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编者按：2024浦江创新论坛——Web 3.0创新论坛以“国内外Web 3.0技术与产业发展趋势、创新成果和产业化应用”为主题，来自政府、研究机构、龙头企业等专家学者围绕Web 3.0前沿趋势、实践案例、解决方案等展开深入研讨。本期专报对Web 3.0创新论坛的嘉宾观点进行梳理，供参考。

Editor's note: With the theme of "development trends, innovation achievements and industry applications of Web 3.0 technology and industries both at home and abroad", the 2024 Pujiang Innovation Forum - Web 3.0 Innovation Forum invited experts and scholars from governments, research institutions and leading enterprises to conduct in-depth discussions on Web 3.0 frontier trends, practical cases and solutions, etc.This special report synthesizes the viewpoints of the guests at the Web 3.0 Innovation Forum for your information.

2024 浦江创新论坛专报之二十一

Special Report 21 of the 2024 Pujiang Innovation Forum

通过技术研发与产业生态驱动 Web 3.0 创新发展

Drive the Innovative Development of Web 3.0 through Technology R&D and Industrial Ecosystem

数字经济的高速发展依赖于大规模、高价值数据的共享流通与高效协同，为整个经济体系提供了持续的动力。区块链和隐私计算等 Web 3.0 底层技术，为数据要素市场的繁荣与可持续发展提供了强有力的技术支撑。**与会嘉宾一致认为，Web 3.0 通过分布式协作机制，不仅支持数据的去中心化管理，更能够保护数据主体的隐私，实现数据要素价值的公平分配，应强化基础理论探索、完善基础设施建设，加快 Web 3.0 技术研发创新，打造产业生态，构建各方参与共治的 Web 3.0 治理体系。**

The rapid development of the digital economy relies on the sharing, circulation and efficient collaboration of large-scale and high-value data, which provides sustained momentum for the entire economic system.The underlying technologies of Web 3.0, such as blockchain and privacy computing, provide strong technical support for the prosperity and sustainable development of the data element market. **The guests present unanimously agreed that through the distributed collaboration mechanism, Web 3.0 not only supports**

decentralized management of data, but also protects the privacy of data subjects and achieves fair distribution of data element value. We should strengthen the exploration of basic theories, improve infrastructure construction, accelerate the R&D and innovation of Web 3.0 technology, create an industrial ecosystem, and build a Web 3.0 governance system with the participation and co-governance of all concerned parties.

一、通过技术创新和场景应用驱动 Web 3.0 发展

1. Drive the development of Web 3.0 through technological innovation and scenario applications

1、技术创新：推动 Web 3.0 核心基础设施建设。Web 3.0 的崛起依赖于区块链、隐私计算等底层技术，这些技术为数据安全、可信流通和隐私保护提供了坚实的基础。**布达佩斯科技经济大学校长 Hassan CHARAF** 指出，区块链、数字资产、去中心化身份、可验证凭证、保密计算和零知识证明等是 Web 3.0 底层技术，这些技术将共同支撑分布式协作和隐私保护。**山东大学计算机科学与技术学院院长、教授成秀珍**强调，区块链是确保 Web 3.0 可信与安全的关键基础设施，并进一步指出元计算作为人工智能的底层技术支撑，通过弹性算力、可信数据和智能算法三个维度，为 Web 3.0 的多场景应用提供了强大的计算能力。**中国科学院院士、北京航空航天大学教授郑志明**强调了隐私计算的重要性并指出，隐私计算不仅关乎国家安全、经济秩序和社会治理，

且通过与区块链技术的结合，能够构建出适应大数据时代的可信数据流通平台。**上海交通大学教授郁昱**指出，安全多方计算、联邦学习和可信执行环境是隐私计算的三大核心技术路线，并提出了后量子密码技术将是应对未来量子计算攻击、保障数据安全的关键。

