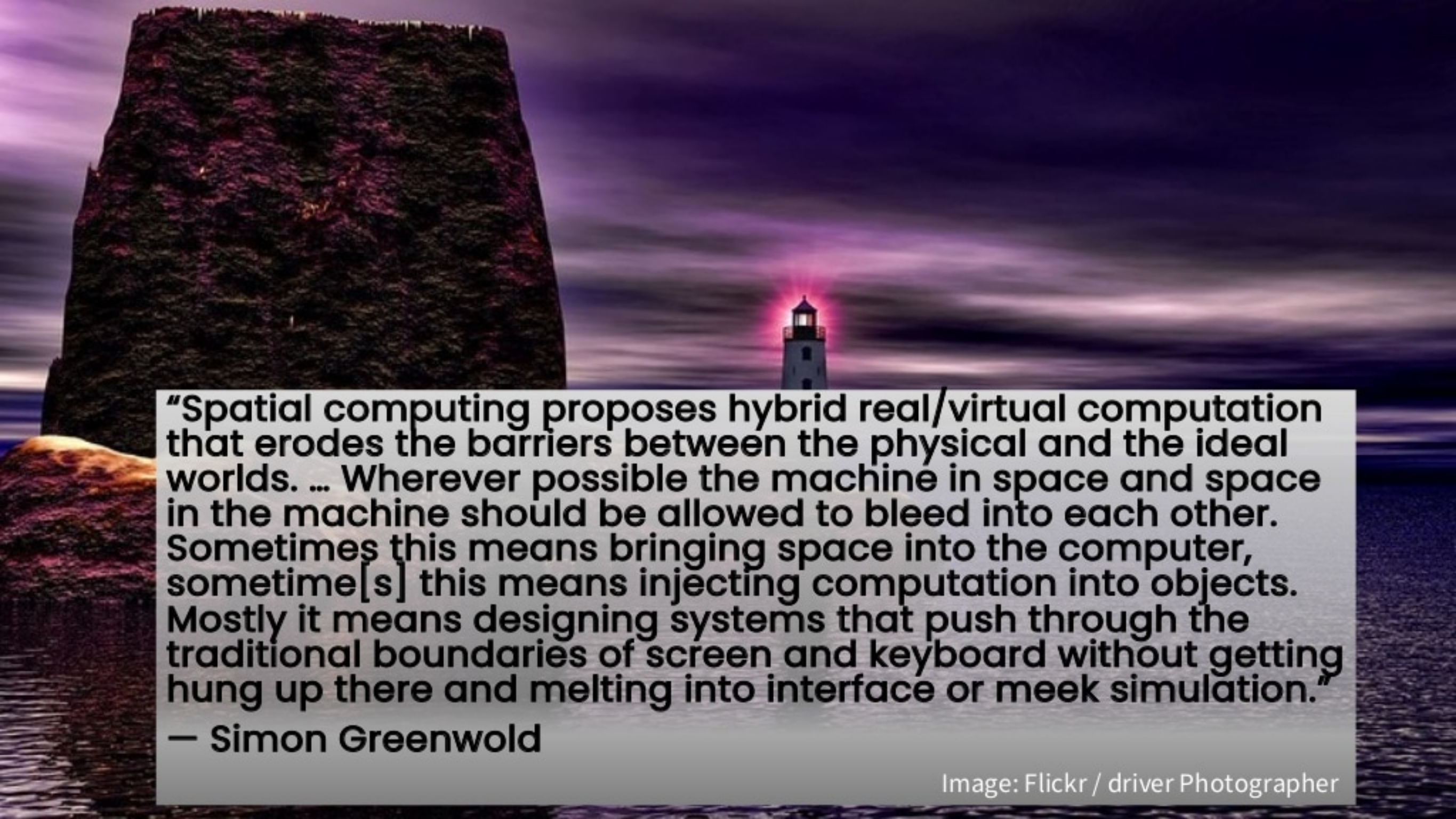
LAYER 4

SPATIAL COMPUTING

Image: John Moeses Bauan

"Spatial computing proposes hybrid real/virtual computation that erodes the barriers between the physical and the ideal worlds. ... Wherever possible the machine in space and space in the machine should be allowed to bleed into each other. Sometimes this means bringing space into the computer, sometime[s] this means injecting computation into objects. Mostly it means designing systems that push through the traditional boundaries of screen and keyboard without getting hung up there and melting into interface or meek simulation."

— Simon Greenwold

Spatial Computing

3D Engines to display geometry animation (Unity, Unreal)

Mapping and interpreting the inside and outside world — geospatial mapping

Data integration from devices (Internet of Things, Internet of Everything) and biometrics from people (for identification purposes as well as quantified self applications in health/fitness)

Next-generation user interfaces to support concurrent information streams and analysis

3D Engines

Create a graphics pipeline for developing 3D environments, and provide an environment for translating geometry into images on the screen

Geospatial Integration

Mapping the world, its data
and traffic and and unifying it
with real-time applications

