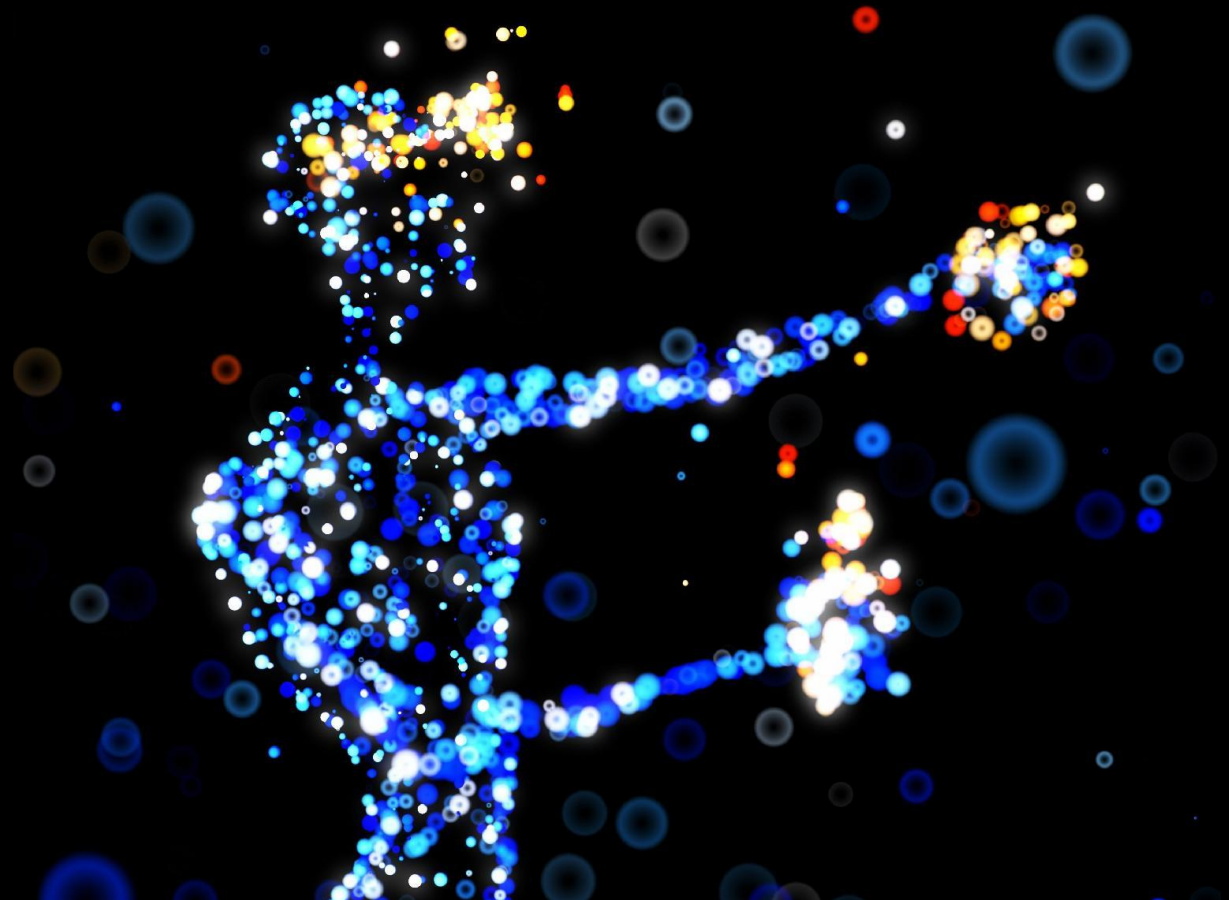


SISO Symposium at IT2EC 2022
London
25 April 2022

Metaverse Developments, Technologies, and Standards - Towards a Military Metaverse?

Andy Fawkes
FIMechE



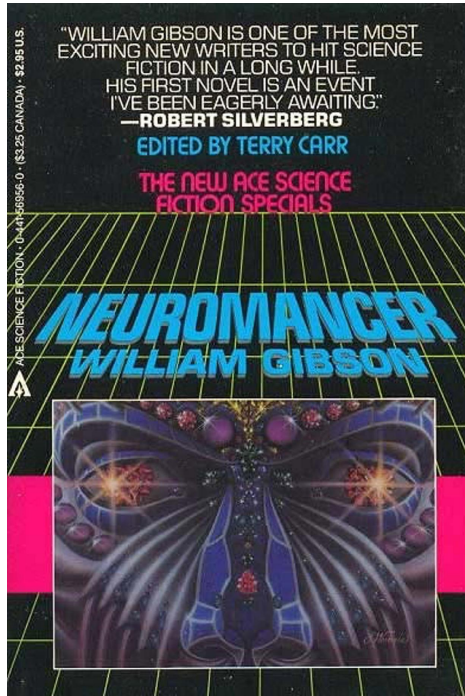
Outline

- **What is the Metaverse and why is it of interest?**
- **Metaverse Developments and Technologies**
- **Metaverse Standards**
- **Towards a Military Metaverse?**

What is the Metaverse and Why is it of Interest?

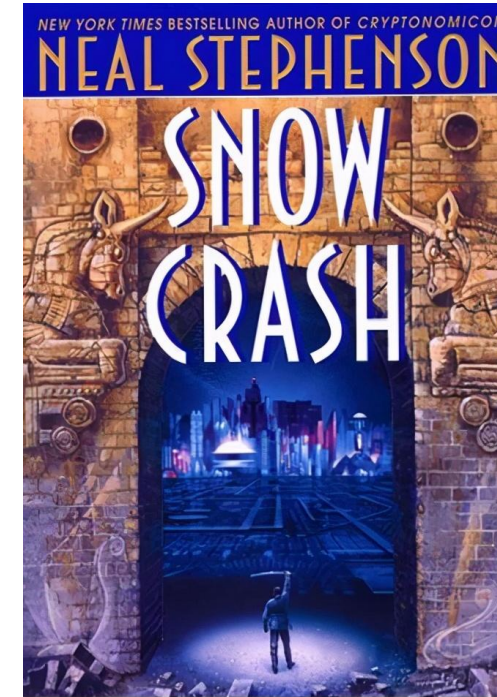
Some Historical Context ...

1984

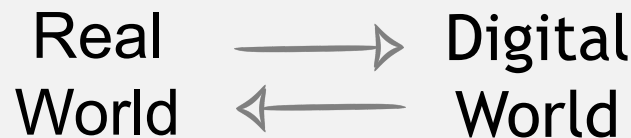


Created by Gibson, the word “**Cyberspace**” is popularised and “*had no real semantic meaning*” a “*mass consensual hallucination*” in computer networks

