

# Conception of a global dispatching system for metauniverse in internet of everything sky-earth computing (i) beyond cloud computing

Zongcheng Li\*

RL of Interdisciplinary Science, Soochow University, 215021 Suzhou, Jiangsu, China

**Abstract.** In order to overcome the serious defects of information mechanism and promote the rationalization of resource allocation, this series of research proposes a hyper-cyber world computing mode which combines the traditional computing mode in various professional application fields with the modern computing mode in the field of information network technology (represented by distributed computing, grid computing, cloud computing and cluster computing), It can be called the Sky-Earth Computing (SEC). Here, "Sky (or Heaven)" metaphors the information world in the field of digital network technology, and "Earth" metaphors the real world in various professional application fields. Facing the ecosphere of metauniverse in Internet of everything, we propose to provide a customized global service dispatcher (GSD) and its enhanced version of the world-wise brain (WWB) with the user as the center. The global service dispatcher to be developed should have at least three functions: unified standard measurement system, supply-demand intelligent docking system, and integrated dispatching center system. Through the development and implementation of super metauniverse system engineering technology, let every user become the center of their own all-interconnected ecosphere (AIE)!

## 1 Introduction

Based on a series of discussions and researches among high-energy physics, astrophysics and cosmology<sup>[1]-[6]</sup>, we now turn to the problem of human reality<sup>[7][8]</sup>, focusing on the interstellar relationship between the earth and space, to explore the connection between the information ecosphere and the real ecosphere, the computing of the information world (including the digital information world and the analog information world) and the computing of the real world (including the real physical world and the real psychological world), so as to establish a "Super Metauniverse Computing" (SMC) with interactive and integrated synergy. This is an advanced computing mode that combines the traditional computing mode of various professional application fields with the modern computing mode of various info-network technology fields (represented by distributed

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\* Corresponding author: [lizongcheng@suda.edu.cn](mailto:lizongcheng@suda.edu.cn)

computing, grid computing, cloud computing and cluster computing). It can be called "Sky-Earth Computing" (SEC).

In traditional Chinese culture, "Sky" (or Heaven) and "Earth" are a pair of basic relative categories. Now, in the context supported by Internet, cloud computing and artificial intelligence technology, we can bring the category of "Sky-Earth" into a new system, metaphorizing the information world with "Sky" and the actual world with "Earth". Artificial intelligence (machine intelligence) is based on computing in the information world, and natural intelligence (human intelligence) is based on computing in the actual world. In the analysis and design of this series of papers, it is necessary with the big data platform<sup>[9][10]</sup> (HDFS cluster, MapReduce / Tez / Spark), the Internet of Things<sup>[11]-[13]</sup> (sensors, RFID, GPS, infrared sensing) and artificial intelligence technology<sup>[14][15]</sup> (AlphaZero, generating antagonistic network GAN, new recursive cortical network, etc.), between the information ecosphere and the actual ecosphere, between the information world computing and the actual world computing, to construct the intelligent integrating system, and the carry out data reconstruction system engineering, thus establish the computer-like system for the processing of big data. As a wisdom-fusing system engineering in the process of intellectualization, synergism and socialization, Sky-Earth computing is not only a new technical system, but also a new industrial system. More importantly, it is the synergy-disposing mode of the new civilized world, involving the technical support system, intelligent integration system, social organization system and ecological synergy system of the new civilized world.

The development of sky-earth computing technology and the organization of super metauniverse system engineering are the new ideas of technology and industry development strategy first put forward by inventor Li Zongcheng in the world after 30 years of painstaking exploration, which can become the basic way to comprehensively improve system software, network software and application software. As early as 2011 and 2012, inventor lizongcheng successively submitted 610 applications for the latest technological invention to the State Patent Office of China (it can be seen from the announcement of the Patent Office of the people's Republic of China), which provided necessary core technology, key technology, basic technology, supporting technology and system integration technology for this comprehensive upgrade and development.