Omniverse provides a way for creators of all types to collaborate in an interoperable 3D environment.
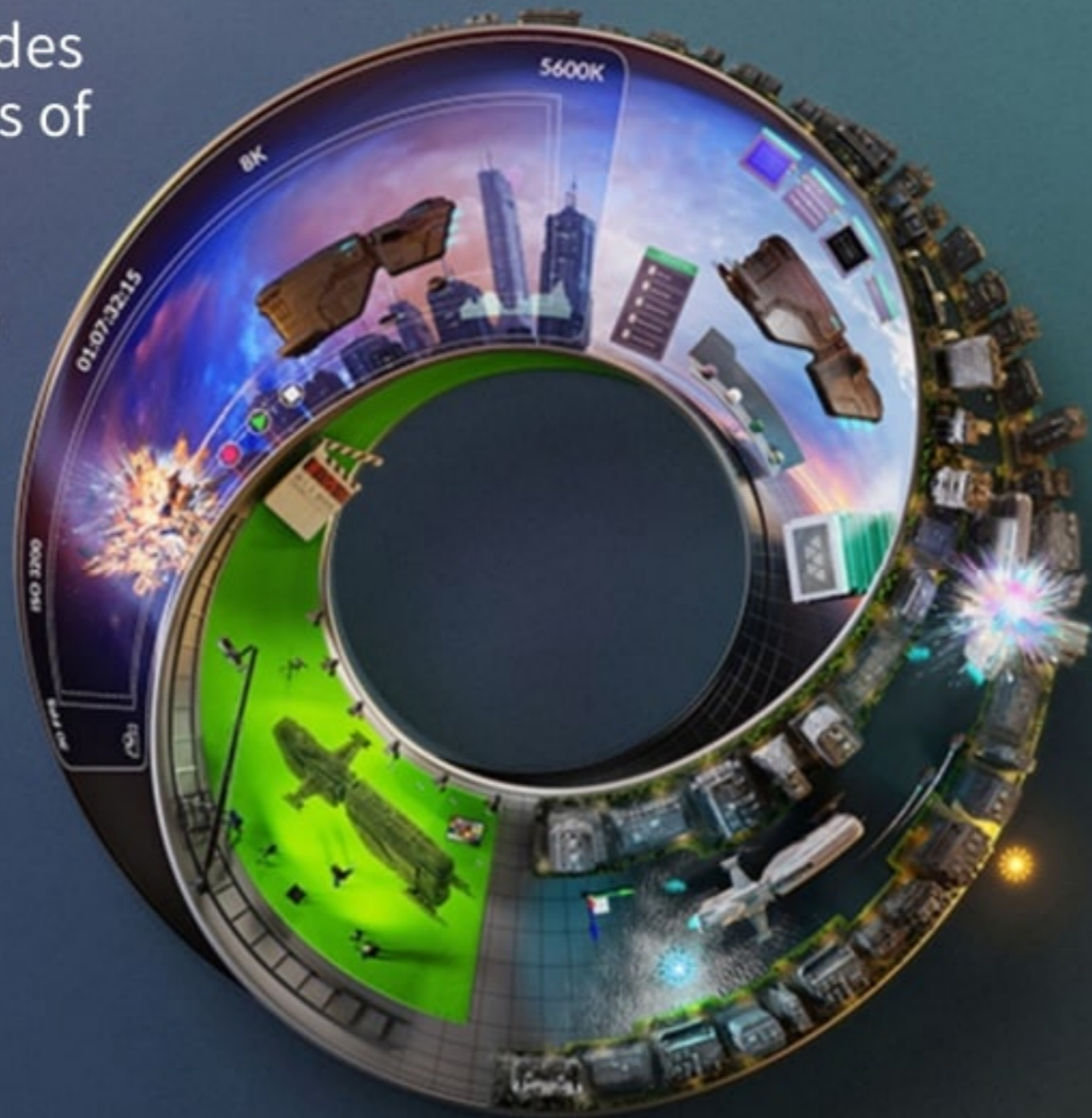
LAYER 5

DECENTRALIZE

Image: Alina Grubnyak

Decentralization

OASIS from *Ready Player One*

Neal Stephenson, author of *Snow Crash*

The ideal structure of the metaverse is the *opposite* of the centralized structure envisioned in fiction like *Ready Player* One or *Snow Crash*:

- Permissionless

- Distributed

- Open

- No central authority to control it

More than Blockchains

Smart Contracts

Open Source and Open Platforms

Self-sovereign digital identity

Emergent versus Constrained Network Growth

Hub & Spoke

No 2nd-Order Nodes
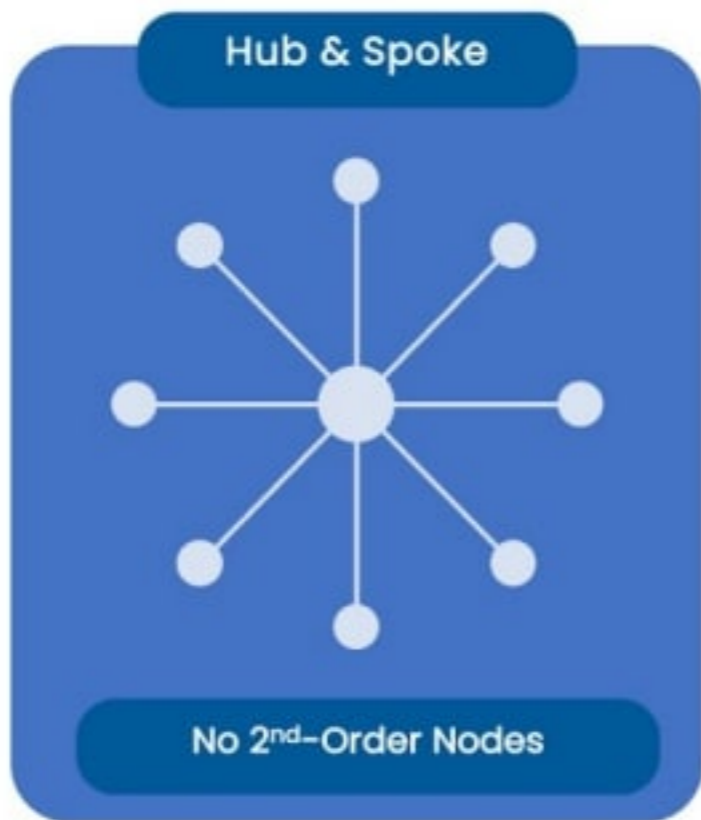
Walled-garden ecosystems; traditional finance; many platforms with API keys where exchanges are only with the central authority

Scale-Free Network

2nd, 3rd ... Nth order nodes

Open Source software development, Wikipedia, social networks, Smart Contract Blockchains

