世界互联网大会
World Internet Conference

科技之魅

CHARM OF SCIENCE AND TECHNOLOGY

世界互联网
领先科技成果发布活动

RELEASE CEREMONY FOR
WORLD LEADING INTERNET SCIENTIFIC AND
TECHNOLOGICAL ACHIEVEMENTS

2022.11.9



2022WORLD
INTERNET CONFERENCE
世界互联网大会
乌镇 峰会·Wuzhen Summit

共建网络世界 共创数字未来
携手构建网络空间命运共同体

TOWARDS A SHARED DIGITAL FUTURE IN A CONNECTED WORLD
BUILDING A COMMUNITY WITH A SHARED FUTURE IN CYBERSPACE

写在《科技之魅》的前面
Preface to The Charm of Science and Technology

科技浪潮奔涌向前，数字时代飞速到来。从“见字如面”到“万物互联”，以互联网为代表的信息技术日新月异，引领世界大踏步迈向数字文明，助推人类社会攀上历史新高峰，展现出无与伦比的科技魅力。

The waves of technology are surging forward, and the digital age is fast approaching. From an era of considerable difficulty in connection and communication to an era of the "Internet of Everything", information technology represented by the Internet is evolving with each passing day, leading the world to digital civilization in great strides, helping human society reach a new level in history, and demonstrating the unparalleled charm of science and technology.

当前，数字技术正以前所未有的速度赋能经济社会发展各领域全过程，一个智能泛在、虚实共生的数字世界正向我们走来。站在数字化变革潮头，预见网络空间发展新趋势，探寻数字化转型新航向，发掘科技示范新成果，将广泛惠及世界各国人民。2022 年世界互联网领先科技成果发布活动汇聚了全球互联网领域最新科技成果，彰显了互联网领域从业者的创造性贡献，引领了未来互联网技术的发展方向，为国际交流互鉴和科技成果转化打开了广阔空间。让我们扬起合作之帆，乘着世界互联网大会的东风，让满载科技创新成果之船驶向美好的未来。

At present, digital technologies are empowering various fields of economic and social development at an unprecedented speed. A digital world of ubiquitous intelligence and co-existence of virtuality and reality is approaching us. Standing at the forefront of digital evolution, foreseeing new trends of development in cyberspace, exploring new directions for digital transformation, and discovering new achievements in scientific and technological demonstration will benefit people all over the world. The World Internet Leading Scientific and Technological Achievements Release Event 2022 collects the latest scientific and technological achievements in the Internet field around the world, highlights the creative contribution of Internet practitioners, guides the future development direction of Internet technology, and creates greater space for international exchanges and mutual learning and the transformation of scientific and technological achievements. Let us raise the sail of cooperation, ride along the wind of the World Internet Conference, and steer the ship of scientific and technological innovation toward a bright future.

今年是世界互联网领先科技成果发布活动连续第七年举办，也是我担任世界互联网领先科技成果专家推荐委员会中方主任的第七年。在十三届全国政协副主席、致公党中央主席、中国科协主席万钢先生的关心指导下，在国际电信联盟副秘书长马尔科姆·约翰逊先生、非洲互联网之父尼·奎诺先生、韩国互联网之父全吉男教授、日本互联网之父村井纯教授等外方专家的支持下，共征集到来自中国、美国、俄罗斯、英国、瑞典等国家的互联网领先科技成果 257 项，涵盖 5G 与 6G、IPv6、人工智能、大数

据、网络安全、超级计算、高性能芯片、数字孪生等前沿领域，涉及基础理论、技术、产品和商业模式等多个类别。经过专家推荐，最终选出 57 项优秀成果汇编成册。随着上述成果不断转化落地，将转换为经济社会发展的新动能，推动社会迎来崭新的繁荣发展期。

This year marks the seventh consecutive year that the event has been held and the seventh year that I have served as the Chinese director of the Recommendation Committee for World Leading Internet Scientific and Technological Achievements. Thanks to the care and guidance of Mr. Wan Gang, Vice-Chairman of the 13th National Committee of the Chinese People's Political Consultative Conference, Chairman of the China Zhi Gong Party, and President of the China Association for Science and Technology, as well as the support of foreign experts including Mr. Malcolm Johnson, Deputy Secretary-General of the International Telecommunication Union, Mr. Nii Quaynor, father of the African Internet, Professor Chon Kilnam, father of the Korean Internet, and Professor Jun Murai, father of the Japanese Internet, 257 leading items of scientific and technological achievements were collected from China, the United States, Russia, the United Kingdom, Sweden and other countries, covering a wide range of cutting-edge fields such as 5G and 6G, IPv6, artificial intelligence, big data, cybersecurity, supercomputing, high-performance chips, and digital twins, and multiple categories such as the fundamental theory, technology, products and business models. Following the recommendation of experts, 57 outstanding achievements were finally selected and compiled. As these achievements continue to be transformed and implemented, they will be converted into new driving forces for economic and social development, facilitating the global community to embrace a new period of prosperity and development.

日月其迈，岁律更新。伴随着世界互联网大会的脚步，《科技之魅》已走过 7 载春秋，一路上记录了互联网科技创新的非凡成就，见证了互联网技术发展的历史变革，展现了前沿科技赋能社会进步的无穷魅力。希望《科技之魅》继续发挥创新引领作用，鼓励全球更多的科技人才和企业积极投身科技创新、不懈探索，为构筑人类社会美好生活图景贡献智慧和力量。

Time passes day by day. Thanks to the World Internet Conference, and The Charm of Science and Technology, both in their seventh year, extraordinary achievements of Internet technology's innovation have been continuously recorded, witnessing the historical evolutions in the development of Internet technology and showing the unlimited charm of cutting-edge technology empowering social advancement. We hope that The Charm of Science and Technology will continue to play its leading role in innovation, encourage more scientific and technological talents and enterprises around the world to actively engage in scientific and technological innovation and unremitting exploration, and contribute its wisdom and strength to a better life for people across the globe.



01

世界互联网领先科技成果

World Leading Internet
Scientific and Technological Achievements

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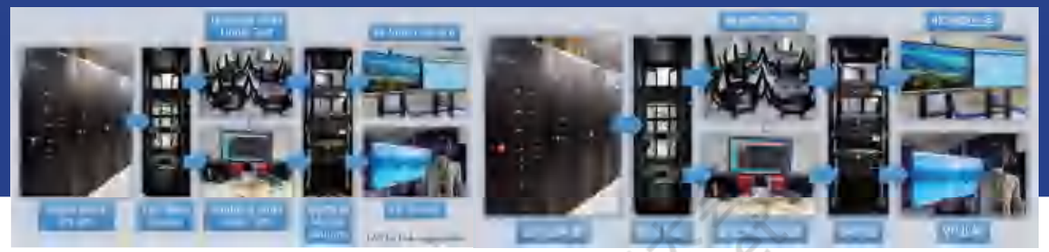
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世界互联网领先科技成果

World Leading Internet Scientific and Technological Achievements

EAGLE 6G：面向6G无线高速接入原型系统及测试环境

EAGLE 6G: An Original Prototype and Evaluation Environment for Enhanced Broadband 6G



鹏城实验室
Peng Cheng Laboratory

北京邮电大学
Beijing University of Posts and Telecommunications

华中科技大学
Huazhong University of Science and Technology

电子科技大学
University of Electronic Science and Technology of China

引言

鹏城实验室联合北京邮电大学、华中科技大学、电子科技大学等构建了“EAGLE 6G”这一面向 6G 的无线高速接入原型系统及测试环境，可提供 6G 关键技术评估、测试能力，助力国际标准化，提升 6G 创新生态体系实力。

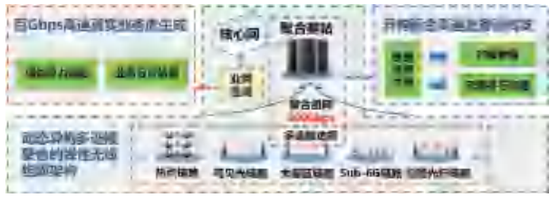
Introduction

Peng Cheng Laboratory, together with Beijing University of Posts and Telecommunications, Huazhong University of Science and Technology, and University of Electronic Science and Technology of China, has developed EAGLE 6G (Elastic multi-AGgregated-Link Environment for 6G), an original prototype and evaluation environment for enhanced broadband 6G, which enables 6G innovative technology evaluation and testing for both academic and industry, laying the foundation for future technological innovation and standardization of 6G technologies.

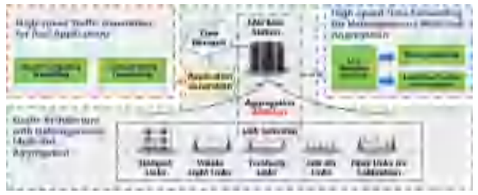
突破未来 6G 业务流动态范围大、高效聚合难、无线业务承载测试难等难题，构建了面向 6G 的无线高速接入原型系统及测试环境

To overcome the challenges of serving future 6G high data-rate applications, including supporting highly dynamic data rates, efficiently aggregating heterogeneous links, and generating high enough data-rate testing flow for wireless applications, the EAGLE 6G research team has developed an original prototype and evaluation environment for enhanced broadband 6G

本成果针对未来 6G 业务流速率（≥ 100Gbps，是 5G 商用网络支撑能力的 100 倍）动态范围大、高效聚合难、无线业务承载测试难等三个挑战展开研究，设计了面向 6G 的异构多链路弹性聚合高速无线接入网架构，建成了原型验证系统，支持高速热点、可见光、太赫兹等无线甚至光纤测试校准链路的异构动态聚合组网，满足业务非均匀大动态等需求，理论分析表明该架构可带来显著的性能增益；攻克了高速业务流的高效聚合难题，通过内核旁路和无锁并行加速提升了动态聚合中的融合效率，可支持 400Gbps 异构聚合，为无线接入技术向 Tbps 演进提供了一种可行途径；攻克了百 Gbps 高速真实业务测试流生成难题，研制了高速无线接入测试网络环境，具备业务测试单流 100Gbps、多流 400Gbps 的真实业务测试能力。



EAGLE 6G 系统架构



The System Architecture of EAGLE 6G

A key objective of the EAGLE 6G project was to address three challenges associated with 6G high data-rate applications (100Gbps, 100 times greater than commercial 5G in capacity), including the ability to support highly dynamic data rates, efficiently aggregate heterogeneous links, and generate a sufficient flow of data-rate testing for wireless applications. The EAGLE 6G architecture is proposed, and a prototype and evaluation environment is released that can support dynamic aggregation of heterogeneous links, such as high-speed hotspots, visible light, terahertz, etc., and even optical fiber calibration links. Based on theoretical analysis, the proposed architecture can significantly improve system coverage and capacity performance by aggregating high data-rate links efficiently. Through the use of kernel bypassing and lock-free parallel acceleration techniques, EAGLE 6G is capable of supporting heterogeneous aggregation of 400Gbps rates. Furthermore, the project can generate hundreds of Gbps of flows for service testing, and eventually develop an evaluation environment that can support tests of 100Gbps for a single service flow and 400Gbps for multiple service flows.

瞄准未来 6G 国际标准化，可在创新研究、标准输出、产学研合作等方面全面支持 6G 关键技术评估和测试

Aiming at the future 6G standardization, EAGLE 6G enables evaluation and testing for 6G innovative technology research, global standardization, and industry-university-research cooperation

本成果为太赫兹等 6G 相关技术提供了高速无线接入测试环境，可进一步为高校、科研院所、设备厂商、运营商提供 6G 创新技术测试服务，提升 6G 创新生态体系实力。本成果已发表高水平期刊 / 会议论文 20 余篇、获授权专利 40 余项，获最佳（学生）论文奖多项。

The EAGLE 6G provides a high-speed wireless communication testing environment for technologies related to 6G, such as terahertz, visible light, and millimeter-wave. Furthermore, it will be able to provide innovative technology testing services for 6G to scientific research institutes, universities, device manufacturers, and operators and enhance the 6G innovation ecosystem. As a result of this project, the research team has published more than 20 high-impact journal and conference papers, received several best (student) paper awards, and has been granted more than 40 patents.



EAGLE 6G 部分获奖、论文发表及专利授权情况
Part of the Awards, Published Papers, and Authorized Patents Based on EAGLE 6G

已对太赫兹、可见光等 6G 潜在关键技术进行验证测试，未来将助力 6G 候选技术评估及标准化，提升 6G 创新生态体系实力

EAGLE 6G has provided tests for potential key technologies of 6G, such as millimeter-wave and terahertz links, and will keep facilitating the evaluation and standardization for 6G promising technologies, as well as empowering the 6G innovation ecosystem

本成果瞄准未来 6G 候选技术评估及标准化，在动态异构聚合无线组网架构、高速业务流转发、真实高速业务流生成等方面实现了突破，为 6G 向 Tbps 级超高速移动接入网演进提供了可行途径，可支持 6G 新技术测试及新应用试验，为 6G 候选技术评估和标准化提供了规范化测试平台，对于加快培育战略性新兴产业、支撑经济社会发展具有重要意义。

Through evaluating and standardizing 6G promising technologies, EAGLE 6G has demonstrated the feasibility of ultra-high-speed mobile access networking at a Tbps-level in the 6G era by demonstrating dynamic heterogeneous link aggregation, high-speed traffic forwarding, and high-speed traffic generation for real applications. The development of strategic emerging industries and the promotion of economic and social development can be further advanced by providing a universal testing platform for evaluating 6G promising technologies and emerging applications.

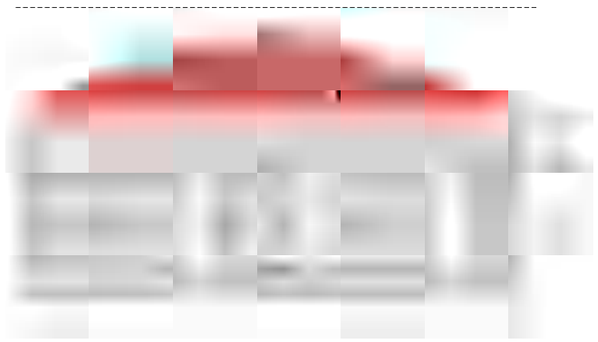
“IPv6+”标准制定、设备研制、组网设计及规模应用

“IPv6+” International Standards Formulation, Device Development, Networking Design and Scale Deployment

中国联合网络通信有限公司
China United Network Communication Co.,Ltd.

华为技术有限公司
Huawei Technologies Co.,Ltd.



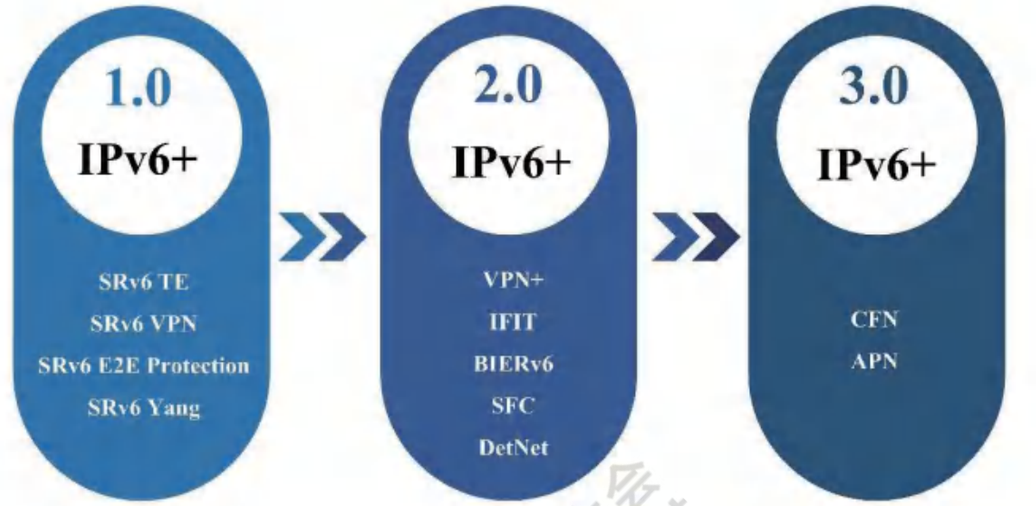


引言

中国联通联合华为公司开展“IPv6+”标准制定、设备研制、组网设计及规模应用，设计电信级网络“IPv6+”综合解决方案，有力提升了北京冬奥等国际赛事的网络服务品质，是信息通信行业助力网络强国和数字中国建设的重要体现。

Introduction

China Unicom and Huawei carried out "IPv6 +" standard formulation, device development, networking design and scale deployment, and designed a comprehensive "IPv6 +" solution for telecom level network which effectively improved the network service quality of international events such as the Beijing Winter Olympics. It is an important embodiment of the information and communication industry to promote the Cyberpower and the construction of Digital China.



构建“IPv6+”技术体系，升级网络联接能力

Building-up of "IPv6 +" technology system, upgradation of network connectivity

“IPv6+”技术体系是以分段路由、网络切片、随流检测、应用感知等为代表的网络技术创新。

The "IPv6 +" Technology System is Network Technology Innovation Represented by Segment Routing, Network Slicing, Streaming Detection, and Application Awareness.

中国联通和华为公司共同围绕业务诉求，开展“IPv6+”技术研究，制定“IPv6+”系列国际标准，提交中国专利 100 多项，推动“IPv6+”技术体系演进及发展。

China Unicom and Huawei have jointly carried out "IPv6 +" technology research, formulated series of "IPv6 +" international standards, submitted more than 100 Chinese patents, and promoted the evolution and development of "IPv6 +" technology system.

开展网络切片技术研究，打造差异化 SLA 服务能力，有效地解决了传统 IP 网络对综合业务承载确定性能力不足的问题，IP 网络从尽力服务演变到服务质量可承诺。

Research on network slicing technology was carried out to create differentiated SLA service capability, which effectively solved the problem of insufficient deterministic capacity of traditional IP network for comprehensive services. The IP network evolved from service with best effort to service with promised quality.

开展随流检测技术研究，以弥补 TWAMP 等常规测量技术的不足，提供精准感知网络承载质量的能力，实现随流逐包检测，实时呈现真实业务流的 SLA。

Carry out research on iFIT（in-situ Flow Information Telemetry）technology to make up for the shortcomings of conventional measurement technologies such as TWAMP, provide the ability to accurately sense the network carrier quality, realize packet by packet iFIT, and present the SLA of business flow in real time.

开展应用感知技术研究，创新性地将应用信息携带进入网络，使网络实时感知应用类型及需求，以提供精细化和定制化服务。

Carry out research on application awareness technology, innovatively bring application information into the network, and enable the network to be aware of application type and demand in real time to provide fine and customized services.

基于上述研究，华为公司率先研制了支持“IPv6+”技术能力的新型路由器设备；中国联通率先开展了基于 SRv6 的可编程组网方案设计；目前，IPv6+ 技术已在中国联通多地网络规模部署，有效提升了网络服务能力与产品创新能力。

Based on the above research, Huawei took the lead in developing new router devices that support the "IPv6 +" technical capability; China Unicom took the lead in designing the programmable networking scheme based on SRv6; At present, IPv6 + technology has been deployed in many provinces and cities of China Unicom, which effectively improves the network service ability and product innovation ability.

推广“IPv6+”应用示范，提升产业服务质量

Promotion of "IPv6 +" Application Demonstration, Improvement of Industrial Service Quality

中国联通和华为公司开展了系列研究和测试工作，为“IPv6+”技术的成熟和服务示范起到了先行先试的作用。

China Unicom and Huawei have carried out a series of research and testing work, which has played a pioneering role in the maturity of "IPv6+" technology and service demonstration.

中国联通率先推进 IPv6+ 规模部署应用，已在河北全省规模部署“IPv6+1.0”能力。

China Unicom has taken the lead in promoting the scale deployment of IPv6+, and realized provincial scale deployment of "IPv6+ 1.0" capability in Hebei.

基于“IPv6+”技术中国联通打造了智慧冬奥数据专网，通过应用 SRv6 技术，针对图片和视频等多媒体数据传送进行优化，为各类业务提供低时延选路、时延劣化感知、时延调优能力；在广东建设了连接珠三角 7 个地市的 SRv6 云骨干网络，基于 SRv6+ 网络切片技术为行业客户提供了高质量服务。目前这些应用示范成功经验正在中国联通 IP 承载网络中全面推广。

Based on the "IPv6 +" technology, China Unicom has created a smart private data network for Beijing Winter Olympics. With the application of SRv6 technology, it optimizes the transmission of multimedia data such as pictures and videos, and provides various services with low delay routing, delay degradation awareness, and delay optimization capabilities; An SRv6 Cloud backbone network connecting seven cities in the Pearl River Delta has been built in Guangdong, providing high-quality services to industrial customers based on SRv6 + network slicing technology. At present, the successful experience of these application demonstrations is being comprehensively popularized in the IP Carrier Network of China Unicom.

聚力“IPv6+”创新实践，助力经济社会转型升级

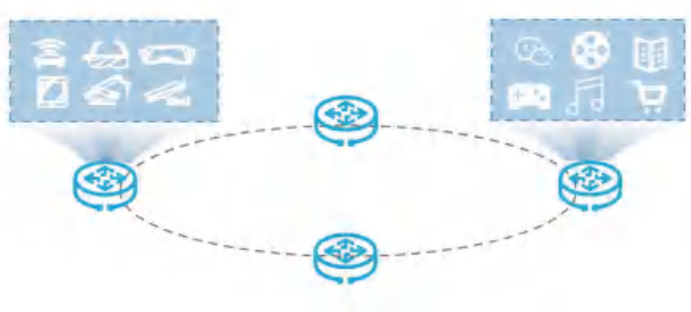
Focus on "IPv6 +" innovation practice to promote the transformation and upgradation of economic society

联通已在多地开展“IPv6+”创新实践，赋能千行百业，产生良好的社会和经济效益。

China Unicom Has Carried Out "IPv6 +" Innovation Practice in Many Places, Enabling Thousands of Industries and Generating Good Social and Economic Benefits.

中国联通与华为持续推动 IPv6+ 国际标准研究，结合网络体系创新打造 IPv6 规模部署新优势，加快网络演进升级，助力经济提质增效。中国联通 SRv6+ 网络切片应用创新已取得良好经济效益，基于 SRv6 业务链、应用 / 算力感知的系列产品已完成试点验证。中国联通与华为通过产品创新、服务创新，有效推动了 IPv6 产业技术升级，提升了电信网络服务质量。

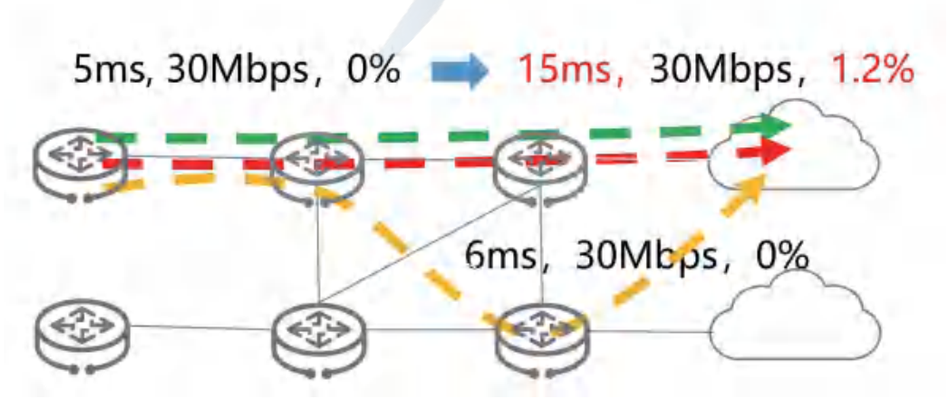
China Unicom and Huawei continuously promote the research of IPv6 + international standards, combine network system innovation to create new advantages of IPv6 scale deployment, accelerate network evolution and upgrade, and help improve the quality and efficiency of the economy. China Unicom's SRv6 + network slice application innovation has brought good economic benefits, and pilot validation of series products based on SRv6 business chain and application/computing power awareness has been completed. China Unicom and Huawei have effectively promoted industrial technological upgradation of IPv6 and service quality of telecommunication network.



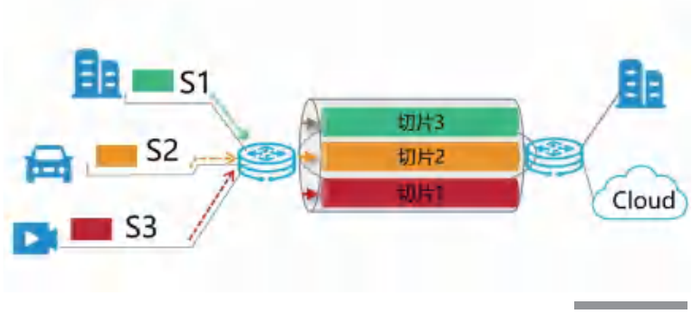
APN 助力需求精准感知
APN Promotes Precise Awareness of Demand



CFN 协议支持算力感知
CFN Protocol Supports Power Awareness



SRv6 实现智能选路
SRv6 Realizes Intelligent Routing



网络切片提供差异化服务
Network Slicing Provides Differentiated Services

IPv6+



欧拉开源操作系统

OpenEuler Open Source OS

华为技术有限公司
Huawei Technologies Co., Ltd.

引言

欧拉是面向数字基础设施的全场景开源操作系统。创造性地实现一套 OS 架构，支持多样性设备；应用一次开发，覆盖服务器、云、边缘、嵌入式等多场景，主流计算架构 100% 支持。

Introduction

The OpenEuler platform is positioned as an enterprise-class, reliable, and secure digital infrastructure operating system that unleashes diversified computing power. Open source contributes to the creation of a sustainable future. With the goal of building an open, diversified, and architecture-inclusive software ecosystem, the OpenEuler open source community is available to global developers. As a superior operating system for all scenarios, it supports multi-architecture computing, including server, cloud, edge, and embedded applications.

全面支持数字基础设施多样性设备，服务数字全场景

Full Support for All-Scenario Digital Infrastructure Devices

技术突破构建全场景操作系统：欧拉开创性地提出全栈原子化解耦，支持版本灵活构建、服务自由组合，通过一套操作系统架构，突破性实现对服务器、云、边缘和嵌入式等场景的支持。

All-scenario OS: OpenEuler proposes full-stack atomic decoupling in order to support flexible versioning and service combining. This OS supports server, cloud, edge, and embedded scenarios using a unified OS architecture.

支持多样性算力操作系统：支持 Intel、AMD、鲲鹏、飞腾、兆芯、龙芯、海光、申威等主流芯片，同时支持 NPU、GPU 和 DPU 等多种异构算力，建立了完整的硬件、软件兼容性测试规范。满足数字时代用户对多样性算力的灵活选择。

Diversified computing power: OpenEuler supports mainstream chips such as Intel, AMD, Kunpeng, Phytium, Zhaoxin, Loongson, Hygon, and ShenWei chips, and multiple processing units such as NPUs, GPUs, and DPUs. It also has complete test specifications for hardware and software compatibility. It meets requirements for diversified computing capabilities in the digital era.



通过一套操作系统架构，南向支持多样性设备，北向支持全场景横向对接开源鸿蒙通过能力共享实现生态互通
A Unified OS Architecture for Diversified Devices (Southbound) and All Application Scenarios (Northbound) Interconnecting with OpenHarmony for Shared Ecosystem Capabilities

全场景融合操作系统：欧拉通过五统一（统一内核、统一构建、统一 SDK、统一连接、统一开发工具），从根本上解决了面向不同场景操作系统的七国八制问题，整体性能提升 10~15%；同时面向开发者打造易用、易开发的工具套件，实现基于欧拉原生应用开发，快速构建友好的开发者生态。

Convergence for all scenarios: OpenEuler unifies kernel, build, SDK, connection, and development tool capabilities in order to resolve OS-device incompatibility issues, resulting in a 10% to 15% improvement in performance. Developers can design applications that run natively on OpenEuler by using a developer-friendly toolkit provided by Open Euler.

支持分布式软总线的数字基础设施操作系统：实现了欧拉和鸿蒙的互通，欧拉覆盖云管边，鸿蒙覆盖端，欧拉 + 鸿蒙共同服务于数字全场景。

Distributed soft bus: Interconnects OpenEuler and OpenHarmony. Combined with OpenHarmony, which covers terminal devices, the two operating systems provide an ecosystem of software for all aspects of digital life.



OpenEuler 22.03 LTS 发布
OpenEuler 22.03 LTS Released

持续推动技术创新和标准化建设：累计申请专利 328 件，已授权 248 件，牵头和联合发起标准 8 项，已荣获 15 个奖项。

Promoted technological innovation and standardization: Submitted 328 patent applications, of which 248 were accepted; led and co-initiated 8 standards, and won 15 awards.

生态繁荣，高速增长，规模应用

Vibrant Ecosystem with Rapid Growth and Large-Scale Application

主流伙伴推出商业发行版：16 家主流操作系统厂商，发布基于欧拉社区版的商业发行版：包括麒麟软件、统信软件、麒麟信安、SUSE、普华基础软件、拓林思、超聚变、H3C、中科创达、科东、中科院软件所、润和软件、中科红旗、中科方德、凝思软件、同源软件等伙伴。

Commercial releases launched by major partners: The 16 major OS vendors have launched their commercial releases based on OpenEuler community releases, including Kylinsoft, Uniontech, Kylinsec, SUSE, iSoft, Turbolinux, xFusion, H3C, ThunderSoft, Kyland, Institute of Software, Chinese Academy of Sciences (ISCAS), Hoperun, Red Flag Linux, NFS China, Linx, and Tongyuan.

头部企业发行自用版：中国移动、中国电信、中国联通、百度、华为云等行业头部企业均基于欧拉社区版发布企业自用版本，并运行于核心系统。

In-house releases developed by top enterprises: Companies in various industries, including China Mobile, China Telecom, China Unicom, Baidu, and Huawei Cloud, have developed their own operating systems based on OpenEuler community releases.

规模应用于各个行业的核心场景：截止目前，整个欧拉系的装机量累计超过 170 万套，规模应用在数字政府、运营商、金融、能源、交通、互联网等行业的核心场景。预计 2022 年底累计装机将超过 300 万套。

Large-scale application in various industries: Over 1.7 million Open Euler-based operating systems have been installed in various industries, including the public sector, carriers, finance, energy, transportation, and the Internet. In 2022, there are expected to be more than 3 million installations.

助力行业数字化转型，引领操作系统技术创新，贡献开源体系建设

Empowering Digital Transformation, Leading OS Technology Innovation, and Contributing to Open Source Construction

欧拉聚焦内核创新。华为作为欧拉开源社区成员，在 Linux Kernel 社区持续贡献，在 5.10，5.14 版本贡献全球领先。

The OpenEuler team is committed to the development of innovative kernels. Taking the lead in Linux Kernel versions 5.10 and 5.14, Huawei is a member of the OpenEuler open source community.

欧拉系操作系统广泛规模使用和稳定运行在各行各业的头部用户的核心系统，累计装机量已经超过 170 万套。



主流操作系统厂商和头部企业发布基于欧拉的发行版
Open Euler-based Distributions Launched by Major OS Vendors and Top Enterprises



欧拉的探索和实践
OpenEuler Exploration and Practices



The Open Euler-based operating systems of more than 1.7 million sets have been installed in various industries and are currently running in the core systems of major corporations.

欧拉开源社区吸引全球超过 370 家全产业链伙伴加入。

The OpenEuler open source community consists of more than 370 partners across the industry chain.

欧拉在技术、社区、商业、生态、人才和开源文化方面的发展经验可以为整个中国开源体系建设做出贡献。

Throughout the open source ecosystem in China, Open Euler's practices in technology, community, business, ecosystem, talent, and open source atmosphere serve as an example.

欧拉已经开通海外镜像，全球 120 个国家、1500 个城市的用户和开发者，共计下载镜像 55 万次。

OpenEuler mirrors have been set up outside China. Up to 550,000 downloads have been completed by users and developers in more than 1,500 cities in 120 countries and regions.

Most active 5.10 employers
By changesets

Huawei Technologies	1434	8.9%
Intel	1297	8.0%
(Unknown)	1075	6.6%
(None)	954	5.9%
Red Hat	915	5.7%
Google	848	5.2%
AMD	698	4.3%
Linaro	670	4.1%
Samsung	570	3.5%
IBM	521	3.2%
NXP Semiconductors	439	2.7%
Facebook	422	2.6%
Oracle	414	2.6%
SUSE	410	2.5%
(Consultant)	404	2.5%
Code Aurora Forum	313	1.9%
Arm	307	1.9%
Renesas Electronics	283	1.7%
NVIDIA	262	1.6%
Texas Instruments	215	1.3%

Most active 5.14 employers
By changesets

Huawei Technologies	1731	11.7%
Intel	1331	9.0%
(Unknown)	1003	6.8%
AMD	879	6.0%
Red Hat	854	5.8%
Google	756	5.1%
(None)	744	5.0%
Linaro	654	4.4%
SUSE	503	3.4%
IBM	445	3.0%
NVIDIA	319	2.2%
Oracle	290	2.0%
Canonical	278	1.9%
NXP Semiconductors	276	1.9%
Facebook	274	1.9%
Arm	255	1.7%
(Consultant)	229	1.6%
Renesas Electronics	203	1.4%
Linux Foundation	170	1.2%
Pengutronix	151	1.0%

华为在 Linux Kernel 5.10 版本贡献全球领先
Huawei Ranks No.1 in Contribution to Linux Kernel 5.10

基于数字对象架构的数联网及大数据互操作技术

Internet of Data Based on Digital Object Architecture and Big Data Interoperability Technology



北京大学
Peking University

中国电子
China Electronics Corporation

北京大数据先进技术研究院
Advanced Institute of Big Data, Beijing

引言

基于数字对象架构的数联网及大数据互操作技术面向数联网基础设施建设需求，突破开放、动态、复杂的互联网环境下数据跨域使用难题，实现可信可管可控的数据互联互通互操作。

Introduction

With the Internet of Data (IoD) and Big Data Interoperability Technology based on Digital Object Architecture (DOA), the needs for the construction of digitalization infrastructure are met. With reliable, manageable and controllable data interconnection and interoperability, the key technology challenges relating to cross-domain data use in an open, dynamic, incontrollable and complex Internet environment are overcome, resulting in reliable, manageable and controllable data interconnection and interoperability.

数据的协议化互联、场景化使用、可信化管控

Using data crossing domains via interconnection protocols and trustworthy mechanisms

本成果采用以数据为中心的开放式软件体系结构和标准化互操作协议，突破了数联网基础设施建设与大规模应用面临的数据跨域使用难题。主要特点包括：

The goal of this achievement is to break through the core technology bottleneck of the construction and large-scale application of the Internet of Things infrastructure by adopting a data-centric and open software architecture. Main features include:

协议化的数据互联框架。基于数字对象架构，将数据资源抽象为数字对象，通过数字对象接口协议规范数据的访问行为，有效控制数据异构性带来的数据互操作复杂性。

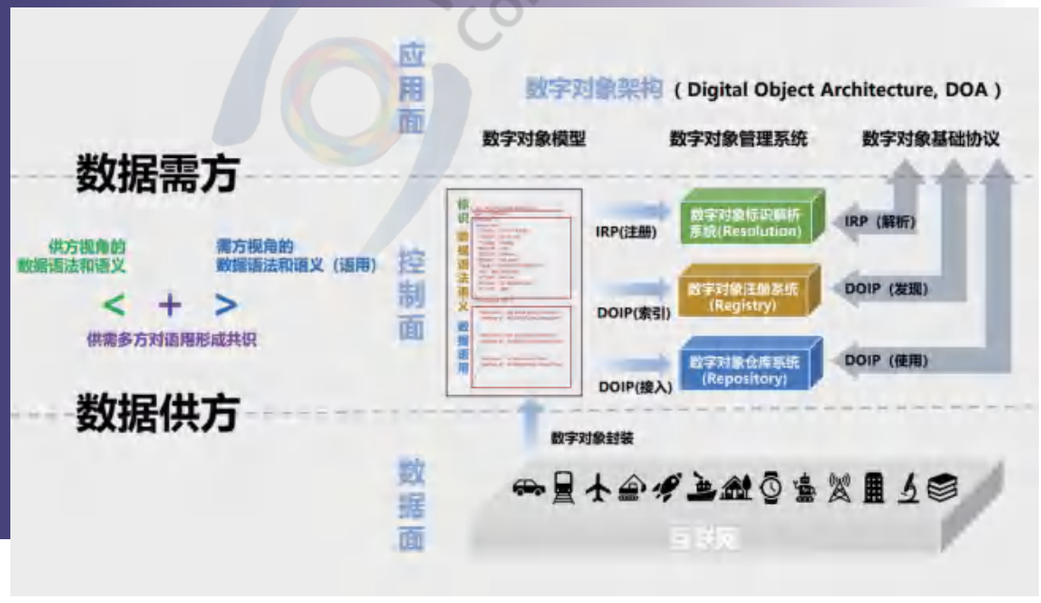
Protocol-based data interconnection. Based on the DOA, the data resources are modeled as digital objects, the data access is regulated by the Digital Object Interface Protocol (DOIP), and then the complexity of data interaction is significantly reduced.

场景化的数据使用模式。基于数据语用原理，采用数字对象操作序列定义给定场景中供需双方对数据语法和语义形成的共识，有效控制场景多样性带来的数据互操作复杂性。

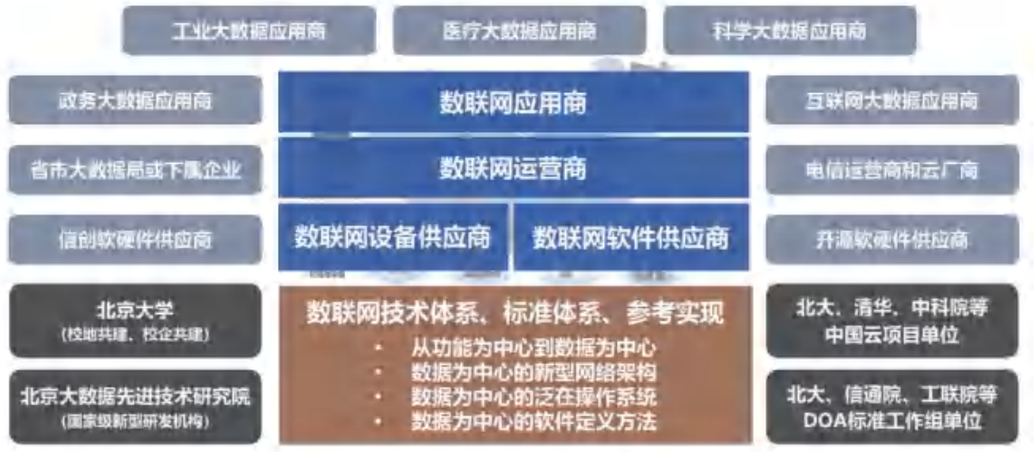
Scenario-oriented data interoperability. Based on the concept of data pragmatics, the consensus of the data syntax and semantics in the given scenario between the data suppliers and consumers is defined as a sequence of DOIP operations, and then the complexity of scenarios is controlled in a programmable manner.

可信化的数据管控机制。通过多主体自适应执行和随机见证共识机制，保障数据全生命周期使用行为和状态变更符合相关各方的要求且可全程追溯，提升数据互操作可信性。

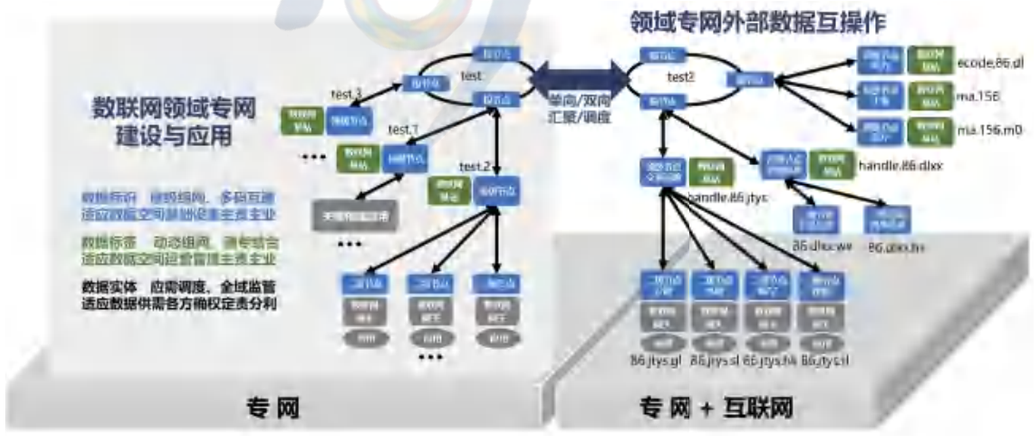
Trustable data use crossing domains. As the data access behavior and state change are self-adaptive and based on random-witness consensus mechanisms, the trustworthiness of data interoperation is enhanced.



基于数字对象架构的数据互操作模型
Data Interoperability Model Based on Digital Object Architecture



数联网技术与产业生态
Data Networking Technology and Industrial Ecology



行业主导、权责一致、域内自主、域间协作的数联网基础设施
Data Networking Infrastructure Dominated by the Industry, with Consistent Rights and Responsibilities, Autonomy in the Domain, and Collaboration Between Domains

开放开源、共建共治的数联网协同创新生态

Open eco-system of Internet of Data with open standard and open source

与互联网发明人、图灵奖得主罗伯特·卡恩博士及其团队开展合作，制定了数字对象架构两大核心协议之一的数字对象互操作协议的新版国际团体标准，实现了数字对象架构的两大核心协议、三大核心系统，并全部开源。至此，形成了以数字对架构为核心、国际先进、全球普适的数联网中国方案。

In cooperation with Dr. Robert Kahn, the inventor of the TCP/IP and the winner of the Turing prize, and his team, the team established a working group to develop and implement the DOA standards, and the team published the new version of the DOIP, one of the two core protocols of the DOA. This achievement implements and open-sources the two core protocols and three core systems of the DOA.

在此基础上，与中国数十家高校、科研机构和行业龙头企业共同开展多个关键领域的数联网基础设施和重大应用的建设和运营，初步形成覆盖中国的数联网领域产学研用、协同创新格局。

Furthermore, the team have established collaborations with dozens of Chinese universities, research institutions, and enterprises to construct and operate IoD infrastructures and applications in a variety of domains, such as medicine, energy, and manufacturing.

数联网正在成为多个行业和区域的以数据为中心的新型基础设施

Internet of Data is becoming the data-centric infrastructure in many domains

政务、工业、能源、医疗、科研等多个关键领域的数联网建设正在稳步推进，并开始支撑重要领域应用。例如，基于数联网的中国工业互联网数据要素登记（确权）试点，构建了中国－省－地市三级架构的数据要素登记（确权）平台，是工业数据要素市场化配置的基础，也为打造全国工业数据资产地图提供了条件。

In recent years, the Internet of Things (IoD) has made significant progress in the fields of government affairs, industry, energy, medicine, scientific research, and other domains, and it has begun to support applications in these areas. As an example, the team have constructed a data element registration platform with a three-level structure of state, province, and city based on the industrial IoD and the pilot construction of China's industrial data element registration (and confirmation of rights). As a result, it provides conditions for the creation of a national industrial data asset map based on market-oriented configuration of industrial data elements.

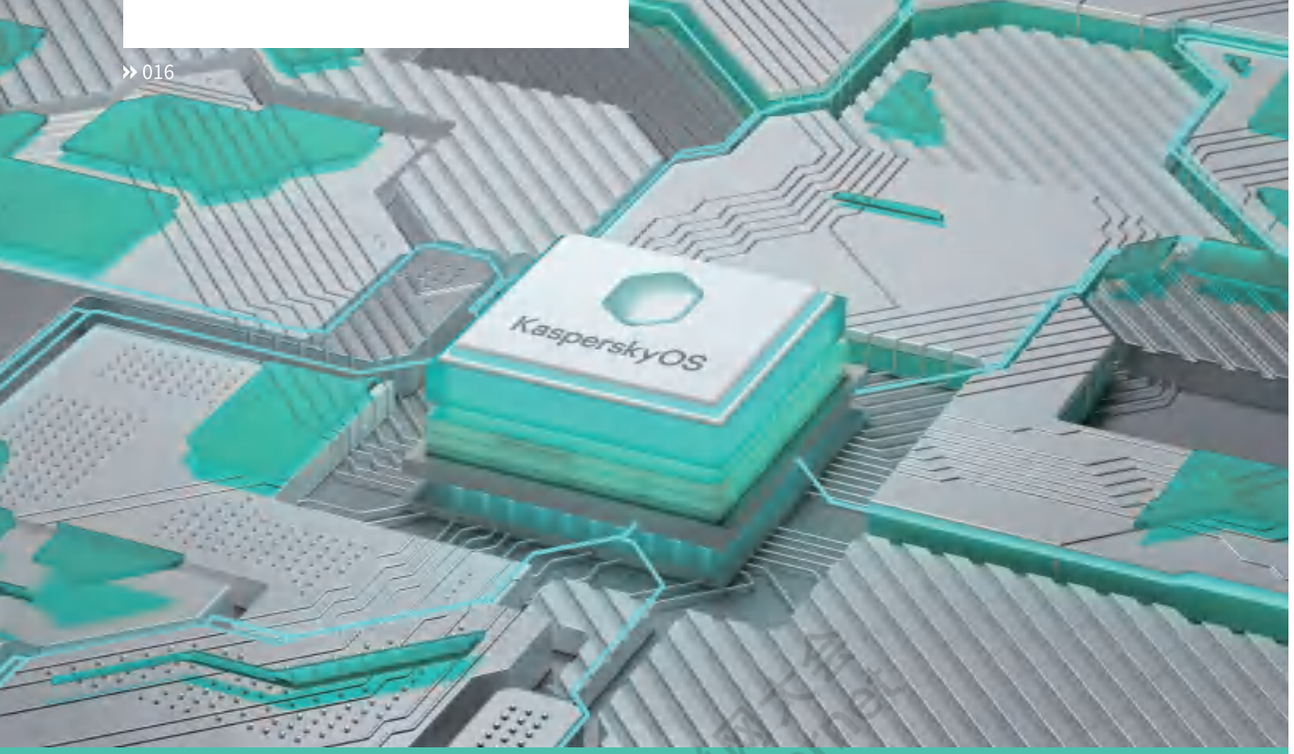
开启数联网“天地一体”新征程

Unified space and ground Internet of Data

2021 年 12 月，数联网卫星节点发射升空，验证了数联网星地链路的连通性和天地数据互操作的有效性，开启了数联网技术发展的新征程。

IoD satellite node has been launched in December 2021, verifying interconnection between satellites and ground nodes and interoperability of satellite-ground data, which marked a new chapter in the development of IoD and DOA technology.





卡巴斯基安全远程工作空间（基于卡巴斯基操作系统）

Kaspersky Secure Remote Workspace (Based on KasperskyOS)

卡巴斯基
Kaspersky

升腾（Centerm）（俄罗斯 TONK）提供了硬件平台、技术支持和专家支持。
Centerm (TONK in Russia) provides hardware platform, technical and expert support.

kaspersky
Centerm
TONK

引言

企业用户的工作站是网络攻击和恶意软件最常见的目标之一。使用瘦客户机是控制对其攻击风险的可行方法之一。要将攻击风险降至最低，还要构建基于瘦客户机硬件的安全设计解决方案。卡巴斯基操作系统成功将这一理念化为了现实。

Introduction

Cyberattacks and malware deployments are common targets on enterprise workstations. To reduce the risk of attack, thin clients can be used instead of traditional personal computers. In order to reduce this risk to a minimum, KasperskyOS built a secure-by-design solution based on thin client hardware.



“卡巴斯基网络免疫”设计奠定产品强大性能

"Kaspersky Cyber Immunity" design lays the foundation for the strong performance of the product

卡巴斯基的“网络免疫”（Cyber Immunity）概念，将理念与方法、安全的架构和专有微内核操作系统卡巴斯基操作系统（微内核由卡巴斯基从零着手开发）集合于一体，是瘦客户机“设计即安全”（secure-by-design）基础设施的基石。

Kaspersky Cyber Immunity - a unique combination of ideology, methodology, secure architecture, and Kaspersky OS (the microkernel was developed from scratch by Kaspersky) enables secure-by-design thin client infrastructure.

其对应的解决方案（即卡巴斯基安全远程工作空间）结合了以下内容:

Kaspersky Secure Remote Workspace is a combination of the following features:

卡巴斯基瘦客户机是一款软件产品，安装在 TONK TN1200 硬件平台上，可显著提高端点安全性。

The Kaspersky Thin Client (KTS) is an endpoint security solution that is installed on the TONK TN1200 hardware platform, which significantly enhances the security of endpoints.

卡巴斯基安全中心，是卡巴斯基产品的企业级管理控制台。

An enterprise-grade management console for Kaspersky products, Kaspersky Security Center (KSC).

卡巴斯基安全管理套件，是卡巴斯基安全中心的专用内插式模块，可集中管理瘦客户机基础架构。

Furthermore, Kaspersky Security Management Suite (KSMS) enables centralized management of thin client infrastructure as an add-on module for Kaspersky Security Center.

这有助于从单个中心管理多达 100,000 个节点：为所有瘦客户机进行监控、配置和交付更新。 当连接到卡巴斯基远程工作空间基础架构时，瘦客户机端进行自动软件部署、漏洞评估、修补和注册、配置。

This helps management of up to 100000 nodes from one center: monitoring, configuring, and delivering updates for all thin clients. When connected to the Kaspersky remote workspace infrastructure, the thin client end performs automatic software deployment, vulnerability assessment, patching, registration, and configuration.

卡巴斯基安全远程工作空间最具创新性的成果在于，我们不仅设法将端点安全性提高到了以往无法企及的水平，还改进了 IT 端点的生命周期，包括部署、配置、库存管理和补丁 / 更新管理。

With Kaspersky Secure Remote Workspace, one of the most innovative achievements has been the improvement of endpoint security to previously unreasonably high levels, as well as the enhancement of IT endpoint lifecycle management, such as deployment, configuration, inventory management, and patch/update management.



百余试点项目证明良好推广基础

More than 100 pilot projects proved a good basis for promotion

卡巴斯基安全远程工作空间在诸多领域均具备优势。在这些领域里，均由大量工作站执行相同的任务，且采用一套标准的应用程序，例如：

Using Kaspersky Secure Remote Workspace can be beneficial in many situations that involve a large number of workstations that perform similar tasks and use a standard set of applications. For example:

- 公共部门
- 银行、金融服务和保险（统称 BFSI）
- 医疗保健
- 教育
- 工业自动化
- 能源、天然气和石油
- 零售

- Public Sector
- Banking, Financial Services and Insurance (BFSI)
- Healthcare
- Education
- Industrial Automation
- Energy, Gas and Oil
- Retail

卡巴斯基安全远程工作空间解决方案，已于 2022 年初起供客户与合作伙伴使用。迄今为止已经执行了百余个试点项目，为多个公共组织和高校机构实施了网络免疫性瘦客户机基础设施项目。

Customers and partners have been able to use Kaspersky Secure Remote Workspace since the beginning of 2022. Over 100 pilot projects have been completed for clients by the team. For public organizations and university institutions, which have already implemented cyber-resistant thin client infrastructure projects.

卡巴斯基计划于 2023 年在其经营有业务的所有市场投放该解决方案。目前卡巴斯基产品在超过 200 多个国家和地区进行销售。

Kaspersky intends to deliver the solution to markets where it has already established a presence in 2023. Kaspersky products are used in more than 200 countries and territories.

创新技术实现成本节约

Innovative technology enabled cost savings

据卡巴斯基的研究结果显示，使用卡巴斯基安全远程工作空间后，至少可将工作场所的总拥有成本（TCO）降低 20%。原因在于，与使用基于其他操作系统的传统台式机、笔记本电脑或上网本相比，无需购买防病毒产品，从而能够节省大笔资金。此外，卡巴斯基瘦客户机还是一款“设计即安全”的设备，且性能水平与其他解决方案相当。

According to Kaspersky's research, using Kaspersky Secure Remote Workspace can reduce an organization's total cost of ownership by at least 20% as compared with using classical desktops, laptops, and nettops based on other operating systems. Furthermore, the Kaspersky Thin Client is a device that is already secure by design with the same level of performance as other solutions.

工作场所成本得以优化的企业，能够将这笔投资用于改善员工所处的社会环境。

By optimizing workplace costs, companies are able to improve their employees' social environments.

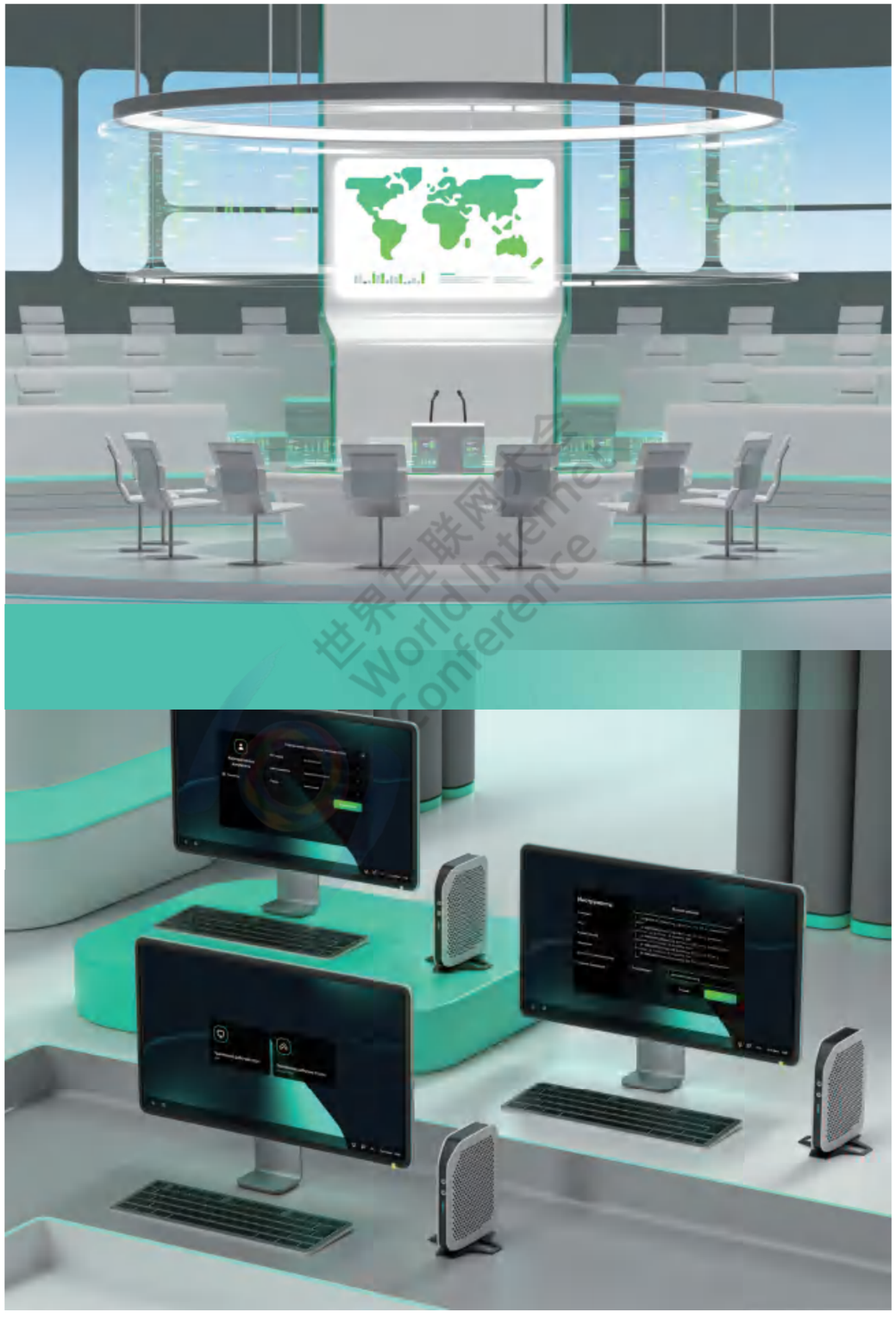
专利产品激励行业发展

Patents and products stimulate the development of the industry

迄今为止，卡巴斯基远程工作空间已经获得 5 项中国国家专利。卡巴斯基相信，未来的 IT 和信息安全将朝着网络免疫的方向迈进。目前卡巴斯基在创建免疫性解决方案方面已领先于竞争对手。然而，尽管卡巴斯基已占据了领先地位，其他企业同样也有必要开发此类解决方案。为了激励这些企业，卡巴斯基与技术合作伙伴一起发布了商用网络免疫产品，目前已上市。

Kaspersky Secure Remote Workspace has received five Chinese national patents to date. As a company, Kaspersky believes that Cyber Immunity is the future of IT and information security. Currently, Kaspersky is ahead of its competitors when it comes to developing immune solutions. Although Kaspersky holds the leading position in this field, other companies are also required to develop similar solutions. In order to inspire other companies, Kaspersky have released commercial Cyber Immune products, which are currently available on the market.

kaspersky



数字内容虚假伪造检测系统和设备

Digital Content Forgery Detection System and Equipment

中国科学院计算技术研究所
Institute of Computing Technology, Chinese Academy of Sciences

北京中科睿鉴科技有限公司（联合申报机构）
Beijing Zhongke Ruijian Technology Co.,Ltd.



引言

近年来，虚假伪造信息在全球互联网的大肆传播给国际公共安全带来严峻挑战。团队分别研发了中国虚假新闻自动检测平台“睿鉴识谣”、软硬协同优化的伪造检测系统及专用设备，为互联网内容安全做出重要贡献。

Introduction

False and fake information has been produced and disseminated over the Internet in recent years, posing a threat to public safety. As part of the research project, the team developed the first Chinese automatic system for detecting false news, Ruijian Shiyao, as well as the first automated system for detecting forgeries, based on software and hardware collaboration and equipment. It is essential that these products contribute to the security of online content.

层层解构技术难题，打造互联网 3.0 时代数据可信底座

Deconstructing technical problems for a credible base of data in Web 3.0

虚假伪造信息已成为全球互联网面临的共同难题，团队在算法创新、系统搭建、落地应用上进行全面布局，历经 9 年攻坚，形成两大里程碑成果：

The global Internet has been plagued by the issue of information forgery. In terms of algorithms, systems, and products, the team has developed a comprehensive picture of false information detection. Two milestone achievements have been achieved and have been applied in practice after nine years of collaborative work:

研发中国 “睿鉴识谣”虚假新闻自动检测平台。针对真实应用场景中所面临的信息不完整性、任务不确定性、环境强对抗性问题展开科技攻关，围绕内容可信、传播可信、用户可信多个维度提出了一系列的信息可信度度量方法。该平台运行 9 年，积累了百万级的争议性新闻线索，十万级的精标谣言数据集，在中国重大事件的虚假信息治理中发挥了重要作用。

The first Chinese automatic false news detection system, Ruijian Shiyao, was developed. In order to measure the credibility of information from diverse perspectives, including the content, the user, and the propagation, the team has proposed a series of methods for assessing information corruption, task uncertainty, and environment adversary in real-world scenarios. For nine years, the platform has accumulated millions of controversial news clues and 100,000 data sets of precise standard rumors, and has played an important role in preventing false information during major events.

研发“图像视频伪造检测与溯源专用设备”。在全球图像视频伪造检测规模化实战部署中，为破解有关精度和性能挑战这两大难题，团队基于软硬跨层协同优化技术，研制出基于中国芯片的伪造检测专用设备：图片及视频的平均检测耗时达到毫秒级，加速比达 10 倍，可支持处理现网流量 2GB/ 秒的并发需求，大大压缩了规模化部署的硬件成本。

The development of equipment for the detection and attribution of image and video forgeries. For the purpose of meeting the urgent need for large-scale, high-accuracy, high-performance forgery detection equipment, the team developed the first Chinese chip-based forgery detection equipment based on cross-layer software and hardware optimization technology. Having an average detection time of 10 ms per image and an acceleration ratio of 10 times, it is capable of handling 2 GB/sec of network traffic concurrently, which significantly reduces the cost of hardware for large-scale deployments.

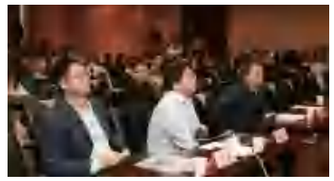
关键节点落地应用，形成中国互联网虚假伪造信息监管治理闭环

Deploying as the key projects and forming a closed loop of supervision and governance of false and forgery information on the Internet

睿鉴伪造检测系统及专用设备已在多个政府部门及互联网媒体企业中落地应用，持续维护国家网络信息安全与稳定。在近期的重大国际事件中，平台快速形成虚假信息专题分析报告，为国家应急处置工作提供有效的决策依据。

The products developed by the team have been applied by government agencies and major online media platforms, protecting the information security of the Internet. An effective decision-making basis for national emergency response was provided by the platform following recent major international events. The platform quickly produced special analysis reports on false information circulated online, enabling effective decision-making.

为推动全球行业发展，团队多次举办论坛及学术比赛，并先后向国内外同行公布了多个中国多模态虚假新闻数据集。在新冠疫情期间，组织举办“2020 科技战疫 – 疫情期间虚假新闻检测比赛”，受到全球学术界及工业界的广泛关注，共计 672 支队伍参赛报名参与了比赛。



各界专家出席 2019 互联网虚假新闻检测全球挑战赛践
The Academic Forum for the 2019 BAAI-ICT False News Detection Global Challenge



北京卫视《科学流言榜》栏目，曹娟研究员正在向公众普及鉴伪技术
At the BRTV Show Scientific Gossip List, Professor Juan Cao Popularizes Forgery Content Detection Technology to the Public

As part of its efforts to promote the global development of the detection of false and forged information, the team has organized a number of academic forums and competitions as well as released the largest Chinese multimodal dataset for the detection of fake news. During COVID-19 Pandemic Competition, we organized the 2020 Fake News Detection competition, which attracted the attention of global academic and industry peers. The competitions have been attended by 672 teams.

倾力普及工具，让虚假伪造检测技术走进百姓

Building false and forgery detection tools for everyone

睿鉴立足社会，面向公众免费开放“睿鉴 AI”微信小程序，提供新闻可信度查询、图片和视频伪造检测等服务，至今累计提供查询服务 31 万余次；从 2018 年起，共计发布 800 多次辟谣信息，推荐阅读量达 1.3 亿。与北京电视台、凤凰卫视等电视平台长期合作打造新闻鉴伪栏目《科学流言榜》和《新闻鉴证组》，协同提供更深度、更准确的未来新闻服务，全方位打造公众自身“免疫力”。

The team developed the applet Ruijian AI, which offers free services for assessing news credibility and detecting fake images and videos. The applet has been visited by more than 310 thousand users so far. Since 2018, Our Toutiao channel AI Shiyao has been providing timely rumor refutation to the public. With a cumulative reading volume of more than 130 million, the channel has released more than 800 rumor refutation articles. In the future, the team will cooperate with the TV shows "Scientific Gossip List" on BRTV and "News Verification Group" on Phoenix TV in order to provide more in-depth and accurate information.



睿鉴 AI 微信小程序免费向公众提供鉴伪服务
The Applet Ruijian AI, which Provides Free Forgery Detection Services



成果已在 Gcash、DANA、TMB 等多个国外金融机构得到应用。成果支持菲律宾头部移动支付提供商 GCash 分布式可扩展构架升级，助力 GCash 在业务高速增长中实现降本增效目标，并具备多可用区金融级容灾的能力。使用该成果后，GCash 存储空间下降 70%，资源成本降低 40% 以上。成果支撑了印度尼西亚支付公司 Dana 千万级别用户业务的稳定运行，2020 年数据库零故障，数据零丢失，业务系统整体可用性超高。

GCash, DANA, and Telenor Microfinance Bank (TMB) are among the financial institutions outside China that have used OceanBase Database. In the Philippines, OceanBase Database helped GCash to upgrade its payment system into a distributed scalable architecture using a distributed database. Through this system, GCash can improve efficiency at lower costs during times of rapid business growth, as well as implement a multi-zone disaster recovery system of financial grade. In addition to reducing GCash's storage requirements by 70%, OceanBase Database also reduces its resource costs by more than 40%. In Indonesia, DANA, a payment service provider, has been able to maintain a stable service for tens of millions of customers through OceanBase Database. The overall availability of DANA's business system was extremely high in 2020, ensuring zero faults and zero data losses.

引言

成果由蚂蚁集团自 2010 年开始完全自主研发，有效解决了联机事务处理关系数据库在强一致性前提下水平扩展的难题，事务处理能力达到国际领先水平。成果已经在国内外 400 余家机构的核心系统得到部署应用，广泛覆盖政务、金融、通信、能源等多个国计民生领域，服务全球用户超过 15 亿，直接和间接经济效益达数百亿元。

Introduction

A fully developed in-house database, OceanBase Database has been updated periodically since 2010. OceanBase Database is a relational database management system capable of supporting online transaction processing (OLTP) in a horizontally scalable architecture, demonstrating a world-class transaction processing capability. A wide range of industries related to the national economy, including government affairs, finance, telecommunications, and energy, have implemented OceanBase Database to power their core business systems. The service is used by more than 1.5 billion people worldwide, contributing to ten billion CNY in direct and indirect economic benefits.

事务处理能力全球领先的全自研国产分布式关系数据库

Distributed relational database developed by a company with a global leadership position in transaction processing

成果由蚂蚁集团完全自主研发，在分布式事务处理、新型存储、无损自动容灾技术等方面具有显著创新，解决了传统数据库面临的扩展性不足、存储成本高、容灾恢复丢数据等问题。其主要创新如下：

The OceanBase Database has been developed entirely by Ant Group in-house. This database makes significant advances in distributed transaction processing, novel storage, and lossless automatic disaster recovery, and overcomes a number of drawbacks associated with conventional databases, such as poor scalability, high storage costs, and data loss during disaster recovery. OceanBase Database innovations include:

数据库系统的无损容灾技术和“三地五中心”城市级故障无损自动容灾方案，实现了在多数派副本正常的情况下保证数据不丢失和服务不中断，RPO=0、RTO<30。

An unprecedented city-level lossless disaster recovery solution is supported by OceanBase Database. A total of five IDCs are deployed across three regions to ensure no data loss or service interruption when the majority of replicas are operating properly, with a recovery point objective (RPO) of 0 and a recovery time objective (RTO) of less than 30 seconds.

研发了每秒千万次事务处理能力的分布式事务处理技术，实现了关系数据库的无限水平扩展和分布式事务的强一致性。在 TPC-C 基准测试中，基于搭建的 1557 台数据库集群，以 7.07 亿 tpmC 的成绩领先全球。

OceanBase Database is capable of processing tens of millions of transactions per second. In this way, relational databases are able to scale horizontally indefinitely and distributed transactions are able to maintain strong consistency. In the TPC-C benchmark test, OceanBase Database was ranked first with 707 million tpmC, which is leading globally.

研发了高压缩比的分布式数据库存储技术，解决了集中式数据库无法平衡“性能”和“压缩”的难题，显著降低了数据存储成本。据中国软评中心数据显示，中国石化使用该成果后，23 套分散系统统一至 1 套，数据存储空间降低为原来的八分之一。

Data storage with a high compression ratio offers customers the ability to leverage database performance and data compression, which is not possible with centralized databases, as well as lowering storage costs significantly. CSTC statistics indicate that OceanBase Database has assisted Sinopec in integrating its 23 dispersed systems into one and has reduced storage costs by approximately 87.5%.

研发了保护技术无形资产的异构数据库平滑迁移技术体系，最大程度降低了现有系统的扩展、迁移改造成本。实现了中华保险和中国移动（山东）在原有 Oracle 上开发的上千万行代码遗产系统的平滑迁移和应用无改造。

Streamlined data migration from heterogeneous databases: This technology protects the company's intangible technical assets and minimizes the cost of scaling and modifying the existing system. China Insurance Corporation (CIC) and China Mobile Shandong have successfully migrated tens of millions of lines of code developed from Oracle databases to OceanBase Database without modifying the applications.