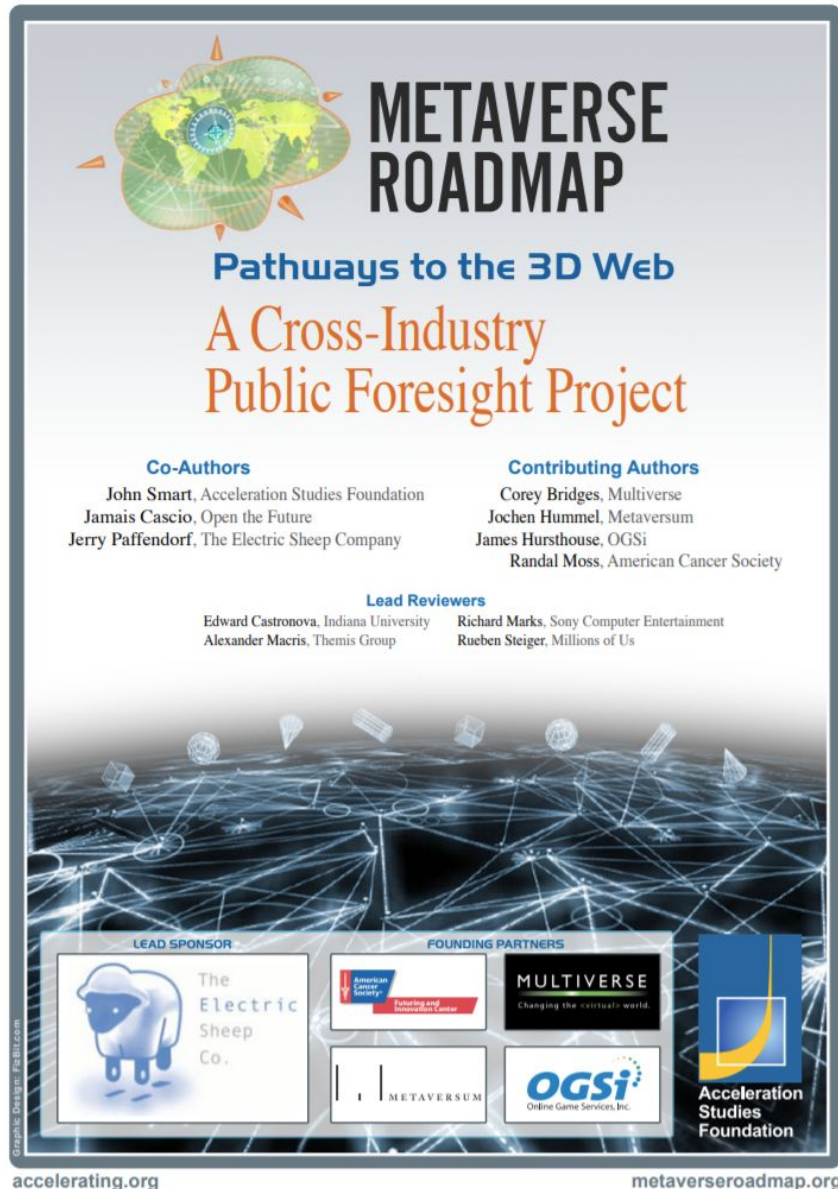
1992



Stephenson creates the word “**Metaverse**”, a portmanteau of "meta" (meaning beyond) and “universe”
“ ... a computer-generated universe ...”



Some More History - 2007



“In sum, for the best view of the changes ahead, we suggest thinking of the Metaverse not as virtual space but as the **junction or nexus of our physical and virtual worlds.**”

Some Contemporary Metaverse Descriptions ...

“A concept of a future iteration of the Internet, made up of persistent, shared, 3D virtual spaces linked into a perceived virtual universe”

Wikipedia



“The metaverse is a seamless convergence of our physical and digital lives, creating a unified, virtual community where we can work, play, relax, transact and socialize.’

J.P.Morgan

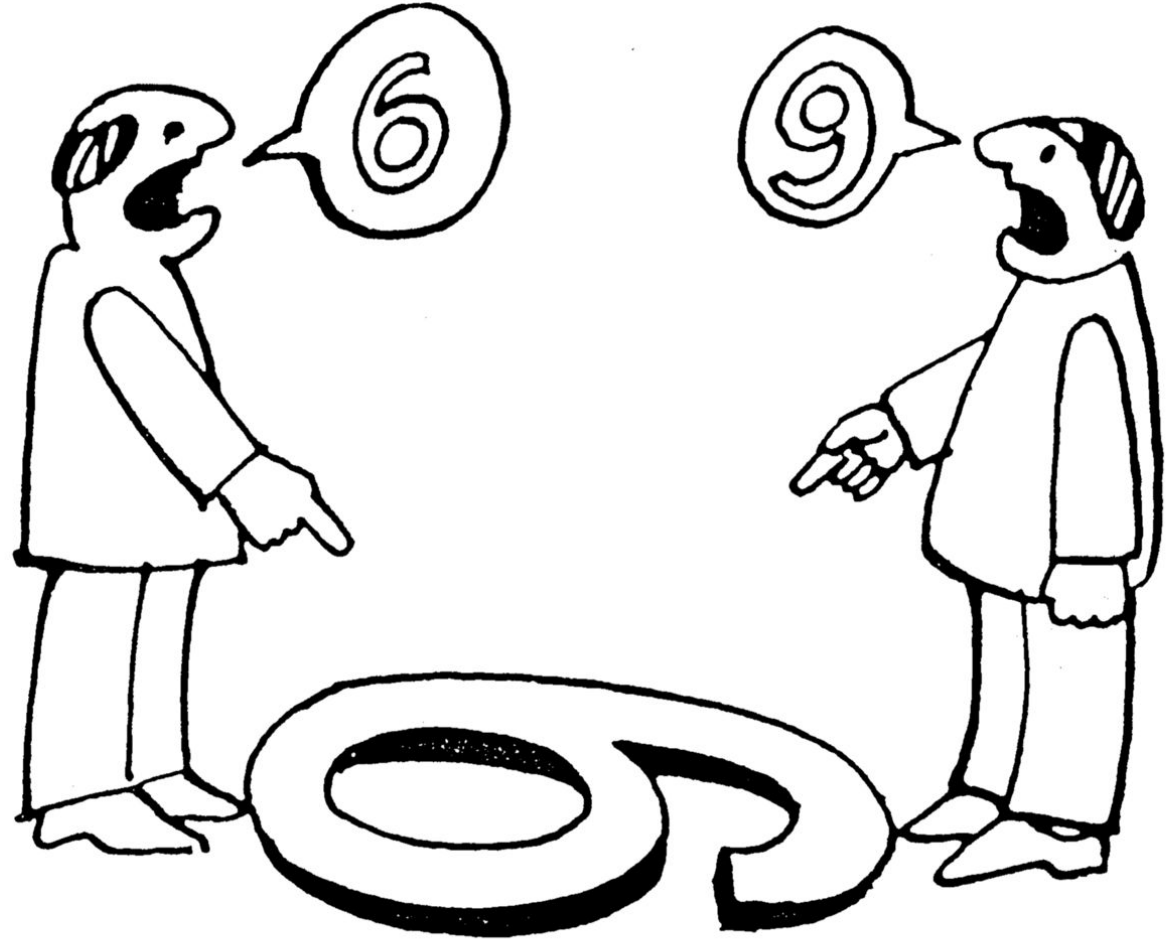
“Opportunities in the Metaverse” 2022

“The metaverse enables us to embed computing into the real world and to embed the real world into computing ...”

Satya Nadella, CEO Microsoft, Microsoft Ignite Nov 2021

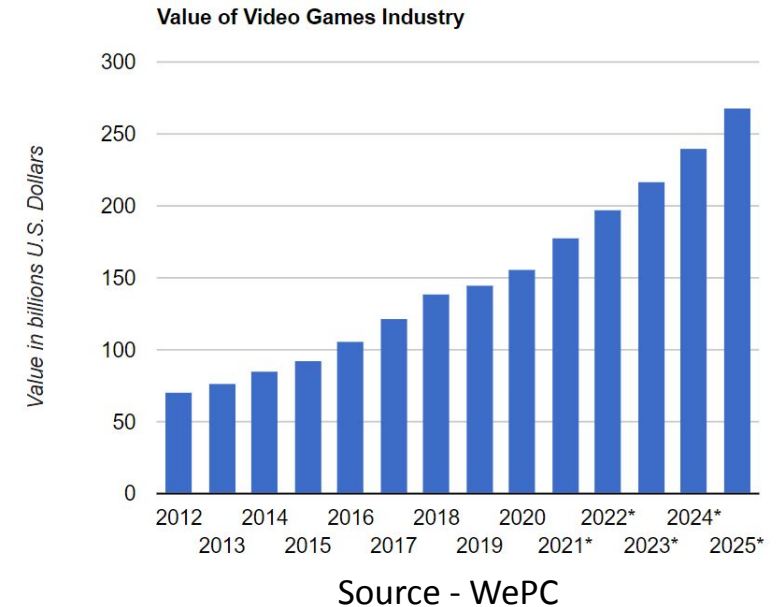


Different Perspectives



What is Different Now?