Network Effects Amplify When Group Formation is Easy

Metcalfe's Law

$$V=n^2$$
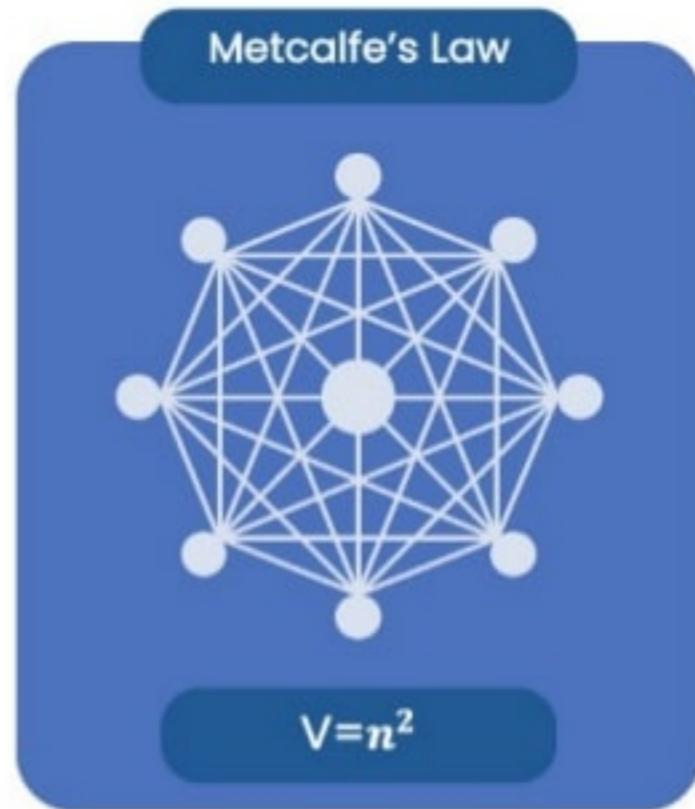
Network value increases exponentially with an increasing number of devices on the network.

Reed's Law

$$V=2^n$$
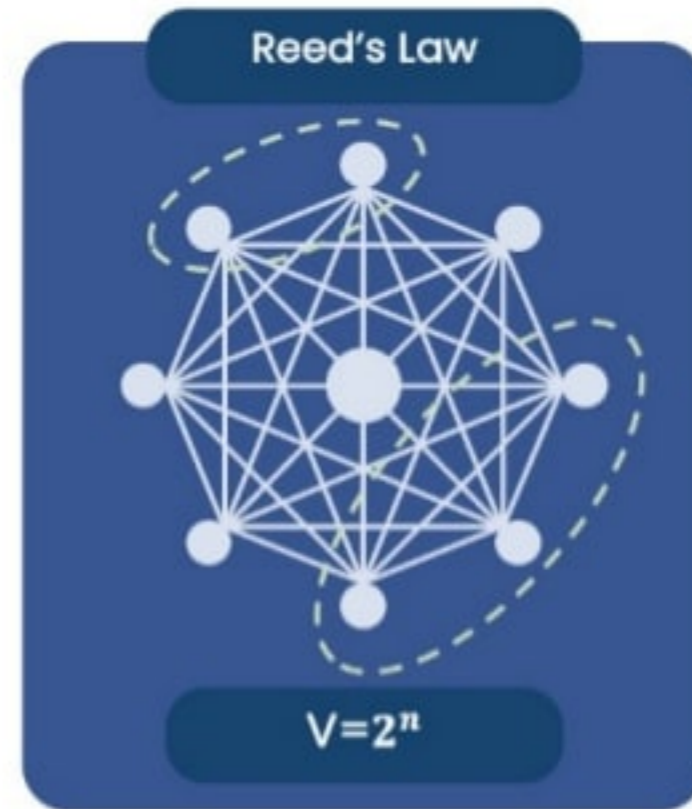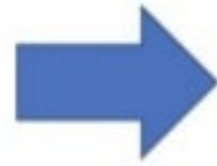
Social networks, messaging apps: network value increases even more than Metcalfe's as subgroups become easier to form.

Internalized vs. Externalized Network Effects

Metaverse experiences will be highly differentiated.