(1) Technological innovation: promoting the construction of core infrastructure for Web 3.0. The rise of Web 3.0 relies on underlying technologies such as blockchain and privacy computing, which provide a solid foundation for data security, trusted circulation, and privacy protection. **Hassan Charaf, President of the Budapest University of Technology and Economics,** pointed out that blockchain, digital assets, decentralized identity, verifiable credentials, privacy-preserving computing, zero-knowledge proof and the like are the underlying technologies of Web 3.0, which will collectively support distributed collaboration and privacy protection. **Cheng Xiuzhen, Dean and Professor of the School of Computer Science and Technology at Shandong University,** emphasized that blockchain is a key infrastructure to ensure the trustworthiness and security of Web 3.0. She further pointed out that as the underlying technical support for artificial intelligence, meta computing provides powerful computing capabilities for multi-scenario applications of Web 3.0 through three dimensions including elastic computing power, trusted data, and intelligent algorithms. Zheng Zhiming,

Member of the Chinese Academy of Sciences and Professor of Beihang University, stressed the importance of privacy computing and pointed out that privacy computing is related to national security, economic order and social governance; furthermore, by combining privacy computing with blockchain technology, we can build a credible data circulation platform adapted to the era of big data. Professor Yu Yu from Shanghai Jiao Tong University pointed out that secure multi-party computation, federated learning, and trusted execution environment are the three core technological routes for privacy computing. And he proposed that post quantum cryptography technology will be the key to dealing with future quantum computing attacks and ensuring data security.

2、场景应用：技术反哺产业，赋能实体经济。Web 3.0 的技术应用正从理论逐步迈向实践，并在能源、金融、政务等多个领域得到广泛应用，推动了技术创新与服务模式的不断演进。Hassan CHARAF 指出，Web 3.0 已广泛应用于数字资产、能源网络设施和公共服务等领域，这些应用正在推动技术革新并加速服务模式的转变。**上海浦芯未来互联网技术研究院副院长张博**指出，ChainWeaver[1]平台通过深度融合区块链、隐私计算和分布式网络共性服务技术，能够在大数据环境下建立安全、可信且可控的数据流通链路，保障隐私安全并高效访问暗数据。**中国太平洋保险**

[1] 上海浦芯未来互联网技术研究院开发的 Web 3.0 开源底层软硬件技术平台。
[1] Web 3.0 open source underlying software and hardware technology platforms developed by Shanghai Puxin Future Internet Technology Institute.

（集团）股份有限公司区块链及物联网首席专家连理指出，区块链能够实现存证溯源、数据协作和价值共享。已推出太保数字藏品平台、数字保管箱、区块链智能理赔以及农业保险服务链等创新服务，进一步提升了行业服务的效率和透明度。**浦芯研究院首席专家、清华大学教授陈婧**强调，区块链与 AI 融合不仅有助于提高区块链系统的安全性，还能有效识别潜在的安全隐患，为数据共享提供更加可靠的技术支持。

(2) Scenario application: Technology nurtures the industry and empowers the real economy. The technical application of Web 3.0 is gradually moving from theory to practice, and Web 3.0 has been widely used in many fields such as energy, finance, and government affairs, promoting the continuous evolution of technological innovation and service models. Hassan Charaf pointed out that Web 3.0 has been widely used in fields such as digital assets, energy network facilities and public services. These applications are driving technological innovation and accelerating the transformation of service models. **Zhang Bo, Vice President of Shanghai Puxin Future Internet Technology Institute**, pointed out that through the in-depth integration of blockchain, privacy computing and distributed network common service technologies, the ChainWeaver [2] platform can establish a secure, credible and controllable data flow link in a big data environment, to ensure privacy security and

efficient access to dark data. **Lian Li, Chief Expert in Block Chain and IoT at China Pacific Insurance (Group) Co., Ltd.,** pointed out that blockchain can achieve blockchain-based storage traceability, data collaboration, and value sharing. China Pacific Insurance (Group) Co., Ltd. has launched innovative services such as the Pacific Insurance Digital Collection Platform, Digital Safe Box, Blockchain Intelligent Settlement of Claims, and Agricultural Insurance Service Chain, further enhancing the efficiency and transparency of industry services. **Chen Jing, Chief Expert of Shanghai Puxin Future Internet Technology Institute and Professor of Tsinghua University,** emphasized that the integration of blockchain and AI not only helps improve the security of blockchain systems, but also effectively identifies potential security risks and provides more reliable technical support for data sharing.

