



IEEE DECENTRALIZED METAVERSE INITIATIVE

GLOBAL WEB3 TECHNOLOGY INDUSTRY ECOLOGICAL DEVELOPMENT REPORT

Authored by

Cheng Chi, *Department Director, Senior Researcher, China Academy of Information and Communications Technology*

Daozhuang Lin, *Chair, IEEE Decentralized Metaverse Initiative*

Ramesh Ramadoss, *Vice Chair, IEEE Decentralized Metaverse Initiative*

Yu Yuan, *Chair, IEEE Persistent Computing Initiative*

Zihang Yin, *Senior Researcher, China Academy of Information and Communications Technology*

Yuwen Zhang, *Senior Researcher, China Academy of Information and Communications Technology*

Tongtong Cheng, *Researcher, China Academy of Information and Communications Technology*

Wenqu Chen, *Senior Researcher, China Academy of Information and Communications Technology*

Lingyuan Yin, *Researcher, China Academy of Information and Communications Technology*

Bin Yang, *Professor, Tsinghua University*

Ling Wei, *Professor, Tsinghua University*

Ralf Ma, *Chair, IEEE P2048 Metaverse Working Group*

TRADEMARKS AND DISCLAIMERS

IEEE believes the information in this publication is accurate as of its publication date; such information is subject to change without notice. IEEE is not responsible for any inadvertent errors.

The ideas and proposals in this specification are the respective author's views and do not represent the views of the affiliated organization.

The Institute of Electrical and Electronics Engineers, Inc. 3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2023 by The Institute of Electrical and Electronics Engineers, Inc.

All rights reserved. 22 November 2023. Printed in the United States of America.

PDF: STDVA26616 979-8-8557-0304-7

IEEE is a registered trademark in the U. S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated. All other trademarks are the property of the respective trademark owners.

IEEE prohibits discrimination, harassment, and bullying. For more information, visit <http://www.ieee.org/web/aboutus/whatis/policies/p9-26.html>.

No part of this publication may be reproduced in any form, in an electronic retrieval system, or otherwise, without the prior written permission of the publisher.

Find IEEE standards and standards-related product listings at: <http://standards.ieee.org>.

NOTICE AND DISCLAIMER OF LIABILITY CONCERNING THE USE OF IEEE SA INDUSTRY CONNECTIONS DOCUMENTS

This IEEE Standards Association (“IEEE SA”) Industry Connections publication (“Work”) is not a consensus standard document. Specifically, this document is NOT AN IEEE STANDARD. Information contained in this Work has been created by, or obtained from, sources believed to be reliable, and reviewed by members of the IEEE SA Industry Connections activity that produced this Work. IEEE and the IEEE SA Industry Connections activity members expressly disclaim all warranties (express, implied, and statutory) related to this Work, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; quality, accuracy, effectiveness, currency, or completeness of the Work or content within the Work. In addition, IEEE and the IEEE SA Industry Connections activity members disclaim any and all conditions relating to: results; and workmanlike effort. This IEEE SA Industry Connections document is supplied “AS IS” and “WITH ALL FAULTS.”

Although the IEEE SA Industry Connections activity members who have created this Work believe that the information and guidance given in this Work serve as an enhancement to users, all persons must rely upon their own skill and judgment when making use of it. IN NO EVENT SHALL IEEE OR IEEE SA INDUSTRY CONNECTIONS ACTIVITY MEMBERS BE LIABLE FOR ANY ERRORS OR OMISSIONS OR DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS WORK, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Further, information contained in this Work may be protected by intellectual property rights held by third parties or organizations, and the use of this information may require the user to negotiate with any such rights holders in order to legally acquire the rights to do so, and such rights holders may refuse to grant such rights. Attention is also called to the possibility that implementation of any or all of this Work may require use of subject matter covered by patent rights. By publication of this Work, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. The IEEE is not responsible for identifying patent rights for which a license may be required, or for conducting inquiries into the legal validity or scope of patents claims. Users are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. No commitment to grant licenses under patent rights on a reasonable or non-discriminatory basis has been sought or received from any rights holder. The policies and procedures under which this document was created can be viewed at <http://standards.ieee.org/about/sasb/iccom/>.