They benefit from networks where the platform favors an ecosystem of open, permissionless development—and benefit from externalized network effects.
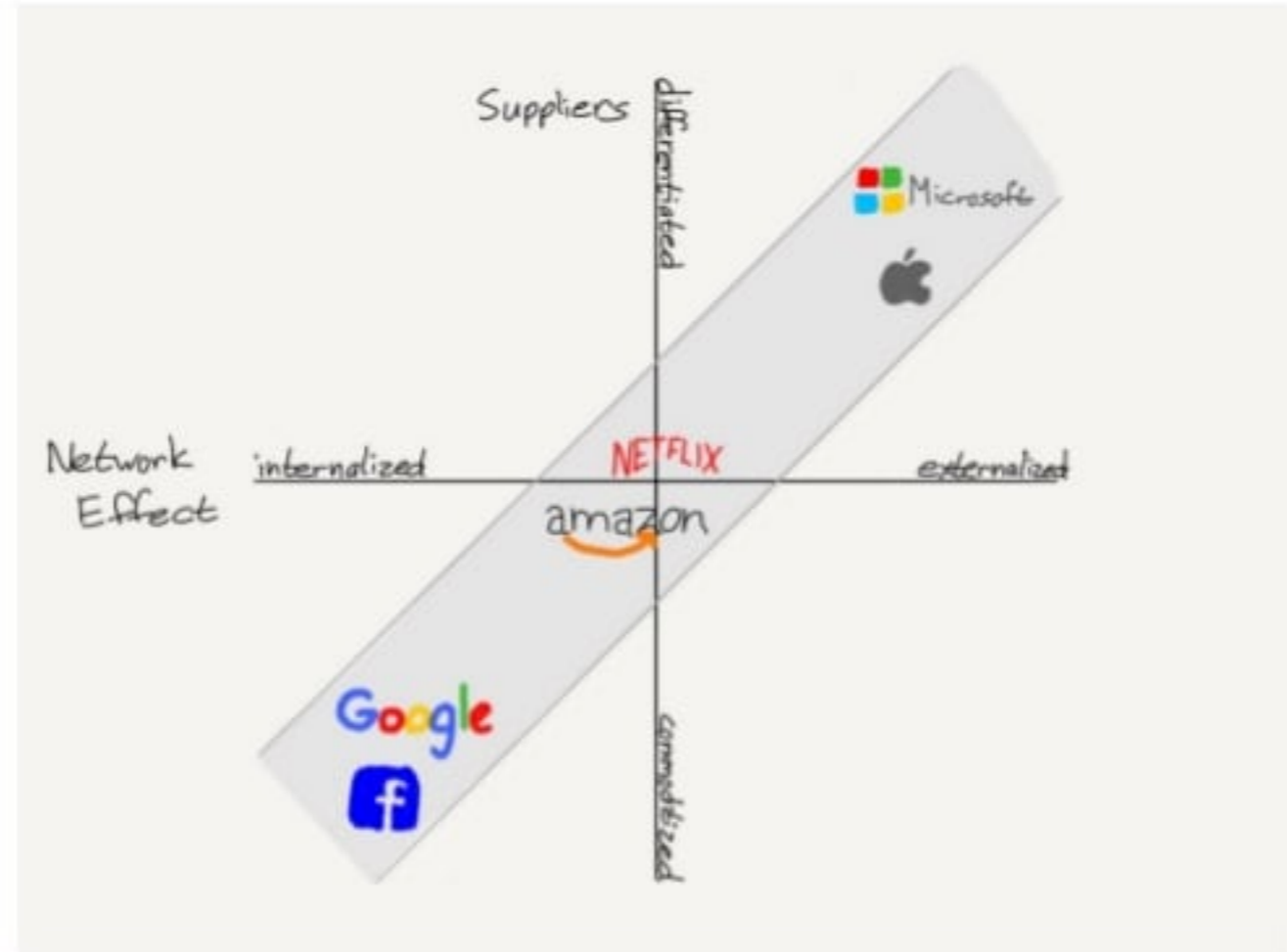
Image: Stratechery.com

Decentralized Digital Identity

Avatar Platforms
Creating interoperable 3D avatars and costume customization

Crucible   WOLF3D

Self-Sovereign Identity
Identification to apps and games in the metaverse based on a wallet rather than an authority

ION   evernym

Radoff's Law

The degree to which a network facilitates interconnections determines the extent of its emergent creativity, innovation and wealth.

Image: Robynne Hu

Highlight: Blockchains for NFT games

Blockchain options for NFT-Powered Games

| Name	Type of Blockchain	Example Games	Transactions Per Second	Fees	Marketplaces	Availability
ethereum	Proof of Work	Cryptokitties, Influenceth	25	$16/txn	OpenSea, Rarible, etc.	Now
ethereum 2.0	Proof of Stake	None yet	100,000	Low?	Anything from Ethereum	Unknown (>1 year expected)
flow	Proprietary. Proof of Stake; separate consensus & compute	Cryptokitties-on-Flow	100	Low	Versus, OpenSea	Now
WAX	Proprietary. Proof of Stake.	Alien Worlds	5000	2% of NFT sales	Atomic Hub	Now
iMMUTABLE	Ethereum Layer-2. Proof of Stake (ZK-Rollup)	Gods Unchained	9000	"Zero gas fees:	Immutable X Marketplace; or export to any Ethereum marketplace	Now (must apply)
enjin	Ethereum. JumpNet: layer-2 PoA Efinity: Polkadot	Lost Relics, Age of Rust	Current: same as Ethereum. Efinity: 700	Same as Eth. Efinity: 2.5% market sales	Enjin Marketplace	Now. Efinity is expected later in 2021.
Algorand	"Pure Proof of Stake"	Blockchain Game Alliance member	46,000 TPS (expected)	Low	TBA	Now
THETA	Proof of Stake / Byzantine Fault Tol.	N/A – but growing eSports NFT minting	>1000 TPS	Low	Theta Marketplace	
Avalanche	Proof of Stake	Blockchain Game Alliance member	>4500 TPS	NFT minting costs "cents"	Polyient	Now
BINANCE	Proof of Staked-Authority private Ethereum-based	Battle Pets	>17	Pennies	Juggerworld (JPG-NFT)	Now
polygon Previously Matic Network	Ethereum Layer-2	Battle Racers, 0xRacers, Decentraland	7,200 TPS	Low	OpenSea; or export to any Ethereum marketplace	Now

LAYER 6

HUMAN INTERFACE

Image: Vu Hoang

Mobile Computers

Smartphones are no longer phones. They are highly portable, always-connected, and powerful computers that happen to have a phone application preinstalled.