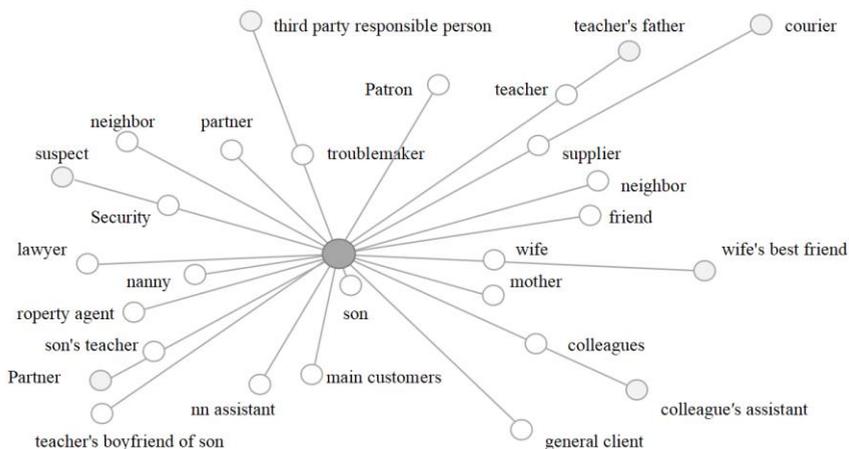
## **2 Idea of user-centered ecosphere in internet of everything**

For various new phenomena, new trends and new problems in international and domestic social economy in recent decades, the object and scope of research are included in the ecosphere system. The "ecosphere" is an ecological concept that has emerged in recent decades<sup>[16][17]</sup>, which is closely related to the concept of the earth biosphere, but also has some differences<sup>[17]-[20]</sup>. In theory, an ecosphere refers to an indivisible natural group formed by the interaction between organisms and their living environment and between organisms through material circulation, energy flow and info-exchange in a certain time and space.

Now, in order to break the monopoly of theocratic system, tyrancratic system and timocratic system on information mechanism, and to make every user become the center of the all-interconnected ecosphere (AIE), we should and must go beyond modern information technology, beyond Internet of things, big data, cloud computing, artificial intelligence and other technology systems, and face every individual, every family, every enterprise, every team, every enterprise, face every community, every organization, every institution, every township, and then face every city, every region, every country, every transnational organization, even the whole world, around the personal ecosphere, family ecosphere, enterprise ecosphere, around the community ecosphere, organization ecosphere, around the

urban ecosphere, regional ecosphere, national ecosphere, transnational organization ecosphere, and even around the whole global ecosphere, we use the technology, software, system, platform and Internet in the modern information field to develop and establish the global service dispatcher, which integrates the technology, software, system, platform and Internet in various professional application fields Software, system, platform and Internet are connected to fully mobilize, configure and utilize global resources to serve every user.

In this series of articles, the ecosphere of a life is defined as an interaction system with a life as the center formed by all the factors that have direct and indirect connection with the life in accordance with the complex relationship structure. By this definition, every advanced life has its own ecosystem. The social ecosystem with a user as the center and composed of all stakeholders is shown in Figure 1: all stakeholders who have direct and indirect relationship with a user form an ecosphere in Internet of everything by various relationships. Here, the dark gray circle represents a user, the light gray circle represents the stakeholders with direct relationship, the white circle represents the stakeholders with indirect relationship, and each arrow line represents the geographic location and distance between the user and the stakeholders.



**Fig. 1.** A social ecosystem with a user as the center and composed of all stakeholders.

Here, the dark gray circle represents a user, the light gray circle represents the stakeholders with direct relationship, the white circle represents the stakeholders with indirect relationship, and each arrow line represents the geographic location and distance between the user and the stakeholders..

In fact, the boundary of each ecosphere is often irregular, and the boundary of highly complex ecosphere in Internet of everything is especially mixed, unclear and irregular. There is an ecosphere with irregular, indistinct and non-simple boundaries. The ecosphere includes complex multiple physical, physiological, information, psychological and social connections. Here, the arrow line has great limitations. It can only represent the distance and direction in time and space, but it can not represent the multiple links between the center (advanced intelligent life, such as users) and the influencing factors at each time and space point.

Every user, no matter individual users (individuals, families, groups, etc.) or group users (organizations, communities, enterprises, institutions, departments, urban and rural areas, regions, countries, transnational alliances, global organizations, etc.), is the center of super metauniverse system engineering, in a self centered ecosystem of everything-interconnection, that is, the center of design, R&D, organization, operation, cooperation, management, adjustment, detection and maintenance.

The ecosphere of each user (individual, group, whole) is an extremely complex ecosphere in Internet of everything, with extremely complex variables, structures and forms, here there are both natural and social processes; there are not only physical connection, biological connection and information connection, but also psychological connection, knowledge connection and social connection (economy, culture, science and technology, education, etc.).

Users have different connections with the influencing factors of different time and space points. The contents, time limit, types, closeness and frequency of contacts are different. For example, there are pure simple connections and complex multiple connections, long-term fixed connections and short-term accidental connections, very close connections and very loose connections, frequent connections and occasional connections, etc.