This Work is published with the understanding that IEEE and the ICom members are supplying information through this Work, not attempting to render engineering or other professional services. If such services are required, the assistance of an appropriate professional should be sought. IEEE is not responsible for the statements and opinions advanced in this Work.

TABLE OF CONTENTS

ABSTRACT.....	5
1. INTRODUCTION TO WEB3	6
1.1. REASONS FOR THE EMERGENCE OF WEB3.....	6
1.2. TYPICAL FEATURES OF WEB3.....	7
1.3. ECONOMIC SPACE OF WEB3	8
1.4. SIGNIFICANCE OF WEB3	9
2. TECHNICAL PERSPECTIVE: WEB3 PROTOCOL STACK AND KEY TECHNOLOGIES	10
2.1. DIGITAL IDENTITY STANDARDIZATION	11
2.2. DIGITIZATION OF OBJECT ASSETS.....	11
3. DEVELOPMENT PERSPECTIVE: WEB3 DEVELOPMENT FRAMEWORK AND CORE ELEMENTS.....	12
3.1. INFRASTRUCTURE	12
3.2. COMPONENT TOOLS	13
3.3. USER ENTRY	14
3.4. INTERACTION INTERFACES	14
3.5. DEPLOYMENT ENVIRONMENT.....	14
4. DEPLOYMENT PERSPECTIVE: WEB3’S IMPACT ON DIGITAL INFRASTRUCTURE.....	15
5. APPLICATION PERSPECTIVE: WEB3 APPLICATION PATTERNS AND TYPICAL SCENARIOS.....	15
5.1. FINANCIAL TECHNOLOGY: ESTABLISHING MULTIPARTY TRUST AND ENHANCING ASSET CIRCULATION	16
5.2. CONTENT CREATION: DERIVATIVE CREATION ECONOMY AND VALUE REDISTRIBUTION.....	17
5.3. GAMING AND ENTERTAINMENT: BUILDING INTERACTIVE WORLDS, REVOLUTIONIZING GAME RULES.....	18
5.4. CULTURAL AND CREATIVE: ACHIEVING DIGITAL OWNERSHIP, UNLEASHING THE VALUE OF COLLECTIBLES	18
5.5. SOCIAL PARADIGM: RESHAPING SOCIAL NETWORKS, FACILITATING INFORMATION EXCHANGE	19
6. WEB3 EVOLUTION TRENDS AND CHALLENGES	20

GLOBAL WEB3 TECHNOLOGY INDUSTRY ECOLOGICAL DEVELOPMENT REPORT

ABSTRACT

Web3 was initially proposed by British computer scientist Tim Berners-Lee in 1998 to describe the concept of the semantic web, which aims to make the internet more understanding of information itself and provide more intelligent services to users. In 2014, Gavin Wood, co-founder of Ethereum, introduced a new concept of Web3, hoping to start a new wave of digital economy based on blockchain, smart contracts, and other technologies.

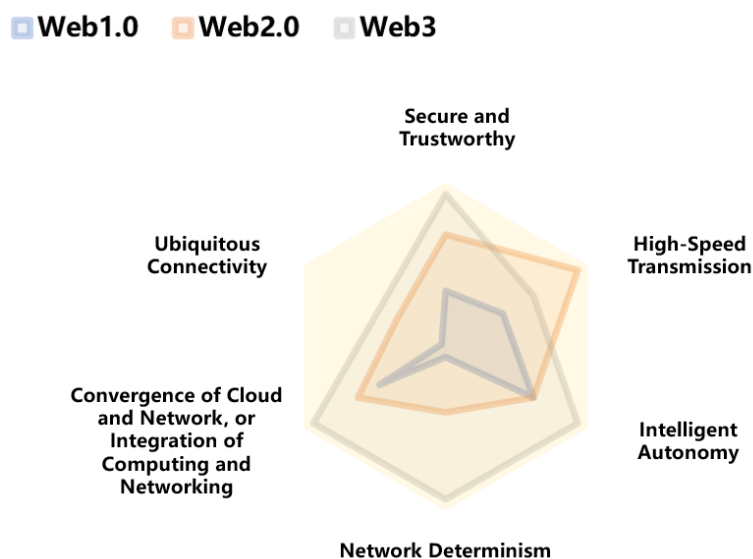
This report believes that Web3 is not just a simple innovation at the application layer of the internet but a comprehensive evolution and systematic upgrade of the internet architecture as a whole. The World Wide Web (Web) provided a graphical and user-friendly interface for users to search and browse web pages, becoming the first successful internet application worldwide. From a narrow perspective, during the Web1.0 era, users could only passively browse web pages, while in the Web2.0 era, users relied on platforms to create and disseminate information. In the Web3 era, users have more autonomy in managing data and can derive value from creating internet content. From a broader perspective, Web3 aims to decentralize the internet and make it more secure by designing new technical protocols and building new infrastructure. It allows users to have control over their digital identities and assets, creating a truly data-centric economic system in the digital world. This integration of technological and economic systems promotes the fusion of the digital economy and the physical economy through collaborative innovation.