With further miniaturization, the right sensors, embedded AI technology, and low-latency access to powerful edge computing systems, they'll absorb more and more applications and experiences from the metaverse.
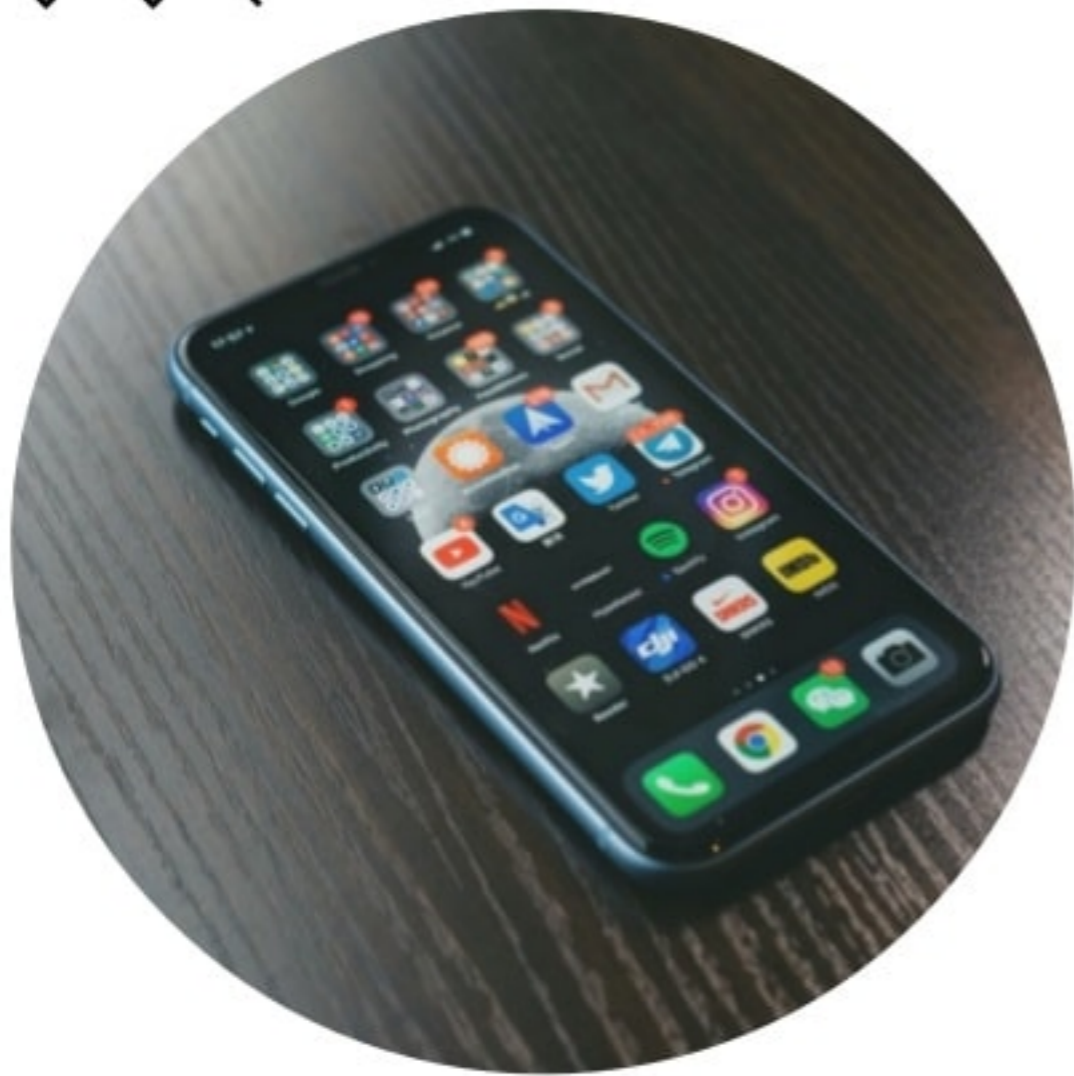
Evolution of Headset Technology

VR systems are essentially smartphones loaded up with stereoscopic video, extra sensors, cameras and haptics.
Image: XR Expo

Future interfaces like these Spectacles from Snap will be much simpler form-factors.

Mindbending Interface Tech

- Brain-Computer Interfaces (both non-invasive and invasive)
- 3D-printed wearables
- Miniaturized biosensors
- Smart contact lenses