山东移动项目完成迁移
Migration Completed for China Mobile Shandong

服务全球 400 余家企业核心系统的稳定运行和长效发展

Stable Operation and Sustainable Development: Serving the Core Business Systems of More Than 400 Enterprises Worldwide

成果满足“数字经济”时代各行业数字化转型对基础设施架构的新需要，适合在裸机环境和云端部署、运行，亦可以弥补集中式架构的短板。经过十余年的发展，成果已在金融、政务、运营商、能源、交通、互联网等多个关键行业得到广泛应用，支撑了蚂蚁集团、网商银行的全部核心系统，以及工商银行、常熟农商行、红塔银行、招商证券、中国人民保险、中华保险、中国石化、阿里巴巴等 400 余家机构的核心系统的稳定运行。成果自 2013 年开始应用于蚂蚁集团内部业务，已覆盖支付宝 100% 核心链路，支撑会员、交易、支付、账务等全部核心业务，并连续确保了支付宝 9 年“双十一”交易的稳定运行。

In this era of the digital economy, the OceanBase Database meets the requirements of a number of industries for infrastructure during digital transformation. It can be deployed and run on bare metal or in the cloud, and it can compensate for the shortcomings of a centralized architecture. OceanBase Database has been widely applied in several key industries, including finance, government affairs, telecommunications, energy, transportation, and online services. All core business systems of Ant Group and Mybank, as well as those of ICBC, Changshu Rural Commercial Bank, Hongta Bank, China Merchants Securities, PICC, CIC, Sinopec, and Alibaba Group, are supported by this system. In 2013, OceanBase Database was first deployed within Ant Group's internal business systems. Currently, it supports all core links of Alipay as well as all core business systems such as membership, transactions, payments, and accounting. During the massive Double Eleven Shopping Festival, it was able to ensure the stable operation of Alipay for nine consecutive years.



2018 支付宝双十一中的 OceanBase 团队 2018 双十一中的 OceanBase 团队
The OceanBase Team in the Double Eleven Shopping Festival 2018

有效解决数据库卡脖子难题，并在降本增效、节能减排方面成效显著

Achieving remarkable results in cost reduction, efficiency improvement, energy conservation, and emission reduction by breaking the stranglehold of database technologies

成果在确保使用机构业务稳定运行的前提下，在提升其业务效率、节省存储空间、降低采购和运维成本方面成效显著。

Currently, OceanBase Databass provides stable business operations, improves business efficiency, reduces storage space requirements, and lowers procurement and operation and maintenance costs.

成果的成功研发和规模化应用，为数据库领域的国际竞争提供了新的赛道与空间，为各行业分布式架构转型奠定了坚实的基础。

OceanBase Database has been successfully developed and commercialized, enabling it to compete internationally in the field of database management. For enterprises in various industries, it provides a solid foundation for transforming their systems into distributed architectures.

国内首个全面自主开源的分布式关系数据库

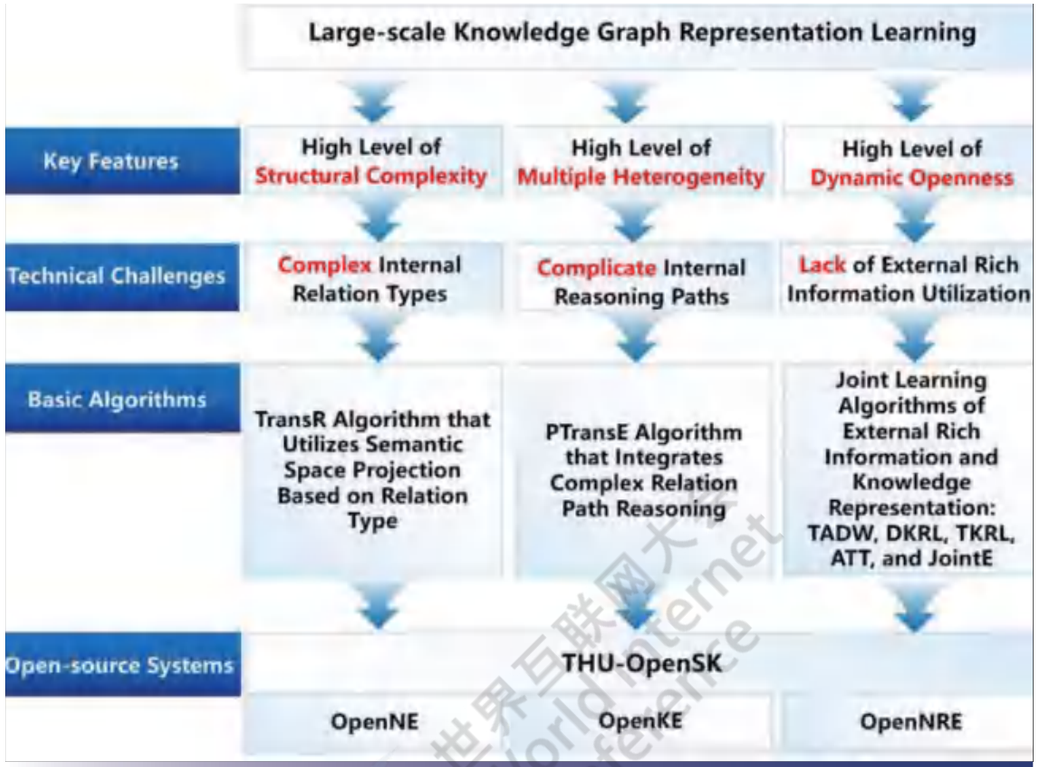
The First Fully In-house Developed and Open-source Distributed Relational Database in China

成果 300 万行核心代码已全部在国内木兰社区开放，致力于构建我国自有产权的数据库产品技术路线和生态体系。开源一年来，已有近 3.39 万名社区用户和 129 位核心代码贡献者，拥有 4.5k 个 Star。成果开源版已应用于快手、携程、贝壳、银联、阳光保险、中国电信、58、360、京东等 200 余家机构。通过开源社区、高校共建人才基地等方式，已累计为行业培养 1 万余名认证数据库人才，教学合作覆盖国内 20 余所高校。

In the Mulan Open Source community, OceanBase has released three million lines of core code. A technology roadmap is being developed that will lead to a Chinese company owning a database ecosystem. The open-source community has attracted approximately 33,900 users and 129 core code contributors over the past year. Over 4,500 stars have been awarded to the project. More than 200 companies have deployed OceanBase Community Edition, including Kuaishou, Trip.com, KE Holdings, UnionPay, Sunshine Insurance, China Telecom, 58.com, Qihoo 360, and JD.com. OceanBase has trained more than 10,000 database professionals through its open-source community and talent incubation partnerships with more than 20 universities in China.



中环联合认证中心（CEC）测算结果
Statistics by China Environmental United Certification Center (CEC)



The Framework of Systematized Basic Algorithms and Open-Source Tools for the Representation Learning of Large-Scale Knowledge Graph

大规模知识图表示学习的体系算法及开源工具

Systematized Basic Algorithms and Open-Source Tools for Representation Learning of Large Scale Knowledge Graph

清华大学
Tsinghua University

引言

大规模知识图及其计算是网络时代海量内容智能信息处理的基础“软”设施。清华大学适时提出并构建了大规模知识图表示学习的体系化基础算法及其开源工具，在学术创新和开源共享方面取得了具国际领先性和影响力的成果。

Introduction

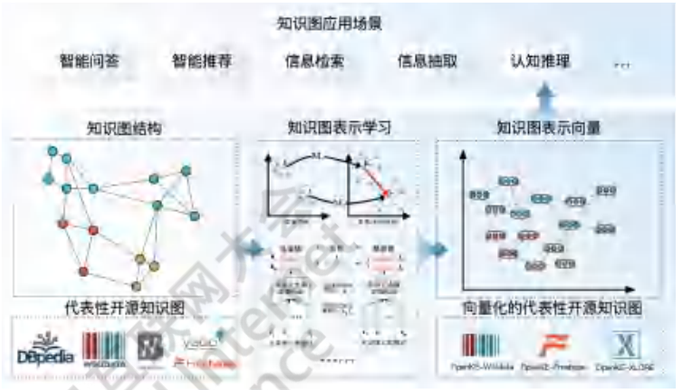
In the Internet era, large-scale knowledge graphs and their computations serve as a "soft" infrastructure for intelligent information processing of massive amounts of content. In academic innovation and open-source sharing, Tsinghua University contributed world-leading and influential results by proposing and constructing the systematized basic algorithms of large-scale knowledge graph representation learning.

国际领先的大规模知识图表示学习体系化基础算法

World-leading systematized basic algorithms for representation learning of large scale knowledge graph

知识图计算是发展新一代人工智能的重大前沿挑战。本成果针对大规模知识图表示学习中内部关系类型复杂、内部推理路径繁复和外部富信息利用匮缺这三个全局性技术难题，建立了基于深度学习框架的体系化基础算法。技术创新包括：基于关系类型专属语义空间投影的 TransR 算法、复杂关系路径推理的 PTransE 算法、融合实体文本属性信息的 TADW 算法、融合实体定义文本描述信息的 DKRL 算法、融合实体类型层次信息的 TKRL 算法、融合关系文本描述信息的 ATT 算法以及互注意力机制驱动的语言模型与知识图耦合 JointE 算法等。

A new generation of artificial intelligence is facing the challenge of large-scale knowledge graph computing. To address three key scientific problems in large-scale knowledge graph representation learning, this project develops systematized fundamental algorithms based on the deep learning paradigm. These problems include the complexity of internal relation types, the complexity of internal reasoning paths, and the insufficient utilization of external rich information. There have been numerous technological innovations, including : The transR algorithm based on relation-specific semantic space projection, the PTransE algorithm for complex relation path reasoning, the TADW algorithm for the fusion of entity-related text attributes, the DKRL algorithm for the fusion of entity definition text description information, and TKRL algorithm for the fusion of entity-related type hierarchy information. The ATT algorithm integrates relational text description information, and the JointE algorithm, employs a mutual attention mechanism in order to perform language modelling and knowledge graph representation learning simultaneously.



知识图表示学习在人工智能研究和应用领域中的全局性重要作用
The Overall Importance of Knowledge Graph Representation Learning in Artificial Intelligence Research and Application

本成果 8 篇代表性论文得到了国际学术界广泛关注，Google Scholar 引用共 6185 次（最高单篇引用达 2611 次），引用者包括图灵奖获得者 Yoshua Bengio、美国国家工程院院士 Tom Mitchell、美国艺术与科学院院士 Tomaso Poggio 等。其中 2 篇分别在人工智能领域国际顶级会议 IJCAI 2015-2020 和 AAAI 2015-2020 发表的全部 3934 篇和 5392 篇论文中，学术影响力排名第二、第五。

This project's eight representative papers have received extensive attention and citations in the international academic community, with a total of 6,185 citations in Google Scholar (the highest citation for a single paper reaches 2,611). Citations include Turing Award winner Yoshua Bengio, National Academy of Engineering member Tom Mitchell, and American Academy of Arts and Sciences member Tomaso Poggio, among others. It is noteworthy that two of the papers ranked second and fifth in citations among the 3,934 papers published in IJCAI 2015-2020 and the 5,392 papers published in AAAI 2015-2020, which are the top-tier international artificial intelligence conferences.

深具国际影响力的知识图表示学习开源系统

Internationally Influential Open-source System for the Representation Learning of Knowledge Graph

本成果在世界影响力最大的开源平台 GitHub 上开源，形成了清华大学大规模知识图表示学习系统 THU-OpenSK，包括 OpenKE、OpenNE、OpenNRE 三套开源工具包，共获 10722 个星标及 3180 次分支创建，在开源时间、星标、分支创建等方面超过国际和中国一流研究机构和企业同类型工具，开源地位居知识图表示领域全球领先之列，成为国际上知识图表示学习的体系化主流工具之一。以 THU-OpenSK

为标志性核心内容的清华大学自然语言处理开源项目 THUNLP 在 GitHub 上受到较高关注。THU-OpenSK 也部署在启智新一代人工智能开源开放平台 OpenI 上，有力支持了开源应用生态建设。

The project was open sourced on GitHub, one of the world's most influential open-source platforms, forming THU-OpenSK, a large-scale knowledge graph representation learning system developed by Tsinghua University. OpenKE, OpenNE, and OpenNRE are three open-source toolkits included in THU-OpenSK, which has been rated 10,722 stars and has been forked 3,180 times. Open-source timing, stars, and forks of the system surpass those of international and Chinese research institutions and enterprises. The influence of THU-OpenSK on open source in the field of knowledge graph representation learning is among the leading positions in the world today, becoming one of the mainstream systematized tools for knowledge graph representation learning worldwide. On GitHub, Tsinghua University's THUNLP project, with THU-OpenSK as its core content, attracts huge amount of attention. Besides THU-OpenSK, OpenI is a new open-source platform of artificial intelligence, which supports the ecological construction of open-source applications.

为人工智能时代知识工程及计算提供关键资源

Contributing Key Resources for the Development of Knowledge Computing in the Era of Artificial Intelligence

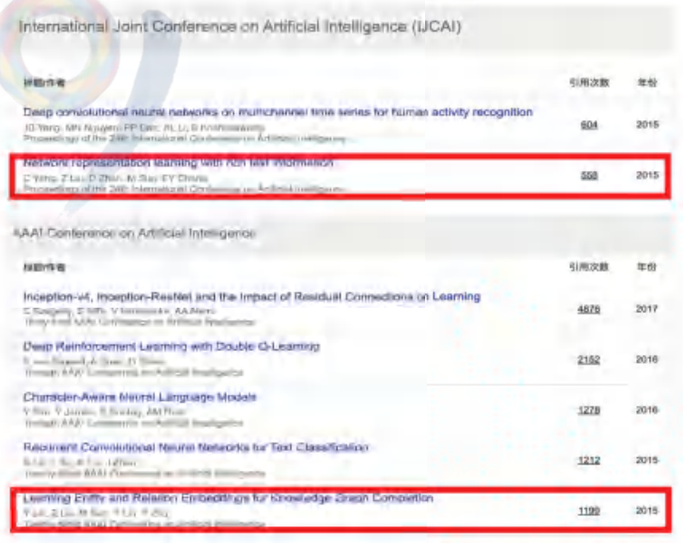
2017 年 THU-OpenSK 成功应用于世界上著名的通用知识图 谱 Freebase 和 Wikidata，构建了两个千万级实体与亿级关系三元组规模的知识图表示模 型 OpenKE-Freebase 和 OpenKE-Wikidata，是国际上较早公开发布的大规模知识图表示模型，为人工智能时代知识工程提供了关键资源。已有来自国际和中国数百个机构的研究开发者使用，产生了良好社会经济效益。

获中国发明专利授权 10 项。相关技术在腾讯微信中实际应用，有效提升了用户体验，显示了对助推数字产业智能化水平的积极作用。

In 2017, Thu-OpenSK was successfully applied to two of the famous large-scale general knowledge graphs in the world, Freebase and Wikidata, establishing two knowledge graph representation models based on 10 million entities and 100 million relational triples each. In the era of artificial intelligence, these are two relatively earlier published large-scale, open-source knowledge graph representation models in the world, contributing key resources to the development of knowledge computing. It has been used by researchers at hundreds of institutions both at home and abroad, resulting in a positive social impact.Ten national invention patents have been obtained as a result of this project. Tencent WeChat has successfully applied some of the techniques of this project, resulting in an improved user experience, thus promoting the intelligent level of the digital industry.



大规模知识图表示学习的体系化基础算法及开源工具系统架构

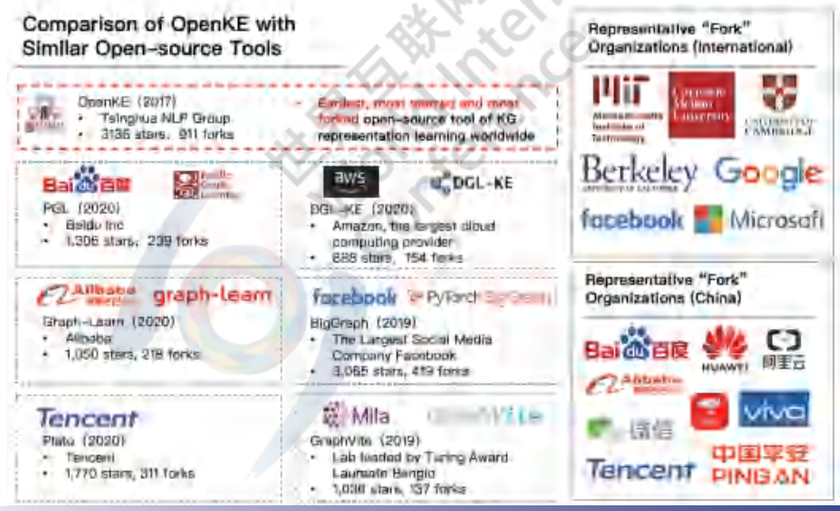


发表于 IJCAI、AAAI 的 2 篇代表性论文的国际学术影响（数据来源：Google Scholar）

International Academic Impact of Two Representative Papers Published in IJCAI and AAAI (Data Source: Google Scholar)



THU-OpenSK 中 OpenKE 的开源影响力
（数据来源：GitHub）



Open-source Influence of OpenKE in THU-OpenSK (Data Source: GitHub)



THUNLP 的开源影响力（数据来源 :Gitstar）



Open-source Influence of THUNLP(Data Source: Gitstar)

中国电信骨干全光网创新与应用

Innovations and Applications of China Telecom Backbone All-Optical Network

中国电信集团有限公司
China Telecom Co.,Ltd.

烽火通信科技股份有限公司
FiberHome Telecommunication Technologies Co.,Ltd.

中兴通讯股份有限公司
ZTE Co.,Ltd.

华为技术有限公司
Huawei Technologies Co., Ltd.

引言

中国电信骨干全光网创新采用一二干融合架构，率先部署基于 ROADM 的全光交换网络和基于 OTN 的政企高质量承载网络，网络覆盖、带宽、质量和时延优势明显，大幅提升基础互联网的带宽和质量，促进了互联网应用的高质量发展。

Introduction

It is China Telecom's first all-optical backbone network (AON) that is innovatively designed to integrate interprovincial and intraprovincial backbone networks via a single architectural approach. With ROADM (Reconfigurable Optical Add-Drop Multiplexer) technology and high-quality OTN (Optical Transport Network) bearer networks, this is the world's first deployed all-optical switching network. As a result of its all-optical backbone network, China Telecom offers a wide network coverage, a large bandwidth, high quality, and low latency, which greatly enhances the bandwidth and quality of the basic Internet, as well as facilitating the development of high quality Internet applications.

四大技术创新建成超大规模骨干全光交换和传输网络

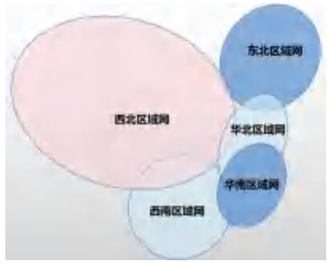
The four major technological innovations have been applied to achieve the large-scale backbone all-optical switching and transmission network

中国电信骨干全光网的研究和建设过程中，从网络架构、超长传输、波长交换、智慧运维等难点出发，实现了多项技术创新：首次提出一二干融合骨干全光网络创新架构，建成覆盖中国范围的一二干融合扁平全光网络；突破全光传输关键技术，优化传输介质、传输码型和传输频谱等全光传输系统设计核心参数，构建了性能指标国际领先的全光传输系统；实现高集成度、高性能的波长级全光交换设备、支持大带宽颗粒交叉容量 OTN 设备，首次在中国光网络部署中引入最新光层 / 电层交换技术；创新性提出分布式和集中式算路相结合的确定性快速动态业务恢复技术，提出波长路由物理层自动标识和校验、光纤连接自动发现等智慧运维技术。系列技术创新支持建成全球规模最大的骨干全光交换传输网络：部署基于 ROADM 技术的全光交换网络，覆盖广、带宽大、恢复快；部署光电协同调度政企高质量承载 OTN 网络，端到端承载，可靠性高。

During the development of China Telecom's backbone all-optical network, a number of technological innovations have been achieved as a result of the difficulties with network architecture, ultra-long transmission, wavelength switching, as well as intelligent operation and maintenance.

A nationwide integrating inter-provincial and intra-provincial flat AON is built first by proposing an innovative architecture for the integration of inter-provincial and intra-provincial backbones. By eliminating bottlenecks in key technologies and optimizing the core parameters of all-optical transmission system design such as transmission medium, code pattern, and spectrum, the all-optical transmission system has achieved world-leading performance indicators. By developing high-integrity and high-performance all-optical switching equipment at wavelength-level, China Telecom is leading the introduction of the latest optical/electrical layer switching technology to Chinese network deployment. As well as providing equipment with granularity-granularity cross-connection capabilities, OTN equipment supports large bandwidth granularity cross-connection.

Moreover, China Telecom has introduced an innovative deterministic fast dynamic service recovery technology that combines distributed and centralized circuit algorithms. It has also been proposed to implement some intelligent maintenance and operation technologies, such as the automatic identification and verification of wavelength routing at the physical layer and the automatic discovery of optical fiber connections. The world's largest backbone all-optical switching and transmission network was established as a result of a series of technological innovations. The deployment of an all-optical switching network based on ROADM technology will provide wide coverage, large bandwidth, and fast recovery. To provide end-to-end service bearing and high reliability to government and enterprise OTN networks based on photoelectric collaborative scheduling.



中国电信五大区域骨干 ROADM 网
China Telecom's Backbone ROADM Network in Five Regions

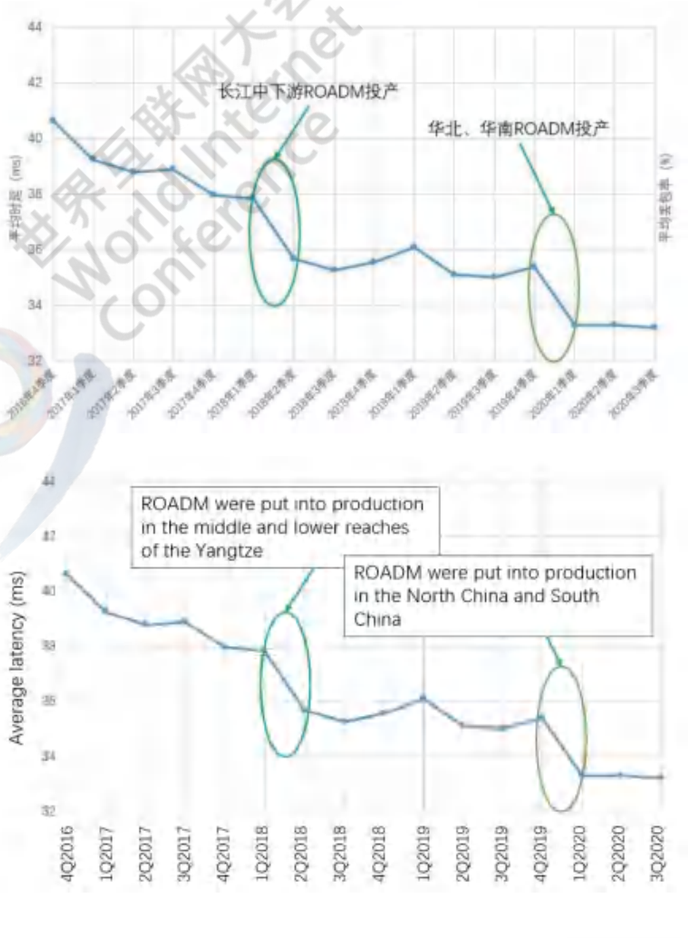
为公众和政企客户提供高可靠低时延大带宽连接

To provide high reliability, low latency and large bandwidth connections for the public and government and enterprise customers

中国电信的骨干全光网作为基础网络，可以为企业和云端架起高可靠、低时延、带宽保证的端到端专用数据传输通道，为算力网络的高质量发展提供了重要引擎。通过各个环节之间的高度协同，产业数字化发展模式的深度融合，为垂直行业提供综合服务，加快建设行业信息化领域的头部服务能力。全光网目前已经为政务、互联网、能源、制造、医疗、教育、金融、农业等各行业提供了数万条高品质的连接服务。全光 ROADM 网络的建设，使得中国公用互联网骨干网——ChinaNet 网络运行质量的大幅提升，为互联网用户提供高速、稳定的通信基础，使得基于视频的网络教育、网络直播等应用得以普及。

Through its all-optical backbone network, China Telecom has established an end-to-end dedicated data transmission channel with high reliability, low latency, and guaranteed bandwidth that is essential to the development of high-quality computing networks across enterprises and the cloud. As a result of the strong cooperation of each service link and the deep convergence of industrial and digital development modes, it has provided comprehensive services for the vertical industry and accelerated the development of the head service capability in the information industry.

To date, the all-optical network (AON) has provided tens of thousands of high-quality connections for government affairs, the Internet, energy, manufacturing, medical treatment, education, finance, agriculture, and many other sectors. A high-speed and stable communication infrastructure has been provided to Internet users by the construction of an all-optical ROADM network, which has greatly improved the operation quality of ChinaNet, a public Internet backbone network. Online education, webcasts, and other applications based on video have also become popular in China.



中国电信互联网网内运行质量统计图
Statistics Figure of China Telecom's Internet Network Operation Quality

实现经济效益和社会效益双丰收

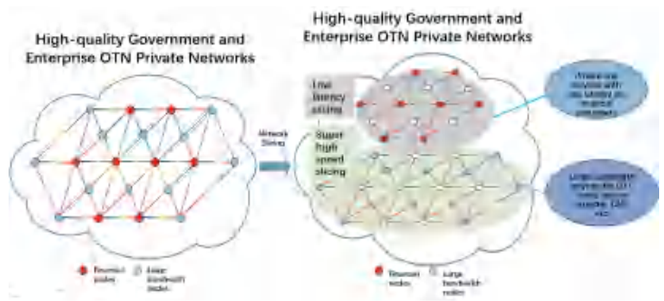
Achieve double abundant harvest for economic and social benefits

中国电信的骨干全光网投入运营以来，经济和社会效益显著。基于骨干全光网开发的专线产品产生直接经济效益 19.7 亿；全光网减少大量建网成本，预估节省成本 8 亿元；低时延、高稳定的网络为金融和 OTT 客户带来可观的间接经济效益。骨干全光网在推动国民经济数字化转型，促进互联网应用与服务快速发展等多方面取得了显著的社会效益。

Since the launch of China Telecom's all-optical backbone network, the company has achieved significant economic and social benefits. It has been estimated that the revenue from private line products based on the backbone all-optical network has reached approximately 1.97 billion yuan. As a result, AON can reduce a significant amount of network construction costs, which is expected to result in savings of up to 800 million yuan. The low latency, high stability and low latency of the backbone all-optical network creates an appreciable indirect economic value for financial customers and OTT users. As a result of China Telecom's all-optical network, the national economy has achieved significant social benefits, such as the promotion of the digital transformation of the national economy and the facilitation of the rapid development of Internet applications and services.



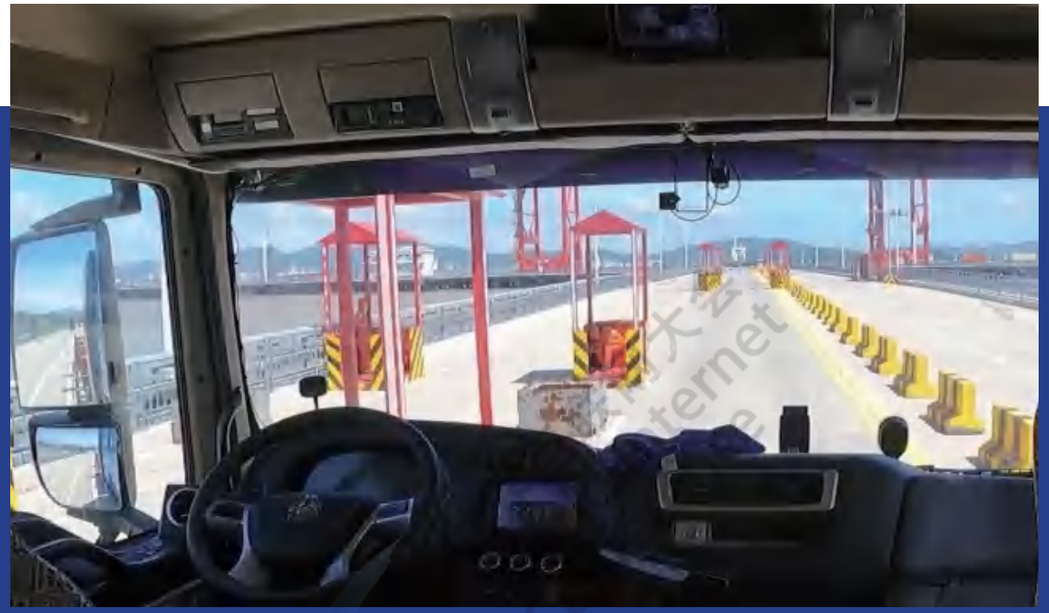
能力，具备显著经济和社会价值



All-optical Networks Offer Many Benefits to Government and Enterprise, Including Wide Coverage,High Quality, Low Latency, High Bandwidth, Service On-Demand, and Rapid Response.

5G 时间关键型通信使能远程操控

5G Time Critical Communication Enabled Remote Controlling



爱立信（中国）通信有限公司
Ericsson （China）Communications Co.,Ltd.

腾讯云计算（北京）有限责任公司
Tencent Cloud Computing (Beijing) Co.,Ltd.

中国移动通信集团有限公司
China Mobile Communications Group Co.,Ltd.

引言

5G 时间关键型通信使能远程操控不仅开创性地为需要高速传输数据的视频流等 eMBB 业务提供了延迟保障，而且为 XR、远程驾驶和远程操控等 5G 新兴应用在真实的波动的无线环境中提供了流畅的用户体验。

Introduction

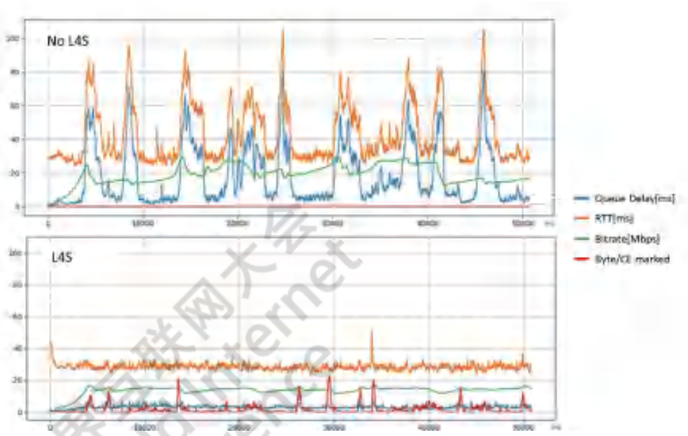
Enhanced Mobile Broadband (eMBB) services, such as video streaming, that require high-speed data transmission, can be accessed using a 5G time-critical communication-enabled remote control. Furthermore, it provides a smooth user experience in real fluctuating wireless environments by enabling new 5G applications such as XR, remote driving, and remote control.

跨层优化，克服无线环境波动，消除延迟，随时随地提供流畅视频

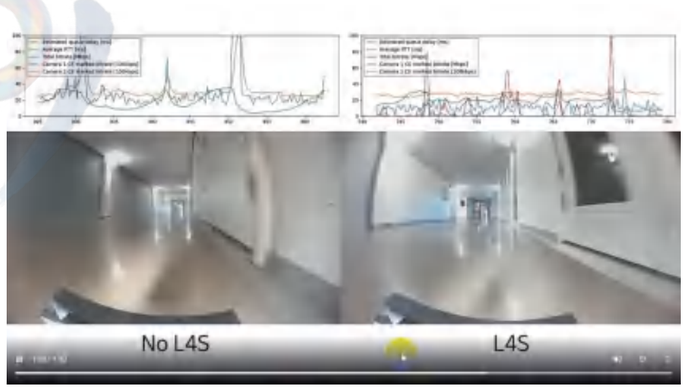
Cross-layer optimization to overcome wireless environment fluctuations, no delays for videos and smooth video anytime, anywhere

当前，大多数 5G 系统都是为增强型移动宽带（eMBB） 业务设计的，能够最大限度提高数据速率，但没有任何延迟的保证。XR、实时视频会议、远程驾驶和远程操控等新兴应用在真实 5G 现网中，受到无线环境和基站负载等因素波动的影响，会在网络中形成拥塞，进而引发“脉冲式”延迟，造成卡顿。为了解决这个问题，爱立信开发了时间关键型通信工具箱，L4S 是其中的重要技术之一。爱立信和中国移动在国际标准化组织 IETF 和 3GPP 引领推动低延迟、低损耗 – 弹性速率（Low Latency, Low Loss – Scalable Throughput，L4S）技术的标准化进程，将 L4S 机制引入 5G 网络，并联合腾讯云开发出了全球首套 5G 时间关键型通信使能远程操控系统。通过无线网络和应用的跨层优化协调，远程驾驶车在广域的多变的 5G 无线环境中移动，操作员仍然可以看到流畅的实时视频，保障了驾驶的安全性。解决了远程驾驶在 5G 现网中突发卡顿的问题，降低了风险，有力推进了远程驾驶从概念走向生产落地。无线网络和应用的跨层优化，也是向 6G 演进的方向之一。

Modern 5G systems are primarily designed for eMBB and maximize data rates without any guarantee of latency. Real 5G networks experience a great deal of fluctuation in radio conditions and base station loading. Emerging applications, such as XR, real-time video conferencing, and teleoperation of vehicles, may require higher data rates than the existing network can support, resulting in queue delays at base stations and streaming stalls. In this case, latency spikes may occur, and video streams may be interrupted. Consequently, Ericsson has developed a time-critical communication (TCC) toolbox, of which L4S is an important component. In the International Organization for Standardization (IETF) and 3GPP, Ericsson and China Mobile are leading the standardization process for Low Latency, Low Loss – Scalable Throughput (L4S) technology. Tencent Cloud has developed, jointly with Ericsson Cloud, the world's first 5G TCC-enabled remote control system, pioneering the introduction of the L4S mechanism into a 5G network. Using cross-layer optimization between wireless networks and applications, when remote driving vehicles operate in a wide-area and variable 5G radio environment, the operator is able to view real-time video in a smooth manner, ensuring the safety of the driver. As a result, remote driving is no longer frozen suddenly in the existing 5G network, risks are reduced, and remote driving is effectively promoted from concept to production. Another direction for the evolution to 6G is cross-layer optimization.



无 L4S 支持和有 L4S 支持的视频流延迟对比，L4S 可显著消除延迟脉冲
Video Stream Delay Comparison Without and With L4S Support, L4S can Significantly Eliminate Delay Pulses



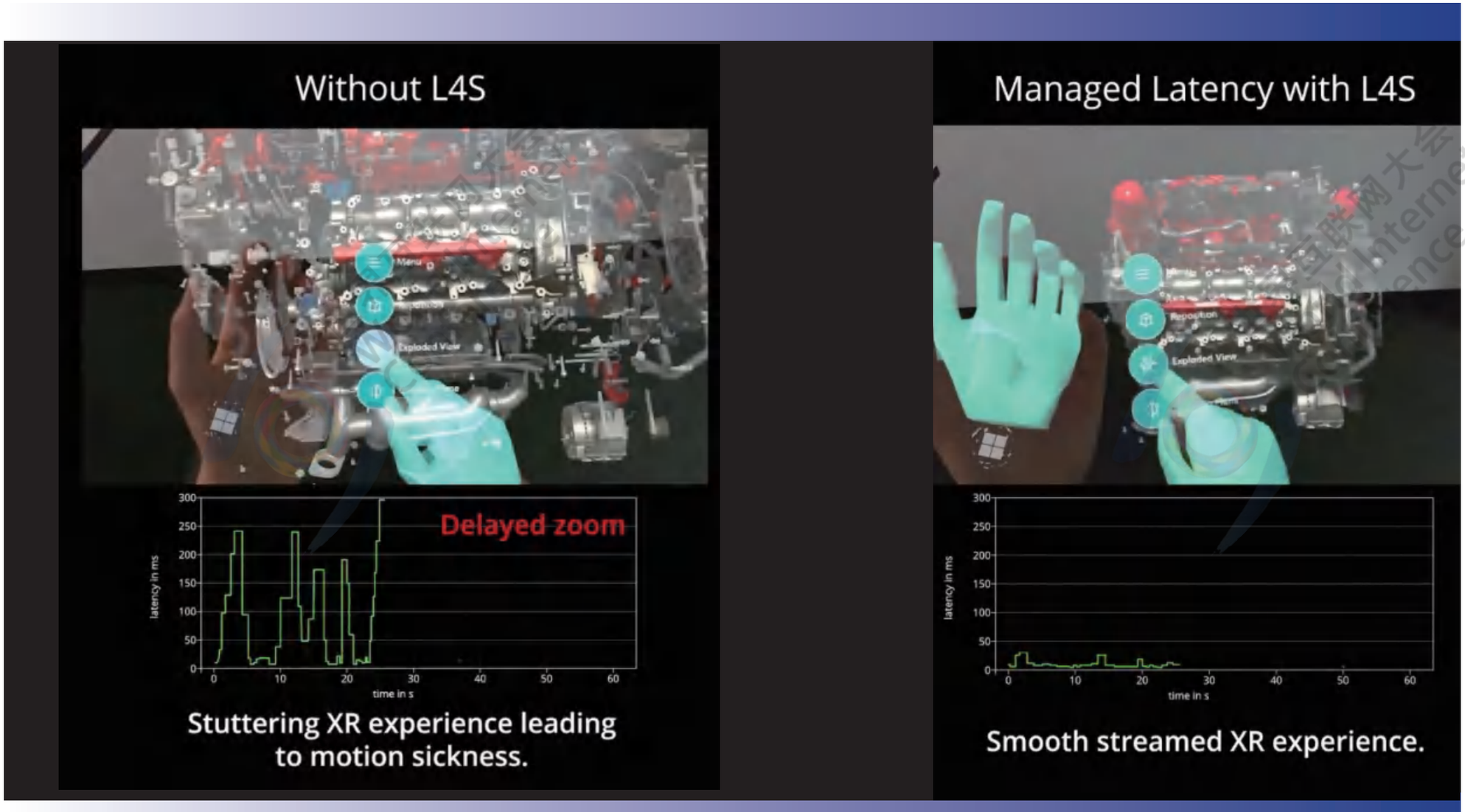
L4S 对远程驾驶体验的改善，L4S 支持的远程驾驶过程中，没有出现延迟脉冲，视频体验流畅
L4S Improves the Remote Driving Experience. With L4S, There is No Delay Pulse During Remote Driving and the Video Experience is Smooth

与国际主流协议兼容，得到众多国际厂商支持

Compatible with international mainstream protocols, supported by many international manufacturers

现在网络主流协议 RTP/RTCP、TCP Prague、DCTCP、QUIC 均支持 L4S。 L4S 在全球著名的开源网站 GitHub 实现部分的开源代码，使用了多媒体自时钟速率自适应（Self Clocked Rate Adaption for Multimedia，SCReAM）算法，适用于主流的 RTP/RTCP 协议。众多国际厂商都表示了对 L4S 技术的支持；从全球来看，德国电信通过白皮书和云游戏的方式；英伟达在其 2022 GPU 技术大会上通过 XR 演示；苹果在其 2022 年全球开发者大会上都展示 L4S 对时延的改善。在中国，在三一智矿内蒙某露天矿无人运输项目中，实现 5G 实时远程辅助驾驶功能落地商用；在多个港口车厂中，地电铲远程操控，落地无人集卡的远程驾驶，抓料机的远程操控项目，乘用车的远程泊车等项目都得到落地实施。

L4S is now supported by all mainstream network protocols, including RTP/RTCP, TCP Prague, DCTCP, and QUIC. A part of L4S's open-source code is implemented on the world-famous open-source website GitHub, using the Multimedia Self Clocked Rate Adaption for Multimedia (SCReAM) algorithm, which is suitable for mainstream RTP/RTCP protocols. The L4S technology has been supported by a number of international manufacturers. At the global level, Deutsche Telekom has demonstrated the benefits of L4S through white papers and cloud games; Nvidia has demonstrated the benefits of XR at its GPU Technology Conference 2022; and Apple has demonstrated the benefits of L4S at its 2022 Global Developers Conference. In China, in the unmanned transportation project of an open-pit mine in Sany Mine in Inner Mongolia, the 5G real-time remote assisted driving function was put into commercial use; other projects have been implemented, including a remote control for the grabber and a remote parking system for a passenger vehicle.



英伟达展示 L4S 技术对 XR 视频流的延迟的改善
Nvidia Shows L4S Technology Latency Improvements for XR Video Streams

或将成为撬动万亿市场的“金”钥匙

Potential to leverage the trillion-dollar market

5G 时间关键型通信在 XR、远程控制、工业控制和移动自动化等各个垂直领域都有广阔的应用。市场咨询公司 Market Research Future (MRFR) 在其报告中指出，“工业控制系统以 10% 的复合年增长率增长，市场规模到 2030 年将达到 1800 亿美元”。根据花旗银行的预测，到 2030 年全球将有 9–10 亿 XR 终端用户，市场价值达到 1–2 万亿美元。5G 时间关键型通信和其赋能的远程操控将在这些市场发挥巨大的作用，帮助这些应用在真实的 5G 网络中随时保持良好的用户体验，加快市场化步骤。

The use of 5G time-critical communication is expected to be widespread in a wide range of vertical fields, including augmented reality, remote control, industrial control, and mobile automation. According to Market Research Future (MRFR), a market research firm, industrial control systems will grow at a compound annual rate of 10% by 2030 and reach a market size of $180 billion. Citibank forecasts that there will be 900-100 million XR end users worldwide by 2030, with a market value of between $1 trillion and $2 trillion. These markets will be impacted by 5G time-critical communications and the remote control they enable. As a result of the 5G TCC enabled remote controlling, these applications will be able to maintain a good user experience at any time within the real 5G network, thereby speeding up the marketing process.



ODPS：数据驱动而生的超大规模多场景融合的大数据计算平台

Open Data Processing Service (ODPS): A Hyper-scale Big Data Computing Platform Designed for Multiple Scenarios

阿里云计算有限公司
Alibaba Cloud Computing Co.,Ltd.

Alibaba Cloud

引言

ODPS 是阿里云自研的一体化大数据计算平台和数据仓库产品，为客户数字化转型提供多功能、低成本、高性能、稳定、安全、开放和易用的整套产品方案，提供了实时离线一体、流批一体、湖仓一体、大数据 +AI 一体的多场景能力。

Introduction

Alibaba Cloud offers an integrated big data computing platform and data warehouse product called ODPS, providing multifunctional, cost-effective, high-performance, stable, secure, open, and easy-to-use solutions for enterprise digital transformation, the company provides a full range of services.

完全自主研发，技术国际领先

It is an internationally leading technology completely independently developed

ODPS 包括多模型统一的计算引擎，超大规模资源统一调度引擎伏羲 Fuxi，多租户安全隔离技术等核心关键技术创新。存储技术上，ODPS 内置 Pangu、OTS 引擎，解决元数据热点瓶颈问题，实现单集群超过 1 万台物理机，3 万节点大规模能力。

As an integrated big data computing platform and data warehouse product developed by Alibaba Cloud, ODPS provides key technology innovations such as the multi-model unified computing engine, hyper-scale unified resource scheduling engine (Fuxi), and multi-tenant security isolation technology.

From the aspect of storage technology, ODPS has built-in Pangu and OTS engines, which solve the bottlenecks of metadata hotspots, allowing it to scale to more than 10,000 physical servers and 30,000 nodes in a single cluster.

ODPS 的 SQL 引擎兼容 Hive 生态，可用一套语法端到端完成所有数仓业务场景，多规则优化器和动态代码生成技术，性能领先开源 Spark3 倍以上，在 TPC-BB 标准测试中，性能和性价比连续 5 年世界第一。除支持原生 SQL 引擎，ODPS 也支持第三方引擎，包括 Spark、Hologres、Python、Mars、图计算引擎、AI 机器学习引擎等。

ODPS utilizes a SQL engine that is compatible with the Hive ecosystem, and is capable of addressing all data warehouse business scenarios in an end-to-end fashion through the use of one syntax. By utilizing a multi-role optimizer and dynamic code generation technology, ODPS is able to achieve over three times the performance of open-source Spark. ODPS has been ranked No. 1 worldwide in terms of performance and cost-effectiveness in the TPCx-BB benchmark test for the past five years.

ODPS 提供跨平台统一元数据、外部数据源自动打通、元数据自动构建等能力，提出湖仓一体架构，为湖仓数据融合及多套烟囱式 Hadoop 大数据系统向高价值数仓整合给出行业新方向。

The Open Data Processing Service (ODPS) offers various capabilities, including cross-platform unified metadata processing, automatic connection to external data sources, and automatic creation of metadata repositories. ODPS has also adopted the data lakehouse architecture, which sets a new standard for the integration of lake and warehouse data, as well as the integration of multiple Hadoop big data systems into high-value data warehouses.

ODPS 具备跨域多集群技术，可在一套统一的账号、权限、元数据和管控能力下，像用一套数仓平台一样，在任意地域集群上开通项目、就近采集数据、跨集群存储或备份数据，跨集群计算，消除中心单点瓶颈。

ODPS has the ability to manage multiple clusters across multiple domains. With a unified set of accounts, permissions, metadata, and management and control capabilities, ODPS allows users to enable projects on clusters in any region, collect data locally, store or back up data across clusters, and perform computing across clusters, eliminating single-point failures in the central cluster.

被国际市场的多行业广泛应用

Widely used in many industries in the international market

目前 ODPS 阿里云一体化大数据计算平台已经被广泛应用于在中国，东南亚，欧洲等市场，生活服务，互联网金融，交通出行，互娱，电商，游戏，媒体，社交，新零售等各个行业。同时也在工业、数字政府、城市管理等领域发挥着不可替代的重要作用。

In China, Southeast Asia, and Europe, ODPS has been widely utilized in various industries including life services, Internet finance, transportation, mutual entertainment, e-commerce, games, media, and social networking. Furthermore, the ODPS plays a vital and irreplaceable role in the fields of industrial engineering, digital government, and urban planning.

ODPS 一体化大数据计算平台成就

Achievements of ODPS integrated big data computing platform

以 ODPS 阿里云一体化大数据计算平台作为核心底座的杭州城市大脑，在杭州实时指挥 1300 个红绿灯路口、200 多名交警。从 2016 年到 2018 年，杭州从全国最拥堵城市排行榜上下降 52 名。政务领域，浙江最多跑一次通过 MaxCompute 大数据处理平台打通政务数据，将与老百姓办事最密切相关的 100 个事项 70 多亿条数据，按照统一标准汇入统一的数据仓，实现共通共享共用。老百姓办事不仅能最多跑一次，甚至有可能一次都不跑

In Hangzhou, China, the Hangzhou City Brain, which uses ODPS as its core, steers 1,300 intersections with traffic lights and more than 200 traffic police in real time. From 2016 to 2018, Hangzhou dropped 52 places from the list of the most congested cities in China as a result of the Hangzhou City Brain. To make government affairs data accessible, Zhejiang has used the MaxCompute big data processing platform. A unified data warehouse based on the same standards imports more than 7 billion pieces of data on 100 affairs that are most closely related to civilian affairs. Thus, civil servants will need to visit the Governmental Affairs Center at most once or even handle government affairs online



围绕 ODPS 一体化大数据计算平台已申请的专利有 159 项，多篇相关论文发表在顶级国际会议上，取得了 22 项软件著作权，通过了多项中国信通院大数据产品能力评测。

A total of 159 patent applications have been filed for the ODPS integrated big data computing platform, many related papers have been published in top international conferences, and 22 software copyrights have been obtained. Furthermore, ODPS has successfully passed a number of big data product capability evaluations conducted by the China Academy of Information and Communication Technology (CAICT).





大规模图神经网络模型端云协同计算平台和应用示范

The Computing Architecture of Device-Cloud Collaborative Graph Neural Network Learning over Distributed Environments as well as Its Applications

浙江大学
Zhejiang University

阿里巴巴达摩院（杭州）科技有限公司
Alibaba

引言

研制了能处理亿级节点和百亿级边所构成超大规模动态图的神经网络学习计算平台，实现端云协同计算范式，既提供云上服务和端侧推理能力，又推动云上模型和端侧模型的协同进化，发挥云上、端侧和端云链各类计算资源最佳效用，赋能经济发展和社会进步。

Introduction

The team conducts a systematic research for device-cloud collaborative learning over large scale of graph data (which in general consists of billions of nodes and millions of edges). Specifically, the team is the first to set up the collaborative learning mechanism for cloud and edge modeling with a thorough technology of the architectures that enable such mechanism. The research can boost the co-evolution of learning models between cloud and edge, providing efficient utilization of computing resource over edge and cloud.

大规模图神经网络端云协同计算平台

The device-cloud collaborative computing platform of graph neural network over large scale data

项目突破了高性能超大规模动态图神经网络学习、一体化大小模型端云协同技术链路、个性化端侧场景轻量级推理等技术难点，取得了体系化、链条化和平台化的技术创新。研制了对超大规模图进行子图分割、分片存储和节点采样等体系化技术，设计了软硬件联合优化的超大规模图神经网络学习和推理加速异构计算架构，实现了支撑端云模型协同进化的链条化技术，引领从云服务和端智能计算模式向端云协同计算跨越，推动新的计算模式形成。

The research has overcome the bottlenecks of dynamical learning of graph neural network over large scale of data, device-cloud collaborative learning through heterogeneous system, and lightweight deep learning framework of inference on-device, and proposed efficient algorithms for subgraph segmentation, subgraph storage and node sampling, devised large-scale graph neural network learning, inference via co-design of software and hardware, supported the implementation of device-cloud collaborative learning. The research is the first systematic implementation of edge-cloud collaborative AI.

项目开源了以超大规模图神经网络学习为核心的端云协同模型进化计算平台，包括图神经网络学习框架 Aligraph、端侧轻量级推理框架瓦力 (Walle) 和端云模型协同平台洛犀 (luoxi)，构建了业界首个产业级端到端的通用型端云协同机器学习基础设施。

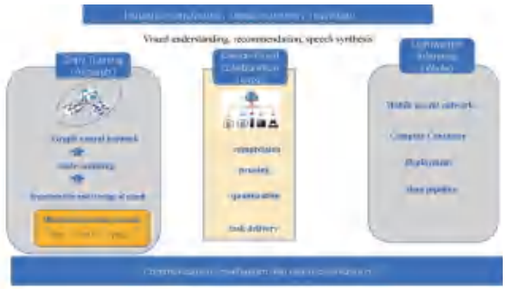
The research has built an universal infrastructure which consists of following components:1)large scale of graph neural network (AliGraph): Aligraph consists of distributed graph storage, optimized sampling operators and runtime to efficiently support not only existing popular GNNs but also a series of in-house developed ones for different scenarios; 2) lightweight deep learning framework of inference on-device (Walle): Walle is a highly efficient and lightweight deep learning framework to supports inference on-device. The core desire behind MNN is to boost the performance of diverse ML tasks on the heterogeneous hardware backends of mobile devices and cloud servers; 3) device-cloud collaboration architecture (luoxi): luoxi consists of a deployment platform, distributing ML tasks to billion-scale mobile devices in time; a compute container, providing a cross-platform and high-performance execution environment, while facilitating daily task iteration; and a data pipeline, supporting more natural and reasonable data flow throughout mobile devices and the cloud.

2019 年在数据挖掘顶级会议 KDD 有关图计算技术报告中，AliGraph 与亚马逊图计算引擎并列为同一级别基础架构被加以介绍。项目成果荣获电子学会中国电子学会 2021 年度科技进步一等奖、2020 年度世界人工智能大会最高奖“卓越人工智能引领者奖”。

The research has been awarded with 2021 Science and Technology Progress Award of Chinese Institute of Electronics (1st Prize) and the Super Artificial Intelligence Leader (SAIL) Award at the World Artificial Intelligence Conference 2020.



支撑端云模型协同进化的链条化技术框架



Chain Technology Framework Supporting Co-evolution of End Cloud Models

端云协同架构支撑技术赋能、产业增效、场景变革

The empowered scenarios over device-cloud collaborative computing

项目通过技术赋能、产业增效、场景变革推动数字经济、工业生产和司法裁判等领域服务模式变革。

The device-cloud collaborative computing platform empowers many of scenarios such as digital economy, industry and Judicial Judgment.

通过阿里云提供图神经网络计算服务，服务百余家企事业单位、日平均调用超过千亿次，以云服务和端智能结合方式推动数字经济的智慧化升级；项目端侧轻量化推理模型服务于交通部门（如高速路管理局）、大型企业（钢铁、煤炭企业）以及中小微企业（如生产园区）和商户，在生产安全监控、产品质量分析和物流人流管理等方面实现了智能前移；项目为浙江省高级人民法院提供图神经网络等核心技术支持，覆盖民事、刑事和行政等 45 种案由，在全省 26 个试点法院开展服务，当庭宣判率达到 90% 以上，比传统审判节约了 50% 以上的时间，为实现“即诉即办、即审即判”智能裁判模式变革提供了技术支撑。

GNN over Aliyun serves more than 100 enterprises and institutions, and is applied more than 100 billion times a day on average, promoting the intelligent upgrading of the digital economy through the combination of cloud services and device intelligence; The lightweight on-device inference serves the transportation departments (such as the highway administration), large enterprises (steel and coal enterprises), small and medium-sized enterprises and merchants, and achieves intelligent forward movement in production safety monitoring, product quality analysis, logistics and human flow management; The project provides core technical support, such as graphic neural network, for the Zhejiang Provincial High People's Court, covering 45 civil, criminal and administrative causes, and provides services in 26 pilot courts across the province. The rate of sentencing in court has reached more than 90%, saving more than 50% of the time compared with traditional trials, which provides technical support for the implementation of the transformation of the intelligent judgment mode of "instant action and instant trial".

领跑端云模型协同应用赋能技术领域

Enabled technologies over the devicecloud co-llaborative computing

构建了首个产业级端到端的通用型端云协同机器学习基础设施，开源开放了计算框架和算法代码，领跑端云模型协同应用赋能这一技术领域，应用于政务、公检法、金融保险、互联网和工业等领域百余家企事业单位，赋能视觉类、推荐类、触达类和语音类等核心场景，支持 3 亿多活跃用户每日 1500 亿次（最高 2235 亿次）端侧推理实时在线需求，以技术手段重塑在线经济和智能司法等业务模式。三年新增销售收入 68.57 亿元、新增利润 21.11 亿元。

The research has built the first industrial end-to-end general-purpose device-cloud collaborative computing machine learning infrastructure, establishing the computing framework and algorithm code open-source, leading the technology field of enabling device-cloud collaborative applications, being applied to more than 100 enterprises and institutions in the fields of government affairs, public security, finance and insurance, the Internet and industry, and enabling core scenarios such as vision, recommendation, touch and voice. It supports more than 300 million active users' real-time online demand for end-to-end inference 150 billion times a day (up to 223.5 billion times), and reshapes business models such as online economy and intelligent justice by technical means. The sales revenue increased by 6.857 billion yuan and the profit increased by 2.111 billion yuan in three years.



项目研究成果赋能智能司法
Project Research Results Empower Intelligent Justice

科教融合培育人工智能创新性人才

Integrating science and education to cultivate artificial intelligence innovative talents

项目开源平台成为“新一代人工智能科教创新开放平台 --- 智海”的组成部分，通过建设大规模 AI 开放科教平台及生态社区，促进人才链、产业链和创新链的有效衔接，参与了“华五首倡、六校联合、企业参与”的 AI+X 微专业，面向非计算机专业人才讲授人工智能知识。

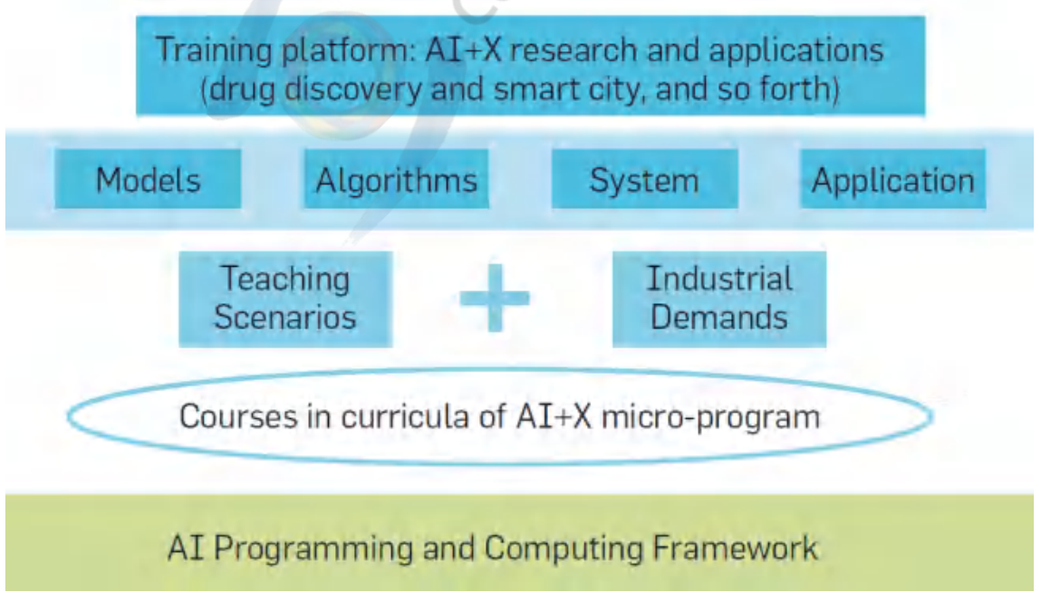
The open source platform of the project has become a part of "a new generation of AI science and education innovation open platform – wise ocean". Through the construction of a large-scale AI open science and education platform and ecological community, it has promoted the effective connection of the talent chain, industrial chain and innovation chain, and participated in the AI+X micro specialty of "China's five initiatives, six school alliances, and enterprise participation", Teaching AI knowledge to non-computer professionals.



智海：新一代人工智能科教平台
Wise Ocean：New Generation AI Science and Education Platform



华五首倡、六校联合、企业参与的 AI+X 微专业
AI+X Major of Five Initiatives from Alliances of Six Universities with Participation of Enterprises



The architecture of Wise Ocean

龙芯 3A5000

LS3A5000

龙芯中科
Loongson

引言

龙芯 3A5000 是首款采用 LoongArch™ 系统的处理器芯片，四核 64 位，主频 2.5GHz，其关键 IP 源代码均为自主编写，芯片内置安全模块，性能逼近市场主流产品水平，具备自主架构、性能超群、生态兼容、安全融合等特点。

Introduction

LS3A5000 is the first general-purpose processor chip supporting a self-developed instruction set architecture named LoongArch™. All source codes of its key IPs are written independently, including built-in security engine modules. The main frequency of the 64-bit quad-core chip is 2.5GHz, and its performance is comparable to other mainstream CPU products. The LS3A5000 has an autonomous architecture, superior performance, ecological compatibility, and security integration features.



龙芯自主指令系统
LoongArch™

龙芯 3A5000 是首款采用 LoongArch ™指令系统的处理器芯片

The LS3A5000 is the first processor from China to support LoongArchTM, a self-developed instruction set architecture

龙芯 3A5000 是面向桌面和服务器等信息化领域的通用处理器，是首款采用龙芯指令系统 LoongArch™ 的处理器芯片，代表了中国自主 CPU 设计领域的最新里程碑成果。

The LS3A5000 is a general-purpose processor chip designed for desktop and server applications. This is the first processor chip that supports a self-developed instruction set architecture known as LoongArchTM, which marks another milestone for China's self-developed processors.

LoongArch™ 基于龙芯二十年的 CPU 研制和生态建设积累，从顶层架构，到指令功能和 ABI 标准等，全部自主设计。LoongArch™ 吸纳了现代指令系统演进的最新成果，运行效率更高。LoongArch™ 充分考虑兼容生态的需求，融合 X86、ARM 等国际主流指令系统的主要功能特性，并依托龙芯团队在二进制翻译方面十余年的技术积累创新，实现跨指令平台应用兼容。

Loongson team has accumulated experience in CPU development and ecological construction over 20 years by developing LoongArchTM. It is designed independently , from the micro-architecture to the instruction set and application binary interface. Aside from demonstrating highly efficient execution, LoongArchTM incorporates major functions of other instruction systems, such as x86 and ARM, for ecological compatibility. Based on LoongArchTM, application compatibility across mainstream instruction systems has been achieved through the technical accumulation and innovation of the Loongson binary translation team over the past ten years.

LoongArch™ 已得到国际开源软件界广泛认可与支持，正成为与 X86/ARM 并列的顶层开源生态系统。已向 GNU 组织申请到 ELF Machine 编号（258 号），并获得 Linux、Binutils、GDB、.NET、GCC、LLVM、Go、Chromium/V8、Mozilla/SpiderMonkey、Javascript、FFmpeg、libyuv、libvpx、OpenH264、SRS 等音视频类软件社区、UEFI（UEFI 规范、ACPI 规范）以及中国龙蜥开源社区、欧拉 Open Euler 开源社区的支持。

Among international open source software communities, LongArchTM is widely accepted and supported and is becoming a top-level open source instruction set ecosystem alongside X86/ARM. The GNU organization has approved a unique ELF Machine number (258), and has been recognized by many software communities, including Linux, Binutils, GDB, .NET, GCC, LLVM, Go, Chromium/V8, Mozilla/SpiderMonkey, Javascript, FFmpeg, libyuv, libvpx, OpenH264, and SRS. The UEFI Forum (UEFI specification, ACPI specification) as well as the OpenAnolis and OpenEuler open source communities have also supported it.

龙芯 3A5000 性能优异，用户广泛

The LS3A5000 offers excellent performance and is popular with a wide range of users

根据中国第三方测试机构的测试结果，龙芯 3A5000 在 GCC 编译环境下运行 SPEC CPU2006 的定点、浮点单核 Base 分值均达到 26 分以上，四核分值达到 80 分以上。

LS3A5000 scores more than 26 points per core and over 80 points for four cores, respectively, in SPEC CPU2006 base benchmarks, using both SPECint and SPECfp in a GCC compiler environment.

龙芯 3A5000 实现了自主性和安全性的深度融合。龙芯 3A5000 中包括 CPU 核心、内存控制器及相关 PHY、高速 IO 接口控制器及相关 PHY、锁相环、片内多端口寄存器堆等在内的所有模块均自主设计。龙芯 3A5000 在处理器核内实现了专门机制防止“幽灵（Spectre）”与“熔断（Meltdown）”的攻击，并在处理器核内支持操作系统内核栈防护等访问控制机制。

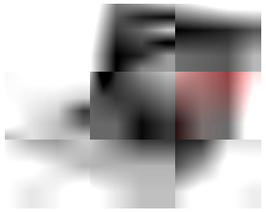
数十家中国知名整机企业、行业终端开发商等基于龙芯 3A5000 研制了上百款整机解决方案产品，包括台式机、笔记本、一体机、金融机具、行业终端、安全设备等，已在电子政务、金融、通信、教育、交通信息化领域得到广泛应用。

LS3A5000 integrates autonomy and security deeply. LS3A5000 contains a number of self-designed modules, including a CPU core, a memory controller, a high-speed IO interface controller, a PLL, a multiport register file, etc. A mechanism for preventing "Spectre" and "Meltdown" attacks, as well as access control policies, such as kernel stack protection for operating systems, are implemented in the processor core. Over the past several years, hundreds of overall hardware solutions have been developed based on LS3A5000 by domestic well-known machine manufacturers and industrial terminal developers, including desktop computers, laptops, all-in-one computers, financial machines, industrial terminals, security equipment, network equipment, industrial control modules, etc. It is currently widely used in the fields of e-government, finance, communication, education, and transportation in the information technology industry.

龙芯 3A5000 应用广泛，中国 LoongArch ™的生态建设已取得初步成果

The LS3A5000 processor has been widely used, and China's LoongArchTM ecosystem has shown some promising results

龙芯 3A5000 主频 2.5GHz，包含 4 个 LA464 处理器核，性能逼近市场主流桌面 CPU 水平。在复杂文档处理、浏览器打开、3D 引擎加速、4K 高清软解、以及各类业务软件处理等方面，龙芯 3A5000 电脑用户体验优异。目前， LoongArch™ 生态已形成一定基础并正在高速发展，不仅为中国关键信息基础设施建设提供自主可控的安全底座，也积极推动了构建独立于 Wintel（Windows+Intel）和 AA 体系的信息技术体系和产业生态。



龙芯 3A5000 笔记本
LS3A5000 Laptop



龙芯 3A5000 一体机
LS3A5000 All-in-one Computer



龙芯 3A5000 应用于电子政务领域
LS3A5000 Has Been Used in the E-government

With four LA464 processor cores and a frequency of up to 2.5GHz, the LS3A5000 is the first processor chip to support LoongArchTM. Its performance is comparable to that of other mainstream products in the CPU market, and its user experience is greatly improved in most daily tasks, such as the processing of complex documents, the opening of web browsers, the acceleration of 3D engines, the decoding of 4K HD, and various business transactions. The LoongArchTM ecosystem has evolved rapidly over the past few years. In addition to providing a secure and autonomous base for the construction of China's critical information infrastructure, the ultimate goal is also to actively promote the development of information technology systems and industrial ecosystems independent of Wintel (Windows+Intel) and AA (Arm+Android).



微软下一代数字孪生平台
—— Azure Digital Twins

Microsoft Azure Digital Twins Platform

微软（中国）有限公司
Microsoft (China) Co., Ltd.

Microsoft

引言

微软 Azure 数字孪生服务是一个全新的物联网平台即服务（PaaS）产品，基于该产品可创建用于描述现实环境的数字孪生图谱，同时可整合物联网实时数据，应用高级数据分析和人工智能技术，获取有关企业业务的洞察结果，并与三维可视化结合，实现高度逼真的可视化效果，进而创造突破性的用户体验并给企业带来更多的业务价值。

Introduction

Azure Digital Twins is a platform as a service (PaaS) offering that enables the creation of twin graphs based on digital models of entire environments. It creates a digital representation of real-world things, places, business processes, and people. These digital twin models can be used to gain visualization and insights that drive better products, optimized operations, reduced costs, and breakthrough customer experiences.

Azure 数字孪生全面赋能数字孪生应用方案开发

Built to simplify and accelerate the creation of IoT connected solutions

Azure 数字孪生平台旨在简化和加速基于 IoT 技术的数字孪生解决方案的创建。凭借其全面的功能，企业可以轻松开发定制化的数字孪生解决方案，其数字孪生建模、服务执行环境及平台服务整合等方面实现创新，核心服务能力包括：

The Azure Digital Twins is a new generation digital twin platform. It was built to simplify and accelerate the creation of IoT connected solutions. With a comprehensive set of capabilities, companies can develop customized, connected solutions with ease. And with the ability to layer your vertical domain specialization—such as 3D or 4D visualizations, physics-based simulation, and AI—on top of Azure Digital Twins, it' s easier than ever to focus on driving results for your customers. This also includes new developer experiences with broad language support for SDKs, Digital Twins Definition Language (DTDL) modeling and validation tools, and the Azure Digital Twins explorer sample which helps visualize the graph representing your environment. Other capabilities at the core of the Azure Digital Twins platform allow you to:

提供业界领先的面向数字孪生数据建模的开放式建模语言，即数字孪生建模语言（DTDL）。

应用 Azure 数字孪生的 DTDL 标准，企业可以轻松创建描述现实环境的数字孪生模型，同时其还提供了面向特定行业标准的预定义 DTDL 模型，从而帮助企业基于现有的行业标准预定义数字孪生模型来加速其数字孪生解决方案的开发和实施。

Use an open modeling language, DTDL, to easily create custom models of intelligent environments. In addition, premade models and converter tools for vertical standards help accelerate development when getting started with use cases across industries.