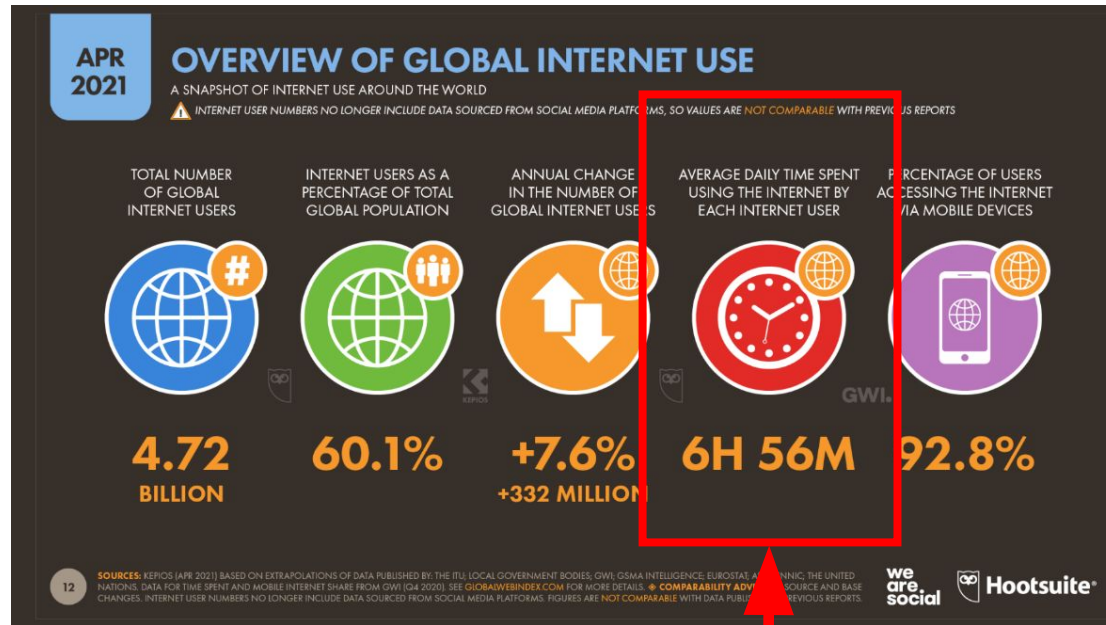
- **Computing Power and Availability**
- **Network Capacity and Reach**
- **Data Storage and Discoverability**
- **XR (VR/MR/AR)**
- **Ubiquitous Gaming**
- **Investment by Big Tech Companies, e.g.**
 - Microsoft
 - Nvidia
 - Meta/Facebook
- **The Pandemic**



The (2D) Internet & Gaming Now Dominate our Waking Lives ...

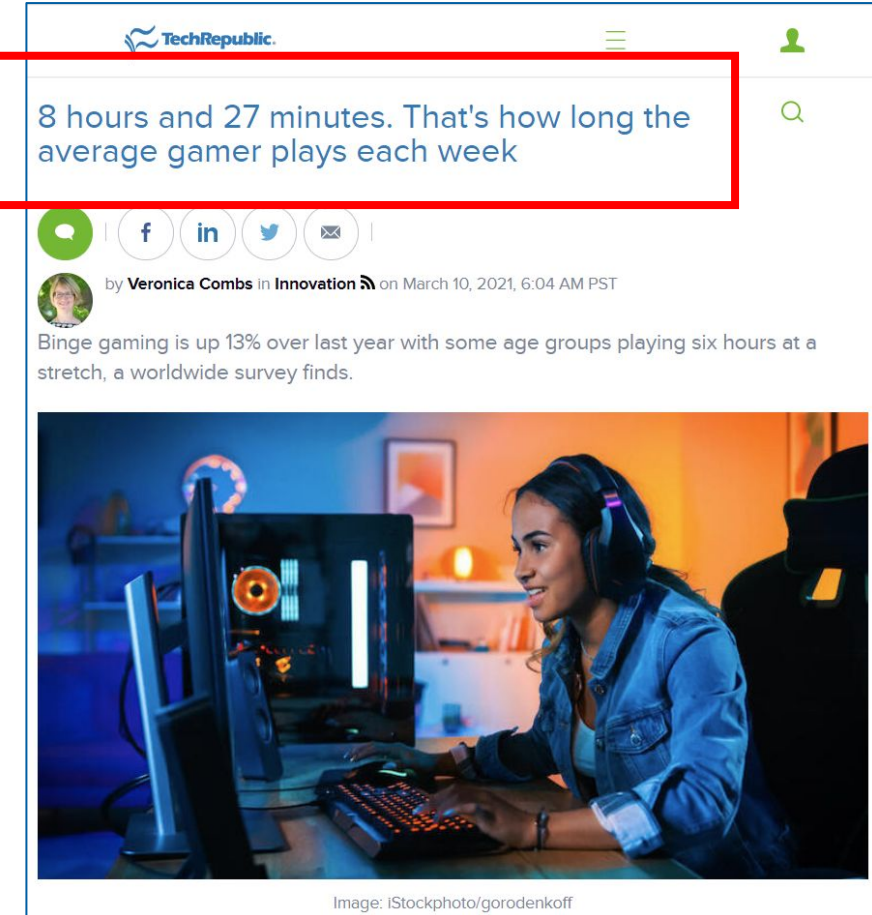
Gaming
>1 hr/day

8 hours and 27 minutes. That's how long the average gamer plays each week



<https://datareportal.com/reports/digital-2021-april-global-statshot>

Internet
7 hrs/day



Science Fiction?

Are we already
living in a
(2D) Metaverse?

Or alternatively, a
Hybrid-verse or
Proto-Metaverse?

Some Common Metaverse and Defence M&S Themes

- **Interoperability**
- **Digital Asset ownership**
- **Security**
- **Networking**
- **Computing**
- **XR/Human-Computing Interfaces**
- **AI**
- **Data & Analytics**
- **User engagement/experience**
- **Community**

Metaverse Big Picture

A Convergence of Technologies & Human Behaviours



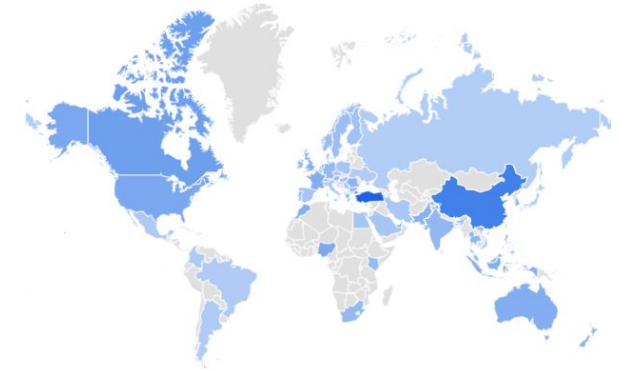
Metaverse Developments and Technologies

Google Trends “Metaverse”