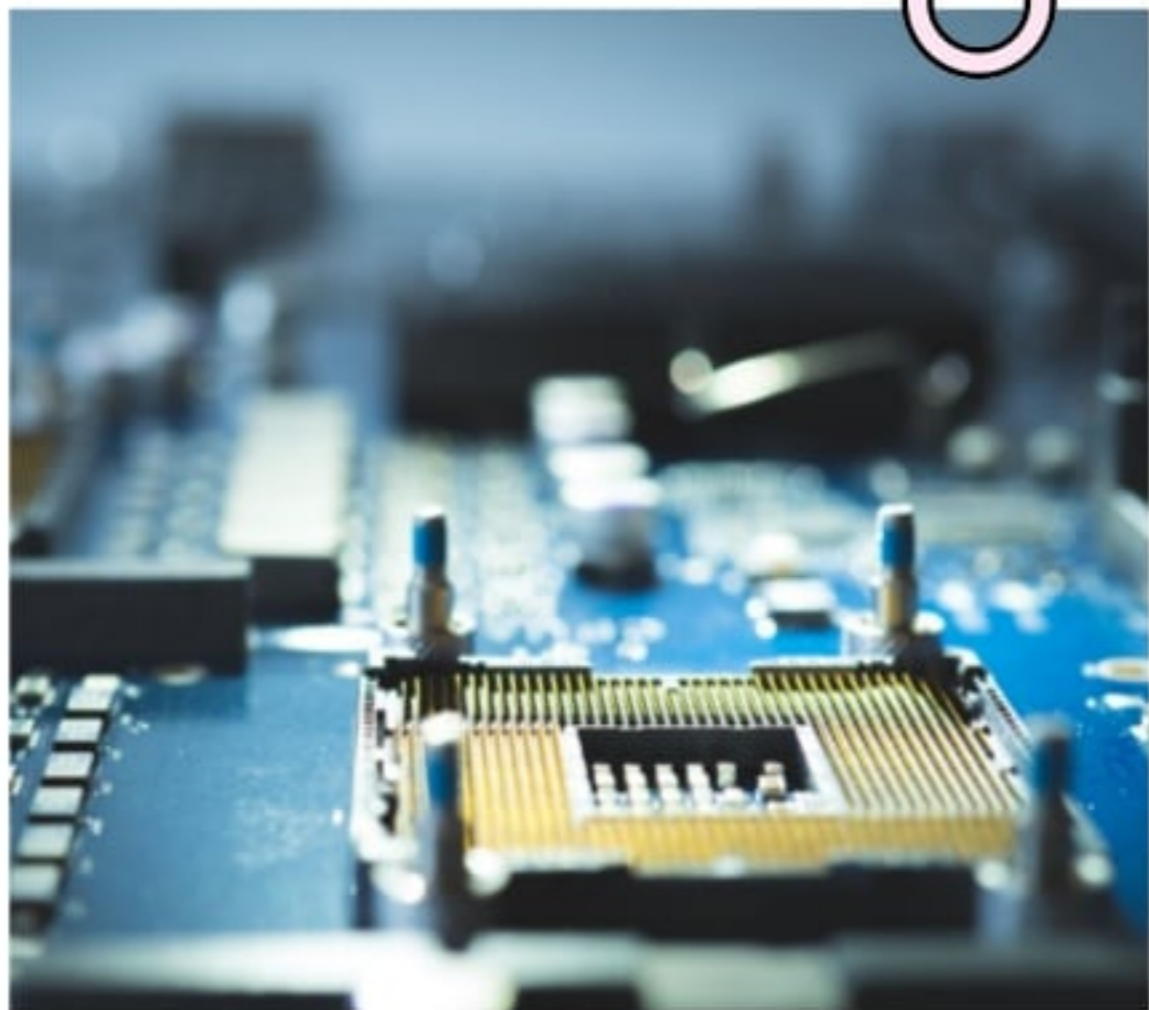*In May 2021, a BCI reached 90 words-per-second for a typing task.*
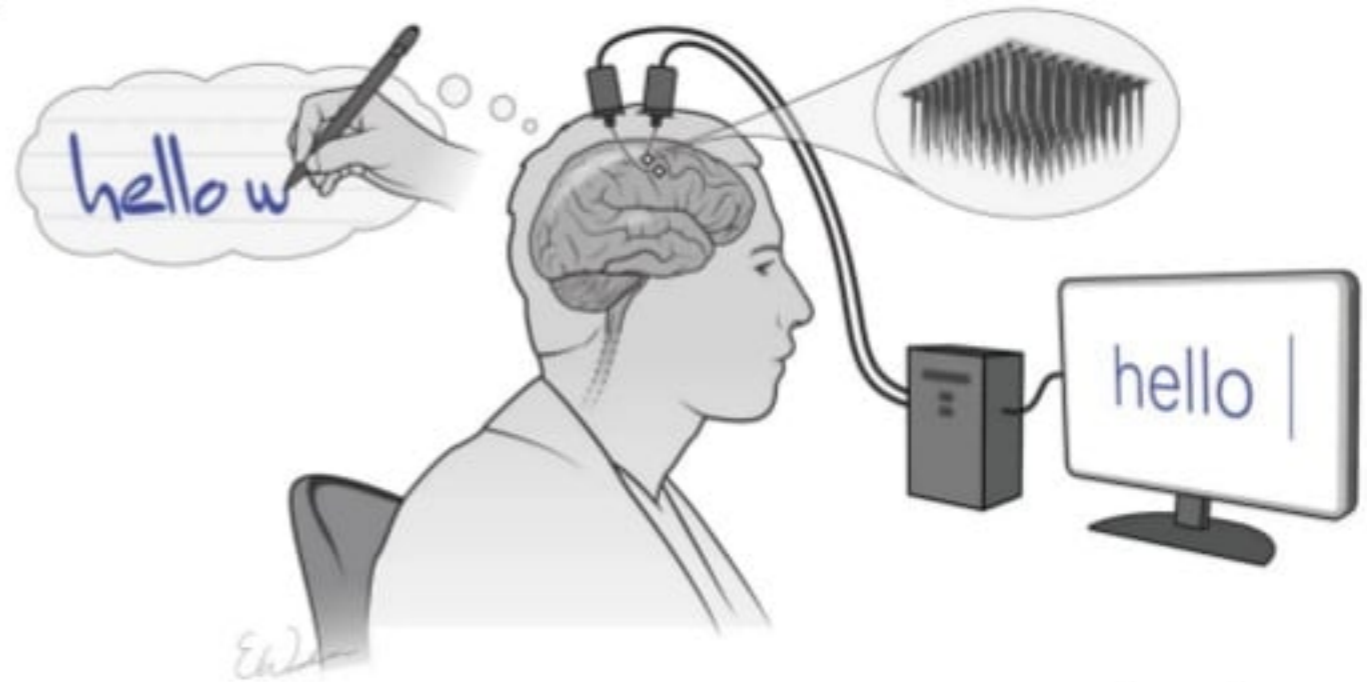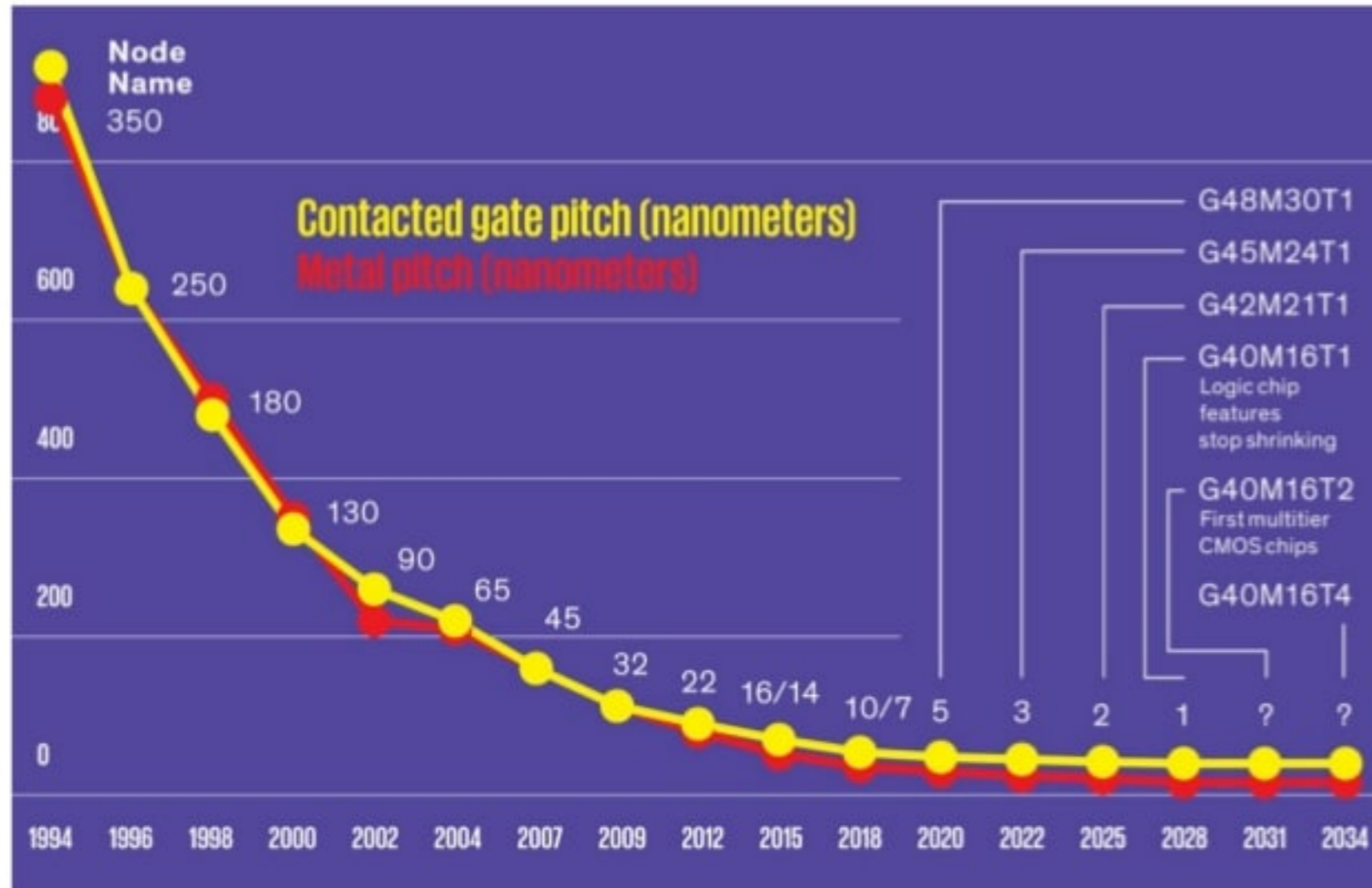