提供可扩展且安全的实时执行环境。

Azure 数字孪生的执行环境包括可靠的事件系统、数字孪生查询引擎及多语言支持的 SDK。利用该执行环境，客户可以构建动态的业务逻辑，使企业的数字孪生业务应用始终反映现实环境的最新状态，同时结合各种条件和关系数据查询，企业可以在数字孪生模型中获取相关的上下文关联数据，可更好地提取业务见解。

Bring digital twins to life with a live execution environment that is scalable and secure and uses data from IoT and other sources. Using a robust event system, you can build dynamic business logic that helps keep business apps fresh and always up to date. You can also extract insights in the context of the modeled world by querying data on a wide range of conditions and relationships.

提供强大的数据和服务整合能力。

Azure 数字孪生可以与 Azure 云平台的各项服务实现无缝的整合能力。通过 Azure IoT 中心可轻松地将来自物联网设备的数据注入 Azure 数字孪生图谱的实体中，利用 Azure Logic Apps 可将企业 ERP 和 CRM 等现有业务系统连接到 Azure 数字孪生，驱动业务流程执行，结合 Azure 数字孪生事件系统，可将数据导出到下游的数据分析、人工智能和 3D 可视化服务，从而实现端到端的数字孪生应用解决方案。

Break down silos using input from IoT and business systems by easily connecting assets such as IoT and Azure IoT Edge devices via Azure IoT Hub, as well as existing business systems such as ERP and CRM to Azure Digital Twins to extract relevant insights across the entire environment. Output to storage and analytics by integrating Azure Digital Twins with other Azure services. This includes the ability to send data to Azure Data Lake for long-term storage or to data analytics services such as Azure Synapse Analytics to apply machine learning. Another important use case is time series data integration and historian analytics with Azure Time Series Insights.

综上所述，Azure 数字孪生服务是全新一代端到端的数字孪生平台。

To sum up, Azure Digital Twins Service is a new generation of end-to-end digital twin platform.



Azure 数字孪生的创新功能
Azure Digital Twins Module



数字孪生在企业的应用
Digital Twins Application in Enterprises

Azure 数字孪生加速数字孪生解决方案落地

Azure Digital Twins accelerates the implementation of digital twins solution

基于 Azure 数字孪生平台的全面功能，企业可结合其自身的行业领域知识来构建定制化的数字孪生解决方案，典型的应用场景包括：

With the comprehensive capabilities of Azure Digital Twins, enterprises can take advantage of your domain expertise on top of Azure Digital Twins to build customized digital twin solutions, typical scenarios including:

实现任意物理环境的数字孪生建模，并以可扩展且安全的方式注入实时数据使数字孪生模型如实反映现实环境状态变化。

Model any environment, and bring digital twins to life in a scalable and secure manner.

连接物联网设备和现有业务系统等的数据资产，使用强大的事件系统构建动态业务逻辑和数据处理。

Connect assets such as IoT devices and existing business systems, using a robust event system to build dynamic business logic and data processing

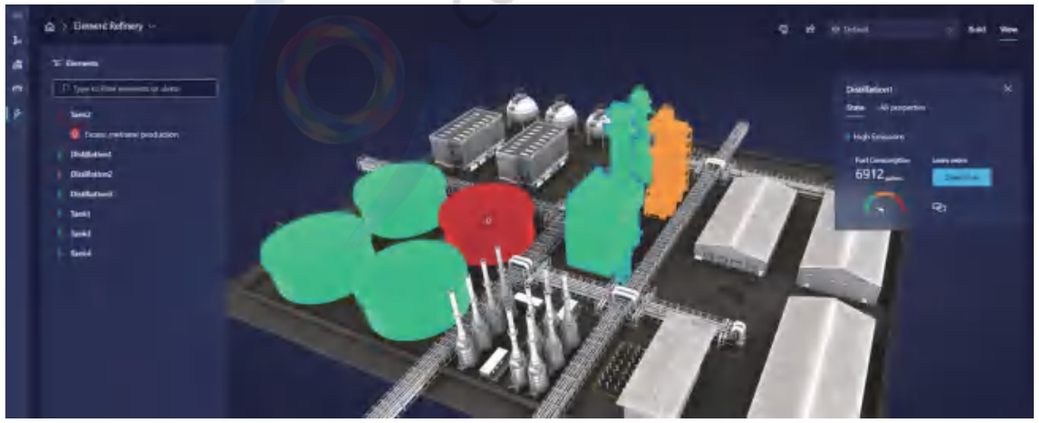
驱动逼真的三维可视化，并在其上下文中显示业务逻辑和孪生数据，并与其他 Azure 数据、分析和 AI 服务集成，更好地跟踪过去并预测未来。

Build connected 3D visualizations of your environment that display business logic and twin data in context - Query historized environment data and integrate with other Azure data, analytics, and AI services to better track the past and predict the future

Azure 数字孪生的价值实现

Azure Digital Twins simplify and accelerate the development of digital twin solutions

通过 Azure 数字孪生，企业可以简化和加速数字孪生方案的构建。应用 Azure 数字孪生提供的开放式数字孪生建模语言，企业可以快速实现建模，以创建反映现实环境的数字表示。该表示可以是楼宇、工厂、能源网络、电网甚至整个城市等现实环境的模型，从而加速企业的数字孪生方案构建，为企业业务、城市公共管理的等应用场景带来实实在在的经济价值。此外通过 Azure 数字孪生服务连接不同的数据源，可轻松打破企业的数据孤岛，为跨整个现实环境提供商业见解，加速企业的数字转型，从而提升企业运营效率同时节省企业的运营成本，为用户提供高质量的产品服务同时创造大量的社会经济效益。



Track the past and help predict the future of any connected environment: Easily model and create digital representations of connected environments with an open modeling language. Model buildings, factories, farms, energy networks, railways, stadiums—even entire cities. Bring these digital twins to life with a live execution environment that historizes twin changes over time. Unlock actionable insights into the behavior of modeled environments via powerful query APIs, and integrates with Azure data analytics. Break down silos within connected environments: Model any physical environment that's important to enterprise's business. Then connect inputs from IoT devices that are using Azure IoT Hub or from any business system to establish a single live integration layer that delivers insights from across the entire environment.

Azure 数字孪生三维可视化展示
Azure Digital Twins Demo

全球首个集成 5G AI 处理器的调制解调器及射频系统

The World's First Modem-RF System with Integrated 5G AI Processor

高通无线通信技术（中国）有限公司
Qualcomm Wireless Communication Technologies (China) Co.,Ltd.

引言

高通公司于 2022 年 2 月推出全球首个集成 5G AI 处理器的调制解调器及射频系统——骁龙 X70，其利用强大的 AI 能力，实现突破性的 5G 性能，包括高达 10Gbps 的 5G 传输速度、超低时延、卓越的网络覆盖和能效，开启 5G 智能连接新时代。

Introduction

Qualcomm launched the Snapdragon X70, the world's first modem-RF system with an integrated 5G AI processor, in February 2022. The Snapdragon X70 leverages the power of artificial intelligence to enable breakthrough 5G performance with the 5G speeds of up to 10 Gbps, ultra-low latency, and superior coverage and power efficiency, pushing the boundaries of 5G connectivity to a new level.

骁龙 X70 利用全球首个 5G AI 处理器，实现突破性的 5G 性能

Snapdragon X70 harnesses the world's first 5G AI processor for breakthrough of 5G performance

骁龙 X70 引入高通 5G AI 套件，优化 Sub-6GHz 和毫米波 5G 链路，其领先特性包括：AI 辅助信道状态反馈和动态优化、全球首个 AI 辅助毫米波波束管理、AI 辅助网络选择、AI 辅助自适应天线调谐。

With its Qualcomm 5G AI Suite, the Snapdragon X70 is designed for 5G link optimizations at Sub-6 GHz and mmWave frequencies, including AI-based channel-state feedback and dynamic optimization, the world's first AI-based beam management, AI-based network selection, and AI-based adaptive antenna tuning.

骁龙 X70 是全球唯一支持从 600MHz 到 41GHz 全部 5G 商用频段的调制解调器及射频系统，为终端厂商设计满足全球运营商要求的终端提供极大灵活性；支持业界最全面的频谱聚合功能，包括全球首个跨 TDD 和 FDD 频谱的下行四载波聚合，以及毫米波和 Sub-6GHz 聚合；支持出色的上行链路性能和灵活性，包括跨 TDD 和 FDD 频段的上行载波聚合以及基于载波聚合的上行发射切换；支持出色的能效，引入第三代高通 5G PowerSave，结合 4 纳米基带工艺和先进的调制解调器及射频技术，在各种用户场景和信号条件中动态优化发射和接收路径。此外，骁龙 X70 还支持毫米波独立组网、真正面向全球市场的 5G 多 SIM 卡和双卡双通等功能。

Qualcomm's Snapdragon X70 is the only commercial 5G modem-RF system that supports all 5G bands, from 600 MHz to 41 GHz, allowing OEMs to design devices that support the needs of global operators. Snapdragon X70 supports the industry's most comprehensive spectrum aggregation capabilities including the world's first 4X downlink carrier aggregation across TDD and FDD, mmWave-Sub-6 aggregation. Through carrier aggregation and switched uplink support across TDD and FDD, it provides unsurpassed uplink performance and flexibility.

凭借可升级软件架构，骁龙 X70 在发布后三个月，即宣布支持高通 Smart Transmit 3.0 新特性，将 Wi-Fi 和蓝牙集成至智能发射架构，进一步提升射频性能。

Furthermore, it has superior power efficiency thanks to Qualcomm's 5G PowerSave 3.0 technology, which includes advanced modem-RF technology and a 4nm baseband process that dynamically optimizes transmit and receive paths across a wide range of user scenarios and signal conditions to maximize power efficiency.

骁龙 X70 面向多类型终端，以平台式创新赋能行业变革

Snapdragon X70 supports a wide array of devices and enables industry transformation with horizontal innovations

随着 5G 建设的持续深化、创新应用的不断扩展，如何充分挖掘 5G 潜能，为广大消费者和行业用户提供更为极致的连接体验，并满足更多应用场景的需求，成为当前通信行业的共同课题。

The industry is faced with a shared challenge today in delivering the most ultimate connectivity experiences for consumers and industrial customers due to the rapid expansion of 5G deployment and innovative applications. By fully unlocking the potential of 5G, the industry can address the demand in a wider range of scenarios.

骁龙 X70 以开创性的方式引入原生的 5G AI 处理能力，展示了“利用 AI 技术提升 5G 性能”的创新范例，助力行业加速推进“AI 和 ML 赋能的端到端通信”前瞻方向的技术演进和产品落地。

This model introduces native 5G AI processing in an innovative manner, providing an example of innovation enhancing 5G performance through AI technologies, enabling the industry to accelerate technology evolution and product implementation within the forward-looking vector of artificial intelligence/machine learning-powered end-to-end communications.

骁龙 X70 预计于 2022 年下半年开始向客户出样，商用移动终端预计在 2022 年晚些时候面市。骁龙 X70 将面向智能手机、笔记本电脑、固定无线接入设备和工业机械等多类型终端，提供突破性的 5G 性能，以平台式创新助力变革众多行业并开启全新体验。

It is expected that customer sampling of Snapdragon X70 will begin in the second half of 2022 and that commercial mobile devices will be launched by the end of 2022. This chip will enable breakthrough 5G performance across a wide range of devices, including smartphones, laptops, fixed wireless access equipment and industrial machines, thereby transforming numerous industries and enabling new experiences.

骁龙 X70 为数字生活和行业应用带来极致 5G 性能

Snapdragon X70 delivers superior 5G performance in digital life and industrial use cases

数字经济正在向更深层次、更广领域探索，成为推动消费升级、稳定经济增长的关键动力。以 5G 和 AI 等为代表的基础技术，正为全球经济的快速发展注入强劲增长动力。

The digital economy is rapidly expanding into new verticals, becoming a key driver of consumption upgrades and economic growth. The rapid development of the global economy is fueled by fundamental technologies such as 5G and artificial intelligence.

作为充分融合 5G 和 AI 技术的首创性产品，骁龙 X70 将通过最为普及的 5G 终端——5G 手机，加速实现“人人享 5G”的美好愿景，大大增强消费者的获得感；此外，骁龙 X70 还将赋能更多的 5G 创新终端和应用，为 5G 激发行业变革提供关键平台支持，助力构建“百花齐放”的终端生态新图景。

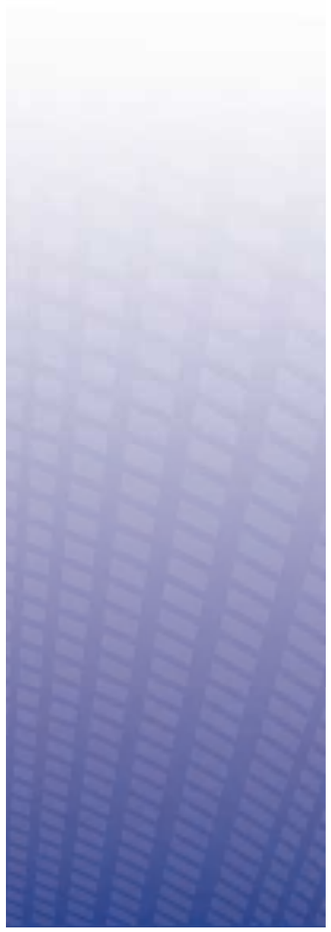
By combining 5G and AI technologies, Snapdragon X70 will accelerate the grand vision of "bringing 5G to everyone" by making 5G smartphones - the most ubiquitous 5G devices - and enhancing subscribers' "sense of gain". Furthermore, Snapdragon X70 will enable more 5G-enabled devices and applications, stimulating industry transformation and enabling a booming and diversified device ecosystem.

骁龙 X70 支持全球首个 5G 毫米波独立组网连接，并凭借强大的载波聚合能力提升 5G 传输速度

Snapdragon X70 enables the world's first 5G standalone mmWave connection and improves 5G speeds with the great capacity of carrier aggregation

骁龙 X70 支持了全球首个 5G 毫米波独立组网连接，实现超过 8Gbps 的峰值传输速度。骁龙 X70 能够支持 5G 毫米波独立组网，即在不使用 Sub-6GHz 频谱锚点的情况下部署 5G 毫米波网络和终端，使运营商能够更灵活地为个人和商业用户提供数千兆比特速度、超低时延的无线光纤宽带接入。此外，骁龙 X70 还支持跨三个 TDD 信道的 5G Sub-6GHz 载波聚合，实现高达 6Gbps 的峰值下载速度。

With peak speeds exceeding 8 Gbps, Snapdragon X70 enables the world's first 5G standalone mmWave connection. With Snapdragon X70, 5G mmWave networks and devices can be deployed without using an anchor in the Sub-6 GHz spectrum. By doing so, operators will have greater flexibility in providing multi-gigabit broadband access to residential and commercial customers with ultra-low latency and multi-gigabit speeds. It is also possible to achieve a peak download speed of 6 Gbps via 5G Sub-6GHz carrier aggregation across three TDD channels with the Snapdragon X70.



02

世界互联网领先科技成果提名项目

World Leading Internet Scientific and Technological Achievements Nominated Projects

百度文心大模型

Baidu Wenxin Industry-Level Knowledge-Enhanced Models

北京百度网讯科技有限公司
Beijing Baidu Netcom Science Technology Co.,Ltd.



引言

文心是百度自主研发的产业级知识增强大模型，构建了模型层、工具与平台层、大模型创意与探索社区的完整布局，大幅降低人工智能开发和应用门槛，加快人工智能大规模产业化进程并拓展人工智能技术边界。

Introduction

Wenxin is a series of Industry-level knowledge-enhanced large models independently developed by Baidu. The full layout of Wenxin includes models, tools and platforms, and a community of large model innovation and exploration. As a result, AI development and application have been lowered to a substantial degree, its large-scale industrialization has been accelerated, and its boundaries have been greatly expanded.

产业级知识增强大模型

Industry-level knowledge-enhanced large models

文心大模型基于飞桨的大规模分布式训练技术优势，创新性地在预训练模型中引入大规模知识，提出了海量无监督文本与大规模知识图谱的平行预训练方法，突破多源异构数据难以统一表示与学习的瓶颈。

Wenxin integrates large-scale knowledge into pre-training by utilizing the distributed training technology of paddle, Baidu's deep learning platform. In order to overcome the bottleneck of unified representation and learning of multiple sources of heterogeneous data, the parallel pre-training on massive unsupervised text and knowledge graphs is used.

以知识增强语义理解为核心，文心实现从单模态大模型到跨模态、从通用基础大模型到跨领域、跨行业持续创新突破。例如，鹏城－百度·文心是知识增强千亿大模型，参数规模达到 2600 亿，在 60 多项 NLP 任务上取得最好效果。

The Wenxin family is built around knowledge enhanced language understanding. Wenxin continues to develop new ground-breaking models, ranging from unimodal to multimodal, and from general-purpose to domain-specific. PCL-BAIDU Wenxin, the knowledge-enhanced model with more than 260 billion parameters in the world, has achieved SOTA on more than 60 tasks related to natural language processing

各行各业广泛应用

Wide application in all walks of life

大模型落地应用最关键要解决的是技术与真实场景要求相匹配的问题。文心大模型采取的落地应用模式是：建设更适配场景需求的大模型体系，提供全流程支持应用落地的工具和方法让大模型充分发挥作用，以及建设开放的生态，以生态促创新。

Bringing technologies together with real-world scenarios is the key to the successful application of large models. With this in mind, Wenxin has developed a system of large models that meets the needs of real scenarios, has developed solutions and tools to ensure the large models function properly, and has developed an open ecosystem to assist in the development of new technologies.

文心大模型通过飞桨深度学习平台开源开放。目前，已有来自于各行各业的超过 10 万开发者基于文心大模型进行AI应用的研发，并应用到制造、能源、城市、金融、媒体等行业场景中。

There is an open source version of the Wenxin models available on PaddlePaddle. In the past few months, more than 100 thousand developers from all walks of life have created artificial intelligence applications using Wenxin models, which are or will be used in manufacturing, energy, urban management, finance, media, and other fields.

在能源、金融、航天领域，文心联合国家电网、浦发银行、中国航天研发了知识增强的能源行业 NLP 大模型国网－百度·文心、金融行业 NLP 大模型浦发－百度·文心、航天行业 NLP 大模型航天－百度·文心，并在电力、金融、航天相关任务上取得显著的效果提升。

Baidu has collaborated with State Grid, Shanghai Pudong Development Bank, and China National Space Administration to develop Industry-level knowledge-enhanced natural language processing models, namely SG-BAIDU Wenxin, SPDB-BAIDU Wenxin, and CNSA-BAIDU Wenxin.

持续创造经济和社会价值

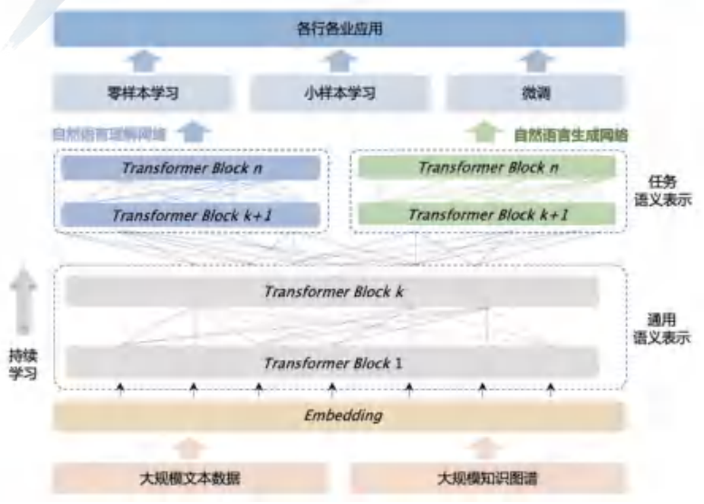
Constantly creating economic and social value

文心大模型已应用于百度百余个产品，直接带来经济效益数百亿元。文心大模型打造的应用落地模式，让标注数据更少、开发效率更高、应用成本更低，带动产业经济价值。例如，在医疗领域应用中，文心大模型将每份病历的检查时间，从 30 分钟缩短到了秒级别。基于 HELIX-GEM 构建的 ADMET 成药性预测模型、药物筛选技术，已经帮助 2 家企业找到高活性的苗头化合物，其中在一个 first-in-class 的自免类疾病靶点上 4 个多小时就成功从 20 万化合物库中筛选到 1 个高活性苗头化合物。

Wenxin models are used in more than 100 Baidu products, resulting in direct economic benefit of tens of billions of RMB. Through Wenxin's application mode, in order to achieve higher development efficiency while using less labelled data and at a lower cost. Wenxin models, for example, have significantly reduced the time it takes to check a medical record from 30 minutes to seconds in medical practice. Two enterprises have found highly active compounds with the help of the ADMET prediction model and the drug screening technology developed based on HELIX-GEM. It took less than five hours for one of them to identify a highly active hit compound from a library of 200,000 compounds designed to target autoimmune diseases, a first-in-class therapeutic target.

同时，文心大模型正在助力持续改善社会问题。大模型训练、推理所消耗的资源极其昂贵，为了解决大模型低成本应用问题，文心打造了绿色应用落地方案，减少资源消耗，推动环境可持续发展。生物计算大模型支持病毒研究，NLP 和 CV 大模型支持 AI 测温、疫情问答、疫情相关资料多语言翻译等 AI 抗疫场景。同时，文心大模型与飞桨共创生态，持续培养复合型的 AI 人才，为推动社会智能化升级贡献力量。

In addition to improving social problems, Wenxin is dedicated to improving the environment. Wenxin has introduced a green scheme to reduce resource consumption and facilitate environmentally sustainable development in light of the resource-intensive nature of large model training and inference. It is possible to perform virus research using large biocomputing models, perform temperature measurement using NLP and CV models, and translate pandemic-related documents from multiple languages using multilingual translation models. The two companies are simultaneously creating an ecology together, promoting social intelligence by developing inter-disciplinary talents.





TDSQL——推进数据库基础技术突破与产业分布式技术升级

TDSQL——Promoting the Breakthrough of Basic Database Technologies and the Upgrade of Industry Distributed Technologies

腾讯科技（深圳）有限公司
Tencent Technology (Shenzhen) Co.,Ltd.

中国人民大学
Renmin University of China

腾讯云计算（北京）有限责任公司
Tencent Cloud Computing (Beijing) Co.,Ltd.

引言

腾讯对分布式数据库技术进行了多年的基础研究创新，在数据一致性与高性能、系统弹性伸缩与高可用、HTAP 融合引擎等方面进行持续创新，研发了具有国际领先水平的、面向未来数字经济的金融级分布式数据库 TDSQL。

Introduction

For many years, Tencent has conducted fundamental research and innovation in distributed database technologies. Tencent is continuing to innovate in the areas of data consistency and high performance, system elasticity scaling and high availability, as well as the HTAP fusion engine. TDSQL (Tencent Database SQL) was developed by Tencent to provide leading international services and prepare the company for a future-oriented digital economy.

不断优化企业级分布式数据库

Constant optimization of enterprise-level distributed database

TDSQL 立足于国际产业对数字化转型升级的需求，对数据库事务处理、系统可用性、安全性、数字化处理等关键技术进行创新突破，解决了传统数据库在扩展性、成本与性能等根本性瓶颈，打造出国际领先的企业级分布式数据库，具备金融级分布式、实时分析、云原生等云时代先进技术能力，推进数据库基础技术突破与产业分布式升级。

TDSQL has made innovative breakthroughs in cutting-edge technologies such as database transaction processing, system availability, security, and digital processing to meet the demands of international industries for digital transformation. With TDSQL, the fundamental bottlenecks of traditional databases are solved in terms of scalability, cost, and performance. TD SQL aims to be a leading international enterprise distributed database system with cloud-native capabilities and financial, real-time analysis capabilities. In addition to the advancement of basic database technologies, TDSQL is promoting the advancement of industry-wide distributed technologies.

TDSQL 是支持全局一致性、多级一致性的金融级高可扩展分布式数据库系统。提出并定义顺序可串行化，在分布式场景中，可在确保数据强一致性下，实现高性能线性水平扩展，提高分布式事务型集群的处理效率。

As a highly scalable distributed database system, TDSQL supports global and multilevel consistency. In TDSQL, sequential serializability is proposed and defined as a means to improve distributed transactional clusters' processing efficiency while ensuring strong data consistency. By achieving high performance with linear horizontal scaling, TDSQL is able to provide high performance with linear horizontal scaling.

TDSQL 实现了基于 Serverless 的弹性高可用架构，并通过 AI 技术使得数据库具备自动驾驶功能。基于这些技术，TDSQL 可进行智能资源调度、敏捷弹性伸缩、数据布局优化、智能调参等，形成高可用、高效率的弹性计算能力。

Through the use of artificial intelligence (AI), TDSQL implements an elastic and highly available architecture based on Serverless. With AI technologies, TDSQL supports highly available and efficient elastic computing capabilities through intelligent resource scheduling, agile elastic scaling, data layout optimization, and automatic parameter tuning.

TDSQL 实现了基于全时态模型的存算分离计算架构。支持线上分析处理，实现秒级实时化，可有效兼顾存储开销和性能，且复杂分析平均时延低。

A full temporal model is used to implement TDSQL's disaggregated storage and computing architecture. For complex analyses, supports online analysis and can process data in real time, effectively balancing storage overhead and performance with low average latencies.



规模化投产金融核心系统，服务 50 万家金融政企客户

Large scale production of financial core systems, serving 500,000 financial government and enterprise customers

突破金融级可用，才能走向企业级通用。TDSQL 已应用于超过 50 万客户，包括主流金融、政务、运营商、工业制造企业。目前，TDSQL 已广泛服务于银行业，助力 20 余家金融机构进行核心系统改造，处于行业领先地位，帮助包括平安银行、张家港银行、昆山农商行、海峡银行、印尼 Bank NeoCommerce 银行等实现核心系统分布式与数字化转型升级。

Through its ability to break through the financial applications, TDSQL moves towards enterprise generality. More than 500000 customers have already deployed TDSQL, including mainstream financial institutions, government agencies, operators, and industrial manufacturers. Furthermore, TDSQL has been widely used in the banking industry, assisting more than 20 financial institutions in implementing core system transformations, and is in the lead position in this field. As a result of its work, many banks (including Ping An Bank, Bank of Zhangjiagang, Kunshan Rural Commercial Bank, Haixia Bank, and Bank Neo Commerce in Indonesia) have been able to deploy the core distributed transactional system and undergo digital transformation and upgrade.

应用至今，TDSQL 已屡次实现分布式数据库领域的领先突破，上线互联网银行核心、上线传统银行核心、帮助银行核心从大机下移分布式平台，实现分布式数据库在国际上的规模化应用推广。TDSQL 还实现数据库关键技术平台化并向全行业开源，推动分布式数据库技术生态规模化发展。

To date, TDSQL has achieved leading breakthroughs in distributed databases, as well as launching the Internet and the traditional banking core systems. With TDSQL, the core systems were transformed from centralized to large-scale distributed systems, promoting a massive number of applications on a global basis. Moreover, TDSQL provides the platform for the development of these key databases and is open source, promoting the development of distributed databases in an ecological and large-scale manner.

以先进技术服务经济发展、支撑社会实现数字化转型

Leveraging technologies to serve economic development and support digital transformation

TDSQL 自应用以来，借在云计算领域的核心技术的优势，帮助客户摆脱对传统集中式产品的依赖，每年节省数十亿 IT 成本。如张家港行应用 TDSQL 后，IT 硬件成本降至原来的 1/5。

Through the use of its cloud computing technologies, TDSQL has helped customers reduce their reliance on traditional centralized products, and save billions of dollars annually in IT costs. Using TDSQL, the IT hardware costs of the Bank of Zhangjiagang were reduced to 1/5 of their original cost.



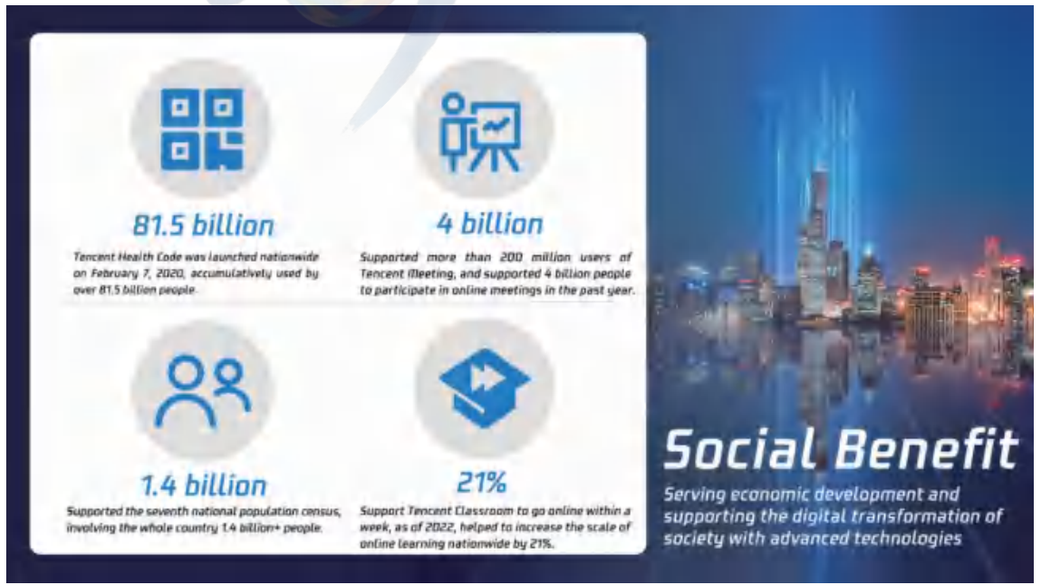
此外，TDSQL 还支撑社会实现数字化转型。在系统应对突发事件、提升社会运营效率方面贡献突出。其支持健康码快速上线，至今亮码超 815 亿人次，覆盖 13 亿人；支持腾讯会议支撑海量用户，帮助社会实现快速复工复产。

TDSQL also contributes to the digital transformation of society. A number of outstanding contributions have been made to the system in response to emergencies and in improving society's operational efficiency. There have been more than 81.5 billion usages of the "health code" so far, covering approximately 1.3 billion people; in addition, it supports Tencent Meeting for massive users and helps society resume work and production as quickly as possible.

TDSQL 在国际上广泛应用，推动全球基础技术实现面向未来的分布式升级。

Internationally, TDSQL is widely used as a means to support future-oriented upgrades to the underlying technology.





智能汽车行业创新：大算力、高性能融合计算芯片 IP 平台

Innovation in the Smart Vehicle Industry: the First Integrated Computing Chip IP Platform with High Computing Power and High Performance in China

安谋科技（中国）有限公司
Arm Technology (China) Co.,Ltd.

安谋科技
arm CHINA

引言

作为面向智能汽车的大算力、高性能融合计算芯片 IP 平台，将全面赋能智能汽车高端芯片产品快速落地，支持中国标准智能汽车体系全面建成，构建开放协同的智能汽车产业生态，为未来向全球推广应用奠定良好基础。

Introduction

As the first integrated computing chip IP platform designed with high computing power and high performance in China, it will comprehensively accelerate the launch of high-end chip products for domestic smart cars, enhancing the establishment of smart vehicle systems that conform to Chinese standards, creating an open and collaborative smart car industry ecosystem, and laying the foundation for the global expansion of domestic smart car chips.

大算力 + 高性能定义智能汽车芯片新规范

Define the new criteria of smart car chips with high computing power and performance

安谋科技突破性地将自研周易 NPU、星辰 CPU、山海 SPU、玲珑 ISP 和玲珑 VPU 等计算单元做底层架构设计创新后进行智能化融合，结合全球领先的 Arm Cortex CPU，Mali GPU 技术，打造面向智能汽车的大算力、高性能融合计算芯片 IP 平台。

Through innovative use of self-developed IPs, including Zhouyi NPU, Star CPU, Shanhai SPU, LINLON ISP and LINLON VPU, Arm China creates the world's first integrated computing chip IP platform with high computing power and high performance for smart vehicles. This platform is the result of the innovative design of the underlying architecture and synergy with the world's leading Arm Cortex CPUs and Mali GPUs.

作为自动驾驶核心计算单元的新一代周易 NPU 是中国领先的大算力 IP，算力高达 320TOPS，可通过并行联接技术扩充至超过 1000TOPS。已在嵌入式、移动终端、智能安防以及智能座舱等领域完成量产商用，完整、成熟的工具链和软硬件生态满足全场景整车智能计算需求。

As the core computing unit of autonomous driving system, the new generation Zhouyi NPU is the leading big computing power IP in China, with a computing power of up to 320TOPS. By expanding the computing power with parallel architecture, it can be expanded to over 1,000TOPS. Moreover, Zhouyi NPU has been put into mass production and has found commercial application in a wide range of industries, including embedded devices, mobile devices, smart security, and smart cockpits. Its integrated chain of tools and full-fledged software and hardware ecosystem can fully meet the computing needs of smart cars in all scenarios.

平台内置 Arm Cortex-A78AE CPU 处理器符合 ASIL D 功能安全标准，可按需配置 2-8 核，提供强大的通用计算处理能力。

With Arm Cortex-A78 AE CPU that complies with the ASIL-D functional safety standards, the platform is available with 2-8 cores based on demand to provide powerful generic computing processing capacity.

在图像、视频数据处理方面，自研玲珑 ISP 和玲珑 VPU 支持高达 16 路摄像头视频信号处理，以及 8K 60/120fps 编解码，达到中国视觉领域芯片 IP 的最高水平。配合 Arm Mali G78AE 车规级 GPU 强大的 2D、3D 图形计算、渲染能力以及突出的硬件虚拟化特性，为智能座舱的丰富应用提供全方位支持。

The LINLON ISP, developed by Arm China, provides support for up to 16 channels of camera video signal processing, as well as 8K 60/120 frames per second coding and decoding, representing the highest level of visual processor developed in China. Combined with strong 2D and 3D graphic computing and rendering capacity of the automotive-level Arm Mali G78AE GPU, plus the outstanding hardware virtualization feature, they provide comprehensive support for the abundant applications in the smart cockpit.

安全方面，平台所有计算单元、互联机制和架构均基于 ISO26262 标准完成车规级验证，自研星辰 CPU 和山海 SPU 则进一步提供高可靠性，支持多场景的安全服务。

In terms of safety, all the computing units, connectivity and architectures of the platform have received automotive-level verification based on the ISO26262 standards. Further support for multi-scenario safety services is provided by Arm China's self-developed STAR CPU and Shanhai system.

大算力、高性能融合计算芯片 IP 平台，赋能中国智能汽车产业

The high-performance integrated computing chip IP platform with high computing power empowers China's smart vehicle industry

截至 2022 年 6 月上旬，该平台已完成整体开发并根据生态合作伙伴反馈持续迭代升级。目前已有多颗基于该平台开发的智能座舱、自动驾驶芯片实现量产，并将逐步搭载在中国智能汽车上销往全球。安谋科技计划协同生态合作伙伴向全球推广实施该平台，将本土创新反哺世界，加速智能汽车技术及产业生态建设，实现国际标准的共创、共建、共享、共赢。

During the early months of June 2022, the overall development of the platform had been completed, and the platform is currently undergoing technical iterations based on the feedback provided by ecosystem partners. To date, a number of smart cockpit and autonomous driving chips developed on the current platform have achieved volume production, and these chips will be used in Chinese cars sold worldwide. As part of its collaboration with industry partners, Arm China will promote this computing platform throughout the world, and provide localized innovation to the rest of the world, strengthening China's discourse power in the global smart car technologies and ecosystem as well as promoting international standards through "co-creation, co-building, co-sharing and win-win".

加速汽车芯片进程 推动汽车智能芯片关键创新

Accelerate localization of automotive chips, and boost crucial innovation of smart vehicle chips

基于该平台，芯片厂商能够快速设计出功能复杂的智能汽车 SoC 芯片，大幅缩短芯片设计周期并提高流片成功率，缩短验证过程。

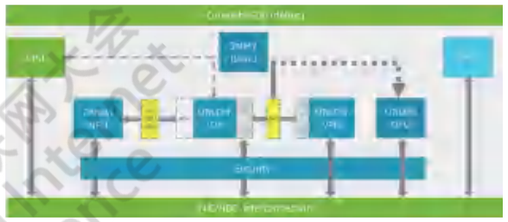
By utilizing this platform, automotive chipmakers are able to rapidly design sophisticated smart car SoC chips, reducing the design cycle, improving tape-out success rates, and reducing verification times.

平台为汽车芯片产品性能的持续提升提供了底层技术支撑，芯片厂商可将资源聚焦于定义更具特色、更符合市场需求的产品以及拓展下游客户，提升智能汽车芯片厂商的整体能力。

Further, the platform provides underlying technology support for automotive chipmakers to continuously improve their products, allowing them to focus their resources on defining more features that better meet market needs and expanding downstream customers. By doing so, domestic smart vehicle chipmakers will be able to enhance their overall capacity.

此外，平台将显著减少产业重复性的研发投入，优化产业人才结构，推动智能汽车产业的良性竞争与快速有序发展。

On top of that, the platform can remarkably reduce overlapping input, and optimize the talent structure of the industry, so as to promote virtuous competition and rapid, orderly development of the smart vehicle industry.



安谋科技大算力、高性能融合计算芯片 IP 平台整体架构图
Overall Structure of
Arm China Integrated Computing Chip IP Platform

赋能汽车产业“中国芯” 共创智能汽车芯片计算标准

Empowering “China-made chips” in the automotive industry, and co-creating the computing standards for smart vehicle chips

该平台是安谋科技“全球标准、本土创新”理念的进一步实践与创新，有利于中国智能汽车芯片上下游生态，包括工具链、软件、算法、系统、方案等各环节的协同和构建，共同参与国际标准的制定。

As part of the “Global standards and localized innovation” concept of Arm China, this platform represents further practice and innovation, benefiting the upstream and downstream ecosystems in China’s smart vehicle chip sector. The smart car chip sector includes collaboration and the development of all sections, including the tool chain, software, algorithm, system, and solution, as well as participating in global standards development.

奇安信大禹平台及重大网络安全防护应用

Dayu Platform and Its Applications on Major Cybersecurity Protection Projects

奇安信科技集团股份有限公司
QI-ANXIN Technology Group Co.,Ltd.

引言

奇安信基于人工智能和大数据技术，研制了大数据安全中台——大禹平台，作为新一代网络安全防护体系核心引擎，实现安全检测、分析与处置能力高效聚合。

Introduction

Qi-Anxin has developed the Dayu platform, a big data security center, based on AI and big data technologies. Providing security detection, analysis, and response capabilities, the platform serves as the core engine of a new generation cybersecurity protection system.

突破四层难题，提升网络安全防护整体能力

Four breakthroughs to elevate the overall cybersecurity protection capability

大禹平台重点突破漏洞与威胁检测、威胁情报聚合分析、态势评估与应急处置等关键技术，系统化提升重要信息系统网络安全防护能力。

It has made significant advancements in the detection of vulnerabilities and threats, the aggregation of threat intelligence, the assessment of situations and the response to emergencies, with the aim of systematically improving the security protection capabilities of critical information systems.

一是突破多层次广覆盖漏洞检测难题。平台支持源代码和二进制代码漏洞检测，具备 2798 类源代码安全漏洞自动化检测能力，相关成果发表于 ICSE，获得全球知名 IT 厂商漏洞致谢 400 余次。

Firstly, the breakthrough in multi-level and wide-coverage vulnerability detection; the platform supports source code and binary code vulnerability detection and is capable of automatically detecting vulnerabilities in 2798 types of source code. The results of the research were published at ICSE and praised more than 400 times by renowned IT manufacturers from both home and abroad.

二是突破高级网络威胁精准检测难题。平台实现对无文件攻击、脚本攻击、内存攻击等行为关联检测，支持对威胁行为动态监控和细粒度行为数据实时分析，是可同时应用上千条规则的高性能实时分析引擎。

Secondly, the platform has achieved breakthroughs in advanced cyber threat accurate detection; in addition to providing dynamic monitoring of threat behaviors, the platform also supports real-time analysis of fine-grained behavior data for fileless attacks, scripted attacks, and memory attacks. Therefore, it is a high-performance and real-time analysis engine capable of applying thousands of rules to actual combat situations.

三是突破海量情报数据聚合分析难题。平台具备细粒度、高精准威胁情报全信息要素采集与提取、百 PB 规模情报数据毫秒级检索，实现对攻击组织“基因”画像和团伙样本智能溯源。

Thirdly, the platform has achieved a breakthrough in the analysis of massive intelligence data aggregation; the platform has been able to collect and extract all elements of threat intelligence with high precision and has retrieved hundreds of petabytes of data in milliseconds, enabling a genetic portrait of the attacking organization to be produced as well as intelligent traceability of gang samples to be produced.

四是突破模糊态势综合分析研判与快速响应难题。通过建立基于不确定推理网络安全对抗态势评估模型，解决态势要素数据模糊场景下的有效评估，可基于预设实现自动处置。

Fourthly, the breakthrough in comprehensive analysis, judgment and rapid response system for fuzzy situations; this platform has established a cybersecurity confrontation situation assessment model based on uncertainty reasoning to achieve effective assessment of situation element data in fuzzy scenarios. An automated response will be initiated based on the presetting.

完成规模应用，护航千行百业数字转型安全

Scale application to escort security of digital transformation of thousands of industries

大禹平台入选国家级数字化转型伙伴行动和中小企业数字化赋能专项行动，并在能源、金融、航空、大型制造业等百余个世界 500 强企业落地应用，得到客户高度认可。

Dayu has been selected to participate in the Country-level Digital Transformation Partnership Initiative and the Special Campaign for Digital Empowerment of Small and Medium-sized Businesses, and has been widely ratified by Fortune 500 companies in the fields of energy, finance, aviation, and manufacturing, among others.

该平台累计检测 30 多万个开发项目、超 100 亿行代码，发现 2000 多万个安全隐患，参与执行中国规模最大的开源软件源代码安全检测公益计划。借助该平台，奇安信持续监测全球范围内活跃的 40 余个 APT 组织。

Since its inception, the company has detected more than 20 million vulnerabilities in more than 10 billion lines of code across 300,000 development projects. In addition, it has implemented the largest open source software source code security testing public welfare program in China. Qi-Anxin has used this platform to monitor more than 40 APT organizations in the world.

奇安信依托该平台保障了北京冬奥会和冬残奥会 OIN 网络，服务覆盖 12 个竞赛场馆、26 个非竞赛场馆、188 个服务场站，超 1 万台终端，共检测日志数量累积超 1850 亿条，日均检测日志超 37 亿条，监测各类网络攻击 3.8 亿次，发现并修复安全漏洞约 5800 个。

Using the platform, Qi-Anxin will be able to secure the Olympic and Paralympic Winter Games' OIN network, which will include more than 10,000 terminals within 12 competition venues, 26 non-competition venues, and 188 service stations during the 2022 Olympics and Paralympic Winter Games. Over 185 billion logs have been detected by the platform (more than 3.7 billion per day on average), 380 million network attacks have been monitored, and approximately 5,800 vulnerabilities have been discovered and patched.

历经实战检验，发挥网络安全体系中枢作用

Experience in actual applications to consolidate its pivot role in cybersecurity system

本成果有力保障了近年来 “一带一路”高峰论坛、世界互联网大会、上合组织成员国峰会、中非合作论坛等多项国家级重大活动网络安全，作为网络安全防御体系的“中枢”发挥了重要作用，荣获国际信息社会世界峰会奖、数博会领先科技成果奖等数十项奖励，平台产品近三年实现营收 43.95 亿元。

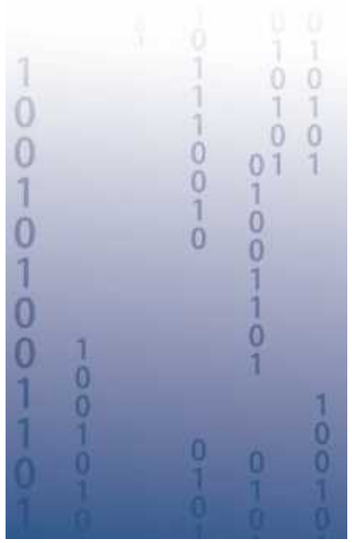
Several country-level events have been safeguarded by this platform, including Belt and Road International Forums, World Internet Conferences, Councils of Heads of State of Shanghai Cooperation Organization (SCO), Forum on China-Africa Cooperation (FOCAC), demonstrating how it plays a pivotal role in cybersecurity defense. It has received dozens of awards, including the Champion Project Award at the World Summit on the Information Society Forum (WSIS) and the Leading Technology Achievement Award at the Big Data Expo. Over the past three years, it has contributed 4.395 billion RMB to Qi-Anxin.

实现技术领先，代表自主技术迈向国际水平

Cutting-edge technologies to mark the proprietary technologies to reach the international level

大禹平台在漏洞检测支持语言类型、漏洞种类数量、开发框架支持等指标方面超越国际代表性产品，并且创新提出多元行为关联分析技术，可构建鉴定模型开展关联分析研判，与全球同类技术相比，率先支持操作系统重启后行为分析及蓝屏检测，并唯一同时兼容操作系统级分析和模拟硬件级分析两种分析模式。

As far as languages, types of vulnerabilities, and development frameworks are concerned, the Dayu platform has been a step ahead of its international counterparts. Additionally, the platform is capable of building identification models in order to carry out correlation analysis and judgment using the multi-behavioral correlation analysis technology. In comparison to similar technologies around the world, this platform is a pioneer in supporting behavior analysis and blue screen detection after rebooting the operating system, as well as being the first of its kind capable of analyzing both operating systems and hardware simulations.





基于高性能人工智能训练芯片的智算集群

Intelligent Computing Cluster Based on High-Performance AI Training Chip

之江实验室
Zhejiang Lab

引言

基于高性能人工智能训练芯片的智算集群（之江天目），是基于开放计算规范的千卡规模的冷板式液冷集群；支持细粒度混合精度，高效负载均衡，高性能分布式数据存储，混合并行支持高性能计算、大数据处理和大模型训练；集群线性加比 >80%，集群 PUE<1.15。

Introduction

The 1,000-card scale intelligent computing cluster based on the Open Compute Project (OCP) specification is designed and implemented, which is also cold-plate liquid-cooled cluster. It supports fine-grained hybrid precision, efficient load balancing, high-performance distributed data storage, and hybrid parallel support for high-performance computing, big data processing and big model training. Cluster linear additive ratio >80%, cluster PUE <1.15.

基于应用特征和算力分配相融合，自适应协同存储、计算和通信的高能效可扩展异构智算集群

An energy-efficient and scalable heterogeneous intelligent computing cluster integrate application features and computing power distribution to provide a flexible, collaborative, and adaptive solution

针对海量数据和应用需求不断发展带来的算力需求和高能耗等问题，从高效并行策略、高效数据存储、合适数据精度、动态负载均衡等视角，我们重新思考构建适合高性能计算、大数据处理和人工智能应用的大规模集群系统（之江天目）。之江天目充分考虑了燧原科技邃思芯片混精支持与 CPU/GCU 芯片架构特性，通过融合通信特征和网络拓扑构建的性能模型、通信拓扑感知的神经网络参数高效交互方法、应用特征和算力分配相融合的高效计算方法，指导将应用进程映射到物理节点。突破当前集群设计方法主要利用“应用算法 – 系统软件 – 硬件架构”局部信息进行分层优化，抽象层次跨度大导致集成代价高，以及超异构硬件资源与应用算法不匹配导致编程难、部署运行效率低等问题。实现全局负载分析和特征提取、跨层协同性能优化，异构资源多粒度虚拟化技术、高效能自适应任务与资源多级映射技术、满足大规模分布式人工智能训练要求的动态表征学习方法和训练范式，以及启发式编译等关键技术。

From the perspective of efficient parallelism strategies, efficient data storage, appropriate data precision, and dynamic load balancing, we rethink the construction of a large-scale cluster system suitable for high-performance computing, big data processing, and artificial intelligence applications. Our approach addresses the problems of increasing computing power consumption and energy consumption by addressing the problems of increasing computing power consumption. Taking into account mixed refinement support for DTU chips and the architecture characteristics of CPU/GCU chips, performance models can be constructed based on communication characteristics and network topology, efficient interaction methods for communication topology-aware neural network parameters, and efficient computation methods that integrate application features and arithmetic power allocation to assist in the mapping of application processes to physical nodes. It breaks through the current cluster design method which mainly uses the local information of "application algorithm - system software - hardware architecture" for hierarchical optimization, which leads to high integration cost due to large abstraction level span and difficult programming and low deployment and operation efficiency due to mismatch between super heterogeneous hardware resources and application algorithm, and realizes global load analysis and feature extraction, cross-layer collaborative performance optimization, heterogeneous resources multi-granularity virtualization technology, high-performance adaptive task and resource multi-level mapping technology, dynamic representation learning methods and training paradigms to meet the requirements of large-scale distributed artificial intelligence training, and heuristic compilation and other key technologies.

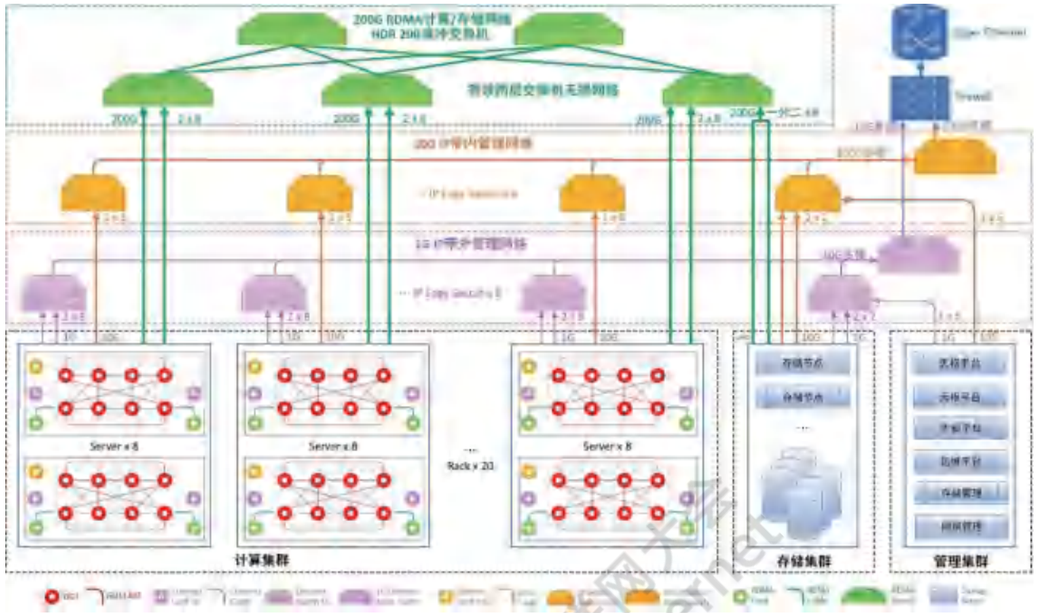
基于高性能人工智能训练芯片构建地可扩展异构智算集群助力形成科学研究新范式

A new paradigm for scientific research can be formed by scalable heterogeneous computing clusters built on high-performance artificial intelligence training chips

该异构智算集群系统核心部件为燧原科技的人工智能芯片，采用 2.5D 立体封装，支持数据精度包含 FP32/FP16/BF16，提供高异构算力、高定制能力和高能效系统。该智算集群既加速了 AI 应用落地，也通过深度融合科学计算、AI 技术、大数据处理技术，加快了科学研究与科学发现进程。该系统已服务于之江实验室智能感知、人工智能、智能计算、智能系统、智能网络等方面的科学研究和重大应用。



基于应用特征和算力分配相融合的高能效异构智算集群
Energy-efficient Heterogeneous Intelligent Computing Cluster
Based on the Fusion of Application Features and Computing Power Allocation



高能效可扩展异构智算集群网络架构
Energy-efficient and Scalable Heterogeneous Intelligent Computing Cluster Network Architecture

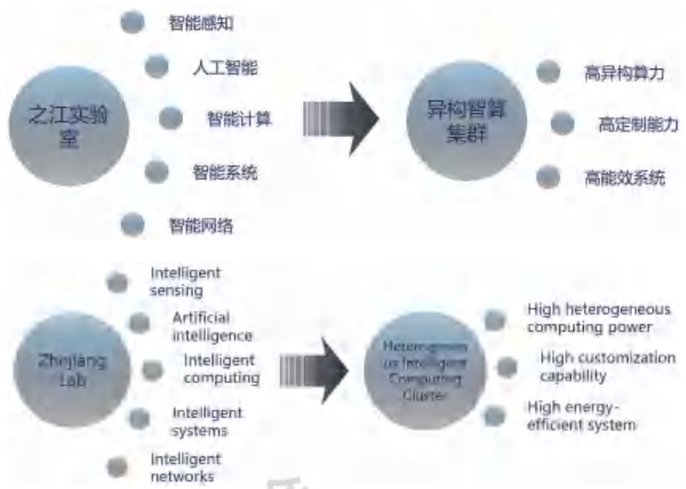
There is an AI chip of enflaming technology at the centre of this heterogeneous intelligent computing cluster system, which is packaged in 2.5D stereo and supports high precision measurements containing FP32, FP16, and BF16.6. The result is a high degree of heterogeneous computing power, a high degree of customization, and a high degree of energy efficiency. The intelligent computing cluster, which integrates scientific computing, artificial intelligence technology, and big data processing, not only accelerates the implementation of AI applications but also speeds up the process of scientific research and discovery. The system has been used at Zhejiang Lab for scientific research as well as major applications in intelligent sensing, artificial intelligence, intelligent computing, intelligent systems, and intelligent networks.

之江天目有助于建立和完善的人工智能产业生态系统，加速上层应用开发落地

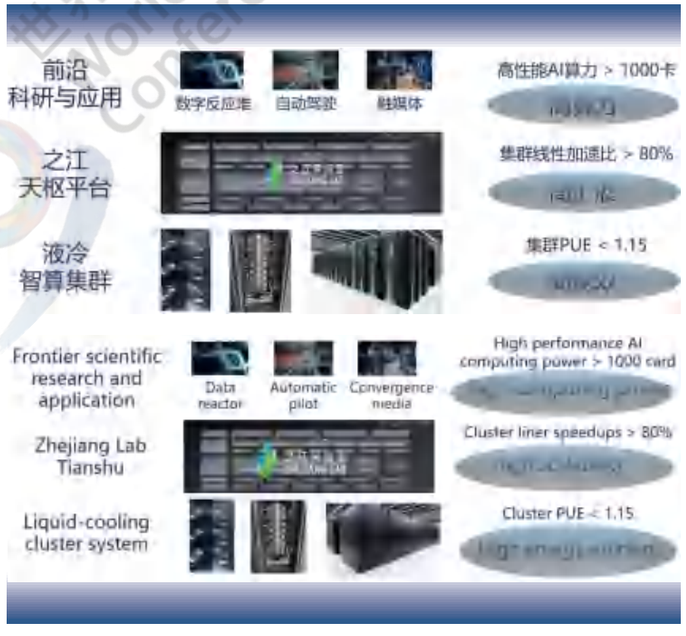
The industry ecosystem is established and improved, and application development is accelerated

人工智能算力基础设施是整个行业与应用加速发展的核心支撑，是数字化建设和智能化转型的关键推动力，将为数字化经济发展作出重要贡献。之江天目的成功部署，有利于加快技术与应用创新，促进产业快速发展，打造高效、高密的 AI 算力，有力推进和加速人工智能技术及上层应用的迭代创新。

As a key driving force for digital construction and intelligent transformation, artificial intelligence computing infrastructure will play a significant role in the rapid development of the entire industry and applications. It will also contribute significantly to the development of China's digital economy. With the successful deployment of this intelligent computing cluster system, innovation in technology and applications will be accelerated, rapid industrial development will be promoted, AI computing power will be created that is efficient and high-density, and China's artificial intelligence technology and applications will be powerfully advanced and accelerated.



智算集群服务之江实验室科研需求
Intelligent Computing Cluster Serving the Research Requirements of Zhejiang Lab



智算集群助力“计算＋”跨学科前沿研究与应用
Intelligent Computing Cluster Improving "Computing+" Interdisciplinary Frontier Research and Application

03

《科技之魅》收录成果

Charm of Science and Technology Collection

大规模图数据分析平台 AtlasGraph

AtlasGraph:
A Large-Scale Graph Data Analytics Platform

北京海致星图科技有限公司
Beijing Haizhi Stargraph Technology Co.,Ltd.

清华大学
Tsinghua University

北京海致科技集团有限公司
Beijing Haizhi Technology Group Co.,Ltd.

引言

本项目产学研相结合，通过存储－计算的协同设计，实现了以分布式图数据库为基础的大规模图数据分析平台。平台已在银行、证券、保险、公安等诸多领域成功应用，为抗击疫情做出了重大贡献，经济和社会效益显著。

Introduction

The objective of this project is to integrate storage and computing in a collaborative manner between industry, academia and research, and to build AtlasGraph, a large-scale graph data analytics platform built on a self-designed distributed graph database. In various important fields such as banking, securities, insurance, public safety, etc., the platform has made a significant contribution to the successful fight against COVID-19 and has gained significant economic and social benefits.

运用图的三维划分计算等高性能图计算技术，突破了图原生的大规模数据存储技术，实现了基于 Rust 语言的分布式混合事务分析处理图数据库

In this project, the distributed hybrid transaction and analytical processing graph database in Rust is realized by bridging key technologies in high-performance graph computing (e.g., the method for partitioning and computing graphs in three dimensions) and graph-native large-scale data storage

创新 1：基于 Rust 语言的分布式混合事务分析处理图数据库

Innovation 1: A distributed HTAP (Hybrid Transaction Analytical Processing) graph database in Rust

统筹考虑软硬件以及系统内部的工作机制，突破了图原生的大规模数据存储技术，构建了能够最大化发挥新型存储介质性能的用户态存储后端，发明了能够充分发挥 RDMA 潜力的远程获取模式，建立了图代数和图查询代价估算模型，提出了规则和代价相结合的混合图查询计划优化方法。最终实现了基于 Rust 语言的分布式混合事务分析处理图数据库。

This project takes into account the hardware, software, and internal working mechanisms of the system as a whole, breaking through the graph-native large-scale data storage technology, where a user-space storage backend that takes full advantage of the capabilities of new storage media has been built, a remote fetching paradigm that fully takes advantage of the capabilities of RDMA has been invented, graph algebra and a cost model for graph queries has been established, as well as the hybrid graph query plan optimization method based on both rules and cost models has been proposed. As a result of these technologies, the project develops the distributed HTAP graph database system based on Rust.

创新 2：大规模图数据的高性能计算技术

①运用图的三维划分与计算方法，通过数据特征优化系统 IO 架构，可减少 90.6%的节点间通讯；②设计实现了通用图随机游走引擎，实现了大图随机游走以片内缓存的速度运行，相关论文发表于 SOSP 2019、2021，成果被腾讯开源高性能分布式图计算框架 Plato 采用；③提出了面向存内计算架构、软硬件协同的图计算系统 GraphP。发表于 HPCA 2018 的论文在 4 年的时间内，已被 HPCA、FAST、MICRO 等顶会的 130 余篇论文引用。

Innovation 2: High-performance computing techniques for large-scale graph data

1) Developed the 3D graph partitioning and computing method, which reduced inter-node communication by 90% by optimizing the system IO stack in accordance with data semantics; 2) developed the first general-purpose, distributed graph random walk engine capable of processing large graphs efficiently. Papers related to the topic were published in SOSP 2019



and 2021, respectively, and Plato, a high-performance graph computing framework open-sourced by Tencent, has adopted the techniques; 3) developed GraphP, one of the first software-hardware co-designed graph processing systems for the PIM (Processing In Memory) architecture. Within just four years of the publication of the related paper in HPCA 2018, 130 related papers have been published in top venues such as IEEE HPCA, USENIX FAST, IEEE/ACM MICRO, among others.

项目技术已广泛应用于疫情防控、银行、证券、保险、能源电力、城市运营、公共安全等重要领域

Several important fields have been benefited by the technologies developed as a result of the project, including epidemic prevention and control, banking, securities, insurance, energy and power, city operations, public safety, etc

项目积极投身开源活动，支持拒绝采样的通用分布式图随机游走引擎、支持以片内缓存速度运行的随机游走系统等单项技术均已实现开源共享，总共分支数达到了 25，星标数超过 100 个。图数据分析平台或相关技术已广泛应用于疫情防控、银行、证券、保险、能源电力、城市运营、公共安全等多个重要领域。在金融知识图谱领域，服务了中国 40 余家金融机构以及 14 个行业 3000 余家企业客户；在警务大数据应用方面，已服务中国 19 个省市的 60 多个地市级公安机关。

The project actively participates in open-source activities. Both the general-purpose distributed graph random walk engine with rejection-based sampling and the random walk system capable of running at cache efficiency have been open-sourced, being forked 25 times and gaining 100+ stars in total. AtlasGraph and the related technologies are widely used in many important fields, including epidemic prevention and control, banking, securities, insurance, energy and power, city operation, and public safety. In particular, the platform has served over 40 state-owned and private financial institutions in China, along with more than 3,000 corporate clients from 14 industries in the field of financial knowledge graphs; over 60 Municipal Public Security Bureaus have used the platform for big data applications in 19 provinces across China.

项目成果的应用提升了公共服务水平，促进了社会发展，近四年已实现新增销售额 13.96 亿元，累计创造利润 6 亿元

The application of the project outcome has enhanced public service capacity, promoted social development, and gained new sales of 1.396 billion yuan and accumulated profits of 600 million yuan in the past 4 years

平台助力疫情防控，保障了人民身体健康。2020 年新冠肺炎疫情期间，海致技术人员多次“逆行”进驻武汉，协助搭建疫情防控数据分析平台和筛查结果数据推送体系。迄今已累计为超过 240 个地区提供疫情研判、智能流调等大数据服务，为成功抗击疫情做出了重大贡献。

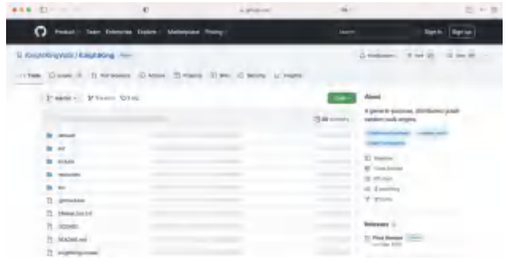
Platforms such as this have played an important role in preventing and controlling epidemics and, therefore, ensuring people's health. For example, Haizhi Group repeatedly assigned technical staff to Wuhan for building the epidemic prevention and control data analysis platform and establishing the distribution system during the COVID-19 pandemic in 2020. Currently, the platform provides such epidemic-related big data services as epidemic modelling, analysis, and screening of contact information for more than 240 counties and cities in China, contributing to the successful fight against COVID-19.

经济效益方面，项目近四年已新增销售额 13.96 亿元，累计创造利润 6 亿元，带动相关云计算配置需求超过 100 亿元。

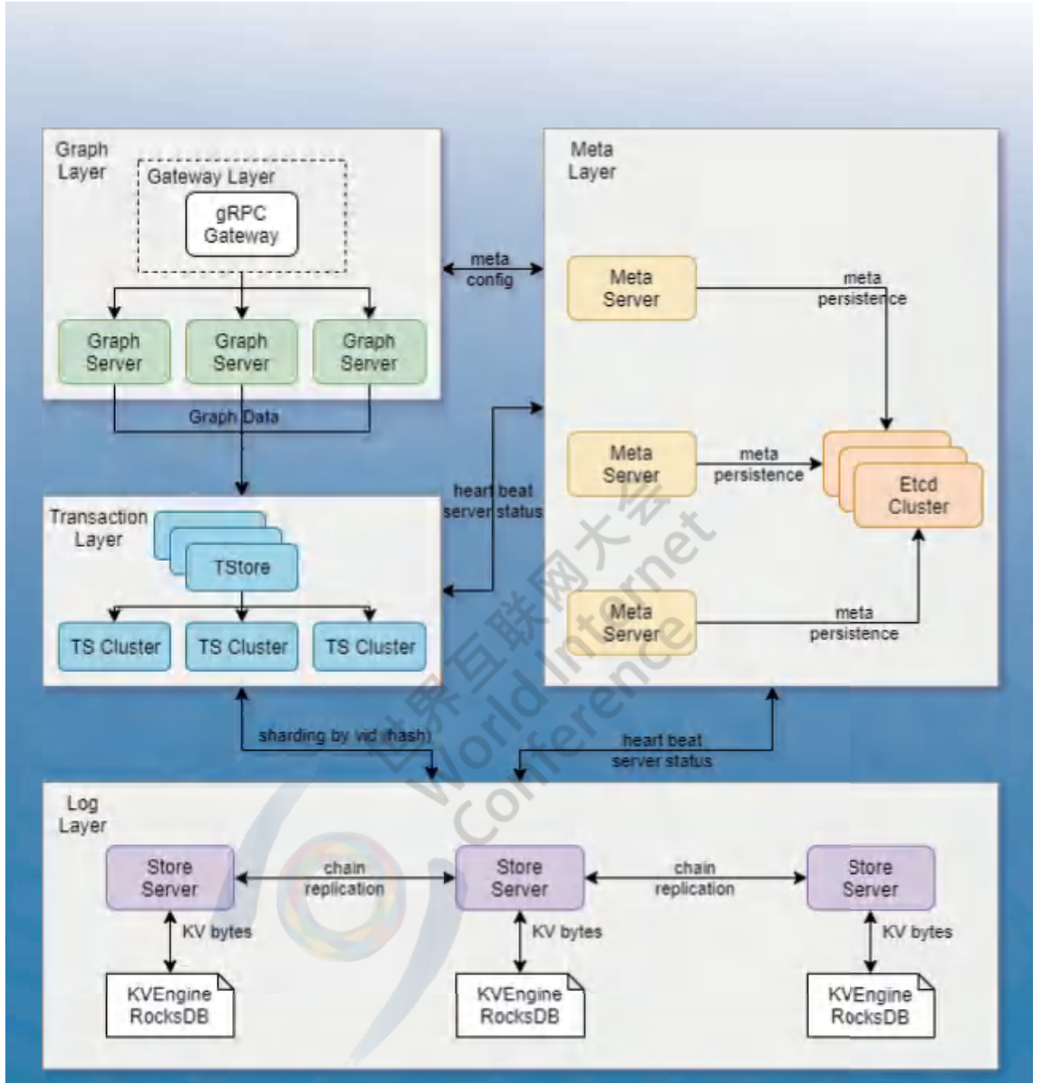
In terms of economic benefits, the project has increased sales by 1.396 billion yuan in the past four years, creating a profit of 600 million yuan accumulatively, and driving the demand for cloud computing configuration of more than 10 billion yuan.

RK	企业	数据	技术	应用	综评
1	海致星图	94.39	93.35	90.21	92.65
2	百分点科技	93.99	91.88	88.78	91.55
3	百度	90.64	89.65	87.16	89.15
4	同盾科技	88.67	87.44	89.83	88.65
5	阿里巴巴	91.77	88.10	85.01	88.29
6	腾讯	92.49	87.66	84.33	88.16
7	搜狗	83.72	88.04	85.09	85.62
8	星环科技	87.17	86.21	83.03	85.47
9	明略科技	85.30	86.75	82.98	85.01
10	拓尔思	84.51	87.22	80.21	83.98
11	中译语通	82.41	81.09	75.04	79.51
12	海翼知	80.30	81.32	74.22	78.61
13	如因智慧	78.05	80.67	75.76	78.16
14	翰亭科技	75.97	81.23	73.01	76.74
15	竹间智能	73.50	78.45	72.77	74.91

海致星图在《互联网周刊》2022 知识图谱企业排行中位居第一
Haizhi Stargraph Ranked First in the 2022 China Internet Week (CIWEEK) Knowledge Graph Enterprises List



通用分布式图随机游走引擎 KnightKing 的开源页面
Homepage for Knightking, a General-purpose Distributed Graph Random Walk Engine Opensourced by the Project



AtlasGraph 图数据分析平台中图数据库的分布式架构
The Distributed Architecture of the Graph Database in Atlasgraph

360 全网数字安全大脑

360 Cyber-Wide Digital Security Brain

360 数字安全集团
360 Digital Security Group

360数字安全
数字安全技术领导者

引言

数字化面临着内、外部双重安全挑战，风险遍布所有场景。感知网络安全态势是最基本、最基础的工作，“看见”是处置和应对的前提，是安全体系建设的核心。360 通过 17 年的积累和沉淀，凝聚为 360 全网数字安全大脑，不断攻克数字安全行业“看不见”风险的难题。

Introduction

Digitalization is faced with dual security challenges, both internal and external, and risks are pervasive in all scenarios. Perceiving the network security situation is the most basic and fundamental work. "Seeing" as the core of security system construction, is the premise of disposal and response. Through 17 years of accumulation and precipitation, 360 has condensed into the 360 Cyber-Wide Digital Security Brain, and constantly overcome the problem of "invisible" risks in the digital security industry.