For example, in a complex ecosystem centered on a user, there are 11 direct factors and 15 indirect factors at different time and space points. The length of arrow line reflects the distance between users and influencing factors. If we number 26 spatiotemporal factors, and divide all kinds of connections into physical connection, biological connection, information connection, psychological connection and social connection, we can assume that:

at spatiotemporal factor point 1, the user only has pure psy connection with this factor point;

at spatiotemporal factor point 2, the user has complex multiple connections with this factor point, including phys connection, bio connection, psy connection and social connection;

at spatiotemporal factor point 3, the user has info and phys contact with the factor point;

at spatiotemporal factor point 4, the user has phys-physiol connection with the factor point;

at spatiotemporal factor point 5, the user only has pure phy connection with the factor point;

at spatiotemporal factor point 6, the user only has pure social contact with this factor point;

at spatiotemporal factor point 7, the user has complex multiple connections with this factor point, including bio connection, info connection, psy connection and social connection;

and so on.

At spatiotemporal factor point 10, the user only has pure info contact with this factor point;

With the movement of the user in the complex space-time range (phys space-time, bio space-time, info space-time, psychological space-time, knowledge space-time, social space-time), the all-interconnected ecosphere will continue to move, and constantly change its various complex variables, complex structures and complex forms (phys form, bio form, information form, psychological form, knowledge form Social form) presents an extremely complex large-scale system state of nonlinear social dynamics.

### **3 Sky-earth computing for super metauniverse**

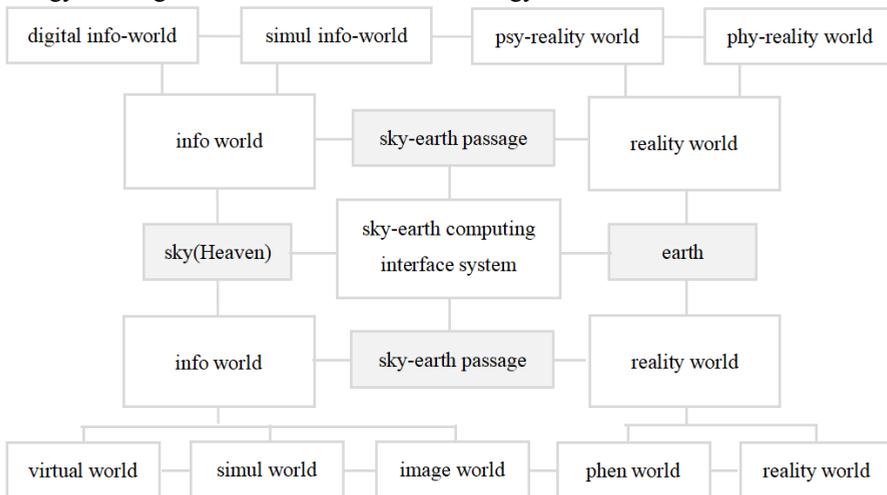
All kinds of all-interconnected ecosphere at all levels can be applied to all activities of advanced intelligent life, such as production-supply-marketing integrated service system, vehicle-transportation system, medical-health care system, intelligent home and building, social networks and games, power and heat management system, office intelligent integrated service, data center, integrated intelligent service system of daily life, electric power and energy system or network, the large-scale advanced intelligent integrated service system in cities, regions, countries and the world, etc. The conception, design, R & D,

organization, operation, management, cooperation, adjustment, detection and maintenance of this system are the complex large-scale system of dynamics processes integrated in the whole field of computer, software, platform, network and physical process, physiological process, psychological process and eventlogical process.

Sky-earth fusion system (SEF) is a world system supported by sky-earth computing technology, which can be regarded as hyper-cyber world systems (HCW), that is to say, a fusion of cyber-physical system (CPS-1), cyber-physiological system (CPS-2) and cyber-psychological system (CPS-3), cyber-eventlogic system (CES), etc.

It is a multi-dimensional complex system that uses sky-earth computing technology and its system engineering to combine computing, network and world environment (including physical environment, physiological environment, psychological environment and eventlogic environment). Through the organic integration and deep cooperation of 3C (computation, communication and control) technology, it can realize the real-time perception, dynamic control and information service of large-scale engineering system in complex society. HCWS based on sky-earth computing can carry out the integrated design of computing, communication with physical system, physiological system, psychological system and reasoning system, and realize the integration of various related systems, processes and elements more reliably, efficiently and cooperatively. Therefore, it has an important and wide application prospect.