Erika Woodrum/HHMI/Nature
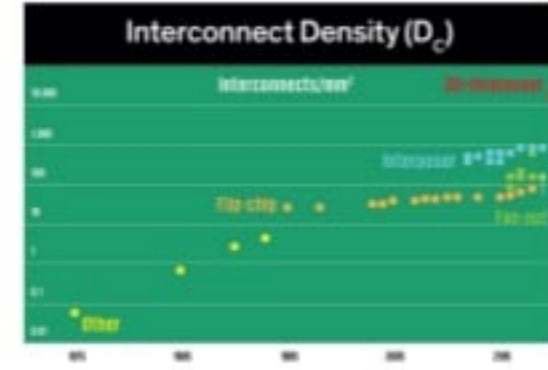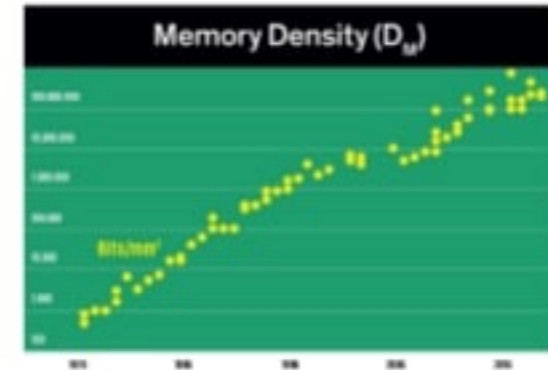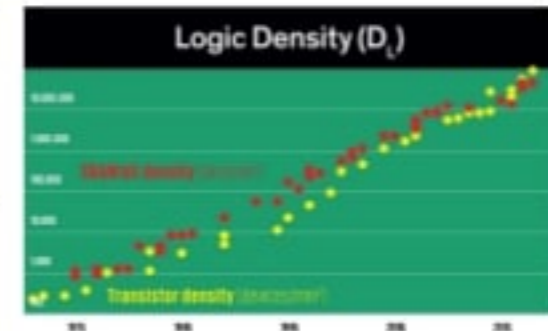
LAYER 7