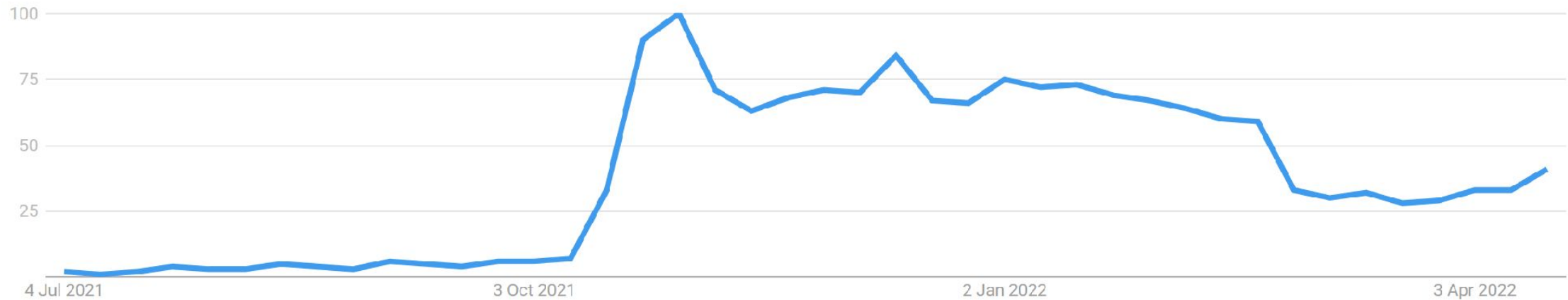


Facebook changes company name to Meta – 28 Oct 21

Interest by region ?



Interest over time ?



Still in the headlines ...



HOME FOOTBALL TV SHOWBIZ FABULOUS SPORT **NEWS** MONEY HEALTH



EXCLUSIVE

News > US News

BATTLEFIELD METAVERSE Inside new military race to dominate the metaverse as US and China prepare for cyber warfare

Christopher Eberhart
21:55, 19 Apr 2022 | Updated: 21:56, 19 Apr 2022



A TECH race to build the most sophisticated and expansive metaverse could establish the next world power and change the future of war.



Newsletters

Bitcoin
\$39,549.13 -2.06%

Crypto Prices →

Top Assets →

Business

Limitless Launches 'Metaverse as a Service,' Plans \$60M Venture Fund

The company behind the Next Earth metaverse is ramping up plans for ecosystem development.

By Brandy Betz · Apr 21, 2022 at 1:09 p.m. GMT
Updated Apr 21, 2022 at 7:26 p.m. GMT



(Waldemar Brandt/Unsplash)

The Next Earth metaverse platform has created a replica of the earth with about 5 trillion tiles and minted [non-fungible tokens](#).



JANUARY 12, 2022

Why the Military Needs a Metaverse - ATARS, the Gateway into the Military Metaverse

KRIS KOLO · FEATURED

Who is Red 6 and Why?

In response to a national security crisis in military flight training that represents an annual \$24B Total Addressable Market, Red 6 developed ATARS (Airborne Tactical Augmented Reality System). ATARS represents a technological breakthrough that for the first time offers a wide field-of-view, full color demonstrable augmented reality solution that works in dynamic outdoor environments.



Red 6's Technology is the First and Only to put virtual airplanes into the real world. Real pilots in real airplanes, flying against synthetic enemies, brought into a digital AR world, up in the sky. This negates the need for the military to

Contemporary “Proto-Metaverse” Developments

- **Microsoft**

- Mesh - a collaboration and communications platform supporting virtual collaboration across multiple devices and the Microsoft Metaverse Apps Stack

- **Nvidia**

- Omniverse™ a scalable, real-time reference development platform for 3D simulation and design collaboration and CloudXR™ delivers XR across 5G and Wi-Fi networks

- **Varjo** Reality Cloud – “Teleport VR”

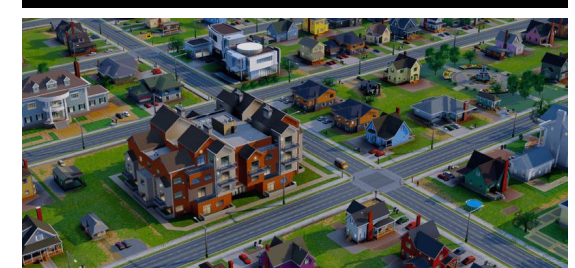
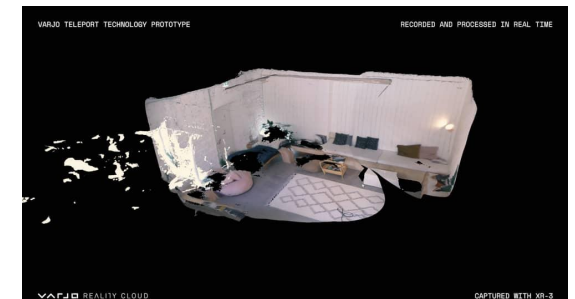
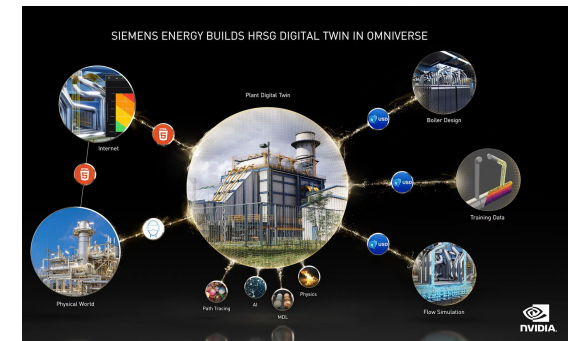
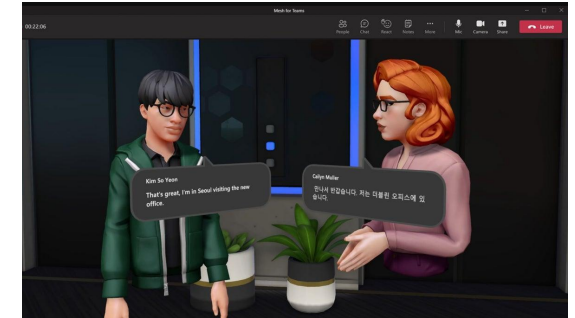
- **Meta Quest 2** HMDs reportedly sold >10m (> sales than Xbox consoles in 2021)

- **Epic Games** Unreal – supports mobile, XR, through to flight sim domes (CAE)

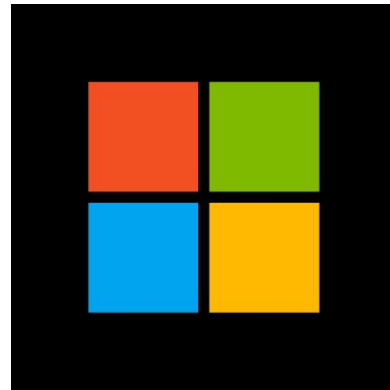
- **Roblox** - 164m monthly active users, creating and playing 3D games, played by >50% US children (<16) in 2020

- **Second Life** – launched 2003, a persistent 3D virtual world (GDP \$650m (2022))

- **Decentraland** - open source 3D virtual world platform with NFT-based land ownership (opened Feb 2020)



Tools are Already Out There



Microsoft metaverse technology stack

Microsoft Mesh & HoloLens

Enable anyone across the planet to collaborate in mixed reality environments.

Microsoft Power Platform

Empower anyone within your organization to interact with and act on the data flowing through your environment. Build applications, dashboards, and intelligent chatbots that modernize workflows.

Azure AI & Autonomous Systems

Azure AI delivers breakthrough insights into all your data. Microsoft Project Bonsai provides a low-code approach to machine teaching and creating intelligent autonomous systems that learn and improve over time.

Azure Synapse Analytics

A comprehensive set of data services that work together to provide predictive analytics, the ability to analyze data across systems, and the ability to track the historical state of your environment.

Azure Maps

The location of things. Indoor private maps enable you to apply location and routing services to people and things in your private environment while keeping data locked down to your enterprise.

Azure Digital Twins

Simplify the creation of detailed, comprehensive digital models. Support for the Digital Twin Definition Language enables modeling of complex relationships between things and systems in your environment.