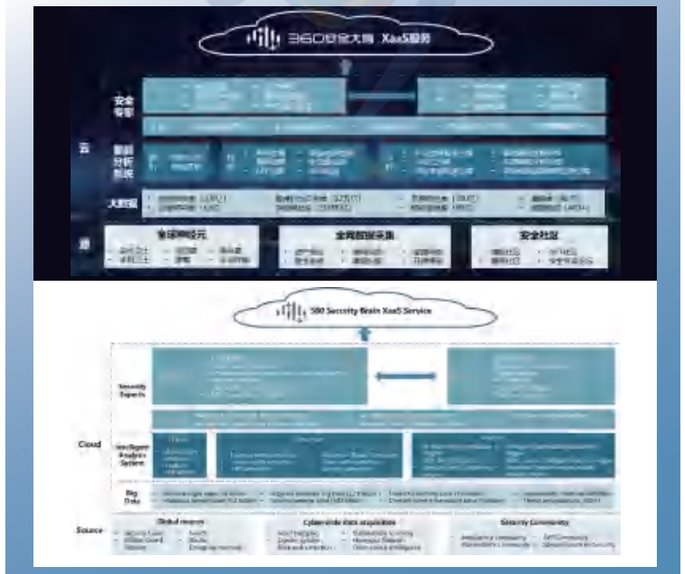
3 大核心汇聚 360 全网数字安全大脑

Three cores gather 360 cyber-wide digital security brain

360 耗时近 20 年，投入 200 亿，聚集超 2000 名安全专家，积累了 2000PB 安全大数据，围绕 360 全网数字安全大脑建立了一套以“看见 + 处置”为核心的安全运营服务体系，形成了“看见”全网态势、“看见”高级威胁攻击的强大能力。

360 spent nearly 20 years, invested 20 billion, gathered more than 2,000 security experts, accumulated 2,000PB of security big data, built a security operation service system centered on "Seeing + Handling" around 360 Cyber-Wide Digital Security Brain, and formed a strong ability to "see" the cyber-wide situation and "see" advanced threat attacks.

具体而言，360 全网数字安全大脑体系的核心分为三个层次，第一层是安全大数据平台，第二层是智能分析和检测平台，第三层专家运营平台，这样才能把全网大数据进行汇聚、分析、处理，形成对安全威胁的洞察，最后通过对外的 XaaS 云端服务为用户提供看见威胁的能力和针对性的行动指引。



Specifically, the core of 360 Cyber-Wide Digital Security Brain system is divided into three layers. The first layer is the security big data platform, the second layer is the intelligent analysis and detection platform, and the third layer is the expert operation platform. In this way, the cyber-wide big data can be gathered, analyzed, and processed to form an insight into security threats. Finally, through external XaaS cloud services, users can see threats and provide targeted action guidance.

在数据层面，360 在过去 17 年为亿万网民保护网络安全，平均每一秒钟要响应 65 万次文件查询，拦截 4 万个恶意网址，拥有超过 300 亿样本，数据规模超过 2000PB，每天新增的数据达到 1500TB。数据积累的同时，也建立了庞大的网址库、域名库、漏洞库、病毒行为库、测绘资产库、国家级威胁组织信息库等，并将他们关联起来，形成了安全大数据平台。

At the data layer, 360 has protected network security for hundreds of millions of Internet users in the past 17 years. On average, it has responded to 650 thousand file queries every second, intercepted 40 thousand malicious Web sites, had more than 30 billion samples, had more than 2,000 PB of data, and added 1,500 TB of data every day. While accumulating data, it has also established a huge website database, domain name database, vulnerability database, virus behavior database, mapping asset database, national threat organization information database, etc., and linked them together to form the security big data platform.

在智能分析和检测平台层面，360 开发了采用人工智能技术的反病毒 / 高级威胁检测智能分析引擎，并逐步发展成为全面的智能分析系统，智能分析研判识别整合了 360 多款引擎，有专门的技术团队维护检测识别所必须的特征规则，并随时将最新的识别特征规则发布到规则库，对于任何一个新的样本，平均可以在秒级提取它的所有特征并和这些攻击活动特征库进行匹配，以确定它属于哪个攻击组织，以及采用了哪些攻击手段。

At the layer of intelligent analysis and detection platform, 360 has developed the anti-virus and advanced threat

detection intelligent analysis engine using AI technology, and gradually developed into a comprehensive intelligent analysis system. Several 360 engines have been integrated in intelligent analysis, research and identification. A special technical team maintains the feature rules necessary for detection and recognition, and releases the latest recognition feature rules to the rule base at any time, For any new sample, on average, all its features can be extracted at the second level and matched with these attack activity feature databases to determine which attack organization it belongs to and which attack means it adopts.

在专家运营层面，在过去的十几年中，360 针对每一种攻击事件都建立了威胁图谱，这也是 360 核心的资产，是通过每一个 APT 攻击的分析，每一次攻防演练的总结，点点滴滴积累起来的。

At the expert operation layer, in the past ten years, 360 has established a threat map for each attack, which is also a core asset of 360. It is accumulated bit by bit through the analysis of each APT attack and the summary of each attack and defense drill.

360 将大数据技术和特征工程、图分析、知识推理等人工智能技术结合，并应用在安全领域形成的目前全球规模最大的，由百亿顶点、千亿边构成的超大规模威胁图谱，通过威胁图谱，可以将 IP、样本、网址、域名、证书、行为等所有与攻防相关的数据都通过特征工程提取他们的关键特征，并将这些特征用图分析的方式形成关联起来，再基于这些特征的关联进行知识推理，从而定位攻击组织。

360 combines big data technology with artificial intelligence technologies such as feature engineering, graph analysis and knowledge reasoning, and applies it to the world's largest threat map formed in the security field, which is composed of 10 billion vertices and 100 billion edges. Through the threat map, all data related to attack and defense, such as IP, samples, web addresses, domain names, certificates and behaviors, can be extracted with their key features through feature engineering. These features are linked by graph analysis, and then knowledge reasoning is carried out based on the correlation of these features to locate the attack organization.

从国家、城市到企业、个人的全面实践

Comprehensive practices from country and city to enterprises and individuals

在国家层面：截至目前，基于 360 全网数字安全大脑，360 捕获 50 个境外 APT 组织，收录掌握全球 400 余个组织威胁情报，获取 20000 多个 APT 威胁样本，构建 1500 个 APT 基因库和检测模型，并形成 APT 攻防对抗知识图谱，同时检测到 5200 多次对中国重要机构单位的高级网络攻击事件。

At the national level, based on 360 cyber-wide digital security brain, 360 has captured 50 overseas APT organizations, collected and mastered threat intelligence from more than 400 organizations around the world, obtained more than 20 thousand APT threat samples, built 1.5 thousand APT gene banks and detection models, and formed an APT knowledge map of offensive and defensive confrontation. At the same time, it has detected more than 5,200 high-level network attacks against important institutions and units so far in China.

在城市层面：360 全网数字安全大脑也已接连服务于重庆、天津、青岛、鹤壁、苏州、郑州、上海、周口等城市数字安全基地运营，树立了标志性的城市级安全服务典范。

At the city level, 360 cyber-wide digital security brain has also successively served the operation of urban digital security based in Chongqing, Tianjin, Qingdao, Hebi, Suzhou, Zhengzhou, Shanghai, Zhoukou and other cities, setting a landmark example of city level security services.

以 360 重庆合川数字安全基地为例，目前城市安全大脑已对重庆市区两级的数据资源管理部门以及政府、企业、运营商、教育、医疗、电力等近百家单位的业务场景进行了集中监控和管理，已发现病毒勒索、Web 攻击、网络钓鱼等安全事件 1803394 次，安全漏洞 10036 个，通过安全态势的感知和通报处置等方式，协助完成了百余个高危风险的安全整改，有效提升了被监管单位的安全防护意识和防护能力。

Taking 360 Chongqing Hechuan Digital Security Base as an example, at present, the city security brain has conducted centralized monitoring and management on the business scenarios of data resource management departments at the urban level in Chongqing, as well as nearly 100 units such as the government, enterprises, operators, education, medical care, and electric power. It has found 1,803,394 security incidents such as virus blackmail, Web attacks, phishing, and 10,036 security vulnerabilities. Through the way of security situation awareness, notification and disposal, it has assisted in the safety rectification of more than 100 high-risk risks, and effectively improved the safety protection awareness and protection capability of the supervised units.



在企业及个人层面：360 全网数字安全大脑每天处理云查 560 亿、拦截恶意网址 7.5 亿、防护勒索攻击 1000 万 +、拦截手机恶意诈骗程序攻击 2000 余万次，在 17 年间为全球 15 亿终端用户提供可靠稳定的安全云服务。

At the enterprise and individual level, 360 Cyber-Wide Digital Security Brain processes 56 billion cloud searches, intercepts 750 million malicious websites, protects 10 million extortion attacks, and intercepts more than 20 million mobile malicious fraud attacks every day, providing reliable and stable security cloud services for 1.5 billion end users worldwide in 17 years.

“看见”数字安全风险，护航数字经济发展

Exposing digital security risks, securing the development of digital economy

360 基于全网数字安全大脑集中精力解决数字安全上“看不见”威胁的问题，同时将数字安全能力复制给城市，复制给各行各业，包括用 SaaS 的模式免费输出给中小微企业使用，加速产业数字化发展，为数字经济的快速发展提供关键助力。

Based on the 360 Cyber-Wide Digital Security Brain, 360 focuses on solving the problem of "invisible" threats to digital security. At the same time, it replicates the digital security capabilities to cities and industries, including the free output of SaaS model to small, medium and micro enterprises, accelerating the digital development of industries, and providing key support for the rapid development of the digital economy.

医疗健康是公共服务领域的重要行业，以天津医科大学总医院为例，360 帮助其构建了以全网数字安全大脑为核心的动态安全运营服务体系。覆盖总医院 300+ 内网服务器，3000+ 终端，接入各类安全数据近 320 亿，帮助总医院实现高级持续性威胁可发现、安全事件可预警、安全态势可感知、威胁情报可分析、攻击行为可追溯，输出全套数据、专家、AI、服务和运营能力，实现了全域态势感知、动态综合防护和持续安全运营。全面保障总医院互联网 + 医疗业务的安全运行，持续提升安全防护能力，有效保障各业务系统安全稳定运行，树立互联网 + 医疗安全运营标杆。

Medical is an important industry in the field of public services. Taking the General Hospital of Tianjin Medical University as an example, 360 has helped it build a dynamic security operation service system with the Cyber-Wide Digital Security Brain as the core. Covering 300+ intranet servers and 3000+ terminals in the general hospital, it has access to nearly 32 billion kinds of security data. It has helped the general hospital to realize the discovery of advanced persistent threats, early warning of security events, awareness of security situations, analysis of threat intelligence, traceability of attack behaviors, and output a full range of data, experts, AI, services and operation capabilities, realizing the global situation awareness, dynamic comprehensive protection, and continuous safe operation to fully ensure the safe operation of the Internet+ medical business of the general hospital, continue to improve the security protection capability, effectively ensure the safe and stable operation of all business systems, and establish the Internet+ medical security operation benchmark.

高性能大算力车载智能芯片
——地平线征程 ®5

Energy-Efficient Automotive-Grade Processor
——Horizon Journey®5

地平线
Horizon Robotics

引言

地平线征程 ®5 是继征程 2 和征程 3 开创中国车载智能芯片量产先河之后，地平线推出的全新一代高性能、大算力全场景整车智能中央计算芯片。征程 5 搭载地平线自研深度学习加速引擎 BPU® 贝叶斯，算力高达 128TOPS，可充分满足全场景自动驾驶和人机交互的量产应用需求。

Introduction

The Journey®5 is the new generation of energy-efficient automotive-grade processor that Horizon introduced after Journey®2 and Journey®3 leading the mass production for smart vehicles in China. Journey®5 is equipped with Horizon's deep learning acceleration engine BPU® Bayes, which provides up to 128TOPS of computing power, and is sufficient to meet the mass production application requirements for autonomous driving and human-computer interaction in full scenario situations.

软硬协同优化，发挥极致性能

Soft and hard co-optimization, maximize performance

车载智能芯片作为智能网联汽车的关键核心零部件，也代表着智能驾驶技术制高点。通过自主创新的可编程深度学习神经网络加速引擎 Brain Processing Unit（简称 BPU®），地平线结合多项突破性的核心技术加速打造新一代 BPU 贝叶斯计算架构。搭载双核贝叶斯架构的征程 5，算力高达 128TOPS，成功弥补中国百 TOPS 级大算力自动驾驶芯片市场的空白。

Automotive-grade processor are the core components of intelligent connected vehicles, which represents that autonomous driving is the cutting-edge technology. As a result of Horizon's independent development of the programmable acceleration engine Brain Processing Unit (BPU), new generations of BPU Bayesian computing architecture have been created. With its dual-core Bayes architecture and computing power of 128 TOPS, Journey®5 successfully filled the gap in China's 100 TOPS class computing autonomous driving processor market.

得益于软硬协同优化，BPU® 贝叶斯为征程 5 带来“可持续成长”的强劲计算性能，在保证高速处理能力的同时实现最优能效比。通过实测对标结果显示，征程 5 真实性能超过 1531 FPS，同精度下征程 5 性能与能效表现突出。

Achieving high-speed processing power while achieving the optimal ratio of energy efficiency due to co-optimization of hardware and software, BPU® Bayes brings "sustainable growth" of robust computing performance to Journey®5. During the benchmarking process, it was determined that Journey®5's real performance could exceed 1531 FPS.

征程 5 凝聚了对深度学习和自动驾驶场景的深度洞察，具备高性能、低能耗、低延迟的特点。依托业内领先的芯片架构设计，征程 5 整合优化的可编程计算资源，支持灵活的硬件加速功能，同时提供适应驾驶场景的灵活 I/O 配置与系统支持，可全面满足 L2-L4 级别自动驾驶多样化开发需求。

With high performance, low energy consumption, and low delay, Journey®5 provides in-depth insights into deep learning and autonomous driving scenarios. A leading-edge processor architecture design enables Journey®5 to integrate and optimize programmable computing resources, support flexible hardware acceleration functions, and provide flexible I/O configurations and system support to accommodate driving scenarios, allowing it to meet the diversified development needs of L2-L4 autonomous vehicles.

征程 5 还拥有全方位的产品功能安全保障并通过 AEC-Q100 车规可靠性验证。作为严格遵循 ISO 26262 功能安全流程开发的车载智能驾驶芯片，征程 5 现已通过 ISO 26262 ASIL-B 功能安全产品认证。征程 5 完整芯片方案均按照 ASIL-B 功能安全产品标准打造，能够为 OEM 和 Tier1 提供系统级的安全保护方案，全面满足功能安全开发要求。

Journey®5 offers a full range of product functional safety assurance, having passed reliability verification of AEC-Q100, As the processor developed in compliance with ISO 26262 functional safety processes, Journey®5 has now received ISO 26262 ASIL-B functional safety product certification. Journey®5's complete processor solutions are built in accordance with ASIL-B functional safety standards, providing OEMs and Tier1 with system-level security protection solutions to meet functional safety development requirements.

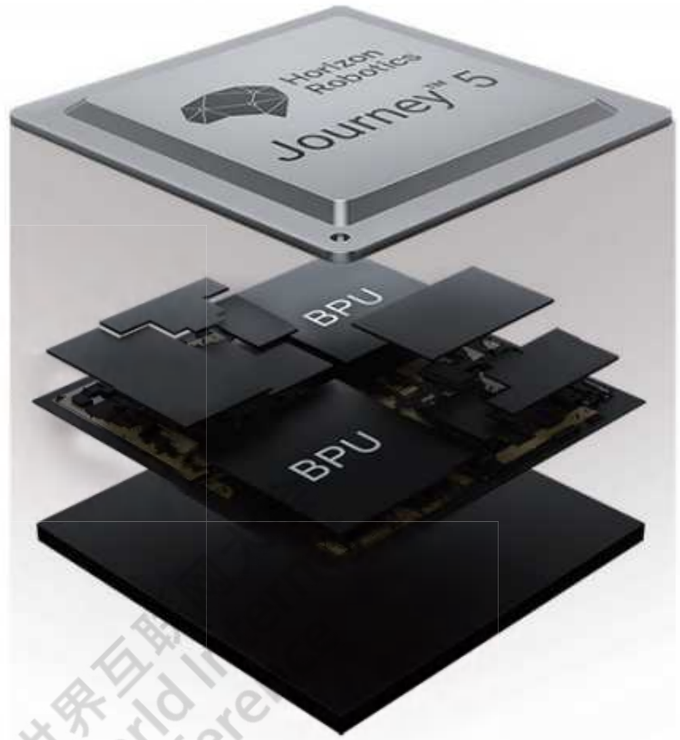
前装量产是检验智能驾驶产品技术的首要标准

Pre-loading and mass production is the primary standard to test the technology of intelligent driving products

基于“全维利他”的开放生态战略，地平线以软硬协同、灵活开放的商业合作模式与产业链上下游伙伴建立开放共赢的合作关系，共建草木繁荣的智能汽车产业生态。地平线已链接包括软硬件 Tier1、ODM、IDH、OEM 等上下游合作伙伴 100 余家，合作覆盖智能驾驶、智能座舱以及泛车载生态的广泛应用场景。

With the aim of building a prosperous intelligent automobile industry ecology, Horizon has developed an open ecology strategy based on "All-dimensional altruism" to establish a win-win cooperative relationship with upstream and downstream partners of the industrial chain by coordinating software and hardware and establishing a flexible and open business cooperation mode. Horizon has a network of more than 100 upstream and downstream partners, including Tier 1, ODM, IDH, OEM, etc. There are a variety of applications scenarios that are covered by the collaboration, including intelligent driving, intelligent cockpits, and pan-vehicle ecology.

2022 年 9 月，征程 5 官宣搭载至理想 L8 实现全球量产首发，



征程 5 搭载双核 BPU® 贝叶斯架构
Journey®5 is Equipped with Dual-core Bayes Architecture



面向高等级自动驾驶开发的核心计算架构——BPU® 贝叶斯
Core Computing Architecture for High-level Autonomous Driving Development- BPU® Bayes

正式成为首款实现前装量产的国产百 TOPS 级大算力智能驾驶芯片。与此同时，征程 5 已获得比亚迪、理想、上汽集团、一汽红旗、自游家汽车等车企的量产合作项目。伴随着觉非科技、轻舟智航、鉴智机器人、福瑞泰克、宏景智驾等软件或系统合作伙伴的加入，基于地平线征程 5 打造量产解决方案的合作伙伴阵营正在逐渐扩大，将加速高阶自动驾驶应用落地。



征程 ®5 芯片在高等级自动驾驶方面的技术优势
Technical Advantages of Journey®5 in the Field of High-level Autonomous Driving

In September 2022, the official of Journey 5 announced In September 2022, the official of Journey 5 announced that the world's first mass production would be achieved and carried by Ideal L8, and it would officially become the first domestic 100 TOPS class computing power intelligent driving processor to achieve mass production. Meanwhile, Journey 5 has obtained mass production cooperation projects with BYD, Li Auto, SAIC Motor, FAW Hongqi, Ziyoujia Automobile and other automobile manufacturers. Several software or system partners have joined, including Jufei Technology, Lighzhou Zhihang, Jianzhi Robot, Freetech, HongjingZhiDriving, etc., which is accelerating the landing of advanced automatic driving applications by expanding the partner camp of building mass production solutions based on Horizon Journey®5.

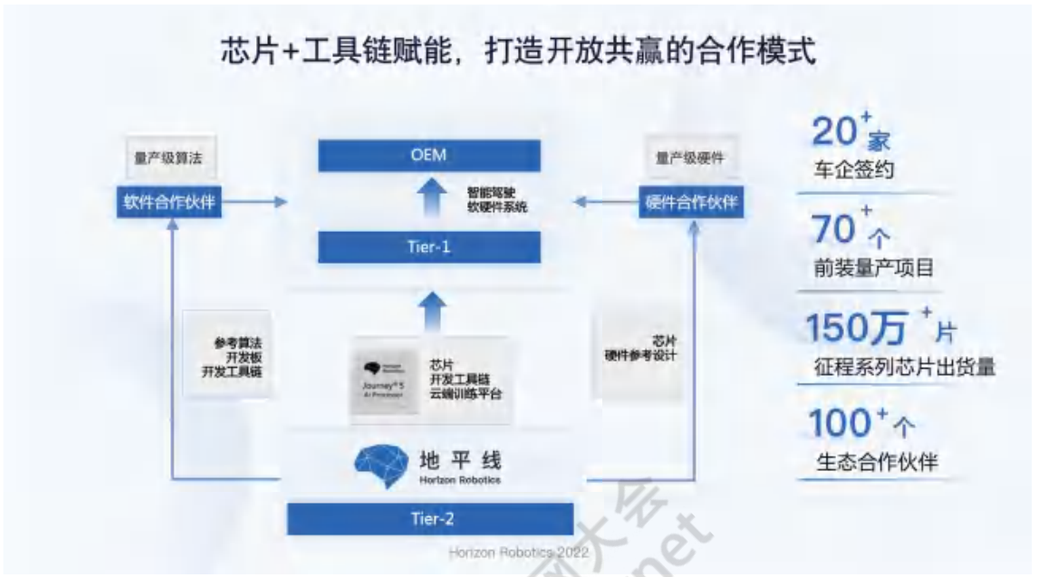
地平线征程系列芯片极致效能，代表了中国车载智能驾驶芯片的领先标准

The efficiency of horizon journey series processors showcases the development of smart driving of China

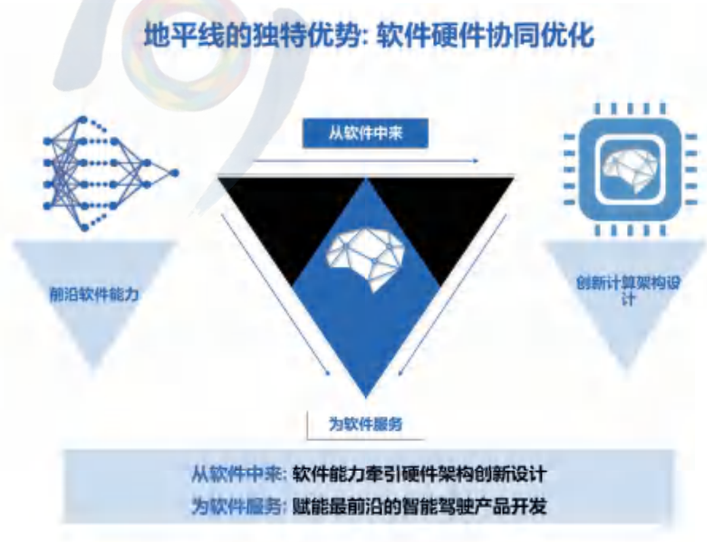
截止到 2022 年 10 月，地平线征程系列芯片累计出货量已突破 150 万片，与超过 20 家车企签下了超过 70 款车型前装量产项目定点，携手合作伙伴实现从 1 到 N 的价值共探。

地平线认为范式级的智能驾驶算法与支持智能算法的硬件体系相结合，是驱动高等级自动驾驶的落地的根本途径。地平线另一核心竞争力是提供专门针对中国驾驶场景开发的视觉感知算法，结合自主研发的自动驾驶专用芯片，能够全面满足车内外视觉感知、视觉建图定位等智能驾驶环境感知需求。地平线规模化量产工程化经验与软硬协同下的高效技术迭代，将全方位赋能汽车智能化普及，助力汽车转型。

Up until October 2022, Horizon Journey processor shipments have exceeded 1.5 million, more than 70 models of preloading mass production project fixed points have been signed with more than 20 vehicle manufacturers, and Horizon Journey is working closely with cooperation partners to achieve value exploration from 1 to N. It is Horizon's belief that the combination of paradigm-level intelligence driving algorithms and hardware systems that support such algorithms will be the key to driving the adoption of high-level automatic driving. Horizon's other competitive advantage is that it provides visual perception algorithms designed specifically for Chinese driving scenarios, which in combination with its own autonomous driving processor, can fully meet the demands of intelligent driving environment perception, such as visual perception within and outside the vehicle, visual mapping positioning, etc. With Horizon's large-scale production engineering experience and efficient technology iteration under soft and hard coordination, we will be able to popularize all-dimensional automotive intelligence and aid in the transformation of automobiles.



地平线将构建开放共赢的合作模式
Horizon Will Build an Open and Win-Win Cooperation Model

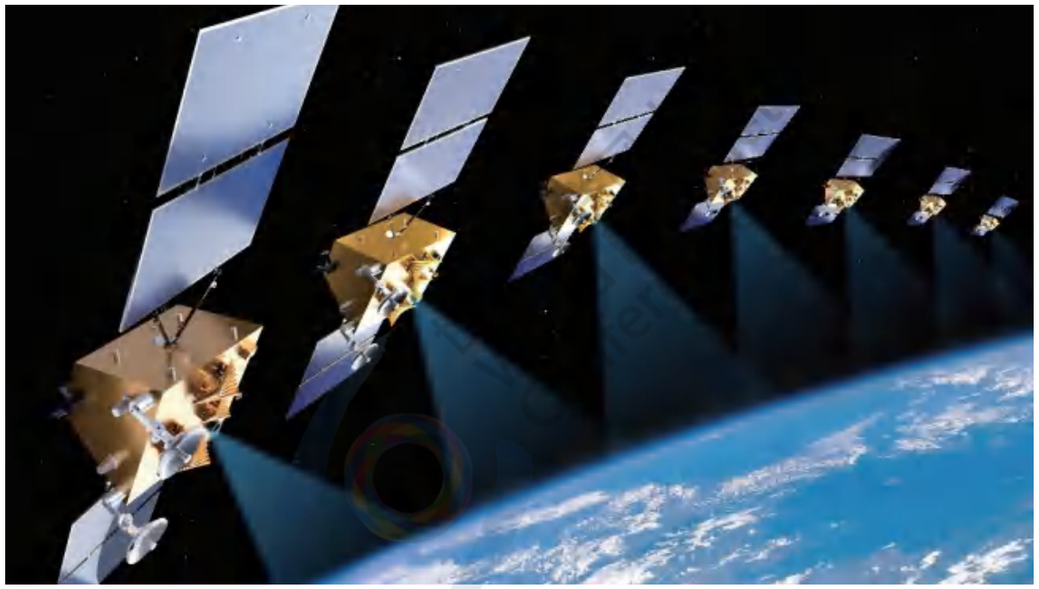


从实际场景开始，软件定义芯片
Starting From the Actual Scenario, Software Defines the Processor

低轨 Q/V 和 Ka 频段宽带通信试验星座及 5G 星地组网应用演示

Application Demonstration of Low-Orbit Q/V and Ka Frequency-Band Wideband Communication Test Constellation and 5G Satellite-Ground Networking

银河航天
GALAXYSPACE



银河航天低轨 Q/V 和 Ka 频段宽带通信试验星座系列卫星在轨模拟图
Simulated Diagram of GALAXYSPACE Low-orbit Q/V and Ka Frequency-band Wideband Communication Test Constellation Series Satellite in Orbit

引言

银河航天自主研发、中国首次批量生产的低轨宽带通信卫星于 3 月 5 日成功发射，并在轨与首发星构建中国首个低轨 V/Ka 频段宽带通信试验星座“小蜘蛛网”，完成了 5G 体制验证、V 频段卫星测控、车载“动中通”等一系列 5G 星地组网应用演示。

Introduction

During the launch of the low-orbit wideband communication satellite independently developed by GALAXYSPACE and mass-produced for the first time in China on 5th March, the first low-orbit wideband communication test constellation with a V/Ka frequency band, "Gossamer," was successfully conducted. In addition to 5G system verification and satellite measurement and control, vehicle-mounted "Satcom On The Move" demonstrations were also completed.

中国首个低轨宽带试验星座

China's first low-orbit wideband test constellation

中国首个低轨宽带试验星座——银河航天“小蜘蛛网”，完成了多星连续通信测试，验证中国具备提供天地一体、覆盖全球、连续通信服务能力。

GALAXYSPACE "Gossamer", China's first low-orbit wideband test constellation, completed China's first continuous communication testing with multiple satellites and demonstrated China's ability to provide global space-ground integration and continuous communication services.

银河航天与中国信息通信研究院、北京邮电大学和联通等组织开展了一系列通信体制验证，在卫星互联网与 5G 深度融合方面迈出重要一步。

GALAXYSPACE has conducted a series of communications system verifications in collaboration with the China Academy of Information and Communications Technology, Beijing University of Posts and Telecommunications, China Unicom, and other organizations, paving the way for the deep integration of satellite Internet and 5G technology.

银河航天完成中国首次低轨宽带试验星座的车载动中通测试，突破车载相控阵天线在实际跑车条件下波束实时精确跟踪低轨卫星的问题，实现车辆行驶中持续卫星通信，迈出低轨卫星互联网应用探索的重要一步。

GALAXYSPACE has completed China's first low-orbit wideband test constellation vehicle "Satcom On The Move" testing. With the aid of beams of phased control antennas mounted on vehicles, the test was able to accurately track low orbit satellites in real time under actual driving conditions. As a result, vehicles have been able to communicate with the satellite continuously during driving, and an important step has been taken in exploring low-orbit satellite Internet applications.

银河航天在自主研制的多颗低轨宽带通信卫星中使用了技术难度较高的 Q/V 等频段，并成功实现了中国首次 V 频段低轨卫星测控，对卫星互联网的产业发展具有积极意义。

GALAXYSPACE has successfully developed low-orbit wideband communication satellites using frequency bands such as Q/V, which are technically challenging. In addition, China has achieved China's first low-orbit V frequency-band satellite measurement and control, which has a positive impact on the industrial development of satellite Internet.

根据该成果批产等经验，银河航天承研了多星干涉 SAR 遥感卫星星座“宏图一号”研制任务，突破了多星编队干涉测绘技术、高精度星间测量与同步和编队构型设计等核心技术，对新型测绘体制卫星设计以及商业遥感卫星研制和模式创新具有积极意义。

GALAXYSPACE has developed the multi-satellite interferometric SAR satellite constellation "Hongtu-1" in accordance with its batch production achievements and other experience. Through the development of core technologies such as interferometric surveying and mapping technology for multiple satellite formations, high-precision inter-satellite measurement and synchronization, and formation configuration planning, we have established a global leadership position in this field. Consequently, it has positive significance for both the design of new surveying and mapping system, as well as the development and innovation of commercial remote sensing satellites.



银河航天 02 批卫星发射现场
The Launching Site of 02 Batch of Satellites of GALAXYSPACE

丰富的垂直行业应用场景

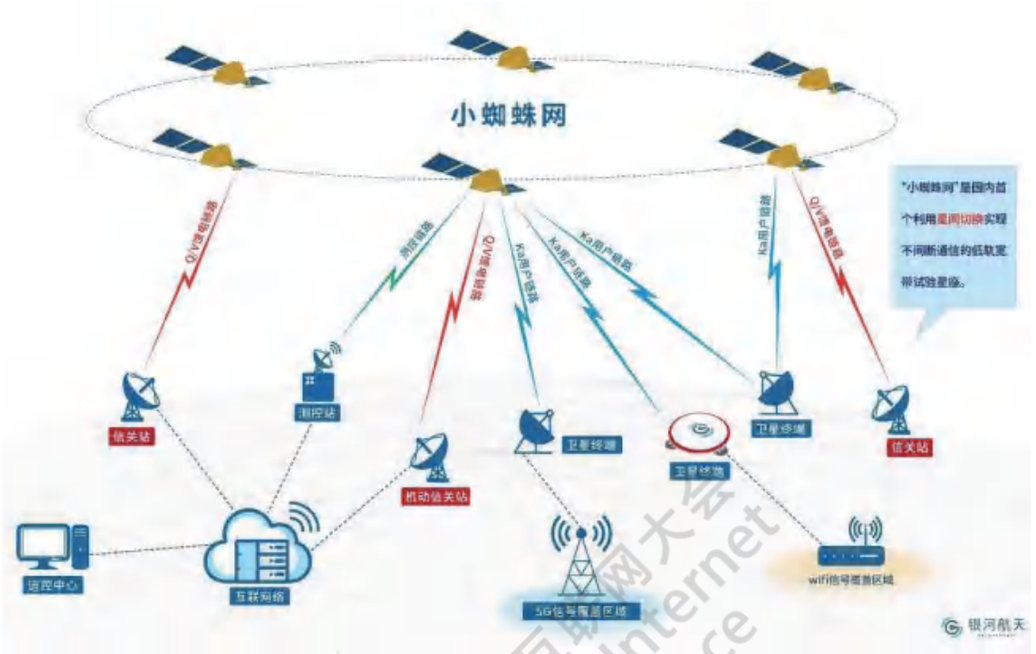
Rich vertical industry application scenarios

该成果能针对性解决应急通信保障、信息基础设施较差或不具备通信覆盖条件地区用户的通信网络需求。主要应用推广情况如下：

By achieving these achievements, we can meet the communication network needs of users in areas that lack communication coverage conditions, lack emergency communication support, and lack a good information infrastructure. The main applications and promotions are as follows:

5G 应急、救灾通信保障场景。发挥卫星互联网与 5G 融合的泛在互联优势，结合无人机等机动平台，提供快速响应的高质量 5G 通信服务，支撑应急场景下 5G 综合应用。

5G communication support scenarios for emergency and disaster relief. With the integration of satellite Internet and 5G, as well as the use of unmanned aerial vehicles (UAVs) and other mobile platforms, high-quality 5G communication services with rapid response will be provided to support the comprehensive application of 5G in emergency situations, utilizing the ubiquitous connectivity advantages of the integration.



银河航天低轨 Q/V 和 Ka 频段宽带通信试验星座“小蜘蛛网”应用示意图
Schematic Diagram of “Gossamer”
Application of GALAXYSPACE Low Orbit Q/V and Ka Frequency-Band Wideband Communication Test Constellation

国家电网信息化及智慧电网应用场景。为电力海量物联网数据采集终端接入以及广域智慧巡检提供传输支撑，实现电网广域信息化覆盖与大数据综合应用。

Application scenarios of State Grid informatization and smart grid. Achieving broad-area information coverage and comprehensive application of big data in the power grid, while providing transmission support for massive IoT data acquisition terminal access and wide-area intelligent inspection.

西部地区及“一带一路”沿线智慧工业应用场景。为工程一线提供高质量数据传输与低时延远程操控服务，实现智慧工业应用与工程一线的高效协调互联。

Application scenarios of intelligent industry along the Belt and Road Initiative in western China. Providing engineering front line personnel with high quality data transmission and low-delay remote control services, as well as coordinating and interconnecting intelligent industrial applications with engineering front line personnel.

运营商 5G 精准覆盖场景。利用卫星互联网宽带、低时延与不依赖地面基建的优势，与 5G 网络的深度融合，在海上平台、航空领域实现运营商 5G 网络的快速精准部署，为 5G 产业向泛在领域拓展提供高性价比解决方案。

Carrier 5G precise coverage scenario. This technology will allow the rapid and precise deployment of carrier 5G networks on offshore platforms and in the aviation industries, while providing cost-effective solutions for the expansion of the 5G industry into the ubiquitous market by leveraging the benefits of satellite Internet wideband, low delay, and no dependence on ground infrastructure.

普惠于民的空间通信基础设施

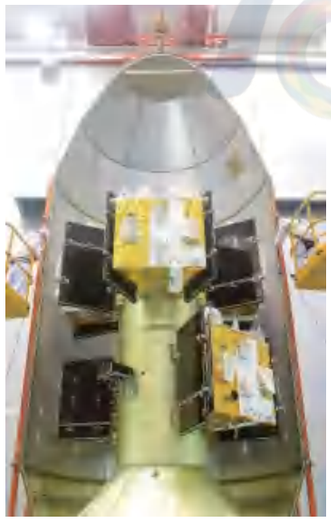
Space communications infrastructure for the benefit of all people

构建了“航天 + 互联网”的跨界融合模式，通过高度集成优化设计，基于模块化、标准化产品建立新型卫星智能制造产线，快速形成低成本规模化效益，推动低轨卫星互联网快速发展。

Internet has been developed. Through highly integrated and optimized design, it has developed a new type of intelligent satellite manufacturing production line utilizing modular and standardized products, resulting in rapid development of low-cost and large-scale benefits, as well as the rapid development of satellite Internet services in low orbits.

依托低轨卫星互联网技术，探索构建天地协同立体生态环境监测体系，提升生态监测数据时效性和生态环境治理能力与治理水平，也为深度参与全球生态环境治理和气候变化应对提供全新的基础能力和技术支撑。

This project will explore the development of a three-dimensional environmental and ecological monitoring system integrating space-ground technologies using low-orbit satellite Internet technology. It will enhance the timeliness of ecological monitoring data and the effectiveness and level of environmental and ecological governance, as well as provide new basic capabilities and technical support for deep participation in global environmental governance and climate change adaptation.



银河航天 02 批卫星位于火箭整流罩内
GALAXYSPACE 02 Batch of Satellites is Located in the Rocket Fairing



银河航天低轨 Q/V 和 Ka 频段宽带通信试验星座系列卫星在轨模拟图
Simulated Diagram of GALAXYSPACE Low Orbit Q/V and Ka Frequency-Band Wideband Communication Test Constellation Series Satellite in Orbit

河图：
高效可扩展的分布式深度学习系统

Hetu:
An Efficient and Scalable Distributed Deep Learning System

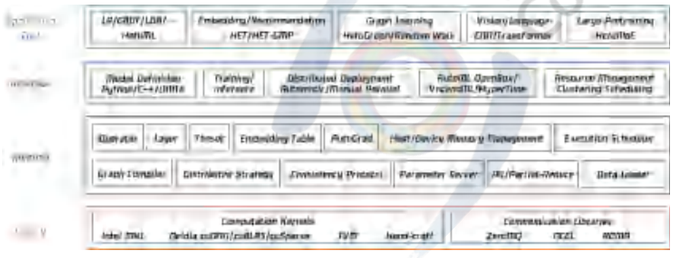
北京大学计算机学院数据与智能实验室
Data And Intelligence Research Lab at Peking University, PKU-DAIR

引言

在过去十年中，深度学习迅速发展，彻底改变了传统的大数据计算范式，在互联网公司等工业场景发挥了巨大的价值。随着数据规模持续增长以及模型结构日益复杂，构建实用的大规模机器学习系统越来越具有挑战性。

Introduction

In the past decade, deep learning has developed rapidly, completely changed the traditional big data computing paradigm, and brought great value in industrial scenarios such as Internet companies. As volume of data continues to grow and the model structures become more complex, building practical large-scale machine learning systems is increasingly challenging.



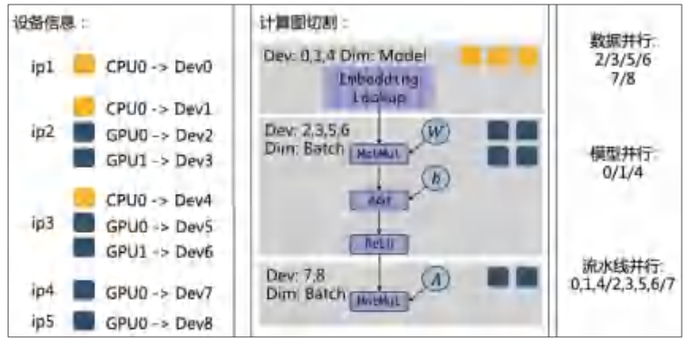
河图系统架构
Overview of Hetu

破局分布式训练桎梏，高效大规模自动并行

Breaking the shackles of distributed training, enabling efficient large-scale automatic parallelism

河图由北京大学计算机学院数据与智能实验室研发，面向高维、大规模深度学习场景，是由中国高校独立自主开发并开源的分布式深度学习系统，兼顾工业界的高可用性和学术界的创新性。

目前世界上主要使用的是 TensorFlow、PyTorch 等深度学习系统，很多新框架也是基于这些系统二次开发。河图不仅与现有系统完全解耦，还提出了一系列创新性技术，在大规模 AI 模型的分布式训练上有着显著的性能优势。针对现有系统存在的功能受限、部署复杂等不足，河图进行了相应的优化设计：首先，河图支持所有主流通信架构、并行模式、同步协议以及常见优化方案，功能更加丰富，通用性强；其次，河图支持半自动以及自动并行模式，硬件自适应感知最优分布式部署方案，部署更加便捷，提高了易用性；最后，河图支持统一分布式计算图中间表达，编译后适配多种通信算子，显著降低了系统架构的复杂性。此外，河图还对来自真实场景的多方面挑战进行了探索，如数据管理、计算加速、网络通信、内存访问、执行调度等。



河图系统硬件感知的自动并行训练
The Hardware-aware Automatic Parallel Technique in Hetu

Hetu is a deep learning system developed by the Data and Intelligence Laboratory of Peking University for high-dimensional, large-scale deep learning scenarios to support various artificial intelligence applications and deployments. Hetu, as the first distributed deep learning system independently developed by the academic groups in Chinese universities, takes into account both the industrial high availability and the academic innovation.

推动数智化变革，服务 AI+ 云计算

Promoting digital and intelligent transformation, serving AI + cloud computing

河图主要应用在云计算、机器学习平台、智能数据中心以及人工智能应用场景，前景广阔，可以降低机器学习开发门槛，推动传统行业受益于人工智能，推动 AI 产业快速落地。目前相关技术已经在腾讯、阿里巴巴、快手、中兴、字节跳动等多个企业的真实场景中落地，例如：1）大规模 AI 计算（腾讯太极机器学习平台）：包括广告大模型训练、预训练大模型、超大规模图神经网络等；2）自动化机器学习（腾讯、快手、中兴、字节跳动等企业）：包括推荐策略优化、集群运维、机器学习模型设计优化等，以及实体工业领域，辅助优化地质页岩分割，航空材料设计等任务；3）智能数据库（阿里云）：包括数据库配置参数智能调参，涉及 RDS MySQL、RDS PostgreSQL、PolarDB MySQL、PolarDB-O 等数据库系统。

Hetu is mainly used in cloud computing, machine learning platform, intelligent data center and artificial intelligence application scenarios. It shows broad promise and reduces the barriers of machine learning development, promotes traditional industries to benefit from artificial intelligence, and accelerates the development of the AI industry. At present, the related technologies of the project have been applied in real scenarios of Tencent, Alibaba, Kuaishou, ZTE, ByteDance, and other companies, such as:1) Large-scale AI computing (Tencent Taiji machine learning platform): large-scale advertising



models, ultra-large-scale pre-training models, super-large graph neural networks;2) Automated machine learning (Tencent, Kuaishou, ZTE, ByteDance and other companies): recommendation strategy optimization, cluster operation and maintenance, machine learning model design optimization, physical industry, assisting in the optimization of geological shale segmentation, aerospace material design, and other tasks; 3) Intelligent database (Alibaba Cloud): tuning parameters of database systems, e.g., RDS MySQL, RDS PostgreSQL, PolarDB MySQL, PolarDB-O, and other database systems.

助力人工智能应用，极致释放数据价值

Helping Artificial Intelligence applications, maximazing the release of data value

河图系统及相关技术已经取得了显著的社会经济效益，例如：

Hetu and its related technologies have achieved significant socioeconomic benefits, such as:

1）大规模分布式训练技术帮助腾讯服务 TB 级规模广告精排大模型训练，累计给广告主带来 15% 的 GMV 提升；2）自动化机器学习技术帮助快手在镜头切分任务中实现自动化生成模型并取代人工设计，提升线上用户留存预测业务模型 AUC 1.2%；3）智能数据库技术在阿里云DAS产品上落地，帮助用户定制化调优参数配置，其中模版参数功能可以提升 13%–50% 的离线 TPS。

1) Large-scale distributed training technology helps Tencent to serve terabyte-scale advertising model training, bringing a cumulative 15% GMV improvement to advertisers; 2) Automated machine learning technology helps Kuaishou achieve automatic generation in shot segmentation tasks The model replaces manual design and improves the AUC of the online user retention prediction business model by 1.2%; 3) The intelligent database technology is implemented on Alibaba Cloud DAS products to help users customize and optimize parameter configuration, among which the template parameter function helps to improve the offline TPS by 13%-50%.

坚持学术创新导向，引领前沿技术趋势

Adhere to the orientation of academic innovation, leading the trend of cutting-edge technology

河图团队相关成果被 SIGMOD、VLDB、ICML、KDD、WWW、NeurIPS、ICDE、AAAI、ICLR 等国际顶级会议或期刊收录，近三年累计发表了 40 余篇 CCF-A 类论文，其中还包括了 2022 年国际万维网大会的最佳学生论文奖。此外，在各项世界级赛事评选中，河图也斩获佳绩，如 2021 年机器之心年度十大开源事件、国际顶级图学习标准 OGB 冠军、2021 年 CIKM AnalyticCup 自动超参数优化赛道冠军、2021 年 CCF BDCI 综合特等奖等，取得学术界和媒体的广泛关注。

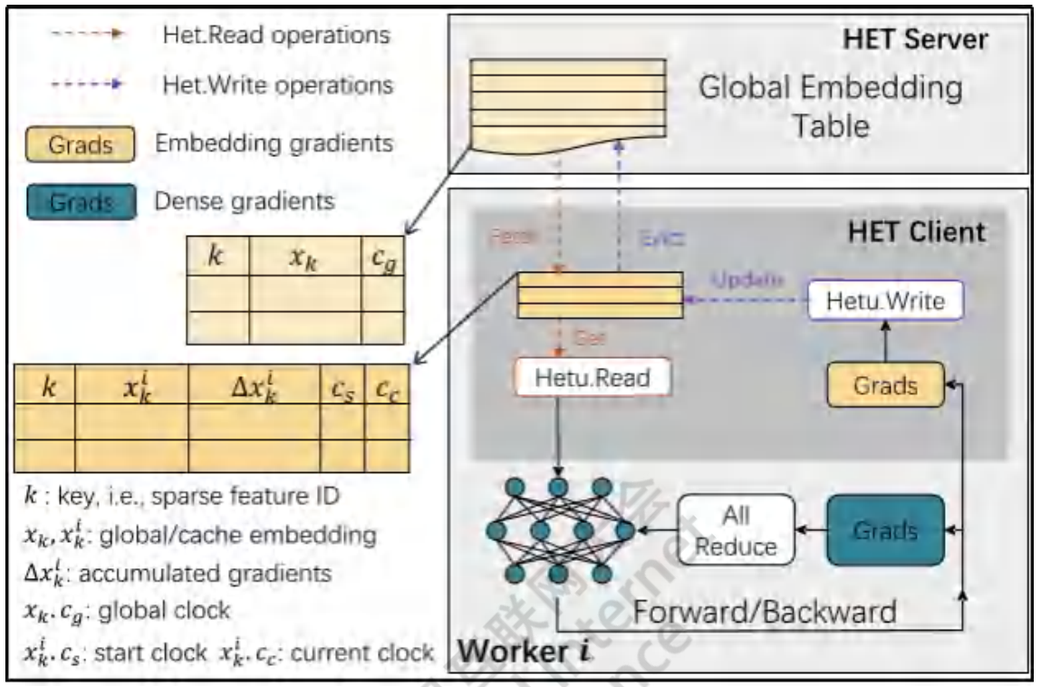
In the past three years, the Hetu team has published more than 40 CCF-A papers in top international conferences or journals such as SIGMOD, VLDB, ICML, KDD, WWW, NeurIPS, ICDE, AAAI, ICLR, etc., including the Best Student Paper Award at The Web Conference (formerly known as International World Wide Web Conference, abbreviated as WWW) 2022. In addition, Hetu has also achieved good results in the selection of various world-class competitions, such as the 2021 Top Ten Open Source Events by Jiqizhixin, the champion of the open graph benchmark (OGB), the champion of the 2021 CIKM AnalyticCup Automatic Hyperparameter Optimization Track, the highest award of 2021 CCF BDCI, etc., has won wide attention from academia and media.



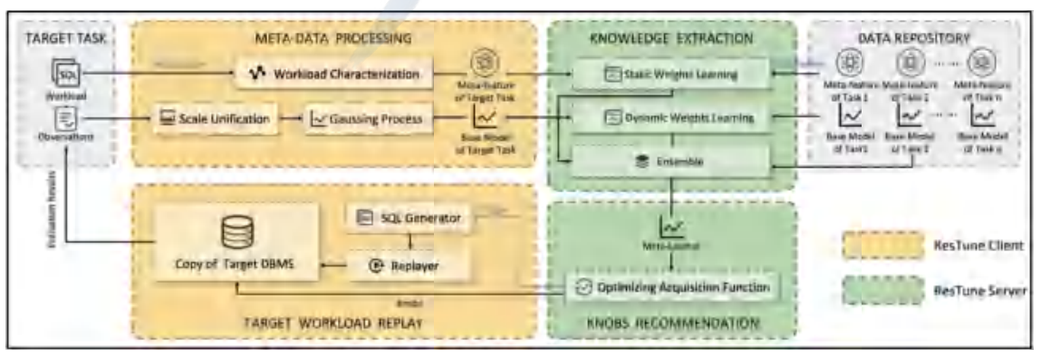
河图团队荣获 TheWebConf 2022 最佳学生论文奖
The Hetu Team Won the Best Student Paper Award of Thewebconf 2022



河图系统入选 2021 年机器之心年度十大开源事件
Hetu is Seleceted as One of the 2021 Top-10 Open Source Events by Jiqizhixin



河图团队广告大模型分布式训练系统架构
The Large-scale Advertising Model Training System Architecture Proposed by Hetu



河图团队数据库智能调参系统架构
The Intelligent Database Tuning System Proposed by Hetu

鹏城云脑：E 级 AI 算力平台

Peng Cheng CloudBrain: E-Scale AI Super-Computing Platform

鹏城实验室
Peng Cheng Laboratory

华为技术有限公司
Huawei Technologies Co.,Ltd.

引言

鹏城云脑 E 级智能算力平台，拥有 1024P ops AI 计算能力和 64PB 高速并行可扩展存储，具有高计算效率、高可靠性、高可扩展性等技术优势。研发了全链条智算基础软件体系，打造了支持千亿级大规模 AI 模型的并行训练平台。

Introduction

The Peng Cheng CloudBrain is an E-scale AI supercomputer platform based on domestic independent technology and offering 1024P ops AI computing power, as well as 64PB of high-speed parallel scalable storage. In addition to being highly efficient and reliable, it also offers high scalability. The basic software system of full chain intelligent computing, and a parallel training platform that supports hundreds of billions of AI models has been developed.

突破关键技术难题，研制 E 级智能算力平台

Develop E-scale AI super-computing platform by breaking through the key technology difficulties

构建 E 级智能算力平台需要解决功耗过高、扩展效率低、数据吞吐瓶颈等挑战性问题。鹏城云脑提出并实现了节点内 CPU 与 NPU 的“AI 计算 – 层次访存 – 片间互连”均衡方案；通过高维拓扑的多协议高带宽互联，实现了训练参数面高扩展网络；提出并实现了基于 MadFS 分布式文件系统的 IO 缓冲中间层技术。鹏城云脑团队构建了全链条的自主可控智算基础软件体系，突破了全机大规模多维度分布式训练技术，有效支持千亿参数 AI 模型的分布式训练。鹏城云脑连续 4 次获得数据吞吐能力评测 IO500 排行榜总榜冠军，连续 2 次获得 AI 算力评测 AIPerf500 排行榜第一。

The development of an intelligent computing platform at the E-level requires the solution of challenging issues such as high power consumption, low expansion efficiency, and data throughput bottlenecks. Peng Cheng CloudBrain has proposed and implemented a balanced solution for CPU and NPU in the node which combines AI computing with hierarchical memory access and inter-chip interconnection. Using a multi-protocol and high-bandwidth interconnection of high-dimensional topologies, a high-scale network of training parameters has been developed. Furthermore, a full-chain autonomous and controllable intelligent computing basic software system has been built, which breaks through the large-scale multidimensional distributed training technology of the entire cluster, and effectively supports the distribution of 100 billion parameters for distributed training of artificial intelligence models. As a result of Peng Cheng CloudBrain's position on the IO500 full list for 4 consecutive years and on the AIPerf500 ranking of AI computing power for 2 consecutive years, the company has ranked first on the IO500 full list for 4 consecutive years.

基于鹏城云脑，鹏城实验室研制并开源了鹏程系列 AI 大模型，刷新了自然语言处理、靶向药物设计等领域 AI 模型的一系列性能指标，支持城市治理、智能交通等近二十个场景的实际应用，支持中小企业应用上千个，形成了具有国际影响力的AI大模型应用技术体系。

On the basis of Peng Cheng CloudBrain, Peng Cheng Lab has developed and open-sourced Peng Cheng AI models, updated a series of performance indicators for AI models in natural language processing, drug design, etc., supporting urban governance, intelligent transportation, and other practical applications. A large model application technology system based on artificial intelligence has also been developed, providing support for thousands of small and medium-sized enterprises (SMEs).

有效支撑重大战略需求，推动产业升级和技术体系并行发展

Effectively support major strategic needs and promote the parallel development of industrial upgrading and technological systems

鹏城云脑自 2019 年 11 月试运行以来，除支持鹏城实验室科研任务外，还为粤港澳大湾区中小企业的科技创新和产业智能升级提供普惠算力服务。其中，鹏城云脑 E 级系统累计机时分配约 542 天，分配率 96.15%，执行任务数约 13 万个。

With the trial operation of Peng Cheng CloudBrain in November 2019, in addition to supporting the scientific research activities of the Peng Cheng Lab, it has also provided inclusive beneficial computing services to assist SMEs in the Guangdong-Hong Kong-Macao Greater Bay Area with technological innovation and industrial smart upgrading, of which Peng Cheng CloudBrain E-level system has been allocated 542 days with a 96.15% allocation rate and around 130,000 tasks executed in total.



河图团队数据库智能调参系统架构
The Intelligent Database Tuning System Proposed by Hetu

鹏城云脑有效支撑了面向群体对抗的强化博弈、“一带一路”小语种翻译、新一代人工智能开源体系建设等重大战略需求，建立了自主可控的智能城市公交体系与未来社区应用示范；有效支持了鹏程系列 AI 大模型的训练，其相关成果应用到合作单位，推动了产业升级和技术体系并行发展。同时，鹏城云脑的落地形成了以人工智能计算中心为主体，提供公共算力服务平台、应用创新孵化平台、产业聚合发展平台和科研创新人才培养平台的发展格局，助力当地的智能制造、智慧医疗、智能数字设计与建造、智能网联汽车产业发展。

Using the Peng Cheng CloudBrain, major strategic needs can be met, including intensified games for group confrontation, the translation of minor languages in the "One Belt, One Road" initiative, and the development of new open source AI systems. A smart city public transportation system that is autonomous and controllable has been established, as well as demonstrations of future community applications. Besides supporting the training of Peng Cheng series AI large models, its related achievements are applied to cooperative units, thus contributing to the parallel development of industrial upgrading and technological systems. Moreover, Peng Cheng CloudBrain has been implemented with an AI computing center as the main body, providing the following platforms: a public computing power platform, an incubation platform for application innovation, an industrial aggregation development platform, a training platform for scientific research & innovation talents. The team assists local manufacturing, healthcare, digital design, construction, and the development of the connected car industry by providing smart computing power services.

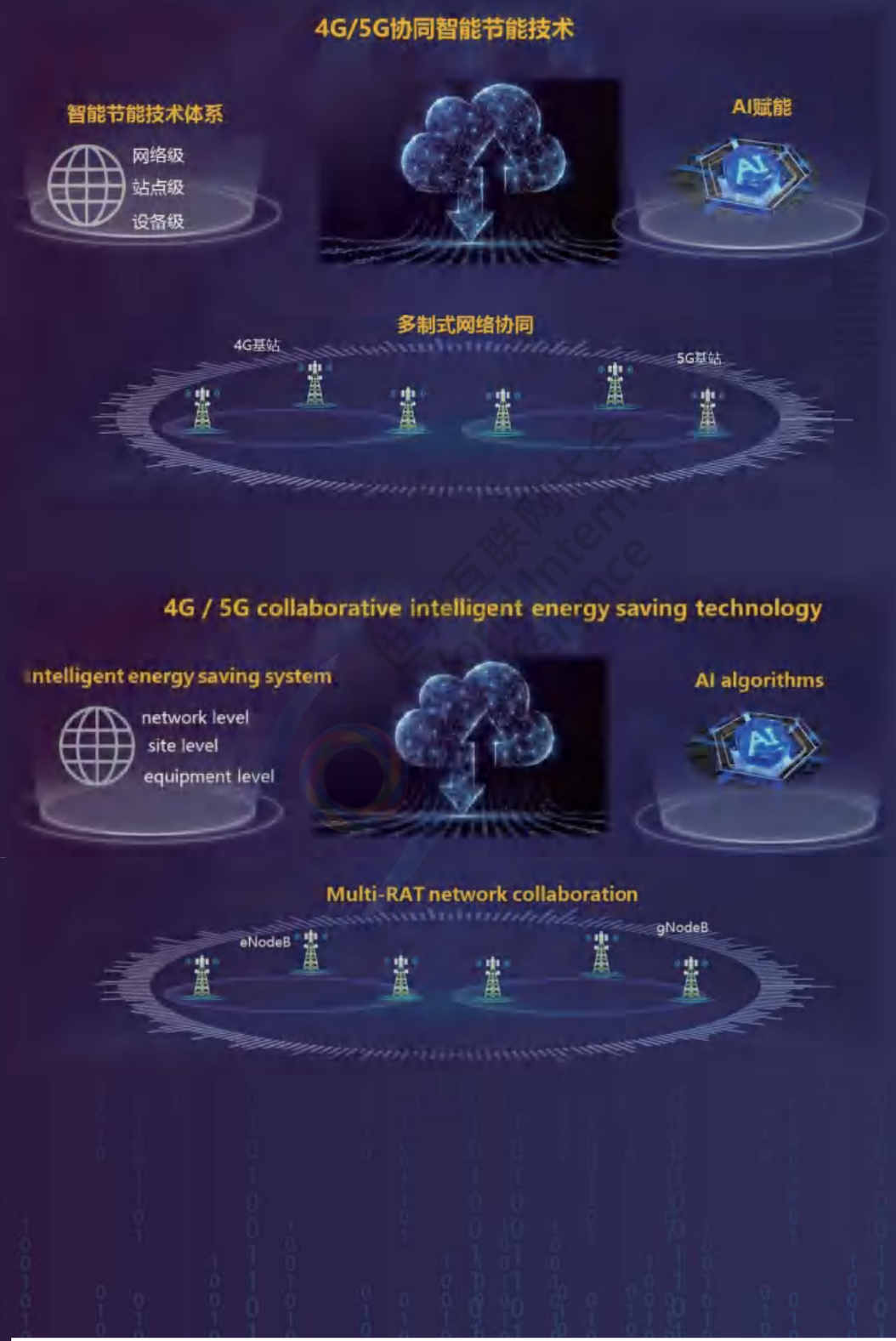


带动人工智能核心产业发展，取得显著的社会和经济效益

Driving the development of Artificial Intelligence core industries and achieved significant social and economic benefits

鹏城云脑是具有公共服务属性的人工智能算力基础设施，已有多家中小企业使用并开展应用创新。基于鹏城云脑，团队在中国产业界率先推出并对外开源千亿级参数中文预训练模型——盘古。它将加速 NLP 产品研发创新，显著降低中小企业研发门槛。同时，鹏城云脑拟通过输出超大算力解决疫情的流调溯源和快速处置工作中面临着巨大的挑战。此外，鹏城云脑示范带动中国 20 个 AI 中心建设，总算力规模达到 2.4E，投资规模超过 74.5 亿，将进一步带动粤港澳大湾区的 AI 核心产业发展，预期规模将突破 100 亿元，带动机器人及智能装备等相关产业规模超 2000 亿元。

Several SMEs have used Peng Cheng CloudBrain to carry out application innovation using artificial intelligence computing infrastructure that has public service attributes. With the launch and open-sourcing of the Chinese pre-training model, which has hundreds of billions of parameters, Pangu will significantly reduce the R&D threshold for SMEs and accelerate the development of NLP products. While at the same time, Peng Cheng CloudBrain seeks to solve the huge challenges associated with the traceability and rapid disposal of the epidemic by utilizing supercomputers. Moreover, 20 AI centers have been constructed in China as a result of the Pengcheng Cloud Brain. There are 2.4E of intelligent computing power, and 7.45 billion dollars have been invested in this technology. By doing so, the Guangdong-Hong Kong-Macao Greater Bay Area will be able to further promote the development of the core AI industry. It is expected that the scale of the project will exceed 10 billion yuan. Robots and intelligent equipment have been driving the scale of related industries to exceed 200 billion yuan RMB. As can be seen from the perspective above, significant economic and social benefits have been achieved.



《科技之魅》**收录成果**

4G/5G 协同智能节能技术研究与应用

Research and Application of 4G/5G Collaborative Intelligent Energy Saving Technology

中国联合网络通信有限公司研究院
Research Institute, China United Network Co.,Ltd.

引言

该成果属于无线通信技术领域，旨在解决 5G 网络能耗大的难题，提升 5G 信息基础设施智能化运营水平，实现精细化、智能化、规模化、绿色低碳化的网络运营。

Introduction

This achievement belongs to the field of wireless communication technology, and aims to solve the problem of high energy consumption of 5G network, improving the intelligent operation level of 5G infrastructure, achieving a large-scale of intelligent, green and low-carbon network operation.

建立 4G/5G 协同智能节能体系，实现网络、站点、设备多层级智能化节能

Establish 4G / 5G collaborative intelligent energy saving system to realize multi-level intelligent energy saving of network, site and equipment

5G 作为数字信息基础设施正处于快速发展期，由于技术演进与设备能力跃升，5G 网络单站能耗远高于 4G。传统的节能技术根据业务潮汐效应分时段关断基站硬件，不支持实时、跨网络、智能的节能管理，导致节能效果不佳、网络运维复杂。如何实现多系统协同的智能化节能、最大化全网能效，将成为全球运营商面临的共同挑战。

As a digital information infrastructure, 5G is in a period of rapid development. Due to the technological evolution and the improvement of equipment capacity, the energy consumption of one base station of 5G network is two or three times of one 4G base station. The traditional energy-saving solution turns off the base station hardware according to the tidal effect of 5G service, which is not supportive of the real-time operation in the manner of intelligent energy-saving management across the whole network. And the traditional energy-saving solution will lead to the poor energy-saving performance and the complexity of network operation and maintenance. How to accomplish intelligent energy saving and maximize the energy efficiency for a multi-RAT network will become a common challenge for global operators.

成果创新提出 4G/5G 协同智能节能体系，基于网络级、站点级、设备级分层架构，实现无线网络智能化节能管理、电源等基础配套设施智能化管控，推动了网络基础设施数字化创新研发与应用：

This achievement innovatively proposes the 4G/5G collaborative intelligent energy saving system. Based on the hierarchical architecture of network level, station level and equipment level, it has achieved intelligent energy-saving management of wireless network, intelligent management and control of power supply and other communication infrastructure facilities, promoting the research and application of digital innovation technologies in network infrastructure:

首次提出“深度休眠”等基站设备级节能创新技术，最大化设备级能效水平。

The innovative energy-saving technologies of base station, such as “deep sleep” and other innovative solutions are proposed to maximize the energy efficiency at the equipment level.

研发 5G 电源智能控制系统，首创智能下电控制策略及基础设施唯一识别码等功能，降低站点级能耗。

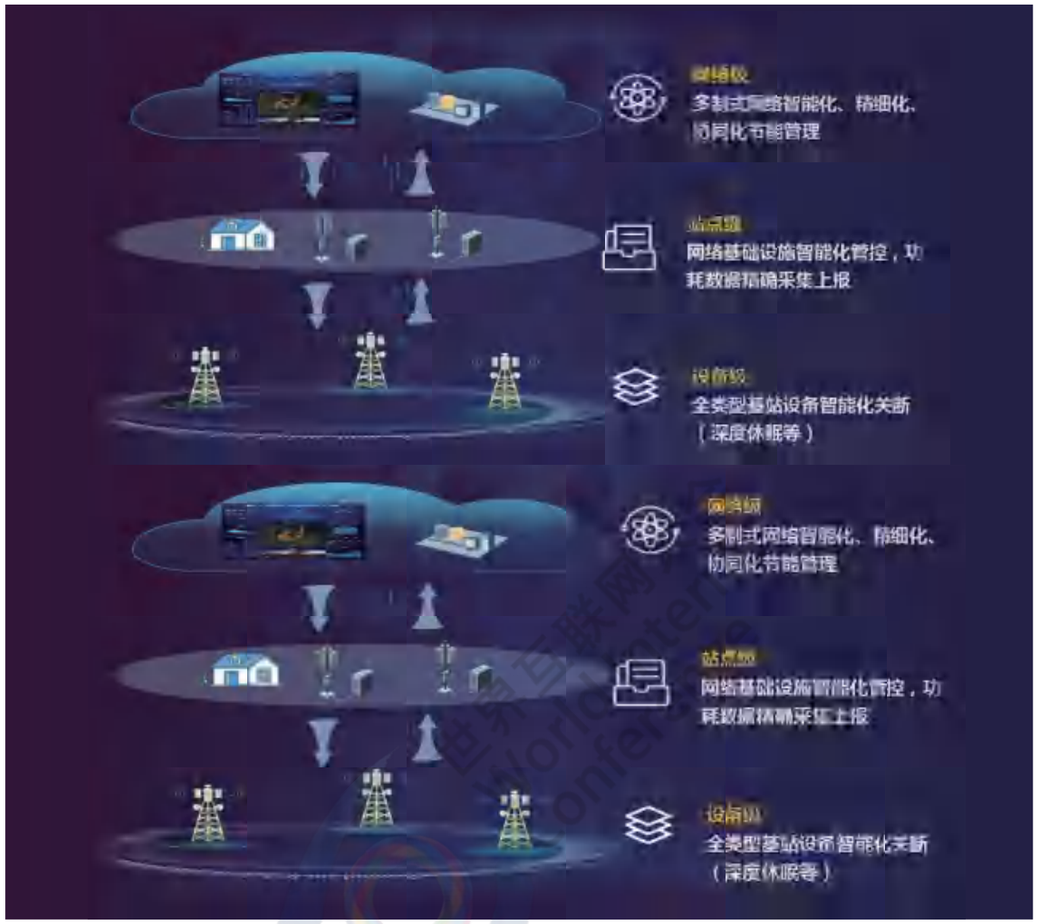
The innovative 5G power intelligent control system is developed, supporting the strategy of intelligent power-off control mechanism and the unique identification code of infrastructure facilities, which greatly reduces energy consumption at the base station level.

率先发布 4G/5G 协同智能节能管理平台，以 AI 技术为突破口，集成多项专利算法，提升了网络级节能效果，减少了网络维护人工投入。

The innovative 4G/5G collaborative intelligent energy-saving management platform is released, taking AI technologies as a breakthrough and integrating a number of patented algorithms, to improve the energy-saving performance at the network level and reduce the cost of labor management in network maintenance.

技术引导与示范应用双轮驱动，促进智能节能技术在全行业推广

Technology guidance, network trial and commercial deployment lead to the promotion of intelligent energy-saving technology in the whole industry



4G/5G 协同智能节能体系
4G / 5G Collaborative Intelligent Energy-saving System

全行业推广“深度休眠”技术，提升基站能效水平

Promote the "deep sleep" technology throughout the industry to improve the energy efficiency of base stations.

该方案将 5G 基站业务闲时功耗降低 80% 以上，作为 5G 基站的基本功能已在中国全面应用。

This solution reduces the power consumption of the 5G base station during idle period by more than 80%. As a basic function of the 5G base station, it has been national-wide deployed in China.