How to connect the world of information (digital information and analog information) with the world of reality (physical reality and psychological reality) will be the key problem in transforming the old civilization world and creating a new civilization world, as shown in Figure 2. In order to achieve the task of space and sky computing, the integration of the two worlds is the primary technology. In this regard, sensor network technology, Internet technology of things and electronic virtual technology are essential



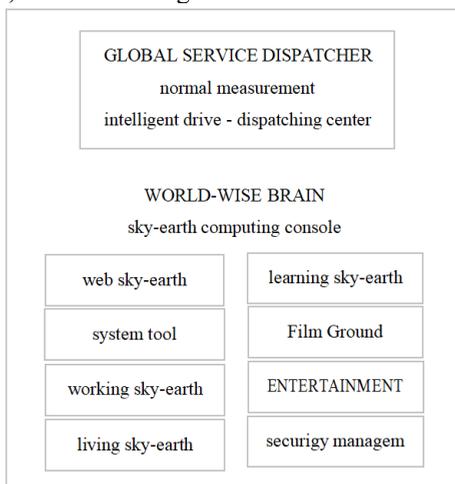
**Fig. 2.** Conception of an interface system of sky-earth computing between info. world and realistic world.

The sky-earth interface system and its channels enable users (individuals, organizations, and Society) to work with multi-channel programs in the physical world, the information world and the psychological world at the same time in their own world. The operation program of each channel runs in the user's own sky-earth channel, that is, in the graphics on the display screen. Most of the sky-earth channel systems allow channels to overlap, and provide users with standard operations to run, such as moving and changing the size of the visual gate, sending the visual gate to the foreground and background, or expanding or

narrowing a sky-earth channel. The sky-earth channel interface system should have the network permeability ability of the interconnection of all things, and allow users to run the channel graphics application program on the remote machine.

MEMS is the abbreviation of micro electro mechanical systems. It is an integrated micro device system composed of micro sensors, micro actuators, signal processing and control circuits, communication interface and power supply. M2M is the abbreviation of machine to machine / man. It is a network application and service with intelligent interaction of machine terminal as the core. It will make the object intelligent control. M2M technology involves five important technical parts: machine, M2M hardware, communication network, middleware and application. M2M (machine to machine) is to effectively control the equipment through mobile communication, so as to greatly expand the business boundary, or create a more efficient business mode than the traditional way, or create a new service completely different from the traditional way.

Through the technology development of super metauniverse system engineering, a customized global service dispatcher (GSD) is provided for each user (individual, group, whole). As the main component of WWB, the global service scheduler should have at least three functional modules, as shown in Figure 3:



**Fig. 3.** Global service dispatcher as main component of world smart brain.

(1) Unified normal measurement. This basic function is the computing technology of grand unified normalization, which can make a unified measurement of all kinds of resources across borders, domains and levels;

(2) Advanced intelligent engine of supply-demand docking. This basic function is to provide customized menus for both supply and demand with the user's movement, and realize the intelligent docking of supply-demand matching as soon as possible through the supply-demand compiled search engine, so as to achieve the holo-synergic intelligent drive;

(3) Advanced intelligent-integrated dispatching system. This basic function is to form a dynamic sequence of ecosphere in the whole process according to the results of large-scale dynamic supply-demand intelligent docking, follow the user's mobile process in switching, and carry out mode conversion, so as to realize the support of global resources for the user.

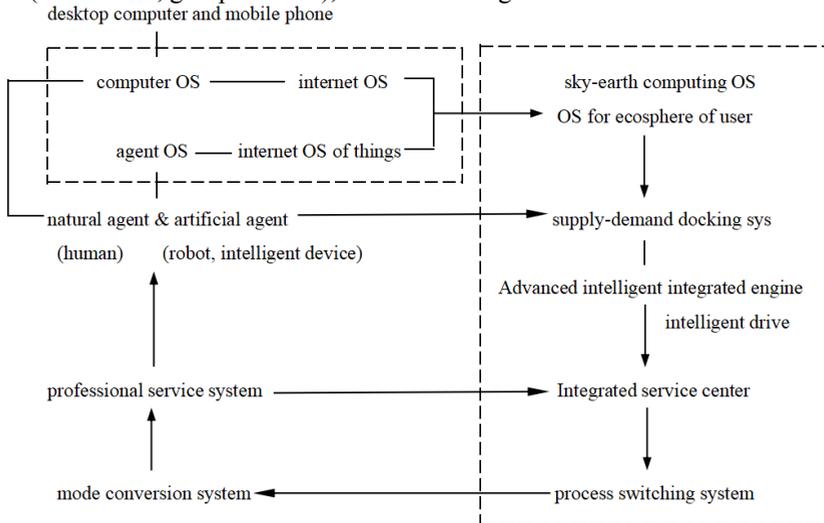
Furthermore, it can be seen that the whole process of real-time dynamic service in developing for the complex large-scale dynamic system of the all-interconnected ecosphere with the user as the center must be a complex synergic-auxiliary process involving different influence areas, different direct influence factors, different indirect influence factors, different influence regions, different influence departments and different

professional fields in different paths, time periods and spatiotemporal points, which can be summed up as a highly complex, highly synergic and highly social auxiliary system engineering.