1. INTRODUCTION TO WEB3

1.1. REASONS FOR THE EMERGENCE OF WEB3

Since the birth of the internet, with the development of Web technologies and applications, it has created digital spaces and extended to form new expansions such as the Internet of Things, connected cars, and industrial internet. High-speed transmission, network determinism, cloud-network integration, security and trustworthiness, intelligent autonomy, and ubiquitous connectivity have become important directions for the development of the next generation of the internet. As shown in FIGURE 1, Web2.0 provides rich interactions between users and platforms and changes the transaction models between businesses and consumers, helping to reduce production and transaction costs. Web3 begins to focus on technologies and models for enhancing human-machine-object interactions, such as augmented reality and virtual reality. It seeks to strike a balance between the efficiency of interactions on the internet and the fair distribution of user identity and data management rights. This is achieved through consensus algorithms, smart contracts, encrypted communication, and other technologies while exploring the realization of data value.

FIGURE 1 Main development directions of the internet and radar chart of Web1.0, Web2.0, and Web3 implementation levels



Web3 provides new impetus by enriching network interaction protocols. As a global information transmission network, the internet relies on foundational protocols like TCP/IP(Transmission Control Protocol/Internet Protocol,TCP/IP) to help ensure the implementation of information transmission channels. However, these

protocols lacked sufficient consideration for trust, security, and the value of data at their inception, resulting in the inability to self-prove identity and verify information. Web3 expands the functionality of the protocol layer through a “fat protocol” structure to support new technologies. Web3 promotes the circulation of data value through the creator economy model. Web3 provides a more flexible value distribution model for organizations and businesses, allowing network owners, content providers, and participants to be more involved in value distribution, facilitating the circulation and market-oriented allocation of data elements. Web3 achieves multiparty collaborative governance through algorithms and machine trust. Web3 emphasizes intrinsic motivation and achieves data autonomous management by storing user data in a distributed network rather than relying on a centralized service provider or specific server. This introduces a new mode of data autonomous management and provides new ideas for digital governance.

1.2. TYPICAL FEATURES OF WEB3

Decentralization: Unlike Web1.0, which was content-centric and lacked network interaction, and Web2.0, which revolved around centralized platforms providing data services, Web3 is a new type of network where all users contribute, govern, and share value. Its core function is to build a user-centric distributed network ecosystem that helps users engage in network interactions independent of platform institutions.

Machine Trust: Traditional internet lacks identity layer design, and the mechanism for network trust primarily relies on centralized institutions to build network security infrastructure. This has led to issues such as identity fraud and data theft. Web3 is a trust model built on consensus mechanisms and blockchain networks. By redefining business protocols through smart contracts, Web3 combines distributed digital identities to redistribute basic rights on the traditional internet, thereby constructing a network of trust among machines.

Creator Economy: In the traditional internet, there is an issue where tech giants control the majority of content-sharing channels through their foundational platforms. The unequal distribution of benefits between platforms and creators affects creative enthusiasm, and the creative economy market cannot be fully exploited. Web3 achieves the development of the creative economy by constructing a balanced collaborative mechanism among platforms, creators, and users. With the help of blockchain incentive mechanisms and smart contracts, Web3 encourages platforms to redistribute value and rights to creators, thus stimulating the growth of the creative economy.