4G/5G 协同智能节能管理平台已在中国联通现网应用

4G/5G collaborative intelligent energy-saving management platform has been province-wide deployed in the network of China Unicom.

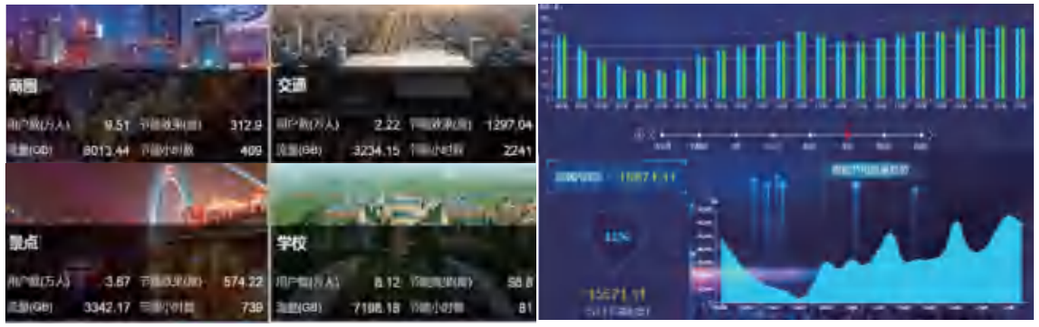
该平台已在天津开展 3 万站规模以上的试点应用，日均节电时长约 3 小时以上，综合节能比例 10% 以上。

The platform has been applied in a pilot scale of more than 30000 base stations in Tianjin. The average daily energy-saving duration is 3 hours or more, the comprehensive energy-saving ratio is more than 10%, and the energy saving effect is remarkable.

5G 电源智能控制系统在中国联通多地应用

5G power intelligent control system in China Unicom has been applied in multiple local networks of China Unicom.

该系统已在内蒙、黑龙江、河南、广东等地应用，站点年运行能耗平均节约 20% 以上。



4G/5G 协同智能节能技术应用场景与效果
Application Scenarios and Effect of 4G/5G Collaborative Intelligent Energy-saving Technology

The system has been commercially deployed in Inner Mongolia, Heilongjiang, Henan, Guangdong, and the annual energy consumption of base station has been reduced by more than 20%.

推动智能节能领域生态建设与标准化

Promoting ecological construction and standardization in the field of intelligent energy saving.

牵头成立“5G 基站 AI 节能联合研究中心”，发布《5G 智能节能技术》系列白皮书，制定多项中国及行业级标准，加速智能节能技术研发与应用。

Leading the establishment of "Joint Research Center of 5G Base Station AI-enable Energy Saving Technology ", issued a series of white papers on 5G intelligent energy saving technology, formulated a number of Chinese standards and industrial standards, and accelerated the research and deployment of intelligent energy saving technologies.

技术创新赋能网络绿色智能化演进，助力网络降本增效

Technological innovation enables the green and intelligent evolution of the network and helps to reduce the costs and increase operational efficiency of network

成果为全球运营商提供了无线网络绿色、智能化运营方面的范例，助力“碳达峰、碳中和”战略目标实施。

This achievement has promoted the development of wireless network energy-saving technology and industry, enabling the green and intelligent evolution of network through technological innovation, providing global operators with examples of wireless network green and intelligent operation, to achieve the goal of "Carbon Peak and Carbon Neutral".

本成果可将 5G 网络能耗降低 10% 以上。按照 5G 单站年度节约用电量 0.27 万度 / 站 / 年、2022 年底中国联通 5G 基站规模约 100 万站进行测算，每年预计节约用电约 27 亿度。

This achievement can reduce the energy consumption of the 5G network by more than 10%. It is estimated that the annual energy saving of single 5G base station is 2700 kwh / station / year. As the scale of China Unicom 5G base station reaches about 1 million by the end of 2022, the annual energy saving will be about 2.7 billion kwh.

拥有多项知识产权，荣获多家国际权威机构认可

It has a number of intellectual property rights and has been recognized by many international authoritative institutions

成果已申请发明专利 40 项、软件著作权 2 项。4G/5G 协同智能节能管理平台荣获了 2021 年度国际电联（ITU）信息社会世界峰会 WSIS ICT 电子环境组冠军奖、2021 年度中国十大著作权人奖等。

This achievement has applied or issued for 40 invention patents and 2 software copyrights. 4G/5G collaborative intelligent energy-saving management platform wins the prizes of Champion of WSIS（World Summit on the Information Society）Prizes 2021 awarded by International Telecommunications Union(ITU), China's Top Ten Copyright Owners 2021 issued by Copyright Protection Center of China, and is recorded into Excellent Practice Case of Green and Low-Carbon Development in the Information and Communication Industry 2022 by China Communications Enterprise Association.



4G/5G 协同智能节能管理平台
荣获多个国际奖项
4G/5G Collaborative Intelligent Energy-Saving Management Platform Wins Several International Awards

城市空间信息全域物联感知与三维建模关键技术及应用

Key Technologies and Applications of Global IOT Perception and 3D Modeling of Urban Spatial Information

同济大学
Tongji University

北京百度网讯科技有限公司
Beijing Baidu Netcom Science Technology Co.,Ltd.

深圳大学
Shenzhen University

北京工业大学
Beijing University of Technology

中国科学院深圳先进技术研究院
Shenzhen Institute of Advanced Technology, Chinese Academy of Sciences

引言

项目组历时近十年的产学研联合攻关，突破了城市空间信息全域物联感知与三维建模关键技术，构建了城市时空信息数字孪生支撑平台，为上层城市大脑指挥中心提供底层服务。

Introduction

The team has spent nearly a decade focusing on the needs of China's smart city strategy and social and economic transformation. In addition to breaking through key technologies related to global IOT perception and 3D modelling of urban spatial information, the digital twin support platform is intended to provide basic services for the city's brain system by providing spatial-temporal information support.

突破全域物联感知与三维建模关键技术，构建城市时空信息数字孪生支撑平台

Breaking through the key technologies of global IOT perception and 3D modeling, and building a digital twin support platform for urban spatial-temporal information

首先，项目组突破了空间信息多粒度精准监测与全域物联感知关键技术：设计出空间信息的多粒度监测模型，与国际上已有最优方案相比，在同等空间覆盖率条件下，所需监测设备节点数量降低 5%；发明了时序 DEM 数据驱动的地表形变监测方法，有效提高了地理信息数据采集的精度和实时性。其次，项目组解决了三维数据的异步通信与联合调度难题：发明了城市空间信息全域感知体系中上下行链路的协调传输方法与基于业务流缓冲状态的联合调度技术，相比于国际上同时期的典型方案，降低了 10.5% 的传输时间开销。另外，项目组创新性地提出了三维空间数据的大规模并发调度与多层次混合索引解决方案：发明了三维空间数据大规模并发调度技术，设计了多磁盘存储、多层次索引的数据库结构，对三维空间信息数据的读取效率提高了 12%，大幅度提高了网络环境下城市三维模型数据的动态调度效率。最后，项目组研发了可提供实时 web 服务的三维可视化引擎，实现了虚拟现实技术、空间 GIS 技术及模拟仿真技术的有机融合。

To begin with, the team has achieved breakthroughs in multi-granularity monitoring of spatial information and global IoT sensing. An information monitoring model with multiple levels of granularity was developed. Under the same spatial coverage rate, the number of monitoring equipment nodes was reduced by 5% in comparison with the best scheme in the world. The surface deformation monitoring method based on time-series DEM data was developed, which improved the accuracy and efficiency of the collection of geographical information. Secondly, the team solved the problem of asynchronous communication and joint scheduling of three-dimensional data. Using a global perception system of urban spatial information, they developed a coordinated transmission method of uplink and downlink as well as a joint scheduling approach based on the buffer state of business flow, which significantly reduced the transmission time cost by 10.5% compared to typical worldwide schemes. Moreover, the team proposed a multi-level hybrid indexing method for 3D spatial data in addition to large-scale concurrent scheduling. Specifically, they developed the technology for large-scale concurrent scheduling of 3D spatial data, as well as the database structure for multi-disk storage and multi-level indexing. These innovations improved the reading efficiency of 3D spatial information data by 12%, as well as improved the dynamic scheduling efficiency of 3D model data under network conditions.

Lastly, the team developed a 3D visualization engine integrating virtual reality, spatial GIS, and simulation technologies to provide real-time web services.



城市空间信息全域物联感知与三维建模总体技术路线图
Technical Roadmap of Global IOT Perception and 3D Modeling of Urban Spatial Information

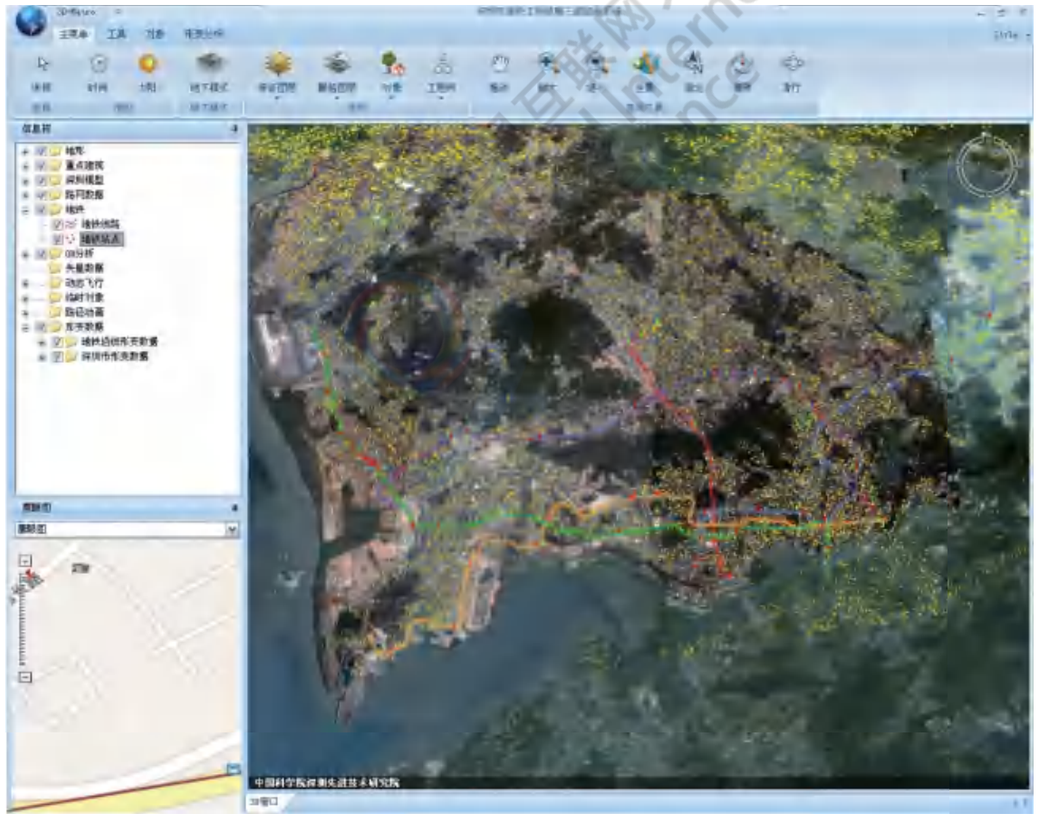
推广项目核心技术，助力区域经济发展

Promoting the key technologies, and advancing the regional economic development

作为城市数字孪生支撑平台的上层应用，项目组研发了城市大脑指挥中心系统。利用大数据和人工智能技术，借助百度地图以及互联网数据、城市视频数据及政府客户数据，对各类指挥场景中的主体进行主动、快速、全面感知，加强数据融通共享。城市大脑系统已经在中国多个市 / 区进



项目组设计建设的北京市海淀区城市大脑智能运营指挥中心
The city brain intelligent operation command center of the Haidian district in Beijing, designed and constructed by the team



项目组研发的深圳市地铁工程健康三维监测系统
Three Dimensional Health Monitoring System of Shenzhen Metro, Developed by the Team

行了推广，例如北京海淀城市大脑指挥中心、云南丽江城市大脑指挥中心、昆明官渡区城市大脑等。项目相关技术也在城市空间信息获取与智能分析、三维建模以及可视化领域进行了应用推广，比如技术成果支撑了上海城市网格化管理平台、上海市交通综合信息平台等系统的建设。

As an upper application of the city digital twin platform, the team has developed the city brain system. By using Baidu maps, Internet data, urban video data, and government customer data, the system can actively, quickly, and comprehensively perceive subjects in a variety of scenarios, enhancing data integration and sharing. The developed city brain system has been implemented in many cities / districts in China, including the Haidian district in Beijing, the city of Lijiang in Yunnan, and the Guandu district in Kunming. The relevant technologies of the project have also been applied and popularized in the areas of urban spatial information acquisition and intelligent analysis, as well as 3D modelling and visualization. Among the technical achievements are the Shanghai urban grid management platform, the Shanghai comprehensive transportation information platform, etc.

引领智慧城市治理新模式

Leading the new mode of smart city governance

项目组研发并推广了城市大脑指挥中心系统，实现了一图纵览互联网与城市孪生资产、一网通管事件处置闭环、一键实现跨模态搜索与融合指挥，为城市管理者提供智能指挥能力和智能决策能力。项目技术成果显著提高了城市运行管理信息的采集精度和范围，并支撑了大规模三维城市模型的网络化应用，助力城市形成精细化、智能化、常态化的城市管理新模式。2019 年至 2021 年，各应用单位累计新增与应用该项目技术相关的销售额合计 30368.2 万元，新增利润合计 1970.5 万元，新增税收合计 2526.8 万元。

It was the team's responsibility to develop and promote the city brain system. In such a system, the twin assets of the city can be viewed using a map, and the entire event can be managed through a unique entrance, as well as enabling cross-modal search and integrated command. In addition to providing managers with the ability to make intelligent decisions, it also provides them with the ability to command intelligently. The technological achievements have significantly improved the collection accuracy and the collection scope of city operation information, supported networked applications of large-scale three-dimensional city models, and assisted the cities in developing a refined, intelligent, and normalized mode of city management.In the period between 2019 and 2021, the accumulated new sales related to the application of the team's technologies totalled 303,682 million yuan, the new profit was 19,975 million yuan, and the new tax was 25.268 million yuan.



项目组设计研发的
昆明市官渡区城市大脑获得东盟
与中日韩数字经济创新大奖
The City Brain System of the Guandu District of Kunming Designed and Developed by the Team Won the Digital Economy Innovation Award of ASEAN and China, Japan and South Korea

木兰开源社区

Mulan Open Source Community

中国电子技术标准化研究院
China Electronics Standardization Institute

北京大学
Peking University

中国人民解放军国防科技大学
National University of Defense Technology

联想（北京）信息技术有限公司
Lenovo (Beijing) Information Technology Co., Ltd.

在本成果的应用推广过程中，得到各国际组织和基金会的大力支持，在开源许可证和项目孵化等方面开展合作。一是开源许可证方面，成果之一木兰宽松许可证 MulanPSL 2.0 的研制和推广得到多个国际组织的支持，开放源代码促进会 OSI 对其完成国际许可证认证，日本开源用户委员会自发翻译日本版并进行宣传推广，Apache 基金会宣布 Apache 2.0 与 MulanPSL 2.0 开源许可证兼容。二是在开源项目孵化运营方面，与 Linux 基金会联合发起成立了 NextArch 子基金会，不断促进中国数据存储、微服务等重点领域的自主科技成果开源项目孵化。与 OIF 基金会（原 OpenStack 基金会）联合开展云计算开源产品的联合测试，共同推动全球开源生态协同建设。

To promote and apply this achievement, extensive in-depth cooperation has been provided with international foundations such as Linux, OpenStack, CNCF, SODA, and TARS as well as their sub-foundations, and close communication and exchanges have been maintained at the multilateral level of open source ecology construction. In China, NextArch is a sub-foundation of the Linux Foundation that promotes the development of open source projects that are independent of the Linux Foundation in key areas such as data storage and microservices. Further, it works closely with OpenStack and other foundations to facilitate the joint testing of cloud computing technologies and products, and to support the collaborative development of global open source ecosystems.

引言

木兰开源社区成立于 2019 年，由中国电子技术标准化研究院牵头建设运营、联合国内十余家产学研单位，共同建成的立足中国、面向全球的具有科技创新特色的中文开源社区。

Introduction

In 2019, the Mulan Open Source Community was established. More than ten domestic industry-university-research units have jointly developed and operated the China Electronics Standardization Research Institute. The company is based in China and operates worldwide. An open source community showcasing technological innovation in the local area.

研发全球首个国际通用的中英文开源许可证，向全球开源生态规则贡献中国智慧，探索中国科技项目开源创新路径

For the first time, contributed to the formulation of global open source ecological rules and designed the domestic open source standard system at the highest level

基于我国法律语境，构建木兰开源许可证族，研发了全球首个中英文双语的国际许可证——木兰宽松许可证（MulanPSL-2.0）。面向开源软件和开放数据集的不同应用需求，研发了木兰宽松许可证、木兰公共许可证、木兰白玉兰开放数据许可证等 3 个不同类别的开源许可证。木兰许可证族基于中国法律语境，既帮助建立中文开发者生态和应用市场，也为中国开源软件产品国际化提供规则保障。同时，木兰开源社区系统性开启了中国开源标准化工作之路，以标准为抓手推动开源底层逻辑和治理规则研究，成功立项 1 项开源领域的国家标准，并系统性构建开源标准体系。并推动中国作为初创国在 ISO/IEC JTC1 下，联合英国、加拿大、印度等其他国家成立“开源软件特别工作组”（AHG7），推动开源软件领域国际标准化工作。此外，木兰开源社区探索了中国科技成果开源模式，拓展了科技项目开源生态发展途径，发展和帮扶中国初创开源项目的培育孵化，为中小微开源项目提供无障碍孵化支持。

In addition to providing intellectual property rules guarantee for China's self-developed open source projects, the Mulan open source community has also promoted the important practice of China's open source business model by producing China's first international bilingual license, which is available in both Chinese and English. Huawei Hongmeng, Euler with other ecological basic projects, and Ant OceanBase database community edition projects with other independent projects have been applied.

Meanwhile, it was responsible for systematically opening up China's open source standardization work, promoting research into China's open source governance and operation rules using standards as its starting point, and successfully establishing China's first national open-source standard. Establish an "Open Source Software Task Force" (AHG7) with other countries to promote China as a start-up country. International standardization of open source software is being promoted by countries such as the United Kingdom, Canada, and India under ISO/IEC JTC1.

立足中国、面向全球，广建“朋友圈”，推动构建全球化发展的开源生态体系

Examined the open source model of Chinese independent software scientific and technological achievements, which have been recognized by both the domestic and international industries

木兰开源社区承载中国科技成果开源创新孵化的重要使命，以促进中国科技项目开源创新和中小微开源项目孵化为核心开展工作。木兰开源社区已汇聚托管中国重点研发计划专项中 21 个项目的 160 项开源成果，注册用户数超过 13 万。“木兰”系列许可证已在中国发起的开源项目中得到广泛应用，截至目前木兰许可证族已有 10 万余个开源项目使用，典型应用包括 OpenEuler 、OpenGuass、方舟编译器等生态基础项目和 OceanBase 数据库社区版等项目，涵盖了云计算、大数据、人工智能等重要领域。此外，木兰开源社区与 Linux、OpenStack、CNCF、SODA、TARS 等国际基金会及其子基金会，共同推动国际国内开源生态协同建设。

The Mulan Open Source Community has been designated as a designated open source community for incubating open source innovation of national scientific and technological achievements. Currently, it has accumulated more than 160 independent open source achievements in more than 20 special projects. A further important feature of Mulan is its incubation of small and medium-sized projects, as well as its continual assistance and development of Chinese open-source start-ups.Open-source incubation and commercial implementation of 12 small, medium, and micro projects such as PiFlow. Some of these projects have received nearly ten million dollars in angel investment rounds. Furthermore, the "Mulan" series of licenses are widely used in China-led open source projects, contributing to China's open source business model. In addition to Huawei Hongmeng, Euler with other projects, and the Ant OceanBase community edition, it has been applied in more than 100,000 open source projects initiated by China. Moreover, the Mulan open source community, Linux, OpenStack, CNCF, SODA, TARS and other international foundations and their sub-foundations jointly promote the development of international and domestic open source ecosystems.

有一定影响力的中文开源社区，为中国开源发展注入新鲜血液和动力

The Mulan open source community has spawned large-scale social and economic benefits

木兰开源社区自主研发的中文木兰系列许可证，已基于华为鸿蒙生态基础项目、方舟编译器项目和阿里 OceanBase 数据库社区版项目，在互联网、银行、保险等行业和应用场景中实现商业模式重要实践。推动成立了中国首个开源基金会—开放原子开源基金会，为中国提升国际开源产业话语权和竞争优势提供支撑和保障。助力了包括 SRS、建木、PiFlow 等 12 个中小微项目的开源孵化及商用落地，部分项目已获得近千万级天使轮国际投资。建立产学研开源社区交流合作通道，与上海白玉兰和上海交大联合成立木兰开源社区南方中心，持续推动木兰在中国更多地区落地。联合国内外开源组织在开源项目孵化、开源规则互认、开源标准检测等方面开展合作，推进构建互联互通的国际开放生态。连续多年举办中国软件大会、中国开源黑客松、木兰技术开放日等开源活动，影响力辐射数万名开发者群体。

In order to promote China's independent open source rule system, the Mulan open source community uses the "Mulan" license as a starting point. Developed independently, the Chinese Mulan series licenses have filled the void left by China's international open source licenses and have attracted considerable attention and applications both at home and abroad. By utilizing the experience gained from license research and development, it was able to promote the successful approval and approval of the country's first open source national standard plan, as well as establish a system of open source standards. Establish the Open Atom Open Source Foundation as China's first open-source foundation in order to support and guarantee the voice and competitive advantage of the independent open source community. A channel for industry-university-research exchange and cooperation in the open source community has been established, in conjunction with Shanghai Magnolia and Shanghai Jiaotong University, to promote the implementation of Mulan in the local community. As a result of open source activities such as the China Software Conference, China Open Source Hackathon, and Mulan Technology Open Day, tens of thousands of developers have benefited from these events.



木兰开源社区黑客松活动
Mulan Open Source Community Hackathon

高性能图计算系统

High Performance Graph Processing System

大数据技术与系统国家地方联合工程研究中心
National Engineering Research Center for Big Data Technology and System

服务计算技术与系统教育部重点实验室
Services Computing Technology and System Lab

集群与网格计算湖北省重点实验室
Cluster and Grid Computing Lab

华中科技大学
Huazhong University of Science and Technology



引言

图计算是关联分析主流技术，研发团队针对极致性能的领域定制难题，提出了基于数据流的加速器设计理论和方法，研发了高性能软硬协同图计算系统，获图计算国际挑战赛 GraphChallenge 2021 全球冠军，在第 18 届 GreenGraph 500 和第 24 届 Graph500 国际排行榜列全球第一。

Introduction

The use of graphs for analyzing complex relationships between entities has been widely adopted. A high-performance graph processing system is designed by the R&D team in order to overcome the limitations of general computation architectures. In the 18th GreenGraph500 and 24th Graph500, the system won the championship for efficient software-hardware co-designs.

高性能软硬协同图计算系统

High-performance software/hardware codesign graph processing system

在硬件架构层面，研发团队提出了基于数据流的加速器设计理论，研制了基于 FPGA 的图计算加速器，提出了数据流驱动的高并行流水结构、局部性感知的缓存架构、“一芯千核”的片上互联架构以及高带宽内存优化技术等关键技术，实现了图计算任务的无阻塞执行和高效率访存。

An FPGA-based graph processing accelerator and a dataflow-based accelerator design theory are proposed at the hardware architecture level by R&D. A number of key technologies have been developed, including dataflow-driven pipelines, locality-aware caches, "one chip, one thousand cores" on-chip interconnections, and high bandwidth memory optimization methods. With the help of these technologies, graph processing can be performed non-blockingly and with efficient memory access.

在执行模型层面，团队提出以路径为中心的并行图计算模型和运行时调度方法。主要通过以路径为中心的并行编程模型和基于路径的异步图计算机制等，最大化图顶点状态传递速度以及数据并行度。

An execution model based on path-centric parallel graph processing is proposed by this team, along with a runtime scheduling method. To maximize the speed of vertex state propagation and data parallelism, the path-centric parallel programming model and the path-based asynchronous graph processing mechanism are used.

在系统软件层面，团队提出拓扑感知的高并发分布式图计算插件。主要通过关联性感知的图数据访问方法、基于核心子图的图计算机制和规则化的任务执行机制等，降低图数据访问开销和提高资源利用率。

A topology-aware distributed concurrent graph processing substrate is proposed at the system software level. Through the correlations-aware data access method, the core-subgraph processing mechanism, and the regularized execution method, the graph data access overhead is reduced and resource utilization is improved.

在开发模式层面，团队提出图计算高层次综合系统和 FPGA 高性能算子库，解决了无法通过高层次编程语言定制底层加速器架构的技术难题，降低了加速器编程门槛，支持典型业务场景的敏捷开发诉求。

A high-level synthesis system for graph processing and a high-performance library based on FPGAs are proposed at the development mode level by this team. They resolve the technical challenge that the low-level accelerator architecture cannot be customized by high-level programming languages, reduce the accelerator programming threshold, and support the agile development requirements of typical business scenarios.

在应用层面，团队提出统一计算架构，突破传统图计算范畴。

To break through the application scope of traditional graph processing, a unified computing architecture is proposed.

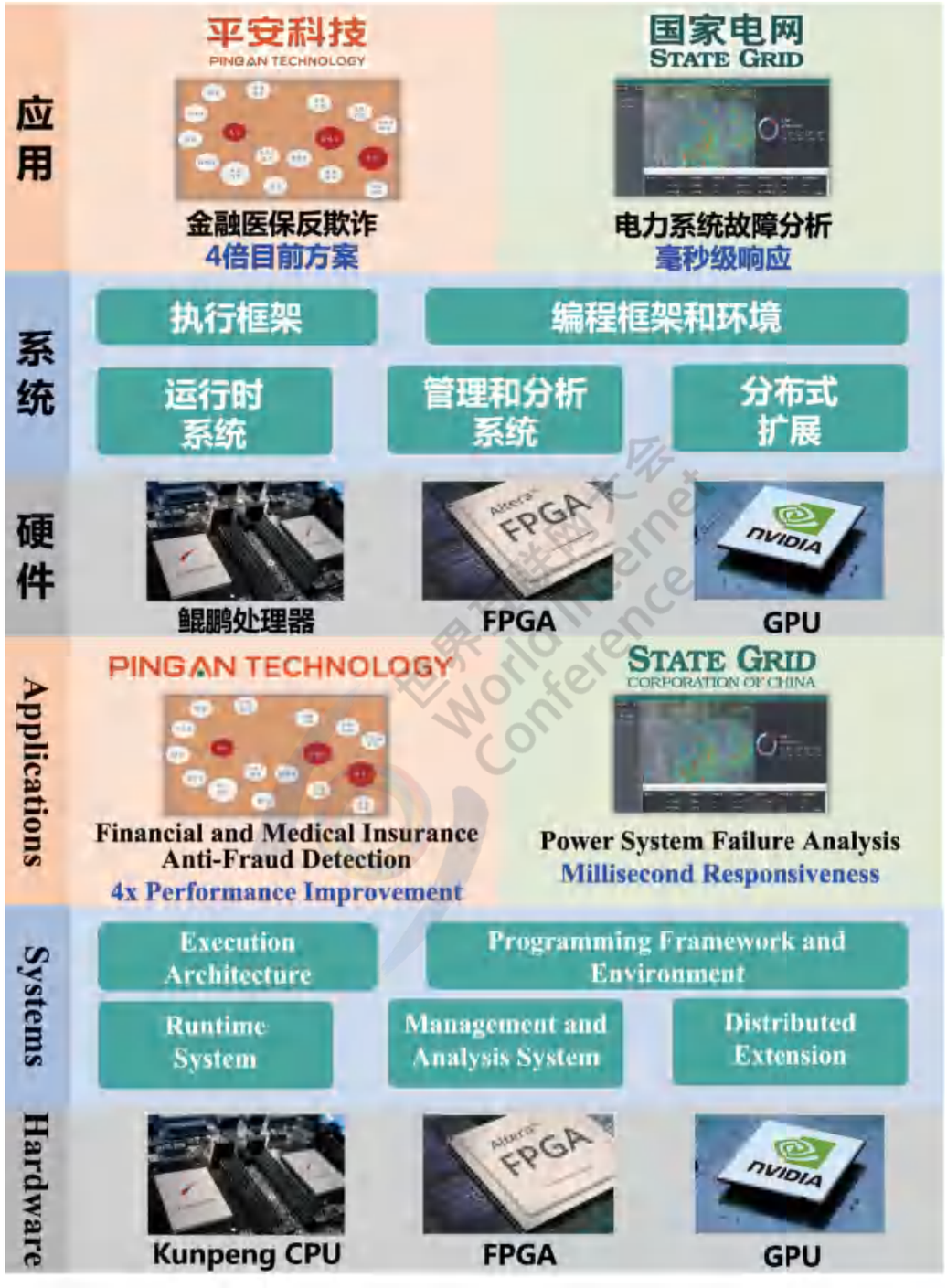


高性能软硬协同图计算系统架构
Architecture of High Performance Software/Hardware Codesign Graph Processing System

软硬协同优化，赋能行业革新

Software and hardware collaborative optimization enables industry innovation

基于图计算硬件加速器，科研团队研发了面向图计算的执行架构、运行时系统、编程框架和环境、管理和分析系统以及分布式扩展等关键技术，构建了面向图计算的技术体系。基于此解决方案，赋能属性复杂且计算密集的国家电网电力图应用，使潮流计算和状态估计的计算时间均从秒级下降至毫秒级别。同时，为平安金融医保图反欺诈检测应用，部署加速系统，相比于传统检测方法，性能提升 4 倍以上。此外，提升了华为鲲鹏服务器并发图计算性能。



高性能图计算系统应用推广示意图
The Application Promotion for High Performance Graph Processing System



2021 GraphChallenge 全球冠军
2021 GraphChallenge Champion

The R&D team has developed key technologies for graph processing based on the graph processing accelerator, such as architecture, runtime system, programming framework, management and analysis system, and distributed extensions. Further, it constructs a technological system towards graph processing. With the help of this solution, it is possible to provide the electric graph application of the State Grid Corporation of China with complex attributes and intensive computation, which reduces the time it takes to calculate the power flow and estimate the state from seconds to milliseconds. As part of this project, the team deploys an accelerated anti-fraud detection system for PingAn's financial and medical insurance graph. The performance of this method is four times better than that of traditional detection methods. Furthermore, the project team has improved the performance of Huawei Kunpeng servers for concurrent graph processing.

斩获图计算领域多项“世界第一”

Won several "World Firsts" in the field of graph processing

科研团队在 2021 年参加了图计算领域最具影响力的国际赛事之一 GraphChallenge，这是首次来自中国的队伍斩获稀疏数据处理赛道全球冠军。同时，在全球图计算性能权威榜单 Graph500 和 Green Graph500 多次登顶：在第 18 届 Green Graph500 排名中性能功耗比全球第一；在第 23 届 Graph500 排名中单机性能全球第一；并在 24 届 Graph500 排名中蝉联全球第一，以单机性能超过分布式系统。相关成果形成了广泛的社会影响，与业界展开深度战略合作，助力相关产业跨越式发展。

One of the most prestigious international events in graph analytics, GraphChallenge, recognized this R&D team's achievement as one of the 2021 Champions. As far as this event is concerned, this is the first time that a Chinese team has won the championship. The achievement also ranks first in terms of performance power consumption ratio in the 18th Green Graph500 and first in terms of single machine performance in the 23rd Graph500. This team's achievements also rank first in the world in the 24th Graph500, outperforming all distributed systems. Supercomputer graph processing performance is measured by the Graph500 and Green Graph500 lists of the Supercomputing Conference. A broad social impact has been achieved as a result of these achievements. To promote the development of related industries, it also establishes a deep strategic cooperation with the industry.

Graph500 和 Green Graph500
榜单登顶
Top of Graph500 and
Green Graph500 Lists



磐久服务器 M 系列
Alibaba Cloud Server M Series

阿里云计算有限公司
Alibaba Cloud Computing Co.,Ltd.

引言

科技快速发展，技术不断迭代，云上部署和应用，云上开发和运维，云原生业务呈现爆发式增长，这给传统数据中心带来极大的挑战。2021 年 10 月杭州云栖大会，阿里云磐久服务器 M 系列首次亮相，在高密容器部署、应用极速启动、低资源消耗和高能效比等技术上实现从芯片、部件到整机系统的软硬融合创新，此外，通过超前业界标准支持和最新工艺采用，磐久服务器 M 系列已成为阿里云下一代云原生服务器硬件产品的代表，为千行百业不断增长的算力需求提供强劲支撑。

Introduction

As the technology evolves rapidly and iterates continuously, cloud solutions are emerging for application deployment, development, and maintenance, and cloud-native business is growing exponentially. This brings huge challenges to traditional data centers. At the Apsara Conference in October 2021, Alibaba Cloud officially launched its Cloud Server (Panjiu) M Series. This server achieves convergent innovation in technologies such as high-density container deployment, fast application startup, low resource consumption, and high energy efficiency ratios for both the hardware and software, from chips, components to the complete machine. In addition, adopting the advanced industry standards and the latest industrial techniques, Panjiu M Series has become a representative of Alibaba Cloud's next-generation cloud-native server products, continuously satisfying the increasing demands for high-performance computing in multiple industries.

应对算力挑战而生 软硬融合云原生服务器典范

Born for computing challenges and a cloud-native server paradigm of the convergence of software and hardware

作为阿里云下一代云原生服务器硬件架构的代表，磐久服务器 M 系列搭载倚天 710 处理器，最新 Arm V9 架构，包含 128 个高性能 CPU 核，总计 600 亿晶体管，性能比业界主流产品高出 20%，能效比提升 50%；遵循方升架构软硬件一体化设计思想，支持计算存储分离、异构加速、资源池化等技术架构；结构设计上，兼容前后出线架构，风冷液冷架构融合统一，系统散热能力可提升 10%；模块化设计，实现存储、计算、异构解耦；硬件产品灵活配置、灵活迭代升级，交付效率提升 50%；自研硬件实现 Multi-Host 技术，具备高可扩展性和超高计算密度；创新自研新形态 PCIe 接口卡 – 方升云卡，支持热插拔，运维效率提升 10 倍的同时，SI 损耗降低 15%。

As a next-generation cloud-native server hardware architecture of Alibaba Cloud, Panjiu M Series is built with Yitian 710 processors based on the latest ARM V9 architecture, including 128 high-performance CPU cores and a total of 60 billion transistors. The performance is 20% higher than the mainstream products in the industry and the energy efficiency ratio is improved by 50%. It follows the design idea of software and hardware integration of Fangsheng architecture and supports the separation of computing from storage, heterogeneous acceleration, and resource pooling. In terms of the architectural design, it is compatible with the front and back outgoing line architecture and has air-cooled and liquid-cooled modes, increasing the system cooling capability by 50%. Panjiu M Series adopts a modular design that can achieve the heterogeneous decoupling of storage and computing. This hardware product can be flexibly configured and upgraded, improving delivery efficiency by 50%. The self-developed hardware uses the Multi-Host technology, achieving high scalability and ultra-high computing density. Fangsheng cloud card, a new self-developed PCIe interface card, supports hot swapping. This increases the maintenance efficiency by 10 times and decreases the SI loss by 15%.

性能优异 配置灵活 应用场景丰富

Excellent performance, flexible configuration, and rich application scenarios

磐久服务器 M 系列已在阿里集团内部大规模部署，应用性能提升显著。在云原生、Java 类应用、存储和数据库场景下单机业务性能均有 30% 以上的提升，在云计算场景更是取得 110% 以上的性能提升。在主流业务场景中，磐久服务器 M 系列采用灵活模块化设计，可根据不同需求自由组合，形成符合多种场景的机型；其高算力和高稳定的特点，在数据库、云游戏及云原生、ARM 原生应用等场景中得到充分验证，尤其适用对服务器有苛刻要求的通信、金融、互联网、制造业等场景。2021 年 11 月，磐久服务器 M 系列全面应用于支撑双 11 核心业务，这证明了其具备业界超高规格的极致性能，以及高效低碳节能的能力。

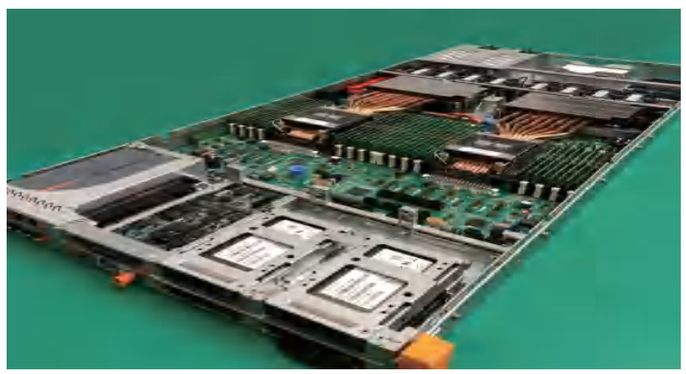
Panjiu M Series has already been widely deployed for internal use within Alibaba Cloud with improved performance. The business performance of single CPU servers is improved by more than 30% in cloud-native, Java applications, storage, and database scenarios and more than 110% in cloud-computing scenarios. In main business scenarios, Panjiu M Series adopts a flexible modular design. That is, it can be combined flexibly based on different needs to form a model that satisfies multiple scenarios. The high computing power and high stability have already been fully verified in the database, cloud game, cloud-native, and ARM-native application scenarios, especially in industrial scenarios that have higher requirements for servers such as telecommunications, finance, Internet, and manufacturing. In November 2021, Panjiu M Series was fully applied to support the core business of the Double Eleven Global Shopping Festival. This proves that it has excellent performance with ultra-high industrial standards, as well as the capabilities such as high efficiency, low carbon, and energy conservation.

追求不断创新 刷新世界纪录

Pursuing continuous innovation and breaking of world records

2021 年 12 月，国际权威云计算评估报告《Gartner Solution Scorecard 2021》发布，以磐久服务器为核心硬件支撑的阿里云 IaaS 基础设施总得分达到 96，位居全球云厂商第一。2022 年 4 月，磐久服务器 M 系列成为 MLPerf® 首个获得 CPU Only 推理性能第一的服务器；2022 年 7 月，磐久服务器 M 系列在 SPECrate®2017 Integer base 基准测试中取得 510 高分，刷新了单路服务器在该项测试中的最好成绩。2022 年 9 月，磐久服务器 M 系列顺利通过 PCIe 5.0 兼容性认证测试，成为全球范围内首个通过 PCIe 5.0 认证测试的量产服务器硬件系统。未来，阿里云磐久服务器将为用户提供更具性价比的云基础设施和更易落地的整体解决方案，创造价值。

In December 2021, Gartner Solution Scorecard 2021, an internationally authoritative cloud-computing assessment report, was released. Alibaba Cloud IaaS infrastructure powered by Panjiu servers scored 96 in total, ranking first among global cloud services vendors. In April 2022, Panjiu M Series became the first server to get the best CPU Only inference performance of MLPerf®. In July 2022, Panjiu M Series refreshed the result of the SPECrate®2017 Integer base test with 510 points, setting a new world record in the single CPU server performance test. In September 2022, Panjiu M Series successfully passed the official PCIe 5.0 compatibility certification, being the first mass-produced server hardware system that passed this test. In the future, Alibaba Cloud will offer more cost-effective cloud infrastructure and implementable solutions with Panjiu servers and create value for users.



智能司法公开关键技术及系统

Intelligent Public Judicial Information Services

清华大学计算机系
Computer Science Department, Tsinghua University



引言

司法公开是全球司法体系面临的共同问题。中国已建成全球规模最大的司法审判信息资源库，司法公平公正得到了有力保障，但司法公开程度和效能仍需进一步提升。“智能司法公开关键技术及系统”系列成果为降低隐私泄露风险、满足复杂信息需求以及提升信息主动利用方面提供了切实有效的解决方案。

Introduction

The lack of judicial openness in the legal system is a global problem. China has built one of the largest judicial information warehouses in the world, which ensures that justice is available to all. However, judicial openness still requires improvements in both degree and effectiveness.The achievement Intelligent Public Judicial Information Services represents a practical and effective method for reducing the risk of privacy leakage, satisfying complex legal information needs, and enhancing proactive information management.

人工智能加持，用创新成果提升司法公开效能

Improve the effectiveness of judicial openness by AI -driven innovative achievements

该成果针对敏感信息管控不足导致存在隐私泄露风险、语义匹配能力不足导致难以满足复杂信息需求、异质用户理解不足导致欠缺个性化主动利用等司法公开体系建设中面临的挑战，为保障司法有序公开的内容安全和隐私保护技术、提升司法公开效用的类案检索技术、化被动为主动的精准推荐技术等关键问题开展了重点攻关，产生了如下创新成果：

During the construction of judicial openness system, there are three key challenges, including: a). Insufficient regulation and control pose a high risk of sensitive information leakage; b). A lack of semantic match capability results in complex information needs being unsatisfied; c). Inadequate proactive personalized information utilization due to a lack of understanding of heterogeneous user groups. In order to address these challenges, this achievement focuses on three aspects of "content security and privacy protection to safeguard judicial openness orderly, relevant legal case retrieval to facilitate judicial information utilization, and accurate judicial information recommendation to transform reactive to proactive use", and makes several breakthroughs on these key problems.

实现了不同类别、不同粒度敏感信息的高效识别，构建了具有关联挖掘能力的风险自动评估系统，使裁判文书敏感信息识别召回率提升 14.1%、准确率提升 16.1%。

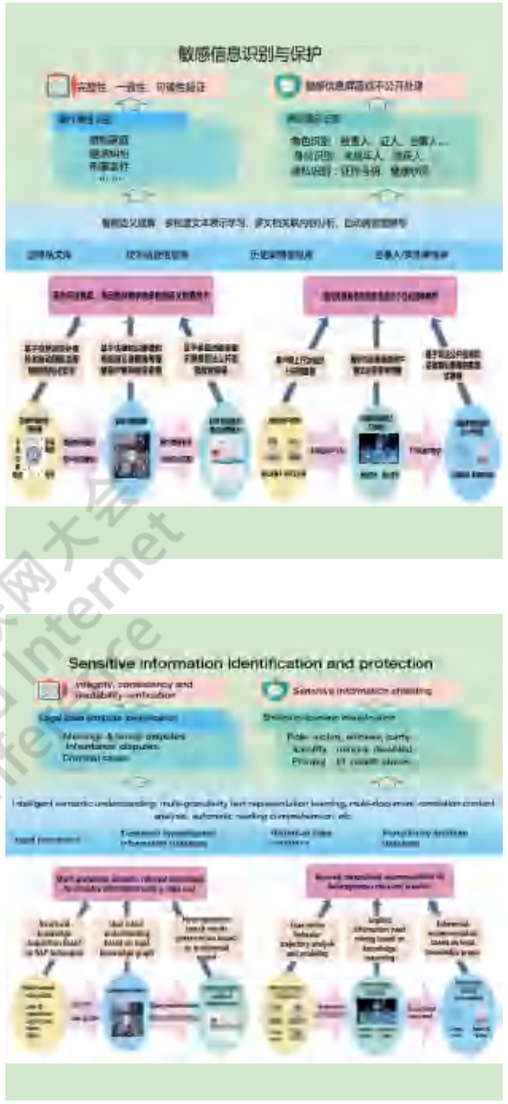
First and foremost, the achievement enables efficient identification and association mining of sensitive information at a multi-granular level with different categories and constructs an automated risk evaluation system for judicial openness, which results in an increase in recall rate from 85.0% to 97% and accuracy rate from 83.0% to 96.4%.

实现了从关键词匹配到面向复杂需求的语义检索技术的进步，构建了融合领域识和多粒度语义信息的类案检索系统，使得排序性能提升 18.6%。

Secondly, this achievement allows for the transformation from keyword retrieval to highly effective semantic retrieval for complex legal information requirements. By incorporating domain knowledge multi-granular semantic information into a legal case retrieval system, a ranking performance improvement of 18.6% is achieved.

实现了具有异质角色和异质场景感知能力的个性化精准司法信息推荐引擎，有效填补了用户认知与海量异构司法公开信息之间的鸿沟，使主动推送信息的用户点击率提升 32.9%。

Lastly, this achievement makes possible an accurate personalized judicial information recommendation engine, which is capable of being aware of heterogeneous roles and scenarios. This recommendation engine improved the clickthrough rate of recommended information by 32.9%, demonstrating its ability to bridge the gap between a limited degree of cognition on the part of the user and a large amount of heterogeneous judicial information on the part of the court.



创新成果核心技术方案
The Core Technical Scheme of the Innovative Achievement

以示范带动大规模应用，以开放推动可持续发展

Promote large-scale application by demonstration and facilitate sustainable development by open access

该成果研制的司法公开综合管理平台服务了 20 余个庭室、280 多位法官，辅助办案 5000 余件，全面审查了 100 余万篇公开文书。示范法院反馈的用户报告均显示，该平台能够节约司法工作人员的办案时间，智能、有效辅助司法公开。

The comprehensive judicial openness management platform, developed by this achievement, has successfully served more than 20 courtrooms and 280 judges, handled more than 5,000 cases, and comprehensively reviewed more than one million judgment documents. The demonstration courts have provided user experience reports that demonstrate that the platform can greatly ease the burden on judicial personnel by allowing them to handle legal cases more efficiently and effectively.

该成果研制的关键技术和数据资源实现了开放共享，能够有效推动司法人工智能技术的可持续发展。首先，该成果首次基于千万级别中文法律文书数据，开源了两个预训练模型 OpenCLap 和 Lawformer，Lawformer 发布后下载量达 1.5 万余次。其次，该成果推出了累积涵盖数百万篇法律文书的 14 个开源数据集，广泛覆盖判决预测、要素抽取、案情标签预测、类案检索等法律任务。

Key technologies and data resources developed in this achievement are made available freely to the public to ensure that the intelligent judicial openness community can develop sustainably. Firstly, this achievement pretrained and released legal pretraining language models, OpenCLap and Lawformer based on tens of millions of Chinese legal documents for the first time. Since its release, Lawformer has been downloaded more than 15,000 times. Secondly, this achievement launched 14 datasets that contains millions of legal documents in total. The datasets, taken as benchmarks in the Challenge of AI in Law (CAIL), cover a wide variety of legal tasks, including judgment prediction, legal element extraction, and legal fact label prediction.

为全球司法公开提供智能化解决方案，为持续培养高端复合人才提供平台

Provide intelligent solutions for global judicial openness and export continuously high-end interdisciplinary talent for legal problem solving

成果完成期间，严格控制成果产出质量、对标国际技术前沿。经过第三方测评机构评测结果和多名领域专家鉴定，一致认为该成果达到了较高的技术水平，具有较强的创新性、应用前景和示范推广可行性，相关学术成果也获得了国际同行评审专家的认可。

During the achievement completion process, the output quality is strictly controlled by means of scientific output management and benchmarking with international technology frontiers. In the evaluation process conducted by an independent testing agency and authentication by several domain experts, it has been unanimously agreed that this achievement reaches a high level of technical excellence, is innovative, has a bright future application potential, and is feasible for demonstration and promotion. International peer-review experts also recognize the high quality of the academic outputs.

依托于该成果，共产生发明专利及软件著作权 17 项、高水平论文 26 篇，培养毕业研究生 41 人、法律技术人员 35 人，获得国际网络检索与数据挖掘大会最佳论文奖，两次在国际著名智能司法评测中摘得第一名。成果团队连续筹办多届全球规模的司法智能技术评测比赛，共吸引了 4924 支国际队伍参赛，为辅助智慧法院建设提供智能化解决方案和复合人才保障。

The achievement results in a wide range of world-leading academic outputs, including 17 patents and software copyrights, 26 high-level papers, and the development of 41 graduate students and 35 legal technicians. One of the outputs received the best paper award at the ACM Web Search and Data Mining conference in 2022. In the International AI in Law Competition, our team achieved first place twice by implementing the leading key technologies. Since 2018, we have also organized annually the Challenge of AI in Law (CAIL) on the global scale, which attracted a total of 4924 international teams to participate. Such that the achievement provides intelligent technical solutions and interdisciplinary talents to support the development of smart courts.





创新成果奖（部分）
The Awards Received by the Achievement
(Only Part of the Awards)

创办互联网司法论坛，促进国际产学研交流合作

Found the Internet Judiciary Forum to promoting international Industry-University-Research communication and cooperation

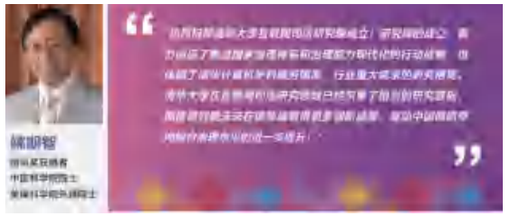
为促进跨国界、跨领域、跨学科的思想碰撞和融合，探索国际性司法公开共同难题的智能解决方案，成果团队成立了清华大学互联网司法研究院，创办了国际互联网司法论坛 –“清华互联网司法论坛”。

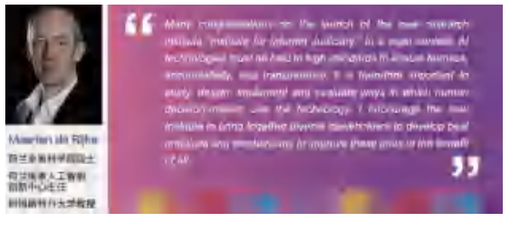
In order to promote the cross-border, cross-field and cross-disciplinary thought collision, and jointly explore the intelligent solution to the common problems of international judicial openness, the achievement team established the Institute for Internet Judiciary and founded the Tsinghua Internet Judiciary Forum.

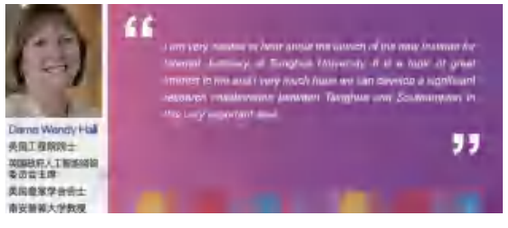
图灵奖获得者姚期智教授、荷兰皇家艺术与科学院院士 Maarten de Rijke 教授、英国工程院院士 Dame Wendy Hall 教授等国际知名专家认为，人工智能技术应用于法律场景具有重大科学意义，研究院的成立有助于深入推进国际交流和合作。国际互联网司法论坛主要围绕互联网司法科技前沿理论、实践难点问题开展系列研讨活动。该论坛目前已举办两届，论坛邀请了亚马逊公司 Alexa 购物搜索首席科学家冉 · 沃尔夫（Ran Wolff）博士、今日头条人工智能研究院院长李航博士、中国政法大学副校长时建中教授等出席论坛并参与专题研讨。

International top-leading experts, such as Prof. Yao Qizhi, Turing Award winner, Prof. Maarten de Rijke, Academician of the Netherlands Royal Academy of Arts and Sciences, Prof. Dame Wendy Hall, Academician of the British Academy of Engineering, believe that the application of artificial intelligence technology to legal context is of great scientific significance, and the establishment of the Institute for Internet Judiciary will be beneficial to further promote international communication and cooperation. The Tsinghua Internet Judiciary Forum, held by the Institute, aims to conduct a series of seminars focusing on the frontier theories and practical problems of Internet judicial science and technology. The seminar has been held for two times so far, and has invited several experts with different background, such as Dr. Ran Wolff, Chief Scientist of Amazon's Alexa Shopping Search, Dr. Li Hang, Dean of ByteDance Artificial Intelligence Research Institute, and Prof. Shi Jianzhong, Vice President of China University of Political Science and Law, to present a report and participate in panel sessions.









高谱效高能效的大规模天线通信系统空时降维传输理论与方法

High Spectrum and Energy Efficient Wireless Transmission Theory and Methods for Space-Time Dimension Reduced Massive MIMO Systems

清华大学
Tsinghua University



引言

本项目围绕 5G 大规模 MIMO 面临的高维通信与低开销低功耗之间的矛盾这一重要科学问题，建立了一套高维 MIMO 信道空时降维传输理论与方法，可大幅降低现代无线通信系统的开销和功耗。相关成果在 5G 商用网络建设中得到了规模应用，为推进和提升信息基础设施建设、运营和服务水平提供了应用示范。

Introductions

In this project, we examine the important scientific issue of the contradiction between 5G massive MIMO's low overhead and low power consumption and the communication in high-dimensional channels. The paper presents a set of high-dimensional MIMO channel space-time dimension reduction transmission theory and method, which can reduce the system overhead and power consumption significantly. In order to improve the construction, operation, and service level of wireless infrastructure, the related achievements have been applied in the construction of 5G networks.

构建高维 MIMO 信道的空时降维理论与方法

The Space-time dimension reduction theory of high-dimensional MIMO channels

本项目在技术和应用领域具有的突出先进性和创新包括：

This project has achieved a number of notable advances and major innovations in the areas of technology and application, including:

高维 MIMO 信道的空时降维理论：深入剖析大规模 MIMO 信道在空域和时域的信道特征，揭示了高维 MIMO 信道实际上分布于慢变低维信道子空间的规律，建立了高维 MIMO 信道的空时降维理论，为低开销低功耗的大规模 MIMO 系统设计提供了重要理论依据。

Space-time dimension reduction theory of high-dimensional MIMO channels: Based on an analysis of the channel characteristics of massive MIMO in both spatial and time domains, it is evident that high-dimensional MIMO channels are distributed in a subspace of low-dimensional channels that is slowly varying, presenting a space-time dimension reduction theory of high-dimensional MIMO channels. Based on this analysis, massive MIMO systems with low overhead and low power consumption can be designed.

高谱效的大规模 MIMO 高维信道信息获取方法：针对高维 MIMO 信道信息获取开销大的挑战，突破经典的“正交导频”设计思路，提出“非正交导频”设计方法；利用大规模 MIMO 信道时频二维稀疏性，提出分布式压缩感知的信道估计方法，可降低导频开销 50%；同时，设计构造信道子空间码本，可降低无线信道反馈开销 40%。

A method of obtaining high-dimensional channel information that is spectrally efficient for massive MIMO: To overcome the high-cost challenge of acquiring high-dimensional MIMO channel information, this project proposes a method of designing high-dimensional MIMO channels that does not follow the classic "orthogonal pilot" approach. By using this method, different antenna pilots can occupy the same time-frequency resources. An optimal pilot pattern is designed based on the finite equidistant principle. A distributed channel estimation method based on compressed sensing is proposed using two-dimensional sparsity, which can result in a 50% reduction in pilot overhead. Further, this project constructs a channel subspace codebook that can reduce channel feedback overhead by 40%.

高能效的大规模 MIMO 模数混合预编码方法：针对大规模 MIMO 功耗高的技术挑战，建立大规模 MIMO 模数混合预编码结构的能效优化模型及设计准则；针对子连接的模数混合预编码结构，揭示子连接结构下非凸的系统和速率优化问题的可分解性；提出基于串行优化的子连接模数混合预编码方法，可提高无线系统能量效率 30% 以上。

The low-dimensional equivalent representation of high-dimensional MIMO channels is analyzed in order to achieve an energy-efficient massive MIMO analog-digital hybrid precoding method. The purpose of this project is to develop an energy efficiency optimization model and design criteria for the massive MIMO modulo-digital hybrid precoding system. Additionally, this project proposes a serial-optimized analog-digital hybrid precoding method for sub-connections. Additionally, the project derives the analytical expressions for the spectral efficiency and energy efficiency of the massive MIMO power domain multiplexing system, which can provide a 30% improvement in the system's energy efficiency.



高维 MIMO 信道的空时降维理论与方法
The Space-Time Dimension Reduction Theory and Applications for Massive MIMO Systems

5G 商用无线网络中的推广与应用

The application in 5G commercial wireless networks

中国移动实测结果表明，本项目设计的重叠导频可降低导频开销 50%，构造的子空间码本可降低信道反馈开销 40%。

According to China Mobile's field test results, the overlapping pilots designed in this project can reduce pilot overhead by 50%, and the constructed subspace codebook can reduce channel feedback overhead by 40%.

基于本项目成果开发的大规模 MIMO 样机先后获 2022 年日内瓦国际发明展金奖、通信领域旗舰会议 IEEE ICC 2022 杰出演示奖。

As a result of this project, the massive MIMO prototype developed has been awarded the Gold Award at the 2022 Geneva International Exhibition of Inventions, and the Outstanding Demonstration Award at the IEEE International Conference on Communications in 2022.

本项目近五年与华为开展合作项目 8 项，合同金额超 1000 万，其中一个项目获 2021 年华为十大优秀校企合作项目。本项目提出的信道子空间码本通过与华为的产学研项目合作，成为华为主导的 5G 增强型 Type II 码本的重要组成部分，已写入 5G 标准（3GPPTS 38.214，R16，Section 5.2.2）。

In the past five years, this project has carried out eight cooperative projects with Huawei with a contract value of more than $10 million. One of the projects has been selected as one of Huawei's top ten outstanding school-enterprise cooperation projects for 2021. Through collaboration with Huawei's industry-university-research project, the channel subspace codebook proposed in this project has become an important part of the 5G enhanced Type II codebook. As a result, it has been incorporated into the 5G standard (3GPPTS 38.214, R16, Section 5.2.2).

本项目提出的信道估计和预编码方法是重要创新性成果，且基于这些成果“研发的基站设备已经在我国 5G 商用网络建设中得到了规模应用”。

The proposed channel estimation and prediction coding method in the project is an important innovative achievement. Based on these findings, "research and development of base station equipment already being used in the construction of the 5G commercial network in China on a large scale".

推进和提升现代网络建设、运营和服务水平

Improve the modern wireless network construction, operation and service level

相关研究成果对学术发展以及社会经济都产生了重大影响。相关的论文成果发表于 IEEE Journal on Selected Areas in Communications、IEEE Transactions on Signal Processing 等国际权威期刊与会议，并多次获得最佳论文奖。论文引用者包括美国、英国、加拿大等国外院士 24 人，IEEE 期刊现任或前任主编 35 人，IEEE Fellow 200 人，以无线通信领域学者为主，同时涵盖微波、天线、芯片、雷达等相关领域。围绕上述成果，申报人通过与华为、中国移动、中兴等企业和开展多个项目合作，积极推动相关技术的落地应用，获得多个应用发明奖。同时，申报人通过参与国家重大专项，助力实现 “5G 引领”的目标。

There has been a significant impact on academics and the social economy as a result of the research results. The academic papers have been published in prestigious international journals such as IEEE Journal on Selected Areas in Communications and IEEE Transactions on Signal Processing. The citations of relevant papers are made by 24 foreign academicians from the United States, the United Kingdom, Canada, etc., 35 current or former chief editors of IEEE journals, and 200 IEEE Fellows. The majority of them are scholars specializing in wireless communication, including microwave, antenna, chip, radar, and other related fields. With respect to the social economy, the applicant actively promotes the implementation and application of relevant technologies through collaboration with Huawei, China Mobile, ZTE, and other enterprises and projects. Furthermore, by participating in major national special projects, the applicant contributes to the achievement of the goal of "5G leadership".



相关应用证明与第三方评价
Application Proof and Third-Party Evaluation



相关应用证明与第三方评价
Application Proof and Third-party Evaluation



相关应用证明与第三方评价
Application Proof and Third-Party Evaluation



腾讯天籁行动——AI 让听障人士“听得清”

Tencent Ethereal Audio Campaign ——AI Makes Hearing Impaired People "Hear Clearly"

腾讯天籁实验室
Tencent Ethereal Audio Lab

腾讯天籁

引言

“天籁行动”是腾讯会议天籁实验室联合腾讯公益基金会、中国聋人协会等机构，于 2020 年国际聋人日发起的科技公益项目，主要面向听障社会责任领域，免费开放腾讯会议背后的天籁 AI 技术，创新性提升助听设备辅听效果，让听障人士“听得清”，帮助他们更好地融入数字社会，助力社会信息无障碍建设。

Introduction

On the International Day for the Deaf in 2020, Tencent Meeting Ethereal Audio Lab, Tencent Public Welfare Foundation, China Association of the Deaf, and other organizations jointly launched the "Ethereal Audio Campaign". In the field of social responsibility for the hearing impaired, Tencent Meeting has applied ethereal AI technology for many years. The hearing aid is ingeniously designed to improve the hearing aid effect, allowing the hearing impaired to "hear clearly", facilitating their integration into the digital society, and assisting in the creation of an information-accessible society.

天籁音频 AI 技术，让听障人士“听得清”

Ethereal Audio AI technology enables people with hearing impairment to "hear clearly"

腾讯天籁行动，面向听障社会责任领域，免费开放腾讯会议背后的天籁 AI 技术，在听力筛查、助听设备降噪、辅听优化、字幕识别优化等领域，实现行业关键技术突破，帮助听障人士在噪音场景下“听得清”。

A number of innovative technological achievements have been made in the field of social responsibility for the hearing impaired utilizing the ethereal AI technology applied in Tencent Meeting for many years. These include hearing screening, noise reduction in hearing aids, hearing aid optimization, subtitle recognition optimization, etc.

其中，天籁行动携手中国人工耳蜗厂商诺尔康，突破了人工耳蜗动态噪音实时处理的难题，提升人工耳蜗语言清晰度与可懂度 40%，目前诺尔康已上市搭载了天籁 AI 技术的第三代耳蜗产品。

In cooperation with Nurotron, the manufacturer of cochlear implants in China, Ethereal Audio Campaign has solved the problem of dynamic real-time noise processing, improving language clarity and intelligibility by 40%. Ethereal AI technology has been incorporated into Nurotron's third-generation cochlear products.

天籁行动携手全球头部人工耳蜗厂商美笛乐 MED-EL，推出集成“听力测试 +AI 辅听 + 远程听力康复服务”的平台——美讯听宝 APP，帮助听损者提升单音节识别率约 66%。并结合腾讯会议远程音视频通讯能力，帮助听障者克服疫情影响，线上即可预约专家调机康复服务。

With the help of MED-EL, a global manufacturer of cochlear implants, Ethereal Audio Campaign launches the Meixuntingbao APP, the platform that combines "hearing test + AI auxiliary hearing + remote hearing rehabilitation service", resulting in a 66% increase in monosyllabic recognition rates for hearing-impaired individuals. Using the remote audio and video communication capabilities of Tencent Meeting, the project is designed to assist hearing-impaired individuals in overcoming the impact of the epidemic by enabling them to schedule online appointments for experts to adjust their machines for rehabilitation purposes.

天籁行动携手中国运营商联通，推出“畅听王卡升级版”，实现单一字节言语识别率和实时字幕识别准确率分别提高 66% 和 5.5 ~ 9.9%，让听障人士不仅“听得清”，而且“看得清”。

It launched the "Smooth Hearing King Card Upgrade" in collaboration with China Unicom, a leading domestic carrier. By incorporating Ethereal AI technology, the single-byte speech recognition rate was increased by 66%, and real-time subtitle recognition accuracy was improved by 5.5-9.9%. Users with hearing impairments are now able to not only hear clearly, but also see clearly.

天籁行动推出完全自研的助听器算法解决方案，可提升国产助听器关键性能指标 85%，让千元级的国产助听器，也能媲美万元级进口助听器的性能。并与助听器厂商智听科技联合研发，推出挚听（腾讯天籁 inside）助听器“公益助老款”，该款助听器具备“低时延、低功耗、好音质”的三大技术优势。同时，为了解决助听器因“啸叫”带给听损人士的长期困扰，天籁行动创新性地提出了啸叫抑制系统性解决方案。这款挚听（腾讯天籁 inside）助听器后期将作为优质老年用品推广应用，助力老龄事业发展。

Ethereal audio campaign launched a completely self-developed algorithm solution for hearing aids, which can improve the key performance indicators of domestic hearing aids by 85%, making domestic hearing aids of thousands of yuan level comparable to imported hearing aids of tens of thousands of yuan level. It has jointly developed with hearing aid manufacturer Smart Listening Technology, the company launched the "Public Welfare Helping the Elderly" hearing aid of Tencent Ethereal Audio inside, which has three major technical advantages of "low delay, low power consumption and good sound quality". At the same time, in order to solve the long-term problem of hearing impaired people caused by "howling" of hearing aids, it innovatively proposed a systematic solution for howling suppression. This kind of hearing aid (Tencent Ethereal Audio inside) will be promoted and applied as a high-quality elderly product to help the development of the elderly cause.



美讯听宝产品界面图



（腾讯天籁 inside）助听器
Tencent Ethereal Audio inside Hearing Aid

广泛链接社会资源，打造听障人士帮扶闭环

Extensively link social resources to create a closed loop for the hearing-impaired

作为腾讯在技术公益领域的创新尝试与标杆，天籁行动以技术公益为基点，除了面向听障社会责任领域免费开放天籁 AI 技术外，还围绕“AI 测听、AI 辅听、公益救助”几个方面，持续推出新举措，并于今年爱耳日启动 2.0 升级，联合多方力量发起“天籁听未来合作体”，聚合社会各界资源，积极为听障人士融入数字社会提供切实有效的帮助。

The Ethereal Audio Campaign is Tencent's innovative initiative and benchmark in the field of technology public welfare. Additionally, it focuses on "AI audiometry, AI assistance, and public welfare assistance" to launch new measures, in addition to free opening of Ethereal AI technology. Ier Day this year was the launch date for the 2.0 upgrade of the project, and the project partnered with various parties to launch "Ethereal Listening to the Future Action Cooperation", which gathered resources from a variety of backgrounds and actively assisted the hearing impaired in integrating into the digital society through practical and effective assistance.



天籁行动 2.0 升级启动仪式
Tencent Ethereal Audio Campaign 2.0 Upgrade Launching Ceremony

联合中国老龄事业发展基金会、中国听力医学发展基金会、北京爱的分贝公益基金会等多家基金会推出面向老年人、青年人才及儿童的听障救助专项公益基金，为听障人士提供带有天籁 AI 技术的助听产品、康复服务、职业培训等。其中与中国老龄事业发展基金会发起的“天籁银发关爱基金”首期试点落地韶关，为韶关听障老人提供免费听力筛查服务，并为韶关 500 位以上的听障老人，免费捐助带有天籁 AI 技术的助听器。后续可在全国老龄化重点区域复制落地，聚焦解决老龄化社会背景下的老年听障问题，帮助他们更好地融入数字社会。

In collaboration with the China Aging Development Foundation, China Audiology Development Foundation, and the Beijing Love Decibel Public Welfare Foundation, we have established special public welfare funds for the elderly, young talents and children with hearing impairment, providing hearing aid products, rehabilitation services, and vocational training with Ethereal Audio AI technology for hearing impaired individuals. In conjunction with the China Aging Development Foundation, the first phase of the "Ethereal Silver Hair Care Fund" was established in Shaoguan, Guangdong Province to provide 500 elderly people with hearing impairments with free hearing screening services and hearing aids with Ethereal audio AI technology. A similar model can be replicated and implemented in key areas of ageing throughout the country in the future, focusing on solving the problem of hearing impairment among the elderly in the context of an ageing society and enabling them to better integrate with the digital age.

同时，为了能够帮助到更多有需要的听障老人，腾讯公益慈善基金会、腾讯 SSV 银发科技实验室、腾讯会议天籁实验室、智听科技还联合启动了挚听（腾讯天籁 inside）助听器「买一捐一」公益救助活动。预售期间，每销售出一台挚听（腾讯天籁 inside）助听器，腾讯与智听科技将为偏远山区听障老人免费捐助一台同款助听器。这也是“腾讯天籁银发关爱基金”继韶关救助行动后，在听障救助领域又一公益举措。

At the same time, in order to help more needy hearing impaired elderly people, Tencent Charity Foundation, Tencent SSV Yinfa Technology Laboratory, Tencent Meeting Ethereal Audio Lab, and Smart Listening Technology also jointly launched the "buy one give one" public welfare relief activity for the hearing aid of Tencent Ethereal Audio inside. During the pre-sale period, every time a hearing aid of Tencent Ethereal Audio inside is sold, Tencent and Smart Listening Technology will donate a hearing aid of the same type for the deaf elderly in remote mountain areas for free. This is also another public welfare measure in the field of hearing disability relief by "Tencent Ethereal Audio Care Fund" following the Shaoguan relief action.