INFRASTRUCTURE

Metaverse Infrastructure

- Enables our devices
- Connects them to the network
- Delivers content and computing power

Chips still getting faster & denser

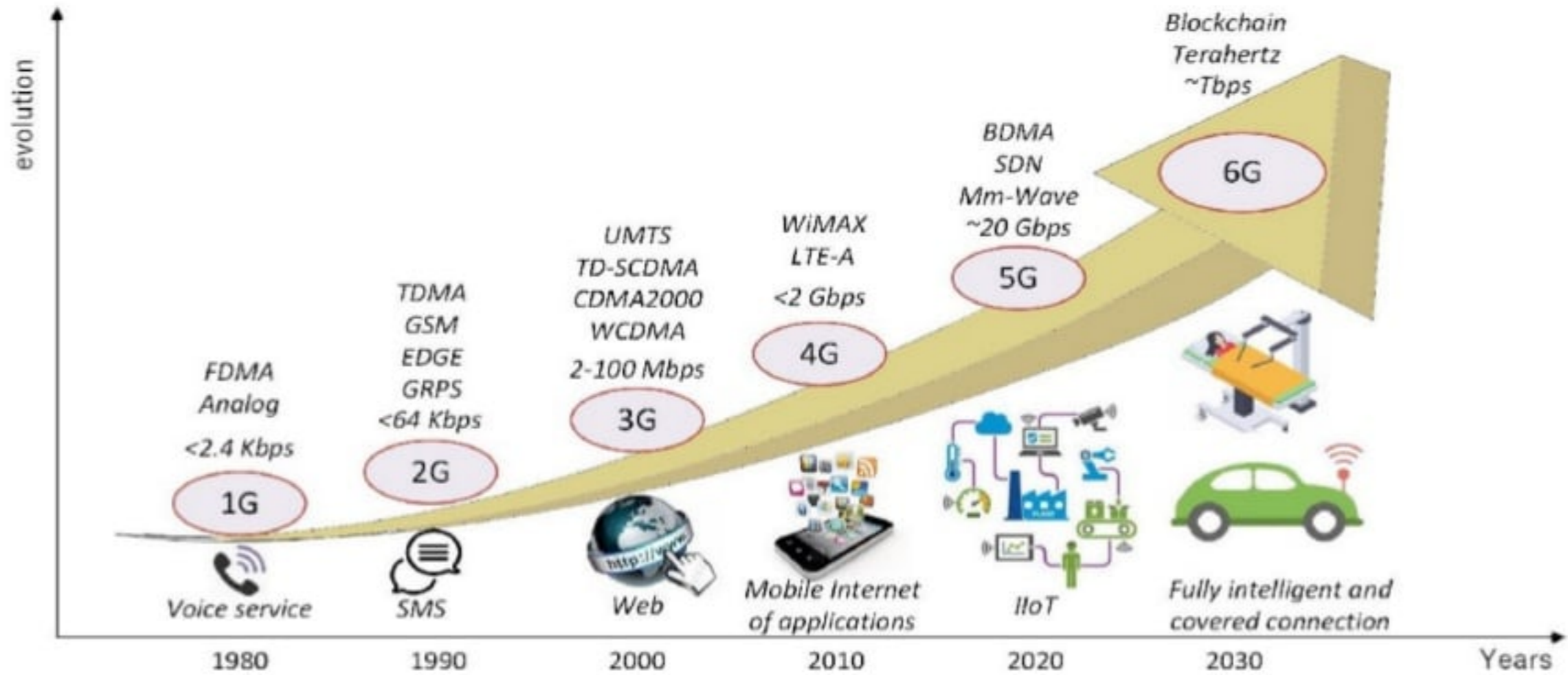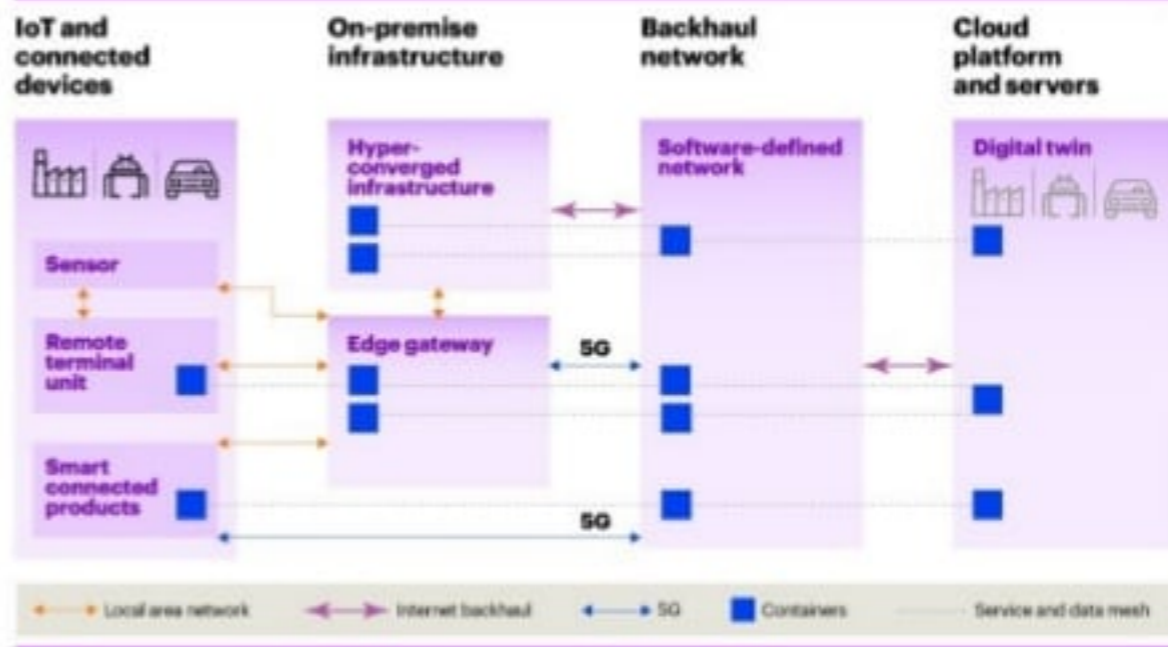IEEE, *A Better Way to Measure Progress in Semiconductors*

4G to 5G to 6G

IEEE, *A Survey on Green 6G Network: Architecture and Technologies*

Evolution of Cloud to Edge Computing

Cloud computing will get more distributed and closer to the edge where AI and data-hungry applications of the metaverse need it.

Visualizing the new compute continuum, from cloud to edge

IoT and connected devices	On-premise infrastructure	Backhaul network	Cloud platform and servers
	Hyper-converged infrastructure	Software-defined network	Digital twin
Sensor			
Remote terminal unit	Edge gateway	5G	
Smart connected products		5G	

Local area network · Internet backhaul · 5G · Containers · Service and data mesh

Source: Accenture

The metaverse is not "a" metaverse. It is the next generation of the Internet: a decentralized multiverse, led by a new and abundant generation of creators.

Thank you

Contact: Jon Radoff

More to read at:
Building the Metaverse blog –
https://medium.com/building-the-metaverse

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"I Fight for the Game Maker"

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