With the support of information technology, such as computer, Internet, cloud computing, big data, artificial intelligence, etc, sky-earth computing, which needs to be vigorously developed, is a kind of technology system for comprehensive utilization of various computers, software, information systems, information platforms and Internet, which is oriented to various real networks (physical network, life network, financial network, event network), information networks (Internet, radio and television network, communication network) and mental networks (spiritual network, knowledge network).

### 4 Advanced smart synthesis design for super metauniverse

We should make use of all kinds of modern information technology, establish a strong new technology system, break all kinds of institutional barriers and man-made barriers at all levels, allocate resources more fairly, reasonably, effectively and continuously, and provide the dynamic services with cross domain, cross time and cross region for all kinds of users at all levels (individuals, groups and all), as shown in Figure 4.



**Fig. 4.** Conception of sky-earth computing operating system with each user as center.

According to the new development plan, the existing operating systems are generally divided into two aspects (categories):

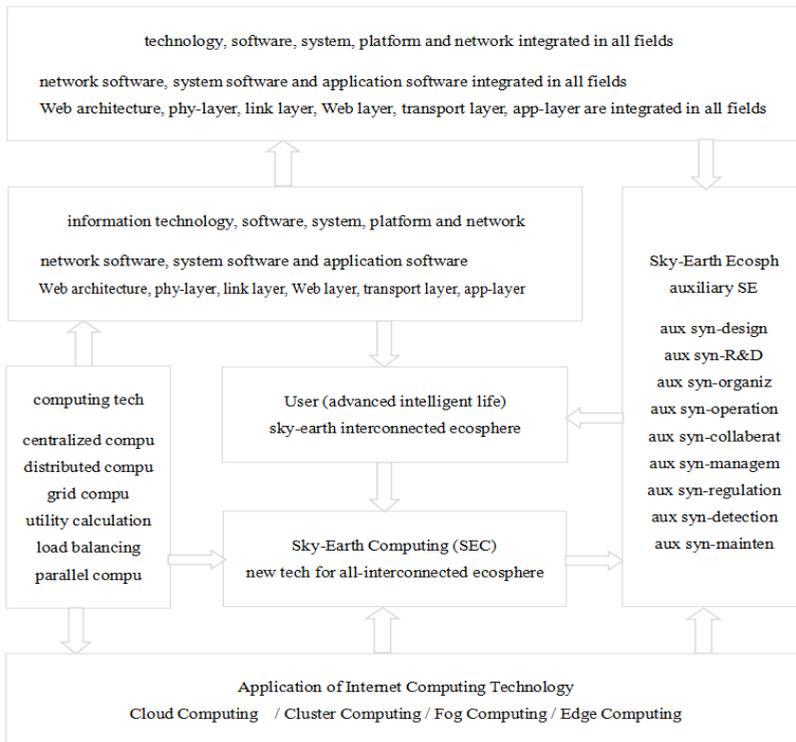
The first category is the computer operating system for computers, PCs, tablets, mobile phones and computing centers, as well as the related Internet operating system (Web OS). Generally speaking, Internet operating system is a kind of virtual operating system based on browser. Users can operate applications on the Internet operating system through the browser. This application is not an ordinary application, but a network application. Web OS provides the operating system services for internet, including network resource addressing, global name space, remote execution program (executing server program on client), resource management, authentication and security.

The second category is the agent operating system for natural agent (human) and artificial agent (robot, intelligent device and intelligent instrument), and the related the Internet operating system of things (and thing-chain Internet operating system). The combination of the kernel and peripheral functional components of IOT operating system

can solve the connection requirements of IOT, such as supporting Ethernet, 3G / 4G, Bluetooth, Wi-Fi, ZigBee, NFC, LiFi, NB-IoT, LoRa, etc. Typical open source IOT operating systems include: RT-Thread, LiteOS, Tizen, TinyOS, RIOT, Contiki, FreeRTOS, ApacheMynewt, Zephyr OS, Ubuntu Core, ARM mbed, AndroidThings, Yocto, Raspbian.

Now, with all kinds of users at all levels (individuals, groups, and the whole) as the center and facing the all-interconnected ecosphere of all kinds of users at all levels (individuals, groups, and the whole), we consider combining these two aspects (two categories) of operating systems according to the three functional requirements of unified standard measurement, intelligent docking drive, and integrated dispatching center, to develop and build the sky-earth computing operating system (SEC OS) for global service dispatcher and WWB (Sky-Earth computing console), and the related all-interconnected ecosphere operating system (ecosphere OS).