Azure IoT

Connect physical assets and run cloud intelligence directly on premises. Sense and monitor anything in your physical environment seamlessly and securely.

The physical world

Tools are Already Out There



Metaverse Related Technologies

Computing	Software	Networking & Security	Human-Computing Interfaces	Data & Digital Twins	AI, Data & Analytics	Automation & Robotics	Sensors	Standards
Quantum	Collaborative 3D Software	6G	eXtended Reality XR	Digital Twins	Personal tutors and guides	Everyday Robotics	Computer Vision	Open
Cloud	Games Engines	Free-space optical comms (FSO) & LiFi	Holographic Imaging	Personal Digital Twin	Natural Language Understanding	Telexistence	Volumetric Video	Industry/Proprietary
Edge	Web 3.0	Zero Trust Security	Haptics	Blockchain/Non-fungible Tokens (NFTs)	Auto/Machine Translation	“Metamobility” and “Mobility of Things”	IoT (Internet of Things)	
Spatial Computing			Wearables	Synthetic Data	Predictive Decision Support			
DNA Digital Data Storage			Human Augmentation		Video and audio optimisation			

Technologies are Maturing at Different Rates & With Different Relevancies to Defence

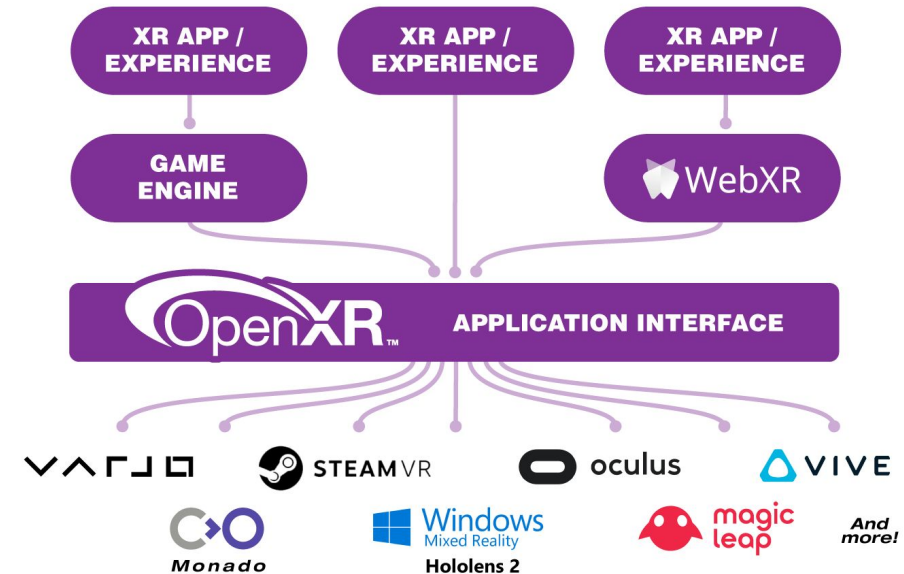
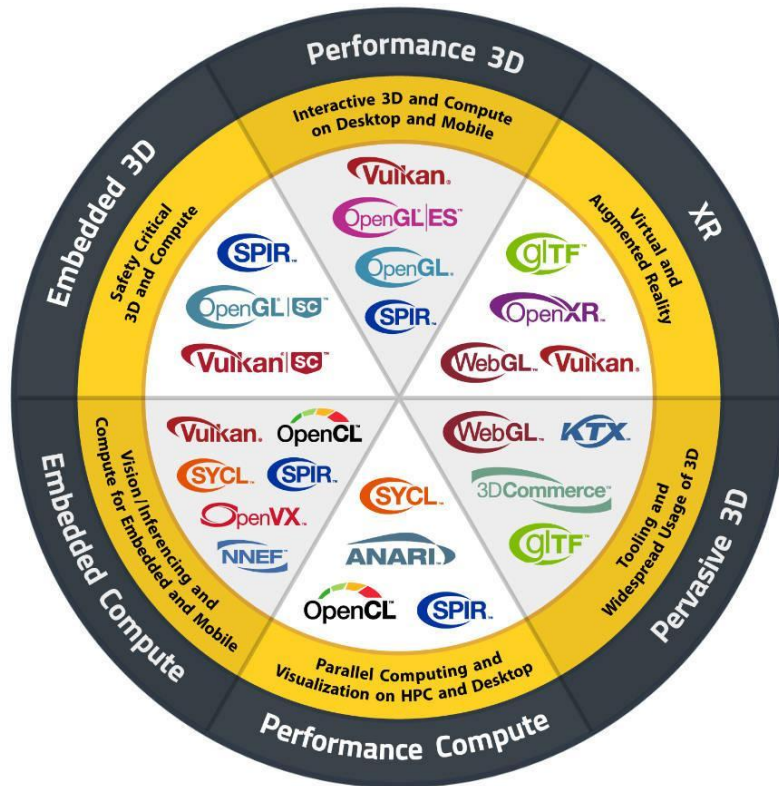


Metaverse Standards

The Khronos Group (Founded 2000)



Khronos Group Promoter
Members (150+ members)