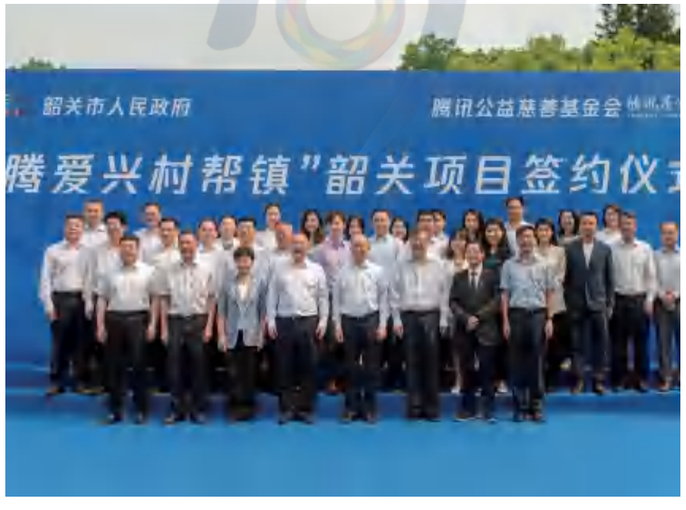
呼吁全社会关注听障人士，共同助力信息无障碍建设

Call on the whole society to pay attention to the hearing-impaired and jointly help the construction of information-accessible society

腾讯天籁行动自发起以来，受到广泛的社会关注与支持。在与诺尔康、美笛乐成功进行人工耳蜗 AI 辅听优化方面的技术验证后，已有越来越多的国际及中国助听器、人工耳蜗等助听设备厂商、运营商与天籁行动展开技术合作与攻坚。

Ethereal AI technology can also benefit the hearing-impaired by launching special relief funds in collaboration with a number of foundations.

同时，通过与多家基金会联合发起专项救助基金的方式，让天籁 AI 技术可以更好地触达听障人士，真正让听障人士受益。其中，“天籁银发关爱基金”首期落地广东韶关，为 500 位老人免费提供带有天籁音频 AI 技术的助听器；“天籁青年人才基金”将在 2022 年为 100 位以上听障青年人才提供天籁耳蜗植入手术补贴；“悦耳行动”倡议已为超过 200 多位听障人士提供人工耳蜗植入手术救助。"帮助听障儿童说出爱”项目，已为 207 位听障儿童提供免费的言语康复服务。在线下听力义诊方面，天籁行动联合中国语言听力康复科学杂志社及辅听设备厂商，在中国 21 个地区，针对 50 岁以上老年听损用户开展线下免费听力义诊活动。



“天籁行动—天籁银发关爱基金”在广东韶关试点落地
“Ethereal Audio Campaign”- Ethereal Audio Yinfa Care Fund was Piloted in Shaoguan, Guangdong

In Shaoguan, Guangdong, the first phase of the "Ethereal Silver Hair Care Fund" was launched, providing 500 elderly residents with free hearing aids equipped with Ethereal Audio AI technology. More than 100 young people with hearing impairment will be provided with subsidies for cochlear implants through the "Ethereal Young Talent Fund" in 2022. Operation Pleasant Ear has provided funding to more than 200 individuals with hearing impairments. During the project "Help Hearing-impaired Children Say Love," 227 hearing-impaired children received rehabilitation training. As part of the offline hearing free clinic initiative, China Language and Hearing Rehabilitation Science Magazine and auxiliary hearing equipment manufacturers have collaborated on free offline hearing clinic activities in 21 regions across China for hearing loss users over 50 years of age.

技术突破及公益成果，受到多家权威机构单位认可

Technological breakthroughs and public welfare achievements have been recognized by many authoritative institutions and units

天籁行动被中国扶贫基金会主动收录为标杆案例，并先后获得了 2022 年 IDC 亚太区智慧城市数字化应用大奖、南方公益传播奖 · 年度奖（以综合指数 70.24 的成绩荣登总榜第一名）、上海报业集团界面新闻“年度臻善案例奖”、“贵阳数博会 · 领先科技成果奖”、“中国互联网大会 · 创新之星”、“新周刊年度公益大会 · 美好发声”、2021 金瞳奖“内容营销大奖”等奖项。

“Ethereal Audio Campaign” was actively included as a benchmark case by the China Poverty Alleviation Foundation. And it successively won the 2022 Asia-Pacific Smart City Digital Application Award, the Southern Public Communication Award (ranked first on the overall list with a composite index of 70.24), and the Shanghai Newspaper Group Interface News' "Annual Improvement Case Award", “Guiyang Digital Expo· Leading Science and Technology Achievement Award”, “China Internet Conference Innovation Star”, “New Weekly Annual Commonweal Conference · Beautiful Voice”, 2021 Golden pupil Award "Content Marketing Award" and other authoritative awards.

2022 年领英全球数字技能框架研究成果

LinkedIn Global Digital Skills Framework Research 2022

北京领英信息技术有限公司
Beijing LinkedIn Information Technology Co.,Ltd.

引言

疫情当下，数字技术加速演进，全球劳动力市场正站在一场变革的交叉路口。领英致力于通过经济图谱建立全球数字技能框架，从技能培养的角度为全球经济政策的制定提供实时且客观的分析预测，帮助人才与机会以全新的方式实现对接。

Introduction

Global labor markets are at the crossroads of change due to the dual effects of the epidemic and the rapid evolution of the digital economy. Through the Economic Graph, LinkedIn is committed to creating a Global Digital Skills Framework. The company is committed to leveraging exclusive technology and data to provide real-time and effective tools to help formulate global economic policies from the perspective of skills development and assisting talents and opportunities to connect more

为拥抱“技能为王”的未来职场，领英构建全球数字技能框架

To embrace the future of skills, linkedin creates the global digital skills framework

通过分析平台上 8.5 亿会员、3.9 万技能、5900 万公司和 12.8 万所教育机构的海量数据，领英以数字化形式展现了全球经济。自 2017 年，领英就使用其独一无二的劳动力数据和数据处理方法来构建全球数字技能框架。

LinkedIn uses its unique data and one-of-a-kind methodology, the Economic Graph, to create this Global Digital Skills Framework. Based on over 850 million members, 39,000 skills, 59 million companies, and 128,000 schools, the Economic Graph represents the global economy. Briefly, it is all LinkedIn data.



在全球数字技能框架下，领英所倡导的“以技能为导向”的招聘打破固有的招聘思维，以更贴合实际需求的方式进行人才匹配，为全球经济创造更多就业机会，帮助人才更快在职场取得成功。

Using the Global Digital Skills Framework, LinkedIn advocates skills-based hiring as it transcends the traditional recruitment model and allows for a more accurate and practical method of matching candidates with employers. In this way, LinkedIn contributes to the creation of more employment opportunities for the global economy and allows more individuals to flourish in the workplace more quickly.

同时，领英利用经济图谱产出了独家的数据研究和创新工具：

With Economic Graph, LinkedIn can deliver data-driven reports and tools, accelerating the process of digital transformation and workforce upskilling.

数据研究助力技能转型：

Exclusive research offers new perspectives on digital transformation:

领英经济图谱团队与清华大学经济管理学院互联网发展与治理研究中心（CIDG）进行了多年关于数字经济的研究，提出“数字人才”这一概念，为全球经济的数字化转型提供独特视角。

In collaboration with the Tsinghua SEM Center for Internet Development and Governance (CIDG), LinkedIn Economic Graph has developed the concept of "digital talent," a vision that provides us with a unique insight into the globalization of the global economy through its digital transformation.

工具助力接轨技能市场：

Keeping talent relevant in the marketplace requires innovative upskilling tools:

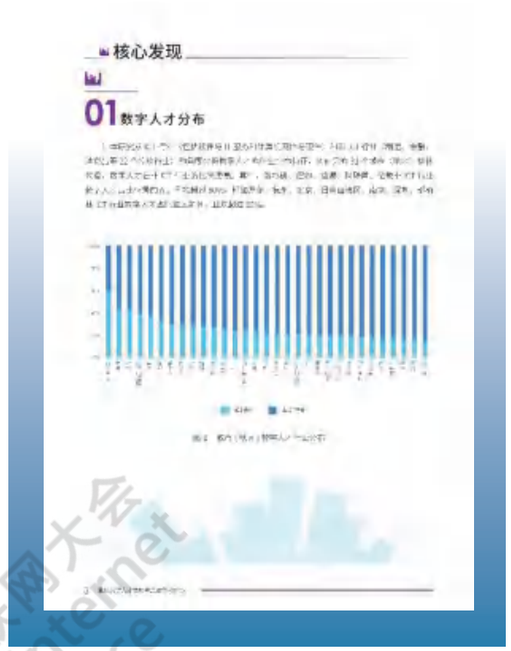
鹰眼数据（Hawkeye）：实时获取全球主要国家及地区的每月最新劳动力数据洞察，包括雇佣率、技能趋势等关键信息。

The Hawkeye Insights report provides directions for upskilling and industry development. The latest monthly labor data insights on major countries and regions around the world are available to individuals, governments and businesses in real time, including key information such as hiring rates and skills trends.

技能数据（Skills IDA）：通过呈现全球行业技能变化图，成为复合型人才有迹可循。

Skills Interactive Data Dashboard helps the global workforce stay competitive in the post-pandemic world. It is possible to stay ahead of the future of work by showing how skills in a specific field have evolved over time, which can provide traces to follow that can lead to becoming an interdisciplinary talent.

职场探索者（Career Explorer）：通过比对现有技能和职位所需技能，轻松匹配下一段职业道路。



领英与清华大学经济管理学院互联网发展与治理研究中心的合作研究
《全球数字人才发展年度报告（2020）》
LinkedIn Economic Graph's
Global Digital Talent Development Report (2020),
collaborated with Tsinghua SEM Center
for Internet Development and Governance (CIDG)

Career Explorer uncovers career paths by matching skills to thousands of job titles. Comparing people's current skills with the top skills required by the role can help people to identify potential career opportunities and prepare for the next step in their career.

全球数字技能框架下，领英帮助 Z 世代更快取得成功

LinkedIn's Global Digital Skills Framework Makes it Easier for Gen Z to Succeed

领英致力于帮助年轻人在职业生涯上有一个良好的开端，为此，我们着手于用全球数字技能框架来装备亟需帮助的初入职场者——Z 世代职场人。我们发现，在领英所倡导的以技能为基础的招聘方法下，入门级员工在职场上取得成功的效率是以资质为准的传统招聘方法的五倍。

In order to enable the world's workforce to embrace a skills-centric future, LinkedIn is launching its Global Digital Skills Framework to enable the entry of the most in-demand career starters, Generation Z, into the labour market. Skills-based hiring is five times more effective than qualification-based hiring at delivering job success for entry-level employees, according to the study.

Z 世代职场人往往拥有雇主迫切寻找的各种急需和尖端技能，而他们的教育和就业经历无法直接反映这一点。而事实上，基于技能的招聘为 Z 世代职场人创造了更多的就业机会。领英数据显示，全球 40% 的雇主现在明确依赖技能来搜索和识别候选人（与去年相比增加了 20%）。

Among the positive changes in the labour market that create more opportunities for Gen Z is the trend towards skills-based hiring, which means emphasizing a candidate's skills and potential rather than solely their education and previous employment history. Employers are often looking for in-demand and cutting-edge skills in Generation Z, which are not necessarily reflected in their employment history. LinkedIn's data indicates that 40% of hirers worldwide rely on skills when searching for and identifying candidates (up 20% from last year).

此外，领英也连续多年发布了《高校校友观察》，就人才培养、就业政策等方面提出了相关建议，供有关部门参考。

LinkedIn has released its University Alumni Insights, which provides substantial assistance to university graduates, proposing recommendations that support the formulation of policy solutions for relevant policy stakeholders relating to higher education and talents.



领英与全球化智库合作研究成果《高校校友观察（2021）》
LinkedIn's University Alumni Insights (2021), collaborated with the Center for China and Globalization (CCG)

全球数字技能框架精准助力数字化转型，以技能培养实现人才理想

LinkedIn's Global Digital Skills Framework Enables Precise Digital Transformation and Promotes Scientific Upskilling

领英利用经济图谱所搭建的全球数字技能框架对于政府、企业和个人都具备科学有效的实际意义。对政府：在宏观层面提供颗粒度更高的人才供需趋势，助力制定人才战略决策；对企业：跨越行业和地域追踪人才，针对当下最紧缺的技能实施人才培养计划；对求职者：借助技能框架，打破学历、经验和地域的界限，通过技能养成实现职业理想。

Governments, corporations, and individuals can benefit from LinkedIn's Global Digital Skills Framework. For policy stakeholders, the framework can provide a higher level of granularity on talent supply and demand trends, allowing the government to make more informed decisions regarding talent management.

受益于独家技术和数据，领英从技能的角度帮助全球劳动力和企业适应瞬息万变的工作场景，提高政策决策的科学性和针对性。

For enterprises, the framework allows them to track the most in-demand skills across industries and regions, as well as upskill their employees accordingly.

以海量数据连接无限机会，经济图谱于全球得到应用

Connect the World's Professionals to Opportunities, LinkedIn's Economic Graph benefits the Global Economy

领英（LinkedIn）作为一家全球领先的职场社交平台，创建于 2003 年，总部位于美国硅谷。领英的愿景是为全球 30 亿劳动力中的每一位创造经济机会，进而绘制世界首个经济图谱。截止 2022 年 7 月，领英全球会员总数已达 8.5 亿，覆盖 200 多个国家和地区，其中，中国会员总数已逾 5,700 万。

Founded in 2003, LinkedIn is the world's largest professional network and is headquartered in Silicon Valley, California, USA. Its vision is to create economic opportunity for everyone in the global workforce and to create the first Economic Graph. As of July 2022, LinkedIn has nearly 850 million members from over 200 countries and territories around the world, with over 57 million Chinese members.

全球政策制定者正利用领英关于数字人才的研究，解决数字化转型的道路上会遇到的实际问题。

LinkedIn's research on the Digital Economy and Digital Talents is being used by policy stakeholders all over the world to solve practical problems in the process of digital transformation.

领英多个关于数字经济领域的研究被主流媒体报道。全球数字技能框架研究获得中国美国商会等机构的官方收录。经济图谱也被评选为 2021 年“携手构建网络空间命运共同体精品案例”。

The Economic Graph's insightful research on various economic fields have been reported by many mainstream media. AmCham China has officially incorporated the Global Digital Skills Framework Research into its Social Impact Initiative. As part of the World Internet Conference in 2021, the Economic Graph was named a "Success Story of Jointly Building a Community with a Shared Future in Cyberspace".



AI 赋能讯飞输入法，广泛无障碍改造弥合“数字鸿沟”

AI Enabling iFLYTEK Input Method, Extensive Barrier-Free Transformation to Bridge the "Digital Divide"

讯飞输入法
iFLYTEK Input Method

引言

手机输入法作为全球互联网应用之一，随时代发展呈现智能化趋势，因此帮助特殊群体跨越“数字鸿沟”具有重要意义。讯飞输入法通过 AI 广泛赋能进行一系列适老化和无障碍改造，便捷广大中老年人和障碍人士无碍沟通。

Introduction

Mobile input is one of the global Internet applications that has evolved with the development of the times to become an intelligent trend. The importance of assisting special groups to cross the "digital divide" cannot be overstated. Using AI, iFLYTEK Input is capable of carrying out a series of aging and barrier free transformations, facilitating communication between the elderly and the disabled.

从用户“痛点”出发，实现多模态无障碍信息输出和输入

Starting from the user's "pain points", multi-modal barrier-free information output and input are realized

在中国 60 岁及以上人口有 2.6 亿，比重达 18.70%，老龄化成为较长时期的基本国情，也因此互联网适老、帮老、助老成为刚需。国际上输入法例如谷歌键盘（Gboard）、微软 Swiftkey 缺少为老年人使用的定制功能。讯飞输入法洞察到看不清、打字慢、IT 技能不足、适老化模式不会用的难题，研发出“长辈模式”，不仅简化交互层级还调整界面视觉，同时内置高识别率手写输入，独家支持 25 种方言语音输入，配备语音播报功能。

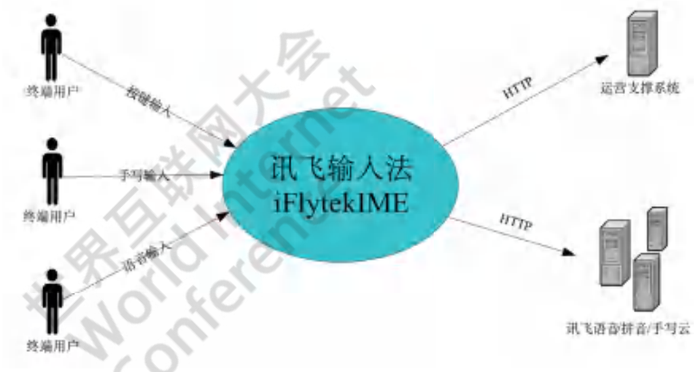
A total of 260 million people in China are over the age of 60, representing 18.70% of the population, and aging has become a fundamental national condition for a long time, so the Internet is helping the elderly has become a just need. A number of international input methods, such as Google Gboard and Microsoft Swiftkey, do not include customized features for the elderly. iFLYTEK Input insight into the elderly can't see the slow typing, insufficient IT skills, suitable for aging mode will not be used problems, developed a "elder mode", which simplifies interaction and adjusts interface vision simultaneously, while the handwriting input has a high recognition rate, 25 dialects of speech are supported in addition to voice broadcasting.

此外，讯飞输入法适配手机无障碍模式，支持全界面语音播报，具有发送 Emoji 表情同步获得表情位置和名称提示的功能。此外，在拍照输入界面实现“看见”文字和“说出”语音功能，支持文字和语音双向转换。

A number of additional features are available as well, including iFLYTEK Input's ability to adapt to mobile phones' barrier-free mode, the ability to broadcast voice via full-interface and the capability to send emoji synchronization to obtain hints about the location and name of an emoji. Additionally, photo input interface shows "see" text and "say" speech function, supporting two-way conversion of text and speech.

讯飞输入法完整内置拼音、语音、手写等交互功能，关联图如下：

iFLYTEK Input method has complete built-in interactive functions such as pinyin, voice and handwriting, and the correlation diagram is as follows:



为了实现真正的无障碍交互，讯飞输入法融合科大讯飞手写识别、语音识别、OCR 基础上，增加机器翻译、语音合成等 AI 核心技术，持续对语音及手写识别算法迭代升级，同时基于“障碍群体”的特点进行广义的无障碍改造。

In order to achieve true barrier-free interaction, iFLYTEK Input method integrates handwriting recognition, speech recognition, and OCR, innovating AI core technologies such as machine translation and speech synthesis, continuously upgraded speech and handwriting recognition algorithms, and carries out generalized barrier-free transformation based on the characteristics of " groups of impaired-people".



语音功能采用科大讯飞自研的前后端一体化的语音识别框架 TFMA(Temporal feedback end-end multi-channel ASR)，使高噪声、多人说话、轻声说话等复杂场景下仍可保持高识别率。

TFMA (Temporal feedback end-end multi-channel ASR) is iFLYTEK's proprietary integrated front-end and back-end speech recognition framework developed by iFLYTEK for the speech function, which ensures the high recognition rate for complex scenarios with high background noise, multi-person speaking, and lower speaking volume.



前后端一体化的语音识别框架 TFMA 主要特点
The Main Features of TFMA, a Speech Recognition Framework that Integrates Front and Rear

OCR 使用第四代识别框架，采用基于语义分割的文字检测技术与超大底层感受野网络以及适用于自然场景的数据增强技术的混合，大幅提升图文识别能力。

OCR has evolved to a fourth generation of recognition framework, which incorporates a combination of text detection based on semantic segmentation along with a super low-level sensory field network and data enhancement technology tailored to natural scenes, resulting in significantly improved graphic and text recognition capabilities.

为了让任何人、任何情况下都能平等地、方便地、无障碍地进行信息交流，讯飞输入法积极构建合作模式，通过研发无障碍输入产品，帮助盲人“看见”精彩的互联网世界。

In order to allow anyone to exchange information equally, conveniently and without barriers in any situation, iFLYTEK Input method actively establishes cooperation model, helping the blind to "see" the wonderful Internet world through the development of barrier-free input products.

为进一步推动无障碍输入生态建设，2021 年讯飞输入法与设备厂商达成合作，推动技术成果共享，联合头部手机厂商小米定制版无障碍输入，旨在让全球每个人都能享受科技带来的美好生活。2022 年 4 月基于 MIUI 系统升级，迭代广义无障碍输入，增加多语种键盘，支持语音自动读屏，打造行业应用案例，让全社会共享成果。

For the purpose of promoting barrier-free input ecology, Xiaomi and iFLYTEK Input method has launched a customized version of barrier-free input in 2021 with the goal of enabling everyone in the world to enjoy the beauty of technology. In April 2022, the MIUI OS will upgrade generalized barrier-free input, incorporating multilingual keyboards and supporting voice automatic screen reading, createing industry application cases, and share the results with the whole society.

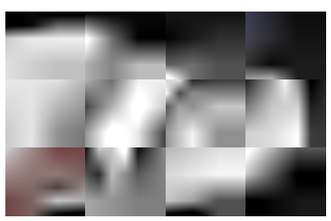
助力“适老化及无障碍专项行动”，使互联网使用场景从“可用”变“通用”

Contributing to the "special action of adapting to aging and accessibility", so that the Internet application scenarios becomes "universal" from "available"

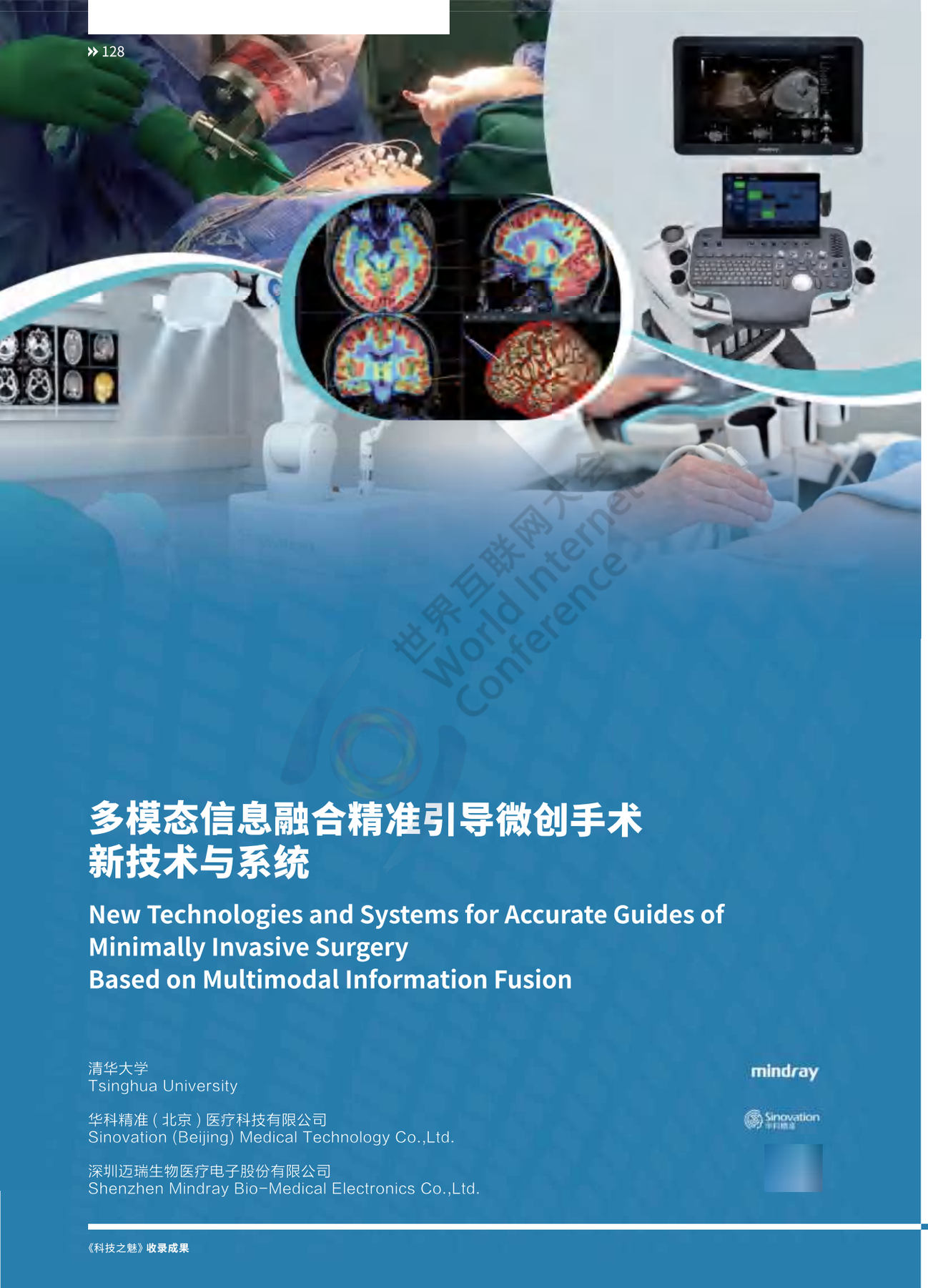
2010 年移动互联网发展初期，讯飞输入法率先推出中文语音输入，并成为主流输入方式，引领传统键盘汉字编码到智能语音的变革。这种高效便捷的输入法也是特殊群体“触网”中的迫切需求。智能手机用户庞大，每人每天花 30 分钟打字，语音输入至少节省 20 分钟，1 年约 120 小时。如果 2.6 亿老年人和 1700 万视障人士有 1 亿使用语音输入，那每年约能节省 120 亿小时。随着多模态智能交互技术成熟，智能终端厂商可内置讯飞输入法，以低成本实现广泛的无障碍人机交互。



OCR 迭代第四代识别框架下的超强扩展能力
The Super Scalability of OCR Iteration Under the Fourth Generation Recognition Framework



iFLYTEK Input method is the first to introduce Chinese voice input as a mainstream input method, transforming traditional Chinese character encoding onto intelligent speech. The "touch net" of special groups also urgently requires this type of efficient and convenient input. There are a significant number of smartphone users, and each individual spends 30 minutes typing a day. Voice input saves at least 20 minutes a day, which is 120 hours in one year. Each year, about 12 billion hours could be saved if 260 million elderly people and 17 million visually impaired people uses voice input. It is possible for intelligent terminal manufacturers to build in iFLYTEK Input to achieve a wide range of barrier-free human-computer interaction at a low cost.



多模态信息融合精准引导微创手术新技术与系统

New Technologies and Systems for Accurate Guides of Minimally Invasive Surgery Based on Multimodal Information Fusion

清华大学
Tsinghua University

华科精准（北京）医疗科技有限公司
Sinovation (Beijing) Medical Technology Co.,Ltd.

深圳迈瑞生物医疗电子股份有限公司
Shenzhen Mindray Bio-Medical Electronics Co.,Ltd.

引言

影像引导精准微创诊疗是现代医学重要的发展方向，项目发明了医学图像数字融合、精准手术规划、精准微创操作的核心技术，推进了微创诊疗新装备的发展，提升了手术精准化与智能化水平。

Introduction

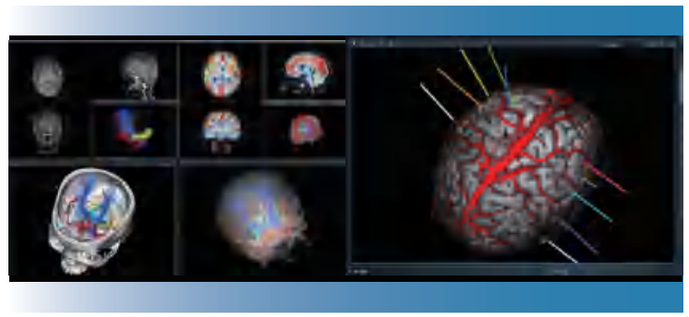
Modern medicine is moving in a significant direction toward image-guided minimally invasive diagnosis and treatment. This project has invented the core technologies of information fusion of multi-modality images, precise surgical planning, and precise minimally invasive operation, improving the precision and intelligence of surgery by developing new equipment for minimally invasive diagnosis and treatment.

发明影像引导精准微创诊疗新方法

The development of new procedures for the diagnosis and treatment of cancer using image-guided minimally invasive techniques

针对微创精准手术注册配准过程依赖手工操作的痛点问题，发明一系列医学影像建模计算与机器主动感知新方法。通过影像计算新技术，实现大脑多模态影像自动配准、无造影剂颅内血管成像与可视化、手术路径自动规划，形成多模态影像神经外科手术规划系统；率先发展用于神经外科手术机器人的单目多视角重建、结构光扫描等数字化跟踪方法，形成世界领先的面扫描注册技术，简化患者注册流程。独家的脑皮层和血管可视化技术，实现了安全手术规划。已形成一系列发明专利和研究论文，在立体定向手术机器人等创新医疗器械产品应用，自动化程度高，安全性好，达到国际先进。

This project has developed new methodologies of image feature extraction and active perception for the registration process of minimally invasive surgery. There have been several patents granted for core inventions. A new image computing technology has enabled the automatic registration of multi-modal images, the imaging and visualization of intracranial blood vessels without contrast agents, and the automatic planning of surgery, creating a multimodal neurosurgery planning system. As a result of the invention and development of digital tracking methods such as multi-view real-time surface reconstruction and structured light scanning for neurosurgery robots, the world's leading face scanning and registration technology greatly simplifies the registration process for patients. Safe surgical planning is made possible by the exclusive technology that allows for the visualization of the cerebral cortex and blood vessels. With the application of innovation to medical device products, such as stereotactic surgical robots, high levels of automation and safety can be achieved, reaching advanced international standards levels.



研发的医学影像建模和手术计划与手术机器人系统
Developed 3D image modeling and surgical planning systems

针对精准微创手术规划与引导，发明了多模态医学影像配准与融合成像新方法，在软组织运动跟踪补偿、跨模态影像融合与可视化方面形成了多项专利成果和研究论文，并在国际获奖。

New methodology of multimodal medical image registration and real-time fusion imaging have been developed. There has been a development of a new methodology for multimodal medical image registration and real-time fusion imaging. As a result of these methods, several patents and research papers have been developed in the areas of motion tracking and compensation of soft tissue, cross-modality image fusion and visualization, which have been awarded at international conferences.



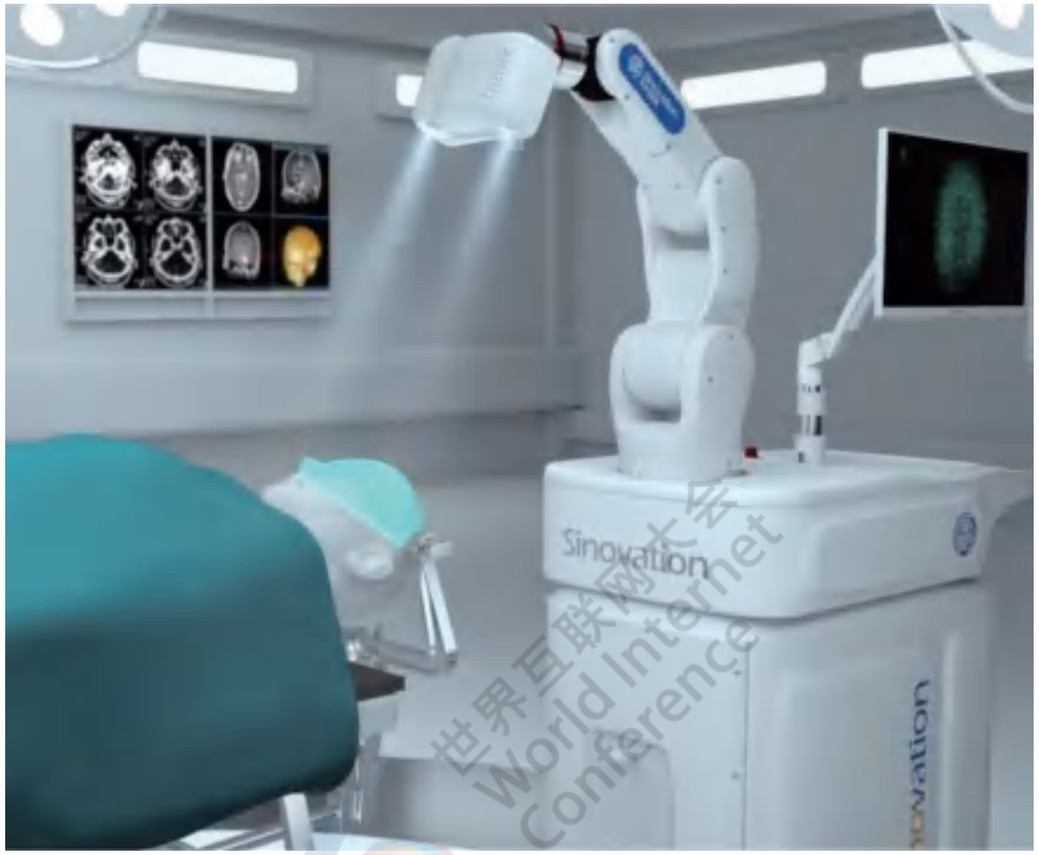
研发的跨模态影像融合超声成像系统
The Developed Cross-modal Image Fusion Technology and Application on Ultrasound Imaging System

技术发明在手术机器人系统、手术导航系统、超声融合成像产品中大规模应用，得到医生的好评并受到媒体的广泛关注。

The technological inventions have been used to develop robotic surgical systems, surgical navigation systems, and ultrasonic fusion imaging products. A number of doctors and media outlets have expressed concern about the innovative working procedures and products.

技术发明转化形成多个国际领先的医疗器械产品

Transforming technological inventions into internationally recognized medical devices



研发的手术计划与手术机器人系统
The Developed Surgical Robotic System

项目的技术发明已在多个医疗器械新产品研制和新功能开发中得到应用，转化到三个医疗器械产品上。分别由华科精准（北京）科技有限公司、深圳迈瑞生物医疗电子股份有限公司完成了产业化研发、医疗器械产品注册和推广应用。所研发的适用于儿童与成人的脑外科手术机器人系统，通过中国创新医疗器械特别审查通道，取得三类医疗器械注册证；所研发的超声融合成像系统具有在线运动建模和实时偏差补偿、呼吸矫正和人体移动矫正功能，达到国际先进，同时通过中国药监局、欧洲 CE、美国 FDA 等多国医疗器械产品注册认证的同类产品，进入国际市场。

New medical device products and new functions have been developed using the technical inventions. China's National Medical Product Administration (NMPA) has licensed three innovative medical devices.

Sinovation (Beijing) Medical Technology Co., Ltd. and Shenzhen Mindray Bio-Medical Electronics Co., Ltd. have completed the industrialization research and development, registration, promotion, and application of medical devices.

As of 2018, Sinovation has developed the brain surgery robot system for children and adults in China, which has been recognized by the NMPA of China as an innovative medical device product and has obtained a third-class medical device registration certificate.

The Mindray ultrasonic fusion imaging system has reached the advanced international level, with features such as online motion modeling, real-time deviation compensation, breathing correction, and human movement correction. The system has obtained the registration certification of medical device products in many countries, such as China NMPA, European CE and American FDA, and has entered the international markets of Europe, American and Asia.



提升产品数字化与智能化水平，精准治疗带来明显社会效益

Digitalization of products and an increase in intelligence level with obvious benefits for precise treatment

项目研发的神经外科手术机器人已在中国二十余个省市 130 多家医院应用，累计完成手术超 3000 例；研发的神经外科手术导航系统在中国几十家医疗单位应用，累计完成手术超过 1000 例。研发的融合超声成像系统在全球市场销售。

Over 130 hospitals in more than 20 provinces in China have already implemented the neurosurgery robotic system developed by the project. There have been more than 3000 successful neurosurgery operations. Over 1000 brain surgeries have been performed using the developed neurosurgery navigation system in dozens of medical units throughout the country.

临床实际应用证明，本项目的技术发明大幅提高了手术规划与术中定位的精度、便捷性与安全性，减少手术创伤和风险。发明的方法和高性能产品，为医生提供了开展微创精准治疗的数字化、智能化新装备，得到临床医生充分认可，国内外同行对项目创新性成果和产品都给予高度评价。

A variety of models of the developed ultrasound fusion imaging system have been sold in the global market to meet the needs of the customers.The inventions developed in this project have been clinically proven to significantly improve surgical planning accuracy, convenience, and safety, and reduce surgical trauma and risks. Methods and products invented by the clinic have been fully recognized by clinicians, allowing them to provide minimally invasive and precise treatments with new and high-performance digital and intelligent equipment. This project has been recognized by both domestic and international counterparts for its innovative achievements and products.





所研发产品系统在临床中的应用
The Clinical Application of the Developed Products

量子计算全球开发者平台

Quantum Computing Global Developer Platform

合肥本源量子计算科技有限公司
Hefei Origin Quantum Computing Technology Co.,Ltd.

本源量子 ORIGIN QUANTUM

引言

量子计算全球开发者平台是 “经典－量子”协同的量子计算开发和应用示范平台，后端同时接入超级计算机和量子计算机服务，为将华东地区打造具有全球影响力的量子中心贡献力量。该平台面向全球量子计算爱好者和开发者，提供全面丰富的量子计算服务。

Introduction

The Quantum Computing Global Developer Platform is the first "classical-quantum" collaborative platform for quantum computing development and application demonstration in China, which has back-end access to both supercomputer and quantum computer services and contributes to the establishment of a quantum center with global influence in Eastern China. The platform provides comprehensive services for quantum computing enthusiasts and developers worldwide.

量超结合 革新发展

Combining quantum computers and supercomputers for joint development

目前中国已有大量线上云平台可以向用户提供超算服务，然而可以提供量子计算服务的平台却寥寥无几，后端可以接入量子计算真机的平台在此前尚未出现。而量子计算全球开发者平台通过云端服务模式，后端同时接入超算和量子计算机真机，提供强大的算力支持，快速赋能全球从业者、开发者成为量子编程专业开发者，在开发端实现快速生成、高效开发，孵化量子计算企业创新创业，支持新技术、新产品的创新应用及更新迭代，发挥量子计算全球开发者平台的应用示范效应，推进全球量子产业创新创业与发展。

At present, China has a large number of online cloud platforms that can provide supercomputing services to users, but there are only a few platforms that can provide quantum computing services, and the platform that can access the real machine of quantum computing in the back end has not appeared before. Through the cloud service mode and based on the platform algorithm model, the Quantum Computing Global Developer Platform quickly empower practitioners and developers to become professional in quantum programming. With rapid generation and agile development, the platform incubates quantum computing enterprises for innovation and entrepreneurship. By updating iteration, the Quantum Computing Global Developer Platform plays a role in demonstrating applications and promoting the innovation and entrepreneurship of global quantum industries.

量子计算全球开发者平台主要包含开发工具、在线编程、行业应用和教育科普四大模块，从而满足不同用户的不同需求，具有创新性的革新。

The Quantum Computing Global Developer Platform mainly contains four modules: development tools, online programming, industry applications, and education and science popularization, thus meeting the different needs of different users. The following is a brief introduction of the four modules.



量超结合的运作模式
A Combined Quantum Computer and Supercomputing Operating Model



真实量子计算机服务和超算提供的虚拟量子计算机服务
Real Quantum Computer Services and
Virtual Quantum Computer Services Provided by Supercomputers

全球推广 收获口碑

Promoted globally and gained a good reputation

量子计算全球开发者平台一经上线，迅速受到全球各界的热烈关注。

Once the Quantum Computing Global Developer Platform was launched, it quickly received keen attention from all walks of life worldwide.

平台成为首届 CCF “司南杯”全球量子计算编程挑战赛的专用平台，吸引全球近 700 支队伍参与报名，首届大赛目前已圆满结束。

The platform became the dedicated platform for the first CCF "Origin Pilot Cup" Global Quantum Computing Programming Challenge, attracting nearly 700 teams worldwide to participate in the competition, and the first competition was completed.

平台成为中国高校量子计算教研一体化平台，量子计算全球开发者平台集体系化课程资源、量子计算实训产品于一体，满足学校教学、学生学习和实践实训需求。本源量子已与中国境内近 50 所高校建立合作关系，目前在和中亚、西亚、东欧等多所高校进行接触，探究全球领域的合作。

Quantum Computing Global Developer Platform has become an integrated platform for teaching and researching quantum computing in Chinese universities, which integrates systematic curriculum resources and practical training products to meet the needs of teaching, learning, and training of quantum computing. Origin Quantum has established partnerships with nearly 50 universities within China and is currently in contact with several universities in Central Asia, West Asia, and Eastern Europe to explore cooperation in the global arena.

平台也已成为全球量子计算交流合作平台。量子计算全球开发者平台已与亚洲和欧洲地区的数家企

业形成商业合作，潜在的其他国际客户也在积极开发，响应“一带一路”的号召，复制中国市场策略，推动量子计算全球开发者平台在全球的占位发展。

The Quantum Computing Global Developer Platform has also become a global platform for quantum computing exchange and cooperation. The platform has already cooperated with several companies in Asia and Europe, and other potential international customers are also actively developing. In response to the call for "One Belt, One Road", Origin Quantum replicates the Chinese market strategy and promotes the global positioning of the Quantum Computing Global Developer Platform.



“司南杯”大赛专用平台
Dedicated Platform for "Origin Cup" Competition

合作共赢 共创生态

Collaborating with individuals, companies, and institutions to build a quantum ecosystem

量子计算全球开发者平台作为面向全球开放服务的量子计算开发平台，开创性的为个人、企业、科研机构等各层面的用户提供学习、协作和创新的服务。

As the first quantum computing development platform with open services for the world, the Quantum Computing Global Developer Platform is a pioneering service that provides learning, collaboration, and innovation for users at all levels, including individuals, enterprises, and research institutions.

该平台整合企业资源，和金融、生物、化学、人工智能、工业设计等多个行业的领先企业进行深度合作，目前已经将部分研究成果转化成量子计算相关应用并在平台上架。

The platform integrates enterprise resources and cooperates deeply with leading enterprises in finance, biology, chemistry, artificial intelligence, industrial design, and other industries, and has already transformed some research results into quantum computing-related applications and shelved them on the platform.

量子科普 人才培养

Conducting quantum science education and personnel training

面向量子计算研发从业人员、爱好者，通过自主知识产权的量子计算平台，着重满足科学研究领域的学习训练需求，满足量子教育领域人才培养需求、为中国培养优秀的量子计算编程人才，引导量子计算领域发展潮流，制定量子计算领域的全国标准以及国际标准，让量子行业研发人员熟悉并追随我们的发展轨迹。

The Quantum Computing Global Developer Platform has independent intellectual property rights and is aimed at quantum computing R&D practitioners and enthusiasts, focusing on meeting the needs of learning and training in scientific research. We will meet the needs of cultivating talents in the field of quantum education and cultivate excellent quantum computing programming talents for China. Origin Quantum will continue to lead the development trend in the field of quantum computing and develop national and international standards in the field of quantum computing so that quantum industry R&D personnel will be familiar with and follow our development trajectory.



和企业共同开发量子计算相关行业应用，可供用户体验
Work with Companies to Develop Quantum Computing-related Industry Applications that are Available for User Experience



量子计算教育板块
Quantum Computing Education Segment

个性化语音增强技术

Personalized Speech Enhancement

腾讯天籁实验室
Tencent Ethereal Audio Lab



引言

疫情以来远程办公兴起，而噪声消除对通话质量至关重要。针对周围干扰人声难以消除的难题，腾讯会议天籁实验室提出个性化语音增强技术，模拟人类听觉机制，抑制周围人声干扰凸显主讲人声音，将该技术实际落地。

Introduction

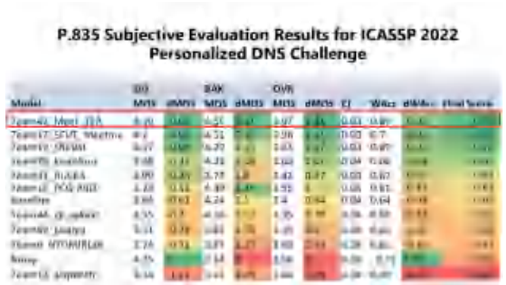
The COVID-19 pandemic has made remote meetings an essential part of our daily lives. The importance of speech enhancement for maintaining high speech quality during remote meetings cannot be overstated. Nevertheless, conventional speech enhancement algorithms do not work well when it comes to suppressing the voice of interference speakers. Towards addressing this issue, Tencent Ethereal Audio Lab, under Tencent Meeting, has proposed a new feature -- "Personalized Speech Enhancement" -- which aims to emphasize the target speaker's speech from a complex multi-talker noisy and reverberant observed signal using the enrollment speech of the target speaker.

夺取 DNS 国际大赛第一名

First place in the international well-known DNS challenge

腾讯会议旗下天籁实验室的个性化语音增强技术在 Interspeech，ICASSP 等国际会议上发表多篇论文，在 ICASSP DNS 2022 国际权威个性化语音增强比赛获得第一，在语音质量分 MOS 上提升达到 1.41，处于国际领先地位。个性化语音增强技术能进一步提升用户的听感体验，但因模型大小限制，实时性，运算速度等限制，在 RTC 产品应用中落地，并非易事。腾讯会议天籁实验室专家不懈努力，勇于探索，使用了大量的语料信息作为训练素材，反复测试后才完成研发上线，成功将该技术落地到产品应用。目前该技术已上线于腾讯会议中，让用户在居家、办公等多种存在干扰人的场景下享有更清楚、更舒适的通话体验，大大提升远程交流效率。

As part of its efforts on personalized speech enhancement, Tencent Ethereal Audio Lab has published a number of papers at top international conferences in the audio area, such as Interspeech and ICASSP. It is well known that Tencent Ethereal Audio Lab's submitted personalized speech enhancement system achieved first place in track 2 of the prestigious ICASSP 2022 DNS challenge, improving the speech quality around 1.41 MOS, and places in the international lead. The application of personalized speech enhancement to real-time communication (RTC) products is not easy due to limitations in model size, processing time, and real-time requirements. Using huge amount of speech data as training data, the researchers in Tencent Ethereal Audio Lab engaged in the practice and innovated, repeatedly tested the system, and finally successfully implemented our customized speech enhancement technology in Tencent Meeting, the RTC product.



ICASSP DNS 2022 个性化语音增强比赛排名，
红框为腾讯天籁实验室系统结果
The Results of Track2 of ICASSP 2022 DNS challenge.
The Red Rectangle Frame is
the Result of the Submitted System
by Tencent Ethereal Audio Lab

成功落地到腾讯会议中

Successful Application to he Tencent Meeting

个性化语音增强技术能在消除环境噪声的基础上，进一步消除周边人声干扰并突显主讲人声音。此技术对于在线会议，云游戏场景，客服场景等都是比较有效的，目前已经成功应用到腾讯会议上，也将被应用在腾讯会议天籁音频模组上及残障人士使用的助听器等公益项目中，创造更大的社会价值。

Personalized speech enhancement eliminates not only the noise but also suppresses the voices of interference speakers to highlight the voice of the target speaker. It is the general understanding that Tencent Ethereal Audio Lab is the first company to launch this new technology on the RTC product and successfully implement it on the Tencent Meeting App. Besides web meetings, this technology can also be used for cloud gaming, custom services, etc. By incorporating this technology into the Tencent Ethereal Audio Lab and hearing aid devices, Tencent Ethereal Audio Lab will be able to create more social wealth for society as a whole.

该技术在腾讯会议上的使用流程如下图：

According to Figure 2 and Figure 3, this is the instruction manual for personalized speech enhancement on the Tencent Meeting App:



环境监测和声纹注册
Background Noise Detection and Speaker Enrollment



使用腾讯会议 App 启用个性化语音增强功能
Enable the New Feature --
“Personalized Speech Enhancement” in Tencent Meeting App



腾讯会议支持合作伙伴列表（部分）
The List of Collaborators Supported by
Tencent Meeting(Partial)

助力新冠疫情下的远程办公

Boost the telecommuting under COVID-19 pandemic

目前个性化语音增强技术已经在腾讯会议上为用户打造更加干净、纯粹的沟通体验。目前腾讯会议用户数已突破 3 亿，服务范围覆盖全球 220 多个国家和地区，已广泛服务于政务、金融、教育、医疗等行业和中小企业高效在线办公，为全球用户提供高清流畅、便捷易用、安全可靠的云视频会议服务，并已为海内外多个大型重要活动提供了稳定、流畅的在线会议音频技术支持与专业可靠的通信保障服务，包括全国两会、广交会、上海国际青年学者论坛等。相信随着个性化语音增强技术的推广，其将更好的提升用户体验，产生更大的社会效益。

Tencent Meeting currently offers users a high-definition, pure and smooth audio communication experience by utilizing personalized speech enhancement. With more than three hundred million users, Tencent Meeting already covers around 220 countries and regions, offering a wide range of services in digital government, digital finance, online education, telemedicine, and remote work for small and medium businesses. Tencent Meeting provides clear, flexible, secure and reliable audio-video conferencing experiences, and has already provided stable, smooth and professional services at numerous large and important international events, including the National People's Congress and the Chinese People's Political Consultative Conference, the Guangzhou Export Commodities Fair, and the Shanghai International Forum for Young Scholars. As personalized speech enhancement technology becomes more popular, the user experience will be greatly enhanced and social benefits will increase.

中国移动 5G+ 空天地一体化应急通信系统

China Mobile 5G and Space-Air-Ground Integrated Emergency Communication System

中移（成都）信息通信科技有限公司
China Mobile Chengdu Institute of Research and Development

中航（成都）无人机系统股份有限公司
AVIC（CHENGDU）UAS Co.,Ltd.

西安电子科技大学
Xidian University

引言

针对重特大自然灾害发生时的短路、断电、断网的“三断”场景，中国移动联合中航工业、西安电子科技大学创新性研发出中国具备完全自主知识产权并投入商业运营的 5G+ 空天地一体化应急通信系统，并在国际首次在自然灾害中实现应急通信大面积快速恢复。用科技保障人民群众的生命安全，成为应急救援的重要保底手段。

Introduction

Accordingly, China Mobile, in cooperation with AVIC and Xidian University, has developed an innovative 5G+ Space-Air-Ground Integrated Emergency Communication System with fully independent intellectual property rights in response to the scenario of "three disruptions" (electricity, traffic, and mobile communication) resulting from extreme and severe disasters. The system has been placed into commercial operation and has been innovatively developed. Additionally, for the first time in the international community, emergency communications were established in a large area of rapid recovery following a natural disaster. Science and technology have become an important means of ensuring the safety of people's lives during times of crisis.

国际上首次解决“三断”灾害场景的大面积应急通信快速恢复难题

In the scenario of "three disruptions," we have solved the problem of rapid recovery of emergency communications over a large area for the first time in the world

为解决极端灾害“三断”场景下的快速应急通信大面积恢复问题，中国移动构建以“高空、中空、低空、地面”四位一体的空天地一体化应急通信体系。突破空对地信号连续覆盖关键技术，在业界首次提出空对地无线网络连续覆盖算法，创新性地提出结合无人机飞行参数的天线挂装方案和飞行方案，实现了无人机在快速移动中对指定区域空对地连续信号覆盖，并已授权发明专利。创新性地自主研发空中信道传播模型，创新性研发高空高速运行状态下多普勒效益的抑制技术。依托创新技术实现了大型固定翼无人机应急通信系统空对地连读覆盖面积超过 60 平方公里，中型无人机应急通信系统对地信号连续覆盖面积超过 70 平方公里。该成果具备完全自主知识产权并已投入实战化运行，进一步丰富了中国应急救援手段，提升应对不同灾害类型的应急通信保障能力，同时也为全球应对自然灾害提供了新思路、新方向。

China Mobile has developed a four-level, three-dimensional Space-Air-Ground integrated emergency communication system that supports high altitude, medium altitude, low altitude, and ground altitude communications in extreme disaster scenarios. The technology of continuous air-to-ground signal coverage has been a breakthrough. For the first time in the industry, a continuous air-to-ground wireless network coverage algorithm has been proposed to enable drones in rapid motion to continuously cover designated areas with air-to-ground signals. As part of the innovative approach, we proposed an antenna mounting scheme and a flight scheme that combine UAV flight parameters.iInnovatively develop the air channel propagation model independently, and innovatively develop the suppression technology of Doppler benefit under high-altitude and high-speed operation.The air-to-ground continuous coverage area of large fixed-wing UAV emergency communication systems exceeds 60 square kilometers based on the innovative technology, while the continuous coverage area of medium-sized UAV emergency communication systems exceeds 70 square kilometers based on the innovative technology. Moreover, the achievement has completely independent intellectual property rights and is currently being used in actual combat operations. Assisting the country to improve its emergency communication capacity in the face of different types of disasters and realizing modern development in emergency rescue capacity by addressing the capacity gap in the field of emergency communication in China.



大型固定翼无人机应急通信系统架构图
The architecture diagram of China Mobile's UAV emergency communication system

广泛参与应急实战救援，打通人民群众通信“生命线”

Participation by a wide range of people in emergency rescue has opened up the "lifeline" of communication for people

该成果已多次应用于应急救灾实战。2021 年 7 月 20 日，河南突发罕见特大暴雨，人民的生命及财产受到了严重的威胁。在工信部、应急部的指导下，中国移动基于大型固定翼翼龙无人机平台的空天应急通信系统跨越 3 战区 4 省 1200 公里抵达河南重灾区。在救援期间，累计接入用户 5953 个，产生流量 1.14GB，单次最大接入用户 648 个，短信提醒发送有效号码 2704 个，持续恢复通信 6 个小时，在抢险救援中发挥了不可替代的重要作用。那条“米河镇的乡亲们，中国移动空中基站抵达你镇上空 …”的短信刷爆了全国人民的朋友圈，为灾区群众及救援队伍提供了应急通信保障，被国内外主流媒体广泛报道。该成果在四川泸定地震、云南哀牢山搜救、四川平武山洪等灾害中也发挥了重要作用。

The Henan Province was hit by a rare heavy rainstorm on July 20, 2021, which caused serious damage to people's lives and property. China Mobile's UAV emergency communication system has been deployed across four provinces, 1200 kilometers, under the guidance of the Ministry of Industry and Information Technology and the Ministry of Emergency Management.

In the rescue period, 5,953 people accessed the public network, generating traffic of 1.14GB, with a maximum of 648 users logging onto the network simultaneously. 2,704 SMS alerts were sent to 2,704 effective numbers, and mobile communications were continuously restored for 6 hours, contributing to the rescue and relief effort in an irreplaceable and important way. It was stated in the text message, "Mihe town folks, China Mobile UAV emergency communication system has arrived over your town..." The text message went viral on the WeChat Moments of the whole country and provided an emergency communication guarantee for people and rescue teams in the disaster area, as widely reported by mainstream media both domestically and abroad.

Furthermore, the achievement has played an important role in disasters such as the earthquake in Luding, Sichuan,the search and rescue in Ai Laoshan Mountain in Yunnan, the flash flood in Pingwu.

经济和社会效益巨大，对中国应急救援现代化建设具有引领作用

The economic and social benefits are substantial, and it plays an important role in modernizing China's emergency rescue system

中国移动 5G+ 空天地一体化应急通信系统作为新技术、新手段为中国政府、企业客户提供信息化、现代化的应急能力与服务。项目已落地覆盖中国二十余省市自治区及希腊等海外国家。该成果已累计参与相关实战救援、应急演练四十余场，累计参与各类保障时长达数千小时，范围覆盖河南、重庆、四川、贵州、辽宁等全国 10+ 省份，为中国人民群众的生命安全保障贡献了坚实力量，经济社会效益巨大。

China Mobile's 5G + Space-Air-Ground Integrated Emergency Communication System provides information and modern emergency rescue capabilities and services for Chinese government and corporate customers. Over 20 provinces in China and other countries, such as Greece, have implemented this technology. Over 40 relevant emergency rescue exercises have been conducted in more than 10 provinces in China, including Henan, Chongqing, Sichuan, Guizhou, and Liaoning. As a result, it contributes significantly to the safety and security of the Chinese people. There are considerable economic and social benefits to be gained.



超高清沉浸式视频制播技术创新及应用

Innovation and Application of UHD Immersive Video Production and Broadcasting Technology

咪咕文化科技有限公司
Migu Culture Technology Co.,Ltd.

引言

中国移动咪咕公司以 5G 端到端产业为核心，与 AICDE 能力多层融合，在超高清直播各环节中沉淀多项技术创新，积累相关专利 100+ 项。2019 年至今通过技术能力共计支撑“5G+4K+VR”超高清直播 28000+ 场，现已成为超高清视频行业领先的视频平台。

Introduction

In the field of live broadcasting, China Mobile MIGU has developed a number of technological innovations and has accumulated more than 100 patents. To date, we have conducted more than 28,000 live broadcasts of "5G+4K+VR", laying the foundation for the long-term development of the UHD video industry in China.



技术创新点

Technology Innovation

5G 即时电影拍摄技术

融合“超低延时 5G 直播”+“广播级远程制作”+“电影级实时调色”等制播技术实现全球首创 5G 即时电影拍摄的整体解决方案，为大型演出和室内演出开创全新的艺术呈现模式。

5G instant cinematography technology

Using a unique combination of "ultra-low latency 5G live streaming" + "broadcast-grade remote production" + "cinematic real-time color grading" and other broadcast technologies, we are introducing the world's first 5G live cinematography.



5G 即时电影拍摄方案与传统方案的对比
5G Instant Cinematography Solution Versus Traditional Solution

全程 5G 网络下真 4K 直播生产解决方案

面向场馆直播服务场景，从现场导播车直播信号输出，至 4K 演示电视机接收直播信号，实现全程 5G 网络下真 4K 直播生产解决方案。

Real 4K live production solution over a full 5G network

During the live production scenario at the venue, from the live signal output of the on-site guide car to the live signal received by the demonstration TV set in 4K, the entire 5G network will be realized under the real 4K live production solution.

异构网络传输的复合场景式视频分布式处理技术

通过异地制播、异构网络传输的视频分布式处理技术，实现多屏同看、云观众、云包厢、大 V 解说等多种直播业务场景服务能力。

Composite scenario-based video distributed processing technology for heterogeneous network transmission

It is possible to realize multiple live screens on one screen, cloud audience, cloud room, and other live business scenarios through heterogeneous production and broadcast, heterogeneous network transmission of video distributed processing technology.

实现热点赛事内容亿级用户并发服务技术

针对世界杯、奥运会等超级热点，优化三级内容分发架构，实现基于 DM-Cache、在快速抽取索引和 LRU 算法淘汰的基础上实现视频直播文件缓存及服务性能提升，通过全链路主备回源策略、自学习重试回源机制、HTTP DNS 服务等 CDN、终端协同机制，提供全国全网亿级用户并发服务解决方案。

Billion-user concurrent service technology

During the World Cup, Olympic Games, and other hot events, MIGU technical team has improved live video file caching and service performance by optimizing the three-level content distribution architecture based on DM-Cache, fast extraction index, and LRU algorithm elimination. Applying CDN and terminal collaboration mechanisms such as full-link main backup back-source strategy, self-learning retry back-source mechanism, HTTP DNS service, etc., we provided a solution for concurrent service for billion of users across the network

AI 直播智能字幕生产技术

通过提升底层算法模型转写效果及字幕抗干扰能力，攻克体育赛事直播场景复杂的技术难题，实现大型国际赛事直播 AI 字幕规模化商用。

AI live caption production technology

The large-scale commercialization of AI subtitles for large international events live nationwide has been achieved by improving the transcription effect of the underlying algorithm model and the anti-interference capability of subtitles. This has overcome the technical challenge of complex live sports event scenarios.

双屏直播同看解决方案

赛事 – 电商双屏直播同看作为一个新型观赛方式，在大型赛事直播上，实现异流双直播的产品形态、助力“场景 + 内容 + 运营”模式，实现边看边播边买的沉浸式用户体验。电商直播整体采用 SaaS 的设计模式，团队以 sdk 方式轻量嵌入到咪咕视频端内，实现端内异流直播。

Dual screen live viewing solution

With this new means of watching the game, dual live streaming will be achieved in the live broadcast of large events, and it will enable users to have a seamless experience of watching while broadcasting and making purchases online simultaneously.

应用场景

Application Scenarios

2019 年起，本成果已成功应用于舞台艺术、演艺、博物馆、体育等领域，支撑了 “4K+5G” 影院直播《天路》、鼠年春晚、欧洲杯、东京奥运会，北京冬奥会全量全场次超高清直播冰雪赛事等多场成功的 5G+4K+AI 超高清直播。截止 2021 年底，咪咕聚合体育 IP 内容已超过 30+，全年赛事场次 8000+，日均场次 20+，涵盖欧洲五大联赛、CBA、NBA、UFC 等丰富多样的体育赛事。

This technology has been successful applications in stage arts, performing arts, museums, sports, and other areas including dance drama "Sky Road" live in "4K+5G" theater, European Cup, Tokyo Olympics, Beijing Winter Olympics, etc. since 2019.

MIGU will aggregate more than 30 sports IP contents by the end of 2021, with more than 8,000 events per year and more than 20 events per day, covering the five major European leagues, the CBA, NBA, and UFC.



AI 直播智能字幕
AI Live Intelligent Subtitling

社会和经济效益

Social and economic benefits

中国移动咪咕公司通过多项技术创新践行央企担当，提升北京冬奥影响力，赢得巨大声誉；推出更具人文关怀的观赛环境“为了听不到的你”智能 AI 字幕功能，以创新科技服务全球超 4 亿听力受损人群；牵头 20 余项、主导或联合发布国际标准 40 余项，并担任了 W3C 标准组织中第一个运营商出身的联合主席，助力超高清全行业快速发展，形成 5G 产业示范。

Through several technical innovations, the China Mobile MIGU company has enhanced the influence of the Beijing Winter Olympics, established artificial intelligence captioning, and provided innovative technology to over 400 million hearing-impaired individuals worldwide. The company has also earned a good reputation in the country. Over the course of its history, MIGU has led or co-led more than twenty international standards or jointly released more than 40 international standards, and has served as the first co-chair of the W3C standards organization of operator origin, contributing to the rapid development of the UHD industry as a whole.

端边云协同的分布式物联网操作系统“CTWing OS”

CTWing OS, a Distributed IoT Operating System with End-Edge-Cloud Coordination

天翼物联
Esurfing IoT

引言

“CTWing OS”是一款由中国电信天翼物联自主研发的分布式物联网操作系统。该系统全面满足固移融合、宽窄结合的海量物联网接入需求，支持亿级超大规模终端安全接入，为数字化应用提供一站式开发部署环境，赋能产业数字化转型升级。

Introduction

The CTWing OS is a distributed IoT operating system developed by ESurfing IoT Tech Co., Ltd of China Telecom, which supports fixed-mobile convergence, massive IoT network access under the wide-narrow bands combination, and secure access for hundreds of millions of large-scale terminal devices. Through the CTWing OS, the industry is provided with a single development and deployment environment for a variety of digitalized applications, promoting an upgrade to digitalization.

聚焦物联网规模化发展复杂性与便捷性难题，解决云边端海量异构资源解耦、亿级超大规模终端安全接入与实时感知、超大规模数据解析、跨行业应用敏捷开发等关键技术和工程问题，系统核心技术指标行业领先

An industry-leading operating system, CTWing OS aims to solve the key technical challenges associated with the complex development of large-scale IoT applications, as well as the massive decoupling of cloud-edge-end heterogeneous resources, secure access to large-scale terminal devices, real-time perception, large-scale data analysis, and agile application development across industry lines, with core systematic specifications leading in the industry

CTWing OS 聚焦解决物联网规模化发展中的终端碎片化、应用长尾化、网络制式多样化、平台种类多样化、边缘形态多样化等难题，率先提出一种基于云原生的分布式物联网操作系统体系架构，解决云边端海量异构资源解耦，支持海量异构资源的协同调度管理。

CTWing OS aims to solve the problems of large-scale development complexity in the IoT industry, such as terminal fragmentation, long tail applications, network diversification, IoT platform differences, IoT edge differences, etc. Using cloud-native technology, the operating system proposes a new type of distributed IoT operating system architecture to manage and decouple massive cloud-edge-end heterogeneous resources.

该系统创新研发海量连接会话信息采集模型和连接业务控制引擎，支持超大规模物联网亿级实时连接管理；通过会话实时调度与处理、低功耗端云对接等机制，支持亿级超大规模终端的安全可靠接入；利用轻量级终端物模型和海量消息推送框架，实现海量物联网异构终端数据与应用的实时交互，支持亿级终端规模下消息的高效实时推送。

As part of the CTWing OS, considerable amount of connection session information collection model and connection service control engine have been proposed and the multimodal communication module automatic management will support tens of millions of IoT connections. Additionally, real-time session scheduling, and low-power device-cloud interaction have been proposed to ensure that hundreds of millions of super large-scale IoT terminal devices can be accessed in a secure and reliable manner. The system provides the capability of interacting in real time with applications and data of massive IoT heterogeneous terminals and to provide high-efficiency messages notification in real-time among large-scale terminal devices by utilizing its lightweight terminal Thing Model and massive message notification framework.

中国通信学会于 2021 年 10 月 15 日对本项目组织了科技成果评价，主任委员、副主任委员分别由中国科学院院士、中国电子学会物联网委员会主任，中国通信学会物联网委员会主任担任，评委会成员一致认为 CTWing OS 在分布式物联网操作系统技术与应用方面达到国际先进水平，应用前景广阔。

An evaluation meeting of scientific and technological achievements for the CTWing operating system was organized by the China Institute of Communications on October 15, 2021. This evaluation committee was chaired by an academician of the Chinese Academy of Sciences, the IoT Committee of the Chinese Institute of Electronics, and the IoT Committee of the China Institute of Communications. According to the evaluation committee, CTWing OS is the international leader for the technology and application of a distributed IoT operating system that can be applied to a wide range of applications.



CTWing OS 应用成果亮相
2021 国际数字科技展
暨天翼智能生态博览会
CTWing OS shows at the 2021
International Digital Technology Expo

服务全球海量 NB-IoT 用户群，携手共创智能数字化新时代

Serve the world's massive NB-IoT users, and work together to create a new era of intelligent digitalization

CTWing OS 依托中国电信云网融合能力底座，面向千行百业提供新型物联网基础设施，开展了大规模工程实践，形成了面向复杂行业场景的天翼云原生服务典型示范，打造了深圳南山数字孪生、广东美的智能制造、武汉疫情防控等一批标杆应用。

Based on China Telecom's cloud-network convergence infrastructure, the new IoT platform has been developed with the CTWing operating system and has been well received by the industry. Numerous industry leading applications and solutions have been developed, including the digitalized application for Nanshan in Shenzhen, the smart manufacturing solution for Midea in Guangdong, and the COVID-19 prevention and control system in Wuhan.

目前，CTWing OS 已服务全网超 3.6 亿物联网用户，管理超 1.2 亿物联网智能终端。中国电信 5G NB-IoT 用户率先破亿，其中，智能燃气连接规模超 6200 万，智能水务连接规模超 5100 万。

So far, the CTWing OS has served more than 360 million IoT subscribers and 120 million IoT intelligent terminal devices. China Telecom has taken the lead in the amount of 5G NB-IoT subscribers of more than 100 million. It possesses 62 million connections of smart gas IoT device connections, and 51 million smart water IoT device connections.

CTWing OS 依托天翼物联产业联盟，开发者大赛，物联网联合开放实验室等创新生态，加快推动产业集聚，加速物联网产业向规模化、集约化、高价值发展，携手生态合作伙伴共创智能数字化新时代。

It is facilitated by the CTWing OS and its ecosystem to congregate the industry partners in the new IoT ecosystem, which includes the E-Surfing IoT industrial alliance, the IoT development competition, and the IoT open laboratory. As a result of the IoT industry's move towards large-scale, high-integration, and high-value development, we will be cooperating with partners to develop the next generation of intelligent digitalization.