The super-metauniverse system engineering supported by information technology, computing technology and network technology is shown in Figure 5:



**Fig. 5.** Sky-earth computing system engineering supported by information technology, computing technology and network technology.

As the basis of new technology development, we should use all kinds of modern information technology, software, system, platform and network (Internet, communication network, radio and television network) to develop, design and configure in comprehensive integration all kinds of technology, software, system, platform and network (energy network, logistics network, capital network, human resource network, knowledge network, social network) in all fields, all levels and all regions, etc), and form the comprehensive-integrated technology, software, system, platform, network, network architecture, link layer, network layer, transmission layer and application layer in the whole field, so as to establish a large-scale unified measurement technology system across fields, levels and regions, and then establish a large-scale power engine for supply-demand docking.

On this basis, the intelligent scheduling center of integrated services is developed and established, so as to develop and establish process switching system and mode conversion system to schedule various resources of centralized computing, distributed computing, grid computing, utility computing, load balancing computing, parallel computing, cloud computing, cluster computing resources, fog computing and edge computing, etc.

On this basis, from the individual user's AIE, manufacturer's AIE, community user's AIE, to the institutional user's AIE, department user's AIE, regional user's AIE, to the sovereign state's AIE, multinational alliance's AIE and global user's AIE, it is likely to allocate resources more equitably, reasonably, effectively and continuously, so as to provide the whole-process dynamic services cross domain, cross time and cross regional real-time for all kinds of users (individuals, groups and whole).

In essence, sky-earth computing is not only limited to traditional and modern computing, but also particularly important. It is an auxiliary system engineering of the all-interconnected ecosphere centered on all kinds of users (advanced intelligent life) at all levels. Based on the comprehensive application of computer technologies such as distributed computing, utility computing, load balancing, parallel computing, network storage, hot backup, and virtualization, it is the aux-synergic designed, aux-synergic developed, aux-synergic organized, aux-synergic operated, aux-synergic managed, aux-synergic adjustment, aux-synergic detection, and aux-synergic maintenance the all-interconnected ecosphere of all kinds of users at all levels, that is, the aux-synergic dynamic process of a complex large-scale system integrated in full fields by computers, softwares, platforms, networks and physical processes, physiological processes, psychological processes, reasoning processes.

## **5 Develop global service dispatching system for each user**

The ultimate goal of the development of sky-earth computing technology is to establish a global support system for every user (individual user, group user and all users). in other words, to equip each user with a world-wise brain (WWB), let every user become the master of his life, the subject of his work, the leader of his entertainment and the protagonist of his social life.

One of the basic aspects of the sky-earth computing technology development to be launched in this series of studies is to develop and produce the world-wise brain, and each world-wise brain is a sky-earth computing console (SECC) serving users. This is a control system which serves every user in the whole process and takes the global service dispatcher (GSD) to be developed as the main component.

As the main component of world-wise brain (WWB) or sky-earth computing console (SECC), global service dispatcher (GSD) consists of three basic components: (1) the technology foundation of big unified measurement across borders and domains, including the big unified measurement technology of weighted configuration and the big unified measurement technology of efficacy value; (2) the dynamial system of supply-demand docking in a large range, including supply-demand compiled input system and holosynergic intelligent engine; (3) the advanced intelligent-integrated dispatching system in whole field and full time, includes visual sky-earth door and World-Internet operating system. For each user, global service dispatcher is an intelligent-integrated dispatching center, through which the process switching system can be realized, and then the mode conversion system can be realized.

The ultimate ideal of the development of sky-earth computing technology is to strive to achieve the following vision:

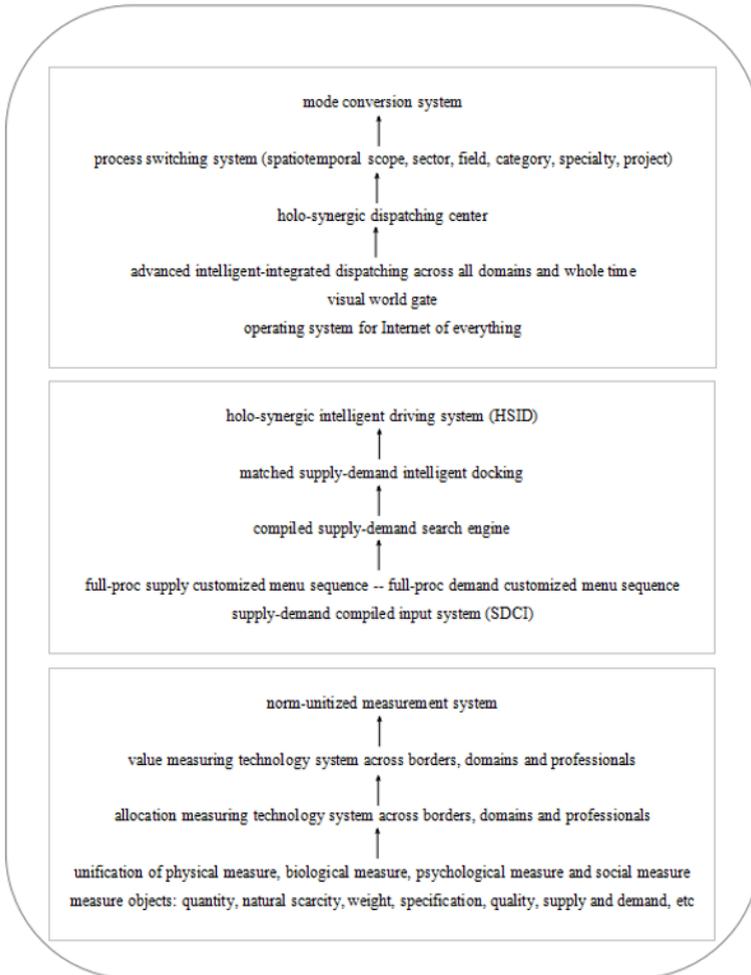
One machine in hand, global support you!

One machine in hand, you are the master of your own world!

Here, "one machine" refers to a world-wise brain as the sky-earth computing console, or a global service dispatcher.

It can be said that users can become their own design center, R&D center, organization center, operation center, cooperation center, management center, regulation center, detection center and maint-center, by using global service dispatcher and sky-earth computing console (world-wise brain).

As shown in Figure 6: According to this series of research, the main functions of GSD should include at least the following three aspects:



**Fig. 6.** Global service dispatcher with three functional modules.

- (1) unified normative measurement across borders, domains and levels  
Dimensional norm / attribute synthesis / weight analysis / unified processing / configuration measurement / efficacy analysis / system synthesis / value measurement / whole process analysis / whole course processing
- (2) holo-synergic intelligent drive across borders, domains and levels  
compilation norm / supply-demand menu / menu sequence / compilation engine / matching analysis / Intelligent synthesis / docking engine / system drive / whole course docking / whole course analysis
- (3) holo-synergic dispatching center across borders, domains and levels

dynamic goal / task set / specialty convergence classification-grading / tradeoff analysis / task assignment / synergic dispatching / process switching / mode conversion / intelligent synthesis / dynamic configuration / dynamic monitoring

If we say that the sky-earth computing console is an extension of the global service dispatcher, then the sky-earth computing worktop (SECW) to be vigorously developed is an extension of the sky-earth computing console.

Sky-earth computing worktop can be divided into large fixed worktop and portable mobile worktop.

The original idea of the development of Sky-Earth computing technology originated from the 610 patent applications submitted by professor Li Zongcheng of Suzhou University to the State Patent Office of the People's Republic of China from early November 2011 to may 2012 (it can be seen from the announcement of the Patent Office of the people's Republic of China). These 610 technological inventions together form a network technology support system of value chain systems engineering, involving the projects such as the development of new technology cluster, related development of new industrial cluster and joint development of commercial, and then involving the projects of emerging strategic-leading industrial cluster that the researchers of this series first put forward in the world.

As a network technology support system of value chain systems engineering, the intelligent integrated network containing the Internet takes the following ten technologies as the key technology that Li Zongcheng submitted to the Intellectual Property Office in May 2012 :

Item 601 --- logic positioning and compilation engine of intelligent-integrated computer network operating system

Item 602 --- flow summary and balancing device of intelligent-integrated computer network operating system

Item 603 --- value measure based on OS/IIC network and its docking equilibrium table

Item 604 --- efficacy configurators based on OS/IIC network and its value measurement system

Item 605 --- load balancing system of resource allocation based on value chain network technology platform

Item 606 --- sky-earth control system for expanding the technologic basis of cloud computing and Internet of things

Item 607 --- control system of intelligent integrated computer network based on sky-earth computing technology

Item 608 --- control system of global docking equilibrium based on value-chain network technology platform

Item 609 --- control system of intelligent integrated cluster based on value-chain network technology platform

Item 610 --- control system of holo-synergic configuration based on value-chain network technology platform

The sky-earth management system proposed by inventor Li Zongcheng for expanding the technical foundation of cloud computing and Internet of things through a number of patent applications is to combine artificial intelligence operation system (AIS) and natural intelligence operation system (NIS) on the information interface between real physical space and electronic virtual space in a graphical operation mode for value chain. Then, the cognitive system and its computer network aux-technology (RS / CNT) is combined with the practice system and its computer network aux-technology (PS / CNT), so as to form a new control system.