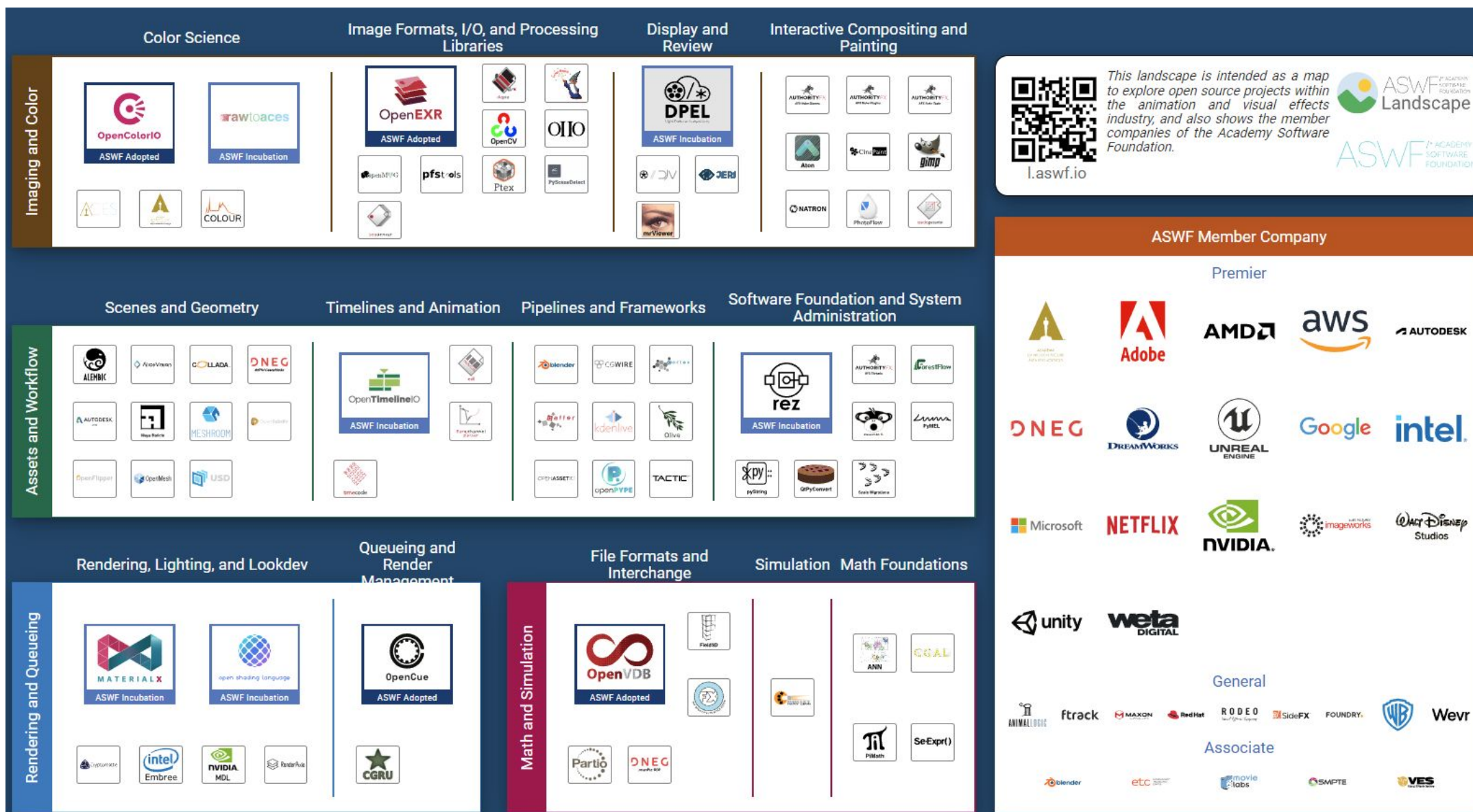


OpenXR provides a single cross-platform, high-performance API between applications and all conformant devices.

Khronos currently identifies six market segments relevant to developers with similar requirements

THE

ASWF's mission is to lower the barrier to entry for developing and using open source software



Other Standards Initiatives

- **Metaverse Interoperability Community Group** (part of the World Wide Web Consortium (W3C)) - Its mission is “to bridge virtual worlds by designing and promoting protocols for identity, social graphs, inventory, and more” (103 participants).
- **Open Metaverse Interoperability Group** - focused on bridging virtual worlds by designing and promoting protocols for identity, social graphs, inventory, and more.
- Nvidia’s Omniverse uses Disney’s Pixar open-source **Universal Scene Description** (USD) file format.
- **Epic Game’s Twinmotion** platform can be used to import models from BIM and CAD programs.
- The **Unity Distribution Portal** enables developers to create a single build of their app for distribution and management across all mobile app stores.
- **Cesium** is an open platform for exploiting 3D geospatial data using the 3D Tiles open standard.
- **Discord** allows developers to plug directly into their communications platform of 150m users.
- The **Digital Twin Consortium** comprises industry, government, and academia founded “to accelerate the development, adoption, interoperability, and security of digital twins and enabling technologies”.
- **MPEG-V** (2020) - Provides “an architecture and associated information representations to enable the interoperability between virtual worlds with the real world, e.g. sensors, vision.”

Fun Fact - In *Snow Crash*, the metaverse’s design is “fixed by a protocol, hammered out by the **Association for Computing Machinery's Global Multimedia Protocol Group**”



Towards a Military Metaverse?

A Defence Perspective on the Metaverse

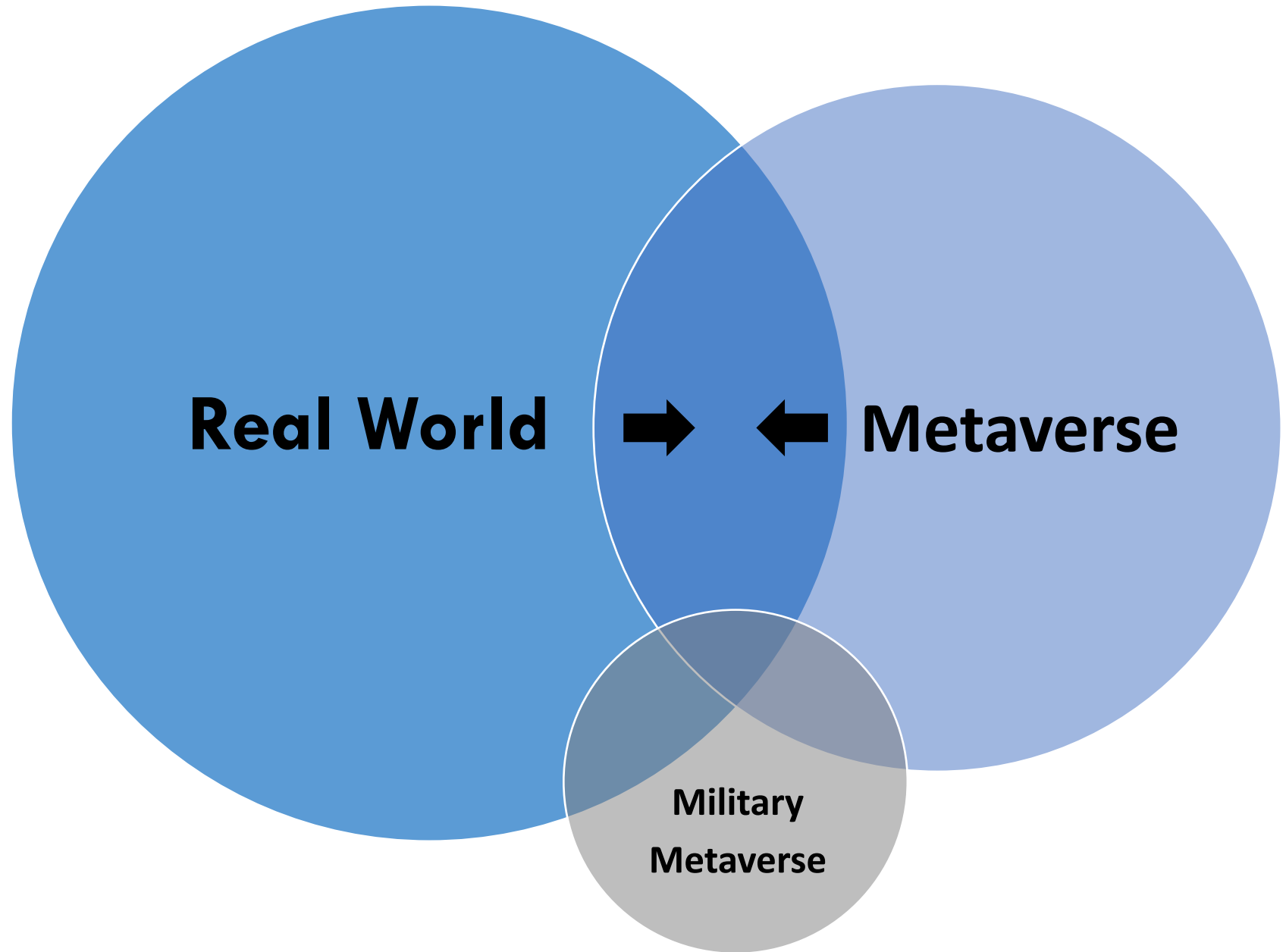
The concepts of virtual reality and avatars in a persistent virtual world(s) remain, however,

the metaverse can be considered now to also embrace a wider **convergence of technologies** of varying maturities that are **bringing the physical and digital worlds together** and

represents the next evolution of computing, a trend from 2D to 3D **interaction, presence and immersion** between humans, machines and the digital world.

The metaverse could be considered a long standing vision without a fixed roadmap to achieve it.