深圳燃气场站
5G+AI 摄像头
the 5G+AI Camera
in the Shenzhen Gas Corp’s Factory



助力美的集团建成
全流程互联互通的透明工厂
Helps Midea Group Build a Transparent
Factory With Full-process Connectivity

服务产业生态，加速行业数字化转型，共创数字价值

Serving industry ecology, accelerating industry digital transformation, and creating digital value together

CTWing OS 提供物联网与 5G、AI 等技术深度融合的应用与解决方案，全面赋能智慧城市、智能制造、社会民生等领域数字化转型升级。

With CTWing OS, IoT applications and solutions are deeply integrated with 5G, AI, and other leading technologies to help build smart cities, smart manufacturing, livelihoods, and other IoT digitalization upgrades.

在城市治理方面，CTWing OS 助力深圳市南山区打造 5G+ 数字孪生感知平台，全方位提升南山区城市治理水平。

CTWing OS was able to assist Shenzhen Nanshan district in building the 5G+ digitalized perception platform, which enhanced city management in Nanshan.

在智能制造方面，CTWing OS 服务石油石化、工矿企业、家电制造等超 1000 万工业互联网用户，加快数字化转型升级。

With regard to smart manufacturing, CTWing OS has assisted more than 10 million industrial internet users, including those in the petroleum and petrochemical, mining, and appliance manufacturing industries, to upgrade to digitalization.

在社会民生领域，CTWing OS 通过在社区、医疗、养老等重点领域和场景的应用部署，服务社会民生，助力人民美好生活。

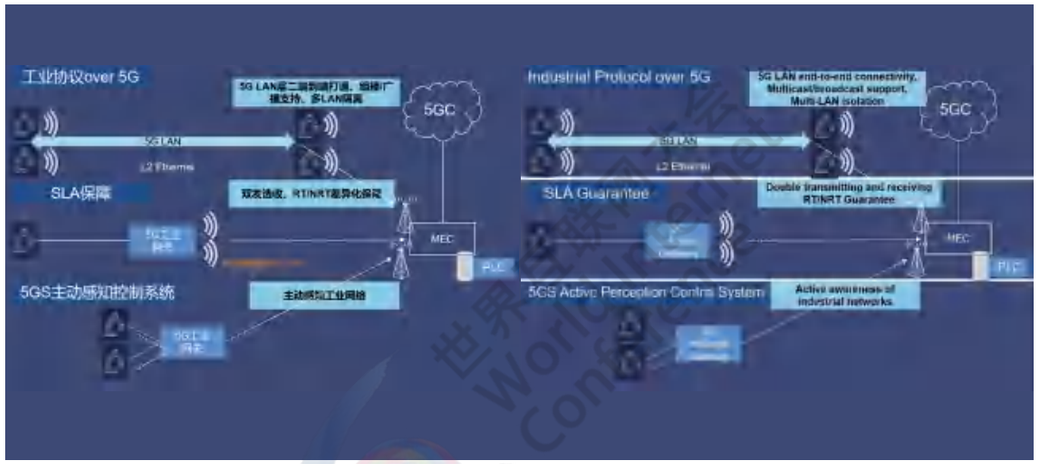
On the issue of people's livelihood, CTWing OS provides applications for community, medical, retirement and other important aspects of people's lives.

工业 5G Advanced 的网络系统

Industrial 5G-Advanced Network System

中国科学院沈阳自动化研究所
Shenyang Institute of Automation (SIA), Chinese Academy of Sciences

华为技术有限公司
Huawei Technologies Co.,Ltd.



引言

5G 与工业自动化的深度融合，可提升网络连接力和稳定性，打造未来工业连接新架构，支撑未来全连接智慧工厂，成为第四次工业革命的核心引擎。沈自所和华为研发工业 5G Advanced 系统，实现 5G 技术和工业内网的网络融合。

Introduction

With a deep integration of 5G and industrial automation, network connectivity and stability can be improved, a new architecture for industrial connectivity can be created, smart factories can be fully connected, and the fourth industrial revolution can be accelerated. With the assistance of the Shenyang Institute of Automation, the Chinese Academy of Sciences, and Huawei, an industrial 5G-Advanced system will be developed, which will allow integration of 5G technology with an industrial intranet network.

工业 5G Advanced 系统通过数据技术、运营技术、信息技术和通信技术的融合创新，传输可靠性从 99.9% 提高到 99.99%，端到端时延从 10ms 以上降低到 4ms，指标达到国际先进水平

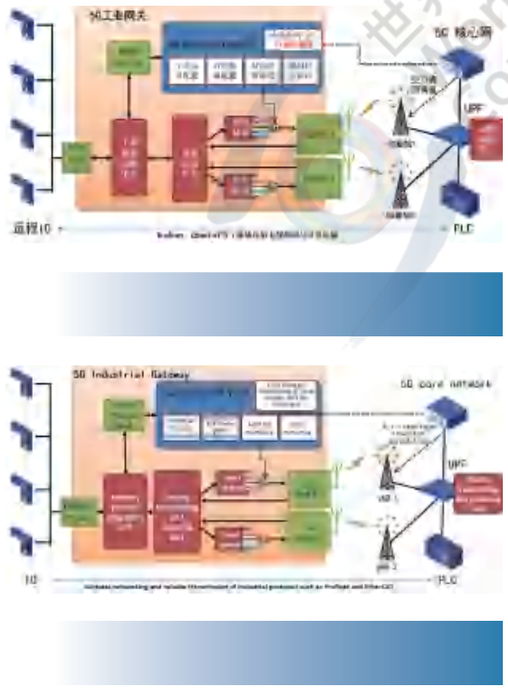
The industrial 5G Advanced system has improved transmission reliability from 99.9% to 99.99% through the integration and innovation of information technology, operation technology, and communication technology. The end-to-end delay has been reduced from more than 10ms to 4ms as a result. As a result, the indicators have reached an advanced level on an international basis

工业 5G Advanced 系统通过对数据技术、运营技术、信息技术和通信技术进行融合创新，实现 5G 内生智能，能够协调工业协议，实现工业生产高可用，并支持云 PLC 等工业应用，降低现场建网成本，组网灵活。

工业 5G Advanced 系统支持 Profinet、EtherCAT 等工业协议的无线组网与可靠传输的工业 5G 系统，5G 网关中的工业协议适配单元负责识别工业协议，提取工业报文的流量、周期和基线时间等特征；5G 网关和 UPF 的双发选收单元将工业协议中的控制业务通过两个不同空口并行发送，提高传输可靠性从 99.9% 提高到 99.99%；5G 网关中的协同调度模块根据工业协议的基线时间和周期等特征，直接控制网关内的发送队列，通过 5G 核心网控制空口资源分配，使工业协议的端到端时延从 10ms 以上降低到 4ms。相关指标达到国际先进水平。

As a result of integrating and innovating data technologies, operational technologies, information technologies, and communication technologies, the industrial 5G Advanced system provides endogenous 5G intelligence, coordinates industrial protocols, ensures high availability of industrial production, and supports industrial applications such as cloud PLC, reducing on-site network construction costs and providing flexible networking capabilities.

Wireless 5G-Advanced technology supports industrial protocols such as Profinet and EtherCAT and provides reliable transmission. As part of the 5G gateway, the industrial protocol adaptation unit identifies industrial protocols and extracts characteristics such as traffic, cycle, and baseline time; A 5G gateway and UPF's dual-transmission and selective-receipt unit sends the industrial protocol control services simultaneously through two different air interfaces, increasing transmission reliability from 99.9% to 99.99%; 5G gateway cooperative scheduling modules are responsible for controlling the sending queue, as well as allocating air interface resources over the 5G core network. This method reduces the end-to-end delay of industrial protocols from more than ten milliseconds to four milliseconds based on the baseline time and period of the industrial protocol. As a result, the relevant indicators have reached an advanced level on the international scale.



工业 5G Advanced 系统架构
Industrial 5G Advanced System Architecture

“基于 5G Advanced 的柔性产线解决方案”对外发布，成果亮相巴塞罗那通信展，获得国际广泛关注

A flexible production line solution based on 5G Advanced was released to the public. The results of this project were exhibited at the Barcelona Communication Exhibition and were widely acclaimed internationally

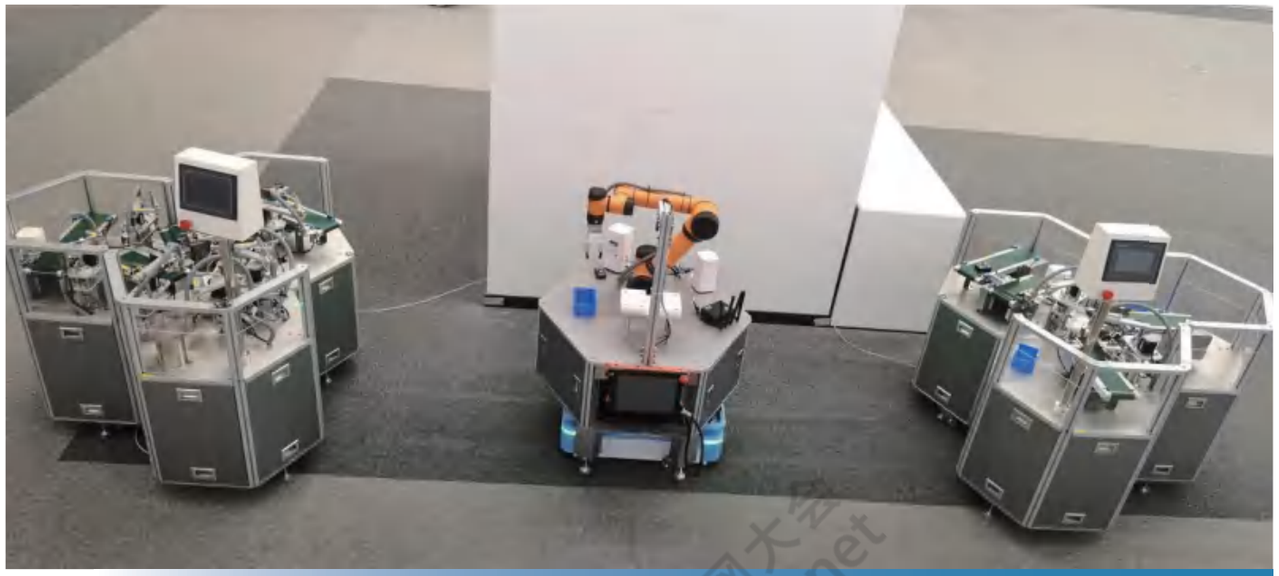
2021 年 11 月 26 日，中国科学院沈阳自动化研究所与华为对外联合发布了“基于 5G Advanced 的柔性产线解决方案”，使 5G 在工业上的应用，从监控、安防等场景的外网辅助阶段，进入到工业内网阶段，使能工业核心生产环节，并展示了基于该方案打造的柔性产线样机。在沈自所实验室已完成了 5G 在工业内网的柔性产线试验，涵盖自动加工、自动装配、自动检测、仓储物流等所有生产环节，验证了工业内网对 5G 通信的网络要求。同时，在华为云核心网创新实验室，也已成功部署可跨产线灵活协同控制的柔性产线样机。通过联合发布的系统解决方案，对工业 5G Advanced 系统成果进行推广，获得业界广泛关注。

“5G Advanced(5.5G)-Based Industry Field Control Solution”成果参加了在 2022 年巴塞罗那通信展，获得国际广泛关注。

A joint release of the "5G Advanced-based flexible production line solution" by Shenyang Institute of Automation of the Chinese Academy of Sciences and Huawei was made on November 26, 2021, enabling the application of 5G technology in industry. Following the external network auxiliary stage of monitoring, security, and other scenarios, the industrial intranet phase began, the industrial core production link was enabled, and the prototype of the flexible production line based on this solution was demonstrated. Shenyang Institute of Automation has successfully completed the flexible production line testing of 5G in the industrial intranet, covering all production links including automatic processing, automatic assembly, automatic detection, warehouse and logistics, and verifying the network requirements of an industrial intranet for 5G communication. Additionally, Huawei has successfully deployed a flexible production line prototype that can be controlled flexibly and collaboratively across multiple production lines in its Cloud Core Network Innovation Lab. As a result of the joint release of the system solution, the industry has been able to promote the achievements of the industrial 5G Advanced system.

In 2022, "5G Advanced (5.5G)-Based Industry Field Control Solution" was presented at the Barcelona Communication Exhibition and received extensive international attention.

On November 26, 2021, the Shenyang Institute of Automation of the Chinese Academy of Sciences and Huawei jointly released the "5G Advanced-based flexible production line solution", which enables the application of 5G in industry, from



基于 5G Advanced 的柔性产线样机
5G Advanced-based Flexible Production Line Prototype

the external network auxiliary stage of monitoring, security and other scenarios. entered the industrial intranet stage, enabled the industrial core production link, and demonstrated the flexible production line prototype built based on this solution. In the laboratory of Shenyang Institute of Automation, the flexible production line test of 5G in the industrial intranet has been completed, covering all production links such as automatic processing, automatic assembly, automatic detection, warehousing and logistics, and the network requirements of industrial intranet for 5G communication have been verified. At the same time, in the Huawei Cloud Core Network Innovation Lab, a flexible production line prototype that can be controlled flexibly and collaboratively across production lines has been successfully deployed. Through the joint release of the system solution, the achievements of the industrial 5G Advanced system have been promoted, which has attracted widespread attention in the industry.

The "5G Advanced (5.5G)-Based Industry Field Control Solution" achievement participated in the Barcelona Communication Exhibition in 2022 and received extensive international attention.

工业 5G Advanced 系统推动 5G 工业应用从外围辅助向核心生产环节渗透，赋能各行各业的新业务和新商业模式，形成中国自主知识产权的工业 5G 技术体系和产业生态

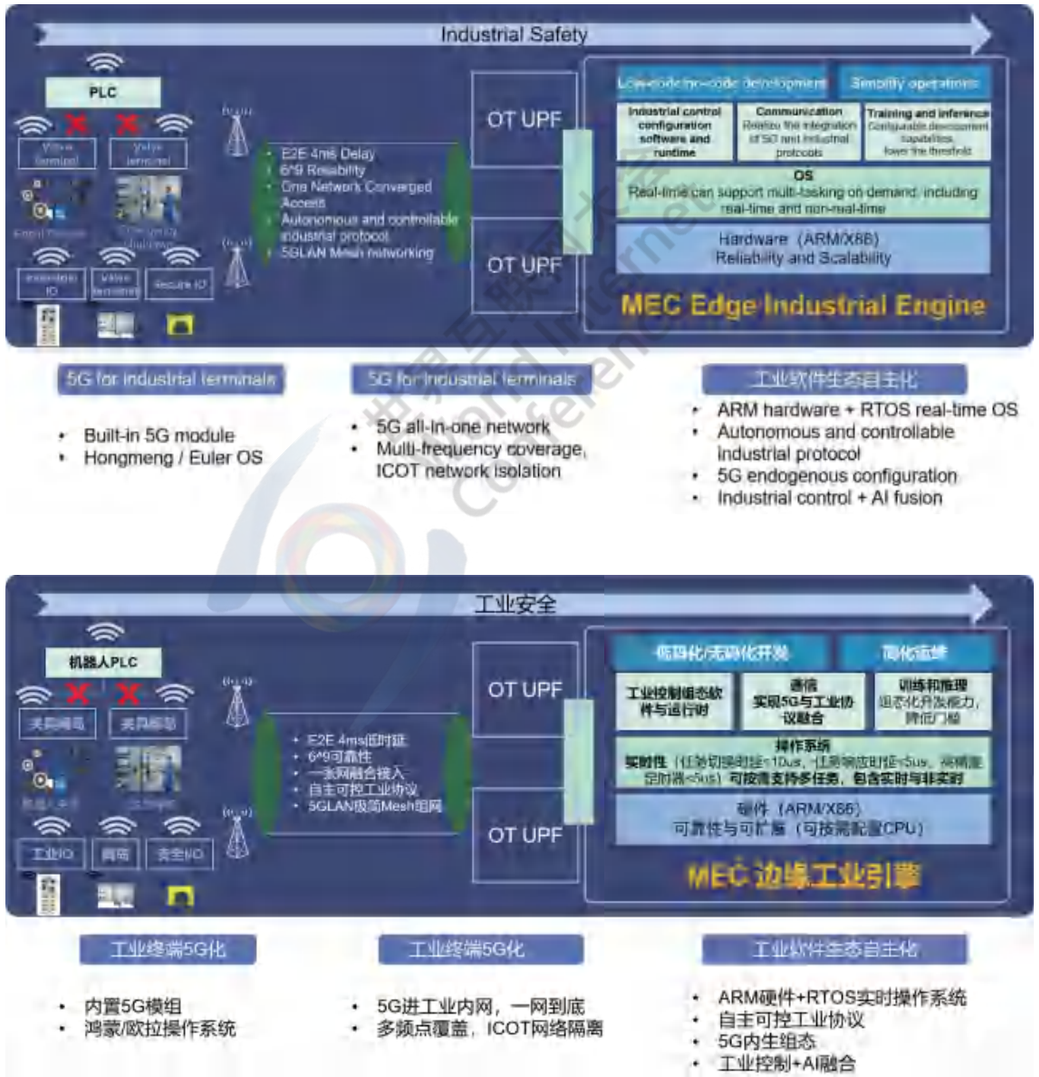
By deploying the industrial 5G Advanced system, 5G industrial applications will be penetrated from peripheral assistance to core production links, new businesses and new business models will be created in all walks of life, and a 5G technology system and industrial ecology will be formed with independent intellectual property rights that are owned by China

工业 5G Advanced 系统推动 5G 工业应用从外围辅助向核心生产环节渗透，简化现场组网、降低现场工业网络的建设和运营成本，提高了生产效率。通过工业 5G Advanced 网络与产业领域业务的深度融合，5G 技术将扩展到更多垂直行业，使 5G 网络真正赋能各行各业的新业务和新商业模式。同时，推动支持工业 5G Advanced 新型网络技术的终端控制器产品发展，形成中国自主知识产权的工业 5G 网络、终端全系统技术体系和产业生态。



5G Advanced 柔性产线方案发布现场
5G Advanced Flexible Production Line Solution Conference

Through the implementation of the industrial 5G Advanced system, 5G industrial applications are able to penetrate from peripheral assistance to core production lines, simplify on-site networking, reduce construction and operating costs of industrial networks on-site, and improve productivity. It is expected that the 5G technology will be applied to more vertical industries through the deep integration of the industrial 5G Advanced network and the industrial business, empowering the network to enable the delivery of new services and the development of new business models for all walks of life. Aside from developing terminal controller products that support the new industrial 5G Advanced network technology, it will also create an industrial 5G network system-wide technical system and industrial ecology that is protected by independent intellectual property rights owned by China.



自主可控的端到端产业链
Self-Controllable End-to-End Industry Chain

一种基于 LCoS 技术的光阀控制芯片

A Light-Modulating Chip Based on LCoS Technology

深圳慧新辰技术有限公司
Shenzhen Huixinchen Technology Co.,Ltd.

引言

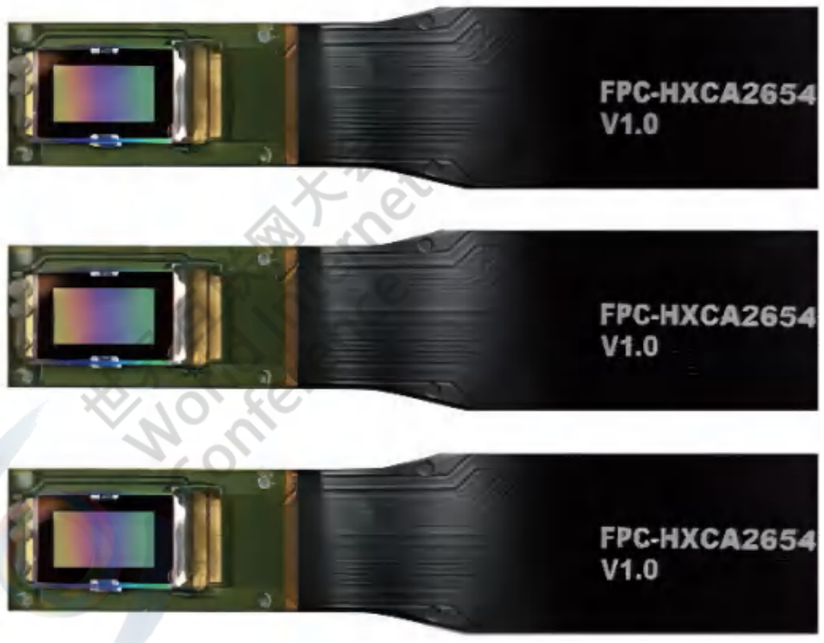
深圳慧新辰技术有限公司（简称“深圳慧新辰”）已推出的 LCoS 光阀芯片，规格为 720P 6000PPI，产品寿命延长，价格下降，年出货能力超过 100 万颗。

Introduction

The 720P 6000PPI LCoS chip developed by Shenzhen Huixinchen Technology Co., Ltd ("Shenzhen Huixinchen") offers a longer lifespan and a lower price. There are more than one million pieces delivered annually.

通过自身独有的芯片设计和封测技术，LCoS 光阀芯片关键性能皆得到提升

Improving major performance indicators of LCoS chip with unique technologies on chip design and packing & testing

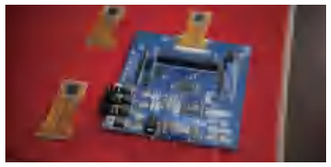


深圳慧新辰自主研发的 LCoS 新品在使用工艺、像素密度等方面都具有极大的比较优势，在产品亮度、可靠性、可拓展性和使用寿命等方面也取得突破：

LCoS products developed by Shenzhen Huixinchen have a number of advantages over previous LCoS products in terms of technologies and pixel density, for example. Brightness, reliability, extensibility, and product life have also been improved:

2019 年至 2021 年间，深圳慧新辰成功发布无机取向 LCoS 芯片及配套光学模组，完成无机取向 LCoS 芯片升级并达到量产条件，成功发布采用 HXCA2672BU LCoS 芯片的终端投影产品。深圳慧新辰通过自身独有的芯片设计和封测技术，使用合作晶圆厂 110nm 成熟制程，将量产化 LCoS 芯片产品的像素密度提高到 6000PPI 级别，以较低的工艺成本实现了产品关键性能的超越，将硅基液晶产品的亮度耐受推高至百万尼特级别，大幅度提高产品的亮度、可靠性、可拓展性和使用寿命，使 LCoS 芯片应用于工业制造、光通讯、车载等复杂工况领域成为真正可能。

As of 2019, Shenzhen Huixinchen has achieved the following milestones: releasing the LCoS chip and supporting optical module (inorganic vertical alignment of liquid crystals); upgrading its LCoS chips to mass production; and releasing the projector and optical engine models T1 and L26H2, embedded with the company's LCoS chip model HXCA2672BU together with its downstream customer. Using its unique chip design and packing technology, Shenzhen Huixinchen adopts a mature 110nm process from a cooperative wafer supplier to raise the pixel density of mass produced LCoS chip products to 6000PPI, resulting in a lower cost and higher performance. Huixinchen's vertical alignment technology, which it developed independently, is responsible for raising the brightness of its LCoS products to millions of nits, thereby enhancing their brightness, reliability, extensibility, and lifespan. These efforts are enabling LCoS products to be applied to sophisticated domains such as industrial manufacturing, optical communication, and vehicle-mounted devices.





无机取向 LCoS 产品
LCoS Products



智能微投领域 --L26H2 型 LCoS 光机
L26H2 Optical Engine
for Mini Smart Projectors



5G 光网络领域 --WSS 波长选择开关
WSS (Wavelength Selev zctive Switch)
for 5G Optical Network

LCoS 芯片应用广泛且在不同领域的开发应用逐见成果

Seeing diversified applications of LCoS chips in increasing domains

LCoS 芯片广泛应用于智能微投、激光电视、5G 光网络、激光雷达、AR/VR、AR-HUD、3D 打印等与光相关的领域。在智能微投领域，深圳慧新辰的 LCoS 芯片产品已与不同层级的下游应用厂商达成合作，面向全球不同市场的 LCoS 芯片出货数量超过 20 万粒。在桌面触控超短焦投影领域，预计 2022 年第三季度推出光学模组样机。在车载领域，已承接客户在车载相控阵激光雷达光阀芯片的委外封测订单。在光固化 3D 打印、冷数据胶片存储、光通讯等领域，均已达成合作意向。

Chips based on LCoS technology are widely used in light-related applications, including smart mini projectors, laser TVs, 5G optical networks, laser radars, AR/VR, AR-HUD, and 3D printing. A total of over 200,000 LCoS chips have been delivered by Shenzhen Huixinchen to its downstream customers in global markets for smart mini projectors. The optical module is expected to be available in the third quarter of 2022 for desktop-touch ultra short throw projectors.

Shenzhen Huixinchen developed a light-modulating chip for infrared 3D scanning for industrial applications, enabling better face recognition in remote and complex settings. For vehicle-mounted devices, Shenzhen Huixinchen has also accepted orders to pack light-modulating chips for vehicle-mounted laser phased array radars. Besides, cooperation intentions have been reached with customers in industries such as photocuring 3D printing, cold data storage on film, and optical communications.

核心团队经验丰富，掌握核心技术与能力

Boasting key technologies and rich experience

深圳慧新辰核心团队的 LCoS 芯片研发经验和技术积累平均超过 15 年，掌握了具有自主知识产权的模拟芯片设计技术、液晶选配、VA 无机取向等三大核心技术，具备独立自主的封装测试和光学设计能力，是当前全球范围内仅有的几家同时具备从芯片到模组全流程能力的公司之一，也是现今批量供货无机 LCoS 芯片的公司之一。

The technical team at Shenzhen Huixinchen has an average R&D experience of over 15 years. Through its key technologies, which include the design of chips, inorganic vertical alignment of liquid crystals, and the selection of liquid crystal materials, as well as its capabilities in packing and testing chips, it enables it to be one of the few companies in the world that can complete the entire manufacturing process of chips and optical modules, as well as one of the manufacturers who supply large quantities of LCoS chips.

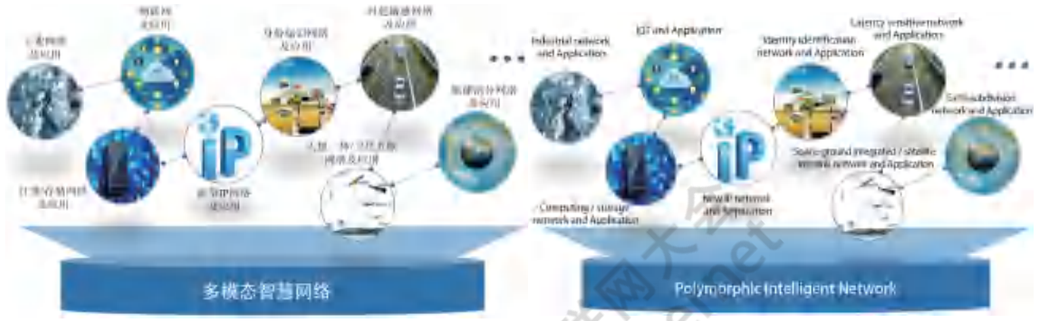


深圳研发中心
R&D Center in Shenzhen

多模态智慧网络

Polymorphic Intelligent Network

之江实验室
Zhejiang Lab



多模态智慧网络发展愿景图
Development Vision of Polymorphic Intelligent Network

引言

多模态智慧网络针对信息网络深度融合发展需求，突破现有网络发展方法论及实践规范限制，形成网络创新发展范式，支持各类新型网络技术体制与现有网络互联互通和演进性发展，为网络技术创新提供体系化解决方案。

Introduction

Aiming at the demand for deep integration development of information networks, polymorphic intelligent network breaks through the limitations of the current network development methodologies and practice norms, forming a network innovation development paradigm, which supports the interconnection and evolutionary development of various new network technical systems and existing networks, and provides systematic solutions for network technology innovation.

多模态智慧网络是信息网络发展范式的重大创新

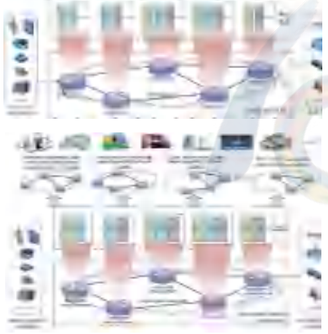
Polymorphic intelligent network is a major innovation of development paradigm in information network

随着互联网与经济社会各垂直行业的深度融合发展，现有技术体制已很难满足垂直行业应用日新月异的多元化应用需求：对单一网络体系的演进式修补使得系统工程复杂度剧增；单一 IP 体制在众多方面制约着网络的传输性能；堆叠式的复杂网络技术体系凸显广义安全威胁；网络与端应用的严格分界难以适应计算、存储、转发一体化趋势。

It has been challenging for the current technical system to satisfy the diversified application needs of the vertical industries due to the deep integration and development of the Internet and the vertical industries of the economic society; the evolutionary repair of a single network system increases the complexity of system engineering. There are many limitations to the transmission performance of the network due to the single IP system. The stacked complex network technical system emphasizes the general security threats and the strict boundaries between network and end application are difficult to adapt to the trend of integrating computing, storage, and forwarding.

针对上述困境，多模态智慧网络创造性地提出了“技术体制与支撑环境分离”的网络创新发展范式，通过突破“多模态寻址路由、全维可定义、智慧管控、内生安全”等技术难题，成功研制多款接入 / 汇聚级、骨干级多模态网元原型，以及多模态智慧网络原理平台，率先实现 IPv4/v6、身份标识、内容标识、地理标识、工控标识等 6 种不同模态网络的共网运行，满足多元化网络及多样化应用共生与共存、演进与变革、功能安全与网络安全兼容并蓄的时代要求，为网络技术发展提供了创新思路和可行技术解决方案。

By addressing the above dilemma, polymorphic intelligent networks propose a network innovation development paradigm that “separates the technical system from the supporting environment”, and successfully develops a wide variety of polymorphic network element prototypes at the access/aggregation level, and backbone-level, by successfully solving technical problems such as "polymorphic addressing routing, full dimension definable, intelligent control and endogenous security." Furthermore, the company has developed the first polymorphic intelligent network principle platform, which has enabled the realization of the common network operation of six different modes of networks, such as IPv4/v6, identity identification, content identification, geographical identification, and industrial control identification. Providing innovative ideas for the development of network technology and facilitating feasible technical solutions to meet the demands of the times in terms of inclusiveness of symbiosis and coexistence, evolution and transformation, functional security and network security for pluralistic networks and diversified applications.



多模态智慧网络体系架构
Polymorphic Intelligent Network Architecture

多模态智慧网络在智能制造行业开展应用验证

Application verification of polymorphic intelligent network in intelligent manufacturing industry

本成果已在智能制造行业开展应用验证：IP 网络模态为远程协同办公提供跨域网络服务；内容标识网络模态为产线机器视觉质检提供高效快捷的数据分发；身份标识网络模态为无人车跨区域巡检提供安全无缝的移动数据传输；地理标识网络模态为紧急事件处置和应急响应提供高精度灵活可定义的按区域通信；工控标识网络模态为产线生产控制提供低延时高可靠的控制信号传输。

Applied to the intelligent manufacturing industry, the results were validated: IP network modality provides cross-domain “best effort” network services for remote collaboration; content identification network modality provides efficient and fast data distribution for production line machine vision quality inspection.For cross-region inspections of unmanned vehicles, identity identification networks provide safe and seamless mobile data transmission; geographical identification networks provide high-precision, flexible, and definable per-region communication for emergency disposal. Providing low latency and high-reliability control signal transmission services for the control of production lines is a key feature of the industrial control identification network modality.

多模态网络所具有的全维度可定义、开放、弹性、通用架构，可天然适配各种新型网络模态的灵活加载，实现不同网络模态的“即插即用”，可充分发挥不同网络模态的能力特点和优势。在智能制造中的应用解决方案也可被高效地复制推广到智慧港口、智能交通车路协同等更多行业领域。

A polymorphic network, with its full dimensional definable open, elastic, and universal architecture, can be easily adapted to the flexible loading of various new network modalities so that the capabilities characteristics and advantages of different network modalities can all be fully accessed. Intelligent manufacturing solutions can be efficiently replicated and extended to more industrial fields, such as smart ports and vehicle-road coordination.

多模态智慧网络正在推动新一代信息网络技术发展与变革

Polymorphic intelligent network is promoting the development and transform of the new generation of information network technology

学术界和产业界已形成多模态智慧网络技术的“产学研测用”新生态。多模态智慧网络业务描述、故障感知等标准制定工作也在国际上引起越来越多关注；多模态智慧网络技术正在推动各类网络模态（如内容标识模态、地理标识模态、工控标识模态等）在 4K 高清视频传输、无人车自动驾驶、工业互联网等新兴网络应用领域不断发展。阶段性成果在重要媒体上被报道或广泛转载。

The academia and industry have formed a new ecology of "production, learning, research, testing and application" of polymorphic intelligent network technology. The development of standards such as polymorphic intelligent network service description and fault awareness has also attracted more and more attention internationally; Polymorphic smart network technology is promoting the continuous development of various network modes (such as content identification mode, geographic identification mode, industrial control identification mode, etc.) in emerging network applications such as 4K high-definition video transmission, autonomous driving of unmanned vehicles, and industrial Internet. The phased achievements were reported by important medias.



多模态智慧网络在智能制造行业的应用
Application of Polymorphic Intelligent Network in Intelligent Manufacturing Industry

5G 增速器

5G Booster

中国移动粤港澳大湾区（广东）创新研究院有限公司
China Mobile GBA Innovation Institute





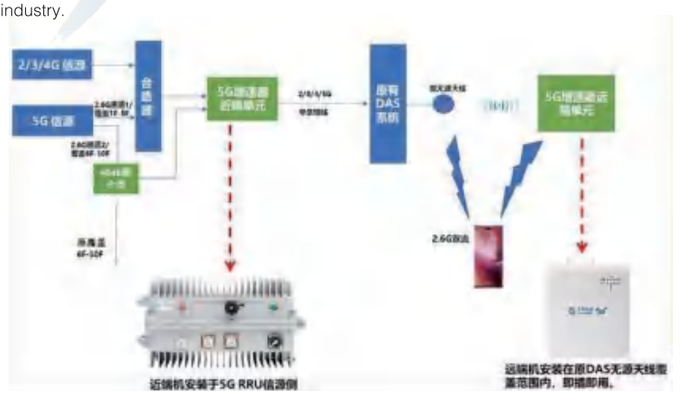
5G 增速器远端机
5G Booster Far-end Machine

5G 增速器采用无线变频装置实现覆盖解决方案

5G Booster is based on wireless frequency shifting technology to solve coverage problem

5G 增速器创新性地提出了 5G 室内覆盖综合解决方案，多个关键技术创新均全球领先，并均实现了率先应用。5G 增速器创新地采用微型模拟窄带滤波技术，实现时延小于 100ns，达到业内最低，并实现自适应时隙同步，提升双流解调性能。引入 Fbar 模拟滤波器及无源混频技术，相比介质滤波器及有源混频，可精准滤波 5G 信号频段，节省模数之间转换，时延更小，多流解调性能更优。采用模拟技术实现近端机与远端机的时钟同步，相比业界普遍采用的恒温本振、数字方式，成本更低、时延更小。

Innovating 5G indoor coverage comprehensive solutions, 5G Booster is a world leader in many key technological innovations, and has achieved its first application in the world. A time delay less than 100ns is achieved by the innovative use of micro analog narrow-band filtering technology in 5G Booster, which is the lowest time delay in the industry. By implementing adaptive slot synchronization, the performance of dual stream demodulation is improved. In contrast to dielectric filters and active mixing devices, Fbar analog filters and passive mixing technology enable accurate filtering of 5G signal frequency bands, saving analog-to-digital conversion, reducing delay, and achieving better multistream demodulation performance than dielectric filters and active mixing devices. It uses analog technology to realize clock synchronization between the near end machine and the far end machine. The cost and delay of this device are less than those of a constant temperature local oscillator and digital mode, which are widely used in the industry.



5G 增速器已在 5G 三期建设规模应用，成效卓著
5G Booster has been applied in the construction scale of 5G phase III with remarkable results

引言

4G 时代，大量单路天馈系统建设在室内，如果 5G 信源简单合路进单路天馈系统中，将无法实现多通道高速率的效果，但若再新建天馈，则将带来投资大、施工难的问题。为此，我们基于无线变频技术成功研发了 5G 增速器。

Induction

In order to save investment in the 4G era, a large number of single way antenna feeder systems have been built indoors. However, simply combining 5G sources into a single way antenna feeder system will not achieve the effect of multi-way high-speed rate. If a new antenna feeder is built, it will lead to large investment and difficult construction. In order to solve this problem, 5G Booster is developed based on wireless frequency shifting technology.

5G 增速器仅对现有的传统的 DAS 分布系统做极简改造。充分利用原有 DAS 分布系统，在原系统中加入 5G 无线变频装置，实现 5G 室内多路基站信号的室内覆盖系统，不需要对现有传统 DAS 分布系统的垂直面、水平面做任何施工改动。同时，5G 增速器仅在合路器位置进行极简改造，无需在现有馈线馈直流远供电，与移频有源天线系统对比，工程量大幅减少。

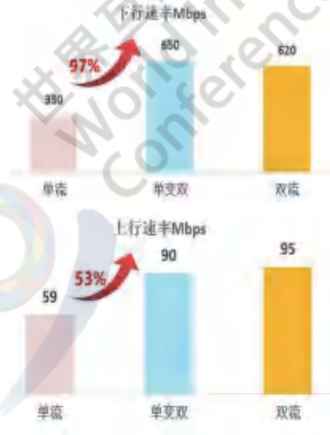
The 5G Booster makes only a small modification to the existing traditional distribution antenna system. It makes full use of the original distribution antenna system. An indoor multi-way 5G base station signal transmission system is achieved by adding a 5G wireless frequency shifter to the original system, which doesn't require any construction changes to the vertical and horizontal planes of the existing traditional distribution antenna system. The only change made by this solution is in the position of the combiner, for which feeding of DC remote power supply into the existing feeder is not required. The engineering quantity is greatly reduced when compared with a frequency shift active antenna system.

5G 增速器作为探索新型的 5G 室分的创新解决方案，已在 5G 三期建设规模应用。5G 增速器等创新技术方案开展相关试点验证工作，并在 5G 二期及三期进行了规模应用，为后续大规模开展 5G 室内覆盖建设积累了宝贵经验。在众多场所进行了室分试点改造，通过无线 + 变频的方式，使得 5G 单路 DAS 升级成双流，实现了用户下行速率的提升。

5G Booster, as an innovative solution for exploring a new 5G compartment, has been applied in the scale of 5G phase III. A 5G booster has been tested and applied in 5G phase II and phase III on a large scale, which has provided valuable experience for the construction of large-scale 5G indoor coverage in the future. The downlink rate of users has been improved by upgrading 5G single way DAS to dual stream through wireless and frequency shifting.

通过现网测试，单路分布系统直接馈入的下行速率为 318Mbps，叠加 5G 增速器后，单变双的下行速率提升到 632Mbps，较单流提升 98%；双路分布系统直接馈入的下行速率 549Mbps，叠加 5G 增速器后，双变四的下行速率提升到 930Mbps，较双流提升 70%；相比直接合路，叠加 5G 增速器后，RSRP 提升 4-7dB、SINR 提升 3-5dB。

Through the current network test, the downlink rate directly fed by the single way distribution system is 318Mbps. After using 5G Booster, the downlink rate of single-to-dual is increased to 632Mbps, which is 98% higher than that of single way system. In the case of dual-to-four distribution, the downlink rate is 549Mbps when fed directly by the system, while the downlink rate of dual-to-four distribution is 930Mbps after using 5G booster, which is 70% greater than that of dual-to-four distribution. Furthermore, the RSRP increased by 4-7 db and the SINR increased by 3-5 db.



叠加 5G 增速器后下行速率提升示意图
Schematic Diagram of Downlink Speed Increase after Adding 5G Booster



5G 增速器自主性比例示意图

经济效益成果收获斐然、社会效益影响深远广泛

The economic benefits and achievements are remarkable, and the social benefits are far-reaching and extensive

目前，5G 增速器的累计收入已超过 3000 万元，相比仅新建 DAS 的方案，投资能够节约投资 3708 万元。根据其成功应用的经验，预估全球市场潜力可达 70 亿元以上。

At present, the accumulated income of 5G Booster has exceeded 30 million yuan. In contrast to the projects of constructing DAS alone, 37.08 million yuan can be saved on the investment. It is estimated that the global market potential of this product can reach more than 7 billion yuan as a result of its successful application experience.

5G 增速器最大程度保护了现有网络投资，提升了网络性能，确保了用户优质体验，起到树立企业良好口碑作用。5G 增速器为独立研发，具有 100% 自主知识产权，具有极简改造、即插即用、多流性能、差异化覆盖等特点，已在中国规模使用，并在国际上受到广泛认可。

Using 5G Booster, the existing network investment is protected to the fullest extent possible, the network performance is enhanced, the user experience is enhanced, and a positive reputation is built for the enterprise. The independently researched and developed 5G Booster possesses 100% independent intellectual property rights. As a result, it has been used on a large scale in China and is widely recognized internationally.



TDOS 天元大数据操作系统

Operation System of TDOS Tianyuan Big Data

浪潮集团
INSPUR Co.,Ltd.

引言

发挥数据要素价值，关键在于建设完善的数据标准化、资产化、商品化体系。天元大数据操作系统以数据资产化、商品化为核心，支持构建行业数据要素化流通的大数据底座，促进“数商服务”的业务创新。

Introduction

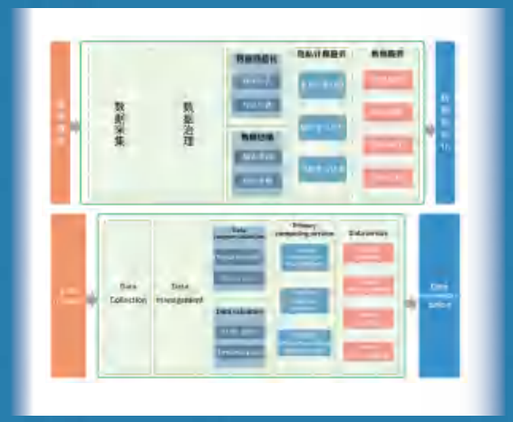
The key to giving full play to the value of data elements lies in building a sound data standardization, capitalization and commercialization system. With data Capitalization and commoditization as the core, Tian Yuan's big data operation system supports the construction of a big data base for the circulation of industry data elements and promotes the business innovation of "digital business services".

打造数据能力自生底座、数据交易服务底座、数据要素化转型底座

Create a capabilities self-generated base for data, a base for data transaction services, and a base for data element transformation

天元大数据操作系统在基于现有的法律和标准基础之上，以数据商品为基本交易对象，从资源管理、资产界定、技术研究、价值打造等方面，进行全新设计。作为数据要素化底座，实现集数据采集、数据资源化管理、数据资产化评估、数据要素化流通与服务于一体的全栈服务能力，研究演化隐私计算的数据产权与隐私保护问题，着力突破制约数据流通的关键技术。构建新的“数商服务”业务创新模式，打造从数据要素化管理、数据要素市场培育、数据共享与融合应用、数据产业研发创新、知识产权保护、融资服务与人才保障等多元融合的数据要素领域服务模式。为政府、企业、科研机构、第三方软件服务商等客户提供数据撮合、加工、评估、定价、存储、交付等一系列环节的“数商服务”业务创新模式。

Based on the existing laws and standards, the Tianyuan big data operation system takes data commodities as the basic transaction objects, and carries out a new design from the aspects of resource management, capital definition, technology research, value creation as the base to realize Data elementalization, as it seeks to realize full-stack service capabilities integrating data collection, data resource management, data capital evaluation, data element-based circulation and services. It also studies data property rights and privacy protection issues in evolutionary privacy computing, strives to break through key technologies that restrict data circulation, and creates a new model for the exploration of data element-based governance in China. Tianyuan big data operation system aims to build a new business innovation model of "digital business services", and create data elements that integrate data elements such as data element management, data element market cultivation, data sharing and integrated applications, data industry R&D innovation, intellectual property protection, financing services and talent protection. Domain service model, so it can provide government, enterprises, scientific research institutions, third-party software service providers and other customers with a "digital business service" business innovation model of a series of links such as data matching, processing, evaluation, pricing, storage, and delivery.



创造性的利用区块链、隐私计算技术解决数据流通难题
Make Use of Blockchain, Privacy Computing Technology in a Creative Way to Solve the Problem of Data Circulation

TDOS 天元大数据操作系统已成功为 10+ 行业提供数据底座能力

Inspur Droso system has successfully provided data base capability for 10+ industries

浪潮卓数作为浪潮集团旗下快速成长的大数据公司，已成功将天元大数据操作系统 (TDOS) 在 10+ 行业落地，支撑了中国 16 个省、102 个市县电商监测分析服务，为 27 个城市的综合金融服务平台以及多地的智慧社区提供数据底座能力。

Inspur Droso has successfully implemented Tianyuan Big Data Operation System (TDOS) in 10+ industries, supporting the e-commerce monitoring and analysis services of 16 provinces and 102 city and county commerce bureaus and providing data base capabilities with comprehensive financial service platforms in 27 cities and many local smart communities.

赛迪顾问（CCID）发布的《2021-2022 年中国大数据市场研究年度报告》中，浪潮卓数连续两年进入中国大数据市场厂商竞争力领导者象限，位居前五，发展能力跃居第二。

In "2021-2022 China Big Data Market Research Annual Report" released by CCID, Inspur Droso ranked in the top five of China's big data market, and its development ability jumped to the second place.



TDOS 助力数据要素化流通



TDOS Supports Elementalization Exchange



TDOS 已成功应用于各行各业）这图不行体现过多政府机构



TDOS has been Adopted in All Business

以数据资产化、商品化为核心充分发挥数据要素价值

Give full play to the value of data elements with data capitalization and commoditization as the core

天元大数据操作系以数据资产化、商品化为核心，把大数据转换成为真正意义的资产，为中国急需推进的数据管理能力成熟度建设，以及数据要素治理提供全方位立体的技术支撑。形成“政府指导，社会参与、市场化运作”的模式，有助于打破行业信息壁垒，优化提高生产效率，推动大数据产业化发展。通过对数据管理能力有较大需求的政企事业单位，提供本地平台建设、数据中台建设、数据服务建设，预计每年增加收入 5000 万元。

With data capitalization and commercialization as the core, Tian Yuan Big Data Operation System transforms big data into assets with real significance, providing all-round and stereoscopic technical support for the maturity of data management capabilities and the governance of data elements that China urgently needs to promote. The formation of a model of "government guidance, social participation, and market-oriented operation" will help break down industry information barriers, optimize and improve production efficiency, and promote the industrialization of big data in the country. Through the provision of local platform construction, data platform construction, and data service construction, it is expected to increase revenue by 50 million yuan per year through government enterprises and institutions with greater demand for data management capabilities.



面向泛在时空大数据的实时地理信息服务平台

Real-Time Geographic Information Service Platform for Ubiquitous Spatiotemporal Big Data

武汉大学
Wuhan University

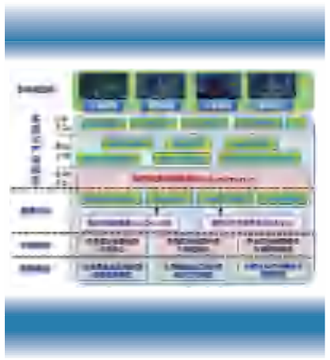
武大吉奥信息技术有限公司
Wuda GeoStar Geoinformatics Co., Ltd.

引言

本项目创新了实时地理信息数据模型，突破了分布式时空数据组织、查询处理、弹性计算等关键技术，研制了全自主、分布式、跨平台 GIS 引擎，构建了实时地理信息服务平台，形成了全新的实时地理信息服务产品体系。

Introduction

Several key technologies have been developed in this project, including distributed organization, efficient data retrieval, high-performance spatio-temporal computing, and innovation of a spatial-temporal data model for real-time geographic information. Additionally, it has developed a fully autonomous distributed cross-platform GIS engine that can be used to build real-time geographic information services as well as to develop service product lines that correspond to those services.



项目突破了实时地理信息服务平台关键技术，成功应对实时地理数据集成表达、融合组织、弹性计算、即时服务带来的巨大挑战

An integrated platform for spatial and temporal information services, based on a comprehensive object representation, elastic cloud computing, and real-time geographic information systems

成果主要创新如下：

Following is a list of the main innovations realized by this project:

国际上较早提出实时地理信息系统概念，系统性创建异源实时地理信息的多维动态集成表达模型，实现多源实时数据、海量历史记录及复杂时空关联关系的全要素统一建模，解决异构实时地理信息的动态一体化描述难题。

A multi-dimensional dynamic integrated representation model of heterogeneous real-time geographical information was systematically developed earlier in the world as a concept of real-time geographic information system (RGIS). An integrated model of multi-source real-time data, large historical records, and complex spatio-temporal correlations was realized, thereby solving the difficult problem of dynamically integrating heterogeneous real-time geographic information.

提出面向实时观测与历史记录的地理信息动态融合方法，构建基于自适应时空切片的泛在时空大数据分布式组织与动态索引方法技术，攻克多源实时地理信息的融合处理与动态组织难题，满足大范围、低延时、高动态的复杂时空查询和分析需求。

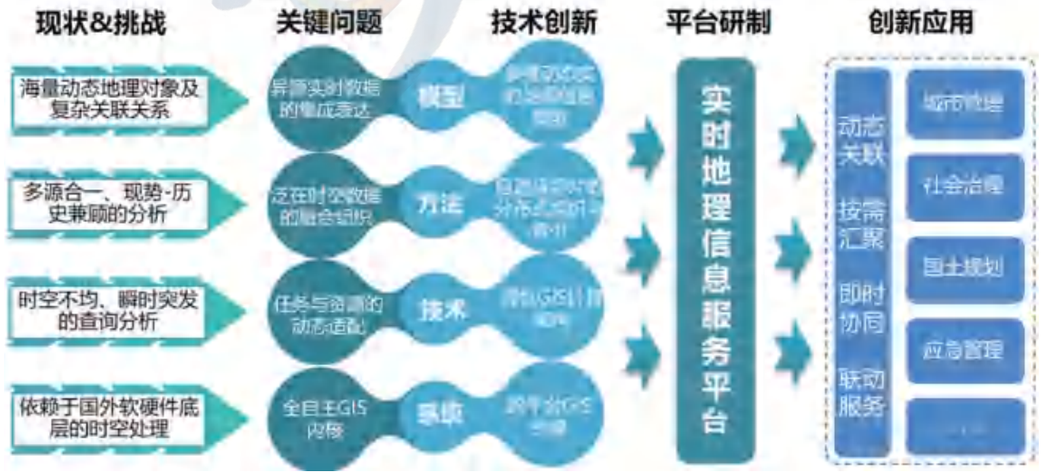
A dynamic fusion method of geospatial information from both real-time observation and historical records was developed by the project team, along with a distributed organization and dynamic indexing method based on adaptive spatio-temporal decomposition. Using this schema, it is possible to overcome the dynamic fusion issue associated with multi-source information, and to meet the needs of low-latency complex spatio-temporal querying and analysis.

设计多层次可伸缩的弹性 GIS 体系架构，构建内外存协同的实时地理信息数据库系统，提出基于超图分割的“任务－资源”动态适配方法，实现百亿级时空观测对象的亚秒级时空检索响应，解决复杂地理计算任务的负载均衡调度。

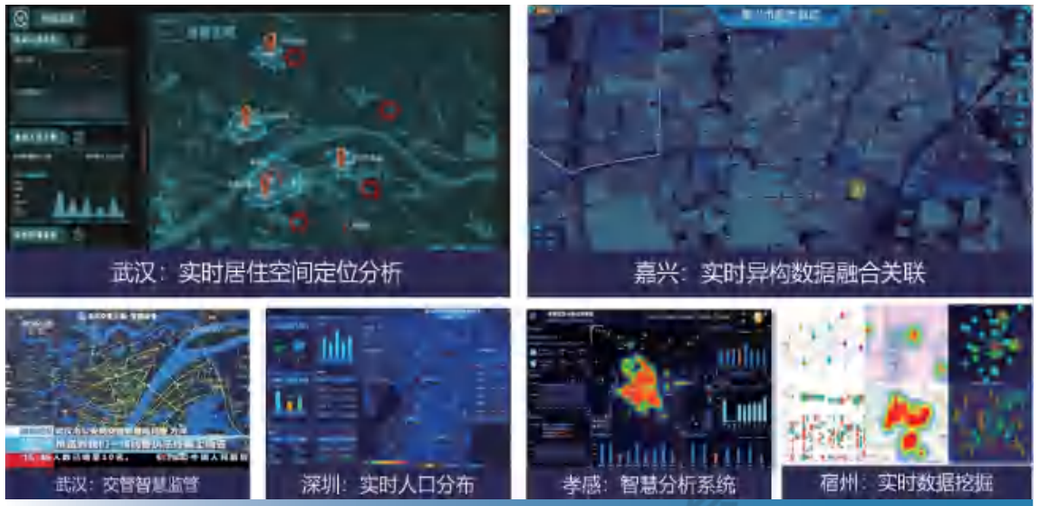
The project team has developed a multi-level scalable GIS architecture and developed a real-time geographic information database. A hybrid memory coordination technique and a "task-resource" dynamic allocation method based on hypergraph partitioning are employed in this system. As a result of this GIS architecture, tens of billions of data records can be accessed in less than a second.

以自主知识产权的分布式跨平台 GIS 引擎为基础，在国际上率先研发实时地理信息服务平台，开展一系列基于实时地理信息服务的创新应用，形成地理信息应用新业态。

The company has developed a real-time geographic information service platform based on a distributed cross-platform GIS engine and successfully conducted a series of innovative applications based on it.



关键问题及主要科技创新
Main issues and major innovations



应用案例
Applications

项目构建了完全自主可控的实时地理信息服务平台技术体系，推出了一系列实时地理信息产品，促进了多领域、大范围的行业应用

Wide application of real-time geographic information services and deep promotion of GIS industry

实时地理信息服务平台在智慧城市、智慧社会、应急管理等领域提供平台级智能化服务解决方案，已在城市管理、社会治理、城市规划、不动产登记、国土资源管理、测绘地理信息、电力、水利等行业整体应用三年以上，建设了我国近 10 个省、50 个市的百余项应用工程，促进了国民经济社会各行业的时空大数据集成应用，为我国智慧城市和智慧社会的建设与发展提供了强有力的信息化支撑。

Over the past three years, the real-time geographic information service platform has been widely used in many fields, including smart cities, society management, and emergency evacuation. The solution has been used in more than 100 projects in more than ten provinces and 50 cities in China, promoting the development of China's GIS industry and contributing to the construction and development of smart cities and smart societies.

项目构建一系列按需共享与联动服务的全新应用，实现了以实时地理信息为核心的系统共建和数据共享，取得了巨大经济效益和显著社会效益

A significant amount of social and economic benefits have been achieved through the sharing of geographical data in real-time and collaborative service applications

武汉大学、武大吉奥信息技术有限公司作为项目研发和应用完成单位，通过该项目研发成果的推广应用，累计实现直接经济效益超 5 亿元。同时，通过以实时地理信息为核心的系统共建和数据共享，避免了系统的重复建设、数据的重复购买或采集，共产生间接经济效益约 50 亿元。此外，项目促进我国地理信息产业技术自主可控与市场升级，催生我国地理信息新型服务业态，培养大批复合型人才。

Through the research and development of this solution, Wuhan University and Wuda GeoStar Geoinformatics Co., Ltd. have obtained direct economic benefits of over 500 million yuan. Through the sharing of data and the application of real-time geographic information, many domains can be reduced in resources and approximately 5 billion yuan of indirect economic benefits can be realized. As a result of this project, the GIS industry in China has been upgraded, and a large number of intellectuals have been cultivated in the country.



全维可定义网络 5.0 新型网络架构

Network 5.0: A Novel Full-Dimension Definable Network Architecture

中国科学院计算机网络信息中心
Computer Network Information Center, Chinese Academy of Sciences

中国信息通信研究院
China Academy of Information and Communications Technology

中国电信股份有限公司
China Telecom Co.,Ltd.

华为技术有限公司
Huawei Technologies Co.,Ltd.

引言

全维可定义网络 5.0 新型网络架构立足改变现有网络“端强网弱”的网络生产关系，通过做强网络，降低应用对终端的依赖，形成以网络为能力主体与责任主体的全新网络产业生态与治理体系，夯实网络空间战略的技术底座。

Introduction

Network 5.0 aims to change the imbalanced Internet situation of “strong end equipment but the weak network”. By strengthening the ability of the network, Network 5.0 reduces the application’s reliance on end equipment. It creates the new network industry ecology and governance paradigm with the network playing a leading role in the capabilities and responsibilities of the Internet, which can promote the governance capacity of cyberspace.

“以网络为中心、可信安全、能力内生”的核心设计理念

Core design concepts: network-centricity, credibility security, and endogenous functionality

全维可定义网络 5.0 新型网络架构提出“以网络为中心、可信安全、能力内生”的核心设计理念，通过设计全维度可定义、协议操作灵活、安全机制内生化的下一代网络协议体系，将确定性传输、内生安全、自治运维、高效管控等作为内生的机制嵌入到网络的数据通信协议当中，形成多模态、体系化、可增量部署的创新网络基础架构。其创新性成果包括：

The core design concept of Network 5.0 is "network-centric, credible security, and endogenous capability". Network 5.0 designed a full-dimension definable, flexible and secure network protocol stack for the next generation network. Data communication protocols of the network have been integrated with deterministic transmissions, endogenous safety, autonomous operations, and efficient control, among other capabilities. Therefore, these capabilities are endogenous in Network 5.0 design. Finally, a multimodal, systematized and incrementally deployable innovation network infrastructure was constructed. The innovation achievements of Network 5.0 are as follows:

提出泛在 IP 协议体系 N5P，增强了多样化标识、灵活可变长地址、多语义寻址路由等特性，并在协议层支持内生安全、确定性转发等网络 5.0 关键能力。

The new ubiquitous IP protocol (N5P) was proposed. N5P embodies the new features of diversified identification, flexible variable-length addresses, multi-semantic addressing routing, etc. Meanwhile, N5P also supports the endogenous security and deterministic transmission at network layer protocols.

提出确定性 IP 技术，是具备支撑三层大规模长距离网络多跳确定性转发的技术，可以实现微秒级的精确性，处于国际领先水平。

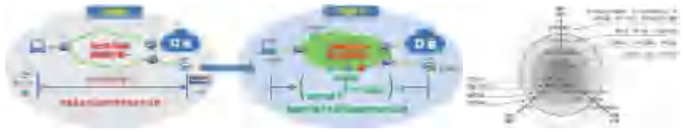
The Deterministic IP (DIP) technology was suggested as a network layer technology capable of supporting multi-hop deterministic networks at large scales.

提出了网络内生可信安全技术，实现零信任通信、匿名化用户隐私及随路 DDoS 治理等端到端安全通信。

It provides endogenous network security, enabling end-to-end secure communications, such as zero-trust communication, anonymized user privacy, and on-path DDoS governance, etc.

开创性地提出算力网络技术，将计算、网络、存储等各类异构资源深度融合，形成新一代 ICT 信息基础设施，以网络为中心，提供算网融合资源服务。

The concept of Computing Power Network was proposed for the first time. Computing Power Network can deeply integrate computing, network, storage and other heterogeneous resources to build a new generation of ICT information infrastructure. It takes the network as the main body to provide computing and networking integration services.



“以网络为中心、可信安全、能力内生”的核心设计理念
The Core Design Concept of Network 5.0 "Network-centric, Credible Security, and Endogenous Capability"

基于 IP 协议扩展，以灵活 IP 为核心的下一代泛在 IP 协议体系 N5P
The Next Generation Ubiquitous IP Protocol Architecture – N5P

产学研多维推广应用

Comprehensive promotion of Network 5.0

基于 N5P 网络协议研发了协议栈功能软件并开源，推动全维可定义网络 5.0 新型网络协议的普及和应用。

The N5P protocol stack functional software was developed and open-sourced to promote the popularity and application of Network 5.0.

将算力网络技术向科研大数据处理、电力能源调度等多个行业进行推广应用。实现了算力网络交易管控原型系统并完成测试验证。在 ITU-T 完成算力网络国际标准立项，在 CCSA 完成系列标准立项，在 CCSA TC614 成立算力网络特别工作组。出版发布了算力网络图书《边缘计算与算力网络》。

The Computing Power Network technology has been promoted and applied to many industries, including scientific big data processing and electricity power management. The computing power transaction control prototype was implemented, tested and verified. The international standard for Computer Power Network was successfully completed in ITU-T, and a series of related standard proposals were accepted by CCSA. The Computing Power Network Ad Hoc Working Group was established in the Networking 5.0 Alliance (CCSA TC614) and the book on Computing Power Network, “Edge Computing and Computing Power Network”, was published.

将提出的去中心化互联网基础设施在 CERNET、中国电信 CNGI 节点、CENI 主节点、Telefonica、西班牙 UC3M 和 UPC 大学的网络中进行了实验性部署。

The proposed decentralized Internet infrastructure has been gradually deployed in CERNET, China Telecom CNGI, CENI, and the networks of Telefonica, Spain UC3M and UPC University.

开发了 DIP 原型样机，依托 CENI 骨干网络与长三角综合试验网开展了部署与测试，目前，DIP 设备已在国际某大型工业制造企业开展应用。

The developed DIP prototypes were tested relying on the CENI backbone network and the Yangtze River Delta comprehensive test network. At present, DIP has been applied in a large international industrial manufacturing enterprise.

领先成果重磅发布及国内外标准全面推进

Leading achievements release & national and international standardization

全维可定义网络 5.0 新型网络架构是网络 5.0 产业和技术创新联盟的创新性成果。联盟在网络 5.0 峰会、中国 SDN/NFV/AI 大会、GNTC 2020 等多项重大活动中对这一成果进行了宣传推广，发布了相关技术报告及技术白皮书 6 份。完成中国通信学会 18 项团体标准立项，其中 11 项团体标准已发布。在 CCSA 完成 10 多个行业标准立项。。基于 ITU-T FG NET 2030 输出 8 份报告，提出了未来 2030 网络的主要的愿景、目标、驱动力、架构设计的原则和主要要素等，在全球引起了广泛关注。

Network 5.0 is the innovative achievement of the Network 5.0 Industry and Technology Innovation Alliance. The alliance has promoted this achievement in many significant events such as the network 5.0 summit, China SDN/NFV/AI conference and GNTC 2020, and released 6 relevant technical reports and technical white papers. China Communications Society has approved 18 group standard proposals, 11 of which have been published.

Over ten industrial standards have been approved by CCSA. As part of ITU-T FG NET 2030, 8 reports are proposed to describe the main vision, objectives, driving forces, principles, and main elements of the architecture design of the future 2030 network, which have attracted the attention of the international community.



FG NET 2030 会议合影
FG NET 2030



移动互联网 IPv6/SRv6 技术创新及超大规模部署

IPv6/SRv6 Technical Innovation and Hyperscale Deployment for Mobile Internet

中国移动通信集团有限公司
China Mobile Communications Group Co.,Ltd.

引言

本项目解决了移动互联网由 IPv4/MPLS 向 IPv6/SRv6 升级换代的技术难题，经过近二十年的努力，实现了移动互联网 IPv6 与 4G/5G 的同步发展，在中国移动建成了全球超大规模部署的 IPv6 移动网络和固定宽带网络，惠及超 9 亿用户，同时实现了 G-SRv6 技术创新和标准突破，推动了 IPv6/SRv6 在全球互联网的广泛应用。

Introduction

The project aims to address technical challenges associated with the transition from IPv4/MPLS to IPv6/SRv6 during the evolution of the mobile Internet. China Mobile has been cultivating IPv6 mobile Internet and 4G/5G simultaneously for almost 20 years. In addition, China Mobile has built the world's massive IPv6 mobile and fixed broadband networks, which serve more than 900 million consumers. To accelerate the adoption of IPv6/SRv6 in the global Internet, several technological innovations and standards breakthroughs have been achieved with G-SRv6.

突破核心技术，主导多项国际标准，实现移动互联网 IPv6/SRv6 跨越式发展

Achieving remarkable achievements in IPv6/SRv6, establishing multiple international standards, and advancing the field of mobile Internet in IPv6/SRv6

本项目突破 IPv6 过渡、SRv6 头压缩等数十项核心技术，主导发布了 30 余项国际标准，推动了移动网、承载网、云基础设施及互联网业务 IPv6/SRv6 端到端跨越式发展。

IPv6/SRv6 services can be developed end-to-end in mobile networks, bearer networks, and cloud infrastructures through these technologies.

针对移动互联网提出了 IPv6 过渡场景、架构和解决方案，中国移动在 3GPP 主导制定 TR23.975、TS29.273 等国际标准，成为运营商 IPv6 部署标准；抓住 4G/5G 发展的历史时机，实现移动网和 IPv6 同步发展，实现了 IPv6 移动网络的超大规模部署。

For the IPv6 transition in the mobile Internet, scenarios, architectures, and solutions have been proposed, several international standards, such as TR23.975 and TS29.273, have been released by China Mobile, which have become the IPv6 deployment standards for operators worldwide. Due to the historical opportunity of 4G/5G deployments, China Mobile has simultaneously developed mobile networks and IPv6, and has realized the large-scale deployment of IPv6 mobile network.

中国移动提出 4G/5G 语音服务采用 IPv6 单栈组网，解决 VoLTE/VoNR 采用 IPv6 部署后与 IPv4 互通的基础性技术问题，打下了 4G/5G 语音使用 IPv6 通信的基础，确保运营商基础通信业务从 IPv4 到 IPv6 的平滑过渡。

IPv6 single-stack networking has been deployed for 4G/5G voice services, which resolves the key technical issues associated with VoLTE/VoNR communication. In this manner, IPv4 to IPv6 voice services are seamlessly transitioned from 4G to 5G networks.

针对移动网特点，中国移动提出 PNAT/BIH 终端 IPv6 过渡技术，并发布成为 IETF RFC6535，被安卓等手机操作系统集成并在全球广泛应用。

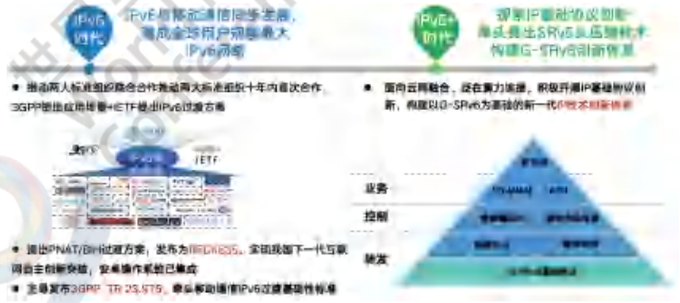
PNAT/BIH-based IPv6 transition technology is proposed based on the characteristics of the mobile network, and has been published as IETF RFC6535. Several mobile operating systems, including Android, have already integrated this technology, making it widely accessible worldwide.

中国移动牵头提出 G-SRv6 压缩帧结构及转发机制，形成完整 G-SRv6 技术体系，被 IETF 采纳成为 SRv6 核心标准，构建了全球领先的 SRv6 策略路由网络。

A compressed SRv6 solution named G-SRv6 has been proposed, which defines the compressed header structure and forwarding mechanism. It has been proposed a series of G-SRv6 protocols, and the key solution has been adopted by the IETF. Chinese Mobile has constructed the world's leading SRv6 backbone network based on G-SRv6 innovations.

中国移动建立并实现互联网业务全栈 IPv6 技术体系，在基础网络、虚拟网元和设备、业务管控调度等层面都取得了技术突破，实现了中国移动互联网应用和云平台大规模 IPv6 部署和应用。

China Mobile has deployed full-stack IPv6 solutions for Internet services and cloud platforms, achieving technical breakthroughs in physical networks, virtual networks, and service management and control.