I would like to express my sincere gratitude to the domestic and foreign researchers, my colleagues and relatives. Without their enlightening instruction, impressive kindness and help, I could not have completed my work.

## References

1. Li Zongcheng, Meta-Interaction Physics between Supergravity and Dark Energy behind Super-Inflation Universe, *Journal of Astrophysics and Astronomy*, 18 September 2021. doi: <https://doi.org/10.1007/s12036-021-09742-2>
2. Li Zongcheng, Hyper-Synergy Physics of Quantum Cosmosphere from Super-Inflation with Rip-Rebound Clusters, *Journal of Astrophysics and Astronomy*, 22 October 2021. doi: <https://doi.org/10.1007/s12036-021-09726-2>
3. Li Zongcheng, Is there A Force System in the Universe that Opposes Supergravity, Quantum Gravity, Strong Force, Weak Force and Universal Gravity? A Big Attempt to Open up A New World of Physics, 2<sup>nd</sup> International Webinar on Quantum Physics and Nuclear Techonology, Coalesce Research Group, November 15 - 16, 2021, Virtual Conference.
4. Li Zongcheng, Spatiotemporal relation of prolongable general relativity in the irreversible process of a dissipative system, *Acta Physica Sinica*, Vol. 52, No.4, April. 2003, 767-773
5. Li Zongcheng, Gravitational relation of prolongable general relativity in the irreversible process of a dissipative system, *Acta Physica Sinica*, Vol. 52, No.4, April. 2003, 774-780
6. Li Zongcheng, Hypothesis on the Bifurcated-Chaos Quantum of atoms under thermal nonequilibrium conditions, *Acta Atomica and molecular physics*, Vol. 10, No.4, 1995, 942-953
7. Li Zongcheng, Paradigm of Historical Axiomatism beyond New Institutionalism: Rebuilt of Management (I) for New Civilization, August 2019, *Paradigm* 23(2), DOI: 10.1177/0971890719861729
8. Li Zongcheng, Framework of Citizen-Autonomous Alliance for Elimination of Power Alienation: Rebuilt of Management (II) for New Civilization, September 2019, *Paradigm* 23(2), DOI: 10.1177/0971890719865157
9. Helene Ratner, Evelyn Ruppert, Producing and projecting data: Aesthetic practices of government data portals, *Big Data & Society*, July 8, 2019.
10. Allen, Corey. How Big Data Can Improve Healthcare. *UBC News*, January 8, 2015.
11. J. Höller, V. Tsiatsis, C. Mulligan, S. Karnouskos, S. Avesand, D. Boyle: From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence. Elsevier, 2014
12. Farooq, M. U.; Waseem, Muhammad; Khairi, Anjum; Mazhar, Sadia. A Critical Analysis on the Security Concerns of Internet of Things (IoT). *International Journal of Computer Applications (IJCA)*, 2015, 11.
13. Ersue, M; Romascanu, D; Schoenwaelder, J; Sehgal, A. Management of Networks with Constrained Devices: Use Cases. IETF Internet Draft, 4 July 2014.
14. Tom Simonite. 2014 in Computing: Breakthroughs in Artificial Intelligence. *MIT Technology Review*, 29 Dec 2014.
15. Katz, Yarden, Noam Chomsky on Where Artificial Intelligence Went Wrong. *The Atlantic*. 1 November 2012

16. Lucas H, An ecological circle, *Australian Nurses Journal*, 1992, 22(1): 22-3
17. Blood, D. A., An ecological study of California bighorn sheep *Ovis canadensis californiana* (Douglas) in southern British Columbia, University of British Columbia, 1961, 303-315
18. Bonfil R., G Munro, H. T. Valtysson, Distant water fleets : an ecological, economic and social assessment, Fisheries Centre, University of British Columbia, 1998
19. Collette L. K, An ecological assessment of Russian olive in western Canada : predicted distribution across its invaded range and insect associations in southern BC, University of British Columbia, 2014, 76-83.
20. Dedić, N.; Stanier, C. *Towards Differentiating Business Intelligence, Big Data, Data Analytics and Knowledge Discovery*. Berlin ; Heidelberg: Springer International Publishing, 2017, 285