二、Web 3.0 发展面临的挑战

2. Challenges faced by the development of Web 3.0

在理论发展方面，郑志明指出隐私计算作为 Web 3.0 的核心技术之一，面临多项理论挑战，包括如何建立支撑隐私计算的新型基础数学理论、探索规则博弈引导下的高效计算方法，以及应对非规则博弈场景下的隐私计算问题。此外，如何通过信息心理学对个体隐私进行度量，以及通过信息社会学评估群体隐私，也是当前隐私计算领域需要解决的重要理论问题。Hassan CHARA

认为，Web 3.0 在开源平台中的数据使用责任问题仍未得到有效解决，缺乏统一的数据平台也阻碍了数据流通效率的提升，迫切需要建立更高效的数据流通机制。

In terms of theoretical development, Zheng Zhiming pointed out that as one of the core technologies of Web 3.0, privacy computing faces multiple theoretical challenges, including how to establish new basic mathematical theories to support privacy computing, how to explore efficient computing methods guided by rule-based games, and how to address privacy computing issues in non-rule-based games scenarios. In addition, how to measure individual privacy through information psychology, and how to evaluate group privacy through information sociology, are currently important theoretical issues that need to be addressed in the field of privacy computing. Hassan Charaf believes that with respect to Web 3.0, the issue of data usage responsibility in open source platforms for has not been effectively resolved, and the lack of a unified data platform also hinders the improvement of data circulation efficiency. Therefore, there is an urgent need to establish a more efficient data circulation mechanism.

在技术突破方面，陈婧表示，区块链技术面临一系列挑战，包括智能合约的复杂性、经济与金融的适应性、隐私与安全，以及技术的可扩展性。她还特别强调了区块链与 AI 结合带来的新技术难题。**连理**指出，区块链技术的发展需要在分布式架构、安

全性和可扩展性之间找到平衡，这是区块链在广泛应用中所面临的主要技术瓶颈。

In terms of technological breakthroughs, Chen Jing said that blockchain technology faces a series of challenges, including the complexity of smart contracts, adaptability to economics and finance, privacy and security, and the scalability of the technology. She also emphasized the new technological challenges brought about by the combination of blockchain and AI. **Lian Li** pointed out that the development of blockchain technology requires finding a balance among distributed architecture, security, and scalability, which are the main technical bottlenecks faced by blockchain in its widespread application.

在数据获取及治理结构方面，张博提到，由于涉及大量的安全和隐私问题，许多高价值的暗数据无法被有效使用，造成了巨大的数据资源浪费，如何突破这一困局成为亟待解决的难题。**上海市联合征信公司总经理陈良贵**指出，区块链技术将在未来的智能革命中发挥中控系统的作用，但其治理机制尚需进一步完善。**北京交通大学教授李超**指出 Web 3.0 链上治理存在多重风险，包括“恶意收购”攻击、“中心化”问题和“选举操纵”等。此外，链下治理则面临“谁来治理”的核心问题，这也是 Web 3.0 生态建设中的一个难点。

In terms of data acquisition and governance structure,

Zhang Bo mentioned that due to the involvement of many security and privacy issues, many high-value dark data cannot be effectively used, resulting in huge waste of data resources. How to break through this dilemma has become an urgent problem to be solved. **Chen Lianggui, General Manager of Shanghai United Credit Reporting Co., Ltd.,** pointed out that blockchain technology will play a central control system role in the future intelligent revolution, but its governance mechanism still needs to be further improved. **Professor Li Chao from Beijing Jiaotong University** pointed out that there are multiple risks in Web 3.0 on-chain governance, including "hostile takeover" attacks, "centralization" issues, and "election manipulation". In addition, off-chain governance faces the core issue of "who shall govern", which is also a difficulty in the construction of the Web 3.0 ecosystem.