**Similar,
Separate &
Connected**



Metaverse v Military Metaverse Features Mapping

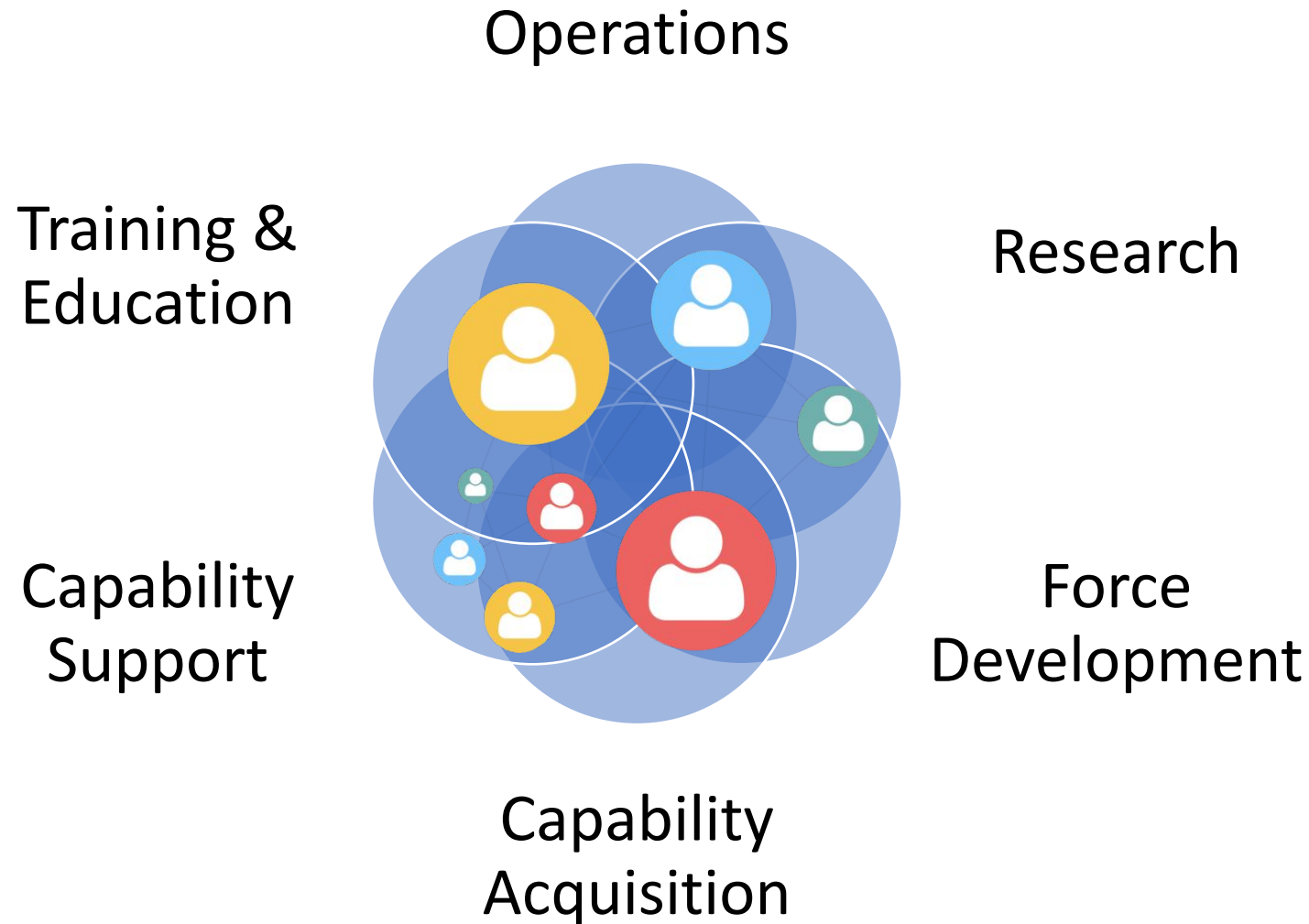
Matthew Ball	Jon Radoff	Lik-Hang Lee et al	Newzoo	Roblox	Microsoft	Nvidia	Military Metaverse
Hardware		Tech Enablers - Network	Metaverse Gateways - Centralised	Identity	Mesh & HoloLens	Omniverse Apps	Discovery
Networking	Experience	Tech Enablers - Edge/Cloud	Metaverse Gateways - Decentralised	Friends	Power Platform	Omniverse Platform	User Interfaces & Immersion
Compute	Discovery	Tech Enablers - Artificial Intelligence	Avatar & Identity	Immersive	Azure AI & Autonomous Systems	Artificial Intelligence	Robotics/Sensors/IoT
Virtual Platforms	Creator Economy	Tech Enablers - Computer Vision	User Interfaces & Immersion	Low Friction	Azure Analytics	Graphics	Data & Digital Twins
Interchange Tools and Standards	Spatial Computing	Tech Enablers - Blockchain	Economy	Variety	Azure Maps	Compute	Virtual Economy
Payments	Decentralization	Tech Enablers - Robotics/IoT	Sodal	Anywhere	Azure Digital Twins	RTX GPU	Content, Services, and Assets
Metaverse Content, Services, and Assets	Human Interface	Tech Enablers - User Interactivity	Play-to-Earn/Collect	Economy	Azure IoT		AI & Computer Vision
User Behaviours	Infrastructure	Tech Enablers - Extended Reality	Infrastructure - Cloud, Scalability & Hosting	Civility	Physical World		Interchange Tools and Standards
		Ecosystem - Avatar	Infrastructure - Visualisation & Digital				Network
		Ecosystem - Content Creation	Infrastructure - Artificial Intelligence				Edge/Cloud
		Ecosystem - Virtual Economy	Decentralised Infrastructure				Security, Privacy and Culture
		Ecosystem - Social Acceptability	Infrastructure - Adtech				Procurement, Culture
		Ecosystem - Security & Privacy	Infrastructure - Connectivity				
		Ecosystem - Trust & Acceptability					
References							
"The Metaverse Primer" June 2021 (https://www.matthewball.io/the-metaverse-primer)	"The Metaverse Value-Chain" 7 April 2021 (https://medium.com/building-the-metaverse/the-metaverse-value-chain-afc9e09e3a7)	All One Needs to Know about Metaverse: A Complete Survey on Technological Singularity, Virtual Ecosystem, and Research Agenda, Lik-Hang Lee et al, Sept 2021	Newzoo Metaverse Ecosystem Infographic 25 June 2022	"Roblox CEO Dave Baszucki believes users will create the metaverse" 27 January 2021 (https://venturebeat.com/2021/01/27/roblox-ceo-dave-baszucki-believes-users-will-create-the-metaverse/)	"Microsoft Metaverse Technology Stack" 26 May 2021 (https://azure.microsoft.com/en-gb/blog/converging-the-physical-and-digital-with-digital-twins-mixed-reality-and-metaverse-apps/)	"Nvidia reveals Omniverse Enterprise for simulating products and worlds" 12 April 2021 (https://venturebeat.com/2021/04/12/nvidia-reveals-omniverse-enterprise-for-simulating-products-and-worlds/)	

A Military Metaverse?



“Persistent secure networked interoperable live, virtual and constructive simulations, synchronized with multi-domain operational systems and enterprise-wide digital twins of equipments, platforms, infrastructure and personnel and the wider human and natural world.”