持续推动 IP 技术演进 初步构建 IP 基础协议创新体系



IPv6 Protocol Innovation System for Technology Evolution

实现 IPv6/G-SRv6
国际标准发展与突破
Development & Breakthroughs
of IPv6/G-SRv6 International Standard





端到端布局，IPv6 网络基础能力全面就绪
End-to-End Upgraded & IPv6 Network Capacity Ready



构建 GSRv6 完整产业链并实现规模应用
G-SRv6 All-round Industry Chain & Scale Deployment

建成全球超大规模的 IPv6 网络基础设施，主导多项 IPv6+ 创新技术，推动 IPv6/SRv6 在全球的广泛部署

Having built the world's large-scale IPv6 network infrastructure, driving numerous IPv6+ innovations, and promoting the deployment of IPv6/SRv6 worldwide

移动网：中国移动持续推进 IPv6 规模部署，实现 4G/5G 网络端到端 IPv6 接入能力，建成全球超大规模应用的 4G/5G 双栈网络和单栈 VoLTE/VoNR 网络，总用户规模达 7.66 亿，涉及基站数量超 500 万，为 1.7 亿家庭宽带用户分配 IPv6 地址。

Mobile Network: China Mobile has accomplished the IPv6 upgrading in 4G/5G network, and built the global large-scale dual-stack 4G/5G network and single-stack VoLTE/VoNR network. These network infrastructures serve 766 million mobile subscribers with more than 5 million base stations, and also allocate IPv6 addresses for 170 million broadband-home users.

承载网：中国移动基于 IPv6/G-SRv6 构建先进的 IP 网络底座。近 1.5 万台路由设备全面完成 IPv6 改造，同时已将 G-SRv6 作为高价值业务的核心协议，基于 SDN+G-SRv6 的创新方案，覆盖全国 300 余个地市、上千台路由器，构建全球领先的承载网。

Bearer network: Recent upgrades to IPv6/SRv6 have been completed on approximately 15,000 routers. Meanwhile, SDN+G-SRv6 solutions for high-value services have been deployed in more than 300 cities and thousands of routers across the country.

云和互联网业务：中国移动已完成“移动云、网络云、IT 云”共 70 余个资源池全面 IPv6 部署，覆盖服务器超 50 万台；自营网站与应用也已全部完成 IPv6 改造，250 多个自营网站 IPv6 支持度达到 100%，130 个自有应用 IPv6 支持度达到 97.8%。

Cloud and Internet services: China Mobile has implemented IPv6 in more than 70 computing pools with more than 500,000 servers, including "mobile clouds", "network clouds", and "IT clouds". Aside from this, more than 250 self-operated websites and 130 applications have fully implemented IPv6, and traffic to self-operated websites and self-owned applications reaches 100% and 97.8%, respectively.

实现 IPv6/SRv6 产业链全方位发展，产生显著经济效益和社会效益

Promoting the maturity of the IPv6/SRv6 industry chain, and bringing economic effectiveness and social benefits significantly

目前中国移动已建成全球超大规模的 IPv6 4G/5G 网络，实现移动网 IPv6 “3G 起步、4G 同步、5G 内生”，全网上万台核心网和承载网设备均支持 IPv6，产生巨大的经济效益。同时中国移动通过引入 G-SRv6 创新技术，可将报文开销压缩 4 倍以上，综合成本节省数百亿元。

There are significant economic benefits associated with China Mobile's IPv6 4G/5G and bearer networks, which include tens of thousands of devices. The G-SRv6 innovative technology has reduced packet overhead by more than four times, thereby significantly reducing network bandwidth costs by tens of billions of yuan.

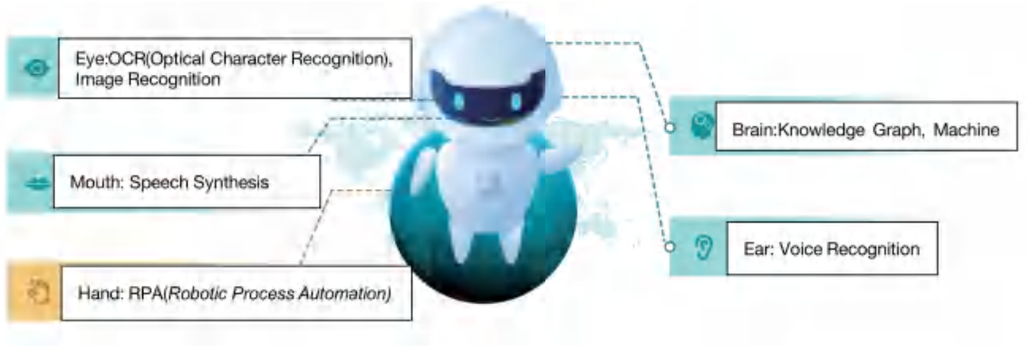
中国移动实现 IPv6 端到端产业链全方位发展，发挥移动互联网应用的头部效益，为 7.6 亿手机用户、1.7 亿有线宽带、1 亿物联网等终端设备提供 IPv6 服务，为咪咕视频等 TOPN 的 200 余款云上应用提供 IPv6 服务，极大促进了 IPv6 的应用发展。

There is a fully developed IPv6 industry chain and ecosystem, serving 760 million mobile phone subscribers, 170 million wired broadband users, 100 million IoT devices, as well as 200 top-level services like Migu Video. Thus IPv6 applications are greatly expanded.



IPv6/SRv6





“RPA+AI”——基于认知智能的人工智能组件融合应用成果

“RPA+AI” —— An Fusion Application of Multiple AI Technologies Based on Cognitive Intelligence

国家电网有限公司大数据中心
Big Data Center of State Grid Coporation of China

引言

RPA+AI 是数字化转型趋势下的新型基础设施，已经成为共识。国家电网有限公司将人脸识别、OCR、语音识别等人工智能组件与 RPA 在业务上串联成为整体，将 AI 能力从单一场景应用中解放出来，延伸 RPA 覆盖的业务链范围，提升 RPA 场景的智慧性，构建了企业级的 RPA 服务能力，进一步强化了基层减负和管理增效，提升了公司业务数字化、智能化水平。

Introduction

In the trend of digital transformation, the combination of robotic process automation (RPA) and artificial intelligence (AI) has become an integral part of the infrastructure of many companies. State Grid Corporation of China (SGCC) has integrated its business processes with RPA and artificial intelligence technology in order to develop an enterprise-level RPA service system, including face recognition, OCR (optical character recognition), voice recognition, and so on. As a result, its digital assets are strengthened, and its gross-root staff burdens are reduced substantially. A further benefit is that it improves the level of business digitization and intelligence of the organization.

融合 AI 能力，赋能 RPA 智能认知

Strengthen the intelligent cognition ability of PRA with AI technologies

工程化的 RPA+AI 应用融合设计

国网公司针对传统 RPA 在基层业务应用的瓶颈，由国网数字化部牵头，国网大数据中心具体负责，创造性的构筑了 RPA+AI 工程化应用平台，能够持续提升在复杂业务环境下的适用能力，实现业务场景的深度覆盖，完成复杂、繁琐的系统操作和数据录入等场景，打破传统 RPA 只能按照特定规则下处理业务的局限。平台以 RPA 组件、自动化需求挖掘为基点，采用低代码自动化应用的用户触点，将任务自动化转化为流程自动化，借助其他 AI 组件及两级部署的应用能力，实现流程场景的一站式封装应用，促进基层班组业务赋能。

RPA+AI application design in Engineering

A solution to the bottleneck problem of traditional RPA applications' use in basic business scenarios has been developed by the Big Data Center of SGCC through the development of an RPA+AI engineering application platform under the direction of the Digitization Department. This platform has been designed so that it is capable of continuously improving its application in complex business scenarios, as well as providing comprehensive coverage of all business scenarios. While performing complex system operations and data collection at the same time, it overcomes the limitation that traditional RPA can only process business in accordance with specific rules. To transform "task automation" into "process automation," the platform uses RPA tools and automated demand mining, as well as low-code automation to transform "task automation" into "process automation." By utilizing other artificial intelligence technologies and deploying them at two levels (headquarters-province), it achieves a one-stop packaging solution for various technological processes and motivates operators at the production line to develop business applications.

打造基于 RPA+AI 的数字化服务新模式

Creating a new digital service mode based on RPA+AI

针对国网公司各业务条线业务量大、重复性高的工作，形成了面向公司各专业 RPA 数字化服务新模式，建成了各专业的 RPA 数字化服务样板间，融合 OCR、NLP、知识图谱等 AI 组件，完成了联合应用场景的开发，为用户提供了无断点的 RPA 流程应用服务。

The Big Data Center of the SGCC has created a new RPA digital service mode, as well as several demonstrations of RPA digital services with different departments, that integrate AI such as OCR, NLP, and knowledge graphs. The component provides users with RPA process application services without breakpoints and completes the development of joint application scenarios.

AI 机器人创新应用

Innovative application of AI robots

基于 NLP、知识图谱、OCR 等人工智能组件，结合实际业务场景，构筑各类型 AI 软件机器人，并通过智能化交互设备，进一步完善了人机协同、人机交互的服务模式。已结合营销业务场景，开发完成了基于网上国网智能客服机器人，结合设备业务场景，开发完成了主设备知识库智能客服机器人。

In conjunction with actual business scenarios, multiple types of AI software robots are built using artificial intelligence technologies such as natural language processing, knowledge graphs, optical character recognition, and so on, and intelligent interactive equipment is used to further improve the service mode of human-computer collaboration and human-computer interaction. For our marketing scenario, we have developed an intelligent customer service robot based on the Online State Grid App; for our equipment business scenario, we have developed an intelligent customer service robot based on the "key equipment knowledge base".

深度融合应用，典型场景共享

Typical applications sharing

RPA+AI 融合应用成果已在国网公司 27 家省公司开展推广应用，在基层业务办理效率、业务流转便捷性等方面起到了极大的促进作用。

RPA and AI fusion applications have been implemented in 27 provincial companies of SGCC, which have enhanced the efficiency of grass-roots staff and facilitated business processes.

将 RPA+AI 服务能力与业务场景深度融合，打造典型应用，进行推



广共享，助力实现业务数字化、数字业务化、场景智能化。数字化服务模式依托人工智能平台在业务部门特别是营销、人资、财务业务中得到初步验证，已经开始推广到包含电网资源业务、客户服务、项目管理等各应用；AI 机器人将陆续部署到国网公司南北服务中心，辅助或者逐步取代人工客服的部分工作。RPA+AI 相关成果已在业务领域广泛应用。

SGCC's Big Data Center has developed typical RPA and AI fusion applications, sharing them via the RPA+AI engineering application platform, by deeply integrating RPA+AI service capabilities with business scenarios. Business digitization, digitization into business, and scene intelligence are all on the agenda for the company. By utilizing artificial intelligence, the digital service model has been initially validated in a variety of business departments, including marketing, human resources, and finance, and has already been promoted for use in applications including power grid resource management, customer service, and project management. In addition, AI robots will be deployed to State Grid's north-south service center to assist and gradually replace some of the manual customer services. Currently, "RPA+AI"-related experience and results are being widely used in the business sector.

RPA+AI 的融合应用可将更多数据结构化，不断挖掘业务流程自动化潜力，助力企业实现持续的增效降本，在大型企业中具有较强的参考性和推广性。

The fusion of RPA and AI can create more structured data, inspire potential application in business process automation, and assist enterprises in reducing costs and improving efficiency. Large enterprises believe that it has a strong referential and promotional value.

服务基层班组，助力减负增效

Reducing the burden on the gross-root staff as well as improving the efficiency of work

盖范围，满足跨专业、跨层级、跨场景的数字化业务流程应用模式要求，进一步提升基层减负的效力。

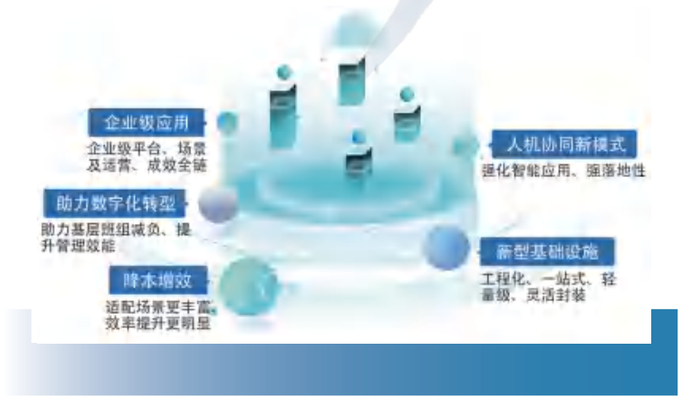
Traditional RPA is mainly aimed at periodic, repetitive, and mechanical operation tasks. It's incapable of dealing with unstructured data processing and cross system business processing. The integrated application of RPA+AI can achieve intelligent processing of unstructured data, expand the service coverage of RPA, meet the requirements of cross professional, cross hierarchical, cross scenario digital business process application mode, and further improve the effectiveness of burden reduction.

以国网大数据中心自研自用的 44 个应用场景为例，使用传统 RPA 流程，需投入资金约 700 万元，提升工作效率 3-5 倍，每月节约时长约 570 小时。使用 RPA+AI 的融合应用，在投入不变的情况下，可以完成覆盖范围更广价值更深的业务场景，实现工作效率 6-8 倍提升，平均每月节约工作时长可达 1200 小时以上。

With 44 RPA and AI fusion applications developed and used by the Big Data Center of SGCC as computing units, it costs approximately 7 million yuan compared to developing traditional RPA applications, 3-5 times more efficient work could be achieved, and about 570 hours of work per month can be saved. With the same investment condition, it would achieve business scenarios with wider coverage and deeper value. Fusion applications of RPA and AI are able to improve working efficiency by 6-8 times, resulting in a monthly savings of about 1200 working hours.

RPA+AI 融合应用完善了传统 RPA 的服务能力，扩展自动化场景的范围和深度，切实服务基层班组减负和管理效能提升，持续推进数字化转型建设，为人工智能发展应用做出创新性的贡献。

By combining RPA and AI applications, you are improving the service capabilities of traditional RPA applications, enlarging the scope of automation work scenes, effectively reducing the workload of gross-roots support teams, and improving management efficiency. A number of innovative contributions are made to the development and application of artificial intelligence.



传统的 RPA 工具主要针对周期性的、重复性的、机械性的操作任务，对非结构化数据处理以及跨系统业务处理的应对能力不足，RPA+AI 的融合应用可以实现对非结构化数据的智能化处理，拓展 RPA 的服务覆

复杂通信环境下的稀疏信号处理理论与方法

Theory and Method on Sparse Signal Processing Under Complex Communication Environments

清华大学
Tsinghua University

引言

下一代无线通信势必朝着超大带宽、超大规模天线、超密集小区的方向发展。针对传统信号处理思想难以适应下一代无线通信与网络发展需求的难题，本项目开辟了稀疏信号处理的新视角，促进信息网络基础设施水平的进一步提升。

Introduction

The next generation of wireless communication will result in ultra-wide bandwidths, ultra-large antennas, and ultra-dense cells, which traditional signal processing ideas are unlikely to accommodate. Through this project, a new perspective is opened up for sparse signal processing, which will contribute to the enhancement of the information network infrastructure.

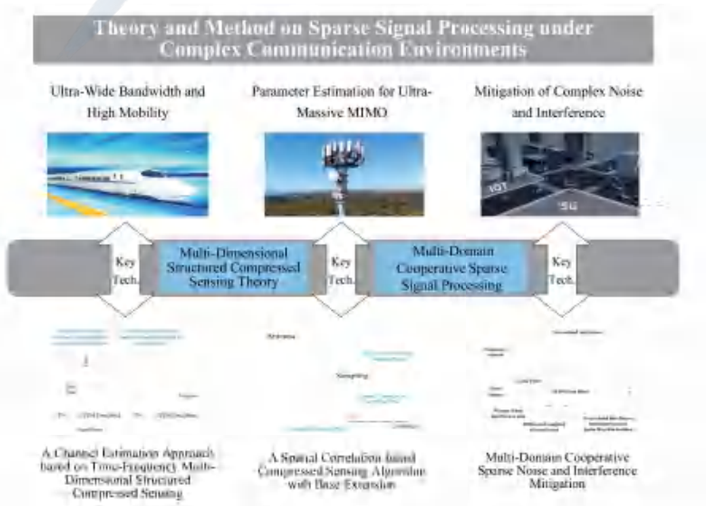


构建基于压缩感知的无线通信信号稀疏处理理论框架

A theoretical framework based on compressed-sensing is presented for sparsely processing wireless communication signals

本项目系统深入地研究了复杂无线通信场景中信号的多维稀疏化特征，建立了刻画稀疏信号与实际无线信道和传输系统内在本质联系的数学模型，提出了基于压缩感知的无线信号处理理论框架，创建了多维结构化压缩感知和多域协同稀疏信号处理的理论和技术体系。

The multidimensional sparse characteristics of practical signals are systematically examined in complex wireless communication scenarios. In order to fully describe the intrinsic relationship between sparse signals and real wireless channels and transmission systems, a mathematical model is developed. Wireless signal processing is conceptualized using a compressed-sensing-based theoretical framework. The development of a multidimensional structured compressed sensing system and a multi-domain cooperative sparse signal processing system is presented.



揭示了无线通信系统中时频二维训练序列的映射关系，提出了基于多域协同压缩感知的无线信道估计模型，该模型证明了基于先验信息辅助的结构化稀疏信号处理方法的有效性，可显著降低压缩感知算法的复杂度、有效提高估计精度。

It is shown that there is a mapping relationship between training sequences in the time domain and those in the frequency domain in wireless communication systems. Using multi-domain cooperative compressed sensing as a channel estimation method, it is demonstrated that the prior information-aided structured sparse signal processing method is effective at reducing the complexity of compressed sensing algorithms and improving the accuracy of estimation.

阐明了大规模天线系统中天线之间的空间相关性。验证了大规模多天线各个信道冲激响应支撑集之间的联合稀疏特征，提出了基于基扩展的信道时变稀疏特性表征方法。

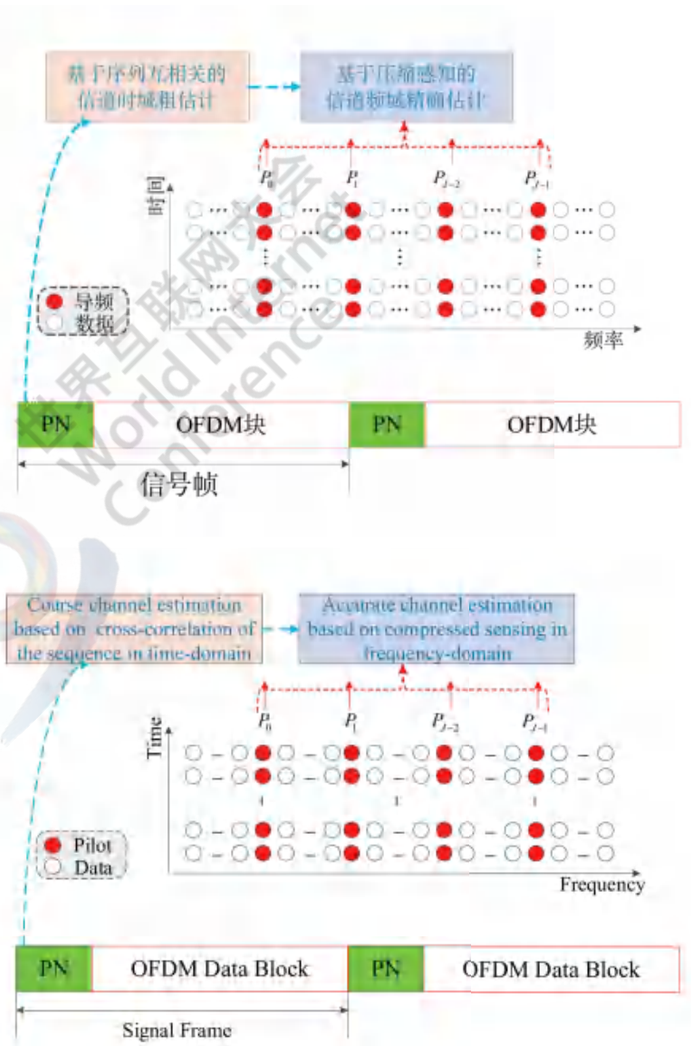
In large-scale antenna systems, spatial correlation is elucidated between multiple antennas. It is shown that the joint sparse feature among the support of the channel impulse responses in ultra-large-scale multi-antenna systems can be verified. Based on basis expansion, a sparse representation method is proposed for time-varying channels.

构建了基于多维压缩感知的时频稀疏噪声干扰估计与消除理论。提出先验信息辅助下基于多维结构化压缩感知的时频稀疏噪声联合消除方法，实现支撑窄带海量机器类通信与增强移动宽带业务共存的窄带干扰消除，有效降低非高斯干扰对通信系统的影响。

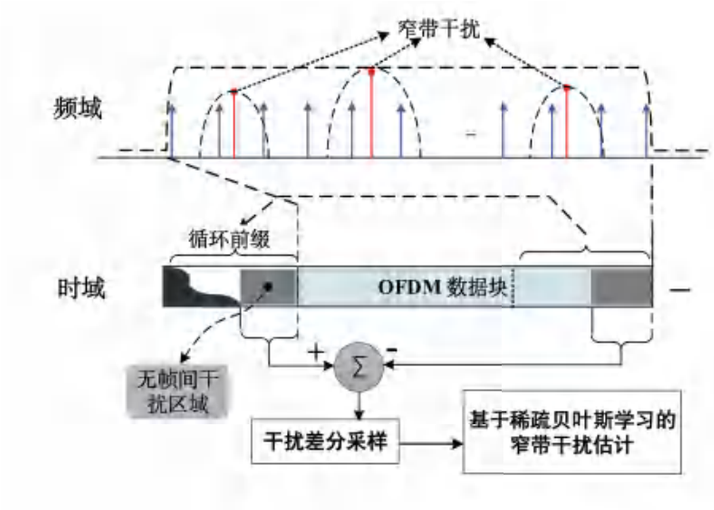
Using multi-dimensional compressed sensing, a theory for suppressing and eliminating time-frequency sparse noise and interference is developed. A prior information aided joint elimination method of time-frequency sparse noise based on multi-dimensional structured compressed sensing is proposed, which supports the coexistence of narrowband massive machine-type communication and enhanced mobile broadband services, and reduces interference from non-Gaussian sources effectively on communication systems in a manner that is both effective and efficient.

在下一代无线通信的多个关键领域推广与应用验证

Multi-field promotion and application verification in the next generation wireless communications



时频协同压缩感知信道估计方法
Time-Frequency Cooperative Compressed Sensing Based Channel Estimation Method



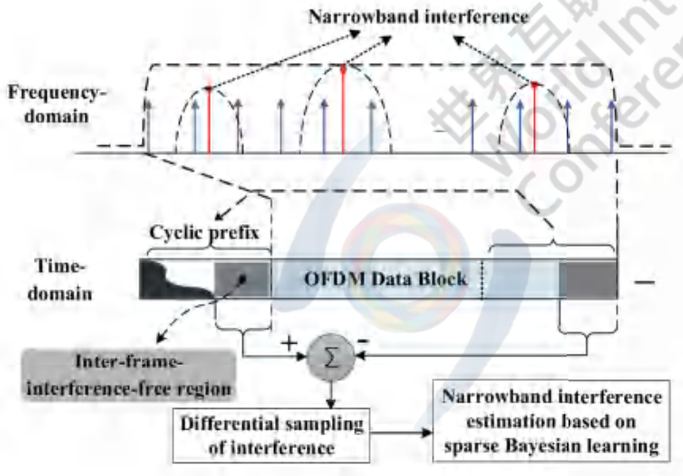
基于稀疏贝叶斯学习的窄带干扰消除方法

提出的噪声抑制算法可用于车联网领域，针对车联网通信中同时存在的时域、频域非高斯稀疏噪声展开研究，提出了基于多维结构化压缩感知理论的时频稀疏噪声联合估计与消除架构，有效提升车联网通信可靠性。

In the field of Internet of Vehicles, the proposed noise suppression algorithm can be applied. Using a joint framework of time-frequency sparse noise estimation and elimination based on multi-dimensional structured compressed sensing, a framework of non-Gaussian sparse noise estimation and elimination in vehicular communication systems is proposed that effectively improves the reliability of vehicular communication systems.

提出的干扰估计消除算法可用于多系统共存领域。针对 5G 无线通信演进中 NB-IoT 窄带物联网与宽带 LTE-A 共存的问题展开研究，提出了基于块稀疏贝叶斯学习理论的 NB-IoT 窄带干扰估计与消除方法。

In the context of multi-system coexistence, the proposed algorithm for estimating and eliminating interference can be applied. The objective of this paper is to consider the coexistence of narrowband internet-of-things (NB-IoT) and enhanced mobile broadband communications (LTE-A) as 5G wireless communications evolve. Based on the sparse Bayesian learning theory, an NB-IoT-specific narrowband interference estimation and elimination method is proposed.



Narrowband interference elimination method based on sparse Bayesian learning

提出的信道估计方法可用于毫米波通信领域，发掘毫米波大规模天线系统中多个天线对应的信道冲激响应支撑集之间的联合稀疏特征，挖掘其在天线空域、信道时延域和信号时间域三个维度的相关性。

A millimeter-wave communication system can benefit from the proposed channel estimation method. As a result of analyzing the joint sparse feature of channel impulse responses corresponding to multiple antennas in large-scale antenna millimeter-wave systems, a correlation is established in three dimensions, namely the spatial domain of the antenna, the delay domain of the channel, and the signal time domain.

提出的多域协同信号处理方法，可用于电力线和可见光通信深度融合系统中，构建深度融合的异构传输架构，突破传统单一网络的通信瓶颈和网络覆盖限制，创新性地将光、电信号和信道进行融合建模与联合处理。

In the deep integration system of power line communication and visible light communication, the proposed multi-domain cooperative signal processing method can be applied to construct a deeply integrated and heterogeneous transmission architecture that overcomes the communication bottlenecks and network coverage limitations of traditional single-type networks. Hybrid modeling and joint processing are achieved by combining optical and electric signals and channels.



电力线与可见光深度融合通信系统
Deeply Integrated System of
Power Line Communication and Visible Light Communication



日内瓦发明展览会金奖
Gold Medal of
the Geneva Inventions Exhibition



基于稀疏贝叶斯学习的窄带干扰消除方法
High-Rate Visible-Light-Based Multimedia Communication System



信息社会峰会冠军奖
Champion Award of the World Summit
on the Information Society

研究成果在下一代通信领域具有广阔的应用前景

The research outcomes have broad application prospects in the field of next-generation communications

该项目提出的理论、模型和方法得到了国际同行的验证和认可，相关成果获得了信息社会世界峰会冠军奖和日内瓦国际发明展览会金奖，相关算法正与国内公司合作进行具有自主知识产权的产品应用研究，为构建具有高谱效、高能效和高可靠性的未来无线通信系统和互联网信息基础设施奠定了理论基础，对下一代互联网信息体系和新型无线通信系统的优化设计具有重要的指导意义和良好的理论技术参考价值。

Academic and industry experts have verified and widely recognized the theories, models, and methods proposed in this project. The Geneva Invention Exhibition's Gold Award and the Champion Award of the World Summit on the Information Society were awarded in recognition of relevant achievements. In cooperation with domestic companies, research is being conducted on products and applications with independent intellectual property rights based on the relevant algorithms. In this project, theoretical foundations were laid for building future wireless communication systems and Internet information infrastructure that are spectrally efficient, energy efficient, and reliable. This document is an important guidance and provides a good theoretical and technological framework for optimizing the design of next-generation Internet information systems and new wireless communication technologies.

新一代高性能云端人工智能推理芯片

A New Generation of High-Performance Cloud AI Inference Chip

上海燧原科技有限公司
Enflame Technology Co., Ltd.

引言

燧原科技第二代 AI 芯片“邃思 2.5”，定位云端推理，对标国际旗舰产品，在关键技术及产品能力上达到国际领先水平，将持续推动规模化的商业落地。

Introduction

“DTU 2.5”(DTU: Deep Thinking Unit) is the second-generation AI chip from Enflame Technology Co., Ltd (aka Enflame), positioned for cloud-based AI inference, benchmarking against the international flagship product. With key technologies and product capabilities, it achieves an international leading level, and it promotes large-scale commercial implementations.



打造领先的 DSA 架构 AI 芯片

Innovating leading DSA architecture AI chip

“邃思 2.5”芯片针对重点领域技术攻关，在以下多方面取得显著突破：

As part of its effort to achieve technical breakthroughs in key areas, "DTU 2.5" has made significant advances in the following areas:

聚焦 AI 加速的计算架构

基于人工智能 DSA 架构设计，聚焦指令集、计算核心及调度系统的微架构创新，可达到国际旗舰相当或更优的计算能力。

AI-focused Accelerating Computing Architecture

In accordance with the design of artificial intelligence DSA architecture (domain acceleration processor), “DTU 2.5” can be implemented for key operators, enabling comprehensive improvement of the multi-level optimization processing capabilities of operators, models, and applications by focusing on microarchitecture innovations in instruction sets (ISA), computing cores, and scheduling systems.

高吞吐低延时的领先存储架构

多层级的分布式片上存储架构，结合业界领先的 HBM2E 设备内存方案，实现芯片级高带宽、高容量、高响应的存储系统。

Leading Storage Architecture with High Throughput and Low Latency

The multi-level distributed on-chip storage architecture, combined with the industry-leading HBM2E device memory solution, realizes a chip-level high-bandwidth, high-capacity, and highly responsive memory system, effectively improving memory access efficiency and data resident capacity.

硬件级虚拟化技术支持算力资源高利用率

既满足云部署的灵活编排要求，同时通过细粒度的资源灵活切分提供多达 6 个性能隔离、安全可靠的虚拟设备。

Hardware Virtualization Technology Supports High Utilization of Computing Resources

In addition to meeting the orchestration requirements of cloud deployment, "DTU 2.5" also offers up to six performance-isolated, safe and reliable virtual devices through fine-grained resource segmentation. Supports multi-tenant and multi-task scenarios and ensures efficient management..

动态性特征支持高速演进的 AI 算法及开发范式

通过软硬协同全栈设计与实现，结合运行时的即时解析、弹性内存分配等技术手段，成功解决动态形状、动态词长、动态 BatchSize 等多类型动态问题。

Dynamic Features Support Rapid Evolution of AI Algorithms and Development Paradigms

It is capable of solving many types of dynamic problems, including dynamic shapes, dynamic word lengths, dynamic batch sizes, etc., successfully. Through the full-stack design and implementation of software and hardware collaboration, real-time analysis, elastic memory allocation and other technical means, and actively exploring possible solutions to higher-order problems, such as dynamic control flow, through the application of real-time analysis at runtime.

基于框架泛化适配架构提升生态支持能力

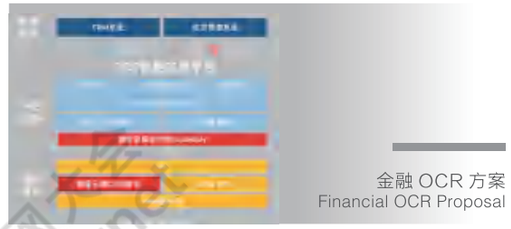
配套软件栈，采用 HLIR (High Level IR) 技术，在框架后端通过高层级语义解析算法网络逻辑，形成统一的抽象描述对接下层组件，高效复用底层软件的调度与算子等实现。

Improve Ecological Support Capability Based on Framework Generalization Adaptation Architecture

Through the implementation of HLIR (High Level IR) technology in "DTU 2.5", a unified abstract description is constructed to connect the lower-level components through a high-level semantic analysis algorithm network logic. The scheduling and operators of the underlying software can be efficiently reused, reducing the difficulty of adapting the new framework and platform, and solving the last mile problem of computing power landing customer solutions.



“邃思 2.5”芯片
“DTU 2.5” Chip



金融 OCR 方案
Financial OCR Proposal

多领域落地与推广

Multi field implementation and promotion

新基建领域，基于数千颗“邃思 2.5”打造的 AI 视频基础设施，可以有效纳入某省会城市近万路视频流，针对城市治理、智慧工地、重大场所管理、智慧社区等多个智慧城市应用场景提供高效服务。

In the new infrastructure construction industry, the AI video infrastructure based on thousands of "DTU 2.5" chips supports nearly 10,000 video streams in the provincial capital city, enabling the provision of efficient services in multiple smart city applications, including urban governance, smart construction sites, major site management, and smart communities.

金融行业，“邃思 2.5”结合国产 AI 平台及算法，针对票据识别、人脸识别、身份证与名片识别、营业执照等文件内容识别等多个智慧识别类应用提供安全高效的整体方案。

In the financial services industry, "DTU 2.5" combines a domestic AI platform and algorithms for a variety of smart recognition applications, including bill recognition, face recognition, ID and business card recognition, business license recognition, and other document content recognition.

互联网行业，落地互联网客户语音识别、内容理解等场景，依托“邃思 2.5”领先的产品能力，为客户提供深度定制优化，最终在多个典型应用场景下取得超过国际旗舰的性能。

In the Internet industry, online chat and dialogue services of Internet companies are empowered by "DTU 2.5" for real-time voice-to-text conversion and picture-based content auditing.

助力人工智能行业加速发展

Empowering the AI industry to accelerate development

经济效益：通过“邃思 2.5”打造算力底座，已为多个客户场景的降本增效及规模化应用提供核心价值，计算效率至少提高一倍，成本也具有明显优势，进而加速各行业人工智能商业化应用落地，促进数字化基础设施不断完善。

Economic Benefits:Through Enflame's cloud AI computing power, partners and customers can benefit from building a computing power base based on "DTU 2.5", providing core value for cost reduction and efficiency enhancements in customer scenarios, which in turn will enable applications to scale up.

社会效益：助力 AI 产业规模化，打造高效的异构计算方案

Social Benefits:Facilitate the Scale of the AI Industry, providing cost-effective heterogeneous computing solutions for the large-scale implementation of intelligent scenarios.

带动产业链发展，推动下游厂商的持续投入

Drive the Development of the Industrial Chain, and encourage downstream manufacturers to invest continuously in advanced node technology, advanced packaging, automated testing, and production line optimization.

人工智能及集成电路的人才储备，打造一批对人工智能和高端 IC 行业具备充分知识和实践经验的高端人才

Build the Talent Pool of AI and IC, focusing on high-end talents who possess both knowledge and practical experience in AI and the high-end IC industry.

HPLC 架起能源互联网通信高速路

HPLC Sets up the Energy Internet Communication Highway

中国电力科学研究院有限公司
China Electric Power Research Institute

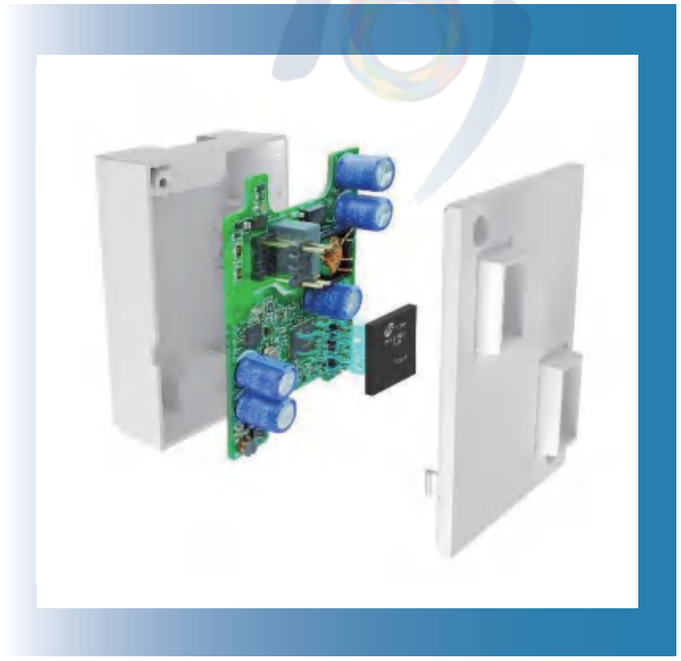
引言

在能源互联网领域，各类产业政策不断推动了能源通信技术的更新迭代。通信需要支撑的业务种类日益丰富，各类节点数量数以亿计。先前的普遍应用的窄带载波技术存在速率低下、传输信号容易被影响的缺点。

Introduction

In the field of energy Internet, various industrial policies have continuously promoted the update and innovation of energy communication technology. The service types to be supported by communications are increasingly diverse, with hundreds of millions of nodes. The previously commonly used narrowband carrier technology has the disadvantages of low rate and easily interfered signals.

HPLC 突破了电力线载波的时频分集拷贝、时序优化、多网络协调等关键技术



HPLC has made breakthroughs in key technologies such as time-frequency diversity copying, timing optimization, and multi-network coordination of power line carriers

项目团队围绕电力线通信技术开展技术攻关，突破了电力线通信的时频分集拷贝、时序优化、多网络协调等关键技术，形成了完整的高速电力线载波通信（HPLC）技术体系。

There have been breakthroughs in key technologies such as time-frequency diversity copying, timing optimization, and multi-network coordination of power line communication by the team, and a complete system for high-speed power line carrier communication (HPLC).

HPLC 具备更高的频带利用率、抗码间干扰能力和抗信道衰落能力，将用户用电信息的通信频度由每日 1 次提升至 96 次，并实现了 90 秒停电自动上报，可以有效支撑大规模能源计量系统的可靠运行。

With capabilities of high frequency band utilization, anti-intersymbol interference and anti-channel fading, HPLC increases the communication frequency of user power information from 1 time to 96 times a day, and it automatically reports power failures within 90 seconds, making it possible to support the reliable operation of large-scale energy metering systems effectively.

HPLC 具备灵活的物理块配置方案，优化信道了接入时序关系，将通信时延降低至 50 毫秒以内，可自适应匹配以智能家居、智慧城市为代表的业务建设需求。

A key characteristic of HPLC is its flexibility in physical block configuration, its optimization of the channel access timing relationship, and the ability to minimize communication delay to less than 50 milliseconds. Consequently, HPLC is capable of adapting to the business construction requirements represented by smart homes and smart cities.



HPLC 可以用于智能抄表、智慧照明、智能家居等领域，利用电力线传输信息
HPLC Uses Power Lines to Deliver Information, and can be Used in Smart Meter Reading, Smart Lighting, and Smart Home and Other Fields

HPLC 通信单元应用数量已超过 2 亿只

The number of HPLC communication units has exceeded 200 million

HPLC 通信单元已在中国部署 2.23 亿只电表，团队以技术转让的形式，与包括华为海思、东软在内的多家国内顶尖集成电路企业紧密合作。截止目前团队已实现成果转化 2.27 亿元。集成电路企业的 HPLC 产品销售额超过 113 亿元。未来团队将继续寻求集成电路企业合作，开拓 5.6 亿只国内电表的广阔市场。

HPLC communication units have been deployed in 223 million energy meters in China, and the team has worked closely with a number of top domestic integrated circuit companies, including Topscomm, Hisilicon and Neusoft in technology transfer. Until now, the team has generated a commercialization income of 227 million yuan. The sales of HPLC products by integrated circuit companies exceeded 11.3 billion yuan. A vast market of 560 million energy meters is expected to be developed in China through collaboration with integrated circuit companies in the future.

国际电表市场方面，团队具备全面参与沙特 500 万智能电表的项目经验。印尼、智利方面对 HPLC 技术高度认可，未来将拥有 7000 万智能表的市场前景。此外，项目团队将成立 IEEE 1901.1 标准认证实验室。在此基础上，团队将寻求具备海外运营能力的投资厂商，拓展海外智能电表的亿万市场。

With full participation in the 5-million smart meter project in Saudi Arabia, the team has extensive experience. With a market potential of 70 million smart meters in the future, Indonesia and Chile have highly recognized HPLC technology. Furthermore, the project team will establish a laboratory for the certification of IEEE 1901.1 standards. To expand the overseas market for smart meters, the team will seek investment from manufacturers with overseas manufacturing capabilities.

项目成果推动了高速载波通信产业链的健康发展

Project results promote the sound development of the high-speed carrier communication industry chain

本项目的研究成果促进了高速载波技术路线的统一，规范了通信芯片的制造标准，推动高速载波通信产业链的健康发展。同时，具有互联互通特征的 HPLC 技术，大幅提升了智能感知通信技术的标准化水平，为后续支撑能源互联网多场景多维度的下一代智能感知通信技术的互联互通化探索了道路。



项目成果规范了各类 HPLC 产品的制造标准
Project Results Standardize the Manufacture of Various HPLC Products

This project promotes the unification of high-speed carrier technology routes, the standardization of communication chip manufacturing processes, and the sound development of the high-speed carrier communication industry chain. The HPLC technology, which is interconnected, has also greatly improved the standardization of intelligent sensing communication technology, and has enabled explorations for the interconnection of the next generation intelligent sensing communication technology to support the energy Internet in multiple scenarios and dimensions.



HPLC 已经在国内外获得广泛应用
HPLC Has Been Widely Used at Home and Abroad



面向量产的智能重卡自动驾驶系统

Heavy-Duty Truck Autonomous Driving System for Mass Production

赢彻科技（上海）有限公司
Inceptio Technology (Shanghai)Co.,Ltd.

赢彻科技（浙江）有限公司
Inceptio Technology (Zhejiang)Co.,Ltd.

引言

自动驾驶技术的实践应用，可以实现降本增效的经济效益以及提升安全、节能环保等社会价值。中国城际货运市场规模庞大，但行业痛点突出，迫切需要创新的解决方案，从而成为自动驾驶技术最佳的实践应用场景。

Introduction

It is feasible to demonstrate the economic benefits of cost reduction and efficiency increase through the practical application of autonomous driving technology, as well as enhancing the social value of safety, energy conservation, and environmental protection through its practical application. Intercity freight in China is a large market, but there are significant pain points, and innovative solutions are essential, resulting in the best practical application scenario for autonomous driving.

全面基于量产、安全、高效、低碳的智能重卡自动驾驶技术

Comprehensive intelligent heavy-duty truck autonomous driving technology with safety, efficiency and low carbon for mass production

由于自动驾驶技术研发起点高，投入大，不确定因素多，因此国际上行业展开重卡 L4 自动驾驶技术的探索，基本采用了后装的技术路线，并不直接面向量产，难以迅速投入大规模的商业应用。为了解决这一难题，赢彻科技在自动驾驶技术上采取了“全栈自研、面向量产”为核心技术策略。

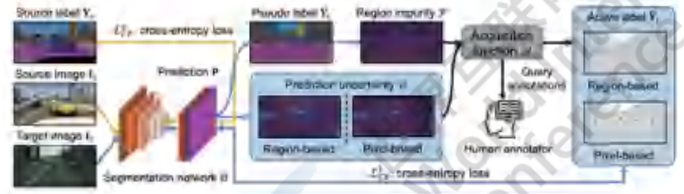
Since the development and research of autonomous driving technologies has a high threshold with many uncertain factors and requires a substantial investment, the industry has begun exploring heavy-duty truck autonomous driving technology, essentially adopting the technical route of retrofitting, rather than dealing directly with mass production, and it is difficult to rapidly implement it in large-scale commercial applications. As a solution to this issue, Inceptio Technology has adopted the core technology strategy of "full stack self-research and mass production oriented" in the field of autonomous driving.

首先，赢彻创新研发了全球领先全栈自研 L4 级卡车自动驾驶核心技术。在算法上，突破性解决了长距离感知、自适应鲁棒控制和节油等技术难点。在软件上，轩辕系统针对功能安全和信息安全，设计了独有的安全管理系统。在计算平台上，轩辕计算平台具备高算力、高能效、高安全的特点。 在线控底盘层面，轩辕系统直接面向卡车量产，这也是行业率先量产的全冗余线控底盘。

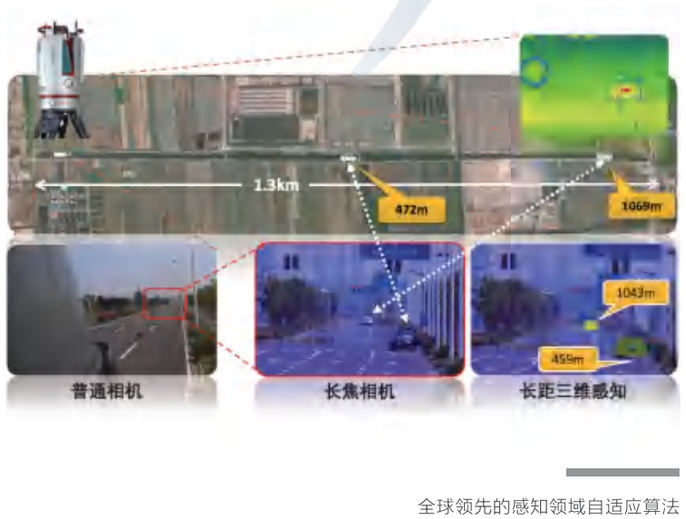
Firstly, Inceptio Technology innovated and developed the world's leading autonomous driving technology used in L4 trucks. In terms of algorithm, technical difficulties such as long-distance sensing, adaptive robust control, and fuel savings have been overcome. With respect to software, Xuanyuan system has developed a unique system for managing information security and functional security. On the computing platform, the Xuanyuan platform is characterized by a high degree of computing power, energy efficiency, and security. On the level of the on-line control chassis, the Xuanyuan system is directly oriented to the mass production of trucks, and it is the first full redundant on-line control chassis in the industry.

其次，赢彻成为业内率先跑通卡车自动驾驶量产的技术公司，与产业链合作实现了五项行业率先量产的领先突破，包括全冗余线控底盘；L3/L4 卡车车规级硬件套装；面向自动驾驶的人机交互系统；抵御各类恶意安全入侵的网络安全设计方案及行业内领先的测试验证体系，2021 年底率先实现 L3 级别自动驾驶卡车的前装量产。

Secondly, Inception Technology became the first technology company in the industry to run through the mass production of autonomous truck driving, and in collaboration with the industrial chain, they produced five leading breakthroughs in the industry, including a fully redundant wire control chassis, a L3 / L4 truck hardware package that meets vehicle quality, a human machine interaction system for autonomous vehicles and a network security design scheme that resists various malicious security intrusions and a leading industry test and verification system. Towards the end of 2021, Inceptio Technology became the first company to mass produce automatic driving trucks at the L3 level.



RIPU 算法框架总览
Overview of RIPU Algorithm Framework



全球领先的感知领域自适应算法
The World's Leading Self-adaptive Algorithm in Perception Field

在技术领先性上，赢彻已业内率先实现依托量产方案的 L4 级自动驾驶重卡全无人驾驶测试，此外还打造出智能重卡领域领先数据闭环平台，将更早实现全无人驾驶重卡的量产。

As in technology advancement, Inceptio is the first company in the industry to achieve the full unmanned test of a L4 level autonomously driving heavy-duty truck based on the mass production scheme. Additionally, it has developed a leading data closed-loop platform for intelligent heavy-duty trucks, which will facilitate the mass production of fully unmanned heavy trucks in the future.

在全球率先实现了车规级智能重卡的量产和运营

Inceptio technology is the first in the world to realize the mass production and operation of intelligent heavy-duty truck with L3 autonomous driving technology which meets vehicle grade

本技术应用已初步形成了覆盖全中国、基于商业合约、按公里付费的运力网络。自 2021 年年底，赢彻科技实现智能卡车的前装量产后，已与京东物流、德邦快递、申通快递、中通快运和雀巢，百威等多家行业头部货主，在多条线路上开展常态化的商业运营。目前量产规模已达数百台，运营里程已超过 500 万公里 0 事故，预计未来一年运营里程将突破一亿公里，将初步形成规模效应。

Initially, this technology was used to establish a transport network covering the entire territory of the People's Republic of China, which was based on contractual arrangements and paid by kilometer. Since the end of 2021, Inceptio technology has been able to produce intelligent trucks in mass quantities. Many industry leaders, such as JD logistics, Debon express, Shentong express, Zhongtong express, Nestle and Budweiser, have conducted normal commercial operations with the company. At present, there are several hundred units in mass production, and more than five million kilometers have been logged in operation. There are no accidents. During the next year, it is anticipated that the operating mileage will exceed 100 million kilometers, which will initially result in a scale effect.

自动驾驶将给干线物流行业带来至少数千亿人民币的技术红利，减少交通安全事故，降低碳排放，并孕育出超级运力平台。

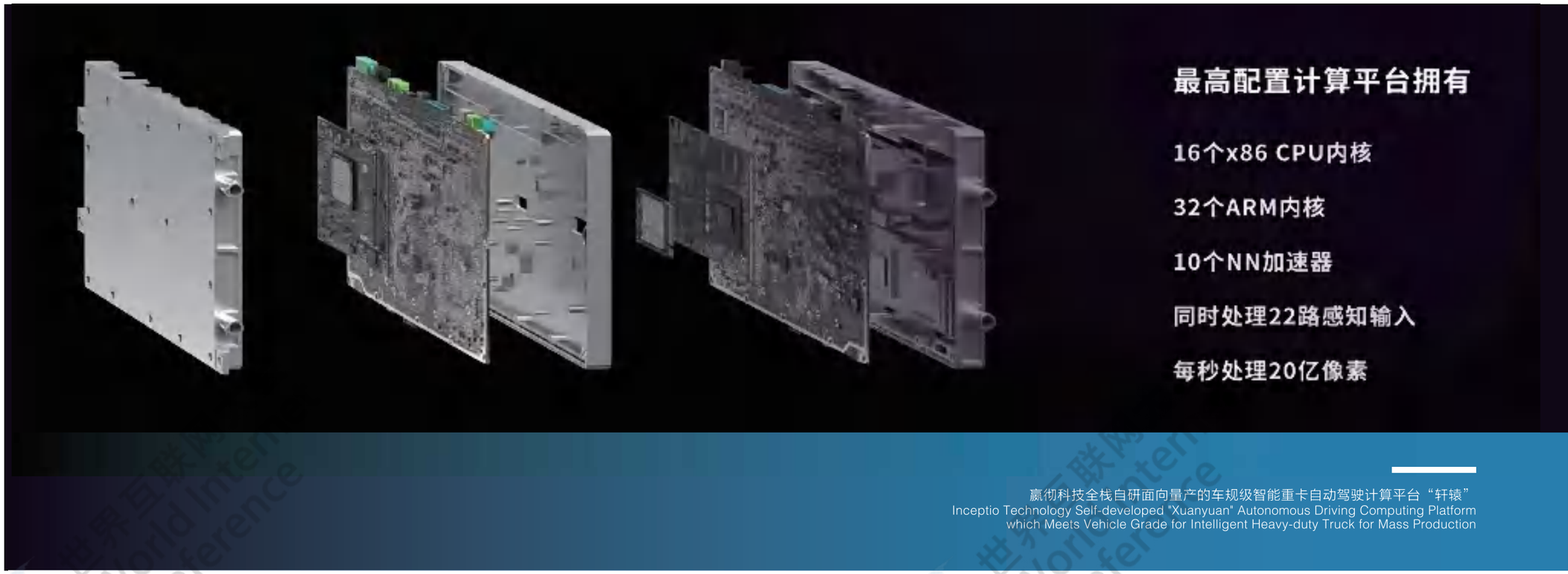
Automatic Driving will Bring Hundreds of Billion CNY of Technical Dividends to the Trunk Logistics Industry, Reduce Traffic Accidents, Reduce Carbon Emissions, and Breed a Super Transport Capacity Platform.

这项基于量产，行业领先的自动驾驶技术在经济效益上首先在部分场景减少了驾驶人员，使双驾变单驾人工成本降低一半。其次，大幅节省燃油消耗，经测试领先的节油算法可降低油耗 5-10%，降低成本的同时创造可持续发展的绿色未来。且安全效果显著提升，数据显示本技术可将碰撞预警次数低于 L0 双驾司机 60% 左右。

In some scenarios, this industry-leading autonomous driving technology has resulted in a reduction in the number of drivers in terms of economic benefits, and has also resulted in a reduction in labor costs by half by replacing two drivers with one. In addition, the fuel consumption has been significantly reduced. Fuel consumption can be reduced by 5-10% with the tested leading fuel saving algorithm, resulting in a green and sustainable future while reducing costs. Moreover, the safety effect has been significantly enhanced. Using this technology, collision warning times can be reduced to approximately 60% for L0 trucks with two drivers.

由于出色的经济，绿色，智能，安全特性，赢彻科技的相关技术产品还入围了联合国工发组织和上海交通大学联合发起的“全球碳中和技术方案 #UNIDOGlobalCall2022”。

UNIDO and Shanghai Jiaotong University have jointly initiated the "global carbon neutral technology program # unidoglobalcall2022" in recognition of the excellent economic, green, intelligent, and safety characteristics of Inceptio technology's related technical products.



赢彻科技全栈自研面向量产的车规级智能重卡自动驾驶计算平台“轩辕”
Inceptio Technology Self-developed "Xuanyuan" Autonomous Driving Computing Platform which Meets Vehicle Grade for Intelligent Heavy-duty Truck for Mass Production



2021 年双十一，赢彻科技与德邦快递联手，
在往返于济南和上海的专线上投放搭载赢彻轩辕系统的智能驾驶重卡
On November 11, 2021, Together with Deppon Express, Inceptio Technology Launched an Intelligent Driving Heavy-duty Truck Equipped with Inceptio Xuanyuan System on the Transportation Route between Jinan and Shanghai



赢彻科技代表在 2022 联合国工发组织碳中和技术方案征集暨 UNIDO Global Call 2022 中国技术储备专家咨询报告会上介绍赢彻技术方案
A Representative of Inceptio Technology Introduced Its Solution at the 2022 UNIDO Carbon Neutralization Technology Scheme Solicitation and UNIDO Global Call 2022 China Technology Reserve Expert Consultation Meeting



2021 年 5 月 14 日上海，SGS 全球功能安全技术中心向赢彻科技颁发了 ISO26262 ASIL D 证书，这是国内首个重卡自动驾驶最高级别的功能安全流程认证
SGS Shanghai Global Functional Safety Technology Center Issued the ISO26262 ASIL D Certificate to Inceptio Technology on May 14, 2021, which is the First Certification in China for a Functional Safety Process for Heavy-duty Truck Autonomous Driving



新型冠状病毒信息库 RCoV19

Resource for Coronavirus 2019 (RCoV19)

中国科学院北京基因组研究所（国家生物信息中心）
Beijing Institute of Genomics,
Chinese Academy ofSciences / China National Center for Bioinformation

本成果得到“一带一路”国际科学组织联盟（ANSO）、国际生物科学联合会（IUBS）、金砖国家（BRICS）国际合作项目支持；与巴基斯坦国立卫生研究所、真纳大学开展新冠病毒基因组联合研究；与美国国家生物技术信息中心建立了新冠病毒基因组数据同步共享机制；为世界卫生组织—中国开展的新冠病毒溯源联合研究提供数据支撑，相关结论写入联合研究报告；2020 年 12 月美国微生物学会特邀本团队代表在公共卫生数据共享研讨会上介绍推广本成果。

This achievement was supported by grants from the Alliance of International Science Organizaions (ANSO), the International Union of Biological Sciences (IUBS), and the BRICS STI Framework Programme. International collaborations have been conducted with the National Institute of Health of Pakistan and the Quaid-i-Azam University, Pakistan, which inferred the possible pathways of introductions and transmissions of SARS-CoV-2 in Pakistan. The SARS-CoV-2 genome sequence data in RCoV19 have been shared synchronously with the US National Center for Biotechnology Information (NCBI). In particular, RCoV19 provided scientific support for the WHO-China joint research on the origins of SARS-CoV-2, which was included in the final report and acknowledged by WHO. The team representative was invited by the American Society for Microbiology to give reports on RCoV19 in an international panel discussion on “Open Sequence Data Sharing for Public Health” in December 2020.

引言

新冠病毒信息库 RCoV19 整合并持续更新全球公开的新冠病毒基因组序列等信息，实时解析新冠病毒变异、监测和追踪病毒的时空动态发展及演化、预警高危变异株，为全球科技抗疫提供数据和信息支撑。

Introduction

The Resource for Coronavirus 2019 (RCoV19) is an open-access information resource on the novel coronavirus. In addition to providing a comprehensive and up-to-date collection of genome sequences for all SARS-CoV-2 isolates that are publicly available, this tool identifies variants in real time, conducts surveillance and monitoring of Spatiotemporal changes in variants, and predicts early warning of high-risk variants. It also provides scientific information and data to support the global fight against COVID-19.

国际领先的新冠病毒综合性信息库

The most comprehensive resource of SARS-CoV-2 at a leading level in the world

RCoV19 于 2020 年 1 月 22 日公开发布并持续更新，是面向全球开放共享的新冠病毒综合性信息库和研究平台，在技术和应用领域具有突出的先进性和创新性，在以下方面处于国际领先水平：

As the open-access resource of SARS-CoV-2, RCoV19 shared to the world is publicly made available since 22 January 2020 and continually updated, maintaining its position as the largest public research platform for SARS-CoV-2 in the world. With its advanced technology, RCoV19 leads the international field in the following areas:

信息整合：基于标准的数据审编与分析流程，实时整合新冠病毒基因组序列、元信息、学术文献等，对不同来源数据进行去冗余和交互引用，全面评估基因组数据质量及完整度。

Integration of SARS-CoV-2 sequences, metadata, and academic literatures in real time using an in-house automated pipeline that integrates manual curation with quality evaluation and value-added annotations.

变异解析与监测追踪：提供自动化快速的新冠病毒基因组序列变异分析，建立了针对突变的时空动态演化监测及追踪方法与平台。

Monitoring the evolution and variation of SARS-CoV-2 through automatic genomic variant analysis and functional annotation.

多维知识审编：系统审编并提供已有实验证据证明的突变功能知识，包括重要突变对病毒传播及核酸检测的可能影响。

Multidimensional knowledge curation for determining the effect of mutations on nucleic acid primers, including host ranges of SARS-CoV-2 and expression data.



“新型冠状病毒信息库 RCoV19”功能模块
Function Modules of RCoV19

可视化展示：动态可视化展示序列增长、变异位点的时空频率、突变率、单体型网络演化等。

Dynamic visualization of SARS-CoV-2 sequence data growth, spatiotemporal change and haplotype network.

在线分析平台：提供基因组拼接与注释、变异鉴定和功能注释、单体型网络构建等全流程在线分析服务。

The online analysis platform includes modules for de novo assembly, BLAST alignment, genome annotation, variant identification, and variant annotation.

高危病毒预警：基于人工智能的高危病毒变异株早期预警体系。

Artificial intelligence-based early warning of high-risk SARS-CoV-2 variants.

被国际同行广泛应用，助力全球科技抗疫

RCoV19 has been widely applied by international researchers, supporting the global study on the evolution, monitoring, and origins of SARS-CoV-2

目前，RCoV19 已收录新冠病毒序列 1200 多万条，为全球 181 个国家和地区近 200 万访客提供在线服务，国际用户占比最高达 60% 以上，数据下载超过 71 亿条，数据库及相关论文累计被引 430 余次。在助力国际抗疫方面，实现与美国国家生物技术信息中心同步共享新冠病毒基因组数据；获得金砖国家新冠病毒基因组研究计划资助，并与巴基斯坦开展新冠病毒合作研究；为世界卫生组织—中国开展的新冠病毒溯源联合研究提供数据支撑，相关结论写入联合研究报告；团队代表应邀在多个国际会议上介绍推广本成果（例如 2020 年 12 月美国微生物学会公共卫生数据共享研讨会），并举办国际培训促进新冠病毒信息国际共享与合作。在服务中国抗疫方面，参与北京新发地市场疫情的序列突变解析和分子溯源研究，为精准锁定疫情可能源头提供科技支撑；参与

国际输入病例新冠序列变异分析，并基于全球序列的突变分析，定期上报监测报告，为散发疫情的精准防控提供咨询指导。

RCoV19 has archived over 12 million SARS-CoV-2 sequences, providing services to nearly 2 million visitors from 181 countries/regions throughout the world (with over 60% of visitors coming from outside the country), with over 7.1 billion sequences being downloaded. International scientific communities have cited the database and related publications more than 430 times. Since February 2020, RCoV19 has been sharing the SARS-CoV-2 genome sequence data synchronously with NCBI. As part of the BRICS STI Framework Programme Response to COVID-19, the team has applied and participated. Research has also been conducted with the National Institute of Health of Pakistan and the Quaid-i-Azam University, Pakistan, to determine possible pathways for SARS-CoV-2 introduction and transmission. The RCoV19 provided scientific support to the joint research conducted by WHO and China on the origins of SARS-CoV-2, which was included in the final report and acknowledged by WHO. RCoV19 was presented at international meetings (such as the American Society of Microbiology Meeting in December 2020) and at international training sessions, which provided global researchers with access to resources and tools for analyzing SARS-CoV-2 sequences.

得到全球高度认可，提升国际影响力

RCoV19 has been globally acknowledged, promoting the influence in this field

RCoV19 被列入《抗击新冠肺炎疫情的中国行动》白皮书，入选 2020 年度中国生物信息学十大进展、2021 年度中科院科技创新亮点成果，作为亮点工作写入《“一带一路”创新发展报告 2021》，研究团队被科技部授予“全国科技系统抗击新冠肺炎疫情先进集体”称号。RCoV19 被美国国立卫生研究院、Elsevier 国际出版集团、韩国国家生物信息中心等 20 多家国际专业机构推荐使用，显著提升了在该领域的国际影响力。

A white paper entitled "Fighting COVID-19: China in Action" was published by the State Council of China in June 2020. The research was recognized as one of the top ten achievements in bioinformatics in China in 2020, and one of the scientific highlights of the Chinese Academy of Sciences in 2021. It was also selected for inclusion in the Belt and Road Innovation Development Report 2021. The team was recognized by the Ministry of Science and Technology of China in 2021 as an "Excellent Group for Fighting COVID-19." by over 20 international institutions with web links on their websites, including the US National Institutes of Health, Elsevier Publishing Group, and the National Bioinformation Center of Korea, which has greatly enhanced international influence in this field.



推荐引用 RCoV19 的国际专业机构（部分）
RCoV19 is Recommended by International Institutions

银河麒麟高级服务器操作系统

Kylin Advanced Server OS V10

麒麟软件有限公司
Kylinsoft

引言

银河麒麟高级服务器操作系统 V10 是针对企业级关键业务，适应虚拟化、云计算、大数据、人工智能、工业互联网时代对主机系统可靠性、安全性、高性能、扩展性和实时性的需求，依据等保四级标准研制，研制过程符合 CMMI 5 级管理体系，提供内生安全、云原生支持、高性能、易管理的新一代自主服务器操作系统。

Introduction

In the era of virtualization, cloud computing, big data, artificial intelligence, and the industrial internet, Kylin Advanced Server OS V10 meets the demands of corporate-level critical businesses in terms of reliability, security, performance, scalability, and real-time performance of the host system. As a result of its development in accordance with Protection Level 4 and the CMMI5 management system, it provides endogenous safety and security, enables cloud-native functionality, and enjoys high performance and manageability.



银河麒麟高级服务器操作系统 V10
Kylin Advanced Server OS V10

openKylin(开放麒麟) 中国首个桌面操作系统根社区

openKylin community is China's first root community of desktop operating system.

openKylin(开放麒麟) 社区是由麒麟软件有限公司主导成立的桌面操作系统根社区，旨在以“共创”为核心、以“开源聚力、共创未来”为社区理念，在开源、自愿、平等、协作的基础上，通过开源、开放的社区合作，构建桌面操作系统顶级社区，推动 Linux 开源技术及其软硬件生态繁荣发展。

KylinSoft Corporation (KylinSoft) is the primary developer of openKylin, the root community of desktop operating systems. Through the concept of joint creation and “pooling strength with open source and creating a better future,”it intends to create a top-tier community of desktop operating systems in order to facilitate a prosperous development of Linux, an open source technology, and its hardware and software ecosystem through open-source and inclusive community cooperation based on principles such as open source, voluntariness, equality, and collaboration.

openKylin 的社区目标是打造“产业主导、平台自主、技术先进、生态丰富”的桌面操作系统根社区。自 2022 年 6 月 openKylin 社区成立以来，积极推进社区建设，目前已有 50+ 企业加入社区，包括操作系统厂商、CPU 厂商、GPU 厂商、整机厂商、软件厂商等，覆盖了行业 50% 的头部企业。成立了 29 个社区 SIG 组，从多维度共同推动社区繁荣发展，打造开源操作系统创新生态。

It is the objective of the openKylin community to establish itself as a rooted community of desktop operating systems that are dominant in the industry, platform-independent, technologically advanced, and ecosystem-rich. There has been a concerted effort to propel the development of this community since it was established in June 2022. As of today, 50+ enterprises (including manufacturers of operating systems, CPUs, GPUs, complete machines, software, etc.) have joined the community, representing 50% of the leading enterprises in the industry. There are 29 community SIGs that have been formed to promote the prosperous development of the community from a variety of perspectives and to build an innovative ecosystem for open source operating systems.

开源人才培养

Open source talent training

高校师生作为最有活力的技术群体之一，是未来开源发展的核心力量，也是 openKylin 社区的重点发展目标之一。

OpenKylin's community of teachers and students is one of the most dynamic technical groups. They will play a significant role in the development of open source in the future.

未来，openKylin 社区将在高校设立高校站，通过互动交流、学习共享、项目建设、实践创新，联合政产学研各方面力量，贯彻人才第一的理念，共同探索中国特色的操作系统专业技术人才新模式。

In the future, the openKylin community will establish stations, colleges, and universities. The forces of government, industry, universities and research institutes will work together to explore a new mode of professional and technical personnel for domestic operating systems based on the concept of talent first by interfacing and communicating, learning and sharing, developing projects, practising, and innovating.

同时持续发起高校开源开发大赛以及开展高校沙龙活动，如“麒麟杯”中国开源应用软件开发大赛、黑客松以及 Linux 沙龙、发布派对等，通过产教融合，扩展教学的手段传播开源文化、培养开源人才。

For the time being, the openKylin community will continue to organize salon activities at colleges and universities and hold open source development competitions, including the "Kylin Cup" China Open Source Application Software Development Competition, Hackathons, Linux Salons, Launch Parties, etc. Through the integration of industry and education, as well as the expansion of teaching methods, the objective is to communicate open source culture and cultivate open source talents.



openkylin 架构
openKylin Community Framework



openkylin 生态
openKylin Community Ecology

积极贡献开源

Actively contribute to open source

推动中日韩开源事业发展，担任三国开源改革委员会中方执行主席。

KylinSoft has promoted the development of open source initiatives in China, Japan, and South Korea as the Chinese Executive Chairman of the Open Source Reform Committee.

参与编制的木兰许可证被 OSI 接纳、成为第一个中文国际开源许可，已被 Linux 基金会等多个组织采用。



高校培训
College Training



中日韩开源会议
China, Japan, and Korea Open Source Conference

Several organizations, including the Linux Foundation, have adopted the Mulan open source license, whose formulators include KylinSoft.

OpenEuler 社区发起者之一，维护社区 300 多个代码包项目，发起成立了 HA、Virt、UKUI、OKD、compat-winapp 和 industrial-control SIG，贡献涉及了桌面、内核、云原生、分布式存储、AI 和高可用等多个领域。

It is KylinSoft's responsibility as one of the earliest contributors to the OpenEuler community to maintain 300 or more code packages and to initiate and establish the HA, Virt, UKUI, OKD, compact-win app, and industrial-control SIGs. The company's contributions span a variety of areas, including desktop, kernel, cloud-native, distributed storage, and high availability.

积极贡献 OpenStack 社区、Fedora 社区、Ubuntu 社区、Ovirt 社区、Autotest 社区、MONO 社区、GlusterFS 社区、Gnome 社区、Hadoop 社区、OpenOffice 社区代码数十万行。

Hundreds of thousands of lines of code have been contributed to OpenStack, Fedora, Ubuntu, Ovirt, Autotest, MONO, GlusterFS, Gnome, Hadoop, and OpenOffice by KylinSoft.

世界互联网大会
World Internet Conference