三、相关建议

3. Relevant suggestions

一是深化基础理论探索，加快技术创新发展。郑志明提出，应优先探索支撑隐私计算的复杂系统与体系安全的基础数学理论，推动联邦学习、跨域安全协同及软硬件融合的隐私计算技术创新。同时，应发展基于非理性假设的演化博弈建模，提升后纳什均衡与动态自适应隐私激励算法的应用，并进一步探索信息心理学与社会学视角下的隐私度量和评估理论，以构建全流程的隐

私保护框架。

The first is to deepen the exploration of basic theories and accelerate the development of technological innovation. Zheng Zhiming proposed that priority should be given to exploring the basic mathematical theories of complex systems and system security that support privacy computing, and to promoting innovations in privacy computing technologies such as federated learning, cross-domain security collaboration, and software and hardware integration. Meanwhile, we should develop evolutionary game modeling based on irrational assumptions, enhance the application of Ex Post Nash Equilibrium and dynamic adaptive privacy incentive algorithms, and further explore privacy measurement and evaluation theories from the perspectives of information psychology and sociology, for the purpose of constructing a whole-process privacy protection framework.

二是加强基础设施建设，完善 Web 3.0 **产业生态。**陈良贵建议，加速推进区块链的核心技术攻关与创新突破，鼓励头部企业与高校、科研院所合作，建立区块链实验室、创新中心等研发平台。此外，需打造区块链孵化平台，形成“政府搭台、企业唱戏”的良性发展模式，发挥头部企业的优势，加快基础链建设。同时，政府应加大支持，引导金融、新能源、工业制造等行业企业上链，推动全产业链协同发展，营造健康的区块链生态体系。

The second is to strengthen infrastructure construction and improve the Web 3.0 industry ecosystem. Chen Lianggui suggested that we should move faster to tackle key problems and make innovative breakthroughs in core technologies of blockchain, encourage leading enterprises to cooperate with universities and research institutes, and establish research and development platforms such as blockchain laboratories and innovation centers. In addition, we should build the blockchain incubation platform, form a healthy development model of "government sets the stage, enterprises perform", leverage the advantages of leading enterprises, and accelerate the construction of basic chains. Meanwhile, the government should increase its support, and guide enterprises in sectors such as finance, new energy and industrial manufacturing to go on-chain, promote the coordinated development of the whole industrial chain, and create a healthy blockchain ecosystem.

三是明确治理主体，鼓励各方共同参与 Web 3.0 治理。李超指出，应坚持“共建、共治、共享”的原则，鼓励社区成员积极参与治理，形成广泛的社会共识。同时，通过设计合理的经济激励模型，提升参与者的积极性与贡献度。**陈良贵**还建议，应加大力度引进国内外区块链高端人才，并鼓励高校开设相关课程，与企业、职校和培训机构联合培养区块链专业人才，持续提升人才数量与质量。

The third is to define the governance entities and encourage

all concerned parties to participate in Web 3.0 governance together. Li Chao pointed out that we should uphold the principle of "governance based on collaboration, participation, and common gains", and encourage community members to actively participate in governance, reaching a broad social consensus. Meanwhile, we should, by designing a reasonable economic incentive model, enhance the enthusiasm and contribution of participants. **Chen Lianggui** also suggested that we should intensify efforts to introduce high-end blockchain talents from both domestic and foreign sources, and encourage universities to offer relevant courses and to work together with enterprises, vocational schools, and training institutions to jointly cultivate blockchain professionals, for the purpose of continuously improves the quantity and quality of talents.

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