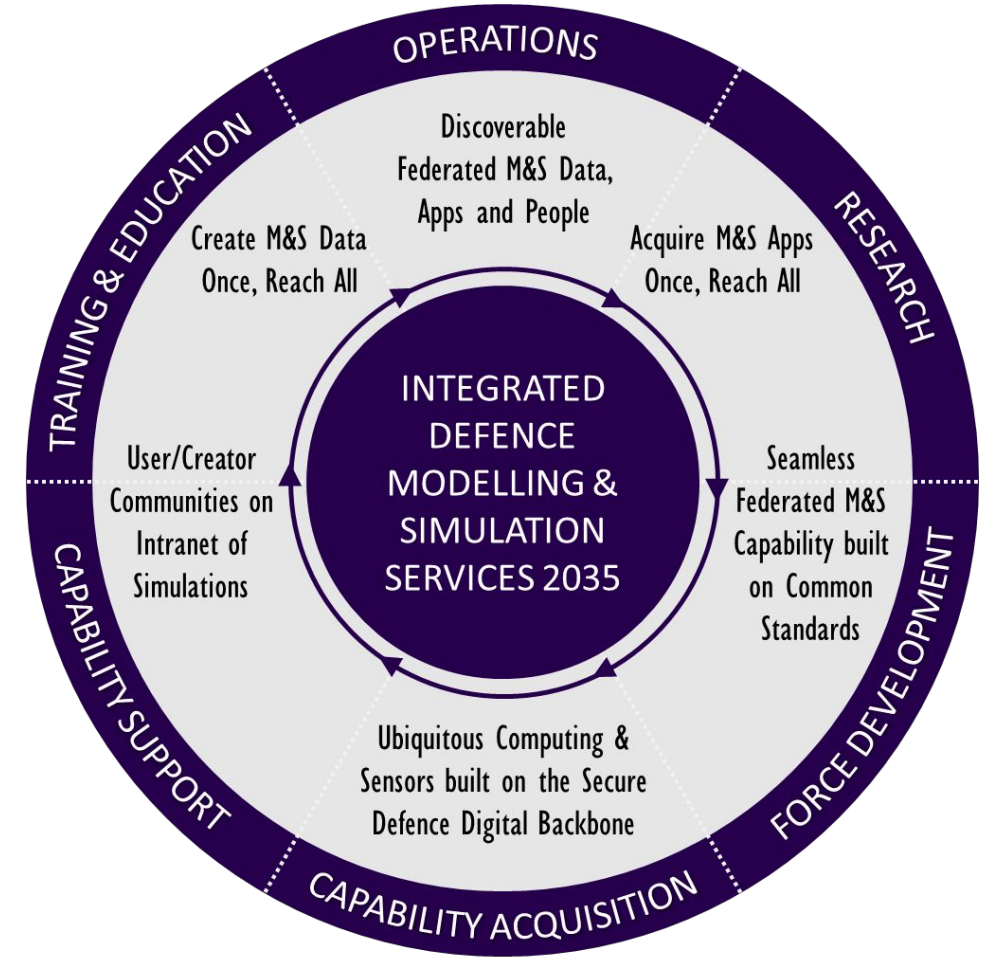
Military Metaverse Consumers/Users



Military Metaverse > Σ

As well as serving use cases across defence, a military metaverse could ensure M&S capabilities are always up to date, consistent, verifiable, cost effective and reach all that can benefit

... realising the full potential of defence M&S, irrespective of distance.



Headlines

The current interest/hype reflects a distant vision that does not seem so distant now

The metaverse is not one technology, but an umbrella term for many converging M&S and wider technologies

No one is currently saying it will be a single virtual world

The metaverse will embed computing into the real world and embed the real world into computing

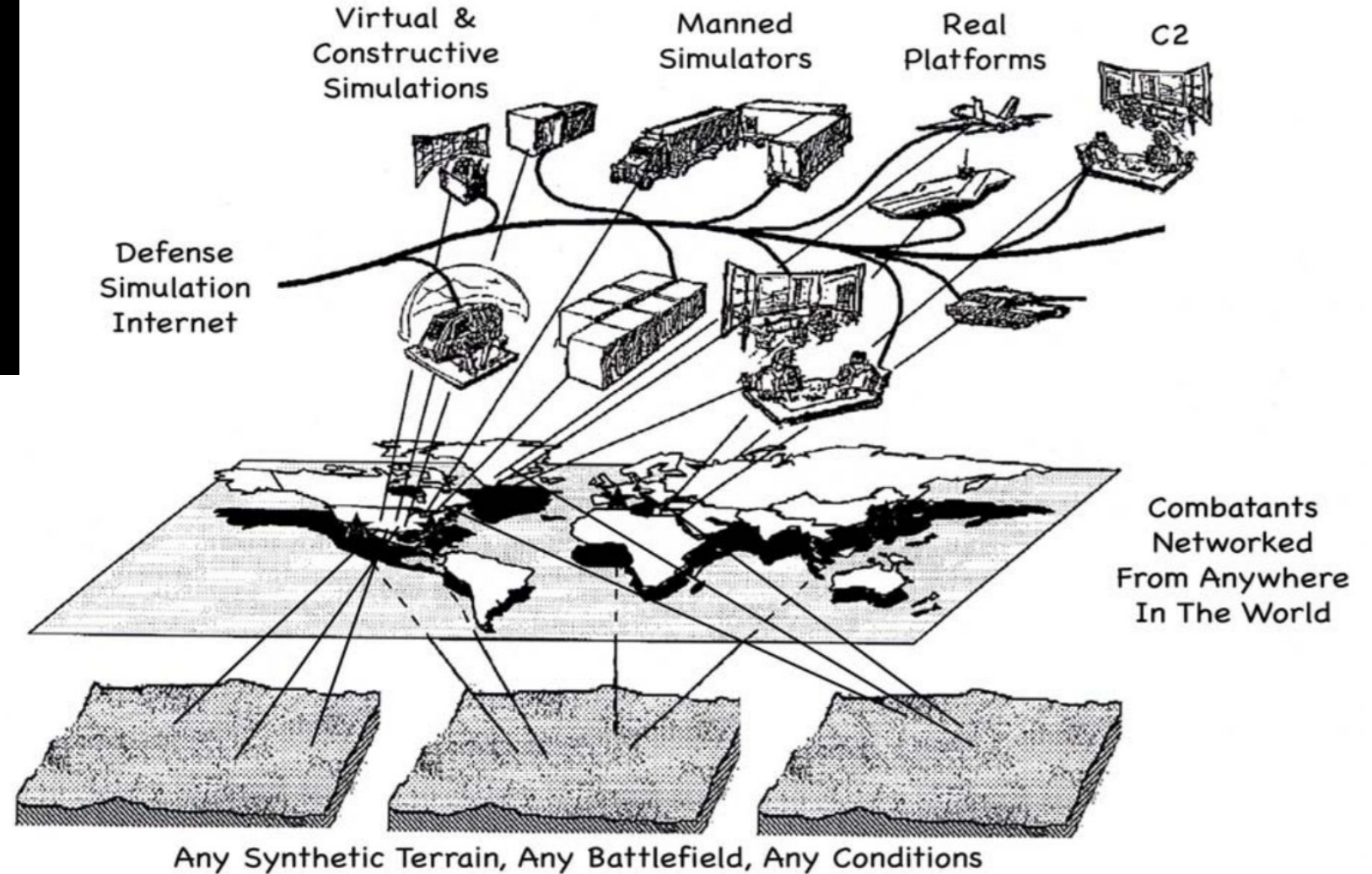
The metaverse is of great significance to defence M&S and the wider digital domain

The weight of \$ external to defence will drive developments, which are likely unpredictable

Defence needs to be an “intelligent customer” for metaverse technologies and standards

A “Military Metaverse” could exploit metaverse-related standards, technologies and approaches, and provide now a unifying vision for future defence enterprise-wide M&S services

A Military Proto-Metaverse: 1980s Distributed Simulation Vision and SIMNET Blueprint



SIMNET's 1980s Vision - Jack Thorpe PhD (Colonel, USAF, retired)

Back to Science Fiction...

1999



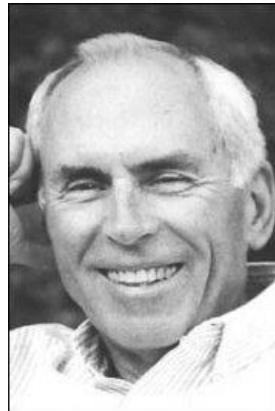
2009



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Questions?

Andy Fawkes
andy.fawkes@thinke.co.uk



Amara's Law

“We tend to overestimate the effect of a technology in the short run and underestimate the effect in the long run.”

Roy Amara PhD (1925 – 2007)
Head of the Stanford Institute for the Future